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NORTH PACIFIC DISTRICT

Preliminary Report

on

Brush Disposal

In the

Yellow Pine Region

of

Washington and Oregon

By

R. H. Westveld
Junior Forester

February 13, 1926

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INTRODUCTION

Disposal of brush after logging in the western yellow pine forest has been a debatable question throughout the history of lumbering. The lumberman has considered it from the standpoint of economics and the forester has thought of it as a fire protection, and incidentally, a silvicultural measure. With increasing stumpage values and a fuller realization that forestry and lumbering must work together to put the lumber industry on a permanent basis, the three-fold purpose of brush disposal is being given more consideration. Any method of brush disposal, therefore, to give maximum results must give a positive answer to the question: Does it give a return commensurate with the expenditure?

There is a wide range in the intensity of brush disposal methods. The annual expenditure of the Forest Service for brush disposal on the National Forests in the yellow pine region of Oregon and Washington is approximately $65,000. In the final analysis, it represents the cost of protecting some 9,000 acres of cut-over land from fire for 5 or 10 years. In contrast, the private owners of timberland in this region spend something like $20,000 for brush disposal on 90,000 or 100,000 acres.

Scope of the Study

That the brush resulting from logging requires some sort of treatment, is a foregone conclusion. How intensive this treatment must be to give a maximum of results has been more or less a matter of speculation. There is damage to young growth when the brush is piled and burned and when it is left where it falls, a forest fire hazard and a possible breeding place for forest insects is created. Observations over a period of years seemed to indicate that reproduction was most abundant and most thrifty in the protection of undisposed brush. To determine for various forest condition, the effect of different methods of brush disposal on advance and subsequent reproduction, and the fire hazard and its costs, a systematic study was begun during the summer of 1925. An extensive survey of the whole situation was made on the Deschutes, Crater, Whitman, and Wallowa Forests and on privately-owned lands adjacent to these Forests. Detailed temporary sample plot work was done on the first three Forests as well as on private lands adjacent to them. This report covers the work done to date. In addition to the information on brush disposal, certain other facts which must be understood to appreciate fully their re-action on brush disposal, are included in the discussion.

Composition and Character of the Yellow Pine Forest

Before Cutting

Western yellow pine is the predominating species of the yellow pine forest. Lodgepole pine, Douglas fir, white fir, sugar pine, western larch, and Shasta red fir, either singly or in different combinations, depending on the locality, are associates of the yellow pine.

The stands are usually uneven-aged, and the different age classes occur as small groups of trees. Most of the merchantable timber falls into the mature and over-mature age classes. There is usually a deficiency of trees in the intermediate age classes ranging from 4 inches to 12 inches in diameter. From 10 to 20 trees per acre fall into this class. The remainder of the stand is composed of advanced reproduction from a few inches to several feet in height. Where fire has been kept out of the forest, reproduction is usually distributed in the understory. The effect of fire on reproduction is illustrated in Fig. 1. The plots, numbers 3 and 15,[2] on which the data is based are adjacent to each other and differ only as to fire history. The former was burned in 1918 and the latter showed evidence of spot fires in 1907.

Reproduction is usually most abundant in natural openings in the stand. In general, reproduction is more uniformly distributed in eastern than in central Oregon. In all cases, reproduction is a valuable part of the Forest. Figs. 2 and 3 show the important role that reproduction plays in the virgin forest. Fig. 4 demonstrates under what conditions reproduction establishes itself. This data was secured on the pumice soils of central Oregon.

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[2] The plot numbers referred to in this report are the numbers of the temporary sample plots studied in the field.

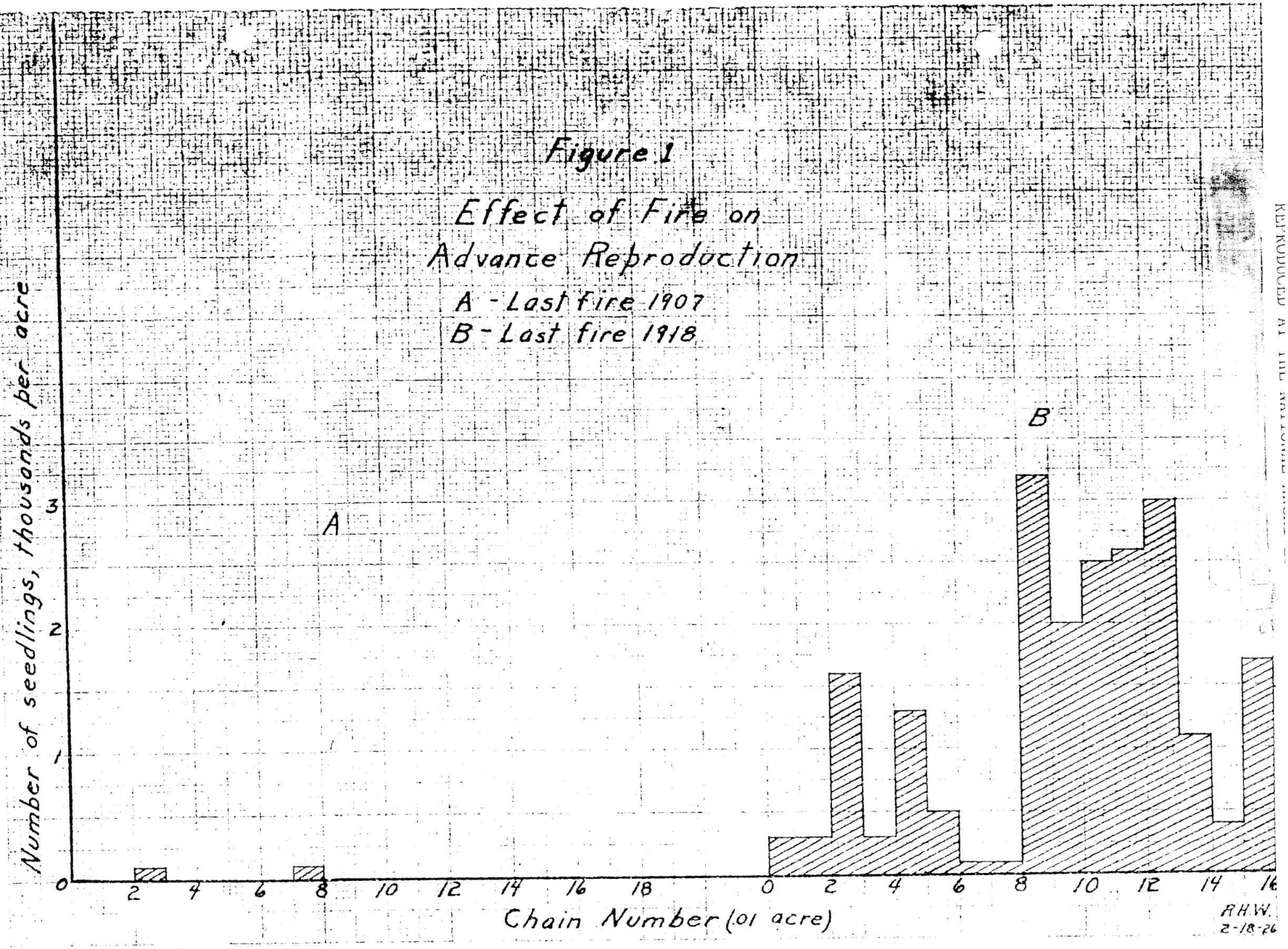
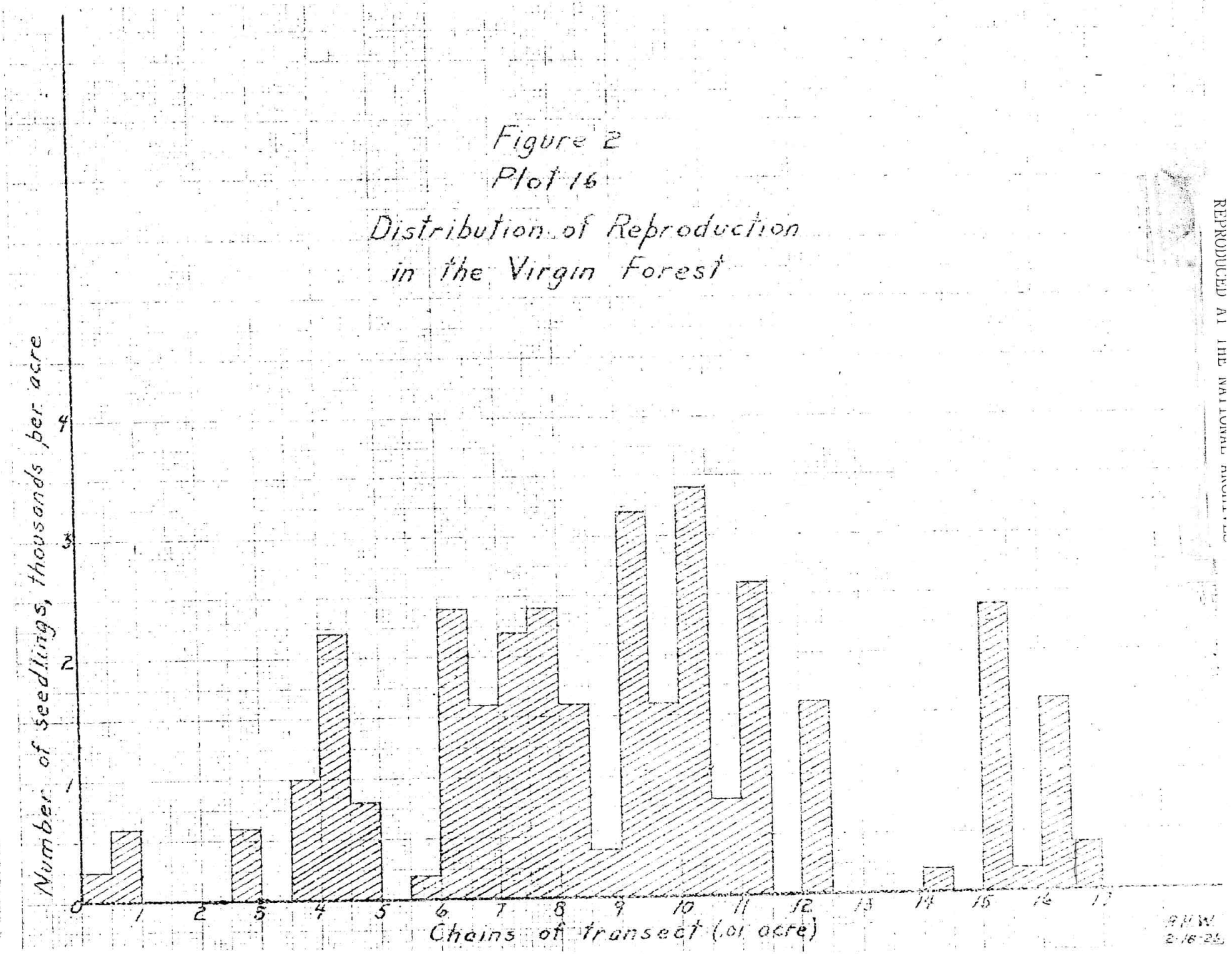
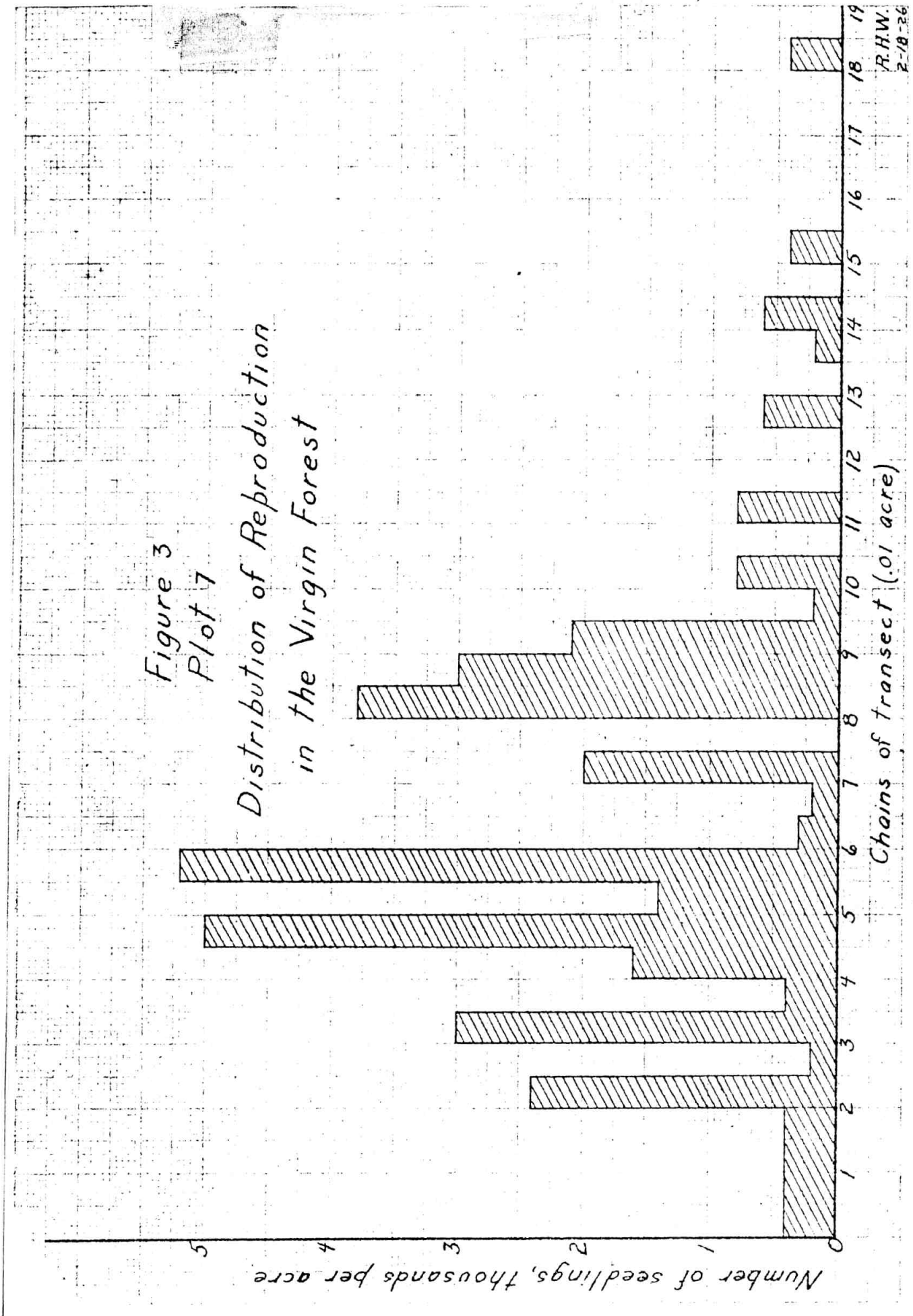
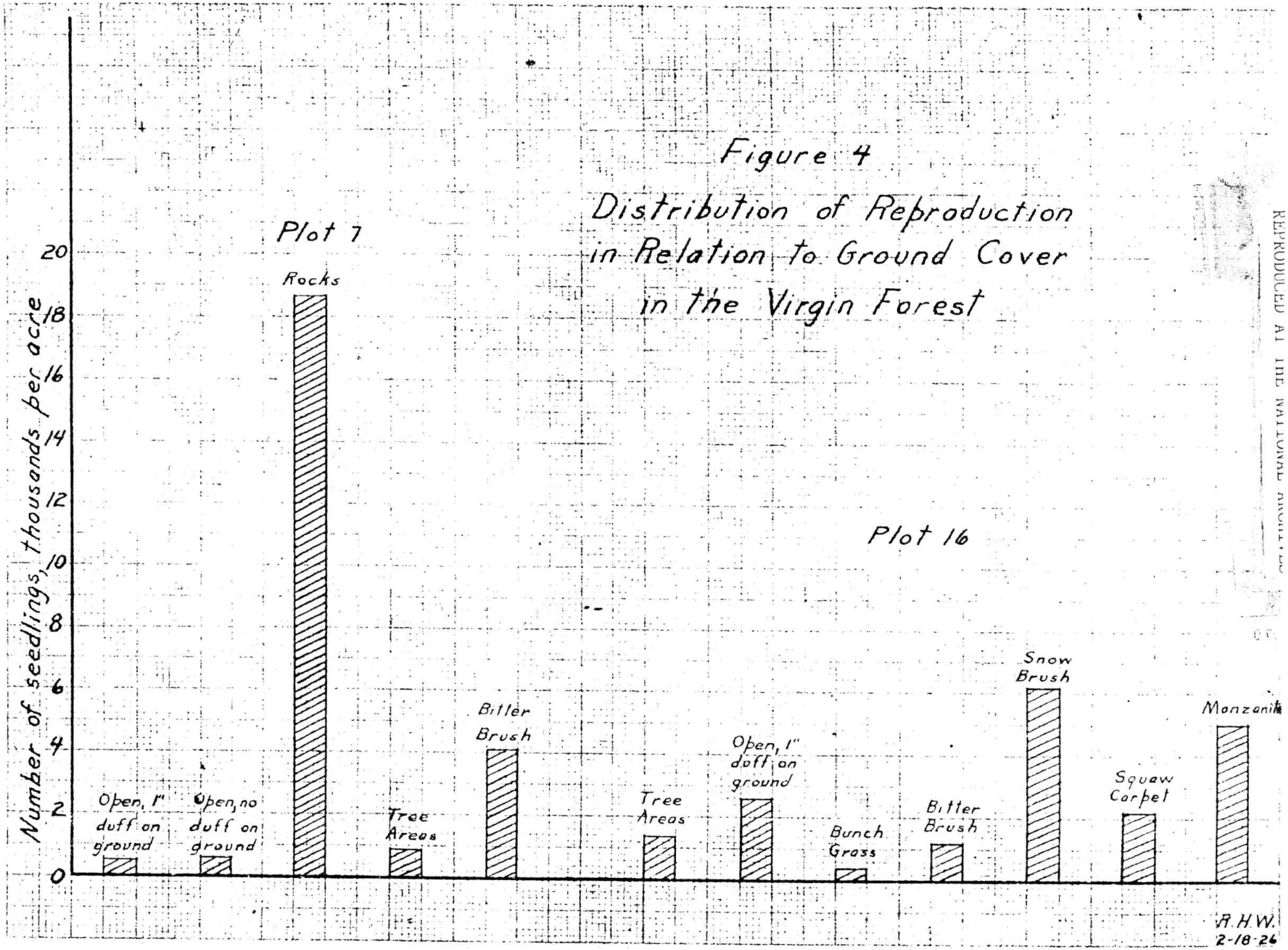


Figure 2
Plot 16
Distribution of Reproduction
in the Virgin Forest







After Cutting

1. On National Forests.

Cutting on the National Forests is based on the selection system which removes all the over-mature and a large portion of the mature timber. From 4 to 7 trees per acre in the thrifty mature class are left as seed trees along with all the immature trees. Cut-over lands carry between three and eight thousand board feet of merchantable timber in addition to a varying amount of reproduction.

2. On Private Lands

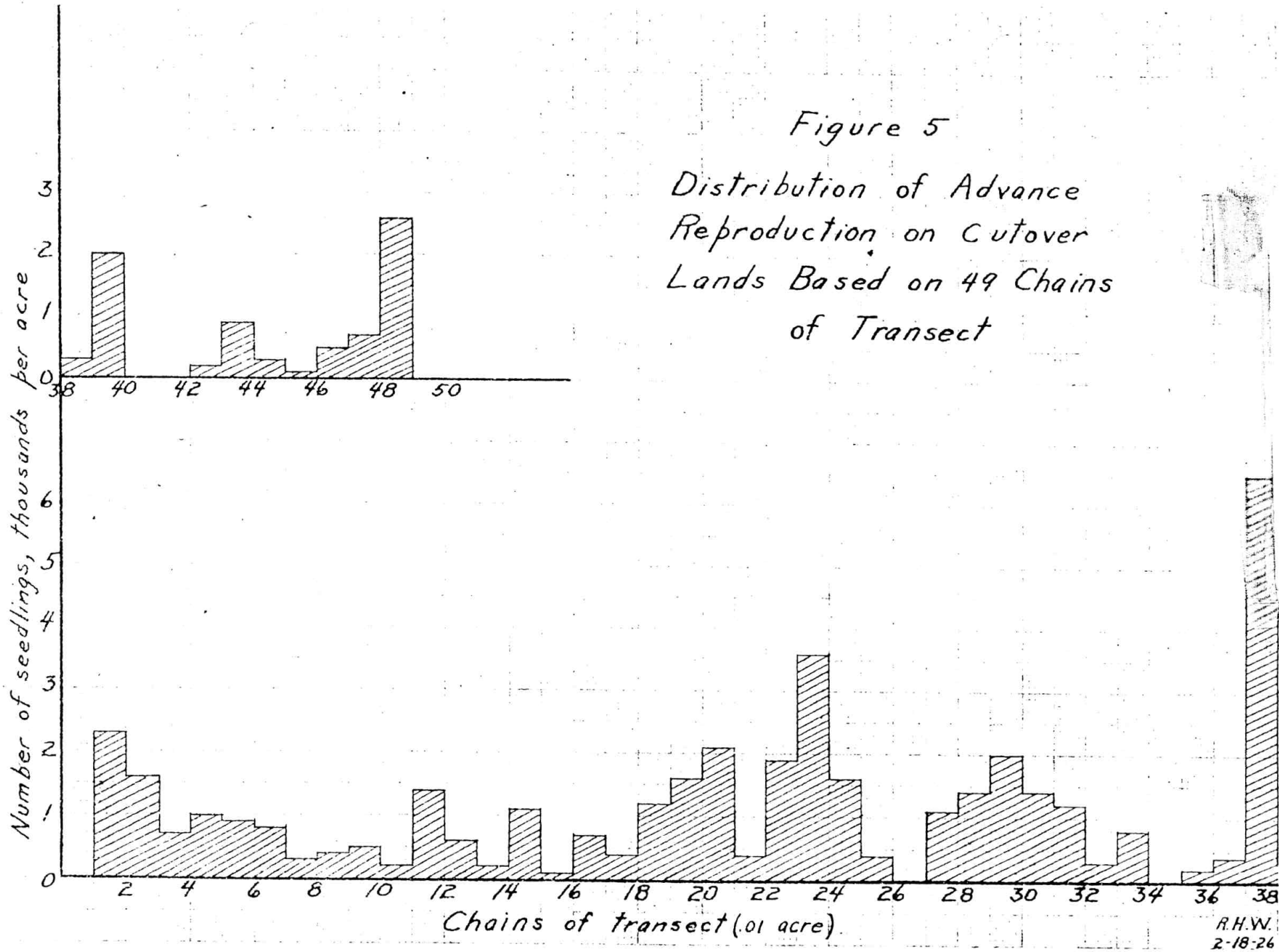
Cutting on private lands is not as conservative as on the National Forests, in fact it is a rare case that any merchantable timber is left standing after logging. However, all of the trees from 4 inches to 12 inches in diameter are left standing in addition to the advance reproduction. It can be seen that with no provision in the form of seed trees for securing subsequent reproduction, the continued productivity of the land depends on the preservation of the trees and seedlings already established on the land.

Logging destroys a certain amount of the reproduction but much of it gets by uninjured. Fig. 5, based on plots 1, 4, 6 and 14 shows the distribution of reproduction on cut-over lands in central Oregon. Anything that brush disposal may do to preserve the well-stocked areas or aid to fill in the gaps which are understocked is one step toward better silvicultural practice.

Fig. 6 shows the relation of reproduction to ground cover on cut-over lands.

Figure 5

Distribution of Advance Reproduction on Cutover Lands Based on 49 Chains of Transect



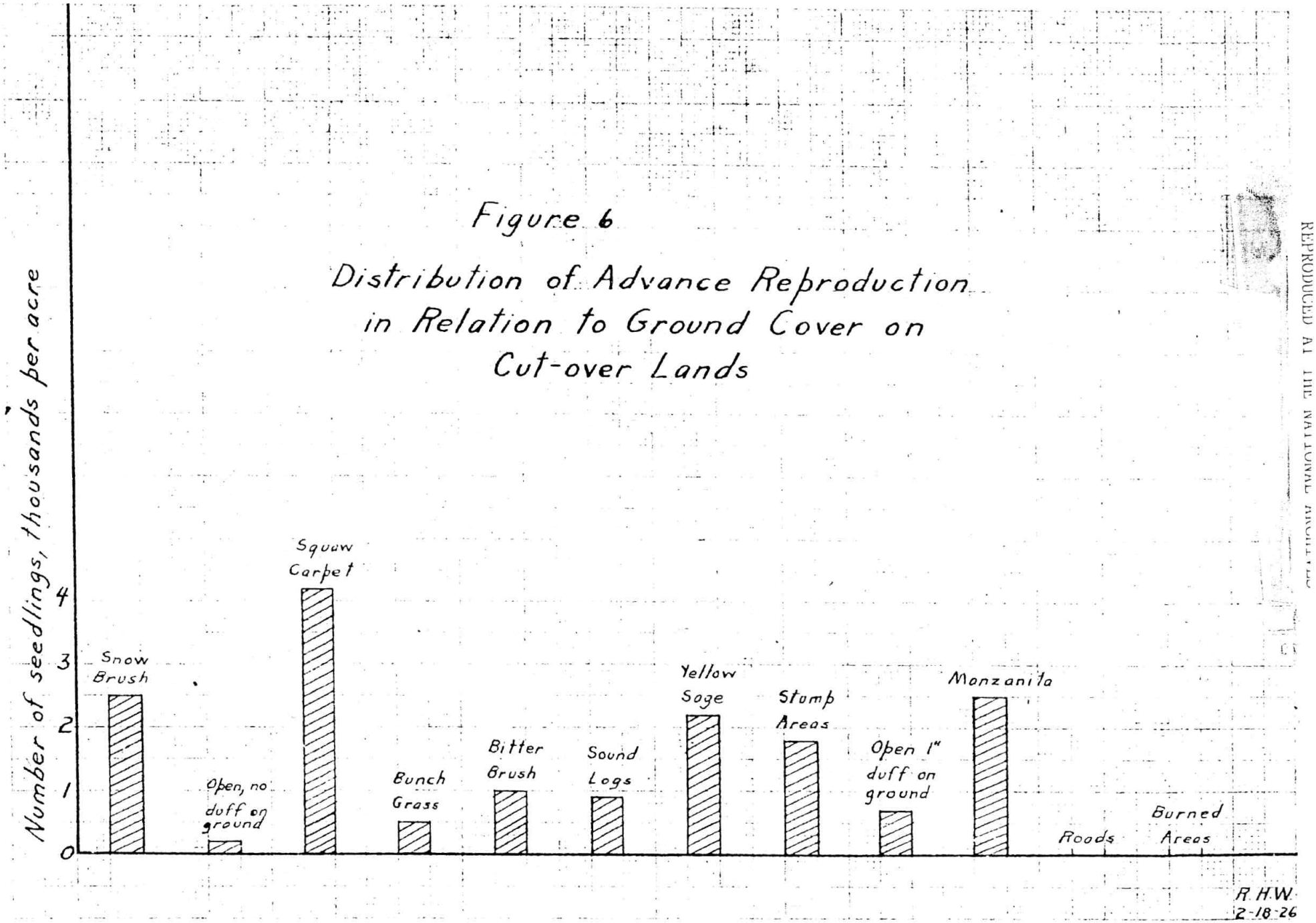


Figure 6

Distribution of Advance Reproduction in Relation to Ground Cover on Cut-over Lands

Brush Disposal Practices

It has been the practice of the Forest Service to pile and burn all brush resulting from logging. On private lands, various methods have been in use at different times. Prior to the passage of state fire laws in Oregon in 1911 and in Washington in 1917, brush on private lands was left undisposed where it fell. After these laws became effective, broadcast burning of brush became the universal practice on private lands. During the past few years, this method has given way in most cases to spot burning and broadcast burning on strips.

The details of the different methods now in practice are discussed separately in the following paragraphs.

Broadcast Burning

Broadcast burning consists of touching off the brush where it falls after the logs have been removed and allowing the fire to run over the area at will. No attempt is made to control the fire unless it endangers uncut timber. The brush lies in scattered patches occupying from 20% to 40% of an area. In order to get a successful burn, it is, therefore, necessary to dispose of the brush when it is fairly dry. Most of the burning is done in late spring or early fall, but in some instances it has been done in mid-summer. The work is done under the supervision of a state fire warden.

The primary object of this method is the removal of the fire hazard which the brush creates. The results obtained are variable. Partially green and in many cases dry brush burned at wet seasons of the year leaves much of the inflammable material unconsumed by the fire. Usually only the needles and the very small twigs are burned. In other words, the fire hazard is at about the same point that undisposed brush would be in two or three years. The material which is left on the ground is completely charred making it less susceptible to fungus attack which makes its rate if decay very slow. In cases where brush, after it has dried out for two or three years, is burned under the most favorable weather conditions, (warm and dry) the inflammable material is entirely consumed. However, this condition rarely occurs so the real object of broadcast burning is not accomplished. In some cases where there is a large amount of reproduction over 3 feet in height, the fire hazard is actually increased. The saplings are not entirely consumed by the fire and really add to the amount of inflammable material on the ground.

The effect of this method of brush disposal on reproduction and the reserve stand is obvious. The time of year and condition of the brush when burned was studied on representative areas. The disastrous effect on the oncoming forest crop is quite generally the same. Two areas studied in detail on the lands of the Oregon Lumber Company near Bates, Oregon show the following results.

Plot No. 17
- Cut – 1921
- Burned – October, 1922
- Reproduction killed by broadcast burning 84.6%
- Poles killed by broadcast burning 100%

Plot No. 18
- Cut – 1919
- Burned – June, 1921
- Reproduction killed by broadcast burning 94.2%
- Poles killed by broadcast burning 91.4%

Other areas studied in a general way showed about the same results. With the destruction of nearly all of the reproduction and in many cases all of the poles, which in the course of 25 years might have seeded such areas, the future productivity of these lands is very uncertain. Therefore, on lands which are to produce continuous forest crops, broadcast burning can be dismissed without any further consideration.

The cost of broadcast burning is estimated to be 20¢ to 30¢ per acre.

Piling and Burning

Piling and burning is the only method of brush disposal practiced extensively on the National Forests. It has been applied to a limited extent by the Pelican Bay Lumber Company on their own lands, but in a shipshod manner. The brush is piled in small compact piles from 7 to 14 feet in diameter and 3 to 5 feet high. The piles are place away from reproduction and reserved trees wherever possible so that a minimum amount of damage to the new forest will result from burning. The piling is done as logging progresses except for a period of 4 or 5 months

during the winter when snow interferes with the work. The brush which accumulates during the winter is piled in the spring after the snow disappears usually about May 1. Piling during the summer is often done after the logs have been bunched. Some operators prefer to pile the brush before any logging is done because it greatly facilitates handling the logs. The disadvantage of this procedure, however, is in the fact that a large number of piles are usually torn down in logging and must be re-built. The cost of piling, incidentally, is greater.

For the past several years brush burning has been done only during the fall and early winter. Much has been said about the weather conditions which are ideal for burning. This theoretical state occurs so rarely, that from a practical standpoint, it is of little value. A few days experience with a torch will convince any one of this fact. It therefore resolves itself into the question: When is brush burned? A couple of good soaking rains in the early autumn after the prolonged dry summer season will make brush burning reasonably safe. The surface soil usually dries out very rapidly following the rains, especially if the skies are not overcast, so the periods of brush burning are usually only a few days in duration. Even with these supposedly favorable conditions, there are such factors as variable winds, and sudden changes in humidity to contend with which make burning hazardous. Such points as lighting the piles in the top and on the leeward side so that they will burn slowly can go a long way toward over-coming these difficulties but are usually overlooked by the uninterested brush burner. Even with conditions favorable at the time of burning, unforeseen prolonged dry spells immediately following the burning, causing dormant fires to take on new life, often prove more disastrous than unfavorable weather at the actual time of burning. Undoubtedly, the most favorable condition for brush burning, but which rarely occurs, is about two inches of dry snow on the ground following a period of dry weather. The brush burning season, it can be seen, is variable; it may consist of only a few days or it may consist of several short periods distributed over a couple of months from the first part of October to early December. It is the usual practice to burn all the accumulated brush each fall. When the burning season is short this is impossible and a large amount of brush must be carried over until the following year.

Piling and burning accomplishes its primary purpose—reducing the fire hazard to a minimum—to a certain degree. There is no question but that the fire hazard is low after the brush has been burned, but—and here is an important consideration—a year and sometimes two years elapse before the disposal is completed, during which time the cut-over areas are a serious menace. At the time that the brush is piled but undisposed of the logging operation is on or near the area, so the piled brush before the burning, especially along the railroad spurs, donkeys, and camps presents a high hazard. The result of this system of piling and burning in two operations is the removal of the hazard usually after the peak of danger has passed.

Of the methods so far discussed, piling and burning, generally speaking, does the least amount of damage to the remaining forest. However, there are exceptions to this statement. Serious damage, though, is usually restricted to a small acreage. There were instances this past fall on the Whitman Forest of fires resulting from brush disposal temporarily getting out of control because of prolonged dry spells immediately following the burning. The result was the destruction of most of the reproduction on areas from three to ten acres in area. Such conditions are the exception rather than the rule so the discussion of the effect of brush burning on advance reproduction would not be complete without a statement of what happens under ordinary circumstances.

With the ordinary weather conditions that can be expected during the brush burning season, the damage which is done to reproduction and reserved trees is not alarming. Detailed study on several sample plots revealed that the burned spots covered from 4% to 10% of the ground space. On these patches all of the advance reproduction is killed. Considering the maximum damage which was found, it must be remembered that the 10% does not represent the same amount of damage that it would if the 10% of the area occurred in a continuous strip. This damage is spotted over the area and if reproduction is plentiful adjacent to these patches the loss will not be noticed after 5 or 10 years. However, where reproduction is inadequate, as is so often the case on the pumice soils of central Oregon, the loss of any reproduction is really a matter for much concern and may not be mended in the course of 25 years. In this connection it should also be stated that brush burning seems to retard the establishment of subsequent reproduction. Extensive observations indicate that subsequent reproduction is much less abundant on the burned spots than adjacent to them under natural conditions, and in many cases is entirely absent. Detailed counts on a limited number of temporary sample plots verify these observations.

Fig. 7 shows the relation between the amount of area occupied by brush piles or burned spots and the volume cut. The data indicates that the amount of damage is in direct proportion to the volume cut provided that the size of pile is constant.

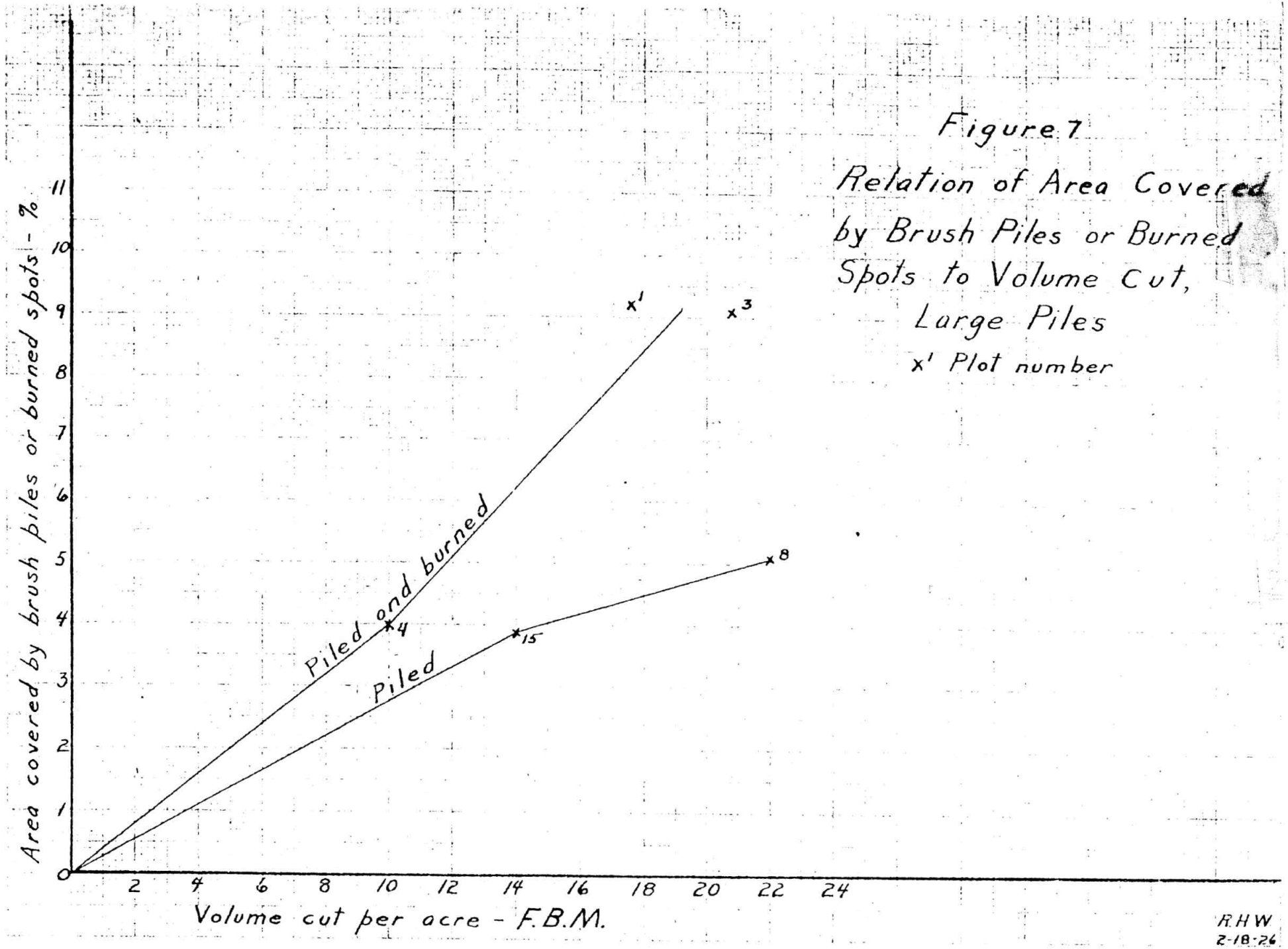


Figure 7

Relation of Area Covered by Brush Piles or Burned Spots to Volume Cut, Large Piles

x' Plot number

R.H.W.
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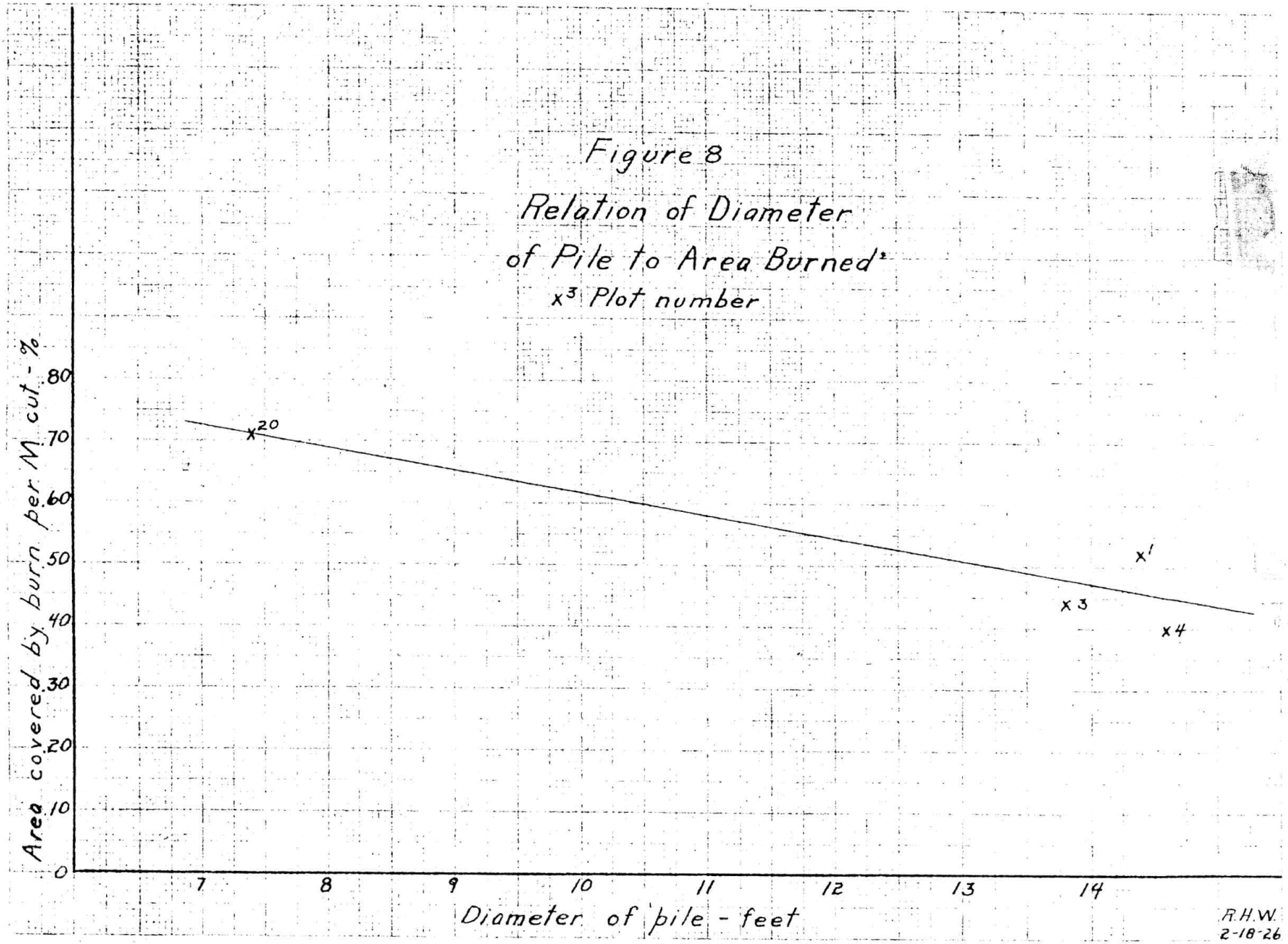
Damage by piling and burning does not end with the destruction of a certain amount of reproduction. The immature bull pines and mature seed trees are sometimes injured more or less. Data was secured on four representative areas to determine what the loss was in poles and merchantable timber. The results were variable and dependent mostly on the weather at the time of the burning. Two areas showed no damage, while the other two areas disclosed 1.0% and 3.9% by volume of damage to merchantable timber. Only those trees which showed evidence of inevitable death because of lowered vitality caused by the fires were classed as damaged. Trees which were blackened by fire, but appeared vigorous and thrifty were classed as undamaged. A check on the accuracy of this data can be secured only on permanent sample plots.

The same areas on which damage to merchantable timber was studied were examined also for damage to unmerchantable bull pines. One area showed no fire loss, whereas the other three plots showed losses of 13%, 18%, and 33% respectively, of the total number of immature trees between 4 inches and 11 inches d.b.h. Such figures are rather unexpected and are worthy of an explanation. As stated early in this report, there is usually a deficiency in the number of immature trees in the yellow pine forest. The areas just mentioned which showed 13% to 33% of that class of trees killed by brush burning originally carried 16, 6, and 6 trees per acre respectively, of the immature class. Applying the various percentages to the foregoing figures shows that 2, 1, and 2 trees per acre, respectively, were killed by fire. Those figures are not quite as alarming as the percentage figures, nevertheless, when it is considered that the loss of those trees will result in lowering the yield of the forest during the next cutting cycle by 500 or 1000 board feet per acre, it is a factor not to be ignored.

There is a difference of opinion among foresters as to the necessity of falling snags as a protective measure on cutover lands in the yellow pine type. The general sentiment is for snag falling but the evidence is not al all conclusive. The time of falling snags has never been give much thought. If snags must be cut, the time of cutting is an important consideration. This was obvious during several days of brush burning on the Whitman Forest last fall. With the exception of a few small areas snags had been cut prior to brush burning. A comparison of these areas was very illuminating. Most of the “hold-over” fires, which, although they did not always develop into a general conflagration, always caused additional damage to reproduction, could be attributed to cut snags. In no instance where snags were standing did brush fires get out of control. One area on which snags were cut prior to burning and under favorable weather conditions was studied in detail. The results showed that 5% of the damage done by brush disposal was caused by fire spreading along the snags. If this is the condition quite generally, then add to it the excessive damage caused by general conflagrations over small areas which are traceable to felled snags, and the matter of falling snags is of no little importance. If it is considered necessary to fell snags as a protective measure, the evidence so far indicates that they should be cut after the brush has been burned.

There is a wide variation in the size of the brush piles, the diameters of the piles ranging from 7 feet to 14 feet. Height of piles varies from 3 feet to 5 feet, the greatest height corresponding to the widest diameter. The tendency seems to be toward small piles, 7 or 8 feet in diameter on the Whitman and Wallowa Forests, and toward the larger piles, 9 to 14 feet in diameter on the Deschutes and the Crater Forests, with the largest piles on the Crater. The data, as shown graphically in Fig. 8 indicates that the smaller the pile the greater is the ground surface burned over per unit of volume cut. The general conclusion to be drawn from this fact is: Large piles do less damage to advance reproduction than small piles and therefore should be the general practice in brush piling. Logical as this statement seems, an analysis of the behavior of various sized piles when burning reveals that exception must be made to this general rule. On the Whitman Forest during October 1925, observations were made on the manner in which piles of different diameters and heights burned. The data secured demonstrated that the height to which flames rose varied with the diameter of the pile, not with the height. For example, of two piles the same height, one six feet and the other eight feet in diameter, the former threw flames ten to twelve feet and latter twelve to sixteen feet high. Again, two piles seven feet in diameter, one three feet and another five feet high, cast flames to an equal height, approximately twelve feet. From the foregoing illustration, it can be readily seen that with the larger piles there is more danger of fire getting into the crowns of small bull pines. Since it is important to save that class of trees, every precaution should be taken to prevent any unnecessary loss by brush burning. There are individual acres which are well stocked with immature trees; on such areas small piles should be the practice. Even where such trees are scarce and it is even more important to save the, small piles should be favored where they are near bull pines. Any method of brush disposal to attain maximum results should be flexible and here is one opportunity to put it in practice.



In connection with the possibilities of improving brush piling as discussed in the foregoing paragraph, there are other ways in which the amount of damage, especially to reproduction, can be avoided. More care in the placing of piles, where possible, in roads and skid trails where the reproduction is already destroyed by logging offers a practical opportunity. Some of the first operations visited were piling brush prior to logging and it was observed that a large percentage of the piles was only a few feet from the roads. Later observations on operations where piling was done after the logging was completed were just as bad in this respect. After extensive investigation, it was decided that piles which were not more than six feet from a road could have been placed in the road with no additional effort or cost. Of course this is not feasible where piling is done before the logging, and that is one decided disadvantage of having the brush piled ahead of the logging. Detailed data on six areas showed that from 7% to 42% of the brush piles were within 6 feet of roads. All this could be avoided if the brush pilers were given proper instructions and close supervision. This fact is worth more than a passing thought.

Nearly every year some piled brush remains unburned. Some years, the brush of more than half of the year's cut, while in other instances only a few isolated patches, remain unburned. When brush is over two years old it is questionable whether the time and effort necessary to burn such brush is justified. The needles have dropped from the branches and it is next to impossible to get the piles to burn. In open country such as so much of the yellow pine type is and where, at the worst, the fire hazard is very low, it seems absurd to burn on isolated patches brush that is over two year old. Under some circumstances, it may be unnecessary to burn brush over one year old.

Most of the brush piling, both in central and eastern Oregon is being done by contract. Contract prices vary from 40¢ to 45¢ per M. Of all the operations studied during the field season, only one, the Own-Oregon Lumber Company was piling brush by day labor. The wage paid was $4.00 per day. The cost of piling was 51.7¢ per M. This operation is cutting a larger amount of Douglas fir than any of the other operations which is reflected in the increased cost.

Burning is always done by day labor receiving $4.00 per day. The average cost of burning over large areas is between 3 and 5 cents per M. The cost varies with the age of the brush and the weather conditions at the time of burning. Undoubtedly, over small areas under adverse conditions the cost will run as high as 10¢ per M.

Swamper Burning

A special form of piling and burning is found in swamper burning. This method disposes of green brush immediately following the falling and before any logging is done. Fires are kindled with pitch wood, using plenty of pitch to create a good sized blaze. The brush is thrown on the fire by the swamping crew in connection with their regular work. The piling and burning is thus accomplished in one operation. This method of brush disposal has been the general practice on small sales on the Chelan Forest for the past couple of years. Through the initiative of Lumberman West, swamper burning was introduced on the Owen-Oregon Lumber Company sale on the Crater Forest on a large scale in the spring of 1925. During January, 1926, it was carried out on an experimental scale on the Deschutes Forest. It is possible to carry out this method only during the spring and fall months when there is sufficient moisture to keep the fire from getting dangerous.

Swamper burning removes the fire hazard as rapidly as it is created because the brush is burned immediately following the falling. There is no brush to carry through the dry summer months. Therefore, it has a decided advantage over piling and burning from the fire protection standpoint. In a mixed stand Lumberman West finds that swamper burning is far superior to piling and burning because species like Douglas-fir lose their needles very readily so that even when the brush is only one year old the piles are very difficult to fire.

No detailed data has been secured on the amount of damage done by swamper burning to reproduction and reserved trees. The following discussion is based entirely on observations in a general way. Because of the fact that brush is continually piled on the fire as it burns down, much more brush is handled by one fire than is the case in piling and burning. It is estimated that the amount of area burned by swamper burning is about one-fifth to one-third as great as by piling and burning. This results in less damage to reproduction. Undoubtedly there are fewer bull pine killed because the green brush burns more slowly and generates less heat than dry brush. Therefore, trees which are close to the piles usually escape injury. There is now an opportunity to speculate on the effect of swamper burning on subsequent reproduction. In his report on this method of brush disposal,

Lumberman West[3] states that logging stirs up the soil on the burned spots, with the result that vegetation comes in quicker. It will be interesting to see if the same holds true for the establishment of subsequent reproduction.

The work done so far with swamper burning indicates that it has a decided influence on logging. With the brush cleared up before any bunching is done, there is practically no foreign material on the ground to interfere with logging. While no data has been secured on this phase of it, all those having worked with the method are of the opinion that the bunching capacity is materially increased over what it ordinarily is where brush is not disposed of before logging. The logging foreman of the Owen-Oregon Lumber Company estimates that the bunching capacity is increased at least 20%.

The limited experience with swamper burning precludes any general statement on the cost of the method. Individual cases can be cited, however, and the factors affecting these costs can be analyzed as a basis for arriving somewhat nearer to a generalization.

On the Owen-Oregon Lumber Company sale on the Crater Forest swamper burning is being done in a mixed type of yellow pine, Douglas fir, and white fir with a wide variation from almost pure yellow pine to pure Douglas fir. The costs vary accordingly. Under the most adverse conditions, the brush of 7 M. feet of logs can be swamper burned per man per day. Under the best conditions the capacity is increased to 10M. feet per man. An average figure of 8 M. is considered conservative. The work is done by day labor receiving $4.00 per day. On that basis, the cost of brush disposal is 50¢ per M. The logging foreman on this operation believes that in general the cost of swamper burning is slightly less than for piling and burning.

On the Brooks-Scanlon Lumber Company sale on the Deschutes Forest, detailed cost figures were kept on a 35 acre experimental area. It was the first experience of both the Forest officer and the brush burners with swamper burning. More or less time was spent experimenting with starting the fires and no effort was made to push the work. In addition to this, the work was done in a scattering stand, averaging a cut of 8 M. per acre which is far below the average cut for central Oregon. During the 96 hours that burning took place, snow or rain fell 10 hours and the brush was wet 41 hours. Even with these limiting factors, the data secured on the area shows that the time required per M. handled was 1.02 hours. Based on an eight hour day each man would swamper burn approximately 8 M. per day. On that basis, the cost is 50¢ per M. Junior Forester Schlatter[4] who handled the work believes that this cost could be reduced to 70% of that figure. A drawback in this case is the fact that brush disposal has always been by contract making it possible for the men to make $7.00 to $8.00 per day. Schlatter believes that on a contract basis anything less than 50¢ per M. will result in too hurried work. However, on one area on the Deschutes where detailed costs were not kept, it is reported that some crews made $7.00 per day on a basis of 35¢ for piling and 4¢ for burning. In general it seems that swamper burning will cost no more than piling and burning and possibly less.

The methods of brush disposal so far discussed deal with burning the brush over an entire area. The next three methods to be discussed may be classed as “no disposal” methods. Where it is intended to leave brush undisposed of, it is essential that large areas be divided into small compartments by fire lines. The importance and the technique of fire line construction is discussed at the end of the report.

Lopping

Lopping has been used to a very limited extent in this region. The most extensive area known is only 40 acres in size on the Deschutes Forest. Occasional small patches were observed on the Wallowa Forest where the Forest Officer in charge of the sale had in mind the protection of the site. Lopping merely consists of cutting all the limbs from the bole of the tree so that they will lie flat on the ground. A modification of this method known as lopping and scattering consists, in addition to the lopping, of scattering the limbs so that they are evenly distributed. There is very little to be gained by scattering since in the yellow pine type, the brush is usually light any way.

Lopping, in preference to leaving the brush as it fell was based on the assumption that the limbs would decay more quickly in contact with the soil than when attached to the bole. This is true in the case of shortleaf-

[3] G. H. West, Report on Swamper Burning, manuscript report, Jan. 26, 1926.

[4] E. J. Schlatter, Swamper Burning Experiment manuscript report, Feb. 6, 1926.

pine[5] but to a very limited degree. Investigations made on yellow pine[6] in the southwest proved the reverse to be true. Lopped brush may be less of a fire hazard than brush left as it falls but that is more or less a speculation.

The only damage which is done by lopping is noted on the reproduction, and that is of little consequence. It usually consists of some of the larger seedlings being bent over. This is not serious and is hardly noticeable after a few years. Where the accumulation of brush is dense, some of the very small seedlings may be killed by smothering.

There has been so little experience with lopping in this region that no costs are available. In the Southwest, where this method has been used quite extensively particularly on the New Mexico Forests, the average cost is about 25¢ per M.

No Disposal

No disposal which consists of leaving the brush lie as it falls was the universal practice of private operators before the States of Oregon and Washington had state fire laws. At the present time the brush is being left in this manner inside of fire lines on some private lands. Although no effort is made to lop any of the brush, lopping naturally occurs on about four-fifths of the bole in the process of log bucking and logging.

The reduction of the fire hazard in this case is entirely dependent on the fire line and efficient protection.

Damage to reproduction and reserved trees by this method is negligible. The damage as in lopping consists of seedlings being bent over and in some instances smothered.

This method involves no cost except the work on fire lines which is discussed later.

Spot Burning

With the change in the Oregon Forest Fire Laws in 1925 which provides that the State Forester may relieve timber owners of burning slash when in his opinion it is unnecessary or is not considered a fire hazard, (Sec. 21 chapter 281, General Law of Oregon, 1925), certain modifications of broadcast burning have resulted. Spot burning in different forms has become a popular method with many private operators. By this method, brush is disposed of only at the most critical points such as railroad spurs, donkey sets, and camp sites. The brush is burned on strips 200 to 500 feet wide either broadcast or on isolated patches where the accumulation of brush is greatest. If broadcast burning is practiced on the strips, it is desirable to build narrow fire lines on each side of the strip before any fires are set. Neglect of that phase of the operation will usually result in a general conflagration.

This method of disposal accomplishes two things: It reduces to some extent the fire hazard at points where fires are most apt to start and it creates vantage points for controlling fires in case they start. The effectiveness of these features of fire protection depends entirely upon the thoroughness of the burn.

The effect of this method of brush disposal on the forest growth is not as disastrous as broadcast burning. The strips or spots constitute from 20% to 50% of the ground space. On these strips, most of the reproduction and reserved trees are killed, which leaves from 50% to 70% of the area, where fire has not burned, in a productive condition. The amount of damage done to young growth is so severe that spot burning should be discouraged.

It is well to state in connection with this method that areas handled in this manner still present an uncertain fire risk. With this fact in mind, one operator, the Shevlin-Hixon Lumber Company, has organized an intensive fire protective system for their cut-over lands. This naturally reduces the area burned over by accidental fires.

No exact figures on the cost of spot burning were secured. It is estimated that the initial cost is between 15¢ and 25¢ per acre. Where intensive fire protection is maintained, there would be an additional annual cost of 4 or 5 cents per acre.

[5] W. H. Long, Investigations of the Rotting Slash in Arkansas Bull. 496, U. S. D. A. 1917, page 7.

[6] W. H. Long, New Aspect of Brush Disposal in Arizona and New Mexico, Proceedings of the Society of American Foresters, Vol. X, No. 4, October 1915, page 383.

FIRE LINES

Fire lines is one phase of brush disposal which, up to the present time, hs come in for very little consideration in this region. It is only during the past year or two that it has been thought of as a possible means of handling slash. The efforts of the Shevlin-Hixon Lumber Company at Bend, Oregon, to reduce the fire hazard on cut-over lands by means of fire lines has been mentioned under Spot Burning. With spot burning, the reduction of the fire hazard is often more apparent than real. It hs been pointed out also that there is an excessive amount of damage to reproduction and reserved trees which is undesirable silviculturally. In considering fire lines, then, the question arises: What type of fire line will be most effective in reducing the fire hazard and still leave the stand most productive?

A line on which brush is piled and burned would result in a minimum amount of damage to the forest. Such lines taking advantage of roads or railroad grades and natural openings in the forest would further reduce the damage. The width of such a line to be most effective is another question. In the Southwest, where fire lines on cut-over lands have been used for many years on the National Forests, 1 200 feet line has been the general practice. Studies being made there at the present time indicate that such a line is entirely adequate.

A fire line of the type mentioned, in itself will not stop a fire. It serves merely as a break from which a suppression crew can work to advantage to stop a conflagration. Therefore, it would seem that under many conditions in the open yellow pine forest, a fire line less than 200 feet would serve the purpose. For example, when logging is done by tractors, the mineral soil is exposed on the roads to a width of 15 feet while with horse logging the roads are usually only 7 feet wide and the destruction is not as complete as with tractor logging. With that in mind, and considering the fact that topography, density of stand, and physical risk are variable it is believed that the width of fire lines should be varied according to these natural advantages or disadvantages.

The distribution of fire lines is another consideration that experience and continued study must determine. In the Southwest, fire lines are laid out at intervals of approximately one-half mile so that the maximum area of continuous undisposed brush is 160 acres. On this basis with the lines varying from 150 feet to 200 feet in width, the fire lines would occupy from 17% to 22% of the total area. Considering that the lines can be so placed in many instances as to take advantage of numerous natural parks and openings in the forest, the amount of the brush that would be piled would be somewhat less than that percentage of the total. On the basis 17-22% of the area piled and burned the cost would vary from 8 to 11 cents per M. On individual areas where openings in the forest are numerous as they are in parts of eastern Oregon the cost would be even less than 8 cents.

A more specific statement on fire lines is not warranted because this phase of brush disposal is in a rudimentary state and only experience can work out the finer details.

Intensive Fire Protection On Cut-over Lands

Even with fire lines dividing extensive areas of cutover lands into small compartments, there is always the possibility that a fire will start. With the large amount of inflammable material on the ground, a fire once started will be more difficult to control than in a virgin forest. It is important, therefore, that the protective organization should be intensive enough to detect fires as soon as they start and have a suppression crew on the ground in a minimum length of time. To accomplish this would require a greater expenditure per acre for the protection of cut-over lands than of virgin forests. The brush is only a temporary hazard so the intensive protection would be necessary only for a limited time. Ordinarily the hazard would be reduced to normal at the end of ten years through decay and disintegration.

For special patrol after logging Show[7] plans the cost at 6 to 7 cents per acre per year, while Weidman[8] considers 4 to 8 cents an adequate expenditure. That, on the basis of a 10 year period puts the cost of protection at 3 to 5 cents per M. of timber logged.

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[7] S. B. Show, Present Logging Practice and Forest Production in the California Pine Region, U. S. Forest Service unpublished report Dec. 1922, page 94.

[8] R. H. Weidman, Public Requirements for Continuous Forest Production in the Northern Yellow Pine Region, U. S. Forest Service, unpublished report, Feb. 1924, page 46.

Brush in Relation to the Fire Hazard

Fire hazard is such an abstract term that it is difficult to arrive at anything like a unanimity of opinion of hazard of this area is 100% or of that area is 50%, the necessity of brush disposal or its intensity could be definitely defined. Lacking such an artificial scale a definition of what constitutes a serious fire hazard is mostly a matter of personal judgment. This situation was quite evident in discussing undisposed brush as a fire menace with individuals and finally asking the question: How long is undisposed brush a serious fire menace? Almost any answer could be expected. Some foresters believe that after three years the peak of the hazard has passed while other imagine that after 10 or 15 years the menace is as great as at the time of logging. Undoubtedly the last class of extremists fail to appreciate that even the virgin forest carries some inflammable material. Since there is this diversity of opinion of brush as a fire menace, an analysis will be made of the possible diminution of this hazard on cut-over lands.

First of all, there are primarily two things which constitute a fire hazard. They are: The amount of inflammable material and the causes of fire. Eliminate either one and the other is removed. With that as a basis, each factor will be analyzed separately, considering the causes of fire first.

The causes of fire are numerous and need not be enumerated. The important thing to consider here is causes, which on cut-over lands are above the average. Regardless of whether or not an area is cut-over there are such causes as lightning, smokers, and incendiarism to contend with. In addition to these, donkey engines, railroad engines, and campers are sources of fire on cut-over lands and which sometimes are operating to a limited extent in the virgin forest. The next consideration is: How long do these extraordinary causes exist? On any specific area, all of these sources of fire are removed in one to three years along with the moving of the logging area. At any one time donkey engines and campers are the cause of fires on a very restricted area where men are on the ground almost continually to detect any fires which may start. Railroad engines may cause fires over a larger area because they are not as stationary as these other causes. At any rate, it is reasonable to conclude that ordinarily the cause of fires is reduced to normal at the end of two years.

The rate at which the amount of inflammable material is reduced to normal through decay and physical factors does not lend itself to so simple an analysis. Undoubtedly, at least 20 or 25 years is required for the logging debris to entirely disappear. That, however, is not the primary consideration. More important than that is the disappearance of the readily inflammable material such as the needles and small limbs. It is a well known fact that all the needles have dropped from the limbs at the end of three years and under certain conditions, in two years. By that time, some of the very small twigs which have partially decayed or have been broken off by grazing animals are being combined with the soil. After the third year, the rate at which the brush decays and is broken up depends on climatic conditions and on the amount of grazing. Each year some of the limbs and needles become mixed with the soil. Ordinarily, at the end of twelve years most of the really inflammable material has disappeared. One instance was observed near Bates, Oregon where only the tops and large limbs were left seven years after logging. This areas was heavily grazed by sheep and that was undoubtedly an important factor in the rapid disintegration. Under average conditions, the amount of inflammable material on the ground is probably no greater on cut-over lands than in the virgin forest at the end of ten years. After that time, the fire hazard is a result of the dense sapling growth. From the foregoing analysis, it may be concluded that the peak of the fire hazard on cut-over lands is the first 2 years after logging and after that the hazard steadily diminishes until after ten years, the menace is back to normal. On the basis of the foregoing considerations, the relative fire hazard with different methods of brush disposal is shown graphically in Fig. 9.

Assigning a theoretical value of 20 to the virgin forest as a working basis the other values are interpreted accordingly. In the case of piling and burning, the fire hazard is shown to increase after 4 years. This probably would not hold true where saplings were dense over a large area. In that instance, heavy shade would kill out most of the grass so that there would be very little inflammable material on the ground.

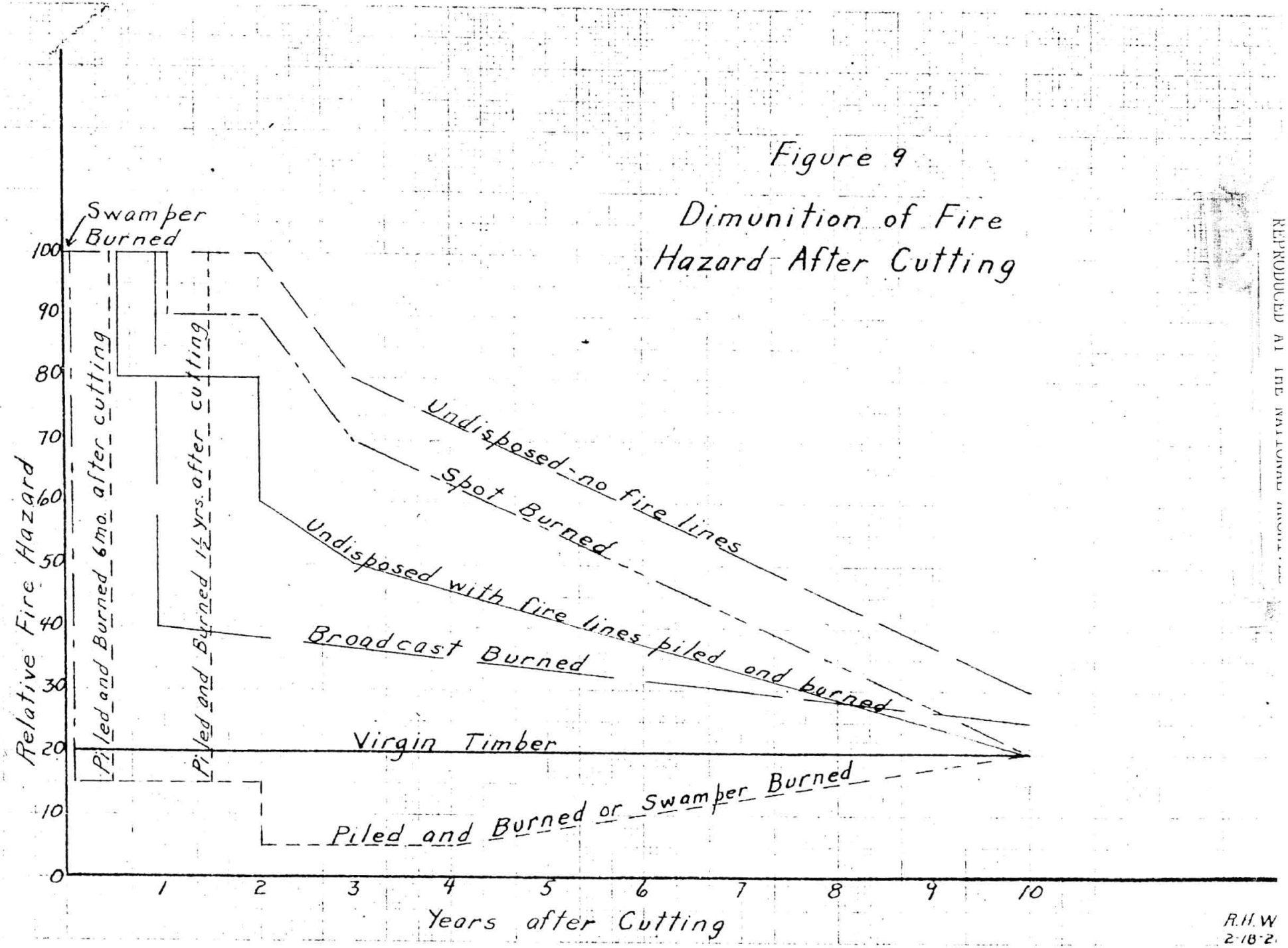


Figure 9

Dimunition of Fire Hazard After Cutting

R.H.W
2-18-2

Silvicultural Effects of Undisposed Brush

Advance Reproduction

Casual observations lead to the conclusion that seedlings in the protection of brush are more vigorous than those growing under natural conditions. To determine whether that was actually the case under all conditions, height growth measurements of seedlings after cutting were made on four typical plots. The growth in height for each year after logging, and the total height was recorded for each seedling on strips 13.2 feet wide. Seedlings which were open grown or dominant were recorded as such. In making the office calculations, the seedlings were classed by their height at the time of cutting. The seedlings which were dominant or open grown at the time of measurement were classed together in the computations. The results are presented in Tables 1 to 4 and shown graphically in Figs. 10 to 12. Each plot will now be discussed individually and comparisons made. Plot numbers 12, 13, and 14 were in central Oregon and plot number 19 was in eastern Oregon.

Plot No. 12, Table 1 and Fig. 10

This plot is on a north slope where exposure to sun and the resultant drying out is at a minimum. The area was clear cut in 1921 and the brush left to lie where it fell, except on small areas near the roads where some of it, that interfered with logging, was piled. The ground cover consists of scattered snow brush, bunch grass, bitter brush, and manzanita.

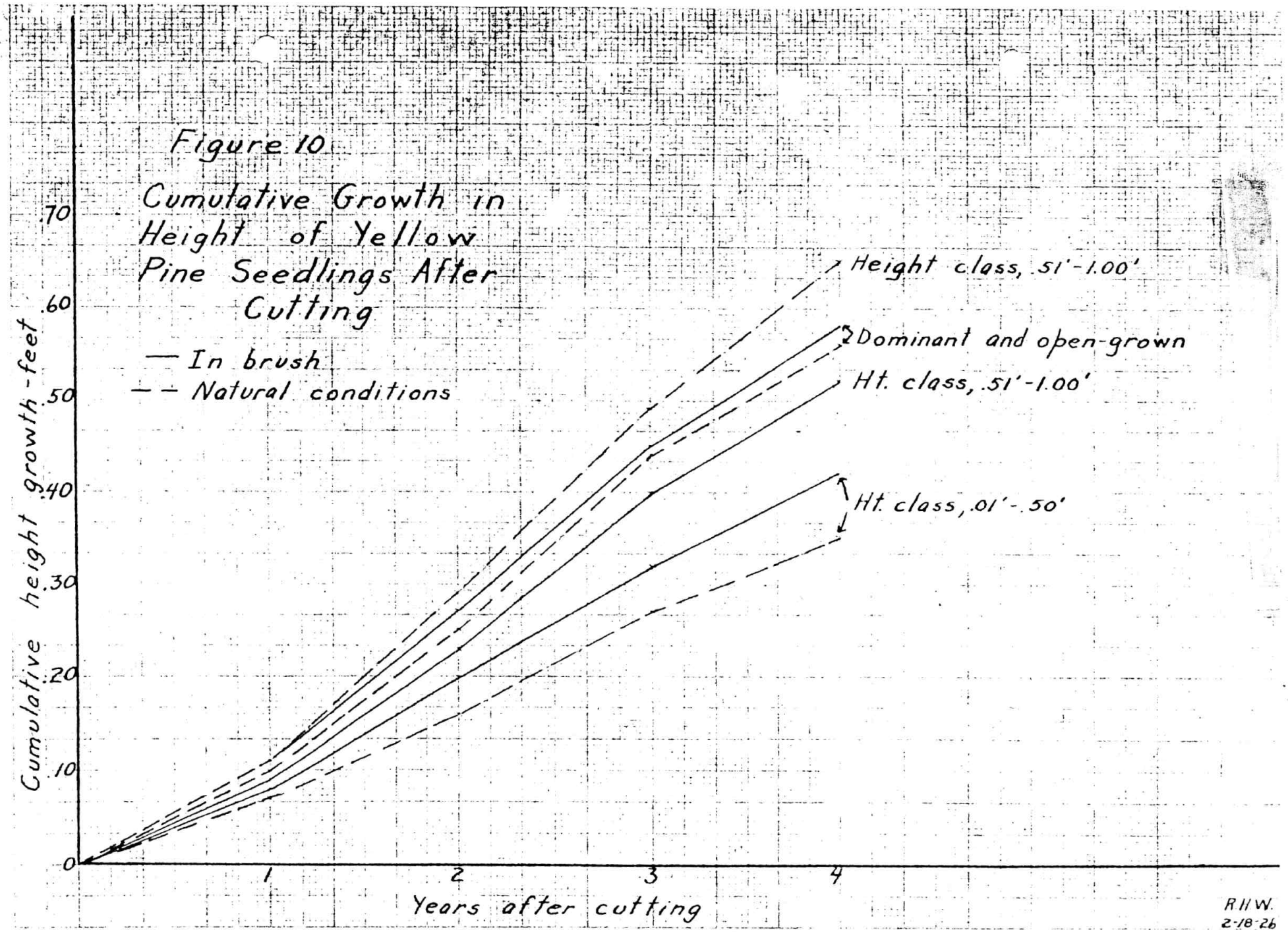


TABLE I.

Height Growth of Yellow Pine Seedlings
After Cutting

Location of Seedling	*Height Class .01' - .50'							*Height Class .51' – 1.00'							Dominant and Open-grown						
	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings
		1	2	3	4				1	2	3	4				1	2	3	4		
	Growth in Feet							Growth in Feet							Growth in Feet						
Snowbrush	.05	.07	.10	.12	.09	.38	123	.12	.14	.25	.29	.15	.83	10	.08	.11	.17	.21	.12	.61	45
Bunch Grass	.06	.04	.04	.08	.06	.22	5	.07	.07	.08	.09	.13	.37	3	.06	.06	.07	.09	.09	.31	5
Bitter Brush	.04	.05	.06	.07	.07	.25	30	.08	.10	.09	.13	.12	.44	2	.07	.09	.15	.13	.08	.45	8
Manzanita	.05	.08	.10	.10	.07	.35	17	.07	.07	.14	.12	.09	.42	5	.07	.09	.15	.13	.08	.45	8
Average of above in natural cond.	.05	.07	.09	.11	.08	.35	175	.10	.11	.18	.20	.16	.65	20	.08	.10	.15	.19	.12	.56	64
Brush	.07	.08	.12	.12	.10	.42	83	.11	.09	.14	.17	.12	.52	18	.09	.11	.16	.18	.13	.58	33

*Height at time of cutting

Table 1 shows that there is practically no difference in the four years' growth after cutting between the seedlings in the slash and those growing under natural conditions. Furthermore, it demonstrates that such shrubs as snowbrush and manzanita are as beneficial to reproduction as slash. Seedlings up to .5 feet show a slight advantage in favor of the brush but for seedlings above that height, the condition is reversed. The dominant and open-grown seedlings have the same height growth under natural conditions as in slash. The reason for no difference in height growth is attributed to the fact that on north slopes there is sufficient moisture in the soil to support constant growth under natural conditions.

Plot No. 13, Table 2, Fig. 11.

This plot is on a southwest slope where exposure to the elements is great. The area was clear cut in 1921 and the brush was left to lies where it fell. The ground cover consists of scattered snowbrush, bitter brush and manzanita.

Table 2 reveals a noticeably greater growth of seedlings in brush over those in natural conditions. The greatest difference is in seedlings up to .5 feet high where the growth is nearly twice as great in slash as in the open. Fig. 11 demonstrates that the height growth of these small seedlings in slash is as great as the growth of the larger height classes and even the dominant and open-grown seedlings under natural conditions. The data for this plot indicates that on south exposures, where drying out of the soil is excessive, the brush helps to conserve moisture which is reflected in greater height growth.

Probably the most striking feature of Tables 1 and 2 is the extremely slow growth of yellow pine seedlings. In order to determine whether this slow growth is characteristic and holds true on selection cuttings as well as on clear cuttings, a plot was measured on National Forest land. The results of plot No. 14 are presented in Table 3. The exposure of the plot is east. The area was cut-over in 1992 under a heavy selection cutting. The ground cover consists of snowbrush, bunch grass, and bitter brush. The results point out that the rate of growth is approximately the same as under natural conditions on plots No. 12 and 13. Apparently, the type of cutting has no effect on the rate of growth of seedlings after cutting, at least for the first three or four years. Height growth in all cases is controlled by the height of the seedling at the time of cutting.

TABLE II.

Height Growth of Yellow Pine Seedlings
After Cutting

Location of Seedling	*Height Class .01' - .50'							*Height Class .51' – 1.00'							*Height Class 1.01' – 1.50'							*Height Class 1.51' – 2.00'							Dominant and Open-grown						
	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings	Year cut over	Years After Cutting				Total 4 yrs.	Basis No. of Seed-lings
		1	2	3	4				1	2	3	4				1	2	3	4				1	2	3	4				1	2	3	4		
	Growth in Feet							Growth in Feet							Growth In Feet							Growth in Feet							Growth in Feet						
Snowbrush	.04	.04	.06	.07	.06	.23	88	.07	.07	.11	.14	.12	.44	36	.09	.07	.13	.13	.13	.46	15	.10	.10	.19	.12	.15	.56	2	.07	.07	.13	.13	.12	.45	50
Bitter Brush	.02	.03	.04	.05	.07	.19	2	.06	.18	.17	.16	.17	.68	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.06	.10	.10	.11	.15	.46	2
Manzanita	.03	.04	.07	.08	.06	.25	23	.07	.06	.11	.12	.10	.39	14	.09	.07	.12	.05	.05	.29	1	-	-	-	-	-	-	-	.06	.06	.11	.13	.10	.40	18
Sound Logs	.09	.07	.11	.05	.07	.30	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stump Areas	.04	.04	.09	.07	.07	.27	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.04	.04	.13	.08	.08	.32	5
Open, no vegetation exposed soil	.05.	.05	.08	.09	.08	.30	11	.08	.08	.11	.12	.14	.45	22	.07	.07	.11	.09	.12	.39	4	.22	.12	.11	.30	.22	.75	1	.08	.07	.11	.11	.13	.42	22
Open, no vegetation duff on soil	.06	.05	.11	.12	.11	.39	10	.06	.06	.12	.12	.10	.40	14	.10	.04	.15	.12	.13	.44	2	.13	.11	.17	.14	.12	.54	2	.08	.07	.15	.13	.12	.47	14
Average of above in natural conditions	.04	.04	.07	.08	.06	.25	149	.07	.07	.11	.13	.12	.43	87	.09	.07	.13	.12	.12	.44	22	.14	.11	.17	.16	.13	.57	5	.07	.07	.12	.13	.12	.44	111
Brush	.06	.07	.11	.13	.13	.44	17	.10	.08	.16	.15	.14	.53	5	.11	.10	.20	.15	.15	.60	8	.07	.05	.03	.07	.10	.25	1	.10	.09	.19	.18	.17	.63	19

*Height at time of cutting

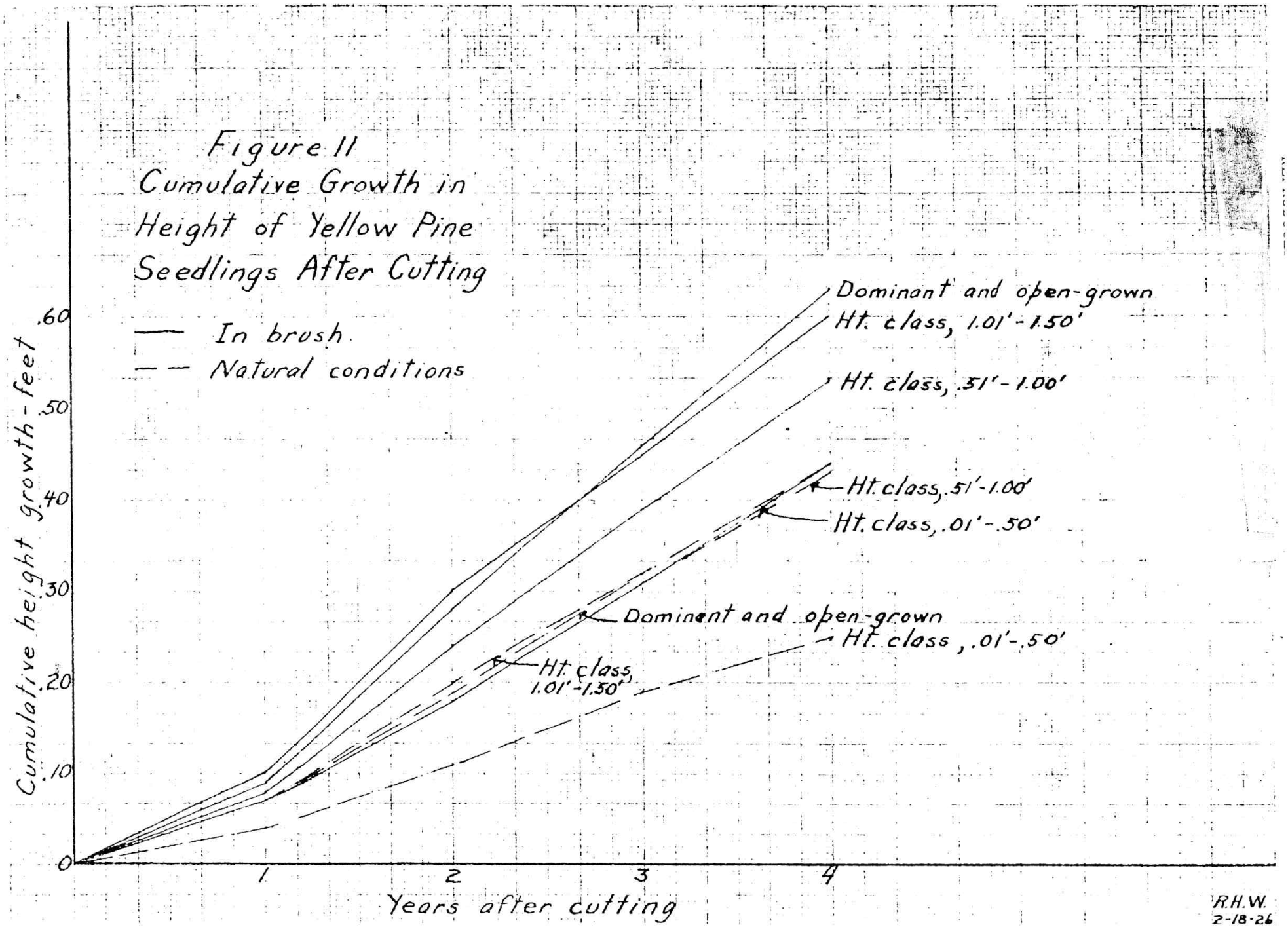


Figure 11
Cumulative Growth in Height of Yellow Pine Seedlings After Cutting
In brush
Natural conditions
Cumulative height growth - feet
0
.10
.20
.30
.40
.50
.60
1
2
3
4
Years after cutting
Dominant and open-grown Ht. class, 1.01'-1.50'
Ht. class, .51'-1.00'
Ht. class, .51'-1.00'
Ht. class, .01'-.50'
Dominant and open-grown Ht. class, .01'-.50'
Ht. class, 1.01'-1.50'
R.H.W.
2-18-26

TABLE III.

Height Growth of Yellow Pine Seedlings
After Cutting

Location of Seedling	*Height Class .01' - .50'						*Height Class .51' – 1.00'						*Height Class 1.01' – 1.50'						*Height Class 1.51' – 2.00'						Dominant and Open-grown					
	Year cut over	Years After Cutting				Basis No. of Seed-lings	Year cut over	Years After Cutting				Basis No. of Seed-lings	Year cut over	Years After Cutting				Basis No. of Seed-lings	Year cut over	Years After Cutting				Basis No. of Seed-lings	Year cut over	Years After Cutting				Basis No. of Seed-lings
		1	2	3	Total 3 yrs.			1	2	3	Total 3 yrs.			1	2	3	Total 3 yrs.			1	2	3	Total 3 yrs.			1	2	3	Total 3 yrs.	
	Growth in Feet						Growth in Feet						Growth In Feet						Growth in Feet						Growth in Feet					
Snowbrush	.04	.05	.08	.10	.23	74	.06	.09	.13	.17	.39	35	.08	.13	.18	.23	.54	19	.09	.11	.15	.20	.46	8	.07	.10	.17	.21	.48	64
Bunch Grass	.03	.04	.05	.06	.15	33	.06	.09	.11	.13	.33	40	.07	.14	.17	.20	.51	17	.10	.14	.16	.20	.50	12	.08	.12	.14	.17	.43	39
Open Duff No vege-tation	.02	.03	.03	.03	.09	23	.07	.05	.07	.11	.23	4	-	-	-	-	-	-	-	-	-	-	-	-	.05	.05	.05	.07	.17	14
Bitter Brush	.02	.02	.02	.03	.07	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.05	.04	.03	.05	.12	4
Stump Areas	.05	.12	.17	.19	.48	25	.09	.17	.26	.29	.72	17	-	-	-	-	-	-	-	-	-	-	-	-	.09	.18	.26	.28	.72	17
Average of above in natural conditions	.03	.05	.08	.09	.22	160	.07	.10	.14	.17	.41	96	.08	.13	.18	.22	.53	36	.10	.13	.16	.20	.49	20	.07	.11	.16	.19	.46	138

Plot No. 19, Table 4 and Fig. 12.

This plot is on a west slope on an area cut clear in 1918. The only plant growth on the area is scattered bunch grass.

Figure 12 demonstrates that the effect of the slash on height growth is noticeable only on seedlings up to .5 feet at the time of cutting, in which case the growth is a third greater in the brush than in the bunch grass. The growth of that class of seedlings in the brush is nearly as great as seedlings from .51 feet to 1.00 feet in the open. The growth of the different height classes between 1.00 feet and 3.00 feet was almost identical and the average is shown in Fig. 12. The larger seedlings show greater growth under natural conditions. This cannot be accounted for.

A comparison of plots 12, 13, and 14 taken in central Oregon with plot 19 taken in eastern Oregon reveals a much more rapid growth of seedlings in eastern Oregon than in central Oregon. The latter plot represents a poorer site than the former plots too. It may be that this can be attributed to one of two things or a combination of both. In the first place, moisture conditions may be more favorable in eastern Oregon. Secondly, the heavier stands in central Oregon may result in worse suppression and stunting of the seedlings, from which they do not recover for several years, than in eastern Oregon.

Summarizing the effect of brush on seedling growth the following is indicated:

1. On north slopes there is not noticeable effect on height growth, although a slight difference is indicated on seedlings under .5 feet at the time of cutting.
2. On exposed sites, all height classes show the beneficial effect of brush in height growth, and the greatest effect is seen in seedlings under .5 feet at the time of cutting in which case the growth is nearly two times as great in the slash as in natural conditions.

The bending over and the smothering of some seedlings by brush has already been mentioned. This damage is of so little importance that it need not be considered a serious disadvantage of undisposed slash.

TABLE IV.

Height Growth of Yellow Pine Seedlings After Cutting

	*Ht. Class .01'-.50'		*Ht. Class .51'-1.00'		*Ht. Class 1.01'-1.50'		*Ht. Class 1.51'-2.00'		*Ht. Class 2.01'-3.00'		Ht. Class 3.00'-4.00'		Dominant and Open-grown	
	Location of Seedling													
	Bunch Grass	Brush	Bunch Grass	Brush	Bunch Grass	Brush	Bunch Grass	Brush	Bunch Grass	Brush	Bunch Grass	Brush	Bunch Grass	Brush
Year	Growth in Feet													
Cutover After Cutting	.06	.08	.10	.11	.14	.14	.15	.16	.15	.16	.26	.18	.16	.16
1	.11	.15	.18	.18	.24	.22	.23	.23	.22	.24	.46	.24	.26	.26
2	.11	.16	.17	.19	.21	.22	.22	.21	.22	.22	.44	.26	.26	.27
3	.14	.23	.26	.26	.31	.32	.32	.34	.31	.33	.70	.33	.40	.39
4	.19	.29	.30	.30	.38	.42	.43	.90	.42	.41	.67	.37	.48	.47
5	.17	.22	.26	.24	.34	.33	.38	.31	.38	.31	.62	.30	.42	.37
6	.21	.29	.31	.31	.40	.39	.43	.37	.48	.37	.80	.37	.46	.46
7	.16	.21	.20	.21	.28	.30	.33	.24	.38	.26	.62	.27	.38	.32
Total 7 years	1.09	1.55	1.68	.171	2.16	2.20	2.34	2.10	2.41	2.14	4.31	2.14	2.66	2.54
Basis, number of seedlings	27	14	56	25	51	36	44	25	18	19	4	9	71	58

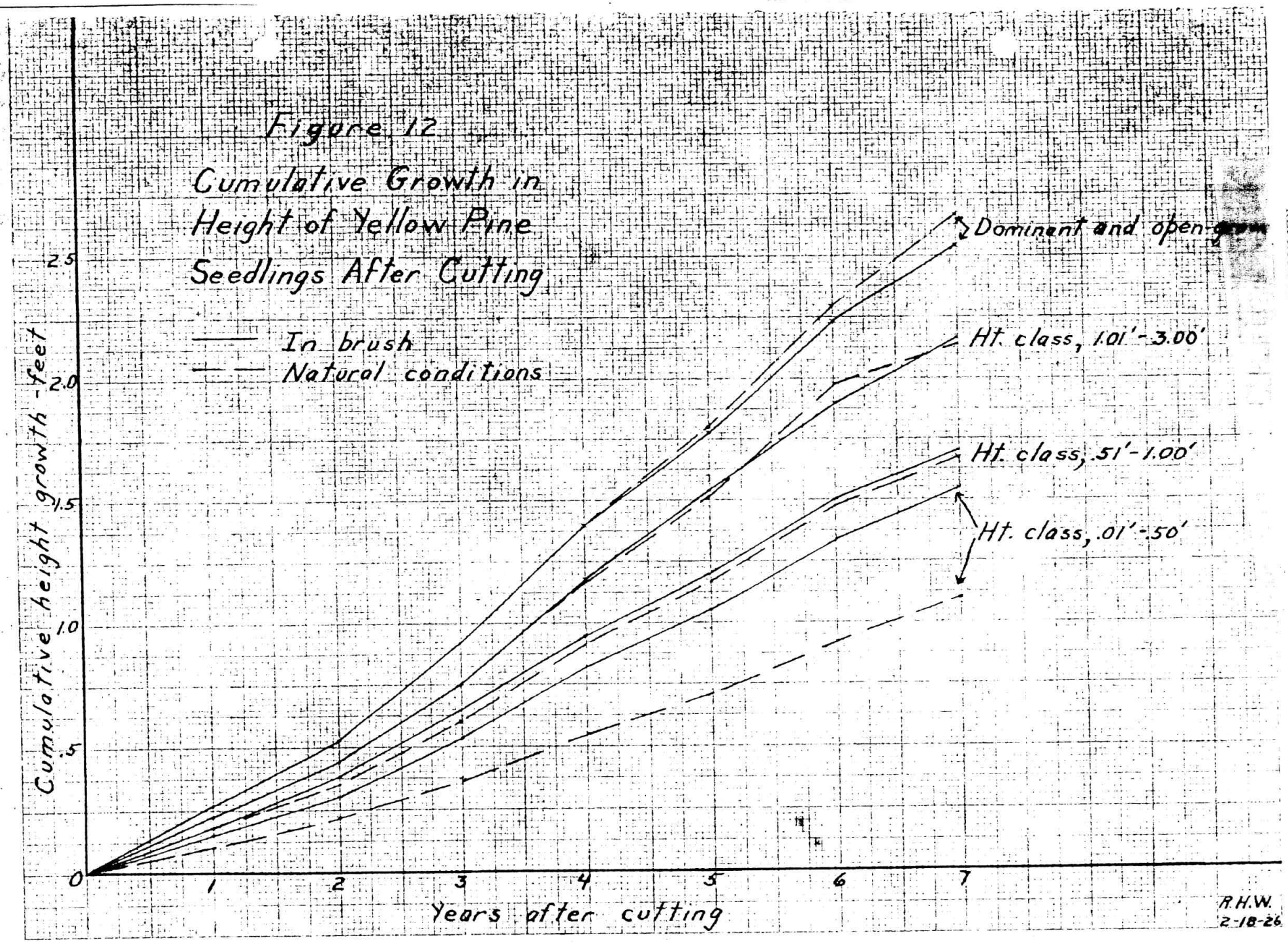
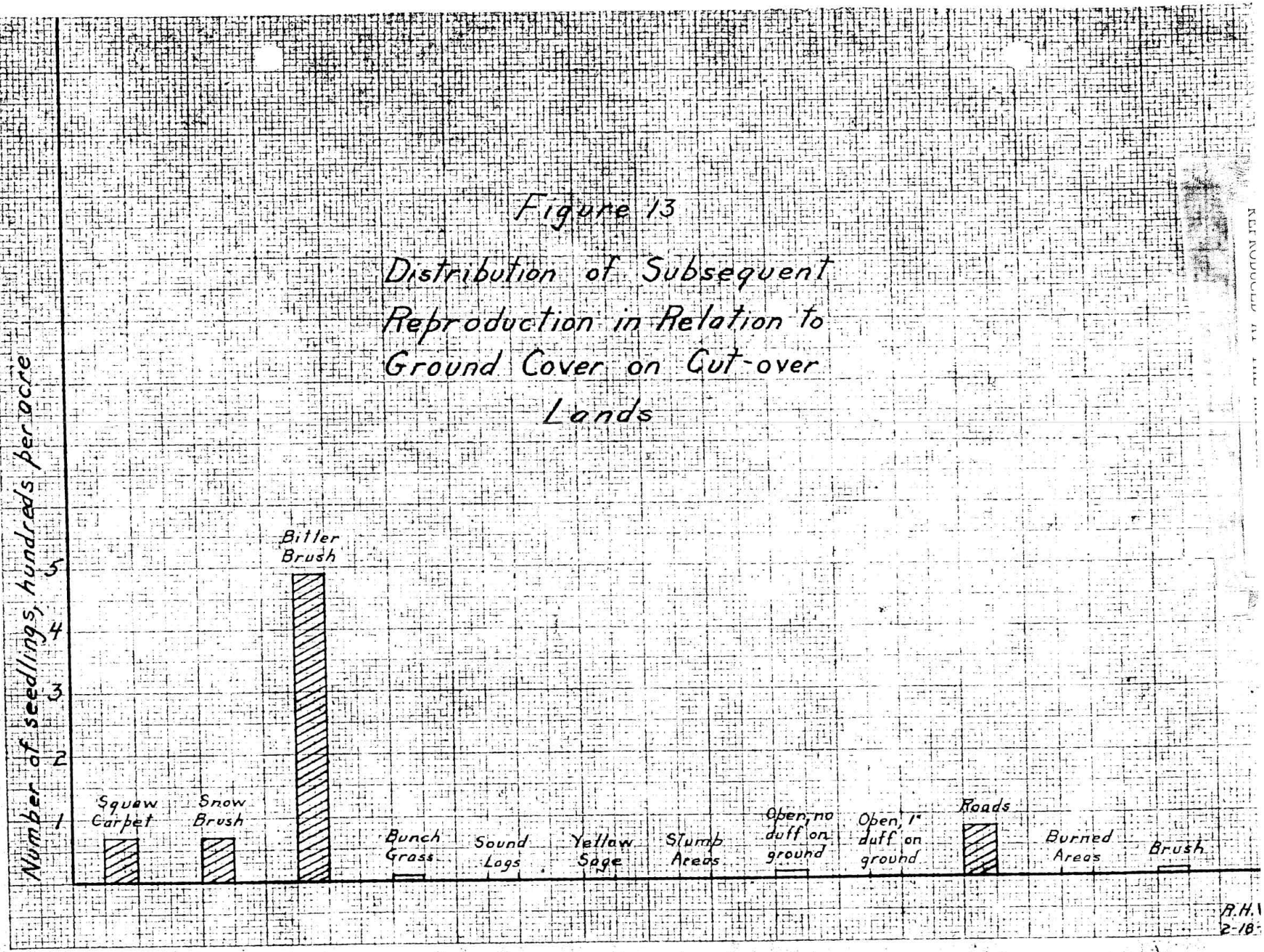


Figure 12
Cumulative Growth in Height of Yellow Pine Seedlings After Cutting
In brush
Natural conditions
Dominant and open-grown
Ht. class, 1.01'-3.00'
Ht. class, .51'-1.00'
Ht. class, .01'-.50'
Cumulative height growth - feet
0
.5
1.0
1.5
2.0
2.5
1
2
3
4
5
6
7
Years after cutting
R.H.W.
2-18-26

Figure 13

Distribution of Subsequent Reproduction in Relation to Ground Cover on Cut-over Lands



Seedlings growing in brush are, of course, less subject to damage by grazing animals than those which are not protected. This is a very important consideration in the Southwest [9]where natural regeneration is greatly retarded by grazing animals especially sheep. In this region, however, grazing does not seem to be a limiting factor in natural reproduction of yellow pine. In central Oregon, grazing is usually light and only occasional seedlings along trails are sometimes browsed. Sheep grazing in eastern Oregon is quite heavy, but even there the damage to seedlings is limited to narrow strips along driveways.

Subsequent Reproduction

No conclusive evidence has been secured on the effect of brush on subsequent reproduction. Areas having undisposed brush are all on private land where the source of seed after cutting is very uncertain because trees are cut to a diameter of 12" DBH. The data showing the distribution of subsequent reproduction in relation to ground cover and brush on cut-over lands is shown graphically in Fig. 13. The interesting point brought out in the relation of subsequent reproduction to herbaceous vegetation. The concentration of the reproduction in vegetation is probably due to several factors. This may be due to additional soil moisture, protection against insolation, protection against frost heaving, and protection of seed from rodents. The data shows no beneficial effects of brush. Pearson's investigations[10] demonstrate that with the exception of bunch grass areas, the establishment of seedlings is aided by slash.

Brush as a Protection Against Erosion

Undisposed brush is considered a means of preventing erosion in certain regions, particularly the Southwest. Timbered areas there are subject to erosion, and skid trails and roads offer an ideal place for it to begin. Where possible, brush is always scattered in the skid trails and becomes an effective means in slowing up or even stopping this process.

In the Northwest, erosion is not a factor on the areas studied so far. The pumice soils of central Oregon act as a sponge, absorbing the rainfall as rapidly as it falls even during heavy rains. Even on steep slopes there is very little run-off. The same holds true in eastern Oregon although there the soils are more of an adobe-like structure. The whole yellow pine region has not been covered as yet by this study, and it may be possible that erosion is a factor to consider on the granitic soils of eastern Washington.

Brush as it Affects Grazing

In considering the advantages and disadvantages of leaving brush undisposed, the effect that it will have on grazing cannot be overlooked. There is no doubt that most of the grasses and other vegetation is choked out where brush lies thick on the ground. The portion of the good which is affected in this manner is so small, about 5%, that it is not an important consideration. Another argument that might be advanced is that the brush makes grazing undesirable and impossible because sheep especially could not be herded on brush covered areas. This may be true to a certain extent for one or two years but observations on older cut-over lands prove that animals graze as readily as though the areas were free of brush. Even though the productive capacity of the range is lowered somewhat, it must be remembered that cut-over lands constitute such a small part of the entire forested land that the loss in value is insignificant.

Entomological Aspects of Brush Disposal

The destructiveness of insects, chiefly Dendroctonus beetles, in the yellow pine forest has been held in the limelight for years. Occasionally an epidemic occurs, and the losses of timber become alarming. Naturally, the relation of insect infestation to brush disposal must be taken into consideration in formulating a policy. At one time, it was assumed that undisposed slash increased the work of Dentroctonus beetles. This has been proven

[9] G. A. Pearson, Natural Reproduction of Western Yellow Pine in the Southwest, Bull. 1105, U.S.D.A. 1923, page 115.

[10] G. A. Pearson, Natural Reproduction of Western Yellow Pine in the Southwest, Bull. 1105, U.S.D.A. April 1923, page 92

not to be the case. Craighead[11], Pearson[12], and Graham[13] are unanimous in the statement that injurious insects breed in the tops and stumps and not in the smaller branches which are usually the portion of the tree destroyed in slash burning. Craighead says, "Slash disposal will not be necessary from the standpoint of this insect." (Referring to Dendroctonus). Graham advocates, for certain insects, piling since injurious insects cannot breed in piles because of insufficient light and adverse moisture conditions.

Throughout the field season investigations were made to determine whether there was any relation between undisposed brush and insect infestation. The only evidence noted was in eastern Oregon on the lands of the Bowman-Hicks Lumber Company where Ips infestation was noted. It was on an area that had been cut over in 1924. There was plain evidence that these insects had first worked in the slash, and upon emerging attacked small saplings and poles. The work was most noticeable where tops had fallen into clumps of reproduction. The largest tree killed was 10 inches in diameter. Ordinarily, trees above 5 inches were not affected. The infestation was restricted to small patches less than a rod square and in no case became general.

Relation of Logging to Brush Disposal

At first thought, the relation of methods of logging to brush disposal may seem rather far fetched. However, since each method of logging leaves the cut-over land in a distinct condition, a few words are in order.

The first difference in the various methods of logging is the percentage of area occupied by roads and the width of the roads. The area occupied by roads varies from 4% for direct skidding to 20 or 30% for tractor logging, and the width of road varies from 4 feet to 15 feet. This all has a bearing on the fire protective scheme. An area having 30% of it occupied by roads 15 feet wide certainly is not as serious a fire hazard as one having only 4% of it covered by roads 4 feet wide. Further study will undoubtedly show that the number of fire lines can be varied with the method of logging.

Another difference in the effect of different methods of logging on brush disposal is the distribution of the slash over an area. Clyde donkey logging distributes the brush evenly over the ground, breaking most of it up and combining it with the soil. The result is a much less fire menace than some other logging methods present. Lidgerwood logging has somewhat the same effect, brush covering in some cases, 50% of the ground. Tractor logging results in a maximum accumulation of windrowed brush along the roads, which is as destructive to reproduction as piling. Six or seven per cent of the ground is often covered by windrowed brush. These facts are of no particular importance in connection with piling and burning, but in the working out of other methods they have a direct bearing on the problem.

Logging Damage

In connection with the study of brush disposal, some data was secured on the extent of damage to reproduction by different methods of logging. Prejudice in some cases and ignorance in others has resulted in over-estimating the undesirability or desirability of various methods of logging. This has resulted in putting the Lidgerwood in the same class as the Clyde donkey and the tractor in the same class as horse logging. An analysis of the data reveals that the Lidgerwood is less destructive to reproduction than the tractor. The following table is a summary showing for various methods of logging, the percentage of areas covered by roads and skid trails on which al reproduction is killed and the percentage of area partially damaged. The partially damaged areas are adjacent to roads where only some of the seedlings are destroyed.

[11] F. C. Craighead, The Dendroctonus Problems, Journal of Forestry, Vol. 23, No. 4, April 1925, page 340.

[12] H. B. Pierson, The Place of Entomology in Silviculture, Journal of Forestry, vol. 23, No. 4, April 1925, page 372.

[13] S. A. Graham, Some Entomological Aspects of the Slash Disposal Problem, Journal of Forestry, Vol. 20, No. 5, May 1922, page 437.

TABLE V.

Damage to Reproduction by Logging

Method of Logging	Area of roads or skid trails per M cut %	Area partially damaged per M cut %
Lidgerwood	.50 (2)	.21 (1)
High wheels with tractor	.68 (1)	1.80 (2)
High wheels with horses	.46 (3)	1.00 (1)
Clyde donkey	1.10 (1)	No Data
Dray with horses on snow	.06 (2)	.29 (1)
Direct skidding	.32 (1)	No Data

Note: The number in the circle denotes the number of plots on which the data is based.

Practical Applications of Brush Disposal

The general conclusion which can be drawn from the first season's field work on brush disposal is the need for greater diversification of methods. It is unreasonable to say that piling and burning should be the universal method or that fire lines alone will solve the problem. The policy in brush disposal must be flexible enough to meet conditions as they exist on the ground. There is no question but that in many instances too much money has been spent on brush disposal while in other cases the expenditure of only a few cents per acre has done more harm than good. Stated more specifically, there are areas where the fire hazard is so low that the expenditure of $5.00 or $10.00 per acre for brush disposal is wasted effort, because piling and burning on strips at a dollar or two per acre would give just as good results. Swamper burning, although in the experimental stage, seems to offer a wonderful opportunity for disposing of the fire hazard along railroads and camp sites and other hazardous areas. Although it will be possible to make certain generalizations after further study, their application will have to be decided on the ground, taking into consideration the amount and size of reproduction, the relative fire risk, topography, values at stake, and the method of logging. In other words, before a general prescription of piling and burning is made for a specific watershed, conditions must be studied in the woods.

Table 6 is a summary of the field data which has not been presented specifically elsewhere in this report but referred to in a general way.

R. H. Westveld

Junior Forester

TABLE 6

(1)

SUMMARY OF FIELD DATA, 1925

Piled and Burned Areas

Plot Number	Location	Topography	Method of Cutting	Year Cut	Method of brush disposal	Method of logging	Volume cut per acre	Area undamaged by logging	Area partially damaged by logging	Area in roads or skid trails	Area in roads per M cut	Average width of roads or skid trails	Total area damaged by brush piles	Area of brush disposal damage caused by felled snags	Area of brush disposal damage caused by down logs	Brush disposal damage adjacent to roads	Snags per acre	Brush piles per acre	Brush piles per M	Brush piles per stump	Average area of piles	Average diameter of piles	Brush disposal damage per M cut	Damage to merchantable reserve stand by brush disposal	Damage to unmerchantable reserve stand by brush disposal	Area R. R. grade	Area landing
							F.B.M.	%	%	%	%	Feet	%	%	%	%	Number	Number	Number	Number	Sq. ft.	Feet	%	% of total volume	% of total number of trees	%	%
1	P.B.L. Co. Sale Crater N. F.	Gentle 3% slope	Selection F.S.	1922	Piled in June burned in Oct.	High wheels with horses	17.6			5.9	.3	7.0	9.2			1.2		22.4	1.28	.79	161.2	14.4	.52	0.0	33.3		
3	P.B.L. Co. private land	Gentle 2% slpe	Clear cut	1922	Piled in Oct. 1922 burned in Oct. 1923	High wheels with horses	20.8			3.3	.2	10.0	9.1			.7		26.4	1.27	1.15	148.1	13.8	.44	1.0	18.0		
4	P.B.L. Co. Crater N.F.	Gentle 3% slope	Selection F.S.	1922	Piled in June burned in Oct.	High wheels with horses	10.0						4.0			.3		18.8	1.90	1.28	182.9	14.6	.40	3.9	13.0		
6	S-H.L Co. Deschutes N.F.	Gentle 10% slope	Selection F. S.	1923	Piled in Sept. burned in Nov.	Lidger-wood	17.2			18.9	1.1	13.0	4.3			1.8		26.0	1.51	1.21	74.0	9.8	.25	0	0	1.5	1.8
8	S-H.L. Co. sale Deschutes N.F.	Gentle 2% slope	Selection F.S.	1925	Piled in May to be burned	Drays with horses	22.3	85.9	6.5	2.5	0.1	7.0	5.1			.4		35.0	1.57	1.93	63.6	9.0	.23			0	0
15	P.B.L. Co. Sale Crater N.F.	Gentle 4% slope	Selection F.S.	1925	Piled June to be burned	High wheels with tractors	14.0	52.6	34.1	9.5	0.7	15.0	3.9			.9		23.9	1.71	1.55	69.7	9.4	.28			0	0
20	B.W.P.L. Co. Sale Whitman N.F.	Rolling 10% slope	Selection F.S.	1924	Piled 1924 burned Oct 1925	Direct skid-ing	11.2			3.6	0.3	4.0	10.1	0.5	0.4	1.7	4.4	75.8	6.79	3.83	43.6	7.4	.71				

*The actual percentage on a 5 acre plot. For the entire Lidgerwood setting, the percentages were 10% and 7.9% respectively

TABLE 6

(2)

SUMMARY OF FIELD DATA, 1925

Undisposed Brush

Plot number	Location	Topography	Method of cutting	Year cut	Method of brush disposal	Method of logging	Volume cut per acre	Area undamaged and not covered by brush	Area partially damaged by logging	Area in roads	Area in roads per M cut	Average width of roads	Area in R.R. grade	Area in landing	Area brush density .1-.3	Area brush density .4-.7	Area brush density .8-1.0	Area brush windrowed	Total area brush	Area brush per M cut	Brush adjacent to roads
							F.B.M	%	%	%	%	Feet	%	%	%	%	%	%	%	%	%
2	P.B.L. Co. sale Crater N.F.	Gentle1% slope	Selection F.S.	1922	Undisposed	Clyde donkey	24.3			27.1	1.1	7.5			60.2	2.2	0.3	0	62.7	2.6	
9	S.-H.L. Co. Private land	Gentle 4%slope	Clear cut	1925	Undisposed	High wheels with tractors	23.1	17.6	29.3	28.6	1.2	15.0	1.0	3.5	4.8	4.5	4.9	5.8	20.0	.87	9.6
10	S.-H.L. Co. Private land	Gentle 4% slope	Clear cut	1925	Undisposed	Lidgerwood	19.1	31.2	4.1	20.9*	1.1	14.0		1.4	9.5	9.2	23.4	0.3	42.4	2.2	14.3
11	B.S.H.L. Co. Private land	Gentle 3% slope	Clear cut	1924	Undisposed	High wheels with horses	15.7	45.8	15.6	14.4	0.9	10.0	2.0	1.7	1.0	2.2	12.5	4.8	20.5	1.3	7.2
5	S.-H.L. Co. Private land	Gentle 3% slope	Clear cut	Dec. 1922	Undisposed	Dray with horses on snow	18.5			0.7	.03	7.0	0	0	9.0	14.2	5.9	0	29.1	1.5	

- The actual percentage on a 5 acre plot. For the entire Lidgerwood setting, the percentages were 10% and 7.9% respectively