Analysis of a Slash Inspection Survey on Private Lands in the Ponderosa Pine Region of Oregon

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ANALYSIS OF A SLASH INSPECTION SURVEY ON PRIVATE LANDS IN THE PONDEROSA PINE REGION OF OREGON

INTRODUCTION

The problem of slash disposal has been subject to continuous study since as early as 1907, when the newly established Forest Service published suggestions for brush disposal in National Forests. Since then new knowledge has been gained, and many new ideas have been developed.

In general, the trend has been away from the application of rigidly set methods of disposal of slash and toward a combination of methods based primarily upon the conditions existing on the area. The volume and distribution of slash, fire hazard, silvicultural influences, scenic values and economics are all factors which will influence the decision regarding the method of disposal.

Under the Oregon Forest Laws the slash left after logging or wood cutting must be removed by burning, unless otherwise provided for by the State Forester. The law also states that where, in the opinion of the forester such burning is unnecessary, or will create a fire hazard, he may relieve by written authorization such persons, firms, or corporations, from the above requirements with respect to part or all of the operation area or require after ten days' written notice

and within a reasonable specified time that the hazard to life or property of others from any part of such operation be removed, and, if he deems the burning of such debris necessary, that this shall be by such method and with such precautionary requirements as the board shall have approved as safe and sufficient for the region or conditions obtaining.[1]

In order to carry out the provisions of the law, the annual slash must be examined within the year and the method of disposal or treatment decided upon by an inspector. The present method of inspection leaves the decision regarding action upon the slash largely to the examiner. The state does provide the examiners with a general policy regarding classification of the slash, but the method of disposal is based to a large extent upon the method of logging.

It would be desirable to base these decisions upon sound judgment, but training to secure uniform, satisfactory results is difficult and expensive. Most of the money available for slash inspection must be used for actual inspection rather than for training. For this reason there is a very urgent need for a sound basis on which to judge the best action to take on any given slash area so it will best meet the requirements of the law and the economic, silvicultural and scenic factors.

How and to what extent certain physical factors present on slash areas affect fire hazard is the primary considera-

[1] Oregon State Board of Forestry, Oregon Forest Laws, 1941. pp.42-43.

tion, since the primary object of slash disposal is to reduce fire hazard within the possibilities of practical control. Reduction of fire hazard may be attained either by burning or by leaving the slash, but most commonly by some method of burning, especially in areas where reduction of fire hazard is the sole or primary reason for treatment of slash. However, in considering factors other than fire danger, it may be advisable to use some other method of disposal. Encouragement of reproduction and conservation of soil and water, for example, are usually accomplished best by leaving the slash on the ground.

In view of the facts that a limited amount of time and money can be spent on annual inspection, and that the time and money that is spent must secure the best possible results, it follows that a sound basis for planning slash disposal - one which is easily understood, workable, and will insure uniform, practical results for all slash areas - will go a long way in securing results.

During the summer of 1942 an inspection of logging operations in Oregon was made by the Oregon State Board of Forestry. The primary purpose of the inspection was to check on compliance with the Oregon Forest Conservation Act, enacted in 1941. In connection with this survey, information regarding the slash on each area was gathered for the Ponderosa

Pine operations. The information from this survey forms the basis for this study, which is primarily a fact-finding analysis to find how and to what extent Ponderosa Pine slash is affected by certain physical factors. The results of the study should help to point the way toward a sound basis for planning slash disposal in the future.

Review of Previous Studies

A study of slash disposal in the Ponderosa Pine region of the Southwest was made by Pearson and McIntyre in 1935.[2] The study indicates that the primary purpose of slash disposal is to reduce fire danger to such a degree as to make control a practical possibility. Pearson indicates that this purpose does not necessarily imply that all slash areas require complete disposal in order to reduce the fire danger to a minimum, or that such disposal will eliminate fire danger. On areas of heavily concentrated slash, an uncontrolled slash fire usually results in killing all the reserve stand. Where brush has been piled and burned, ordinarily a fire kills most of the trees less than twelve inches in breast-height diameter, but few above that size; partial disposal may save the larger of the trees that would otherwise be killed by fire. On such areas of heavily concentrated slash, complete disposal may not be the only answer. It may be possible to remove just enough slash so that a protective organization can stop fires before they reach large proportions.

Pearson also states as a secondary purpose of slash disposal the encouragement of reproduction, (occasionally) to thin reproduction, and to conserve soil and water. The first two are sometimes attained by removing the slash, sometimes by leaving it to decay; the last always calls for leaving it. Under certain conditions these purposes some-

[2] Pearson, G.A., and McIntyre, Slash Disposal in the Ponderosa Pine Region ofthe Southwest. U.S.D.A. Circ. no. 357. Washington, D.C. 1935.

times outweigh fire protection and thus assume major importance.

In a study in eastern Oregon made by Munger and Westveld (1930)[3], it was found that at the end of the first year the needles had turned to a light-brown color but were still attached to the twigs. The second year about 80 percent of the needles had dropped, and by the end of the third year practically all the needles had dropped. A year later all the needles had fallen except for an occasional bunch, and Western red rot, the most rapid of all rots attacking Western Yellow Pine slash, was by then abundant in the tops and was extending into attached branches. At the end of the seventh year all needles had dropped and nearly all branches up to one inch (d.i.b.) were on the ground. Western red rot had largely completed its work on the cull logs, tops, and large limbs. The slash hazard in these areas is considered to have decreased materially after five years, still more after ten years, and after fifteen to twenty years to have practically disappeared. The hazard from the slash proper, i.e., the material under four inches in diameter, is practically neutralized after about fifteen years.

[3]Munger, T.T., and Westveld, R.H., Slash Disposal in the Western Yellow Pine Forests of Oregon and Washington. U.S.D.A. Tech. Bull. no. 259, Sept., 1931.

THE GENERAL SITUATION

Area

The Ponderosa Pine region in Oregon includes the areas on the east slope of the Cascade Range and the adjoining mountains and plateaus, the slopes of the Cascades south of the Umpqua river, and the Blue Mountains of eastern Oregon. Although much of the area is in National Forest, an important part of it is in private ownership.

Climate

Precipitation is decidely seasonal in character. It varies in amount from 15 inches on the borders between desert and forest to more than 50 inches on the west slopes of the Cascade Range. Approximately 37% of this total occurs in winter, 27% in spring, 12% in summer, and 24% in fall. A considerable part of the winter precipitation is in the form of snow, but usually the ground is bare for long periods.[4]

Temperature

Low temperatures in winter and high temperatures in summer are characteristic of the region. The temperature range is greater throughout most of the region than in the areas west of the Cascades. Daily fluctuations in temperature are equally extreme throughout most of the region.

Topography

As compared with the part of Oregon west of the summit of the Cascade range, a great deal of the Ponderosa Pine

[4]U.S.D.A. Yearbook of Agriculture, Climate and Man, 1941. Washington, D.C. Pp. 1085-1086.

region is comparatively level or rolling. The Blue Mountains of eastern Oregon and the Cascades in southern Oregon are the major areas of rough topography.

The Ponderosa Pine Type

Ponderosa Pine is the most xerophytic conifer in the Pacific Northwest, and will grow on a wide variety of conditions. It grows in uneven-aged stands, either in pure stands or in mixture with other conifers. The average volume of a stand of mature Ponderosa Pine is about ten thousand bd. ft. per acre. Although virgin stands are uneven-aged, it will grow in even-aged stands under management.

Debris Left after Logging

In comparison to the west coast Douglas-fir forests, in which extremely heavy concentrations of debris are left after logging, that left after logging in the Ponderosa Pine region is relatively light. This is partly because of the relatively small volume per acre in the Pine, and partly because not all the volume is removed in one cutting. In many cases a good reserve stand is left after logging.

The slash consists primarily of tops and limbs. Logs left in the woods are not numerous enough to greatly add to the fire hazard as a general rule. Underbrush is usually very light, consisting mainly of grass and low shrubs. The most important single factor on many areas is the presence of Cheat Grass. It is highly inflammable, especially in the early summer months, and causes fire to spread very rapidly.

COLLECTION OF DATA

Area Examined

The survey covered the lands of thirty-six Pine operators. In doing so, seventy-one separate Pine areas were investigated comprising an actual 100% tally of 624 acres and a 2½% tally of 25,000 acres. The size of sample areas varied from a half section on the lands of some smaller operators to three sections on some of the larger companies. All the area was examined during the summer of 1942.

Method of Survey

The survey was made through use of a line-and-plot method of gathering field information. This was done on sample areas which were representative of the areas as a whole. The data was gathered on one-tenth acre square plots, spaced five chains apart, and the lines were spaced one-fourth mile apart. This resulted in a 2½% tally of those sections sampled.

Information Collected

The following information was obtained at the center of each of the one-tenth acre plots:

1. Amount of slash existing at the time of examination, estimated in percent of the total ground surface covered by slash.

2. Probable amount of slash on the ground immediately after logging, estimated in percent of ground covered.

3. Probable rate of spread of fire and resistance to control of fire. The standard symbols of L, M, H, and X were used, representing low, moderate, high, and extreme conditions respectively. These symbols are the same as those used by the U.S. Forest Service in fuel type classification.

4. Steepness and direction of slope.

ANALYSIS OF DATA

Certain of these data were analyzed in an attempt to achieve results of practical significance in slash disposal. The results shown in this study show the following:

1. Rate of disintegration of Ponderosa Pine slash.
2. Relation of disintegration of slash to direction of slope.
3. Relation of disintegration of slash to original percent of ground surface covered by slash.
4. Relation of (a) rate of spread and (b) resistance to control of fire to the amount of ground surface covered by fresh slash.

The results of each of the above analyses are presented in graphical form in order to show them as accurately and clearly as possible.

RESULTS

Rate of Disintegration of Ponderosa Pine Slash

The amount of slash left after logging in the Ponderosa Pine region is reduced materially in the first four years, as shown in Fig. 1. For the first two years the slash disintegrates by about one-eighth of the original amount per year; by the end of the third year sixty-three percent of the original slash has fallen to the ground and ceased to be a hazard factor. This indicates that the greatest loss of needles and small twigs is in the first three years after logging, with the largest yearly loss in the second or third year. After this, the rate of disintegration falls off, probably because the bulk of the remaining slash is composed of larger material such as limbs and tops. This material decomposes more slowly because of the slower action of the rots which attack and decay the wood. The action of Western Red Rot, the most rapid of all rots attacking Ponderosa Pine slash, does not become apparent until the fourth year or later.[5]

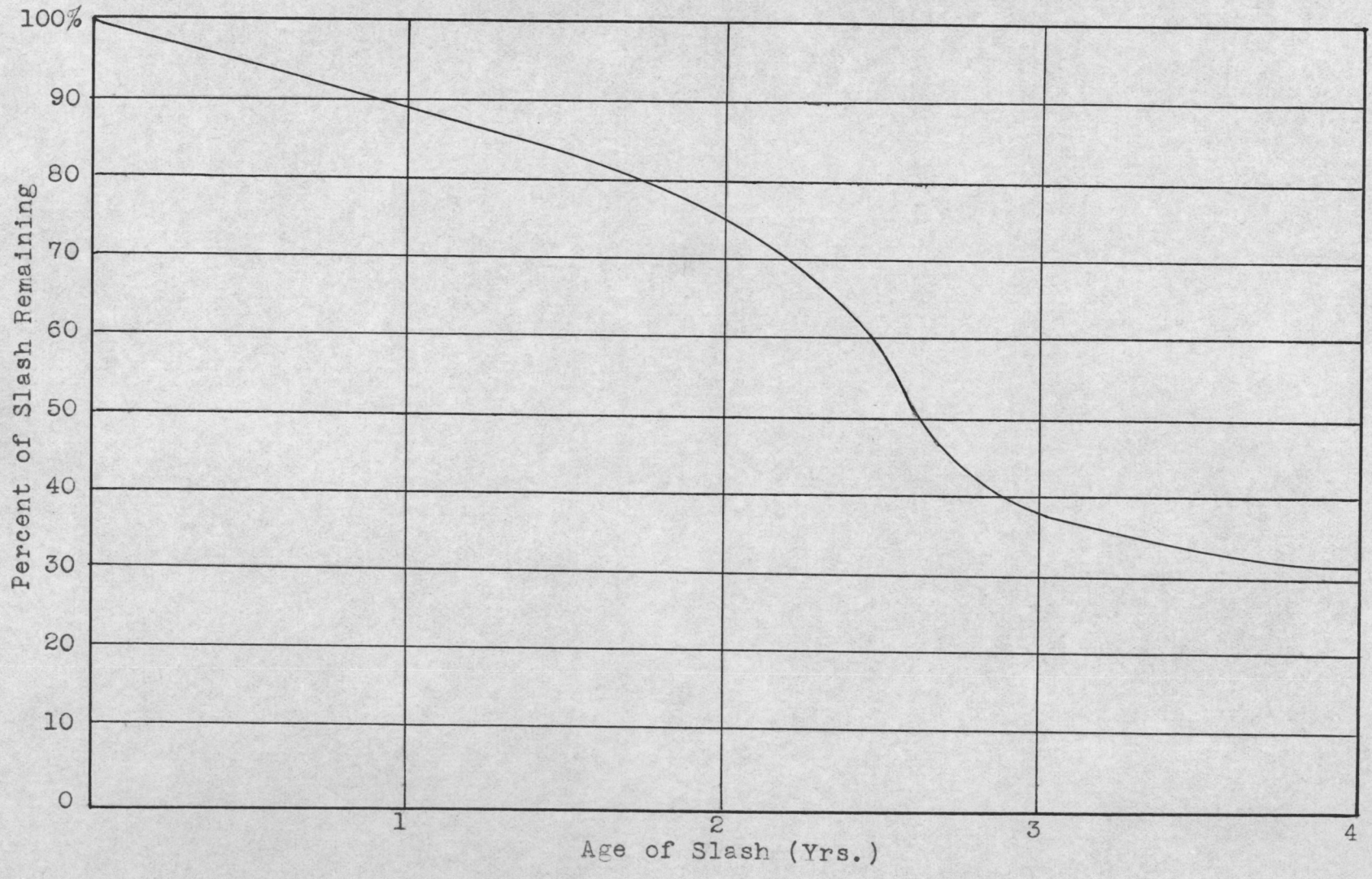
Relation of Slash Decay to Aspect

A comparison of the rates of decay of Ponderosa Pine slash on north, south, east, and west slopes is shown by the bar graph (Fig. 2). The reason for making this comparison was to determine the effect, if any, of aspect (direction of slope) on the rate of slash decomposition, inasmuch as

Age of Slash in Years	Percent of Ground Covered by Slash		
	after completion of logging	At time of survey	Percent Remaining
1 yr.	14.4%	12.5%	86.9%
1	26.2	23.2	88.7
2	26.9	21.2	79.1
2	15.6	10.7	71.4
3	8.7	4.1	46.4
3	20.0	6.2	31.2
4	10.7	3.9	36.9
4	21.9	6.6	30.0
4	19.2	3.7	19.6

Table I. Rate of Decomposition of Ponderosa Pine Slash.

Fig. 1. Rate of Decomposition of Ponderosa Pine Slash



Age of Slash (Yrs.)	Percent of Ground Surface Covered by Slash											
	North Slope			South Slope			East Slope			West Slope		
	When Logged	When Insp.	Percent Left	When Logged	When Insp.	Percent Left	When Logged	When Insp.	Percent Left	When Logged	When Insp.	% Left
1	55	55	100%	365	350	95.9%	580	550	94.8%	135	135	100%
2	150	110	73.3	---	---	----	285	165	58.0	---	--- -	----
3	90	40	33.3	655	175	26.3	135	60	44.4	65	20	30.8
4	330	105	31.8	85	30	35.3	410	120	29.3	---	---	---
5	210	10	4.8	400	0	0.0	---	---	----	270	30	11.1

Table II. Effect of Aspect (Direction of Slope) upon Rate of Slash Decomposition.

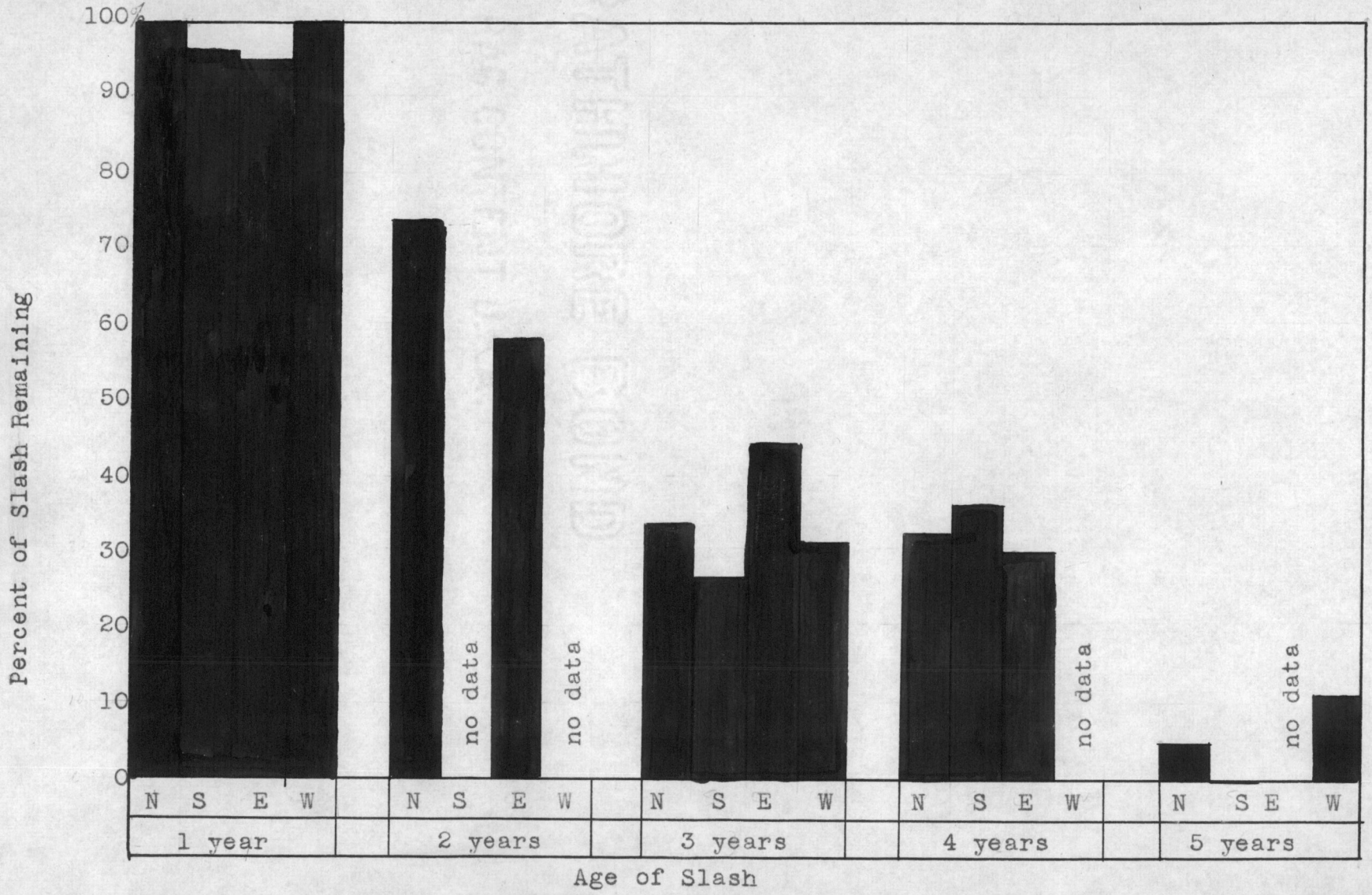
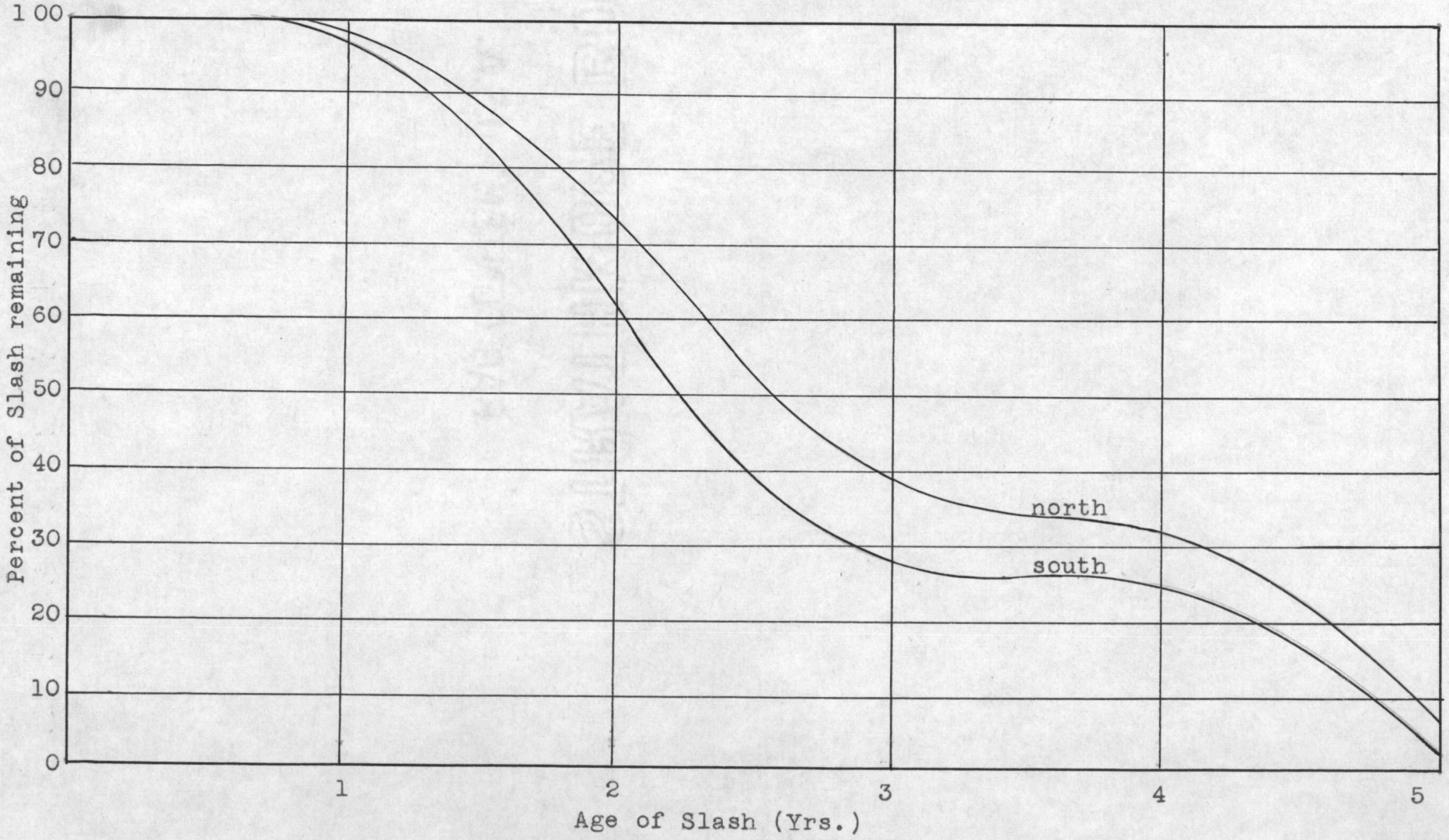


Fig. 2. Effect of Aspect (Direction of Slope) on Rate of Slash Decomposition.

Fig. 2 (a). Rate of Slash Decomposition on North and South Slopes.



this directly affects fire hazard. The results indicate that the direction of slope does have some effect upon the rate of decrease of slash concentration. Fig. 2 shows the slash disintegrated somewhat more slowly on the north slopes than on the south slopes. The dryness of the south slopes evidently tends to speed up the rate of slash decomposition. Loss of needles and twigs from the limbs and tops is the primary factor in reducing the slash hazard for the first four years.

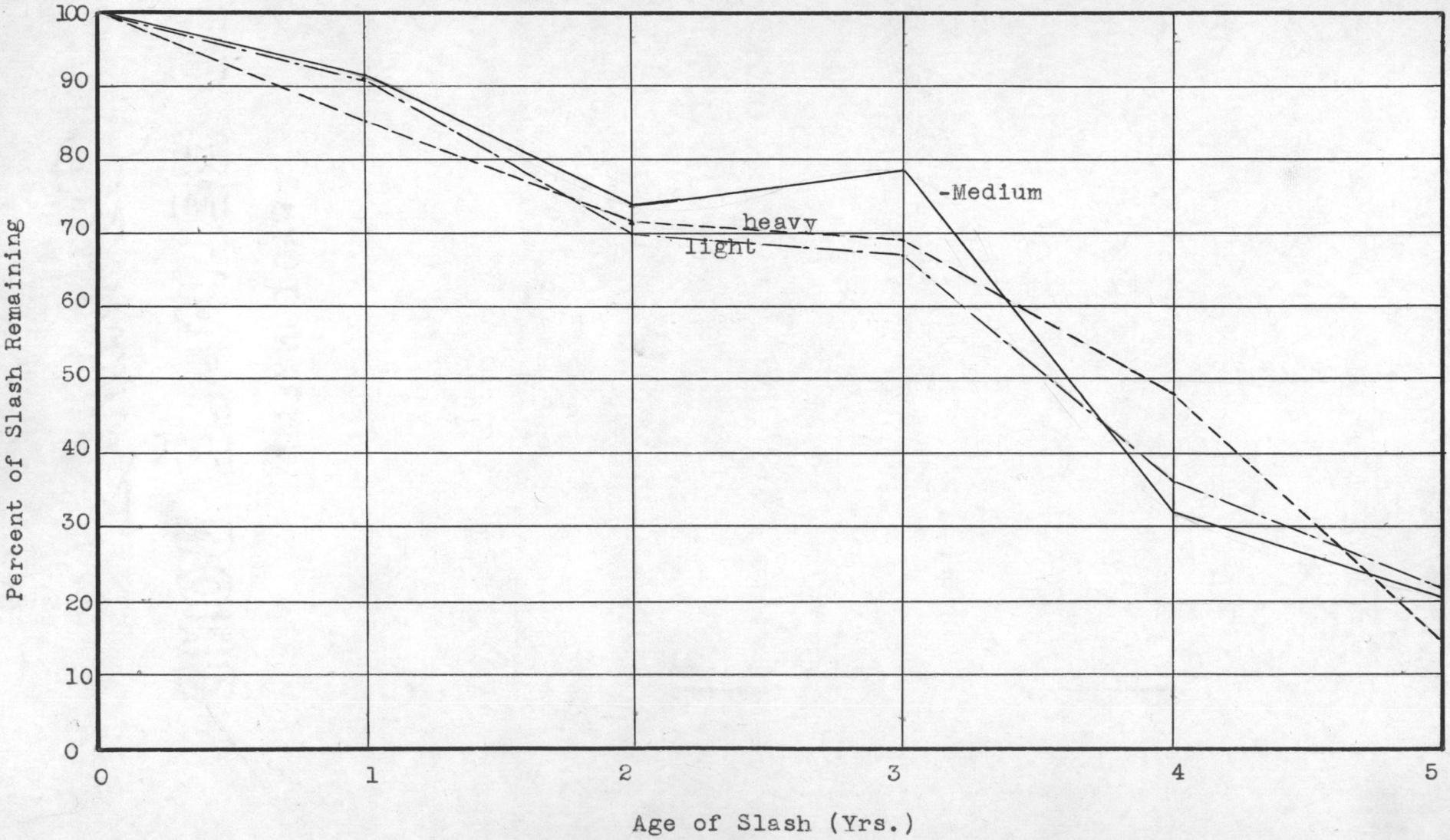
The reason for a less marked difference in rate of decay on the various aspects probably lies in the fact that a major portion of the sample areas were taken on only moderately steep or rolling terrain. If the data taken on each aspect had been sufficient to be divided into classes based on steepness of slope, the results may have shown a more marked variation between rate of decay and aspect as the steepness of slope increased.

Relation of Slash Decay to Original Amount

The reason for this comparison was to determine the correlation between the original amount of slash left on the ground and the rate at which it decays.

The sample plots were divided into three classes on the basis of degree of slash concentration. For each of the classes the percent of the original slash remaining after each year was plotted on a graph.

Fig. 3. Relation of Original Amount of Slash to Rate of Decomposition.

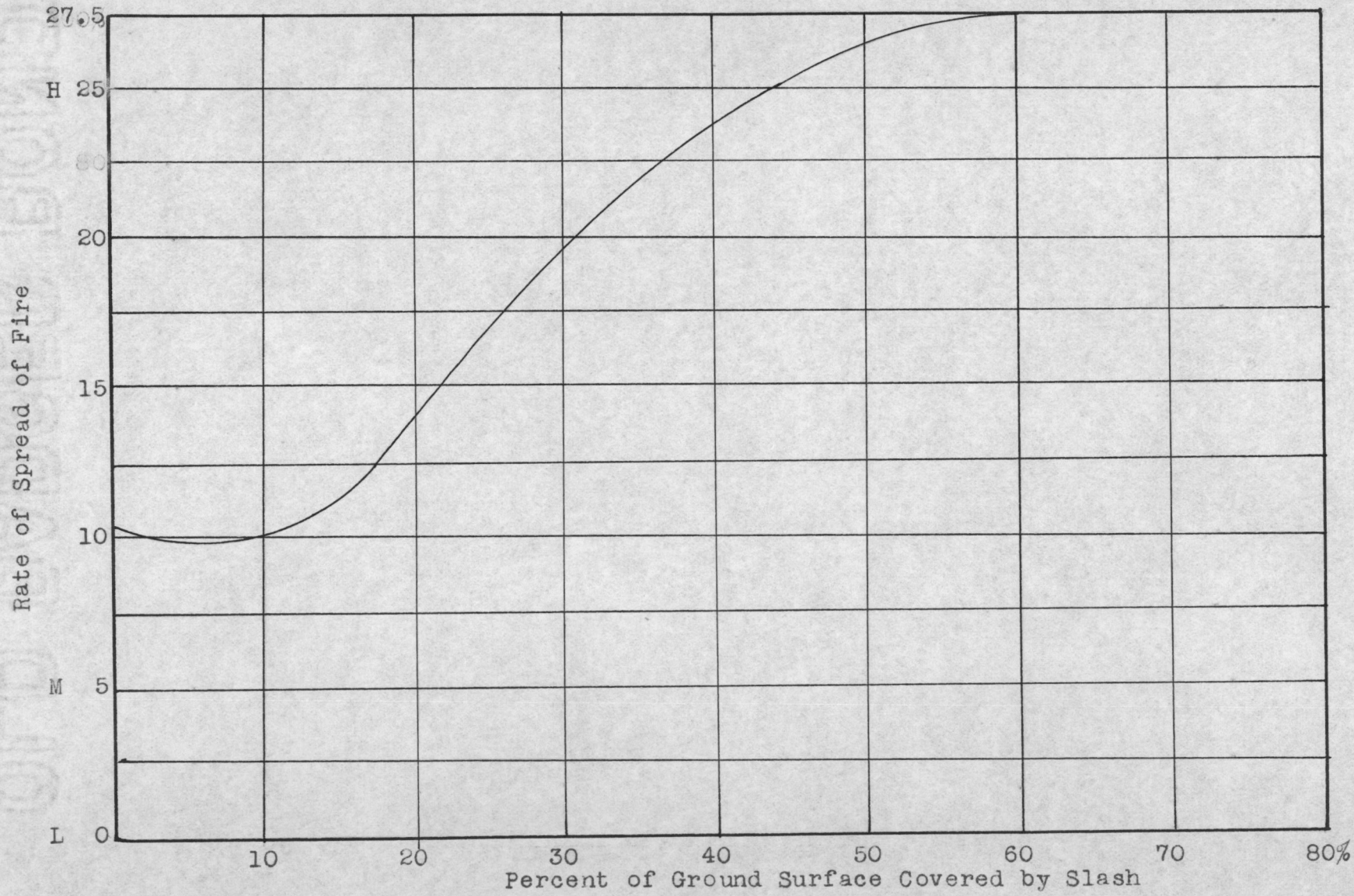


The results (Fig. 3) show no definite correlation between these two factors. In other words, the rate of decomposition of slash is not affected in any consistent manner by the original amount of slash. The yearly fluctuations in the graph are probably due to the method of gathering field information rather than to the actual rate of disintegration. All the field work was done in one season. By collecting the data in this manner the yearly difference in climate affected each year's figure to some extent. There is also a possibility that the difficulty in estimating original slash concentration on the sample plots affected the results. The significance of the graph, however, is in the nearly uniform rate at which slash decays on all degrees of slash concentration. This means that, after any given time, the amount of slash remaining will larger on the highly concentrated slash areas than on those with light concentrations.

Relation of Amount of Slash to Rate of Spread of Fire

This comparison was based on percent of surface covered by Ponderosa Pine slash at the time of logging, and the estimated rate of spread of fire as used in the U.S. Forest Service fuel type classification. Rate of spread is divided into four classes: low, moderate, high, and extreme, for which the respective numerical values of 1, 5, 25, and 125 were used in plotting the information graphically. (Fig. 4)

Fig. 4. Effect of Degree of Slash Concentration upon Rate of Spread of Fire.



The data used was taken entirely from current slash areas, that is, areas in which the logging was done in 1942, in order to avoid the element of time. From the graph it can be seen that the rate of spread varies directly with the concentration of slash. A moderate rate of spread is shown to exist on areas which did not have any slash on them. There is evidently little increase in rate of spread in areas having 15% or less of the ground covered by slash. The increase in rate of spread on areas which have more than this amount, however, is proportional to the increase in amount of slash, up to the heavy concentrations of 50% or more of the ground covered. These heavy concentrations averaged slightly above a high rate of spread.

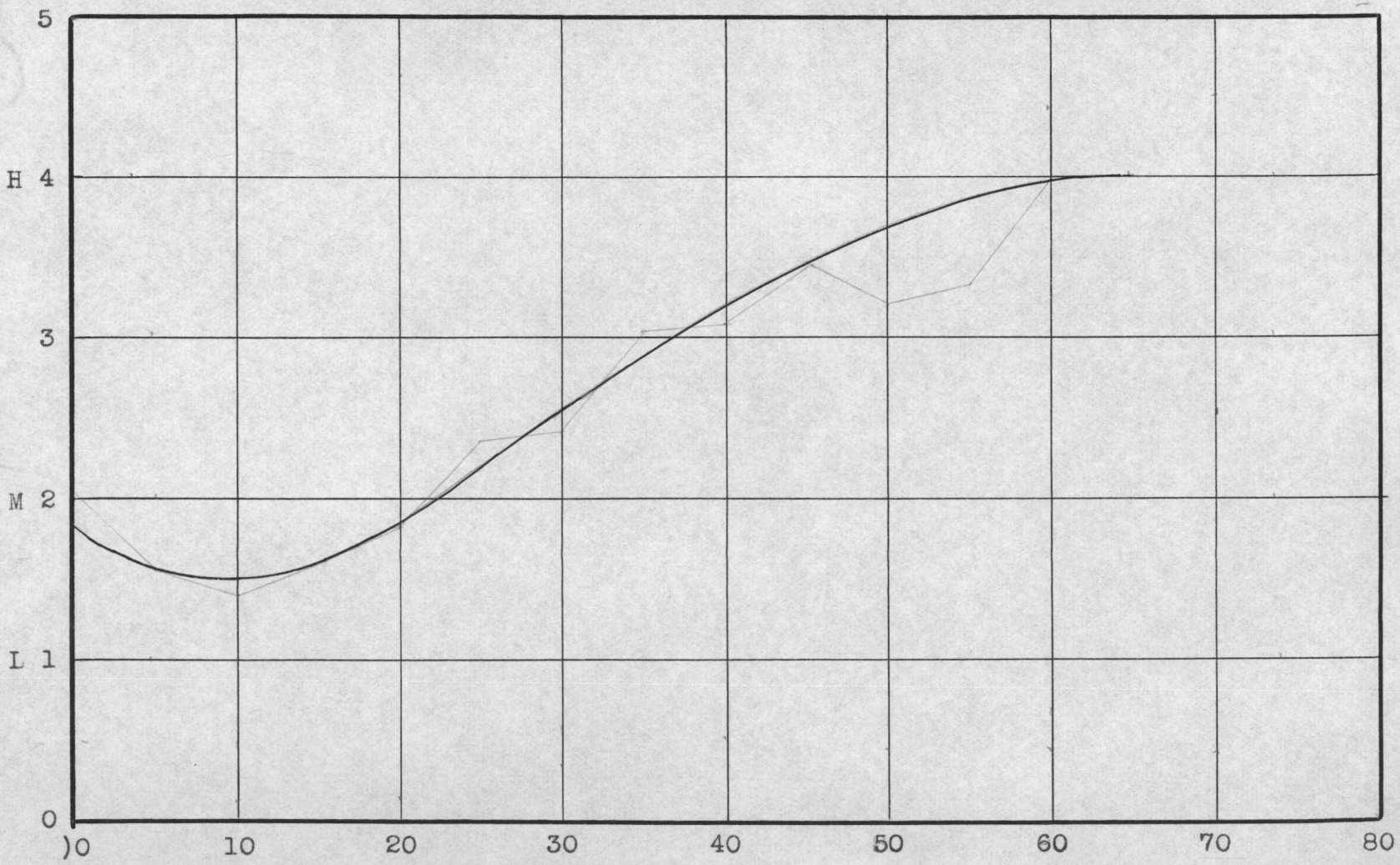
The role of Cheat Grass in rate of spread of fire is especially important in eastern Oregon. It occurs on areas disturbed as a result of improper grazing practices, and is widely distributed throughout the region. On areas in which it occurs, it is a major cause of high rate of spread. The rate of spread curve (Fig. 4) shows that on areas having no slash on them the rate of spread is slightly more than moderate, and this may be attributed mainly to the presence of Cheat Grass. After logging, the ground is torn up and much of the Cheat Grass temporarily removed; replacement of this hazard by the small amount of slash which is left on a great number of these areas does not add to the fire hazard. This lessens the need for added protection or for disposal

of the slash when the amount left is rather small. By the time the Cheat Grass becomes re-established the slash has disintegrated to a large extent.

Resistance to Control

The same method was used in preparation of this graph as in the rate-of-spread study. Low, moderate, high, and extreme resistances to control were given the respective numerical values of 1, 2, 4, and 8. For each percent class of ground covered by slash the average resistance to control was computed and plotted in graphical form. From Fig. 5 it can be seen that resistance to control of fire varies proportionately with the concentration of slash, on areas where slash covers from twenty to sixty percent of the ground area. A moderate resistance to control exists on the areas on which there is no slash, and this remains nearly the same for areas on which slash covers up to twenty percent of the ground. On areas of heavy concentration, where sixty percent or more of the ground is covered by slash, there is a high average resistance to control.

Fig. 5. Effect of Degree of Slash Concentration upon Resistance to Control of Fire.



OTHER FACTORS

Size of Slash Area

On small slash areas burning can be accomplished much more safely than on extensive areas, other things being equal. Usually the small areas are surrounded by timber which acts as a firebreak. If a fire gets out of control it cannot gain the momentum on a small area that is possible on a large one. The conflagration hazard on these large areas is considerable, especially when no natural or man-made fire-breaks exist.

Fire Hazard on Adjacent Areas

Burning can be accomplished more safely where the surrounding fuels are a low fire hazard. Where these fuels have a high hazard, such as in snag patches or on Cheat Grass slopes, the chances of safe burning are greatly lessend and must be done cautiously, using adequate fire breaks and keeping the intensity of the fire at a minimum.

Intensity of Fire Protection

Where the existing fire protection system is sufficient to meet increased hazard resulting from slash, the desired results can be obtained more cheaply by leaving the slash than by burning. The ease and expense of increasing the intensity of protection to meet any new slash hazard is an important factor in deciding whether or not to require the slash to be burned.

Presence of Abnormal Risk of Fire

The presence of highways, railroads, logging operations,

or recreational areas adjacent to slash areas will increase the necessity for quick reduction of the hazard. This may be offset by burning strips along the roads or around the high risk areas, or it may require hazard reduction by partial burning over the entire area.

Others

The silvicultural effect of burning upon the area may in some places be very important. For example, in areas where reproduction is limited because of inadequate seed source or poor growing conditions, protection of the reproduction is vital. Burning, if done, must be done carefully to avoid damage to the yound trees. Caution must also be exercised in burning where the residual stand or the seed trees left are important to the future productiveness of the area.

Some consideration must be given to maintenance of the scenic beauty of the area, especially where such areas are accessible to the public. Where preservation of these values is important the slash should either be left or partially burned so that a minimum of the area is left in a poor condition from this standpoint.

The economic factor is also important. The object of planning slash treatment should be not only to bring about hazard reduction, but to bring it about in the method most inexpensive to the operator. In many cases similar results can be obtained by more than one method. The economic factor is important in choosing which of these methods to use.

Partial Burning

Disposal of slash by partial or spot burning will often reduce the fire hazard to normal with little injury to the residual stand and to the soil itself. On an area where from 50 to 70 percent of the ground is covered by slash spot burning will reduce the hazard to normal and a maximum of from 35 to 55 percent of the ground surface will be burned over. This would be a very heavy concentration of slash over most of the region. Where slash covers less than one-third of the ground area, only 10 to 20 percent of the ground area need be exposed to burning in reduction of the hazard to normal. Because the largest number of samples from the survey had light amounts of slash such as this, such areas might be considered as average for most of the region. Spot burning on these areas has definite advantages in securing the desired results with consideration to the law and the economic, scenic, and silvicultural factors.

CONCLUSIONS

1. The amount of slash left after logging in the Ponderosa Pine region of Oregon is reduced through natural disintegration on an average of 63% in the first three years. By the end of the fifth year nearly all the needles and twigs have fallen off and decay proceeds at a slower rate.

2. The direction of slope does have a slight effect on the rate at which the needles and twigs fall off. Slash disintegrates in this way faster on the south slopes than on the north slopes. This does not include decomposition due to rots, as the period encompassed by this study was too short to allow rot to become advanced in the slash. Steepness of slope also has an effect on this decay. The steep slopes will more likely show a greater variation in rate of decay for different aspects than will the moderate slopes.

3. The degree of concentration of slash left after logging does not affect the rate of its disintegration to any marked extent, although the total volume left after a given time is larger on areas of high concentration than on low concentration of slash.

4. The rate of spread and resistance to control of fire both show a direct correlation with the amount of slash left after logging.

RECOMMENDATIONS

The following applications of the results obtained from this study are recommended in development of a standardized method of dealing with Ponderosa Pine slash in eastern Oregon:

1. Slash areas having less than fifteen percent of the ground surface covered by slash may be left without burning and without requiring additional protection, as there is no marked increase in fire hazard up to that point.
2. Partial disposal of slash is recommended where it covers more than one-half of the total ground area.
3. Either partial disposal or increased protection from fire is recommended for areas on which the slash covers between 15% and 50% of the total ground surface. Partial disposal should be done with the object of reducing the fire hazard to the normal hazard existing on the general area. If the slash is not to be burned, increased protection facilities should be maintained until the slash has disintegrated to a point at which a normal hazard exists.

The results of this report show that for average situations a period of five years allows time for the hazard due to slash concentration to be reduced within the limits of practical control under ordinary existing protection facilities.

To fit these recommendations into such a plan as outlined above is one thing, but to make it work satisfactorily

is another. If it were possible to reduce all the factors which are present on slash areas to figures, and include all of them in a plan, such a plan could probably be used on any area. However, due to the nature of many of these factors they cannot be treated in this manner. Sound judgment must be relied upon to give these factors their proper consideration. The method of application of these recommendations, then, is to first decide upon the proper treatment of slash on that basis, and then to modify the plan where necessary in accordance with the importance of the other factors such as size of area, risk, silvicultural and scenic factors, and economic factors mentioned earlier in this report.

REFERENCES

Pearson, G.A., and McIntyre
Slash Disposal In the Ponderosa Pine Forests of the Southwest. U.S.D.A. Circ. no. 357. Washington, D.C. 1935.

Munger, T.T., and Matthews, Donald M.
Slash Disposal and Forest Management after Clear-cutting in the Douglas-fir Region. U.S. D.A. Circ. no. 586. Washington, D.C. 1931.

Munger, T.T. and Westveld, R.H.
Slash Disposal in the Western Yellow Pine Forests of Oregon and Washington, U.S.D.A. Tech. Bull. no. 259. Washington, D.C. 1931.

Holmes, J.S.
Suggestions for the Disposal of Brush in the National Forests. U.S.D.A., Forest Serv. (Pub.). 1907.

U.S. Dept. of Agriculture.
Yearbook of Agriculture, Climate and Man, Washington, D.C. 1942.