SLASH DISPOSAL IN THE DOUGLAS FIR

by

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S L A S H D I S P O S A L I N T H E D O U G L A S F I R

INTRODUCTION

Logging operations in the Douglas Fir region leave the ground covered with large amounts of slash. With the approach of dry summer weather, this slash becomes a severe fire hazard which must be given very special attention if the area is to be safeguarded against fire. Because the problem is so complex and because it has so many angles to be considered, it has never been satisfactorily solved.

The problem first started when settlers and loggers first came to this region and started cutting trees. At this time the problem was of little importance and no one thought much about it. Each individual burned or left his slash as he saw fit and there was little serious effect because the area was so sparsely settled. From this early beginning, the problem of slash disposal and protection steadily grew until in 1910, when an especially disasterous fire season caused the situation to be brought to the attention of the Forest Service, private operators and the public. In 1911, as a result of this disasterous season, a few fire protection measures were enacted, one of which was the slash disposal law. (1) This forest fire law stated, "All persons, firms, corpreations engaged in logging in this state shall each year burn their slashing." This law was the basic reason for broadcast burning of slash to come into common practice as it is today. Because the operators were out to make as much money as they could and had no use for the land after

it had been logged they broadcast burned because it was by far the cheapest way of complying with the law.

This law tended to solve the problem for the time being, because it was only a protection problem; but as time passed and more land became logged off and the territory became more densily populated, the problem took on new aspects until today we need a new solution. This new solution must fulfill the silvicultural demand as well as the protection demand.

DEFINITION OF TERMS

Douglas Fir Region: This area extends from British Columbia to Southern Oregon and from the coast line to the Cascade Range. Forest conditions vary on all parts of this range. By reason of their history, the stands vary from young stands of almost every age class to very old stands; unevenaged stands as well as evenaged stands, though the former prevail. Stands vary also as to density because of fire, partial cutting or inadequate original stocking. For the purpose of this thesis, the region will be broken into only two parts. The fog belt along the coast and the Douglas Fir zone proper. In the fog belt, the precipitation is heavy and the humidity holds high through much of the summer, and Sitka spruce and western hemlock dominate the forests. This type is practically confined to a strip along the coast, with extensions up the principal river, twenty-five miles or so wide at the north and tapering off to a very narrow strip in southwestern Oregon. The other part includes the rest of the area as far as merchantable Douglas fir extends up into the Cascades. In this zone Douglas fir usually composses

Classification and Areas of Various Types
of Stands in the Douglas Fir Region (2)

Forest Type Class	Area by ownership, in thousands of acres.			
	Private	Nat'l Forest	Other	Total
Saw timber stands, trees mostly over 20" in Diameter.	5,836	4,346	2,190	12,372
Second growth, from sapling size to 20" in diameter.	4,246	1,245	1,006	6,497
Nonstocked old cutovers.	576	6	84	666
Recent cutovers, clear cut since 1920.	1,824	54	282	2,160
Other types (high-mountain types, woodlands, hardwoods, old burns etc.)	2,171	3,831	1,285	7,307
Total forest land in Douglas Fir region.	14,653	9,502	4,847	29,002

Figure 1.

sixty to one hundred percent of the stand, the proportion increasing from north to south or with a diminution of moisture. The most common associates are western hemlock, western red cedar, lowland white fir, silver fir, Port Orford cedar and noble fir. There are occasionally a few hardwoods such as red alder and bigleaf maple.

Slash: The term slash means the limbs, tops, cull logs, broken under-

brush, and other debris left on the ground following a logging operation. The heavy slash includes the larger pieces of waste wood i.e., pieces over three feet long and over three inches in diameter. (2) The material of this nature ranged from 17 to 137 cords on different logging areas.

Fine slash includes the needles, twigs, small limbs, splinters, and other dead woody material not classed as coarse debris. This was measured to be from 37 to 114 cords per acre on different logging shows. This slash is usually distributed more or less evenly over the ground and piled in the canyons and near the donkey setting.

Broadcast Burning: In broadcast burning fires are started and allowed to burn over the area occupied by slash. Around the edges of the cutover area it is common practice to clear firebreaks. If the area is extensive, interior firebreaks may be needed to divide the area into blocks. Natural firebreaks or trails opened in the logging will frequently serve the purpose without expenditure for special firebreaks. If firebreaks are used, however large the blocks should be, will depend on the conditions in each case, among which amount and inflammability of the slash and difficulties of controlling the fire are of primary importance.

Broadcast burning is usually a cheap method of disposal for it requires no piling and very little handling of the slash. The slash is frequently burned as it lays without any treatment whatsoever. From practically nothing to two dollars per acre is the usual range in cost. Since the stand is heavy on most areas in the

Douglas fir the average cost per thousand board feet is very small. Under circumstances requiring both the construction of firebreaks dividing the area into small blocks and the felling of unmerchantable trees the maximum costs occur. When so conducted the process of broadcast burning may become a little more expensive.

FACTORS TO BE CONSIDERED

The Oregon State Slash Disposal Law: (1) "Every one, by which is meant every person, firm or corporation, engaged in logging or wood cutting, or permitting logging or wood cutting upon his lands in this state, thereby creating a fire hazard, shall, unless relieved by the state forester, each year remove such hazard by burning his annual slashing, by which is meant the tops and inflammable refuse left after logging or wood cutting, that may carry fire or cause it to be spread, at such time and in such manner and with such provisions of help as shall afford all necessary precautions against the spread of fire to other property, etc."

The reduction of the fire hazard is the principal consideration at present; the effect of slash disposal on reforestation has been a minor consideration. Private operators usually follow this law and are in favor of it.

Logging Methods: The most common, and until recent years the almost universal method of logging in the Douglas fir region, is with donkey engine and cable. The machines are powered with either steam, gas, or electricity, and the rigging is either high lead, slack line, or tight line. Regardless of type of machine or rigging, this donkey engine cable method of logging almost always results in approx-

imately clear cutting. All usable trees are felled, to get maximum volume production per acre, and most of the smaller trees are knocked down in the felling of the big trees or are later laid low by the logging lines or by the wind. Sometimes after logging a few non-merchantable trees of saw timber size are left standing, in clumps or singly. More often, over extensive areas practically no trees are left standing.

In the last few years, to an increasing extent, crawler tractors have been used in this region to haul logs from stump to landing. This equipment may be used in connection with clearcutting, but more often, its use results in cutting and removing only the trees of highest merchantability and leaving a considerable part of the stand uncut. This is called partial or selective logging.

Such a method of cutting very much complicates the problem of slash disposal and protection against fire. If no burning is done the hazard is great; if the slash is burned the fire is almost certain to kill the remaining trees, destroying their present or future value, if any, and converting them into snags that will make fire more difficult to handle.

(2) Of the 125,000 to 175,000 acres cut over in this region annually, probably 90% would be classed as clear cut. While tractor logging and its concomitant partial cutting are undoubtedly on the increase, clear cutting, with donkey engines or some other type of logging equipment, is likely to continue to be practiced on a large scale for some time to come, and the problem of protecting and

managing clear-cut lands will continue to be a large and live issue.

EFFECT OF BURNING ON FOREST SOILS

Partially humified material on the forest floor may contain 2% or more of nitrogen. (3) All the nitrogen is lost when organic matter burns. Under some conditions this loss may amount to several hundred pounds per acre.

There are some compensating effects which follow burning. Ash is liberated and becomes an immediate source of available nutrients. Burning destroys organic acids and liberates bases which further neutralize acids in the soil, thus improving conditions for biological processes and plant growth.

(3) The forest tree depends for its nutrition largely upon the mineralization of the litter dropped on the forest floor. Most of the humus material and the humification processes occur on the top of the soil. As the process continues, some of the soluable humus is leached into the top soil, which is very porus and absorptive to a depth of six inches or more. (7)

When fire enters the forest, both litter and the humification material are consumed at once. Even the humus in the immediate surface soil may be partially burned out.

In an area burned over to dispose of slash, the humus content of the soil is low in the immediate surface and increases with depth. In an unburned area the humus content of the surface soil is high and decreases with depth.

The immediate effect of burning is to produce a rather liberal supply of plant food. This is favorable both to soil organisms and

Humus Study in Burned and Unburned Douglas Fir Forest Soil (3)

Depth	Unburned	Burned
Surface inch	4.86 % of humus	1.70 % of humus
$4\frac{1}{2}$" to $7\frac{1}{2}$" depth	4.81 " " "	3.78 " " "
$10\frac{1}{2}$" to $12\frac{1}{2}$" depth	3.77 " " "	4.47 " " "

Figure 2.

plants growing on the soil. Just after a burn which destroys the over growth there is likely to follow a rather profuse vegetation of wild grasses and herbs that produce excellent humus materials. Even legumes may volunteer. It is well known that clover starts easily when seeded in the ash after a burn. Leaving out the damage which is done the trees, should the burn occur only once or very infrequently, the effect upon the soil fertility may not be very disasterous.

Nevertheless, what represents several years of leaf fall is consumed by fire in a few minutes. (3) Data collected indicate that in some sections of a young forest, ten tons of litter and humus material to the acre were found. In old forests there are several times as much and as many as one hundred tons have been reported.

In timber that is so dense as to prevent growth of grass, the renewal of so much humus material would require several years. The litter fall per season probably does not exceed two tons and may be considerably less. Repeated burning therefore, must soon result in a condition where there is soon no longer any organic material in the

soil to humify. Nature's method of renewing forest soils becomes inoperative. Only one result can follow. Impoverished moisture capacity, and generally unfavorable conditions. It would seem rather dangerous to conclude, therefore, that because the immediate effect of burning is helpful, the general practice even with controlled fires repeated frequently would benifit the soil.

The temporary effect of burning may be helpful at least in some respects, but, since the productivity of forest soils depends upon gradual mineralization of the fallen litter, it does not appear reasonable to expect continuous and often repeated burning to improve forest soil.

THE REBURNING OF DOUGLAS FIR CUT OVER LAND

A slash fire on a recent Douglas fir cutting very often overlaps adjoining areas previously burned. It spreads uncontrolled to once burned land, it starts spot fires a thousand feet or more away, it sends out fingers in various directions. This process results in much of the logged off land having, not one burning immediately after logging, but one of two reburns in the succeeding few years.

(2) Observations extending over five years on three hundred natural reproduction plots give a historic record of the actual amount of reburning in twenty-two different cut over areas in various parts of western Oregon and Washington, both on private and on national forest lands. They show that the rate of reburning such areas is rather alarming and a serious menace to the continuous productivity of the land. Within the last five years, fifteen out of the twenty-two groups of plots were visited by a second fire, and two areas by a

third fire. Of the three hundred one individual plots, seventy one, or twenty four per cent, have been reburned to date. This indicates that the rate of reburn is about five per cent a year. (2) Whether this land will continue to be subject to this same rate of reburning is conjectural. Prior to the second fire, twelve of the fifteen areas had at least a light stocking of seedlings, some as high as two thousand to the acre; now the burned portions of these areas, with one exception, are practically without seedlings.

When a slash area is burned promptly after logging, some reproduction generally starts immediately on the mineral soil. Other reproduction follows from seed blown in from the near by edge of green timber or from seed trees which may have been left standing. If, after logging moves back the edge of green timber and all the seed trees are dead or windthrown, a second fire visits the area and burns up all the reproduction, there is little chance for more to get started. (4)

PLANT SUCCESSION IN RELATION TO FIRE

The number and severity of burns depletes the soil and kills off the desireable plants in varying degrees. In many cases the plant succession is set back to the moss stage, and has a much longer road back to the climax type than areas that have been less seriously destroyed by fire.

The Moss Stage: When a severe burn occurs in the Coast Range and all or nearly all of the vegetation is killed, an invasion of plants to the area begins almost at once. These first pioneers are mostly thallophytic

or bryophytic plants, especially if the fire occurred in late summer or fall. (5) The exact sequence of this invasion was not observed as the study was undertaken several weeks after the fire. At that time, moss was the dominating vegetation and continued to be so until early spring of the following year.

The Weed and Fern Stage: In early spring, following a forest fire, an area is invaded by ferns and herbaceous, annual and perennial plants. In such invasions, bracken fern, fireweed, lupine, and bull thistle often dominate. (5) The spores or seeds of these plants are from two sources; (a) Disseminated from bordering vegetation by wind, animals, etc., or (b) held over in the duff or soil from previous vegetation on the area.

The reactions of reduced light brought about by this new community is distinctly detrimental to the mosses and these gradually become fewer in number.

Shrub Stage: This stage varies in its time of appearance. It may invade a burned over area immediately after a fire or two or more years, depending upon the severity of the fire and the occurrence of previous fires. On the particular area studied for this stage the shrubs first began to appear the year following the fire. (5) The shrubs invade an area from adjacent areas either by seeds or by rhizomes. In such invasions, ocean spray, hazel, snowberry, rhododendron, and serviceberry often dominate. The shrubs overtop and shade the herbs and when the shrubby growth becomes sufficiently dense, the former plants find the habitat so modified that growth becomes almost

impossible. The shrubs react on the environment by retarding wind movement, increasing humidity, reducing soil evaporation, and enriching the soil. All these conditions tend toward making a protection for tree seedlings.

The Woodland Stage: The first species of trees to appear are mainly hardwoods. On the eastern part of the Coast Range these may be western white oak, chinquapin, or broadleaf maple. On the western side alder, vine maple, broadleaf maple, and cascara may dominate. These trees further modify the environment and make conditions more ideal for the growth of coniferous trees and less favorable for themselves.

Douglas Fir Subclimax Stage: Douglas fir, which is often thought of as the climax type, sooner or later invades a denuded area. This species is, with respect to abundance and extent, the most important dominant. It does not, however, constitute a climax, for its dominance is due to the continued arresting of vegetational development by fire. Hence, being indefinitely held by a factor other than climatic control, it is termed a subclimax. (5)

Climax Forest Stage: If forest fires are definitely excluded on an area, developmental processes will go on and the succession of stages will continue. Finally a stage will be reached when the plants that are dominate are able to reproduce themselves under their own shade, and conditions of temperature, humidity, soil moisture, evaporation, fertility, etc. This condition will be permanent so long as the climatic, edaphic, or biotic conditions are unchanged or no other agency destroys the vegetation. This is known as the climax formation

and in the Coast Range forests western red cedar and western hemlock are the dominates.

Modifications: The above stages of succession are modified both by the severity of fires and their previous occurrence. Only in the case of a severe fire occurring on an area that has been previously burned would the development of vegetation take the definite course as given above. Often fires only partially destroy the vegetation and do not always destroy seeds which are on the trees or stored in the duff. Neither do fires always remove all the litter, humus, and duff that covers the forest floor.

SLASH DISPOSAL AS IT EFFECTS FIRE HAZARD

Because of weather conditions, amount of slash, etc., broadcast burning is the prevailing practice in the Douglas fir region, and its only practical alternative is to leave the slash unburned on the ground and give the area added protection for as long as necessary.

In attempting to compare the merits of these two alternatives we must decide how long broadcast burning reduces the fire hazard, how long unburned slash remains a high fire hazard and what the principal factors are that constitute the fire hazard on a cutover area.

Ground Cover Comparison: Unburned slash areas present a much different picture from burned over areas the first few years after logging. On burned areas the fuel from new vegetation of various kinds is the principal factor in building up rate of spread, on unburned areas slash itself is the principal fuel. Usually annuals do not come in so thickly on unburned as on burned land. Progressive changes in unburned slash follow: first needles drop off, and then the winter rains

and snow tend to pack it so that many masses are formed which hold dampness. This compacting of the slash is possibly the most important factor reducing probable rate of spread of fire.

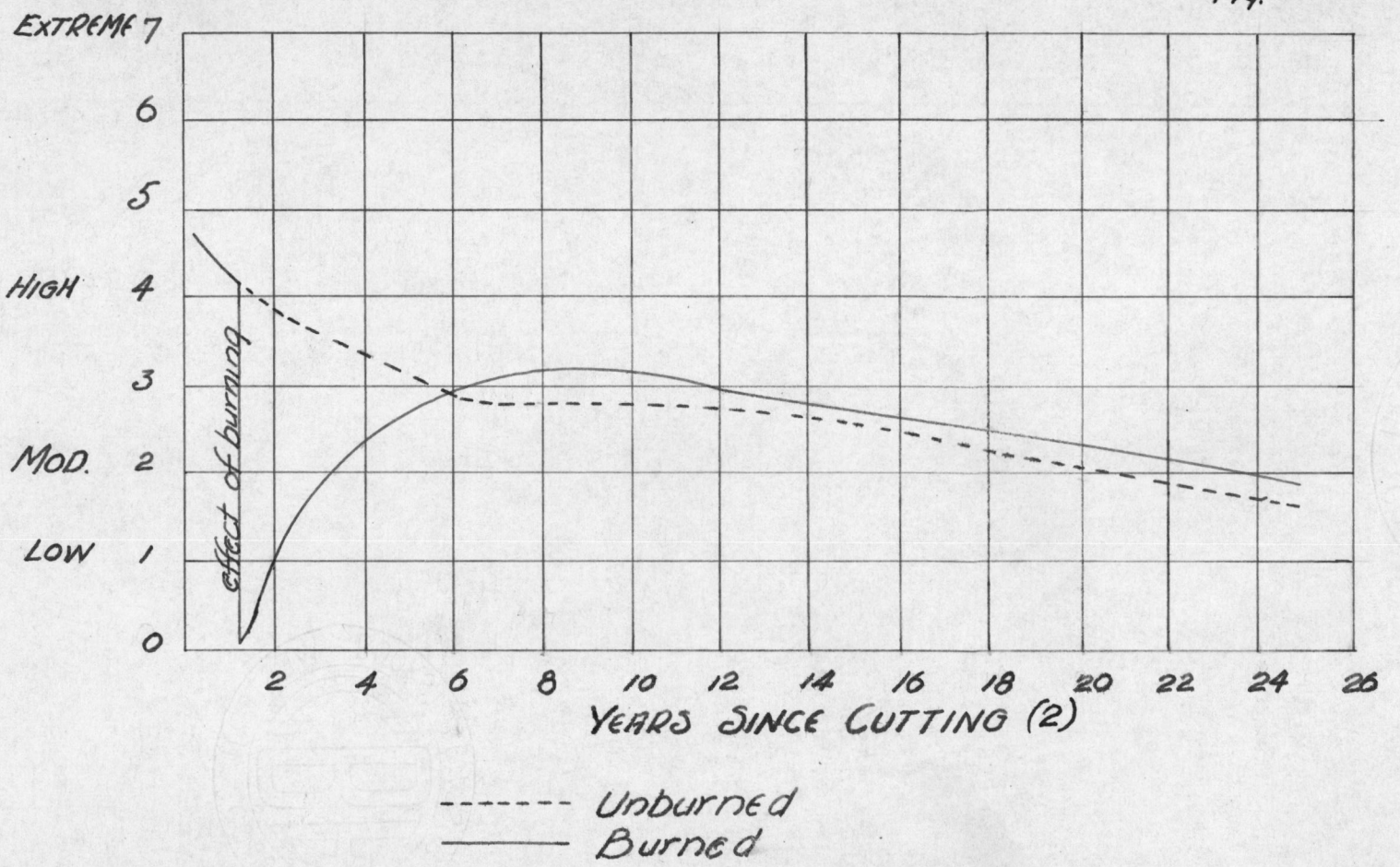
Rate of Spread: The most interesting indication of graphs shown as fig. 2 is that the rate of spread on burned areas equals that on unburned areas in about six years after the slash fire. The equalization is due more to the increase in the rate on burned areas than to any very marked decrease in the rate of the unburned slash. This six is average, some spots take more or less. (2)

Effect of Continuous Reburns: Study of the rate of spread on cutover areas indicates that the shading of the ground by ground cover is tremendously important. Any procedure in handling slash areas that will promote rapid formation of a complete forest cover and dense shade of conifers or such hardwoods as alder, maple, willow will do more to reduce the rate of spread rating than almost anything else now known. Therefore, it follows that anything which promotes reforestation also promotes reduction of fire hazard. Burning brings in fire weed, braken, etc.

It is pertinent to observe that the many thousands of acres of high hazard cut over lands existing today in the Douglas fir region as a result of repeated fires or lack of seed supply or both will remain in their present unproductive and unsatisfactory fire hazard condition indefinitely unless the fires are stopped and a forest cover develops. In order to meet this last requirement, planting may be justified in some places. A part of the expense of planting might be recovered through reduction in the cost of fire protection that will eventually

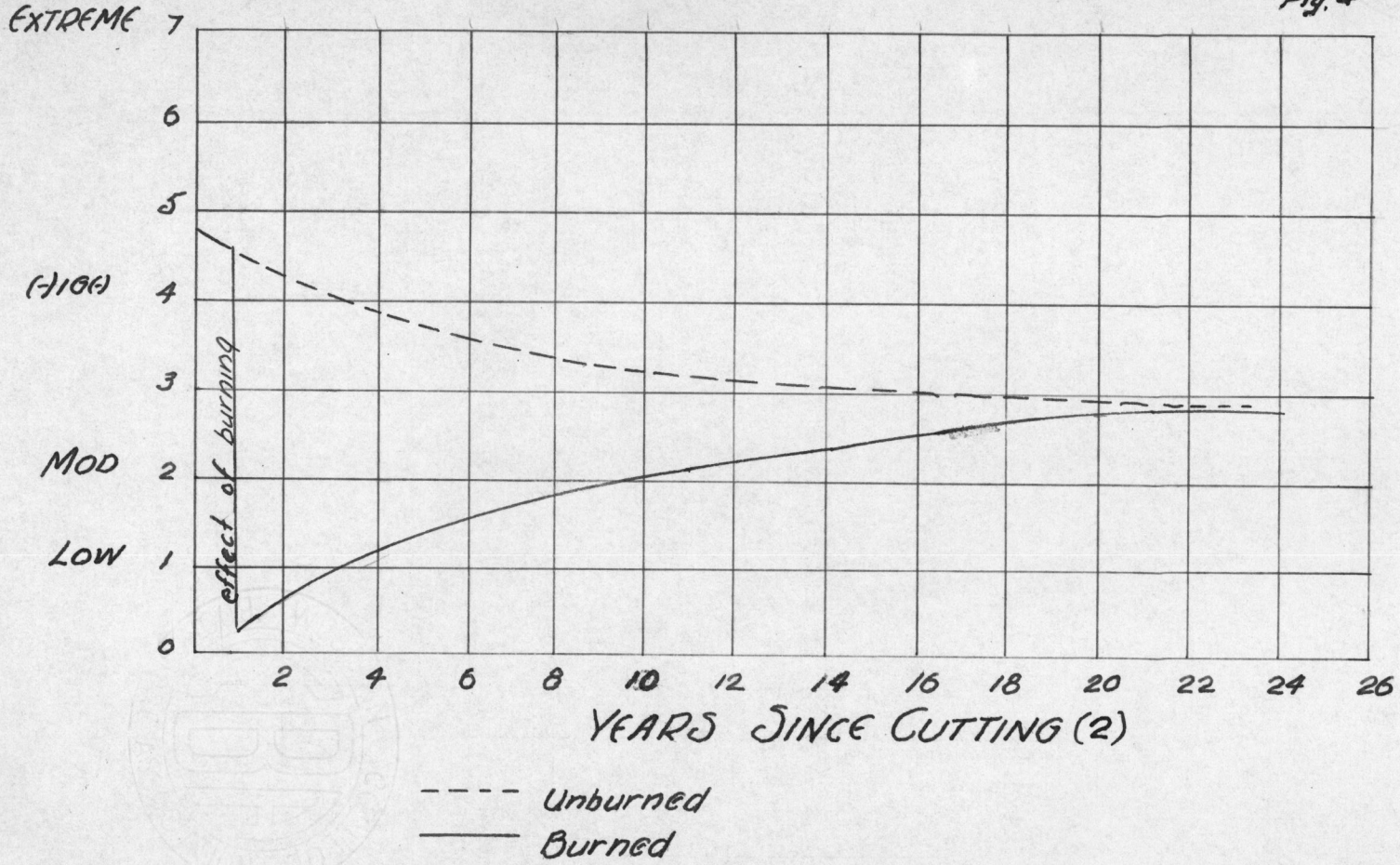
RATE OF SPREAD

Fig. 3



RESISTENCE TO CONTROL

Fig. 4



NATURAL STOCKING

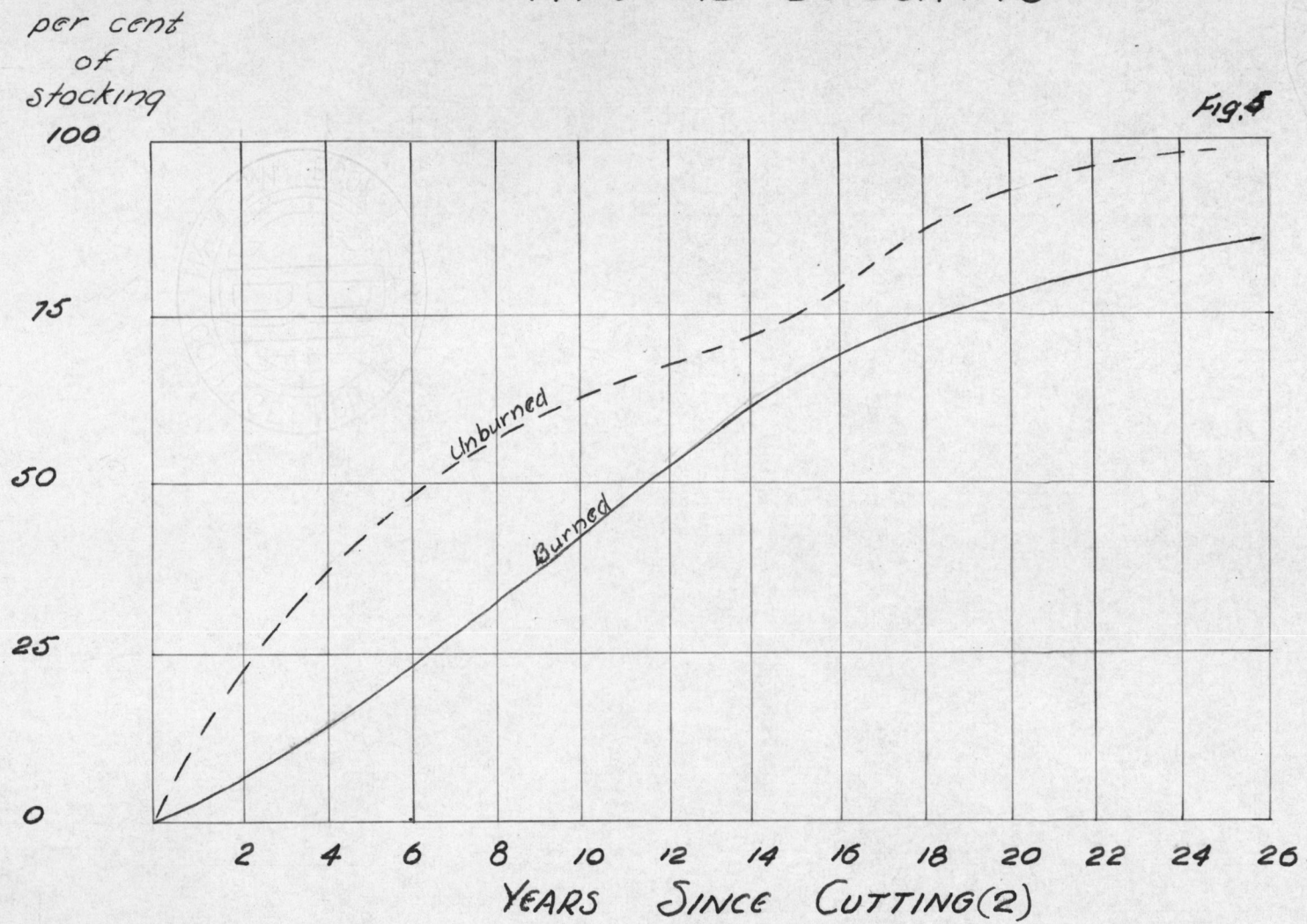


Fig. 4

result. If the areas are not reforested the cost of fire protection will remain high, and this high cost will be incurred on land that is not productive.

Conflagration Hazard: The extent and continuity of fuels largely determines the possibility of a conflagration. It is pertinent to observe that large continuous areas of cut-over land are a very special conflagration hazard because of the possibility that a fire will spread to large size before it can be controlled. This conflagration hazard is greater for continuous bodies of cut over land than it is for equal areas of timbered lands because the rate of spread and resistance to control tends to be greater on the cut over than on the timbered lands. Furthermore there is always the danger that a fire will gain sufficient momentum on cut over lands, especially if there is an abundance of fuel such as unburned slash, to start a conflagration in adjacent green timber. As cutting progresses in any locality the conflagration hazard increases, particularly when the cut over lands of several logging operations merge. Thus where it might be good practice to leave unburned reasonably small isolated bodies of slash, it might be very bad practice to allow extensive, continuous areas of unburned slashings to accumulate and build up the conflagration hazard. It is well to consider the ultimate extent of highly inflammable areas, as well as other factors of fire danger, and plan the slash disposal practices so as to keep the conflagration hazard to a minimum.

Reforestation on Burned and Unburned Areas: The impression has long

existed in the minds of many in the Pacific northwest that slash burning, by removing the debris and exposing the mineral soil, is beneficial if not actually necessary for the natural regeneration of Douglas fir. This is now known to be far from the truth. (6) In fact, from almost every point of view broadcast slash burning is detrimental to natural reforestation to a greater or lesser degree. It may not be as detrimental as a hot uncontrolled fire in midsummer, which broadcast burning is supposed to prevent, but it is more detrimental than leaving the slash unburned.

Seedlings on Burned and Unburned Areas Eight years after Logging.

Unburned		Burned	
544	per acre	352	per acre
1,760	" "	96	" "
1,472	" "	11	" "
280	" "	80	" "
640	" "	288	" "
720	" "	200	" "
808	" " average	146	" " average

Figure 6. (4)

In studies made by Dahl J. Kirkpatrick he found that unburned areas had on an average of ten times as many seedlings as burned. This figure may vary with the time after logging that the burning takes place. If the slash is burned immediately after logging and the fire is not too hot, there may be a considerable number of seedlings come up from seed stored in the duff. If, however, the fire is delayed one or two years, all the seedlings that may have come up

from seed on the area is destroyed. In the process of burning such an area, the seed trees if any have been left are usually killed and the area will have to be artificially restocked if it is to ever grow trees again.

CONCLUSIONS AND RECOMENDATIONS

In suming up the effects of a slash fire we find that:

1. When slash fires are started and allowed to burn over an area the fire often burns for considerable distance into the green timber around the edge.

2. The slash fire destroys in a few minutes that valuable humus layer that has taken the forest many years to build. It also leaves the area free of its protecting cover and subject to erosion.

3. An area burned over by a slash fire has a better than fifty per cent chance of burning over again in the next twenty years.

4. Slash fires usually kill seed trees which may have been left accidentally or on purpose on the area. This cuts off the seed supply forms a new fire hazard, in that the dead seed trees become snags.

5. Slash fires cause a large growth of annuals to come in and form a new fire hazard. The fire hazard rating of these is equal to that of the slash in six years.

6. This large growth of annuals causes a large number of rodents to come into the area and make it difficult for the area to become reseeded by any trees that may be left or by those around the edge of the area.

Burning the Slash Has a Few Benificial Effects:

1. It removes heavy slash from the area and replaces it with

relatively cool burning annual plants.

2. It is a cheap method of caring for the slash.

3. Ash is liberated and becomes an immediate source of available nutrients.

4. It kills the rodents so that the first seeds that blow in would have a better chance of surviving.

Recomendations: Although it is undoubtedly more difficult and therefore more expensive to carry an area of unburned slash until it has reforested than it is to carry burned land for the same period of time, this should be done whenever possible. For the first few years, much care and effort will be required. In as much as lightning causes less than three per cent of the fires on the Pacific coast man must cause the other ninety-seven per cent. Therefore it is extremely important that trespass be eliminated.

We must keep down the conflagration hazard by limiting the sizes of the unburned slash areas. Keep slash covered areas separated by green timber. We should take further precautions such as building roads through the slash covered area. This measure will not only break up the slash covered areas into smaller units, but will provide greater accesability to the area.

Along much traveled roads the trees should either be left standing in the first place for aesthetic purposes or the slash burned after logging to eliminate the hazard.

When it is absolutely necessary that the slash be burned, it should be burned as soon after logging as the weather will permit,

before seed on the ground has started to grow. Before firing the slash a fire line should be built around the area to be burned, sufficient fire fighting men and equipment should be on hand, the weather and time of day should be right, slash should be cleared away from the bases of all potential seed trees that may be left standing on the area, and all other necessary precautions should be taken to see that the fire does not get away.

After the slash fire, the area should be given intensive protection to be sure that a reburn does not occur. Planting may be employed where a quick cover is desired for aesthetic, soil conservation, or water protection reasons merit it.

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