THE SECONDARY SPECIES PROBLEM[1]

By

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The Secondary Species Problem

W.C. Lowdermilk & George Hamilton

I. Introduction:

In the white pine stands of northern Idaho, particularly in the Coeur d' Alene and Kaniksu regions a considerable portion of the timber volume is unmerchantable. This is so for two reasons; namely either because of a lack of demand for certain species or because of defectiveness of the trees. The species comprising for the most part this unmerchantable volume are western hemlock and lowland white fir, both of which are distinctly tolerant.

Of the merchantable species, white pine is by far the most valuable, and is the one primarily sought in the reproduction. The areas are managed for white pine to which the region is particularly adapted.

But white pine is a semi-tolerant tree and will not reproduce itself and thrive unless it enjoys 50 percent or more of light.

To cut from the stand the merchantable species only being chiefly the white pine leaves sufficient of the un-merchantable trees generally to preclude by their shade the satisfactory return of a stand of white pine. Hence the problem.

II. The Problem:

This condition creates the problem of the removal or disposal of the unmerchantable species to a sufficient extent to assure the desired stand of white pine reproduction. The measure is expensive. It requires careful examination to ascertain the most economical and at the same time effective way of accomplishing the desired result.

III. Premises:

In approaching the problem certain general premises need to be taken into account. They are

(1) A second logging operation may be counted on in the same watershed within a period of 20 to 30 years.

No drainage is completely cut out. For example: Lieberg drainage contained a stand of some 150 million board feet. The present sale will cut out only one-third of that amount. The methods of treatment now in use are carried out under this supposition.

(2) At the time of the next cut railroad transportation will most generally be the method used. A closer utilization of products of all species will be assured thereby.

(3) The disposal or removal of the inimical shade producing species should increase the value of the future crop to an amount equivalent or greater than the cost of such removal.

At best, a comparison between the yields to be expected from an area on which the secondary species are not removed and one on which they are removed is hypothetical. A difference will result, however. It requires a careful appraisal of the factors controlling the problem to estimate the justifiable expenditure and a suitable result in the work.

(4) A sound hemlock 16 inches d.b.h. will have a greater value at the end of 30 years than a young white pine tree 20 feet tall.

This premise is based upon the urgent need for timber that is predicted for the period following the next 25 to 60 years. It is further based upon the actual value of the hemlock and a mean accumulated value of the young white pine.

III. The Object and Scope:

The object of the study is to determine

(1) The proper treatment for stands containing unsound hemlock and white fir.

(2) The most economical and satisfactory method of opening up a stand to secure the restocking of western white pine.

The study comprises an examination of the white pine region on both the Coeur d'Alene and Kaniksu National Forests.

IV. Discussion.

This problem was early recognized and measures were employed from the first cuttings to solve it. A general girdling of the unmerchantable species regardless of soundness or size was first employed. Investigations on methods of killing trees were pushed before it was determined experimentally to what extent and where girdling should be used.

This early practice resulted in

(1) The destruction needlessly of sound timber.

(2) The creation of very hazardous fire conditions where the risk is high.

(3) The killing of trees on southerly exposures where their shelter was distinctly needed for the survival of western white pine reproduction.

The method as used formerly is unsatisfactory. A modifications of girdling and entirely different measures have been studied to arrive at the desirable practice. Consequently several measured plots were treated under controlled and varied methods. But before considering the plots in detail a number of typical areas will be described. Conclusions will be drawn therefrom on the basis of the results found on the areas following either purposeful or accidental treatment.

Typical Areas:

1. Cathcart Drainage
    (a) Location – Little North Fork. White pine type.
    (b) Entire drainage
    (c) All exposures exist; Gradient varies from 30 to 70 percent
    (d) Treatment:

Slash from merchantable trees was piled and burned.

All W. H. and L. W. F. were girdled regardless of their soundness or size.

The results are incomplete. The reproduction of the western white pine is satisfactory. The stand was opened out sufficiently to prevent the general survival of western hemlock seedlings and at the same time to favor the growth of white pine seedlings. But so far few of the girdled trees have wind thrown.

The principal concern for this area, is therefore, what will be the appearance and condition of the area in 10 years. In that time all girdled trees will be down. They will form a mat of inflammable material that will present a high fire hazard. The menace on this drainage will be particularly dangerous were the risk is high as for example along the trail and along the creek bottoms. A conception of the future appearance of the tract may be had after an examination of the following areas: Picnic Creek and Sands Timber Claim Cutting on Sands Creek.

Conclusions

(1) Trees along trails should be left green to a distance, on each side, of the maximum tree length at least.
(2) Trees along streams should be left green to a distance, on each side, of the maximum tree length at least.
(3) The wholesale girdling of trees may create a greater fire hazard than can be justifiably accepted. The protection liability of logging slash is considered equal to the cost of its removal. Likewise the protection liability of wind thrown girdled trees must be charged against the measure of girdling.

2. Sands Creek Area:

    (a) Location: Sands Creek near Honeysuckle R. S.
    (b) Sands Timber Claim cutting
    (c) Generally two exposures – gradient 30-60 percent
    (d) Treatment: The Sands Timber Claim was cut in 1908-1909 (?) under no restrictions. Merchantable timber only was extracted. No slash disposal was carried out. A fire, however, burned over a portion of the logged area before the operation was complete (see stump evidence)

This tract furnishes an interesting contrast in results in leaving the unmerchantable trees standing and in securing their windthrow. On the burned area practically all the trees are wind thrown. A considerable volume of slash lies upon the ground and is equivalent to that of the logging slash. Reproduction is coming in rather satisfactorily. But on the unburned portion of the tract the ground is heavily shaded and reproduction consists of the tolerant species chiefly. Under this shelter the opportunity is limited for the survival of western white pine reproduction. The hazard from the logging slash is greatly reduced.

Conclusions:

(1) Neither portion of the tract is an example of desired conditions – on the burned area the hazard is too high, and on the unburned area the shade is too dense for a satisfactory restocking of white pine.

(2) A method of treatment which will favor a medium course is indicated.

(3) A whole sale girdling of trees will create a menace equivalent to the hazard of the original logging slash. Such hazard is a protection liability and equivalent to the cost of removing it. In this case it would be $15.00 approximately. This tract indicates what the Cathcart area will look like within 10 years or less time.

3. Picnic Creek Tract (Sale)

(a) Location – Mouth of Picnic Creek on Little North Fork.

(b) Flat at the mouth of the creek

(c) The original stand was marked, whereby W.W. P. trees were reserved. All unmerchantable trees were girdled. The tract was cut 1913-1914.

This area presents the condition in part that may be expected to result from wholesale girdling. On the flat not all the trees have come down but sufficient have done so to create a dangerous menace. This is accentuated because traversed by a road and trail.

Conclusions:

(1) The general or wholesale girdling of trees will create a dangerous fire menace particularly where the risk is high as along roads and trails.

(2) Girdling trees is inadvisable on the narrow river flats of the mountain streams. In such locations are or most likely will be built trails and roads.

(3) On flat areas it has not been demonstrated that girdling will insure the desired result in restocking.

4. The Weber Timber Claim Area.

(a) Location: Weber Creek on Little North Fork

(b) Larger portion of a steep drainage

(c) Exposures – to E. and W. with gradients of 20-80%

(d) Treatment: The timber was cut in 1916 under U. S. Forest Service supervision. The slash was piled but never burned. No girdling of trees was done.

This tract presents an interesting study in the amount of light needed for W.W. P. reproduction as well as in the hazards that unburned slash presents after a period of 6 years.

Conclusions:

(1) A girdling of only a part of the trees left should suffice to open up the stand for W.W.P. reproduction. The proportion will be varied by exposure according to the amount of light needed on the forest floor.

(2) The preservation of a strip of green trees on each side of streams, both principal and lateral, serves as an effective firebreak and vantage lines from which to fight back forest fires.

The Hamilton Plots

A series of plots were laid off on the Coeur d'Alene National Forest in the Lieberg drainage. On these different methods of treatment were carried out to determine the most satisfactory one. The plan of treatment was worked out my Messrs. Weber, Neff, Earle, Brookes and Hamilton. George Hamilton carried the plans into execution. They will be discussed in order as follows:

Plots 1 & 2

(a) Location: Culbertson Draw near Camp No. 2

(b) Plot 1 area 1.36 acres. Plot 2 area 2.40 acres.

(c) Both plots face the east with a gradient of 20-60 percent

(d) Treatment: Both plots were treated in the same manner. The merchantable timber was cut, the slash therefrom piled and burned. Then all of the un-merchantable trees were felled and the resultant slash piled and burned.

The following tables set forth the results in costs. Not sufficient time has elapsed to indicate the results in restocking.

Figure No. 1.

View of Hamilton Plot No. 2. - Showing the appearance of the tract after the white fir and western hemlock had been felled – the resultant slash piled and burned with the slash from the merchantable trees.

Hamilton Plots Nos. 1 & 2

Table 1

Volume Cut in M. B. F.

(Stump Scale)

Plot	Per Acre		Totals		For Plot	Area Acres
	W.W.P.	Other Spp.	W.W.P.	Other Spp.		
1	35.7	3.7	48.0	5.5	53.5	1.36
2	20.5	4.8	49.2	11.6	60.8	2.40

Table 2.

Reserved Trees

Summary and Condition

Trees by D. B. H. Classes

	Healthy		Unhealthy				Dead				
D.B.H. Classes	Unaffected	Scorched roots	Resin streaks	Scorched roots	Insect attacks	Misc.	Fire	Insects	Misc.	Windthrown	Totals
4-11	14	--	--	4	1	1	1	3	--	2	26
12 +	15	--	4	4	--	1	3	--	--	6	33
Plot 1 Totals	29	--	4	8	1	2	4	3	--	8	59
4-11	5	2	2	1	1	1	1	3	--	2	18
12+	23[o]	5	1	6	2	--	1	1	--	1	40
Totals Plot 2	28[o]	7	3	7	3	1	2	4	--	3	58

[o] Of which 14 are W.L.

Measures of Slash disposal and sanitation

(1) Slash disposal from merchantable species.

Plot No. 1 – per acre at 60 cents per M.B.F.	$23.64
Plot No. 2 – per acre at 60 cents per M.B.F	15.18
	38.82
Average per acre	$19.41

(2) Slashing and piling of unmerchantable species

Table 3

Trees slashed by

D.B.H. Classes

Plot	Inch D.B.H			Classes			Total Trees	Area
	2-6	6-10	10-14	14-18	18-22	22 +		
No.1.	201	77	16	4	2	--	300	1.36
No.2.	148	67	18	11	4	2	250	2.40
Totals	349	144	34	15	6	2	550	

Total cost $117.28 21.3 cents per tree

Cost per acre average $34.49.

The total costs per acre are then as follows:

(1) Slash disposal for merchantable trees	$19.41
(2) Sanitation – complete slashing of unmerchantable secondary species piling and burning the slash…	$34.49
Total	$53.90

Plot No. 3

(a) Location: West exposure of Lieberg Creek opposite Camp No. 2. Stand is classified as A2.

(b) Area 4.0 acres

(c) Exposure west with gradient of 30-80 percent.

(d) Treatment: after the stand was logged over all western hemlock and all defective white fir were felled, and the slash therefrom pile and burned.

The costs per acre are as follows:

(1) Slash from merchantable species was disposed of at the rate of 60 cents per M.B.F. The cut per acre is not known exactly.

(2) Sanitation measures

For the 40 acre plot ……	$107.73
Cost per acre…	$ 26.93

As a result the stand is opened up to 60-75 per cent light. This is an A2 stand or was and by the definition and the purpose of treatment no sanitation measures are needed in these stands nor should be carried out. The stand is marked for increased growth and not for reproduction. Hence the opening out of the stand other than to give growing space to reserved trees is not needed. In fact a distinct advantage exists to keep the forest floor well shaded in order to prevent the springing up of an under story of tolerant trees, which at the time of the final reproduction cutting will only add to the expense of preparing the ground for W.W.P. reproduction

Plot 4:

(a) Location: beside the road on Lieberg Creek.

(b) Area 1.0 acre (10 chains x 1 ch.)

(c) Exposure to the northwest with gradients from 50-80 percent.

(d) Treatment: After the slash from the merchantable trees had been disposed of all western hemlock and all defective white fir were felled, and the resultant slash piled and burned.

The fire in burning the piles was allowed to run over the slope, as a result several trees were injured.

The stand cut from this plot as shown by a stump scale was rather heavy, being 47,600 B.F. for all species. Of these 40.100 B. G. or 84 % were W.W.P. This stand presents another interesting case. The original stand could be classed as an A2 or as a type of B1. Of white pine 92 trees were cut and of other species 20 were cut. The diameter classes in which practically 80% of the cut trees occurred is 14-20. Of the 69 reserved trees per acre 51 are W.W. P. and 18 of other species.

The following table sets forth the condition of reserved trees one year following the disposal of slash and treatment of the secondary species.

Table 4

Plot No. 4
Reserved Trees
Summary & Conditions
Trees by D.B.H. Classes

D.B.H Classes	Healthy			Unhealthy			Dead			
	Unaffected	Root scorched	Resin streaks	Root scorched	Insect attacked	Misc.	Fire	Insects	Wind thrown	Totals
W.W.P										
4-11.	21	6	--	--	--	6	--	--	3	35
12+	5	4	--	4	--	--	--	--	2	15
										51
Other species										
4-11	5	1	--	1	--	--	--	--	--	7
12+	3	2	--	4	--	1	--	--	1	11
										18
Totals all species										
	34	13	--	9	--	7	--	--	6	69

Fig. 2

View of Hamilton Plot No. 5
Western Hemlock and white fir slashed and
ready for broad cast burning.

Of the reserved white pine trees approximately 50 % after one year are unaffected by the slash disposal and sanitation measures. Those with scorched roots yet appearing healthy are 20%, and the unhealthy trees comprise another 20%. 10% of the white pines were wind thrown the first year.

No separate record of the cost of the disposal of slash from the merchantable trees was kept, but at the rate of 60 cents per M.B.F. should be for the acre 28.56

The cost of the sanitation measures of which a careful record was kept by Hamilton the cost per acre was $27.20

The total cost per acre was therefore 55.76

By this measure the stand being upon a very steep slope was opened up to almost full light.

This plot demonstrates the inadvisability of destroying the stand of secondary species. It was not necessary, for the stand at present is rather too open and sufficient trees of desirable species stand upon the ground to make possible a second cut. The plot further demonstrates the need of designating what trees should be slashed and what trees should be reserved. It shows up the inadvisability of setting diameter limits for the general destruction of defective western hemlock and white fir. If some method would make it possible to designate as in marking the trees to be treated either by girdling or by slashing, the irregularities of the stand might easily be taken into account. As for example on this acre plot, in groups of reserved white pine trees, no girdling or slashing would be indicated. But in those spaces devoid of white pine reserved trees, and where reproduction of the white pine is desired the treatment necessary to open up the stand to the proper amount of light would be indicated by a second marking.*

Plot No. 5

(a) Location: McMahon draw off Tie Creek near Camp No. 2

(b) Area 10.7 acres

(c) Exposure; SE with a gradient of 30-70 percent.

(d) Treatment; after the merchantable timber had been cut and logged all western hemlock and white fir trees regardless of soundness were felled upon the slash from the merchantable trees. The felled trees were then lopped.

*The double Marking Method: Monthly Report. Silvical Investigations November, 1921.

Fig. 3

View of Hamilton Plot No. 5.

Showing the western hemlock slashed and the tract ready to be burned broadcast .

This view was taken May 27, 1922

Fig. 4

View of Hamilton Plot No 5 – showing the portion of the tract burned over broadcast. This view was taken May 31, 1922 on the day following the burning.

The plan included a broadcast burning of the plot at a favorable season. A few western larch trees were left with the hope that some would survive the broadcast burn.

The cost of this measure was as follows:

(a) Slashing and lopping per acre		$20.76
(b) Burning controlled broadcast		
(on basis of 3 acres) per acre		5.00
	Total	25.76

It must be noted that the slash from the merchantable trees was disposed of in the broadcast burn; hence the slash disposal and sanitation are combined.

On May 31 one third of this plot was burned broadcast. A fire line was cleared around the area, small streams on three sides being taken advantage of. This tract may be described as having the form roughly of a horse's hoof—Small streams skirted the slope and bounded the edges of the hoof form. Across the top was constructed a fire line separating the cut over area on the ridge from the uncut forest higher up. In this tract were included about three acres.

Fore was set at 4.00 p.m. after the area was in shadow. A strip fully fifty feet wide on the up slope edge was burned out. The slash burned so readily that it was not considered safe to set fire at the bottom of the slope at first. Accordingly the fir was made to progress down the slope in stages by setting at favorable times a line of fire not more than 100 feet below the burning edge. The area was burned over satisfactorily. But the fire, due to the large amount of accumulated debris, burned very hot and furiously and injured or killed all trees left standing. It is probably that the duff layer was consumed over a larger percentage of the tract than desired. Subsequent observations are needed to verify this. The intensity of the fire was due to the dry air conditions, and to the dry condition of the slash. Burning was made impossible a few day previously by a rain. In waiting for the conditions to become favorable the most suitable day was let go by because of other work. The day previous to the one on which the fire was set is believed to have been the proper one. This point indicates one of the handicaps to this method of disposing of slash; namely the difficulty of choosing the correct time to burn. And since the favorable and safe times are of such short duration frequent disasters may be counted on.

The cost of broadcast burning these three acres under control includes the costs of clearing a fire line, and of burning and of the patrol afterwards. It was approximately $15.00 or at the rate of $5.00 per acre.

Obviously this manner of treatment is possible of use on a restricted type of stand. It is needless to hope for the survival of trees left standing. The method will serve certain very old stands, which may be blocked out for uniform treatment. But no very extensive use of broad cast slash burning can be hoped for.

Plot No.6

(a) location: McMahon draw – adjacent to Plot No. 5

(b) Area: 8.0 acres.

(c) Exposure, SE with gradients ranging from 30-80%.

(d) Treatment: After the cutting, the slash from merchantable trees was piled. Then only the defective hemlock and defective whit fir were felled. The tops were lopped and the slash thrown on the existing piles. All sound hemlock and sound white fir were left standing.

The burning of the slash is not yet completed. Conclusions must in part wait upon the completion of the disposal.

The costs are as follows:

(a) Piling and burning slash from merchantable trees at 60 cents per M.B.F.

The cut per acre is not known.

(b) Cost of slashing all defective trees and

piling resultant slash, total	$226.40
Cost per acre	28.30

The slash is not yet burned – the burning however is considered to be taken care of in the 60 cents per M. charge.

Plots 7 and 8

(a) Location: Hemlock draw – Lieberg Creek.

(b) Area Plot 7 – 6.8 acres

Plot 8 – 4.2 acres

(c) Exposure:

Plot 7 – E	30-80 percent
Plot 8 – NW	20 -75 percent

(d) Treatment: Both plots were treated in a similar manner. The slash is burned only on Plot No. 7.

The method was

To pile slash from merchantable trees
To fell and pile resultant slash from trees up to 12“ d.b.h.
To girdle all defective trees above 12“ d.b.h.
To burn the slash piles at a favorable time.

The following tables set forth the summarized data for Plot No. 7.

Table 5

Stand cut by species and volume

Plot No. 7 – Acres 6.8
Basis: 100 percent stump scale

Species	B.F. Total	B.F. Per acre
W.W.P.	103,740	15,250
W.L.	1,240	180
W.F. & W.H.	18,435	2,710
	123,415	18,140

Table 6

Reserved Trees

Summary and Condition

D.B.H. Classes	Healthy			Unhealthy			Dead			Totals
	Unaffected	Roots Scorched	Resin Streaked	Roots Scorched	Insect Attacks	Misc.	Fire	Insects	Windthrown	
W.W.P.										
411	20	3	--	2	--	1	--	--	--	26
12+	34	5	--	--	1	4	--	--	--	44
Other Species										
4-11	2	2	--	--	--	--	1	--	--	5
12+	37	6	--	1	--	3	--	--	--	47
Totals	93	16	--	3	1	8	1	--	--	122
Per acre	13.7	2.4	--	.5	+	1+	+	--	--	17.9

It is to be noted from the above table that much less damage was done to the reserved trees than in the other plots. This may be due partly to two causes: namely a smaller cut per acre and a smaller amount of slash on the ground, since only a portion of the un-merchantable trees were felled.

This stand represents a typical B-1 classification. Of the reserved trees per acre the white pine averaged a little less than 8 trees of which 3 are below 12 inches d.b.h. and 5 are 12 inches d.b.h. or larger.

The girdled trees are shown in the following table.

Girdled Trees

By

D.B.H. Classes – Area 6.8 acres

Basis 100 percent tally

D.B.H. Classes	Girdled Trees			
	W.H.	Other Species	Total	per acre
10-12	30	15	45	6.5
14-16	53	23	76	11.0
18-20	30	5	35	5.0 plus
22-24	16	6	22	3.3 plus
26-28	8	--	8	1.3
30-32	1	--	1	.2 plus
34-36	4	--	4	.6
	142	49	191	28.

The weighted average diameter of the girdled trees is 18.2 inches d.b.h. No record was kept of the slashed trees.

The cost may now be set forth:

Disposal of slash from merchantable trees

at 60 cents per M.B.F. Per acre $10.89

Falling and piling slash from defective unmerchantable trees and girdling 28 trees with an average diameter of 18.2 inches 14.64

The burning of all the slash both from the unmerchantable trees and from the defective trees cost little or no more than the burning of the slash from the merchantable trees, and no additional cost is therefore allowed.

The total cost per acre is for both measures $25.53

The costs of falling and piling the slash on Plot No. 8 are somewhat greater per acre than those for Plot No. 7, namely $20.35. it would appear that this method of treatment would vary between $15.00 and $25.00 per acre for average stands.

After a careful examination of the results on the ground, the method of treatment used on Plots 7 and 8 appears to meet most of the objections found in the preceding described areas and plots.

This is a compromise method which minimizes the objections of the

(a) excessive cost of slashing all inferior species

(b) excessive fire danger of girdling all unmerchantable trees.

It is the windthrown small hemlock that forms the continuity of slash, and which augments the hazard of girdled areas. The large trees are less numerous (28 per acre) and when windthrown will not interfere with travel over the area. Although as will be pointed out below not trees along trails and in the stream bottoms should be girdled.

This method thus far represents the solution to the problem. But it must be used with some flexibility in order to secure the proper opening of the forest floor to light. The amount of light admitted should be the guide to the variation in the numbers and diameters of trees to be felled and those to be girdled.

It is at this point that the method under consideration appears to be too rigid and mechanical. For if workmen are informed that all defective hemlock trees must be girdled little discretion may be counted on to adapt or alter the treatment to the needs of variations in the stand.

To make the control flexible a method is proposed which will make possible the treatment of each acre or fraction thereof according to the individual demands of that part of the stand.

In brief the plant is as follows:

(1) Pile the slash from merchantable cut trees. (Slash may also be burned if other slash would increase the volume to an unsafe amount for burning) or sanitation.

(2) By a second marking designate trees (by some simple method as by notching)

(a) To be felled

(b) To be girdled

and perform this work during or after the disposal of logging slash.

(3) Burn the piled slash.

On Plot No. 7 the slash from the unmerchantable felled trees was piled on the slash piles consisting of the slash from merchantable trees. The slash was burned in the later afternoon and evening. Good results were secured.

This is practically the same statement of the method of handling these stands set for in the Monthly Silvical Investigations report for November 1921 by W. C. Lowdermilk. The following paragraph is quoted:

> “The primary object of this procedure is to permit the man in charge of disposal to take advantage of the irregularities of the stand, to secure the greatest opening at the least expense. Dense groups of the secondary species are to be left green and intact. This method will maintain the cutover tract in a satisfactory condition for protection. This is a half measure but girdling likewise is a half measure, with the disadvantage of leaving an area in a hazardous condition”.

And in view of the fact that protection is considered to be 80-92 percent of the forestry problem the disadvantage of fire hazard has the greater weight.

Two one-acre plots of sample marking were done to illustrate the method to be followed. One plot is located in 3 Million Draw and the other on the point of the ridge separating Hemlock Creek from Lieberg Creek.

The Kaniksu Areas.

At the present writing a plot of approximately 20 acres is being treated on the Kalispell Creek portion of the Dalkena sale area. The white pine has been cut clean from the area. The remaining trees and snags except the larch are being felled. At a safe time in the fall the slash will be burned broadcast. Data and results will be available at a later time.

The hemlock problem on the Kalispell area is at its worst. The land is generally flat. Under the stand are two under stories of tolerant species. The lower under story consists of trees 1 to 4" d.b.h. and act as so many umbrellas in shading the ground. Even though the white pine is cut out the stand is not opened up to any appreciable degree except at skidways, and since most of the white fir and hemlock on this flat area is defective the stand is left in a decidedly unproductive condition. Some sort of sanitation measure is indicated.

An acre was laid out and given sample treatment under the scheme of sanitation marking for the disposal of defective trees. This will indicate the general method advocated under the sanitation marking.

Sanitation Marking:

A review of the methods as carried out indicates the silvicultural mistake of adapting a uniform method of treatment to an irregular stand of timber. The treatment would be adapted to the modifications of the stand. But such adaptation calls for thoughtful application, for it is a solving of a continuous problem as it opens up in the cutting of timber. This treatment calls for careful marking, - marking that involves knowledge of the light requirements of the species involved and a knowledge of the laws of forest sanitation. It is sanitation marking.

At the present time is needed particularly a knowledge of the manner in which fungi produce defects, and under what conditions and at what ages trees are most apt to be affected. The excellent progress that was being made in this subject was bought to an untimely conclusion by the loss of Dr. James R. Weir, July 1, 1921. The need for an increased application of sanitation measures will be progressively felt as cutting in the white pine stands continues. For this reason it is strongly advocated that a continuance of the work done by Dr. Weir be provided for in the district.

Sanitation marking when carefully applied and executed should bring about favorable restocking conditions and a condition of permissible and safe hazard over the cut-over tract with the minimum of expenditure. It requires moreover thoughtful application on the ground.

Summary

The following table is a summary of methods of treatment. A comparison in costs may be made. The comparison in results had best be observed on the ground to weigh properly the varying factors. It is the intention of this report to bring together the considerations affecting the problem. And at the conclusion of the field trip wherein the various methods of treatment were studied on the ground the method of treatment to be followed may thereby be decided upon the more easily.

SUMMARY OF METHODS OF TREATMENT

Treatment	Stand		Cost of Treatment						Remarks
			Disposal of slash from Merchantable trees.	Sanitation measures un-merchantable trees				Total cost all measures	
	Merchantable Vol.	Unmerchant-able trees		Felling & piling slash	Girdling	Fire hazard liability of girdled trees	Total sanitation costs		
	M.B.F.	Number	per acre	per acre	per acre	per acre	per acre		
(1)	32.3	--	19.41	34.46	--	--	34.39	53.90	
I (2)	?	?	?	26.93	--	--	26.93	--	
(3)	47.6	?	28.56	27.20	--	--	27.20	55.76	
II	?	?	00.00	25.76	--	--	25.76	25.76	
III	?	?	?	28.30	--	--	28.30	--	
IV	18.14	28 over 12” d.b.h.	10.89	13.24	1.40	5.00 *	19.64	30.89	
V	?	--	?	7.40	1.00	5.00*	13.40	--	

* estimated

I. Pile & burn, slash & burn all W.H. & W.F

II. Slash and broadcast burn

III. Pile and burn, slash defective WH & L.W.F. only

IV. Pile and burn, slash and burn all defective trees up to 12” d.b.h., girdle trees above 12” d.b.h.

V. Pile and burn. Disposal in accordance with sanitation marking.

Method of treatment IV seems to solve the problem more nearly than the preceding methods. And treatment V is designed more completely to satisfy the demands made on the treatment of white pine stands of timber containing large quantities of un-merchantable and defective species.

General Conclusions

1. The destruction of sound hemlock or white fir is not justifiable.
2. Liability of girdled trees is equal to the expense of disposing of the mat of slash caused by the windthrown trees. This should be charged against the measure in comparisons with others.
3. Portions of the stand which will not pay their own way in sanitation measures should be delimited from the sale area. The minimum unit so excluded may be placed at 2 1/2 acres.
4. The girdling of defective secondary species is justifiable within certain restrictions.
5. The girdling of trees along trail, roads and streams to a distance of one chain on each side of such trails, roads and streams, **is unwise and unsafe.**
6. A method of treatment under sanitation marking will more nearly satisfy the requirements for restocking and reduction of the fire hazard to a safety point in cutting than other methods which have been put into use.

Missoula, Montana

June 15,1922

Addenda

The Kalispell Creek Slashed Plot:

On the Dalkena sale area of the Kalispell Creek drainage, a plot approximately 20 acres in size containing a meadow of about 2 acres was laid off. On it the white pine was cut clean. Subsequently the unmerchantable trees with the exception of the western larch and Douglas fir were slashed preparatory to the burning broadcast of the entire area. A fire line was constructed around the area to isolate it.

The following table is a tally of the trees which were slashed.

Table 7.

Summary of Slash Trees

20-acre plot – Kalispell Creek

Sec. 11. T. 60 N., R 5 W.

Diameter Classes Inches.	Species									
	WWP		WH		WF	WRC	Mixed		Totals	
	Trees	Snags	Trees	Snags	Trees	Trees	Trees	Snags	Trees	Snags
2-8	83	--	2089	-	131	763	54	1	3120	1
10+	64	59	1145	9	32	233	17	2	1491	70
	147	59	3234	9	163	996	71	3	4611	71

The costs of slashing these trees and of preparing the area for broadcast burning are as follows: The slash will be burned in the fall. The cost of this operation is still to be added.

Table 8

Cost of Slashing and Preparing a 20-acre Plot for Broadcast Burning.

Item	Costs	
	In Man days	In Dollars
Clearing fire line	42 1/2	$128.75
Piling slash away from reserved larch	30 1/4	99.12
Slashing trees	141	480.50
Filer	208 5/8	74.25
Foreman	20	66.61
Oil	--	4.50
Totals	262 3/8	853.73

The area of the plot on which timber was standing does not exceed 18 acres. This is not known exactly because of the irregular form of the enclosed meadow. The cost per acre therefore for this operation was approximately $47.50. This is a higher figure than was anticipated. To this must be added the cost of burning and subsequent patrol.

This operation will cost approximately $2.50 per acre. The total will therefore, be about $50.00.

If planting is necessary for restocking its cost must be added, which must be increased by the reciprocal of the survival percent which may reasonably be expected.

An inspection of this plot should be made within one year after burning and subsequently to establish the course of forest succession upon it. In fact it is recommended that permanent sample reproduction plots be established in this slashed area.