

TREATMENT OF UNDERSTORY HEMLOCK IN THE WESTERN WHITE PINE TYPE

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This article discusses the desirability of slashing the understory of hemlock to secure white pine regeneration when logging the mixed western white pine stands of Northern Idaho. If not slashed, the hemlock will recover to give good volume returns; the decision as to treatment depends primarily upon the proportion of defect in the hemlock.

SILVICULTURAL practice for the national forests in the mixed western white pine stands of northern Idaho has long been complicated by the economic problems arising from the presence of aggressive, tolerant, low-value species, such as western hemlock (*Tsuga heterophylla*) and lowland white fir (*Abies grandis*), in association with the less tolerant, faster-growing, high-value western white pine (*Pinus monticola*). Purely silvicultural measures to encourage the germination and survival of white pine (for example, the creation of more favorable light conditions on cut-over areas through the girdling and felling of unmerchantable hemlock and white fir) have always been contested on the grounds that these expensive measures were economically unsound. As a result, silvicultural practice in the white pine type has continually reflected the effort to maintain a common-sense balance between good silviculture and good economics.

This struggle is aptly and clearly illustrated in a problem dealing with the treatment of understory hemlock stands, the object of discussion in this paper. Western hemlock is, of course, a common overwood associate in the mixed western white pine stands of northern Idaho. Less commonly it also occurs in the form of dense, uneven-aged, distinctly younger understories often composed of thrifty-looking, pointed-crowned individuals giving every promise of making excellent growth upon the removal of the overwood.

The occurrence of such stands within the boundaries of national forest cutting areas has made it necessary to decide, when the overwood is logged off, whether or not the understory should be left to increase in volume and form the basis of the next cut, or be removed in a special and costly sanitation felling and the area thus cleared for white pine reproduction. White pine will not reproduce satisfactorily under the heavy shade of the understory trees.

As information on the recovery and growth of the hemlock understory was essential to any logical solution of this problem, the writer was requested to make a study of two cut-over areas on the Coeur d'Alene National Forest, each of which contained a stand of understory hemlock released by logging about 18 years ago. On each of these cuttings, the Ault and Skookum areas, the original stand consisted of an overwood, chiefly western white pine, with an understory of western hemlock and white fir. Only some 30 to 50 per cent of the total number of trees were white pine, but these individuals contained about 90 per cent of the merchantable volume. The logging operation changed conditions very materially, removing almost all of the pine and leaving hemlock as the predominant species. The general composition of the stands on both the Ault and Skookum areas before and after logging is shown in Figure 1. On the Ault area, containing the more typical understory stand, the logging operation left about 267 trees per

acre, of which 75 per cent were hemlock. These trees ranged from 1 to 11 inches in diameter and from 8 to 45 feet in height, averaging about 7 inches in diameter, breast high, and 20 feet in height when released by logging. Some 95 per cent were under 10 inches in diameter. These understory trees were mostly from 50 to 70 years of age, whereas the overwood was 120 to 140 years old. In the understory, however, individuals were found as young as 10 and as old as 100 years of age.

To study the growth of these released understories and thus derive figures applicable to understory stands on going sales, two one-fifth-acre plots were established on each cutover area and increment borings taken on every tree within the plot boundaries to determine the rate of diameter growth before and after release. In addition, all understory hemlocks and white firs were felled and sectioned back from the tip to determine the rate of height growth before and after cutting. The average rates of growth based on the above measurements are listed in Table 1. On the Ault cutting, 18 years, and on the Skookum cutting, 17 years had elapsed since the removal of the overwood stand.

It is evident from these figures that, on the average, understory hemlocks and white firs will recover from suppression and accelerate in rate of growth when released. About 90 per cent of the hemlock and 95 per cent of the fir show definite acceleration in diameter growth, and 62 per cent of the hemlock and 74 per cent of the fir show definite acceleration in height growth. The understory

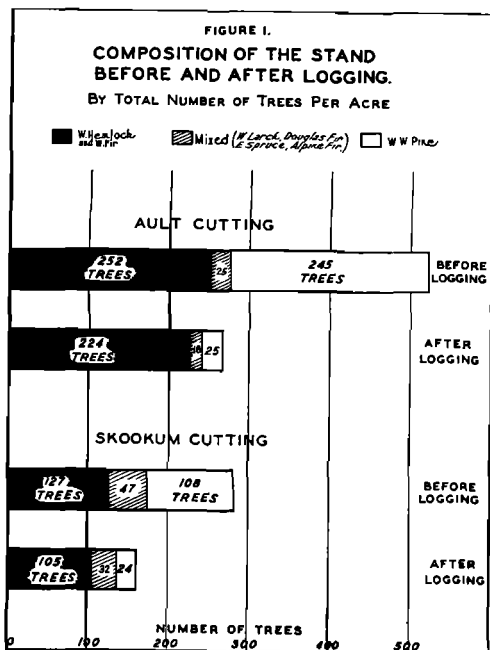


Fig. 1.—Composition of the stand before and after logging.

trees are now growing fast enough to produce a considerable volume of timber 30 to 40 years after the original cutting if the average rate of growth holds up without material change. Conditions on the Ault and Skookum cuttings indicate that an understory stand of 160 to 270 trees per acre is not overcrowded 17 to 18 years after release and that the present rate of growth may very reasonably be expected to hold without material change to at least the end of the 30-year period.

The predicted yields of these understory stands are shown in Table 2. Note that these are gross yields, no allowance being made for loss through death, windfall, or

TABLE 1

AVERAGE RATE OF GROWTH BEFORE AND AFTER LOGGING. BASIS 102 WESTERN HEMLOCK; 21 WHITE FIR

Species	Diameter growth per decade		Height growth per decade	
	Before logging	After logging	Before logging	After logging
	Inches	Inches	Feet	Feet
Western hemlock	0.86	1.56	5.8	6.8
Lowland white fir	0.57	1.10	3.3	5.1

defect. They are given in the International one-eighth-inch log rule for all trees 7 inches and up. These yields were computed by predicting the diameter and height of each tree 20, 30, and 40 years after release, using the average rate of growth attained by that individual in the period since release, and reading the corresponding volumes from second-growth volume tables. Values from both of the areas studied have been averaged in this table.

The yields to be expected under favorable conditions from seedling stands, if the hemlock understory were slashed and such stands started at the time of the original logging, are also shown in Table 2. They are likewise in the International one-eighth-inch log rule for all trees 7 inches and up. These values are from normal yield tables for fully-stocked stands on good sites (S. I. 60). There seems little reason to doubt that, on lower protected slopes of this sort, seedling stands, largely white pine, will be promptly secured if the hemlock understory is removed. This has been common experience on such clear-cut aspects throughout the white pine type. A case in point is a patch of clear-cut, broadcast-burnt area on the Ault cutting immediately alongside one of the understory stands examined in this study. This area, a portion of the Ault cutting on which the understory stand was actually destroyed by a broadcast burn, contains a splendid stand of

reproduction in which white pine is dominant on 95 per cent of the area. The seedlings are well distributed and commonly reach 6 and occasionally 14 feet in height.

It was early evident, however, that the gross yield shown in Table 2 for hemlock understories would be unobtainable in many instances due to the prevalence of heart rot in such stands. This item varies widely and probably must be measured separately for each area considered, but, in the understory stands actually examined, from 40 to 60 per cent of the trees showed some sign of rot. It is impossible to estimate accurately the exact effect of this appreciable amount of defect on future yields. From the standpoint of cubic volume production it is relatively unimportant¹ and, in addition, will probably be checked to some extent by the release of the understory trees.² But from the standpoint of board-foot yields the prevalence of heart rot is a serious factor, for in a low-value species such as hemlock, particularly in small trees of the understory type, any tree appreciably defective would be practically worthless to the logger.

To sum up the situation at this point, it seems clear that if the hemlock understory stands are left they will recover from suppression and produce larger gross volumes from 30 to 40 years after release than seedling stands grown for the same period. This apparent advantage, however,

TABLE 2
PREDICTED YIELDS IN BOARD FEET FROM UNDERSTORY AND SEEDLING STANDS
International 1/8-inch rule; trees 7 inches and up

Predicted yields from	Volume per acre		
	Number of years since logging		
	20	30	40
	Board feet	Board feet	Board feet
Understory stands	7,350	11,600	17,900
Seedling stands	0	600	4,450

¹First Progress Report on the Study of Decay in Western Hemlock, by E. E. Hubert. Manuscript.

²The Influence of Thinning on Western Hemlock and Grand Fir Infected with *Echinodontium Tinctarium*, by J. R. Weir and E. E. Hubert. JOURNAL OF FORESTRY, Vol. 17, Pp. 21-35. 1919.

must be weighed against a number of other considerations: (1) The seedling stands are potentially the greater timber producers over a 100-year rotation, as they will average 735 board feet per acre per year against a short-time maximum of 450 board feet per year from the hemlock understories; (2) the understory stands are subject to material amounts of defect which will greatly reduce the gross board-foot yields; (3) in addition, their future value is problematical, for hemlock now costs more to log and mill than it is worth (though it seems probable, judging from past experience in other forest regions, that sound hemlock will pay its way 30 or 40 years hence); (4) if these stands are left for 30 or 40 years, it may be difficult to reproduce the area to more desirable species when the present understory is finally removed.

On the other hand, if the hemlock is slashed when the pine overwood is logged, it seems certain beyond a reasonable doubt that the area will reproduce satisfactorily and that this reproduction will be chiefly white pine. It will cost, however, some \$10 per acre, based on actual experience, to slash the hemlock and thus clear the way for the reproduction stand. The reproduction stands must be able to carry this cost at a reasonable rate of interest and still show a profit before it can financially justify its establishment.³

It is plain that any attempt to decide

the merits of understory versus seedling stands on the basis of money returns necessarily involves an almost prohibitive amount of speculation. Relative money returns will vary with a number of factors including the actual yields obtained, the amount of defect in the understory, the percentage of white pine in the seedling stand, the establishment and carrying charges on the seedling stand and, above all, the actual and relative stumpage values of western hemlock and western white pine at the time the hemlock understory is removed. Nevertheless, the computations of net returns under fairly reasonable if admittedly speculative conditions are more helpful than no computations at all in sizing up the situation. Accordingly, comparative returns under one such set of conditions are given in Tables 3 and 4. Note that these values are derived by multiplying the estimated yields 40 years after logging, as shown in Table 2, by the proper stumpage value, the stand being considered as hemlock or a compound of hemlock and white pine only, for the purpose of this comparison. The stumpage prices are based on the assumption that if hemlock reaches a plus-stumpage value white pine will be worth, as at present, about \$15 more per thousand. Forty years is chosen as the point of comparison because beyond this time competition and suppression will undoubtedly materially affect the rate of

TABLE 3
STUMPAGE VALUES OF UNDERSTORY STANDS. 40 YEARS AFTER RELEASE

Per cent of defect	Values per acre				
	Stumpage price per thousand				
	0.50	1.00	1.50	2.00	2.50
			Dollars and cents		
0	8.95	17.90	26.85	35.80	44.75
20	7.16	14.32	21.48	28.64	35.80
40	5.37	10.74	16.11	21.48	26.85
60	3.58	7.16	10.74	14.32	17.90
80	1.79	3.58	5.37	7.16	8.95

³Blister rust control costs are not a factor in this problem since control work must be carried on to protect nearby stands even if the understory hemlock is left.

growth of the hemlock understory, and accurate yield predictions beyond this point are therefore impossible.

It is true that both the seedling and understory stand at this time will consist of small trees, the largest of the understory trees, for example, running only 14 to 16 inches in diameter. It is also true that the seedling stand at 40 years of age is potentially a larger timber producer than the understory, and probably relatively higher financial returns could be obtained from the seedling stand at some other age. Nevertheless, the lack of accurate data on the yield of the hemlock understory necessitates comparison at this time, and in view of the speculative nature of all such estimates a comparison 40 years after release is felt to be satisfactory.

These tables illustrate the theoretical nature of such comparisons, for obviously any one can obtain a different set of returns by varying any of a number of factors. Yet the majority of such tables, based on fairly reasonable-looking values, lead to one general indication; namely, it seems highly probable that only sound or nearly sound hemlock stands will yield financial returns as high as those obtainable from the seedling stands grown for the same period. It must be emphasized that the definitions of sound and unsound stands as given herein are necessarily tentative, and more must be learned about the probable increase of rot in understory

stands and its effect on merchantable contents before a sound decision can be made as to the presence or absence of material amounts of defect.

With these facts in mind and giving due consideration to the speculative nature of the estimated money returns, the writer would advocate the following treatment of hemlock understory stands containing a large percentage of vigorous trees with pointed crowns:

1. Retain the hemlock understory if it is sound; i. e., if 40 per cent or less of the trees show signs of defect at time of release. This figure can be obtained quite readily by boring a number of trees selected at random and examining the cores for signs of rot.

This procedure seems justified by the following reasoning:

- a. It seems undesirable deliberately to destroy sound wood at a relatively high cost when its future value is unknown.

- b. Money returns from sound hemlock understories may equal or even exceed the net returns from seedling stands 40 years after the original logging; at least, hemlock has a good chance of paying its way.

- c. There is no \$10-per-acre cash investment to lose if the area burns.

2. Slash the hemlock understory if it is defective; i. e., if over 40 per cent of the trees are defective at the time of original logging.

TABLE 4

STUMPAGE VALUES OF SEEDLING STANDS, 40 YEARS OLD
GROSS VALUES MINUS COST OF \$10.00 AT 3½ PER CENT

Per cent of white pine in seedling stand	Net values per acre				
	Stumpage price per thousand				
	0.50 WH 15.50 WP	1.00 WH 16.00 WP	1.50 WH 16.50 WP	2.00 WH 17.00 WP	2.50 WH 17.50 WP
60	2.69	4.91	7.13	9.36	11.59
70	9.36	11.58	13.81	16.03	18.26
80	16.04	18.26	20.48	22.71	24.94
90	22.71	24.94	27.16	29.39	31.61

WH: western hemlock. WP: western white pine.

This procedure seems justified for the following reasons:

a. If the stand is defective, it would cost a considerable amount, anyway, to clear the area 40 years after the original cut. For example; if, in the case of the areas just described, the hemlock understory were 40 per cent defective, the second cutting would leave about 74 unmerchantable trees per acre, including many trees 12 to 16 inches in diameter. It would be desirable to remove these trees in order to favor the seedling stand to be established at that time. This cost would materially lessen any profits obtained from the understory stand.

b. It seems undesirable deliberately to

grow defective, low-grade timber on some of the best white pine land, particularly when large amounts of such material are already available.

c. The money returns from defective understories will probably be exceeded by money returns from seedling stands.

d. Reproduction stands of desirable species may be difficult to obtain when the hemlock understories are finally logged.

This general policy would be consistent with the present Forest Service policy in the region with regard to the treatment of mature hemlock occurring with white pine; namely, to retain the sound trees and slash the defective.