research notes

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VICTORIA, B.C. 1949

Treatment of Red Alder in the Coastal Region of British Columbia

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TREATMENT OF RED ALDER
IN THE
COASTAL REGION OF BRITISH COLUMBIA

Introduction

There are several species of alder growing along the Coast of British Columbia, but the largest of these is the red alder (Alnus rubra). It is a fast-growing, short-lived tree, usually found on alluvial soils along streams or moist hillsides where the coniferous forests have been either destroyed or, following logging, have not yet become re-established. Red alder is commonly found as a pioneer species on cut-over lands and, due to its ability to flourish under a wide range of environments, it regenerates extensive areas. On medium-quality soils with excellent sub-irrigation, such as in the Fraser and Squamish valleys, it forms an alder-birch-maple association. Westward, towards the coast and on the islands, this association changes so that broadleaved stands are almost entirely alder, particularly when located on wet and swampy sites.

The wood of red alder is pale reddish-brown in colour and light in weight, with an attractive grain which makes it eminently suitable for cabinet work. A few years ago, alder was of local importance only and that largely as fuelwood. However, as the excellence of this wood becomes better appreciated, it is assuming increased economic importance. In 1947, the cut in the Coastal Region was about 7,000,000 board feet. This raw material, in addition to providing cordwood for fuel and fish-smoking purposes, is utilized by at least four principal wood-manufacturers producing furniture of solid or plywood stock. Apart from the furniture industry, the wood may be put to a host of uses, varying from clothes-pins, bobbins and spools, to chairs, panels, tables, and other items of house-furnishings. Unfortunately, this potential field in utilizing the wood is tempered by an inherent instability of markets, due in some measure to the inability of pure, untreated, second-growth alder to produce quality material. Can silvicultural treatment provide, within a given rotation, a sufficient volume of high-quality lumber, such as straight logs of adequate length for veneer and furniture purposes, to ensure the establishment and maintenance of profitable alder markets? It is beyond the scope of this paper to make a prediction, but an example can be quoted to illustrate the value of cultural treatment in pursuit of such an objective. Speaking on timber utilization, H. A. Cox* says, "In Finland, before the birch stands were subjected to silvicultural treatment with a view to supplying plywood material for the plywood industry, the stumpage value of birch was lower than for any other species. Prior to the war, however, it had increased so much that no other species had so high a value."

In summary, the economic and silvicultural aspects indicate the desirability of considering red alder stands as material assets to units, particularly farm woodlots, operating on a sustained-yield basis. Further, in support of these two aspects are such facts as the spontaneous regeneration of alder stands, their valuable leaf-litter properties, and their comparatively low fire-risk.

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* H. A. Cox--Modern Trends in Timber Utilization. Paper presented at the Fifth Empire Forestry Conference, London, England, 1947.

Like many forestry queries, the problem of formulating a management policy for even-aged red alder stands necessitates a long-term study before a complete solution will be available. In 1948, a study was initiated by the British Columbia Forest Service with the establishing of a series of replicated thinning plots in an alder-grove situated within the area of the Lake Cowichan Forest Experiment Station. Some of the findings resulting from these observations are worthy of record.

Under observation since 1930, measurements revealed that growth increment of this stand, at 36 years of age, had already passed its peak and, although the overall volume per acre was superior to the yield table value for B. C. Alder site one, the individual tree volume was very much lower, due to the high number of stems per acre. As it did not appear desirable, economically, to clear-cut an area in which so few trees were of merchantable size, it was decided to find out whether the application of free thinning would increase, appreciably, the merchantable value of selected trees. Thus, not only was an opportunity provided to study the effects and results of thinning, but also to acquire knowledge of the management of alder stands from an economic and silvicultural aspect.

Stand History

About 1908, the parent stand of Western Red Cedar was partially fire-killed. Frequent windfalls occurred. In 1934, the remaining snags were felled, causing some damage to the alder stand then established and 23 years old. Today, the alder stand is pure and even-aged (37 years). Prior to thinning, the crown-cover was complete. Alder is the dominant tree species while beneath it are scattered a few hemlock and spruce. There is no true understorey. Although sparse in 1930, ground-cover is now abundant with the frequent species being skunk-cabbage, swordfern, may-leaves, miner's lettuce, horsetails, trillium, and devil's club. Due to the overflow from a nearby natural spring and inadequate drainage system to guide the run-off, much of the site is wet. Even where water is not evident in large pools on the ground, free water can be found 12 to 18 inches below the surface.

Type of Thinning and Degree of Cut

A free thinning was applied. This procedure followed no specific rules. Its aim was to foster the choicest trees by cutting out competitors, regardless of their crown-class. The choicest trees were those with straight, clean boles, and the best distributed crowns. Two degrees of cut were employed and arbitrarily fixed at 30 per cent and 40 per cent by cubic volume of existing stand volume, prior to treatment.

Presentation of Data

The 30 per cent cut, the 40 per cent cut, and an uncut area were considered as three treatments and allotted four experimental plots each, thus providing three replications per treatment. The stand data on these individual plots, summarized in Table I, indicate that there is considerable range in the total volumes of certain plots. However, an average of this range reveals that the alder-grove consisted of 420 trees per acre, each 12.5

merchantable cubic feet, or a total merchantable yield, measured outside the bark, of 5,300 cubic feet per acre. The portion of the area set aside for thinning had a merchantable yield of 5,700 cubic feet per acre and of this volume 36.4 per cent was removed in the thinning operation.

The thinned material provided an intermediate yield of 2,100 merchantable cubic feet outside the bark or, in terms of one cord to 95 cubic feet, 22 cords to the acre. Analysis of the thinning by tree-dominance and diameters showed that the thinned material consisted largely of:

1. diameter inch-classes 5, 6, 7, 8, and 9, and that of these classes, 50 per cent fell within the 5 and 6-inch classes; and

2. dominant, codominant, and intermediate trees in equal numbers.

TABLE 1 -- RED ALDER 37 YEARS OLD, FIRST THINNING
PLOT DATA PER ACRE

	Main Crop[1]							Thinnings						
Sub Plot	No. of stems	Mean dominant height	Mean D.B.H.	Total B.A.B.H.	Mean volume per tree	Volume[2] O.B.	Volume[2] U.B.	No. of stems	Mean D.B.H.	Mean volume per tree	Volume[2] O.B.	Volume[2] U.B.	Thinning Ratio[3]	Remarks
1 a	160	92.0	10.2	91.4	24.0	3,845	3,490	80	9.1	19.1	1,527	1,392	28.8	30% Thinning
b	220	79.0	9.3	104.6	18.8	4,132	3,845	310	6.8	7.5	2,312	2,014	35.9	
c	200	76.0	9.5	99.2	16.7	3,348	3,128	110	8.3	14.5	1,595	1,365	32.3	
d	460	62.0	7.2	131.2	7.4	3,398	3,134	270	6.2	5.6	1,520	1,338	30.9	
2 a	140	70.0	8.6	56.2	15.8	2,211	2,040	190	6.9	7.7	1,456	1,293	39.7	
b	180	96.0	9.8	94.0	21.0	3,783	3,467	230	7.3	11.9	2,627	2,361	43.0	40% Thinning
c	140	96.5	10.5	85.2	27.6	3,872	3,535	150	8.3	15.2	2,280	2,057	37.0	
d	290	75.0	8.7	121.2	14.7	4,274	3,870	400	6.9	8.1	3,239	2,960	43.0	
3 a	370	90.0	9.4	177.9	19.8	7,320	6,655							
b	460	58.0	6.7	113.4	6.9	3,190	2,900			Unthinned				Control
c	460	70.0	8.1	163.5	11.6	5,340	4,854							
d	350	63.4	8.6	139.9	10.7	3,740	3,400							
1 and 2	224	81.0	9.0	97.9	16.1	3,608	3,314	218	7.3	9.5	2,069	1,847	36.4	Mean per acre all thinning plots
3	410	70.3	8.2	148.7	11.9	4,898	4,452							Mean per acre all control plots

1 *Main crop is the stand after thinning.*
2 Volumes are true cubic measure to merchantable height (4.0 inch top diameter).
3 Thinning-ratio is per cent volume removed in thinnings.

A study of the periodic and mean annual increments (Table 2 and Figure 1) revealed that the periodic increment reached a maximum at 17 years. This maximum was reached irrespective of stand density, but as might be expected, the increment-value was highest in the least dense portions of the stand. After 17 years, the curve of periodic increment dropped until, at 31 years, it fell below the mean annual curve. However, the mean annual continued to rise and reached its maximum at about 35 years of age. Therefore, if the "object of management" is to produce merchantable trees in the shortest time for, let us say, the furniture industry, these curves suggest a technical rotation of 40 years. Also of interest in Figure 1, is the curve of a

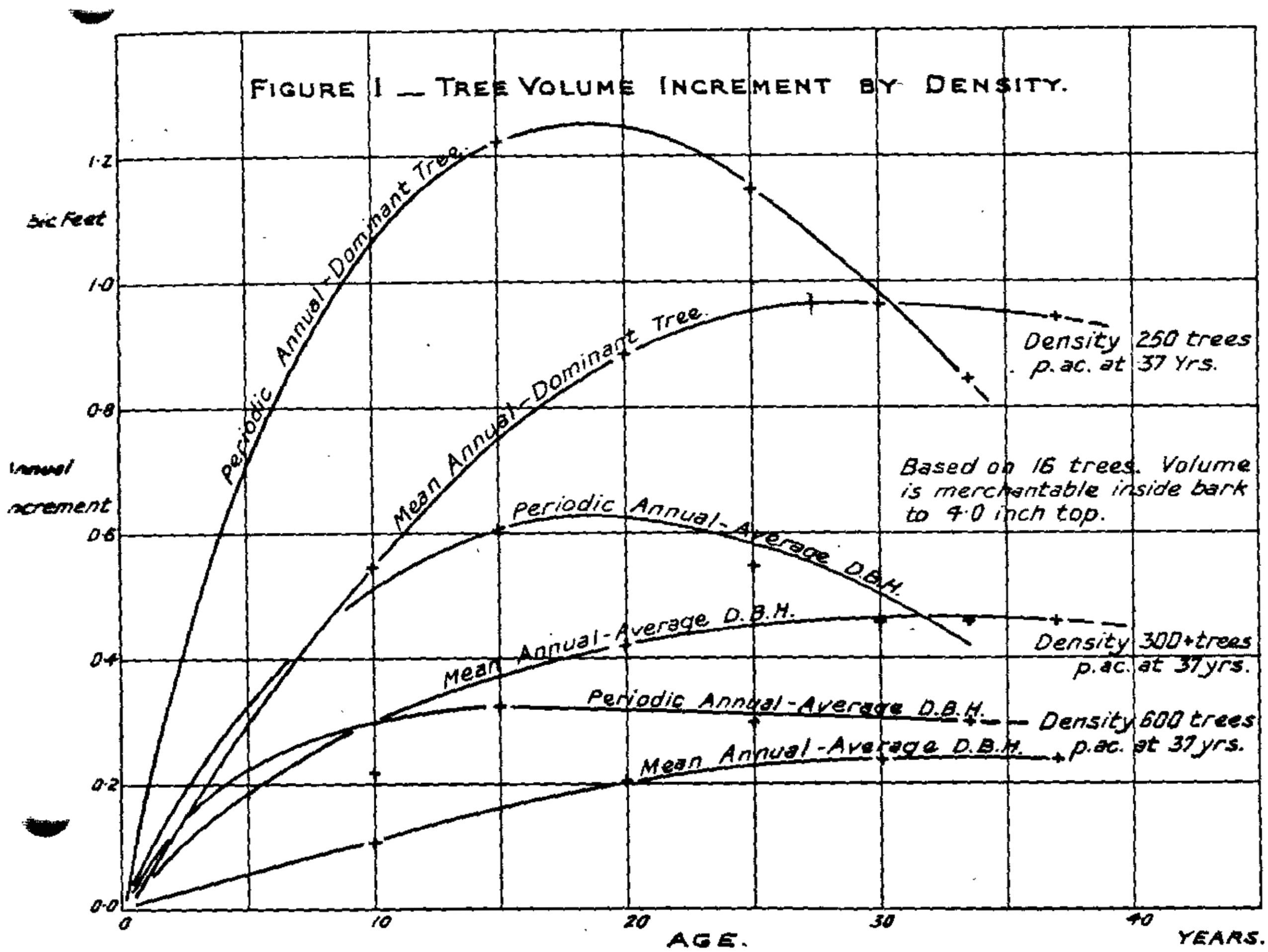
TABLE 2 -- PERIODIC AND MEAN ANNUAL INCREMENT PER TREE

Age	No. of trees per acre at 37 years								Remarks
	600				300				
	*PAI	SE	MAI	SE					
37.0			0.24	.024			.46	.035	Volume is
33.5	.30	.042			.46	.065			merchantable
30.0			0.24	.022			.46	.031	cubic feet
25.0	.30	.031			.55	.046			inside bark
20.0			0.21	.027			.42	.035	per tree per
15.0	.32	.050			.61	.050			annum
10.0			0.11	.014.			.22	.018	

* PAI -- Periodic Annual Increment
MAI -- Mean Annual Increment
SE -- Standard Error

dominant tree where the density is 250 trees per acre. This density is much lower from an earlier age than the rest of the stand. The trees are located on a gently sloping site where there is excellent sub-irrigation across and down the slope. A snag-falling operation of the many large cedar-snags in this section eliminated a considerable number of the 23-year-old alder trees and was, in effect although not in purpose, similar to a thinning. The rapid volume production of the surviving trees reached a peak in performance of over 1.2 cubic feet annual increment per tree inside bark at seventeen years. Translated to tree-size, this means that dominant trees 37 years old attained a size of 13 inches diameter (B.H.) and an inside-bark diameter of 9.0 inches at 44 feet. It is likely, therefore, that on good sites, a 30-40 year rotation is sufficiently long to produce a stand of individual trees each 35-40 cubic feet merchantable volume, particularly if cultural treatment is used to put this rapid increment to good use on chosen trees.

Before thinning operations commenced, the presence of epicormic branches on 40 per cent of the tree boles within all the sample plots stimulated speculation as to what their growth-response would be to the increased amount of light penetrating the canopy after thinning. It is possible they will develop strongly. Perhaps trees presently free of epicormic growth will be induced to awaken dormant buds. Should this be a result of thinning, it may be difficult to see where the quality value of the thinnings lies, unless a "bird's-eye" wood as attractive as its sister, maple, can be developed in the utilization sphere. The presence of these branches before thinning made it difficult to reconcile the idea that, under natural conditions of stand development and full canopy closure, any increase of light had been of a sufficient intensity to cause the vigorous sprouting of dormant buds upon the main stems. Therefore, it is suggested that other factors may have influenced their development. In a sample of 25 trees, the age of the epicormic branches ranged from 5-8 years, or a mean of 6.5 years, which



meant that bud-dormancy was broken when the stand was 30.5 years of age. The curves of periodic and mean annual increment (Figure 1) indicate that the periodic annual fell below the mean annual at 31 years, that is, about the same time. Perhaps a relationship does exist. Due to fierce competition, certain trees felt a need for more assimilating surfaces. Hence, they developed their leaf buds on the main stems in order to utilize the light infiltrating the canopy. The tendency to sprout dormant buds may not be all due to external stimuli. It may be that some trees, possessing inherent physiological characteristics, differ from their neighbours in the degree of susceptibility to stimuli. Some may be more prone than others to sprout dormant buds.

Utilization of Thinned Material

Since trees 9 inches D.B.H. and over formed only a small proportion of trees thinned and many of these logs had a twist or sweep, utilization as sawlogs was not possible. The material provided only fuel-wood.

Cost of Thinning Operation

Based on a set of operations during one month, costs are listed below as man-days per cord.

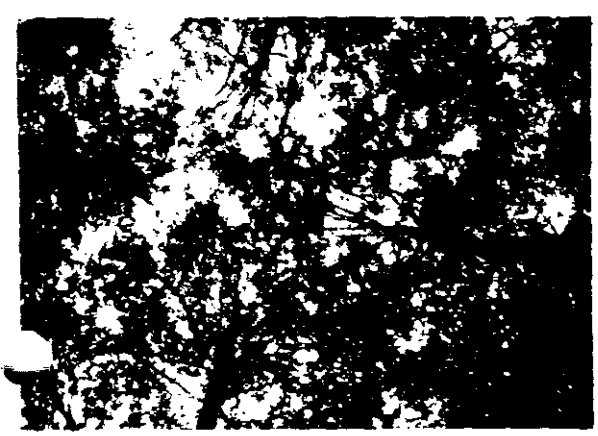
Item	Man-days per cord
Falling and bucking (Swede saws and axes)	0.57
Skidding * (1/4-1/2-mile haul to landing at truck road)	1.343
Yarding to skidding road	0.636
Cutting and splitting	0.658
Haul to Railroad (6 miles and loading freight car)	0.235

Total man-days to produce one cord -- 3.442.

* Includes cost of yarding trails in thinned areas to yard out 20 cords. If a truck road had been substituted for the long skid haul, this cost would have been materially lower.

Thinning the 20-Year-Old Stand

As stated in the discussion on rates of growth, stem analysis of the 37-year-old trees showed that the periodic increment reached a maximum at 17 years of age. This would indicate that a thinning at that age would yield the greatest results in quantity of wood produced. Therefore, with a view to studying the effect of such treatment, a 20-year-old stand was also thinned. After thinning, 200 per acre of the straightest dominants, each averaging a total volume of 12.2 cubic feet, formed the residual stand. The thinned material consisted of 350 trees per acre, each 6.8 cubic feet, or a total cubic volume of 2,400 cubic feet, inside the bark. Photographs Nos. 1 and 2 illustrate the aspect of the crown-density before and after thinning.



No. 1. Aspect of crown-canopy in 20-year-old stand before thinning.

No. 2. Aspect of crown-canopy in 20-year-old stand after 50 per cent (by volume, cu. ft.) thinning.

Conclusion

Although only newly started and, therefore, not conclusive, this study indicates that an opportune time to conduct a heavy thinning in pure alder-stands growing on good sites would be between 15 and 20 years. This would ensure that appreciable increment be placed on selected straight dominants at the period of its most rapid accretion and assist in the production of a merchantable stand within a 30- to 40-year rotation. However, the occurrence of epicormic branching merits consideration as a deterrent to quality sawlog production. Consequently, the ideal objective is to establish a rotation and density which discourages the production of epicormic branching, but encourages the most increment and the straightest stems. Thinning experiments now established in the 20- and 40-year age classes must be continued a number of years to yield conclusive results. Upon the evidence of these findings, two issues must wait. Firstly, the measure of assistance cultural treatment affords in approaching the ideal condition; and secondly, the economic soundness of a cultural investment designed to provide merchantable quantity and quality of material on a rotation of 40 years.