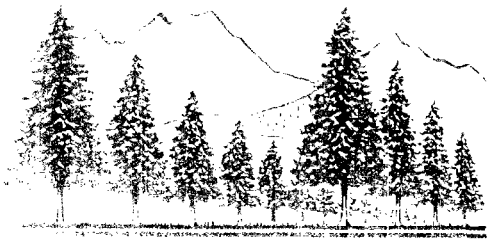

research notes

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SCARIFICATION IN ENGELMANN SPRUCE-ALPINE FIR FORESTS

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A Co-operative Study

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INTRODUCTION

In the Interior of British Columbia several cutting methods have been used to harvest forests of spruce and alpine fir. The more common are single-tree-selection of more than 50 per cent of the merchantable volume, and diameter-limit clear-cutting. To a limited extent group-selection and clear-cutting of strips and patches have been employed. Most of these methods have a twofold objective. First, by making a partial cut, a residual stand remains for further harvest cuts and, second, by opening up the stand regeneration should be encouraged. The situation in many of these stands is complicated by the presence in varying amounts of overmature, decadent alpine fir. The results, to date, are not entirely satisfactory. Logging destroys large numbers of poles and saplings and also damages many trees of the residual stand, while reproduction becomes established very slowly. Since reproduction is the key to sustained yield, ways and means of securing adequate reproduction of desirable species at a reasonable cost must be found for these forest types. With this in mind a series of cutting methods and seed-bed treatments were tried at Bolean Lake near Falkland, B. C., on a large-scale, experimental basis in 1951. It is too early to record the results, except for some tentative conclusions in respect to one seed-bed treatment--scarification. The results from scarification were so encouraging that, in 1953, an economic study was initiated near Sock Lake, northwest of Clearwater, B. C., on the costs of scarifying by various means.

This is a preliminary report on some aspects of these two studies.

SCARIFICATION AT BOLEAN LAKE

The study-area is located in an overmature, relatively even-aged, plateau form of spruce-alpine fir at an elevation of 5,000 feet. Spruce comprises about 90 per cent of the merchantable volumes. Gross volumes range from 4 to 30 M f.b.m. with average, net volumes --12 inches d.b.h. and over--of 11 M f.b.m. spruce and 1.5 M f.b.m. alpine fir per acre. Cull factors were 20 and 40 per cent respectively.

The soil is a shallow, sandy-loam to loam, glacial till containing many large boulders. It is a podzol with a deep humus layer. Throughout are scattered large and small areas of restricted drainage.

Part of the study of cutting methods and seed-bed treatments consisted of scarifying to expose mineral soil on a 25-acre block prior to a winter logging operation. The machine used was a TD 14A equipped with a hydraulically operated, brush-piling blade (Figure 1). The scarified block was criss-crossed with short strips. Resultant disturbance appeared satisfactory. Underbrush, windfalls, moss, and humus were removed and the mineral soil bared. As the machine advanced, roots, windfalls, brush, and rocks became ensnared in the blade. Consequently, it was necessary to back up, dump the load and proceed in another direction after having disturbed 30 to 100 feet of surface. Scarification was completed in three days, in spite of time lost in repairing hydraulic lines which were severed on three occasions. The tractor was rented from an operator whose equipment was already on the area, hence no transportation charges were involved. The rental for 27 hours was $273.00. Supervisory costs amounted to approximately $45.00. The total cost per acre for scarifying was, therefore, about $13.00. It was concluded that a lighter machine might have done the job just as well and more economically.

Area Scarified

Sixteen one-fifth acre plots were established prior to scarifying and they were mapped subsequently to determine the portion scarified. The scarified area ranged from 6 to 46 per cent with an average of 26.6 per cent. It would have been difficult to treat a larger percentage of the area because of the density of the stand, windfalls, boulders, and occasionally swampy ground.

Quality of Exposed Seed-bed

Mil-acre quadrats were located systematically at one-chain intervals along 64 chains of scarified strips. The results are shown in Table I:

TABLE I

Seed-bed Type	Percentage of Scarified Area
Mineral Soil	34.0
Litter	26.8
Rotted Wood	26.3
Undisturbed Surface	12.9

In comparison with the undisturbed reserve block, the scarified surface contained twice as much rotted wood and 70 times as much mineral soil.

Germination and Survival

In July of the year following scarification, germination was tallied on 499, sixteenth mil-acre plots. The scarified seed-beds supported 188,500 spruce and 5,000 alpine fir seedlings per acre. Slightly more seedlings were found on mineral soil than on rotted wood. Adjacent, non-scarified seed-beds averaged 682 spruce and 86 alpine fir seedlings, clearly demonstrating the advantage of mineral soil and rotted wood seed-beds.

Preliminary plans called for winter logging following scarification. Unfortunately, logging was delayed until late in the summer of 1952 with the result that skidding over the scarified strips destroyed most of the germinates. On a small portion of the block that was scarified but not logged there was 100 per cent stocking two years after scarification. On seed-beds logged over after scarification, spruce stocking was still 23 per cent. Sixty-one per cent of the seedlings alive after logging were alive in 1953. Survival, like germination, was better on mineral soil than on rotted wood. Practically no survival was recorded in the undisturbed adjoining area.

This study strongly suggests that with adequate seed, spruce regeneration may be obtained at a reasonable cost through scarification to expose mineral soil.

ECONOMICS OF SEED-BED PREPARATION--SOCK LAKE

The initial success at Bolean Lake prompted a more thorough study of methods and costs of seed-bed preparation. During the summer of 1953, the economics of site preparation after logging were studied in the spruce-alpine fir type near Sock Lake. Five methods of treatment were employed. Strict records of work time were kept. The five methods chosen were:

1. Scarification with brush-blade equipped tractor only;

2. Scarification with brush-blade equipped tractor, and bucking of windfall;

3. Hand scarification;

4. Windrow, bunch, and burn logging debris, and tractor scarification;

5. Clear cut and burn.

All methods were applied on ten-acre blocks excepting No. 5, which was carried out on five-acre blocks. All treatments were replicated three times to obtain representative data.

Topography of this area, which is relatively flat, is characterized by numerous rocky ridges, and swampy and wet areas in the intervening draws. Many early-summer water-courses traverse the draws. Each swamp is the source of a seasonal creek.

The soil is a podzol of very coarse texture, approximately $1\frac{1}{2}$--2 feet in depth on the average. Numerous large granitic boulders, of glacial origin, are strewn throughout the area. These large boulders were the cause of most difficulty in scarifying the area.

The timber type is composed of Engelmann spruce, alpine fir, and a minor quantity of Douglas fir and lodgepole pine. Volume by species is spruce 85 per cent, alpine fir 14 per cent, and other species 1 per cent. The average age of the spruce is 230 years, of the alpine fir, 140 years, and of the Douglas fir, 230 years.

The average volumes removed by species per acre, are as follows:

Spruce	8,750 f.b.m.
Alpine fir	710 f.b.m.
Douglas fir	17 f.b.m.
Total	9,477 f.b.m.

The amount of logging debris and windfall after logging was medium to heavy. Figure 2 shows examples of this debris after logging.

A TD 14 tractor, equipped with a hydraulically operated brush-blade and 6 raker teeth, was used for scarification. One-man I.E.L. power saws were used for felling and bucking.

Results of the time study of treatment methods are given in Table II.

TABLE II—WORK-TIME PER ACRE

	Treatment Number	Man Hours		Tractor Hours	Power Saw Hours
Brush-blade scarifying	1	Max.	5.6	1.6	
		Av.	4.5	1.6	
		Min.	3.0	1.5	
Bucking plus brush-blade scarifying	2	Max.	9.0	1.1	5.5
		Av.	8.6	1.1	3.6
		Min.	4.6	0.8	1.1
Hand scarifying	3	Max.	17.2		
		Av.	13.6		
		Min.	9.7		
Windrow with brush-blade and burn	4	Max.	30.2	4.7	3.3
		Av.	30.2	4.7	3.2
		Min.	14.3	3.1	1.3
Clear cut and burn	5*	Max.	127.2	3.6	22.8
		Av.	55.8	2.4	12.7
		Min.	12.8	0.8	4.6

*Power saw-hours and equivalent man-hours spent clear-cutting; other time used building fireguard.

Costs of the various methods of treatment are listed in Table III. The following B. C. Forest Service rates for contract work were used, with times from Table II as the basis for comparison.

Man-hour (labourer)	$1.32
Tractor-hour (TD 14 & operator)	10.00
Power Saw (with operator)	2.00

TABLE III-COSTS BY VARIOUS TREATMENT METHODS (DOLLARS) PER ACRE

	Treatment Number		Labour	Tractor	Power Saw	Total
Brush-blade scarifying	1	Max.	$5.28	$16.00	$	$21.28
		Av.	3.83	16.00		19.83
		Min.	1.98	15.00		16.98
Bucking plus brush-blade scarifying	2	Max.	3.17	11.00	11.00	25.17
		Av.	5.15	11.00	7.20	23.35
		Min.	3.56	8.00	2.20	13.76
Hand scarifying	3	Max.	22.70			22.70
		Av.	17.95			17.95
		Min.	12.80			12.80
Windrow with brush-blade and burn	4	Max.	29.30	47.00	6.60	82.90
		Av.	29.44	47.00	6.40	82.84
		Min.	13.07	31.00	2.60	46.67
Clear cut and burn	5*	Max.			45.60	45.60
		Av.			25.40	25.40
		Min.			9.20	9.20

* Cost of clear cutting only; no burning costs.

The use of the tractor equipped with a brush-blade resulted in scarifying approximately 70 per cent of the area, after excluding the area in rock and swamps. With hand scarification the distance between scarified areas was approximately 12 feet, with 4 square feet of soil exposed on each worked area. This results in 300 plots per acre. Although the area amounts to only 3.3 per cent of the total surface this figure is misleading. If a high proportion of the plots should become stocked then a measure of success has been attained.

Evaluation of Costs

Hand Scarification, Treatment 3, showed the lowest average costs per acre. While 300 plots per acre may prove inadequate as a means of obtaining satisfactory stocking, the possibility of more intensive hand scarification should not be overlooked. For instance, further work involving different hand-tools, under different site conditions, and coupled with direct seeding may be alternatives worthy of consideration.

Scarification With Tractor Only, Treatment 2, was the most economic mechanical means of baring mineral soil. The cost of bucking windfalls, added under Treatment 2, was not accompanied by a material compensatory reduction in tractor hours and the total cost per acre was greater by this combination of methods.

In Treatment 5 costs include clear cutting only. The added cost of controlled burning would make application of this treatment wholly impractical.

Treatment 4, Windrow with Brush-blade and Burn, also proved to be impractical.

Conclusions

Treatments 4 and 5, Windrow and Burn, and Clear Cut and Burn, have been shown to be uneconomic and, therefore, impractical. Treatment 2, Bucking of Windfalls plus Tractor Scarifying, proved to be no improvement over Treatment 1, Scarifying with Tractor Equipped with Brush-blade. This latter treatment is, therefore, the most economic and practical mechanical method tried.

In this mechanical age, hand-scarification methods are not likely to prove popular, nevertheless this method should not be overlooked in future trials.

The indicated costs of $20.00 per acre for seed-bed preparation are not unreasonable if satisfactory stocking is attained. It is quite possible that these costs may be reduced by pre-planning of operations and the use of modified equipment. Again, different soils and sites may prove to be more easily scarified. Further speculation is premature for more information is needed on seed-tree requirements, weed competition, and other aspects relative to the problem of attaining satisfactory re-stocking. These findings should encourage further study in the silvicultural requirements of spruce-alpine fir forests and trials of practical methods of achieving the desired ends.

FIGURE 1

Four-prong, brush-piling blade
for tractor scarifying.

FIGURE 2

Windfall and debris following logging.

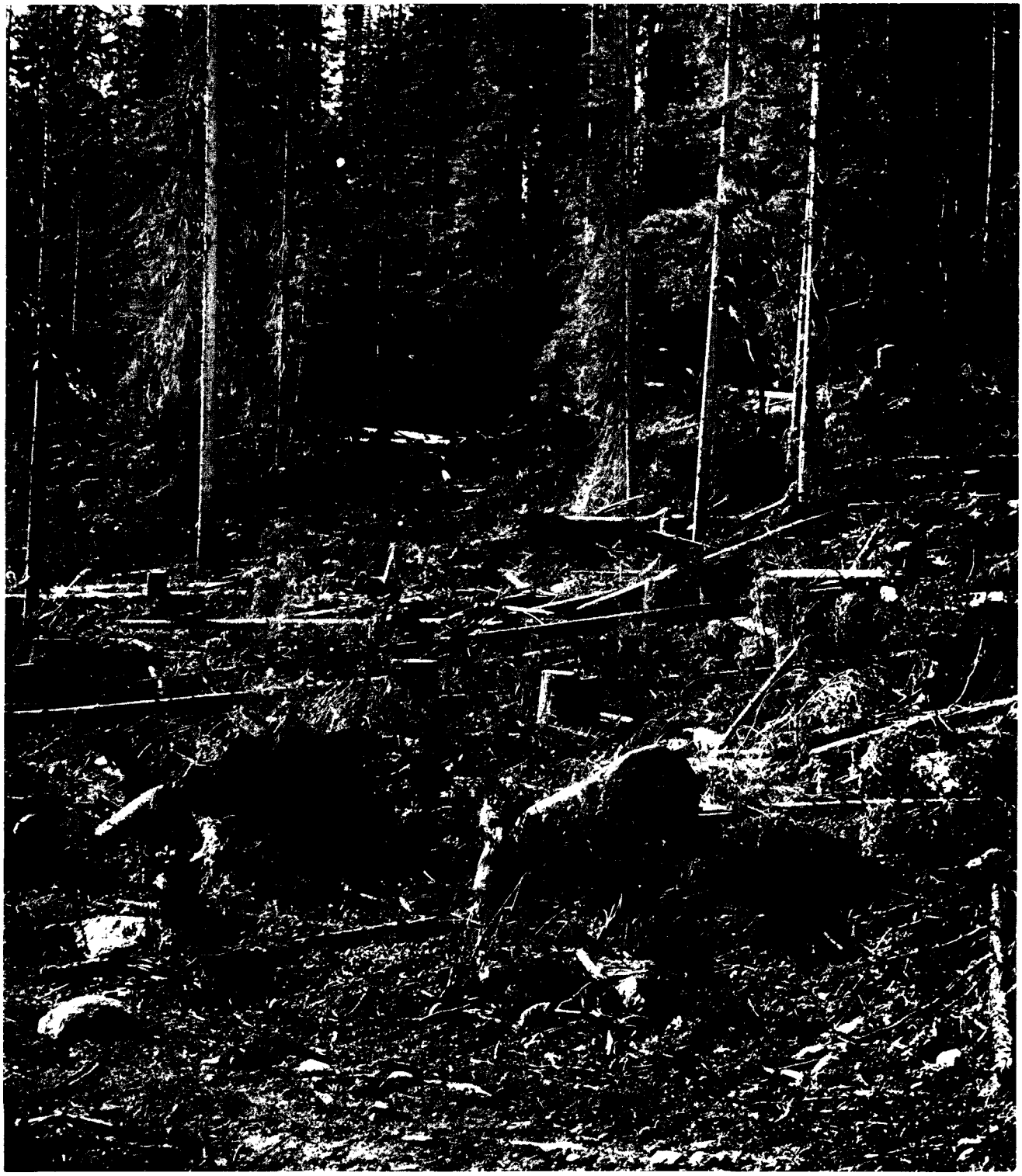

FIGURE 3

Tractor scarifying
without bucking.

FIGURE 4

Windrow with brush blade and burn--Treatment 4.

FIGURE 5

Clear-cut area ready for burning - Treatment 5