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Tree-Length — Wheeled Skidder Logging And Its Effects In Certain Black Spruce Forests Types In Quebec

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Tree-Length — Wheeled-Skidder Logging And Its Effects In Certain Black Spruce Forest Types In Quebec

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This is a report on a survey carried out to assess the effects of tree-length — wheeled-skidder logging system on certain black spruce, black-spruce — balsam-fir, and black-spruce — jack-pine forest types in Quebec. Results show such a system greatly reduces the amount of advance growth which was present before the logging operation. Although skid trails could cover 30% of the cutover, little scarification of the humus to mineral soil occurred. Very few seed trees exist after logging. The problems of restocking these areas are discussed.

Introduction

Although extensive developments have taken place in mechanical logging of pulpwood stands, little quantitative work by research silviculturists has been carried out to assess effects of new logging systems on advance growth, on degree of soil scarification and on quantity and quality of residual regeneration on the cutover.

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It can be fully appreciated that any project dealing with mechanized logging in eastern Canada involves a vast field. For this reason, through cooperation of the Pulp and Paper Research Institute of Canada, the Department of Forestry and Rural Development of Canada and several pulp and paper companies, sample areas were established from Ontario to the Maritime provinces. The joint project covered practically all mechanical logging systems operating in the major forest types of the regions (Webber *et al.*, 1968). This paper reports results of the survey on the tree-length — wheeled-skidder logging system when employed in certain black spruce cover types in Quebec.

Objectives of the study were to assess the effects of this logging system on (a) advance growth present at time of logging, (b) type of residual forest left after a clear-cut logging operation, (c) degree of soil scarification caused by the equipment and (d) type of seed bed created with regard to the possibility of natural seeding immediately after logging.

The five study areas were established in the summer of 1966 by the Forest Research Laboratory, Quebec. These areas were logged that same year and postcut sampling took place immediately after logging. All these areas, with the exception of area 5, were in Bla. forest section (Rowe, 1959). Area 5 was in the B7 section. There were major differences of forest type and stand composition among all areas, and for this reason, each is described briefly (Table I).

Methods

Minimum areas of four acres* were chosen, rectangular in shape, and sampled using a system of strips and milacre quadrats. The four-acre blocks were selected on sites typical of machine operating conditions. Each was located so it incorporated all the usual characteristics of the logging system with wood going to one landing.

The four strips that traversed the sample block were each 20 links wide. To determine the stand table, all trees over one inch d.b.h. were tallied.

*In two instances, smaller areas were selected.

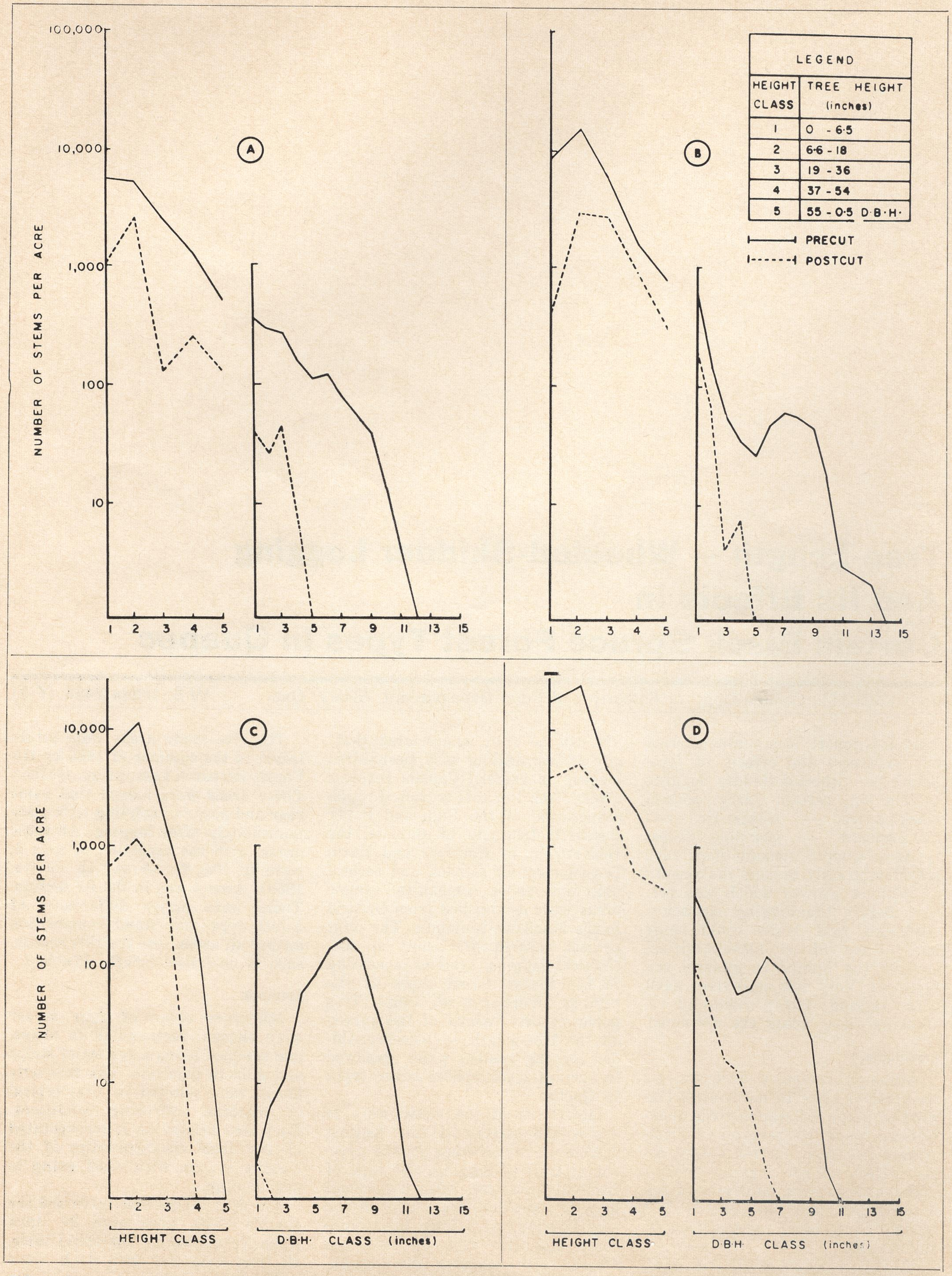

FIG. 1. These four graphs show precut and postcut stem densities for advance growth plus the main stand for four of the five study areas, illustrating reduction in stems/acre for different height classes.

The amount and distribution of advance growth up to three inches d.b.h. was based on a milacre quadrat tally. Five groups, 10 milacres each, were distributed at random on each traverse line which was the centre line of the tally strip. A tree seedling count was taken on the first quadrat of each group of 10 and a presence/absence tally per species was taken on the remaining nine. The milacre quadrat was considered stocked if it contained one healthy seedling. On all quadrats, seedlings and trees were recorded by species using seven size classes.

During logging operations, records were kept of machine make and model, tire size, load size and crew organization. Where possible, information on weather conditions before and during logging were recorded. Photographs of stand type and forest flora were taken before logging, along with photographs recording ground conditions, seedbed type and residual stand following logging.

In the postcut sampling, the strips were tallied again the same way as in the precut tally. The groups of milacre quadrats were similarly relocated and tallied.

For ground condition classification, two samples, each one square link in area, were taken on each milacre quadrat. The ground classification recorded depth and density of slash cover, shading index of that sample and degree of soil disturbance both within and outside of machine tire tracks.

Results

Advance growth — Figures 1 and 2A illustrate precut and postcut stem density data for advance growth plus the main stand for the five study areas. The advance growth comprises height classes 1 to 5 plus the one-in. and two-in. d.b.h. classes. The reduction in number of stems per acre for each of these classes is illustrated in the figures.

Percent stocking data for advance growth, both before and after logging, are in Table II. Reduction in total stocking ranged from 14% in stand 2 to 55% in stand 5. The reduction in total stem density was much greater, the corresponding data for the two areas being 78% and 96%, respectively (Table II).

Soil Scarification — By reason of operating technique, effects of the machine on the soil are more intensive than extensive (Fig. 2B). The area of intensive operation is at the landing. The main skid trails branch out from here and, after further branching, end in an area of compacted, dense slash. The four-acre study blocks usually covered one of these patterns completely. As a result of the definite skidding pattern followed, classification of ground disturbance was divided into two parts — that affected by machine tires and that which fell outside this zone.

Less than 30% of the total area of any of the cutovers was affected by tire tracks with the average be-

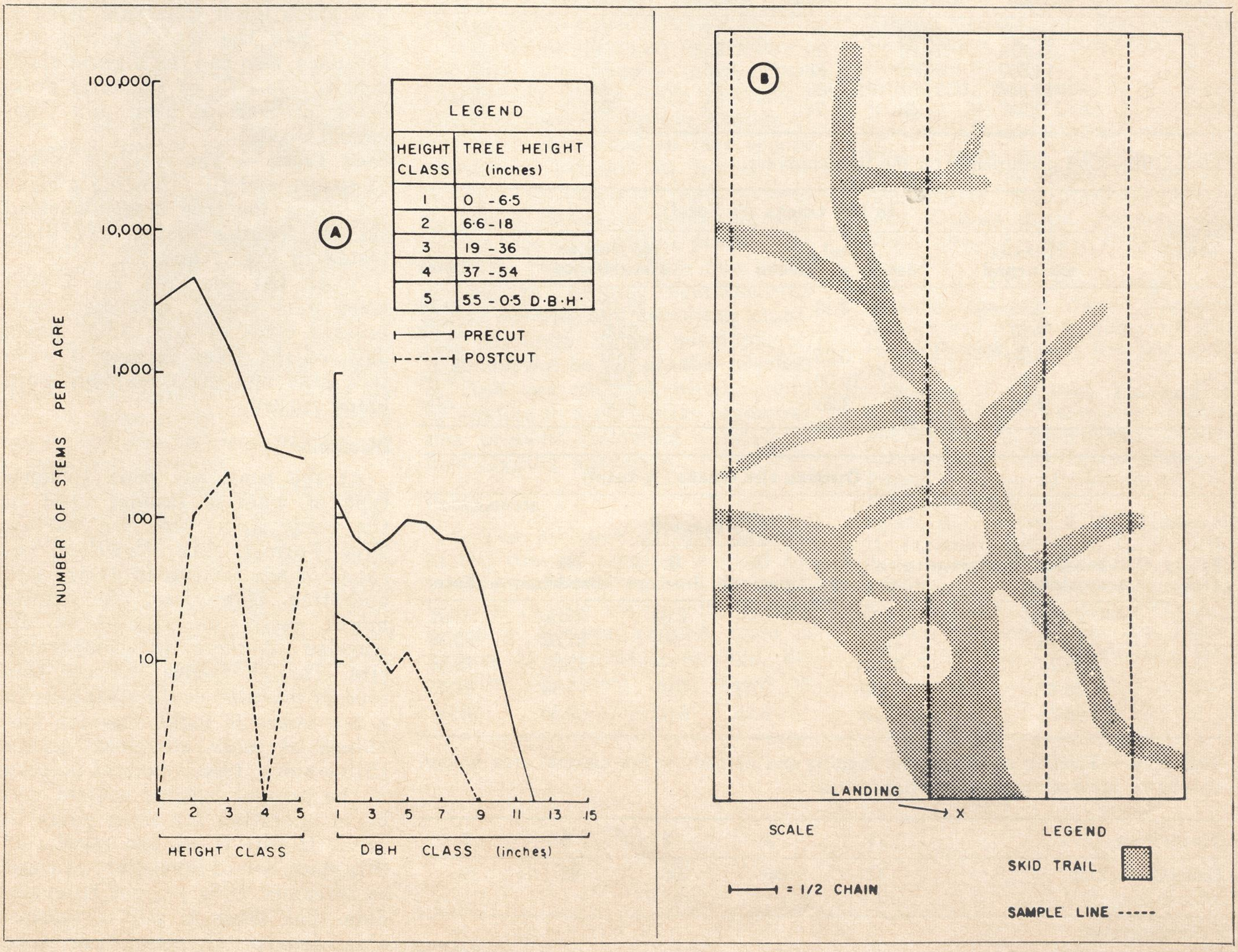

FIG. 2. (A) shows precut and postcut stem density data for the fifth study area. (B) The area of intensive skidding operations is located at the landing, with skid trails branching out from here.

TABLE I — Description of the five study areas.

Study area	Association	Site class.*	Soil type	Elevation (ft. above sea level)	Aspect	Exposure	Drainage
1	Black spruce-balsam fir on a *Hypnum* site	II	Glacial till origin: 10-in. organic layer covers a silt loam soil	900	Southeast	Moderate	Impeded
2	Pure black spruce on a *Kalmia-Ledum* site	III	Fluvioglacial origin: 8-in. organic layer covers a very stony, sandy loam soil	700	West	Severe	Impeded
3	Pure black spruce on a *Calliergon-Vaccinium* site	II	Fluvioglacial origin: 4-in. organic layer covers a very stony, sandy loam soil	700	West	Severe	Good
4	Balsam fir-black spruce on a *Hypnum-Hylocomium* site	II	Till origin: 12-in. organic layer covers a coarse-textured sandy soil	3000	East	Severe	Impeded
5	Jack pine-black spruce on a *Kalmia-Vaccinium* site	III	Esker: 2-in. organic layer covers a coarse, gravelly sand	1800	East	Moderate	Very Good

*Linteau, A. 1955. Forest Site classification of the northeastern coniferous section, boreal forest region, Quebec. Canada, Dept. Northern Affairs and National Resources, Forestry Branch, Forest Res. Div. Bull. 123.

TABLE II — Precut and postcut total stem density and total stocking of the advance growth on the five cutovers.

Study area	Stem density (no. stems/acre)		Percent stocking		% Reduction in	
	Precut	Postcut	Precut	Postcut	Stem density	Stocking
1	15,250	4,063	95	41	73	54
2	31,978	7,124	99	85	78	14
3	18,507	2,300	88	66	88	22
4	47,168	12,392	100	82	74	18
5	9,647	388	74	19	96	55

TABLE III — Soil disturbance on the five cutovers.

Study area	In tire tracks (% Total)			
	Humus disturbed	Soil deeply disturbed	No humus disturbance	Total
1	3.13	3.13	23.13	29.39
2	8.57	—	9.05	17.62
3	16.50	0.25	5.00	21.75
4	3.75	10.00	2.19	15.94
5	4.25	3.25	0.50	8.00

Study area	Outside tire tracks (% total)					
			Soil exposed			
	Soil buried under deep slash	Humus slightly disturbed	A horizon	B horizon	No disturbance	Total
1	27.50	6.88	—	0.63	35.60	70.61
2	41.19	13.57	—	—	27.62	82.38
3	23.75	23.50	—	—	31.00	78.25
4	26.87	11.56	3.12	0.63	41.88	84.06
5	46.25	21.00	6.25	6.00	12.50	92.00

TABLE IV — Existing stocking after logging and percent of the cutover area favourable to its survival for the five study areas.

Study area	1	2	3	4	5
Existing stocking after logging, %	41	85	66	82	19
Percent cutover favourable to existing advance growth	63	51	58	66	27

tween 15% and 20% (Table III). It is most evident that scarification of the ground surface to expose mineral soil is practically negligible, maximum for all areas being 10%. In all other areas the figure was much lower than this. Area 5, which had the least ground disturbance, also had the highest slash density (46.3%) of the total area, being covered in deep and compacted slash.

Seed Trees — The residual stands of spruce and fir following a clear cut using the tree length-wheeled skidder logging system are illustrated in Fig. 1 and 2A.

In all but one area, no. 5 seed trees were poorly developed, suppressed trees of 4-in. d.b.h. Some 20% of the trees in area 5 were jack pine and the remainder were black spruce.

Discussion

At the time, the most common type of wheeled skidder used in the study areas was the Carrett Tree Farmer, C4B. However, because of similarities in design and operating techniques the results might easily be applied to all wheeled skidders of comparable size. Though trends indicate this type of machine could disappear in a few years to make way for machines of more advanced design (Silversides, 1966), general opinion is the present logging system will be in operation for some years to come. If this is so, the results of this study are of immediate concern to foresters. It is evident from the data that there is still a reasonable density of stems per acre throughout all cutovers. However, the percent stocking figures are more important in relation to the successful establishment of the second timber crop. From a purely quantitative standpoint, stand 1, with only 41% stocking, is moderately stocked. Stand 5 with 19% is a failure. The criteria used here are taken from stocking standards established by Candy (1951). Area 3 with 66% is well stocked and areas 2 and 4 with 85 and 82%, respectively, are fully stocked.

However, the survival probability of the existing advance growth will depend on the nature of the slash and the shading that affect that advance growth. From the ground classification data, the percent area of each cutover favourable to advance growth is illustrated in Table IV. With less than 67% of any cutover area favourable for survival of existing advance growth, percent stocking figures will diminish. Remeasurement of the study areas in 1968 will determine the extent of the change.

The advance growth was most intensively affected around the truck landing and in the skid trails and was often too patchy or too severely damaged to be relied on to restock the area. These areas must be regenerated artificially. The most practical and economic approach would be to plant container seedlings.

If, during logging, scarification is required to expose mineral soil, then it is not being obtained by the wheeled skidders in operation today. In the tire tracks, soil disturbance was negligible and when it did occur, it was usually extreme; i.e. the subsoil was exposed. Therefore, little regeneration will be obtained from cones in the logging slash, because the seed will fall on unsuitable seedbeds.

Because of possible seeding-in, regeneration surveys are often delayed until five years after logging. Such a practice might have been valid before mechanized logging because there was usually a residual stand which provided a seed supply. After mechanical logging in the forest types studied, few seed trees are left and opportunities for additional regeneration are minimal. The seed trees left are of an inferior phenotype. They have invariably been suppressed trees, are not fecund at time of release and will not produce seed for a few years. Even immediately after logging, favourable seedbeds are rare and, after three to four years, these favourable seedbeds will have disappeared because of the invasion of competitive vegetation and other factors (Jarvis *et al.*, 1966).

The question of satisfactory stocking is controversial. Are developments in mechanized harvesting systems heading toward a forest grown specifically for the requirements of a particular machine or are machines being developed to suit the forest? It is felt the current trend falls into the latter category; that is, the development of single-tree processing systems. If the current trend toward these systems continues, then the requirements will be large-diameter trees with maximum volume per stem and an even distribution of these trees throughout.

If such stands must be produced for the next timber crop, then logged-over areas with estimated stocking survival figures similar to the areas described in this report cannot be allowed to follow the process of natural regeneration. Artificial means of hastening and aiding this regeneration process are urgently required. With new techniques in ground scarification, aerial seeding and container planting currently under development, it should not be too great a problem to find one method which could be applied to a particular regeneration problem following a mechanized logging operation.

Conclusions

1. The advance growth present at the time of logging is most intensively affected around the landing and in skid trails. Post-logging stocking figures ranged from a failure to adequately stocked, depending on forest type. Based on ground condition data, it is estimated that less than 67% of any of the five cutovers is favourable to survival of this existing advance growth.

2. Little effective soil scarification occurred either in the skid trails or on the remainder of the cutover. It is also concluded from the data and from visual observation in the field that dense and reasonably well-distributed slash from a tree-length logging operation has been the main factor in reducing effective soil scarification.

3. Natural seeding-in from residual seed trees on the cutover will be minimal. These trees are few in number, poorly-developed, suppressed individual stems. With minimal effective scarification, seed produced is unlikely to fall on mineral soil seedbeds. **P&P**

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