SPRUCE REGENERATION RESULTING FROM SEED TREE CUTTING AND CLEARCUTTING IN NEWFOUNDLAND

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INTRODUCTION

The balsam woolly aphid (Adelges piceae Ratz.) has been a serious problem in balsam fir (Abies balsamea (L.) Mill.) stands in Newfoundland for over twenty years. Because of the lack of success in controlling this insect by direct methods, attention was focused in the early 1960's on silvicultural controls and conversion of fir stands to other species. Accordingly, a study was started in 1962 on four areas in central and western Newfoundland to determine whether "seed tree" logging in fir, spruce and mixedwood stands would induce better spruce regeneration than the usual clearcut methods. This report summarizes the results of that study.

DESCRIPTION OF AREAS

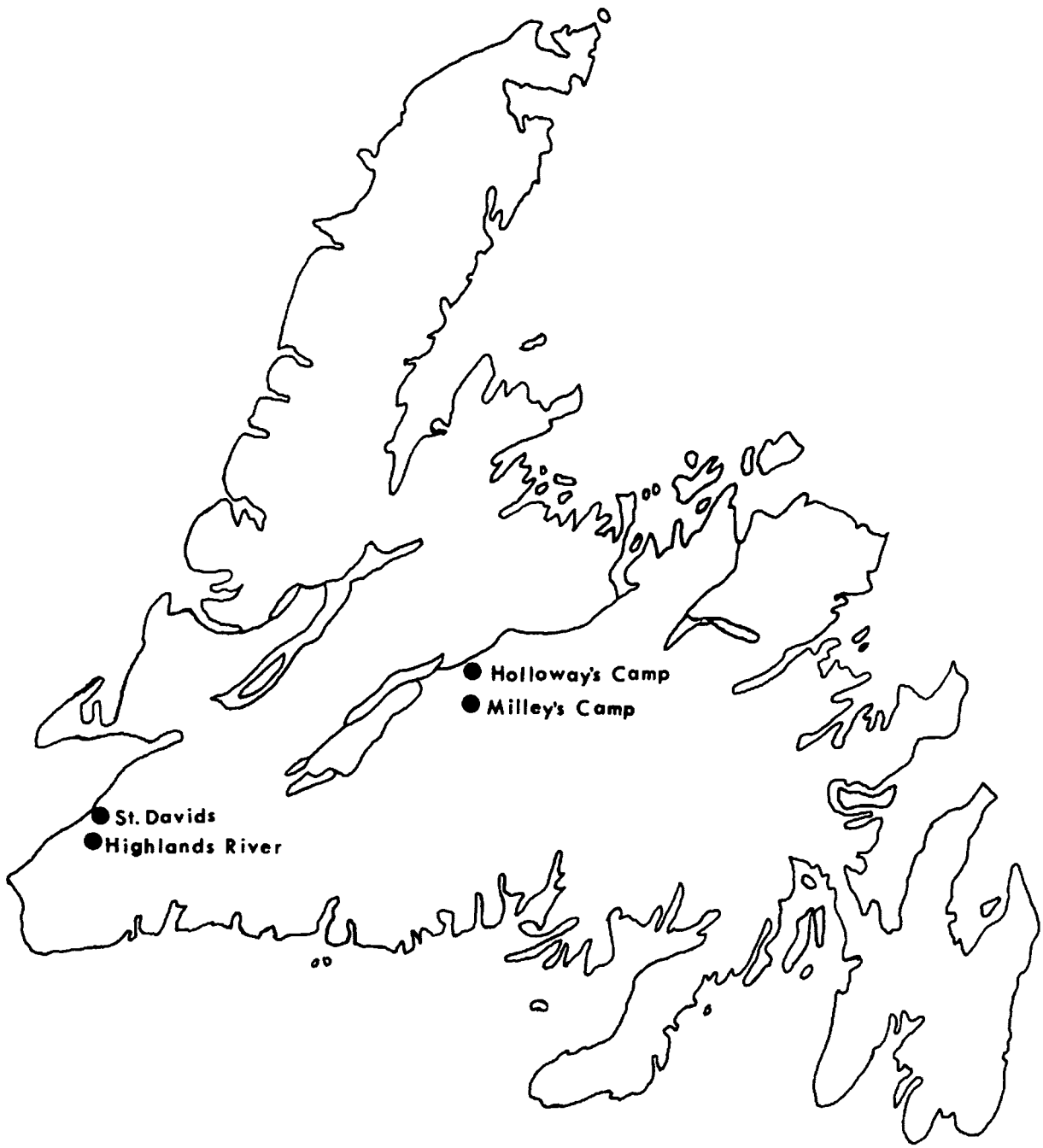
Two of the study areas, Holloway's Camp (Area 1) and Milley's Camp (Area 2), are in the Grand Falls Forest Section - B28a, while the other two areas, Highlands River (Area 3) and St. Davids (Area 4), are in the Corner Brook Forest Section - B28b (Figure 1) (Rowe, 1959).

The terrain of Area 1 is rolling with gentle slopes and a general southerly aspect. Soils are well-drained, stone-free, sandy loams and sites are fresh. The organic mantle was a mor about 2 to 3 inches thick and ground vegetation was primarily feather mosses with some herbaceous plants. Prior to logging the area supported a 55-year-old, fully-stocked, black spruce (Picea mariana (Mill.) BSP.) stand. Cutting created much disturbance, resulting in the formation of many favourable seedbeds (e.g. mineral soil, mixed soil and organic materials, decayed wood and thin humus).

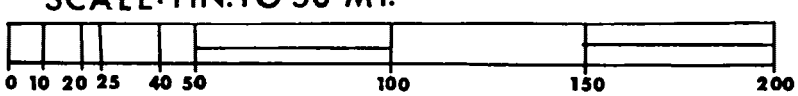
Area 2 is situated on the west side of a low ridge. Slopes vary from 5 to 20 percent and the general aspect is southwest. Soils are well-drained, stony, sandy loams. On the upper slopes sites are fresh and the organic mantle was a mor about 2 to 3 inches thick; ground vegetation was primarily herbaceous plants. On the lower slopes sites are wet and the organic mantle was a thick mor; ground vegetation was primarily sphagnum and feather mosses. The area supported a 75-year-old stand containing 80 percent balsam fir and 20 percent white spruce (Picea glauca (Moench) Voss). Logging did not appreciably disturb the organic mantle.

FIGURE 1:

LOCATION OF STUDY AREAS IN CENTRAL AND WESTERN NEWFOUNDLAND



SCALE: 1 IN. TO 50 MI.



On Area 3 the terrain is strongly rolling with alternate ridges and valleys but with an overall aspect to the northeast. Soils are stony, coarse, sandy loams. On the ridges and upper slopes sites are fresh; the organic mantle was a thin mor and ground vegetation was feather mosses and herbaceous plants. On the lower slopes sites are very moist; the organic mantle was a thick muck and the ground vegetation was made up of sedges, grasses and various mosses. Prior to logging the area supported an all-aged stand of balsam fir with scattered white spruce, black spruce and white birch (Betula papyrifera Marsh.). Cutting operations created scarcely any disturbance of the organic mantle.

The topography of Area 4 is gently rolling with an overall north-west aspect. Soils are sandy loams and, in general, sites are fresh, with some moist to wet patches. On the fresh sites the organic mantle was a thin (2 to 3 inches) mor and ground vegetation was made up of mosses and herbs. On the wetter areas the organic mantle was a thick (5 to 10 inches) mor and the ground vegetation was made up of feather mosses, sphagnum and some grasses. The area supported a mature stand of balsam fir with an admixture of black and white spruce and some white birch. Logging had little effect on the organic mantle.

METHODS

Portions of all four areas were logged in the fall of 1962 by the "seed tree" system. Wherever possible seed trees were black spruce but in some places white spruce had to be used. A record was made of these trees; most were 5 to 8 inches in diameter and had well-formed crowns. Adjoining portions were commercially clearcut and used for controls.

In the summer of 1963 permanent regeneration plots, each consisting of five milacre quadrats in the form of a cross, were established at a spacing of 5 chains by $2\frac{1}{2}$ chains on Areas 1 and 3. Temporary plots, consisting of 10 contiguous milacre quadrats were established at similar spacings in Areas 2 and 4.

On Areas 1 and 3 a tally was made of all seedlings by species and size classes on the center quadrat of each plot; spruce only was tallied on the other four quadrats. On Areas 2 and 4 a complete tally by species and size classes was made on the fifth and tenth quadrat of each plot; spruce only was tallied on the other quadrats.

During the summer of 1968 the areas were re-examined using the same survey techniques as those used in 1963. On Areas 2 and 4 temporary plots were established in essentially the same locations as those established in 1963.

RESULTS AND DISCUSSION

The average number of seed trees per acre on each area in 1962 (immediately after cutting), in 1963, and in 1968 is shown in Table I. By 1963, one year after logging, many of the trees had been blown down; by 1968 practically none remained. These results are similar to those of other studies employing "seed-tree" cutting near Norris Arm and Fishels Brook (Robinson, 1970).

TABLE I

AVERAGE NUMBER OF SEED TREES PER ACRE

Area	1962 (after cut)	1963	1968
1	6.6	3.0	0
2	1.5	0.6	0
3	4.1	3.5	0.5
4	5.0	0	0

Percent stocking and number of stems per acre of spruce regeneration in 1963 and 1968 are shown in Table II. All areas were understocked in 1963 according to Candy's criterion (1951). However, by 1968 percent stocking and number of stems per acre had increased considerably and all areas but one could be considered moderately well-stocked. Stocking was best on Area 1, poorest on Area 3 and intermediate on Areas 2 and 4. The good stocking on Area 1 is probably the result of an abundant seed supply (the stand was pure spruce) and the presence of many good seedbeds which resulted from logging disturbance. The decrease in stocking between 1963 and 1968 on Area 3 has been attributed to severe competition from grasses and raspberries which sprang up in great profusion on the rich moist to wet sites in the depressions and valleys, especially on the area that had been clearcut.

TABLE II

SPRUCE REGENERATION

Area	Treatment	Percent Stocking		Stems/Acre	
		1963	1968	1963	1968
1	Seed tree cut	12	42	518	1552
	clear cut	18	55	950	2990
2	Seed tree cut	20	47	554	1064
	clear cut	24	30	496	661
3	Seed tree cut	32	27	610	468
	clear cut	24	9	467	124
4	Seed tree cut	21	49	400	1045
	clear cut	29	43	519	1205

In general, stocking figures on each area are about the same for both "seed tree" cutting and clearcutting. This is to be expected since most seed trees blew down soon after logging.

Distribution of spruce seedlings on each area by size classes is shown in Figure 2. Seedlings in classes 3 and 4 are advance growth; generally, those in classes 0 to 2, which are the most abundant, became established after logging.

Observations indicated that many of the spruce seedlings originated from seed released from cones in the slash; the most favourable seedbeds were mineral soil, decayed wood, polytrichum moss, shallow humus and sphagnum moss. These observations are in agreement with results presented by Howard (1964), Dickson and Nickerson (1958), Place (1955), and Vincent (1965).

Percent stocking and number of stems per acre for balsam fir and white birch in 1963 and 1968 are given in Table III. With the exception of Area 1, all were fully stocked to balsam fir in 1968; seedlings varied in height from 1 to 3 feet. The poor stocking to fir on Area 1 is attributed to a scarcity of seed. White birch, 2 to 3 feet in height, is well represented on all areas.

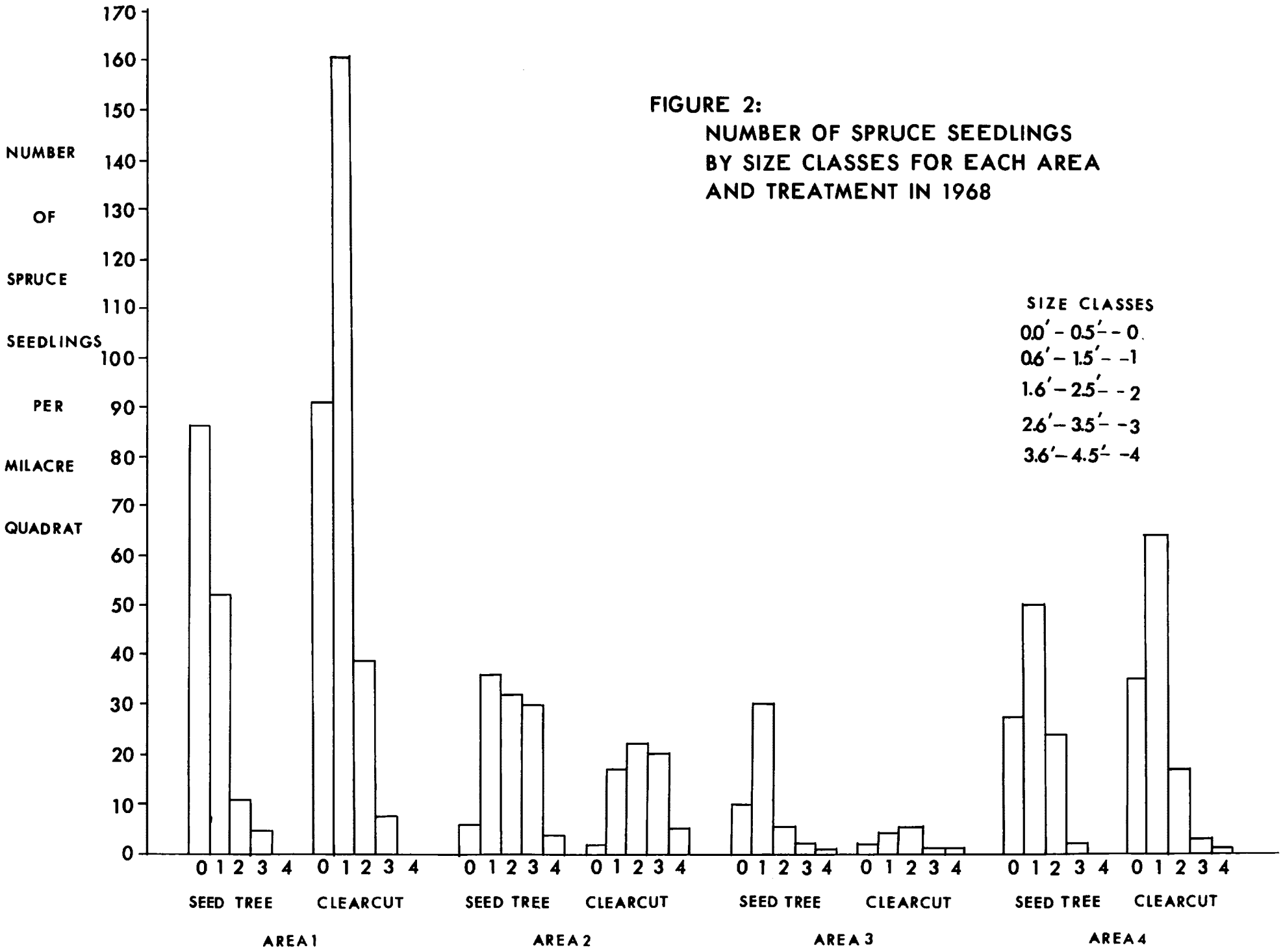


FIGURE 2:
NUMBER OF SPRUCE SEEDLINGS
BY SIZE CLASSES FOR EACH AREA
AND TREATMENT IN 1968

TABLE III

BALSAM FIR AND WHITE BIRCH REGENERATION

Area	Treatment	Balsam Fir				White Birch			
		Percent Stocking		Stems/Acre		Percent Stocking		Stems/Acre	
		1963	1968	1963	1968	1963	1968	1963	1968
1	Seed tree cut	-	14	-	172	-	48	-	2300
	clear cut	-	10	-	150	-	30	-	1900
2	Seed tree cut	81	96	27,200	16,900	9	50	300	2700
	clear cut	87	89	18,800	14,500	52	41	7100	1200
3	Seed tree cut	62	76	17,600	9,000	24	38	700	2000
	clear cut	76	90	10,300	7,700	14	57	700	1200
4	Seed tree cut	83	98	7,200	7,300	-	58	-	3200
	clear cut	81	71	5,300	7,600	43	43	7000	1800

SUMMARY AND CONCLUSIONS

In 1962 a study was undertaken in central and western Newfoundland to determine whether "seed-tree" cutting would induce better spruce regeneration on upland sites than clearcutting. The results revealed that most of the seed trees blew down shortly after logging. They confirm results from other studies employing "seed-tree" logging and suggest that this type of cutting is not worthwhile in Newfoundland where gale-force winds blow frequently.

In general, most of the areas were reasonably well-stocked to spruce five years after logging. Since most of the seed trees blew down shortly after logging it is not surprising that stocking to spruce was about the same after "seed-tree" cutting as it was after clearcutting.

Regeneration of black spruce was associated with seedbed type. Favourable seedbeds included sphagnum moss, decayed wood, mineral soil, polytrichum moss and shallow humus. Black spruce seedlings were most abundant on the fresh to moist sites where competition from ground vegetation was less severe than it was on the rich, very moist to wet sites.

White birch has regenerated well on all areas; so has balsam fir, except on Area 1 where the low stocking is presumed to have resulted from a scarcity of seed. Barring catastrophic events such as fire, second-growth mixedwood stands should develop on all areas. The next stand on Area 1 will probably be a mixture of spruce and birch, while on the other areas it will be fir and birch with a small spruce component.

Results indicate that fresh to moist upland spruce and fir cutovers regenerate well without any site treatment beyond the normal disturbance due to logging. There are sufficient spruce seedlings present in all areas to form adequate mature stands. However, because of competition from fir and birch it is not likely that the spruce content at rotation age will be any greater than in the previous stands; probably it will be less. If economical techniques could be developed to favour these natural spruce seedlings it might obviate the need for costly artificial regeneration treatments.

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