SPRUCE REGENERATION

The papers presented at the Annual Meeting on Spruce Regeneration in various geographical regions of the Dominion were turned over to members particularly interested in the section to which the original paper pertained, with the request that they lead the discussion on them. The following comprise the discussion papers submitted dealing with the original papers as indicated.

THE MARITIMES — H. D. LONG

By K. B. BROWN
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NO SPECIAL work has been done recently in connection with Spruce Regeneration in the Maritimes so far as we know, and Mr. Long's paper is based on a general analysis of the problem.

He quotes literature on the subject to show that moisture in the natural forest seed bed is usually a controlling factor in spruce regeneration. Lack of moisture in the humus during dry periods and failure of the spruce seedling to reach mineral soil causes mortality during the first year.

Since success of spruce reproduction depends largely on the depth of raw humus, the solution of the problem may lie in determining cutting methods which will cause more rapid decomposition and correct the unfavorable condition. This is a field for valuable experimental work.

Seed supply, chemical composition of the soil, competition from other plants, and other variants are also important influences on the establishment of spruce seedlings.

From general observation of natural forest conditions and the results of disturbances we note that spruce reproduction is often excellent in old fields, burns and cut-over areas. Spruce logs have been cut for many years from areas burned in 1825. Some of our best present stands of spruce originated after fires of about seventy years ago. Fields cultivated until a few years ago now carry excellent stands of spruce. There are, of course, failures and stands of inferior species. Some fields grow up in alders instead of spruce.

Regarding the importance of the problem, opinions vary. When this paper was presented to the Maritime Section in December last several members employed by pulp and paper Companies were of the opinion that it would not pay to spend much money to secure spruce in preference to balsam fir or hardwoods because of advances in manufacturing methods. It was agreed that spruce has more definite advantages for the lumber industry.

The general opinion of the Maritime Section may, I think, be summed up to the effect that spruce regeneration is an important problem, but is by no means the most important one facing us at the moment.

QUEBEC — HENRI ROY

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Every forestry article written by Mr. Roy is both interesting and instructive, and his present paper on Spruce Regeneration is no exception.

In fact, it is most interesting, and full of a wealth of concise information extremely useful to anyone employed in our Balsam-Spruce forests.

It is true that, in his opening remarks, he subjects us to a suspicion of benevolent castigation. We must, nevertheless, admit that this is fully warranted.

There is no doubt, however, that the underlying thought throughout the article is one of encouragement, and I recommend that all the fearful among our foresters read it, mark it, and inwardly digest it.

I will only attempt to discuss Mr. Roy's article in relation to conditions, as I feel they exist, in the Saguenay district.

In this region, as is well known, logging operations, to all intents and purposes, are confined to the extraction of pulpwood for newsprint manufacture.

The forest is admirably suited for this purpose, in that it is dominated by balsam fir and black spruce. Possibly a short and general description of this forest would not be out of place.

By volume, balsam fir forms about 45 per cent, spruce 38 per cent, white birch 15 per cent, and other miscellaneous species, such as poplar, yellow birch, cedar, jack pine, larch, etc., about 2 per cent. The various combinations of these species give rise to different types, varying from pure spruce and pure balsam to pure white birch.

By far the most common type is the mixed softwood, composed of balsam fir, black spruce, and white birch.

The following figures are probably sufficiently reliable to give a general idea of the distribution of these types, in the present merchantable stands. It might here be mentioned that the merchantable stands cover about 75 per cent. of the total area, exclusive of waste and water.

	Per Cent.
Softwood (balsam fir, spruce, white birch)	46
Pure Balsam	23
Mixed wood (white birch, balsam fir, spruce)	19
Pure Spruce	11
Pure White Birch	1

The pure spruce stands are scattered, small and largely confined to those sites as described by Mr. Roy, namely, swamps, steep and rocky slopes and alpine table lands. Most of the many lakes, rivers and streams are also fringed by a narrow strip of black spruce.

The pure white birch and mixedwood stands have evidently resulted from fire, and it appears that they finally revert to the softwood type, as the birch and poplar gradually succumb to the balsam fir and spruce.

If we eliminate the pure spruce type, the distribution of species, by volume, in the merchantable stands, would be about as follows:—balsam fir, 49 per cent., spruce, 33 per cent., white birch, 15 per cent., other species, 3 per cent.

It will be noted that the forest is almost completely devoid of tolerant hardwoods, and thus, at the outset, one of the most disturbing silvicultural difficulties, is eliminated.

The difficulty of combatting tolerant hardwoods is mentioned by Mr. Roy, and it is a source of satisfaction to note that this problem is, evidently, almost non-existent in the Saguenay district.

In the pure spruce stands, most of which are confined to swamp areas, layering, as pointed out by Mr. Roy, is the usual method of propagation.

Since, therefore, in this type, practically the whole of the regeneration is spruce, it hardly seems necessary to discuss ways and means of obtaining it.

With respect to the other types, however, covering as they do about 90 per cent. of the area, a very real problem presents itself, if we really do wish to replace all other species by spruce.

In these types there is usually—one might say always—an abundance of reproduction, varying from an average of about 1000 seedlings per acre in the hardwood type to an average of about 7000 per acre in the softwood or pure balsam types. It is significant to note, furthermore, that the composition of the regeneration apparently tends to remain constant, with balsam fir forming about 90 per cent., spruce 8 per cent. and white birch 2 per cent.

Perhaps figures from a few sample plots, taken in mature stands, will illustrate the difficulty.

<i>Percentage of Hardwood Trees in Stand</i>	<i>Percentage of Balsam in Regeneration</i>
5	89
39	93
64	93

Based on the same plots, if we ignore the hardwood trees altogether, and base our figures on the balsam and spruce only, we have:

<i>Percentage of Spruce Trees in Stand</i>	<i>Percentage of Balsam in Regeneration</i>
8	92
25	91
52	93

Apparently balsam fir tends to thoroughly dominate the reproduction, regardless of the percentage of seed trees of other species.

It can readily be seen what a real problem exists for anyone who wishes to replace the present forest by a spruce forest. Especially is this true, if the change in composition is to be brought about by the introduction of some cutting method applicable to the trees alone.

Even should only the balsam be cut, it appears almost certain that no real increase in the percentage of Spruce would result for a number of rotations, if then.

In any system of partial cutting, it would still be necessary to leave some balsam fir, since to leave the spruce only would probably expose them to such an extent that it is almost certain that they would soon blow down.

In any case, what sort of a chance would the seeds from these trees have, falling, as they would, upon a forest floor already thoroughly impregnated with balsam fir?

As an illustration: two one-half acre plots, adjacent to each other, were established in the common softwood type, on a less than normally exposed site. These plots were cut out during the ordinary course of logging, but 16 spruce seed trees were left on the one and 20 balsam fir seed trees on the other. When examined two years later, every one of the trees had been windthrown, including four white birch trees which had also been left.

For some years past, a large area of this region has been logged by a method resembling the clear-cutting method. All the balsam and spruce was cut to a minimum d.b.h. of about 4 inches.

Figures from a few permanent sample plots will serve to illustrate, in a general way, the result of this method as affecting the relationship between the spruce and balsam regeneration.

I have selected 25 plots, which were established in softwood and mixed-wood stands.

Each plot was 2 chains by $2\frac{1}{2}$ chains, or one-half acre, and established just prior to logging operations.

All the trees and saplings were recorded by species in one inch d.b.h. classes. The plot was then gridironed by equidistant parallel strips, and along each strip, at uniform intervals, single-examination seedling plots, $8\frac{1}{4}$ feet square, were laid out. On each of these plots, all seedlings were tallied by species in height classes. Twenty such seedling plots were taken in each of the half acre permanent plots.

By re-examining these plots in the same manner just after logging, and thereafter at intervals, a fairly accurate idea could be had of the effects of the logging method.

The following figures have been obtained by averaging the results of these plots, as obtained just prior to logging, and as obtained at the last examination, the intervals varying from 5 to 9 years. For this purpose, it might be assumed, that the average length of time since cutting, for all plots, is 7 years. The figures are confined to spruce and balsam fir only.

		Before logging	7 years after logging
Trees	(3.6" d.b.h. and over)	Spruce 18 per cent.	
Saplings	(0.6"—3.5" d.b.h.)	Spruce 8.4 per cent.	Spruce 8.7 per cent.
Seedlings	(Less than 0.6" d.b.h.)	Spruce 7.0 per cent.	Spruce 9.5 per cent.

It is interesting to note also that before logging, 9 per cent. of the balsam and spruce seedlings were 4 feet and over in height. Seven years after logging, the number of saplings had increased by 109 per cent.; the seedlings, on the other hand, were only 78 per cent. of the original number, but 21 per cent. were 4 ft. and over in height.

Balsam still predominates, but these general figures do seem to suggest that, by this much abused method of cutting, the spruce is holding its own.

Though these figures may be too general to show more, yet they do arouse in one the suspicion that the percentage of spruce is actually increasing as the years pass by, and that, finally when the stand again reaches the same age as the original, the proportion of spruce will again be the same as it was in the original stand.

In this connection, let me quote a most re-assuring passage from Mr. Roy's paper:—

"It is thought that spruce more than balsam, is dependant for early survival, upon a quick mineral soil footing, but once it is firmly established, it has greater endurance against all causes of mortality. In the younger stages, balsam is more plentiful than spruce, but loses this supremacy gradually by heavier mortality in the sapling stage."

If we have no other instrument but the axe and saw with which to regulate our forest, then, with respect to increasing spruce in the future stands of this region, the regeneration of which is already preponderantly balsam fir, it seems to me that one could do little better than to clear-cut the trees of the two competitors, and allow the regeneration to fight it out amongst themselves.

It seems reasonable to suppose, given a clear field, that the species with the greater endurance and immunity to attack, will then be given some advantage in its fight for existence with its weaker but superabundant adversary.

From an economic point of view, this system of cutting is evidently almost ideal.

The results to date seem to suggest that it is an excellent method from the viewpoint of silviculture also, though, of course, we cannot be definitely sure of this until the cut-over areas are much older. Nevertheless, it is a most encouraging state of affairs.

An examination of areas cut-over about 10 years ago, shows a very healthy stand of regeneration; original softwood stands now average about 10,000 balsam and spruce seedlings, per acre, and about 1000 balsam and spruce saplings per acre; original mixedwood stands about 5,000 balsam and spruce seedlings per acre and about 900 balsam and spruce saplings per acre. This regeneration is in a most healthy condition, and about 96 per cent. was established before logging operations.

The mean annual height growth of about 250 balsam and spruce, now dominant in an area cut-over about nine years ago, was about 0.13 feet per annum before logging; for the nine year period after logging, this average has increased to 0.53 ft. per annum, and appears to be definitely still on the increase.

This softwood regeneration is quite uniformly scattered throughout the area, and the risk of it being replaced by hardwoods seems to be exceedingly remote.

Summer operations and winter operations appear to yield the same results, and, to date, there does not appear to be any indication of growth stagnation, due to over-crowding, with respect to the dominants at least, since they appear to segregate themselves from their less fortunate confreres, at an early date.

Though seldom recognized as such, we might say that slash disposal is in practice, since the minimum stump height is seldom over 1 foot, and the trees are utilized to a minimum top d.i.b. of 3.5" or 2.5"; comparatively short tops and individual branches, therefore, form the slash and, being in close contact with the ground, soon decay.

After walking through these cut-over areas with an operator and noting these results, it would be a task indeed to persuade him that the method of cutting was ruining our forests. If he were ever skeptical of forestry advice

before, he would be doubly so after such an attempt. It seems to me that in some cases we are practicing forestry though we do not always recognize it as such.

In the early days, the general conception of a forester was one who preached fire protection, then later, closer utilization, then later still the advisedness of artificial regeneration. Now the tendency is for him to be a silviculturist. It seems to me that we must bear in mind that a forester is not just one of these, but all of them and a great deal more besides. Silviculture is only one factor in Forest Management, and at that, is only a means to an end and not an end in itself.

It seems to me that the economic aspect must be given due weight by foresters. I doubt if the ultimate ideal of forestry has ever been attained, or ever will be, when it is concerned with a property managed for some commercial product. Especially is this true when the demand for that product is dependent upon an international market.

Forest management, under such conditions at least, must be founded upon the principle of compromise; and, if we do not recognize this fact, its proper introduction will be all the more difficult, if not impossible.

At this early stage, even the bases of this compromise will be ever changing, making the task even more difficult; acquisition of new knowledge necessitating a change in technique, on the one hand, and changing market conditions and requirements on the other hand.

Take for example the fluctuating annual demands of the pulp and paper industry during the last twenty years. What a problem in Forest Regulation based upon the silvicultural aspect only!

Do we really wish to convert our Saguenay forests into spruce forests? Balsam fir is also an admirable pulpwood species. Not so long ago an epidemic of Spruce Budworm broke out; at that time, to replace balsam with spruce seemed an excellent idea. What of it to-day? We are now menaced by an epidemic of European Spruce Saw-fly. At least, the Spruce Budworm tends to confine its activities to old and weakened trees, but the European Spruce Saw-fly does not appear to be so fastidious.

The time element, it seems to me, will always be a thorn in the flesh to silviculturists, and add great weight to the arguments of the purely economic aspects of the problem.

This state of affairs, I should imagine, will continue until the element of risk has greatly diminished, or is brought under reasonable control. Take for example the danger of fire, insect epidemics, and, to some extent, the loss of forest land through settlement.

I suppose we all agree that old stands should be cut out before young stands. But we can agree in principle only, since the distribution of age-classes, as now existing, is due to accident. Proper forest regulation requires the distribution of age-classes both in place as well as in time; surely, the location of our mill sites, power sites, transportation sites, must exert a tremendous influence upon any decision as to the proper, and most desirable distribution of the age-classes in our future forests. To bring about this desired distribution, it is quite conceivable that some younger stands should be cut before some of the older.

Canada has tremendous forest wealth. I think we should always bear this in mind, before considering the recommendation of any silvicultural policy, which might, among other things, impose increasing costs upon our industry, and which, in view of this wealth, might hardly be considered as justifiable.

I have a dim recollection of an article which was published in the Canadian Pulp & Paper Magazine a few years ago; it was written by the late Professor N. M. Millar, and was entitled "Let's Beat the Bugs to It." It seems to me that there was a wealth of good advice in that title, let alone the article itself.

I myself have heard the following, addressed to foresters or would-be foresters: "I would have you go forth as John the Baptist crying in the wilderness." When one sees the mass of regeneration struggling for release in these northern forests, one thinks more of Moses who delivered the children of Israel out of the house of bondage.

Moderation must be one of our guiding principles, and Mr. Roy points this out admirably, as he checkmates any tendency towards technical fanaticism. I will quote from Mr. Roy's paper:—

"Laying hard and fast rules to apply to extensive and non-uniform areas will never do, either from the point of view of extraction or of silviculture."

In conclusion, it is only fair to point out that in this northern forest, there is one fact which acts as a cooling balm to any harassed forester, who is attempting to apply some method of silviculture. I can do no better than to quote again from Mr. Roy's paper:—

"Spruce and Balsam are naturally good reproducing species under the climatic and edaphic conditions of the Province, and even under harsh treatment or no silviculture at all they will continue to be dominants in our northern coniferous forest."

I have no doubt that many of my observations and remarks are of a decidedly controversial nature. But it seems to me that controversy will always be the rule, until definite results are forthcoming, based upon local experience, and obtained throughout a whole rotation.

The figures on growth, regeneration, composition and distribution of types, etc., are based on data obtained from the files of Price Brothers & Company, Limited. For the interpretation of these figures, the writer alone is responsible.

Grateful acknowledgment is hereby made to Price Brothers & Company, Limited, for their kind permission to use these data.

ONTARIO—J. B. MILLAR

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In Mr. Millar's paper, he modestly refers to the theoretical nature of his suggestions for cutting methods to obtain better spruce regeneration. They at least represent the most advanced thought in the area to which they apply, and it seems that none of the rest of us will be able to give him much of an argument along these lines.

He suggests that experimental cuttings of this nature might form a basis for logging procedure ten to twenty years hence. I would support Mr. Henri Roy's view that the time to begin this sort of thing is now.