PROBLEMS IN REFORESTATION IN NORTHEASTERN NOVA SCOTIA

by

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ABSTRACT

The northern mainland of Nova Scotia and Cape Breton Island is a complex region geologically, climatically, and historically and consequently has a mosaic of forest types. These forests are now being harvested at an increasingly rapid rate. Many of the cutover areas have no regeneration problems and will likely again support productive forests, but increasingly more sites where natural regeneration is inadequate or where regrowth will result in unproductive stands are being harvested. Some of the regeneration problems of such sites, specifically those involving old-field spruce, ericaceous ground cover, and increasing balsam fir and hardwood contents are discussed and are examined in relation to the region's new and dynamic reforestation program. In conclusion, general research and development needs are outlined and suggestions made for further efforts in land classification, postharvest treatments to encourage natural regeneration, thinning and spacing, hardwood silviculture, species selection, and quality of nursery stock.

RESUME

Le secteur nord de la terre férme en nouvelle-écosse et l'île du Cap-Breton constituent une région complexe aux points de vue géologique, climatique et historique et il en résulte une mosaique de types forestiers. Ces forêts sont maintenant récoltées de plus en plus rapidement. Dans beaucoup de forêts déboisées, la régénération est bonne et de nouvelles forêts productives s'établiront probablement. Mais des forêts sont aussi exploitées où la régénération naturelle n'est pas adéquate et où le futur peuplement restera improductif. À propos de quelques-uns de ces cas, l'auteur étudia le problème, notamment celui des épinettes dans les camps abandonnés, celui des terrains trop couverts d'éricacées, et celui des forêts où la proportion du sapin baumier et de feuillus augmente. Ces cas sont étudiés par l'auteur ce par suite du nouveau et dynamique programme de reboisement mis en application par le service Canadien des Forêts. En conclusion, l'auteur dresse dans ses grandes lignes les besoins de Recherches et de Développement. Il suggère que des efforts supplémentaires soient faits dans les domaines de la classification des terres, des traitements après coupe en vue d'augmenter la régénération naturelle, des éclaircies et de l'espacement des arbres de la sylviculture des feuillus, du choix des essences, et la qualité des plants de pépinière.

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INTRODUCTION

Few, if any, of the problems discussed in this report are unique to northern and eastern Nova Scotia. However, they have current relevance to this region because of the combination of problems created by an expanding pulp and paper industry that is exploiting a limited forest resource, and a dynamic relatively advanced reforestation program designed to replace and improve this resource. In the broadest sense, the reforestation problems stem from a failure to direct research efforts to present and future management needs, and from an inadequate application of available technical information. These failings affect forestry everywhere but their impact may be felt sooner in this region than in many others.

The extreme variability in soils, climate, and history of the region prevents the isolation of any single problem which, by its solution would significantly enhance reforestation practices. Instead, a series of differing but interrelated problems are evident. To systematically resolve all of them would require the combined efforts of many agencies and specialists over a long period of time. However, on the basis of the problems outlined, a list is given of the more obvious research and development needs that could be met with a reasonable level of effort, within an acceptable period of time. Neither the problems nor the research and development needs are exhaustively covered. The inclusion of the research and development needs does not imply that efforts are not already in progress, or that past efforts have not been successful.

Many of the problems have been discussed elsewhere and conclusions have been made that could be applied toward their solution. Drinkwater (1957b) and Jablanczy (1967) have provided considerable insight into regeneration of old-field white spruce. The hardwood forests of the region have been discussed in detail by Drinkwater (1957a). The problem of ericaceous ground cover has been studied by Damman (1971) Hall and Aalders (1968), and Hall *et. al.* (1973). Also, there is a large volume of literature on nursery management, site treatment, harvesting methods, insects and diseases, nutrient recycling, and forest fertilization, some of which may apply to this region. This report can deal only superficially with the many possibilities for forest improvement, but it is hoped that it will stimulate further discussion and effort on the part of both managers and researchers.

PRESENT FOREST COVER

The land areas considered here are for the most part within the nine counties of northern and eastern Nova Scotia (Table 1) although the forest types and problems discussed extend into other parts of the Atlantic region. The region includes half the land area, half the forested land, and slightly more than half the softwood land in the Province. The forest types include parts of the Maritime Uplands, Fundy Bay, Atlantic Shore, and Maritime Lowlands ecoregions of Loucks' (1962) classification, or Sections A5b, A7, A9, A12, and A13 of Rowe's (1959) classification. Bedrock and soils vary considerably but are developed mainly from crystalline rocks in the upland areas and from sandstones, shales, limestones, and gypsums in the lowlands (Goldthwait 1924).

The climate is relatively humid with short cool summers and moderately long winters. Maritime influences increase as one moves eastward from Cumberland County to the Atlantic Shore; precipitation increases from 40 in. to 55 in. (160 to 220 cm) per annum, relative humidity increases from an average of 75% to 85% per annum, the number of foggy days increases from about 10 to about 70 per year. January temperatures increase from a mean of 15°F (-10°C) to a mean of 25°F, (-4°C) and the month of highest mean temperature moves from July to August (Putnam 1940). Such climatic and geological variation has resulted in a complex series of forest types.

History has had a profound effect on the forests of the region; in many areas this effect obscures that of climate and geology. Uniform stands of timber occupy large areas of variable topography and soil type. Some of the land was once cleared for agriculture and was thereby subjected to erosion, compaction, rock removal, and mixing of the upper soil horizons. Many of the remaining forested areas have been subjected to high-grading for nearly two centuries. Repeated burning has had a noticeable impact, resulting in large acreages of scrub hardwood and barrens.

About 70% of the merchantable timber is softwood, mainly spruce and fir (Tables 1 and 2). Nearly one third of the softwood volume is on the Cape Breton Plateau where extensive stands of balsam fir have reached merchantable size and are now being harvested. Approximately 10% of the merchantable volume is white spruce (Table 2), most of which has developed in pure stands on land once cleared for cultivation or pasture (Drinkwater 1957b). In the Cobequid Bay region, red spruce predominates on old fields, and throughout the mainland region this species is an important component of the upland mixedwood forests. In the St. Mary's river basin good stands of black spruce form the dominant cover. Less productive forests include lowland black spruce, where there is often a delicate balance between sparse tree cover and dense ericaceous ground cover, spruce-fir thickets typical of the eastern shore - Cape Breton Lowlands regions, and the hardwood hilltops described by Drinkwater (1957a).

PRESENT DEPLETION RATE

Because of a time lag in the availability of data, an up-to-date assessment of this constantly changing situation is impossible. However, if the trends of the past decade are continuing, the rate of harvesting the timber stands is still accelerating mostly because of the establishment of two large pulp and paper mills in the area. Between 1960 and 1973 pulpwood production nearly quadrupled to 1.5 million cubic metres (0.6 million cords) within the nine-county region under consideration (Table 3). In addition, an annual harvest of about 0.5 million cubic metres (100,000 Fbm) is being cut for lumber, giving an estimated total harvest of 2 million cubic metres[1]. Assuming that yields average 160 m^3/ha (30 cords/acre) then over 12,000 ha (30,000 acres) are logged annually, representing almost 1% of the softwood forest land or 0.5% of the total forest land (Table 1). Most likely, productivity averages less than 160 m^3/ha, and the yearly acreage of cutover more than the estimated 12,000 ha. In comparison, the amount of burned-over land averages 400 ha (1000 acres) annually (Table 4).

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[1]Nova Scotia Dept. of Lands and Forests. Annual Reports for the years ended March 31, 1970, 1971, 1972, 1973 and 1974.

If the capacity to regenerate rapidly to well-stocked stands of commercial species were uniformly high, the present depletion rate would appear inconsequential. However, this is not always the case because logging is increasing on problem areas, e.g. old-field spruce sites where regeneration is often slow, sparsely covered black spruce bogs that have a dense ericaceous ground cover, and the eastern shore region where reproduction is likely to be too dense. With the increasing use of heavy machinery, clearcuts are becoming larger, thereby decreasing the likelihood of natural seedfall and exposing seedlings to more intense radiation.

The intensity of the present harvesting operation raises many questions about the long-range impact on the environment and on resource depletion. It also provides an opportunity to replace the present forest cover with more productive stands. The main question within the scope of this report is therefore the adequacy of present reforestation practices in providing better forests for the next rotation.

PRESENT REFORESTATION PRACTICES

The term 'reforestation' is used here in its broadest sense, to include natural restocking, planting, or other artificial means of regeneration. Thus, in this report, any measure that encourages natural seedfall, establishment of seedlings, or development of young stands is considered a reforestation practice. Most of the accepted measures, e.g. strip cutting, leaving seed trees, scarification, thinning, direct seeding, and planting, are already being practiced to some extent.

Under older logging methods natural regeneration was considered to be adequate in most parts of the region. Candy (1951) found most cut-over areas in Nova Scotia well stocked when compared to dryer regions of Canada but he noted that most of the softwood regeneration was balsam fir. Restocking burned-over land was generally poor in terms of softwood cover. A survey of seven recent clearcuts (Table 6), showed that natural regeneration produces a satisfactory number of trees, but the distribution and species composition is less promising. Although prior to harvesting, most stands were predominantly spruce, regeneration consisted largely of fir or hardwoods. Spacing of softwood regeneration was very uneven. Some older clearcuts, especially on old-field spruce sites, have been observed with practically no regeneration.

At present, the only obvious measure taken during logging to encourage natural seedfall is strip cutting, which has been adopted as a standard practice by one paper company. Superior seed trees of desired species have been left on a few cutover areas, but these have generally been felled by wind within the following year. Likewise, wind has caused considerable damage to trees left after strip cutting.

Methods of improving natural seedling establishment after cutting appear to be poorly developed in this region. No instances are known where light scarification or slash dispersal has been practiced purely for the purpose of aiding natural regeneration.

There is considerable effort toward improving young stands through thinning and spacing[2]. Methods include manual thinning, cutting strips with machines, and a combination of the two.

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[2] Routledge, H.T. Silviculture for the new forest. Woodlands Section, Can. Pulp and Paper Assoc. Montreal, 1971.

Direct seeding of tree species has met with limited success in Nova Scotia as in much of the rest of Canada (Waldron 1973). Post (1966) found direct seeding clearly inferior to planting white spruce on one northern Nova Scotia site. Records show that only 30 acres were seeded in the province between 1969 and 1973[1]. There has been no direct seeding in conjunction with new logging methods nor are devices used to protect seedlings from moisture extremes, fungi, etc.

Planting is the main silvicultural practice in areas with poor or unsuitable natural regeneration. The provincial nursery supplies 1 to 2 million tree seedlings annually for the whole province (Table 5) and about 1 million containerized seedlings are produced and planted in eastern Nova Scotia. Thus on the average about 5% of each year's cut- and burned-over land is planted.

To be worthwhile, the productivity of plantations should substantially exceed that of stands that develop naturally. For many reasons, some of which will be discussed later, they do not always do so. Natural stands are also poor in many localities, therefore planting and related reforestation practices cannot be dismissed in favour of natural regeneration. The only apparent avenue is improvement of present practices and development of new ones to fit particular situations. The mosaic nature of the forests of the region precludes any single, all-encompassing scheme to solve all the problems relating to reforestation. Instead, some specific problems will be examined in an attempt to point out possible new approaches.

SOME SPECIFIC REFORESTATION PROBLEMS

Regeneration of Old-Field White Spruce.

Over 0.5 million acres of woodland are abandoned farmland. Most of this is pure softwood, usually white spruce with a small percentage of balsam fir, red spruce, or tamarack. Stocking is usually dense, allowing no advance regeneration and little understory vegetation. Productivity is relatively high (30 to 50 cords per acre) but growth tends to stagnate before stands reach 60 years of age (Drinkwater 1957b). Since most of these stands are readily accessible and productive they are an attractive source of pulpwood. Furthermore, they are amenable to clearcutting with heavy machinery because of their relatively even terrain and uniformity and because manual cutting is often difficult in such dense, limby growth.

Regeneration has been noticeably slow on many areas cleared of old-field spruce. In a regeneration survey of several forest types, 90% of the acreage that required replanting 5 years after cutting was on land previously supporting old-field white spruce[3]. In a study of eight cutover areas of old-field origin, Jablanczy (unpublished report) found adequate spruce regeneration only in areas that had previously supported a large red spruce component and which consequently had some advance regeneration. On one recent old-field cutover in eastern Nova Scotia, regeneration to conifers was dense on some areas but absent from about half the cutover and most of this regeneration was balsam fir rather than the more favoured white spruce (Table 6, McLellan's Mtn.).

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[3]MacGregor, D.A., Scott-Maritimes Ltd. Abercrombie, N.S. Personal Communication.

A carpet of feather mosses (*Pleurozium schreberi, Hylocomium splendens, Dicranum* spp.) develops in most old-field stands and is often the sole ground cover (Drinkwater 1957b). After cutting, this is a poor medium for survival of any small seedlings that may have originated as advance regeneration and it is likewise a poor seedbed for post-cutting germinants. Often a dense layer of hair-cap moss (*Polytrichum commune*) develops after cutting and this also provides a poor seedbed (Jablanczy and Baskerville 1969). Rapid invasion of clearcuts by ferns, grasses, and broadleaved plants that formed part of the weed population on the original farmstead may further check the establishment of conifers.

The acreage of old-field land that has failed to regenerate satisfactorily after cutting is not known, but since about half the white spruce clearcuts visited appeared to have inadequate restocking, and all that were regenerating had a preponderance of balsam fir, a decrease in productivity can be expected if corrective measures are not applied.

To date, corrective measures attempted on an operational basis are strip cutting, as recommended by Jablanczy (1967), or planting. It is too early to assess the value of strip cutting as it has only recently been tried by one company. Large-scale planting has not yet been carried out and requires the choice of appropriate species.

Ericaceous Ground Cover.

On the poorer soils or in areas subjected to repeated burning a dense cover of lambkill (*Kalmia angustifolia*) and other heath plants often develops which can remove from circulation, for long periods of time, much of the nutrients that might otherwise be recycled (Damman

1971). These shrubs develop in stands with a light canopy and increase in density after the removal of tree cover by fire or cutting (Martin 1955, Hall and Aalders 1968). On recent clearcuts, new shoots of lamb-kill have been observed in abundance, and a near-doubling in density from 10 and 14 to 18 and 25 stems per square metre was recorded in two black spruce stands in southwestern Nova Scotia during the year following cutting. This type of ground cover has an adverse effect on regeneration and on stand development. The existence of barrens in most regions of Nova Scotia is an illustration of one possible end result of repeated disturbance on lands that have ericaceous ground cover.

Control of ericaceous vegetation is possible through the use of herbicides, fire, or shade (Hall *et. al.* 1973). The first two practices have somewhat dubious application in large-scale forestry. The use of shade, through planting fast growing tree species that will rapidly form a closed canopy, is a logical alternative, but care must be taken to plant species that will survive to merchantable age on the shallow, poorly drained, or infertile soils on which ericaceous cover is often found.

The Increasing Balsam Fir Component.

Cutting, as opposed to fire, as a means of stand removal appears to increase the proportion of balsam fir in the subsequent rotation. In three out of seven clearcuts examined (Table 6) fir regen-eration was greater than 50% in areas that had previously supported stands which were predominantly spruce. Possibly the spruce:fir ratio increases with stand development and with the natural thinning that occurs in fir thickets, but nevertheless, a gradual increase in the proportion of fir in Nova Scotia forests is evident. From the standpoint of decay (Davidson 1957, Davidson and Redmond 1957) and susceptibility to budworm and balsam woolly aphid damage (Greenbank 1970) this species is inferior to spruce. Silvicultural techniques to encourage spruce reproduction over that of balsam fir would therefore be beneficial.

Spacing.

On many clearcuts, reproduction of tree species is overabundant. This is especially true in the spruce-fir forests along the eastern shore area of Guysborough, Richmond, and Cape Breton counties. In one stand near Lower St. Esprit the average stem diameter was 6 inches for trees 50 to 60 years of age. Regeneration, especially to fir, was abundant, indicating the inception of yet another dense stand (Table 6). In other areas throughout the region, very uneven regeneration has resulted in scattered thickets interspersed with open areas.

Spacing trials initiated by Nova Scotia Forest Industries have shown promise of increasing growth rates of individual trees and producing apparently healthier stands. However, there is some uncertainty about the economics of thinning and spacing, the optimum densities, the increase in per acre yield on a short rotation, and the relevance of spacing, in light of new technologies that allow whole tree utilization and the use of chipper-harvesters.

Since the density problem involves mainly balsam fir it could be considered similar to the problem of the increasing balsam fir component. Biological or chemical methods of selectively decreasing the density of balsam fir might contribute much to better spacing in parts of eastern Nova Scotia. Because herbicides have potentially undesirable side effects, biological methods should be considered first. The most promising biological control measure might be the manipulation of indigenous fungus diseases that are specific to fir. Another possibility might be the manipulation of the balsam woolly aphid in young stands.

The Role of Hardwoods.

Most of the hardwood stands in this region are of poor quality (Drinkwater 1957a) and hence in low demand. Although there are in progress some attempts at stand improvement, e.g. thinning and pruning, large-scale operations of this type must await some economic incentive. The pulp and paper industry uses a small proportion of hardwood but there are many hardwoods left standing after cutting mixedwood stands. Hardwoods are still considered weeds in many places and most reforestation efforts are directed toward stands of pure softwood.

Maintenance of a pure softwood cover could be ecologically unsound on many sites because of a tendency for such forests to tie up nutrients in unavailable form in surface litter. Deciduous trees may, in contrast, improve nutrient recycling (Daubenmire and Prusso 1963, Evers 1967, Iverson and Sowden 1959, Page 1974). Dense hardwood cover may suppress conifer regeneration, but a light cover can be favourable by providing protection from excessive radiation (essential for species such as red spruce) or from attacks by insects (e.g. the white pine weevil). Many hardwoods regenerate quickly after clearcutting thereby providing immediate ground cover and protection against soil erosion.

Hardwood stands can be improved through better understanding of their defects and through appropriate management (Petro 1971, Shigo and Larson 1969, Stillwell 1955). If used for pulpwood, a certain amount of defect might be accepted or perhaps avoided through harvesting on short rotations (Einspahr and Benson 1968, McAlpine *et. al.* 1966).

Site Classification and Species Selection.

The complex geology, climate, and history of the region makes uniform silvicultural practice impossible. Even at the local level, the mosaic nature of the site generally renders inappropriate a uniform treatment of a large block of land. Nevertheless, there persists a tradition of cutting large blocks and applying reforestation measures with little regard for land forms, drainage patterns, or soil properties.

Other disturbing tendencies include inadequate matching of species to site in planting and the use of exotic tree species and seed from outside the region without adequate testing for their suitability. Such practices are unlikely to result in better forests and maximum yields. For example, many of the established red pine plantations (many of midwestern U.S. origin) are now being damaged by *Scleroderris* canker and *Sirococcus* shoot blight (Magasi 1974). Scots pine, also quite widely planted, is often poorly adapted to local site and climatic conditions, as evidenced by its poor form in mature plantations. Norway spruce has been highly recommended for planting (Holst 1963) but considerably more attention should be given to defects in existing plantations before it is widely planted.

Because of their adaptation to the climate and their resistance to most indigenous fungi and insects, the native species should be the primary sources of material for reforestation. Of these, fir and the hardwoods often regenerate naturally to such an extent that on most sites thinning rather than planting is necessary. White pine and red pine, while much less abundant, usually regenerate adequately. Increased planting of the three native spruces, which are favoured pulpwood species, will almost certainly be necessary to maintain or exceed their present level of production.

Planting.

The increasing practice of evaluating performance of existing plantations (Roller and Hunter 1975) will give valuable direction to future planting programs, especially in terms of species selection, site preparation, weed control, and other factors affecting trees after they leave the nursery. It will be more difficult to assess the long term impact of seedling quality at the time of planting. Production in Maritime nurseries has been seriously affected during the past few years by disease and nutritional problems as well as by adverse weather and incorrect use of chemicals (Wall 1974, Magasi *et. al.* 1975). All of these disorders (Table 7) affect seedling costs, post-planting survival, and later performance in the plantation.

Nursery practice on a large scale is relatively new to the region and continues to suffer growing pains. Broadly speaking, practices which have worked well elsewhere are being adopted, but there has as yet been very little modification of these practices to accommodate local climate, soils, and diseases. Seedlings grown in container systems developed in Scandinavia have been subject to numerous problems including temperature extremes, nutrient imbalances, fungicide injury (Table 7), and frost heaving after planting. Many of the recommended practices for conventional nurseries have been developed in the midwest (Wilde 1958, Armson and Sadreika 1974), where climate and soils differ considerably from the Maritimes.

To a large extent, problems with seedling quality have affected species selection. Red pine, the most favored plantation species, usually grows rapidly in the nursery and produces a seedling that is relatively easy to plant. Survival and growth during the early years in the plantation are impressive in most cases (Roller and Hunter 1975). Spruces, with their slower growth rate and their tendency for post-planting growth check are much less popular as plantation species and will remain so until techniques for their culture are improved.

While significant increases in nursery production may not be necessary, increases in seedling quality are essential. Without quality, the practice of planting is not a worthwhile venture.

RESEARCH AND DEVELOPMENT NEEDS

The problems discussed above are by no means all-inclusive but they clearly show the need for further research, surveys, and transfer of information. Several lines of research and development are immediately evident and are outlined below.

1. Land Classification and definition of lands suitable for forestry.

   A biophysical classification of non-agricultural lands is now in progress[4]. Such classifications are fundamental to planning, logging, and reforestation activities. Lands of low productivity possessing severe reforestation problems can then be identified and removed from consideration as productive forest land and efforts can be placed on more amenable sites.

2. Harvesting practices in relation to regeneration. Jablanczy (1967) has outlined a scheme for cutting old-field spruce that takes into consideration exposure, wind directions, and seedfall. Other factors such as season of cutting, surface conditions in relation to seedling establishment, control of seed production, and the microclimate of clearcuts need further study.

3. Post-harvest treatments to encourage natural regeneration. A wider range of techniques are required to encourage natural regeneration after harvest as well as a better understanding of the effects of timing and intensity of site treatment. In addition to new approaches, there is a need for wider testing of accepted methods, e.g. scarification, slash dispersal, and controlled burning.

4. Selective thinning of natural regeneration. Present methods of thinning natural regeneration are either non-selective or labor intensive. Perhaps selective chemicals or biotic agents could assist. Barring the trial and error approach, development along these lines could require a long and costly research program. Therefore, the goals must be examined carefully in relation to possible future changes in harvesting methods.

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[4] Nova Scotia Dept. of Lands and Forests. Annual Report for the Year Ended March 31, 1974.

5. Ecology and utilization of hardwoods. Much work on hardwood utilization and silviculture has already been done elsewhere, but it needs to be tested and incorporated into a program that is applicable to Nova Scotia conditions. The role of hardwoods in soil development and their influence on softwoods in a mixedwood stand need further clarification.
6. Direct seeding methods. Past attempts at direct seeding have been rather discouraging, but harvesting methods have changed giving rise to different surface conditions on many sites. Likewise, a wider variety of adjuvants, fungicides, bird repellants, and other materials are now available and should be tested.
7. Species and genotype selection for planting. Emphasis should be placed on selecting native tree species for planting. Even with these, there has to be careful consideration of their site requirements and of local problems from insects, disease, or climate. For example, should white spruce be planted on old-field spruce sites in view of the incidence of root rot in many of the older stands? Resolution of many specific problems will require research, but the main requirement at present is better communication between land manager and researcher in applying existing knowledge.
8. Improvement of nursery seedling quality. Improvement in seedling quality involves many agencies and specialists. Further research is needed in seedling nutrition, container systems, control of root and seedling diseases, epidemiology of foliage diseases, and weed control. Part of this research consists of adapting known practices to local conditions. More emphasis is needed on nursery

management education in forestry and technical school curricula. Finally, there must be open channels of communication between researchers and practitioners. At present, many research findings are not reaching nursery managers, and in turn, nursery problems are not fully appreciated by researchers.

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Table 1. Area of forest land and volume of merchantable timber in northeastern Nova Scotia, by county[1]

	Area						Volume			
	Acres (thousands)			Hectares (thousands)			ft^3 (millions)		m^3 (thousands)	
County	Total	Total Forest	Softwood	Total	Total Forest	Softwood	Total Forest	Softwood	Total Forest	Softwood
Cumberland	1075	850	396	436	344	160	731	542	20700	15348
Colchester	904	765	388	366	309	157	655	453	18548	12828
Pictou	714	582	280	289	236	113	478	316	13535	8948
Antigonish	360	280	163	146	113	66	210	145	5946	4106
Guysborough	1052	837	531	426	339	215	551	371	15603	10506
Inverness	959	829	443	387	335	179	948	631	26844	17868
Victoria	724	577	370	393	234	150	638	488	18066	13819
Richmond	324	261	202	131	106	82	199	162	5635	4587
Cape Breton	643	495	285	260	200	115	438	297	12403	8410
Total	6753	5477	3059	2740	2218	1238	4849	3404	137308	96390
Total for Nova Scotia	13712	10762	5721	5560	4360	2318	9202	6476	260571	183380

[1]Compiled from the Nova Scotia Forest Inventory reports for the Truro Subdivision (1968), the Antigonish Subdivision (1965), and the Cape Breton Island Subdivision (1970).

Table 2. Percentage of merchantable timber in northeastern Nova Scotia, by species and county

	% Volume[1]						
	White spruce	Red and black spruce	Balsam fir	Hemlock	Pines	Larch	Hardwood
Cumberland	4.1	45.9	18.6	1.7	1.2	1.0	25.7
Colchester	6.4	26.6	30.9	3.6	0.6	0.9	30.9
Pictou	12.7	19.8	25.4	6.1	1.6	0.5	34.0
Antigonish	29.9	9.3	27.5	1.5	0.6	0.4	31.0
Guysborough	5.5	26.4	29.8	0.4	3.5	1.6	32.7
Inverness	10.7	6.4	47.2	0.9	0.5	0.8	33.5
Victoria	11.2	7.7	55.6	0.4	1.4	0.3	23.4
Richmond	11.0	23.2	43.1	0.4	0.6	3.3	18.6
Cape Breton	15.5	15.2	32.5	1.2	1.0	2.4	32.2
N.E. Nova Scotia	10.1	20.5	35.4	1.8	1.2	1.0	29.8

[1]Compiled from Nova Scotia Forest Inventory Reports for Truro Subdivision (1968), Antigonish Subdivision (1965) and the Cape Breton Island Subdivision (1970).

Table 3. Pulpwood production in northeastern Nova Scotia counties, 1960-1973[1]

County	Cords[2]				Cubic meters[2]			
	1960	1965	1970	1973	1960	1965	1970	1973
Cumberland	14627	19506	35470	55547	35206	45950	85374	133698
Colchester	3506	9642	99398	75479	8439	23208	239244	184080
Pictou	4730	27815	86862	97924	11385	66949	209070	235696
Antigonish	8879	56727	55265	83740	21371	136538	133019	201556
Guysborough	13086	77052	93202	95392	31497	185459	224331	229602
Inverness	47781	78303	25015	111900	115006	188470	60209	269335
Victoria	18528	78962	37023	34727	44596	190056	89112	83585
Richmond	15353	31733	38566	35898	36954	76379	92826	86404
Cape Breton	10415	20725	29424	35914	25068	49884	70821	86442
Total	136905	400465	560225	627521	329521	963891	1348422	1510399
Total for Nova Scotia	304708	652028	831828	996145	733432	1569385	2002151	2397651

[1] Annual Reports for the years ended March 31, 1961, 1966, 1971 and 1974, Nova Scotia Department of Lands and Forests.

[2] Based on a per cord volume of 85 ft^3 or 2.407 m^3 solid wood.

Table 4. Area of land burned in northeastern Nova Scotia, 1969-1973[1]

County	Acres					Hectares				
	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973
Cumberland	164	97	63	652	406	66	39	25	264	164
Colchester	149	20	16	8	44	60	8	6	4	18
Pictou	127	441	18	87	147	51	178	7	35	59
Antigonish	27	130	31	51	55	11	53	13	21	22
Guysborough	1030	99	281	937	34	417	40	114	379	14
Inverness	81	69	37	182	41	33	28	15	74	17
Victoria	2	5	5	2	5	1	2	2	1	2
Richmond	30	28	9	41	55	12	11	4	17	22
Cape Breton	224	241	134	986	68	91	98	54	399	27
Total	1834	1130	594	2946	855	743	457	240	1193	346
Total for Nova Scotia	2813	2209	1157	5882	5884	1138	894	468	2378	2380

[1]Annual reports for the years ended March 31, 1970, 1971, 1972, 1973, 1974, Nova Scotia Department of Lands and Forests.

Table 5. Number of trees distributed for outplanting from the Provincial Nursery[1]

	Number of trees (thousands)[2]				
	1969	1970	1971	1972	1973
Crown lands	308	840	536	452	847
Pulp and Lumber Company Lands	216	306	160	277	363
Private Lands	204	63	244	194	243
Total[1]	728	1,210	940	922	1,467

[1]Includes trees planted in southwestern Nova Scotia but does not include trees produced outside the province or in private nurseries.

[2]Annual Reports of the Nova Scotia Department of Lands and Forests, 1970 to 1974.

Table 6. Natural regeneration on seven clearcut areas in northeastern Nova Scotia

Location	Years since cut	Original tree cover[1]				Regeneration[1]			
			%				%		
		Trees/ha	Spruce	Fir	Hardwood	Seedlings/ha	Spruce	Fir	Hardwood
Wards Brook Cumberland County	1	999	74	12	14	658	28	8	64
Stanley Hants County	1	802	100	0	0	1190	60	0	40
McLellan's Mtn. Pictou County	4	540	74	26	0	746	24	52	24
Upper Musquedoboit Halifax County	1	887	28	69	3	385	0	48	52
Caledonia Guysborough County	2	2060	93	7	0	1390	7	28	65
Sherbrooke Guysborough County	1	1760	42	48	10	3125	14	72	14
Lower St. Esprit Richmond County	1	1350	60	29	12	1961	17	81	2

[1]Counts made by the 'closest individual method' of Cottam and Curtis (1956) on 30-50 plots spaced at equidistant intervals over clearcuts 5 ha in size or larger.

Table 7. Primary causes and incidence of major seedling disorders observed in Maritime forest nurseries, 1970-1974

Causal Agent	Conventional Nursery: Seedbed and 1-0	Conventional Nursery: 2-0 and 3-0	Conventional Nursery: Transplant	Greenhouse Container
Seedling or root infecting fungi	5	3	2	3
Foliage fungi	3	4	1	
Arthropods		1	1	1
Nutritional, heavy metal toxicity		1	1	1
Temperature extremes				2
Moisture extremes				3
Herbicide injury	1			1
Fungicide injury				3
Unknown		1		5