# FIELD SURVEY OF PLANTATIONS IN HALIFAX COUNTY, NOVA SCOTIA

by

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# ABSTRACT

This report presents results of an assessment of 38 forest plantations in Halifax County, Nova Scotia. Nearly all of the plantations were established on old fields. Data on survival, height and diameter increment, and volume production are presented and discussed.

Data obtained were highly variable, and did not permit extensive statistical analyses. Dissimilarity of sites, age-class, and seedling quality used for planting influenced the results considerably and in most cases did not allow a controlled comparison between plantations and species. However, observations on height growth and height variation at different age-classes in different soils for white, red, and black spruces, and red pine reflect the ability of white spruce to colonize and grow well on old fields as compared to the much slower growth and poorer survival of red spruce. Black spruce and red pine are intermediate.

The report also compares survival and height growth of native conifers to lodgepole pine and Norway spruce by means of bar diagrams and tables.

Recommendations are made to guide the establishment of future plantations in southwestern Nova Scotia.

## Résumé

Les auteurs donnent les résultats d'une évaluation de 38 plantations forestières dans le comté de Halifax, Nouvelle-Écosse. La plupart d'entre elles avaient été établies dans des champs abandonnés. Sont présentés et analysés la survie, l'accroissement de hauteur et de diamètre et la production de volume.

Les résultats s'avérèrent très variés et conséquemment ne permirent pas que l'on effectue des analyses statistiques détaillées. Les stations, les classes d'âge et la qualité des semis utilisés pour les plantations variaient au point d'influencer les résultats considérablement; et, dans la plupart des cas, elles ne permirent pas une comparaison raisonnée entre les plantations et les espèces. Cependant, selon les observations sur la croissance en hauteur et la variation de hauteur par classes d'âge en sols différents en ce qui concerne les Épinettes blanche, rouge et noire et le Pin rouge, on constate que l'Épinette blanche s'implante et croît mieux que l'Épinette rouge dont la croissance est beaucoup plus lente et la survie moindre. L'Épinette noire et le Pin rouge sont intermédiaires.

Dans ce rapport on compare aussi la survie et la croissance en hauteur des résineux indigènes par rapport au Pin tordu latifolié (Pinus contorta) et à l'Épinette de Norvège (Picea abies) au moyen de graphiques à barres (histogrammes) et de tableaux.

On donne des conseils sur la façon d'établir des plantations dans le sud-ouest de la Nouvelle-Écosse.

# INTRODUCTION

In 1974, data on tree survival and growth, and information on soil and other site conditions were obtained from 38 forest plantations in Halifax County, Nova Scotia. These plantations were established at various dates between 1944 and 1970, and they occupy a total of 106 acres (42.8 ha). This report summarizes the results of the assessment, and on the basis of these results makes preliminary recommendations for improving reforestation success. It is the third in a series of reports presenting results of assessments of older plantations in southwestern Nova Scotia (Roller and Hunter, 1972[1], 1974).

# THE STUDY AREA

## *General Description*

Halifax County is located in south-central Nova Scotia (Fig. 1). It has an area of 5,939 $km^2$ and is the largest county of the province. Farming and forestry are among the most important industries in the County. Most of the plantations assessed are located on provincial Crown Land, but several, including most of those using exotic species, have been established on private land. One particularly notable collection of exotic and native species is located at Point Pleasant Park, covering 75 ha of federal Crown land at the extreme south end of the City of Halifax. Locations of the plantations are shown in Fig. 2.

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[1]Roller, K.J. and S. Hunter. 1972. Maritimes Forest Research Centre. Internal Report M-74.

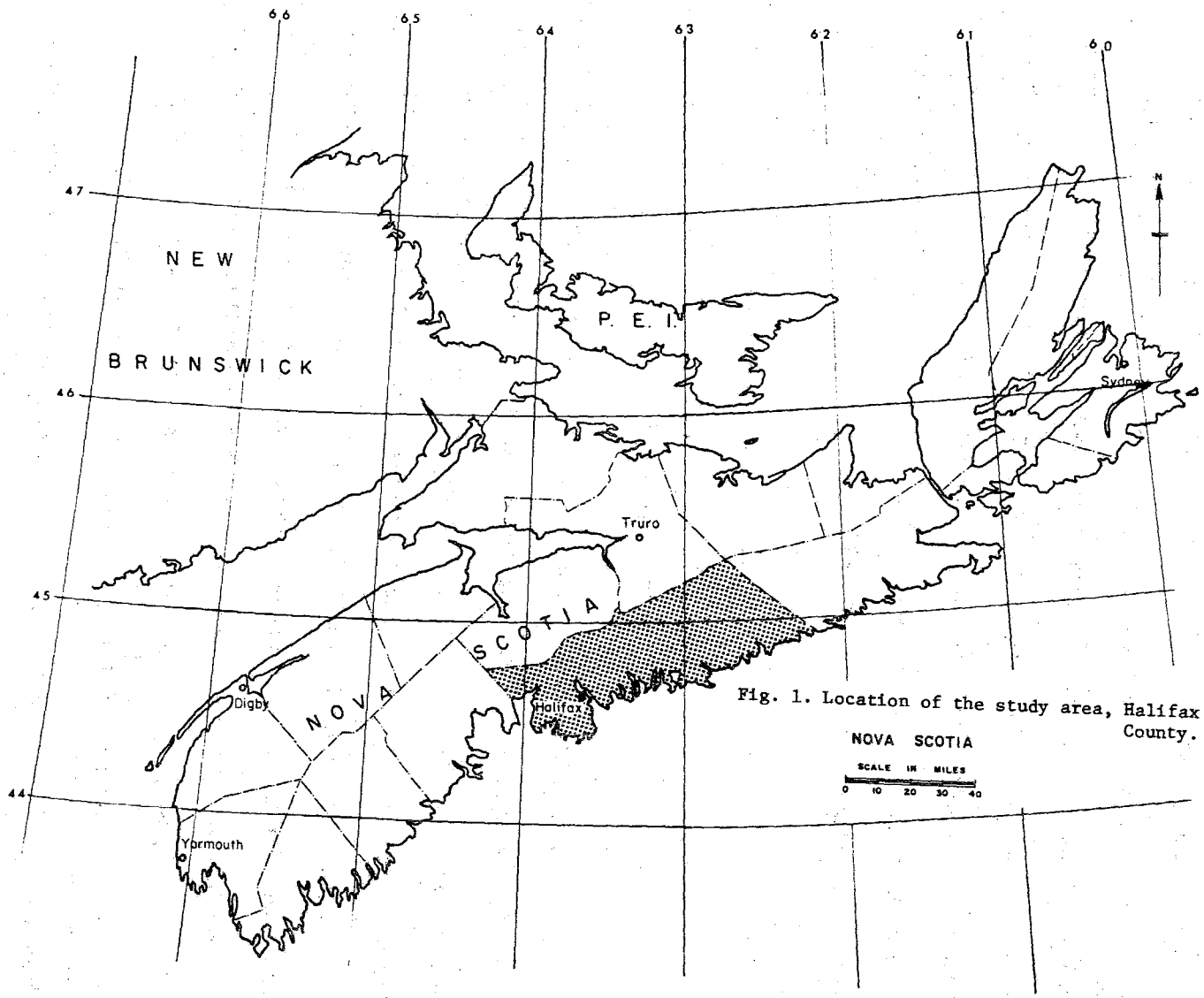



Fig. 1. Location of the study area, Halifax County.

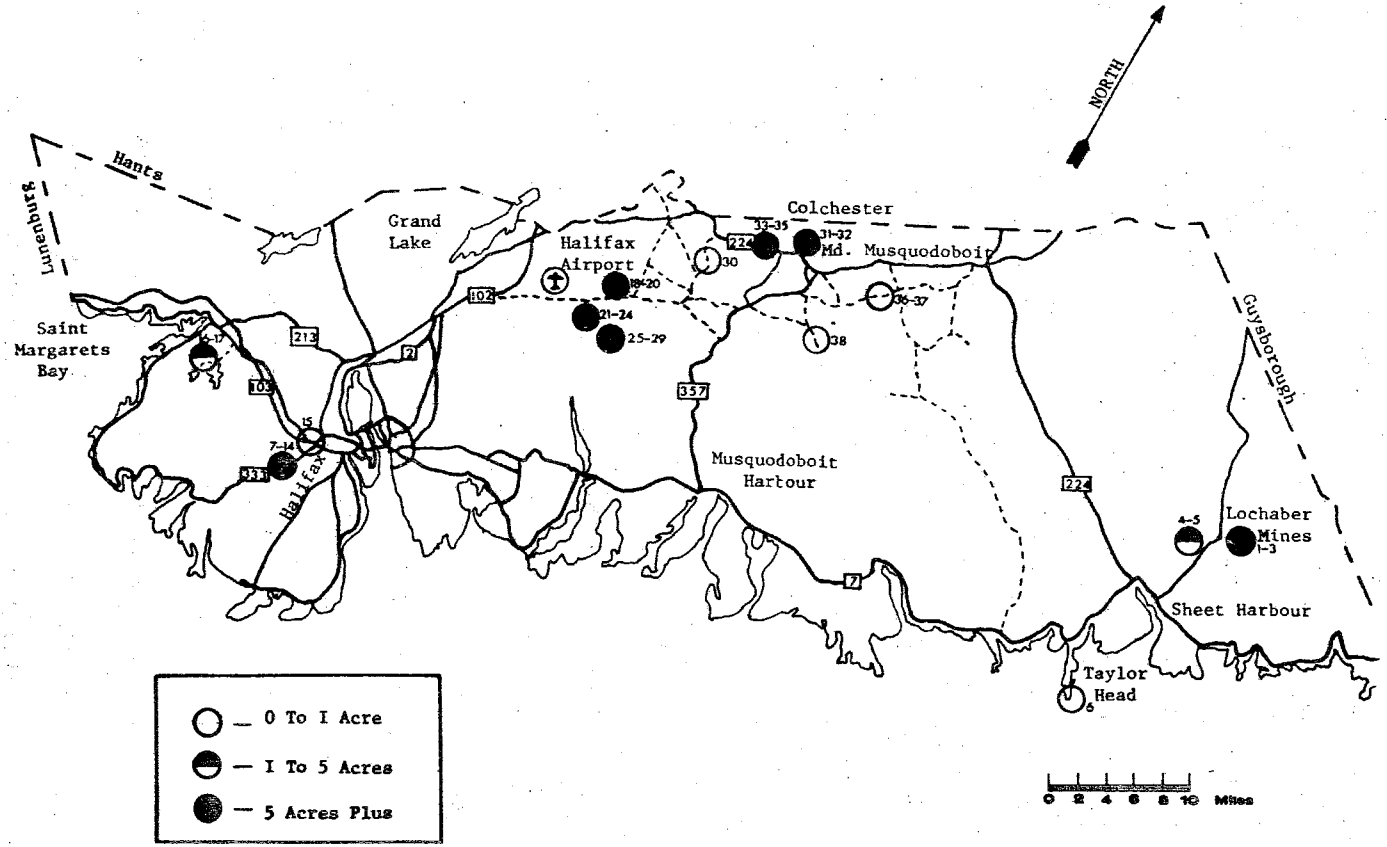



Figure 2. Locations of plantations surveyed.

## *Climate*

Halifax County lies within the humid temperate zone. The mean annual temperature recorded at the weather station in Upper Stewiacke (elevation 152 m) is about 5.7°C, with a minimum of -7.4°C in February and a maximum of +18.3°C in July. This represents the inland climate of Halifax County where most of the plantations are located. The annual average precipitation is 1038 mm, which includes 1841 mm snowfall. Along the coast, where the climate is influenced by the Atlantic Ocean, the average annual precipitation and temperature are higher, and the frost-free period is longer, than inland. The shortest frost-free period is 90 days inland, with the first fall frost occurring on September 10, while the longest frost-free period is 171 days at Dartmouth, where the first fall frost occurs on October 25 (30-year means).

## *Soils*

The soils of the County have developed almost entirely from glacial drift. The main differences in the soils are associated with variations in texture and composition of the parent material, which is derived mainly from granite and quartzite.

In the assessed plantations, the following soil series were represented according to maps prepared by MacDougall and Cann (1963): Wolfville (36%), Bayswater (21%), Halifax (13%), Queens (12%), Rockland (12%), and Cumberland (1%). With the exception of the Rockland and Cumberland types, the listed soil series all belong to the Humic Podzol Great Group; Halifax, Gibraltar, and Wolfville soils are classified

under the orthic subgroup, and Bayswater and Queens soils under the gleyed subgroup. A description of the characteristics of these types of soils can be found in the System of Soil Classification for Canada (Anon. 1974). MacDougall and Cann classified Rockland as a land type having bedrock exposed on at least 60% of the surface, or having extremely shallow or stony till over bedrock. It occurs over granite or quartzite rock formations and cannot be classified under any other soil type. The Cumberland soil series has undifferentiated horizons, formed in fertile alluvial deposits; it has little importance in the evaluation of the plantations as it is good agricultural soil and only constitutes 1% of the assessed area.

In addition to the above general classification based on maps, one soil profile from a pit dug in each plantation was examined. Observations on the soil pits showed a number of differences in texture, moisture content or level of ground water, and cementation or depth of parent material, from typical conditions indicated by the maps. In general, the surface of old field soils has been continuously disturbed by cultivation or grazing, resulting in the absence of L-H and Ae horizons. A thin restored L-H horizon was, however, found in several examples of the Wolfville soil. Also in the Wolfville soil series, mottling and dull colors were commonly detected within 50 cm of the surface, indicating a close relationship to the gleyed humic podzol subgroup. Average rooting depth in this series was 30 cm. The Halifax soil series, formed mostly on quartzite parent material, has a very firm C horizon and cobbly and gravelly coarse fragments in the B horizon. Rooting depth in this soil averaged 40 cm. The poorest quality soil in the orthic group

was the Gibraltar soil series that is formed on granite. It usually has very coarse, gravelly fragments cemented in the Bf horizon. The average rooting depth was 20 cm in this soil.

The Bayswater and Queens soils were characterized by wetness in the upper part of the solum. Iron mottling occurs in the Bhfg and Bfg horizons with the latter often being blotched black and grey, and with diffused upper and lower boundaries related to the fluctuating water table. In these soils, ground water was found at 35 to 45 cm in pits in June 1974 when the survey was carried out. This probably represents one of the highest water tables of the year. The Bfgh horizon of the Bayswater soil was sandy clay loam with gravelly coarse fragments, overlying a very firm BC and C horizon. However, the C horizon was quite deep and the average rooting depth was found to be 53 cm. The Queens soil series exhibited very shallow horizons formed over sandstone and shale bedrock. The BC and C horizons were extremely firm and the average rooting depth was 25 cm.

### *Vegetation*

About 70% of the county is under productive forest. Conifers grow on 37%, mixedwood on 30%, and hardwood on 3% (MacDougall and Cann, 1963). The dominant softwood species are red spruce (38%) and balsam fir (33%). Other softwoods include black spruce, white spruce, hemlock, red pine, and white pine. The most common hardwoods are red maple (50%) and yellow birch (24%), together with lesser amounts of white birch, white ash, sugar maple, and beech (Hawboldt, L.S. and R.M. Bulmer, 1958).

White pine, red spruce, and hemlock are the most common species where the forest has not been burned. Red oak, red maple, and white birch, often mixed with white pine and black spruce, constitute stands of fire origin. Black spruce dominates on poorly drained lands.

Different ground cover species and communities are associated with differences in soil series. In areas sampled, blueberry, sheep laurel, and bracken were constantly present on Halifax and Gibraltar soils. On Gibraltar soil, broom crowberry, huckleberry, and lichens appeared with the above plants to varying degrees, reflecting the dryness of this soil type. On Bayswater soil, sedge and blackberry were the common ground cover plants, associated with scattered steeplebush, pin cherry, and willows. Most of the Wolfville and Queens soils were occupied by grasses, occasionally mixed with blueberry and mosses.

Fire appears to have been responsible for the extensive barrens in the southeastern part of the county, most of which have been mapped as Rockland. These barrens are now covered by sheep laurel, bracken, blueberry, bearberry, witherod, and huckleberry.

## METHODS

In June 1974, 10% of the trees in each plantation, in randomly selected rows, were measured to determine survival, height, height increment, and diameter. All plantations were examined for infestations of fungi, insects, and other forms of damage.

# RESULTS

A total of 42.8 hectares of plantations was surveyed. The Nova Scotia Department of Lands and Forests planted 30.3 hectares of this area with seedlings produced at the Forest Tree Nursery at Lawrencetown, Annapolis County. Private owners planted the remaining 12.5 hectares, mainly with introduced species whose origin is uncertain and not recorded.

Most of the plantations, 34.3 hectares, were established on old fields; 2.8 hectares were on cutovers, 5.6 hectares on barrens, and 0.1 hectare on a sand dune.

Only coniferous species were planted, the major ones being red pine (56%), red spruce (23%), white spruce (10%), and black spruce (4%). Lodgepole pine, Norway spruce, Scots pine, Virginia pine, and pitch pine comprise the remainder.

## *Spacing and Survival*

Spacings used when planting the three native spruces and red pine are presented in Table 1.

For the other species, initial spacing varied from 0.9 x 1.2 m to 3.7 x 1.8 m. Irregular spacing was also utilized, mostly on Gibraltar soil (Appendix A, Table 2, Pl. No. 16, 17), where land formation and rockiness made it necessary to use the better microsites within the planting area. No explanation can be given, however, why spruces were planted at a wider spacing more frequently than red pine.

Table 1. Spacings used in planting native spruces and red pine

| | Spacing (metre) | | | |
|---|---|---|---|---|
| | 1.8 x 1.8 (6 x 6 ft) | 1.8 x 2.4 (6 x 8 ft) | 2.4 x 2.4 (8 x 8 ft) | Irregular |
| Number of seedlings/ha | 2990 | 2244 | 1680 | 1420 |
| | Species distribution (%) in spacing | | | |
| Spruce (red, black and white) | 40 | 40 | 75 | 0 |
| Red pine | 60 | 60 | 25 | 100 |

Average survival of native spruces was 64% and of red pine 62% at 10 years after planting (survival data for individual plantations are given in Appendix A and are shown by species and soil type in Fig. 3). At an initial 2.4 x 2.4 m spacing these survival rates will result in about 1050 trees/ha. Experience in many parts of North America has been that about 2500 trees/ha is an optimum planting density for a wide variety of sites and species; such a density is also considered optimum for old field sites in Nova Scotia to ensure a fully stocked stand. In general, the assessed plantations have below optimum numbers of stems per hectare.

Where available, data on stock age suggest that most seedlings were large enough and of adequate quality at the time of planting. In several cases, the relatively low survival rates can be attributed to severe grass competition resulting from an absence of any site preparation or other cultural treatments either before or after planting. Unsuitability of some species for the sites on which they were used and the inherent poor soil quality of some sites probably also contributed to the low survival rates.

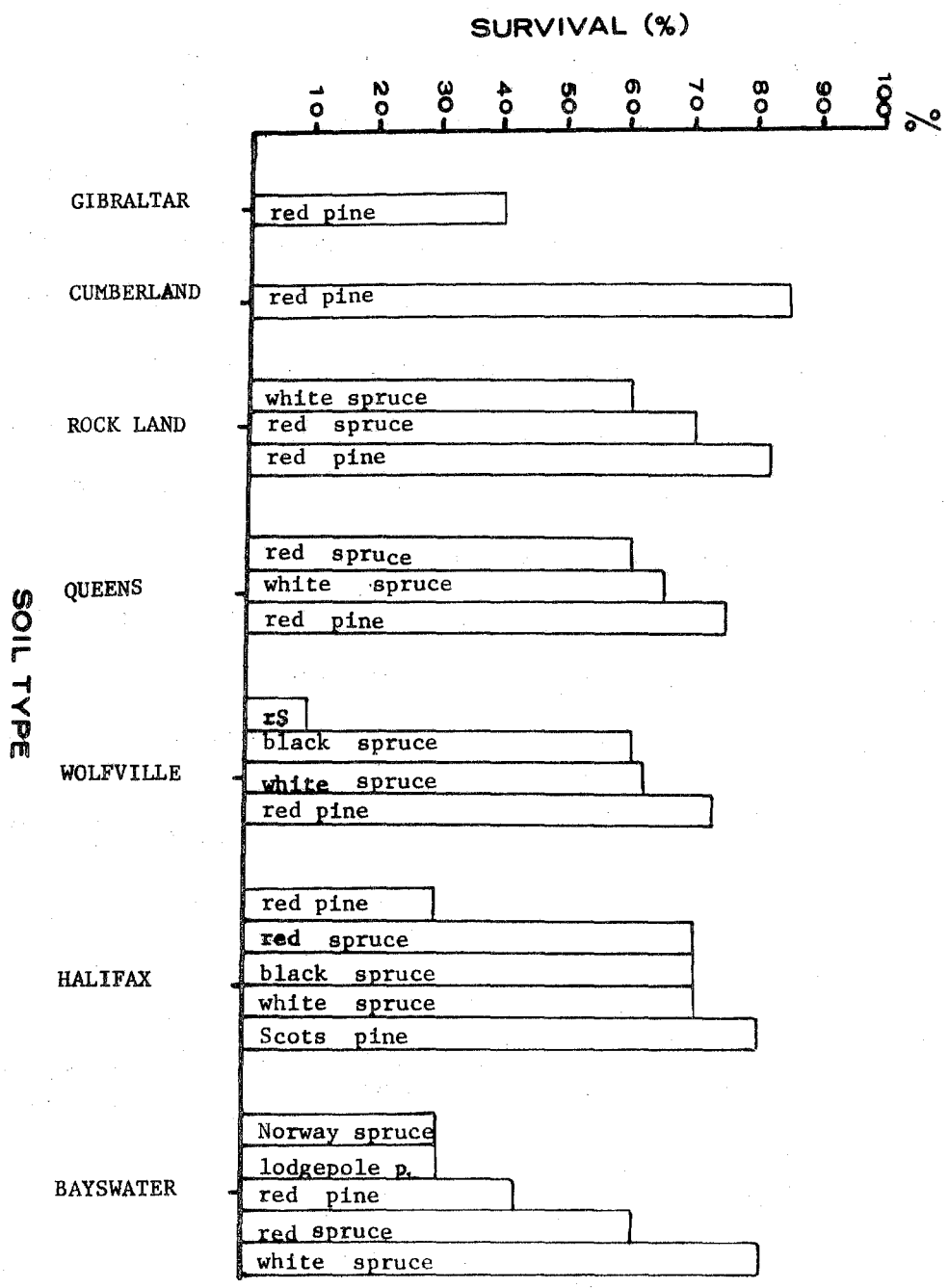



Fig. 3. Percentage survival of trees planted in different soils.

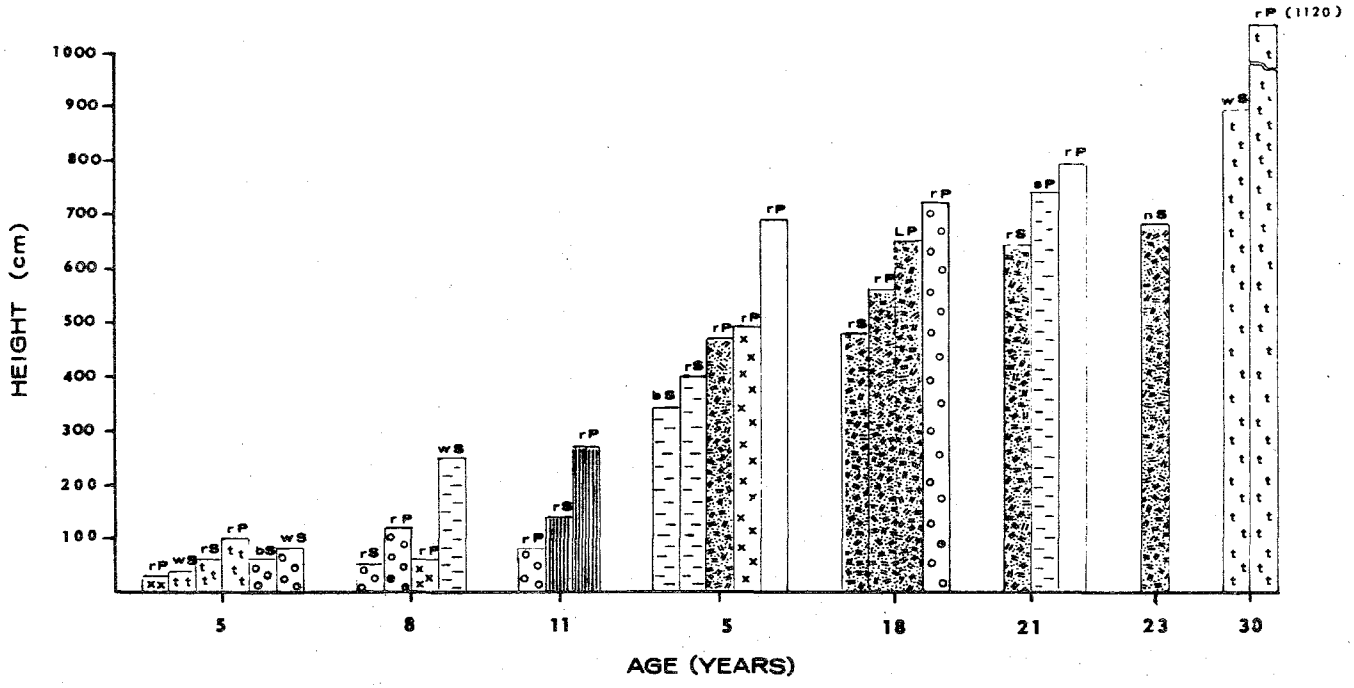
None of the plantations were affected by serious infestations of fungi or insects. The most damaging agent, particularly for pines, was porcupine, which caused a fairly large loss of trees.

Red spruce on Wolfville soil at Clattenburg Brook (Pl. No. 24) exhibited the lowest survival of all. This plot was located in the poorest part of a large plantation of red spruce, white spruce, and red pine, where drainage was poor and weed competition severe; these are conditions of which red spruce is intolerant. The other two species are growing better on this site than the red spruce. Norway spruce and lodgepole pine showed poor survival on the sticky, compact, and structureless gleyed soil of plantations 12 and 13. The poorly drained lower soil horizon is probably responsible for the low survival of the red pine on Halifax soil, while spruces having shallower root systems than red pine, are growing fairly well on this series. In Gibraltar soil, only a 20 centimetre rooting depth was measured, giving inadequate room for the deeper root system of red pine and resulting in a very low survival of this species. On the Wolfville, Queens, and Cumberland soils, and on the Rockland land type, the good performance of the species that have been planted, especially of red pine, can be explained by the relatively good drainage and adequate depth of the solum.

### *Height Growth*

Total height attained in the various plantations is shown by age-class and soil type in Fig. 4. In general, red pine has shown the best height-growth of all native species in all age classes and on all

Fig. 4. Total height of planted trees from 5 to 30 years in age on different soils.



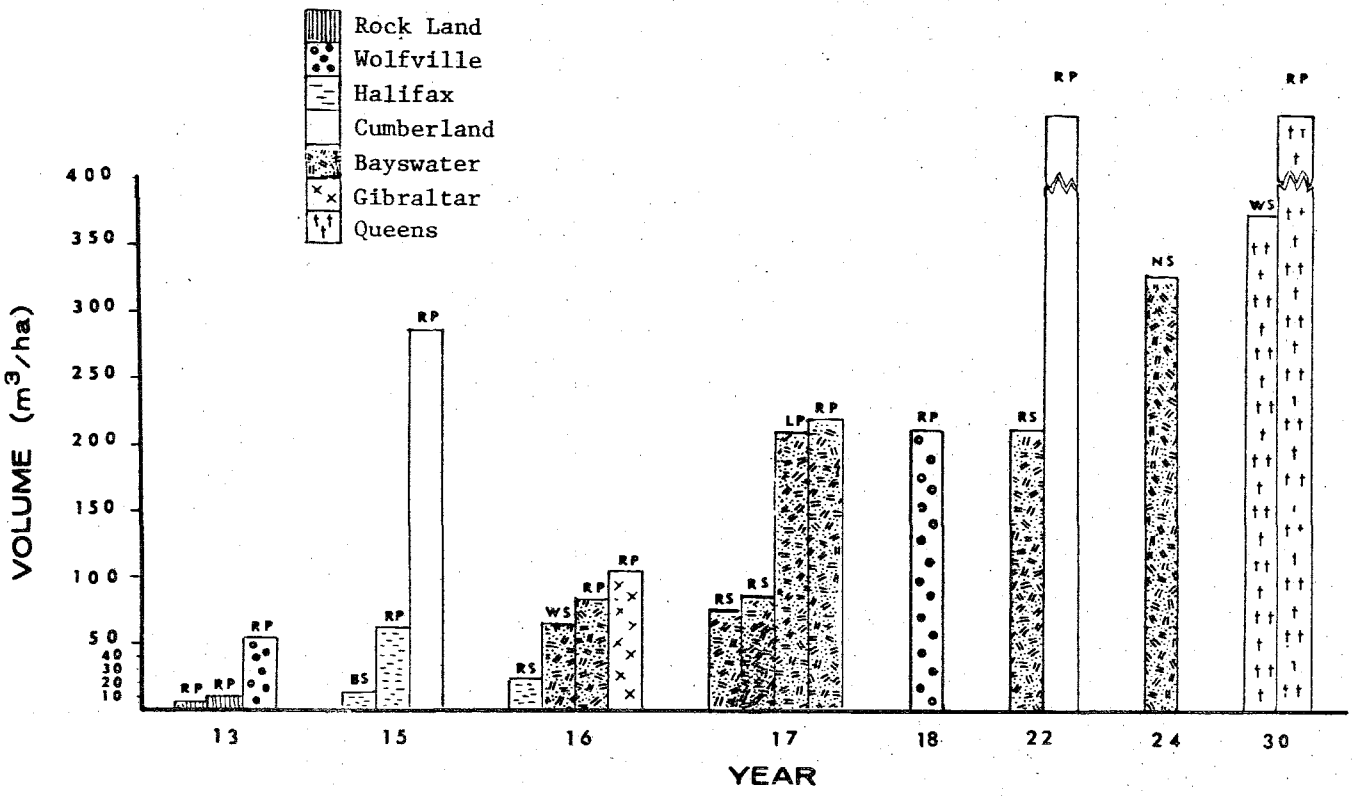



Fig. 5. Comparative volume production per hectare at different ages and on different soils.

soils except the Gibraltar series. Here the shallow rooting depth and the cemented BC horizon are responsible for the reduced growth rate of red pine.

An examination of height growth attained by the four native species at different ages shows a pattern of progressively increasing rate of growth up to an age of about 25 years. It is evident that most of the plantations went through a period of "planting check" about 5 to 6 years after establishment, possibly caused by excessive grass and other weed competition combined with dry summer conditions.

Also, coefficient of variation analysis has shown that the variation in height within each of the four native species used was about three times higher at age 2 to 5 years than it was at 20 to 24 years. This suggests that uneven early growth patterns will gradually disappear with increasing age of the plantations.

Table 2 illustrates the maximum height and diameter of introduced and native species growing in close proximity to one another and on the same soil series at Goodwood (Pl. No. 7-10, 12, 13). Norway spruce and lodgepole pine have exhibited better maximum diameter and height growth than the native species on this site, but their very poor survival and the great number of stunted and damaged trees suggests that they may not be suitable for use on a large scale.

### *Volume Production*

Figure 5 shows the relationships between soil series, age class, and comparative volume production. Volume data on the chart have been calculated on the basis of fully-stocked stands containing 2500 trees/ha; values can therefore be used for comparative purposes but

Table 2. Comparison of growth, survival, and disease resistance of introduced and native tree species in Halifax County, Nova Scotia

| Species | Plantation Number | Year of Planting* | Total Number of Seedlings planted | Max. dbh (cm) | Max. Height (cm) | Mean Height (cm) | Survival % | Damaging Agents | Healthy Trees % |
|---|---|---|---|---|---|---|---|---|---|
| Red pine | 8 | 1957 | 6000 | 16 | 610 | (560) | 40 | Porcupine | 10 |
| Red spruce | 7 and 9 | ?1957 | 5200 | 10 | 595 | (476) | 60 | nil | 90 |
| Lodgepole pine | 12 | 1957 | 3600 | 19 | 732 | (650) | 30 | Porcupine, Needle cast | 5 |
| White spruce | 10 | 1958 | 2400 | 11 | 671 | (500) | 80 | nil | 100 |
| Norway spruce | 13 | ** | 3600 | 19 | 823 | (680) | 30 | Porcupine, Weevil | 60 |

*Estimated from annual rings.

**This species was probably also established in 1957 or 1958 but using older stock than for the other species.

not, because of stocking differences, to indicate actual volume production in any of the assessed plantations.

The superior volume production of red pine in most age classes and on most types of soil is notable. The effects of soil quality on volume increment are also evident; for example, 13 years after planting red pine can be expected to produce almost five times as much volume on Wolfville soils as on Rockland sites. However, all old field sites studied, with the exception of those on Rockland, gave evidence of supporting satisfactory early growth and promise of later producing a merchantable stand.

## DISCUSSION AND CONCLUSIONS

Data obtained from this assessment were highly variable, and did not permit extensive statistical analyses. Dissimilarity of site, age-class and seedling quality used for planting influenced the results considerably and in most cases did not allow a controlled comparison between plantations and species. The purpose in gathering and summarizing these observations has therefore been to assist in identifying and analyzing reforestation problems and in providing some guidance on effective plantation establishment practice in Halifax County and neighbouring parts of Nova Scotia.

Grass competition is considered primarily responsible for much of the mortality of the planted seedlings on old fields. Under such conditions, the young trees are forced to compete with dense ground vegetation for rooting space soon after planting. Root system growth is slowed and the seedlings are consequently less able to satisfy their moisture demands during summer drought. This suggests that when

plantations are to be established on old fields, the entire ground surface should be cultivated before planting; further cultivation and/or careful use of herbicides may also be necessary during the first few years after planting, especially for species such as red spruce and red pine that are particularly susceptible to competition from dense ground vegetation.

A definite conclusion on the best size and age of planting stock cannot be drawn from this assessment because of insufficient data, although it is clear that the quality of seedlings must be considered carefully. In general, it appears that better results will be obtained with larger plants, such as 2-2 transplants for spruce. For red pine, 2-0 and 3-0 stock are suggested for use on old fields and plantable barrens, respectively.

Planting abandoned fields previously used for agricultural purposes requires detailed knowledge of site conditions, including vegetation, climate, soil, and geomorphology. The assessment also showed that there are several other factors to consider when selecting the best species for planting. For instance, it was observed that *red spruce* exhibited the smallest average height growth and the least healthy shape among the spruces planted (Fig. 6). Red spruce grows best under shade during the first 4 or 5 years after planting and retains a marked shade tolerance thereafter. This condition will not be available for red spruce in open fields, and therefore red spruce appears to be a dubious candidate for old field plantations. *Black spruce* thrived better on old field sites than did red spruce, especially on northern slopes and at lower elevations, perhaps because of cooler moister conditions. The superior growth of *white spruce* over the other spruces (including Norway spruce) can be attributed to its adaptability to various site

Fig. 6. Invasion of wS on abandoned pasture

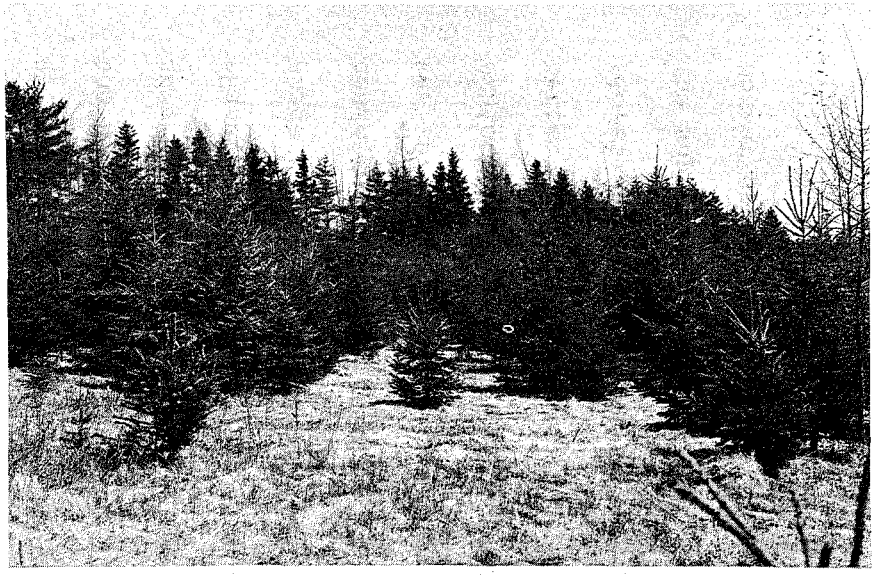


Fig. 7. Red spruce plantation on Halifax soil, 15 y.o. some natural wS in the foreground

Fig. 8. Pitch pine on Cumberland soil, 21 y.o.

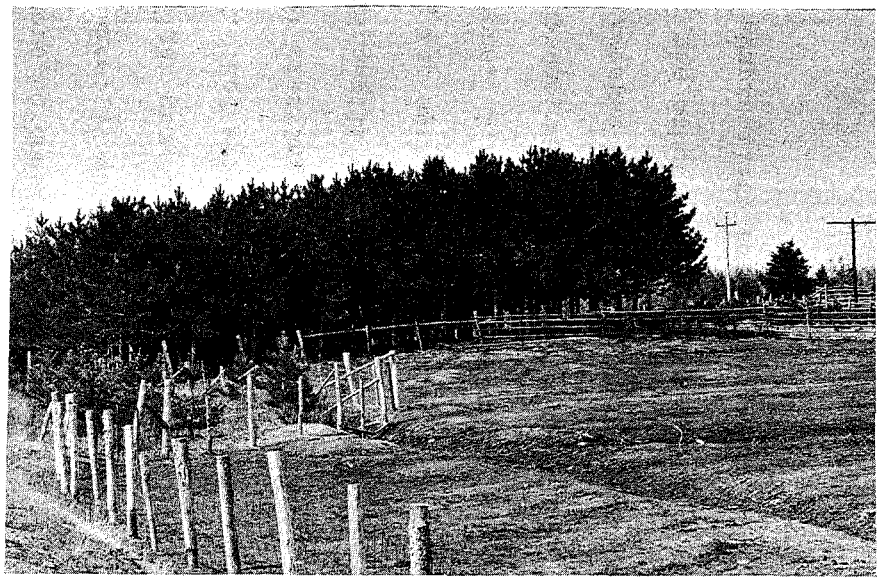


Fig. 9. Red pine on Cumberland soil, 15 y.o.

conditions, and to its preference for full light, especially as it grows older (Fig. 4). White spruce has spread by natural regeneration on to a large percentage of abandoned farm lands (Fig. 7). A height growth of 40 to 50 cm per year at age 20 to 25 years was measured in some white spruce plantations, although in more exposed locations, especially on dry southern slopes, dense vegetation increased the adverse effects of the inadequate moisture supply, with marked detrimental effects on growth. Differences in soils resulted in markedly different growth rates of *red pine*, which generally thrives on a fresh to moist acidic sandy loam lacking a hard-pan (Fig. 8). Red pine does not readily tolerate grass competition.

Commercially-valuable broadleaved trees, such as sugar maple, red maple, yellow birch, white birch, white ash, and hybrid poplars may also be suitable for planting alone or in mixture with conifers. However, data on seedling production and planting methods and on site selection, are not yet available for these species.

Some exotic species have grown reasonably well in trial plantations (e.g. pitch pine, Fig. 9) and should continue to be used in this manner, but none are as yet of proven value for use in large-scale reforestation programs.

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# APPENDIX A: Summaries of Plantation Records

Summary of Plantation Records for Halifax County (See Fig. 2 for locations).

| Plantation number | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Species | rS | bS | rP | sP | wS | VP | rS |
| Year planted | 59 | 60 | 60 | 54 | 65 | 63 | 57 |
| Stock age (years) | ? | ? | ? | ? | ? | ? | ? |
| Spacing (m) | 1.8x2.4 | 1.8x2.4 | 1.8x2.4 | 2.4x2.4 | 2.4x2.1 | 0.9x1.2 | 2.4x2.4 |
| Survival (%) | 70 | 70 | 30 | 80 | 70 | 80 | 60 |
| Mean height (m) | 4.0 | 3.4 | 4.1 | 7.4 | 2.5 | 2.0 | 4.9 |
| Soil type | Halifax | Halifax | Halifax | Halifax | Halifax | Dune | Bayswater |
| Area (ha) | 2.0 | 1.2 | 0.8 | 0.6 | 1.0 | 0.1 | 2.0 |
| Status | Good | Good | Poor | Good | Fair | Fair | Good |
| Number trees planted | 5000 | 3000 | 2000 | 1500 | 2500 | 300 | 4500 |

| Plantation number | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|
| Species | rP | rS | wS | rP | LP | NS | rS |
| Year planted | 57 | 57 | 58 | 58 | 57 | 51 | 52 |
| Stock age (years) | ? | ? | ? | ? | ? | ? | ? |
| Spacing (m) | 1.8x1.8 | 2.4x2.4 | 1.8x1.8 | 1.8x1.8 | 1.8x1.8 | 1.8x1.8 | 2.4x2.4 |
| Survival (%) | 40 | 60 | 80 | 45 | 30 | 30 | 50 |
| Mean height (m) | 5.6 | 4.8 | 5.0 | 4.7 | 6.5 | 6.8 | 6.4 |
| Soil type | Bayswater | Bayswater | Bayswater | Bayswater | Bayswater | Bayswater | Bayswater |
| Area (ha) | 2.0 | 0.3 | 0.8 | 0.8 | 1.2 | 1.2 | 0.6 |
| Status | Poor | Poor | Good | Poor | Poor | Poor | Poor |
| Number trees planted | 6000 | 700 | 2400 | 2400 | 3600 | 3600 | 1300 |

| Plantation number | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|
| Species | rP | rP | rP | wS | bS | rP | rP |
| Year planted | 58 | 67 | 69 | 69 | 68 | 66 | 67 |
| Stock age (years) | ? | 2-2 | 2-0 | 3-0 | 3-2 | 2-2 | 2-2 |
| Spacing (m) | 1.8x1.8 | Irr. | Irr. | 2.4x2.4 | 2.4x2.4 | 1.8x2.4 | 2.4x2.4 |
| Survival (%) | 60 | 40 | 20 | 62 | 60 | 80 | 75 |
| Mean height (m) | 4.9 | 0.6 | 0.3 | 0.9 | 0.6 | 1.2 | 1.4 |
| Soil type | Gibraltar | Gibraltar | Gibraltar | Wolfville | Wolfville | Wolfville | Wolfville |
| Area (ha) | 0.6 | 0.8 | 0.8 | 1.6 | 0.4 | 5.3 | 3.6 |
| Status | Good | Poor | v.Poor | Fair | Fair | Fair | Good |
| Number trees planted | 1800 | 1200 | 1200 | 3000 | 800 | 19,000 | 5200 |

Abbreviations used in plantation record summaries and in Figs. 3, 4 and 5.

| Item | Abbreviation | Full Name |
|---|---|---|
| Species | wS | white spruce |
| | rS | red spruce |
| | bS | black spruce |
| | NS | Norway spruce |
| | rP | red pine |
| | VP | Virginia pine |
| | LP | lodgepole pine |

| Plantation number | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|
| Species | wS | rP | rS | rP | rP | rP | rS |
| Year planted | 69 | 67 | 67 | 62 | 62 | 64 | 64 |
| Stock age (years) | 2-2 | 2-2 | 3-2 | ? | ? | 2-2 | 3-2 |
| Spacing (m) | 2.4x2.4 | 2.4x2.4 | 1.8x1.8 | Irr. | 1.8x2.4 | 3.7x1.8 | 2.4x2.4 |
| Survival (%) | 60 | 80 | 10 | 50 | 85 | 80 | 70 |
| Mean height (m) | 0.7 | 1.5 | 0.5 | 4.0 | 2.7 | 2.0 | 1.4 |
| Soil type | Wolfville | Wolfville | Wolfville | Wolfville | Rockland | Rockland | Rockland |
| Area (ha) | 0.2 | 0.8 | 2.4 | 0.8 | 2.0 | 1.6 | 1.6 |
| Status | Fair | Good | v.Poor | Poor | Good | Good | Good |
| Number trees planted | 1000 | 1300 | 6500 | 1000 | 4000 | 2300 | 2990 |

| Plantation number | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
|---|---|---|---|---|---|---|---|
| Species | wS | rP | rP | wS | wS | rS | rP |
| Year planted | 64 | 56 | 44 | 44 | 68 | 69 | 68 |
| Stock age (years) | 3-2 | 2-2 | ? | ? | 3-2 | 2-2 | 3-0 |
| Spacing (m) | 2.4x2.4 | 1.8x1.8 | 2.4x2.4 | 2.4x2.4 | 1.8x1.8 | 1.8x1.8 | 1.8x1.8 |
| Survival (%) | 60 | 85 | 80 | 80 | 50 | 60 | 80 |
| Mean height (m) | 1.3 | 7.2 | 11.2 | 8.9 | 0.4 | 0.6 | 1.2 |
| Soil type | Rockland | Wolfville | Queens | Queens | Queens | Queens | Queens |
| Area (ha) | ? | 0.3 | 1.2 | 0.4 | 0.4 | 0.4 | 0.6 |
| Status | Good | Good | Good | Good | Poor | v.Poor | Fair |
| Number trees planted | ? | 1000 | 1350 | ? | 900 | 1000 | 1400 |

| Plantation number | 36 | 37 | 38 |
|---|---|---|---|
| Species | rP | rP | rP |
| Planting date | 52 | 59 | 70 |
| Stock age (years) | ? | ? | 2-2 |
| Spacing (m) | 3.1x2.4 | 2.1x2.4 | 1.8x1.8 |
| Survival (%) | 85 | 85 | 65 |
| Mean height (m) | 7.9 | 6.9 | 0.7 |
| Soil type | Cumberland | Cumberland | Queens |
| Area (ha) | 0.2 | 0.2 | 2.0 |
| Status | v.Good | v.Poor | Poor |
| Number trees planted | 300 | 300 | 3000 |

| Soil type | Area (ha) | % | |
|---|---|---|---|
| Halifax | 5.6 | 13 | |
| Bayswater | 8.9 | 21 | |
| Gibraltar | 2.2 | 5 | |
| Wolfville | 15.4 | 36 | |
| Rockland | 5.3 | 12 | |
| Queens | 5.0 | 12 | |
| Cumberland | 0.4 | 1 | |
| Total | 42.8 ha | | (105.8 acres) |

APPENDIX B: Common and Botanical Names of Species Cited in Text

Common and Botanical Names of Species Cited in Text

| | |
|---|---|
| Bearberry | *Arctostaphylos uva-ursi* (L.) Spreng |
| Blackberry | *Rubus* spp. |
| Blueberry | *Vaccinium angustifolium* Ait. |
| Bracken | *Pteridium aquilinum* (L.) Kuhn |
| Broom crowberry | *Corema conradii* Torr. |
| Grasses | *Anthoxanthum, Panicum, Nardus, Poa* spp. etc. |
| Huckleberry | *Gaylussacia baccata* (Wong) K. Koch. |
| Lichens | *Cladonia* spp. |
| Mosses | *Polytrichum* spp. |
| Pin cherry | *Prunus pensylvanica* L. |
| Sedges | *Cyperus* spp. |
| Sheep laurel | *Kalmia angustifolia* L. |
| Steeplebush | *Spiraea tomentosa* L. |
| Witch-hazel | *Hamamelis virginiana* L. |
| Witherod | *Viburnum cassinoides* L. |

| | |
|---|---|
| Ash, white | *Fraxinus americans* L. |
| Beech | *Fagus grandifolia* Enrh. |
| Birch, white | *Betula papyrifera* Marsh. |
| Birch, yellow | *B. allegheniensis* Britten (*B. lutea* Michx. f.) |
| Fir balsam | *Abies balsamea* (L.) Mill |
| Hemlock | *Tsuga canadensis* (L.) Carr. |
| Maple, red | *Acer rubrum* L. |
| Maple, sugar | *A. saccharum* Marsh. |
| Oak, red | *Quercus rubra* L. |
| Pine, jack | *Pinus banksiana* Lamb. |
| Pine, lodgepole | *P. contorta* Dougl. |
| Pine, pitch | *P. rigida* Mill |
| Pine, red | *P. resinosa* Ait |
| Pine, Scots | *P. sylvestris* L. |
| Pine, Virginia | *P. virginiana* Mill. |
| Pine, white | *P. strobus* L. |
| Spruce, black | *Picea mariana* (Mill) BSP. |
| Spruce, Norway | *P. abies* (L.) Karst. |
| Spruce, red | *P. rubens* Sarg. |
| Spruce, white | *P. strobus* L. |
| Willows | *Salix* spp. |