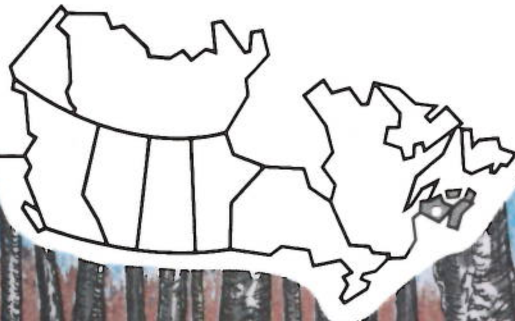
Agriculture Canada
Canadian Forestry Service

Agriculture Canada
Service canadien des forêts

Thinning Tolerant Hardwoods in Nova Scotia

J.C. Lees



Information Report M-X-152
Maritimes Forest Research Centre

MARITIMES FOREST RESEARCH CENTRE

The Maritimes Forest Research Centre (MFRC) is one of six regional establishments of the Canadian Forestry Service, within Agriculture Canada. The Centre conducts a program of work directed toward the solution of major forestry problems and the development of more effective forest management techniques for use in the Maritime Provinces.

The program consists of three major elements - research and development, technical and information services, and forest resources development. Most research and development work is undertaken in direct response to the needs of forest management agencies, with the aim of improving the protection, growth, and value of the region's forest resource for a variety of consumptive and nonconsumptive uses; studies are often carried out jointly with provincial governments and industry. The Centre's technical and information services are designed to bring research results to the attention of potential users, to demonstrate new and improved forest management techniques, to assist management agencies in solving day-to-day problems, and to keep the public fully informed on the work of the Maritimes Forest Research Centre.

The forest resources development branch is responsible for development, implementation, and administration of joint federal/provincial forest resources development agreements in the three Maritime provinces, for the creation of employment opportunities in the development of the forest resources, and for providing economic information to landowners and decision-makers for identifying and evaluating forest management alternatives.

THINNING TOLERANT HARDWOODS IN NOVA SCOTIA

by

J.C. Lees

Maritimes Forest Research Centre
Fredericton, New Brunswick

Information Report M-X-152

Department of Agriculture
Canadian Forestry Service

1984

Catalogue no. Fo46-19/152E
ISBN 0-662-13600-8
ISSN 0704-769X

Copies of this report may be obtained at no charge from

Maritimes Forest Research Centre
Canadian Forestry Service
P.O. Box 4000
Fredericton, N.B. Canada E3B 5P7

Une traduction francaise de ce rapport, intitulé "Eclairie de feuillus tolérants en Nouvelle-Ecosse", peut être mise à la disponibilité de quiconque en fait la demande.

ABSTRACT

A thinning study was begun in 1959 in Nova Scotia to improve quality in tolerant hardwoods. Yellow birch was favored in a birch, sugar maple, and beech mixture. Remeasurement in 1965 showed a worthwhile response to heavy thinning to release crop tree crowns. Subsequently birch crop trees suffered damage from porcupine feeding, exposure of emergent dominant crowns, and decay spreading from butt scars caused by logging. In a 1978 thinning of the original control, light, and heavily thinned plots, the then more vigorous sugar maple was favored and diseased beech and damaged yellow birch discriminated against. Chemical thinning was carried out in 1978 on one of the four (1960) treatment blocks. Beech and yellow birch were susceptible to treatment (60-100% crown kill). Sugar maple was less so (14-52%). Reassessment in 1980 showed that standing volumes were 60 $m^3 \cdot ha^{-1}$ on heavily thinned (1960) plots, 74 $m^3 \cdot ha^{-1}$ on lightly thinned (1960) plots and 83 $m^3 \cdot ha^{-1}$ on control (1960) plots. Total volume production to date has been 150 $m^3 \cdot ha^{-1}$ (heavy), 147 $m^3 \cdot ha^{-1}$ (light) and 188 $m^3 \cdot ha^{-1}$ (control). Stand volumes and stem quality will be assessed in 1988.

RESUME

Une étude de l'éclaircie a été entreprise en 1959 en Nouvelle-Écosse en vue d'améliorer la qualité des feuillus tolérants. Le bouleau jaune à été favorisé dans un mélange de bouleaux, d'érable à sucre et de hêtre à grandes feuilles. Les mesures prises en 1965 ont indiqué une réponse satisfaisante à la forte éclaircie pratiquée pour dégager les cimes des arbres d'avenir. Par la suite, les bouleaux ont subi des dommages causés par les porcs-épics, par l'exposition des cimes dominantes et par la pourriture s'étant développée à partir des blessures du pied infligées lors des travaux. En 1978, lors d'une éclaircie des parcelles témoins et traitées (à légère et forte éclaircies) originales, les érables à sucre alors plus vigoureux ont été favorisés au détriment des hêtres malades et des bouleaux jaunes endommagés. Une éclaircie chimique a été pratiquée en 1978 dans l'une des quatre parcelles traitées (1960). Le hêtre et le bouleau ont été durement touchés (60 à 100% de mortalité de la cime), mais l'érable à sucre l'a été moins (14 à 52%). Un réexamen en 1980 a indiqué un volume sur pied de 60 m^3/ha dans les parcelles fortement éclaircies (1960), de 74 m^3/ha dans les parcelles légèrement éclaircies (1960) et de 83 m^3/ha dans les parcelles témoins (1960). Les productions totales en volume jusqu'ici s'élèvent à 150, 147, et 188 m^3/ha, respectivement. Le volume des peuplements et la qualité des tiges doivent être évalués en 1988.

INTRODUCTION

The project "Thinning Immature Yellow Birch" was first proposed in 1958 by the original investigator, M.H. Drinkwater. He argued that the supply of sawlog quality birch[1] in Nova Scotia was dwindling and that sugar maple, and the disease-prone beech were competing more successfully for available sites (Drinkwater 1957).

Because yellow birch occurs in mixed hardwood stands along with white birch, red maple, poplars, beech, sugar maple, and scattered softwoods, Drinkwater proposed selecting yellow birch crop trees, releasing their crowns and thinning among other stems to maintain "full stocking", natural pruning, and complete crown cover. Crop tree release was to begin at age 30 years. Thinnings were to produce fuelwood. Reassessment was planned at age 50 and further thinning was then to be carried out.

A stand suitable for treatment was found on Crown land on Sugarloaf Mountain (elev. 190 m above sea level) in Cumberland County, Nova Scotia, and in the A-13 Cobequid Forest Section (Rowe 1972), (about 45°34'N, 63°49'W).

The district is part of the northern slope of the Cobequid "mountains", rolling hills that extend north to the Cumberland lowlands, and the Northumberland Strait between Nova Scotia and Prince Edward Island. The Sugarloaf Brook valley at the study area is narrow and deep and is joined by several intermittent streams that cross the slope. Exposure to wind is severe and tree height growth is limited except in sheltered valley sections.

Soils are brown gravelly sandy loams on till derived from granite-ortho-ferro-humic podzols of the Wyvern series (Nowland and MacDougall 1973). Moderately deep profiles occur on the gentle slopes, but the soil is shallow on the steep slopes. Drainage is rapid.

The forest is young second-growth mixed tolerant hardwoods originating from fire that burned in late May 1921 through recent mixedwood cutovers. In 1959, of the total basal area of 23 $m^2 \cdot ha^{-1}$, 63% was yellow birch, 25% sugar maple, and 12% beech. The stand was about 35 years old, 10 m in height with stem diameters ranging from 2 to 15 cm.

TREATMENTS

Crown release to favor yellow birch was completed in 1960, a remeasurement was carried out in 1965, and an assessment of the response to thinning in 1977.

In 1959, two intensities of thinning, light, 1 - 1.5 m between crowns; heavy, 2.5 - 3 m between crowns, and an unthinned control treatment had been assigned to three sections on each of five 4-acre (1.6-ha) blocks. By 1965 one block had been lost in power line right-of-way clearing (Fig. 1).

Between 1959 and 1977, the identified yellow birch crop trees had been severely damaged by porcupines feeding in the crowns and at the rootswell, where sap flowing from logging wounds may have attracted them.

Two tussock moth, Orgyia leucostigma (J.E. Smith), outbreaks during the period 1956-1976 caused extensive but temporary defoliation of sugar maple and white birch. Butt rot was common in logging-damaged stems. Increment borings in 1977 (Table 1) showed a decrease in radial growth of all species over the previous 10 years following an initial increased response during the first five years after treatment.

These considerations led to my decision in 1978 to thin all treatment plots

[1] Scientific and common species names are appended.

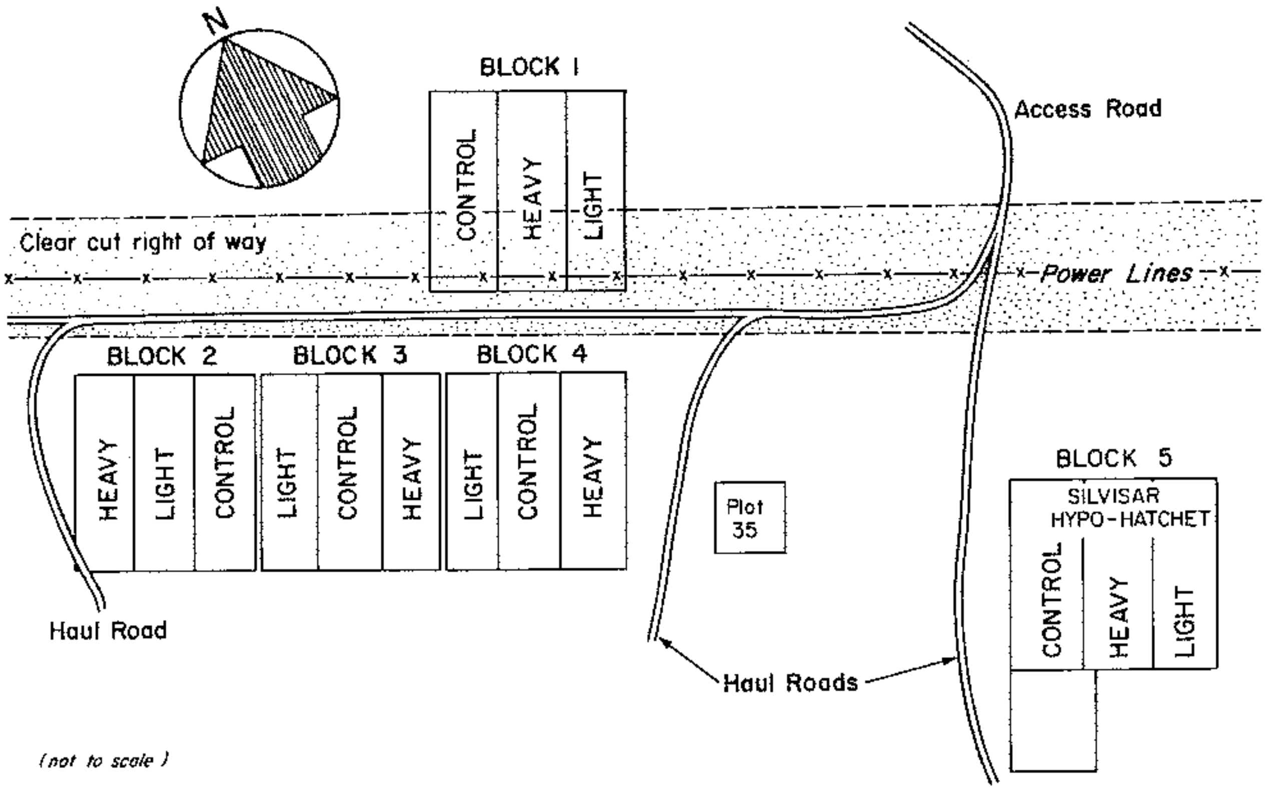


Fig. 1. Study block layout

Table 1. Mean radial increment of sample dominants before and after thinning

Thinning treatment (n)	5 years before 1960 thinning P.A.I. (mm)	5 years after 1960 thinning P.A.I. (mm)	10 years (1957-67) P.A.I. (mm)	10 years (1967-77) P.A.I. (mm)
Heavy (13)	1.22	2.04	1.72	1.54
Light (12)	1.1	1.6	1.53	1.51
Control (10)	1.32	1.54	1.41	1.16

*P.A.I., Periodic annual increment.

and their surrounds to a more or less uniform residual stocking, thus creating three thinning intensities, and to compare responses in 10 years (1988) using practical stocking guidelines for northern hardwoods (Leak et al. 1969) then in use in New England, and now proposed for Maritimes woodlot owners (Lees and Embree 1983).

The resulting treatments were

1. A heavy thinning in the 1960-control plots, discriminating against diseased beech, sprout clump maple (thinned to one stem), and porcupine-damaged birch.

2. A moderate thinning in the 1960 lightly-thinned plots, discriminating against beech and favoring maple.

3. A light thinning in the 1960 heavily-thinned plots, favoring sugar maple.

All potential crop trees were marked and released individually; the other stems were thinned to a 6 x 6-m spacing. Basal area removals ranged from 75% on some control plots, to 25% on plots previously heavily thinned. The crews, provided by the Nova Scotia Department of Lands and Forests, (NSDLF) were encouraged to make changes in the marking as required, and they tended to favor the better beech stems which, if removed, would create a gap in the canopy. The thinning is illustrated in Figs. 2, 3, and 4. Skid trails 4 m wide were cut at 40 m intervals using a chainsaw. The wood was cut and piled in 8-foot (2.4-m) lengths. Extraction was by a Gafner "Iron Mule" swing-frame forwarder, equipped with a grapple loader. Logging-damaged stems were then cut and removed. One heavy-thinning plot (35) was marked but left unthinned for a further comparison in 1988. One complete block (5) was chemically thinned by a NSDLF crew using "Silvisar 500" and a

Fig. 2. Before thinning, 1978

As a percentage of the basal area, yellow birch and sugar maple have steadily increased in the stands thinned in 1960, and beech has declined. In the control stands thinned in 1978, yellow birch remains steady, sugar maple increased from 18 to 33%, and beech declined naturally from 27% in 1965 to 10% in 1978 before thinning, and to 5% after thinning.

Table 4 shows estimates of total standing volumes derived from the basal area, quadratic mean tree diameter (Table 5) and mean height of dominant sample trees for each plot (Table 6); and introduces a discussion of the effectiveness of the 1960 thinnings.

When 1978 thinnings were added to standing volumes in 1980, the original control plots produced 188 $m^3 . ha^{-1}$, light thinning 147 m^3, and heavy 150 m^3. Since no product was generated in 1960, it is questionable whether these 30-year-old hardwood stands were suitable for treatment at that time. The diseased beech occupied valuable space useful for the growth of the other species, and should be removed in thinnings, but precommercial or noncommercial thinning is difficult to justify in terms of total volume production. A market for whole-tree chips would change this picture, but the shallow soils on the steep slopes and the exposed crest of the hill at Sugarloaf may not be the best sites on which to examine cost-effectiveness of tolerant hardwood thinning. Soil chemical analyses on samples collected in 1982 (appended) showed that while major nutrients were not deficient, they were available at low levels in the rooting zone at 20-30 cm depth, pH was low (4.6), and higher nutrient values at 0-10 cm were probably attributable to hardwood litter decomposition and comminution <u>in situ</u>, and not to the parent material.

CONCLUSION

This is an important demonstration, for the Maritime Provinces, of thinning in tolerant hardwoods. In 1957, Drinkwater correctly predicted the shortage of quality hardwood logs. He probably could not have guessed at the recent increases in domestic fuelwood consumption - a market for thinnings, and the availability of thinning subsidies. There is now an appropriately treated 22-acre (8.9-ha) stand of mixed tolerant hardwoods. It is 56 years old, thinned at ages 31 and 51 years. Both thinnings produced fuelwood in today's terms, probably sufficient to cover the costs of the operation. The 1978-79 thinning crew, which had no previous experience of this type of treatment, went on to complete other successful thinnings on Crown lands.

Thinning is now a common practice in the three Maritime Provinces, especially on private woodlots. The operation is usually cost-shared with government, and there is interest in results from "older" trials such as this. Reassessment of the Sugarloaf plots for further thinning is planned for 1988. At that time, it will be important to evaluate stem quality, and total "value production" - the original study objective, as well as total volume production.

Table 4. Total standing volume estimates, ($m^3.ha^{-1}$)

	After thinning 1960	Interim 1965	Removed 1978	After thinning 1980	Total volume production 1980
Heavy	63	68	90	60	150
Light	68	71	73	74	147
Control	84	102	105	83	188

Table 5. Mean diameter of selected dominant sample trees (cm)

		After thinning 1960	Interim 1965	After thinning 1980
Heavy	Yellow birch	10.4	12.5	18.2
	Sugar maple	9.9	11.6	16.5
	Beech	9.1	11.1	18.3
	All (n)	10.2 ± 2.5 (393)	12.3 ± 2.7 (360)	17.4 ± 2.5(76)
Light	Yellow birch	10.3	11.8	18.0
	Sugar maple	10.6	11.5	19.1
	Beech	9.8	12.1	17.2
	All (n)	10.3 ± 2.5 (393)	11.8 ± 2.7 (398)	18.3 ± 3.3(89)
Control	Yellow birch	10.5	11.8	17.4
	Sugar maple	10.8	12.1	17.5
	Beech	9.6	10.7	18.1
	All (n)	10.4 ± 2.3 (469)	11.7 ± 2.6 (441)	17.5 ± 3.3(89)

Table 6. Mean height of selected dominant sample trees (m)

	Species	After thinning 1960	Interim 1965	After thinning 1980
Heavy	Yellow birch	10.2	11.1	13.3
	Sugar maple	10.5	11.3	13.3
	Beech	8.7	9.6	13.8
	All (n)	10.0 ± 4.8 (396)	10.0 ± 4.2 (349)	13.3 ± 1.3(76)
Light	Yellow birch	10.6	11.2	13.7
	Sugar maple	10.3	11.3	14.5
	Beech	9.0	9.7	14.8
	All (n)	10.5 ± 4.8 (396)	11.1 ± 4.4 (394)	13.9 ± 1.3(89)
Control	Yellow birch	10.5	11.4	14.7
	Sugar maple	10.4	11.5	14.8
	Beech	9.2	9.7	14.8
	All (n)	10.2 ± 4.9 (482)	11.3 ± 4.8 (445)	14.8 ± 1.2(89)

REFERENCES

Drinkwater, M.H. 1957. The tolerant hardwood forests of northern Nova Scotia. Can. Dep. North. Aff. Nat. Resour., Can. For. Res. Div. Tech. Note 57.

Leak, W.B.; Solomon, D.S., Filip, S.M. 1969. A silvicultural guide for northern hardwoods in the Northeast. USDA For. Serv. Res. Pap. NE 143.

Lees, J.C; Embree, D.G. 1983. New England hardwood stocking guides should work for Maritime woodlot owners. Can. For. Serv. MFRC. Tech Note. 85.

Nowland, J.L., MacDougal, J.I. 1973. Soils of Cumberland County, Nova Scotia. Nova Scotia soil survey report No 17. 133 p. and maps.

Rowe, J.S. 1972. Forest regions of Canada. Dep. Environ., Can. For. Serv. Publ. 1300. 172 p. and map.

Safford, L.O. 1983. Silvicultural guide for paper birch in the Northeast (revised). USDA For. Serv. Northeast For. Exp. Stn. Res. Pap. No. 535.

SPECIES NAMES

Trembling aspen	_Populus tremuloides_ Michx.
Largetooth aspen	_Populus grandidentata_ Michx.
Grey birch	_Betula populifolia_ Marsh.
White birch	_Betula papyrifera_ Marsh.
Yellow birch	_Betula alleghaniensis_ Britton
Red maple	_Acer rubrum_ L.
Sugar maple	_Acer saccharum_ Marsh.
Mountain maple	_Acer spicatum_ Lam.
American beech	_Fagus grandifolia_ Ehrh.

APPENDIX

Soil samples from the Sugarloaf thinning area (5 bulked samples from each sample depth and location)

Location	Depth cm	pH	Ca (me/100g)	K (me/100g)	Mg (me/100g)	P ppm	Exch.cap. me/100g	OM % by wt	N % by wt
Top,back	0-10	4.7	0.11	0.06	0.04	10.5	8.89	6.5	0.15
	10-20	4.1	0.6	0.09	0.28	9.13	13.16	8.5	0.22
	20-30	5.0	0.17	0.04	0.04	6.13	8.18	5.6	0.11
Plot 35 (Control)	0-10	4.3	0.5	0.09	0.25	6.13	12.1	8.09	0.21
	10-20	4.6	0.17	0.04	0.05	5.5	8.89	6.07	0.13
	20-30	4.6	0.14	0.04	0.05	3.5	7.83	4.84	0.1
Front line	0-10	4.2	1.02	0.14	0.41	9.38	11.75	9.7	0.25
	10-20	4.3	0.4	0.1	0.2	4.75	13.52	8.77	0.28
	20-30	4.6	0.14	0.07	0.08	5.5	7.84	5.27	0.16