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EFFECTS OF SOME STAND AND SEEDBED TREATMENTS ON LESSER VEGETATION IN A BOREAL ONTARIO MIXEDWOOD

by

R. F. SUTTON

Sommaire et conclusions en français

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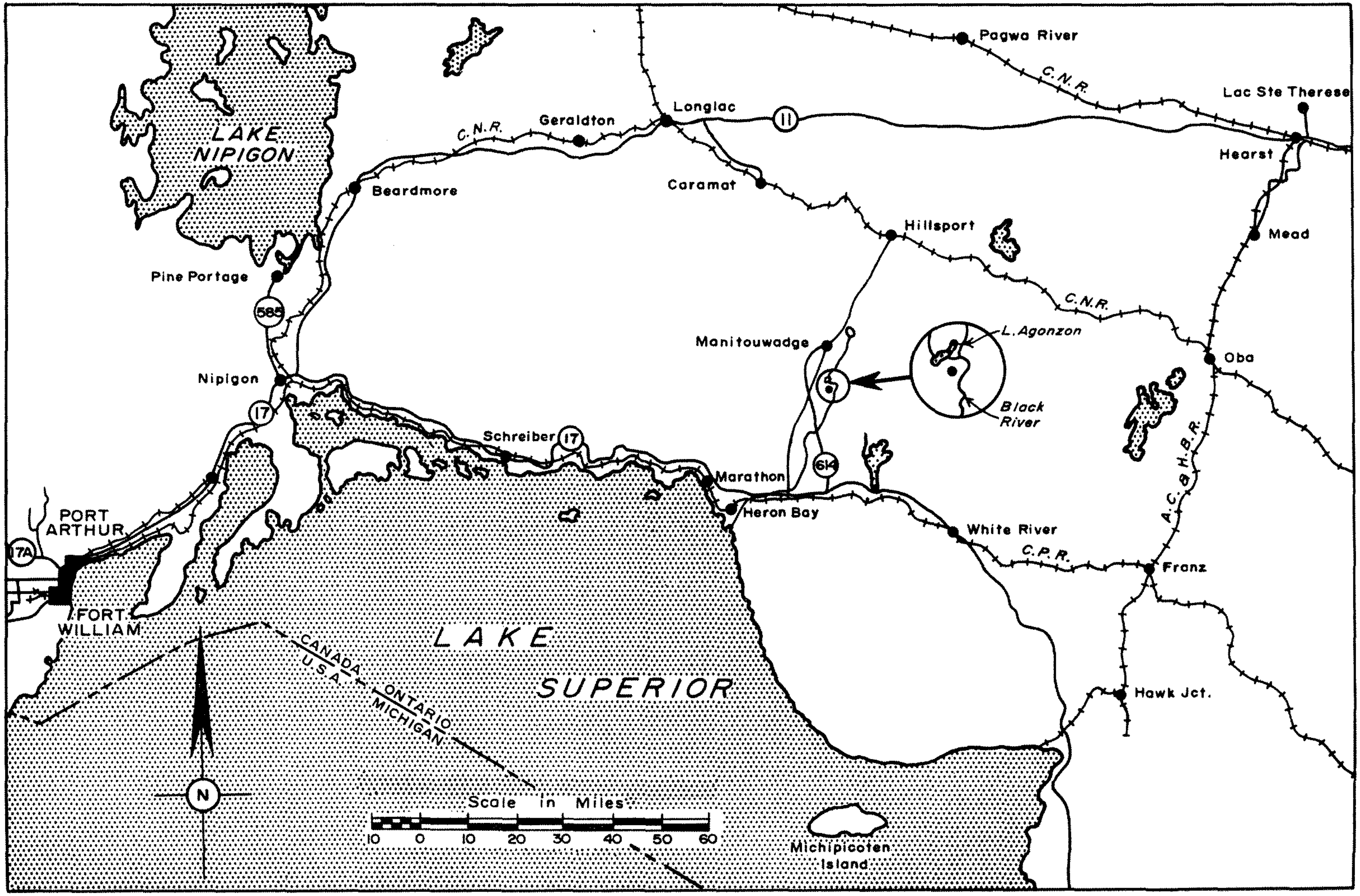

FRONTISPIECE: Key to Location of Study Area.

Effects of Some Stand and Seedbed Treatments on Lesser Vegetation in a Boreal Ontario Mixedwood[1]

by

R. F. SUTTON[2]

INTRODUCTION

Attention is being turned increasingly to the problem of regeneration of mixedwoods in the boreal forest. Various treatments have been carried out in attempts to increase, relatively and absolutely, the amount of desirable reproduction. A noteworthy example is provided by Co-operative Forest Research Project RC-17, which has as its objective the development of "methods of regenerating the mixedwood slope types of northwestern Ontario to coniferous species, especially spruce, following cutting" (MacLean 1959).

The present study was carried out in 1957 on fresh sites on the RC-17 experimental area to provide information on the course and rate of successional changes in vegetation following disturbances effected by given treatments. This area had been subjected to combinations of four overstorey and two principal seedbed treatments in the period 1953-56, and offered several interesting, treatment-induced conditions within a small compass.

THE STUDY AREA

The study was carried out at latitude 49° 00′ north, longitude 85° 49′ west, about 45 miles by road northeast of Heron Bay, Ontario (Frontispiece).

The whole region has been glaciated and relief is strongly influenced by the underlying ice-eroded Precambrian granites and gneisses. Broadish, flat-topped, SSW-NNE ridges constitute the most striking feature of the landscape. Sampling for the study was carried out on gentle middle-upper and upper ESE-facing slopes of one such ridge, at an elevation of about 1,200 feet.

The overlying till is generally somewhat stony, but in places the uppermost foot of soil is almost free of stones, and may be aeolian. Depth to bedrock is at least three and usually four or more feet on the area chosen for this study. Typically, the parent material is a sandy loam, and, at depths greater than 24 to 30 inches, it is calcareous and effervesces strongly when treated with dilute hydrochloric acid. The soil type is grey-wooded podzolic. Table 1 presents a description of a profile typical for the study area.

Thornthwaite's (1948) method of obtaining a figure for the effective precipitation by relating precipitation to temperature and latitude has been used by MacLean (1959) to calculate the march of precipitation and evapotranspiration at RC-17. Briefly, the growing season weather for the years immediately following the initial seedbed treatments was hot and dry in 1955, and adequately moist in 1956 and 1957.

The study area was occupied by an overmature mixedwood stand that originated after fire in 1761. By the time that the RC-17 treatments were initiated in 1953, the stand had become open and decadent. On fresh sites with deep soil,

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white spruce[3] (occurring as scattered, old, emergent dominants), balsam fir, and infrequent black spruce together accounted for about 60 per cent of both the total per acre volume[4] of 2,200 cubic feet, and the total per acre basal area of 90 square feet (Berry 1953). White birch and trembling aspen formed the hardwood component. Shrubs were dense and vigorous in many parts of the area.

TABLE 1. DESCRIPTION OF SOIL PROFILE TYPICAL FOR THE STUDY AREA

Horizon	Thickness (ins.)	Lower Limit (ins.)	Colour	Est. Vol. Stones (%)	Texture of materials* <2mm in diameter: (%)			Texture Class	pH	Structure
					Sand	Silt	Clay			
A_0.....	2	2	Black	0	—	—	—	—	—	Fibrous mor
A_2.....	4	6	Ash-grey	0-2	39.6	55.0	5.4	Silt loam	4.7	Single grain
B_2.....	7	13	Rust-brown	5	49.2	42.6	8.2	Loam	4.9	Blocky
B_3.....	5	18	Yellow-brown	5	57.1	35.5	7.4	Sandy loam	5.2	Platy
C_1.....	12	30	Light grey-brown	5	57.1	32.4	10.5	Sandy loam	5.9	Platy
C_{2g}....	18+	48+	Light grey-brown	5	52.8	36.1	11.1	Sandy loam	7.9	Platy

*By Bouyoucos (1927, 1951, 1953) method.

THE STUDY

Objective

The lesser vegetation of an overmature mixedwood stand in boreal Ontario was examined in the late summer of 1957. The stand had been subjected to various treatments beginning in 1953. The objective of the study was to determine quantitatively:

(*a*) what changes had taken place in the lesser vegetation of fresh sites; and

(*b*) the significance of observed differences.

Conditions Sampled

The ten conditions sampled (Figure 1) fall into three groups:

Group I Forest floor undisturbed
- A—No overstorey treatment, canopy 89%
- B—Hardwoods poisoned 1954, canopy 80%
- C—Conifers cut 1953, canopy 26%
- D—Clear cut 1953, canopy 12.5%

Group II Unincorporated forest floor organic matter removed 1954
- E—No overstorey treatment, canopy 39%
- F—Hardwoods poisoned 1954, canopy 5.5%
- G—Conifers cut 1953, canopy 9%
- H—Clear cut 1953, canopy nil

Group III Unincorporated forest floor organic matter removed 1956
- I—No overstorey treatment, canopy 23%
- J—Clear cut 1953, canopy nil

[3]Botanical names and authorities are given in the Appendix.
[4]Trees 5 inches and more in d.b.h.

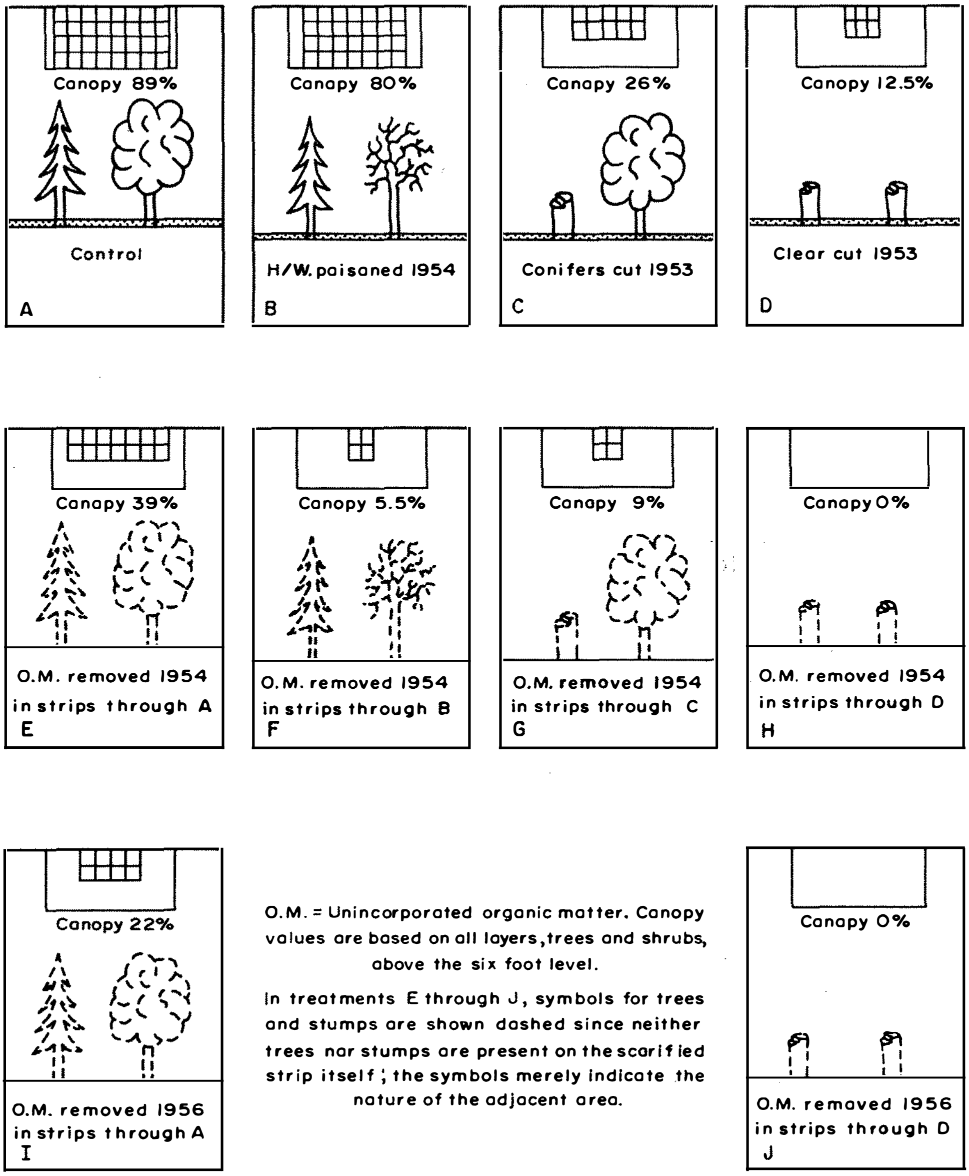


FIGURE 1. Diagrammatic representation of treatments A to J.

NOTE: Canopy density figures refer to *all* layers, including shrubs, above 6 feet in height, and are based on 100 random "moosehorn"[5] readings from the 6-foot level in each condition.

In Group I treatments, where the forest floor was largely undisturbed, the lesser vegetation of the control condition A[6] in 1957 is assumed to be representative of that occupying the study area in its undisturbed state in 1953, since no major disturbance had taken place since that time. In condition B, hardwoods of

[5]The moosehorn densiometer, developed by the Department of Forestry, was described by Robinson (1947). The present model, the 25-dot Hilborn modification, has been in use since 1951.
[6]See Tables 2 and 3.

d.b.h. 4.5 inches and over were poison-frill girdled in the late summer of 1954: some were still alive in 1956, but production of foliage was low, and by 1957 virtually all poisoned hardwoods were dead. In condition C, all merchantable conifers of 4.5 inches and over were cut in 1953, and slash was left where it lay. The clear cut, condition D, was created by removing all trees of 4.5 inches d.b.h. and over.

Group II conditions E, F, G, and H, have in common the removal of the unincorporated organic matter of the forest floor in 1954. A tractor-mounted root-rake was used to expose mineral soil in strips through the appropriate stand conditions. Thus, condition E was created by baring strips about seven feet wide through the otherwise undisturbed stand. Canopy density values in this group include the canopy of branches extending over the strips from adjacent tall shrubs. The values obtained largely reflect the extent of the immediate post-scarification canopy, although there had been some increase in canopy density owing to growth and "sagging" of shrub stems.

One of the most obvious and important environmental changes resulting from the stand treatments was in the amount of light reaching the ground. The canopy density as estimated by the "moosehorn" was less than half that in the undisturbed control, but this tells only part of the story. The clearance of vegetation from the treated strips also removed the considerable canopy formed by vegetation under six feet in height. Thus there was more light and, at least in the first instance, less leaf-fall as compared with the control. The depression of the scarified strips below the level of the surrounding forest floor, the raised borders of debris along the edges of the strips, and the "alley" effect on wind velocity and direction, all influenced the distribution and amount of leaf litter and hence also of smothering of seedlings. Colour and albedo were changed. Creation of the scarified strips also caused major changes in drainage patterns: in the control, there was never any sign of puddling and channelled surface flow, but these were much in evidence on the scarified strips.

In Group III, comprising conditions I and J, the unincorporated organic matter of the forest floor was removed in 1956, but not quite so completely as in the otherwise similar operations carried out two years earlier in Group II.

Sampling and Analysis

Twenty quarter-milliacre quadrats were sampled at random along two lines, two chains apart, in each of the 10 conditions. These 200 quadrats form the basis for statistical comparisons between the lesser vegetation of the undisturbed control condition and the flora of the other conditions. In addition to the quantitative data collected, qualitative assessments were made to aid the interpretation of statistical analyses.

Quantitative data were subjected to a ranking method of statistical analysis. Ranking has several advantages; it is speedy, does not require the data to follow the normal distribution, and takes into account not only numbers of individuals but also numbers of stocked quadrats (Moroney, 1954). Differences in density-frequencies of each species and for groups of species between condition A (control) and each of the other nine conditions in turn were tested for significance.

Information was also gathered about trees and shrubs one inch and more in d.b.h. Three one-tenth-acre plots were laid out in each of blocks 1 to 6 of the RC-17 experiment. These plots were restricted to main stand treatments only, i.e. conditions D, B, C, and A were sampled in blocks 1 to 4, while in blocks 5 and 6 the plots were situated not in conditions I and J but in the main stand conditions from which I and J were created by seedbed treatment. Table 2 gives a summary of the results obtained.

TABLE 2A. NUMBERS PER ACRE OF LIVE AND DEAD STEMS, CONIFERS, HARDWOODS, AND SHRUBS, 1 INCH AND MORE IN D.B.H. ON THE STUDY AREA.

(0.3 ACRES SAMPLED IN EACH CONDITION)

	Condition sampled	Live and dead (bracketed), stems, d.b.h. between				
		1–2 in.	2–3 in.	3–7 in.	7–12 in.	Over 12 in.
Conifers	A	117(0)	10(3)	50(7)	80(7)	30(0)
	B	77(0)	13(7)	10(0)	43(0)	7(10)
	C	40(13)	10(0)	53(10)	7(0)	0(0)
	D	70(17)	23(0)	0(0)	0(0)	0(0)
	(I)*	327(67)	50(20)	100(13)	90(13)	10(0)
	(J)*	63(3)	3(0)	3(0)	0(0)	0(0)
Hardwoods	A	30(0)	7(0)	0(3)	27(3)	33(17)
	B	13(0)	3(0)	0(0)	0(20)	0(23)
	C	77(3)	0(0)	0(0)	10(3)	20(20)
	D	173(3)	0(0)	0(3)	0(3)	0(10)
	(I)*	67(3)	10(0)	7(3)	27(7)	30(27)
	(J)*	190(0)	0(0)	0(0)	0(3)	0(0)
Shrubs	A	910(277)	93(40)	0(0)	0(0)	0(0)
	B	950(193)	157(30)	13(0)	0(0)	0(0)
	C	343(127)	17(40)	0(0)	0(0)	0(0)
	D	127(177)	27(10)	0(0)	0(0)	0(0)
	(I)*	923(323)	33(7)	0(0)	0(0)	0(0)
	(J)*	373(487)	27(33)	0(0)	0(0)	0(0)

TABLE 2B. MAIN COMPONENTS IN CONIFER, HARDWOOD AND SHRUB CLASSES

	Condition sampled	% of total live stems, d.b.h. between				
		1–2 in.	2–3 in.	3–7 in.	7–12 in.	Over 12 in.
(Conifers) *Abies balsamea*	A	89	67	93	79	44
	B	91	50	67	77	100
	C	67	67	63	50	—
	D	100	100	—	—	—
	(I)*	95	87	87	81	0
	(J)*	89	0	0	—	—
(Hardwoods) *Betula papyrifera*	A	57	100	—	100	90
	B	100	100	—	—	—
	C	26	—	—	100	100
	D	0	—	—	—	—
	(I)*	80	100	100	100	100
	(J)*	5	—	—	—	—
(Shrubs) *Acer spicatum*	A	80	97	—	—	—
	B	68	97	80	—	—
	C	94	100	—	—	—
	D	69	100	—	—	—
	(I)*	53	30	—	—	—
	(J)*	38	74	—	—	—

*Sampling in main stand conditions from which I and J were created by seedbed treatment.

Results

The results of tests of the significance of differences are given in Table 3, which also shows the numbers of individuals of each of the main components of lesser vegetation in each of the ten conditions sampled, and serves to summarize the more important quantitative data. Figures for total numbers of individuals found in each condition are followed by a bracketed number which gives the

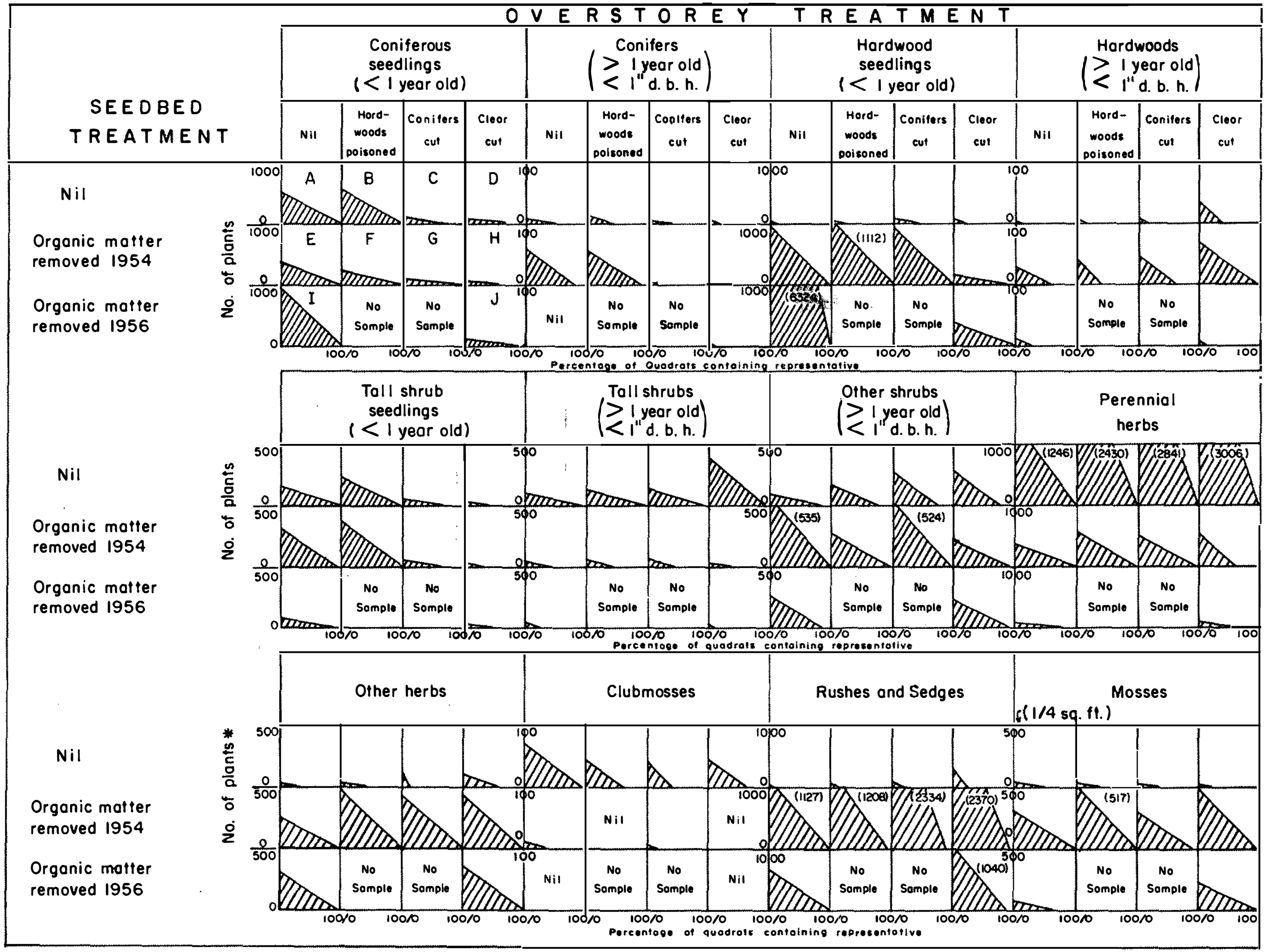
TABLE 3. NUMBERS OF INDIVIDUALS OF MAIN SPECIES AND (STOCKED QUADRATS) IN THE TEN SAMPLED CONDITIONS. (TWENTY ONE-QUARTER-MILLIACRE QUADRATS EXAMINED PER CONDITION.)

Species	Condition									
	A	B	C	D	E	F	G	H	I	J
	(Group I: Humus undisturbed)				(Group II: Humus removed in 1954)				(Group III: Humus removed 1956)	
	(Control)	(Hard-woods poisoned)	(Conifers cut)	(Clear cut)	(A scarified)	(B scarified)	(C scarified)	(D scarified)	(A scarified)	(D scarified)
Abies balsamea[1]	438(20)	542(20)	31(14)**	17(13)**	403(20)	294(20)	43(16)**	14(7)**	905(20)	72(17)**
A. balsamea[2]	10(8)	17(7)	5(5)	9(3)	56(16)**	50(17)**	2(2)	1(1)	0 *	0 *
Acer spicatum[1]	137(20)	224(19)	43(13)**	11(7)**	320(19)**	369(20)**	42(12)**	8(4)**	65(17)**	20(9)**
A. spicatum[2]	55(17)	52(13)	107(16)	144(13)	30(5)**	23(3)**	40(7)*	1(1)**	2(1)**	0 **
Anaphalis margaritacea	0	0	0	0	7(5)	55(6)	20(5)	13(1)	0	0
Anemone quinquefolia	87(16)	42(9)	27(5)**	6(4)**	55(7)*	5(3)**	6(4)**	0 **	4(2)**	3(1)**
Aralia nudicaulis	73(17)	37(13)	37(10)*	117(16)	8(3)**	5(1)**	12(4)**	10(4)**	10(5)**	12(5)**
Aster sp.[1]	0	0	0	35(2)	687(18)**	800(19)**	2,221(18)**	4,727(19)**	198(14)**	437(19)**
A. macrophyllus	227(19)	137(4)	252(13)	322(14)	10(3)**	4(1)**	65(2)**	4(2)**	1(1)**	0 **
Betula papyrifera[1]	14(1)	19(3)	51(7)	3(2)	960(19)**	1,048(20)**	888(20)**	93(16)**	6,312(20)**	335(20)**
B. papyrifera[2]	1(1)	0	0	1(1)	0	0	3(1)	6(3)	0	0
Carex spp.	6(1)	4(2)	82(4)	230(5)	1,126(20)**	1,135(19)**	2,292(18)**	2,370(19)**	663(20)**	1,040(16)**
Cinna latifolia	0	2(1)	0	0	1(1)	15(3)	0	0	0	0
Clintonia borealis	241(20)	260(20)	283(16)	334(20)	27(9)**	18(5)**	7(2)**	7(1)**	3(1)**	14(2)**
Cornus canadensis	336(20)	354(18)	1,064(18)	799(15)	54(9)**	168(11)**	120(9)**	74(4)**	8(6)**	20(3)**
Corydalis sempervirens	0	0	0	0	0	0	0	0	35(11)**	29(3)
Corylus cornuta[1]	2(2)	1(1)	0	0	1(1)	0	0	0	0	0
C. cornuta[2]	47(12)	67(13)	27(5)	234(10)	14(6)	31(5)	21(2)*	13(3)*	34(3)	7(1)**
Diervilla lonicera	47(10)	3(1)*	3(2)*	91(9)	495(19)**	123(11)	325(16)**	110(14)	208(16)*	161(3)**
Dryopteris disjuncta	0	5(2)	79(3)	42(3)	0	3(1)	54(2)	0	0	0
Epilobium spp.[2]	6(2)	0	0	2(1)	136(17)**	314(15)**	1,211(18)**	810(12)**	62(9)	351(19)**
E. angustifolium	0	0	8(3)	0	3(1)	3(1)	0	0	0	0
E. glandulosum	2(1)	0	104(3)	5(3)	62(10)*	53(5)	3(1)	174(9)*	5(1)	6(1)
Galium triflorum	3(1)	8(6)	6(2)	56(3)	67(8)	133(12)**	9(3)	7(2)	28(5)	17(4)
Geranium bicknellii	0	1(1)	0	9(4)	95(16)**	133(19)**	155(20)**	192(19)**	159(14)**	284(19)**
Linnaea borealis	33(2)	22(1)	13(4)	2(1)	0	0	0	0	0	0
Lonicera canadensis	2(2)	0	9(2)	0	0	0	0	0	0	8(2)
Lycopodium clavatum and *L. annotinum*	13(7)	16(4)	6(1)	4(2)	0	0	0	0	0	0
L. obscurum	54(18)	24(10)**	30(7)*	40(12)	10(5)**	0 **	1(1)**	0 **	0 **	0 **
Maianthemum canadense	47(10)	66(13)	214(12)	18(3)	16(4)	3(1)*	3(1)*	0 **	4(3)	2(1)*
Mitella nuda[3]	0	1,284(11)**	390(8)*	1,176(7)	21(2)	63(2)	108(3)	83(1)	0	0

TABLE 3. NUMBERS OF INDIVIDUALS OF MAIN SPECIES AND (STOCKED QUADRATS) IN THE TEN SAMPLED CONDITIONS (TWENTY ONE-QUARTER-MILLIACRE QUADRATS EXAMINED PER CONDITION.) (concluded)

Species	Condition A	B	C	D	E	F	G	H	I	J
	(Group I: Humus undisturbed)				(Group II: Humus removed in 1954)				(Group III: Humus removed 1956)	
	(Control)	(Hard-woods poisoned)	(Conifers cut)	(Clear cut)	(A scarified)	(B scarified)	(C scarified)	(D scarified)	(A scarified)	(D scarified)
Petasites palmatus	0	0	99(4)	0	3(1)	43(2)	7(3)	59(2)	0	0
Picea glauca[1]	13(10)	14(5)	0 **	1(1)*	12(8)	3(3)	3(3)	1(1)*	55(12)	5(4)
P. glauca[2]	1(1)	1(1)	1(1)	0	9(6)	8(6)	1(1)	3(3)	0	1(1)
Polygonum cilinode	2(2)	1(1)	51(5)	34(6)	20(4)	95(11)**	216(16)**	24(7)	11(6)	56(9)
Populus balsamifera[1]	0	0	0	0	1(1)	21(4)	8(4)	3(2)	9(1)	0
P. balsamifera[2]	0	0	0	0	17(5)	23(5)	29(10)**	28(16)**	1(1)	0
P. tremuloides[1]	0	0	2(1)	0	6(3)	43(7)	42(7)	26(7)	3(2)	0
P. tremuloides[2]	1(1)	1(1)	4(1)	30(6)	11(8)	13(4)	11(8)	36(12)**	7(3)	5(1)
Ribes lacustre	2(1)	0	4(1)	7(1)	1(1)	1(1)	0	1(1)	0	0
R. triste	0	7(2)	0	6(2)	0	0	0	0	0	0
Rosa acicularis	0	0	4(1)	4(2)	2(1)	1(1)	0	0	10(4)	0
Rubus hispidus	0	0	0	0	0	0	0	4(1)	1(1)	0
R. idaeus strigosus	0	0	39(4)	3(2)	4(2)	63(9)*	68(10)**	41(7)	8(3)	6(3)
R. pubescens	20(6)	95(10)	177(11)	153(8)	16(4)	53(9)	117(9)	20(4)	0	20(6)
Salix spp.	0	0	0	0	14(8)*	13(6)	10(8)*	10(5)	0	0
Streptopus roseus	86(20)	78(16)	84(14)	54(13)*	22(8)**	4(3)**	22(5)**	3(2)**	1(1)**	9(4)**
Trientalis borealis	32(11)	61(9)	18(6)	45(9)	2(2)*	4(3)*	11(5)	1(1)**	4(3)*	6(5)
Viburnum edule	4(2)	14(4)	11(4)	9(3)	3(2)	0	2(1)	0	0	0
Viola renifolia	99(19)	111(17)	290(18)	88(14)	98(17)	211(16)	97(16)	36(10)**	19(8)**	10(8)**
Bryophyta (¼-sq. ft)	51(10)	29(7)	22(6)	4(2)	319(20)**	517(20)**	295(18)**	490(19)**	83(13)	217(19)**

[1]Plants in their first year.
[2]Plants in second or subsequent years.
[3]Because of form of plant, counts of *Mitella* are of leaves.
*Significantly different from A (5< level).
**Highly significantly different from A (1< level).
NOTE: Per acre figures may be obtained by multiplying numbers of individuals by 200.



*Except for mosses which are in quarter square feet.

FIGURE 2. Diagrammatic representation of density and frequency of specified group components of the flora of the conditions examined. Letters A to J in the top left grid label the treatments.

number of quadrats (maximum 20) which contained a representative of that component of lesser vegetation. An entry in Table 3 followed by a single or double asterisk denotes, with a P of less than .05 or .01 respectively, that there is a real difference between that condition and the control. A diagrammatic condensation of these data is shown in Figure 2.

(*a*) *Treatments* not *involving removal of unincorporated organic matter* (*Group I*)

These treatments effected little change in species composition of the lesser vegetation on fresh sites. Characteristic components remained the perennial herbs *Aster macrophyllus, Clintonia borealis,* and *Cornus canadensis,* perennial pteridophytes, e.g. *Lycopodium obscurum* and shrubs, e.g. *Acer spicatum* and *Corylus cornuta.* Bryophytes were minor, inconspicuous components of these floras.

Most of the variation in amount and composition of lesser vegetation between the conditions within this undisturbed forest floor group can be attributed reasonably to changes effected in canopy density and, particularly, in seed supply. The data suggest that while some species, e.g. *Aster macrophyllus,* were stimulated by increased light to produce more seed than they produced in undisturbed forest, other species, e.g. *Acer spicatum,* were stimulated to grow vegetatively, at least for a few years, rather than to produce seed.

(*b*) *Treatments involving removal of unincorporated organic matter* (*Groups II and III*).

The flora of treatments in Groups II and III were found to be quite different from that characterizing the control. Virtually all the pre-existing vegetation had been removed by root-rake treatment, and mineral soil was exposed over most of the treated area. The soil surface was left loose but often the ground was more scalped than scarified. Bryophytes, notably *Polytrichum juniperinum,* the first large-scale invaders, made their appearance during the first growing season after treatment. Light-seeded biennials, e.g. *Geranium bicknellii* and *Corydalis sempervirens* followed quickly, and (particularly the former) became conspicuous components of the floras. Light-demanding perennials, e.g. *Polygonum cilinode* and *Carex* spp., increased steadily, and within a year after treatment, sprouting occurred from shrub roots that had survived more or less undamaged.

Some mineral soil remained exposed three years after treatment. The proportion of the seedbed remaining bare seemed to vary directly with the canopy density. In much of the clear-cut, scarified area, only unfavourable micro-topography, e.g. hollows subject to flooding, remained to be colonized. In the more shaded, scarified, deferred-cutting area, more favourable micro-topography was still unoccupied by vegetation. It is estimated that, in the shadiest places, some mineral soil may remain exposed for as long as five or more years after treatment.

The treatment offering the best chance of establishing coniferous reproduction seems to be one which provides a mineral soil seedbed and opens the canopy slightly, if at all, while retaining all the coniferous seed-trees. Table 4 shows that the percentage of fir in first-year coniferous regeneration was virtually the same in all treatments, and that although the percentage of fir in older regeneration was of a like order in Group I treatments, it was lower in treatments of Group II. Also, the mineral soil seedbeds of Group II resulted in a four-fold increase in the percentages of second-year and older seedlings in the regeneration, spruce as well as fir. Within Group II, best results (in terms of both survival of seedlings beyond the first vulnerable year and numbers of spruce) were obtained with treatments E and F in which coniferous trees were not cut and in which the decrease in canopy density resulted solely from the creation of the scarified strips (E) or from this plus poisoning of hardwoods (F). Root-rake treatment alone enabled light adequate for satisfactory growth of coniferous seedlings to reach the ground surface. A concurrent reduction of tree layer canopy density is unnecessary and would advance the onset of strong competition from shrubs and lesser vegetation.

TABLE 4. NUMBERS OF BALSAM FIR AND WHITE SPRUCE SEEDLINGS, PERCENTAGES OF TOTALS THAT ARE FIR, AND PERCENTAGES OF SEEDLINGS THAT ARE IN SECOND YEAR OR OLDER, IN THE 20 QUARTER-MILLIACRE QUADRATS SAMPLED PER CONDITION.

Group	Condition	Seedlings in first year			Seedlings in second year or older			Seedlings in second year or older (% of totals)	
		Fir	Spruce	% Fir	Fir	Spruce	% Fir	Fir	Spruce
I	A	468	13	97	10	1	91	2.1	7.1
	B	542	14	97	17	1	94	3.0	6.7
	C	31	0	100	5	1	83	13.9	100.0
	D	17	1	94	9	0	100	34.6	0.0
Group totals......		1,058	28	97	41	3	93	3.7	9.7
II	E	403	12	97	56	9	86	12.2	42.9
	F	294	3	99	50	8	86	14.5	72.7
	G	43	3	93	2	1	67	4.4	25.0
	H	14	1	93	1	3	25	6.7	75.0
Group totals......		754	19	98	109	21	84	12.6	52.5
III	I	905	55	94	0	0	—	0.0	0.0
	J	72	5	94	0	1	0	0.0	16.7
Group totals......		977	60	94	0	1	0	0.0	1.7

NOTE: Per acre figures may be obtained by multiplying numbers of individuals by 200.

SUMMARY AND CONCLUSIONS

The lesser vegetation of fresh sites in a 200-year-old mixedwood in boreal Ontario was studied during the summer of 1957. A number of stand and cultural (seedbed) treatments had been applied from one to four years previously. The objective was to determine what changes in lesser vegetation had taken place as a result of these treatments. The difficulty of maintaining satisfactory proportions of spruce and fir in successive stands of boreal mixedwoods has caused widespread concern, from which derives the interest in seedbed—lesser vegetation relationships and in the extent to which they can be manipulated.

Sampling was carried out in nine treatment-induced conditions and a control area. Quantitative data were obtained from a total of 200 quarter-milliacre quadrats. These data were analyzed statistically by a ranking method, and the significance of differences between the occurence of each component of the flora in the control condition and in the flora of the other nine conditions were determined.

The study showed that the lesser vegetation on fresh sites of an overmature mixedwood in boreal Ontario was changed relatively slightly in species composition by silvicultural treatments that did not disturb the forest floor, at least within the period studied. However, densities of the components of lesser vegetation were affected by changes in canopy density. Seed production and vigour were altered in some species. Treatments in which mineral soil was exposed carried flora quite different from that characteristic of the control condition and enhanced survival of, and percentage of spruce in, coniferous regeneration.

SOMMAIRE ET CONCLUSIONS

Au cours de l'été de 1957, l'auteur a étudié la basse végétation de stations fraîches dans un peuplement mixte de 200 ans dans la zone forestière boréale de l'Ontario. Divers traitements d'amélioration avaient été appliqués au peuplement et aux terrains de germination au cours des quatre années précédentes.

L'étude avait pour objectif de déterminer l'influence de ces traitements sur la végétation du sous-bois. La difficulté de maintenir des proportions satisfaisantes d'épinettes et de sapins dans les peuplements mixtes successifs de la zone boréale a causé beaucoup de souci et a suscité l'intérêt qu'on porte aujourd'hui aux rapports entre l'efficacité des terrains de germination et la végétation basse, et de la mesure dans laquelle ces rapports pourraient être modifiés artificiellement.

On a prélevé des échantillons dans neuf emplacements traités pour y réaliser certaines conditions et dans un emplacement témoin. On a recueilli des données quantitatives ayant trait à 200 quadrats d'un quart de milliacre chacun. On a ensuite procédé à une analyse statistique de ces données par la méthode des rangs puis on a pu déterminer le degré de signification des écarts entre chaque composante de la flore de l'emplacement témoin et de celle des neuf autres emplacements à l'étude.

L'étude a révélé que la basse végétation des stations fraîches dans un peuplement mixte suranné de la zone forestière boréale de l'Ontario a relativement peu changé de composition à la suite des traitements sylvicoles qui laissaient la couverture morte intacte, tout au moins au cours de la période d'étude. Toutefois, la densité des composantes de la basse végétation a subi l'influence des variations de la densité de la voûte foliacée. Chez certaines essences, la production de semences et la vigueur ont changé. Les traitements nécessitant la mise à nu du sol minéral ont donné lieu à l'apparition d'une flore très différente de celle qui croissait à l'emplacement témoin; ces traitements favorisaient la survivance et la reproduction des épinettes dans la régénération des conifères.

APPENDIX

Botanical Check List

(The names used here are in accordance with Grout (1940) for mosses and with Fernald (1950) for flowering plants and ferns).

MOSSES

Botanical Name

Atrichum angustatum (Brid.) Bry. Eur.
A. undulatum (Hedw.) Beauv.
Aulacomnium palustre (Web. and Mohr) Schwaegr.
Brachythecium oxycladon (Brid.) Jaeger and Sauerb.
B. reflexum (Starke) Bry. Eur.
B. salebrosum (Web. and Mohr) Bry. Eur.
B. starkei (Brid.) Bry. Eur.
Calliergonella schreberi (Bry. Eur.) Grout
Ceratodon purpureus (Hedw.) Brid.
Dicranella heteromalla (Hedw.) Schimp.
Dicranum fuscescens Turn.
D. muhlenbeckii Bry. Eur.
D. scoparium Hedw.
D. undulatum (Ehrh.) Sturm.
Drepanocladus uncinatus (Hedw.) Warnst.
D. uncinatus var. *plumosus* (Bry. Eur.) Ren.
Hylocomium splendens (Hedw.) Bry. Eur.
Hypnum crista-castrensis Hedw.
H. reptile Mx.
Mnium affine Bland.
M. cuspidatum Hedw.
M. drummondii Bry. Eur.
Orthodicranum flagellare syn. *Dicranum flagellare* Hedw.
Plagiothecium denticulatum (Hedw.) Bry. Eur.
Pleurozium syn. *Calliergonella, vide ante.*
Polytrichum commune Hedw.
P. juniperinum Hedw.
P. piliferum Hedw.
Rhytidiadelphus triquetrus (Hedw.) Warnst.

PTERIDOPHYTES, GRASSES, SEDGES, HERBS, SHRUBS AND TREES

Botanical Name	Common Name
Abies balsamea (L.) Mill.	Balsam fir
Acer spicatum Lam.	Mountain maple
Alnus rugosa (Du Roi) Spreng.	Speckled alder
Amelanchier bartramiana (Tausch) Roemer	Mountain juneberry
Anaphalis margaritacea (L.) C. B. Clarke.	Pearly everlasting
Anemone quinquefolia L.	Wood anemone
Aralia hispida Vent.	Bristly sarsaparilla
A. nudicaulis L.	Wild sarsaparilla
Aster ciliolatus Lindl.	Ciliate aster
A. macrophyllus L.	Large-leaved aster
Athyrium filix-femina (L.) Roth	Lady fern
Betula papyrifera Marsh.	White birch
Carex aurea Nutt.	Golden sedge
C. brunnescens (Pers.) Poir.	Brownish sedge

Botanical Name	Common Name
C. houghtonii Torr.	Houghton's sedge
C. praticola Rydb.	Prairie sedge
C. scoparia Sckuhr.	Broom-like sedge
Chrysanthemum leucanthemum L.	White daisy
Cinna latifolia (Trev.) Griseb.	Wood reedgrass
Circaea alpina L.	Alpine enchanter's nightshade
Clintonia borealis (Ait.) Raf.	Corn-lily
Coptis groenlandica (Oeder) Fern.	Goldthread
Cornus canadensis L.	Bunchberry
C. stolonifera Michx.	Red osier
Corydalis sempervirens (L.) Pers.	Pale corydalis, Rock-harlequin
Corylus cornuta Marsh.	Beaked hazel
Diervilla lonicera Mill.	Bush-honeysuckle
Dracocephalum parviflorum Nutt.	Small-flowered dragonhead
Dryopteris disjuncta (Ledeb.) C. V. Mort.	Oak fern
D. phegopteris (L.) Christens.	Long beech-fern
Epilobium angustifolium L.	Fireweed
E. glandulosum Lehm.	Glandular willow-herb
Equisetum scirpoides Michx.	Dwarf scouring-rush
E. sylvaticum L.	Wood-horsetail
Fragaria virginiana Duchesne	Strawberry
Galium triflorum Michx.	Sweet-scented bedstraw
Geranium bicknellii Britt.	Bicknell's cranesbill
Goodyera repens (L.) R. Br.	Dwarf rattlesnake-plantain
Lathyrus ochroleucus Hook.	Yellowish-white vetchling
Linnaea borealis var. *americana* (Forbes) Rehd.	Twinflower
Lonicera canadensis Bartr.	Fly-honeysuckle
Luzula acuminata Raf.	Acuminate woodrush
Lycopodium annotinum L.	Interrupted clubmoss
L. clavatum L.	Running clubmoss
L. obscurum L.	Ground pine
Maianthemum canadense Deaf.	Wild lily-of-the-valley
Mitella nuda L.	Bishop's-cap
Osmunda claytoniana L.	Interrupted fern
Petasites palmatus (Ait.) Gray	Sweet coltsfoot
Picea glauca (Moench) Voss	White spruce
P. mariana (Mill.) BSP	Black spruce
Polygonum cilinode Michx.	Climbing buckwheat
Populus balsamifera L.	Balsam poplar
P. tremuloides Michx.	Trembling aspen
Prunus pensylvanica L.F.	Bird-, pin-cherry
Pteridium aquilinum (L.) Kuhn	Bracken
Pyrola secunda L.	One-sided wintergreen
P. virens Schweigger	Greenish wintergreen
Pyrus decora (Sarg.) Hyland	Mountain-ash
Ribes glandulosum Grauer	Skunk-currant
R. lacustre (Pers.) Poir.	Bristly black currant
R. triste Pall.	Red currant
Rosa acicularis Lindl.	Rose
Rubus hispidus L.	Bramble
R. idaeus var. *strigosus* (Michx.) Maxim.	Raspberry
R. pubescens Raf.	Dwarf raspberry
Rumex acetosella L.	Sheep-sorrel, common sorrel
Salix bebbiana Sarg.	Long-beaked willow

Botanical Name	Common Name
S. lucida Muhl	Shining willow
Sambucus pubens Michx.	Red-berried alder
Streptopus roseus Michx.	Twisted-stalk
Thuja occidentalis L.	White cedar
Trientalis borealis Raf.	Star-flower
Trifolium pratense L.	Red clover
Viburnum edule (Michx.) Raf.	Squashberry, mooseberry
Vicia americana Muhl.	American vetch
Viola renifolia Gray	Kidney-leaved violet

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