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FOREST TYPES OF THE GRAND LAKE AND NORTHWESTERN LAKE MELVILLE AREAS OF LABRADOR

by
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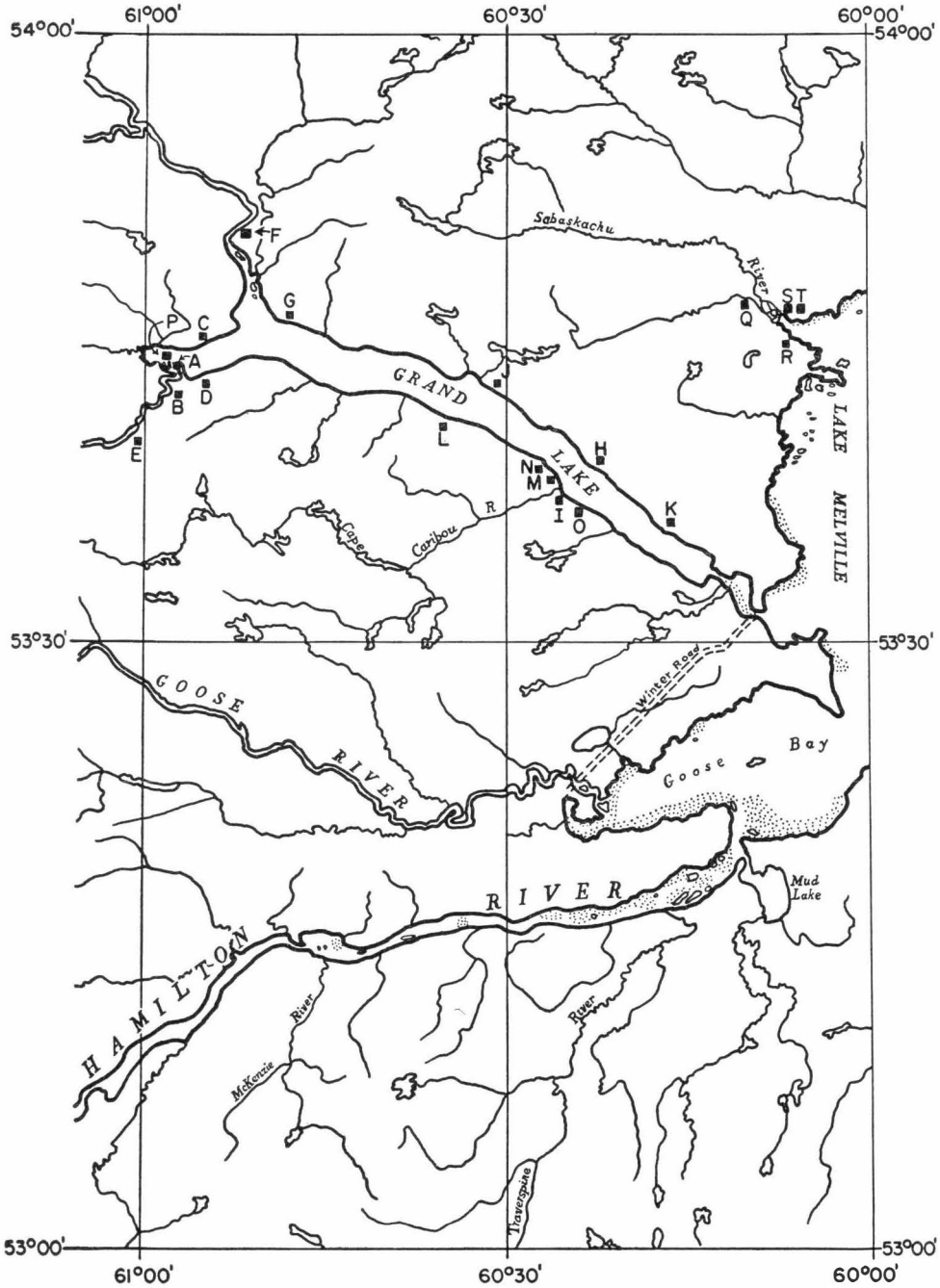

GRAND LAKE — LAKE MELVILLE AREA

Showing

Location of Sample Blocks _ _ _ _ _ _ _ A ■ ect.

Scale in Miles

8 4 0 8 16

Forest Types of the Grand Lake and Northwestern Lake Melville Areas of Labrador

(Project NF 19)

by

W. C. Wilton[1]

INTRODUCTION

The forests of Labrador are possibly the least known of the boreal forests of the world; until quite recently there were still large tracts which had not been visited by any persons other than trappers and Indians.

A number of expeditions of an exploratory nature have devoted considerable effort toward classifying the flora of the region; notable among them have been those of Mrs. Leonides Hubbard (1908), A. P. Low (1896), and B. H. Wetmore (1923). The work of the Tanner Expedition (1944) along the Atlantic Coast of Labrador is considered to be the most important so far undertaken, and this expedition attempted the first comprehensive forest classification of the region. Ilmari Hustich, a member of the party, supplemented his early work by further studies of the Labrador Peninsula in 1946, 1947 and 1948 and, as a result, was able to divide the Labrador forests into major forest types according to the principles developed by Cajander (Hustich 1949). Owing to the vast extent of the area, his work was of necessity somewhat generalized.

During 1948 the Photographic Survey Corporation Limited of Canada carried out an aerial inventory and limited ground check of a 5,000-square-mile block in the Goose Bay area. This has been the only volumetric survey of any consequence yet undertaken.

Only a small part of the forests of Labrador have been exploited. A certain amount of sawmilling has taken place in the Lake Melville region and there has been some pitprop and pulpwood cutting in the Cartwright area. These operations have only scratched the surface however, and the vast bulk of the forest has remained untouched. The ever-increasing demand for wood makes it most unlikely that this situation will remain unchanged and it is generally conceded that the Labrador forests are destined to play an important role in the Canadian economy.

The present scanty information of the region must be greatly augmented before any large-scale development can take place. In particular a more detailed knowledge of ecological and mensurational data is essential.

At the request of the Provincial Government and the British Newfoundland Corporation, a study of forest conditions in the general area of Lake Melville was carried out during the summer of 1956. Detailed information was collected on a number of small homogeneous areas with a view to providing a better understanding of the principal forest types and sites prevalent in the region.

The area chosen for the study was that portion of the British Newfoundland Corporation timber block which lies to the northwest of Lake Melville; it includes the watershed of Grand Lake, the rivers flowing into Grand Lake, and the Sabaskachu River which empties directly into Lake Melville (see front map).

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PHYSIOGRAPHIC DESCRIPTION

Geographic Position

The entire eastern coastline of Labrador is a succession of deep bays and inlets but nowhere else do the navigable waters extend so far inland as in Lake Melville, a 115-mile-long tidal lake which flows into the Atlantic, by way of Hamilton Inlet, at 53°30′ north latitude and 56°30′ east longitude. Together with Hamilton Inlet, it offers a continuous waterway which permits seagoing vessels to penetrate approximately 150 miles inland.

Grand Lake which lies roughly at right angles to Lake Melville flows into it by way of Northwest River approximately 20 miles north of Hamilton River. It has a length of about 40 miles and an average width of about $1\frac{1}{2}$ miles, and differs from Lake Melville by being entirely fresh. Four rivers of notable size flow into Grand Lake; the Beaver, Susan, and Nauskaupi Rivers enter near its western end, and the Cap Caribou River joins it midway along its south shore. The Sabaskachu River flows through a narrow rock-ribbed valley with the same general trend as Grand Lake, emptying into Lake Melville at Sabaskachu Bay some 16 miles north of the Grand Lake outlet.

Geology and Topography

The geology of the Lake Melville District has been adequately described by E. M. Kindle (1924) and much of the basic information contained in this section was obtained from his report. According to Kindle, "the southern two-thirds of the (Labrador) peninsula is a plateau that, in a few places, rises more than 2,000 feet above sea level. The Lake Melville region lies on the eastern border of this plateau. The major part of it may be regarded as belonging to the marginal part of this extensive plateau, where wide and deep valleys become dominant geographic features. This region is deeply incised by three main valleys connected directly with the sea, and by numerous minor ones. Two of these valleys, Lake Melville and Double Mer, are bordered along part of their northern sides by lowlands a few miles wide, rising from 50 to 200 feet above sea level. These lowland plains, which may be called the Lake Melville and the Double Mer lowlands, are cut in sedimentary rocks, which may be of Precambrian age".

The Hamilton River forms an extension of the Lake Melville plains whereas Grand Lake and the rivers at the head of the lake, particularly the Nauskaupi, form a minor or subsidiary lowland. The valley occupied by Grand Lake and the lower Nauskaupi River is probably the result of faulting. Like it, the broad mature valleys of Beaver, Susan, and Cape Caribou Rivers, were also formed in pre-glacial times and all were profoundly modified by glaciation. The weight of the ice sheet caused considerable depression but this trend has been reversing since late Pleistocene and there has been re-elevation to a little more than 300 feet.

The mountains of the plateau surrounding the Grand Lake valley are composed of crystalline rocks of Precambrian age rising to heights of 800 to 2,000 feet above the valley floor. From the east side of the lake the land slopes moderately to the plateau. The west side is precipitous except where the relief is broken by the valley of the Cape Caribou River, one to two miles in width.

In general the surface materials of the entire area may be subdivided into three categories according to topographic position. Fluvial-lacustrine deposits occur in the river valley lowlands and to a lesser extent along the fringe of the west side of Grand Lake. They are usually of great depth and show considerable variation in composition depending upon the circumstances of their deposition. Bank-cutting along the lower Beaver River has exposed some beautifully varved

clays which in places reach a height of 75 feet above the river. Sand terraces are prevalent on the lower Susan and Nauskaupi Rivers and in each case the highest terrace is about 130 feet above the present river level. In many other places, from two to six feet of sand overlie the lacustrine clays, and frequently silts, sands, and clays are intermixed.

On slopes higher than 300 feet above Grand Lake and the tributary rivers, the surface materials are thin and stony with glacial clays predominating. It is probable that the soils resulted both from the weathering of a thin glacial deposit and to some extent from the breakdown in situ of the gneissic bedrock.

At the top of the plateau, at heights ranging from 800 to 1,500 feet, the effects of glaciation are most obvious. The surface is very uneven with many small lakes and bogs resulting from glacial damming. Drumlins are frequent. There are numerous low rounded gneissic ridges which are usually covered by stunted tree growth and Cladonia lichens. However, most of the region at the edge of the plateau has a moderate depth of till soil and the picture is not that of extreme desolation which is so often associated with the main Labrador uplands.

Climate

According to the Thornthwaite (1948) classification the whole of Labrador belongs to the prehumid climatic type. The Lake Melville area, being a considerable distance from the coast, has a somewhat drier climate than the average. The moisture index, compiled by the Thornthwaite system, is 67 for Goose Airport; this is equivalent to a B_3 humid climatic type.

The following climatic summary was compiled from the observations of the Meteorological Station, Department of Transport, Goose Bay, elevation 114 feet above sea level. The evenly distributed precipitation has an annual mean of 31 inches. The long-term mean monthly temperatures (F°) are:

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
—2	4	16	28	40	52	61	58	51	38	25	9

The absolute maximum and minimum temperatures are 100°F. and —35°F. respectively. The average frost-free period is 104 days, extending from the first week of June to the middle of September.

The Grand Lake area lies in a zone subject to frequent summer thunder showers. From the first week in July to the middle of August, at least one such shower occurred almost daily in 1956. The heavy rains, which usually lasted for a few minutes, were frequently accompanied by thunder and lightning.

THE FOREST

The forests of the Labrador Peninsula lie entirely within the boreal forest region. The Lake Melville-Grand Lake area is situated within the B.12 section (Rowe, 1959) which is characterized by a vegetation richer than that of the surrounding area.

The widespread coniferous forest consists of black spruce and balsam fir, with some white spruce and eastern larch. In pure stands the black spruce is found on poor sites at both extremes of the moisture range; associated with balsam fir, it is characteristic of shallow upland soils as well. Mixed stands of balsam fir, black spruce and scattered white spruce are typical of deep soils in the river valleys and lowland plains.

Changes take place where the original forest is disturbed. Following fire, black spruce takes over a wide range of sites, usually in pure stands although occasionally mixed with white birch and trembling aspen. These hardwood species sometimes form small pure patches after fire; they also pioneer on landslides and other areas of soil disturbance. Seen from a distance the straight,

light-green lines of aspen and white birch on steep hillsides surrounded by the darker green of the coniferous forest often present a striking picture.

According to Low (1896), "black spruce is the most abundant tree of Labrador and probably constitutes over ninety per cent of the forest". This may be true for the entire Labrador Peninsula, but for the Grand Lake and Northwestern Lake Melville areas a composition of 60 per cent black spruce, 30 per cent balsam fir, and 10 per cent other species appears to be more accurate.

STUDY METHODS

Sample areas were first located on aerial photographs and then examined on the ground to check their suitability. Twenty localities were selected, 16 being in the Grand Lake area and the remaining four near the Sabaskachu River, and at each an intensive sampling of areas homogeneous as to cover type and age class was made by means of ten one-tenth-acre plots laid out in a "herringbone" pattern. Short lines were first established at two-chain intervals on each side of a baseline and at right angles to it, and the plots were placed at three-chain intervals along the lines, except where some adjustment had to be made to prevent sampling of more than one forest condition.

The following data were collected for each area:

(1) Measurements on the ten one-tenth-acre plots:
   (a) Diameter tally by species and one-inch classes of all trees 0.6 inch and over at breast height.
   (b) Diameter, height, age and crown class of three systematically selected trees of the dominant species.
   (c) Depth of litter on humus.
   (d) List of lesser vegetation species by abundance.
   (e) Amount of reproduction, classified by species and size.
   (f) Other pertinent information including origin of stand, disturbance since origin, slope, aspect, and topographic position.

(2) Stem analysis of from one to five dominant trees.

(3) Detailed soil description from one or more soil pits.

(4) General forest description.

(5) Landform description.

In the field, the site of each plot was classified as good, medium or poor, taking into account all pertinent factors such as soil type, drainage, tree species composition, growth rate, history, and lesser vegetation. The initial classification was later checked and corrected by office compilation of the data.

PRINCIPAL FOREST TYPES

Hitherto the work of Hustich (1949) has provided the principal source of information concerning Labrador forest types. This investigator classified the forests by relating tree cover, lesser vegetation, and soil moisture regime, and named the types by linking the dominant tree species with characteristic minor plants. He grouped the main forest types under three divisions of a moisture series, as follows:

A. Dry series
   1. Conifer lichen forest
   2. Conifer dwarf shrub-lichen forest
   3. Conifer blueberry forest

B. Moist series

4. Conifer feathermoss forest
5. Conifer bunchberry forest
6. Rich conifer forest
7. Mixed groves

C. Wet series

8. Open bog forest
9. Black spruce muskeg
10. Rich swamp forest

In the present study Hustich's classification has been found useful. However, some modifications were necessary as his classification was drawn up for the entire Labrador peninsula and was too general for the present more detailed study. When working in a smaller area one is likely to encounter fewer types, although subdivision into subtypes and variants may appear to be necessary and feasible. In the classification adopted, the types are grouped in five moisture series forming a gradient from very dry to very wet. The terms are relative, and they indicate varying degrees of site moistness as estimated in comparison to the optimum or "moist" condition. (Table 1).

TABLE 1. FOREST TYPES OF THE LAKE MELVILLE AREA.

(Modification of Hustich Classification)

Forest Type	Moisture Regime	Site Class*
1. Black spruce/lichen, fire type	Very dry	III
2. Black spruce-balsam fir/feathermoss, undisturbed type	Dry	II
3. Black spruce/feathermoss, fire type	Dry	II
4. Fir-spruce-birch/rich herb, undisturbed type	Moist	I
5. Black spruce-white birch/bunchberry, fire type	Moist	I
6. White birch/bunchberry, fire type	Moist	I
7. Black spruce-balsam fir/sphagnum, undisturbed type	Wet	II
8. Black spruce/ledum, undisturbed type	Very wet	III

*Site class I—Good
II—Medium
III—Poor

The lesser vegetation of the forest types of the Lake Melville area was found to be dominated with few exceptions by mosses and lichens; according to other investigators this is true of the entire Labrador forested area. Feathermosses in particular predominate in all types except the very wet and very dry, and difficulties therefore arose when attempting to classify forest types according to the most prominent lesser vegetation species. Wherever possible, the mosses and lichens have been ignored in the vegetative description.

Since the composition of the virgin forest is usually altered by disturbance, it is common to find two or more forest sub-types growing on the same soil and moisture conditions. Fire in particular has made vast inroads into the Labrador forests and high percentages of all types, except the wet ones, have been burned over within the past 250 years. These burned areas may progress to the original type, but at present they can be considered as distinct sub-types. Their status is indicated in Table I by adding the word "fire" to the type name.

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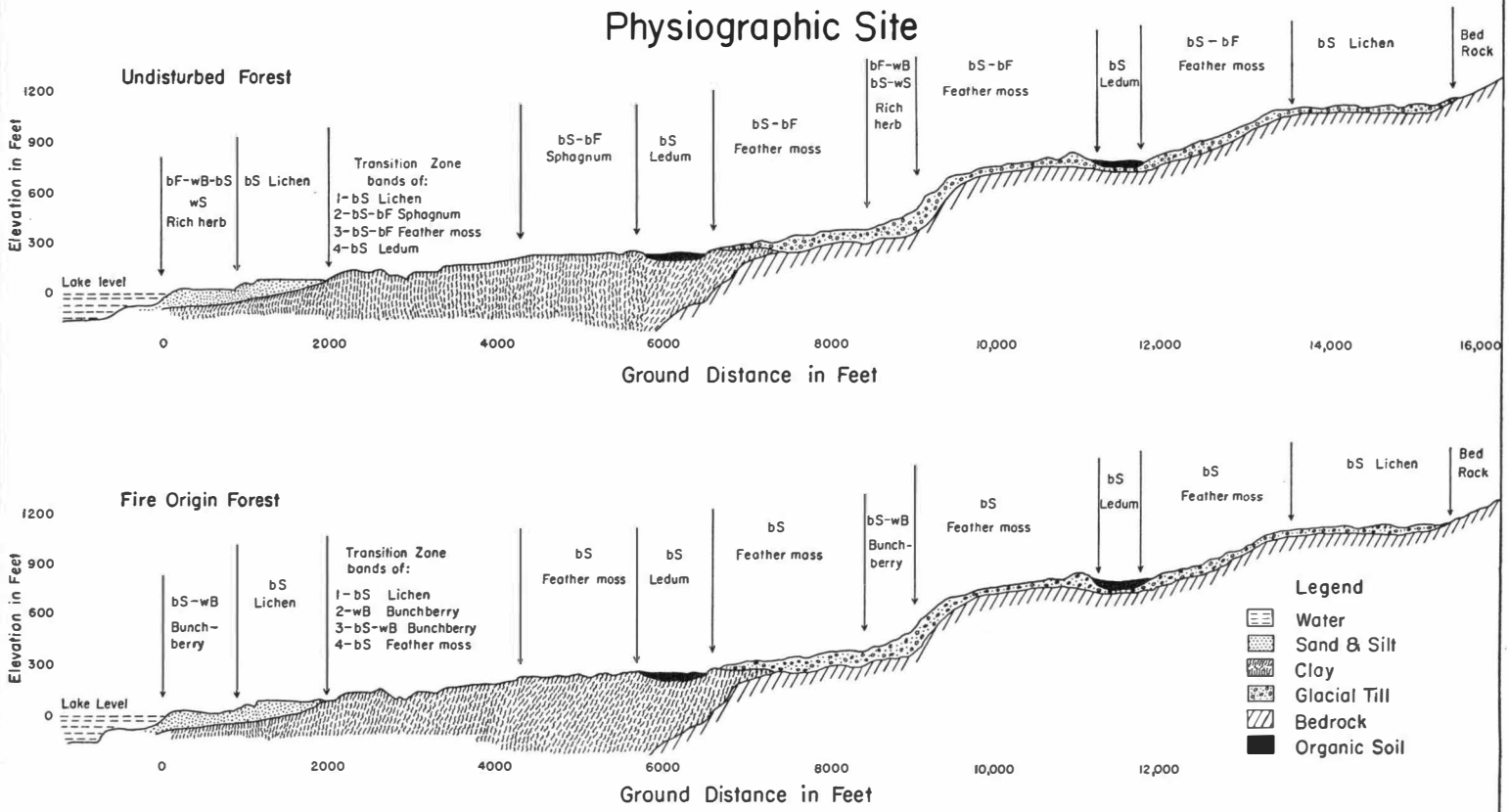
Figure 1

Relationship of Forest Types to Physiographic Site



The relationship of the forest types to physiographic site is shown in Figure I.

DESCRIPTION OF FOREST TYPES

(1) Black Spruce/Lichen, Fire Type

This forest type is encountered on elevated sand terraces and on high plateaux where the bedrock has a very thin soil covering. Ground cover consists of a dense mat of lichen with sparse Labrador tea and blueberry; dwarf birch is occasionally present, especially on the uplands.

On the elevated terraces there is a great depth of silty sand, low in nutrients and moisture-holding capacity. On the highlands the soil varies but is usually a coarse stoney sand which appears to have been formed in situ from bedrock; soil depth seldom exceeds six inches over bedrock.

The tree cover is almost exclusively open, consisting of black spruce with an occasional stunted larch. The forest is very slow-growing and tree diameters rarely exceed six inches at breast height. Tree heights seldom exceed 30 feet. Only one area in this type was sampled in detail but many other areas were inspected and described. The stand table for the sampled area (Table 2) shows 1,295 trees per acre; this represents a spacing of about 5.8 feet and under normal conditions would be considered adequate. However, most of the trees are in the one- and two-inch diameter classes; they are barely alive and are putting on a negligible amount of new growth.

TABLE 2. BLACK SPRUCE/LICHEN, FIRE TYPE STAND, 55 YEARS OLD.

Stand Table, Trees per Acre by Species and Diameter Classes.

(Basis—Area F)

Diameter at Breast Height (inches)	Black Spruce	Eastern Larch	Total
1	434	58	492
2	519	13	532
3	176	2	178
4	64	—	64
5	25	—	25
6	4	—	4
Total	1,222	73	1,295

The reproduction is mainly black spruce (Table 3). A small amount of larch is usually present, but seldom grows to merchantable trees. The black spruce reproduction is mainly from layering, whereas larch always reproduces from seed. It appears that the only time black spruce reproduces from seed is after a fire. Out of 63 quadrats stocked to black spruce, the regeneration on 49 quadrats (78 per cent) resulted from layering. It is probable that the dense lichen carpet restricts the amount of seed reaching the soil and those seedlings that do become established are often killed during the hot dry part of the

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summer. The reflected light from the white lichen surface may cause high temperatures which results in a higher percentage of cones opening on the trees than is the case in other black spruce types.

TABLE 3. BLACK SPRUCE/LICHEN, FIRE TYPE FOREST

Reproduction* in Per Cent on Milacre Quadrats.

(Basis — 110 quadrats)

Black spruce	57
Eastern larch	1
Black spruce and eastern larch	3
Unstocked	39
Total	100

*Reproduction is classed as trees 0.5 inch in diameter at breast height and under.

The sample area was burned about 55 years ago, making the stand one of the youngest encountered. The merchantable volume was 1.1 cords per acre which is considered well below the average for the forest type. Elsewhere the average age observed was approximately 100 years and the average volume per acre about 5 cords. However, regardless of age or present volume, the spruce/lichen fire type forest must be considered unproductive. It is essentially a fire type forest; considering the dry site and the highly combustible nature of the ground vegetation, it could not be otherwise. Fire history is so closely related to this type that it is difficult to know which is cause and which is effect.

(2) Black Spruce-Balsam Fir/Feathermoss, Undisturbed Type

This type is found on upper mountain slopes and hills of glacial origin. It is seldom found on lacustrine deposits below the 300-foot level. Ground cover is a dense carpet of Hylocomium, Calliergon, and Hypnum mosses with scattered blueberry, Labrador tea, and partridgeberry. Shrubs and broadleaved herbs are entirely absent.

On the mountain slopes the soil is a coarse sand and sandy loam varying in depth from six inches to three feet over bedrock. The fine clay particles have been washed out during the course of time and are now deposited in scattered wet depressions. On the sides of the low rounded glacial hills, the soil is deeper and consists of sandy loam with an admixture of small angular stones. Deep ravines with small rocky streams are usually situated between the glacial hills and knolls.

The tree cover is about equally proportioned between black spruce and balsam fir. The diameters seldom exceed 12 inches at breast height and the tree heights are usually about 40 feet. The stand table for this type (Table 4) shows 1,360 trees per acre of all sizes, more than half of them being below merchantable size.

TABLE 4. BLACK SPRUCE-BALSAM FIR/FEATHERMOSS, UNDISTURBED FOREST.

Stand Table, Trees Per Acre by Species and Diameter Classes.

(Basis — Areas D,H,L, and S)

D.B.H. (inches)	Black Spruce	Balsam Fir	White Birch	Total
1	108	149	—	257
2	129	156	—	285
3	80	100	—	180
4	65	84	—	149
5	80	83	—	163
6	66	61	1	128
7	56	36	1	93
8	35	15	2	52
9	17	7	1	25
10	12	3	1	16
11	4	2	—	6
12	2	1	1	4
13	1	1	—	2
Total	655	698	7	1,360

Adequate reproduction is not a problem in this forest type. Table 5 shows that 94 per cent of the quadrats examined were stocked to either black spruce, balsam fir, or both. Balsam fir reproduction originates always from seed, whereas 97 per cent of the black spruce came from layering.

TABLE 5. BLACK SPRUCE-BALSAM FIR/FEATHERMOSS, UNDISTURBED FOREST.

Reproduction in Per Cent on Milacre Quadrats.

(Basis — 400 quadrats)

Black spruce	25
Balsam fir	38
Black spruce and balsam fir	31
Unstocked	6
Total	100

This is an undisturbed and uneven-aged forest type. The maximum ages were about 200 years but the average age for merchantable trees was between 125 and 150 years. The average merchantable volume for the four areas sampled was 25.3 cords per acre.

The feathermoss forest is widespread but not continuous, the forest pattern being considerably broken by areas of poorer drainage. It is a good pulpwood forest which should reproduce to balsam fir after cutting.

(3) Black Spruce/Feathermoss, Fire Type

The forests of Labrador are very susceptible to destruction by fire. The effects of fire on future forest productivity may be good or bad, depending upon frequency, time, and severity of burn. Whatever the ultimate effect on the forest, the present effect is to simplify the vegetative pattern. Successional trends following fire have received considerable attention and to a large extent can be predicted. The physical and chemical changes which take place in the soil following fire are not as well understood. Writing on the forests of Alaska, H. J. Lutz (1956) reported, "Soil texture and structure, so far as is known, are not changed by burning". Whether the forest soils of Labrador behave in a similar manner to those of Alaska is not known. However, preliminary investigations indicate that the soils became drier following burning; this may be the result of destruction of the thick moss and raw humus layer which otherwise acts as a sponge and keeps the soil moist.

The black spruce/feathermoss fire type forest is a typical example. It has the same site class and moisture series as the spruce-fir/feathermoss undisturbed forest and any difference is only that which the fire has caused in the vegetation. Consequently, it is natural to expect the type to occur on the same locations and soils as the spruce-fir/feathermoss undisturbed type. To some extent this is true; fire types are usually found on the upper mountain slopes and hills of glacial origin where the soil is coarse sand or sandy loam over bedrock. However, the spruce/feathermoss fire type forest is also found on the lowland lacustrine sands, silts, and clays which, in the absence of fire, are considered to belong to a wetter soil series.

The ground cover, regardless of where the type is found, is a dense mat of Calliergon, Hylocomium, and Hypnum mosses with lesser quantities of blueberry and partridgeberry. Mountain alder is usually present. The stands are even-aged and mainly black spruce with limited numbers of white birch, balsam fir, and poplar. Although most of the stands were approximately 90 years old, ages were encountered up to 200 years. The stand table for the sampled areas (Table 6) has been divided into two parts, based on age classes, to better demonstrate the rate of growth and successional trends. It shows surprisingly little difference in the size of the merchantable trees for the different age classes. This suggests that the 200-year-old stands are past their prime and are now deteriorating, an assumption which is borne out by the large number of dead and windblown trees present in the older stands and the large number of younger balsam fir which are replacing the spruce.

TABLE 6. BLACK SPRUCE/FEATHERMOSS, FIRE TYPE FOREST.

Stand Table, Trees Per Acre by Species and Diameter Classes.

90-Year-Old-Stand (Basis—Areas B and G)

D.B.H. (inches)	Black Spruce	White Birch	Poplar	Total
1	345	3	—	348
2	663	53	3	719
3	562	44	4	610
4	382	46	4	432
5	277	44	6	327
6	107	24	5	136
7	51	10	2	63
8	10	5	3	18
9	3	—	1	4
10	1	—	—	1
Total	2,401	229	28	2,658

200-Year-Old Stand (Basis—Area A)

D.B.H. (inches)	Black Spruce	Balsam Fir	Total
1	67	37	104
2	148	110	258
3	169	52	221
4	226	53	279
5	273	17	290
6	187	11	198
7	106	4	110
8	30	—	30
9	2	—	2
10	—	—	—
11	1	—	1
Total	1,209	284	1,493

The reproduction pattern is somewhat similar for both age classes. Approximately the same amount of spruce reproduction was present in each case although the older class had the more fir (Table 7). The total amount of reproduction is much less for this type than for the undisturbed type. All fir

reproduction has originated from seed whereas only eight per cent of the black spruce originated from this source.

TABLE 7. BLACK SPRUCE/FEATHERMOSS, FIRE TYPE FOREST.

Reproduction in Per Cent on Milacre Quadrats.

90-Year Age Class (Basis—200 quadrats)

Black spruce	17
Balsam fir	2
White birch	1
Poplar	2
Unstocked	78
Total	100

200-Year Age Class (Basis—100 quadrats)

Black spruce	36
Balsam fir	12
Black spruce and balsam fir	6
Unstocked	46
Total	100

The younger stand had a volume of 17.6 cords, and the older one a volume of 24.1 cords per acre. Based on these volumes it is evident that mean annual increment is falling off rapidly. Probably this trend would have been more pronounced had sampling been carried out in the 120-year age class, because there is evidence to show that maximum increment is reached at this age. Consequently, a rotation age of 120 years is considered reasonable for the black spruce/feathermoss fire type forest.

(4) Fir-Spruce-Birch/Rich Herb, Undisturbed Type

This type is encountered usually on the lower mountain slopes where there is a thick layer of rich glacial deposits and where the moisture conditions are favourable; it is found occasionally on alluvial deposits in the immediate vicinity of river banks. Ground cover consists of dense Calliergon and Hylocomium mosses but the somewhat xerophytic blueberry and partridgeberry which are characteristic of the drier types, here are replaced by more moisture-loving plants. The characteristic species, which are usually present but never dominant, are bunchberry, twinflower, starflower, and wild lily-of-the-valley.

The soil is a deep sandy loam and is usually well drained. Where the type occurs in narrow fringes along river banks, the soil is composed of fine sands, silts and clays which have been deposited during spring flooding.

The tree cover is more diversified than that encountered elsewhere. The stand is composed of approximately 78 per cent balsam fir, 17 per cent black spruce, and the remaining 5 per cent is equally proportioned between white spruce and white birch. This is the so-called "big timber type" of Labrador.

The scattered white spruce grow to considerable size; the largest tree encountered measured 37 inches in diameter at breast height and 105 feet in height. Balsam fir and black spruce also attain better size than on any other forest type and trees 15 inches in diameter and 90 feet tall are not infrequent. Table 8 illustrates the wide range of diameter classes.

TABLE 8. FIR-SPRUCE-BIRCH/RICH HERB, UNDISTURBED FOREST.
Stand Table, Trees Per Acre By Species and Diameter Classes.
(Basis — Areas E,N,O,P,T)

D.B.H (inches)	Balsam Fir	Black Spruce	White Spruce	White Birch	Total
1	190	14	1	1	206
2	209	30	8	1	243
3	130	30	4	3	167
4	96	23	3	2	124
5	108	37	4	5	154
6	93	34	4	4	135
7	62	22	4	3	91
8	34	14	4	2	54
9	26	9	2	3	40
10	18	6	3	1	28
11	9	2	1	1	13
12	5	2	0.8	0.6	8.4
13	2	2	.4	.4	4.8
14	0.4	1	.6	.2	2.2
15	.8		.6	.2	1.6
16			.2	.2	0.4
17			.2	.2	.4
18			.4	.2	.6
19			.4		.4
20			.8		.8
21			.2		.2
23			.2		.2
24			.2		.2
27			.2		.2
28			.2		.2
Total	983	226	38.0	28.0	1,275.0

The reproduction pattern for this cover type is different from that of the other types. It is shown in Table 9 that 89 per cent of the quadrats were stocked, which is comparable to the stocking in other undisturbed cover types. The reproduction is predominantly balsam fir however, whereas in most other cover types the reproduction is mainly black spruce.

TABLE 9. FIR-SPRUCE-BIRCH/RICH HERB, UNDISTURBED FOREST.
Reproduction in Per Cent by Milacre Quadrats.
(Basis — 430 quadrats)

Black spruce	3
Balsam fir	73
Black spruce and balsam fir	5
White birch	1
Balsam fir and white birch	3
Balsam fir and white spruce	4
Unstocked	11
Total	100

The average age of merchantable trees in this type is about 125 years, but ages ranging up to 250 years are not uncommon. The average merchantable volume of conifers is approximately 40.8 cords per acre while the volumes of individual one-tenth-acre plots exceeded 80 cords to the acre; such high volumes were usually due to the presence of exceptionally large scattered white spruce.

The fir-spruce-birch undisturbed type is not extensive. It is confined to sheltered areas which have not been burned for a very long time. Probably the type occupied a much wider area formerly but it has been reduced to what might be considered a remnant of the primeval forest.

(5) Black Spruce-White Birch/Bunchberry, Fire Type

The spruce-birch/bunchberry fire type forest is the burned-over counterpart of the spruce-fir-birch/rich herb forest. It occupies the same sites as the latter, that is, the rich glacial deposits on the lower steep mountain slopes, and is found occasionally on lacustrine deposits which, in the absence of fire, are considered to be too moist for optimum growth. Hylocomium, Hypnum and Calliergon mosses completely cover the forest floor but bunchberry is more prolific here than elsewhere and appears to be the characteristic forest plant. Blueberry and sheep laurel are sometimes present in small quantities and starflower, false lily-of-the-valley and snowberry are occasionally seen. Mountain alder is usually present.

The soil is a sandy loam on the glacial slopes and usually a clay loam on the lacustrine deposits. The type rarely occurs on level terrain and it usually occupies well-drained sites.

TABLE 10. SPRUCE-BIRCH/BUNCHBERRY, FIRE TYPE FOREST.

Stand Table, Trees Per Acre By Species and Diameter Classes.

(Basis — Areas I and M)

D.B.H. (inches)	Black Spruce	Balsam Fir	White Birch	Total
1	45	3		45
2	126	4	28	158
3	134	2	44	180
4	155	1	43	199
5	208	1	45	254
6	220	2	21	243
7	157		12	169
8	64		2	66
9	25		1	26
10	9			9
11	2			2
12	0.5			0.5
Total	1,145.5	13	196	1,351.5

Black spruce is the dominant species; white birch and poplar are common but balsam fir and white spruce are very rare. Stand density is extremely high. The stand table (Table 10) shows approximately 850 merchantable softwood stems per acre which is too high for optimum growth. All the sampled areas were burned about 100 years ago and should now be approaching rotation age. The high stand density however has retarded the rate of growth in what normally would be considered fast-growing stands. This has resulted in average merchantable trees being only about six inches in diameter and 45 feet in height.

Reproduction is adequate but not overly abundant in this forest type. The following table shows that 56 per cent of the quadrats were stocked with conifers. This comparatively low stocking is undoubtedly due to the high stand density and does not reflect adverse site conditions. Black spruce reproduction is entirely from layering whereas balsam fir is from seed. Commercial cutting of spruce in this type would present regeneration difficulties. If the stand were clear cut it probably would be necessary to resort to artificial restocking.

TABLE 11. SPRUCE-BIRCH/BUNCHBERRY, FIRE TYPE FOREST.

Reproduction in Per Cent on Milacre Quadrats.

(Basis—200 quadrats)

Black spruce	44
Balsam fir	8
Black spruce and balsam fir	4
Unstocked	44
Total	100

The spruce-birch/bunchberry fire type is highly productive and for pulpwood production is much superior to the other types encountered in the Lake Melville area. These 100-year-old stands have an average merchantable volume of approximately 34.5 cords per acre and, although the trees are not exceptionally large, they are dense and clean-boled. The type is confined to burned areas with optimum soil and moisture conditions; hence it is not very extensive. The narrow steep-sided valley of Cape Caribou River is the prime example of the site, extending over approximately 5,000 acres.

(6) White Birch/Bunchberry, Fire Type

This is a type of limited occurrence. It is found chiefly along the shore fringe of Grand Lake on steep-sloped lacustrine deposits up to an elevation of 300 feet. The ground vegetation is dominated by cryptogams but Hylocomium and Calliergon have been largely replaced by clubmosses. Bunchberry is prolific, and starflower and twinflower are usually present in limited quantities. Underbrush consisting of mountain alder, mountain ash, and squashberry are prevalent in this hardwood forest.

The soil is well-drained and consists of approximately three feet of sandy loam overlying clay. Occasional small groves of black spruce are encountered on the clay soil in wet depressions in the hardwood stands.

White birch comprises about 85 per cent of the total tree cover (Table 12), black spruce and balsam fir are present in about equal quantities, and there are occasional trembling aspen and white spruce. Usually the black spruce

occurs in small groves, while the other species are associated in a mixture with the birch. The average tree diameters are five to six inches and the average height is about 50 feet; scattered fast-growing balsam fir and white spruce extend as dominants above the normal stand canopy.

TABLE 12. WHITE BIRCH/CORNUS, FIRE TYPE FOREST.
Stand Table, Trees Per Acre By Species and Diameter Classes.
(Basis — Area C)

D.B.H. (inches)	Black Spruce	Balsam Fir	White Birch	White Spruce	Poplar	Total
1	1	28	7	1	—	37
2	10	37	167	—	—	214
3	17	18	249	1	1	286
4	14	11	194	1	—	220
5	17	4	201			222
6	11	4	139			154
7	3	2	60		1	66
8	1		38			39
9	1	2	8			11
10	1		1			2
11						
12						
13						
14					2	2
15						
16						
17		1				1
Total	76	107	1,064	3	4	1,254

Hardwood stands in this region do not perpetuate themselves. Occasionally they take over the ground following fire but within one generation the type reverts to softwoods. The following reproduction table shows that this tendency towards a softwood stand has already started, as nearly all the reproduction is coniferous. In this type black spruce reproduces by layering, and it would appear as a general rule that black spruce on the Lake Melville area originates from seed only after fire.

TABLE 13. WHITE BIRCH/CORNUS, FIRE TYPE FOREST.
Reproduction in Per Cent By Milacre Quadrats.
(Basis — 110 quadrats)

Balsam fir	34
Black spruce	13
Black spruce and balsam fir	10
Black spruce and white birch	3
Balsam fir and white birch	2
Unstocked	38
Total	100

Only one stand was examined in detail. It originated from fire 75 years ago and is interesting because the surrounding fire type forest is about 90 years old; this would indicate that the hardwood stand originated from a second

burning of the softwood forest within one rotation. The scattered softwoods had an average volume per acre of approximately 3.5 cords. Hardwood volumes, which are considerable, were not compiled. White birch trees were tall and straight with a considerable length of clear bole; they should make a good commercial product at an age of 100 to 120 years. However, the stands of this type are scattered and comparatively small and it is doubtful whether there is sufficient to warrant a commercial operation.

(7) Black Spruce-Balsam Fir/Sphagnum, Undisturbed Type

This is the common type on lacustrine clays with gentle sloping to level terrain. It also occurs in local depressions on mountain slopes and plateau tops where the soil is composed of glacial clay. Sphagnum moss is the characteristic ground vegetation and is usually found in small dense patches which cover from 25 per cent to 50 per cent of the surface. Hypnum, Hylocomium, and Calliergon mosses are present but no longer dominant and have been replaced to some extent by the moisture-preferring snowberry. The proportion of Labrador tea increases in this forest type, and horsetail and bakeapple, which are typical bog plants, are occasionally seen. High underbrush consists mainly of scattered patches of alders which completely fill small openings in the stand.

The soil is a clay, or thin sand overlying compacted clay on the lacustrine flats. In the mountain depressions it is usually a sandy clay overlying bedrock. All soils have the mottled appearance of gleyzation, and water is usually encountered at less than 2.5 feet from the surface at all seasons.

Black spruce and balsam fir are present in about equal proportions and white birch and white spruce appear as very rare invaders. This forest type is very similar in species composition and tree size to the spruce-fir/feathermoss forest, the only apparent difference being a somewhat higher proportion of spruce here. A comparison of the following stand table (Table 14) with Table 4 will illustrate the similarity.

TABLE 14. SPRUCE-FIR/SPHAGNUM, UNDISTURBED FOREST.
Stand Table, Trees Per Acre By Species and Diameter Classes.
(Basis—Areas K and R)

D.B.H. (inches)	Black Spruce	Balsam Fir	Total
1	100	154	254
2	134	159	293
3	116	123	239
4	93	72	165
5	119	94	213
6	92	50	142
7	55	28	83
8	37	7	44
9	18	7	25
10	6	1	7
11	2		2
Total	772	695	1,467

Reproduction is adequate in the spruce-fir/sphagnum forest. Table 15 shows that 88 per cent of the quadrats were stocked to one or more species with balsam fir being dominant. Practically all the black spruce originates from layering whereas all other species originate from seed.

TABLE 15. SPRUCE-FIR/SPHAGNUM, UNDISTURBED FOREST.
Reproduction in Per Cent By Milacre Quadrats.
(Basis—200 quadrats)

Black spruce	29
Balsam fir	37
Black spruce and balsam fir	22
Unstocked	12
Total	100

The spruce-fir/sphagnum undisturbed forest is extensive. The burned-over counterpart of this forest type was not found and such is to be expected if the hypothesis developed earlier, of a drying-out of the soil following the fire, is correct. The average age of the trees is about 120 years but sound trees 250 years of age are not unusual. The volume per acre of sampled areas was approximately 23.4 cords. This forest type forms the bulk of the pulpwood stand, particularly in the Sabaskachu River area.

(8) Black Spruce/Ledum, Undisturbed Type

This forest type is found on flat terrain at all elevations where the drainage is retarded. Ground cover is normally in two strata. The lower layer consists of a carpet of Sphagnum, Hylocomium, and Hypnum moss with scattered bake-apple and other moisture-loving plants. The upper stratum is composed of Labrador tea which normally covers 25 per cent to 75 per cent of the ground.

TABLE 16. BLACK SPRUCE/LEDUM, UNDISTURBED FOREST.
Stand Table, Trees Per Acre By Species and Diameter Classes.
(Basis—Area J)

D.B.H. (inches)	Black Spruce	Balsam Fir	Total
1	422	55	477
2	448	77	525
3	214	66	280
4	134	40	174
5	132	37	169
6	70	22	92
7	37	5	42
8	11	—	11
9	5	—	5
Total	1,473	302	1,775

The soil is deep compacted lacustrine clay on the lowland plains and shallow clay over bedrock on the plateau top. Above the mineral soil there is usually a thick layer, one to two feet, of wet black organic muck.

The tree cover is approximately 80 per cent black spruce and 20 per cent balsam fir. Growth is slow and trees seldom exceed 9 inches at breast height. The stand height is about 30 feet. Stand density is usually good. Table 16 shows 1,775 trees per acre, although most of them are below merchantable size even though their ages may exceed 100 years.

Reproduction is prolific. It is shown in Table 17 that 91 per cent of the quadrats were stocked, mainly to black spruce. The high rate of stocking is largely due to the slow rate of growth, as it normally takes 40 to 60 years for trees to reach breast height. All black spruce and a high percentage of balsam fir originated from layering.

TABLE 17. BLACK SPRUCE/LEDUM UNDISTURBED FOREST

Reproduction in Per Cent By Milacre Quadrats.

(Basis—100 quadrats)

Black spruce	54
Balsam fir	9
Black spruce and balsam fir	28
Unstocked	9
Total	100

The black spruce/Ledum forest is extensive. At the plateau top in particular, at an elevation of 800 to 1,000 feet, this type together with the spruce lichen forest, extends over vast areas and comprises most of the forest cover. It is uneven-aged, the average age of trees being about 150 years while trees more than 300 years old are not unusual. The average merchantable volume is 10.4 cords per acre. In most circumstances, the present stand could be harvested but probably the land it occupies should be excluded from the long-term productive forest area.

VOLUME PRODUCTION OF FOREST TYPES

Area of Forest Types

The Grand Lake-Lake Melville area extends over approximately 405,000 acres. This study was not designed to give detailed volumetric data and consequently the sampling was more qualitative than quantitative. In order to present a complete picture however, it seems essential to give some idea of the extent of the various forest types. It should be realized that the estimates of the area are quite subjective and no degree of accuracy can be quoted.

Aerial photographs at a scale of 20 chains to one inch were used in the field study and the small sampling units plotted on these photographs. The sample areas were studied under a stereoscope until familiarity with all observational characteristics was obtained. Observations were then extended to the photographs of the entire area on a percentage basis. The results are shown in Table 18. The area of non-forest land and water does not include Grand Lake or that portion of Lake Melville shown on the front map; it does include the area of smaller lakes and rivers.

TABLE 18. TENTATIVE CLASSIFICATION SHOWING RELATIVE OCCURRENCE OF VARIOUS FOREST CONDITIONS ON STUDY AREA.

Land Classification	Per Cent of Area
Forested Area	76
Non-forested Area	24
Total	100

Forest Classification		
Forest Type	Site	Per Cent of Area
*(1) Black Spruce/Lichen, fire type	III	25
(2) Black Spruce-Balsam Fir/Feathermoss, undisturbed	II	18
(3) Black Spruce/Feathermoss, fire type	II	9
(4) Fir-Spruce-Birch/Rich Herb, undisturbed	I	1
(5) Spruce-Birch/Bunchberry, fire type	I	4
(6) White Birch/Bunchberry, fire type	I	1
(7) Black Spruce-Balsam Fir/Sphagnum, undisturbed	II	18
*(8) Black Spruce/Ledum, undisturbed	III	24
Total		100

* Unproductive forest.

Forest Growth

The three principal site divisions under which all forest types were grouped provides the basis for growth predictions. The distribution of age classes in the different forest types and the limited sampling precluded the construction of yield tables and only very tentative estimates of growth and yield can be provided.

The method used here of classifying areas into site classes of good, medium, and poor growth is entirely subsidiary to the forest type classification. The site classes are merely a convenient method of grouping forest types into classes with rather similar growth characteristics. For example, the very dry spruce/lichen forest and the very wet spruce/Ledum forest differ greatly in their ecology but as the trees growing on these types were found to have approximately the same growth rate and form, they were grouped together in the poor site class for the purpose of volume table construction and growth prediction. Similarly, the "dry" and "wet" forest types were grouped to form the medium site class. Species composition and stand density may differ in these types within a site class and consequently the volumes per acre are different for each forest type.

Most of the forest sampling was carried out in virgin all-aged stands. These stands are in a state of equilibrium where the mortality balances the current

growth and are not adaptable to estimates of mean annual increment. There was sufficient sampling of even-aged stands in each of the three site classes to provide some indication of growth trends and the estimates can be used to approximate the growth potentialities of similar sites occupied by the virgin all-aged stands.

The method has certain failings; the most serious is that even-aged stands in this area are of fire origin and consist mainly of black spruce, whereas the virgin stands have certain percentages of other species. Probably burned-over virgin stands would regenerate to black spruce, but the trend following clear-felling would be toward balsam fir. Another drawback is the lack of sufficient age-class sampling; in most types only one age class was obtained, usually an immature age. This excludes the possibility of showing the growth trend from an early age to maturity and makes it impracticable to calculate a rotation age for each type. As a result the estimated rotation age is a general average for all sites; differences for each must be assumed.

In general the Lake Melville forests are slow-growing. If age is disregarded, there is often very little difference in diameter increment for trees of the same size growing on different sites. This is particularly true with black spruce. Table 19 shows the diameter increment of black spruce for the three sites for the age classes sampled. The reason why trees on the poorest sites have apparently better periodic diameter increment than the better sites is that the trees on Site III sample are much younger and the stands are understocked, thereby allowing maximum opportunity for diameter growth.

TABLE 19. PERIODIC DIAMETER INCREMENT OF BLACK SPRUCE BY DIAMETER, SITE AND AGE CLASSES, 1946 TO 1956.

D.B.H. (inches)	Site I	Site II		Site III
	100 Years	90 Years	200 Years	55 Years
4	0.41	0.35	0.18	0.48
5	.44	.39	.24	.54
6	.48	.42	.28	.59
7	.51	.46	.32	.63
8	.54	.49	.35	
9	.57	.52	.38	
10	.59	.55	.40	
11	.61			
12	.62			

Diameter increment, while expressing the growth of individual trees, is not a suitable measure for expressing the growth of forest stands. Volume increment, either current or mean annual, for a number of different age classes is normally used for this purpose. In this study the compilation of volume increment has been severely handicapped by a lack of sufficient age-class distribution. Two age classes were obtained in the Site II or medium site but in the Site I and Site III classes only one was sampled. Table 20 shows the mean and current annual increment as obtained from these samples.

TABLE 20. MEAN ANNUAL AND CURRENT ANNUAL INCREMENT, CUBIC FEET PER ACRE, BLACK SPRUCE.

Site	Age of Stand	MAI	CAI
I	100	27	59
II	90	16	41
II	200	10	-11
III	55	2	10

The 1956 field work was designed to sample the principal forest conditions within the area and was not intended to produce yield tables for each site. However, the trend of mean and current annual increment as it effects the rotation age is of major interest. Consequently, a series of trial curves were prepared. These current and mean annual increment curves were based on the traditional shape of such curves, and were drawn to pass through the few known points of reference. Maximum current annual increment was assumed to have been reached at 90 years; from available observations this appears reasonable.

The rotation age, as calculated from the intersection of the approximate mean and current annual increment curves, is about 120 years. At this point, growth for the good, medium, and poor sites is 27, 22, and 8 cubic feet per acre respectively.

SUMMARY

Little factual information is available concerning the forests of the Labrador Peninsula. These stands perhaps represent the greatest unexploited portion of the boreal forests of the world and will undoubtedly increase in importance in the future. Before any large-scale development takes place it is essential to increase the present scanty knowledge concerning them, particularly in the fields of ecology, growth and yield, in order to provide a basis for their rational management.

A preliminary survey of the forests in the Grand Lake and Northwestern Lake Melville areas was made in 1956 to identify and describe the principal forest types by a study of their ecological characteristics and to obtain some information as to their growth potential.

Sampling units of ten one-tenth-acre plots were established in homogeneous forest conditions. On 20 such areas a thorough examination was made of the vegetative patterns and mensurational data were collected.

The classification of forest types was based upon forest cover and minor vegetation and resulted in eight principal divisions. Each of the types was classed into one of three site classes, according to landform, soil nature, and soil moisture. The ecological descriptions of forest types and sites were later augmented and substantiated by the addition of growth and yield data.

Close correlation of merchantable volumes was found between the different sampling units within a forest type, whereas the volumes were found to differ widely between types. This adds substance to the ecological descriptions and tends to show that the dividing of the forest by vegetational characteristics is on a sound basis.

The poorest forest type had a merchantable volume of approximately five cords per acre whereas the best type supported 41 cords per acre. The volumes of other types are distributed fairly uniformly in between, giving an over-all

unweighted average of 22 cords per acre. There were insufficient data for the construction of yield tables for each site, but as an average for all sites an economic rotation age of about 120 years is considered reasonable. At this age, the good, medium, and poor sites have a mean annual increment of 27, 22, and 8 cubic feet per acre, respectively.

Using aerial photographs and working on the basis of recognizable characteristics, the approximate percentage of each forest type within the region was calculated.

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Appendix I

LIST OF COMMON AND SCIENTIFIC NAMES OF SPECIES

Common Name	*Scientific Name*
TREES	
Balsam fir	*Abies balsamea* (L.) Mill.
Black spruce	*Picea mariana* (Mill.) BSP.
White spruce	*Picea glauca* (Moench) Voss.
White birch	*Betula papyrifera* Marsh.
Trembling aspen (Poplar)	*Populus tremuloides* Michx.
Eastern larch	*Larix laricina* (Du Roi) K. Koch.
Mountain-ash	*Sorbus decora* (Sarg.) Schneid.
Willow	*Salix* spp.
SHRUBS	
Labrador tea	*Ledum groenlandicum* Retz.
Blueberry	*Vaccinium* spp.
Dwarf birch	*Betula michauxii* Spach.
Partridgeberry	*Vaccinium vitis-idaea* var. *minus* L.
Mountain alder	*Alnus crispa* (Ait.) Pursh.
Sheep laurel	*Kalmia angustifolia* L.
Snowberry	*Gaultheria hispidula* (L.) Bigel.
Squashberry	*Viburnum edule* (Michx.) Raf.
HERBS	
Bunchberry	*Cornus canadensis* L.
Twinflower	*Linnaea borealis* L.
Starflower	*Trientalis borealis* Raf.
Wild lily-of-the-valley	*Maianthemum canadense* Desf.
Creeping snowberry	*Gaultheria hispidula* L.
Horsetail	*Equisetum arvense* L.
Bakeapple	*Rubus chamaemorus* L.
Twisted stalk	*Streptopus* spp.
Fern	*Dryopteris* spp.
MOSSES	
Reindeer moss	*Cladonia* spp.
Sphagnum moss	*Sphagnum* spp.
Hylocomium moss	*Hylocomium splendens* (Hedw.) BSG.
Hypnum moss	*Hypnum crista-castrensis* L.
Calliergon moss	*Calliergon schreberi* Willd.
Clubmoss	*Lycopodium* spp.

Appendix II

TABLE 1. BALSAM FIR

Average Height and Merchantable Volume* per Tree by Diameter and Site Classes.

Diameter at B.H.	Average Total Height			Merchantable Volume		
	Site Class			Site Class		
	I	II	III	I	II	III
(inches)	(feet)			(cubic feet)		
4	37	26	17	1.4	1.2	0.7
5	42	32	23	2.5	2.1	1.6
6	47	37	28	3.9	3.2	2.7
7	51	41	33	5.8	4.8	4.0
8	55	45	38	8.1	6.8	5.8
9	59	50	42	10.9	9.4	8.0
10	63	53	46	14.2	12.1	10.7
11	66	57	49	17.9	15.6	13.6
12	69	60	51	22.5	19.5	16.8
13	71	62		26.8	23.6	
14	72			31.5		
15	73			36.7		
16	75			48.3		

*Stump height 1 foot, top diameter 3 inches, Form Class 65, Form-class Volume Tables.

TABLE 2. BLACK SPRUCE

Average Height and Merchantable Volume* per Tree by Diameter and Site Classes.

Diameter at B.H.	Average Total Height			Merchantable Volume		
	Site Class			Site Class		
	I	II	III	I	II	III
(inches)	(feet)			(cubic feet)		
4	36	30	24	1.0	0.9	0.8
5	42	36	30	2.0	1.7	1.4
6	46	40	34	3.3	2.9	2.5
7	50	44	38	5.0	4.5	4.0
8	53	46	40	7.1	6.3	5.7
9	55	48	41	9.5	9.1	7.4
10	56	49	42	12.1	10.8	9.6
11	57	49	43	15.0	13.3	11.9
12	58	50	44	18.1	16.1	14.5
13	59	50	45	21.8	19.0	17.4
14	60	53		25.5	21.9	
17	61			37.8		

*Stump height 1 foot, top diameter 3 inches, Form Class 62.5, Form-class Volume Tables.

TABLE 3. WHITE SPRUCE—SITE I

Merchantable Volume Table,* Form Class 65, Labrador.

Diameter at B.H. (inches)	Height (feet)	Volume (cubic feet)
4	31	1.0
5	38	2.0
6	45	3.5
7	50	5.3
8	54	7.5
9	59	10.3
10	62	13.6
11	65	17.4
12	68	21.7
13	70	26.3
14	73	31.7
15	75	37.3
16	76	42.9
17	77	49.2
18	79	56.6
19	80	64.2
20	81	72.4
21	82	82.0
22	83	91.0
23	84	100.0
24	85	111.0
25	86	120.0
26	87	131.0
27	88	144.0
28	89	155.0

*Stump height 1 foot, top diameter 3 inches.