

A. J. Kerwin

**A STUDY OF THE MENSURATIONAL
CHARACTERISTICS OF SOME
IMPORTANT FOREST TYPES OF
NORTHERN NEWFOUNDLAND**

by

G. Page, J.P. Bouzane, D. Bajzak
and R.S. van Nostrand

**FOREST RESEARCH LABORATORY
ST. JOHN'S, NEWFOUNDLAND
INFORMATION REPORT N-X-41**

**CANADIAN FORESTRY SERVICE
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MARCH, 1970**

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A Study of the Mensurational Characteristics
of Some Important Forest Types of Northern
Newfoundland

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Forest Research Laboratory

St. John's, Newfoundland

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PREFACE

This report embodies the results of one of four allied projects designed to obtain mensurational information for the more important forest types within various Forest Sections of the island of Newfoundland. Similar reports have already been prepared for western Newfoundland (Bajzak, Bouzane, and Page, 1968) and, in an unpublished form, for central Newfoundland (Bajzak, 1962).

The project was designed by R.S. van Nostrand and field work was carried out in 1960 and 1961 by R.S. van Nostrand and J.P. Bouzane. Data analysis has been carried out by J.P. Bouzane under the direction of D. Bajzak. Preparation of the data has been completed and the report written by G. Page in consultation with the co-authors.

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
GENERAL DESCRIPTION OF NORTHERN NEWFOUNDLAND	1
Soil and Climatic Conditions	3
The Forests	3
METHODS	4
Plot Location	4
Mensurational Techniques	4
THE FOREST TYPES OF NORTHERN NEWFOUNDLAND	6
Taxus-Balsam Fir Forest Type	9
Dryopteris-Balsam Fir Forest Type	38
Dryopteris-Hylocomium-Balsam Fir Forest Type	55
Rubus-Balsam Fir Forest Type (Mitella Variant)	72
Pleurozium-Balsam Fir Forest Type	88
DISCUSSION	101
SUMMARY AND CONCLUSIONS	104
LITERATURE CITED	109

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Number of samples from individual forest types	7
2	Local form class merchantable volume and stock tables: Taxus-Balsam fir forest type (Age 55-70) . .	17
3	Local form class merchantable volume and stock tables: Taxus-Balsam fir forest type (Age 71-85) . .	18
4	Local form class merchantable volume and stock tables: Taxus-Balsam fir forest type (Age 86-100) . .	19
5	Local form class merchantable volume and stock tables: Taxus-Balsam fir forest type (Age 101+) . . .	20
6	Stand and basal area tables: Taxus-Balsam fir forest type (Age 55-70)	21
7	Stand and basal area tables: Taxus-Balsam fir forest type (Age 71-85)	22
8	Stand and basal area tables: Taxus-Balsam fir forest type (Age 86-100)	23
9	Stand and basal area tables: Taxus-Balsam fir forest type (Age 101+)	24
10	Stem analysis data table: Taxus-Balsam fir forest type (Age 55-70)	34
11	Stem analysis data table: Taxus-Balsam fir forest type (Age 71-85)	35
12	Stem analysis data table: Taxus-Balsam fir forest type (Age 86-100)	36
13	Stem analysis data table: Taxus-Balsam fir forest type (Age 101+)	37
14	Local form class merchantable volume and stock tables: Dryopteris-Balsam fir forest type (Age 86-100)	44
15	Local form class merchantable volume and stock tables: Dryopteris-Balsam fir forest type (Age 101+)	45

LIST OF TABLES (Cont'd)

<u>Table</u>		<u>Page</u>
16	Stand and basal area tables: Dryopteris-Balsam fir forest type (Age 86-100)	46
17	Stand and basal area tables: Dryopteris-Balsam fir forest type (Age 101+)	47
18	Stem analysis data table: Dryopteris-Balsam fir forest type (Age 86-100)	53
19	Stem analysis data table: Dryopteris-Balsam fir forest type (Age 101+)	54
20	Local form class merchantable volume and stock tables: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100)	61
21	Local form class merchantable volume and stock tables: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	62
22	Stand and basal area tables: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100)	63
23	Stand and basal area tables: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	64
24	Stem analysis data table: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100)	70
25	Stem analysis data table: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	71
26	Local form class merchantable volume and stock tables: Rubus-Balsam fir forest type (Age 86-100)	78
27	Local form class merchantable volume and stock tables: Rubus-Balsam fir forest type (Age 101+)	79
28	Stand and basal area tables: Rubus-Balsam fir forest type (Age 86-100)	80
29	Stand and basal area tables: Rubus-Balsam fir forest type (Age 101+)	81

LIST OF TABLES (Cont'd)

<u>Table</u>		<u>Page</u>
30	Stem analysis data table: Rubus-Balsam fir forest type (Age 86-100)	86
31	Stem analysis data table: Rubus-Balsam fir forest type (Age 101+)	87
32	Local form class merchantable volume and stock tables: Pleurozium-Balsam fir forest type (Age 101+).	93
33	Stand and basal area tables: Pleurozium-Balsam fir forest type (Age 101+)	94
34	Stem analysis data table: Pelurozium-Balsam fir forest type (Age 101+)	98
35	Stocking of regeneration by individual forest types .	99
36	Number of stems of regeneration per acre by height classes for individual forest types	100
37	Volume and volume increment per acre by individual forest types	102

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Map of insular Newfoundland showing forest regions . .	2
2	White spruce height/age curve: all forest types . . .	8
3	Balsam fir height/diameter curve: Taxus-Balsam fir forest type	11
4	White spruce height/diameter curve: Taxus-Balsam fir forest type	12
5	Balsam fir height/age curve: Taxus-Balsam fir forest type (Age 55-70)	13
6	Balsam fir height/age curve: Taxus-Balsam fir forest type (Age 71-85)	14
7	Balsam fir height/age curve: Taxus-Balsam fir forest type (Age 86-100)	15
8	Balsam fir height/age curve: Taxus-Balsam fir forest type (Age 101+)	16
9	Stand table diagrams: Taxus-Balsam fir forest type .	25
10	Balsam fir stem analysis diagram: Taxus-Balsam fir forest type (Age 55-70)	26
11	White spruce stem analysis diagram: Taxus-Balsam fir forest type (Age 55-70)	27
12	Balsam fir stem analysis diagram: Taxus-Balsam fir forest type (Age 71-85)	28
13	White spruce stem analysis diagram: Taxus-Balsam fir forest type (Age 71-85)	29
14	Balsam fir stem analysis diagram: Taxus-Balsam fir forest type (Age 86-100)	30
15	White spruce stem analysis diagram: Taxus-Balsam fir forest type (Age 86-100)	31
16	Balsam fir stem analysis diagram: Taxus-Balsam fir forest type (Age 101+)	32

LIST OF FIGURES (Cont'd)

<u>Figure</u>		<u>Page</u>
17	White spruce stem analysis diagram: Taxus-Balsam fir forest type (Age 101+)	33
18	Balsam fir height/diameter curve: Dryopteris-Balsam fir forest type.	40
19	White spruce height/diameter curve: Dryopteris-Balsam fir forest type	41
20	Balsam fir height/age curve: Dryopteris-Balsam fir forest type (Age 86-100)	42
21	Balsam fir height/age curve: Dryopteris-Balsam fir forest type (Age 101+)	43
22	Stand table diagrams: Dryopteris-Balsam fir forest type	48
23	Balsam fir stem analysis diagram: Dryopteris-Balsam fir forest type (Age 86-100)	49
24	White spruce stem analysis diagram: Dryopteris-Balsam fir forest type (Age 86-100)	50
25	Balsam fir stem analysis diagram: Dryopteris-Balsam fir forest type (Age 101+)	51
26	White spruce stem analysis diagram: Dryopteris-Balsam fir forest type (Age 101+)	52
27	Balsam fir height/diameter curve: Dryopteris-Hylocomium-Balsam fir forest type	57
28	White spruce height/diameter curve: Dryopteris-Hylocomium-Balsam fir forest type	58
29	Balsam fir height/age curve: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100).	59
30	Balsam fir height/age curve: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	60
31	Stand table diagrams: Dryopteris-Hylocomium-Balsam fir forest type	65

LIST OF FIGURES (Cont'd)

<u>Figure</u>		<u>Page</u>
32	Balsam fir stem analysis diagram: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100)	66
33	White spruce stem analysis diagram: Dryopteris-Hylocomium-Balsam fir forest type (Age 86-100)	67
34	Balsam fir stem analysis diagram: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	68
35	White spruce stem analysis diagram: Dryopteris-Hylocomium-Balsam fir forest type (Age 101+)	69
36	Balsam fir height/diameter curve: Rubus-Balsam fir forest type	74
37	White spruce height/diameter curve: Rubus-Balsam fir forest type	75
38	Balsam fir height/age curve: Rubus-Balsam fir forest type (Age 86-100)	76
39	Balsam fir height/age curve: Rubus-Balsam fir forest type (Age 101+)	77
40	Stand table diagrams: Rubus-Balsam fir forest type . .	82
41	Balsam fir stem analysis diagram: Rubus-Balsam fir forest type (Age 86-100)	83
42	White spruce stem analysis diagrams: Rubus-Balsam fir forest type (Age 86-100)	84
43	Balsam fir stem analysis diagram: Rubus-Balsam fir forest type (Age 101+)	85
44	Balsam fir height/diameter curve: Pleurozium-Balsam fir forest type	89
45	Black spruce height/diameter curve: Pleurozium-Balsam fir forest type	90
46	Balsam fir height/age curve: Pleurozium-Balsam fir forest type (Age 101+)	91
47	Black spruce height/age curve: Pleurozium-Balsam fir forest type (Age 101+)	92

LIST OF FIGURES (Cont'd)

<u>Figure</u>		<u>Page</u>
48	Stand table diagrams: Pleurozium-Balsam fir forest type	95
49	Balsam fir stem analysis diagram: Pleurozium-Balsam fir type (Age 101+)	96
50	Black spruce stem analysis diagram: Pleurozium-Balsam fir forest type (Age 101+)	97
51	Volume/basal area relationships by forest types . . .	103
52	Number of stems/basal area relationships by forest types	105
53	Balsam fir site-index curves (all forest types) . . .	106

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INTRODUCTION

Between 1960 and 1962 data were collected on the mensurational characteristics of the important forest types within each of the four main Forest Sections of the Island of Newfoundland (Rowe, 1959). The purpose of the work was to provide growth data for mature or semi-mature crops of the major merchantable forest types whose ecological characteristics had previously been described by Damman (1963, 1964, 1967).

Results obtained form a basis for more detailed investigations of growth trends in relation to crop and site conditions and provide useful information on various mensurational features such as rotation lengths and volume production for practical application by forest managers.

Reports have already been prepared giving the results of the studies in central Newfoundland - Forest Section B28a (Bajzak, 1962) and western Newfoundland - Forest Section B28b (Bajzak, Bouzane, and Page, 1968). This report presents results for Forest Section B29 in northern Newfoundland.

In the report a brief description is given of vegetative characteristics, related soil conditions, and distribution of each forest type under consideration (after Damman, 1963), together with its major mensurational features. The latter include height/age and height/diameter curves, stem analyses, local form class merchantable volume and stock tables, basal area and stand tables, mean annual increment figures, and the stocking of regeneration. The forest types are subsequently compared on the basis of these characters, and the individual height/age curves related to site-index curves for balsam fir compiled from data for all the forest types.

GENERAL DESCRIPTION OF NORTHERN NEWFOUNDLAND

Forest Section B29 occurs on both the eastern and western sides of the Long Range Mountains (Forest Section B31) which form the backbone of the Great Northern Peninsula (Figure 1). To the east of

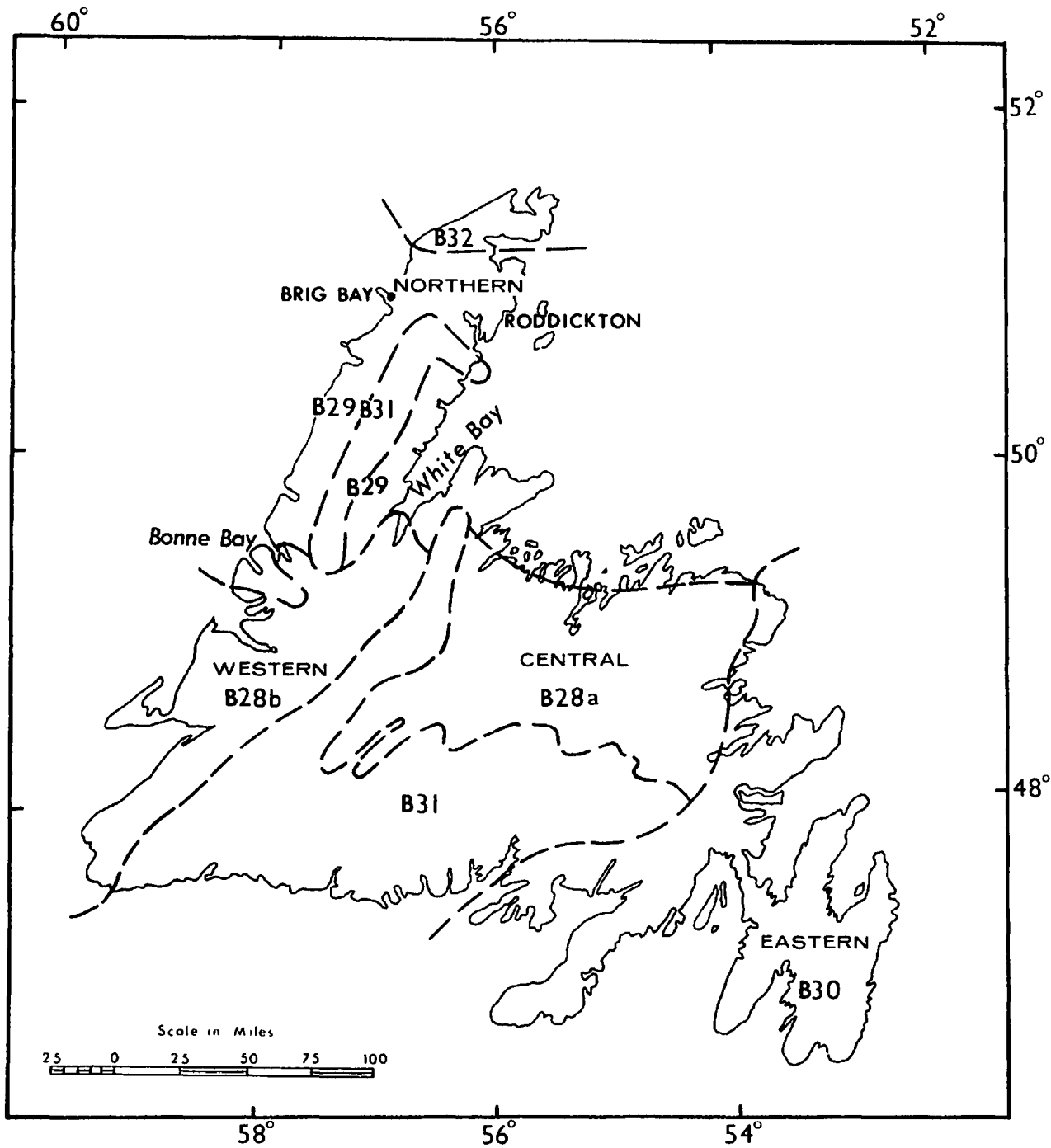


Figure 1. MAP OF INSULAR NEWFOUNDLAND SHOWING FOREST REGIONS (AFTER ROWE, 1959)

the central massif forest stands occur mainly in sheltered river valleys, while to the west they occupy an area of coastal lowland. The mountain range does not extend to the northern extremity of the peninsula, and a lowland occupies the entire width of the peninsula between the communities of Roddickton and Brig Bay. This latter area contains the majority of the merchantable forests within Forest Section B29. At the northern tip of the peninsula the closed forest grades into open lichen-woodland of the forest-tundra transition (Forest Section B32). To the south, the boundary is marked by a transition, along a line from Bonne Bay to southern White Bay, to the richer, more productive, forests of section B28b.

Soil and Climatic Conditions

Palaeozoic sedimentary rocks consisting predominantly of limestones, sandstones and slates, underlie most of the sample area. The entire area was glaciated and is now covered by a layer of glacial till of varied thickness. Well-drained podzols are the most common soils.

Climatic conditions show a marked gradation from south to north along the Great Northern Peninsula, with conditions in the northern half being much more severe than in any of the other major forest regions of the island. Hare (1952) reports mean air temperatures for the Roddickton area of approximately 14° and 53° for January and July respectively (compare readings of 17° and 62° for Deer Lake, and 23° and 59° for St. John's). The vegetative season (i.e. the date on which mean air temperature rises above 43°F) starts about 5th June and continues for approximately 120 days. This compares with between 150 and 160 days for most of the other forested parts of the island. Annual precipitation averages a little over 35 inches, making this one of the drier parts of the island. Snowfall averages 125 inches per annum.

The Forests

Balsam fir (Abies balsamea (L.) Mill.) is the most abundant and commercially most important species of the region. Growth is generally inferior to that in central and western Newfoundland, but many good pulpwood stands occur and insect damage has not been severe in recent years. Black spruce (Picea mariana (Mill.) BSP) is also a major component in many stands, while white spruce (Picea glauca (Moench) Voss) is common as a minor component. Tamarack (Larix laricina (Du Roi) K. Koch) occurs throughout, more particularly under extreme site conditions. Section B29 is distinguished from most other parts of Newfoundland in that it contains no white pine (Pinus strobus L.) except within the Bonne Bay area.

White birch (Betula papyrifera Marsh.) and trembling aspen (Populus tremuloides Michx.) are common as minor stand components. Balsam poplar (Populus balsamifera L.) is common, especially on

calcareous soils. Yellow birch (Betula alleghaniensis Britt.) and red maple (Acer rubrum L.) do not occur within Forest Section B29.

METHODS

Plot Location

Sampling was carried out in the lowland area between Roddickton and Brig Bay (latitudes 50°40' to 51°00'N).

Only the most important of the merchantable forest types were considered in this study. Stands which appeared to be at or approaching maturity, and which were not obviously over- or under-stocked, were selected from aerial photographs. Suitable compass lines were determined by detailed examination of the photographs and subsequently located in the field. Forest type boundaries were mapped by walking the compass lines and recording appropriate positions where changes were observed.

Square 1/10 acre plots were laid out at random along those parts of each compass line which passed through suitable stands. In cases where a prospective plot centre was found to be less than one chain from a forest type boundary the plot was moved one chain ahead or to right or left, whichever position placed it furthest from the forest type boundary.

Mensurational Techniques

(a) Plot Measurements

On each plot a complete tally was taken of living trees having a breast height diameter of more than 0.5 inches. Data were recorded by species and one-inch diameter classes. Standing dead trees were tallied separately.

Total height, breast height diameter, and crown class were recorded for two crop trees (more than 3.5 inches breast height diameter) of each of the softwood species that were present on each plot. Increment borings were taken at breast height on these same trees to permit the determination of age and radial increment during the previous ten years. No intermediate, suppressed, or obviously deformed trees were sampled.

(b) Stem Analysis

Stem analyses were carried out on dominant and/or co-dominant trees of a diameter close to the crop average for each of the three major softwood species (balsam fir, black spruce, and white spruce). Suitable

trees were selected on the basis of a maximum of one per plot, and their breast height diameters were marked and measured before felling.

Each selected stem was cut at six inches above the root collar and the distance from breast height to the top of the tree was recorded. Discs were removed from the stem at one foot above the root collar, at breast height, at 4.5 feet above breast height, and at four foot intervals above this point to the top of the tree.

Average diameters inside and outside the bark were recorded and the total number of rings counted on each disc. Every tenth annual ring (counting inwards from the cambium) was marked on a radius of average length and the distance from the pith to each decade mark determined.

Form class data were collected from any suitable windthrown trees located on or near the sample plots. Species and total height were recorded, and each tree was marked at breast height and at half height above breast height to permit the diameters (inside and outside bark) to be measured at these points.

(c) Regeneration

Data on regeneration were obtained from every second sample plot. On appropriate plots a series of ten contiguous milacre quadrats was marked out from the plot center in the direction of the compass line. The tallest seedling of each species in each quadrat was recorded and classified in the following way:-

<u>Height Class</u>	<u>Height in Feet</u>
a	Less than 0.5
b	0.6 - 1.5
c	1.6 - 2.5
d	2.6 - 3.5
e	3.6 - 4.5
f	More than 4.5 (up to a maximum of 0.5" d.b.h.)

A complete count of all regeneration was recorded by individual species on the tenth quadrat. Seedlings of less than two years of age were excluded.

THE FOREST TYPES OF NORTHERN NEWFOUNDLAND

Five of the most important and productive forest types in northern Newfoundland were sampled. The number of plots established in each type is listed in Table 1. In most of the forest types the sample plots cover a wide range of ages. Up to four age classes (55-70, 71-85, 86-100, 101+) have therefore been recognized where necessary, and mensurational data are presented separately by forest type and age class.

A short description (from Damman, 1963) of stand and vegetative characteristics, related soil conditions, and distribution, is given for each forest type. Mensurational characteristics are recorded as follows:-

- (a) Height/diameter curves for individual softwood species
- (b) Height/age curves for individual softwood species
- (c) Local form class merchantable volume tables and stock tables
- (d) Stand and basal area tables
- (e) Stand and basal area diagrams
- (f) Stem analysis diagrams for individual softwood species
- (g) Stem analysis data tables

The height/age curves have been constructed from a combination of height/age data and stem analysis data. Points shown on the curves at ages below the quoted lower age limits for the various forest types are derived from stem analyses and from height/age data for individual trees whose ages are below the average ages of the plots concerned. Data were insufficient to permit the construction of height/age curves for white spruce in each of the forest types and one combined curve has therefore been constructed for that species (Figure 2). This curve shows that, on average, white spruce achieves a height of 31 feet at 50 years and 50 feet at 100 years in the merchantable forest types that were sampled.

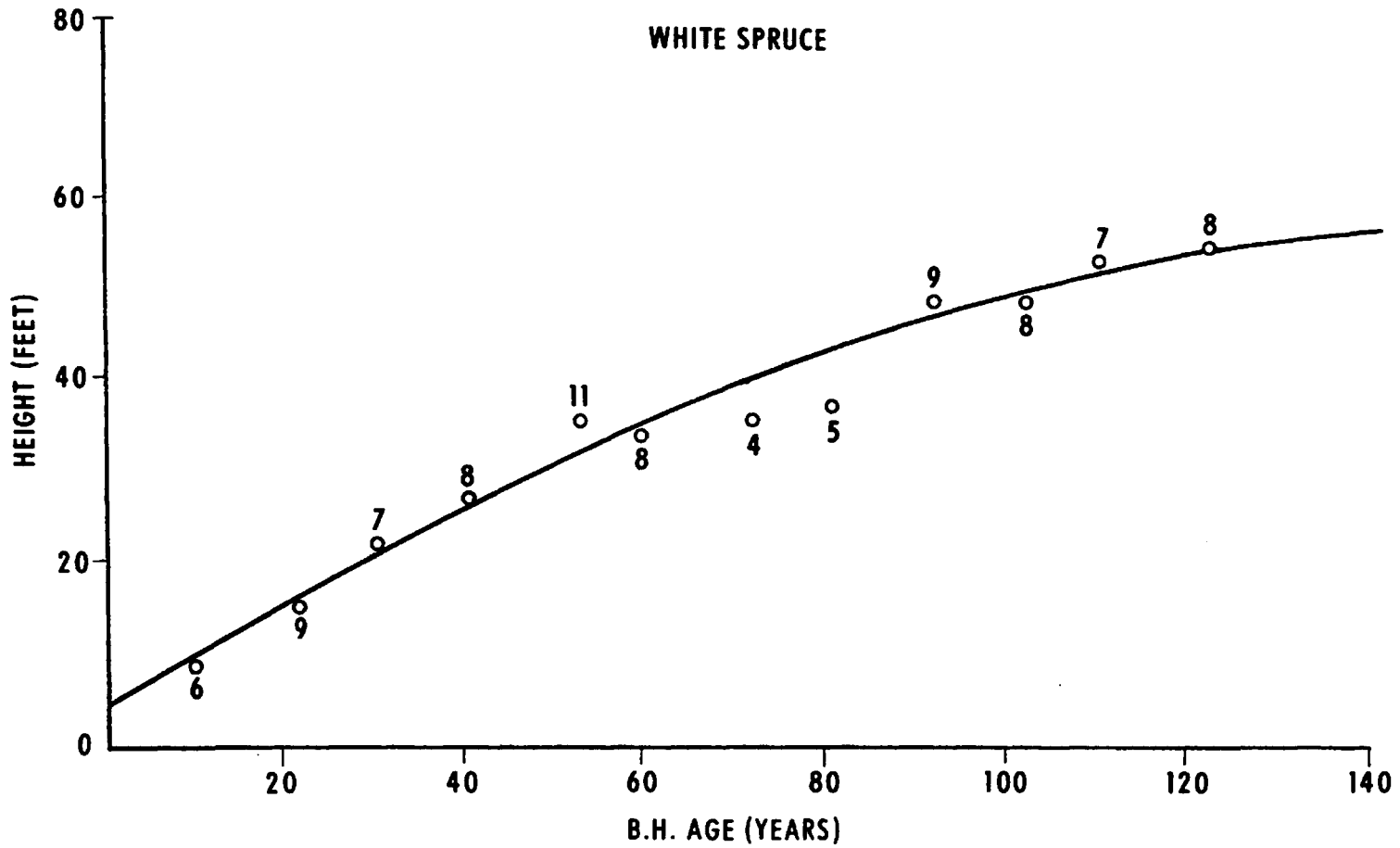
It was found that height/diameter relationships were similar for all age classes within any one species and forest type. Height/diameter curves are therefore presented by species and forest type only, regardless of age class.

Table 1

Number of Samples from Individual Forest Types

Forest Type	Range of plot average ages (years)	Number of samples
Taxus-balsam fir	55-70	14
Taxus-balsam fir	71-85	12
Taxus-balsam fir	86-100	9
Taxus-balsam fir	101+	10
Dryopteris-balsam fir	86-100	5
Dryopteris-balsam fir	101+	22
Dryopteris-Hylocomium-balsam fir	86-100	10
Dryopteris-Hylocomium-balsam fir	101+	29
Rubus-balsam fir	86-100	7
Rubus-balsam fir	101+	13
Pleurozium-balsam fir	101+	17

FIG. 2 HEIGHT/AGE CURVE
ALL FOREST TYPES & AGE CLASSES
WHITE SPRUCE



Taxus-Balsam Fir Forest Type

Description

This type consists of almost pure, well-stocked balsam fir stands with scattered white spruce and very few white birch.

A dense moss carpet, dominated by Hylocomium splendens and Pleurozium schreberi, covers the forest floor. The herb layer is relatively poorly developed, consisting chiefly of Cornus canadensis, Maianthemum canadense, Listera cordata, Linnaea borealis, and Trientalis borealis. The shrub layer consists almost entirely of Taxus canadensis in large, scattered patches.

This forest type is of widespread occurrence on well-drained, calcareous soils in limestone till areas. The soil profile is almost invariably a 'limestone podzol', i.e. an orthic podzol, often with some humus enrichment in the upper B₂ horizon and with a highly calcareous C horizon or limestone bedrock at a depth of one to two feet. Faint mottling may occur in the lower B horizon.

Mensurational Characteristics

Height/diameter curves for balsam fir and white spruce are very similar in shape, with average diameters of 6 inches at 39 feet and 10 inches at 52 feet (Figs. 3 and 4). Height/age curves for balsam fir in the two younger age classes, 55-70 years and 71-85 years (Figs. 5 and 6), show more rapid height growth than do the curves for the two older age classes (Figs. 7 and 8). Stands in the younger age classes average 35 feet at 50 years and 46 feet at 80 years. The older stands show heights of 28 feet at 50 years, 41 feet at 100 years.

Total softwood merchantable volume was 3,095 cubic feet per acre in the 55-70-year-old age class (Table 2). This rose to 3,167 cubic feet in the 71-85-year-old age class (Table 3), and to 3,530 cubic feet in the 86-100-year-old age class (Table 4), but fell again to 3,085 cubic feet in the 101+ age class (Table 5). Total number of living stems per acre (1-inch diameter class and above) was 2,364 in 55-70-year-old stands (Table 6), 1,507 in 71-85-year-old stands (Table 7), 1,082 in 86-100-year-old stands (Table 8), and 985 in stands over 100 years of age (Table 9). Corresponding basal area figures are 221, 199, 194, and 170 square feet per acre, respectively.

Balsam fir constitutes between 89% and 95% of the stands in the four age classes in terms of number of stems per acre (Fig. 9). In terms of basal area, fir forms between 83% and 89% of the stands. White and black spruce together constitute between 8% and 10% of the basal area.

Stem analysis diagrams and tabulated data for balsam fir and white spruce for each of the four age classes are given in Figs. 10-17 and Tables 10-13. The white spruce sample trees have all shown somewhat more rapid volume growth than the balsam fir trees of comparable height and age.

Regeneration is good (Tables 35 and 36). All sample quadrats were stocked, and the number of young softwood stems per acre averaged 13,200.

FIG. 3 HEIGHT/DIAMETER CURVE

TAXUS-BALSAM FIR FOREST TYPE

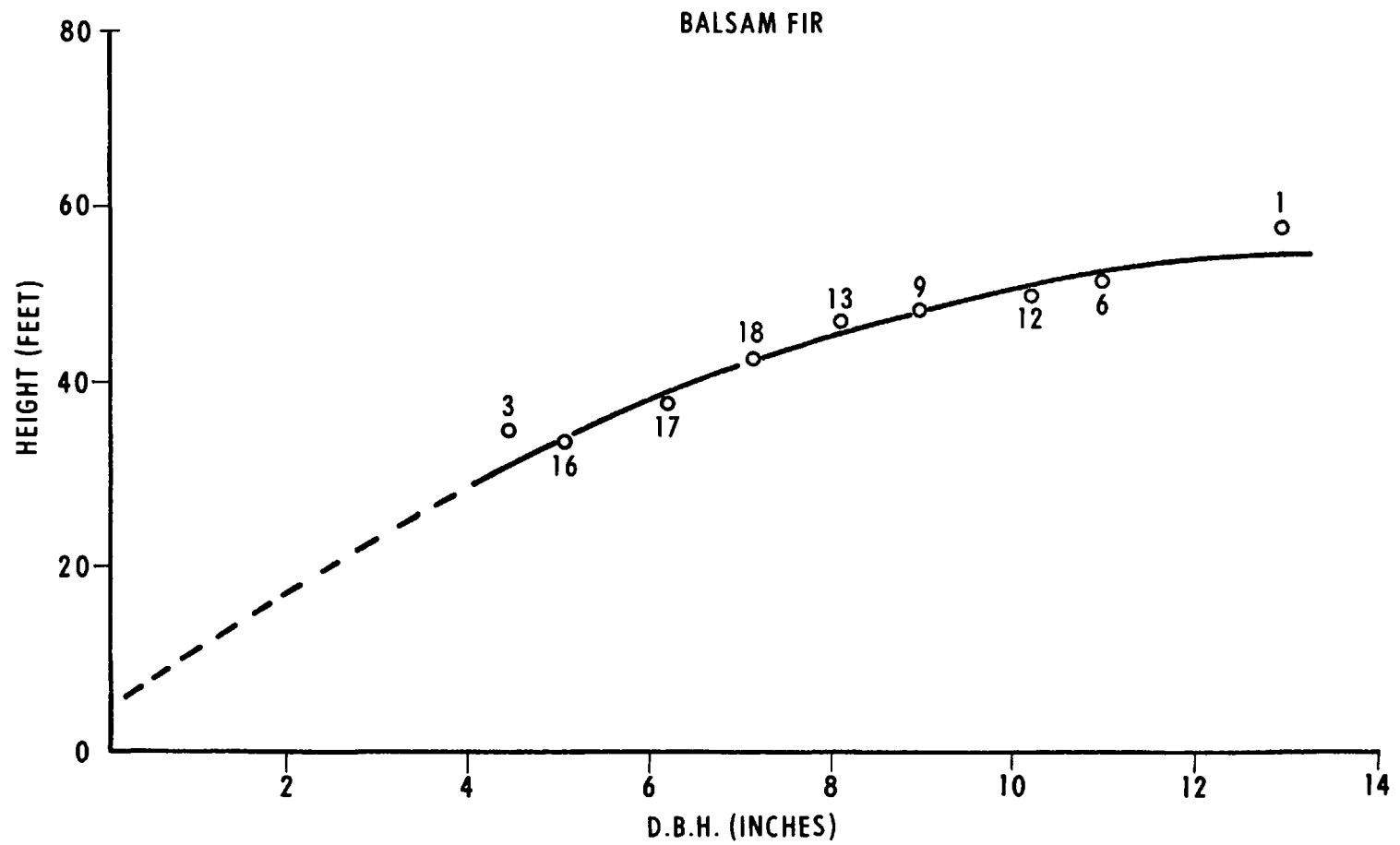


FIG. 4 HEIGHT/DIAMETER CURVE
TAXUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE

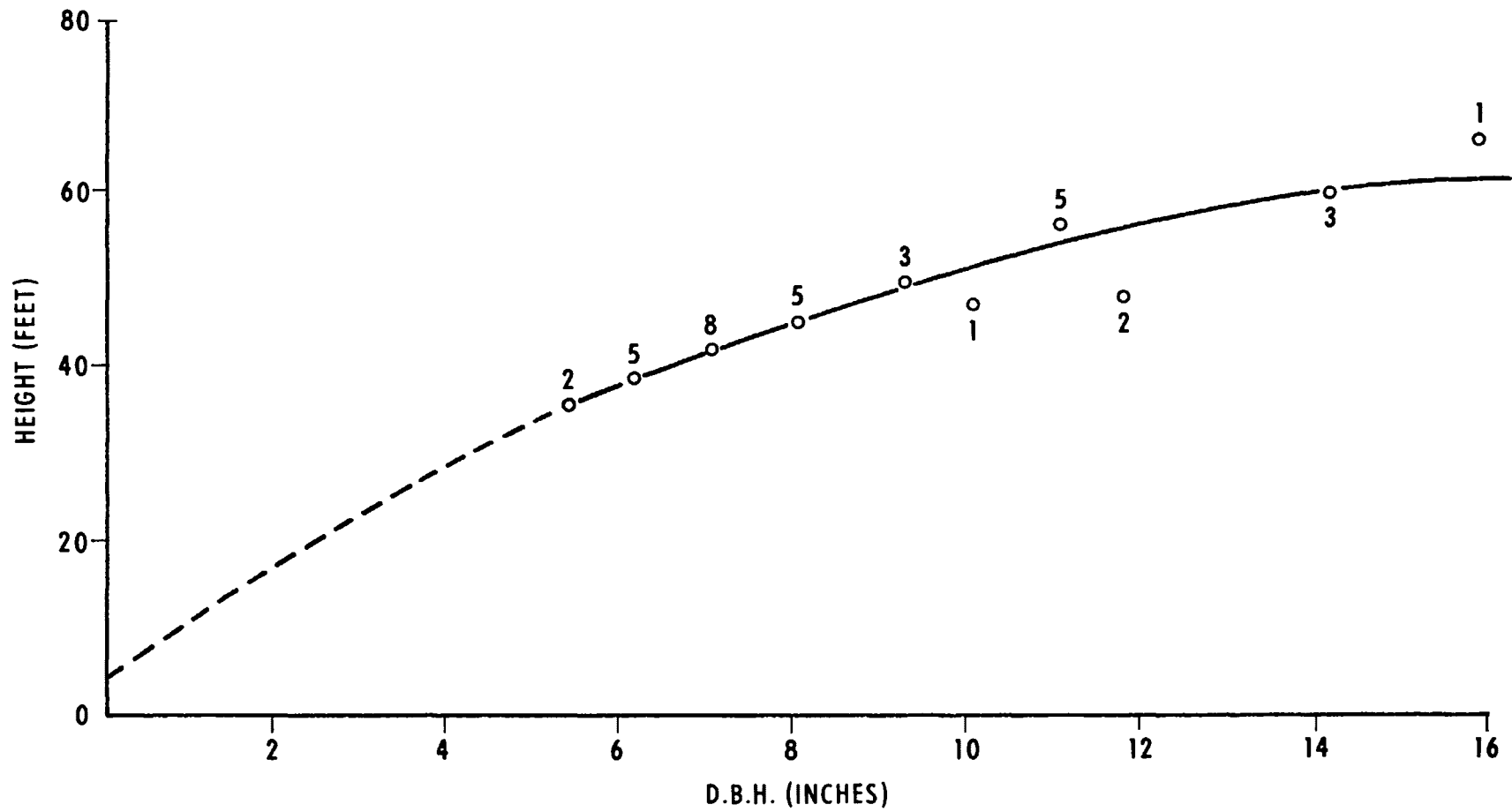


FIG. 5 HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE
AGE CLASS: 55-70
BALSAM FIR

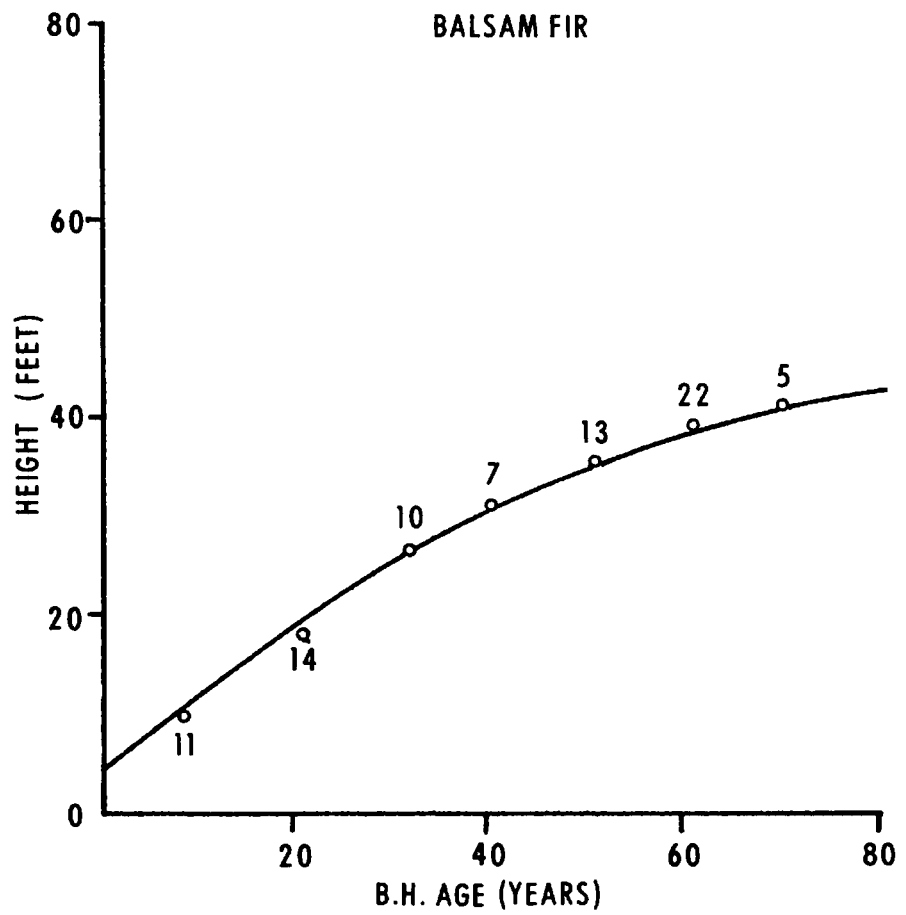


FIG. 6 HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE

AGE CLASS: 71-85

BALSAM FIR

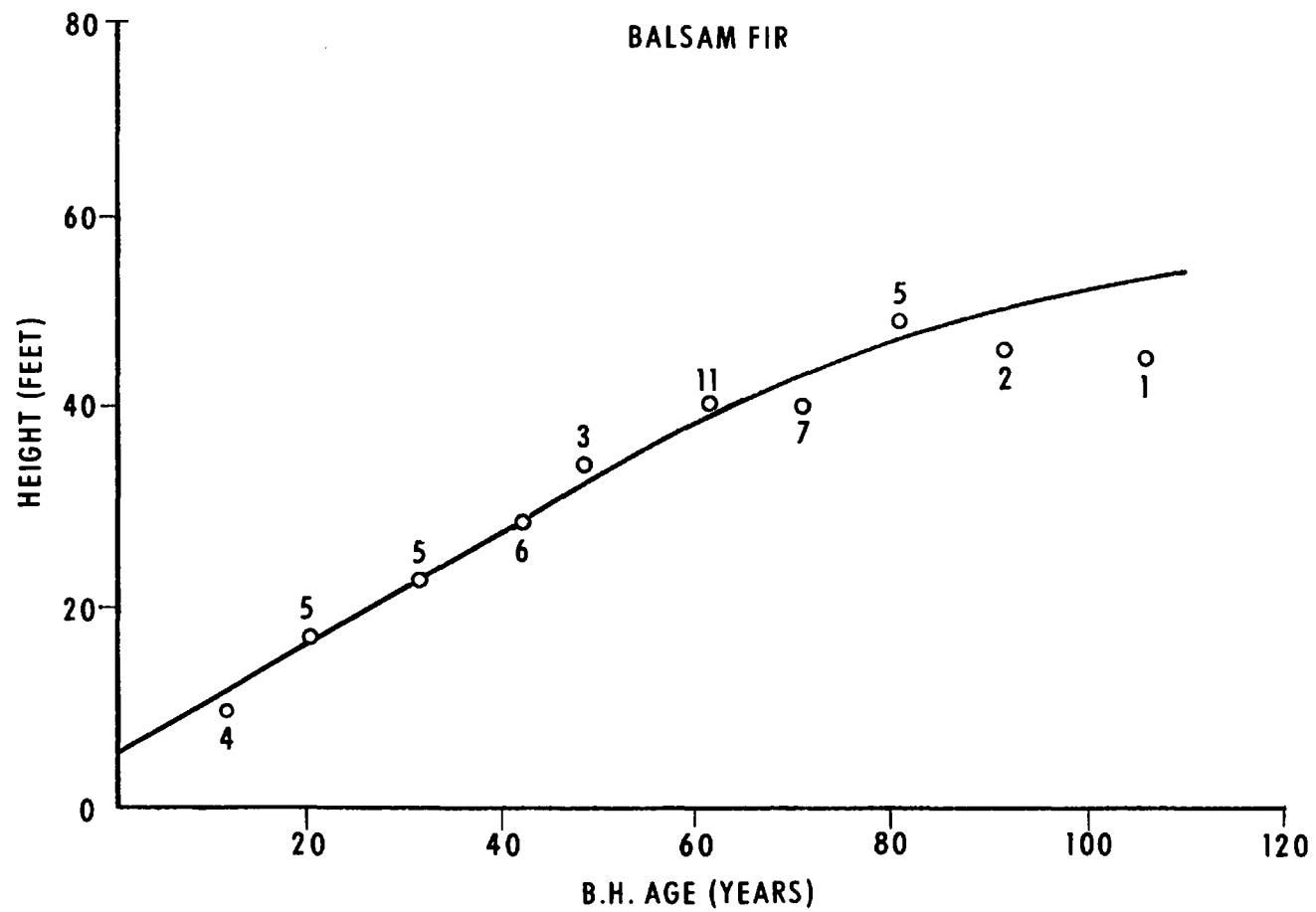


FIG. 7 HEIGHT/AGE CURVE

TAXUS-BALSAM FIR FOREST TYPE

AGE CLASS: 86-100

BALSAM FIR

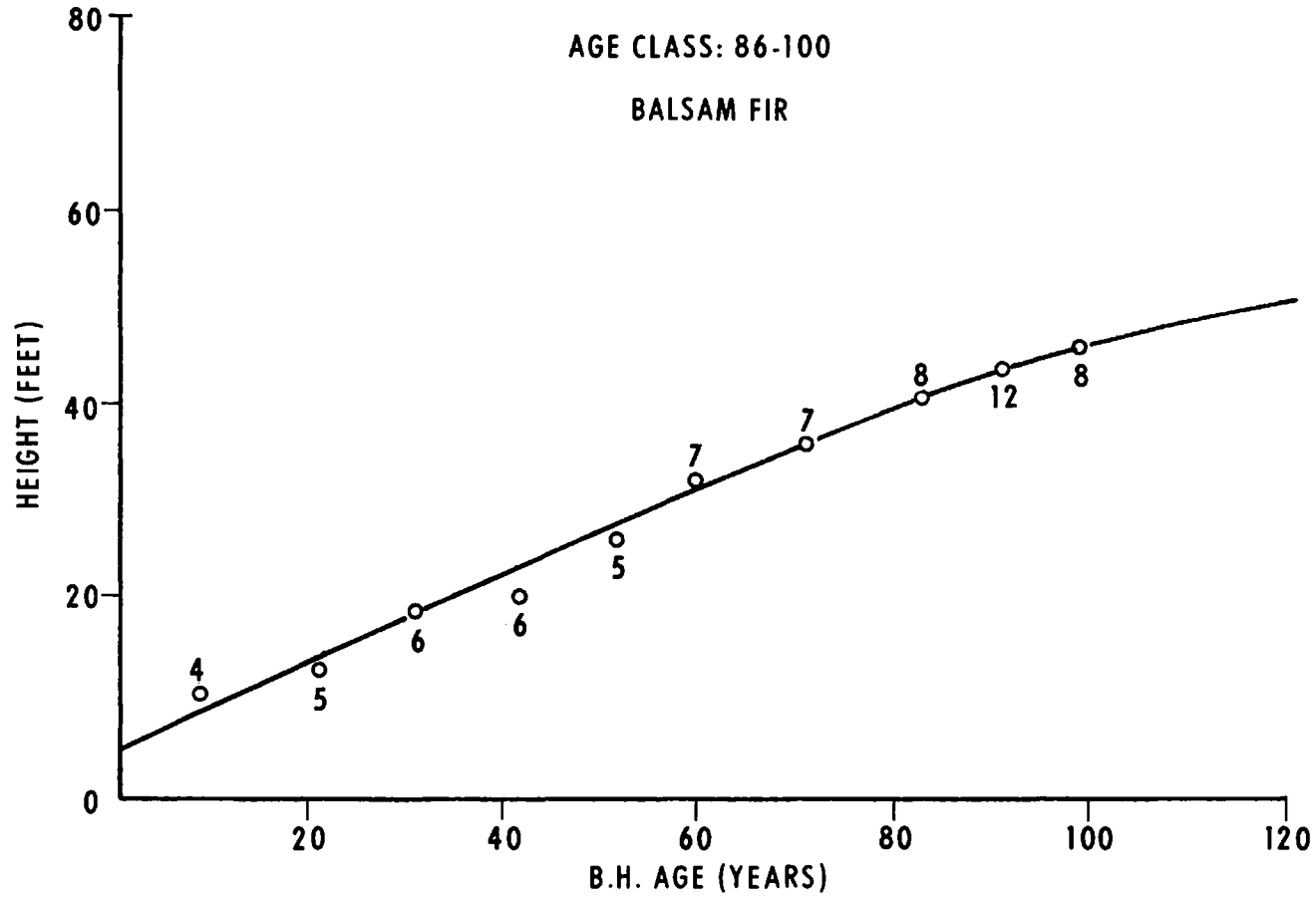


FIG. 8 HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE

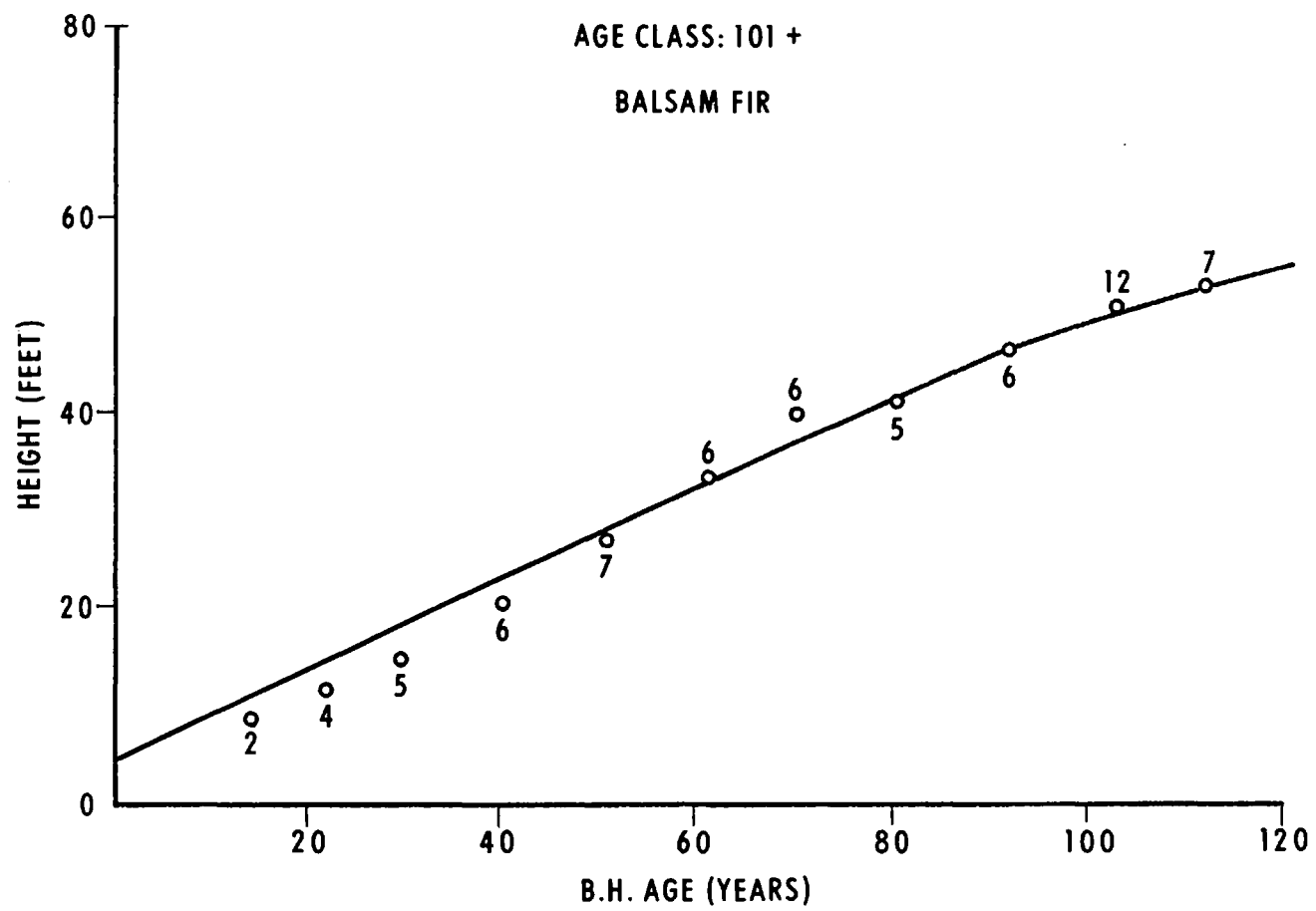


Table 2

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

TAXUS-BALSAM FIR FOREST TYPE

Age: 55-70 Years

SPECIES FORM CLASS		BALSAM FIR 68		BLACK SPRUCE 70			WHITE SPRUCE 65		
D.b.h. (Inches)	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	M. Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.	Ht. Ft.	M. Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.
4	29	1.2	455.0	28	0.8	4.4	34	1.0	12.1
5	34	2.2	705.5	32	1.6	12.4	37	2.0	41.4
6	38	3.4	658.2	36	2.8	18.4	39	3.1	42.2
7	42	4.9	392.0	39	4.4	19.4	42	4.6	39.6
8	45	6.8	272.0	42	6.3	27.7	44	6.3	26.4
9	48	9.2	104.8	45	8.7	28.7	46	8.4	47.8
10	50	11.8	59.0	-	-	-	47	10.7	14.9
11	50	14.3	10.0	-	-	-	48	13.4	28.1
12	-	-	-	-	-	-	49	16.4	11.4
13	-	-	-	-	-	-	49	19.3	27.0
14	-	-	-	-	-	-	49	22.5	15.8
15	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	49	29.6	20.7
Total			2,656.5			111.0			327.4

*Stump height one foot: Top diameter outside bark three inches.

Table 3.

LOCAL FORM CLASS MERCHANTABILITY TABLES AND
STOCK TABLES

TAXUS-BALSAM FIR FOREST TYPE

Age: 71-85 Years

SPECIES FORM CLASS		BALSAM FIR 62		WHITE SPRUCE 66		
D.b.h. (Inches)	Height Feet	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Height Feet	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.
4	36	1.2	264.0	36	1.1	4.5
5	39	2.2	421.5	41	2.2	14.5
6	41	3.4	507.2	44	3.4	28.2
7	44	4.9	490.0	46	5.0	29.0
8	46	6.7	407.8	49	7.0	35.0
9	48	8.7	254.0	51	9.3	61.4
10	49	10.9	190.8	52	11.9	29.8
11	50	13.4	144.7	53	14.7	48.5
12	50	16.0	80.0	54	18.0	14.4
13	50	18.8	30.0	54	21.3	34.0
14	50	21.8	34.8	54	24.7	19.8
15	-	-	-	-	-	-
16	50	28.4	22.7	-	-	-
Total		2,847.5		319.1		

*Stump height one foot: Top diameter outside bark three inches.

Table 4

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

TAXUS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

SPECIES FORM CLASS		BALSAM FIR 68		BLACK SPRUCE 70			WHITE SPRUCE 62		
D.b.h. (Inches)	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	M. Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.	Ht. Ft.	M. Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.
4	31	1.3	141.4	28	0.8	4.4	37	1.0	3.3
5	37	2.2	239.4	32	1.6	12.4	42	2.1	2.3
6	42	3.6	407.8	36	2.8	18.4	46	3.5	7.7
7	47	5.4	491.9	39	4.4	9.6	50	5.0	16.5
8	50	7.6	532.0	42	6.3	35.2	52	6.8	14.9
9	52	9.9	505.8	45	8.7	28.7	54	9.2	51.5
10	53	12.4	412.9	-	-	-	56	11.8	66.0
11	54	15.3	186.6	-	-	-	57	14.7	16.2
12	54	18.2	140.1	-	-	-	59	18.3	20.1
13	54	21.4	23.5	-	-	-	60	22.0	48.4
14	-	-	-	-	-	-	61	25.9	57.0
15	-	-	-	-	-	-	-	-	-
16	54	32.6	35.8	-	-	-	-	-	-
Total			3,117.2			108.7			303.9

*Stump height one foot: Top diameter outside bark three inches.

Table 5

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

TAXUS-BALSAM FIR FOREST TYPE

Age: 101 Years +

SPECIES		BALSAM FIR		BLACK SPRUCE			WHITE SPRUCE		
FORM CLASS		63		70			67		
D.b.h.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	M. Vol.
(Inches)	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre
		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.
4	31	1.1	69.3	-	-	-	33	1.1	2.2
5	37	2.0	136.0	32	1.6	4.8	38	2.0	4.0
6	41	3.3	217.8	36	2.8	16.8	42	3.3	9.9
7	45	4.9	298.9	39	4.4	8.8	45	5.0	15.0
8	49	7.0	343.0	42	6.3	6.3	48	7.0	28.0
9	52	9.3	381.3	45	8.7	26.1	51	9.4	18.8
10	55	12.1	411.4	-	-	-	53	12.2	36.6
11	57	15.4	323.4	-	-	-	55	15.3	15.3
12	58	18.5	277.5	-	-	-	57	19.2	19.2
13	58	21.7	238.7	-	-	-	-	-	-
14	58	25.2	50.4	-	-	-	60	27.5	27.5
15	-	-	-	-	-	-	61	32.1	64.2
16	58	33.4	33.4	-	-	-	-	-	-
Total		2,781.1		62.8			240.7		

*Stump height one foot: Top diameter outside bark three inches.

Table 6

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

TAXUS-BALSAM FIR FOREST TYPE

Age: 55-70 Years

Number of Plots: 14

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*
1	373.6	408.6	1.86	5.0	2.8	.02	2.8	6.4	.01	..	..	..	381.4	417.8	1.89
2	427.8	233.6	9.41	0.7	0.7	.02	3.6	5.0	.08	..	..	..	432.1	239.3	9.51
3	420.7	79.2	26.61	1.4	..	.06	10.7	1.4	.52	..	..	..	432.8	80.6	27.19
4	379.2	7.1	32.99	0.7	..	.06	12.1	1.4	1.05	..	..	..	392.0	8.5	34.10
5	320.7	5.0	43.62	0.7	..	.10	20.7	0.7	2.82	1.4	..	.19	343.5	5.7	46.73
6	193.6	0.7	37.94	2.1	..	.41	13.6	..	2.66	1.4	..	.27	210.7	0.7	41.28
7	80.0	0.7	21.36	0.7	..	.18	8.6	..	2.30	..	..	..	89.3	0.7	23.84
8	40.0	..	13.96	..	..	..	4.2	0.7	1.46	2.1	..	.73	46.3	0.7	16.15
9	11.4	1.4	5.04	..	..	..	5.7	..	2.52	2.1	0.7	.92	19.2	2.1	8.48
10	5.0	0.7	2.72	..	..	..	1.4	..	.76	0.7	..	.38	7.1	0.7	3.86
11	0.7	0.7	.46	..	..	..	2.1	..	1.38	1.4	..	.92	4.2	0.7	2.76
12	..	..	..	..	..	..	0.7	0.7	.54	..	..	..	0.7	0.7	.54
13	..	0.7	..	..	..	..	1.4	..	1.29	1.4	..	1.29	2.8	0.7	2.58
14	..	..	..	..	..	..	0.7	..	.74	..	..	..	0.7	..	.74
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	0.7	..	.98	..	..	..	0.7	..	.98
TOTAL	2,252.7	738.4	195.97	11.3	3.5	.85	89.0	16.3	19.11	10.5	0.7	4.70	2,363.5	758.9	220.63

*Living trees

Table 7

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

TAXUS-BALSAM FIR FOREST TYPE

Age: 71-85 Years

Number of Plots: 12

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*
1	198.3	185.0	.92	5.8	0.8	.02	0.8	4.1	..	0.8	..	..	205.7	189.9	.94
2	226.6	165.8	4.98	2.5	..	.06	1.6	3.3	.04	0.8	..	.02	231.5	169.1	5.10
3	217.5	60.8	10.66	0.8	..	.04	0.8	3.3	.04	0.8	..	.04	219.9	64.1	10.78
4	220.0	18.3	19.14	1.6	..	.14	4.1	..	.36	..	..	..	225.7	18.3	19.64
5	191.6	2.5	26.06	1.6	..	.22	6.6	..	.90	0.8	..	.10	200.6	2.5	27.28
6	149.2	2.5	29.24	..	..	..	8.3	..	1.62	0.8	..	.16	158.3	2.5	31.02
7	100.0	5.0	26.70	..	..	..	5.8	..	1.54	2.5	..	.66	108.3	5.0	28.90
8	60.8	..	21.22	..	..	..	5.0	..	1.74	..	..	..	65.8	..	22.96
9	29.2	1.6	12.90	..	..	..	6.6	..	2.92	2.5	..	1.10	38.3	1.6	16.92
10	17.5	1.6	9.54	..	..	..	2.5	..	1.36	2.5	0.8	1.36	22.5	2.4	12.26
11	10.8	0.8	7.12	..	..	..	3.3	..	2.18	2.5	..	1.65	16.6	0.8	10.95
12	5.0	2.5	3.92	..	..	..	0.8	..	.62	..	..	..	5.8	2.5	4.54
13	1.6	..	1.48	..	..	..	1.6	..	1.48	1.6	..	1.48	4.8	..	4.44
14	1.6	..	1.71	..	..	..	0.8	..	.86	..	0.8	..	2.4	0.8	2.57
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	0.8	..	1.12	..	..	..	..	..	..	..	..	..	0.8	..	1.12
TOTAL	1,430.5	446.4	176.71	12.3	0.8	0.48	48.6	10.7	15.66	15.6	1.6	6.57	1,507.0	459.5	199.42

*Living trees.

Table 8

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

TAXUS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

Number of Plots: 9

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*
1	136.6	93.3	.68	4.4	1.1	.02	1.1	2.2	..	..	..	..	142.1	96.6	.70
2	118.7	57.7	2.61	6.6	2.2	.14	..	1.1	..	..	..	..	125.3	61.0	2.75
3	114.4	43.3	5.60	2.2	1.1	.10	..	1.1	..	1.1	..	.05	117.7	45.5	5.75
4	108.8	21.1	9.46	5.6	..	.48	3.3	..	.28	4.4	..	.38	122.1	21.1	10.60
5	108.8	22.2	14.80	7.8	..	1.06	1.1	..	.14	6.6	..	.90	124.3	22.2	16.90
6	113.3	8.8	22.20	6.6	..	1.29	2.2	..	.43	5.6	..	1.10	127.7	8.8	25.02
7	91.1	7.7	24.32	2.2	..	.58	3.3	2.2	.88	6.6	..	1.76	103.2	9.9	27.54
8	70.0	6.6	24.43	5.6	..	1.95	2.2	1.1	.76	4.4	..	1.54	82.2	7.7	28.68
9	51.1	4.4	22.58	3.3	..	1.46	5.6	..	2.48	4.4	..	1.94	64.4	4.4	28.46
10	33.3	3.3	18.14	..	1.1	..	5.6	..	3.05	1.1	..	.60	40.0	4.4	21.79
11	12.2	3.3	8.05	..	..	..	1.1	..	.72	1.1	..	.72	14.4	3.3	9.49
12	7.7	2.2	6.04	..	..	..	1.1	1.1	.86	1.1	..	.86	9.9	3.3	7.76
13	1.1	..	1.01	..	..	..	2.2	..	2.02	1.1	..	1.01	4.4	..	4.04
14	..	..	..	..	..	..	2.2	1.1	2.02	1.1	..	1.18	3.3	1.1	3.20
15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	1.1	..	1.54	..	..	..	..	..	..	..	..	..	1.1	..	1.54
TOTAL	968.2	273.9	161.46	44.3	5.5	7.08	31.0	9.9	13.64	38.6	..	12.04	1,082.1	289.3	194.22

*Living trees

Table 9

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

TAXUS-BALSAM FIR FOREST TYPE

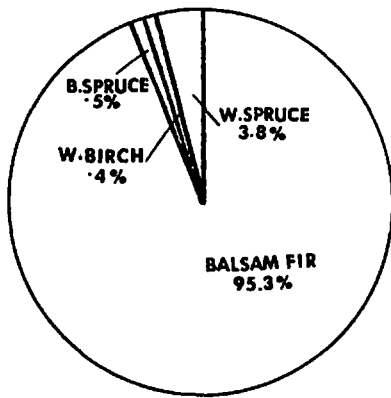
Age: 101 Years +

Number of Plots: 10

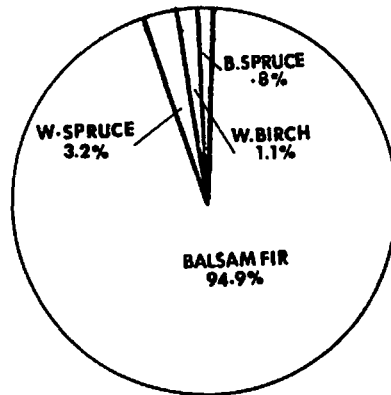
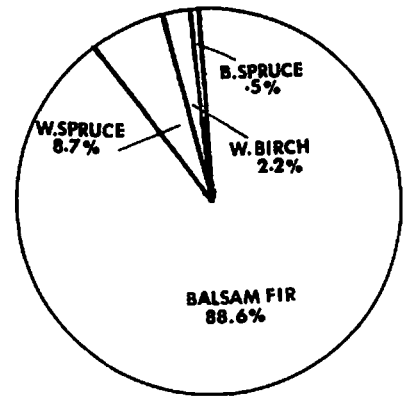
D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq. Ft.*
1	229.0	32.0	1.14	16.0	..	.08	..	..	..	..	..	..	245.0	32.0	1.22
2	130.0	25.0	2.86	4.0	..	.08	..	2.0	..	1.0	..	.02	135.0	27.0	2.96
3	102.0	20.0	5.00	1.0	..	.04	3.0	2.0	.14	3.0	..	.14	109.0	22.0	5.32
4	63.0	11.0	5.48	..	..	..	2.0	1.0	.17	3.0	1.0	.26	68.0	13.0	5.91
5	68.0	4.0	9.24	3.0	..	.40	2.0	..	.27	1.0	..	.14	74.0	4.0	10.05
6	66.0	3.0	12.94	6.0	..	1.18	3.0	1.0	.58	2.0	1.0	.39	77.0	5.0	15.09
7	61.0	7.0	16.28	2.0	..	.53	3.0	..	.80	7.0	..	1.86	73.0	7.0	19.47
8	49.0	1.0	17.10	1.0	..	.34	4.0	2.0	1.40	2.0	..	.70	56.0	3.0	19.54
9	41.0	1.0	18.12	3.0	..	1.32	2.0	1.0	.88	2.0	1.0	.88	48.0	3.0	21.20
10	34.0	2.0	18.53	..	..	..	3.0	1.0	1.64	4.0	..	2.18	41.0	3.0	22.35
11	21.0	4.0	13.86	..	..	..	1.0	..	.66	4.0	..	2.64	26.0	4.0	17.16
12	15.0	2.0	11.78	..	..	..	1.0	..	.78	..	..	..	16.0	2.0	12.56
13	11.0	1.0	10.14	..	..	..	..	1.0	..	..	1.0	..	11.0	3.0	10.14
14	2.0	..	2.14	..	..	..	1.0	..	1.06	..	..	..	3.0	..	3.20
15	..	..	..	..	..	..	2.0	1.0	2.45	..	..	..	2.0	1.0	2.45
16	1.0	..	1.40	..	..	..	..	..	..	..	..	..	1.0	..	1.40
17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	1.0	..	..	..	..	..	1.0	..
TOTAL	893.0	113.0	146.01	36.0	..	3.97	27.0	13.0	10.83	29.0	4.0	9.21	985.0	130.0	170.02

*Living Trees

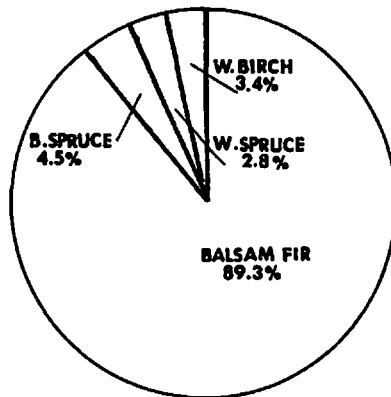
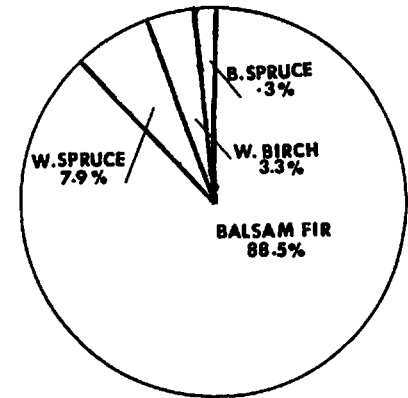
FIG. 9 STAND TABLE DIAGRAMS: TAXUS-BALSAM FIR FOREST TYPE



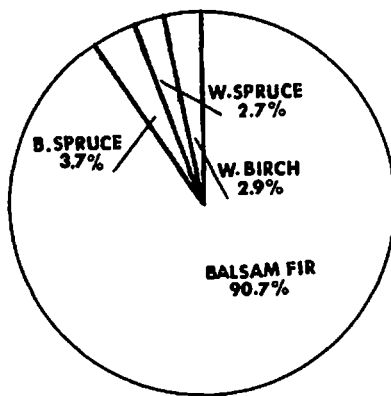
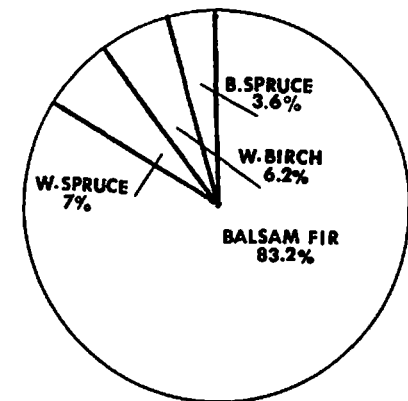
AGE 55-70



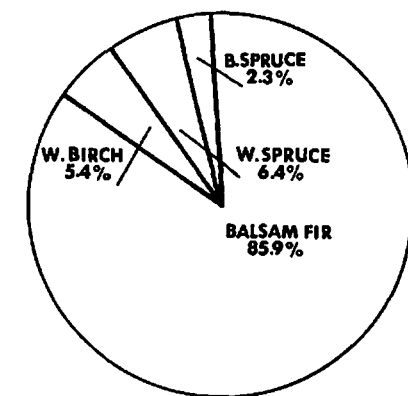
AGE 71-85



AGE 86-100



AGE 101 +



NUMBER OF STEMS

BASAL AREA

FIG. 10 STEM ANALYSIS DIAGRAM

TAXUS-BALSAM FIR FOREST TYPE

AGE 55-70

BALSAM FIR

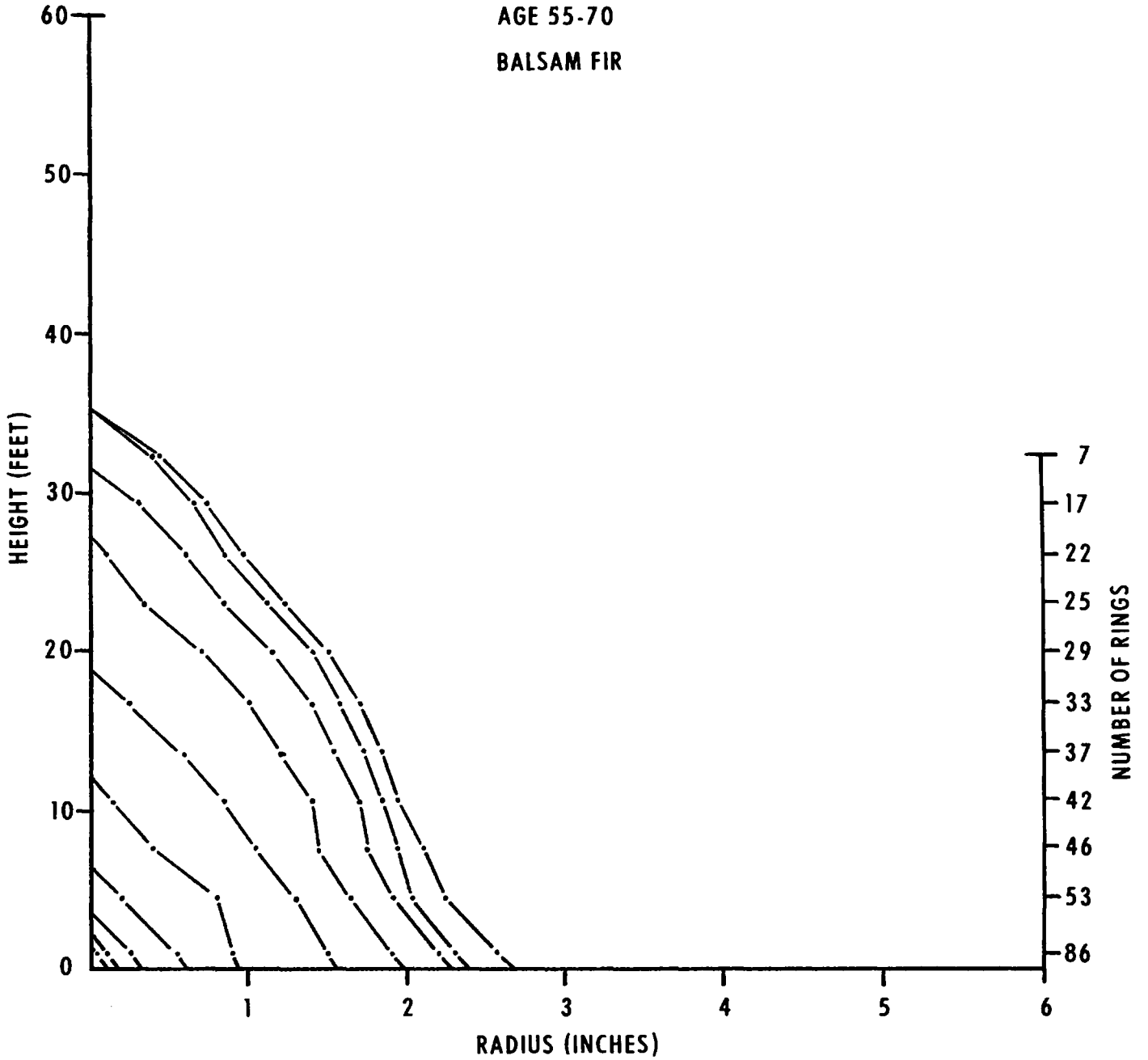


FIG. 11 STEM ANALYSIS DIAGRAM
 TAXUS-BALSAM FIR FOREST TYPE
 AGE 55-70
 WHITE SPRUCE

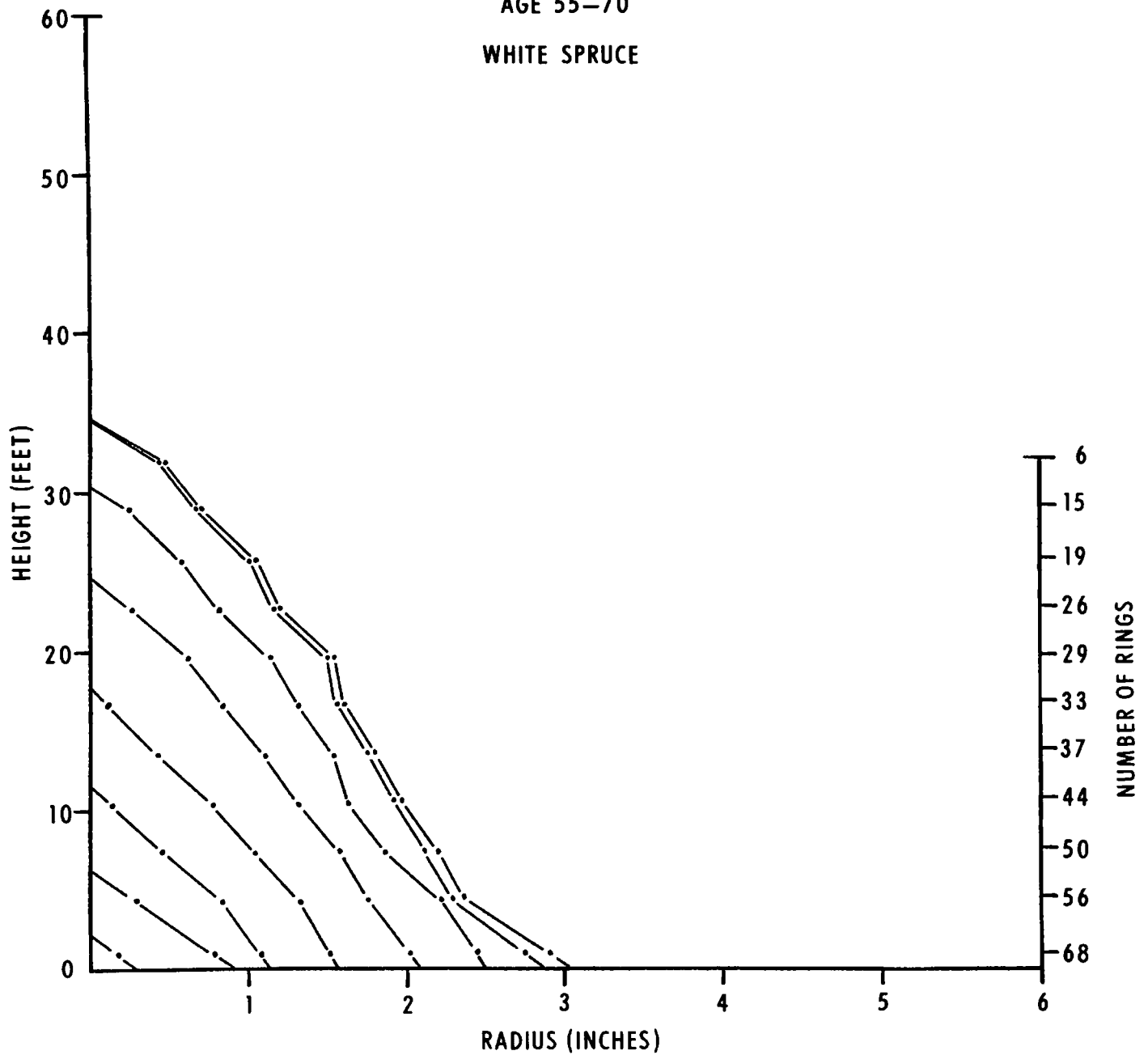


FIG. 12 STEM ANALYSIS DIAGRAM

TAXUS-BALSAM FIR FOREST TYPE

AGE 71-85

BALSAM FIR

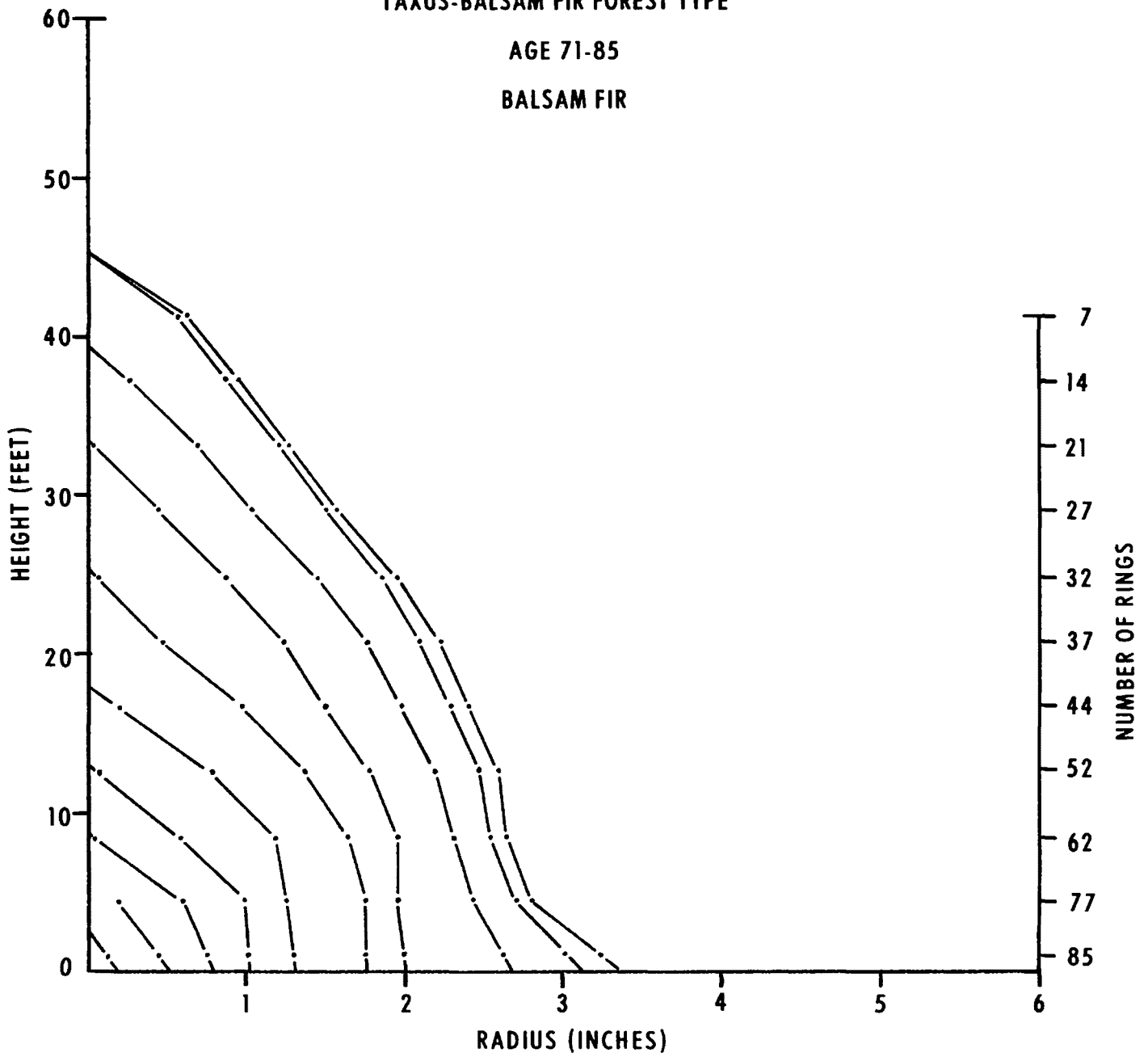


FIG. 13 STEM ANALYSIS DIAGRAM

TAXUS-BALSAM FIR FOREST TYPE

AGE 71-85

WHITE SPRUCE

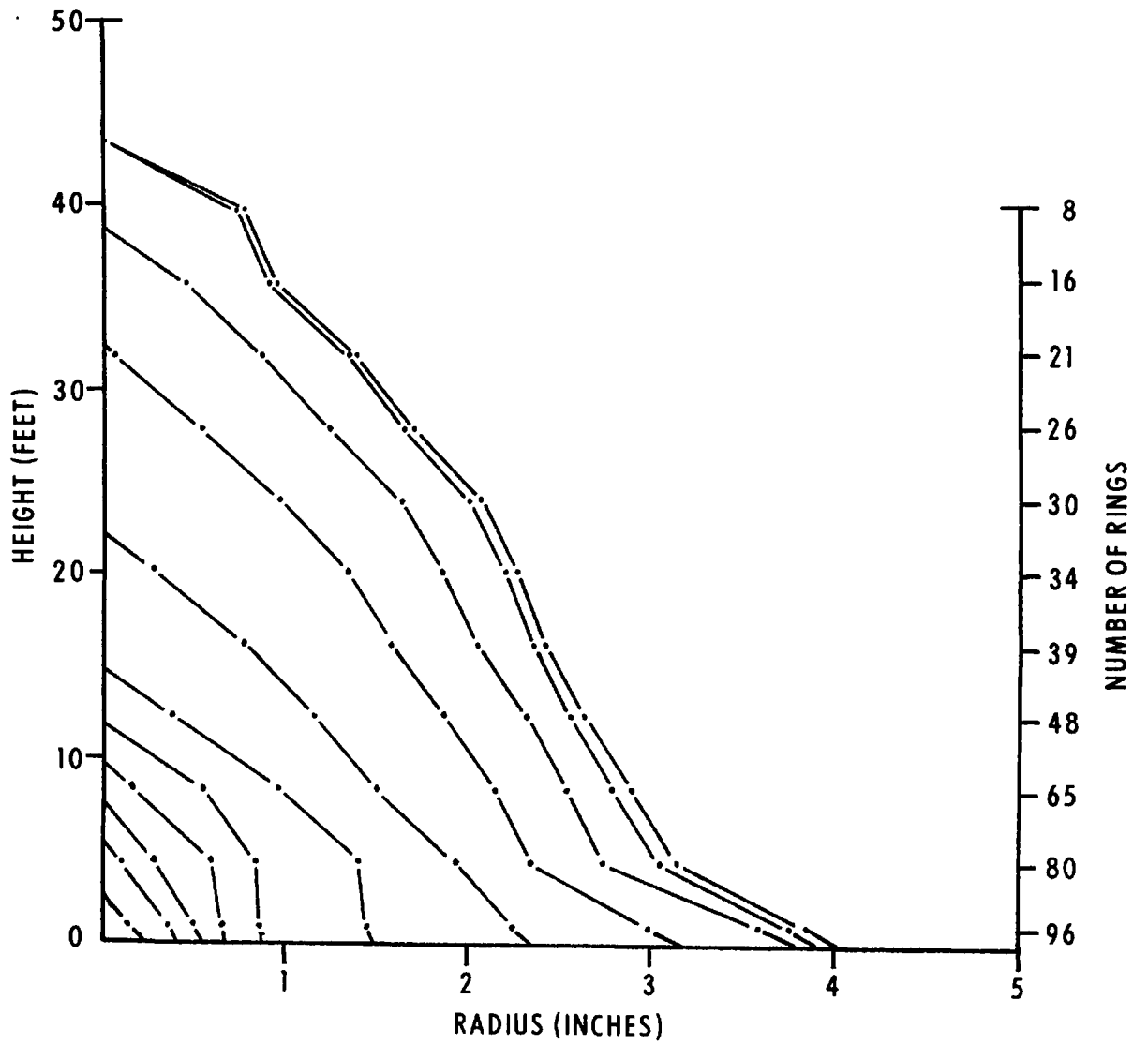


FIG. 14 STEM ANALYSIS DIAGRAM

TAXUS-BALSAM FIR FOREST TYPE

AGE 86-100

BALSAM FIR

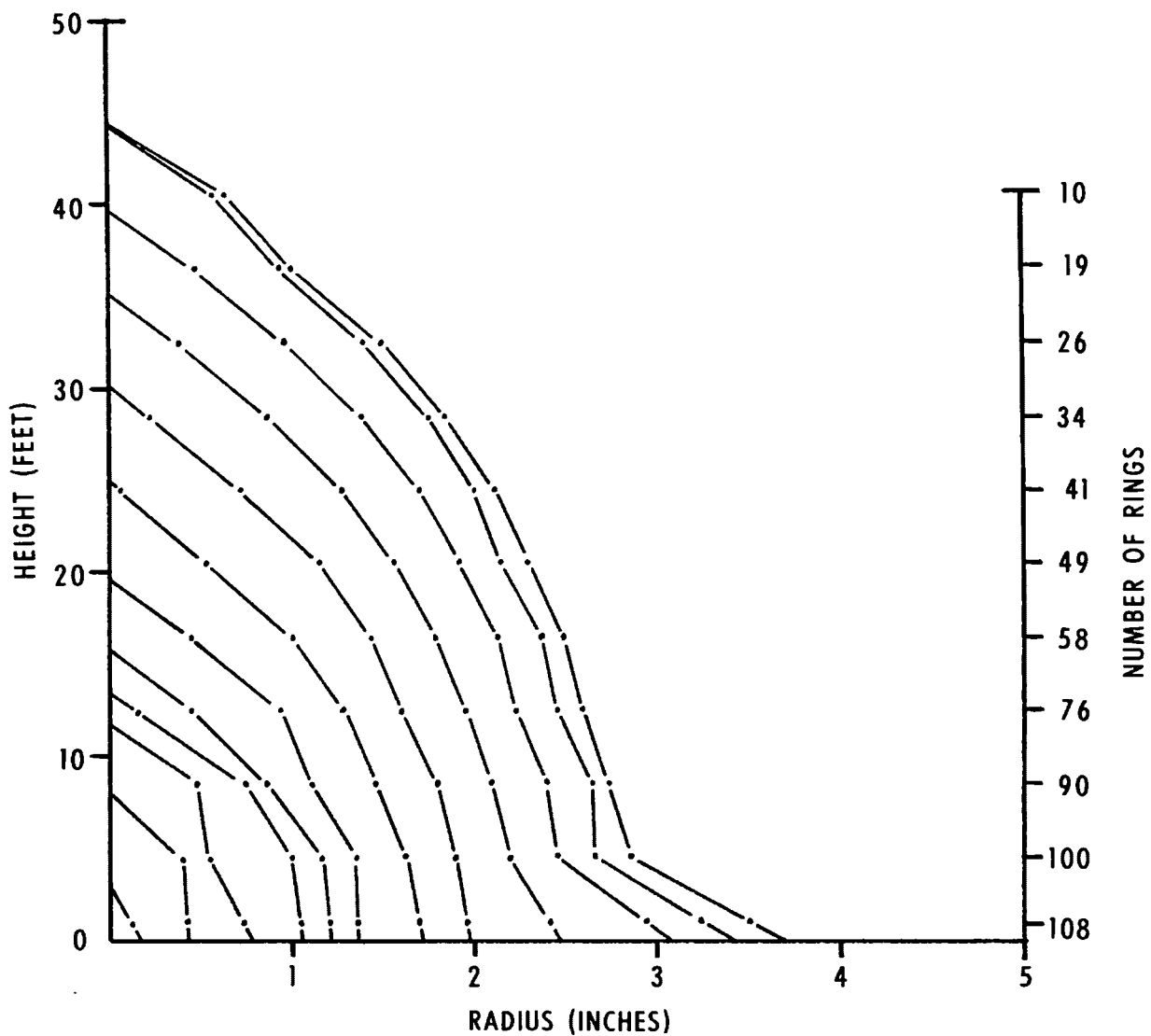


FIG. 15 STEM ANALYSIS DIAGRAM
TAXUS-BALSAM FIR FOREST TYPE

AGE 86-100

WHITE SPRUCE

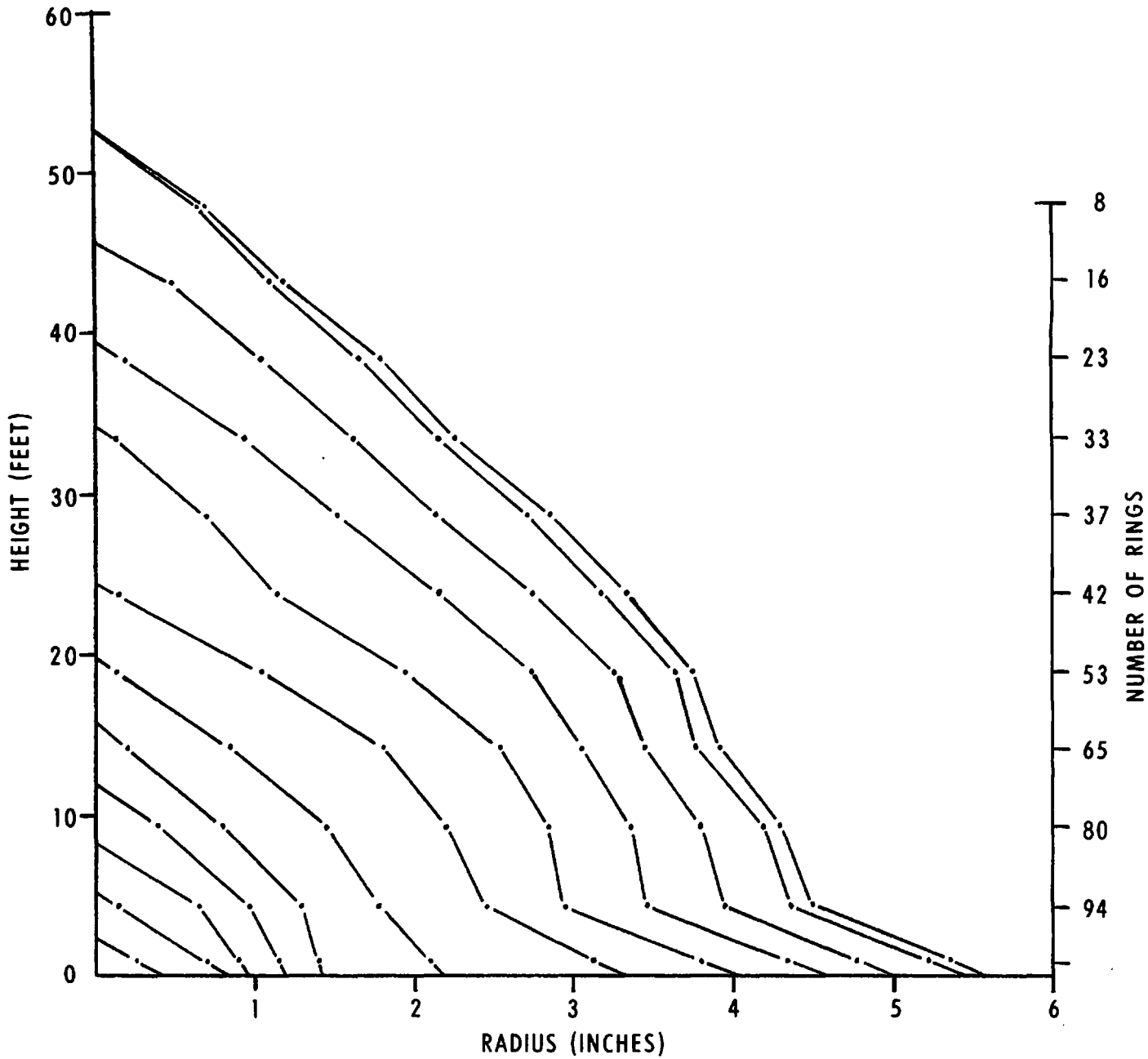


FIG. 16 STEM ANALYSIS DIAGRAM
 TAXUS-BALSAM FIR FOREST TYPE
 AGE 101 +
 BALSAM FIR

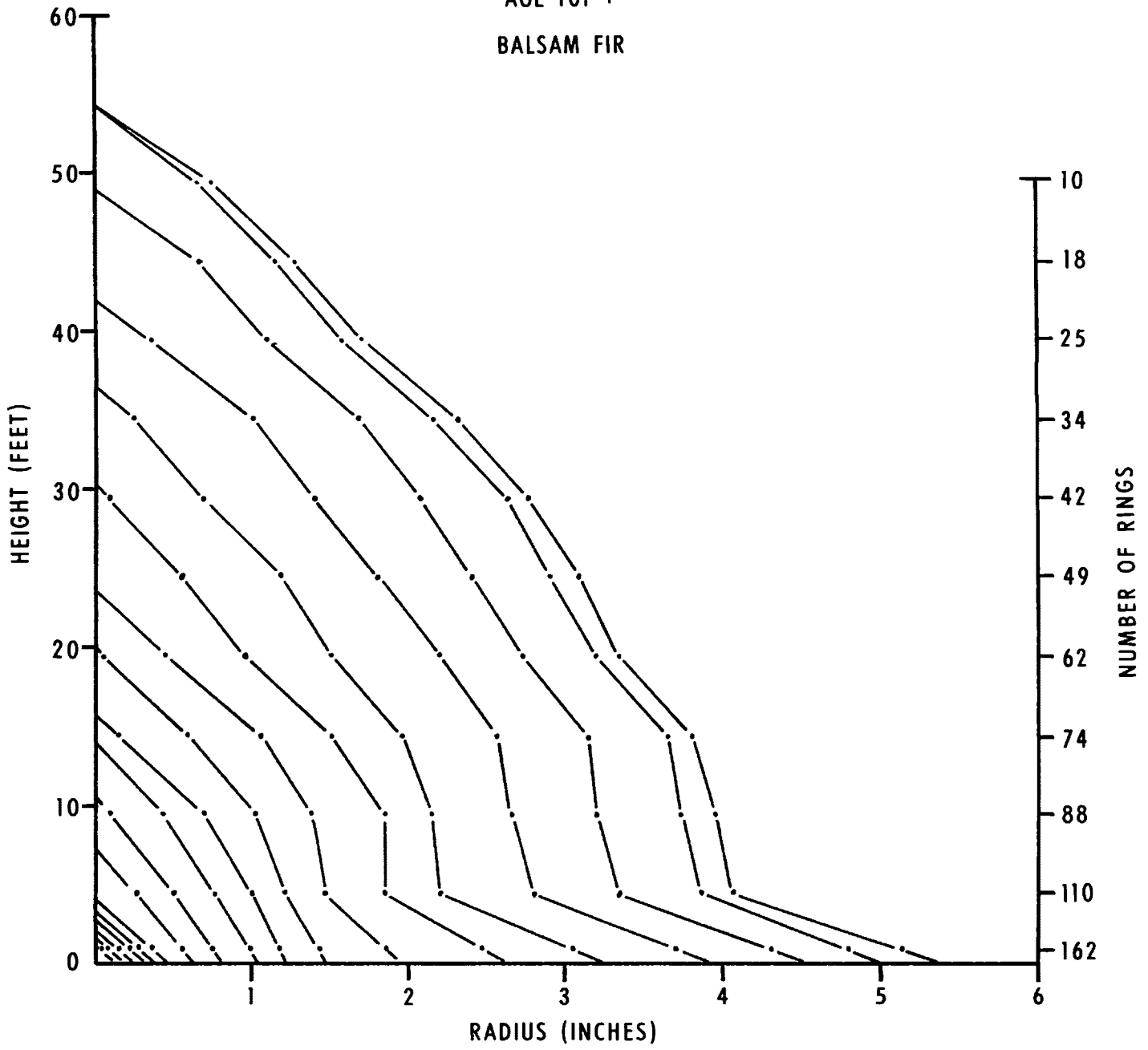


FIG. 17 STEM ANALYSIS DIAGRAM

TAXUS-BALSAM FIR FOREST TYPE

AGE 101 +

WHITE SPRUCE

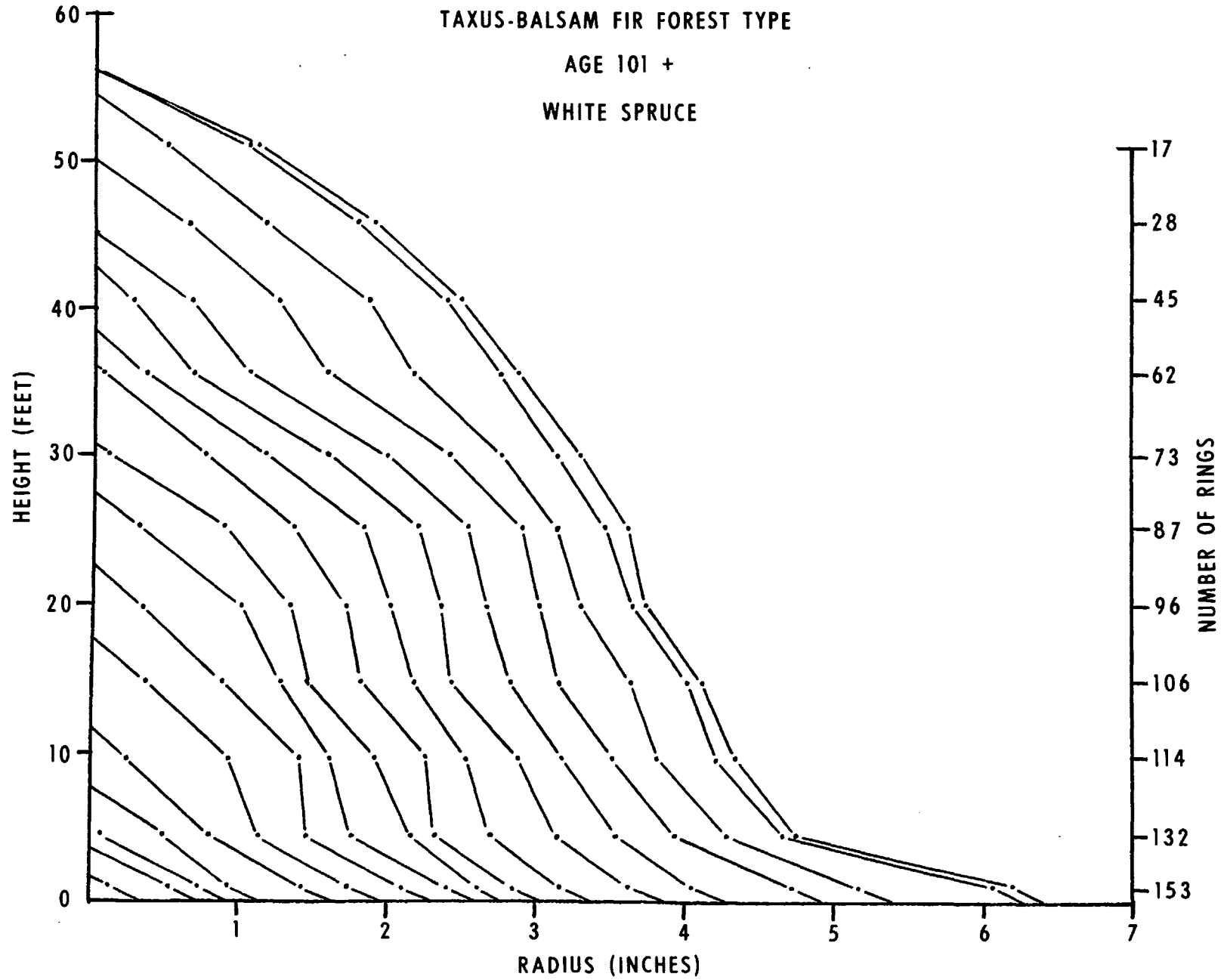


FIG. 23 STEM ANALYSIS DIAGRAM
 DRYOPTERIS-BALSAM FIR FOREST TYPE
 AGE 86-100
 BALSAM FIR

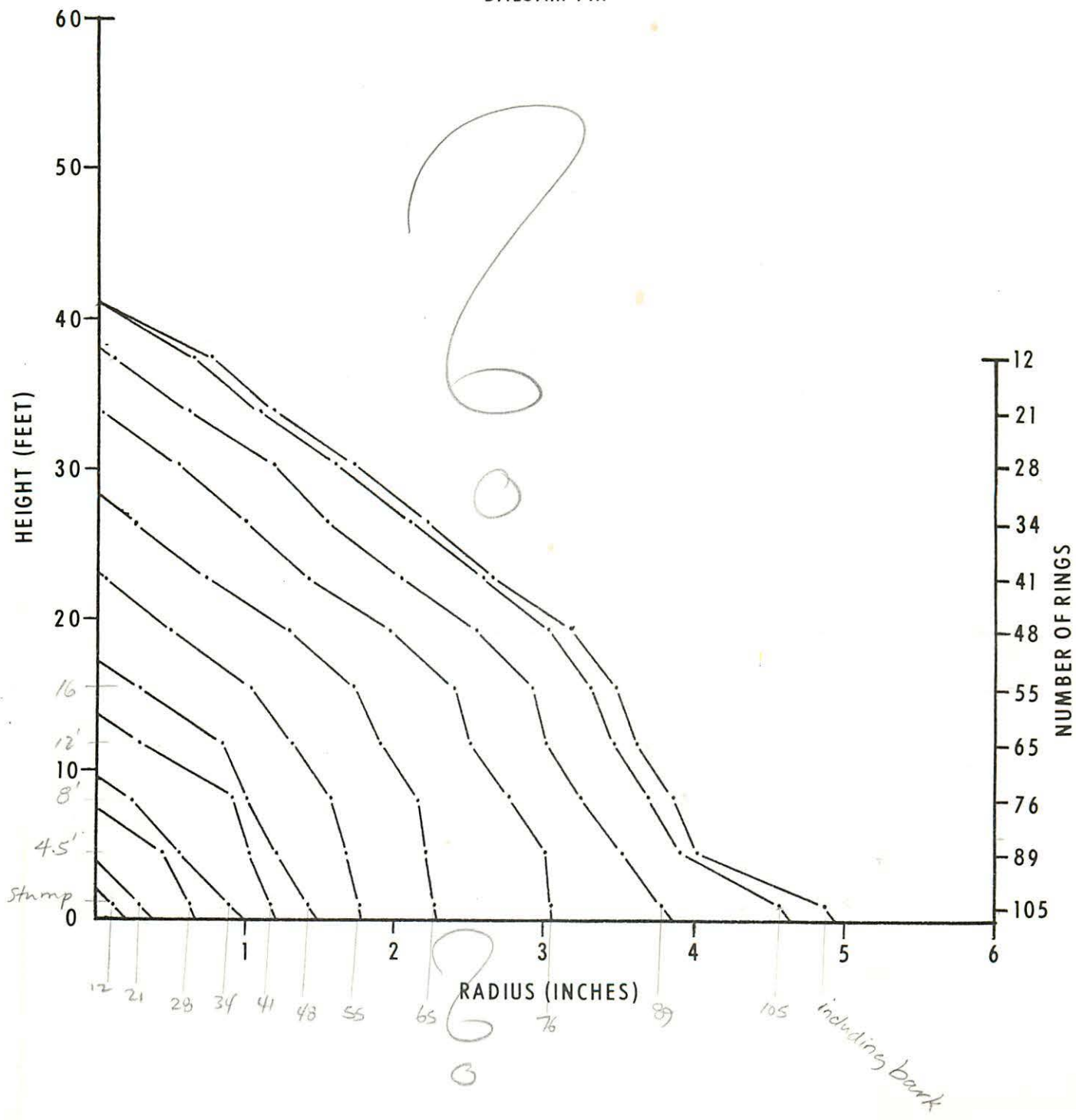


FIG. 24 STEM ANALYSIS DIAGRAM
DRYOPTERIS-BALSAM FIR FOREST TYPE
AGE 86-100
WHITE SPRUCE

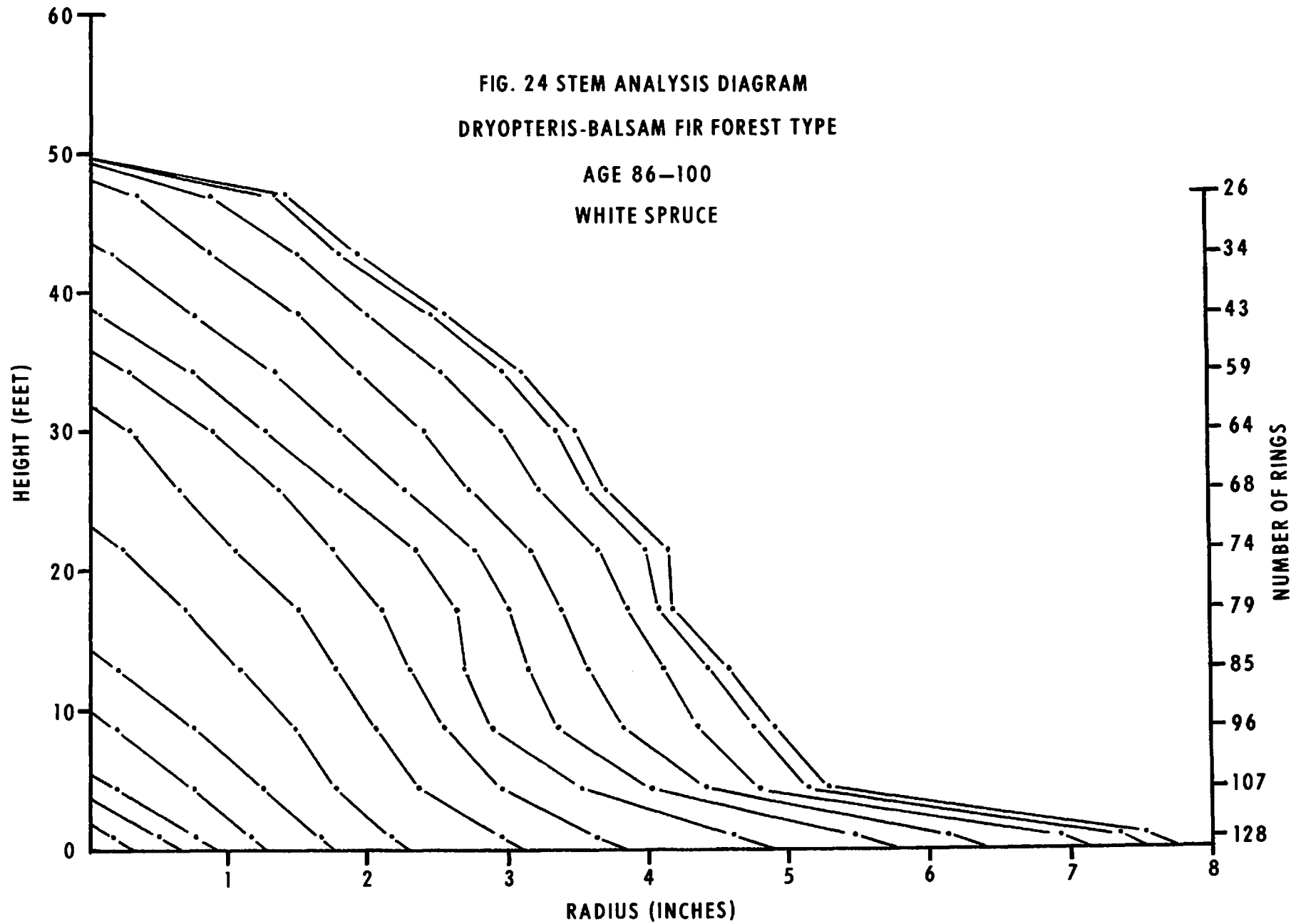
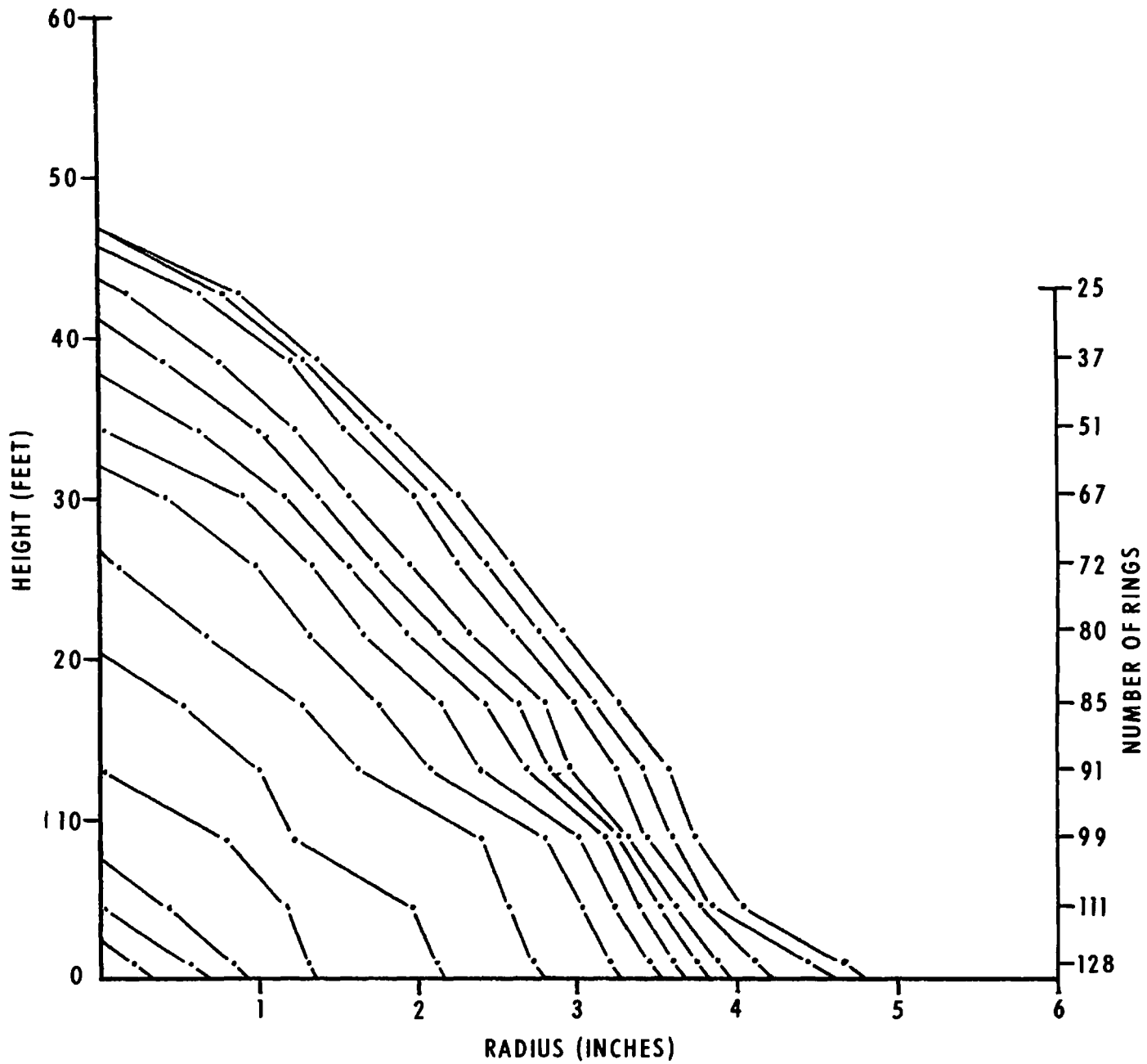
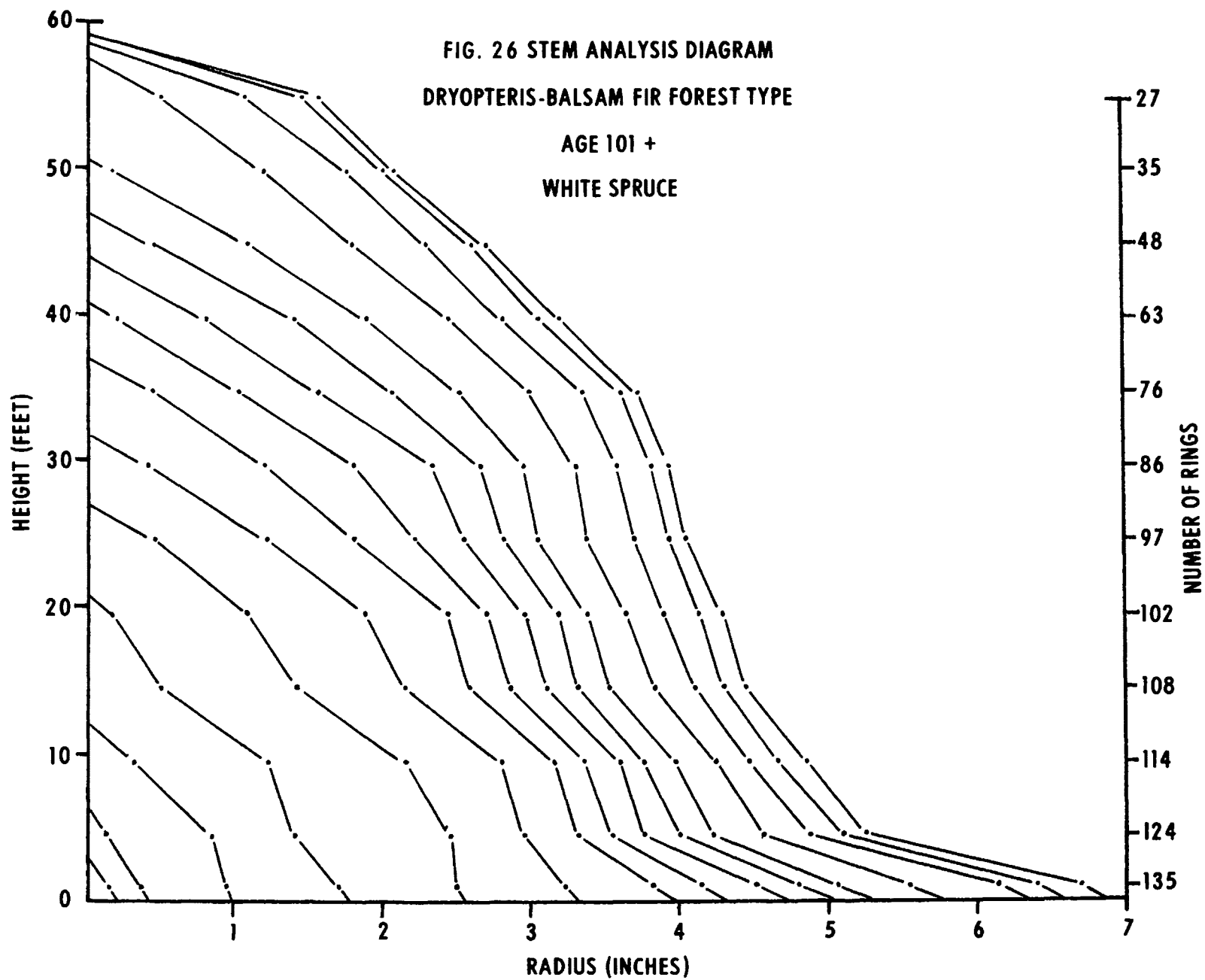


FIG. 25 STEM ANALYSIS DIAGRAM
 DRYOPTERIS-BALSAM FIR FOREST TYPE
 AGE 101 +
 BALSAM FIR





STEM ANALYSIS DATA TABLE
 DRYOPTERIS-BALSAM FIR FOREST TYPE
 Age Class: 86-100 Years

	Balsam Fir (Fig. 23)	White Spruce (Fig. 24)
Age at breast height (years)	89	107
Diameter breast height (inches)	8.00	10.56
Total height (feet)	41.2	49.8
Total volume (cu. ft.)	7.48	16.10
Merchantable volume (cu. ft.)	6.63	14.50
Total volume increment by decades:-		
1960 - 1950	2.586	3.570
1950 - 1940	1.727	3.132
1940 - 1930	1.491	2.428
1930 - 1920	.909	2.048
1920 - 1910	.440	1.666
1910 - 1900	.124	1.417
1900 - 1890	.162	1.036
1890 - 1880	.024	.515
1880 - 1870	.017	.187
1870 - 1860	--	.078
1860 - 1850	--	.016
1850 - 1840	--	.008
Merchantable volume increment: -		
1960 - 1950	1.704	2.200

Table 19

STEM ANALYSIS DATA TABLE

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age Class: 101+ Years

	Balsam Fir (Fig. 25)	White Spruce (Fig. 26)
Age at breast height (years)	111	124
Diameter breast height (inches)	8.07	10.50
Total height (feet)	47.2	59.0
Total volume (cu. ft.)	7.78	18.43
Merchantable volume (cu. ft.)	7.12	16.55
Total volume increment by		
decades: -		
1960 - 1950	.805	3.225
1950 - 1940	1.092	2.521
1940 - 1930	.595	2.520
1930 - 1920	.639	1.580
1920 - 1910	.730	1.414
1910 - 1900	.828	1.398
1900 - 1890	1.102	1.201
1890 - 1880	.992	1.442
1880 - 1870	.714	1.443
1870 - 1860	.221	1.102
1860 - 1850	.032	.475
1850 - 1840	.016	.101
1840 - 1830	.003	.006
Merchantable volume		
increment: - 1960 - 1950	.710	3.050

Dryopteris-Hylocomium-Balsam Fir Forest Type

Description

This forest type was originally named the Clintonia-balsam fir type by Damman (1963). It consists of well-stocked balsam fir forests with an admixture of black spruce and white birch. White spruce is occasionally present.

The shrub layer consists only of very scattered Amelanchier bartramiana and Sorbus americana. The herb layer usually covers more than 20% of the forest floor, and consists chiefly of Clintonia borealis, Maianthemum canadense, Cornus canadensis, Vaccinium ovalifolium and Dryopteris spinulosa. The moss layer usually forms a continuous carpet but in stands containing much birch it may be interrupted. Hylocomium splendens and Pleurozium schreberi are the main components.

Stands of this type are widely distributed throughout the sample area. They occupy well-drained locations on till soils derived from non-calcareous bedrock. They are less common on limestone till, where they occur only if the limestone bedrock, or the highly calcareous basal till, is covered by a deep englacial till layer. Typical soil conditions are orthic podzols in loams and sandy loams. Mottling is often present in the lower B or C horizons.

Mensurational Characteristics

Similar height/diameter curves have been obtained for balsam fir and white spruce (Figs. 27 and 28). A diameter of 6 inches corresponds to a height of 35 feet and a diameter of 10 inches to a height of 48 feet. Balsam fir height/age curves show slightly more rapid height growth in the younger age class of 86-100 years (Fig. 29) than in the older age class of over 100 years (Fig. 30). The younger age class reaches 30 feet at 50 years and 50 feet at 100 years, while the older age class reaches 26 feet and 47 feet, respectively, at the same ages.

Total softwood merchantable volume averages 2,646 cubic feet per acre in the younger age class (Table 20) and 2,438 cubic feet per acre in the older age class (Table 21). Total number of stems per acre averages 752 in the younger stands (Table 22) and 743 in the older stands (Table 23). Corresponding basal area figures are 162 and 142 square feet per acre.

In the younger stands 91% of the stems are balsam fir, making up 85% of the basal area (Fig. 31). In the older stands 86% of the stems are fir, making up 82% of the basal area. White and black spruce

together occupy about 8% of the basal area in both age classes.

Volume increments for the balsam fir and white spruce sample trees are similar (Figs. 32-35; Tables 24 and 25); trees in the younger age class have grown more rapidly in both species.

Regeneration is good (Tables 35 and 36), with 98.7% stocking and an average of 14,500 young softwood stems per acre.

FIG. 27 HEIGHT/DIAMETER CURVE

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

BALSAM FIR

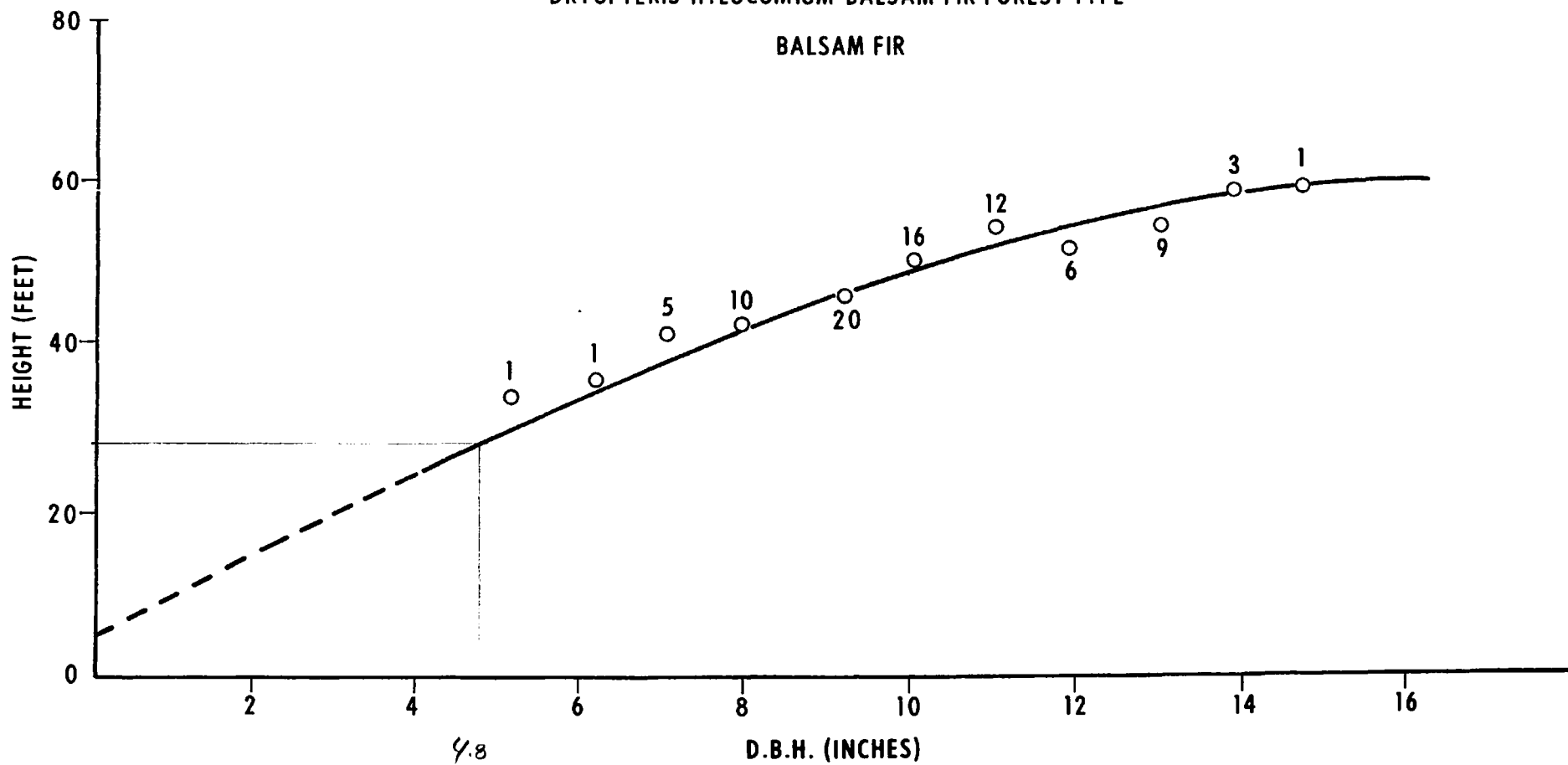


FIG. 28 HEIGHT/DIAMETER CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE

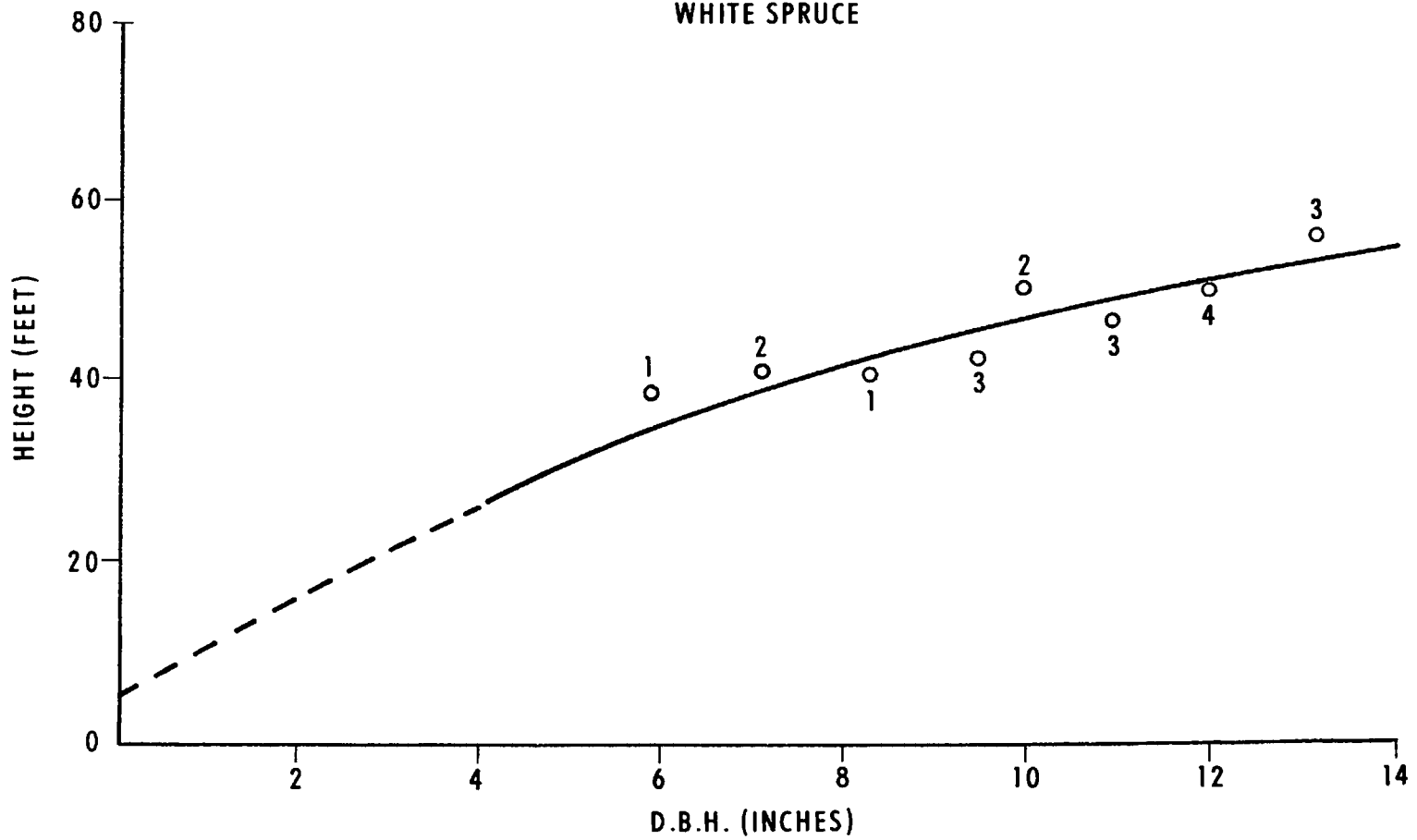


FIG. 29 HEIGHT/AGE CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
AGE CLASS: 86-100
BALSAM FIR

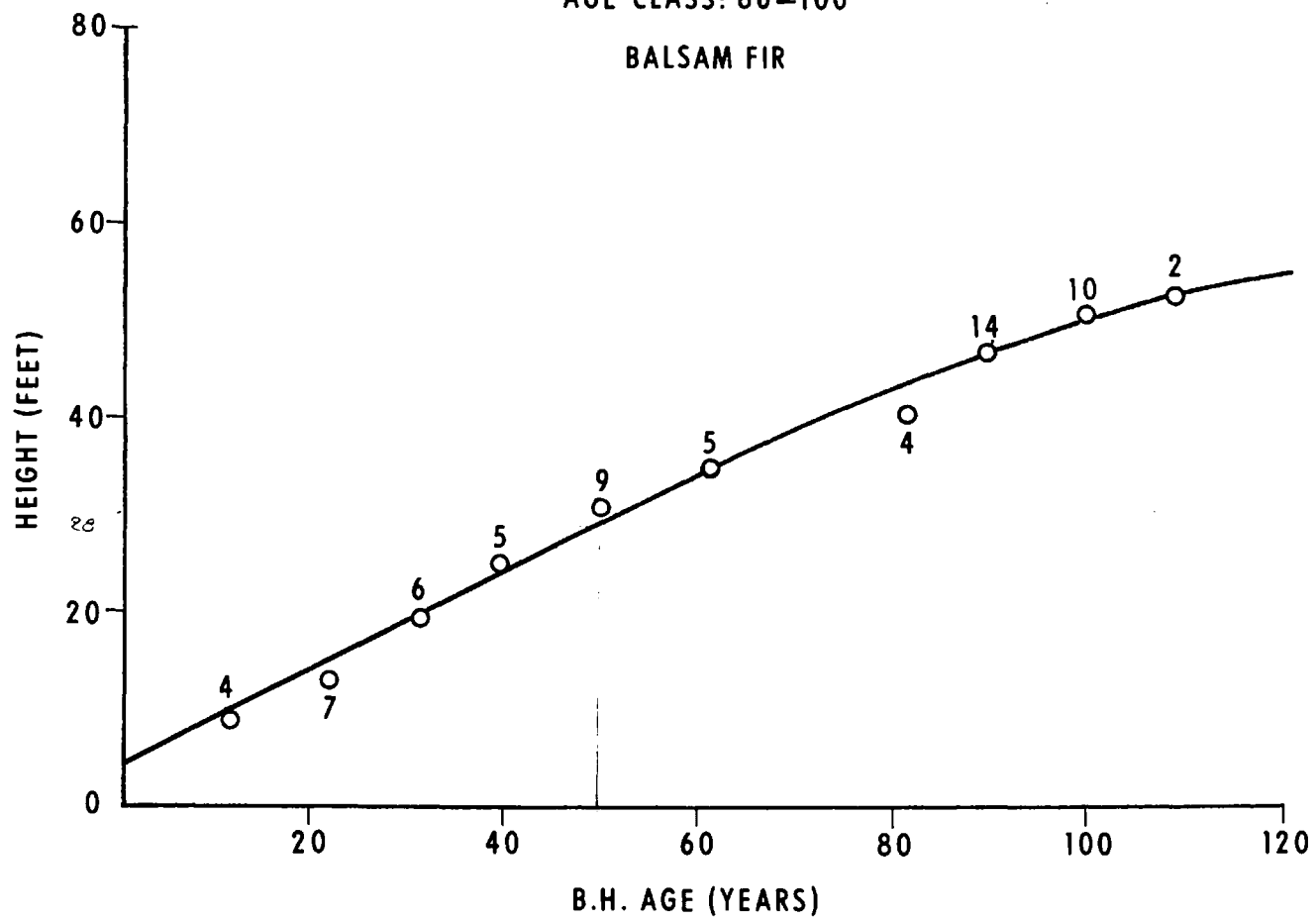


Table 10

STEM ANALYSIS DATA TABLE

TAXUS-BALSAM FIR FOREST TYPE

Age Class: 55-70 Years

	Balsam Fir (Fig. 10)	White Spruce (Fig. 11)
Age at breast height (years)	53	56
Diameter breast height (inches)	4.50	4.70
Total height (feet)	35.3	35.0
Total volume (cu. ft.) . . .	1.77	2.08
Merchantable volume (cu. ft.)	1.38	1.57
Total volume increment by decades: -		
1960 - 1950	.354	.575
1950 - 1940	.529	.611
1940 - 1930	.484	.516
1930 - 1920	.299	.248
1920 - 1910	.086	.092
1910 - 1900	.017	.037
1900 - 1890	.003	.002
Merchantable volume increment: -		
1960 - 1950	.330	.510

Table 11

STEM ANALYSIS DATA TABLE
 TAXUS-BALSAM FIR FOREST TYPE
 Age Class: 71-85 Years

	Balsam Fir (Fig. 12)	White Spruce (Fig. 13)
Age at breast height (years)	77	80
Diameter breast height (inches)	5.62	6.28
Total height (feet)	45.4	43.5
Total volume (cu. ft.)	3.88	4.48
Merchantable volume (cu. ft.)	3.37	3.98
Total volume increment by decades: -		
1960 - 1950	1.106	1.310
1950 - 1940	1.179	1.243
1940 - 1930	.650	1.077
1930 - 1920	.533	.523
1920 - 1910	.237	.220
1910 - 1900	.111	.062
1900 - 1890	.050	.030
1890 - 1880	.014	.010
1880 - 1870	.001	.005
Merchantable volume increment: -		
1960 - 1950	0.980	0.940

Table 12

STEM ANALYSIS DATA TABLE

TAXUS-BALSAM FIR FOREST TYPE

Age Class: 86-100 Years

	Balsam Fir (Fig. 14)	White Spruce (Fig. 15)
Age at breast height (years)	100	94
Diameter breast height (inches)	5.72	8.98
Total height (feet)	44.4	52.8
Total volume (cu. ft.)	4.38	11.04
Merchantable volume (cu. ft.)	3.71	9.94
Total volume increment by decades: -		
1960 - 1950	1.404	3.209
1950 - 1940	.945	2.256
1940 - 1930	.748	2.145
1930 - 1920	.523	1.552
1920 - 1910	.341	1.134
1910 - 1900	.165	.452
1900 - 1890	.078	.150
1890 - 1880	.109	.077
1880 - 1870	.043	.049
1870 - 1860	.018	.018
1860 - 1850	.001	—
Merchantable volume increment: -		
1960 - 1950	1.040	2.400

Table 13

STEM ANALYSIS DATA TABLE
 TAXUS-BALSAM FIR FOREST TYPE
 Age Class: 101 + Years

	Balsam Fir (Fig. 16)	White Spruce (Fig. 17)
Age at breast height (years)	110	132
Diameter breast height (inches)	8.14	9.46
Total height (feet)	54.3	56.3
Total volume (cu. ft.)	9.41	13.93
Merchantable volume (cu. ft.)	9.82	12.86
Total volume increment by decades: -		
1960 - 1950	2.722	2.988
1950 - 1940	2.454	2.616
1940 - 1930	1.885	1.856
1930 - 1920	.946	1.632
1920 - 1910	.657	1.168
1910 - 1900	.350	.944
1900 - 1890	.174	.752
1890 - 1880	.096	.416
1880 - 1870	.075	.424
1870 - 1860	.031	.360
1860 - 1850	.013	.256
1850 - 1840	.003	.096
1840 - 1830	.002	.048
1830 - 1820	.002	.024
1820 - 1810	.001	—
Merchantable volume increment: 1960 - 1950	2.650	2.752

Dryopteris-Balsam Fir Forest Type

Description

Balsam fir and balsam fir-white birch stands make up this type. Some white spruce is also present. In undisturbed areas, stands are usually well-stocked and predominantly coniferous, but in areas disturbed by fire, logging, or wind, stands often contain much white birch.

The shrub layer consists of widely scattered Acer spicatum and Viburnum edule. Most conspicuous is the luxuriant fern layer of Dryopteris spinulosa spp. americana which covers the forest floor. The remaining herb layer is poorly developed, although Maianthemum canadense, Cornus canadensis, Clintonia borealis, and Linnaea borealis are always present. Mosses are not very common owing to the dense fern layer and the abundance of birch litter.

Well-drained, nutrient-rich orthic podzols formed in non-calcareous till are the typical soils on which this forest type is found. There is usually a weakly developed fragipan in these soils at a depth of about $1\frac{1}{2}$ feet over which some seepage occurs. Slight mottling is common in the lower B or C horizon.

Mensurational Characteristics

Height/diameter curves are similar in shape for balsam fir and white spruce (Figs. 18 and 19). A diameter of 6 inches corresponds to a height of approximately 36 feet, and a diameter of 10 inches to a height of 50 feet. The two age classes (86-100, and 101+) possess similar balsam fir height/age curves, which reach 30 feet at 50 years and 50 feet at 100 years (Figs. 20 and 21).

Softwood merchantable volume totals 2,496 cubic feet per acre in the younger age class (Table 14) and 2,307 cubic feet per acre in the older age class (Table 15). The younger stands have, on average, a total of 584 stems per acre and a basal area of 161 square feet per acre (Table 16). In the older stands the figures are 654 stems and 138 square feet per acre (Table 17).

In the younger age class balsam fir constitutes 84% of the stand in terms of number of stems and 86% in terms of basal area (Fig. 22). The situation is reversed in the older age class where fir forms 86% of the stand in terms of number of trees and 83% in basal area. The spruces are a minor component, forming only between 1% and 3% of the basal area.

Stem analysis diagrams (Figs. 23-26) and tabular data (Tables 18 and 19) show similar increment rates for the two age classes in each of the two species. The white spruce sample trees have grown more rapidly than the balsam fir.

Regeneration is good, with 95.6% of the sample quadrats stocked (Table 35). There are an average of 11,300 young softwood stems per acre (Table 36).

FIG. 18 HEIGHT/DIAMETER CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE

BALSAM FIR

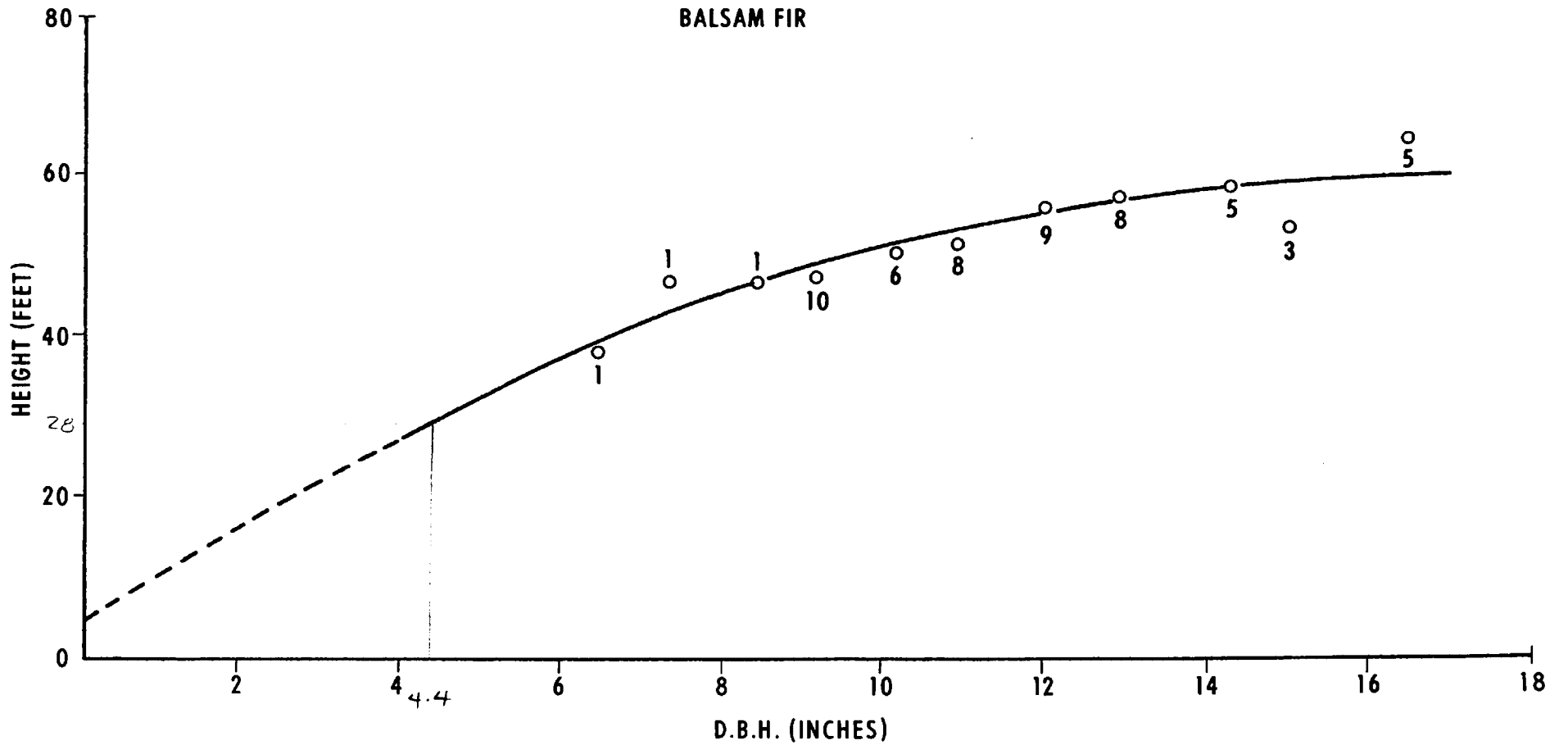


FIG. 19 HEIGHT/DIAMETER CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
WHITE SPRUCE

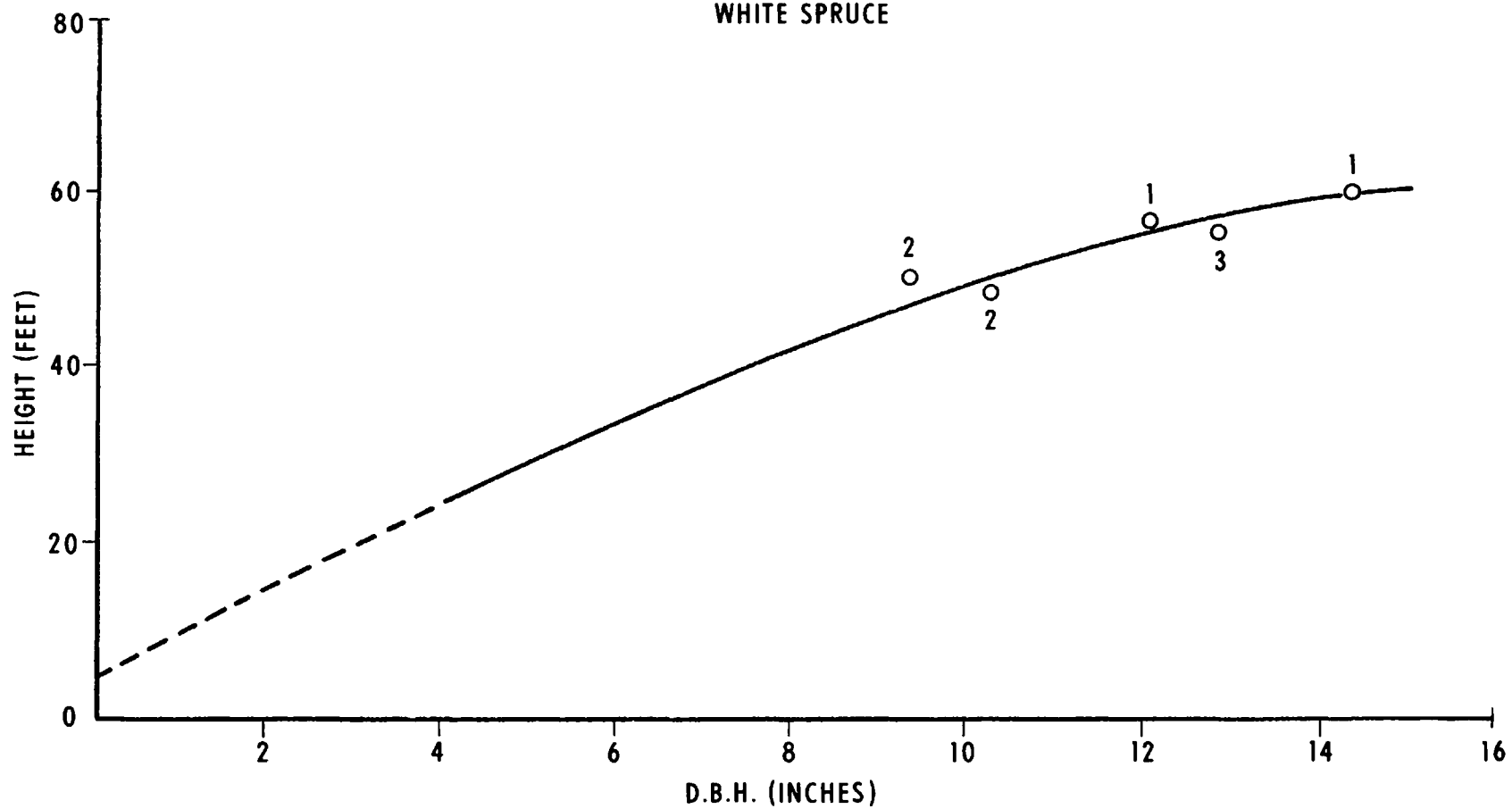


FIG. 20 HEIGHT/AGE CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
AGE CLASS: 86-100
BALSAM FIR

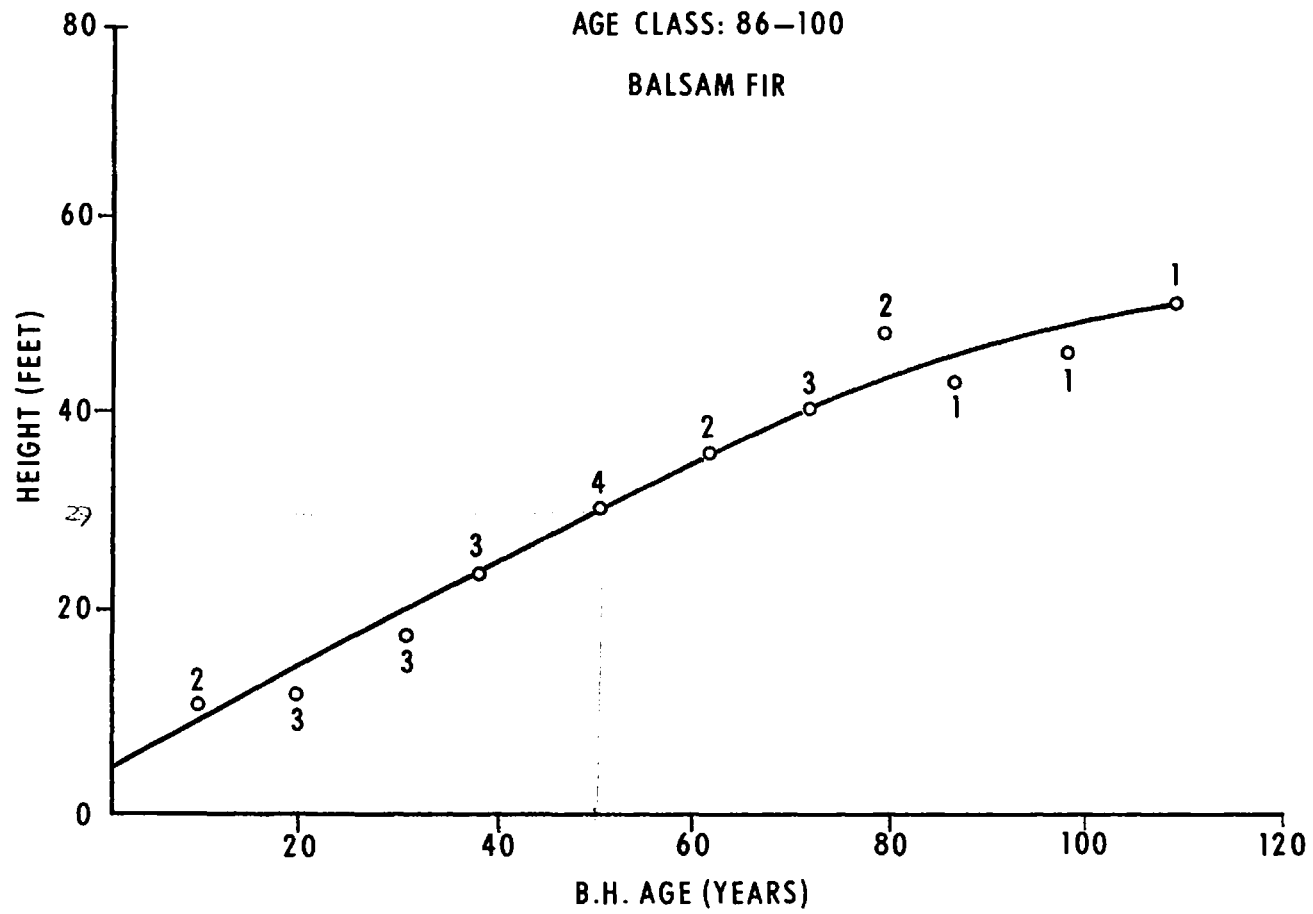


FIG. 21 HEIGHT/AGE CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE

AGE CLASS: 101 +
BALSAM FIR

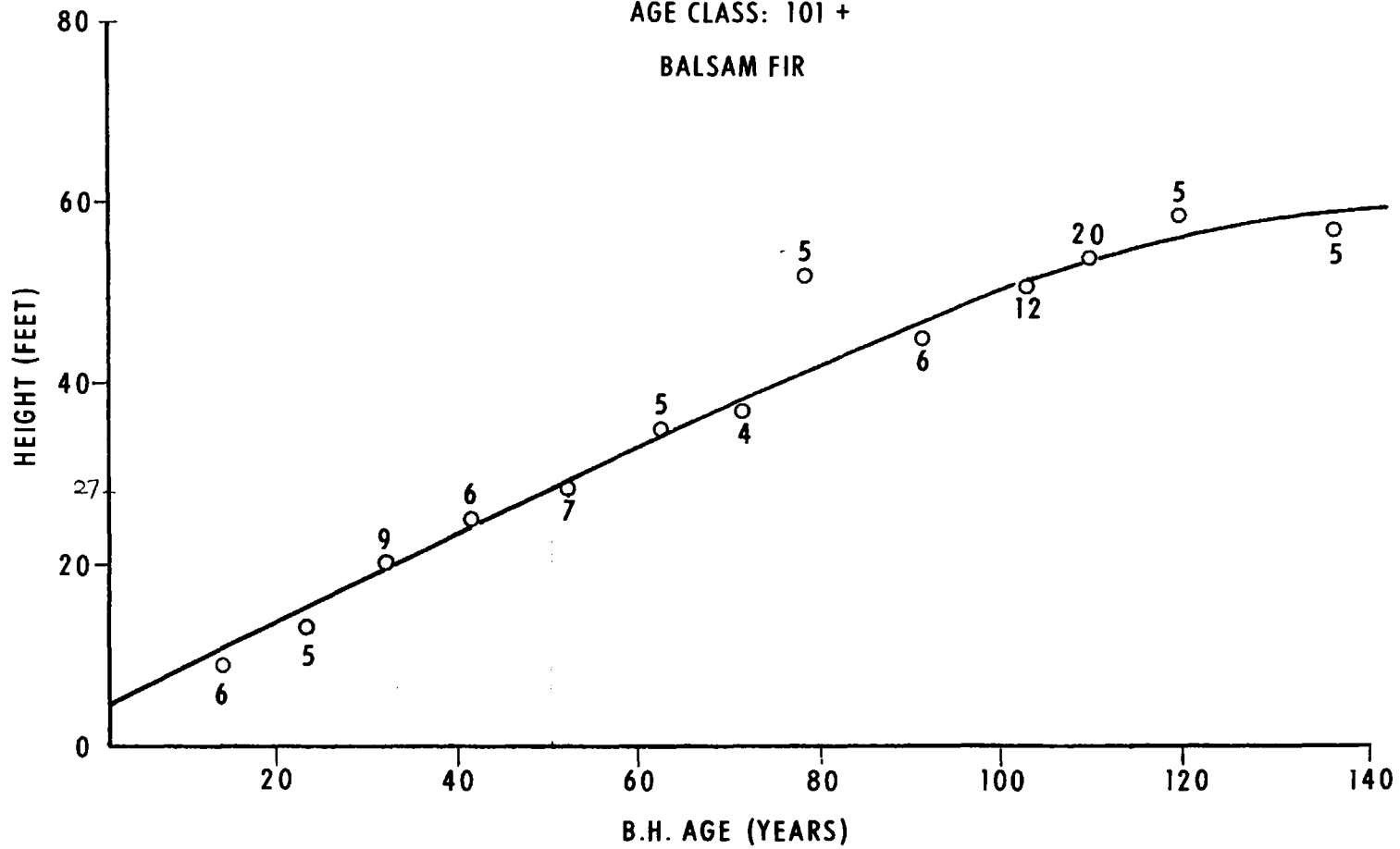


Table 14

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND
STOCK TABLES

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

SPECIES FORM CLASS		BALSAM FIR 62		WHITE SPRUCE 67		
D.b.h. (Inches)	Height Feet	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Height Feet	Merch Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.
4	28	1.0	34.0 ↓	-	-	-
5	33	1.8	90.0 ↓	-	-	-
6	37	3.0	162.0	-	-	-
7	40	4.3	326.8	36	4.2	16.8
8	43	6.2	483.6	-	-	-
9	45	8.1	405.0	45	8.5	34.0
10	47	10.3	247.2	-	-	-
11	49	13.1	366.8	-	-	-
12	51	16.3	65.2	-	-	-
13	53	19.5	117.0	-	-	-
14	54	23.3	93.2	-	-	-
15	55	27.2	54.4	-	-	-
Total			2,445.2	50.8		

*Stump height one foot: Top diameter outside bark three inches.

- 77 -

Table 15

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND
STOCK TABLES

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age: 101 Years +

SPECIES		BALSAM FIR		WHITE SPRUCE			BLACK SPRUCE		
FORM CLASS		64		67			70		
D.b.h.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	M. Vol.
(Inches)	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre
		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.
4	28	1.1	26.0	23	0.8	2.2	-	-	-
5	32	1.9	35.3	28	1.6	1.4	-	-	-
6	36	3.1	66.3	32	2.6	3.6	-	-	-
7	39	4.4	138.2	36	4.0	1.6	39	4.4	1.8
8	42	6.2	194.7	41	6.1	11.0	42	6.3	2.5
9	46	8.6	313.0	45	8.5	18.7	45	8.7	3.4
10	49	11.1	267.5	49	11.3	4.5	47	11.4	4.6
11	51	13.9	214.1	-	-	-	49	14.4	5.8
12	54	17.5	350.0	-	-	-	-	-	-
13	56	21.3	259.9	57	22.6	20.3	-	-	-
14	58	25.5	153.0	-	-	-	-	-	-
15	59	29.8	107.3	-	-	-	-	-	-
16	60	34.4	48.2	-	-	-	-	-	-
17	60	38.8	34.9	-	-	-	-	-	-
18	60	43.5	17.4	-	-	-	-	-	-
Total			2,225.8			63.3			18.1

*Stump height one foot: Top diameter outside bark three inches.

Table 16

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

Number of Plots: 5

D.b.h. Classes	BALSAM FIR			WHITE SPRUCE			WHITE BIRCH			MOUNTAIN ASH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*
1	42.0	20.0	.21	6.0	..	.03	14.0	..	.07	..	..	62.0	20.0	.31
2	22.0	54.0	.48	2.0	..	.04	10.0	..	.22	..	..	34.0	54.0	.74
3	16.0	48.0	.78	..	8.0	..	6.0	2.0	.29	..	..	22.0	58.0	1.07
4	34.0	54.0	2.96	..	10.0	..	2.0	..	.17	..	..	36.0	64.0	3.13
5	50.0	26.0	6.80	..	14.0	..	8.0	4.0	1.08	2.0	.27	60.0	44.0	8.15	
6	54.0	30.0	10.58	..	8.0	..	6.0	..	1.18	..	..	60.0	38.0	11.76
7	76.0	16.0	20.29	2.0	8.0	.53	..	..	..	..	..	78.0	24.0	20.82
8	78.0	14.0	27.22	2.0	4.0	.70	12.0	..	4.18	..	..	92.0	20.0	32.10
9	50.0	2.0	22.10	..	..	..	8.0	..	3.54	..	..	58.0	2.0	25.64
10	24.0	2.0	13.08	..	..	..	..	..	..	..	..	24.0	2.0	13.08
11	28.0	..	18.48	..	..	..	10.0	..	6.60	..	..	38.0	..	25.08
12	4.0	..	3.14	..	..	..	2.0	..	1.57	..	..	6.0	..	4.71
13	6.0	2.0	5.53	..	..	..	..	..	..	..	..	6.0	2.0	5.53
14	4.0	2.0	4.28	..	..	..	2.0	..	2.14	..	..	6.0	2.0	6.42
15	2.0	..	2.45	..	..	..	..	..	..	..	..	2.0	..	2.45
Total	490.0	270.0	138.38	12.0	52.0	1.30	80.0	6.0	21.04	2.0	.27	584.0	330.0	160.99	

*Living trees.

Table 17

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

DRYOPTERIS-BALSAM FIR FOREST TYPE

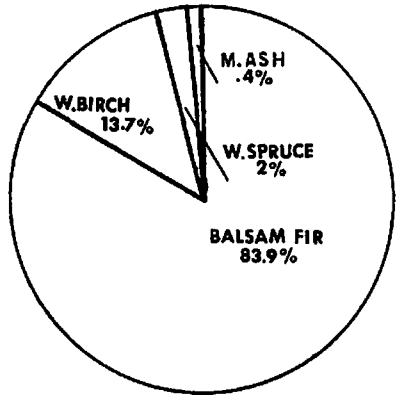
Age: 101 Years +

Number of Plots: 22

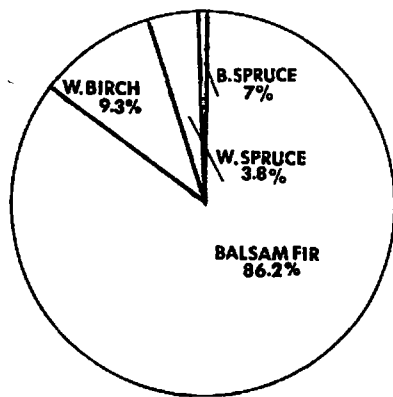
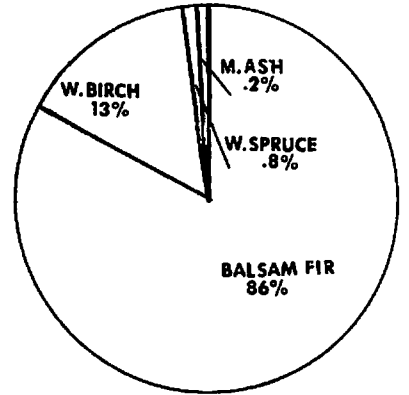
D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*
1	205.8	12.7	1.02	1.8	..	.01	9.5	0.9	.05	30.0	..	.15	247.1	13.6	1.23
2	67.2	8.6	1.48	0.4	..	.01	2.7	0.4	.06	1.4	..	.03	71.7	9.0	1.58
3	43.1	5.9	2.11	..	..	..	1.8	3.2	.08	0.9	..	.04	45.8	9.1	2.23
4	23.6	8.6	2.05	..	..	..	2.7	0.9	.23	0.9	..	.08	27.2	9.5	2.36
5	18.6	11.4	2.52	..	0.4	..	0.9	1.8	.12	1.4	0.4	.19	20.9	14.0	2.83
6	21.4	6.8	4.19	..	0.4	..	1.4	1.8	.27	1.8	..	.35	24.6	9.0	4.81
7	31.4	12.7	8.38	0.4	..	.10	0.4	1.8	.10	0.9	..	.24	33.1	14.5	8.82
8	31.4	7.2	10.96	0.4	0.4	.14	1.8	2.7	.62	2.7	0.4	.94	36.3	10.7	12.66
9	36.4	8.2	16.08	0.4	..	.18	2.2	1.4	.97	2.7	1.4	1.19	41.7	11.0	18.42
10	24.1	7.2	13.13	0.4	..	.22	0.4	0.9	.22	5.4	0.4	2.94	30.3	8.5	16.51
11	15.4	5.9	10.16	0.4	..	.26	..	0.9	..	2.2	..	1.45	18.0	6.8	11.87
12	20.0	1.8	15.70	..	..	..	..	0.4	..	2.2	..	1.72	22.2	2.2	17.42
13	12.2	3.2	11.24	..	..	..	0.9	0.4	.82	1.8	..	1.66	14.9	3.6	13.72
14	6.8	0.9	7.26	..	..	..	..	..	..	3.2	..	3.42	10.0	0.9	10.68
15	3.6	..	4.42	..	..	..	..	..	..	2.2	..	2.70	5.8	..	7.12
16	1.4	0.4	1.95	..	..	..	..	..	..	..	..	..	1.4	0.4	1.95
17	0.9	..	1.42	..	..	..	..	..	..	0.9	..	1.42	1.8	..	2.84
18	0.4	..	.70	..	..	..	..	..	..	0.4	..	.70	0.8	..	1.40
Total	563.7	101.5	114.77	4.2	1.2	.92	24.7	17.5	3.54	61.0	2.6	19.22	653.6	122.8	138.45

*Living trees.

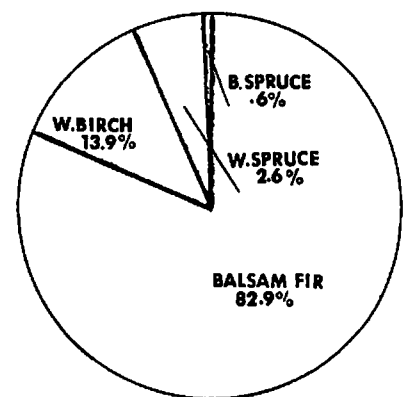
FIG. 22 STAND TABLE DIAGRAMS: DRYOPTERIS-BALSAM FIR FOREST TYPE



AGE 86-100



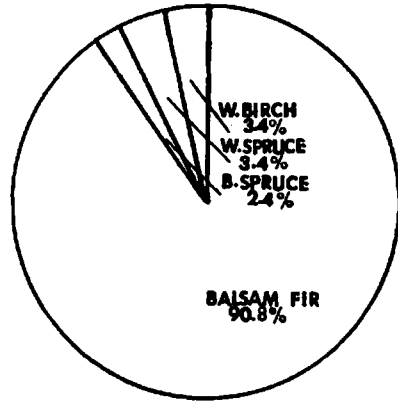
AGE 101 +



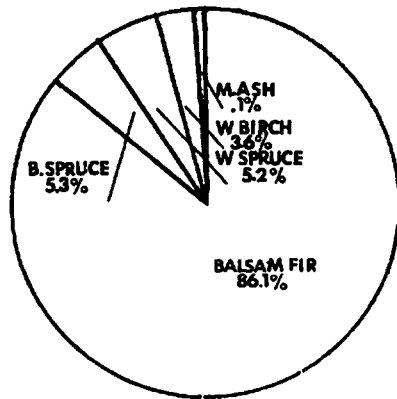
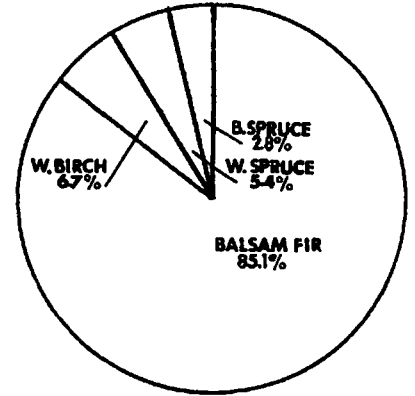
NUMBER OF STEMS

BASAL AREA

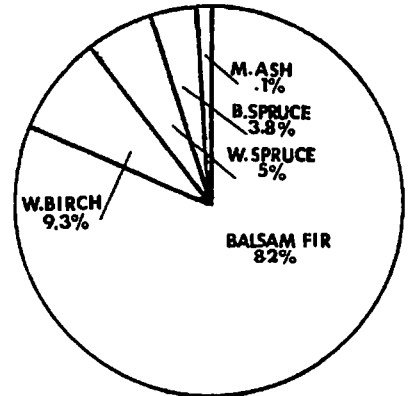
FIG. 31 STAND TABLE DIAGRAMS: DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE



AGE 86-100



AGE 101 +



NUMBER OF STEMS

BASAL AREA

FIG. 32 STEM ANALYSIS DIAGRAM
 DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

AGE 86-100

BALSAM FIR

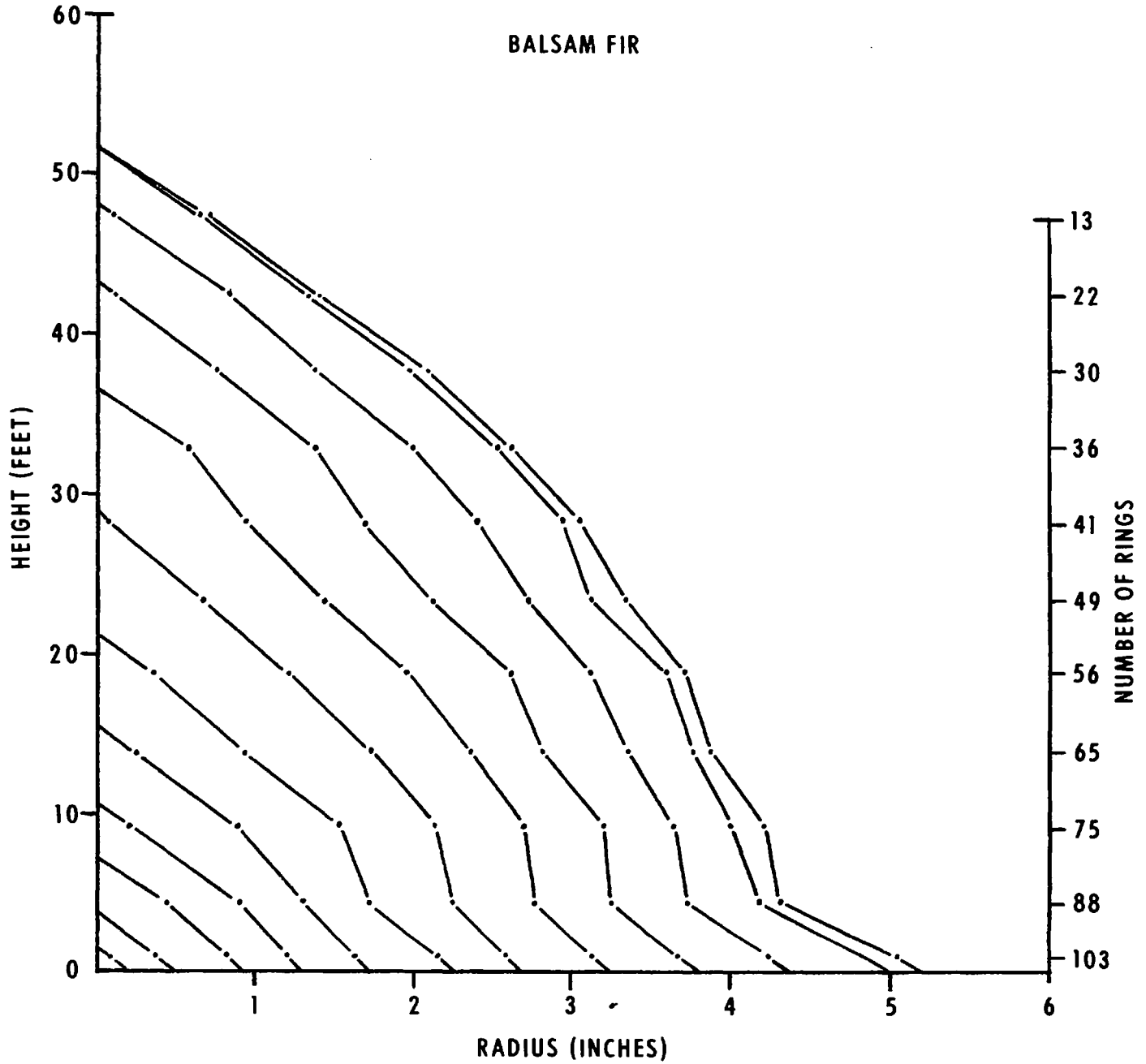


FIG. 33 STEM ANALYSIS DIAGRAM

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

AGE 86-100

WHITE SPRUCE

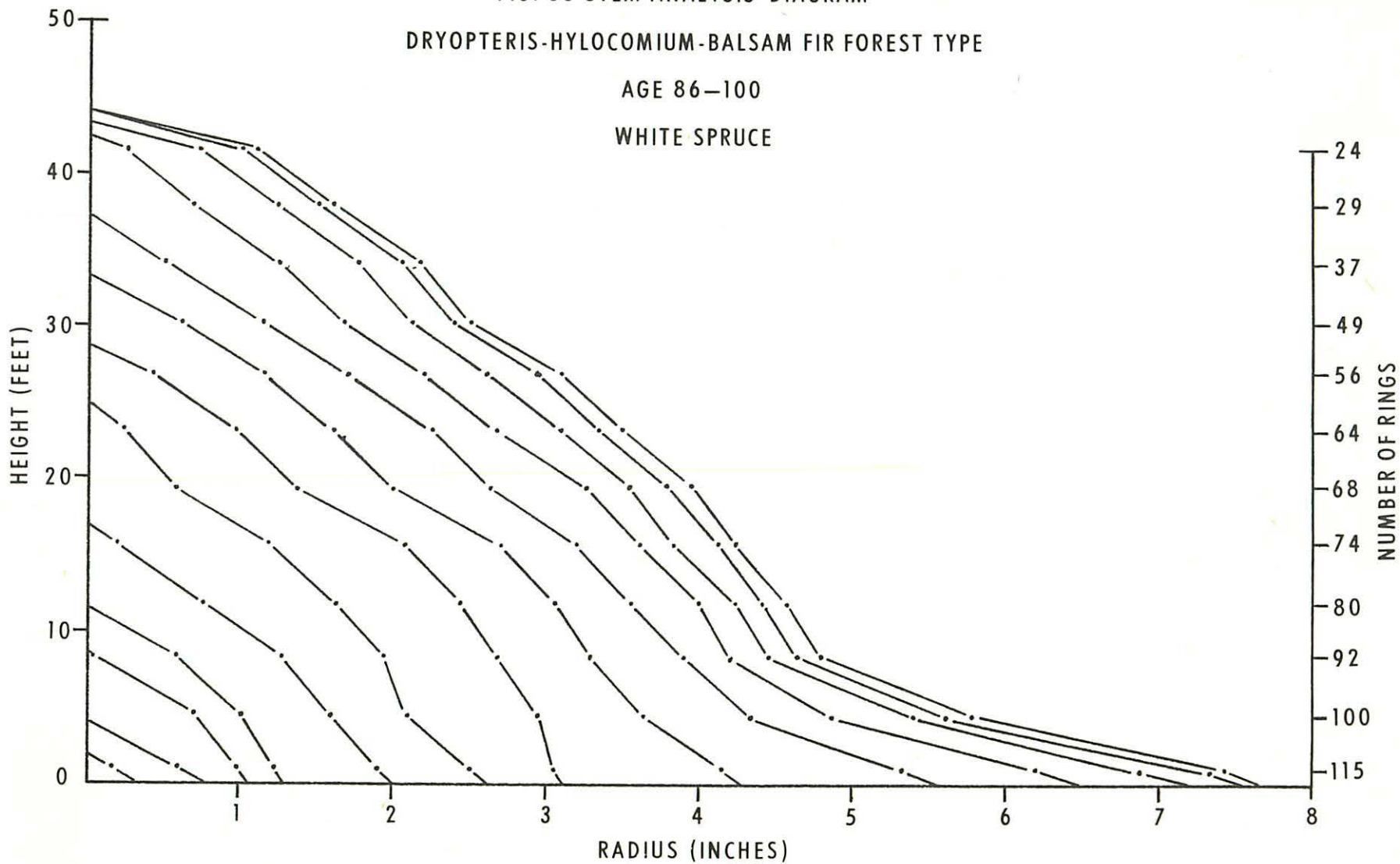


FIG. 34 STEM ANALYSIS DIAGRAM
 DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
 AGE 101 +
 BALSAM FIR

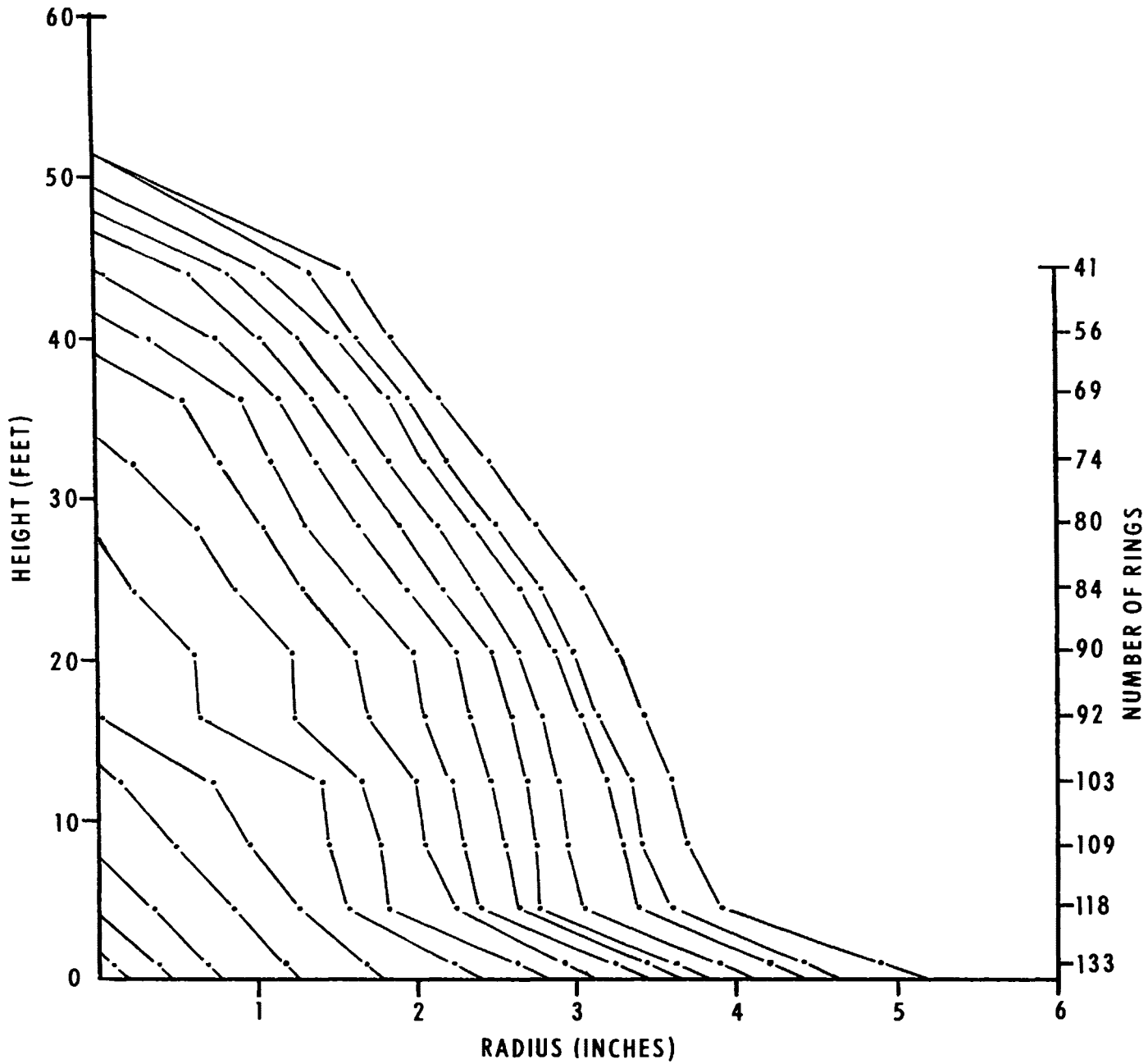


FIG. 35 STEM ANALYSIS DIAGRAM
 DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
 AGE 101 +
 WHITE SPRUCE

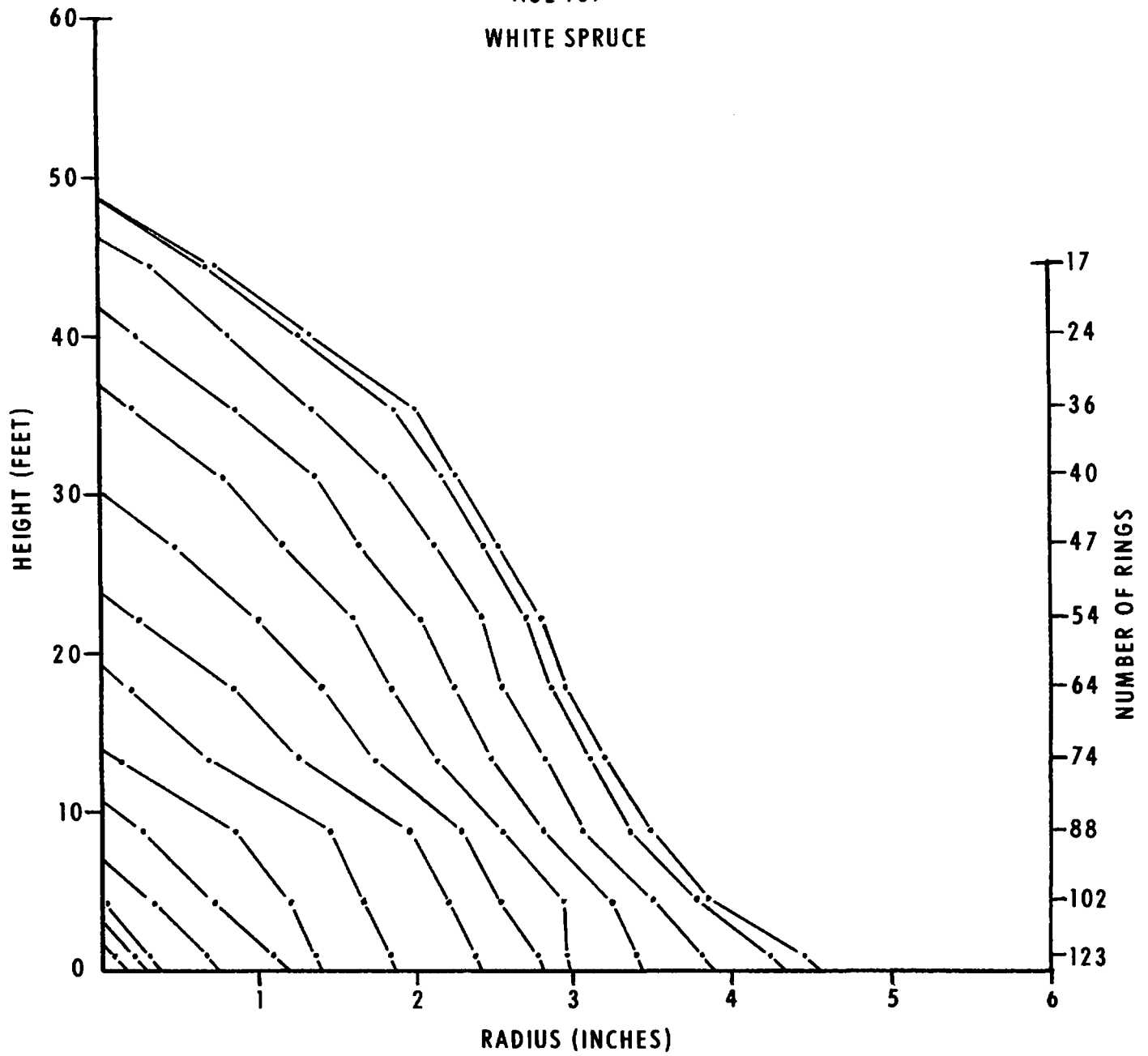


Table 24

STEM ANALYSIS DATA TABLE

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age Class: 86-100 Years

	Balsam Fir (Fig. 32)	White Spruce (Fig. 33)
Age at breast height (years)	88	100
Diameter breast height (inches)	8.63	11.56
Total height (feet)	51.9	44.0
Total volume (cu. ft.)	10.98	13.86
Merchantable volume (cu. ft.)	9.17	13.00
Total volume increment by decades: -		
1960 - 1950	3.458	2.466
1950 - 1940	2.445	2.131
1940 - 1930	2.455	2.385
1930 - 1920	.940	2.283
1920 - 1910	.903	1.933
1910 - 1900	.444	1.478
1900 - 1890	.207	.701
1890 - 1880	.091	.309
1880 - 1870	.035	.093
1870 - 1860	.002	.062
1860 - 1850	.002	.014
Merchantable volume increment: 1960 - 1950	2.570	1.950

Table 25

STEM ANALYSIS DATA TABLE

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age Class: 101 + Years

	Balsam Fir (Fig. 34)	White Spruce (Fig. 35)
Age at breast height (years)	118	102
Diameter breast height (inches)	7.82	7.70
Total height (feet)	51.5	49.0
Total volume (cu. ft.)	9.09	7.55
Merchantable volume (cu. ft.)	7.42	6.82
Total volume increment by decades: -		
1960 - 1950	2.238	2.056
1950 - 1940	1.285	1.392
1940 - 1930	.873	1.187
1930 - 1920	.804	.956
1920 - 1910	.911	.742
1910 - 1900	.824	.599
1900 - 1890	.754	.353
1890 - 1880	.592	.172
1880 - 1870	.446	.069
1870 - 1860	.228	.023
1860 - 1850	.103	.002
1850 - 1840	.022	.001
1840 - 1830	.005	--
Merchantable volume increment: -		
1960 - 1950	0.720	1.500

Rubus-Balsam Fir Forest Type (Mitella variant)

Description

This forest type consists of almost pure and usually well-stocked balsam fir stands. White spruce and white birch occur scattered throughout, while black spruce is occasionally present.

Viburnum edule, Cornus stolonifera, and Acer spicatum are the main components of the poorly developed upper shrub layer. Taxus canadensis is abundant in the lower shrub layer. Herbs usually cover less than half the forest floor. Over twenty species are usually present, however, the most prominent being Mitella nuda, Dryopteris spinulosa ssp. intermedia, Rubus pubescens, Dryopteris disjuncta, Listera cordata, Cornus canadensis and Linnaea borealis. The forest floor is covered with an almost continuous moss carpet of Rhytidiadelphus triquetrus, Hylocomium umbratum, Dicranum majus, Hylocomium splendens, and Pleurozium schreberi.

This type is common on moist lower slopes and in valley bottoms, especially on calcareous parent materials. Soils are typically nutrient-rich gleysols, calcareous gleysols, or sometimes mucky gleysols. Soil texture varies greatly.

Mensurational Characteristics

Height/diameter curves for balsam fir and white spruce are almost identical (Figs. 36 and 37). A diameter of 6 inches corresponds to a height of 36 feet and a diameter of 10 inches to a height of 49 feet. The balsam fir height/age curves (Figs. 38 and 39) are markedly different in form, with the older stands (101+ age class) having a height advantage at all ages up to 110 years. At 50 years the average height is 26 feet in the younger age class (86-100 years) and 38 feet in the older class. At 100 years the younger age class reaches 47 feet while the older age class reaches 49 feet.

Merchantable softwood volume totals 2,435 cubic feet per acre in the younger age class (Table 26) and 2,236 cubic feet per acre in the older age class (Table 27). There are an average of 935 and 708 stems per acre in the younger and older age classes, respectively (Tables 28 and 29). Associated basal area figures are 153 and 131 square feet per acre.

Balsam fir constitutes between 84% and 87% of the stands of the two age classes in terms of number of stems per acre, and between 79% and 80% of the basal area (Fig. 40). White spruce occupies a further 11% to 12% of the basal area.

Stem analysis diagrams and tabulated data for balsam fir and white spruce are given in Figs. 41-43 and Tables 30-31. No white spruce sample tree was available in the 101+ age class. In the younger age class the spruce has grown more rapidly than the fir.

Regeneration is generally good, with 87.5% of the sample quadrats stocked (Table 35). There are an average of 7,700 young softwood stems per acre (Table 36).

FIG. 36 HEIGHT/DIAMETER CURVE

RUBUS-BALSAM FIR FOREST TYPE

BALSAM FIR

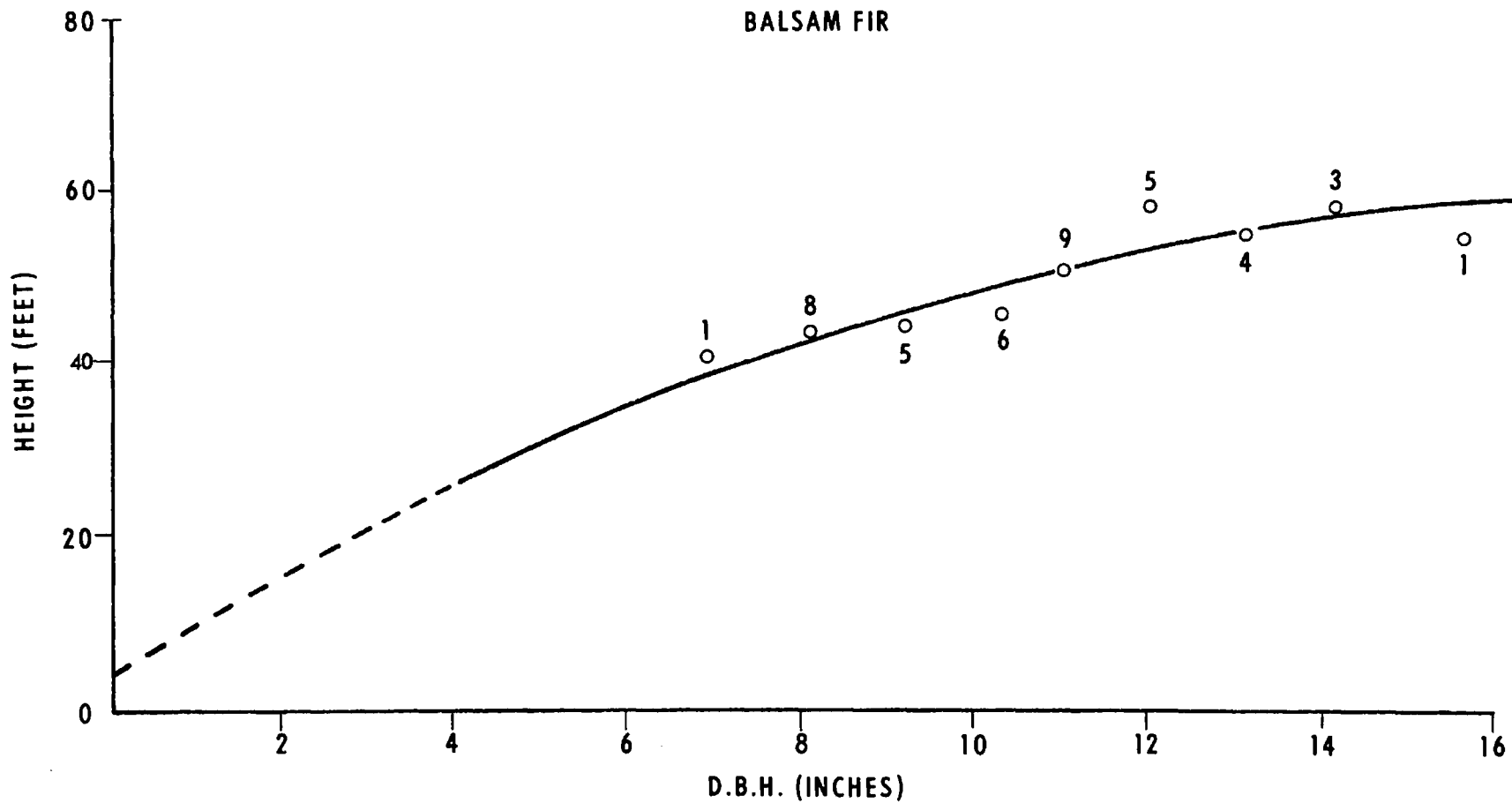


FIG. 37 HEIGHT/DIAMETER CURVE
RUBUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE

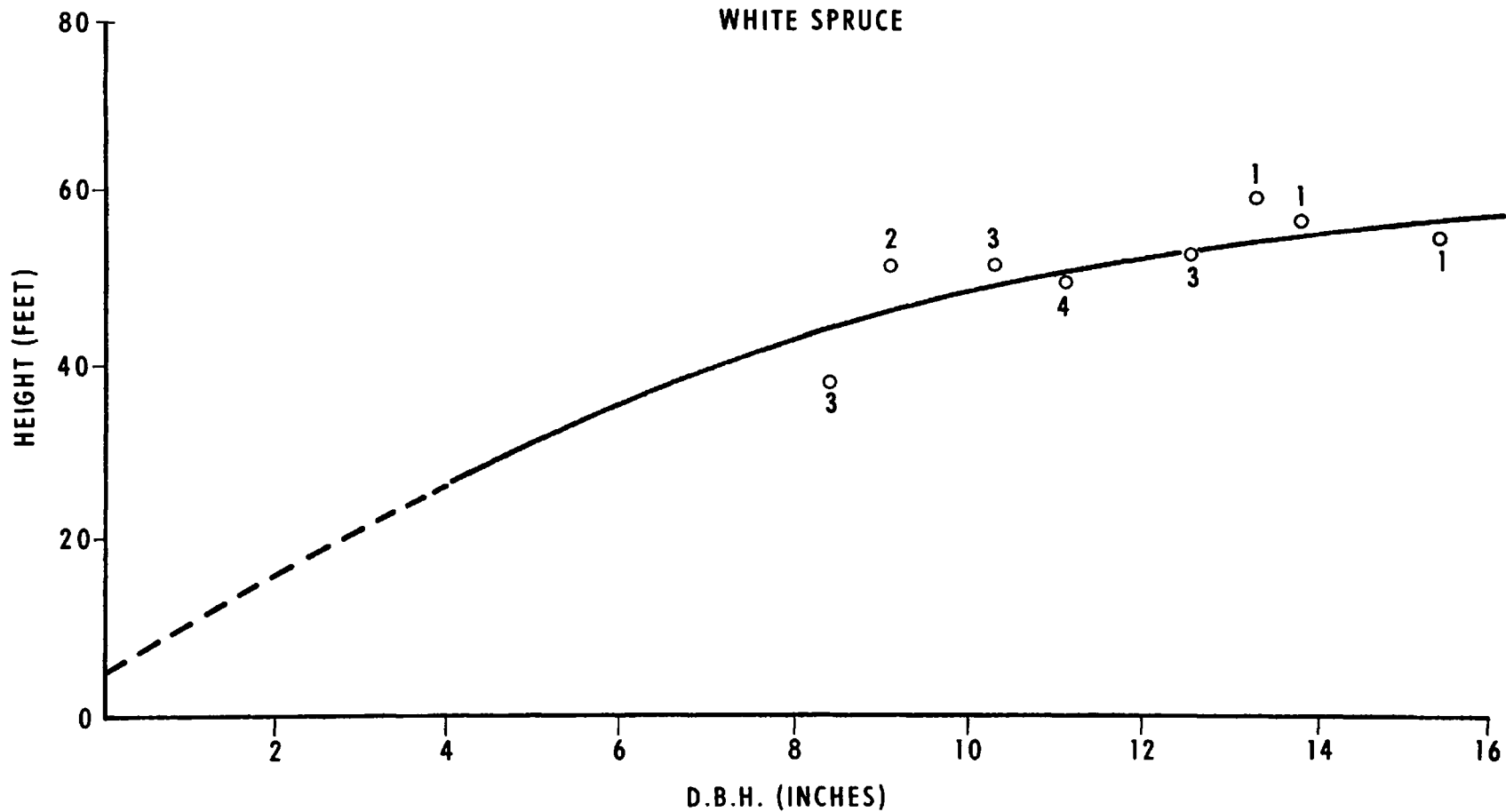


FIG. 38 HEIGHT/AGE CURVE
RUBUS-BALSAM FIR FOREST TYPE
AGE CLASS: 86-100
BALSAM FIR

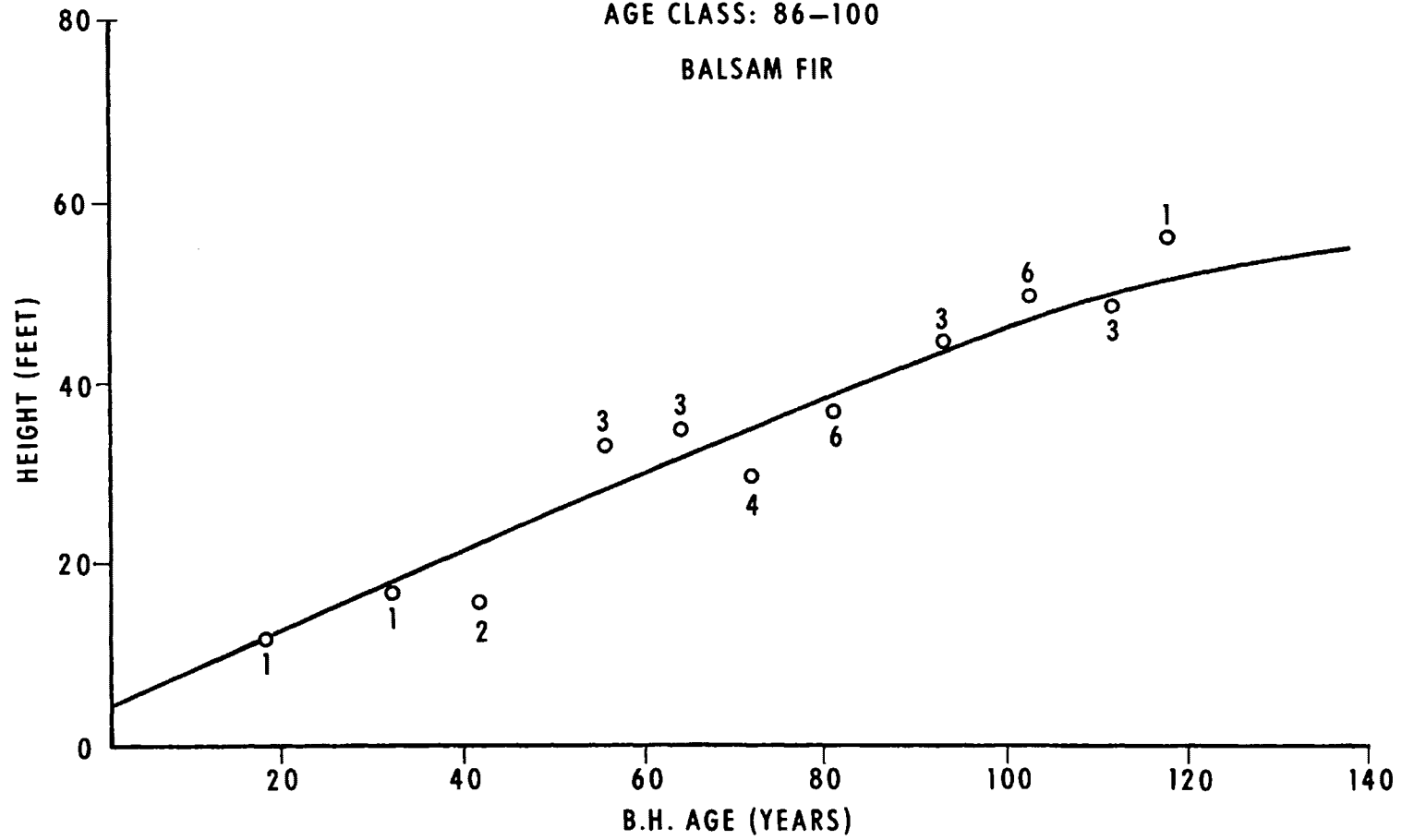


FIG. 39 HEIGHT/AGE CURVE
RUBUS-BALSAM FIR FOREST TYPE

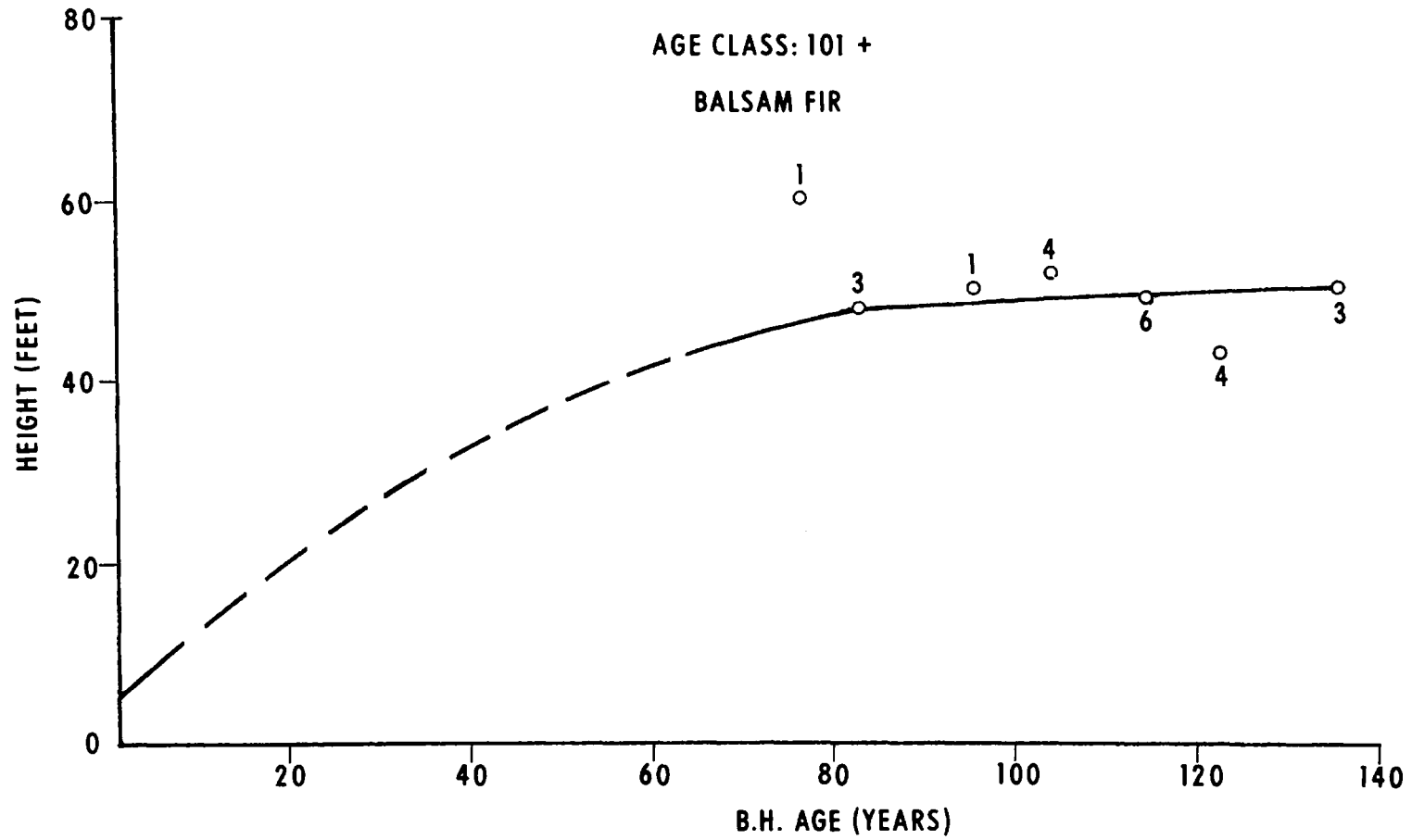


Table 26

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

RUBUS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

SPECIES		BALSAM FIR		BLACK SPRUCE			WHITE SPRUCE		
FORM CLASS		62		70			61		
D.b.h.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	Merch. Vol.
(Inches)	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre
		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.
4	29	1.0	70.0	28	0.8	4.6	25	0.9	1.2
5	33	1.9	97.6	32	1.6	2.2	30	1.7	7.1
6	38	3.2	150.7	36	2.8	3.9	34	2.7	7.6
7	41	4.6	177.6	39	4.4	6.2	38	4.0	5.6
8	44	6.4	237.4	-	-	-	41	5.6	23.5
9	45	8.3	343.6	-	-	-	44	7.7	21.6
10	47	10.5	224.7	-	-	-	47	10.1	42.4
11	48	13.0	278.2	-	-	-	49	13.1	36.6
12	49	15.8	202.2	-	-	-	51	16.1	45.0
13	50	18.9	134.2	-	-	-	53	19.6	54.8
14	50	22.0	61.6	-	-	-	54	23.0	32.2
15	50	25.0	35.0	-	-	-	55	26.9	37.6
16	50	28.7	40.2	-	-	-	-	-	-
18	50	35.9	50.2	-	-	-	-	-	-
Total		2,103.2		16.9			315.2		

*Stump height one foot: Top diameter outside bark three inches.

Table 27

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

RUBUS-BALSAM FIR FOREST TYPE

Age; 101 Years +

SPECIES FORM CLASS		BALSAM FIR 62		WHITE SPRUCE 64		
D.b.h. (Inches)	Height Feet	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Height Feet	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.
4	24	0.8	28.3	27	0.9	1.4
5	29	1.7	35.4	32	1.8	2.7
6	33	2.8	51.5	36	2.8	10.6
7	37	4.2	157.9	40	4.3	6.4
8	42	6.0	157.2	43	6.1	28.0
9	45	8.1	199.2	46	8.3	44.8
10	49	10.7	287.8	49	11.0	25.3
11	52	13.9	234.9	52	14.1	64.8
12	55	17.5	255.5	54	17.6	40.4
13	58	21.5	247.2	57	21.7	49.9
14	60	25.8	159.9	58	25.5	38.2
15	61	29.9	23.9	-	-	-
16	61	34.2	27.4	-	-	-
17	61	38.4	57.6	-	-	-
Total			1,923.7			312.5

*Stump height one foot: Top diameter outside bark three inches.

- 79 -

Table 28

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

RUBUS-BALSAM FIR FOREST TYPE

Age: 86-100 Years

Number of Plots: 7

RED SPRUCE		WHITE BIRCH			MOUNTAIN ASH			T O T A L		
Trees	Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*
1.4	.10	1.4	..	..	..	..	..	287.0	51.3	1.42
1.4	.22	..	..	..	1.4	..	.03	122.8	22.8	2.70
..	.14	..	..	..	..	..	..	114.2	27.1	5.60
5.7	.12	..	..	..	..	..	..	77.1	18.5	6.71
1.4	.57	..	..	..	..	..	..	57.0	12.8	7.75
..	.54	1.4	..	.27	..	..	..	52.7	5.7	10.31
2.8	.37	1.4	..	.37	..	..	..	42.8	11.4	11.41
5.7	1.46	2.8	..	.98	..	..	..	44.1	12.8	15.38
1.4	1.24	..	..	..	..	..	..	44.2	7.1	19.54
4.2	2.28	..	..	..	..	..	..	25.6	7.0	13.94
4.2	1.84	1.4	..	.92	..	..	..	25.6	7.0	16.88
2.8	2.20	1.4	..	1.10	..	..	..	17.0	5.6	13.34
1.4	2.58	..	..	..	..	..	..	9.9	1.4	9.12
..	1.50	1.4	..	1.50	..	..	..	5.6	1.4	5.99
..	1.72	2.8	..	3.44	..	..	..	5.6	..	6.88
..	..	1.4	..	1.95	..	..	..	2.8	..	3.90
..
..	..	..	..	..	..	..	..	1.4	..	2.47
32.4	16.88	15.4	..	10.53	1.4	..	.03	955.4	191.9	153.34

Table 29

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

RUBUS-BALSAM FIR FOREST TYPE

Age: 101 Years +

Number of Plots: 13

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			MOUNTAIN ASH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq.Ft.*
1	200.8	19.2	1.00	6.2	..	.03	13.8	0.8	.06	19.2	..	.09	1.5	..	..	241.5	20.0	1.18
2	96.2	7.6	2.12	5.4	..	.12	7.6	0.8	.16	2.3	..	.05	0.8	..	.02	112.3	8.4	2.47
3	53.0	12.3	2.60	3.0	..	.14	4.6	1.5	.22	..	..	..	..	..	..	60.6	13.8	2.96
4	35.4	10.8	3.08	..	..	..	1.5	1.5	.13	..	0.8	..	..	..	..	36.9	13.1	3.21
5	20.8	5.4	2.82	0.8	..	.10	1.5	1.5	.20	0.8	0.8	.10	..	..	..	23.9	7.7	3.22
6	18.4	4.6	3.60	..	..	..	3.8	0.8	.74	0.8	..	.16	..	..	..	23.0	5.4	4.50
7	37.6	6.9	10.04	..	0.8	..	1.5	0.8	.40	2.3	..	.61	..	..	..	41.4	8.5	11.05
8	26.2	3.8	9.14	..	..	..	4.6	2.3	1.60	4.6	..	1.60	..	..	..	35.4	6.1	12.34
9	24.6	4.6	10.87	..	..	..	5.4	1.5	2.38	0.8	0.8	.35	..	..	..	30.8	6.9	13.60
10	26.9	7.6	14.66	..	..	..	2.3	0.8	1.25	0.8	..	.44	..	..	..	30.0	8.4	16.35
11	16.9	3.0	11.15	..	..	..	4.6	2.3	3.04	5.4	..	3.56	..	..	..	26.9	5.3	17.75
12	14.6	6.2	11.46	..	..	..	2.3	0.8	1.80	0.8	0.8	.62	..	..	..	17.7	7.8	13.88
13	11.5	2.3	10.60	..	..	..	2.3	2.3	2.12	0.8	..	.74	..	..	..	14.6	4.6	13.46
14	6.2	0.8	6.62	..	..	..	1.5	1.5	1.60	2.3	..	2.46	..	..	..	10.0	2.3	10.68
15	0.8	1.5	.98	..	..	..	..	..	..	..	..	..	..	..	..	0.8	1.5	.98
16	0.8	0.8	1.12	..	..	..	..	..	..	..	..	..	..	..	..	0.8	0.8	1.12
17	1.5	0.8	2.36	..	..	..	..	..	..	..	..	..	..	..	..	1.5	0.8	2.36
Total	592.2	98.2	104.22	15.4	0.8	.39	57.3	19.2	15.70	40.9	.32	10.78	2.3	..	.02	708.1	121.4	131.11

*Living trees

Table 23

LAND TABLE AND BASAL AREA PER ACRE BY SPECIES

SPRIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 101 Years +

of Plots: 29

PLOT NO.	WHITE BIRCH		MOUNTAIN ASH			T O T A L			
	Basal Area Sq.Ft.*	No. of Trees Living Dead	Basal Area Sq.Ft.*	No. of Trees Living Dead	Basal Area Sq.Ft.*	No. of Trees Living Dead	Basal Area Sq.Ft.*		
.04	1.4	..	..	..	..	196.1	27.5	.96
.12	0.3	..	..	..	..	99.6	16.1	2.17
.18	1.4	..	.06	..	..	74.2	13.4	3.61
.24	1.0	..	.08	..	..	45.8	11.3	3.97
.23	2.8	..	.38	0.3	..	51.3	8.9	6.97	
.53	1.7	0.3	.33	..	..	44.7	8.8	8.75
.82	..	0.3	..	..	..	46.2	7.8	12.32
.98	1.4	..	.48	0.3	..	40.4	7.9	14.09	
.75	3.8	0.6	1.68	..	..	52.4	10.4	23.16
.92	2.4	0.6	1.30	..	..	33.3	4.3	18.12
.66	4.4	1.0	2.90	..	..	25.6	3.7	16.90
1.33	1.0	..	.78	..	..	15.8	8.9	12.38
.28	1.0	0.6	.92	..	..	6.8	3.0	6.27
..	1.4	..	1.50	..	..	5.5	1.3	5.88
..	2.0	..	2.45	..	..	4.4	0.6	5.39
..	0.3	..	.42	..	..	0.6	0.3	.84
..	..	..	..	..	..	..	0.3	..
..	..	..	..	..	..	0.3	..	.53
7.08	26.3	3.4	13.28	0.6	..	.14	743.0	134.5	142.31

ees

Table 23

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 101 Years +

Number of Plots: 29

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			MOUNTAIN ASH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*
1	173.8	26.2	.86	11.3	0.3	.06	9.6	1.0	.04	1.4	..	..	..	..	..	196.1	27.5	.96
2	87.6	15.8	1.92	5.9	..	.13	5.8	0.3	.12	0.3	..	..	..	..	..	99.6	16.1	2.17
3	65.2	11.4	3.19	3.8	..	.18	3.8	2.0	.18	1.4	..	.06	..	..	..	74.2	13.4	3.61
4	40.6	9.3	3.53	1.4	0.3	.12	2.8	1.7	.24	1.0	..	.08	..	..	..	45.8	11.3	3.97
5	43.4	8.6	5.90	3.1	..	.42	1.7	0.3	.23	2.8	..	.38	0.3	..	.04	51.3	8.9	6.97
6	38.2	7.6	7.48	2.1	0.6	.41	2.7	0.3	.53	1.7	0.3	.33	..	..	..	44.7	8.8	8.75
7	40.0	6.2	10.68	3.1	0.3	.82	3.1	1.0	.82	..	0.3	..	..	..	..	46.2	7.8	12.32
8	33.1	7.6	11.55	2.8	..	.98	2.8	0.3	.98	1.4	..	.48	0.3	..	.10	40.4	7.9	14.09
9	45.2	8.9	19.98	1.7	0.6	.75	1.7	0.3	.75	3.8	0.6	1.68	..	..	..	52.4	10.4	23.16
10	28.2	3.1	15.36	1.0	..	.54	1.4	0.6	.92	2.4	0.6	1.30	..	..	..	33.3	4.3	18.12
11	19.6	1.7	12.94	0.6	..	.40	1.0	1.0	.66	4.4	1.0	2.90	..	..	..	25.6	3.7	16.90
12	12.8	2.0	10.04	0.3	0.3	.23	1.7	6.6	1.33	1.0	..	.78	..	..	..	15.8	8.9	12.38
13	5.5	2.4	5.07	..	..	..	0.3	..	.28	1.0	0.6	.92	..	..	..	6.8	3.0	6.27
14	3.8	1.0	4.06	0.3	..	.32	..	0.3	..	1.4	..	1.50	..	..	..	5.5	1.3	5.88
15	2.4	0.6	2.94	..	..	..	..	..	..	2.0	..	2.45	..	..	..	4.4	0.6	5.39
16	0.3	0.3	.42	..	..	..	..	..	..	0.3	..	.42	..	..	..	0.6	0.3	.84
17	..	..	..	..	..	..	..	0.3	..	..	..	..	..	..	..	..	0.3	..
18	0.3	..	.53	..	..	..	..	..	..	..	..	..	..	..	..	0.3	..	.53
Total	640.0	112.7	116.45	37.4	2.4	5.36	38.4	16.0	7.08	26.3	3.4	13.28	0.6	..	.14	743.0	134.5	142.31

*Living trees

FIG. 30 HEIGHT/AGE CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

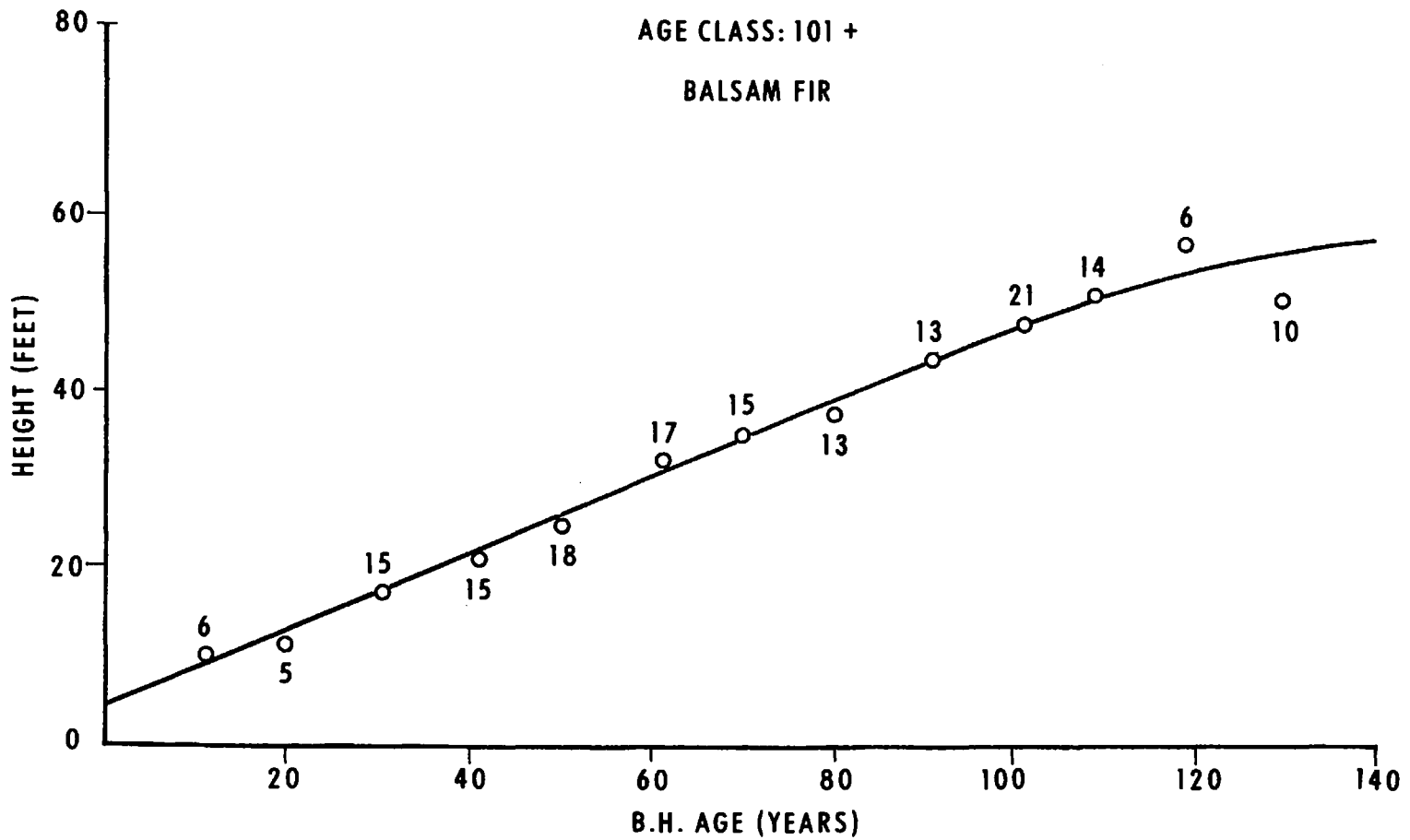


Table 20

LOCAL FORM CLASS MERCHANTABILITY TABLES AND
STOCK TABLES

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 86-100 Years

SPECIES FORM CLASS		BALSAM FIR 62		BLACK SPRUCE 70			WHITE SPRUCE 60		
D.b.h. (Inches)	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.
4	25	0.9	44.1	-	-	-	33	1.0	1.0
5	29	1.7	88.4	32	1.6	1.6	-	-	-
6	34	2.8	151.2	36	2.8	2.8	41	3.0	12.0
7	38	4.1	209.0	39	4.4	8.8	44	4.5	13.5
8	42	6.0	378.0	42	6.3	6.3	46	6.0	24.0
9	46	8.2	352.6	45	8.7	17.4	-	-	-
10	49	10.7	278.2	47	11.4	11.4	50	10.5	10.5
11	52	13.9	333.6	-	-	-	51	13.2	39.6
12	55	17.5	192.5	-	-	-	53	16.3	32.6
13	57	21.2	148.4	50	20.5	41.0	-	-	-
14	58	25.0	125.0	-	-	-	-	-	-
15	59	29.0	29.0	-	-	-	57	27.1	27.1
16	59	33.1	66.2	-	-	-	-	-	-
Total		2,396.2		89.3			160.3		

*Stump height one foot: Top diameter outside bark three inches.

Table 21

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND
STOCK TABLES

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 101 Years +

SPECIES FORM CLASS		BALSAM FIR 65		BLACK SPRUCE 70			WHITE SPRUCE 64		
D.b.h. (Inches)	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	Merch. Vol.* Per Tree Cu. Ft.	Merch. Vol. Per Acre Cu. Ft.	Ht. Ft.	Merch Vol.* Per Tree Cu. Ft.	M. Vol. Per Acre Cu. Ft.
4	29	1.2	48.7	28	0.8	1.1	28	1.0	2.8
5	33	2.1	91.1	32	1.6	5.0	32	1.8	3.0
6	36	3.2	122.2	36	2.8	5.8	36	2.8	7.6
7	40	4.7	188.0	39	4.4	13.6	39	4.2	13.0
8	43	6.5	215.2	42	6.3	17.6	41	5.8	16.2
9	47	8.9	402.2	45	8.7	14.8	44	7.6	13.6
10	50	11.5	324.3	47	11.4	11.4	47	10.6	14.8
11	53	14.7	288.1	49	14.4	8.6	49	13.5	13.5
12	55	18.0	230.4	50	17.5	5.2	52	17.1	29.0
13	58	22.1	121.6	-	-	-	54	20.7	6.2
14	59	26.2	99.6	50	23.8	7.1	-	-	-
15	60	30.6	73.4	-	-	-	-	-	-
16	60	34.8	10.4	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-
18	60	43.9	13.2	-	-	-	-	-	-
Total			2,228.4			90.2			119.7

*Stump height one foot: Top diameter outside bark three inches.

1
62
-

Table 22

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

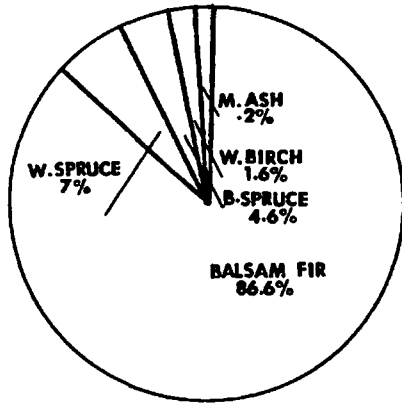
Age: 86-100 Years

Number of Plots: 10

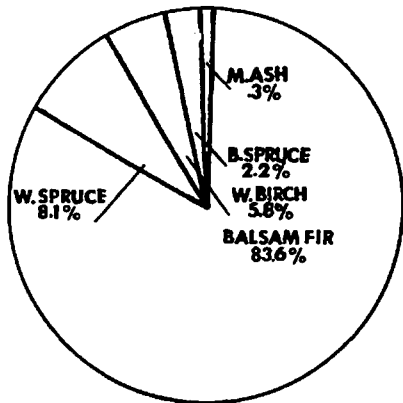
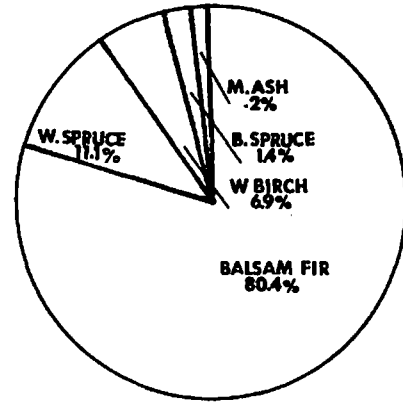
D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq. Ft.*	Living	Dead	Sq.Ft.*
1	119.0	27.0	.60	7.0	..	.04	1.0	..	..	2.0	..	.01	129.0	27.0	.65
2	91.0	20.0	2.00	1.0	..	.02	2.0	..	.04	..	..	..	94.0	20.0	2.06
3	84.0	20.0	4.11	..	..	..	4.0	..	.20	1.0	1.0	.04	89.0	21.0	4.35
4	49.0	17.0	4.26	..	..	..	1.0	3.0	.08	..	..	..	50.0	20.0	4.34
5	52.0	9.0	7.07	1.0	1.0	.14	..	1.0	..	4.0	..	.54	57.0	11.0	7.75
6	54.0	3.0	10.58	1.0	..	.20	4.0	..	.78	3.0	..	.58	62.0	3.0	12.14
7	51.0	1.0	13.62	2.0	..	.53	3.0	1.0	.80	3.0	..	.80	59.0	2.0	15.75
8	63.0	4.0	21.98	1.0	..	.34	4.0	..	1.40	2.0	5.0	.70	70.0	9.0	24.42
9	43.0	7.0	19.00	2.0	..	.88	..	..	..	3.0	..	1.32	48.0	7.0	21.20
10	26.0	2.0	14.17	1.0	1.0	.54	1.0	..	.54	1.0	..	.54	29.0	3.0	15.79
11	24.0	7.0	15.84	..	..	..	3.0	..	1.98	2.0	..	1.32	29.0	7.0	19.14
12	11.0	1.0	8.64	..	..	..	2.0	..	1.57	2.0	..	1.57	15.0	1.0	11.78
13	7.0	1.0	6.45	2.0	..	1.84	..	2.0	..	2.0	..	1.84	11.0	3.0	10.13
14	5.0	1.0	5.34	..	..	..	..	..	..	..	..	..	5.0	1.0	5.34
15	1.0	..	1.22	..	..	..	1.0	..	1.22	..	1.0	..	2.0	1.0	2.44
16	2.0	..	2.79	..	..	..	..	..	..	..	..	..	2.0	..	2.79
17	..	..	..	..	..	..	..	..	..	1.0	..	1.58	1.0	..	1.58
Total	682.0	120.0	137.67	18.0	2.0	4.53	26.0	7.0	8.61	26.0	7.0	10.84	752.0	136.0	161.65

*Living trees

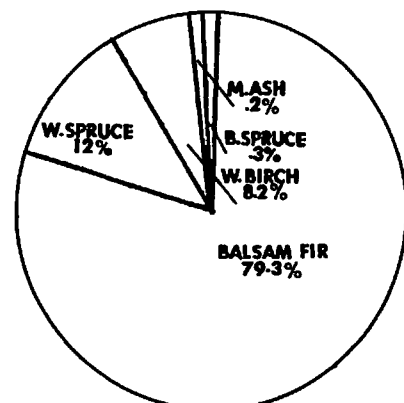
FIG. 40: STAND TABLE DIAGRAMS: RUBUS-BALSAM FIR FOREST TYPE



AGE 86-100



AGE 101 +



NUMBER OF STEMS

BASAL AREA

FIG. 41 STEM ANALYSIS DIAGRAM

RUBUS-BALSAM FIR FOREST TYPE

AGE 86-100

BALSAM FIR

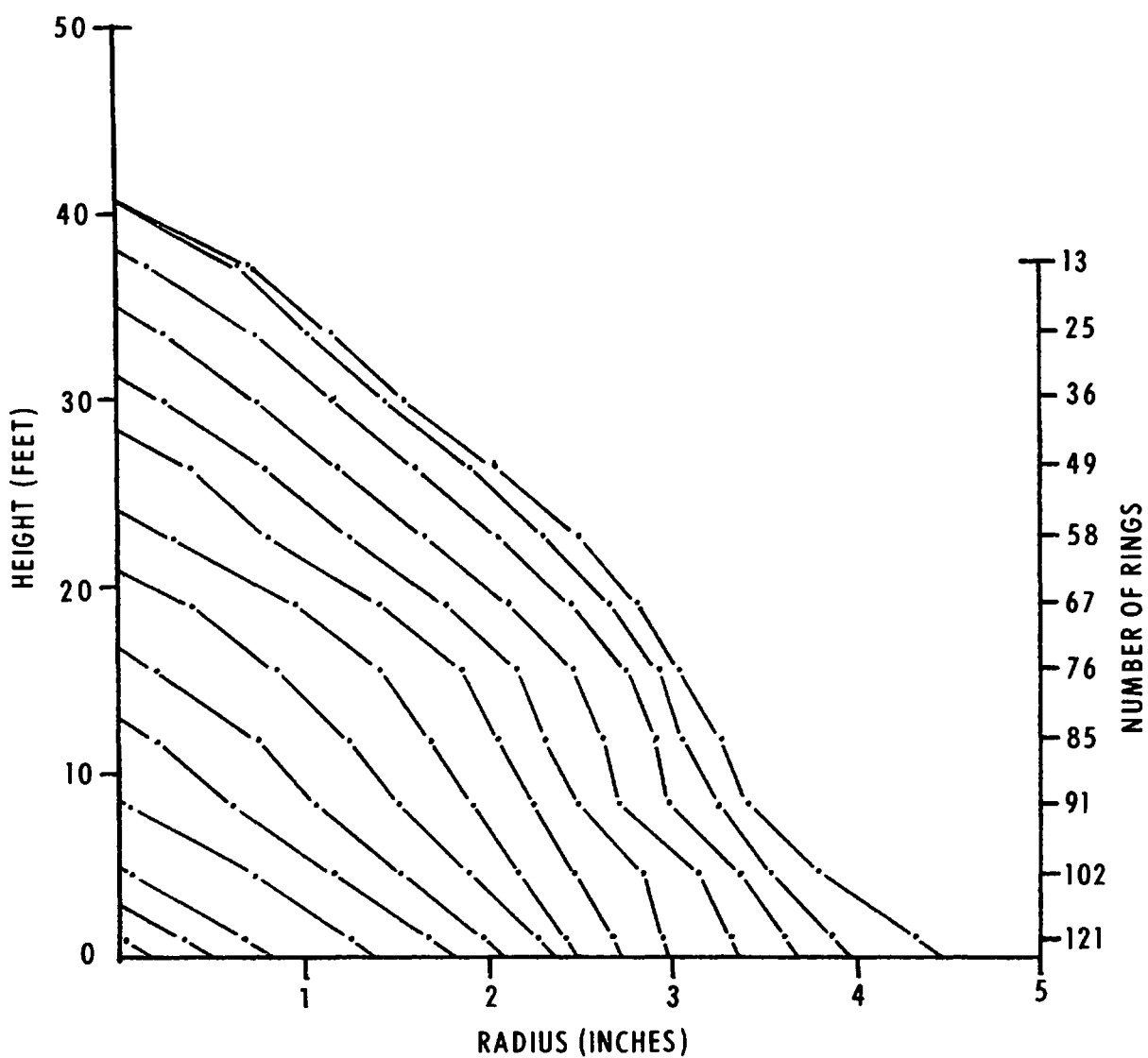


FIG. 42 STEM ANALYSIS DIAGRAM

RUBUS-BALSAM FIR FOREST TYPE

AGE 86-100

WHITE SPRUCE

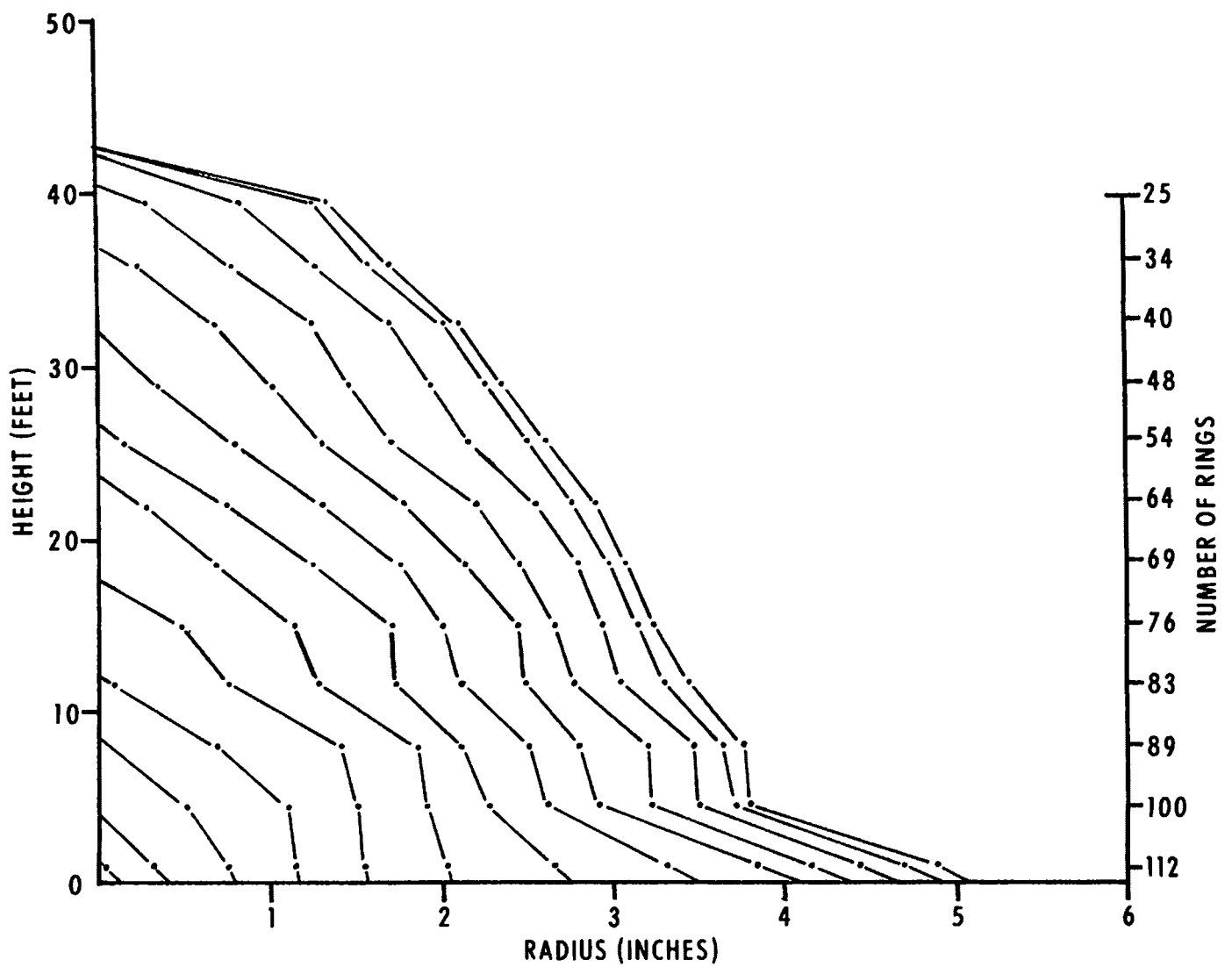


FIG. 43 STEM ANALYSIS DIAGRAM
RUBUS-BALSAM FIR FOREST TYPE

AGE 101 +

BALSAM FIR

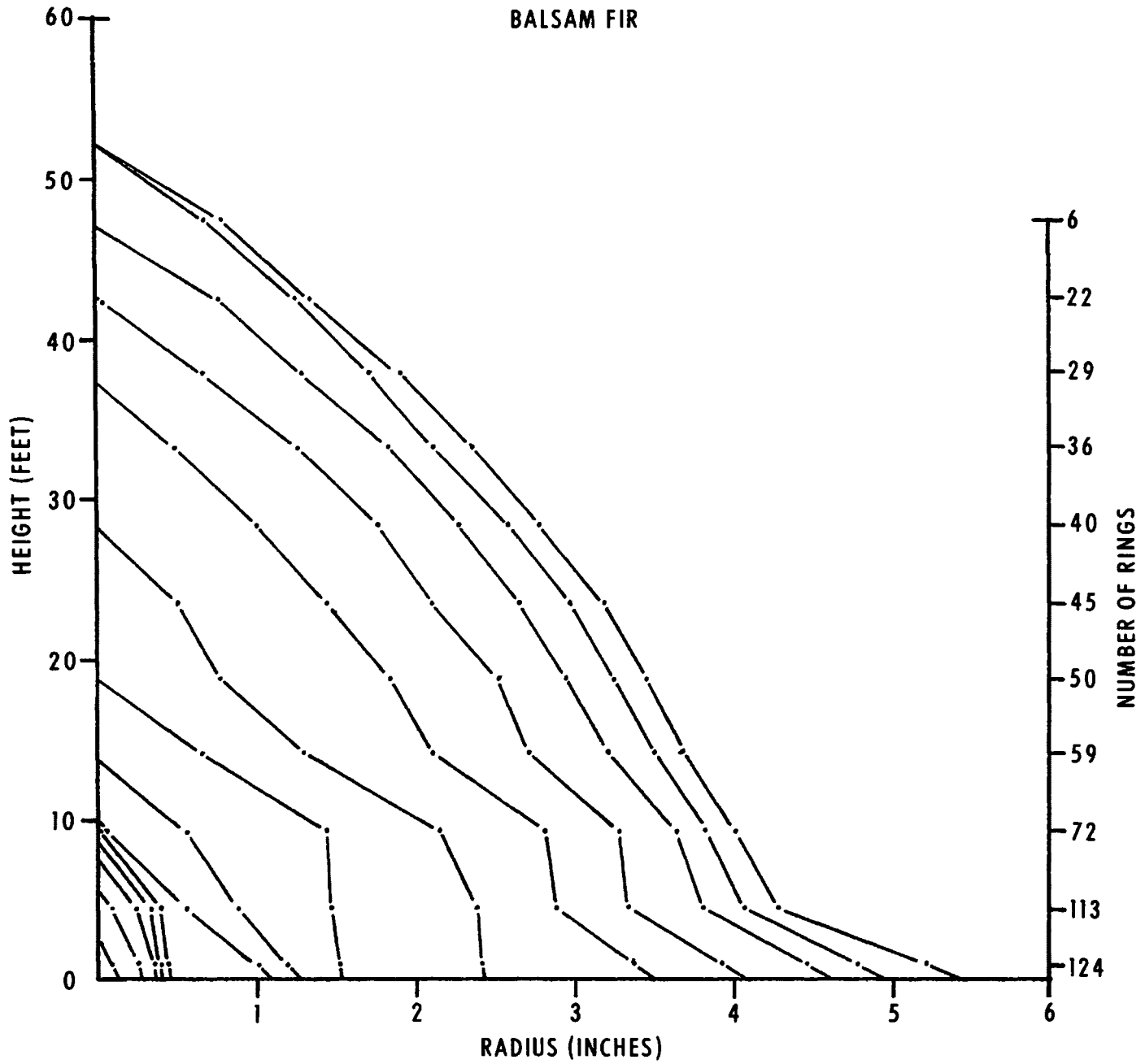


Table 30

STEM ANALYSIS DATA TABLE

RUBUS-BALSAM FIR FOREST TYPE

Age Class: 86-100 Years

	Balsam Fir (Fig. 41)	White Spruce (Fig. 42)
Age at breast height (years)	102	100
Diameter breast height (inches)	7.56	7.60
Total height (feet)	40.7	42.7
Total volume (cu. ft.)	5.60	7.61
Merchantable volume (cu. ft.)	5.06	7.20
Total volume increment by decades: -		
1960 - 1950	.850	1.640
1950 - 1940	1.040	1.276
1940 - 1930	.860	1.144
1930 - 1920	.760	1.036
1920 - 1910	.640	.901
1910 - 1900	.500	.666
1900 - 1890	.410	.481
1890 - 1880	.240	.292
1880 - 1870	.170	.138
1870 - 1860	.100	.036
1860 - 1850	.030	.004
Merchantable volume increment: -		
1960 - 1950	0.790	1.130

Table 31

STEM ANALYSIS DATA TABLE

RUBUS-BALSAM FIR FOREST TYPE

Age Class: 101 +

	Balsam Fir (Fig. 43)
Age at breast height (years)	113
Diameter breast height (inches)	8.56
Total height (feet)	52.2
Total volume (cu. ft.)	9.30
Merchantable volume (cu. ft.)	8.62
Total volume increment by decades:	
1960 - 1950	1.660
1950 - 1940	2.270
1940 - 1930	2.040
1930 - 1920	1.780
1920 - 1910	1.010
1910 - 1900	.430
1900 - 1890	.090
1890 - 1880	.020
Merchantable volume increment:	
1960 - 1950	1.590

Pleurozium-Balsam Fir Forest Type on Orthic Podzols

Description

These forests are usually well-stocked, consisting mainly of balsam fir or balsam fir and black spruce. Scattered white birch are also present.

Shrubs are absent or very sparse. Gaultheria hispidula is often abundant, but the herb layer as a whole is poorly developed and common forest plants such as Maianthemum canadense, Linnaea borealis, Cornus canadensis, and Clintonia borealis are sparse. There is a thick moss carpet dominated by Pleurozium schreberi, with Hylocomium splendens as a sub-dominant species.

This forest type is normally restricted to drier slopes and hill tops covered with deep, non-calcareous till layers. Soils are usually sandy loams with an orthic podzol profile and humus enrichment in the B₂ horizon. Mottling occurs occasionally in the lower part of the profile.

Mensurational Characteristics

Height/diameter curves for balsam fir and black spruce are very similar up to a diameter of about 9 inches (Figs. 44 and 45). A six-inch diameter corresponds to a height of 30 feet for both species, but at 10 inches diameter balsam fir has a height of 43 feet and black spruce a height of 41 feet. At 12 inches diameter the difference is more marked with fir achieving a height of 47 feet and spruce a height of 43 feet. Height/age curves (Figs. 46 and 47) reveal a comparable type of development, with fir showing more rapid height growth than black spruce throughout the rotation. At 50 years, balsam fir achieves a height of 22 feet and black spruce a height of 20 feet. At 100 years, fir reaches 36 feet and spruce 33 feet.

Merchantable softwood volume averages 1,497 cubic feet per acre (Table 32). There are an average of 1,088 stems per acre and a basal area of 120 square feet per acre (Table 33).

Balsam fir forms 69% of the stand by number of stems, and black spruce contributes an additional 27% (Fig. 48). In terms of basal area, the proportions are 76% for fir and 19% for black spruce.

Stem analysis diagrams (Figs. 49 and 50) and tabular data (Table 34) show more rapid increment for balsam fir compared to black spruce.

All sample quadrats were stocked with regeneration (Table 35), and the number of young softwood stems per acre averaged 14,000 (Table 36).

FIG. 44 HEIGHT/DIAMETER CURVE
PLEUROZIUM-BALSAM FIR FOREST TYPE
BALSAM FIR

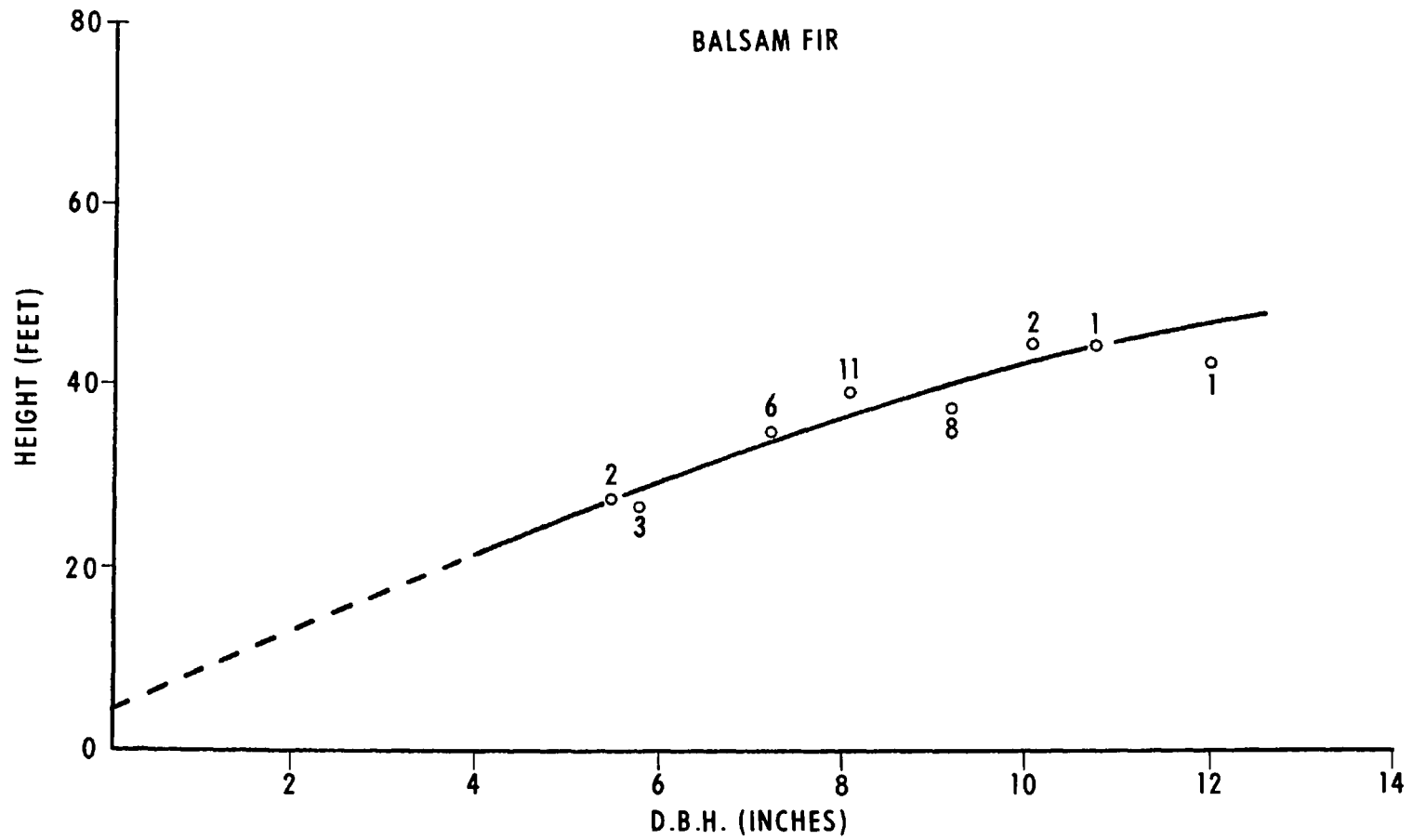


FIG. 45 HEIGHT/DIAMETER CURVE
PLEUROZIUM-BALSAM FIR FOREST TYPE
BLACK SPRUCE

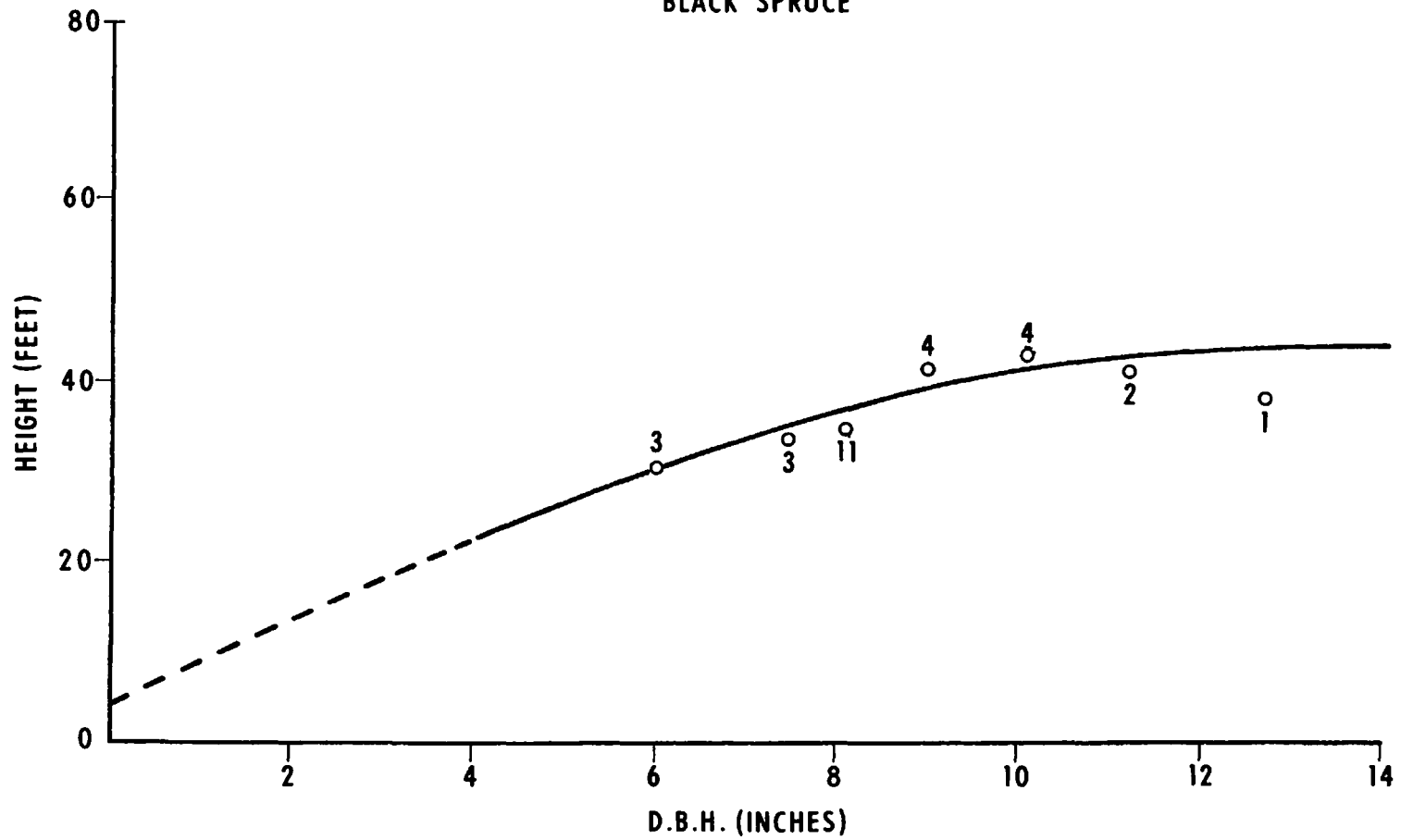


FIG. 46 HEIGHT/AGE CURVE
PLEUROZIUM-BALSAM FIR FOREST TYPE
AGE CLASS: 101 +
BALSAM FIR

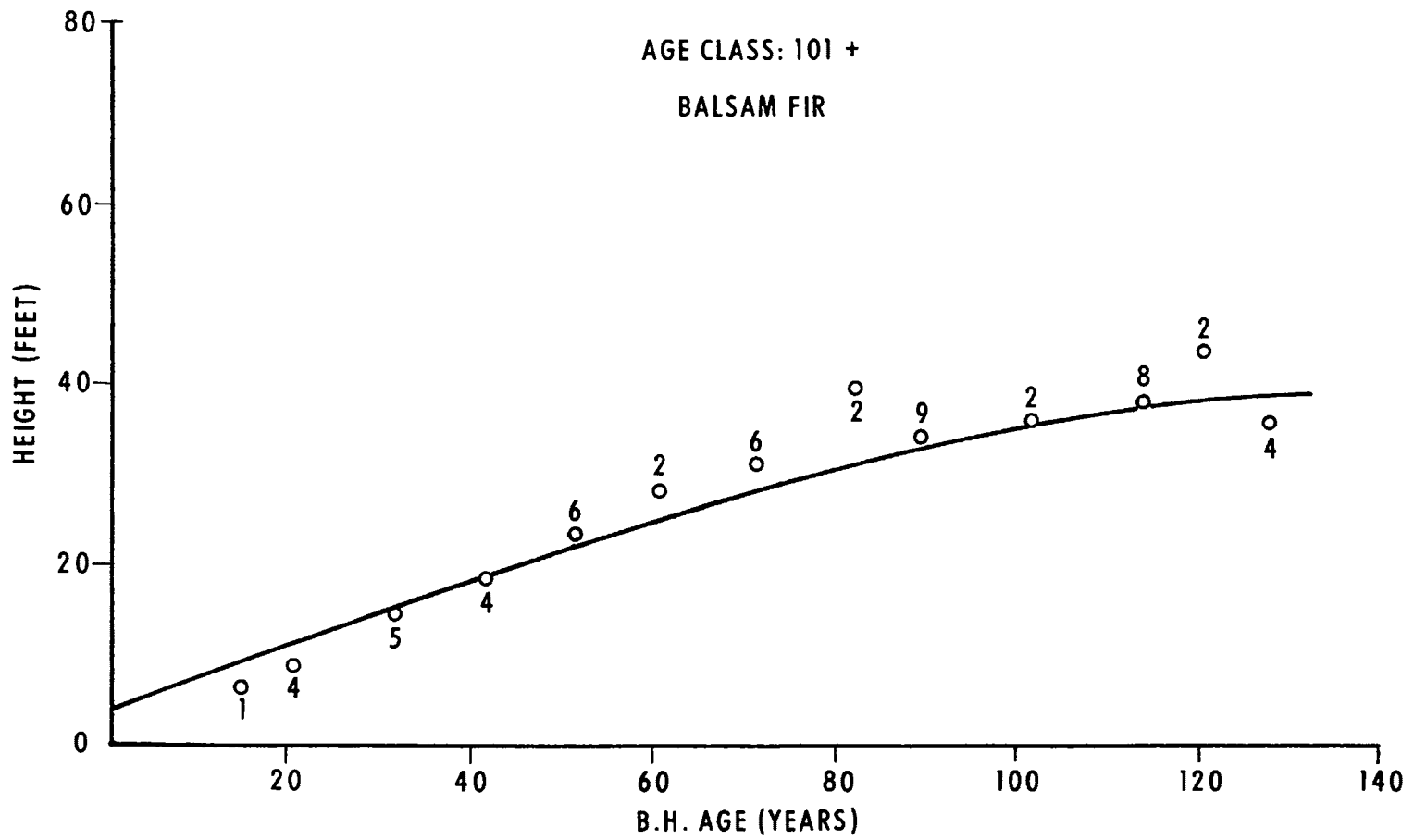


FIG. 47 HEIGHT/AGE CURVE
PLEUROZIUM-BALSAM FIR FOREST TYPE

AGE CLASS: 101 +
BLACK SPRUCE

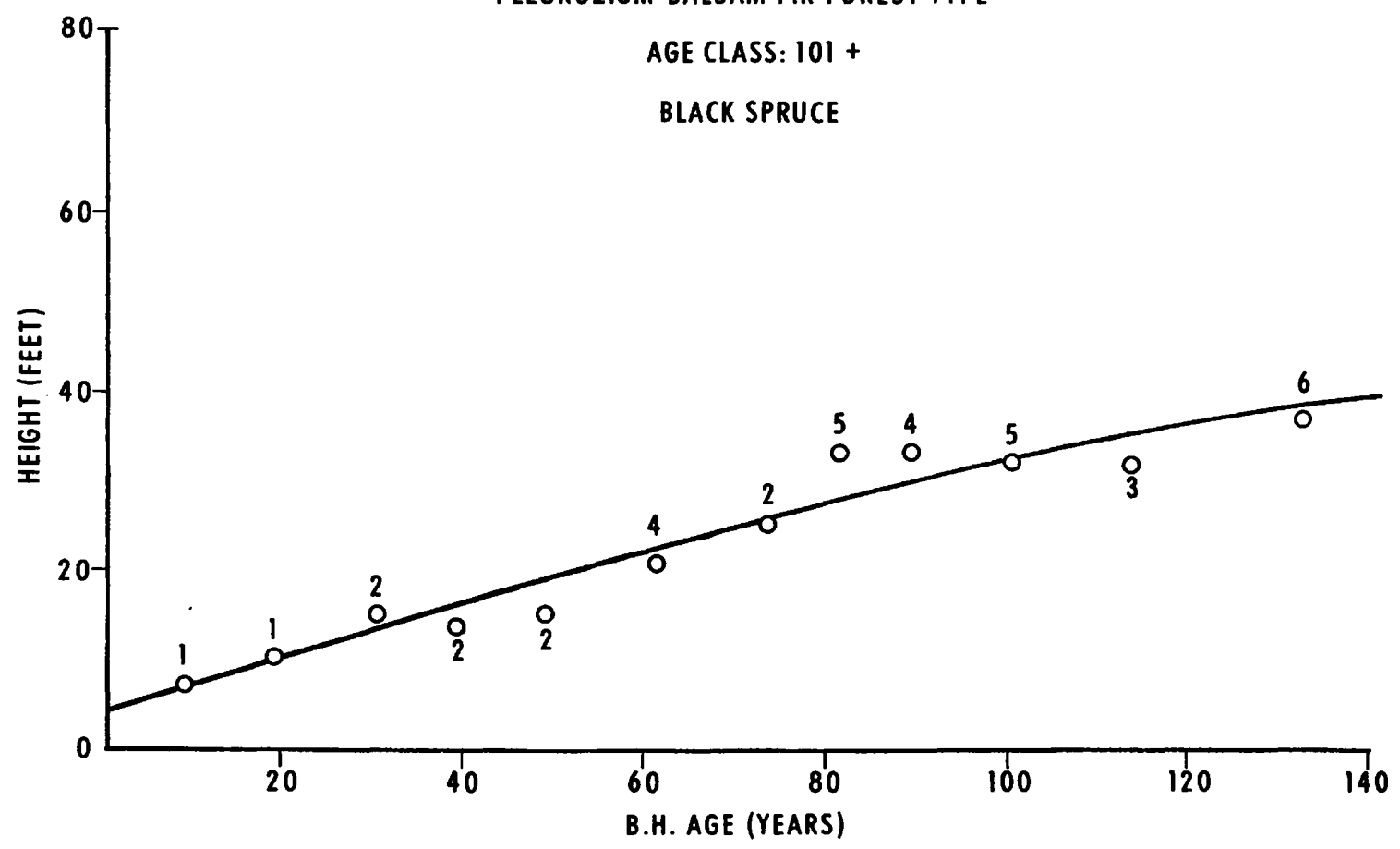


Table 32

LOCAL FORM CLASS MERCHANTABILITY VOLUME TABLES AND
STOCK TABLES

PLEUROZIUM-BALSAM FIR FOREST TYPE

Age: 101 Years +

SPECIES		BALSAM FIR		BLACK SPRUCE			WHITE SPRUCE		
FORM CLASS		65		70			65		
D.b.h.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	Merch. Vol.	Ht.	Merch. Vol.*	M. Vol.
(Inches)	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre	Ft.	Per Tree	Per Acre
		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.		Cu. Ft.	Cu. Ft.
4	20	1.0	52.8	24	0.8	14.8	20	0.8	1.1
5	24	1.7	68.0	27	1.5	15.0	-	-	-
6	28	2.7	98.2	30	2.4	37.6	28	2.4	3.4
7	32	3.9	127.9	33	3.7	50.3	-	-	-
8	35	5.4	258.1	35	5.3	45.6	-	-	-
9	38	7.3	229.2	38	7.4	68.0	-	-	-
10	41	9.6	122.8	40	9.7	68.8	-	-	-
11	43	12.1	77.4	41	12.2	34.2	-	-	-
12	45	14.9	53.6	43	15.2	21.2	-	-	-
13	47	17.5	49.0	-	-	-	-	-	-
Total			1,137.0			355.5			4.5

*Stump height one foot: Top diameter outside bark three inches.

Table 33

STAND TABLE AND BASAL AREA PER ACRE BY SPECIES

PLEUROZIUM-BALSAM FIR FOREST TYPE

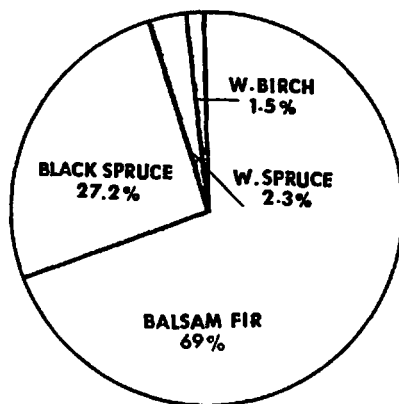
Age: 101 Years +

Number of Plots: 17

D.b.h. Classes	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE			WHITE BIRCH			T O T A L		
	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area	No. of Trees		Basal Area
	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*	Living	Dead	Sq.Ft.*
1	193.5	10.0	0.97	125.2	..	0.62	7.0	..	0.04	1.2	..	0.01	326.9	10.0	1.64
2	149.4	17.6	3.29	66.4	1.2	1.46	5.2	1.2	0.11	..	..	..	221.0	20.0	4.86
3	85.9	28.2	4.21	29.4	1.2	1.44	1.2	0.6	0.06	1.2	..	0.06	117.7	30.0	5.77
4	63.5	14.7	5.52	16.4	0.6	1.42	1.8	..	0.24	1.2	0.6	0.10	82.9	15.9	7.20
5	55.3	14.7	7.52	9.4	2.4	1.28	1.8	..	0.47	..	0.6	..	66.5	17.7	9.04
6	56.4	14.1	11.05	12.9	2.4	2.52	2.4	..	0.64	1.8	..	0.35	73.5	16.5	14.39
7	42.4	8.8	11.32	11.2	2.4	2.99	2.4	0.6	0.62	2.4	1.2	0.64	58.4	13.0	15.59
8	50.6	10.6	17.66	8.2	1.2	2.86	1.8	0.6	0.53	4.1	1.8	0.43	64.7	14.2	21.57
9	31.8	5.2	14.06	8.8	0.6	3.89	1.2	..	..	1.2	..	0.53	43.0	5.8	19.01
10	11.2	5.8	6.10	5.8	..	3.16	..	..	..	0.6	..	0.32	17.6	5.8	9.58
11	7.0	7.0	4.62	2.4	0.6	1.58	..	0.6	..	0.6	..	0.40	10.0	8.2	6.60
12	2.9	1.8	2.28	..	..	..	..	..	..	0.6	..	0.48	3.5	1.8	2.76
13	2.4	..	2.21	..	..	..	..	0.6	..	..	..	..	2.4	0.6	2.21
14	..	..	..	..	..	..	..	0.6	..	..	..	..	..	0.6	..
Total	752.3	138.5	90.81	296.1	12.6	23.22	24.8	4.8	2.87	14.9	4.2	3.32	1,088.1	160.1	120.22

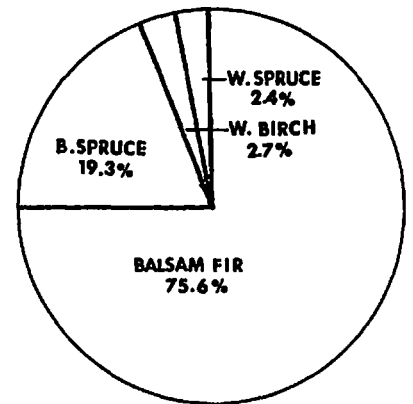
*Living trees

FIG.48 STAND TABLE DIAGRAMS: PLEUROZIUM-BALSAM FIR FOREST TYPE



NUMBER OF STEMS

AGE 101 +



BASAL AREA

FIG. 49 STEM ANALYSIS DIAGRAM
 PLEUROZIUM-BALSAM FIR FOREST TYPE
 AGE 101 +
 BALSAM FIR

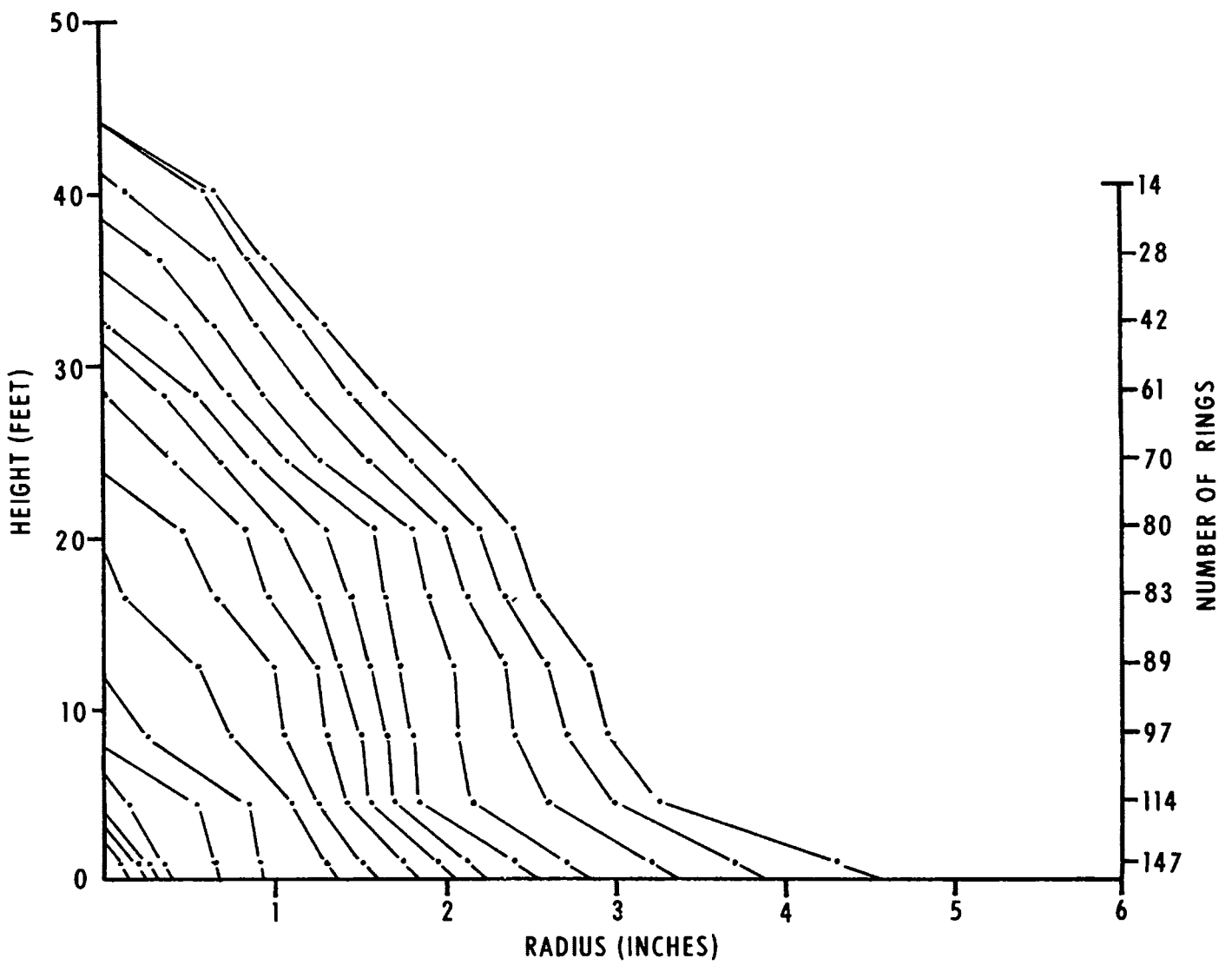


FIG. 50 STEM ANALYSIS DIAGRAM
PLEUROZIUM-BALSAM FIR FOREST TYPE
AGE 101 +
BLACK SPRUCE

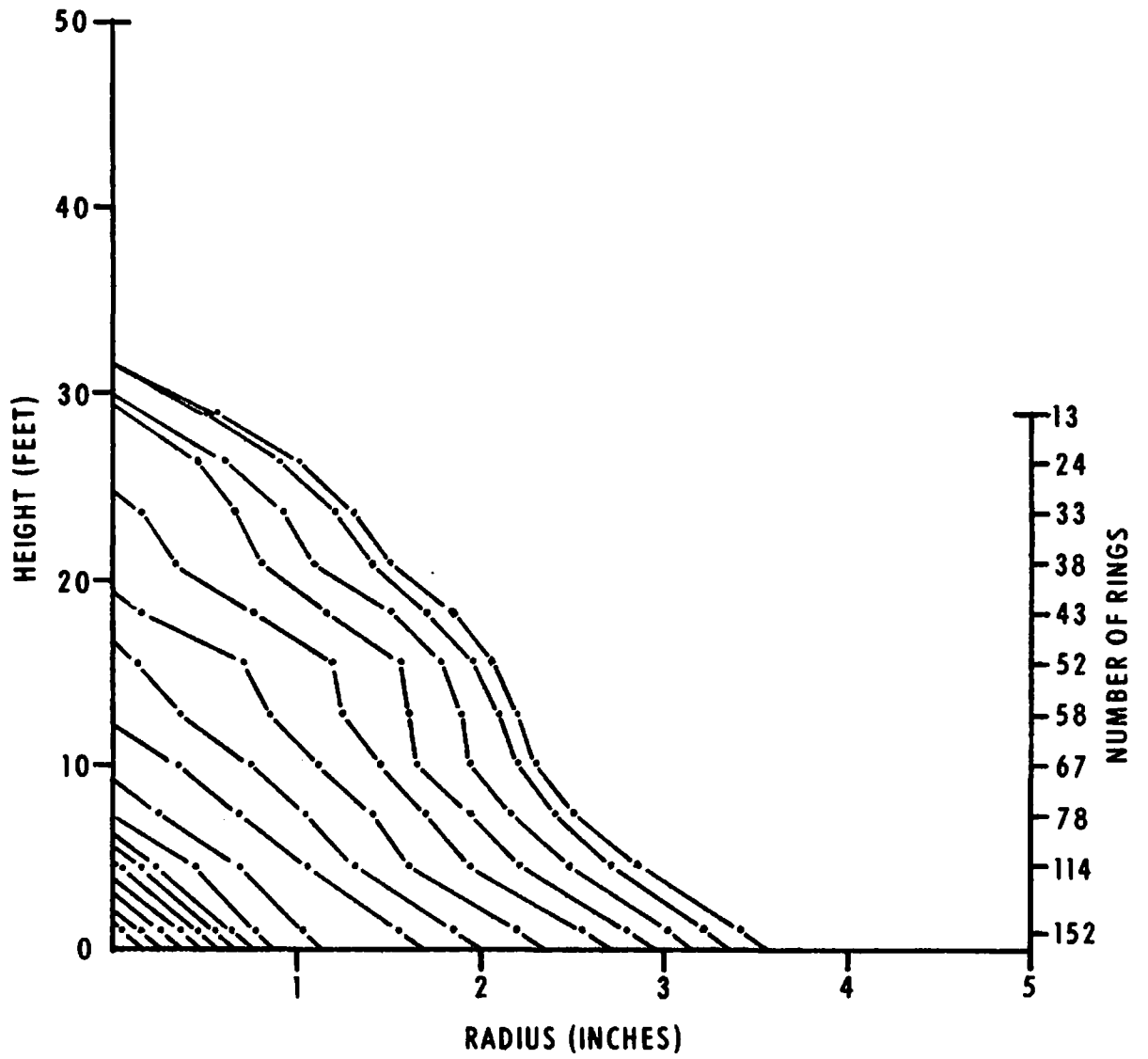


Table 34

STEM ANALYSIS DATA TABLE

PLEUROZIUM-BALSAM FIR FOREST TYPE

Age Class: 101+ Years

	Balsam Fir (Fig. 49)	Black Spruce (Fig. 50)
Age at breast height (years)	114	114
Diameter breast height (inches)	6.50	5.70
Total height (feet)	44.1	31.6
Total volume (cu. ft.)	4.33	2.65
Merchantable volume (cu. ft.)	3.82	2.29
Total volume increment by decades: -		
1960 - 1950	1.011	.529
1950 - 1940	1.027	.503
1940 - 1930	.562	.485
1930 - 1920	.407	.415
1920 - 1910	.312	.299
1910 - 1900	.293	.131
1900 - 1890	.247	.124
1890 - 1880	.241	.037
1880 - 1870	.154	.019
1870 - 1960	.060	.008
1860 - 1850	.016	.006
1850 - 1840	.003	.004
1840 - 1830	-	.005
1830 - 1820	-	.002
1820 - 1810	-	.001
Merchantable volume increment: -		
1960 - 1950	0.860	0.520

Table 35

STOCKING OF REGENERATION BY INDIVIDUAL FOREST TYPES

(all age classes)

Species	Stocking (percent of sample quadrats)				
	Taxus-bF forest	Dryopteris-bF forest	Dryopteris-Hylocomium-bF forest	Rubus-bF forest	Pleurozium-bF forest
bF	61.2	51.3	60.0	50.0	10.0
bS	0.6	-	-	-	-
wB	-	1.9	-	-	-
bF & wB	10.0	22.5	14.7	25.0	-
bF & wS	10.6	7.5	12.1	10.0	-
bF & bS	8.2	0.6	4.3	-	80.0
bF, wB, & wS	8.8	11.2	6.0	2.5	-
bF, wB, & bS	0.6	-	0.8	-	10.0
bF, wS, & bS	-	-	0.4	-	-
bF, wB, wS, & bS	-	0.6	0.4	-	-
Total stocked	100.0	95.6	98.7	87.5	100.0
Unstocked	-	4.4	1.3	12.5	-

DISCUSSION

All stands sampled during this study were at or approaching maturity, and in most cases the age ranges of the samples were the same in each forest type. Valid comparisons can therefore be made between all the types that were sampled.

Merchantable volume figures (Table 37 and Figure 51) show the *Taxus-balsam* fir forest type to be the most productive, containing over 3,000 cubic feet per acre at maturity. The *Pleurozium-balsam* fir type is the least productive, with approximately 1,500 cubic feet per acre. The *Dryopteris-balsam* fir, *Dryopteris-Hylocomium-balsam* fir, and *Rubus-balsam* fir types contain similar merchantable volumes of between 2,236 and 2,645 cubic feet per acre.

In general, the forests of northern Newfoundland are less productive than those in western Newfoundland because of the more severe climatic conditions under which they are growing. The *Dryopteris-balsam* fir and *Dryopteris-Hylocomium-balsam* fir types contain average merchantable volumes of 2,400 and 2,500 cubic feet per acre in northern Newfoundland and 3,300 and 3,000 cubic feet per acre in western Newfoundland (Bajzak, Bouzane, and Page, 1968). However, the *Taxus-balsam* fir type is much more productive in northern Newfoundland than in western Newfoundland, where it was the poorest of the types sampled and contained an average merchantable volume of 1,650 cubic feet per acre. This type occurs on deep, well-drained limestone tills in northern Newfoundland, but on shallow, limestone pseudogleysols in western Newfoundland. These differences in soil conditions are believed to account for the marked difference in productivity between the two regions.

The volume figures also show, in every forest type where the comparison can be made, that the 86-100 year-old age class has a greater mean merchantable volume than the 101+ age class. This suggests that, although over-maturity could not be detected visually, some degree of decadence has already taken effect in stands of over 100 years of age.

The above ranking of the forest types in relation to productivity is in agreement with the ranking of the mean annual increment figures given in Table 37. The increment figures for the *Taxus-balsam* fir type also show that the maximum mean annual increment for that type is reached at a breast height age of not more than 65 years, and possibly sooner. The other, less productive, types probably take longer than the *Taxus-balsam* fir type to reach their maximum mean annual increments. However, crops of more than 86 years of age have probably passed their maxima in all forest types.

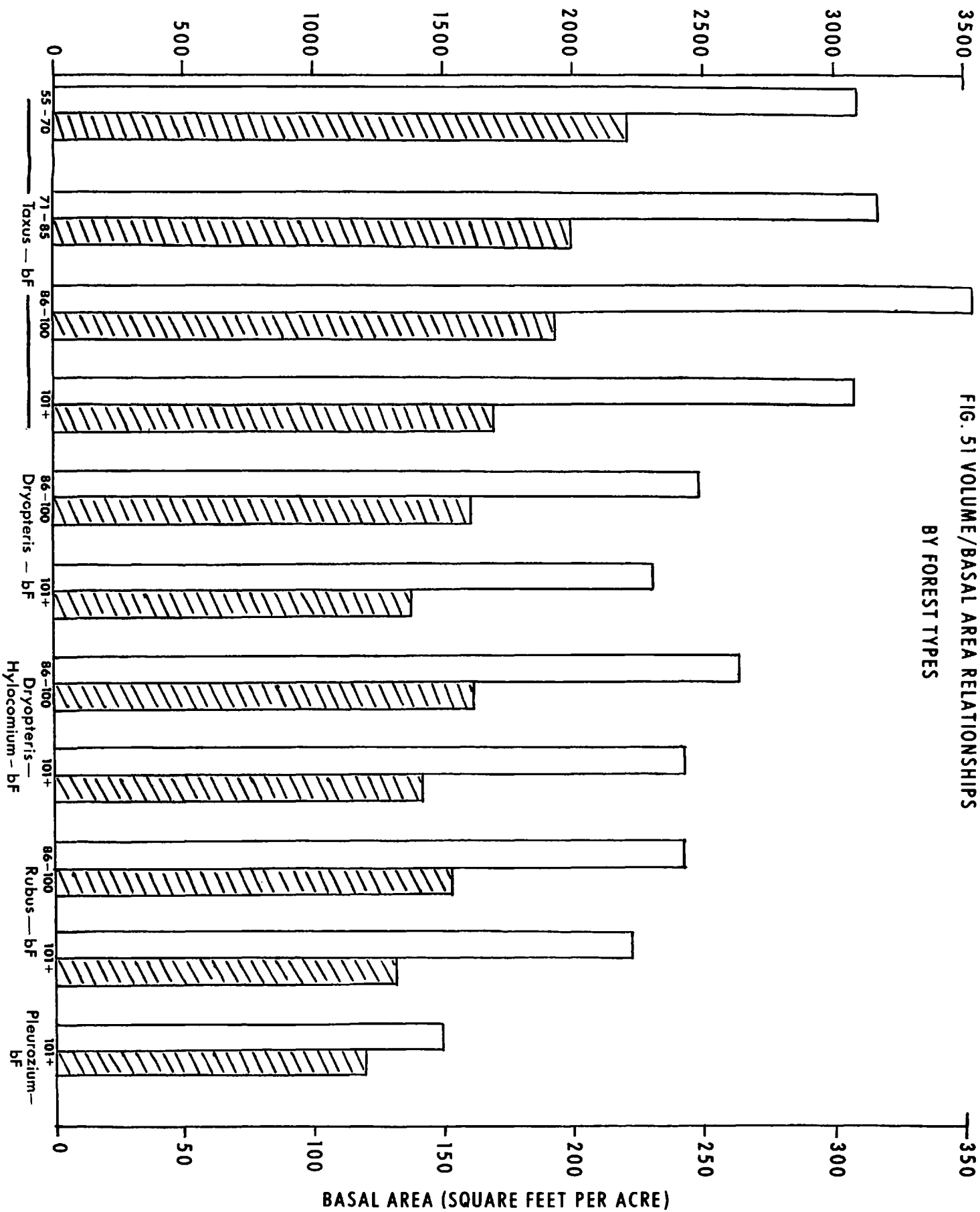
Table 37

VOLUME INCREMENT PER ACRE BY INDIVIDUAL FOREST TYPES

Forest Type	Age Class	Average breast height age of sample plots	Total merch. volume (cu. ft.) - 1961	Mean annual increment (cu. ft.) based on breast height age	Mean annual increment (cu. ft.) based on breast height age + 15 years*
Taxus-bF type	55-70	62.33	3094.9	49.65	40.02
Taxus-bF type	71-85	77.42	3166.6	40.90	34.26
Taxus-bF type	86-100	92.33	3529.8	38.23	32.89
Taxus-bF type	101+	110.70	3084.6	27.86	24.54
Dryopteris-bF type	86-100	93.40	2496.0	26.72	23.03
Dryopteris-bF type	101+	116.27	2307.2	19.84	17.58
Dryopteris-Hylocomium-bF type	86-100	93.00	2645.8	28.45	24.50
Dryopteris-Hylocomium-bF type	101+	113.83	2438.3	21.42	18.93
Rubus-bF type	86-100	93.86	2435.3	25.95	22.37
Rubus-bF type	101+	113.77	2236.3	19.66	17.37
Pleurozium-bF type	101+	118.82	1497.0	12.60	11.19

*.....Examination of stem analyses and previous experience in northern Newfoundland has shown that an average of 15 years is required for the softwood species in most merchantable forest types to reach breast height.

MERCHANTABLE SOFTWOOD VOLUME (CUBIC FEET PER ACRE)



Basal area (Figure 52) ranges from an average of 220.63 square feet per acre in the *Taxus*-balsam fir forest type (55-70 age class) to an average of 120.22 square feet per acre in the *Pleurozium*-balsam fir type (101+ age class). The *Dryopteris*-balsam fir, *Dryopteris*-*Hylocomium*-balsam fir, and *Rubus*-balsam fir types have average basal areas between 161.65 and 131.11 square feet per acre. In all the forest types the older age classes have lower basal areas and a lesser number of stems per acre than the younger age classes.

Height/diameter relationships are similar for the *Dryopteris*-balsam fir, *Dryopteris*-*Hylocomium*-balsam fir, and *Rubus*-balsam fir types. In comparison, the *Taxus*-balsam fir type shows relatively greater heights corresponding to given diameters, while the *Pleurozium*-balsam fir type has lesser heights corresponding to the same diameters. Similar relationships between the types can be observed in terms of the height/age curves, with the *Taxus*-balsam fir type showing the most rapid height growth, especially in the younger age classes, and the *Pleurozium*-balsam fir type showing the slowest height growth.

Considerable similarity in shape was noted between the balsam fir height/age curves for each of the forest types. Data from all the types have therefore been used to construct a set of standard site-index curves for balsam fir (Figure 53). The normal procedure for constructing site-index curves from height/age data was followed (Bruce and Schumacher, 1950). Agreement between the site-index curves and the height/age curves for individual forest types is reasonably good. Using a reference age of 50 years, the maximum difference between an individual height/age curve and the appropriate site-index curve is approximately 10 feet at 100-120 years of age.

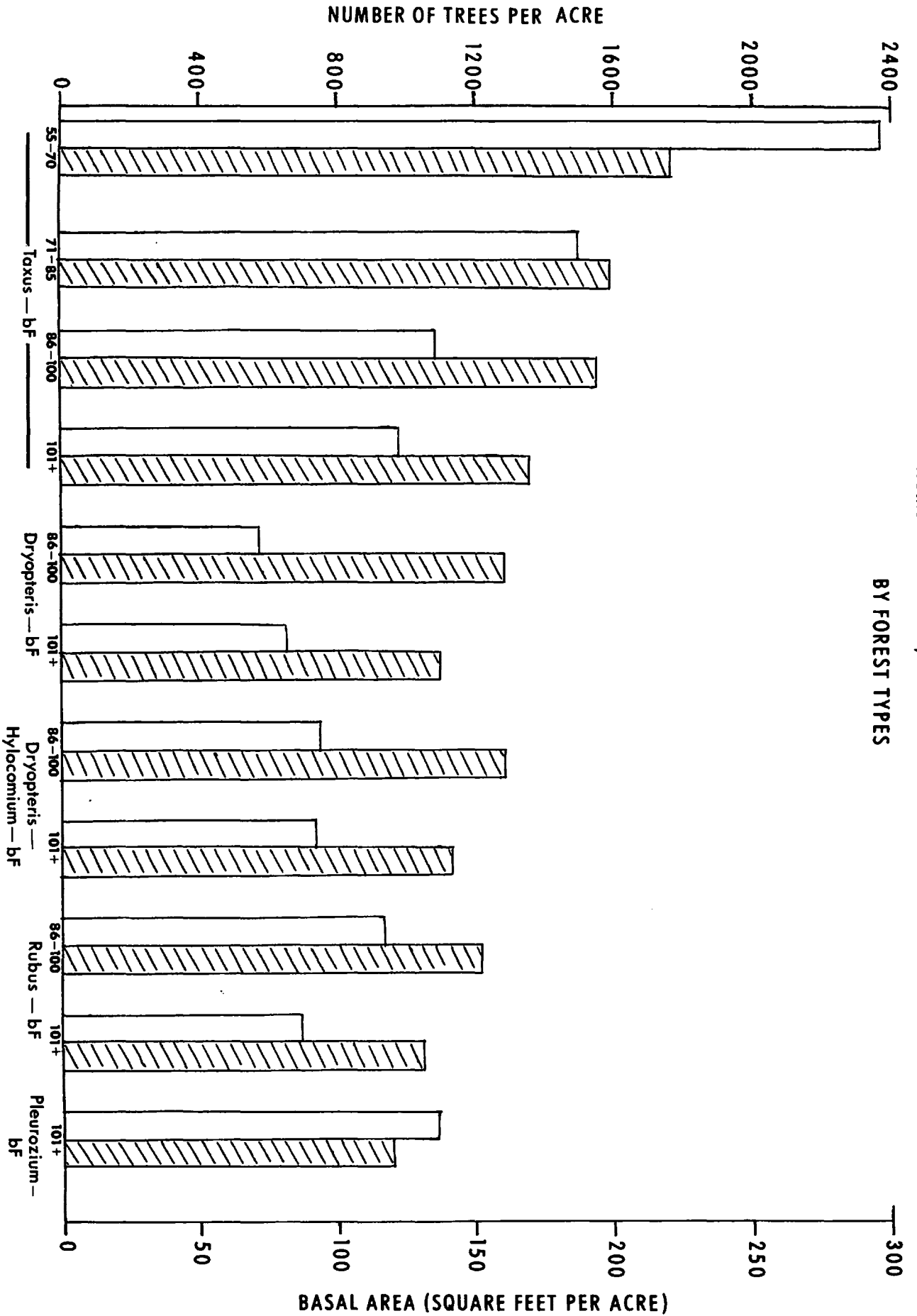
Regeneration is good in all the forest types, and fully-stocked second-growth stands should develop in all cases.

SUMMARY AND CONCLUSIONS

Mensurational data for five of the most important forest types in northern Newfoundland were collected in 1960 and 1961.

On each sample plot a diameter tally was carried out and measurements of height, diameter, and age were taken on selected dominant and co-dominant trees. Additional trees were used to supply stem analysis and form class data.

FIG. 52 NUMBER OF STEMS/BASAL AREA RELATIONSHIPS BY FOREST TYPES



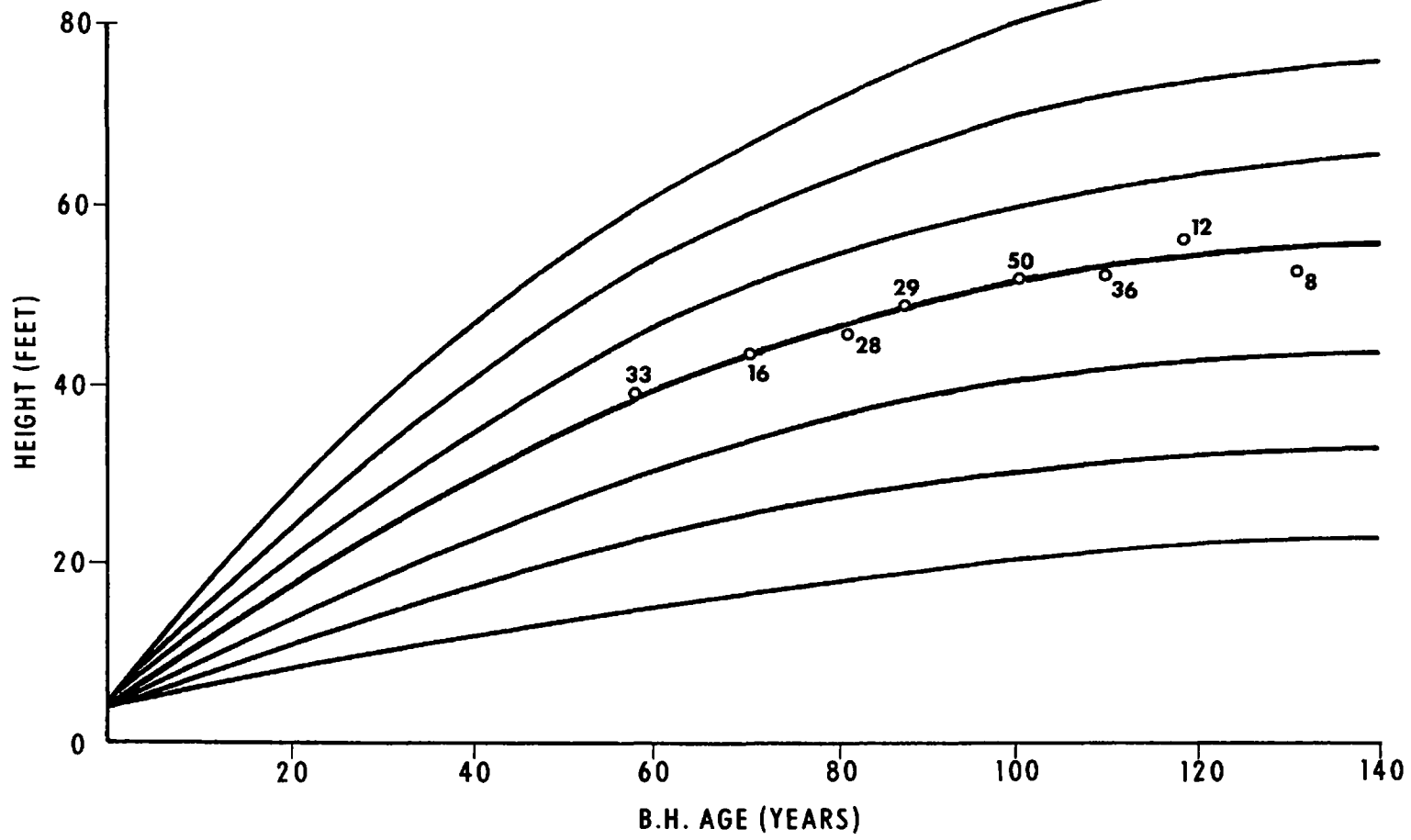


FIG. 53 BALSAM FIR SITE-INDEX CURVES (ALL FOREST TYPES)

Height/diameter and height/age curves, stand and basal area tables, local form class merchantable volume tables, and stock tables have been prepared for each age class of each forest type. Certain selected stem analysis trees have been reconstructed in diagrammatic form.

Conclusions have been drawn from these data as follows:-

- (1) Merchantable volume, volume increment, basal area, height/age, and height/diameter data all indicate that for practical purposes the forest types can be divided into three groups which represent meaningful differences in productivity:
 - (a) Taxus-balsam fir forest type
 - (b) Dryopteris-balsam fir, Dryopteris-Hylocomium-balsam fir, and Rubus-balsam fir forest types.
 - (c) Pleurozium-balsam fir forest type.
- (2) There are small mensurational differences between the three types listed in (b) above, but also a large measure of overlap between them, and differences are not considered to be of significance for practical purposes.
- (3) In all forest types for which data are available, the 86-100 year-old age class contained a greater merchantable volume and greater basal area than the 101+ age class. This is considered to be an indication of the onset of decadence amongst crops over 100 years of age at breast height. Stands should therefore be harvested before reaching an age of 100 years in order to avoid volume losses (and probably also a greater incidence of cull and decay).
- (4) Maximum mean annual increment is attained in the Taxus-balsam fir type at a breast height age of not more than 65 years. The optimum pulpwood rotation in this type is therefore not more than 80 years (allowing 15 years for the attainment of breast height), and is probably somewhat less. The age of attainment of maximum mean annual increment in the other types cannot be determined from the available data; it is, however, less than 90 years at breast height.

- (5) Individual height/age curves for balsam fir in each of the forest types correspond reasonably well to one another and to the series of site-index curves constructed from data for all the forest types. The greatest differences between the two types of curves occur at ages in excess of 100 years.
- (6) Regeneration is good in all the forest types and fully stocked second-rotation crops should develop in all cases.
- (7) The *Taxus*-balsam fir forest type is more productive in northern Newfoundland than in western Newfoundland, while the *Dryopteris*-balsam fir and *Dryopteris*-*Hylocomium*-balsam fir types are less productive than in western Newfoundland.
- (8) Stem analysis data show that in most forest types individual white spruce trees grow more rapidly in volume than do balsam fir trees of comparable age. However, in all the forest types sampled, balsam fir forms the major part of the merchantable volume on a per acre basis.

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