A STUDY OF THE MENSURATIONAL CHARACTERISTICS OF SOME IMPORTANT FOREST TYPES OF WESTERN NEWFOUNDLAND

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and G. Page

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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 of various sections of the island of Newfoundland. An unpublished report has already been prepared for central Newfoundland by Bajzak (1962).

The project was designed and field data were collected by D. Bajzak[1] in 1962. Tables and figures have been prepared by J.P. Bouzane[2], and the text written by G. Page[1] and J.P. Bouzane in consultation with the co-author. The assistance of D. Wells in drawing the figures is acknowledged.

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INTRODUCTION

Four major forest regions have been recognized on the island of Newfoundland by Rowe (1959). Their locations are shown in Fig. 1. These regions have formed the basis for most of the recent descriptive and mensurational studies in Newfoundland. Damman (1964 and 1967) has described and classified forest stands in these regions on the basis of stand characteristics, lesser vegetation, and soil types.

A knowledge of the detailed mensurational characteristics of the forests of Newfoundland is an essential pre-requisite for their management. The group of studies of which this work forms part was set up to provide this necessary mensurational information. Since an accepted delineation of forest regions was available this was used as the basic framework, and independent studies were carried out in each of the four main regions; namely, western, central (Bajzak, 1962), northern (in preparation), and eastern.

Within the western region mensurational data were collected for individual forest types as described by Damman (1967). Only productive forest types were considered in this study, and sampling was confined to stands at or approaching maturity. No stands which were obviously over- or under-stocked were sampled.

It is considered that this approach should provide valuable information concerning the mensurational significance of the forest types while also producing data of immediate value to forest management in the areas concerned. It is later proposed to compare the four forest regions on the basis of their mensurational characteristics.

In this report a brief description is given of the vegetative characteristics, related soil conditions, and the distribution of each forest type under consideration (after Damman, 1967), 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 and periodic 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.

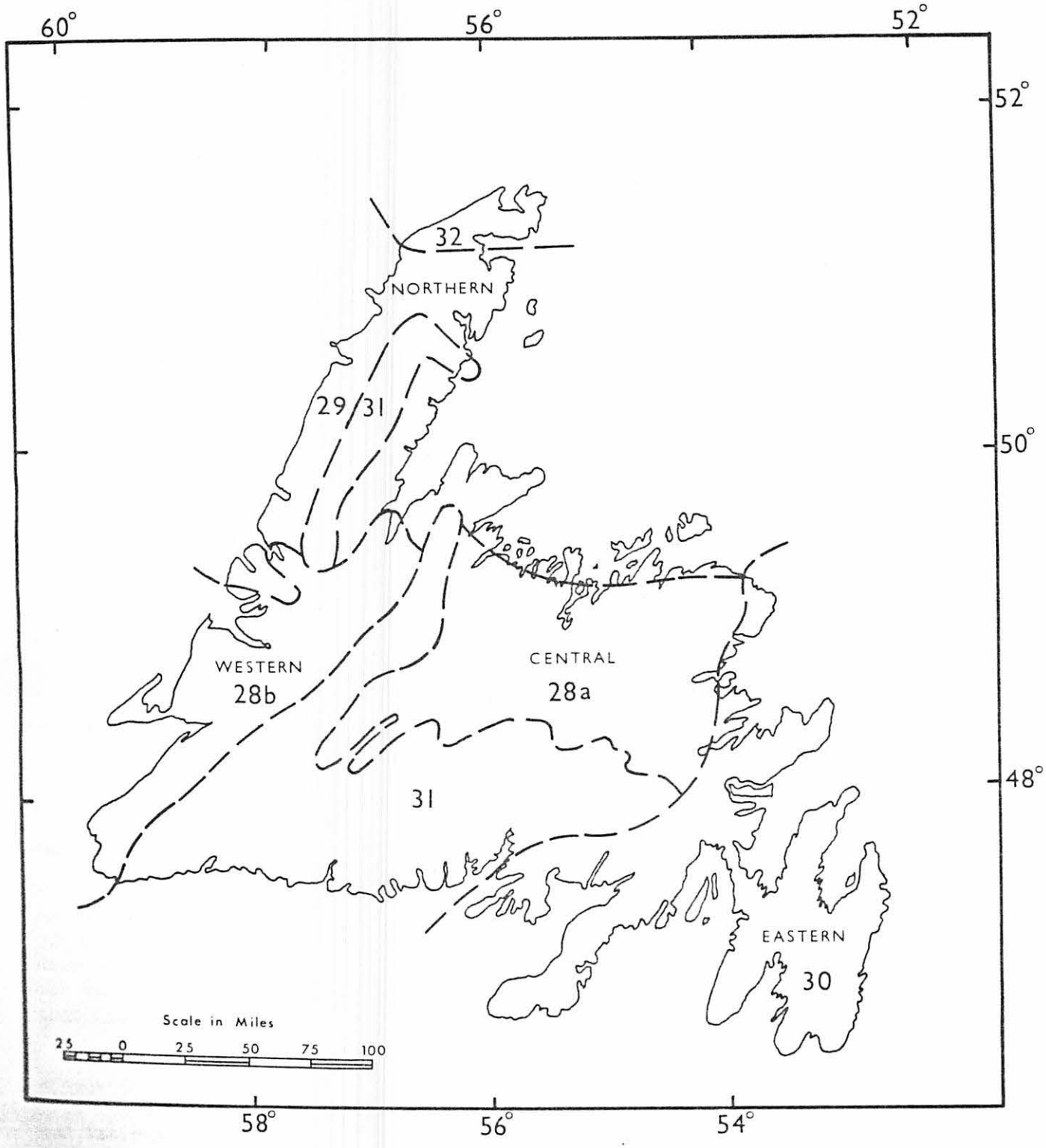


Fig. 1.

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

GENERAL DESCRIPTION OF WESTERN NEWFOUNDLAND

The location of western Newfoundland (Forest Section 28b of the Boreal Forest Region) is shown in Fig. 1. It is an area of varied topography, encompassing the Humber River, Grand Lake, and St. George's Bay lowlands, the western slopes of the Long Range Mountains, and a number of other smaller mountainous areas. It is bounded to the east by the barrens of the southern Long Range Mountains, and to the north and northeast by a transition towards the poorer forests and barren lands of the Northern Peninsula along a line from Bonne Bay to southern White Bay.

Soil and Climatic Conditions

Palaeozoic sedimentary rocks underlie most of the region. Volcanic and plutonic rocks occupy smaller areas but very few rocks of this type occur in the parts of the region that were sampled. Podzol profiles are typical in the mixed glacial drift which covers the bedrock over most of the region.

An average annual precipitation of between 40 and 55 inches has been reported for the region by Hare (1952). This total includes an average snowfall of 100 to 200 inches. The vegetative season (i.e. the date on which mean air temperature rises above 43°F) starts between the 10th and 20th of May and continues for approximately 155 days. Mean air temperatures in January and July average 13° and 61°F respectively, and the annual average of mean daily temperatures is approximately 39°F. Elevation ranges from sea level to more than 2,500 feet, and it is probable that climatic conditions at the higher elevations are more severe than those quoted above.

The Forests

Balsam fir (Abies balsamea (L.) Mill.) is the most abundant and commercially most important species of the region. Its growth is generally good although serious losses in the form of mortality and decreased growth rates have occurred in recent years due to attack by the balsam woolly aphid (Adelges piceae (Ratz.)) and the hemlock looper (Lambdina fiscellaria fiscellaria (Guen.)).

Black spruce (Picea mariana (Mill.) BSP) and white spruce (Picea glauca (Moench) Voss) occur widely throughout the area but are much less abundant than balsam fir. Eastern white pine (Pinus strobus L.) and tamarack (Larix laricina (Du Roi) K. Koch) are also to be found within the region but are of no commercial significance.

White birch (Betula papyrifera Marsh.) and trembling aspen (Populus tremuloides Michx.) are common, especially on some of the more nutrient-rich sites. Yellow birch (Betula alleghaniensis Britt.) is of more

limited distribution, being confined in the western region to an area south of Corner Brook. This forest section is also distinguished from other parts of Newfoundland by a relative abundance of mountain maple (Acer spicatum Lam.). Other hardwoods of scattered but widespread distribution within the region include balsam poplar (Populus balsamifera L.) and mountain ash (Sorbus decora (Sarg.) Schneid., and Sorbus americana Marsh.).

METHODS

Plot Location

Sampling was carried out in the northern and central parts of the region. That part of the region south of latitude 48°30' N. was excluded owing to the high incidence of balsam woolly aphid attack in that area.

Stands which appeared to be at or approaching maturity 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 three chain intervals along those parts of each compass line which passed through suitable stands. In cases where a prospective plot center 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, exact 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 included.

(b) Stem Analyses

Stem analyses were carried out on ten 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 wind-thrown 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 the bark) to be measured at these points.

(c) Regeneration

Data on regeneration were obtained from every second plot of each forest type. On appropriate plots a series of five contiguous milacre quadrats (6.5 feet square) 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:-

Class	Height in Feet
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 4.6 (up to a maximum of 0.5 inches d.b.h.)

A complete count of all regeneration was recorded by individual species on the fifth quadrat. Seedlings of less than two years of age were excluded. The proportion of the regeneration originating from layers or sucker growth was noted.

THE FOREST TYPES OF WESTERN NEWFOUNDLAND

Five of the most important and productive forest types in western Newfoundland were sampled. The number of plots established in each type is listed in Table 1. Plots of the Dryopteris-Rhytidiadelphus-balsam fir forest type covered a much larger age range than did those of any other forest type, and they were therefore divided into two groups (ages 70-85 years, and 86-110 years). These two age groups have been treated as independent units as regards the mensurational data.

A short description (from Damman, 1967) 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) Stem analysis diagrams for individual softwood species
(f) Stem analysis data tables
(g) Stand and basal area diagrams

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.

TABLE 1

NUMBER OF SAMPLES FROM INDIVIDUAL FOREST TYPES

Forest Type	Range of plot average ages (years)	Number of samples
Dryopteris-Rhytidiadelphus-Balsam Fir Forest Type	70-85	7
Dryopteris-Rhytidiadelphus-Balsam Fir Forest Type	86-110	11
Dryopteris-Balsam Fir Forest Type	56-71	14
Hylocomium-Balsam Fir Forest Type	60-75	14
Dryopteris-Hylocomium-Balsam Fir Forest Type	55-67	26
Taxus-Balsam Fir Forest Type (Epigaea Subtype)	93-120	13

Dryopteris-Rhytidiadelphus-Balsam Fir Forest Type

Description

This forest type is composed predominantly of balsam fir together with small amounts of white spruce, black spruce, and white birch.

Dryopteris spinulosa var. americana is abundant but usually covers less than half of the forest floor. Common herbaceous species include Clintonia borealis, Cornus canadensis, Linnaea borealis, Trientalis borealis, and Maianthemum canadense. The well-developed moss layer is dominated by Hylocomium umbratum, Rhytidiadelphus loreus, and Dicranum majus. Shrubs are rare in mature stands, although Vaccinium ovalifolium occurs regularly.

This type is widely distributed in areas where an englacial till layer of mixed petrography (usually over two feet in depth) covers limestone bedrock or highly calcareous basal till. The typical associated soil type is an orthic podzol or, more rarely, a limestone podzol or dry limestone pseudogleysol.

Mensurational Characteristics

Balsam fir and white spruce reach an average breast height diameter of 10 inches, at a height of 60-64 feet in both age groups (Figs. 2, 3, 8, and 9). Height/age curves for white spruce (both age classes) and balsam fir (86 - 110 age class) are very similar in shape (Figs. 5, 10, and 11), reaching an average height of 38 - 40 feet at 50 years and approximately 60 feet at 100 years. The height/age curve for balsam fir aged 70 - 85 years (Fig. 4) reaches 49 feet at 50 years and 62 feet at 80 years.

Total softwood merchantable volume in the 70 - 85 age class was approximately 3,320 cu. ft. per acre (Table 2), while in the 86 - 110 age class this was raised to approximately 4,460 cu. ft. per acre (Table 5). Total number of living trees per acre (all species) averaged 565 for the younger age class and 507 for the older age class (Tables 3 and 6). Corresponding basal area figures are 189 and 193 sq. ft. per acre respectively.

In the older age class balsam fir constitutes an average of 71% of the stands in terms of number of trees per acre and 74% in terms of basal area per acre. The situation is reversed in the younger age class where balsam fir constitutes 83% of the number of stems but only 77% of the basal area (Fig. 14).

Stem analysis diagrams and tabulated data for balsam fir and white spruce for each of the two age classes are given in Figs. 6, 7, 12, and 13, and Tables 4 and 7. For each species the tree from the younger age class has, at all stages during its development, shown more rapid volume

increment than the tree from the older age class, and both balsam fir trees show a maximum rate of volume increment greater than that shown by white spruce.

Regeneration is good (Table 28). In the 70-85 age class 96% of the quadrats were stocked with balsam fir of less than 0.5 feet in height and the remaining 4% carried mixed balsam fir and white spruce of 0.6 - 1.5 feet in height. In the 86-110 year age class 90% of the quadrats were stocked with balsam fir 1.6 - 2.5 feet high and 10% were unstocked.

Fig. 2.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 70-85

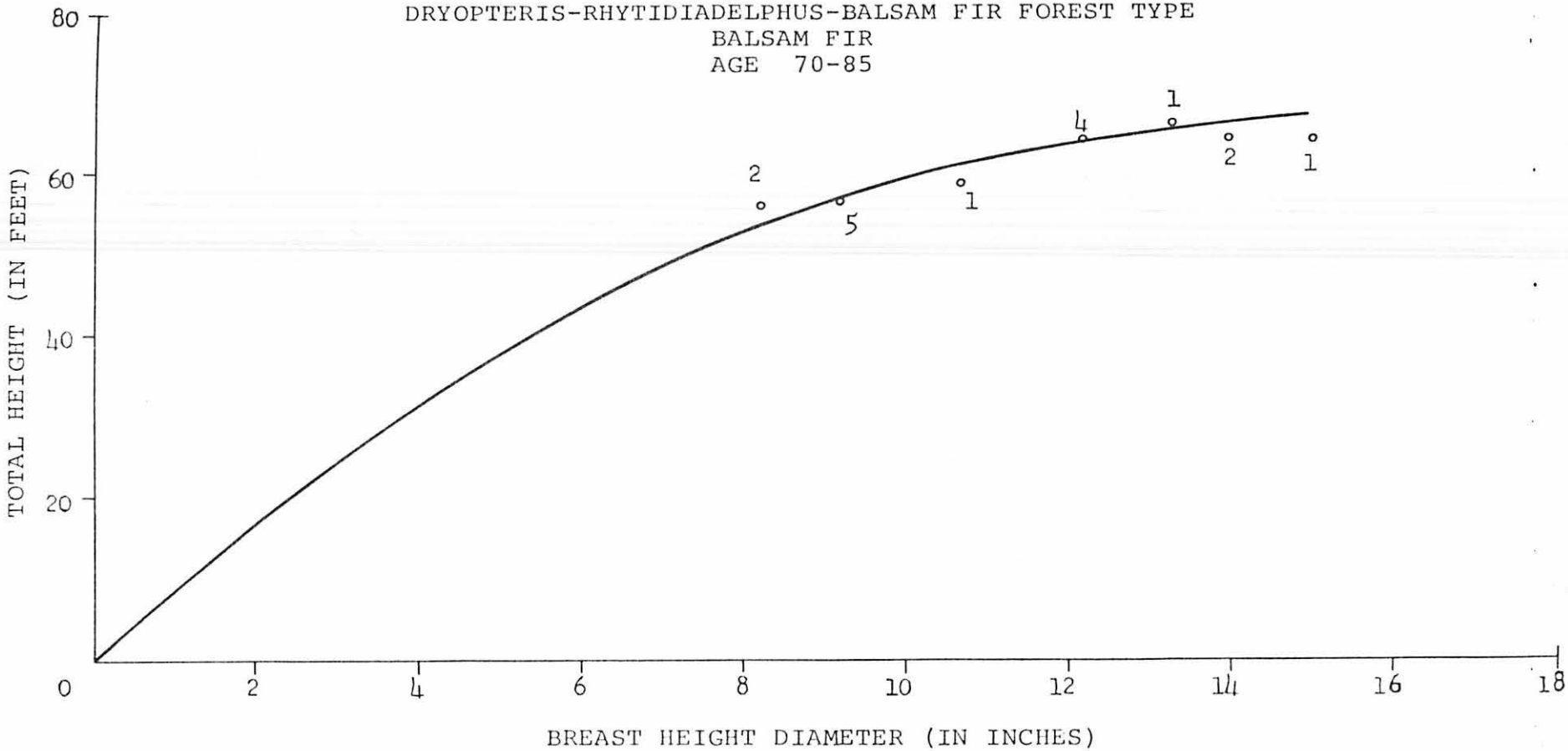


Fig. 3.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 70-85

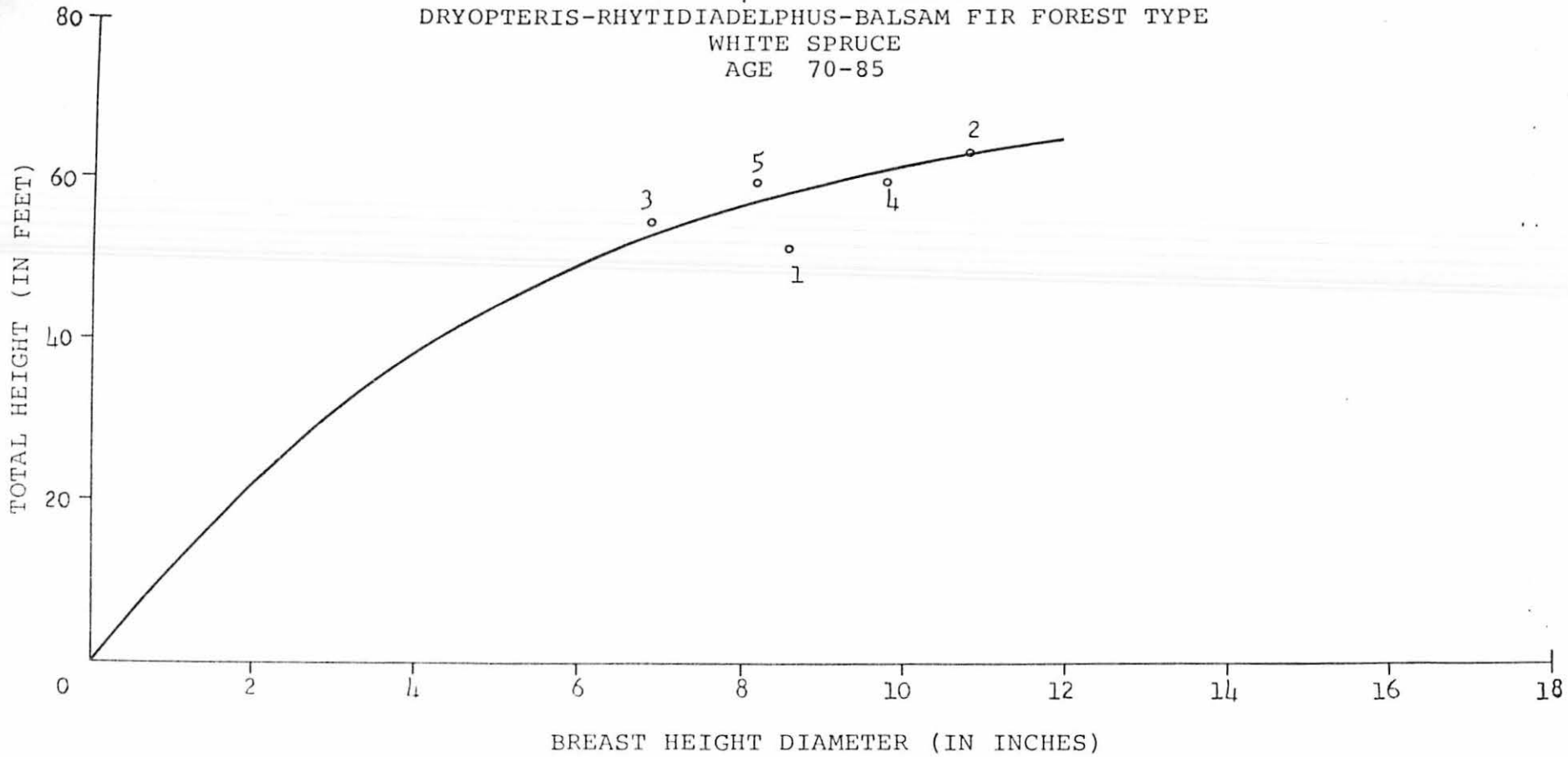


Fig. 4.
HEIGHT/AGE CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 70-85

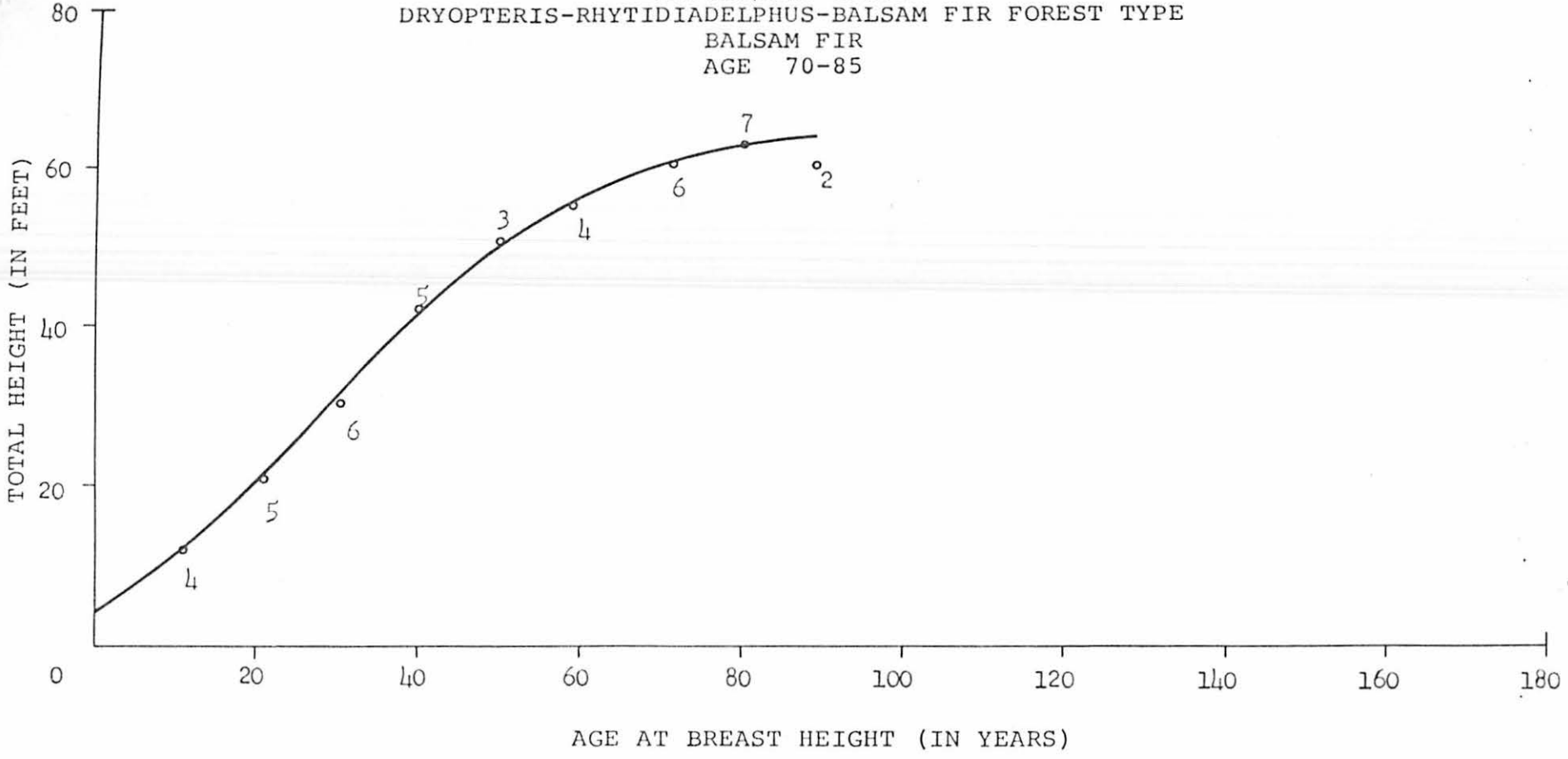


Fig. 5.
HEIGHT/AGE CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 70-85

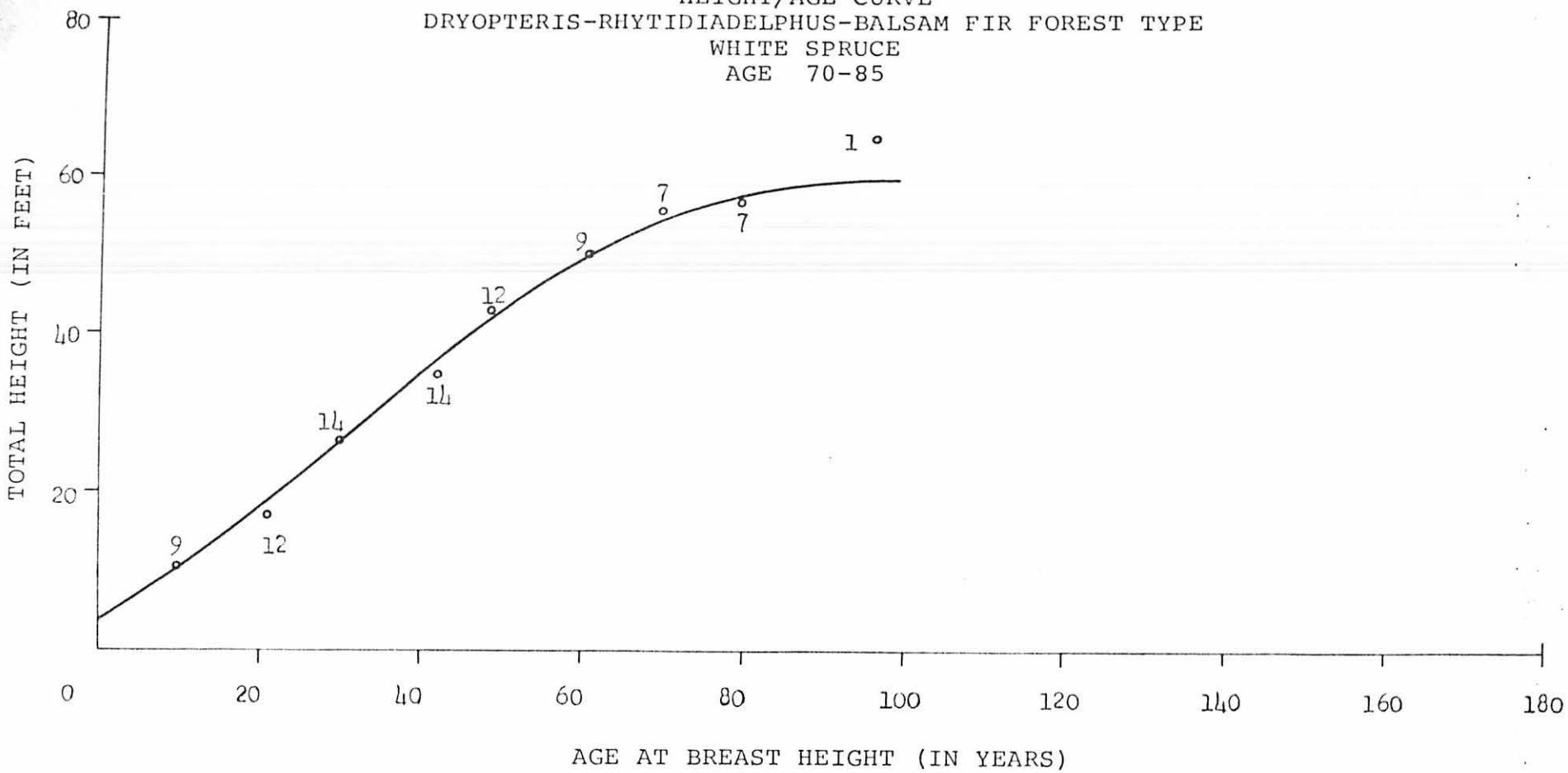


TABLE 2

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND STOCK TABLES

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age: 70-85 Years

SPECIES:	BALSAM FIR			WHITE SPRUCE		
FORM CLASS:	67			66		
D.b.h. (Inches)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)
4	31	1.3	59.41	36	1.1	6.27
5	38	2.2	125.62	43	2.2	28.38
6	43	3.7	169.09	49	3.7	21.09
7	48	5.8	256.94	53	5.6	56.00
8	53	8.0	376.80	57	7.8	10.92
9	56	10.6	515.16	59	10.4	73.84
10	59	13.7	371.27	61	13.4	76.38
11	61	17.0	340.00	63	16.9	23.66
12	63	20.9	418.00	-	-	-
13	65	25.2	360.36	65	25.0	72.50
14	66	29.7	169.29	-	-	-
15	66	34.2	99.18	-	-	-
16	66	39.5	55.30	-	-	-
17	66	45.2	63.23	-	-	-
18	66	51.3	71.82	-	-	-
Total:			3451.52			369.04

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

TABLE 3

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age: 70-85 Years

Number of Plots: 7

.h.. sses	BALSAM FIR			WHITE SPRUCE			WHITE BIRCH			MOUNTAIN ASH			T O T A L		
	No. of Trees per acre Living	Dead	Basal Area per acre (Sq. Ft.)	No. of Trees per acre Living	Dead	Basal Area per acre (Sq. Ft.)	No. of Trees per acre Living	Dead	Basal Area per acre (Sq. Ft.)	No. of Trees per acre Living	Dead	Basal Area per acre (Sq. Ft.)	No. of Trees per acre Living	Dead	Basal Area per acre (Sq. Ft.
1	30.0	15.7	0.15	1.4	1.4	0.01		1.4					31.4	18.5	0.14
2	24.3	27.1	0.53										24.3	27.1	0.53
3	32.9	20.0	1.61	1.4	4.3	0.07	2.9		0.14				37.2	24.3	1.82
4	45.7	20.0	3.98	5.7	5.7	0.50	5.7		0.50				57.1	25.7	4.98
5	57.1	12.9	7.77	12.9	2.9	1.75	1.4		0.19				71.4	15.8	9.71
6	45.7	8.6	8.96	5.7		1.12	1.4		0.28	1.4		0.28	54.2	8.6	10.64
7	44.3		11.32	10.0		2.67	1.4		0.38		1.4		55.7	1.4	14.87
8	47.1		16.45	1.4		0.50	2.9		1.00				51.4		17.87
9	48.6		21.47	7.1		3.16	1.4		0.63	1.4		0.63	58.5		25.95
0	27.1		14.79	5.7	1.4	3.11							32.8	1.4	17.90
1	20.0		13.20	1.4		0.94	4.3		2.83				25.7		16.97
2	20.0		15.70				1.4		1.12				21.4		16.82
3	14.3		13.17	2.9		2.63							17.2		15.80
4	5.7		6.11				5.7	1.4	6.11				11.4	1.4	12.22
5	2.9	1.4	3.51				1.4		1.75				4.3	1.4	5.26
6	1.4		1.99				4.3		5.98				5.7		7.97
7	1.4		2.25		1.4		1.4	1.4	2.25				2.8	2.8	4.50
8	1.4		2.52				1.4		2.52				2.8		5.04
TAL:	469.9	105.7	145.98	55.6	17.1	16.46	37.0	4.2	25.68	2.8	1.4	0.91	565.3	128.4	13 .99

Fig. 6.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 70-85

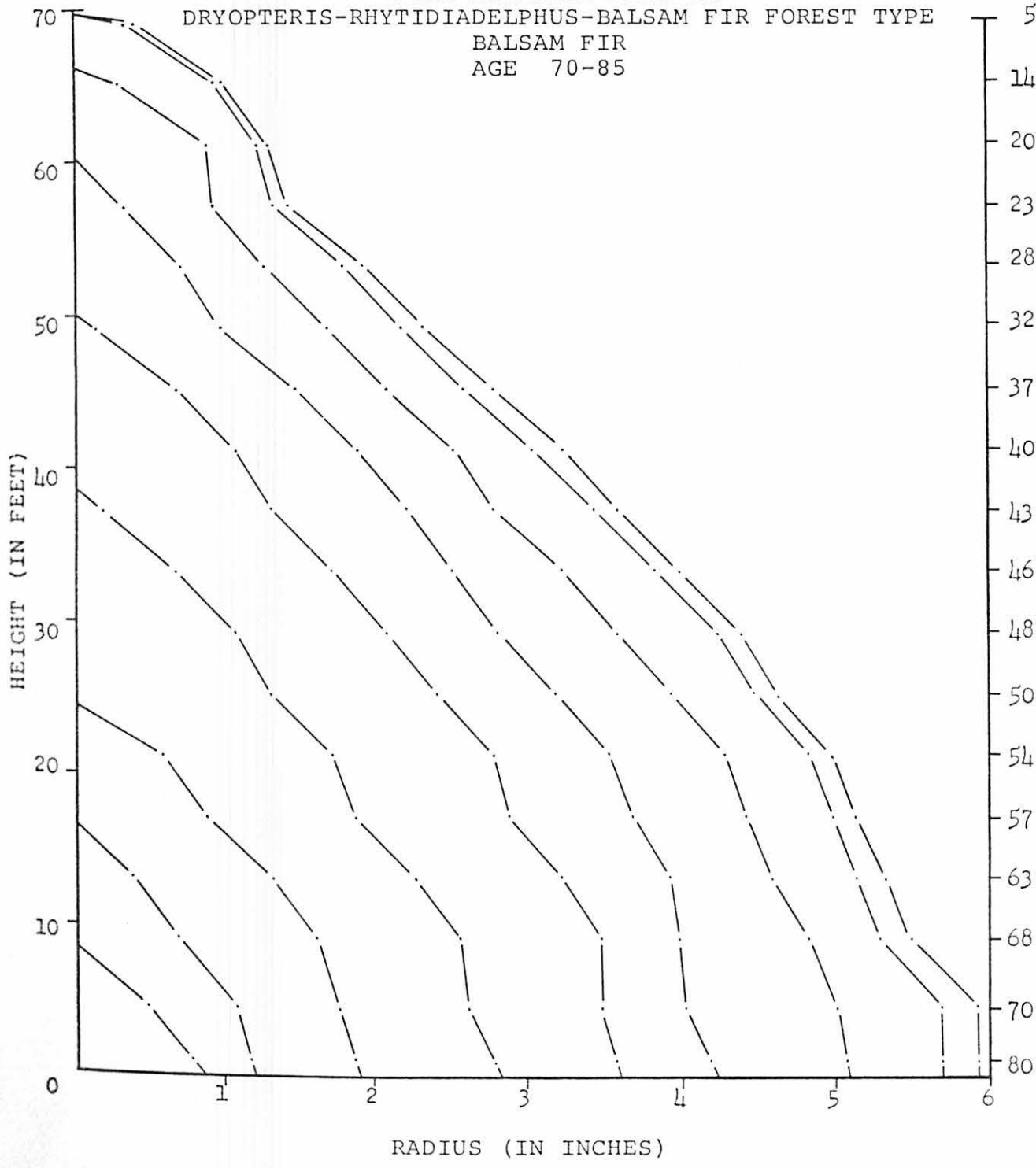


Fig. 7.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 70-85

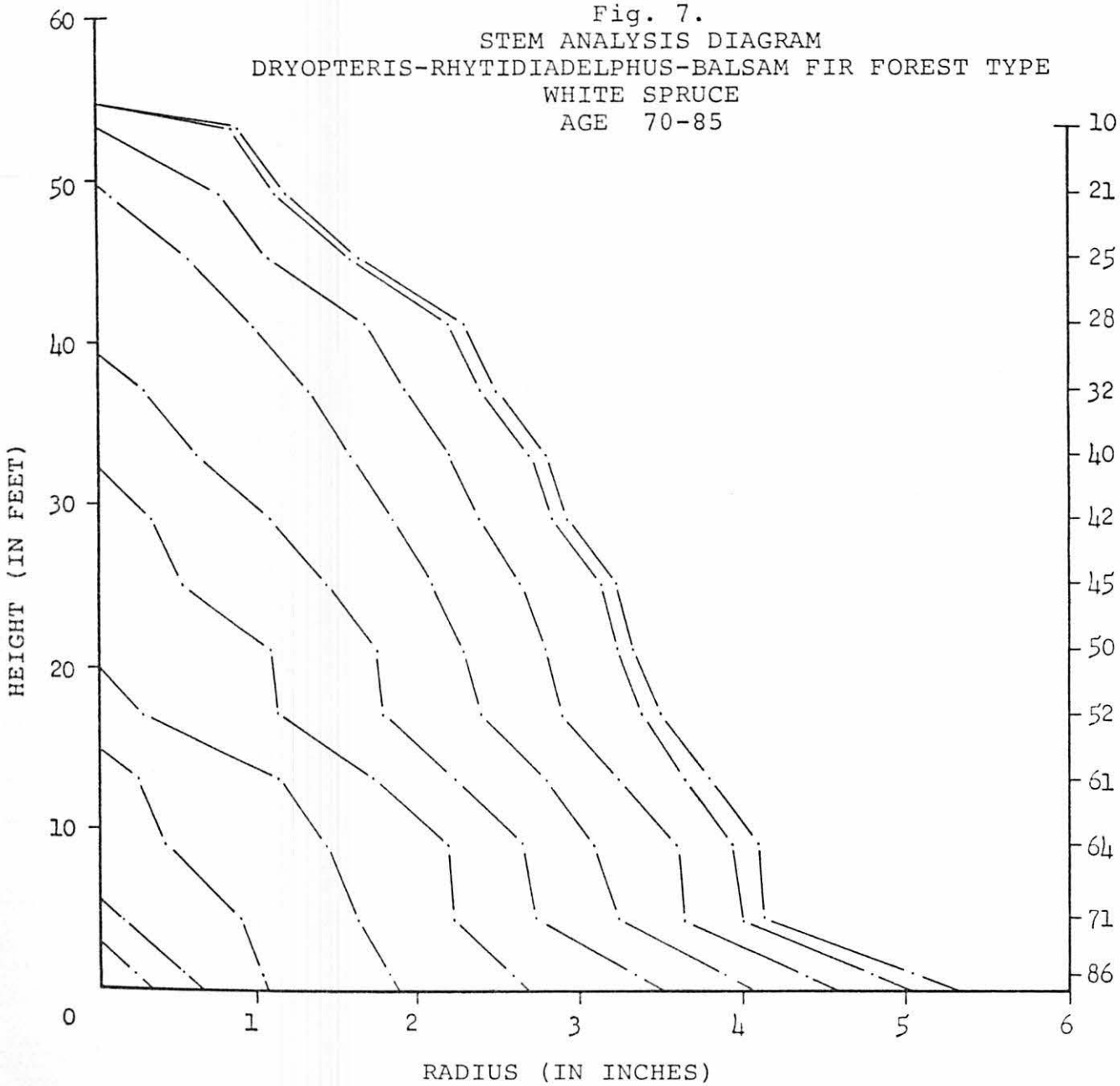


TABLE 4

STEM ANALYSIS DATA TABLE

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age Class: 70 - 85 Years

		BALSAM FIR (Fig. 6)	WHITE SPRUCE (Fig. 7)
Age at breast height (years)		70	71
Diameter breast height (inches)		11.90	8.30
Total height (feet)		69.6	54.4
Total volume (cu. ft.)		22.07	10.86
Merchantable volume (cu. ft.)		20.88	10.08
Total volume increment by decades (cu. ft.):-	1963-1953	5.31	2.71
	1953-1943	5.86	2.60
	1943-1933	4.07	2.27
	1933-1923	3.75	1.46
	1923-1913	2.06	1.06
	1913-1903	.78	.60
	1903-1893	.19	.15
	1893-1883	-	.01
Merchantable volume increment (cu. ft.)	1953-1963	4.90	2.11

Fig. 8.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 86-110

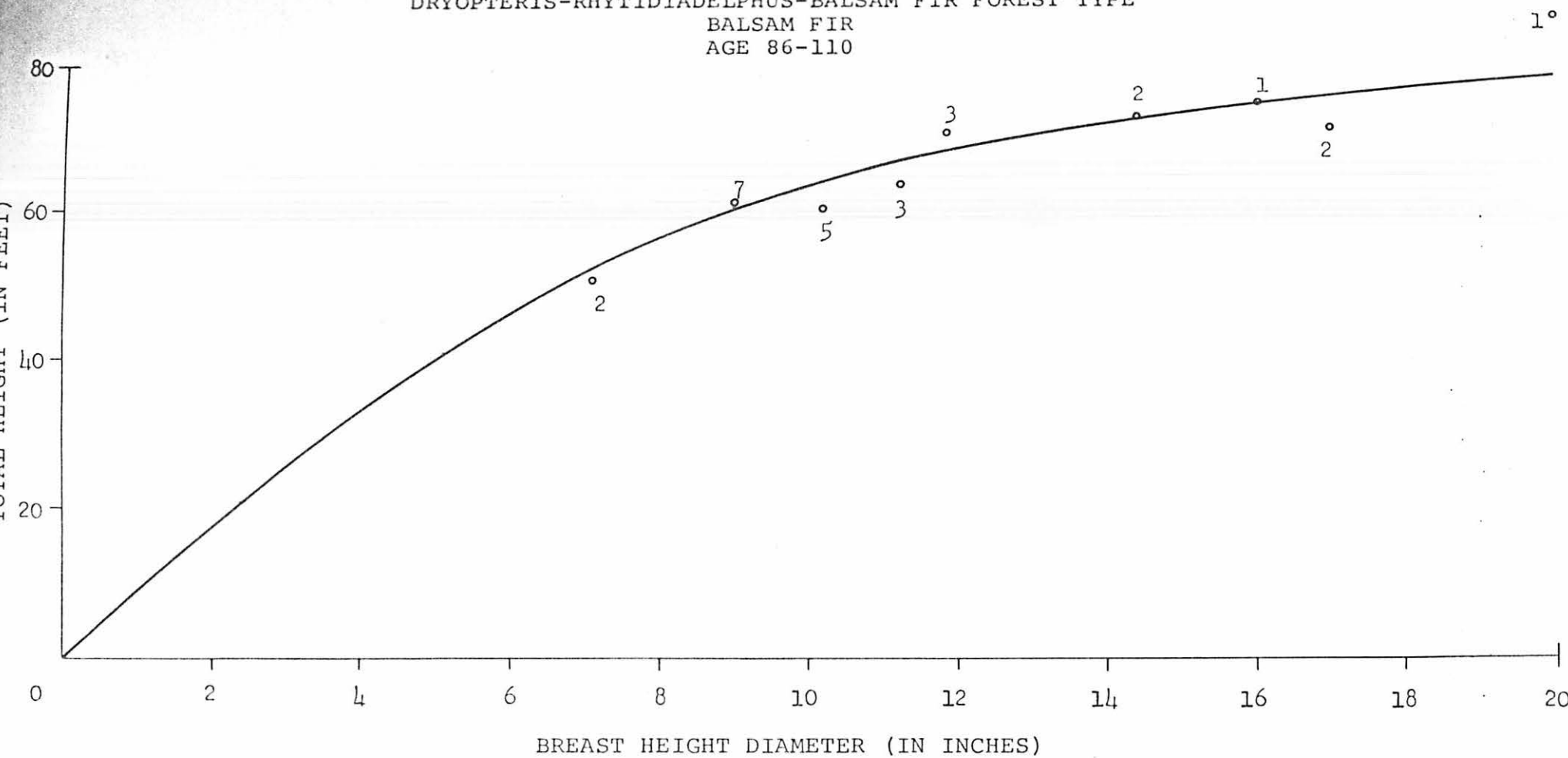


Fig. 9.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 86-110

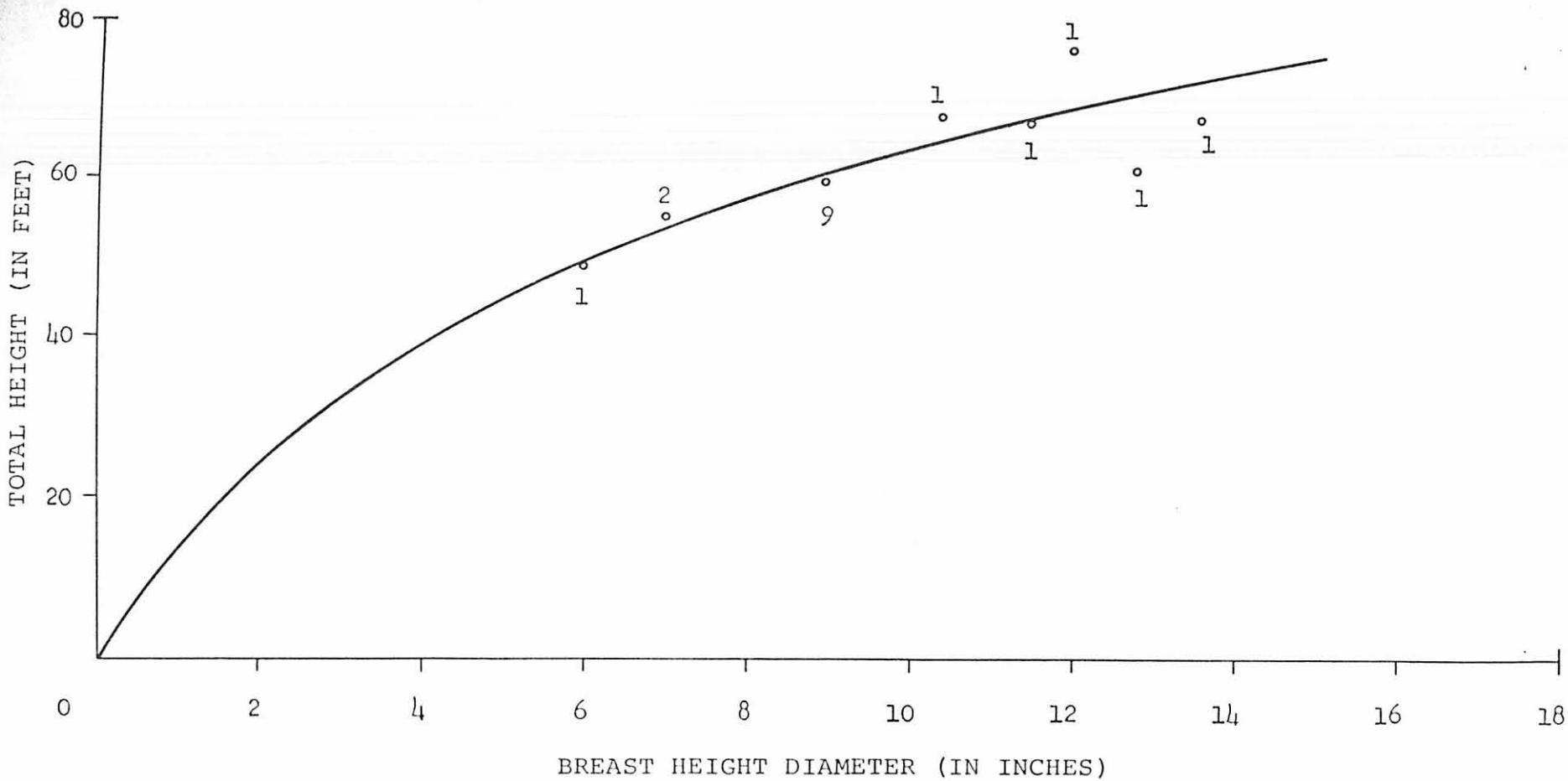


Fig. 10.
HEIGHT/AGE CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 86-110

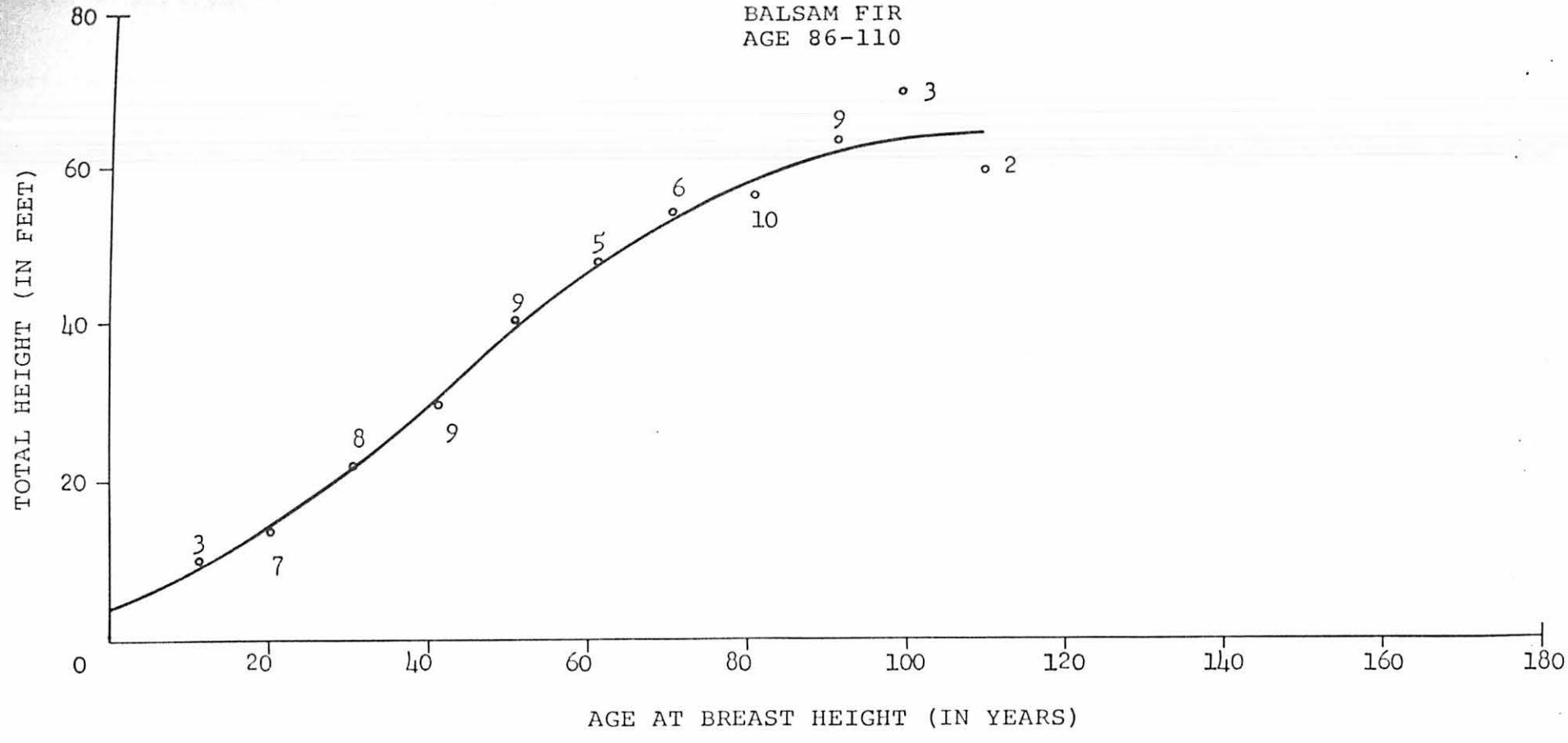


Fig. 11.
HEIGHT/AGE CURVE
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 86-110

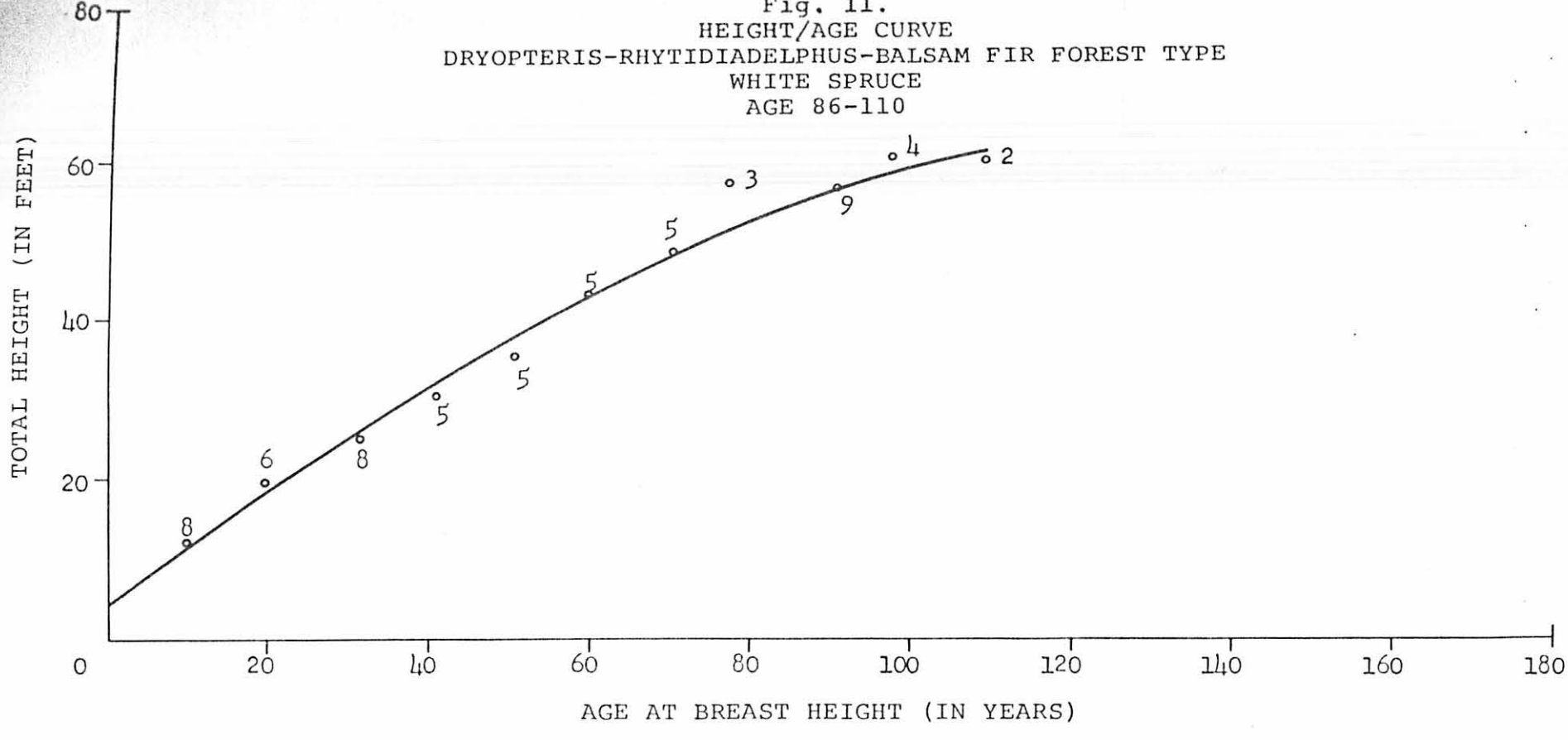


TABLE 5

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND
STOCK TABLES

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age: 86-110 Years

SPECIES:	BALSAM FIR			WHITE SPRUCE		
ORM CLASS:	70			68		
D.b.h. (Inches)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)
4	32	1.34	26.00	37	1.2	9.84
5	39	2.36	52.32	44	2.4	32.64
6	45	3.85	114.00	49	4.0	36.40
7	50	5.80	205.90	53	5.9	21.24
8	55	8.35	267.12	56	8.2	52.48
9	59	11.41	393.30	59	11.3	62.15
10	62	14.74	583.00	62	14.4	12.96
11	66	18.92	326.97	65	18.4	49.63
12	68	23.16	330.48	68	22.9	103.05
13	70	27.90	379.44	70	27.7	24.93
14	72	33.23	576.09	73	33.5	60.30
15	73	38.83	174.60	75	39.4	35.46
16	74	44.92	202.05	-	-	-
17	75	51.45	46.26	-	-	-
18	76	53.38	105.12	-	-	-
19	77	65.77	59.22	-	-	-
20	78	73.70	66.33	-	-	-
TOTAL:			3963.20			501.13

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

TABLE 6

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age: 86-110 Years

Number of Plots: 11

D.b.h. Classes	BALSAM FIR			WHITE SPRUCE			WHITE BIRCH			MOUNTAIN ASH			T O T A L		
	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.
	Living	Dead		Living	Dead		Living	Dead		Living	Dead		Living	Dead	
1	25.5	10.9	0.13	1.8	-	0.01	-	-	-	-	-	-	27.3	10.9	0.14
2	26.4	10.0	0.58	2.7	1.8	0.06	-	-	-	-	-	-	29.1	11.8	0.64
3	20.9	13.6	1.02	4.5	5.5	0.42	5.5	-	0.27	-	-	-	30.9	19.1	1.31
4	20.0	13.4	1.74	8.2	0.9	0.71	4.5	-	0.40	0.9	-	0.08	33.6	17.3	2.93
5	21.8	3.6	2.97	13.6	0.9	1.85	6.4	-	0.87	-	-	-	41.8	4.5	5.69
6	30.0	6.4	5.88	9.1	-	1.78	8.2	-	1.60	-	-	-	47.3	6.4	9.26
7	35.5	5.5	9.47	3.6	-	0.97	5.5	-	1.46	-	-	-	44.6	5.5	11.90
8	31.3	0.9	11.10	6.4	-	2.22	8.2	-	2.86	0.9	-	0.32	47.3	0.9	16.50
9	24.5	3.6	15.27	5.5	-	2.41	8.2	-	3.62	-	-	-	48.2	3.6	21.30
10	40.9	1.8	21.80	0.9	-	0.56	12.7	-	6.94	-	-	-	53.6	1.8	29.24
11	17.3	0.9	11.40	2.7	-	1.80	5.5	-	3.60	-	-	-	25.5	0.9	16.80
12	16.4	-	12.85	4.5	-	3.57	2.7	-	2.14	-	-	-	23.6	-	18.56
13	13.6	-	12.57	0.9	0.9	0.84	0.9	-	0.84	-	-	-	15.4	0.9	14.25
14	17.3	-	18.46	1.8	-	1.94	3.6	-	3.89	-	-	-	22.7	-	24.29
15	4.5	-	5.58	0.9	-	1.12	-	-	-	-	-	-	5.4	-	6.70
16	4.5	-	6.35	-	-	-	0.9	-	1.27	-	-	-	5.4	-	7.62
17	0.9	-	1.43	-	-	-	-	-	-	-	-	-	0.9	-	1.43
18	1.8	-	3.21	-	-	-	-	-	-	-	-	-	1.8	-	3.21
19	0.9	-	1.79	-	-	-	-	-	-	-	-	-	0.9	-	1.79
20	0.9	-	1.98	-	-	-	-	-	-	-	-	-	0.9	-	1.98
21	-	-	-	-	-	-	0.9	-	2.19	-	-	-	0.9	-	2.19
TOTAL:	304.5	73.8	145.58	67.1	10.0	20.89	73.7	-	31.87	1.8	-	0.40	507.1	83.6	197.33

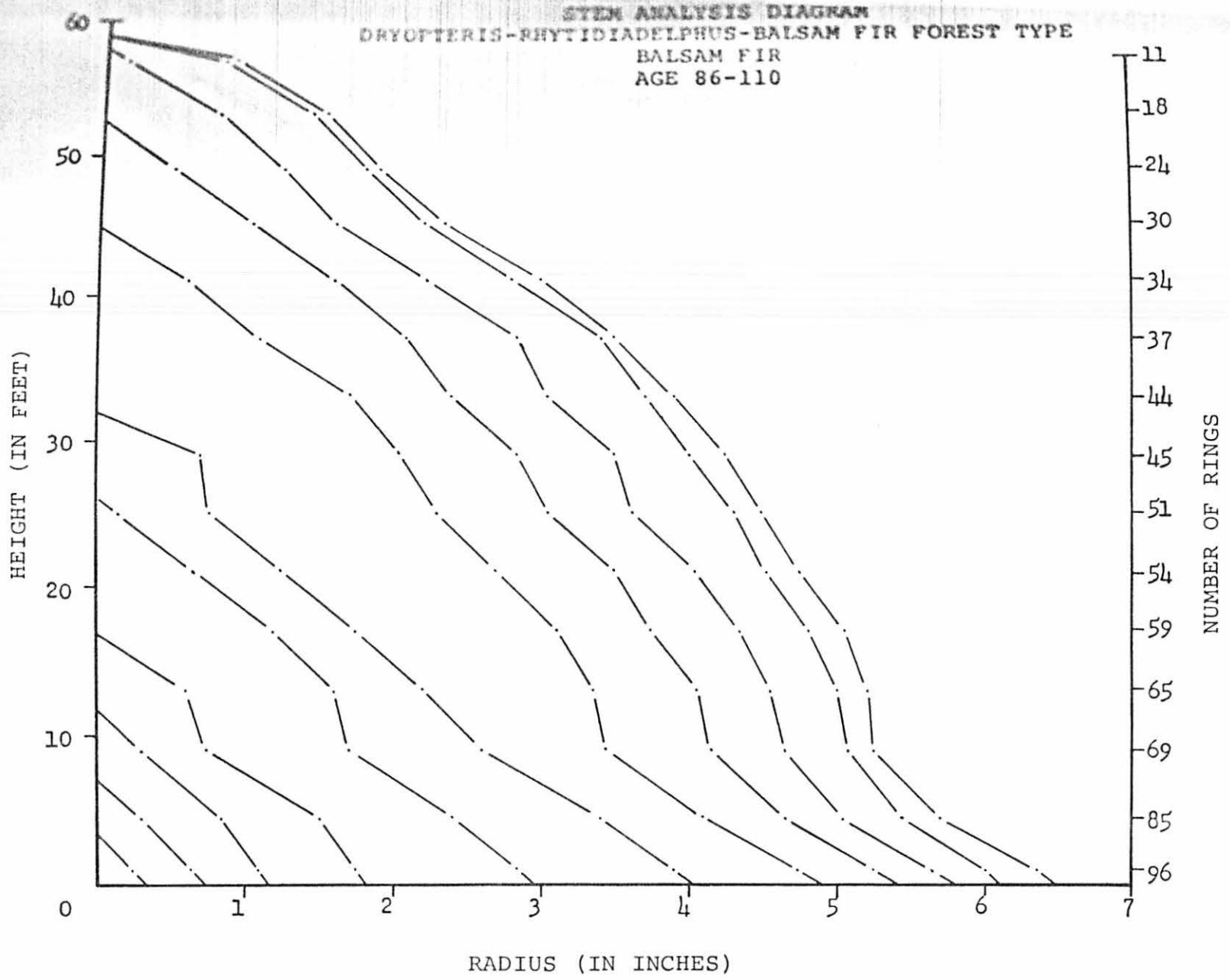

STEM ANALYSIS DIAGRAM
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 86-110
HEIGHT (IN FEET)
60
50
40
30
20
10
0
1
2
3
4
5
6
7
RADIUS (IN INCHES)
11
18
24
30
34
37
44
45
51
54
59
65
69
85
96
NUMBER OF RINGS

Fig. 13.

STEM ANALYSIS DIAGRAM
DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 86-110

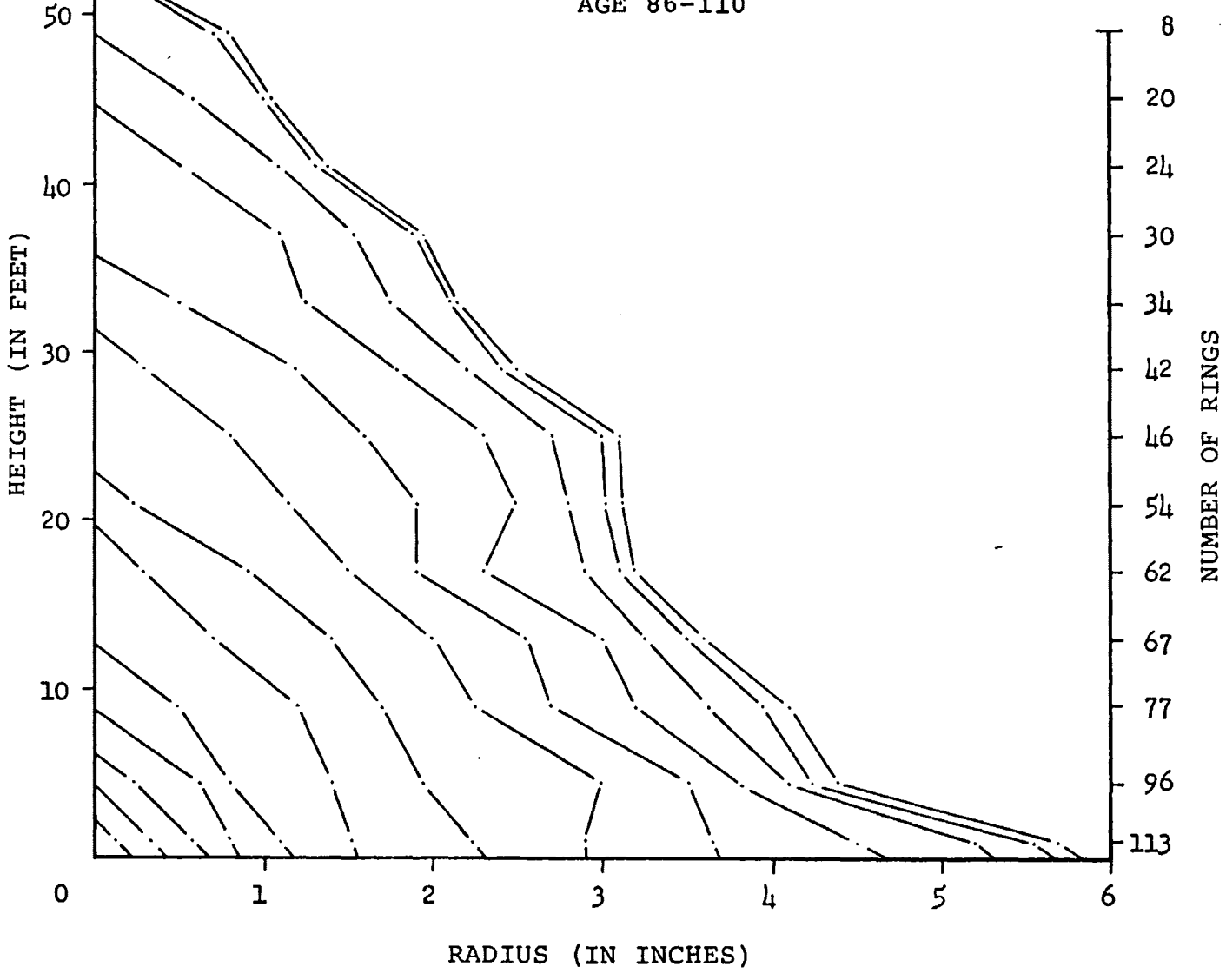


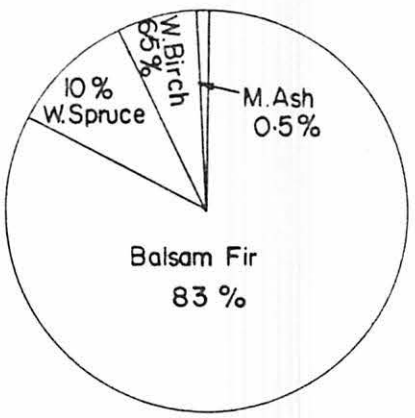
TABLE 7

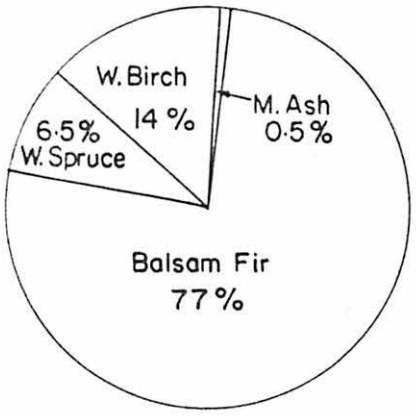
STEM ANALYSIS DATA TABLE

DRYOPTERIS-RHYTIDIADELPHUS-BALSAM FIR FOREST TYPE

Age Class: 86-110 Years

	BALSAM FIR (Fig. 12)	WHITE SPRUCE (Fig. 13)
Age at breast height (years)	85	96
Diameter breast height (inches)	11.40	8.80
Total height (feet)	58.8	53.1
Total volume (cu. ft.)	20.09	9.87
Merchantable volume (cu. ft.)	18.93	8.77
Total volume increment by decades (cu. ft.):- 1963-1953	4.44	1.54
1953-1943	4.04	2.05
1943-1933	4.01	2.15
1933-1923	4.14	1.62
1923-1913	1.82	1.33
1913-1903	1.18	.64
1903-1893	.33	.40
1893-1883	.10	.08
1883-1873	.03	.05
1873-1863	-	.01
Merchantable volume increment (cu. ft.): 1953-1963	3.76	1.35



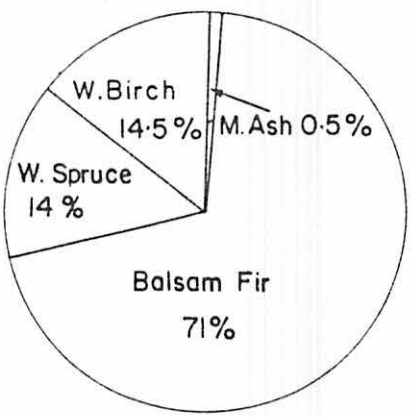


AGE 70-85

NUMBER OF TREES PER ACRE

BASAL AREA PER ACRE

AGE 86-110



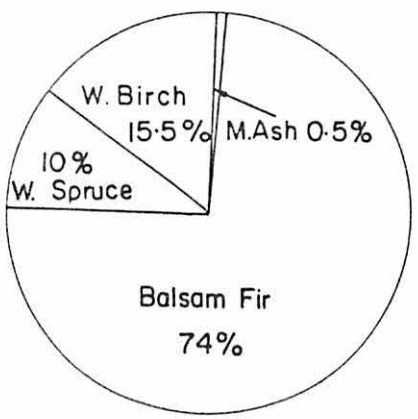


Fig. 14. STAND TABLE DIAGRAMS: DRYOPTERIS-RHYTIDIADELPHUS. -BALSAM FIR FOREST TYPE

Dryopteris-Balsam Fir Forest Type

Description

Included in this forest type are mixed forests of balsam fir, white birch, and yellow birch. Yellow birch is, however, absent from this type in areas north of Deer Lake and at higher elevations. White spruce is a frequent but scattered component. The density and composition of the tree layer is highly variable. Undisturbed stands are usually well-stocked and predominantly coniferous, but disturbed forests often contain much birch. Windthrow is common in mature stands.

When present the shrub layer consists only of widely scattered specimens of Acer spicatum and Betula lutea. The most prominent characteristic of these forests is the luxuriance and abundance of the two- or three-foot high fern layer. This layer consists almost entirely of Dryopteris spinulosa var. americana and completely covers the forest floor. Cornus canadensis, Clintonia borealis, Maianthemum canadense, and Trientalis borealis are common, but their abundance is limited by the prolific growth of fern. Of the mosses, Hylocomium umbratum, Hylocomium splendens, Dicranum majus, and Rhytidiadelphus loreus are usually present in small quantities.

This forest type usually occurs on well-drained, nutrient-rich, orthic podzols on loams, silt loams, and sometimes sandy loams. Slight gleying is commonly present at a depth of 15 to 24 inches in association with seepage above a weakly developed platy fragipan or a fragmented bedrock surface. It is common on middle and lower slopes around Grand Lake where it is underlain by slate and shale. The Rubus-balsam fir type and Acer thickets usually occur on wetter parts of the same slopes in close association with this forest type.

Mensurational Characteristics

Height/diameter relationships for balsam fir and white spruce are very similar up to a height of 50 feet (at an average diameter of 6.2 inches) but there is some divergence beyond that point, balsam fir reaching a diameter of 8.0 inches at 60 feet while white spruce reaches the same diameter at a height of 56 feet (Figs. 15 and 16). Height/age curves show a similar type of relationship (Figs. 17 and 18). Both species reach approximately 50-55 feet at 50 years, but in older crops the white spruce height curve flattens more sharply than that of balsam fir so that at 70 years there is some 13 feet difference between the two curves.

An average softwood merchantable volume of 3,340 cu. ft. per acre has been recorded (Table 8). The number of living trees per acre (all species) averages 683 and basal area per acre reaches 197 sq. ft. (Table 9).

Balsam fir constitutes 70% of the number of stems per acre but only 64% of the total basal area (Fig. 21). Stem analysis diagrams (Figs. 19 and 20) and tabular data (Table 10) show similar increment rates for balsam fir and white spruce.

Regeneration is usually poor to adequate on the forest floor but abundant on rotten logs. Balsam fir seedlings of 0.6 - 1.5 feet in height were present on 97% of the quadrats, and mixed balsam fir, white spruce, and white birch occupied the remaining 3% (Table 28).

Fig. 15.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 56-71

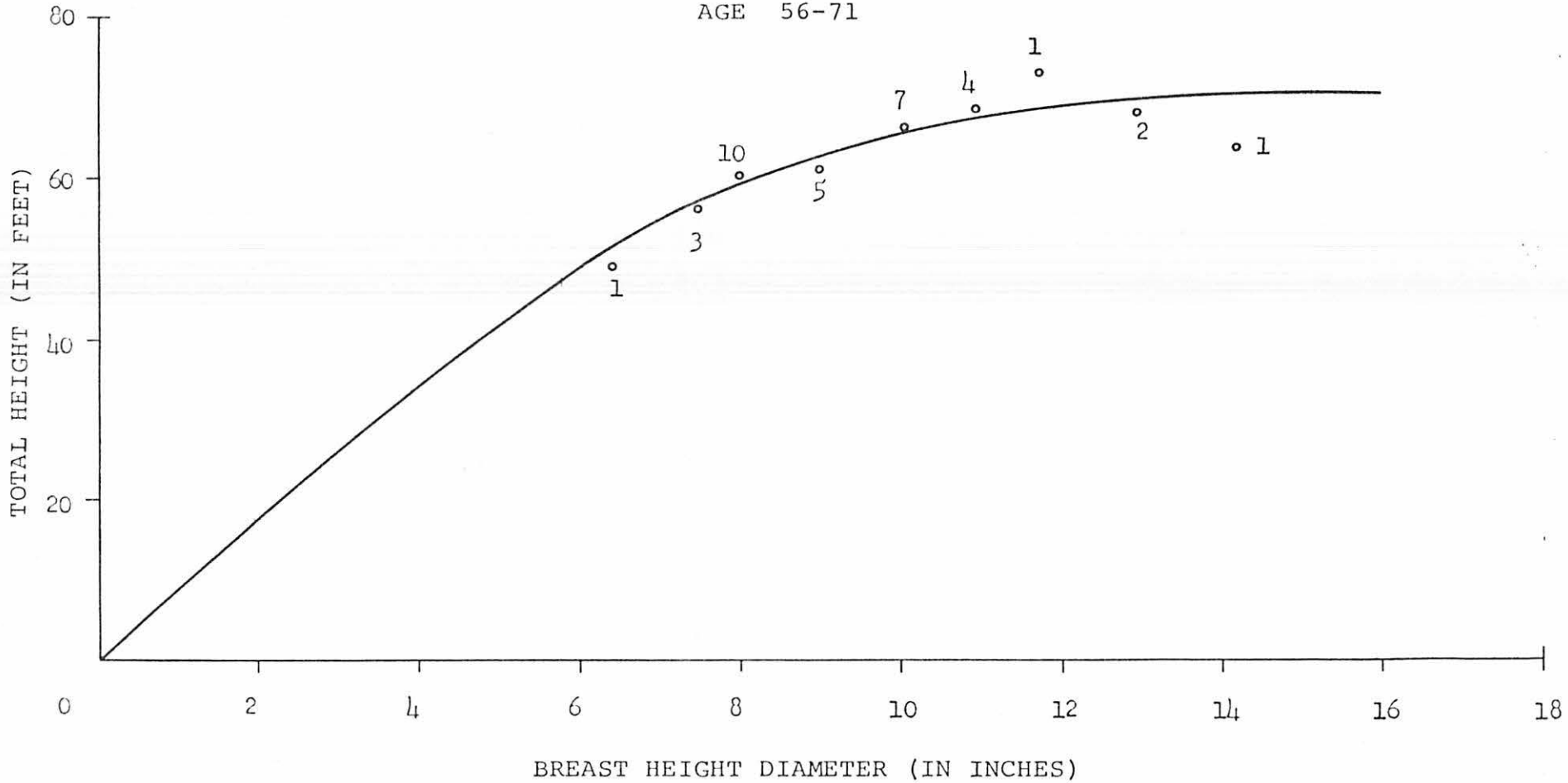


Fig. 16.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 56-71

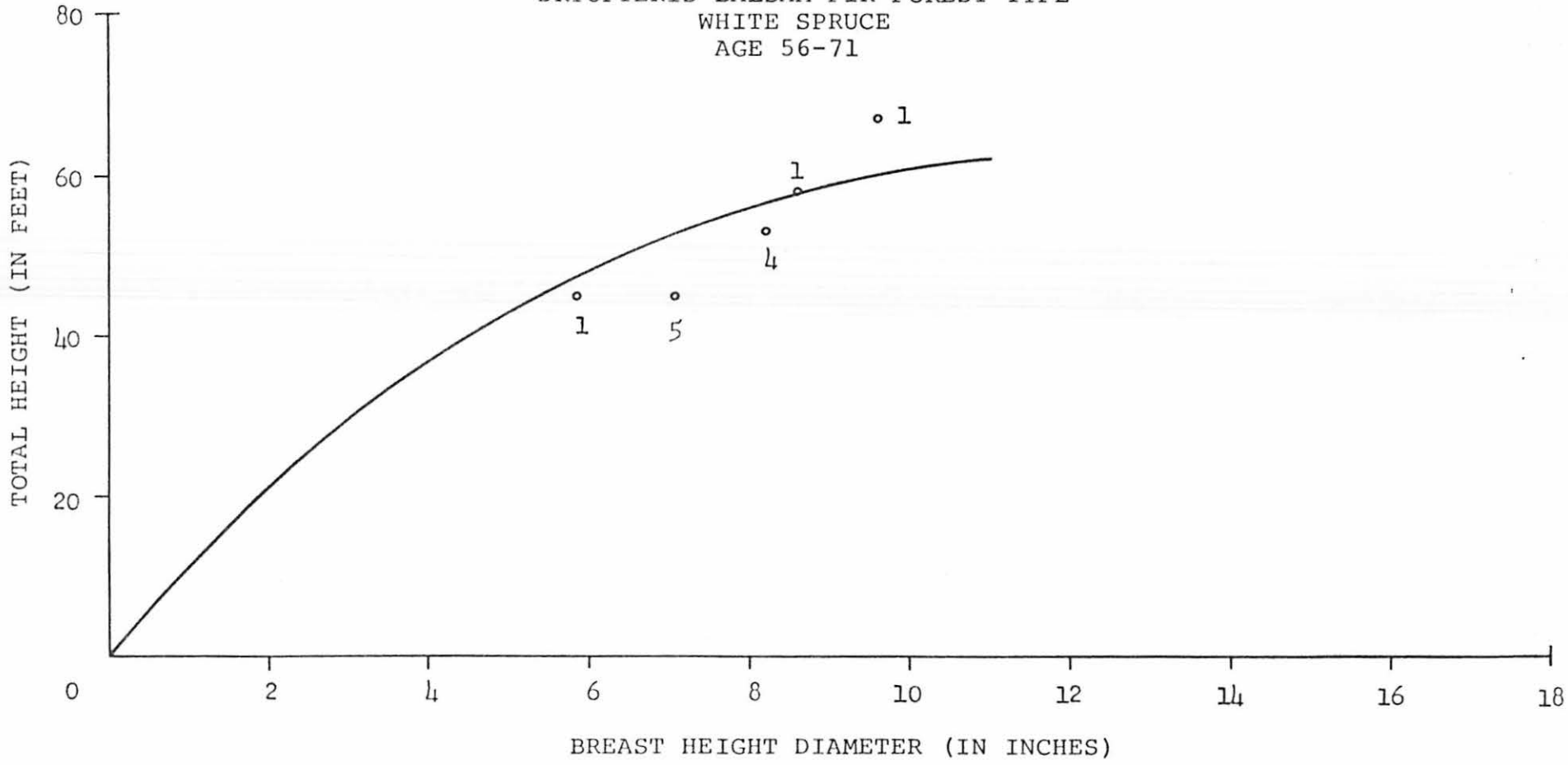


Fig. 17.
HEIGHT/AGE CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 56-71

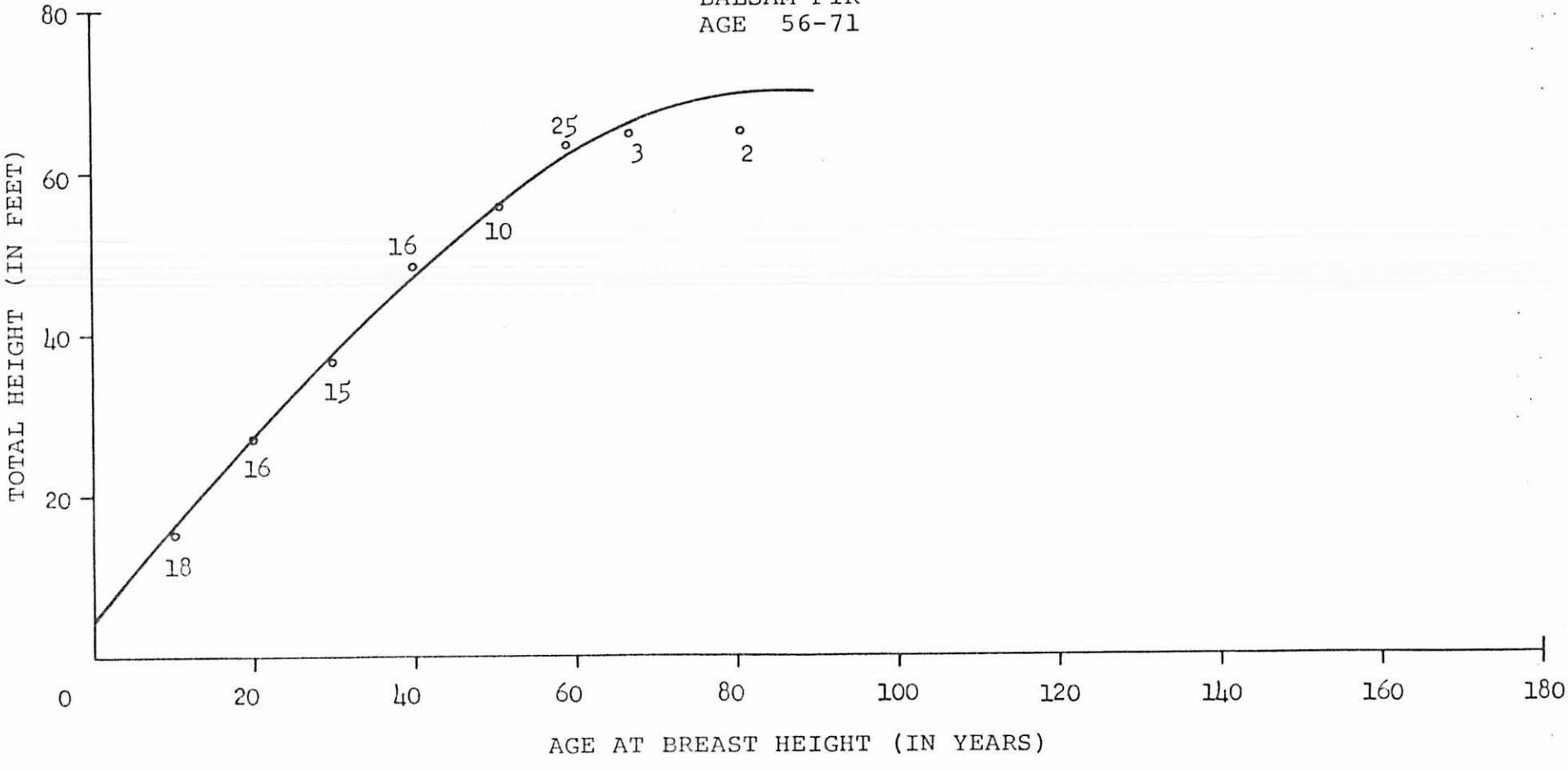


Fig. 18.
HEIGHT/AGE CURVE
DRYOPTERIS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 56-71

TABLE 8

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND STOCK TABLES

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age: 56-71

SPECIES:	BALSAM FIR			WHITE SPRUCE		
FORM CLASS:	69			67		
D.b.h. (Inches)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)
4	36	1.4	70.98	36	1.1	3.96
5	43	2.5	162.50	42	2.3	6.67
6	50	4.2	291.06	48	3.8	13.68
7	55	6.4	420.48	53	5.7	28.50
8	59	9.0	578.70	56	8.0	45.60
9	63	12.1	613.47	59	10.7	31.03
10	66	15.6	435.24	61	13.9	9.73
11	67	19.2	328.32	62	17.3	36.33
12	69	23.5	49.35	64	21.3	-
13	70	27.9	100.44	64	25.1	17.57
14	70	32.4	45.36	-	-	-
15	71	37.8	52.92	-	-	-
TOTAL:			3148.82			193.07

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

TABLE 9

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

DRYOPTERIS-BALSAM FIR FOREST TYPE

Age: 56-71 Years

Number of Plots: 14

h-sses	BALSAM FIR			WHITE SPRUCE			WHITE BIRCH			YELLOW BIRCH			T O T A L		
	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.
	Living	Dead		Living	Dead		Living	Dead		Living	Dead		Living	Dead	
1	7.9	27.9	0.04	-	-	-	-	-	-	-	-	-	7.9	27.9	0.04
2	19.3	59.3	0.42	-	-	-	2.1	2.9	0.05	-	-	-	21.4	62.2	0.47
3	37.1	57.1	1.82	2.9	2.1	0.14	7.1	1.4	0.35	0.7	-	0.04	47.8	60.6	2.35
4	50.7	37.9	4.41	3.6	1.4	0.31	20.7	1.4	1.80	1.4	-	0.12	76.4	40.7	6.64
5	65.0	10.7	8.84	2.9	2.1	0.39	20.0	0.7	2.72	1.4	-	0.19	89.3	13.5	12.14
6	69.3	2.1	13.58	3.6	1.4	0.70	20.7	0.7	4.06	6.4	-	1.26	100.0	4.2	19.60
7	65.7	5.7	17.55	5.0	0.7	1.34	17.1	-	4.58	3.6	-	0.95	91.4	6.4	24.42
8	64.3	1.4	22.44	5.7	-	1.99	16.4	0.7	5.73	2.9	-	1.00	89.3	2.1	31.16
9	50.7	1.4	22.42	2.9	-	1.26	10.7	-	4.74	1.4	-	0.63	65.7	1.4	29.05
0	27.9	-	15.18	0.7	0.7	0.39	7.1	-	3.89	-	-	-	35.7	0.7	19.46
1	17.1	-	11.31	2.1	-	1.41	7.9	-	5.19	1.4	-	0.94	28.5	-	18.85
2	2.1	-	1.68	-	0.7	-	4.3	-	3.36	1.4	-	1.12	7.8	0.7	6.16
3	3.6	-	3.29	0.7	-	0.66	5.0	-	4.61	-	-	-	9.3	-	8.56
4	1.4	-	1.53	-	-	-	2.1	-	2.29	1.4	-	1.53	4.9	-	5.35
5	1.4	-	1.75	-	-	-	-	-	-	-	-	-	1.4	-	1.75
6	-	-	-	-	-	-	0.7	-	1.00	-	-	-	0.7	-	1.00
7	-	-	-	-	-	-	1.4	-	2.25	1.4	-	2.25	2.8	-	4.50
8	-	-	-	-	-	-	1.4	-	2.52	-	-	-	1.4	-	2.52
9	-	-	-	-	-	-	0.7	-	1.41	-	-	-	0.7	-	1.41
0	-	-	-	-	-	-	0.7	-	1.56	-	-	-	0.7	-	1.56
L:	483.5	203.5	126.26	30.1	9.1	8.59	146.1	7.8	52.11	23.4	-	10.03	683.1	220.4	196.99

Fig. 19.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 56-71

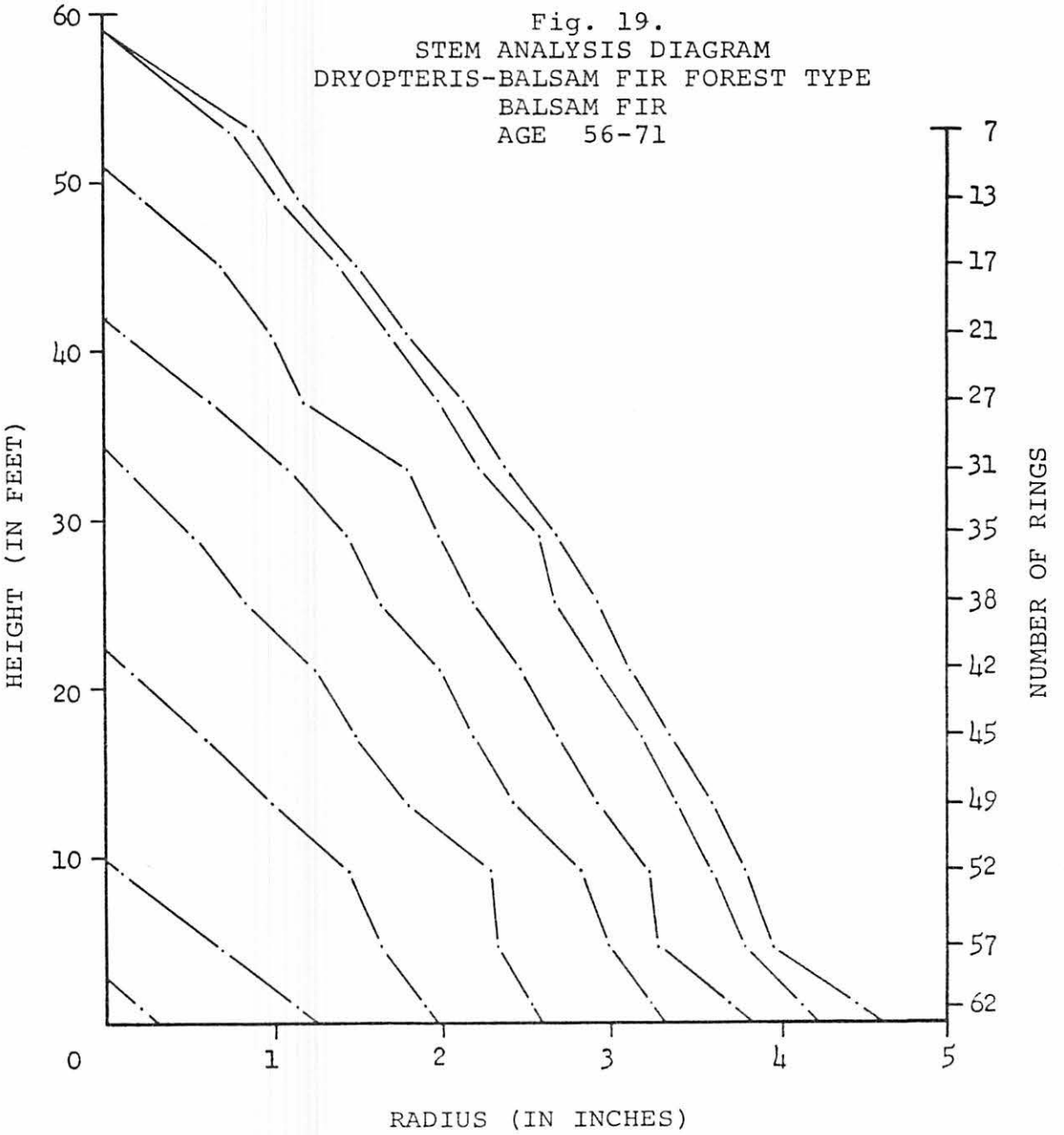


Fig. 20.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 56-71

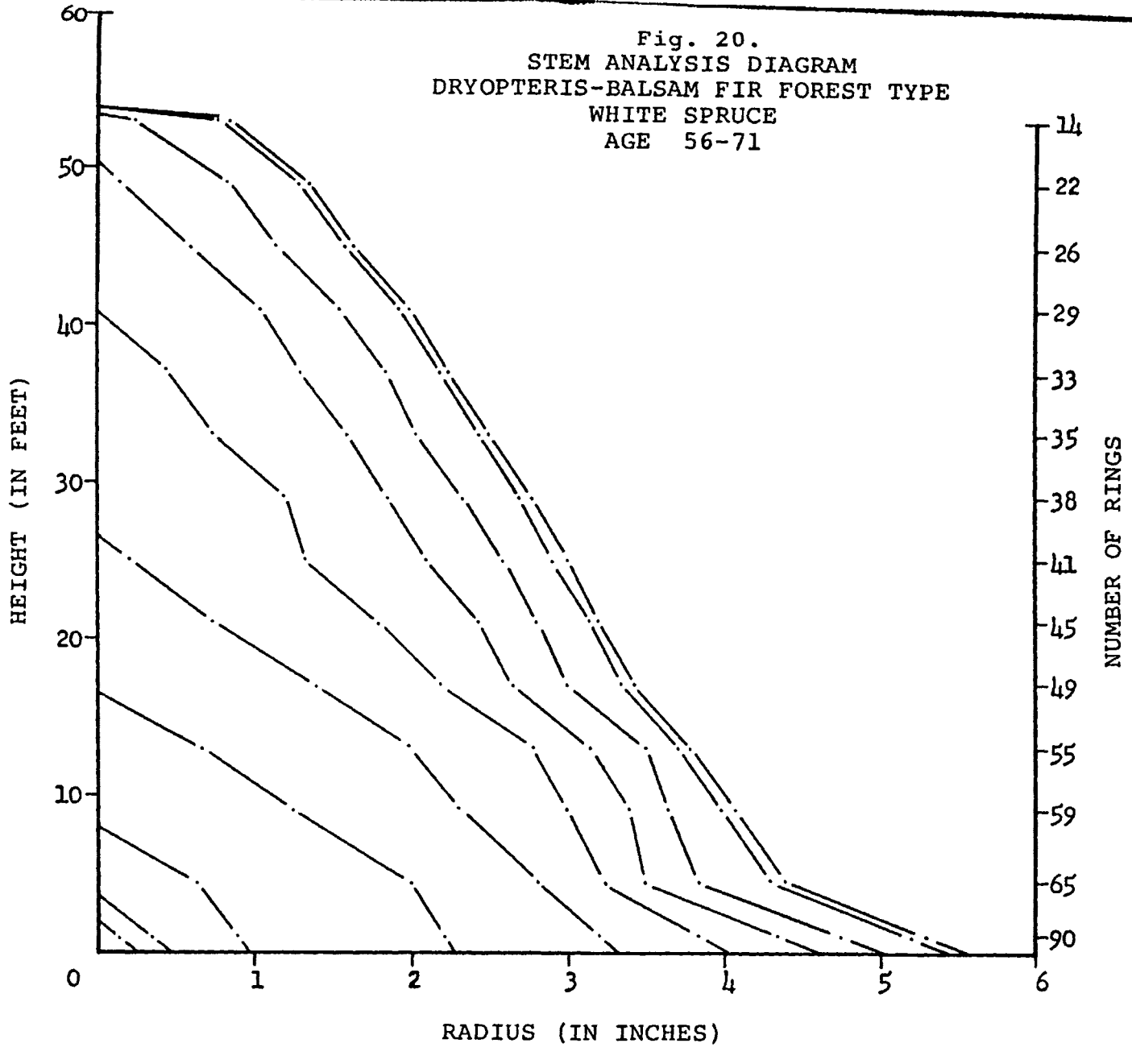


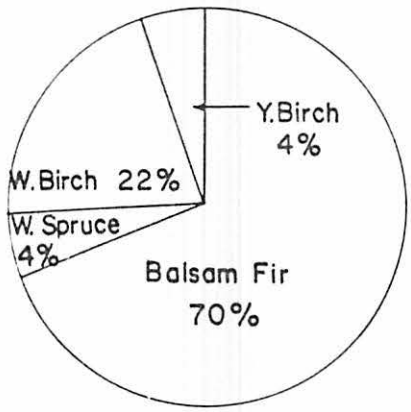
TABLE 10

STEM ANALYSIS DATA TABLE

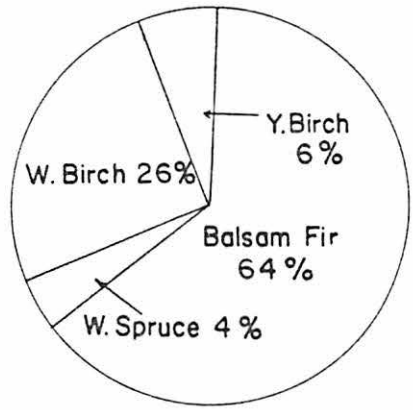
DRYOPTERIS-BALSAM FIR FOREST TYPE

Age Class: 56 - 71 Years

		BALSAM FIR (Fig. 19)	WHITE SPRUCE (Fig. 20)
Age at breast height (years)		57	65
Diameter breast height (inches)		7.95	8.77
Total height (feet)		58.9	53.6
Total volume (cu. ft.)		9.80	10.93
Merchantable volume (cu. ft.)		8.17	9.76
Total volume increment by decades (cu. ft.)	1963-1953	2.79	2.89
	1953-1943	1.98	2.34
	1943-1933	1.96	2.27
	1933-1923	1.30	2.15
	1923-1913	0.65	1.89
	1913-1903	0.12	0.81
	1903-1893	-	0.18
Merchantable volume increment (cu. ft.):-	1953-1963	2.34	2.34



NUMBER OF TREES PER ACRE



BASAL AREA PER ACRE

Fig. 21. STAND TABLE DIAGRAM: DRYOPTERIS-BALSAM FIR FOREST TYPE (AGE 56 - 71)

Hylocomium-Balsam Fir Forest Type

Description

This type consists of well-stocked balsam fir forests with white birch as a constant component. White spruce and black spruce occur frequently and larch occasionally. In western Newfoundland white pine is most common in this type, especially in the more inaccessible parts where logging has not been severe in the past. Transitions to the Pleurozium-balsam fir type are common.

A carpet of mosses covers the forest floor and, except for the absence or rare occurrence of Rhytidiadelphus loreus and Hylocomium umbratum, this greatly resembles the moss carpet of the Dryopteris-Hylocomium-balsam fir forest type. The herb layer, consisting mainly of Cornus canadensis, Maianthemum canadense, Linnaea borealis, Clintonia borealis, and Trientalis borealis, is poorly developed and usually covers less than 10% of the forest floor. Listera cordata, Goodyera repens, and Moneses uniflora are often present and separate this type from the Pleurozium-balsam fir type.

Moist to well-drained sites on rocky or nutrient-poor till soils such as those overlying sandstone or granite are the usual areas occupied by this forest type. Associated soils are usually seepage pseudogley podzols and light loamy orthic podzols, although mor lithosols and litho-regosols with seepage can also carry this type of forest. The Hylocomium-balsam fir type is the predominant forest type in other parts of Newfoundland, but on the relatively nutrient-rich soils in western Newfoundland it is fairly rare, being replaced by the more demanding forest types (particularly the Dryopteris-Hylocomium-balsam fir type).

Mensurational Characteristics

The data on which these results are based is somewhat complex. Certain of the plots are from the true Hylocomium-balsam fir type as already described. Other data are from plots with no Dryopteris present but nevertheless occurring on similar soil and topographic conditions to the Dryopteris-Hylocomium-balsam fir type. While some loss of accuracy may have resulted from the combination of these two types, it was considered the only practical approach to adopt since the occurrence of transitions between the two types makes their separation extremely difficult.

Balsam fir and white spruce height/diameter curves are very similar, reaching a breast height diameter of 10 inches at 54-55 years (Figs. 22 and 24). The curve for black spruce is of a basically similar shape but somewhat more flattened, reaching 10 inches diameter at 50 years (Fig. 23). Black spruce and white spruce height/age curves are almost exactly the same. Heights of 39 feet at 50 years and 46-48 feet at 80 years are

achieved (Figs. 26 and 27). Balsam fir crops average a slightly greater height at 50 years (42 feet) and reach 53 feet at 80 years (Fig. 25).

This forest type has an average merchantable volume of 3,310 cu. ft. per acre (Table 11). The number of living trees per acre (all species) averages 1,368 and basal area per acre averages 204 sq. ft. (Table 12).

Balsam fir constitutes 88% of the stand in terms of number of trees per acre but only 77% in terms of basal area (Fig. 31). Corresponding values for white spruce are 1.5% and 3% and for black spruce 6% and 9% respectively. The maximum volume increment of balsam fir is greater than that of white spruce which is in turn greater than that for black spruce (Figs. 28, 29, and 30, and Table 13).

Regeneration is good. Balsam fir of less than 0.5 feet in height occupied 85% of the quadrats, and balsam fir and white spruce of the same height were present on the remaining 15% (Table 28).

Fig. 22.
HEIGHT/DIAMETER CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 60-75

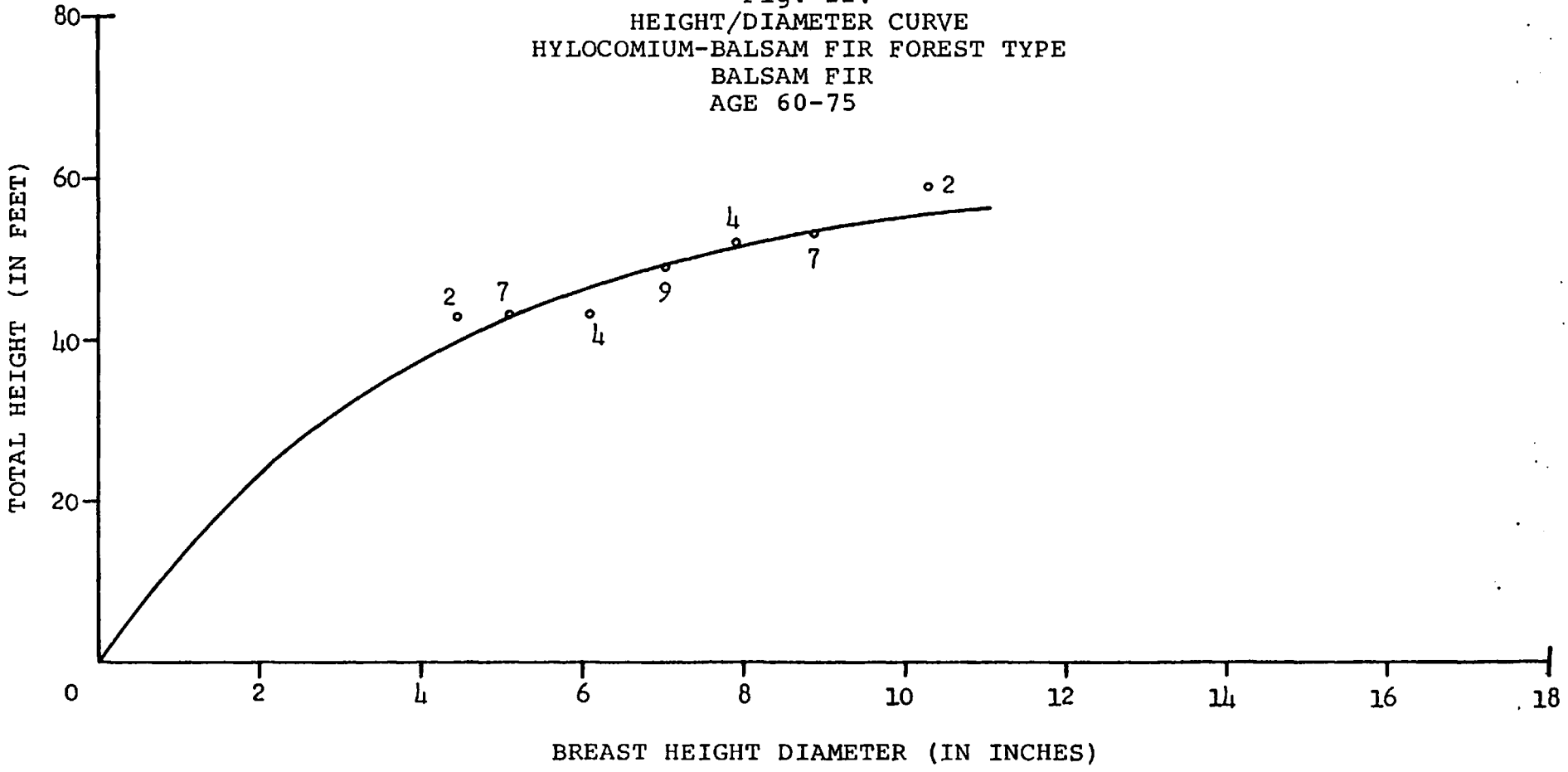


Fig. 23.
HEIGHT/DIAMETER CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 60-75

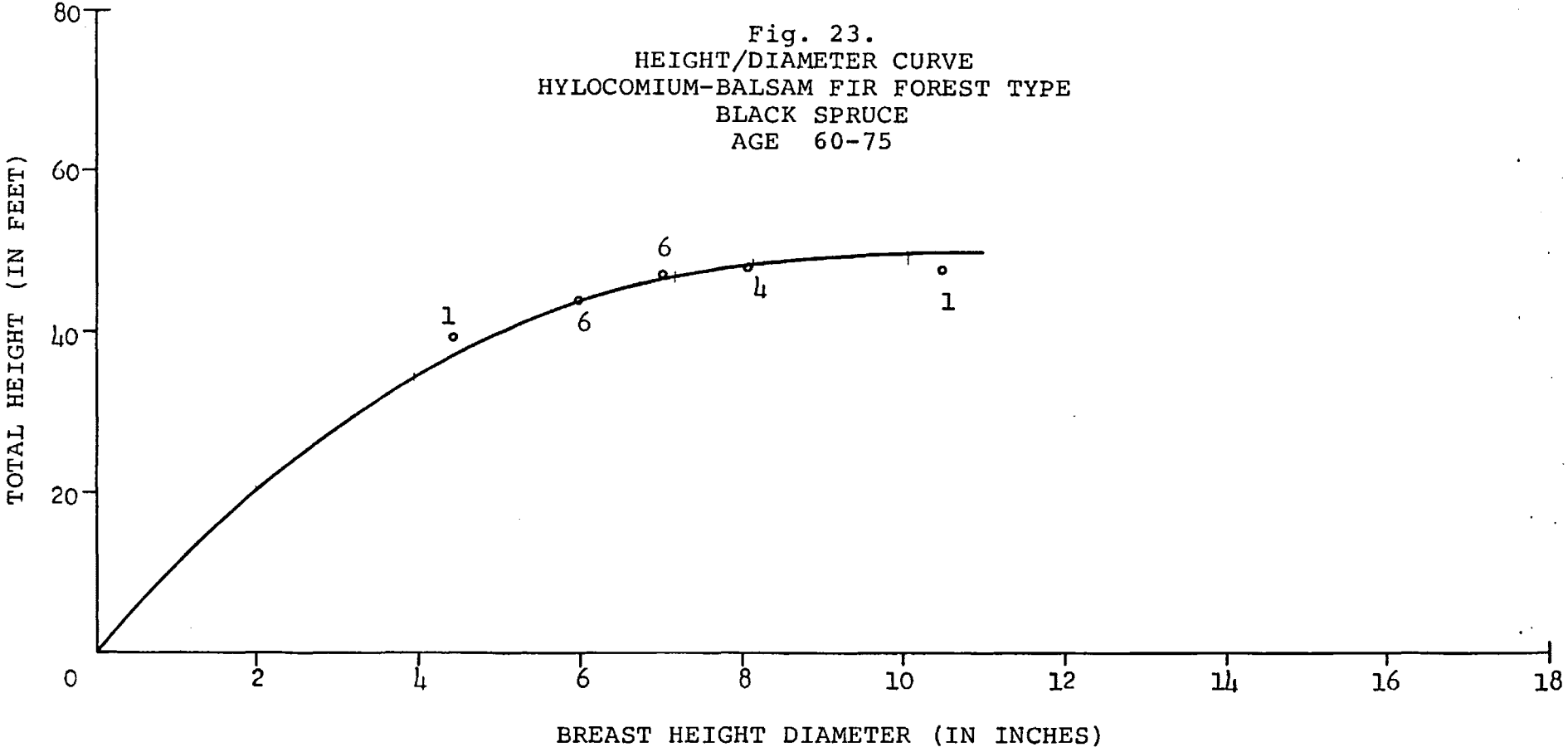


Fig. 24.
HEIGHT/DIAMETER CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 60-75

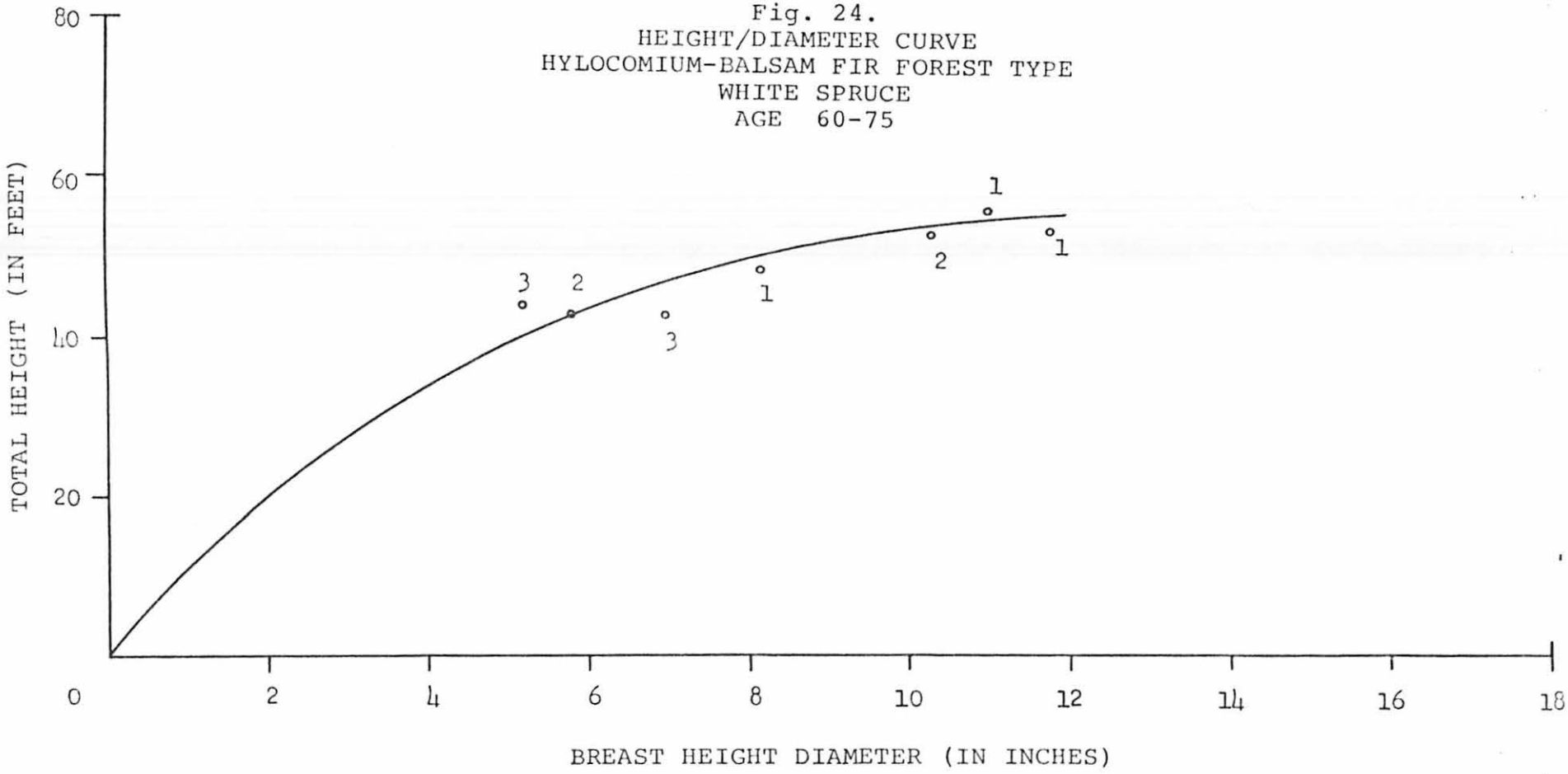


Fig. 25.
HEIGHT/AGE CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 60-75

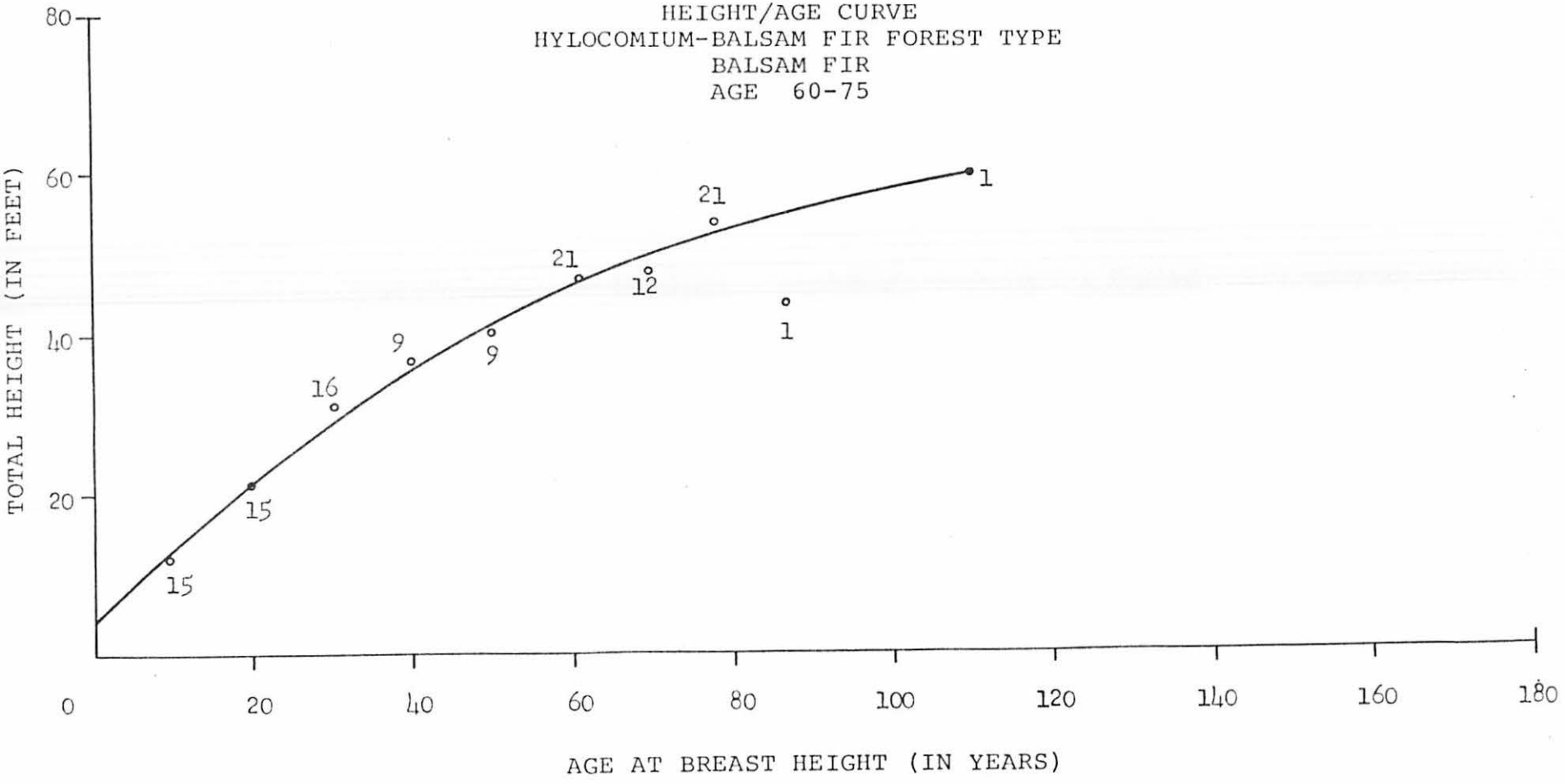


Fig. 26.
HEIGHT/AGE CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 60-75

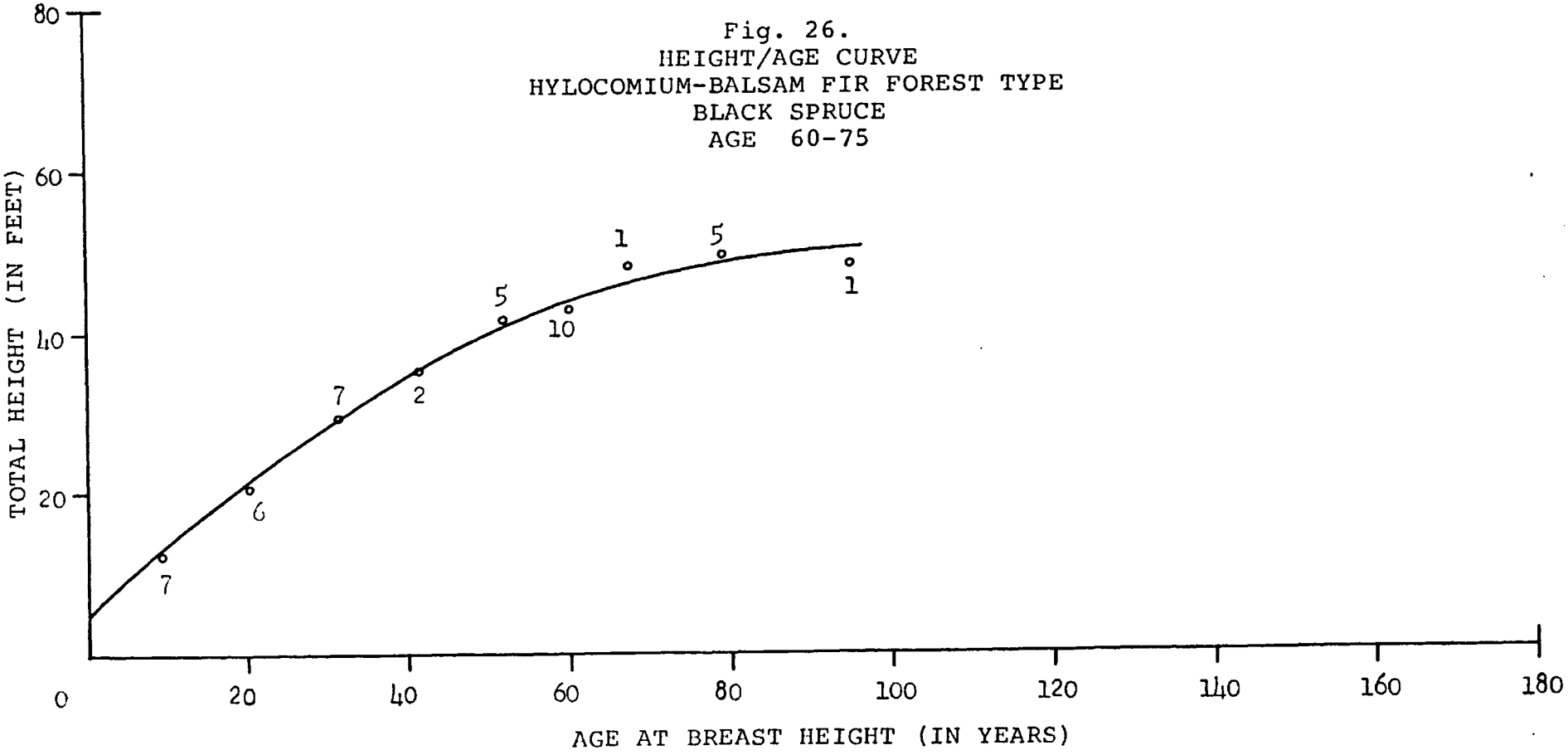


Fig. 27.
HEIGHT/AGE CURVE
HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 60-75

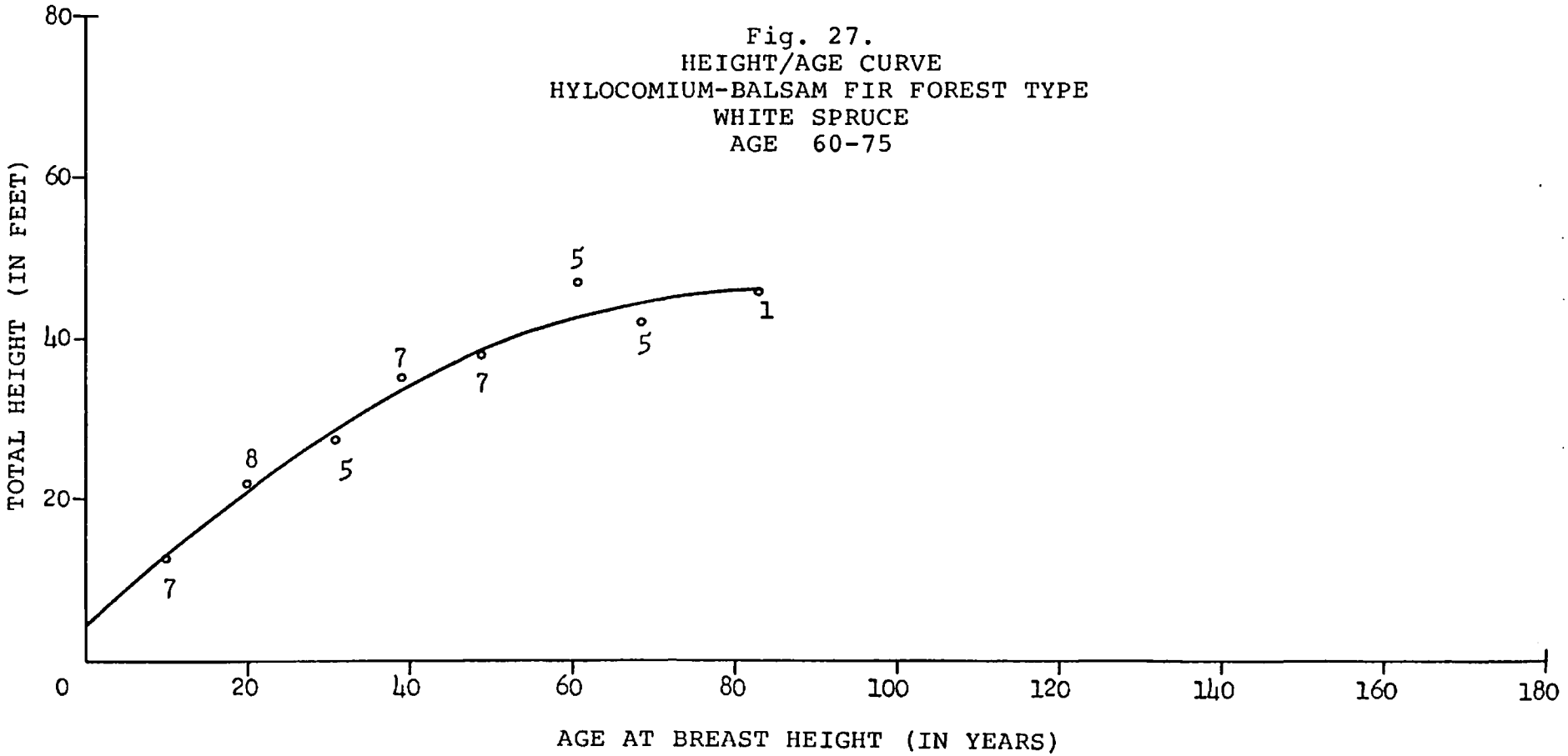


TABLE 11

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND STOCK TABLES

HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 60-75 Years

SPECIES:	BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE		
FORM CLASS:	71			60			59		
D.B.H. (Inches)	Height (Feet)	Merch.Vol.* per tree (cu. ft.)	Merch.Vol. Per Acre 1962 (cu. ft.)	Height (Feet)	Merch.Vol.* per tree (cu. ft.)	Merch.Vol. Per Acre 1962 (cu. ft.)	Height (Feet)	Merch.Vol.* per tree (cu. ft.)	Merch.Vol. Per Acre 1962 (cu. ft.)
4	37	1.4	386.96	35	1.0	12.10	34	0.7	0.98
5	42	2.5	551.75	40	2.0	24.20	39	1.7	6.12
6	46	3.9	557.31	44	3.5	54.95	44	3.0	4.20
7	49	5.7	520.98	47	5.3	56.71	47	4.6	6.44
8	51	7.8	312.00	48	7.2	51.12	50	6.7	9.38
9	53	10.3	213.21	49	9.5	34.20	52	8.8	12.32
10	55	13.4	143.38	50	12.1	25.41	54	11.4	7.98
11	57	16.5	117.15	-	-	-	55	14.0	29.40
12	58	19.9	41.79	50	17.5	12.25	56	17.1	23.94
13	59	23.8	-	-	-	-	57	20.5	14.35
14	60	28.1	39.34	-	-	-	57	24.0	-
15	-	-	-	52	28.3	19.81	58	28.0	-
16	-	-	-	-	-	-	58	32.0	22.40
TOTAL:			2883.87			290.75			137.51

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

TABLE 12

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 60-75 Years

Number of Plots: 14

D.b.h. Classes	BALSAM FIR			WHITE SPRUCE			BLACK SPRUCE		
	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)
	Living	Dead		Living	Dead		Living	Dead	
1	40.0	184.3	0.20	-	-	-	6.4	3.6	0.03
2	117.9	305.0	2.59	3.6	-	0.08	5.0	4.3	0.11
3	225.7	161.4	11.06	1.4	1.4	0.07	14.3	0.7	0.70
4	276.4	51.4	24.05	1.4	0.7	0.12	12.1	0.7	1.06
5	220.7	9.3	30.02	3.6	-	0.49	12.1	-	1.65
6	142.9	2.9	28.00	1.4	-	0.28	15.7	-	3.08
7	91.4	0.7	24.41	1.4	-	0.38	10.7	-	2.86
8	40.0	1.4	13.96	1.4	-	0.50	7.1	-	2.49
9	20.7	0.7	9.16	1.4	2.9	0.63	3.6	-	1.58
10	10.7	-	5.84	0.7	-	0.39	2.1	-	1.17
11	7.1	-	4.71	2.1	-	1.41	-	-	-
12	2.1	-	1.68	1.4	-	1.12	0.7	-	0.56
13	-	-	-	0.7	-	0.66	-	-	-
14	1.4	-	1.23	-	-	-	-	-	-
15	-	-	-	-	-	-	0.7	-	0.88
16	-	-	-	0.7	-	1.00	-	-	-
17	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-

TABLE 12 (Cont'd)

D.b.h. Classes	WHITE PINE			WHITE BIRCH			YELLOW BIRCH			T O T A L		
	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.
	Living	Dead		Living	Dead		Living	Dead		Living	Dead	
1	-	-	-	-	-	-	-	-	-	46.4	167.9	0.23
2	-	-	-	5.7	0.7	0.13	-	-	-	132.2	310.0	2.91
3	-	-	-	7.1	-	0.35	-	-	-	248.5	163.5	12.81
4	0.7	-	0.14	7.1	-	0.62	-	-	-	297.7	52.8	25.99
5	-	-	-	2.1	-	0.29	-	-	-	238.5	9.3	32.45
6	-	-	-	7.1	-	1.40	1.4	-	0.28	168.5	2.9	33.04
7	-	-	-	1.4	-	0.38	-	-	-	104.9	0.7	28.03
8	-	-	-	3.6	-	1.25	-	-	-	52.1	1.4	18.20
9	-	-	-	3.6	-	1.58	0.7	-	0.32	30.0	3.6	13.27
10	-	-	-	7.1	-	3.89	0.7	-	0.39	21.3	-	11.68
11	-	-	-	0.7	-	0.47	-	-	-	9.9	-	6.59
12	-	-	-	1.4	-	1.12	-	-	-	5.6	-	4.48
13	-	-	-	0.7	-	0.66	-	-	-	1.4	-	1.32
14	-	-	-	1.4	-	1.53	0.7	-	0.76	3.5	-	3.82
15	0.7	-	0.88	1.4	0.7	1.75	-	-	-	2.8	0.7	3.51
16	-	-	-	1.4	-	1.99	0.7	-	1.00	2.8	-	3.99
17	-	-	-	0.7	0.7	1.13	-	-	-	0.7	0.7	1.13
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	0.7	-	1.41	0.7	-	1.41
20	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL:	1.4	-	1.02	52.5	2.1	18.54	4.9	-	4.16	1367.5	713.5	204.86

Fig. 28.
STEM ANALYSIS DIAGRAM
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 60-75

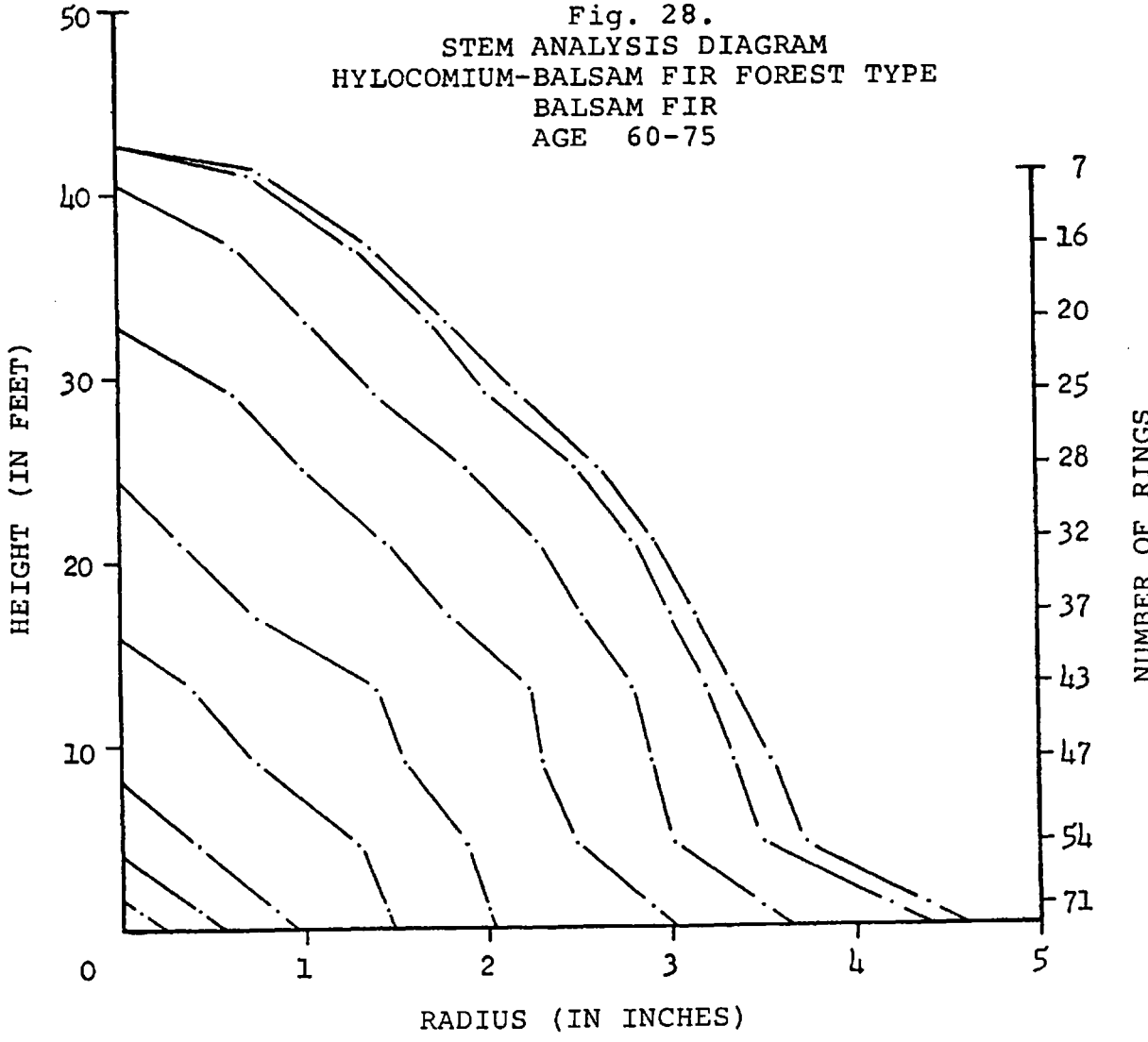


Fig. 29.
STEM ANALYSIS DIAGRAM
HYLOCOMIUM-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 60-75

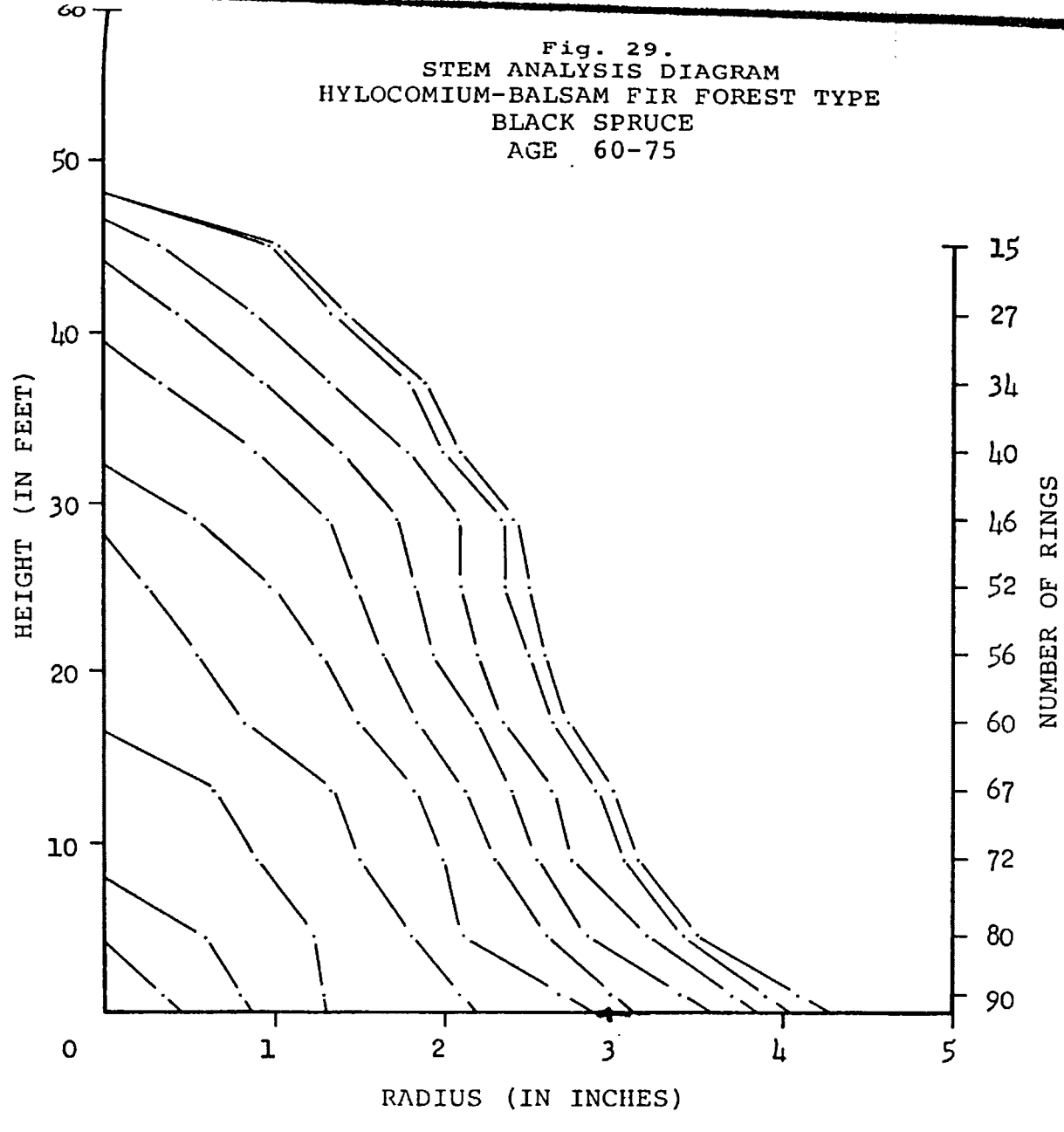


Fig. 30.
STEM ANALYSIS DIAGRAM
HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 60-75

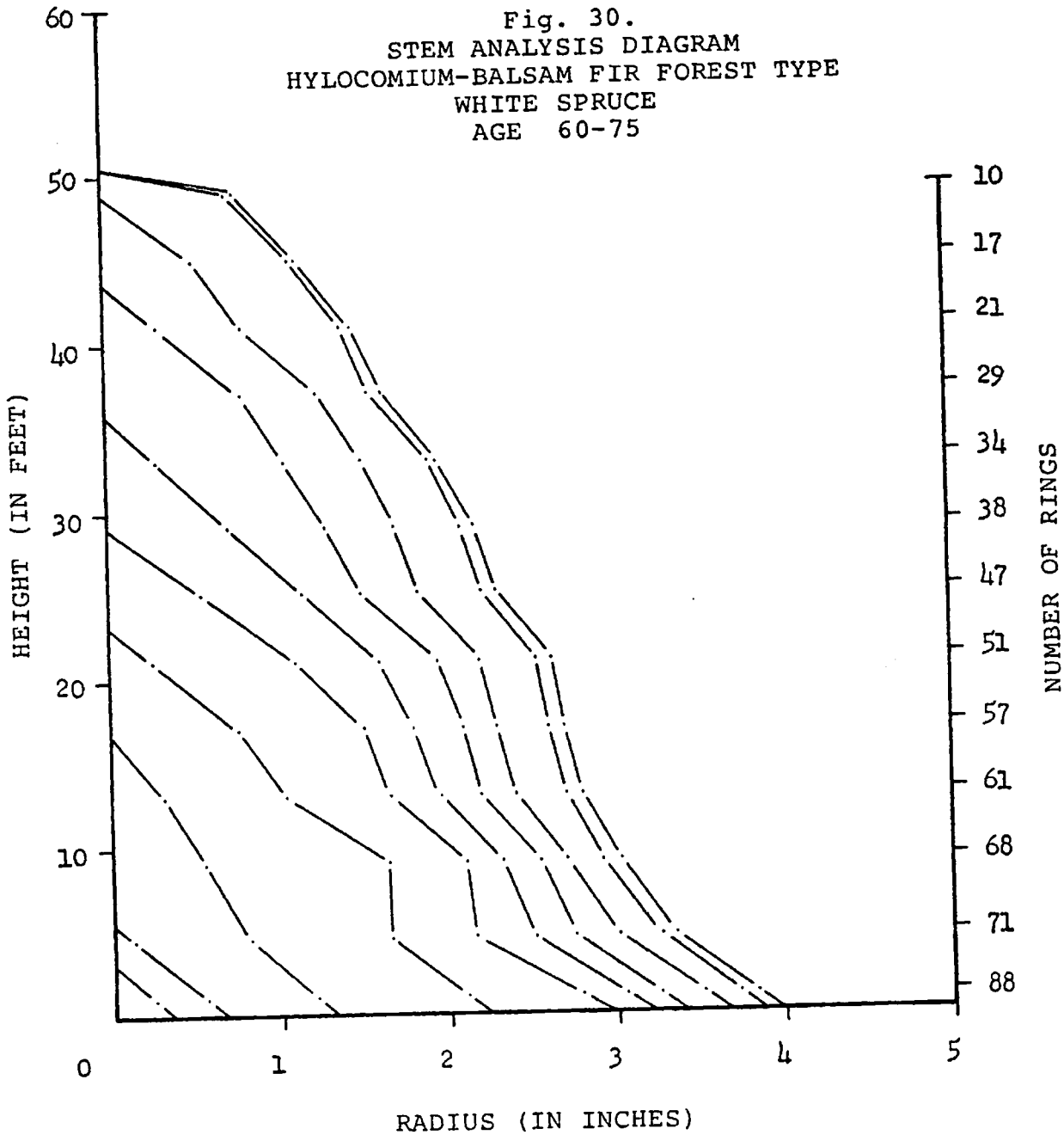


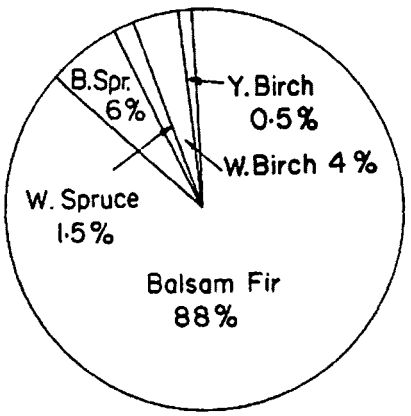
TABLE 13

STEM ANALYSIS DATA TABLE

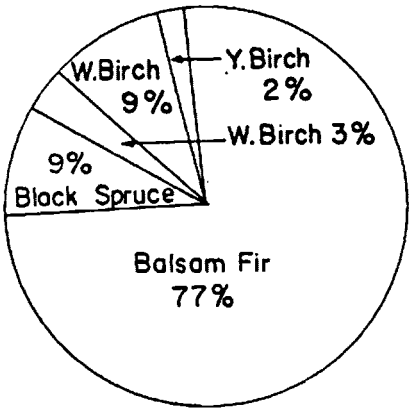
HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age Class: 60 - 75 Years

		BALSAM FIR (Fig. 28)	BLACK SPRUCE (Fig. 29)	WHITE SPRUCE (Fig. 30)
Age at breast height (years)		54	80	71
Diameter breast height (in.)		7.50	7.10	6.60
Total height (Feet)		42.5	48.2	50.4
Total volume (cu. ft.)		6.87	6.51	6.04
Merchantable volume (cu. ft.)		6.18	5.80	5.31
Total volume increment by decades (cu. ft.)	1963-1953	2.28	1.28	1.44
	1953-1943	2.08	1.17	1.05
	1943-1933	1.56	1.06	0.91
	1933-1923	0.67	1.05	0.76
	1923-1913	0.28	0.92	0.96
	1913-1903	0.05	0.07	0.73
	1903-1893	-	0.60	0.16
	1893-1883	-	0.29	0.02
	1883-1873	-	0.06	-
Merchantable volume increment (cu. ft.):	1953-1963	1.89	1.03	1.24



NUMBER OF TREES PER ACRE



BASAL AREA PER ACRE

Fig. 31. STAND TABLE DIAGRAM: HYLOCOMIUM-BALSAM FIR FOREST TYPE (AGE 60-75)

Dryopteris-Hylocomium-Balsam Fir Forest Type

Description

These forests are usually well-stocked and consist mainly of balsam fir, with white birch, yellow birch, and white spruce as regular components.

Acer spicatum and Sorbus americana are the most common shrubs. Dryopteris spinulosa var. americana is always present but usually covers less than 25% of the ground. The moss layer, dominated by Hylocomium splendens, forms a continuous carpet in all except young stands or stands with much birch in the tree layer. Small clumps of Sphagnum capillaceum, Sphagnum quinquefarium, and Bazzania trilobata are usually present, together with Clintonia, Cornus, Linnaea, Maianthemum, and Trientalis.

This is the most common forest type in western Newfoundland. It is found on orthic podzols formed on sandy loams and loamy sands, on shallow soils on loams, on till soils with a platy fragipan, and occasionally on moist gley podzols with seepage pseudogleying. This forest type is especially abundant on deep sandy loams of the Grand Lake Area and on sandy loams and loamy sands near Trout Brook, but it also occurs on terrace slopes in the glaciofluvial deposits along Harry's River.

Mensurational Characteristics

Height/diameter curves for balsam fir and white spruce (Figs. 32 and 33) both show a total height of 58-59 feet corresponding to a breast height diameter of 10 inches. There are considerable differences between the two species at other points on the curve, however. For instance, an average diameter of 4 inches corresponds to an average height of 40 feet for balsam fir but only 27 feet for white spruce. Height/age curves (Figs. 34 and 35) are similar in shape although the white spruce appears slower growing, reaching heights of 43 feet at 50 years and 52 feet at 80 years, as compared to the balsam fir which reaches 50 feet at 50 years and 64 feet at 80 years.

Total softwood merchantable volume for this forest type averages 3,030 cu. ft. per acre (Table 14). The number of living stems per acre (all species) averages 837 while basal area reaches 191 sq. ft. per acre (Table 15)

Balsam fir occupies 87% of the stands in terms of number of trees but only 71% in terms of basal area (Fig. 38). The balsam fir stem analysis tree shows greater volume increment than the white spruce tree, although height growth is very similar (Figs. 36 and 37, Table 16).

Regeneration is good, 88% of the total being balsam fir of less than 0.5 feet in height. Balsam fir and white spruce between 0.6 and 1.5 feet high occupy 11% of the quadrats, while balsam fir and white birch occur on 1% of the total (Table 28).

Fig. 32.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 55-67

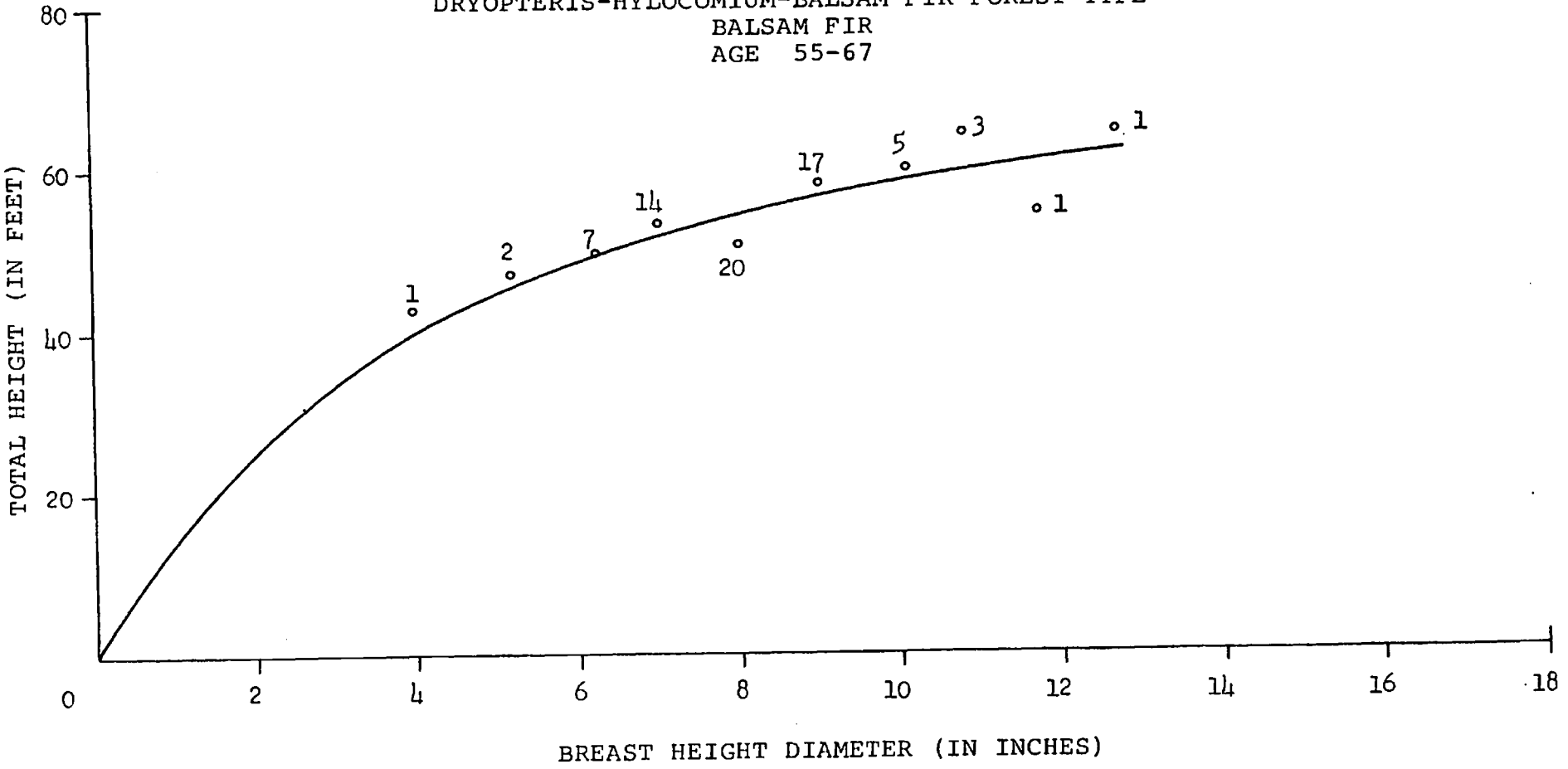


Fig. 33.
HEIGHT/DIAMETER CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 55-67

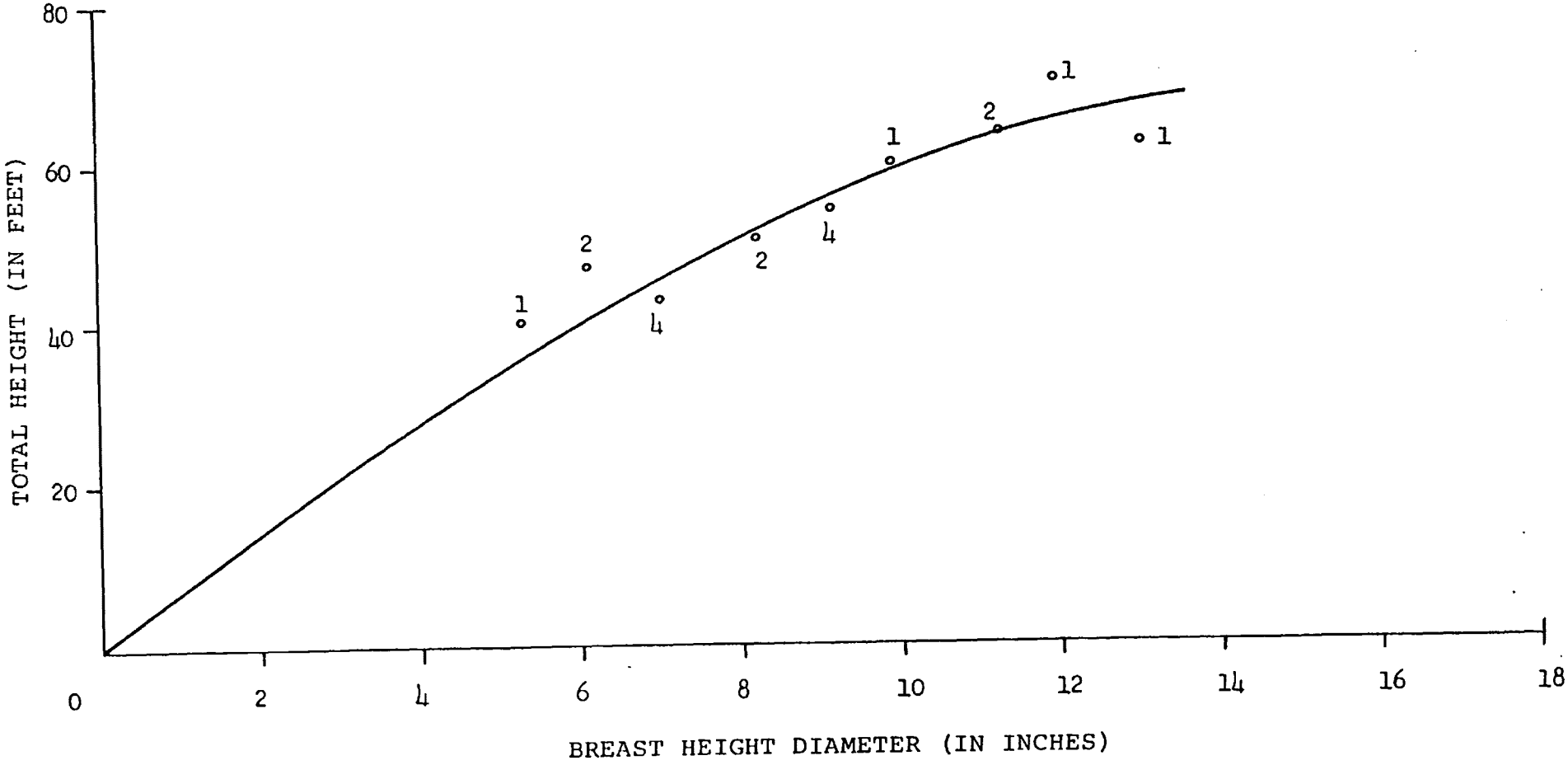


Fig. 34.
HEIGHT/AGE CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 55-67

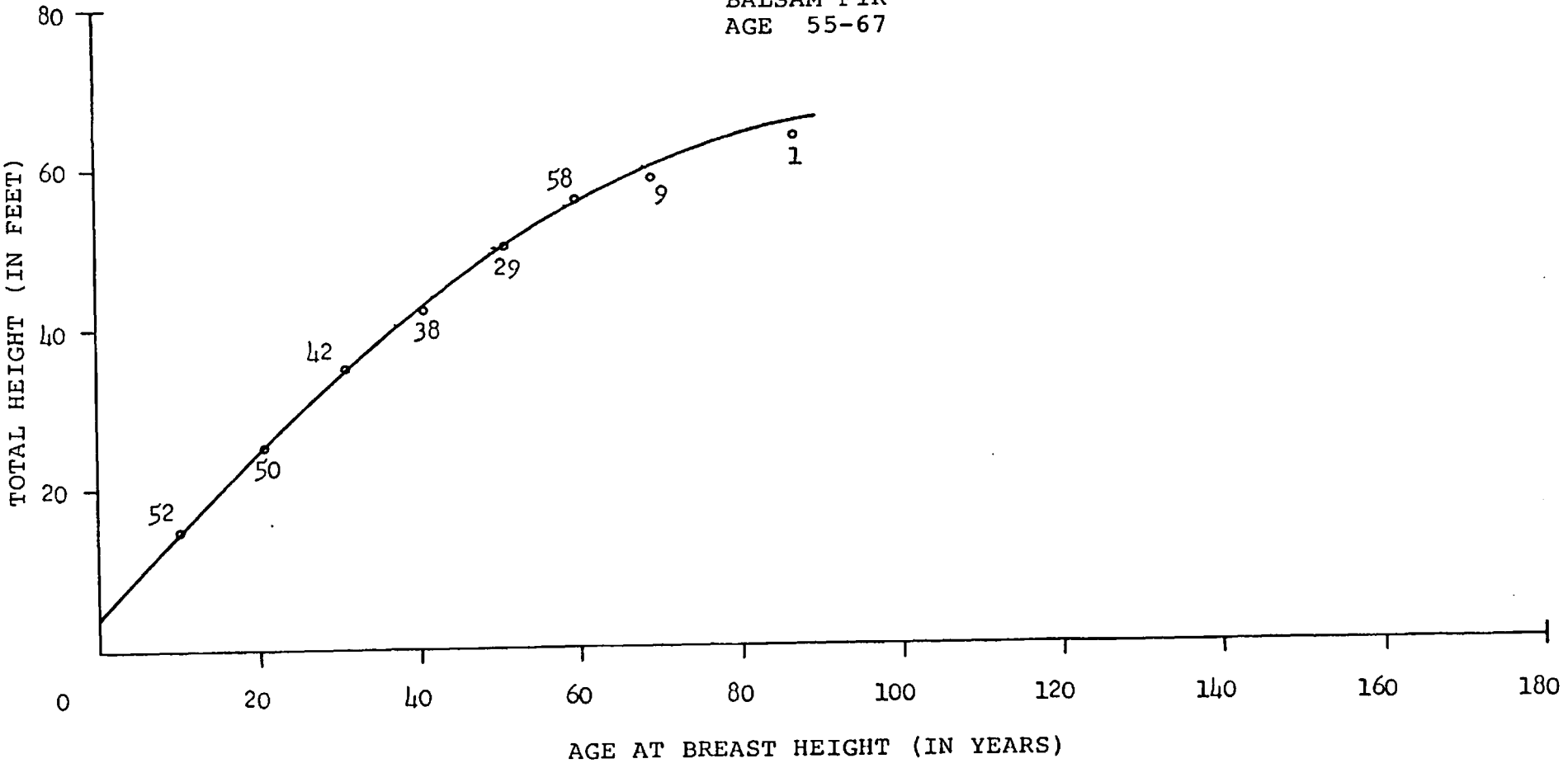


Fig. 35.
HEIGHT/AGE CURVE
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 55-67

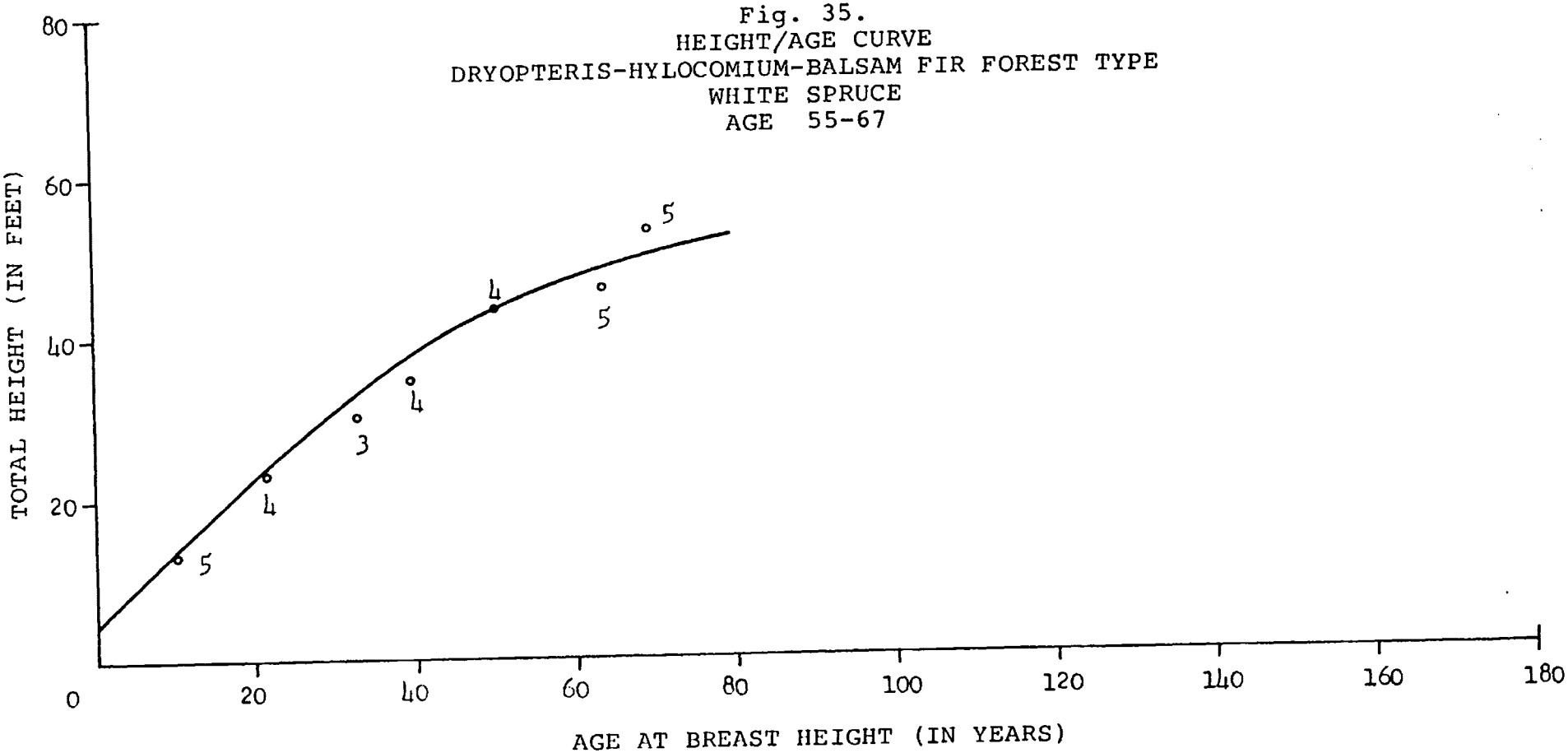


TABLE 14

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND STOCK TABLES

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 55 - 67 years

SPECIES:	BALSAM FIR			WHITE SPRUCE		
FORM CLASS:	67			68		
D.b.h. (Inches)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch. Vol. Per Acre 1962 (Cu. Ft.)
4	40	1.5	154.65	27	0.9	3.15
5	45	2.6	287.04	33	1.8	-
6	49	4.1	410.00	39	3.2	2.56
7	52	5.9	528.64	45	5.1	7.65
8	54	8.1	498.15	50	7.4	8.88
9	56	10.6	326.48	55	10.3	12.36
10	58	13.4	221.10	59	13.7	5.48
11	60	16.8	136.08	63	17.8	7.12
12	61	20.2	171.70	66	22.3	33.45
13	62	24.1	84.35	67	26.6	10.64
14	63	28.5	11.40	68	31.4	25.12
15	63	32.7	39.24	-	-	-
16	64	37.8	15.12	-	-	-
17	64	42.7	34.16	-	-	-
TOTAL:			2918.11			116.41

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

TABLE 15

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age: 55 - 67 Years

Number of Plots: 26

.b.h. lasses	BALSAM FIR			WHITE SPRUCE			WHITE BIRCH		
	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)
	Living	Dead		Living	Dead		Living	Dead	
1	26.5	50.4	.13	-	-	-	-	0.4	-
2	74.6	76.9	1.64	1.2	0.4	0.03	1.2	1.9	0.03
3	90.4	41.2	4.43	-	0.8	-	6.9	2.7	0.34
4	103.1	21.2	8.97	3.5	-	0.30	8.8	-	0.77
5	110.4	6.2	15.01	-	-	-	7.7	-	1.05
6	100.0	0.8	19.60	0.8	-	0.15	8.1	-	1.58
7	89.6	0.8	23.93	1.5	-	0.41	6.2	0.4	1.64
8	61.5	0.4	21.48	1.2	-	0.40	2.3	-	0.81
9	30.8	-	13.60	1.2	-	0.51	2.3	-	1.02
10	16.5	-	9.01	0.4	-	0.21	4.2	-	2.31
11	8.1	0.8	5.33	0.4	-	0.25	6.2	-	4.06
12	8.5	-	6.64	1.5	-	1.21	3.1	-	2.42
13	3.5	0.4	3.19	0.4	-	0.35	2.3	-	2.13
14	0.4	0.4	0.41	0.8	-	0.82	5.0	0.4	5.34
15	1.2	-	1.42	-	-	-	3.1	-	3.78
16	0.4	-	0.52	-	-	-	0.4	-	0.54
17	0.8	-	1.21	-	-	-	0.4	-	0.61
18	-	-	-	-	-	-	0.8	0.4	1.36
19	-	-	-	-	-	-	0.4	-	0.76
20	-	-	-	-	-	-	0.8	-	1.68
21	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	0.4	-	1.21
30	-	-	-	-	-	-	0.4	-	1.89

TABLE 15 (Cont'd)

.h. sses	YELLOW BIRCH			MAPLE			MOUNTAIN ASH			TOTAL		
	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.	No. of Trees per acre		Basal Area per ac. Sq. Ft.
	Living	Dead		Living	Dead		Living	Dead		Living	Dead	
1	-	-	-	-	-	-	-	-	-	26.5	50.8	0.13
2	1.2	-	0.03	-	-	-	-	-	-	78.2	79.2	1.73
3	1.2	-	0.06	-	-	-	0.8	-	0.04	99.3	44.7	4.87
4	1.5	-	0.13	-	-	-	1.2	-	0.10	118.1	21.2	10.27
5	2.3	-	0.31	0.8	-	0.10	0.4	-	0.05	121.6	6.2	16.52
6	1.9	-	0.38	0.4	-	0.08	0.4	-	0.08	111.6	0.8	21.95
7	1.5	0.4	0.41	0.8	-	0.21	0.4	-	0.10	100.0	1.6	26.70
8	1.2	-	0.40	-	-	-	-	-	-	66.2	0.4	23.09
9	0.4	-	0.17	-	-	-	-	-	-	34.7	-	15.30
10	1.9	-	1.05	-	-	-	-	-	-	23.0	-	12.58
11	2.3	-	1.52	-	-	-	-	-	-	17.0	0.8	11.16
12	1.5	-	1.21	-	-	-	-	-	-	14.6	-	11.48
13	0.4	-	0.35	-	-	-	-	-	-	6.6	0.4	6.02
14	-	-	-	-	-	-	-	-	-	6.2	0.8	6.57
15	0.8	-	0.94	-	-	-	-	-	-	5.1	-	6.14
16	1.5	-	2.15	-	-	-	-	-	-	2.3	-	3.23
17	0.4	-	0.61	-	-	-	-	-	-	1.6	-	2.43
18	0.4	-	0.68	-	-	-	-	-	-	1.2	0.4	2.04
19	0.4	-	0.76	-	-	-	-	-	-	0.8	-	1.52
20	0.4	-	0.84	-	-	-	-	-	-	1.2	-	2.52
21	0.4	-	0.92	-	-	-	-	-	-	0.4	-	0.92
24	0.4	-	1.21	-	-	-	-	-	-	0.8	-	2.42
30	-	-	-	-	-	-	-	-	-	0.4	-	1.89
TOTAL:	22.0	0.4	14.13	2.0	-	0.39	3.2	-	0.37	837.4	207.3	191.48

Fig. 36.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 55-67

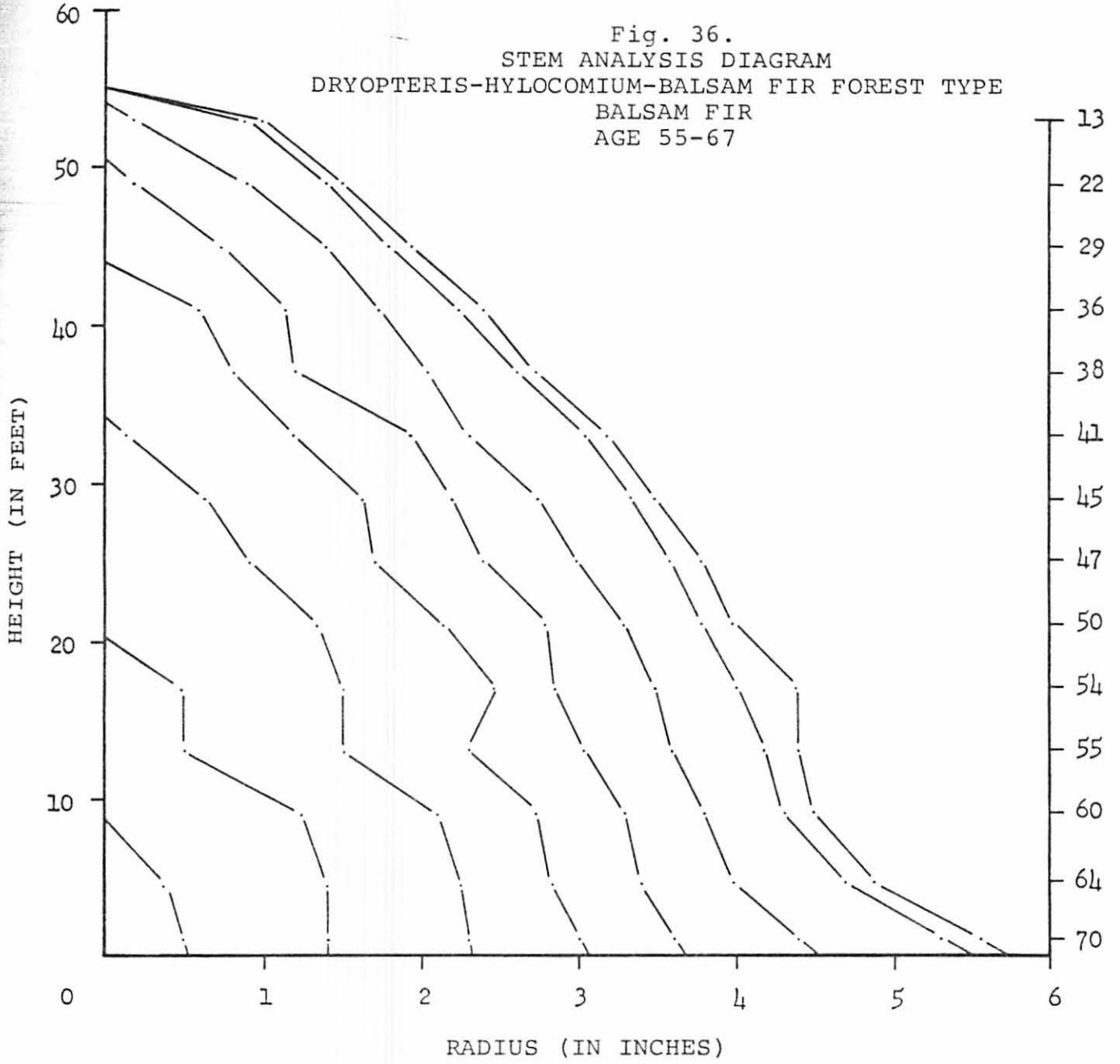


Fig. 37.
STEM ANALYSIS DIAGRAM
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 55-67

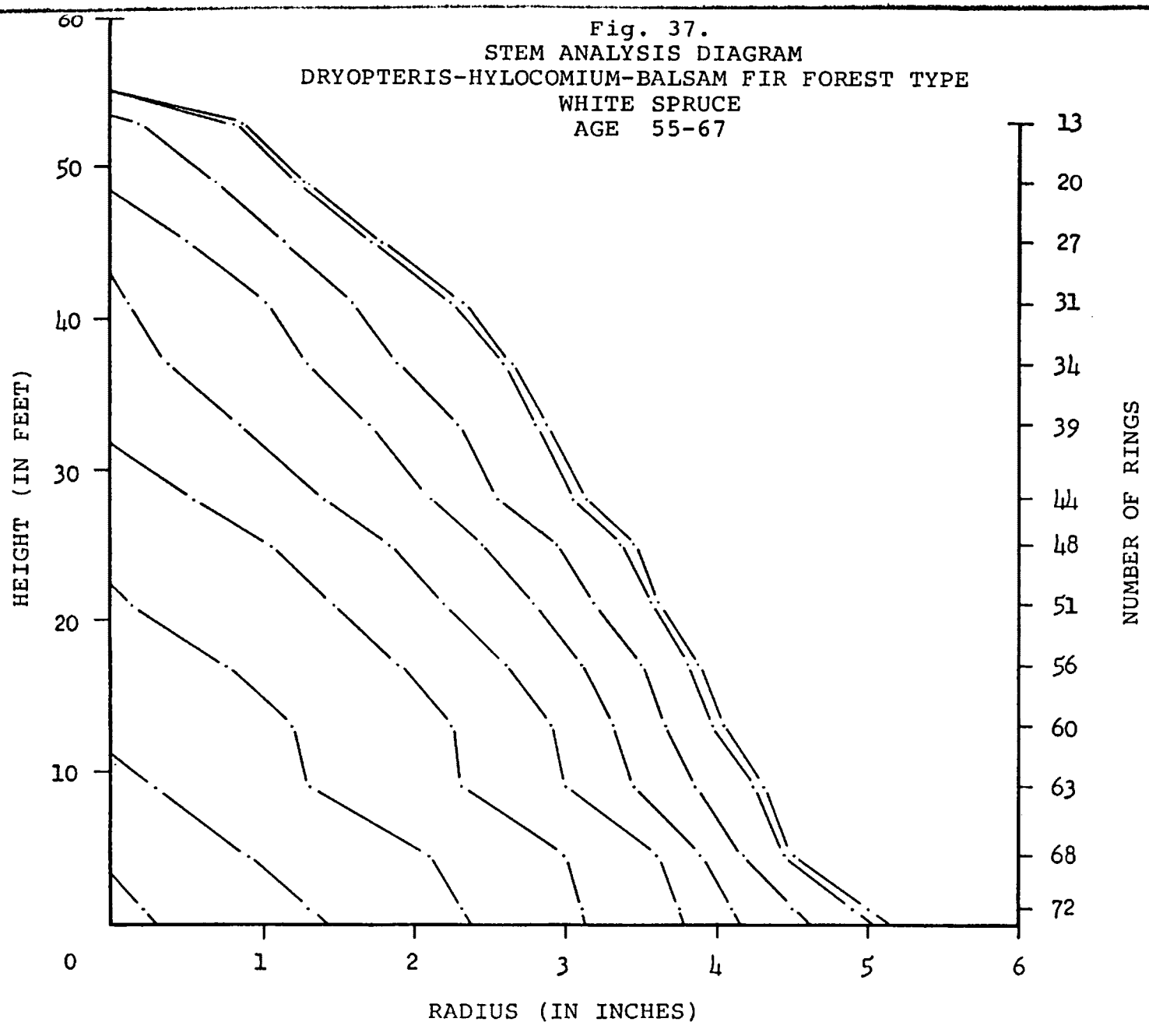


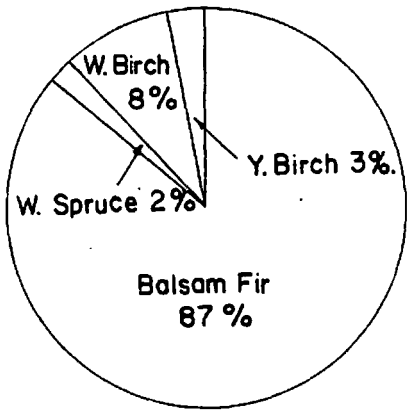
TABLE 16

STEM ANALYSIS DATA TABLE

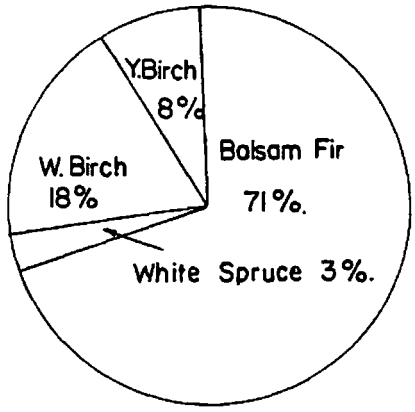
DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE

Age Class: 55-67 Years

		BALSAM FIR (Fig. 36)	WHITE SPRUCE (Fig. 37)
Age at breast height (years)		64	68
Diameter breast height (inches)		9.85	9.05
Total height (feet)		55.1	54.9
Total volume (cu. ft.)		14.13	12.6
Merchantable volume (cu. ft.)		13.15	11.76
Total volume increment by decades (cu. ft.)	1963-1953	4.33	2.89
	1953-1943	3.36	2.34
	1943-1933	2.30	2.27
	1933-1923	2.25	2.15
	1923-1913	1.37	1.89
	1913-1903	0.45	0.87
	1903-1893	-	0.18
Merchantable volume increment (cu. ft.):-	1953-1963	4.05	2.65



NUMBER OF TREES PER ACRE



BASAL AREA PER ACRE

Fig. 38. STAND TABLE DIAGRAM: DRYOPTERIS-HYLOCOMIUM-BALSAM FIR FOREST TYPE (AGE 55-67)

Taxus-Balsam Fir Forest Type (Epigaea Subtype)

Description

This forest type consists of nearly pure balsam fir with some black spruce, and scattered white spruce and white birch.

Patches of Taxus canadensis occur irregularly throughout this type. Scattered specimens of Acer spicatum, Cornus stolonifera, and Amelanchier sp. are also to be found. Trientalis, Linnaea, Clintonia, Cornus, and Dryopteris are common, together with Epigaea repens, Gaultheria hispidula, Coptis groenlandica, and Aralia nudicaulis. The continuous moss carpet is dominated by Hylocomium splendens, but Sphagnum capillaceum, Sphagnum quinquefarium, and Bazzania trilobata are also common.

The Epigaea subtype often occurs in close association with the type, but stands of the subtype are generally more open and less productive. They occur on shallow and strongly-mottled limestone pseudogleysols in limestone areas with shallow englacial till layers. A raw humus layer of 6-12 inches in depth is usually present.

Mensurational Characteristics

Balsam fir and black spruce have similar height/diameter relationships (Figs. 39 and 40), reaching breast height diameters of 5 inches at 20 feet and 10 inches at 30 feet. White spruce has an average height of 36 feet at 5 inches diameter and 53 feet at 10 inches diameter (Fig. 41). Height/age curves for white spruce and black spruce are very similar in shape reaching 18 and 21 feet at 50 years and 34 and 38 feet at 100 years respectively (Figs. 43 and 44). The balsam fir curve is essentially similar in shape but somewhat steeper, reaching 25 feet at 50 years and 43 feet at 100 years (Fig. 42).

Total softwood merchantable volume per acre averages 1,665 cu. ft. (Table 17). Total number of living trees per acre (all species) equals 1,137, and basal area averages 118 sq. ft. per acre (Table 18).

In terms of number of stems per acre balsam fir occupies 82% of this forest type and black spruce 12%, while in terms of basal area per acre the figures are 76% and 12% respectively (Fig. 47). The balsam fir stem analysis shows more rapid growth in height and volume than does that for black spruce (Figs. 45 and 46, and Table 19).

Regeneration is usually poor to adequate. Balsam fir of 0.6 - 1.5 feet in height occupied 40% of the sample quadrats, black spruce 1.6 - 2.5 feet high occupied 4%, and mixed balsam fir and black spruce (2.6 - 3.5 feet high) was present on a further 4% (Table 28). 52% of the quadrats were unstocked.

Fig. 39.
HEIGHT/DIAMETER CURVE
TAXUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 93-120

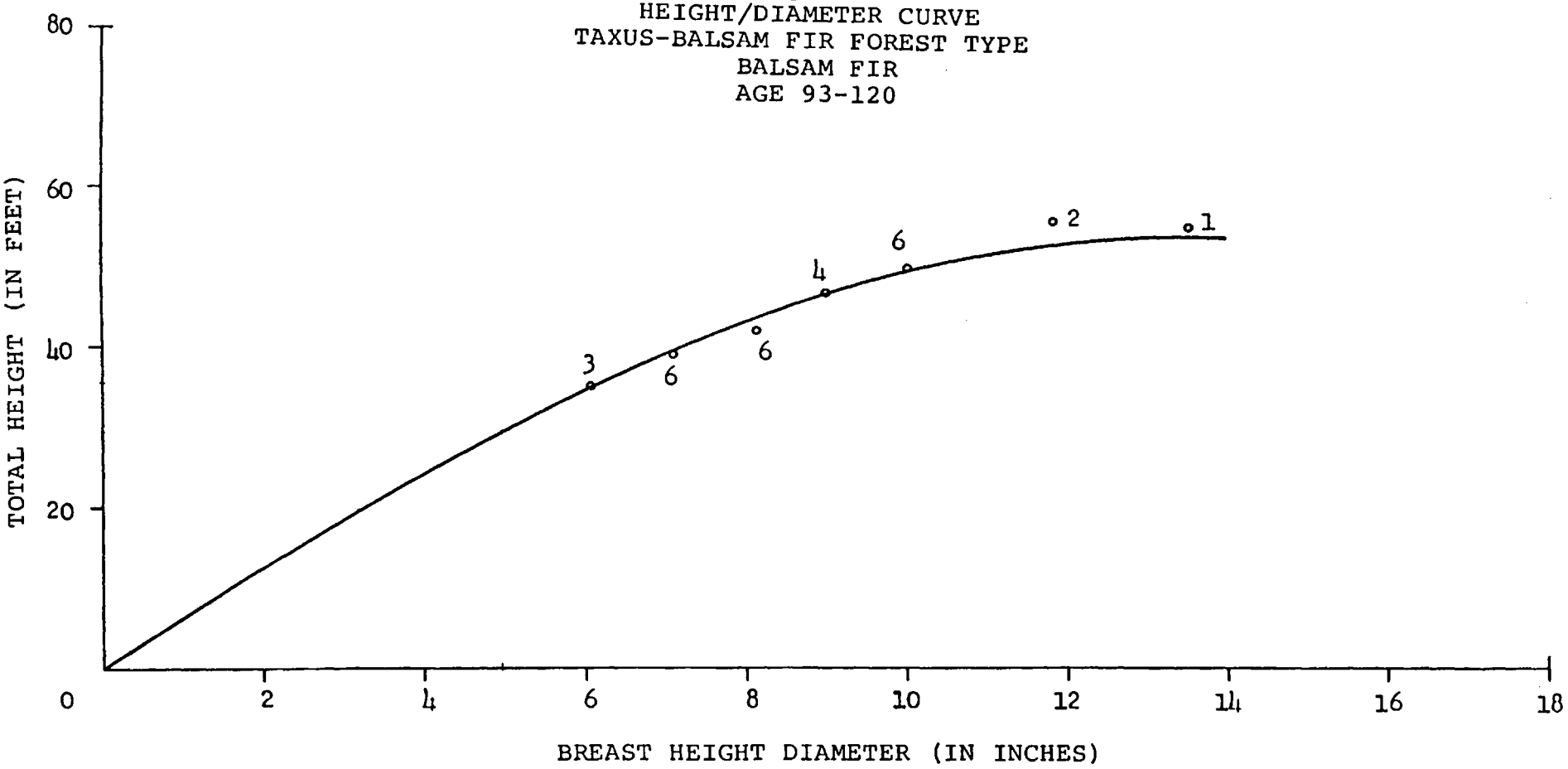


Fig. 40.
HEIGHT/DIAMETER CURVE
TAXUS-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 93-120

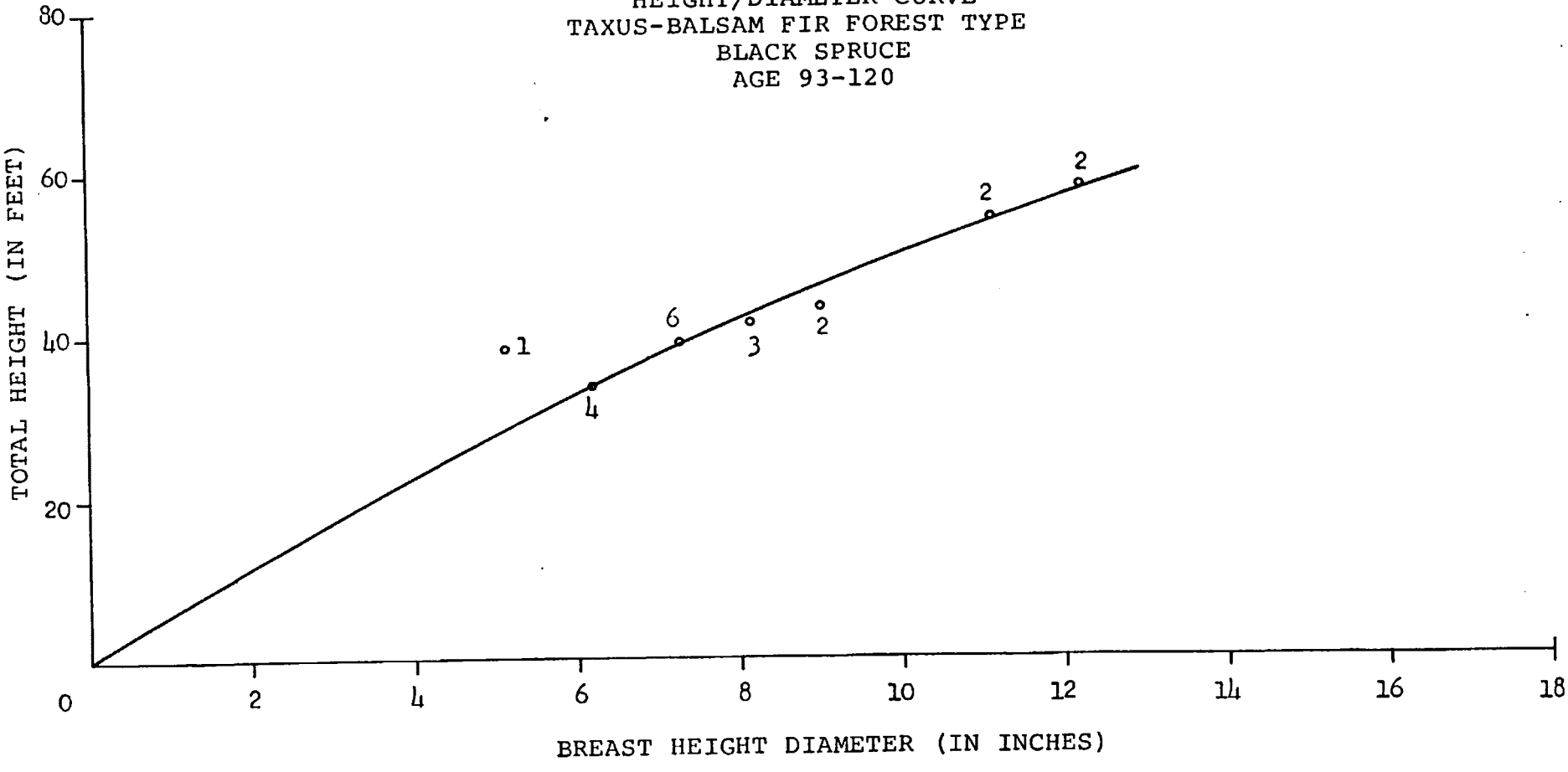


Fig. 41.
HEIGHT/DIAMETER CURVE
TAXUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 93-120

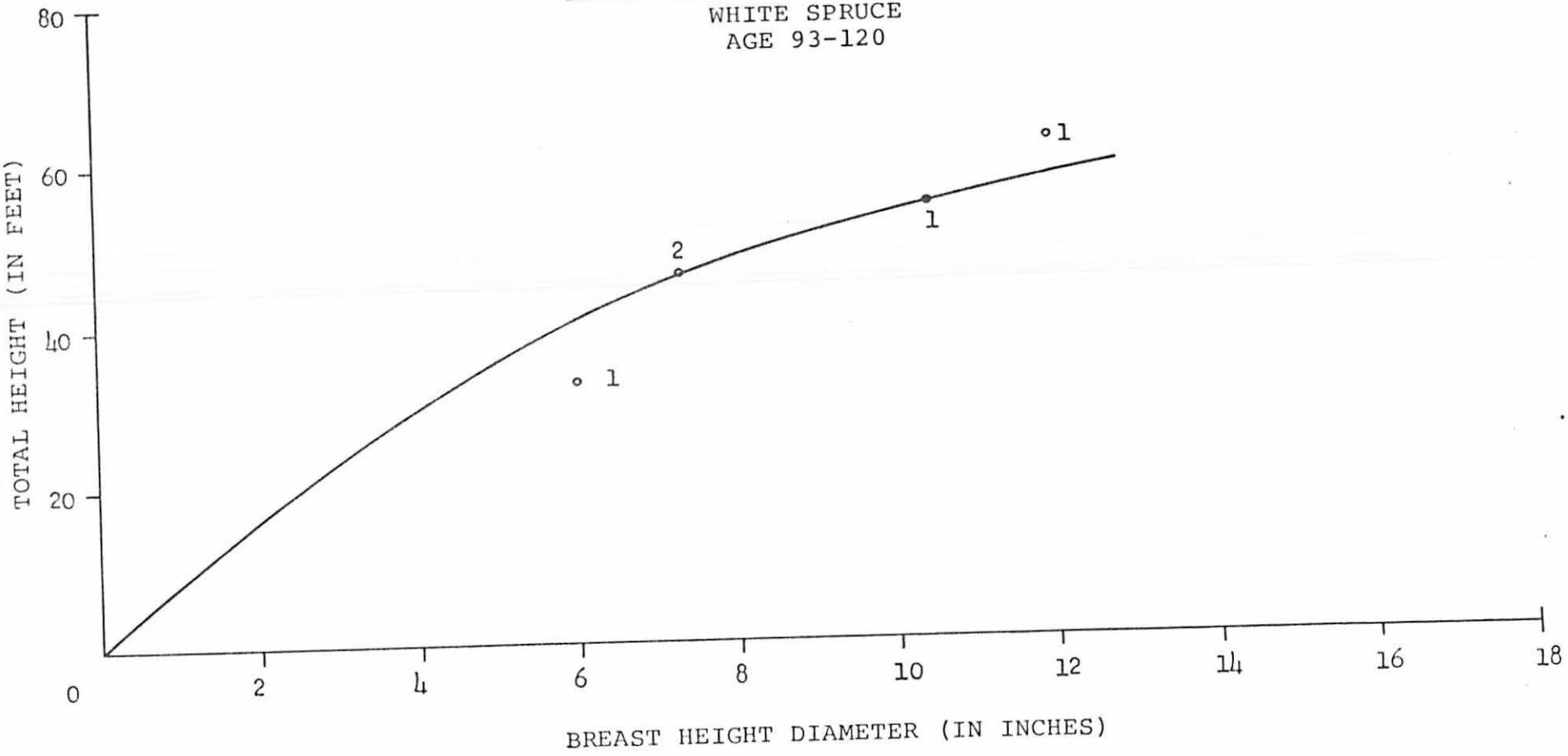


Fig. 42.
HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 93-120

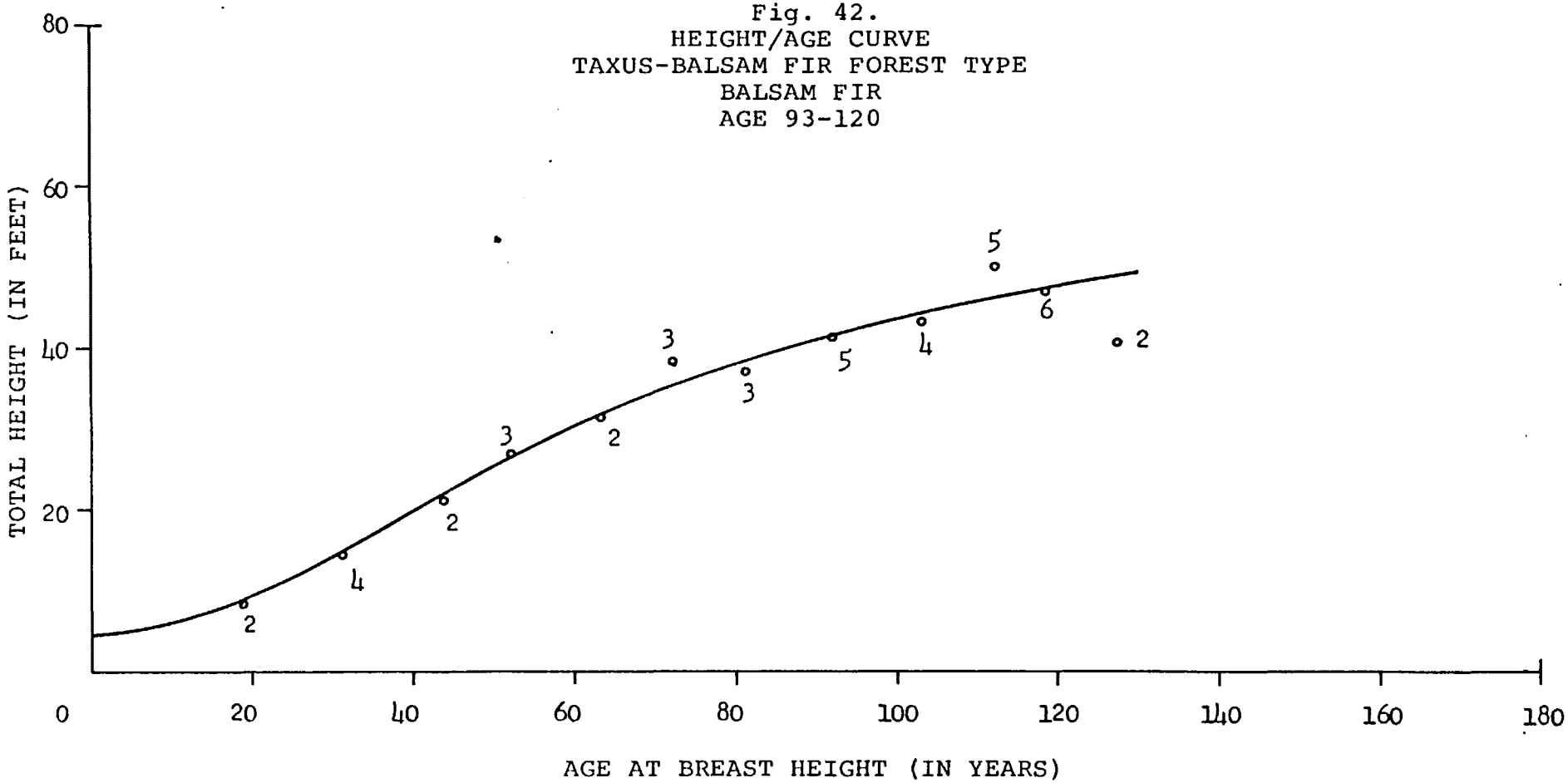


Fig. 43.
HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 93-120

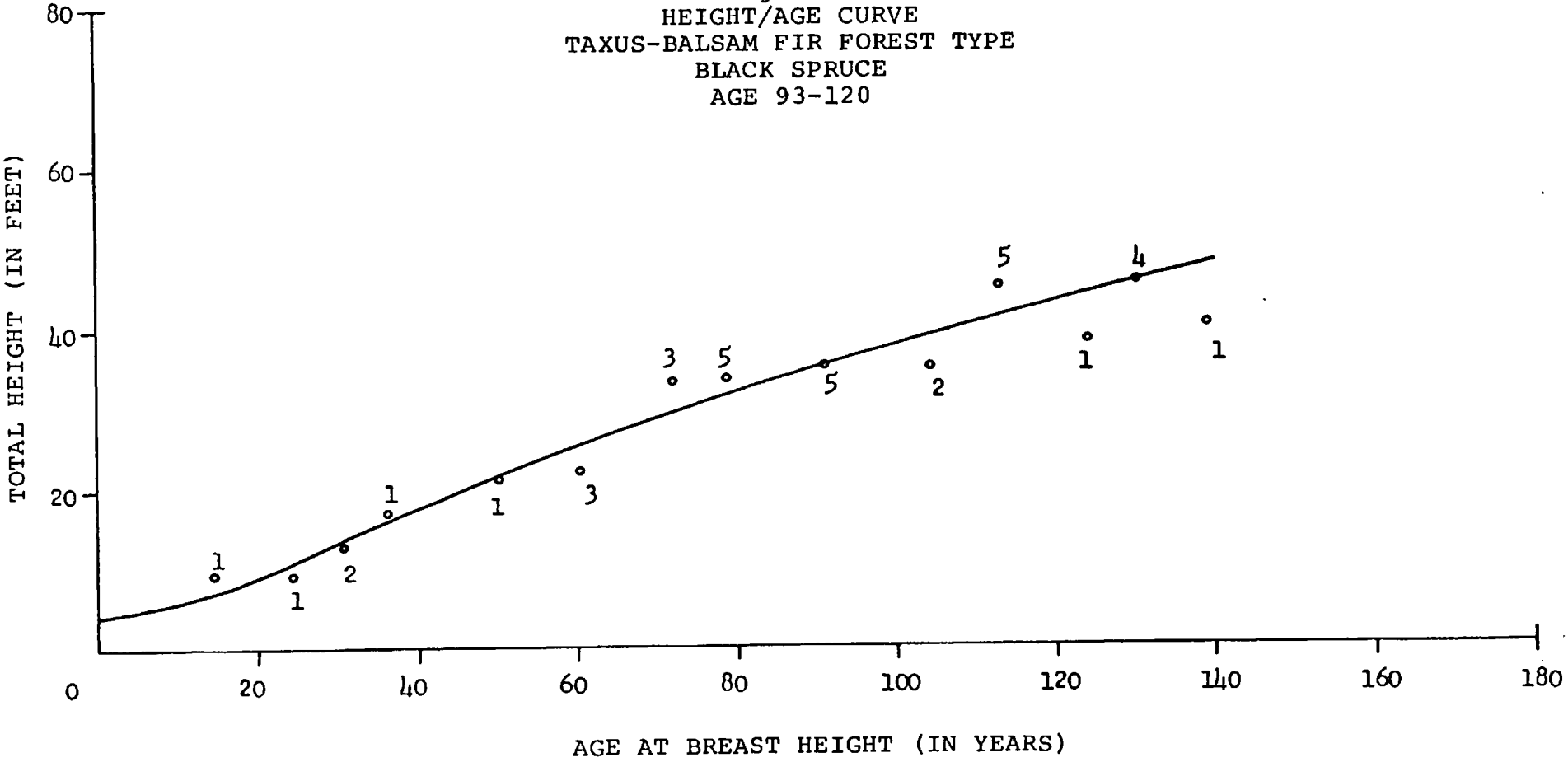


Fig. 44.
HEIGHT/AGE CURVE
TAXUS-BALSAM FIR FOREST TYPE
WHITE SPRUCE
AGE 93-120

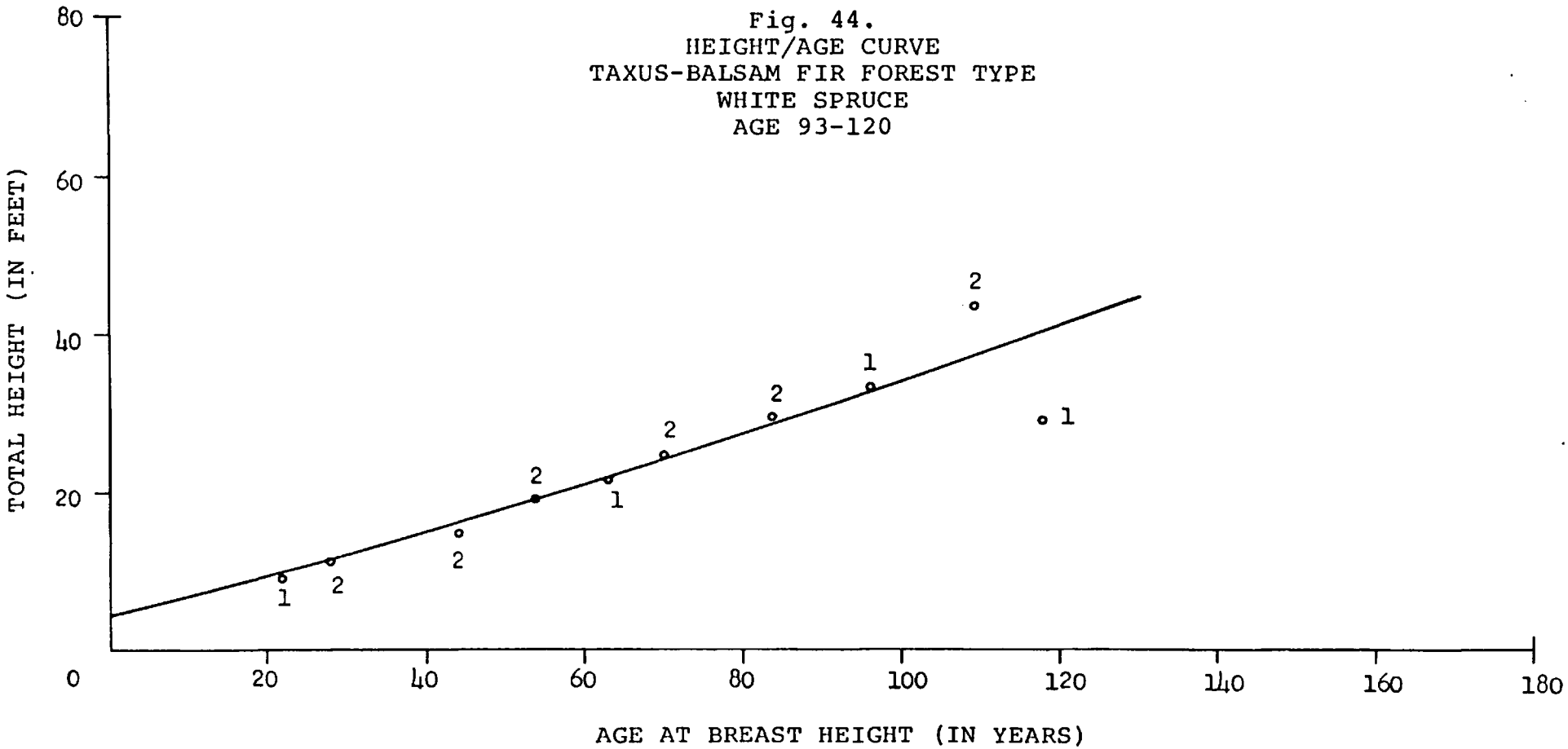


TABLE 17

LOCAL FORM CLASS MERCHANTABLE VOLUME TABLES AND STOCK TABLES

TAXUS-BALSAM FIR FOREST TYPE

Age: 93-120 Years

SPECIES:		BALSAM FIR			BLACK SPRUCE			WHITE SPRUCE		
FORM CLASS:		65			71			60		
D.b.h. (Inches)	Height (Feet)	Merch.Vol.* Per Tree (Cu. Ft.)	Merch.Vol. Per Ac. 1962 (Cu. Ft.)	Height (Feet)	Merch. Vol.* Per Tree (Cu. Ft.)	Merch.Vol. Per Ac. 1962 (Cu. Ft.)	Height (Feet)	Merch.Vol.* Per Tree (Cu. Ft.)	Merch.Vol. Per Ac. 1962 (Cu. Ft.)
4	23	1.1	115.94	23	0.8	3.04	29	0.6	0.48
5	28	1.9	166.63	28	1.5	5.70	35	1.6	1.28
6	34	3.1	209.87	33	2.6	22.10	40	2.8	-
7	39	4.6	236.90	37	4.2	32.34	45	4.5	10.35
8	43	6.5	165.10	42	6.3	34.02	48	6.4	14.72
9	47	8.9	178.80	46	8.9	27.59	51	8.6	-
10	50	11.5	115.00	50	12.1	45.98	53	11.2	8.96
11	52	14.4	33.12	53	15.5	35.65	55	14.0	21.00
12	54	17.7	67.26	57	19.7	15.76	57	17.4	-
13	55	21.1	31.65	60	24.3	19.44	60	21.7	17.36
14	56	24.5	19.92	-	-	-	-	-	-
TOTAL:			1340.19			241.62			74.15

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

TABLE 18

STAND TABLES AND BASAL AREA TABLES (BY SPECIES)

TAXUS-BALSAM FIR FOREST TYPE

Age: 93-120 years

Number of Plots: 13

b.h. Classes	BALSAM FIR			WHITE SPRUCE			BLACK SPRUCE		
	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)	No. of Trees per acre		Basal Area per acre (Sq. Ft.)
	Living	Dead		Living	Dead		Living	Dead	
1	245.4	23.1	1.23	3.1	-	0.02	67.7	-	0.34
2	193.8	13.8	4.26	3.8	-	0.08	20.8	-	0.46
3	126.9	6.9	6.22	0.8	-	0.04	4.6	-	0.23
4	105.4	3.1	9.17	0.8	-	0.07	3.8	-	0.33
5	87.7	0.8	11.93	-	-	-	3.8	-	0.52
6	67.7	-	13.27	2.3	-	0.45	8.5	-	1.66
7	51.5	0.8	13.76	2.3	-	0.62	7.7	-	2.05
8	25.4	-	8.86	-	-	-	5.4	-	1.88
9	20.0	2.3	8.84	0.8	-	0.34	3.1	-	1.36
10	10.0	2.3	5.45	1.5	-	0.84	3.8	-	2.10
11	2.3	-	1.52	-	-	-	2.3	-	1.52
12	3.8	0.8	3.02	0.8	-	0.60	0.8	-	0.60
13	1.5	-	1.42	-	-	-	0.8	-	0.71
14	0.8	-	0.82	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-
TAL:	942.2	53.9	89.77	16.2	-	3.06	133.1	-	13.76

Cont'd

TABLE 15 (Cont'd)

b.h.	WHITE BIRCH			MAPLE			MOUNTAIN ASH			T O T A L		
	No. of Trees per acre		Basal Area	No. of Trees per acre		Basal Area	No. of Trees per acre		Basal Area	No. of Trees per acre		Basal Area
	Living	Dead	per ac. Sq. Ft.	Living	Dead	per ac. Sq. Ft.	Living	Dead	per ac. Sq. Ft.	Living	Dead	per ac. Sq. Ft.
1	0.8	-	-	0.8	-	-	4.6	0.8	0.02	322.4	23.9	1.62
2	0.8	-	0.02	-	-	-	0.8	0.8	0.02	220.0	14.6	4.84
3	2.3	-	0.11	-	-	-	0.8	-	0.04	135.4	6.9	6.64
4	5.4	-	0.47	-	-	-	1.5	-	0.13	116.9	3.1	10.17
5	3.8	-	0.52	-	-	-	0.8	-	0.10	96.5	0.8	13.07
6	4.6	-	0.90	-	-	-	-	-	-	83.1	-	16.28
7	5.4	-	1.44	-	-	-	-	-	-	66.9	0.8	17.87
8	3.1	-	1.07	-	-	-	-	-	-	33.9	-	11.81
9	1.5	-	0.63	-	-	-	-	-	-	25.4	2.3	11.2
10	2.3	-	1.26	-	-	-	-	-	-	17.6	2.3	9.65
11	2.3	-	1.52	-	-	-	-	-	-	6.9	-	4.56
12	3.1	0.8	2.42	-	-	-	-	-	-	8.5	1.6	6.64
13	0.8	-	0.71	-	-	-	-	-	-	3.1	-	2.84
14	-	-	-	-	-	-	-	-	-	0.8	-	0.82
15	-	-	-	-	-	-	-	-	-	-	-	-
TAL:	36.2	0.8	11.12	0.8	-	-	8.5	1.6	0.31	1137.0	56.3	118.02

Fig. 45.
STEM ANALYSIS DIAGRAM
TAXUS-BALSAM FIR FOREST TYPE
BALSAM FIR
AGE 93-120

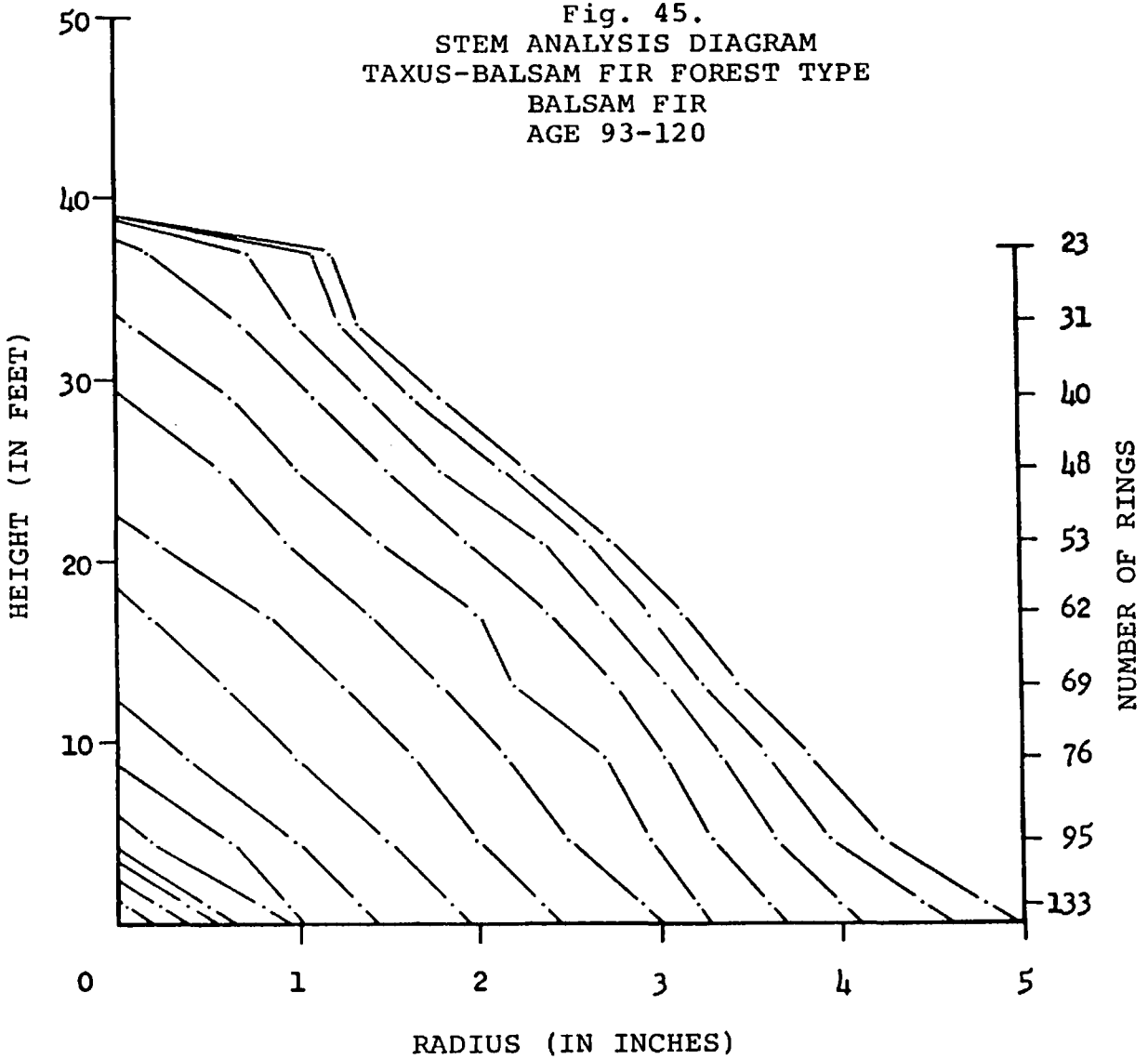


Fig. 46.
STEM ANALYSIS DIAGRAM
TAXUS-BALSAM FIR FOREST TYPE
BLACK SPRUCE
AGE 93-120

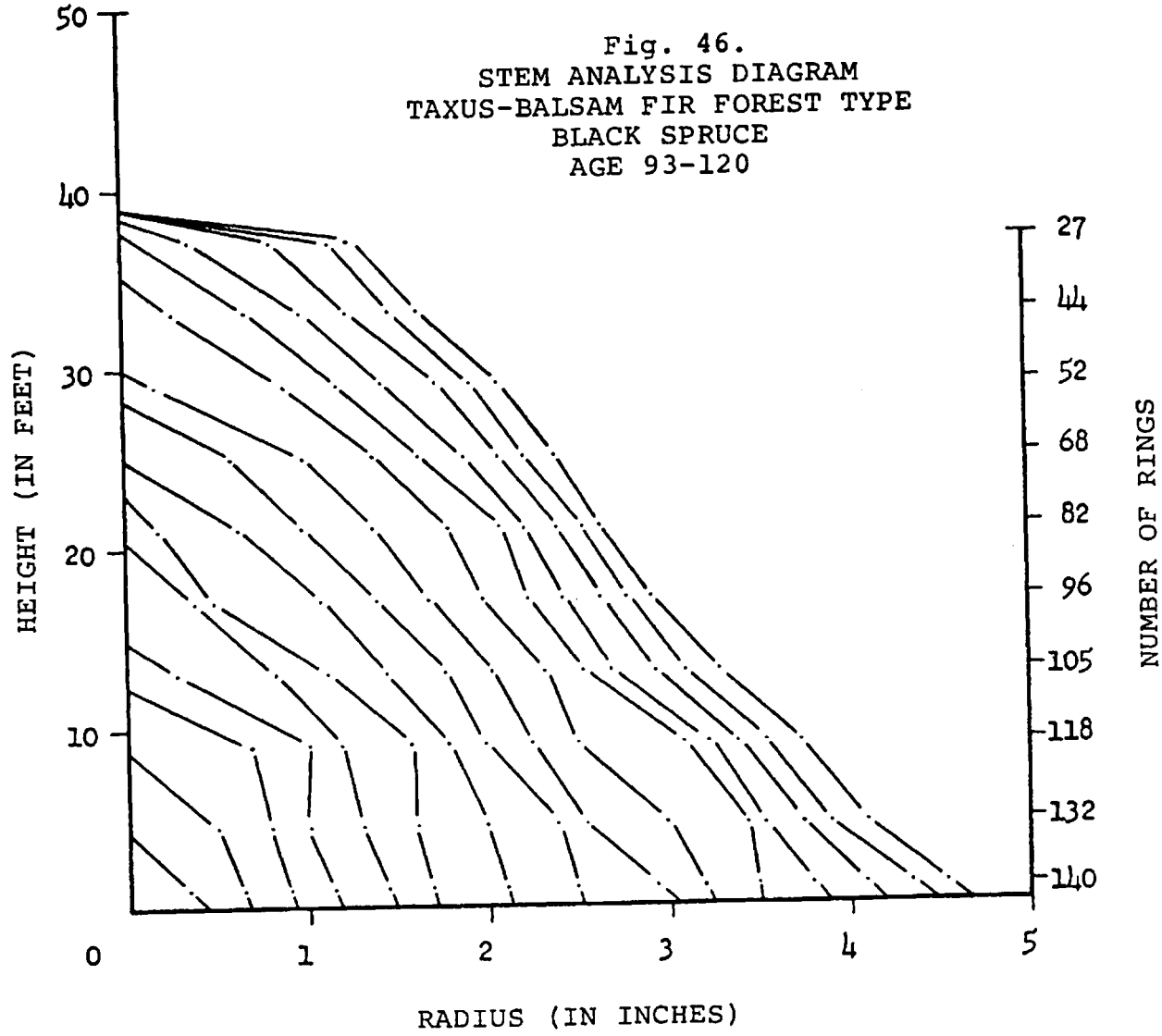


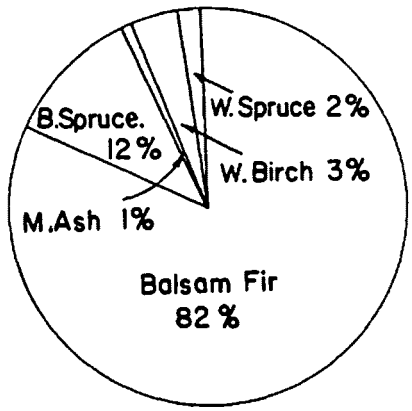
TABLE 19

STEM ANALYSIS DATA TABLE

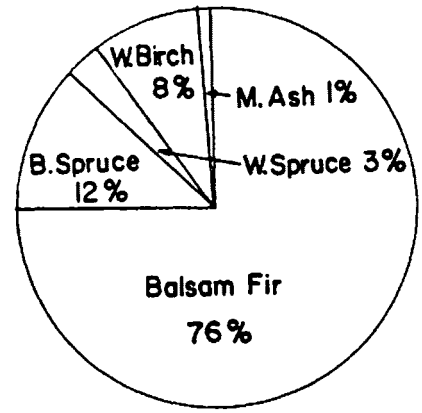
TAXUS-BALSAM FIR FOREST TYPE

Age Class: 93 - 120 Years

		BALSAM FIR (Fig. 45)	BLACK SPRUCE (Fig. 46)
Age at breast height (years)		95	132
Diameter breast height (inches)		8.50	8.20
Total height (feet)		39.5	38.9
Total volume (cu. ft.)		6.89	6.78
Merchantable volume (cu. ft.)		6.11	6.18
Total volume increment by decades (cu. ft.):-	1963-1953	1.21	0.76
	1953-1943	1.24	0.83
	1943-1933	1.30	0.68
	1933-1923	1.08	1.12
	1923-1913	0.89	0.86
	1913-1903	0.34	0.66
	1903-1893	0.27	0.58
	1893-1883	0.11	0.54
	1883-1873	0.41	0.21
	1873-1863	-	0.20
	1863-1853	-	0.27
Merchantable volume increment (cu. ft.):-	1953-1963	1.06	0.64



NUMBER OF TREES PER ACRE



BASAL AREA PER ACRE

Fig. 47.

STAND TABLE DIAGRAM: TAXUS-BALSAM FIR FOREST TYPE (AGE 93-120)

BASIC STATISTICAL ANALYSES

Values for the mean, standard deviation, standard error of the mean, and coefficient of variation are presented for individual softwood and hardwood species in each of the forest types. Factors considered are number of trees per acre and basal area per acre, as follows:-

(i) Living trees more than 3.5 inches breast height diameter:

(a) Number of trees per acre (Table 20)

(b) Basal area per acre (Table 21)

(ii) Dead trees more than 0.5 inches breast height diameter (Table 22).

(iii) Living trees more than 0.5 inches breast height diameter:

(a) Number of trees per acre (Table 23)

(b) Basal area per acre (Table 24)

(iv) Dead trees more than 0.5 inches breast height diameter:

(a) Number of trees per acre (Table 25)

(b) Basal area per acre (Table 26)

(v) Ranges of selected stand characteristics in individual forest types (Table 27).

The coefficient of variation of number of trees per acre for balsam fir ranges from 27.3% (in the Hylocomium-balsam fir type) to 38.3% (in the Dryopteris-Rhytidiadelphus-balsam fir type, 70-85 year age class) for living trees of more than 3.5 inches breast height diameter, and from 24.7% (in the Taxus-balsam fir type) to 46.9% (in the Dryopteris-Rhytidiadelphus-balsam fir type, 70-85 year age class) for living trees of more than 0.5 inches breast height diameter. For dead balsam fir the ranges are 86.9% to 170.2% and 63.0% to 100.1%, respectively.

For all species (living trees of more than 0.5 inches diameter) the coefficient of variation of number of trees per acre ranges from 20.0% in the Dryopteris-balsam fir type to 39.6% in the Dryopteris-Rhytidiadelphus-balsam fir type. Values based on dead trees of more than 0.5 inches diameter are 61.7% and 103.0%.

For basal area per acre the coefficient of variation ranges from 20.4% (Dryopteris-Hylocomium-balsam fir type) to 32.2% (Dryopteris-balsam fir type) for living balsam fir of more than 3.5 inches breast

height diameter. For trees of more than 0.5 inches diameter extreme values are 17.0% (Hylocomium-balsam fir type) and 31.1% (Dryopteris-balsam fir type). For all species the limits are 10.5% (Hylocomium-balsam fir type) and 23.1% (Dryopteris-balsam fir type). Much higher ranges apply to dead trees in the same way as for number of trees per acre.

The ranges of number of trees per acre and basal area per acre (both based on trees of more than 0.5 inches diameter) and of softwood merchantable volume per acre are given in Table 27 for individual forest types. The greatest differences between maximum and minimum values are 1,680 trees (Hylocomium-balsam fir type), 189.9 sq. ft. per acre (Dryopteris-balsam fir type), and 4,108 cu. ft. per acre (Dryopteris-balsam fir type). Corresponding minimum differences are 340 trees per acre (Dryopteris-Rhytidiadelphus-balsam fir type, 86-110 year age class), 60.0 sq. ft. per acre (Hylocomium-balsam fir type), and 1,190 cu. ft. per acre (Taxus-balsam fir type).

TABLE 20

VARIATION IN NUMBER OF TREES PER ACRE FOR INDIVIDUAL

FOREST TYPES, BASED ON LIVING TREES MORE THAN 3.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Number of trees per acre					
				Black Spruce	White Spruce	Balsam Fir	White Birch	Yellow Birch	Mountain Ash
yopteris-Rhytidiadelphus-lsam fir forest type	70-85	7	Mean	-	52.86	382.85	34.28	-	2.86
			SD	-	+32.00	+146.70	+18.12	-	± 4.87
			SEM	-	±12.12	± 55.57	± 6.86	-	± 1.84
			CV%	-	60.5	38.3	52.9	-	170.3
yopteris-Rhytidiadelphus-lsam fir forest type	86-110	11	Mean	-	58.18	291.82	68.18	-	1.82
			SD	-	+48.74	± 79.72	+50.56	-	± 4.04
			SEM	-	±14.68	± 24.01	±15.23	-	± 1.22
			CV%	-	83.8	27.3	74.2	-	222.0
yopteris-balsam fir rest type	56-71	14	Mean	-	27.14	419.28	137.14	-	22.86
			SD	-	+29.72	±146.15	+87.83	-	±63.29
			SEM	-	± 7.78	± 38.26	±22.99	-	±16.57
			CV%	-	109.5	34.9	64.0	-	276.9
locomium-balsam fir rest type	60-75	14	Mean	65.00	16.43	813.57	40.00	5.00	-
			SD	+89.67	+16.45	+220.0	+22.53	+13.44	-
			SEM	±23.47	± 4.30	± 58.12	± 5.90	± 3.52	-
			CV%	138.0	100.1	27.0	56.3	268.8	-
yopteris-Hylocomium-lsam fir forest type	55-67	26	Mean	-	11.54	534.62	62.69	19.62	2.31
			SD	-	+12.86	+159.15	+59.36	+33.76	± 6.51
			SEM	-	± 2.52	± 31.20	±11.64	±+6.62	± 1.28
			CV%	-	111.4	29.8	94.7	172.1	281.8
xus-balsam fir forest type	93-120	13	Mean	40.00	8.46	376.15	32.31	-	2.31
			SD	+37.85	+13.44	+129.00	+26.18	-	± 4.38
			SEM	±10.51	± 3.73	± 35.83	± 7.27	-	± 1.22
			CV%	94.6	158.9	34.3	81.0	-	189.6

TABLE 21

VARIATION IN BASAL AREA PER ACRE FOR INDIVIDUAL FOREST TYPES,

BASED ON LIVING TREES MORE THAN 3.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Basal area per acre (Sq. Ft.) Black Spruce	White Spruce	Balsam Fir	White Birch	Yellow Birch	Mountain Ash
vopteris-Rhytidiadelphus-lsam fir forest type	70-85	7	Mean	-	16.38	143.70	25.55	-	0.91
			SD	-	± 9.42	±31.20	±17.87	-	± 1.71
			SEM	-	± 3.57	±11.82	± 6.77	-	± 0.65
			CV%	-	57.5	21.7	69.9	-	187.9
voptoris-Rhytidiadelphus-lsam fir forest type	86-110	11	Mean	-	19.71	143.85	31.65	-	0.39
			SD	-	±14.34	±39.90	±19.90	-	± 1.05
			SEM	-	± 4.32	±12.02	± 5.99	-	± 0.32
			CV%	-	72.8	27.7	62.9	-	269.2
voptoris-Balsam fir rest type	56-71	14	Mean	-	8.45	123.98	51.71	-	10.00
			SD	-	±10.06	±39.90	±22.83	-	±30.57
			SEM	-	± 2.63	±10.44	± 5.98	-	± 8.00
			CV%	-	119.1	32.2	44.2	-	305.7
locomium-balsam fir rest type	60-75	14	Mean	15.32	6.98	143.36	18.06	4.15	-
			SD	±63.55	± 9.26	±29.44	±13.37	±13.48	-
			SEM	±16.64	± 2.42	± 7.71	± 3.50	± 3.53	-
			CV%	414.8	132.7	20.5	74.0	324.8	-
ropteris-Hylocomium-lsam fir forest type	55-67	26	Mean	-	4.62	130.34	34.93	13.70	0.33
			SD	-	± 5.44	±26.56	±22.93	±26.99	± 1.10
			SEM	-	±10.67	± 5.21	± 4.50	± 5.29	± 0.22
			CV%	-	117.8	20.4	65.6	197.0	333.3
us-balsam fir forest type	93-120	13	Mean	12.74	2.92	78.06	10.60	-	0.24
			SD	±11.82	± 5.45	±23.85	± 7.88	-	± 0.46
			SEM	± 3.28	± 1.51	± 6.62	± 2.19	-	± 0.13
			CV%	92.8	186.6	30.6	74.3	-	191.7

SD = Standard deviation; SEM = Standard error of the mean; CV = Coefficient of variation.

TABLE 22

VARIATION IN NUMBER OF TREES AND BASAL AREA PER ACRE FOR INDIVIDUAL FOREST TYPES, BASED ON DEAD TREES MORE THAN 3.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		WHITE SPRUCE		BALSAM FIR		WHITE BIRCH	
				No. of Trees per acre	Basal Area per acre (Sq. Ft.)	No. of Trees per acre	Basal Area per acre (Sq.Ft.)	No. of Trees per acre	Basal Area per acre (Sq.Ft.)
pteris-Rhytidiadelphus-am Fir Forest type	70-85	7	Mean	11.43	3.92	42.86	6.92	2.86	4.00
			SD	±17.22	± 5.77	±39.03	± 5.29	± 4.87	± 6.91
			SEM	± 6.71	± 2.18	±14.78	± 2.00	± 1.84	± 2.62
			CV%	155.0	147.2	91.1	76.4	170.3	172.8
pteris-Rhytidiadelphus-am fir forest type	86-110	11	Mean	2.73	1.04	39.09	8.14	-	-
			SD	± 6.46	± 2.79	±66.55	±15.99	-	-
			SEM	± 1.94	± 0.84	±20.04	± 4.82	-	-
			CV%	236.6	268.3	170.2	196.4	-	-
pteris-balsam fir st type	56-71	14	Mean	7.14	1.84	59.28	7.83	3.57	0.61
			SD	± 9.94	± 3.56	±51.51	± 6.38	± 6.33	± 1.22
			SEM	± 2.60	± 0.93	±13.48	± 1.67	± 1.66	± 0.32
			CV%	139.2	193.5	86.9	81.5	177.3	200.0
comium-balsam fir st type	60-75	14	Mean	3.57	1.32	66.42	7.30	1.42	2.00
			SD	± 8.41	± 3.63	±58.12	± 6.36	± 3.63	± 5.13
			SEM	± 2.20	± 0.96	±15.21	± 1.66	± 0.95	± 1.34
			CV%	235.6	275.0	87.5	87.1	255.6	256.5
pteris-Hylocomium-am fir forest type	55-57	26	Mean	-	-	30.77	4.44	-	-
			SD	-	-	±41.36	± 5.79	-	-
			SEM	-	-	± 8.11	± 1.14	-	-
			CV%	-	-	134.4	130.4	-	-

SD = Standard Deviation; SEM = Standard Error of the Mean; CV = Coefficient of Variation.

TABLE 23

VARIATION IN NUMBER OF TREES PER ACRE FOR INDIVIDUAL FOREST TYPES, BASED ON LIVING TREES MORE THAN 0.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Number of trees per acre							
				Black Spruce	White Spruce	Balsam Fir	White Birch	Yellow Birch	Mountain Ash	Maple	All Species
ryopteris-Rhytidia-elphus-balsam fir forest type	70-85	7	Mean	-	55.71	470.00	37.14	-	2.86	-	565.71
			SD	-	±35.05	±220.63	±17.04	-	± 4.87	-	±224.26
			SEM	-	±13.28	±83.59	± 6.45	-	± 1.84	-	± 84.95
			CV%	-	62.9	46.9	45.9	-	170.3	-	39.6
ryopteris-Rhytidia-elphus-balsam fir forest type	86-110	11	Mean	-	67.27	354.64	73.64	-	1.82	-	507.27
			SD	-	±53.49	±133.89	±49.85	-	± 4.04	-	±103.25
			SEM	-	±16.11	±40.32	±15.01	-	± 0.82	-	± 31.10
			CV%	-	79.5	37.8	67.7	-	222.0	-	20.4
ryopteris-balsam ir forest type	56-71	14	Mean	-	30.00	483.57	146.43	23.57	-	-	683.57
			SD	-	±28.82	±141.34	±89.40	±63.44	-	-	±136.86
			SEM	-	± 7.54	± 37.00	±23.40	±16.61	-	-	± 35.83
			CV%	-	96.1	29.2	61.1	269.2	-	-	20.0
ylocomium-balsam ir forest type	60-75	14	Mean	90.71	21.43	1197.14	52.86	5.00	-	-	1368.57
			SD	±119.83	±21.43	±420.70	±38.51	±13.44	-	-	±484.44
			SEM	± 31.37	± 5.61	±110.13	±10.08	± 3.52	-	-	±126.82
			CV%	132.1	100.0	35.1	72.9	268.8	-	-	35.4
ryopteris-Hylocomium-alsam fir forest type	55-67	26	Mean	-	12.69	726.15	70.77	21.92	3.08	1.92	836.54
			SD	-	±14.29	±225.60	±77.45	±36.45	±8.37	±6.33	±247.48
			SEM	-	± 2.80	± 44.24	±15.19	± 7.15	±1.64	±1.24	± 48.52
			CV%	-	112.6	31.1	109.4	166.3	271.8	329.7	29.6
axus-balsam fir forest type	93-120	13	Mean	133.08	16.15	942.30	36.15	-	8.46	-	1136.92
			SD	±100.94	±27.54	±232.85	±29.87	-	±16.75	-	±228.88
			SEM	± 28.03	± 7.65	±64.68	± 8.30	-	± 4.65	-	± 63.58
			CV%	75.8	170.5	24.7	82.6	-	198.0	-	20.1

SD = Standard Deviation; SEM = Standard Error of the Mean; CV = Coefficient of Variation

TABLE 24

VARIATION IN BASAL AREA PER ACRE FOR INDIVIDUAL FOREST TYPES

BASED ON LIVING TREES MORE THAN 0.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Basal Area per acre (Sq. Ft.) Black Spruce	White Spruce	Balsam Fir	White Birch	Yellow Birch	Mountain Ash	Maple	All Species
opteris-Rhytidia-phus-balsam fir est type	70-85	7	Mean	-	16.46	146.00	25.69	-	0.91	-	189.06
			SD	-	± 9.53	±32.49	±17.66	-	± 1.71	-	±26.18
			SEM	-	± 3.61	±12.31	± 6.69	-	± 0.65	-	± 9.92
			CV%	-	57.9	22.3	68.7	-	187.9	-	13.8
opteris-Rhytidia-phus-balsam fir est type	86-110	11	Mean	-	20.00	145.58	31.92	-	0.40	-	197.90
			SD	-	±14.41	±40.41	±19.72	-	± 1.05	-	±21.24
			SEM	-	± 4.34	±12.17	± 5.94	-	± 0.32	-	± 6.40
			CV%	-	72.1	27.8	61.8	-	262.5	-	10.7
opteris-balsam forest type	56-71	14	Mean	-	8.59	126.26	52.11	10.04	-	-	197.00
			SD	-	± 9.97	±39.31	±22.75	±30.58	-	-	±45.57
			SEM	-	± 2.61	±10.29	± 5.96	± 8.01	-	-	±11.93
			CV%	-	116.1	31.1	43.7	304.6	-	-	23.1
ocomium-balsam forest type	60-75	14	Mean	16.17	7.13	157.21	18.54	4.15	-	-	204.22
			SD	±20.87	± 9.33	±26.72	±13.56	±13.48	-	-	±21.37
			SEM	± 5.46	± 2.44	± 6.99	± 3.55	± 3.53	-	-	± 5.59
			CV%	129.1	130.9	17.0	73.1	324.8	-	-	10.5
opteris-Hylocomium-sam fir forest type	55-67	26	Mean	-	4.65	136.54	35.30	14.13	0.36	0.39	191.37
			SD	-	± 5.44	±27.60	±23.24	±27.05	± 1.14	±1.13	±36.53
			SEM	-	± 1.07	± 5.41	± 4.56	± 5.30	± 0.22	±0.22	± 7.16
			CV%	-	117.0	20.2	65.8	191.4	308.1	289.7	19.1
us-balsam fir est type	93-120	13	Mean	13.76	3.06	89.77	11.13	-	0.32	-	118.03
			SD	±12.29	± 5.57	±23.28	± 7.96	-	± 0.62	-	±22.58
			SEM	± 3.41	± 1.55	± 6.47	± 2.21	-	± 0.17	-	± 6.27
			CV%	89.3	182.0	25.9	71.5	-	193.8	-	19.1

SD = Standard Deviations; SEM = Standard Error of the Mean; CV = Coefficient of Variation

TABLE 25

VARIATION IN NUMBER OF TREES PER ACRE FOR INDIVIDUAL FOREST

TYPES BASED ON DEAD TREES MORE THAN 0.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Number of trees per acre					
				Black Spruce	White Spruce	Balsam Fir	White Birch	Mountain Ash	All Species
opteris-Rhytidiadelphus-sam fir forest type	70-85	7	Mean	-	17.14	105.71	4.28	-	128.57
			SD	-	+19.76	± 80.59	± 5.34	-	± 83.35
			SEM	-	± 7.48	± 30.52	± 2.02	-	± 31.57
			CV%	-	115.3	76.2	124.8	-	64.8
opteris-Rhytidiadelphus-sam fir forest type	86-110	11	Mean	-	10.00	73.64	-	-	83.64
			SD	-	+12.64	± 66.67	-	-	± 67.42
			SEM	-	± 3.81	± 20.08	-	-	± 20.31
			CV%	-	126.4	90.5	-	-	80.6
opteris-balsam fir est type	56-71	14	Mean	-	9.28	203.57	7.86	-	221.42
			SD	-	+13.84	+198.10	+11.88	-	+200.91
			SEM	-	± 3.62	± 51.86	± 3.11	-	± 52.59
			CV%	-	149.1	97.3	151.1	-	90.7
ocomium-balsam fir est type	60-75	14	Mean	9.28	5.00	697.14	2.14	-	715.00
			SD	+15.42	± 9.40	+439.34	± 4.25	-	+445.29
			SEM	± 4.04	± 2.46	+115.01	± 1.11	-	+116.57
			CV%	166.2	188.0	63.0	198.6	-	62.3
opteris-Hylocomium-sam fir forest type	55-67	26	Mean	-	1.15	199.23	6.15	-	206.92
			SD	-	± 3.25	+126.39	+16.02	-	+127.77
			SEM	-	± 0.64	± 24.78	± 3.14	-	± 25.05
			CV%	-	282.6	63.4	260.5	-	61.7
us-balsam fir forest type	93-120	13	Mean	-	-	53.85	-	1.54	56.15
			SD	-	-	± 53.93	-	+3.75	± 57.81
			SEM	-	-	± 14.98	-	+0.98	± 16.06
			CV%	-	-	100.1	-	243.5	103.0

SD = Standard Deviation; SEM = Standard Error of the Mean; CV = Coefficient of Variation

TABLE 26

VARIATION IN BASAL AREA PER ACRE FOR INDIVIDUAL FOREST TYPES,

BASED ON DEAD TREES MORE THAN 0.5 INCHES D.B.H.

Forest Type	Age Class	No. of Plots		Basal Area Per Acre (Sq. Ft.) Black Spruce	White Spruce	Balsam Fir	White Birch	Mountain Ash	All Species
ryopteris-Rhytidiadelphus-alsam fir forest type	70-85	7	Mean	-	4.13	8.58	4.01	-	16.84
			SD	-	± 5.68	± 5.83	± 6.90	-	±11.02
			SEM	-	± 2.15	± 2.21	± 2.61	-	± 4.17
			CV%	-	137.5	137.5	172.1	-	65.4
ryopteris-Rhytidiadelphus-alsam fir forest type	86-110	11	Mean	-	1.35	9.08	-	-	10.43
			SD	-	± 2.75	±15.97	-	-	±15.67
			SEM	-	± 0.83	± 4.81	-	-	± 4.72
			CV%	-	203.7	175.9	-	-	150.2
ryopteris-balsam fir orest type	56-71	14	Mean	-	1.94	12.07	0.74	-	14.82
			SD	-	± 3.72	± 9.83	± 1.33	-	±12.50
			SEM	-	± 0.97	± 2.58	± 0.35	-	± 3.27
			CV%	-	191.8	81.4	179.7	-	84.3
ylocomium-balsam fir orest type	60-75	14	Mean	0.21	1.40	22.74	2.02	-	26.42
			SD	± 0.40	± 3.61	±11.62	± 5.12	-	±14.42
			SEM	± 0.10	± 0.94	± 3.04	± 1.34	-	± 3.77
			CV%	190.5	257.9	51.1	253.5	-	54.6
ryopteris-Hylocomium-alsam fir forest type	55-67	26	Mean	-	0.04	8.40	1.37	-	9.92
			SD	-	± 0.13	± 6.78	± 3.98	-	± 7.15
			SEM	-	± 0.02	± 1.33	± 0.78	-	± 1.40
			CV%	-	325.0	80.7	290.5	-	72.1
axus-balsam fir forest ype	93-120	13	Mean	-	-	4.22	-	0.02	4.84
			SD	-	-	± 3.71	-	± 0.06	± 3.91
			SEM	-	-	± 1.03	-	± 0.02	± 1.08
			CV%	-	-	87.9	-	300.0	80.8

SD = Standard Deviation; SEM = Standard Error of the Mean; CV = Coefficient of Variation

TABLE 27

RANGES OF SOME SELECTED STAND CHARACTERISTICS FOR

INDIVIDUAL FOREST TYPES

Forest Type	Age Class	No. of trees per acre			Basal area per acre (Sq. Ft.)			Merchantable volume per acre (Cu. Ft.)		
		Based on trees of more than 0.5 inches d.b.h.						Based on softwoods		
		Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
ropteris-Rhytidiadelphus-alsam fir forest type	70 - 85	1020	320	566	235.65	150.37	189.06	4607	2584	3821
ropteris-Rhytidiadelphus-alsam fir forest type	86 - 110	770	430	507	232.23	166.22	197.90	6036	2211	4464
opteris-Rhytidiadelphus alsam fir forest type	56 - 71	850	420	684	305.45	115.55	197.00	4966	858	3342
ocomium-balsam fir orest type	60 - 75	2370	690	1368	237.73	177.74	204.24	4459	2575	3312
ropteris-Hylocomium-alsam fir forest type	55 - 67	1500	420	836	262.48	131.50	191.37	3886	1553	3034
us-balsam fir forest type	93 - 120	1470	780	1137	152.52	85.14	118.03	2305	1115	1656

DISCUSSION

Data were collected from stands which were at or approaching maturity and therefore the ranges of age classes that were sampled for the various forest types are not identical. For this reason comparisons between forest types should be carried out with caution. However, it is considered that changes in mensurational characteristics are unlikely to occur after crops have reached maturity and valid comparisons between forest types should therefore be forthcoming from the results that have been presented.

Merchantable volume figures show the Dryopteris-Rhytidiadelphus-balsam fir forest type to be the most productive and the Taxus-balsam fir forest type the least productive of those forest types that were sampled. Volume/density and volume/basal area relationships for individual forest types, with the types arranged in descending order of volume production, are shown in Figs. 48 and 49.

The Taxus-balsam fir type is older than the other types but yet much below them in terms of volume production and rate of height growth, and it would seem clear that this type is distinct mensurationally as well as floristically and pedologically from the other types that were sampled.

It would seem possible that some or all of the additional volume carried by the Dryopteris-Rhytidiadelphus-balsam fir type is an effect of age rather than rate of growth. It is likely, if a comparison were to be made on the basis of crops of the same age, that the volume production of the Dryopteris-Rhytidiadelphus-balsam fir type would be no better than that of the Dryopteris-balsam fir type. The additional volume present in the Dryopteris-Rhytidiadelphus-balsam fir type (age 86-110) is, nevertheless, larger than might be expected in a relatively old crop, and it may be that the samples for that type and age group were, by chance, on slightly better than average site conditions.

Therefore, it would appear that the Dryopteris-Rhytidiadelphus-balsam fir and Dryopteris-balsam fir types could be combined for mensurational purposes without any loss of accuracy. The height/age curves for these two types are similar (with the Dryopteris-balsam fir type showing slightly faster height growth) and they thus provide additional evidence in favour of such an amalgamation.

The Dryopteris-Hylocomium-balsam fir type shows height growth as good as that for the two types discussed above. However, for heights of up to 50 feet, its diameter increment is relatively slow and hence it can be separated on the basis of total volume production.

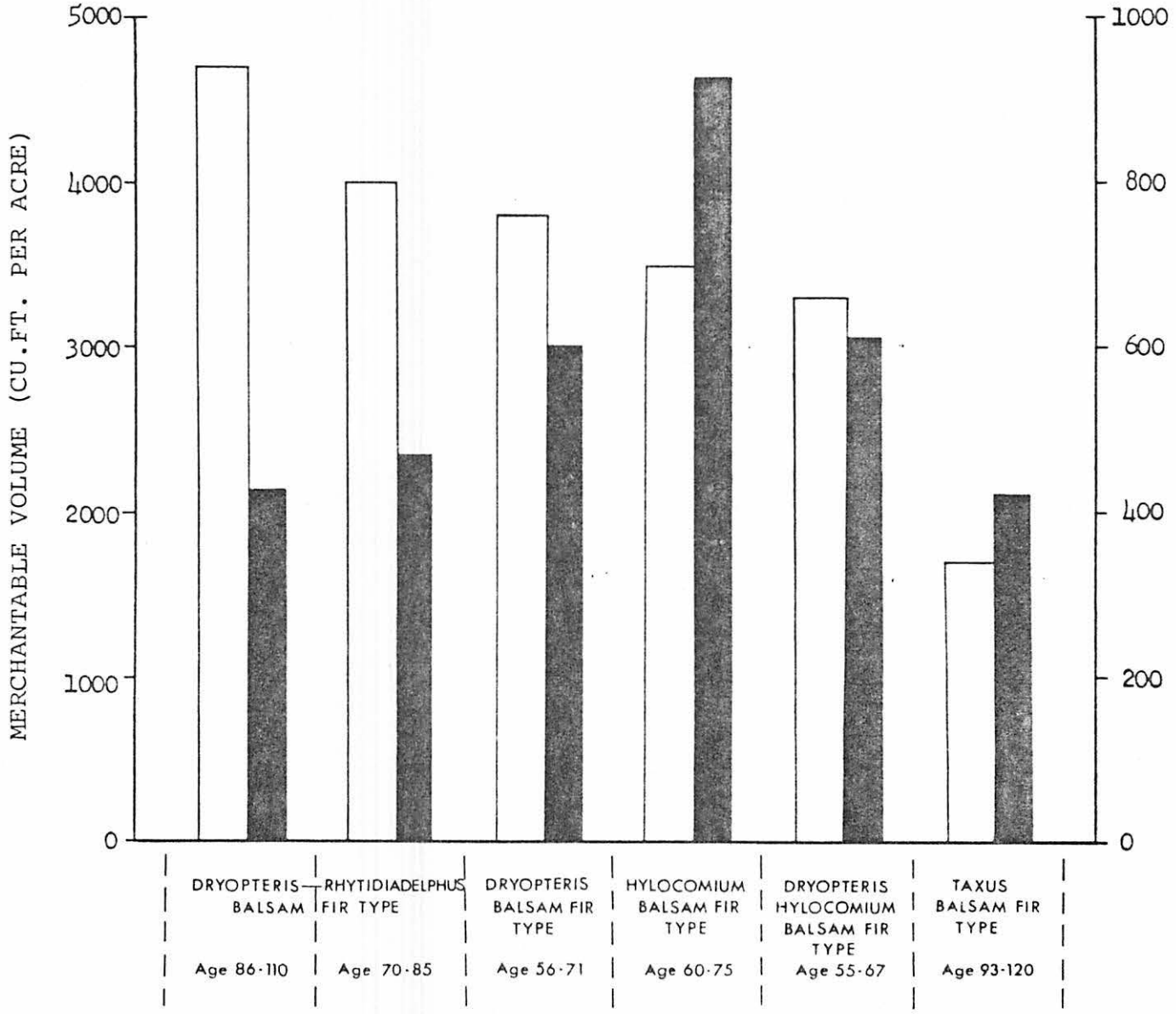


Fig. 48. VOLUME/DENSITY RELATIONSHIPS BY FOREST TYPES

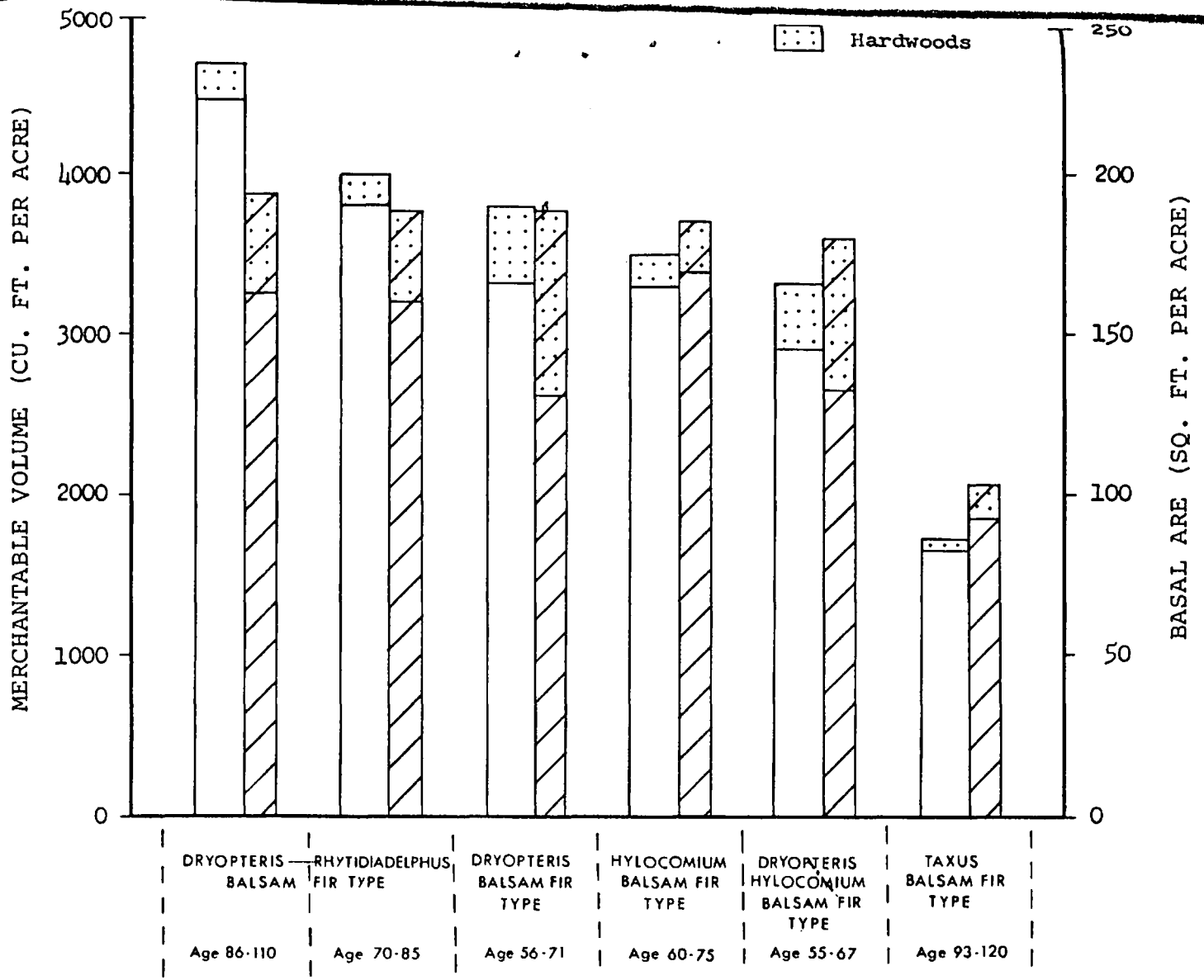


Fig. 49. VOLUME/BASAL AREA RELATIONSHIPS BY FOREST TYPES

As noted earlier, it is probable that the Hylocomium-balsam fir type includes two dissimilar forest conditions. A few of the plots belong to a "genuine" Hylocomium type, which is a rather poor type of forest, while the remaining plots represent a dense version of the Dryopteris-Hylocomium-balsam fir type in which the crop has shaded out any Dryopteris which would otherwise have been present. With the possible exclusion of the poorer Hylocomium type, the Hylocomium and Dryopteris-Hylocomium forest types would seem to form a second convenient unit for mensurational purposes.

The Dryopteris-Rhytidiadelphus-balsam fir and the Taxus-balsam fir are the only two of these types which were sampled which occur on limestone bedrock. Both these types appear to reach maturity at an older age than do the other forest types and it would seem likely that this is an effect of the soil conditions on which they are growing. In practical terms this would seem of value to forest management when it is necessary to delay the harvesting of certain areas. Crops growing on limestone would appear most able to withstand such delay without becoming decadent.

Further insight into the relative maturity of the various forest types is provided by the volume increment figures (Table 28). These figures should, however, be interpreted with caution owing to the number of assumptions that were involved in their production.

Values of periodic annual increment per acre for the period 1953-1962 were derived from diameter increment figures and stand tables. Ten-year diameter increment of individual trees was plotted against 1962 diameters for each of the major softwood species in each of the forest types. The observed relationships were used as a basis for reducing 1962 stand table figures to produce estimated 1953 stand tables. Standing dead trees tallied in 1962 were assumed to have been living in 1953. Merchantable volume estimates were then derived from stand table and form class figures in the usual way.

Periodic annual increment is less than or about equal to mean annual increment in the Dryopteris-Rhytidiadelphus-balsam fir and Dryopteris-balsam fir types, but more than mean annual increment in the Hylocomium-balsam fir, Dryopteris-Hylocomium-balsam fir, and Taxus-balsam fir types. On this basis the first two forest types might be regarded as mature while the other three types have not yet reached that condition. However, owing to the different average ages of the various forest types, these figures do not necessarily conflict with the earlier conclusion concerning the relative maturity of the types growing on limestone. The Taxus-balsam fir type in particular appears capable of maintaining volume increment over a long rotation.

TABLE 28

VOLUME INCREMENT PER ACRE BY INDIVIDUAL FOREST TYPES

Forest Type	Age Class	Total Merchantable volume (Cu. Ft.) 1962	Net Periodic Annual increment (Cu. Ft.) 1953 - 1962	Mean annual increment (Cu. Ft.) based on breast height age	Mean annual increment (Cu. Ft.) based on breast height age + 10 yrs.*
...opteris-Rhytidiadelphus-...lsam fir forest type	70-85	3821	38.16	48.25	42.93
...opteris-Rhytidiadelphus-...lsam fir forest type	86-110	4464	43.78	47.12	42.51
...opteris-balsam fir ...rest type	56-71	3342	37.15	54.95	47.07
...locomium-balsam fir ...rest type	60-75	3312	60.83	51.30	44.16
...opteris-Hylocomium- ...lsam fir forest type	55-67	3034	67.79	50.52	43.34
...us-balsam fir ...rest type	93-120	1656	38.05	15.48	14.28

* Previous experience in Newfoundland has shown that an average of 10 years is required for the softwood species in most merchantable forest types to reach breast height.

Basal area figures indicate that all of the more productive types are growing on sites which are capable of maintaining a fully stocked forest which makes use of present site potential to the fullest extent possible. The Taxus-Balsam fir site type would seem unable to maintain full stocking and this contributes in large part to its very much reduced volume yields. These relationships are reported in the results of the regeneration sampling (Table 29). All the more productive types show between 90% and 100% stocking of regeneration. The quadrats in the Taxus-balsam fir type were only 40% stocked, however, and it would appear likely that the low stocking which is characteristic of the present crop will be repeated in future crops of this type.

The height/age curves show significant differences in rate of height growth between several of the forest types, but at the same time considerable similarity in shape. It was therefore considered of interest to compare these individual height/age curves with a set of standard height/age curves for balsam fir constructed from the same data. The normal procedure (including the coefficient of variation modification) for constructing site-index curves from height/age data was followed (Bruce and Schumacher, 1950). The resulting set of curves is presented in Fig. 50. There were no trees with a breast height age of less than 50 years, and therefore the lower (dashed) portions of the curves were extrapolated and as a result are of very limited use.

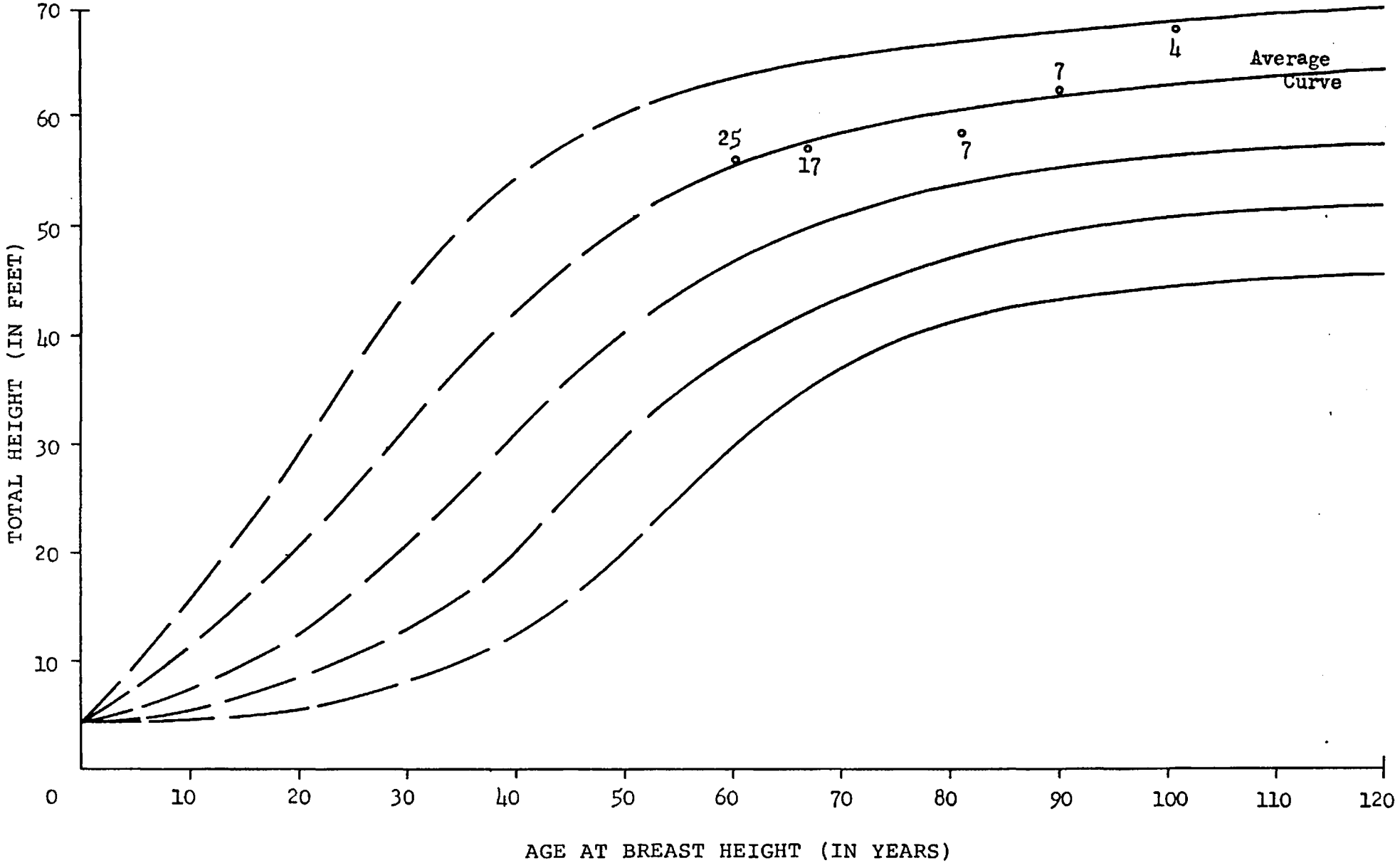
Agreement between the two types of curves is relatively good, especially in the middle age range and near the average site index curve. Divergence is most marked at older ages on the higher site-index curves and on the lower site-index curves particularly at the younger ages. These are the positions where the coefficient of variation modification has had the most marked influence. Using a standard reference age of 50 years the maximum difference recorded between an individual height/age curve and the appropriate site-index curve is approximately 7 feet (for the Dryopteris-balsam fir type at 80 years).

TABLE 29

REGENERATION BY INDIVIDUAL FOREST TYPES

Species	Stocking (Percent of sample quadrats)	Average height (feet)
Dryopteris-Rhytidiadelphus-Balsam Fir Forest Type (Age 70-85)		
Balsam Fir:	96%	0-0.5
Balsam Fir and White Spruce:	4%	0.6-1.5
Dryopteris-Rhytidiadelphus-Balsam Fir Forest Type (Age 86-110)		
Balsam Fir:	90%	1.6-2.5
Unstocked:	10%	-
Dryopteris-Balsam Fir Forest Type (Age 56-71)		
Balsam Fir:	97%	0.6-1.5
Balsam Fir, White Spruce and White Birch:	3%	0.6-1.5
Hylocomium-Balsam Fir Forest Type (Age 60-75)		
Balsam Fir:	85%	0-0.5
Balsam Fir and White Spruce:	15%	0-0.5
Dryopteris-Hylocomium-Balsam Fir Forest Type (Age 55-67)		
Balsam Fir:	88%	0-0.5
Balsam Fir and White Spruce:	11%	0.6-1.5
Balsam Fir and White Birch:	1%	0.6-1.5
Taxus-Balsam Fir Forest Type (Age 93-120)		
Balsam Fir:	40%	0.6-1.5
Black Spruce:	4%	1.6-2.5
Balsam Fir and Black Spruce:	4%	2.6-3.5
Unstocked:	52%	-

Fig. 50.
BALSAM FIR SITE-INDEX CURVES
ALL FOREST TYPES



SUMMARY AND CONCLUSIONS

Mensurational data for five of the most important forest types in western Newfoundland were collected in 1962.

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

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 forest type. Certain of the larger stem analysis trees have been reconstructed in diagrammatic form. Basic statistical analyses of number of trees, basal area, and merchantable volume per acre have been presented and compared.

For practical purposes where volume yield is the major consideration, it is considered that three groups of forest types may be recognized:-

(a) Dryopteris-balsam fir and Dryopteris-Rhytidiadelphus-balsam fir forest types.

(b) Dryopteris-Hylocomium-balsam fir and Hylocomium-balsam fir forest types.

(c) Taxus-balsam fir forest type.

Age differences are thought to account for much of the observed difference in volume production between the forest types in the first group. The second group is considered to consist largely of one forest type, with significant floristic (but not mensurational) differences being present due to variations in crop density.

The various forest types cannot be grouped as readily in terms of height growth. If a distinction is required on this basis it may be necessary to deal with each forest type independently or to use combined site-index curves. Site-index curves prepared for balsam fir show relatively good agreement with the individual height/age curves although the coefficient of variation modification would appear to have had a largely detrimental effect in this regard.

Where management requirements make it necessary for certain crops to be left until they are relatively old, it would seem advisable that those on limestone (in particular the Taxus-balsam fir type) should be chosen for this purpose because they reach maturity later than those in other areas. Increment figures show that, at the ages sampled, three of the five forest types still show a periodic annual increment greater than their mean annual increment.

Regeneration is good in most of the forest types and fully-stocked second growth crops would seem likely to be produced. However, the low level of stocking in the Taxus-balsam fir type will probably be repeated in future rotations unless ameliorative practices are applied.

More detailed and more exact data will be required before any final conclusions can be drawn concerning the exact relationships between the various forest types (including those types that have not been sampled in this study). However, the information presented above contains several features of immediate practical significance to forest management.

LITERATURE CITED

Bajzak, D. 1962. A study of the mensurational characteristics of some forest types of central Newfoundland. Unpublished report, Can. Dept. For., Forest Research Branch. 91 pp.

Bruce, D. and F.X. Schumacher. 1950. Forest mensuration. McGraw-Hill, New York. 483 pp.

Damman, A.W.H. 1964. Some forest types of central Newfoundland and their relation to environmental factors. Can. Dept. of For., For. Res. Branch Contribution No. 596. (Forest Science Monograph No. 8). 62 pp.

Damman, A.W.H. 1967. The forest vegetation of western Newfoundland and site degradation associated with vegetation change. Ph.D. Thesis, Univ. of Michigan. 319 pp.

Hare, F.K. 1952. The climate of the island of Newfoundland. A geographical analysis. Can. Dept. Mines and Techn. Surv., Geogr. Bull. 2: 36-89.

Rowe, J.S. 1959. Forest regions of Canada. Can. Dept. N. Aff. and Natl. Res., For. Br., Bull. 123. 71 pp.