

AN INVESTIGATION OF THE 1953 BLOWDOWN
IN ITASCA STATE PARK.

by

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AN INVESTIGATION OF THE 1953 BLOWDOWN IN ITASCA STATE PARK

INTRODUCTION

Itasca State Park, comprising about 32,000 acres, is located in northern Minnesota. Lake Itasca, source of the Mississippi River, is perhaps the most prominent feature within the park. The University of Minnesota Forestry and Biological Station is located on this lake and uses the entire park as a field laboratory for students in forestry and other biological sciences.

On May 10, 1953 a severe windstorm passed through Itasca State Park. During the summer following, it was discovered that the storm felled about fifteen acres of a pole-sized spruce-balsam fir stand located along the west side of Lake Itasca. Upon learning of the damage it was decided to investigate the area to determine the nature and extent of the blowdown. This investigation was carried out during September of 1953 by the University of Minnesota School of Forestry.

Within the park itself the windstorm travelled just off the shore along the west side of Lake Itasca. This part of Itasca State Park is characterized by swampy areas separated by low ridges. Little damage occurred in the low swampy area. Most of the destruction was confined to the low ridges.

A well stocked pole-sized stand of sixty-year-old spruce-balsam was located on the area hardest hit by the storm. Hardwoods, primarily paper birch, comprised a little more than forty percent of the total number of trees in the stand. Balsam fir, white spruce, and paper birch were the trees predominating within the blowdown itself. The following tree species were found on the four permanent plots established in or near the blowdown area:

<i>Abies balsamea</i>	-	balsam fir
<i>Picea glauca</i>	-	white spruce
<i>Pinus strobus</i>	-	white pine
<i>Pinus resinosa</i>	-	red pine
<i>Betula papyrifera</i>	-	paper birch
<i>Ulmus americana</i>	-	american elm
<i>Fraxinus nigra</i>	-	black ash
<i>Acer rubrum</i>	-	red maple

Throughout this report these species are referred to by the common names given above.

LITERATURE REVIEW

Much has been written about the effect of wind upon the forest, but little about the effect of winds of extremely high velocity such as occurred in Itasca in 1953. Most writers agree that the amount of damage from winds of hurricane velocity cannot be predicted or prevented. Some of the observations on the effects of high velocity winds are summarized below.

Baxter (1) states that species composition and form of stand are not as important in determining the amount of damage resulting from a hurricane as are aspect and exposure. The investigation carried out in Itasca State Park in 1953 corroborates this statement.

In discussing hurricane damage in the Bartlett Experimental Forest from the 1938 hurricane, Jensen (8) states that the amount of damage was clearly reflected by differences in exposure. He also mentions that rain which had fallen two days before the hurricane had soaked the soil and had weakened the tree anchorage.

The magnitude of destruction caused by some storms is brought out by Clapp (4) in discussing the New England hurricane of 1938. Shortly after that storm of September 21, 1938, a preliminary estimate placed the amount of timber destroyed at about three billion board feet. Clapp summarized the three main problems arising from the storm as being protection, salvage, and rehabilitation. From his investigation of the hurricane damage of 1938, Clapp was led to believe that the primary factors in the destruction wrought by the storm were not species, composition, or form of the stand, but aspect and exposure.

The area covered by a storm may vary considerably. Harmon (6) states that the New England hurricane of 1938 swept over fourteen million acres. The area damaged by the storm in Itasca Park amounted to fifteen acres. Although a storm may cover a wide area it may cause only localized damage.

Toumey and Korstian (9) state that trees growing on ridge tops are especially liable to succumb to windfall, particularly if a windstorm occurs during the wet season when the soil is wet and loose.

Behre (2), in a study of a 1916 windstorm in the Adirondacks, found that balsam fir suffered the greatest damage irregardless of the previous cutting history of the stand. He attributed this to the shallow root system and decay of balsam fir.

Hawley and Stickel (7) state that hardwoods are less susceptible to windfall than are conifers, especially when they have no leaves. They conclude that irrespective of the treatment or composition of stands of any age, damage by tornadoes and violent windstorms can never be prevented. This is the same conclusion expressed or implied by the other authors mentioned above.

PURPOSE OF THE INVESTIGATION

The original purpose of this study was to determine the nature and extent of the damage in Itasca State Park resulting from the windstorm of May 10, 1953. After an examination of the damaged area it was decided to extend the original purpose in order to initiate a study of regeneration trends on this type of blowdown area.

Permanent plots were established and the initial observations were made as the first step in studying the trend of forest regeneration within the blowdown area. The study was confined to a sixty-year-old pole-sized spruce-balsam stand located on a series of low ridges within Itasca State Park.

METHOD OF INVESTIGATION

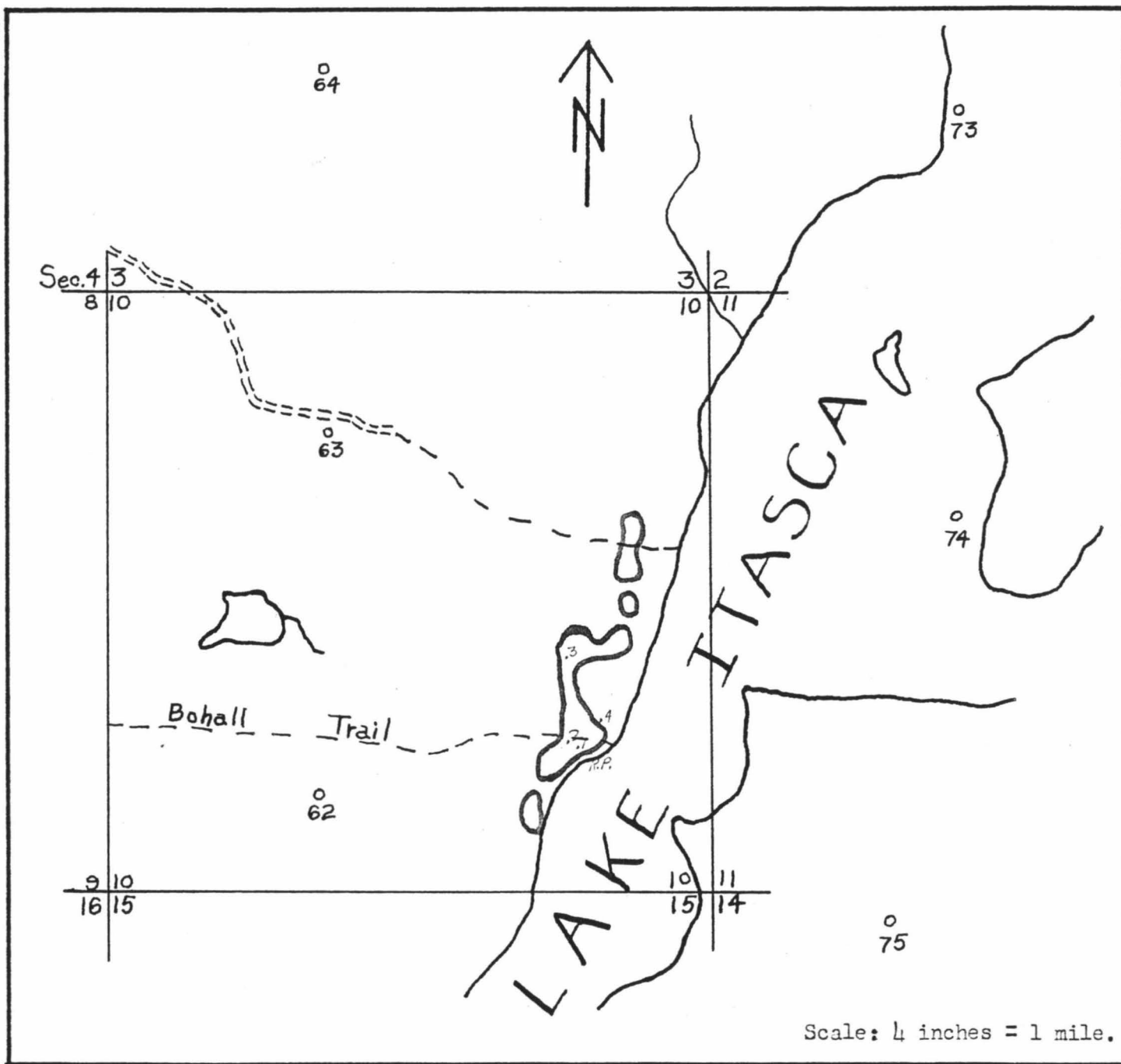
Preliminary Examination

A brief preliminary survey of the blowdown area was made on September 8, 1953. A more comprehensive examination was made a week later on September 15. The latter examination located the extent of the damaged area and determined the type of damage resulting from the storm. From notes made on these and later surveys, the blowdown area was later delineated on aerial photographs in the office. From these photographs the blowdown was outlined on a large base map of Itasca Park and the area was determined by planimeter. The approximate area of the blowdown as determined by this method was found to be fifteen acres. Figure 1 is the map of the blowdown from which the area was obtained.

Location of Plots

As a result of these two preliminary surveys it was decided to establish four permanent plots, three inside and one outside the blowdown area. It was felt that this was an opportunity to follow the process of natural

1953
BLOWDOWN AREA - ITASCA STATE PARK



The area outlined in red indicates the approximate extent of the blowdown area.
Small circles and numbers indicate aerial photograph centers.
Symbol R.P. indicates reference point location.
Numbers inside red area show plot locations.

regeneration on a blowdown area and that this could best be done through the use of permanent plots.

A reference point was first established near the shore line of Lake Itasca. This point was located about twenty feet from the lake on the side of a moderately steep bank sloping directly into the water. A red-topped wooden stake about two inches square and two feet long was driven into the ground at this point. From the stake, a photograph (figure 2) was taken facing the south end of the west arm of Lake Itasca as an aid in relocating the reference point.

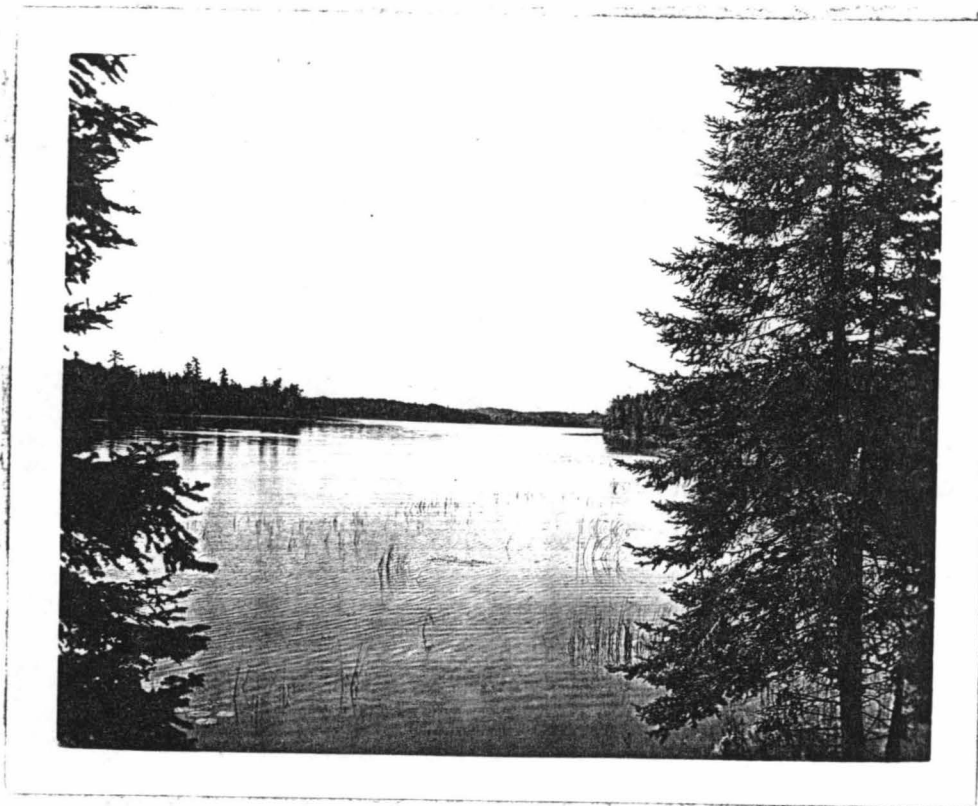
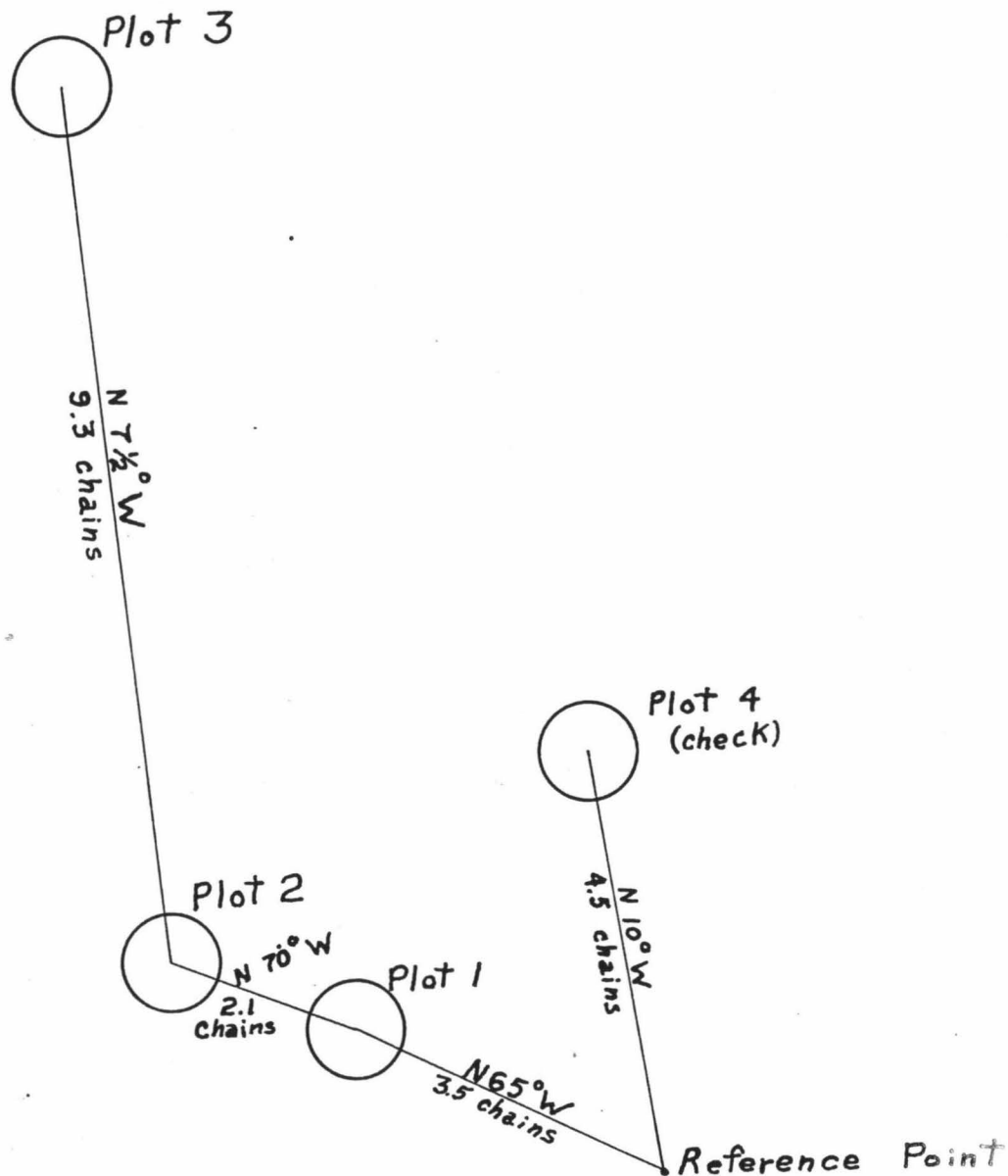


Figure 2

Lake Itasca, West Arm. This photograph was taken from the reference stake for the blowdown plots on September 16, 1953 at 10:00 am. It was taken at f25 with 1/25 second exposure.

ITASCA BLOWDOWN PLOTS - 1953



SCALE: 1 inch = 2 chains.

The reference point is located on a bank about twenty feet from Lake Itasca. On the larger map this point is designated by R.P.

Figure 3.

From this reference point the locations of plots number 1 and number 4 were established. The location of plot number 2 was established from plot number 1 and the location of plot 3 from number 2. Figure 3 gives the bearings to and distances between plot locations.

Circular plots were used to gather the information desired. By using circular plots, a simple method of locating trees on a map of the plot using polar coordinate graph paper could be used. Circular plots also require only one stake for accurate location and relocation.

The plots were not laid out by the use of random selection. It was felt that random selection, although desirable, was not necessary in the establishment of a trend study such as this. Furthermore, it was recognized that to avoid locating the plot center in situations where extreme physical difficulties might have to be overcome to gather data (such as in the center of a large pile of blowdown material), some judgement on the part of the investigator would be needed.

The general location of each plot was selected to give what was believed to be a representative sample of the blowdown area. The actual location of the plot center was determined by throwing an object at random into the general location area of each plot. The center stake of the plot was established at the point where the object landed. The stake used for the center of the plot was the same type as that used for the reference point stake.

Collection of the Data

From each center stake a circular reproduction plot, 1/500 acre in area, was laid out. A count of all tree reproduction and a tally of each species by age classes was made. The average height for each species in each age class was also estimated.

All brush species found on the reproduction plot were tallied by species and by the following height classes: 0 to 1 foot, 1 to 3 feet, and 6 feet

and over. A list of the vegetation found on the plot with a notation as to its relative abundance was also recorded.

Following this, a 1/10 acre circular plot was laid out using the stake as the center. All trees within this plot were plotted on polar coordinate graph paper at a scale of ten feet to one inch. The distance from the center stake to each tree was measured with a steel tape to the nearest foot. Bearings to the tree were read from a hand compass. The Diameter Breast High (DBH) of each tree so plotted was measured with a diameter tape to the nearest tenth of an inch and recorded.

All standing trees plotted on the graph were designated by a number, and all fallen trees were designated by a letter. Timber that had been blown down was plotted in a position corresponding to the original standing position of the down tree. Only standing trees and trees blown down by the storm were plotted on the graph.

On each 1/10th acre plot an estimate of the ground covered by trees blown down by the storm was expressed as a percentage of the total area within the plot. It was felt that the estimate of the area covered by blowdown on the plots was not sufficiently large to be applied to the total blowdown area, so additional estimates were made.

Two line transects totaling 13 chains (858 feet) were measured to provide a larger sample of the ground covered by down trees. One transect, nine chains in length, was set up from plot 3 towards plot 2. A second transect, four chains long from plot 2 towards plot 1, was also taken. A bearing for each transect line was decided upon and a chain tape was laid out along this bearing. The amount of down timber crossed by the chain tape was measured. All the foliage and branches of down trees covering the ground was counted as down timber. The length of the chain tape crossing down timber along the transect was expressed as a percentage of the entire

length of the transect. This percentage was in turn used as a crude approximation of the percent of area of the entire blowdown that was covered by down timber.

Soil samples were taken from each plot. A sample pit was dug within the 1/10 acre plot but outside of the 1/500 acre plot. Samples from each soil horizon were taken. These soils were later analyzed in the laboratory using the hydrometer method of mechanical soil analysis.

Increment borings were made in a sample of trees on each plot, the number of cores taken varying from plot to plot. The height and diameter was measured for each tree that was sampled. Borings were made in balsam fir, white spruce, and paper birch. The cores of balsam fir and white spruce were later counted in the office. Because of the difficulty of counting the annual rings of paper birch and the uncertain results obtained, it was decided not to include age determinations of paper birch in the investigation. The increment cores were taken at a stump height of one foot where possible. Where rot was present at stump height, cores were taken at breast height, $4\frac{1}{2}$ feet.

In estimating the age of each tree bored at a one foot height, the number of rings on the increment core (from the bark to the center) was counted. From figure 13 and from other sources it was estimated that balsam fir required eight years to grow to a height of one foot. For those trees that were bored at a height of $4\frac{1}{2}$ feet, a figure of 18 years was used as the number of years required for balsam fir to grow to that height. This figure is at best only an approximation. It was obtained from the Lake States Forest Experiment Station as the overall average time for balsam fir to grow to a height of $4\frac{1}{2}$ feet.

PRESENTATION AND ANALYSIS OF THE RESULTS

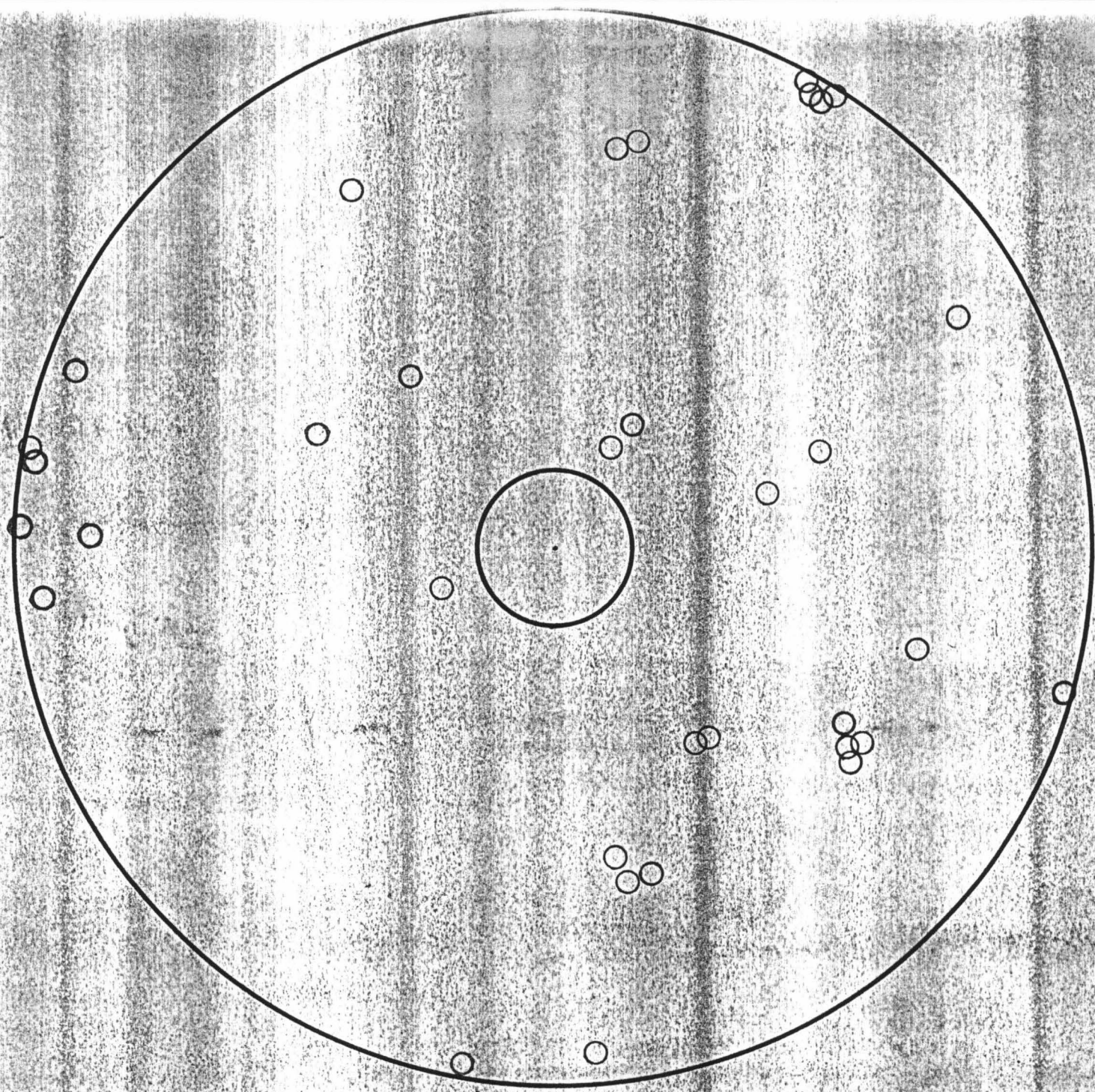
Blowdown Plot Data

The locations of the trees within each plot are shown by figures 4, 5, 6, and 7. On each figure, standing trees are designated by a green dot and a number. Trees that were blown down by the storm are designated by a brown dot and a letter. Transparent overlays for each figure give the species of each tree on the plot.

The trees shown on the plot graphs are listed by plots on pages 13, 15, 17, and 19. The number or letter, species, and DBH of each tree on each plot are given. From these tally sheets it can be seen that the large majority of the trees left standing on the plots within the blowdown area were paper birch. Few balsam fir or other conifers remained standing after the storm.

Table I summarizes the data presented on pages 13, 15, 17, and 19. The number of trees tallied on each plot are classified by species and are separated on the basis of whether they are standing or down. It is interesting to note that sixty percent of all the trees on the three plots within the blowdown area were blown down by the storm. Of the total number of trees on the three plots, forty-five percent were balsam fir that had been blown down. Almost thirty-six percent of the total trees on the plots were paper birch which remained standing. The remaining nineteen percent included standing balsam fir, down paper birch, and basswood, both standing and down. On the check plot outside of the blowdown area (plot number four) white spruce was an important constituent of the stand, making up twenty-one percent of the total number of trees on the plot.

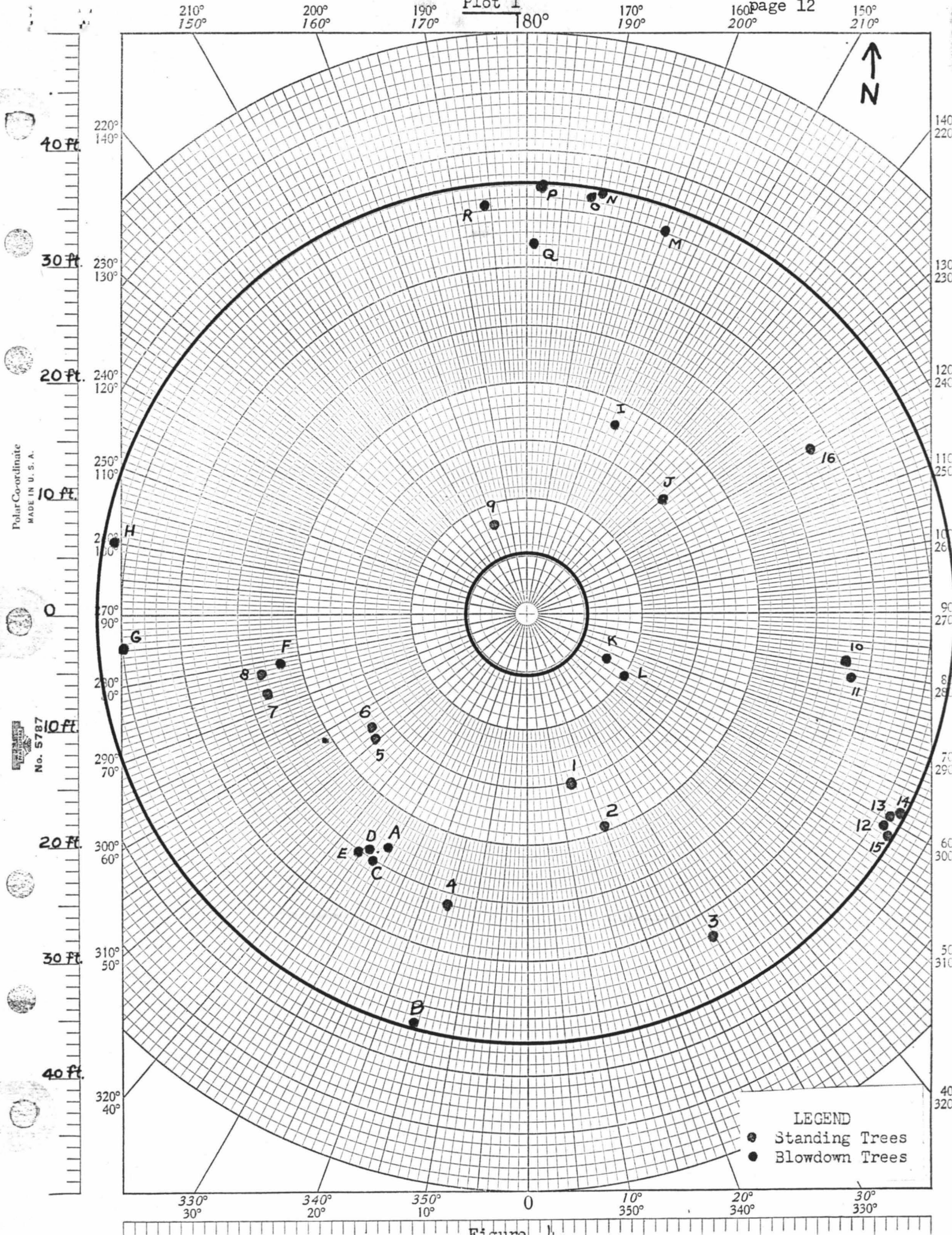
Plot 1



LEGEND

- Balsam Fir
- Paper Birch
- Baswood

Plot 1



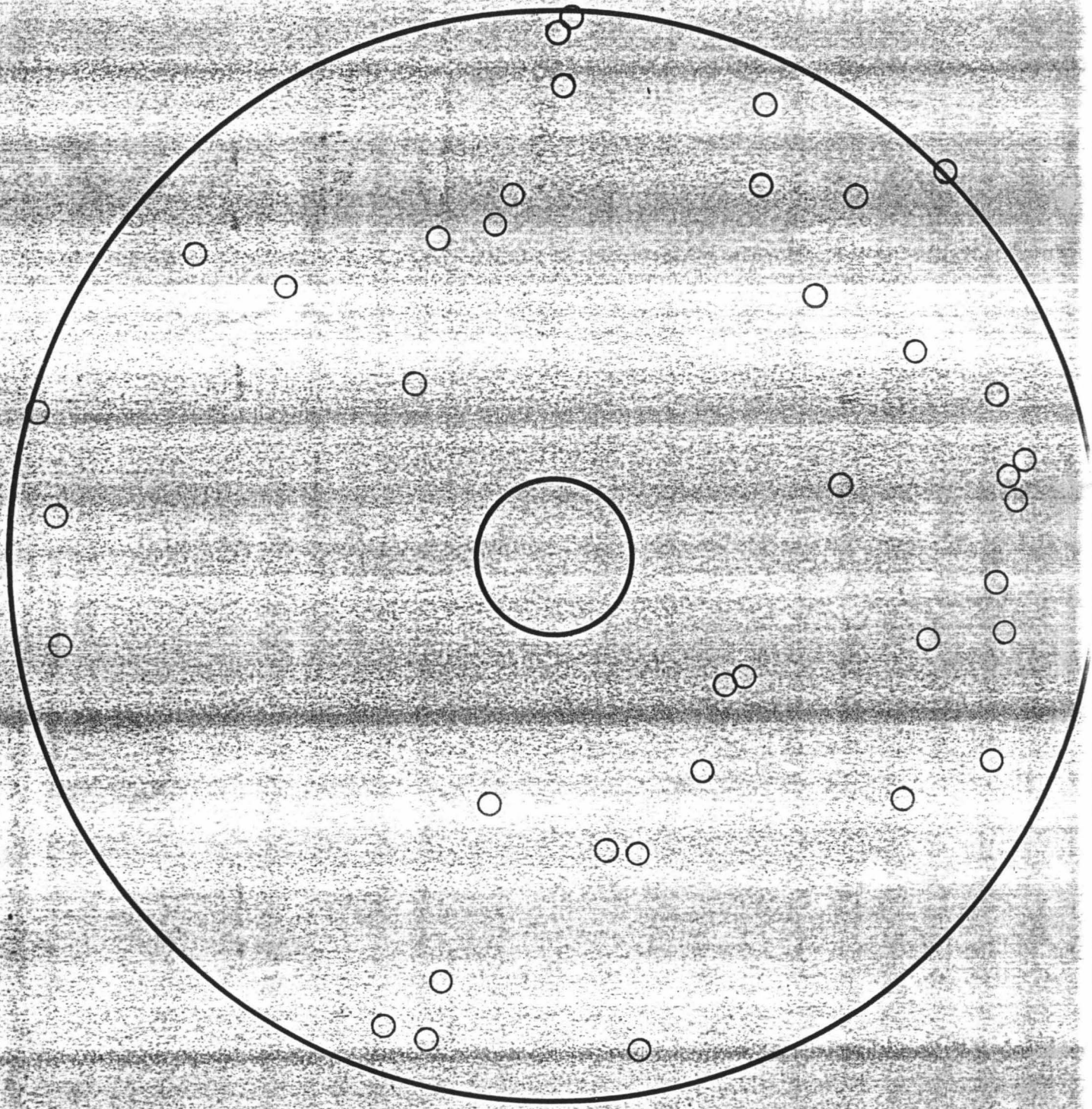
Polar Coordinate
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Figure 1.

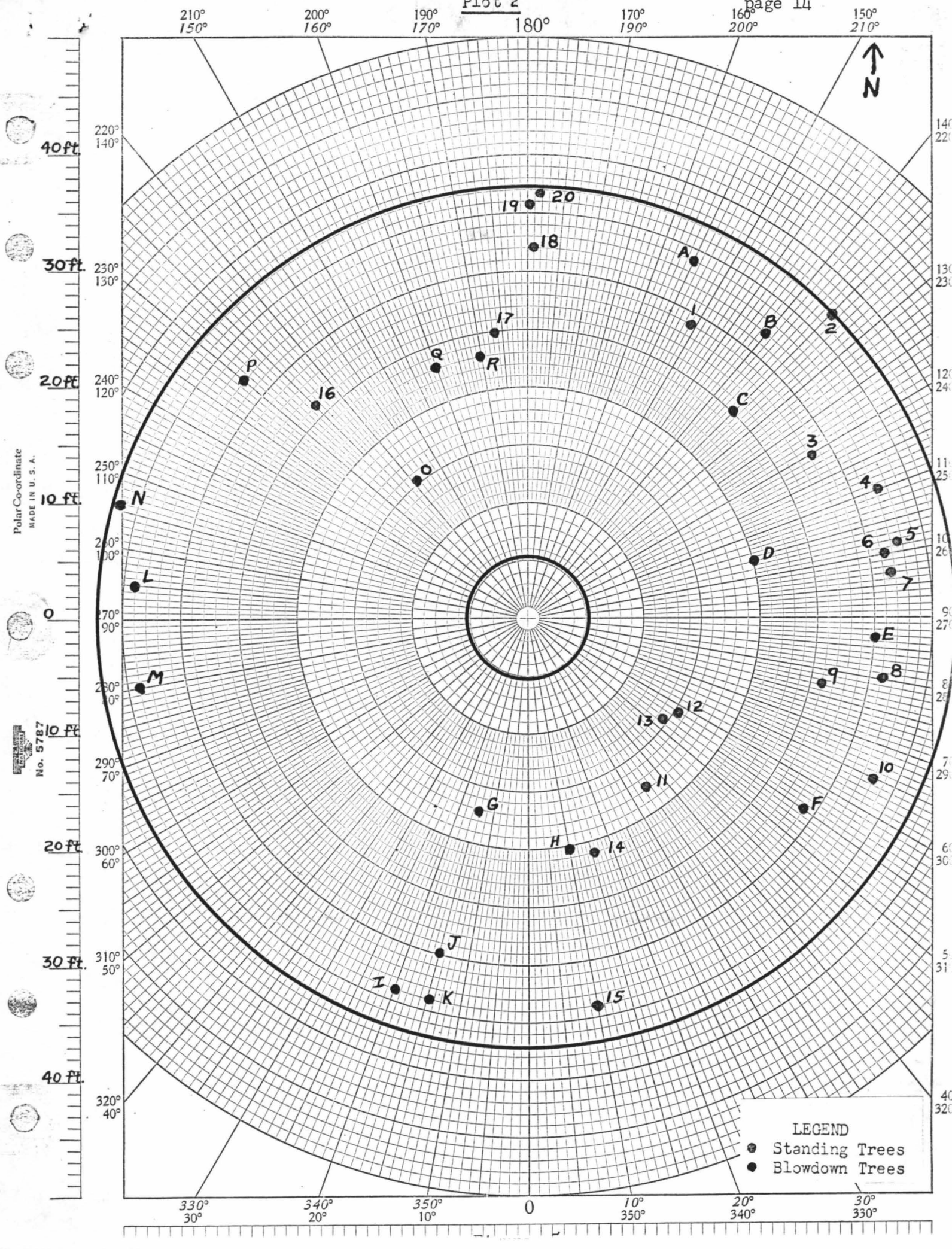
ITASCA BLOWDOWN PLOT NUMBER 1
TREE TALLY

Standing Trees			Blowdown Trees		
<u>Tree Number</u>	<u>Species</u>	<u>DBH (inches)</u>	<u>Tree Letter</u>	<u>Species</u>	<u>DBH (inches)</u>
1	Birch	5.4	A	Balsam Fir	8.3
2	Birch	3.5	B	Balsam Fir	9.3
3	Birch	2.9	C	Birch	3.9
4	Birch	5.0	D	Birch	4.2
5	Birch	6.0	E	Birch	3.9
6	Birch	4.6	F	Basswood	4.0
7	Basswood	4.9	G	Birch	6.7
8	Basswood	6.2	H	Balsam Fir	7.9
9	Birch	6.3	I	Balsam Fir	10.4
10	Birch	6.0	J	Balsam Fir	10.3
11	Birch	5.3	K	Birch	6.2
12	Birch	4.6	L	Balsam Fir	8.3
13	Birch	3.8	M	Balsam Fir	8.8
14	Birch	6.4	N	Birch	4.2
15	Birch	3.2	O	Balsam Fir	2.6
16	Birch	6.0	P	Balsam Fir	5.1
			Q	Balsam Fir	8.7
			R	Balsam Fir	5.7



LEGEND

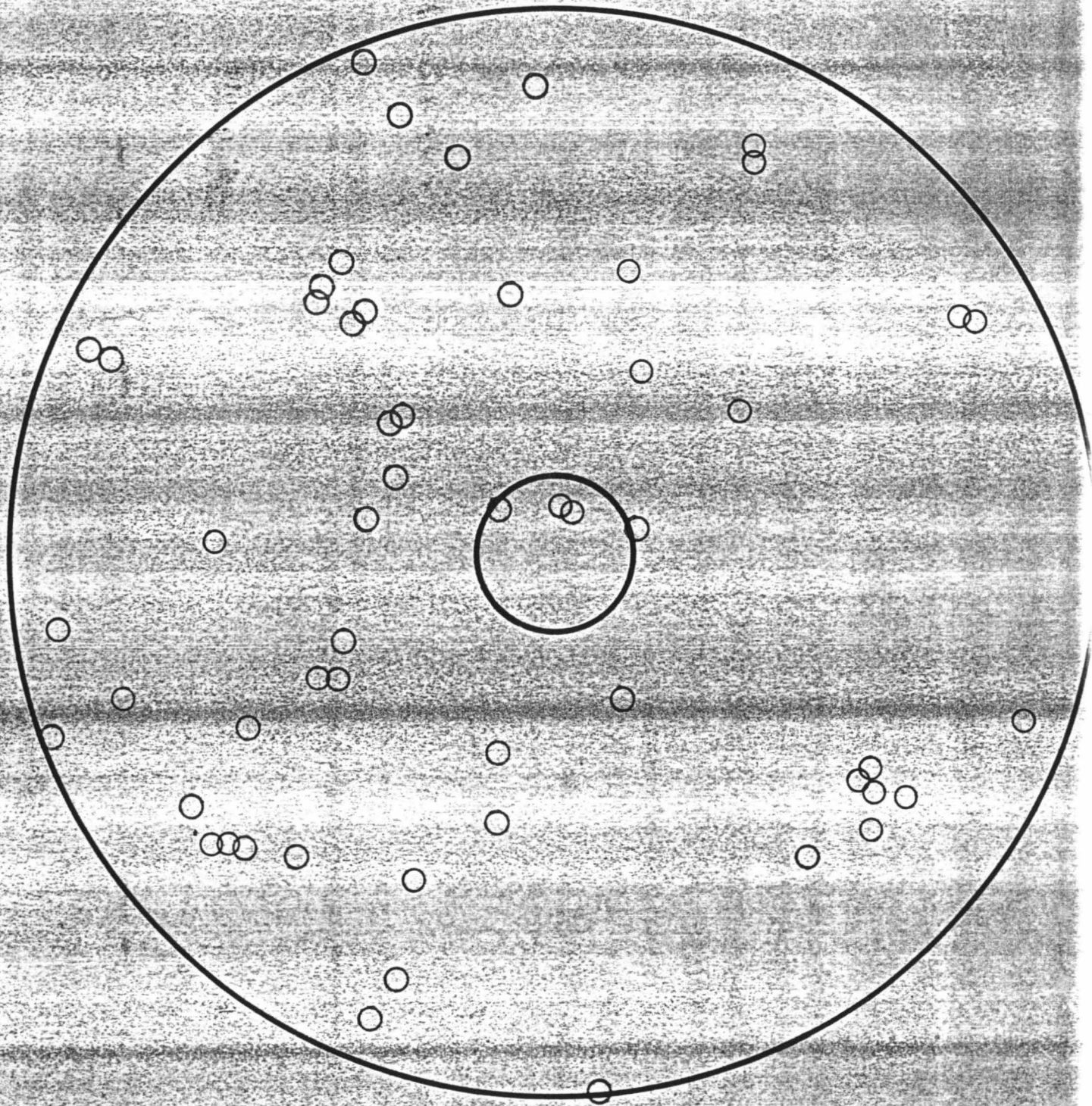
- Balsam Fir
- Paper Birch
- Basswood



ITASCA BLOWDOWN PLOT NUMBER 2
TREE TALLY

Standing Trees			Blowdown Trees		
<u>Tree Number</u>	<u>Species</u>	<u>DBH (inches)</u>	<u>Tree Letter</u>	<u>Species</u>	<u>DBH (inches)</u>
1	Birch	8.4	A	Balsam Fir	6.3
2	Birch	4.4	B	Balsam Fir	8.2
3	Birch	5.5	C	Balsam Fir	7.8
4	Balsam Fir	3.2	D	Balsam Fir	5.6
5	Birch	5.2	E	Balsam Fir	6.4
6	Birch	4.9	F	Balsam Fir	8.2
7	Birch	5.4	G	Balsam Fir	6.4
8	Birch	6.1	H	Balsam Fir	6.1
9	Birch	5.8	I	Balsam Fir	7.6
10	Birch	6.2	J	Birch	7.2
11	Birch	8.7	K	Balsam Fir	8.8
12	Basswood	4.4	L	Balsam Fir	11.0
13	Basswood	6.4	M	Balsam Fir	9.9
14	Birch	4.8	N	Balsam Fir	9.2
15	Birch	4.2	O	Balsam Fir	7.0
16	Birch	6.0	P	Balsam Fir	10.2
17	Birch	4.4	Q	Balsam Fir	9.3
18	Birch	3.7	R	Birch	5.8
19	Birch	6.0			
20	Birch	5.0			

Plot 3



LEGEND

- Balsam Fir
- Paper Birch

210° 150° 200° 160° 190° 170° 180° 170° 190° 160° 200° 150° 210°

Polar Co-ordinate
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FRANKLIN
No. 5787

40 ft.

30 ft.

20 ft.

10 ft.

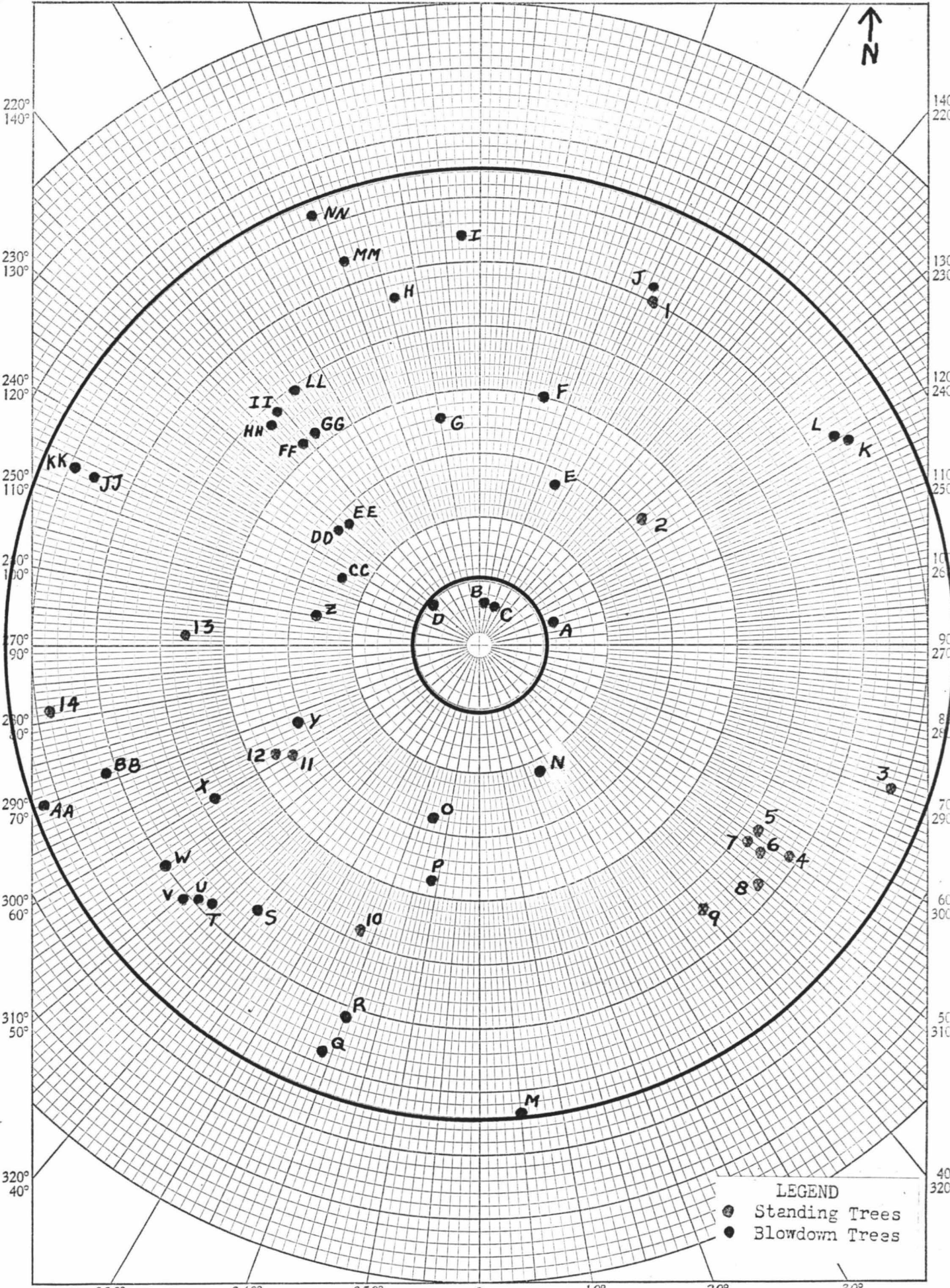
0

10 ft.

20 ft.

30 ft.

40 ft.



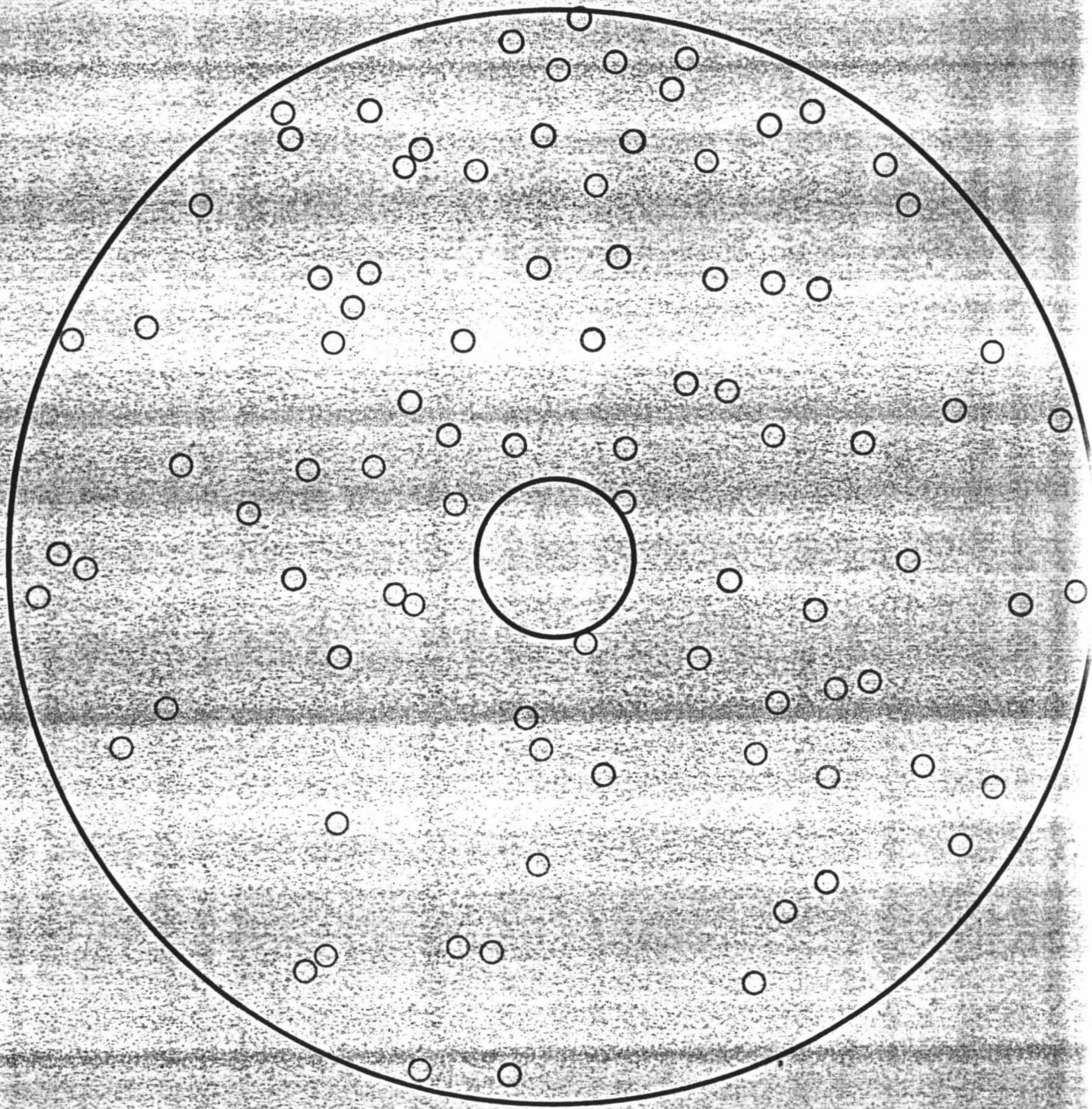
LEGEND
 ● Standing Trees
 ● Blowdown Trees

330° 30° 340° 20° 350° 10° 0 10° 350° 20° 340° 30° 330°

Figure 6

ITASCA BLOWDOWN PLOT NUMBER 3
TREE TALLY

Standing Trees			Blowdown Trees		
<u>Tree Number</u>	<u>Species</u>	<u>DBH (inches)</u>	<u>Tree Letter</u>	<u>Species</u>	<u>DBH (inches)</u>
1	Birch	6.3	A	Balsam Fir	6.7
2	Birch	5.4	B	Birch	4.4
3	Birch	4.4	C	Birch	5.8
4	Birch	5.9	D	Balsam Fir	2.4
5	Birch	5.7	E	Birch	7.4
6	Birch	5.7	F	Birch	6.5
7	Birch	3.2	G	Balsam Fir	6.4
8	Birch	5.2	H	Balsam Fir	6.9
9	Birch	3.0	I	Balsam Fir	4.7
10	Birch	5.8	J	Birch	5.9
11	Birch	6.5	K	Birch	7.4
12	Birch	5.6	L	Birch	7.2
13	Birch	4.9	M	Balsam Fir	5.4
14	Birch	6.6	N	Balsam Fir	5.5
			O	Balsam Fir	8.2
			P	Balsam Fir	4.5
			Q	Balsam Fir	5.0
			R	Balsam Fir	6.5
			S	Balsam Fir	2.7
			T	Balsam Fir	4.8
			U	Birch	3.0
			V	Birch	5.0
			W	Balsam Fir	5.0
			X	Balsam Fir	5.4
			Y	Balsam Fir	6.9
			Z	Balsam Fir	7.3
			AA	Balsam Fir	6.9
			BB	Birch	4.1
			CC	Balsam Fir	3.2
			DD	Balsam Fir	6.0
			EE	Balsam Fir	5.5
			FF	Balsam Fir	7.0
			GG	Balsam Fir	7.5
			HH	Balsam Fir	4.7
			II	Balsam Fir	4.6
			JJ	Balsam Fir	3.8
			KK	Balsam Fir	6.0
			LL	Balsam Fir	3.0
			MM	Balsam Fir	5.0
			NN	Balsam Fir	4.3



LEGEND

- Balsam Fir
- Paper Birch
- White Spruce
- Ash

ITASCA BLOWDOWN PLOT NUMBER 4
TREE TALLY

Standing Trees			Standing	
Tree Number	Species	DBH (inches)	Tree Number	Species
1	White Spruce	13.6	51	White Sp
2	Balsam Fir	6.2	52	Balsam F
3	Birch	5.1	53	Balsam F
4	Balsam Fir	6.6	54	Balsam F
5	Balsam Fir	1.9	55	White Sp
6	Balsam Fir	3.1	56	Birch
7	Balsam Fir	3.6	57	Balsam F
8	Ash	6.2	58	Birch
9	Balsam Fir	4.7	59	Balsam F
10	Birch	8.5	60	White Sp
11	Balsam Fir	4.3	61	Balsam F
12	Birch	9.2	62	White Sp
13	Ash	3.4	63	Birch
14	Birch	5.8	64	Balsam F
15	Birch	4.5	65	Birch
16	White Spruce	10.4	66	White Sp
17	White Spruce	5.9	67	Birch
18	Balsam Fir	3.5	68	Balsam F
19	White Spruce	4.2	69	Birch
20	Balsam Fir	5.6	70	Balsam F
21	Balsam Fir	8.4	71	Birch
22	White Spruce	11.8	72	Birch
23	Balsam Fir	4.6	73	Balsam F
24	Balsam Fir	6.8	74	Balsam F
25	White Spruce	7.1	75	Balsam F
26	Balsam Fir	4.0	76	White Sp
27	Birch	8.0	77	Balsam F
28	Balsam Fir	7.3	78	Balsam F
29	Balsam Fir	5.8	79	Balsam F
30	Birch	3.6	80	White Sp
31	Balsam Fir	5.3	81	Balsam F
32	White Spruce	7.2	82	Balsam F
33	Balsam Fir	7.2	83	Balsam F
34	Balsam Fir	7.8	84	Balsam F
35	White Spruce	13.4	85	White Sp
36	Balsam Fir	4.2	86	Birch
37	Birch	3.0	87	Balsam F
38	Balsam Fir	3.2	88	Birch
39	Balsam Fir	3.9	89	Balsam F
40	Balsam Fir	6.3		
41	Balsam Fir	3.2		
42	Balsam Fir	3.6		
43	Balsam Fir	7.3		
44	White Spruce	4.0		
45	Balsam Fir	3.1		
46	White Spruce	3.8		
47	White Spruce	3.5		
48	Birch	8.3		
49	Balsam Fir	3.5		
50	Birch	3.4		

TABLE I
ITASCA BLOWDOWN PLOTS

Number of trees and percent of trees on plot (expressed as a percentage of the total number of trees on plot).

Plot Number	Standing Trees								Blowdown Trees								Plot Total	
	Balsam Fir	Paper Birch	Basswood	Total	Balsam Fir	Paper Birch	Basswood	Total	Balsam Fir	Paper Birch	Basswood	Total	Balsam Fir	Paper Birch	Basswood	Total		
	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent		
1			14	41.2%	2	5.9%	16	47.1%	11	32.4%	6	17.6%	1	2.9%	18	52.9%	34	100.0%
2	1	2.6%	17	44.7%	2	5.3%	20	52.6%	16	42.1%	2	5.3%			18	47.4%	38	100.0%
3			14	25.9%			14	25.9%	30	55.6%	10	18.5%			40	74.1%	54	100.0%
Total	1	.8%	45	35.7%	4	3.2%	50	39.7%	57	45.2%	18	14.3%	1	.8%	76	60.3%	126	100.0%

Plot Outside of Blowdown Area

Number of trees and percent of trees on plot (expressed as a percentage of the total number of trees on plot).

Plot Number	Standing Trees					Blowdown Trees				
	Balsam Fir	White Spruce	Paper Birch	Ash	Total	NONE				
	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent	No. trees	per-cent
4	48	53.9%	19	21.4%	20	22.5%	2	2.2%	89	100.0%

Using the data presented on pages 13, 15, 17, and 19, the basal area of each standing or down species within each plot was computed from a basal area table (3). The results are set forth in table II.

Table I indicated that sixty percent of the total number of trees on the plots had fallen as a result of the storm. This sixty percent accounted for almost seventy percent of the total basal area of the trees originally on the plots. It is also interesting to note that the standing paper birch, which accounted for thirty-six percent of the total number of trees on the plots, amounted to only twenty-eight percent of the total basal area.

Perhaps the most striking observation made during the investigation was that while seventy-one percent of the paper birch remained standing after the storm, only two percent of the balsam fir were still standing. Many of the standing balsam fir had tops broken off or were leaning badly. Figure 8 illustrates the general appearance of a typical portion of the blowdown area in September 1953, about four months after the storm.

TABLE II
ITASCA BLOWDOWN PLOTS

Basal Area (In square feet and expressed as a percent of the total basal area per plot)

Plot Number	Standing Trees								Blowdown Trees								Plot Total	
	Balsam Fir		Paper Birch		Basswood		Total		Balsam Fir		Paper Birch		Basswood		Total			
	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent		
1			1.90	27.1%	.34	4.8%	2.24	31.9%	3.86	55.1%	.82	11.7%	.09	1.3%	4.77	68.1%	7.01	100.0%
2	.05	.5%	2.94	31.0%	.29	3.1%	3.28	34.6%	5.73	60.4%	.47	5.0%			6.20	65.4%	9.48	100.0%
3			2.24	25.1%			2.24	25.1%	4.94	55.3%	1.75	19.6%			6.69	74.9%	8.93	100.0%
Total	.05	.2%	7.08	27.8%	.63	2.5%	7.76	30.5%	14.53	57.2%	3.04	11.9%	.09	.4%	17.66	69.5%	25.42	100.0%

Plot Outside of Blowdown Area

Basal Area (In square feet and expressed as a percent of the total basal area per plot)

Plot Number	Standing Trees								Blowdown Trees									
	Balsam Fir		White Spruce		Paper Birch		Ash		Total									
	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	Sq. ft.	per- cent	NONE							
4	6.75	39.6%	6.06	35.6%	3.97	23.3%	.25	1.5%	17.03	100.0%								



Figure 8

The photograph above illustrates the general condition of the southern end of the Itasca blowdown about four months after the storm. This photograph was taken on September 16, 1953, from about 35 feet south of the center stake of plot number 1, facing west. It was taken at 9:00 am. at f 11 - 1/25 second exposure.

Reproduction plots

Using the 1/10 acre plot stake as the center, a 1/500 acre plot was laid out. On this plot, the reproduction of all tree species found was recorded by age class intervals of one year. The average height for each class within each species was estimated.

Figures 9, 10, 11, and 12 present in graphic form the actual count by age classes for each plot. Figure 13 shows the average height by age classes for balsam fir. Table III summarizes the height data for all other species found on the plots.

A comparison of figures 9, 10, 11, and 12 shows clearly the wide variation between plots in age class distribution of balsam fir. The large number of one- to three-year-old black ash seedlings on the check plot is also very prominent.

For the most part there was little ground vegetation on the plots except for plot number 1. There was almost a complete absence of brush species within the blowdown area. A summary of the vegetation and brush found on the plots is given on page 31.

The relative abundance was indicated for each species by the use of the terms abundant, moderately abundant, and sparse. The following classification was used:

- sparse 0 - 10 percent of the plot ground area covered.
- moderately
abundant 10 - 50 percent of the plot ground area covered.
- abundant 50 - 100 percent of the plot ground area covered.

These terms were assigned according to the percent of ground within each plot covered by the species of vegetation under consideration.

Plot 1

Reproduction Count
1/500 acre plot

Legend






- Balsam Fir
- White Spruce
- American Elm



Figure 9.

Plot 2
 Reproduction Count
 1/500 acre plot

Legend

-  Balsam Fir
-  White Pine
-  Black Ash
-  Paper Birch
-  American Elm

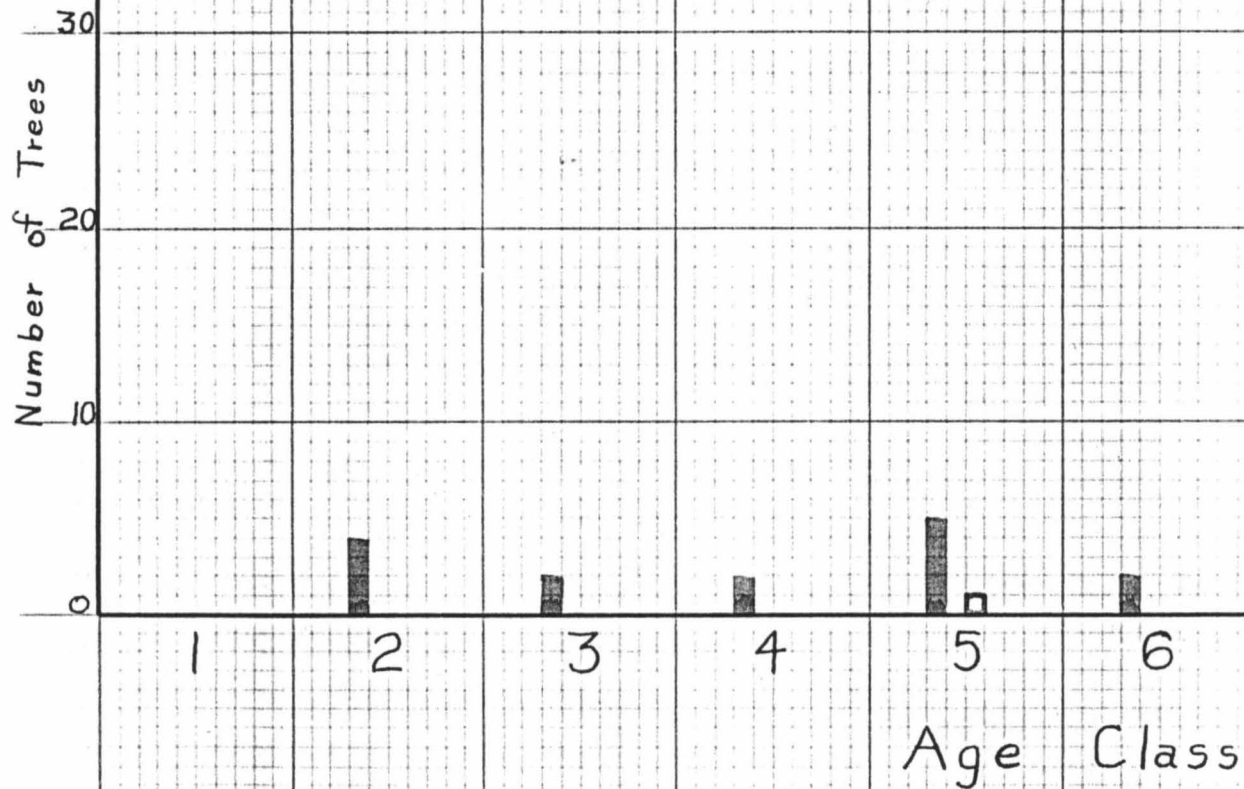


Figure 10.

Plot 3

Reproduction Count
1/500 acre plot

Legend

- Balsam Fir
- White Pine
- Red Pine
- White Spruce

Number of trees

1 2 3 4 5 6 7 8 9 10+

Age Class

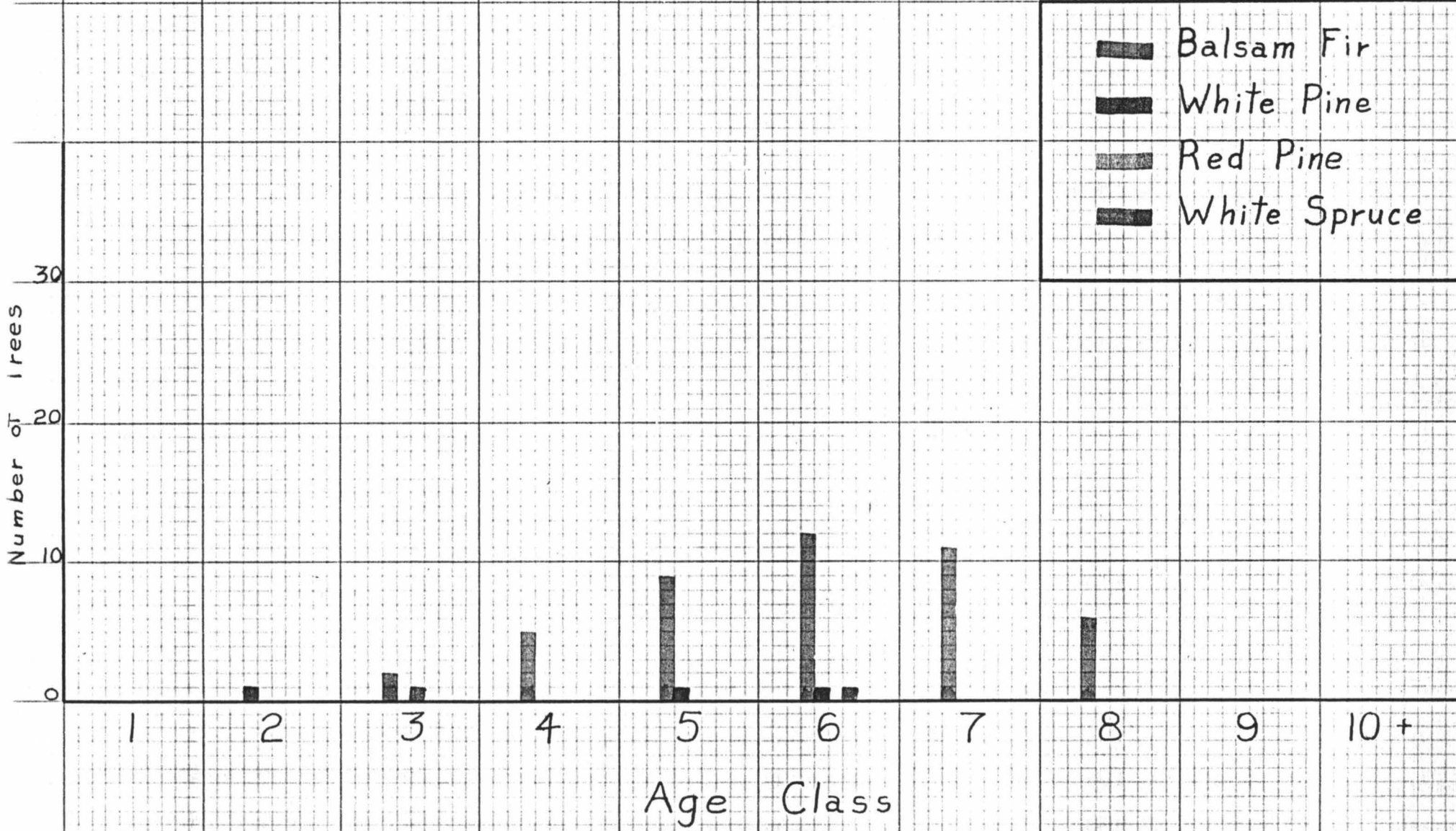






Figure 11

Plot 4

Reproduction Count
1/500 acre plot

Legend

-  Balsam Fir
-  Black Ash
-  American Elm
-  Red Maple

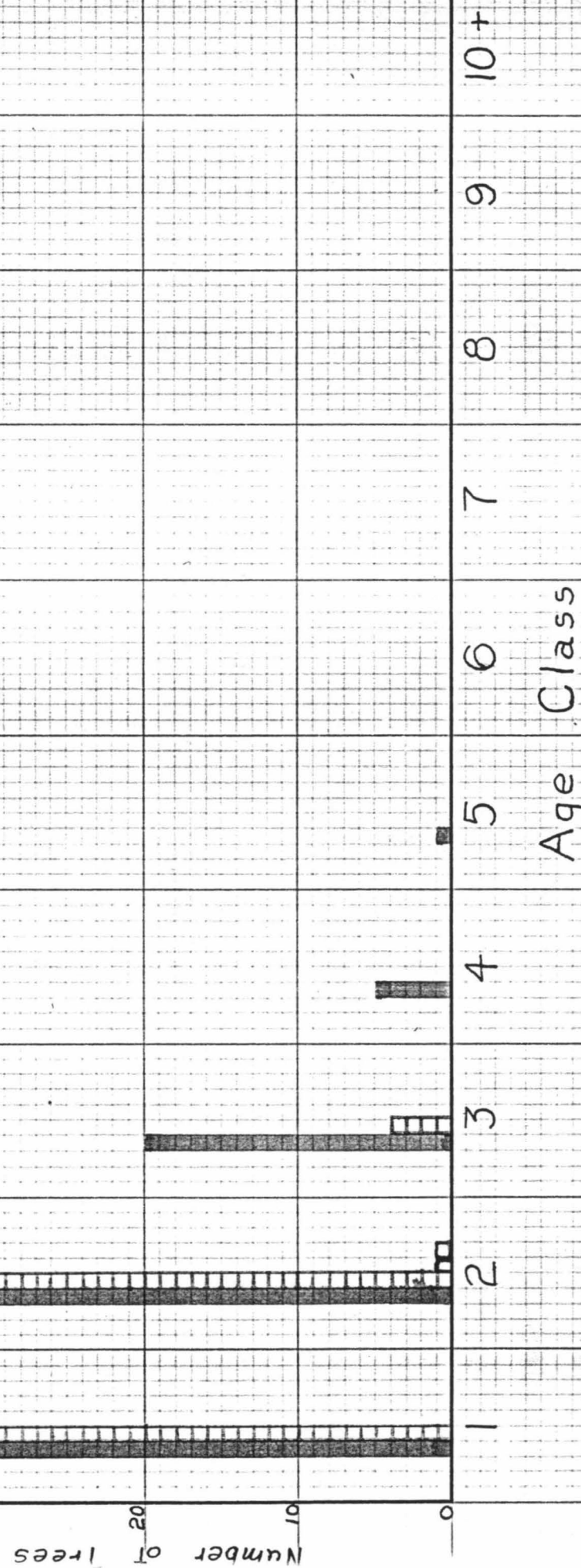
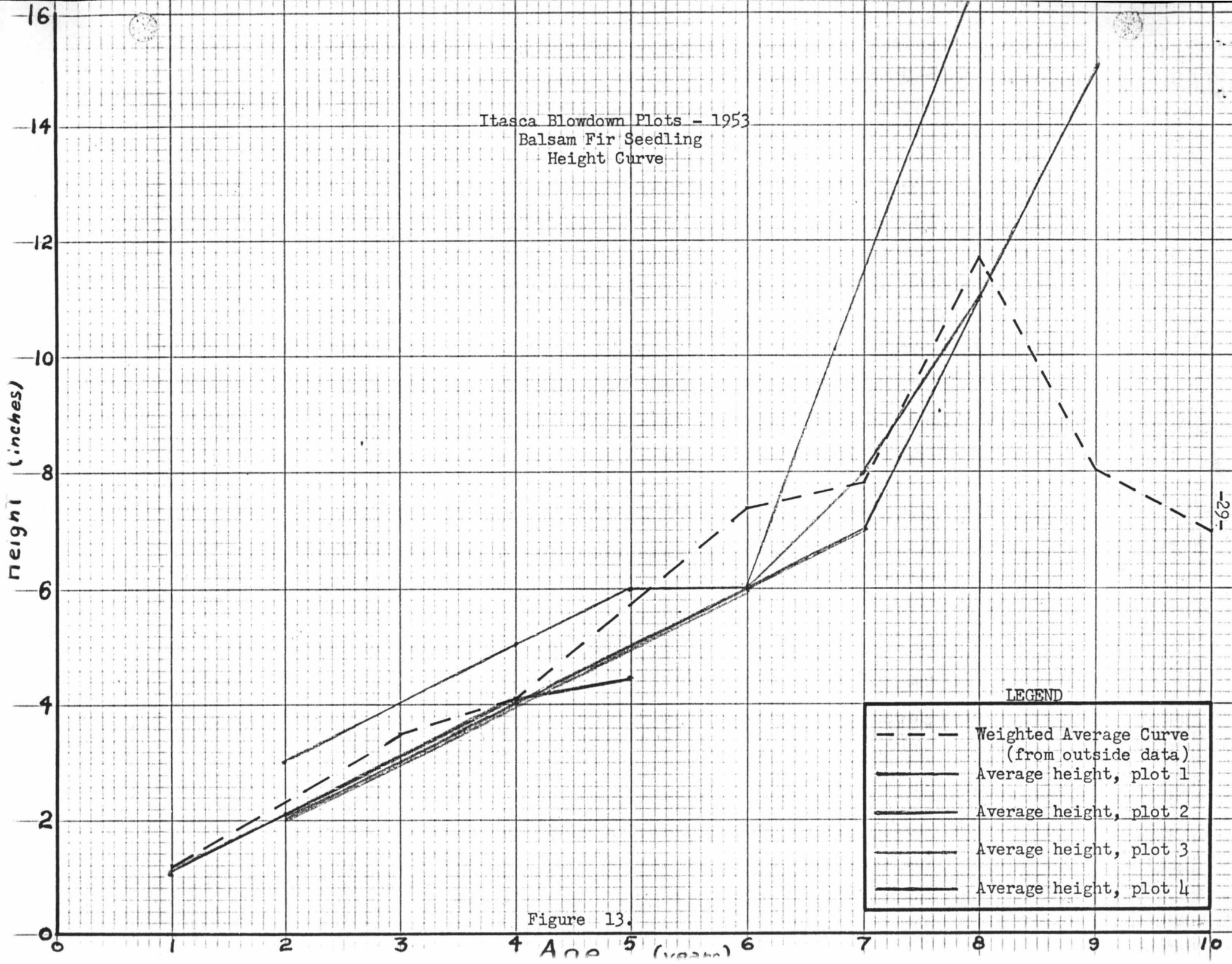


Figure 12.



Vegetation present on the 1/500 acre reproduction plots.

Plot Number 1.

Aster macrophyllus - abundant
Fragaria sp. - moderately abundant
Aralia nudicaulis - sparse

Plot Number 2.

Fragaria sp. - abundant
Aster macrophyllus - moderately abundant
Galium sp. - sparse
Aralia nudicaulis - sparse
 grasses - sparse
Pteris aquilina - sparse

Plot Number 3.

Aster macrophyllus - sparse
Convolvulus sepium - sparse
Galium sp. - sparse

Plot Number 4.

Aralia nudicaulis - sparse
Aster macrophyllus - sparse
Caulophyllum
 thalictroides - sparse
Convolvulus sepium - sparse
Fragaria sp. - sparse
Galium sp. - sparse
 grasses - sparse
Maianthemum canadense - sparse
Thalictrum dioicum - sparse

Brush species present on 1/500 acre reproduction plots.

Plot Number 1.

	<u>Number of stems.</u>	<u>Height class.</u>
<i>Rubus strigosus</i>	11	0 - 1 feet
" "	2	1 - 3 feet

Plot Number 2.

<i>Rubus strigosus</i>	2	0 - 1 feet
" "	1	1 - 3 feet

Plot Number 3.

<i>Rubus strigosus</i>	1	0 - 1 feet
------------------------	---	------------

Plot Number 4.

No brush on this plot.

Estimation of Area Covered by Down Timber.

The percent of the area of each plot covered with down timber was estimated and recorded. Almost all of the down trees were still green and the ground covered by the foliage of the fallen trees was included in this percentage. Less than ten percent of plot 1, from twenty to thirty percent of plot 2, and about ten percent of plot 3 was covered by down timber.

Because it was felt that a larger sample of the amount of ground covered by blowdown was needed, two additional transects were run. Out of a total length of 858 feet, it was found that 317 feet of the transects was covered by blowdown. This was 36.9 percent of the total transect length. This percentage was used as an estimate of the total amount of the blowdown area actually covered by down timber.

Photographic Record.

Photographs of the center of each plot were taken as an aid in relocating the plot centers in the future. These photographs are figures 14, 15, 16, and 17. The location from which each picture was taken and the photographic details are given with each illustration. All of the photographs illustrating this report were taken with a 4 x 5 Crown Graphic on Kodak Pan-X film. They were processed by the university photo lab.



Figure 14

Plot number 1 - This photograph was taken about fifteen feet southeast of the plot center stake on September 18, 1953 at 9:15 am. It was taken without flash at f16 - 1/10 second exposure.

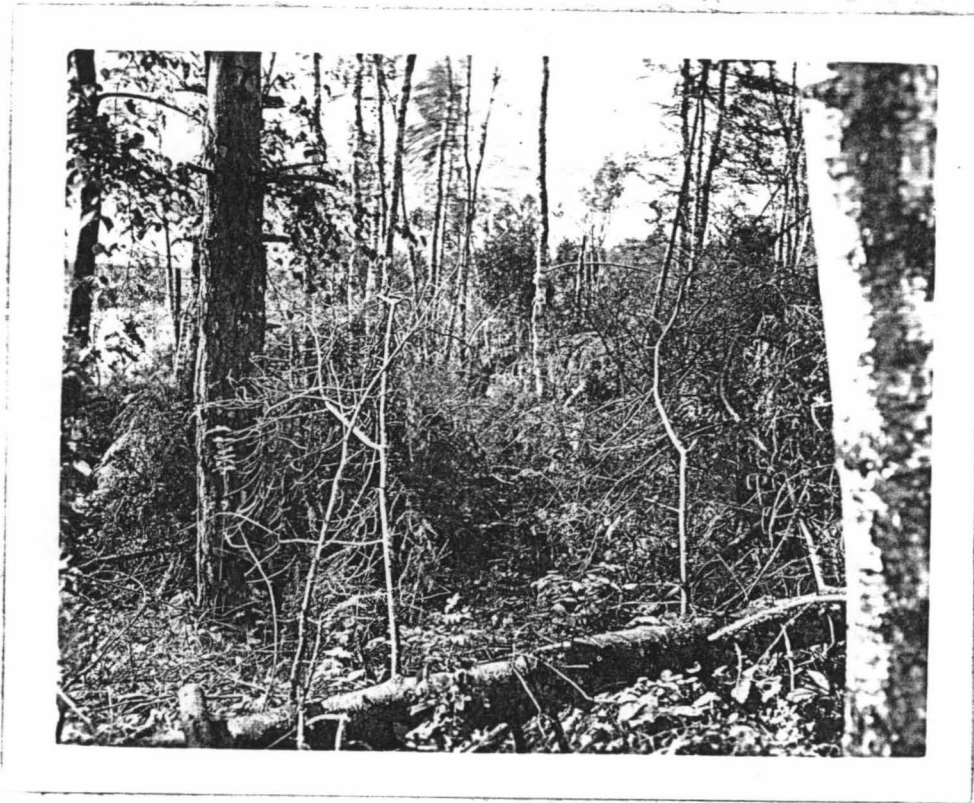


Figure 15

Plot number 2 - This photograph was taken about twenty feet north of the plot center stake on September 18, 1953 at 9:45 am. It was taken with flash at f16 - 1/5 second exposure.



Figure 16

Plot number 3 - This photograph was taken about twenty feet southwest of the plot center stake, on September 18, 1953 at 11:00 am. It was taken with flash at f11 - 1/25 second exposure.



Figure 17

Plot number 4 - This photograph was taken about fifteen feet north of the plot center stake on September 18, 1953 at 10:00 am. Taken with flash at f11 - 1 second exposure.

Soil Analysis.

Soil analyses of the A horizons of each plot were made and the following results were obtained.

- Plot number 1 - 17.6 percent silt and clay content.
- Plot number 2 - 19.6 percent silt and clay content.
- Plot number 3 - 28.4 percent silt and clay content.
- Plot number 4 - 37.7 percent silt and clay content.

As a result of this analysis the following approximate textural classes were given to the soils from the A horizons of the plots (5).

- Plot number 1 - loamy sand.
- Plot number 2 - loamy sand.
- Plot number 3 - sandy loam.
- Plot number 4 - sandy loam.

These textural classes coincide closely with those given to these soils in the field. Depths of the A_0 , A_1 , A_2 (where definitely present), B, and C horizons are given in graphic form by figures 18, 19, 20, and 21.

Age-height-diameter Relationships.

The diameter, height and age data obtained on the four plots is presented in Table IV. It was from this data that an approximate mean age of sixty years for the stand was computed.

Using the data in Table IV, the diameter of balsam fir was plotted over age (figure 22). From this figure it can be seen that throughout the range of tree diameters sampled there is little variation in age.

Because of the heterogeneous composition of the blowdown, no attempt was made to estimate the volume of timber blown down by the storm.

Soil Profile - Plot # 1

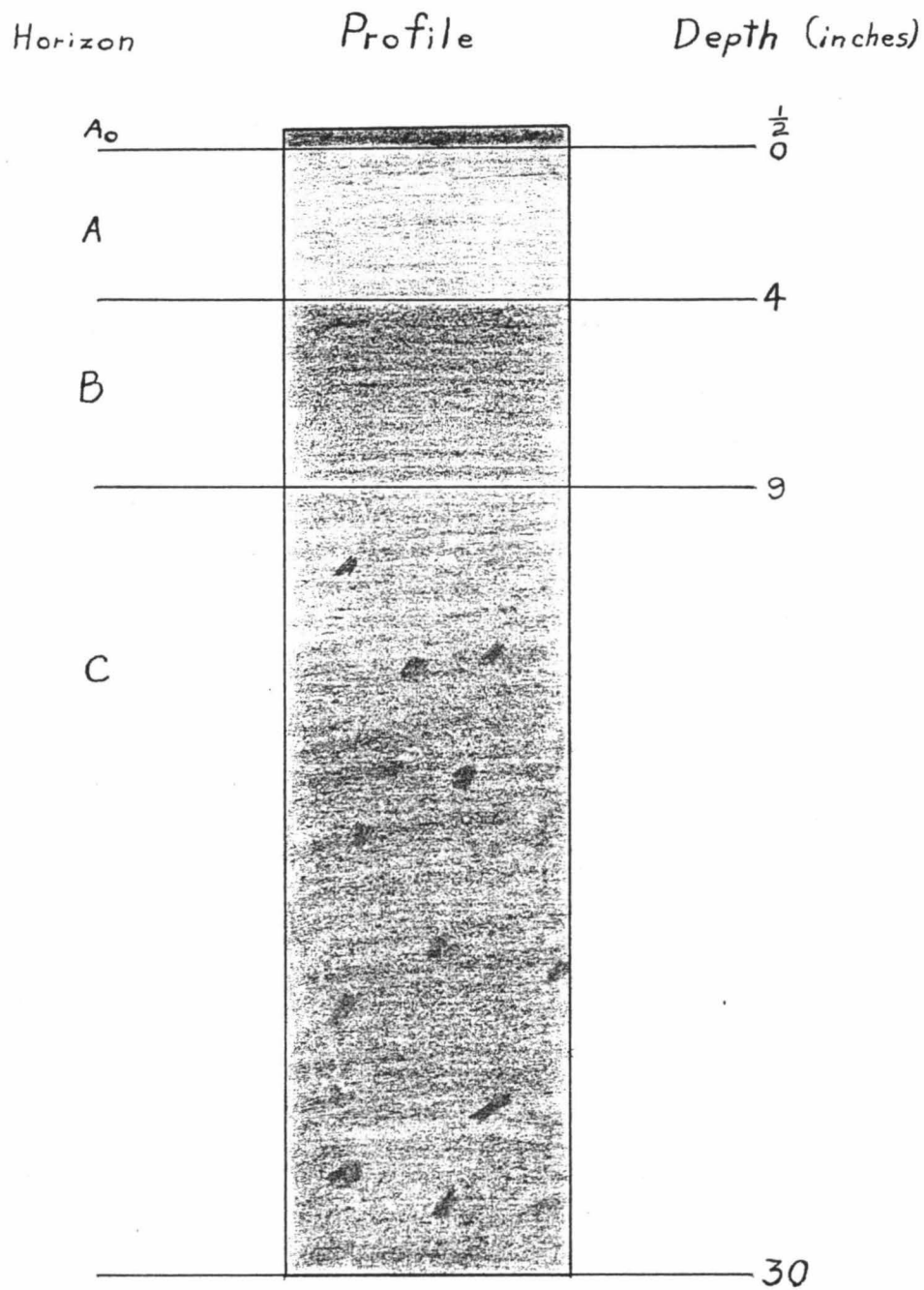


Figure 18.

Soil Profile - Plot #2

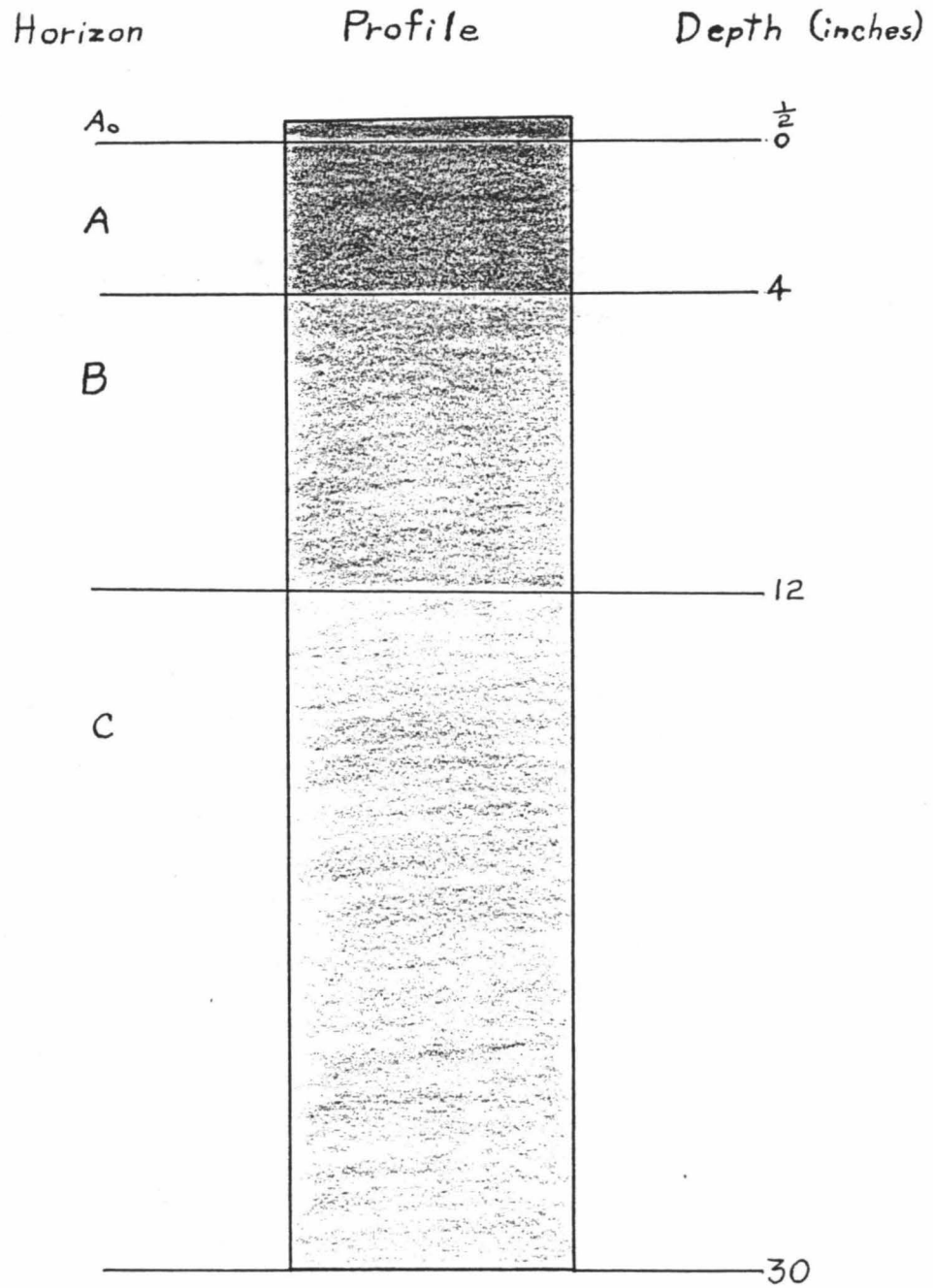


Figure 19.

Soil Profile - Plot #3

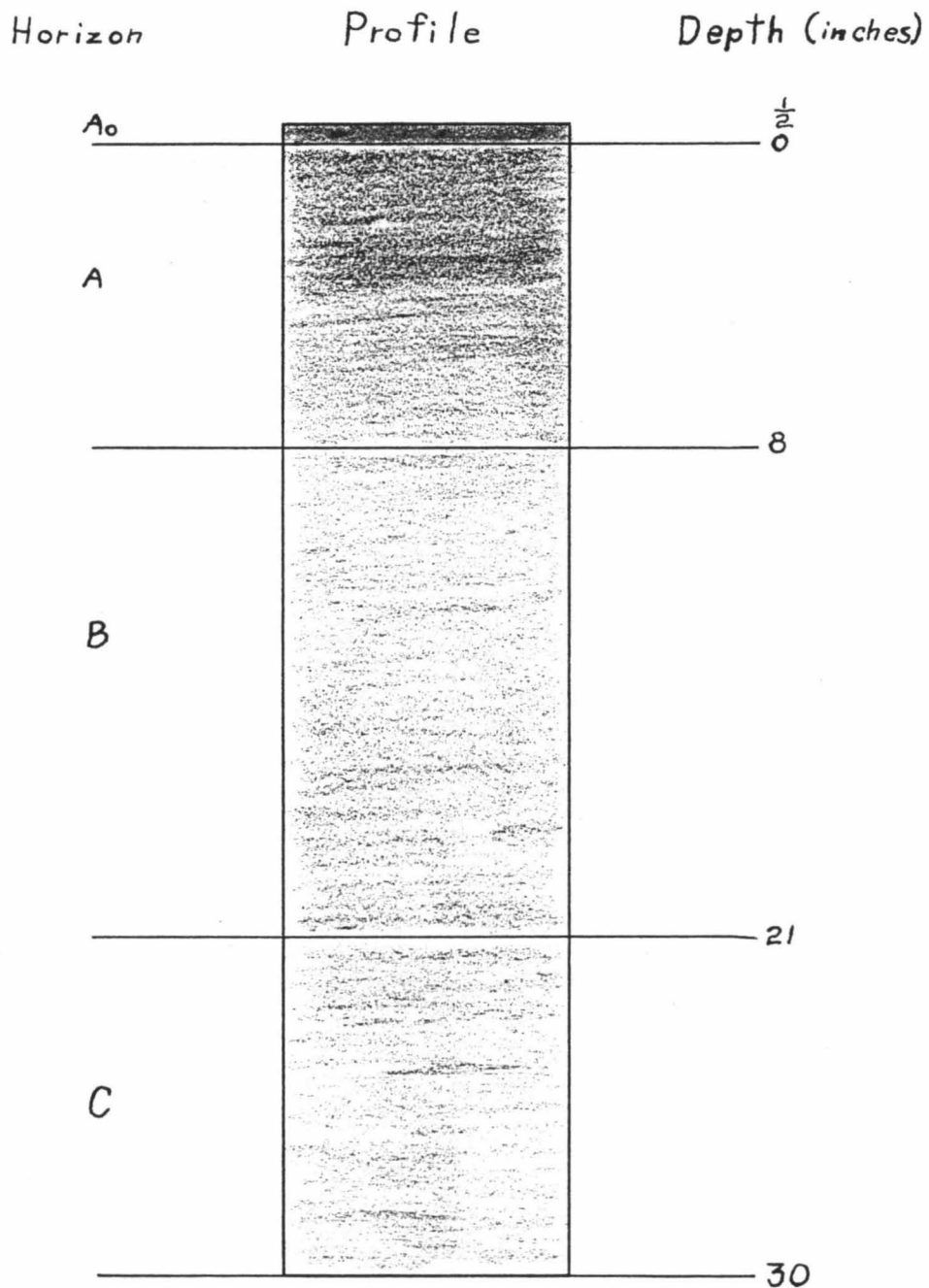


Figure 20.

Soil Profile - Plot # 4

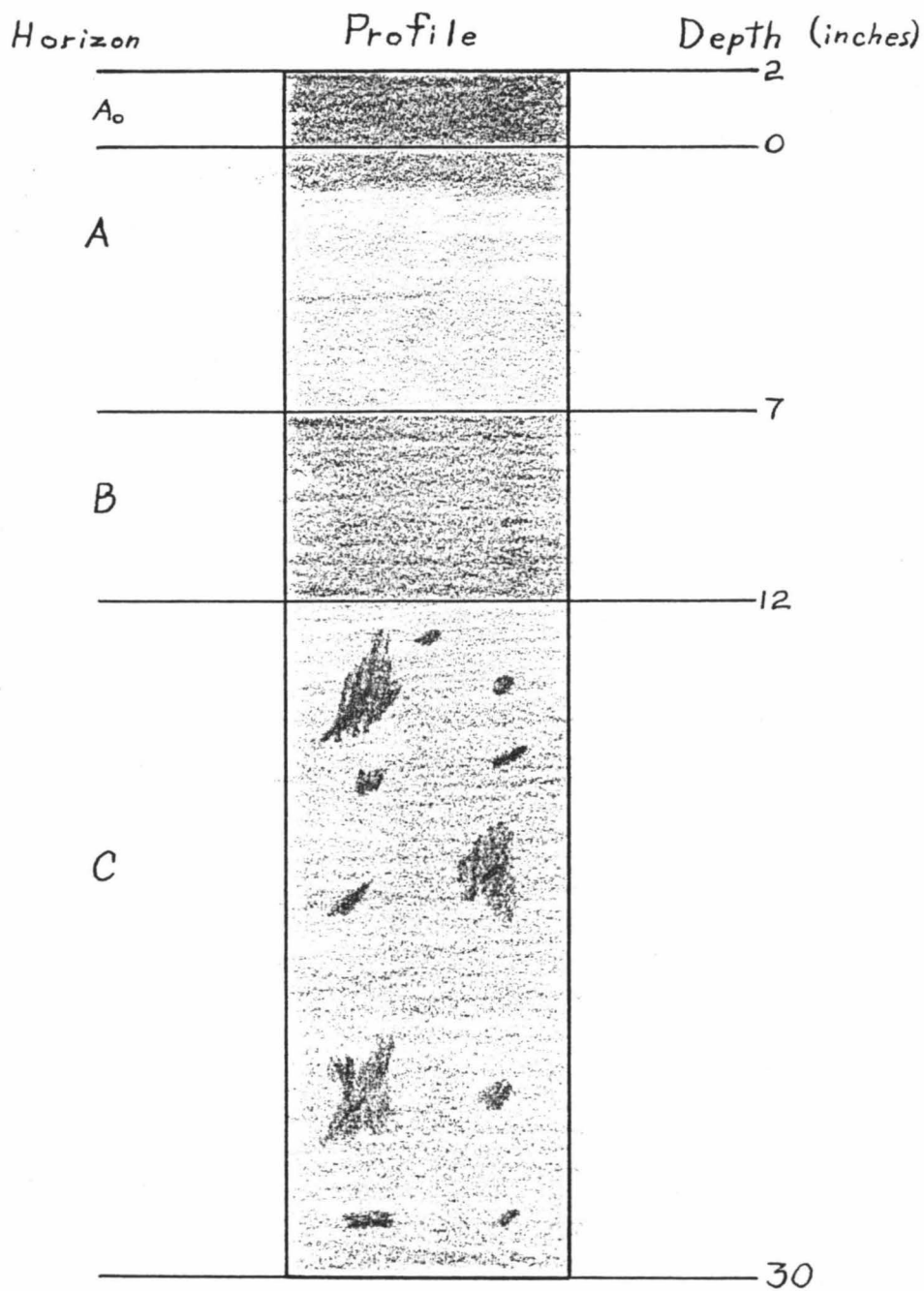


Figure 21.

TABLE IV

Diameter - Height - Age Data From Permanent Plots

BAISAM FIR

Increment cores taken at one foot height.

<u>Tree Number</u>	<u>Plot Number</u>	<u>DBH (inches)</u>	<u>Height (feet)</u>	<u>Annual rings counted on core. (AR)</u>	<u>Years to grow to height of one foot. (Y)</u>	<u>Age (AR/Y)</u>
5	2	7.8	38	47	8	55
7	2	8.9	46	56	8	64
13	1	6.6	41	51	8	59
14	1	7.8	48	45	8	53
15	1	3.7	28	37	8	45
31	4	7.0	48	54	8	62
34	4	5.4	44	54	8	62
35	4	7.8	54	57	8	65

Increment cores taken at 4½ foot height.

2	2	9.3	38	50	18	68
6	2	7.5	35	49	18	67
13	1	6.6	41	43	18	61
17	1	9.4	44	51	18	69
25	3	4.1	27	50	18	68
28	3	5.7	42	48	18	66

WHITE SPRUCE

Increment cores taken at one foot height.

26	3	7.2	38	54	8	62
30	4	7.1	52	53	8	61
32	4	6.1	52	57	8	65
36	4	13.3	71	57	8	65

Figure 22

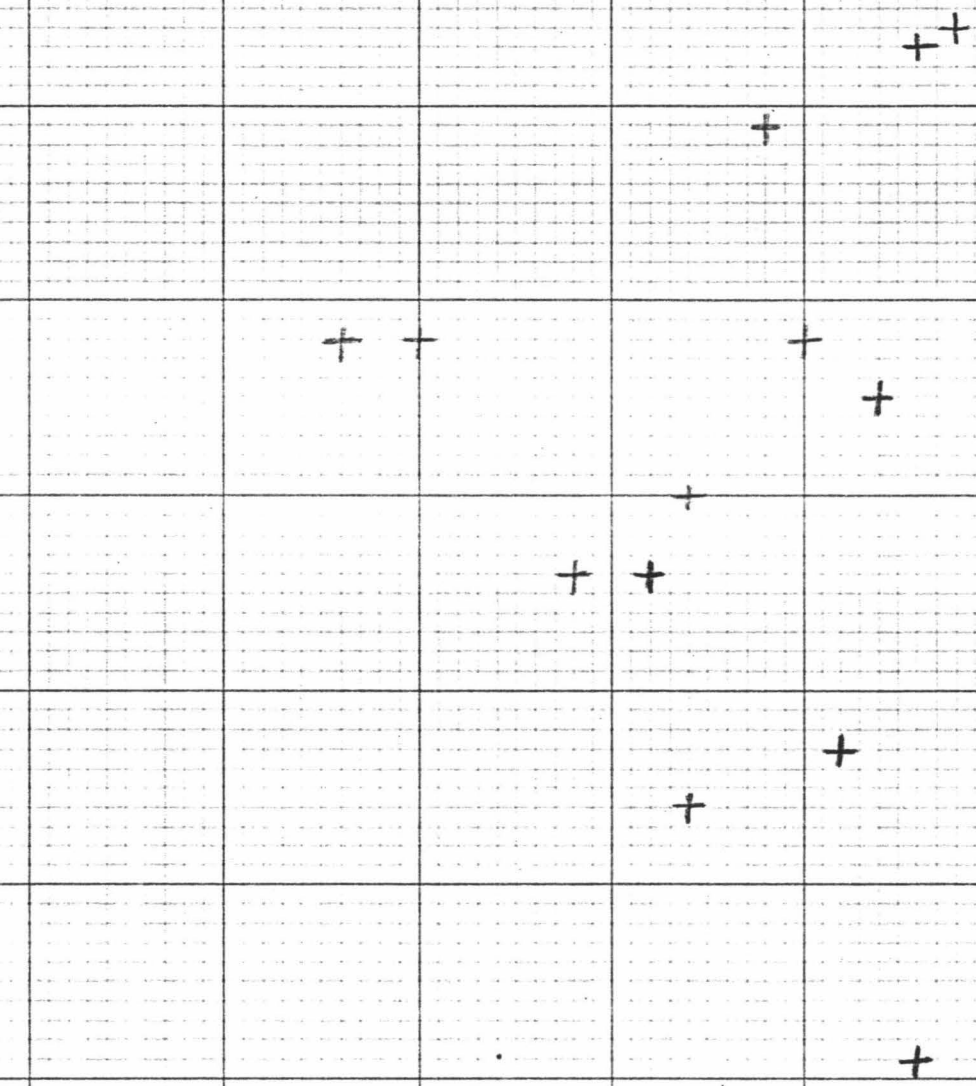
Balsam Fir Diameter - Age Relationship.
Permanent Plots - Itasca Blowdown 1953.

D.B.H. - (inches)
10
9
8
7
6
5
4
3

40 50 60 70
Age (years)

LEGEND

- + Cores taken at a height of one foot.
- + Cores taken at a height of $4\frac{1}{2}$ feet.



General Observations.

Almost all of the uprooted balsam fir were found to have rotted roots. Uprooting appeared to have been the major cause of the blowdown damage. Many balsam fir had been broken off instead of having been uprooted. All of the broken trees examined were found to have butt rot. The trees so broken off were completely dead and in many cases the needles had dropped off.

Of the nineteen balsam fir bored for increment cores, eleven had rotten centers at a one foot stump height. All of these except one were sound at breast height.

Most fallen balsam fir still had one or more roots left in the soil. At the time of the examination, four months after the storm, it was noticed that many of the tips of down balsam fir had bent upward. Apparently many down trees were still alive and growing.

The fallen paper birch still retained green leaves at the time of the investigation. Most, if not all, of the paper birch still had one or more roots in the soil. Apparently these roots were sufficient to sustain growth in the tree.

Undoubtedly many factors are responsible for a greater percent of balsam fir than of hardwoods having been blown down in the storm. Balsam fir on the site of the blowdown had a shallow, rotted root system. The root system of paper birch on the other hand, appeared to be more sound. It is reasonably certain that at the time of the storm on May 10, the paper birch in the area were not in full leaf. If this were the case, the birch offered much less resistance to the wind than the balsam fir, and thus sustained less damage. This may be a partial explanation of the difference in the degree of damage to balsam fir as compared to paper birch.

The north end of the blowdown area contained a small area of aspen blowdown. No plots were established in this area because of its limited extent as compared to the rest of the blowdown area.

Great difficulty was experienced in moving about in the blowdown area. Many groups of fallen trees were almost impenetrable, having been piled to a height of from fifteen to twenty feet in some instances. The down trees were not laying in any one direction but appeared to have fallen in a random pattern.

Insect damage in most of the down timber was proceeding at a rapid rate. The chewing sound made by the insects could be plainly heard when standing in the blowdown area. Long, stringy piles of sawdust were to be found under almost every down log.

Most of the storm damage occurred on the ridge tops along the lake. In many instances low areas between ridges were untouched by the windstorm, although adjoining ridge tops were heavily damaged. It was because of this fact, that the four permanent plots were set up on the top or side of ridges within the blowdown area rather than in the few low places in which damage occurred.

SUMMARY

On May 10, 1953, a severe windstorm passed through Itasca State Park in northern Minnesota. This storm blew down about fifteen acres of sixty-year-old, pole-sized spruce-balsam fir forest. During September of 1953 an investigation was carried out to determine the nature and extent of the damage resulting from the storm.

Four permanent plots were set up in the hope that continued observations in the future would indicate the possible trend of regeneration on this blow-down area. The location of all the standing and down timber on four 1/10 acre plots was recorded. The amount of reproduction classified by species and age classes was measured on four 1/500 acre plots. Soil samples from each plot were taken and later analyzed. Photographs of each plot and of the general area were made.

Perhaps the most interesting observation arising out of this survey was that ninety-eight percent of the conifers (primarily balsam fir) on the plots were blown down, while only twenty-eight percent of the hardwoods on the plots were blown down.

No attempt was made to determine the volume of fallen timber on the area.

It was estimated that approximately thirty-seven percent of the ground within the blowdown area was covered by fallen timber. Little vegetation and almost no brush was found on the permanent plots.

Insect damage was proceeding at a rapid rate. Much of the fallen timber had already sustained insect attacks four months after the storm.

Undoubtedly the most important accomplishment of this investigation was the initiation, through the establishment of permanent plots, of a trend study of regeneration on a blowdown area. It is hoped that the plots established can be remeasured in 1955 and at suitable intervals in the years following.

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September 15, 1955

I

Examination of Blowdown area on Lake Itasca by
A.L. Lundgren & E. Bakusis.

The blowdown area was examined on the ground by
Bakusis & Lundgren.

The blowdown was ~~about~~ ^{fragment} ~~4,000-5,000~~ feet long & of
varying width, 500-1000 feet. It occurred almost entirely
on ~~the~~ tops & the sides of ^{hills}. Very little timber was
windthrown on low, marshy or swampy places. The ^{hills} ~~ridges~~ ran North
& South, formed a ^{discontinuous} ~~ridge~~ that ran roughly N. & S.

The Original cover type over most of the b.d. area
was ~~sp~~ balsam fir, ~~spruce~~, birch mixed with some spruce &
a little hardwoods. On the north end of the blowdown
~~stands~~ the stand was composed of an overstory of aspen & a
understory of balsam fir. Occasional large Red Pine were found
as part of the overstory.

Almost all of the balsam fir & spruce on the ~~area~~ blowdown
area were windthrown. Few of the hardwoods (except aspen
on the north end) were appeared to be directly blown down.
Most of the hardwoods ~~that~~ (mostly birch) that were
down appeared to have been knocked down by falling
spruce or fir. ~~Conversely~~, many of the few ~~remaining~~ conifers
remaining standing were standing only, because they were
caught & held up by birches or other hardwoods. ~~The~~
Most of the ~~standing~~ fir & spruce ^{remaining standing} on the area had
tops broken out of them.
The wind ~~appeared to have taken~~ out almost all of the conifers where
it struck irrespective of size &/or age.

It was noted that, as expected, most of the ~~the~~ large
roots of balsam fir were rotten. A few of the fallen
trees had cracked open & the majority of these showed brown
cubical butt rot. (They may have cracked open because
they had rot.)

The fallen trees were laid out in an almost impenetrable
mass.

Sept. 15, 1953

II

It was very difficult to move around in the area.

Preliminary Investigation of Windthrow in Itasca.

The windthrow area was looked over by Bruce Brown, Egolf Bakusis, & A.L. Lundgren on Sept. 8.
~~From~~ A brief reconnaissance indicated:

1. The majority of the trees blown down were balsam fir.
2. Most of the paper birch were left standing.
3. Those paper birch on the ground seemed to have been pushed over by falling trees rather than by the wind.
4. Balsam fir had a very poor root system. - Many roots rotted off. No tap root.
- ? 5. Very little breakage occurred. Mainly complete windthrow.
- ? 6. The windthrow occurred irrespective of topography or exposure.
7. Much beetle damage to balsam fir already.

Outline of investigation:

- ✓ 1. Take photographs of the area & any specific things that might be of interest.
- ✓ 2. Determine the percentage composition of blow-down trees by (a) species (b) dbh. classes (c) age classes.
3. ~~Determine~~ Investigate root condition of blow down trees.
Presence of rot, broken roots, extent of root system.
4. Determine area damaged. Make rough map of area.
5. Determine general extent of beetle damage of fallen timber.
6. Obtain general information about the area. -
 - a) general aspect of the terrain -
 - b) soil conditions
 - c) cover type.
7. Get information about the storm

Permanent Plots.

Four permanent plots were established in the blowdown area. Three of these were located in the blowdown and the other was located just outside of the actual blowdown.

A reference point (a stake) was established on the lakeshore on the edge of the blowdown. From this stake, plots #1 and #4 were established. From plot #1, plot #2 was established. From plot #2, #3 was established. Plots numbers 1, 2, and 3 were located in the blowdown while plot number 4 was located just outside of the blowdown area.

The following information was gathered from each permanent plot:

- 1.) The amount of reproduction on a 2-millacre circular plot ^{tallied} by species and estimated age. (Egolf's Bactusis estimated the age) The average hits for each age class by species.
- 2.) The amount of brush on the 2-millacre plot ^(radius 5.266') tallied by species and size class (0-1', 1-3', 3-6', 6'+)
- 3.) A general description of the ground vegetation with a remark as to each species relative abundance.
- 4.) A plot and tally of all the ~~live~~ standing and blowdown trees on a 1/4 acre circular plot.

Permanent Plots.

Four permanent plots were established in the blowdown area. Three of these were located in the blowdown and the other was located just outside of the actual blowdown.

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The following information was gathered from each permanent plot:

- 1.) The amount of reproduction on a 2-millacre circular plot ^{tallied} by species and estimated age. (Egolf's Bactus estimated the age) The average hits for each age class by species.
- 2.) The amount of brush on the 2-millacre plot ^(radius 5.266') tallied by species and size class (0-1', 1-3', 3-6', 6-7')
- 3.) A general description of the ground vegetation with a remark as to each species relative abundance.
- 4.) A plot and tally of all the ~~live~~ standing and blowdown trees on a 1/4 acre circular plot.

Permanent Plots (continued)

- 5.) An estimation of the percent of ground covered by the blowdown.
- 6.) Increment borings and height measurements of the major species, both standing and down.
- 7.) Soil samples from 1 pit dug on each plot from the A₁, B, and C horizons.
- 8.) A picture ~~at~~ showing the plot center stake for each plot.

Photographs taken by Allen L. Lundgren at Itasca State Park

Photo Number.

1. Lynn Saddle Trail. Plot E. - Red Pine - Balsam fir understory. Balsam fir cut out. (Exposed for Plus X film by mistake) September 16, 1953, 7:15 am. f32 - $1\frac{1}{2}$ sec.
2. Same as above but with correct exposure. f32 - $2\frac{1}{2}$ seconds. (film spoiled.)
3. Red Pine stand. Lynn saddle trail, Balsam fir understory. Sept. 16, 1953, 7:30 am. f16 - $1\frac{1}{4}$ second.
4. Lake Itasca- west arm. Taken from blowdown reference stake on bank above lakeshore. Sept. 16, 1953, 10:00 am. f25 - $1/25$ seconds.
5. Itasca Blowdown. Taken $\frac{1}{2}$ chain south of plot number 1 - looking west. Sept. 18, 1953 9:00 am. f11 - $1/25$ sec.
6. Plot number 1, Taken from 15 ft. SE of Plot stake. Sept. 18, 1953. 9:15 am. Clear day. f16 - $1/10$ sec.
7. Plot number 2, taken from about 20 ft. north of plot stake. With flash. f16 - $1/5$ sec. Sept 18, 1953 9:45 am.
8. Plot number 4. Taken from about 15 ft. north of the plot stake. Sept. 18, 1953, 10:00 am. f11 - 1 sec.
9. Plot number 4. Taken from 15 ft. north of plot stake. Sept. 18, 1953 10:00 am. f11 - 1 sec. with flash.
10. Plot number 3. Taken about 20 ft. SW of plot stake. Sept. 18, 1953. 11:00 am. f11 - $1/25$ sec. with flash.

All of the above pictures were taken on Pan-X film with the School's 4 x 5 camera. They were developed by the photo lab on the Ag Campus.

Sept. 15, 1953

White Pine along Buhall? trail —

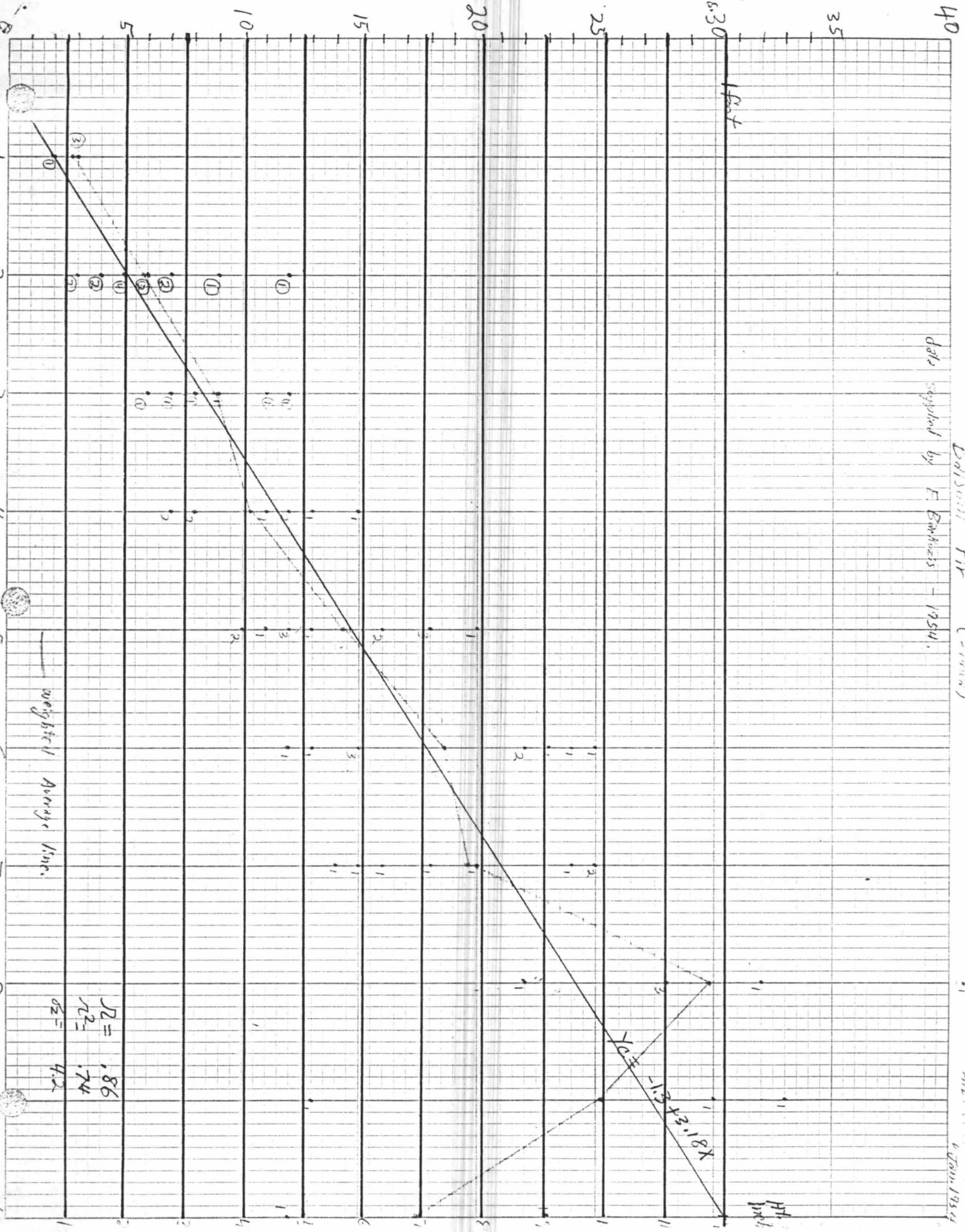
140" circumference at 4½ ft. (DBH)

(44½" Dia.) (dia. Tap) 112 feet high

(measured with an Abney Hand level at 2 chains)

Edison Fir (1906)
 data supplied by F. Barkness - 1954.

M.L. ...
 6 Jan 1954



$r^2 = .86$
 $r^2 = .74$
 $dz = 4.2$

$K = 81.2 \times 2.3$
 $K = 186.76$

Balsam fir ^{secondly the neighbor}
 from Backuzis. (Itasca.)

Age	Height	No.	Age	Height	No.
1	2	1	5	16	2
1	3	3	5	18	3
2	3	2	5	20	1
2	4	2	6	12	1
2	5	4	6	13	1
2	6	2	6	15	3
2	7	2	6	22	2
2	9	1	6	23	1
2	12	1	6	24	1
3	6	1	6	25	1
3	7	1	7	14	1
3	8	1	7	15	1
3	9	1	7	16	1
3	11	1	7	18	1
3	12	1	7	20	1
4	7	2	7	24	1
4	8	2	7	25	2
4	11	1	8	22	1
4	12	2	8	28	3
4	13	1	8	32	1
4	15	1	8	41	1
5	10	2	9	13	1
5	11	1	9	30	1
5	12	3	9	33	1
5	13	1	10	12	1
			10	23	1

Balsam fir seedling Age - Height.
 from Backuzis

Age	Height	Age	Height.	Age	Height
1	2	4	7	6	15
1	3	4	7	6	15
1	3	4	8	6	15
1	3	4	8	6	22
2	3	4	11	6	22
2	3	4	12	6	23
2	4	4	12	6	24
2	4	4	13	6	25
2	5	4	15	7	14
2	5	5	10	7	15
2	5	5	10	7	16
2	5	5	11	7	18
2	6	5	12	7	20
2	6	5	12	7	24
2	7	5	12	7	25
2	7	5	13	7	25
2	9	5	16	8	22
2	12	5	16	8	28
3	6	5	18	8	28
3	7	5	18	8	28
3	8	5	18	8	32
3	9	5	20	8	41
3	9	5	20	9	13
3	11	6	12	9	30
3	11	6	12	9	33
3	12	6	13	10	12
				10	23