fern occur throughout the swamp. Goldthread is abundant on the hummocks, which also contain other wildflowers such as wild sarsaparilla, starflower, and wild lily of the valley.

In order to protect this unique area, the town of Vernon bought a 450-acre piece of land that includes the swamps. The forest is called the J. Maynard Miller Forest after the person most involved in protecting the area. Although the rest of the forest is being developed for logging and recreational uses, a 300-foot buffer zone has been set aside around the swamps. No cutting except for routine trail maintenance is allowed in this zone. Uncontrolled foot traffic and of course logging could cause soil and organic matter to wash into the swamps, suffocating the roots. Even well-meaning visitors can kill the trees and other rare plants simply by trampling on them and compacting the soil. For this reason the town would like visitors to check with the town office so that they can keep track of how often the swamps are visited.

Remarks: *The swamp is magnificent at any time of year; however June offers the widest variety of wildflowers. Fort Drummer State Park, a public campground, is located 1 mile south of Brattleboro.*

Thanks John. I saw this when it came out and was especially pleased that the map + directions take people to a site ~2 miles from our trail!

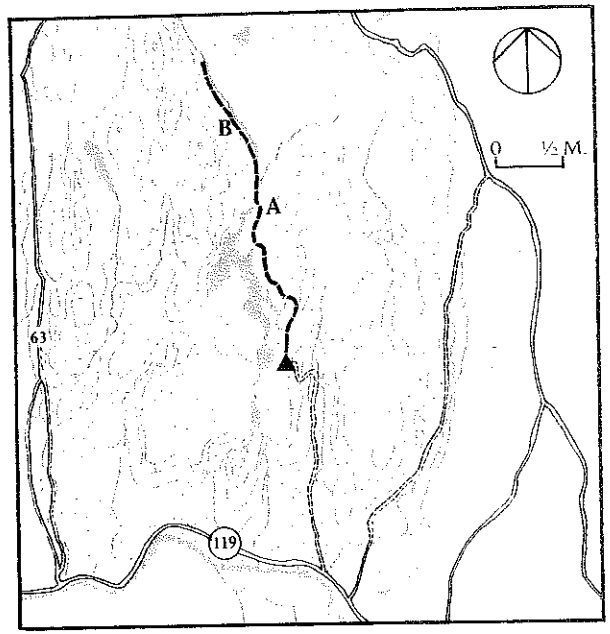
53. Harvard Forest Blowdown

Directions: **Winchester, N.H. From Brattleboro, Vt., take Route 119 across the river and southeast to the reservoir entrance on the left, east of the town of Winchester.**

Ownership: **New Hampshire Division of Parks and Recreation.**

The process of forest succession is evident throughout New England: old fields are reverting to forest, and woodland habitats are changing as some species reach their climax and others become dominant. It is a fascinating process, but almost everywhere it is one that is heavily influenced by human activity, such as agriculture, logging, and

I have never checked to see what is at that site. This is archival material



tree planting. However, the Harvard Forest Blowdown is a unique example of a once virgin tract of forest that was destroyed by natural forces—the great New England hurricane of 1938—and is now in the process of recovering without human influence or disturbance. Here we can see how magnificent the primeval forest was, and how nature has recovered from its own destructive forces through the centuries.

The area known as the Harvard Forest Blowdown is a 20-acre tract on the eastern slope of Pisgah Mountain. From the trailhead at the Pisgah Reservoir (**A**), follow Pisgah Brook northward through a hardwood forest for 1 mile. As you approach the blowdown area (**B**), you will have to begin scrambling over some of the giant tree trunks that still lie rotting on the forest floor, several decades after they were felled by the storm.

At the time of their destruction, these trees composed one of the finest stands of old-age woodland in New England. It was a mixed stand, consisting of red maple, beech, and yellow birch, but dominated by white pine (see **#12, #28,** and **#71**) and hemlock (see **#23**), some of which were over 300 years old and reached heights

of 150 feet and diameters of up to 4 feet. The forest had been intensively studied by Harvard University for 10 years before the blowdown for clues to the natural successional process and information about the New England forests of centuries past.

On September 21, 1938, the most devastating hurricane of modern New England history moved up the Connecticut River valley, destroying a large percentage of central New England's forests by breaking off and uprooting trees. Because of their great height and width, stands of large, old-age trees were especially vulnerable to the storm's winds. This hurricane struck a blow to the region's timber industry from which it has never recovered. Many landowners were discouraged from raising timber, and forest managers today will not allow trees to reach these huge proportions because of their increased susceptibility to storm damage. Unlike this tract, the Cathedral Pines in Cornwall, Conn. (see **#12**) were spared destruction owing to their protected location on a western slope.

Following the storm, a decision was made not to clear up the fallen timber here but rather to see what nature would do if left alone. Today, among the remains of the fallen giants, we see a young forest mostly of hemlock and beech, although some paper birch, red spruce, and red maple have taken hold. Many of these trees seeded very quickly in the depressions created by uprooted trees, where the soil was exposed and was not covered by the usual thick layer of organic debris on the forest floor. It is somewhat of a mystery that no white pines have become established even though that was a dominant species before the storm. One theory holds that although white pine is a pioneer species, often the first to become established in abandoned fields, the exposure of the subsoil allowed the hardwoods and hemlocks to get a head start in growth. By the time the white pines were seeded, they were shaded from sunlight by the other new growth and therefore lost the battle. However, this is by no means certain, and it remains a puzzling question to forest ecologists, who are looking to the blowdown tract for answers regarding the ancient processes of forest succession that created the original virgin trees.

Remarks: *The trail leading to the blowdown is moderately difficult on a steady though gradual incline. The ground can be muddy in the spring. There is no actual trail through the blowdown area, so it is important to keep your bearings when wandering among the trees. Allow 2 to 2½ hours for the round-trip walk. Fishing is permitted with a state license, in ponds and streams. Camping is prohibited, but there are campsites at nearby Mount Monadnock (see* **#72**).

54.
Rhododendron State Park

Directions: **Fitzwilliam, N. H. From Brattleboro, Vt., take Route 119 across the river and southeast about 27 miles to Fitzwilliam Depot. After 0.5 mile (before reaching the village of Fitzwilliam), turn north (left) onto the access road to the park; look for the sign. Drive 2 miles to the park entrance.**

Ownership: **New Hampshire Division of Parks and Recreation.**

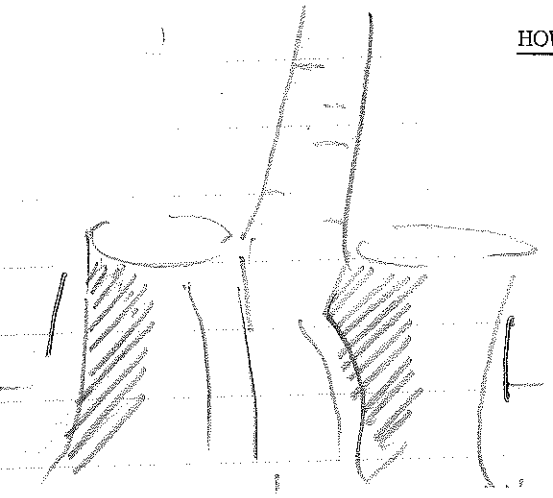
Among the most beautiful of all wildflowers in New England is the mountain rosebay, or catawba rhododendron, a shrub that is very common in the woodlands of the central and southern Appalachians but quite rare in the Northeast. It grows in the wild in New England only in a handful of scattered colonies, and this accessible 16-acre stand is well worth a visit in mid-July, when the large pink blossoms are in full bloom.

Rhododendron is a member of the heath family (see **#74**) and is closely related to azaleas and mountain laurel (see **#69**). Most people are familiar with various hybrid members of the rhododendron family, which are common in gardens throughout New England. However, this native stand is a disjunct community, meaning that it is common to another region with different climatic and growing conditions. (See **#52** for more on disjunct communities.) It tells us much about the climate of the Northeast in past centuries and about the ability of some plants to adapt to changing conditions.

It is widely believed that after the last glacial period, our climate was somewhat milder than it is today. This warmer period occurred about 4,000 to 6,000 years ago and is known as a *hypsithermal interval*, or *climatic optimum*. During this time, a forest typical of southern regions spread into New England. Some of the trees included pitch pine, chestnut oak, blackgum, and tuliptree. In the shrubby understory, sassafras, redbud, and flowering dogwood were common along with the mountain rosebay. About 1,100 to 1,500 years after the warming trend began, the weather patterns changed,

350 YEARS OF FOREST HISTORY ON A 1/10th ACRE PLOT

PLACE Harvard Pisgah Tract in S.W. New Hampshire near Ashuelot.



HOW THE HISTORY WAS RECONSTRUCTED

The age of the living white birch growing on a clone of chestnut sprouts tells when they were cut. The sprout age shows when the parent tree was cut; judging from its size the original chestnut germinated in the early 1700's. With this kind of approach, the growth of many dead stems can be placed in time on the plot.

HISTORY

THE FOREST BEFORE 1665

Evidence: Lines and patches of charcoal in the forest floor were identified as:

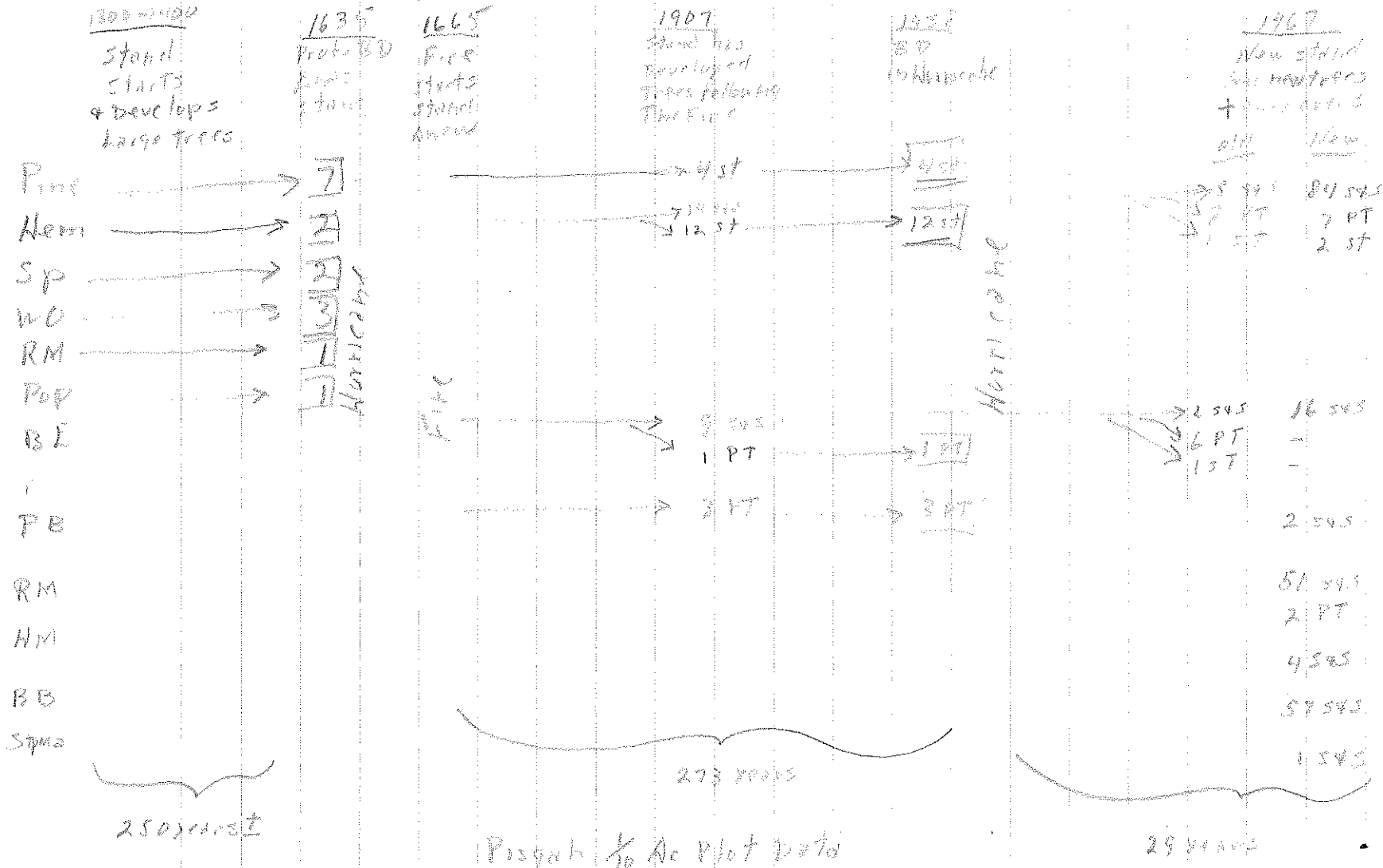
SPECIES	NUMBER OF STEMS
Pinus strobus	7
Picea spp.	2
Quercus alba	3
Acer rubrum	1
Tsuga canadensis	2
Populus spp.	1

Picea probably *P. rubens*, *Populus* probably *P. tremuloides* or *P. grandidentata*

THE FOREST FIRE ABOUT 1665

Evidence: All stems blown down in the 1938 hurricane germinated after 1665. Four of them had charcoal beneath the root collar but no fire scars along their length. These four germinated in 1673, 1677, 1678, 1687.

Note: Because stems of previous forest were severely charred they were probably down at time of fire. They might have been blown down by the 1635 hurricane since its storm track is believed to have passed over the area.



Present 1/10 Ac Plot Data

SWS = Seedlings Saplings <5" dbh
PT = Pole Timber 5" - <10" dbh
ST = Saw Timber 10" & larger

THE FOREST BETWEEN 1665 and 1938

The table shows you what the forest was like shortly before its destruction

Diameter Class (dbh)	Total per class	Hemlock	White Pine	Beech	Paper Birch
.75 6"tall	7	6 (6)		1 (1)	
ow .5" dbh	5	4 (4)		1 (1)	
-1.0" dbh	2	1 (1)		1 (1)	
"-2.0"	2			2 (2)	
"-3.0"	1			1 (1)	
"-4.0"					
.0"-5.0"					
.0"-6.0"	1			1 (1)	
.0"-7.0"					
.0"-8.0"	1				1
.0"-9.0"	1				
9.0'-10.0"	1	1			
0.0"-11.0"					
11.0"-12.0"	1				1
12.0"-13.0"	1	1			
13.0"-14.0"	2	2			
14.0"-15.0"	1	1			
15.0"-16.0"	1	1			
16.0"-17.0"	2	2			
17.0"-18.0"	1		1		
18.0"-19.0"					
19.0"-20.0"	1	1			
20.0"-21.0"	1	1			
21.0"-22.0"	1	1			
22.0"-23.0"	1		1		
23.0"-24.0"	2	1	1		
24.0"-25.0"					
25.0"-26.0"	1		1		
26.0"-27.0"					
27.0"-28.0"					
28.0"-29.0"					
29.0"-30.0"	1				
31.0"-32.0"					
Total per species	38	27	5	7	

The numbers in parentheses are the number of trees in each size class that have survived to the present.

Note: 1. All stems larger than 7.0 ins d.g.i. did not survive the 1938 hurricane. Smaller stems survived to help build a new forest after the storm.

2. The forest had hemlock and pine in common with the pre-fire forest, otherwise its composition was different.

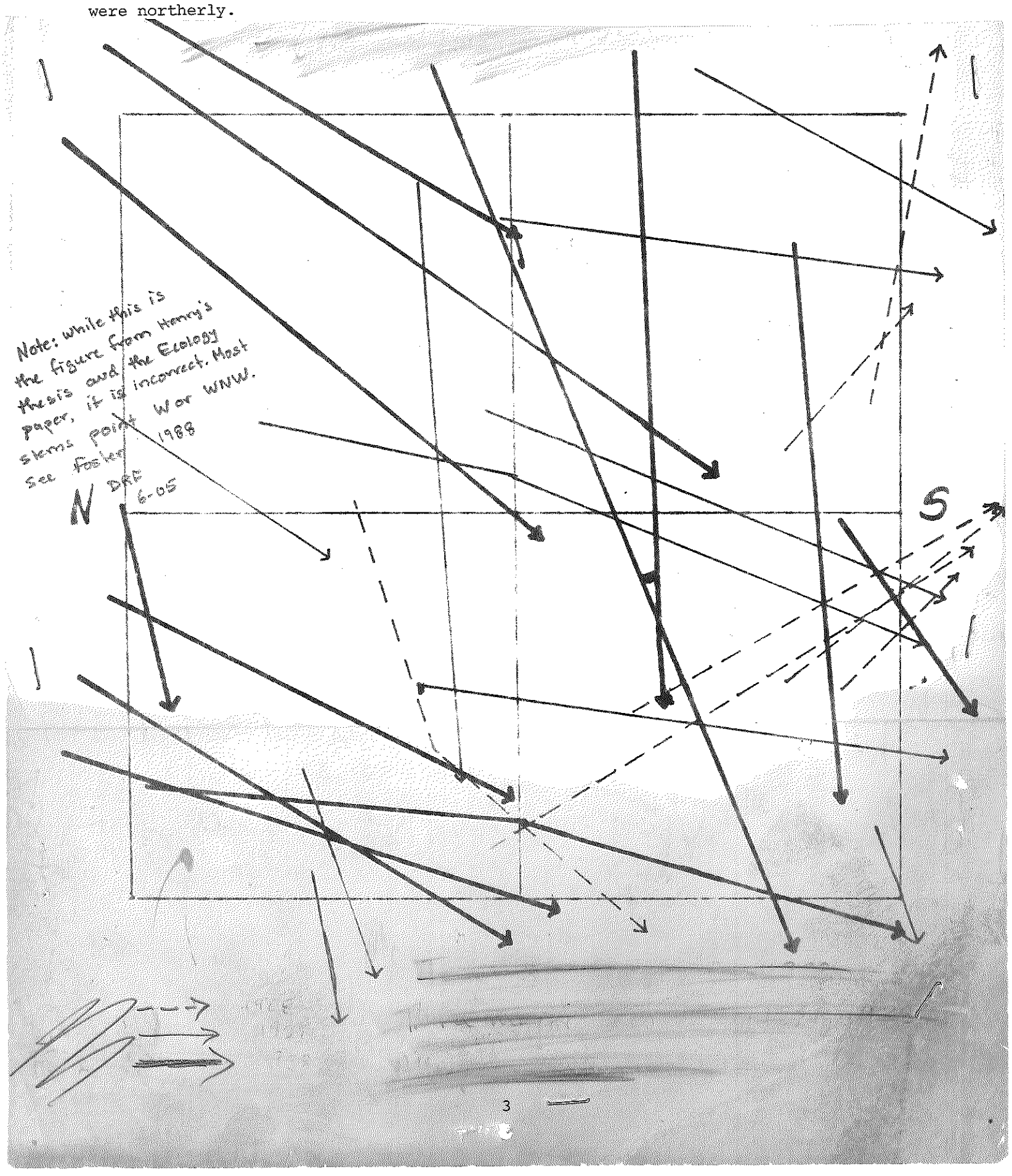
3. 74% of the stems blown down in the hurricane commenced growth between 1665-1705. Hemlock continued to enter the forest after this period. Pine did not. The forest showed little change in composition after its inception.

4. 5 of the 6 pine on the plot were between 85' and 100' high. The tallest hemlock was 85' tall. Pine projected above the hemlock in the canopy of the forest.

5. Sudden increases in growth ring width (releases) were noted in the forest until 1850. Minor disturbances may have stimulated these growth changes during the long history of the forest.

WINDSTORMS BETWEEN 1908-1938

The diagram shows you the directions of stem fall on the plot produced by three severe windstorms in 1908, 1921 (tornado), 1938 (hurricane). All winds were northerly.



THE FOREST BETWEEN 1938 AND 1967

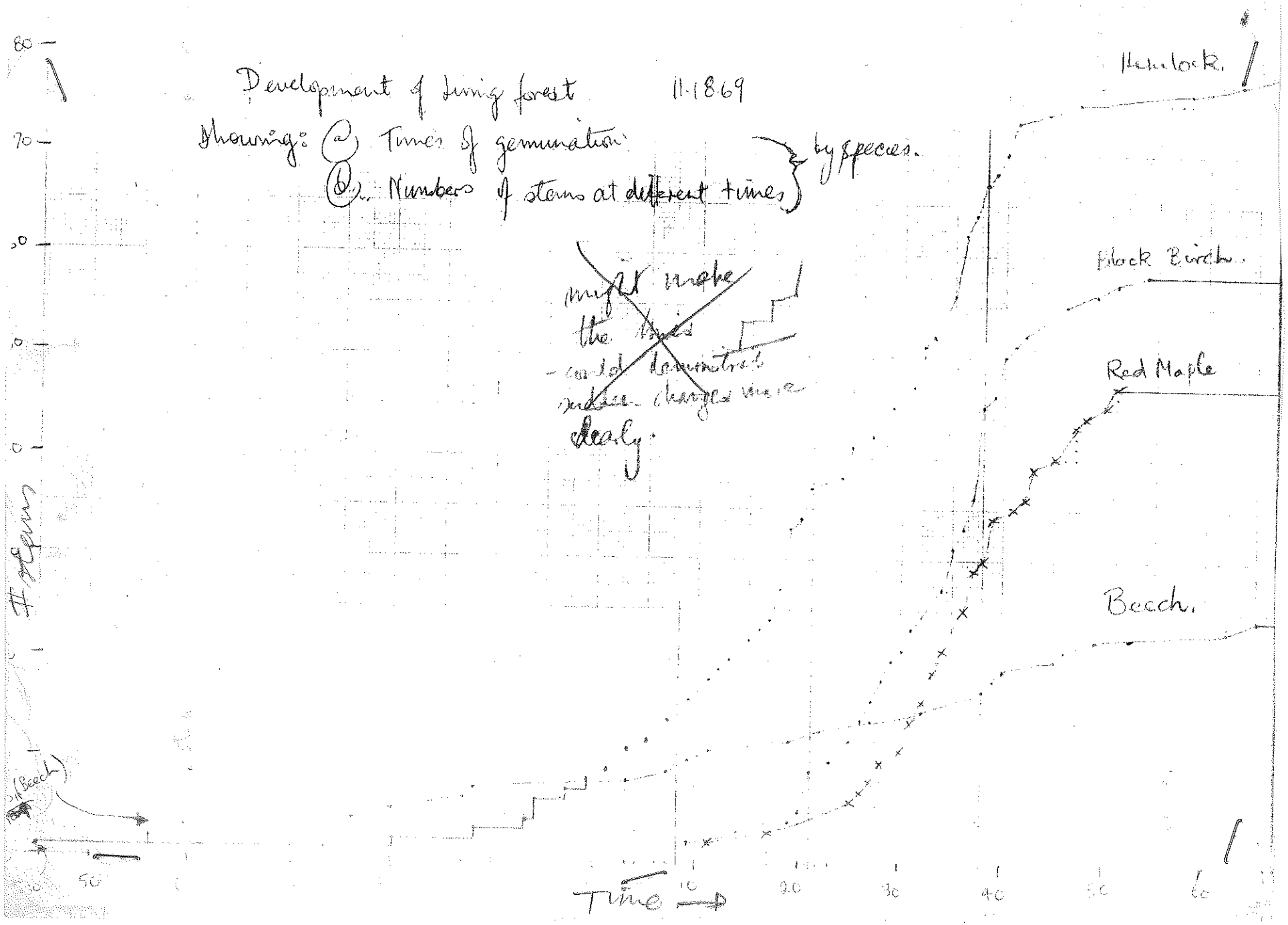
Compare the table with that for the forest 1665-1938.

Diameter Class (dbh)	Total per class	Hemlock	Black Birch	Red Maple	Beech	Sugar Maple	Paper Birch	Striped Maple
above 6" tall below .5" dbh	26	24		2				
.5"-1.0"	24	11	4	6	3 (1)			
1.0"-2.0"	74	23	21	22	5	3		
2.0"-3.0"	54	16 (2)	19	13	4	1		1
3.0"-4.0"	33	9 (1)	12	7	3 (1)		2	
4.0"-5.0"	20	6 (1)	4	4	3			
5.0"-6.0"	9	7 (1)		1	1			
6.0"-7.0"	10	6		1	~~3~~ (3)			
7.0"-8.0"	4	1			3 (1)			
8.0"-9.0"	1	1 (1)						
9.0"-10.0"	2	1 (1)			1 (1)			
10.0"-11.0"	1	1						
11.0"-12.0"	~~1~~	1 (1)			~~1~~			
~~12.0"-13.0"~~	~~1~~	~~1~~						
Total per species	261	~~108~~ 63	57	~~26~~	4	2	1	

Parentheses are around trees that survived the hurricane.

The beech and hemlock in the forest canopy are trees that survived the storms. Black birch and red maple are new invaders. There are no pine this time.

CUMULATED GERMINATIONS THROUGH TIME SHOW IN MORE DETAIL HOW THE CURRENT COMPOSITION OF THE FOREST IS DERIVED



Note: Beech and hemlock both invaded the old forest at a slow rate but hemlock increased greatly in abundance at the time of the disturbances, beech did not. Red maple and black birch have their origins at the times the old forest canopy is broken up. Black birch increases in number particularly about the last two storms. This is related to colonization of new habitats - tree throw mounds (75% of the living birch were on mounds or shallow soil above stones).

Stems of hemlock alive at the times of disturbance showed pronounced changes in growth rate. 50% (25 in 49) of all hemlock releases occurred between 1937 and 1941. 12 were in 1938. Hemlock was particularly able to respond to crown opening.

CONCLUSION

The data indicate that changes in forest composition chiefly occur about the times of disturbance. Little change occurs between disturbances and succession seems unimportant. Knowing how the germination and growth of each species is affected by disturbances may be useful for predicting forest change through time.

Summary of Stump Count Data for the
Pisgah Forest region of Southwestern
New Hampshire

Year of Germination	Age counted back from 1930.	Number of Stems
1871-1880	50-59	1
1811-1820	110-119	2
1801-1810	120-129	1
1791-1800	130-139	8
1781-1790	140-149	11
1771-1780	150-159	7
1761-1770	160-169	10
1751-1760	170-179	16
1741-1750	180-189	19
1731-1740	190-199	2
1721-1730	200-209	5
1711-1720	210-219	1
1701-1710	220-229	1
1691-1700	230-239	10
1681-1690	240-249	18
1671-1680	250-259	25
1661-1670	260-269	21
1651-1660	270-279	15
1641-1650	280-289	7
1631-1640	290-299	2
1621-1630	300-309	4
1551-1560	370-379	1

Table showing ages of cut trees in four plots in the Pisgah Forest region of southwestern New Hamshire.

Plot # 28

White Pine	Hemlock
135	148
136	148
135	149
145	
150	

Plot # 23

Beech	Chestnut
172	175
	180
	180
	179

Plot # 10

White Pine	165	Hemlock	262
Beech	175		270
White Ash	158		
Hemlock	185		

Plot #3

White Pine	Hemlock
232	253
240	245
259	260
234	240
238	
239	
246	

Table 2. 1967 stand table of a tenth acre forest plot, Harvard Pisgah Tract, S.W. New Hampshire. Numbers in parentheses are stems alive in 1907. (compare with Table 1.).

D.b.h.classes (inches)	All stems per class	Hemlock	Black Birch	Red Maple	Beech	Sugar Maple	Paper Birch	Striped Maple
6 in. high -.4d.b.h.	30	26		2	2			
0.5 - 0.9	15(1)	7	4	2	2(1)			
1.0 - 1.9	77	25	21	22	6	3		
2.0 - 2.9	51(2)	16(2)	18	13	2	1		1
3.0 - 3.9	33(3)	9(2)	10	9	3(1)		2	
4.0 - 4.9	16(1)	6(1)	4	3	3			
5.0 - 5.9	9(3)	7(3)		2				
6.0 - 6.9	9(6)	6(3)			3(3)			
7.0 - 7.9	4(3)	1			3(3)			
8.0 - 8.9	1(1)	1(1)						
9.0 - 9.9	2(2)	1(1)			1(1)			
10.0 - 10.9	1	1						
11.0 - 11.9								
12.0 - 12.9	1(1)	1(1)						
Total	249(23)	107(14)	57	53	25(9)	4	2	1

Stems above two inches account for 139 B.A. Ft. per Acre
There were 249 stems on the tenth acre plot.

Table 1. 1907 stand table of a tenth acre forest plot, Harvard Pisgah Tract, S. W. New Hampshire. The distribution of stems among d.b.h. classes was calculated from growth rate data. Numbers in parentheses are stems still alive in 1967.

D.b.h. classes (inches)	All stems per class	Hemlock	White Pine	Beech	Paper Birch
6 in. high -.4 d.b.h.	7 (7)	6 (6)		1 (1)	
.5 - .9	6 (6)	4 (4)		2 (2)	
1.0 - 1.9	4 (4)	3 (3)		1 (1)	
2.0 - 2.9	2 (2)			2 (2)	
3.0 - 3.9	3 (3)			3 (3)	
4.0 - 4.9	1 (1)	1 (1)			
5.0 - 5.9					
6.0 - 6.9					
7.0 - 7.9	1			1	
8.0 - 8.9	1				1
9.0 - 9.9	1				1
10.0 - 10.9					
11.0 - 11.9					
12.0 - 12.9	1				1
13.0 - 13.9	1	1			
14.0 - 14.9	2	2			
15.0 - 15.9	2	1	1		
16.0 - 16.9	1	1			
17.0 - 17.9	3	3			
18.0 - 18.9	1		1		
19.0 - 19.9					
20.0 - 20.9	1	1			
21.0 - 21.9	1	1			
22.0 - 22.9	1	1			
23.0 - 23.9					
24.0 - 24.9	2	1	1		
25.0 - 25.9					
26.0 - 26.9					
27.0 - 27.9					
28.0 - 28.9					
29.0 - 29.9	1		1		
30.0 - 30.9					
31.0 - 31.9					
Total	43 (23)	26 (14)	4	10 (9)	3

Stems above two inches D.B.H. account for 393 B.A. Ft. per Acre distributed among 26 stems out of a total of 43 on the plot.

EVIDENCE FOR THE EFFECT OF SEVERE DISTURBANCES ON FOREST COMPOSITION, SOUTHWESTERN NEW HAMPSHIRE

A ~~quarter~~ plot in the Harvard Pisgah Tract near Ashuelot, S.W. New Hampshire provided a unique opportunity to study long term ~~successional~~ changes in forest composition using Earl Stephen's techniques, because this area had never been logged. David Henry did such an analysis in 1967 for a Master of Forest Science degree and these are his results.

Chronology of the Forest on a tenth acre plot

~~Charred wood fragments in the forest floor~~
Presettlement Forest

Charred wood fragments in the forest floor indicate a largely coniferous forest (11 of 16 stems) stood in the plot at a distant time and ~~burned~~ that it burned. The date of the fire is indicated by the germination dates of the trees that followed the fire. The wood fragments were charred almost to the center so they were probably down and dry when they burned. They may have blown down in the 1635 hurricane. This ancient forest contained: 7 white pine, 2 hemlock, 2 spruce, 3 white oak, 1 red maple and 1 poplar.

1665:

Five old growth conifers blown down in or shortly before ~~1665~~ the 1665 hurricane had charcoal directly beneath their boles but no fire scars along their stems. Their germination dates are: 1600, 1626, 1628, 1637, 1637. Hence, these trees followed a severe fire that destroyed the presettlement forest in or before 1665.

1907:

The forest that followed the 1665 fire was blown down in or before 1938. The largest pine were probably 100-120 feet tall and the largest hemlock between 90 and 100 feet.

Wind disturbances that destroyed the 1907 forest;

1898	Three stems fell in wind and rain storm in August.
1909	Six stems fell in windstorm in February
1921	Ten stems went in summer tornado
1938	Eight stems fell in the september hurricane.

All stems above 5 inches D.b.h. (1907 stand table) were destroyed by 1938. Smaller stems were not windthrown and survived to make up part of the post-hurricane forest (numbers in parentheses, 1907 and 1967 stand tables). Although hemlock and beech surviving the 1938 hurricane contributed many stems in the 1967 forest, other species, principally black birch and red maple, have come in abundantly. The largest of these, although smaller than the beech and hemlock in D.b.h. were equal to or taller than them in height (about 35' high in 1967).

Interpretation of the forest chronology

Three different forests have grown on the plot since 1600. Hemlock is the only species present at all times. These three forests are separated in time by two severe disturbances-a fire about 1665 (possibly preceeded

by a windstorm) and the 1938 hurricane (preceeded by lesser storms). Trees germinating after one storm are destroyed in the next. Little change in forest composition occurred in the 273 years between the fire and the hurricane. Changes appear about the times of the disturbances. For example, black birch and red maple are two species entering the forest after the wind storms of this century that were not there previously. In particular, 32 (56 %) of the black birch date to one or other of the storms in 1909, 1921 or 1938. They have germinated on the mounds kicked up by fallen trees-a new microenvironment created specifically by the storms.

Supplementary information

Growth rings were counted on tree stumps in the Pisgah Forest region, logged for the first time in 1930. Three graduate students of that time, Branch, Lotti and Daley, did this work as part of a study to find out as much as possible about the presettlement forest. The age data were collected from sa samples scattered over an area of 5000acres. In the stump count data there are two peaks of germination centering around 1741-1750 and 1671-1680. Charcoal was found in all plots where stump growth rings were counted. Furthermore, age counts of adjacent trees in tenth acre plots are quite uniform with the exception of plot #10 in which there are two ages. The charcoal in the soil and the two periods around which most stems became established suggest that at least two disturbances, probably fires, had been widespread and severe. Probably, disturbances occurred over large areas in the presettlement forest and most trees were the first crop following these disturbances.

CONCLUSIONS

* Violent disturbance is quite natural for forests of this area. Nature is as destructive as a logging operation. If man had not cleared the forest to farm, hurricanes would have taken away much of the forest anyway.

* Forest succession-- cannot be demonstrated because the larger trees are destroyed before the young ones can replace them with age.

* A tree growing up after one wind storm will probably blow down in the next

* Early settlers probably did not see many trees much bigger than those today.

* We dont realize the importance of hurricanes because our life span is much shorter than the time between storms.

* A Forest manager must take account of the likelihood of windstorm damage. Every year he must decide if he should venture his growing stock for one more year.