Annual Report to
Department of Conservation and Recreation
On Research of
Friends of Mohawk Trail State Forest
For year of 2004

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I. Introduction

This report covers: (1) the forest research performed by **Friends of Mohawk Trail State Forest (FMTSF)** from January 2004 through February 2005, and (2) what is being planning for 2005. This report also updates "**Report on Forest Research at Mohawk Trail State Forest",** which was formally presented to William Rivers on February 5, 2004. That report covered research done in **MTSF** and **MSF** through February 2004.

The 2003 "**Report on Forest Research at Mohawk Trail State Forest"** is an 88-page document that explains the objectives of **FMTSF** and presents the results of the forest research conducted by **FMTSF** in 2003 and prior. The 2003 report is an extremely important document in that it provides the historical background for **FMTSF** interest in old growth forests, and equally importantly, the growth in our interest in exemplary second-growth forest sites in several Massachusetts state forests, notably **MTSF,** Monroe State Forest (**MSF),** and Mount Greylock State Reservation. Readers are referred to the 2003 report for full background details.

II. Continued Exemplary Forest Site Measurement and Documentation

Since 1996, the **Eastern Native Tree Society (ENTS)** has been collecting measurement data on exemplary big and/or tall tree sites throughout the eastern United States. Some sites are well known and others are not and are being put on the map through **ENTS** efforts. The data collection effort for the big/tall tree sites has been extensive and the number one priority. Part of the core mission of **ENTS** has always been is to document both public and private forest sites that exhibit exemplary characteristics in terms of composition and maximum tree age and dimensions. However, over the past five years, **ENTS** has assembled an expert team of tree measurers and forest researchers, spanning many professions. The job of identifying and documenting exemplary sites has fallen to **ENTS** because other organizations, professional and amateur, seldom have the expertise or interest to put specific sites into context with others. Before **ENTS** involvement, many, and we do mean many, outstanding sites went largely unnoticed, or at least undocumented.

As reported in the 2003 **FMTSF** report, **MTSF** has proven to be not just an exemplary forest site, but an extraordinary one for reasons that are still not entirely clear. Some of the present research of **FMTSF** and **ENTS** is being designed to understand the reasons for the site's capacity to grow extremely tall trees of at least dozen and a half species. So far, there appears to be nothing unique about the soils or the climate. While the productive sites in Mohawk are generally well protected, so are they in dozens of other Massachusetts locations. Average tree age does play a significant role in explaining the extraordinary tree heights in Mohawk, but only to a degree. The analysis continues.

The primary method that **ENTS** uses for site analysis is to measure a species on sites with both similar and dissimilar climate, soils, terrain, and site history to develop a range of growth characteristics and to establish relative and absolute species maximums. As we gained experience in site-based analysis, we devised a system utilizing the Rucker index concept as explained in the 2003 report. The Rucker index originally utilized tree height as a measure of site productivity and species potential. However, the concept of using height measurements has been extended to circumferences (or diameters) and the system of **ENTS** points - the multiplication of height by circumference, as a crude indicator of trunk volume. By computing Rucker indices on many sites throughout the Northeast, we have developed a database of sufficient depth to be able to identify truly exemplary sites for many species and home in on species maximums. The 2003 report provides some of the comparative data. However, data collection is an ongoing process and the picture can be expected to change, if only in degree, as we continue building the database. Sections A-C below are presented to update and extend the Rucker height comparisons included in the 2003 report.

A. Rucker Index Analysis

1. Comparison of Rucker Indices for 40 forest sites in the eastern United States

As is explained in the 2003 report, **ENTS** makes extensive use of the Rucker index to compare site growing conditions and to identify exemplary forest and stand development. We make comparisons on both relative and absolute scales for each species. In terms of absolutes, we do not expect to see tuliptree measurements in New England compare with those in the mountains of North Carolina. However, comparisons along a narrow gradient of latitude make sense. Also, the definition of what constitutes an exemplary site is fairly broad. Sites exhibiting trees reaching absolute or regional maximums for any of four dimensions are defined as exemplary. But, we are equally interested in sites exhibiting trees that have reached threshold dimensions in a limited period of time. This is suggestive of forestry's site indexing methodology.

Table #1 below lists Rucker height indices for the 40 best sites we have so far found in Pennsylvania, Massachusetts, New York, New Hampshire, North Carolina, and South Carolina. Our primary focus is the Northeast. We include the southern sites as a means of comparing/contrasting of the very best we have found in the entire East to the Northeast. However, in terms of the Rucker Indexes listed in table #1, it needs to be understood that the Great Smoky Mountains National Park (GSMNP) is not strictly comparable to any of the other sites, since it is geographically much larger than the others. The GSMNP encompasses over 520,000 acres. An area in the Smoky Mountains comparable in size to **MTSF** would have a Rucker index of between 156 and 159. The Park as a whole reflects an eastern maximum for a public property.

Table #1: Comparison of Rucker Indices for 40 Important Eastern Forest Sites

Pennsylvania	
	Rucker Index
Cook Forest State Park	135.9
Wintergreen Gorge	128.5
Fairmont Park	127.7
Ricketts Glen State Park	126.3
Anders Run N.A.	122.3
Walnut Creek Gorge	121.7
Hemlocks N.A.	114.8
Heart's Content N.A.	113.8
Lake Erie Community Park	113.6
Coho Property	113.2
Alan Seeger N.A.	111.1
Scott Community Park	109.6
Tionesta N.A.	109.4
Allegheny River	105.0
Detweiler Run N.A.	104.7
Laurel Run Rd-Centre Co.	104.6
Glen Greenwood Park	98.1
Bear Meadows N.A.	93.7
Parker Dam State Park	85.6

Massachusetts	
Site	Rucker Index
Mohawk Trail State Forest	135.2
Ice Glen	126.2
Monroe State Forest	120.5
Northampton	119.3
Easthampton	116.6
Mount Tom	114.9
Laurel Hill	112.5
Bartholomew Cobble	112.5
Bullard Woods	111.9
Conway	111.7
Arcadia Wildlife Sanctuary	111.5
Hatfield Floodplain	107.4
Bryant Woods	106.5

New Hampshire	
Site	Rucker Index
Claremont-Private	116.5

New York	
Site	Rucker Index
Zoar Valley	136.2
Vanderbilt Estate	126.9
Green Lake	118.0
Kaaterskill Falls	111.5

South Carolina	
Site	Rucker Index
Tamassee Knob	146.1
Congaree Swamp NP	145.9

North Carolina	
Site	Rucker Index
GSMNP	163.6

Notes: The dominance of Pennsylvania sites in the above table results from a concentrated effort by **ENTS** members to cover the Keystone state in-depth. Pennsylvania has a historical role as the repository of significantly big and/or tall trees. Even with the above coverage though, we have a long way to go to cover the entire state. The southeastern area of Pennsylvania still has significant sites, and with additional searching, the

Rucker index of Fairmont Park in Philadelphia will likely exceed 130, probably approach 135. Also, we expect to confirm at least one site in the 130 class in New Jersey. What this means is that with increased searching, **MTSF**'s present claim to 3rd place in the Northeast will likely slip to 4th or 5th. However, given the small size of **MTSF** and its latitude, Mohawks position in the hierarchy of northeastern sites will remain remarkable, if not an anomaly.

Beyond the Northeast, Mohawk's overall eastern position will continue to slip as more and more sites are added within the south. Hardwoods over wide geographical areas and conifers along the Appalachian spine in the South reach impressive heights when allowed to grow on good sites for 100 years or more. But, given what we now know, **MTSF** will continue to hold a very high ranking for sites located from latitude 40 degrees north and beyond.

2. Comparison of Maximum Heights: MTSF, State, Regional, and Eastern U.S.

The 2003 report discussed the extraordinary track record of **MTSF** in the heights of its trees relative to other northeastern sites. Mohawk's record continues to be impressive, particularly with respect to white pine, white ash, sugar maple, northern red oak, bigtooth aspen, and yellow, black, and white birch. Although American elm is listed below as a regional champion, it has been greatly under-sampled because of its scarcity. Similarly, bitternut hickory has been under-sampled relative to its known potential. Extended searching in southern Connecticut will likely reduce the Mohawk's share of the New England champions by two to four species. We point this out now because we do not want to mislead readers of this report. But, irrespective of future discoveries, Mohawk's number of height champions will remain well beyond any other single public or private property within New England. **MTSF** will continue to dominate the New England sites.

Table #2: Comparison of 21 Species for Maximum Height

	Maximum Height	Maximum Height	Maximum Height	Maximum Height	Maximum Height
Species	In MTSF	In Massachusetts	In New England	In Northeast	In East
White pine	166.1	166.1	166.1	181.2	186.5
White ash	151.5	151.5	151.5	151.5	167.1
N. red oak	133.5	133.5	133.5	135.2	153.0
Sugar maple	133.1	133.1	133.1	133.1	151.0
Hemlock	131.0	138.0	138.0	145.7	168.9
American beech	130.0	130.0	130.0	130.1	136.6
Bitternut hickory	128.4	128.4	128.4	136.4	156.3
Big tooth aspen	127.7	127.7	127.7	127.7	127.7
American basswood	125.4	125.4	125.4	128.7	128.7
Black cherry	125.4	125.4	125.4	140.0	146.7
Red maple	124.5	124.5	124.5	136.6	142.3
Red pine	116.3	121.3	121.3	121.3	143.6
Black birch	116.2	116.2	116.2	116.2	118.8
American elm	115.6	115.6	115.6	115.6	135.0
Red spruce	114.7	129.5	129.5	129.5	154.7
Shagbark hickory	111.8	134.4	134.4	134.4	152.0
White birch	110.5	110.5	110.5	110.5	110.5
Black oak	110.5	110.5	110.5	116.7	143.8
Yellow birch	102.9	102.9	102.9	102.9	113.8
White oak	101.8	115.3	115.3	126.8	147.2
Cottonwood	95.0	129.0	129.0	134.4	136.4

3. Iterated Rucker Index for MTSF

As was illustrated in the 2003 report, the Rucker index is often computed iteratively. The iterative process is fully explained in that report. The table #3 below summaries the Rucker height, circumference, and **ENTS** Points indexes for **MTSF** through 15 iterations. This is the number of iterations for which the height index stays above a value of 120. Appendix I, included at the end of this report, lists the actual measurements for trees included in the 15 height iterations and the 2 circumference iterations. More time will be spent in 2005 cataloging the largest girth trees in **MTSF**. Presently, the trees in the database are skewed toward the tallest so the circumference and **ENTS** Points indexes can be expected to rise in 2005.

Table #3: Summary of Rucker Indices

Rucker Height Index Summary			
Iteration	Height	Circumference	ENTS Points
1	135.2	7.4	1019.3
2	132.6	7.3	988.7
3	130.5	6.2	831.4
4	129.1	7.0	912.4
5	128.1	7.5	971.7
6	127.1	6.7	867.8
7	126.4	6.2	790.9
8	125.6	7.1	913.3
9	124.5	6.3	795.1
10	123.6	6.7	839.4
11	122.8	6.3	782.8
12	121.9	6.1	758.4
13	121.4	6.5	792.0
14	121.0	5.1	634.9
15	120.3	6.6	819.4

Rucker Circumference Index Summary			
Iteration	Height	Circumference	ENTS Points
1	104.1	12.4	1313.9
2	112.8	10.4	1173.6
3	115.0	9.6	1108.6
4	116.9	9.2	1076.1
5	113.3	8.9	1032.2
6	114.7	8.8	1024.7
7	119.1	8.6	1038.4
8	116.5	8.3	981.5
9	111.1	8.1	929.5
10	119.9	8.0	972.2
11	114.7	7.8	907.5
12	121.0	7.7	940.2
13	113.7	7.5	874.9
14	115.0	7.4	865.4
15	117.3	7.3	868.3

Rucker ENTS Points Summary			
Iteration	Height	Circumference	ENTS Points
1	116.7	11.9	1367.5
2	121.3	10.0	1220.7
3	120.9	9.5	1156.0
4	115.5	9.3	1088.3
5	120.1	8.7	1055.3
6	118.2	8.7	1037.9
7	119.5	8.4	1017.4
8	120.4	8.0	977.4
9	120.5	8.0	966.6
10	117.9	7.9	943.5
11	112.2	8.2	924.5
12	121.6	7.4	907.4
13	116.2	7.6	888.0
14	117.1	7.3	873.7

15	119.8	7.1	866.0

The following table summarizes the roles of individual species in the height indexes. Surprises for us include American basswood, bigtooth aspen, and black cherry. Basswood is lightly distributed throughout **MTSF,** yet it competes well for canopy dominance. Bigtooth aspens can be isolated individuals or in clonal small groups, but are still thinly distributed in Mohawk. Black cherry is widely distributed in **MTSF**, but nowhere is it abundant. The important role of these species in maintaining high indices was not predicted.

Table #4: Relative Abundances of Individual Species in Rucker Index

Species	# times represented	Percentage
White pine	15	100.0%
White ash	15	100.0%
Sugar maple	15	100.0%
N. red oak	15	100.0%
Hemlock	15	100.0%
Black cherry	14	93.3%
A. basswood	13	86.7%
Red maple	10	66.7%
Bigtooth aspen	10	66.7%
Bitternut hickory	9	60.0%
American beech	5	33.3%
Black birch	3	20.0%
Red spruce	2	13.3%
Red pine	2	13.3%
White birch	1	6.7%
Shagbark hickory	1	6.7%
Black oak	1	6.7%
American elm	1	6.7%

B. Updated List of Massachusetts Height Champions

The following updated table shows **MTSF's** continued dominance in terms of the number of tall tree champions for Massachusetts. Mohawk presently claims title to 18 of the 47 species being tracked. This represents 38% of the total. We have included four non-native species in our list. Were we to eliminate them, Mohawk would claim 16 out of 43 species, for a still remarkable percentage of 37. With the inclusion of more species, native or non-native, Mohawk will likely not claim more champions in the future. As the search continues for exceptional trees, on the basis of probability alone, Mohawk is likely to lose its championship claim for a few of the species included in table #5 below. Regardless, of eventual slippage, **MTSF** will certainly retain the title to more height champions than any other state or federal property in New England well into the foreseeable future. Its competitors elsewhere in the Northeast will likely continue to be restricted to a handful of properties, at present, Zoar Valley, NY, Cook Forest, PA, and Fairmont Park, PA.

Could the unforeseen dominance of Mohawk be explained by over-sampling that property and under-sampling the rest of the state? To a very small degree, this may be true, but we have spent many hours in our searches, looking at the most productive areas we have found ourselves, or to which our attention has been directed. Mohawk's dominance is authentic and is why **ENTS** labels **MTSF** as the forest icon of Massachusetts.

Table #5: Massachusetts Height Champions

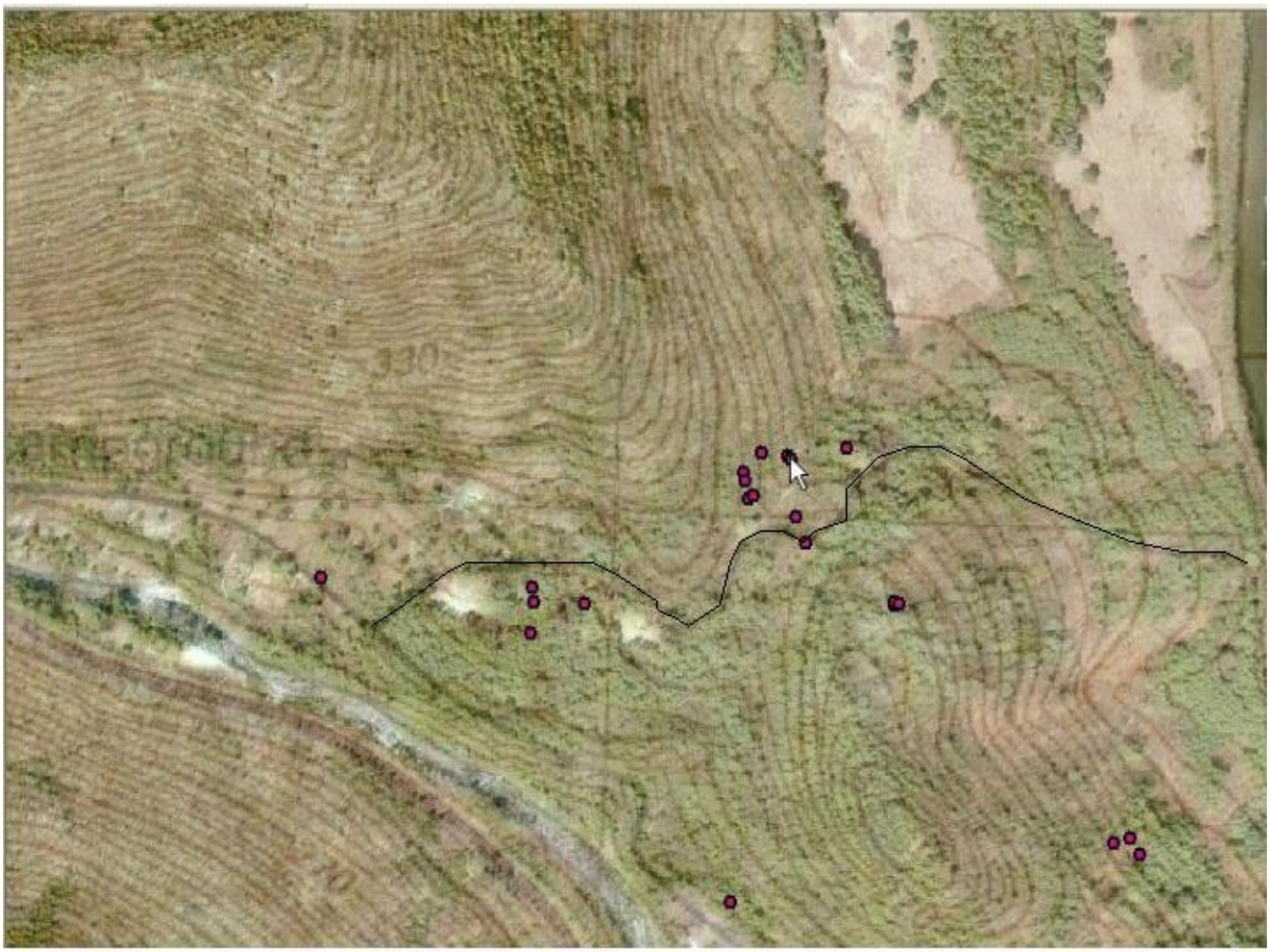
Species	Location	Height	Circumference	ENTS Pts	H/D Ratio	DOM
White Pine	MA-Charlemont-MTSF-Trees of Peace	166.2	10.1	1678.6	51.7	1/29/2005
White Ash	MA-Charlemont-MTSF-Trout Brook	151.5	6.2	939.3	76.8	11/20/2004
Hemlock	MA-Stockbridge-Ice Glen-Ice Glen	138.1	10.2	1408.6	42.5	10/30/2004
Sycamore	MA-Easthampton-Town-Poccumuck	136.5	13.2	1797.7	32.4	2-20-2005
Shagbark Hickory	MA-Stockbridge-Ice Glen-Ice Glen	134.4	5.1	685.6	82.8	10/3/2004
Northern Red Oak	MA-Charlemont-MTSF-Todd Mtn	133.5	9.3	1241.2	45.1	11/25/2004
Sugar Maple	MA-Charlemont-MTSF-Todd Mtn	133.1	11.4	1520	36.7	10/23/2004
Tuliptree	MA-Northampton-Mill River-Hampshire Gazette	133.1	13.4	1783.1	31.2	1/1/2005
American Beech	MA-Charlemont-MTSF-Clark Ridge-North	130	7.8	1014.1	52.4	10/14/2002
Red Spruce	MA-Williamstown-Mt Greylock SR-Hopper	129.2	6.5	839.9	62.4	11/11/2000
Eastern Cottonwood	MA-Ashley Falls-Bartholomew's Cobble	129	18.8	2425.6	21.6	1/16/2005
Bitternut Hickory	MA-Savoy-MTSF-Clark Ridge-Indian Flats	128.4	4.1	526.4	98.4	7/28/2002
Big Tooth Aspen	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	127.7	3.5	447	114.6	10/24/2002
Norway Spruce	MA-Charlemont-MTSF-Trout Brook	127.1	4.2	534	95.1	10/9/2004
Black Cherry	MA-Charlemont-MTSF-Trout Brook	125.4	5.5	689.9	71.6	3/27/2004
American Basswood	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	125.4	5.9	739.9	66.8	3/8/2004
Red Maple	MA-Charlemont-MTSF-Clark Ridge-North	124.5	6.5	809.5	60.2	4/18/2004
Red Pine	MA-Holyoke-Mt Tom State Reservation	121.3	5.4	656.8	70.6	11/1/2003
Pignut Hickory	MA-Stockbridge-Ice Glen-Ice Glen	120.8	6.4	773	59.3	3/30/2002
Silver Maple	MA-Hatfield-Town-???	118.9	11.1	1320.2	33.7	2/23/2002
Black Locust	MA-Northampton-Mill River-Hampshire Gazette	118.7	6.3	747.6	59.2	11/23/2003
Slippery Elm	MA-Greenfield-Town-Town	118	6.8	802.4	54.5	2/24/2002
Black Birch	MA-Charlemont-MTSF-Clark Ridge-North	116.2	3.6	412.4	101.4	10/14/2002
American Elm	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	115.6	6.5	751.3	55.9	3/14/2004
White Oak	MA-Stockbridge-Bullard Woods-Bullard Woods	115.3	6.9	795.9	52.5	3/14/2004
Green Ash	MA-Easthamapton-Manhan River	113.7	10.5	1137	35.7	2-20-2005
Butternut	MA-Northampton-Mill River-Hampshire Gazette	111.7	6	664.5	58.5	7/21/2002
White Birch	MA-Charlemont-MTSF-Clark Ridge-North	110.5	5.2	574.4	66.8	10/14/2002
Black Oak	MA-Savoy-MTSF-Clark Ridge-Ash Flats	110.5	4.8	530.2	72.3	8/18/2002
Pin Oak	MA-Northampton-Town-Squeaky Peters Park	105.7	11.5	1215.8	28.9	1/19/2002
Swamp White Oak	MA-Northampton-Mill River-Hampshire Gazette	104.2	9.9	1031.9	33.1	1/1/2005
Yellow Birch	MA-Charlemont-MTSF-Trout Brook	102.9	6.8	699.9	47.5	10/23/2004
White Spruce	MA-Charlemont-MTSF-HQ	102.9	6.9	709.7	46.9	7/6/2001
European Beech	MA-Northampton-Mill River-Hampshire Gazette	101.2	10.6	1072.7	30.0	8/10/2002
Chestnut Oak	MA-Shelburne-Private-Private	98.7	6.2	612.2	50.0	9/29/2002
Pitch Pine	MA-Holyoke-Mt Tom State Reservation	92	5	460.1	57.8	4/14/2002
Black Willow	MA-Whately-Town-Town	88.7	19.1	1694.9	14.6	7/17/2003
Mockernut Hickory	MA-Holyoke-Mt Tom State Reservation	87.3	4.1	358.1	66.9	10/25/2004
Bur Oak	MA-Northampton-Smith College-Smith College	87.2	11.2	976.5	24.5	2/16/2002
Quaking Aspen	MA-Williamstown-Mt Greylock SR-Hopper	85.4	8.7	742.9	30.8	11/8/2000
Catalpa	MA-Holyoke-Town-Town	85	7.7	654.7	34.7	3/2/2002
Ginkgo	MA-Northampton-Smith College-Smith College	84	15.1	1268.2	17.5	2/16/2002
Hackberry	MA-Hatfield-Town-???	83.7	10.2	854	25.8	2/16/2002
Scarlet Oak	MA-Holyoke-Mt Tom State Reservation	83.6	6.7	560.3	39.2	9/1/2002
Black Gum	MA-Holyoke-Mt Tom State Reservation	81	7.2	580.9	35.3	4/2/1999
Hop Hornbeam	MA-Savoy-MTSF-Cold River East	78.2	3.3	258	74.4	10/23/2003
American Chestnut	MA-Mount Washington-Mount Everett SR	66.3	3.5	99.5	59.5	5/27/2002

C. Summary of Unique and Exemplary Trees and Forests in MTSF

This final section on the unique and exemplary trees of **MTSF** is devoted to what we consider to be the most unusual facts about Mohawk's tall trees. The following list is presented to readers of this report as a convenient summary in hopes that they will better sense the uniqueness of **MTSF** within New England.

1. **Greatest population of 150-foot tall trees in New England**. With 72 trees (71 white pines and one white ash) measured to a height of 150 feet or more, **MTSF** has the largest population of 150s in New England. For a period of time, a private property at Claremont, NH was thought to have a larger population of 150s. However, subsequent visits to that property have allowed us to establish the boundaries of the tall tree population. Current estimates are now between 40 and 50 pines in the 150 class on the Claremont property. For comparison purposes 104 trees have been documented in Cook Forest, PA to heights of 150 feet. Mohawk currently ranks a solid second in the Northeast in this category. See the Appendix for an updated listing of the 150-foot white pines in Mohawk.
2. **Single tallest tree in New England**. The Jake Swamp white pine stands 166.1 feet tall. Its latest measurements have been conducted with 5 separate sets of equipment and 4 experienced measurers. The Claremont tall tree is also listed as 166.1 feet, but our last measurement of it in early December could not confirm the 166 figure. Until additional measurements can be taken of the Claremont tree, the two pines should probably be considered co-champions. See the map on the next page for the location.
3. **Most species state height champions of any property in the Northeast**. The 18 statewide height champions, as reflected in the table #4, above is a remarkable achievement for any state property, let alone one as small as **MTSF**. As we have previously stated, that a small state forest in Massachusetts could have so many champions begs for an explanation. Given the large forested acreage that Massachusetts now boasts, one might believe that the distribution of champions would be wider, much wider. The full explanation must await more analysis. However, high-grading and over-cutting of mature trees in Massachusetts forests is the likely explanation.
4. **Champion white ash of the Northeast**. In 2004, **FMTSF** confirmed a pocket of "super-growth" white ash trees in the Trout Brook watershed. A new individual height champion was measured at 151.5 feet. It is located at 42.625 degrees latitude north and is the northern most hardwood we have measured to reach 150 feet in height. So far, 15 white ash trees in **MTSF** have been measured to heights of 140 feet or more. Only two other ash trees in the Northeast are known to reach that height threshold. A third will likely be confirmed in Ricketts Glen, PA. As with Mohawk's overall ranking, the reasons for Mohawk's white ash dominance remains unknown to us. Other species such as bigtooth aspen and the three species of birches that we list as Northeastern champions are not singled out for special consideration like the white ash because these latter species have been under-sampled in potentially competing forests.
5. **Largest number of species reaching significant height thresholds on any property in New England**. As has been pointed out, **MTSF** is not the province of just a few species of trees that reach significant height thresholds. Twenty-two species surpass 100 feet. Twelve species surpass 120 feet, six species surpass 130 feet, two surpass 150 feet, and one surpasses 160 feet. No other New England property is even remotely close to these numbers.
6. **Second greatest population of 160-foot tall trees in New England.** The Claremont, NH private property has 7 white pines that reach 160 feet. **MTSF** has 5. Within the next 3 years, an additional 3 white pines in Mohawk will likely reach 160 feet. In addition, the Mohawk trees are growing faster than the Claremont trees, and barring significant disturbance, Mohawk will surpass the Claremont property in all comparison categories within 2 to 4 years.
7. **Oldest dated hemlock in Massachusetts.** A hemlock in the Cold River A site has been dated to 488 years as a solid core. A reasonable projection to the base of the tree is 20 years. The tree is almost certainly over 500 years of age.
8. **Largest confirmed acreage of old growth.** **MTSF** has the largest confirmed acreage of old growth forest of any of our state forests. The confirmed acreage of forest high in old growth characteristics is between 700 and 800 acres.

Map Showing Location of Trees of Peace and Jake Swamp Tree:



Notes:

1. Purple dots represent trees in our GIS database. Many others will be added in 2005.
2. The dot with the white arrow pointing to it is the Jake Swamp tree.
3. The dot on the road is the Calibration tree and marks the start of the Cherokee-Choctaw grove.
4. The single dot on the south side of the road and to the east is the Jani Tree.
5. The cluster of 3 dots in the lower right hand corner are white pines in the Encampment grove
6. The cluster of 4 dots toward the west end is in the Pocumtuck pines.
7. The western most dot is in the Indian Springs grove.
8. The single southern most dot is in the Headquarters Hill grove.
9. Over 200 white pines have been tagged in the Trees of Peace, the adjacent Cherokee-Choctaw grove, and the Elders grove.

III. SELECTION OF TREES FOR HEIGHT AND VOLUME GROWTH ANALYSIS

A. Height and Radial Growth Patterns

As a consequence of the tree measurements that have been taken in **MTSF** over a period of 16 years, and Mohawk's dominance throughout that period, the goal of **FMTSF** and **ENTS** has been to better understand tree growth potential. This has led us to begin modeling trunk and limb volume for several species in Mohawk. Because of the large amount of work involved, modeling has remained largely a goal. However, we are now prepared to begin more intensive modeling for the Mohawk white pines, because it is *Pinus strobes* that has continued to interest us most. The upward and radial growth patterns for pines in the 120+ year age bracket have surprised us. Silvicultural data suggest slower growth rates for the species in the 120-160-year age class. For instance, the Jake Swamp tree has been growing at the rate of 0.9 feet in height and 0.4 inches in girth per year since 1992. The tree is presently between 145 and 150 years in age. Assuming the Jake Swamp tree encounters no crown breakage, we project an absolute maximum height for the tree at between 175 and 180 feet and a maximum circumference of between 11 and 11.5 feet. Our data suggest that these dimensions will be reached in 30 to 35 years. What do these numbers mean in terms of differential volume growth between now and when the tree reaches its maximum dimensions? What have the rates been in the past? What will the numbers be over the economic life of the Jake tree? These and related questions are the ones we seek to answer.

B. Measurement Methodology and Errors

To answer the above questions, we must accurately track radial and height growth. Tracking radial growth for the Mohawk pines is a simple, standardized process. We take periodic circumference measurements and calculate the equivalent radial growth. In a few instances, we will take cores to get exact ages for the trees in a stand and examine the internal patterns of growth. There is no need to change the methodology we use to track radial growth. But height data is another matter. Compiling accurate height growth data by foresters for standing trees has always been a challenge, albeit not a widely recognized one. Computing volumes has been even more of a challenge since trees are not cylinders, cones, paraboloids, or neiloids. Their actual volumes often differ considerably from those projected through the use of charts, which may average out for large numbers of trees, but not for individual trees. Our challenge then is to get accurate height data and to develop better methods for modeling trunk and limb volumes. As explained in the 2003 report, **ENTS** has solved the height measurement challenge. Below we expand on the original explanation.

Traditional tangent-based methods common to forestry for computing tree height are far too inaccurate to track annual growth. In a computer simulation of 1837 trees, the average difference between tangent-based versus sin-based height determinations was 8.2 feet. As explained in the 2003 report, sine-based calculations are the correct ones since they calculate to an actual treetop instead of a projected one. Predictably, the tangent and sine methods give approximately the same result for straight, narrow-crowned trees on level ground. The most conspicuous errors associated with the tangent method occur from tall, broad-crowned trees growing in level terrain. Without realizing it, measurers often shoot forward protruding limbs that from a distance appear to be the top, but in actuality are out in front of the trunk. On a tall, broad-crowned hardwood, this can produce large over-measurements. Of course, if the top of a tree cannot be seen, it cannot be accurately measured, regardless of technique. However, whatever is seen or taken as the top will be accurately measured by the sine method, while users of the tangent method will often treat the twig being measured as though it were over the base of the tree. In such cases the sine method understates the full height and the tangent method over-states it. But it is the tangent-based error that leads to measuring to a projected or false top, instead of an actual one and is what produces most height measurement errors in champion tree lists. Some of these errors are on the order of 50 feet or more. The following table summarizes the 1837 tree sample in terms of differences between the methods.

Table #6: Frequency Distribution of Measurement Errors from Sin Versus Tan Methods

Summary Count of difference in ft between to methods

No. <= 10:	No. >20 and <=30	No. >20 and <=30:	No.>30 and <=40	No. > 40
1342	333	97	42	23

Although **ENTS** developed the sine-based method of measuring tree height in 1995. Since then, **ENTS** has continued to increase our accuracy. With sufficient time, and repeated measurements, a tree, **ENTS** can get to with +/- 0.5 feet on 67% of measured trees, +/- 1.0 on 90%, and +/- 1.5 feet on upwards of 95%.This level of accuracy combined with photographs of the crowns of sample trees (see next section for a discussion of the photography) will allow us to monitor annual growth to within 2 to 3 inches. For an updated explanation of **ENTS** tree measuring methodology, readers are referred to the **ENTS** website at www.uark.edu/misc/ents.

C. White Pine Growth Monitoring Project:

Table #6 below identifies 40 sample trees that will be monitored over the next 5 years with annual updates to DCR. See Appendix I for data collection sheet format. The trees in the table have been selected from 3 age classes: 81-120, 121-160, and over 160. White pines under 80 years of age are very fast growers. That age class has been excluded because growth rates for younger trees are usually not in doubt. The operative challenge is to understand the metrics associated with slowing growth for white pines on good growing sites.

More specifically, our interest is in monitoring the growth of mature pines on good to exceptionally good sites to understand how long they sustain fast growth in relative and absolute terms. The trees in Table #6 all exhibit good growth. Some exhibit excellent growth. Their locations vary in elevation from 665 to 1043 feet. The trees grow in several terrain classes. For example, the Joseph Brant pine grows on a steep slope at an elevation of 1043 feet while the Metacomet tree grows on relatively level ground in a slight depression that provides a reliable source of moisture to the trees roots. The Turtle Tree grows on level ground, but in a slightly drier area. The Jake Swamp tree grows on a slope near a small water drainage.

The variables associated with white pine growth are well known to silviculture and there is no shortage of data on expected rates and volumes of growth over what is considered to be the economic life of the species. However, the late Karl Davies discovered flaws in the methodologies used by the U.S.D.A. Forest Service to project tree growth and volume increases from taking annual diameter measurements. Davies was an economist as well as a forester and was highly qualified to challenge the Forest Service's methodology. Davies traced much of the source data to studies done in white pine stands near Yarmouth, Maine on sites that were no especially productive. When challenged, the Forest Service researchers failed to justify the methodology they used. Their defensiveness spoke to the possibility of a flawed process and the results they got through applying their volume increase models Massachusetts forests did not apply to productive sites in western Massachusetts. To have used their projections would have yielded highly misleading results. Unfortunately, Karl Davies died of cancer in October 2003 and so far none of the other foresters who subscribed to his approach to assessing volume growth have picked up where he left off. Several unusually combative Massachusetts foresters who supported Karl Davies's work have proven themselves to be incapable of performing his level of economic analysis. Though capable of doing so, the academic community has not picked up the ball. However, essence of the work of Karl Davies has not gone unrecognized by **FMTSF** and **ENTS**. For a number of years, we had been independently observing rates of growth in the pine stands of **MTSF** that deserved attention. Hopefully our planned white pine sampling work will help to fine tune silvicultural understanding of growth rates, volume increases, and site maximums for white pines growing in environments similar to that of **MTSF**.

Table #7: Sample of White Pines to be Monitored in MTSF

Name of Tree	Grove	Tag	Latitude DD	Longitude DD	Altitude Ft	Hgt Ft	Cir Ft	Age Class 40-80	81-120	121-160	>160
Metacomet	Pocumtuck	1	42.648	72.93959	835	150.3	9.0		X		
Frank James	Pocumtuck		42.6421389	72.93922	838	151.1	8.9		X		
Massasoit	Pocumtuck		42.642	72.93919	835	146.6	8.0		X		
Bellows	Pocumtuck		42.6416944	72.93922	833	141.1	7.9		X		
Cabin #2	Pocumtuck		42.642	72.93853	846	142.8	10.3		X		
Jake Swamp	Trees of Peace	58	42.6434722	72.93628	815	166.1	10.1			X	
Joe Norton	Trees of Peace	52	42.6434444	72.93592	810	163.2	9.3			X	
Guardian	Trees of Peace	70	42.6428611	72.93581	846	151.0	7.4			X	
Tom Porter	Trees of Peace	31	42.6432778	72.9365	827	155.4	8.1			X	
Mirror	Trees of Peace	77	42.6435278	72.93517	836	151.7	10.5			X	
Arvol Lookinghorse	Trees of Peace	26	42.6430278	72.93642	846	152.1	9.1			X	
Clutter	Trees of Peace	27	42.6431944	72.93647	843	152.4	10.4			X	
Lynn Rogers	Trees of Peace	34	42.6430556	72.93636	847	150.9	8.4			X	
John Brown	Trees of Peace	48	42.6434167	72.93589	812	156.8	7.9			X	
Calibration	Cherokee		42.6426111	72.93567	755	153.0	8.5			X	
Jani	Cherokee		42.6420278	72.9345	800	150.8	10.7			X	
Sky	Cherokee		42.6420556	72.9345	800	145.0	8.9			X	
Celeste	Cherokee		42.6420278	72.93444	796	148.3	8.4			X	
Algonquin	Algonquin		42.6491667	72.93528	670	158.6	8.7			X	
Bear	Algonquin		42.6496667	72.93561	675	152.4	10.4			X	
Frank Decontie	Algonquin		42.6491667	72.93528	666	158.8	10.1			X	
Turtle	Algonquin		42.6490833	72.93494	665	152.7	7.9			X	
Circle	Algonquin		42.6491111	72.93581	690	151.9	8.4			X	
Jani's Rest	Cold River		42.6413611	72.95306	807	140.6	9.1			X	
Totem Trail	Cold River		42.6419722	72.96492	770	141.9	10.8			X	
Black Brook	Cold River		42.6336944	72.97519	1043	145.5	9.4				X
Indian Springs	Indian Springs		42.6421944	72.94197	807	140.5	11.5			X	
Saheda	Elders	154	42.6504167	72.94936	690	163.5	11.5				X
Little Saheda	Elders		42.6504444	72.94939	685	152.6	9.8				X
Tecumseh	Elders		42.6505278	72.94925	675	160.1	11.4				X
Crazy Horse	Elders	162	42.6505556	72.94928	680	157.5	7.9				X
Benchmark	Elders	155	42.6504167	72.94933	685	147.9	10.9				X
Brant	Clark North		42.6539444	72.9615	1034	160.5	10.6				X
Trout Brook	Trout Brook		42.6323889	72.93281	768	151.9	8.2			X	
Bertha’s Sister	Trout Brook		42.6325	72.92989	745	140.3	12.1			X	
Bertha’s Little Sister	Trout Brook		42.6324167	72.93008	740	145.6	10.2			X	
Lee Frelich	Encampment		42.6397778	72.93161	748	157.7	8.3			X	
Will Blozan	Encampment		42.6398333	72.93139	739	151.9	10.0			X	
Colby Rucker	Encampment		42.6396667	72.93125	735	153.8	9.5			X	
DennyJakeChuck	HQ		42.63915	72.93658	747	141.7	9.1			X	

Map #2: Locations of Sample Pines:

1. The northern most pine is the Joseph Brant pine. Its age is between 150 and 175 years.
2. The next northern most pines are the Saheda, Little Saheda, Tecumseh, Crazy Horse, and the Bench Mark trees in the Elders Grove.
3. The cluster of squares in the northeast part of the map are trees in the Algonquin Grove and include the Algonquin, Frank Decontie, Circle, Bear, and Talking Turtle tree.
4. The red square high on Todd Mountain is a mistake.
5. The largest cluster are sample trees in the Trees of Peace grove and include the Jake Swamp, Joe Norton, Guardian, Tom Porter, Arvol Lookinghorse, Mirror, Clutter, John Brown, and Lynn Rogers trees.
6. Close to this cluster are the Calibration, Jani, Sky, and Celeste trees.
7. To the east and south is a small cluster in the Encampment pines that include the Lee Frelich, Will Blozan, and Colby Rucker trees.
8. The southern most collection in Trout Brook includes the Trout Brook Bertha's Sister, and Bertha's Little Sister.
9. The western most tree is the Black Brook tree. The two to the east are misplaced, but include the Totem Tree next to Route #2 and the Jani's Rest tree on the north side of Cold River, but just off Route #2.

D. Photographic Documentation of Crown Growth

The crowns of the above 40 research trees will be photographed prior to the 2005 growing seasons to record the state of crown development. **FMTSF** board member and **ENTS** researcher John Knuerr will do the photography work. A notebook will be maintained on the 40 research trees recording annual measurements and providing photographic documentation. We will identify the precise location for each tree where measurements and photographs are taken. Remembering that the above sample has been selected to analyze the growth potential of white pines for three age classes over a range of growing conditions, we are hoping that the resulting data can be used as a baseline to growth under natural conditions for the ages classes being tracked. The data on these trees may eventually influence timber rotation plans for white pines growing in similar locations in other state forests.

From the white pine study, we intend to extend the research to several hardwood species with commercial value to include: white ash, sugar maple, and northern red oak. Extension of photographic methods to the hardwoods will take time due to the broader crown structures of the latter. At this point we do not know how much work is involved in documenting annual growth with the use of crown photography. We will keep DCR fully informed of our progress and appreciate the opportunity to be able to do the analysis.

IV. FOREST CLASSIFICATION ANALYSIS

The year 2004 was a light period for old-growth research, inventorying, and mapping. **FMTSF** tried a new method of boundary identification that involved sampling boundaries of areas of old growth with the intention of filling in gaps as time allows. The following summary is a documentation of our old growth work in 2004 and the challenges we continue to face in defining more precise boundaries.

A. Todd and Clark Mountain Old Growth:

Old growth on Todd and adjoining Clark Mountains in **MTSF** has a highly irregular boundary due to past land use patterns and the natural ruggedness of the topography. In accessible areas, logging took place frequently on the lower slopes. Past escaped fires from burning off fields at the base of Todd influence the current ecology of Todd Mountain. Ridge spines that include a gentler gradient were both natural logging and fire corridors. For example, old growth starts at coordinates 42 degrees, 38 minutes, and 35.9 seconds north latitude and 72 degrees, 56 minutes, and 10.4 second of latitude west on the conspicuous southeastern spine of the east end of Todd Mountain. The old growth starts abruptly and coincides with a vertical ledge that effectively blocked logging that was no doubt occurring throughout the 1800s. The logging occurred on the spine of the ridge from the rock ledge down to what is now the group campsite. At the upper set of coordinates, the altitude is approximately 1080 feet. At that point, the forest consists mostly of northern red oak, white oak, black birch, and hemlock. Mountain laurel forms much of the understory. Progressing northward along the east end of Todd Mountain, the old growth dips to an elevation of 780 feet, following a rugged boulder field of considerable botanical diversity. The boulder field provides black bear with den sites. Tree ages on the boulder field vary greatly due to the complex disturbance regime. Hemlock, black birch, yellow birch, and sugar maple commonly reach ages over 200 years, but because of rapid aging by the resident trees, some of the older appearing trees grew rapidly and aged early. Tree dating by eye is risky here.

In several important ways, the Todd-Clark Ridge old growth and mature second growth provides us with some of our most challenging ecological puzzles. There is an abundance of old, multi-aged forest which is considered old growth by a number of prominent forest ecologists. Other ecologists seek to impose strong age criteria that would preclude all but the areas of highest average age as being classified as old growth. Our challenge is to delineate the distinct age classes of Todd-Clark in ways that DCR can understand – amidst the many definitions of old growth that have circulated around. In the past we attempted several classification schemes to differentiation what we called prime old growth from areas that had most of the characteristics of the prime areas, but not all. As with all classification systems that seek to break up a continuum into discreet classes, we ran into a number of problems. Boundaries were never distinct. We also got differing opinions from expert consultants who gave us readings on several prominent areas over which we were ambivalent.

Increasingly, forest ecologists studying old growth like to distinguish what they call primary forest from secondary forest. Primary forests are forests that have no logging history. Secondary forests will have experienced varying amounts of logging. The old growth classification cuts across both classes.

If Todd-Clark is defined as the ridge complex to the north of Route #2 within **MTSF**, we can trace out 1680 acres belonging to that ridge complex. The following regions have been identified within the 1680 acres:

1. Old-growth primary forest (**150 acres**)
2. Mixed old-growth primary and mature forest with light burn signature (**200 acres**)
3. Mixed old-growth primary and mature forest with heavy burn signature (**250 acres**)
4. Mature second-growth forest (**950 acres**)
5. Young re-growth forest (**80 acres**)
6. Open fields (**25 acres**)
7. Headquarters complex (**5 acres**)
8. Campground and cabins (**13 acres**)
9. Picnic area (**7 acres**)

The first two classes of forest are the ones that **FMTSF** has been mapping as old growth. Trees are commonly above 150 years of age with individual specimens up to 400 years or older. Class three has an abundance of trees in the 130 to 175-year age class. Some of this area has a thin distribution of trees in the 200 to 300-year age class. There are no conspicuous signs of logging in the first three classes of forest, but the fire history shows through clearly for classes 2 and 3. The 4th class of forest encompasses some of the most spectacular areas and includes trees commonly 90 to 175 years of age. These are mature second growth forest and can exhibit an occasional old growth specimen, but the human hand is everywhere present. The 5th class is young re-growth forest. Most is white pine or mixed hardwoods. The exception is the 1930s red pine stand that includes trees up to 70 years in age.

Areas of unusually high growth were described in the 2003 report on the north side of Clark Ridge and on the south side on old river terraces named Ash Flats and Indian Flats. Extensive work is planned for these two sites in 2005. Ash Flats exhibits possibly what is the finest display of mature white ashes in the Commonwealth. Trees are 90 to 120 years of age and have achieved heights up to 144 feet as of two growing seasons ago. **FMTSF** will return to take comparative measurements this year..

B. Trout Brook Watershed Old Growth and Mature Second Growth:

The Trout Brook watershed covers 1090 acres with a history of much more severe cutting than on the Todd-Clark ridge. A breakdown of the acreage similar to the Todd-Clark ridge follows.

1. Old-growth primary forest (**30 acres**)
2. Mixed old-growth primary and mature second-growth forest with light burn signature (**30 acres**)
3. Mixed old-growth primary and mature second-growth forest with heavy burn signature (**100 acres**)
4. Mature second-growth forest (**910 acres**)
5. Young re-growth forest (**20 acres**)

The primary forest in the Trout Brook watershed lies at the end of the Totem Trail following the rocky ledge beneath the overlook and consists of 30 acres at most. There are patches on Hawks Mountain that fit category 2 above and also totals to about 30 acres. Areas on ridge spines of Hawks Mountain show the effects of past fire, particularly in the crowded stunted hemlock zone. The acreage is 100 acres. A small area of young re-growth is near route #2. By far the largest acreage of forest is mature second growth, although not quite as old as that on Todd-Clark. After intensive logging in the 1800s and early 1900s, the area is growing back extremely well in places, but lags in others. Patterns of excessive past cutting are evident. However, Trout Brook cove is one of the most promising areas that we have seen that incorporates sufficient forest recovery to warrant protection as a forest preserve and wild area. The aesthetics of Trout Brook and Trout Brook west are undeniable. As coarse woody debris continues to accumulate, stream protection increases and habitat value improves.

The old growth near Totem Trail has a fine collection of old growth sugar maples, one of which is 10.3 feet in circumference and reaches to 132 feet in height. As such, it is the second tallest we have measured in **MTSF.** A forest-grown hop hornbeam measure 4 feet in circumference. The second-growth white ashes are exceedingly handsome below the Totem Trail old growth. This area affords us one of the best locations to study the growth rates in young-mature white ash and sugar maple stands.

A surprise in Trout Brook has been the remnant Norway spruce plantation that occupies about 7 acres. The trees were probably planted in the 1930s and are at most 65 years old. Several exceed 120 feet in height. At 127.1 feet, one of the Norway spruces is the tallest we know of in New England. It has a worthy competitor in Stockbridge, Massachusetts that should be considered a co-champion.

Perhaps the most significant area of the Trout Brook watershed lies between Trout Brook and West Trout Brook. A ridge side of fast growing white ash trees has produced a cluster of “super ash trees”. The following table reflects white ash trees that were all measured by the team of Bob Leverett, John Eichholz, John Knuerr, and Susan scott in November 2004.

Table #8: White Ash Trees in Upper Trout Brook Cover

Height	Circumerence	Height to Diameter Ratio
151.5	6.2	76.8
145.9	7.3	62.8
142.4	8.0	55.9
141.8	8.3	53.7

These extremely tall ash trees will be monitored along with those growing at the following locations:

1. Indian Flats on the Todd-Clark ridge
2. Ash Flats on the Todd-Clark ridge
3. The north side of Clark Ridge
4. The Totem Trail Grove

Collectively the above locations include 15 of the 17 white ash trees in the Northeast that have been measured to heights of 140 feet or more. The ash continue to be healthy in these areas.

C. Cold River North-facing Side Alone Route #2:

The area of forest just west of the confluence of Trout Brook and Cold River to the confluence of Cold River and Black Brook has always been an area of special interest in terms of old growth characteristics and mature second growth forest. A breakdown of the forest classes follows.

1. Old-growth primary forest (**120 acres**)
2. Mixed old-growth primary and mature second-growth forest with light burn signature (**25 acres**)
3. Mature second-growth forest (**225 acres**)
4. Mixed young re-growth and mature forest (**400 acres**)

The primary old-growth forest is one of our most impressive. Ages on hemlocks date to 500 years, allowing for 10 to 15 years to the base from core height. Black birch date to slightly over 300 years. Other species are comparably old so that the average age of the main block of old growth is quite high. However, the forest is a dynamic ecosystem with multiple age classes for the represented species, but also a stable environment. Past descriptions of a large contiguous block of old growth with geographical coordinates of 42 degrees, 37 minutes, and 57.5 minutes of latitude north and 72 degrees, 57 minutes and 57.7 seconds of longitude west, have identified the block as Cold River A. Other areas of old growth to the east hug the ledge environment high on the ridge.

Areas of forest near the top of the ridge are classified as type #4 and reflect a fairly intense past cutting history. Because of accessibility, this forest was over-cut. Tree form lags that found at lower elevations. For instance, at 42 degrees, 38 minutes, and 9.7 seconds of latitude north and 72 degrees, 56 minutes, and 18.6 seconds of longitude west, tree growth form is uniformly good. It is our understanding that a stand improvement cut was carried out in the vicinity of the coordinates at some time in the past. Overall, the silviculturists did a very good job. By contrast, at coordinates 42 degrees, 37 minutes, and 53.8 seconds latitude north and 72 degrees, 55 minutes, and 41.9 seconds longitude west, whatever took place in the past was the antithesis of good silviculture. Tree form is seldom very good.

Our observance of tree form in the mature second-growth areas of **MTSF** suggests that we might perform DCR a useful service by developing a tree form index rating system. The index would not be strictly Silvicultural, but could find use where stand management objectives are broader than just timber harvesting. Development of such an index should incorporate input from foresters, wildlife biologists, forest ecologists, and other kinds of forest advocates.

D. Black Brook East Side Alone Black Brook Road:

In past old growth identifications, this area has been identified as Black Brook and Cold River B. The breakdown of the forest classes follows.

1. Old-growth primary forest (**25 acres**)
2. Mixed old-growth primary and mature second-growth forest with light burn signature (1**5 acres**)
3. Mixed old-growth primary and young to mature second-growth forest with light burn signature (**75 acres**)
4. Mixed young re-growth and mature forest (**18 acres**)

No research was conducted in this area during 2004 except of a visit with Dr. David Orwig and Tony D’amato to look at study plots of theirs. The forest along the ridge spine that divides Cold River from Black Brook has seen considerable disturbances in the past, but there is an abundance of trees in the 150-year age class and up. Natural disturbance appears to have been the dominant factor in class #2 forest except at the lower boundary, where an old logging road made its way diagonally up the ridge side. The logging pattern appears to have centered on the forest adjacent to the road on the downhill side, since a swath of old growth dominates the ridge starting at Black Brook and going part way up the ridge toward the road. This has always been a puzzling pattern to us.

The Black Brook old growth boasts some of the older appearing hemlocks in the entire system. Ages over 300 years are common. Old growth characteristics in the best 12 to 15 acres are classic.

E. Remaining Areas of MTSF:

Classification of the remaining forests of in the river gorges/valleys of **MTSF**, **MSF**, and **SMSF** will be completed this season. Upland forests are almost uniformly of the class young to mature second growth.

V. MISCELLANEOUS TOPICS:

A. ENTS Rendezvous of October 2004

In October 2004, **ENTS** members assembled at **MTSF** and **MSF** to search for and document important trees for both sport and research and climb the Henry David Thoreau pine in **MSF**. The visit included the following team of scientists, naturalists, and other ENTS members.

1. Dr. Lee Frelich, Director for Center of Hardwood Ecology, University of Minnesota
2. Dr. Robert Van Pelt, temperate rainforest researcher, University of Washington
3. Dr. David King, rainforest researcher, Harvard University
4. Dr. Thomas Diggins, forest ecologist, Youngstown State University
5. Will Blozan, President of **ENTS**, and principal **ENTS** canopy researcher, Black Mountain, NC
6. Dale Luthringer, Principal naturalist and educational specialist, Cook Forest State Park, PA
7. Howard Stoner, Mathematics professor, Hudson Valley Community College
8. Gary Beluzo, Professor of Environmental Science, Holyoke Community College, MA
9. John Eichholz, mathematician, **ENTS**
10. Ed Coyle**,** arborist**, ENTS**
11. Bob Leverett, President**, FMTSF,** Executive Director**, ENTS.**

Objectives of the rendezvous were to:

1. Document additional important trees of **MTSF** to enhance our overall understanding of the growing environments in Mohawk,
2. To confirm/refute **ENTS** measurements made to date,
3. Allow forest ecologist Lee Frelich an opportunity to assess two swath of old growth forest in **MSF**.
4. Climb the Henry David Thoreau white pine and model its volume.

The team added several new champion trees and reinforced the lesson that Mohawk still has secrets to divulge. Dr. Frelich was highly impressed with the Dunbar Brook old growth and identified what he considers to be the signatures of two past natural disturbances that explain the abundance of white ash. Dr. Frelich ranks the Dunbar Brook old growth high in his list of northeastern sites in terms of advanced structural features, site richness, and old growth characteristics. There has never been any serious doubt about the ecological and aesthetic values of the Dunbar Brook site to those of us who regularly visit and study it, but confirmation of its value by one of the leading old growth forest experts in the eastern United States is extremely important to know where a site ranks within our Massachusetts forests.

The climb of the Henry David Thoreau white pine in MSF took place on October 24th, 2004. Climbers included Will Blozan, Ed Coyle, and Dr. Robert Van Pelt. Observers included Dr. Lee Frelich, Howard Stoner, Dale Luthringer, and Bob Leverett. Purpose of the climb was to get an exact height of the Thoreau pine and model its trunk volume.

Measuring the height of the Thoreau pine has always presented us with a major challenge because the tree's crown is very broad and the surrounding vegetation thick. Finding a vantage point where the tips of the crown and the base are simultaneously visible have always proven to be a virtually impossible. The tree was originally measured in 1990 with a transit by Jack Sobon and Bob Leverett. The height was set at 152.4 feet from that measurement based on two triangulations separated by approximately 90 degrees. Subsequent measurements were made with laser and clinometer using traditional ENTS techniques until the Oct 24th measurement. Questions about the accuracy of our past measurements of the Thoreau pine, which we had always suspected, centered around possible crown damage and/or simply not seeing the top. Over the years there has been some indication of loss of crown, but the likelihood of a nested or hidden top was what we feared most. The following table shows the challenge we faced.

Table #9: Heights Obtained for the Henry David Thoreau Pine

Height-ft	DOM	Circumference-ft at 4.5 ft	Method
152.25	04-Apr-98	12.08	laser-clinometer
155.31	15-Sep-01	12.20	laser-clinometer
156.24	13-Nov-01	12.20	laser-clinometer
156.20	21-Sep-03	12.30	laser-clinometer
156.90	27-Sep-04	12.40	laser-clinometer
160.23	24-Oct-04	12.40	tape drop

The only way our concerns were going to be taken care of was to schedule a climb of the tree. Will Blozan, Bob Van Pelt, and Ed Coyle formed the climbing team. Will Blozan was the lead climber. The lower than actual height measurements shown above, indeed, did reflect a nested top, not visible to laser bounces. The measurements illustrate a conclusion that ENTS reached several years ago. When we fail to get within a +/- 1.5 feet of true height because we are not seeing the top, our measurements understate full tree height. Over-measurements result only from equipment that is out of calibration, or by misreading the scales, not by measuring to a projected (false) top as occurs with the tangent method.

Using his Impulse Laser, Dr. Robert Van Pelt modeled the trunk volume of the Thoreau pine and arrived at a trunk volume of 825 cubic feet. Quick calculations on limb volume led Van Pelt to conclude that 5% of the trees volume is in its limbs. This leads to an overall trunk and limb volume of 868 cubic feet. Assuming that only 50% of the trunk volume could be converted to usable lumber, this puts the board feet equivalency of the Thoreau Pine at 4,950 board feet. Here limb volume is being ignored. Using conversion charts for usable board feet for a tree the size of the Thoreau pine, the huge tree would likely yield more lumber than calculated above. Perhaps between 5,500 and 6,000 board feet.

While we certainly do not advocate cutting down the great tree to satisfy our curiosity, our calculations should give pause to those who believe that maturity for a white pine such as the Thoreau tree occurs in 50 or 60 years or when the pine reaches a diameter of around 24 inches because of the slowing of differential growth rates thereafter. Using a shape factor of 1 / 2.25 to account for Van Pelt's measured volume and assuming the tree reached 2.2 feet in diameter and 130 feet in height at age 60 years, the tree would have averaged 0.22 inches of radial growth per year and would have achieved a trunk volume of 220 cubic feet. The tree's current diameter is 3.95 feet and the tree is approximately 160 years old. Using these measurements and assumptions, the tree would have averaged 0.08 inches per year of radial growth from age 61 to the present to get to its current radius. The addition of volume would have been 650 cubic feet to reach its current volume of 825 cubic feet of trunk volume. A linear projection of volume growth at age 60 years (i.e. 220 cubic feet) to age 160 would result in a volume of 660 cubic feet, as compared to the current calculated volume of 825 cubic feet. The conclusion must be that in terms of volume growth, the Thoreau pine has done most of its volume growing since age 60.

We do not know at what rate the Thoreau pine is now adding volume. We suspect it has slowed down considerably, but could continue to add significant volume for another 50 years or more. Regardless, of what the future growth rates for the Thoreau pine are, the above calculations are suggestive of a relatively long rotation period for white pines on good growing sites comparable to natural areas like the Dunbar Brook watershed of **MSF** and the fast-growth areas of **MTSF.** Data from these sites can yield lots of valuable information to allow silviculturists to fine tune their calculations for comparable areas of western Massachusetts.

As a footnote to the climb and the volume modeling of the Thoreau pine, the great tree is the exclusive New England member of the 12 x 160 club, trees of any species that have a CBH of 12 feet or more and a height of 160 feet or more. There are several trees in the 12 x 150 club, but only one in the 12 x 160. Pennsylvania has at least 5 white pines that make the 12 x 160 club. Wisconsin has one and in the past, many. So far, none have been confirmed in other states of the Northeast.

B. Dr. Lee Frelich's Visit to Dunbar Brook, MSF:

The following trip report was submitted by the Vice President of **ENTS** in October 2004 following his visit to Dunbar Brook in **MSF**. Dr. Frelich's field notes are included below in their entirety.

Dunbar Brook:

Dunbar brook has a large primary forest remnant on steep slopes with many large boulders, dominated by sugar maple, yellow birch, and white ash, with some beech, hemlock, red maple, basswood and white pine. The forest experienced some major blowdown probably about 30 years ago (an exact date can be determined by coring some of the pole-sized trees that survived and will show a release from suppression). The blow down was most severe at mid slope, indicating that the wind hit the slope at an acute angle (i.e. it was neither parallel to nor at right angles to the valley and adjacent ridge). This produced turbulence at mid slope and patches of blowdown of varying size from a few trees to nearly an acre. The heavily hit stands have an abundance of young synchronously-released trees (total age of these trees may vary by a century or more because they were suppressed for varying amounts of time before the storm), with scattered larger trees that survived the storm. These larger trees are more abundant in boulder-filled draws that run perpendicular to the ridge, where they had better anchorage and where slightly less exposed, being rooted 5-10 feet lower than surrounding trees. Many of the large survivor trees show evidence of branch and crown breakage from the storm. The developmental stage of these stands has been variously described as a mature-sapling mosaic, multi-aged pole stand or disturbed stand with mature remnants. Some stands were not hit as hard by the wind and have a larger component of large trees with classic multi-aged forest stage of development. Most of the original northern hardwood forests from Minnesota to New Hampshire went back and forth from mature sapling mosaics to old multi-aged stands in response to wind storms of varying intensity. Therefore this stand provides an ideal exhibit of how northern hardwoods respond to the type of natural disturbance that is thought to have perpetuated northern hardwoods for the last several thousand years.

The successional status of the stands varies little, since the released understory reflects the late-successional composition of the overstory. Species that are mid-tolerant of shade, such as white ash, yellow birch, and red maple, are common in old multi-aged stands because some of the gaps there are large enough and have enough light to support growth of those species, even if stands are not hit by storms such as the one that hit Dunbar Brook a few decades ago. Therefore, primary forest remnants are a mixture of shade-tolerant and mid-tolerant species, and this mixture forms the so-called climax species composition. There is a rich moss flora and a lot of species of wildflowers including nodding trillium.

Hemlock is starting to form a neighborhood fairly high up on the slope, where there is a cluster of several large trees that vary in age, with multi-aged saplings surrounding them. Once this patch becomes consolidated, it could maintain itself until the climate changes. I envision it as similar to the initial phase of hemlock patch development in Sylvania, MI that occurred 3000 years ago.

Parsonnage Brook:

On Parsonnage Brook, there is a much different type of primary forest dominated by hemlock and red spruce, that originated after a severe stand-leveling disturbance, probably wind, during the mid to late 1800s. As with Dunbar Brook, the canopy has synchronous release but the total tree age varies because suppressed trees released by the storm were various ages. What is different here with respect to the disturbance, is that it was much more intense, and nearly leveled the stand, leaving only a handful of mature survivors. The stand was probably dominated by sapling-sized trees at the time the surrounding stands were logged, and is the likely reason that stand is still in primary condition. At this point, the first few gaps large enough to recruit new saplings into the canopy are starting to form (i.e. the stand is reaching the end of the stem exclusion stage and ready to enter the transition to uneven aged condition).

This stand is dominated by late-successional species now and was right after the disturbance, at which time it would have been an example of a young late-successional stand. The disturbance did not cause any succession, which is defined as directional change in species composition.

This stand has very thick duff, which is a consequence of the high C:N ratio of the leaf litter of hemlock and red spruce, which is decomposed at a slow rate, allowing a lot of accumulation. There may be remnants of logs from the previous canopy buried in the duff, now in category 5 of decay.

This stand has analogs in the highlands of the Porcupine Mountains, MI, where there are a few hemlock stands (mixed with white spruce and white cedar in that case) surrounded by hardwoods.

C. Methodology for Site Comparisons:

The amount of attention that **FMTSF** and **ENTS** have paid to tree heights in the research and documentation done to date may seem extraordinary. There are several reasons for our intense focus. Most have been discussed in the 2003 report. However, we will revisit those reasons here.

The first reason for the focus on tree heights has been to perfect measurement techniques that yield accuracy to within +/- 1.0 feet, do not require use of a transit, and can be applied within a crowded forest environment where tree crowns can become confused, where tops can be hidden by outward reaching branches, and where concurrent views of crown and base are difficult to find. The second reason for our preoccupation has been our desire to determine the absolute dimensional limits of growth for eastern species, height being an important dimension. The third reason has been our push to get good historical documentation for our prime forest sites while the trees are still standing. Existing tree height information is often in error by tens of feet. So appeal to historical sources does not work. The fourth reason has been our interest in measuring site productivity using tree height growth as an indirect measure. And as a fifth reason, admittedly, we have sporting interests.

The 2005 season will see a more detailed site analysis that fulfills reason number four. In traditional forestry much has been made of computing site indices where tree height at 50 years of age is computed for a sample of trees on a site. An average tree height of 100 feet yields a site index of 100. A site index of 80 means an average height of 80 feet for the trees that are 50 years old. However, multi-aged sites present major challenges to the site index concept. Consequently, the concept is mainly appropriate to sites that are planted where tree ages are known.

There is an alternate method for analyzing site fertility at least in a comparative way and that is to compute height to diameter ratios. For a sufficiently large sample of trees of a particular species lying in a particular diameter class, e.g. 23 to 25 inches, the better site will usually produce the taller trees for a species. Spatial distributions must be taken into consideration and competition by members of the same and different species must also be considered. However, with proper allowances for these factors, height to diameter ratios allows us to compare sites in terms of their growing conditions for a particular species. The methodology and measurement protocol for H/D ratio analysis has long been established by Dr. Lee Frelich. An added benefit of this method is that it allows us to avoid having to take lots of tree cores, something we try our best to avoid.

Our current plan is to use H/D ratio analysis to compare the site productivity for the following sites with respect to the four species of trees listed in table #9 below.

Table #10: Species and Sites for H/D Analysis

White Ash:

1. Ash Flats
2. Indian Flats
3. Trout Brook divide
4. Clark Ridge, north side
5. Base of Todd Mountain-east side

White Pine:

1. Trees of Peace
2. Cherokee-Choctaw grove
3. Pocumtuck grove
4. Algonquin grove
5. Encampment grove
6. Elders grove
7. Shunpike pines
8. Headquarters Hill grove

Sugar Maple:

1. Clark Ridge, north side
2. Trout Brook, Totem Trail ridge
3. Ash Flats
4. Base of Todd Mountain-east side

Northern Red Oak

1. Shunpike area
2. Clark Ridge, south side
3. Trout Brook, east side
4. Base of Todd Mountain-east side

A primary objective of the H/D analysis will be to first identify the best growing sites for each species and then determine what combination of climatic, terrain, and geological factors explain the observed differences in the H/D ratios.

D. Orienteer's Guide to Mohawk Trail State Forest:

The absence of good literature on the sights of **MTSF** has long been a problem in the minds of advocates of the scenic, historic, cultural, and ecological treasures of **MTSF**. The need to balance the public's right to enjoy the resources of a relatively small region like MTSF versus the protection of them from overuse has always been a primary concern of **FMTSF**. We seek to reach a balance that preserves the ecological role of **MTSF** with public enjoyment of what can quickly become a fragile environment. Individuals and small groups are better than large groups. We have been considering an orienteer's guide to **MTSF** that would provide GPS coordinates of a selection of features appropriate for visitation. Most coordinates would be on the existing network of roads and trails. None would be in fragile areas. We would get DCR permission first before pursuing such a guide.

E. Dedication of the Jani Grove:

On May 15, 2004, an area of stately white pines was dedicated to the late Jani Leverett. Jani was the president and co-founder of **FMTSF** and the wife of Bob Leverett. The 'Jani Grove' is introduced by a plaque built at the **MTSF** Headquarters. The Jani Grove and Jani Pine are part of the Cherokee-Choctaw Grove of research pines' of **MTSF**. The dedication of these pines attests to DCR's interest and appreciation of the cultural, scientific, and aesthetic values of Mohawk's great white pine stands. It is this appreciation that allows **FMTSF** and **ENTS** to form such a productive partnership with the Bureau of Forestry.

A second dedication occurred on October 23, 2004. It was attended by Priscilla Geigis, James DiMaio, and Robert Mellace. This second dedication further affirmed DCR's support of the role of **FMTSF** in its broad educational and research program. We are most appreciative.

F. Re-visiting the Value and Role of MTSF:

In the 2003 report we spent considerable time making a case for the importance to the Commonwealth of Massachusetts of **MTSF**. We noted the funding that states such as Michigan gave to their forest icon, Hartwick Pines State Park. Cook Forest State Park in Pennsylvania was also cited. Big Oak Tree State Park in Missouri is a third example of a state that has recognized the importance of its big tree preserve. **MTSF** is on a par with these other state forest icons. We have much to be proud of in our forest icon. In fairness to past state representatives who did not seem to recognize what they had in **MTSF**, except for the old growth areas, much of Mohawk is still a relatively young forest. It is just now coming into its own. Many of the large Hartwick pines as well as those in Cook Forest are between 250 and 300 years of age. The pines of **MTSF** surpass those of Hartwick Pines State Park and are not far behind the pines of Cook Forest at a considerably younger age.

The new concept of placing 20% of DCR forests in reserve status is a sound one that **FMTSF** fully supports. We applaud the current administration for this bold initiative. There should be no question where **MTSF** and **MSF** belong in the plan. Perhaps with the exception of some of the upland portions of these two forests, any reasonable assessment of their wilderness, scientific, ecological, scenic, historical, and cultural values must place them near, if not at the top of the list of Massachusetts sites to preserve. Many of our forests and parks in Massachusetts are needed by people seeking respite from urban crowding. These places are enjoyable to the many and probably important in the minds of local people to preserve, but they are not the least bit exceptional. By contrast, the old growth and champion trees of **MTSF** and the superb old growth of **MSF** are anything but ordinary and deserve the highest protections that we can give them. We look forward to working with DCR to delineate high quality forest reserves.

G. Photographic Images of MTSF

As a final topic of this report, we present a selection of 8 digital images of **MTSF** and 2 of **MSF** for readers who may not be familiar with the scenic and natural treasures of what may be the Commonwealth of Massachusetts's most important combined natural, historical, cultural, scientific, and recreational asset. The images include:

1. Ash Flats, a highly productive white ash site
2. Cold River Gorge old growth forests show their shaggy forms
3. Jake Swamp Tree, tallest tree in New England
4. Stafford meadow looking north toward the Algonquin pines
5. Stafford meadow looking south toward the Trees of Peace
6. Measuring a white pine in the Pocumtuck Grove
7. Scenic view across Deerfield River from Shunpike area of MTSF
8. Climbing the Thoreau pine
9. Dale Luthringer looking at the Grandfather pine
10. Jani and her pine

FMTSF has a large gallery of scenic photographs of **MTSF**, **MSF,** Mount Greylock SR, Mount Washington SF. Many of these photographs will be placed on the **ENTS** website in the near future. **FMTSF** will continue to photographically document the significant trees, the historic and cultural sites, and the scenic vistas of **MTSF**. A future project of **FMTSF** is to prepare a photographic documentation of the important features of **MTSF** for DCR.

H. Summary Comments

FMTSF and **ENTS** greatly appreciate and value of our working relationship with DCR and the support given us by all levels. We look especially forward to the 2005 season. The data collection structures we put into place in 2004 will begin to bear results in 2005. With over 200 tagged research trees, HOBO units for temperature and rainfall installed, GPS coordinates to feed a GIS database, photography to track annual crown growth, historical research, soil analysis, visits by consulting scientists, naturalists, and with an active interpretive program, we will be climbing up another rung on the ladder.

We would like to begin a program of showing key people in DCR important areas of **MTSF** and **MSF**. Bob Leverett has done this in the past to include escorting Peter Webber, Warren Archey, Bill Rivers, Doug Poulin, Joann Nunes, all the local staff of **MTSF**, Pat Swain, Jack Lash, Andrea Lukiens. More recently Leslie Luchonok, James DiMaio and Robert Mellace have been shown some of the accessible white pine areas. On several past occasions members of the Massachusetts Forestry Association and the Forest Stewards Guild have been shown key areas of old growth and exemplary second growth. Many environmental organizations have been escorted around **MTSF** and **MSF**. Consulting scientists who have visited these two state forests with us reads like a who's who. We have even entertained Russian scientists, reporters from many large papers, even Japan, done a television documentary through former WQED of Pittsburgh that went around the world, and any number of famous authors and photographers. We have entertained many Native American dignitaries. The list goes on. None of the visitors from any of the disciplines ever went away disappointed or thought our presentations had been exaggerated.

We obviously believe that **MTSF** and **MSF** are forest treasures, certainly unsurpassed in the Commonwealth, but based on **ENTS** many programs and visits throughout the eastern United States, for their latitude and forest history, we have two jewels of national importance. We look forward to continuing to serve DCR and the people of the Commonwealth in researching, documenting, and providing interpretive programs for our two forest icons. Every participating member of **FMTSF** and **ENTS** feels an intense sense of gratitude to be able to be part of what we all believe to be our life's mission. Jani Leverett was all about **MTSF** and its values. She would have been not only proud, but grateful to DCR for the opportunities you have afforded us.

Photo #1: Ash Flats: Shown with researchers Bob Leverett and Kim Jensen.

Ash Flats includes areas of hardwoods where the basal area exceeds 200 square feet per acre and individual ash trees reach 140 feet. The trees are between 90 and 120 years of age. Understanding the extraordinary productivity of Ash Flats is a research objective of FMTSF.

Photo #2: Old Growth Forests Along the Cold River

The Cold River Gorge has an abundance of primary and secondary old growth forests. In this photograph, the shaggy appearance of the forest, the wild look, is hardly noticed by the multitude of motorists speeding by. But old postcards from the 1920 period show the forest looking essentially as it does today. Anna M. Starr who wrote of natural areas in the 1920s listed the old growth acreage at 3260 acres. One later researcher placed the acreage at 2400. Another placed it at 150. The researchers were obviously concentrating on very different characteristics. In identifying what they thought was old growth. There is no way to know how many acres of original growth forest existed at the time MTSF was formed. Some of the ancient forest was probably lost in silvicultural activities on the south-facing side of the gorge and perhaps in parts of Trout Brook. Today, we have broadened our thinking. We now value places such as the Cold River Gorge with its abundance of trees in the 200 to 400-year age range. DCR has an excellent record of preserving the Commonwealth's old growth when it is informed of remaining pockets such as those in MTSF. However, in many places throughout the East, vestiges of primary forest survive in a precarious balance between the forces of preservation and the ever present danger of development influences. Road widening schemes, ski expansions, logging pressure, etc. all place these national treasures at risk. Natural causes can also doom an area of old growth, such as infestations of the hemlock woolly adelgid. The answer may be in establishing a broad system of forest preserves. However, the opportunity to create forest preserves seldom comes along due to changing attitudes within the public. It now appears that we will have the opportunity to protect the remaining old growth and wild forests in Massachusetts. The Cold River Gorge should be near, if not at, the top of the list.

Photo #3: Jake Swamp Tree: Tallest tree in New England.
The current height of the champion is 166.1 feet. It was 155.2 feet in 1992. Its circumference is 10.1 feet.

Photo #4:Stafford Meadow looking north. The Algonquin grove is in the distance. The crowns are shaggy.

Photo #5: Stafford Meadow looking south. The Trees of Peace Grove are in the center of image. Their crowns are irregular. Twenty trees in the grove reach 150 feet or more. Two exceed 160 feet.

Photo #6: Measuring a White Pine in the Pocumtuck Grove. The straight trunks of many of the Mohawk pines stand in contrast to weevil-damaged trees that make up so much of southern New England's white pine forests. However, many white pine stands on private lands are never allowed to mature so that truly stately forests are a rarity. Some private consulting foresters believe that 24 or 25 inches should represent the upper level of white pine growth before cutting. The Mohawk pines stand to remind all of us that a species like Pinus strobus continues to grow productively up well past 100 years and in some cases past 150. Mohawk's pines are highly aesthetic and should be preserved to the greatest extent possible, but they can still yield valuable silvicultural data for years to come. FMTSF is setting up a variety of experiments to determine the rates and amounts of volume increase correlated to age and environmental and terrain variables. Dr. Lee Frelich, Director of the Center For Hardwood Ecology is the principal consultant to FMTSF on this research.

Photo #7: Scenic view across the Deerfield River from the Shunpike area. The mountain across the Deerfield is Negus mountain. A prime resource of MTSF is its abundance of gorgeous scenery. Views from atop Todd and Clark mountains and from the Totem Trail are the favorites, but compelling scenes such as the one above can be found at lower elevations. Bill McKibben, a well-known writer on environmental issues once walked the Mohawk Trail atop the Todd-Clark Ridge with Bob Leverett. As the two suddenly came upon a scenic vista, Bill McKibben told Bob that the area along the old Mohawk Trail was one of the most under-stated scenic attractions that he had seen. That was quite a statement for a world traveler to make. It served to reinforce in Bob's and Jani's minds as to why they considered MTSF to be their forest Mecca. This walk was taken well before the confirmation of Mohawk's abundance of champion tall trees. However, the ugly scars of the sand and gravel mining operation farther up the Deerfield River on private property should serve as a constant reminder that the price of preserving our last great places is eternal vigilance.

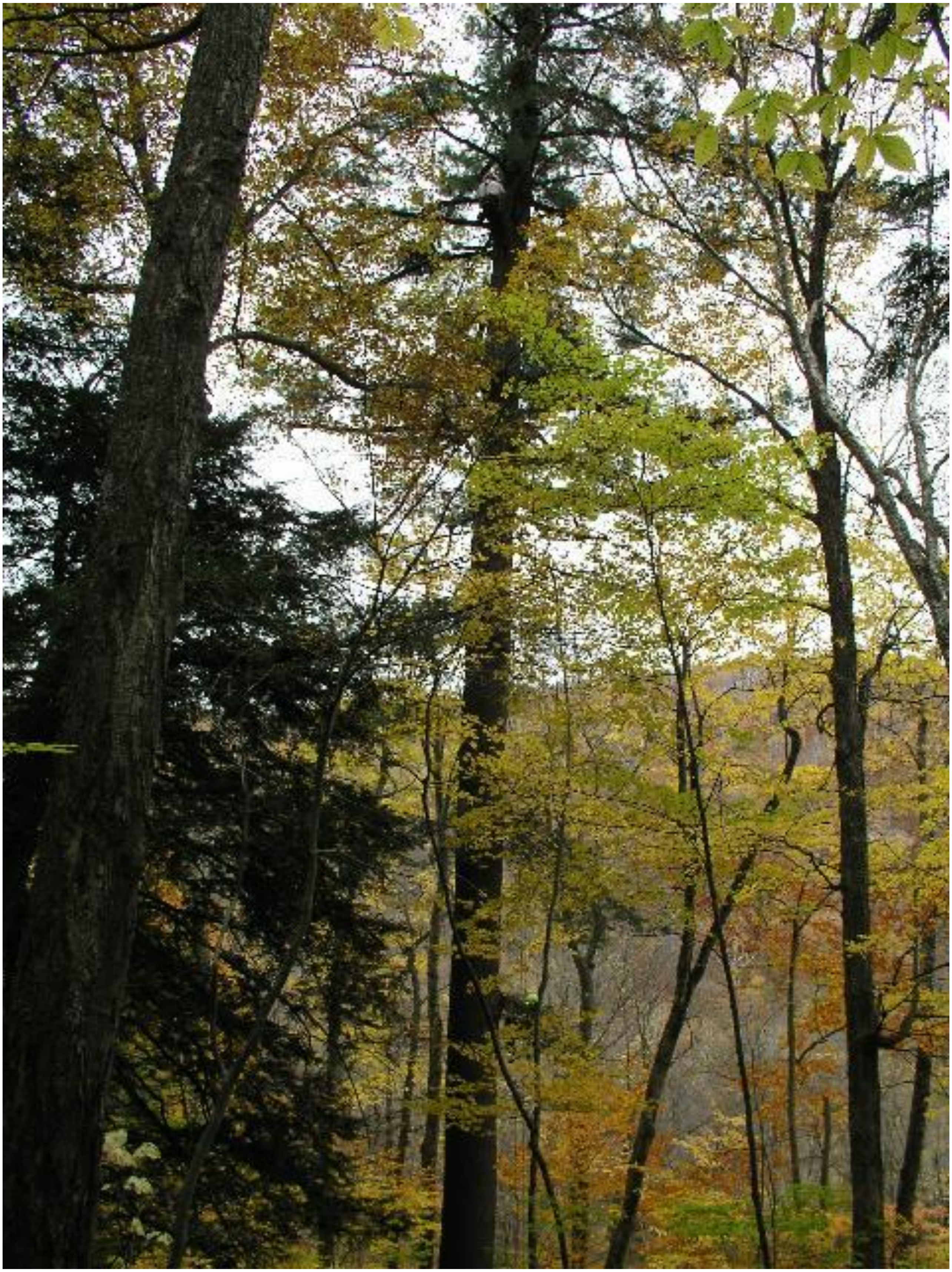


Photo #8: Climbing the Thoreau Pine. Dr. Robert Van Pelt is scene climbing into the crown portion of the Thoreau pine. Arborist Ed Coyle is scene farther down. Climber extraordinary Will Blozan is in the top of the crown. The tape drop done on this great tree proved it to be 160.2 feet in height. At between 12.3 and 12.4 feet in circumference, the Thoreau pine is New England's only tree that has the combined dimensions of 12-foot or greater circumference and a 160-foot or greater height.

Photo #9: Dale Luthringer looking at the Grandfather pine. The Grandfather pine measures a solid 13.7 feet in circumference and is 144.4 feet tall. The tree falls just shy of earning 2000 ENTS big tree points which are calculated by taking circumference by height. A number of huge, widely scattered white pines grown in the Dunbar Brook watershed. A dozen species of hardwoods reach significant size in Dunbar, including a white ash 14.7 feet in circumference and 121.9 feet tall. The tree was cored around 1990. It was 270 years old then. It is now 285 years old. Although Dunbar Brook cannot match MTSF for tall trees, nonetheless MSF can claim a Rucker index of not less than 120.5. Additional searching will likely raise the index to 121 or even 122, but not likely higher. The older forest of Dunbar sports larger trees than what is typically found in MTSF, but with age comes crown breakage. Still, the forest is sufficiently multi-aged to have trees in their absolute prime. The shorter stature of the Dunbar Brook old growth and mature second growth is a scientific puzzle that FMTSF intends to solve. Soils in Dunbar are rich and deep. Forest protections are significant. Rainfall is near the highest in the state. There are no obvious answers to why the Dunbar forest doesn't support a Rucker index near to that of MTSF has no obvious answer.

Photo #10: Jani and her pine. Jani Leverett, late president of MTSF and director of the American Indian Movement for Massachusetts, had unswerving loyalty to Mohawk.

Appendix I

Rucker Height Index Report 15 Iterations

Location: **MTSF**

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
166.1	WP	MA-Charlemont-MTSF-Trees of Peace	10.1	1677.9
151.5	WA	MA-Charlemont-MTSF-Trout Brook	6.2	939.3
133.5	NRO	MA-Charlemont-MTSF-Todd Mtn	9.3	1241.2
133.1	SM	MA-Charlemont-MTSF-Todd Mtn	11.4	1520.0
131.0	HM	MA-Savoy-MTSF-Black Brook	10.7	1396.9
130.0	AB	MA-Charlemont-MTSF-Clark Ridge-North	7.8	1014.1
128.4	BNH	MA-Savoy-MTSF-Clark Ridge-Indian Flats	4.1	526.4
127.7	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	3.5	447.0
125.4	BC	MA-Charlemont-MTSF-Trout Brook	5.5	689.9
125.4	ABW	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.9	739.9
135.2	**Rucker Index**		**7.4**	**1019.3**

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
163.6	WP	MA-Charlemont-MTSF-Clark Ridge-North	11.5	1881.9
147.4	WA	MA-Charlemont-MTSF-Clark Ridge-North	9.5	1400.4
132.0	SM	MA-Charlemont-MTSF-Trout Brook	10.3	1359.6
130.6	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.0	914.2
128.7	AB	MA-Charlemont-MTSF-Clark Ridge-North	7.6	978.4
127.9	HM	MA-Charlemont-MTSF-Entrance	8.0	1023.0
125.4	BNH	MA-Charlemont-MTSF-Todd Mtn	3.4	426.3
124.5	RM	MA-Charlemont-MTSF-Clark Ridge-North	6.5	809.5
123.6	ABW	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.2	642.8
122.0	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	3.7	451.3
132.6	**Rucker Index**		**7.3**	**988.7**

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
163.2	WP	MA-Charlemont-MTSF-Trees of Peace	9.3	1522.8
145.9	WA	MA-Charlemont-MTSF-Trout Brook	7.3	1065.1
131.9	SM	MA-Charlemont-MTSF-Clark Ridge-North	7.0	923.5
130.1	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.9	1027.8
126.1	HM	MA-Charlemont-MTSF-Trout Brook	6.7	844.5
122.4	RM	MA-Charlemont-MTSF-Clark Ridge-North	6.5	795.6
121.5	ABW	MA-Charlemont-MTSF-Trout Brook	4.9	595.3
121.4	BNH	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.3	643.2
121.4	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	3.2	388.3
120.9	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.2	507.9
130.5	Rucker Index		6.2	831.4
160.5	WP	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	10.6	1701.3
144.8	WA	MA-Savoy-MTSF-Clark Ridge-Ash Flats	6.7	970.0
130.6	SM	MA-Charlemont-MTSF-Clark Ridge-North	7.9	1032.0
127.3	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.0	891.3
125.2	HM	MA-Charlemont-MTSF-Trout Brook	7.9	988.9
121.8	RM	MA-Charlemont-MTSF-Trout Brook	7.0	852.7
121.0	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.3	520.3
120.5	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	6.2	747.3
120.2	ABW	MA-Charlemont-MTSF-Trout Brook	4.6	552.8
118.8	AB	MA-Charlemont-MTSF-Trout Brook	7.3	867.1
129.1	Rucker Index		7.0	912.4

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
160.1	WP	MA-Charlemont-MTSF-Clark Ridge-North	11.4	1825.5
144.5	WA	MA-Savoy-MTSF-Clark Ridge-Ash Flats	8.3	1199.5
129.8	SM	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.3	947.4
126.7	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.0	886.7
123.9	HM	MA-Charlemont-MTSF-Trout Brook	7.0	867.6
120.9	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.3	520.1
119.7	ABW	MA-Charlemont-MTSF-Trout Brook	7.8	934.0
118.8	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.9	582.3
118.6	BNH	MA-Savoy-MTSF-Clark Ridge-Ash Flats	7.7	913.6
118.2	RM	MA-Charlemont-MTSF-Trout Brook	8.8	1040.0
128.1	Rucker Index		7.5	971.7

Height	Species	Location	Circumference	ENTS Points
158.8	WP	MA-Charlemont-MTSF-Algonquin Pines	10.0	1587.7
143.5	WA	MA-Charlemont-MTSF-Todd Mtn	6.8	976.1
129.7	SM	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	9.4	1218.9
125.2	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.2	901.2
123.5	HM	MA-Savoy-MTSF-Black Brook	9.0	1111.1
120.7	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.7	567.3
118.4	BNH	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.4	639.5
118.3	BC	MA-Charlemont-MTSF-Encampment Pines	4.8	567.6
117.1	ABW	MA-Charlemont-MTSF-Trout Brook	4.5	527.2
116.3	RP	MA-Charlemont-MTSF-Red Pine Grove	5.0	581.4
127.1	Rucker Index		6.7	867.8

Height	Species	Location	Circumference	ENTS Points
158.6	WP	MA-Charlemont-MTSF-Algonquin Pines	8.7	1380.2
143.2	WA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.7	816.2
129.1	SM	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.7	994.1
123.7	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	6.9	853.4
122.9	HM	MA-Charlemont-MTSF-Trout Brook	9.2	1126.7
119.0	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.6	547.3
118.3	BNH	MA-Charlemont-MTSF-Trout Brook	4.7	556.0
116.5	ABW	MA-Charlemont-MTSF-Clark Ridge-North	6.5	757.0
116.4	BC	MA-Charlemont-MTSF-Trees of Peace	4.0	465.5
116.2	BB	MA-Charlemont-MTSF-Clark Ridge-North	3.6	412.4
126.4	Rucker Index		6.2	790.9

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
157.8	WP	MA-Charlemont-MTSF-Algonquin Pines	10.1	1593.9
142.4	WA	MA-Charlemont-MTSF-Trout Brook	8.0	1139.0
127.7	SM	MA-Charlemont-MTSF-Trout Brook	10.0	1276.6
122.5	HM	MA-Charlemont-MTSF-Entrance	9.9	1212.9
121.8	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	8.0	974.3
118.2	BNH	MA-Savoy-MTSF-Clark Ridge-Indian Flats	4.3	508.4
118.0	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	3.9	460.1
116.1	BC	MA-Charlemont-MTSF-Encampment Pines	4.8	557.3
115.6	ABW	MA-Charlemont-MTSF-Clark Ridge-North	5.7	659.1
115.6	AE	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	6.5	751.3
125.6	**Rucker Index**		**7.1**	**913.3**

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
157.7	WP	MA-Charlemont-MTSF-Encampment Pines	8.3	1308.6
141.8	WA	MA-Charlemont-MTSF-Trout Brook	8.3	1176.9
127.6	SM	MA-Charlemont-MTSF-Todd Mtn	8.4	1072.2
121.9	HM	MA-Savoy-MTSF-Cold River East	7.6	926.1
121.3	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.6	557.9
115.8	BTA	MA-Charlemont-MTSF-Todd Mtn	5.7	660.1
115.7	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike	0.0	0.0
114.7	RS	MA-Savoy-MTSF-Cold River East	7.3	831.4
114.5	AB	MA-Charlemont-MTSF-Trout Brook	7.3	835.8
114.2	ABW	MA-Charlemont-MTSF-Clark Ridge-North	5.1	582.4
124.5	**Rucker Index**		**6.3**	**795.1**

Height	Species	Location	Circumference	ENTS Points
157.5	WP	MA-Charlemont-MTSF-Clark Ridge-North	7.9	1244.0
141.7	WA	MA-Charlemont-MTSF-Trout Brook	9.9	1403.2
125.7	SM	MA-Charlemont-MTSF-Clark Ridge-Elders Grove	7.0	880.2
121.1	HM	MA-Charlemont-MTSF-Algonquin Pines	7.4	896.2
120.2	NRO	MA-Savoy-MTSF-Clark Ridge-Ash Flats	8.1	973.4
115.0	BC	MA-Charlemont-MTSF-Todd Mtn	6.1	701.5
114.0	BTA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.1	467.4
114.0	RM	MA-Charlemont-MTSF-Trout Brook	7.4	843.5
113.5	BNH	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	3.7	419.8
113.0	ABW	MA-Charlemont-MTSF-Clark Ridge-North	5.0	564.8
123.6	Rucker Index		6.7	839.4

Height	Species	Location	Circumference	ENTS Points
156.8	WP	MA-Charlemont-MTSF-Trees of Peace	7.9	1238.4
141.5	WA	MA-Savoy-MTSF-Clark Ridge-Indian Flats	7.9	1118.0
125.3	SM	MA-Charlemont-MTSF-Trout Brook	5.2	651.5
120.7	HM	MA-Charlemont-MTSF-Trout Brook	7.1	857.0
119.2	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	8.8	1049.2
114.9	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike	4.1	470.9
113.6	RM	MA-Charlemont-MTSF-Clark Ridge-North	7.7	870.6
112.2	BB	MA-Charlemont-MTSF-Todd Mtn	5.9	666.3
111.9	BNH	MA-Savoy-MTSF-Cold River East	4.2	470.1
111.8	SBH	MA-Charlemont-MTSF-Encampment Pines	3.9	436.1
122.8	Rucker Index		6.3	782.8

Height	Species	Location	Circumference	ENTS Points
156.0	WP	MA-Charlemont-MTSF-Trees of Peace-Mast Pines	8.1	1263.2
141.3	WA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.5	777.4
123.6	SM	MA-Charlemont-MTSF-Todd Mtn	9.8	1211.4
120.7	HM	MA-Charlemont-MTSF-Trout Brook	7.0	844.8
117.7	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	6.9	812.2
113.5	RM	MA-Charlemont-MTSF-Todd Mtn	5.0	567.5
112.6	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike	5.1	574.3
111.7	BB	MA-Charlemont-MTSF-Trout Brook	5.0	558.7
111.3	ABW	MA-Charlemont-MTSF-Clark Ridge-North	4.6	510.0
110.6	RP	MA-Charlemont-MTSF-Red Pine Grove	4.2	464.5
121.9	Rucker Index		6.1	758.4

Height	Species	Location	Circumference	ENTS Points
155.4	WP	MA-Charlemont-MTSF-Trees of Peace	8.1	1258.5
141.1	WA	MA-Savoy-MTSF-Clark Ridge-Ash Flats	5.8	818.3
123.6	SM	MA-Charlemont-MTSF-Clark Ridge-North	6.1	753.8
120.6	HM	MA-Savoy-MTSF-Cold River East	6.5	783.6
117.5	NRO	MA-Charlemont-MTSF-Clark Ridge-North	12.3	1445.2
112.3	BC	MA-Charlemont-MTSF-Encampment Pines	5.1	572.5
111.7	RM	MA-Charlemont-MTSF-Trout Brook	6.4	715.1
111.3	BB	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	4.4	489.8
110.6	ABW	MA-Savoy-MTSF-Clark Ridge-Indian Flats	4.6	508.9
110.5	WB	MA-Charlemont-MTSF-Clark Ridge-North	5.2	574.4
121.4	Rucker Index		6.5	792.0

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
155.1	WP	MA-Charlemont-MTSF-Algonquin Pines	6.7	1039.0
140.3	WA	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.6	785.7
123.5	SM	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.4	666.7
120.0	HM	MA-Savoy-MTSF-Black Brook	8.2	984.2
117.4	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	8.2	962.4
111.8	BC	MA-Charlemont-MTSF-Trout Brook	4.4	491.9
111.7	RM	MA-Charlemont-MTSF-Trout Brook	5.1	569.6
110.5	BO	MA-Savoy-MTSF-Clark Ridge-Ash Flats	4.8	530.2
110.0	BNH	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	2.9	318.9
109.5	AB	MA-Charlemont-MTSF-Trout Brook	0.0	0.0
121.0	Rucker Index		5.1	634.9

Height	*Species*	*Location*	*Circumference*	*ENTS Points*
155.0	WP	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	9.8	1519.4
140.2	WA	MA-Charlemont-MTSF-Trout Brook	8.4	1177.3
123.4	SM	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	8.6	1061.5
119.8	HM	MA-Savoy-MTSF-Black Brook	8.9	1066.0
116.3	NRO	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	7.1	825.4
111.5	RM	MA-Charlemont-MTSF-Trout Brook	0.0	0.0
110.5	BC	MA-Charlemont-MTSF-Clark Ridge-Shunpike	4.2	464.0
109.8	BNH	MA-Charlemont-MTSF-Clark Ridge-Shunpike Area	5.0	549.1
109.0	ABW	MA-Charlemont-MTSF-Clark Ridge-North	7.3	795.5
107.7	RS	MA-Savoy-MTSF-Cold River East	6.8	735.7
120.3	Rucker Index		6.6	819.4

Rucker Circumference Index Report Two Iterations

Location: MTSF

Circumference	*Species*	*Location*	*Height*	*ENTS Pts*
18.4	SM	MA-Charlemont-MTSF-Todd Mtn	106.5	1959.7
14.8	HM	MA-Savoy-MTSF-Clark Ridge-Cold River A	105.8	1565.4
14.6	WP	MA-Charlemont-MTSF-Trout Brook	148.3	2164.8
13.0	BLCT	MA-Charlemont-MTSF-Todd Mtn	84.8	1101.9
12.5	RM	MA-Charlemont-MTSF-Trout Brook	93.9	1173.2
12.3	NRO	MA-Charlemont-MTSF-Clark Ridge-North	117.5	1445.2
11.2	WA	MA-Charlemont-MTSF-Clark Ridge-North	123.4	1381.7
10.0	YB	MA-Charlemont-MTSF-Trout Brook	75.0	750.2
8.6	BB	MA-Savoy-MTSF-Cold River E	80.5	691.2
8.6	BC	MA-Savoy-MTSF-Cold River C	105.5	905.5
12.4	**Rucker Index**		**104.1**	**1313.9**

Circumference	*Species*	*Location*	*Height*	*ENTS Pts*
13.3	HM	MA-Savoy-MTSF-Clark Ridge-Cold River A	97.2	1292.4
12.7	WP	MA-Charlemont-MTSF-Trout Brook	130.6	1659.0
11.6	NRO	MA-Charlemont-MTSF-Clark Ridge-North	110.1	1276.6
11.4	SM	MA-Charlemont-MTSF-Todd Mtn	133.1	1520.0
10.3	RM	MA-Charlemont-MTSF-Todd Mtn	111.3	1149.8
9.9	WA	MA-Charlemont-MTSF-Trout Brook	141.7	1403.2
9.6	YB	MA-Charlemont-MTSF-Trout Brook	87.3	840.0
8.5	AB	MA-Charlemont-MTSF-Trout Brook	100.5	858.4
8.3	WO	MA-Charlemont-MTSF-Indian Springs	96.7	802.9
7.8	ABW	MA-Charlemont-MTSF-Trout Brook	119.7	934.0
10.4	**Rucker Index**		**112.8**	**1173.6**

Rucker Index Definition:

For the site being measured, a search is made for the tallest member of each of the ten tallest species. The height of the tallest member of each of the chosen species is carefully measured by ENTS-engineered techniques. The ten heights are then averaged. The result is formally called the Rucker Site Index. In an iterated index, the ten selected trees are removed and the process is applied again from the remaining unselected trees.

List of 150-foot White Pines in MTSF

Location	Height	Circumference	TreeName	Date Last Measure
Trees of Peace	166.1	10.1	Jake Swamp Tree	2/22/2005
Clark Ridge-North	163.6	11.5	Saheda	9/12/2004
Trees of Peace	163.2	9.3	Joe Norton Tree	5/30/2004
Clark Ridge-Shunpike Area	160.5	10.6	Brant Pine	9/20/2003
Clark Ridge-North	160.1	11.4	Tecumseh	10/24/2003
Algonquin Pines	158.8	10.0	Frank Decontie	2/22/2005
Algonquin Pines	158.6	8.7	Algonquin Tree	10/16/2004
Algonquin Pines	157.8	10.1	William Commanda Tree	2/29/2004
Encampment Pines	157.7	8.3	Lee Frelich Pine	4/5/2004
Clark Ridge-North	157.5	7.9	Crazy Horse	5/3/2004
Trees of Peace	156.8	7.9	John Brown Tree	3/28/2004
Trees of Peace-Mast Pines	156.0	8.1	Mast Tree #2	4/5/2004
Trees of Peace	155.4	8.1	Tom Porter Tree	3/28/2004
Algonquin Pines	155.1	6.7	Little Frank Decontie#1	5/30/2004
Clark Ridge-Shunpike Area	155.0	9.8	Oneida Pine	9/20/2003
Encampment Pines	153.8	9.5	Colby Rucker	10/26/2003
Pocumtuck Pines	153.3	7.3	Will's Tree #1	10/25/2003
Cherokee Grove	153.0	8.5	Calibration Tree	6/20/2004
Clark Ridge-North	152.9	9.0	Sacajawea	5/30/2004
Algonquin Pines	152.7	7.9	Talking Turtle	6/22/2002
Encampment Pines	152.6	10.0	Loona's Pine	3/29/2004
Clark Ridge-North	152.6	9.8	Little Saheda	6/24/2004
Encampment Pines	152.4	9.4	Tom Diggins	5/22/2004
Trees of Peace	152.4	10.4	Clutter Tree	5/30/2004
Algonquin Pines	152.4	10.4	Bear Tree	7/1/2002
Pocumtuck Pines	152.3	7.8	Will's Tree #6	10/25/2003
Trees of Peace	152.3	7.1	Tip-up Tree #3	3/28/2004
Encampment Pines	152.1	8.0	Southern Sentinel	8/14/2004
Trees of Peace	152.0	9.0	Arvol Looking Horse Tree	3/28/2004
Pocumtuck Pines	152.0	6.3	Unnamed	11/9/2003
Algonquin Pines	151.9	8.4	Circle Pine	2/22/2005
Encampment Pines	151.9	10.0	Will Blozan	4/5/2004
Trout Brook	151.9	8.2		10/31/2004
Trees of Peace	151.7	10.5	Mirror	10/16/2004
Algonquin Pines	151.5	6.9	Thanksgiving Surprise	11/25/2004
Encampment Pines	151.5	10.0	Jess Riddle	4/11/2004
Pocumtuck Pines	151.3	6.5	Massasoit	9/5/2003
Trees of Peace-Mast Pines	151.3	8.8	Mast Tree #1-Wynona LeDuk	5/25/2003
Algonquin Pines	151.2	8.4	Brightside Tree	6/22/2002
Trees of Peace	151.2	7.1	Tip-up Tree	5/25/2003
Pocumtuck Pines	151.1	8.4	Frank James Tree	9/6/2003
Encampment Pines	151.1	11.7	Dale Luthringer Tree	10/26/2003
Encampment Pines	151.1	7.2	Susan Benoit Pine	8/21/2004
Encampment Pines	151.0	8.2		7/16/2004
Pocumtuck Pines	151.0	7.3	Will's Tree #5	10/25/2003
Trees of Peace	151.0	7.4	Guardian Tree	8/31/2003
Trees of Peace	150.9	8.4	Lynn Rogers Tree	3/28/2004
Trees of Peace	150.9	8.2	Tip-up Tree #2	3/28/2004
Algonquin Pines	150.8	6.7	Middle Tree	6/22/2002

Cherokee Grove	150.8	10.7	Jani Tree	5/1/2004
Trees of Peace	150.7	7.9		3/28/2004
Encampment Pines	150.6	7.6	Lisa Bozzuto	4/11/2004
Encampment Pines	150.6	7.4	Susan Benoit	4/11/2004
Trees of Peace-Mast Pines	150.6	7.8	Mast Tree #3	12/22/2002
Pocumtuck Pines	150.6	6.5	Unnamed	3/18/2004
Trees of Peace	150.5	9.4	Tom Cheyenne-Father	3/28/2004
Trees of Peace	150.5	8.1	Unnamed	3/28/2004
Encampment Pines	150.5	8.3	Howard Stoner	4/11/2004
Cherokee Grove	150.5	9.2	Charles Yow Tree	6/20/2004
Encampment Pines	150.5	10.8	Ed Frank Tree	4/11/2004
Pocumtuck Pines	150.5	7.7		6/7/2004
Encampment Pines	150.5	9.2	Jess #2	9/6/2004
Encampment Pines	150.5	8.0	Michael Davie	4/11/2004
Clark Ridge-North	150.4	8.6	Washakie	5/30/2004
Encampment Pines	150.4	10.1	Lisa Bozzuto #2	9/6/2004
Pocumtuck Pines	150.3	7.3		6/9/2004
Pocumtuck Pines	150.3	7.8	Unnamed	11/9/2003
Trees of Peace	150.3	9.1	Dave Chief Tree	3/28/2004
Pocumtuck Pines	150.3	7.7	Will's Tree #4	10/25/2003
Trees of Peace-Mast Pines	150.3	7.8	Mast Tree #4	5/25/2003
Encampment Pines	150.1	7.6	Diane Gray	4/11/2004

Growth Monitoring Data Collection Sheet:

WHITE PINE GROWTH MONITORING DATASHEET: Mohawk Trail State Forest										
Site:		Tree Name		Latitude	Longitude	Dist to Marker	Aspect to Marker	Tag No.		
DOM	Measurer	CD	BD	CA	BA	Method	Add-on	Hgt	Cir	Condition