Bulletin of the Eastern Native Tree Society

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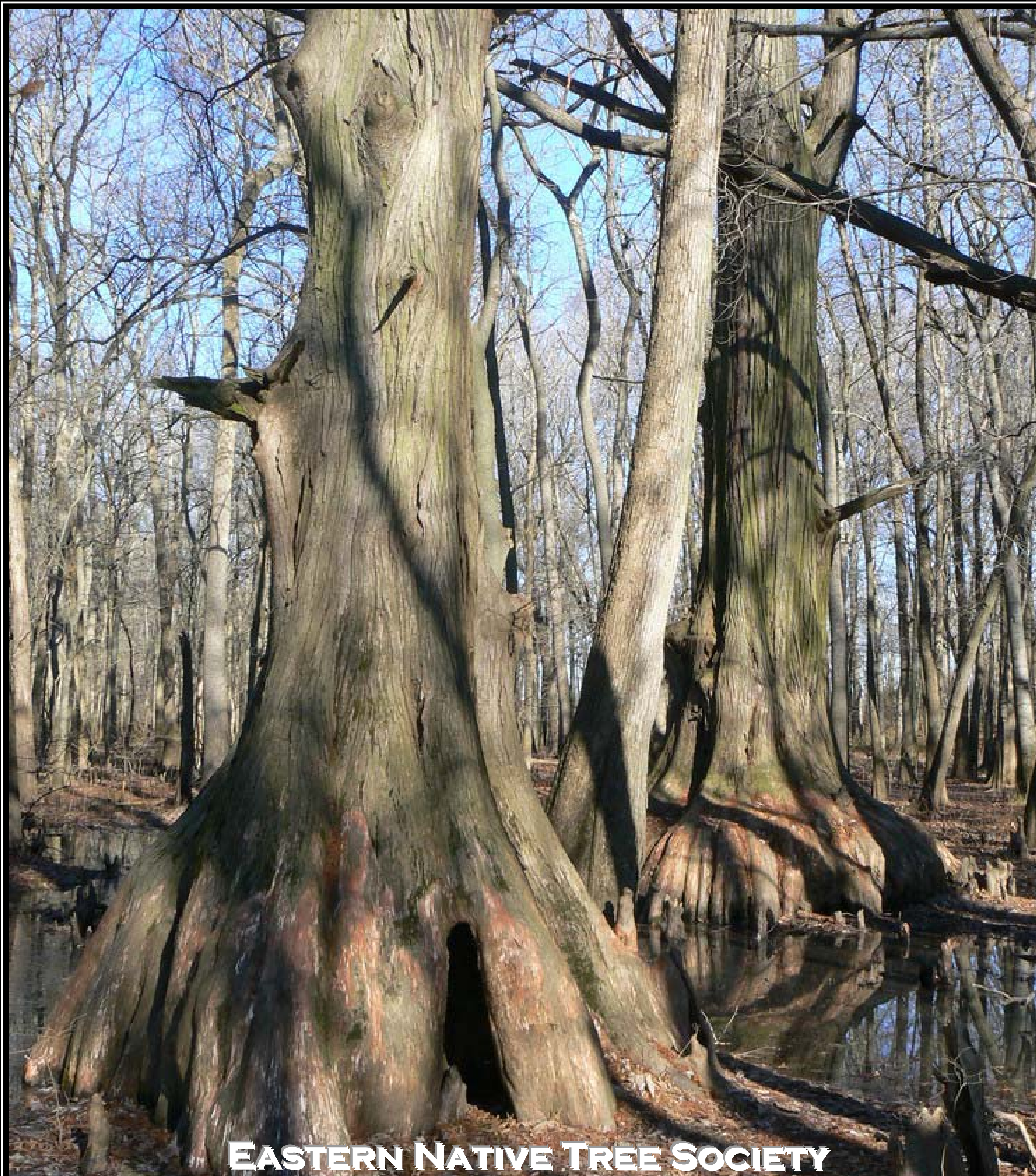

Bulletin of the Eastern Native Tree Society

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Mission Statement:

The Eastern Native Tree Society (ENTS) is a cyberspace interest group devoted to the celebration of trees of eastern North America through art, poetry, music, mythology, science, medicine, and woodcrafts. ENTS is also intended as an archive for information on specific trees and stands of trees, and ENTS will store data on accurately measured trees for historical documentation, scientific research, and to resolve big tree disputes.

Membership and Website Submissions:

Membership in ENTS is FREE and automatic. Simply sign up for our online discussion list, ENTSTrees, at: http://lists.topica.com or send an e-mail to ENTSTrees-subscribe@topica.com. Submissions to the ENTS website in terms of information, art, etc. should be made to Edward Frank at: ed_frank@hotmail.com

The *Bulletin of the Eastern Native Tree Society* is provided as a free download in Adobe™ PDF format (optimized for version 5 or newer) through the ENTS website. The Eastern Native Tree Society and the *Bulletin of the Eastern Native Tree Society* editorial staff are solely responsible for its content.

COVER: Spring comes late to the flooded bottomlands and remnant ancient baldcypress of the Cache River State Natural Area in the extreme southern tip of Illinois. Photo by Don C. Bragg.

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NEW FEATURES OF THE *BULLETIN*

In my years of research in forestry and ecology, I have noticed a number of trends related to the publication of information on the natural world. First, the quantity and scientific quality of these materials are continually increasing, as new techniques, technologies, and our ability to interpret the environment improves. Second, the pressure to publish "significant" new research in prestigious journals has turned most scientists (myself included) into machinations of the profession, driven by objectives like the number of peer-reviewed publications or contact hours with students or the general public. In all too many cases, we have lost the wonderment that so many of our predecessors had towards the uniqueness of the natural environment, and the many fascinating attributes of the world around us are lost to the cruel calculus of tenure and promotion.

But I would also argue that this has evolved because we don't believe there is a venue to share our discoveries with the rest of the world. In times now long since past for most professional journals, pages were reserved for unique discoveries or conditions. In many cases, a picture or diagram, with even a few sentences, was published to share features of interest, whether or not they proved scientifically revolutionary. These brief comments or notes often preserved accounts of the environment that are now viewed almost incredulously by the public.

With this issue, I want to reinstitute this tradition. Call it the rebirth of a "Ripley's Believe it or Not"-like featurette in which properly vetted descriptions or images of unusual or extreme natural phenomena can be preserved for posterity. Found a strangely fused pair of trees? Send in a picture and description, and we'll publish it for the world. Taken pictures of an unusual albino moose? Send 'em in! We'll consider anything of the sort, so long as it is sufficiently unique to warrant preservation in this digital format. I have included an example in this issue with the hope of encouraging the readers to submit many of the neat things we see discussed in the e-mail discussion list. In addition to this change, I also have expanded the "Notable Trees and Forest" section to include appropriately detailed historical trees and forests.

Don C. Bragg
Editor-in-Chief

Cypress knees carpet the forest floor in a frequently inundated portion of the Congaree Swamp National Park in South Carolina. Photo by Don C. Bragg.

ANNOUNCEMENTS AND SOCIETY ACTIONS

More Tropical Hardwood Giants Found in Borneo

Dr. Roman Dial of Alaska Pacific University recently returned from an expedition to Borneo, where he met with Brett Mifsud and Tom Greenwood and surveyed many trees, including climbing and measuring a number Tawau Hills Park. So, currently they feel comfortable with the following species' heights: *Shorea faguetiana* (290 ft); *Koompassia excelsa* (281 ft); *Shorea argentifolia* (278 ft); *Shorea superba* (277 ft); *Hopea nutans* (272 ft); *Shorea johorensis* (270 ft); *Shorea smithiana* (270 ft); and *Shorea gibossa* (266 ft). All of these trees were found in less than 2 square miles of forest.

2006 Tsuga Search Annual Summary Released

In January of 2007, Will Blozan and Jess Riddle released a report chronicling their efforts on the Tsuga Search Project. According to their report, "New finds and the application of new techniques have catapulted the Tsuga Search into a new level of knowledge of *Tsuga canadensis*. Much of this progress was made possible by the support of the National Park Service, especially Kristine Johnson and Tom Remaley of the Great Smoky Mountains National Park. Their support of the project resulted in a cost-match contract of $25,000 for the project! This funding, combined with the continued private financial support from Appalachian Arborists, Inc., has fostered a highly significant year for eastern hemlock discoveries." The rest of this report can be found on the ENTS website:

http://www.nativetreesociety.org/tsuga/2006_tsuga_search_summary.htm

The report further elaborates on some of their most significant discoveries in 2006.

A Reminder: Please Help Support the Tsuga Search!

As mentioned earlier, the Tsuga Search Project is a joint effort between the Great Smoky Mountains National Park (GSMNP) and the Eastern Native Tree Society (ENTS) to locate, climb, measure, document, and treat (for hemlock woolly adelgid) the greatest of the remaining live eastern hemlocks in the GSMNP. Part of the funding for this work will come through the GSMNP, and the rest will have to be raised through donations to ENTS, whose fiscal agent is the Friends of Mohawk Trail State Forest (FMTSF). Please send contributions to:

Friends of Mohawk Trail State Forest
106 Morningside Drive
Florence, MA 01062

The check should be made out to the "Friends of Mohawk Trail State Forest" and show "Tsuga Search Project" on the memo line. Periodic reports on the project will be issued to Edward Frank for posting on the ENTS website and for reporting in the *Bulletin of the Eastern Native Tree Society*, including financial summaries of the disposition of project funds (donors can remain anonymous to the Society as a whole). Tsuga Search needs your support now!

Kentucky Old-Growth Society Formed

Dr. Neil Pederson of Eastern Kentucky University has helped form the "Kentucky Old-Growth Society." A website detailing some of their goals and objectives can be found at:

http://people.eku.edu/pedersonn/kogs.html

An organization meeting will be held on June 15-16, 2007, at Pine Mountain State Resort in Pineville, Kentucky. A number of Ents will be speaking at this meeting—check out the website for more details.

Cook Forest Big Tree Extravaganza

The next Cook Forest Big Tree Extravaganza is scheduled for Saturday, April 21, 2007 at Cook Forest State Park located near Cooksburg, Pennsylvania. A full slate of events is planned, including presentations by a number of distinguished speakers, including Bob Leverett, Dale Luthringer, Gary Beluzo, Scott Bearer, Todd Ristau, and Lee Frelich. Will Blozan also plans to climb the Seneca Hemlock. This event is free to the public, and further details can be found at the following website:

http://www.nativetreesociety.org/events/cook2007/spring_2007_cook_forest.htm

RUCKER INDEXING ANALYSIS—A SYSTEM FOR DETERMINING MAXIMUM SPECIES DIMENSIONS AND SITE POTENTIAL

Robert Leverett and Will Blozan

Eastern Native Tree Society

INTRODUCTION

What is the maximum girth, height, crown spread, or volume that a tree species can achieve across its full geographical range? Where and under what conditions does a species reach its dimensional maximums? Which eastern forest sites historically grew the biggest trees? How do today's famous big tree sites compare with one another in terms of their abundance of large and/or tall trees? What does the historical record tell us about the maximum size of species? Can big tree sites be validly compared to each other where species mixes do not match? By what measures can sites be compared to one another in terms of tall and/or large trees? Answers to these and other questions fall within the province of a new tool called Rucker Indexing Analysis (RIA), developed by the Eastern Native Tree Society (ENTS). As presented, RIA is intended for use in three basic ways: (1) to determine the maximum dimensions that eastern species can achieve locally, regionally, and range-wide; (2) to compare maximum species size (potential and actual), at specific forest sites, and (3) to evaluate sites using a tree dimension at some overall level of species aggregation. But before formally presenting RIA, we shall provide some background information to explain what has motivated the development of this new system of tree and site dimensional analysis.

RIA is named in honor of the late Colby Rucker of Maryland who was one of the three principal architects of the "Rucker Index" concept. The other two architects of concept are ENTS co-founders Will Blozan and Robert Leverett. Will Blozan was probably the first to propose the idea of the index as a new measure of a site's "tree tallness." The concept quickly took shape out of telephone conversations and e-mail messages of the late 1990s.

In retrospect, Rucker indexing can be viewed as the first attempt by ENTS to measure tree growth performance at different forest sites for comparison purposes. Most people interested in trees, either professionals or amateurs, probably think that answers to the questions posed in the first paragraph are readily available. Certainly, data on big trees are not in short supply and big tree articles are frequently encountered in the media. Nor is there any shortage of forest-based mathematics for calculating individual tree dimensions and aggregated site-based statistics. Forestry professionals are experts at measuring the standing volume of timber on a site, measuring the volumes of logs sent to a mill, and calculating rates of volume change over time. The mathematics brought to bear in these calculations are called forest "mensuration." Foresters are usually the ones consulted by the public about tree dimensions. In the public's eye, foresters are most likely to have the answers to questions about how large species grow and where they achieve their maximums.

Other disciplines are also involved in forest mathematics. Ecologists decipher forest processes and study how forests develop naturally. Whereas the mathematics of the forester is targeted toward measuring timber growth, the mathematics of the ecologist is applied to many less tangible forest processes. Ecologists might calculate the volume of leaf litter per unit area in a certain type of forest or the volume and distribution of space in forest gaps. However, there are many overlaps between the two professions in terms of the knowledge they seek and their use of forest mathematics. Statistics with hypothesis testing is commonly employed in both professions. It is also likely that forest ecology grew out of the forestry profession as a logical consequence of foresters seeking to understand timber seen as a renewable resource.

While forest scientists and forestry professionals collect vast amounts of data on trees growing at various spatial scales, from individual trees and small clusters to entire landscapes, gaps remain in our understanding of maximum species performance across the sites that they occupy. This is true despite forestry measures like site index that utilize tree height and data collected from forest plots in which tree diameters and heights are measured and tracked.

One reason for the information gap on maximum species performance is that forestry and forest science usually deal with aggregate data and trends based on broad averages. Dimensions of isolated trees usually fall in the category of trivia. Comparisons of the maximum dimension that a species achieves at one site compared to others, at least heretofore, have been of little serious interest. As a consequence, errors and misconceptions have crept into both popular and scientific literature relative to species maximums. Correcting this informational deficiency has been a motivating factor in the development of RIA. ENTS has become the central repository of accurate maximum tree dimension data.

At its most fundamental, RIA uses a tree dimension such as height, girth, height-to-diameter ratio, or total trunk volume to arrive at both species-specific size information and aggregate site-based measures—the latter being the primary focus of RIA. Comparisons are made among sites to develop site-based profiles for a tree dimension of interest. A side benefit of RIA has been the cataloging by ENTS of exemplary forest sites from the standpoint of big and/or tall trees. This information is available to the public through the ENTS website.

From the work that we've done to date and how it has been presented, it may first appear to the beginner that RIA is purely a site-based analysis. However, the concept of exceptional growth, as revealed through RIA, is not restricted to forest sites of limited physical area. RIA can be applied across wide geographical regions to include the entire eastern forest biome. Still, we would emphasize that RIA started more modestly. RIA initially focused on computing an index for a forest site using the maximum tree height for each of the ten tallest species. Except for perhaps the smallest sites, RIA is always a work in progress, since taller trees are usually discovered over time, and of course, tree dimensions change with annual growth and damage from a variety of causes.

Although RIA was initially applied to tree heights, it has since been applied to the other tree dimensions. An important, if not initially controversial, extension to RIA has been iterating a site's index to reveal patterns of species behavior not visible through computation of a single value. If the dataset is sufficient, with the iterated index, we get a more complete picture the performance each species at a site. However, there are limitations to the iteration concept that will duly be pointed out.

As a summary statement to this introduction, it is the ENTS position that RIA yields our best statistical assay of maximum tree dimensions at the sites we study. It would be hard to overstate the importance of Rucker indexing in helping us to understand the maximums that an eastern species can achieve locally, regionally, and across its entire range.

We will now turn to the basics of RIA and investigate its application to a number of important eastern forest sites. Case studies will be presented for *Liriodendron tulipifera* as an example of species-based data derived through RIA. We will follow the tuliptree with an introduction to site-based data, and then turn to Mohawk Trail State Forest in western Massachusetts as an example of a complete site-based application of RIA. Future articles will include other uses of RIA and a look at some interesting facts and conclusions drawn from RIA.

BASIC CONCEPT OF RIA

At its simplest, RIA examines a forest site through a specific tree dimension such as height or girth. RIA, as a process, is performed by computing an index, as will be described, on the selected tree dimension. The intention is that the index will summarize the chosen dimension for the site in some illuminating manner. The dimension is measured for multiple species up to some number, characteristically 10, to arrive at an overall site index. Initially, ENTS focused exclusively on the dimension of tree height. Height is still the dimension of choice, but other dimensions are increasingly used and no less valuable to RIA.

The basic process of computing the traditional Rucker site index for the height dimension requires finding and measuring the tallest individual tree of each of the ten tallest species at a site and then averaging the ten heights. The resulting average is defined as the Rucker Height Index (RHI). Each tree making up the index must be of a different species. For example, there can't be two white pines in the computation of an index for a site. Used as a single number, without further analysis, the RHI can be interpreted as a measure of a site's existing degree of tree "tallness." The use of exactly 10 species in the index represents a tradeoff between capturing species diversity and achieving computational simplicity. At this incipient level of Rucker analysis, the biggest job is locating the tallest single member of each species. This step requires experience that cannot be acquired in a short period of time.

A caution is in order at this point. Presented as a single number, the RHI says nothing about the species comprising the index, the ages of the trees at a site, successional patterns, or the site history. Nor does RHI prescribe a size for a site. RHI is just an average that is suggestive of how tall the trees are at the site at a point in time. Consequently, using an RHI without elaboration constitutes little more than a sporting endeavor. All ENTS members who use RIA understand this, but in brief conversations and e-mail exchanges, outsiders can easily get the wrong impression and not recognize the scientific purpose of RIA and its deeper levels.

Because ENTS is seeking to discover species height maximums, ENTS has concentrated most of its attention on the forest sites with the tallest trees. To this end, ENTS makes concentrated searches for the eastern sites with the tallest trees and then seeks the maximums at those sites. However, experience has shown us that it will take multiple visits to a particular site of no more than 50 ac (and preferably by more than one measurer) to find the site's maximums. So, it is fair to say that RHI is always a work in progress. As an example, the most measured site in ENTS is probably Mohawk Trail State Forest (MTSF), which has a current RHI of 136.1 ft. Reaching this value has taken a team of ENTS researchers several years of intensive searching and measuring. The payoff is that the analysts who study the MTSF can now state, with confidence, that further increases to Mohawk's RHI are likely to be minimal and that its long-term maximum RHI can be expected to vary between 134 and 137 ft. If this is true, and we can make a very strong case that it is, then we have made a significant determination about the maximum height growth performance of the tree species in MTSF.

We can learn a lot from applying RIA to a single site, but by computing the RHI for dozens of sites and making comparisons for individual and groupings of species, patterns emerge that allow us to pinpoint conditions that consistently produce the tallest trees and eventually confirm species maximums. It must be kept in mind that when comparing the indices for two sites, the species comprising the index at one site usually do not match the species at the other, certainly not completely, and the wider the geographical separation, the greater the disparity. Whichever species are the tallest at a site dictates which ones are included in an index calculation. Consequently, the comparison of two RHIs usually does not produce a strictly "apples-to-apples" comparison. It is more "fruit-to-fruit," and, consequently, the value of a comparison is very limited when simply comparing two numbers. Since the species composition of a particular index is solely dependent on the distribution of tree heights at the site, quick conclusions about one index compared to another are always risky. One proceeds with caution because a simple index comparison, i.e., the contrast of two numbers, does not answer questions of real scientific interest such as what best explains the difference between the numbers.

This said, multiple site index comparisons have allowed us to create some interesting site lists ordered by RHI value. The lists are ordinarily presented in descending order on RHI. The common-sense interpretation of a comparison of two indices in a list is that the site with a higher RHI possesses a wider distribution of tall trees than the site with the lower index. This is generally true. Taking the process further, an actual ENTS comparison includes examining the species comprising the index, site conditions, tree ages, etc.

In summary, the objectives to be served by RIA include the following:

- Determining and documenting the maximum dimensions of species growing on a particular site at a particular point in time and over a span of time;
- Drawing site-based conclusions about the growth performance of a species;
- Determining the maximum dimensions to which an eastern species can grow at given sites, both regionally and across its full geographical range;
- Determining geographically where each species reaches its maximum dimensions and what environmental conditions explain achievement of maximum growth potential;
- Cataloging the most impressive big tree/tall tree sites;
- Investigating various inter- and intraspecific relationships, e.g. does achievement of great height or girth in one species correlate positively or negatively to height or girth in another; and
- Developing probability curves for species dimensions, locally, regionally, and range-wide.

A NOTATIONAL SYSTEM FOR RIA

Single and Iterated Indices

As previously mentioned, RIA can be applied to different tree dimensions—principally height, girth, height-to-diameter ratio, crown spread, trunk volume, and possibly age. Efficiently referring to indices requires mathematical notation. The following system nomenclature has been developed for RIA:

RHI (Rucker index for height),
RGI (Rucker index for girth),
RRI (Rucker index for height-to-diameter ratio),
RSI (Rucker index for crown spread),
RVI (Rucker index for trunk volume).

RHI and RGI are the indices most often used. In RGI, the term "girth" is used in preference to "circumference," which implies a circular trunk form. Circularity is seldom the case in tree trunks, although variances are often minor.

In more advanced applications of RIA, a second type of index is used to measure the depth of tall/large trees at a site. The objective is to distinguish statistical outliers from more stable height patterns. To achieve this objective, the index is iterated. The process of iteration involves removing the first ten species making up the initial index and calculating a new index on the trees that remain. This is tantamount to ignoring the 10 original trees as though they do not exist and then examining what the site produces from the remaining trees. This version of the Rucker index is called an iterated index. Notation needed for this variation is of the form RHI_i, where "*i*" represents the iteration number. Thus, in the expanded notation, RHI_2 represents the second iteration of the Rucker Height Index. *RHI* and RHI_1 are equivalent notations.

A final variation of the indexing concept is to relax the 10-species requirement and base the index on either fewer or more than 10 species. Less than 10 is the more common option. Using less than 10 species allows the sites with low species diversity to be included in RIA. If we choose other than 10 species to form an index, we need to expand the notation. From these preliminary descriptions, we can express the concepts of RIA mathematically. The following notation is shown for the height dimension. The non-iterated index will first be addressed.

Let N = the number of species comprising the index, j denote the jth species in a non-iterated index (where $1 \le j \le N$), and VH_j = height dimension for the jth species, where the species are ordered in descending value on height. Then *RHI* is defined as:

$$RHI = \frac{\sum_{j=1}^{N} VH_j}{N} \qquad [1]$$

If indexing is extended over M iterations, the index for the ith iteration would be expressed as follows:

$$RHI_i = \frac{\sum_{j=1}^{N} VH_{i,j}}{N} \qquad [2]$$

where i denote the ith iteration (and $1 \le i \le M$). Note that for an iteration, i remains fixed as j successively takes on values from 1 to N. If N is other than 10, the notation expands to become:

$$RHI_{i,N} = \frac{\sum_{j=1}^{N} VH_{i,j}}{N} \qquad [3]$$

Note that N is fixed and communicates the number of species in any iteration. If we encounter an index expressed as $RHI_{3,12}$, it would denote the third iteration of the index based on 12 species. There is also an index that the represents all iterations. We define the composite index $CRHI_{M,N}$ as:

$$CRHI_{M,N} = \frac{\sum_{i=1}^{M} \sum_{j=1}^{N} VH_{i,j}}{M\ N} \quad [4]$$

where M expresses the number of iterations for the number of species (N) for which the index is defined. It can be seen that $CRHI_{M,N}$ is no more than the arithmetic mean over all the trees included in the M iterations. However, $CRHI_{M,N}$ is conceptually different from RHI or RHI_i because $CRHI_{M,N}$ can include the same species multiple times.

The best application of the above notation is for situations where species values within iterations and iteration indices need to be distinguished for further analysis. However, knowing the name of the species identified only as the jth value in the ith iteration imposes a need that is not handled in conventional mathematic notation. Computer arrays such as employed in Visual Basic provide the means of identifying species by name within array notation. We will present a paper later on a database model for storing and manipulating data from the RIA iteration process.

DOMINANCE, PERSISTENCE, AND THE DROP INDEX

As the number of iterations increase, our attention logically turns toward examining the behavior of the species comprising the iteration sequence. For example, how long does a species persist in the sequence and how dominant is it when present? These questions suggest a subordinate set of indices, i.e., those indices computed from the iteration sequence. We will now examine the role of each species in the iterated index from the standpoint of how dominant a species is when present, and secondly, how persistent a species is through the iteration process. We will then turn to the pattern of the sequence, treated as a whole. We need to first define some new terms.

Dominance:

- D = Dominance score of a species in an iterated index (based on 100 points)
- N = Number of iterations in an iterated index
- P = Number of species in an iteration (the number of places to fill)
- M = Number of iterations in which a species is present
- P_i = Position of a species in the ith iteration
- S_i = Raw score of species on the ith iteration (height, girth, etc.), where $S_i = P + 1 - Pi$
- d_i = Dominance score of species on the ith iteration

Then:

$$d_i = (S_i / P) \times 100 \quad [5]$$

$$D = \left(\sum_{i=1}^{M} d_i \right) \Big/ M \quad [6]$$

Persistence:

- N = Number of iterations
- M = Number of iterations in which a species is present
- X_i = 1 if species is present in the ith iteration, 0 if not
- P = Persistence score for species

$$M = \left(\sum_{i=1}^{N} X_i \right) \quad [7]$$

$$P = (M/N) \times 100 \quad [8]$$

Note that the notation for persistence does not identify the species. That connection must be made externally. Both D and P are defined on the basis of 100 points being a perfect score for a species. For example, if a species is at the top of the dominance list in all iterations where it appears (which may not be all), it scores 100 points for dominance. If a species is present in all iterations, regardless of dominance, it scores 100 points for persistence.

Dominance-Persistence Index (DPI):

$$DPI = (D \times P)/100 \quad [9]$$

The DPI of a species tells us the most about a species that is widely distributed over a site as the iterations increase.

Drop Index:

How does an iterated index behave as the number of iterations increases? There are several approaches that we could pursue. This question gets to the heart of how the tall trees are distributed. Are there large numbers of trees of a species in the same height range so that progressing from one iteration to the next proceeds along a descending linear path? We might choose to investigate the behavior of an iterated index by calculating the RHI drop for the Nth iteration from the first iteration as a percentage of the first iteration value. This suggests an index of dropping value. The Drop Index (DI_N) is calculated as follows:

$$DI_N = \left[(RHI_1 - RHI_N) / RHN_1 \right] \times 100 \quad [10]$$

EARLY APPLICATIONS OF RIA

In applying RIA, ENTS tree-measuring experts initially concentrated on a handful of sites. Several were well known and long recognized to grow very large and/or tall trees. Among the well-known sites ENTS has investigated are Cook Forest State Park (Pennsylvania), Heart's Content (Pennsylvania), the Great Smoky Mountains National Park (GSMNP, in Tennessee/North Carolina), Hartwick Pines State Park (Michigan), Congaree National Park (South Carolina), Beall Woods (Illinois), and Big Oak Tree State Park (Missouri). Plenty of anecdotal information and champion tree data existed on tree dimensions for these well-known sites, but no studies were found by ENTS that presented a truly reliable picture of species height performance.

Beyond well-known forests and parks, a few important sites studied by ENTS were not generally well known for having prominent trees, especially exceptionally tall ones. These sites have since achieved prominence largely through RIA. MTSF and Ice Glen in Massachusetts, Zoar Valley in New York, and Meeman-Shelby Forest State Park in Tennessee are examples. But regardless of how well known or relatively unknown a site is, sources of information available for tree heights are usually inaccurate. We have attributed the inaccuracies to forest researchers using tangent-based height measurement methods.

If formal forestry-based scientific studies do not supply the data that RIA provides, what about the statistics presented in the national and state champion tree lists? Can data in these lists be useful in RIA? The answer is a simple and emphatic—*NO!* In a champion tree list, one finds a single member of a species listed. The geographical locations of species in the list are widely scattered. So the champion tree lists are not site-based. A second reason is that the trees earning the greatest number of points in the champion tree lists seldom provide good information on the maximum for a specific dimension, especially height or crown spread. The champion lists do a better job of capturing maximum girth dimensions, but there are problems there also based on variations in tree form predicated on whether or not a tree grows inside a forest or out in the open. Coppice tree forms and measurements taken at different points on the trunk are two more problems. Our conclusion is that there is little, if any, useful information in the champion tree lists that provides the kind of data that flows through RIA.

Beyond the site-based tree dimension indices, we can get a good idea of the kinds of information that can be extracted from RIA by taking a particular species and posing questions about the performance of a dimension for the species over a range of latitude and/or longitude.

LIRIODENDRON TULIPIFERA – A CASE STUDY

What can we say about the maximum height performance of *Liriodendron tulipifera* using data collected through RIA? We typically assume that the maximum size of a species is significantly diminished near its northern and southern range limits, but to what extent? Does the change in a maximum follow a predictable pattern with changes in latitude or longitude? Where does a particular species reach its overall maximum height, girth, spread, volume? Answers to these questions can be obtained from data gathered with the RIA.

The tuliptree has a broad geographical range, extending from Vermont and New York southward to Florida and westward to Illinois and Missouri. The species is well represented in southern Michigan and is found in the eastern part of Arkansas. The tuliptree reaches its northeastern range limit in the Connecticut River Valley of western Massachusetts at approximately 42.5 degrees latitude. The tuliptree may have grown farther along this northeastern corridor in the past, before much of Massachusetts was cleared, but is found north of 42.5 degrees now only where planted. The tuliptree occasionally escapes into woodlands from parks or yard plantings, but it never establishes a convincing presence beyond its natural range. Near its northeastern range limit, *Liriodendron* does not compete well where forest succession controls species propagation. Given its northeastern range limit in western Massachusetts, how well does the tuliptree perform growth-wise? Beyond its northeastern limit, what can we conclude about the maximum dimensions it achieves as we move westward and southward? The data gathered through ENTS RIA is providing is a clear picture of the growth maximums that this species reaches.

Within 30 miles of its northeastern limits, the tuliptree has been measured to heights of up to 140.9 ft. However, so far, only one tree has been found over 140 ft and 12 over 130 ft. Three northeastern sites within 0.2 degree of latitude of one another have specimens of tuliptree over 130 ft in height and 10 sites has been located within 0.3 degrees of latitude with trees measuring over 120 ft. The most northeasterly that we have documented of significant height is a 125.4-ft tall tree growing on the home site of Emily Dickenson in Amherst, Massachusetts at a latitude of 43.375 degrees. A competing tree grows on the property of Monica Jakuc Leverett at 127.0 ft at latitude 43.35 degrees.

The tallest tuliptrees grow in woodlots and forest ravines. The large-diameter tulips grow in the open. Based on our data, we can conclude that near its northeastern range limit, the tuliptree can reach 120 ft in height fairly often and is capable of reaching between 135 and 140 ft on rare occasions. It is reasonable to put 140 ft as the upper height limit of the tuliptree at its natural northeastern range limit, with allowance for statistical outliers.

Moving westward, heights in central New York at approximately the same latitude at the northeastern limit have been documented to 145 ft in two locations, and in extreme western New York to the mid-140s, with one exceptional tree, which reaches 156 ft in Zoar Valley at 42.4 degrees latitude. We have not identified the reason(s) for the slight increase in height going from east to west and even slightly north. It does not appear to be length of growing season or average annual temperature.

As we move southward, the height maximum for the tuliptree increases. Southern Pennsylvania and eastward to the Washington, DC area, tuliptrees can reach 160 ft. A single tuliptree in West Virginia has been measured to 173 ft. Tuliptrees have been recorded accurately in the Wabash River Valley to heights of 165 ft. In the southern Appalachians, tuliptrees in forest-grown environments become giants, reaching girths of 15 to 25 ft and heights of between 160 to just under 180 ft. Baxter Creek in the Cataloochee District of the Great Smoky Mountains National Park has an impressive collection of trees between 170 and 178.5 ft in height. At least one tree in the in Baxter Creek is expected to exceed 180 ft within 2 to 3 years. At this point, the Great Smoky Mountains and surrounding ranges appear to be the pinnacle of development of the species.

These maximums reveal a clear pattern of increasing height going from north to south to the latitude of between 35 and 36 degrees, then a drop in maximum height toward the extreme southern parts of the range. Our data suggest that the best development for the species may be tri-modal, with the southern Appalachians, the West Virginia Allegheny Mountains, and parts of Kentucky, Indiana, and Illinois being the centers of maximum development. There is a need for more research if we want to understand where and under what conditions a species like *Liriodendron* reaches its dimensional maximums.

SITE-BASED APPLICATIONS OF RIA

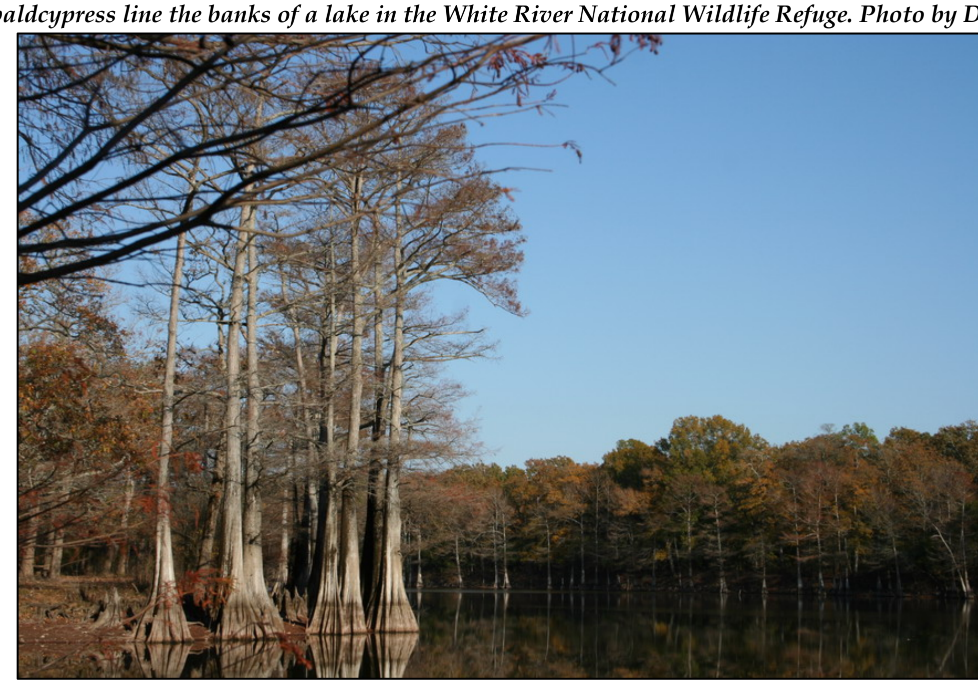
From the early applications of RIA, a seemingly unlikely northeastern site (MTSF) joined the well-known eastern tall tree locations known for their abundance of tall trees. A second unlikely site later joined the list—Zoar Valley, New York. RIA shows these two sites to be exceptional in terms of the heights of their trees for their respective geographical areas. A second Massachusetts site, Ice Glen, has also been revealed as an exceptional performer. Several Pennsylvania sites, including Ricketts Glen, show up well, but data coming from MTSF, Cook Forest State Park, GSMNP, Congaree National Park, and Zoar Valley have provided the strongest incentives for ENTS members to expand their searches, locate the best tree-growing sites, and apply RIA.

Among the above listed sites MTSF, Cook Forest, and the Smokies have been especially prominent. It has been these sites that have led to most of the advancements in RIA. The GSMNP has given ENTS a ceiling index for eastern forests. There are several watersheds in the GSMNP that have RHI values above 155 ft. The GSMNP, as a whole, has an index of 163.6 ft. There is a scattering of southeastern sites that have RHI values between 150 and 152 ft. Collectively, these sites tell us what eastern species can do on a range-wide basis. As we move into the northern states, the best sites are in the mid-130s. There appears to be around a 20-point drop going from south to north.

For a time, MTSF boasted the highest Rucker index in the Northeast, and emphasized the importance of thorough searches by ENTS to test the hypothesis that MTSF was an exceptional growing site. We have since discovered tall trees growing at many locations heretofore unknown. We currently have a good search image to employ in identifying candidate tall tree sites. Protected ravines and gorges of our wilder parks provide candidate tall tree environments, as do forests in more benign terrain of old estates and city parks. But somewhat surprisingly, even though the list of impressive tall tree sites is growing, the early sites continue to hold high rankings, at least regionally. In the Northeast, Zoar Valley, Cook Forest, and MTSF have stayed at the top of the rankings.

This raises some interesting research questions. Are the high RHIs of Zoar Valley, Cook Forest, and MTSF: (1) an anomaly dependant on a few statistical outlier trees; (2) reflective of a lack of wider geographical searching; (3) have to do with past or present forest practices; (4) reflecting the result of highly favorable environmental growing conditions in combination with a long growth history; (5) explained otherwise; or (6) some combination of the above? To determine if Mohawk's high index was dependent on a few statistical outliers and consequently not as ecologically significant as the RHI indicated, the Rucker index concept was extended to include an index iteration process. Iterating an index represented the first extension of RIA beyond the initial RHI.

Graceful baldcypress line the banks of a lake in the White River National Wildlife Refuge. Photo by Don C. Bragg.



A COMPARISON OF BASELINE-TANGENT TREE HEIGHT MEASUREMENTS TO THE SINE METHOD

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ABSTRACT
A delay in obtaining a laser rangefinder in 2003 led my students and me to measure the heights of a number of northeastern trees by baseline-tangent methods that are prone to overestimation. However, we were later able to compare these results to subsequent rangefinder sine-based measurements of some of the same trees. Carefully applied baseline-tangent methods on level ground overestimated tree height by an average of 3.0 ± 0.8% (± SE, n = 16 trees), and by 11.0% for one specimen of American sycamore (*Platanus occidentalis*). Laser-sine methods are always preferred for reliability (and are likely the only possible approach to measuring tree height on slopes and across obstructions), but the performance of baseline methods demonstrated here suggests exaggerations of up to 50% are entirely avoidable, even when using less than ideal methods.

INTRODUCTION
It is no secret that members of the Eastern Native Tree Society take a sense of quirky pride in being labeled tree height measuring "fanatics." A devotion to accuracy and precision is certainly a most desirable trait for scientists, foresters, and amateur woodland enthusiasts alike. While the most ardent debates over maximum tree heights usually involve species champions listed on state and national "big tree" registers, reliable measurement is no less important to studying the ecology and silvics of forest ecosystems. The commercial forester must accurately assess growth performance under various management strategies in order to maximize yield and quality of harvested timber products. Likewise, the ecologist may quantify height potential as one important metric of local and/or regional responses of tree species to the myriad environmental and biological dynamics that shape the world's forests.

Unfortunately, however, the reporting of tree height is rife with inaccuracy, sometimes of staggering proportions (see ENTS (2005) for a discussion of eastern trees whose big-tree-list reported heights were overestimated by 9 to 54%). The influence of such inaccuracy can and does often reach beyond the immediate assignment of champion status to individual trees. Unsubstantiated height reports have occasionally been quoted by highly respected academic volumes (e.g. Oliver and Larson 1996) and field guides/manuals (Burns and Honkala 1990, Petrides 1998), and thus may be granted legitimacy they do not deserve. Furthermore, acceptance of significantly over-estimated tree heights lessens the notability of accurately measured trees, and may even diminish arguments for conservation based on this notability. Two such examples are the recently and accurately documented *Liriodendron tulipifera* (tuliptree) groves (39 to 43 m in height) in Robinson State Park, central Massachusetts, and the multiple species of impressive height (36.5 to 47.5 m) reported in Zoar Valley, western New York. In both cases, exemplary vertical development, especially in light of northerly latitudes, contributes to the case for protection of these woodlands.

The objective of the present paper was to compare tree height measurements of forest-grown eastern trees as determined independently by two different techniques: 1) the preferred sine-based approach that uses distance to the top of a tree measured with a laser rangefinder (Blozan 2006), and 2) a tangent-based calculation that uses a baseline determined with a tape measure. The opportunity to compare these two techniques presented itself through a delay in the processing of a small internal equipment grant at Youngstown State University during winter/spring of 2003, causing us to estimate heights of Ohio and New York State trees without a laser rangefinder. Some of these trees were subsequently re-measured by laser-sine methods later in 2003 and during 2004 (two examples are shown in Figure 1). Thus, we obtained independent measurements of the same trees by different techniques, closely spaced in time (i.e., minimizing height change due to crown growth and/or breakage), and determined by the same observer(s). Presumably, the overriding factor in any differences in height determinations for individual trees should have been technique.

METHODS
The 16 trees included in this study were located in Zoar Valley, western New York State, and in Kyle Woods and Poland Woods, both in northeastern Ohio. Each site is an excellent tall-tree reserve, with multiple species exceeding 33 m in height. Study trees were all located on relatively flat ground with direct access to their bases, so only one triangle (i.e., above eye level) was needed to calculate height, regardless of specific technique. For both measuring techniques eye level was assumed to be 1.7 m.

Sine-based height estimates followed procedures detailed in Blozan (2006) using a Nikon 400 laser rangefinder to measure distance to the top of the tree (i.e., the hypotenuse of the triangle), and either a Suunto bubble clinometer or a precision carpenter's protractor (with a swing-arm that could act as a

Figure 1. Two of the 16 trees for which baseline-tangent and subsequent laser-sine heights were compared. Left image: **Platanus occidentalis** *(American sycamore) in Zoar Valley, New York, in grove that also contains northeast US height record (46.3 m) specimen. Tree in the foreground was measured to 43.9 m by laser-sine and to 45.4 m by baseline tangent—an overestimate of 3.5%. Right image: Slippery elm* **(Ulmus rubra)**, *also in the Zoar Valley. Height measured to 36.7 m by laser-sine and to 37.7 m by baseline tangent—an overestimate of 2.7%.*

plumb-bob) to measure angle of elevation. I have found both angle-measuring devices equivalent when hand-held, although a clinometer attached to a tripod should always be used when measuring distant trees for which each increment of elevation converts to a larger amount of tree height. Although laser-sine measurements are not entirely free of potential error, they have repeatedly been verified by climbs and tape-drops (e.g., ENTS 2003, ENTS 2006), and so are considered the most accurate "standard" against which to compare the results of other techniques.

For tangent-based height estimates (i.e., no rangefinder) angle of elevation was measured as above, but a tape measure was used to measure a baseline along the ground (i.e., the adjacent side of the triangle). We chose to forego the use of a standard baseline of 30 m, and instead first identified a clear vantage point to a tree's crown after which we measured the resulting baseline. Further, we did not assume that the baseline necessarily extended to the trunk, but instead attempted to identify the point on the ground directly beneath our chosen high point of each tree. This often involved conducting one or more "walk-ups" to a tree before the baseline was actually measured.

RESULTS AND DISCUSSION

Perhaps not surprisingly, baseline-tangent methods most often returned greater height estimates for individual trees than did laser-sine methods (Table 1). Overestimates averaged 3.0±0.8% (±SE) among all 16 trees for which the two methods were compared. Baseline-tangent measuring underestimated only one tree (a 36.9-m *Liriodendron tulipifera* in Kyle Woods) and yielded exactly the same height as laser-sine measuring for another (a 33.4-m shagbark hickory (*Carya ovata*) in Poland Woods). Four other trees were estimated to within ~ 1% of laser-sine values, but the other 10 trees, including all Zoar Valley specimens, were overestimated by between 1.6 and 11.0% (Table 1). The two largest overestimates (of a 34.5-m *Platanus occidentalis* in Poland Woods and a 40.1-m bitternut

Table 1. Comparison of height estimates of 16 eastern forest-grown trees made by sine-based (hypotenuse measured with laser range finder) and tangent-based (baseline determined with tape measure) methods.

Location / Species	DBH (in cm)	Height (in m) Laser-sine	Height (in m) Baseline-tangent	Difference (in %)
Zoar Valley, New York				
Slippery elm (*Ulmus rubra*)	54	36.7	37.7	2.7
Yellow birch (*Betula allegheniensis*)	69	29.5	30.8	4.1
American beech (*Fagus grandifolia*)	71	35.4	36.4	2.8
White ash (*Fraxinus americana*)	65	40.1	41.8	4.3
Bitternut hickory (*Carya cordiformis*)	45	40.1	43.3	7.9
Black walnut (*Juglans nigra*)	72	37.8	39.2	3.8
American sycamore (*Platanus occidentalis*)	79	43.9	45.4	3.5
Poland Woods, Ohio				
American sycamore	150	34.5	38.2	11.0
Coffeetree (*Gymnocladus dioica*)	69	33.7	34.3	1.6
American beech	83	34.0	34.6	1.6
Shagbark hickory (*Carya ovata*)	59	33.4	33.4	0.0
Tuliptree (*Liriodendron tulipifera*)	107	37.5	37.6	0.2
Sugar maple (*Acer saccharum*)	81	32.3	32.7	1.0
Kyle Woods, Ohio				
American basswood (*Tilia americana*)	112	33.5	34.5	3.2
Shagbark hickory	50	35.0	35.3	1.0
Tuliptree	81	36.9	36.2	-1.8
			Average percent over-estimate =	**3.0**

hickory (*Carya cordiformis*) in Zoar Valley) represented > 3 m of error.

From a statistical perspective, height overestimation by baseline-tangent measurement was significant, and not the product of random variation (paired t-test, P = 0.0009). There was no relationship between the degree of overestimate and the actual height of individual trees (simple linear regression, R^2 = 0.023, P > 0.05), i.e., both tall and short trees suffered similar ranges of percentage error.

Interestingly, the two most seriously overestimated trees differed notably in growth form and accessibility. The Poland Woods *Platanus occidentalis* was a large and spreading tree with a complex morphology, and was surrounded by a dense mid-story and shrub layer, and by a number of pools of standing water. Consequently, it represented perhaps as difficult a situation as could be envisioned for measuring tree height on flat ground without a rangefinder. The mid-story made it difficult to maintain visual contact with the crown's high point, and the shrubs and pools physically interfered with laying out a tape-measured baseline.

In contrast, the Zoar Valley *Carya cordiformis* was a slender tree with a compact crown, and was not surrounded by any notable obstructions. Unlike the Poland Woods tree, there were no obvious reasons why this specimen should have proved so difficult to measure by baseline-tangent. Clearly, even such "easy" trees can be substantially mismeasured when lacking a rangefinder, even when attempts are made to minimize the most likely sources of error.

Despite the rather large degree of error generated for these two trees, we were somewhat surprised at the reasonable performance of baseline-tangent methods in general. However, it must be repeated that these trees, located on level ground with mostly unobstructed access, represented a nearly ideal situation for measuring tree height. For trees on sloping ground or separated by obstructions from the observer (e.g., across a river), laser-sine methods are not only preferred for accuracy, but are likely the only practical option.

Given such precautions, a casual observer can probably generate defensible tree height estimates without a rangefinder (ideally, of course, subject to re-measurement by laser-sine) if the following protocols are adopted:

- Dispense with using a standard baseline distance from the tree, and let good sight lines dictate the location of the measuring vantage point.
- Never assume a baseline to extend to the trunk, but instead try as much as possible to locate a point on the ground beneath the highest branch.

- Ensure that a tape measure is as straight and taught as possible. All else equal, any slack or deviation from a straight line will translate into an overestimate of tree height.
- Become familiar with previously reported tree height ranges (e.g., ENTS 2004) so that improbable heights can be re-checked (they will usually be in error).

In light of the passable performance demonstrated here of baseline-tangent methods applied carefully in simple tree measuring situations, the wildly exaggerated heights all too often reported are inexcusable. At the very least, an observer without a laser rangefinder should be able to report plausible tree heights worthy of further investigation, rather than grossly inaccurate results that are inevitably refuted by large amounts. Given the increasing affordability of laser rangefinders (a Nikon 400 cost only $200 US), however, anyone with more than a passing interest in tree height and other aspects of forest dimensions will likely acquire one.

ACKNOWLEDGEMENTS
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LITERATURE CITED

Blozan, W. 2006. Tree measuring guidelines of the Eastern Native Tree Society. Bulletin of the Eastern Native Tree Society 1:3-10.

Burns, R.M., and B.H. Honkala. [tech. coord.] 1990. Silvics of North America: vol. 2. Hardwoods. Agriculture Handbook 654, USDA Forest Service, Washington, DC.

ENTS. 2003. Will Blozan's tree climbs. (discussion thread) http://www.nativetreesociety.org/treeclimbs/blozantreeclimbs.htm.

ENTS. 2004. Tallest examples of eastern native tree species. http://www.nativetreesociety.org/bigtree/webpage_tall_tree_list.htm.

ENTS. 2005. Mis-measured trees. (discussion thread) http://www.nativetreesociety.org/measure/mismeasured_trees.htm.

ENTS. 2006. Ice Glen Pine, MA, climb. (discussion thread) http://www.nativetreesociety.org/fieldtrips/mass/iceglen/ice_glen_pine_climb.htm.

Oliver, C.D. and B.C. Larson. 1996. Forest stand dynamics. Update Edition. John Wiley and Sons. New York, NY.

Petrides, G.A. 1998. Peterson's field guide to eastern trees. Houghton Mifflin Company, New York, NY.

Tupelo gum appearing through the mists of the White River National Wildlife Refuge. Photo by Don C. Bragg.

THE USIS HEMLOCK CLIMB: FEBRUARY 2007

Will Blozan

Eastern Native Tree Society

The Usis Hemlock. Photo by Will Blozan.

The climb of the Usis hemlock in Cataloochee went as planned yesterday (February 15, 2007). We entered the valley with thick hoarfrost covering the ridges and a light snow falling in the brisk 9° air. Jess Riddle, Jason Childs, Josh Kelley and I comprised the team. As some of you may recall, the name "Usis" is a Cherokee word for antler. This name was chosen due to the huge reiterated limbs composing a significant portion of the crown. After being immersed in the canopy for six hours I firmly believe it is a fitting name.

The trunk of the Usis Hemlock is gradually tapered and stout even up to the top. Jess Riddle (standing next to the base) taped the trunk to just over 60 inches in diameter. Aggressive treatments with pesticide for hemlock woolly adelgid should allow this tree to recover as it is in fairly good health and has not fully defoliated yet. Photo by Will Blozan.

Literally within a few hundred yards of the conservation area we have been treating for HWA we spotted a huge hemlock in a gorgeous rich cove. Jess initially thought it was one he had previously seen but when we got closer realized it was a new tree. An "elk highway" literally crosses the base of the tree (well fertilized, too), and we saw several elk while surveying the ridge.

Some of the large, fused branches of the Usis Hemlock that made volume determination very difficult. Photo by Will Blozan.

To give you an idea of the crown, imagine this: a huge canopy perhaps 110 ft in length and 50 ft wide at the widest point. Supporting this huge crown is a stem 5 ft in diameter and over 170 ft tall. The odd thing is the crown is otherwise normal in dimension for a tree this size, but it is offset from the trunk 15 to 20 ft. In order to support this huge structure well away from the trunk, this tree has grown multiple massive upturned limbs that have sprouted new trunks, some over 40 ft tall. These structures allow for the canopy to extend farther than an ordinary descending branch would. Two of the big reiterations are actually fused; one of which likely has a path length of continuous, non-vertical wood close to 50 ft from the trunk. We do not know what event caused such a one-sided crown to form in such stark contrast to other big hemlocks.

Jason Childs in the "Window of Wood," 100 ft up the Usis Hemlock. Photo by Will Blozan.

Jess and I felt certain this tree, which was just discovered two weeks ago, would be a big one, easily exceeding 1300 ft^3 of trunk volume. This suspicion was confirmed when I tried to set my climbing rope on a stout reiteration; I was not able to throw the throw bag high enough due to the height of the structure. Since I can routinely throw 80 to 90 ft the size of the tree became obvious, as it looked quite big at that point. I switched to a lighter bag and got the line set and headed up. While ascending and setting the reference tape straight up the trunk, I had to zig-zag my way up, dodging the huge reiterations—some over 1.5 ft thick.

I was not sure exactly how tall this tree would be, but my two laser shots from different positions were 172.5 ft and 172.9 ft. This was the first tree I have climbed and tape-dropped that was measured with my new equipment. Jess had calculated a slightly lower height with his gear, so I was not sure what would result. After I found a straight path for the tape through the gnarly upper trunk, I found the top to be very stout and was able to actually touch the topmost sprig (and set a new personal tie-in height record of 169 ft). Fellow climber Jason Childs had joined me by this time and he helped set the tape at the proper height while Jess and Josh Kelley zeroed the base. Well, a loud ENTS yelp resounded in Nellie Cove as the tape drop was read—a new height record of 173.1 ft, beating the previous record of 172.1 ft, set just last week!

The height of this tree, though seemingly not much more than a 150 to 160 ft tree more typical of what I climb, became apparent as we descended the trunk and recorded incremental girths for the volume calculations. I had to ask Jason if we really were 150 ft off the ground when the trunk was one foot thick. And I asked again, when at over 135 ft up the diameter had swelled to over 20 inches. What's more, one of the reiterations originated at 124 ft up with a diameter of over 11 inches. This seemed awfully big for so high up, and after extending outwards for 10 feet it turned up and ascended to a tip 149 ft above the ground.

The complex array of the multiple large reiterations, which by the way were almost perfectly aligned on the same azimuth, combined with the mid-teens temperature to confound our measurements. In our cold delirium a top we noted as a prong of a large reiteration below would turn out to be an entirely new one from even farther below. To add more confusion, two of the huge reiterations were fused and some parts belonged to one limb system and some were parts of another. We had to do some detective work to figure out the proper section to map. This was a first, as was literally crawling on hands and knees across a wide hemlock limb over 90 ft up without fear of falling (I was roped in of course, Mom!). The bottom line is this tree was huge, complex and challenging.

Jason and I measured and mapped the ten largest reiterations from trunk origin to terminal tip on every significant limb > 5 inches in diameter. It was tedious, but well worth it—hopefully, Dr. Robert Van Pelt will draw the tree in his superb scale renderings (http://www.forestgiants.com). The data also allow a fairly accurate determination of the volume of these structures. Dr. Van Pelt has found a high correlation in trunk volume and reiteration size in redwoods; lots of reiterations equate to lots of trunk volume. The Usis Hemlock may support this finding, as it is one of the largest hemlocks Jess and I have documented in the Tsuga Search Project. The main trunk was stouter than either of us imagined. The diameter at breast height was big, but not exceptional. What was exceptional was the slow taper of the trunk, the extreme length of the trunk, and a record 9.5 ft girth at 100 ft up. All these factors combined to produce a trunk volume of 1379 ft^3, just 6 cubes less than the largest known in the national park. However, much to my surprise (again) the reiteration volume tallied up to an astonishing 154 cubes of wood! Thus, Usis has a combined structural volume of 1533 ft^3. The current volume record is the Cheoah Hemlock in Highlands, North Carolina at 1564 ft^3, including reiterations.

To me, the Usis Hemlock summarizes, in one tree, the superlatives of the species, *Tsuga canadensis*. It is an ancient tree with extreme character, height and mass. It grows in the wild, rich slopes of the southern Appalachian treasure of Great Smoky Mountains National Park. I feel fortunate to be in a situation to document trees such as the Usis Hemlock, and attempting to preserve for future generations the grandest examples of a regionally vanishing tree. For those holding your breath, the Usis Hemlock is in massive decline from hemlock woolly adelgid (HWA), and is unlikely to respond to conventional treatments—at least not promptly enough to recover to its former glory. Large sections of the crown are already dead and very few needles remain. However, it has not yet produced a second flush of twigs yet, so provided enough buds survived the first HWA attack and treatments are effective, it may survive. It is hard to imagine such a massive tree succumbing to such an utterly undignified death.

A spectacular view of the Smoky Mountains from the top of the Usis Hemlock. Photo by Will Blozan.

COOK FOREST STATE PARK, PENNSYLVANIA: JULY 2003

Dale Luthringer[1] and Colby B. Rucker[2]

[1] Environmental Education Specialist, Cook Forest State Park, Cooksburg, Pennsylvania

[2] (Deceased), Eastern Native Tree Society

Located in Clarion, Forest, and Jefferson Counties in north-western Pennsylvania, Cook Forest State Park contains some of the finest examples of old-growth forest in the eastern United States. Named for the Cook family, from whom the land was purchased in 1927, the park comprises 7,949 ac, of which approximately 1,300 ac is considered old-growth forest, using the Allegheny National Forest definition (185+ yr old). This includes areas that have been selectively cut in the past but are now showing old-growth characteristics. Most of the old-growth is in one of five designated areas.

The 181 ft Longfellow White Pine.

Photo by Will Blozan.

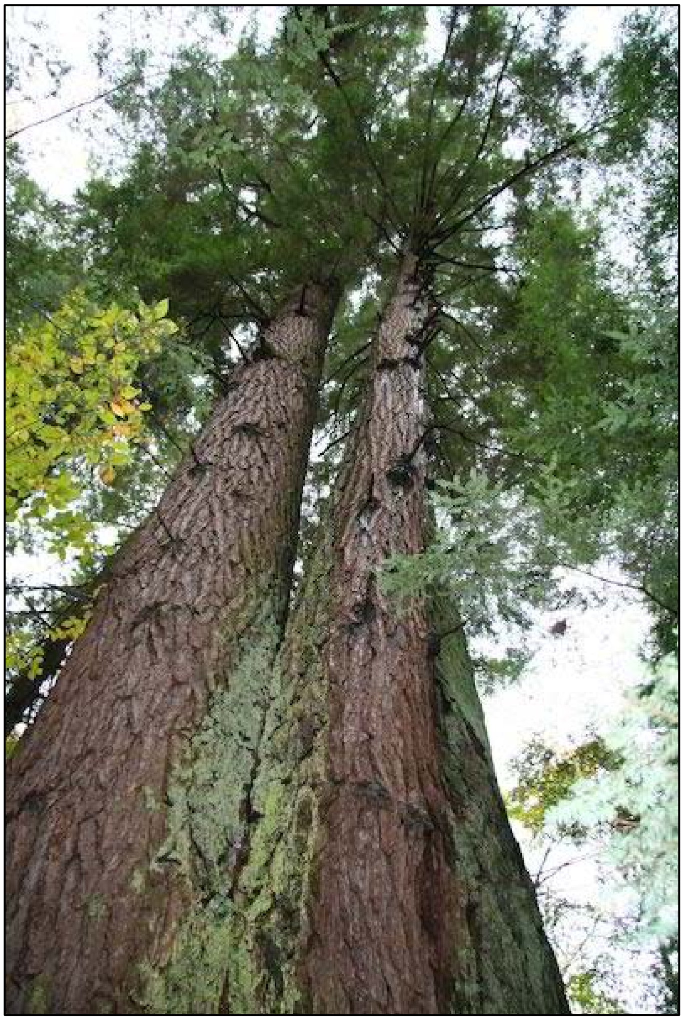
COOK FOREST OLD-GROWTH AREAS

Forest Cathedral Natural Area: Probably Pennsylvania's finest and largest intact old-growth forest, this site is noted for its old-growth white pine and hemlock, and has one of the highest concentrations of tall white pine in the entire eastern United States. Approximately 315 ac in the Forest Cathedral's 448 ac are classified as old-growth, including some areas that have been selectively cut in the past. About 171 ac have remained untouched, with numerous 225 to 450 yr old trees. In 1969, the Secretary of the Interior designated the Forest Cathedral a registered National Natural Landmark.

Swamp Forest Natural Area: This 246 ac tract includes a large forested wetland at the headwaters of Brown's Run, in the northeast section of the park. The entire area is classified as old-growth, with a handsome stand of northern red oak, white oak, red maple, hemlock, black cherry and American beech. Dr. David A. Orwig of Harvard Forest (Harvard University) has dated some white oaks to over 283 yr. He also determined that much of the area has been selectively cut and burned-over possibly two times in the last 200 yr.

Seneca Forest Special Management Area: Old-growth accounts for approximately 305 ac of this 313.5 ac area, of which about 100 ac have never been touched. A beautiful stand of old-growth white pine and hemlock occupies the steep slopes overlooking the Clarion River, which flows through the southern portion of the park. Historically part of the original Forest Cathedral tract, much of the Seneca Forest dates to a forest fire following a severe drought in 1644, as indicated by the ancient pitch pines that started growing after a fire. Unfortunately, in July of 1976, many of these pitch pines were destroyed by a tornado. Other old-growth includes red, chestnut, and white oak along with beech and old-growth white pine and eastern hemlock. Certain areas within this section were selectively cut and burned once in the late 1880s.

Cook Trail Area: Located in the southeast section of the park, between Cemetery and Troutman Run Roads, behind the River Cabins, and near the Cook family cemetery, this stand was selectively cut but is now showing old-growth forest characteristics. The total area is about 200 to 300 ac, of which approximately 150 ac are considered old-growth. Some very fine old-growth eastern hemlocks, ancient red, white, and chestnut oaks, a few tall white pines, beech, and old-growth black gum remain in this area. A one-acre study plot has been fenced to exclude deer in order to determine the effect of deer density on old-growth forest characteristics.



A large double hemlock in Cook Forest State Park. Photo by Randy Brown.

Deer Meadow Trail Area: This very lightly traveled portion of the park is in the Upper Tom's Run Valley, and totals about 200 to 300 ac. Once selectively cut, 150 ac are now showing old-growth characteristics, and contain old-growth eastern hemlock, white oak, and beech.

TALL TREES OF COOK FOREST—A FOREST PROFILE

All tree heights were measured by Dale J. Luthringer, Environmental Education Specialist, Cook Forest State Park, and other members of the Eastern Native Tree Society, using laser-clinometer based techniques. Compilation by Dale J. Luthringer and Colby B. Rucker, corrected to July 2003.

Dale Luthringer standing at the base of the Karl Davies Black Cherry. Photo by Will Blozan.

EDITOR'S NOTE: Don't miss the next Cook Forest Big Tree Extravaganza, slated for April 21, 2007!

Table 1. Species, height, circumference at breast height (CBH), and location of the tallest known individuals at Cook Forest State Park, Pennsylvania, as of July 2003.

Species	Height (ft)	CBH (ft)	Location	Observer(s) (date)
			UPLAND DOMINANTS—UPPER SLOPE	
Eastern white pine	180.9 [a]	11.1	"Longfellow Pine," Longfellow Trail, Forest Cathedral Natural Area, Clarion County	Blozan & Busch (4/20/02)
Eastern hemlock	143.9	11.8	Seneca Trail, Seneca Forest Special Management Area, Clarion County	Luthringer (3/3/03)
Black cherry	137.0 [e]	8.1	Off west side of Ridge Trail, Seneca Forest Special Management Area, Clarion County	Blozan (4/20/02)
Red maple	126.0 [e]	9.0	Near Joyce Kilmer Trail and Indian Springs, Forest Cathedral Natural Area, Clarion County	Luthringer (3/18/02)
Cucumbertree	122.9 [t]	7.2	Ridge Trail, Seneca Forest Special Management Area Clarion County	Luthringer (10/01)
Sugar maple	111.9 [e]	4.3	Breezemont Drive, Clarion County	Luthringer (2/12/02)
Yellow birch	92.2 [e]	7.6	West side Forest Road, opposite Shelter #1, Seneca Forest Special Management Area, Clarion County	Luthringer (10/01)
			UPLAND DOMINANTS—MID-SLOPE	
White oak	124.8 [k]	10.6	Near Indian Springs, Forest Cathedral Natural Area, east of Route 36, Clarion County	Luthringer (2/20/03)
American beech	124.3 [e]	6.4	Ridge Trail, Seneca Forest Special Management Area, Clarion County	Blozan (4/20/02)
Northern red oak	122.9 [e]	9.5	Hemlock Trail side of ridge off Ridge Trail, Seneca Forest Special Management Area, Clarion County	Leverett and Diggins (4/20/02)
Chestnut oak	111.1 [e]	5.4	River Cabins Flats (second bench), upstream from River Cabins area, Forest County.	Luthringer (12/18/02)
Black oak	104.5 [k]	5.9	Headwaters of Little Heffern Run, Upper Tom's Valley, Clarion County	Luthringer (2/18/02)
Blackgum	104.3 [e]	5.8	Seneca Forest Special Management Area, Clarion County	Luthringer (10/29/02)
			UPLAND DOMINANTS—LOWER SLOPE	
Tuliptree	136.6 [e]	8.2	River Cabins Flats (first bench), upstream of River Cabins area, Forest County	Luthringer (11/8/02)
White ash	128.3 [e]	7.6	River Cabins Flats (first bench), upstream of River Cabins area, Forest County	Luthringer (11/8/02)
Black birch	107.8 [e]	5.4	River Cabins Flats, upstream from River Cabins area, Forest County	Luthringer (11/8/02)
American basswood	110.2	10.0 [d]	South bank of Clarion River, Jefferson County	Luthringer (6/23/03)
Bitternut hickory	106.2 [e]	4.3	River Cabins Flats, upstream from River Cabins area, Forest County	Luthringer (12/9/02)
Black walnut	84.2 [e]	6.5	River Cabins area, Forest County	Luthringer (10/1/02)
Shagbark hickory	83.9 [e]	3.8	River Road, near canoe launch, Forest County	Luthringer (10/1/02)
			UPLAND/RIPARIAN INTERFACE	
American sycamore	105.9 [t]	20.6	South side of Clarion River across from River Cabins (double tree), Jefferson County	Luthringer (11/21/00)
Black locust	104.6 [e]	6.3	River Cabins area, Forest County	Luthringer (10/1/02)
Slippery elm	78.5 [e]	4.0	Clarion River, Forest County	Luthringer (10/1/02)
			XERIC EXPOSURE	
Pitch pine	81.9 [e]	4.2	Fire Tower, Clarion County	Luthringer (12/18/02)
Red pine	42.1 [e]	1.8	Fire Tower, Clarion County	Luthringer (12/18/02)

Table continued on the next page.

Table 1 (cont.). Species, height, circumference at breast height (CBH), and location of the tallest known individuals at Cook Forest State Park, Pennsylvania, as of July 2003.

Species	Height (ft)	CBH (ft)	Location	Observer(s) (date)
			UNDERSTORY OR ARBORESCENT SPECIALISTS	
Witch hazel	37.8	0.8	1976 tornado opening, Seneca Forest Special Management Area, Clarion County	Cohen & Luthringer (7/9/03)
Great rhododendron	20.0[e]	0.9	Fire Tower, Clarion County	Luthringer (12/18/02)
Mountain maple	19.3[e]	1.1	Tom's Run Trail, Forest County	Luthringer (12/18/02)
Mountain laurel	14.6[e]	0.4	Fire Tower, Clarion County	Luthringer (12/18/02)

[a] laser/clinometer (sine top + pole) measurement
[b] Impulse laser measurement
[d] tentative measurement
[e] laser/clinometer (sine top + sine bottom) measurement
[k] 5.0 ft + near-vertical laser measurement
[t] laser/clinometer (sine top + tangent bottom) measurement

Large quantities of dead wood can be found scattered in parts of the Cook Forest. Photo by Dale Luthringer.

SOME SHORTLEAF "YELLOW" PINE TIMBER OF THE LOUISIANA LUMBER COMPANY

Don C. Bragg

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P.O. Box 3516 UAM, Monticello, AR 71656

This stand of timber was found near Clarks, Louisiana on the property of the Louisiana Lumber Company. The image was taken from the January 5, 1907, issue of the trade journal *American Lumberman*, which is a renowned source of historical photographs of big trees, impressive stands of timber, and the loggers and mills that processed them into boards and other products. In particular, this image was taken from an advertisement of the Louisiana Lumber Company, which was touting its "wares" in the form of timber yet to be cut. Very few stands of virgin shortleaf pine can be found in any part of the South nowadays, especially those as open and dominated by large trees as the one shown in this picture.

An impressive example of the shortleaf pine timber of the Louisiana Lumber Company from an original 1907* American Lumberman *advertisement.

GIANT HOLLOW TUPELO GUM FROM THE WHITE RIVER NATIONAL WILDLIFE REFUGE

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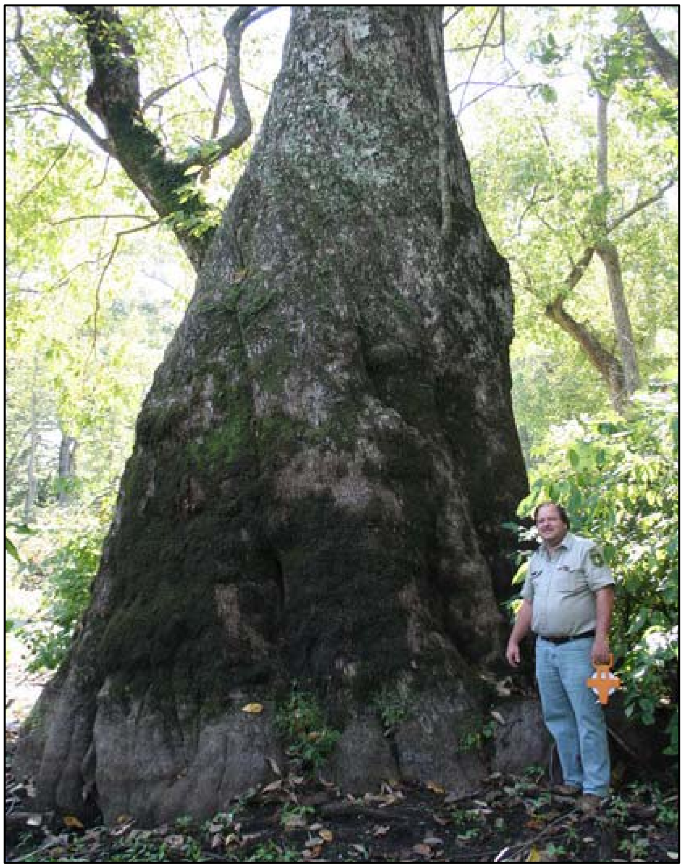


The massive tupelo gum (*Nyssa aquatica*) shown in the picture above was recently "discovered" on the White River National Wildlife Refuge in eastern Arkansas. "Discovered" is in quotes because the tree had been known for years, but until water levels dropped from extended drought, it was inaccessible (the base of the bole of the tree is free of moss because in typical years, it would have been submerged).

This tupelo gum measured out at an impressive 33.1 ft in circumference at 4.5 ft above the ground. This tree topped out at 77.2 ft tall, with a mere 37.4 ft crown spread. Though not nearly as impressive as it would have been had it not lost its top, this tree came close to becoming the national champion. Another giant tupelo nearby was measured earlier in the summer by Dr. Tom Diggins of Youngstown State University at a little more than 30 ft in circumference. Neither of these trees were particularly tall, due to a history of lost crowns following severe disturbances (probably wind events many decades ago). Remarkably, an even bigger tupelo gum was recently discovered not too many miles from these, and will almost certainly be the next national champion.

Besides its girth, what made this tree impressive is the large cavity that occupies most of the volume of the swollen base. People familiar with the species know that tupelo gums almost always have large, swollen bases (similar to the baldcypresses (*Taxodium distichum*) that they usually share swamps with). Many of the oldest of these are hollow, decayed over the centuries of their growth. Few, however, are large enough to camp in, as this specimen is!

The decay column extends up the bole to the point in the crown where the top has broken off, making this tupelo gum completely hollow.

Given the loss of the bulk of its wood, it is impossible to determine the age of this individual. Specimens of this size dating over 500 yrs have been found in the general area, so it is likely this tupelo is comparable.

All pictures by Don C. Bragg.

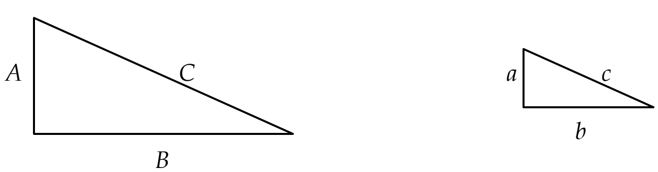
SIMILAR TRIANGLES: THE SIREN SONG OF A POTENTIAL TOOL

Robert T. Leverett

Founder, Eastern Native Tree Society

The geometrical concept of similar triangles provides a powerful tool for tree measurers. However, as with the percent slope method, it is often misapplied to tree height. But used correctly, the method gives us one more tool to work with. Let's look at the concept of similar triangles.

Similar triangles are triangles that have the same overall shape. One is just a blown-up or reduced version of another. Because similar triangles have the same shape, corresponding angles of similar triangles are equal and corresponding sides are proportional in length. It is the condition of proportionality of side length that allows us to compute tree height. But how does the process work?



Assume we have two triangles that are similar. Triangle *ABC* is the larger and *abc* the smaller where the lengths of the sides are designated by *A*, *B*, and *C* for the larger and *a*, *b*, and *c* for the smaller. The condition of proportionality leads to the following relationships:

$$A/B = a/b$$
$$A/C = a/c$$
$$B/C = b/c$$

These are all algebraic expressions and can be manipulated to get equivalent forms such as $B/A = b/a$, $B/b = A/a$, and $b/B = a/A$, etc. Now suppose that we form a big triangle *ABC* such that *A* is the tree's height and *B* is the baseline from the measurer to the trunk. Now, if we can form a smaller similar triangle *abc* where we can measure sides *a, b*, and *c*, we can measure the baseline (*B*) to the tree and can compute the tree's height by using the $A/B = a/b$ proportionality relationship. Algebraically rearranging, we get $A = B(a/b)$. This last formula is what often accompanies diagrams showing how to measure tree height using similar triangles. If side *A* is vertical and the two triangles are truly similar, then the process works. However, what happens when side *A* is not vertical (the line from the crown-point to the base is not vertical)? Then the process does not work and that will be the case when the crown-point is not directly over the base of the tree. Sound familiar?

Similar triangles can also be used very productively for determining crown-point offset. However, that determination requires a multi-step process that will be explained with diagrams at the April ENTS event at Cook Forest State Park (in Pennsylvania). In fact, all the material in these e-mails will be brought together in what I hope will be our first crack in producing an ENTS "Guide to Dendromorphometry."

As an aside, "dendromorphometry" was a term created by Gary Beluzo, partly in jest and partly in seriousness to describe the energy with we Ents expend pursuing our passion. Gary, is of course, a first class dendromorphometrist. Gary once made up certificates for John Knuerr and myself. However, the idea of formalizing dendromorphometry as an official ENTS discipline has merit.

ENTS could issue certificates to bona-fide dendromorphometrists—both in fun and in all seriousness.

INSTRUCTIONS FOR CONTRIBUTORS

SCOPE OF MATERIAL
The *Bulletin of the Eastern Native Tree Society* accepts solicited and unsolicited submissions of many different types, from quasi-technical field reports to poetry, from peer-reviewed scientific papers to digital photographs of trees and forests. This diverse set of offerings also necessitates that (1) contributors specifically identify what type of submission they are providing; (2) all submissions should follow the standards and guidelines for publication in the *Bulletin*; and (3) the submission must be new and original material or be accompanied by all appropriate permissions by the copyright holder. All authors also agree to bear the responsibility of securing any required permissions, and further certify that they have not engaged in any type of plagiarism or illegal activity regarding the material they are submitting.

SUBMITTING A MANUSCRIPT
As indicated earlier, manuscripts must either be new and original works, or be accompanied by specific written permission of the copyright holder. This includes any figures, tables, text, photographs, or other materials included within a given manuscript, even if most of the material is new and original.

Send all materials and related correspondence to:

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Monticello, AR 71656

Depending on the nature of the submission, the material may be delegated to an associate editor for further consideration. The Editor-in-Chief reserves the right to accept or reject any material, regardless of the reason. Submission of material is no guarantee of publication.

All submissions must be made to the Editor-in-Chief in digital format. Manuscripts should be written in Word (*.doc), WordPerfect (*.wpd), rich-text format (*.rtf), or ASCII (*.txt) format.

Images can be submitted in any common format like *.jpg, *.bmp, *.tif, *.gif, or *.eps, but not PowerPoint (*.ppt). Images must be of sufficient resolution to be clear and not pixilated if somewhat reduced or enlarged. Make sure pictures are at least 300 dots per inch (dpi) resolution. Pictures can be color, grayscale, or black and white. Photographs or original line drawings must be accompanied by a credit line, and if copyrighted, must also be accompanied by a letter with express written permission to use the image. Likewise, graphs or tables duplicated from published materials must also have expressly written copyright holder permission.

PAPER CONTRIBUTIONS (ALL TYPES)
All manuscripts must follow editorial conventions and styling when submitted. Given that the *Bulletin* is edited, assembled, and distributed by volunteers, the less work needed to get the final product delivered, the better the outcome. Therefore, papers egregiously differing from these formats may be returned for modification before they will be considered for publication.

Title Page
Each manuscript needs a separate title page with the title, author name(s), author affiliation(s), and corresponding author's postal address and e-mail address. Towards the bottom of the page, please include the type of submission (using the categories listed in the table of contents) and the date (including year).

Body of Manuscript
Use papers previously published in the *Bulletin of the Eastern Native Tree Society* as a guide to style formatting. The body of the manuscript will be on a new page. Do not use headers or footers for anything but the page number. Do not hyphenate text or use a multi-column format (this will be done in the final printing). Avoid using footnotes or endnotes in the text, and do not use text boxes. Rather, insert text-box material as a table.

All manuscript submissions should be double-spaced, left-justified, with one-inch margins, and with page and line numbers turned on. Page numbers should be centered on the bottom of each new page, and line numbers should be found in the left margin.

Paragraph Styles. Do not indent new paragraphs. Rather, insert a blank line and start the new paragraph. For feature articles (including peer-reviewed science papers), a brief abstract (100 to 200 words long) must be included at the top of the page. Section headings and subheadings can be used in any type of written submission, and do not have to follow any particular format, so long as they are relatively concise. The following example shows the standard design:

FIRST ORDER HEADING
Second Order Heading
Third Order Heading. The next sentence begins here, and any other levels should be folded into this format.

Science papers are an exception to this format, and must include sections entitled "Introduction," "Methods and Materials," "Results and Discussion," "Conclusions," "Literature Cited," and appendices (if needed) labeled alphabetically. See the ENTS website for a sample layout of a science paper.

Trip reports, descriptions of special big trees or forests, poetry, musings, or other non-technical materials can follow less rigid styling, but will be made by the production editor (if and when accepted for publication) to conform to conventions.

Table and figure formats. Tables can be difficult to insert into journals, so use either the table feature in your word processor, or use tab settings to align columns, but DO NOT use spaces. Each column should have a clear heading, and provide adequate spacing to clearly display information. Do not use extensive formatting within tables, as they will be modified to meet *Bulletin* standards and styles. All tables, figures, and appendices must be referenced in the text.

Numerical and measurement conventions. You can use either English (e.g., inches, feet, yards, acres, pounds) or metric units (e.g., centimeters, meters, kilometers, hectares, kilograms), so long as they are consistently applied throughout the paper. Dates should be provided in month day, year format (June 1, 2006). Abbreviations for units can and should be used under most circumstances.

For any report on sites, heights must be measured using the methodology developed by ENTS (typically the sine method). Tangent heights can be referenced, especially in terms of historical reports of big trees, but these cannot represent new information. Diameters or circumference should be measured at breast height (4.5 ft above the ground), unless some bole distortion (e.g., a burl, branch, fork, or buttress) interferes with measurement. If this is the case, conventional approaches should be used to ensure diameter is measured at a representative location.

Taxonomic conventions. Since common names are not necessarily universal, the use of scientific names is strongly encouraged, and may be required by the editor in some circumstances. For species with multiple common names, use the most specific and conventional reference. For instance, call *Acer saccharum* "sugar maple," not "hard maple" or "rock maple," unless a specific reason can be given (e.g., its use in historical context).

For science papers, scientific names MUST be provided at the first text reference, or a list of scientific names corresponding to the common names consistently used in the text can be provided in a table or appendix. For example, red pine (*Pinus resinosa*) is also known as Norway pine. Naming authorities can also be included, but are not required. Be consistent!

Abbreviations. Use standard abbreviations (with no periods) for units of measure throughout the manuscript. If there are questions about which abbreviation is most appropriate, the editor will determine the best one to use. Here are examples of standardized abbreviations:

inch = in	feet = ft
yard = yd	acre = ac
pound = lb	percent = %
centimeter = cm	meter = m
kilometer = km	hectare = ha
kilogram = kg	day = d

Commonly recognized federal agencies like the USDA (United States Department of Agriculture) can be abbreviated without definition, but spell out state names unless used in mailing address form. Otherwise, spell out the noun first, then provide an abbreviation in parentheses. For example: The Levi Wilcoxon Demonstration Forest (LWDF) is an old-growth remnant in Ashley County, Arkansas.

Citation formats. Literature cited in the text must meet the following conventions: do not use footnotes or endnotes. When paraphrasing or referencing other works, use the standard name date protocol in parentheses. For example, if you cite this issue's Founder's Corner, it would be: "…and the ENTS founder welcomed new members (Leverett 2006)." If used specifically in a sentence, the style would be: "Leverett (2006) welcomed new members…" Finally, if there is a direct quotation, insert the page number into the citation: (Leverett 2006, p. 15) or Leverett (2006, p. 16-17). Longer quotations (those more than three lines long) should be set aside as a separate, double-indented paragraph. Papers by unknown authors should be cited as Anonymous (1950), unless attributable to a group (e.g., ENTS (2006)).

For citations with multiple authors, give both authors' names for two-author citations, and for citations with more than two, use "et al." after the first author's name. An example of a two-author citation would be "Kershner and Leverett (2004)," and an example of a three- (or more) author citation would be "Bragg et al. (2004)." Multiple citations of the same author and year should use letters to distinguish the exact citation: Leverett 2005a, Leverett 2005b, Leverett 2005c, Bragg et al. 2004a, Bragg et al. 2004b, etc.

Personal communication should be identified in the text, and dated as specifically as possible (not in the Literature Cited section). For example, "…the Great Smoky Mountains contain most of the tallest hardwoods in the United States (W. Blozan, personal communication, March 24, 2006)." Examples of personal communications can include statements directly quoted or paraphrased, e-mail content, or unpublished writings not generally available. Personal communications are not included in the Literature Cited section, but websites and unpublished but accessible manuscripts can be.

Literature Cited. The references used in your work must be included in a section titled "Literature Cited." All citations should be alphabetically organized by author and then sorted by date. The following examples illustrate the most common forms of citation expected in the *Bulletin*:

Journal:

Anonymous. 1950. Crossett names giant pine to honor L.L. Morris. Forest Echoes 10(5):2-5.

Bragg, D.C., M.G. Shelton, and B. Zeide. 2003. Impacts and management implications of ice storms on forests in the southern United States. Forest Ecology and Management 186:99-123.

Bragg, D.C. 2004a. Composition, structure, and dynamics of a pine-hardwood old-growth remnant in southern Arkansas. Journal of the Torrey Botanical Society 131:320-336.

Proceedings:

Leverett, R. 1996. Definitions and history. Pages 3-17 *in* Eastern old-growth forests: prospects for rediscovery and recovery, M.B. Davis, editor. Island Press, Washington, DC.

Book:

Kershner, B. and R.T. Leverett. 2004. The Sierra Club guide to the ancient forests of the Northeast. University of California Press, Berkeley, CA. 276 p.

Website:

Blozan, W. 2002. Clingman's Dome, May 14, 2002. ENTS website http://www.uark.edu/misc/ents/fieldtrips/gsmnp/clingmans_dome.htm. Accessed June 13, 2006.

Use the hanging indent feature of your word processor (with a 0.5-in indent). Do not abbreviate any journal titles, book names, or publishers. Use standard abbreviations for states, countries, or federal agencies (e.g., USDA, USDI).

ACCEPTED SUBMISSIONS

Those who have had their submission accepted for publication with the *Bulletin of the Eastern Native Tree Society* will be mailed separate instructions to finalize the publication of their work. For those that have submitted papers, revisions must be addressed to the satisfaction of the editor. The editor reserves the right to accept or reject any paper for any reason deemed appropriate.

Accepted materials will also need to be accompanied by an author contract granting first serial publication rights to the *Bulletin of the Eastern Native Tree Society* and the Eastern Native Tree Society. In addition, if the submission contains copyrighted material, express written permission from the copyright holder must be provided to the editor before publication can proceed. Any delays in receiving these materials (especially the author contract) will delay publication. Failure to resubmit accepted materials with any and all appropriate accompanying permissions and/or forms in a timely fashion may result in the submission being rejected.

The murky waters of a springtime flood along the Ouachita River in southern Arkansas reflects a stand of overcup oak and tupelo gum. Photo by Don C. Bragg.