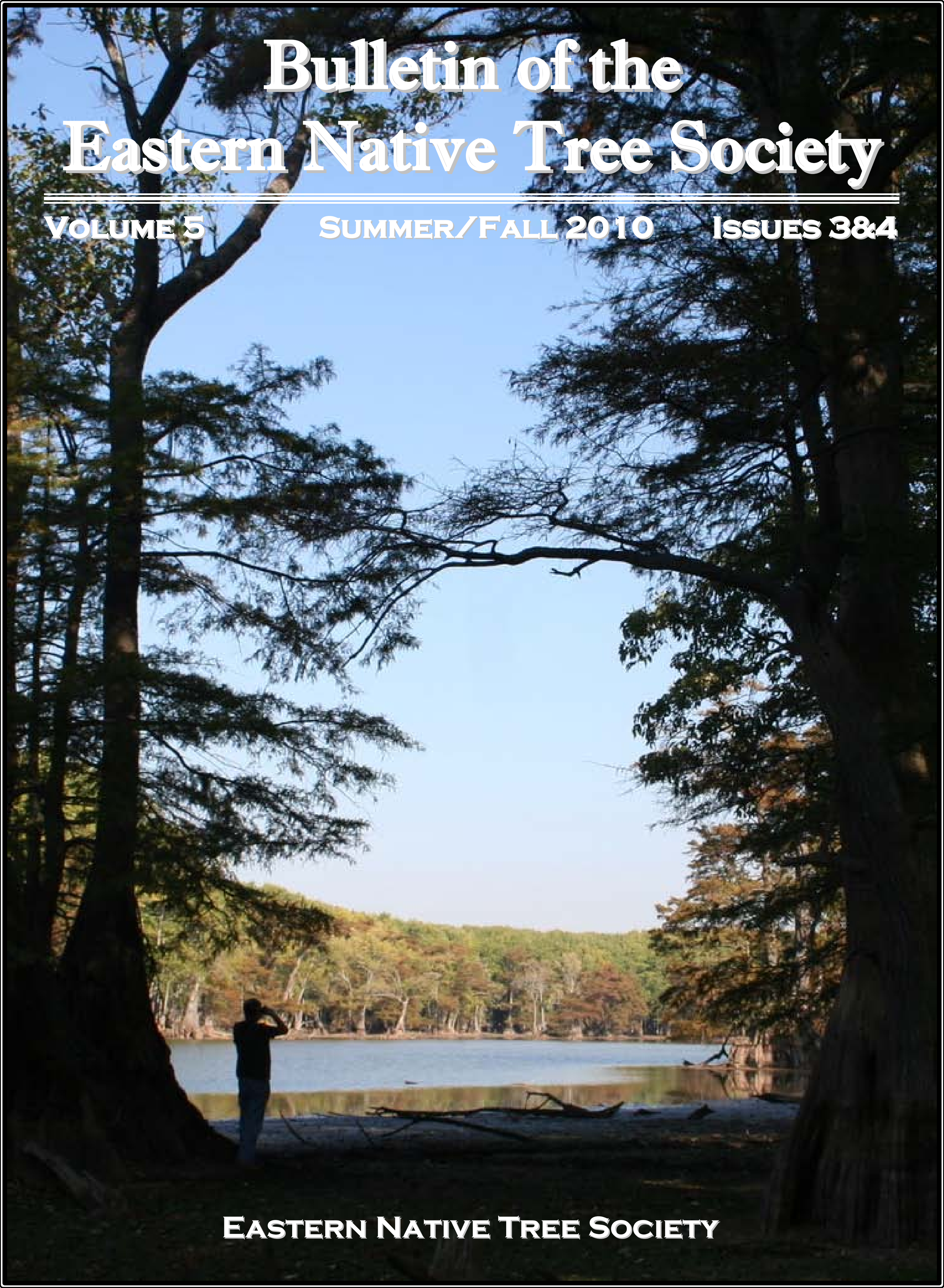
Bulletin of the Eastern Native Tree Society

Volume 5 Summer/Fall 2010 Issues 3&4



Eastern Native Tree Society

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.

ENTS Officers:

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Membership and Website Submissions:

Membership is free when you sign up for our discussion group, ENTSTrees, at: http://groups.google.com/group/entstrees?hl=en. 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: After another dry summer, fall colors begin along the shores of Ole Lake near Belzoni, Mississippi. Photo by Don C. Bragg.

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A DESPERATE PLEA FOR MORE SUBMISSIONS

Summer has come and gone, and now even fall is starting to feel like a distant memory. Actually, it is more like a reminder to me that another *Bulletin of the Eastern Native Tree Society* should be produced. Unfortunately, it is getting harder and harder to produce these issues. Part of this is strictly my fault—an abundance of work- and family-related activities keep me from digging into the new issue. Part of the problem is a lack of submissions of outside materials. Bob Leverett keeps soldiering on, producing interesting new material on a regular basis.

But we need new blood to keep this journal alive. Bob can only generate so many articles, and I can only write so many field trip pieces on Lake States pine forests or southern cypress swamps. We need original new submissions from the multitudes of active ENTS tree measurers and other adventurers. Whether it's a trip to a local favorite big tree spot, or a major park, or even an international destination, we have room for the submission. Fancy yourself a poet? Send us your nature-related poetry! Have a good eye for photography? We love to include images of the natural sort! Have a significant tree- or measurement-related scientific contribution? We're interested! A comedic touch? Try us! We are even interested in any meetings or other events that are of utility to the membership.

In short, we need YOU!

Don C. Bragg
Editor-in-Chief

A strong July wind blows the pines and birches lining the southern shore of Lake Superior near the tip of Michigan's Keweenaw Peninsula. Photo by Don C. Bragg.

ANNOUNCEMENTS AND SOCIETY ACTIONS

A Significant New Publication of Interest to Ents

Dr. Neil Pederson, currently of the Lamont-Doherty Earth Observatory of Columbia University, recently published a paper in the entitled "External Characteristics of Old Trees in the Eastern Deciduous Forest" (*Natural Areas Journal*, 2010, Volume 30, Issue 4, pages 396-407). Dr. Pederson, a renowned dendrochronologist and long-time member of the Eastern Native Tree Society, developed this guide to help resource managers and other interested parties identify individual trees in eastern landscapes that have the potential to be particularly old.

Dr. Pederson describes the utility of six different external characteristics (smooth bark, low stem taper, high stem sinuosity, sparse crowns with thick limbs, low crown volume, and low leaf area to trunk volume ratio) to suggest specimens that may prove to be older than their size otherwise indicates. Recognizing that none of these characteristics is a guarantee of agedness, this paper blends his years of very detailed cross-dating of thousands of trees across eastern North America with his experiences in searching stands for candidate trees.

This paper is abundantly populated with photographic examples and has been written in a fashion that even a fairly casual reader can appreciate the utility of this approach. Much of what is presented here can translate to other ecosystems in other parts of the world, and represents a significant advance in the study of our highly disturbed eastern deciduous forests.

The article is not available online without a subscription to the *Natural Areas Journal*, but you can likely receive a copy by sending a request directly to Dr. Pederson at adk@ldeo.columbia.edu.

An old-growth mixed conifer stand in central Sweden. The largest trees are Scots pine* (Pinus sylvestris)*, with Norway spruce* (Picea abies) *and aspen* (Populus tremula) *co-dominating the overstory. Photo by Don C. Bragg.

MEASURING TREE HEIGHT BY TAPE AND CLINOMETER SCENARIOS

Robert T. Leverett

Founder and Executive Director, Eastern Native Tree Society

INTRODUCTION

Measuring the dimensions of trees has long been the work of mensurationists, foresters, lumbermen, forest ecologists, arborists, and big tree hunters. More recently, climate scientists have joined the group as the role of trees in carbon sequestration is being studied with greater urgency. Despite the irregular forms of trees and the many dimensions that could be of interest, trunk diameter, tree height, and log volume are the dimensions of greatest interest to forestry professionals. For trees that are cut and end up as logs in mills, high tech solutions involving lasers increase the accuracy for the simple dimensions such as log length and thickness and more complicated dimensions such as log volume with and without the bark. Circumference, height, and crown spread are the dimensions of primary interest to big tree hunters. Field foresters routinely measure diameter and height. Tree diameters are measured with D-tapes, regular tapes, calipers, and Biltmore Sticks, and can be done by anyone with minimal training. By contrast, height has traditionally presented special measuring challenges, and consequently, has been the greatest single measuring focus of the Eastern Native Tree Society (ENTS).

Today, tree height can be measured utilizing some combination of hypsometers, laser rangefinders, clinometers, and tape measures. It can be argued from a historical perspective that with the introduction of the clinometer, the tree height measurement methodology in the field suddenly became straightforward and simple—at least judging by the diagrams and instructions accompanying most popular brands of clinometers. From the measuring diagrams, it appears all that is needed is a tape measure and a clinometer. Typically, there are no warnings or cautions accompanying the diagrams. But progress toward attaining acceptable accuracy in measuring tree height with these two implements has been highly deceptive.

For those of us in ENTS striving to achieve greater accuracy in measuring tree height, we have turned to the combination of the laser rangefinder and the clinometer or that combination as implemented in several brands of hypsometers. We use these instruments in combination of what we call sine-based trigonometry. Employing the laser rangefinder to measure distances directly from the eye to the target and the clinometer to measure angles has improved accuracy and allowed experienced members to routinely obtain height measurements accurate to under a foot, sometimes within one- or two-tenths of a foot. But whether we like it or not, the simple clinometer and tape combination will continue to be used by timber professionals and big tree hunters to measure tree height. Far more tree measurers will use the tape and clinometer than the ENTS preferred laser rangefinder and clinometer combination for several years to come. The biggest reason is equipment cost. The second reason is the ostensible avoidance of calculations involving trigonometric functions.

The slow progress in moving toward better equipment and methods for measuring tree height has been a source of concern to ENTS since the mid-1990s. The tape and clinometer method has been associated with many mismeasured trees by professionals and amateurs alike. These height errors have greatly reduced the value of the champion tree lists as potential sources of research information and in some cases have led to greatly skewed perceptions about where trees reach their greatest heights and what those heights are, species by species. This situation has prevented truly exceptional specimens from being recognized as such due to the existence of mismeasured trees in champion tree lists. The primary problem rests not so much in the tape and clinometer as valid instruments, but the careless employment of those instruments either through ignorance or expediency. This is a critical point to understand.

Tape and clinometer users routinely make simplifying assumptions about tree form and proceed without testing their assumptions. Although our eyes behold a bewildering variety of shapes, when it comes to measuring height, measurers reduce the model to one equivalent to measuring a vertical telephone pole. The result is trees that may be mismeasured by tens of feet being accepted without the apparent awareness of the measurer or others. This situation may sound inconceivable to timber professionals, who have been measuring tree height for years, but it is, nonetheless, true. ENTS has many examples of trees being mismeasured with tape and clinometer by as much as 50 ft, and in one well-publicized example, 67 ft! Errors in height measurement equivalent to the height of whole trees is no trivial matter.

Can anything be done to improve the situation and move us all forward in the tree-measuring world without abandoning the tape and clinometer combination altogether? The answer is yes. The simplest approach is to do a better job of educating tree measurers on actual tree geometry and how that geometry impacts traditional tree measuring techniques, and in particular, the use of tape and clinometer. As a step in the direction of education, this article will explore the use of tape and clinometer and show how it can be productively employed to avoid the problems of the past, although often at the sacrifice of the simplicity promised in the instructions accompanying clinometers.

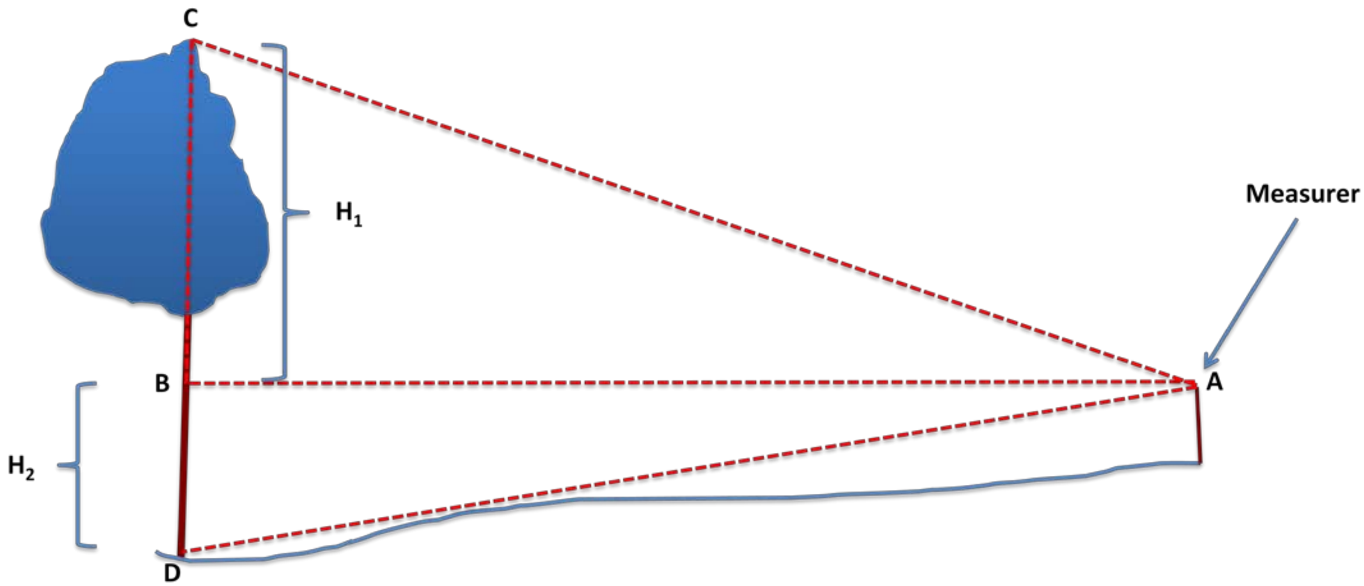


Figure 1. Standard diagram of clinometer-based height measurement.

MEASUREMENT SCENARIOS FOR TAPES AND CLINOMETERS

Method 1

There are a number of measurement scenarios where tape and clinometer can be productively employed. We will explore all of them, but first we will identify the scenario to which the tape and clinometer method is meant to be applied. In the diagram above (Figure 1), a tree is shown on the left and a measurer on the right. The measurer's eye is denoted by *A*. The top of the tree is denoted by *C* and the bottom of the trunk by *D*. The point *B* is on the trunk and level with the measurer's eye. From this configuration, a right triangle can be formed from the measurer's eye at *A* out to the trunk at *B*, straight up to *C* (90 degree angle), and back to the measurer's eye at *A*. *AC* is the hypotenuse of the right triangle thus formed. *AB* is the leg to be measured with tape. Angle *BAC* is measured with the clinometer, and *BC* is the leg to be calculated using the distance and angle. Similarly, triangle *ABD* is a right triangle. In the diagram *H1* is the component of height above eye level and *H2* is the component below. This is the classic diagram supplied with a clinometer for measuring tree height.

Figure 1 shows the top of the tree directly over the base. The lines *CD*, *CB* and *BD* are all vertical. If the assumption that the top is directly over the base is fulfilled and the line *AB* is level, then the triangle *ABC* is by definition a right triangle. A clinometer with an angle scale or a percent slope scale and a tape can be used to measure tree height. There are actually two components, i.e., the part above eye level and the part below. Ideally the baseline, as measured with the tape, is exactly 100 ft in length.

In the classic measuring scenario, the measurer positions themselves at *A* and sights to the top of the tree at *C* with a clinometer having an angle scale or a percent slope scale (or both). The level baseline from eye to trunk is measured with tape. If the clinometer measures angles, the angle to the top is taken from the end of the baseline and then the length of the baseline is multiplied by the tangent of the angle from the eye to the top of the tree. If the clinometer has a percent slope scale and the baseline is exactly 100 ft, then the reading from the percent slope scale of the clinometer to the top of the tree is the height above eye level, i.e., the scale reading is the height above eye level. If the baseline is not exactly 100 ft, then the baseline is multiplied by the scale reading and the result divided by 100. A similar procedure is used for the component of height below eye level and the two components of height are added together to get total tree height. The position where the above and below eye level measurements, i.e., *A* in the diagram, stays fixed. The process just explained implements the definition of tree height as the vertical distance between two horizontal planes, one through the highest tip of the tree and the other through the base. Figure 2 has been simplified to translate this measuring strategy into mathematical equations.

In Figure 2, *D* represents the distance from eye to trunk, i.e., the distance *AB*. If *a* is the angle from *A* to *C*, then by the laws of right triangles:

$$H = D \tan(a) \quad [1]$$

If the right scale of the clinometer is a percent of slope scale, we can define pct(*a*) as the scale reading corresponding to the angle *a*. The following formula holds:

$$\tan(a) = \frac{pct(a)}{100} \quad [2]$$

We can also define *H* according to the equivalent formula:

$$H = D\frac{pct(a)}{100} \quad [3]$$

Using a clinometer with a percent of slope scale avoids having to use trigonometry tables.

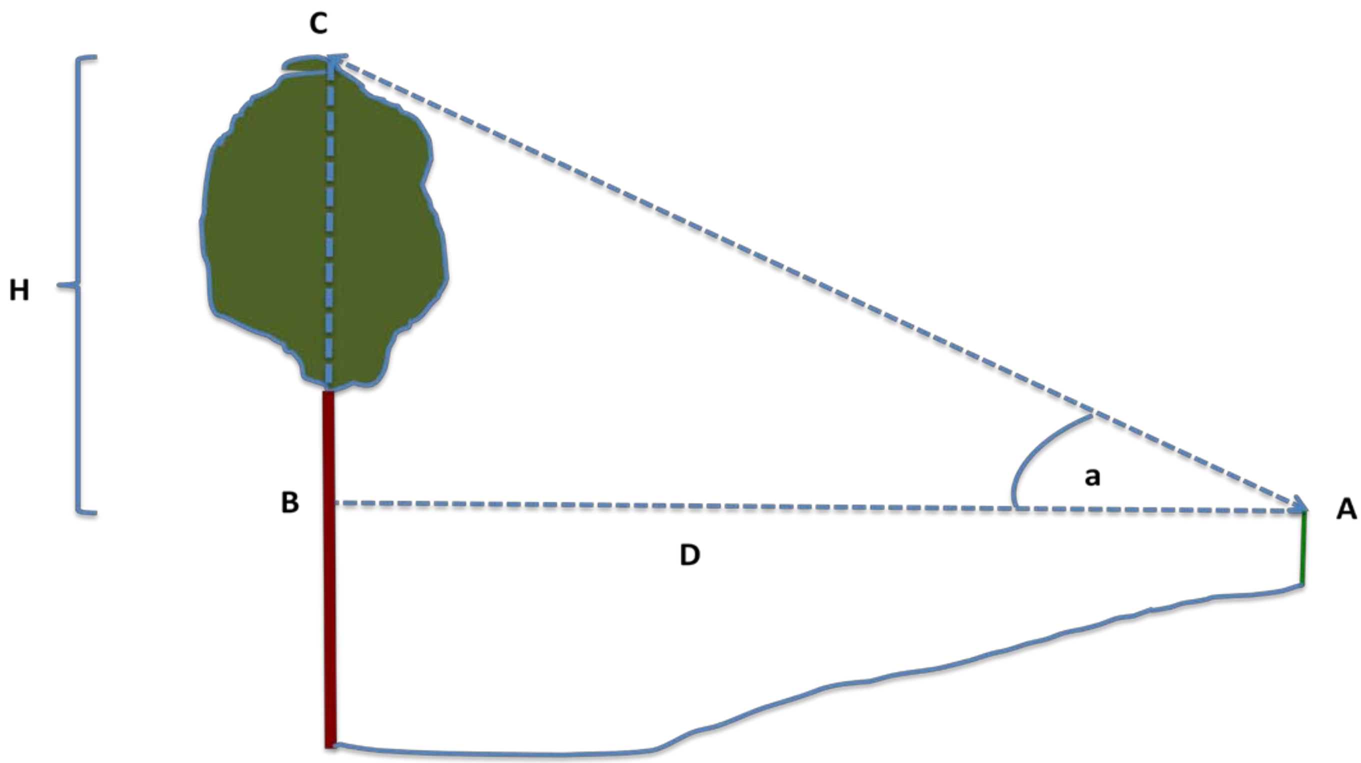


Figure 2. Simplified tree height diagram for the tangent method.

In addition, if D = 100, the we get the very simple formula:

$$H = pct(a) \quad [4]$$

This procedure can be repeated for the component of height below eye level and the height above and height below added together to get the total height.

It is the above method that makes the use of a tape and clinometer so appealing, especially for novices. At a baseline distance of 100 ft, the tree's height above and below eye level can be read directly as readings from the percent slope scale. However, the critical assumption made in using this technique is that the top of the tree is directly over the base. While this assumption is fulfilled, or at least nearly so, for many young, plantation conifers, it is seldom met for older, broad-crowned hardwoods. It is certainly not fulfilled for straight conifers that are leaning. Consequently, tape and clinometer users often make significant tree height measuring errors without even being aware of the assumptions behind the measuring model that must be fulfilled. Others may realize that they have a problem for trees that obviously lean, but the actual architecture of the broad-crowned hardwoods is simply ignored. Still other measurers are aware of the problem and attempt to make adjustments, but with unknown success. If tape and clinometer are to be useful, we must be able to accommodate actual tree architecture.

Let's now look at a more realistic measuring scenario that takes into account tree geometry. There are two complicating factors that the measurer often faces when measuring tree height. The top may not be over the base and/or the measurer may not be able to see the actual top. Figure 3 shows both these conditions. In the diagram, we will deal with only the part of the tree above eye level because the part below presents a much simpler measuring situation.

The true top of the tree is shown at E and the measurer's eye is at A. The point on the trunk at eye level is at B, and D is the point directly below the top of the tree and at eye level. The objective is to measure the distance h. But as the diagram shows, this is not being done. The triangle that needs to be constructed and measured is ADE, but the triangle that is actually being measured is ABC. In this illustration the measurer sights to what he thinks is the tree top, but mistakenly sights a point on an extended limb that is blocking the view of the actual top. The point sighted on the extended limb is at a higher angle (a) than the angle to the actual top of the tree (b) and at a shorter horizontal distance than the base of the tree (B) and under-measures the position directly below the true top of the tree (D) by even more. Using the Method 1 formula, the height of the tree is calculated to be tree height = tan(a) x AB. If the distance AB is 100 ft, the percentage scale can be used then tree height = $pct(a)$.

Using this erroneously high angle and the overly long distance to the base of the tree, the tree's height is calculated to be BC, when it is actually DE. The error between the tree's calculated height and its true height is shown as e. In this case, the measurer comes up with a height that is too great.

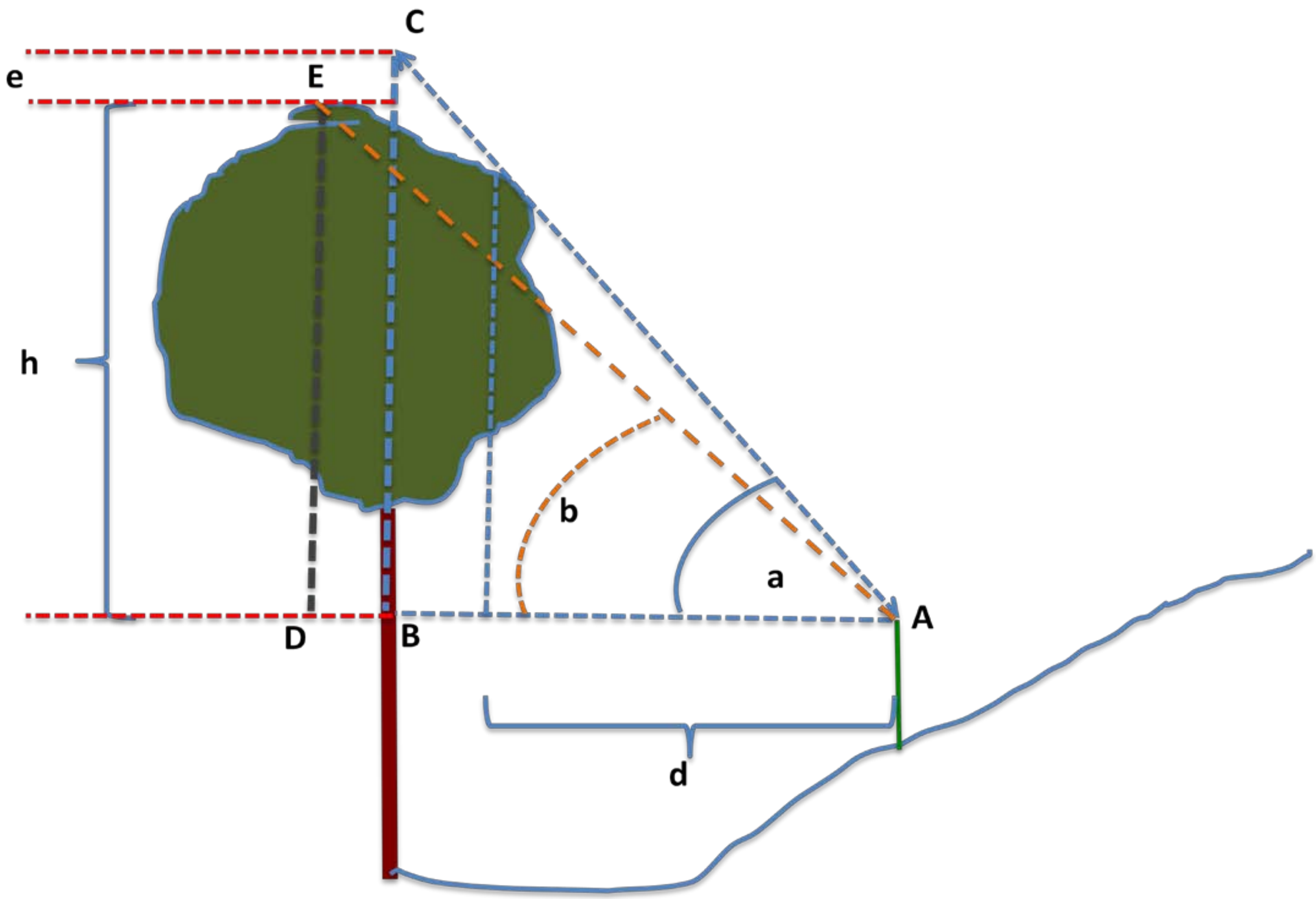


Figure 3. A more complicated arrangement of tree crown and landform.

The baseline, or horizontal distance, to the point directly beneath the point on the extended limb being measured is *d*. If that distance had been used for the height calculation rather than *AD*, the result would have been the correct height of the point on the limb, but not for the true top of the tree. It would have understated the actual true height of the tree. In the diagram, what is actually being calculated is the height of a projected top, not the actual top. In fact, we have three baseline distances: (1) *d* which should be used for the point being measured; (2) *AB*, the one actually used, which produces height to a projected top, and (3) *AD*, the correct baseline. Were *AD* used with angle *a*, the result would be an even greater error. The correct angle for the top is angle *b*, which the measurer has no way of knowing because point *E* is not visible.

The preceding diagram illustrates the challenge of measuring tree height when measuring assumptions aren't fulfilled. If the measurer can't see the top, it can't be measured, regardless of technique used. But whatever is identified as the top and measured should be measured accurately. Is there anything that can be done to measure the height of the top of the tree above eye level, when it is not known, at least initially, if the top is directly over the base? Provided we can see the top, the answer is yes. We will begin with a simple model, and we will call it Method 2.

Method 2

Using Method 2 the height of the tree above a level baseline can be determined by measuring the angle to the top of the tree from two different positions, one farther than the other along the same baseline and horizontal plane, if the distance between these two measuring points is known. This is what I am calling an exterior baseline method.

In Figure 4, the measurer positions himself at location *A* and measures the angle *EAC* to the top of the tree. The angle is designated as *a*. The measurer then moves back to a second location at *B* and measures the angle *ABC*, designated as *b*. The distance from *A* to *B* in the diagram is shown as *D*. Also, *AB* is assumed to be horizontal. The point directly level with the measurer's eye and directly beneath *C* is shown as *E*. In the diagram, it is shown as a point on the trunk. The points *A*, *B*, and *C* all lie in the same vertical plane. However, no assumption is made about where the base of the tree lies relative to *C*. With this model completed, the objective is to measure the height *H*. The following formula will accomplish the task:

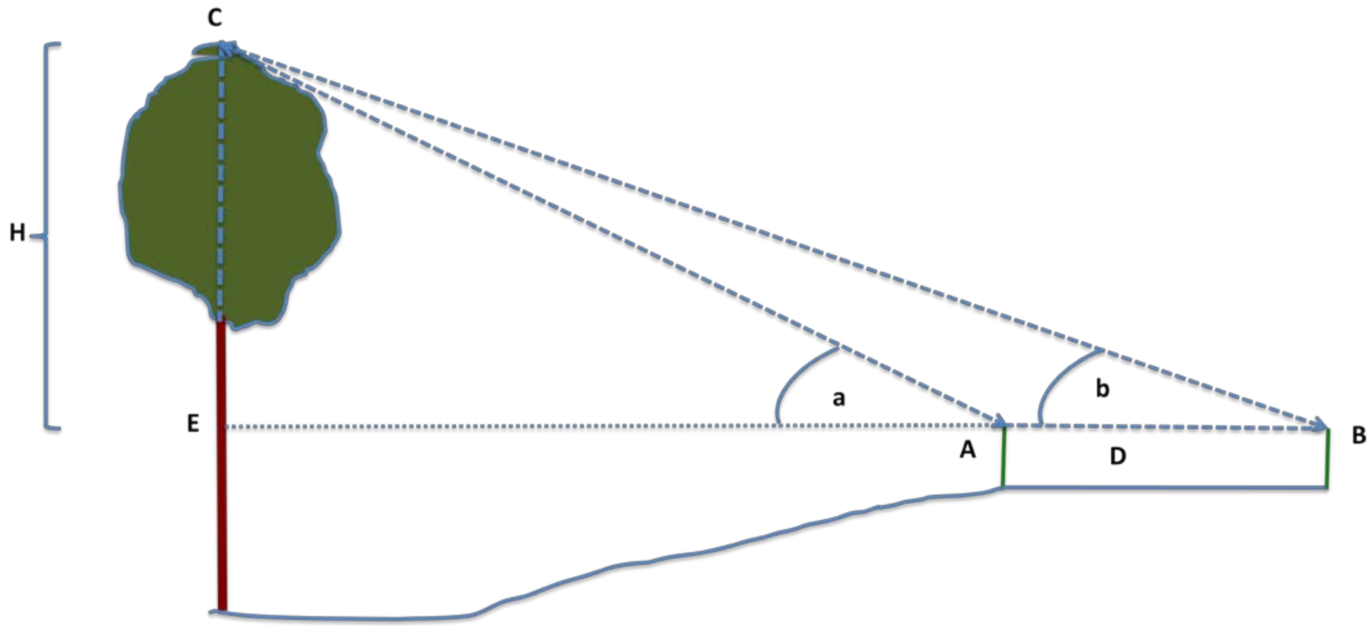


Figure 4. An example of the exterior baseline method.

$$H = \frac{D\tan(a)\tan(b)}{\tan(a)-\tan(b)} \quad [5]$$

If the right scale of the clinometer is percent slope, we can use the formula:

$$\tan(x) = \frac{pct(x)}{100} \quad [6]$$

and substitute for the tangent functions in the first formula to arrive at:

$$H = \frac{D\,pct(a)pct(b)}{pct(a)-pct(b)}\left(\frac{1}{100}\right) \quad [7]$$

I will emphasize that this formula computes the vertical distance that *C* is above *A* or *B*. Although the diagram shows the base of the tree as being directly below the top of the crown, nowhere in the process do we make this assumption. We do assume that the line from *A* to *B* is horizontal, but this formula works regardless of where *C* is in relation to the base of the tree. To also emphasize, an assumption that must be fulfilled is that the same vertical plane contains the points *A*, *B*, *C*, and *E*.

This formula, which utilizes an exterior baseline (baseline does not run all the way to the trunk) represents a significant leap forward in our capacity to use a tape and clinometer to obtain accurate tree height measurements. If the method has a weakness, it is in the assumption that *AB* is level, i.e., the measurer must be on level ground to use the method. However, a lot of trees are on sloping or uneven ground. If this approach is to be of real value, we must accommodate sloping ground. This situation is discussed in the next method and lifts the horizontal restriction on *AB*.

Method 3

Method 3 extends the exterior baseline approach discussed as Method 2, by expanding upon it to accommodate measurements where measurement points *A* and *B* are located on sloping ground. The same vertical plane must contain *A*, *B*, *C*, and *E*, but *AB* need not be horizontal.

In Method 3, the measurer positions himself at position *A* and shoots the angle to the top of the tree at *C* (Figure 5). The measurer moves up hill and shoots *C* again from the position *B*. The distance from *A* to *B* is designated as *D* in the diagram. Remember that positions *A* and *B* represent locations of the measurer's eye. *E* represents the point at eye level with *A* that is directly beneath *C*.

The objective is to calculate *H*. As with Method 2, no assumption is made as to where the base of the tree is relative to the top. The following formulas allow us to calculate *H*:

$$H = \frac{D\tan(b)\tan(c)\sin(a)}{[\tan(a+c)-\tan(b+c)]\cos(a+c)} \quad [8]$$

In this formula, we see terms involving the sine and cosine functions. Trigonometric tables must be available. Ideally the measurer has a calculator with these functions on them or plugs the values into a computer spreadsheet set up to do the calculations. Otherwise, a book with sine and cosine values must be used. The obvious disadvantage of this method is the intimidating looking formula for *H*. However, the tradeoff is accuracy versus simplicity leading to unacceptably large errors. Practice makes the process palatable. The sloping ground scenario is likely to be the most prevalent field situation.

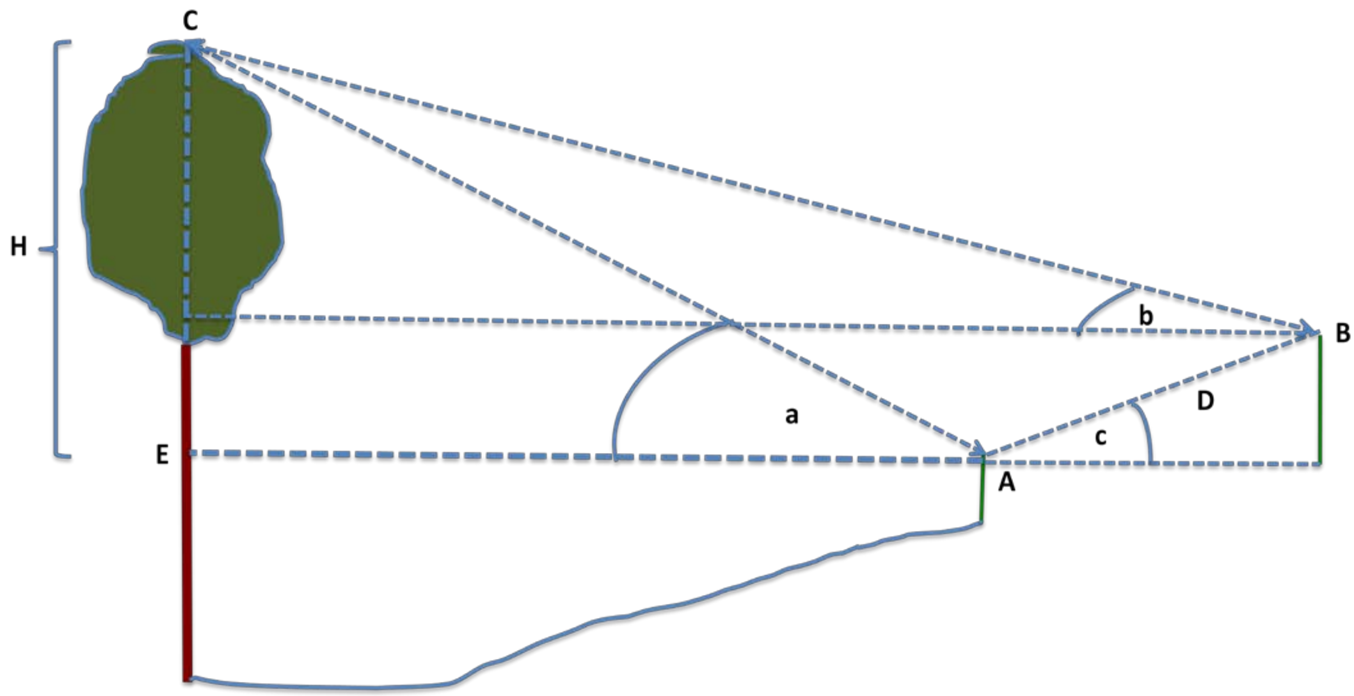


Figure 5. Scenario for Method 3.

Method 4

Method 4 examines how to measure the tree height *H*, from two points in which the exterior baseline is vertical (Figure 6). This somewhat unlikely scenario might occur when taking shots at the crown of a tree from successive stories of a building. Another example would be an arborist climbing a tree. Two successive shots could be taken at a known height interval. The next method illustrates the scenario of the vertical baseline.

In the above diagram, the measurer's eye is at position *A* to measure the angle to the top of the tree at *C*. The measurer moves up vertically to where his eye is at *B* where the angle to *C* is measured. The distance between *A* and *B* is measured. *B* is vertically above *A*. No assumption is made about where the base of the tree is relative to the top. The following formula can be applied to compute *H*:

$$H = \frac{D\tan(a)}{\tan(a) - \tan(b)} \quad [9]$$

If the clinometer has a percent slope scale, $pct(x)$ is defined as follows:

$$\tan(x) = \frac{pct(x)}{100} \quad [10]$$

The formula below can be applied using $pct(x)$:

$$H = \frac{D\,pct(a)}{pct(a) - pct(b)} \quad [11]$$

Remember that $pct(x)$ is the reading from the clinometer's percent slope scale, assuming there is one. If x is the angle to the target, then $pct(x)$ is the clinometer reading, which is just the tangent of the angle times 100. This method has a surprisingly simple calculation, but the opportunities for its use are likely to be limited. If a clinometer is used with other scales such as scales dependent on the chain, as a unit of horizontal measurement, the measurer's flexibility is greatly reduced. The measurer must be positioned at multiples of 66 ft from the tree's trunk—an awkward scenario.

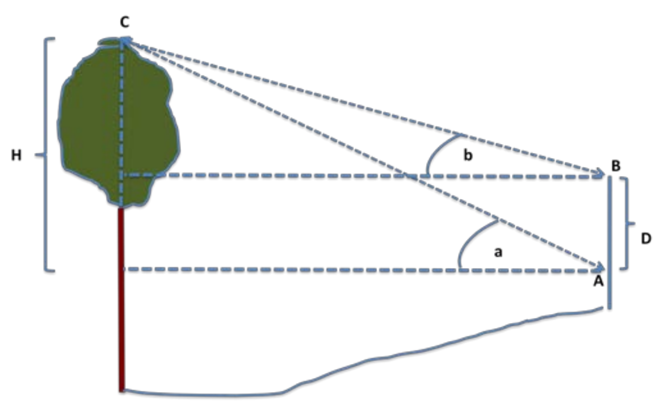


Figure 6. Scenario for Method 4.

Method 5

Method 5 is one that has been used by mensurationists to get around the problem of the top of the tree not being over the base. It has moderate application, especially for conifers that lean where the high point of the tree can be located relative to the position of the base.

Figure 7. Scenario for Method 5.

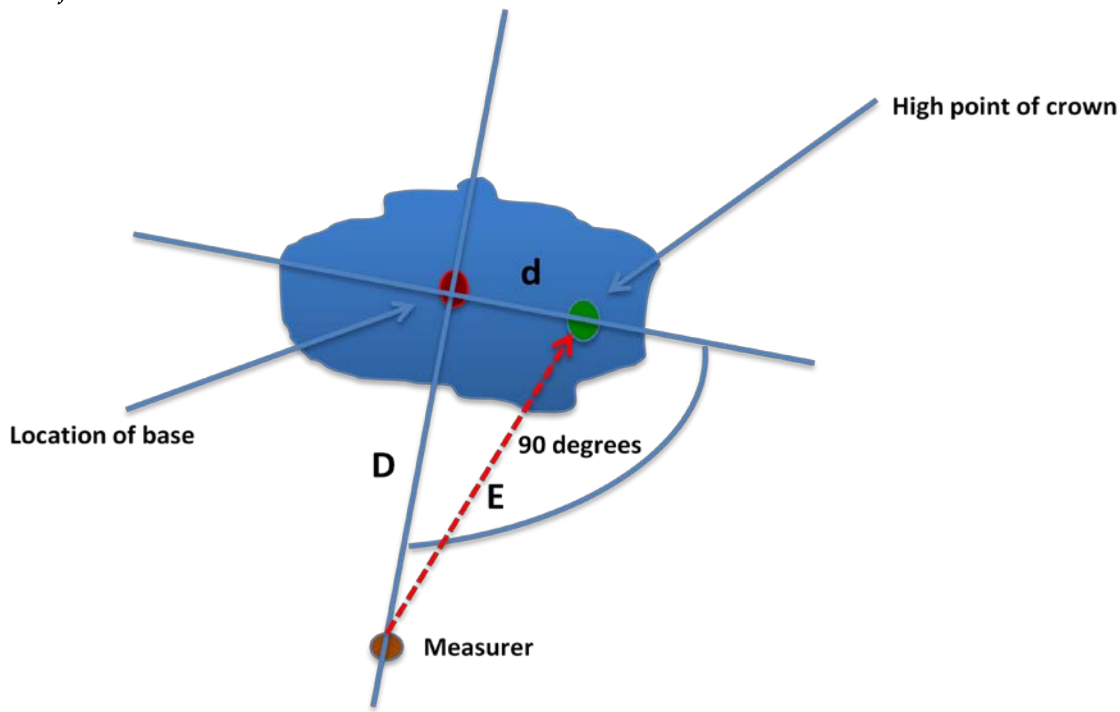


Figure 7 is a top down view of a tree. The blue field represents the vertical projection down to the ground of the crown of the tree being measured. The red circle in the blue field represents the location of the base of the tree. The green circle represents the location of the top of the tree projected down to ground level. The location of the measurer is identified in the diagram. *D* represents the horizontal distance between the measurer and the base of the tree. The actual baseline to from the measurer to the high point of the crown is the distance *E* shown in the diagram.

However, if the measurer can position themselves so that the vertical plane that contains the base and the high point of the crown is perpendicular to the vertical plane that contains the measurer and the base of the tree, then the distance *D* can be used as a substitute for the distance *E*. The variable *d* represents the horizontal distance between the base and the crown high point. Method 1 is applied to compute the height of the tree above eye level using *D* for the baseline. How good is this procedure? An example will help to illustrate its effectiveness. Suppose the distance *D* is 100 ft and *d* is 10 ft. Then *E* can be computed with the Pythagorean Theorem:

$$E = \sqrt{D^2 + d^2} = \sqrt{100^2 + 10^2} = 100.5 \quad [12]$$

Using *D* as a surrogate for *E* leads to only a 0.5-ft error in the length of a 100-ft baseline as a surrogate for the actual 100.5-ft baseline. If we express *d* as a proportion of *D*, we can relate *E* to the proportion *p* and length *D* through the following formula:

$$E = D\sqrt{p^2 + 1} \quad [13]$$

A value of $p = 0.10$ leads to:

$$E = 1.005D \quad [14]$$

So using *D* as a surrogate for *E* is a good strategy if, and it is a big if, the crown high point can be lined up relative to the base and measurer's position as explained above. In closed canopy forests, this technique is of extremely limited value.

The next method is actually a technique for locating the projection of the high point of the crown vertically down to ground level, so that Method 1 can be directly applied.

Method 6

This method is called crown-point cross-triangulation and is somewhat labor intensive in the since that it needs two people to be done efficiently. Before the introduction of the laser rangefinder, dendromorphometrists Bob Leverett and Will Blozan used this technique extensively. It can still be used, but there is no need for it if the measurer has a good laser rangefinder and clinometer.

In Figure 8, *E* represents the location of the base of the tree and F represents the location of the crown high point - the actual location as opposed to the vertical projection down to eye level, which is the role of *C*, i.e., the variable *C* represents the spot on at eye level directly beneath *F*. It is the downward vertical projection of *F*. If the measurer at *A* can locate *C*, or at least the spot on the ground corresponding to *C*, then the distance *AC* can be measured and used in Method 1 to get tree height above eye level. The angle from *A* to *F* is denoted by a in the second diagram. To be efficient, the measurer needs an assistant, two tapes, and a plumb bob.

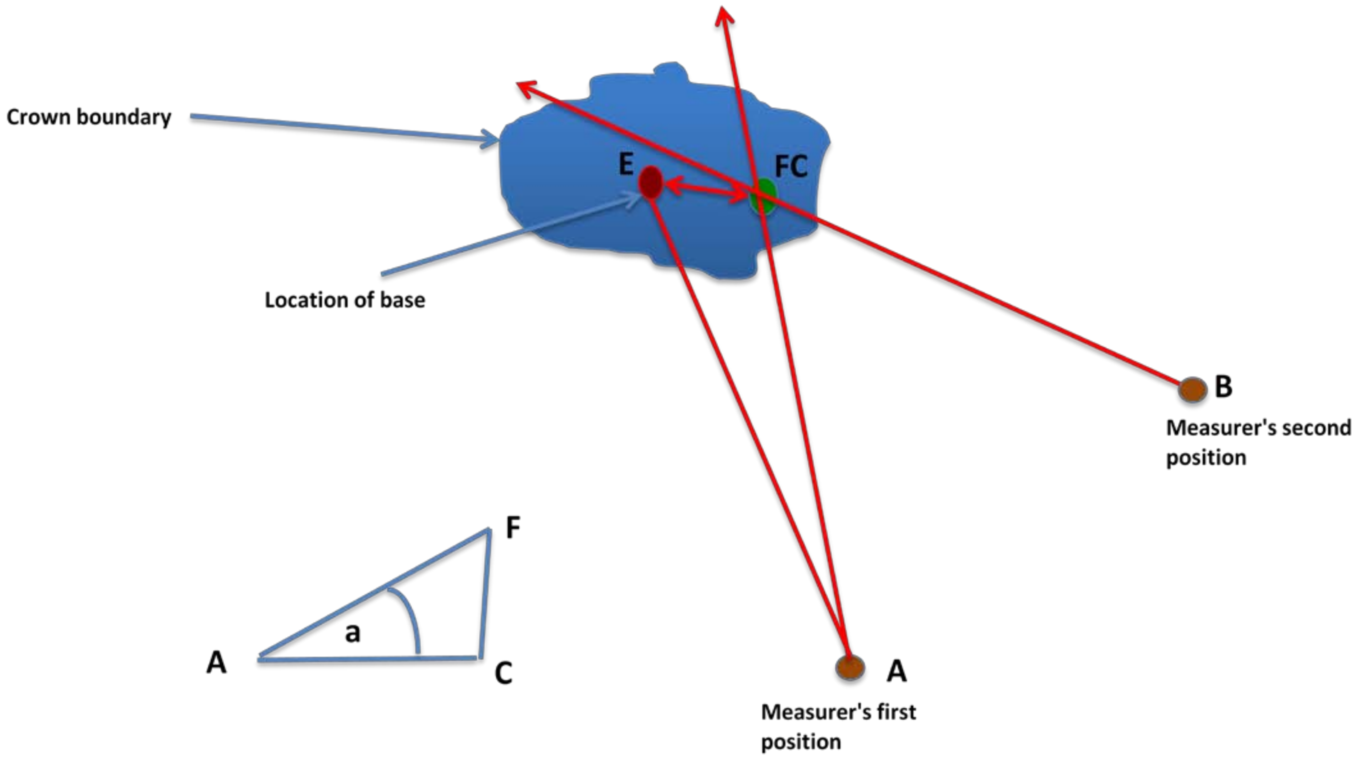


Figure 8. A diagram of cross-triangulation (Method 6).

The measurer holds the plumb bob up to mask *F* and directs the assistant to walk in the direction of *F*, passing beneath it. The plumb bob is used to guide the assistant. The first tape marks the path of the assistant and passes under the point *F*. The tape is left on the ground. The measurer then moves to point *B* with the second tape and repeats the process, directing the assistant to walk in the direction of *F*, passing under *F* stretching the second tape. Where the two tapes cross marks the point *C*, directly beneath *F*. A baseline can then be established from either *A* or *B* to *C*, and Method 1 applied.

Method 7

Method 7 is an alternative method that can be substituted for cross-triangulation methodology described in Method 6. It provides an alternate technique for first determining the baseline from measurer to the crown-point. But first a few explanatory comments to reinforce the reason we are presenting the technique. It is a far different challenge to measure the height of an actual tree in a forest as compared to working out a strategy on paper from the comfort of one's office. The latter often treats the tree as a geometrically regular object, but actual trees are not geometrically regular. A tree top is seldom located directly over its base, and limbs and twigs from the tree being measured plus limbs and twigs from nearby trees often obscure the vision of the tree's top. Uneven terrain often makes it very difficult to establish level lines where simple measuring techniques call for them. Determining where the top of a tree, i.e., the crown's highest point, is in relation to the base is critically important, but often not done or only approximated. Regrettably, trees just do not reconfigure themselves to make measuring easy for scientists, timber professionals, or amateur tree measurers. We will frequently emphasize the point that measuring actual tree height in a forest is not the equivalent of measuring the height of a vertical telephone pole in a level parking lot. The serious tree measurer must locate the crown's high point in relation to their eye in order to determine how high the tree's top is above eye level. A similar process must be used for the tree's base relative to the measurer's eye.

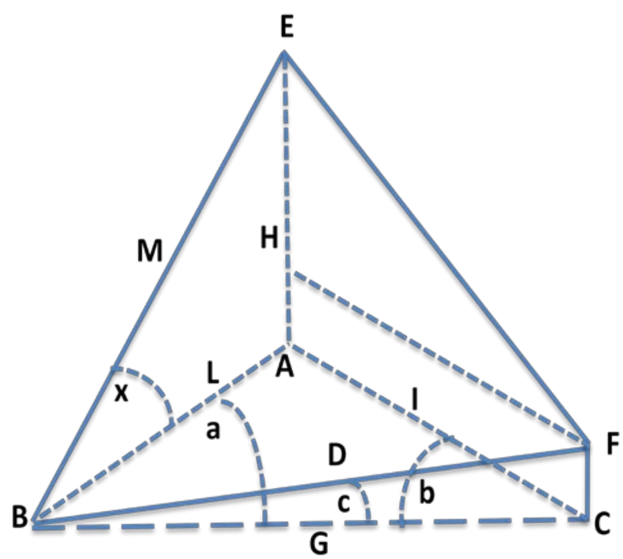


Figure 9. Graphical representation of Method 7.

However, measuring from eye level to the base of the tree is usually a much simpler process, because a level line from the measurer's eye to the trunk, down to the base of the tree, and then back to the measurer's eye often forms a right triangle, or very nearly so—unless the point on the trunk is well above the base and the tree leans. This method is perhaps the most difficult to visualize, but is presented in the interest of providing the measurer with the widest range of tools possible where the budget is limited and a good laser rangefinder isn't available.

In Figure 9, the objective is to measurer the tree's height H above eye level by first determining the correct baseline from the measurer to the point beneath the crown's high point at eye level. The measurer first positions himself at point B, looking toward E, the top of the tree. In the diagram the line BA or L is the baseline to be determined and angle ABE or x is to be measured. The point B is marked and the angle x is measured with the clinometer. The measurer then moves linearly to a second location shown as F in the diagram where E can be seen and marks the point. In the diagram, F is shown as above B, but F can be level with B or below B. That is, there is no requirement for BF to be horizontal, which makes the technique fit far more field situations. The distance between B and F is denoted in the diagram as D. D will serve as the primary baseline in determining L. From B, the direction of E is measured using a compass, as is the direction of F. The angle ABC, or a, is then computed. The measurer moves to position F and takes compass bearings on the direction of E relative to B. Angle b is computed. If BF is not horizontal, the measurer must measure the vertical angle FBC or c. This is because the triangle ABC is the one constructed to measure L. The line BC must be horizontal for the method to work. The following formula is then used:

$$H = \frac{D\cos(c)\tan(b)\tan(x)}{[\tan(a)+\tan(b)]\cos(a)} \quad [15]$$

The result is the height of the tree above eye level. Note that no assumption is made as to where the base of the tree is relative to the crown high point. The measurer must determine the height of the tree below eye level, but that is usually simple and lends itself to Method 1. The advantage of this method over Method 6 is that only one person is needed to do it. The disadvantage is the intimidating looking formula that must be used. Note also that this method does not require that the baseline and the points A and E be in the same vertical plane. There is no requirement to line up the points, which makes the method very flexible.

We will present one more method to aid tape and clinometer users when a tree is on sloping ground and the eye level position of the end of the baseline is too high on the tree to reach. An assumption is tacitly made that the measurer must be positioned well above the level of the base to see the high point of the crown. This assumption fits with the experience of most tree measurers, measuring trees in mountainous terrain. This last method shows how to calculate the length of a level baseline from eye to trunk.

Method 8

In the above diagram, the desired baseline is D. The angle from eye to the base of the tree is denoted by a. L is measured with a tape. D is then calculated using the equation below:

$$D = L\cos(a) \quad [16]$$

The above formula requires the use of trigonometry tables. The most convenient form of a table comes in small, inexpensive scientific calculators that can be purchased for as little as $20.

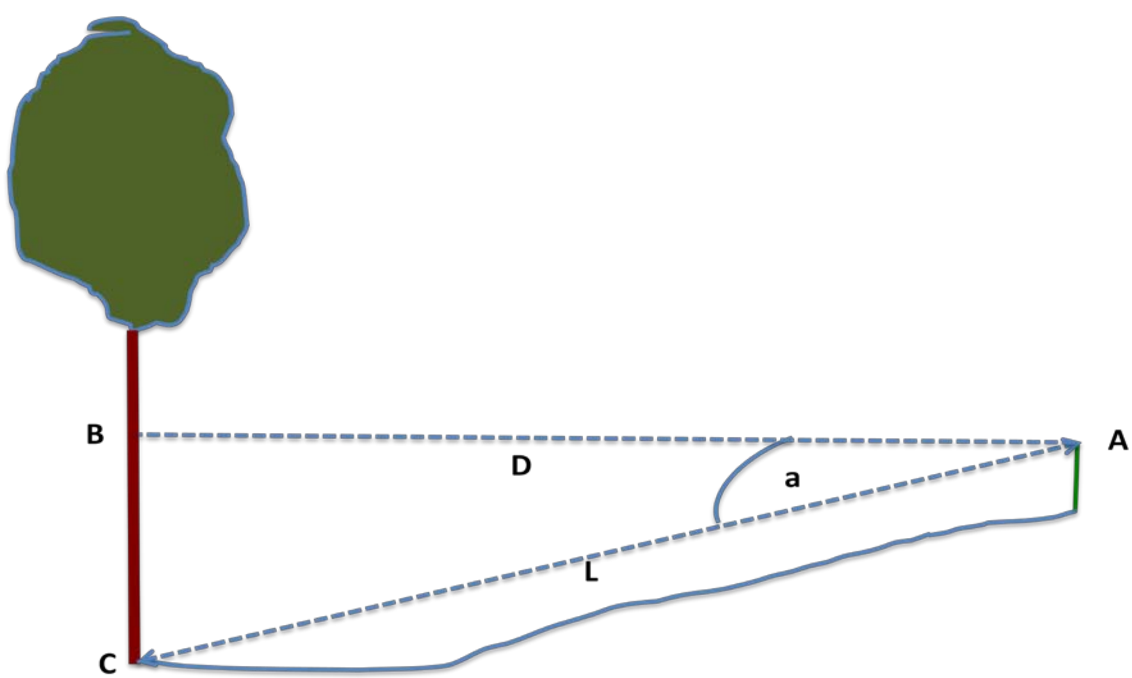


Figure 10. Graphical representation of Method 8.

SUMMARY COMMENTS ON THE EIGHT METHODS

The eight methods presented above would seem to complicate out of all proportion the conventional simple tangent-based method of measuring tree height, especially Methods 3 and 7. The jump in complexity will probably come at as a disappointment to tape and clinometer users looking for the magic bullet. After all, isn't the advantage of the tape and clinometer method supposed to be its simplicity, speed, and inexpensiveness, and haven't these advantages been espoused by generations of tree measuring professionals? If one has a homemade clinometer, the expense of the equipment needed is just the cost of a tape measure and a calculator with trigonometry tables. The total could be as little as 35 or 40 dollars. One can imagine students being given simple explanations for the use of tape and clinometer and then marching triumphantly into the forest to measure the heights of compliant trees by simply positioning themselves 100 ft away from the base and reading the tree's height from a scale on their clinometer—no fuss, no bother—and compromised accuracy.

An ancillary purpose of this article is to drive home the message that correct use of tape and clinometer is seldom as straightforward as the diagrams accompanying clinometers imply. There are trees that can be measured quickly and accurately with a tape and clinometer, but they tend to be plantation conifers. Although the diagrams accompanying clinometer instructions often show the profile of a hardwood, the diagrams in fact treat trees like the plantation conifers, with the top of the tree directly over the base.

Any serious attempt to accurately measure the height of a tree requires that the high point of the crown be actually determined in relation to the base of the tree—not merely assumed to be directly over the base. The crown high point is usually offset from the base by anywhere from a couple of feet to twenty or more. This is especially true for older trees. Consequently, we need methods for triangulating the location of the high point of the crown relative to the base and the measurer's eye. Because this triangulation often isn't done with the wide scale use of tape and clinometer, or more to the point, misuse, an epidemic of mismeasured trees promulgated through the big tree registers has been the result.

While the current generation of older tape and clinometer users may continue to favor the use of these instruments because of the simplicity of Method 1 and equipment cost considerations, there is little justification for professionals to tolerate the kinds and magnitudes of tree height measuring errors that are routinely made, and oddly, tape and clinometer users often seem unaware of the magnitude of the errors. Acknowledging the reality, we have written this article to provide help to the serious tape and clinometer user. The key is to apply these instruments intelligently by determining the horizontal offset of the high point of the crown from the base. If doing so renders the method too inefficient or too complicated in the eyes of its users, then it is time for the professionals to acknowledge the need to move on to methods that are reasonably fast and eliminate the problems that are commonly associated with Method 1. That wasn't possible in the past, but is now.

It is time for measurers to move up to laser rangefinder and clinometer or hypsometers that combine the features of the separate items. This said, from the ENTS perspective, the more tools we have in our measuring toolkit, the better off we are. Consequently, ENTS does not advocate abandoning the tape and clinometer altogether. We embrace all measuring techniques that can be shown to produce accurate results when applied properly. If the tape and clinometer user adheres to the cautions included in this article and chooses the right measuring model, tape and clinometer can still result in acceptable accuracy.

For the above methods, a serious tree measurer that plans to stay with the tape and clinometer needs to add two more instruments: (1) a good compass, which is likely to already be owned; and (2) a scientific calculator with trigonometry functions. With these instruments, the measurer can determine valid baselines for both top and bottom of the tree. The rest is whether or not the right top is being measured.

For my final comments, tape and clinometer methods suffer not so much from theoretical deficiencies, but from misapplication. It would appear that the new user is hoping to measure tree heights without any knowledge of the mathematics behind the scene. As a consequence, we fear that tape and clinometer only users become accustomed to moving fast through the woods with the expectation of measuring tree height without having to do any calculations, or at most multiplying a clinometer reading by a baseline length. This expectation is highly unrealistic as the above 8 methods show.

There are experienced foresters who become skilled at compensating for the crown offset problem and in spotting the top of a tree within a complex crown structure. But these skills are hard to pass along. We suspect that far more tape and clinometer users routinely mismeasure tree height than do it correctly. We hope this article will supply the requisite methods to allow these measurers to improve their skills. In the end, there is no substitute for a good laser rangefinder and clinometer or a hypsometer that combines the two instruments in a way that directly measures the hypotenuse of the right triangle from eye to crown. But those on a very tight budget can at least take comfort in knowing that tree height can be accurately measured by using the methods we have presented in the article.

NORTHERN LAKE STATES OLD-GROWTH VISITS: JULY 2010

Don C. Bragg

Research Forester, Southern Research Station, USDA Forest Service, Monticello, Arkansas

During the month of July 2010 I revisited a number of old-growth sites in northern Wisconsin and the Upper Peninsula of Michigan.

My first stop (with my brother Bob) on July 12 was a perennial favorite—Cathedral Pines State Natural Area on the Nicolet National Forest near Lakewood, Wisconsin. This tract of old-growth eastern white pine-eastern hemlock-red pine is a rare remnant of mature conifer timber in the predominantly hardwood-covered moraines of this part of Wisconsin. A great blue heron rookery can also be found in the tops of the tall pines, making this an interesting (and noisy) adventure during nesting season.

In previous visits to Cathedral Pines, I had encountered some reasonably tall eastern white pines (125 to 135 ft), but I had apparently missed the tallest of the individuals, for which others had reached 150+ ft. Paul Jost had earlier recommended some areas, so my brother (pictured below) and I took advantage of a free afternoon to search.

A quick scan of the area around the main trail reaffirmed my previous experiences—decently tall trees, but no 150s. After a while and remembering the lessons of finding taller trees sheltered by deep valleys, we decided to head cross-country towards some steeply undulating terrain off to the side of the main trails. Bingo! Taller trees immediately appeared, growing at the bottom of the swales and in other sheltered areas along this portion of the stand:

Species	DBH (in.)	Height (ft)
eastern white pine	43.7	151.5
eastern white pine	41.2	149.0
eastern white pine	44.8	155.0
eastern white pine	37.5	155.5

Fairly tall eastern hemlocks were present, but not measured.

Left and right: Eastern white pines at Cathedral Pines State Natural Area in northern Wisconsin. Photos by Don C. Bragg.

Picture of hemlock-pine stand at Cathedral Pines. Photo by Don C. Bragg.

Regrettably, we only had a couple hours to look for tall trees. Cathedral Pines is a beautiful and easily accessible stand of virgin timber that can be driven to (the parking lot is along an old logging road in the midst of the big pines). Unfortunately, like so many of these stands, attrition is gradually taking many of the large pines. Many recently dead snags stand as a testament to this loss. The eastern hemlock still appear vigorous, but if the hemlock woolly adelgid ever gets here, the stand will be devastated.

I then proceeded to my parents' home in Rhinelander for a family visit. While we were driving there, my brother handed me a copy of a book he had on some of the state-preserved natural areas of Wisconsin. I was amazed at how many relict old stands had been protected in the county I had grown up in—my hometown of Rhinelander was for a time in the late 1800s one of the principle centers of white pine lumbering in the country. In the past, I've posted on some of these stands, including Holmboe Woods only a short distance from downtown Rhinelander. This tract just scratched the surface of possibilities. Not having a lot of time available, I chose to visit a couple other stands in the Rhinelander area, starting with Sugar Camp Hemlocks State Natural Area, just a few miles from where I grew up.

Sugar Camp Hemlocks is a relatively small stand of somewhat old (perhaps 150 to 200 yr old) eastern hemlock, with a super-canopy of eastern white pine and red pine, and a mixture of yellow birch, sugar maple, and other hardwoods. This stand would have been reminiscent of much of the moraines in the Northwoods of Wisconsin prior to lumbering, and probably was spared largely because it wasn't big enough to cut in the late 1800s. Few of these trees grew very large:

Species	DBH (in.)	Height (ft)
Eastern white pine	35.8	104.0
Eastern hemlock	24.1	92.5
Eastern white pine	26.4	100.0
Red pine	21.9	94.5
Red pine	23.4	88.5
Eastern hemlock	20.9	90.0

Sugar Camp Hemlocks State Natural Area near Rhinelander, Wisconsin. Photo by Don C. Bragg.

About 13 miles north of Rhinelander, on the Northern Highland-American Legion State Forest, was my next tree measuring destination: Germain Hemlocks State Natural Area. I had been aware of this stand from my high school years, as a good buddy of mine had grown up on a lake that is partially surrounded by this natural area. In fact, the stand is accessed through the boat launch on the upper end of this lake, from which I had ventured forth numerous times. A prolonged drought had left the lake unusually low.

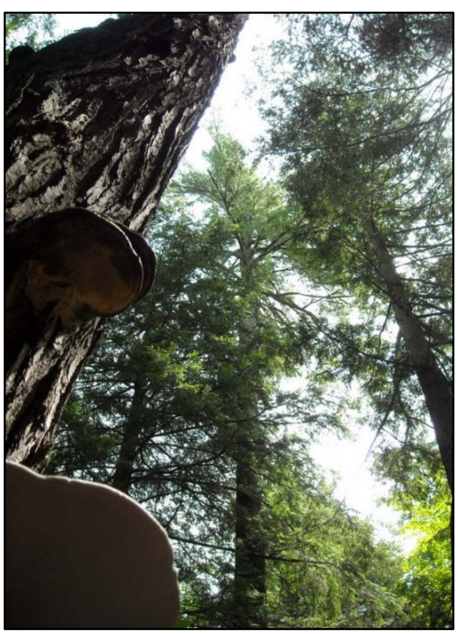
As with Sugar Camp Hemlocks, Germain Hemlocks is located on a moraine, with the taller trees found in the lower spots where they are more sheltered from windstorms and lightning and the growing conditions tend to be slightly moister and more nutrient rich. The stand is heavily dominated by eastern hemlock, with a scattering of eastern white pine and a number of northern hardwood species, including sugar maple, yellow birch, and American basswood.

Walking along the trail that leads through the stand, it was readily apparent that the trees were larger than Sugar Camp hemlocks, probably due to a somewhat better quality site and perhaps a somewhat older condition:

Species	DBH (in.)	Height (ft)
Eastern hemlock	22.1	97.5
Eastern hemlock	24.4	100.5
Eastern hemlock	27.2	85.5
Eastern white pine	30.7	102.0
Eastern white pine	32.9	108.5
Eastern white pine	33.7	113.5
Eastern white pine	29.8	105.0
Eastern white pine	34.1	131.5

The tallest pine at this stand was a fair distance from the parking area, near the end of my measuring time. I'm hopeful there are more individuals of comparable stature (or better) nestled elsewhere in the old-growth remnant. Given their somewhat larger girth, I am also hopeful that more 100 ft tall eastern hemlocks are present in this stand, especially in some of the steeper areas.

Driftwood exposed along the shore of the lake on the south side of Germain Hemlocks State Natural Area near McNaughton, Wisconsin. Photo by Don C. Bragg.



More pictures from Germain Hemlocks State Natural Area. Photos by Don C. Bragg.

A few of the Estivant Pines in the Keweenaw Peninsula of Michigan. Photo by Don C. Bragg.

One final image to share: a picture of some of the old-growth eastern white pine at Estivant Pines Nature Sanctuary, now owned by the Michigan Nature Association. These pines are impressive in girth, if not height, and are older than in many places (although I'm dubious of the 600 years claimed by some). Located near the very tip of Michigan's Keweenaw Peninsula, these old and weather-beaten trees have survived countless bitter winters and the driving winds blowing off of Lake Superior just a few miles away. I only had a brief trot through this stand this summer, but it was long enough to confirm what I'd suspected—though they tower over adjacent hardwoods and conifers, the old white pines are not particularly tall. Given the rough environment, even the 110 to 120 ft that they probably max out at on this site is still quite impressive.

The Giant Cypress of Sky Lake WMA, Mississippi: An Update, October 2010

Don C. Bragg

USDA Forest Service, Southern Research Station, P.O. Box 3516 UAM, Monticello, AR 71656

You may recall an issue (Volume 3, Issue #1, Winter 2008) of the *Bulletin of the Eastern Native Tree Society* from a few years back that featured the giant baldcypress at Sky Lake Wildlife Management Area (WMA) near Belzoni, Mississippi. At this time, the area had been protected by the state of Mississippi, but little in the way of access and interpretation had been done, save a website that made vague reference to planned improvements. As these pictures will show you for better or worse, the "improvements" have begun.

First, some background on this recent trip. In mid-October of this year I received an email from Dr. Mark Bonta, a professor of geography at Delta State University in Cleveland, Mississippi. Mark and Larry Pace, a retired postal worker turned photographer, have been working on a book on the natural areas of Mississippi. Some of the best examples of remnant ancient baldcypress and water tupelo can be found along the rivers and oxbow lakes of the Mississippi Delta including, of course at Sky Lake WMA. In his email, Mark expressed concerns regarding the work being done near the big cypress at Sky Lake, and invited me to join Larry and himself to a visit to the Belzoni area the next time it was convenient. Given my relatively quiet work schedule and the fact that it has been another dry summer, I suggested we meet quickly and they agreed.

First, let me say that eventually there will be a nice facility here, with (hopefully) meaningful interpretive facilities and a very solidly built trail to the big trees. However, what I saw this day certainly amazed me, and often disappointed me, and sometimes infuriated me. Gary Smith and Beth Koebel, steel yourselves…

Larry Pace looks at the construction of an amphitheater near the approach to Sky Lake WMA. Photo by Don C. Bragg.

The extensive construction of the interpretive facility was the first sight to greet us as we arrived at Sky Lake. This was considerably larger than I had imagined it would be, but it looked like it would help to draw people to the site, so that wasn't necessarily a problem. However, the heavy-duty road leading into the old oxbow, coupled with Mark's descriptions, led me to start fearing the worst…

…And it was as bad as it had sounded! When Gary Smith and I had first ventured to Sky Lake, the first sign you saw of the impressive cypress was a large, dead-headed cypress along the faint trail that crossed the oxbow. Well, the tree is still there, but check out the road next to it!

They are building an elevated boardwalk from the high natural levee along the old oxbow out to the largest cypress. This will permit year-round access to those who can't (or won't) brave the swamps and snakes to see them otherwise.

This road is as substantial as it is because the construction company needed to get large trucks in to haul the boards, beams, and concrete to the boardwalk area. Yes, the dry summer allowed full-size concrete trucks to drive all the way into the swamp to pour scores of large concrete postholes needed to support the ample boardwalk being constructed (more pictures on that later).

The dryness of this year was adequate to support the weight of these large vehicles without adding too much fill or gravel, which was good, but obviously there was a LOT of vehicle traffic into the site, and almost all of it passed within a few feet of this ancient monarch.

There was also some superficial wounding to this tree (and many others), and hopefully it will survive that injury. This tree still looked healthy, but it is hard to say if the root damage it must have experienced will be permanent.

Construction road built to haul supplies into the new boardwalk at Sky Lake WMA. Photo by Don C. Bragg.

Remember the big cypress on the cover? Here's another view of it, with Gary Smith for scale:

Now try this slightly different view on for size, with a Bobcat skid-steer for scale:

Both photos by Don C. Bragg.

An example of the boardwalk nearing completion at Sky Lake WMA. Note the old cypress stump, probably from when the swamp was originally logged decades ago. This stump is about 6 ft tall, and the boardwalk looks like it will be 8 to 10 ft above the ground along most of its route. Photo by Don C. Bragg.

Yes, once again, heavy vehicle traffic upon the base of a giant. This tree is one of the two cypress specimens known at Sky Lake to be greater than 40 ft in circumference, and yet it received no special treatment whatsoever!

The donors and agencies who contributed funds to this project can rest assured that they are getting a high-quality boardwalk (no kidding here, folks). Over the years, I have walked on many such boardwalks, and can assure you few would match the solidness of this one—large square pressure-treated posts held firmly in the ground by ample concrete pours and assembled into a walkway with an abundance of pressure-treated southern yellow pine. The boardwalk also seems to have been placed so that people shouldn't be able to reach the big cypress and vandalize them, but I would expect at least some vandalism to occur now, given the ease of access.

The work area around the boardwalk has an abundance of cut-off pieces of pressure-treated lumber, spilled concrete, and small trees felled to get them out of the way. Other construction debris and a multitude of trails created by heavy equipment also cover the site, causing Mark to express considerable concern about how this site will be cleaned up once construction is finished. When the water fills the oxbow, most of the surface disturbance will be cover by feet of murky water (mercifully!).

I am torn on how to consider this work. The trees were never very accessible, and their new-found visibility may help inspire people towards greater acts of conservation and preservation in the future, just as happens in many zoos. This project was not implemented with the lightest footprint possible, although it probably is the most cost-effective way to have done this construction, and the dry summer allowed for better access. I realize that many of the most visible impacts of the work (especially the roads) will quickly be covered with vegetation and obscured over time. My biggest fear is that in a couple years, when I go to see the completed project, some (hopefully not most) of the big cypress will be dead, and others covered in graffiti and litter. For these trees to have survived untold centuries of climate extremes and the worst people have had to offer only to be killed by a misguided access project would be a travesty.

Above: The largest of the baldcypress at Sky Lake, also over 40 feet in circumference, is hollow and surrounded by tall (over 6-ft) cypress knees. Below: The new boardwalk will dead-end at this tree, which will hopefully survive the recent damage and new exposure to people. Both photos by Don C. Bragg.

OLE LAKE, MISSISSIPPI: OCTOBER 2010

Don C. Bragg

USDA Forest Service, Southern Research Station, P.O. Box 3516 UAM, Monticello, AR 71656

So you don't think my visit with Dr. Mark Bonta of Delta State University was all doom and gloom, we had a productive visit to another site of ancient baldcypress. Before we went to visit the construction at Sky Lake, we drove to an old river channel called Ole Lake, also near Belzoni, Mississippi. While it is apparent that the cypress here are not as old as those at Sky Lake, they are also quite ancient, and very impressive individuals themselves.

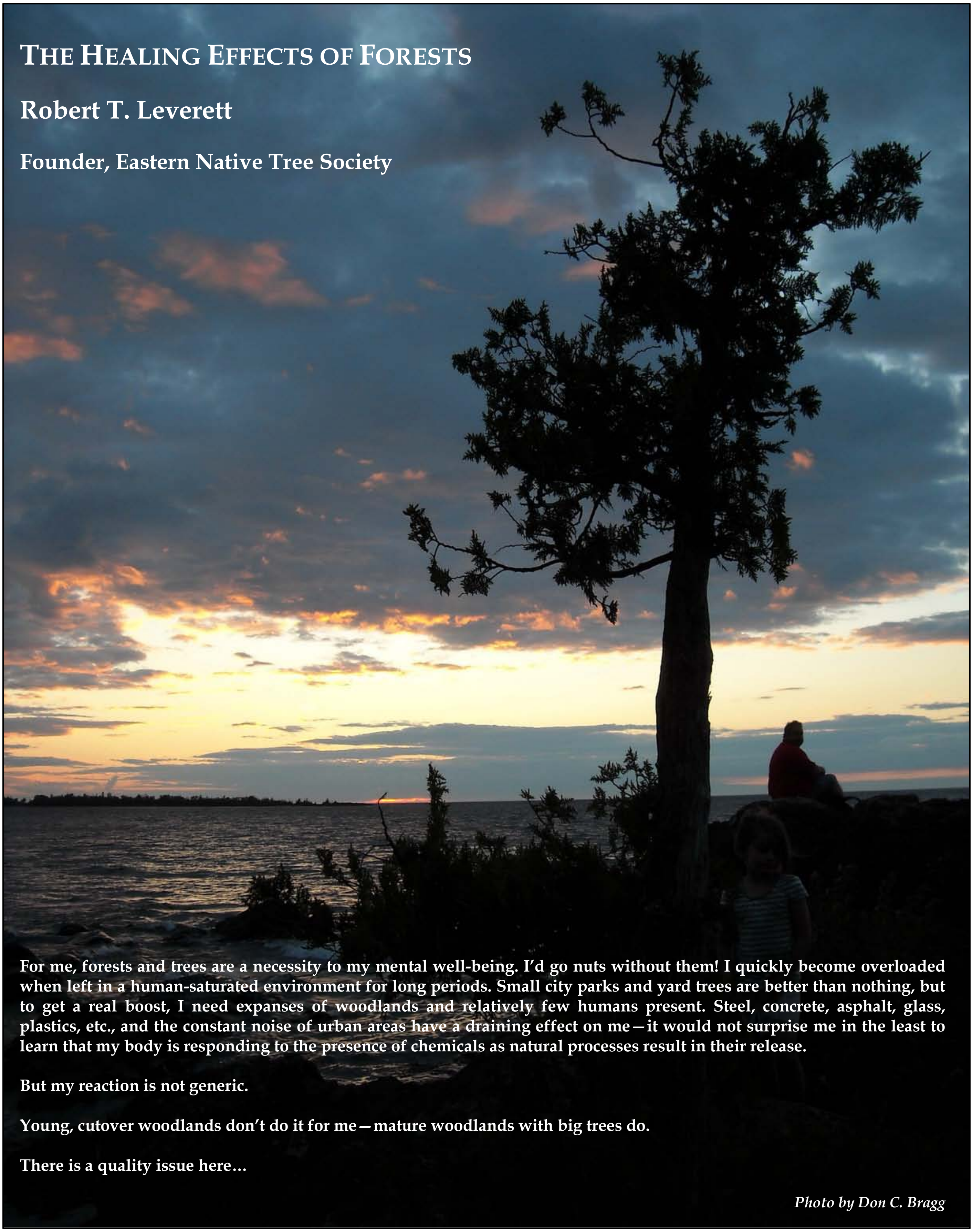
The recent drought has significantly lowered the level of Ole Lake, allowing for closer inspection of these trees. Most impressive is how their heavily buttressed bases are configured—the majority of tree biomass seems to be at or below typical water levels. Kind of like an iceberg, I suppose, except constructed out of wood!

Signs of wildlife abounded in the exposed mud flats, many of which had dried to a cracked, hard crust. Though we found evidence of past lumbering (including an old, partially buried cypress log with one end sawn off), it was quickly apparent why these trees were left—most were hollow or poorly formed, and therefore of little interest to loggers. Some cypress also showed signs of burning in their hollow interiors, although it was hard to say if this was caused by lightning or a surface fire that may have burned from the neighboring high ground into the cypress during a similar period of drought in the past. Ole Lake is surrounded by private property, so access is limited, but this is definitely a cool place!

Some of the many examples of exposed buttressed cypress at Ole Lake near Belzoni, Mississippi. The typical water marks of this lake are clearly visible, suggesting the quantity of biomass in this portion of the tree. Photo by Don C. Bragg.

Top: Mark Bonta standing in the hollow trunk of one cypress. Bottom: Fall colors at Ole Lake. Both photos by Don C. Bragg.

A view looking south across Ole Lake. Photo by Don C. Bragg.



The Healing Effects of Forests

Robert T. Leverett

Founder, Eastern Native Tree Society

For me, forests and trees are a necessity to my mental well-being. I'd go nuts without them! I quickly become overloaded when left in a human-saturated environment for long periods. Small city parks and yard trees are better than nothing, but to get a real boost, I need expanses of woodlands and relatively few humans present. Steel, concrete, asphalt, glass, plastics, etc., and the constant noise of urban areas have a draining effect on me—it would not surprise me in the least to learn that my body is responding to the presence of chemicals as natural processes result in their release.

But my reaction is not generic.

Young, cutover woodlands don't do it for me—mature woodlands with big trees do.

There is a quality issue here…

Photo by Don C. Bragg

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:

Don C. Bragg
Editor-in-Chief, *Bulletin of the ENTS*
USDA Forest Service-SRS
P.O. Box 3516 UAM
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.

Ancient baldcypress reflecting the early morning October sun in the still waters of Ole Lake near Belzoni, Mississippi. Photo by Don C. Bragg.