Bulletin of the Eastern Native Tree Society

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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:

Editorial Board, *Bulletin of the Eastern Native Tree Society*:

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

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COVER: A light coating of snow helps to accentuate the deep greens of loblolly pine, the russet of oak leaves, and the deep blue of a January sky in southern Arkansas. Photo by Don C. Bragg.

TABLE OF CONTENTS

WHOSE WOODS THESE ARE…

For those Ents snowbound in the Northeast or Lake States this year, the winter lament of someone in the South has got to ring pretty hollow—but bear with me a moment. We have had five snowfalls in Arkansas during the last month, including one that dropped over two feet (yes, feet!) of snow in the northwestern part of the state, and that is plenty for this year! Yet, the coldest of the seasons should always be considered a special time. To me, winter conjures memories of snow drifting down into a hushed woods, and recollections of my parents repeating certain verses of Robert Frost's famed "Stopping By Woods on a Snowy Evening." The piney woods I daily walk through on the University of Arkansas at Monticello campus take on a special glow after our all too infrequent snowfalls. When they happen, I feel my mind race back to my youth, and the long northern Wisconsin winters. Gone are most of the uncomfortable or unpleasant memories of winter, and only fond remembrances remain. I only hope my children will be able to say the same!

It is also interesting to follow the conversations on the ENTS Bulletin Board regarding the trials and attributes of cold, snowy winters. I doubt if many New Englanders would agree right now, but prolonged cold is a blessing to the eastern hemlocks facing a slow death from the proboscis of the hemlock woolly adelgid. Ice and snow can tear down trees young and old, knocking out power but also renewing stands by providing gaps in the canopy (not to mention dead wood for habitat). Deep snows may cause white-tailed deer to starve, but too many deer consume too many herbaceous plants so important to our eastern forests. Winter is a vital if complicated part of our lives, and one we should embrace…

Well, at least until February!

Don C. Bragg
Editor-in-Chief

A tupelo-cypress swamp reflects the fading January sun in a small bayou flowing into the Ouachita River in Bradley County, Arkansas. Photo by Don C. Bragg.

ANNOUNCEMENTS AND SOCIETY ACTIONS

Seventh Forest Summit To Be Held in October 2011

Professor Gary Beluzo cordially invites the public to the Seventh Forest Summit to be held on Thursday, October 13 through Friday, October 14, 2011 at Holyoke Community College in Holyoke, Massachusetts. As always, this year's program is free to the public, and will feature a number of top scientists and other key individuals who cherish our forests. The program is still being formed, but to date the keynote speaker is Dr. David Stahle, a prominent dendrochronologist from the University of Arkansas. Other confirmed participants include Dr. Henry Art (Williams College), Dr. Jesse Bellemare (Smith College), Professor Beluzo (Holyoke Community College), Dr. Lee Frelich (University of Minnesota), and Dr. Neil Pederson (Columbia University). Please check on the Summit's website (http://www.hcc.edu/forest/) for future updates to the program.

Fall 2011 ENTS Rendezvous Also In October

According to tradition, the fall ENTS Rendezvous will immediately follow the HCC Forest Summit. This year's event, to be held on Saturday, October 15, 2011, will be held in Charlemont, Massachusetts. Details will follow—check the ENTS Bulletin Board and website for further information.

2011 North American Dendroecological Fieldweek in Virginia

Interested in learning more about tree-ring work? Don't miss this opportunity! Registration is now open for the 21st Annual North American Dendroecological Fieldweek (NADEF), to be held at the Mountain Lake Biological Station in Virginia from August 1-9, 2011. Dr. James Speer has included some information about the research projects below through which will be taught basic and advanced dendrochronological techniques. Go to the website (http://dendrolab.indstate.edu/NADEF.htm) for more information and log in to Virginia Tech's webpage (http://www.cpe.vt.edu/reg/nadef/) to register for the conference today. Please contact him directly at jim.speer@indstate.edu if you have any questions about the fieldweek.

The group leaders and projects are:

Introductory Group: Grant Harley (University of Tennessee) and John Peterson (Virginia Tech). This group will learn the basics of dendrochronology, including more time spent on site and tree selection, crossdating, detrending, and understanding chronology. This group will take the time to survey the techniques of the other projects.

Fire History: Margot Kaye (Penn State). Chestnut oak fire history from the Warspurr Trail.

Wood Anatomy: Carolyn Copenheaver (Virginia Tech) and Audrey Zink-Sharp (Virginia Tech). Explore the wood anatomy of pitch pine.

Dendroarchaeology: Henri Grissino-Mayer (University of Tennessee). Conduct a dendroarchaeological project on an old cabin.

Dendroclimatology: Dave Stahle (University of Arkansas). Conduct a dendroclimatic reconstruction at the Cliffs of Eggleston overlooking the New River.

Sclerochronology: Bryan Black (Hatfield Marine Science Center). Examine the rings in the shells of fresh water muscles or salt water clams.

You can also write to:

James H. Speer, PhD
Interim Coordinator of the Center for Science Education
Director of the Office of Sustainability
Director of the North American Dendroecological Fieldweek (NADEF)
Associate Professor of Geography and Geology
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A NUMERICAL METHOD OF PLOTTING TREE SHAPES WITH LIVE OAKS USED AS AN EXAMPLE

Edward Forrest Frank

Associate Editor and Webmaster, Eastern Native Tree Society

INTRODUCTION

Anyone who looks at trees realizes that different tree species tend to have different shapes. Tree shapes also appear to vary within a single tree species. Three basic parameters are generally used to approximate tree shape: height, bole girth, and average crown spread. These values are used in a big tree formula utilized by American Forests since 1940 (American Forests 2010) to calculate the point value of individual trees for inclusion in their Big Tree List.

The Eastern Native Tree Society (ENTS) uses height and girth in calculating in their own ENTS formula and use either two or all three of these parameters in calculating the Tree Dimension Index (TDI) first proposed by Will Blozan for comparing trees within a single species (Blozan 1995).

Given there are three parameters involved, another approach is to evaluate tree shapes and tree shape families using ternary (triangular plot) diagrams. The idea was first proposed in January 2005 by Edward Frank, but the tree measurement data was not readily available at the time to test the concept (Frank 2005).

METHODS AND MATERIALS

Jess Riddle compiled a new spreadsheet listing of the maximum dimensions of trees measured by the ENTS members using their methodology in 2008. An updated compilation was completed in October 2009 (Riddle 2009). This latest compilation including 609 lines of tree measurement listings, and representing 192 species, formed a basis for testing the ternary diagram concept. Ideally for each tree species the list included one line representing the tallest of the species, one line representing the tree with the largest girth, and one line represent the tree with the largest crown. Some trees species have a particularly large specimen or may alternatively have only had a limited number of specimens measured. In these cases a single tree may be listed multiple times as the largest specimen for more than one parameter.

Some of the limitations of the information collected is reflected in the data set. All three parameters were not collected for each tree or each tree species, so some lines are absent and some fields within these lines are empty. In other instances, trees with similar values were both listed because these measured values were within a reasonable amount of error of each other and considered indistinguishable. Therefore, there are more than three lines of entries included for some tree species.

Average Tree

The first step in the analysis is to determine what an average shape for trees is in general. These three basic parameters can be expressed as a ratio of height to girth to average crown spread. Some trees are tall and narrow, while others are low and broadly spreading.

Since this listing was of the largest trees of 192 different species, a compilation was used to calculate the average ratio of these values was to average the values for each parameter for all of the measurements included in the listing. For the trees provided in the ENTS list, the average height was 87.6 ft, the average girth was 100.1 inches, and the average spread was 54.9 ft. It is not critical that these values be exact for analysis purposes, but they could be further refined as the general measurement data set grows larger. These numbers were then in turn used to standardize the measurements of an individual tree.

Standardization

Standardization simply means comparing your values or results to some standard. In this case what is being compared is the height, girth, and crown spread values of each measured tree to that of an “average” tree as determined above. To standardize each measured parameter, the quantity is divided by the standard value as determined above. For example, if a tree exactly matched this average or standard tree it would have these same dimensions: a height of 87.6 ft, a girth of 100.1 inches, and an average spread 54.9 ft. Following this procedure these values are divided by the average values. You get height = 87.6/87.6 = 1, girth = 100.1/100.1 = 1, and crown spread = 54.9/54.9 = 1. Thus, an average tree has a standardized ration of 1:1:1, which is what should be expected for average values for each dimension.

Values greater than one are acceptable. Whether the tree is larger or smaller overall or in any one dimension, this process of “standardization” converts the measured values to some percentage of the standard value. A tree 175.2 ft tall, with a girth of 100.1 inches, and a crown spread of 27.45 ft would have a standardized value of 2:1:0.5, meaning it twice as tall as standard, the same girth as standard, and half the crown spread of standard. So in effect the tree is tall with a small crown spread relative to a standard tree. The result of the standardization process is that the actual measurements are not themselves being compared, but the proportion of those measured values to the standard.

Normalizing Data

The next step is to normalize the data set so that the sum of the three parameters will equal one. This will enable the shapes of different trees of different sizes to be compared. For example if a tree was twice as tall, had twice the girth, and twice the crown spread of the average tree, the standardized values for this tree would be 2, 2, and 2 respectively. The proportions of each of the three parameters are the same as they would be for an average tree, with values of 1, 1, and 1, or those of a smaller tree with values of 0.5, 0.5, and 0.5. This means that all of these trees are the same shape, they are just different sizes. Since the goal of this process is to compare the shapes of trees rather than their sizes, the process of normalization is used to eliminate the variation in the standardized values due to differences in the overall size of the tree.

To normalize the data all of the ratios are changed to the same base value. In this case because a ternary diagram is being used, the goal is for three values to maintain the same relative ratios, but adjust them so that the sum of the three values total to 100%. To do this, first add up the three normalized values. In the case of the standard tree example this would be 1 + 1 + 1 = 3. Then each of these individual values are divided by that total (3) to get a decimal value. This yields 0.333 : 0.333 : 0.333. To convert to percentage, each is then divided by 0.01 (or multiplied by 100). to yield 33.33% : 33.33% : 33.33%. This value plots dead center on the ternary plot and represents the shape of an average tree. Each individual set of measurements are standardized in the same way. This is calculated by summing the numeric value of each of the three parameters as determined in the standardization procedure above, and then dividing each individual parameter by that sum. For use in the ternary diagram these decimal values must be multiplied by 100 to convert them to a format usable by the program. These calculations can be done by hand, or can easily be accomplished in Excel. The results of these calculations represent the shape of the tree without regard to size differences among different trees.

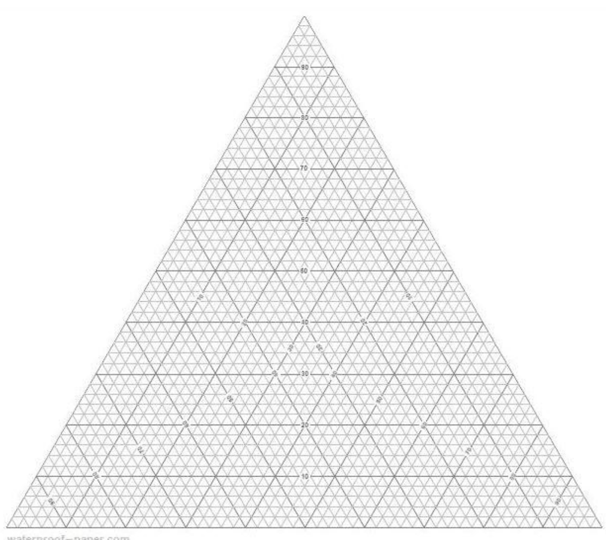

Figure 1. Blank version of a ternary plot graph.

Plotting the Data

The final step is to plot these results as a graph to better compare the results. A ternary diagram is one in which three different or tri-plot parameters totaling 100% may be plotted. A ternary diagram has three scales each running from one side to the apex at the opposite side of the triangle (Figure 1). A graph paper template may be downloaded from:

http://www.waterproof-paper.com/graph-paper/ternary-diagram-triangular-graph-paper.shtml

which can be used to hand plot the calculated values.

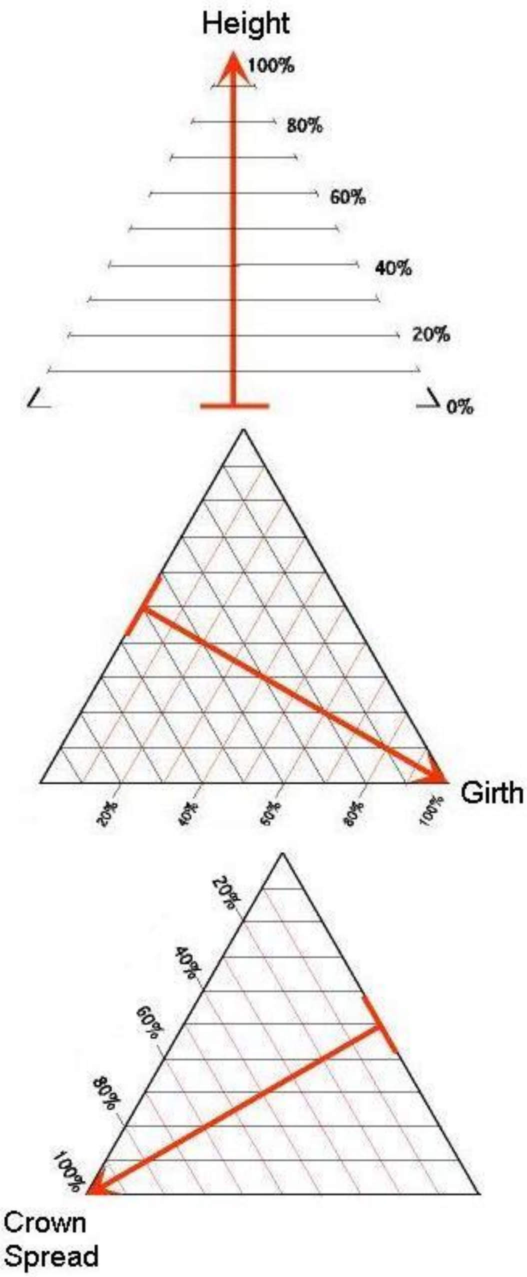

Figure 2. A ternary diagram works because the baseline represents 0% height, while the point at the top is 100%. Similarly, the 100% of girth is in the lower right corner, and the crown spread is maximum in the lower left corner (adapted from Fitcher 2000).

Any three percentages that add up to 100% will plot as an unique point on the ternary diagram. It is important that if using Tri-plot, that the three columns of data plugged into program are in the proper order. Column A must be normalized height, Column B must be normalized girth, and Column C must be normalized spread so that the results are plotted consistently from set to set. This way height 100% is at the top, the girth 100% is at the bottom right corner, and spread 100% is at the lower left corner of the plot. The program is easy to use, but one note is that a generated diagram should be saved as a picture file before overwriting the data cells.

RESULTS AND DISCUSSION

After eliminating duplicate trees from the original ENTS Maximum List, and eliminating all measurement sets that did not include all three parameters, a table including 112 trees measurement sets remained.

It should be noted that some of the largest trees in the ENTS Maximum List data set were not included because their measurements lacked one or more parameters. The Boogerman Pine, for example, the tallest known white pine was not included because the measurements of the tree did not include an average crown spread measurement. The set of maximum tree measurements reflects of average crown spread information because this parameter is difficult to collect in the field. Figure 3 is a plot of the overall data set.

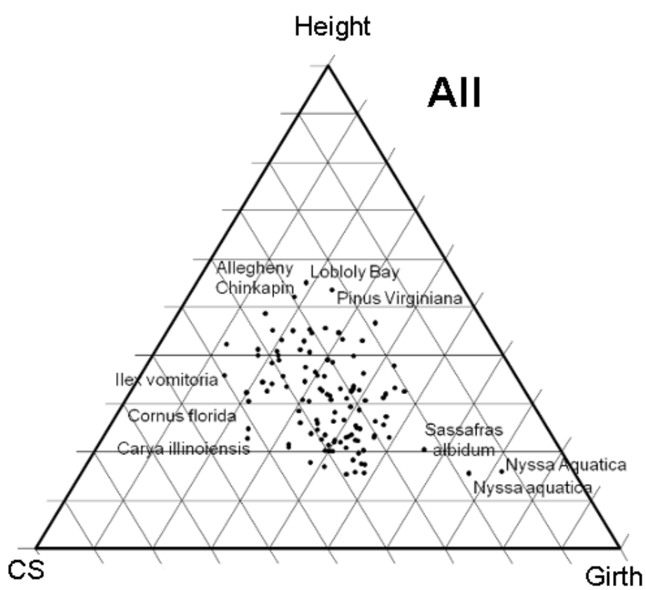

Figure 3. Summary graph of all 112 of the trees included from the ENTS Maximum List in the initial tree shape plot. Outlying points are labeled as to species.

The species represented by the outlying points are noted on the diagram. The loblolly bay, Virginia pine, and Allegheny chinkapin in the data set are tall relative to the other parameters. The two examples of *Nyssa aquatica* have a very large girth in relation to the other parameters. It often has a very bulbous base at measuring level before abruptly narrowing to a more standard tree shape. None of the trees have a particularly exaggerated girth with respect to the other parameters. The graphs can be separated into smaller groups by genus (Figure 4).

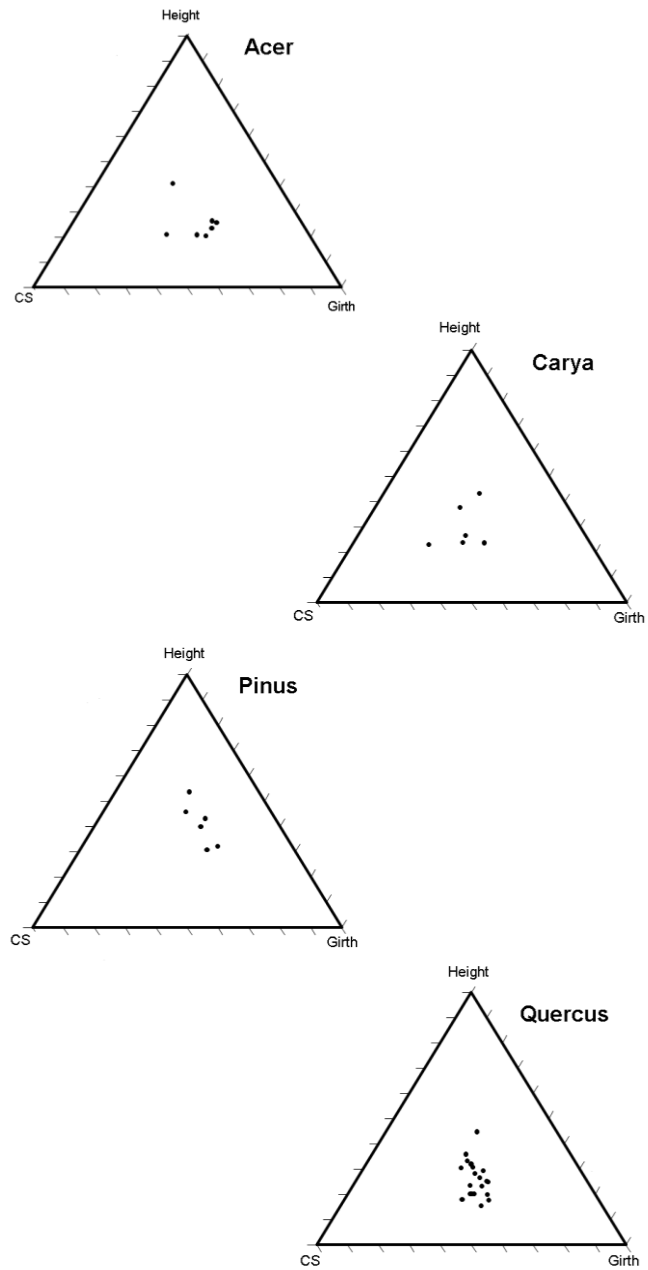

*Figure 4. Separate plot of tree shape four genera (***Acer, Carya, Pinus,*** and ***Quercus***) included from the ENTS maximum list.*

These are the only families for which there was data for a sufficient number of species to make a meaningful plot and only the largest examples from the ENTS Maximum List were included in the plots. Overall, it is at first somewhat surprising that the shapes of different species of trees do not tend to form more distinctive clusters within the overall plot, but upon further consideration it is reasonable that plots of such a large variety of tree species with little repetition of any single species would not tend to form distinctive clusters. Plots of trees from the same family do show that there is some clustering tendency within these tree families. The data also include trees that are forest grown or open to partially forest grown. Some of the trees are growing in ravines, others in flat areas, or river floodplains. Some are growing where there are better soil conditions and areas with varying amounts of rainfall.

There might be a general pattern of differences between different settings in which the trees were found—open-grown versus forested. In general the graph shows that different trees have different shapes and that the shapes represented tend to be closer to the average shape in proportions than they do the more extreme ranges of proportions. If there was a clear distinction between the shapes of trees open grown in the set and trees grown in the forest in the set, instead of a single pretty uniform grouping there would have been a double set of clusters. The crown spread average for trees in which this value was not measured may have been different from those that were. The standard tree shape is based upon the data collected and incorporating as wide a variety of trees as possible. Changing this parameter in the calculations would result either in the effective stretching or compression of that axis compared what is shown, but really would not affect whether or not a clustering pattern was present or not. The exact values of each of these values aren't critical to the calculation, a reasonably good approximation is sufficient to delineate patterns and distributions. These values can be revised as needed as more data is added into the sets. As it stands there is no reason to believe that the actual standardized average crown spread value with many more measurements would be substantially different from what was used in these initial calculations.

Live Oak (*Quercus virginiana*) Data Set
These results above indicate that the methodology is basically sound. The next step is to test this process using a larger data set. The data set generated by Lawrence Tucei's as part of his Live Oak Project:

http://www.nativetreesociety.org/projects/liveoak_project/index_liveoak.htm

was selected because this data set have a substantial number of listings for a single species that includes all three parameters needed for the analysis—height, girth, and crown spread. There is a question of whether or not the data set is biased because it only includes trees with girths of greater than 20 ft which are, for the most, part open grown.

To a degree, these are self-selected data, but to what degree does having minimum criteria for one dimension bias the other measurements? If all of the trees encountered that meet that minimum girth measurement are measured, it restrains that single measurement, the others are free to be whatever they are. It simply means that the analysis is looking at one subset rather than the entire population of the species. It would not be practical or meaningful to look at the entire population because seedlings and saplings outnumber the mature specimens by a large margin. Therefore, it is reasonable to set some minimum criteria in at least one dimension to limit the sample population. In many listings the minimum criteria selected is height. For example, if all of the white pines in the northeast greater than 150 ft were plugged into the process it would still be meaningful because the other parameters are not artificially constrained.

The data set used for the analysis included 140 live oak trees (a sample of which is shown in Table 1). These ranged in girth from 19 to 40 ft, in height from 39 to 81 ft, and crown spreads from 90 to 177 ft, and no trees were excluded from the dataset.

Table 1. Example of the normalized data of five of the largest girth live oaks of the 140 included in this tree shape analysis.

	------------ Normalized (%)	-----------	
Tree name	height	girth	spread
Seven Sisters Oak	7.90	58.25	33.85
E.O. Hunt Oak	6.55	52.35	41.10
Walkaih Bluff Oak	9.33	51.47	39.21
Middleton Oak	11.00	58.08	30.92
Saraland Oak	10.25	57.82	31.93

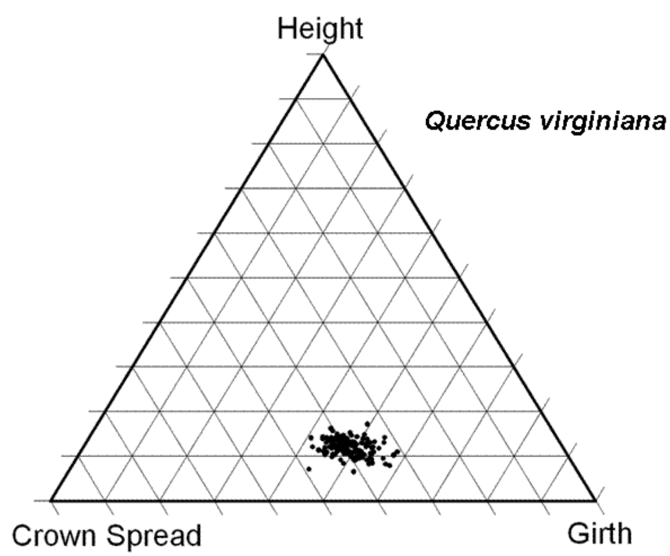

Figure 5. Plot of the normalized data of the 140 live oak trees included in the tree shape analysis.

Figure 5 demonstrates that live oak is relatively short when compared to their width and girth. The proportions plot well below those of a standard tree shape. An average tree shape plots in the center of the diagram. The diagrams to not relate to the overall size of the tree, just to the relative proportion of the height, girth, and crown spread. If compared to the diagram of the initial data set generated from Jess Riddle's ENTS Maximum List, the cluster representing the live oak falls on the extreme edge of the general pattern of tree shapes as a group. The height proportion exhibits a maximum of 17.23% of the shape value and a minimum of 6.55%, the girth (minimum of 19 ft in the data set) exhibits a maximum of 58.25% and a minimum of 40.25%, and Average Crown Spread maximum of 49.08% and a minimum of 30.92%. This forms an extremely tight cluster of shapes for these trees. In general these represent the largest specimens of live oak and represent open grown specimens, but the tightness of the shape cluster is still remarkable. It is even more interesting to note that the data set contains both multiple trunk trees and single trunk trees and both plot within the same tight cluster.

CONCLUSIONS

Ternary plots can be used to graphically display any set of data that includes three terms which total to some constant. Generally this constant is 1 or 100%. This is ideal for plotting the three most commonly measured tree dimensions. For situations where there are three parameters that do not add to a single constant, one option to be considered is a three-dimensional scatter plot. For more complex problems with more than three variables there are a variety of other ordination techniques that can be used.

One such option used successfully in many ecological applications is non-metric multidimensional scaling (NMDS). The draw-back is that it is quite a bit more complicated and it is even more difficult for the non-mathematical inclined to visualize the process and results. A website at Oklahoma State University (http://ordination.okstate.edu/) provides an overview of various ordination techniques that might be considered. The most popular reference book on how to apply various ordination techniques is "Analysis of Ecological Communities" by Bruce McCune and James Grace. It can be ordered from this website:

http://home.centurytel.net/~mjm/book.htm

The accompanying software (PCORD) is available at this website:

http://home.centurytel.net/~mjm/pcordwin.htm

PCORD does all sorts of analyses useful to forest ecologists, and is the first choice for many analyses (Frelich 2010a,b; Riddle 2010).

NMDS and other techniques will likely prove useful in the future as more varieties of tree data are collected. At one of the recent ENTS events, Dr. Tom Diggins, did a presentation in which he used a NMDS analysis to look at the distribution and orientation and size of coarse woody debris at Zoar Valley, New York. Various types of these ordination techniques are being used by forest ecologists on a regular basis and are a logical evolution of the type of tree analysis presented here.

For this particular application—determining overall tree shape based upon height, girth, and crown spread information the ternary plot is ideal. It is simple to implement and is understandable to even non-mathematicians among us.

LITERATURE CONSULTED AND CITED

American Forests. 2010. History of the Big Tree Program. http://www.americanforests.org/resources/bigtrees/history.php. Accessed December 13, 2010.

Blozan, W. 2005. Re: Formulas for points—my meager take on things. http://www.nativetreesociety.org/measure/tdi/dimension_rating_index.htm. Accessed December 13, 2010.

Department of Geography, Loughborough University. 2010. Tri-plot: Ternary diagram plotting software http://www.lboro.ac.uk/research/phys-geog/tri-plot/. Accessed December 11, 2010.

Eastern Native Tree Society. 2010. ENTS website. http://www.nativetreesociety.org. Accessed December 13, 2010.

Fichter, L. 2000. Reading a ternary diagram and creating rock names. http://csmres.jmu.edu/geollab/fichter/SedRx/readternary.html. Accessed December 13, 2010.

Frank, E. 2005. Tree form analysis. http://www.nativetreesociety.org/measure/volume/tree_form_analysis.htm. Accessed December 13, 2010.

Frank, E. 2010a. A numerical method of plotting tree shapes. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en Accessed December 13, 2010.

Frank, E. 2010b. A numerical method of plot of Live Oaks. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en Accessed December 13, 2010.

Frank, E. 2010c. Live oak shapes. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en. Accessed December 13, 2010.

Frelich, L. 2010a. ENTS discussion list comment. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en Accessed December 13, 2010.

Frelich, L. 2010b. ENTS discussion list comment. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en Accessed December 13, 2010.

MjM Software Design. 2010. Order Page for "Analysis of Ecological Communities." http://home.centurytel.net/~mjm/book.htm. Accessed December 13, 2010.

MjM Software Design. 2010. PCORD: Multivariate analysis of ecological data. http://home.centurytel.net/~mjm/pcordwin.htm. Accessed December 13, 2010.

Oklahoma State University Ecology. 2010. Ordination methods for ecologists. http://ordination.okstate.edu/. Accessed December 13, 2010.

Riddle, J. 2009. ENTS Maximum List. http://www.nativetreesociety.org/bigtree/maxlist/Max%20list%202.1.xls. Accessed December 13, 2010.

Riddle, J. 2010. ENTS discussion list comment. http://groups.google.com/group/entstrees/browse_thread/thread/e167a0fa2b52e343?hl=en Accessed December 13, 2010.

Tucei, L. 2010. Live Oak Project. http://www.nativetreesociety.org/projects/liveoak_project/index_liveoak.htm. Accessed December 13, 2010.

Waterproof-paper.com. 2010. Free Ternary Diagram – Triangular Graph Paper. http://www.waterproof-paper.com/graph-paper/ternary-diagram-triangular-graph-paper.shtml. Accessed December 13, 2010.

What species of tree is this? It is native to much of the South, including Arkansas… Photo by Don C. Bragg.

LIVE OAK CROWN VOLUMES

Edward Forrest Frank[1], Robert T. Leverett[2], and Larry Tucei[3]

[1] Associate Editor and Webmaster, Eastern Native Tree Society

[2] Founder, Eastern Native Tree Society

[3] Eastern Native Tree Society

INTRODUCTION

The crowns of most trees are too irregular in shape to be modeled by a simple geometric figure. The exception may be the shallow dome-like crowns of open grown live oak (*Quercus virginiana*) trees in southern and southeastern United States. A good description of the general form would be to liken it to the exposed portion of a hemisphere partially buried in the ground. Larry Tucei has documented many trees of this general form as part of his Live Oak Project:

http://www.nativetreesociety.org/projects/liveoak_project/index_liveoak.htm

A model was developed that can be used to determine the volume of tree canopies of this shape. The objective is to calculate the volume of part of a hemisphere starting at the apex and going down for a distance of h_1. At the start, the radius of the hemisphere is not known. Figure 1 shows the part of the hemisphere of interest.

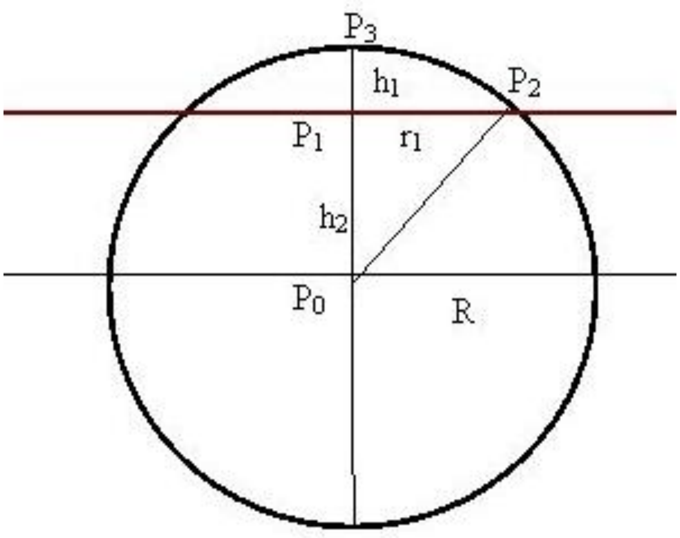

Figure 1. Basic circular relationships.

In the diagram there is a height h_1 which is the height of the part sticking out of the ground. In a tree this is the height of the tree ($h_1 = R - h_2$). There is also r_1 which is the pseudo- radius of the hemisphere at the point it intersects the ground surface as measured from the center of the circle at ground level to the edge of the circle. This is the crown spread divided by two. Definitions:

R = radius of hemisphere (unknown)

h_1 = distance from top of hemisphere to point P_1, i.e. P_1 to P_3

r_1 = distance P_1 to P_2

h_2 = distance from P_0 to P_1

V_q = volume of hemisphere from P_3 to P_1

V_p = volume of hemisphere from P_0 to P_1

V = volume of hemisphere

The portion above the brown line is the area of interest, i.e. the part of the hemisphere above ground. The volume of the area above the brown line is what we want to determine.

$$R = \frac{r_1^2 + h_1^2}{2h_1}$$

$$h_2 = R - h_1$$

$$V = \frac{2}{3}\pi R^3$$

$$V_p = \frac{\pi}{3}(3R^2 h_2 - h_2^3)$$

$$V_q = V - V_p$$

These formulas were used to develop an Excel spreadsheet to calculate the crown volume. The values measured for the tree—tree height and average crown radius—to be plugged into the cells and the formulas in the spreadsheet makes the calculations:

http://www.nativetreesociety.org/measure/problems/Problem_11.xls

A tree crown fits this shape model if: a) it has a domed shaped top surface, b) the base of the crown is flat or at ground level on a flat surface, and c) the width of the crown spread is greater than or equal to twice the vertical thickness of the crown. A number of trees documented and measured by Larry Tucei as part of the Live Oak Project:

http://www.nativetreesociety.org/projects/liveoak_project/index_liveoak.htm

fit these general shape parameters. Four examples were selected based upon photographs that showed the entire canopy form for testing this methodology, and are presented below (in cubic feet). These were calculated based upon maximum crown spread. Average maximum crown spread would result is smaller volumes.

Looking at the results, it can be seen that by far the largest volume crown measured was for a live oak—the Walkaih Bluff Oak at almost 1,000,000 ft^3. The Middleton Oak, one of the largest trunk volume live oaks known, and certainly the largest ever accurately modeled, finished last out of the trees calculated. Other live oaks have either a more upright trunk form, or were not selected for this initial calculation set because photographs documenting crown form were not available. All pictures are by Lawrence Tucei, except for Will Blozan's Middleton Live Oak photograph.

Shrine of the Holy Cross Oak #1, Alabama (above): CBH 22.6 ft, spread 124.5 ft, and height 75 ft.
http://www.nativetreesociety.org/fieldtrips/alabama/knollpark/andrew_jackson_oak_and_knoll_park.htm
The crown volume was calculated both considering the crown to extend to the ground and the crown extending only to a height of about 10 ft as it appears to be in the photograph. Crown volume = 677,413 ft^3 calculated to the ground, Crown volume calculated with base of crown at 10 ft = 539,444 ft^3. The latter is likely the better estimate.

Middleton Oak, SC (above): CBH 32.8 ft, spread 118 ft, and height 67.5 ft.
http://www.nativetreesociety.org/fieldtrips/south_carolina/middeltonoak/middelton.htm
Again, the measured height of 69 ft was used for one crown volume calculation and also used 59 ft for height to offset the small pointed top sticking out of the main mass of the canopy. Using the full crown height, the crown volume = 530,117 ft^3, while using a height of 59 ft the crown volume drops to 430,145 ft^3. The latter volume is likely the better of the two approximations.

Walkaih Bluff Oak, Picayune, MS (above): Spread 165 ft and height 73 ft. Crown volume = 984, 149 ft^3.

Josephine Stewart Oak, LA (above): spread 156 ft and height 74.6 ft.
http://www.nativetreesociety.org/fieldtrips/louisiana/oak_alley/oak_alley_plantation.htm
Crown volume = 930,309 ft^3.

DISCUSSION

Looking at the photographs it can be seen that many of the oaks match exceptionally well with the ideal dome form. For these trees this formula and spreadsheet can be used to calculate an excellent measure of crown volume. Other trees are not as perfect and do not match the ideal form nearly as well. For these trees the crown volume measurement is not as accurate, but I believe it is still a useful good approximation. Crown volume is not a commonly calculated measurement. The simplicity of this methodology, for these dome forms at least, will enable this measure to be calculated quickly and should promote wider usage in tree descriptions and comparisons. There are few trees in the eastern United States that can hope to match the crown volumes of many of these larger live oaks. Some broadly spreading sycamore trees and a few open grown white pines are likely among the few that will make the grade.

Many of the live oak trees do not have a perfectly round crown foot print. One axis of the tree will be broader than the perpendicular axis. If these values are relatively close, simply averaging the two axis to obtain an average crown spread. If they are widely different then the lengths of the axis can be converted to an equivalent circular radius for use in the crown volume calculation using this formula is (minor radius axis)(major radius axis) × 0.5. This correction is not large. For a tree with minor axis of 50 ft and 90 ft, averaging the radii will yield an average value of 70 ft, while the geometric formula yields a value only slightly smaller at 67.1 ft.

This crown volume modeling process may include gaps or voids within the canopy volume. For modeling purposes these areas of negative space are considered part of the crown volume. They change the overall branch and leaf density of the crown, but not its volume. As a quick calculation in the field, you can treat many of these forms as 1/2 of a scalene ellipsoid or 1/2 egg-shaped. In this rough crown volume estimate, first measure the length of major and minor axis of the crown spread and then measure the crown height. Then:

Volume = (length major axis) (length minor axis) (height) × 0.5

This is not perfect because this calculation assumes the full half ellipse is present with the sides starting vertical and curving over to form the top of the crown, when in fact many of these represent portions "sliced" from the top of the ellipsoid rather than a full hemisphere of the ellipsoid. The final calculations can later be made using the spreadsheet formulas.

Obviously the canopy form varies between open grown and forest grown examples of a single species, and certainly the canopy form will vary between species. These examples presented here deal with a specific subset of canopy forms meeting a specific shape criterion. They are not meant to be applied to tree with other canopy shapes.

LITERATURE CITED

Frank, E.F. 2009. Live oak crown volumes. http://www.nativetreesociety.org/measure/volume/liveoakcrown/live_oak_crown_volumes.htm. Accessed December 10, 2010.

Leverett, R. 2009. Crown volume problem #11. http://www.nativetreesociety.org/measure/problems/Problem_11.htm. Accessed December 10, 2010.

Tucei, L. 2010. Live oak project. http://www.nativetreesociety.org/projects/liveoak_project/index_liveoak.htm. Accessed December 10, 2010.

Here's another view of a different specimen of the question of what species of tree is this from the previous article… Photo by Don C. Bragg.

A TREE SO NICE THEY INVENTED IT TWICE!

Fred Paillet

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As a tree hugger growing up in New England, I learned to appreciate trees in the wilds of the White Mountains and Adirondacks. It would be hard to name a favorite among the many obvious choices: white pine, sugar maple, beech, northern red oak, and paper birch. But yellow birch has always seemed to be the very soul of the northern hardwood biome. Part of this is just an accident of forestry economics. Loggers removed the largest specimens of the valuable hardwoods, pine, and spruce. Large old yellow birches were left behind to stand out as old forest patriarchs, with their shaggy plates of bark and broken and regenerating crowns (Figure 1).

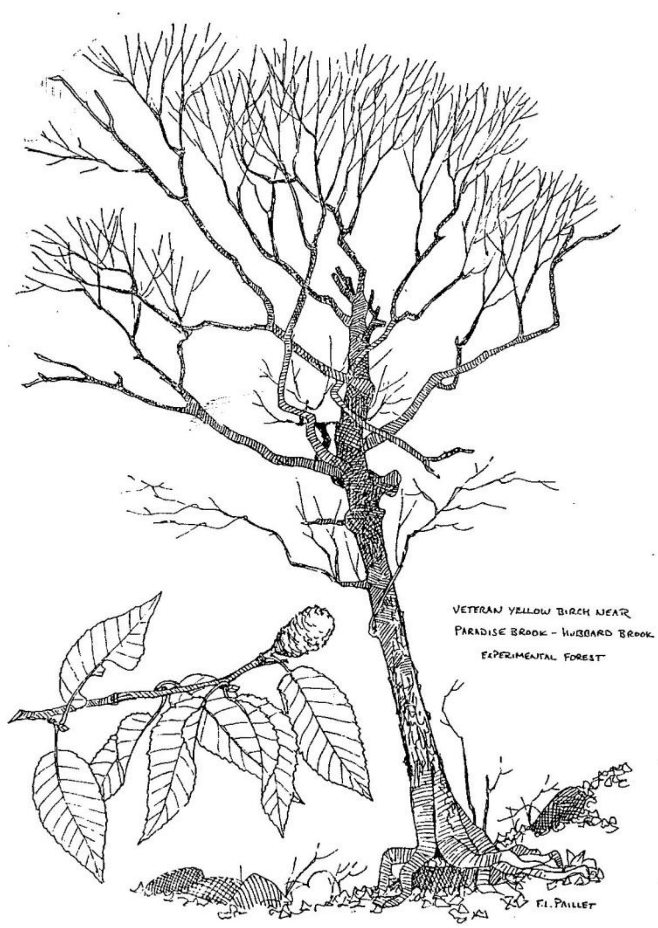

Figure 1. A typical old veteran yellow birch on the slopes above Hubbard Brook New Hampshire's White Mountains.

Young stands of yellow birch, in contrast, have gracefully slim trees with silvery bark peeling away in delicate scrolls. As if that weren't enough, yellow birch has another endearing habit—it tends to grow from seedbeds formed by the tops of rotting stumps and logs or from the mossy beds provided by glacial erratic boulders. That habit results in old trees with stilt roots where the woody substrate has long since rotted away, or with gnarled masses of roots draped over rocks and descending into cervices (Figure 2). When birches are established on the rocky banks of mountain streams, erosion undermines the base of the tree and makes the root exposure even more dramatic. Yellow birch has always been an integral part of the quest for colorful speckled trout in mountain brooks (Figure 3).

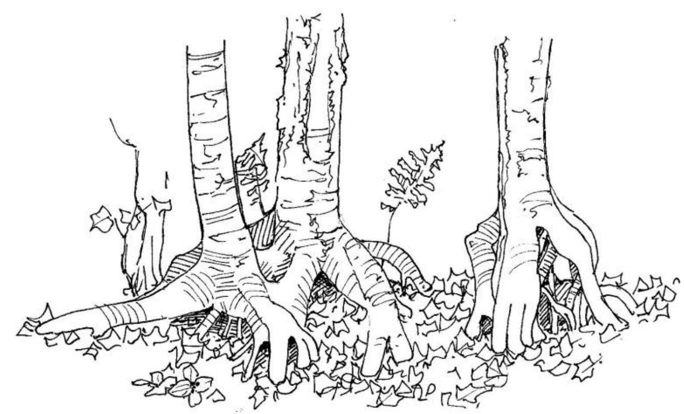

Figure 2 (above). Stilt roots mark the long faded evidence of former nursery logs near Mirror Lake, Hubbard Brook Experimental Forest.

Figure 3 (below). The roots of a yellow birch growing on rocky banks overlooking a trout pool near Thoreau Falls in New Hampshire's Pemigewasset Wilderness.

So if one has to define a single tree as a symbol of the north woods, for me that would be *Betula allegheniensis*.

When later life brought opportunities to see more of our eastern forests I had the chance to experience yellow birch in other habitats. The tree often comes to dominate the forest in that transition zone between northern hardwoods and spruce-fir, with yellow birch filling in as beech and maple drop out. I found the same phenomenon in the southern Appalachians in the Great Smokey Mountains and Mt. Rogers. Yellow birch showed up in steep defiles connecting lakes along portages in the Boundary Waters of southwestern Ontario, or where foaming streams descended down to the north shore of Lake Superior. These outlying pockets of trees seldom grow to gigantic proportions but they still have the habit of producing dramatic bundles of contorted roots where they grow along streams or project outward from rocky ledges.

Yet another revelation of yellow birch was associated with the crests of outlying Appalachian ridges. Sturdy birches are a standard part of the transition from deciduous to boreal conifers in the Blue Ridge province. But, as Whittaker (1956) noted in his famous monograph on the Great Smokey Mountain forest, there are some mountains with grassy balds instead of boreal conifers. He attributed these to the "Thunderhead Peak" phenomenon, where a warmer climate in the early Holocene forced the conifers to retreat to higher elevations. There was no seed source to allow for spruce and fir to return to outlying peaks that failed to provide a refuge for these species. The result has implications for yellow birch, which by default fills in at upper elevations. This has produced some wonderfully picturesque trees in a sort of elfin forest. A kind of over-grown deciduous bonsai (Figure 4). Dwarfed and contorted birches are especially apparent in places like the balds adjacent to the Kilmer Grove and along the Cherohala Highway in southwestern North Carolina.

But the biggest surprise for me was to see essentially the same tree in the Russian Far East (Figure 5). I had long wanted to visit the famed Ussuri Forest, which is supposedly a near analog of our New England forests (Matthiessen 2001) and provides the backdrop in a classic Russian exploration story (Arsiniev 1923). A modern and more systematic botanical description of forests in the greater Amur region is summarized by Del Tredici (2005). When I finally arrived in the Sikote-Alin country, the general aspect was indeed like that of the White Mountains. The well-rounded ridges were of about the same elevation, with a transition from deciduous trees to spruce and fir on the upper third of the tallest peaks. The flagged crowns of large emergent white pines (*Pinus koraiensis*) dotted the lower slopes. The bright red foliage of maples contrasted with the orange and browns of oak, ash, elm, and linden at the height of the foliage season. Yellow alleys of aspen and white birch (*Betula platyphylla*) marked the extent of old burns meandering along the well drained soils of outwash plains between the ridges. But the most surprising find was another birch (*Betula costata*) that appeared nearly identical to our yellow birch, becoming especially abundant in the mid-elevation transition forest.

Figure 4 (above). A stunted and wind battered yellow birch on a rocky ridge above the Joyce Kilmer grove and adjacent to a typical Appalachian bald.

Figure 5 (below). Portrait of a typical Russian yellow birch in the Ussuri Preserve in the Russian Far East.

The tree had the same silvery bark when young, maturing into the large, corky plates of older trees. The leaves had the same shape and texture. Even the seed cones looked similar. Some of the other general similarities with New England forests were not so exact. For example, the Russian "cedar" looks strikingly like our eastern white pine, but the ecology is very different as the tree produces pinyon-like nuts from massive cones. This imposes a very different regime in seedling propagation that relies on bird and rodent dispersal and allows establishment in deep leaf litter. In the case of yellow birch, the analogy seemed almost exact. This even applies in forestry, where the Russians long considered the tree useless except for firewood. Cut-over forests thus contain the same scenic old veteran birches we see in America. But all that has recently changed. During my visit I saw long trains of flatbed railroad cars filled with the massive meter-thick logs of birch. All of them headed south to the Chinese furniture industry. Even so, the Russian yellow birch is so abundant and prolific that this probably represents more of an economic opportunity than a threat to the tree. Otherwise, it was a real thrill to see one of my most favorite trees in such an exotic environment. A tree so nice they had just had to invent it twice.

LITERATURE CITED

Arsiniev, V.K. 1923. Dersu Uzala (1996 translation of Russian original by Malcolm Burr). McPherson & Company, Kingston, NY. 352 p.

Del Tredeci, P. 2005. Capturing and cultivating *Chosenia*. Arnoldia 63(3):18-27.

Matthiessen, P. 2001. Tigers in the snow. North Point Press. 208 p.

Whittaker, R.H. 1956. Vegetation of the Great Smokey Mountains. Ecological Monographs 26(1):1-80.

Yellow birch leaves illuminated by the summer sun at Porcupine Mountains State Park in Michigan. Photo by Don C. Bragg.

REFLECTIONS ON STILLNESS

Robert T. Leverett

Founder, Eastern Native Tree Society

The enjoyment of stillness and the gift of silence from the ever-growing pollution of human generated noise are blessings that nourished the souls of early wilderness advocates like John Muir.

We may yet find stillness, but we have lost virtually all of that freedom of silence…

The overhead hum of airplanes can be heard in all places, near and far. There is a virtue in searching out the remaining wild places and promoting their value to us, especially in terms of spiritual connections.

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*
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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.

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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. 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.

A large dead baldcypress now spreads its branches for eagles, cormorants, and vultures over the waters of Cane Creek Lake near Star City, Arkansas. Photo by Don C. Bragg.