Tree crown measurement

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The **crown of a tree** consists of the mass of foliage and branches growing outward from the trunk of the tree. The average crown spread is the average horizontal width of the crown, taken from dripline to dripline as one moves around the crown. Some listings will also list the maximum crown spread which represents the greatest width from dripline to dripline across the crown.[1][2][3] Other crown measurements that are commonly taken include limb length, crown volume, and foliage density. Canopy mapping surveys the position and size of all of the limbs down to a certain size in the crown of the tree and is commonly used when measuring the overall wood volume of a tree.

Average crown spread is one of the parameters commonly measured as part of various champion tree programs and documentation efforts. American Forests, for example, uses a formula to calculate Big Tree Points as part of their Big Tree Program[3] that awards a tree 1 point for each foot of height,[4] 1 point for each inch of girth,[5] and ¼ point for each foot of crown spread. The tree whose point total is the highest for that species is crowned as the champion in their registry. The other parameter commonly measured, in addition to the species and location information, is wood volume.[6] A general outline of tree measurements is provided in the article Tree Measurement[7] with more detailed instructions in taking these basic measurements is provided in "The Tree Measuring Guidelines of the Eastern Native Tree Society" by Will Blozan.[1][2]

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Largest Recorded Crown Spreads

Data on greatest crown spread is somewhat limited as this parameter is not measured as frequently as are tree height and trunk girth. The largest recorded is the "Monkira Monster" (Eucalyptus microtheca) located at the Neuragully Waterhole in southwestern Queensland, Australia which measured 239 feet in 1954.[8] A Raintree (Samanea saman) in Venezuela was measured to have a crown spread of 207 feet in 1857. It reportedly is still living, but in poor health.[8] A University of Connecticut site[9] suggests that in the wild they may have crown spreads up to 80 meters. Robert Van Pelt measured a crown spread of 201 feet of a Kapok Tree (Ceiba pentandra) at Barro Colorado Island, Panama in 2003.[8]

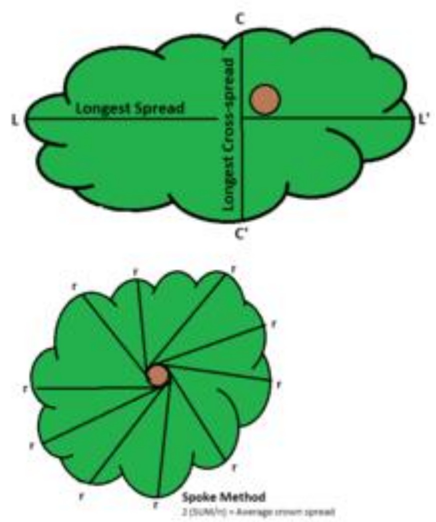
Crown Spread Methodologies

Cross-method. The average crown spread is the average of the lengths of longest spread from edge to edge across the crown and the longest spread perpendicular to the first cross-section through the central mass of the crown.[1][2][3] Crown spread is taken independent of trunk position. Spread should be measured to the tips of the limbs, not to "notches" in the crown shape, and at approximately right angles from each other.

Average crown spread= (longest spread + longest cross-spread)/2

The surveyor locates the point on the ground immediately below the branch tip on one end of the measurements and marks that position. He then moves to opposite side of the crown and locates the point under that branch tip. The spread along that line is the horizontal distance between those two positions. On steeply sloping ground (> 15 degrees) the taped distance between the two points can be corrected to a true horizontal by using basic trigonometry. Horizontal distance = cos (inclination) x slope distance. The help of an assistant or the use of a laser rangefinder can greatly speed this process.

When using a laser rangefinder, as in measuring tree height, several points on the far edge of the crown can be explored to find the furthest point. A laser rangefinder is also useful for measuring crown spread where one side of the crown is not easily accessible, such as a tree growing on a cliff side or other barrier. Measurements using a laser rangefinder if made at a steep angle greater need to be corrected for true horizontal distance using the formula above.



Tree crown spread measurement

Spoke Method. When using the spoke method, four or more measurements are taken from the outer dripline of the crown to the side edge of the trunk. The distance to the side edge of the trunk is for all practical purposes equal in length to the distance to the center of the trunk. If the measurement from the dripline of the crown to the side edge of the trunk is not level, then the measured length must be converted to a horizontal distance. Spoke length = cos(inclination) x (measured distance) If the slope angle is less than 10 degrees the difference between the horizontal distance and the measured length will be less than 1.5% for slope distances less than 100 feet. These individual spoke lengths are averaged and this average is equal to half the average crown spread. The more spokes measured in the process, the more accurate the characterization of the average crown spread.

2 (SUM/n) = Average crown spread

This is the preferred method of canopy researchers and is probably the most accurate, and can also be used to quantify crown area. On large trees it can be accomplished quickly with a laser rangefinder.[1]

Another instance where a laser rangefinder and clinometer are useful is if the canopy is high off the ground. For example, white pine typically has a long bare stem, with branching beginning far up the trunk. In these cases a series of shots taken to the outer reaches of the branches standing at the side of the trunk can be used to calculate the length of spokes. In this case the angles will be steep, and the length of a spoke will be:

cos(inclination) x (laser measured distance) = spoke length

Google Earth Measurements. With the increased availability of high resolution air photos available through Google Earth[10] crowns of individual trees can be distinguished providing another option for measuring crown spread.[11] The latitude and longitude of the tree can be read directly from Google Earth. Google Earth itself includes a ruler tool that can be used to measure diameters or spokes across the crown of the tree. Alternatively the crown area can be measured and crown spread calculated from that value. EasyAcreage V1.0 (demo version)[12] is a Google Earth area measurement tool that calculates the area of any shape outlined on the Google Earth display. Outline the edge of the trees canopy, following the branches and hollows around the canopy perimeter, including any enclosed hollows within the canopy outline and read the area provided by Easy Acreage. Average crown spread can be determined with a simple formula:

Crown Spread = $2(\text{area}/\pi)^{1/2}$

Here we see that area is the area of an equivalent circle. For critical measurements, it is advisable to check the measurement made through a remote sensing application in person.

Leverett[13][14] has also provided four options for measuring the crown area through compass and clinometer surveys around the outer edge of the crown or through a combination of measurements from the edge of the crown and to the trunk, and those around the crown perimeter. All four circumscribe the crown area's drip-line with a polygon and divide the polygon into a series of adjacent triangles, measure the area of each triangle and sum them. One option, the Polygonal Method, measures each side of a triangle to compute its area. The second and third methods uses azimuths and one distance to the trunk calculate the area. The fourth method, the Azimuth Method, requires only azimuths and distance measurements from point to point around the crown perimeter.

Polygonal Method. The measurer walks the perimeter of the crown following the drip line fairly closely. Points are identified on the ground that represent the outline of the crown and marked in a way so that the next point is always visible from the prior one. For the first point, the distance to the center of the tree's trunk is measured along with the vertical angle to the point. Then the distance to the next exterior point is measured along with the vertical angle. The measurer moves to that next exterior point and repeats the process, continuing clockwise until the crown is encircled. The last leg of the first triangle becomes the first leg of the second triangle, and so on, so only the first triangle requires measurements for all three legs. The result is a series of adjacent triangles with the sides determined. The area of each triangle is computed from its sides, and the sum of the areas computed. Each triangle covers part of the crown area. The sum of the triangles equals the total projected crown area. The instruments needed include a laser rangefinder or a tape measure and a clinometer.

Azimuth Method. In the he fourth method the measurer does not interact with the trunk or any internal point of the polygon. The measurer walks the perimeter shooting horizontal distances and azimuth to the next point until the crown's perimeter is circled. This is the simplest and most flexible method of the four. This method can also easily be used to measure the areas of other features encountered, for example, tree groupings or vernal ponds.

Maximum crown spread is another measurement that is sometimes collected. Maximum crown spread is the maximum width of the crown along any axis from the dripline on one side of the tree to the dripline on the opposite side of the tree.

Crown Density

The USDA Forest Service, has published a guidance document[15] on field evaluations of a variety of crown characteristics beyond that of the normally taken basic measurements. Included are a series of definitions of terms, crown shape, crown density/foliage transparency, un-compacted live crown ratio, vigor class, and various dieback evaluations.

Crown density is the amount of crown branches, foliage and reproductive structures that blocks light visibility through the crown. Each tree species has a normal crown that varies with the site, genetics, tree damage, etc. It also serves as an indicator of expected growth in the near future. The crown density may be estimated using a Crown Density-Foliage Transparency Card.[15][16] Using the card for reference the observer estimates what percentage of the light is being blocked by the crown mass. Estimates are made from two different directions at right angles and reconciled to determine crown density. There also are variety electronic densitometers that will measure crown or foliage density.[17]

Crown Volume Estimates

Crown volume includes the entire living canopy of a tree from the base of the live crown to the upper edge of the crown and from the outer edge of the branch tips inward. It does not include dead branches, above or below the living portion of the canopy, nor any epicormic sprout below the base of the living crown. It does include hollows or voids encompassed within those boundaries. Crown volume does measure the mass of the branches or foliage as it does not include measurements of the density of foliage and branches not their weight. The crown volumes generally cannot be adequately represented by simple geometric shapes due their irregularity in form.

For extremely complex shapes the surface of the crown can be mapped in three dimensions from a series of external or internal survey stations. From each station the position of a point on the surface of the crown can be mapped using a compass, laser rangefinder, and clinometer. Measurements made include azimuth from the surveying location, distance from surveying position, distance to the point, and inclination to the point. These can be converted to (x, y, z) coordinates for each point, and the measurements between different surveying locations can be tied together by measuring the relative positions between the different surveying locations.

The distance to the target point: cos(inclination) x lasered distance = (horizontal distance)

The position of the point relative to your position using magnetic north is: y-axis = (horizontal distance) x cos(azimuth) x-axis = (horizontal distance) x sin(azimuth) The height of the point relative to the measurement position is: z-axis = sin(inclination) x laser measured distance = height

Sufficient measurements must be made to generate a three dimensional surface plot of the outer edge of the canopy. The volume can then be broken into smaller slices, the volume of each individual slice calculated, and the volume of all the slices added together to determine total volume canopy.

Live Oak Crown Volumes. 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.[18] A model was developed that can be used to determine the volume of tree canopies of this shape. 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 3) the width of the crown spread is greater than or equal to twice the vertical thickness of the crown.

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 $[(\text{radius}_{\text{minor axis}})(\text{ radius}_{\text{major axis}})]^{0.5}$ This correction is not large. An Excel spreadsheet was developed to implement the volume calculations.[19]

Profile Rotation Method.[20] The volume of the crown can be determined using three values: 1) crown spread, 2) crown thickness, and 3) crown shape. The thickness of the crown and the average crown spread will be measured and the general crown shape of the tree will determined by visual comparison with a chart. The crown shape will be used to derive a Crown Form (CF) value for different tree shapes and will be the third parameter of the crown volume calculation formula. The crown of a tree can be subdivided into 10 disks each representing 1/10th of the height of the crown. The diameter of each disk can be expressed as some fraction of the average crown spread. Whether the tree is taller and each disk represents a greater length of the crown, or if the crown spread is larger or smaller, each disk will represent the same fraction of the total volume of the crown. Consider that there must be a single cylinder of the same height as the crown thickness that has the same volume as the irregularly shaped crown. The problem then becomes one of determining the diameter of this cylinder so that its volume equals that of the crown of the tree. The volume of each of the individual disks can be calculated by using the formula for the volume of a cylinder:

Volume of disk = $(\pi)(\text{height})(\text{radius}^2) = (\pi)(\text{height})(\text{diameter}^2)/4$

By rearranging the numbers a formula can be derived for the radius needed for the single cylinder solution. The height and π drop out and the result is the needed radius equal to the square root of the average of the radius2 for each of the disks.

$\text{Radius}_{(\text{cylinder})} = [\text{AVERAGE } (r_1^2 + r_2^2 + \ldots + r_x^2)]^{0.5}$

Tree shape profiles can be calculated individually for each tree encountered. However, examining the profiles of a large number of trees of different species found that typical profiles varied in a regular pattern, and for each profile family there was a Crown Form value that could be used to calculate the volume of the crown. Each different crown shape will have an associated crown shape ratio of the measured maximum average crown spread to radius of the equivalent cylinder diameter. This value cannot be used directly but first must be converted to a unique Crown Form factor value.

The formula for an equivalent cylinder may be expressed as follows:

Crown volume = Volume equivalent cylinder = $(\pi)(h(r)^2 = (\pi)$(thickness of crown)[(crown shape ratio)(average maximum crown spread)]$^2/4$, where average maximum crown spread = 2 average maximum radius

The constants can be rearranged to derive a Crown Form factor:

CF = $[(\pi)(\text{crown shape ratio})^2]/4$

The overall volume equation can then be rewritten as follows:

Crown volume = (CF) x (crown thickness) x (average maximum crown spread)^2

Thus the complex problem of estimating crown volume is reduced to two easily measured parameters – average maximum crown spread and crown thickness, and one value that can be determined using visual matching of shapes from a table of standard shapes. Open areas contained within the rotation volume are considered part of the crown volume, while stray branch tips extending outside of the rotation volume are excluded. Some trees simply have a crown shape that is too irregular to use this methodology to determine crown volume. These trees, if a crown volume value is required, will need to be evaluated in sections and the volume of each section calculated individually.

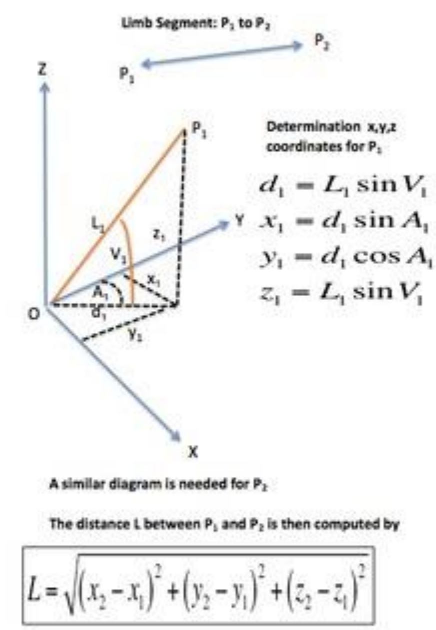
Limb Length

The longest limb is measured from the collar where it emerges from a trunk to its farthest horizontal extent. It should also be noted if the limb is self-supporting or if it is touches the ground somewhere along its length. The length of the limb may also be measured along the contours of the limb itself. If easily accessible this can be accomplished by simply using a tape measure. If the limb cannot be reached then remote measurement methods need to be used. There are several viable measurement techniques that can provide us with useful information about limb extension.[21]

Straight Line Length from beneath. The length of a limb can be measured with a laser rangefinder and clinometer if both end points of the limb are visible from a point beneath the end of the limb. The vertical distance is measured to the end of the limb directly over the measuring point at an angle of 90 degrees. The inclination and distance to the other end of the limb where it emerges from the trunk are then measured. The straight line length of the limb from trunk to tip can then be calculated using the Law of Cosines.[22]

For long limbs with changing curvature determining the limb length into smaller segments with each segment measured independently will almost always be required if acceptable accuracy is to be achieved. The length can be calculated based on a bivariate curvilinear regression model using multiple measurement points. This holds promise provided a regression program is used that allows for both bivariate linear and nonlinear regression. A good statistical package that provides this capability is Minitab, which supports second and third degree equations. Regression models for parabolas and exponential curve forms have been developed by NTS in Excel spreadsheet format for the benefit of measurers who don't use statistical software. Of particular interest is the parabolic curve. A spreadsheet application of this for parabolic curves has been developed by NTS. The spreadsheet fits a parabola to 4 or more points (up to 10 allowed) using the least squares method and then calculates the limb length (s) using Simpson's Rule to evaluate the definite integral.[22][23]

Limb Length via External Reference Position. Ground based measurements can be used to measure the limb length and diameters of branch sections remotely through the use of a monocular w/reticle or photographic analysis. The length of a segment can be determined by measuring the position of the end points of the branch in 3-dimensional space from an external reference position. The length is then calculated by applying Pythagorean's Theorem.[24] The following diagram illustrates the process.



Three dimensional coordinate calculations

From the external reference position O, the direct distance to L_1 is measured to P_1 along with the vertical angle V1 and azimuth A_1. The coordinates x_1, y_1, and z_1 are then computed. The same process is followed for P_2.

This sequence is carried out as follows:

The horizontal distance d_1 from the initial reference point O to a target point P_1 is computed as d_1 = cos(inclination) x laser distance = $L_1 \sin V_1$ The value of x at the first point is: x_1 = sin(azimuth) x horizontal distance = $d_1 \sin A_1$ The value of y at the first point is: y_1 = cos(azimuth) x horizontal distance = $d_1 \cos A_1$ The value of z at the first point is: z_1 = sin(inclination) x laser distance = $L_1 \sin V_1$ This process is repeated for P_2 to get (x_2, y_2, z_2) The final step is to compute the distance from P_1 to P_2 (L) using the following formula. $L = [(X_2-X_1)^2+(Y_2-Y_1)^2+(Z_2-Z_1)^2]^{1/2}$ Note that we are squaring the changes in the x, y, and z values, adding these squares together and taking the square root of the sum.[24]

Leverett[25] has developed a methodology where the length of a limb is measured using a monocular w/reticle aligned along the orientation of the limb, the distance to either end of the limb segment, and a calculated scaling factor to determine limb length. Essentially the apparent length of the limb at each end as using the distance to that point and the scaling factor for that distance as if the limb were perpendicular to the observer. These lengths are considered to be the top and base of a regular trapezoid with a height equal to the difference in the distance between the two points. The true length of the limb can then be calculated by treating it as a diagonal of the trapezoid.

Canopy Mapping

Canopy mapping is the process whereby the positions and size of the branches within the canopy are mapped in three dimensional space.[26][27][28] It is a labor intensive process that usually reserved for only the most significant specimens. This is usually done from a set position or a series of positions within the tree. Sketches and photographs are used to facilitate the process. Trees are climbed and the overall architecture is mapped including the location of the main stem and all reiterated trunks, in addition to all branches that originate from trunks. The position of every branch point in the canopy down to a certain size and also the positions of various reiterations, breaks, kinks, or any other eccentricities in the tree are also mapped. Each mapped trunk and branch is measured for basal diameter, length, azimuth, Climbers measure specific circumferences and detail other features within the tree.

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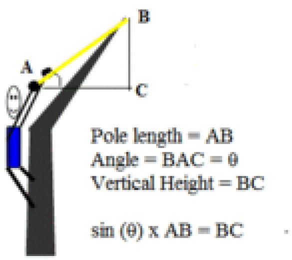
Tree volume measurements serve a variety of purposes, some economic, some scientific, and some for sporting competitions. Measurements may include just the volume of the trunk, or the volume of the trunk and the branches. Volume measurements can be achieved via tree climbers making direct measurements or through remote methods.[1][2] In each method, the tree is subdivided into smaller sections, the dimensions of each section are measured and the corresponding volume calculated. The section volumes are then totaled to determine the overall volume of the tree or part of the tree being modeled. In general most sections are treated as frustums of a cone, paraboloid, or neiloid, where the diameter at each end and the length of each section is determined to calculate volume. Direct measurements are obtained by a tree climber who uses a tape to measure the girth at each end of a segment along with its length. Ground-based methods use optical and electronic surveying equipment to remotely measure the end diameters and the length of each section.

The largest trees in the world by volume are all giant sequoias in King's Canyon National Park.[3] They have been previously reported by trunk volume as: 1) General Sherman at 52,508 cubic feet (1,486.9 m^3), General Grant at 46,608 cubic feet (1,319.8 m^3), and President at 45,148 cubic feet (1,278.4 m^3). The largest non-giant sequoia tree currently standing, Lost Monarch, is, at 42,500 cubic feet (1,203.5 m^3), larger than all but the top five largest living giant sequoias. The Lost Monarch is a Coast Redwood (Sequoia sempervirens) tree in Northern California that is 26 feet (7.9 m) in diameter at breast height (with multiple stems included), and 320 feet (98 m) in height.[4] In 2012 a team of researchers led by Stephen Sillett did a detailed mapping of the branches of the President tree and calculated the volume of the branches to be 9,000 cubic feet (250 m^3). This would raise the total volume for the President from 45,000 cubic feet to 54,000 cubic feet (1,500m^3) surpassing the volume of the General Grant Tree.[3][5] It should be noted the branch volume of the General Grant and General Sherman Trees have yet to be measured in this detail.

Direct Volume Measurements – Trunk

Tree climbers can physically measure the height and circumference of a tree using a tape. The distance from the highest climb point and the top of the tree is measured using a pole that extends from the tree top to the anchor point of the tape. This height is noted and the diameter of the tree is measured at that point. The climber then rappels down the tree measuring the trunk circumference by tape wrap at different heights with the height of each measurement referenced to the fixed tape running down the trunk.

Direct trunk measurements are obtained by a tree climber.[1][2] The climber will ascend into the tree until he reaches the highest safe climbing point. Once this point is reached, the climber drops a weighted throw line straight to the ground. A measuring (reference) tape is then attached via a small carabineer to the dropped throw line and pulled up to the top, following the vertical path of the weight's descent. The tape is affixed to the trunk at this point via several thumbtacks at this point and allowed to hang freely down the trunk. The exact position of the tack relative to the top of the tree is noted. If the top of the tree was not safely reachable a pole or stick is used to assist in measuring the remaining distance to the high point of the tree.



Tree Top Measurement

The climber pulls up an extendable pole and uses it to reach to the top of the tree from the point at the upper end of the tape. If not vertical, the slope of the leaning pole is measured and the length of the pole is measured. The vertical distance added by the pole to the tape length is (sin Θ x pole length). The lower end of the tape is terminated at the base of the tree. If on sloping ground this is the mid-slope point between the lowest and highest sides of the tree. The total height of the tree is equal to the measured distance from the base at mid-slope to the upper end of the tape where affixed to the tree plus the vertical height measured to the actual top of the tree. Girth measurements are made by wrapping the tape around the tree perpendicular to the bole at successive intervals as the climber rappels down the tree. All points of measurement are referenced for height above ground as measured on the fixed reference tape. Measurement intervals are subjectively chosen based on changes in trunk taper. An area where a change in profile is observed (in or out) is measured with a tape. Clear sections of trunk are selected so as to not include branch collars, burls, etc. For greatest accuracy, measurements are taken on single-trunked trees at no more than 10 foot (3 m) intervals.[1][2]

Additional measurements are generally required where the trunk branches or bifurcates or where there are trunk reiterations.

Reiterations are identified by an upturned branch that had gained apical dominance and formed an additional branch supporting trunk. Reiteration lengths are terminated at the point of trunk contact. Trunk reiterations are measured and added to the final trunk volume. A bifurcation is defined as a split or fork in the trunk that forms two or more often similarly sized ascending trunks. Bifurcations often form an irregularly shaped fused section that cannot be accurately measured with a tape for the purpose of computing cross-sectional area. All bifurcation lengths are terminated at estimated pith origination from the main stem.[1][2]

Frame Mapping

As part of the Tsuga Search Project, a frame mapping technique was developed to allow characterization of significantly large fusion areas at forks in the trees.[1][2] With two climbers, each on opposite sides of the tree, an area of fusion is selected to be measured. Two poles, longer than the diameter of the fused section, are lifted in place and connected by a thin rope threaded through opposite ends so they are adjustable. The poles are temporarily tensioned and the distance between the ends measured. Adjustments are made until they are parallel and perpendicular to the axis of the trunk. The slight tension between the poles holds them steady against the trunk. Tents stakes wedged in the bark can also be used to level and steady the frame. One end is designated the y axis, and the adjacent side the x axis. Measurements are made with a carpenters tape from the frame to the edge of the trunk and the profile of the trunk shape is plotted. The data is then entered into a trapezoidal area function in an Excel™ spreadsheet and converted into cross sectional area so as to calculate the equivalent circumference to use in the volume formula.

Footprint Mapping

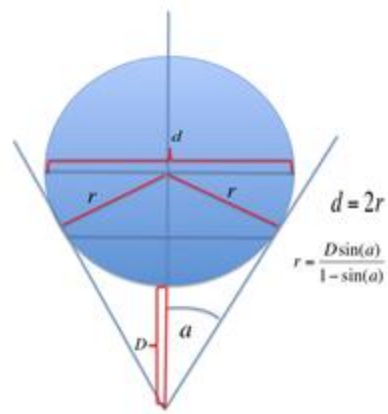
Many trees flare outward significantly at the base and this basal wedge has a complex surface of bumps and hollows. This becomes an even more complex volume in trees growing on a slope. Approximations of the volume of this basal segment using best estimates of the effective diameters exhibited may be used in many cases. In other cases footprint mapping is an option. In footprint mapping a level, rectangular reference frame is placed around the base of the tree, to create a horizontal plane. The position of the multiple points on the trunk surface is measured with respect to the frame and plotted. This process repeated at different heights creating a series of virtual slices at different heights. The volume of each individual slice is then calculated and all are added together to determine the volume of the basal wedge.

Remote Volume Measurements – Trunk

Remote measurements of trunk volume are usually made from a position on the ground where the observer has a clear view of the entire length of the trunk. Measurements may be made using professional surveying equipment such as a total station or an instrument such as the Criterion RD1000, using a combination of a monocular w/reticle, laser rangefinder, and clinometer, using photographic methods combined with a laser rangefinder and clinometer, or by using cloud mapping techniques.

Electronic surveying instruments such as a total station allows the observer to measure the position of each diameter measurement and the length of the trunk section between each measurement. With most of the instruments, the diameter is determined by measuring the angle of azimuth between the opposite sides of the trunk. Laser-measured distances to the sides of the trunk representing the ends of the diameter and the included angle are used with the law of cosines to calculate the diameter. The Criterion RD 1000 has a special feature that allows the diameter to be measured through a visible display. These length and diameter values then can be used to determine the volume of the individual section.

Another technique is available for those who possess instruments that will measure horizontal angles. The following diagram shows how to measure diameter remotely using a laser rangefinder to shoot the distance to the middle of the trunk and a transit or compass or another device to measure the horizontal angle created by the diameter. Note that in this method, the measurer shoots to the middle of the trunk instead of either edge. Also, the full diameter does not have to be visible from the point of measurement. It is a common misconception that closer distances lead to errors because the measurer can't see the full diameter. However, if the trunk is round, closeness is not a factor. In the diagram d = diameter, D = distance from measurer to middle of the tree, a = angle from the middle to the edge of the trunk. A variation of this method is to measure the complete angle taken up by the image of the trunk and divide it by 2 to get angle a.



Trunk diameter measurement

A combination of a monocular w/reticle, laser rangefinder, and a clinometer [1][2] can be used to do go from simple diameters to a full measure of trunk volume. A monocular w/reticle is a small telescope with an internal scale visible through the glass. The monocular is mounted on a tripod and the trunk of the tree is sighted through the monocular. The width of the trunk is measured as so many units of the reticle scale. The height above, or distance below, instrument and distance of the target point is measured using the laser rangefinder and clinometer. The distance is measured to the center (side) of the tree. With the distance known, the diameter of the tree measured expressed as units of the reticle scale, and an optical scaling factor for the monocular w/reticle, provided by the diameter of the tree at that point can be calculated:

Diameter= (Reticle scale) X (distance to target) ÷ (optical factor)

To assure accuracy, the calibration of the optical factor should be checked for each instrument rather than solely relying upon the manufacturer's specifications.

A series of tree diameters up the trunk of the tree are systematically measured using this procedure from the base of the tree to the top and their height is noted. Diameters can sometimes be measured with the monocular w/reticle in sections where it is difficult to obtain accurate laser distances because intervening thin brush or branches. Distances to the obscured section may be interpolated from measurements made above and below the obscured section.

Some photographic methods are being developed to allow calculation of diameters of trunk and limb segments in photographs that contain a scale of known size and where distance to the target is known.[6][7][8] Essentially The camera is treated as if it were a monocular w/reticle and the "optical factor" for the camera at a particular focal length is calculated for each photograph based upon the size of a reference scale and its distance from the camera. The scale need not be present in every image of an individual tree so long as the focal length has not been changed between images.[9] Using this principle a shot can be made of each measurement point through an enlarged image to make the girth measurements easier and more accurate. In addition this allows the central, less optically distorted portion of the image to be used for the measurements. The measured diameter of the almost cylindrical section is not going to vary significantly with viewing angle. Using data from clinometer and distance measurements at each end of a segment, the height, length, and distance of intermediate points can be calculated and the trunk diameters at these points can be measured. One advantages of the photographic method is the ubiquity of the digital camera. In addition, once the framework data is measured in the field, the trunk diameter measurement process can be done later on a computer. The photographic image can be also easily be re-measured if an error is encountered in the calculations.

Point cloud mapping is a process being developed by Michael Taylor [10][11][12] using optical parallax scanning technology whereby thousands of measurements are made around the trunk of a tree. These can be used to recreate a three-dimensional model of the trunk and volume data is among the values that can be calculated. There are a handful of widely available technologies including ground LIDAR and optical parallax scanners that can quickly and accurately map a trunk. LIDAR has the best range. The problem is in a cluttered forest environment you get a lot of 'noise' and unwanted cloud points, hundreds of thousands potentially, but these can be filtered out. The surface of tree trunks can be mapped using an optical scanner which measures pixel off-set ratio between a digital camera focal center and line laser projection and blends with photo pixel data. Taylor reports [11] this optical data can be supplemented using a system such as an Impulse200LR laser and Mapsmart software [13] to target tight areas where cloud density is low and/or not reachable by optical scanning technology, provided a properly scaled skeleton framework is established with the MapSmart/Impulse200 combination first. The data can be saved as a *.ply file which can be viewed and manipulated with a variety of software packages including the free open source 3D graphics viewer Meshlab.[14] There are several software programs available that can be used to calculate the volume of the space defined by the point cloud including some tree specific currently under development.[15]

Currently only the lower portions of the trunks of tree have been successfully mapped using point cloud mapping technology, but various options to map the entire trunk length of these trees are being evaluated. The point cloud mapping of the base of these trees can quickly create a 3D representation of the base of these large trees in much more detail than can be practically obtained through traditional footprint mapping.

Limb and Branch Volume Measurements

Limb and branch volumes present significant challenges. Not only must the girths of each end of the branch segment be measured, but the length of the limb segment must be determined as well for limbs oriented in different directions. The collected information must further be organized to assure that each section has been measured and none have been measured twice. The length and diameter measurements of the limbs can be accomplished by climbers physically measuring these values, or through remote methods, or a combination of both. In most cases the branch diameters are only measured down to a certain lower size limit, and the volume of the remaining finer branches is ignored, or extrapolated.

The volume of the limbs and branches can be significant. For example the Middleton Live Oak (Quercus virginiana), height 67.4 feet, dbh 10.44 feet, crown spread 118 feet) was found to have a trunk volume of 970 ft ^{3} (24.5 m ^{3}) and a branch volume of 3,850 ft ^{3} (109 m ^{3}) [16] The branch volume was almost 4x that of the trunk. In contrast the volume of the Sag Branch Tuliptree (Liriodendron tulipifera), height 167.7 feet, dbh 7.08 feet, crown spread 101 feet) had a trunk volume of 2430 ft ^{3} (68.6 m ^{3}) and a branch volume of 1560 ft ^{3} (44.17m ^{3}).[16] The volume of the branches on the tuliptree was only 64.2% that of the trunk.[16] The President Tree (Sequoiadendron giganteum) [3] was measured in 2012 to have a trunk volume of 54,000 cubic feet (1,500 m ^{3}) of wood and a branch volume of 9,000 cubic feet (250 m ^{3}) of wood in the branches. In this giant tree the branch volume was only 16.7% that of the trunk volume. In many trees with smaller or fewer large branches the branch volume may average as low as 5 -10% of the trunk volume.

Detailed three dimensional mapping of the trunk and major branches of trees can be done for significant specimens. The methodology used to map the Middleton Oak and the Sag Branch Tuliptree was developed by Dr. Robert Van Pelt.[17] This process is called canopy mapping. It may be used to measure branch volume from within the tree itself for exception or complex trees. Ground based measurements may also be made where the branches can be adequately traced within the crown of the tree.

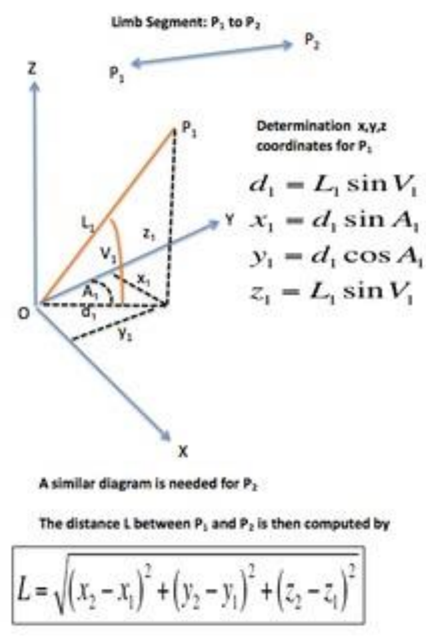
Canopy Mapping

Canopy mapping is the process whereby the positions and size of the branches within the canopy are mapped in three dimensional space.[17][18][19][20] It is a labor intensive process that usually reserved for only the most significant specimens. This is usually done from a set position or a series of positions within the tree. Sketches and photographs are used to facilitate the process. Trees are climbed and the overall architecture is mapped including the location of the main stem and all reiterated trunks, in addition to all branches that originate from trunks. The position of every branch point in the canopy down to a certain size and also the positions of various reiterations, breaks, kinks, or any other eccentricities in the tree are also mapped. Each mapped trunk and branch is measured for basal diameter, length, and azimuth. Specific circumferences and other features within the tree are measured by climbers.

Van Pelt et al. (2004) outlined the process in Quantifying and Visualizing Canopy Structure in Tall Forests: Methods and a Case Study.[17] In the example he used a LTI Criterion 400 Laser Survey instrument to map the tree canopies. It is essentially a device that includes a laser-rangefinder, clinometer, and a compass. The LTI Criterion 400 uses an infrared semi-conductor laser diode for slope distance measurement. A vertical tilt-sensing encoder provides vertical inclination, while a fluxgate electronic compass measures magnetic azimuth, completing the data required to establish a point's three-dimensional location in space. It was is used to map the position of every branch point in the canopy down to a certain size and also the positions of various reiterations, breaks, kinks, or any other eccentricities in the tree. This is usually done from a set position or a series of positions within the tree. Sketches and photographs are used to facilitate the process. Trees were climbed and the architecture mapped in accordance with criterion previously established. This involves mapping the location of the main stem and all reiterated trunks, in addition to all branches that originate from trunks. Each mapped trunk and branch was measured for basal diameter, length, azimuth, Climbers measure specific circumferences and detail other features within the tree. In addition a footprint map of the base of the tree is made to calculate the exact volume of the basal section of the tree. The data is processed in Excel to generate a volume calculation. Graphing functions can be used to create a 3-dimensional figure of the tree data. Dr. Van Pelt also uses an Excel macro to rotate the image so that it can be viewed from different angles. In the cases of the Middleton Live Oak and Sag Branch Tulip each of the trees were mapped from a single set station from within the canopy of each tree.[16]

Ground Based Measurements

Ground based measurements can be used to measure the limb length and diameters of branch sections remotely through the use of a monocular w/reticle or photographic analysis. Where the trunk itself is sloping away from vertical, additional measurements need to be made to determine the true length of each trunk segment rather than simply treating it as a vertical column. The length of a segment can be determined by measuring the position of the end points of the branch in 3-dimensional space from an external reference position. The length is then calculated by applying Pythagorean's Theorem.[21] The following diagram illustrates the process.



Three dimensional coordinate calculations

From the external reference position O, the direct distance to L_1 is measured to P_1 along with the vertical angle V_1 and azimuth A_1. The coordinates x_1, y_1, and z_1 are then computed. The same process is followed for P_2. This sequence is carried out as follows: The horizontal distance d1 from the initial reference point O to a target point P_1 is computed as d_1 = cos(inclination) x laser distance = $L_1 \sin V_1$ The value of x at the first point is: x_1 = sin(azimuth) x horizontal distance = $d_1 \sin A_1$ The value of y at the first point is: y_1 = cos(azimuth) x horizontal distance = $d_1 \cos A_1$ The value of z at the first point is: z_1 = sin(inclination) x laser distance = $L_1 \sin V_1$ This process is repeated for P_2 to get x_2, y_2, z_2 The final step is to compute the distance from P_1 to P_1 (L) using the following formula. $L = [(X_2-X_1)^2+(Y_2-Y_1)^2+(Z_2-Z_1)^2]^{1/2}$

Note that the computation involves squaring the changes in the x, y, and z values, adding these squares together and taking the square root of the sum.[22]

Leverett [23] has developed a methodology where the length of a limb is measured using a monocular w/reticle aligned along the orientation of the limb, the distance to either end of the limb segment, and a calculated scaling factor to determine limb length. Essentially the apparent length of the limb at each end as using the distance to that point and the scaling factor for that distance as if the limb were perpendicular to the observer. These lengths are considered to be the top and base of a regular trapezoid with a height equal to the difference in the distance between the two points. The true length of the limb can then be calculated by treating it as a diagonal of the trapezoid.

Volume Calculations

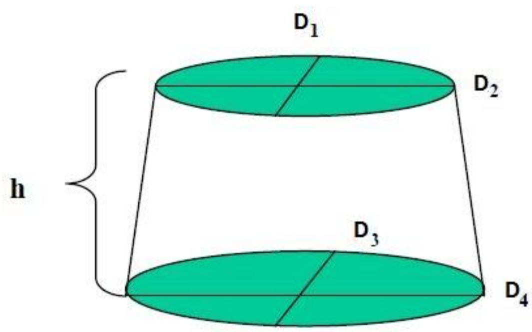
To calculate trunk volume, the tree is subdivided into a series of segments with the successive diameters being the bottom and top of each segment and segment length being equal to the difference in height between the lower and upper diameters, or if the trunk is not vertical, the segment length can be calculated using the limb length formula above. Whether using the aerial or ground based methods, the diameter or girth measurements do not need to be evenly spaced along the trunk of the tree, but a sufficient number of measurements need to be taken to adequately represent the changes in diameter of the trunk. Cumulative trunk volume is calculated by adding the volume of the measured segments of the tree together. Where segments are short, the volume of each segment is calculated as the volume of a frustum of a cone where volume is calculated by any of the three forms:

Volume= $h(\pi/3)(r_1^2 + r_2^2 + r_1r_2)^2$

Volume= $h(\pi/12)(D_1^2 + D_2^2 + D_1D_2)$

Volume= $h/3)(A_1 + A_2 + (A_1A_2)^{1/2})$

A similar, but more complex formula can be used where the trunk is significantly more elliptical in shape where the lengths of the major and minor axis of the ellipse are measured at the top and bottom of each segment.[1][2]

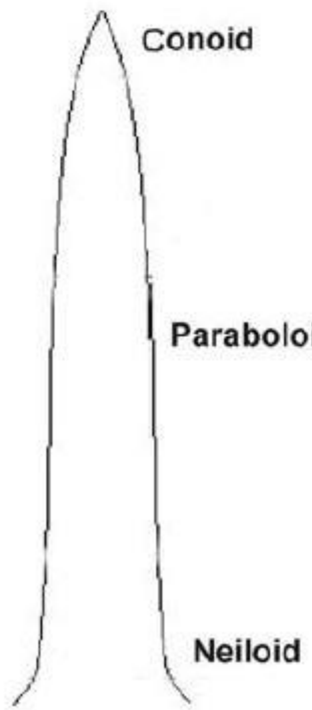


Let D_1 = major axis of upper ellipse of the frustum D_2 = minor axis of upper ellipse of the frustum D_3 = major axis of lower ellipse of the frustum D_4 = minor axis of lower ellipse of the frustum h = height of frustum V = volume of frustum π = 3.141593

Volume= $h(\pi/12)\{[(D_1)(D_2)] + [(D_3)(D_4)] +[(D_1D_2D_3D_4)^{1/2}]\}$

While this formula is more involved than the equivalent for a circle, if the major and minor axis of each ellipse are equal, the result is the more familiar formula for the frustum of a right circular cone.

The volume calculations for these individual frustums of trunk segments can be further refined by considering the overall shape of the trunk. Tree trunks change shape, or more appropriately, curvature multiple times from base to top. It is not uncommon to see the base of a tree as neiloid in shape for 3 to 10 feet. This neiloid shape then changes to a cylinder or paraboloid for perhaps several tens of feet and then to a cone for the remaining distance.



Tree shape with height

The best method for modeling that is to divide the trunk into adjacent segments no more than 3 to 5 feet in height/length and then apply either the cone, paraboloid, or neiloid frustum form to each.[24][25] This is a labor intensive process. To gain efficiency, longer sections can be chosen that appear to the eye to have uniform curvature. However, the longer the segment, the more important it is to choose the optimum solid. Over longer frustums, the greater volume contribution of the paraboloid or the lesser volume of the neiloid becomes apparent when compared to the basic conical form. Therefore when modeling longer frustums the measurer needs to perform independent checks to insure that the right solid has been chosen. One way to check is to take a diameter measurement at an intermediate point and then project what the diameter would be for the chosen model at the point. If the projected diameter is substantially greater or lesser than the measured diameter, then the selected solid is not the right choice. In this case, an intermediate form that combines the two forms through weighting may be appropriate. The measurer selects weights and applies them to each solid formula to arrive at an intermediate result. Each frustum can represent a different parent cone, paraboloid, or neiloid so that there is not a need to impose a single form on the entire tree.

The formula for the volume of a frustum of a paraboloid [24][25] is: $V = (\pi h/2)(r_1^2 + r_2^2)$, where h = height of the frustum, r_1 is the radius of the base of the frustum, and r_2 is the radius of the top of the frustum. This allows us to use a paraboloid frustum where that form appears more appropriate than a cone. Frustums are then dictated by visual inspection.

As an extension of this approach, the neiloid form is one whose sides are concave, so its volume is less than that of a cone. The neiloid form often applies near the base of tree trunks exhibiting root flare, and just below limb bulges. The formula for the volume of a frustum of a neiloid:[26] $V = (h/4)(A_b + (A_b^2A_u)^{1/3} + (A_bA_u^2)^{1/3} + A_u)$, where A_b is the area of the base and A_u is the area of the top of the frustum. This volume may also be expressed in terms of radii:

$$V = \left(\frac{h}{4}\pi\right)\left(r_b^2 + r_b^{\frac{4}{3}}r_u^{\frac{2}{3}} + r_b^{\frac{2}{3}}r_u^{\frac{4}{3}} + r_u^2\right)$$

The final tree volume is the sum of the volumes for the individual frustum sections for the trunk, the volumes of sections measured as bifurcations, the volume of the basal flare, the volume of miscellaneous unusual sections, and the volumes of the limbs (if applicable.)

Volume Changes Over Time

Forestry data suggests that the slowdown of diameter growth is correlated to a commensurate slowdown in volume growth, but the association is not always straightforward. Diameter represents linear growth and volume is growth within a three dimensional context. Slowdown in radial growth rates can occur without slowdown in corresponding cross-sectional area or volume growth. Leverett [27] compared growth rates of six young white pines (Pinus strobus), 75 to 90 years in age, growing along Broad Brook, MA with that of eleven old growth white pines from various other forest sites around Massachusetts. As anticipated, the smaller trees grow at a higher relative rate, but their actual volume increase is less than the larger trees with an average annual trunk volume increase is 6.76 ft^3 (0.191m^3).

Some of the older Mohawk Trail State Forest pines in western Massachusetts are growing at a rate of slightly less than double the rate of the young pines in terms of absolute volume increases with an average annual volume increase of 11.9 ft3 over the referenced time periods. The Ice Glen pine, in Stockbridge, Massachusetts, estimated to be around 300 years old or possibly older based on dating of nearby pines, shows a decline in annual volume increase to approximately half of that for the trees in the 90 to 180-year age class, but still averaged a volume increase of 5.8 ft^3 over the five year monitoring period. This study shows that these old trees continue to add significant volume even into old age.

Trunk Shape over Time

Tree trunks not only vary in shape from top to bottom, but also vary in shape over time. The overall shape of a tree trunk can be defined as a Form Factor: V = F * A * H, where A = area of the base at a designated height (such as 4.5 feet), H = full height of tree, and F = the form factor.[28] Examinations of white pines samples in Massachusetts found a sequence of progressive changes in shape over time. Young pines were found to have a Form factor between 0.33 and 0.35, forest grown pines in the age class of 150 years or more had a form factor of between 0.36 and 0.44, and stocky old-growth outlier pines would on occasion achieve a Form factor of between 0.45 and 0.47. The Form factor concept is parallel to idea of Percent Cylinder Occupation.[29][30] The volume of the trunk is expressed as a percentage of the volume of a cylinder that is equal in diameter to the trunk above basal flare and with a height equal to the height of the tree. A cylinder would have a percent cylinder occupation of 100%, a quadratic paraboloid would have 50%, a cone would have 33%, and a neiloid would have 25%. For example the old growth hemlock trees (Tsuga canadiensis) measured as part of the Tsuga Search Project [31] were found to have occupation percentages from 34.8% to 52.3%

for the intact, single trunked trees sampled. In general trees with a fat base or a trunk that quickly tapers scores low on the list, while trees that taper more slowly have higher values. Those trees with broken tops will have anomalously high values. If the base diameter is taken within the area of basal flare the overall volume will be anomalously low.

Basic Volume Estimates

One goal of looking at overall tree shape is to find a method of determining overall tree volume using a minimum of measurements and a generalized volume formula. The simplest method to achieve this is to model the entire trunk with one application of a solid. Application of one form to the whole tree has been discussed as a way to get a quick volume approximation. But, the method is unlikely to produce an accurate result.

Given the general form changes from the base to top of the tree and the pattern of change in form factor over time, a predictive model was developed and applied to a variety of trees in New England where volume estimates were made based upon measurements tree height, girth at breast height, girth at root flair, and assigned values for form factor (taper), and a flare actor For young to mature eastern white pines, applying the cross-sectional area at trunk flare with full tree height in the cone formula almost always overstates the fully modeled volume. Similarly, using the cross-sectional area at breast height with full tree height in the cone formula usually understates the volume. These values provide an upper and lower bound for actual volume for younger trees. Old-growth pines can develop a columnar form, and if they have only a modest root flare, the actual trunk volume can exceed the volume as estimated by the upper bound formula. In an analysis of 44 trees, including 42 eastern white pines, one eastern hemlock, and a single tuliptree, the average of the upper- and lower-bound volumes as compared to the modeled volume shows that the average divided by the modeled volumes is 0.98 with a standard deviation of 0.10. The volumes of 34 trees fall within the hypothetical upper- and lower-bound calculations.[32]

Better results can be obtained using subjectively assigned factors to incorporate the taper of the trunk and characterize the basal flare. Trees with major root flare or pronounced taper skew the formula. Extreme root flare produces noticeable overestimates of volume. Conversely, a rapid trunk taper leads to an estimated volume that is too low. This can be addressed if we create multipliers for the averaged volume—one for flare and one for taper. If, by visual inspection, we see a large flare, we could use a flare multiplier of 0.90, otherwise 1.00. If we saw a very slow taper, we could use a taper multiplier of 1.11.By using separate factors for flare and taper and multiplying them together to create a composite factor.[32]

$$V = F_1F_2H(C_1^2+C_2^2/75.4)$$

where C_1 = circumference at root flare, C_2= circumference at 4.5 feet, H = full tree height, F_1 = flare factor, F_2= taper factor, and V = volume. Any objection to equation rests primarily with the subjective nature of $F_1$and F_2. The value 75.4 = 24 π, where 24π substitutes for factor of 12π in the formula for a volume of frustum of a cone encompassing a full tree using one base circumference, converting it to a volume formula that uses a basal circumference that is the average of circumferences C_1 and C_2. By using separate factors for flare and taper and multiplying them together, we create a composite factor. It is suggested that these flare and taper could be extended in some cases to values in the range of 0.80 and 1.25 to allow extreme forms to be characterized by the formula. Similarly a model of overall trunk volume could potentially be predicted by using height, girth above basal flare, and the percent cylinder occupation for that species and age class. However at this time there is insufficient data available to test this concept.

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Re: Wikipedia Articles

by Don » Thu Apr 04, 2013 12:21 pm

Ed, I happened to run across these last night, only had time to scan them, but thought they were incredible! Good job, hope to have time tonight to take a closer look. Impressive effort, likely to see use in in my akbigtreelist webpage!

Don

Re: Wikipedia Articles

by **Jeroen Philippona** » Thu Apr 04, 2013 5:34 pm

Hi Ed, This is really superb work! You have spent a lot of time in this! I don't know if you did it all on your own. Perhaps some of the experienced ENTS and people like Steve Sillett and Bob van Pelt have some comments, but this is probably the standard text now on this subject!
I hope many tree measurers will use your texts as a guide.
One tiny remark: you write the President Giant Sequoia has 54.000 cubic feet trunk volume and 9000 branch volume. This must be 45.000 ft3 trunk volume, 9000 branch volume and 54.000 total volume.

Jeroen

Re: Wikipedia Articles

by **edfrank** » Thu Apr 04, 2013 5:50 pm

Jeroen, That is correct - the trunk volume of the President is 45,000 cubic feet and the branch volume 9000 for a total of 54000. I did a minor edit to explicitly state that in the text. I wrote the text, Bob Leverett reviewed it and made some editing comments and revised some sections in the volume document.

Re: Old Growth Forest

by **Joe** » Fri Apr 05, 2013 8:29 am

dbhguru wrote :James, this article is pretty good, but leaves an important story largely untold - the real role of the U.S.F.S in old growth protection. With respect to the Pisgah and Nantahala, the Forest Service had to be dragged kicking and screaming all the way. Resistance to Rob Messick's work and the work of others, including myself in the early 1990s, is the story of the timber lobby's iron grip on the Forest Service in those days. It is a grip that loosens from time to time depending on the administration that is in power, but at the slightest opportunity big timber's fingers tighten and short-sightedness returns to that beleaguered federal agency, which is caught in the middle of a titanic struggle. It isn't clear to me where the Obama administration is going to come down on capping big timber's influence on federal agencies. It's always a crapshoot. [Old Growth Forest http://web.archive.org/web/20100923023605/http://ncmountaintreasures.org/info/old_growth.html]

common with state agencies too- it's almost funny how ridiculous are the excuses they use to justify timber mgt.- about how it's to enhance wildlife, protect the water, blah, blah, blah.... they'll never just admit that it's to produce timber for economic reasons- which would be a fair enough rational to do so, but they should just say it and give up the lame justifications.... of course if they did that, they'd also have to find a way to counter arguments that much of the forest should be in reserves... especially given the fact that our economy really doesn't need to manage all the forests for economic reasons- the forests are so abundant, that timber prices to the owners are very low- if much of the forest land was put into reserves, the sale price for timber to the owners might go up a bit, which would have almost zero negative impact to the economy because the percent of the value that goes to the forest owner from the sale price of finished wood products is trivial, like the fact that the value that goes to a farmer for a box of breakfast cereal is something like 3 cents....

here in Mass., during the "vision process" for mgt. of state forest lands... the industry made the absurd claim that it costs more to manage forests as reserves than it does to manage it for timber!- that might be true if just ignore the cost for the foresters, their offices and all the 6 figure income bosses in a huge hierarchy- yet, did the state citizens ever make a profit with several hundred thousand acres of land with that timiber mgt.? NEVER, it always cost far more for timber mgt. that the owners of this state land got in return... and now while the timber markets are still in a Depression, common sense would say that the state should continue its moratorium on timber harvests to help raise the price on private timber, but no.... they're just aching to get back into the timber harvesting business which has been so good to THEIR careers...

Joe Zorzin

Re: Fused redwoods

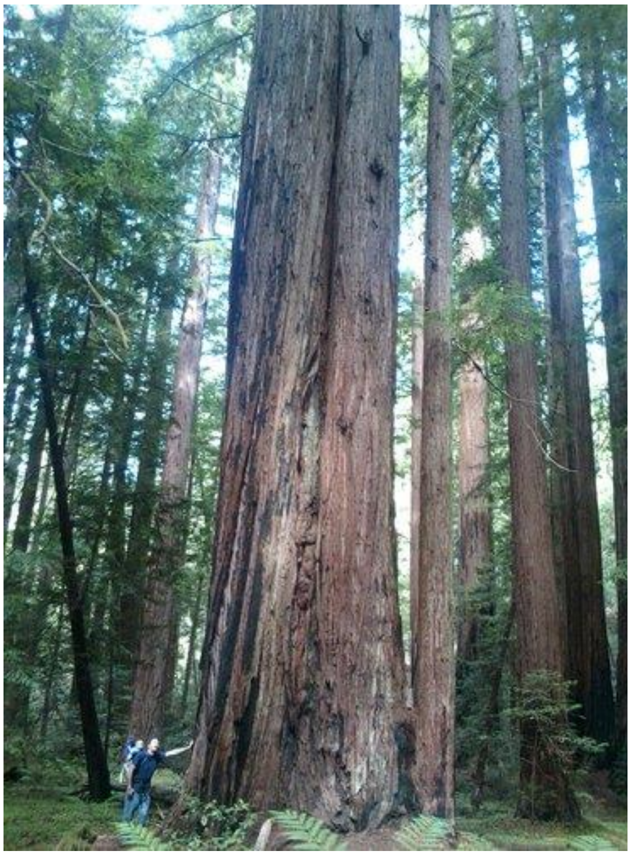
by **Mark Collins** » Mon Apr 01, 2013 8:12 pm

I came across this excellent example of a fused redwood over the weekend. Many fused redwoods seem to have one smaller tree attached to the side like this one pictured. To walk around to the backside of this incredible tree and see the giant fire cave was breathtaking. This fused redwood had a cbh of 58 feet, 6 in.

Re: Fused redwoods

by **JohnnyDJersey** » Wed Apr 03, 2013 9:38 pm

Here is a nice fused tree from Montgomery woods that I'm sure Mark has seen a few times. I didn't measure it. There's also a huge fused wall of wood in Prairie Creek on the nature trail by the visitors center.



John D Harvey

East Coast Big Tree Hunter

Re: Fused redwoods

by **JohnnyDJersey** » Wed Apr 03, 2013 9:43 pm

And since were on the topic, here's Cathedral fused tree from the cheesy but interesting, Trees of mystery tourist attraction. Too bad there's a bunch of signs in front of it.

John D Harvey

Wilmington, NC

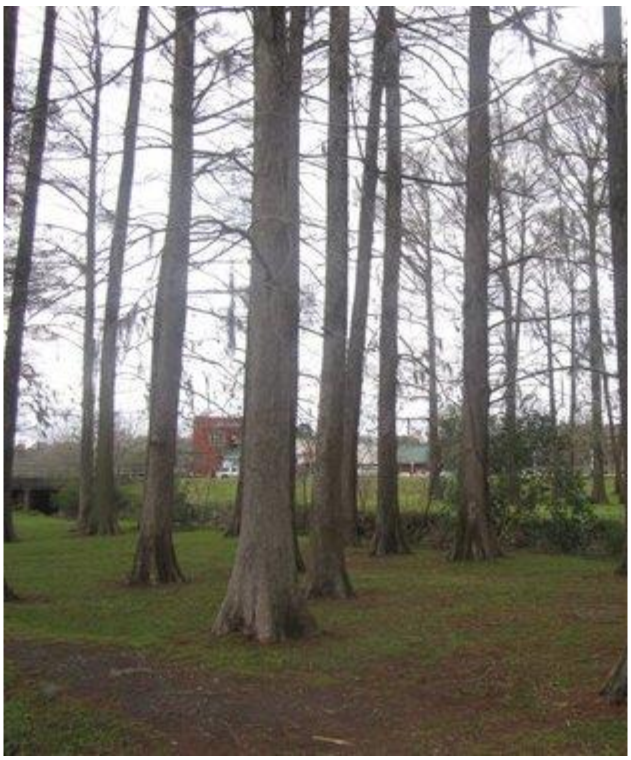
by **bbeduhn** » Fri Apr 05, 2013 12:28 pm

Wilmington City Park by Wilmington National Cemetery

This is a small park along a tidal stream with primarily baldcypresses. They are growing nicely, perhaps 60-80 years old.

Taxodium distichum 102.1' 105.8' 110.3' 112.9' 113.3'

Platanus occidentalis 109.8'



Baldcypresses

Roots along tidal stream

Bluethenthal Wildflower preserve, UNCW

This preserve has plenty of older loblolly pines and black gums mixed with much younger forest. I relied on some placards to identify several species.

Pinus taeda loblolly pine 88.3' 94.3' 83.7' 85.5' cbh 9'10"

Magnolia grandiflora S. magnolia ~50'

Persea borbonia red bay 30+'

Cliftonia monophylla titi ~17'

Liquidambar styraciflua sweetgum 96' 102'

Taxodium ascendens pondcypress 73' 75' 76.0'

Pinus serotina pond pine 69.7'

Nyssa sylvatica black gum 70'
could be biflora but looks like sylvatica

Some longleafs just outside of the preserve

Re: Photo Measuring for Trunk Modeling

by **dbhguru** » Mon Mar 04, 2013 9:42 am

NTS,

Below are the results of yesterday's photo measurement exercise. I decided to apply the simple photo-measuring method to the big double pine about half a mile upstream from the house. I keep close tabs on its height since it is one of a mere handful of trees in the lower Connecticut River Valley that reaches the threshold height of 140 feet. Yesterday's re-measurement yielded 140.3 feet. I have the variance down to 0.2 feet from the range of 140.1 - 140.3 feet.

Since the pine is a double, the form of the lower trunk is not circular. I think the Broad Brook Pine's form approximates an ellipse. It is definitely not circular. So measuring the girth with a tape and then calculating a diameter based on a circle should exceed the minor axis and fall short of the major axis. At the least, the photo-measured width of the major axis should exceed the circular diameter. That is what happened yesterday.

The point of measurement shown in the image is on the uphill side of the tree. I should have taken the time to have repeated the process at 90 degrees going around the trunk to catch the minor axis. I was floundering around in the snow, which is still quite deep. So, rested and then I decided to go a little farther upstream to a white pine stand that I visited fairly often back in 2007 when I was recovering from the shingles. It is a handsome stand, but devilishly difficult to measure. When the hardwoods leaf out, the measuring season ends. Well, outside the snow cover, yesterday, measuring conditions were ideal. I confirmed four new 130s with the tallest at 137.0 feet. This places the number of 130s in the Broad Brook corridor at 10. I plan to return to the stand today and resume the documentation.

I'll also take the minor axis measurement of big double. Since it doesn't take much time to take a photo of the trunk with a reference object, I can be productive when in the field. All the work is done back at my computer in comfort. The key is to be organized in terms of what you want to measure for a tree when on site.

Robert T. Leverett

Re: Photo Measuring for Trunk Modeling

by **Don** » Wed Apr 03, 2013 6:57 pm

Bob, I guess I need to take another look at our standards for dbh measure...it was my understanding that the diameter was to be measured, effectively perpendicular to the "pith", not level (unless the tree was perpendicular to the level ground). The Lyndacker Pine appears to have noticeable lean in the photo, and measuring on the level would have the effect of adding girth.
Presumably you set this up to compare to a level Excel/field DBH comparison and kept both level?
Are there implications mathematically for orienting the Macroscope off-level?

Don Bertolette

Re: Photo Measuring for Trunk Modeling

by **dbhguru** » Fri Apr 05, 2013 9:20 pm

Don

Sorry it has taken me so long to respond. You are absolutely right. We are supposed to measure girth perpendicular to the pith line. I got sloppy that day and measured level across the trunk. So in my photo analysis, I followed what I had done in the field. Bad Bob!

Robert T. Leverett

Magnolia Lake Bald Cypress, NJ

by **chamaecyparis** » Sat Apr 06, 2013 10:30 am

NTS

I am sending you a couple of photos I took over the Easter weekend of 2 Bald Cypress trees growing in the front yard of a home on Route 9 in Oceanview, NJ directly across from Magnolia lake. This property is on the east side of Route 9 several hundred yards south of the entrance to Sea Isle City. The trees are about 6 or 7 miles northeast of the Cypress in Beaver Swamp.

Robert Kranefeld

A very nice yellow birch, MA

by **dbhguru** » Sat Apr 06, 2013 8:46 pm

NTS,

Today I was in a favorite old growth haunt in the Berkshires and came upon a very handsome yellow birch. Just wanted to share it. You need to double click on the image to expand it. It needs expansion to convey the impact.

Robert T. Leverett

Field Report, my first trip to the redwoods w/photos...

by **JohnnyDJersey** » Wed Apr 03, 2013 8:27 pm

First off let me say to those who have never been...you must go at least once before you die. Even if it means selling all your baseball cards, buying a used car instead of a new one, or taking out a second mortgage. I will be going at least once a year from here on out, as soon as this August for a more extensive hiking/searching trip.

I made this trip with my wife and my 1 year old son. Of course I wouldn't have it any other way, however it did limit a lot of what I could have done in 5 days. I was caring the 30 lb little guy in a baby backpack almost the whole time so unfortunately I didn't make it back to Grove Of The Titans or hike Boyscout Trail for safety reasons. Next time I will. That being said I was able to make it to, Muir Woods, Montgomery Woods, Richardson Grove, Humboldt Redwoods, Prairie Creek, and Jed Smith, and even spend the last day of the trip in San Fran as a treat for my wife who hiked many miles with me.

My first instinct, after the pure Awe of so many big trees was to immediately find the largest ones I could, known or unknown. I broke my 100ft tape in the process but did visit 6 or 7 trees over 50ft CBH and many 40+. I located the famed Arco Giant, 11th largest coast redwood, Giant Tree, Big Tree, Brotherhood Tree, and many more without much work, with the fam tagging behind. In the process I did come up with different observations and opinions:

1 I always thought that Muir woods would be a waste of time and many seem to trash it online. However, I was here between 7am and 9am before the traffic started and I found it wonderful. The trees are all a brilliant red, not the drab grey of the northern trees. Even though they are not as big as the parks to the north, they kind of set me up for what I could expect and knowing the trees were only getting bigger was exciting.

2 Montgomery woods is a B@!* to get to. The drive up Orr Springs Road can tie knots in your gut with all the loops and dangerous twists but the pay off is amazing. Isolated, gigantic, tall, blazing red trees. Breathtaking and peaceful.

3 From what I saw, Prairie creek is a better visit than Jed Smith as a whole and is my favorite all around park. minus the grove of the Titans, I would say its trees are bigger too, on average.

4 Aside from what RedwoodHikes.com (great website) says, I found Founders Grove to be more enjoyable than Stout Grove. The trees are taller obviously and other than the Stout Tree, the trees are bigger. If the Dyerville Giant was still standing, founders grove would blow it away. (As long as your there early in the AM)

5 Something that's not mentioned much that makes the JSSP and PCRSP so grand are the large Sitka

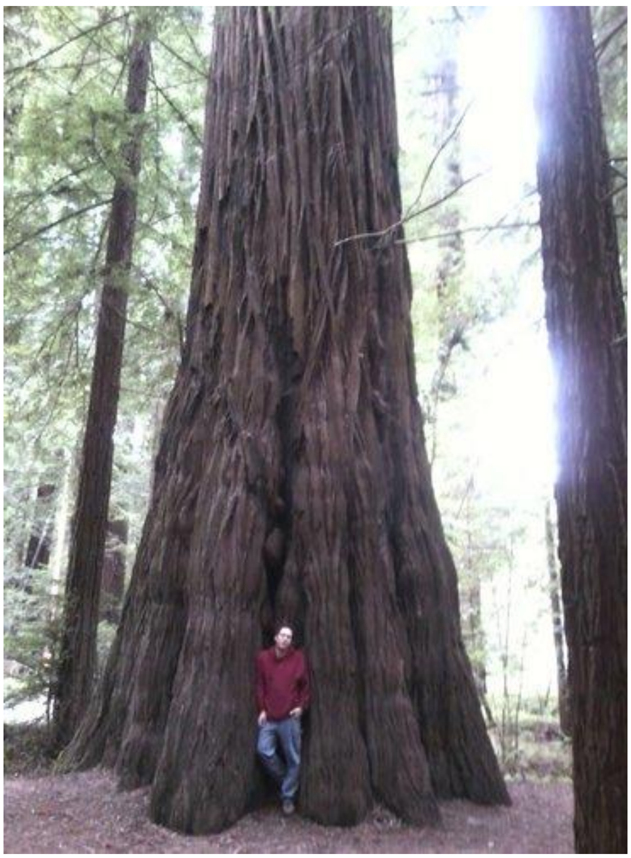
Spruce and Douglass Fur alongside the redwoods.
I took hundreds of photos but below Ill post some of my favorites.

John D Harvey

Re: Field Report, my first trip to the redwoods w/photos...

by **JohnnyDJersey** » Wed Apr 03, 2013 8:36 pm

Some of my favorite trees here, Ill post a few more later.

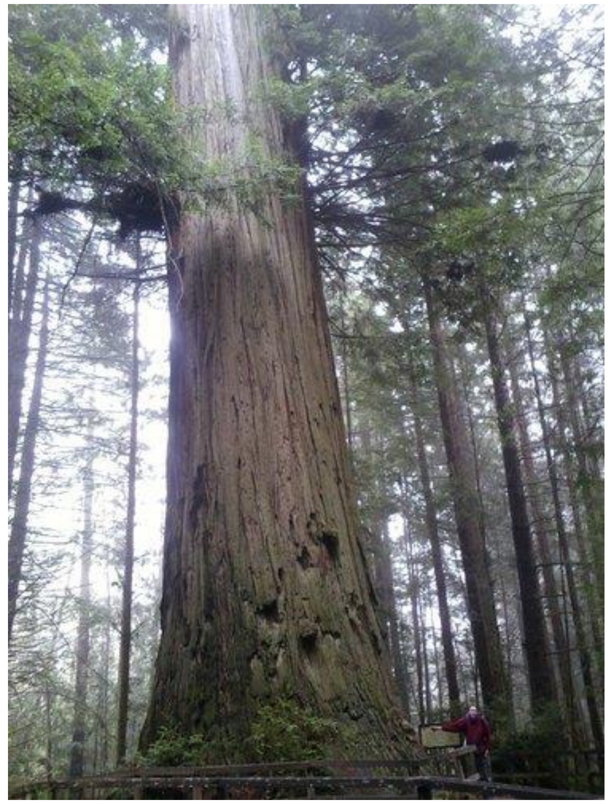


49ft5in

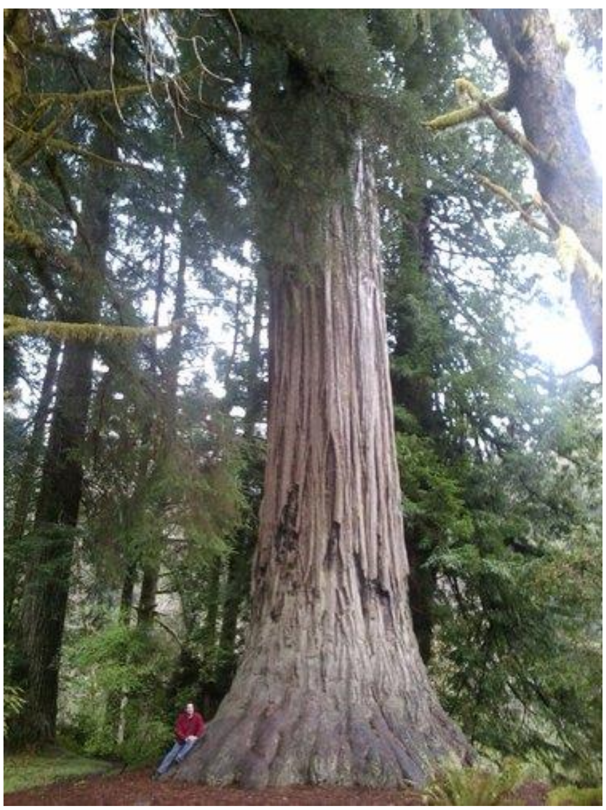
Stout Tree 53ft7in CBH

Arco Giant PCRSP 11th largest around 70 CBH

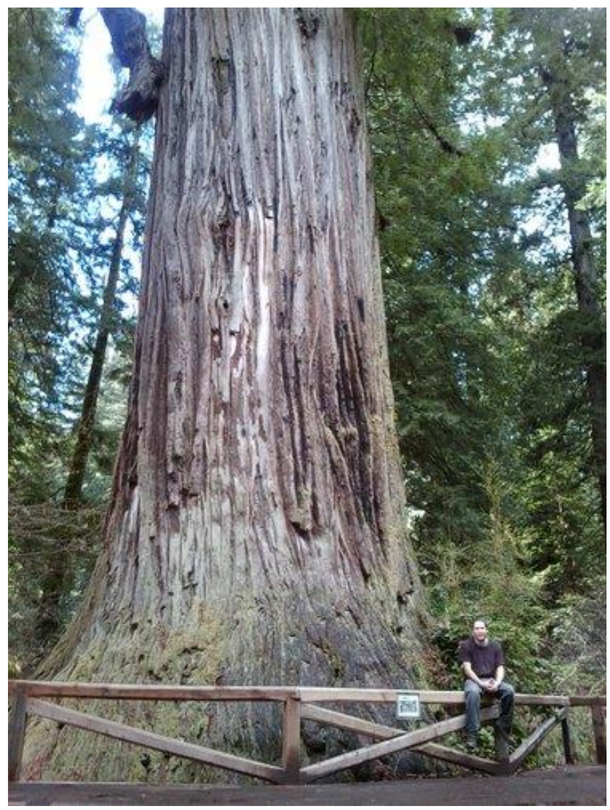
Giant Tree 58'6" CBH



Brotherhood Tree 58ft1in CBH 299ft high?



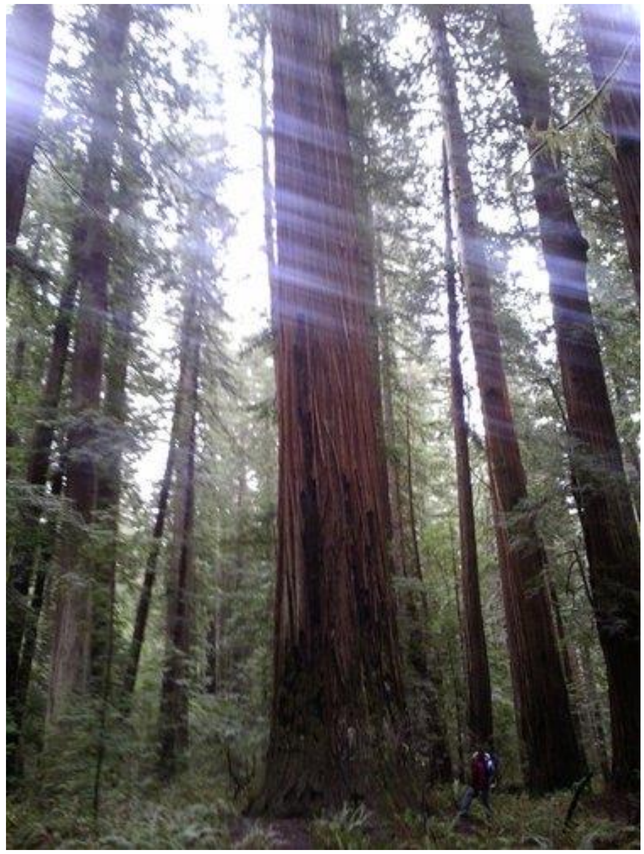
PCRSP picnic area 58+ CBH



Big Tree PCRSP

48ft CBH small taper Ave of the Giants

John D Harvey



Libby Tree

John D Harvey

Re: Field Report, my first trip to the redwoods w/photos...

by **JohnnyDJersey** » Thu Apr 04, 2013 1:43 pm

Photo of the Libby Tree, one of my favorite trees HRSP.

Re: Field Report, my first trip to the redwoods w/photos...

by **F.Jakobsson** » Thu Apr 04, 2013 3:39 pm

John, thanks for photos and field report, your enthusiasm is infectious! Apart from being brilliant red, the southern redwood forests I visited (Henry Cowell, Big Basin and Muir Woods) also smelled so wondrously good.
When I two years later went to the northern redwoods I only occasionally felt a whiff of this fragrance.
I visited the southern redwoods in September and the northern redwoods in June.
I have often wondered if this scent had to do with the time of year, the location or a combination.
Has anybody else had the same experience?

Fredrik

Re: Field Report, my first trip to the redwoods w/photos...

by **JohnnyDJersey** » Sat Apr 06, 2013 8:22 pm

I've talked to a couple of my friends about them doing the same trip. Because I went before tourist season it was much cheaper and easier. I made no reserve for a hotel room, just winged the entire trip. just reserved my airline tickets two weeks in advance and my rent a car. The whole trip cost me less than 2000$ That was with staying in some very nice hotels, renting a Ford Fusion hybrid, gas, airfare for 2 from Philadelphia, souvenirs, and eating whatever we wanted really. If I was going to do an economy trip it would have been close to 1500$. Not terribly expensive. A lot less than doing Disney World or Jamacia Id say.

John D Harvey

April 10 Premier of Shinrin-yoku (Forest Bathing)

by **michael gatonska** » Thu Apr 04, 2013 6:48 pm

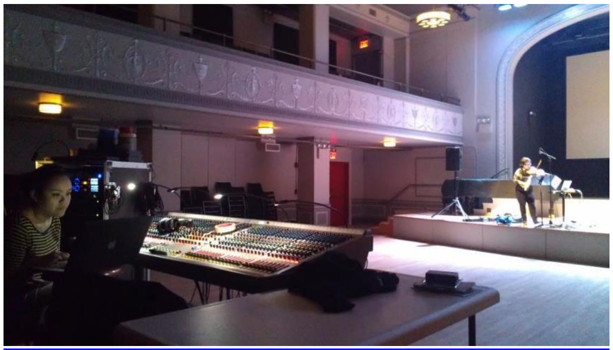
Dear NTS:

This coming Wednesday, April 10, 2013 @ 8:00 pm will be the premier of my new composition Shinrin-yoku (Forest Bathing) at Roulette in Brooklyn, NY.

Composed for the violinist Mari Kimura - and a first for me as a composer, the Shinrin-yoku project involves the Augmented Violin System (developed at IRCAM), an Interactive Computer System, and an Interactive Audio/Visual component that will manipulate images that I have snapped hiking in various places.

Shinrin-yoku (Forest Bathing) was composed in 2013. The title is a Japanese word that means “forest-bathing”, and my original ideas for the composition were centered on a forest bathing trip that involves visiting a forest for relaxation and recreation while breathing in wood essential oils regarded as being natural aromatherapy. The musical form was built by following an amplitude map which originated from a soundscape that I had captured of wind blowing through trees. The map served as a natural model to determine various parameters such as linear shapes and dynamic intensities. As the music unfolds, other soundscapes that I recorded of distinct habitats are interwoven to add coloration and texture. This project was made possible through the generosity of New Music USA and the Puffin Foundation. Hope to see you there

Michael Gatonska – April 10, 2013 Rehearsal with Mari Kimura for the concert tonight at Roulette



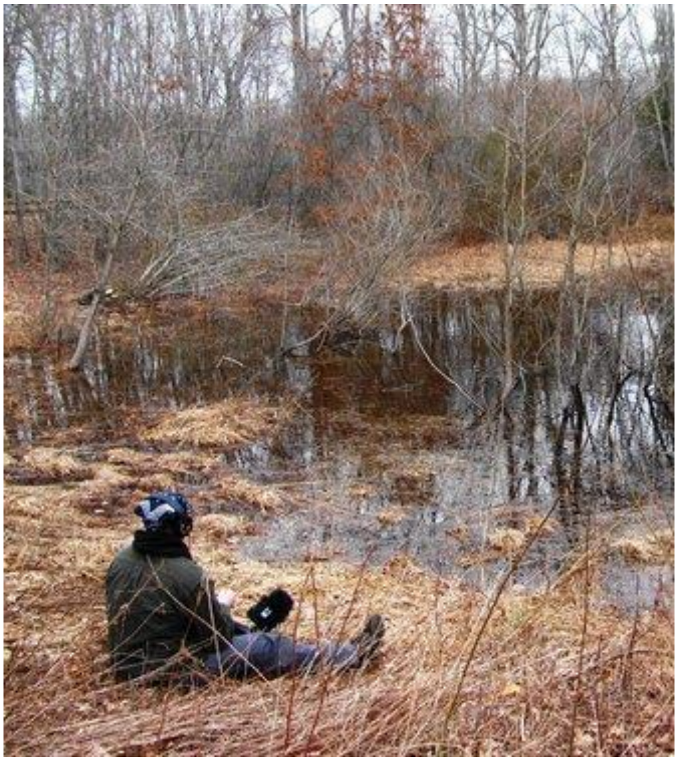
Michael Gatonska – April 16, 2013 Performance of my piece Shinrin-yoku by violinist Mari Kimura. The image is of my hand on the Thoreau tree, the tallest white pine by volume in New England.

Vernal Pool & Wood Frogs

by **michael gatonska** » Sun Apr 07, 2013 4:30 pm

NTS,
Although not really tree related, it is the sound of male wood frogs. I thought this soundscape that I just captured came out pretty descent...

Setting up equipment by the vernal pool...



Recording by the vernal pool

Rana sylvatica (wood frogs)
Taken from the info found below.

Location: Bolton, CT
Date: March 31, 2013
Time: 3:30 p.m.
State: CT
Description: late afternoon at a vernal pool in deciduous woods
Habitat: vernal/coniferous/deciduous/lakes/hiking trails/state park
VoxType: afternoon
Category: soundscape
Recorder: H2next
Mics: H2next
Sample rate: 48k 24 bit
Microphone pattern: Double MS stereo-2 channel; 150 °
Take# 1
Anthrophony: traffic, airplane
Geophony: natural vernal pool high/gusty winds in deciduous forest/
Biophony: wood frogs
Weather: cloudy

Temp: 43 Fahrenheit
Humidity:
Wind: moderate 10-with gusts up to 30 mph
GPS: Lat/Lon: 41.72°N 72.44°W Elevation: 597 ft
Recordist: Michael Gatonska
Notes: windjammer/monitored with headphones

Michael Gatonska

Dexter Elm, Malden, MA

by **edfrank** » Sat Apr 06, 2013 9:16 pm

The gypsy moth. Porthetria dispar (Linn.). A report of the work of destroying the insect in the commonwealth of Massachusetts, together with an account of its history and habits both in Massachusetts and Europe (1896)

Author: Forbush, Edward Howe, 1858-1929; Massachusetts. Agriculture, State Board of; Fernald, Charles Henry, 1838-1921

Illus. in: Edward Howe Forbush, The Gypsy Moth, plate XXXVI.

The book 110MB pdf can be downloaded from here for free: **http://archive.org/details/gypsymothporthet00forbuoft** The plate is on page 248 of the pdf file.

The work of extermination was begun on the principle that, if the moths could be exterminated from one tree, they could be eradicated from any number of trees, providing the same kind of work that cleared the first tree could be carried on simultaneously over a large area. It was soon found thatthe moth could be cleared from trees of ordinary size by honest, thorough, intelligent labor. Yet many doubters asserted that it was impossible to clear the larger trees. Medford, being one of the oldest towns in the State, had many very large elms. This was also true of Maiden. It was believed by some of the residents that it would be impossible to clear the moths from these trees except by the aid of a balloon. The largest tree in the infested region was selected for trial of the possibility of extermination. This tree is situated on the property of the Messrs. Dexter of Maiden, and stands in front of the old Dexter mansion.

The tree has been owned by this family for more than two hundred years. If not the largest tree in the State, it is one of the largest. Early in 1891 an attempt was made to clear the moths from the tree, and a gang of four men, who had had some experience, went to work upon it to destroy the eggs of the moth. After working for several days upon the tree they reported it cleared. Another gang of men was put at work upon the tree, and six hundred additional egg-clusters were discovered. Notwithstanding this, caterpillars appeared in the spring upon the tree. It was then sprayed thoroughly, an extension ladder sixty-five feet in length being used, together with several additional ladders placed in various parts of the tree. Later in the season all the holes in the limbs were covered or filled, and the few egg-clusters found were treated with creosote oil. In 1892 the tree was banded with tarred paper, which was kept constantly moist with a mixture of tree ink, tar and oil. A few caterpillars were found, however, on the tree, having hatched probably from scattered eggs left in thecrevices of the bark. In 1893 no caterpillars appeared, and no form of the moth has been found since 1892 upon the tree. In the inspections of the tree every care has been taken to go over it thoroughly, from its highest branches to the base of the trunk.*

The dead limbs have been removed and holes have been covered, but no other work has been necessary at the regular inspections. Plate XXXVI. shows men at work in the inspection of the tree. The extermination of the moth from many orchards was accomplished without much difficulty. Plate XXXVII. shows apple trees which were seriously injured during the season of 1891 by the gypsy moth. They were cleared of the moths and so treated that in 1892 they regained a large part of their foliage (Plate XXXVHI.) . They have borne very little fruit, however, since 1891. Having learned that it was possible and holes have been covered, but no other work has been necessary at the regular inspections. Plate XXXVI. shows men at work in the inspection of the tree.

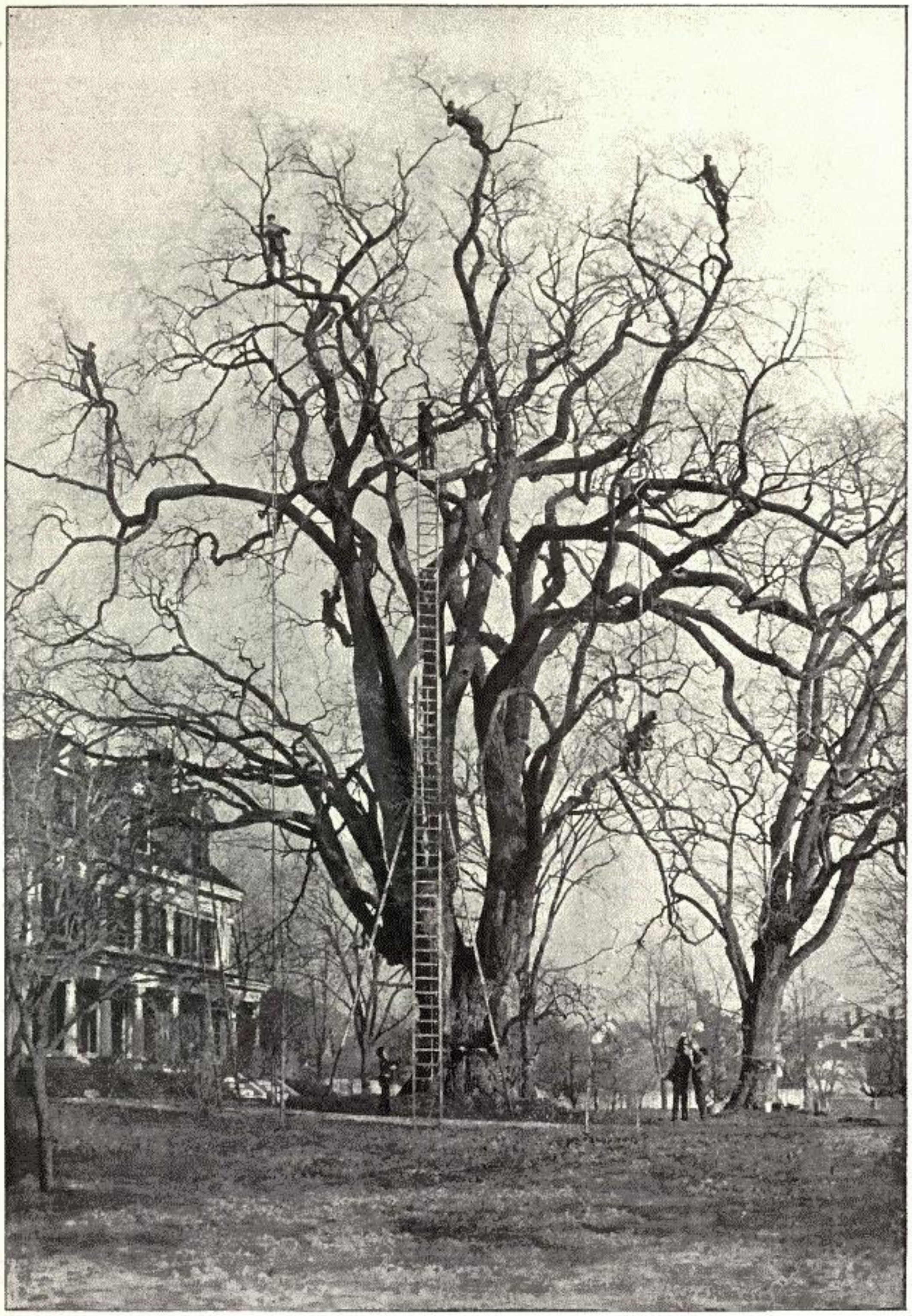


PLATE XXXVI. Men at work on the Dexter elm, Malden. From a photograph.

Edward Forrest Frank

Re: Dexter Elm, Malden, MA

by **Jess Riddle** » Sat Apr 06, 2013 11:47 pm

Ed, I had to sit and stare at the photo with my jaw on the floor for a few minutes. Thanks for digging up this photo.

It's also interesting what people considered a reasonable amount of work a hundred odd years ago.

Jess Riddle

Re: Dexter Elm, Malden, MA

by **Bart Bouricius** » Sun Apr 07, 2013 9:47 am

Interesting photo. I worked in Westchester County New York in the 70's when owners of wealthy estates would have our crew working with hand saws for weeks to manicure trees. I don't think this shows much regarding OSHA, compared with the willingness of people who have too much money to know what to do with it, spending it on their estates in whatever ways they could think of.

Based on this description, I would say that if the moths did not kill the tree, the treatment for the moths would eventually do it in. I remember in the late 70's and in the 80's many trees were killed by people putting axle grease bands around the trees to prevent caterpillars from crawling up the trees. A non damaging product "tangle foot" was available for this purpose, but it was more expensive. Continuously soaked tar paper and creosote painted on the tree would surely do immense damage. Similarly research on painting cuts after trimming branches was done at Cornell University in the early 70's. It took forever to convince arborists of what the research demonstrated conclusively; that the paint retarded the healing process. Yes there may be some unusual exceptions where some paint can be used, but clearly arborists had been doing more harm than good with this methodology for a long time, and were extremely resistant to change based on solid evidence.

Bart Bouricius

Re: Tall Freeman maple, OH

by **Rand** » Sun Apr 07, 2013 9:10 pm

Obligatory Stitch

Airlie Gardens, Wilmington, NC

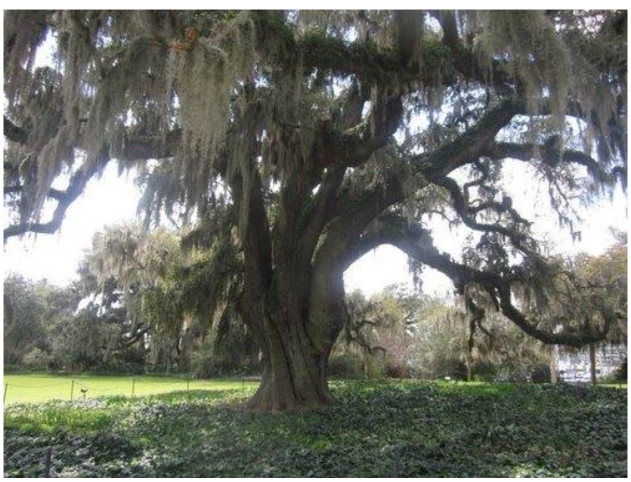
by **bbeduhn** » Wed Apr 03, 2013 3:40 pm

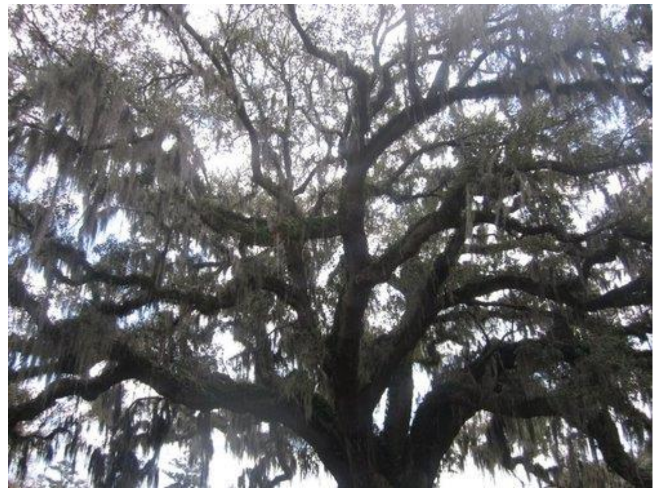
I arrived at airlie Gardens and requested permission to measure their giant live oak. I was soon greeted by their Environmental Education manager, Matt Collogan. He was very entusiastic about the tree and the gardens and granted access to the bole of the tree, which is currently roped off.

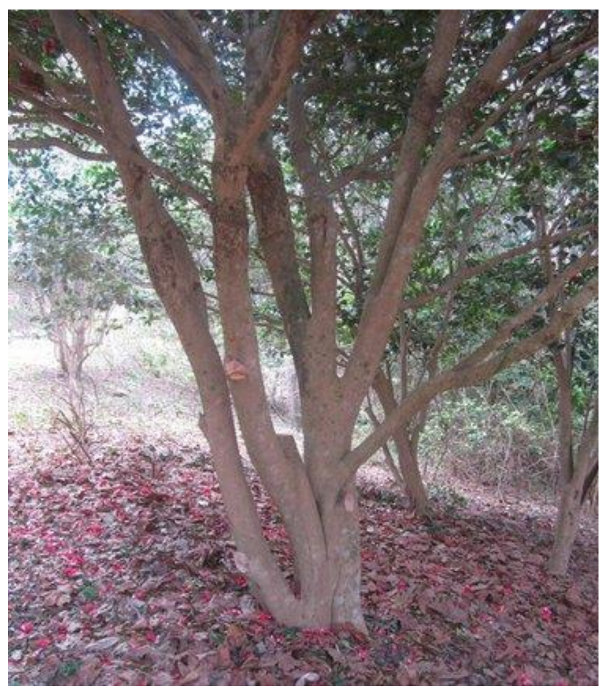
I read about the dimensions for the Airlie Oak and was intrigued. 128' tall, 257" cbh and a 104' spread...oh, and it's 400-450 years old. Obviously, this numbers were arrived at by the experts. The Forest Service had one of their measurers do the numbers. They did get one dimension right.

cbh 258" or 21'6"
h 70.0'
spread 124.5'
age 200-250?

Camellia Japonica
cbh 2'7" h 13.6' spread ~20'







Re: Airlie Gardens, Wilmington

by **bbeduhn** » Mon Apr 08, 2013 9:41 am

Some more numbers from Airlie Gardens.

Pinus taeda loblolly pine 91.0' 92.5' 94.9' 97.0'
99.0' 101.0' 101.6' 102.6'
103.1' 103.7' 103.8' 103.8'
107.7' 108.0' 111.1' 111.5'
8'10.5' cbh 89.0'
10'3" cbh 99.0'
11'3" cbh 108.0'

Magnolia Grandiflora S. Mag 70.0' 71.5' 72.2'
74.4' 83.1' 84.7'

Ilex opaca Am. holly 54.9'

10'3" cbh 99' loblolly

8'10.5" cbh 89.0' loblolly

11'3" cbh 108.0' loblolly

108.0' loblolly crown

loblolly with osprey nest

young baldcypress grove

aluminus titanium with steelus audobon

glass bottle house

glass bottle house with Rachel

glass interior

Old Black Gum? (NY)

by **lucager1483** » Mon Apr 08, 2013 4:52 pm

I've attached a few pictures of the two largest black gum (*nyssa sylvatica*) I've been able to find on Howland's Island, up here in NY. The taller of the two is 72', and the fatter is 96" around at breast height. I've probably mentioned them in the past, but finally got out today and paid them a visit. I'd like to know what y'all think would be a possible age range, given the pictures and the following site description: The two trees are part of a group of 5-10 mature black gums growing in close proximity, along with many saplings and seedlings of the same species; the terrain is basically elevated swamp that floods regularly, but not necessarily every year; associated species are swamp-loving northern hardwoods (mostly beech, ashes, elms, and soft maple); the black gums disappear as the ground gets both drier and wetter. My guess is that the trees may be very old, just based on the bark characteristics and gnarly growth form, but this is only a guess. Here are the pics:

Also, the surrounding upland, well-drained northern hardwood forest has been logged (probably several times), but this particular swamp does not appear to have been disturbed, at least to the same degree. Thank you for your consideration.

Elijah

Re: Old Black Gum?

by **Jess Riddle** » Mon Apr 08, 2013 10:27 pm

Elijah,

You're talking about the trees at the north end of Hickory Hill, right? I remember those trees. They certainly predate the surrounding forest, but they never stood out to me as particularly old for black gum. I would expect them to be over 200 years, but it's difficult to say beyond that. As you say, that site is just elevated enough to have decent soil drainage, and the soils are relatively nutrient rich. I remember a lot of hickories in the surrounding forest with the tallest trees reaching a little over 100'. Black gums never grow that fast, but I would be surprised if those trees grew super slowly under those conditions.

Jess

MYSTERY HIGH BOLE BARK CRACKING

by **Green Tree Doctor** » Mon Apr 08, 2013 4:26 pm

MYSTERY HIGH BOLE BARK CRACKING on residential southern pin oak (Greenville, South Carolina). Dozens of longitudinal cracks from 1 foot above ground to 6 feet below crown; new 3 foot cracks; old 8 to 15 foot cracks. Bark cracks do put extend into the wood, though the largest crack has a few inches of wood decay beyond the crack. Owner planted this 20 inch oak 25 years ago when it was 8 feet tall, 12 feet from his cement driveway. Owner first noticed cracking 2 years ago.

The oak has a small pine straw mulch bed, well irrigated, fair drainage, clay soil smells normal, 5.4 soil pH, little soil organic matter, roots healthy color, soil compaction moderate, never fertilized, area vegetation healthy, no fires, no excavation, no hardscape removal, no construction, no paving, no lightning injuries, no trunk girdling, good root flares, no boring pests, no leaf pests, no bark sun scalding, no obvious cankers, some black exudation on larger cracks with no odor, 40% crown leaf density, bacterial leaf scorch, bumper crop of acorns, several small dead branches in crown, no dieback, leaves not chlorotic but could be darker green and a little larger. Bark test for phytophthora came back negative (Bartlett Research Lab, Charlotte, NC). The owner tried closing the largest cracks with black pruning tar and brown caulking. The owner planted at the same time another pin oak about 30 feet away along this drive. This oak looks much healthier with no bark cracking. Any idea what this might be?

Randy Cyr

Re: MYSTERY HIGH BOLE BARK CRACKING

by **Rand** » Tue Apr 09, 2013 9:24 pm

The only thing I've seen like that was on silver maple trees. It was caused by several weeks of abnormal warmth in february followed by a nasty cold snap. Lots of cracks in the bark, dead twigs, branches etc. I guess the tree filled with sap and then froze? (Silver maples are the first trees to bloom in the spring in NW Ohio) Peach trees were also similarly affected. Had silver maple in the back yard do this and ten years later the tree still hadn't been able to grow over the largest dead spot (Maybe ~4" wide).

Probably not what's going on in your case, but I thought it was interesting anyway.

Rand Brown

Re: MYSTERY HIGH BOLE BARK CRACKING

by **mdavie** » Wed Apr 10, 2013 12:45 pm

That is strange. I was going to suggest the Easter freeze a few years ago as a possibility. You may not notice the cracks until the callus starts bumping out after the injury, which would coincide with the timeline for the owner noticing.

Michael Davie

Hemlock Wooly Adelgid found at Cook Forest SP, PA

by **edfrank** » Mon Apr 08, 2013 5:40 pm

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

News for Immediate Release

April 8, 2013

Insect Threat to Hemlock Trees Discovered in Western Pa. State Parks

Harrisburg – A non-native, invasive insect that attacks and kills Eastern hemlock trees has advanced westward across Pennsylvania to Clarion and Jefferson counties where infestations have been confirmed in two state parks, Department of Conservation and Natural Resources Secretary Richard Allan announced today.

"The hemlock woolly adelgid, a pervasive insect threat that has killed thousands of hemlocks across the state, has been detected in both Cook Forest State Park, Clarion County, and Clear Creek in neighboring Jefferson County," Allan said. "This discovery is especially unsettling as significant growth of signature hemlock enrich both parks' forests.

"Home to the most significant Eastern hemlock stand north of the Smoky Mountains, Cook Forest State Park is famous for its old-growth trees. Its 'Forest Cathedral' of towering hemlock and white pine is a National Natural Landmark."

For this reason, and in the face of the insect's steady, northwestward spread, DCNR entomologists, foresters and park officials had ramped up early-detection efforts at the two parks. Attempts to delineate wooly adelgid infestation and chart feasible methods to combat its spread now are under way, Allan said.

"Park staff members have been regularly monitoring for the pest and those surveys paid off with early detection that will allow for greater treatment options and better success," said Allan. "Weather and snow cover have hampered attempts to gauge the insect's spread but we know infestation is localized along the Clarion River, which flows through both Cook Forest and Clear Creek state parks."

DCNR will be embarking on a two-pronged treatment effort, the secretary said, that relies on selective application of insecticides and the release of predatory beetles.

"This will be a continuation of a cooperative effort among our bureaus of forestry, state parks and others that in recent years has seen more than 70 sites and 11,000 trees treated in 21 counties," Allan said.

Also, DCNR is partnering with the USDA Forest Service, The Nature Conservancy and other interested agencies and partners to develop an Eastern hemlock management plan for Northwestern Pennsylvania. In addition, its Bureau of Forestry is drafting a hemlock conservation plan for Pennsylvania.

The Cook Forest State Park infestation area includes some of the Eastern United States' tallest hemlocks, including the celebrated Seneca Hemlock, the area's third-tallest climbing more than 147 feet. Although not yet known to be infested, other old-growth stands at Cook Forest, including the Forest Cathedral, are in danger due to the close proximity to this area.

The woolly adelgid is a fluid-feeding insect, easily detected by telltale egg sacs resembling cotton swabs that cling to undersides of hemlock branches. Introduced into the United States from Asia, it first was discovered in southeastern Pennsylvania in 1969 and steadily has been spreading westward. It now is found in 56 of Pennsylvania's 67 counties.

Homeowners and other private property owners can learn more about the woolly adelgid, damage it causes, and efforts to combat it at www.dcnr.state.pa.us (click on "Forestry," then "Insects and Disease" at upper left).

The Pennsylvania Parks & Forestry Foundation is accepting contributions to be used to combat the insect at Cook Forest and Clear Creek state parks. Donation checks, payable to Pennsylvania Parks & Forestry Foundation, or PPFF, can be sent to Cook Forest State Park, ATTN: HWA Fund, P.O. Box 120, Cooksburg, Pa., 16217.

For details on Cook Forest, Clear Creek and Pennsylvania's other 118 state parks, call 1-888-PA-PARKS between 7 a.m. and 5 p.m. Monday through Saturday; or visit www.dcnr.state.pa.us (select "Find a Park").

Media contact: Terry Brady, (717) 772-9101

Re: Hemlock Wooly Adelgid found at Cook Forest SP, PA

by **edfrank** » Mon Apr 08, 2013 6:37 pm

From Friends of the Allegheny Wilderness:

Disheartening news today about the continued spread of the non-native invasive insect known as the hemlock wooly adelgid.

If you are a fan of our majestic ancient old-growth hemlock trees here in northwest Pennsylvania you may wish to take the time this spring/summer/fall to visit special wild places such as Cook Forest State Park immediately south of the Allegheny National Forest, the ANF's Tionesta Scenic and Research Natural Areas in McKean and Warren Counties, and the Hearts Content old-growth in southern Warren County.

Take lots of photos, or draw or paint if that is your aptitude. Commit what you see to your memory banks so you can tell your children and grandchildren. Just to be on the safe side. But let's hope for the best that the spread of the hemlock wooly adelgid will be arrested, and that these last remnant old-growth hemlocks can be saved!

Friends of Allegheny Wilderness

Re: Hemlock Wooly Adelgid found at Cook Forest SP, PA

by **Will Blozan** » Mon Apr 08, 2013 7:03 pm

FU*#&(!!

Will Blozan

I think we can all agree with this sentiment.

Re: Hemlock Wooly Adelgid found at Cook Forest SP, PA

by **Matt Markworth** » Mon Apr 08, 2013 7:48 pm

I agree. Go see them. I made the trip in 2010. If you like a quiet car-camping experience, then camp at Heart's Content (Campsite #19 is nice) and drive over to Tionesta and drive down to Cook Forest.

What a scene!

- Matt

Help identifying 3 shrubs I found growing in Marshall Forest, GA

by **samson'sseed** » Tue Apr 09, 2013 8:54 pm

I was able to identify every species of tree I found growing in Marshall Forest, but some of the shrubs stumped me.

Here are photos of 3 species I failed to ID.

Despite Marshall Forest being considered old growth, I didn't see any exceptionally large trees there. Maybe it's because the site is sloping and on thin soil. I don't think I saw a single tree more than 3 feet in diameter. However, there was a lot of interesting storm damage. We've had an unusually rainy late winter in Georgia followed by several days of high winds. The following photo is one result. Some kind of oak was holding the pine tree up.

I took a wrong turn on the way and accidentally found a rare stand of cane growing at least 20 feet high on a bluff next to the Coosa River, but I couldn't stop to take a photo.

I also had a chance to visit Lavender Mountain behind Berry College. They are trying to re-establish a population of longleaf pine here. They refer to it as "mountain longleaf pine." It's a disjunct northern population of the species. Funny, I visited Moody forest last year and didn't see a single longleaf pine, but I did find some longleaf pine seedlings here where one wouldn't expect them.

I'll have more photos and write more about this on my website in a few days.
www.markgelbart.wordpress.com

[Re: Help identifying 3 shrubs I found growing in Marshall Forest, GA]()

by **Jess Riddle** » Wed Apr 10, 2013 2:54 pm

Mark,

Your unknowns look like heavenly bamboo (Nandina domestica), Chinese privet (Ligustrum sinense), and Carolina cherry laurel (Prunus caroliniana). None of them are native to northwest Georgia (though cherry laurel is native to the coast), and Chinese privet is a particularly bad invasive.

Jess Riddle

Mass Champion Cottonwood

by **dbhguru** » Thu Apr 04, 2013 7:20 pm

NTS,

Today, Bart Bouricius, Ray Asselin, and I went to Pittsfield at the request of teh Parks manager to remeasure the big cottonwood on Columbus Avenue. First a look at it.

The stats of this big tree are:

Girth = 24.7 feet

Height = 86.0 feet

Crown Spread = 80.0 feet

Crown Points = 402

This is the champ.

Robert T. Leverett

Re: Mass Champion Cottonwood

by **Will Blozan** » Thu Apr 04, 2013 7:34 pm

Bob, DAMN! Very impressive. Too bad it is a fusion though. Seems many cottonwood champs are multi-stemmed.

Will

Re: Mass Champion Cottonwood

by **dbhguru** » Thu Apr 04, 2013 9:31 pm

Will, oddly, when at the tree, it does not show signs of being a fusion. However, looking at the photo, it looks like there's a separate trunk on the right fused with a much larger trunk on the left. There aren't any of the usual signs of a split going down to the ground on either side. This is an interesting tree to study Ray Asselin got extra shots of it. I'll see if he can send them to me for posting.

Robert T. Leverett

Re: Mass Champion Cottonwood

by **edfrank** » Thu Apr 04, 2013 9:57 pm

Bob, It is an interesting problem. There are two ways to trace the trunks in the one overview image:

Either option seems valid. More photos would help, but might not resolve the situation.
Edward Forrest Frank

Re: Mass Champion Cottonwood

by **Don** » Fri Apr 05, 2013 2:19 am

Anybody care to hazard a guess on the history of the tree?
I'm pretty much as far away as one can get and still be in the US, but I could imagine this to be a rather large coppice of a single cottonwood that did get to be a reasonably large girth before being severed/injured/stressed. Perhaps a hundred years ago?

Don Bertolette

Re: Mass Champion Cottonwood

by **edfrank** » Fri Apr 05, 2013 11:22 am

Joe wrote: Is *it possible to do genetic study of the different stems to tell if it's a single tree or a multiple? I suppose in theory--- but it's probably not available technology.*

Joe, DNA can be done, but the question really is how you are defining a single tree. It is likely that this cottonwood grew from a single root mass so the parts would be genetically the same (mostly). What we are really asking is whether this is a single trunk tree or a multiple trunk tree. The point being that the combined girth of combined multiple stems increases much faster that does the girth of a single trunk. So if you define the tree as a single trunk, then they can be genetically the same from the same root mass, but be two different trees, or if you consider all trunks from a single root mass to be one tree, it is still a choice between multitrunk versus single trunk. In either case the growth forms are different and in my opinion should be considered as different entities on a big tree listing.

Edward Forrest Frank

Re: Mass Champion Cottonwood

by **Joe** » Fri Apr 05, 2013 11:32 am

Ed, what you say makes sense. By the way, a question just flashed into my mind which I don't we'll ever answer, but, it would be cool if we could know details about the largest tree that ever existed on this planet. I wonder how much bigger it was than whatever tree currently holds the record. A similar question- I wonder what tree lived longer than any other. Oh, well, lots of questions.... like, what the hell is dark energy? Just read about it in the latest Discover magazine. It's 70% of everything, yet we know virtually nothing about it. I presume when we do figure it out- it will be a fountan of information about the universe. And when we do figure it out- some new great mystery will arise. The future of science is exciting- too bad we'll miss most of it.

Joe Zorzin

Re: Mass Champion Cottonwood

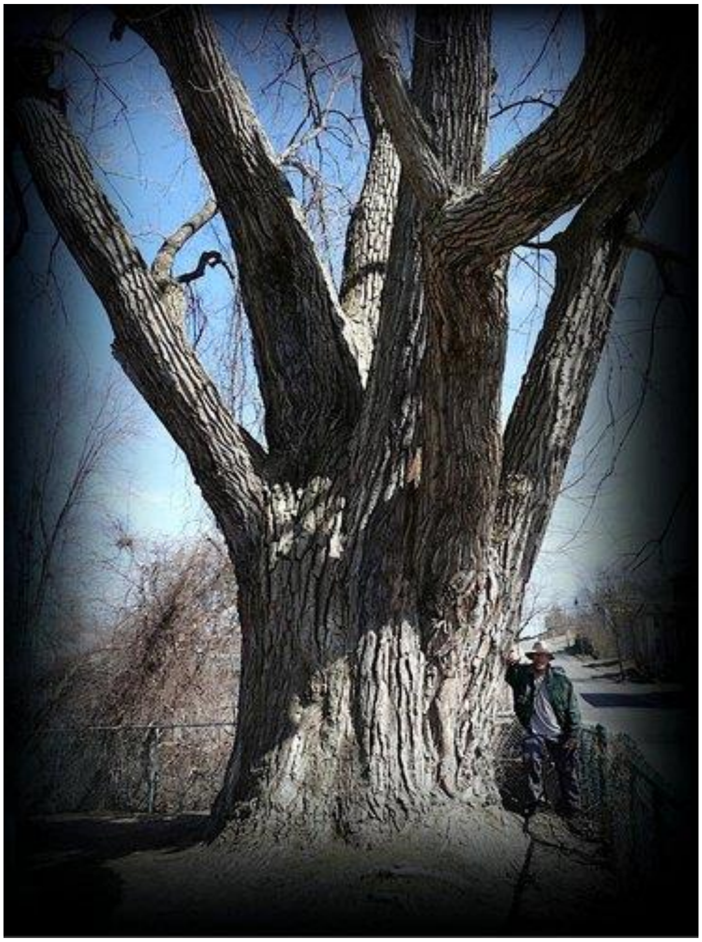
by **dbhguru** » Fri Apr 05, 2013 4:54 pm

Ed, Don, Joe,

Here is another image of the cottonwood taken by Ray Asselin.

Maybe we can take these discussions to the next level - if we can agree on what the next level is.

Robert T. Leverett



Re: Mass Champion Cottonwood

by **edfrank** » Fri Apr 05, 2013 5:44 pm

This is essentially the same angle as the image above. It does look like the two branches on the right are from a separate trunk than the rest of the tree.

We always say that the combined girth of these multitrunk trees is greater than those of a single trunk tree. That is clear when there is a large hollow in the center with trunks growing up around the perimeter. I wonder if this is really true with trunks growing in close proximity such as this one. I posted this before and some of you commented on it: viewtopic.php?f=143&t=3271

Expressed mathematically, Leonardo's rule says that if a branch with diameter (D) splits into an arbitrary number (n) of secondary branches of diameters (d1, d2, et cetera), the sum of the secondary branches' diameters squared equals the square of the original branch's diameter. Or, in formula terms: D2 = ∑di2, where i = 1, 2, … n. For real trees, the exponent in the equation that describes Leonardo's hypothesis is not always equal to 2 but rather varies between 1.8 and 2.3 depending on the geometry of the specific species of tree. But the general equation is still pretty close and holds for almost all trees.

Does this apply to the stems growing from the roots? Does this mean the sum of the diameter of the stems growing in close proximity, or merged into a clump create a combined girth basically equal in diameter to what these roots would have produced as a single trunk?

As for the next level - I suppose we could all type in superscript.

Edward Forrest Frank

Re: Mass Champion Cottonwood

by **edfrank** » Fri Apr 05, 2013 6:03 pm

The other piece of evidence that informs my comment is the fact that the multistem live oak trees all fit into the same tight clump on the tree shape ternary diagram whether they were single trunk or multitrunk. The girth was constrained by the girth requirements to make the list, but none of the other parameters were limited in any fashion.

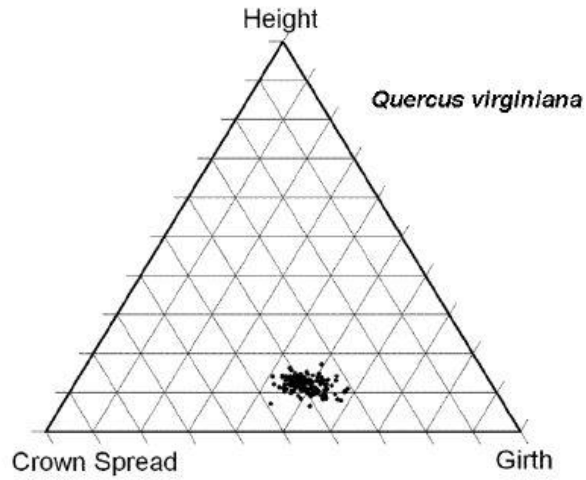


Figure 5. Plot of the normalized data of the 140 live oak trees included in the tree shape analysis.

Edward Forrest Frank

Re: Mass Champion Cottonwood

by **Bart Bouricius** » Fri Apr 05, 2013 9:24 pm

My impression when looking at this tree in person was that at least one pith line went pretty close to the base, but aesthetically, you have to admit that a tree who's branches diverge at 8 or 10 feet as opposed to only 5 feet looks more deserving of big tree status than the more obvious multi-trunk octopus regardless of what the pith line says.

Re: Mass Champion Cottonwood

by **dbhguru** » Fri Apr 05, 2013 9:36 pm

Ed, Don, Will, Bart, et. al.,

Intriguing questions. I think with the laser and reticle, we can do some serious analysis on trees that split into multiple trunks versus multiple trunks that fuse, especially for trees in earlier stages of coppicing or fusing.

Monica and I leave for the Virginia and then the Smokies on Sunday. While in the southern Apps, I think I'll do some experiments on area and diameters of these forms below and above the split. I'll begin with simpler forms and work toward more challenging ones. The reticle-based measurements that we can take are sufficiently accurate now to make the this kind of analysis feasible. Who knows what conclusions we'll reach.

Any ideas or suggestions on what forms to measure and where would be appreciated. As long as I can see and differentiate a trunk, I can measure its diameter. Reticles rule.

Robert T. Leverett

Re: Mass Champion Cottonwood

by **Will Blozan** » Sat Apr 06, 2013 8:55 am

Ed, At first glance this idea seems to have some merit with the resolution of multi-trunked trees, and could be a simple answer for nominations to state and national listings. Although not "perfect" (there is no fork under ground) the stems would nonetheless have to be supported physiologically (roots) by a similar equivalent mass below. I would assume the equation works downward as well, but may have a smaller factor. Very interesting and I will ponder it a bit.

Will Blozan

Re: Mass Champion Cottonwood

by **Don** » Sat Apr 06, 2013 4:06 pm

Ed, Bob, Joe-
I've looked at this tree now several times, and have to say it's a challenge. From the view offered, I'm inclined to say it's a single.
It occurs to me that I'd want to see more of the tree before weighing in with much gravity...in the context of champion tree candidacy, I'm currently thinking that 3-4 photos (perhaps from each of four cardinal directions) would be needed, if possible to obtain.
Kinda ends up as a multi-stem 'pithing contest'...: > /
Trying to image the pith lines in 3D, with a rotating animation

Don Bertolette

Re: Mass Champion Cottonwood

by **edfrank** » Sun Apr 07, 2013 7:49 pm

This image was posted to Facebook by Ontario's' Landmark Trees:

They wrote:

While out looking at trees in Toronto we came across this interesting stump of Manitoba Maple (Acer negundo). This species is considered by many to be a weed, and possibly this multi-trunked individual was cut for that reason. You can see from the thickness of the rings in the cross-section that this tree grew vigorously during its short life. We thought this pattern was interesting- look at how each trunk has become shaped as it accommodates the growth of the other stems

Looking at the photo, and thinking about other examples I have seen, The multitrunk trees grow in all directions until they abut each other. Then after this point growth in all but the outward direction is very small. Each trunk's growth is primarily along the face that is outward from the trunk - essentially the same as what a single trunk would do. They might get an early jump of girth because they grow inward to meet each other as well as outward. But then again, if this were a single trunk tree that inward growth might simply have been directed outward from a single point to achieve a similar net growth in cross-section. So after the fusion of the trunks I don't think they are really adding girth faster than a single trunk would achieve. And while there may be some faster growth initially as the trunks grow toward fusion, I am not even sure that is actually what happens. Thoughts people?

Ed

Re: Mass Champion Cottonwood

by **dbhguru** » Sun Apr 07, 2013 8:44 pm

Ed, I can see where you are going. You may be right, especially in a case where the stems are very close together from the beginning. I'm less sure about what is happening in big coppices where the individual stems start from the circumference of a big stump. There they have lots of room to grow rapidly before coalescing. Even then, the individual trunks, pointed outward have growing room up the trunks.

Something is at work with huge coppices like the Buckland Oak, which had an enormous girth. No single-trunk tree could compete with it in the region. Of course, there is the possibility that it wasn't a coppice from a single root system, but actually the fusion of two (or more) trees nourished by separate root systems.

I have my Vortex Solo with me and intend to use some of my time to model a wide variety of tree forms, concentrating on multi-trunk forms just below and above the point of separation. I'm unsure of what to expect in terms of cross-sectional area above and below the point of separation. I presume that Da Vinci's rule approximates the behavior before and after separation. We can certainly find out. May take a little time, but we have the capability.

Robert T. Leverett

Re: Mass Champion Cottonwood

by **Will Blozan** » Sun Apr 07, 2013 8:55 pm

NTS, For what it is worth, Jess and I have frame mapping of eastern hemlock fusions above and below the fusion into "normal circular" cross-sections. Seems as though useful analysis can only come from circular equivalent dimensions. Frame mapping is one way and would be fairly quick with the new "Bosch-girl lasers".

Ed, as for the box-elder example (of which I don't believe that tree is a box-elder BTW...looks more like white mulberry) the growth of the stems themselves are just one consideration of growth relative to a single pith stem. It is possible the crown i.e. leaf area is far greater for a given size on a multi-trunked tree with the same "diameter" of a single trunk tree. Those 20 year old box-elder-mulberry fusions are far larger in diameter than the same aged single trunk. Just a thought.

Will

Re: Mass Champion Cottonwood

by **edfrank** » Sun Apr 07, 2013 9:43 pm

Bob and Will,

I am not married to the idea, I just think it is worth considering. I see value in looking over the possibilities and pros and cons of the various angles.

Bob, in the initial post I wrote: "We always say that the combined girth of these multitrunk trees is greater than those of a single trunk tree. That is clear when there is a large hollow in the center with trunks growing up around the perimeter." So I was not considering the fusion of larger coppice structures, just those close fusions.

To play Devil's advocate, consider that many of these coppices, such as the silver maple coppices I have commented about before on some of the ARIW islands, are the result of trees growing from the roots of a previously existing tree that was destroyed by flooding or similar activity. There is some substantial differences between these and newly grown trees from seeds. These coppices and rings of trees already have a well developed root system that is initially oversized for the small sprouts that spring up. So it is possible that these sprouts are growing faster because of a pre-existing large root mass. So can we predict the size of a single trunk tree and the rate of growth it might have growing from that root mass or whether or not it would be similar in size to the cross-sectional area of the multiple stems forming the coppice? (I am of the opinion that the cross-section of all of the coppice trunks would be greater than that of a single trunk. With an oversized root system already developed they should grow rapidly initially until they start infringing on each other's space. - but can I actually know this is true?)

Will about the greater crown area of the coppice - that is a valid idea, but the only data I have that addresses this question is the 140 live oak trees in the shape analysis and it doesn't show any difference in crown area or height for multitrunked trees as opposed to those with a single stem. We might have enough data on white pine to do a similar analysis, but I don't have the data at my fingertips.

Edward Frank

Re: Mass Champion Cottonwood

by **dbhguru** » Mon Apr 08, 2013 8:04 am

Ed, Will,Don,Bart, et. al.,

Very useful discussion. Thinking about the role of auxiliary root systems, extra crown, angle of trunks, etc., opens the door for lots of investigation. We are turning a corner in dealing with these complex forms.

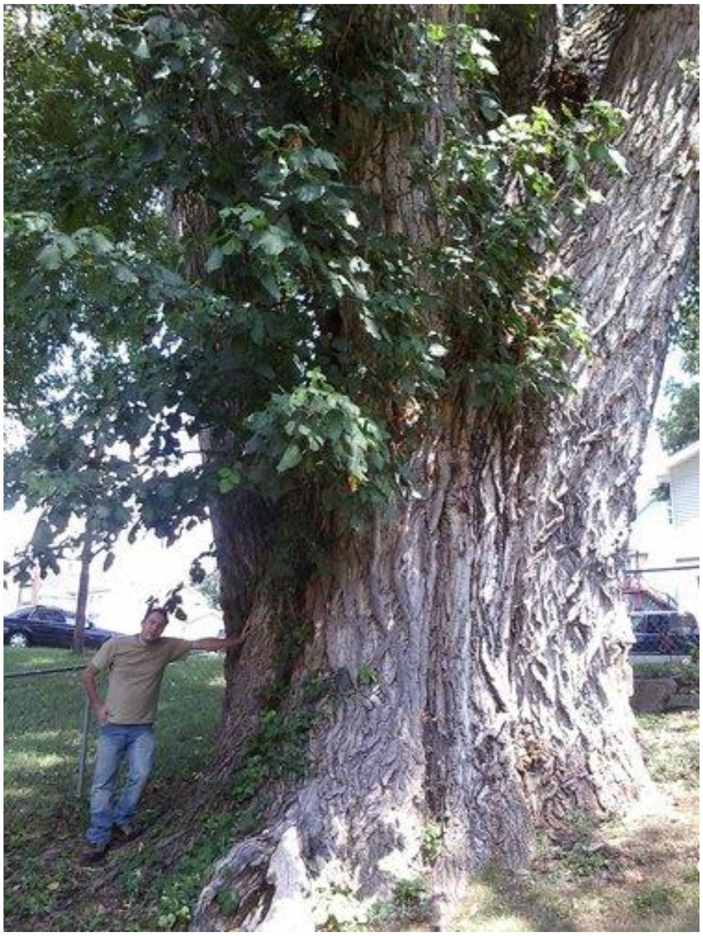
Well, we're ready to hit the road. We're in Shippensburg, PA right now, and the day promises to be gorgeous. Looking forward to redbuds and dogwoods farther south. I'll post images as often as I can. We're going to Ramsey's Draft today. Should be some good stuff to report on by tonight.

Robert T. Leverett

Re: Mass Champion Cottonwood

by **JohnnyDJersey** » Wed Apr 10, 2013 8:19 pm

Reminds me of the 32ft CBH PA champ I've visited. Also some sort of split trunk.



John D Harvey

Charlottesville Airport Oak, VA

by **dbhguru** » Wed Apr 10, 2013 8:01 am

NTS,

Yesterday, I measured the locally famous Airport White Oak for the Charlottsville, VA airport officials. It's a honey. Its girth is 24.2 feet. Its height is 72.0 ft, and its average spread is 94 feet. Total points = 388.0. The Airport is saving it as a local landmark, but restricting access. I was initially asked to measure it by a Charlottsville Tree Steward. Here are two images.

Robert T; Leverett

Re: Charlottesville Airport Oak

by **dbhguru** » Wed Apr 10, 2013 7:19 pm

Brian, Robert, Evidently it took a lot of citizen activism to get the oak saved, but it has happened. I was very pleased to have been asked to measure the tree.

Robert T. Leverett

Re: Charlottesville Airport Oak

by **edfrank** » Wed Apr 10, 2013 8:34 pm

NTS, Bob had a few modifications to better pursue his tree measurement passions: