The Appalachian Trail MEGA-Transect Chestnut Project: A Preliminary Pilot Project Report

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Introduction

Thirty-six volunteers from the Potomac Appalachian Trail Club (PATC), the Appalachian Trail Conservancy (ATC) and The American Chestnut Foundation (TACF) submitted chestnut count reports during 2008 in connection with the piloting of the Appalachian Trail (A.T.) MEGA-Transect Chestnut Project. Collectively, these volunteers counted more than 10,000 chestnut trees while hiking more than 400 miles of the A.T. It should be noted that several sections were hiked and counted by more than one hiker. Counting those duplicated sections, over 500 miles were hiked by the volunteer data collectors.

The Chestnut Project is part of a larger A.T. MEGA-Transect partnership initiated during a symposium convened by ATC[3] in November, 2006. A transect, or strip of ground along which ecological measurements are made at regular intervals, is a method of collecting data where it is impractical to study the entire area. The prefix MEGA- means great or large, and has the double meaning of referring to the span of the A.T. from Maine (ME) to Georgia (GA). The MEGA-Transect seeks to engage citizen scientists in monitoring key indicators of environmental health, and to use new and existing data to increase understanding of environmental issues impacting both the A.T. and the larger Appalachian region. With those resources, the ATC hopes to use the MEGA-Transect program to "inform and engage the American public, decision-makers and stakeholder organizations to manage and protect the A.T. environment, attain the goals of existing natural resources and environmental legislation, and to make sound decisions for positive change" (Dufour and Crisfield, 2008).

Genesis of the Chestnut Project

Participation in the A.T. MEGA-Transect initiative was first considered while researching the possibility of A.T.-based events for the TACF 25th Anniversary Planning Committee. Kathy Marmet suggested to President and CEO Marshal Case that TACF might benefit from becoming a MEGA-Transect partner, and, in early 2007, he submitted the TACF logo for posting on ATC's MEGA-Transect web page as an expression of partnership interest.

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[3] ATC is a volunteer-based non-profit organization dedicated to the preservation and management of the A.T. The A.T. includes more than 2170 miles of trail through the Appalachian heart of the American chestnut range, within a 250,000 acre protected greenway stretching from Maine to Georgia. ATC staff and volunteers coordinate efforts of 30 trail maintenance clubs and their volunteers, numerous federal and state agencies, and nearly 40,000 members.

The partnership for the Chestnut Pilot Project developed informally through email exchanges and phone conversations, including several conference calls set up by Caroline Dufour, ATC Lands and Resources Coordinator, to enable TACF scientists, ATC staff and potential coordinators of trail club volunteers to explore the feasibility and scientific usefulness of collecting chestnut data along the A.T. In addition to her understanding of the A.T. and the relationships between the diverse government agencies and trail clubs sharing responsibility for A.T. maintenance, Dufour also contributed important insights based on her awareness of best practices for citizen science[4].

An inspiration for the Chestnut Pilot Project came from a study conducted by Eric Wiese in 1999, while a student of Dr. Hill Craddock at the University of Tennessee at Chattanooga. Wiese recorded counts of all American chestnut trees that he could see from the trail (a visual transect), while hiking the entire length of the A.T. during a single hiking season (Jordan and Sisco, 2006; Wiese and Craddock, 2000). He used the Appalachian Trail Data Book, a hiker resource listing mileage between trail landmarks (updated and published annually by ATC[5]). He attached a counter to his hiking pole, recording the count in his Data Book and resetting the counter when he reached a known landmark. He counted more than 40,000 American chestnuts along the A.T. Wiese converted his counts over segments of varying lengths into chestnuts per mile so that he could compare frequency of observed chestnut with trail altitude[6].

Methods

Doug Boucher, Bob Pickett and Kathy Marmet met in December of 2007 to develop plans for training of volunteers and details of the data gathering process. Boucher, a forest ecologist[7], provided scientific expertise. Pickett, PATC Naturalist, had agreed to recruit and coordinate PATC volunteers to collect data. Marmet took notes, asked questions and created a draft plan and data collection forms which were circulated for comment among those who had participated in the conference calls.[8]

One goal was compatibility with the Wiese data. Pickett took on the task of dividing the length of the PATC-maintained portion of the A.T. into segments compatible with the Wiese data. Because the area of visibility along the trail is variable, the Wiese data do not provide population density measurements that can readily be compared to other studies of American chestnut populations. Based in part on Wiese's after the fact estimates of typical trail visibility, a distance of fifteen feet on either side of the centerline of the trail was selected for the pilot project counts. Although Wiese had counted everything that he could identify as American chestnut, a minimum height of three feet was adopted for the pilot project.

[4] See http://www.birds.cornell.edu/citscitoolkit/toolkit/resources for links to citizen science best practices resources.
[5] Wiese used the Appalachian Trail Data Book 1998 (20th ed.) & 1999 (21st ed.), Daniel D. Chazin, ed., The Appalachian Trail Conference (now Appalachian Trail Conservancy) Harpers Ferry, WV.
[6] Data available at: http://chestnut.cas.psu.edu/mega-transect.html
[7] Boucher is also a founding Board Member of the Maryland Chapter of TACF, a former Professor of Biology at Hood College, currently Director of the Tropical Forest and Climate Initiative for the Union of Concerned Scientists.
[8] Documents available at: http://chestnut.cas.psu.edu/mega-transect.html

Two report forms were developed: a Chestnut Count Report and a "Large Tree" Report. The Chestnut Count Report instructs data collectors to count all trees having a live stem 3 feet or more in height and a base within 15 feet of the trail. Multiple shoots originating from a single root system would be counted as one tree. In addition to requesting a total count, the form included space to record the count, asked for the number of doubtful identifications (not to be included in the count) and requested an estimate of the area of trail visibility where less than 15 feet on either side of the trail.

Data collectors completed a separate "Large Tree" Report for each tree with circumference 25 inches or more at 4.5 feet above the ground. This form included a request for GPS location, if known, distance from trail, which side of the trail and other location information. Data collectors were asked to record measurement of circumference in inches at four and a half feet above ground (breast height) and give an estimate of tree height. They were also asked to note whether there were flowers present, burs present on the ground or on branches, obvious signs of blight, whether there were multiple shoots from a single root system, and if so, the number of shoots in addition to the one measured.

ATC Web Editor Leanna Joyner set up an interface based on the two report forms at www.appalachiantrail.org/chestnutmonitoring to enable volunteers to submit data reports online. Each report submitted via the web interface generated an email report, and recorded the data in a spreadsheet on the ATC web server. For the pilot project, data collectors were asked to return the paper data sheets that they had used in the field by mail regardless of whether they submitted their data online.

Marmet prepared a data collector kit to be provided to each volunteer at training. The kit included a large zip lock bag to protect report forms from rain, a Chestnut Count Report form and several "Large Tree" Report forms, a set of eight double sided, laminated 4 ¼" by 5 ½" chestnut identification cards[9], an inexpensive five-foot measuring tape, a pencil, a large addressed and stamped return envelope and a checklist of essential and helpful items for data collection. Not included at the time of training, but recommended (and included in the Pennsylvania kits) is a fifteen-foot length of heavy cord or small rope for measuring distance from the trail. Suggested optional items include trail maps, hand lens or microscope, a GPS unit and a digital camera. Training sessions were held in several locations including Gambrill State Park near Frederick, MD, the Shenandoah National Park Headquarters in VA and several locations in eastern PA. These hands-on workshops served to teach potential hikers how to identify American chestnuts, the guidelines for what trees to count, and how to measure the larger trees. The above-mentioned packets were also distributed to each hiker.

[9] Files for printing identification cards are at http://www.vatacf.org/treeid.html

The first Chestnut Count Report was submitted via the web interface on June 1, 2008 for a count completed May 18th. Of the total of 209 Chestnut Count Reports submitted between June 1 and November 12, 2008, 69 reports had been submitted through the web interface. The last web interface report was submitted October 20th for a count completed October 6th. The earliest count date reported was April 8 for counts in New Jersey by an active Pennsylvania volunteer. This would have been before the earliest training date. The last Chestnut Count Report was received November 12, 2008. Some of the reports submitted during November were submitted by email only. No "Large Tree" Reports were submitted electronically.

Results

Counts were submitted for a total of 402.8 miles of trail between Neels Gap in Georgia, and Bellvale, NY (5.9 miles north of the New Jersey line), between which is a total distance of 1329.2 miles (Table 1). Average trail miles hiked for all data collectors was just over 14 miles. Excluding the top four data collectors - who hiked and counted as many as 112 miles - the average distance hiked was 8 miles.

The average chestnut count per mile of trail hiked was 20.9 for all data collectors, and varied from none to 86.4. Data collectors reported obscured vision for only 1.9% of the total area of the thirty-foot trail corridor included in counts.

State	Count of American Chestnuts	Total Distance Hiked and Counted	Total Miles of Trail per State	Percent of Trail Miles Counted	Chestnut Density (trees/mile)
GA	2673	36.8	83.3	44.18	72.64
VA	3078	142.2	554	25.67	21.65
WV	2	5.5	6.4	85.94	0.36
MD	1192	37.8	40.8	92.65	31.53
PA	2356	102.2	229.3	44.57	23.05
NJ	795	71.3	71.3	100.00	11.15
NY	12	7	88.3	7.93	1.71
Grand Total	10108	402.8	1073.4	37.53	25.09

Table 1. *Counts of chestnuts within each state hiked. In most states, not all sections were hiked. In the case where sections were hiked and counted by two or more hikers, the largest of the counts were used in these sums.*

Only five "Large Tree" Reports were submitted for trees twenty-five inches or larger in circumference at four and a half feet above ground. Several other large trees were noted on count forms, including some just outside the count corridor, some less than twenty-five inches but producing burs and some noted in areas for which counts were not submitted.

Notes on count forms and email correspondence with data collectors include a variety of information that may be helpful in refining the pilot project design. One data collector, who is accustomed to using a GPS unit while hiking, recorded geographic coordinates for each of the trees reported on his Chestnut Count Report. Another hiker, Laurie Potteiger of ATC, sent photographs of each of the large trees that she reported (Figure 1 next page), along with reflections on the count process by email. All data collected, including notes from hikers, are available at this website: http://chestnut.cas.psu.edu/mega-transect.html.

Discussion

Figure 1: *New Jersey American chestnut north of Sunfish Pond.*

By utilizing the concept of the transect, this pilot study set out to better define best practices for establishing 1) a baseline snapshot of chestnut density along the Appalachian Trail and 2) a data set from which those variables that define chestnut occurrence could be extracted. In addition, by incorporating the use of volunteer citizen scientists, the project has an added benefit of increasing awareness not only among project participants, but also several communities of hikers, naturalists, and residents along the trail.

Laurie Potteiger, who hiked over 112 miles total, hiked the entirety of the New Jersey section. Her counts of trees found along the trail can be found in Figure 2[10] . Based on Potteiger's counts, one can see significant pockets of high chestnut density where other areas have few to no chestnuts. What makes that one section in the central part of the New Jersey Appalachian Trail special for chestnut survival? Are there differences in soil type between those areas? Elevational differences? Land use differences? Most likely, it's a combination of all of those.

The observation of pockets of trees in some areas, but none in others, has been noted in other contexts. In 1993, Dr. Fred Paillet documented the irregularity of presence and absence of American chestnut clones in several locations within the natural range (Paillet, 1993). With more data and/or a refinement of scale on which to observe occurrence along the Appalachian Trail, those variables that appear to dictate density of American chestnut sprouts may be derived.

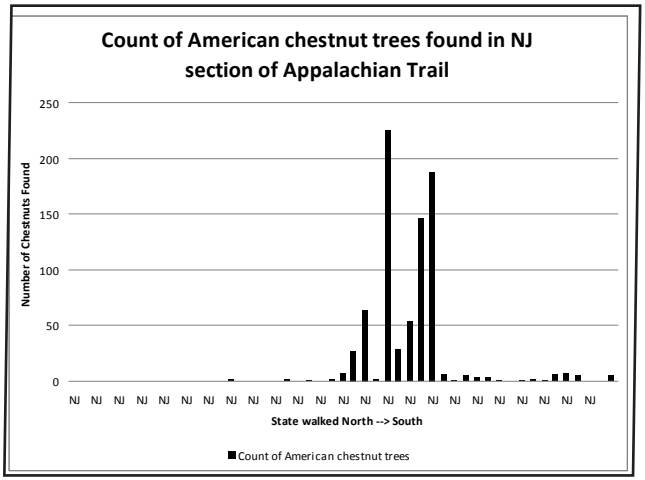

Figure 2*. This chart shows a distinct difference in chestnut density along certain parts of the Appalachian Trail within New Jersey.*

One possible way to look at several variables on a large geographic scale is to more fully utilize GIS (Geographic Information System) technology. Many layers of geographic information are available at no cost. But, currently, there are no geographic data associated with the counts taken by our volunteer hikers in 2008. To do this type of analysis, trail segments used as data-collection units must first be defined in terms of GPS coordinates. Once this is done, it may be possible to analyze the pilot and future data in terms of several abiotic variables that are potential predictors of chestnut, including elevation, aspect, slope, and rock and soil types.

[10] Note that these counts differ considerably from the counts of another hiker who counted the same area. This issue will be covered below in the "Refinement of Methodology" section.

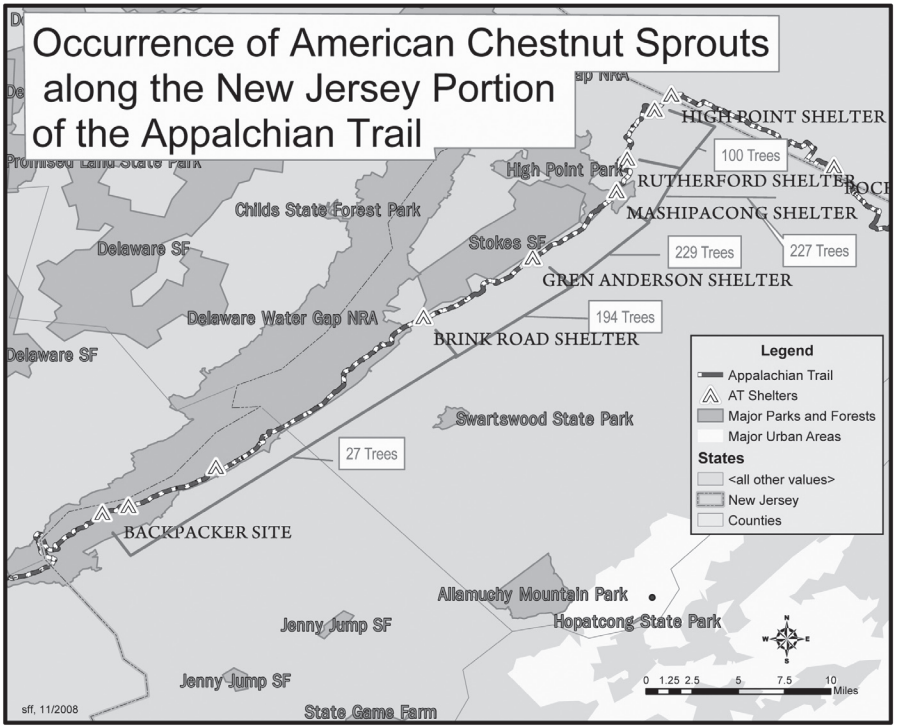

***Figure 3**. More sprouts were found in the northern half of the NJ trail.*

A detailed database of GPS coordinates exists for the centerline of the A.T., shelters, and trail and road crossings. Using these datasets together, it will likely be possible to unite GPS coordinates with the available segment data used by hikers. Unfortunately, that process will likely be time consuming and the task of analyzing hundreds of miles of chestnut counts in terms of the potentially identified variables may be quite formidable, requiring the piecing together of many data sets designed for smaller areas.

But there is still great potential. Looking again at Laurie Potteiger's counts of chestnut sprouts in a geographic format (Figure 3), with only a single layer, that of location of public lands, we can see a definite pattern of chestnut distribution. The trees Potteiger found are all in the northern half of the NJ sections of trail, on the outskirts of publicly owned lands. Why are more chestnuts found near those lands managed by the state (Stokes State Forest and High Point State Park) while fewer are found on Federal lands (Delaware Water Gap National Wildlife Refuge area)? Of course, other variables likely contribute, but looking at only one layer can give one an idea of the potential power of geographic based analysis.

Examples of analysis of these types of geographic data applied to chestnut presence and absence do exist. Among those involved in the refinement of the A.T. MEGA-Transect chestnut pilot project are Dr. Songlin Fei[11] and Joe Schibig[12]. Fei et al., (2007) collaborated on a spatial habitat modeling study of American chestnut in Mammoth Cave National Park. Professor Schibig and his students and volunteers inventoried American chestnut sprouts in the park from 2003

[11] Assistant Professor of Forest Biometrics & Spatial Analysis at the University of Kentucky, Department of Forestry.
[12] Professor of Biology, Science Department, Volunteer State Community College, Gallatin, TN

–2006, recording ecological data and geographical coordinates with a GPS unit. Dr. Fei used the chestnut coordinates to map the chestnut sites over various geological formations within the park and to generate a predictive map of the most likely areas in the park to find additional chestnut trees. The results of the Mammoth Cave National Park study illustrate the potential usefulness of the type of data being gathered in the A.T. MEGA-Transect Chestnut Project, particularly if it can be made compatible with other data linked to geographic coordinates. It also provides a model for using graphic display of complex analytical techniques to communicate results to non-scientists—a key aspect of the Citizen Science process[13].

Refinement of Methodology

The A.T. MEGA-Transect Chestnut Project has been carried out so far primarily by volunteers and with virtually no budget. The experience and results from the pilot process suggest possible improvements to the initial approach, and raise important issues that will need to be addressed as planning for future work continues.

At the beginning of the pilot project, the data segments defined by the 2008 Appalachian Trail Data Book seemed to be the best available units for data reporting in the absence of equipping volunteers with GPS units. The 2008 Data Book defines 1494 segments over a total distance of 2185 miles for an average of 1.46 miles per segment. The shortest segment is 0.1 mile; the longest 7 miles. More than half the trail distance is in segments of between 0.9 miles and 2.8 miles. By looking at the current dataset, however, it appears that some longer segments outlined by the data book may overlook potential environmental variables that may be important to defining chestnut presence. For the next steps, the planning group will need to determine whether the Data Book segments are small enough units to provide adequate detail for analysis.

If the Data Book segments are not small enough, how can we establish a fine enough scale on which our hikers can feasibly base counts? One possibility is to implement the use of GPS units. The finest scale possible, of course, would be to GPS every tree encountered. One pilot data collector recorded GPS coordinates and diameter at breast height for all 25 American chestnut trees counted in two segments totaling 3.8 miles, and indicated that he did not find it difficult or particularly time consuming to take those measurements. But in some segments of the same distance, hundreds of trees were found. In addition, for all data collectors to use GPS units, we would need funding or donation of sufficient GPS units to make them available to all data collectors, and would need to provide training in the use of GPS units.

In general, the web interface worked fairly well, and was used by many volunteers. It will be interesting to see what comments the volunteers have on their experience of using the interface. A few discrepancies found between paper and web entries suggest possible areas for improving the reliability of web entries.

[13] See 2007 TACF Annual Meeting presentation by Fei at http://chestnut.cas.psu.edu/mega-transect.html

A major issue for the entire project is the reliability of data submitted by the volunteers. In some cases, the hikers had never seen an American chestnut tree and experienced only a one-day, intensive identification workshop before they set off to find the trees. In some sections that were duplicated, counts were at least on the same scale. For instance, in southern PA near Michaux State Forest, hikers found and identified roughly the same number of trees, typically within the same range. But in some cases, like that in New Jersey, one hiker found significantly fewer sprouts, hundreds fewer, than a second hiker.

A primary variable to note is not only the difference in hikers, but also the date hiked. In both cases, one hiker went either in the early spring or late fall. At both of these times, chestnuts may be found, but it's generally more difficult to identify trees without leaves than during the height of the season when both leaves and flowers may be present. Typically, both in the lab and in the field, it's much easier to identify leaf samples in late June and early to late July. Based on these observations, it appears that it would be prudent to set a more stringent range of dates for data collection in the future. Instead of letting hikers count whenever they can, it may be best to ask hikers to hike only during mid to late summer.

The task of counting American chestnuts within a forest setting requires a complex skill set. The ability to distinguish between American chestnut and other trees is relatively simpler to teach than the ability to systematically seek out the variety of visual patterns presented by American chestnut (See accompanying illustrations by Fred Paillet). Assessing and improving reliability of counts will be a key focus for 2009.

Conclusion and Next Steps

The A.T. MEGA-Transect Chestnut Project generated considerable interest among potential volunteers without any concerted effort to publicize it. Those who participated as data collectors were generous in their willingness to share their experiences so that we could learn from them. The project has also generated interest among TACF scientists. With dozens of hikers involved and introduced to the chestnut project, the pilot project for chestnut counting within the framework of the A.T. MEGA-Transect can be deemed a success. Though not all sections were hiked, the organizers of the project have learned a great deal that can be applied to a more in depth and, possibly, larger scale project along the Appalachian Trail.

By establishing a baseline, it will be possible to monitor how certain changes will affect chestnut density. Disturbances such as deer density, fire, blow-downs, pest invasions, and climate change, could all be examined by their effect on chestnut density and distribution throughout the trail over the coming decades. We will also have a way to monitor the long-term status of chestnuts in a wild area, free from development and address questions such as, what is the life-span of a chestnut sprout and how are they affected by various disturbances?

ATC has submitted a letter of intent to the National Science Foundation (NSF) Informal Science Education program with the intention of submitting a full application for funding in June 2009. At its October 24, 2008 meeting, the TACF Science Cabinet endorsed TACF participation in the ATC grant application, and established a committee to work with the project. The key to future success of the Chestnut Project is to use the pilot project experience and expertise of scientists who have done related research to refine the data gathering process. If that can be done, volunteer effort may be more effectively used and has the potential to produce data that are likely to make a substantial contribution to future understanding of American chestnut ecology. This article and the accompanying web page are an invitation to contribute to that process.

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