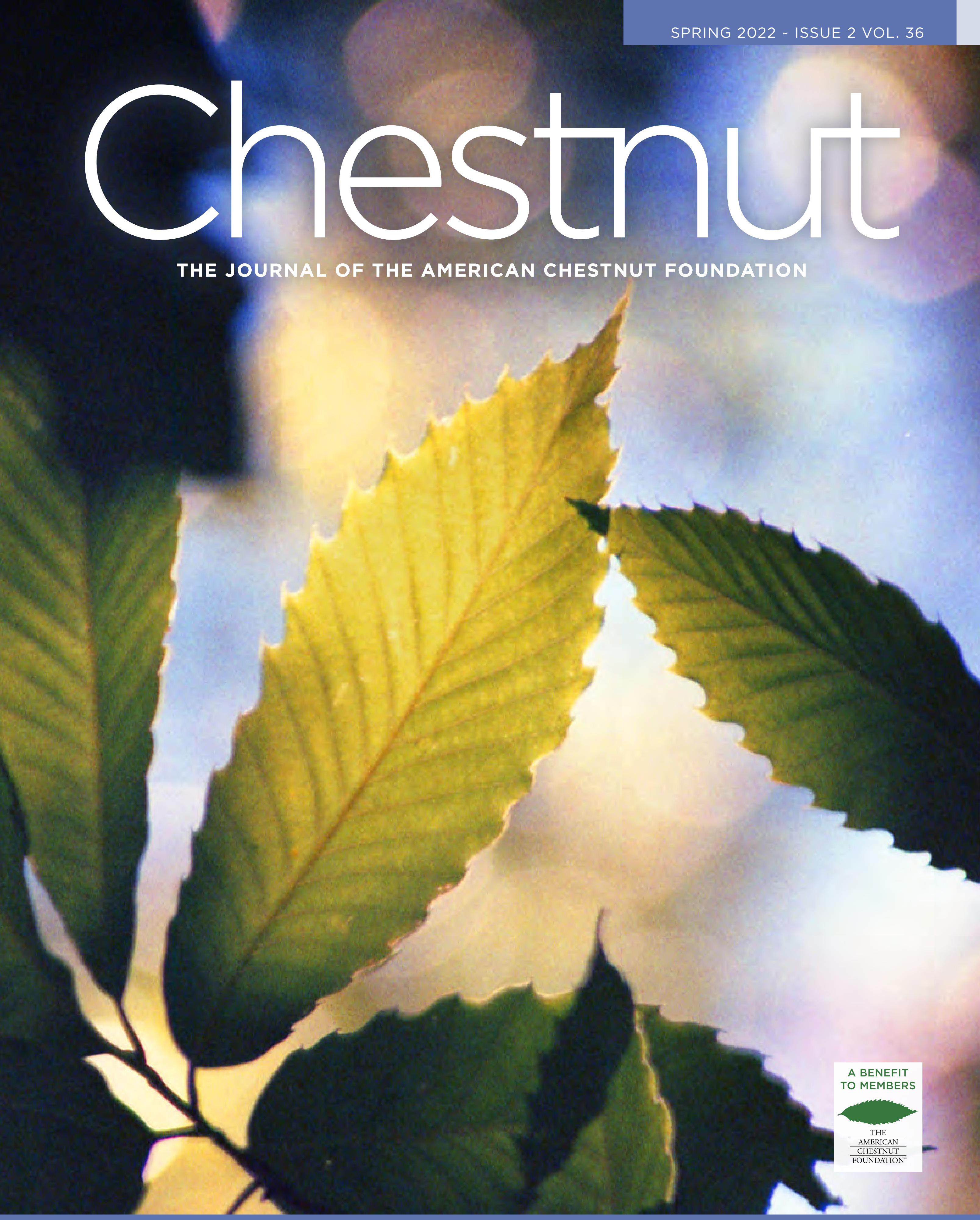
SPRING 2022 ~ ISSUE 2 VOL. 36

Chestnut

THE JOURNAL OF THE AMERICAN CHESTNUT FOUNDATION



A BENEFIT TO MEMBERS

THE AMERICAN CHESTNUT FOUNDATION

~ SPECIAL EDITION: ONGOING PERSEVERANCE OF THE WILD AMERICAN CHESTNUT ~

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A BENEFIT TO MEMBERS

THE AMERICAN CHESTNUT FOUNDATION

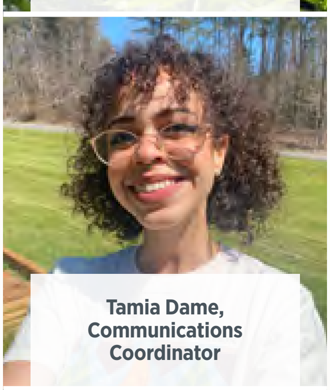
8 Years as a: CHARITY NAVIGATOR ★★★★ Four Star Charity

living wage CERTIFIED

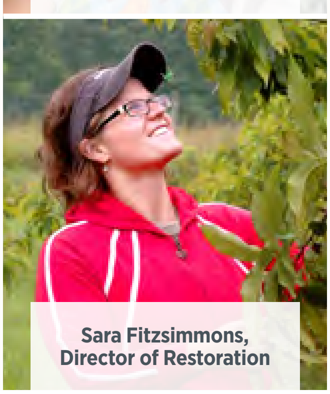
Lisa Thomson

President and CEO

Jules Smith, Director of Communications



Tamia Dame, Communications Coordinator



Sara Fitzsimmons, Director of Restoration

DEAR CHESTNUT ENTHUSIASTS,

Over the last few years, TACF has enjoyed increased national visibility and media attention. This past year alone we welcomed more than 1,300 new members, experienced a 17% increase in giving, and exceeded our $250,000 year-end appeal goal by nearly $100,000. Through focused planning by our staff philanthropy team and your generosity, it was one of our most successful years. The Foundation depends on annual, private funding and this support allows us to grow and remain financially sound in a time of uncertainty. Please accept our deepest gratitude.

Because of increased media requests, we have strengthened our communications team in order to respond quickly and accurately. **Jules Smith, TACF's director of communications**, has a background in broadcast production and experience to manage these requests, recruiting the right spokesperson from TACF's community of staff and volunteers. Last year we hired **Tamia Dame, communications coordinator**, to support Jules' efforts and shore up our social media presence. Since Tamia started last June, our Facebook "likes" have increased by 8% and Instagram followers are up 32%. These two platforms seem to best fit our constituency, though we are also exploring TikTok as a resource for sharing educational video clips to attract a broader range of demographics.

Director of restoration Sara Fitzsimmons has participated in a multitude of media stories for more than two years now and is often our lead spokesperson. As a 20-year veteran, Sara has a keen ability to speak well on her feet and bring our mission to life with deep knowledge and enthusiasm. She has been featured in numerous podcasts, including NPR and PBS, and recently participated in a conservation series being produced by ABC.

We are excited to have the national stage, but are not stopping there to get the word out! With a documentary film in the works (see page 24 in this issue) and repeated national exposure, TACF will reach new constituents in the private and public sector. Please share your own chestnut stories with friends and family. Encourage them to learn more about TACF and, better yet, ask them to join! Membership is the pipeline to more engagement, so we need your help to recruit more "chestnutters." But for now, I offer my sincere thanks to you for keeping us strong, focused, and moving forward as we solve this complex mission together. The future will experience a forest of resilient chestnuts!

Lisa Thomson

Lisa Thomson, President and CEO
The American Chestnut Foundation

Gold Leaf and Film

The cover photo was taken by Jacob Pease, winner of TACF's 2021 American Chestnut Photo Contest. Jacob used his creative eye and a film camera to recount the nostalgia and sentiment of this foundation tree species.

THE AMERICAN CHESTNUT FOUNDATION™

WHAT WE DO

The mission of The American Chestnut Foundation is to return the iconic American chestnut to its native range.

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SAMPLING, IDENTIFICATION, AND USE OF

Wild American Chestnuts

By Kendra Collins, TACF New England Regional Science Coordinator

The American Chestnut Foundation pollinates and harvests chestnuts from hundreds of trees every year. This is pretty impressive for a species that is considered functionally extinct! While many of these trees are in our orchard collections, the wild American chestnut parent of most of these orchard trees was identified by a volunteer, member, or landowner as a possible American chestnut, and then confirmed with a sample identification. Sounds simple enough, however there are several important steps between finding a wild American chestnut tree and having it included in our conservation efforts.

Finding, Collecting, and Submitting a Good Sample

An American chestnut tree could be found at any time of year but the most common times for people to notice them are in mid-summer when they are flowering, in the fall when they are producing burs, or a bit thereafter when the burs may be seen on the ground. The burs in particular often capture attention, as they are distinct with their sharp, dense spines and velvety interior. Those more familiar with the species also develop a good eye for the foliage, which has a distinctive way of hanging that you may come to recognize the more time you spend around chestnut trees. And then, of course, the presence of chestnut blight fungus can be quite recognizable as well.

When a new chestnut tree is found, the first question is often "Is this an American chestnut?" American, Chinese, Japanese, and European chestnut, as well as Allegheny chinquapin, are all somewhat common in the eastern U.S. Further complicating identification, all chestnuts readily hybridize. Figuring out what type of chestnut you have can be tricky!

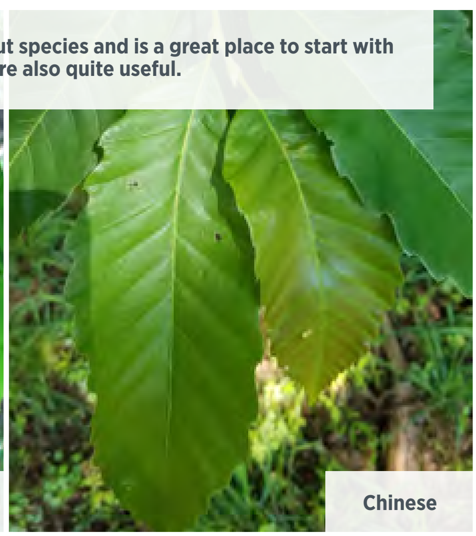
The best way to have a chestnut properly identified is to collect a good leaf and twig sample. There are characteristics of the leaves, buds, and twigs that are all helpful for identification. A good sample should be collected from a sunny exposure if at all possible, and include 6-12" of twig and several attached, green leaves. The sample should then be arranged so the leaves are all flat (not folded or crumpled), and pressed well. A plant press works great here (visit the fact sheet on our website for instructions: acf.org/resources/tacf-fact-sheets/), but placing a sample between a few sheets of paper towel or newspaper and pressing with a heavy book can work just as well.

A well-pressed sample can be packaged for shipping. The best method is to make a "sample sandwich" with a piece of cardboard, paper towel, then the sample, covered with another paper towel, and topped with another piece of cardboard. This whole stack can then be placed in a shipping envelope. Plastic should not be used to package samples, as the leaves often get moldy, making them difficult and unpleasant to work with.

Before shipping a sample, it is important to include some information about the tree the sample was collected from. Most commonly, submitters fill out our Tree Locator Form, which requests some basic information about the tree, its health, and flowering status, as well as contact information for the submitter and landowner. This contact information is particularly important for any trees we want to work with, as we need to obtain proper permissions. There is also a smartphone app called TreeSnap (treesnap.org) that captures similar details and is a great tool for collecting information on the fly. TreeSnap does not

Leaf morphology varies across the chestnut species and is a great place to start with identification, though the twig and buds are also quite useful.

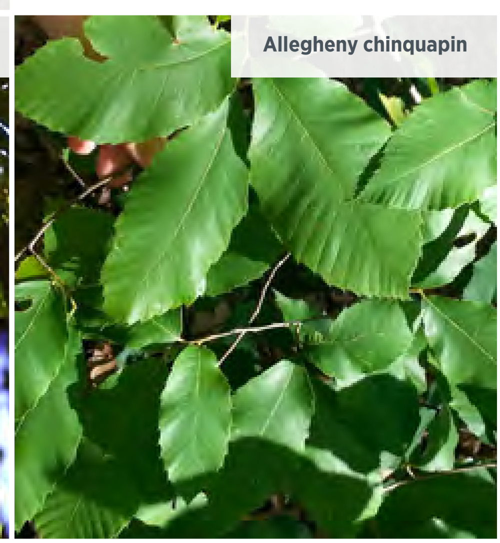
American



Chinese

Japanese

European



Allegheny chinquapin

collect contact information, so we prefer that submitters include the TreeSnap sample ID on our Tree Locator Form, but still provide their contact information and that of the landowner (if known).

Once the sample is pressed and packaged, along with the data we need to make the sample useful, it can be shipped to one of our sample ID locations. Most go to the regional science coordinator for a given region, but it is worth checking our website for the best option: acf.org/resources/identification/

Sample Identification

Sample identification is an exercise using a suite of morphological traits to determine the most likely match for the sample. Morphologic traits can be somewhat plastic, making this kind of ID a good, but not exact, science. This is why an adequate, pressed sample of fresh leaves from a sunny part of the crown is important – it provides the best material to work with. We have recently worked to develop a genetic model for teasing apart the various chestnut species; however, this capability is very new to us and current plans only include limited and strategic use of genetic assessments.

The traits we use for morphologic identification are those that tend to diverge across the chestnut species. The macroscopic traits include: the thickness, shape, luster, and dentation of the leaf; the angle of the leaf base; the shape, color, and hairiness of the buds; presence and shape of the stipules; color, hairiness, and relative thickness of the stem; and character of the lenticels. In addition, there are several types of leaf hairs on the underside of the leaf that vary across the chestnut species. The character of vein hairs along the midrib, presence or absence of interveinal simple and stellate hairs, as well as the shape and abundance of microscopic trichomes, all help hone in on a good identification.

Example of a well-prepared sample for identification (top), and one that was not properly pressed and packaged (bottom), making identification much more difficult.

Looking at all of these traits, a typical American chestnut has a thin, canoe-shaped leaf with a dull leaf surface and hooked or breaking ocean wave dentation. Buds are often red or orange, smooth, and pyramidal in shape, protruding from the stem at a 45-degree angle. Stipules are not persistent, but when present are narrow. Twigs are usually reddish (new growth), not hairy, thin, and have small, white lenticels. On the underside of the leaf, American chestnuts usually have long, wispy hairs on the midrib only, no hairs on the leaf surface, and the leaf surface has many four-celled orange-ish trichomes that are often described as having a "hot cross bun" shape.

In contrast, Chinese chestnut is the most common species to be confused with American chestnut but there are quite a few differences if you know what to look for. A typical Chinese chestnut has a thick, rowboat-shaped leaf with a shiny leaf surface and triangular or even bristly dentation. Buds are tan or pea green, hairy, oval shaped, and appressed to the stem. Stipules are persistent and flared. Twigs are usually tan and stout, new growth is hairy, and lenticels are large and more cream colored. On the underside of the leaf there are many hairs – short, unruly hairs on the midrib, and simple and stellate hairs typically cover the leaf surface. The trichomes characteristic of Chinese chestnut look like a little wilted lollipop, and are most often seen on the midrib.

While these are the typical traits of American and Chinese chestnut, there is certainly variation within the species, and particularly in sun vs. shade samples. The other common chestnut species – Japanese and European chestnut, as well as Allegheny chinquapin – exhibit variation in many of these traits as well. Hybrids can be very tricky to tease apart, as they often show traits of more than one species, or one species may present more dominant morphology. You can find more detailed ID information about all chestnut species on our website: acf.org/resources/identification/

How are Sampled Trees Used?

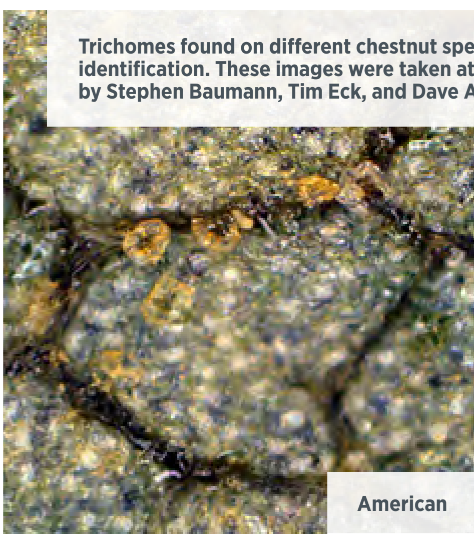
Once a sample is identified, the sample submitter is contacted with an ID report and the data about the tree they sampled is entered in our *dentata*Base database. The data on each sampled tree adds to an ever-growing inventory of wild trees existing on the landscape. When samples are submitted in poor condition, or without enough information, we may not be able to identify them but we will reach out to the submitter with better instructions for sampling if they wish to try again.

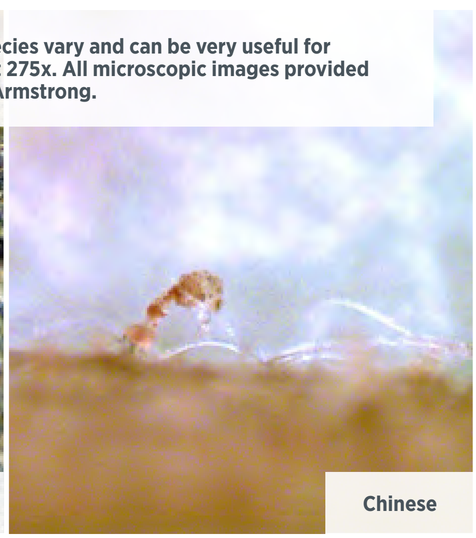
If a sampled tree may be of use in our program, the local chapter is alerted and invited to reach out to the submitter or landowner to discuss potential next steps. In recent years, much of our chapter work has been focused on germplasm conservation, and flowering wild American chestnuts have been the primary interest for trees submitted through our ID program. These trees may be candidates for harvesting open-pollinated seed, or for planning controlled pollinations. Nuts from these wild trees are then planted in germplasm conservation orchards or used in other ways to support our programs.

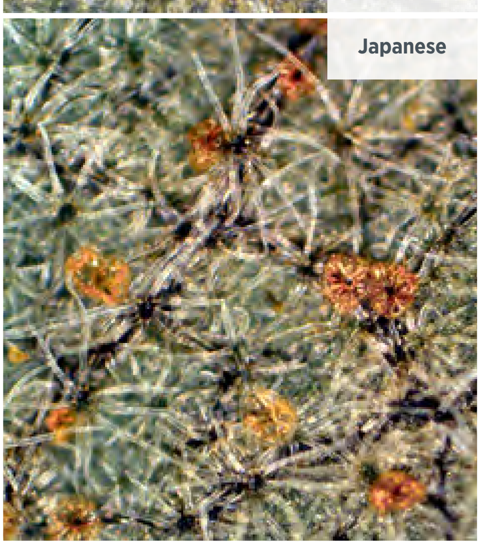
The use of these samples does not end there, however. We have used the wild tree inventory data for a variety of scientific projects. For example, over the past few years, TACF has collaborated with Virginia Tech on a landscape genomics project, looking at the range-wide diversity of the species. This project called for sampling wild-type American chestnuts from as many ecotypes as possible throughout the native range. These data collected through our sample ID program proved very helpful in strategically locating sampling sites. We have also identified areas of the native range with greater genetic diversity or less representation in our conservation efforts. Our wild tree inventory data gives us the opportunity to identify trees in those areas that may not be flowering but could be used for grafting or other propagation techniques.

How Can You Get Involved?

A crucial goal of our program continues to be germplasm conservation and we can always use more people scouting for wild trees, so take a hike and share your results! In addition, many state chapters have a committee or working group devoted to following up on reported trees, assessing pollination and/or harvest potential, as well as planning and executing these activities. If you would like to get involved in pollinating or harvesting wild trees, please reach out to your local regional science coordinator or state chapter to learn more about how you can receive training or assist in these efforts. Contact information can be found at acf.org.







Trichomes found on different chestnut species vary and can be very useful for identification. These images were taken at 275x. All microscopic images provided by Stephen Baumann, Tim Eck, and Dave Armstrong.

TRACKING AND DOCUMENTING

Chestnut Tree Locations

By Sara Fern Fitzsimmons, TACF Director of Restoration and Jack Alcorn, 2020 TACF Duke Standback Intern

TACF tracks the location and associated data regarding chestnut trees in three different ways: The Tree Locator Form (TLF) program via *dentata*Base, TreeSnap, and iNaturalist. In the previous article, Kendra Collins documents the process used for tracking trees via our TLF, along with the online and mobile application, TreeSnap. iNaturalist is a program developed by the California Academy of Sciences and National Geographic, and is used to track any living organism around the world.

Wild American chestnut in Western North Carolina.

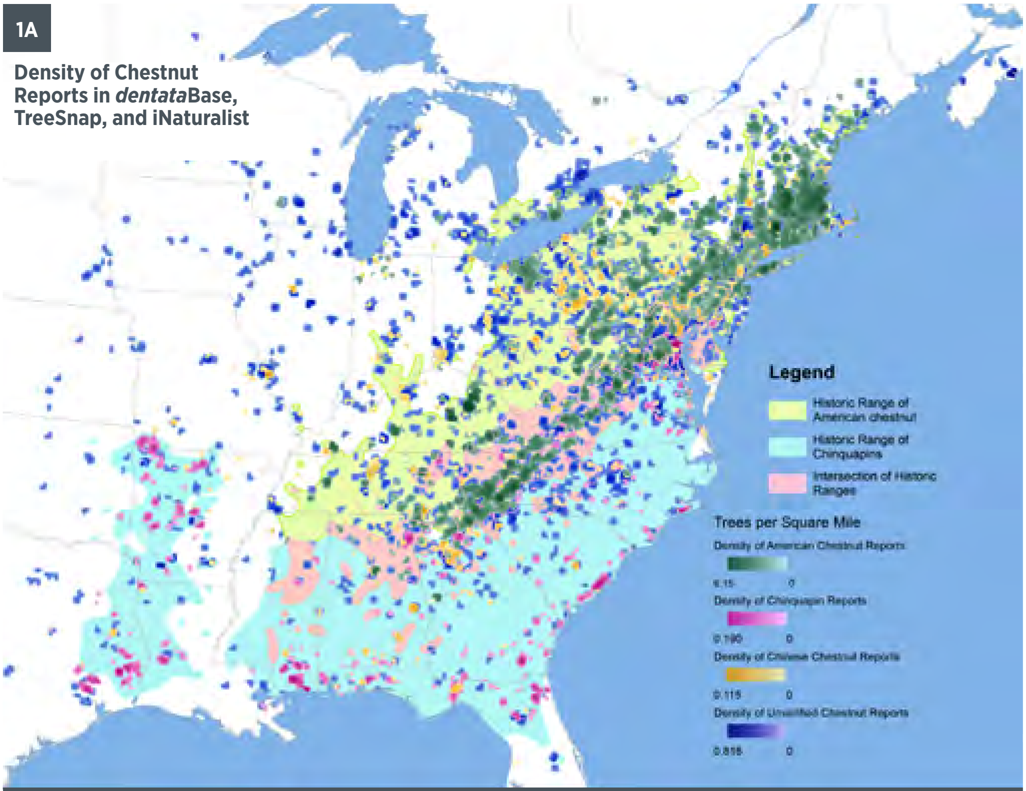
With the coronavirus pandemic at its height and many people on lockdown, the 2020 Duke Stanback Internship recipient and co-author of this paper, Jack Alcorn, was required to work a remote-only role. Typically, summer internships with TACF focus heavily on field work, so we strategized to define a set of computer-based projects which would benefit the Foundation.

After pouring over a few options, we settled on creating a suite of descriptive and spatial analyses on those three tree-tracking datasets. The 2016 paper by Dalgleish et al. had already established an excellent reference for determining the current status of American chestnut in the wild, so what could these three datasets offer in addition?

A major difference between the data used in Dalgleish et al. (2016) is the way in which the data are collected and reported. The Forest Inventory Analysis (FIA) data used for Dalgleish et al. (2016) follows the systematic implementation of permanent forest plots, of which each tree species size and abundance are captured on a regular basis by trained personnel. In contrast, the three datasets TACF uses are all ad hoc reports with heavy sampling biases. A majority of those are submitted by the public, some of whom have little to no training in tree identification or mensuration.

The Applications

When the records are combined, the incredible power of crowd-sourced and citizen scientist-driven projects are revealed. As a start, looking at the sheer number of trees reported around the world shows a clear pattern of who and where the application is being used (**Table 1**). The American chestnut (*Castanea dentata*) in America and the European chestnut (*C. sativa*) in Europe are the most commonly documented species. iNaturalist is a global application, whereas TreeSnap and *dentata*Base are used exclusively in North America. Most of the Asiatic species



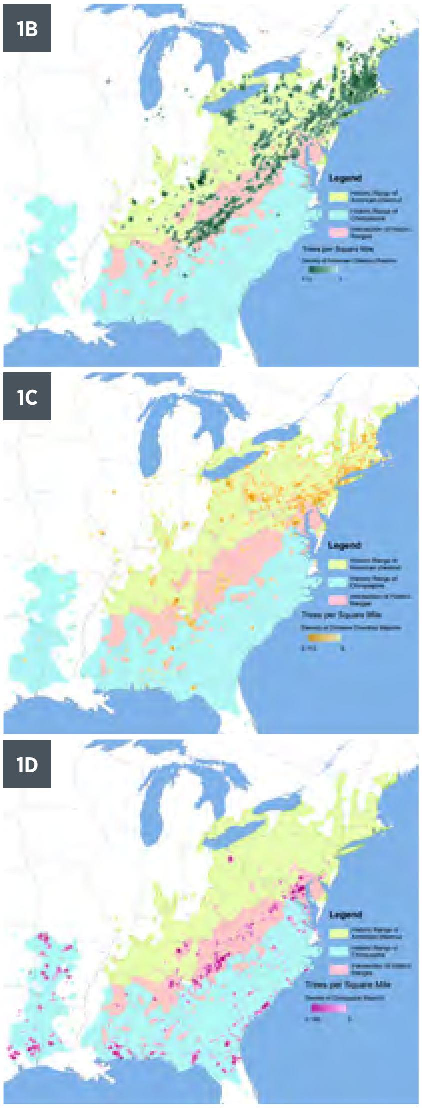


FIGURE 1. Maps showing the relative density of publicly-reported chestnuts in the eastern United States via iNaturalist, TreeSnap, and TACF's *dentata*Base. These maps show verified reports of American chestnut (1B), Chinese chestnut (1C), and the combined reports of four native chinquapin species (1D: Ozark chinquapin, Allegheny chinquapin, Alabama chinquapin, and Florida chinquapin). The unverified chestnut reports could be chestnuts of currently unidentified species but could also be non-chestnuts. These reports are all from TreeSnap and iNaturalist, and await crowd-sourced agreement. Other chestnut species (European and Japanese) are found in the eastern U.S., but have reported at the lowest frequencies and are not shown on these maps. American chestnuts are by far the most often reported chestnut species in the U.S., both because there is great interest in the species, and also because it is likely the highest population of chestnut species in the eastern U.S.

	Research Grade			Needs Identification		
Species	**dB**	**iNat**	**TS**	**iNat**	**TS**	**Grand Total**
Castanea	124			3,604	82	**3,810**
C. alabamensis	4					**4**
C. crenata	34	115		193		**342**
C. dentata	5,317	5,274	484	2,716	4,548	**18,339**
C. henryi	1			4		**5**
C. mollissima	1,553	493		1,313		**3,359**
C. ozarkensis	1	87		5		**93**
C. pumila	20	802		287		**1,109**
C. pumila floridana		8		2		**10**
C. pumila pumila		1		1		**2**
C. sativa	19	5,333		3,093		**8,445**
C. seguinii	2			21		**23**
Grand Total	**7,329**	**12,113**	**484**	**11,239**	**4,630**	**35,795**

TABLE 1: A review of species type and confidence in the identification between three species tracking databases: TACF's *dentata*Base (dB), iNaturalist (iNat), and TreeSnap (TS). These counts are current as of March 2022 and reflect the global counts of these species.

TACF's Tree Locator Form (TLF) program primarily uses a paper-based form but is also integrated with TreeSnap. This format takes the longest amount of time and effort to complete but, in theory, offers the most accurate and robust data. As described in Kendra's article (pg. 4), submitters of a given tree's location and measurements are requested to send in a leaf sample for identification. Acquiring and shipping a leaf sample is more arduous and costly than simply taking a few pictures in Treesnap or iNaturalist. Accordingly, the follow-up identification process often takes several weeks simply because those doing the identification have many other competing tasks, especially during a busy field season. Once a sample is identified, the data then need to be manually entered into *dentata*Base, TACF's in-house, customized tree-tracking software, another time-intensive task.

shown in Table I, especially *C. mollissima* and *C. crenata*, are also logged in North America, though there is increasing usage of iNaturalist in Asia.

iNaturalist and the accompanying mobile application "Seek" are fun and easy to use programs which combine artificial intelligence (AI) and user scoring to determine the validity of a given observation. Table I shows two different groups of data: "Research Grade" and "Needs Identification." These are quality-control groupings set by iNaturalist to determine how much agreement exists within the community saying a given species is what it really is. The obvious advantage of iNaturalist is the enormous number of observations and location data it can generate. The disadvantage is that no other metrics are gathered about any given organism.

TreeSnap is a lot like iNaturalist. TreeSnap is an application, both for both PCs and mobile devices, led by the Universities of Tennessee and Kentucky. The program tracks not only American chestnut but also other threatened tree species throughout the United States. There are currently more than 12,000 trees catalogued by TreeSnap, with 40% of them being tagged as American chestnuts.

Scientists and software developers for TreeSnap worked closely with researchers who study those threatened species to create the application so the data would be most useable for their research. TreeSnap data set is hypothetically the second best for TACF's cataloguing because it not only tracks location like iNaturalist, but also provides tree measurement and flowering information. Tracking trees is very easy to do, and there is a simple "agree/disagree" process for users to upvote or downvote the identification of a given tree.

The benefits of *dentata*Base are not only that location data are acquired, but size and other demographic data area are also captured. Most important for breeding purposes is size and flowering/fruiting data. As documented by Dalgleish et al. (2016), there are hundreds of millions of small American chestnut sprouts in the understory of eastern U.S. forests. Unless those suppressed sprouts are grafted or otherwise vegetatively propagated, they cannot be used in conservation or restoration programs. Fruiting trees have the greatest utility. Of the 5,317 American chestnuts logged in *dentata*Base, only 1,315 are noted as bearing any flowers (male or female) for a rate of 25%. In TreeSnap, the rate is 15%. These rates are much higher than what is found across the landscape, again pointing to a biased sampling scheme for what is contained within the records of *dentata*Base, reflecting the types of data and trees which have the greatest direct utility to TACF.

Sources for Error

A challenging aspect to any citizen scientist application is knowing how accurate the reported data are. One way to improve the accuracy of any work is to offer training. Some TACF tree submitters have been trained for identification work, but the majority have not.

There are many areas where error can enter into these datasets. The first is being able to identify an American chestnut. The most common species we receive at our offices are Chinese and other exotic chestnuts (**Table 2**), which are about 47% of the samples we receive. The next grouping are oaks, especially sawtooth oak which looks very similar to Japanese chestnut. Next, are hickories, horse chestnuts, and elm. Then it becomes downright confusing – pawpaw, maple, even osage orange have come

Common Name Group	Number Identified
American chestnut	795
Exotic chestnuts	781
Oaks	28
Buckeye	23
Birch/Elm	15
Beech	8
Hickory	5
Other	5
Total	**1,660**

TABLE 2: Number of Chinese chestnut and non-chestnut leaf samples sent to and identified by Penn State Partnership Office between 2006 – 2019.

across the desks of TACF ID personnel. Non-chestnut samples represent about 5% of all samples received.

On occasion, people sometimes employ easy-to-use tools for unintended purposes. TreeSnap, for example, has been used to track planted trees. Because users have direct access to the mobile application, they can log their planted trees and have immediate access to them. Unfortunately, TreeSnap cannot take observations on those trees over time. As a planted tree grows, we discourage logging another entry for height, diameter, or flowering in TreeSnap to avoid creating another entry for that same individual tree. *Dentata*Base tracks observations of trees over time but is a more complex interface.

The more data collected, the greater the risk of input error. Because both TreeSnap and *dentata*Base take measurement and flowering data, these metrics often show where users have the most trouble, especially with outliers. If I see a diameter of 120″, then I am sure that 1) the tree is a Chinese chestnut and/or 2) I have been given circumference, not diameter. Most of these errors can be ascertained by looking at extreme outliers, but they are not always obvious, and those are the errors of most concern.

Results and Utility of Data from *dentata*Base, TreeSnap, and iNaturalist

Despite the potential error contained in these datasets, there can still be an enormous amount of utility, as long as those sources of error are recognized and accounted for in an analysis. One of the most exciting results to come from these data is a paper recently published by TACF's 2018 Duke Stanback Intern, Paul Noah. Using confirmed point data from TreeSnap and *dentata*Base, Noah et al. (2021) derived a range-wide habitat suitability model for American chestnut, and determined trends which can be used for installing restoration populations now and in the future. For example, based on his analyses, we discovered that the single biggest contributing factor to wild-type American chestnut occurrence was sand content of soils. Therefore, when choosing a site for reintroduction populations, we recommend a soil/sand content between 25% - 75%. While chestnuts can and will grow in other types of soils, that range should give the greatest chance of success as long as other best management practices are followed.

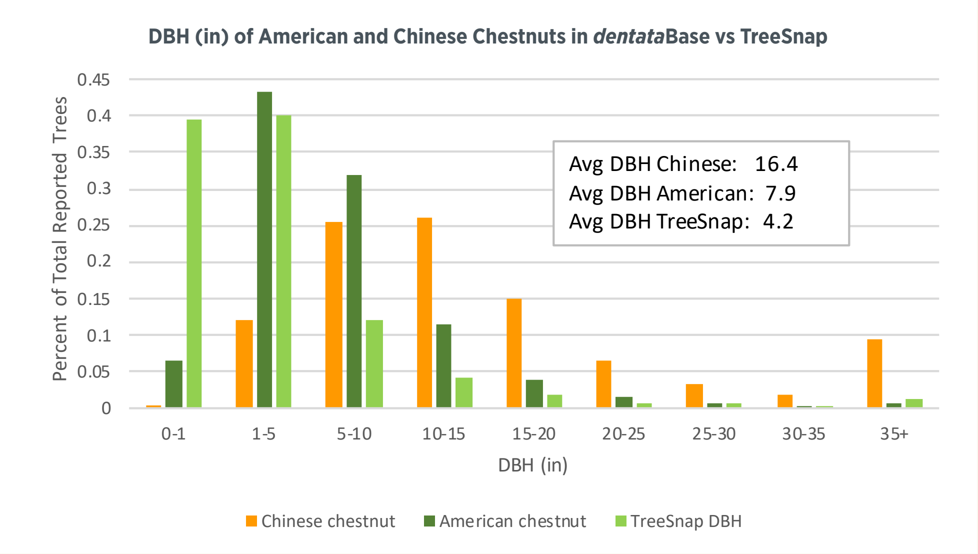
Other interesting trends can also be evaluated. For example, the article on page 21 illustrates the potential for outcrossing of blight-resistant American chestnut populations with wild-type Americans and/or exotic and hybrid chestnuts. Looking at more than 6,000 chestnut points between iNaturalist and *dentata*Base, we see that wild American chestnuts tend to be found in forested areas, while planted, exotic chestnuts tend to be found in developed and open land cover types (**Table 3**). Looking at the maps in Figure 1, this can be verified somewhat visually by viewing that a majority of Chinese chestnut reports appear to congregate around urban and farm areas, and that they peak out from under the locations where wild American chestnuts are largely reported (**Figure 1A**).

Further, the reports indicate wild American chestnut populations represent over 10 times those of exotic chestnuts, suggesting the potential for reintroduced disease-resistant American chestnuts will encounter wild-type American chestnuts more often than exotic chestnuts. Again, because of the sampling bias inherent when using non-systematically collected data, we should continue to review these trends over time, especially as more reports are verified.

As reported in Dalgleish et al. (2016) some 84% of American chestnut sprouts captured in FIA data are 1″ diameter at breast height (DBH) or smaller. In TreeSnap only 2% of trees are in this size class, and even fewer of these trees are captured in *dentata*Base. As opposed to the FIA dataset used for the Dalgleish et al. paper (2016), the trees collected for each of these three databases result from a number of sampling biases. The sites where people tend to find and record trees are easily accessible (from a trail or road), and the trees are readily noticeable (fruiting

Land Cover Type	American chestnut		Exotic chestnuts	
Forest	3,379	67%	395	36%
Developed	1,012	20%	502	45%
Field	263	5%	163	15%
Other	371	7%	51	5%
Total Trees	**5,025**		**1,111**	

TABLE 3: Including only "research grade" trees located in the eastern U.S. from iNaturalist and *dentata*Base, more than 6,000 trees were mapped and correlated to landcover type using ArcMap 10.8.1. The greatest number of American chestnuts were found in forested areas, whereas exotic trees were found primarily in open or developed plots. Exotic trees can be found in forested areas, but they are easy to spot. "Exotic" chestnuts are defined as trees which are either known to be planted species from Europe or Asia, as well as hybrids using non-native chestnut species.



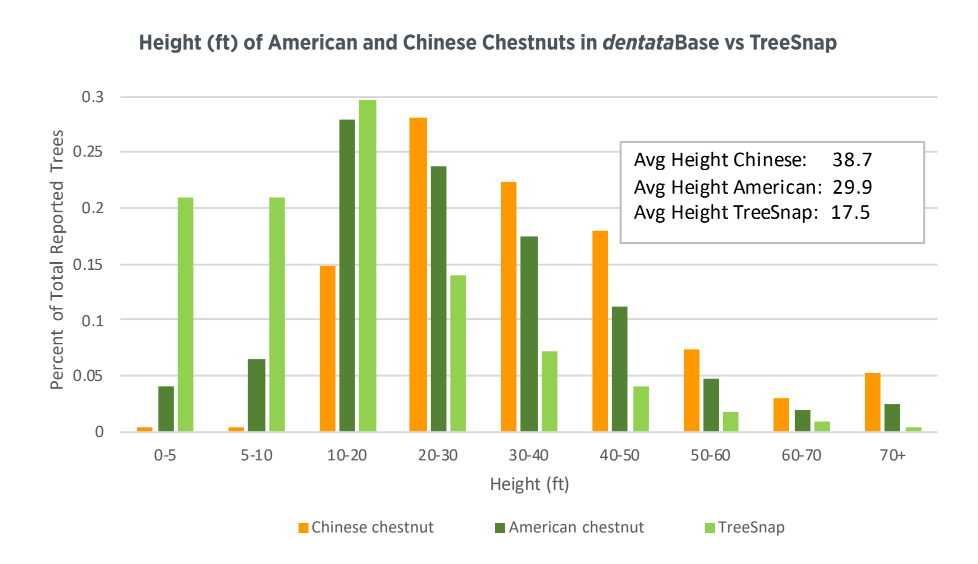


FIGURE 2. Percentage of reported populations in various DBH (in) and height (ft) classes. *Dentata*Base captures both American and Chinese chestnuts while TreeSnap only officially accepts American chestnut reports. American chestnut trees logged in *dentata*Base tend to be larger since they are frequently used for breeding and nut collection, whereas the accessible TreeSnap mobile app receives reports of many smaller trees.

or generally large). That does not mean that the remnant population of American chestnuts is larger than the average reported by Dalgleish et al. (2016), just that those are the trees that are found and logged by the public. When standing in a sea of hundreds or even thousands of American chestnut sprouts, most reporters do not take the time or effort to document every single stem, like that which is done for the FIA analyses.

Because of the way trees are reported for *dentata*Base and TreeSnap, they each capture different cross-sections of the wild-type American chestnut population. TreeSnap is much easier to use and therefore captures the smaller sprouts more commonly seen while *dentata*Base trends toward the capture of larger, fruiting trees (**Figure 2**). While chestnuts can and do produce chestnut seeds at a small size, the primary limiting factor for seed production is sunlight. In TreeSnap, the average diameter of flowering trees is 12″ DBH while that in *dentata*Base is 9.5.″

Final Thoughts

Each of these datasets have strengths and weaknesses, but each have their own potential utility, especially when combined for further analysis. Knowing which trees are producing chestnuts allow researchers to hone in on those populations for either direct breeding or collection of open-pollinated nuts for germplasm conservation orchards. As reported in multiple studies, and most recently by Sandercock et al. (2022, preprint), the highest genetic diversity of *Castanea dentata* is found through the southwestern portions of the chestnut range. Using crowd-sourced reports, more area can be covered by more people, giving greater potential to capture that germplasm for diversification of restoration populations.

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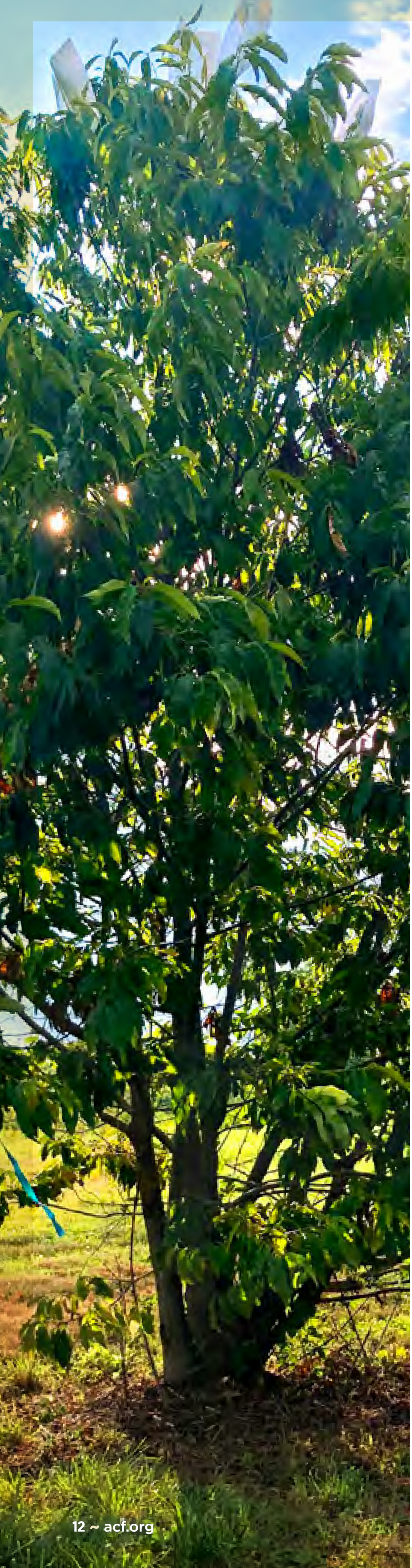


Evidence for Blight Resistance

IN THE WILD AMERICAN CHESTNUT POPULATION

By Jared Westbrook, TACF Director of Science

When I first started working for TACF seven years ago, I was skeptical that wild American chestnuts had any resistance to chestnut blight. Did these so-called large surviving trees happen to get infected with weakly virulent strains of chestnut blight? Was the blight that infected these trees itself infected with viruses that reduced its virulence? Were the surviving trees cryptic hybrids that inherited resistance from Asian chestnut species? If a few trees did in fact have low levels of resistance, did they also happen to live in ideal chestnut habitat where they were able to acquire resources to fight the infection? A few lines of evidence have convinced me that a precious few American chestnuts have moderate levels of blight resistance and that this resistance can be passed on to future generations.

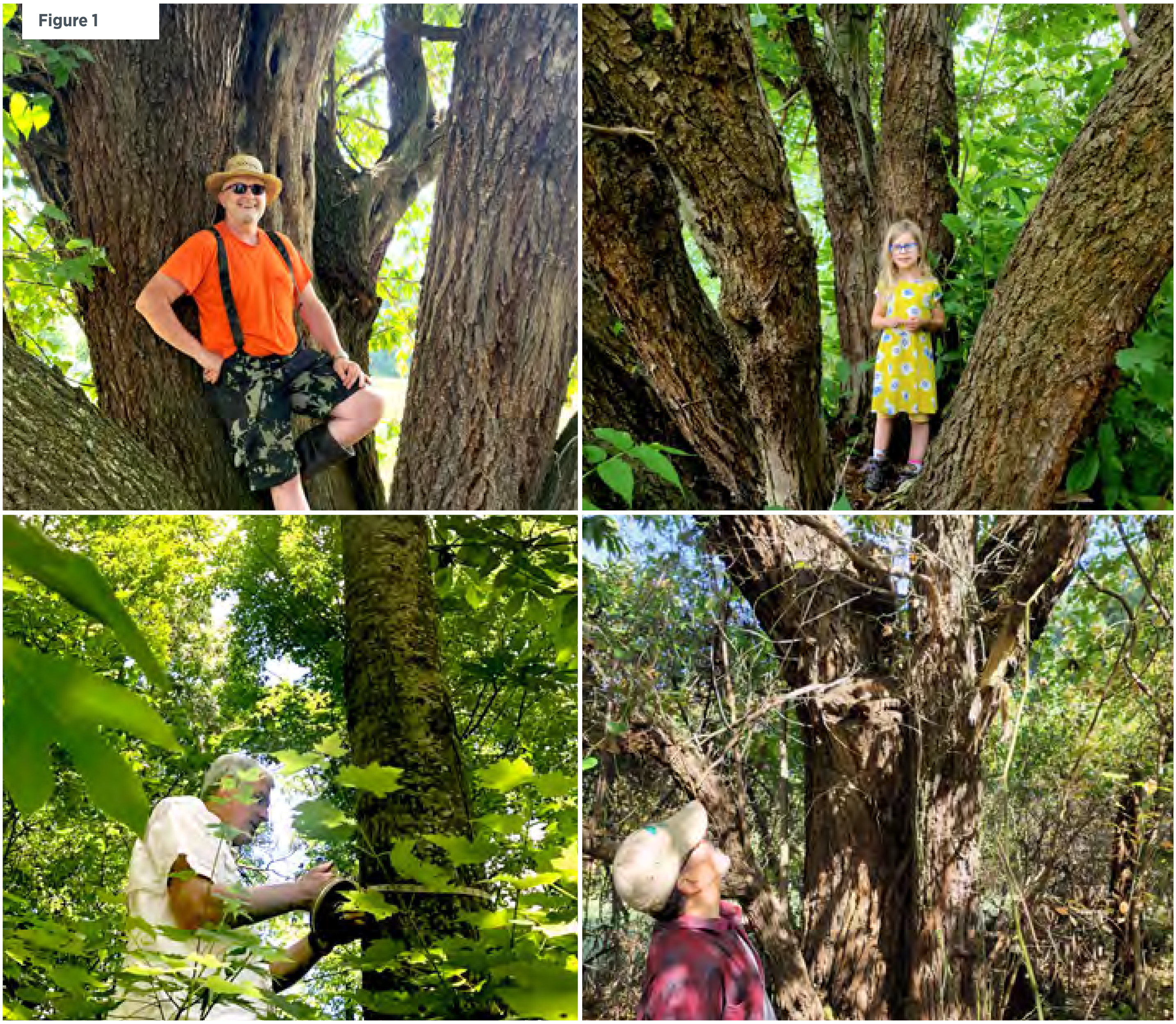
Large surviving American chestnut trees confirmed to have 100% *Castanea dentata* ancestry

We recently sequenced the whole genomes of 384 American chestnut trees to better understand geographic patterns of genetic diversity and climate adaptation in the wild-type American chestnut population (Sandercock et al. 2022). The sample of trees we sequenced included seven putative large surviving American chestnuts: the 'Avalon' tree from Georgia, the 'Ort,' 'Kelly,' 'Walbridge,' and 'Schaeffer' trees from Pennsylvania, the 'Adair' tree from Kentucky, and the 'Amherst' tree from Virginia. All the large surviving trees were naturally infected with chestnut blight and had main stems that were greater than 10″ in diameter. They all displayed the "cruddy bark" phenomenon where cankers surround the stem but remain superficial and do not girdle the trees (**Figure 1**). To determine if any of the putative blight-resistant American chestnuts had hybrid ancestry, we also sequenced the whole genomes of 15 to 19 individuals of seven other *Castanea* species (*C. pumila*, *C. ozarkensis*, *C. mollissima*, *C. crenata*, and *C. sativa*) for comparison to the American chestnut trees. All of the large surviving trees had 100% *C. dentata* ancestry except for the Kelly tree from Pennsylvania, which had ~12% European chestnut (*C. sativa*) ancestry and 88% American chestnut ancestry.

Selected progeny of large surviving chestnuts have intermediate resistance to chestnut blight

My predecessor, Fred Hebard, performed controlled pollinations between a number of large surviving American chestnuts and planted the progeny at TACF's Meadowview Research Farms. Current Meadowview staff and I recently assessed the long-term blight resistance of 48 progeny of intercrosses among 12 large surviving wild-type trees. All the progeny were inoculated with virulent strains of the blight over a decade ago and the trees ranged in age from 16 to 25 years. We visually assessed these trees for survival of the main inoculated stem, percent of the tree canopy that was healthy, presence/absence of large cankers, exposed wood, stump sprouts, and blight fungal sporulation from cankers. Blight resistance data from the individual trees and their relatives were used to estimate the genetic resistance of the large surviving progeny relative to typical blight-susceptible American chestnuts, resistant Chinese chestnuts, and partially-resistant American chestnut backcross hybrids. I created a blight resistance index from the sum of the individual traits and scaled this index from 0 = average of typical blight-susceptible wild-type American chestnuts, to 100 = average of blight-resistant Chinese chestnuts. The blight resistance indices of the ten most resistant progeny of the large surviving trees varied from 43 to 25. We genotyped nine out of ten of these progeny, and all trees had 100% American chestnut ancestry (Westbrook et al. preprint). For context, the blight resistance indices of the top 5% most resistant backcross selections (137 selected trees) varied from 40 to 80 (average

Figure 1



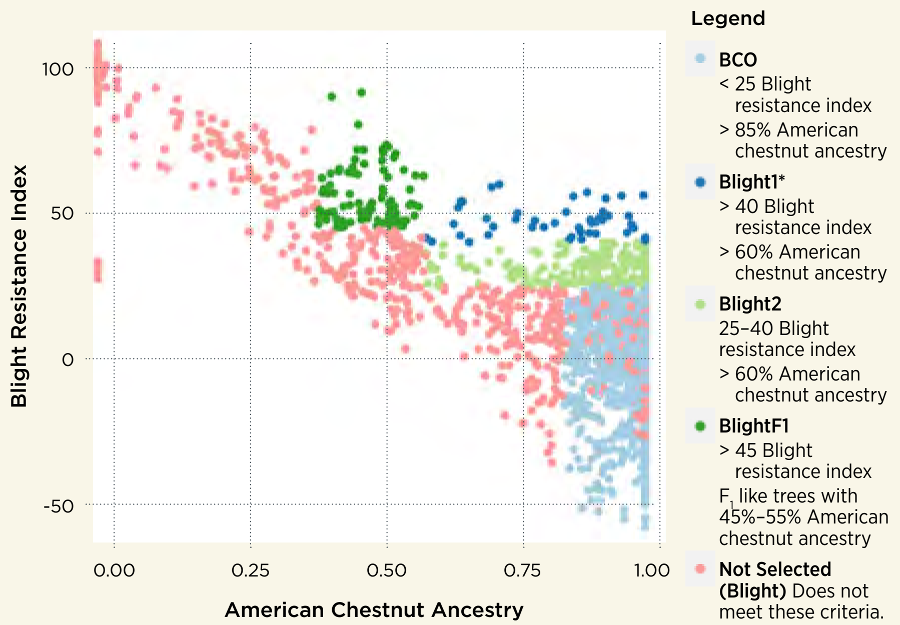
TACF members with large surviving American chestnuts trees. Pictured clockwise from top left, Jay Brenneman (PA/NJ Chapter) with the Ort tree, Parker Lingenfelter (PA/NJ Chapter) with the Walbridge tree, Marty Cippolini (GA Chapter) with the Avalon tree, and John Scrivani (VA Chapter) with the Amherst tree.

50) while American chestnut ancestry varied from 60% to 100% (average 88%) (**Figure 2**). These results confirm that blight resistance in American chestnut is heritable.

Utilizing blight resistance from wild-type American chestnut in our breeding program

The American Chestnut Cooperators Foundation, another group focused on improving blight resistance in American chestnut, has spent the last 25 years breeding large surviving American chestnuts and selecting the most resistant progeny (Griffin et al. 1983; Griffin 2000; Griffin et al. 2005). Repeated cycles of breeding and selection among the progeny of large surviving American chestnut will likely be necessary to improve blight resistance to levels suitable for restoration. Furthermore, the genetic diversity and regional adaptation in a large surviving American chestnut breeding program are likely to be limited given the rarity of resistant wild-type trees to use as parents.

Figure 2: Blight resistance in TACF's chapter breeding programs v. American chestnut ancestry.



*NOTE that some trees of our 'Blight1' selections have 100% American chestnut ancestry.

Figure 3

TACF has recently pollinated progeny of large surviving American chestnuts with blight tolerant Darling 58 pollen to combine wild and transgenic resistance to chestnut blight. Pictured left is a second-generation offspring of three large surviving wild trees and pictured right is an offspring of a large surviving tree in Georgia.

The American Chestnut Foundation's breeding program has also incorporated blight resistance in the large surviving American chestnut trees by using these trees as parents in our backcross breeding program. For example, backcross progeny of a large surviving tree near Springer Mountain, GA are planted at a site near University of Georgia (UGA). The Georgia Chapter selected two progeny from this cross for blight resistance and the selected trees had blight resistance indices of 39 and 43, respectively. Genotyping of these trees revealed that the selected progeny had 100% *C. dentata* ancestry possibly indicating that the resistance was inherited from the wild American chestnut parent rather than the backcross hybrid parent. In 2021, we bred the 'Springer Mountain 3' progeny and five other progeny of large surviving trees with transgenic blight-tolerant Darling 58 trees (**Figure 3**). Our goal with these crosses is to determine if blight resistance of the large surviving trees adds to the already high levels of resistance expected for the Darling 58 trees.

We would like to systematically incorporate blight resistance from American chestnut by continuing controlled pollinations among the large surviving trees and with our most blight-resistant backcross hybrids and transgenic trees. We also plan to graft and collect pollen from the wild trees in the forest to preserve and incorporate the genetics of these trees in our breeding program. If you come across large surviving American chestnuts in the forest, please let us know by documenting the location of the trees in TreeSnap and sending us leaf and twig samples via our Tree Locator Form (bit.ly/tree-locator-form) to confirm the species identity. Where I was once a skeptic, I am now in awe that these few precious trees survived when billions of others succumbed.

DOCUMENT the location of the trees on TreeSnap: treesnap.org

SEND leaf and twig samples via our Tree Locator Form: bit.ly/tree-locator-form

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American Chestnut Entryway Table 2022 Raffle

$25 per ticket

ONLINE SALE BEGINS JUNE 1 AND ENDS SEPTEMBER 26
WINNING TICKET TO BE DRAWN SATURDAY, OCTOBER 1

We are filled with gratitude and excitement in anticipation of receiving a wormy American chestnut entryway table for our upcoming 2022 Raffle. The table is being handcrafted and donated by Jon Taylor (pictured), talented woodworker and longtime member of the Carolinas Chapter. Jon enjoys working with a variety of wood but has a special affinity for American chestnut.

Rescued from the exterior of a barn in Western North Carolina, Jon is fashioning this storied wood into a table that is sure to become a coveted heirloom. Once complete, it will measure 48″ wide by 14″ deep by 30″ high.

Tickets will be available for purchase on TACF's website when the sale begins. The winning ticket will be drawn at our 2022 American Chestnut Symposium Celebration Dinner on October 1. Participants do NOT have to be present to win.

TACF employees and their family members are excluded from this raffle.
All proceeds benefit TACF's mission toward American chestnut restoration.

2022 SPRING APPEAL

Efficient Systems for Effective Results

Spring is here, orchards are set in rows, and seedlings await to be nestled in earth. The roar of mowers, buzzing of trimmers, and the hum of a drone taking inventory overhead are clear indicators of one of the busiest seasons at TACF's Meadowview Research Farms. With 150 acres composed of three farms and five facilities, including a lab, greenhouse, and high light growth building, efficiencies are key to accomplishing day-to-day tasks toward our collective goal to rescue the American chestnut tree.

Your support of TACF's 2022 Spring Appeal will streamline daily processes and seed production in a sustainable way. There is a pressing need for a cabbed backhoe, rotary mower, and wood chipper. A backhoe increases capacity for moving substrate and large objects, while a chipper reuses biomass removed annually from older orchards. These three crucial pieces of machinery alone total nearly $70,000. Your generosity provides the means for Meadowview staff to work more efficiently, yielding effective results.

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Chestnut and Chestnut Blight

IN NORTH CAROLINA

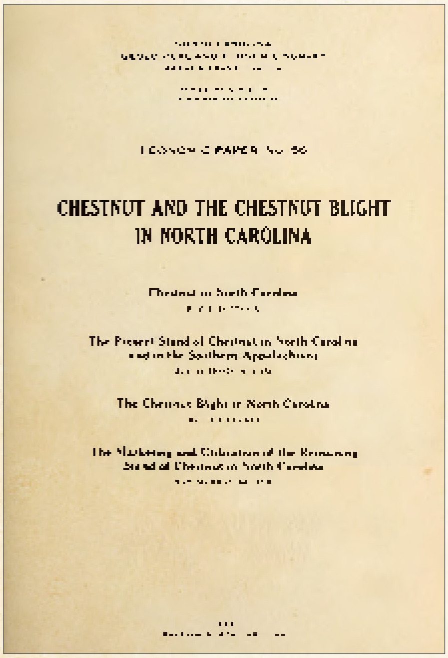
By Doug Gillis, Carolinas Chapter President

Review of the 1925 NC Economic Paper No. 56

Economic Paper No. 56 from 1925 is 32-pages filled with historic photographs and illustrations. It includes four somewhat disconnected articles: *Chestnut in North Carolina* by P.L. Buttrick; *The Chestnut Blight in North Carolina* by G.F. Gravatt, Office of Forest Pathology, U.S. Bureau of Plant Industry; *Present Stand of Chestnut in North Carolina and the Southern Appalachians*, by E.H. Frothingham; and *A Comprehensive Plan for the Marketing and Utilization of the Remaining Stand of Chestnut Necessitated by the Chestnut Blight Situation*, by E. Murray Bruner, U.S. Forest Service, Asheville, NC. The article can be found here: bit.ly/chestnut-blight-NC-1925.

Brent S. Drane, director of the North Carolina Geological and Economic Survey, submitted the paper to North Carolina Governor Angus W. McLean on January 30, 1925, for publication. Drane stressed that the present and future security of forest products in North Carolina rested upon protection against forest fires and understanding diseases, particularly chestnut blight. A reason for suppressing forest fires was to give other species of lumber trees a chance to fill the void that would be created when the blight attacked chestnut trees.

The American chestnut was in decline in North Carolina before the threat of blight became an imminent concern. P.L. Buttrick wrote in his 1912-1913 article that the presence of chestnut trees in North Carolina had decreased significantly since about 1840, especially in the western Piedmont, along the eastern slopes of the Blue Ridge, and at lower elevations in the mountains. Gravatt, in his 1925 article, commented that a “fungous” root rot had been killing and continued to kill chestnut trees. The trees continued to be cut for lumber, tannin extract production, and other uses. Tannin extract was used in the leather tanning business. In 1919, 70 million board feet of chestnut were cut for lumber while 160.8 million board feet were cut as cordwood. By 1923, the amount cut for lumber dropped nearly 50%. The


ECONOMIC PAPER No. 56

CHESTNUT AND THE CHESTNUT BLIGHT IN NORTH CAROLINA

Chestnut in North Carolina

The Present Stand of Chestnut in North Carolina and in the Southern Appalachians

The Chestnut Blight in North Carolina

The Marketing and Utilization of the Remaining Stand of Chestnut in North Carolina

amount cut for cordwood dropped 20%. Three and a half times more chestnut was cut for cordwood than for lumber in 1923. The paper makes a case for a steady supply of chestnut cordwood to maintain North Carolina's ten tannin extract businesses. J.S. Holmes, North Carolina State Forester, projected that the disappearance of chestnut from western North Carolina forests, due to blight, was a foregone conclusion. Loss of the chestnut tree would remove 27% of the timber growth in western North Carolina. More care in cutting and subsequent management of forest trees, especially those that would replace the chestnut tree, would be an important strategy going forward.

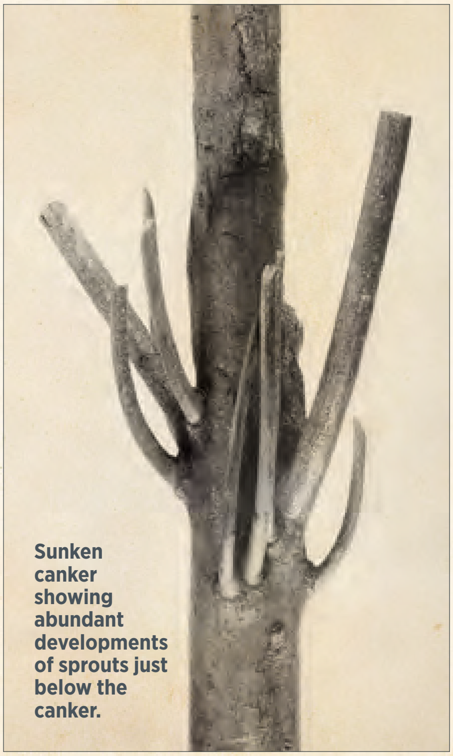
Cutting chestnut trees for timber use was secondary to its use as cordwood. Holmes commented that less than one-third of the stand of chestnut wood was suitable for lumber use. The remoteness of some stands and lack of access to railroad lines made it too costly to market the better-quality chestnut wood that grew on north slopes and in deep coves. Buttrick noted that much of the chestnut on south slopes and ridge tops were unmerchantable, or best used for cordwood. He stated that older chestnut trees of 5′ in diameter at breast height often were not good for timber cutting. Older tree trunks tended to be hollow inside with dead limbs atop the trees. Gravatt noted that with large chestnut trees, root rot infection killed the top part of the tree initially. Presence of cankers lower down on trunks of dying trees would help distinguish the killer of the chestnut tree as blight and not root rot. Buttrick reasoned that if blight laid waste to the many chestnut trees in North Carolina, methods of disposing of and utilizing dead and infected timber would need to be developed.

Gravatt explained that the fight against the blight ceased in 1915, dooming the stand of chestnut trees in the Southern Appalachians. By 1925, the blight had invaded about three-fourths of the commercial range of chestnut. Gravatt had hoped that the higher percentage of tannin of Southern Appalachian chestnut trees would retard the spread of the blight. That hope passed. He estimated that 10 – 40% of chestnut timber killed by blight would be lost to wood rot and an inability to harvest the wood. He wrote that dead wood was more difficult to harvest than live wood, and that some dead chestnut trees


Family poses in front of a large dead American chestnut in Tremont Falls, TN, circa 1920. Photo credit: Great Smoky Mountains National Park Library.

Typical Cove Timber, Chestnut, Yellow Poplar, Northern Red Oak, etc.—Graham County, North Carolina
Photo U. S. Forest Service

could be used for telephone and telegraph poles, though more likely for extract wood. Gravatt promoted fire protection over the range of chestnut to preserve the supply of chestnut wood, particularly for use as cordwood to supply tannin extract businesses. Gravatt commented that the limited effort to find or develop a resistant chestnut, either native or exotic, was promising, but much more time was needed before results could be expected.



Sunken canker showing abundant developments of sprouts just below the canker.

E.H. Frothingham was most concerned about the availability of chestnut wood to supply the ten tannin extract plants operating in the state. The capacity of the ten plants to use chestnut cordwood was about twice the amount cut in 1923 in North Carolina. Many tanneries had their own extract plants. Plants producing only tannic acid would need to market their product in the north and in foreign countries. Frothingham made no comments about chestnut blight and how the disease could affect tannin extract production. Interestingly, he remarked that young chestnuts grow rapidly and it was likely that 20 years after an area was cut over, new stands of chestnut could yield ten cords of chestnut wood per acre.

E. Murray Bruner focused on how best to market and utilize the present stand of chestnut and add years to the life of the chestnut wood-using industries. He suggested that the remaining stand of chestnut be marketed in a systematic and orderly manner. The needs of the industries should be met with wood from infected areas first and supplemented with wood from the uninfected areas only in amounts to meet industry needs. Bruner was concerned that owners of healthy stands of chestnut, upon learning of the approach of blight, would consider immediate harvesting of their wood and throwing it on the market, competing with those harvesting wood from infected stands. To counter that approach, he suggested that a new breed of extension foresters work with plant pathologists to forecast when timber owners should harvest their wood. Eradication of chestnut trees in areas where advanced infection was occurring would be part of the plan. Bruner also suggested that the extension foresters work with timber owners to secure rapid and complete utilization of heavily infected areas while holding in reserve lightly infected areas for as long as possible, or until the market was ready to absorb wood from them. He advocated that cooperative marketing associations be formed to help in the effort.

Outcrossing

OF INTRODUCED, DISEASE-RESISTANT AMERICAN CHESTNUT POPULATIONS

By Sara Fern Fitzsimmons, TACF Director of Restoration

Flowering wild American chestnut tree in the Penn State University Stone Valley Experimental Forest.

What happens when blight-resistant American chestnuts are put into the wild? There are a lot of unknowns and questions to be asked regarding the future of American chestnut restoration, but a common set of inquiry we get at our TACF offices deals with the issue of outcrossing to wild and/or planted chestnut trees already in the landscape. While we cannot predict the future, we can make a few generalizations about what can happen, and take steps to ensure our reintroduction efforts result in a long-term, sustainable, blight-resistant American chestnut population throughout the species' native range.

Outcrossing to Wild American Chestnut Trees

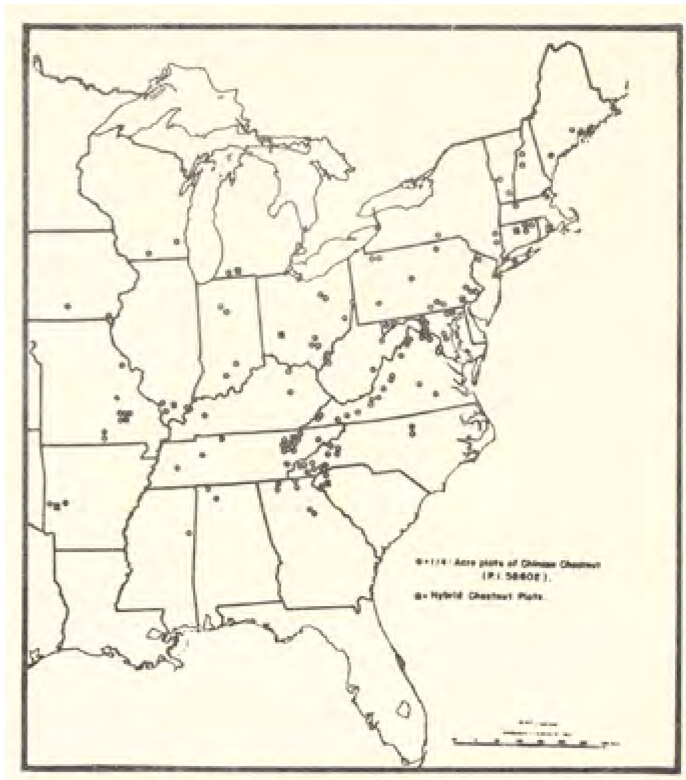
One chance for outcrossing of blight-resistant American chestnut (BRAC) materials is with wild-type American chestnut (WTAC) populations. Based on recent analysis of Forest Inventory Analysis (FIA) data, Dalgleish et al. (2016)[1] estimate that there are some 431 million American chestnut sprouts remaining in the wild. While that certainly seems like a lot, this is a fraction of the original estimate of four billion trees.

In addition, the majority of these remaining 431 million WTAC trees will not be flowering. Dalgleish et al. find that approximately 84% of the WTAC trees are 1″ diameter at breast height (DBH) or less. That an overwhelming majority of the remaining wild-type population consists of small, suppressed sprouts is not surprising.

One of TACF's most successful citizen science projects is that of the Appalachian Trail Mega-Transect Project. Hikers volunteer to learn how to properly identify and count American chestnuts they observe along the Appalachian Trail. Since 2008, hikers have counted more than 500 miles of trail, primarily from Georgia to the NY/NJ border, finding 18,376 trees[2].

Of those, 18,376 trees counted, only 107 were deemed as "large." A "large" tree is one greater than 13″ in circumference at breast height or 4.1″ DBH, defined because that is the general size a tree would need to reach in order to flower[3], which is about 0.5%. If we assume such a number can be applied across the range, this means that there are approximately 2.1 million flowering American chestnut trees in the wild.

That is still a lot of trees, but consider that there is some 100+/- million acres of suitable chestnut habitat within the original range of the American chestnut[4]. Based on these estimates, outcrossing to WTACs is possible, and will probably occur, but at a very small amount. As long as reintroduced populations of BRACs are large enough, what little outcrossing does occur with WTAC populations should be of little consequence. Interbreeding BRACs should easily outcompete outcrosses over time, leading toward a self-sustaining, blight-resistant American chestnut population.



Selection of USDA Chinese chestnut test plots established in 1926 (Diller 1952).

BRACs have the greatest chance of interacting with flowering, wild-type American chestnuts if they are planted in a recent clearcut. On such a site, chestnut sprouts respond very quickly to the new influx of sunlight, can grow many feet per year, and start flowering en masse in as little as five years. Depending on the size of the cut and number of sprouts, these flowering American chestnuts trees can produce thousands of nuts every year.

Of course, those wild trees will eventually get the blight and die. In fact, American chestnut trees in clearcuts typically have higher blight incidence and greater mortality than do sprouts in understory sites (Griffin 1989)[5]. In general, released sprouts in clearcuts have completed flowering and the main stem is dead by age 13-18, leaving subsequent stump sprouts back into a suppressed understory, and non-flowering state.

It is possible, then, to utilize these types of sites to encourage greater American chestnut diversification, but they will have to be managed as such. Unmanaged, the outcross progeny will most likely be outcompeted by more robust BRACs and their intercross progeny.

Outcrossing to Planted Asiatic and Hybrid Chestnut Trees

Perhaps of more potential impact to the progeny of BRAC plots are the thousands, if not millions, of planted Chinese, Japanese, and a myriad hybrid chestnut trees that can be found throughout the original range of the American chestnut.

Japanese chestnuts are likely the first Asiatic chestnut introduced into the United States, with importations documented back to 1876 (Anagnostakis 1997)[6]. For this reason, the Japanese chestnut has been the most likely suspect for having brought chestnut blight to the United States. The first Chinese chestnuts appear to have been imported in about 1900 (Anagnostakis 1997). A world-renowned plant explorer for the USDA, Frank Meyer, sent some of the first Chinese chestnuts to the U.S. during an expedition to China in 1907 (Lord 2005)[7]. More than 500 official USDA importations were made between that time and 1954 representing tens of thousands of chestnuts planted throughout the United States (Diller 1954)[8].

From the 1930s through the 1950s, the USDA tested many Chinese chestnut and hybrids in the eastern United States (Diller 1960)[9]. Breeding of blight-resistant, timber-type chestnuts was undertaken by the USDA (Diller et al. 1964)[10] and the Connecticut Agricultural Experiment Station (CAES) since at least 1930 (Jaynes and Graves 1963)[11]. There are hundreds of named chestnut cultivars, several of which are available for purchase in the United States (Anagnostakis 2020)[12]. Presently, hundreds of U.S. private and state-run nurseries sell many Asiatic and hybrid chestnut tree seedlings to hobby farmers.

A West Virginia farmer and two of his eight 20-year-old Asiatic chestnut trees, furnished for an experimental planting by the U.S. Department of Agriculture, 1939.

Unfortunately, while these references give us an indication that there are many exotic chestnuts in the landscape of the eastern United States, it does not give us a good indication of how many there might be. In general, however, we know where they are located, and this can be a good starting place for surmising their effect on BRAC populations.

For the most part, Asiatic chestnut trees and their hybrids will be found on farms, in fencerows, or in cleared areas. In an accompanying article in this same issue, we find that exotic chestnuts can be found in these types of locations 65% of the time on average (pg. 8). There are several reasons for this. The first is that many of the initial plantings by the USDA were with private farmland owners. The second is that these trees have a difficult time competing with our native forest trees (Diller et al. 1964), a primary reason TACF has invested resources to retain American chestnut character.

Knowing that these trees are generally going to be found in open spaces and/or near farmlands, we can assume that as long as BRAC plantings occur in recently forested lands, the chance for them to come into contact with these exotic trees is minimal. However, some crossing will surely happen. In the long-run – like the possibility of crossing with wild-type American chestnuts – the resulting progeny should not have the competitive capacity of their BRAC counterparts. As long as TACF plants large enough origin populations, interbreeding BRAC trees should easily outcompete outcrosses over time, leading toward a self-sustaining, blight-resistant American chestnut population.

Summary

Crossing of reintroduction populations of blight-resistant American chestnuts with wild-type American chestnuts and/or planted exotic chestnut trees will occur, but likely in very small proportion to the crossing that will occur within the reintroduced populations themselves. Crosses to wild-type American chestnuts would produce trees with inferior blight resistance that should allow blight-resistant American chestnuts to outcompete them. Crosses to exotic trees should produce progeny that do not have the competitive capacity to grow among native tree populations, thus allowing blight-resistant American chestnuts to outcompete them in the long term. In either case, reintroduced, blight-resistant American chestnut populations will need to be significant enough to ensure appropriate crossing within the population to allow for their progeny to outcompete those few outcrosses that will inevitably occur.

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[2] All data collected by hikers are available at TACF's Mega-Transect website: http://ecosystems.psu.edu/research/chestnut/reports/mega-transect

[3] Just because a tree is large enough to flower, doesn't mean it will. Flowering in American chestnut is driven primarily by access to sunlight and age.

[4] Suitable chestnut habitat is defined as that which is not paved or otherwise developed, not currently used in agricultural production, and which is not considered to be a wetland site of any kind.

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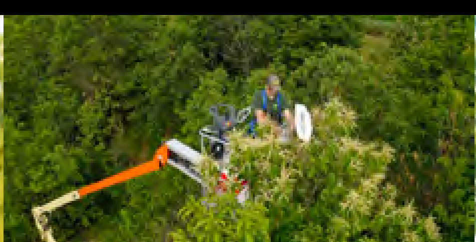
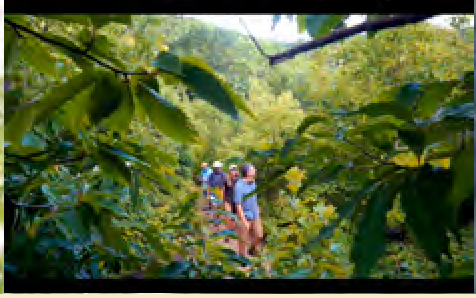
PREMIERE ANNOUNCEMENT COMING SOON!

American Chestnut Documentary Film

THE AMERICAN CHESTNUT FOUNDATION is excited to announce that we are in the final production stages of a documentary film about the beloved American chestnut and its restoration! The film covers the tree's storied past and promising future – its historical significance, countless benefits, and perpetual will to live. You will hear from researchers and citizen scientists determined to save it, and from luminaries such as President Jimmy Carter, Dolly Parton, Barbara Kingsolver and others, all who have their own unique connection to this treasured tree. Our hope is that the film will educate a broad audience, not only about why it is crucial to rescue the American chestnut, but how its rebirth could help save other threatened tree species. As we move closer toward the film's premiere, either this fall or next spring, updates will be shared through TACF's website, social media platforms, and e*Sprout*.





Of Flight and Flowers

By John B. Hewlett and Jacob R. Pease, Murray State University

"Murray Unicom, Skylane four seven seven 'fife' November taking off active runway two 'tree'" – a broadcast heard within a thirty-mile radius as we lined our craft up for immediate departure on a warm June morning. "Tree," coincidentally, is official aeronautical speak for the number three. The first rays of a vermilion sun shone at our six o'clock. Western wildfire smoke, having traveled the jet stream hundreds of miles, made morning colors all the more brilliant as we completed pre-flight checks.

We throttled forward, landing gear left terra firma, and we made a gentle turn eastbound in what would be our airborne science platform for this "hop." It is not lost on us that just as there is a confluence of four great rivers in the western end of the Bluegrass State, we were aloft of a metaphorical confluence of modern technology and a piece of our ancient natural heritage – the chestnut.

Mid to late June is flowering season in Kentucky, and the time of year when one may be lucky enough to spot the brilliant white of an emerging chestnut peeking from the verdant canopy. However, in our line of work, we are more interested in replacing luck with results.

Geographic Information Systems (GIS) software has become a priceless tool used by researchers, land managers, epidemiologists, urban planners, and many other professions the world over. It is both powerful and versatile, but how does GIS relate to chestnut conservation? Well, success may look like finding optimal orchard sites or locations where we are most likely to find wild trees. The future of breeding efforts and genetic conservation depend on a fundamental understanding of where modern chestnuts are located – all the better if they are flowering.

With funding from NASA and TACF, we have had the good privilege to conduct aerial surveys across the Commonwealth of Kentucky in the past. Our initial efforts took us over the Daniel Boone National Forest (DBNF) and Land Between the Lakes (LBL) in 2019. The pandemic relegated us to a single flight over LBL in 2020. After each outing, however, our timing improved, our methods became sharper, and our search image for the elusive trees became keener. In 2021, our goal was to utilize habitat suitability models from Jacob's master's thesis to hone in on pollen-producers worth more than their weight in gold.

The suitability model was forged from research on elevation, soil, slope, and land-use. Optimal criteria from each data layer were overlaid and

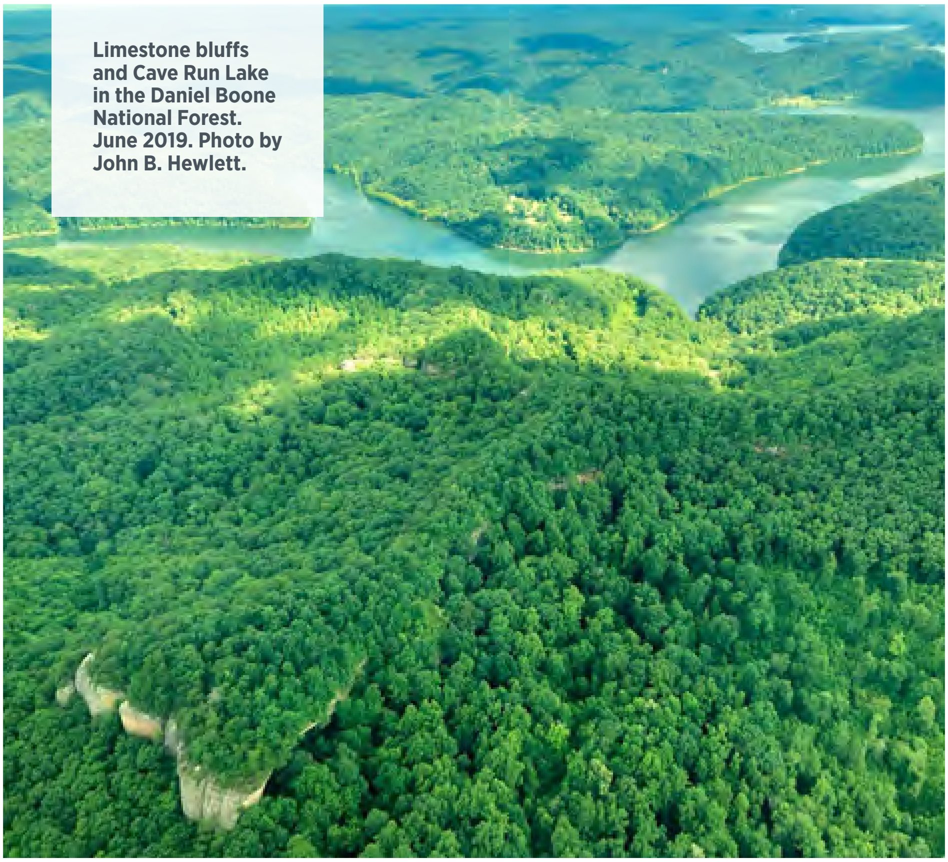
John Hewlett and Jacob Pease sitting in the cockpit of the survey aircraft during an aerial chestnut survey of western Kentucky in 2021. Photo by John B. Hewlett.

provided us with experimental sites where trees may be more likely to persist. With transects drawn through the sites, coordinates entered into the navigation system of the Cessna 182, and cameras in tow, we took off. Our mission to search for cream-colored catkins amidst a sea of leaves and twigs on a humid summer day above LBL was under way.

The day began as a cool reprieve from the western Kentucky heat, but temperatures a thousand feet in the air quickly rose with the sun. The cabin of the aircraft became sweltering as we began our transects in search of remnant trees. The Land Between the Lakes is roughly 170,000 acres of mixed prairie and upland hardwood forest. Looking out from the craft, you would be remiss to ignore the beautifully vast canopy resembling the rolling knolls of the Bluegrass region. The land is so vast, in fact, that LBL is the largest inland peninsula in North America. Finding trees here is difficult.

Using a combination of GIS techniques and a degree of aeronautical prowess, both experimental and control transects were programmed into the onboard navigational systems. Throughout the flight on this summer morning, positive signs of chestnut presence were documented, though not the presence of the chestnuts themselves. *Oxydendrum arboreum*, commonly known as sourwood, was brilliantly visible to the naked eye emerging from the dense canopy below. Sourwood is notable because two species bloom white flowers in the month of June in our area: the American chestnut and the sourwood. Interestingly enough, the ecology of sourwood is very similar to that of chestnut: the ranges overlap and the trees have similar habitat requirements. Thus, seeing sourwoods may help validate the suitability models and offer the opportunity to ground truth American chestnuts in the same area.

To our knowledge these flights are the only ones that combined GIS modeling with aerial surveys that utilized both experimental and control transects to find American chestnuts on the landscape. We feel that combining these methods offers the very best chance to find emerging, mature trees during the flowering season over their



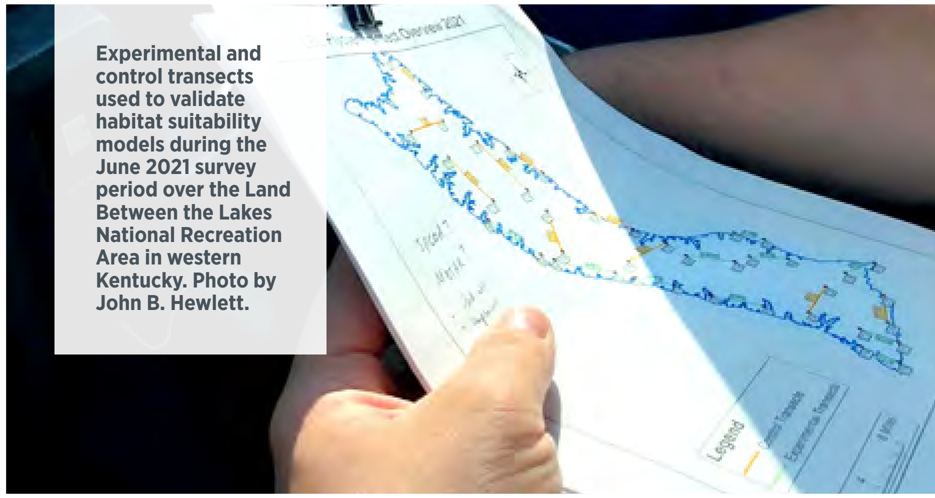
Limestone bluffs and Cave Run Lake in the Daniel Boone National Forest. June 2019. Photo by John B. Hewlett.

Mammoth Cave National Park during an aerial survey of its perimeter in June of 2021. Photo by John B. Hewlett.

Referenced in the last paragraph, the largest American chestnut in the northeast is in Hebron, Maine and inspired the recent endeavors of Pease and Hewlett in Kentucky. Even though the tree was not discovered from the air, its finding in 2012 was encouraging and prompted ME Chapter leaders to take further steps in locating more large surviving trees in the state. Thanks to the development of partnerships with two laboratories that specialize in image and geospatial analysis, the ME chapter has located several of these large trees via flyovers. Pease and Hewlett enthusiastically continue to conduct aerial surveys and anticipate that their findings will contribute several mature chestnuts to the KY Chapter's cause.

range. We hope and encourage others to pursue similar surveys in the future.

The morning ended much as it had begun – our feet planted firmly on the ground. This flight on June 19 marked the last survey of 2021; chestnut catkins are very transient after all. Our results from the flight, based on the presence of numerous flouring sourwoods, may show that the combination of aerial survey and habitat suitability modeling could work synergistically. Aerial surveys for American chestnuts are not without precedent. In fact, the largest tree in the northeast was found by doing this very thing. At the confluence of technology and perseverance, we may well be rewarded with glimpses of an icon of the American landscape – glimpses that will become more common if we fulfill our responsibility to pursue a future full of American chestnuts.



Experimental and control transects used to validate habitat suitability models during the June 2021 survey period over the Land Between the Lakes National Recreation Area in western Kentucky. Photo by John B. Hewlett.

AUTHOR BIOS

JOHN B. HEWLETT teaches in the Department of Biological Sciences at Murray State University. In addition to conducting research at the nexus of endocrinology, wildlife disease epidemiology, and ecology he is a licensed commercial pilot and instructor with over 3,100 hours flight time and is interested in the interface between aeronautics and applications in biology.

JACOB R. PEASE conducts research that pertains to the multidisciplinary reintroduction of the American chestnut (*Castanea dentata*) in some of Kentucky's public lands. This project focuses on combining principles of GIS, conservation, forestry, remote sensing, and forest ecology to streamline the reintroduction process for native tree species that face extirpation or extinction by anthropogenic factors.

2022 American Chestnut Photo Contest

Photo by Tim Pharis, Park Ranger at Rocky Fork State Park, TN.

Each year, TACF's American Chestnut Photo Contest attracts a variety of unique and stunning images of American chestnut and American chestnut hybrids. This tree is a model subject waiting on your imaginative eye to capture its visual qualities. Is there an American chestnut near you? Find its best feature, take creative pictures, then submit your favorites. The winner will receive a one-year membership to TACF and the winning photo will be published on a future cover of our award-winning magazine, *Chestnut*!

ALL ENTRIES MUST:

- be submitted digitally via email or a link to a cloud drive by September 1, 2022;
- relate to the American chestnut;
- be at least 2,400 x 3,000 pixels (7.6 MBs) and submitted in a jpeg or tiff file format;
- include name of photographer and contact information;
- include a full caption including names of subject(s), location, and title;
- be limited to a total of five photos;
- be previously unpublished and cannot be entered into another contest.

EMAIL ADDRESS FOR SUBMISSIONS: jules.smith@acf.org
More information at: bit.ly/22TACFphotocontest

NATIONAL VOLUNTEER WEEK

April 17-23, 2022

"The debt that each generation owes to the past, it must pay to the future."

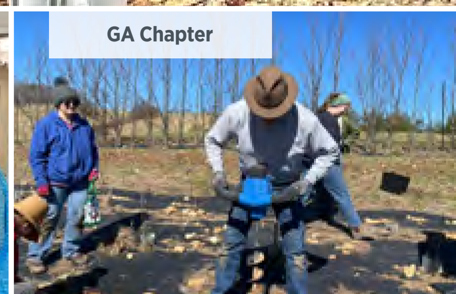
~ Abigail Scott Dunaway

Every year, thousands of dedicated stewards volunteer their time toward American chestnut restoration. National Volunteer Week 2022 took place from April 17-23, celebrating the theme of "Empathy in Action." TACF's ever-growing legion of volunteers embodies intergenerational empathy, as Abigail Scott Dunaway beheld. The loss of the American chestnut is a debt that today's volunteers have inherited, and work tirelessly to amend for the sake and benefit of future generations.

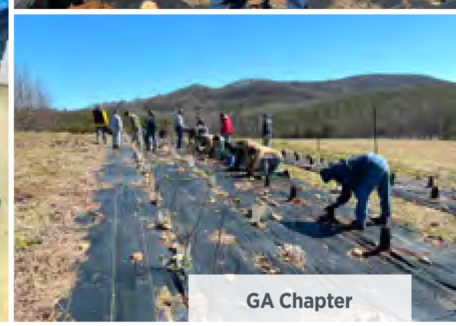
In honor of National Volunteer Week, TACF recognizes that our volunteers drive our mission forward. Their varying roles and tasks bring us ever closer to a shared goal – robust eastern U.S. forests, restored with thriving stands of American chestnut. It is their tireless efforts that will someday be immortalized in the shade of these magnificent trees.

VA Chapter

PA/NJ Chapter



GA Chapter



GA Chapter

MA/RI Chapter

Chestnut Shortbread

This recipe for tasty chestnut shortbread is courtesy of Stefan Schenter and Chantal Lucini of Beary Strong.

Stefan Schenter, personal trainer and nutrition blogger, and Chantal Lucini, fitness coach and Ph.D. in biotechnology, share this recipe inspired by the Japanese love of chestnuts in cuisine. Pair this classic treat with a fruit salad and iced hibiscus tea to bring some sweetness (and chestnuts!) into this spring season. Find the recipe on their website: bit.ly/chestnutshortbread

Ingredients

4 oz cold butter
3.5 oz all-purpose flour
3.5 oz chestnut flour
2 oz cane sugar
1 teaspoon cane sugar to sprinkle
1 pinch of salt

Method

Preheat the oven to 390° F.

Mix all the ingredients quickly, either using a food processor, or by hand until you have a dough.

Roll out the dough between two pieces of parchment paper until it is approximately 1/4 inch thick. Cut out squares with a knife and place them on a baking tray.

Sprinkle some sugar on the cookies and bake them in the oven until golden. It will take between 20 and 30 minutes depending on your oven. Take them out and let them cool. While cooling, separate them gently with a knife, if necessary. Resist the urge to eat them immediately, as they are best after a couple of days!

A Tribute to Edward O. Wilson

By Lisa Thomson, TACF President & CEO

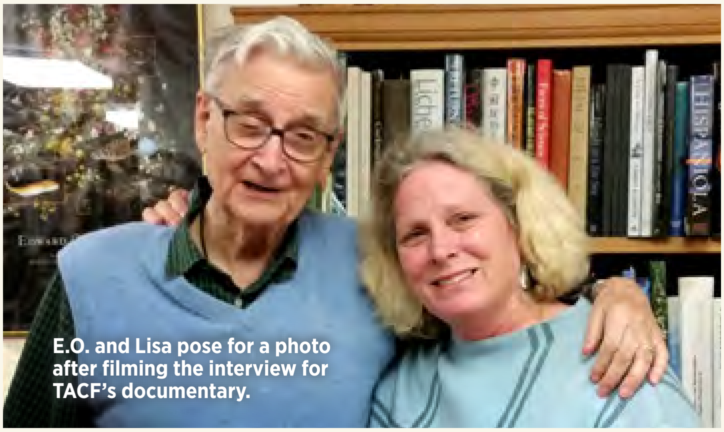
> "You teach me, I forget.
> You show me, I remember.
> You involve me, I understand."
>
> ~ E.O. "Ed" Wilson, 1929-2021
> Father of Biodiversity and Honorary Director at The American Chestnut Foundation

Since hearing of Ed's passing, a day I knew would come but dreaded, there is little I can add to the many deserved accolades of this towering conservationist. Ed is considered the father of biodiversity, a prolific author, and an unparalleled scientist with endless curiosity and energy. We are saddened he is no longer with us, but he leaves a profound legacy.

Little did I know I would actually have an opportunity to meet and get to know Ed, thanks to introductions by his staff at the E.O. Wilson Biodiversity Foundation (EOWBF) and one of The American Chestnut Foundation's (TACF) board members, Dennis Liu. He was a hero since my undergraduate days studying ecology in the late 1970s. After joining TACF, I had an idea that he might be interested in our bold mission to rescue a species; after all, his Half-Earth Project was an urgent call to prevent extinction across our planet. Upon receiving his contact information, I sent a humble email inquiring about his potential familiarity with TACF's work. I also asked if he would kindly consider the invitation to be recognized as an honorary director of our organization, and consent to be interviewed for our documentary film. Much to my surprise, he responded immediately with enthusiastic affirmatives on both counts.

In November 2017, filmmaker Jake Boritt and I traveled to Harvard University, where Ed was a professor and scholar at the Museum of Comparative Zoology. His long-time assistant, Kathy Horton, met us and we navigated through the catacombs of the old building until reaching Ed's offices and labs. It is hard to describe my excitement and nervousness meeting him, after having worked in the environmental field for nearly 40 years. My unease disappeared the minute this tall, unassuming man greeted us with the warmth of a true southern gentleman. While Jake set up for the film shoot, Ed invited me into his office and we chatted one-on-one for more than a half hour. Although I do not remember everything about our conversation, I certainly recall how at ease he made me feel and how he personally ensured me that TACF's mission matters.

After his interview, Jake and I were treated to a luncheon with several of his colleagues; myrmecologists who curated and studied his vast collection of ant specimens from all over the world. At the conclusion of the visit, Ed asked if I had heard of the conifer Torreya; I replied, "taxifolia? If so, yes!" Thanks to my previous work with The Nature Conservancy and the Apalachicola Bluffs and Ravines Preserve, home to this rare species, I was familiar with how close it was to



E.O. and Lisa pose for a photo after filming the interview for TACF's documentary.

A portion of my interview with E.O. Wilson can be viewed here: bit.ly/EOWtribute

extinction. He then enthusiastically invited our lead scientist Jared Westbrook and I to give a talk on chestnut restoration at the Tree of Life conference to be held the following winter in North Florida.

Dennis, EOWBF's vice president for education, graciously agreed to join our board of directors in 2019. He has shared his expertise in distilling complex scientific projects into accessible, compelling stories with great passion and elegance. He speaks of his friend and mentor: "Although Ed was a renowned Harvard Professor and global spokesperson for biodiversity, his heart remained in his boyhood home of Alabama and its wetlands, longleaf pine, and yes, American chestnut. Ed understood that achieving our goal of saving Earth's biodiversity would take national, regional and local efforts and he was a strong proponent of communities like TACF's conservation work. Ed hoped that the Half-Earth Project could be an inspiration and umbrella for such efforts." Dennis enabled some TACF supporters and I to attend Half-Earth Day in New York City in October 2018 which was yet another unforgettable and inspiring experience.

I continued to correspond with Ed on occasion and in our last email exchange he had this to say: "Lisa, it's always great to hear from you. I include TACF's great achievement in almost all my conversations and talks about conservation." At that moment, I knew earning Ed's sincere affection for TACF's audacious goal was a soaring vote of confidence. Rest in peace, dear Ed, and may your teachings and grace live on forever.

A conversation with E.O. (right) and Paul Simon (left) at Half-Earth Day, October 2018.

E.O. delivers keynote address at the Tree of Life Conference, Torreya State Park in Bristol, FL, March 2018.

Jake Boritt films the interview with E.O. Wilson, November 2017.

IN HONOR
OF OUR TACF MEMBERS

DECEMBER 17, 2021 – MARCH 24, 2022

Peter and Donna Buck
From:
Nancy Buck

Rodney Byam
From:
Jennifer Byam

Kendra Collins
From:
Garden Club of Hartford

Hartwell and Martha Davis
From:
Sarah Davis

James Dixon
From:
Erica Baasten

Michael Durphy
From:
Aram Durphy

Eric Evans
From:
James R. Young

Richard Frase
From:
Mary J. Frase

Peter Fry
From:
Allan McLane Chambliss, Jr.

Charles H. Gibbs
From:
Christopher Gibbs

Andrea Harris
From:
Jacob Harris Sherman

Laura Harrison
From:
Amy Myjer

Julie Henson
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Daniel Moore

Dr. Joe James
From:
Kendrick Prewitt

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Cheryl Timmons

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From:
John C. Jerit

Daniel A. Mahoney
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Celia Gavett

Rex Mann
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Roger and Anita Metcalf

Mary and Roberto Martinez
From:
Nancy Buck

Dr. Karl Mech
From:
Diane and Ed Caso

Mel Cooke Mount
From:
Teresa Cooke

Michael Nolan
From:
Kevin Clements

Our Holy Earth Mother
From:
CedarLight Grove, ADF

Jules Smith
From:
Givens Estates, Inc.

The Steve Antoline Family
From:
David Hutchison

The Thomson Family and TACF's Mission
From:
Alyce T. Fritz

Lisa Thomson
From:
Garden Club of Hartford

Christopher Timmons
From:
Cheryl Timmons

Tom Todd
From:
Nora Todd

Rob Waggener
From:
Lorri Steiner

Joey L. Webster
From:
Joseph H. Webster

Yeeting that Blight into the Sea
From:
Anna Sproul-Latimer

IN MEMORY
OF OUR TACF MEMBERS

DECEMBER 17, 2021 – MARCH 24, 2022

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Beverly BaRoss

Martin Brabson
From:
Home Helpers

James Ely Bradfield
From:
John G. and Amy Bradfield

Greg Brooks
From:
Marian Post and Paul Eisenhauer

Jonathan David Byler
From:
Wayne and Jeanne Hearn

Casey Castleman
From:
Ruth Snyder

Fredric L. Cheyette
From:
Catherine and Oren Cheyette

Kenneth P. Christman, Jr.
From:
The Perr/Christman Fund

Rex I. Cordt
From:
Darren Veach

Willie and Alice Cruise
From:
Herbert Ley

Herbert Eplee
From:
Shirley J. Eplee

Brian Feign
From:
George A. Kaepplinger

Donald Firth
From:
Deb and Michel Ridgeway

George "Jim" Freytag
From:
Matthew G. Freytag

William G. Garrison
From:
Martha Fleischman
Frederick Gardiner
Ann Riker
Charles Rubinger
Barbara and Douglas Williamson

William G. Garrison and Kate Garrison
From:
Anonymous

H. Gibson Guion
From:
Hobart G. Guion

Vincent Hatton
From:
Anne L. Hatton

Dr. Walker R. Heap II
From:
Joseph Brabant
Walker Heap III
Carol Hills
Robert Radke and Jacqueline Ruette-Radke
Cait Schadock
Benjamin Sparacino

Donna Honsinger
From:
R. Bill Mitchell

Hugh Byron Howell
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Roy Christiansen
Roy Clayton
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Leslie Malueg
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Amcor Specialty Cartons
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Jeffrey Zeiders

Joseph "Joe" Pennell Kirk
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Cynthia Geary

Dr. Jimmy Joe Maddox
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Anonymous
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Elizabeth Campanella
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Elizabeth Stirling

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Deanna D. Dunaway

Charles H. Talbert, Ph.D.
From:
Johnny M. Mullen

Walter G. Thomson
From:
Alyce T. Fritz

Barrett D. Transue
From:
Elise H. Transue

Frank Carlton Yingling
From:
Susan Austin
Joan U. Rebholz

We regret any errors or omissions and hope you will bring them to our attention.

THE AMERICAN CHESTNUT FOUNDATION™
50 N. Merrimon Avenue
Suite 115
Asheville, NC 28804

SAVE THE DATE: THE AMERICAN CHESTNUT FOUNDATION'S

2022 Chestnut Symposium: A Resilient Forest

CROWNE PLAZA RESORT IN ASHEVILLE, NC
SEPTEMBER 30 – OCTOBER 2, 2022

What better place to hold the return of our in-person meetings than in the heart of Appalachia and native range of the American chestnut, Asheville, North Carolina?

Explore "A Resilient Forest" as we embark on topics including: assisted migration, climate change, wildlife, birds and pollinators, and much more. Prepare your questions for a LIVE panel discussion with TACF science staff, and chestnut science and restoration field experts. Join us for a tour of the USDA Resistance Screening Center, or bring your trail shoes and take part in guided hikes to locate wild American chestnut trees.

We are honored to welcome Joey Owle, Eastern Band of Cherokee Indians Secretary of Agriculture and Natural Resources. Joey will be keynote speaker at our Saturday evening event.

Online registration and hotel reservations open in early June. Watch for further details and updates in e*Sprout*, on our social media platforms, and the website.