



ADVENTURE SCIENTISTS

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TIMBER TRACKING: EASTERN BLACK WALNUT

PROJECT REPORT 2021

A partnership with the U.S. Forest Service





MIA TAYLOR AND JOSH JOHNSON COLLECT SAMPLES IN WAYEHUTTA, NORTH CAROLINA

ERIC FANNING

COVER: JESSICA LARMON HOLDS UP A BLACK WALNUT IN THE WILLIAM B. BANKHEAD NATIONAL FOREST, ALABAMA

ANDY BORK

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TIMBER TRACKING: EASTERN BLACK WALNUT



SUMMARY

Adventure Scientists' embarked on its fifth species of the Timber Tracking project by adding eastern black walnut (*Juglans nigra*) sample collection. Volunteers collected leaf, twig, and tree core samples from black walnut trees from July 2021 through January 2022. In total, 145 volunteer teams collected samples from 932 trees. Their collection included 483 leaf samples, 942 twig samples, and 491 tree core samples. We took samples from black walnut trees in 32 states in the eastern and central U.S., covering the full extent of the species range. Our partners at the U.S. Forest Service will analyze these samples to build comprehensive genetic and chemical reference libraries. These reference libraries will enable land managers to enforce anti-poaching regulations, improve forestry management practices, and plan for climate change impacts. For this project, Adventure Scientists created field protocols and volunteer training materials in consultation with project partners, secured permits, and selected where and when to collect samples. We then recruited, trained, and managed volunteers who collected data in the field. When volunteers returned samples to us, we inspected and reviewed all physical specimens and metadata to ensure quality. Together with our partners, we are building foundational reference libraries that will help law enforcement combat illegal logging, as well as guide resource managers who can preserve the genetic diversity of these important tree species.

PROJECT CONTEXT

Eastern black walnut, *Juglans nigra*, is a native deciduous tree and among the most valuable hardwood species in North America. Black walnut timber is highly prized for its straight, dark, and fine-grained heartwoods, and a popular wood choice for furniture, gunstocks, flooring, coffins, and veneer. Black walnut is actively logged and managed, accounting for more than 40 million dollars in export sales to 67 different countries between the years of 1999-2003 alone (Shifley 2004). Due to its high value, black walnut is a common target for illegal timber theft across its range.

Initial results suggest that experts can extract DNA from black walnut wood samples with relative ease, and a new DNA profiling test shows excellent discrimination between individual trees.

The U.S. Forest Service has developed genetic markers to identify individual black walnut trees with the goal of improving forensic tools for investigating black walnut theft. Current sampling schemes are too sparse to reveal whether genetic markers can be used across the full range of black walnut. A denser sampling design allows the U.S. Forest Service to produce a comprehensive reference library, which will in turn supply prosecutors with the information needed to demonstrate high-certainty identities and source wood origins to within tens of miles. This precision is essential for cases where wood products are transported across state lines for milling or shipping purposes.

The goal of the Timber Tracking: Eastern Black Walnut Project is to create a forensic reference library that encompasses the uniqueness of individual black walnut DNA profiles and reveals trends across the species' range. This library will allow our partners to determine the individual and geographic origin of wood and the legality of wood evidence in timber theft cases. This builds upon Adventure Scientists' efforts since 2018 to collect range-wide samples from species targeted by timber poaching black walnut is the most recent focal species, following projects for bigleaf maple (*Acer macrophyllum*), coast redwood (*Sequoia sempervirens*), western redcedar (*Thuja plicata*), and Alaska yellow-cedar (*Callitropsis nootkatensis*).

Big Leaf Maple



972
trees

Timber Tracking Collections

2018-2022

Coast Redwood



1,219
trees

Western Redcedar



1,115
trees

Eastern Black Walnut



932
trees

Alaska Yellow-Cedar



908
trees



BALCK WALNUT TREES HAVE DARK HEARTWOOD AS SHOWN HERE IN A TREE CORE TAKEN BY JESSICA LARMON IN ALABAMA

ANDY BORK

PROJECT DESIGN

Current black walnut collections allow analysts to determine a wood product's source at the state level. Our project fills existing data gaps and allows partners to determine provenance at a finer, population-level scale. We achieved this through an opportunistic sampling scheme that aimed to collect between 800 to 1,000 samples across public lands in each of the 32 states spanning the species' historic native range.

To avoid cluster-sampling bias, we prioritized:

- parcels managed by the U.S. Army Corp of Engineers, as these lands typically fit the preferred habitat type of black walnut;
- parcels managed by U.S. Forest Service and National Park Service, as these lands have typically experienced less human development; and
- public parcels contained within states around the margins of black walnut's native historic range, as these populations may contain higher genetic diversity.

We avoided municipal or city parks (i.e., spaces largely manicured and curated for the enjoyment of people), as well as parcels within municipalities that have a history of landscaping (e.g., post offices and historic sites) in order to minimize the probability of collecting a transported or cloned individual. We limited collection from private lands to trees that meet a size requirement, to minimize sample collection from cloned individuals.

The following 32 states span the current natural black walnut range in the U.S.:

Texas, South Dakota, Nebraska, Kansas, Oklahoma, Louisiana, Arkansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Kentucky, Tennessee, Mississippi, Alabama, Indiana, Michigan, Ohio, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Maryland, Delaware, New Jersey, Pennsylvania, New York, Connecticut, Vermont. We acquired permits on 966 public land parcels, including those managed by the U.S. Forest Service, National Park Service, U.S. Army Corps of Engineers, as well as state forests, state parks, and city parks.

We collaborated with Dr. Richard Cronn, Research Geneticist in the U.S. Forest Service, to develop and approve project protocols. Nick LeBonte, Region 9 Geneticist for the U.S. Forest Service, consulted on design and developed a field guide and simplified dichotomous key that Adventure Scientists' adapted for volunteer training.



PORTIA AND ADVENTURE DOG, CHESEPEAKE, PREPARE SAMPLES FOR PHOTOS IN WASHINGTON DC AND VIRGINIA

KYLE DAGENAIS

VOLUNTEER MANAGEMENT

VOLUNTEER RECRUITMENT

A total of 810 volunteers submitted applications. We accepted 787 volunteers, which equated to 515 teams.

Given the ease with which researchers are able to derive genetic material from either black walnut leaves during the growing season or twigs during the dormant season, volunteers were able to collect samples year round. Continuous field sampling provided the opportunity to recruit volunteers throughout the year.

The recruitment strategy focused on getting at least five volunteer teams from all 32 states. We recruited volunteers through Adventure Scientists' produced media including email newsletters, and social media posts and ads. In addition, we made direct contact with national and local organizations, including environmental organizations, outdoor communities, universities, native plant societies, arborist groups, Reddit forums, and volunteer connection websites.

We screened volunteers for their GPS navigation skills, off-trail hiking skills, access to a smartphone, observational skills, and ability to follow protocols. Volunteers come to Adventure Scientists with a wide diversity of skills and backgrounds. With this in mind, we made efforts to recruit volunteers who self-identified as members of identities often marginalized in both the science and outdoor recreation fields. We featured four of these volunteers in the training modules, field protocols, and recruitment materials, to communicate that all qualified individuals are welcome and needed in our project.

We required all volunteers to complete online training modules prior to data collection. Our training modules included background information on timber theft issues, the ecological and cultural context of eastern black walnut, black walnut identification skills, a walkthrough of the technology required for data collection, and step-by-step videos and photos of proper implementation of the protocol. We offered two training tracks: one with instruction level and repetition designed for volunteers new to field data collection and a second, accelerated training for those with extensive field data collection experience. Volunteers self selected their track. All volunteers passed the same post-training quiz with 100% accuracy to ensure high data quality and had unlimited attempts to do so.

Adventure Scientists provided project equipment and printed field protocols to volunteers. This included sample envelopes, a tool to take a tree core (increment borer), a tool to access leaves/twigs on higher branches (saw toss tool), alcohol cleaning kit, silica desiccant, and a tape measure. We required volunteers to print out permitting documentation and provide their own smartphone or tablet for data collection.





THE BELANGER FAMILY MEASURES A BLACK WALNUT IN THE FINGER LAKES NATIONAL FOREST, NEW YORK

KARYN BELANGER

Our project protocols emphasized data quality, environmental precautions, and volunteer safety. These documents provided detailed instructions on how to prepare for field visits, species identification, how to collect high quality samples and metadata, disinfect equipment, and successfully transfer data and samples to Adventure Scientists upon leaving the field. Ninety-six percent of volunteers who responded to our end-of-season survey indicated that they were “provided with the necessary materials and training resources to be successful as a volunteer” (54% strongly agree and 42% agree). A new tool that we developed for this project allowed volunteers to sign up directly for the permitted land parcels where they wanted to collect samples, enabling other volunteers to have a continuously updated view of where sampling was needed. This prevented duplicate sampling and allowed volunteers to successfully plan their trips.

Once volunteers shipped samples back to Adventure Scientists’ headquarters, we checked samples into our database and verified sample quality. We found volunteers misidentified a few samples (0.02%), sent in the wrong sample type (2.10%), or failed to send in associated metadata required for analysis (4.01%). The remaining 93.89% of samples were high quality and mailed to Dr. Cronn for analysis.

We communicated with volunteers via email, phone calls, and text messages. In addition, we sent monthly newsletters to keep volunteers informed and engaged throughout the field season. We thanked our volunteers with Adventure Scientists branded merchandise, donated products, and pro-deal codes from our corporate partners. We hosted monthly online web events, photo contests, a “Black-Out Bingo Contest,” and a “Holiday Data Collection Blitz” contest to keep volunteers engaged with the project. In July, two staff members traveled to South Carolina to host a volunteer event, camped along the Chattooga River with volunteers, and recruited for the project.

We housed all volunteer resources (training, permits, sample mailing instructions, etc.) on a password-protected volunteer website so that volunteers could easily find relevant information in one place.



MIA TAYLOR AND JOSH JOHNSON ASSEMBLE SAMPLES FROM THEIR EXPEDITION IN NORTH CAROLINA



JESSICA LARMON COLLECTING BLACK WALNUT SAMPLES IN THE WILLIAM B. BANKHEAD NATIONAL FOREST, ALABAMA

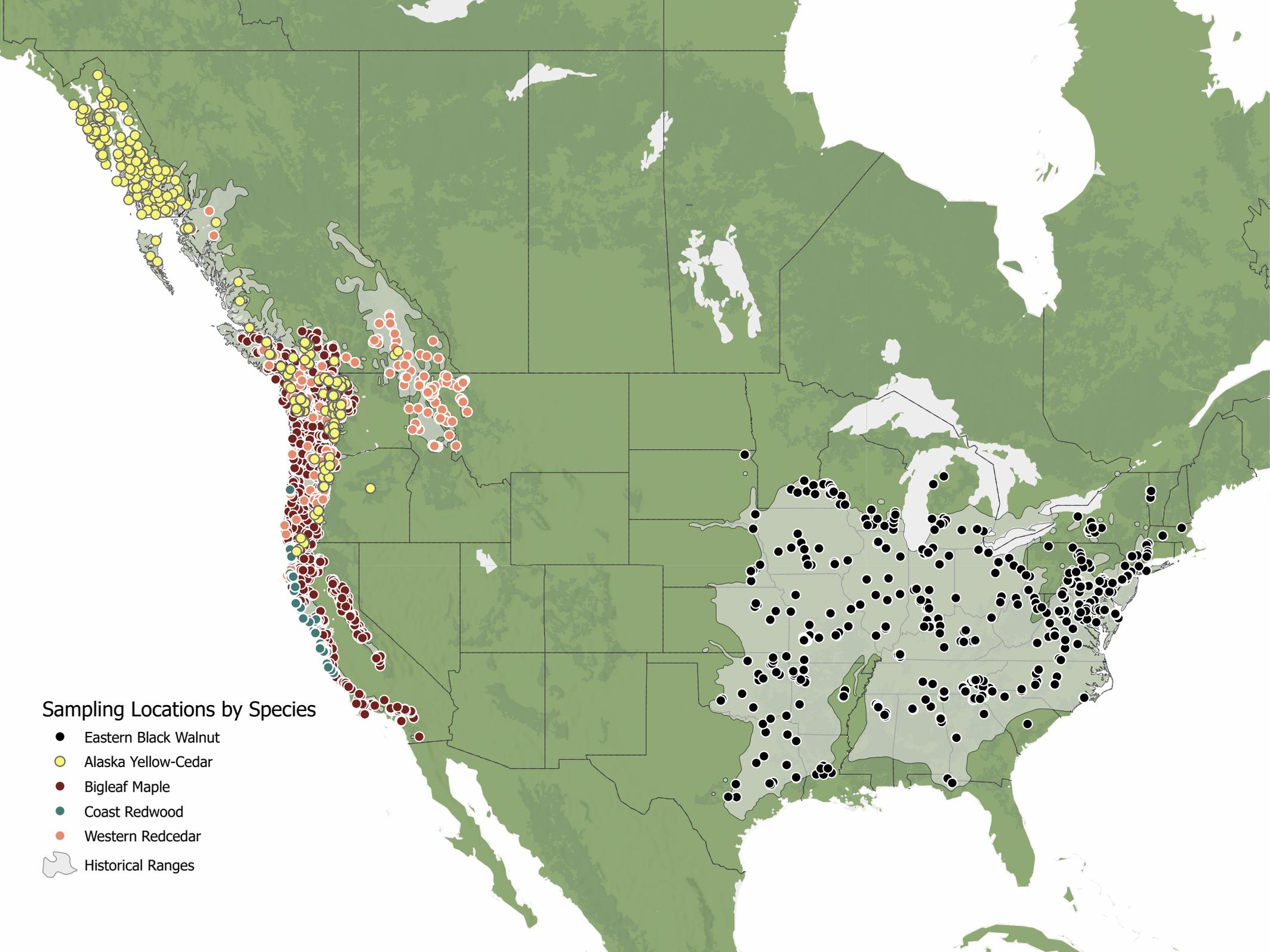
ANDY BORK



DATA COLLECTION & RESULTS

Adventure Scientists volunteers collected 483 leaf samples, 932 twig samples, and 491 core samples from 932 trees, well-distributed across the species range in all 32 states. Volunteers collected the most samples in the growing season (approximately July through September), with leaf, twig, and core samples from 510 trees. In the dormant season (October - January), volunteers collected twig and core samples from 422 trees.

In collaboration with Dr. Cronn, we set a target goal to collect samples from 800-1000 trees, and we successfully completed sampling for an extensive reference library with 932 trees.



Sampling Locations by Species

- Eastern Black Walnut
- Alaska Yellow-Cedar
- Bigleaf Maple
- Coast Redwood
- Western Redcedar
- Historical Ranges



ANNE RUSSELL GREGORY, SENIOR MANAGER OF DEVELOPMENT, COLLECTS SOME OF THE PROJECT'S NORTHERNMOST SAMPLES IN VERMONT

DATA END-USE

Dr. Rich Cronn (U.S. Forest Service) will analyze DNA from leaf and twig samples (Gupta et al. 2001). Additional collaborators will use tree cores to create a reference library of chemical fingerprints (Cody et al. 2005). In addition to contributing to their scientific fields, these collections will enable researchers to establish new tools that support the successful prosecution of poachers and illegal traders of these valuable tree species in the future.



Rich Cronn

*USFS Research Geneticist
Land and Watershed
Management*



"Our collaborators who are analyzing wood chemistry...are currently analyzing new approaches for predicting the geographic source of wood using 'chemical fingerprinting' based on a rapid/inexpensive mass spectroscopy method. The black walnut core collection is the largest spatial population study of cores made available to date for mass spectroscopy; nothing comparable exists at this geographic scale. The collection will allow scientists to test multiple different prediction methods and it will provide a great contrast for DNA-based prediction methods. We're all extremely jazzed."



RENEE BARKER HIKING ALONG A NARROW STRIP NEXT OF THE RIVER BANK TO GET TO THE BASE OF A BLACK WALNUT TREE

PROJECT PRESS

The New York Times

TIMBER POACHERS SET A FOREST ON FIRE. TREE DNA SENT ONE TO PRISON.

November 10, 2021

A Washington case makes national headlines as the first time tree DNA evidence appears in federal court. Adventure Scientists volunteers' efforts are mentioned and the article quotes project partner Dr. Cronn.

This article ties Adventure Scientists' black walnut data collection efforts to the bigger picture of timber poaching in the U.S. The reporter calls for volunteers to join the project.

REPUBLICAN HERALD

TREE DNA USED TO ID ILLEGAL TIMBERING

August 6, 2021

Highland OUTDOORS

West Virginia's Outdoor Magazine

BLACK WALNUTS ON THE BLACK FORK: CITIZEN SCIENCE CLOSE TO HOME

March 10, 2022

Volunteer Dylan Jones writes about his experience in West Virginia: "Even though I was just a handful of casual miles from home after a half-day of work, I felt the same rush of excitement and accomplishment as I did while bottling glacial runoff on an untrodden trekking route in Chilean Patagonia. That is what's so beautifully transcendent about citizen science—being part of something much larger than your own selfish outdoor pursuits adds intangible value to even the most mundane of outings."



CHRISTOPHER TARANGO USES A SAW TOSS TOOL TO CUT DOWN A BRANCH FOR SAMPLING, NEW YORK



MAGALI ROJAS AND AIDA WINTERS EXAMINE BLACK WALNUT LEAVES FOUND OUTSIDE OF KANSAS CITY, MISSOURI

VOLUNTEER EXPERIENCE

Adventure Scientists' volunteers cumulatively contributed 1857 days to this project, totaling over 5 years worth of their valuable time. In contrast, this is 609 days more than what volunteers contributed for the 2019 Timber Tracking project, which covered three species (coast redwood, western redcedar, and Alaska yellow-cedar).

"I found that I can succeed in finding samples needed. Gave me confidence in my hiking skills and found that I have a lot of determination to help with any research project that protects our environment and natural resources."

-Gloria Chavez





"I really enjoyed the opportunity to give back to the environmental and outdoor recreation communities. This experience also provided me with the incentive to explore areas in Virginia and North Carolina I was unfamiliar with and likely would not have explored otherwise."

- Joshua Barth

Black walnut has the largest species range compared to the other species in the Timber Tracking Project, covering 32 U.S. states. In addition, this geographic range was new to Adventure Scientists as an organization, and prior to this project we did not have a large cohort of volunteers familiar with our work in the eastern and central U.S. We are impressed by the response by volunteers throughout this project, as we had a network of committed volunteers who went above and beyond the requirements for this project. Each volunteer team collected 7.5 samples on average. Our top three extraordinary volunteers collected samples from 49 trees, 44 trees, and 33 trees.

Rodger Breedlove from Louisiana has been an active citizen scientist spending time surveying birds, but he had never scientifically sampled trees. He found that there were no known black walnut trees in Louisiana's public forests, so he decided to take matters into his own hands. Rodger put out an ad in his local paper and paid the first 10 people to let him sample their trees on private land. Rodger was responsible for collecting all of our samples in Louisiana!

"It was great! Fantastic citizen science training, I actually sent it to a friend who works at an environmental NGO" and "Very well done, very clear, nicely organized."

-Anonymous feedback submitted on the training

Having hope for a better future is one of the reasons people volunteer for conservation. Carol Pollio had a distinguished career as a scientist for the National Park Service. Now retired, she volunteers with many conservation projects. One day while out searching for trees in Delaware she saw a rainbow painted shell with the word "hope" sitting in a knot in a tree, and felt moved to share it with us because it brightened her day. Volunteering with this project continues Carol's lifelong dedication to conservation.

We sought feedback from volunteers in a survey, and received 78 responses. 85.7% of respondents indicated that the project increased their awareness and knowledge of the illegal timber trade and the impact on forests, and 59.7% reported that they have undertaken conservation actions as a result of the project. Some example statements from the returned surveys include, "I am raising awareness in the arborist community about this project and DNA research and the value of black walnuts, water quality, forest ecology etc" and "reducing my entire family's paper/tree consumption, staying (more) informed about an issue I had no idea was happening before."

"I was made delightfully aware of the massive black walnuts in our area. Pushing through 6 to 12 inches of snow for our final collection, I really appreciated how old and how big so many of the trees are here in the hedgerows and gullies."

-Mariann Fessenden





LESSONS LEARNED

RECRUITMENT

Since the eastern black walnut range is throughout the eastern and central US, we developed a comprehensive recruitment strategy to target volunteers across 32 states. We don't currently have a large volunteer cohort in this area, so anticipated needing more recruitment effort compared to projects we run in the western U.S. We contacted hundreds of organizations and targeted social media ads to bring volunteers into our network. This approach was quite successful, resulting in a high number of applicants for the project. We didn't see as high a rate of volunteer follow-through compared to other projects, and we learned some lessons about this approach that we will consider for future recruitment in new geographic areas. We plan to be more specific about volunteer commitment and responsibilities before volunteers apply to the project. Also, we may choose to pursue more targeted recruitment in certain areas, as opposed to broad recruitment, as project needs dictate.



ZENA CASTEEL AND CHRISTOPHER TARANGO CELEBRATE A FUN DAY OF SAMPLING IN THE FINGER LAKES NATIONAL FOREST, NEW YORK

ACKNOWLEDGMENTS

We are grateful for our volunteers – this research would not have happened without them. Many volunteers provided resources to support the project above and beyond giving their time, and we are incredibly grateful for their donations. It's incredible to work with so many people who are driven by a desire to contribute directly to conservation. Numerous land management agencies supported this project through their partnership in study design, on-the-ground logistics, and help securing permits and authorizations. We would like to thank Rich Cronn (U.S. Forest Service) and Nick Lebont (U.S. Forest Service) for collaborating with us to design the study for a meaningful impact on illegal timber trade. We were also fortunate to collaborate with Ed Espinoza (U.S. Fish and Wildlife Service). Adventure Scientists' donor partners made the expansion of this project possible, as well as Adventure Scientists' other work. This project was funded in part by Lyda Hill Philanthropies, Ohrstrom Foundation, Cornell Douglas Foundation, Clif Family Foundation, and Houston Family Foundation. We are incredibly grateful for their partnership and support. GaiaGPS's in-kind donation waived subscription fees for their navigation app for all volunteers. Outdoor Research, Sunski, Peak Design, and Croakies helped us thank our volunteers with great prizes throughout the field season. Every member of the Adventure Scientists team contributed their optimism, creativity, and exemplary work ethic to help launch this project. Special thanks go to our contracted e-Learning Course Creator Spring Petta, GIS Contractor John Roseberry, Permitting Contractor Cedar Mathers-Winn, Executive Director Gregg Treinish, Technology Manager Ricky Jones, Volunteer Manager Katya Koepsel, and Project Coordinator Isabella Pritchard.

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ZENA CASTEEL AND CHRISTOPHER TARANGO FOUND BEAUTIFUL GROVES OF BLACK WALNUT TREES IN THE FINGER LAKES NATIONAL FOREST, NEW YORK



ADVENTURE SCIENTISTS

PO BOX 1834 | BOZEMAN, MT 59771

406.624.3320 | info@adventurescientists.org

For more information:

www.adventurescientists.org