

# DIVERSIFICATION OF DISEASE- RESISTANT AMERICAN CHESTNUT



SARA FITZSIMMONS – PSU AND TACF

CONTINENTAL DIALOGUE ON NON-NATIVE  
FOREST INSECTS & DISEASES

CLEVELAND, OH

TUESDAY, NOVEMBER 19, 2019



# AMERICAN CHESTNUT

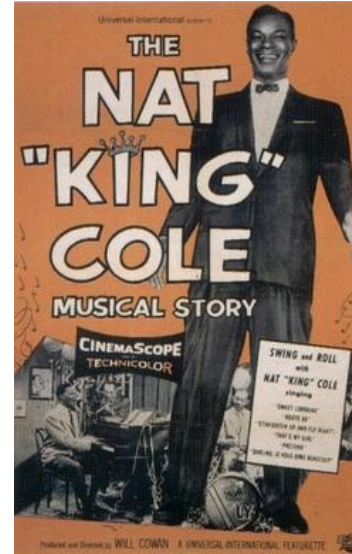




# American Chestnut: The Tree



- High-value timber species
- Nuts valuable to wildlife
- Tannins used in tanning leather
- Nuts valuable to people and livestock
- Culturally significant





# Chestnut Blight

First identified  
NYC in 1904

Fungus -  
*Cryphonectria*  
*parasitica*

Spread quickly,  
functionally wiped  
out chestnut as  
overstory tree by  
1950's





# Restore the American chestnut tree to its native range

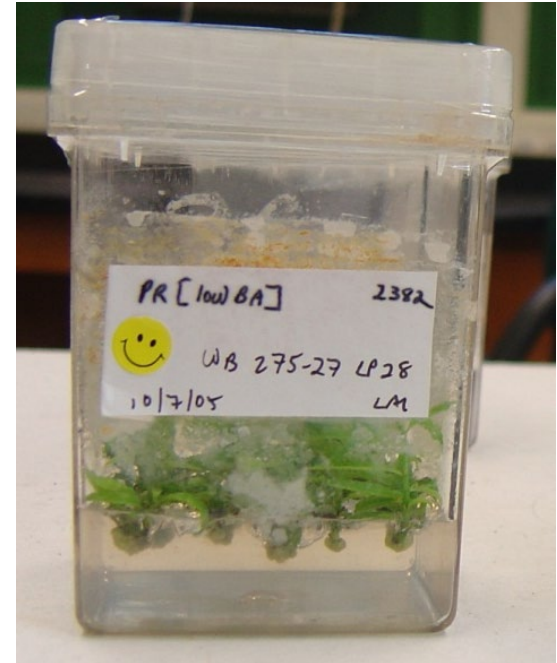


# How to Make a Disease-Resistant American Chestnut?



## 3BUR

Breeding, Bio-control, and Biotechnology  
United for Restoration





# Breeding





# American Type with Intermediate Blight Resistance





# BioControl



**Uninfected Bark**



**Non-lethal Canker**

# Infect the **Fungus** with a **Virus**



**Virulent**

**no virus**

**Hypovirulent**

**virulent virus**

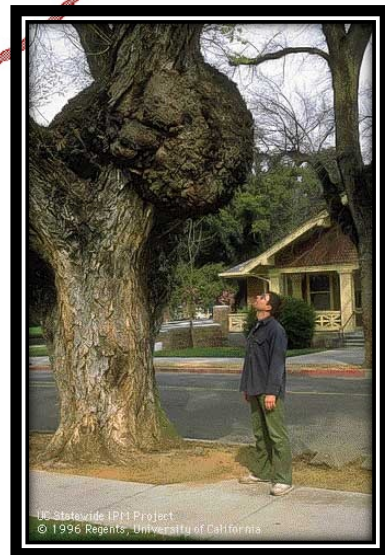
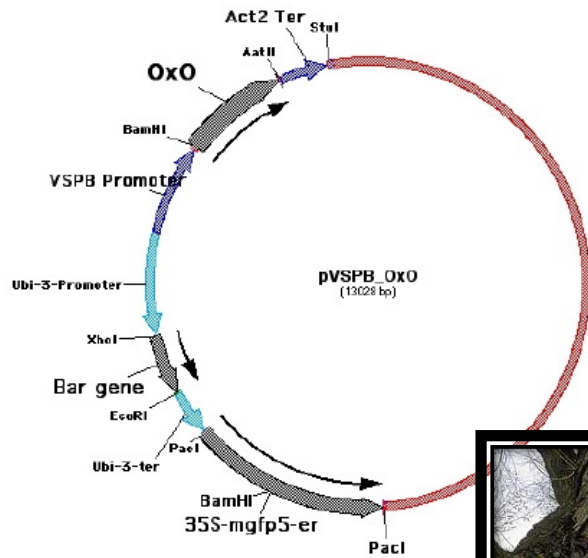
**Hypovirulent**

**weak virus**





# Biotechnology

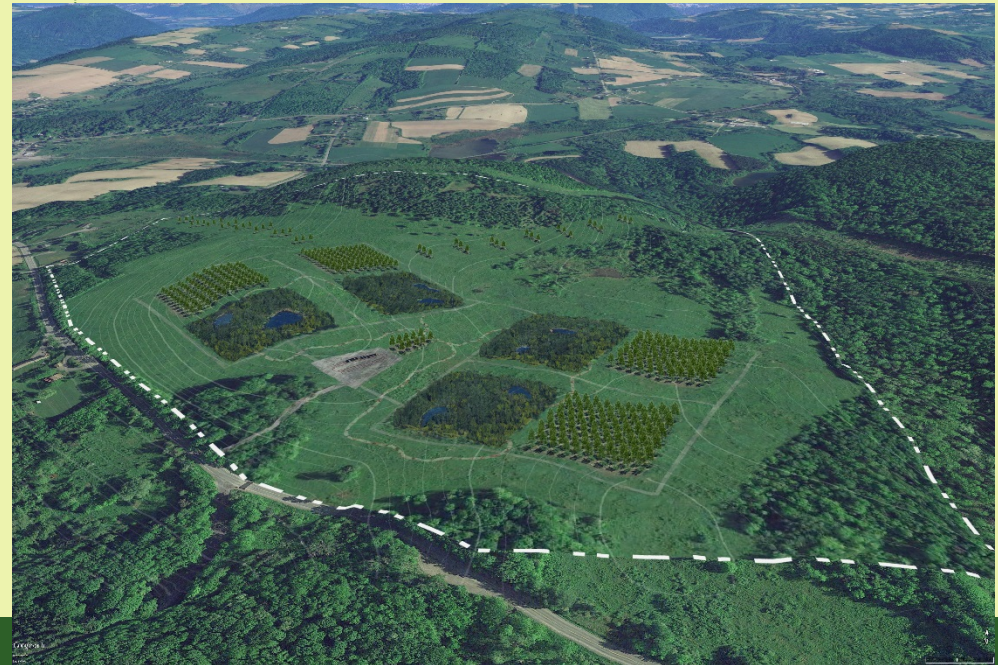




# Permitting

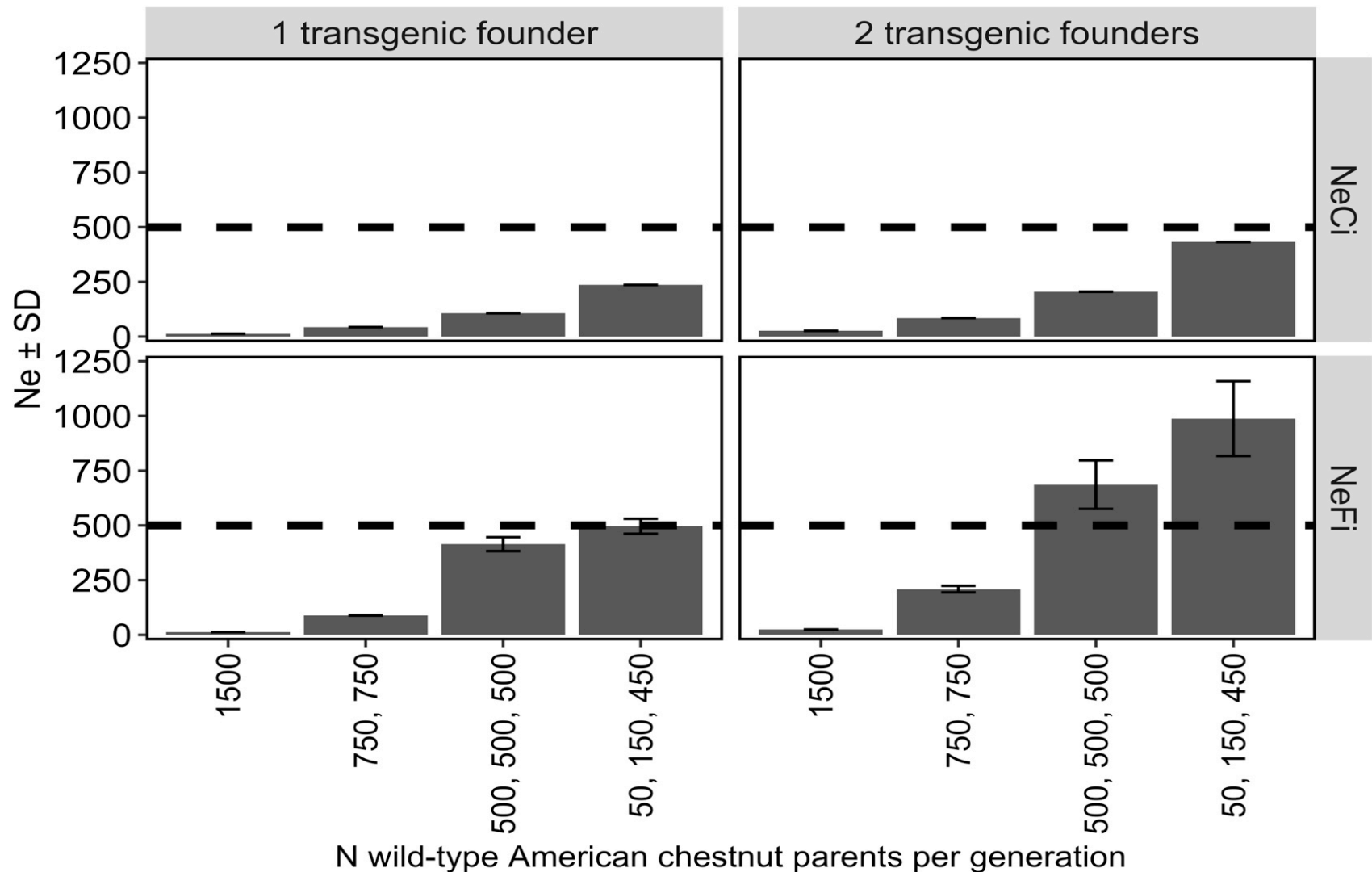


- Looking to deregulate in the next 2-5 years.
- Depends on regulatory approval by EPA, USDA, and FDA





# 3 generations of outcrossing transgenic to wild-type trees required to expand effective population size to 500



# Germplasm conservation for diversification



Collect seed from wild trees



Transplant sprouts from forest into orchard



Graft wild scion

***Objective:* Collect seed, transplant, or graft 1000 wild-type American for use in breeding with blight-tolerant transgenic trees**



# Ex Situ Conservation



- Challenges of vegetative propagation
  - Doesn't readily root
  - Delayed graft incompatibility and blight infection
  - Tissue Culture on embryos



- Challenges of seed storage
  - Viability drops significantly after first 6 months.
  - 2 years, max



# Current Status in the Wild

Dalgleish et al.  
*Forests*. 2016.

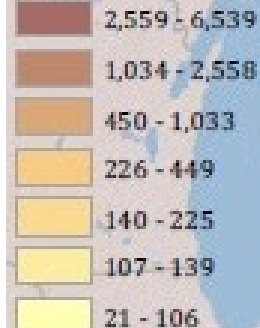
- 430 Million Trees
- ~84% sprouts < 1" dbh

Appalachian Trail  
Mega-Transect

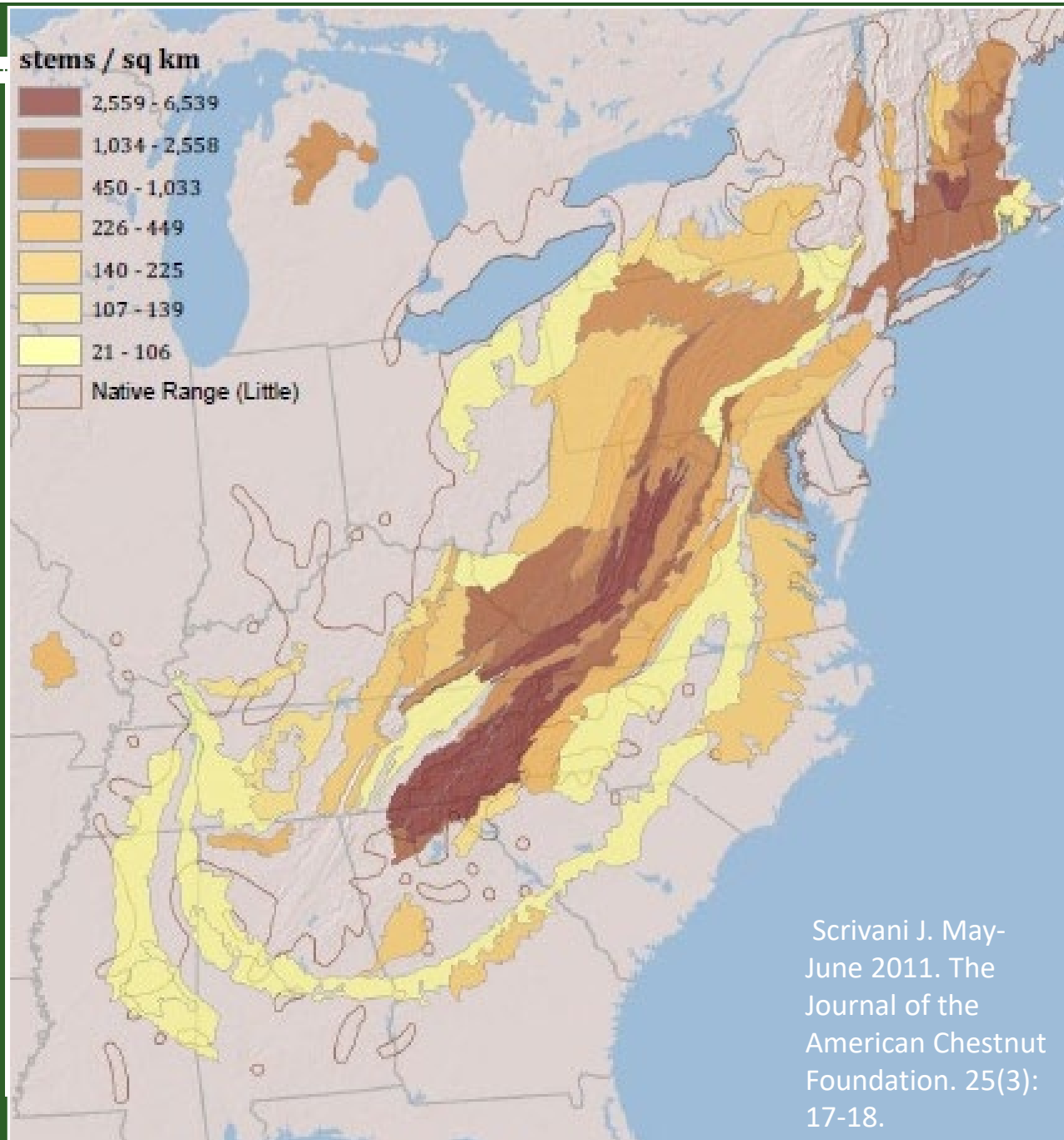
- 18,376 trees counted
- Only 107 were > 4" dbh (0.5%)



stems / sq km



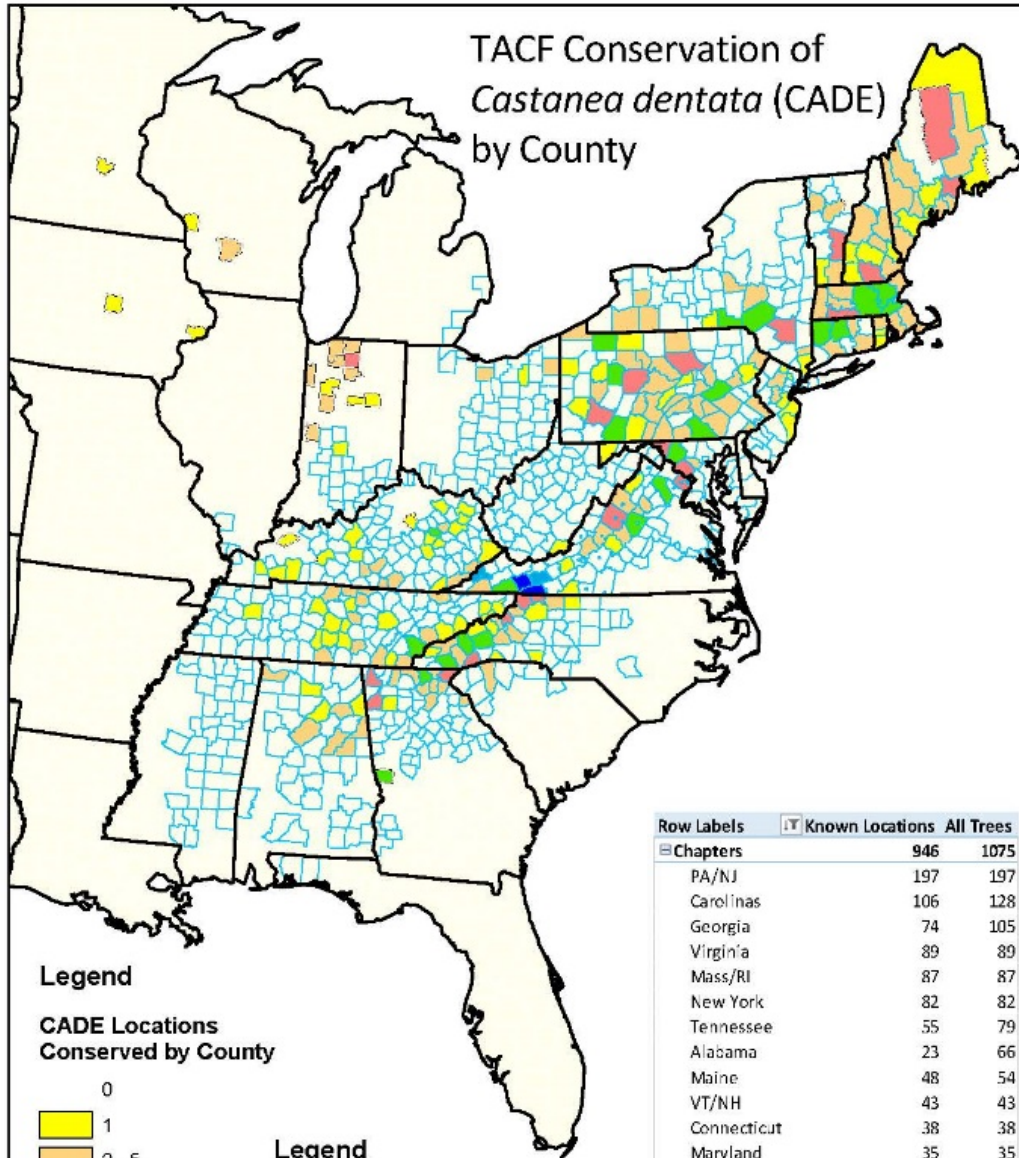
Native Range (Little)



Scrivani J. May-June 2011. The Journal of the American Chestnut Foundation. 25(3): 17-18.

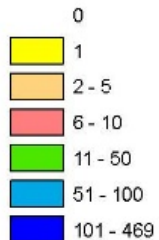


## TACF Conservation of *Castanea dentata* (CADE) by County



### Legend

#### CADE Locations Conserved by County



### Legend

#### CADE\_Range\_Counties

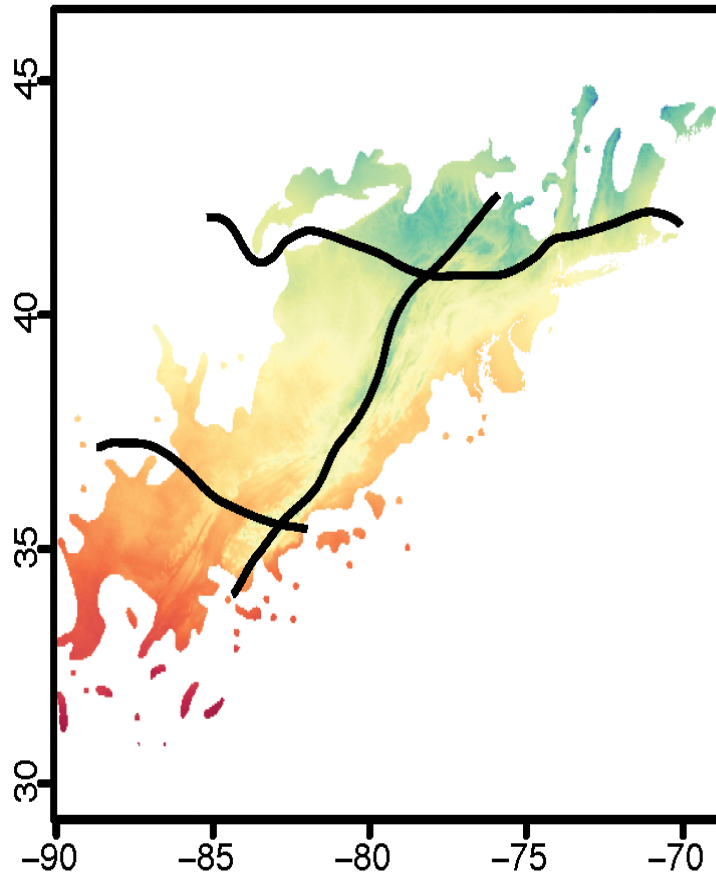


Row Labels	Known Locations	All Trees
<b>Chapters</b>	<b>946</b>	<b>1075</b>
PA/NJ	197	197
Carolinas	106	128
Georgia	74	105
Virginia	89	89
Mass/RI	87	87
New York	82	82
Tennessee	55	79
Alabama	23	66
Maine	48	54
VT/NH	43	43
Connecticut	38	38
Maryland	35	35
Indiana	32	35
Kentucky	33	33
Ohio	4	4
<b>Meadowview</b>	<b>890</b>	<b>962</b>
Meadowview	890	962
<b>Grand Total</b>	<b>1836</b>	<b>2037</b>

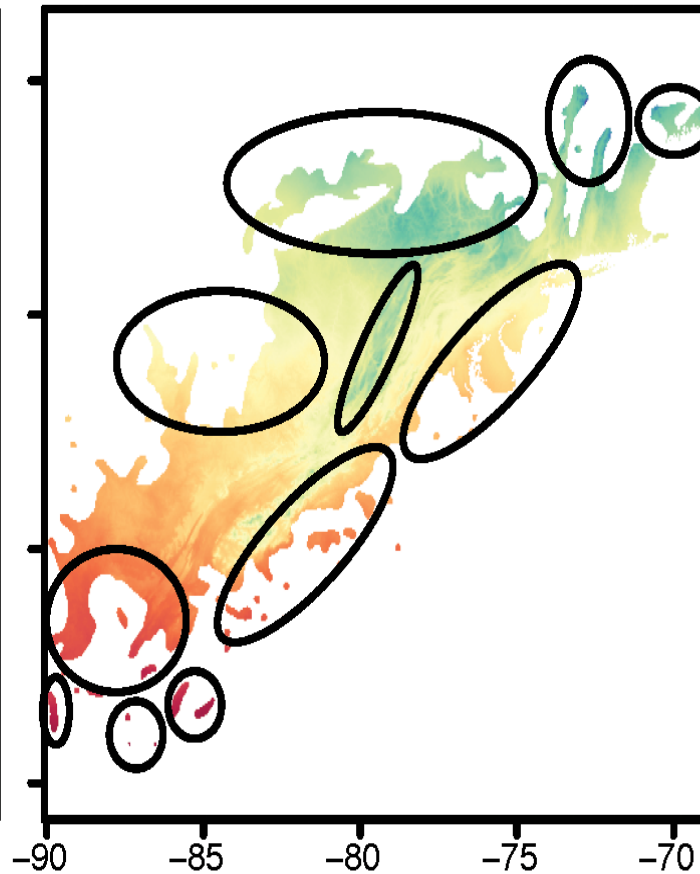
## Diversification of Disease Tolerant Chestnuts



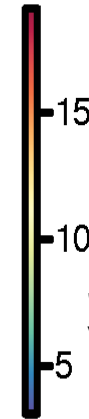
# Genome-informed germplasm conservation



**Management units delineated by population structure due to migration and genetic drift**



**Locally adapted subpopulations delineated by genome-environment association analysis and machine learning**



Jason Holliday  
Virginia Tech





# Finding American Chestnuts







- Find the trees



## Tree Locator Form TreeSnap



- Verify species
- Staff and trained volunteers



**Purpose:** This form is to help TACF® record, map, and analyze chestnut trees across their native range.

**Result:** An analysis of the macro and microscopic characteristics of the leaf and twig sample will be completed by a TACF identification expert and the results will be sent to the submitter in 4-8 weeks.

### LEAF and TWIG SAMPLE

- 6-12" of twig and *attached, mature, green* leaves growing in the full sun.
- Press sample *flat* between sheets of cardboard and place in an envelope.
- Use a single paper towel between the sample and cardboard to cushion and absorb moisture.
- Do *not* wrap in plastic, as samples will mold in the mail.
- Do *not* ship overnight. It's not necessary and we won't ID your sample right away.

### Tree Locator Form

**Location:**

County: \_\_\_\_\_

Town: \_\_\_\_\_ State: \_\_\_\_\_

Latitude (N): \_\_\_\_\_ Longitude (W): \_\_\_\_\_



THE  
AMERICAN  
CHESTNUT  
FOUNDATION®

**Location information is crucial.** The closer you can get us to a tree with your directions, the better. Lat/Long measures are the best.

- You may obtain location information from Google Maps (<http://maps.google.com>). Right-click and select "What's here".
- If you can't obtain Lat/Long measurements, then please attach a map and/or directions to the tree from the nearest road.

### **Tree Information:**

SIZE: Diameter (inches @ 4.5ft): \_\_\_\_\_ Height (feet): \_\_\_\_\_

HOW MANY: ☐ Isolated Tree ☐ Clump of Trees (number): \_\_\_\_\_

☐ Clear-cut w/ many sprouts/trees \_\_\_\_\_ (~acres)

NUTS: Burs: ☐ None ☐ Few ☐ Many ☐ Unknown

CATKINS: ☐ Present ☐ Absent ☐ Unknown

SURROUNDINGS: ☐ Full Sun ☐ Partial Shade ☐ Full shade

☐ Sunken Canker

BLIGHT: ☐ Not Visible ☐ Visible ☐ Swollen Canker

Could we reach the tree with a large truck? ☐ Yes ☐ No

Comments \_\_\_\_\_

### **Owner of Property Information**

Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

E-mail: \_\_\_\_\_

Are there restrictions to viewing the tree? ☐ Yes ☐ No  
Is permission of the owner suggested before viewing? ☐ Yes ☐ No

### **Form Submitted By:**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone: \_\_\_\_\_ E-mail: \_\_\_\_\_

**Submission address - please choose the office closest to the tree located.**

Tom Saielli, The American Chestnut Foundation, 50 N. Merrimon Ave, Suite 115, Asheville, NC 28804

Matt Brinckman, VA DOF, 900 Natural Resources Drive, Charlottesville, VA 22903

Sara Fitzsimmons, Pennsylvania State University, 206 Forest Resources Lab, University Park, PA 16802

Kendra Collins, USFS Northern Research Station, 705 Spear St, South Burlington, VT 05403



- Find the trees

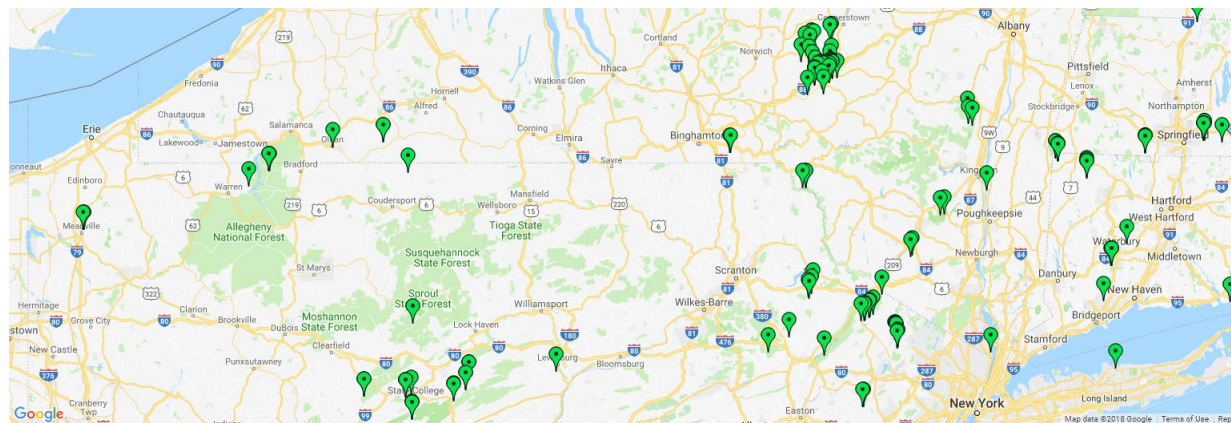


Tree  
Locator  
Form



TreeSnap

- Verify species
  - Staff and trained volunteers



## Observations by State

[View All](#)

State	Number of Observations Reported
Kentucky	696
North Carolina	328
Virginia	278
Tennessee	126
New York	89
Ohio	77
Pennsylvania	71
Massachusetts	68



# Mill Grove (Seed Derived) Germplasm Conservation Orchard (GCO)



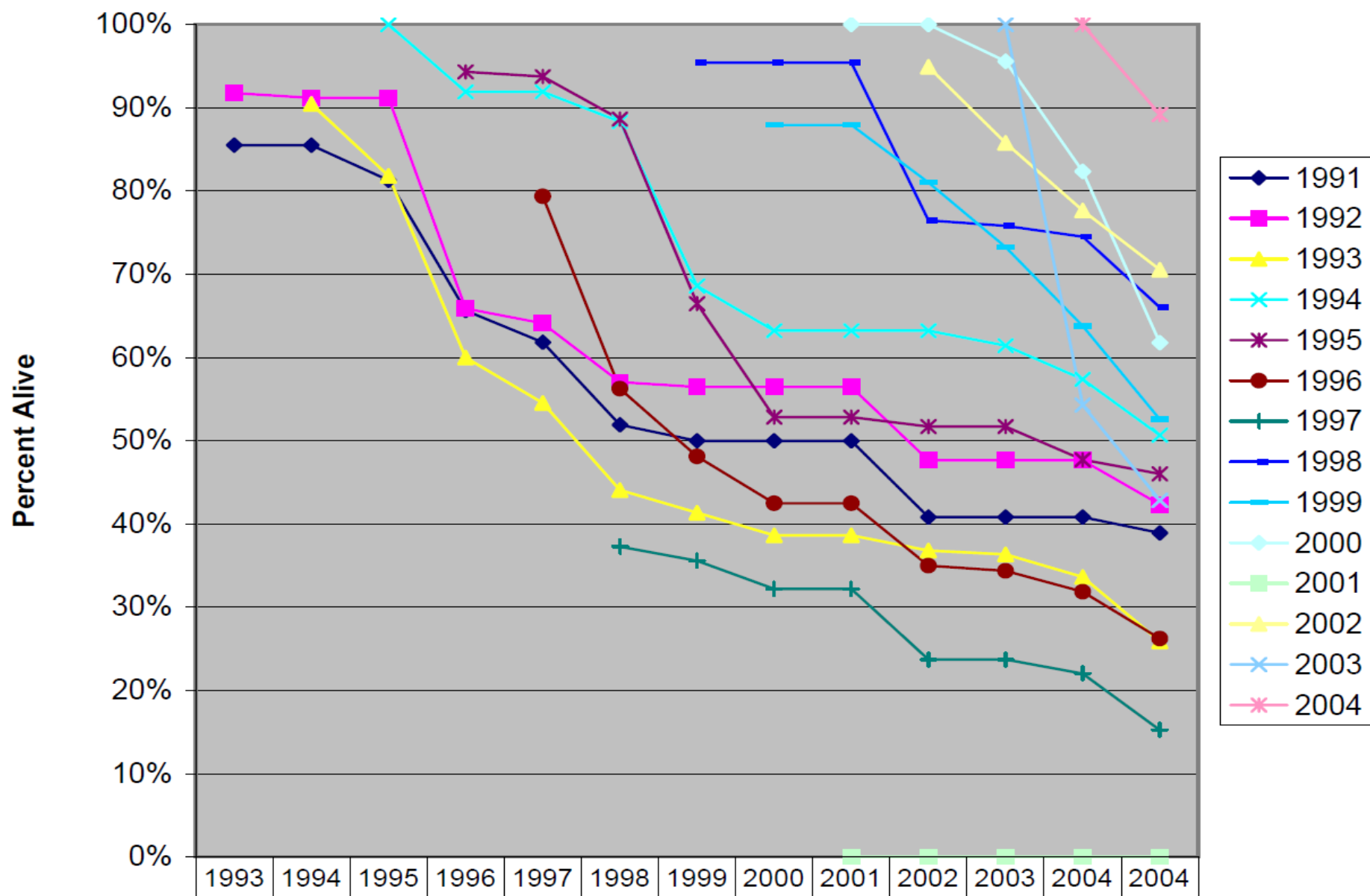


# Purdue University / Duke Energy Grafted GCO





# American Chestnut Survival at William W. White Plantation





# Haun American Chestnut Orchard

## Sandy Lake, PA

planted 1983






# Haun Chestnut Harvest







# Questions?

Email: [sff3@psu.edu](mailto:sff3@psu.edu)

Phone: 814-863-7192