Updates on Creation and Deployment of Disease-Resistant American Chestnut

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PSU AND TACF

CONTINENTAL FOREST DIALOGUE

DECEMBER 15, 2021

American Chestnut

American Chestnut: The Tree

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- 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

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Restore the American chestnut tree to its native range

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How to Make a Disease-Resistant American Chestnut?

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3BUR

Breeding, Bio-control, and Biotechnology United for Restoration

Breeding

American Type with Intermediate Blight Resistance

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BioControl

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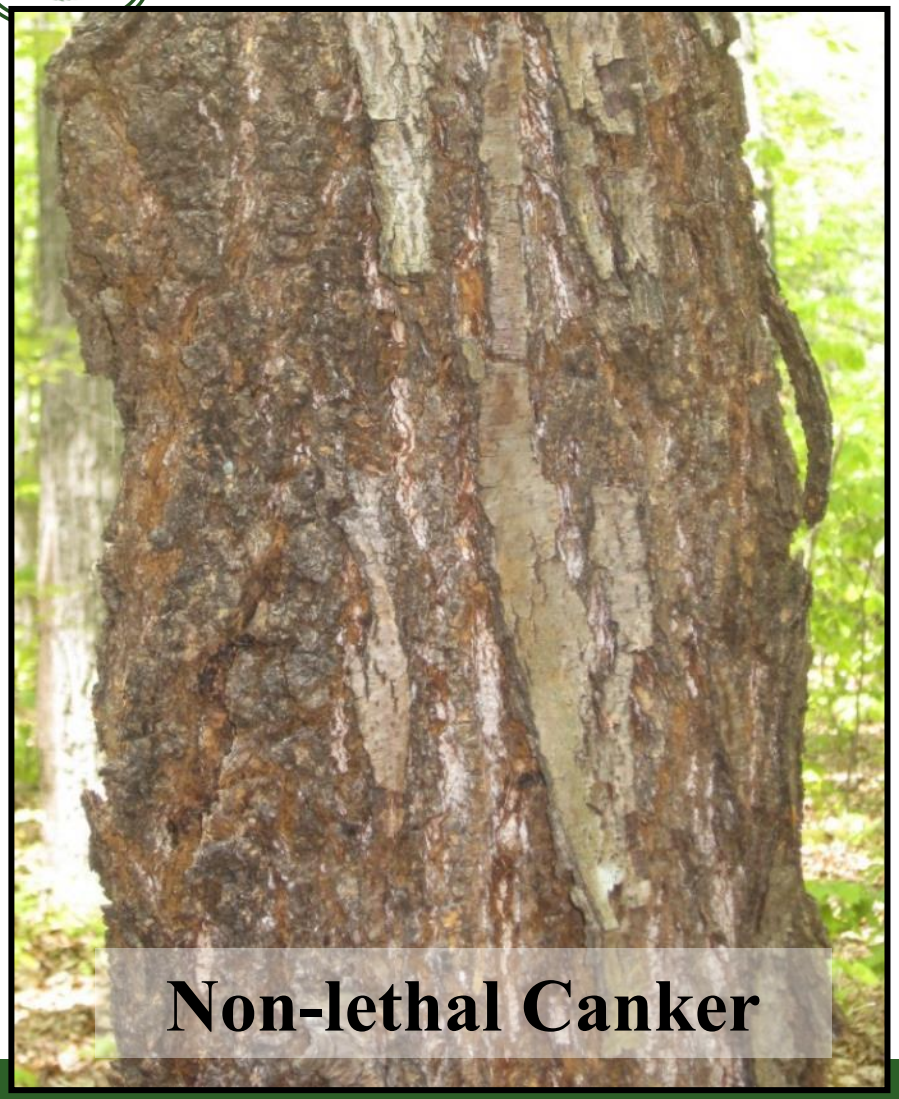
Uninfected Bark



Non-lethal Canker

Infect the Fungus with a Virus

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Virulent	Hypovirulent	Hypovirulent
no virus	virulent virus	weak virus

Biotechnology

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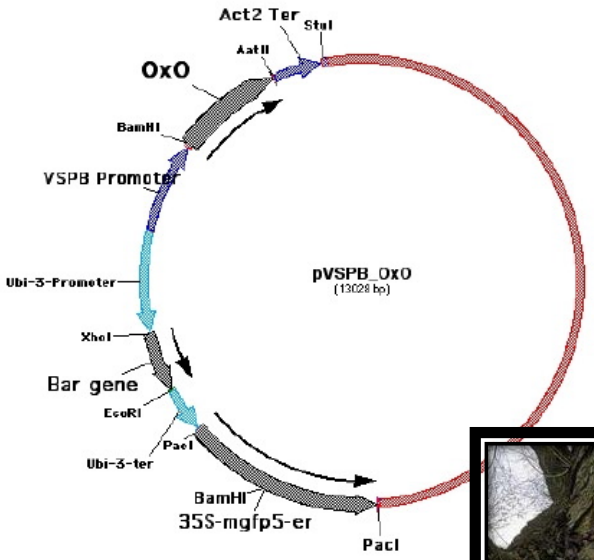

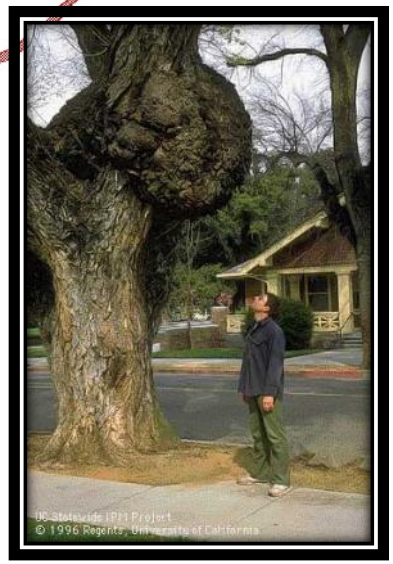

Deregulation of Darling 58

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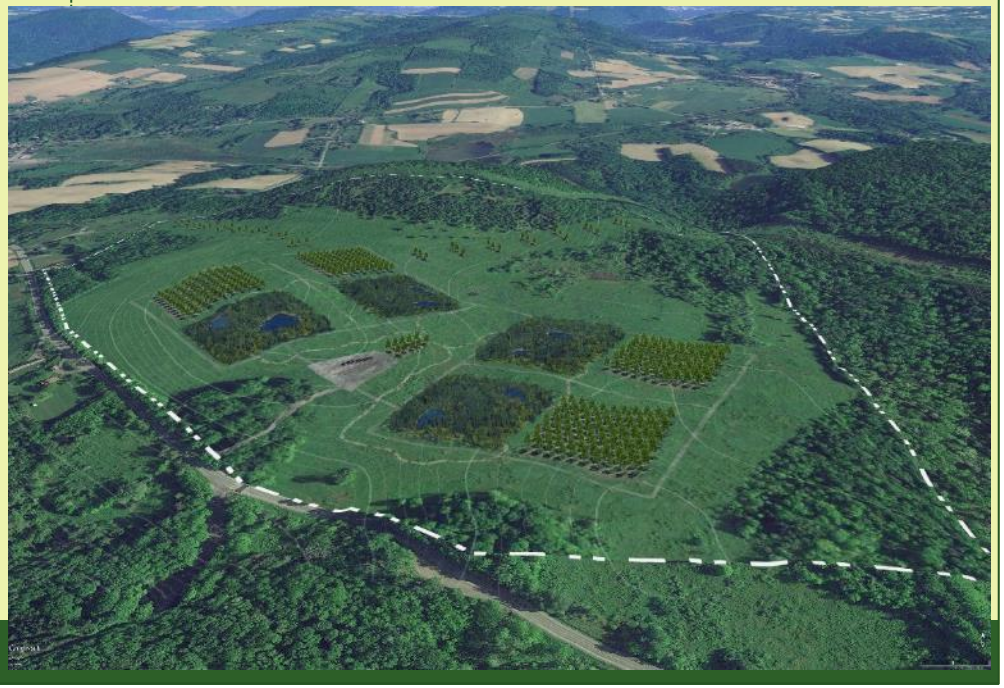
- Looking to deregulate in the next 2-5 years.
- Depends on regulatory approval by EPA, USDA, and FDA



Public Comment Period Results

Form Letters

51% vs <1%

Overarching Group	Negative	Neutral	Positive	Grand Total
Public	1510	24	1501	3035
TACF	67	4	961	1032
Individualized Outreach	5	1	151	157
ESF			77	77
Organizational	1		18	19
Grand Total	**1583**	**29**	**2708**	**4320**

63% Positive Comments

- Academic Responses
  - 91 Individuals from 71 Universities
- Over 100 organizational comments
  - Schools, Federal and State Agencies, Conservation Organizations, Municipalities, etc., etc.

Comparison to Other Analogous PCPs

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APHIS Application Status: 1992 - Present

Crop Type	Deregulated	Pending	Withdrawn	Grand Total
Commodities	124	7	28	159
Trees	5	2	2	9
Flowers	2		1	3
Grand Total	**131**	**9**	**31**	**171**

DEREG

Apple
Plum
Papaya

NOT DEREG

Eucalyptus

Apple

- Petition submitted 2012 / 2016
- Random selection shows general support, "I want to eat this apple"
- ~ 2,000 comments to NOI in 2013
  - >72,000 signatures against

Eucalyptus

- Petition submitted 2012
- Random selection shows general criticism, "You will ruin the environment"
- > 6,500 comments to NOI in 2013
  - 3 comments against with over 30,000 signatures
- 24 total Issues raised in comments
- EIS drafted in 2017 => Stalled

https://www.aphis.usda.gov/aphis/ourfocus/biotechnology/permits-notifications-petitions/petitions/petition-status

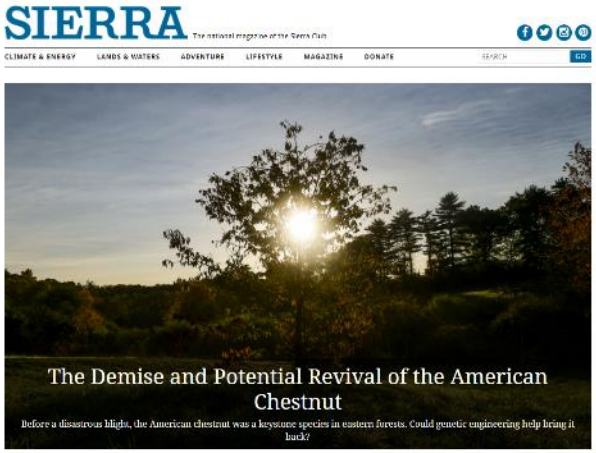
Gaining Support for Transgenics over Time

- Official Policy / Organizational Statements
  - Federal and State Forestry Agencies
    - USFS
    - VA, PA, CT, NC, NY, WV, WA
  - The Nature Conservancy (TNC)
  - Society of American Foresters (SAF)
  - Eastern Band of the Cherokee Indians (EBCI)
- Forest Health vs. Commercial Applications
- Sierra Club
  - From vehement opposition (2000)→ lukewarm non-opposition (2020), support from membership (<=2020)

Eucalyptus Lawsuit against APHIS

✓ Sierra Club;
X Center for Biological Diversity;
X Dogwood Alliance;
X International Center for Technology Assessment;
* Center for Food Safety
* Global Justice Ecology Project

https://www.sierraclub.org/sierra/2021-2-march-april/feature/demise-and-potential-revival-american-chestnut



Steps to Darling 58 Deregulation

- Submission of petitions to USDA (1/20), EPA (8/21), and FDA (pending)

- USDA Public Comment Period (8/2020)
- USDA Notice of Intent (8/2021)
- USDA Environmental Impact Statement (expected, 8/2023)
- USDA Decision (8/2023+)

- EPA Decision (expected spring 2023)
- FDA Decision (expected spring 2023)

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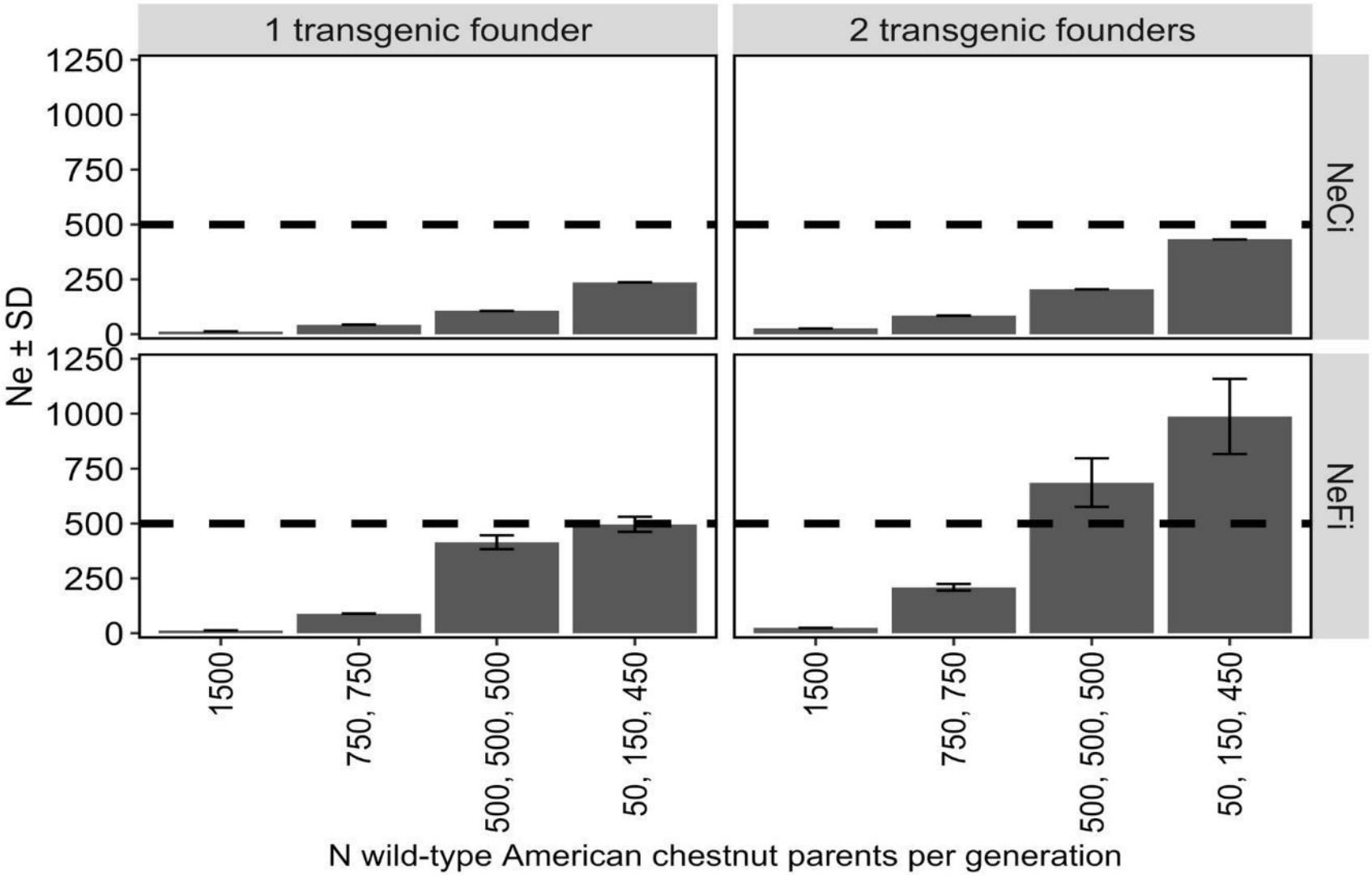
3 generations of outcrossing transgenic to wild-type trees required to expand effective population size to 500



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**

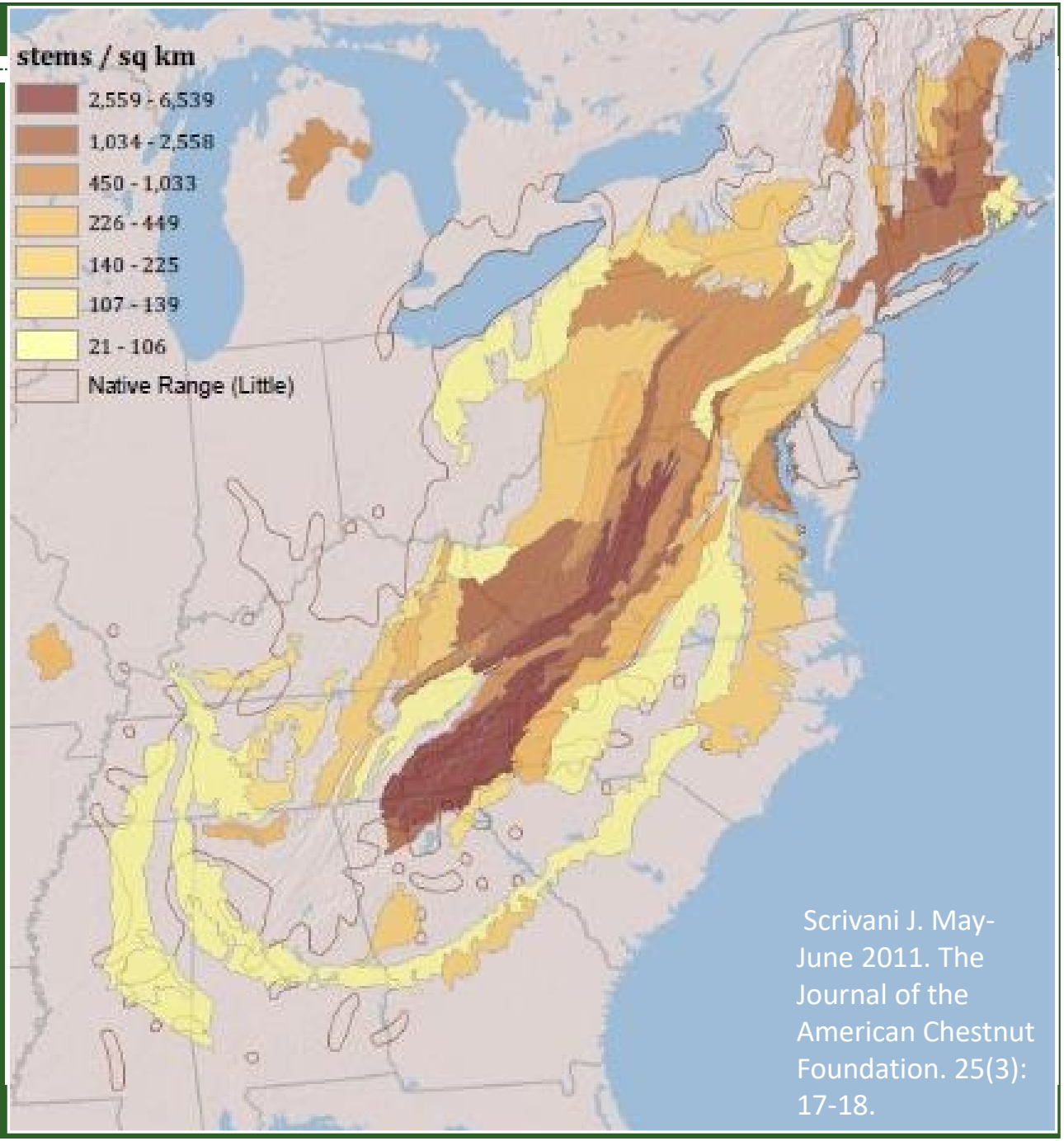
Current Status in the Wild

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%)



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

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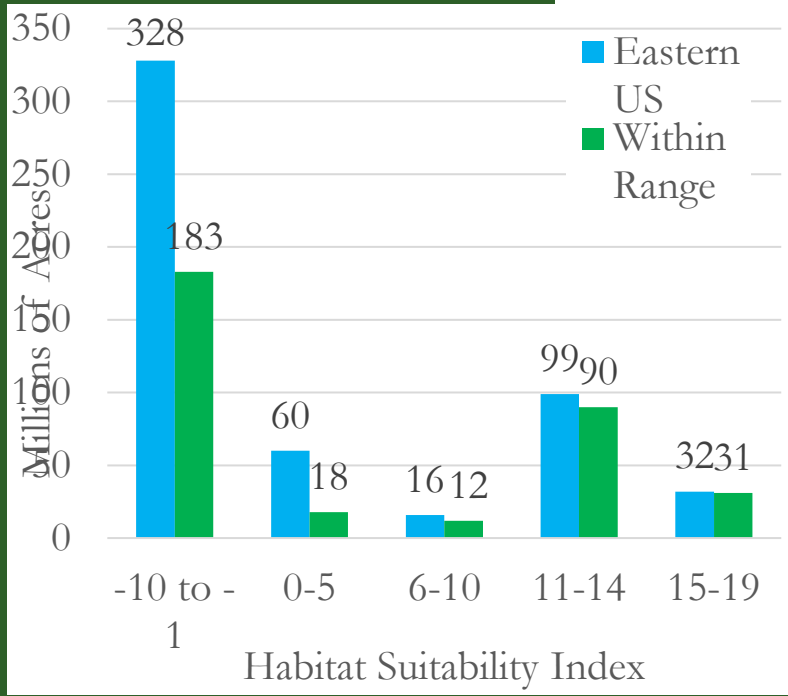
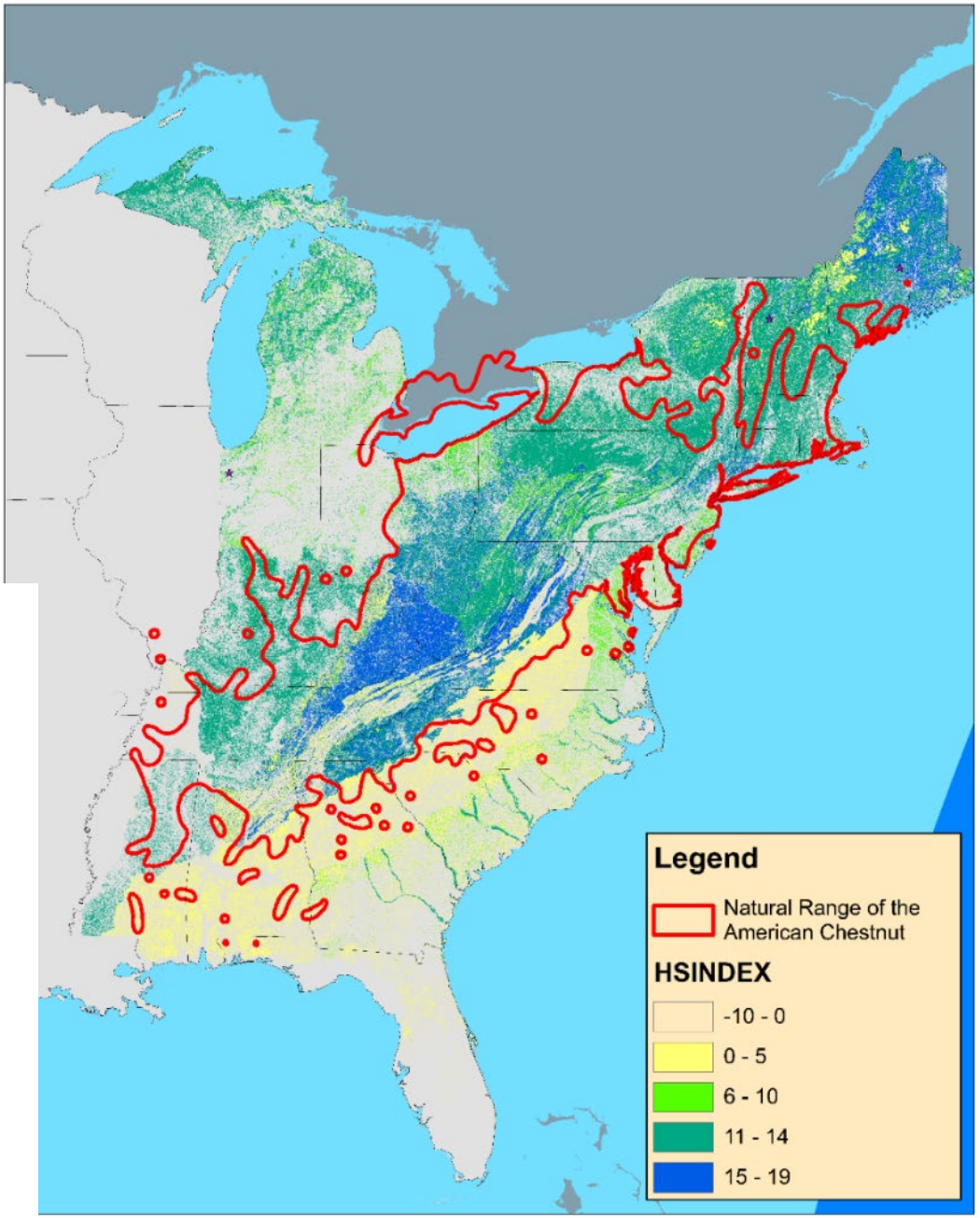
REINTRODUCTION AND RESTORATION

Habitat Suitability





Some chestnut habitat is highly suitable for chestnut growth, but not suitable for planting

Best Management Planting Practices, Guidelines, and Monitoring

Seed and Seedling Production

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Disease-Resistant American Chestnut Deployment and Draft Timeline

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Darling 58 and Best BC Crosses and Production

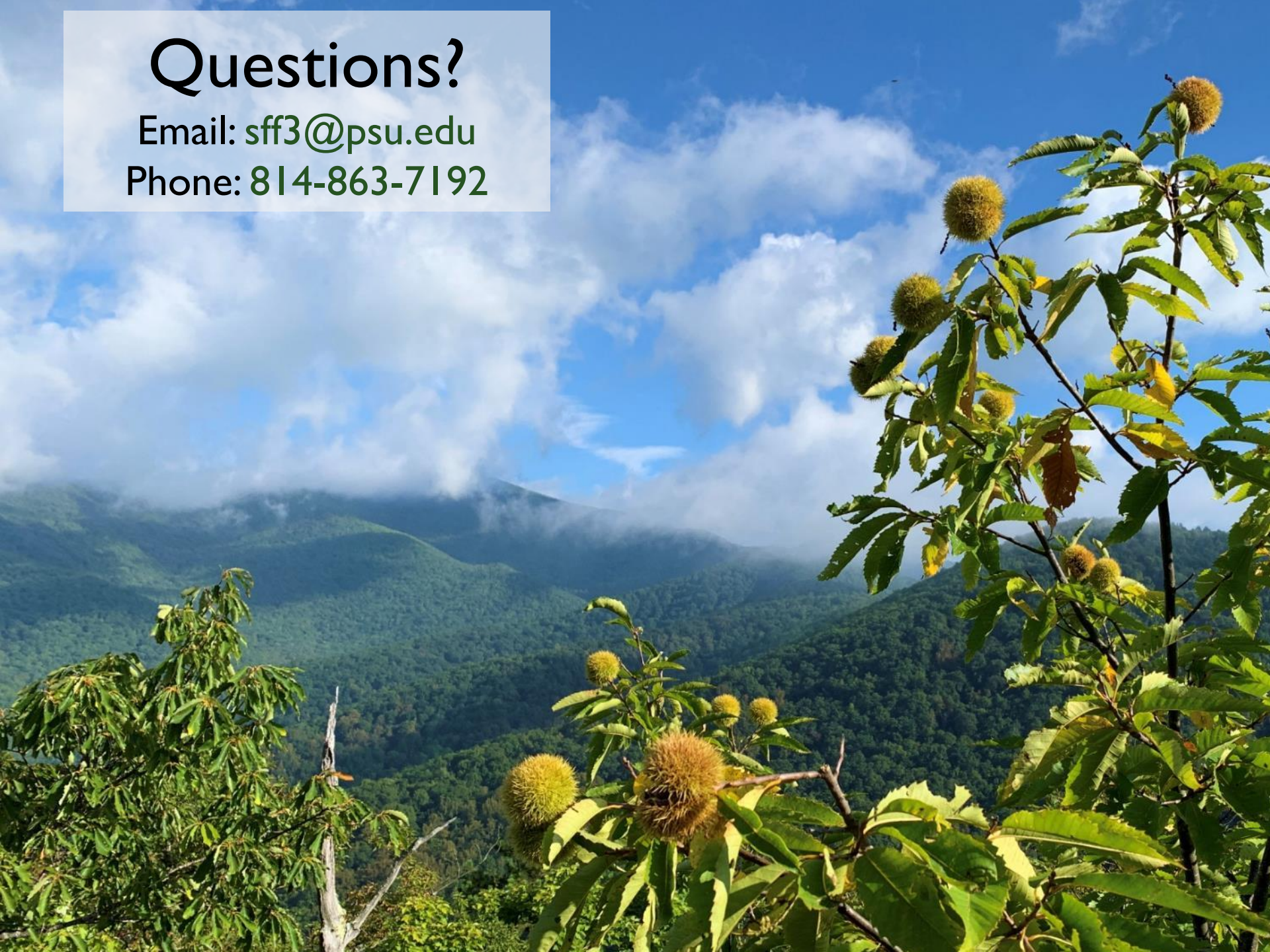
Next OxO Crosses (Wound Inducible Promoter and …..)
Stacked resistance Crosses (BC and PRR)

Stacked Resistance Crosses
Gene Edited Trees?

What's next???

Reintroduction and Restoration Plantings

2020	2030	2040	2050	2060
100 Acres	500 Acres	5000 Acres	20,000 Acres	50,000 Acres *5% of 1M Goal*
		1M SDLNGS		**2M SDLNGS**



Questions?

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