Plant Reintroduction and Seed Banking (aka *Ex situ* conservation)

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NORTH CAROLINA BOTANICAL GARDEN
THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

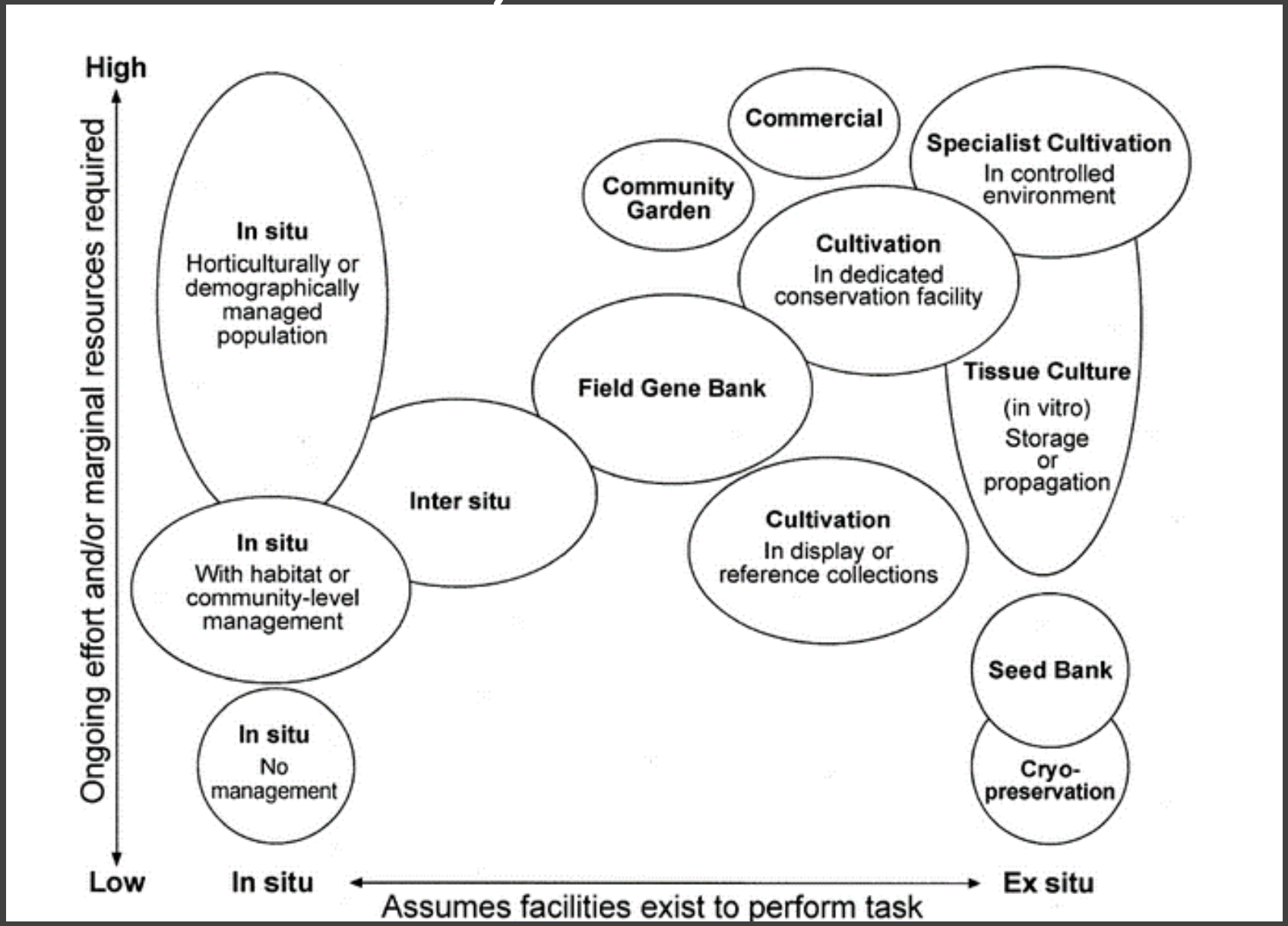
Ex situ Conservation

Protecting species outside of their natural habitat to areas equipped for their protection and preservation

Center for Plant Conservation

Everything you always wanted to know about plant conservation, but were afraid to ask.

The *ex situ/in situ* continuum



What is *ex situ* delivering?

- 1,800 botanic gardens hold 2.5 million accessions, representing over 18,000 taxa
- About 100 taxa exist only in botanic gardens
- Many *ex situ* collections vastly outnumber surviving wild populations
- In the US, over 80 rare taxa are being reintroduced (mostly through CPC)
- **Seeds of Success** (US DOI/BLM) partners providing seed of common plants for broad scale habitat restoration

Determining *ex situ* needs in plant conservation

- Are *ex situ* activities appropriate and needed?
- If so, what techniques?
  - Cultivation?
  - Seed banking as an "insurance policy"?
  - Alternative techniques for taxa that cannot be stored?
  - Reintroduction/translocation?

Clues that *ex situ* activities are needed

- Small populations (size and/or number decreasing)
- Increased fragmentation and/or isolation
- Variable environment or current stressors
- Imminent threats
- Highly degraded habitat
- Genetic or demographic problems
- High priority species not receiving “attention”

More clues – Plants aren't reproducing

- No seeds….
  - Lack of pollinators
  - Lack of compatible mates
- No seedlings…
  - Poor conditions for establishment
  - Fruit dispersal agent unknown or lacking
  - Severe inbreeding

Seed processing and storage at NCBG

MILLENNIUM SEED BANK PARTNERSHIP
Kew

Center for PLANT Conservation

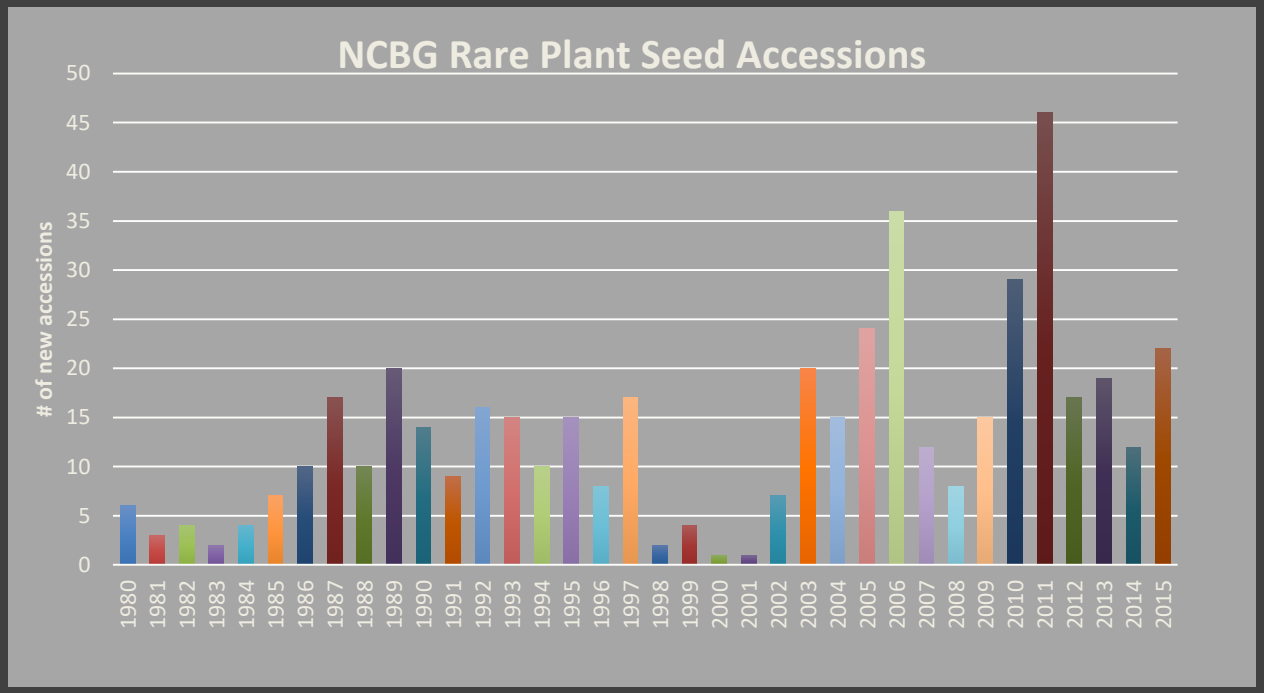
Conserving and restoring
America's native plants

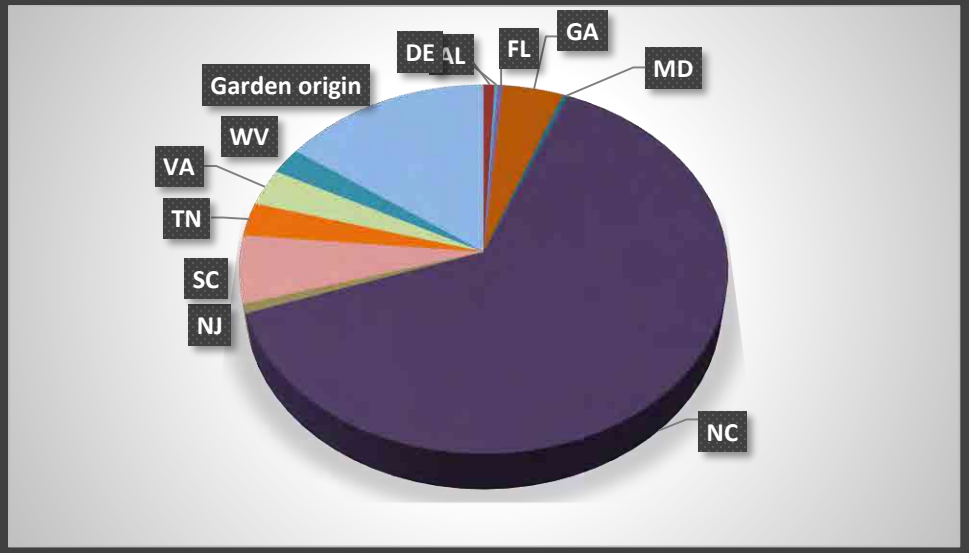
America's flora is at risk...

Today nearly 30 percent of the native flora in the United States is considered to be of conservation concern. Without human intervention, many of these plants may be gone within our lifetime. Eighty percent of the at-risk species are closely related to plants with economic value somewhere in the world, and more than 50 percent are related to crop species.

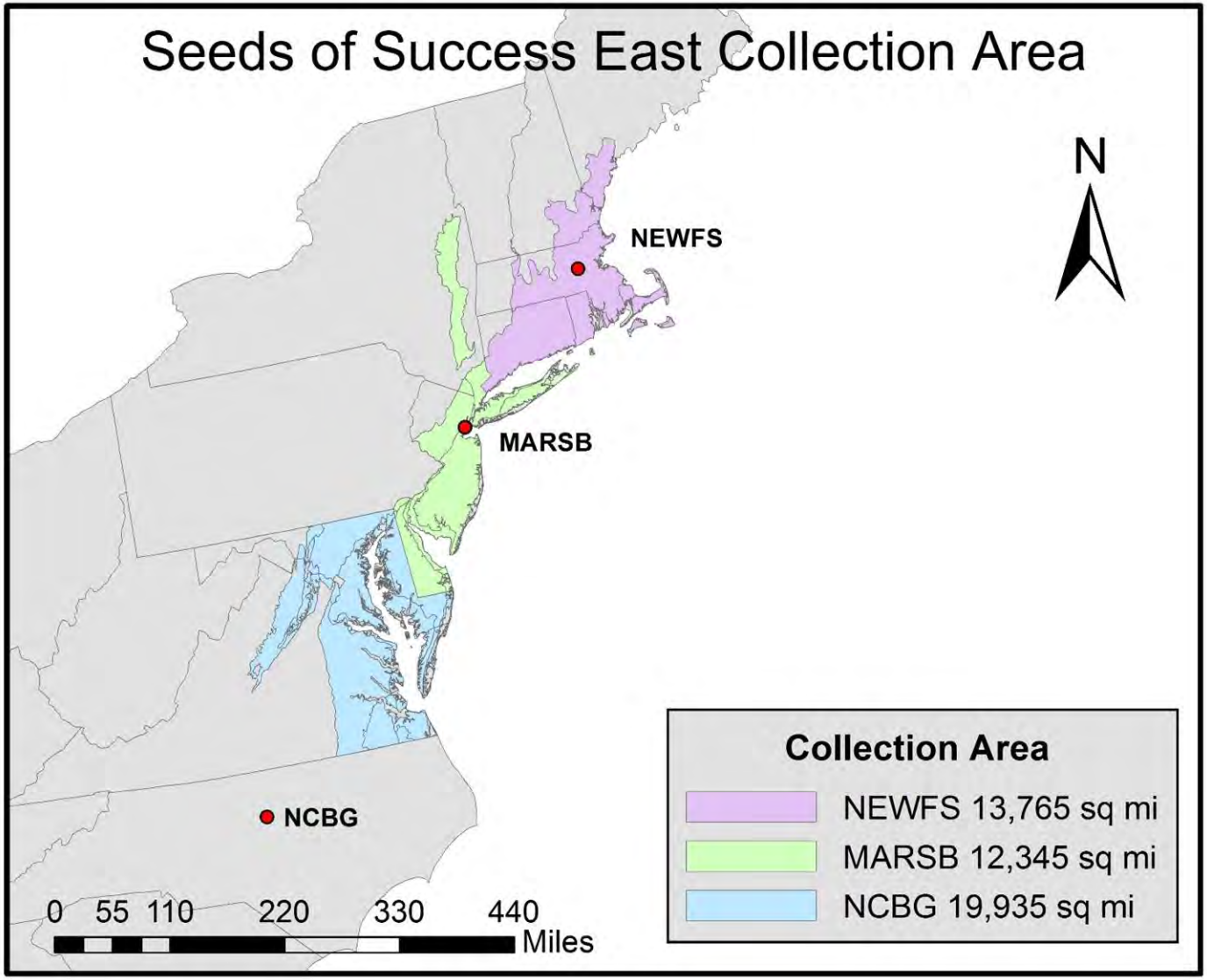
...but it can be saved.

CPC Collections at NCBG





Conservation and Land Management Interns through Seeds of Success


Seeds of Success East Collection Area
N
NEWFS
MARSB
NCBG
0 55 110 220 330 440
Miles
Collection Area
NEWFS 13,765 sq mi
MARSB 12,345 sq mi
NCBG 19,935 sq mi

YOUR WORK MATTERS

Please Tell Us About Your Native Plant and Seed Needs

The Seeds of Success East partnership is pleased to announce that our online survey of Native Plant and Seed Use in the Eastern United States is now open! Responses to this survey will help support the development of a native plant materials program based on the real-world needs of land managers, restoration ecologists, and other conservation/horticultural professionals.

This survey supports Goal 1 of the National Seed Strategy for Rehabilitation and Restoration, which aims to "Identify seed needs, and ensure the reliable availability of genetically appropriate seed."

By sharing information about your native plant and seed needs, you are helping us build a successful framework that puts ***the right seed in the right place at the right time.***

mailchi.mp/27318aceb876/your-work-matters-please-participate-in-a-survey-of-native-plant-use-1922269?e=72b9813eeb

Seeds of Success East is a 5-institution partnership that collects critically needed seed and works to further long-term seed conservation efforts in the Eastern U.S.

SOS East Partners

Mid-Atlantic Regional Seed Bank
New England Wildflower Society
North Carolina Botanical Garden
Chicago Botanic Garden
USDA/NRCS Cape May Plant Materials Center

Range-wide *ex situ* seed conservation and population genetic architecture analysis in Venus' flytrap

North Carolina Botanical Garden and
Carolina Center for Genome Sciences

Funded by the International Carnivorous Plant Society

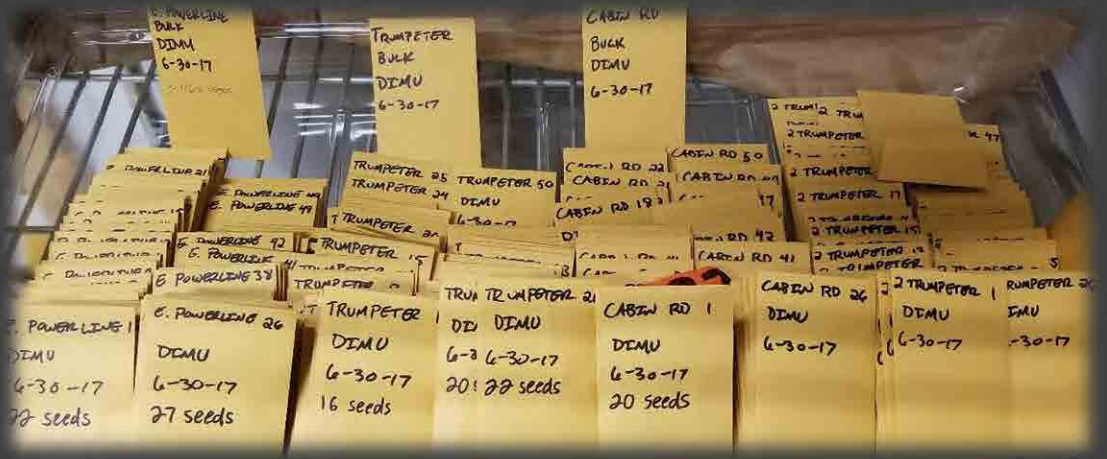
Specific Aims:

- Sample 150 VFT populations across the entire existing range for both tissue and seeds and create a long-term seed bank as a conservation resource.
- Evaluate standing genetic variation in 30 select populations using restriction site associated DNA sequencing (*Next Generation* RAD-seq).

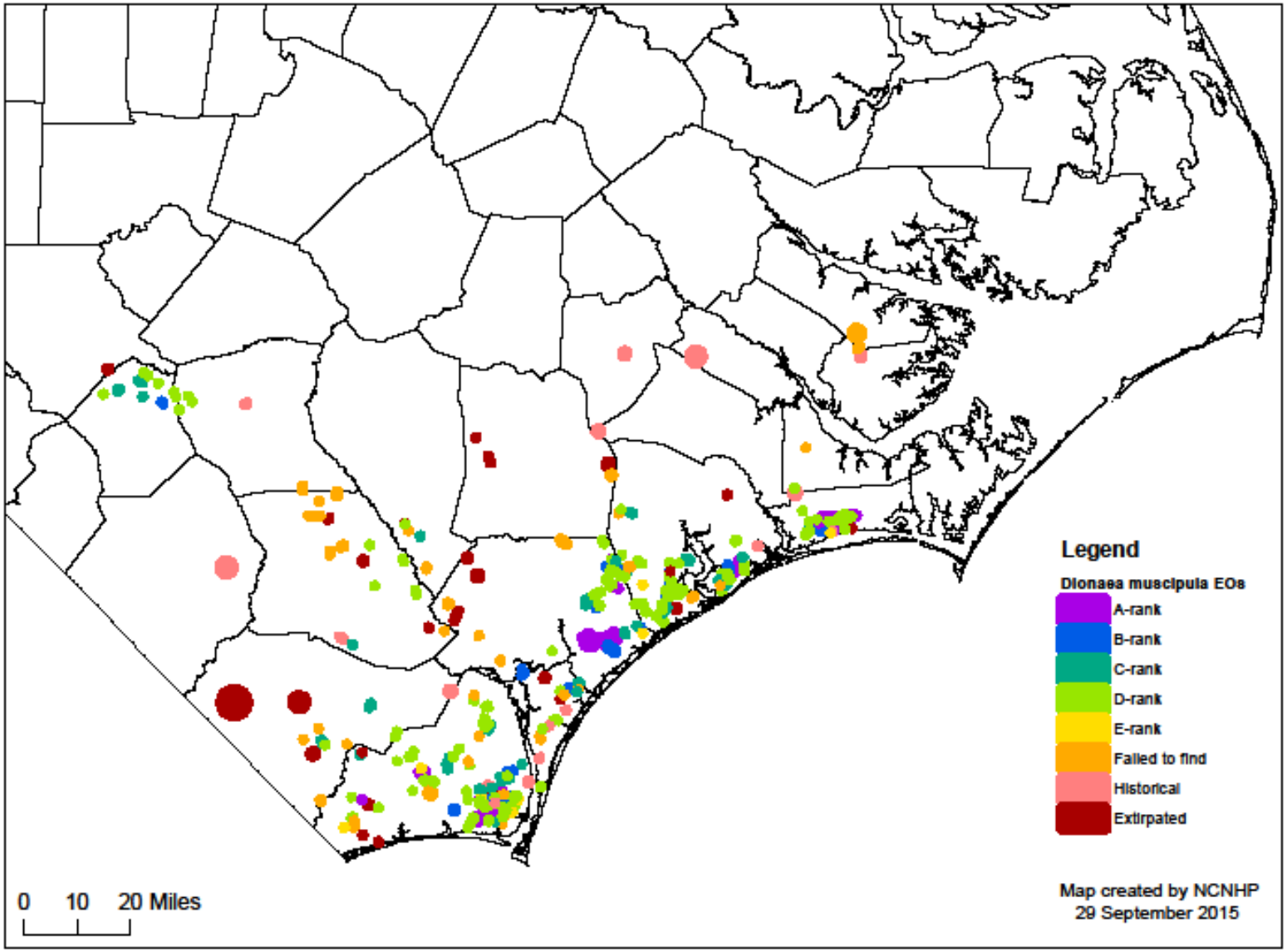
Current status of VFT in NC

- Since 1958 (1st range-wide inventory) ½ of known populations are now extirpated
- 31 EOs (across 14 counties) are considered extirpated
- From 1992 to 2002 overall population number declined 17% & subpopulation number declined 23%
- 40% of extant populations contain 10-100 individuals and these rank as “D”
- Poaching now a felony in Pender, New Hanover, Brunswick, and Onslow counties
- A candidate for state-listing through NC Plant Conservation Program

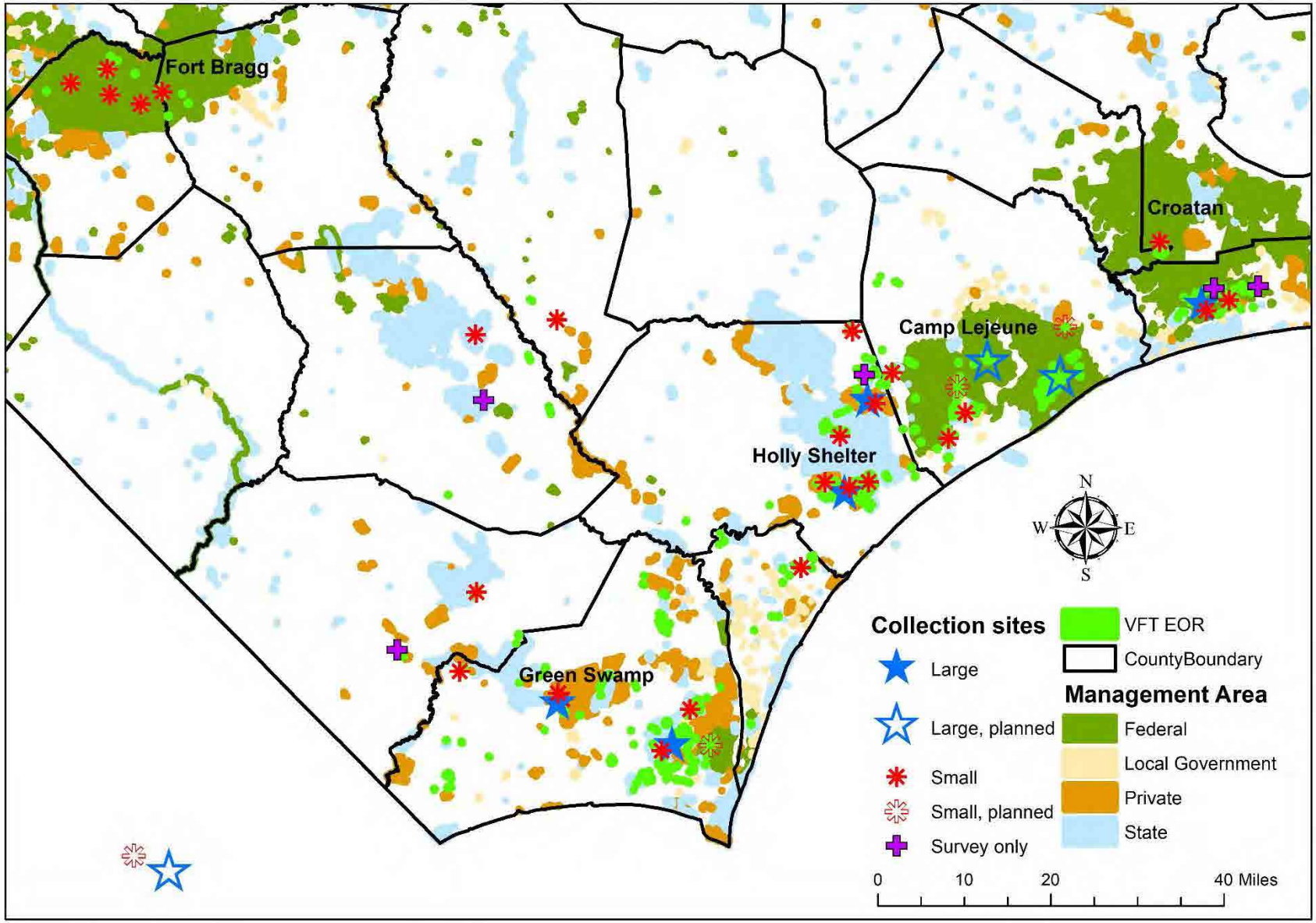

BSL SITE 2
BULK

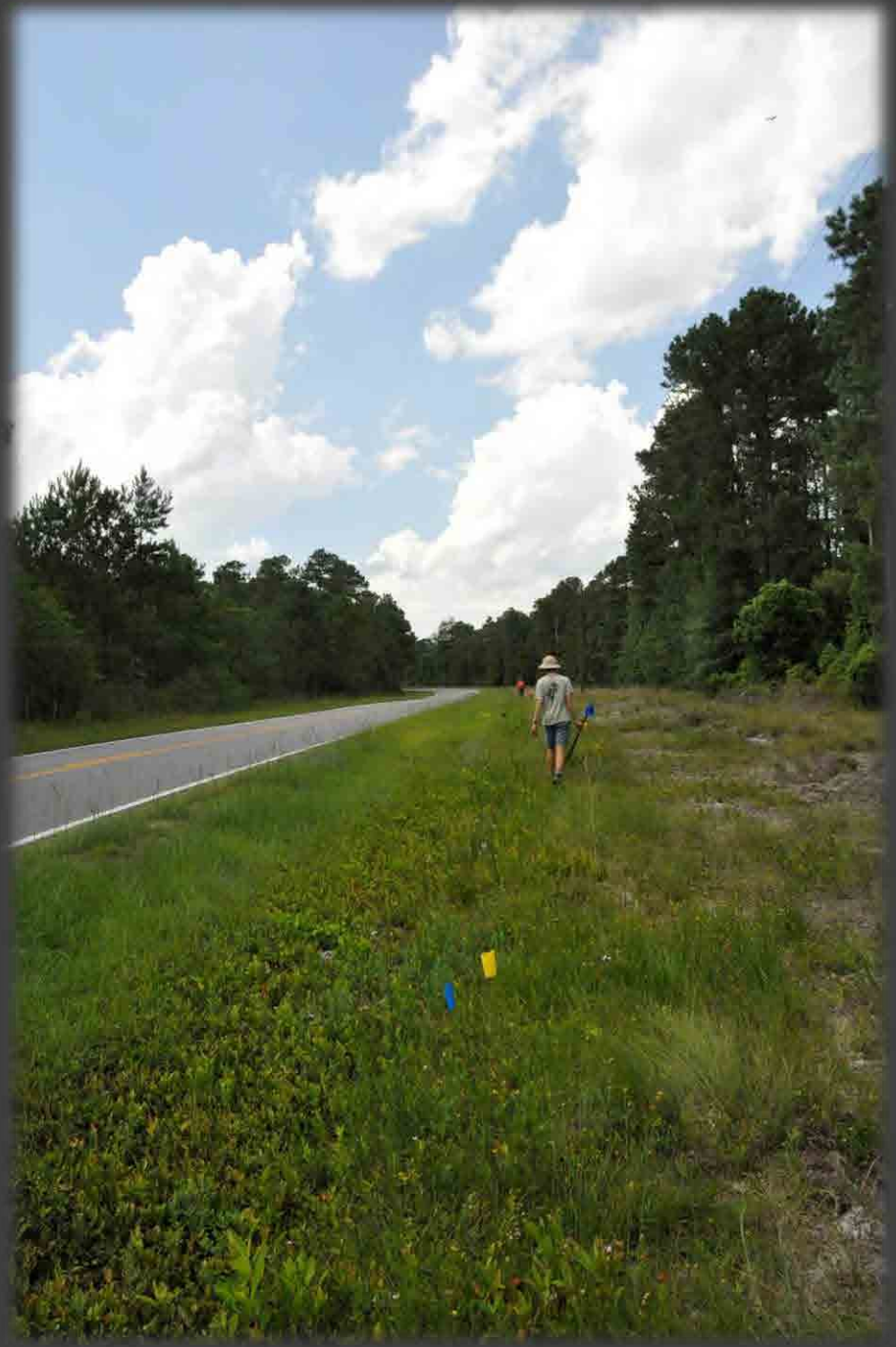

BULK
DIMU
6-30-17
TRUMPETER
BULK
DIMU
6-30-17
CABIN RD
BULK
DIMU
6-30-17
E. POWERLINE 26
DIMU
6-30-17
27 seeds
TRUMPETER
DIMU
6-30-17
16 seeds
CABIN RD 1
DIMU
6-30-17
20 seeds
CABIN RD 26
DIMU
6-30-17

Dionaea muscipula
Element Occurrences in North Carolina



Venus Flytrap Tissue and Seed Collection Sites





Coastal Plain Backroad
Asphalt Seep (Wet Subtype)


Reintroducting *Ptilimnium nodosum*
to the Deep River, NC
Funded by National Fish
and Wildlife Foundation and the
Center for Plant Conservation

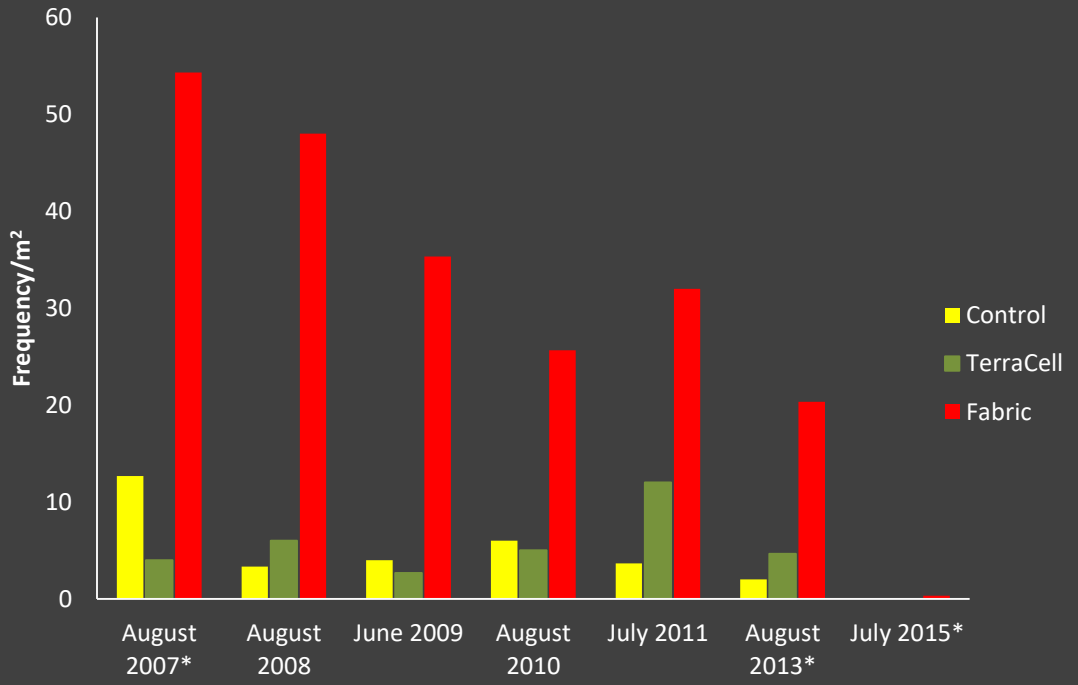
Reintroduction of *Ptilimnium nodosum* with students, interns, and volunteers

Monitoring

Project summary

- Researched mating system
- Reintroduced 700 *P. nodosum* using experimental treatments to test best practices for use in dynamic riverine systems
- Now surveys are needed downstream to look for successful colonization!

Average Frequency of P. nodosum per Treatment



Frequency measured by presence/absence in 10 cm^2 cell. * Frequency estimated by individual accounts, assuming 1 individual/10cm^2.

Translocating *Lysimachia asperulifolia* and rhizome dynamics

Funding provided by NCDOT and ESTCP

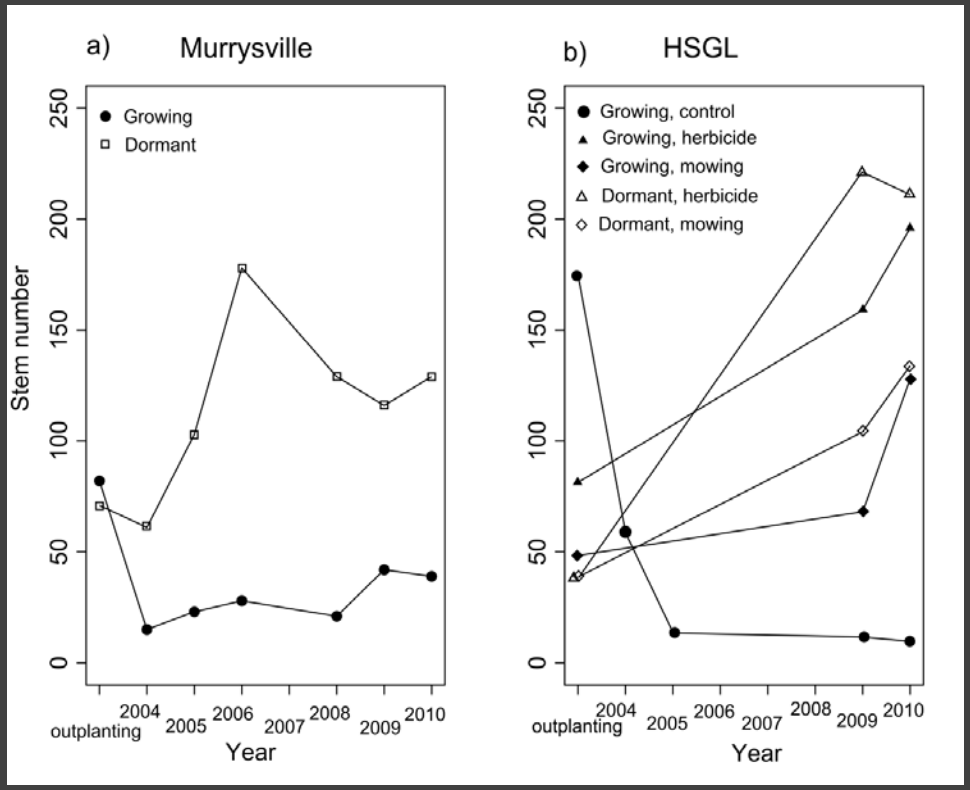
Lysimachia asperulifolia (Rough leaf loostrife)

From Kunz et al 2014

- NC/SC coastal plain endemic
- Self incompatible, rhizomatous herb
- Pseudo-annual life history
- Limited flowering and fruiting, very limited within population pollination, varying levels of sterility and S allele diversity and low seed germination
  - (Franklin *et al*,2006)

What is the cause of population growth?

From Kunz et al 2014



- Reintroduced populations show growth and >10 survivorship
- Since flowering/fruiting rates low and there is no sign of sexual recruitment how/why are some populations growing?
  - Multiple stems per rhizome?
  - Natural rhizome division?

Demonstration of reintroduction protocols for use in species recovery, conservation and mitigation on Fort Bragg

Sandhills lily
Lilium pyrophilum
(Skinner and Sorrie)

Rough-leaved loosestrife
Lysimachia asperulifolia (Poiret)

Sandhills milkvetch
Astragalus michauxii
(Kuntze)

Georgia leadplant
Amorpha georgiana
(Wilbur)

ESTCP

Environmental Security Technology Certification Program

Matthew Hohmann – US Army ERDC-CERL
Wade Wall – US Army ERDC-CERL

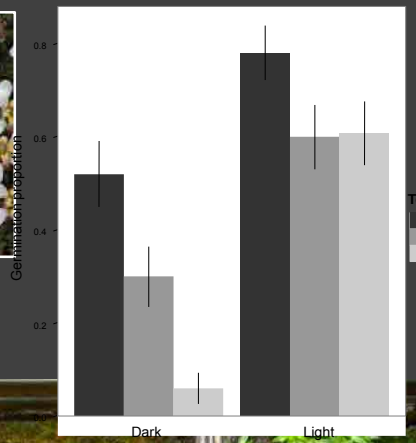
Michael Kunz – NC Botanical Garden
Johnny Randall – UNC-Chapel-Hill

Dale Suiter – US FWS, Ecological Services, Raleigh Field Office

Janet Gray – US Army Fort Bragg

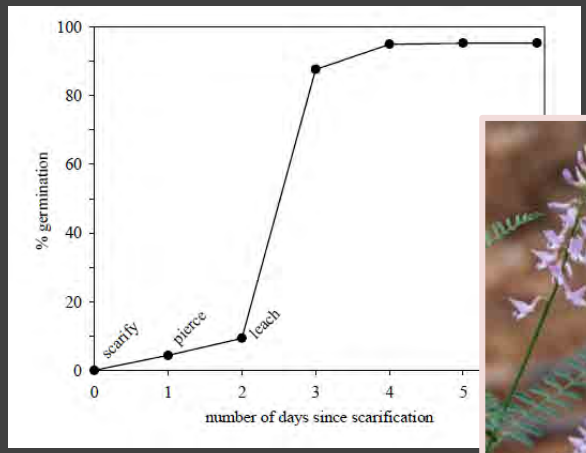
Establishing Propagation Protocols

Marchin et al (2009) & USDA Woody Plant Seed Manual



Wall et al (2010)

Kunz and Randall (unpub.data)



Weeks (2005)

Kunz, Franklin, and Randall (2013)






Planting and labeling thousands of seedlings…


Project Review

Established reintroduction protocol manual for 4 target species

Propagules

Germination

Production

Site Selection

Out-planting

Maintenance

Monitoring

Successful establishment and continued monitoring for success

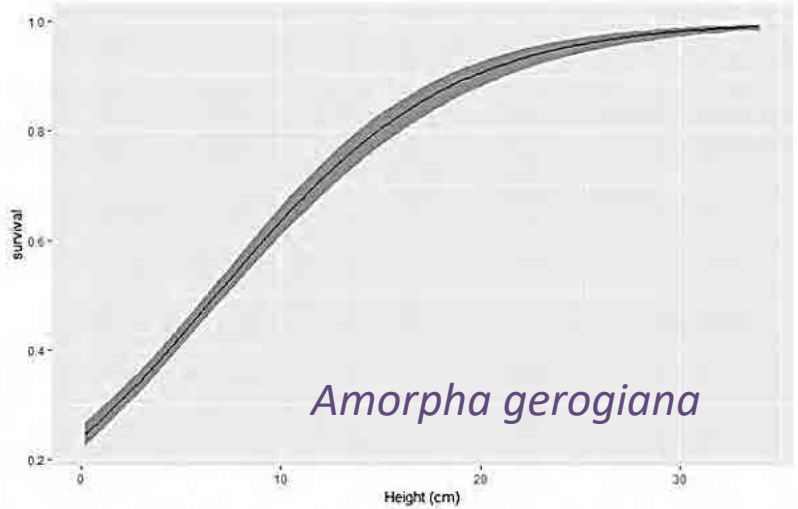


Figure 19: Survival as a function of outplant height (cm). Line represents best fit and dark gray represents 95% confidence intervals for *Amorpha georgiana*. $B_0 = -1.1541$, $B_1 = 0.1707$

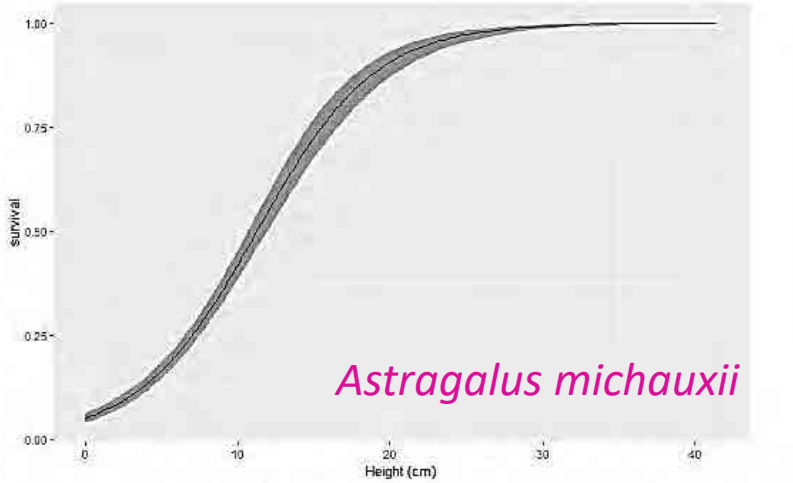


Figure 25: Survival as a function of outplant height (cm). Line represents best fit and dark gray represents 95% confidence intervals for *Astragalus michauxii*. $B_0 = -2.923$, $B_1 = 0.259$

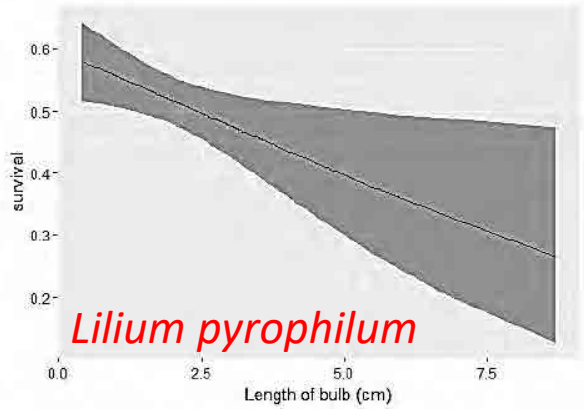


Figure 31: Survival as a function of outplant height (cm). Line represents best fit and dark gray represents 95% confidence intervals for *Lilium pyrophilum*. $B_0 = 0.389$, $B_1 = -0.162$

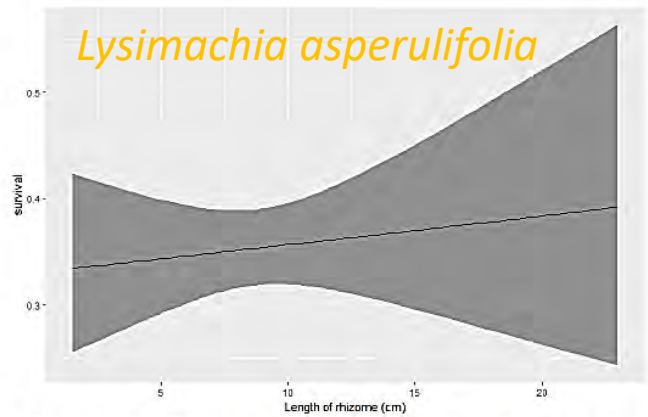
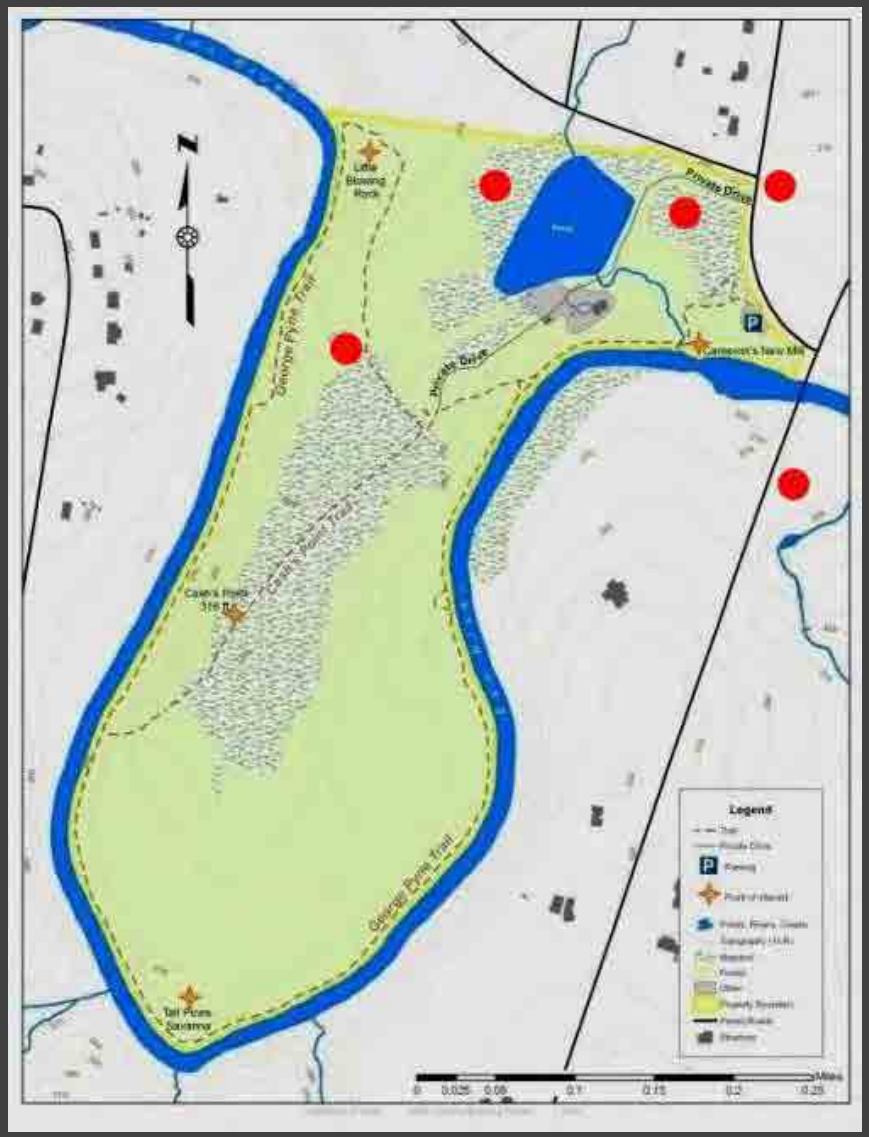


Figure 37: First year survival of *Lysimachia asperulifolia* outplants as a function of rhizome length (cm) at outplanting. Line represents best fit and dark gray represents 95% confidence intervals.

Figures by Wade Wall

Echinacea laevigata

Smooth coneflower



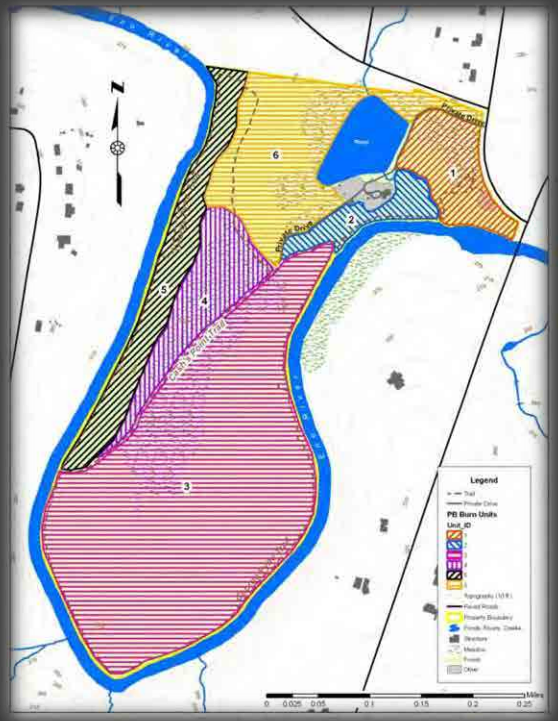
Funded by **National Fish and Wildlife Foundation** and CPC

Echinacea laevigata – seedling processing and planting

Tracking progress

- Whole plants are more successful than seeds
- Recruitment by seedling and clonal growth
- Adults transition from reproductive to not, and back among years


PENNY'S BEND
NATURE PRESERVE


Legend
Trail
Private Drive
PB Burn Units
Unit_ID
Property Boundary
Roads
Structure
Meadow
Forest
Other
Miles

Restoration of seabeach amaranth

- Seed collection and increase
- Long term storage
- Restoration on 6 US Fish and Wildlife Refuges throughout the species' range


PENNY'S BEND
NATURE PRESERV
25 Years of NCBG Volunteer Service