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INVASIVE SPECIES SUMMIT: CHALLENGES, STRATEGIES, AND PERSPECTIVES

FRI, NOV 6, 2015

Afternoon Session A:
Conserving Biodiversity

Co-presented with Lower Hudson Partnership for Regional Invasive Species Management

LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN

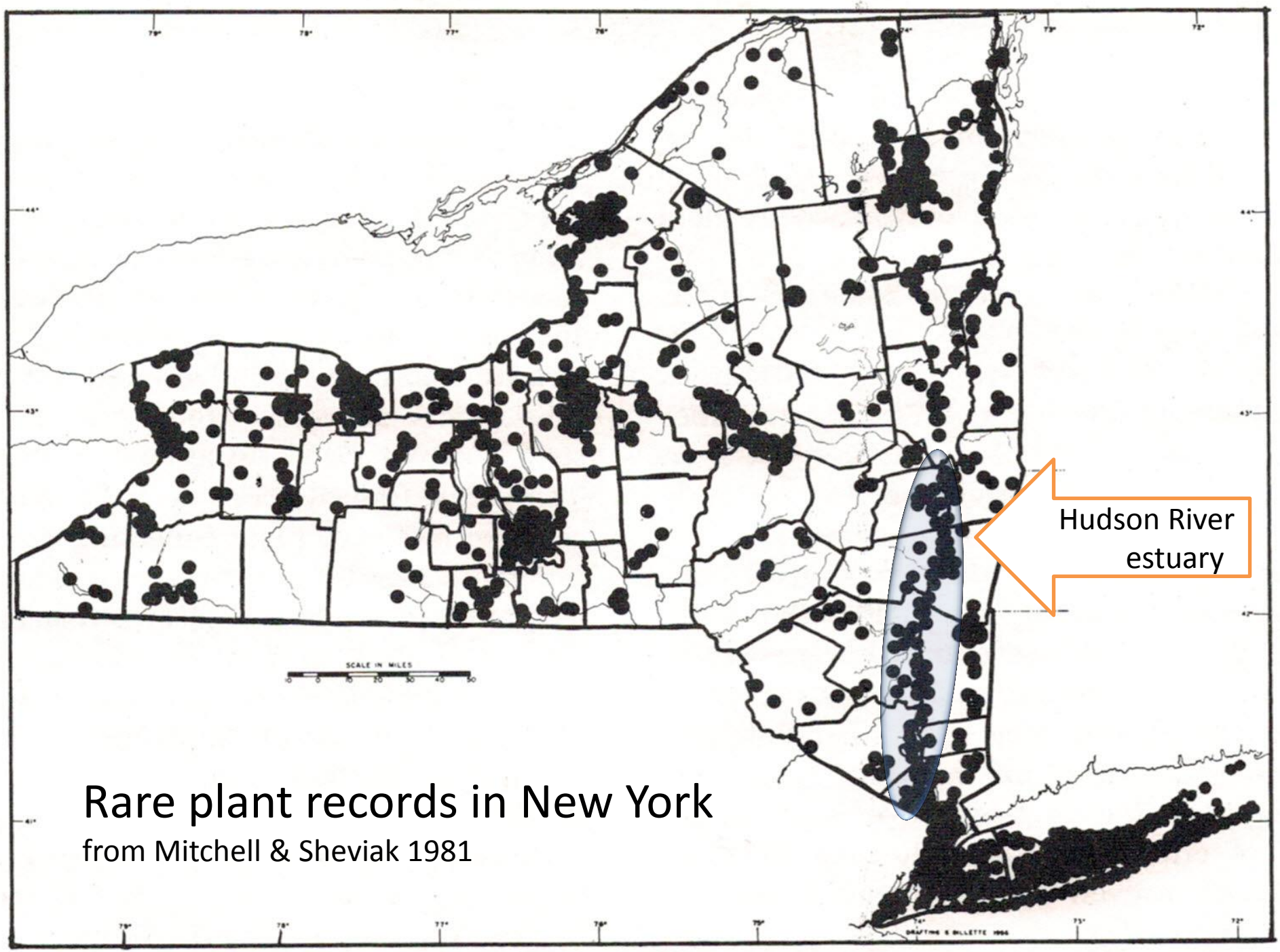
Invasive Species Threats to Rare Plants in the Hudson River Tidal Wetlands

Work in progress!

Erik Kiviat

HUDSONIA

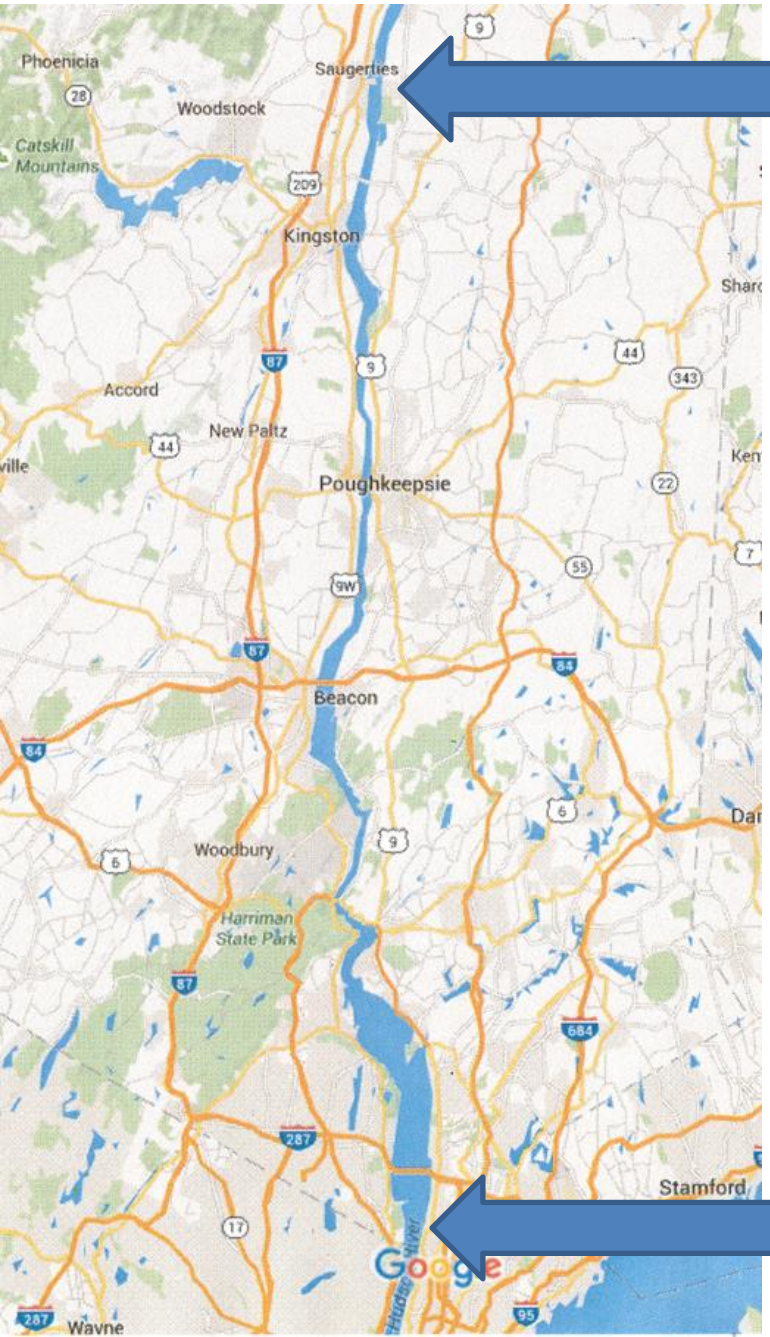
Environmental Research and Education
Science for Conservation



Rare plant records in New York

from Mitchell & Sheviak 1981

Study Area



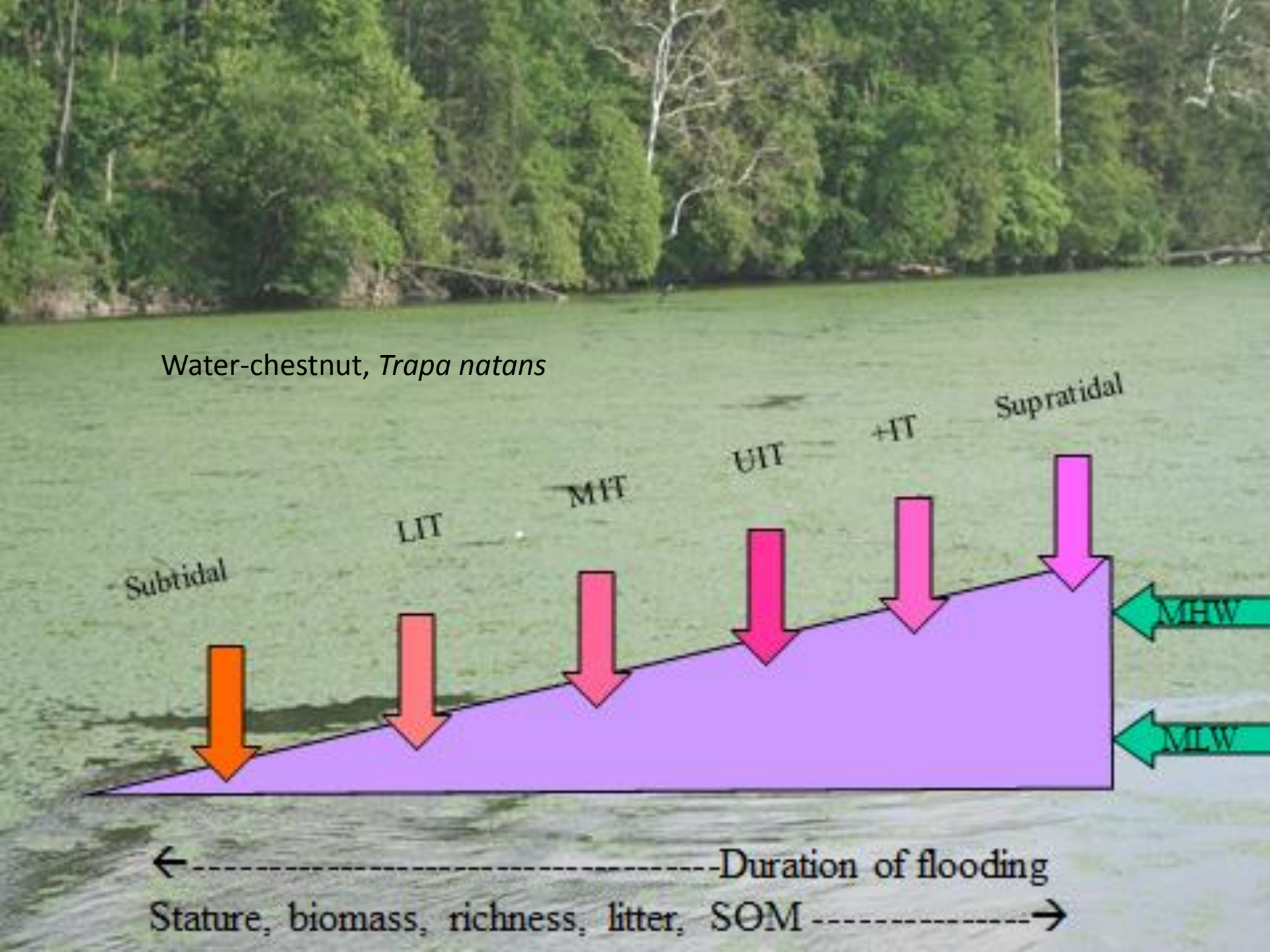
Saugerties Marshes
Tivoli Bays

Kingston Marshes

Vanderburg Cove

	Approx. max. salinity
Fishkill Creek	
Constitution Marsh	ca. 2 ppt
Con Hook	
Manitou Marsh	
Iona Island	ca. 7 ppt
Haverstraw Marshes	
Croton Marshes	
Piermont Marsh	ca. 14 ppt

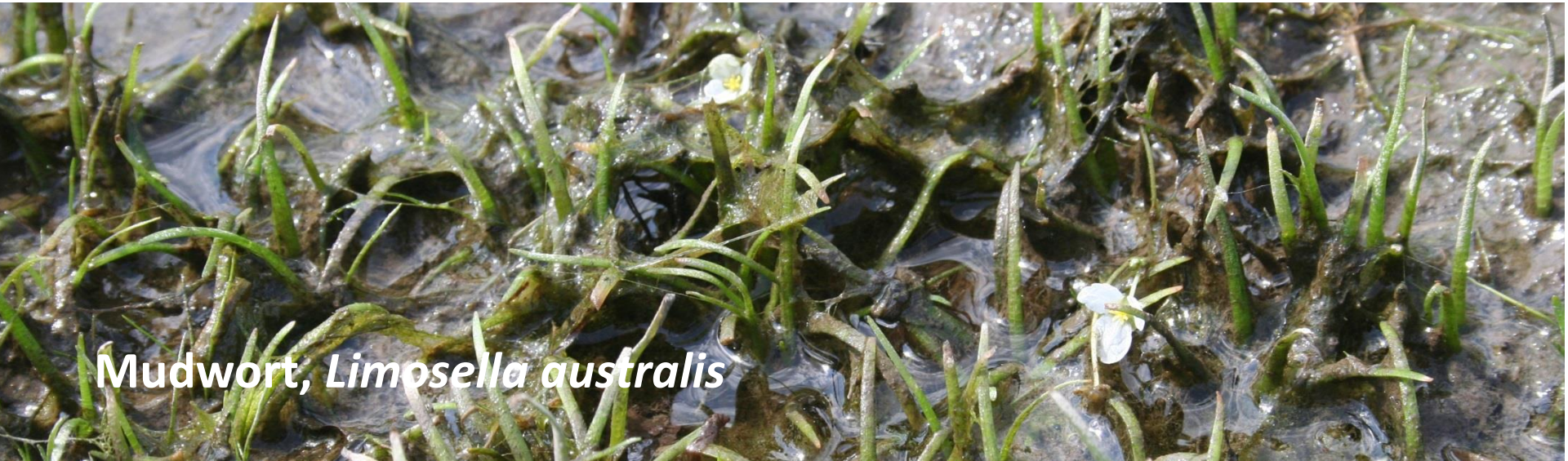
Water-chestnut, *Trapa natans*



Which species?

Rare native plants, mostly S1 and S2,
plus one regionally rare species;
47 rare species stands (> 1 individual) sampled

"Invasive" plants (weeds), nonnative taxa
(plus cattail and sweetflag)
within 10 m of a rare species stand



Fifteen rare species sampled (no. of stands)

Bidens laevis, smooth bur-marigold 2

Bidens bidentoides, estuary beggarticks 2

Bolboschoenus novae-angliae, New England bulrush 6?

Cardamine longii, Long's bittercress 1

Cyperus flavescens, yellow flatsedge 1

Heteranthera reniformis, kidney-leaved mud-plantain 3

Lilaeopsis chinensis, lilaeopsis 2

Limosella australis, mudwort 4

Najas guadalupensis muenscheri, Muenscher's naiad 1

Orontium aquaticum, goldenclub 3

Plantago cordata, heart-leaved plantain 3

Sagittaria montevidensis spongiosa, spongy arrowhead 9

Sagittaria subulata, awl-leaved arrowhead 5

Spartina cynosuroides, tall cordgrass 2 *(regionally rare)*

Symphyotrichum subulatum, saltmarsh aster 3

Data Collection

For rare species and each weed within 10 m:

-Intertidal level
-Stand extent (truncated at maximum of 100 m2)
-Maximum shoot length
-Stand density
-Flowering or fruiting

-Distance between rare species and weed

-”Competitiveness” Index
(sum ranked vigor metrics)
- Weed species richness within 10 m of rare species

Yellow flatsedge
Cyperus flavescens

Saltmarsh aster
Symphyotrichum subulatum

Thirty-four weeds sampled

-7 graminoids

-12 forbs

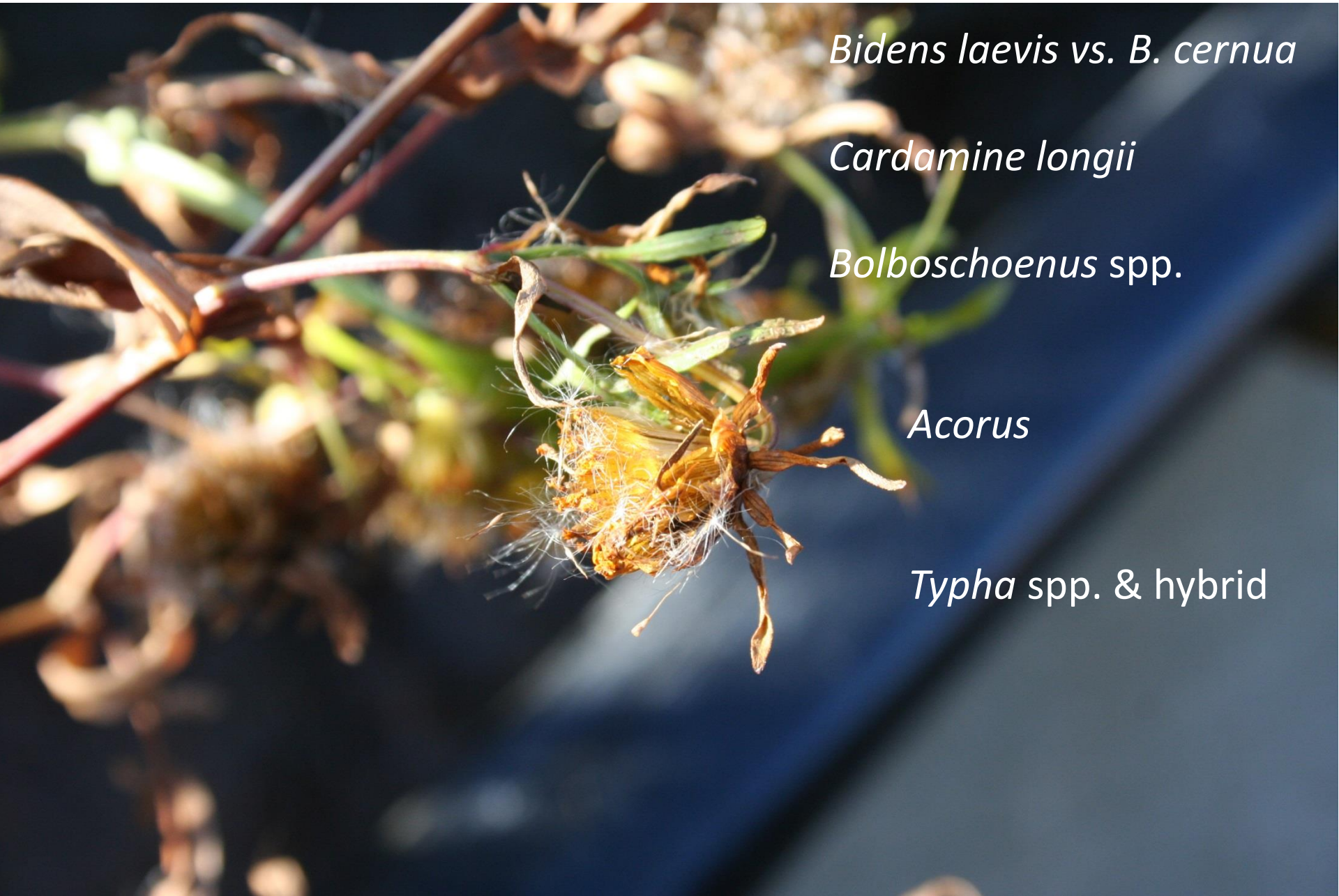
-6 vines

-5 shrubs

-2 trees

-2 aquatics

Taxonomic Problems

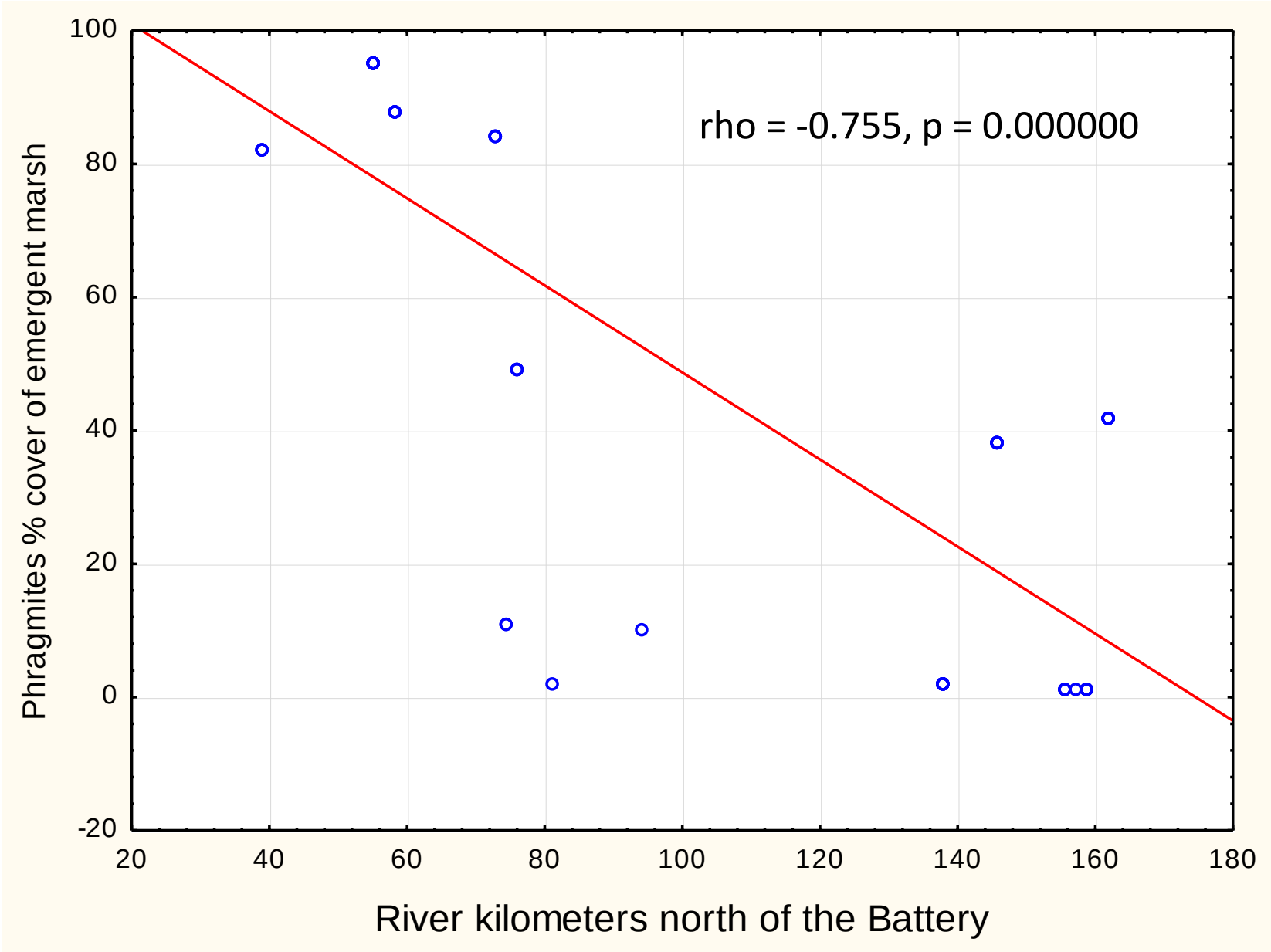


Kidney-leaved mud plantain
Heteranthera reniformis

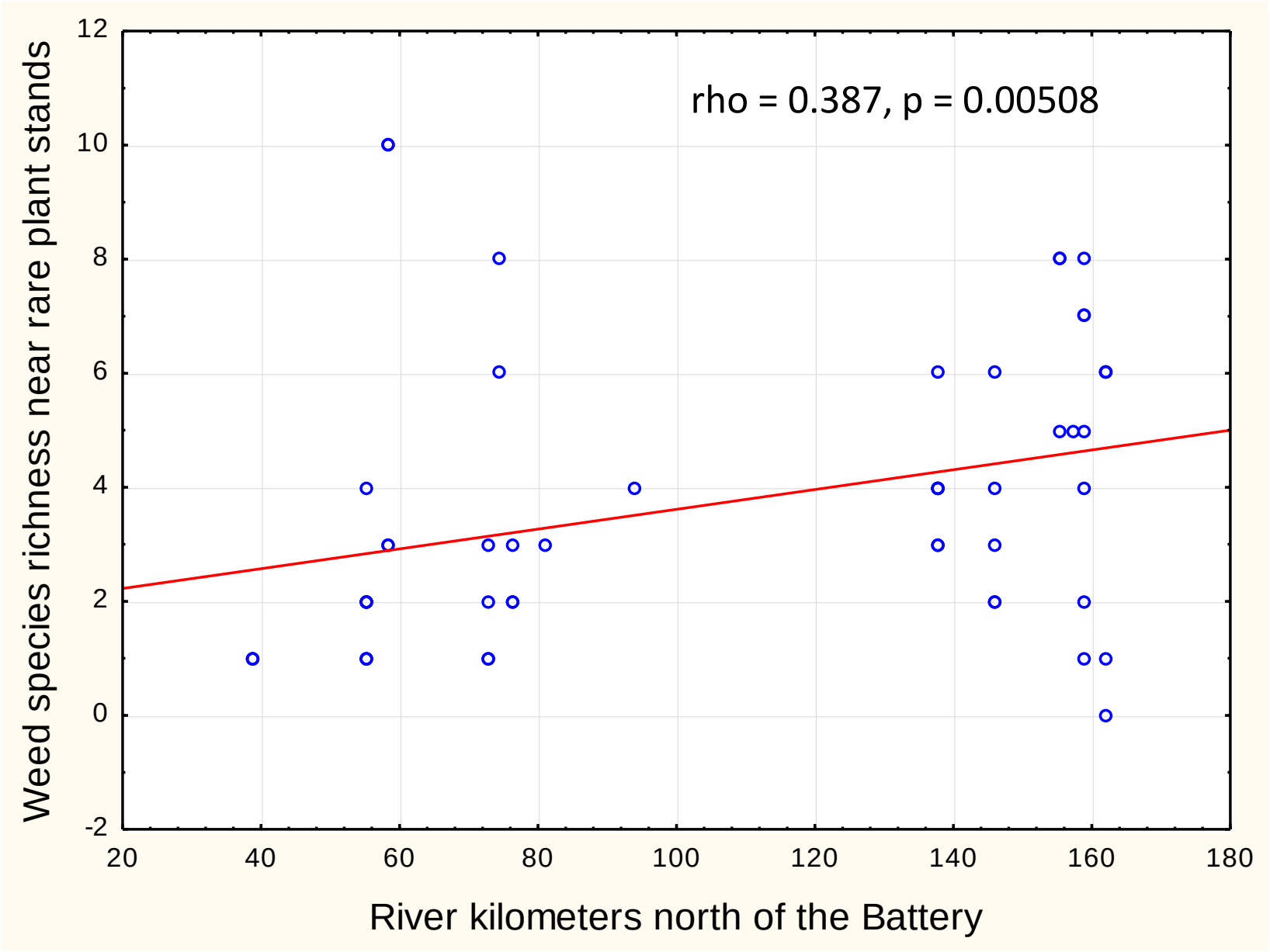
Spongy arrowhead, *Sagittaria montevidensis spongiosa*
Awl-leaved arrowhead, *Sagittaria subulata*


Long’s bittercress, *Cardamine longii*

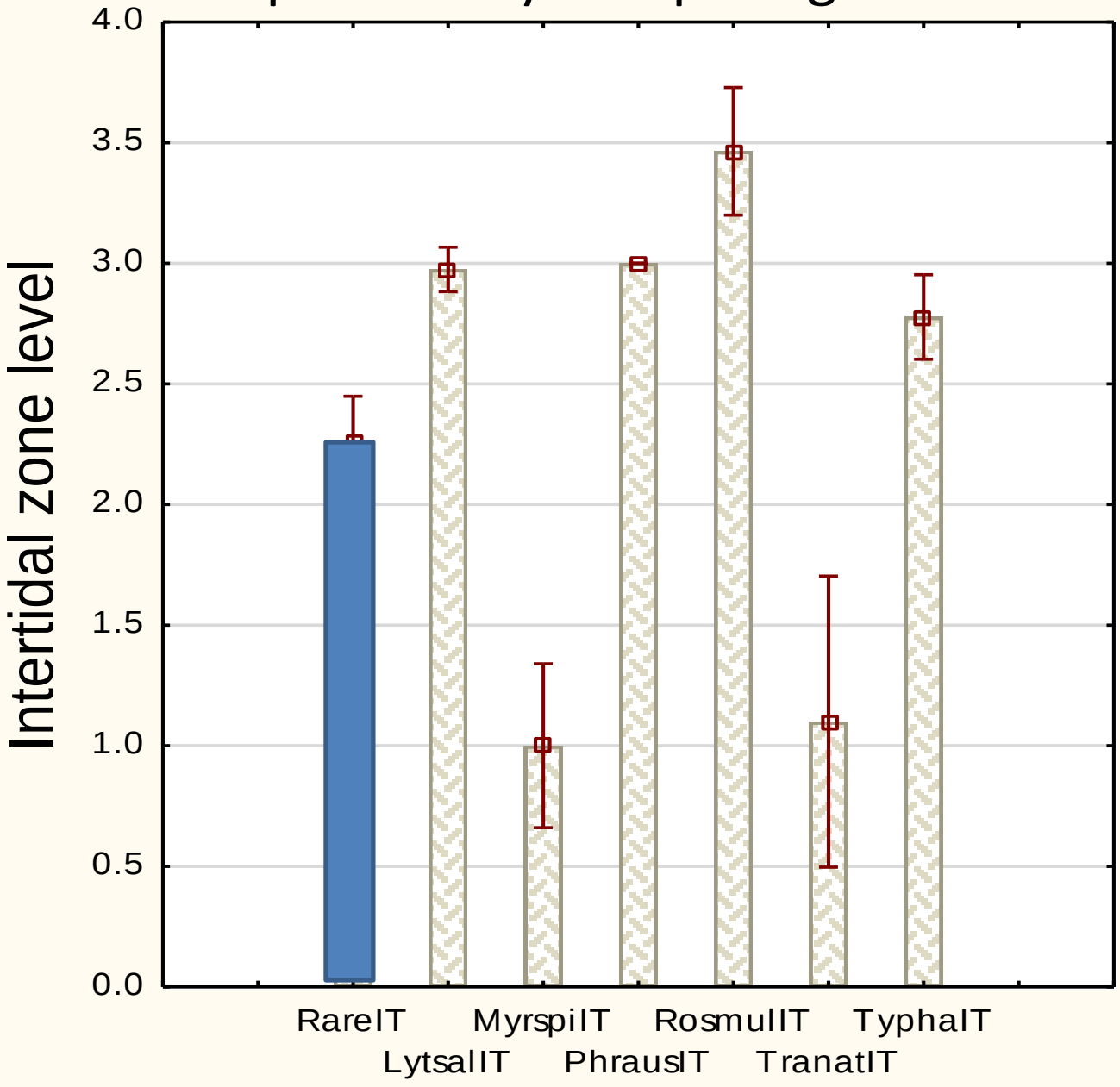
Phragmites covers larger areas of the more southern marshes



Weed species richness is greater in the more northern marshes



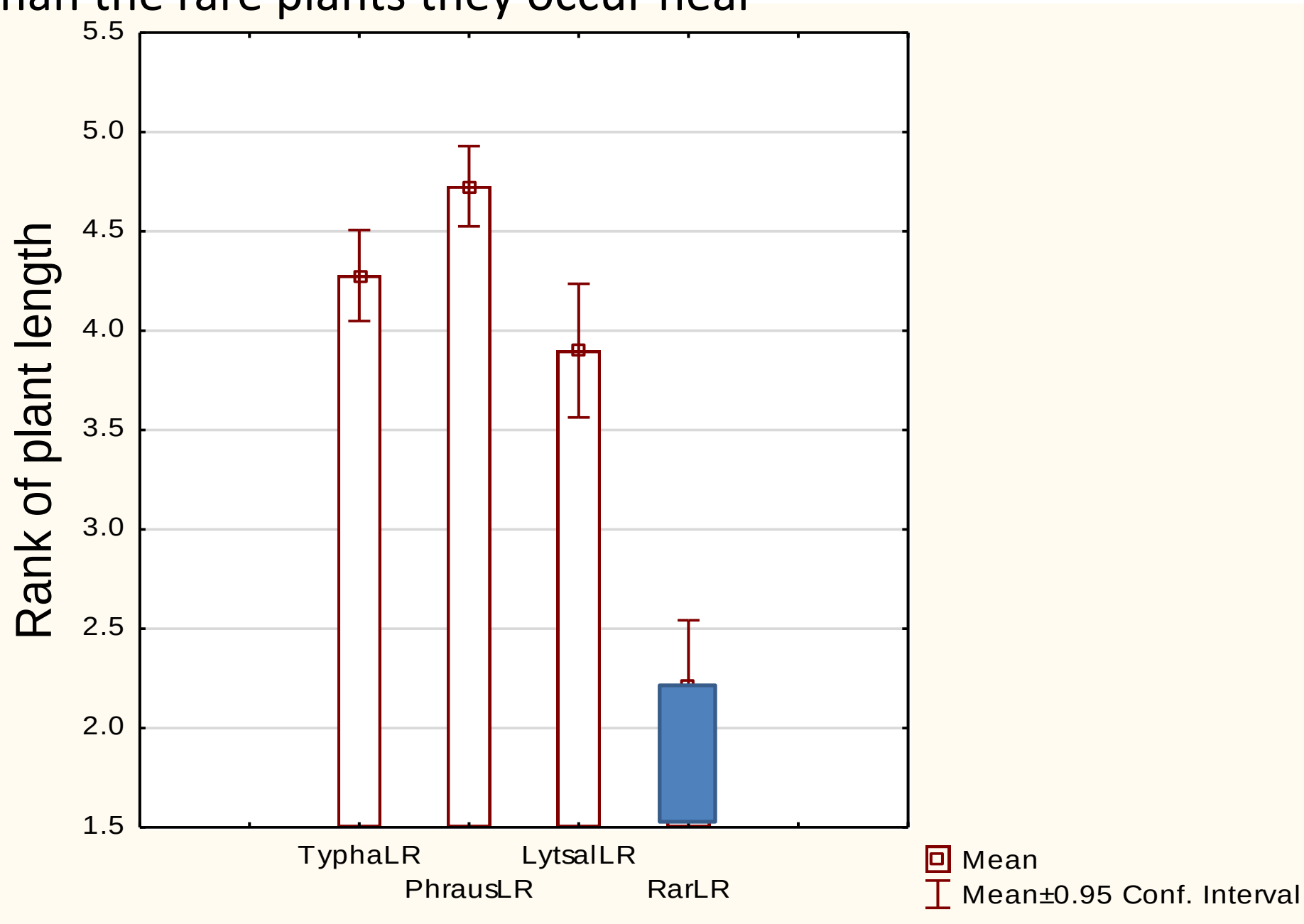
Many occurrences of rare plants are separated vertically from potentially competing weeds



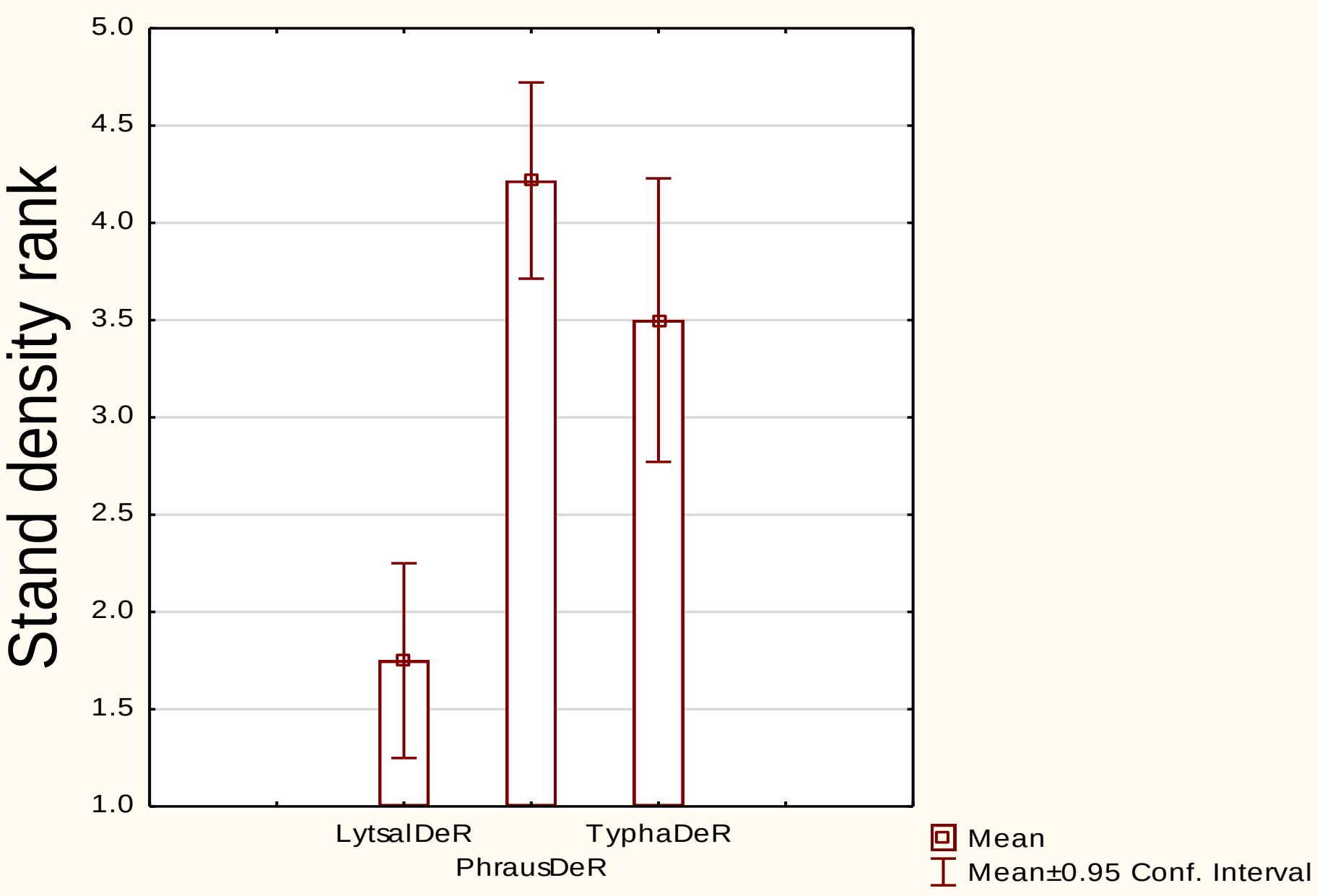
Of 50 rare plants stands, weeds within 10 m:

-*Phragmites*, 23 stands
-P. loosestrife, 20 stands
-Cattail, 18 stands

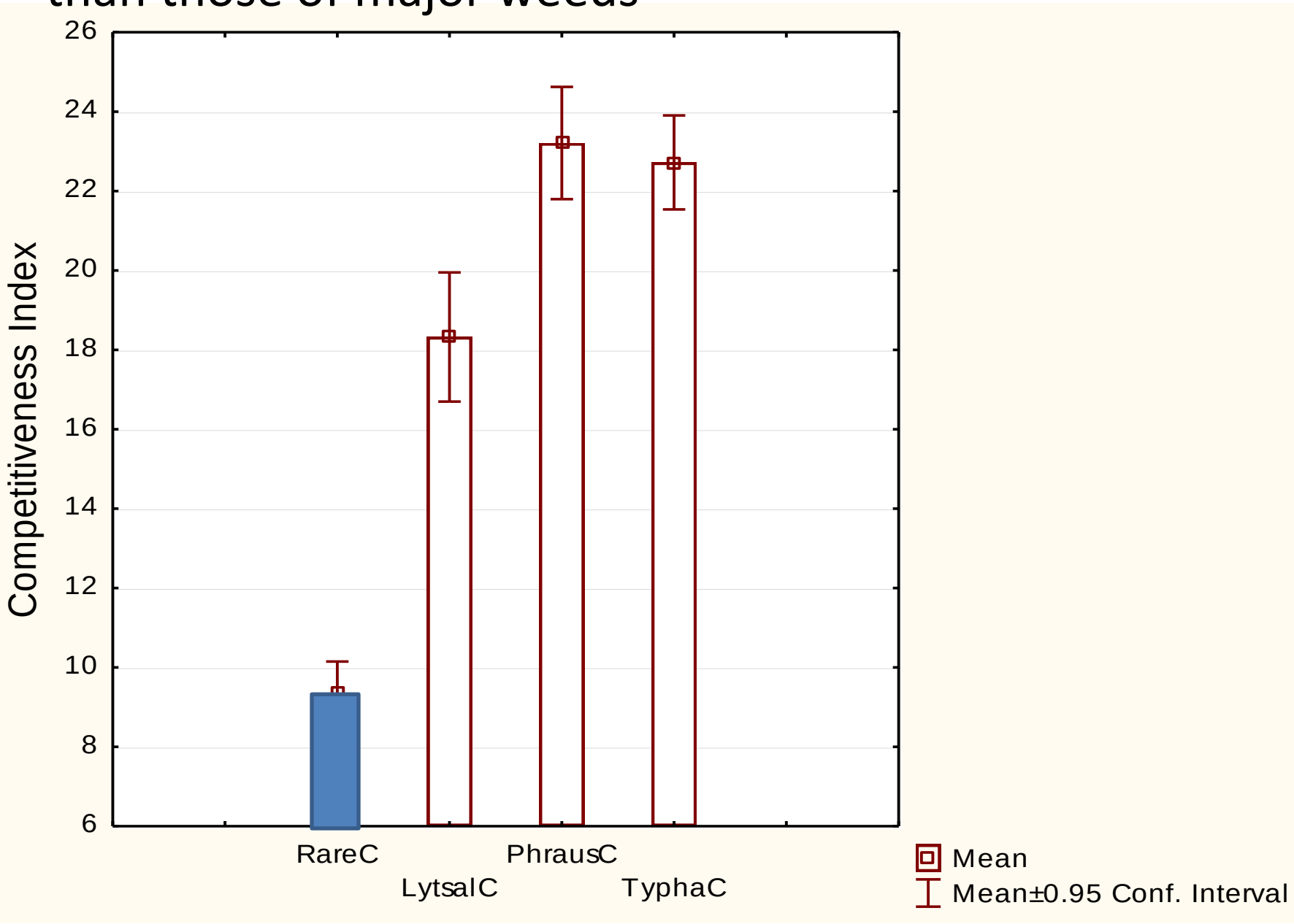
Three common competitive weeds are longer than the rare plants they occur near



Purple loosestrife stands are less dense than *Phragmites* or cattail stands



Competitiveness indices of rare species are lower than those of major weeds



Conclusions?

-A one-season study allows generation of hypotheses;
stronger evidence from longitudinal studies is needed

-Rare species of lower (and middle?) intertidal zone are
less threatened by weeds than rare species of upper intertidal zone

-Phragmites and cattail may be the weeds of greatest concern

-Close proximity of rare species and weeds requires
precise techniques to manage weeds without
lethal or sublethal effects on rare species

-We hope to identify rare species stands with best potential
for management

Chris Graham, Gretchen Stevens

key colleagues

Heart-leaved plantain, *Plantago cordata*

Acknowledgments

Rare plant locality data:
- Robert Naczi & David Werier
- New York Natural Heritage Program

Field and lab collaboration:
-Chris Graham
-Gretchen Stevens

Volunteers:
-Gowri Varanashi, David Decker, Annie Jacobs

Bard College Field Station

Funding:
-Lower Hudson PRISM and NYSDEC

Purple loosestrife and heart-leaved plantain

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How Do Predator-Promoting Invasive Plants Affect Native Communities?

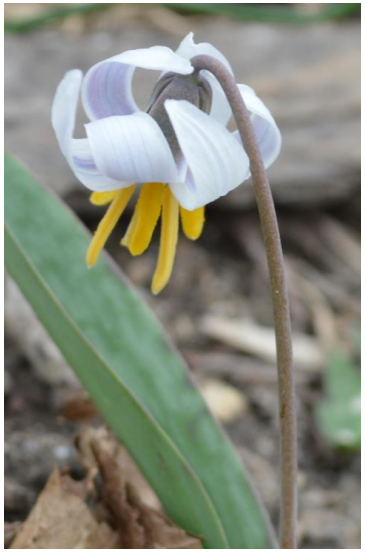
Lauren M. Smith, PhD
Yale University

Eastern deciduous forests are diverse…







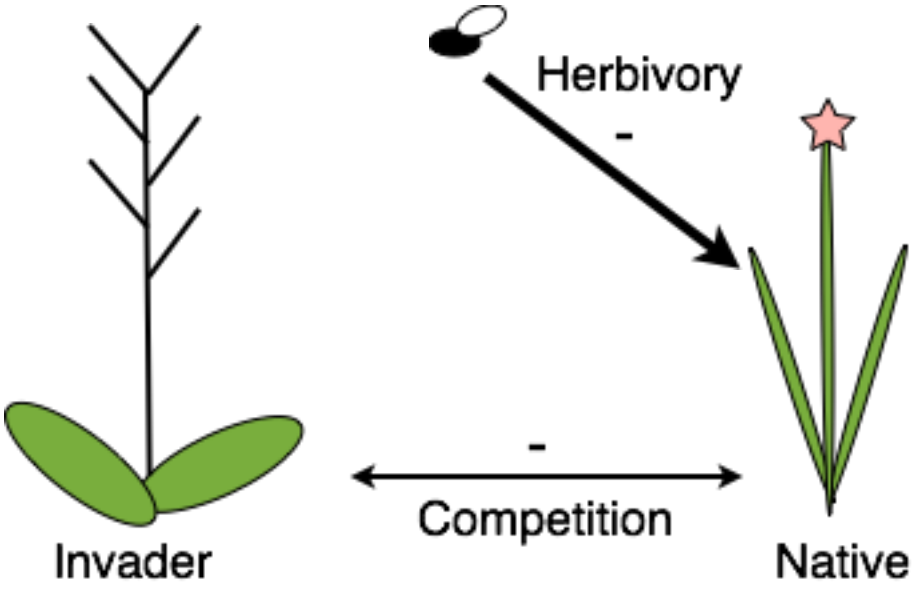
Photos by Lauren Smith and Gerald N. Smith

But species invasions threaten diversity

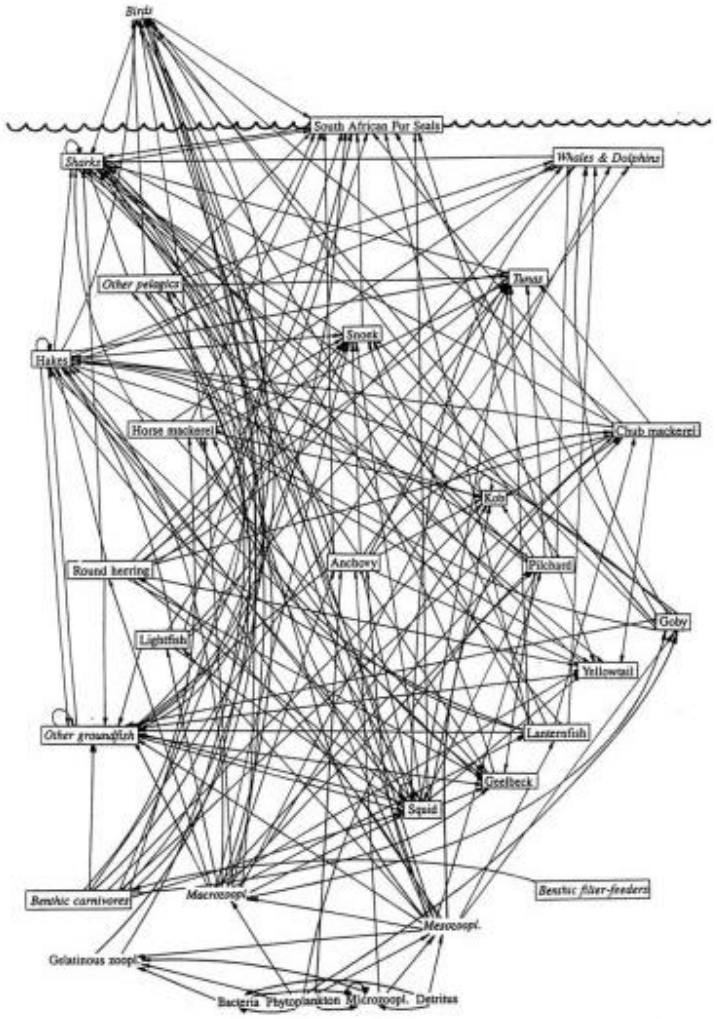
Photos by Lauren Smith and Gerald N. Smith

But which invaders reduce diversity? (The Passengers vs. Drivers Debate)

We usually focus on one or two trophic levels…

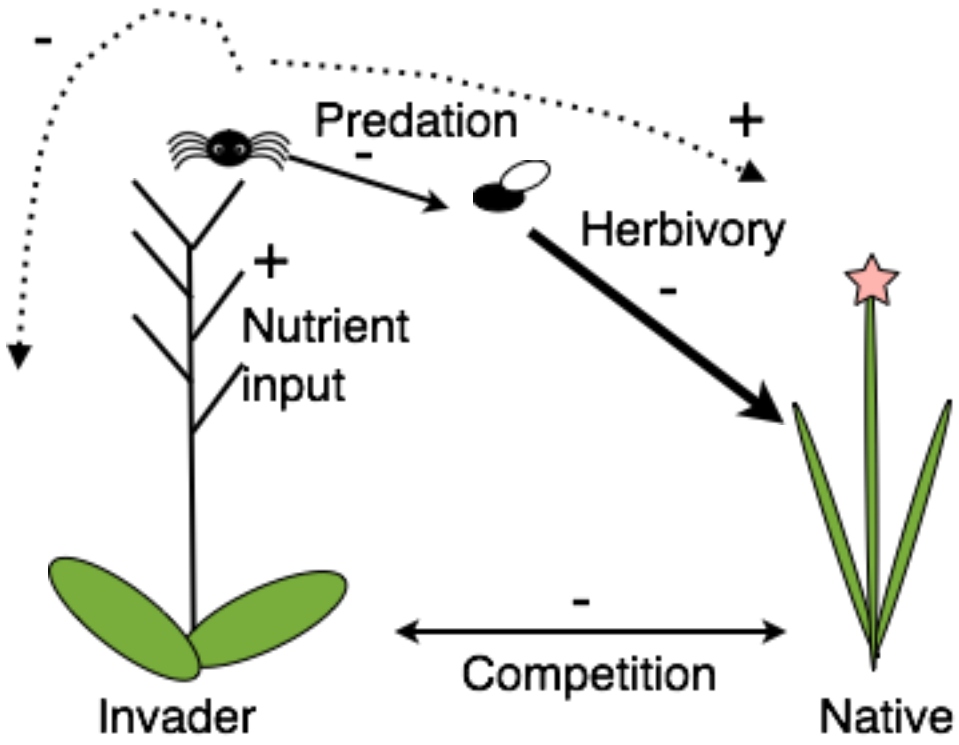


But species interact in large, complex food webs!



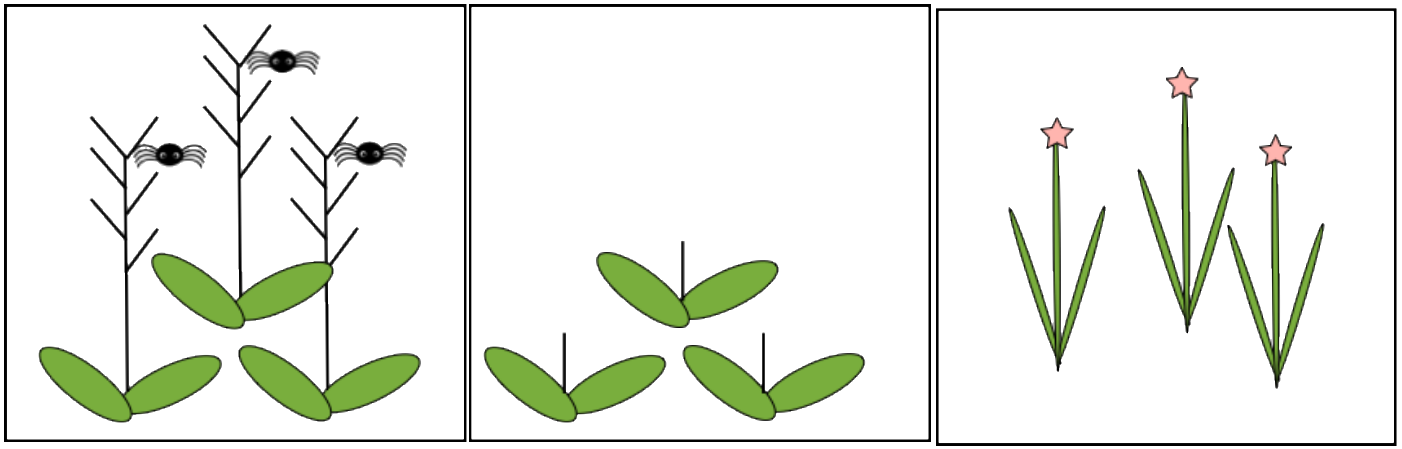
Garlic mustard

We need to study garlic mustard in food webs!



Field Experiment

Siliques Present | Siliques Absent | Natives

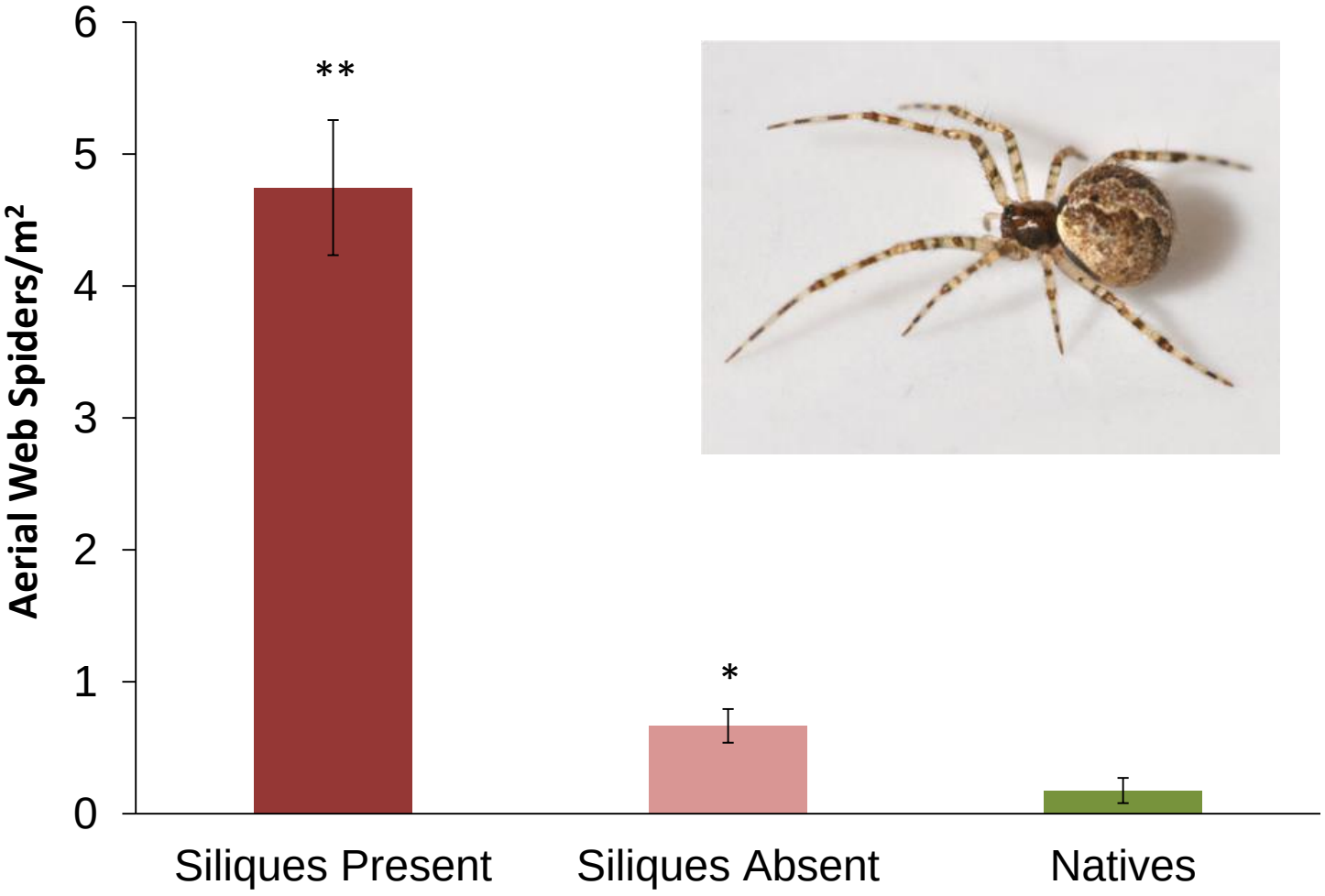


Measured:

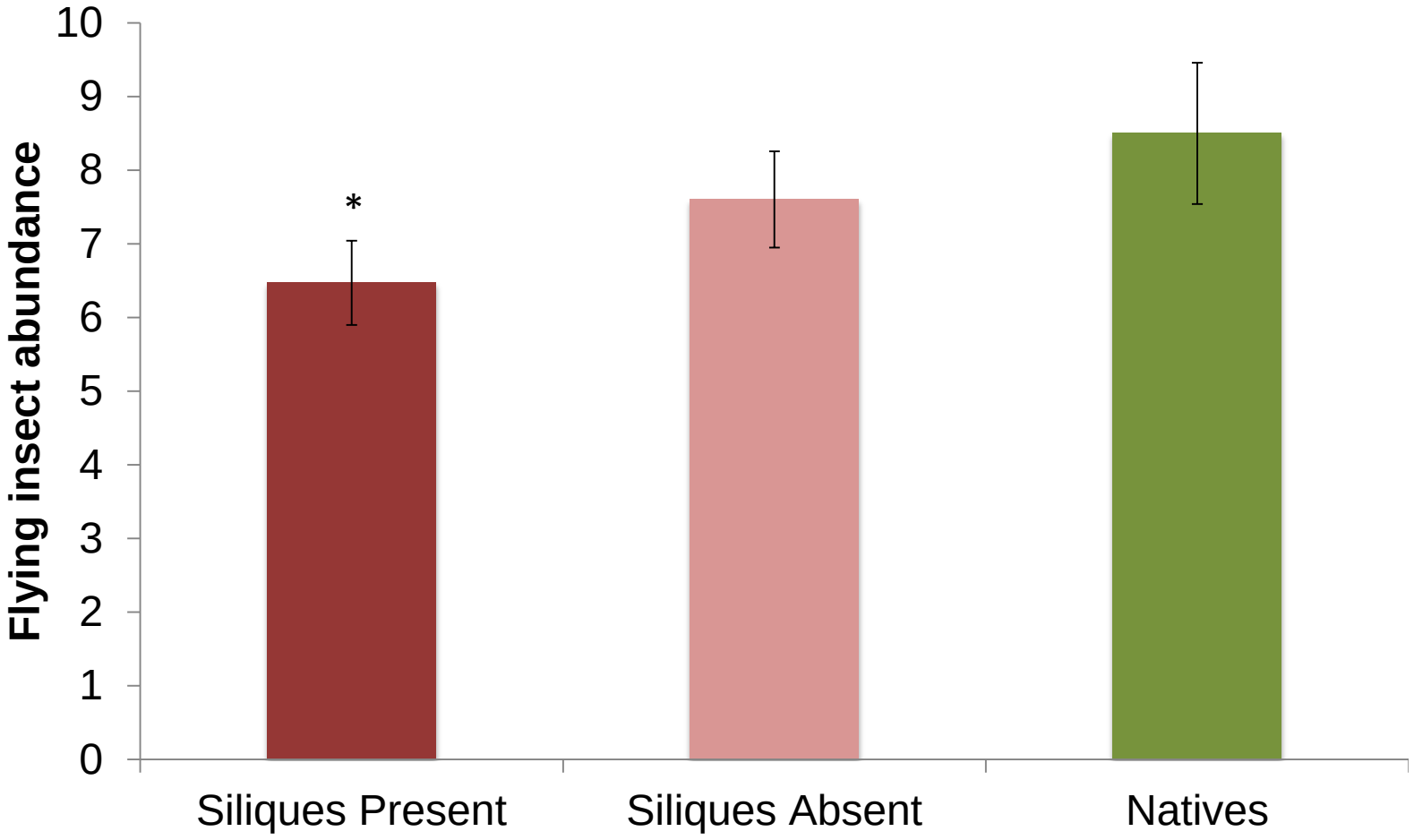
1) Aerial web spider abundance
2) Flying insect abundance (sticky traps)
3) ‘Phytometer’ growth

102 plots, 34 replicates

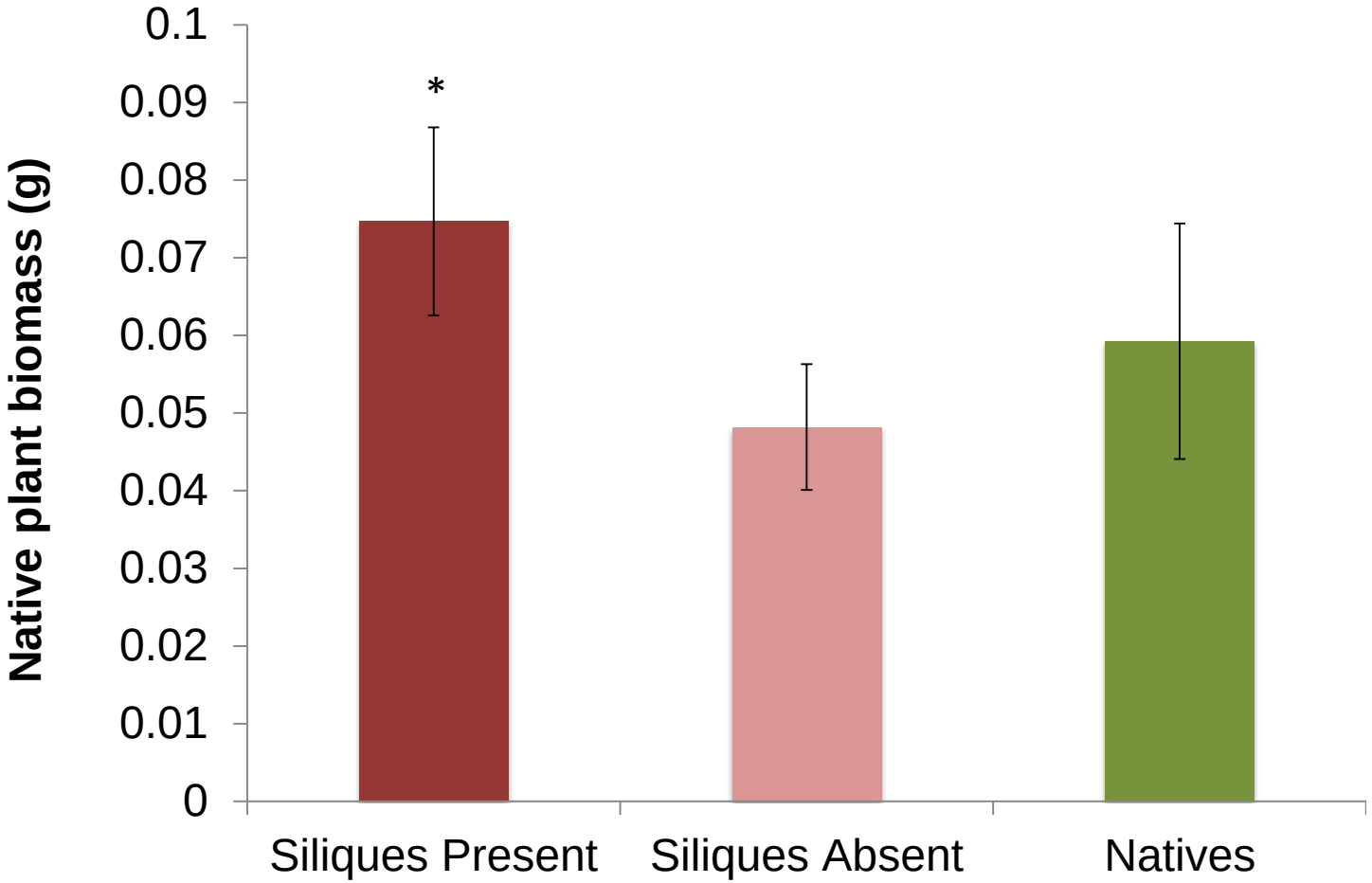
Garlic mustard is a predator promoter



Garlic mustard indirectly reduces native insect abundance



Garlic mustard indirectly increases native plant growth



By providing habitat for spiders, garlic mustard may reduce its own negative impact on plant biodiversity!

-

+

-

+

What about other invasive species?

From deVore and Maerz, 2014

How can we apply this new knowledge to invasion management?

Some invaders are ‘self-regulating,’ and may not drive biodiversity loss in the long run.

Others are ‘self-promoting,’ and will require active management to prevent biodiversity loss.

Food web interactions are one part of the picture, we must take other invasion drivers into account.

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Mid-Atlantic Regional Seed Bank

Molly Marquand

NATIVE ASH SEED COLLECTION PROGRAM

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Mid-Atlantic Regional Seed Bank

Greenbelt
Native Plant Center
City of New York Parks & Recreation

A CHANCE TO PRESERVE A SPECIES AHEAD OF EXTINCTION

Who We Are

- A Program of the NYC Parks Department Greenbelt Native Plant Center
- Located on Staten Island
- Mid-term seed bank (15 degrees C, 15% relative humidity)
- Launched in 2012 with support from NFWF, US Botanic Garden, and others
- First effort is a focus on early successional species including ash
- Other projects with DOI focusing on species to enhance coastal resiliency in face of climate change

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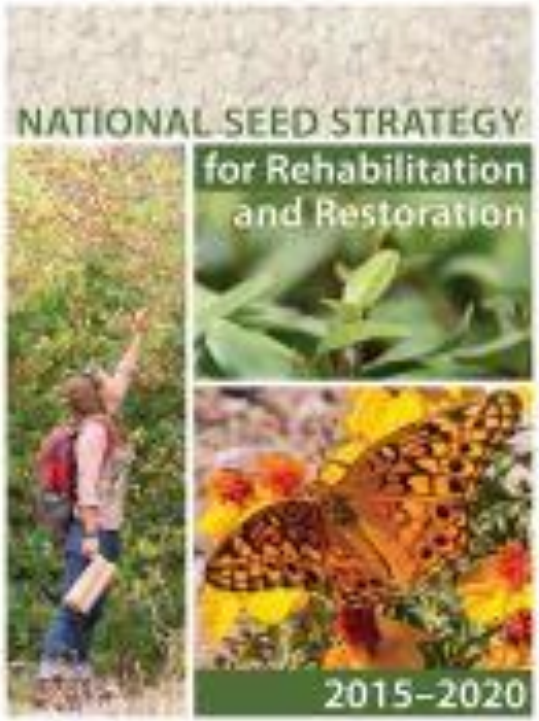
National Seed Collection Effort

• **US Seeds of Success National Seed Bank**
  - Conservation of all approx 14,000 taxa with orthodox seeds
  - Currently 7 national partners (including Greenbelt Native Plant Center) and 1 federal agency (BLM)

•**USDA National Center for Genetic Resources Preservation** Ft. Collins, CO
  - Conventional storage, up to 50 years
  - Cryogenic storage, viability indeterminate
  -Primary repository for all SOS collections

National Seed Strategy for Rehabilitation and Restoration: 2015-2020



- 12 Federal Agencies + Plant Conservation Alliance (300 Non-Federal Partners)
- Calls for the coordinated establishment of a **nationwide network of native seed collectors, growers, seed banks and seed storage facilities**

www.blm.gov/seedstrategy

Why Collect and Bank Seed?

- Effective ex situ conservation tool
- Facilitates restoration of the species the ecosystem
- Fast, inexpensive
- Long term storage
- Easily distributed
- Locally adapted seed means better ecological integration and restoration success in the future!

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Why Ash Seed?

- *Agrilus planipennis* – native to Asia
- Michigan 2002
- New York – Spring 2009
- Ash are an important early successional tree with high wildlife value
- Green, Black and White are most susceptible
- Visual surveys rarely detect infestations early


nature.org

- Near 100% mortality in forests near invasion center
- Functional extirpation of ash
- Most destructive and economically costly forest insect in N.A.

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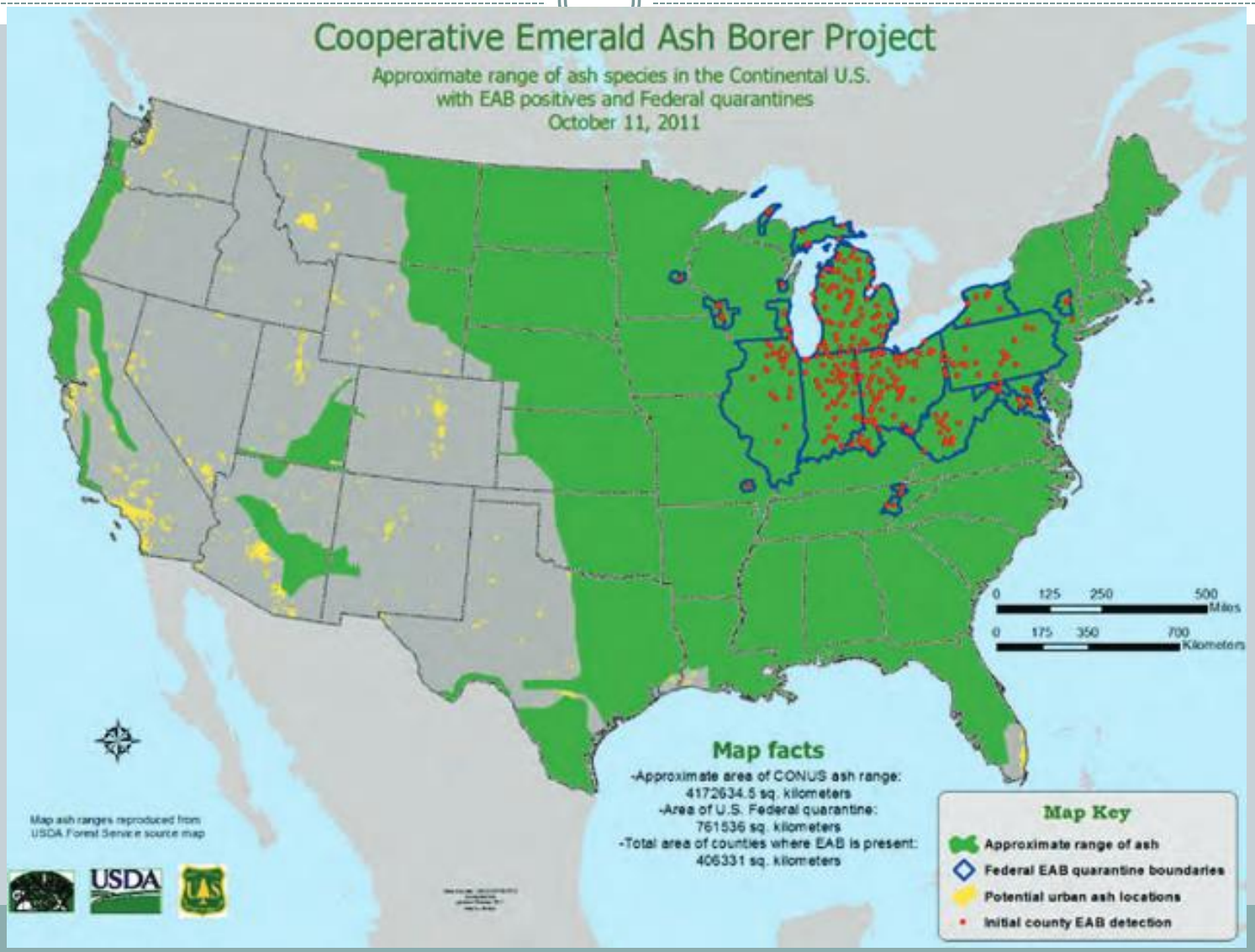
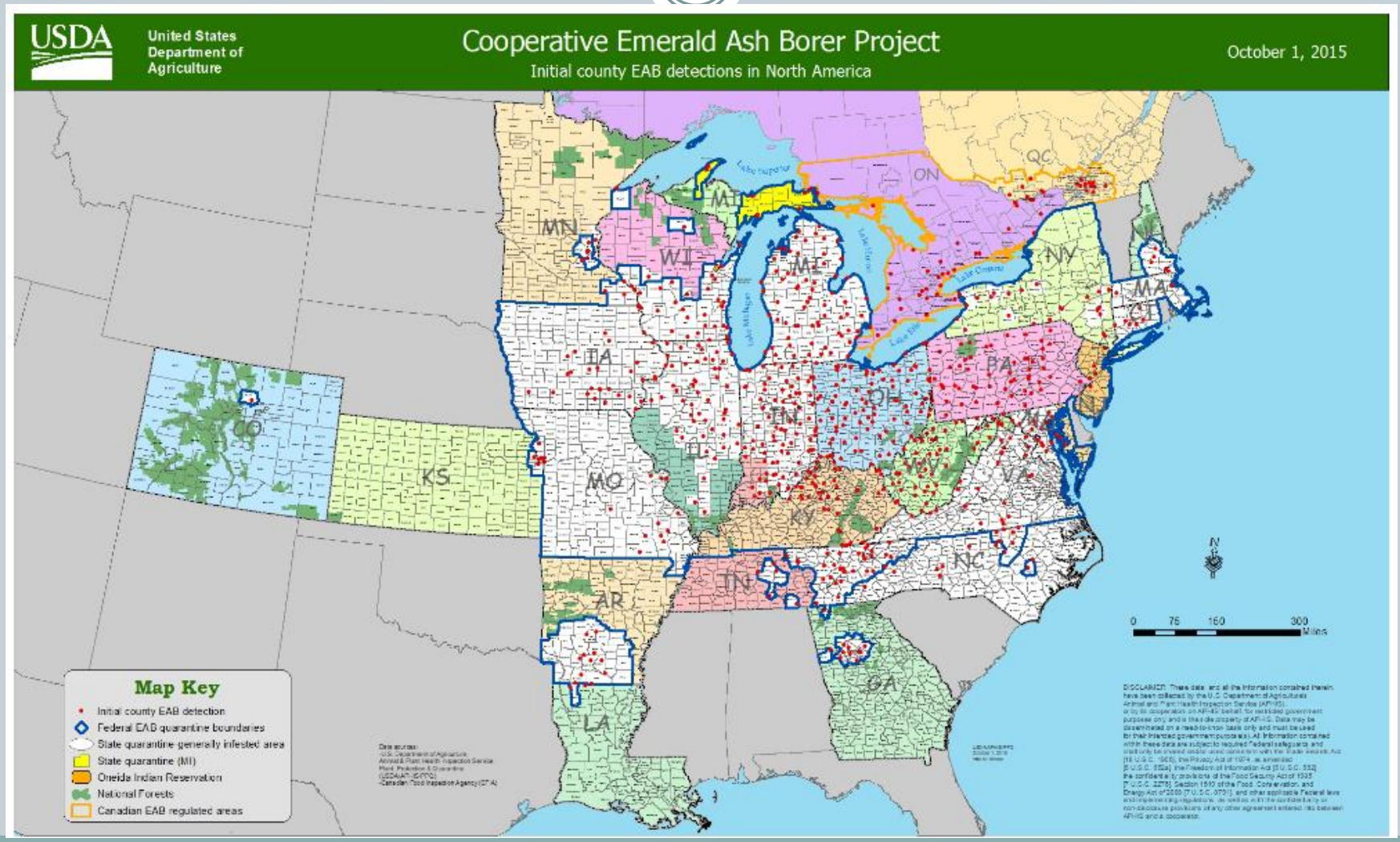
Approximate range of *Fraxinus* sp

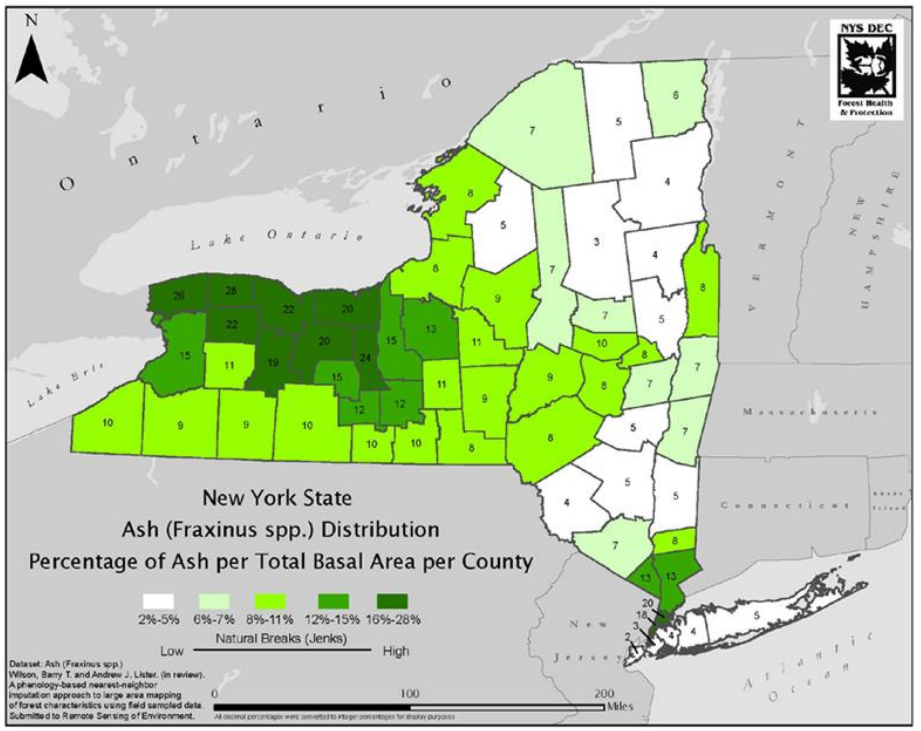


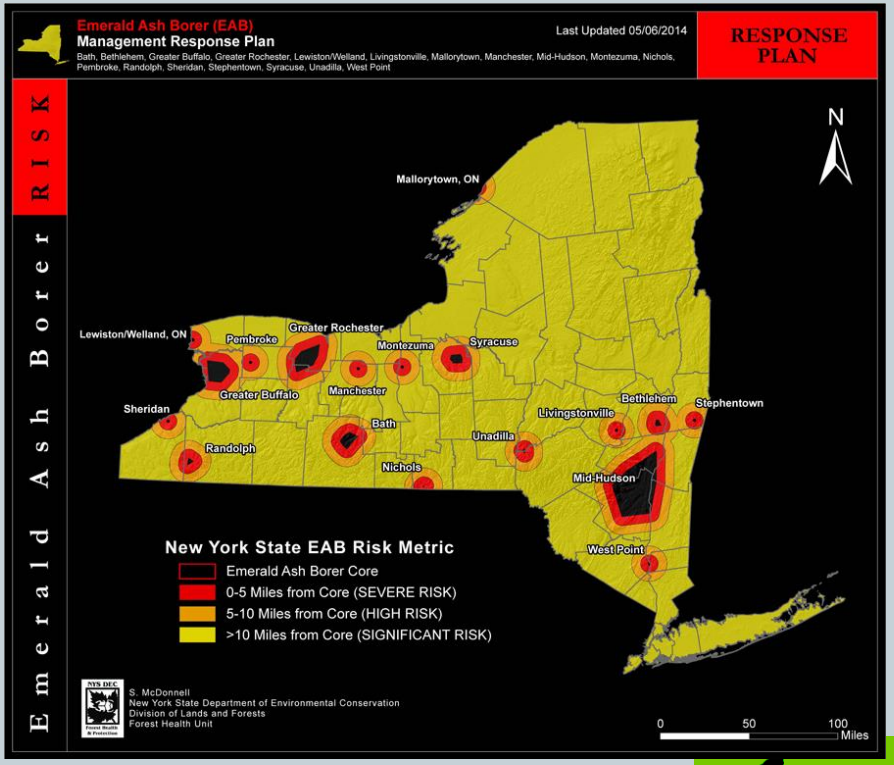
Current EAB infestations nationwide



Ash and EAB in New York State

Ash Distribution by County





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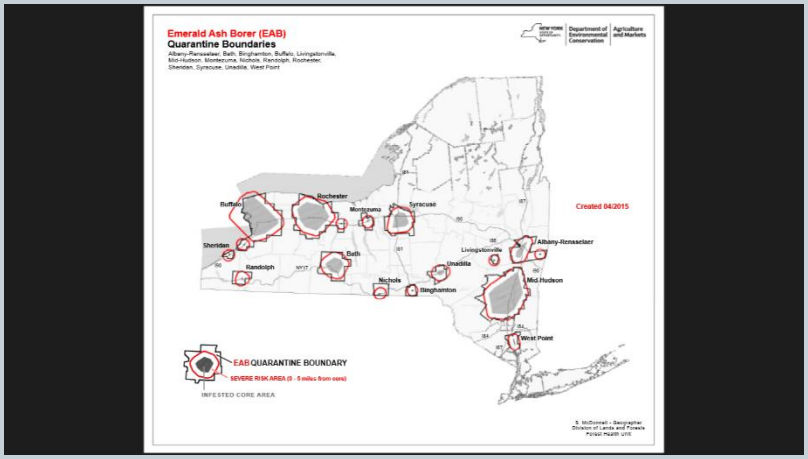
Management Options

- Quarantines
- Tree removal and replacement
- Systemic insecticides
- Bio-controls (native and non)
- Seed Collection



Andrew Sabai

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Nationwide Collection Program

- USDA/ARS and USFS National Seed Lab – 2010
- Made available to researchers and breeders
- Stored long term in hopes of a workable solution

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MARS-B Efforts in New York State

Funding

- 3 Year grant from the Northeastern Area State and Private Forestry Association
- 5 Workshops in NYS each year
- 150 Collections over 3 years

Species

- *Fraxinus americana*
- *Fraxinus pennsylvanica*
- *Fraxinus nigra*

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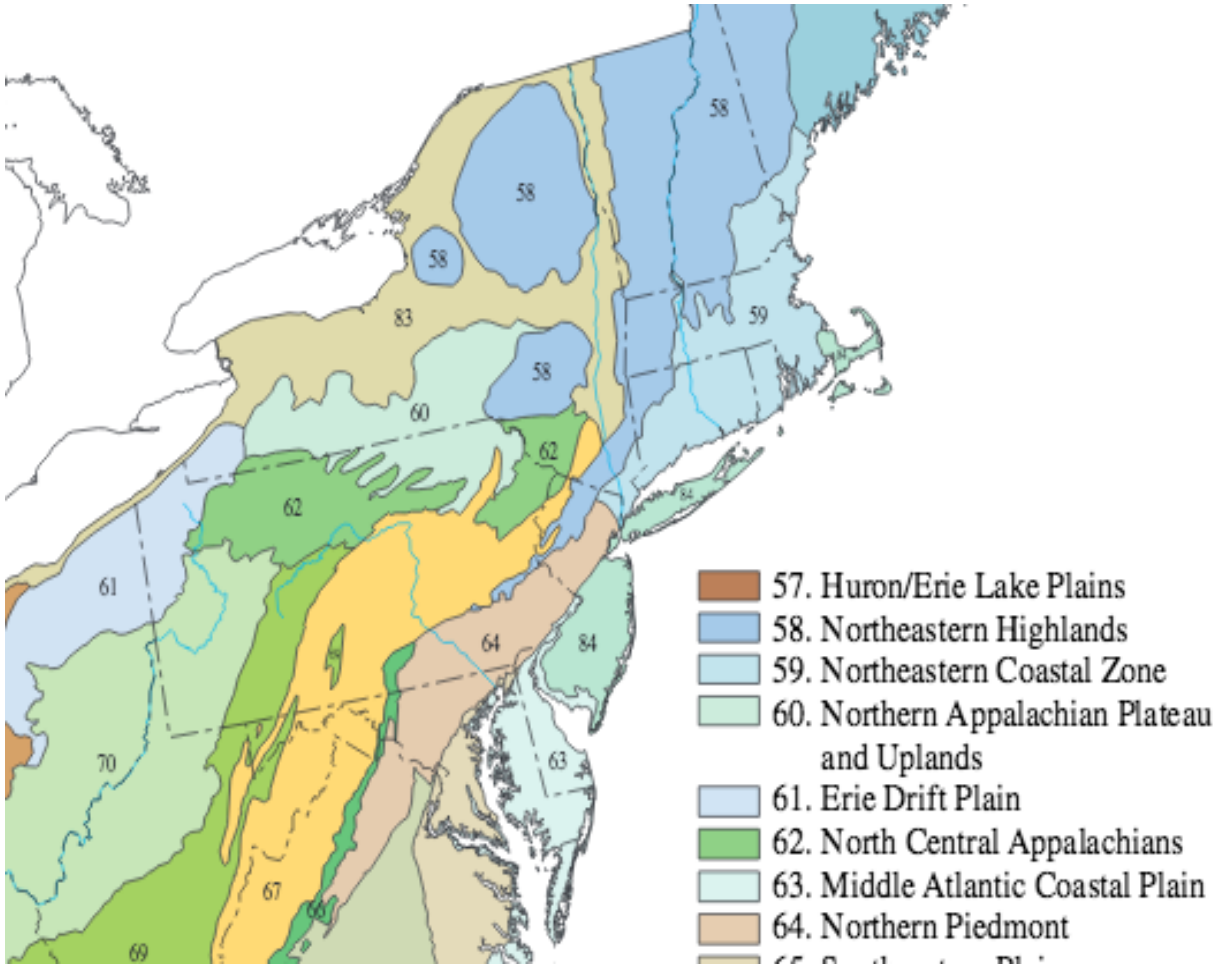
Strategy

- 50 collections – per species
- Collections distributed evenly across ecoregions
- Ecoregions are based on environmental characteristics like soils, evapotranspiration rates, etc.



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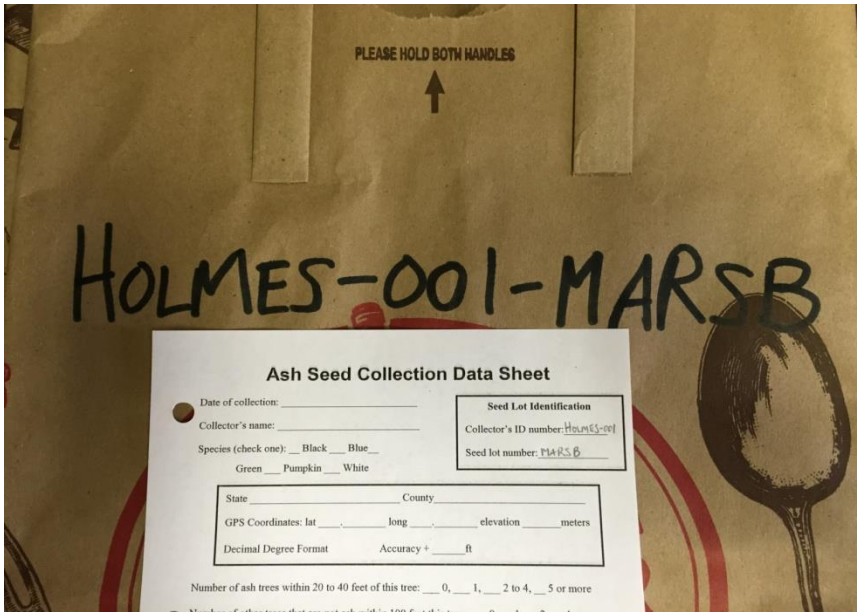
Seed Collection Protocol



- Collect only from naturally occurring trees
- Seed must be mature
- Lack of significant insect damage
- Labled according to USFS protocol
- Shipped to National Lab in GO

How the Seeds Will Be Stored Long Term

- Dried with air of 30% relative humidity or less until dry.
- Sealed in a moisture proof container
  - 4 to 6 mill poly-foil bag, or
  - Plastic bottle with a tight lid
- Frozen at – 8°C or below
- Can be stored for 50 years in these conditions
- All collections recorded in the federal Germplasm Resources Information Network (GRIN)

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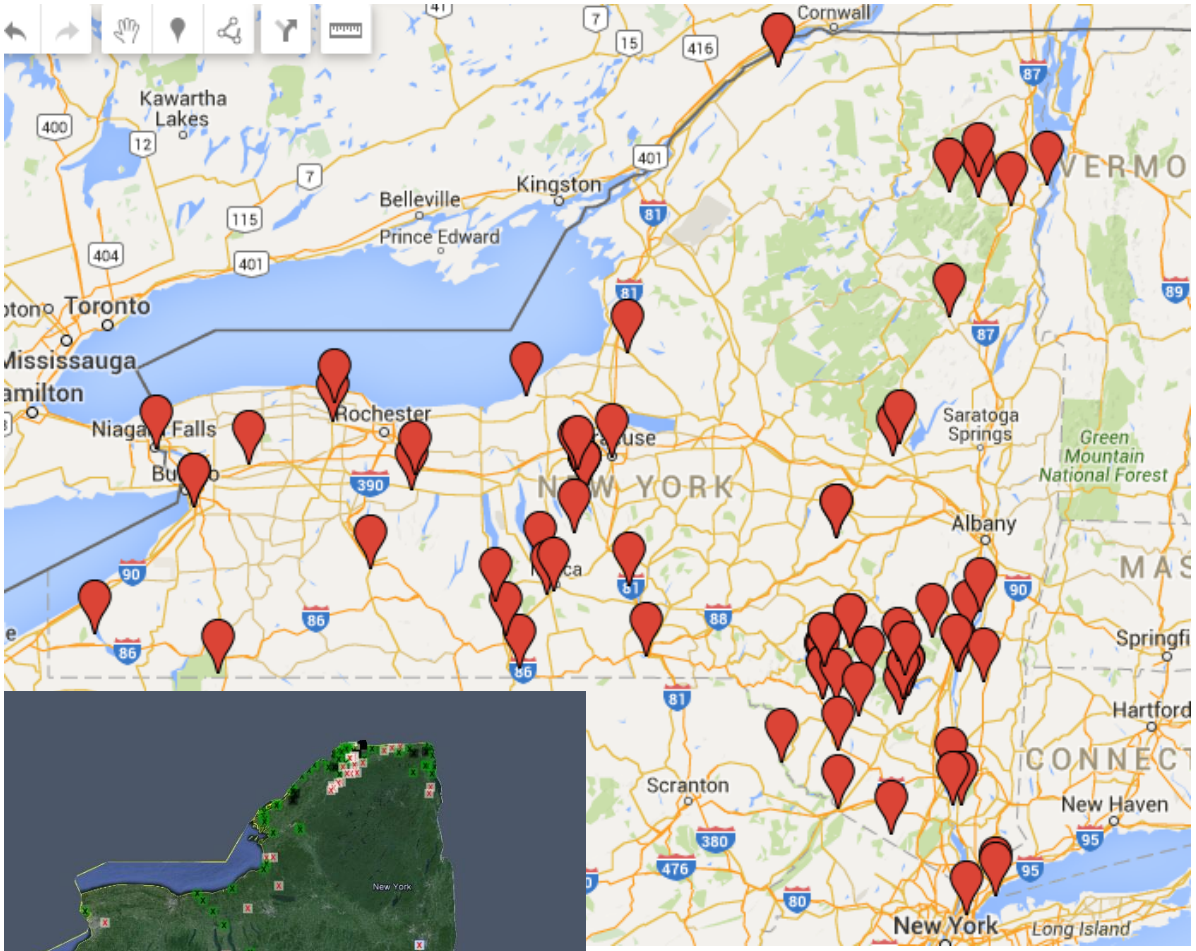
Current Collections Status

- Over 60 volunteer collectors across 8 ecoregions
- Made over 200 collections so far



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Thank you!


Greenbelt
Native Plant Center
City of New York
Parks & Recreation


SENECA NATION OF INDIANS
Keeper of the Western Door


DEPARTMENT OF ENVIRONMENTAL CONSERVATION
NEW YORK STATE


SEEDS
OF SUCCESS


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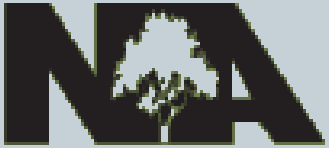
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE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OFFICE OF PARKS·RECREATION·HISTORIC PRESERVATION
NEW YORK STATE


CHICAGO
BOTANIC
GARDEN


Cornell University
College of Agriculture and Life Sciences
Department of Natural Resources

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Assessing and preparing for plant invasion facilitation by pest insect invasions

Radka Wildova
Jonathan Rosenthal

Ecological Research Institute

Plant invasions in terrestrial systems

Typically enabled by anthropogenic disturbance:

- Roads, trails
- Power lines
- Housing developments
- Clear cutting
- Abandonment of cultivated land

Could disturbance from invasive pest insects/pathogens also enable plant invasions?

MENTION INCREASE IN LIGHT AVAILABILITY AS LIKELY FACILITATOR

- MENTION INVASIVE PLANTS THAT BENEFIT FROM INCREASED LIGHT

If pest disturbances facilitate plant invasions

Then:

1) Even protected, largely intact ecosystems are threatened

2) Land managers need to factor these pest invasions into management plans/activities

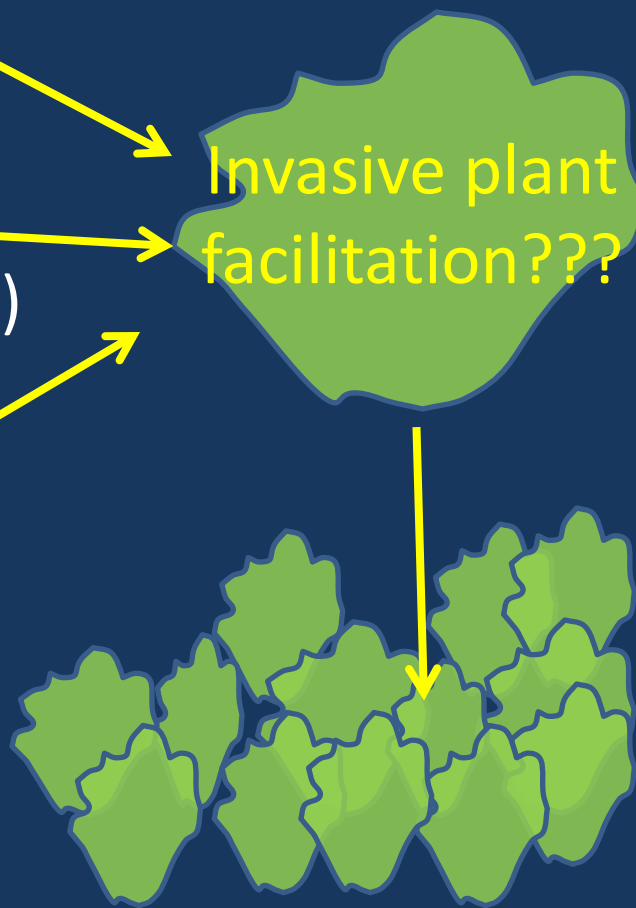
- To date - surprisingly little research on forest pest facilitation of invasive plants:
  - K. Knight & colleagues in OH, MI looking at EAB effects on invasive *Lonicera* (no results yet avail.)
  - Eschtruth et al. (2006) found invasive plants in HWA-infested hemlock forest, but didn't demonstrate causal relationship

We've examined such potential facilitation in several systems

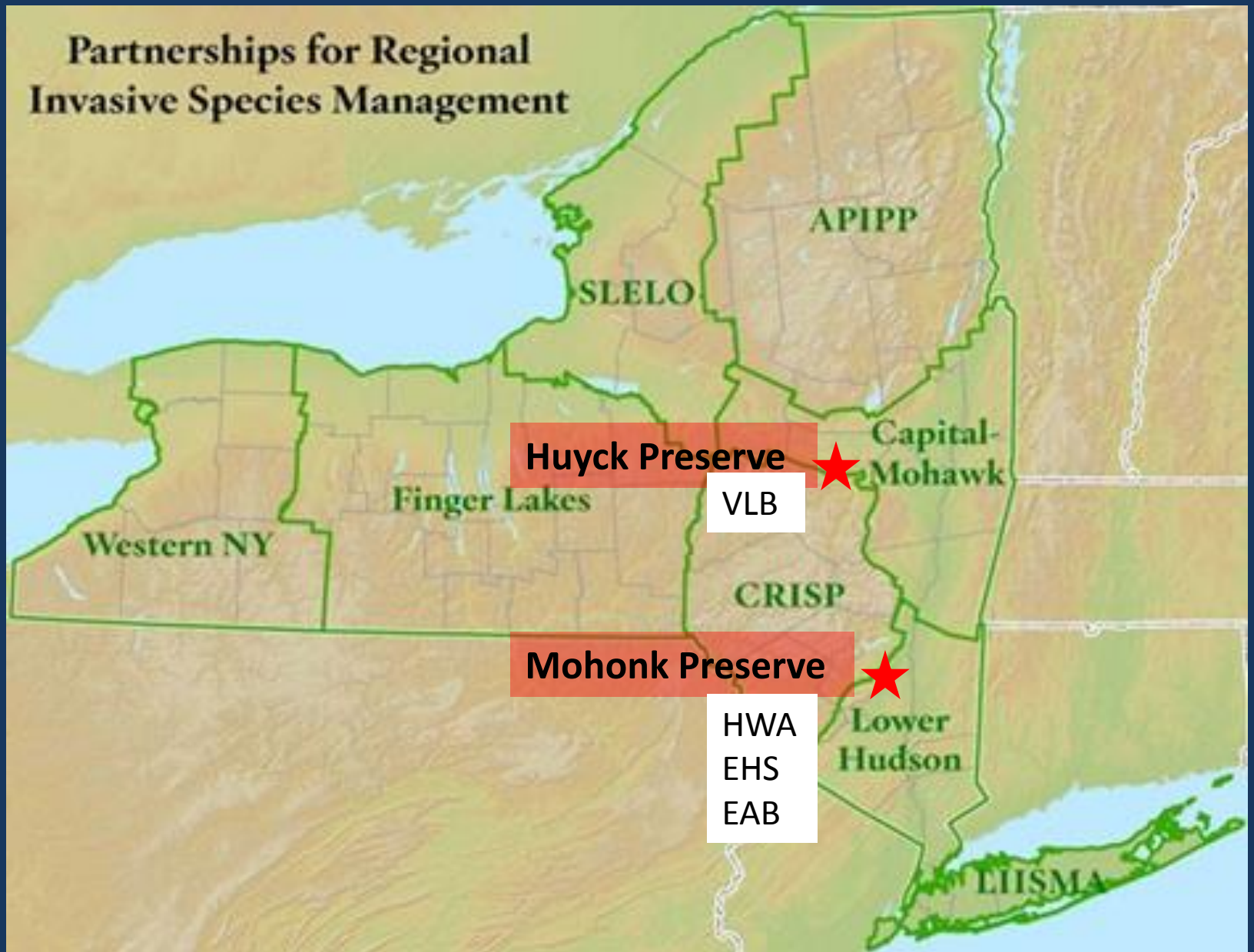
1. Pest: viburnum leaf beetle (VLB)
   Host: native viburnums

2. Pests: Hemlock woolly adelgid,(HWA)
   and hemlock elongate scale (EHS)
   Host : eastern hemlock

3. Pest: emerald ash borer (EAB)
   Host: white ash



Study locations



Story 1 : Viburnum leaf beetle

Melissa Beveridge Huyck Preserve artist-in-residence, 2009

From: Europe

Hosts: Viburnum species

23 known susceptible species in North America

How did the beetle get here?

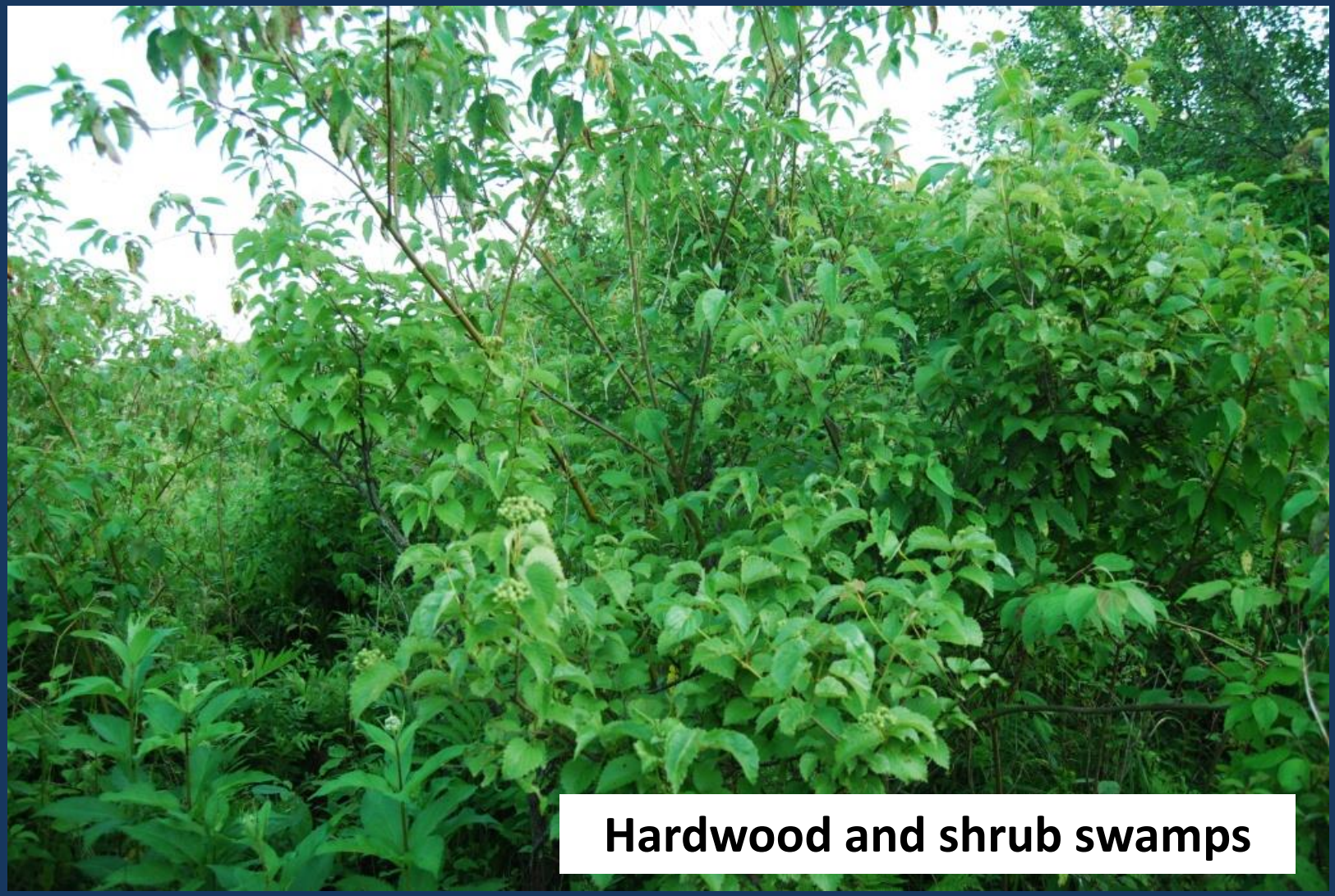
Viburnum leaf beetle spread

Established in 1970
Ottawa, Ontario

became invasive

British Columbia
Alberta
Ontario
Quebec
Great Plains
Great Lakes
Northeast
Four Corners
Mid-Atlantic

Ecosystem dominated by arrowwood (*Viburnum recognitum*)



Provides food for herbivores

Spring azure butterfly

Hummingbird moth

…and their predators and parasites

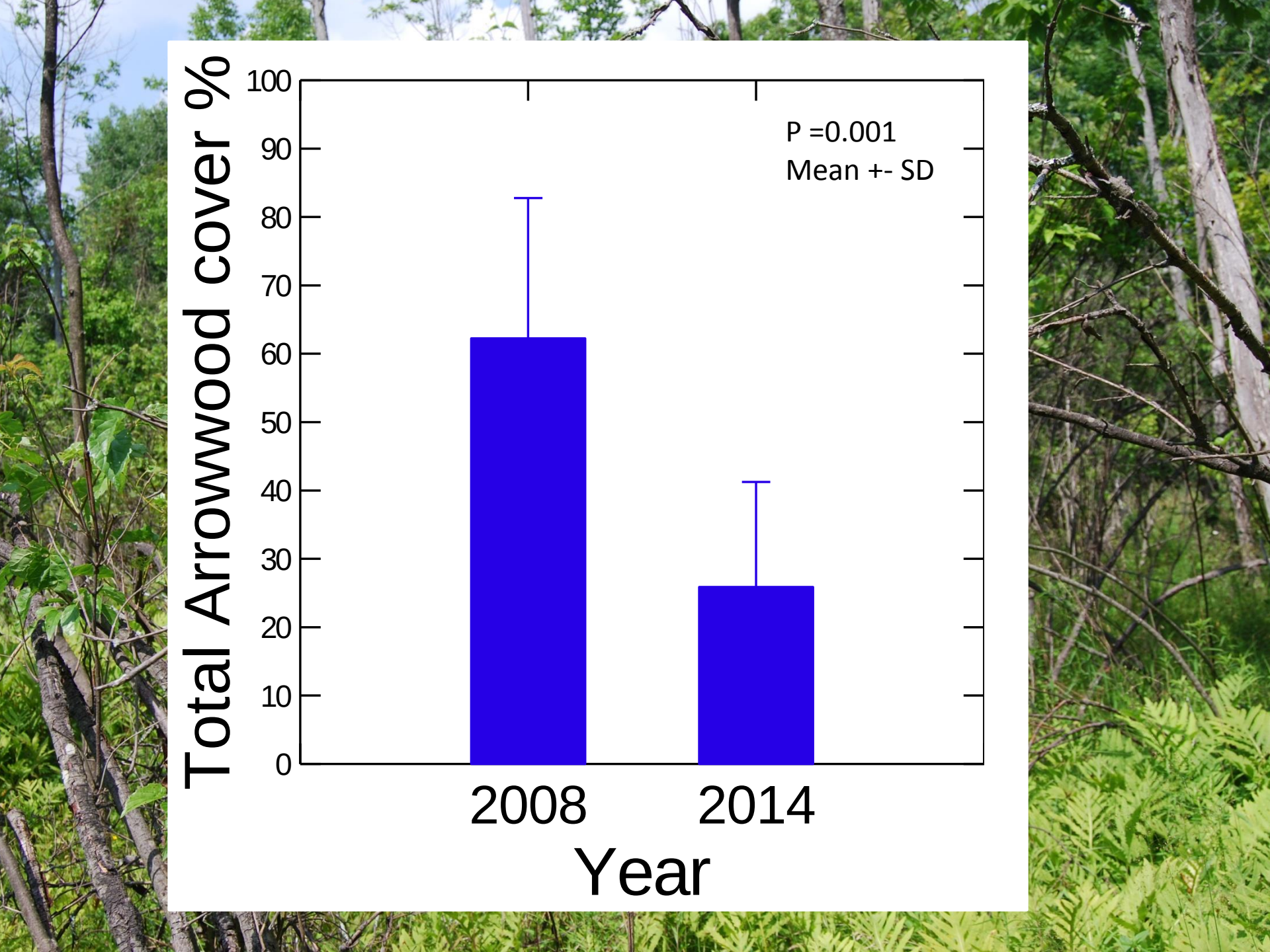
… and nesting habitat for birds

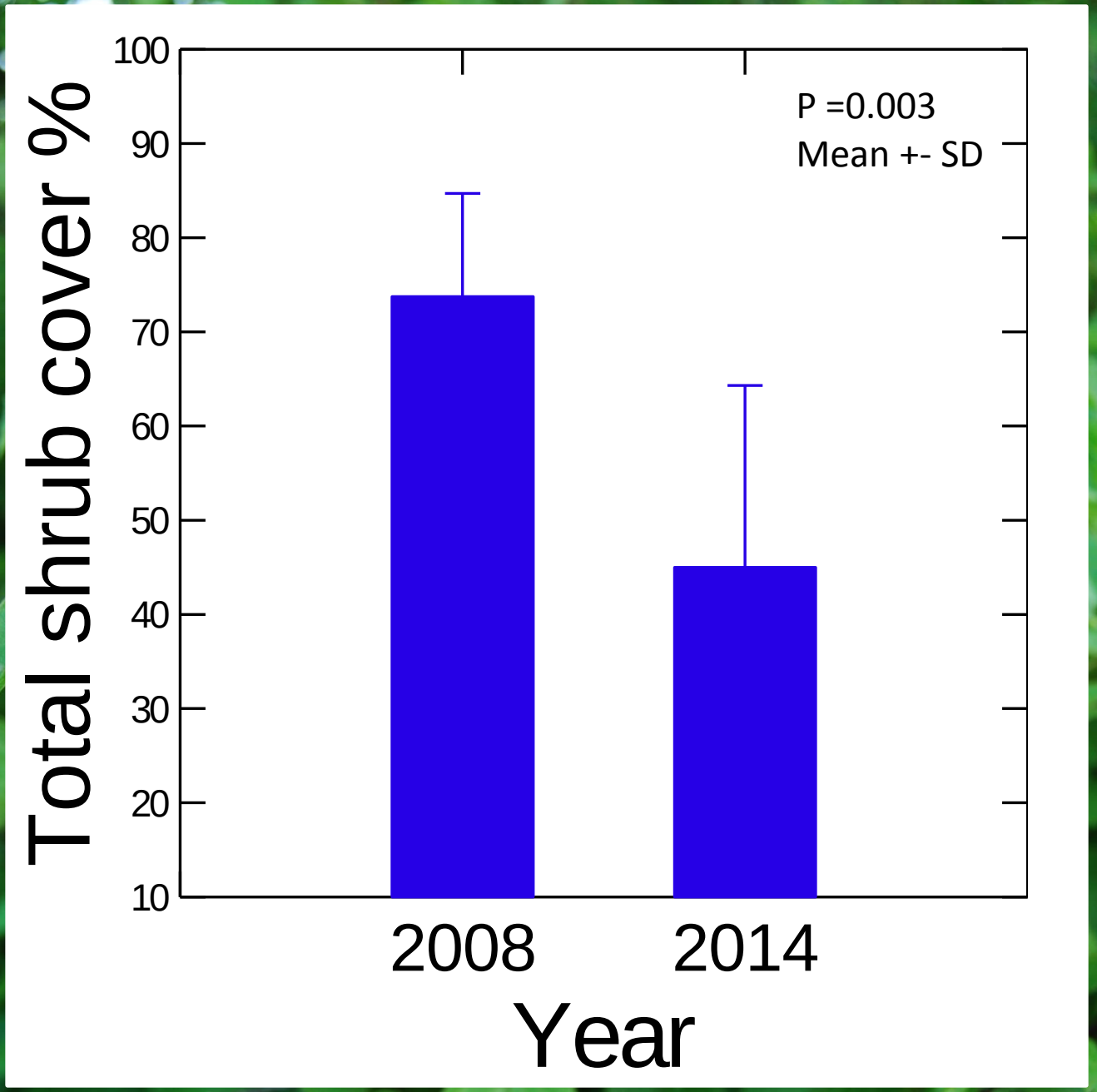
Shelter for many animals

[INSERT PHOTO]

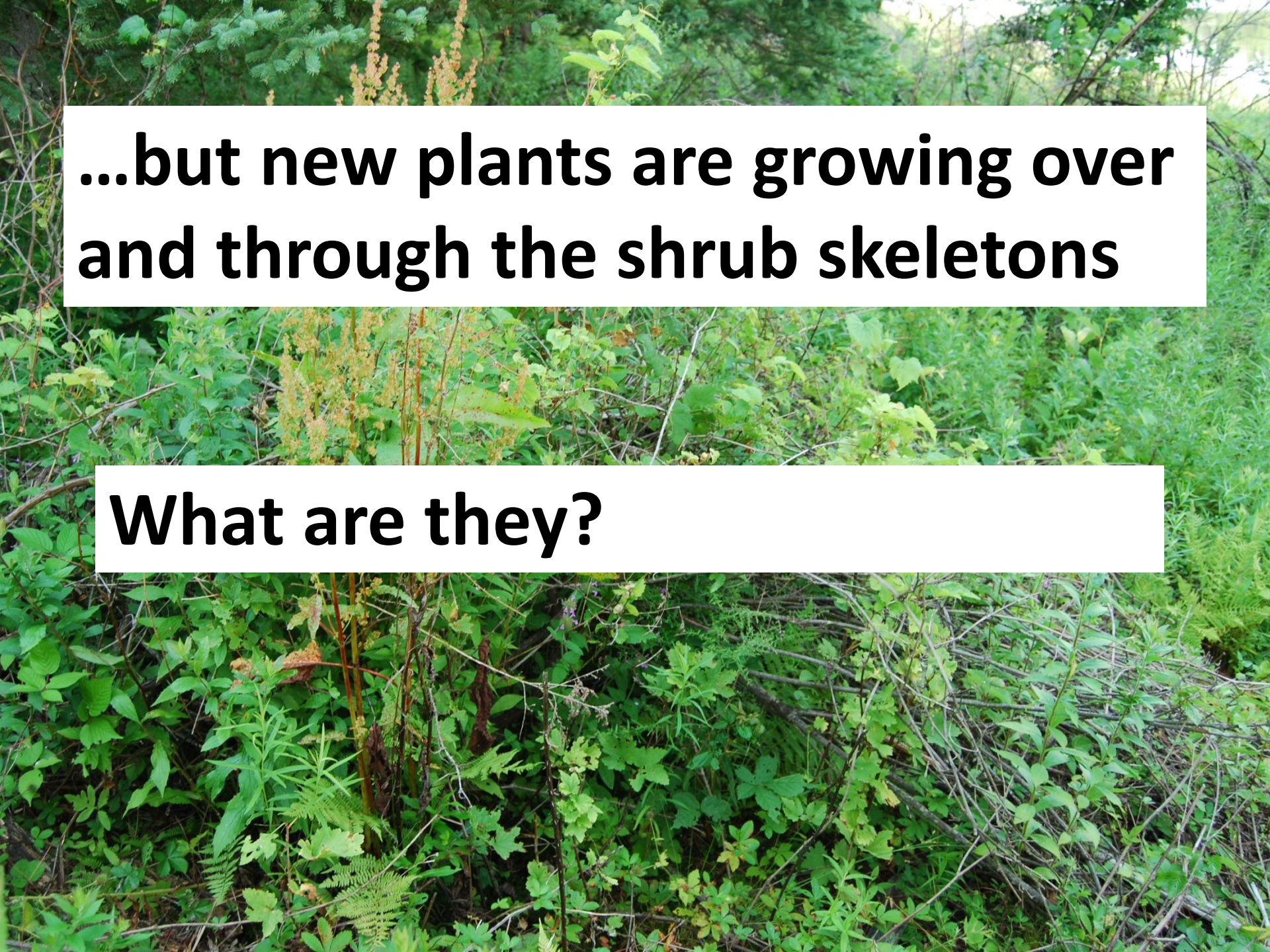
Established vegetation study plots in 2008 [?ADD PHOTO?]

Vegetation changes 2008-2014


Total Arrowwood cover %
100
90
80
70
60
50
40
30
20
10
0
P =0.001
Mean +- SD
2008
2014
Year


Total shrub cover %
100
90
80
70
60
50
40
30
20
10
P =0.003
Mean +- SD
2008
2014
Year

Also, changes in hydrology and microclimate



…but new plants are growing over and through the shrub skeletons

What are they?

Invasive exotic plants

Multiflora rose

Common buckthorn

Oriental bittersweet

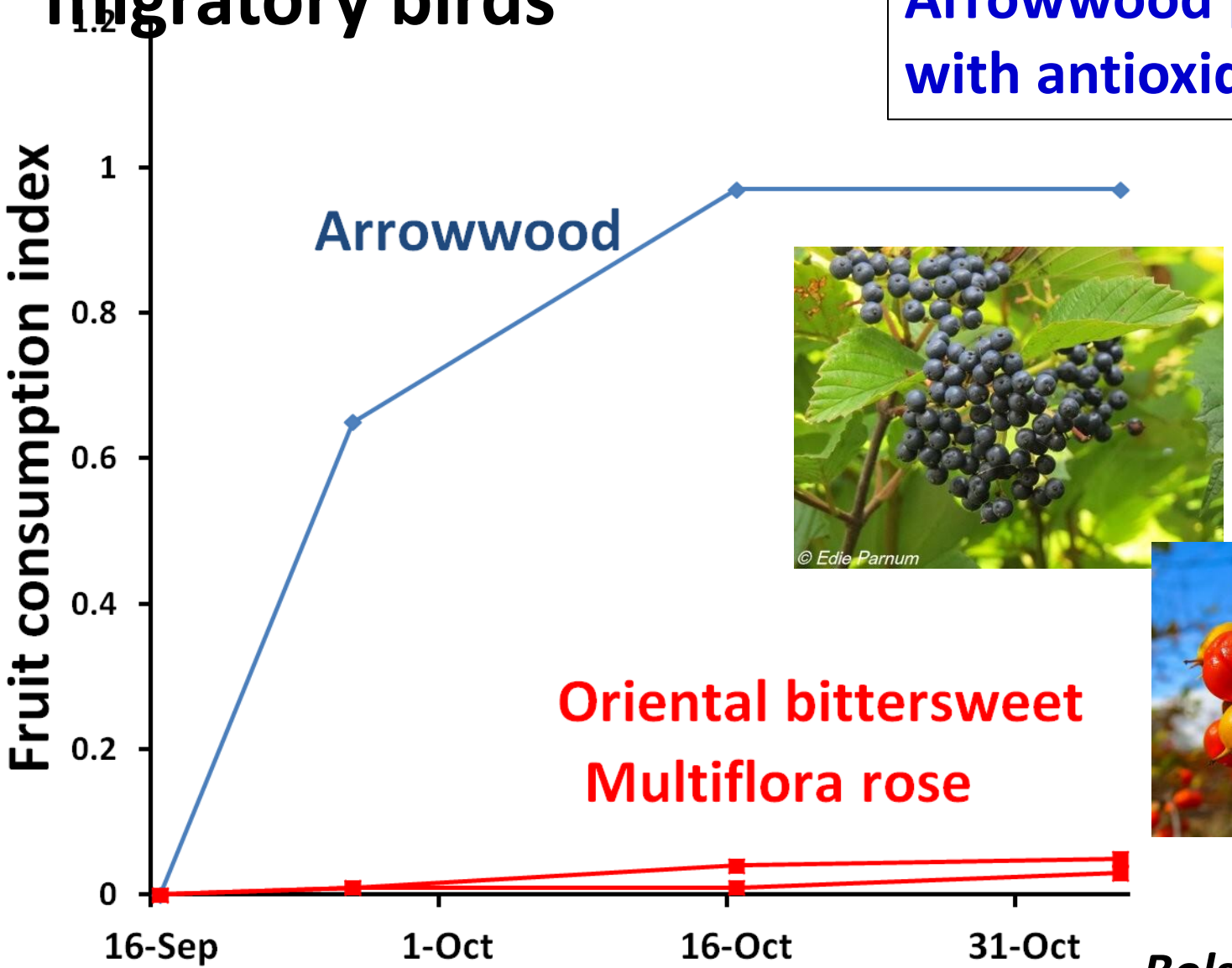
Japanese barberry

In 2008, no invasive plants in plots

Can the invasives perform arrowwood's ecosystem functions?

Arrowwood vs. invasive berries for migratory birds

Arrowwood packed with antioxidants, fat



Bolser et al. 2013

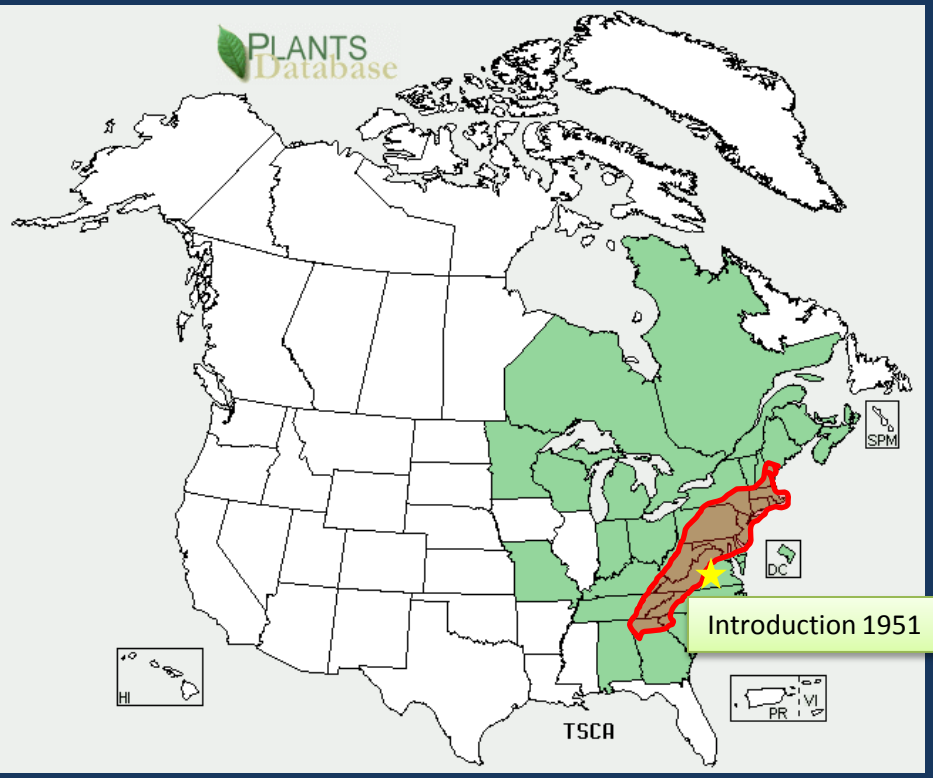
- Physical structure of habitat will differ
- Beaver food? No.

Story 2 : Hemlock woolly adelgid and elongate hemlock scale

HWA

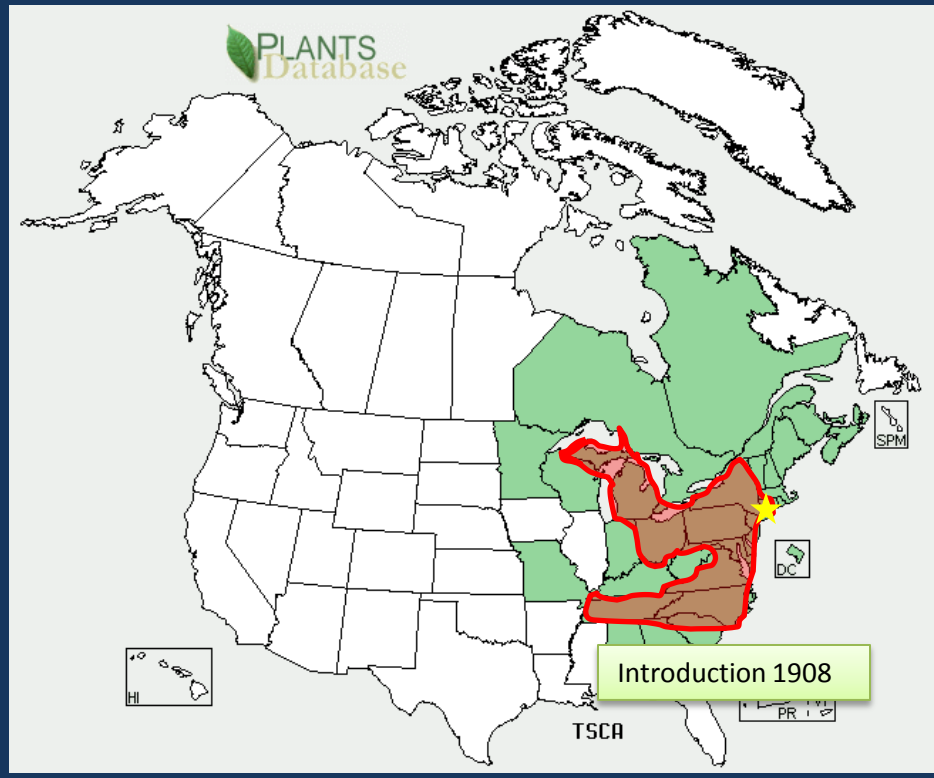
EHS

Hemlock woolly adelgid (HWA)



Data from USDA, 2009

Elongate Hemlock scale (EHS)



Data from USDA, 2011

Host: eastern hemlock

INSERT SLIDE(S) ABOUT HEMLOCK IMPORTANCE

Impacts of HWA Reverberate Though the Ecosystem

Hemlock Woolly Adelgid

Death of trees

Change in tree species composition

Warming of streams may impact fish

Increased nutrient losses

Decline of some bird species

Good regeneration of many tree species

But, guess what else is establishing?

Japanese stilt grass

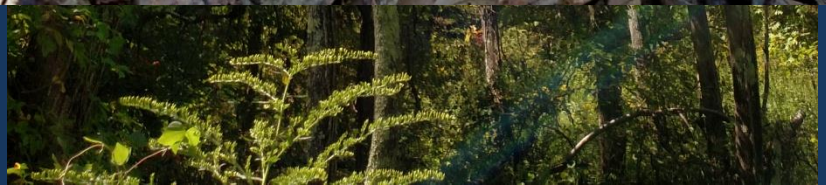
Morrow's honeysuckle

Oriental bittersweet

Japanese barberry

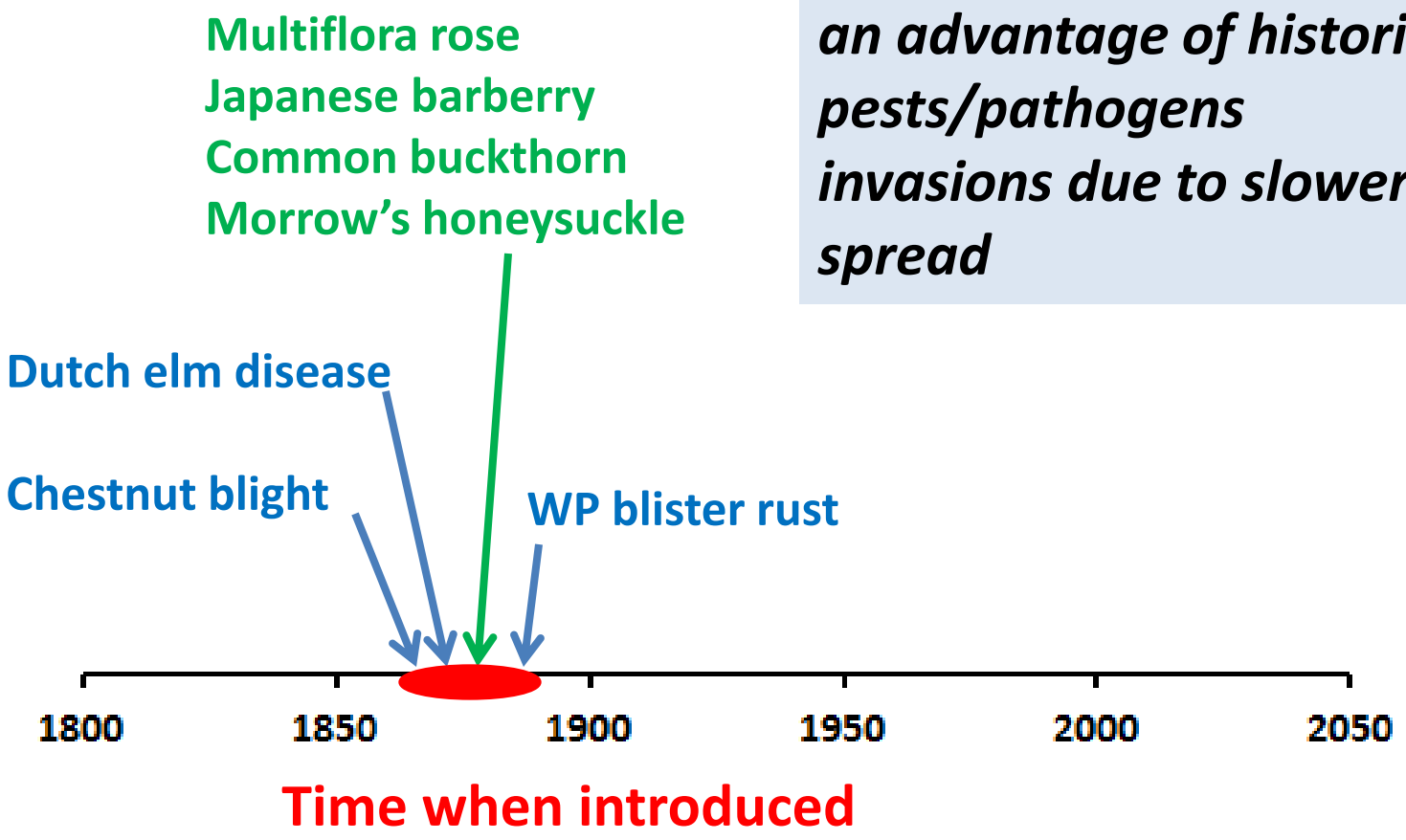
Factors seeming to affect invasive plant establishment

INSERT ASH SLIDES

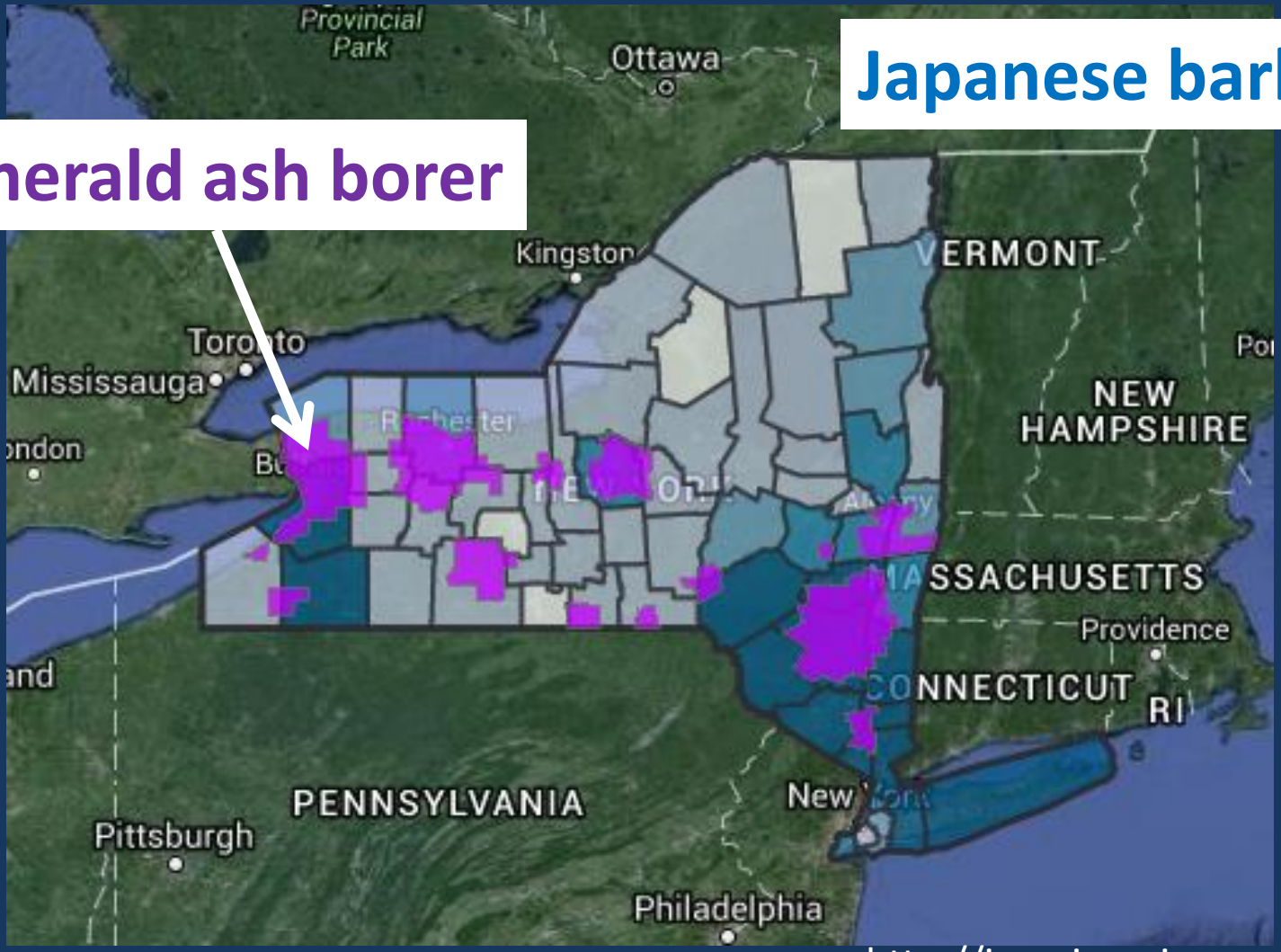


Introduction of forest pests, pathogens and invasive plants

Speculations:
Exotic plants did not take an advantage of historical pests/pathogens invasions due to slower spread



Recent pests invasions overlap with plant invasions



http://imapinvasives.org/nyimi/map/

NYBG/125

INVASIVE SPECIES SUMMIT: CHALLENGES, STRATEGIES, AND PERSPECTIVES

FRI, NOV 6, 2015

Afternoon Session A:
Conserving Biodiversity

Co-presented with Lower Hudson Partnership for Regional Invasive Species Management

LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN