



Invasive Plant Species In Restoration Projects

*St. Lawrence-Eastern Lake Ontario Invasive Species Symposium
June 20, 2019
Altmar, New York*

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Today's Goals

Introduce 3 drivers of Restoration Ecology

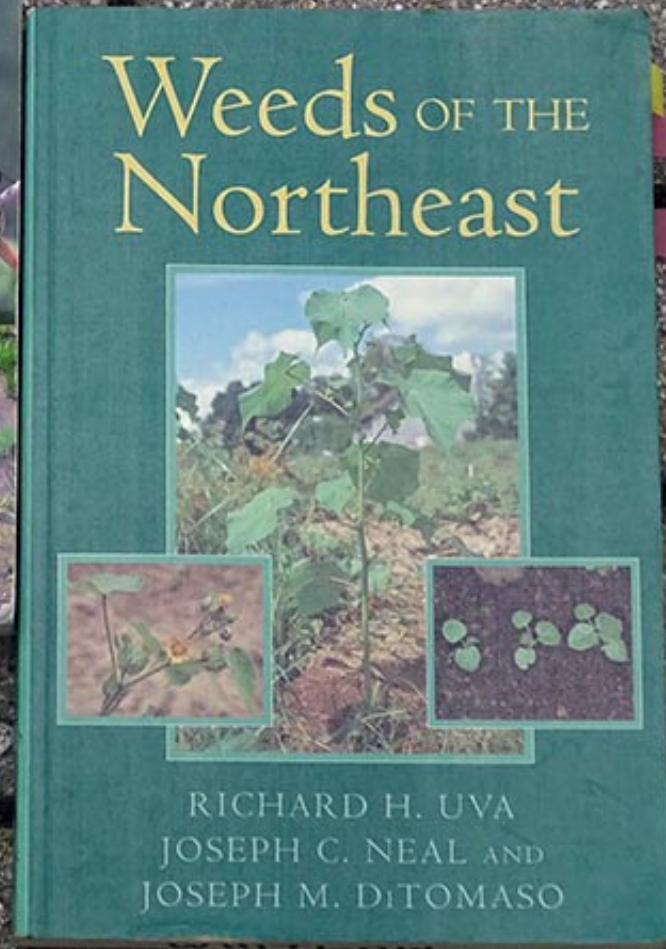
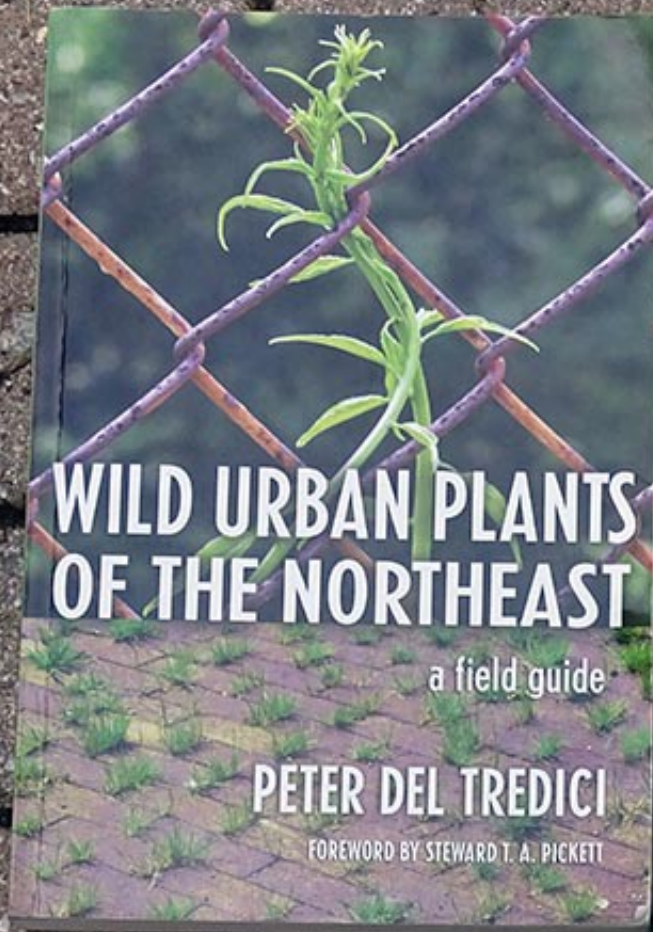
Introduce 2 theories of Invasion Biology

Present a case study and lessons learned

Recommended approaches

Necessary, but not necessarily sufficient!

*Knowledge begins with
proper identification*





***Busman's Tour of Exotic Invasive Species
of Upstate New York***

***You undoubtedly saw some of these
on your way to the conference.***

Pale Swallow wort



Leaves



Flowers



Fruits



Japanese Knotweed





Phragmites




Chickory





St. John's Wort

A photograph of a garden scene. In the foreground, there is a patch of tall green grass. Behind it, several stalks of Giant Hogweed are visible, featuring large, deeply lobed green leaves and clusters of small white flowers. In the background, a dense thicket of Day-Lilies is in full bloom, displaying numerous bright orange flowers. The overall scene is lush and green.

Day-Lily

Giant Hogweed







Bull Thistle



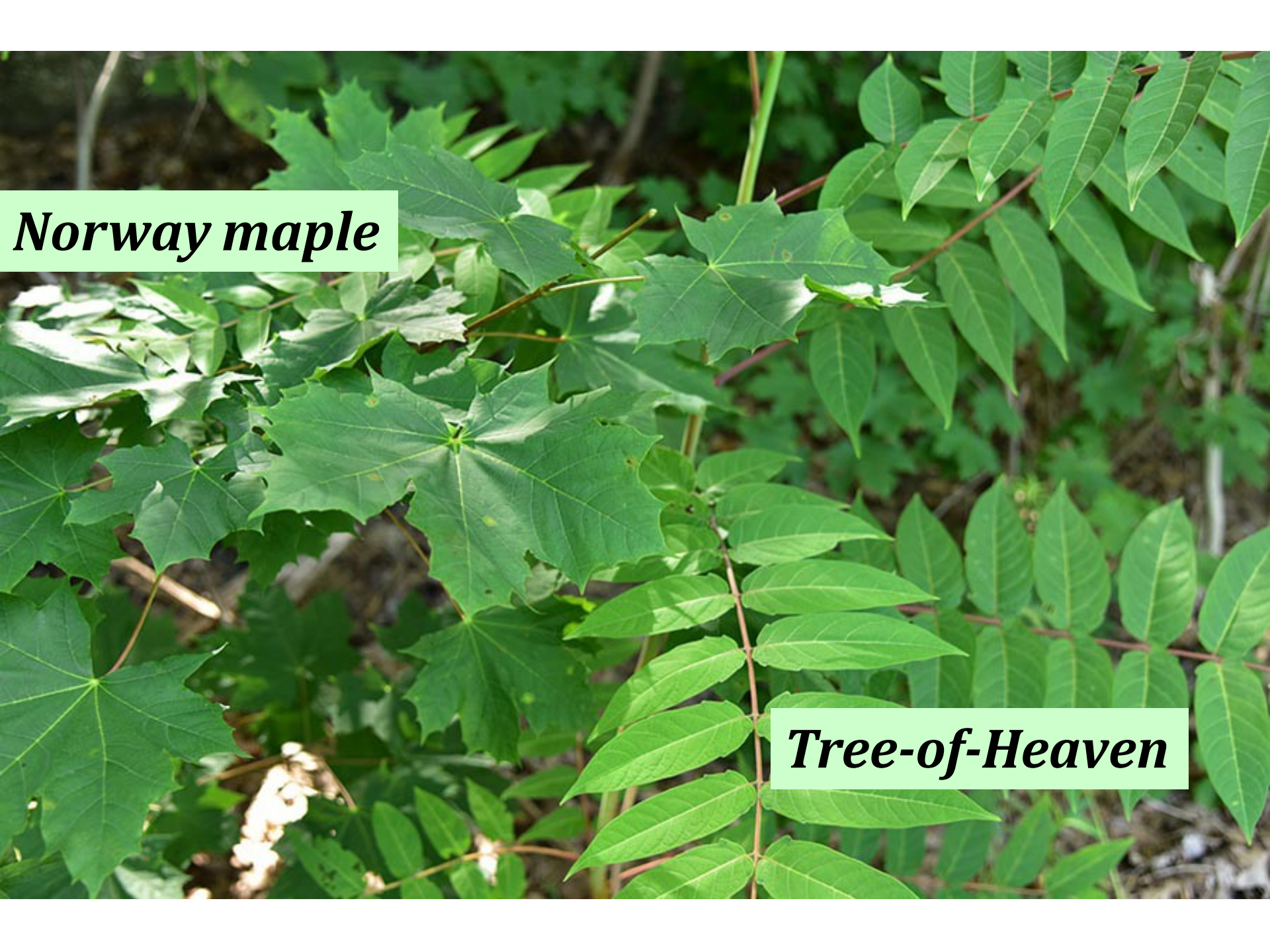
Tartarian Honeysuckle



Butter-and-Eggs



Teasel

A photograph showing two types of green leaves. On the left, there are Norway maple leaves, which are large and deeply lobed with serrated edges. On the right, there are Tree-of-Heaven leaves, which are smaller, pinnately compound, and have a more uniform shape. The background is a dense thicket of green foliage.

Norway maple

Tree-of-Heaven

Myrtle covering forest floor



Trillium growing on “normal” forest floor





Purple loosestrife

Spotted Knapweed

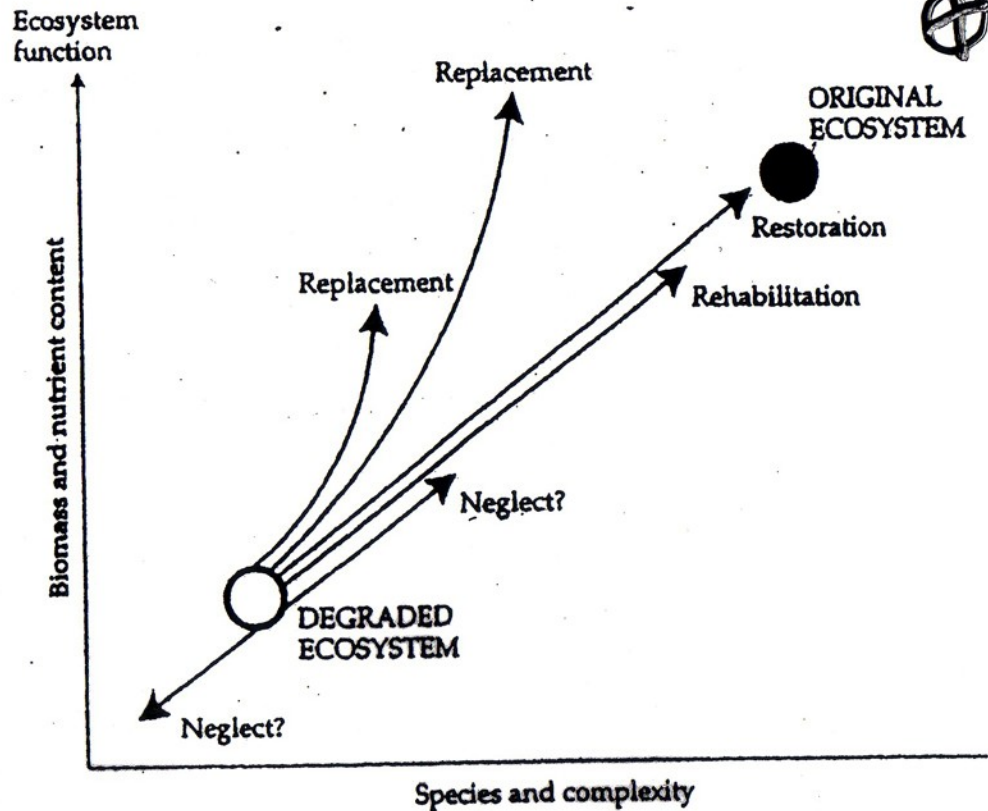


*Invasive species are everywhere,
aided and abetted by human activities
and
good intentions.*

We are all in this together

The Restoration Context

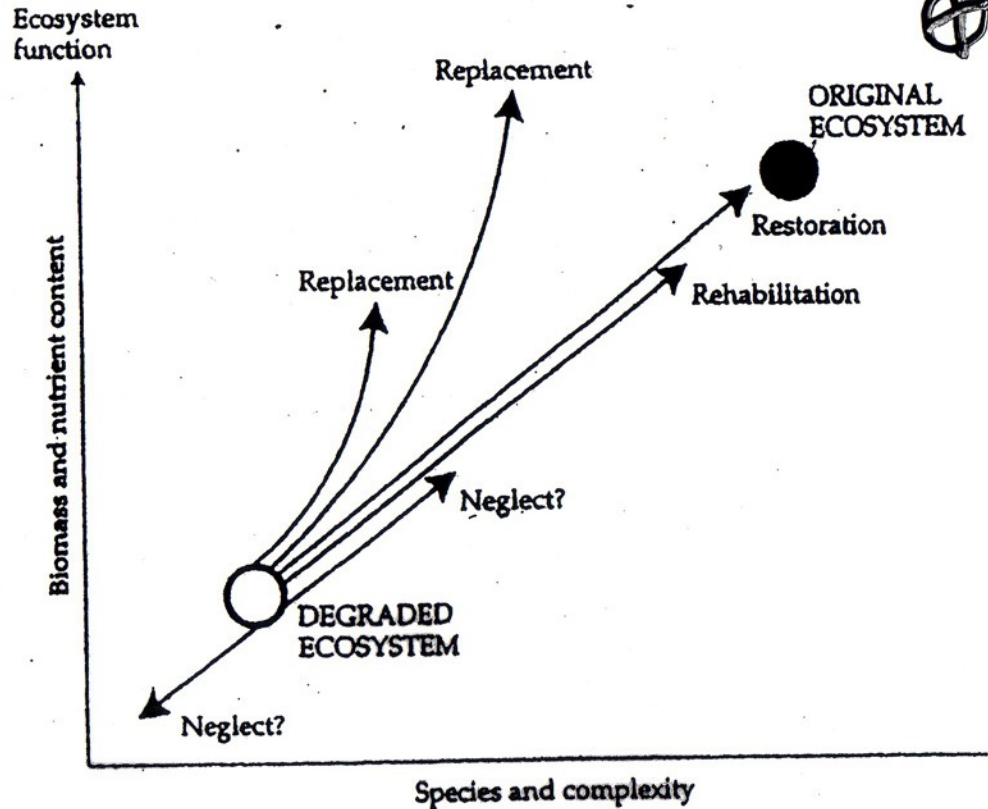
Figure 14.1 The trajectory of a restoration project may be viewed in terms of ecosystem structure and function. A change in both dimensions occurs upon degradation; the restoration process is an attempt to direct the system back toward the original state. Complete restoration would involve return to that state; partial return, or other trajectories, would result in rehabilitation or replacement by a different system. (Modified from Bradshaw 1984.)



From: Meffe and Carroll, 1994. Principles of Conservation Biology. Sinauer Associates, Sunderland, MA. 600 pp.

Figure 14.1 The trajectory of a restoration project may be viewed in terms of ecosystem structure and function. A change in both dimension occurs upon degradation; the restoration process is an attempt to direct the system back toward the original state. Complete restoration would involve return to that state; partial return through other trajectories, would result in rehabilitation or replacement by a different system. (Modified from Bradshaw 1984.)

FUNCTION AXIS



FORM AXIS

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Figure 14.1 The trajectory of a restoration project may be viewed in terms of ecosystem structure and function. A change in both dimension occurs upon degradation; the restoration process is an attempt to direct the system back toward the original state.

FUN

Ecosystem function

Replacement

ORIGINAL ECOSYSTEM

Restoration

Rehabilitation

Form follows function: A familiar adage.

What do you want the project site to do?

FUN

Biomass

Neglect?

DEGRADED ECOSYSTEM

Neglect?

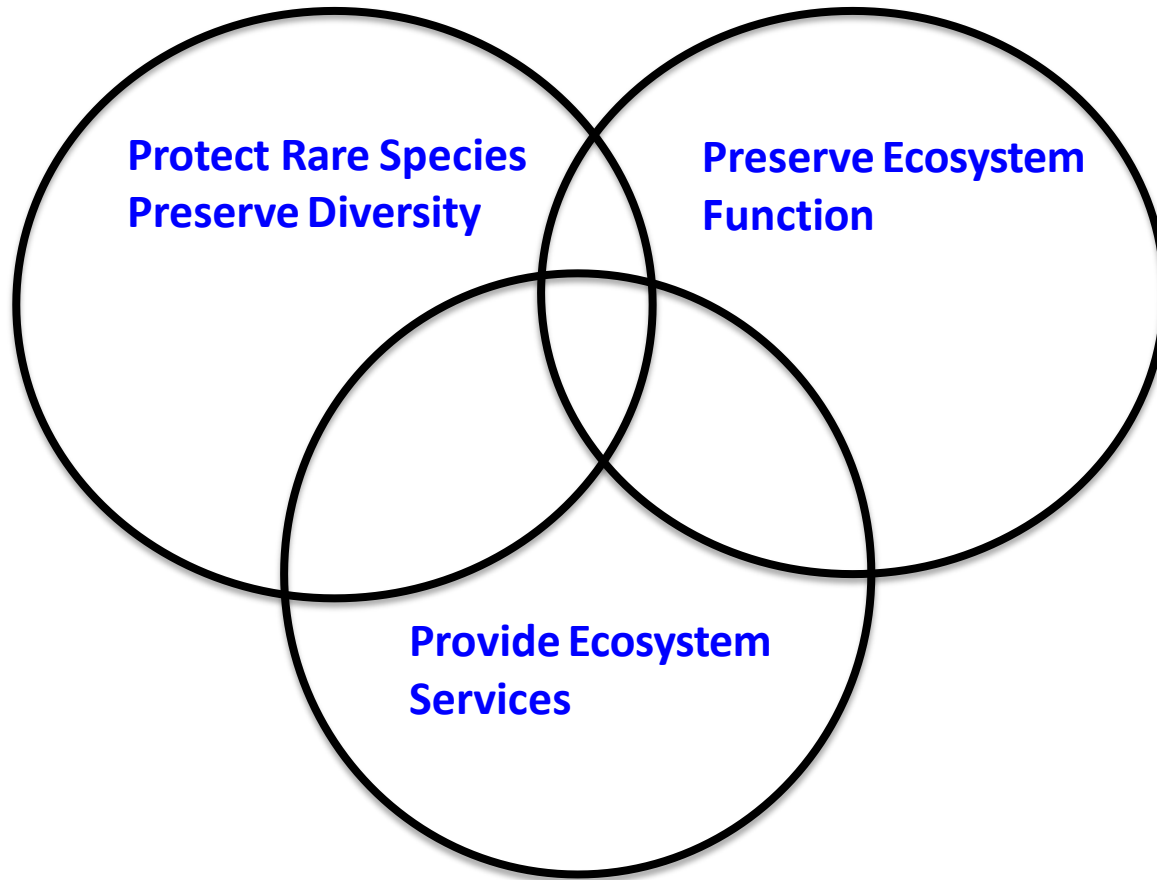
Species and complexity

FORMAXIS

From: Meffe and Carroll, 1994. Principles of Conservation Biology. Sinauer Associates, Sunderland, MA. 600 pp.

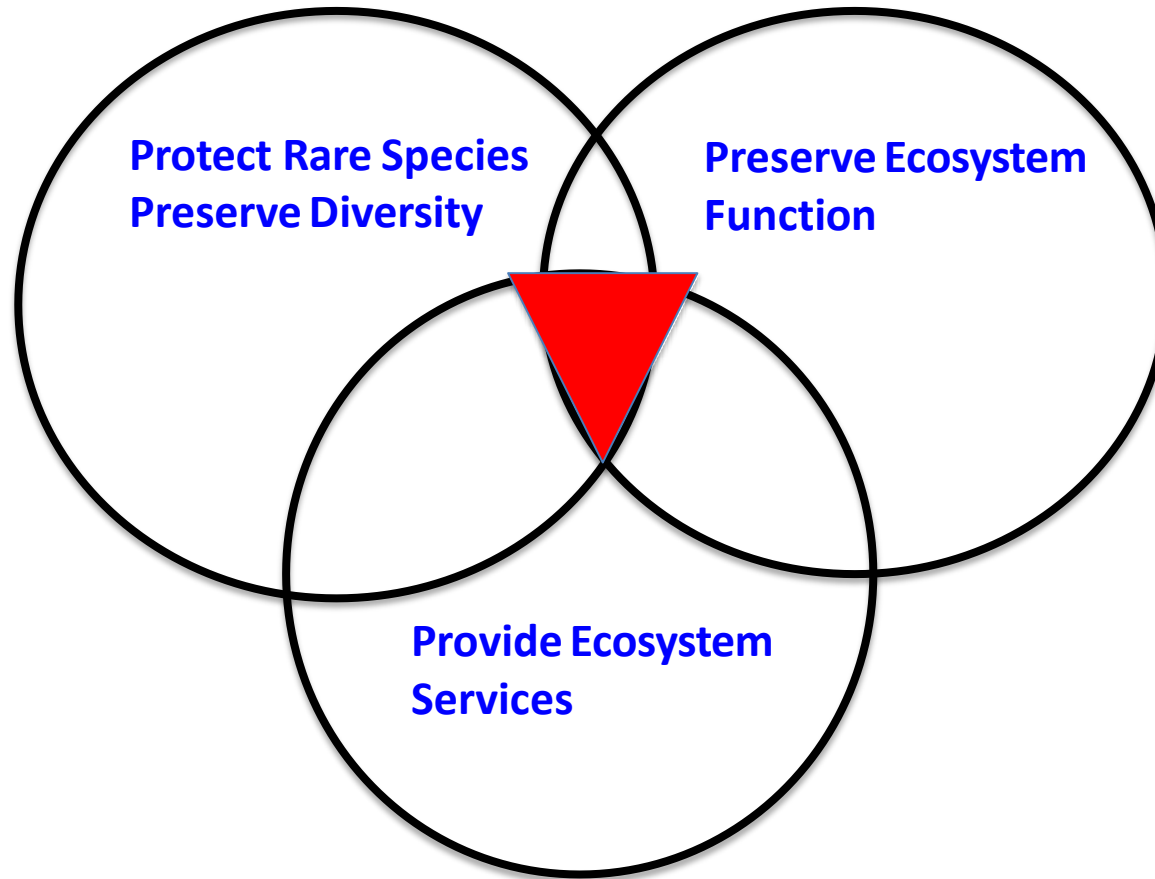
Setting the stage:

Why do restoration in the first place?



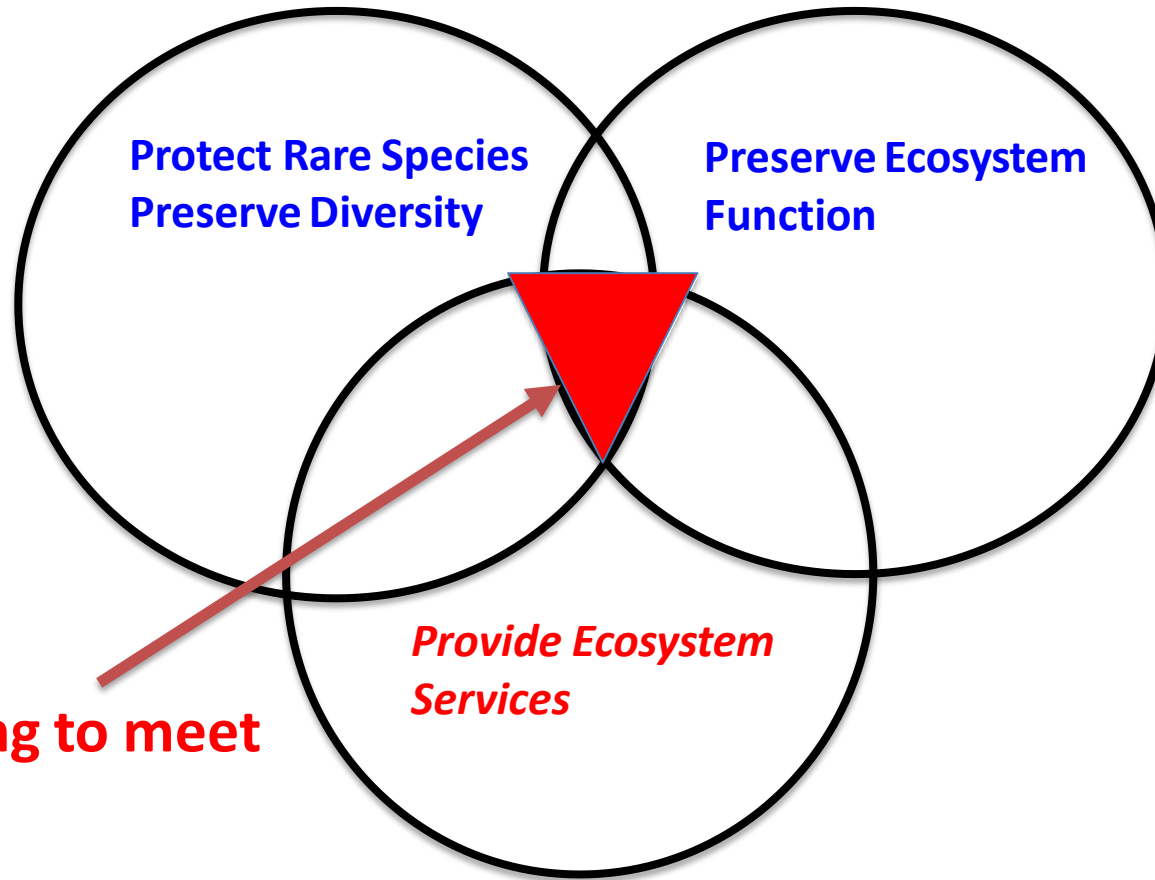
Setting the stage:

Why do restoration in the first place?



Setting the stage:

Why do restoration in the first place?



Protect Rare Species
Preserve Diversity

Preserve Ecosystem
Function

*Provide Ecosystem
Services*

**It's challenging to meet
all 3 goals!**

The Ecosystem Services Approach

requires us to decide what we want

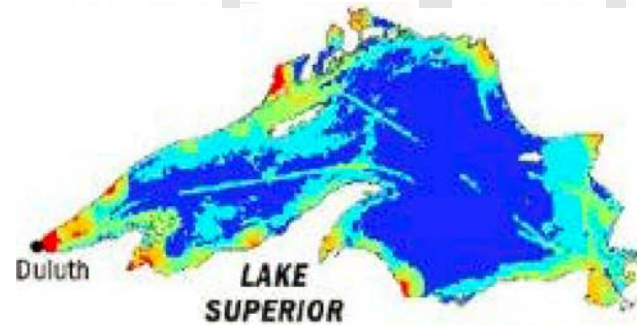
an ecosystem to do

Ecosystem Services

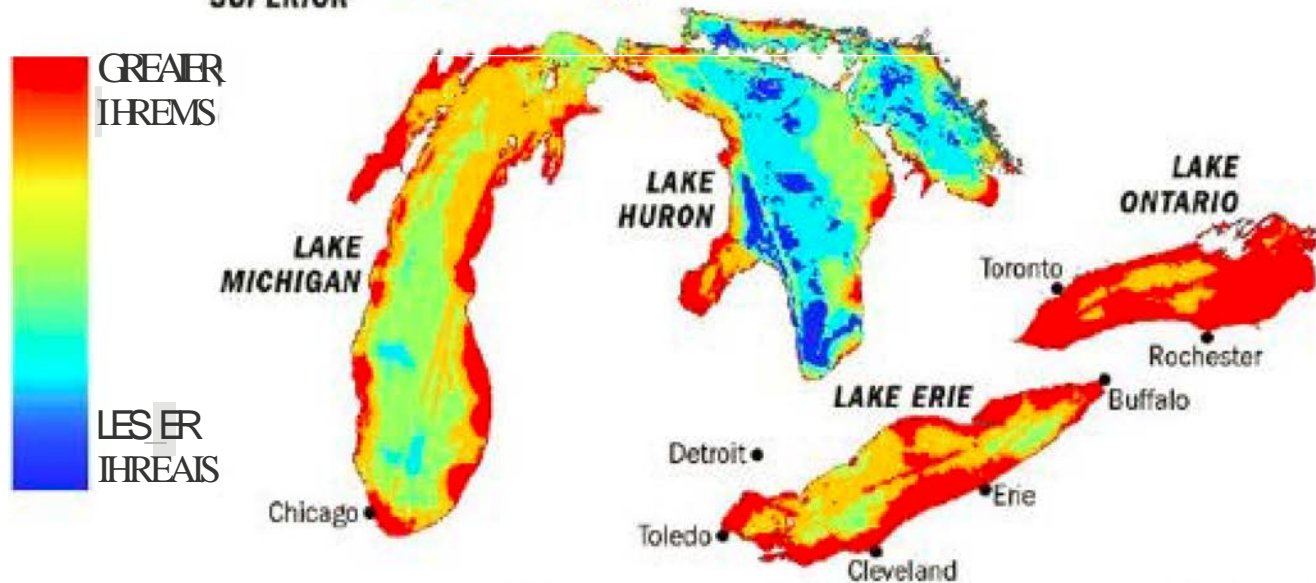
Clean Air

Clean Water

Measuring threats to the lakes



Researchers at the University of Wisconsin and the University of Michigan created this Great Lakes "threat map" by analyzing 34 stressors that affect the lakes. Those stressors include invasive species, toxic algae, erosion, development and toxic pollutants. The analysis ranks Lake Erie as the second-most-threatened lake, behind Lake Ontario.

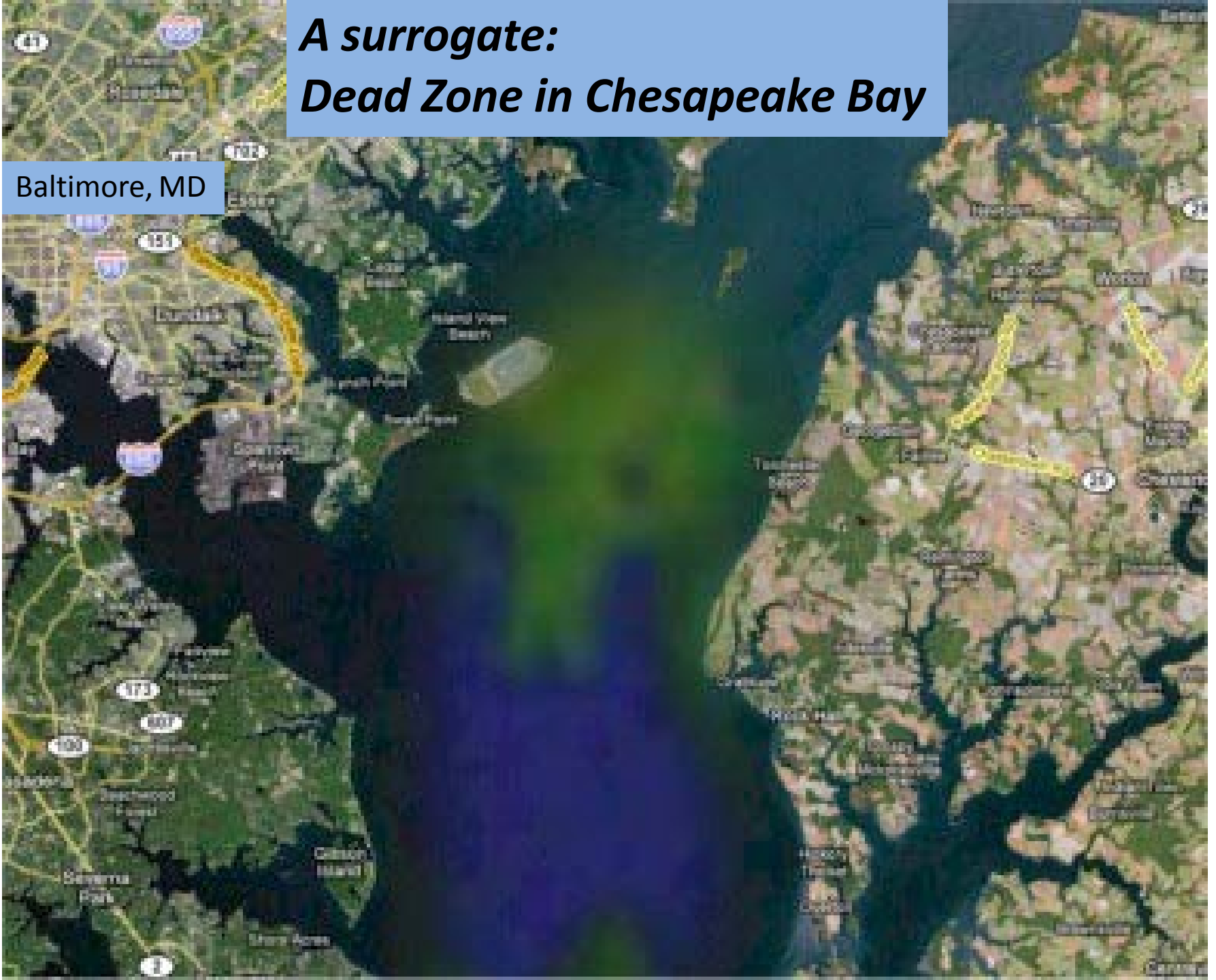


Sources: Great Lakes Environmental Assessment and Mapping Project, University of Michigan

THE COLUMBUS DISPATCH

A surrogate: Dead Zone in Chesapeake Bay

Baltimore, MD



A satellite map of the Chesapeake Bay watershed. The map shows the bay and its tributaries, including the Potomac, Rappahannock, and James rivers. Major cities like Baltimore, Washington D.C., and Annapolis are visible. A large blue text box is overlaid on the right side of the map, and a smaller blue text box is on the left side near Baltimore.

Dead Zone in Chesapeake Bay

Baltimore, MD

Eutrophication caused by N & P pollution

Agriculture

Urban & suburban development

Transportation, fossil fuel combustion

Watershed includes 40 million acres

MD, VA, WVA, PA, DC, **NY**

A satellite map of the Chesapeake Bay region, showing the bay, surrounding land, and major roads. A blue box at the top contains the title 'Dead Zone in Chesapeake Bay'. A smaller blue box on the left side of the map is labeled 'Baltimore, MD'. A large blue box in the center contains text about the Clean Water Act and EPA's Total Maximum Daily Loads, New York's annual limit of 10.54 million pounds of nitrogen, and the importance of wetlands.

Dead Zone in Chesapeake Bay

Baltimore, MD

Clean Water Act & EPA

*established **Total Maximum Daily Loads** for
each jurisdiction in the watershed*

*New York's annual limit is **10.54 million pounds**
of N*

*Wetlands help preserve water supply and
quality*

hence

The need to mitigate for wetland loss

A satellite map of the Chesapeake Bay region. A blue box at the top contains the title 'Dead Zone in Chesapeake Bay'. A smaller blue box on the left side of the map is labeled 'Baltimore, MD'. A large blue box in the center contains text about 'Mitigation Wetlands'. The map shows the bay, surrounding land, and major roads like I-95 and I-83.

Dead Zone in Chesapeake Bay

Baltimore, MD

Mitigation Wetlands: new, constructed wetlands

Off site

Typically 2:1 replacement

Today's example is intended to mitigate for losses caused by the Millennium Pipeline and Expansion of Binghamton Airport

A Poster child for an invasive species

Reed Canarygrass (Phalaris arundinacea)





Theories of Invasion Biology

Based on Species Characteristics

Propagule Pressure

Seeds

Rhizomes, other vegetative organs

Based on Site Characteristics

Disturbance Hypothesis

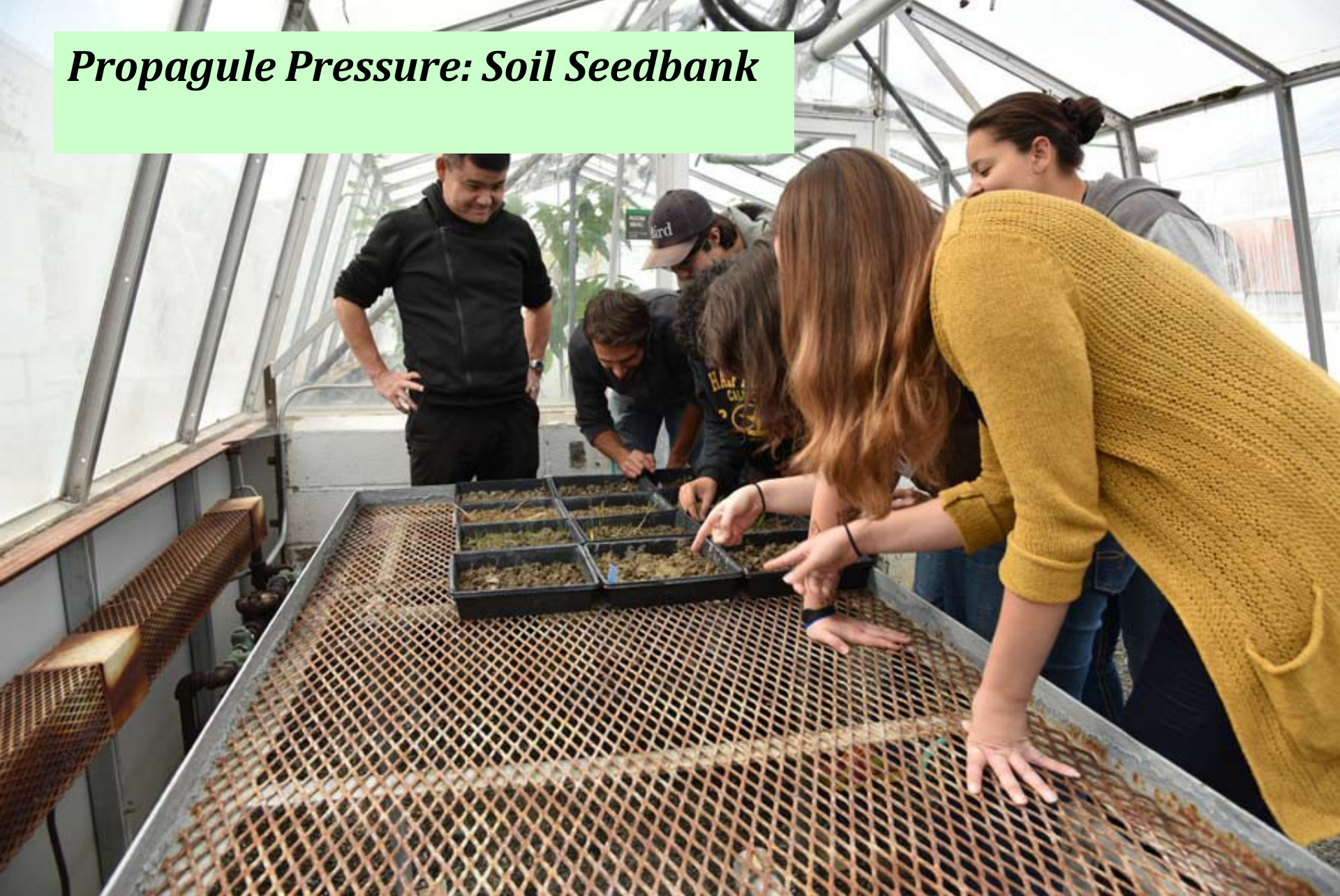
*Disturbances make resources
more available*

Clearing existing vegetation

Mowing roadsides



Propagule Pressure: Soil Seedbank



Soil Seedbank: 1 Week



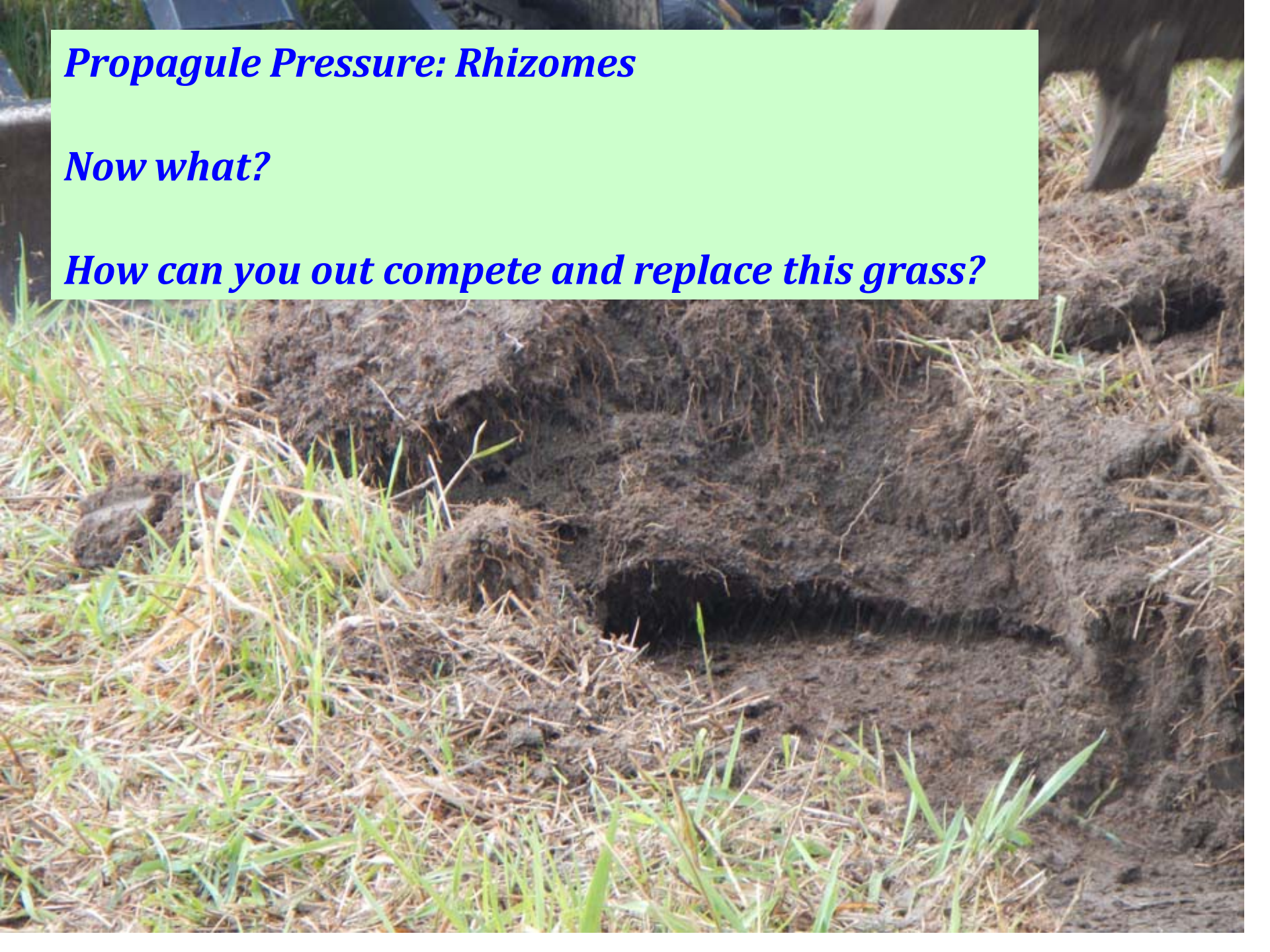
Soil Seedbank: 3 Weeks



Propagule Pressure: Rhizomes

Now what?

How can you out compete and replace this grass?



Let's mow it!



1 Week Later!

Maximum allowed by Army Corps cover is 5%



Let's herbicide it!

*Rodeo: Wetland formulation of Roundup
(Glyphosate)*



***1 Week Later!
Some damage***



Unsprayed



***Test: Mow and mulch around previously planted trees
Give trees a temporary advantage***



What about shading?

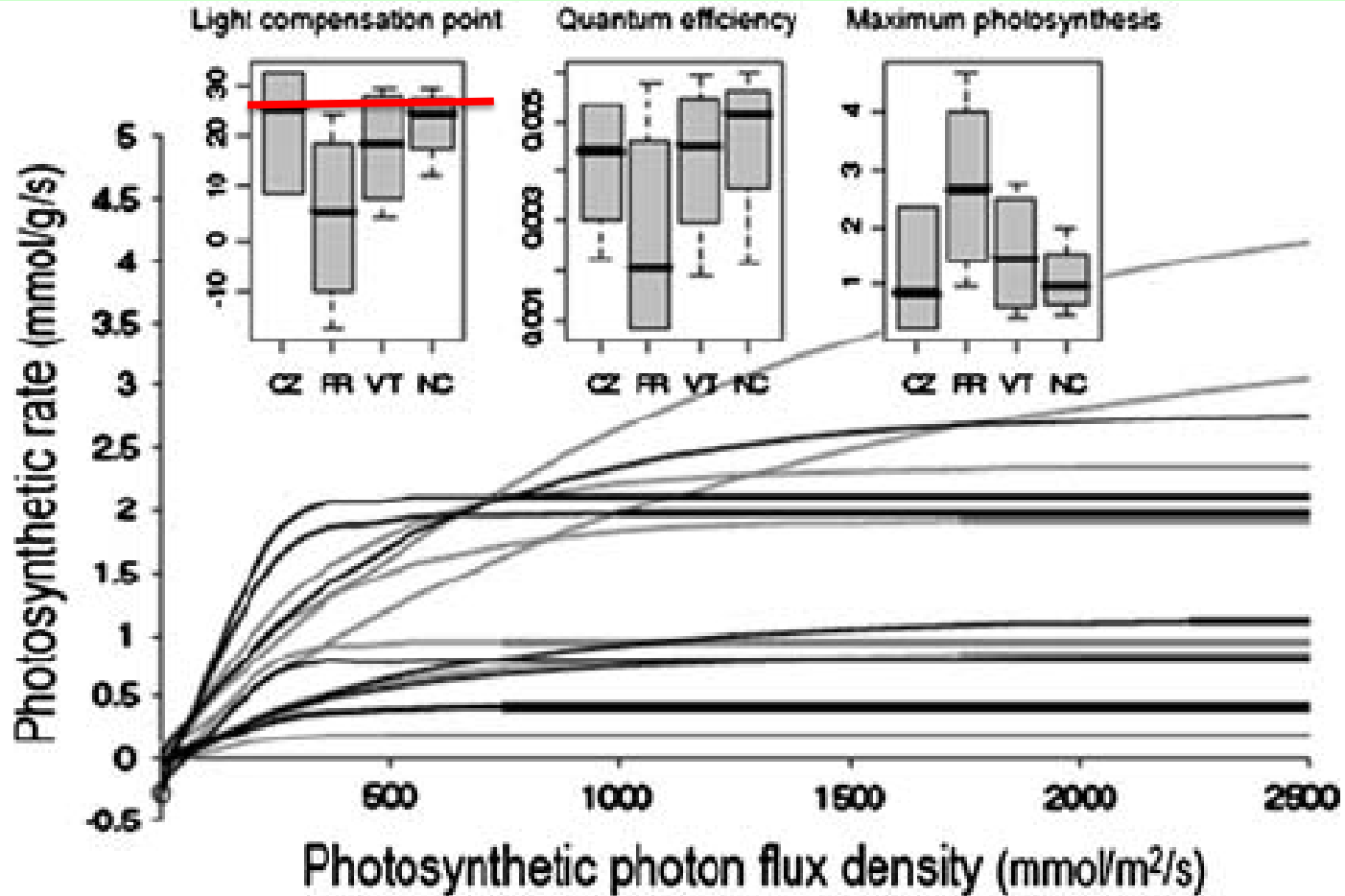


Requires high density and height



Plant physiology steps to the plate!

Phalaris has a high **Light Compensation Point**: Doesn't tolerate shade



Biol Invasions (2008) 10:1317–1325
DOI 10.1007/s10530-007-9206-x

ORIGINAL PAPER

Genetic variation in photosynthetic characteristics among
invasive and native populations of reed canarygrass
(*Phalaris arundinacea*)

Craig Brodersen · Sébastien Lavergne ·
Jane Molofsky

CZ = Czech Republic
FR = France
VT = Vermont
NC = North Carolina

Light Response Curve for Reed Canary Grass

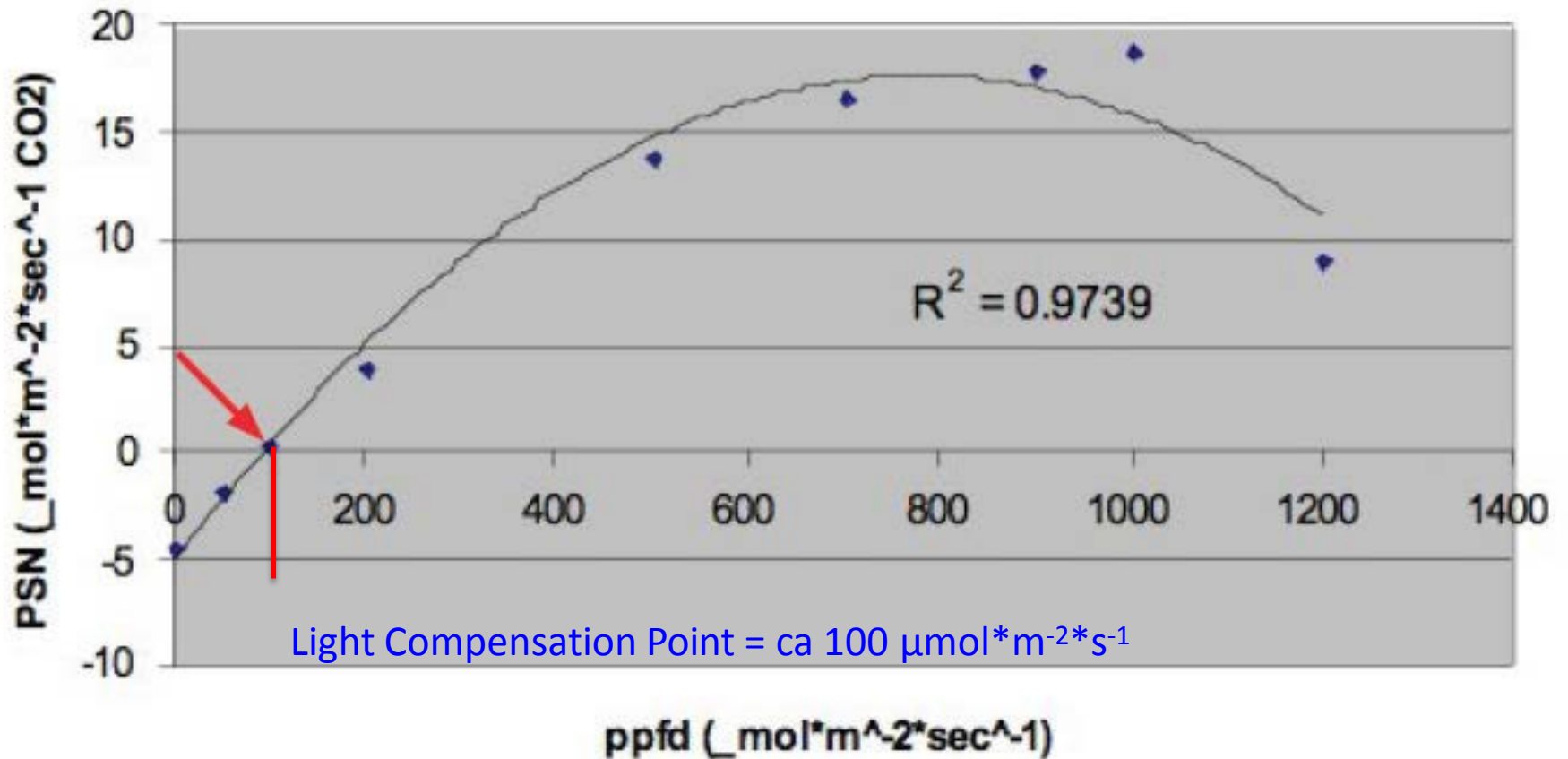
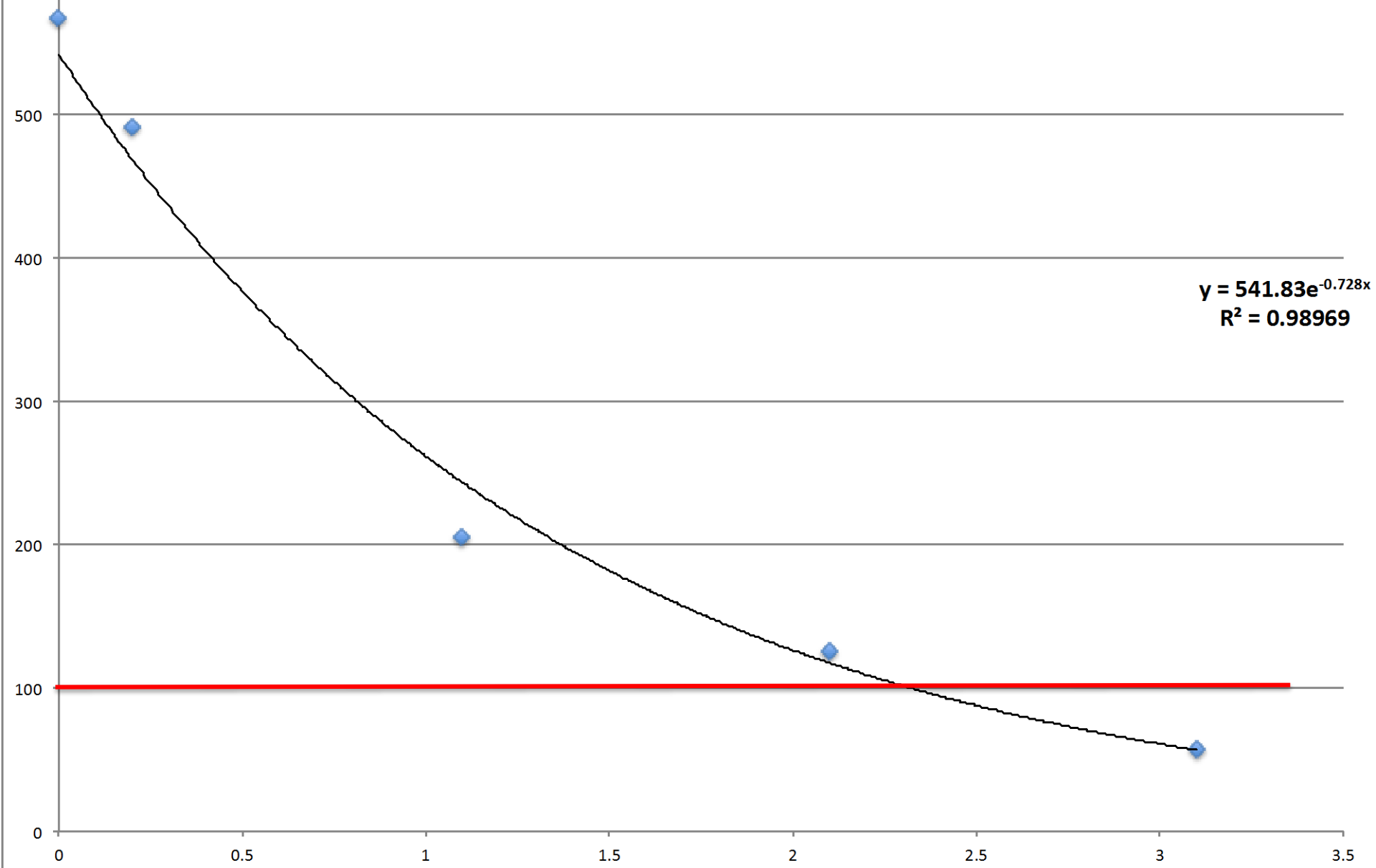


Figure 1. Reed Canary Grass Light Response Curve. Light compensation point is indicated by a red arrow. Below this point, Reed Canary Grass will respire to death.

How high a canopy is needed to shade out Phalaris?













Take Home:

What do you want the ecosystem to do?

***What functions are currently being performed by the
invasive species?***

Cannot just eradicate, must replace!

Long term sustainability depends on competitive exclusion

Need to understand entire system

Many details poorly understood

***Long term commitment to maintenance until community
becomes self-regulating***

***You may not be able to meet all restoration goals;
must set priorities***

Questions?

