



**21st Century Tools  
for Tackling  
Invasive Plants:  
Identify, Prioritize,  
Mobilize!**

**Elizabeth Farnsworth**

**New England Wild Flower Society**

Tell your neighbor a **success** story!



Christopher Mattrick



# My own **invasive** story: *Phragmites*



Laura Meyerson, Alyssa Mahoney



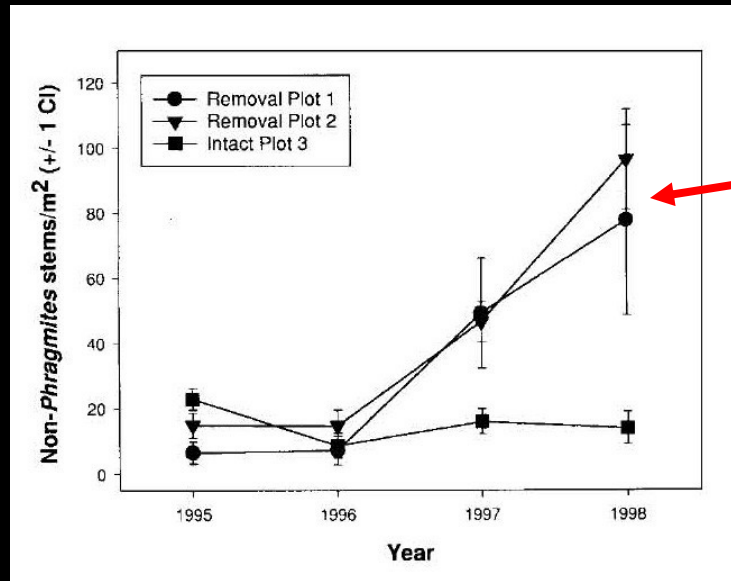
**What are the effects on tidal wetland  
community structure when  
*Phragmites* is removed?**





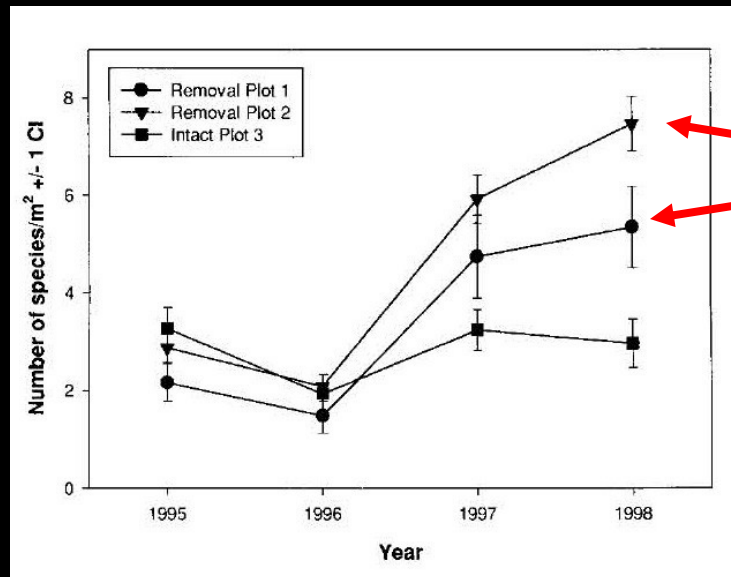
# Recovery of wetland vegetation

Density



Removal plots

Species richness



Removal plots

**YAY!**





# What species come in?

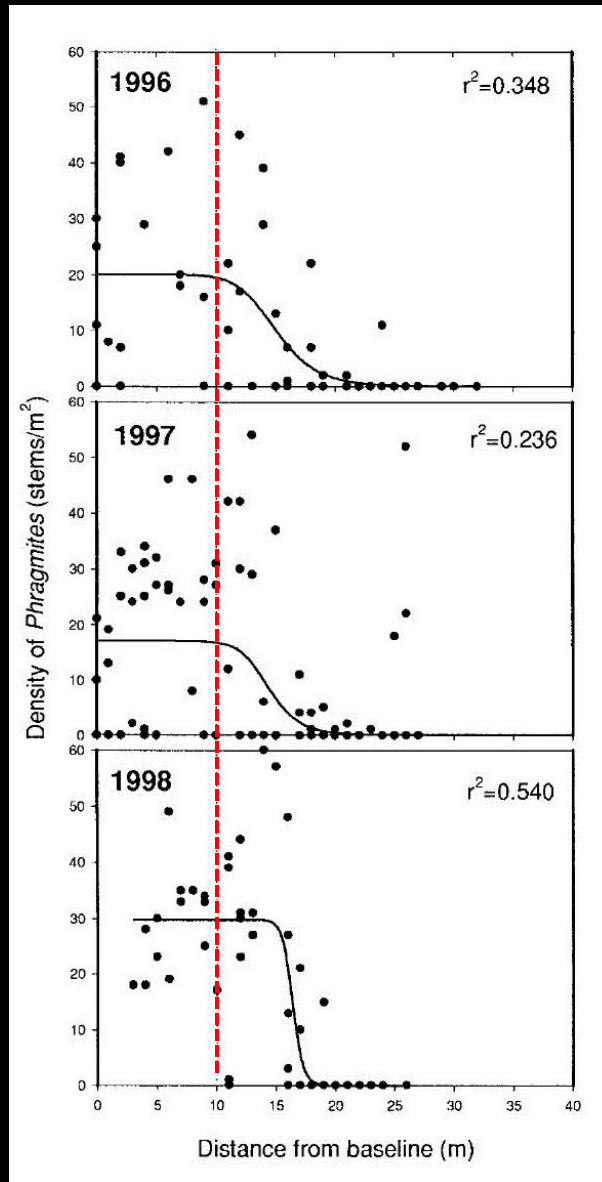


**Year 2**  
**Wild rice!**  
**Yay!**



**Year 3**  
**Cattails!**  
**Hmmm!**

# Does the *Phragmites* come back?





Is it **hopeless**???



# We HAVE made **progress** in:

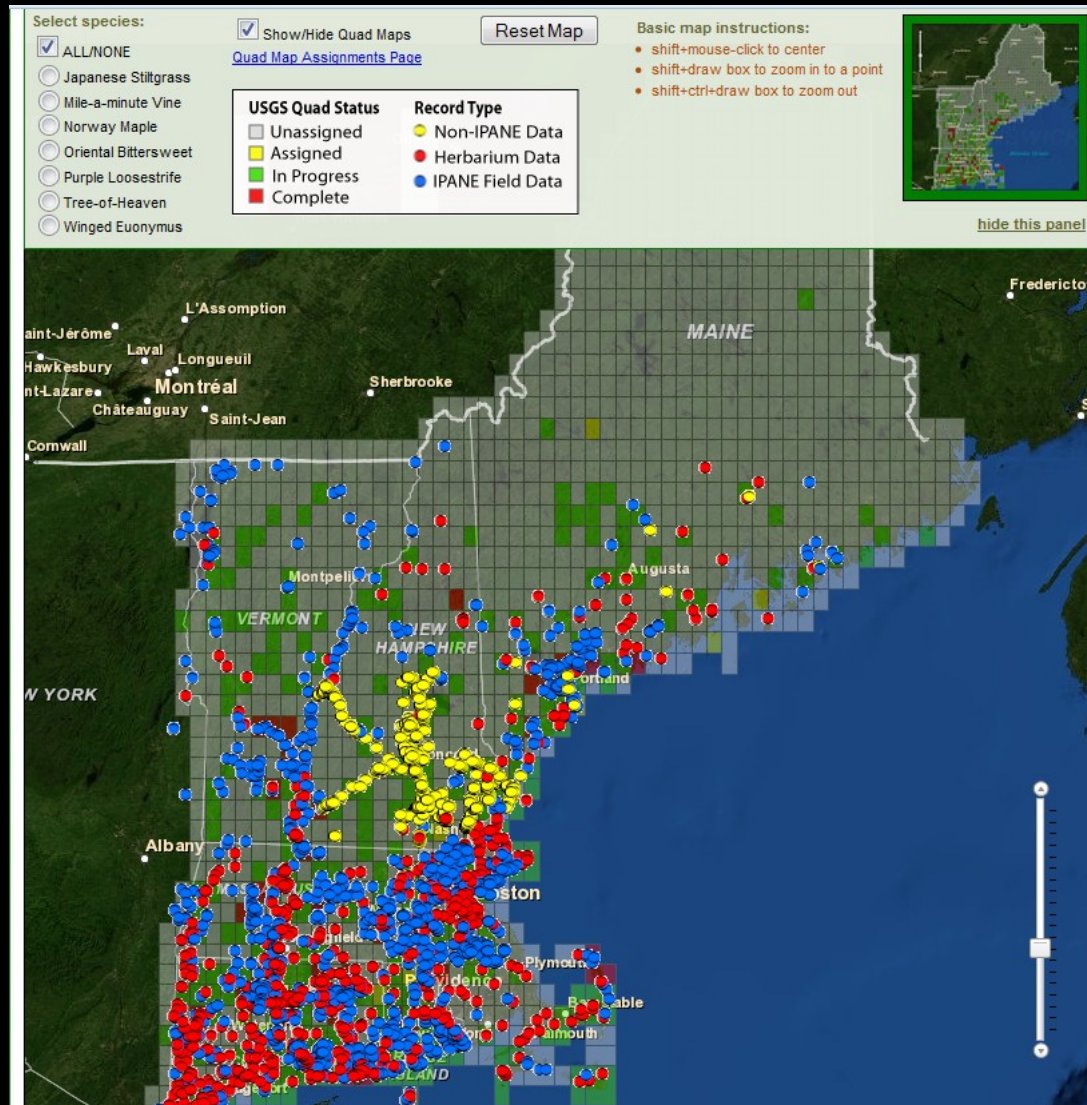
- **Identifying** most invasive species
- **Targeting** new potential invasives
- **Improving** the science
- **Educating** the public
- **Restoring** sites with volunteers





# Identifying most invasive species

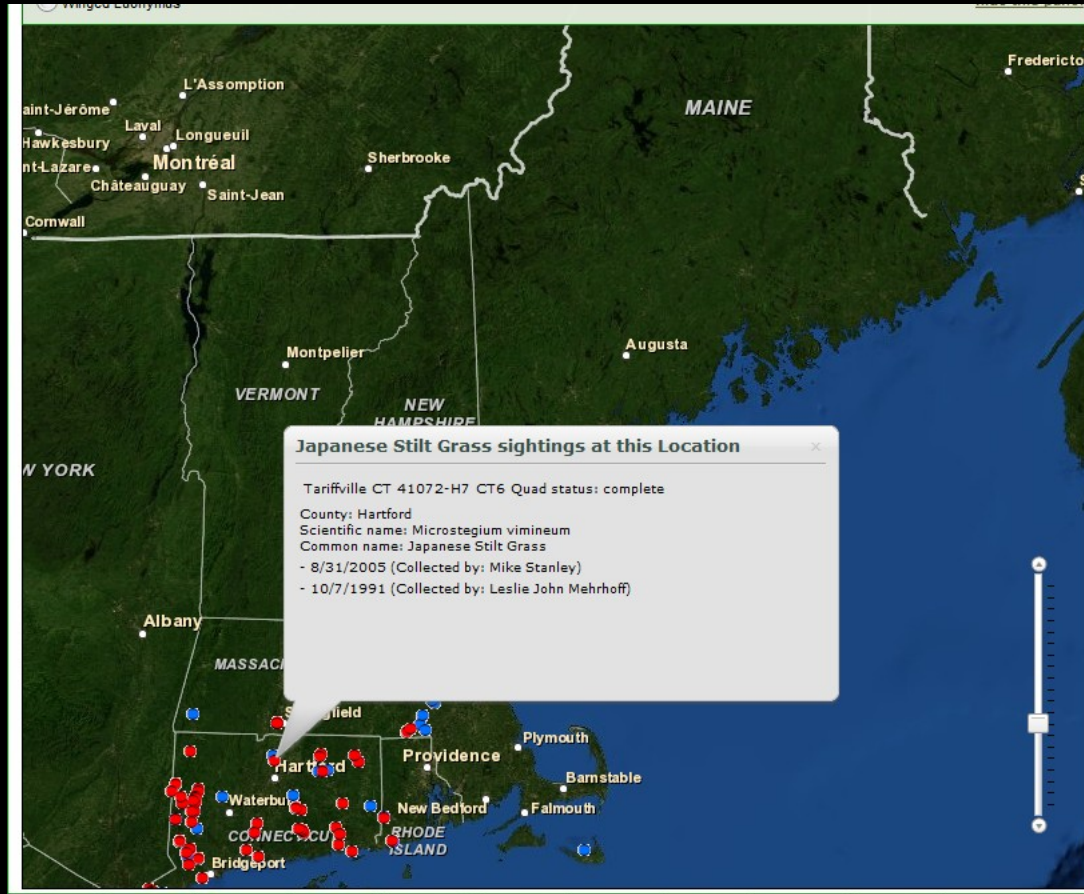
## Regional atlases



IPANE  
mapping  
tool

# Identifying most invasive species

## Regional atlases

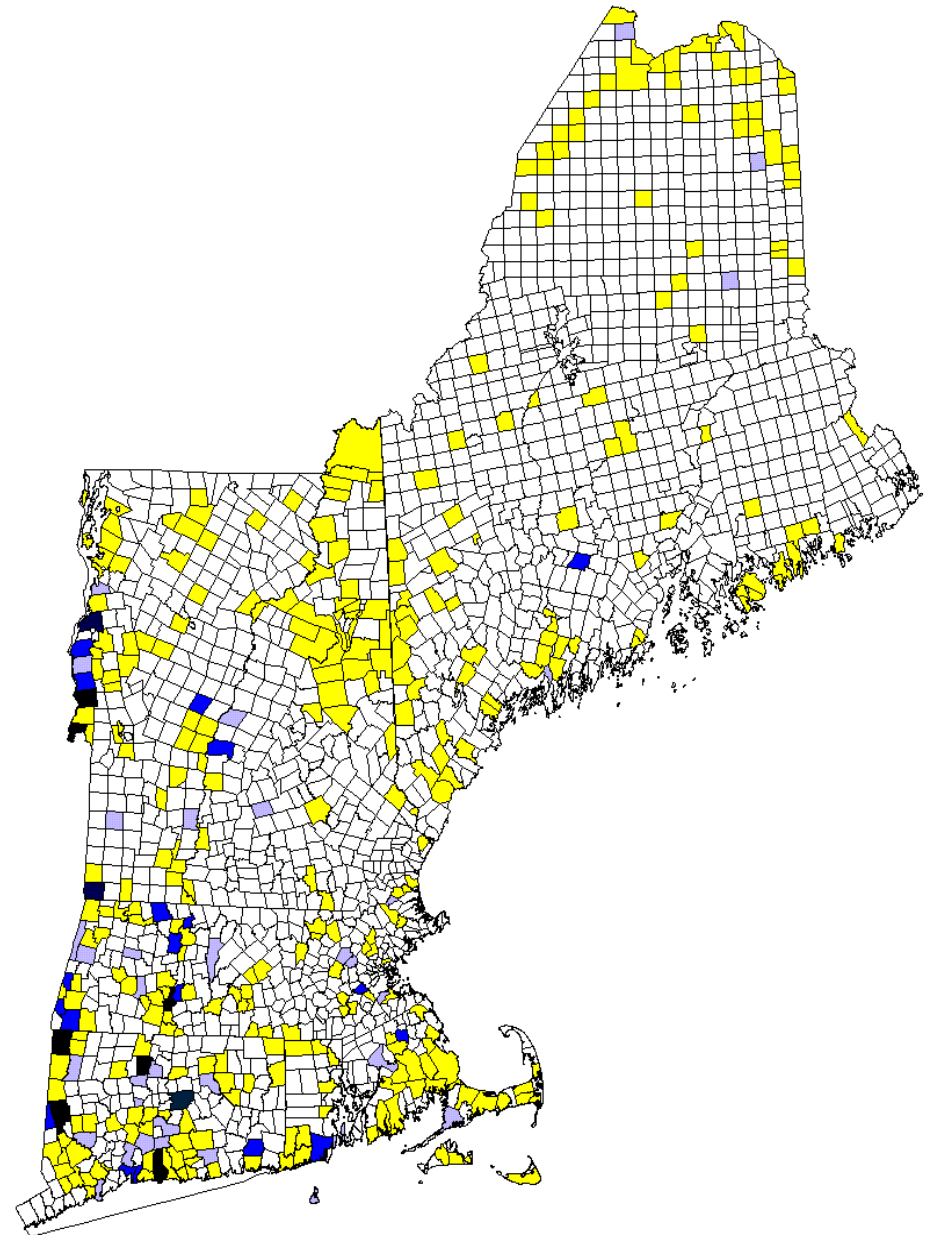


*Microstegium vimineum*



# Map data

- Clusters of **invasive** species at **rare** plant sites
- Major rivers
- Invasion frequency is correlated with rare species richness



# **Targeting** new potential invasives

## **Characteristics of invasives**

**Small seeds**

**Plastic life histories**

**Multiple habitats**

**Non-biotic pollination**

**Taxonomic novelty**

**New ecosystem functions**

**Polyploidy**

**Small genomes**

**Pyšek et al. 2009. *Diversity & Distributions* 15: 891-903**

**Schmidt et al. 2012. *Ecological Applications* 22: 1512–1525**

**te Beest et al. 2011. *Annals of Botany* (doi:10.1093/aob/mcr277)**



# *Phragmites!*



**McCormick et al. 2010. *Journal of Ecology* 98:1369-78**



# *Phalaris arundinacea*

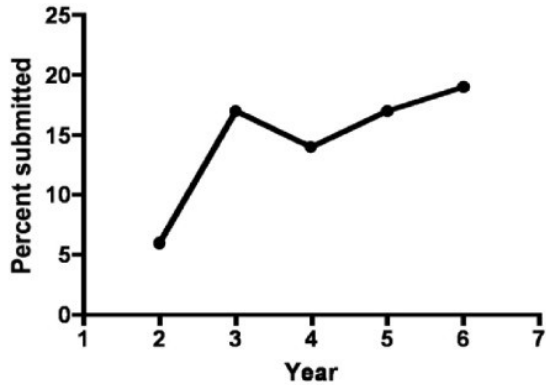


Lavergne et al. 2010. *Annals of Botany* 105: 109–116  
Lavergne and Molofsky. 2007. *PNAS* 105: 3883–3888



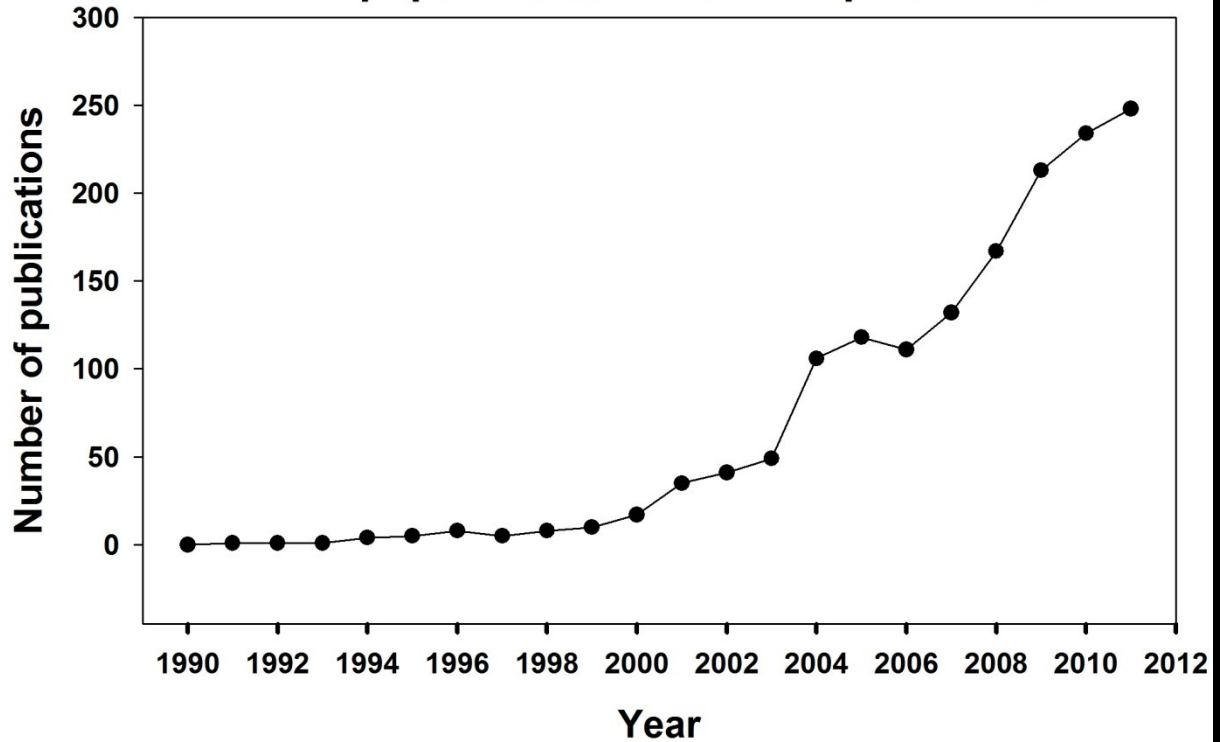
# Improving the science

Invasive species



*Natural Areas Journal*  
2002-2006

Trends in papers with "Invasive Species" in title



Science Citation Index

# **Improving** the science

**Rapid evolution**

**Allelopathy**

**Demographic models**

**Community assembly & invasibility**

**Ecosystem ecology**

**Plant-soil interactions**

**Biotic homogenization**

**Responses to climate change**

**Calloway & Maron. 2006. *TRENDS in Ecology and Evolution* 21:369-74**

**Lockwood et al. 2007. *Invasion Ecology*. Blackwell Publishing, USA**

**Davis, M. 2009. *Invasion Biology*. Oxford Press, UK**



# Improving the science



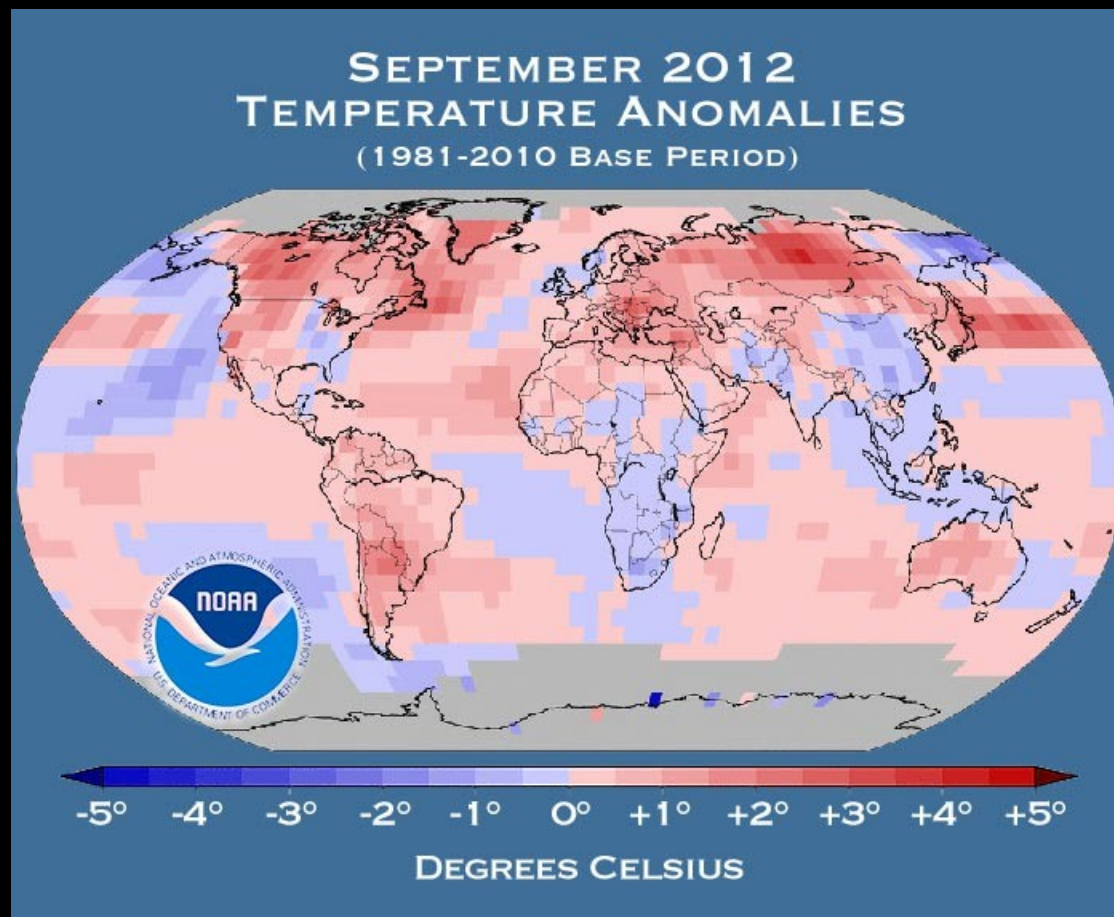
Less of a “controversy” than we think.

*Invasion Biology: Paradigms Glossed. Anne Arbutnot, 2012.*

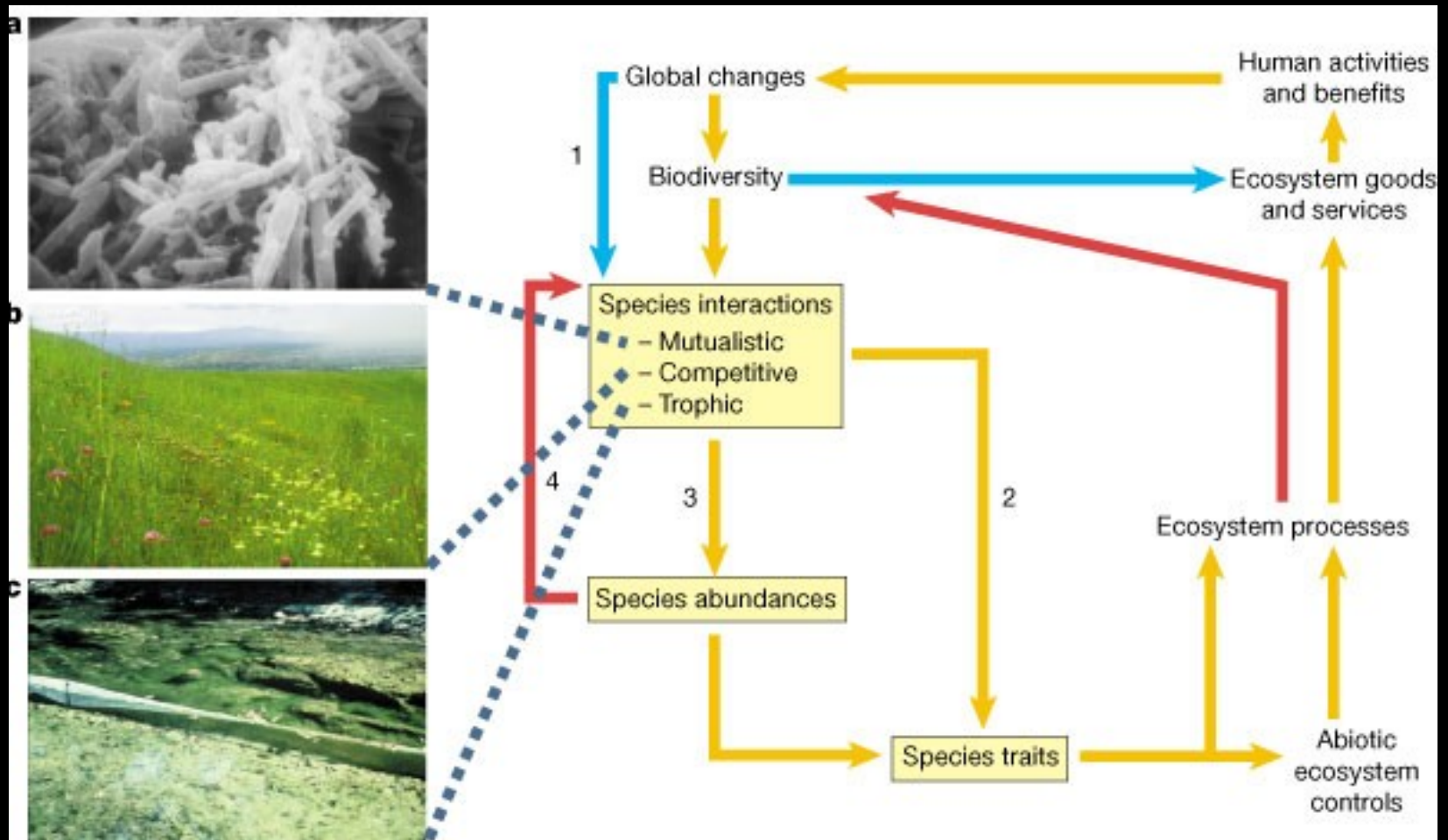
# Improving the science

Multi-trophic interactions

Responses to climate change



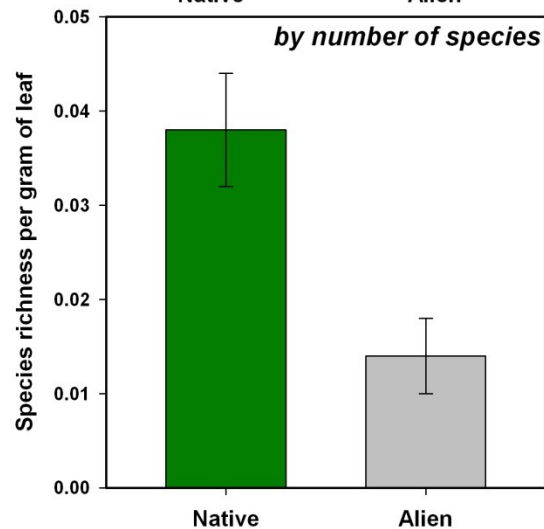
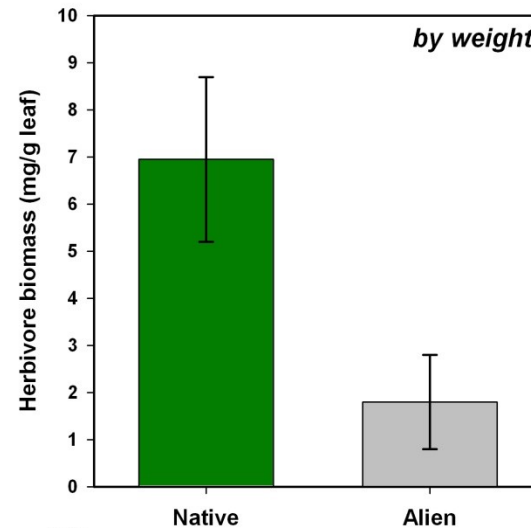
# Multi-trophic interactions





# Herbivores

Native plant species support more herbivores



Tallamy, D. 2007. *Bringing Nature Home*. Timber Press, OR.

# Global Warming: Bottom-up



*Microstegium vimineum*



Kourtev et al. 1999. *Biological Invasions* 1: 237–245  
Heneghan et al. 2007. *Pedobiologia* 50: 543-551

# Deer: Top-down



**Seed dispersal**  
**Removal of competing vegetation**

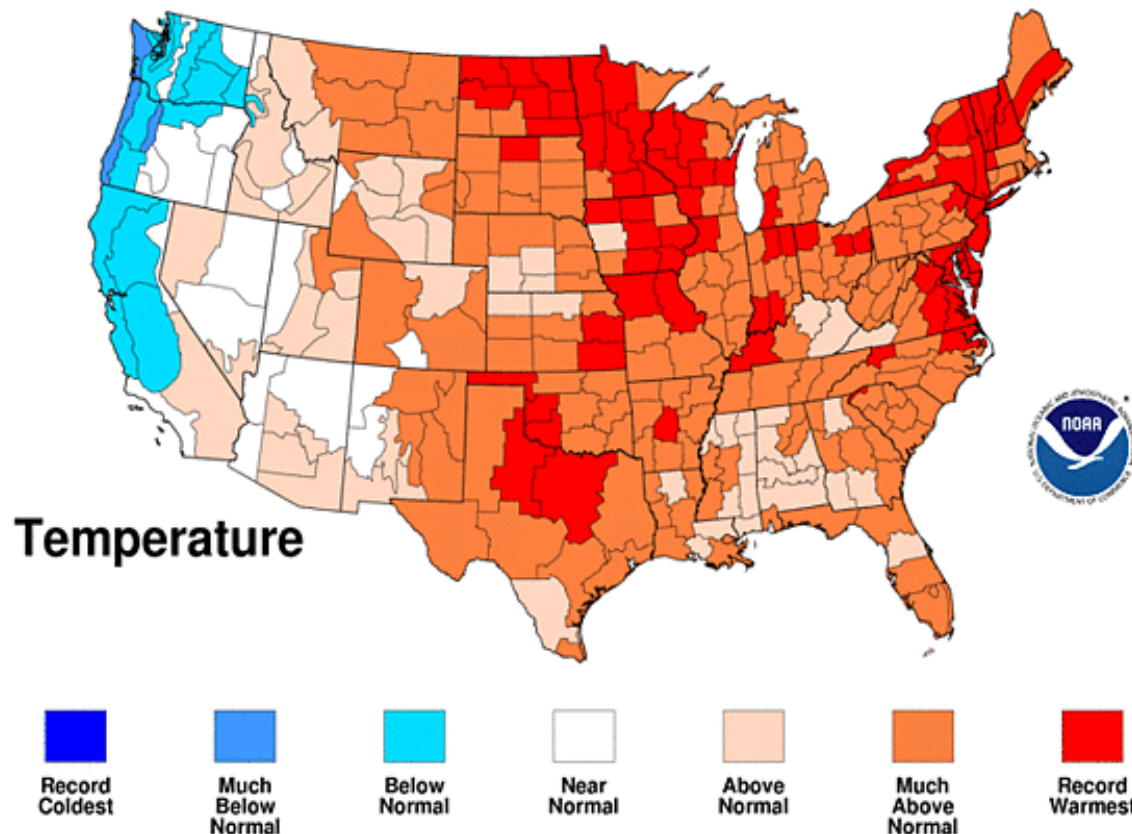
**Williams & Ward. 2006. *Natural Areas Journal* 26: 383-390.**



# Responses to climate change

## May 2011 - Apr 2012 Divisional Ranks

National Climatic Data Center/NESDIS/NOAA



# Responses to climate change in Concord, MA

**Invasives track seasonal temperature variation  
better than natives**

**Invasives shifted flowering time:**

**11** days earlier than natives and

**9** days earlier than non-native non-invasives

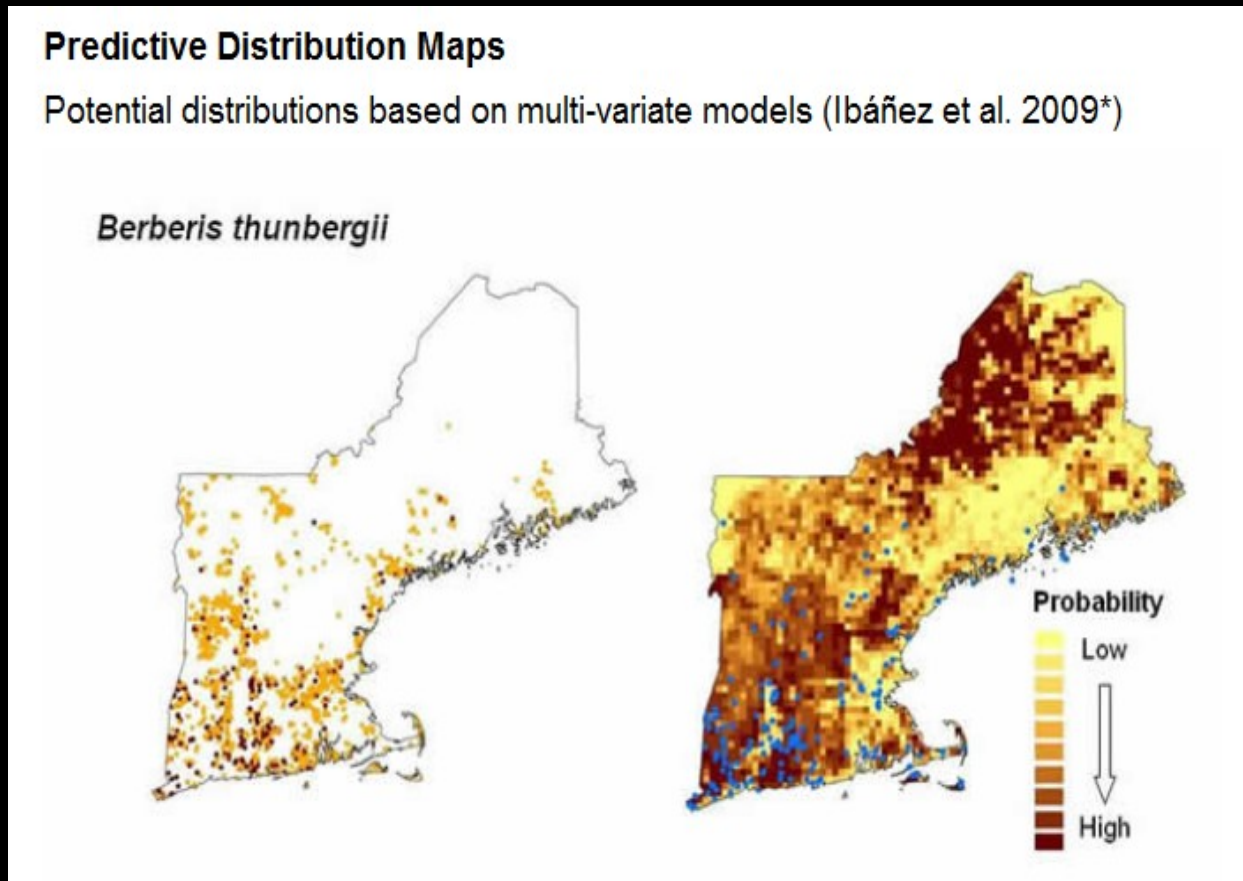
# Management advantage?





# Responses to climate change

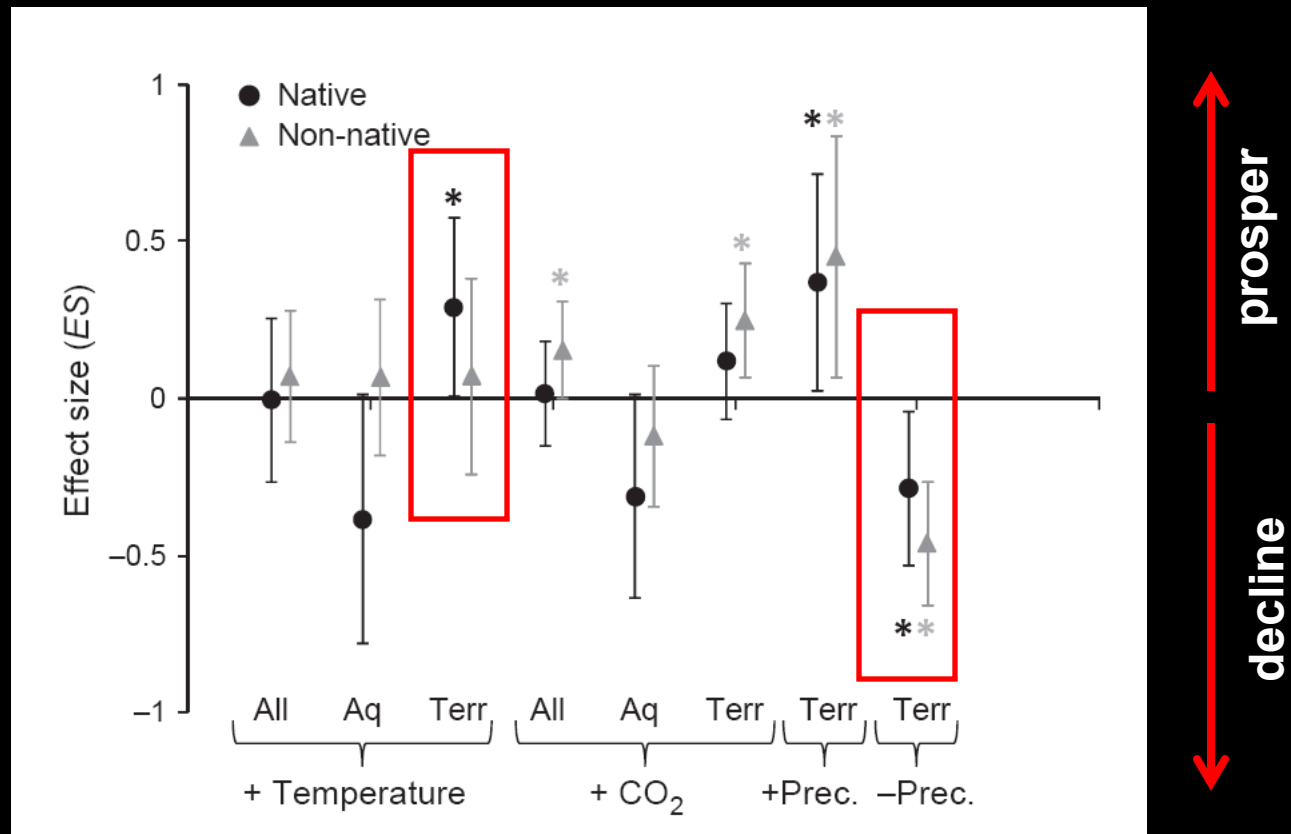
## Models of present, potential and future species range



Ibáñez, I., et al. 2009. *Ecological Applications* 19: 359-375.

# Responses to climate change

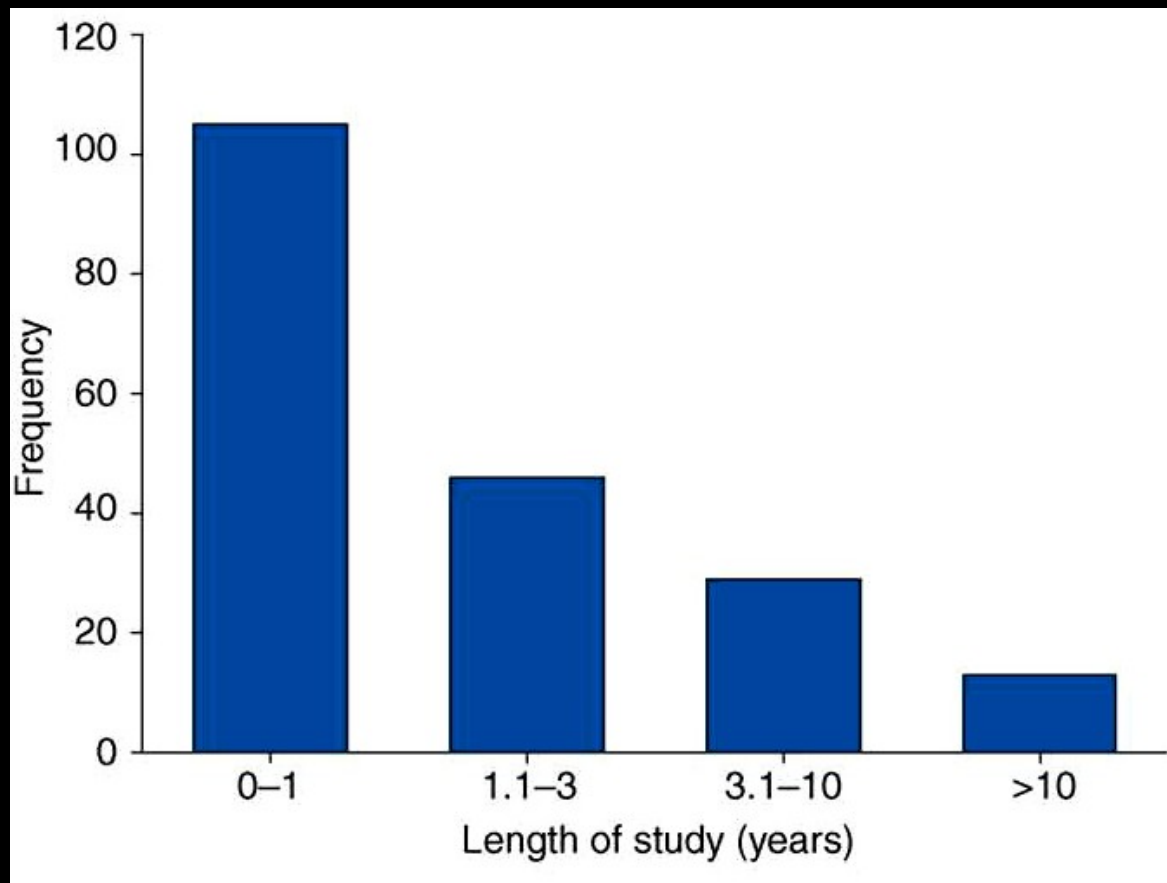
All invasives “poised to prosper?”



Sorte, C., et al. 2012. *Ecology Letters* doi: 10.1111/ele.12017.

# Need for long-term study

That's what pointy-headed academics are for...



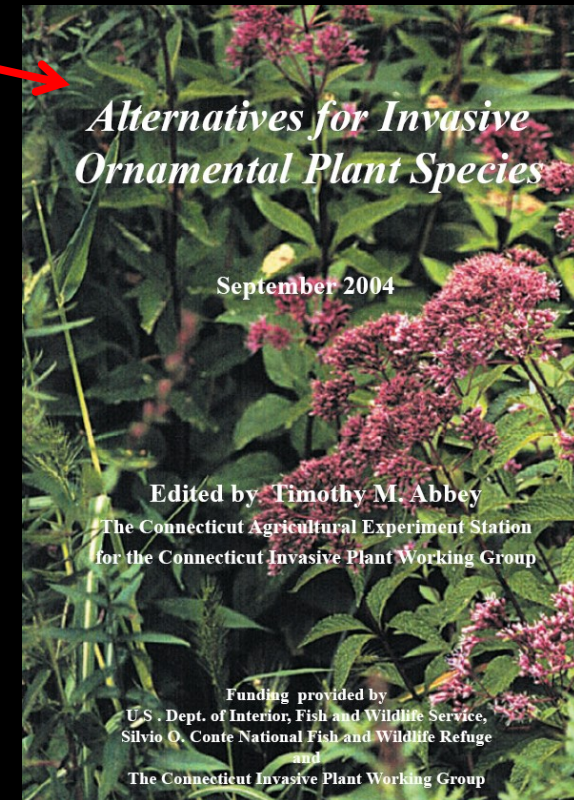
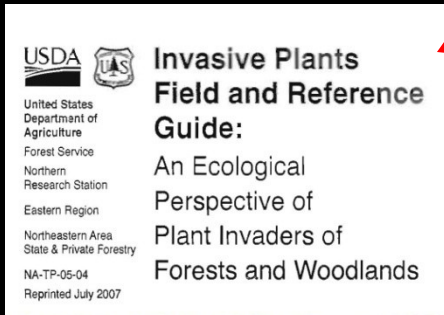
Strayer, D., et al. 2006. *TRENDS in Ecology & Evolution* 21: 645-651.






# Educating the public

Fact sheets  
Alternatives  
Go Botany!










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### Simple ID Key

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Go Botany encourages informal, self-directed education in botany for science students and beginning and amateur botanists. Professors, teachers, and environmental educators can share curricula and teaching ideas.

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#### Plant of the Day: PRUNUS VIRGINIANA *choke cherry*

Choke cherry may get its name from its astringent and rather unappetizing fruits. The flowers are borne on drooping racemes at the ends of branches, appearing with the leaves in late May and June. Its broad, egg-shaped leaves distinguish it from its look-alike, pin cherry ...


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# Narrow to group



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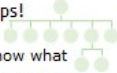
You are here: [Simple Key](#)

## Which group best describes your plant?

Want help getting started?  
If you're not sure what to do from here, take a look at this [Help page](#) for instructions.


[GET HELP](#)

Shortcut to Groups!



If you already know what group your plant is in, start with the clickable plant map to find your plant more quickly.


[VIEW MAP](#)



**Woody plants**  
*Trees, shrubs, sub-shrubs, and lianas*

- KEY CHARACTERISTICS  
Stems have secondary thickening (i.e., bark)
- EXCEPTIONS  
Some small, low-lying shrubs can be mistaken for herbaceous plants.
- [VIEW A SHORT VIDEO ABOUT THIS GROUP](#)


[MY PLANT IS IN THIS GROUP](#)



**Aquatic plants**  
*Plants with most of their parts submerged under water*

- KEY CHARACTERISTICS  
Specialized leaves and tissues that can withstand flooding
- EXCEPTIONS  
Some upland plants can be flooded temporarily but are not specialized for living under water
- [VIEW A SHORT VIDEO ABOUT THIS GROUP](#)

[MY PLANT IS IN THIS GROUP](#)



**Grass-like plants**

# Narrow to subgroup



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You are here: Simple Key > Orchids and related plants

## Want help getting started?

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GET HELP

## Shortcut to Groups!

If you already know what group your plant is in, start with the clickable plant map to find your plant more quickly.

VIEW MAP

## Is your plant in one of these subgroups?



### Orchids

Plants in the family Orchidaceae

#### KEY CHARACTERISTICS

Orchids have highly specialized flowers with colors and structures that attract (and sometimes fool) insect pollinators. Sacs, called pollinia, contain the pollen grains. It is easiest to tell orchids apart by their flowers, so it helps to observe a mature, flowering plant. The leaves have parallel veins and are often oval (narrow in a few species). Sometimes the veins are prominent enough to make the leaf look pleated (i.e., *Cypripedium* species). Notice whether the leaves all grow at the base of the plant, or whether some grow on the stem. Some orchids produce leaves with green-and-white or spotted color patterns. The seeds are tiny and dispersed by wind. Young embryos get a head-start by drawing nutrients from associated fungi (mycorrhizae).

#### EXCEPTIONS

Orchid leaves can be confused with lily leaves, but orchid flowers -- with a large, modified lip -- are very different from all other monocots.

MY PLANT IS IN THIS SUBGROUP



### Irises, lilies, and other "monocots"

Lilies, irises, aroids and others

#### KEY CHARACTERISTICS

"Monocots" are a broad category of plants that include grasses, sedges, and orchids (all plants whose embryos have only one leaf). Here, we separate out these other categories and just include the remaining species. The leaves have Look

# Answer some questions

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You are here: Simple Key > Orchids and related plants > Orchids

## Orchids

25 matching species

Photos List

Show photos of: flowers

Pick a question from this scrollable list:

- Habitat?
- New England state?
- Leaf arrangement?
- Number of leaves on stem?
- Form of lower petal?
- Lower petal outline?
- Main color of lower petal?
- Nectar spur?

GET MORE QUESTIONS

Add a few more questions for narrowing your matching species.

Already know the family or genus?

Family:

Genus:

Start Over:

*Arethusa bulbosa*  
dragon's-mouth

*Calopogon tuberosus*  
tuberous grass-pink

*Corallorhiza maculata*  
spotted coral-root

*Corallorhiza trifida*  
early coral-root

*Cypripedium acaule*  
pink lady's-slipper

*Cypripedium parviflorum*  
yellow lady's-slipper

*Cypripedium reginae*  
showy lady's-slipper

*Epipactis helleborine*  
broad-leaved helleborine



# Answer some questions



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You are here: Simple Key > Orchids and related plants > Orchids

Pick a question from this scrollable list:

- Habitat?
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- Form of lower petal?
- Lower petal outline?
- Main color of lower petal?
- Nectar spur?

GET MORE QUESTIONS

Add a few more questions for narrowing your matching species.

Already know the family or genus?

Family:  Clear

Genus:  Clear

Start Over:

CLEAR ALL

## Orchids


Photos List

25 matching species


### How are the leaves arranged along the stem?

The leaf arrangement may change higher up on the stem. Look at the leaf arrangement near the midpoint between the base of the stem and the base of the inflorescence.


don't know




alternate: there is one leaf per node along the stem (14)



opposite: there are two leaves per node along the stem (1)



the leaves are growing only at the base of the plant (basal) (9)



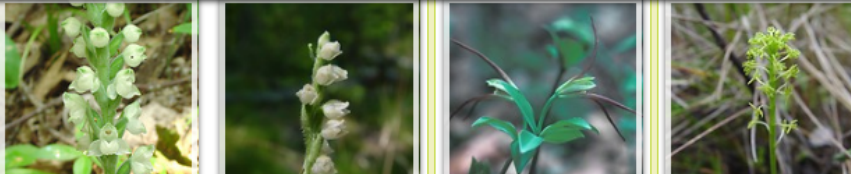
there are no apparent leaves except on the reproductive stems (2)



whorled: there are three or more leaves per node along the stem (2)

doesn't apply (0)

APPLY SELECTION



# Drawings of characters

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## Orchids

25 matching species

Photos List

Pick a question from this scrollable list:

- Habitat?
- New England state?
- Leaf arrangement?
- Number of leaves on stem?
- Form of lower petal?
- Lower petal outline?
- Main color of lower petal?
- Nectar spur?

**GET MORE QUESTIONS**

Add a few more questions for narrowing your matching species.

Already know the family or genus?

Family:


Genus:

Start Over:

**How are the leaves arranged along the stem?**

The leaf arrangement may change higher up on the stem. Look at the leaf arrangement between the base of the stem and the base of the inflorescence.

- don't know
- alternate: there is one leaf per node along the stem (14)
- opposite: there are two leaves per node along the stem (1)
- the leaves are growing only at the base of the plant (basal) (9)
- there are no apparent leaves except on the reproductive stems (2)
- doesn't apply (0)
- whorled: there are three or more leaves per node along the stem (2)



# Glossary – All terms defined

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You are here: **flower array; arrangement of flowers on a stem**

Pick a question from this scrollable list:

- Inflorescence type?**
- Main color of lower petal?
- Form of lower petal?
- Lower petal length?
- Lower petal outline?
- Spots on lower petal?
- Leaf arrangement?
- Nectar spur?

**GET MORE QUESTIONS**

Add a few more questions for narrowing your matching species.

Already know the family or genus?



Family:

Genus:

Start Over:

**What type of inflorescence does the plant produce?**

An inflorescence is an array of flowers on a single stem. Be sure to look at a mature specimen with fully open flowers.

don't know      doesn't apply (0)

the inflorescence has only one flower or a pair of flowers on it (6)

the inflorescence is a raceme (a long unbranched stem with stalked flowers growing along it) (11)

the inflorescence is a spike (a long unbranched stem with flowers along it that lack stalks) (11)

*Cypripedium acaule* pink lady's-slipper

*Cypripedium parviflorum* yellow lady's-slipper

*Cypripedium reginae* showy lady's-slipper

*Epipactis helleborine* broad-leaved helleborine



# Innovations

## The Whaddyagot feature

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### Orchids

25 matching species

What types of things can you tell about your plant?

Optional. Check one or more boxes based on things you can actually see, in order to get the next best questions to answer. Or, just press the button.

- flowers
- fruits or seeds
- growth form
- leaves

GET MORE QUESTIONS

GET MORE QUESTIONS

Add a few more questions for narrowing your matching species.

Already know the family or genus?

Family:  Clear

Genus:  Clear

Start Over:

*Cypripedium acaule* pink lady's-slipper

*Cypripedium parviflorum* yellow lady's-slipper

*Cypripedium reginae* showy lady's-slipper

*Epipactis helleborine* broad-leaved helleborine

*Corallorhiza trifida* early coral-root

# Innovations

## Next best question feature

More questions added

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You are here: Simple Key > Orchids and related plants > Orchids

Pick a question from this scrollable list:

- Lower petal length?
- Inflorescence type?
- Spots on lower petal?
- Main color of lower petal?
- Form of lower petal?
- Lower petal outline?
- Leaf arrangement?
- Nectar spur?

GET MORE QUESTIONS

Add a few more questions for narrowing your matching species.

Already know the family or genus?

Family:  Clear




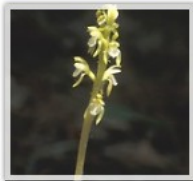








Genus:  Clear

Start Over:

### Orchids

25 matching species

Show photos of: flowers

 <i>Arethusa bulbosa</i> dragon's-mouth	 <i>Calopogon tuberosus</i> tuberous grass-pink	 <i>Corallorhiza maculata</i> spotted coral-root	 <i>Corallorhiza trifida</i> early coral-root
 <i>Cypripedium acaule</i> pink lady's-slipper	 <i>Cypripedium parviflorum</i> yellow lady's-slipper	 <i>Cypripedium reginae</i> showy lady's-slipper	 <i>Epipactis helleborine</i> broad-leaved helleborine
			

# Taxon Information Page



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Search...



You are here: Simple Key > Woody plants > Woody broad-leaved plants > *Celastrus orbiculatus*

## *Celastrus orbiculatus* Thunb.

### Asian bittersweet, Asiatic bittersweet



#### New England Distribution

Adapted from BONAP data

- present
- absent



#### North America Distribution

Adapted from BONAP data



Click to enlarge

Native to North America?

No

Sometimes Confused With:

*Celastrus scandens*:  
flowers in a terminal array of 6

## Facts About

Asian bittersweet was introduced from its native East Asia in 1860 and now grows in much of the eastern United States. This aggressive vine tolerates both high sun and deep shade, and can quickly overtop and girdle trees. This species has long been regarded as an attractive ornamental. Its abundant clusters of yellow seeds surrounded by a fleshy red aril are often used to make festive wreaths and flower arrangements. Seeds are spread when the plants are later thrown away. Birds also relish the fruits and disperse the seeds far and wide.

## Habitat

Edges of forests, forests, man-made or disturbed habitats, meadows or fields, shrublands or thickets

## Characteristics



# Dichotomous Keys

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## Dichotomous Keys to Groups

- Go back, start with family or genus

Want help getting started? [GET HELP](#)

Jump to a Group

Photos: Group 1 of 9

**1A.** Plants typically reproducing by spores, seeds and fruits not produced; gametophyte independent of sporophyte; ferns and fern-like plants. [SEE FAMILIES IN 1A](#) [GROUP 1](#)

**1B.** Plants typically reproducing by seeds, the seeds borne within a fruit or not; gametophyte dependent on sporophyte; seed plants. [SEE FAMILIES IN 1B](#) [CHOOSE THIS LEAD](#)



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## Dichotomous Keys to Groups

- Go back, start with family or genus

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Jump to a Group

Photos: Group 1 of 9

**1B.** Plants typically reproducing by seeds, the seeds borne within a fruit or not; gametophyte dependent on sporophyte; seed plants. [SEE FAMILIES IN 1B](#) [GO BACK](#) Revisit this choice

**2A.** Plants not producing by true flowers; seeds commonly borne in strobili on the surface of a scale (embedded in a fleshy axis in Taxus, never enclosed in an ovary; styles and stigmas absent; trees and shrubs narrow, scale- or needle like, usually persistent; leaves. [SEE FAMILIES IN 2A](#) [GROUP 2](#)

**2B.** Plants usually producing true flowers, seeds enclosed in an ovary; stigma(s) and usually style(s) present, elevated above the ovary; woody or herbaceous plants, with various types of leaves. [SEE FAMILIES IN 2B](#) [CHOOSE THIS LEAD](#)



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## Dichotomous Keys to Groups

- Go back, start with family or genus

Want help getting started? [GET HELP](#)

Jump to a Group

Photos: Group 1 of 9

**1B.** Plants typically reproducing by seeds, the seeds borne within a fruit or not; gametophyte dependent on sporophyte; seed plants. [SEE FAMILIES IN 1B](#) [GO BACK](#) Revisit this choice

**2B.** Plants usually producing true flowers, seeds enclosed in an ovary; stigma(s) and usually style(s) present, elevated above the ovary; woody or herbaceous plants, with various types of leaves. [SEE FAMILIES IN 2B](#) [GO BACK](#) Revisit this choice

**3A.** Leaf blades unusually parallel-veined (or the plants thalloid in some Araceae); seeds with 1 cotyledon; perianth typically 3- or 6-merous; vascular bundles scattered throughout the stem; secondary growth absent. [SEE FAMILIES IN 3A](#) [GROUP 3](#)

**3B.** Leaf blades usually pinnately veined; seeds with 2 cotyledons, perianth typically 4-, 5-, or more - merous; vascular bundles arranged around a central pith; secondary growth absent or present. [SEE FAMILIES IN 3B](#) [CHOOSE THIS LEAD](#)

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- My Profile
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**My Profile** Edit Profile

ZachSmythe  
"Your saying here"  
Joined 03/28/2011

Upload Photo

Geo Region	Cape Cod
Total Species	76
Total Locations	267
Lists	6
Tribes	1

Find Friends and Colleagues  
Enter person's name

Recent Sightings



Nymphaea odorata

Share sightings

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**Sightings Locator**

Show recent plant sightings for


Enter plant name

**How to Use**  
Enter a plant name and we'll show on the map where its been seen recently.

**Don't see a plant you think should be there?**  
You will see all recent sightings that others have marked for public display, or for viewing by a Tribe that you belong to.


Rare and endangered plants will not be displayed.

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**Ask the Botanist**

"Ace" Acer  
Our Ace Botanist is here to help you identify a plant, suggest locations for seeing provide you with expert scientific guidance on all things in the New England plant Registered users can ask questions, all visitors can see the answers.




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**Sightings Locator**

Show recent plant sightings for

**Sighting Details**



Latin Name *Camboba caroliniana*

Common Name Carolina Fanwort

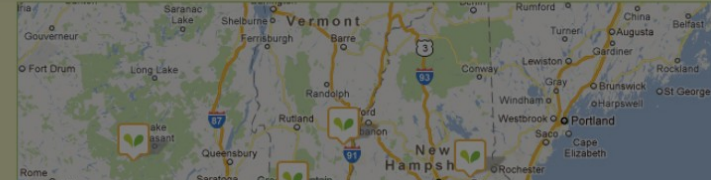
Location Burlington, VT

Lat/Long 44.473, 73.155

Date June 27, 2012 8:14AM

Sighted by Greenman [Contact](#)

Notes Oh no! Invasive plant now being seen in Lake Champlain. Located near Johnson's Marina.



Sign up, create checklists



# Helping kids ID invasives



Jim Sirch



# Restoration with volunteers

## Can it work?

Pepperweed (*Lepidium latifolium*) in Salisbury and Newburyport



80% controlled with multi-agency and volunteer participation

# Mile-a-minute vine (*Persicaria perfoliata*) in Westford, MA



University of  
Connecticut

College of Agriculture and Natural Resources

Department of Plant Science and Landscape Architecture

CIPWG HOME

Home

About mile-a-minute

Species Identification

Similar Species Guide

State Contacts

Distribution Information

MAM Resources

Biological Control

Control Options

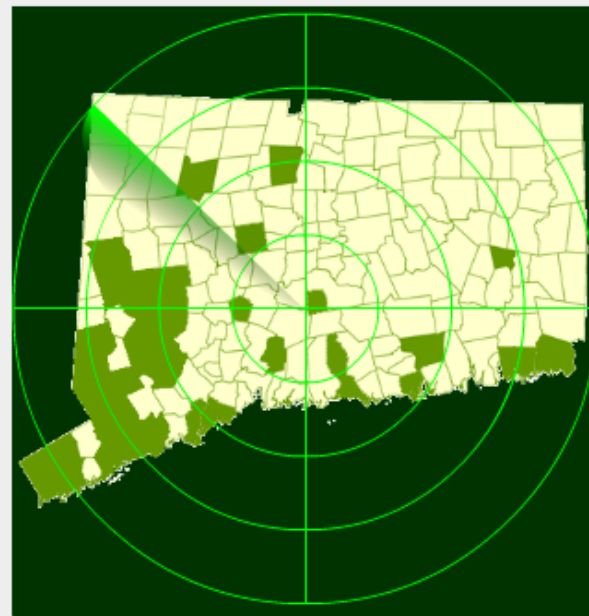
News Archive

\*For the Press

Other Invasive Species

**-Online Reporting Form-**

Welcome to the CT mile-a-minute vine website!

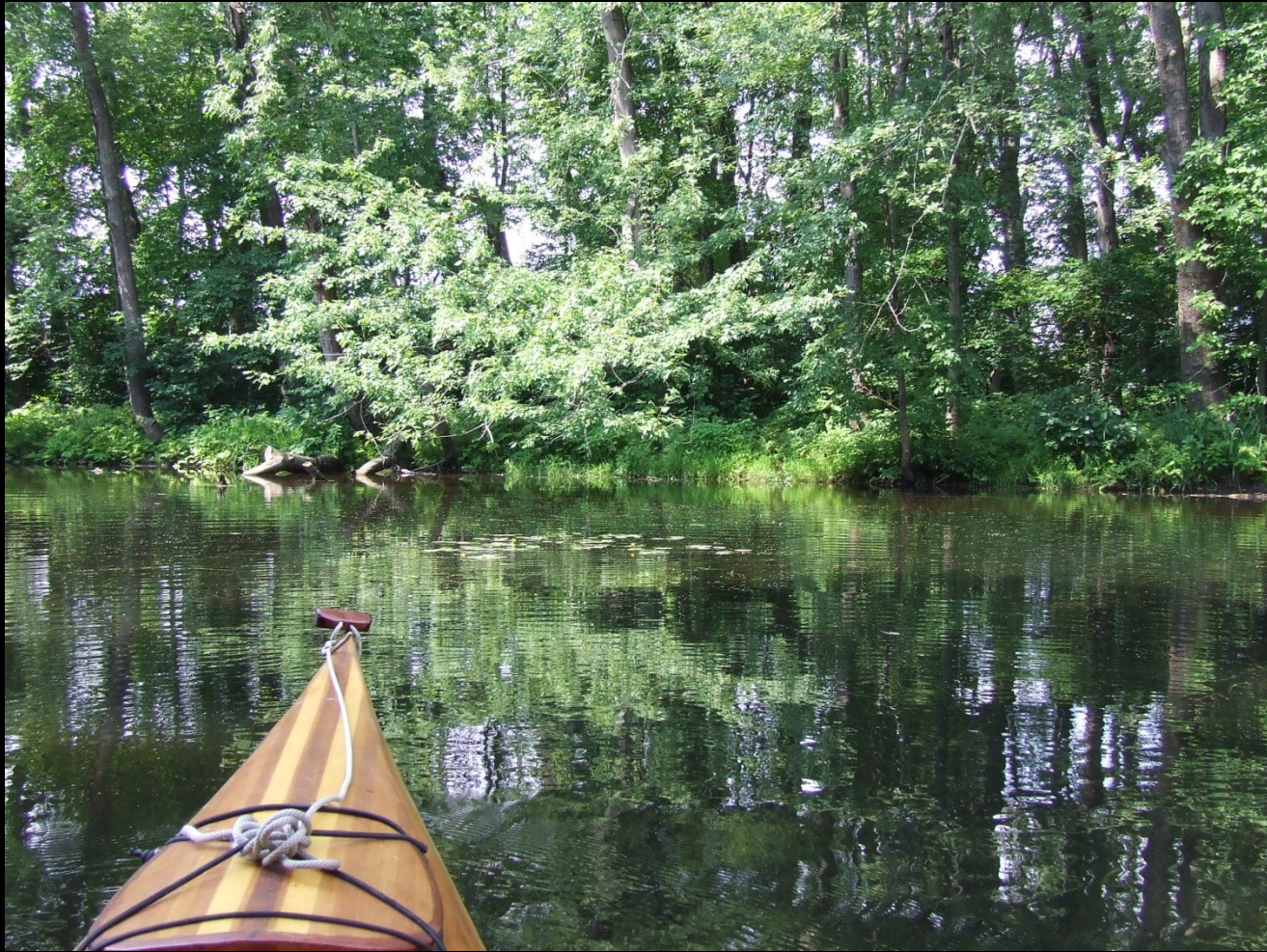


Mile-a-minute detected in towns marked in green

**Volunteers recruit volunteers, significant reduction in 3 years**



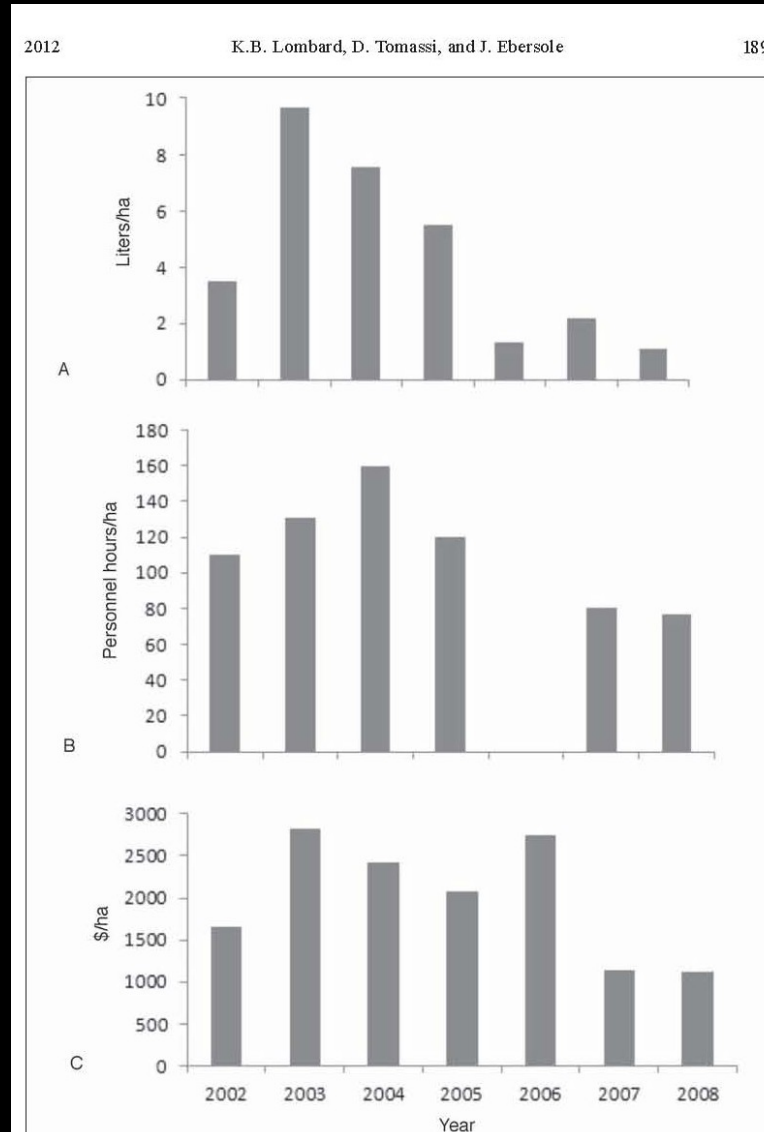
# Water Chestnut (*Trapa natans*) in Connecticut River tribs



**Consistency and continual monitoring**



# Common reed (*Phragmites australis*) Barnstable, MA

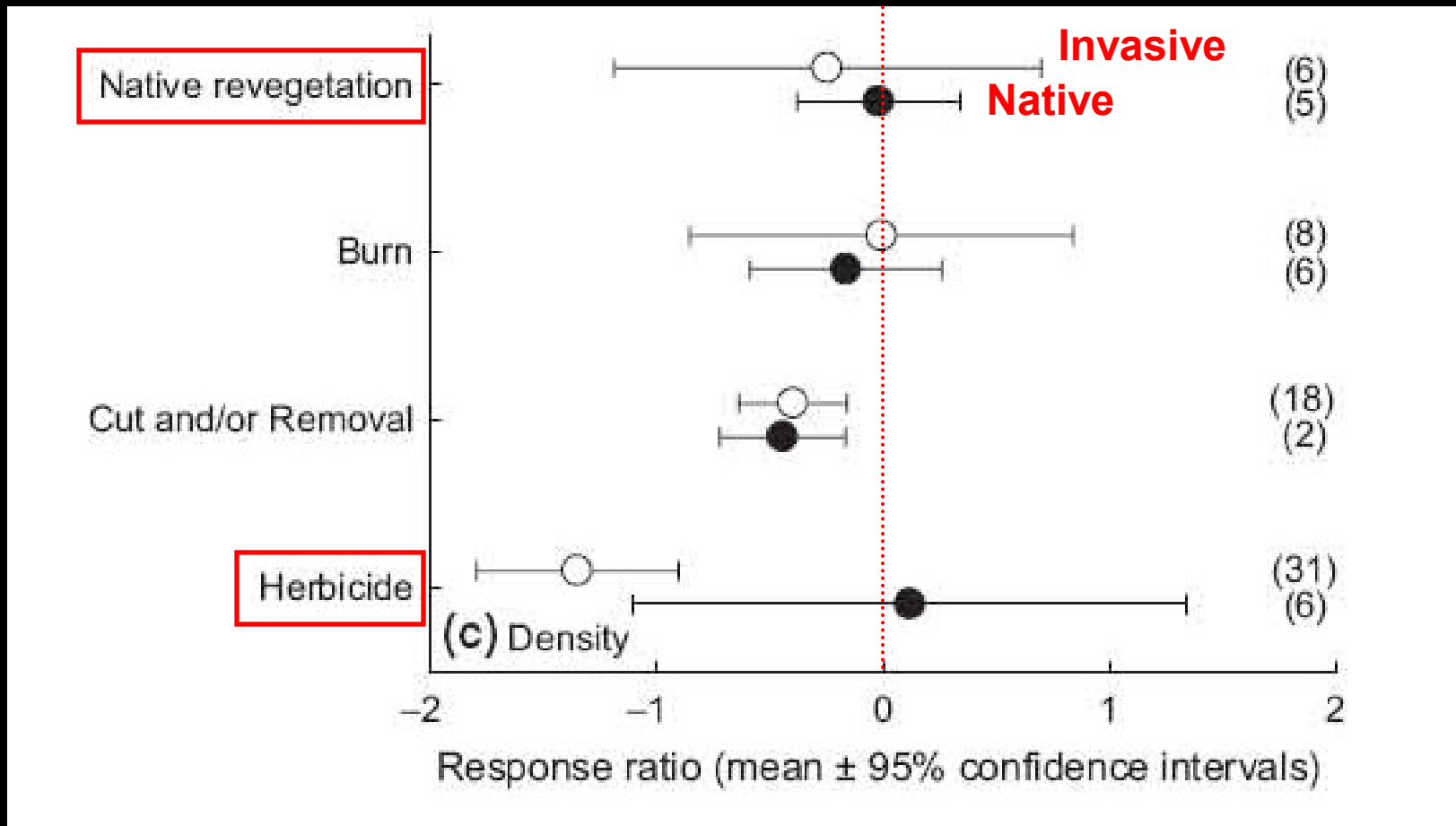


Herbicide

Person-hours

\$ per hectare

# Meta-analysis of invasive control outcomes



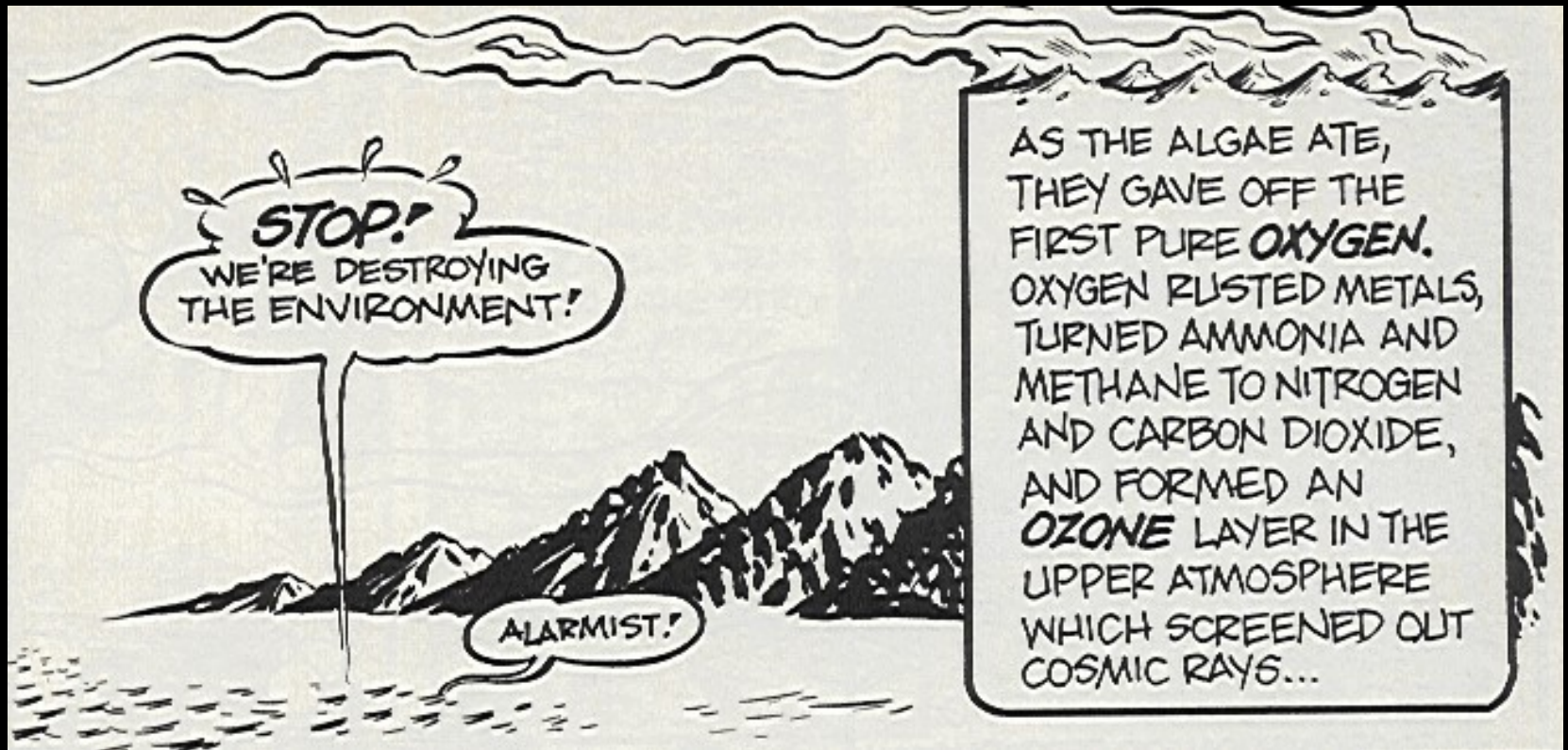
# We HAVE made **progress** in:

- **Identifying** most invasive species
- **Targeting** new potential invasives
- **Improving** the science
- **Educating** the public
- **Restoring** sites with volunteers





# What do we need to do?



**Step back and take a deep breath...**

# What do we need to do?

Management = Science.

Share your science.

The screenshot displays the National Invasive Species Information Center (NISIC) website. At the top left is the USDA logo and the text "United States Department of Agriculture National Agricultural Library". To the right is the "NATIONAL INVASIVE SPECIES INFORMATION CENTER" logo. Below the header is a navigation menu with links for Home, About NISIC, News and Events, Council, Help, and Contact Us. A breadcrumb trail reads "You are here: Home / Resource Library / Databases / Regional". The main content area is titled "Resource Library" and features a "Databases" section. Under "Regional", there is a description: "Describes databases available online related to invasive species regionally. See **Resource Library - Databases** for general resources, other species, and expertise information." Two database entries are listed: "Alaska EDDMapS - Early Detection and Distribution Mapping System" and "Alaska Exotic Plants Information Clearinghouse - AKEPIC Database (formerly AKEPMP)". A sidebar on the left contains a search bar and navigation options like "Browse by Geography" and "Browse by Subject". A right sidebar includes a "Resource Library" menu and a "Media Help" section.

USDA United States Department of Agriculture National Agricultural Library

NATIONAL INVASIVE SPECIES INFORMATION CENTER

Home About NISIC News and Events Council Help Contact Us

You are here: Home / Resource Library / Databases / Regional

## Resource Library

### Databases

#### Regional

Describes databases available online related to invasive species regionally. See **Resource Library - Databases** for general resources, other species, and expertise information.

**Database:** Alaska EDDMapS - Early Detection and Distribution Mapping System  
**Host:** University of Georgia's Center for Invasive Species and Ecosystem Health  
**Scope:** The Alaska Exotic Plant Information Clearinghouse (AKEPIC) Database is a collaborative effort to compile information on the distribution and abundance of exotic and invasive plant species in Alaska. EDDMaps (Early Detection and Distribution Mapping System) Alaska provides a more accurate picture of the distribution of invasive species in the Alaska.

**Database:** Alaska Exotic Plants Information Clearinghouse - AKEPIC Database (formerly AKEPMP)  
**Host:** University of Alaska - Anchorage, Alaska Natural Heritage Program

SHARE [social media icons]

### Resource Library

- Agencies and Organizations
- Databases**
- Discussion Groups
- Educational Resources
- Frequently Asked Questions
- Identification Resources
- Image Galleries
- Invasive Species Lists
- Publications

### Media Help

To view PDF files you must have Adobe Acrobat



**What do we need to do?**

**Don't just yank stuff out.**

**Put plants back in.**





**What do we need to do?**

**Know when to walk away.**

**Invaded places DO provide good data.**



John Burns

# What do we need to do?

**Adopt a long-term view**

**What fostered the invasion?**

**Interactions change**

**Plan for a changing planet**

**Conserve proactively**

**Think big.**

**Nature, like politics, can drive you  
a little nutty...**



**Don't lose hope!**





**Thanks to**

**CIPWG**

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