Implications of Climate Change on Invasive Species in the Northeast

& Considerations for Management

Eastern Lake Ontario Invasive Species Symposium
June 20, 2019

Carrie Brown-Lima
NY Invasive Species Research Institute at Cornell University

Toni Lyn Morelli
NE CASC, USGS

Northeast RISCC Management
Regional Invasive Species & Climate Change

Bethany Bradley
UMASS Amherst

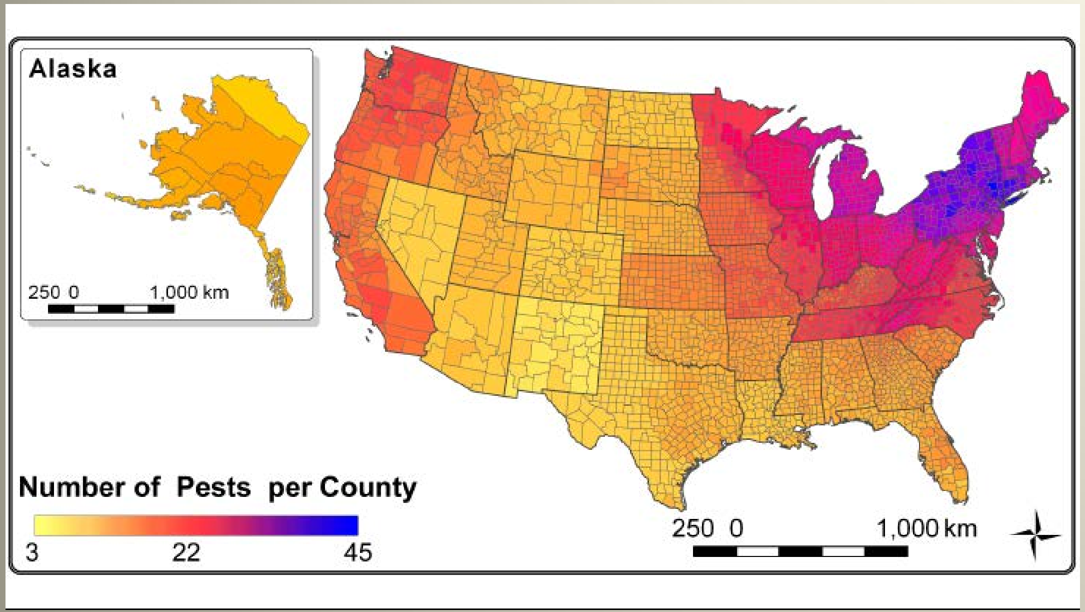
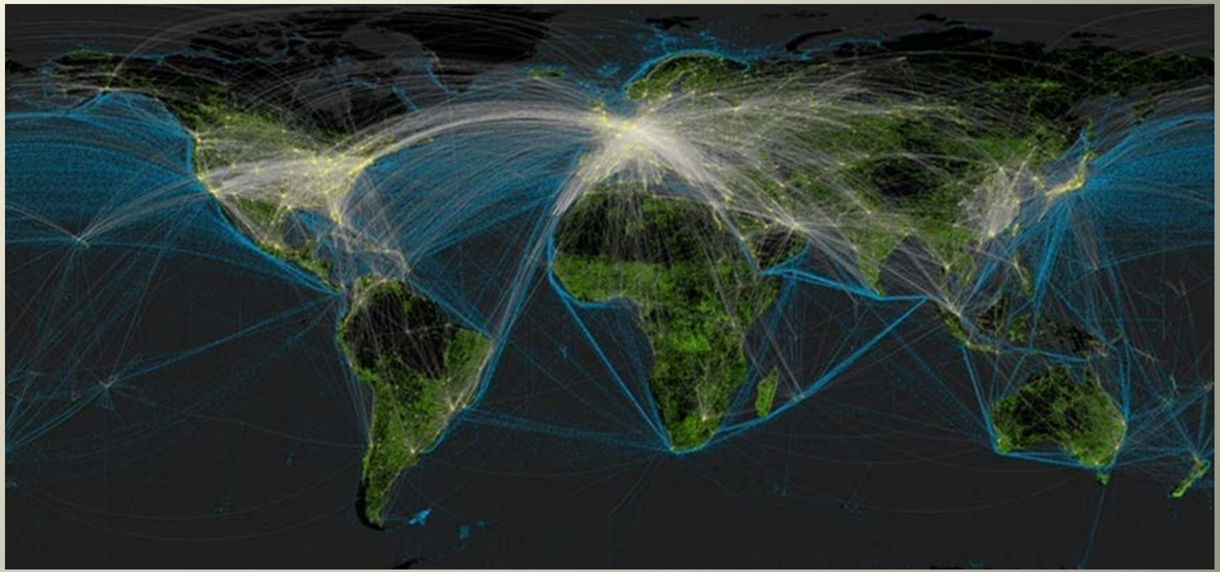
NE CASC Northeast Climate Adaptation Science Center
Cornell University Founded A.D. 1865
New York Invasive Species Research Institute
New York State of Opportunity Department of Environmental Conservation
UMASS Amherst

The New York Invasive Species Research Institute

Established in 2008 with the mission *to communicate and coordinate invasive species research to help prevent and manage the impact of invasive species in New York State and beyond"*

Working with PRISMs, iMapInvasives, NYS Invasive Species Council, NYS Invasive Species Advisory Committee, NYS DEC ISCU, CCE and others

PI: Dr. Bernd Blossey, Cornell University


Alaska
250 0 1,000 km
Number of Pests per County
3
22
45
250 0 1,000 km



Invasive Species and Climate Change

The White House

Office of the Press Secretary

For Immediate Release December 05, 2016

Executive Order -- Safeguarding the Nation from the Impacts of Invasive Species

EXECUTIVE ORDER

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(b) Federal agencies shall consider the impacts of climate change when working on issues relevant to the prevention, eradication, and control of invasive species, including in research and monitoring efforts, and integrate invasive species into Federal climate change coordinating frameworks and initiatives.

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(b) Federal agencies shall consider the impacts of climate change when working on issues relevant to the prevention, eradication, and control of invasive species, including in research and monitoring efforts, and integrate invasive species into Federal climate change coordinating frameworks and initiatives.

How can we manage for upcoming biological invasions in the light of climate change?

Today’s talk

- Climate Change – what changes are occurring?
- Invasive species responses to these changes and the implications for invasive species management
- How can we increase knowledge and tools to incorporate climate change considerations into invasive species management decisions?

Northeast RISCC Management
Regional Invasive Species & Climate Change

RISCC Leadership team:




Bethany Bradley

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NY Invasive Species Research Institute
Cornell University

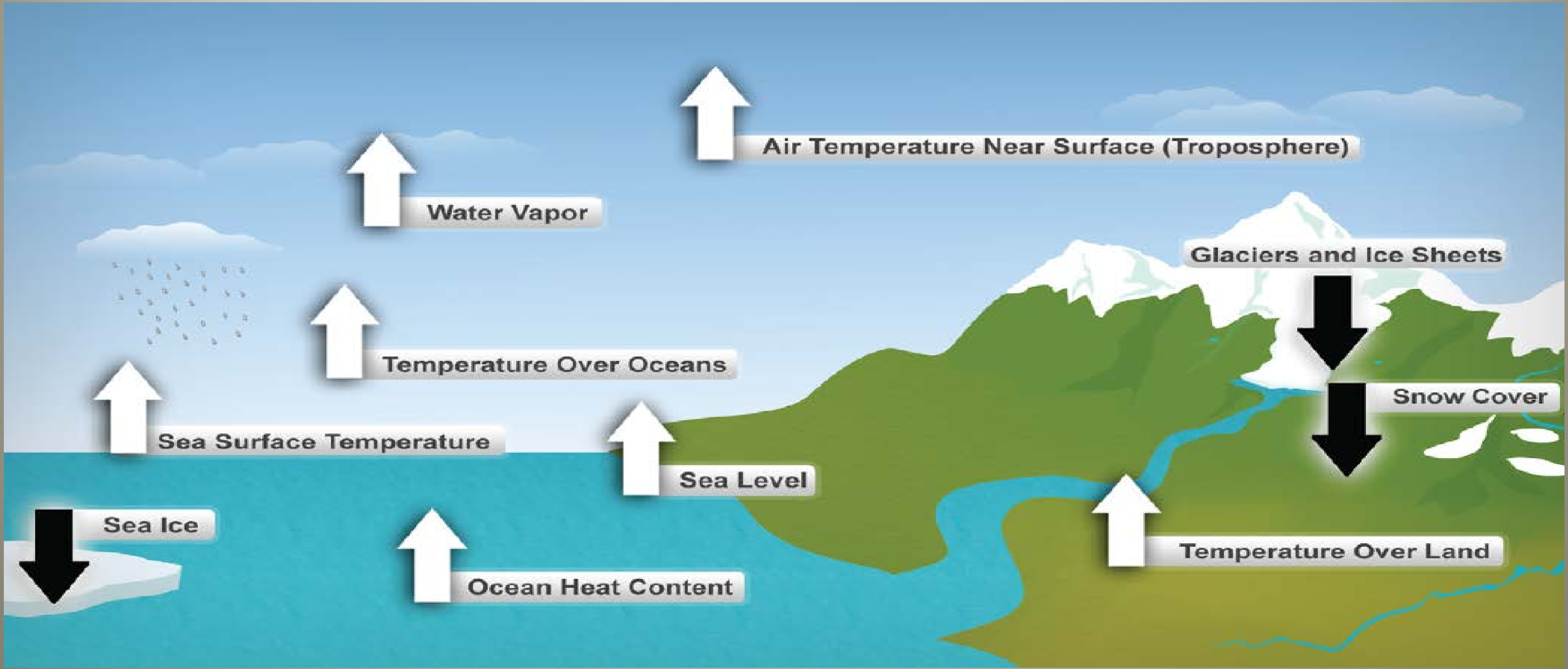
Jenica Allen

Assistant Professor
University of New Hampshire

Today’s talk

- Climate Change 101 – what changes are occurring?

The climate is changing…..



Decreasing trend

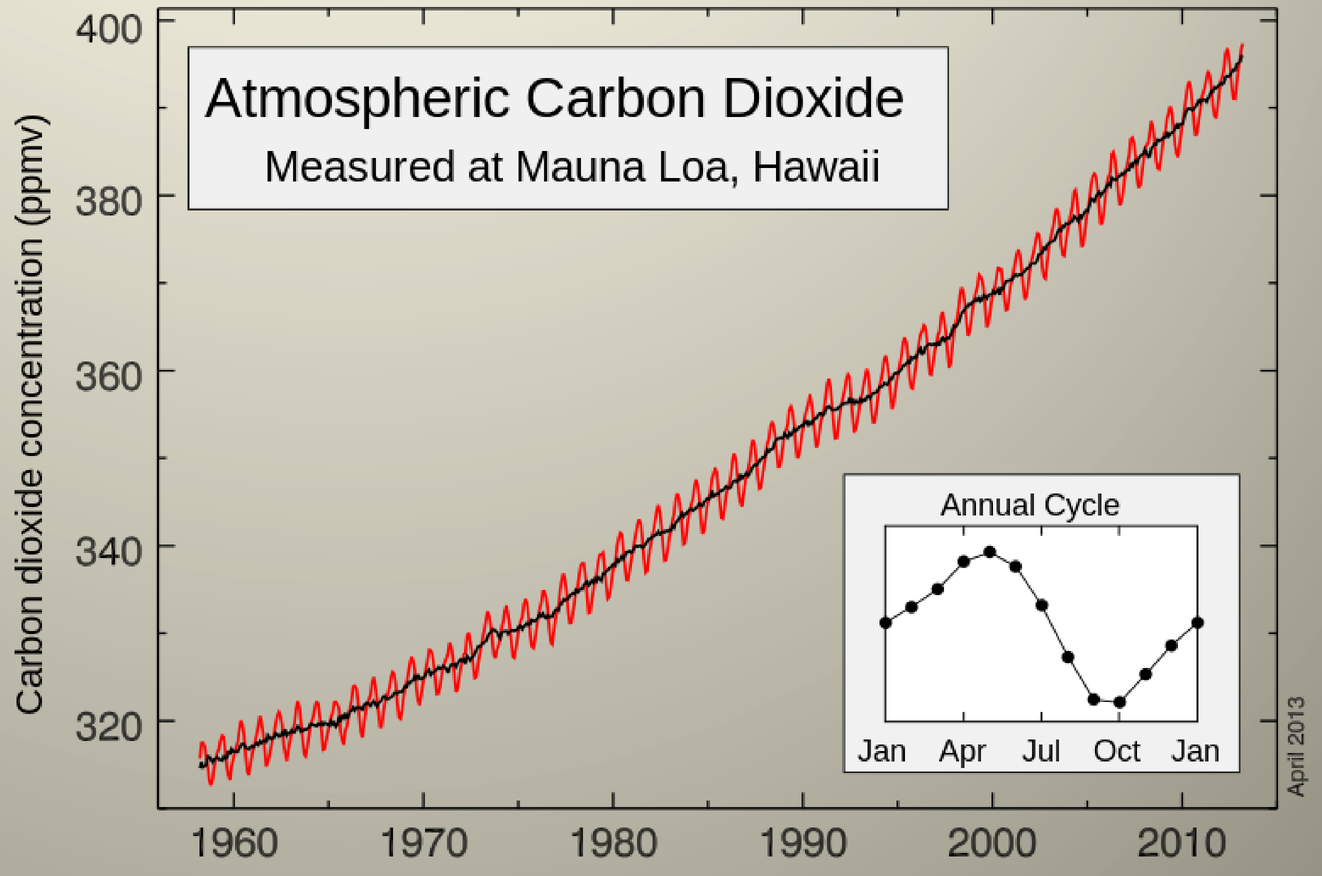
Increasing trend

Figure source: NOAA National Climate Data Center

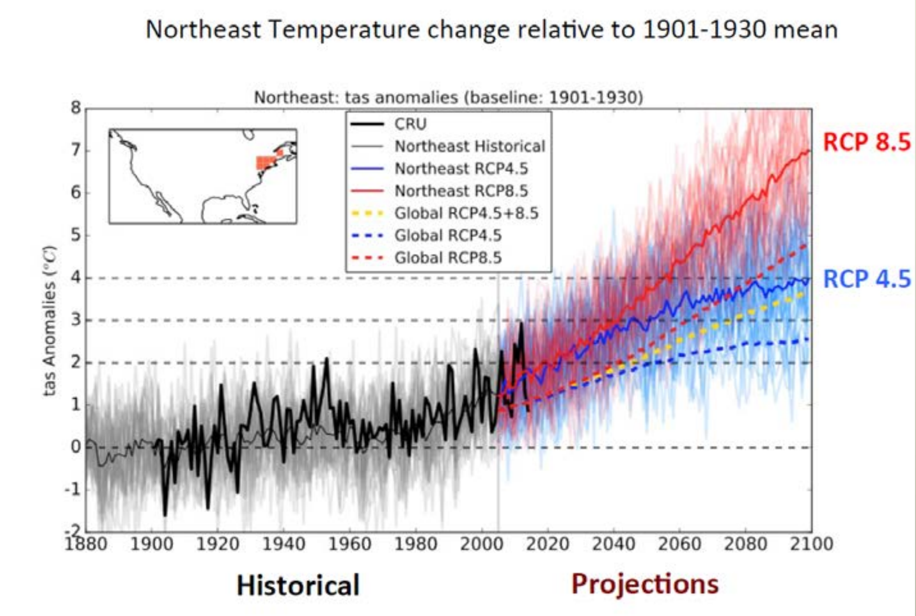
Rising CO_2

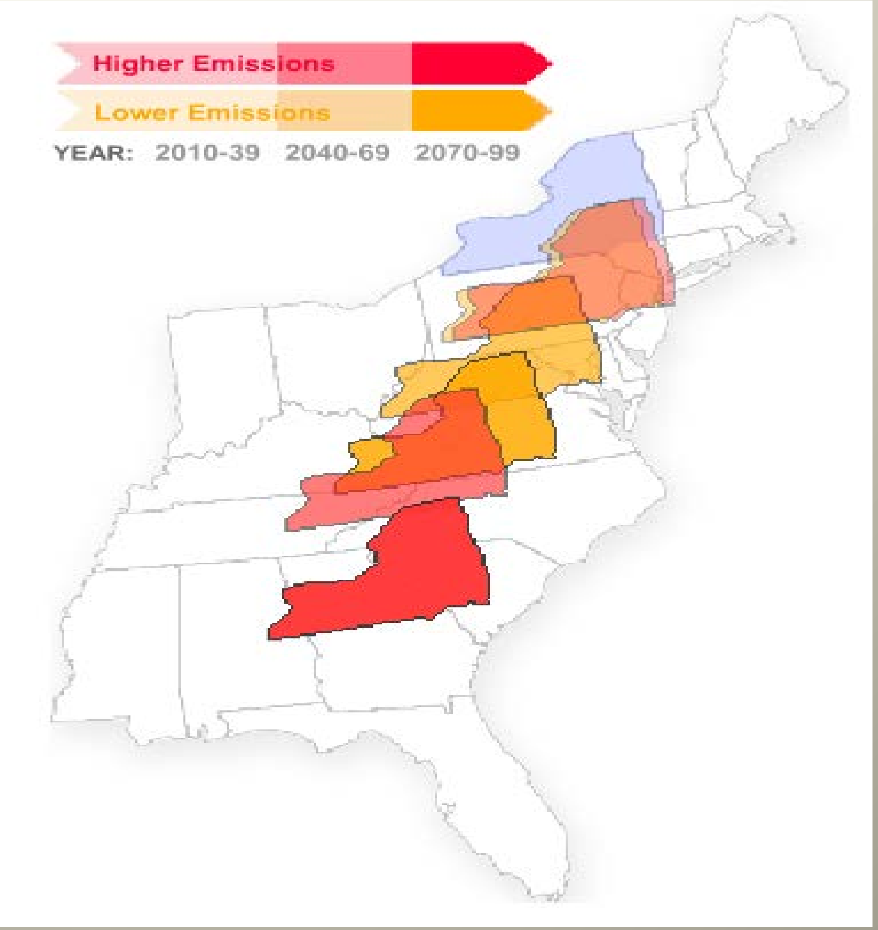
Atmospheric CO_2

- Risen from 280 pre-industrial
- Over 400 today



Northeast average temperature rise

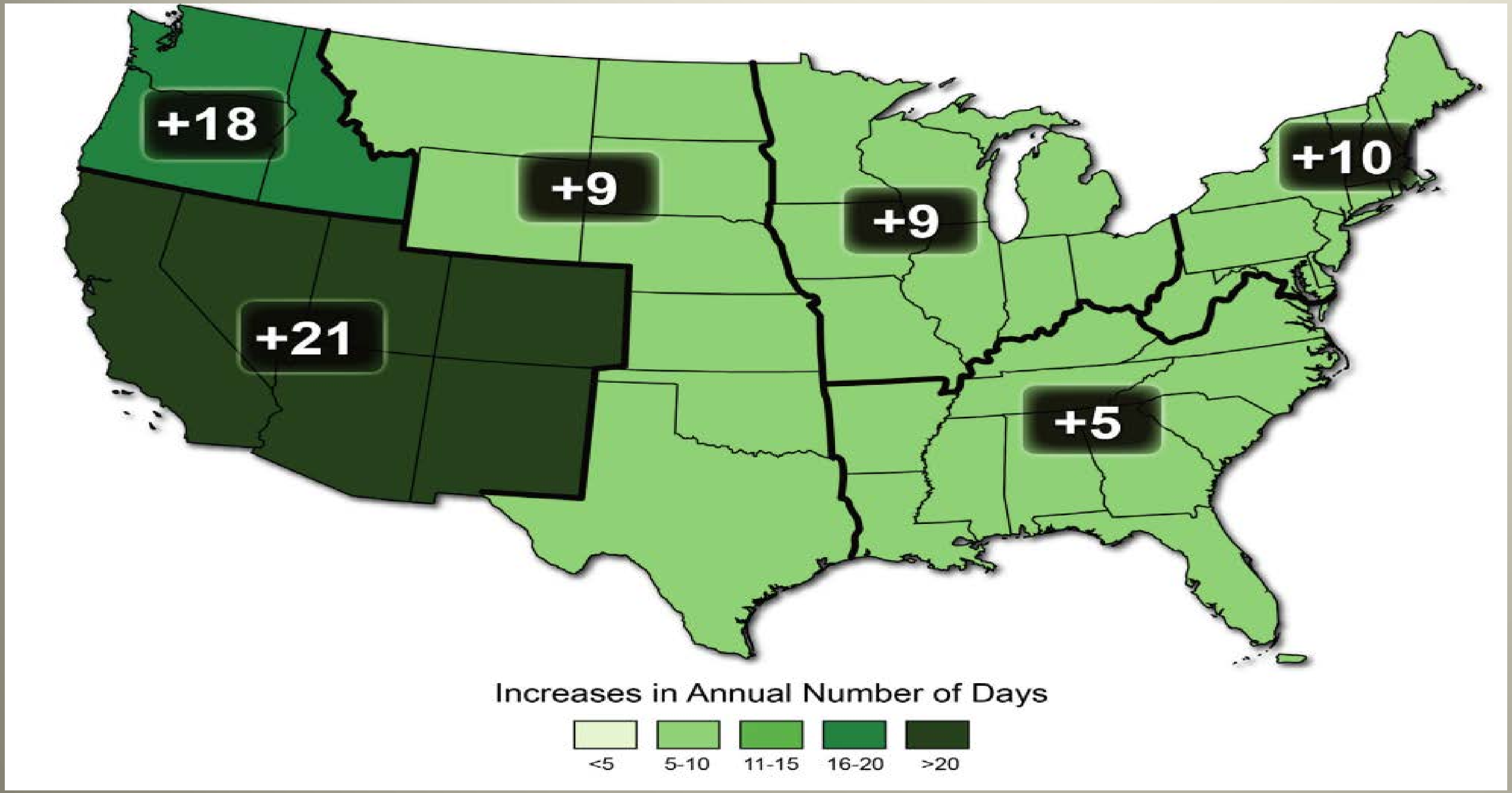




http://www.ucsusa.org/global_warming/science_and_impacts/impacts/global-warming-northeast-migrating-states.html

UCS USA

"Milder winters"
Observed changes in frost-free season (1991-2012)



- Frost free and growing seasons have increased nationally since 1980s
- Largest increases in west, continued lengthening is projected
- Earlier spring snow melt, less snow overall
- Lake ice forms later, melts earlier

2014 NCA report

Figure source: NOAA National Climate Data Center

Increasing frequency of temperature and precipitation extremes
and also extreme weather events

Red River flood near Fargo, ND

NJ.com

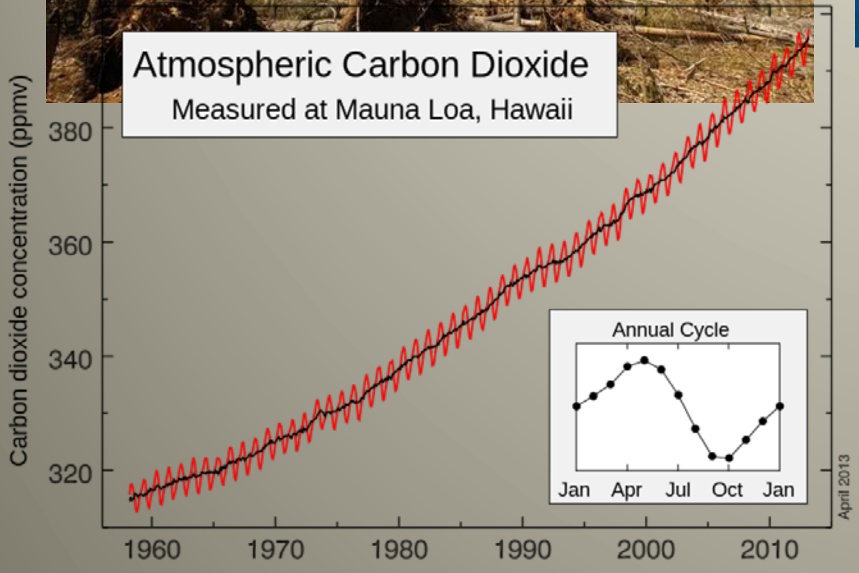
Hurricane Sandy damage in Newark Watershed

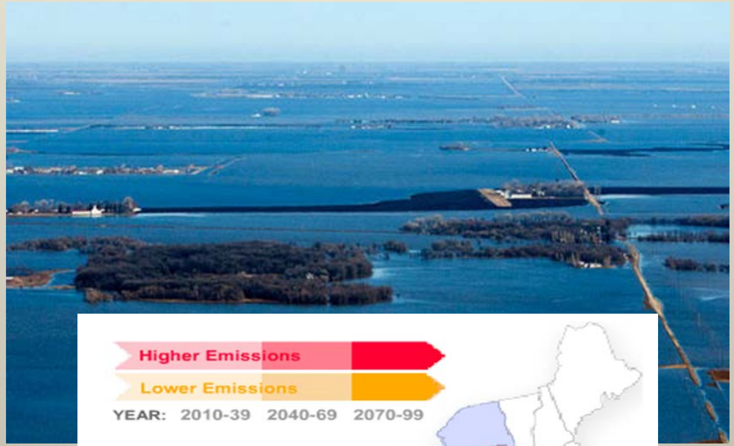
Heat waves/droughts cause fires in the West

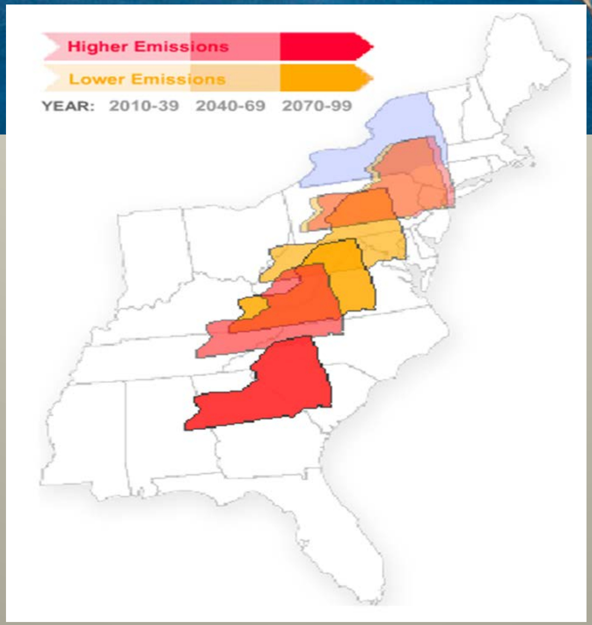
Today’s talk

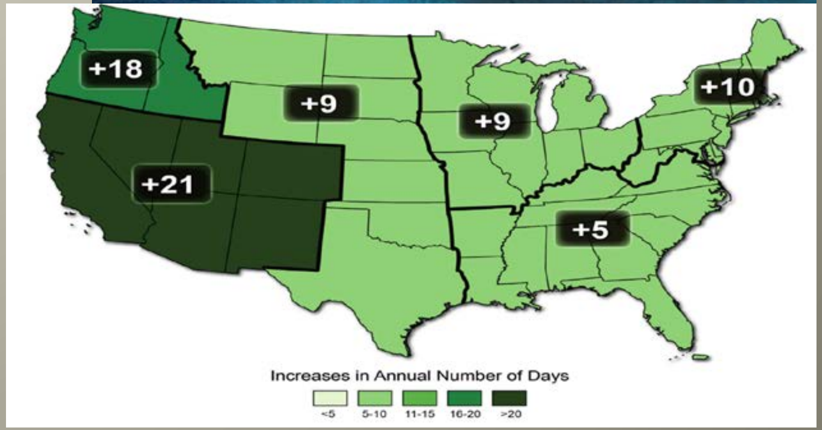
- Climate Change – what changes are occurring?
- Invasive species responses to these changes and the implications for invasive species management

Under these conditions, many invasive species are given a competitive edge:

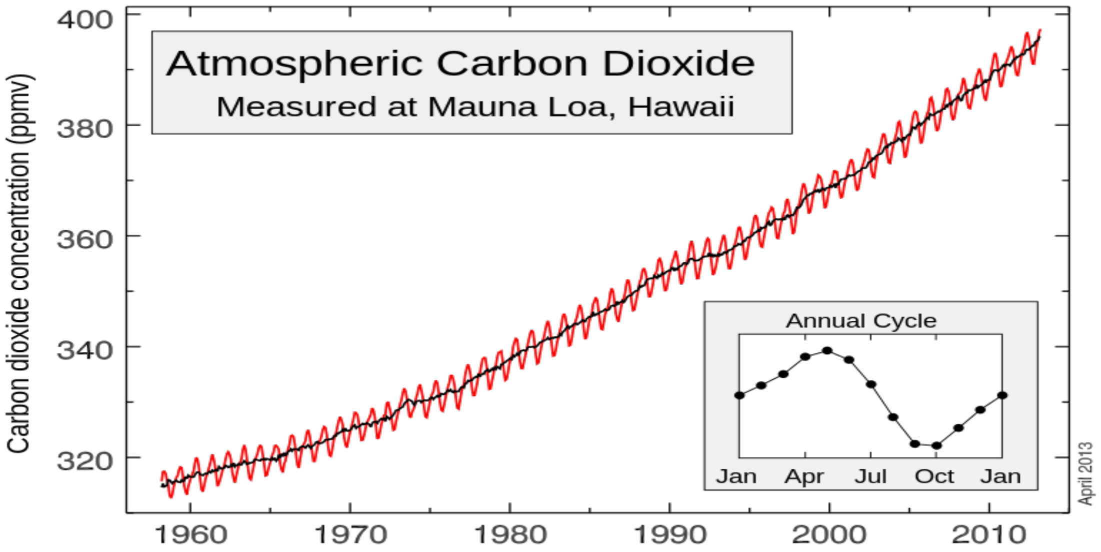




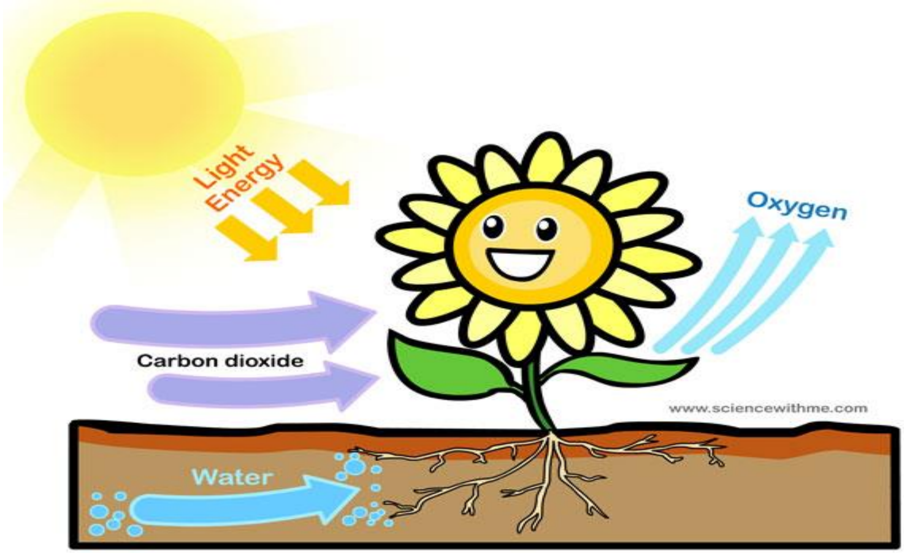




Rising CO_2

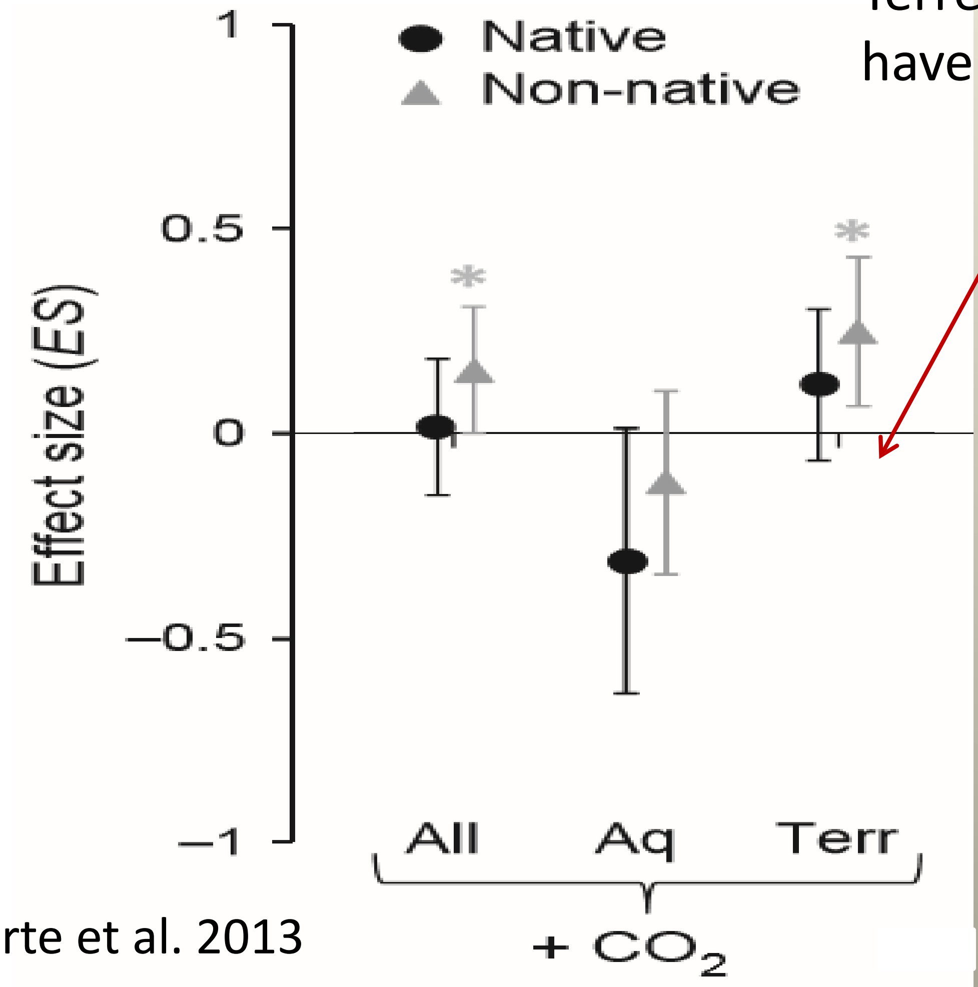


Plants ❤ CO_2



Rising CO_2

Invasive plants do better still



Sorte et al. 2013

Terrestrial invasive plants have a larger advantage

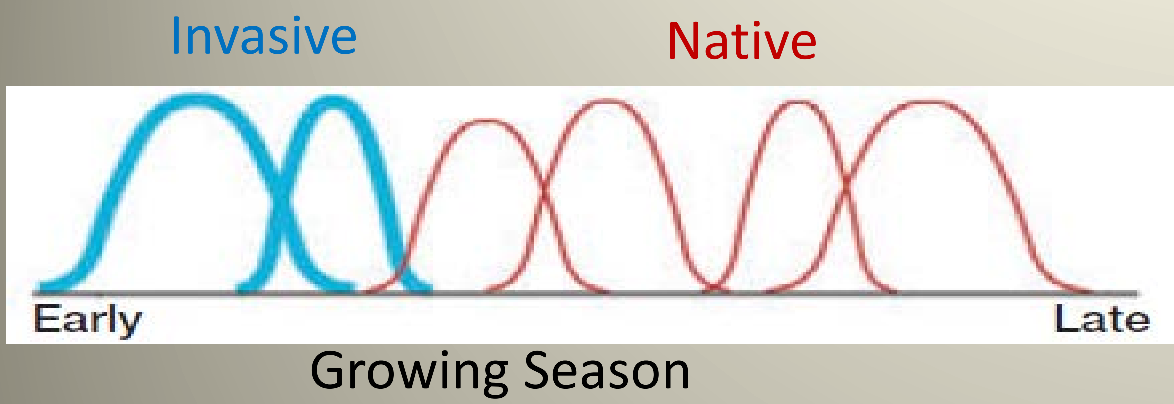
Bigger…… and harder to kill

Differential efficacy of the herbicide glyphosate to control the aggressive perennial weed, Canada thistle, at ambient and future CO2 concentrations. Credit: Ziska et al. 2004.

Warming temperatures

Milder winters and Priority Effects:

Some invasive plants show earlier spring green-up



Wolkovich & Cleland 2011

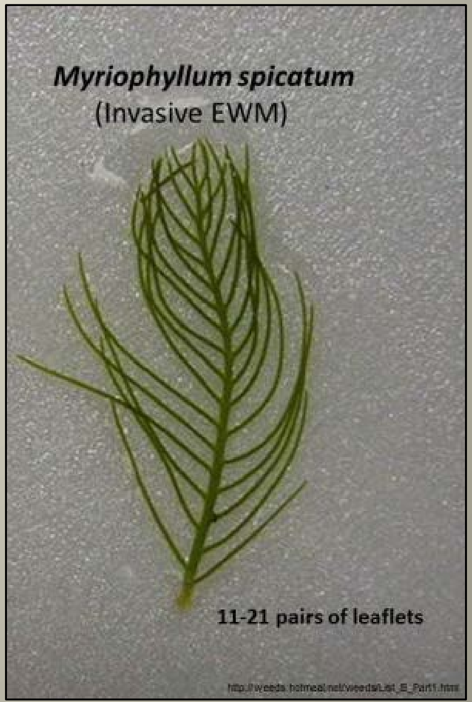
Barberry *(B. thunbergii)*

Garlic mustard (*A. petiolata*)

Honeysuckle (*L. maackii*)

Buckthorn (*R. cathartica*)

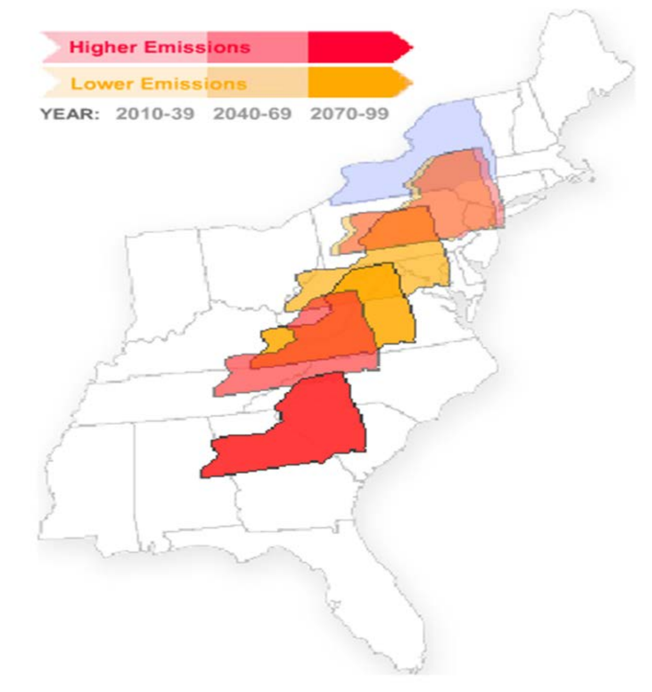
Warming temperature

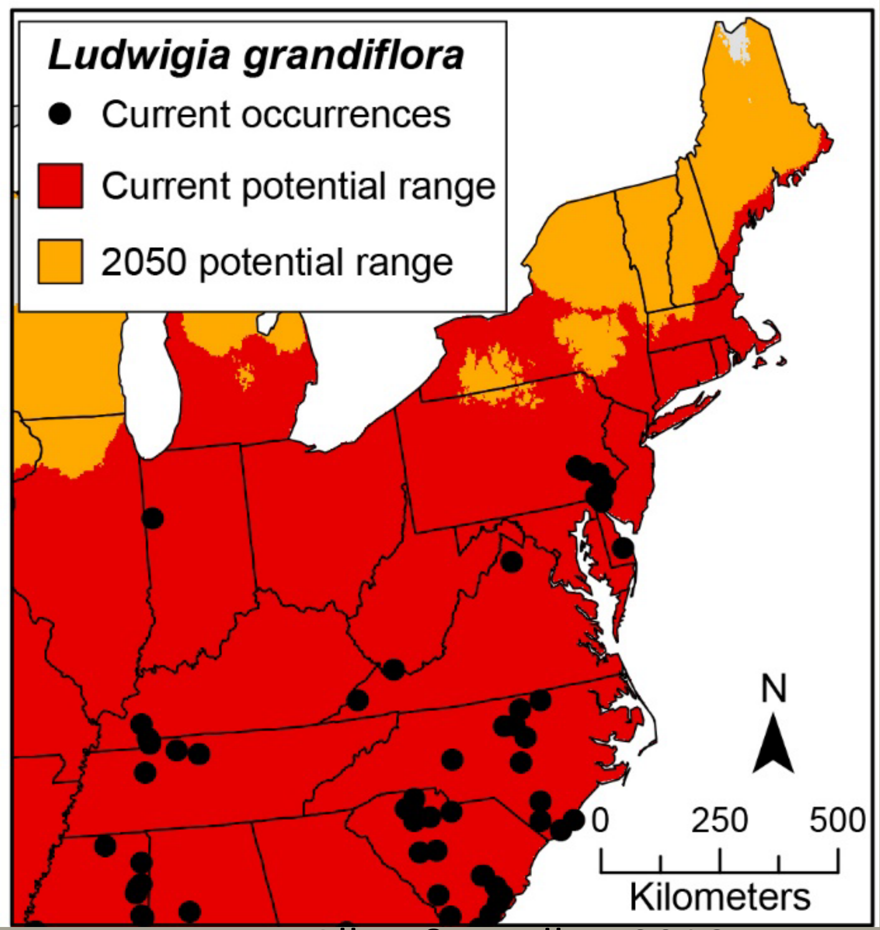


Warmer water gives an competitive advantage for some invasives, results in growth and longer growing season

Warming temperature

(Invasive) species respond by shifting their ranges

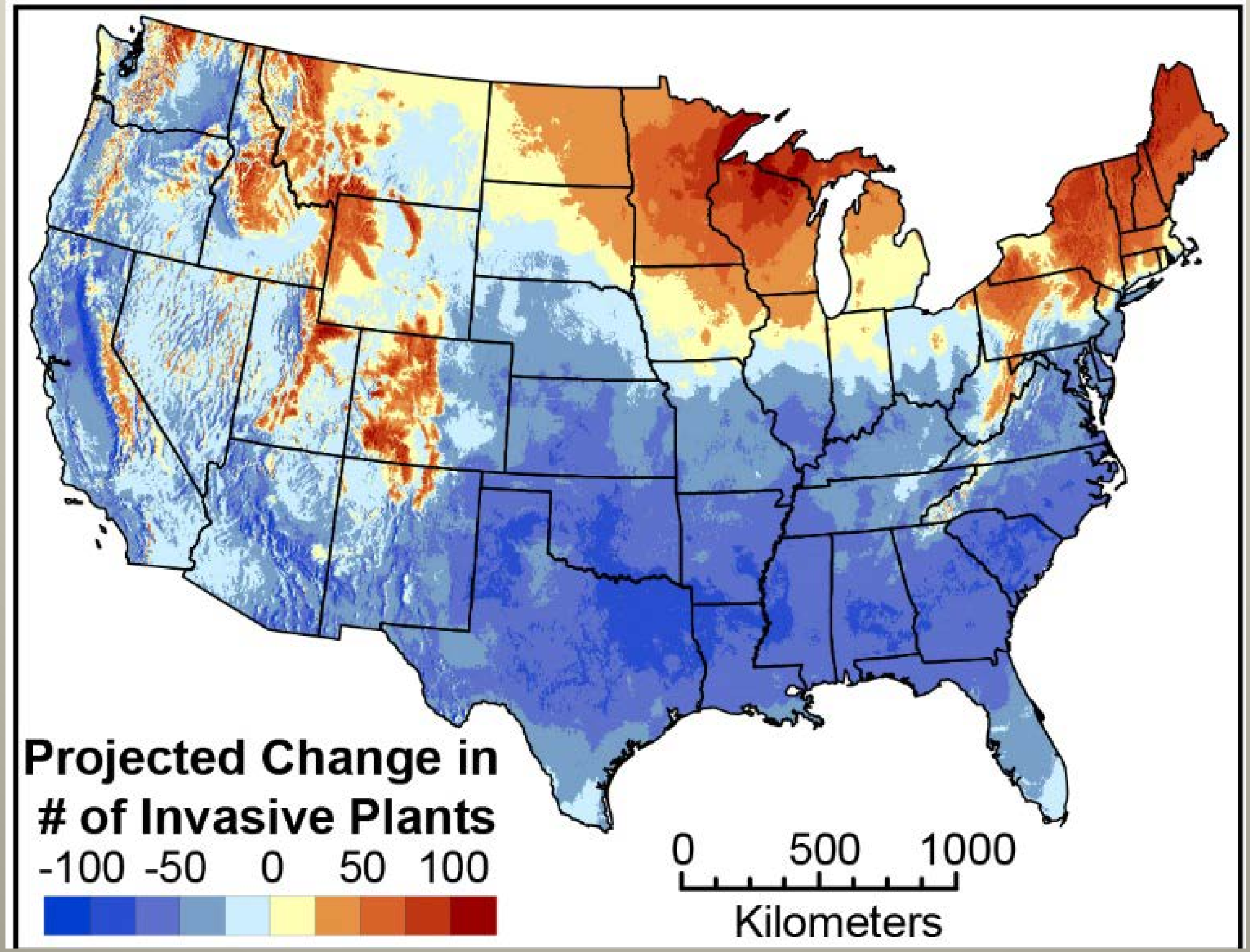




Allen & Bradley, 2016

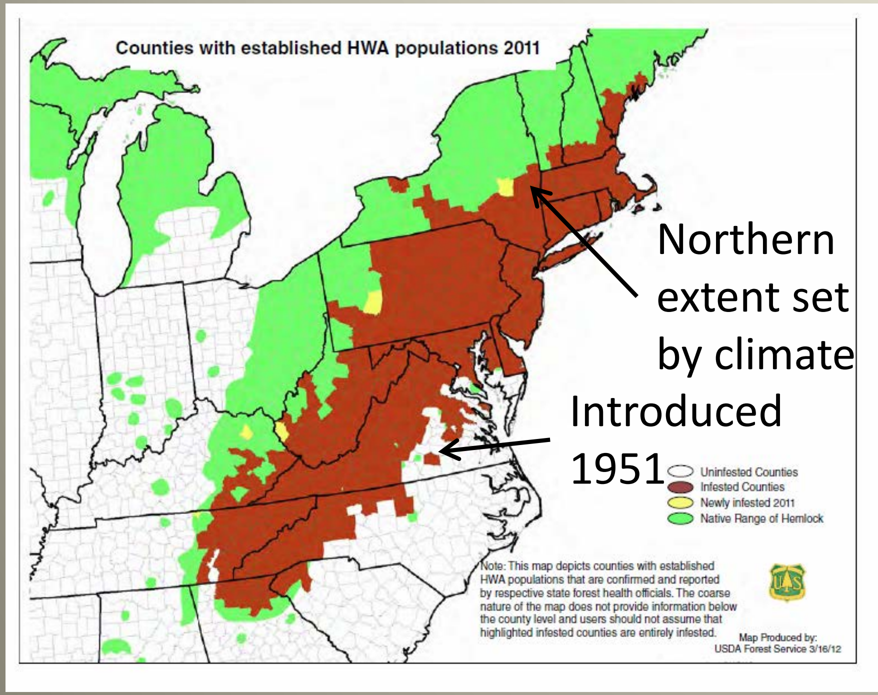
Photo: Alain Dutartre

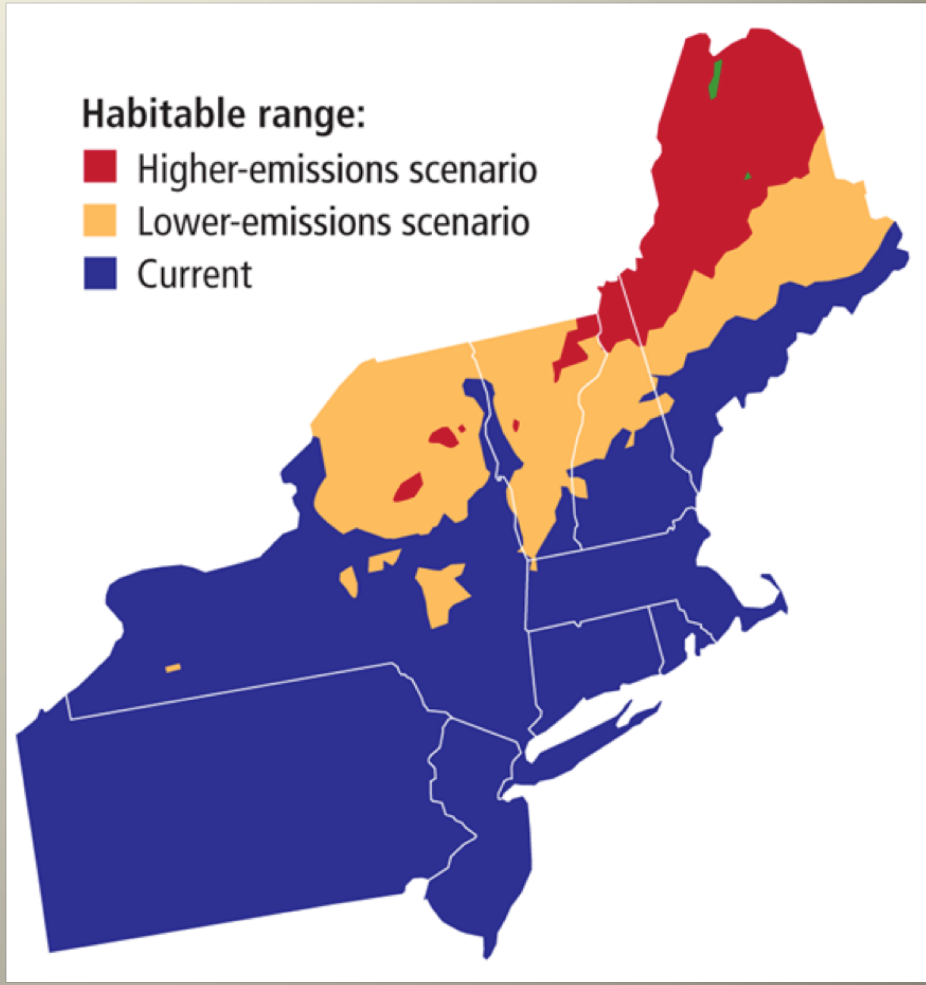
The northeast is a hotspot of future invasion



Allen & Bradley, 2016

Forest pests such as Hemlock Woolly Adelgid will continue to spread Northward as the climate warms

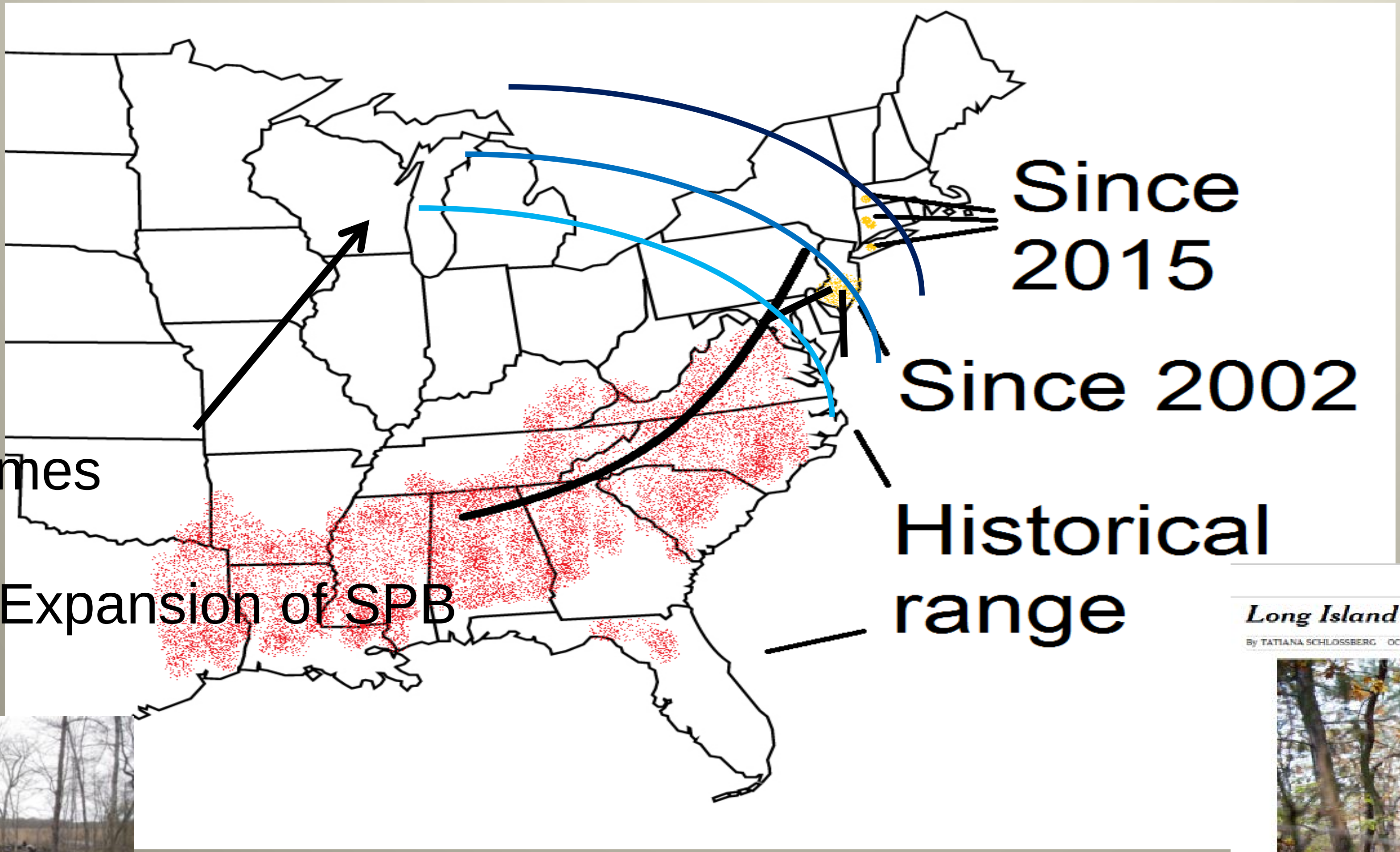




Source: Northeast Climate Impact Assessment, 2006
Slide by G. Lovett

Area habitable by HWA in 2100 under different CO2 emissions scenarios

Southern Pine Beetle expansion with warmer winters



Retreat of
Cold Extremes

Expansion of SPB


The New York Times

Long Island Confronts Destructive Southern Pine Beetles

By TATIANA SCHLOSSBERG OCT. 28, 2014

Robin Donohue, a wildlife biologist, inspected a pitch pine at the Wertheim National Wildlife Refuge in Shirley, N.Y., this week. Gordon M. Grant for The New York Times

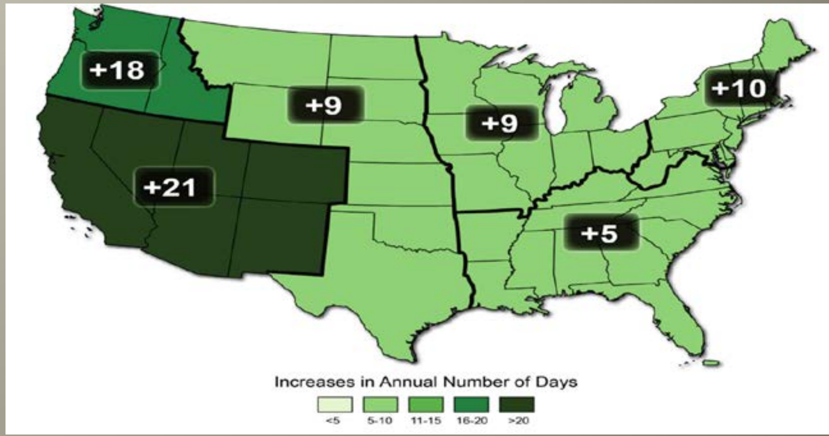
Range expansion of temperature-limited aquatic species

Water Hyacinth

Asian Clam

Changes in disturbance regime favors invasive species

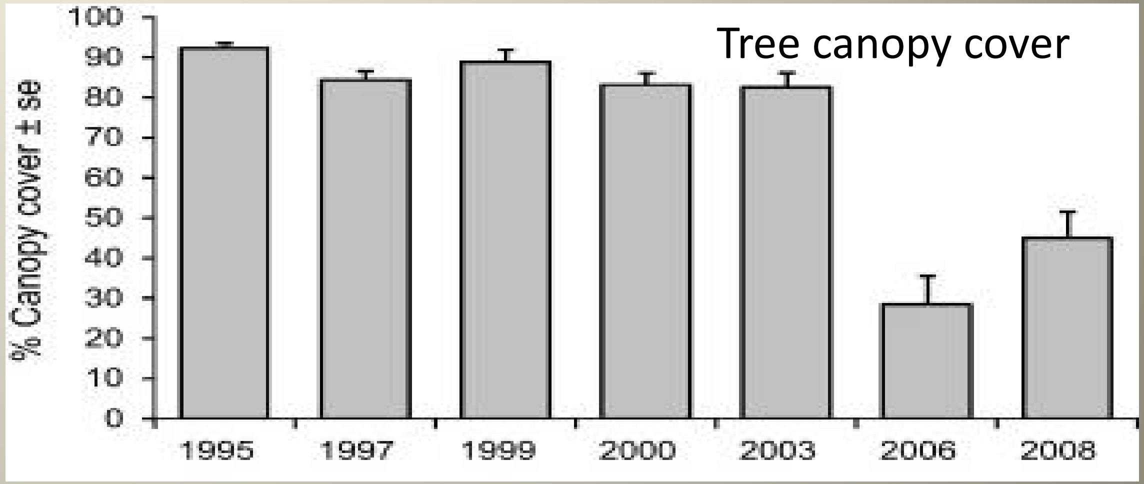
ex: ice scouring effect removed

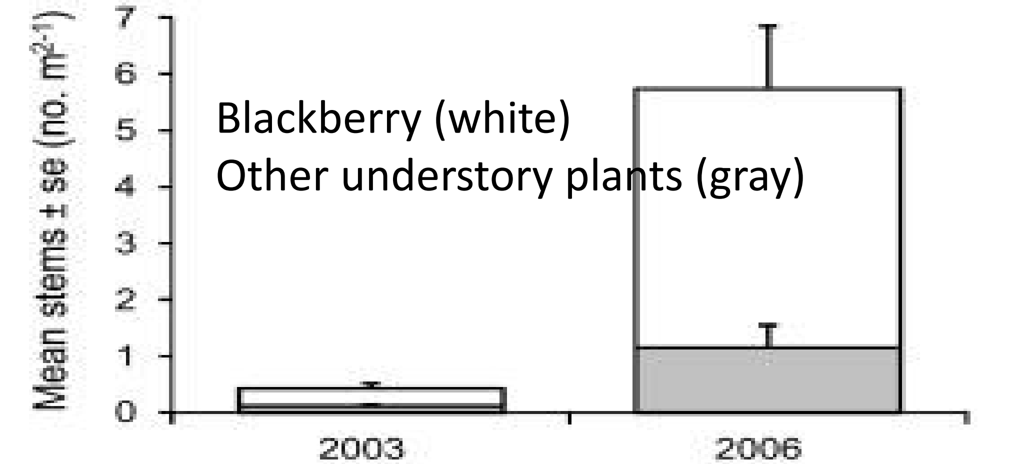


Increased extreme events

Extreme events cause native species mortality and allow invasive species to move in

Understory (invasive) plants thrive following disturbance from Hurricane Katrina. Duration of effect unknown.

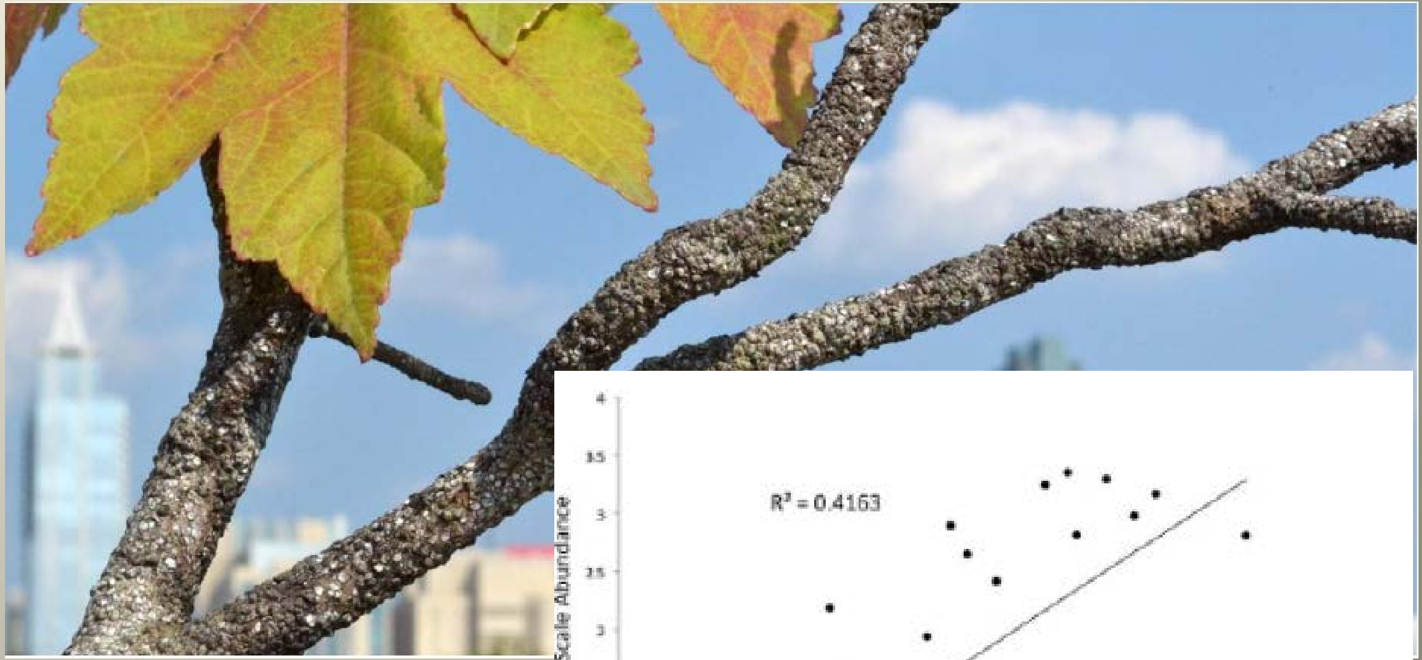


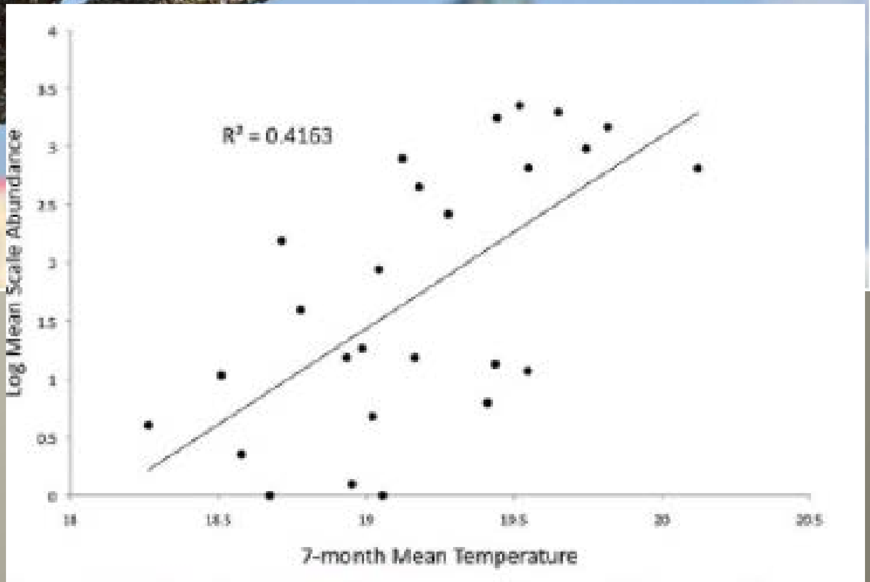


Brown et al. 2011

Warmer climate + drought=
more stressed trees and more abundant pests

- Gloomy scale insects, *Melanaspis tenebricosa and red maples*
- Warmer, more drought-stressed trees harbored more successful pests than cooler, less drought-stressed trees.
- As cities and natural habitats become hotter and drier, damaging scale insects will become more abundant.

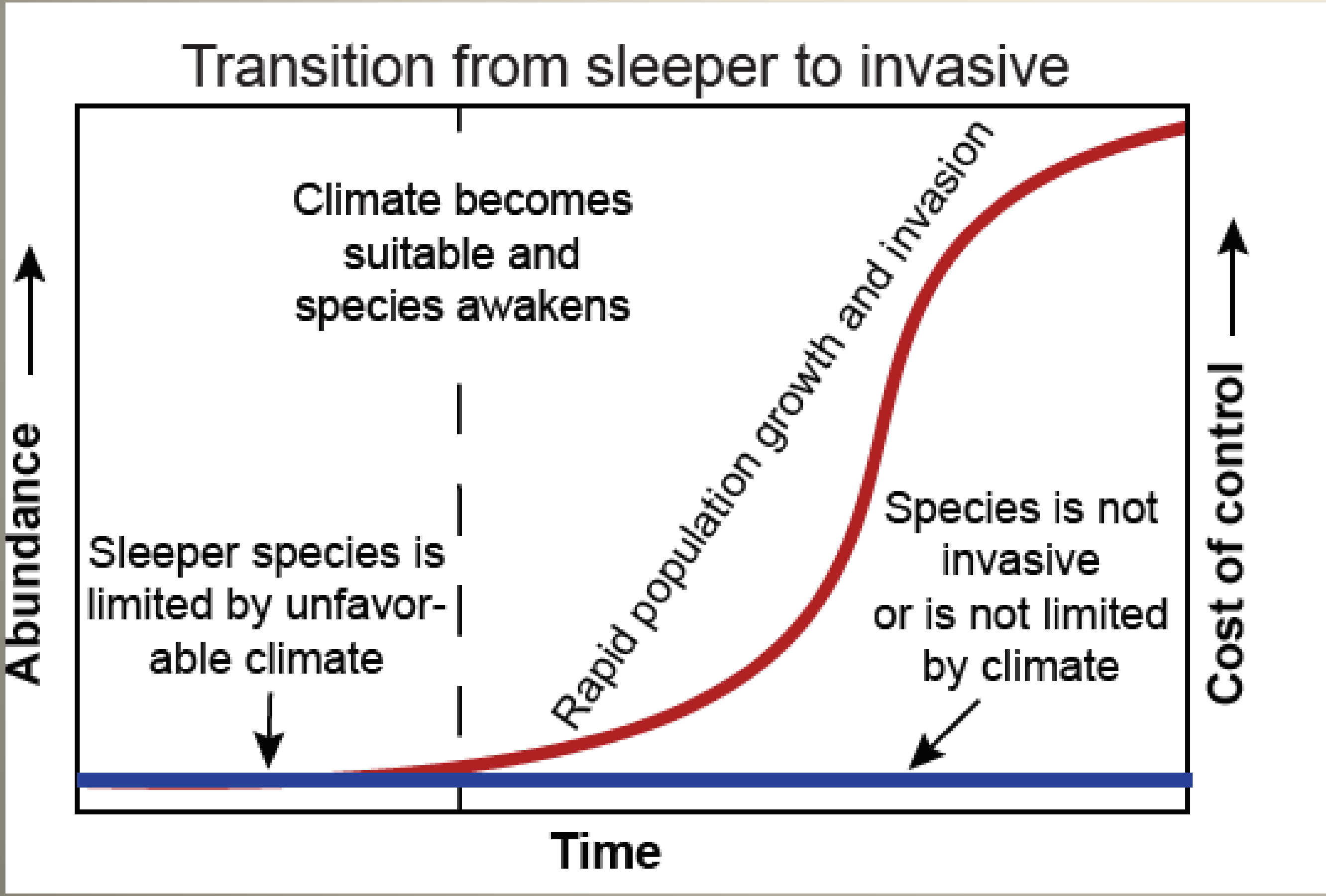




Linear regression of seven-month mean temperature and log mean scale abundance per 0.6 m of maple twig (log(y) = 229.95+1.65x).

Adam Dale (UF) and Steven Frank (NCSU)

"Unknown" future invaders: "Sleeper Species"



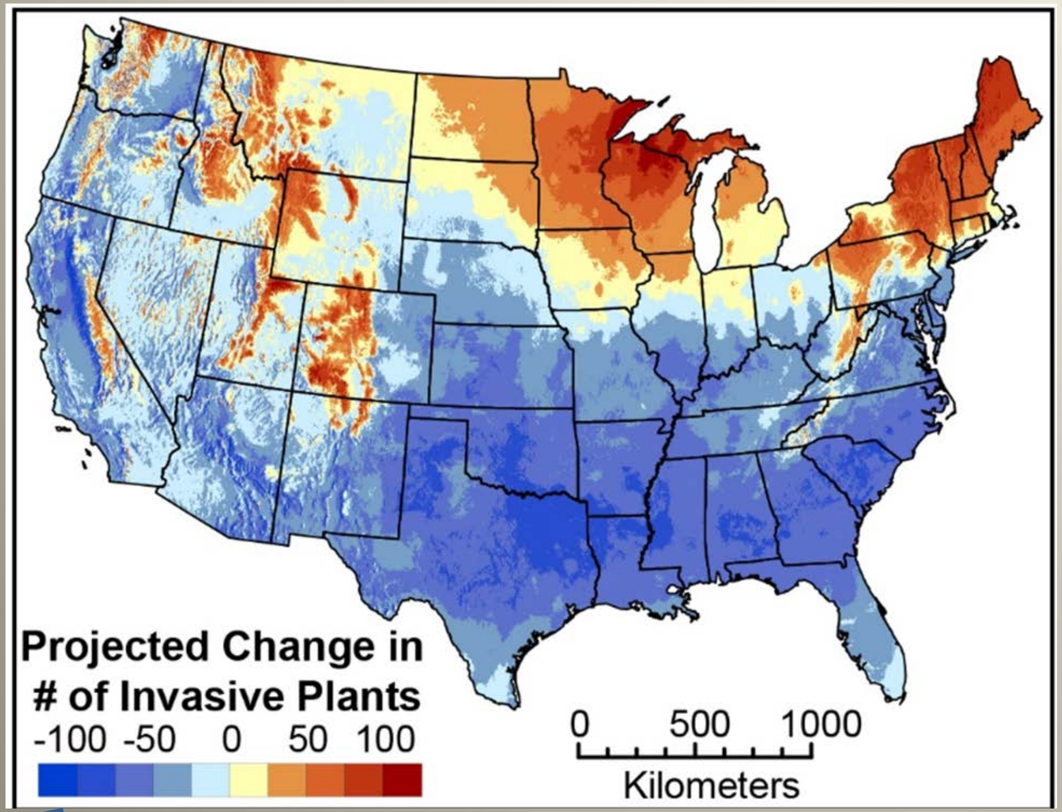
Bradley, Bethany A.; Beaury, Evelyn; Fusco, Emily J.; Laginhas, Brittany; Morelli, Toni Lyn; and Pasquarella, Valerie, "Regional Invasive Species & Climate Change Management Challenge: Preparing for sleeper species" (2018). *Environmental Conservation Educational Materials*. 2.
https://doi.org/10.7275/R5F18WXT

- Non-native species that are present but not invasive because growth is limited by biotic or abiotic conditions
- Often climate is the limiting factor and if climate becomes suitable, the species will proliferate

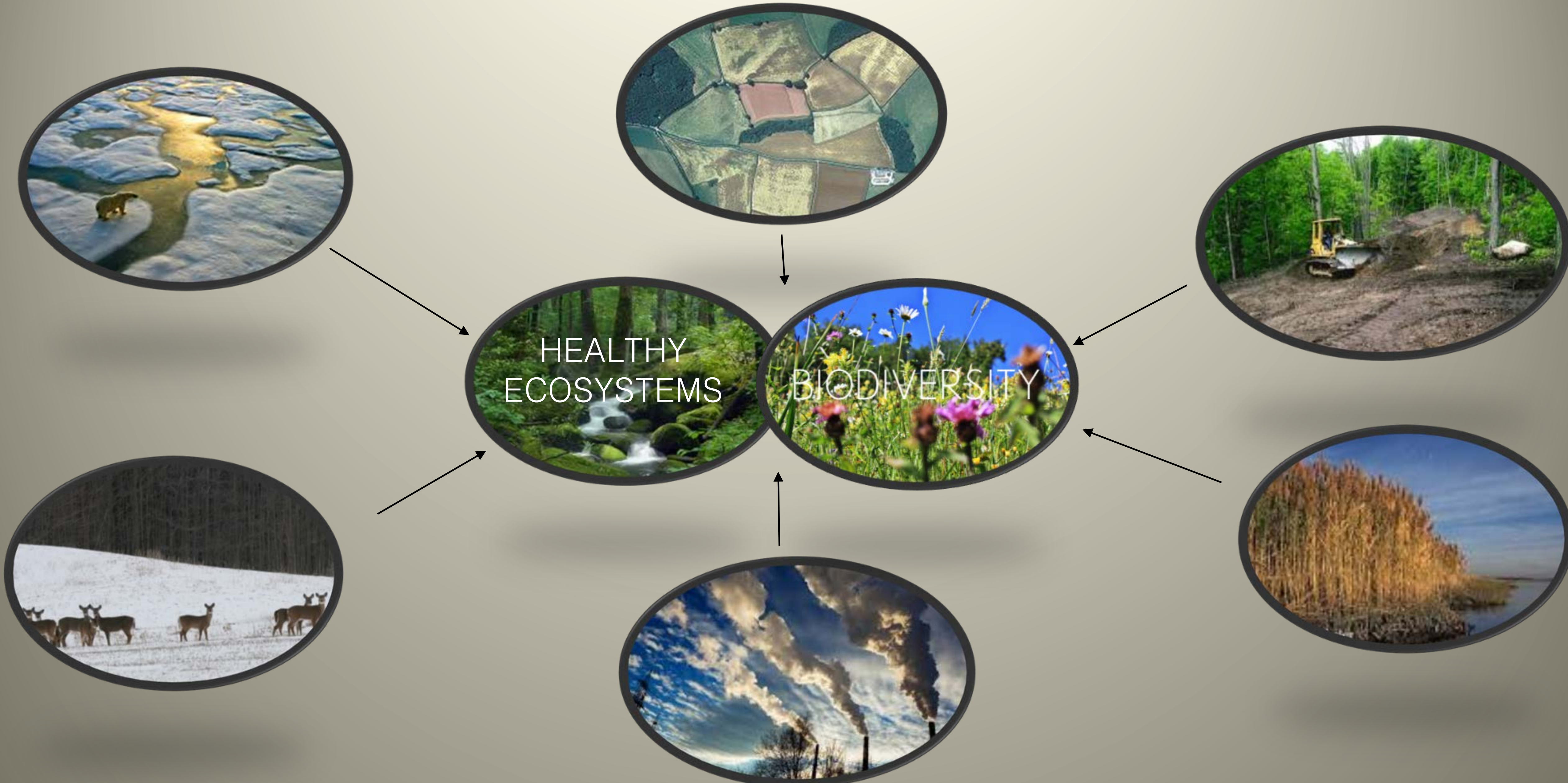
Examples of sleeper species

A) Acorn barnacle (*Austrominius modestus*), a cold-intolerant species first introduced around 1955 off the U.K. coast, did not become invasive until 50 years later after a series of mild winters. **B)** Mayweed chamomile (*Anthemis cotula*) was introduced to Massachusetts over a century ago. Its ability to respond quickly to climate change may give the plant a competitive advantage, shifting it from naturalized to invasive. **C)** First discovered in New York in 2004, Sirex woodwasp (*Sirex noctilio*) currently impacts stressed pines. Increasingly frequent disturbance events due to climate change may lead to greater damage from this forest pest.

Climate change does not always benefit invasive species



Responses are species and context specific!


HEALTHY
ECOSYSTEMS
BIODIVERSITY

Climate Change's Opportunities for Invasive Species

- Increased growth and density of invasives due to higher CO_2
- "Hardier" invasives under higher CO2 show resistance to herbicide treatment
- Potential reduced effectiveness of biocontrols if phenology is mismatched
- Earlier green-up (via priority effects or greater plasticity) for invasives and other competitive advantages
- Northward shifts for invasives due to warmer temperatures and milder winters
- Increased new establishment due to increased disturbance
- Waking up "sleeper" invasive species

How could this research knowledge translate to management decisions?

Extend boat washing stations beyond traditional Memorial day to Labor day

Plant native to avoid introducing potential sleeper species

Seek additional management tools in preparation for hardier invasives under increased CO_2

Including IS in planning for extreme events response

Proactively consider regulating invasive species from Southern states

Adjusting treatment timing to address earlier phenology

Look to neighbors to the south for species on the move

Today’s talk

- Climate Change – what changes are occurring?
- Invasive species responses to these changes and the implications for invasive species management
- How can we increase knowledge and tools to incorporate climate change considerations into invasive species management decisions?

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“consider opportunities to apply innovative science and technology…..”

CONTRACTOR'S REPORT

The INNOVATION SUMMIT

VISION+SCIENCE+TECHNOLOGY=SOLUTIONS

DECEMBER 5, 2016 · WASHINGTON, DC

REPORT

The Federal Government defines invasive species to mean, with regard to a particular ecosystem, a non-native organism whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human, animal, or plant health. —EXECUTIVE ORDER 13751

INVASIVE SPECIES: URGENT ACTION IS REQUIRED

It is the policy of the United States to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established.[1] Every aspect of national security is at risk. Invasive species adversely impact plant and animal health, limit food and water availability, jeopardize the integrity of critical infrastructure, threaten the livelihoods and cultures of people who are largely dependent upon local resources, increase the likelihood for large-scale damage from natural disasters, and infest military equipment and training facilities, thus compromising military readiness. The harm caused by invasive species costs governments, industries, and private citizens substantial economic losses. In the United States, environmental damages and associated losses are already amounting to more than $100 billion annually.[2]

MAKING THE CASE FOR INNOVATION

Although policy makers, land managers, and the public are increasingly aware of the invasive species issue, the commitment to problem resolution remains well below that needed to a
Why? In part, the answer is that the invasive species issue has been plagued by
misconception. Invasive species challenges are frequently considered too com
and too costly to overcome. This perspective undermines political and public
financial and intellectual investments necessary to overcome substantial challen
the inspiration and capacity to innovate.

It is clear, nevertheless, that investments in technology innovation can be ga
tinely, they are demonstrating that seemingly insurmountable challenges can
substantial return on investment. Problems can be solved. The current toolbo
vasive species is incomplete and, in many cases, inadequate. However, investm
innovation can enable us to change the invasive species conversation from "We

1 Executive Order 13751; https://www.fedcenter.gov/Bookmarks/index.cfm?id=305
2 Pimentel et al. 2005; http://www.sciencedirect.com/science/article/pii/S092180

“We Can Do This……”

The man who has the time, the discrimination, and the sagacity to collect and comprehend the principal facts and the man who must act upon them must draw near to one another and feel that they are engaged in a common enterprise. (Woodrow Wilson, 1856–1924.)

Increasing research on invasive species

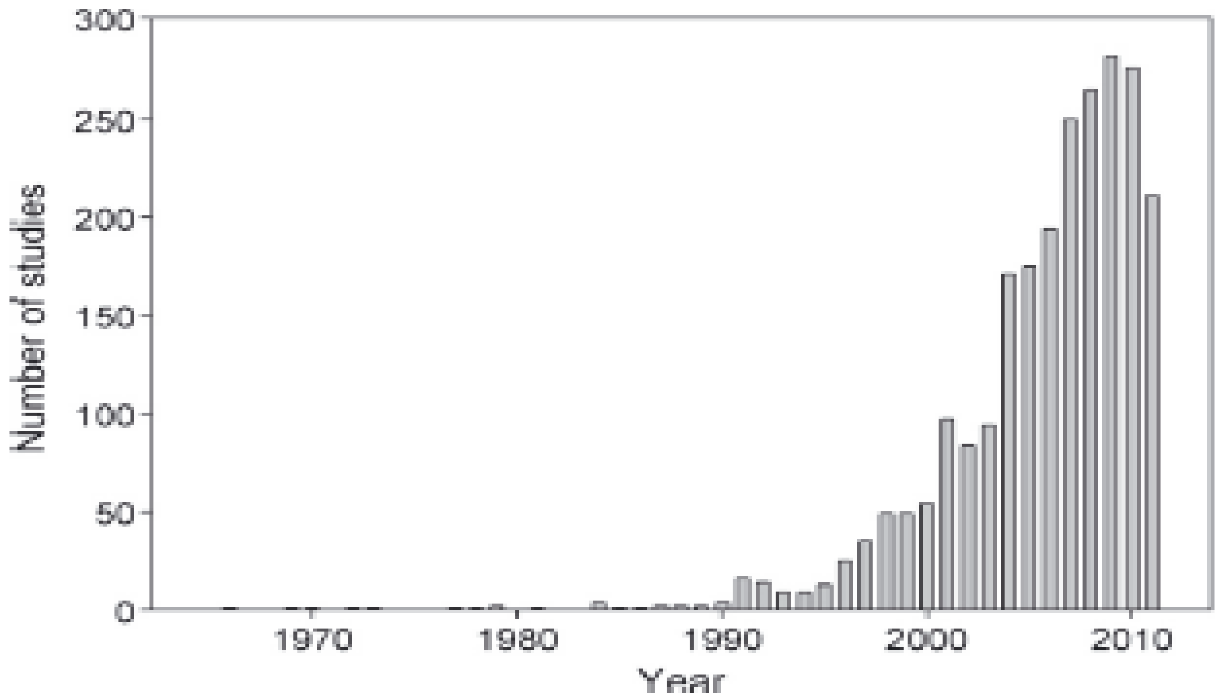


Figure 3. The number of studies published per year included in the field synopsis. The most recent year (2011) only included records included in the database through September (journals published at different dates in September will vary in their inclusion in the database) and indexed on the Web of Science as of September 2011.

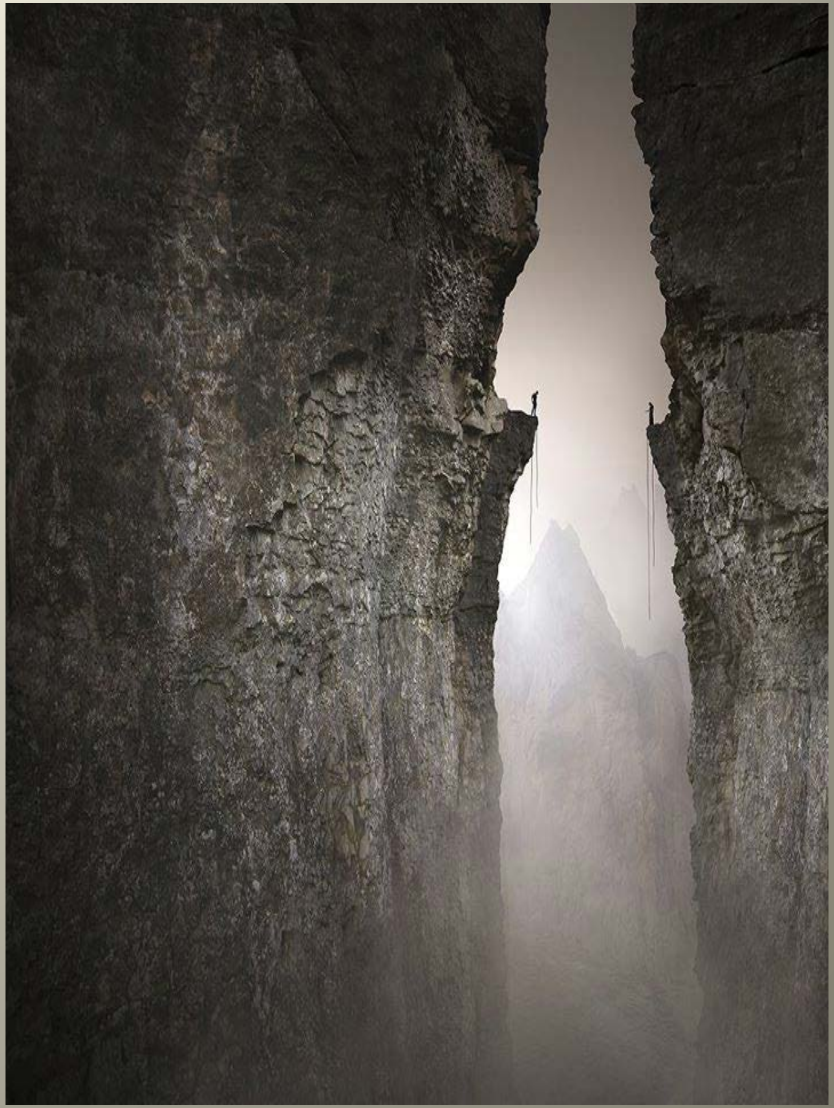
Biological invasions: a field synopsis, systematic review, and database of the literature

Edward Lowry[1], Emily J. Rollinson[1], Adam J. Laybourn[1], Tracy E. Scott[1,2], Matthew E. Aiello-Lammens[1], Sarah M. Gray[1,3], James Mickley[1,4] & Jessica Gurevitch[1]

The "Knowing- Doing Gap" in IS Management and Research

"There is a gap between research and practice, so that scientific information accumulates, but is not incorporated into management actions."

- Matzek et al. 2014.Conservation Letters



Where do invasive plant managers get the information that directs their management decisions? *(Matzek et al. 2014)*

Informal conversations and learning from own experiments

Written material synthesized in books, newsletters, or Web sites

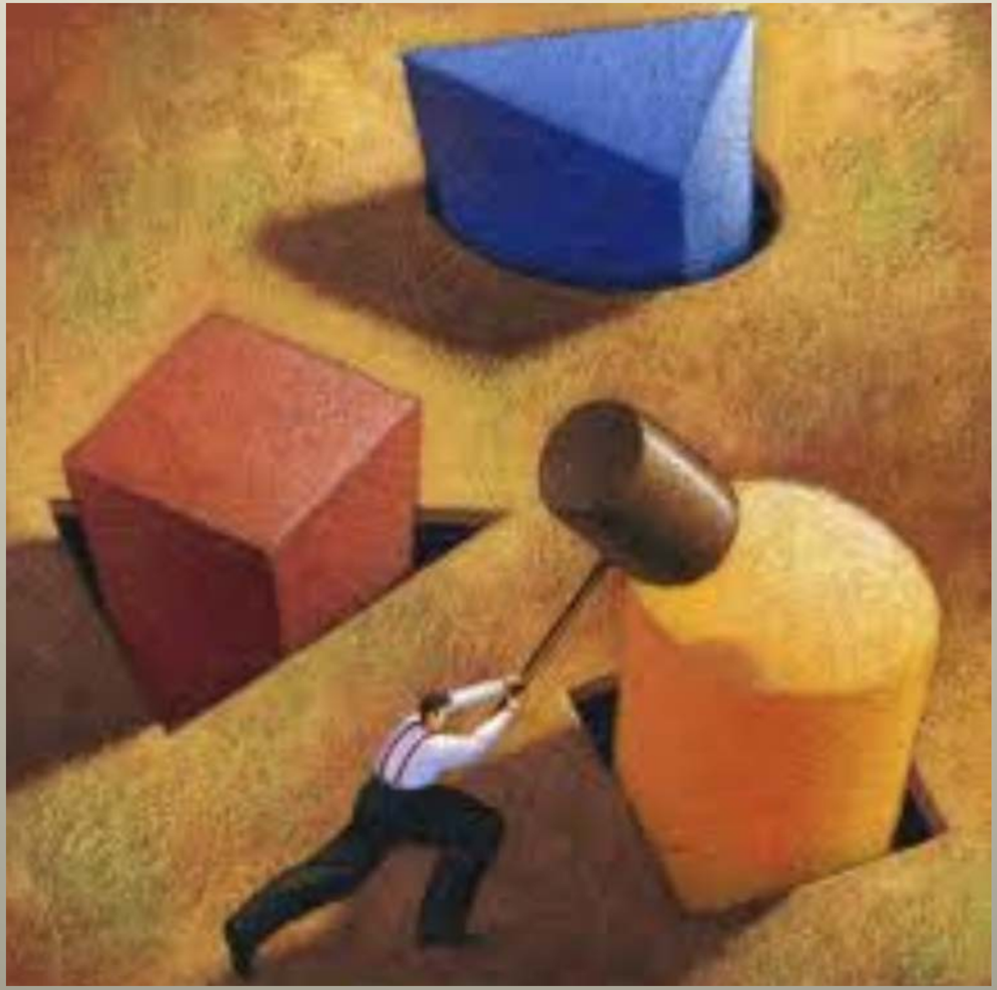
Conference/ symposium attendance

Peer review journals

Ranked Highest

Ranked Lowest

Often the information doesn't exist or research doesn't address the specific question



New York Invasive Species Research Institute

IS Managers asking:

How can we manage for upcoming biological invasions in the light of climate change?

New York Invasive Species Research Institute

Northeast RISCC Management

Regional Invasive Species & Climate Change

http://people.umass.edu/riscc/

How can we manage for upcoming biological invasions in the light of climate change?

USGS
science for a changing world

NE CASC
Northeast Climate Adaptation Science Center

UMASS AMHERST

New York Invasive Species Research Institute

Cornell University

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http://people.umass.edu/riscc/

Bring together invasives species and climate change researchers and managers to understand the information needs and develop a strategy to address those needs through information sharing and targeted research

Northeast RISCC Management

Regional Invasive Species & Climate Change

http://people.umass.edu/riscc/

1. Understand and communicate the ways that Invasive species and climate change interact

2. Identify managers needs for information and gaps in knowledge

3. Conduct research to address knowledge gaps and develop tools to assist in incorporating climate change into invasive species management and policies

Northeast RISCC Management
Regional Invasive Species & Climate Change

Activities

- Symposia (2017 & 2018 at UMass; 2019 in coordination with NAISMA in Saratoga Springs)

Northeast RISCC Management — Regional Invasive Species & Climate Change

Activities

- Symposia (2017 & 2018 at UMass; 2019 in coordination with NAISMA in Saratoga Springs)
- Research summaries

Join our listserv: Email “ne_riscc-l-request@cornell.edu" with the subject "join" to sign up.

Northeast RISCC Management — Regional Invasive Species & Climate Change

Activities

- Symposia (2017 & 2018 at UMass; 2019 in coordination with NAISMA in Saratoga Springs)
- Research summaries
- 2-page ‘management challenge’ documents

Synthesizing scientific research and providing management recommendations

Northeast RISCC Management

Regional Invasive Species & Climate Change

Management Challenge

Warming Waters: Implications for Invasive Species in the Northeast

SUMMARY: Climate change is warming northeastern water bodies and changing the environmental conditions that structure aquatic communities, presenting new challenges for the management and conservation of these ecosystems. The altered physical, chemical, and biological conditions resulting from warming waters may benefit or harm native ... expand. Here, we summariz... size the growing body of sc... drafting management plans...

Changing Aquatic Eco...

In the Northeast, water temperatures... In long-term studies, stream and lak... and fall freezing later[2,3]. Stream flows...

How Does Temperatu...

Temperature is a key variable that inf...

Northeast RISCC Management

Regional Invasive Species & Climate Change

Management Challenge

Preparing for sleeper species
Climate change could awaken some naturalized species

Summary

Many naturalized non-native species never become invasive and generally are not prioritized for management due to limited resources. However, climate change could enhance the success of these species, causing some to become invasive. Therefore, we need to reassess the current pool of naturalized species to identify and prioritize management of 'sleeper' species.

What are sleeper species?

Sleeper species are naturalized in a region, potentially invasive, but not yet invasive because they are limited by biotic or abiotic conditions. Many naturalized species remain at low abundance and will never become invasive, but others are constrained by unfavorable climate conditions. Climate change could create newly favorable conditions for natural-

Subject: Research summary: Warming, nutrients, and invasion
Date: Thursday, October 25, 2018 11:50:51 AM

This week's summary tests the effects of multiple global change stressors on red maple. While some warming could help maple seedlings, adding invasion or excess nutrients to the mix was generally harmful to growth.

Wheeler, J. A., Frey, S. D., and Stinson, K. A. (2017). Tree seedling responses to multiple environmental stresses: Interactive effects of soil warming, nitrogen fertilization, and plant invasion. *Forest Ecology and Management* 403: 44–51.

Summary:

In addition to the impending rise in global temperatures, scientists have also observed increases in soil nutrients and invasive plant populations throughout New England. However, the combined effects of these stressors on regionally important tree species establishment has yet to be thoroughly investigated. Wheeler et al. (2017) sought to fill this knowledge gap by measuring the compound effects of soil warming, nitrogen addition, and invasion of garlic mustard (*Alliaria petiolata*), on red maple (*Acer rubrum*) seedling growth, phenology, survival, and root symbioses. Of the four traits measured, Wheeler et al. (2017) found that red maple seedling growth and beneficial fungal relationships were enhanced by soil warming. Interestingly, these positive effects were offset by interactions between any two of the global change stressors, but not by an interaction between all three stressors. The authors suggest that while soil warming may increase red maple growth initially, plant productivity may suffer from decreased soil water and excess nitrogen in combined treatment applications. Similarly, the benefits of warming appear to be inhibited by the chemical compounds produced by garlic mustard. Given the interactions between the global change impacts observed in this study, Wheeler et al. (2017) encourage forest managers to evaluate the combined effect of both abiotic and biotic interactions in future plans to conserve tree seedlings under predicted climate change scenarios.

Take-home points:

- Soil warming, nitrogen deposition, and impacts of invasive plant species are a threat to native tree seedlings in New England.
- The combined effects of soil warming and nitrogen deposition, and soil warming and garlic mustard, have been shown to inhibit the growth and symbioses of red maple seedlings.
- Further studies on plant-soil feedbacks will enhance our understanding of interactive effects of global change in New England forests and throughout other regionally important ecosystems.

Management implications:

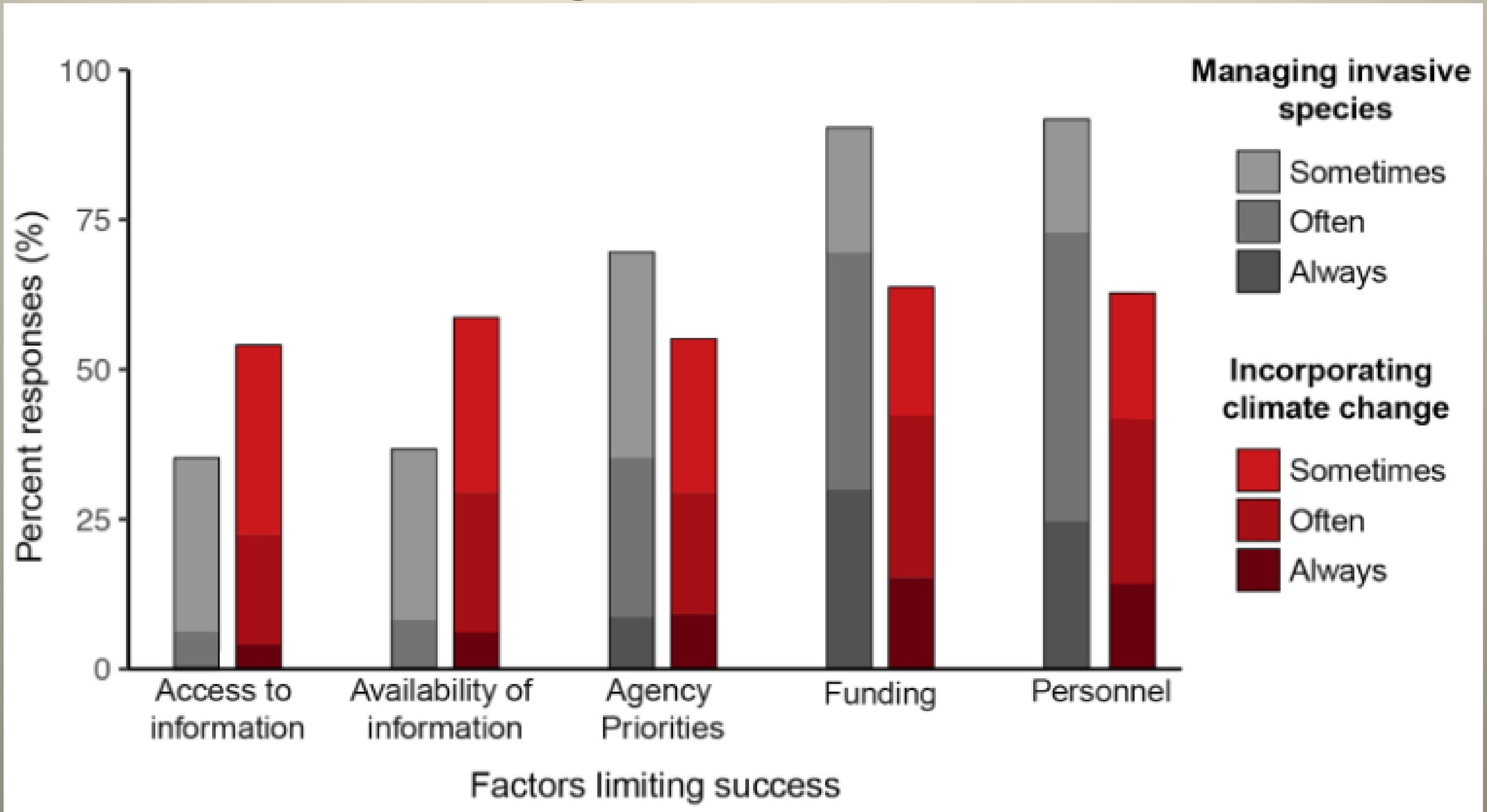
- Knowing the projected global change impacts local to your area can help plan for future climate change scenarios since different combinations of stressors have different impacts.

Northeast RISCC Management
Regional Invasive Species & Climate Change

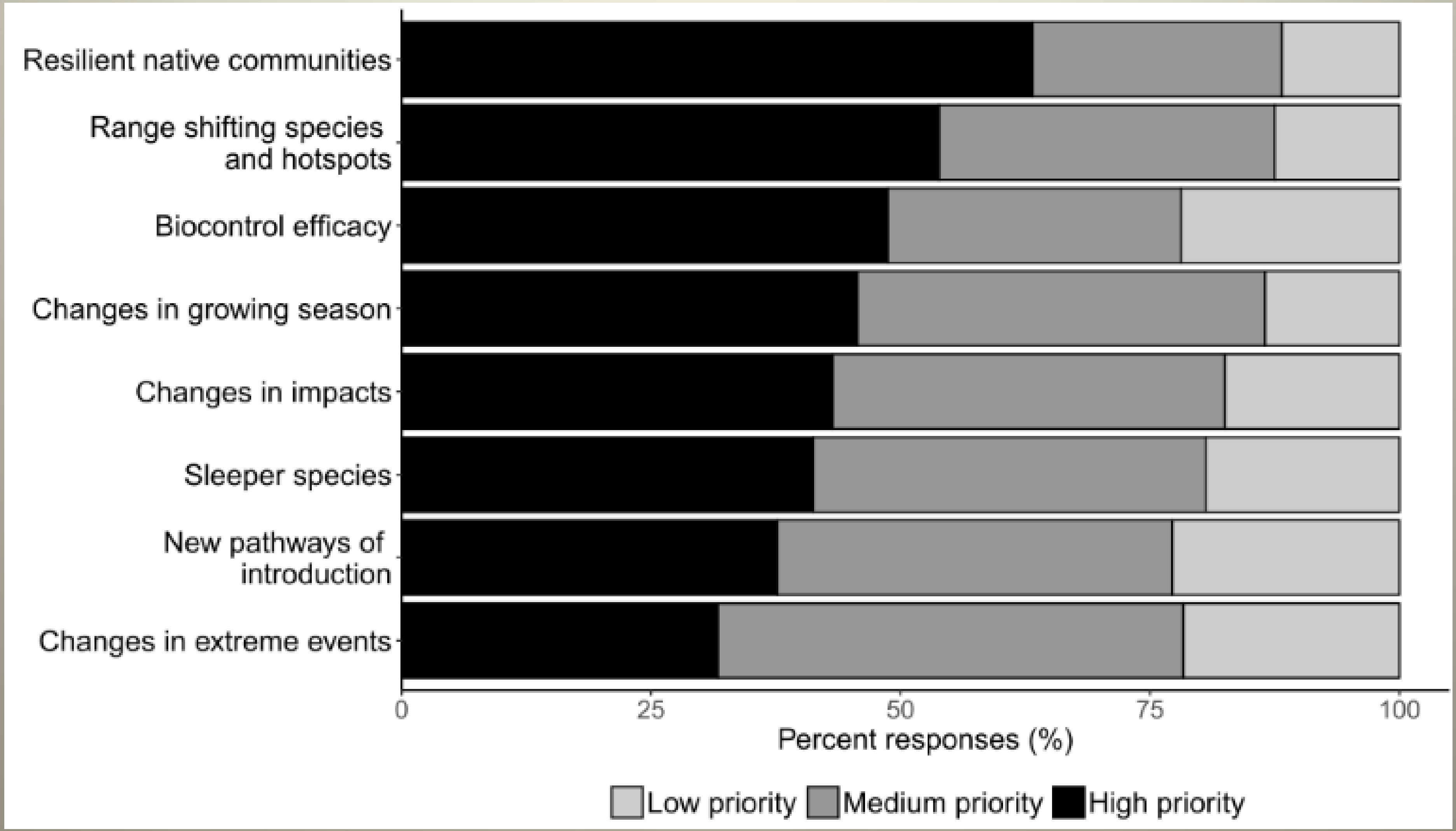
Activities

- Symposia (2017 & 2018 at UMass; 2019 in coordination with NAISMA in Saratoga Springs)
- Research summaries
- 2-page 'management challenge' documents
- Survey of manager priorities and research needs

Lack of information is a barrier to including climate change in management actions



Manager's research priorities



Managers are already incorporating 'climate smart' solutions into management

Strategic Planning
Project development and planning
Increasing/improving partnerships
Incorporating climate change into invasive species management plans
Considering new objectives and priorities

Thinking Proactively (Preventative Management)
Identifying and managing new invasives
Planting native species adapted to climate change
Planning for more extreme events
Population/Habitat management for climate adaptation
Managing other stressors on the landscape
Protecting coastal resources from/adapting to sea level rise, including focusing on uplands

Treatment and Control
Changing timing of treatment and monitoring
Improving known invasive species control

Education and Outreach
Educating self and staff about climate change and new treatment techniques
Increasing public and social engagement in invasive species removal
Encouraging policy changes
Talking to partners in warmer regions about current methods

Northeast RISCC Management

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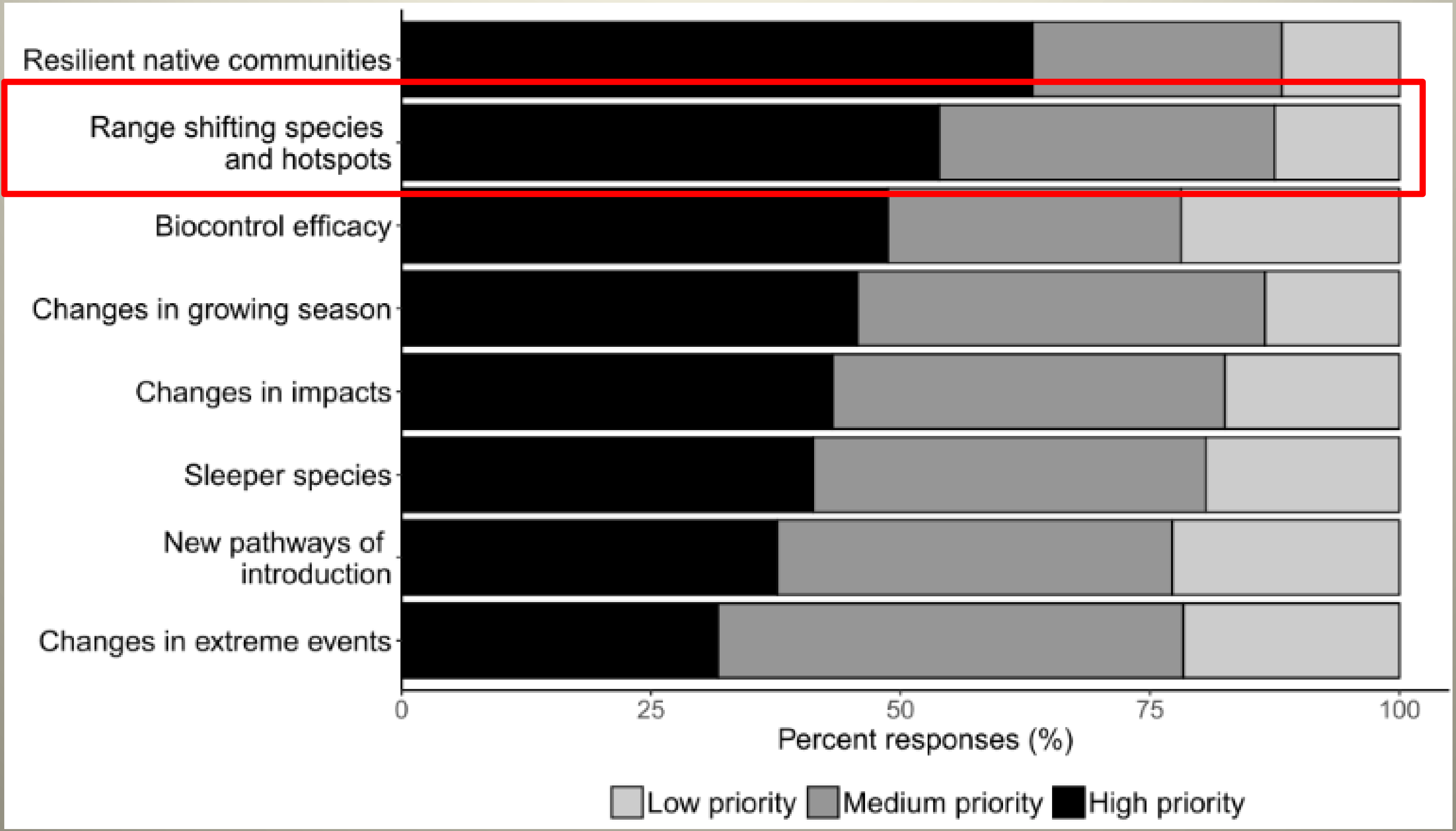
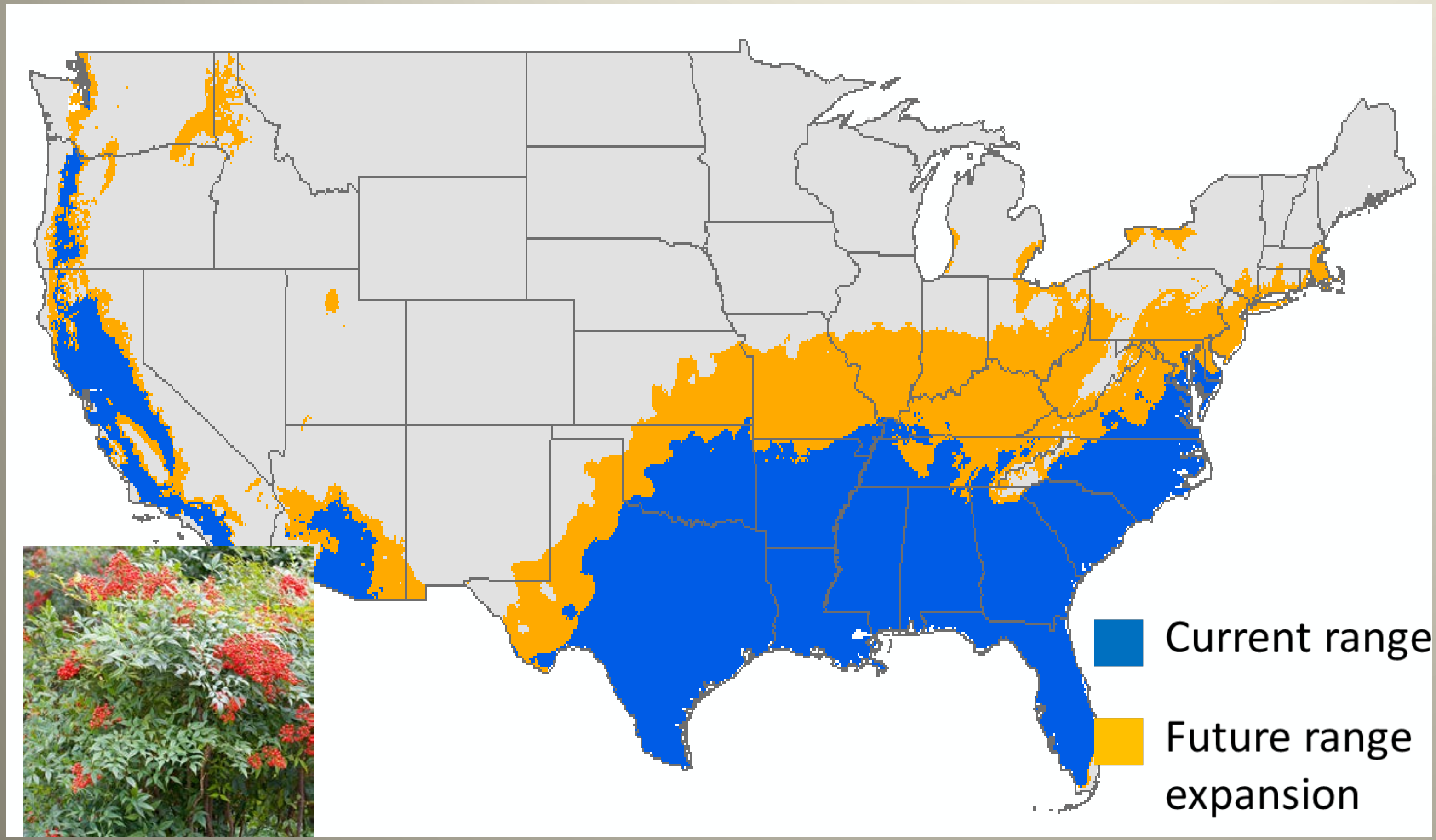
- 2-page 'management challenge' documents
- Survey of manager priorities
- *Original research* resulting from manager interests and requests

Manager's research priorities



Creating State Watch Lists:

Use models to identify species-level range shifts with climate change



Nandina domestica
sacred bamboo

Dr. Jenica Allen
University of New Hampshire

Fundng provided by NSF and NE IPM Center

Online App Development:
Watch Lists of Range-Shifting Invasive Plants

The species included in the list generated are those which have not been observed in the state nor predicted to be there by a current climate model.

Choose your State

New Hampshire

Choose the number of models

0

Refine the list by

- Show me everything
- Species currently in an adjacent state
- Species currently within the ecoregion
- Species currently within a radius

Choose a radius (in miles)

100 | 900 | 2,800

100 400 700 1,000 1,300 1,900 2,500

Apply Changes

Species List | Map Selection

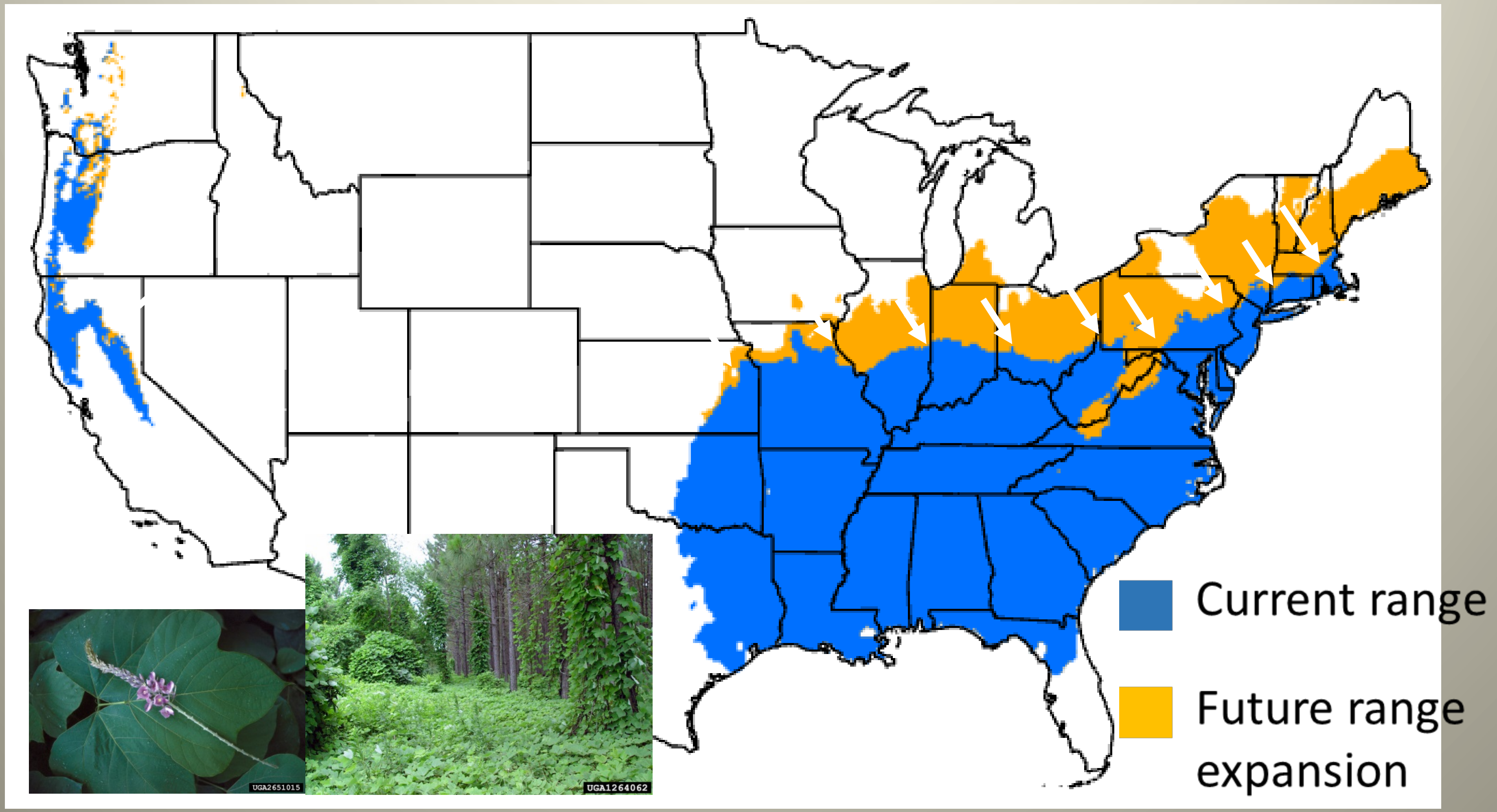
Northeastern IPM Center

Project funded by the Northeastern IPM Center through Grant #2014-70006-22484 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

USDA NIFA Award #2017-67023-26272

USDA

Opportunity for Proactive Programs



Pueraria montana var. lobata
kudzu

Example watch list for New York + New England (species are not yet established)

Could establish currently, expand ranges by 2050			
Achyranthes japonica	*Ceratocephala testiculata*	*Ludwigia grandiflora*	*Sacciolepis indica*
Aegilops ovata	*Clerodendrum chinense*	*Lythrum virgatum*	*Schedonorus pratensis*
Alhagi maurorum	*Cruciata pedemontana*	*Mahonia bealei*	*Sinapis arvensis*
Alyssum murale	*Cunninghamia lanceolata*	*Murdannia keisak*	*Spartium junceum*
Ambrosia artemisiifolia	*Cytisus striatus*	*Oplismenus hirtellus*	*Stachys arvensis*
Anchusa arvensis	*Daphne laureola*	*Petrorhagia dubia*	*Stellaria media*
Anthriscus caucalis	*Elaeagnus pungens*	*Pinus pinaster*	*Tamarix africana*
Arum italicum	*Euphorbia oblongata*	*Poncirus trifoliata*	*Thymelaea passerina*
Avena sterilis	*Euphorbia esula*	*Prunus laurocerasus*	*Trifolium hirtum*
Cardaria chalepensis	*Festuca brevipila*	*Pseudelephantopus spicatus*	
Cardaria pubescens	*Gastridium phleoides*	*Pseudognaphalium luteoalbum*	*Tripleurospermum perforatum*
Centaurea iberica	*Hedera hibernica*	*Quercus acutissima*	*Ventenata dubia*
Centaurea macrocephala	*Hypericum calycinum*	*Rubus macrophyllus*	*Vitex agnus-castus*
Centaurea melitensis	*Kniphofia uvaria*	*Rubus ulmifolius*	*Vitis vinifera*
Centaurea virgata	*Leontodon taraxacoides*	*Rubus vestitus*	*Youngia japonica*
Centranthus ruber	*Lotus pedunculatus*	*Rumex stenophyllus*	
Could establish by 2050			
Allium paniculatum	*Conyza bonariensis*	*Jasminum multiflorum*	*Phyllanthus tenellus*
Ardisia elliptica	*Cortaderia selloana*	*Lagerstroemia indica*	*Phyllostachys aurea*
Arundo donax	*Crotalaria spectabilis*	*Ligustrum japonicum*	*Prunus lusitanica*
Avena barbata	*Dalbergia sissoo*	*Liriope spicata*	*Senna occidentalis*
Bellardia trixago	*Ehrharta erecta*	*Mosla dianthera*	*Sesbania punicea*
Brachypodium distachyon	*Firmiana simplex*	*Nandina domestica*	*Tamarix aphylla*
Buddleja lindleyana	*Hedera helix*	*Peganum harmala*	*Urochloa distachya*
Carduus tenuiflorus	*Hemarthria altissima*	*Persea americana*	

But, which species do we manage?

Could establish currently, expand ranges by 2050			
Achyranthes japonica	*Ceratocephala testiculata*	*Ludwigia grandiflora*	*Sacciolepis indica*
Aegilops ovata	*Clerodendrum chinense*	*Lythrum virgatum*	*Schedonorus pratensis*
Alhagi maurorum	*Cruciata pedemontana*	*Mahonia bealei*	*Sinapis arvensis*
Alyssum murale	*Cunninghamia lanceolata*	*Murdannia keisa*	*Spartium junceum*
Ambrosia artemisiifolia	*Cytisus striatus*	*Oplismenus*	*Stachys arvensis*
Anchusa arvensis	*Daphne laureola*	*Petrorhag*	*Stellaria media*
Anthriscus caucalis	*Elaeagnus pungens*	*Pinus*	*Tamarix africana*
Arum italicum	*Euphorbia oblongata*	*Pc*	*Thymelaea passerina*
Avena sterilis	*Euphorbia esula*	*us*	*Trifolium hirtum*
Cardaria chalepensis	*Festuca brevipila*	*opus spicatus*	
Cardaria pubescens	*Gastridium phleoid*	*nalium* *m*	*Tripleurospermum perforatum*
Centaurea iberica	*Hedera hibern*	*cus acutissima*	*Ventenata dubia*
Centaurea macrocephala	*Hypericum*	*bus macrophyllus*	*Vitex agnus-castus*
Centaurea melitensis	*Kniphof*	*Rubus ulmifolius*	*Vitis vinifera*
Centaurea virgata	*Leo*	*Rubus vestitus*	*Youngia japonica*
Centranthus ruber		*Rumex stenophyllus*	
d establish by 2050			
Allium paniculatum	*onariensis*	*Jasminum multiflorum*	*Phyllanthus tenellus*
Ardisia elliptica	*Co eria selloana*	*Lagerstroemia indica*	*Phyllostachys aurea*
Arundo donax	*Crotalaria spectabilis*	*Ligustrum japonicum*	*Prunus lusitanica*
Avena barbata	*Dalbergia sissoo*	*Liriope spicata*	*Senna occidentalis*
Bellardia trixago	*Ehrharta erecta*	*Mosla dianthera*	*Sesbania punicea*
Brachypodium distachyon	*Firmiana simplex*	*Nandina domestica*	*Tamarix aphylla*
Buddleja lindleyana	*Hedera helix*	*Peganum harmala*	*Urochloa distachya*
Carduus tenuiflorus	*Hemarthria altissima*	*Persea americana*	

100 species!!

Prioritize watch lists with impacts assessment (EICAT)

Diversity and Distributions, (Diversity Distrib.) (2015) **21**, 1360–1363

BIODIVERSITY LETTER

Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT)

Charlotte L. Hawkins[1], Sven Bacher[2], Franz Essl[3], Philip E. Hulme[4], Jonathan M. Jeschke[5,6], Ingolf Kühn[7,8], Sabrina Kumschick[9,10],

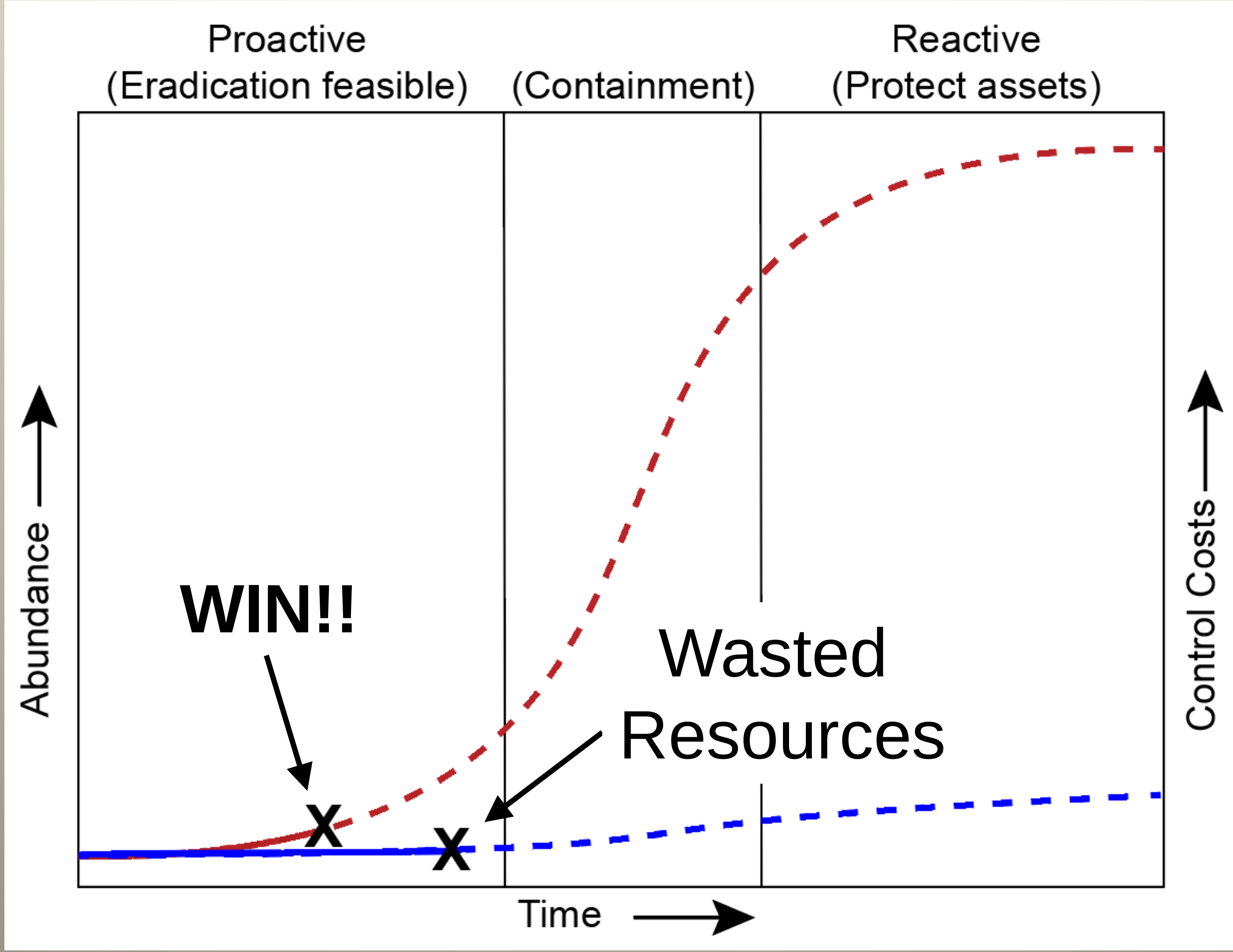
Species	Impact Mechanism	Max. Impact Score
Ludwigia grandiflora	Competition	4
	Hybridization	NA
Large-flower primrose-willow	Disease Transmission	NA
	Parasitism	NA
Forb/herb, Subshrub	Poisoning/Toxicity	4
	Bio-Fouling	4
	Chemical Impact	NA
	Physical Impact	3
	Structural Impact	4
	Interaction	3
	Agricultural	Present
	Economic	Present
	Human Health	Present

Number of Papers Assessed: 11

Mei Rockwell-Postel

Bethany Bradley

We need to prioritize



Prioritized watch list based on impacts

Could establish currently, expand ranges by 2050			
Achyranthes japonica	*Ceratocephala testiculata*	***Ludwigia grandiflora***	*Sacciolepis indica*
Aegilops ovata	*Clerodendrum chinense*	*Lythrum virgatum*	Schedonorus pratensis
Alhagi maurorum	*Cruciata pedemontana*	*Mahonia bealei*	Sinapis arvensis
Alyssum murale	***Cunninghamia lanceolata***	*Murdannia keisak*	Spartium junceum
Ambrosia artemisiifolia	*Cytisus striatus*	*Oplismenus hirtellus*	***Stachys arvensis***
Anchusa arvensis	*Daphne laureola*	*Petrorhagia dubia*	Stellaria media
Anthriscus caucalis	*Elaeagnus pungens*	Pinus pinaster	*Tamarix africana*
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Avena sterilis	Euphorbia esula	*Prunus laurocerasus*	*Trifolium hirtum*
Cardaria chalepensis	*Festuca brevipila*	*Pseudelephantopus spicatus*	
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Centaurea iberica	Hedera hibernica	Quercus acutissima	*Ventenata dubia*
Centaurea macrocephala	*Hypericum calycinum*	*Rubus macrophyllus*	Vitex agnus-castus
Centaurea melitensis	*Kniphofia uvaria*	Rubus ulmifolius	Vitis vinifera
Centaurea virgata	*Leontodon taraxacoides*	*Rubus vestitus*	***Youngia japonica***
Centranthus ruber	Lotus pedunculatus	*Rumex stenophyllus*	

Could establish by 2050			
Allium paniculatum	***Conyza bonariensis***	*Jasminum multiflorum*	*Phyllanthus tenellus*
Ardisia elliptica	*Cortaderia selloana*	*Lagerstroemia indica*	*Phyllostachys aurea*
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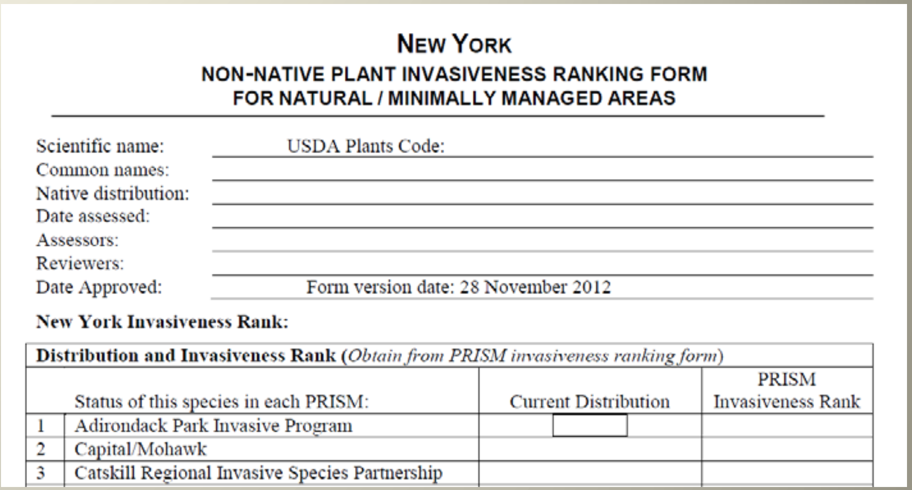
Brachypodium distachyon	*Firmiana simplex*	*Nandina domestica*	***Tamarix aphylla***
Buddleja lindleyana	*Hedera helix*	Peganum harmala	*Urochloa distachya*
Carduus tenuiflorus	*Hemarthria altissima*	Persea americana	

High priority *Medium priority* *Low priority* *Data Deficient* Not yet analyzed

Example outcome:

Use models to identify species-level range shifts with climate change

Genus	species	Common Name
Araujia	sericifera	White bladderflower
Ardisia	elliptica	Shoebutton
Arundo	donax	Giant reed
Asclepias	curassavica	Bloodflower
Avena	barbata	Slender oat
Bellardia	trixago	Mediterranean linseed
Brachypodium	distachyon	Purple false brome
Buddleja	lindleyana	Lindley's butterflybush
Canna	indica	Indian shot
Carthamus	lanatus	Woolly distaff thistle
Cestrum	diurnum	Day jessamine
Conyza	bonariensis	Asthmaweed
Cortaderia	selloana	Uraguayan pampas grass
Crotalaria	spectabilis	Showy rattlebox
Ehrharta	erecta	Panic veldtgrass
Firmiana	simplex	Chinese parasoltree
Hedera	helix	Algerian ivy
Hemarthria	altissima	Limpograss
Hibiscus	tiliaceus	Sea hibiscus
Jasminum	multiflorum	Star jasmine
Lagerstroemia	indica	Crapemyrtl
Ligustrum	japonicum	Japanese privet
Liriope	spicata	Creeping liriope
Mosla	dianthera	Miniature beefsteak plant
Nandina	domestica	Sacred bamboo
Nerium	oleander	Oleander
Paspalum	urvillei	Vasey's grass
Peganum	harmala	Harmal peganum
Persea	americana	Avocado
Phyllanthus	tenellus	Mascarene island leaf-flower
Polypogon	viridis	Beardless rabbitsfoot
Sesbania	punicea	Rattlebox
Tamarix	aphylla	Athel tamarisk
Tamarix	chinensis	Five-stamen tamarisk

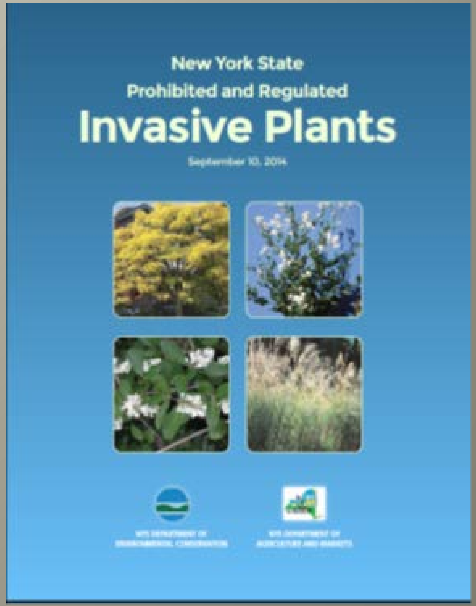


NEW YORK
NON-NATIVE PLANT INVASIVENESS RANKING FORM
FOR NATURAL / MINIMALLY MANAGED AREAS

Scientific name: USDA Plants Code:
Common names:
Native distribution:
Date assessed:
Assessors:
Reviewers:
Date Approved: Form version date: 28 November 2012

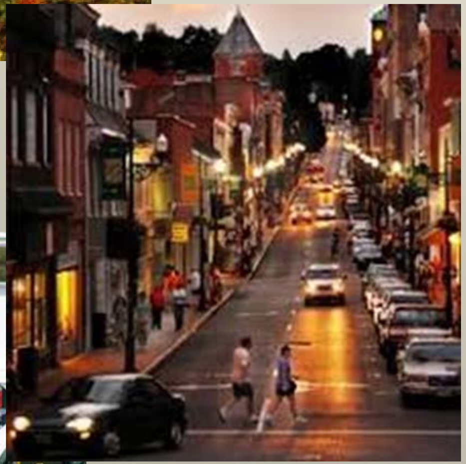
New York Invasiveness Rank:

Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form*)			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program		
2	Capital/Mohawk		
3	Catskill Regional Invasive Species Partnership		



Get involved:

- Check out NE RISCC website: https://people.umass.edu/riscc/
- Join our network: ne_riscc-l-request@cornell.edu with the subject "join"
- Participate in climate change sessions at NAISMA
- Let us know about any research or management you are doing related to invasive species and climate change: riscc@umass.edu




SARATOGA
10
9
8
7
6
1
5
4


NAISMA
NORTH AMERICAN INVASIVE SPECIES MANAGEMENT ASSOCIATION
CONNECTING SCIENCE TO ACTION
NYISRI
New York Invasive Species Research Institute
2019 NAISMA - NYISRI
JOINT CONFERENCE
"Connecting Science to Action"
September 30 - October 3 | Saratoga Springs, NY
Registration is now open for the 2019 North American Invasive Species Management Association – New York Invasive Species Research Institute joint conference. Please join us for presentations, workshops, tours, and special symposia that highlight successful initiatives that bridge the gap between science and action across geographic, political, and and public-private boundaries.
Click HERE For more information or to register.
KEYNOTE SPEAKERS
Dr. Jeff Morisette
National Invasive Species Council Secretariat
Connecting science to action from a federal government perspective
Dr. Bethany Bradley
University of Massachusetts Amherst
Implications of climate change for invasive species
Allison Catalano
Imperial College, UK
Learning from failure in conservation
Dr. David Lodge
Atkinson Center for a Sustainable Future
Cornell University
Connecting science to action
Dr. William Powell
State University of NY College of Environmental Science and Forestry
How to produce a blight-tolerant American chestnut tree
Dr. Bernd Blossey
Cornell University
How to measure success in invasive species management

Carrie Brown-Lima
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Northeast RISCC Management
Regional Invasive Species & Climate Change

http://people.umass.edu/riscc/

New York Invasive Species Research Institute

Cornell University Founded A.D. 1865

New York State of Opportunity | Department of Environmental Conservation