Monitoring invasive species potential in the face of climate change

Northeast Regional Invasive Species and Climate Change (RISCC) Management

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Next 15 Minutes

1. How is climate changing?

2. How can we monitor for the interaction of climate change and invasives?
   1. Earlier phenology
   2. Range shifts
   3. Increased disturbance
   4. Rising atmospheric CO$_2$

3. What can managers do? A RISCC Management framing!

B. Bradley
1. How is climate changing?
Observed changes in temperature (1991-2012)

Figure source: NOAA National Climate Data Center
Projected changes in temperature

Northeast Temperature change relative to 1901-1930 mean

Karmalkar & Bradley (NE CSC – UMASS)
In Revision
Northeast average temperature rise
Sea Level Rise by Century

Central reconstruction shown. Bars +/- 2 inches before 20th century
Source: Kopp et al. 2016 (PNAS)
Northeast average precipitation change

*Slight increase on average*

1895 – 2015
More frequent extremes

**Droughts & Floods**

- **U.S. Drought Monitor**
  - Northeast

- Red River flood near Fargo, ND
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

Figure source: NOAA National Climate Data Center

2014 NCA report
How can we monitor the interaction of climate change and invasives?
Rising temps and altered precipitation do not directly favor invasives

Sorte et al. 2013

Difference in Effect Size

Invader Favored

Native Favored

Sorte et al. 2013
Earlier phenology

Priority Effects: Several invasive plants show earlier spring green-up

- Garlic mustard (A. petiolata)
- Honeysuckle (L. maackii)
- Buckthorn (R. cathartica)
- Barberry (B. thunbergii)

Growing Season
Wolkovich & Cleland 2011
Selective Loss of Native Diversity


Species whose flowering times do not respond to temperature have decreased greatly in abundance

Increased Plasticity (Response to change)

Wolkovich & Cleland, 2011

Willis et al., 2008
Invasive plants are more responsive to temperature

More ‘plastic’ invasive plants are increasing in abundance

Willis et al., 2010
Invasives have a dispersal advantage
Many species are likely to perform poorly within their current ranges, requiring range shifting

Introduction Pathways:
Invasive fish

Invasive plants

Fuller 2003
Lehan et al. 2013
Emerald Ash Borer: habitat constrained by very cold climates

Warmer temperatures are increasing forest pest range and abundance

DeSantis et al. 2013

EAB habitat constrained by very cold climates
Southern Pine Beetle expansion with warmer winters

Expansion of SPB

Since 2002

Since 2015

Historical range

Retreat of Cold Extremes

The New York Times

Long Island Confronts Destructive Southern Pine Beetles

BY TANIA KOLBOWSKY, OCT 20, 2014

Photo: William J. Alatriste, special to The New York Times
Projected year of emergence of SPB-suitable climates

Multi-run mean (162 runs)

SPB reaches boreal forests towards 2080

Throughout New England by 2050s

Coastal areas are immediately vulnerable

Horton (Columbia U) & D'Amato (UVM) & Kevin Dodds (USFS) & colleagues
Moving North: Projected Kudzu Invasion
Understory (invasive) plants thrive following disturbance from Hurricane Katrina. Duration of effect unknown.
Many invasives are disturbance responsive (aka ‘weedy’)

Eschtruth & Battles, 2009
Plants ❤️ CO₂

Rising atmospheric CO₂

Carbon dioxide concentration (ppmv)

Invasive plants do better still

Terrestrial invasive plants have a larger advantage. Also, bigger = harder to kill

![Effect size (ES) for Native and Non-native plants under Ambient and Future CO2 conditions.](image)

Sorte et al. 2013

B. Bradley

Canada thistle

Ambient CO2

Future CO2
Climate Change’s Opportunities for Invasive Species and for Monitoring

• Earlier green-up (via priority effects or greater plasticity) for invasives

• Northward shifts for invasives due to increased dispersal or milder winters

• Better establishment due to increased disturbance

• Increased growth and density due to higher CO$_2$ - hardier invasives will show advantage
Northeast RISCC Management!
Workshop Objective:
To understand the information needs of invasive species managers surrounding climate change and develop a strategy to address those needs through information sharing and targeted research.
Collaborators and Participants

• USGS
• New York Invasive Species Research Institute
• University of Massachusetts
• Vermont Department of Forests, Parks, & Recreation
• Maine Natural Areas Program
• Massachusetts Department of Environmental Protection
• Massachusetts Coastal Zone Management
• North Atlantic LCC
• NYC Environmental Protection Bureau of Water Supply
• USA National Phenology Network
• USDA Forest Service Northern Research Station (NRS)
• iMap
• The Nature Conservancy (TNC)
• Adirondack Park Partnership for Invasive Species Management
Initial workshop served to:

1) Bring together climate and invasive species scientists with invasive species managers and policy makers from the northeast to promote a two-way dialogue

2) Share regional knowledge about current management strategies and scientific insights

3) Identify and address planning and information needs of managers related to invasive species and climate change
Examples of Identified Research Needs

• Synthesize current IS/CC knowledge and provide recommendations

• Project upcoming species for prevention and early detection

• Understand how extreme events influence IS establishment and spread

• Establish guidance on how to incorporate climate change and invasive species science into IS management plans
Actions IS Managers are taking to incorporate CC

- Modifying list of early detection species based on those likely to expand their range

- Actively managing pathways of invasion that are likely to bring new invasive species (those similar to existing problem species - ex: Asian Gypsy moth)

- Changing management season (field crews starting earlier and ending later)

- Prioritizing invasive species management in areas/habitats that are likely to be vulnerable to extreme weather

- Incorporating climate change information into outreach materials

- Establishing demonstration plots to show climate change impacts
Monitor! Monitor! Monitor!

- There was a great deal of interest in monitoring/research on invasive species spread following an extreme weather event.
- Can we synthesize research that addressed this issue?
- Can we use these data to predict future invasions and effective management strategies following extreme weather events?
- How are effective treatment periods for invasive species shifting?
- What are other agencies doing to improve early detection in the face of climate change?
Ongoing work on hot spots:

Led by Jenica Allen (UNH)

Create state-level ‘watch lists’ of invasive plants that could colonize under current & future climate
Next Steps

- Formalize the work group
- Foster the listserve and promote information flow
- Create an expert advisory group
- Coordinate a regional conference/working group meeting
- Synthesis paper with managers and researchers
Get Involved

• Join NE RISCC Management Listserv
  ne_riscc-l@list.cornell.edu

• Participate in next meeting/conference
  ne_riscc-l@list.cornell.edu

• Join working group/advisory group
  ne_riscc-l@list.cornell.edu

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Regional Effort on Invasive Species and Climate Change (RISCC) Management

Project Type: Core Research Project

Project Leader:
Toni Lyn Morelli
Bethany Bradley

Project Fellows:
Volere Pasquarella

Status: Ongoing

Science Themes:
Ecological vulnerability and species response to climate variability and change

Invasive species and climate change represent two of the five major global change threats to ecosystems. An emerging initiative of the Northeast Climate Science Center aims to develop management-relevant research to improve invasive species management in the face of climate change. Through working groups, information sharing and targeted research, this project addresses the information needs of invasive species managers in the context of climate change. RISCC Management is collaboratively led by the Department of Interior Northeast Climate Science Center, the New York Invasive Species Research Institute, and the University of Massachusetts to address the question “How can we manage for upcoming biological invasions in the light of climate change?” The working group combines climate and invasive species scientists with invasive species managers and policy makers from the northeast to promote a two-way dialogue to 1) share regional knowledge about current management strategies and scientific insights; and 2) identify and address planning and information needs of managers related to invasive species and climate change

Presentations:
Northeast Regional Invasive Species and Climate Change (RISCC) Management Workshop Presentation: "Implications of Climate Change for Invasive Species" by Alex Bryan and Bethany Bradley, UMass Amherst, July 2, 2016.

Other: