2014 Annual Report

Hottest year globally on record!

NE CSC
Northeast Climate Science Center

Improving the way climate science informs resource management

The Northeast Climate Science Center (NE CSC) was created to provide scientific information, tools, and techniques that managers and other parties interested in land, water, fish, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change in the Northeast and Midwest region. It is part of a national network of 8 CSCs.



2014 NE CSC highlights...

- Funded over $2 million in stakeholder-driven climate research
- Trained 22 Graduate and Postdoctoral Fellows in the stakeholder-driven research paradigm
- Hired new USGS postdoctoral researcher to focus on stakeholder outreach and climate communications
- Co-sponsored Shifting Seasons Summit to highlight tribal climate adaptation capacity
- Presented more than 100 papers at professional conferences and meetings
- Maintained popular website, webinar series, and e-newsletters

Who we are...

The NE CSC, with its core of seven consortium institutions, assembles outstanding expertise in climate science and natural and cultural resources management. The NE CSC provides resource managers with deep and diverse knowledge and research skills for successfully meeting the regional needs for climate scenarios, impact assessments, decision frameworks, models (ecological, hydrological, physical), education and stakeholder outreach throughout the region. The NE CSC works closely with natural resource management partners including Landscape Conservation Cooperatives (LCCs), as well as federal, state, and tribal partners that lie within the NE CSC domain.

Photo: Jenn Nikonczyk

Priority Science Themes

1: Climate change projections and assessments

2: Climate impacts on land-use and land-cover

3: Climate impacts on freshwater resources and ecosystems

4: Climate impacts on Atlantic and Great Lakes coastal and nearshore environments

5: Ecosystem vulnerability and species response to climate variability and change

6: Impacts of climate variability and change on cultural resources

7: Decision frameworks for evaluating risk and managing natural resources under climate change

Outreach: Climate Assessment and Projections Communication

NE CSC stakeholders are impacted by climate change in a variety of ways, and thus have very different climate science needs. Water resource managers need to know how rainfall intensity will change on a watershed basin scale. Farmers are curious how growing season length will change for their 400-acre farm. Alex Bryan, an NE CSC postdoctoral fellow, is investigating and communicating to stakeholders how these and other management-relevant variables are changing. He is analyzing and comparing data from a variety of observational and modeling data sets in effort to better understand and clearly communicate the uncertainties associated with future projections. By meeting NE CSC stakeholders, he is able to provide information and guidance about future climate scenarios tailored to their priorities and decisions. In addition, he plans to expand the climate science capacity of NE CSC by partnering with other CSCs, federal agencies and universities. With the help of these partnerships, Alex hopes to advance management-relevant climate science and improve how that science gets communicated.

"Alex has reached out personally to the Gulf Coastal Plains & Ozarks LCC to better understand our climate science needs, and share his knowledge and expertise with our Conservation Science team and partners. I really appreciate the efforts of the NE CSC in maintaining direct communications with LCCs, and strengthening the scientific foundations that we need to address climate change. These types of collaborations between the Climate Science Centers and LCCs represent a winning formula for success in developing the 21st century adaptation strategies we need to combat climate change."

- Greg Wathen, Gulf Coastal Plains & Ozarks Landscape Conservation Cooperative

Featured Research: Storm Transposition Tool Helps Communities to Prepare for Extreme Rainfall

NECSC's PI Ken Potter and Affiliated Investigator David S. Liebl (both at University of Wisconsin-Madison) have developed a tool that allows communities to identify vulnerability to high runoff flows and flooding from extreme rainfall events, before damage occurs.

Climate scientists project heavier and more frequent extreme rainstorms for the Great Lakes region in the future. While these rare events carry the risk of damage and injury, most municipalities use actual experience from past large storms to design or modify their infrastructure. Working with NE CSC Fellows Nicholas Hayden, Zachary Schuster, and Pearl May, and with initial funding from NOAA's Sectoral Applications Research Program, the team found a way to use the rainfall record from a "real" extreme storm, one that contaminated 2,500 wells and caused over $34M in damage in Wisconsin, to assess risk in a community that had never experienced it. The research team digitally "transposed" the 2008 storm over other watersheds, so that runoff, stream flows, and lake levels could be modeled as if the rain had fallen over those locations to discover both unforeseen vulnerabilities and mitigation opportunities.

A case study transposed historic storm data to near Madison, WI, resulting in overland flows and urban runoff that would swell streams to new heights, Lake Mendota (shown here) overflowing its banks, the closure of the regional airport, and the City of Madison being split in half by floodwaters that could remain standing for as long as ten days. (Figure: Daniel Fletcher)

Based on this analysis, city and county officials are taking steps to reduce risk from future extreme storms by: evaluating the ability to detain water in natural depressions upstream, improving monitoring of rainfall and stream flows, updating water level management scenarios to increase downstream discharges prior to heavy rainfall, budgeting for more sandbags and emergency response capacity, identifying infrastructure at greater risk of flooding, and discussing new controls on stormwater runoff from urbanized areas.

As a result of this project, communities are now able to use NOAA NEXRAD rainfall data from recent extreme rainfall events to demonstrate what would happen if that event had occurred over their location, and identify stormwater vulnerabilities and options for building resilience.

Photo: Naked Creek in Shenandoah National Park, VA. (Andrew Dietrich, USGS)

Graduate Research Profile: Paul Damkot, University of Massachusetts Amherst

Impacts of Climate Change on Brook Trout Habitat

Rising stream temperatures associated with climate change cause concern for the long term persistence of stream-dwelling fishes in the northeast. The distribution of brook trout, a species that inhabits headwater streams and has a narrow thermal tolerance, is expected to shift upstream as water temperatures increase. However, increased hydrologic variability associated with climate change may cause the upper reaches of some headwater streams to switch from perennial to intermittent flow, making brook trout susceptible to habitat loss and range contraction at both ends of its distribution. In addition, little is known about the current upstream limits of brook trout distribution. Paul Damkot's NE CSC-supported Ph.D. research analyzes factors influencing the upstream limits of brook trout distribution and seeks to identify habitat that will remain thermologically and hydrologically resilient. The results of this research will help natural resource managers determine which streams and watersheds should be the focus of conservation and habitat restoration efforts in the future.

Improving Baseline Mapping Across the Region

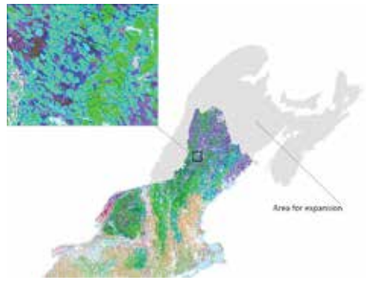
Critical Evaluation of Methods and Outcomes for Habitats/Ecological Systems Classification and Mapping in the Northeast and Midwest U.S.

David Diamond and collaborators from Missouri Resource Assessment Partnership and NatureServe developed a project comparing maps and classification systems for the Northeastern and Midwestern U.S. from various producers to identify the strongest qualities in each. Investigators compared maps produced by LANDFIRE (LF), Southeast GAP Analysis, The Nature Conservancy (TNC), and NatureServe and concluded that that there was no one best map for any particular area, but that each had its strengths and weaknesses.

Each map exhibits qualities and challenges unique to end users' needs. The TNC map is most cartographically appealing. The LF effort adheres to set national methods and standards and producers are often unable to respond to the individual concerns of regional, state, or local users. Depending on their needs, end users must create customized maps at their own cost (e.g. the TNC map), modify national maps, or simply use national maps as they are delivered. The National Landcover Dataset, which was not assessed as part of this effort, has the longest history of being refreshed at regular intervals but maps the fewest vegetation types. It is easy to interpret, and would be the most straightforward for a local user to modify by using map overlays.

Classifications were from TNC, SE GAP analysis, USFS LANDFIRE, and NatureServe.

Extending the Northeast Terrestrial Habitat Map to Atlantic Canada



The U.S. Northeast Terrestrial Habitat Map will be extended into Canada.

The Northeast US and Atlantic Canada share many of the same types of forests, wetlands, and natural communities and, from a species perspective, the region is one contiguous landscape. However, resources are classified and mapped differently on the two sides of the border, creating challenges for species modeling and ecosystem evaluation. To remedy this, ecologists from TNC collaborated with Canadian scientists to produce the first international map of terrestrial habitats for the region. The mapping effort was led by TNC Scientists, Mark Anderson and Charles Ferree, the creators of the US Northeast Terrestrial Habitat Map. The final product will be seamlessly integrated with the US map.

The project used extensive spatial data on geology, soils, landforms, wetlands, elevation, and climate, compiled from various provincial and national sources. All four provinces and the largest forest management company contributed spatially comprehensive forest inventory data, which consists of millions of polygons depicting the exact tree composition of individual forest stands, and has no counterpart in the US. Finally, the Atlantic Conservation Data Centre contributed spatial locations of over 16,000 species locations including herbaceous plants, herptiles, mammals, and birds, and these were used to confirm the habitat types.

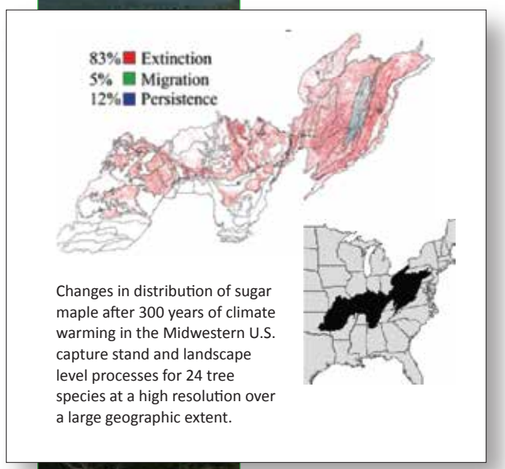
The results will be used to predict species locations and forecast species range shifts related to climate change and will provide scientists and managers on both sides of the border with information on the distribution, quantities and condition of our shared natural resources. Jointly funded by the NE CSC and the North Atlantic LCC.

Mapping Species Distribution in the Face of Climate Change

Frank Thompson's research group at the University of Missouri, Columbia address two questions: 1) How do climate, habitat, and landscape factors affect abundance, distribution, and population trends of birds? 2) What is the relative importance of tree species characteristics, ecological succession, timber harvest, and climate change in determining future tree species distribution and abundance in the Eastern U.S.; and how do these factors interact?

Northern Bobwhite.
Photo: Roy Cohutta, USFWS.

NE CSC Fellow, Jaymi LeBrun identified associations between environmental variables and bird abundance using hierarchical models and readily available data sources including the North American Breeding Bird Survey, National Land Cover Data, and PRISM climate data. Models were developed for several warbler species and northern bobwhite, and used to predict abundance patterns across the Midwestern U.S. Habitat variables impacted patterns of abundance in migratory and resident species, although climate was also influential in predicting abundance for some species occupying more open habitat. Northern bobwhite abundance was increased with warmer winter temperatures and, of the species studied, exhibited the most significant effect from climate change.



Changes in distribution of sugar maple after 300 years of climate warming in the Midwestern U.S. capture stand and landscape level processes for 24 tree species at a high resolution over a large geographic extent.

Fellows Wenjuan Wang and Jacob Fraser used a coupled forest landscape and ecosystem modeling approach to project how tree species distributions change under climate change across the central hardwood region of the U.S. Distributions of the southern species loblolly and shortleaf pine, and yellow-poplar expanded while distributions of the northern species sugar maple, American beech, eastern white pine, and red spruce, and widely distributed species of oak and pignut hickory contracted. These results are being used in the Central Hardwoods and Central Appalachians Climate Change Response Frameworks, a collaborative, cross-boundary approach among scientists, managers, and landowners to incorporate climate change considerations into natural resource management.

These projects are complete! Details at: necsc.umass.edu

White Mountains, NH. Photo: Toni Lyn Morelli.

2014 Fellows Retreat: Science Communication and Hardwood Forests

The University of Missouri hosted the Second Annual NE CSC Fellows Retreat, October 8-10, 2014, at Reis Biological Station near Steelville, MO. Twenty-two graduate student and postdoctoral fellows from six NE CSC partner institutions gathered to share their research, meet with natural resource managers, develop interdisciplinary connections and collaborations, and learn about climate impacts to the central hardwoods forest ecosystem.

Fellows meet with staff of the Mark Twain National Forest in Steelevile, MO Photo: Addie Rose Holland

Through a variety of field trips and activities, Fellows evaluated different adaptation options in the context of managing conservation areas for biodiversity and hydrological function, considered forest adaptation concepts through the Northern Institute of Applied Climate Science adaptation workbook, and learned about management and adaptation challenges on the Mark Twain National Forest.

"Getting out into the woods on fieldtrips to hear from land and wildlife managers at the National Forest was incredibly eye opening. Talking with them reminded us that climate change is one of many concerns that they deal with on a daily basis."

- Jane Foster, NE CSC Postdoctoral Fellow, University of MN

Featured Research: Shifting Seasons - Building Capacity for Tribal Climate Change Adaptation Summit

In October 2014 NE CSC Consortium Institution, the College of Menominee Nation's Sustainable Development Institute, hosted 153 participants from Tribal, federal, state, higher education and non-profit agencies and organizations to work together on developing opportunities to build capacity for Tribal climate change adaptation in the Northeast U.S.

The four day event took place in Keshena Wisconsin on the Menominee reservation and focused on issues facing Tribes in relation to climate change, including access to governmental and academic resources. The Summit included a variety of activities intended to introduce concepts to the participants, including: a Menominee community and forestry tour related to climate change monitoring; an Eco-Café designed for quick one-on-one introductions between federal and academic resources and Tribal representatives; and also plenary sessions and training for both climate change planning and working with Tribes.

"I am grateful to have had the opportunity to hear and learn from so many unique perspectives about climate change and our shared environment, and how we might work together to help future generations carry these responsibilities."

- Mary Ratnaswamy, NE CSC Federal Director

Smokey Town Singers, Shifting Seasons Summit, Kashena, WI. Photo: Julie Edler

2014 Summit. Photo: Julie Edler, College of Menominee Nation.

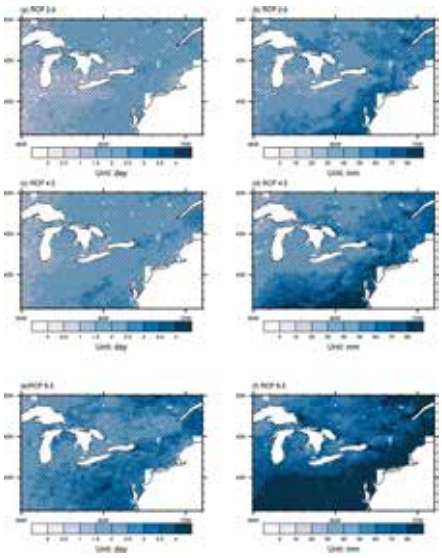
Research Expertise at the NE CSC:

• Downscaling and validating current and future climate models for the region, as well as assessing paleoclimate resources for studies of climate extremes
Led by Raymond Bradley, University of Massachusetts

• Conducting assessments of climate change projections over the Northeast to understand extreme events and sea level rise and to improve the downscaling of climate models for impacts assessments
Led by Radley Horton, Columbia University

• Evaluating impacts of climate change on water resources, including streamflow, stream temperature, stream health, and water supply systems to aid resource management decisions
Led by Richard Palmer, University of Massachusetts

• Predicting the impact of climate change on stream temperatures in the Driftless Area (WI); understanding the role of soil frost on climate change impacts on groundwater recharge; assessing vulnerability to extreme rainfalls through storm transposition
Led by Ken Potter, University of Wisconsin



Future changes of number (days) and amount (mm) of extreme precipitation under different emissions scenarios for the period 2050-2099 relative to 1950-1999. (Ning et al., in press)

Fiddler Crab (*Uca Pugnax*) found north of its historical range on Plum Island, Massachusetts. Photo: David Johnson

• Building bridges between tribes and climate change scientists in the northeast region to encourage cross-cultural/cross-forest exchange, trainings, and outreach
Led by Chris Caldwell, College of Menominee Nation

• Developing modeling approaches to link climate to population, ecosystem, and landscape models; predicting effects of succession, management, and alternative climate scenarios on forested landscapes in the Eastern U.S.; and determining impacts of climate on avian demographics and populations
Led by Frank Thompson, University of Missouri

• Using occupancy modeling, species distribution modeling, geospatial analysis, and population and landscape genetics techniques to facilitate natural and cultural resource management and habitat and species conservation in the face of climate and land use change
Led by Toni Lyn Morelli, University of Massachusetts

• Understanding the effects of eutrophication and changes to freshwater input on food webs, habitats and top predators in estuaries and freshwater rivers
Led by Linda Deegan, Marine Biological Laboratory

• Studying the effects of climate, disturbance, and management decisions on temperate and boreal forests and associated priority bird populations as well as the ecological, biodiversity, and hydrological impacts of the emerald ash borer on black ash forests
Led by Tony D'Amato, University of Minnesota

• Assessing the capability of current and potential future landscapes to provide integral ecosystems and suitable habitat for representative species, as well as forecasting wildlife vulnerabilities to climate change
Led by Curt Griffin, University of Massachusetts

• Analyzing the effects of hydrologic change and climate variability on the distributional changes of spruce-fir forests, forest-dependent wildlife, and stream fish, as well as policy responses to extreme flow events in relation to climate resilience
Led by Keith Nislow, University of Massachusetts

• Evaluating the vulnerability and adaptive capacity of aquatic and marine species to the impacts of climate change, fishing pressure, and pollution to inform adaptation and conservation strategies
Led by Michelle Staudinger, USGS

• Studying the impacts of climate change and other environmental drivers on population dynamics, mammalian ecology and conservation, endangered species management, landscape conservation design, and conservation policy
Led by Mary Ratnaswamy, USGS

Project Awards in FY'14:

Development of Dynamically-Based 21st Century Projections of Snow, Lake Ice, and Winter Severity for the Great Lakes Basin to Guide Wildlife-Based Adaptation Planning, with Emphasis on Deer and Waterfowl.
Lead PI: Michael Notaro, University of Wisconsin-Madison

Science to Inform Management of Floodplain Conservation Lands under Non-Stationary Conditions.
Lead PI: Dr. Robert Jacobson, USGS Columbia Environmental Research Center

Ecological and management implications of climate change induced shifts in phenology of coastal fish and wildlife species in the Northeast CSC region.
Lead PI: Michelle Staudinger, Adrian Jordaan, University of Massachusetts Amherst

Early Career Climate Communications and Networking.
Lead PI: Michelle Staudinger and Ezra Markowitz, University of Massachusetts Amherst

Avian Indicators of Climate Change Based on the North American Breeding Bird Survey.
Lead PI: James D Nichols, USGS Patuxent Wildlife Research Center

Incorporating Social Drivers to Optimize Conservation Practices that Address Gulf Hypoxia and Declining Wildlife Populations Impacted by Extreme Climate Events.
Lead PI: Jack B. Waide, USGS UMESC

Climate Assessment and Scenario Planning for the Northeast U.S.
Lead PI: Mary Ratnaswamy, DOI Northeast Climate Science Center

White-tailed deer feeding in winter. Photo: Indiana DNR

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This is the third Annual Report of the NE CSC and covers the activities of Jan-Dec 2014.
Front page photo credit (L to R): Bill Deluca, Addie Rose Holland, Dan Hocking.