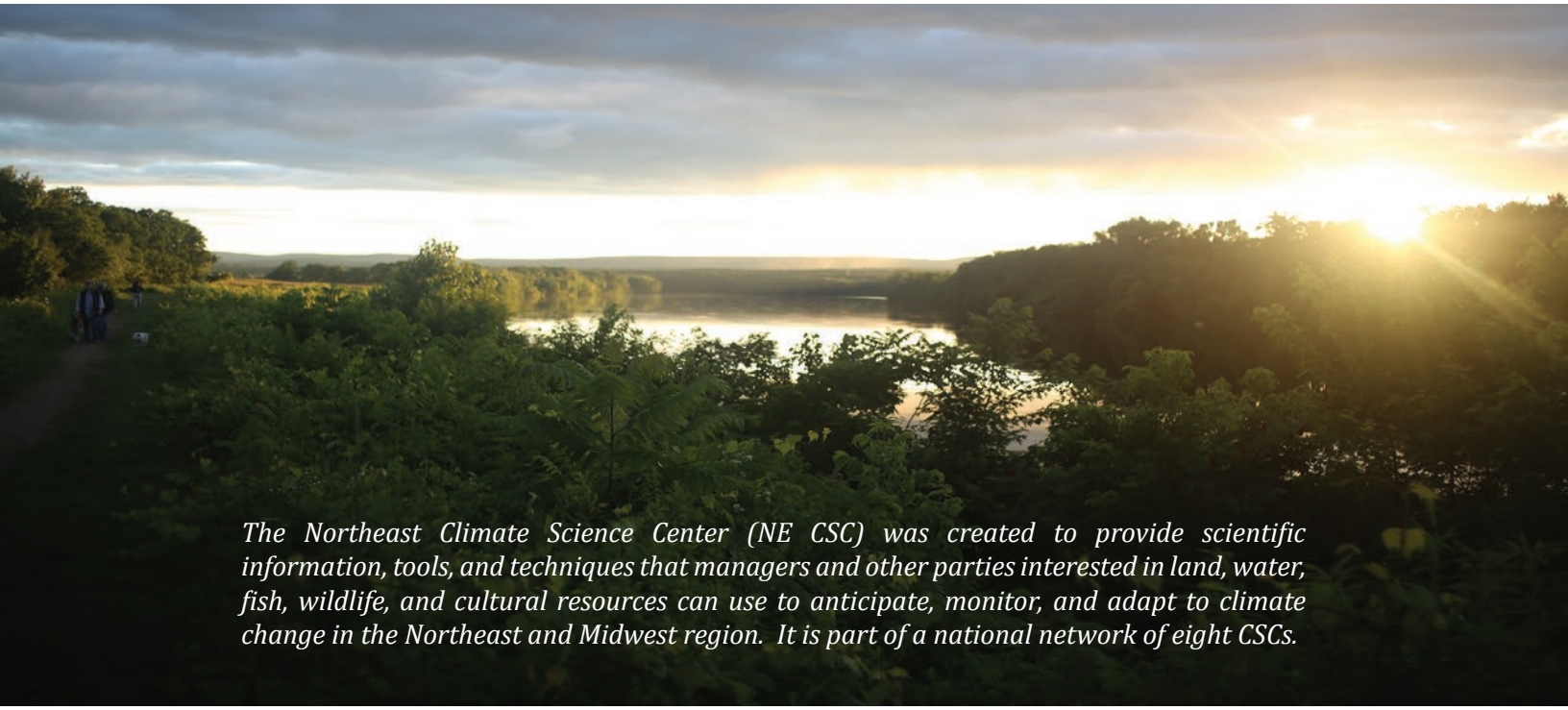
2015 Annual Report

Hottest year YET 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 eight CSCs.

2015 NE CSC highlights...

- Funded over $700,000 of new stakeholder-driven climate research in 2015; over $7.5M toward 80 projects since 2013
- Trained 32 Graduate and Postdoctoral Fellows in the stakeholder-driven research paradigm
- Compiled guidance for state managers in their wildlife action plan revisions and a state-level tool for climate adaptation
- Hired new Communications and Outreach Manager
- Presented more than 100 papers at professional conferences and meetings

Message from the Directors...

This has been a tremendously productive year for the NE CSC. We are seeing our collaborative research on the impacts of climate change put into action for adaptive management of regional natural and cultural resources. Our funding has sponsored over 80 projects since our launch and they are contributing to a substantial portfolio of actionable science to meet the regional needs for climate scenarios, impact assessments, decision frameworks, models (e.g., ecological, hydrological, and physical), and climate adaptation tools. Our education and stakeholder outreach has been successful in communicating the results of our research throughout the region. We are very excited about what lies ahead at NE CSC, as we continue to learn, evolve and build on our successes working 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.

Richard Palmer
University Director, UMass Amherst

Mary Ratnaswamy
USGS Director

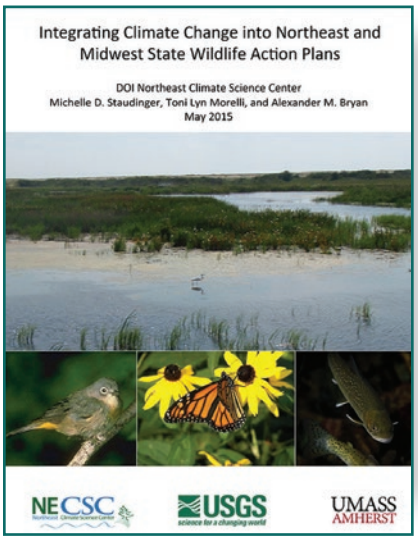
Priority Science Themes

- Climate change projections and assessments
- Climate impacts on land-use and land-cover
- Climate impacts on freshwater resources and ecosystems
- Climate impacts on Atlantic and Great Lakes coastal and nearshore environments
- Ecosystem vulnerability and species response to climate variability and change
- Impacts of climate variability and change on cultural resources
- Decision frameworks for evaluating risk and managing natural resources under climate change

Outreach: Integrating Climate Change Into State Wildlife Action Plans

Every ten years, state natural resources management agencies across the United States are given the task of analyzing the status of fish and wildlife and their habitats and revising their State Wildlife Action Plans, or SWAPs, which serve as comprehensive guides for conservation. As climate change is having an increasing impact on our natural environment, fish and wildlife agencies need to incorporate the effects of climate change in their planning efforts. In preparation for the 2015 SWAPs revisions, NE CSC staff members Michelle Staudinger, Toni Lyn Morelli, and Alex Bryan led the development of an in-depth report for the Northeast and Midwest comprised of projections in climate change, species vulnerabilities and adaptations to climate change, and strategies to sustain fish and wildlife populations and habitats. Just weeks after its completion, we saw the science produced by the NE CSC being put into action plans, allowing for more effective management of fish and wildlife populations.

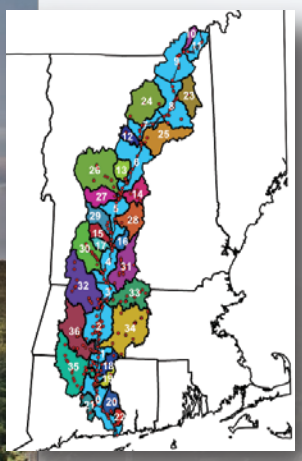
"We are plugging through our climate change chapter where we are basically using the regional report as a guide, following it as an outline and leaving in regional information where pertinent and adding in Maryland-specific info to follow. It has really helped us think more clearly in this - AND definitely helped us in making the decision to separate climate change from the threats chapter into its own chapter."
- Ingrid Brofman, Maryland Department of Natural Resources



"Your review is the clearest and most complete I've yet seen on what adaptation is and what options there are."
-Todd Jones-Farrand, Science Coordinator Gulf Coastal Plains & Ozarks LCC

Featured Research: Improving Floodplain Management and Understanding of the Effects of Climate Change on Water Systems

Richard Palmer, University Director at the NE CSC and Department Head of Civil and Environmental Engineering at the University of Massachusetts, has made the impacts of climate change on water resources a focal point of his research career. Palmer has worked with NE CSC Fellows on several projects that address the effects of climate change on water systems as well as floodplain management and drought detection.



Connecticut River and its sub-basins

In an effort to improve floodplain management, Dr. Palmer, with NE CSC co-PI Keith Nislow, his graduate student Bogumila Backiel, and NE CSC Graduate Fellow Abigail Ericson are exploring reconnecting floodplains and restoring green space as a management strategy to minimize risk and increase resilience in the context of climate and landscape change. This project focuses on identifying solutions to managing river flows in order to maintain important infrastructure services such as water supply, flood control and hydropower, while supporting river ecosystems.

NE CSC Fellows Katie Booras and Alexandra McIntyre are working to evaluate and update the current drought management plan of the Susquehanna River Basin. They are investigating the value of incorporating streamflow forecasts and other important drought indices into a composite drought index that will allow for the prediction and classification of drought severity. This research will assist the city of Baltimore and the greater Susquehanna River Basin in establishing a cohesive, data-driven drought management plan.

Another project evaluates the impacts of climate change on the biological resources of the Connecticut River Basin and is co-funded by The Nature Conservancy and the US Army Corps of Engineers. The study has yielded a hydrology model of the river comprised of 112 different future hydrology scenarios associated with climate change. This project provides critical research on potential climate change scenarios in the Connecticut River Watershed while also providing a comprehensive basis for future watershed studies conducted by NE CSC.

Connecticut River Valley. Photo: Andy Castillo

NE CSC Graduate Fellow Profile: Marie Schaefer

Michigan State University and the College of Menominee Nation's Sustainable Development Institute

Manoomin, or wild rice, is both a food source and an essential ingredient of the identity of the Indigenous people of the northern states of the U.S. and the Great Lakes. The production practices carry a rich and varied cultural significance, with multi-generational communities coming together for hand-harvest and processing events, called ricing (see photo, page 6). However, wild rice relies on aquatic conditions that are highly vulnerable to rising temperatures, changes in precipitation patterns, and altered aquatic landscapes from dams and logging, and the capacity to subsist from wild rice has diminished greatly for indigenous peoples of these regions. Marie Schaefer's NE CSC-funded graduate research seeks to understand these factors by incorporating indigenous and scientific knowledge related to the restoration of wild rice habitats and revitalization of the cultural practices that are part of ricing. Marie, an Anishinaabe from Michigan, uses an indigenous community-based participatory research framework to understand how this collaboration between knowledge systems can contribute to sustainable futures for indigenous and non-indigenous peoples. This research promises to advance adaptation strategies for the protection of wild rice in a changing landscape.

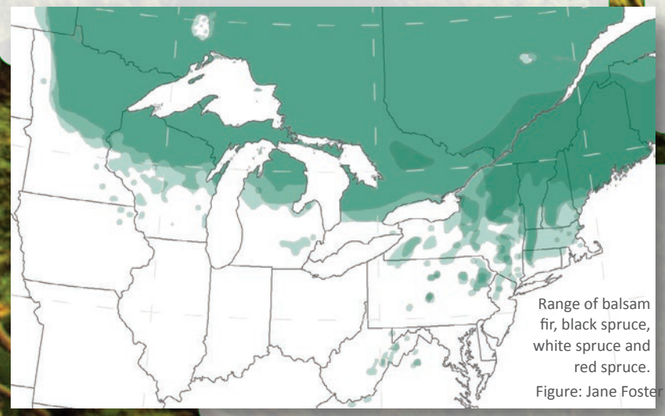
Focus on Spruce-Fir Habitat...

Identifying Climate Change Refugia at High Elevation

Climate scientists and ecologists are working to predict how climate change will affect species and ecosystems. Although the effects will be far-reaching, there are areas that are buffered from climate change, allowing valued ecological and physical resources to persist. NE CSC researchers aim to forecast the location of these "climate change refugia" in order to guide conservation efforts, focused primarily on northern montane species. For example, researchers are developing tools to identify sites most likely to support spruce-fir forest and its associated wildlife species over the long term under projected climate change scenarios.

Northern Montane Forest

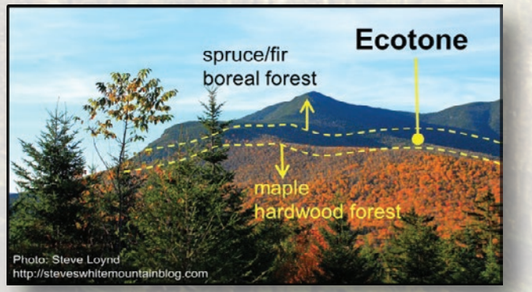
High elevation spruce-fir forests are rare but critical habitats for many unique species. At 2,500 to 4,500 ft in elevation, the northern montane forests are comprised primarily of red spruce and balsam fir. These forests make up only a fraction of the northerm states' landscape, but contribute greatly to regional biodiversity. A wide variety of bird species such as the rare Bicknell's thrush, and mammals such as the Canada lynx, northern flying squirrel, the long-tailed weasel, and the rock shrew are found in this ecosystem. In addition to protecting biodiversity, managers are also interested in preserving significant cultural and recreational resources in this region.



Range of balsam fir, black spruce, white spruce and red spruce.
Figure: Jane Foster

Forest Response

NE CSC Fellow Jane Foster and NE CSC Principal Investigator Tony D'Amato modeled the effects of climate change on spruce-fir forest ecosystems. They focused their models of spruce-fir occurrence on the Green and White Mountain National Forests, northern Maine, and the Border Lakes region of Minnesota, as all of these areas encompass critical spruce-fir habitat. As the climate warms in northern latitudes, boreal forests were expected to recede upslope, with northern hardwood species moving up behind. Yet Drs. Foster and D'Amato have found this pattern does not always hold, reporting both rapid downward shifts and concurrent increases in boreal species within the region. Their findings suggest



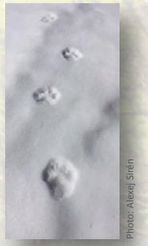
that in fact the boreal forests are on a path of recovery following a century of harvest and other human land use and disturbance. This will be an important consideration for managers who are working to understand the effect that climate has on range shifts for species dependent on this habitat type and montane ecosystems in general.

This project is complete! Details at: necsc.umass.edu

Wildlife Studies

Mammals and Changing Winters

Toni Lyn Morelli, USGS Research Ecologist at the NE CSC, is also working to identify mechanisms causing ecological changes in northeastern U.S. mountains. Toni Lyn and her team seek to understand how red squirrels, a predator of vulnerable montane birds, are responding to climate change. In addition to analyzing long-term survey data, they are working in the Presidential Mountains of New Hampshire to collect DNA from and radio collar red squirrels in order to understand their distributional responses to climate change and to better predict population cycles.



Lynx tracks in the snow

Likewise, warming temperatures may be helping generalist carnivores like coyote and bobcat outcompete Canada lynx and marten. Preliminary research from NE CSC Fellow Alexej Siren shows that warmer winters cause populations of Canada lynx, which are highly adapted to hunting snowshoe hares in areas with deep, powdery snow, to contract their northeastern distribution. Scientists project warmer winters in the region and more precipitation falling as rain rather than snow. In combination, these changes are forecasted to increase crusting conditions, reduce snowfall and depth, and reduce the length of the snow season. Alexej is combining the latest research in climate science, population dynamics, and ecological condition to find potential conservation options for this denizen of the north.

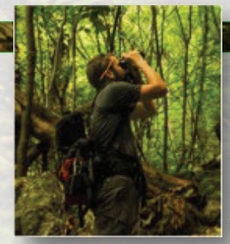
Vulnerability of Birds and Prospects for Conservation

Our researchers are working with wildlife and forest managers and non-governmental organizations in northern New Hampshire, Vermont, and Maine to improve our ability to accurately forecast and address threats to priority bird species. For example, researchers at the NE CSC, including U.S. Forest Service research scientist Dave King with NE CSC Postdoctoral Fellows Bill DeLuca and Joel Ralston, have found that some bird species are declining. In the White Mountain National Forest, NE CSC Fellow Tim Duclos is investigating the influence of climate as a driver of montane bird distribution. He conducted a comprehensive bird abundance, temperature, vegetative, and predator-prey community assessment on 150 sampling points over 15 elevational transects across 15 mountains in the Presidential Range. This research provides better predictions of species response to changes in montane climate and forest structure. For managers, this information is critical in order to continue to best conserve high-elevation spruce-fir bird communities under climate change scenarios and land use change.

Bicknell's Thrush

Landscape-Scale Conservation Planning

With a growing number of model results indicating the effects of climate change on ecological processes and species responses, the next step is to provide resource managers with decision-support tools to help them in their landscape conservation design. NE CSC investigators Kevin McGarigal and Curt Griffin (PI with the NE CSC) are leading efforts to assess the consequences of landscape change, including climate and urban growth, on ecological integrity and species distributions across 13 northeastern states. Additionally, Toni Lyn Morelli and colleagues are developing a framework for identifying and managing climate change refugia as a key strategy for conservation in the face of ongoing climate change.



NE CSC Graduate Fellow Tim Duclos

White Mountains, NH. Photo: Tim Duclos.

2015 Fellows Retreat: Climate Adapation in Northern Wisconsin

In September, twenty Graduate and Postdoctoral Fellows gathered in Suring, Wisconsin to share their research, develop collaborations, and learn from stakeholders and scientists who have established strong working relationships. The Fellows Retreat, hosted by the University of Wisconsin and the College of Menominee Nation through the Sustainable Development Institute, included presentations by representatives from the Menominee Tribe, members of the Great Lakes Indian Fish and Wildlife Commission, Ducks Unlimited, Wisconsin Department of Natural Resources, and researchers from University of Wisconsin. Fellows acquired skills for engaging with tribal leaders and resource managers and learned about climate-related challenges and adaptation solutions in the Northern Wisconsin region.

Fellows with partners on the Wolf River, Menominee Reservation, Wisconsin. Photo: Thomas Bonnot

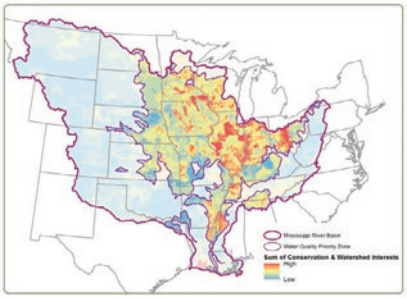
Through our visits with members of the Menominee Nation, I saw great examples of stewards that are deeply attached to their environment and desire to understand how they should best manage their forests under future changes."
Thomas Bonnot, NE CSC Graduate Fellow
University of Missouri Columbia

Photo: Thomas Bonnot

Above: Menominee Tribal members Dale Kakkak (CMN staff member) and Jennifer Gauthier show NE CSC fellows how to process wild rice at the Mawaw Ceseniyah Language and Culture Center

Featured Research: Social Drivers that Influence Conservation Practices

Across the Mississippi River Basin, some of the most compelling and widespread conservation challenges are focused on reducing nutrient runoff from agricultural lands, which contributes to Gulf hypoxia, while also enhancing habitat for species of management concern, especially grassland and riparian bird species. NE CSC Affiliated Investigator Jack Waide leads the project, "Incorporating Understanding of Social Drivers that Influence Implementation of Conservation Practices that Improve Water Quality and Wildlife Habitat," in collaboration with colleagues at the USGS, Landscape Conservation Cooperatives and universities. They are working to complete a decision support tool to identify areas where strategic implementation of select conservation practices in specific watersheds will improve both water quality and avian habitat.



Sum of conservation and watershed interests within the Mississippi River Basin

Recognizing that landowner participation and support is critical for conservation practices to be successful, team members are conducting a suite of detailed landowner surveys to enhance our understanding of landowner preferences and motivation for implementing specific conservation practices on the ground. Results of this research will lead to an enhanced understanding of how landowners and managers shape adaptation and resilient livelihoods beyond climate risks and, ultimately, how to better address Gulf hypoxia and declining wildlife populations as impacted by extreme climate events.

Research Expertise at the NE CSC:

The NE CSC, with its core of seven consortium institutions, assembles outstanding expertise in climate science and natural and cultural resources management.


Photo: Molly Patterson

• 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

• Assessing emergent risks associated with climate extremes, including combined impacts of multiple extremes; potential implications of climate models (used for projections) not capturing key processes associated with some extremes; impacts on natural and built systems; and limited coupling to concurrent advances in the science of adaptation
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

• Assessing strengths and limitations of global and downscaled regional climate models in ecological applications; climate science communication; understanding the impacts of climate change on forest ecosystems and subsequent effects on air quality
Led by Alex Bryan, USGS

Actionable science produced by the NE CSC: An online comprehensive guide to making adaptation decisions at a local level.

• 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 and mitigating vulnerability to extreme rainfalls through storm transposition
Led by Kenneth Potter, University of Wisconsin

• Building bridges between Tribes and climate change scientists in the northeast region to develop increased capacity for nation-to-nation cross-cultural and cross-disciplinary research, education, outreach, and practical applications
Led by Chris Caldwell, College of Menominee Nation

• 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

• 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 and disturbance on temperate and boreal forests and associated wildlife species and developing and evaluating adaptive management strategies for addressing global change impacts
Led by Tony D'Amato, University of Minnesota

• Predicting effects of climate and land-cover change on ecological integrity and species of conservation concern; developing decision-support tools for resource managers to evaluate risk and manage ecological systems under climate and land-cover change; and assessing ecological vulnerability and species response to climate variability and change
Led by Curt Griffin, University of Massachusetts

• Analyzing the effects of changes in hydrologic and thermal regimes and climate variability on the distributional changes of aquatic wildlife and stream fish, as well as management and policy responses to extreme flow events in relation to climate resilience
Led by Keith Nislow, University of Massachusetts

• 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

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

• Understanding how climate change affects river flow, lake levels, and temperature regimes in the Great Lakes basin, and the diverse consequences for fish and fisheries
Led by Peter McIntyre, University of Wisconsin

• Using ecological modeling, field surveys, geospatial analysis, genetics techniques, decision analysis, and translational ecology 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, USGS

Where we're headed...

Project Awards in FY'15:

Supporting Collaborative Relationships between Tribes and Climate Science in the Northeast Region to Address Climate Impacts
Lead PI: Chris Caldwell, College of Menominee Nation Sustainable Development Institute

Characterizing Local and Rangewide Variation in Demography and Adaptive Capacity of a Forest Indicator Species
Lead PI: Evan H Campbell Grant, USGS Patuxent Wildlife Research Center

Pilot Study to Evaluate Coastal Change Using Unmanned Aerial Systems (UAS)
Lead PI: Erika E. Lentz, USGS Woods Hole

An Integrated Assessment of Lake and Stream Thermal Habitat Under Climate Change
Lead PI: Jordan S. Read, USGS

Climate Effects on the Culture and Ecology of Sugar Maple
Lead PI: Kristina Stinson, UMass Amherst

Does Variation in Life History and Evolutionary Response Affect Species Vulnerability to Climate Change? Implications for Management
Lead PI: Benjamin Letcher, USGS

Reconnecting Floodplains and Restoring Green Space as a Management Strategy to Minimize Risk and Increase Resilience in the Context of Climate and Landscape Change
Lead PI: Richard Palmer

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necsc.umass.edu

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College of Menominee Nation Sustainable Development Institute
Columbia University in the City of New York
USGS science for a changing world

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This is the fourth Annual Report of the NE CSC and covers the activities of Jan-Dec 2015.
Front page photo credit: Andy Castillo, Communications Intern