

2019 Annual Report

# NECASC

Northeast Climate Adaptation Science Center



Improving the way climate adaptation science informs resource management



## Our Year in Numbers

35 peer-reviewed publications

50 presentations

30 student & postdoctoral fellows

10 projects completed & 7 projects launched

## Update from the Directors

The past year was a true “watershed” for NE CASC. We completed an extremely successful Cycle I of funding for the Center (from 2012 – 2019) with scores of scientific products delivered to stakeholders in support of their natural resource management needs. We are happy to announce that UMass Amherst and its consortium members were chosen by USGS to host Cycle II of the NE CASC for the next five years. As we continue responding to stakeholder needs in Cycle II, we will undoubtedly encounter evolving challenges and emerging opportunities. In the coming year, NE CASC will engage dozens of resource managers and researchers to inform a five-year strategic science plan. Such outreach distinguishes our work and is crucial to our success.

A core strength of NE CASC is its investment in the scientific and natural resource management leaders of tomorrow. Our Graduate Fellows program provides an opportunity for outstanding scholars to excel academically, gather real-world experience, and network with experts across our regional consortium to prepare them for a lifetime of solving many of the most challenging problems our society faces. We have great things to achieve on the horizon - and a lot of work ahead of us. With the successes of Cycle I to build upon, we are well positioned to maintain our position as a leader in the delivery of actionable science to natural resource managers across the Northeast.



**Richard Palmer**  
University Director  
UMass Amherst



**David Reidmiller**  
Federal Director, USGS

## Our Mission

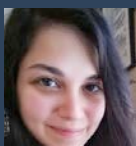
*NE CASC helps fish, wildlife, ecosystems and people adapt to the impacts of climate change. We pursue this mission by focusing on the following priority science themes:*

- *Climate change projections and assessments*
- *Impacts on land-use and land-cover*
- *Impacts on freshwater resources and ecosystems*
- *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*

## Our Staff



**Addie Rose Holland**  
Deputy University Director



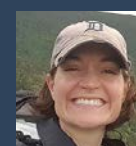
**Sara Smith**  
Midwest Tribal Resilience Liaison



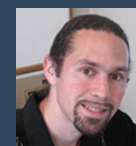
**Will Kazmier**  
Communication & Outreach Manager



**Michelle Staudinger**  
Science Coordinator, USGS



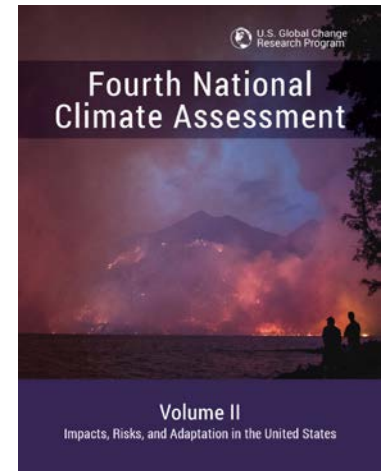
**Toni Lyn Morelli**  
Research Ecologist, USGS



**Casey Thornbrugh**  
Tribal Climate Science Liaison

NE CASC enthusiastically welcomed Dr. David Reidmiller as the center's Acting Federal Director last fall. In this capacity, Reidmiller has begun playing a major role in advancing the mission of the center by helping shape its vision, develop its strategic plan, and increase engagement within its expansive network of partners.

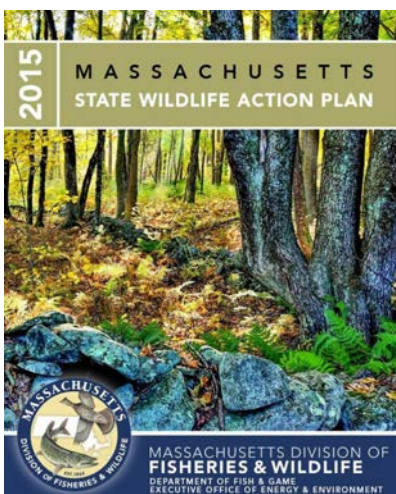
Prior to this appointment, Reidmiller was detailed to the U.S. Global Change Research Program at the White House Office of Science and Technology Policy, where he served as Director of the Fourth National Climate Assessment. Earlier in his career, he spent five years as the Chief Climate Scientist and Lead Climate Technology Negotiator at the U.S. State Department. He completed his Ph.D. in Atmospheric Sciences at the University of Washington in 2010. "I am delighted to welcome Dr. Reidmiller to the Northeast CASC," said Richard Palmer, University Director of the Northeast Climate Adaptation Science Center. "Dave's wide-ranging experience working at the intersection of climate science and public policy make him ideally suited for this position. In addition to his outstanding credentials in atmospheric chemistry, Dave has acquired invaluable experience while coordinating the Fourth U.S. National Climate Assessment. As a result, he has a keen grasp of the emerging issues in climate science and has become deeply familiar with those moving the science forward. It would be impossible to imagine a better fit for this role."



## Focus on Outreach

Over the past 15 years, State Wildlife Action Plans (SWAPs) have proven to be visionary documents that provide invaluable guidance to state fish and wildlife agency conservation efforts. According to a recent national survey by the Association of Fish and Wildlife Agencies, SWAPs are widely regarded as the governmental documents to most effectively account for climate change as a threat to wildlife diversity. As we look ahead to SWAP revisions in 2025, immense opportunities for and significant barriers to incorporating new climate science have already emerged.

Preparation efforts for the revision process across the thirteen Northeast SWAP states have been led by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). The committee has closely coordinated with state wildlife diversity managers and SWAP coordinators



to facilitate communication and productive discussion. NE CASC has in turn fostered a strong partnership with the committee through a team led by Karen Terwilliger.

In the last year, Terwilliger and her collaborators have established a Northeast Climate Change Working Group to promote regional ex-

change of current information and priorities among state fish and wildlife agencies. The team has used the Working Group to synthesize information from these agencies and has identified specific needs for climate change information as well as the barriers to acquiring it.

Results from this synthesis have revealed priority information needs, including terrestrial and aquatic habitat connectivity and conservation, invasive species, and sea level rise. Information is also needed regarding adaptive capacity and tracking of phenology, precipitation, temperature changes, drought, and water quality. Northeast SWAP states have identified the lack of time, expertise, capacity and funding as key barriers inhibiting development and implementation of adaptation efforts.

The SWAP synthesis also revealed that states rely heavily on NECASC for information, especially the 2015 DOI Northeast Climate Science Center report (produced by Michelle Staudinger and colleagues). Recently, states have expressed the need for a regional climate change component update for their 2025 SWAP revisions.

Finally, monitoring for climate change was identified as a priority need by NEFWDTC. The Working Group can guide assessment and identify priorities for monitoring, particularly measurable variables for Regional Species of Greatest Conservation Need (RSGCN) and their key habitats, information to be included in the 2025 SWAP revisions. NE CASC will assist in their development and communication.

## Tribal Engagement

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*Participants in the October, 2019, Tribal Adaptation Menu Workshop held in Keshena, Wisconsin. Three additional workshops also took place in 2019.*

There are 60 federally-recognized Tribal Nations in the NE CASC region, as well as numerous state-recognized and unrecognized Tribal Nations and Indigenous communities. In 2019, NE CASC led efforts in partnership with the College of Menominee Nation and United South and Eastern Tribes Inc. (USET) to fuse Indigenous knowledge and culture with climate adaptation planning, train a new generation of Tribal climate adaptation planners, and provide technical support for Tribes engaged in the adaptation planning process.

Spring 2019 witnessed the publication of the *Tribal Adaptation Menu*, a groundbreaking document that uniquely provides a framework for integrating Indigenous and traditional knowledge, culture, history and language into the climate adaptation planning process. Developed by an expansive team including Midwest Tribal resilience liaison Sara Smith and NE CASC PI Chris Caldwell, the Menu catalogs a far-reaching collection of climate change adaptation actions for natural resource managers. Following publication of the Menu, Sara Smith organized four well-attended workshops to help guide Tribal resource managers and others in their use of this tool. In recognition of their “noteworthy advances promoting Indigenous perspectives to confront some of today’s most pressing challenges,” the Tribal Adaptation Menu Team received the 2019 Climate Adaptation Leadership Award for Natural Resources from the Association of Fish and Wildlife Agencies.

More than 35 Tribal community members converged on the College of Menominee Nation in Keshena, Wisconsin, last June to participate in the 2019 Indigenous Planning Summer Institute (IPSI). Since joining NE CASC in 2014, Chris Caldwell and the CMN Sustainable Development Institute have

made this week-long, immersive educational experience a focal point of their consortium activities. Each summer, IPSI affords a new cohort of undergraduate and graduate students the opportunity to learn about a broad array of Indigenous planning concepts, techniques, and outcomes in the areas of forestry, agriculture, and community strategizing; visit the Menominee Nation Forest, an internationally renowned originator of sustainable forestry; and become part of a community dedicated to advancing sustainability. This year, IPSI participants worked especially closely with Menikānaehkem, a women-led Menominee grassroots organization as well as the nearby Oneida and Stockbridge Munsee Nations.

Casey Thornbrugh, NE and SE CASC Tribal climate science liaison with USET, organized a Tribal Climate Resilience Summit on the Oneida Indian Nation in Upstate New York last August. A group of 70 Tribal leaders, Tribal students, and representatives of the Northeast and Southeast Climate Adaptation Science Centers gathered to address climate change impacts on Tribal Nations, Tribal climate adaptation plans as well as opportunities and resources for building resilience within Tribal entities. To facilitate the development of Tribal climate vulnerability assessments and adaptation plans, Thornbrugh also organized a writing retreat for professional and technical staff who are developing these documents for their Tribes. Held in November at the NOAA Greater Atlantic Regional Fisheries Office in Gloucester, Massachusetts, the multi-day event included remote and in-person components. Participants included representatives of the Saint Regis Mohawk Tribe, the Aroostook Band of Micmacs and the Wampanoag Tribe of Gay Head (Aquinnah).

## New & Completed Projects

<b>Evaluating forest adaption scenarios</b>	Frank Thompson	Developed climate change adaptation forest management strategies focusing on resistance, resilience, and transition for varied locations.
<b>Effects of hydrologic change on stream fish distribution</b>	Keith Nislow, Ben Letcher,	Predicted future upstream limits and consequent habitat distributions for brook trout under climate change scenarios.
<b>Effects of small impoundments on stream temperatures</b>	Keith Nislow, Ben Letcher	Investigated impact of dam removal on stream thermal regimes in the context of rising air temperatures caused by climate change.
<b>Decision-support for headwater stream habitats</b>	Keith Nislow, Ben Letcher, Evan Grant	Developed decision-support tools to guide management of cold water stream habitats.
<b>Evaluating trends in streamflow extremes</b>	Richard Palmer	Evaluated the impact of warmer climates on the statistical properties of streamflows in the 20th and 21st centuries.
<b>How variation in life history and evolutionary response affect vulnerability to climate change</b>	Ben Letcher	Used tagging data and genomic approaches to explore how brook trout will respond to climate change.
<b>Development of a Wildlife Adaptation Menu</b>	Olivia LeDee	Developed and tested a “menu” of climate change adaptation actions that are suitable for wildlife management in terrestrial ecosystems.
<b>Hyperscale modeling to predict temperature changes in lakes</b>	Jordan Read	Generated an improved assessment of aquatic habitat for Midwest lake fisheries and provided estimates of contemporary thermal habitats.
<b>Climate change induced shifts in phenology of coastal fish and wildlife</b>	Adrian Jordaan, Michelle Staudinger	Improved understanding of shifts in the timing of Key life events for fishes, marine mammals, and migratory shore and seabirds in the NE.
<b>Mechanisms for species responses to climate change</b>	Curtice Griffin	Identified mechanisms that drive projected changes in the distribution of vulnerable wildlife and tree populations.
<b>Mapping connected refugia for conservation concern species</b>	William DeLuca	Mapping well-connected refugia that will remain crucial habitat for wildlife under climate change.
<b>Reducing vulnerability of grassland birds to climate change</b>	Benjamin Zuckerberg	Synthesizing the vulnerability of grassland ecosystems to climate change across the Central Flyway
<b>Using sediment availability to reduce tidal marsh vulnerability to sea level rise</b>	Jonathan Woodruff	Comprehensively assessing salt marsh vulnerability to sea level rise, focusing on the movement of sediment into salt marshes.
<b>Development and evaluation of climate change adaptation tools</b>	Thomas Bonnot	Developing a tool to assess the effectiveness and utility of adaptation approaches at creating resilient landscapes of natural communities.
<b>Climate adaptation in forests and waters of the Menominee Region</b>	Chris Caldwell, Frank Kutka	Assessing the scope of possible shifts in availability of forest products and other indicator species under climate change.
<b>Adirondack fish conservation</b>	Peter McIntyre	Using observational data and genomic methods to manage key Adirondack lake fishes such as Summer Suckers, minnows, and smallmouth bass.
<b>Great Lakes fish migrations</b>	Peter McIntyre	Examining how climate is altering the timing of migrations across the Great Lakes and the role of these large migrations in fertilizing streams.

## NE CASC Fellows

Despite its storied tradition, the New England fishing industry has entered a state of crisis. In response to chronic overfishing, NOAA has assumed management of the Atlantic cod population, severely constraining harvest of the region's most iconic fish. Additionally, warming sea-surface temperatures resulting from climate change have undermined the productivity of lobsters, sea scallops, and groundfish, among other species. This resulting inaccessibility has significantly increased the cost of locally caught seafood, suppressing demand and increasing consumption of cheaper, imported fish.

Although the future appears bleak for New England's fisheries, the research of NE CASC fellow Amanda Davis suggests that the region's fishing industry may have cause for optimism. An environmental conservation graduate student at the University of Massachusetts Amherst (UMASS), Davis has begun investigating the possibility that obscure but regionally abundant fish species have the potential to boost consumption of locally harvested fish.

Working with a varied team of collaborators that includes the UMass Department of Food Science, UMass Dining Services, and a seafood distributor, Davis began her project by studying consumer perception of fish species such as haddock, hake, dogfish, and scup. To do so, she has

conducted surveys and sensory experiments evaluating knowledge of these local seafood options as well opinions of their taste, texture, aroma, and appearance. Results indicate that factors such as familiarity with and availability of these options explain their seeming unpopularity. When given the opportunity to evaluate unfamiliar local species, consumers respond favorably to them. These findings suggest that changes in seafood marketing and distribution can significantly shape consumer purchasing decisions and thus positively impact the regional seafood industry.

Given the far-reaching implications of Davis' research, it is not surprising that it has garnered support from a wide range of sources. Her work has been made possible by funding from an NSF Advanced Award, a UMass Social Science and Environment Seed Grant, and a 2018 Division of Marine Fisheries' (DMF) Seafood Marketing Pilot Grant.

"Transitioning to abundant local seafood is a win-win scenario for consumers, regional industry, and the environment," Davis says. "In our area, a fraction of food miles is attached to local catches versus imported seafood. The 'boat-to-table' system is a desirable way to significantly reduce our carbon footprint, strengthen our local economy, and support our communities. And, as my research has begun to show, such a transition lies within reach."



*NE CASC fellow Amanda Davis works with a collaborator from UMass Dining Services to prepare a seafood taste test.*

### *Training the next generation of climate scientists and resource managers*

The NE CASC Fellows program provides an early-career peer forum for graduate students and postdocs to engage in interdisciplinary science while receiving an introduction to coproduction and stakeholder engagement. Interacting via regularly scheduled meetings, Fellows routinely share their science, discuss research-related challenges, and develop a richer understanding of how impactful science is developed. An annual two-day Fellows Retreat in varied locations provides an opportunity to highlight place-based climate challenges and hone research and stakeholder engagement skills.

Our fellows are diverse in experience, expertise, and background. They have gone on to careers in a wide variety of fields, including science, management, and boundary-spanning roles with state, federal, non-profit, and private employers. We're proud of the unique interdisciplinary research collaboration opportunities fellows receive--and we know this experience strengthens their commitment to cultivating coproduced, actionable science.

## Featured Research: Declining Lake Ice

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Over the past century, ice cover in many Wisconsin lakes has declined by an average of one month during winter, a stunning development in a state where ice fishing has become a vital component of a lucrative winter tourism industry. Despite the dramatic nature of this shift, the prevailing view that winter is limnologically inconsequential has preempted investigation of its implications for the year-round health of Wisconsin lakes and the aquatic life inhabiting them.

Wisconsin winters have become shorter and more variable over the past several decades, however, and climate projections indicate that this trend may intensify in the coming decades. As the climate continues to warm, the once unimaginable scenario of Wisconsin winters unaccompanied by frozen lakes may become a reality. Consequently, the changing nature of winter may have significant though hidden consequences for the state's nearly 12,000 lakes .

Exploring potential ramifications of this possibility, NE CASC PI Hilary Dugan is one of the first researchers to challenge the

conventional wisdom regarding the irrelevance of winter to lakes. For Dugan, Wisconsin's vanishing lake ice raises fundamental questions about how lakes are impacted by climate change and what its ripple effects might be.

To begin investigating this issue, she and her research team have deployed snow plows and snow blowers to keep acres of lake surface free of snow throughout the winter. Preventing snow accumulation on lakes will reasonably simulate the ice-free lakes in Wisconsin's future by allowing sunlight to penetrate through the food web. Dugan suspects that more light will spur additional winter algae growth, which in turn may set off a chain reaction that could alter the nutrient, greenhouse gas, and aquatic life composition of many Wisconsin lakes. Dugan's innovative experiments thus serve as a key to understanding how Wisconsin's lakes might evolve in the coming decades and may provide the foundation for a plan to help the species that inhabit them adapt to the impacts of climate change.

## Featured Research: Adaptive Capacity

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Climate change poses a variety of threats to biodiversity and local population persistence, but the magnitude of its impact is not fully understood. To investigate this issue, two NE CASC projects examine how adaptive capacity might be enhanced or undermined in future climate scenarios.

A project led by Evan Grant investigates how the inundation level of vernal pools, seasonal wetlands that provide critically important short-term habitat for amphibian species of conservation concern, might impact amphibian life-cycle completion. Researchers used approximately 3,000 field observations of inundation in 450 pools to train machine-learning models that predict the likelihood of pool inundation based on pool size, day of the year, climate conditions, short-term weather patterns, and soil, geologic, and landcover attributes. The models helped generate predictions of pool wetness across five seasonal time points, three short-term weather scenarios, and four sets of downscaled climate projections. Together with long-term monitoring of individual pools at the site scale, this regional-scale study can support amphibian conservation by helping to identify pools that are best positioned to serve as refugia from changing climate.

Led by Benjamin Letcher, a second project estimated thermal performance curves in the wild for Brook Trout and developed models of daily survival as a function of stream flow and temperature. These models provide a foundation for adding adaptive capacity information to growth and survival models. Modeling showed that Brook Trout grow fastest at about roughly two degrees lower than estimates from laboratory studies while also highlighting the importance of tributaries as refuges from floods for small fish and as risky locations for larger fish in warm summers.

The project also developed new genetics tools for Brook Trout that allow researchers to evaluate questions related to adaptability. This approach identified differences among populations from Georgia to Maine. In the future, this tool can be used to evaluate genetic adaptation to stream warming among other environmental changes.

# Research Expertise from the NE CASC

NE CASC, with its core of nine consortium institutions, assembles climatologists, biologists, ecologists, and hydrologists, working together to inform natural and cultural resource management.

## Thomas Bonnot | University of Missouri

Avian reproductive ecology • Impact of climate change on habitat and populations of song birds and bats • Sustainable adaptive landscape management

## Bethany Bradley | UMass Amherst

Invasion ecology • Interactions between climate change, land use, and invasive species • Fire ecology

## Chris Caldwell | College of Menominee Nation

Tribal resilience • Connecting tribes and climate scientists • Cross-cultural and cross-disciplinary education • Applied research and outreach.

## Anthony D'Amato | University of Vermont

Impacts of climate change and invasive species on forest ecosystems • Temperate and boreal forests • Adaptive management • Silviculture • Forest disturbance

## Linda Deegan | Woods Hole Research Center

Coastal Processes • Estuaries • Eutrophication • Freshwater Processes • Food web interactions

## Hilary Dugan | University of Wisconsin-Madison

Lake modeling • Land use • Atmospheric and climate changes in biogeochemical flux • Aquatic processes.

## Radley Horton | Columbia University

Climate extremes • Risk assessment • Combined impacts of multiple extremes • Natural and built systems

## Dana Infante | Michigan State University

Stream fishes • River catchment hydrology • Landscape and climate factors affecting stream ecology • Sustainable management of aquatic systems

## Olivia LeDee | USGS

Wildlife impacts • Adaptation planning • Decision analysis • Natural resource policy • Conservation funding.

## Peter McIntyre | Cornell University

Great Lakes and inland lakes • Aquatic connectivity • temperature and flow regimes • Fish migrations • coastal fisheries. • Nutrient loading

## Toni Lyn Morelli | USGS

Landscape and species conservation • Climate adaptation • Translational ecology • Mammal vulnerability • Decision analysis.

## Keith Nislow | UMass Amherst

Landscape conservation design • Ecodrought • Forest management • Species dynamic response to extreme flows

## Richard Palmer | UMass Amherst

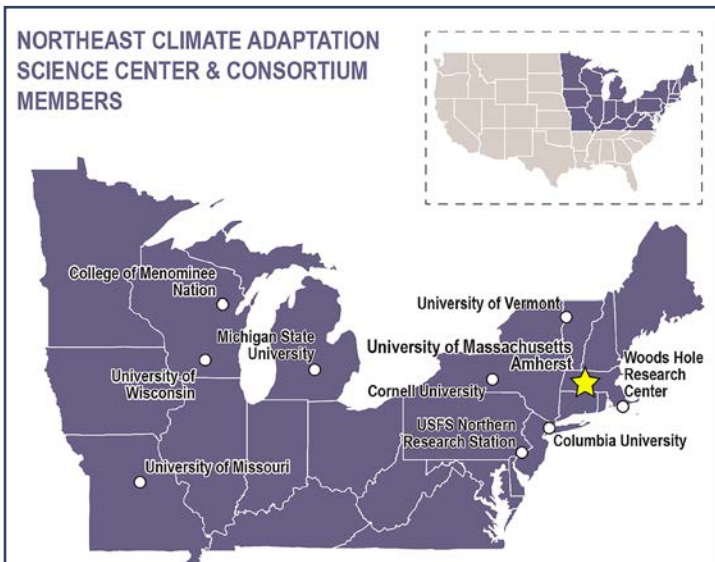
Stream flows, temperature, and health • Climate change impacts on surface water hydrology • Water supply systems • Decision analysis.

## Michelle Staudinger | USGS

Aquatic and marine species vulnerability and adaptive capacity • Phenology • Adaptation and conservation strategies.

## Jonathan Woodruff | UMass Amherst

Geomorphology and sedimentology of coastal and fluvial systems • Estuarine and tidal river dynamics



The University of Vermont



Cornell University

Columbia University  
IN THE CITY OF NEW YORK



UMASS  
AMHERST





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