



2020 Annual Report

NECASC

Northeast Climate Adaptation Science Center

Helping Fish, Wildlife & Ecosystems Adapt to the Impacts of Climate Change

The Year in Actionable Science: A Message from Our Directors



Last summer, NE CASC researchers conducted forest adaptation experiments in New Hampshire while donning masks to help halt the spread of COVID-19.

Despite the obstacles posed by the COVID-19 pandemic throughout most of the past year, NE CASC researchers continued to make significant progress in advancing our mission: Providing actionable science to resource managers so they can incorporate our evolving understanding of climate change into their decision-making and planning. As a result, we have many accomplishments to report. During 2020, we held a successful online “Biological Thresholds” workshop that exceeded participation goals and expanded our network. We also initiated a novel multi-state invasive species council, amplified our pioneering work on climate- change refugia, led the first comprehensive assessment of sand lances in the North Atlantic, and developed new projections for floods and droughts in Massachusetts.

Organizationally, NE CASC completed its first full year of Cycle II funding in 2020 while benefiting from a Congressional decision to increase investment in the national CASC program and create a standalone Midwest CASC. We are excited that these changes will double financial support for our region and enable us to provide much improved service to our community of partners.

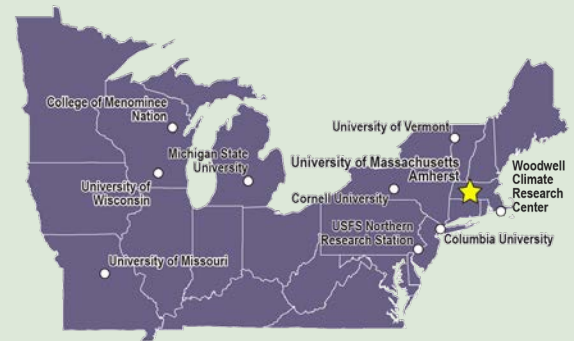
We also announced the appointment of Dr. Katherine Smith as our permanent Federal Director (read more on p. 2). She replaces Dr. David Reidmiller, who stepped down as acting Federal Director to take a position as Director of a new climate center at the Gulf of Maine Research Institute.

In the coming year we are looking forward to returning to a more recognizably “normal” work environment as we continue pursuing our main passions—delivering impactful science where it is needed most and preparing a new generation of adaptation specialists to engage in the many climate challenges that lie ahead.

—Richard Palmer & Katherine Smith

Our Work

Driven by an academic consortium of eight research institutions, the Northeast Climate Adaptation Science Center assembles a team of climate scientists, ecologists, hydrologists and biologists to work with natural resource managers in developing actionable science that will inform their decision making.



We accomplish this goal by focusing on seven research areas:

- Climate **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 environments**
- **Ecological vulnerability** and **species response** to climate change
- Impacts of climate change on **cultural resources**
- **Decision frameworks** for evaluating risk and managing natural resources in the midst of climate change

2020 In Numbers

56 Publications

45 Presentations

37

Research Fellows

Project & Personnel Updates



A New Approach to Invasive Plants

NE CASC research shows that climate change will render the Northeast a hotspot for invasive plants, suggesting that coordinated, multi-state action is needed to preempt the most harmful impacts of future invasions. Led by **Bethany Bradley**, the Regional Invasive Species and Climate Change Management Project (RISCC) began working toward this goal last February by organizing a workshop for invasive species managers across the Northeast. Ultimately, RISCC seeks to develop a multi-state council that will work with managers and legislative bodies to establish a long-term strategy for combating invasive species.



Tiny Songbird, Major Insights

PIs **Thomas Bonnot** and **Frank Thompson** recently teamed with federal and state partners to reintroduce the brown-headed nuthatch to Missouri's Mark Twain National Forest, where the songbird was extirpated more than 100 years ago. Returning the species to the area will help revitalize the forest's ecosystem, as nuthatches create pine tree cavities that are reused by many bird species. By monitoring the birds for the next two years, researchers will also use the reintroduction to test the efficacy of assisted migration. While this technique is well known as a tool for helping species adjust to new habitats in the face of climate change, it has rarely been used on songbirds.



Massachusetts Floods & Droughts

While Massachusetts has witnessed many recent extreme hydrological events, few statewide studies provide projections of riverine floods and droughts generated by high-resolution, physically-based hydrological models and multiple climate change projections. **Richard Palmer** and collaborators used this approach on 86 Massachusetts river basins to produce uniquely detailed hydrological estimates for the coming century. Their work shows that 100-year floods during winter will likely increase, flood magnitudes during spring will decrease, and droughts will be most intense during the fall.



Illuminating the Atlantic Ecosystem

Though it is a comparatively small aquatic creature, the sand lance plays a significant role in sustaining the dynamic ecosystem of the Northwest Atlantic Ocean (NWA). Despite its importance, however, most aspects of the sand lance's ecology, population dynamics, and vulnerability to current and future environmental changes are poorly understood. Led by **Michelle Staudinger**, a team of 24 researchers began addressing this information gap by producing the first comprehensive assessment of the sand lance in the NWA. The study marks the first step needed to properly inform relevant management, climate adaptation and conservation efforts related to this critically important forage fish.

Dr. Katherine Smith Appointed New Federal Director



The Northeast Climate Adaptation Science Center recently welcomed Dr. Katherine Smith as our new Federal Director. In this capacity, Dr. Smith will play a leading role in advancing our mission by helping articulate the center's vision, formulate its long-term strategic plan, and enhance collaboration with our network of partners.

Dr. Smith brings 13 years of experience leading national and regional federal science programs to her position at NE CASC. Prior to her appointment, she served as Assistant Station Director of the U.S. Forest Service Pacific Northwest Research Station. There she provided research program direction and developed interdisciplinary research initiatives to inform land management and climate adaptation strategies. Smith received a Ph.D. in Ecology from the University of Georgia and a MS in Fisheries and Wildlife Management from Michigan State University.

New & Completed Projects

In the past year, NE CASC researchers completed 6 projects on a variety of topics, including changing phenology for marine mammals in the Gulf of Maine, the role of vernal pools as climate-change refugia, biological thresholds, and the efficacy of slow-the-flow techniques in watershed management. Another 5 projects were initiated on topics that include brook trout persistence in warming streams, sensitivity of lakes to winter water-level drawdowns, development of a biodiversity monitoring protocol to support coastal adaptation, and climate change-induced shifts in waterfowl populations. To learn more, go to: www.necsc.umass.edu/2020-Projects.

Center Highlights

Transforming Our Perceptions of Climate Change: Pioneering Refugia Work Leads to Special Issue in Top Journal

As countless scientific studies have documented, climate change is expected to have profoundly negative impacts on wildlife, habitats and ecosystems around the globe. Less commonly understood, however, is the extent to which the conservation of climate-change refugia may serve as an effective climate adaptation strategy. Areas that are relatively buffered from climate change, refugia can provide short-term protection for native species in addition to sustaining biodiversity and ensuring ecosystem function in the long term.

Roughly a decade old, the concept of climate-change refugia remains obscure to many within and beyond the scientific community. Interest in this idea has steadily grown, though, and a recent special issue of *Frontiers in Ecology and the Environment*, a leading academic journal, helped bring it into focus.



An NE CASC project examining inundation patterns in over 400 vernal pools helped shed light on how these seasonal habitats may serve as climate-change refugia.

Published in June, the special issue addresses a wide spectrum of topics in the field, including refugia related to water, fire, fish, wildlife, forests, and the entire boreal biome. “The special issue offers a look back at how far we’ve come and a look forward to what’s still needed, highlighting conservation successes as well as what more remains to be done,” said **Toni Lyn Morelli**, editor of the special issue and a NE CASC research ecologist.

Morelli is a founding member of the Refugia Research Coalition (RRC), a national network of scientists and resource managers funded by the Northeast and Northwest Climate Adaptation Science Centers to advance refugia research and translate it into conservation on the ground. Their work has helped place regional CASCs at the forefront of refugia research and inspired

Morelli to propose the special issue. Underlying the issue’s diverse array of topics is a clarion call to broaden the scope of refugia management by moving beyond the narrow focus on climate and landscape factors to a more comprehensive understanding of this topic. According to Morelli, accounting for ecological complexity, scale and species’ ability to adapt to changing conditions will better capture the conservation potential of refugia.

Given the advances in refugia research, resource managers are increasingly well equipped to put refugia conservation into practice, a circumstance that may help shift the terms under which climate change is most frequently discussed. “Climate-change refugia conservation is an opportunity for hope, a chance to be proactive in a time of adversity and uncertainty,” said Morelli.

Tribal Engagement Highlights

Tribal Adaptation Menu Workshop

Prior to the COVID-19 shutdown, Midwest Tribal Resilience Liaison **Sara Smith** collaborated with colleagues to organize the latest installment in a series of workshops facilitating use of the Tribal Adaptation Menu, a document that uniquely blends climate adaptation science with traditional knowledges to promote Tribal climate resilience. This multi-day event brought together five Tribal Nations across the Northeast along with the National Park Service and several intertribal agencies to engage with six distinct projects. Topics included invasive species, indigenous food systems, and lake management. Future workshops will continue once bans on in-person meetings are lifted.

College of Menominee Nation

The College of Menominee Nation (CMN) Tribal Engagement Team shifted significantly last summer when PI **Chris Caldwell** was selected to become CMN’s Interim President. While Caldwell is missed, the team has continued to pursue many goals under new PI **Frank Kutka**, who is developing a sustainable agriculture degree program at the college. A current focal point for the team is organizing the upcoming Shifting Seasons 3 Summit, which will bring together Tribal representatives from across the country to discuss climate adaptation research needs and strategies. The event will feature an Earth Day appearance by guest speaker Winona LaDuke.

United Southern & Eastern Tribes

NE CASC Tribal Climate Science Liaison **Casey Thornbrugh** and his colleagues from the United Southern and Eastern Tribes (USET) received the 2020 Association of Fish and Wildlife Agencies (AFWA) Climate Adaptation Leadership Award. They were recognized for developing a Tribal climate change adaptation webpage, which serves as an informational resource available for the 33 Tribes located in the USET region as well as Tribes outside the area. Thornbrugh also hosted a webinar on invasive species for Tribal environmental and natural resources staff. Presenters included NE CASC researchers **Bethany Bradley, Toni Lyn Morelli, and Anthony D’Amato**.

Education & Outreach

NE CASC Alumnus Publishes Groundbreaking Eutrophication Study

Runoff of nutrients such as nitrogen and phosphorus, elements found in common agricultural fertilizers, poses one of the greatest threats to rivers, lakes, and marine coastlines across the globe. This “nutrient loading” creates favorable conditions for eutrophication, a transformation in water chemistry that often results in algal blooms, oxygen-starved “dead zones”, and contaminated drinking water.

Although regulation of eutrophication focuses on large rivers, the role smaller tributaries may play in eutrophication has been largely overlooked. This gap in existing knowledge may have significant consequences for large water bodies such as the Great Lakes, which are fed by hundreds of relatively small, somewhat anonymous tributaries in addition to large, well-known rivers.

“The PNAS article wouldn’t have been possible without my participation in the NE CASC Fellows Program, which challenged me to conceptualize my work from the perspective of serving stakeholders and producing actionable science.”

—Robert Mooney

To investigate this issue, former NE CASC fellow **Robert Mooney** completed an unprecedented study while still a graduate student at the University of Wisconsin-Madison, where he is now a postdoctoral researcher. Circumnavigating Lake Michigan, Mooney traversed thousands of miles

while painstakingly collecting multiple water samples from almost all of the lake’s 300 tributaries to obtain unique “snapshots” of their nitrogen and phosphorus inputs.

Recently published in the prestigious journal *Proceedings of the National Academy of Sciences*, Mooney’s results reveal that smaller tributaries can transport a disproportionately large amount of dissolved, highly bio-available nitrogen and phosphorus to Lake Michigan, indicating their unexpectedly large potential to spur the development of algal blooms along the lake’s coast. Based on these findings, Mooney identifies small tributaries as ripe candidates for environmental regulation, opening a new approach to maintaining Lake Michigan’s water quality and preserving its delicate ecosystems.

Center Holds Successful Biological Thresholds Workshop

More than 160 resource managers and scientists participated in a three-day NE CASC science planning workshop, “Biological Thresholds in the Context of Climate Change,” which took place via Zoom last fall. Designed to identify resource management priorities in addressing the potential climate change-induced crossing of biological thresholds—points where minor alterations in climatic conditions produce disproportionately large and undesirable responses in species or ecosystems—the workshop attracted attendees from 50 governmental agencies and 21 states.

The workshop’s presentations, panel discussions and breakout group exchanges revealed that managers are highly concerned about approaching thresholds in many areas but do not possess the information required to recognize and anticipate these tipping



Participants in the “Biological Thresholds” workshop expressed concern regarding approaching thresholds for predators such as the marbled salamander and Canada lynx.



points. “As a result, managers often find themselves in a difficult position because they want to implement strategies that help avoid thresholds, but they are also uncertain about specific actions to take in this area,” said NE CASC Principal Investigator **Anthony D’Amato**. “Fortunately, NE CASC personnel can help fill existing gaps in the understanding of biological thresholds by using the center’s wide-ranging expertise to co-develop the field experiments, modeling and tools necessary to assist managers in effective decision making.”

The workshop’s strong attendance indicates that NE CASC has many

opportunities to work with resource managers on this topic. “The fact that the workshop drew such a geographically diverse and energetic group of participants suggests that NE CASC has established a reputation for developing the innovative and actionable science that is essential to tackling the most challenging problems faced by resource managers,” said NE CASC Research Ecologist **Toni Lyn Morelli**. “The terrific turnout will in turn help NE CASC expand our network of partners, develop new collaborations, and open new avenues for delivering impactful science where it is needed most. We are eager to begin new work in this critical area.”