

# Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans

DOI Northeast Climate Science Center

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## EXECUTIVE SUMMARY

The Department of Interior Northeast Climate Science Center (NE CSC) conducts research that responds to the regional natural resource management community's needs to anticipate, monitor, and adapt to climate change. The NE CSC is supported by a consortium of partners that includes the University of Massachusetts Amherst, College of Menominee Nation, Columbia University, Marine Biological Laboratory, University of Minnesota, University of Missouri Columbia, and University of Wisconsin. The NE CSC also engages and collaborates with a diversity of other federal, state, academic, tribal, and non-governmental organizations (NGOs) to conduct collaborative, stakeholder-driven, and climate-focused work.

The State Wildlife Action Plans (SWAPs) are revised every 10 years; the most recent target deadline of October 2015. SWAP coordinators have been challenged to incorporate climate change impacts and species responses into their plan revisions. This synthesis is intended to inform the science going into Northeast and Midwest SWAPs across the 22 NE CSC states ranging from Maine to Virginia, and Minnesota and Missouri in the eastern United States. It is anticipated that this synthesis will help guide SWAP authors in writing specific sections, help revise and finalize existing sections, be incorporated as an appendix or addendum, and help guide the implementation of plan strategies and actions over the next decade.

The purpose of this NE CSC-led cooperative report is to provide a synthesis of what is known and what is uncertain about climate change and its impacts across the NE CSC region, with a particular focus on the responses and vulnerabilities of Regional Species of Greatest Conservation Need (RSGCN) and the habitats they depend on. Another goal is to describe a range of climate change adaptation approaches, processes, tools, and potential partnerships that are available to State natural resource managers across the Northeast and Midwest regions of the United States. Through illustrative case studies submitted by the NE CSC and partners, we demonstrate climate change adaptation efforts being explored and implemented across local and large-landscape scales.

The overall report is divided into four sections and addresses the following climate and management relevant questions:

1. **Climate Change in the Northeast and Midwest United States:** How is the climate changing and projected to change across the Northeast and Midwest regions of the United States?
2. **Northeast and Midwest regional species and habitats at greatest risk and most vulnerable to climate impacts:** What are the relative vulnerabilities of fish and wildlife species and their habitats to climate change in the Northeast and Midwest?
3. **Biological responses to climate impacts with a focus on Northeast and Midwest Regional Species of Greatest Conservation Need (RSGCN):** How are threatened fish

and wildlife likely to respond or adapt to climate change in the Northeast and Midwest?

4. **Scale-appropriate adaptation strategies and actions in the Northeast and Midwest United States:** What approaches, strategies, and actions could be taken to sustain fish, wildlife and their habitats in the short and long term across the Northeast and Midwest?

The outline and content for this document were developed with input from State Coordinators, members of the Northeast Association of Fish and Wildlife Agencies and Midwest Association of Fish and Wildlife Agencies, DOI Northeast Climate Science Center affiliated researchers, and other partners including the Landscape Conservation Cooperatives, the Northern Institute of Applied Climate Science, the Wildlife Conservation Society, and The Nature Conservancy. Terwilliger Consulting, Inc., was especially instrumental in helping connect and coordinate the authors of this report with State representatives through conference calls and email surveys to develop the most needed and effective information for current SWAP revisions.

On a final note, the SWAPs are living documents that can be added to and evolve on timescales beyond the 10-year revision cycle. The development of this report was timed such that SWAP coordinators and writers would have sufficient time to implement this input before their October 2015 deadline. However, this document is also meant to serve as a starting point for coordinated and collaborative climate science and adaptation across the region; the NE CSC endeavors to continue to provide actionable science during the coming years in collaboration with its diverse federal, state, NGO, and academic partners.

## KEY FINDINGS BY CHAPTER

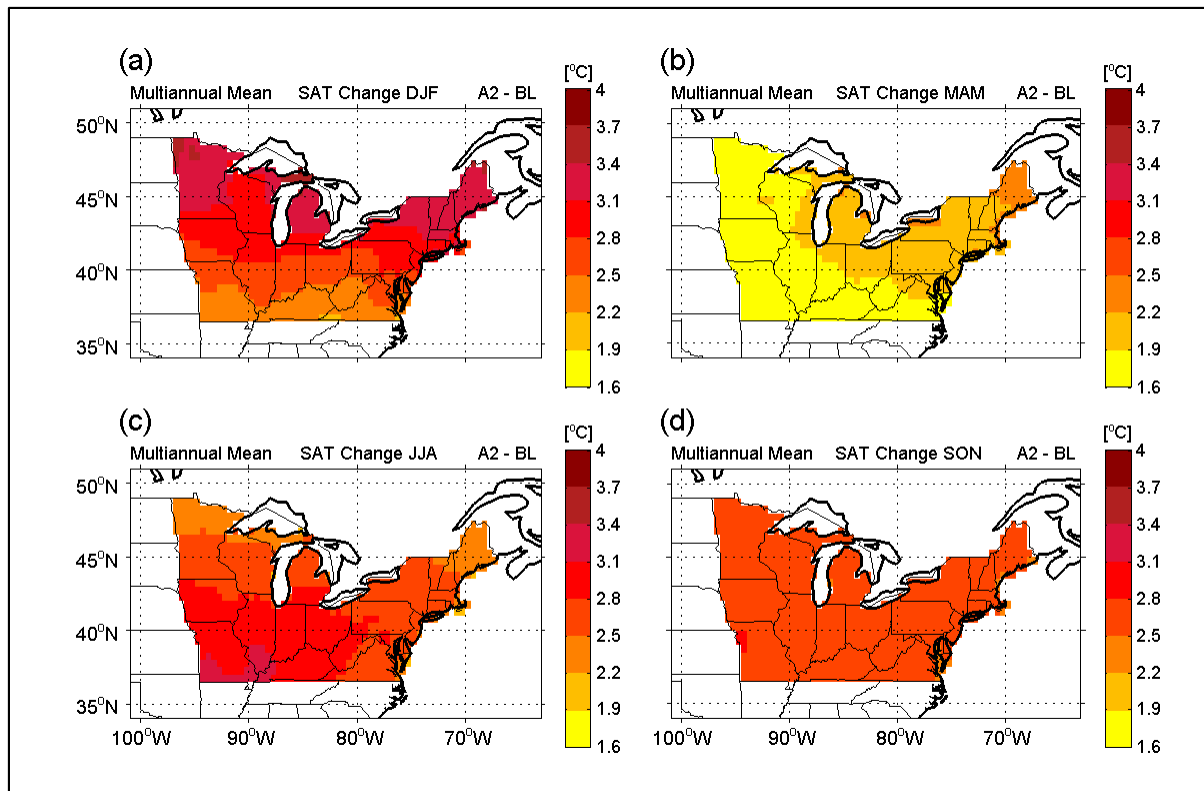
### CHAPTER 1: CLIMATE CHANGE IN THE NORTHEAST AND MIDWEST UNITED STATES

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#### Summary Points

The climate is changing rapidly in ways that have already impacted wildlife and their habitats. Chapter 1 provides a summary of the observed past and projected future climate changes in the region that are relevant to wildlife and ecosystems, as well as what we know and don't know in order to raise managers' confidence in their planning. A number of large-scale regional changes affect the overall terrestrial landscape within the Northeast and Midwest United States:

- Warming is occurring in every season, particularly in winter, at higher latitudes, at higher elevations, and inland (i.e. away from the ocean and lake coasts).
- Heatwaves may become more frequent, more intense, and last longer.
- Precipitation amounts are increasing, particularly in winter and with respect to high-intensity events in summer.
- Snow is shifting to rain, leading to reduced snowpacks and extent of snow cover, as well as harder, crustier snowpacks.
- Atmospheric moisture content is likely to increase.
- Wind speeds are declining, though wind gusts may be intensifying.
- Streamflows are intensifying.
- Streams are warming.
- Thunderstorms may become more severe.
- Floods are intensifying, yet droughts are also on the rise as dry periods between events get longer.
- Blizzards and ice storms are occurring more often in some areas, though most areas are experiencing milder winters (i.e., warmer and with less snow).
- Growing seasons are getting longer, with more growing degree days accumulating earlier in the season.



**Chapter 1, Figure 3:** Projected warming across the NE CSC region by season: (a) winter (December, January, and February), (b) spring (March, April, and May), (c) summer (June, July, and August), and (d) autumn (September, October, and November). Values represent the differences between the 1979 – 2004 and 2041 – 2070 average temperatures for each season. Multi-model means from the North American Regional Climate Change Assessment Program (NARCCAP), based on a high emissions scenario, are used (Data and map for Northeast published by Rawlins et al. (2012); maps extended by F. Fan, written communication).

In addition, localized climate change is occurring in specific regions:

- U.S. Atlantic coast
  - Sea level is rising at an accelerating rate.
  - Tropical cyclones and hurricanes may be intensifying and storm tracks have been shifting northward along the coast.
  - Oceans are warming and becoming more acidic.
- Great Lakes
  - The lakes are warming.
  - Winter maximum lake ice extent is shrinking.
  - Lake evaporation rates are increasing.

- Lake-effect snow events are becoming more severe, longer lasting, and shifting to rain, but occurring less often.
- Water levels have decreased, but may not be linked to anthropogenic climate change.
- Appalachians
  - Warming may be occurring more rapidly at higher elevations.
  - Greater intensification of heavy rainfall events may be occurring.

In the short term (i.e., over the next 5-20 years), the direction and magnitude of warming in the global climate are mostly consistent across all emissions scenarios and with strong agreement across models. Accordingly, we are certain that the Northeast and Midwest will see longer growing seasons. We are likely to see shifts from snow to rain, though shifts in the amount of total precipitation (rain and snow) are less certain. Severe weather events (e.g., thunderstorms, tornadoes) are challenging to detect. Soil moisture and evapotranspiration trends are neither robustly observed nor consistent among modeling studies.

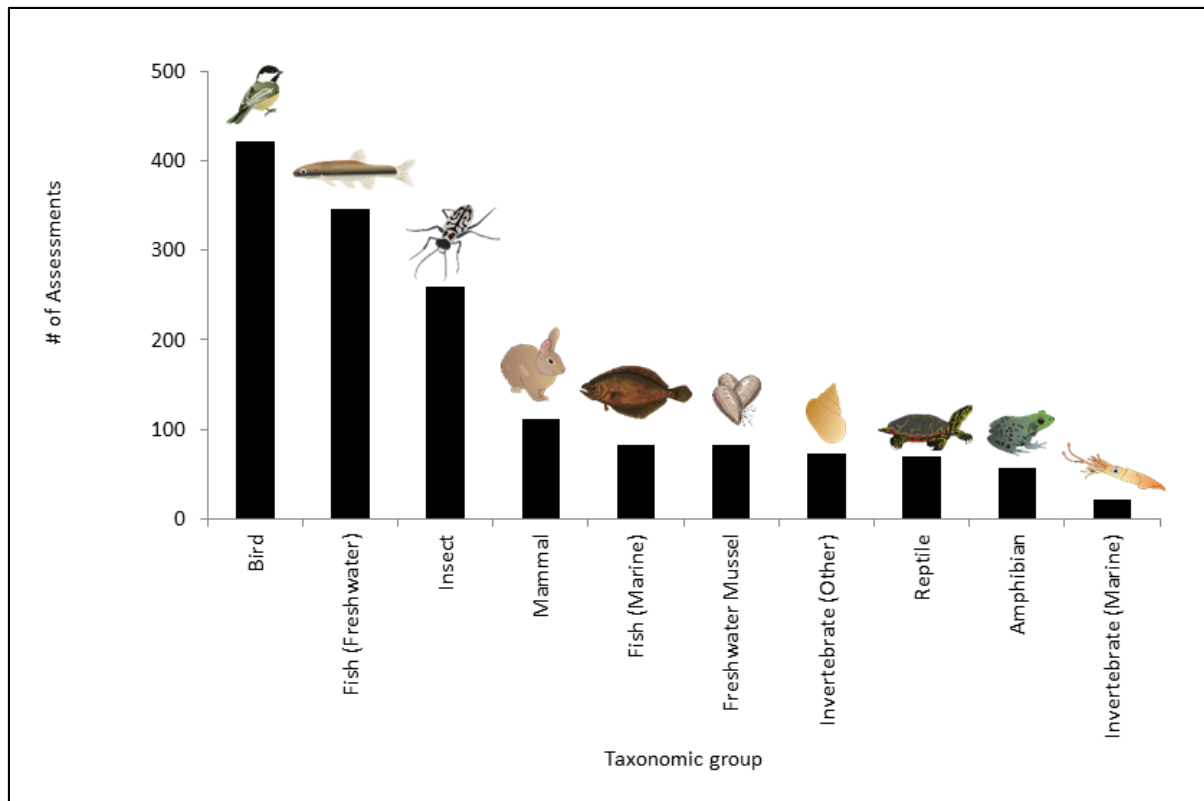
## CHAPTER 2: NORTHEAST AND MIDWEST REGIONAL SPECIES AND HABITATS AT GREATEST RISK AND MOST VULNERABLE TO CLIMATE IMPACTS

**Authors:** Michelle Staudinger (USGS, NE CSC), Laura Hilberg (University of Massachusetts Amherst), Maria Janowiak (Northern Institute of Applied Climate Science, U.S. Forest Service), Chris Swanston (Northern Institute of Applied Climate Science, U.S. Forest Service)

### Summary Points

- *Vulnerability* is defined as the susceptibility of a species, system or resource to the negative effects of climate change and other stressors.
- *Climate change vulnerability* is composed of three separate but related components: exposure, sensitivity, and adaptive capacity.
- *Climate Change Vulnerability Assessments* targeting ecological systems can be focused at the species, habitat, or ecosystem level; there are different interpretations, treatments, and approaches to assessing climate change vulnerability. Therefore, it is important to examine the specific factors that were considered and the definitions used to evaluate the vulnerabilities of conservation targets within each study.
- NatureServe's Climate Change Vulnerability Index (CCVI) was the most commonly used framework across studies included in this synthesis to assess fish and wildlife species across the Northeast and Midwest; freshwater mussels, amphibians, and fish were scored as either extremely or highly vulnerable, while the majority of birds and mammals received low vulnerability rankings.
- Other (non-CCVI) species-focused vulnerability assessment frameworks ranked marine fish and invertebrates as highly vulnerable, and the majority of birds and mammals as having moderate or low vulnerability.
- Overall, birds were the most frequently assessed taxonomic group across the region, but generally yielded relatively low vulnerability scores. However, vulnerability of migratory birds and other species may be underestimated when the full life-cycle or connections among breeding, wintering, and migratory habitats are not taken into account.
- The Climate Change Response Framework (CCRF) was the most commonly used methodology across studies included in this synthesis to assess habitats in the Northeast and Midwest; spruce-fir, lowland conifer, Appalachian northern hardwood forests, as well as bogs and fens were classified as highly vulnerable to climate change.
- Other (non-CCRF) habitat-focused assessments generally scored tundra, freshwater aquatic, and coastal habitats as highly vulnerable to climate change.
- Forests were the most frequently assessed habitat group across the region.





**Chapter 2, Figure 2:** Number of vulnerability assessment rankings by major taxonomic groups across 16 regional studies. Icons courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science ([ian.umces.edu/symbols/](http://ian.umces.edu/symbols/)).

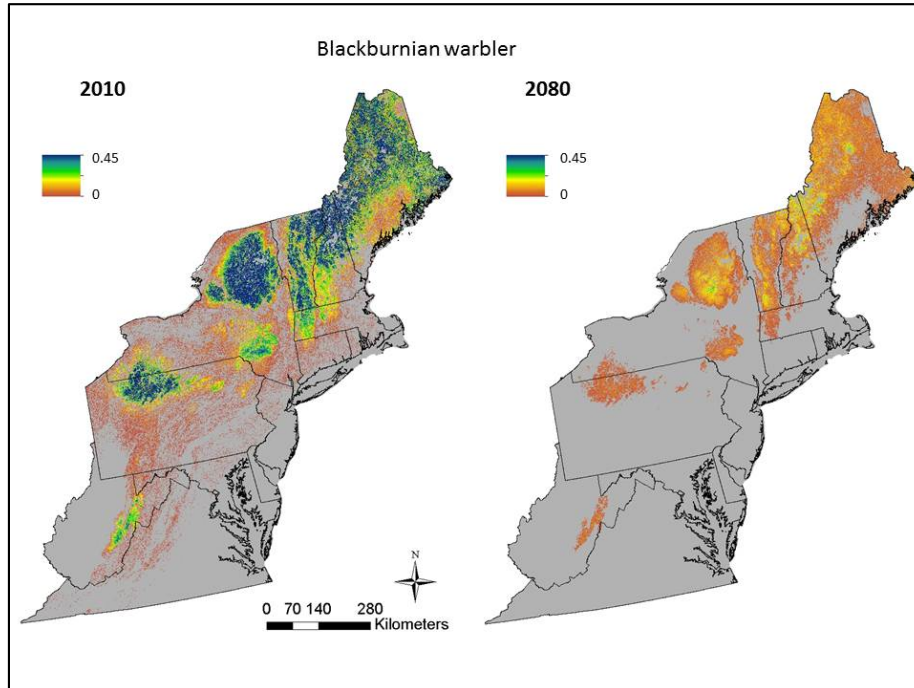
The objectives of chapter 2 are to describe climate change vulnerability, its components, the range of assessment methods being implemented regionally, and examples of training resources and tools. Climate Change Vulnerability Assessments (CCVAs) have already been conducted for numerous Regional Species of Greatest Conservation Need and their dependent habitats across the Northeast and Midwest. This chapter provides a synthesis of different assessment frameworks, information on the locations (e.g., States) where vulnerability assessments were conducted, lists of individual species and habitats with their respective vulnerability rankings, and a comparison of how vulnerability rankings were determined among studies.

## CHAPTER 3: BIOLOGICAL RESPONSES TO CLIMATE IMPACTS WITH A FOCUS ON NORTHEAST AND MIDWEST REGIONAL SPECIES OF GREATEST CONSERVATION NEED (RSGCN)

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### Summary Points

- Climate change will have cascading effects on ecological systems.
- These changes are expected in the form of shifts in timing, distribution, abundance, and species interactions.
- Some wildlife groups in the Northeast and the Midwest, including montane birds, salamanders, cold-adapted fish, and freshwater mussels, could be particularly affected by changing temperatures, precipitation, sea and lake level, and ocean processes.
- Interspecific interactions and land use change could exacerbate the impacts of climate change.
- A focus on habitat connectivity, water quality, and invasive species is among the many options to increase resilience for wildlife populations in the face of climate change.



**Chapter 3, Figure 1:** Change in Landscape Capability (LC) from 2010 to 2080 for the Blackburnian warbler and the eastern meadowlark. The Blackburnian warbler is predicted to have a 71% reduction in LC in the Northeast by 2080. In contrast, the eastern meadowlark is expected to maintain throughout most of its Northeastern U.S. extent by 2080.

Chapter 3 reviews the responses to climate change on the 367 Regional Species of Greatest Conservation Need (RSGCN) identified by the Northeast Fish and Wildlife Diversity Technical

Committee (NEFWDT), technical experts from states' natural resource agencies (**Appendix 3.1**). These species were chosen based on their conservation status, listing in SWAPs, and the percentage of their range that occurs in the Northeast. The objectives of this chapter are to: summarize how regional biodiversity has already responded and is expected to respond to climate change; summarize information on specific RSGCN species responses to climate change to date and anticipated under future scenarios; characterize the greatest uncertainties about how biodiversity and RSGCN species will respond to climate change in the future; and highlight where other factors are expected to exacerbate the effects of climate change. A systematic review of the peer-reviewed literature, primarily using the ISI Web of Knowledge to search for papers on each species related to "climate", "temperature", or "precipitation", allowed us to review some of the ways climate change will affect regional species of conservation concern.

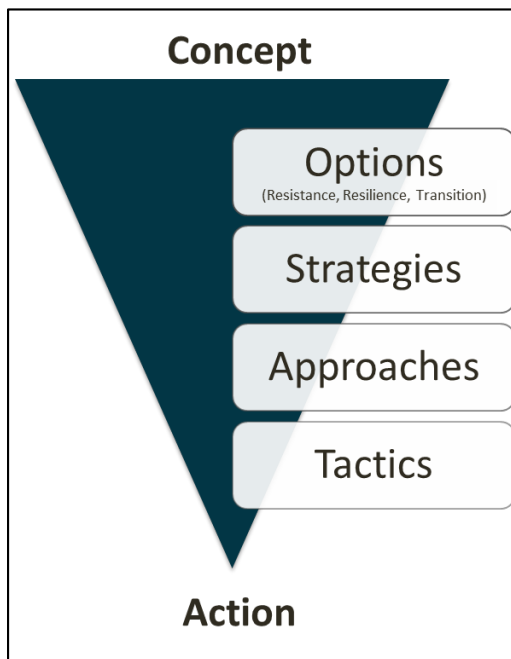
## CHAPTER 4: SCALE-APPROPRIATE ADAPTATION STRATEGIES AND ACTIONS IN THE NORTHEAST AND MIDWEST UNITED STATES

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### Summary Points

- *Climate Change Adaptation* is a growing field within conservation and natural resource management. Actions taken toward climate change adaptation account for climate impacts and ecological responses, both current and projected into the future. These actions attempt to accomplish a number of goals, including the conservation of wildlife and ecosystems by reducing vulnerability and increasing resilience.
- Climate change adaptation strategies and approaches for natural resources can be thought of as part of a continuum of potential actions ranging from 1) options or goals to 2) strategies, 3) approaches, and 4) tactics.
- There are a range of decision support tools and processes to aid climate change adaptation. This document highlights several including the Adaptation Workbook, Climate Change Vulnerability Assessments, Structured Decision Making, Adaptive Resource Management, and Scenario Planning. It will also provide case studies on the application of these tools across the Northeast and Midwest.
- Improved, better-integrated, and increasingly coordinated monitoring systems would be helpful to detect, track, and attribute species and habitat shifts to climate change over spatiotemporal scales. We highlight regional examples of projects and programs addressing these challenges.
- Illustrative case studies of climate change adaptation efforts are presented across landscape/ecoregion, state, and local scales.
- **Appendix 4.1** provides a synthesis of over 900 general, species, and habitat-specific adaptation strategies and tactics from 9 regional studies being considered or implemented across the region.

The study of climate change adaptation is a relatively new and rapidly growing field focused on preparing for and responding to the current and future impacts of climate change. The goal of this chapter is to highlight different approaches, processes, and tools currently being used across the region through illustrative case studies at varying scales. In addition, we provide a synthesis of numerous species and habitat-specific adaptation strategies and actions from existing assessment reports and management plans, which is intended to showcase a range of possibilities for natural resource management under future global change. This report does not prescribe one specific approach to taking action; instead, we outline a range of adaptation tactics, which will require thoughtful consideration of the needs of the species, habitat, and location, the stakeholders and partners involved, the scale that a decision or policy is being implemented at, and the financial and personnel resources available to managers.



**Chapter 4, Figure 1:** Actions for adaptation actions become increasingly specific along a continuum of options, strategies, approaches, and tactics.