



Climate Change and Biodiversity in Maine: A Summary of Vulnerability of Habitats and Priority Species

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Introduction

As we watch temperatures climb and experience extremes in weather, it is clear that climate change has become a tangible threat to Maine's ecosystems. Long-term research has shown that Maine's wildlife are already responding to climate change.¹ We will likely lose some of Maine's native wildlife and observe permanent changes to their habitats in the coming decades. By 2100, average temperatures may increase 3° to 13°F. In response, the predicted northward shift of species ranges has begun. Rising temperatures will allow pests such as Winter Moose Tick (*Dermacentor albipictus*) and Hemlock Wooly Adelgid (*Adelges tsugae*) to become more common, potentially harming native wildlife and their habitats. Drought may occur more frequently and impact all habitats, especially wetlands. Sea level will likely rise three to six feet and will flood coastal marshes and beaches.

Recognizing these challenges, a team of Maine scientists assessed the vulnerability of wildlife and habitats to a changing climate and then identified general strategies to reduce their vulnerability.² Other states have taken this first step as they aim to update their state wildlife action plans (SWAPs) by 2015. States originally created SWAPs to set conservation priorities and obtain additional federal funding for wildlife. Maine's plan was prepared by the Maine Department of Inland Fisheries and Wildlife (MDIFW) and is called the Comprehensive Wildlife Conservation Strategy (CWCS).³ In 2013, the Beginning with Habitat Program, an MDIFW-led partnership of state and federal agencies, and conservation organizations, completed a vulnerability assessment to help update the 2015 CWCS.⁴ This summary provides highlights of this assessment, including the vulnerability of Maine's wildlife, plants, and habitats, and a description of a few key adaptation strategies.⁵

¹ Jacobson et al.. 2009. Maine's Climate Future: An Initial Assessment. Orono, ME: University of Maine.

² Staudinger, et al. 2012. Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 Natl. Climate Assess.. Coop. Rep. to the 2013 National Climate Assessment. 296 p.

³ MDIFW. 2005. Maine's comprehensive wildlife conservation strategy. MDIFW. Augusta, ME.

⁴ Whitman et al. 2013. Climate Change and Biodiversity in Maine: Vulnerability of Habitats and Priority Species. Manomet Center for Conservation Sciences (in collaboration with Maine Beginning with Habitat Climate Change Working Group) Report NCI-2013-03. 105 pp. Brunswick, ME.

⁵ This research was funded by the Manomet Center for Conservation Sciences, Maine Outdoor Heritage Fund, and The Nature Conservancy. The findings and conclusions in this article are those of the authors and do not necessarily represent the view of the U.S. Fish and Wildlife Service.



Methods

Over 100 Maine scientists helped conduct this vulnerability assessment. They ranked the climate change vulnerability of 442 species, 21 CWCS Key Habitats, and 47 natural community types. This included 213 animal species identified by the 2005 CWCS as Species of Greatest Conservation Need (SGCN; Priority 1 and 2), 163 state-listed Threatened or Endangered plant species, and 66 additional species. Highly vulnerable species and habitats were those predicted to have large declines in population size and/or range in Maine between 2050 and 2100.

Ninety percent of the participating scientists were confident that this approach was useful for assessing species vulnerability to climate change.

Species at Risk

The eastern moose (*Alces alces americana*) is a northern species that is found across Maine and was ranked highly vulnerable to climate

change. It may be vulnerable to Winter Moose Ticks (*Dermacentor albipictus*) that can survive mild winters and can cause severe hair loss and increased calf mortality.

Photograph by Corey Raimond.

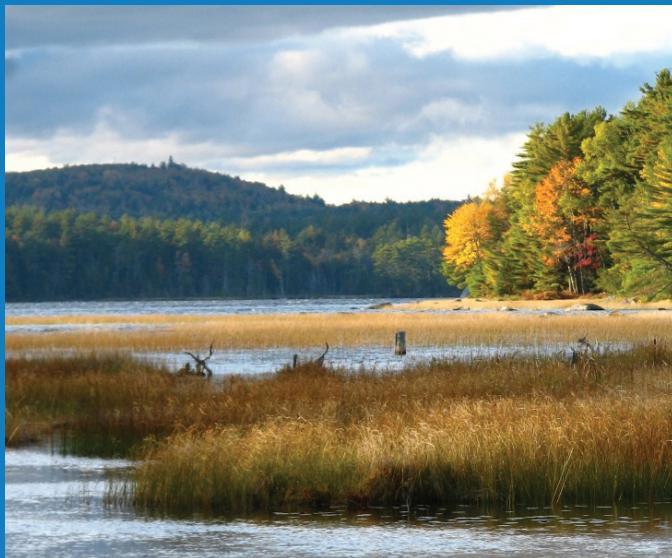
Climate change will greatly increase the vulnerability of one-third of all Maine species assessed. Of 442 ranked species, 37% were ranked highly vulnerable to climate change and another 38% were ranked moderately vulnerable.

Fifty percent of SGCN mammals and state-listed Threatened or Endangered plant species were ranked highly vulnerable to climate change (Table 1). All species groups had many species that were ranked highly vulnerable to climate change. This includes iconic species such as the common loon (*Gavia immer*), eastern moose (*Alces alces americana*), Atlantic puffin (*Fratercula arctica*), and landlocked salmon (*Salmo salar Sebago*). Twelve non-listed fungi and lichen species were added to the assessment and 11 were ranked as highly vulnerable.

Habitat needs and traits of many SGCN make them vulnerable to climate change. The five traits most frequently associated with species with high vulnerability to climate change included: high degree of habitat specialization, highly patchy distribution in Maine, movement limited by barriers, dependence on stable seasonal water levels, and southern range limits in Maine.

Table 1. Species group, N (number of species ranked), species highly vulnerable (%), and common traits of highly vulnerable species. All species includes fungi and lichen species.

SPECIES GROUP	NUMBER OF SPECIES RANKED	SPECIES HIGHLY VULNERABLE (%)	COMMON TRAITS OF HIGHLY VULNERABLE SPECIES
Plants	178	50%	<ul style="list-style-type: none">› Linked to vulnerable habitats (e.g., wetlands, alpine, and northern uplands)› At southern edge of their range in Maine› Linked to fragmented habitats that limit movement
Invertebrates	82	20%	<ul style="list-style-type: none">› Highly specific habitat requirements› At southern edge of their range in Maine› Movement limited by barriers› Dependent on vulnerable habitats (e.g., cold-water, coastal habitats)
Fish	18	27%	<ul style="list-style-type: none">› Dependent on vulnerable habitats (e.g., cold-water)
Amphibians & Reptiles	8	25%	<ul style="list-style-type: none">› Dependent on vulnerable habitats (e.g., wetlands)
Birds	128	33%	<ul style="list-style-type: none">› At southern edge of their range in Maine› Linked to vulnerable habitats (e.g., marine, wetlands, northern forests)› Also uses vulnerable habitats for migration and/or wintering
Mammals	16	50%	<ul style="list-style-type: none">› At southern edge of their range in Maine› Dependent on vulnerable habitats (e.g., boreal forest)
All Species	442	37%	<ul style="list-style-type: none">› High degree of habitat specialization› Highly patchy distribution in Maine› Movement limited by barriers› Dependence on stable seasonal water levels› At southern edge of their range in Maine



Wetlands and other freshwater habitats occupy about 25% of Maine's area and were ranked moderately or highly vulnerable to climate change, with peatlands (bogs and fens) being the most vulnerable. Warming and drought may reduce the amount of habitats like vernal pools, cold-water pools in streams, and spawning beds. Three important adaptation strategies are maintaining water quality and shoreland protection, and improving fish passage at stream crossings.

Photo by Andrew Whitman.

Habitats at Risk

More than 50% of the Species of Greatest Conservation Need found in three Comprehensive Wildlife Conservation Strategy, Key Habitats (Alpine, Montane Forest, and Peatlands) ranked highly vulnerable to climate change. Most species in early successional and human-affected ecosystems (e.g., agriculture) had low vulnerability.

Climate change poses a large threat to 10% of Maine's habitats. The most vulnerable habitats are alpine and montane systems, peatlands, northern river shores, spruce flats, and cedar lowlands. Coastal and aquatic systems are considered at least moderately vulnerable to climate change, but this is uncertain as their loss is influenced by factors that are difficult to project. Northern forest types also are moderately vulnerable, while oak-pine forests and barrens are likely to expand. Together, moderately and highly vulnerable habitats cover more than 33% of Maine.



Chestnut oak (*Quercus montana*) is commonly found in oak-hickory forests in southern New England and into York County. Warmer temperatures and drier summers may lead to this species becoming widespread in Maine by 2100.
Photo by Maine Natural Areas Program.

Strategies for Conserving Maine's Wildlife in the Face of Climate Change

Overall, if we maintain large areas of high-quality habitat, habitat connections and corridors, and hotspots of species diversity, then Maine can expect a promising future for its wildlife and their habitats. Applying the following four actions will greatly reduce threats posed by climate change to Maine's wildlife:

1. Update Maine's Comprehensive Wildlife Conservation Strategy, and SGCN list, considering climate change vulnerability. For example, American Marten (*Martes americana*) and Cape May Warbler (*Dendroica tigrina*) are uncommon, but their populations are relatively secure for now. They may need to be assigned to a higher SGCN priority level because they were ranked highly vulnerable to climate change. More conservation consideration may need to be given to habitats ranked highly vulnerable to climate change, such as peatlands. Some habitat conservation strategies may need to be revised. For example, selection of low-lying coastal habitats for conservation should take into account the availability of nearby upslope areas that could become salt marsh when sea level rises.

2. Apply innovative conservation strategies aimed at reducing new threats, including conservation of:

- › Low-lying coastal areas to allow adjacent tidal marshes move upslope as sea level rises;
- › Biological hotspots where enduring biophysical features (e.g., underlying geology, hydrology) will always support many species (e.g., rich soils, fens) or species with unique needs (e.g., areas of glacial outwash); and
- › Cool refuges for northern species such as cold water inflows, mountainous areas, north-facing slopes, closed canopy forest (especially use along shorelines), and coastal areas.



Alpine habitats occupy less than a 0.1% of Maine's land but host a disproportionate number of SGCN and state-listed Threatened or Endangered plant species and rare habitats. They were ranked highly vulnerable to climate change. Some alpine areas may persist but climate change will alter these habitats. One key adaptation strategy will be to minimize hiker impacts.

Photo by Andrew Whitman.



The wild brook trout (*Salvelinus fontinalis*) finds its last stronghold in Maine and was ranked as moderately vulnerable to climate change. Increasing water temperatures will reduce their growth, reproduction, and survival.

Summer drought could reduce cool-water refuges, impacting this and other cold-water species.

Photograph by Eric Enbretson.

3. Continue to apply existing conservation strategies as they play a key role in climate change adaptation, including:

- › Identify and maintain travel corridors (e.g., ridgelines and streams) to allow plants and animals to move north;
- › Conserve a network of diverse habitats across Maine to support many species, including some that may not be here yet;
- › Identify and maintain large blocks of good habitat to improve wildlife population health and ability of wildlife to cope with climate change;
- › Protect water quality and riparian areas to help safeguard aquatic species from warming temperatures and extreme rainfall;
- › Increase the number of conserved "stepping stones" to allow for wildlife movement, in particular in developed areas; and
- › Restore important wildlife habitats in existing conservation areas, such as reconnecting streams.

4. Apply regional strategies in cooperation with neighboring states and provinces. Maine must work with neighboring states and provinces if it is going to succeed at conserving Maine's wildlife and their habitats. Key threats to Maine's future wildlife lie south of Maine's borders. If states to the south do not maintain adequate wildlife populations and travel corridors, then southern species will not be able to move north to Maine. Likewise, maintaining connections between habitats in Maine is essential to allow species to move across Maine and into adjacent provinces.



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