TAKING ACTION TOGETHER:

NORTHEAST REGIONAL SYNTHESIS

FOR

STATE WILDLIFE ACTION PLANS

Prepared for the Northeast Fish and Wildlife Diversity Technical Committee

By

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Executive Summary

Wildlife moves continuously across state boundaries. Ecosystems and habitats stretch across borders as if they didn't exist. Weather events, pollution, disease, and climate change all transcend the limits of political jurisdiction. Cross-border, regional approaches to wildlife conservation and planning are still relatively new; but they are necessary.

Collaboration among states to achieve shared conservation goals is the way of the future, and for that reason, *Taking Action Together: The Northeast Regional Synthesis for State Wildlife Action Plans* is a major achievement. Its regional focus does not ignore or supersede the responsibilities of individual states. Rather, it aims to help states do the work of conservation more effectively, at home; and then to help them reach beyond their own boundaries, to pursue collaborative approaches and joint solutions to the challenges of wildlife conservation in the 21st century.

The Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) and its partner organizations, public and private, offer the *Northeast Regional Synthesis* as a work in progress, an early result of our long-term commitment to regional collaboration and successful conservation of wildlife species and the lands and waters that sustain them.

This document represents a landmark regional collaboration in the history of wildlife conservation in the United States. It is also designed as a practical tool that will help guide state fish and wildlife agencies and their conservation partners in setting priorities and making on-the-ground conservation decisions that affect the future of wildlife and the habitats that support wildlife in the Northeast. It is both a success story and a strategic step forward for state and regional wildlife conservation in the Northeast.

The origins of the *Northeast Regional Synthesis* extend as far back as the 1980s. Decades before Congress required every state to adopt a State Wildlife Action Plan (SWAP), state fish and wildlife agencies in the Northeast—specifically the NEFWDTC of the Northeast Association of Fish and Wildlife Administrators (NEAFWA)—worked together to identify regional priorities, including a list of Regional Species of Greatest Conservation Need (RSGCN).

This RSGCN list served as an early guide for wildlife conservation efforts in the region. It was also visionary in explicitly recognizing that wildlife, the habitats that sustain wildlife species, and the threats to wildlife are not confined within state boundaries. Recognition of this fact helped states identify and prioritize those species and habitats that can be most effectively addressed at the multistate scale.

The original SWAPs were drafted in 2005, and by federal mandate were required to be revised at least once every ten years. In 2006, having just finished work on the first round of SWAPs, representatives of state fish and wildlife agencies met in Albany, New York. They identified six regional priority needs for wildlife conservation and created a Regional Conservation Needs (RCN) Grant Program in response. It was an unprecedented collaborative step. The fish and wildlife agencies in thirteen Northeast states (from Maine to Virginia) and the District of Columbia each agreed to contribute 4% of their federal appropriation every year to support the RCN Grant Program, which would approach conservation needs and priorities from a regional perspective.

By joining forces in this way, the Northeast states created a model program, one that provides for more efficient and effective use of limited resources, including scarce conservation dollars. RCN grants support cutting-edge research and conservation; draw on the best available scientific expertise; leverage funds through a matching requirement; and take a landscape-scale approach to needs and priorities identified in the SWAPs.

The six priority areas identified in 2006 focused on: 1) developing a regional Geographic Information System (GIS) platform for assessing critically important habitat types; 2) identifying and responding to the threats posed by invasive species; 3) achieving sustainable populations of species of greatest conservation need (SGCN); 4) adopting stream flow/management and water quality standards to protect aquatic life; 5) creating guidelines and tools to support local planning; and 6) developing regional indicators to measure success in wildlife conservation.

The *Northeast Regional Synthesis* summarizes and provides links to information on the more than fifty individual projects funded through the RCN Grant Program since 2007. Ten years of funding through the RCN Grant Program has kept a close focus on these priorities, and especially on creating new tools and resources that the individual states can apply, both in conservation planning decisions and in the SWAP revision process. RCN grants have also supported important new research on urgent conservation challenges: on the causes of White Nose Syndrome in bats, Rana virus in reptiles, and the effects of climate change and invasive species on wildlife and habitats throughout the region. The RCN grants served as seed money, creating a ripple effect with multiple spin-off supplemental projects and partner involvement across the region. The New England cottontail project is a powerful example of the effectiveness and ability of states to engage in conservation on the ground to proactively preempt federal listing.

As the Northeast states were about to begin work on the first ten-year SWAP revisions, fish and wildlife agencies convened again in Albany in 2011. The group included thirteen state agencies (NEAFWA and NEFWDTC), six federal agencies, and representatives from twelve non-profit organizations and universities. Their goal was to develop a regional conservation framework to address the priorities and needs identified.

As in the first Albany conference, the emphasis was on creating a regional perspective and a set of common tools that would support work at the state level. There was a strong focus on developing tools for conservation design and information management; monitoring and evaluation; and especially on adopting a regional lexicon, a common vocabulary that would allow states to communicate and share information more effectively while also lending greater clarity and efficiency to regional conservation efforts.

The importance of this regional lexicon can hardly be overstated, and the usefulness of the *Northeast Regional Synthesis* is due in large part to the fact that the states have agreed upon and are now using a common language in their conservation work. The lexicon calls for the use of many of the strategically designed RCN projects to provide these common terms and systems. One key example is the collaboration between The Nature Conservancy, NEFWDTC, and North Atlantic Landscape Conservation Cooperative to develop the Northeast habitat classification systems for both terrestrial and aquatic habitats and produce a seamless overlay for the Northeast region. Similarly, the lexicon calls for the use of standard classification systems to categorize and describe threats (International Union for the Conservation of Nature) and actions (Wildlife TRACS [Tracking and Reporting Actions for the Conservation of Species]). This allows for more meaningful assessment and analysis at the regional scale.

Overall, the Northeast is the most densely populated and intensively developed region of the country. Large tracts of wild or minimally developed land still remain in parts of the region, but fragmentation of habitat and loss of the "connectivity" that supports many SGCN is widespread. It is a pervasive and growing problem that all individual state wildlife agencies and their partners must address. It is also one that demands the kind of regional thinking and regional responses the *Northeast Regional Synthesis* is designed to support.

The same is true of the challenges posed by invasive species and climate change, which affect SGCN and their habitats from the coastlines and estuaries to inland waterways and from lowland areas to the region's highest mountain peaks. The effects of climate change are discussed throughout the *Northeast Regional Synthesis*, and many of the projects funded through the RCN Grant Program and cited in the document were undertaken in response to

this region-wide threat. The intent is to help the state agencies responsible for wildlife conservation and their partners better understand and respond to climate change through the SWAP revision process.

The *Regional Synthesis* was developed with seven primary objectives.

1) To provide a regional context for addressing the priorities identified in the 2015 SWAPs, reaching across multiple jurisdictions in response to regional needs. This includes management of waterways, invasive species control, and habitat connectivity among others.

2) To encourage collaborative, regional approaches that achieve significant economies of scale.

3) To highlight what defines the Northeast region in terms of its ecological uniqueness and the wildlife species it supports.

4) To organize and compile existing state-specific information into a single resource that enables multi-jurisdictional strategies and approaches.

5) To establish consistency based on standard terminology, taxonomies, habitat classifications, and categories for threats, stressors, and actions.

6) To foster improved communication across jurisdictions and among regionally focused agencies and programs.

7) To assist with the adoption of conservation measures, policies, and plans.

Congress has mandated that all SWAPs address the same eight elements: Species, Habitats, Threats, Actions, Monitoring, Review, Coordination, and Public Participation. The *Northeast Regional Synthesis* follows this organizational structure, with an emphasis on elements 1-6. The following is a chapter-by-chapter summary of the information this document contains.

Chapter 1: Species

Using lists developed by the states through the SWAP revision process, the NEFWDTC has identified 366 fish and wildlife species as being of greatest conservation need, region-wide (RSGCN). The compiled list of all Northeast SWAP SGCN included 87 mammals, 263 birds, 65 reptiles, 73 amphibians, 299 fish, 27 tiger beetles, and 101 freshwater mussel species and subspecies. These numbers represent a significant percentage of Northeast region species in all of these taxonomic groups. The large number of species included in these lists reflects the magnitude of the threats facing fish and wildlife species in the Northeast, as well as the commendable efforts of the individual Northeast states to ensure that their SWAPs were comprehensive in their coverage of species in major taxonomic groups.

Chapter 1 describes in detail the work of the NEFWDTC and includes information on representative RSGCN and case studies of RCN grant-funded projects focusing on individual species, groups or guilds of species (e.g., Marine Birds). It also considers broader issues such as identifying migratory landbird stopover sites in the Northeast and assessing priority amphibian and reptile conservation areas in light of climate change. Several key RCN grant-funded projects were developed and highlighted as examples of proactive conservation that was designed for states to preempt the need for federal listing of such species as the New England cottontail and the Blanding's and wood turtles.

Chapter 2: Habitat

This chapter describes the most important habitats for RSGCN, as identified by the SWAPs and through RCN grant-funded projects. It highlights the regional habitat classification systems and maps that were developed for the region. Case studies and project summaries provide information and direct links to the results of RCN-funded research. Not surprisingly, connectivity issues and fragmentation of habitat are an important focus. The history, current status, and projected changes in key habitats of the Northeast are also discussed, including forests, wetlands, lakes, ponds, rivers, and streams.

Building upon the habitat classification systems, RCN grant-funded projects such as the Regional Conservation Assessment and Geospatial Condition Analysis describe the status and condition of important Northeast habitats through the use of these standardized, region-wide mapping data and a GIS tool to evaluate the condition of habitats in terms of land secured for conservation, connectedness, the local context (degree of human conversion nearby), landscape "permeability" (allowing for the passage of animals), and predicted development.

This chapter also explores a range of topics and resources such as the integrity of ecological systems, terrestrial and aquatic habitat maps, Northeast habitat classification systems, and resilient sites for species conservation, among many others. RCN grant-funded research on shrub lands and young forests, tidal marshes, freshwater aquatic systems, coastal marine systems, and habitats and threats in North Atlantic watersheds and estuaries is also summarized.

Chapter 3: Threats

Major threats to SGCN and their habitats in the Northeast include development, invasive species, pollution, human intrusion and disturbance, modification of natural systems, and climate change. This chapter explores the relationship between these pressing threats and the needs and current status of various indicator species. It also addresses more specific threats such as habitat loss and degradation; threats to forests through loss and fragmentation; threats to wetlands, lakes, ponds, streams, and rivers; threats to unique habitats such as summits and cliffs; threats to selected SGCN species; and habitat vulnerability in the face of climate change. A detailed picture of the threats to terrestrial habitats has been developed through the Geospatial Condition Analysis mentioned above.

RCN grant-funded projects to better assess key threats include studies of regional focal areas for SGCN based on site adaptive capacity, network resilience, and connectivity; forecasting the effects of sea-level rise on piping plovers and responsive conservation strategies; threats to aquatic systems in the region; water management and use; wildlife diseases; new energy developments; and many others.

Chapter 4: Conservation Actions

An important focus of the *Northeast Regional Synthesis* is ***action***—actions to be taken by the states and their partners to support region-wide conservation and development of tools to guide strategic action steps at all levels. Chapter 4 begins with a ranking of key actions identified in the SWAPs, including land and water protection; addressing gaps in research and existing data; management of individual species; and public education.

Chapter 4 then identifies a range of conservation strategies and actions that have already been developed and implemented for priority species in the Northeast, with funding from the RCN Grant Program. Funding has been strategically targeted through successive years of the RCN Grant Program to accomplish the following objectives:

- ✓ Develop base maps for the Northeast
- ✓ Identify high priority RSGCN
- ✓ Design data collection protocols and collect data

- ✓ Perform GIS data analysis and mapping for RSGCN
- ✓ Design and implement conservation strategies for RSGCN
- ✓ Design and implement monitoring programs for RSGCN
- ✓ Identify and address emerging threats

Case studies presented cover a broad range, from development of climate change habitat and species vulnerability indices, to addressing fish passage and aquatic connectivity, invasive species, and wildlife diseases, to integrated monitoring to inform conservation and species management. Other RCN grant-funded projects summarized in this chapter include development of decision support tools for addressing threats in the Northeast; tools to design sustainable and permeable landscapes; tools to address aquatic habitats and threats in North Atlantic watersheds and estuaries; and the "conservation action guidance" in the Northeast lexicon.

Chapter 5: Monitoring

This chapter focuses on regional efforts to monitor the status and trends of RSGCN and their habitats and to evaluate the effectiveness of conservation actions. It highlights the Monitoring and Performance Reporting Framework developed to help states meet the expectations set by Congress and the U.S. Fish and Wildlife Service (USFWS) for SWAPs and State Wildlife Grants. It provides a list of general conservation targets and indicators at the regional scale.

Building on the success of this Framework, the State Wildlife Effectiveness Measures Project was developed and further combined with the USFWS Wildlife TRACS system to track and report project outputs and effectiveness measures along with the outcomes of projects focused on individual species and habitats. These tools, combined with the Northeast lexicon mentioned earlier and a SWAP database in development that consolidates information from all fourteen individual SWAPs, provide states with greatly enhanced capacity to monitor and evaluate the success of their wildlife conservation actions.

Chapter 6: Regional Coordination, Review, and Priorities

This final chapter offers practical suggestions for how to use the *Northeast Regional Synthesis*, highlighting important collaborative, region-wide projects supported through the RCN Grant Program. It also provides a set of recommendations for the future. These include:

- ✓ Developing a regional threats assessment
- ✓ Maintaining and enhancing the *Northeast Regional Synthesis* as a dynamic, web-based planning tool
- ✓ Continuing to develop a regional landscape conservation design approach and toolkit to support wildlife conservation decisions
- ✓ Collaborating with the Northeast Climate Change Working Group to compile and integrate regional climate change data; and developing a consistent guidance and context for SWAP revisions
- ✓ Working with the Northeast Conservation and Education Association to develop consistent guidance and context for SWAP revisions and implementation
- ✓ Charging the NEFWDTC to regularly review and evaluate its projects, products, and the RSGCN list.

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ABBREVIATIONS & ACRONYMS

AFWA – Association of Fish and Wildlife Agencies

BMP – Best Management Practice

BOEM – Bureau of Ocean Energy Management

CCVI – Climate Change Vulnerability Index

CMECS – Coastal and Marine Ecological Classification Standard

CMP – Conservation Measures Partnership

COA – Conservation Opportunity Area

DOE – Department of Energy

DOT – Department of Transportation

EBTJV – Eastern Brook Trout Joint Venture

ELOHA – Ecological Limits of Hydrologic Alteration

EPA – Environmental Protection Agency

GAP – Gap Analysis Program

GIS – Geographic Information System

HUC – Hydrologic Unit Code

IEI – Index of Ecological Integrity

IPCC – Intergovernmental Panel on Climate Change

ITIS – Integrated Taxonomic Information System

IUCN – International Union for the Conservation of Nature

LCAD – Landscape Change, Assessment and Design

LCC – Landscape Conservation Cooperative

LCI – Landscape Context Index

NAC – Northeast Aquatic Connectivity

NALCC – North Atlantic Landscape Conservation Cooperative

NASA – National Aeronautics and Space Administration

NEAFWA – Northeast Association of Fish and Wildlife Agencies

NEAHCS – Northeast Aquatic Habitat Classification System

NEC – New England cottontail

NEFWDTC – Northeast Fish and Wildlife Diversity Technical Committee

NEPARC – Northeast Partners for Amphibian and Reptile Conservation

NETWHCS – Northeast Terrestrial Wildlife Habitat Classification System

NEXRAD – Next-Generation Radar

NFWF – National Fish and Wildlife Foundation

NHD – National Hydrography Dataset

NLCD – National Land Cover Dataset

NOAA – National Oceanographic and Atmospheric Administration

NRCS – National Resource Conservation Service

NWF – National Wildlife Federation

NWI – National Wetlands Inventory

PARCA – Priority Amphibian and Reptile Conservation Areas

PIF – Partners in Flight

RCN – Regional Conservation Needs

RSGCN – Regional Species of Greatest Conservation Need

SCI – Staying Connected Initiative

SGCN – Species of Greatest Conservation Need

SWAP – State Wildlife Action Plan

SWG – State Wildlife Grants

TNC – The Nature Conservancy

TRACS – Tracking and Reporting Actions for the Conservation of Species

USDA – U.S. Department of Agriculture

USFWS – U.S. Fish and Wildlife Service

USGS – U.S. Geological Survey

WMI – Wildlife Management Institute

WNS – white-nose syndrome

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INTRODUCTION

FISH AND WILDLIFE DIVERSITY CONSERVATION IN THE NORTHEAST STATES

The Northeast region of the United States encompasses approximately 263,000 square miles and a wide diversity of jurisdictions, including 13 states and the District of Columbia, 17 federally recognized Native tribes, and 398 counties. This region is home to a remarkable diversity of fish and wildlife, from whales and saltwater fishes to alpine butterflies and moths; from vernal pool salamanders to cave beetles; from anadromous shad, catadromous eels and cold water trout to an extraordinary array of forest, shrub and grassland birds.

The Northeast region is geographically and ecologically diverse, with 143 terrestrial and 259 aquatic ecological communities (Anderson and Olivero Sheldon 2011). These communities include a broad spectrum of coastal, inland and freshwater aquatic ecosystems ranging in elevation from ocean beaches and low-lying coastal plains to mountains reaching 6,000 feet above sea level in the Appalachians. Given the region's size, its north-south orientation, and its varied topography, the Northeast supports a high diversity of major plant community types and ecological habitats. These range from treeless arctic-alpine tundra at the highest elevations to boreal conifer forests, to various deciduous forest types at lower elevations, to freshwater wetlands, and to coastal habitats including intertidal beaches and marshes.

To conserve this rich biological heritage, conservation agencies in the Northeast have established a broad range of partnerships for fish, wildlife and habitat conservation, including Partners in Flight (PIF) for bird conservation; the Northeast Partners for Amphibian and Reptile Conservation (NEPARC); the Joint Ventures and Atlantic Coast Fish Habitat Partnership for migratory bird and fish conservation; and most recently, the Department of the Interior's Landscape Conservation Cooperatives (LCCs). A driving force behind these and other wildlife conservation initiatives has been an assortment of regional coordinating bodies such as the Northeast Association of Fish and Wildlife Agencies (NEAFWA) and its Fish and Wildlife Diversity Technical Committee (Fish and Wildlife Diversity Committee), which operate on a separate and broader level than the individual partnerships. Wildlife management agencies from the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia, as well as the District of Columbia,

participate in the NEAFWA. The NEAFWA (one of four regional affiliates of the Association of Fish and Wildlife Agencies) is tasked with promoting and coordinating conservation activities across the Northeast United States. The NEFWDTC has led wildlife diversity conservation projects for the NEAFWA and comprises the Wildlife Diversity representative from each Northeast state and District of Columbia.

Humans are also an important part of the Northeast landscape, where 72.4 million people (23.5% of the nation's population) live on less than 7% of the nation's land base. Much of the developed human footprint is focused along the eastern coastline between Boston and Washington, DC, but suburban and exurban areas are also expanding rapidly throughout much of the region. According to the most recent assessment by The Nature Conservancy (Anderson and Olivero Sheldon 2011), 28% of the land base in the Northeast states has already been modified significantly by humans.

Although some parts of the Northeast are heavily urbanized, the region also includes many rural lands and wild areas, especially along the Appalachian Mountains and other mountain chains. Remarkably, some portions of the Northeast remain relatively wild, with 73 federally designated wilderness areas, 70 National Wildlife Refuges, and six National Forests. In fact, 16% of the land area in the Northeast states—more than 24 million acres—has already been placed in some form of protective conservation ownership (Anderson and Olivero Sheldon 2011)

As human impacts on the region's landscape continue to grow, the scale, pace, and complexity of threats to biodiversity in the Northeast states increase at an alarming rate. Climate change imposes tremendous challenges for wildlife conservation and exacerbates all threats including residential and commercial development, invasive species, and wildlife diseases. To address these issues comprehensively, the Northeast states have joined together in several innovative, collaborative partnerships through the NEAFWA and its Fish and Wildlife Diversity Committee. These partnerships and their outcomes are summarized in Chapters 4 and 6 of this document. This unprecedented collaboration of state, federal, and private organizations provides for more efficient use of limited conservation dollars and draws on the best available science and expertise to identify the highest priority species and habitats in need of conservation.

PURPOSE AND NEED FOR THIS DOCUMENT

This document is intended to inform State Wildlife Action Plan revisions as well as conservation planning at many scales in the Northeast. It is available for use by local, state, regional, and national conservation entities. It represents a milestone in the long-term relationship between the Fish and Wildlife Diversity Technical Committee and its partners that continues to produce a strategic and focused series of tools, plans and alliances. Through the Regional Conservation Needs (RCN) grants program, more than 30 separate reports, resource documents, and other tools are now available to help guide regional conservation. More recently, the LCCs have built upon the work of the RCN Grant Program to develop additional landscape conservation information and tools, with almost 20 new projects guided by the Northeast regional conservation framework developed collaboratively with the states. These projects address the landscape-scale wildlife conservation needs of the Northeast, as prioritized by the states in coordination with partners.

As states revise their Wildlife Action Plans for approval, there is a need to synthesize this regional information in a way that is most useful and applicable to their own needs, as well as to the needs of partners in their planning processes. The intent of this document is to provide the regional context, synthesized information, and priorities to support states in their Wildlife Action Plan development and implementation. It is also to raise the awareness and use of these shared regional priorities. This document can be used in its entirety by states to address the regional context (as an appendix or by reference). Individual sections can also be used to address each of the required elements for Wildlife Action Plans. The six primary objectives of the document are described below.

Provide regional context – This document has been designed to help provide a regional setting for many of the conservation priorities identified in Northeast states' individual Wildlife Action Plans. Many conservation issues are broader than any one state or jurisdiction. For example, restoring the New England cottontail requires collaboration among many states to achieve a stable population. Likewise, coordinated conservation activities such as river management, invasive species control, and habitat connectivity are often most effective when implemented across multiple state jurisdictions. This document will help each of the state fish and wildlife agencies identify opportunities for collaborative action across a regional landscape; take advantage of economies of scale; and ensure that vulnerable species are not overlooked. The document also provides basic background information about the region as a whole—its special habitats, species, and human impacts. This regional

perspective is essential for understanding the dynamics of fish and wildlife conservation as practiced in the Northeast states.

Address regional conservation priorities – The information contained in this document will help state fish and wildlife agencies and their partners address the most pressing conservation issues through a collaborative, regional approach involving the states, LCCs, and partners identified in Regional Conservation Planning Workshops (see below). The thematic categories identified at these planning workshops (Habitat Mapping, Biological Assessment and Goal-Setting, Conservation Design to Action, Monitoring and Research, and Information Management) roughly correspond to the Wildlife Action Plan conservation elements and to the Northeast Planning Framework that have been used to structure this document. Accordingly, this Regional Synthesis serves as a compendium of information for states and their public and private partners. It helps these (and other) stakeholders to address the regional conservation needs identified at those Regional Conservation Planning Workshops. It also emphasizes the importance of coordinating conservation activities and provides economies of scale for regional planning.

Highlight what is important and defining about the Northeast region – This document brings attention to the special ecological features of the Northeast states, including the region's numerous endemic species and globally rare communities, its biodiversity hotspots (such as calcareous communities and salt marsh habitats), and its diversity of species associated with early successional habitats that are now of conservation concern. It also places information about threats, stressors, and conservation activities into a regional context, and provides further support for continued collaborative conservation across state lines.

Organize existing information – One of the most valuable aspects of this document is its organization and presentation of existing regional information about species, habitats, threats and stressors, conservation actions, and monitoring and evaluation programs of either regional interest or regional concern. Although a wealth of information about these topics is contained in most states' Wildlife Action Plans, this document brings together and organizes the state-specific information at a regional scale, thus making it easier for groups of states to develop multi-jurisdictional conservation strategies and approaches.

Facilitate consistency – This document summarizes and incorporates the Northeast regional lexicon, using standard terminology for each of the eight required elements. It follows standard taxonomies for species recommended by the national Best Practices (AFWA 2012) and developed by the Integrated Taxonomic Information System (ITIS) and NatureServe. It also applies standard habitat classifications (Gawler 2008, Olivero and Anderson 2008) as well as standard taxonomies for threats, stressors, and conservation actions developed by the International Union for the Conservation of Nature (IUCN) and the Conservation Measures Partnership. These are further described in Salafsky et al. (2008). By using standard definitions and classifications, the ability of Northeast states to communicate and collaborate effectively across jurisdictional boundaries is greatly enhanced.

Assist with conservation adoption – By clearly identifying a set of shared conservation priorities relevant to the entire Northeast region, this document supports the efforts of individual states and their partners to adopt and incorporate regional conservation priorities into future iterations of their Wildlife Action Plans. It also helps to facilitate the development of regional and state-level partnerships. Identifying shared regional conservation priorities may also make it easier to obtain buy-in and support for the Wildlife Action Plans, both from the private sector and from public entities, including non-governmental organizations as well as municipal and federal agencies. These regional priorities will also provide states with the support they need to commit limited resources to conserve species and habitats that may not be the highest priority in their state, but which have a high importance to regional conservation.

BACKGROUND

State fish and wildlife agencies in the Northeast United States have been working collaboratively on wildlife conservation priorities for more than half a century. By the 1980s, state wildlife diversity managers coordinated to develop a regional list of priority species—now called the Regional Species of Greatest Conservation Need (RSGCN)—and to identify regional conservation needs. The information included in this document comes primarily from a suite of regional projects initiated by this group and from their efforts through the Fish and Wildlife Diversity Technical Committee. These projects have been designed through a coordinated regional prioritization process to address important conservation needs and, more recently, to help with implementation revision of Wildlife Action Plans for the Northeast states.

Originally drafted at the request of Congress to enable eligibility for funding through the State Wildlife Grants Program, the first Wildlife Action Plans were successfully completed by wildlife management agencies in each of the 56 U.S. states and territories in 2005. Together, the 14 Northeast plans represent a highly detailed blueprint for wildlife conservation across the Northeast United States. Each plan identifies a set of species of greatest conservation need, priority wildlife habitats for conservation, threats and stressors, recommended conservation actions, partnership and outreach opportunities, and methods for monitoring and evaluation. Although each of the plans is based on a common set of elements, the individual state wildlife agencies were given considerable latitude by Congress and the U.S. Fish and Wildlife Service to customize their plans to fit their particular conservation needs. While the ability to develop unique, customized plans provides some benefits to the states, one obvious drawback is the inherent difficulty of comparing across states. At the same time, such an analysis can help to identify major conservation issues that extend beyond state lines to larger landscape or regional scales.

Recognizing this need, NEAFWA held the first in a series of meetings in Albany, NY in 2006. The purpose was to coordinate implementation of the plans on a regional level. As a result of that meeting, the Northeast states, working with the U.S. Fish and Wildlife Service (USFWS) and Wildlife Management Institute (WMI), began pooling a portion (4%) of their State Wildlife Grant funds program allocation to develop a grant program that that would regional conservation needs. Since then, the RCN grant program has since funded development of dozens of key regional tools including regional habitat classification and models (Gawler 2008, Olivero and Anderson 2008). It has helped build collaborative regional monitoring programs (NEAFWA 2008); assessed the impacts of climate change on a regional level (Anderson 2011; Galbraith 2013); and contributed significant funding every year towards regional conservation needs. This regional culture of cooperation has also enabled states to pool and leverage their individual resources for wildlife conservation to address issues of common interest to the entire region.

FIRST STEPS: IDENTIFYING PRIORITY SPECIES FOR REGIONAL CONSERVATION

As states developed nongame and endangered species programs in the 1980s, they focused conservation efforts primarily on federal and state endangered or threatened wildlife. Although distribution and abundance data for taxonomic groups other than birds was limited, the NEFWDTC applied this approach, along with additional priority-setting methods, to nongame wildlife taxa in the Northeast region. Development of coordinated regional species lists began in the 1980s (French and Pence 2000) and led to the first region-wide list of species in need of conservation published by the Committee and in subsequent

species accounts (Terwilliger 2001). Hunt (2005) adapted the methodology to rank fish and wildlife species as Species of Greatest Conservation Need (SGCN) in the New Hampshire Wildlife Action Plan. This methodology was applied region-wide by the NEPARC to identify high-priority members of the northeast herpetofauna.

This priority-setting process continues to evolve. The RSGCN list is built upon the concept of review and re-evaluation by the NEFWDTC in order to maintain a current catalog of species that are of regional conservation interest. The most recent effort began in 2011, when the regional taxonomic expert teams updated the RSGCN list, and those results have been incorporated into this document along with additional data compiled by NALCC for regional species prioritization.

REGIONAL PLANNING AND PRIORITIZATION ADVANCED BY CROSS-BORDER COLLABORATION

The regional collaboration and conservation partnerships described in this document stem from a regional planning process initiated by the NEFWDTC. That process included the workshops described below and led to regional priority setting and to the RCN Grant Program designed to fund these priority needs. Informed by these regional priorities for species and habitat conservation, states may work together or individually on priority actions.

2006 REGIONAL CONSERVATION PLANNING WORKSHOP (ALBANY I)

In 2006, after the first round of State Wildlife Action Plans had been completed, a workshop was held to work towards identifying regional conservation priorities. NEAFWA's Fish and Wildlife Diversity Technical Committee, with funding from the National Fish and Wildlife Foundation and Doris Duke Charitable Foundation, held a meeting in Albany, New York. Forty-five people attended the meeting, representing the NEAFWA, the Association of Fish and Wildlife Agencies (AFWA), the USFWS, and all but one state in the region.

The meeting focused on identifying specific actions to further fish and wildlife conservation in the region. These actions reflected the conservation priorities identified in the Wildlife Action Plans. The process began with a list of 41 priority conservation actions developed by the NEFWDTC (then called the Northeast Endangered Species and Wildlife Diversity Committee), and an additional 31 priority actions

were identified by states at the meeting. From this list of 72 priority actions, six regional priority needs were identified (see Figure 0.1):

1. Select regional land cover, stream, and habitat classification systems, create a regional geographic information system (GIS) platform, and then identify quality and critically imperiled habitat types and locations.

2. Identify the top 20 invasive species and related issues that negatively impact SGCN and develop implementation actions and monitoring protocols to gauge effectiveness of management actions.

3. Identify a network of Northeast conservation focus areas to support sustainable populations of SGCN.

4. Develop regional in-stream flow standards, guidelines, and policies that support effective management of the water quantity and temperature, mimic natural conditions, and protect aquatic life from thermal stress and other flow-related threats.

5. Develop guidelines for training local planning boards on how to incorporate Species of Greatest Conservation Need and their key habitats into local planning.

6. Develop regional indicators and measures (of SGCN, habitats, strategies, and Wildlife Action Plan effectiveness) to ensure successful conservation.

NORTHEAST RCN GRANT PROGRAM

One of the most important outcomes of the first Albany workshop was the creation of the RCN grant program to address the conservation priorities that had been identified (Figure 0.1). Since 2007, the NEAFWA members (thirteen states and the District of Columbia) have contributed 4% of their annual federal State Wildlife Grants (SWG) Program funding to support projects of regional conservation interest. This funding is offered through an annual request for proposals administered by the NEAFWA in collaboration with the WMI and USFWS. The funds are used to address conservation priorities that are shared across multiple jurisdictions.

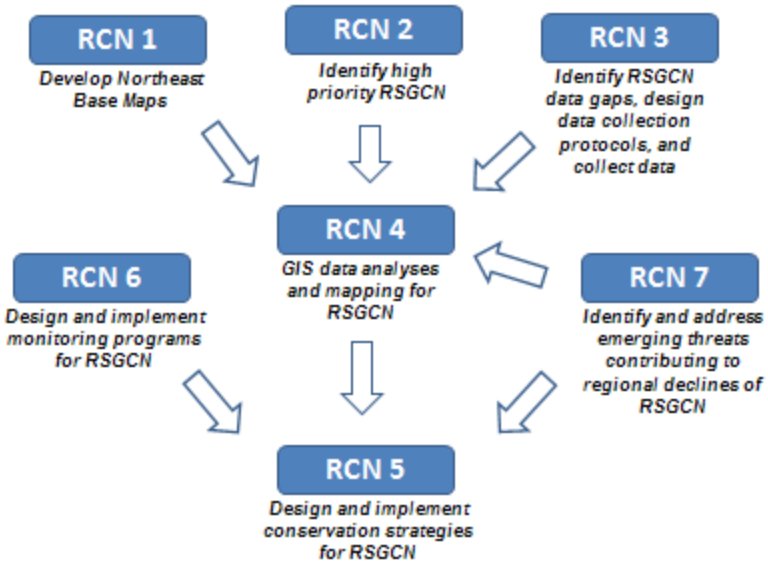


Figure 0.1. Schematic of the Regional Priority Framework for Ordering Priority Activities from Albany I Workshop. Source: NEAFWA.

Funding priorities for the Northeast RCN Grant Program continue to evolve. Many of the initial priorities have been funded and are reported in this document. The program itself practices adaptive management, refining priorities and selecting topics for funding so as to respond to urgent emerging wildlife needs, while at the same time continuing to address longstanding regional conservation concerns and keeping common species common. Details about the specific funding priorities addressed during each RCN grant cycle are available at the RCN website, http://www.rcngrants.org.

Over the first 5 years, the RCN program awarded than $1.8 million to address regional fish and wildlife management challenges and high-priority conservation initiatives. Partners matched these awards for total conservation funding of $3.6 million between 2007 and 2011. Many of the funded projects have produced results that were used as the foundation for successful grant proposals to implement recommendations or further study the species, habitat, or threat. (Figure 0.2)

Figure 0.2. 2007-2011 RCN Funded projects by topic area.

In the years ahead, this grant program will continue to support innovative conservation approaches that address conservation priorities across the Northeast states. The RCN Grant Program thus represents a significant regional conservation collaboration success story and serves as a model for the nation (Meretsky et al. 2012), one that is expected to continue as long as financial support continues to be

provided by the Northeast states. Funding is also available for regional collaboration through the competitive portion of the SWG Program administered by the USFWS.

2011 REGIONAL CONSERVATION PLANNING WORKSHOP (ALBANY II)

The second Northeast Regional Conservation Planning Workshop was held in Albany, New York in 2011. Thirteen state agencies, six federal agencies and 12 non-profit organizations and universities were represented. The workshop was convened and sponsored jointly by the NEAFWA and the North Atlantic Landscape Conservation Cooperative (NALCC) of the USFWS.

Having already set regional priorities at the first meeting, participants at the second meeting recognized the need for an effective approach to implement and address these priorities. Therefore the second meeting focused on the development of a regional conservation framework to guide the regional effort as it moved forward. The foundation of this framework was the NEAFWA RCN priority topic areas (listed above and described in Figure 0.1) and the components of the USFWS's Strategic Habitat Conservation approach (http://www.fws.gov/strategic-conservation/). The proposed framework included the following components: Priorities; Biological Assessment; Goal-Setting; Conservation Design; Science Translation Tools; Conservation Adoption; Conservation Delivery; Monitoring, Evaluation and Research; and Information Management (see Chapter 4 and Figure 0.2).

As in the 2006 workshop, priority needs were identified and ranked within the framework components under each element. Overall priorities reflected in these needs included an immediate focus on communications, dissemination, and adoption; the importance of developing an effective information management system; and an emphasis on expediting delivery of the right actions in the right places. (http://rcngrants.org/content/summary-report-northeast-regional-conservation-framework-workshop-2011-0). Subsequent products have reflected these priorities, including the development of the present document.

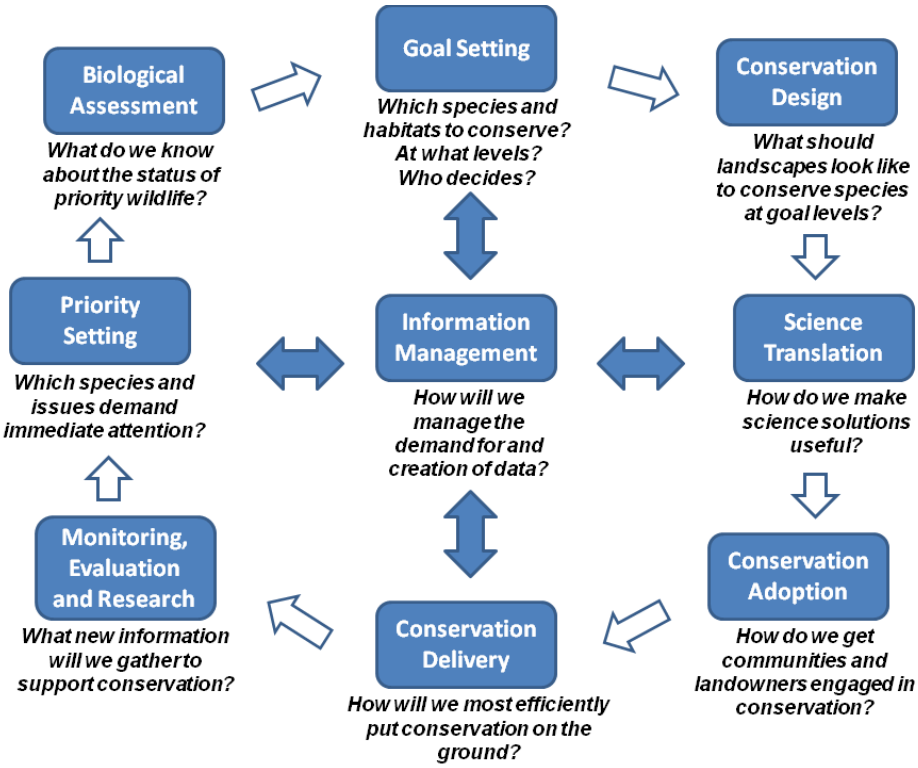


Figure 0.3. Northeast Conservation Framework, developed by the NALCC and the Northeast Association of Fish and Wildlife Agencies. Source: NALCC.

This common framework, developed by the NALCC and the NEAFWA, is very similar to the Strategic Habitat Conservation approach developed by the USFWS and the U.S. Geological Survey (USGS), but it places greater emphasis on the design, translation, and adoption of the science and tools, as well as on information management. Existing science, data, and translational tools can be organized so that managers can discriminate between what is available and what is still needed. The partners in the framework also developed a regional conservation lexicon providing a common terminology for discussing conservation projects and conservation priorities across the Northeast states.

LANDSCAPE CONSERVATION COOPERATIVES

A new forum for regional and cross-jurisdictional conservation science partnerships was created in 2011 through a national network of 22 Landscape Conservation Cooperatives (LCCs). Established by the U.S. Department of the Interior, LCCs are based on successful models of wildlife and habitat conservation

pioneered by the USFWS. Each LCC provides opportunities for states, tribes, federal agencies, non-governmental organizations, universities, and other groups to address increasing land use pressures and widespread resource threats and uncertainties amplified by a rapidly changing climate. LCC members agree on common goals for land, water, fish, wildlife, plant, and cultural resources and jointly develop the scientific information and tools needed to prioritize and guide more effective conservation actions by partners toward those goals.

The four LCCs that work with the Northeast states (see Figure 0.3) are:

- Appalachian LCC, which includes portions of Connecticut, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Virginia, and West Virginia;
- South Atlantic LCC, which includes southern and southeastern Virginia;
- Upper Midwest and Great Lakes LCC, which includes portions of New York and Pennsylvania;
- North Atlantic LCC, which includes the entire states of Connecticut, Delaware, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, and the District of Columbia, as well as the remaining portions of Maryland, Pennsylvania, New Jersey, New York, and Virginia.

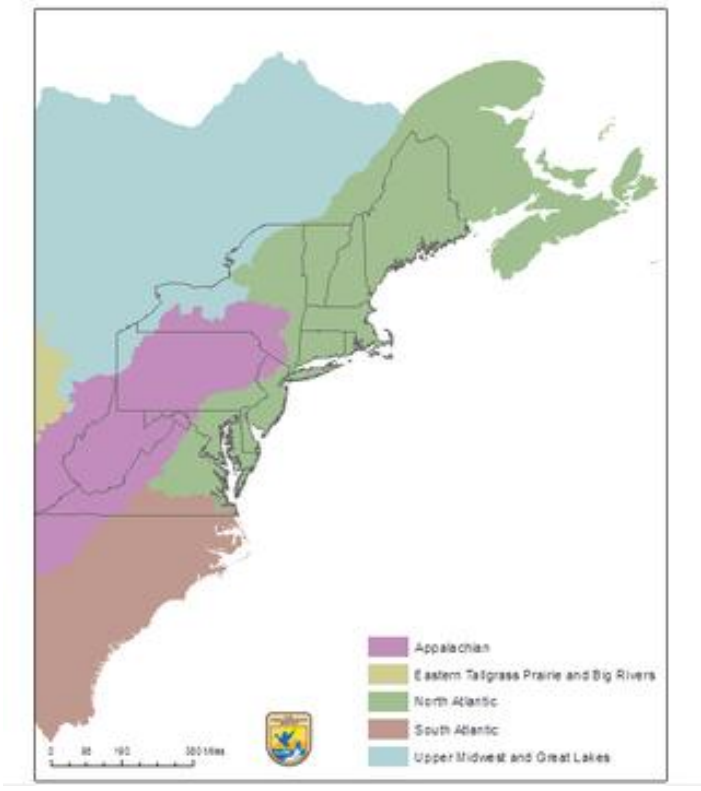


Figure 0.4. Landscape Conservation Cooperative boundaries in the Northeast United States.

Northeast region LCCs recognized the importance of complementing existing partnerships and the value of collaborating closely with the NEAFWA. The NALCC in particular has aligned its activities closely with NEAFWA, including co-location of meetings, synchronization of annual timelines for the LCC and the RCN grants process, consolidated grants administration through the WMI, joint development of projects at a Northeast region scale, and joint efforts to develop regional information for State Wildlife Action Plan updates.

ORGANIZATION OF THIS DOCUMENT

The structure of this document closely follows the order and structure of the individual State Wildlife Action Plans. As mandated by Congress, each State Wildlife Action Plan must address the same eight elements. In the current document, these elements are addressed at the regional scale, as follows:

Chapter 1 addresses Element 1 (Species) by summarizing the regional distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agencies deem appropriate. The focus is on species that are indicative of the diversity and health of the Northeast states and regional wildlife. RSGCN are highlighted in this chapter.

Chapter 2 addresses Element 2 (Habitats) by summarizing the regional extent and condition of habitats and community types essential to conservation of Northeast RSGCN. This chapter highlights the regional terrestrial and aquatic habitat classification systems, maps, guides, and assessments now available for use in the Wildlife Action Plan revisions.

Chapter 3 addresses Element 3 (Threats) by summarizing the problems identified in RCN, LCC and competitive SWG project reports that may adversely affect RSGCN or their habitats. It also describes the priority research and survey efforts needed to support restoration and improved conservation of these species and habitats.

Chapter 4 addresses Element 4 (Actions) by summarizing conservation actions and tools proposed in RCN, LCC and competitive SWG project reports. The focus is on conservation of RSGCN and their habitats and on priorities for implementing such actions.

Chapter 5 addresses Element 5 (Monitoring) by summarizing the Northeast Monitoring and Performance Reporting Framework (NEAFWA 2008), monitoring protocols, and plans that were identified in RCN and competitive SWG project reports. Again, the focus is on monitoring RSGCN and their habitats, on monitoring the effectiveness of the conservation actions summarized in Chapter 4, and on adapting these conservation actions to respond appropriately to new information or changing conditions.

Chapter 6 addresses Elements 6-8 - by summarizing regional coordination and processes to review the plan at intervals not to exceed ten years (**Element 6**). It summarizes plans for coordinating the development, implementation, review, and revision of Wildlife Action Plans with federal, state, and local agencies and Native American Tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats (**Element 7).** It also addresses public participation in the development and implementation of these plans **(Element 8).**

Required Elements for State Wildlife Action Plans

Element 1: "… information on the distribution and abundance of species of wildlife, including low population and declining species as the state fish and wildlife department deems appropriate, that are indicative of the diversity and health of wildlife of the state;"

Element 2. "identifies the extent and condition of wildlife habitats and community types essential to conservation of species identified under *Element 1;*"

Element 3. "identifies the problems which may adversely affect the species identified under *Element 1* or their habitats, and provides for priority research and surveys to identify factors which may assist in restoration and more effective conservation of such species and their habitats;"

Element 4. "determines those actions which should be taken to conserve the species identified under *Element 1* and their habitats and establishes priorities for implementing such conservation actions;"

Element 5. "provides for periodic monitoring of species identified under *Element 1* and their habitats and the effectiveness of the conservation actions determined under *Element 4*, and for adapting conservation actions as appropriate to respond to new information or changing conditions;"

Element 6. "provides for the review the state wildlife conservation strategy and, if appropriate revision at intervals not to exceed ten years;"

Element 7. "provides for coordination to the extent feasible the state fish and wildlife department, during development, implementation, review, and revision of the wildlife conservation strategy, with federal, state, and local agencies and Indian tribes that manage significant areas of land or water within the state, or administer programs that significantly affect the conservation of species identified under *Element 1* or their habitats."

Element 8. "A State shall provide an opportunity for public participation in the development of the comprehensive plan required under *Element 1*."

INTENDED AUDIENCE/USE

This document is a product of the RCN Grant Program (RCN 2011-07) and is intended to serve as a resource for fish and wildlife agency staff and their conservation partners during their comprehensive review and revision of Wildlife Action Plans. It is also a resource for other conservation agencies and organizations in the Northeast and for other conservation planning processes in each of the Northeast states. The document provides a regional conservation context in which each of the Northeast states participates and should therefore be incorporated into local, state, and regional planning efforts.

States are encouraged to use part or all of the text of this document in their Wildlife Action Plan revisions to address the regional context of state-specific concerns. State wildlife agencies and their partners are welcome to copy or reproduce any of the material contained in this document and to incorporate entire sections or chapters from this document into the corresponding chapter of their Wildlife Action Plan as needed. They are also welcome to use the entire document as a chapter or section providing regional context for their Action Plan; or to include it as an appendix or reference (NEFWDTC 2013).

FURTHER INFORMATION

Contact the NEFWDTC: Jenny Dickson, Chair, Jenny.Dickson@ct.gov; Dan Rosenblatt, Vice Chair, dlrosenb@gw.dec.state.ny.us

Northeast Regional Conservation Needs Grants Program: http://rcngrants.org

Wildlife Action Plans: www.teaming.com

Association of Fish and Wildlife Agencies:

SWAP [State Wildlife Action Plan] Best Practices report: http://teaming.com/sites/default/files/SWAP%20Best%20Practices%20Report%20Nov%202012.pdf

SWAP Revision Resources from TWW: http://teaming.com/swap-revision-guidance-best-practices

State Wildlife Action Plan Revisions Guidance:

http://www.wildlifeactionplan.org/sites/default/files/Revision%20Guidance%20Letter%20NAAT.pdf

Eight Required Elements and Sub-Element Guidance in Wildlife Action Plans:

http://www.wildlifeactionplan.org/sites/default/files/NAAT%20Sub-elements.pdf

Official 2007 SWAP Revision Guidance from USFWS:
http://www.teaming.com/sites/default/files/Revision%20Guidance%20Letter%20NAAT.pdf

Northeast Association of Fish and Wildlife Agencies (NEAFWA): http://www.neafwa.org/

Albany I Workshop: http://www.northatlanticlcc.org/resources/pdfs/8_Albany_I_Summary_and_Projects_List.pdf

Albany II Workshop: http://rcngrants.org/content/summary-report-Northeast-regional-conservation-framework-workshop-2011-0

Landscape Conservation Cooperatives: http://www.fws.gov/landscape-conservation/lcc.html

- Appalachian: http://www.applcc.org/
- North Atlantic: http://www.northatlanticlcc.org/
- South Atlantic: http://www.southatlanticlcc.org/
- Upper Midwest and Great Lakes: http://www.greatlakeslcc.org/

CHAPTER 1—REGIONAL SPECIES OF GREATEST CONSERVATION NEED

This chapter provides information about the 367 fish and wildlife species identified as Regional Species of Greatest Conservation Need (RSGCN) in the Northeast by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). It also highlights priority species for which dedicated conservation activities have been supported through the Regional Conservation Needs Grant and partner programs. In addition, it summarizes the most current efforts for these species, addressing their status and distribution. Examples of ongoing regional models and maps of species distributions illustrate the types of information and data products available to states at http://www.fws.gov/northeast/science/nalcc.html. Case studies illustrate how the Regional Conservation Planning Framework is applied to high-priority RSGCN species. Examples of management actions adopted in multiple Northeast states to ensure the conservation of these targeted RSGCN species are also summarized. Please see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC (2013) for additional information and links to each Regional Conservation Needs (RCN) project mentioned in this chapter.

BACKGROUND

The approach for identifying RSGCN has evolved through several complementary efforts focused on the conservation of specific taxonomic groups to the more comprehensive analysis reported here.

As states developed nongame and endangered species programs in the 1980s (French and Pence 2000), they focused conservation efforts primarily on federally and state endangered or threatened wildlife. State biologists and species experts often evaluated species populations within their political boundaries, which sometimes resulted in listing of species occurring at the edges of their geographic ranges (e.g., Henslow's sparrows and upland sandpipers). At the same time, biologists increasingly recognized the need to evaluate species with populations that were endemic to the region (e.g., New England cottontail and Bicknell's thrush) or that had high percentages of their populations in the region (e.g., golden-winged warbler and wood thrush). Regional and national conservation efforts for bird species began in the late 1980s and led to the formation of Partners in Flight (PIF) in 1990. PIF is a partnership that developed priority-setting methods for bird species. Rosenberg and Wells (1999) developed and applied a methodology to rank bird conservation priorities for the Northeast by combining distribution and abundance data from state breeding bird atlases and the North American Breeding Bird Survey. The

resulting range-wide assessments defined "responsibility" as that portion of a species' range that falls within the geographic area in question—usually a state boundary.

Additional priority-setting methods were summarized for non-game species throughout the Northeast region (Therres 1999), resulting in the first region-wide list of species in need of conservation. This list consolidated information from NEFWDTC members from all Northeast region states and identified 106 nongame species, including 15 mammals, 23 birds, 15 reptiles, 12 amphibians, 30 fish, and 11 freshwater mussels in need of regional conservation. Hunt (2005) applied this methodology to develop conservation priorities for the 127 SGCN in the New Hampshire Wildlife Action Plan (New Hampshire Fish and Game 2006), including insects and freshwater mussels. A similar ranking methodology was applied by the NEPARC to identify high-priority Northeastern herpetofauna. This NEPARC priority-setting process has been applied across taxa by the NEFWDTC to develop the Northeast RSGCN list.

The most recent RSGCN review and re-evaluation was conducted by the NEFWDTC regional taxa teams in 2011-2013 with assistance from the North Atlantic Landscape Conservation Cooperative (NALCC), and is provided here along with ongoing additional species prioritization efforts by NALCC. The most recent effort highlights collaboration between the NEFWDTC and the NALCC to improve and implement a screening of Northeast wildlife for conservation need and responsibility, and to better understand and quantify species risk in the region. NALCC, NEFWDTC, and state staff set out to assemble the best available data from diverse sources for each of the 355 species and subspecies. The result of this ongoing effort will be a thorough evaluation of data quality for each, including maps of probable distribution and known occurrence.

In parallel, NALCC has assembled landscape and environmental data for the Northeast region, providing state-by-state perspective on urbanization, natural resources, connectivity, climate, and many other factors. When combined with maps of species distributions, this information will allow conservation partners to understand the relative condition of important locations for each species. Ultimately, having access to all the best available data will allow states and their partners to identify the best opportunities to conserve land for wildlife.

SELECTION CRITERIA AND METHODS

All major taxonomic groups were considered for the RSGCN screening process described below: birds, mammals, marine mammals, freshwater and marine fish, amphibians, reptiles, and invertebrates. Due to insufficient information, many groups of invertebrates were not included. Instead, with the exception of tiger beetles and freshwater mussels, only the federally listed or candidate species are included until a more thorough review can be completed for these important taxa. Several invertebrate taxa (odonates and mussels) are the subject of current RCN project status reviews by experts in the region, and these efforts will result in updated invertebrate lists.

The RSGCN screening criteria were applied to all 14 jurisdictions in the Northeast, with the intention that: 1) the list is available for voluntary adoption by states in their planning processes including Wildlife Action Plan revisions; and 2) the process and results satisfy certain Wildlife Action Plan requirements under Element 1. Additional factors were also considered in updating the process and list. Emerging threats (such as disease), changes in taxonomy, and other important updates are incorporated into the process as well.

Species on the RSGCN list are categorized according to *conservational need* (the percentage of Northeast states that list the species as SGCN in their 2005 SWAP) and *regional responsibility* (the percentage of the species' North American range that occurs in the Northeast) (see Figure 1.1). This methodology was adapted from distribution and risk-based prioritizations used for birds (Carter et al. 2000, Wells et al. 2010), reptiles and amphibians (NEPARC 2010), and in the creation of state agency endangered species lists (Hunt 1997, Joseph et. al. 2008, Wells et. al. 2010). Additional analyses were applied by the NALCC to a composite list of 2,398 species published in Northeast SWAPs (Whitlock 2006), and applications will continue to be developed through collaboration with the Northeast states and NEFWDTC.

The process for selecting RSGCN species can be summarized in these steps:

1. State SGCN are compiled into one Composite SGCN List (Whitlock 2006) (2398 species). For this report, the 2005 State Wildlife Action Plans provided state SGCN. In the future, each Northeast state will identify a list of SGCN based on State Level Screening Criteria, using the Northeast Lexicon as guidance for additional consistency across the region (Crisfield and NEFWDTC 2013). The Composite SGCN List will be generated from these individual state lists.

2. The Composite SGCN list is screened for Regional Responsibility. (Regional Responsibility for each species = the number of Northeastern states in which the species is known to occur divided by the number of North American states in which the species is known to occur.)
3. The Composite SGCN list is screened for Regional Conservation Need. (Regional Conservation Need for each species = the number of Northeastern states listing the species as SGCN in 2005 divided by the number of Northeastern states in which the species is known to occur.)
4. Need is based on regional Conservation Need-Ranking Criteria (see Figure 1.1).
5. The RSGCN Ranking Criteria are defined and updated in the Lexicon project and/or spatial analysis.
6. The RSGCN List is defined by the RSGCN Selection Threshold Criteria (see Figure 1.1).

In total, 355 species or subspecies have more than 50% of their North American range in the Northeast region or are identified by more than half of Northeast states as being species of greatest conservation need in 2005 State Wildlife Action Plans (shown in red in Figure 1.1). . (Species scoring below 50% for both factors were excluded (shown in gray in Figure 1.1).

Conservation Need (N^*)= $\frac{\text{N States in need}}{\text{States in NE range}}$	Regional Responsibility (R^*)	
	High	Low
	>50% of Range	<50% of Range
Very High (≥75%)	1	2
High (≥50%)	3	4
Moderate (≥25%)	5	
Low (<25%)	7	
<3 states in NE	9	

Figure 1.1. RSGCN Inclusion Criteria Categorization. N = the number of states listing the species in 2005 State Wildlife Action Plans and R= the percentage of a species' North American range that occurs in the Northeast.

RSGCN LISTS

NatureServe tracks fish and wildlife diversity of the Northeast, including 1,260 species of the seven major taxonomic groups highlighted in this document (mammals, birds, reptiles, amphibians, fish, tiger beetles, and freshwater mussels). Only species that regularly occur in the region are included, and many invertebrate taxa are under review and therefore omitted from this analysis. Of the 1,260 species in these

taxa groups, almost 30% (366 species) have been identified by the NEFWDTC as RSGCN based on these species' conservation status and listing in State Wildlife Action Plans, as well as the percentage of the species' North American range that occurs in the Northeast (see Table 1.1 for a breakdown of RSGCN by major taxonomic groups and Figure 1.1 for more information on the RSGCN criteria). The invertebrate list is incomplete, and because the RSGCN process continues to evaluate them, only the two major invertebrate groups reviewed through the RSGCN process are included in this analysis. Interestingly, the development of the RSGCN list supports earlier findings that a significant percentage of the Northeast's wildlife species are in urgent need of dedicated conservation attention, with Stein et al. (2000) and The Heinz Center (2002, 2008) suggesting that approximately 33% of animal species in the United States are at elevated risk for extinction.

Table 1.1 RSGCN Species by Major Taxonomic Group.

Taxonomic Group	Number of RSGCN Species
Mammals	45
Birds	110
Reptiles	29
Amphibians	36
Fish	101
Tiger Beetles	11
Freshwater Mussels	23
Other Federally Listed Invertebrates	11
Total	366

Major taxonomic groups with the highest percentage of RSGCN in the Northeast include amphibians (40%), reptiles (39%), and tiger beetles (39%) (see Table 1.2). Threats to amphibians and reptiles from disease, water quality impairment, and habitat loss are well known and are discussed further in this document. Tiger beetles are associated with early successional habitats or areas such as beaches that are prone to human disturbance, and thus are at elevated risk from human activities (Knisley and Schultz 1997). Of the 355 RSGCN analyzed in Table 1.2 (analysis excludes the 11 additional federally listed invertebrates not evaluated through the RSGCN process), approximately 16% are considered to be of high regional responsibility (meaning that the northeastern states account for 50% or more of the species'

range) and high regional concern (meaning that more than 50% of the northeastern states identified the species as SGCN). Tiger beetles had the highest percentage of species ranked high in both regional responsibility and regional concern (21%). The next-closest group, reptiles, had 8% of species in this category. Additionally, almost 30% of the RSGCN are listed under the federal Endangered Species Act as Endangered, Threatened or Candidate species for listing. Mammals had the highest percentage of species with federal listing status, at 27% of the total number of species occurring in the Northeast.

The compiled list of all Northeast State Wildlife Action Plans' Species of Greatest Conservation Need (SGCN) (Whitlock 2006) included 87 mammals, 263 birds, 65 reptiles, 73 amphibians, 299 fish, 27 tiger beetles, and 101 freshwater mussel species and subspecies. These numbers represent a significant percentage of Northeastern species in all seven of these taxonomic groups (Table 1.2). The large number of species included in these lists reflects the magnitude of the threats facing fish and wildlife species in the Northeast, as well as the commendable efforts of the individual Northeast states to ensure that their State Wildlife Action Plans were comprehensive in their coverage of species in major taxonomic groups.

For vertebrates as a whole, the percentage of species identified as SGCN in one or more of the Northeast State Wildlife Action Plans approaches 70% of the total number of vertebrate species occurring in the Northeast (Table 1.2). The percentages of tiger beetles and freshwater mussels that were identified as SGCN by one or more of the Northeastern states are even higher. For tiger beetles, 27 of the 28 species that occur in the Northeastern states were identified as SGCN in one or more of the original Northeast State Wildlife Action Plans. Similarly, 101 of the 111 Northeastern species of freshwater mussels were listed as SGCN by one or more of the Northeastern states in their original State Wildlife Action Plans.

Table 1.2. Regional SGCN: Summary Statistics. Sources: NatureServe and NALCC.

Taxonomic Group	Number of Species in Region*	Number of Species that are State SGCN**	Percent of species that are State SGCN	Number of RSGCN***	Percent of species that are RSGCN	Number of High Responsibility, High Concern Species***	Percent of High Responsibility, High Concern Species	Number of Species with Federal Status***	Percent of Species with Federal Status
Mammals	128	87	68%	45	35%	8	6%	33	26%
Birds	387	263	68%	110	28%	12	3%	34	9%
Reptiles	74	65	88%	29	39%	6	8%	11	15%
Amphibians	91	73	80%	36	40%	3	3%	4	4%
Fish	441	299	68%	101	23%	16	4%	11	2%
Tiger Beetles	28	27	96%	10	36%	4	14%	2	7%
Freshwater Mussels	111	101	91%	23	21%	7	6%	4	4%
Other Federally listed invertebrates = 11									

** From NEPARC website and the comprehensive lists of vertebrate species, tiger beetles, and freshwater mussels on the NatureServe Explorer website*

*** From Whitlock (2006) comprehensive list of SGCN for all Northeast states (2005 State Wildlife Action Plans)*

**** From most recent version of RSGCN list, produced by NEFWDTC and partners*

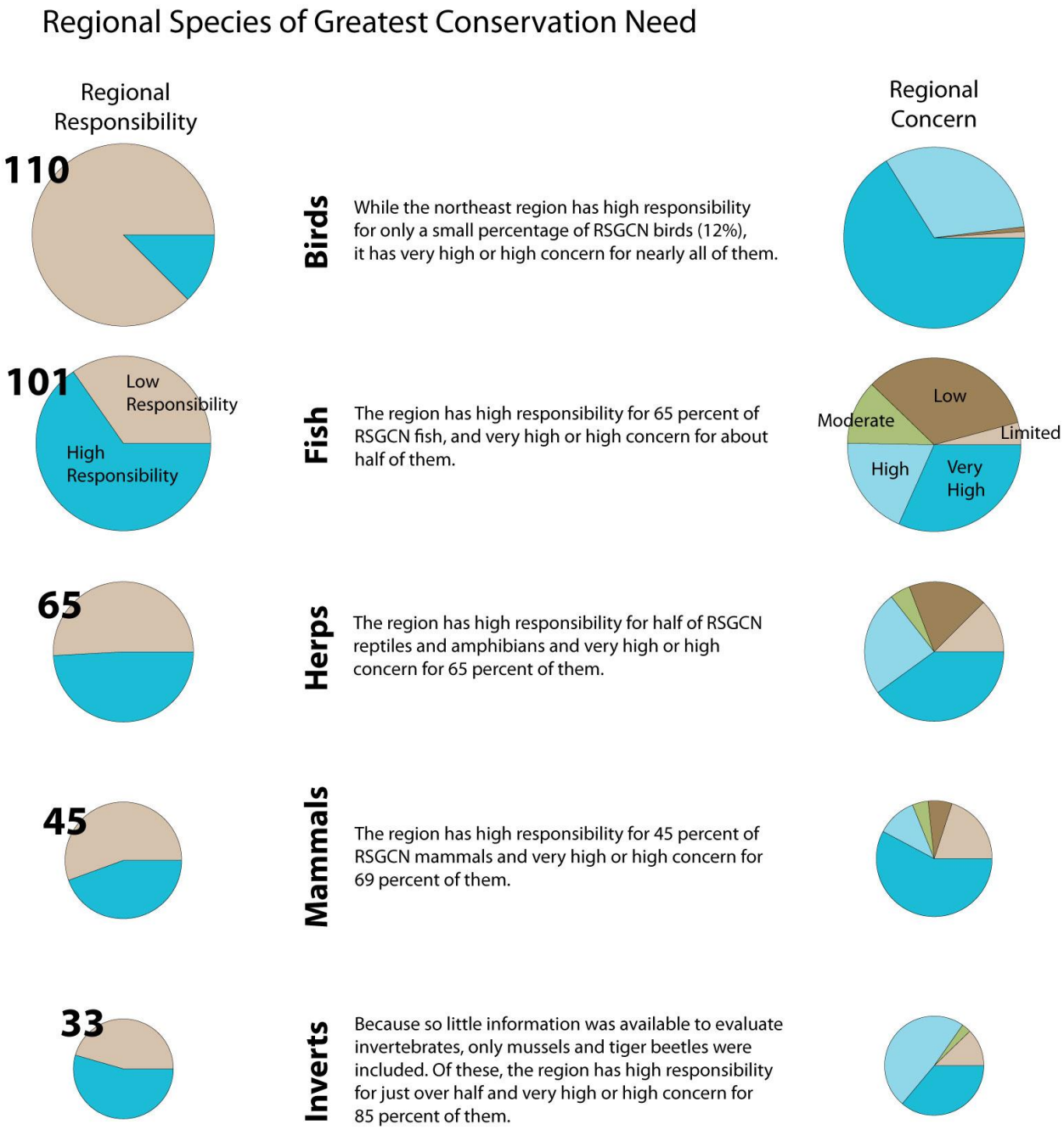


Figure 1.2. Regional Species of Greatest Conservation Need, by taxonomic group. Pie graphs on the left show the portion of the species for which the region has high responsibility (in blue). Pie graphs on the right show the level of regional concern.

The NEFWDTC continues to refine the RSGCN process and list to incorporate species in other major invertebrate groups. There is a solid foundation of invertebrate conservation in the Northeast on which these efforts are being built. Many of the Northeast states included information about other major invertebrate groups in their original State Wildlife Action Plans. These groups included butterflies and moths (Order Lepidoptera), odonates (Order Odonata), snails, slugs, and saltwater mollusks (Phylum Mollusca), and cave beetles (Order Coleoptera, Family Carabidae), all of which were treated by one or more individual Northeast states in their first State Wildlife Action Plans. However, information about conservation status and regional responsibility has not yet been analyzed in detail for all Northeastern species in these groups, and thus they are not included in the current document. Based on the very large number of species in some of these groups, one might also reasonably expect a significant number of potential RSGCN. According to Whitlock (2006), the individual Northeast states listed 1,138 invertebrate species in addition to tiger beetles and freshwater mussels as SGCN in their original State Wildlife Action Plans. These species represent just a fraction of the total diversity of invertebrate species in the Northeast. For example, more than 15,000 species of insects alone have been recorded from New York State (Leonard 1928). Recall that approximately 30% of the animal species that have been analyzed to date by NEFWDTC have been selected as RSGCN (see discussion above and Table 1.2). If only 30% of the 1,138 additional invertebrate species listed by Whitlock (2006) were to be screened as RSGCN by NEFWDTC, the list could nearly double its present size.

The NEFWDTC taxonomic teams will continue to review information about status and trends for species in additional major invertebrate groups, including dragonflies and damselflies (Order Odonata), butterflies, moths, and skippers (Order Lepidoptera), and bees (Order Hymenoptera, Superfamily Apoidea). Updated RSGCN lists for these taxonomic groups are forthcoming from NEFWDTC. In the interim, because ongoing RSGCN review efforts are not complete for all invertebrate taxa, the RSGCN list also includes 11 federally listed invertebrate species that belong to taxonomic groups other than tiger beetles and freshwater mussels. These RSGCN include one burying beetle, two butterflies, a spider, three snails, two isopods, and two amphipods. These species are included on the RSGCN list because of their thorough status assessments and listing under the federal Endangered Species Act.

Table 1.3 lists all of the highest priority species from the list of RSGCN updated December 16, 2013. This table includes those species for which there is both a high degree of conservation concern for the species overall, and a high responsibility on the part of state fish and wildlife agencies in the Northeast

states to take leadership in the conservation of these species. It also includes 11 additional invertebrate species that have been formally protected under the Endangered Species Act. Many of these species have been the focus of regional conservation efforts, coordinated by states and/or the U.S. Fish and Wildlife Service (USFWS), to help prevent further population declines and the need for a listing under the federal Endangered Species Act. A complete list of RSGCN is provided by major taxonomic group in Appendix 2.

Table 1.3. Regional Species of Greatest Conservation Need listed in decreasing level of regional responsibility and concern

RSGCN List: Mammals							
Scientific Name [B,M,W,A,E]=[Breeding, Migratory, Wintering, Atlantic, Eastern population]	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Microtus chrotorrhinus carolinensis	Southern Rock Vole	High	V. High	3	100%	53%	—
Myotis leibii	Eastern Small-footed Myotis	High	V. High	11	91%	78%	—
Neotoma magister	Allegheny Woodrat	High	V. High	8	75%	80%	—
Sciurus niger cinereus	Delmarva Fox Squirrel	High	V. High	4	75%	74%	EE (PDL)
Sorex dispar	Long-tailed Shrew	High	V. High	10	70%	52%	—
Sorex palustris punctulatus	Southern Water Shrew	High	V. High	4	100%	50%	—
Sylvilagus transitionalis	New England Cottontail	High	V. High	8	75%	81%	C
Sorex palustris albibarbis	American Water Shrew (Eastern)	High	High	9	0%	0%	—
Sorex cinereus fontinalis	Maryland Shrew	High	Mod.	3	0%	0%	—
Sorex fumeus	Smoky Shrew	High	Mod.	12	17%	64%	—
Condylura cristata	Star-nosed Mole	High	Low	14	7%	71%	—
Napaeozapus insignis	Woodland Jumping Mouse	High	Low	12	8%	75%	—
Parascalops breweri	Hairy-tailed Mole	High	Low	11	9%	70%	—
Corynorhinus townsendii virginianus	Virginia Big-eared Bat	High	Limited	2	100%	67%	E
Glaucomys sabrinus fuscus	Virginia Northern Flying Squirrel	High	Limited	2	100%	58%	DL
Microtus breweri	Beach Vole	High	Limited	1	100%	44%	—
Microtus pennsylvanicus provectus	Block Island Meadow Vole	High	Limited	1	0%	0%	—

Microtus pennsylvanicus shattucki	Penobscot Meadow Vole	High	Limited	1	0%	0%	—
Peromyscus leucopus easti	Pungo White-footed Deermouse	High	Limited	1	0%	0%	—
Sorex longirostris fisheri	Dismal Swamp Southeastern Shrew	High	Limited	1	100%	56%	—
Eptesicus fuscus	Big Brown Bat	Low	High	14	29%	71%	—
Lynx rufus	Bobcat	Low	High	14	21%	50%	—
Martes americana	American Marten	Low	High	8	38%	50%	R
Phocoena phocoena	Harbor Porpoise	Low	High	5	40%	53%	—
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	Low	Limited	1	100%	44%	E
Myotis grisescens	Gray Myotis	Low	Limited	1	100%	56%	E
Balaenoptera borealis	Sei Whale	Low	V. High	4	0%	0%	E
Balaenoptera musculus	Blue Whale	Low	V. High	3	0%	0%	E
Balaenoptera physalus	Fin Whale	Low	V. High	6	33%	59%	E
Cryptotis parva	North American Least Shrew	Low	V. High	9	44%	68%	—
Eubalaena glacialis	North Atlantic Right Whale	Low	V. High	5	60%	67%	E
Lasionycteris noctivagans	Silver-haired Bat	Low	V. High	13	23%	70%	—
Lasiurus borealis	Eastern Red Bat	Low	V. High	14	21%	68%	R
Lasiurus cinereus	Hoary Bat	Low	V. High	13	38%	67%	—
Lynx canadensis	Canadian Lynx	Low	V. High	6	33%	73%	—
Megaptera novaeangliae	Humpback Whale	Low	V. High	5	40%	64%	E
Mustela nivalis	Least Weasel	Low	V. High	5	80%	56%	—
Myotis lucifugus	Little Brown Myotis	Low	V. High	14	36%	61%	R
Myotis septentrionalis	Northern Myotis	Low	V. High	14	43%	67%	—
Myotis sodalis	Indiana Myotis	Low	V. High	9	78%	76%	E
Perimyotis subflavus	Tricolored Bat	Low	V. High	14	36%	53%	R
Physeter macrocephalus	Sperm Whale	Low	V. High	2	0%	0%	E
Spilogale putorius	Eastern Spotted Skunk	Low	V. High	4	100%	71%	—
Sylvilagus obscurus	Appalachian Cottontail	Low	V. High	4	100%	65%	—
Synaptomys cooperi	Southern Bog Lemming	Low	V. High	13	46%	63%	—
RSGCN List: Birds							
Ammodramus caudacutus	Saltmarsh Sparrow	High	V. High	10	60%	85%	R
Calidris canutus [M]	Red Knot	High	V. High	8	38%	82%	PT,R
Catharus bicknelli	Bicknell's Thrush	High	V. High	6	83%	93%	PE,R
Charadrius melodus [A]	Piping Plover	High	V. High	11	82%	91%	ET,R
Falco peregrinus [E]	Peregrine Falcon	High	V. High	14	71%	100%	—

Hylocichla mustelina	Wood Thrush	High	V. High	14	50%	91%	R
Laterallus jamaicensis	Black Rail	High	V. High	7	86%	85%	—
Setophaga cerulea	Cerulean Warbler	High	V. High	13	54%	78%	—
Sterna dougallii	Roseate Tern	High	V. High	9	67%	86%	ET
Vermivora cyanoptera	Blue-winged Warbler	High	V. High	14	50%	77%	R
Aquila chrysaetos [B,W]	Golden Eagle	High	High	12	83%	87%	—
Piranga olivacea	Scarlet Tanager	High	High	14	36%	92%	—
Passerculus sandwichensis princeps [M,W]	Ipswich Sparrow	High	Low	2	100%	55%	—
Melospiza georgiana nigrescens	Coastal Plain Swamp Sparrow	High	Limited	3	0%	0%	—
Accipiter gentilis	Northern Goshawk	Low	V. High	11	55%	79%	—
Ammodramus henslowii	Henslow's Sparrow	Low	V. High	13	69%	71%	—
Ammodramus maritimus	Seaside Sparrow	Low	V. High	10	40%	92%	—
Ammodramus savannarum	Grasshopper Sparrow	Low	V. High	14	71%	93%	R
Anas rubripes [B,W]	American Black Duck	Low	V. High	14	21%	93%	R
Antrostomus vociferus	Eastern Whip-poor-will	Low	V. High	14	36%	81%	R
Arenaria interpres [M,W]	Ruddy Turnstone	Low	V. High	10	10%	91%	—
Asio flammeus	Short-eared Owl	Low	V. High	13	77%	79%	—
Asio otus	Long-eared Owl	Low	V. High	14	50%	90%	—
Bartramia longicauda	Upland Sandpiper	Low	V. High	14	93%	86%	R
Botaurus lentiginosus	American Bittern	Low	V. High	14	71%	85%	R
Bubulcus ibis	Cattle Egret	Low	V. High	—	—	—	—
Calidris maritima [M,W]	Purple Sandpiper	Low	V. High	8	25%	89%	R
Cardellina canadensis	Canada Warbler	Low	V. High	13	23%	88%	—
Chlidonias niger	Black Tern	Low	V. High	—	—	—	—
Chordeiles minor	Common Nighthawk	Low	V. High	14	64%	83%	R
Circus cyaneus	Northern Harrier	Low	V. High	14	86%	95%	—
Cistothorus platensis	Sedge Wren	Low	V. High	13	85%	77%	R
Coccyzus erythropthalmus	Black-billed Cuckoo	Low	V. High	14	36%	90%	—
Colinus virginianus	Northern Bobwhite	Low	V. High	12	25%	87%	—
Contopus cooperi	Olive-sided Flycatcher	Low	V. High	12	33%	62%	—
Dolichonyx oryzivorus	Bobolink	Low	V. High	14	50%	83%	R
Egretta caerulea	Little Blue Heron	Low	V. High	10	70%	84%	—
Egretta thula	Snowy Egret	Low	V. High	12	67%	82%	R
Egretta tricolor	Tricolored Heron	Low	V. High	—	—	—	—
Euphagus carolinus [B,W]	Rusty Blackbird	Low	V. High	11	45%	80%	—
Falcipennis canadensis	Spruce Grouse	Low	V. High	—	—	—	R
Gavia immer	Common Loon	Low	V. High	—	—	—	R

Gelochelidon nilotica	Gull-billed Tern	Low	V. High	—	—	—	—
Geothlypis formosa	Kentucky Warbler	Low	V. High	10	50%	70%	R
Haematopus palliatus	American Oystercatcher	Low	V. High	9	44%	86%	R
Helmitheros vermivorum	Worm-eating Warbler	Low	V. High	11	45%	89%	R
Histrionicus histrionicus [E,W]	Harlequin Duck	Low	V. High	—	—	—	—
Ixobrychus exilis	Least Bittern	Low	V. High	14	86%	89%	R
Lanius ludovicianus	Loggerhead Shrike	Low	V. High	12	58%	65%	—
Limnothlypis swainsonii	Swainson's Warbler	Low	V. High	—	—	—	—
Melanerpes erythrocephalus	Red-headed Woodpecker	Low	V. High	—	—	—	—
Numenius phaeopus [M]	Whimbrel	Low	V. High	—	—	—	—
Nyctanassa violacea	Yellow-crowned Night-Heron	Low	V. High	11	64%	93%	—
Nycticorax nycticorax	Black-crowned Night-Heron	Low	V. High	14	57%	88%	—
Parkesia motacilla	Louisiana Waterthrush	Low	V. High	14	14%	87%	R
Picoides dorsalis	American Three-toed Woodpecker	Low	V. High	—	—	—	—
Pipilo erythrophthalmus	Eastern Towhee	Low	V. High	14	14%	93%	R
Podilymbus podiceps	Pied-billed Grebe	Low	V. High	14	79%	87%	—
Pooecetes gramineus	Vesper Sparrow	Low	V. High	14	57%	80%	—
Porzana carolina	Sora	Low	V. High	14	64%	72%	—
Protonotaria citrea	Prothonotary Warbler	Low	V. High	10	50%	82%	R
Rallus elegans	King Rail	Low	V. High	13	54%	84%	R
Rynchops niger	Black Skimmer	Low	V. High	—	—	—	R
Scolopax minor	American Woodcock	Low	V. High	—	—	—	R
Setophaga castanea	Bay-breasted Warbler	Low	V. High	—	—	—	—
Setophaga discolor	Prairie Warbler	Low	V. High	14	21%	88%	R
Spizella pusilla	Field Sparrow	Low	V. High	14	36%	83%	R
Sterna forsteri	Forster's Tern	Low	V. High	—	—	—	—
Sterna hirundo	Common Tern	Low	V. High	13	62%	90%	R
Sterna paradisaea	Arctic Tern	Low	V. High	—	—	—	—
Sternula antillarum	Least Tern	Low	V. High	11	82%	90%	R
Sturnella magna	Eastern Meadowlark	Low	V. High	14	43%	86%	R
Thryomanes bewickii	Bewick's Wren	Low	V. High	5	20%	100%	—
Toxostoma rufum	Brown Thrasher	Low	V. High	14	43%	92%	R
Tringa semipalmata	Willet	Low	V. High	11	18%	83%	R
Tyto alba	Barn Owl	Low	V. High	12	67%	88%	—

Vermivora chrysoptera	Golden-winged Warbler	Low	V. High	12	75%	83%	PE
Antrostomus carolinensis	Chuck-will's-widow	Low	High	—	—	—	—
Bonasa umbellus	Ruffed Grouse	Low	High	14	14%	92%	R
Buteo lineatus	Red-shouldered Hawk	Low	High	14	50%	83%	R
Buteo platypterus	Broad-winged Hawk	Low	High	14	43%	88%	—
Calidris alba [M,W]	Sanderling	Low	High	9	33%	88%	R
Calidris pusilla [M]	Semipalmated Sandpiper	Low	High	8	25%	85%	R
Catharus fuscescens	Veery	Low	High	—	—	—	—
Certhia americana	Brown Creeper	Low	High	—	—	—	—
Chaetura pelagica	Chimney Swift	Low	High	14	21%	88%	—
Cistothorus palustris	Marsh Wren	Low	High	14	36%	81%	R
Coturnicops noeboracensis [M]	Yellow Rail	Low	High	—	—	—	—
Empidonax traillii	Willow Flycatcher	Low	High	13	8%	93%	R
Empidonax virescens	Acadian Flycatcher	Low	High	—	—	—	—
Eremophila alpestris	Horned Lark	Low	High	—	—	—	—
Falco sparverius	American Kestrel	Low	High	14	36%	86%	—
Gallinago delicata	Wilson's Snipe	Low	High	—	—	—	—
Gallinula galeata	Common Gallinule	Low	High	14	50%	92%	—
Icteria virens	Yellow-breasted Chat	Low	High	—	—	—	—
Limosa fedoa [M]	Marbled Godwit	Low	High	—	—	—	—
Mniotilta varia	Black-and-white Warbler	Low	High	—	—	—	R
Phalaropus tricolor	Wilson's Phalarope	Low	High	—	—	—	—
Piranga rubra	Summer Tanager	Low	High	—	—	—	—
Rallus longirostris	Clapper Rail	Low	High	—	—	—	R
Riparia riparia	Bank Swallow	Low	High	14	29%	76%	R
Setophaga americana	Northern Parula	Low	High	14	36%	91%	—
Setophaga caerulescens	Black-throated Blue Warbler	Low	High	13	31%	88%	—
Setophaga citrina	Hooded Warbler	Low	High	—	—	—	—
Setophaga fusca	Blackburnian Warbler	Low	High	—	—	—	R
Setophaga tigrina	Cape May Warbler	Low	High	—	—	—	—
Setophaga virens	Black-throated Green Warbler	Low	High	—	—	—	—
Somateria mollissima	Common Eider	Low	High	—	—	—	R
Spiza americana	Dickcissel	Low	High	—	—	—	—
Vireo flavifrons	Yellow-throated Vireo	Low	High	14	21%	92%	—
RSGCN List: Reptiles and Amphibians							

Glyptemys insculpta	Wood Turtle	High	V. High	13	92%	78%	R
Glyptemys muhlenbergii	Bog Turtle	High	V. High	9	67%	84%	TS,R
Malaclemys terrapin terrapin	Northern Diamondback Terrapin	High	V. High	7	14%	0%	E,R
Plestiodon anthracinus anthracinus	Northern Coal Skink	High	V. High	4	75%	50%	—
Coluber constrictor constrictor	Northern Black Racer	High	High	6	17%	0%	—
Eurycea longicauda	Longtail Salamander	High	High	8	38%	79%	—
Pseudacris kalmi	New Jersey Chorus Frog	High	High	5	40%	61%	—
Pseudemys rubriventris	Northern Red-bellied Cooter	High	High	9	44%	68%	—
Pseudotriton ruber	Red Salamander	High	High	8	38%	74%	—
Desmognathus monticola	Seal Salamander	High	Mod.	4	25%	69%	—
Gyrinophilus porphyriticus porphyriticus	Northern Spring Salamander	High	Mod.	6	33%	67%	—
Plethodon hoffmani	Valley and Ridge Salamander	High	Mod.	4	25%	60%	—
Desmognathus fuscus	Northern Dusky Salamander	High	Low	14	14%	64%	—
Desmognathus ochrophaeus	Allegheny Mountain Dusky Salamander	High	Low	7	57%	50%	—
Diadophis punctatus edwardsii	Northern Ring-necked Snake	High	Low	6	33%	69%	—
Eurycea bislineata	Northern Two-lined Salamander	High	Low	14	21%	81%	—
Gyrinophilus porphyriticus	Spring Salamander	High	low	12	25%	100%	R
Gyrinophilus porphyriticus duryi	Kentucky Spring Salamander	High	Low	2	0%	0%	—
Plethodon cylindraceus	White-spotted Slimy Salamander	High	low	2	50%	70%	—
Plethodon glutinosus	Slimy Salamander	High	Low	8	50%	56%	—
Plethodon punctatus	White-spotted Salamander	High	Low	2	100%	58%	—
Plethodon wehrlei	Wehrle's Salamander	High	Low	5	40%	64%	—
Storeria dekayi dekayi	Brownsnake	High	Low	14	21%	64%	—
Thamnophis brachystoma	Short-headed Gartersnake	High	Low	2	50%	58%	—
Desmognathus orestes	Blue Ridge Dusky Salamander	High	Limited	1	100%	56%	—
Gyrinophilus subterraneus	West Virginia Spring Salamander	High	Limited	1	100%	64%	—
Plethodon hubrichti	Peaks of Otter Salamander	High	Limited	1	100%	56%	—

Plethodon kentucki	Cumberland Plateau Salamander	High	Limited	2	50%	56%	—
Plethodon nettingi	Cheat Mountain Salamander	High	Limited	1	100%	64%	T
Plethodon shenandoah	Shenandoah Salamander	High	Limited	1	100%	56%	E
Plethodon virginia	Shenandoah Mountain Salamander	High	Limited	2	0%	0%	—
Virginia pulchra	Mountain Earthsnake	High	Limited	4	100%	68%	—
Ambystoma laterale & jeffersonianum	Blue-spotted Salamander complex	Low	V. High	8	88%	79%	—
Ambystoma tigrinum	Tiger Salamander	Low	V. High	6	67%	70%	—
Aneides aeneus	Green Salamander	Low	V. High	4	100%	61%	—
Caretta caretta	Loggerhead	Low	V. High	9	67%	81%	ET,R
Cemophora coccinea copei	Northern Scarletsnake	Low	V. High	5	40%	67%	—
Chelonia mydas	Green Turtle	Low	V. High	9	56%	64%	ET
Clemmys guttata	Spotted Turtle	Low	V. High	14	79%	77%	R
Crotalus horridus	Timber Rattlesnake	Low	V. High	13	54%	80%	—
Cryptobranchus alleganiensis	Eastern Hellbender	Low	V. High	5	100%	78%	—
Dermochelys coriacea	Leatherback	Low	V. High	9	44%	65%	E
Emydoidea blandingii	Blanding's Turtle	Low	V. High	5	100%	77%	—
Eretmochelys imbricata imbricata	Atlantic Hawksbill	Low	V. High	4	0%	0%	E
Heterodon platirhinos	Eastern Hog-nosed Snake	Low	V. High	12	50%	72%	R
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Low	V. High	10	50%	64%	E
Lithobates virgatipes	Carpenter Frog	Low	V. High	4	100%	71%	—
Pantherophis guttatus	Red Cornsnake	Low	V. High	5	60%	67%	—
Pseudacris brachyphona	Mountain Chorus Frog	Low	V. High	4	75%	73%	—
Pseudotriton montanus montanus	Eastern Mud Salamander	Low	V. High	3	100%	55%	—
Regina septemvittata	Queen Snake	Low	V. High	8	63%	68%	—
Scaphiopus holbrookii	Eastern Spadefoot	Low	V. High	11	55%	83%	—
Terrapene carolina carolina	Eastern Box Turtle	Low	V. High	6	83%	72%	R
Thamnophis sauritus	Eastern Ribbonsnake	Low	V. High	14	50%	100%	—
Acris crepitans	Northern Cricket Frog	Low	High	8	50%	74%	—
Agkistrodon contortrix	Copperhead	Low	High	10	70%	70%	—
Ambystoma opacum	Marbled Salamander	Low	High	12	58%	70%	R
Anaxyrus fowleri	Fowler's Toad	Low	High	13	54%	70%	—
Apalone spinifera spinifera	Spiny Softshell	Low	High	7	57%	67%	—
Graptemys geographica	Common Map Turtle	Low	High	7	100%	60%	—

Liochlorophis vernalis	Smooth Greensnake	Low	High	12	58%	71%	—
Lithobates pipiens	Northern Leopard Frog	Low	High	11	45%	70%	—
Necturus maculosus	Mudpuppy	Low	High	8	75%	60%	—
Opheodrys aestivus	Rough Greensnake	Low	High	7	71%	76%	—
Plestiodon laticeps	Broad-headed Skink	Low	High	6	33%	64%	—
RSGCN List: Fishes							
Acipenser brevirostrum	Shortnose Sturgeon	High	V. High	12	58%	84%	E,R
Acipenser oxyrinchus	Atlantic Sturgeon	High	V. High	12	67%	71%	—
Ammodytes americanus	American Sand Lance	High	V. High	2	0%	0%	—
Enneacanthus obesus	Banded Sunfish	High	V. High	11	64%	78%	—
Fundulus luciae	Spotfin Killifish	High	V. High	6	50%	70%	—
Ichthyomyzon greeleyi	Mountain Brook Lamprey	High	V. High	4	75%	88%	—
Notropis bifrenatus	Bridle Shiner	High	V. High	13	54%	95%	—
Percina macrocephala	Longhead Darter	High	V. High	3	67%	87%	—
Alosa aestivalis	Blueback Herring	High	High	13	23%	90%	SC
Alosa mediocris	Hickory Shad	High	High	10	30%	67%	—
Alosa pseudoharengus	Alewife	High	High	12	42%	95%	SC,R
Etheostoma vitreum	Glassy Darter	High	High	4	75%	92%	—
Exoglossum laurae	Tonguetied Minnow	High	High	4	50%	83%	—
Notropis amoenus	Comely Shiner	High	High	8	38%	93%	—
Percina notogramma	Stripeback Darter	High	High	4	50%	92%	—
Percina peltata	Shield Darter	High	High	8	25%	93%	—
Apeltes quadracus	Fourspine Stickleback	High	Mod.	12	42%	64%	—
Cottus girardi	Potomac Sculpin	High	Mod.	4	50%	94%	—
Dasyatis centroura	Roughtail Stingray	High	Mod.	0	0%	0%	—
Etheostoma variatum	Variegate Darter	High	Mod.	4	50%	83%	—
Leucoraja garmani	Rosette Skate	High	Mod.	0	0%	0%	—
Microgadus tomcod	Atlantic Tomcod	High	Mod.	6	0%	0%	—
Notropis procne	Swallowtail Shiner	High	Mod.	8	25%	95%	—
Noturus flavus	Stonecat	High	Mod.	8	25%	93%	—
Opsanus tau	Oyster Toadfish	High	Mod.	1	0%	0%	—
Percina oxyrhynchus	Sharpnose Darter	High	Mod.	3	33%	89%	—
Pseudopleuronectes americanus	Winter Flounder	High	Mod.	2	0%	0%	—
Tautogolabrus adspersus	Cunner	High	Mod.	2	0%	0%	—
Alopias vulpinus	Common Thresher Shark	High	Low	0	0%	0%	—
Amblyraja radiata	Thorny Skate	High	Low	0	0%	0%	SC
Clupea harengus	Atlantic Herring	High	Low	2	0%	0%	—

Cottus caeruleomentum	Blue Ridge Sculpin	High	Low	5	40%	87%	—
Cottus cognatus	Slimy Sculpin	High	Low	3	33%	83%	—
Cyprinella analostana	Satinfin Shiner	High	Low	8	25%	94%	—
Exoglossum maxillingua	Cutlip Minnow	High	Low	10	30%	95%	—
Fundulus heteroclitus	Mummichog	High	Low	12	8%	94%	—
Fundulus majalis	Striped Killifish	High	Low	4	25%	86%	—
Hemitripterus americanus	Sea Raven	High	Low	1	0%	0%	—
Hybognathus regius	Eastern Silvery Minnow	High	Low	11	45%	94%	—
Isurus oxyrinchus	Shortfin Mako	High	Low	0	0%	0%	—
Lamna nasus	Porbeagle	High	Low	0	0%	0%	SC
Lepomis auritus	Redbreast Sunfish	High	Low	14	14%	96%	—
Leucoraja erinacea	Little Skate	High	Low	1	0%	0%	—
Leucoraja ocellata	Winter Skate	High	Low	1	0%	0%	—
Lophius americanus	Goosefish	High	Low	2	0%	0%	—
Malacoraja senta	Smooth Skate	High	Low	0	0%	0%	—
Menidia menidia	Atlantic Silverside	High	Low	5	40%	67%	—
Merluccius bilinearis	Silver Hake	High	Low	2	0%	0%	—
Paralichthys oblongus	Fourspot Flounder	High	Low	1	0%	0%	—
Peprilus triacanthus	Butterfish	High	Low	2	0%	0%	—
Prionace glauca	Blue Shark	High	Low	0	0%	0%	—
Prionotus carolinus	Northern Searobin	High	Low	2	0%	0%	—
Prionotus evolans	Striped Searobin	High	Low	2	0%	0%	—
Scomber scombrus	Atlantic Mackerel	High	Low	2	0%	0%	—
Scophthalmus aquosus	Windowpane	High	Low	2	0%	0%	—
Semotilus corporalis	Fallfish	High	Low	14	29%	96%	—
Sphyrna zygaena	Smooth Hammerhead	High	Low	0	0%	0%	—
Squalus acanthias	Spiny Dogfish	High	Low	2	0%	0%	—
Tautoga onitis	Tautog	High	Low	3	0%	0%	—
Umbra pygmaea	Eastern Mudminnow	High	Low	7	29%	88%	—
Urophycis chuss	Red Hake	High	Low	2	0%	0%	—
Zoarces americanus	Ocean Pout	High	Low	1	0%	0%	—
Dipturus laevis	Barndoor Skate	High	Limited	1	0%	0%	—
Myoxocephalus octodecemspinosus	Longhorn Sculpin	High	Limited	2	0%	0%	—
Sphoeroides maculatus	Northern Puffer	High	Limited	2	0%	0%	—
Squatina dumeril	Atlantic Angel Shark	High	Limited	2	0%	0%	—
Acipenser fulvescens	Lake Sturgeon	Low	V. High	4	75%	94%	—
Alosa sapidissima	American Shad	Low	V. High	13	23%	88%	R
Ammocrypta pellucida	Eastern Sand Darter	Low	V. High	4	75%	81%	—

Anguilla rostrata	American Eel	Low	V. High	14	36%	96%	R
Enneacanthus chaetodon	Blackbanded Sunfish	Low	V. High	5	80%	80%	—
Erimystax dissimilis	Streamline Chub	Low	V. High	4	75%	73%	—
Etheostoma camurum	Bluebreast Darter	Low	V. High	4	75%	94%	—
Etheostoma maculatum	Spotted Darter	Low	V. High	3	67%	93%	—
Etheostoma tippecanoe	Tippecanoe Darter	Low	V. High	3	67%	91%	—
Hiodon tergisus	Mooneye	Low	V. High	4	50%	73%	—
Ichthyomyzon bdellium	Ohio Lamprey	Low	V. High	4	75%	88%	—
Ichthyomyzon fossor	Northern Brook Lamprey	Low	V. High	4	75%	81%	—
Lampetra aepyptera	Least Brook Lamprey	Low	V. High	5	60%	94%	—
Lepomis gulosus	Warmouth	Low	V. High	4	50%	95%	—
Lethenteron appendix	American Brook Lamprey	Low	V. High	13	54%	92%	—
Moxostoma carinatum	River Redhorse	Low	V. High	4	75%	81%	—
Notropis chalybaeus	Ironcolor Shiner	Low	V. High	6	100%	75%	—
Noturus insignis	Margined Madtom	Low	V. High	9	11%	92%	R
Percina copelandi	Channel Darter	Low	V. High	5	80%	82%	—
Percina evides	Gilt Darter	Low	V. High	4	75%	81%	—
Polyodon spathula	Paddlefish	Low	V. High	4	50%	70%	—
Prosopium cylindraceum	Round Whitefish	Low	V. High	5	80%	84%	—
Salmo salar	Atlantic Salmon	Low	V. High	7	14%	93%	R
Salvelinus fontinalis	Brook Trout	Low	V. High	12	33%	96%	R
Acantharchus pomotis	Mud Sunfish	Low	High	6	67%	68%	—
Salvelinus alpinus oquassa	Arctic Char			3	NA	NA	—
Ameiurus melas	Black Bullhead	Low	High	5	40%	75%	—
Amia calva	Bowfin	Low	High	5	40%	91%	—
Catostomus catostomus	Longnose Sucker	Low	High	9	67%	86%	—
Coregonus clupeaformis	Lake Whitefish	Low	High	5	40%	60%	—
Cottus cognatus	Slimy Sculpin	Low	High	10	30%	83%	R
Etheostoma fusiforme	Swamp Darter	Low	High	12	50%	79%	—
Ichthyomyzon unicuspis	Silver Lamprey	Low	High	4	50%	75%	—
Lota lota	Burbot	Low	High	7	71%	94%	—
Salvelinus namaycush	Lake Trout	Low	High	5	0%	0%	—
Sander canadensis	Sauger	Low	High	5	40%	92%	—
RSGCN List: Tiger Beetles							
Cicindela ancocisconensis	Appalachian Tiger Beetle	High	High	9	78%	76%	—
Cicindela marginipennis	Cobblestone Tiger Beetle	High	High	8	88%	83%	—

Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	High	Very High	7	86%	82%	T
Cicindela puritana	Puritan Tiger Beetle	High	Very High	5	80%	86%	T,R
Cicindela rufiventris hentzi	Hentz's Red-bellied Tiger Beetle	High	Very High	1	100%	88%	—
Cicindela abdominalis	Eastern Pinebarrens Tiger Beetle	Low	High	4	75%	80%	—
Cicindela dorsalis media	White Tiger Beetle	Low	High	4	50%	73%	—
Cicindela lepida	Ghost Tiger Beetle	Low	High	8	63%	79%	—
Cicindela patruela	Barrens Tiger Beetle	Low	High	13	46%	73%	—
Cicindela unipunctata	One-spotted Tiger Beetle	Low	High	8	13%	0%	—
RSGCN List: Freshwater Mussels							
Alasmidonta heterodon	Dwarf Wedgemussel	High	V. High	11	91%	90%	E,R
Alasmidonta varicosa	Brook Floater	High	V. High	14	86%	82%	—
Elliptio fisheriana	Northern Lance	High	V. High	5	60%	82%	—
Lampsilis cariosa	Yellow Lampmussel	High	V. High	12	83%	86%	—
Lasmigona subviridis	Green Floater	High	V. High	7	100%	78%	—
Leptodea ochracea	Tidewater Mucket	High	V. High	11	91%	79%	—
Ligumia nasuta	Eastern Pondmussel	High	V. High	11	91%	84%	—
Alasmidonta undulata	Triangle Floater	High	High	14	57%	82%	—
Anodonta implicata	Alewife Floater	High	High	13	46%	95%	—
Lampsilis radiata	Eastern Lampmussel	High	Mod.	14	57%	76%	—
Epioblasma torulosa gubernaculum	Green Blossom	High	Limited	1	100%	0%	E
Pleurobema collina	James Spinymussel	High	Limited	2	100%	89%	E
Villosa perpurpurea	Purple Bean	High	Limited	1	100%	83%	E
Alasmidonta marginata	Elktoe	Low	V. High	6	67%	85%	—
Ligumia recta	Black Sandshell	Low	V. High	6	83%	94%	—
Truncilla truncata	Deertoe	Low	V. High	4	100%	69%	—
Anodontoides ferussacianus	Cylindrical Papershell	Low	High	5	100%	73%	—
Lampsilis fasciola	Wavyrayed Lampmussel	Low	High	4	100%	94%	—
Lampsilis ovata	Pocketbook	Low	High	6	100%	94%	—
Lasmigona compressa	Creek Heelsplitter	Low	High	5	80%	67%	—
Leptodea fragilis	Fragile Papershell	Low	High	6	100%	76%	—
Margaritifera margaritifera	Eastern Pearlshell	Low	High	9	67%	81%	—
Villosa iris	Rainbow	Low	High	4	100%	73%	—
RSGCN List: Other Federally Listed Invertebrate Taxa							
Nicrophorus americanus	American burying beetles	N/A	N/A	N/A	N/A	N/A	E

Lycaeides melissa samuelis	Karner blue butterfly	N/A	N/A	N/A	N/A	N/A	E
Neonympha mitchellii mitchellii	Mitchell's satyr butterfly	N/A	N/A	N/A	N/A	N/A	E
Microhexura montivaga	Spruce-fir moss spider	N/A	N/A	N/A	N/A	N/A	E
Succinea chittenangoensis	Chittenango ovate amber snail	N/A	N/A	N/A	N/A	N/A	T
Triodopsis platysayoides	Flat-spired three-toothed snail	N/A	N/A	N/A	N/A	N/A	T
Polygyriscus virginianus	Virginia fringed mountain snail	N/A	N/A	N/A	N/A	N/A	E
Stygobromus hayi	Hay's spring amphipod	N/A	N/A	N/A	N/A	N/A	E
Stygobromus kenki	Kenk's amphipod	N/A	N/A	N/A	N/A	N/A	C
Lirceus usdagalun	Lee County Cave Isopod	N/A	N/A	N/A	N/A	N/A	E
Antrolana lira	Madison Cave isopod	N/A	N/A	N/A	N/A	N/A	T

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; DL-Delisted; PDL-Proposed delisted; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

MAMMALS

Forty-five species of mammals have been designated as RSGCN in the Northeast based on their current conservation status, the percentage of their distribution contained in the region, the number of states that listed them as Species of Greatest Conservation Need in their 2005 State Wildlife Action Plans, and in response to emerging issues and threats (see Table 1.4). Seven mammal species are considered to be of "high" or "very high" concern and were listed in the majority of Northeastern Wildlife Action Plans: southern rock vole, Eastern small-footed myotis, Allegheny woodrat, Delmarva fox squirrel, long-tailed shrew, southern water shrew, New England cottontail, and the American water shrew (Eastern). They are also considered to be of "high" regional responsibility, as at least half of their range occurs in the Northeast (see Figure 1.1 for further explanation of selection and threshold criteria for RSGCN species).

Several taxonomic groups are well-represented among RSGCN, particularly bats, with fourteen species. One species, the Eastern small-footed myotis, is recognized as high responsibility and high concern throughout the Northeast. The RSGCN list also includes the federally endangered Indiana bat, which has

been the subject of considerable conservation research and attention (see http://www.fws.gov/midwest/endangered/mammals/inba/ for more information). Most of the northeastern species of bats are acutely threatened by the advent of white-nose syndrome (WNS), a fungal disease that alters the torpor cycle and metabolism of overwintering bats and leads to significant mortalities. The competitive State Wildlife Grants (SWG) program has provided funding to the Northeast states, and the RCN grant program has supported a series of research studies designed to elucidate the causal factors of WNS and to test possible therapeutic and preventive treatments for the disease (see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013 for project details; see also http://rcngrants.org/content/exploring-connection-between-arousal-patterns-hibernating-bats-and-white-nose-syndrome and http://rcngrants.org/content/laboratory-and-field-testing-treatments-white-nose-syndrome-immediate-funding-need-northeast for more information about these projects). Ten bat species (Indiana, Eastern small-footed, Northern, little brown, Southeastern, gray, silver-haired, hoary, Eastern red, and tricolored bat) are listed as SGCN in the majority of Northeast State Wildlife Action Plans.

When the SWG project began in the winter of 2008, WNS was only known to be present in New York and the adjacent states of Connecticut, Massachusetts, and Vermont. Unfortunately, by the spring of 2009, it had swept south all the way to western Virginia. Although the explosive growth of the WNS problem was unexpected, this grant was critical to preventing state agencies from being completely overwhelmed by the crisis. Eleven states participated in this grant: Pennsylvania, New Hampshire, Vermont, Connecticut, New Jersey, Delaware, Maryland, West Virginia, Virginia, Wisconsin, and New York. Although each state individually pursued a strategy to handle the WNS crisis, they shared common goals of developing a public reporting system, improving public outreach, coordinating sample requests, and improving their ability to monitor and track bat populations. They met and shared information on successful strategies to achieve these goals, and participated in federal efforts to coordinate the response. All states achieved these broad goals. The group also cooperated in identifying and selecting research priorities that were most important to states already experiencing heavy mortalities associated with WNS.

Four vole species are included on the RSGCN list, all of which are endemics with very limited distribution; the beach vole in Massachusetts, the Block Island vole in Rhode Island, the Penobscot meadow vole in Maine, and the southern rock vole in Virginia, West Virginia and Maryland. Two endemic squirrels are also ranked high on the RSGCN list: the Delmarva fox squirrel in Delaware, Maryland and Virginia and the Virginia northern flying squirrel in Virginia and West Virginia. The Delmarva fox squirrel has been the subject of considerable conservation attention since its early listing

under the federal Endangered Species Act in 1967. The status of this species has improved dramatically in recent decades, and delisting at the federal level is now a possibility. For more information about this species please visit (http://www.fws.gov/endangered/esa-library/pdf/squirrel.pdf). The Pungo white-footed deer mouse in Virginia is another endemic rodent of high responsibility but limited concern.

Nine shrew species are included on the RSGCN list, including the Maryland and the southern water shrews, which are localized and endemic to southern portions of the region and thus of "very high" regional concern. The long-tailed shrew has been identified as a SGCN in the majority of State Wildlife Action Plans in the Northeast.

The New England cottontail and the Allegheny woodrat are two formerly widespread small mammal species that are now considered RSGCN based on documented evidence of population decline. These species have also been identified as Species of Greatest Conservation Need in the majority of State Wildlife Action Plans in the Northeast, indicating that a general state of concern exists throughout most of the region. The New England cottontail has been the subject of substantial regional collaboration and coordination, including the development of regional survey and monitoring protocols for the species and the development of a comprehensive species restoration and conservation plan (please see: http://www.newenglandcottontail.org/sites/default/files/conservation_strategy_final_12-3-12.pdf and http://rcngrants.org/content/development-noninvasive-monitoring-tools-new-england-cottontail-populations-implications for more information about these projects).

The RSGCN list of open-water marine mammals included six whales (Sei, blue, humpback, sperm, northern right, and fin whales) which are also identified as SGCN in all the relevant Northeast states. The conservation of whales in the Northeast has been a significant concern since the depletion of local populations due to whaling in the mid nineteenth century, and this concern continues with the prospect of new offshore energy developments. Some Northeast whale species (e.g., blue, fin whales) have shown signs of recovery since a global whaling ban was imposed in the 1970s. Other Northeast whales, such as the North Atlantic right whale, have never recovered from the heavy harvest pressure prior to 1970. Inclusion of whales as SGCN in the State Wildlife Action Plans is complicated by the fact that multiple agencies have jurisdiction over the conservation of these mammals, including state marine fisheries programs, National Oceanographic and Atmospheric Administration (NOAA), USFWS, and the state wildlife agencies. Some U.S. states choose to include whales and other marine mammals such as seals in

their State Wildlife Action Plans, while others do not because of the extensive protections already afforded marine mammals under the Marine Mammal Protection Act. Additional information is available through NOAA's National Marine Fisheries Service Northeast Regional Office at http://www.nero.noaa.gov/Protected/mmp/ and the USFWS at www.fws.gov/le/USStatutes/MMPA.pdf.

Table 1.4. Mammal RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List: Mammals							
Scientific Name	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Microtus chrotorrhinus carolinensis	Southern Rock Vole	High	V. High	3	100%	53%	—
Myotis leibii	Eastern Small-footed Myotis	High	V. High	11	91%	78%	—
Neotoma magister	Allegheny Woodrat	High	V. High	8	75%	80%	—
Sciurus niger cinereus	Delmarva Fox Squirrel	High	V. High	4	75%	74%	EE (PDL)
Sorex dispar	Long-tailed Shrew	High	V. High	10	70%	52%	—
Sorex palustris punctulatus	Southern Water Shrew	High	V. High	4	100%	50%	—
Sylvilagus transitionalis	New England Cottontail	High	V. High	8	75%	81%	C
Sorex palustris albibarbis	American Water Shrew (Eastern)	High	High	9	0%	0%	—
Sorex cinereus fontinalis	Maryland Shrew	High	Mod.	3	0%	0%	—
Sorex fumeus	Smoky Shrew	High	Mod.	12	17%	64%	—
Condylura cristata	Star-nosed Mole	High	Low	14	7%	71%	—
Napaeozapus insignis	Woodland Jumping Mouse	High	Low	12	8%	75%	—
Parascalops breweri	Hairy-tailed Mole	High	Low	11	9%	70%	—
Corynorhinus townsendii virginianus	Virginia Big-eared Bat	High	Limited	2	100%	67%	E
Glaucomys sabrinus fuscus	Virginia Northern Flying Squirrel	High	Limited	2	100%	58%	DL
Microtus breweri	Beach Vole	High	Limited	1	100%	44%	—
Microtus pennsylvanicus provectus	Block Island Meadow Vole	High	Limited	1	0%	0%	—
Microtus pennsylvanicus shattucki	Penobscot Meadow Vole	High	Limited	1	0%	0%	—
Peromyscus leucopus easti	Pungo White-footed Deermouse	High	Limited	1	0%	0%	—
Sorex longirostris fisheri	Dismal Swamp	High	Limited	1	100%	56%	—

	Southeastern Shrew						
Eptesicus fuscus	Big Brown Bat	Low	High	14	29%	71%	—
Lynx rufus	Bobcat	Low	High	14	21%	50%	—
Martes americana	American Marten	Low	High	8	38%	50%	R
Phocoena phocoena	Harbor Porpoise	Low	High	5	40%	53%	—
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	Low	Limited	1	100%	44%	E
Myotis grisescens	Gray Myotis	Low	Limited	1	100%	56%	E
Balaenoptera borealis	Sei Whale	Low	V. High	4	0%	0%	E
Balaenoptera musculus	Blue Whale	Low	V. High	3	0%	0%	E
Balaenoptera physalus	Fin Whale	Low	V. High	6	33%	59%	E
Cryptotis parva	North American Least Shrew	Low	V. High	9	44%	68%	—
Eubalaena glacialis	North Atlantic Right Whale	Low	V. High	5	60%	67%	E
Lasionycteris noctivagans	Silver-haired Bat	Low	V. High	13	23%	70%	—
Lasiurus borealis	Eastern Red Bat	Low	V. High	14	21%	68%	R
Lasiurus cinereus	Hoary Bat	Low	V. High	13	38%	67%	—
Lynx canadensis	Canadian Lynx	Low	V. High	6	33%	73%	—
Megaptera novaeangliae	Humpback Whale	Low	V. High	5	40%	64%	E
Mustela nivalis	Least Weasel	Low	V. High	5	80%	56%	—
Myotis lucifugus	Little Brown Myotis	Low	V. High	14	36%	61%	R
Myotis septentrionalis	Northern Myotis	Low	V. High	14	43%	67%	—
Myotis sodalis	Indiana Myotis	Low	V. High	9	78%	76%	E
Perimyotis subflavus	Tricolored Bat	Low	V. High	14	36%	53%	R
Physeter macrocephalus	Sperm Whale	Low	V. High	2	0%	0%	E
Spilogale putorius	Eastern Spotted Skunk	Low	V. High	4	100%	71%	—
Sylvilagus obscurus	Appalachian Cottontail	Low	V. High	4	100%	65%	—
Synaptomys cooperi	Southern Bog Lemming	Low	V. High	13	46%	63%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; DL-Delisted; PDL-Proposed delisted; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

BIRDS

One hundred and ten species of birds have been identified as RSGCN in the Northeast, based on conservation status, the percentage of their range included in the region, and the number of states that listed them as SGCN in their 2005 State Wildlife Action Plans (see Table 1.5). Of these birds, ten species were ranked by the NEFWDTC as "very high" concern and "high" responsibility for the Northeast, which

encompasses more than 50% of their range. Each of these ten species is emblematic of an important and vulnerable Northeast habitat, including coastal beaches, coastal islands, salt marshes, early successional habitats, and unfragmented forests.

Thirty-five of the 110 RSGCN birds occur along the Northeast region's coast, either in salt marshes, beaches, dunes, or offshore islands. Throughout the Northeast, these habitats have been heavily impacted for centuries by human activities, including development, pollution, marsh filling and draining, spraying for mosquito control, and recreational use of beaches. In sum, these activities represent formidable threats to coastal bird species. Among these species, the piping plover, red knot, and roseate tern have been the subjects of considerable conservation attention in the Northeast due to their current or proposed listing under the Endangered Species Act.

Piping plovers, along with American oystercatchers, red knots, and least terns, rely on sandy beaches which are under constant threat across the Northeast from human development and recreational use. The red knot has also been the subject of regional conservation measures, and has recently been proposed for federal listing. This remarkable bird nests in the high arctic and overwinters in the southernmost part of South America. During spring migration, red knots stop along the Atlantic shores (especially Delaware Bay) to feed on horseshoe crab eggs. Conservation measures implemented for their breeding, migration and wintering areas also benefit other shorebirds including the willet, ruddy turnstone, semipalmated and purple sandpipers, and sanderling that inhabit the Delaware Bay and other estuaries along the Northeast coast.

Colonial nesting water birds represent an important guild that includes gulls, terns, skimmers, herons, and egrets. All of these species had declined significantly by the early 20th century as a result of overharvest for the millinery trade. By the latter half of that century, species such as terns had been displaced from many colonies by the increasing gull populations, although these populations have declined somewhat in recent years as landfills have either closed or implemented more effective sanitation measures. Roseate terns in particular are highly vulnerable, since the bulk of the population is concentrated in a handful of colonies from New York to Maine. In addition to the ongoing threat from gulls, these colonies are also subject to risks such as oil spills and sea-level rise.

Sea-level rise from climate change is expected to be a major threat to the Northeast's extensive salt marsh systems, many of which are already heavily degraded from past ditching, filling, and associated coastal development. The Northeast encompasses almost the entire breeding range of the saltmarsh sparrow, and has high responsibility for black rail, both of which nest in salt marsh habitat. And while freshwater marshes are generally better protected today than in the past, they remain far less common than they were historically, and they are still subject to degradation from pollution and development.

The Black Duck Joint Venture, a partnership established under the North American Waterfowl Management Plan, has brought together scientists, conservationists, and hunting organizations across the species' historic range to coordinate conservation efforts including monitoring, research, and communications. Based on best available science, this Joint Venture has established a species-wide population goal of 640,000 black ducks across both the Atlantic and Mississippi flyways. These efforts have benefited other wetland and marsh species, such as the bitterns, rails, sedge and marsh wrens, herons, egrets, grebes, and shorebirds through conservation of freshwater marshes in the region.

According to the Northeast Regional Conservation Assessment (Anderson and Olivero Sheldon 2011) there have been substantial changes, both increases and declines, in wetland bird populations over the past 40 years. Species change is correlated with the degree of conversion in the buffer zone and with the density of nearby roads. River-related wetlands have seen the most severe declines, and tidal marshes have seen the least. Some changes appear to be species-specific and may not be tightly related to local wetland characteristics.

Bird species associated with early successional communities including grasslands, shrub-scrub habitats, and young forests are also well represented, with 27 species on the RSGCN list. These include a mix of grassland obligates such as upland sandpiper, Henslow's sparrow, and Eastern meadowlark; shrubland species like prairie warbler and brown thrasher; and species like Eastern whip-poor-will and American woodcock that require a sometimes complex mix of seral stages to complete their life cycles. The amount and distribution of these habitat types declined significantly across the Northeast during the twentieth century, as abandoned farm fields matured into forests and human developments replaced many former old-field areas. Over longer time scales, early successional habitats may not have been as widespread during pre-settlement times when the landscapes of the Northeast were more extensively forested.

The only early successional species for which the Northeast has high responsibility is the blue-winged warbler, with 48% of the continental population in the region, while the closely related golden-winged warbler has been shifting its range north and west and is now far less common than it was only 20-25 years ago. Species-specific conservation initiatives for early successional birds include the Golden-winged Warbler Working Group, Woodcock Management Plan (http://timberdoodle.org/), and National Bobwhite Quail Initiative. There are also several state or regional efforts to manage these habitats on a broader scale, as well as for the regionally endemic New England cottontail. Such efforts have the potential to benefit shrubland and young forest birds even if birds are not the direct target of the management activity.

According to the Conservation Status Assessment (Anderson and Olivero Sheldon 2011), among the 22 bird species that preferentially breed in grasslands and fields, 17 have experienced persistent, widespread declines. These include Eastern meadowlark, field sparrow, northern bobwhite, ring-necked pheasant (a non-native), brown thrasher, song sparrow, common yellowthroat, grasshopper sparrow, red-winged blackbird, killdeer, savannah sparrow, golden-winged warbler, vesper sparrow, yellow-breasted chat, blue-winged warbler, prairie warbler, and bobolink. This trend probably reflects the expansion of these species' habitat during the period of widespread farming and pasturing followed by agricultural abandonment and a return of the land to forest.

Among forest species, the Northeast has extremely high responsibility for Bicknell's thrush, which is endemic to high-elevation conifer forests from New York to Nova Scotia. This species is vulnerable to development and degradation of its sensitive breeding habitat, as well as during the non-breeding season (see below), and has recently been proposed for listing under the ESA. The Northeast has responsibility for three other forest songbirds; the wood thrush, scarlet tanager, and cerulean warbler. These and many other species are known to be sensitive to habitat fragmentation and edge effects, thus making human activities such as roads and development important threats. According to the Conservation Assessment (Anderson and Olivero Sheldon 2011), there have been substantial changes, both increases and declines, in forest bird abundances over the past 40 years. Species abundance changes have been correlated with degree of fragmentation, with the road-riddled oak-pine forests showing declines in 11 species and increases in 10 species. Changes in boreal bird populations appeared less extensive, suggesting that the impact of habitat fragmentation on bird abundance has been greater than the impact of logging. The data are limited, however, and more research is needed to confirm this pattern.

In fragmented landscapes and/or small habitat patches, direct threats such as predation and brown-headed cowbird brood parasitism are higher, often rendering such habitats into ecological sinks. Emerging threats include changes in forest composition that may in turn result from invasive insects or diseases and/or climate change. It is also important to note that not all forest birds are the same, with some requiring older or younger seral stages or different levels of structural diversity. In the north of the region, several species restricted to boreal conifer forests and wetlands are either declining or their status is poorly known (e.g., olive-sided flycatcher, rusty blackbird, bay-breasted warbler), and thus continued or increased conservation attention is warranted.

Several additional species do not fit easily into one broad habitat category. These include the golden eagle, a historic but extirpated breeder that is now known to winter in significant numbers in the Appalachians, and the peregrine falcon, which remains sensitive to disturbance at cliff nesting sites, even though it is no longer listed under the Endangered Species Act. Other raptors, especially the bald eagle and osprey, have shown dramatic comebacks in the past 20-30 years as a result of intense conservation action, including the banning of DDT, protection of nest sites, and active hacking programs. At the same time, there is increasing concern for entire guilds such as aerial insectivores (swifts, swallows, nightjars, flycatchers), which are showing significant and unexplained declines across the Northeast.

Because the majority of birds on the RSGCN list are migratory, it is increasingly important to acknowledge that many of them face threats outside a given state or even the Northeast as a whole. Birds can be affected by habitat loss, disturbance, altered food supplies, and even direct human persecution at any stage of their annual cycle, and in some cases these threats are highest in the non-breeding season. For example, almost all Bicknell's thrushes winter on the Caribbean island of Hispaniola, where deforestation continues to be an important issue. If habitat conservation does not occur on this species' winter grounds, there is only so much the Northeast can do to ensure its survival. Similarly, migratory shorebirds breed in the arctic, winter in South America, and only occur in the region during stopover. States are increasingly aware of their role in full life cycle conservation for these species, even though they do not breed in the region. In an effort to assist the states in including international conservation issues and actions within their State Wildlife Action Plans, the Association of Fish and Wildlife Agencies (AFWA) has provided draft wording, information, and tools that can be used to develop an international section or to integrate full lifecycle conservation into these Plans. It is important to note that SWG grant

funds can be used for international conservation efforts as long as they connect to species and objectives identified in the SWAP (Hahn 2013).

Table 1.5. Bird RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List: Birds							
Scientific Name [B,M,W,A,E]=[Breeding, Migratory, Wintering, Atlantic, Eastern population]	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Ammodramus caudacutus	Saltmarsh Sparrow	High	V. High	10	60%	85%	R
Calidris canutus [M]	Red Knot	High	V. High	8	38%	82%	PT,R
Catharus bicknelli	Bicknell's Thrush	High	V. High	6	83%	93%	PE,R
Charadrius melodus [A]	Piping Plover	High	V. High	11	82%	91%	ET,R
Falco peregrinus [E]	Peregrine Falcon	High	V. High	14	71%	100%	—
Hylocichla mustelina	Wood Thrush	High	V. High	14	50%	91%	R
Laterallus jamaicensis	Black Rail	High	V. High	7	86%	85%	—
Setophaga cerulea	Cerulean Warbler	High	V. High	13	54%	78%	—
Sterna dougallii	Roseate Tern	High	V. High	9	67%	86%	ET
Vermivora cyanoptera	Blue-winged Warbler	High	V. High	14	50%	77%	R
Aquila chrysaetos [B,W]	Golden Eagle	High	High	12	83%	87%	—
Piranga olivacea	Scarlet Tanager	High	High	14	36%	92%	—
Passerculus sandwichensis princeps [M,W]	Ipswich Sparrow	High	Low	2	100%	55%	—
Melospiza georgiana nigrescens	Coastal Plain Swamp Sparrow	High	Limited	3	0%	0%	—
Accipiter gentilis	Northern Goshawk	Low	V. High	11	55%	79%	—
Ammodramus henslowii	Henslow's Sparrow	Low	V. High	13	69%	71%	—
Ammodramus maritimus	Seaside Sparrow	Low	V. High	10	40%	92%	—
Ammodramus savannarum	Grasshopper Sparrow	Low	V. High	14	71%	93%	R
Anas rubripes [B,W]	American Black Duck	Low	V. High	14	21%	93%	R
Antrostomus vociferus	Eastern Whip-poor-will	Low	V. High	14	36%	81%	R
Arenaria interpres [M,W]	Ruddy Turnstone	Low	V. High	10	10%	91%	—
Asio flammeus	Short-eared Owl	Low	V. High	13	77%	79%	—
Asio otus	Long-eared Owl	Low	V. High	14	50%	90%	—
Bartramia longicauda	Upland Sandpiper	Low	V. High	14	93%	86%	R
Botaurus lentiginosus	American Bittern	Low	V. High	14	71%	85%	R
Bubulcus ibis	Cattle Egret	Low	V. High	—	—	—	—
Calidris maritima [M,W]	Purple Sandpiper	Low	V. High	8	25%	89%	R
Cardellina canadensis	Canada Warbler	Low	V. High	13	23%	88%	—
Chlidonias niger	Black Tern	Low	V. High	—	—	—	—

Chordeiles minor	Common Nighthawk	Low	V. High	14	64%	83%	R
Circus cyaneus	Northern Harrier	Low	V. High	14	86%	95%	—
Cistothorus platensis	Sedge Wren	Low	V. High	13	85%	77%	R
Coccyzus erythropthalmus	Black-billed Cuckoo	Low	V. High	14	36%	90%	—
Colinus virginianus	Northern Bobwhite	Low	V. High	12	25%	87%	—
Contopus cooperi	Olive-sided Flycatcher	Low	V. High	12	33%	62%	—
Dolichonyx oryzivorus	Bobolink	Low	V. High	14	50%	83%	R
Egretta caerulea	Little Blue Heron	Low	V. High	10	70%	84%	—
Egretta thula	Snowy Egret	Low	V. High	12	67%	82%	R
Egretta tricolor	Tricolored Heron	Low	V. High	—	—	—	—
Euphagus carolinus [B,W]	Rusty Blackbird	Low	V. High	11	45%	80%	—
Falcipennis canadensis	Spruce Grouse	Low	V. High	—	—	—	R
Gavia immer	Common Loon	Low	V. High	—	—	—	R
Gelochelidon nilotica	Gull-billed Tern	Low	V. High	—	—	—	—
Geothlypis formosa	Kentucky Warbler	Low	V. High	10	50%	70%	R
Haematopus palliatus	American Oystercatcher	Low	V. High	9	44%	86%	R
Helmitheros vermivorum	Worm-eating Warbler	Low	V. High	11	45%	89%	R
Histrionicus histrionicus [E,W]	Harlequin Duck	Low	V. High	—	—	—	—
Ixobrychus exilis	Least Bittern	Low	V. High	14	86%	89%	R
Lanius ludovicianus	Loggerhead Shrike	Low	V. High	12	58%	65%	—
Limnothlypis swainsonii	Swainson's Warbler	Low	V. High	—	—	—	—
Melanerpes erythrocephalus	Red-headed Woodpecker	Low	V. High	—	—	—	—
Numenius phaeopus [M]	Whimbrel	Low	V. High	—	—	—	—
Nyctanassa violacea	Yellow-crowned Night-Heron	Low	V. High	11	64%	93%	—
Nycticorax nycticorax	Black-crowned Night-Heron	Low	V. High	14	57%	88%	—
Parkesia motacilla	Louisiana Waterthrush	Low	V. High	14	14%	87%	R
Picoides dorsalis	American Three-toed Woodpecker	Low	V. High	—	—	—	—
Pipilo erythrophthalmus	Eastern Towhee	Low	V. High	14	14%	93%	R
Podilymbus podiceps	Pied-billed Grebe	Low	V. High	14	79%	87%	—
Pooecetes gramineus	Vesper Sparrow	Low	V. High	14	57%	80%	—
Porzana carolina	Sora	Low	V. High	14	64%	72%	—
Protonotaria citrea	Prothonotary Warbler	Low	V. High	10	50%	82%	R
Rallus elegans	King Rail	Low	V. High	13	54%	84%	R
Rynchops niger	Black Skimmer	Low	V. High	—	—	—	R
Scolopax minor	American Woodcock	Low	V. High	—	—	—	R
Setophaga castanea	Bay-breasted Warbler	Low	V. High	—	—	—	—
Setophaga discolor	Prairie Warbler	Low	V. High	14	21%	88%	R
Spizella pusilla	Field Sparrow	Low	V. High	14	36%	83%	R
Sterna forsteri	Forster's Tern	Low	V. High	—	—	—	—
Sterna hirundo	Common Tern	Low	V. High	13	62%	90%	R
Sterna paradisaea	Arctic Tern	Low	V. High	—	—	—	—
Sternula antillarum	Least Tern	Low	V. High	11	82%	90%	R
Sturnella magna	Eastern Meadowlark	Low	V. High	14	43%	86%	R

Thryomanes bewickii	Bewick's Wren	Low	V. High	5	20%	100%	—
Toxostoma rufum	Brown Thrasher	Low	V. High	14	43%	92%	R
Tringa semipalmata	Willet	Low	V. High	11	18%	83%	R
Tyto alba	Barn Owl	Low	V. High	12	67%	88%	—
Vermivora chrysoptera	Golden-winged Warbler	Low	V. High	12	75%	83%	PE
Antrostomus carolinensis	Chuck-will's-widow	Low	High	—	—	—	—
Bonasa umbellus	Ruffed Grouse	Low	High	14	14%	92%	R
Buteo lineatus	Red-shouldered Hawk	Low	High	14	50%	83%	R
Buteo platypterus	Broad-winged Hawk	Low	High	14	43%	88%	—
Calidris alba [M,W]	Sanderling	Low	High	9	33%	88%	R
Calidris pusilla [M]	Semipalmated Sandpiper	Low	High	8	25%	85%	R
Catharus fuscescens	Veery	Low	High	—	—	—	—
Certhia americana	Brown Creeper	Low	High	—	—	—	—
Chaetura pelagica	Chimney Swift	Low	High	14	21%	88%	—
Cistothorus palustris	Marsh Wren	Low	High	14	36%	81%	R
Coturnicops noeboracensis [M]	Yellow Rail	Low	High	—	—	—	—
Empidonax traillii	Willow Flycatcher	Low	High	13	8%	93%	R
Empidonax virescens	Acadian Flycatcher	Low	High	—	—	—	—
Eremophila alpestris	Horned Lark	Low	High	—	—	—	—
Falco sparverius	American Kestrel	Low	High	14	36%	86%	—
Gallinago delicata	Wilson's Snipe	Low	High	—	—	—	—
Gallinula galeata	Common Gallinule	Low	High	14	50%	92%	—
Icteria virens	Yellow-breasted Chat	Low	High	—	—	—	—
Limosa fedoa [M]	Marbled Godwit	Low	High	—	—	—	—
Mniotilta varia	Black-and-white Warbler	Low	High	—	—	—	R
Phalaropus tricolor	Wilson's Phalarope	Low	High	—	—	—	—
Piranga rubra	Summer Tanager	Low	High	—	—	—	—
Rallus longirostris	Clapper Rail	Low	High	—	—	—	R
Riparia riparia	Bank Swallow	Low	High	14	29%	76%	R
Setophaga americana	Northern Parula	Low	High	14	36%	91%	—
Setophaga caerulescens	Black-throated Blue Warbler	Low	High	13	31%	88%	—
Setophaga citrina	Hooded Warbler	Low	High	—	—	—	—
Setophaga fusca	Blackburnian Warbler	Low	High	—	—	—	R
Setophaga tigrina	Cape May Warbler	Low	High	—	—	—	—
Setophaga virens	Black-throated Green Warbler	Low	High	—	—	—	—
Somateria mollissima	Common Eider	Low	High	—	—	—	R
Spiza americana	Dickcissel	Low	High	—	—	—	—
Vireo flavifrons	Yellow-throated Vireo	Low	High	14	21%	92%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

REPTILES AND AMPHIBIANS

REPTILES

The RSGCN list includes 29 reptile species, among them 14 turtles, two lizards, and 13 snakes (see Table 1.6). Of these species, six (wood turtle, bog turtle, Northern diamondback terrapin, Northern coal skink, Northern black racer, and Northern red-bellied cooter) are considered to be of high regional responsibility for management as well as high or very high regional conservation concern. These high-priority reptile species, along with many of the other reptilian RSGCN, are under threat from multiple sources, including habitat loss, habitat fragmentation, water pollution, habitat conversion to agriculture, and illegal harvest.

Turtles on the RSGCN list include four species that have both high regional responsibility and high or very high regional concern. One of these is the bog turtle, a small species associated with calcareous wetlands in the Northeast. The bog turtle is currently protected under the federal Endangered Species Act and has been the subject of several collaborative conservation initiatives, including efforts led by the USFWS and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. The diamondback terrapin, a symbol of the state of Maryland and the Chesapeake Bay ecosystem, is also ranked as high responsibility and high regional concern. Two other species of very high concern, the Blanding's turtle and the Wood turtle, have been the subject of recent regional conservation efforts sponsored by the RCN Grant Program and the Northeast Partners in Amphibian and Reptile Conservation (NEPARC) in response to evidence of recent population declines. See Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013 and the following websites (http://www.northeastparc.org/workinggroups/blandings.htm and http://www.northeastparc.org/workinggroups/woodturtle.htm and http://rcngrants.org/content/wood-turtle-glyptemys-insculpta-northeastern-united-states-status-assessment-and) for links to these projects.

Five species of marine sea turtles are included on the RSGCN list (the loggerhead, green turtle, leatherback, Atlantic hawksbill, and Kemp's Ridley sea turtle), all of which are protected under the U.S. Endangered Species Act. Because of their broad distributions but significant range-wide declines, these species are considered to be low regional responsibility but of very high conservation concern.

Thirteen species of snakes are included on the RSGCN list, of which one (the Northern black racer) is both high regional responsibility and high regional concern. The RSGCN list includes both of the region's venomous species, the copperhead and the timber rattlesnake. The discovery of skin lesions on timber rattlesnakes at sites near Boston and elsewhere in the northern part of the species' range created considerable concern for the long-term viability of this iconic regional species. However, a project funded through the RCN Grant Program suggests that, because snakes with fungal lesions show no other signs of health impairment and fewer lesions were observed in the fall than in the spring, snakes may be recovering from fungal dermatitis over the summer. With funding from the RCN Grant Program, researchers sampled 98 snakes in 9 populations and found a wide range of dermatitis prevalence from 0-53% and averaging 33% (McBride et al. 2015). Seventy-five percent of these fungal lesions were attributed to *Ophidiomyces ophiodiicola*, which has been implicated by other researchers as a possible cause of dermatitis in snakes. Interestingly, dermatitis was more prevalent in the spring (53%) than in the fall (17%). Infected snakes were otherwise healthy based on analysis of blood samples and many biologists believe snakes are recovering from dermatitis over the warm summer months. In general, the report finds that dermatitis is unlikely to be a serious concern in timber rattlesnake populations in the Northeast (see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013 and http://rcngrants.org/content/assessment-and-evaluation-prevalence-fungal-dermatitis-new-england-timber-rattlesnake for additional information).

The RSGCN list includes just two lizards, both skinks in the genus *Plestiodon*. The Northern coal skink is a species of high regional responsibility and very high concern, while the broad-headed skink is considered to be of low regional responsibility but high conservation concern.

AMPHIBIANS

The RSGCN list for the Northeast includes 35 species of amphibians, of which 28 are salamanders, five are frogs and two are toads. Three species, the longtail salamander, red salamander, and New Jersey chorus frog, are high regional responsibility as well as high regional concern. Amphibian species in the

Northeast are under threat from many different causal factors, including wetland loss, water pollution, groundwater contamination, exurban and suburban sprawl, increased habitat fragmentation from roads and new human developments, and exotic, non-native diseases.

The New Jersey chorus frog is both high regional responsibility and high regional concern. Frog populations have declined in the United States and elsewhere following the introduction of exotic diseases such as chytridiomycosis and ranavirus, for which there appears to be relatively little immunity among native amphibian populations.

The Appalachian Mountains are a well-known center of endemism for salamander taxa, including many narrowly endemic and rare species such as the Cheat Mountain, Shenandoah, and Peaks of Otter salamanders. Ten species of salamanders on the RSGCN list are in the genus *Plethodon*, which contains many of the most narrowly endemic, range-restricted taxa. The RSGCN list also includes four species of the genus *Ambystoma*, the mole salamanders.

The hellbender, a very large aquatic salamander associated with major rivers in the eastern United States, has been identified as a high-priority species for the RCN grant program. Populations of hellbenders have declined precipitously due to water pollution, sedimentation, and the damming and channelization of major rivers throughout the eastern United States. In addition, chytrid fungi have been responsible for reducing captive populations and are thought to be causing additional declines in wild populations of the species. The Ozark subspecies of the hellbender was added to the federal Endangered Species list in 2011, and a similar listing for the eastern subspecies is being contemplated. Conserving the hellbender will require integrated conservation action on the part of state, federal, and private conservation agencies, exactly the sort of partnership that could be supported and fostered through the RCN Grant Program.

Table 1.6. Amphibian and Reptile RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List: Reptiles and Amphibians							
Scientific Name	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Glyptemys insculpta	Wood Turtle	High	V. High	13	92%	78%	R
Glyptemys muhlenbergii	Bog Turtle	High	V. High	9	67%	84%	TS,R
Malaclemys terrapin terrapin	Northern Diamondback Terrapin	High	V. High	7	14%	0%	E, R
Plestiodon anthracinus anthracinus	Northern Coal Skink	High	V. High	4	75%	50%	—
Coluber constrictor constrictor	Northern Black Racer	High	High	6	17%	0%	—
Eurycea longicauda	Longtail Salamander	High	High	8	38%	79%	—
Pseudacris kalmi	New Jersey Chorus Frog	High	High	5	40%	61%	—
Pseudemys rubriventris	Northern Red-bellied Cooter	High	High	9	44%	68%	—
Pseudotriton ruber	Red Salamander	High	High	8	38%	74%	—
Desmognathus monticola	Seal Salamander	High	Mod.	4	25%	69%	—
Gyrinophilus porphyriticus porphyriticus	Northern Spring Salamander	High	Mod.	6	33%	67%	—
Plethodon hoffmani	Valley and Ridge Salamander	High	Mod.	4	25%	60%	—
Desmognathus fuscus	Northern Dusky Salamander	High	Low	14	14%	64%	—
Desmognathus ochrophaeus	Allegheny Mountain Dusky Salamander	High	Low	7	57%	50%	—
Diadophis punctatus edwardsii	Northern Ring-necked Snake	High	Low	6	33%	69%	—
Eurycea bislineata	Northern Two-lined Salamander	High	Low	14	21%	81%	—
Gyrinophilus porphyriticus	Spring Salamander	High	low	12	25%	100%	R
Gyrinophilus porphyriticus duryi	Kentucky Spring Salamander	High	Low	2	0%	0%	—
Plethodon cylindraceus	White-spotted Slimy Salamander	High	low	2	50%	70%	—
Plethodon glutinosus	Slimy Salamander	High	Low	8	50%	56%	—
Plethodon punctatus	White-spotted Salamander	High	Low	2	100%	58%	—
Plethodon wehrlei	Wehrle's Salamander	High	Low	5	40%	64%	—
Storeria dekayi dekayi	Brownsnake	High	Low	14	21%	64%	—
Thamnophis brachystoma	Short-headed Gartersnake	High	Low	2	50%	58%	—
Desmognathus orestes	Blue Ridge Dusky Salamander	High	Limited	1	100%	56%	—
Gyrinophilus subterraneus	West Virginia Spring Salamander	High	Limited	1	100%	64%	—
Plethodon hubrichti	Peaks of Otter Salamander	High	Limited	1	100%	56%	—
Plethodon kentucki	Cumberland Plateau Salamander	High	Limited	2	50%	56%	—
Plethodon nettingi	Cheat Mountain Salamander	High	Limited	1	100%	64%	T

Plethodon shenandoah	Shenandoah Salamander	High	Limited	1	100%	56%	E
Plethodon virginia	Shenandoah Mountain Salamander	High	Limited	2	0%	0%	—
Virginia pulchra	Mountain Earthsnake	High	Limited	4	100%	68%	—
Ambystoma laterale & jeffersonianum	Blue-spotted Salamander complex	Low	V. High	8	88%	79%	—
Ambystoma tigrinum	Tiger Salamander	Low	V. High	6	67%	70%	—
Aneides aeneus	Green Salamander	Low	V. High	4	100%	61%	—
Caretta caretta	Loggerhead	Low	V. High	9	67%	81%	ET ,R
Cemophora coccinea copei	Northern Scarletsnake	Low	V. High	5	40%	67%	—
Chelonia mydas	Green Turtle	Low	V. High	9	56%	64%	ET
Clemmys guttata	Spotted Turtle	Low	V. High	14	79%	77%	R
Crotalus horridus	Timber Rattlesnake	Low	V. High	13	54%	80%	—
Cryptobranchus alleganiensis	Eastern Hellbender	Low	V. High	5	100%	78%	—
Dermochelys coriacea	Leatherback	Low	V. High	9	44%	65%	E
Emydoidea blandingii	Blanding's Turtle	Low	V. High	5	100%	77%	—
Eretmochelys imbricata imbricata	Atlantic Hawksbill	Low	V. High	4	0%	0%	E
Heterodon platirhinos	Eastern Hog-nosed Snake	Low	V. High	12	50%	72%	R
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Low	V. High	10	50%	64%	E
Lithobates virgatipes	Carpenter Frog	Low	V. High	4	100%	71%	—
Pantherophis guttatus	Red Cornsnake	Low	V. High	5	60%	67%	—
Pseudacris brachyphona	Mountain Chorus Frog	Low	V. High	4	75%	73%	—
Pseudotriton montanus montanus	Eastern Mud Salamander	Low	V. High	3	100%	55%	—
Regina septemvittata	Queen Snake	Low	V. High	8	63%	68%	—
Scaphiopus holbrookii	Eastern Spadefoot	Low	V. High	11	55%	83%	—
Terrapene carolina carolina	Eastern Box Turtle	Low	V. High	6	83%	72%	R
Thamnophis sauritus	Eastern Ribbonsnake	Low	V. High	14	50%	100%	—
Acris crepitans	Northern Cricket Frog	Low	High	8	50%	74%	—
Agkistrodon contortrix	Copperhead	Low	High	10	70%	70%	—
Ambystoma opacum	Marbled Salamander	Low	High	12	58%	70%	R
Anaxyrus fowleri	Fowler's Toad	Low	High	13	54%	70%	—
Apalone spinifera spinifera	Spiny Softshell	Low	High	7	57%	67%	—
Graptemys geographica	Common Map Turtle	Low	High	7	100%	60%	—
Liochlorophis vernalis	Smooth Greensnake	Low	High	12	58%	71%	—
Lithobates pipiens	Northern Leopard Frog	Low	High	11	45%	70%	—
Necturus maculosus	Mudpuppy	Low	High	8	75%	60%	—
Opheodrys aestivus	Rough Greensnake	Low	High	7	71%	76%	—
Plestiodon laticeps	Broad-headed Skink	Low	High	6	33%	64%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

FISHES

One hundred and one fish species have been identified as RSGCN in the Northeast, making them one of the most numerous vertebrate groups listed (see Table 1.7). These fish taxa include representatives of all of the major fish families found in the Northeast, with certain families (Percidae, Cyprinidae, Salmonidae) particularly well represented. Associated habitats for these fish species span the full range of northeastern aquatic environments, including freshwater, estuarine, and marine systems. Migratory (both anadromous and catadromous) species as well as non-migratory species are represented. This list of species reflects the best current knowledge about the conservation status of fish species in the Northeast. It was recently updated by the members of NEFWDTC, using the American Fisheries Society's 2013 list for the most recent taxonomic classification of these species.

Human activities continue to impact aquatic systems across the Northeast, and fish populations face many threats. The recent American Fisheries Society and USGS analysis (http://www.actionbioscience.org/biodiversity/walsh.html) describes the most significant threats to freshwater fish. Destruction or modification of habitat, including dam construction, stream channelization, mining, conversion of forests to agriculture, and urban and suburban development, can lead to declines in population and reduction in these species' range. Pollution from point and non-point source contaminants likewise reduces water quality to the point where only highly tolerant fish species survive. Sedimentation of fine particulates can also smother bottom substrates, causing declines in bottom-dwelling species that require clean substrates and good water quality.

Introduction of non-native species, which may result in hybridization, competition, and predation, has also impacted native species. Examples include the Northern snakehead (now established in the Potomac River), the rusty crayfish, fishhook water flea, and diatoms such as didymo. These and other non-native species can alter freshwater aquatic environments, which in turn effects all species in the system,

including fish RSGCN. Parasitism and diseases such as whirling disease (introduced from Europe) have affected many wild and hatchery populations of trout and salmon species in the United States and Canada. Overharvesting for commercial, recreational, scientific, or educational purposes has also historically affected some species such as sturgeon.

Global climate change and related shifts in weather and rainfall patterns across the Northeast likewise have the potential to alter water quality and quantity in many streams, lakes, and rivers. The results can be detrimental for many fish species. Climate change can also exacerbate the other threats listed above. Most of these threats apply to freshwater, estuarine, and marine fish species in the Northeast.

From a taxonomic perspective, most of the fish RSGCN in the Northeast are small-bodied freshwater species in the families Percidae (darters and perches) and Cyprinidae (chubs and minnows), a pattern which holds true across North America (http://www.actionbioscience.org/biodiversity/walsh.html). These smaller fish are primarily threatened by alteration of their habitats, whether from sedimentation, construction of dams and similar barriers, or other forms of aquatic habitat destruction and contamination.

The RSGCN list also includes several of the more primitive living fishes, among them six species of lamprey, three species of sturgeon, and the paddlefish. These fishes are truly ancient, with the first sturgeon fossils appearing in the Triassic Period and forms similar to the modern sturgeon appearing by the Late Cretaceous, with little subsequent change in morphology. Populations of these distinctive fish species have been greatly reduced through overharvest and habitat alteration. The paddlefish is one of only two species in its lineage to have survived until modern times. The other recent species of paddlefish (formerly found in China) is now thought to be extinct.

Fourteen cartilaginous fishes, including seven sharks, six skates, and one stingray are also listed. These fish are all marine or estuarine in their habitat associations. The list of sharks includes two, the short-finned mako and the thresher shark, which are considered regulated game species that may be harvested by saltwater anglers. Global populations of sharks and many other cartilaginous fishes have been decimated in recent decades through over-harvest for the commercial market.

Other fish species on the list are popular with recreational or commercial anglers. These include the Atlantic salmon, American and hickory shad, blueback and Atlantic herring, American eel, brook trout,

lake trout, and Atlantic mackerel. Several of these species have been the subject of intensive conservation efforts, including habitat conservation work to benefit wild runs of Atlantic salmon in Maine; dam removal and fish passage improvements throughout the mid-Atlantic to benefit shad and herring species; and the Eastern Brook Trout Joint Venture which has been working to restore habitat and increase connectivity for brook trout across the eastern United States.

Most of the species that are harvested for recreational and commercial purposes are imperiled for a variety of reasons not limited to simple harvest management. Dams and habitat destruction have played a significant role in the decline of Atlantic salmon, shads and herrings, for example. Coordinated fisheries management efforts have not yet yielded recoveries of those stocks. Some genetic strains of Atlantic salmon in Maine are now federally listed as endangered. Non-native species have also played a role in the decline of harvested fish species, most notably with the advent of non-native sea lampreys, which hastened the decline of lake trout in the Great Lakes beginning in the 1950s. Climate change also poses a significant potential threat to recreational fisheries. Brook trout are cold water species that are sensitive to warming temperatures and are thus especially vulnerable under warmer climate regimes. Climate-driven changes increases in water temperature are exacerbated by the loss of shading vegetation in riparian zones surrounding the cold water streams that provide habitat for these fish.

Several up-to-date sources of information can be useful to the Northeast states in developing the marine component of their Wildlife Action Plans. NOAA's National Marine Fisheries Service and the Atlantic States Marine Fisheries Commission maintain status information on species of conservation need. The Atlantic Coast Fish Habitat Partnership's recent plan, which presents important overview information on many of the Northeast states SGCN and RSGCN species, can be found at http://fishhabitat.org/partnership/atlantic-coastal-fish-habitat-partnership. This plan summarizes key species, habitat, threat, and conservation action information. Recent review articles by the American Fisheries Society and USGS with information about fish declines in North America can be found at http://www.actionbioscience.org/biodiversity/walsh.html.

Table 1.7. Fish RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List: Fishes							
Scientific Name	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Acipenser brevirostrum	Shortnose Sturgeon	High	V. High	12	58%	84%	E,R
Acipenser oxyrinchus	Atlantic Sturgeon	High	V. High	12	67%	71%	—
Ammodytes americanus	American Sand Lance	High	V. High	2	0%	0%	—
Enneacanthus obesus	Banded Sunfish	High	V. High	11	64%	78%	—
Fundulus luciae	Spotfin Killifish	High	V. High	6	50%	70%	—
Ichthyomyzon greeleyi	Mountain Brook Lamprey	High	V. High	4	75%	88%	—
Notropis bifrenatus	Bridle Shiner	High	V. High	13	54%	95%	—
Percina macrocephala	Longhead Darter	High	V. High	3	67%	87%	—
Alosa aestivalis	Blueback Herring	High	High	13	23%	90%	SC
Alosa mediocris	Hickory Shad	High	High	10	30%	67%	—
Alosa pseudoharengus	Alewife	High	High	12	42%	95%	SC,R
Etheostoma vitreum	Glassy Darter	High	High	4	75%	92%	—
Exoglossum laurae	Tonguetied Minnow	High	High	4	50%	83%	—
Notropis amoenus	Comely Shiner	High	High	8	38%	93%	—
Percina notogramma	Stripeback Darter	High	High	4	50%	92%	—
Percina peltata	Shield Darter	High	High	8	25%	93%	—
Apeltes quadracus	Fourspine Stickleback	High	Mod.	12	42%	64%	—
Cottus Girardi	Potomac Sculpin	High	Mod.	4	50%	94%	—
Dasyatis centroura	Roughtail Stingray	High	Mod.	0	0%	0%	—
Etheostoma variatum	Variegate Darter	High	Mod.	4	50%	83%	—
Leucoraja garmani	Rosette Skate	High	Mod.	0	0%	0%	—
Microgadus tomcod	Atlantic Tomcod	High	Mod.	6	0%	0%	—
Notropis procne	Swallowtail Shiner	High	Mod.	8	25%	95%	—
Noturus flavus	Stonecat	High	Mod.	8	25%	93%	—
Opsanus tau	Oyster Toadfish	High	Mod.	1	0%	0%	—
Percina oxyrhynchus	Sharpnose Darter	High	Mod.	3	33%	89%	—
Pseudopleuronectes americanus	Winter Flounder	High	Mod.	2	0%	0%	—
Tautogolabrus adspersus	Cunner	High	Mod.	2	0%	0%	—
Alopias vulpinus	Common Thresher Shark	High	Low	0	0%	0%	—
Amblyraja radiate	Thorny Skate	High	Low	0	0%	0%	SC
Clupea harengus	Atlantic Herring	High	Low	2	0%	0%	—
Cottus caeruleomentum	Blue Ridge Sculpin	High	Low	5	40%	87%	—
Cyprinella analostana	Satinfin Shiner	High	Low	8	25%	94%	—
Exoglossum maxillingua	Cutlip Minnow	High	Low	10	30%	95%	—
Fundulus heteroclitus	Mummichog	High	Low	12	8%	94%	—
Fundulus majalis	Striped Killifish	High	Low	4	25%	86%	—

Hemitripterus americanus	Sea Raven	High	Low	1	0%	0%	—
Hybognathus regius	Eastern Silvery Minnow	High	Low	11	45%	94%	—
Isurus oxyrinchus	Shortfin Mako	High	Low	0	0%	0%	—
Lamna nasus	Porbeagle	High	Low	0	0%	0%	SC
Lepomis auritus	Redbreast Sunfish	High	Low	14	14%	96%	—
Leucoraja erinacea	Little Skate	High	Low	1	0%	0%	—
Leucoraja ocellata	Winter Skate	High	Low	1	0%	0%	—
Lophius americanus	Goosefish	High	Low	2	0%	0%	—
Malacoraja senta	Smooth Skate	High	Low	0	0%	0%	—
Menidia menidia	Atlantic Silverside	High	Low	5	40%	67%	—
Merluccius bilinearis	Silver Hake	High	Low	2	0%	0%	—
Paralichthys oblongus	Fourspot Flounder	High	Low	1	0%	0%	—
Peprilus triacanthus	Butterfish	High	Low	2	0%	0%	—
Prionace glauca	Blue Shark	High	Low	0	0%	0%	—
Prionotus carolinus	Northern Searobin	High	Low	2	0%	0%	—
Prionotus evolans	Striped Searobin	High	Low	2	0%	0%	—
Scomber scombrus	Atlantic Mackerel	High	Low	2	0%	0%	—
Scophthalmus aquosus	Windowpane	High	Low	2	0%	0%	—
Semotilus corporalis	Fallfish	High	Low	14	29%	96%	—
Sphyrna zygaena	Smooth Hammerhead	High	Low	0	0%	0%	—
Squalus acanthias	Spiny Dogfish	High	Low	2	0%	0%	—
Tautoga onitis	Tautog	High	Low	3	0%	0%	—
Umbra pygmaea	Eastern Mudminnow	High	Low	7	29%	88%	—
Urophycis chuss	Red Hake	High	Low	2	0%	0%	—
Zoarces americanus	Ocean Pout	High	Low	1	0%	0%	—
Dipturus laevis	Barndoor Skate	High	Limited	1	0%	0%	—
Myoxocephalus octodecemspinosus	Longhorn Sculpin	High	Limited	2	0%	0%	—
Sphoeroides maculatus	Northern Puffer	High	Limited	2	0%	0%	—
Squatina dumeril	Atlantic Angel Shark	High	Limited	2	0%	0%	—
Acipenser fulvescens	Lake Sturgeon	Low	V. High	4	75%	94%	—
Alosa sapidissima	American Shad	Low	V. High	13	23%	88%	R
Ammocrypta pellucida	Eastern Sand Darter	Low	V. High	4	75%	81%	—
Anguilla rostrata	American Eel	Low	V. High	14	36%	96%	R
Enneacanthus chaetodon	Blackbanded Sunfish	Low	V. High	5	80%	80%	—
Erimystax dissimilis	Streamline Chub	Low	V. High	4	75%	73%	—
Etheostoma camurum	Bluebreast Darter	Low	V. High	4	75%	94%	—
Etheostoma maculatum	Spotted Darter	Low	V. High	3	67%	93%	—
Etheostoma tippecanoe	Tippecanoe Darter	Low	V. High	3	67%	91%	—
Hiodon tergisus	Mooneye	Low	V. High	4	50%	73%	—
Ichthyomyzon bdellium	Ohio Lamprey	Low	V. High	4	75%	88%	—
Ichthyomyzon fossor	Northern Brook Lamprey	Low	V. High	4	75%	81%	—
Lampetra aepyptera	Least Brook Lamprey	Low	V. High	5	60%	94%	—
Lepomis gulosus	Warmouth	Low	V. High	4	50%	95%	—
Lethenteron appendix	American Brook Lamprey	Low	V. High	13	54%	92%	—
Moxostoma carinatum	River Redhorse	Low	V. High	4	75%	81%	—

Notropis chalybaeus	Ironcolor Shiner	Low	V. High	6	100%	75%	—
Noturus insignis	Margined Madtom	Low	V. High	9	11%	92%	R
Percina copelandi	Channel Darter	Low	V. High	5	80%	82%	—
Percina evides	Gilt Darter	Low	V. High	4	75%	81%	—
Polyodon spathula	Paddlefish	Low	V. High	4	50%	70%	—
Prosopium cylindraceum	Round Whitefish	Low	V. High	5	80%	84%	—
Salmo salar	Atlantic Salmon	Low	V. High	7	14%	93%	R
Salvelinus fontinalis	Brook Trout	Low	V. High	12	33%	96%	R
Acantharchus pomotis	Mud Sunfish	Low	High	6	67%	68%	—
Salvelinus alpinus oquassa	Arctic Char			3	NA	NA	—
Ameiurus melas	Black Bullhead	Low	High	5	40%	75%	—
Amia calva	Bowfin	Low	High	5	40%	91%	—
Catostomus catostomus	Longnose Sucker	Low	High	9	67%	86%	—
Coregonus clupeaformis	Lake Whitefish	Low	High	5	40%	60%	—
Cottus cognatus	Slimy Sculpin	Low	High	10	30%	83%	R
Etheostoma fusiforme	Swamp Darter	Low	High	12	50%	79%	—
Ichthyomyzon unicuspis	Silver Lamprey	Low	High	4	50%	75%	—
Lota lota	Burbot	Low	High	7	71%	94%	—
Salvelinus namaycush	Lake Trout	Low	High	5	0%	0%	—
Sander canadensis	Sauger	Low	High	5	40%	92%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast states with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

INVERTEBRATES

The RSGCN list is an incomplete and evolving list that currently includes the federally listed invertebrates as well as representatives of two major invertebrate taxa, the tiger beetles (Order Coleoptera, Family Cicindelidae) and freshwater mussels (Order Unionoidea, Families Margaritiferidae and Unionidae) (see Tables 1.8, 1.9 and 1.10). These taxa are listed and discussed separately in the sections that follow. Information is also provided on selected butterfly, moth and pollinator taxa that have been identified as having regional conservation significance. The RSGCN list of invertebrates is in the process of being updated. States are encouraged to include invertebrate taxa and refer to Whitlock (2006) for invertebrates listed as SGCN by Northeast states as they develop and revise their individual SGCN lists.

Compared to the vertebrates, there is an overwhelming lack of data for many invertebrate taxa in the Northeast region. This lack of information and conservation attention is recognized by the NEFWDTC, and efforts will continue to fill in these information gaps through coordinated regional efforts. Projects funded through the RCN Grant Program have already focused on providing and maintaining information on select invertebrate taxa (see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013 for a complete list of funded projects). More information about the RCN-funded conservation assessment of dragonflies and damselflies can be found on the RCN website at http://rcngrants.org/content/conservation-assessment-odonata-dragonflies-and-damselflies-northeastern-region. The Carnegie Museum of Natural History has also developed a web-accessible database of invertebrate museum specimen records for the Northeast that will allow researchers or institutions to access and analyze data on invertebrate taxa (see: http://iz.carnegiemnh.org/sgcninverts/default.asp for more information).

Additional invertebrate taxa will be assessed through the RSGCN ranking process so that these important but poorly-known taxa will also be better represented in the RSGCN list as a result of comprehensive expert reviews. The NEFWDTC's Invertebrate Taxa Team is in the process of updating the RSGCN list, and this will be an ongoing priority. The Team has begun its RSGCN assessments of key pollinator species (including butterflies, moths, skippers, and bees) and crayfish among other taxa. Until the RSGCN species screening process is complete for other invertebrate groups, only the federally listed invertebrate species are included here, as they have undergone thorough assessments during the listing process for endangered, threatened and candidate species under the Endangered Species Act. As state and regional efforts continue to provide additional information, this invertebrate list will evolve to reflect additional knowledge and conservation efforts. States are encouraged to include invertebrates in their state SGCN list and Wildlife Action Plans to fully represent the array of wildlife species as required by Element 1.

TIGER BEETLES

Tiger beetles are a group of highly active, predatory beetles that have been variously classified as either a subfamily (Cicindelinae) within the larger Family, Carabidae, or as a separate Family, Cicindelidae. The RSGCN list includes 11 tiger beetle taxa, encompassing more than half of the Northeast tiger beetle fauna (see Table 1.8). Several tiger beetle species remain common throughout the Northeast, including forms such as the six-spotted tiger beetle (*Cicindela sexguttata*), bronzed tiger beetle (*Cicindela repanda*), and punctate tiger beetle (*Cicindela punctulata*), which can be found in many urban and suburban areas. The

RSGCN list of tiger beetles was recently revised to remove species that are of low conservation concern in the Northeast.

The tiger beetle fauna of the Northeast includes one entirely endemic species, the federally-listed (and RSGCN) Puritan tiger beetle *Cicindela puritana*, which is found only at sites along the Connecticut River and Chesapeake Bay. There are also two endemic tiger beetle subspecies (and RSGCN) in the Northeast, *Cicindela rufiventris hentzii*, which is associated with rocky hills in the Boston metropolitan area and *Cicindela patruela consentanea*, which has been found in recent years only in the New Jersey Pine Barrens. Both of these taxa occur primarily on public lands and in relatively small populations.

Several tiger beetles on the RSGCN list are known to be in decline range-wide and thus may merit regional conservation attention. These include *Cicindela patruela*, a pine barrens and ridge-top barrens species that has been lost from many of its historic sites in the Northeast states, as well as *Cicindela lepida*, a species that was formerly associated with sand dunes and other open sandy areas across the central and eastern states. The tiny pine barrens specialist *Cicindela abdominalis* is found at relatively few sites across the entire Northeast, although populations of this species in the New Jersey Pine Barrens appear robust and probably are secure.

Certain guilds of tiger beetles are known to be at elevated risk for extirpation or even extinction. Population declines have been documented in many species of tiger beetles associated with ocean beaches, including two Northeast RSGCN, the federally listed *Cicindela dorsalis dorsalis* and its southern counterpart *Cicindela dorsalis media*. Riverine tiger beetles are also highly vulnerable to extirpation due to human activities, and riverine species such as *Cicindela ancocisconensis* and *Cicindela marginipennis* are on the RSGCN list. The federally listed (and RSGCN) tiger beetle *Cicindela puritana* combines both types of vulnerability across its highly disjunct distribution, with populations found on riverine sandbars in New England and also at cliffside beaches along the shores of the Chesapeake Bay.

One of the tiger beetles on the RSGCN list is primarily nocturnal/crepuscular and thus often overlooked in diurnal beetle surveys. *Cicindela unipunctata* was once thought to be uncommon to rare throughout its range, but pitfall trapping studies in the New Jersey Pine Barrens demonstrated that this species can occur in large numbers nocturnally/crepuscularly at sites where it is not observed during daylight hours (Boyd 1985).

Table 1.8. Tiger beetle RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List-Tiger Beetles							
Scientific Name	Common Name	RSGCN Concern	RSGCN Responsibility	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Cicindela ancocisconensis	Appalachian Tiger Beetle	high	high	9	78%	76%	—
Cicindela marginipennis	Cobblestone Tiger Beetle	high	high	8	88%	83%	—
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	high	very high	7	86%	82%	T
Cicindela puritana	Puritan Tiger Beetle	high	very high	5	80%	86%	T,R
Cicindela rufiventris hentzi	Hentz's Red-bellied Tiger Beetle	high	very high	1	100%	88%	—
Cicindela abdominalis	Eastern Pinebarrens Tiger Beetle	low	high	4	75%	80%	—
Cicindela dorsalis media	White Tiger Beetle	low	high	4	50%	73%	—
Cicindela lepida	Ghost Tiger Beetle	low	high	8	63%	79%	—
Cicindela patruela	Barrens Tiger Beetle	low	high	13	46%	73%	—
Cicindela unipunctata	One-spotted Tiger Beetle	low	high	8	13%	0%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; PE-Proposed endangered; PT-Proposed threatened; SC-Species of concern; R-NALCC Representative Species.

FRESHWATER MUSSELS

The 23 freshwater mussel species on the RSGCN list for the northeastern states include seven taxa that are high regional responsibility as well as high or very high conservation concern. These are the dwarf wedgemussel, brook floater, northern lance, yellow lampmussel, green floater, tidewater mucket, Eastern pondmussel, triangle floater, and alewife floater (see Table 1.9). Of these species, all are found in five or more Northeast states, while five are found in ten or more Northeast states.

Freshwater mussels are a large and highly diverse group of mollusks associated with freshwater streams and rivers worldwide. Although freshwater mussels are found in most Northeast states, the bulk of the species diversity is found in the southeastern drainages of the Ohio, Tennessee, Cumberland, and Mobile Rivers. Portions of these drainages with associated mussels occur in several Northeast states, including Virginia, West Virginia, and Pennsylvania (Williams et al. 1993; see: http://fishwild.vt.edu/mussel/PDFfiles/Conservation_status.pdf for an overview).

These mussels have been hard-hit by a broad range of factors, including water pollution, sedimentation, stream alteration, dams, gravel mining, and harvest of the mussels for use in button factories, and more recently for the cultured pearl industry (Williams et al. 1993; see: http://fishwild.vt.edu/mussel/PDFfiles/Conservation_status.pdf for an overview). In recent years, considerable conservation resources have been dedicated to conserving and restoring remnant mussel populations. Conservation actions that can benefit mussels include removal of pollution sources, restoration of historic flow patterns in streams to reduce sedimentation, and removal of dams and other barriers to movement of fish hosts transporting larval mussels. Formal protection for many of these species under the federal Endangered Species Act as well as the species protection statutes of many states prevents commercial harvest of the mussels for their shells. Another conservation action currently being used is the translocation of mussels gleaned from healthy populations to supplement other, reduced populations whose viability is at risk. Research at Virginia Tech's Freshwater Mollusk Conservation Center (see: http://fishwild.vt.edu/mussel/), White Sulphur Springs National Fish Hatchery (see: http://www.fws.gov/northeast/wssnfh/index.html), and other institutions is helping to determine the conditions necessary for captive propagation of freshwater mussel species. The intent of captive propagation is to develop source populations for future species restoration and reintroduction efforts and to re-establish populations where they have been extirpated.

The brook floater (*Alasmidonta varicosa*) is a freshwater mussel species (and a high regional responsibility, very high regional concern RSGCN) that has declined rapidly throughout its range due to habitat loss, stream fragmentation, loss of riparian vegetation buffers, upstream land degradation, pollution, altered flow regimes, extreme spring floods, and summer droughts. While the Northeast holds the largest populations of the brook floater range-wide, long-term research shows that populations once large and robust have either declined by 50% to 95% or are gone completely. With funding from the RCN Grant Program, the USFWS and partners are conducting a regional status assessment to document trends

and occurrences of brook floater populations throughout the Northeast as well as on a state-by–state basis. The status assessment will also include a review of significant threats to populations and recommendations for high priority conservation areas in each state.

Occurrence datasets from the 12 northeastern states will be standardized into one regional file for mapping and modeling efforts at both the state and hydrologic unit code-8 (HUC-8) watershed levels. A comprehensive dataset with maps that include distributions, occurrences, trends, and land use patterns will be produced for each of the states in the Northeast region. Habitat suitability and environmental associations of brook floater populations will be modeled. The final report will include regional and state status assessments documenting trends and occurrences of populations, an overview and inventory of significant threats to populations, recommendations of high priority conservation areas, and recommendations of locations for future studies that could close data gaps in the region. As with the Blanding's turtle and New England cottontail, this is another example of how the Northeast Planning Framework is applied at a regional level for a RSGCN priority species. For more information about the project, please visit: http://rcngrants.org/content/conservation-status-brook-floater-mussel-alasmidonta-varicosa-northeastern-united-states

Table 1.9. Freshwater Mussel RSGCN, listed in decreasing level of concern and responsibility.

RSGCN List-Freshwater Mussels							
Scientific Name	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Alasmidonta heterodon	Dwarf Wedgemussel	High	V. High	11	91%	90%	E,R
Alasmidonta varicosa	Brook Floater	High	V. High	14	86%	82%	—
Elliptio fisheriana	Northern Lance	High	V. High	5	60%	82%	—
Lampsilis cariosa	Yellow Lampmussel	High	V. High	12	83%	86%	—
Lasmigona subviridis	Green Floater	High	V. High	7	100%	78%	—
Leptodea ochracea	Tidewater Mucket	High	V. High	11	91%	79%	—
Ligumia nasuta	Eastern Pondmussel	High	V. High	11	91%	84%	—
Alasmidonta undulata	Triangle Floater	High	High	14	57%	82%	—
Anodonta implicata	Alewife Floater	High	High	13	46%	95%	—

Lampsilis radiata	Eastern Lampmussel	High	Mod.	14	57%	76%	—
Epioblasma torulosa gubernaculum	Green Blossom	High	Limited	1	100%	0%	E
Pleurobema collina	James Spinymussel	High	Limited	2	100%	89%	E
Villosa perpurpurea	Purple Bean	High	Limited	1	100%	83%	E
Alasmidonta marginata	Elktoe	Low	V. High	6	67%	85%	—
Ligumia recta	Black Sandshell	Low	V. High	6	83%	94%	—
Truncilla truncata	Deertoe	Low	V. High	4	100%	69%	—
Anodontoides ferussacianus	Cylindrical Papershell	Low	High	5	100%	73%	—
Lampsilis fasciola	Wavyrayed Lampmussel	Low	High	4	100%	94%	—
Lampsilis ovata	Pocketbook	Low	High	6	100%	94%	—
Lasmigona compressa	Creek Heelsplitter	Low	High	5	80%	67%	—
Leptodea fragilis	Fragile Papershell	Low	High	6	100%	76%	—
Margaritifera margaritifera	Eastern Pearlshell	Low	High	9	67%	81%	—
Villosa iris	Rainbow	Low	High	4	100%	73%	—

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

BUTTERFLIES AND MOTHS

The Invertebrate Taxa Team is in the process of reviewing the conservation status of species in the order Lepidoptera—the butterflies, moths, and skippers. These species will be included in the next RSGCN update, expected after the state SGCN lists are updated. This updated list will then be used to inform the RSGCN screening process. Several important regional trends are already apparent from a draft provisional list and from the state lists of lepidopteran SGCN in the Northeast. Among butterflies and their relatives, two families predominate on these lists, the skippers (Family Hesperiidae) and the blues, coppers, and elfins (Family Lycaenidae). The latter family includes the well-known Karner blue butterfly (*Lycaeides melissa samuelis*), a federally endangered species that occurred historically from Wisconsin east to New Hampshire. The Karner blue has been the subject of substantial interagency cooperation and collaborative conservation over a twenty–year period, with efforts to restore habitat and re-introduce populations already well under way by the time the first SWAPs were developed. The RSGCN list

hopefully will focus attention more broadly on other butterfly and moth taxa that are in need of the types of conservation activities that have already been developed for the Karner blue.

Butterflies of the families Hesperiidae and Lycaenidae occur in large numbers on the regional and state SGCN lists because many species in these families are small-bodied, relatively weak fliers that also exhibit very specific host plant requirements or other narrow ecological specializations such as association with specific vegetation communities. In addition, the larvae of many species of Lycaenidae participate in symbiotic relationships with ants, so that both the larval host plant and suitable ant partners must be available in order for the species to thrive.

The regal fritillary (*Speyeria idalia*, Family Nymphalidae) is a regionally rare and globally declining butterfly species that is associated with remnant grassland and prairie habitats in the eastern and central United States. Formerly found from Colorado to Maine, the eastern populations of this butterfly have crashed in recent decades. Once found in nearly every northeastern state, the only remaining populations in the Northeast occur at sites in Pennsylvania and Virginia. Recovery of the butterfly is dependent on re-establishment of prairie communities that support the species of violets on which its larva feeds. The regal fritillary has benefited from careful management at the remaining sites in Pennsylvania, and it is hoped that a broader collaborative conservation effort might help to bring back this butterfly.

Other major groups of Lepidoptera represented in the draft RSGCN List include *Papaipema* moths, sphinx or hawk moths, and giant silkworm moths. The larvae of moths in the genus *Papaipema* (Family Noctuidae) bore into the stems and tubers of prairie plants, and the moths are characteristic species of grassland habitats across the eastern and central United States. With the decline in eastern grassland areas, populations of certain species of these moths have become rare in the Northeast. The family of sphinx or hawk moths (Family Sphingidae) includes several well-known agricultural pests as well as several rare and declining species. Certain hawk moths are diurnally active and many species can be important pollinators of flowers with long, tubular corollas.

Giant silkworm moths (Family Saturniidae) are among the most colorful and spectacular species of northeastern Lepidoptera. Several of the largest and most beautiful species of these moths have recently declined across the Northeast. These declines have been attributed to increased spraying of chemicals for mosquito and pest control as well as to increased anthropogenic light pollution, which disrupts the normal

nocturnal flight patterns of these insects. The buck moths (genus *Hemileuca*) are diurnally-active giant silkworm moths that are closely associated with oak species in pine-oak barrens throughout the Northeast region. The brightly colored black, white, and red adult buck moths fly during very specific windows of time (usually in mid-afternoon during certain days in late autumn). The eggs and larvae of these moths can be found on oak species in dry barrens habitats. Populations of two species of buck moths in the Northeast have experienced noticeable declines, which in turn have been attributed partly to the loss and conversion of suitable barrens habitat, and to the broadcast spraying of insecticides for control of pest insect populations. Fortunately at least one of these species remains common and abundant elsewhere in its range. It is even considered a pest of oak trees in the Southeast.

Other lepidopteran species such as the frosted elfin and the monarch butterfly have recently emerged as potentially significant regional species of conservation need. Work is under way to determine the region-wide conservation status of these species and other butterflies and moths in the Northeast.

POLLINATORS

Considerable concern has been expressed about the conservation status and population trends of these important taxa across North America (see http://www.nap.edu/catalog.php?record_id=11761 for an overview). Pollinators are animals that visit flowers and help plants to complete their reproductive cycles. Most pollinator species are invertebrates, specifically insects. Major pollinator groups in the Northeast include social and solitary bees, as well as many flies, beetles, butterflies, and moths. Reports focusing on pollinators are available for use by state fish and wildlife agencies from the Xerces Society (see website http://www.xerces.org/pollinator-conservation/ for more information), the Pollinator Partnership (see http://www.pollinator.org/ for more information) and from the Heinz Center for use by states in revising their SWAPs (The Heinz Center 2013a, 2013b; see http://www.heinzctr.org/content/pollinators for more information). The Heinz Center report, also available from the AFWA (see http://www.wildlifeactionplan.org/tool/pollinators-and-state-wildlife-action-plans-voluntary-guidance-state-wildlife-agencies), describes methods and approaches for incorporating information about the conservation of animal pollinators into the SWAPs.

NORTHEAST INVERTEBRATES LISTED UNDER THE FEDERAL ENDANGERED SPECIES ACT

The NEFWDTC recommends that federally listed invertebrates be considered as RSGCN in the interim, while a more complete invertebrate RSGCN list is developed. Since freshwater mussels and tiger beetles were evaluated using the RSGCN process, those taxa are listed above. Table 1.10 lists the additional invertebrate species that are formally listed in the Northeast region (USFWS Region 5) under the federal Endangered Species Act as of November, 2013. Links to USFWS websites at the end of this section provide more information about invertebrate species.

Table 1.10. Northeast invertebrates listed under the federal Endangered Species Act, arranged by major group and scientific name.

Group	Scientific Name	Common Name	Listing Status	Northeastern States
Amphipods	*Stygobromus hayi*	Hay's spring amphipod	Endangered	DC, MD
Amphipods	*Stygobromus kenki*	Kenk's amphipod	Candidate	DC, MD
Isopods	*Antrolana lira*	Madison Cave isopod	Threatened	VA, WV
Isopods	*Lirceus usdagalun*	Lee County Cave Isopod	Endangered	VA
Beetles	*Nicrophorus americanus*	American burying beetles	Endangered	MA, RI
Butterflies	*Lycaeides melissa samuelis*	Karner blue butterfly	Endangered	NH, NY
Butterflies	*Neonympha mitchellii mitchellii*	Mitchell's satyr butterfly	Endangered	VA
Snails	*Polygyriscus virginianus*	Virginia fringed mountain snail	Endangered	VA
Snails	*Succinea chittenangoensis*	Chittenango ovate amber snail	Threatened	NY
Snails	*Triodopsis platysayoides*	Flat-spired three-toothed snail	Threatened	WV
Spiders	*Microhexura montivaga*	Spruce-fir moss spider	Endangered	VA

The following USFWS websites provide taxonomic and biological information about these species as well as information on listing factors under the Endangered Species Act, recovery plans and actions.

http://www.fws.gov/newengland/endangeredspec-NEListedSpecies.htm

http://www.fws.gov/endangered/species/us-species.html

http://www.fws.gov/northeast/EcologicalServices/endangeredspecies.html

http://www.fws.gov/endangered/regions/index.html#tabs-5

ADDITIONAL INFORMATION ABOUT THE RSGCN DEVELOPMENT PROCESS

DATA DESCRIBING THE DISTRIBUTION OF RSGCN

NALCC compiled data from multiple sources, identifying known locations of RSGCNs. Many conservation, taxonomy, and wildlife research organizations maintain records of the "precise" location of wildlife observations. In the most general sense, each such observation may be interpreted as a species "presence" observation—also called a species occurrence—with applications to the study of species distribution, habitat preferences, and the relative condition of available habitat.

NatureServe and Natural Heritage member programs are important sources of data describing RSGCN locations. A detailed data-sharing and terms-of-use agreement between NALCC, NatureServe and the states stipulates limitations of display and sharing. NALCC agreed to return all state-owned species occurrence data upon completion of the SWAP Synthesis project and SWAP revisions. NatureServe provided an evaluation of taxonomy and conservation status (S-ranks) for all North American states and provinces in which each RSGCN occurs.

Many RSGCN are not well-represented by NatureServe or Natural Heritage member programs. Underrepresentation results when a species that is rare in one state and common in others gets tracked only in the Natural Heritage program in the state where it is rare. Some taxa are not well represented because there are state and federal programs responsible for tracking them independently. To help fill these gaps NALCC included data from other sources such as bird, reptile, and amphibian atlases, other USFWS and state programs, and individual research projects. Data were aggregated in a Geographic Information System (GIS) so that the distribution of species can be mapped. For some species, focused conservation efforts have already assembled presence data and implemented conservation models.

RSGCN DATA QUALITY

There are many modes of wildlife observation, from collection to sighting, hearing, and radio-telemetry. Seasonality and migration impart different meanings to observations. Survey techniques and biological constraints, such as fish living in streams, dictate the format of the presence data depicted in GIS (points, lines, or polygons). In order to achieve compatibility of different data sources, all data were transformed to points. Nonetheless, each species observation has unique implications and limitations; therefore, we categorized each observation to carefully track information about the sources and derivation of data. As

data were aggregated in one GIS database, we performed "clean-up" and quality control to ensure consistency of attribute fields, naming conventions, geodesic projections and other relevant standardization operations. NALCC coordinated three levels of quality control for RSGCN data:

- Data Quality Survey: NALCC deployed a data quality survey for RSGCN, and states responded to questions about the age, extent, and quality of data for species occurring in their states;
- NatureServe Assessment: NALCC contracted NatureServe to respond to the Data Quality Survey, resolve taxonomic issues, and summarize data quality for each species;
- Taxonomic Teams: NEFWDTC's taxonomic teams reviewed each species' status rankings, verified location data and overall species distributions, checked taxonomy, and assessed confidence in data for mapping, modeling, and assessing the relative condition of habitats.

RELATIVE CONDITION OF RSGCN POPULATIONS AND HABITATS DESCRIBED BY BASE DATA LAYERS

The environmental data compilation effort included three primary components: 1) data developed by partners through the Northeast Regional Conservation Needs (RCN) grants program administered through the Wildlife Management Institute (WMI); 2) existing regionally or nationally-consistent spatial data available through public sources including government agencies and research institutes; and 3) creation of new data layers by the NALCC, using one or more existing layers obtained from partners or publicly available sources.

Information from the first category of commissioned data, funded via the RCN program and the NALCC, includes many spatial data layers representing ecosystem, habitat and geology types; current and future projected human impacts on resources; and climate. The last includes current and projected future conditions based on Intergovernmental Panel on Climate Change (IPCC) scenarios.

The Landscape Ecology Lab at the University of Massachusetts Amherst, chaired by Kevin McGarigal, has provided many spatial data layers and will continue to deliver additional regionally consistent layers as these become available. The Eastern Division of The Nature Conservancy (TNC) also provided numerous spatial data layers as well as reporting documentation, summary sheets on habitats, and standardized symbology for numerous raster data layers. The aim of all RCN and NALCC-funded data creation initiatives through UMass Amherst and TNC is to serve as a resource for use within State Wildlife Action Plans and other regional conservation efforts.

Data falling into the second category of existing regionally or nationally consistent spatial data includes the latest products from the National Land Cover Dataset (NLCD), the National Wetlands Inventory (NWI) and other layers essential to understanding the landscape. The NALCC has created a value-added component to each of these by clipping the geographic extent of the data to the states in the Northeast region. In some cases, such as with gridded SSURGO data (National Resource Conservation Service, NRCS) and 30-meter elevation data (U.S. Geological Survey, USGS), the NALCC has also clipped the geographic extent to the state level for each state in the northeast region.

Data falling into the final category of new data layers created by the NALCC includes products extracted from existing datasets (e.g., the "aspect" category within TNC's Landforms dataset); reclassifications (e.g., "50 percent or greater" canopy threshold assigned to the NLCD canopy cover dataset); and creation of distance grids, such as distance to wetlands, using the latest combination of available wetlands datasets.

DATA QUALITY SUMMARY

Species expected to have highest data quality were selected by a preliminary survey that screened data quality and completeness of coverage. The freshwater mussel taxonomic team reviewed data and rankings for the top 20% of the RSGCN. The team found that 100% of the gaps in state-by-state data coverage for NatureServe and other sources compiled by NALCC represent true gaps in distribution, where the species may be presumed absent. Eighty-eight percent of NatureServe S-ranks agreed with the expert opinions of team members. Assuming that the specific issues identified are resolved as prescribed, the team was generally confident in the quality of the data to facilitate mapping, distribution modeling, and habitat condition for the following species: green floater, dwarf wedgemussel, brook floater, Tidewater mucket, pocketbook, wavyrayed lampmussel, Eastern pondmussel, and black sandshell.

ONGOING DEVELOPMENT OF FUTURE RSGCN SCREENING METHODS

In its continuing effort to improve the RSGCN process, the NEFWDTC is collaborating with NALCC to explore additional methods and data to refine the process. Ultimately, the goal of screening will be to shorten and refine species lists and help focus conservation actions where they are needed most. The following section describes this ongoing collaborative effort as well as a conceptual approach that will improve understanding of species risk across the region and also help in identifying RSGCN species.

In coordination with the NEFWDTC, NALCC is developing additional methods to screen the status of many species across large geographies. The approach is built upon estimates of three basic quantities for each species: 1) a measure of the entire original distribution, 2) a measure of the current threatened distribution, and 3) a measure of the extirpated distribution (see Figure 1.2). The proportion of each of these quantities intersecting the Northeast, or any other planning geography, provides a powerful tool to understand the relative security of species.

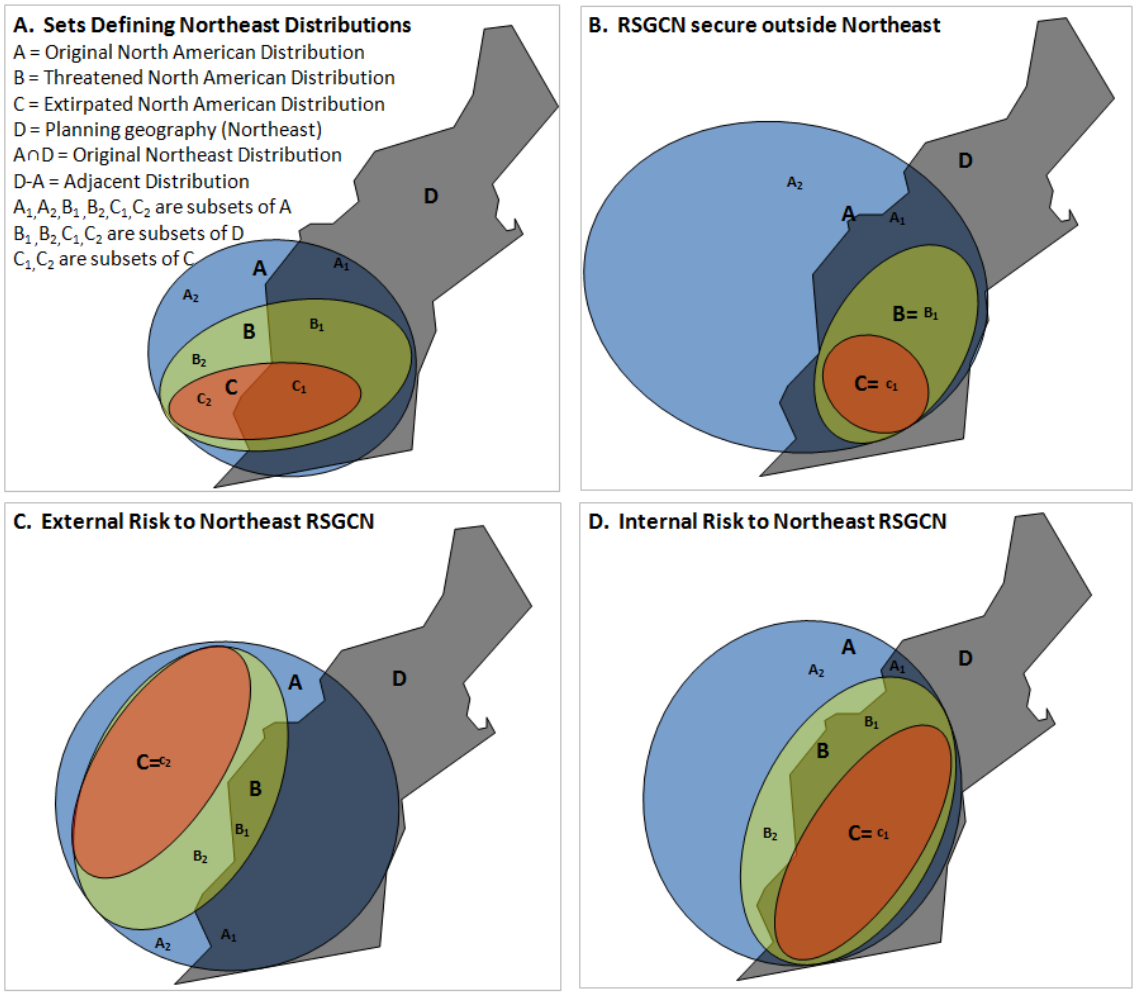


Figure 1.3. A conceptual diagram of species screening technique under development by NALCC. A) represents the original, threatened, and extirpated distributions overlapping Northeast; B) represents the screening to detect species that are largely secure outside the planning area; C) represents the screening to detect species at high risk outside the planning area; D) represents the screening to detect species at risk within the planning area.

APPLICATIONS

Regional environmental and species data have broad application to conservation planning. They also support many SWAP-required elements and planning processes:

- Information gathering on populations, habitats, threats, and relative condition (Elements 1-3);
- Selection criteria for species of greatest conservation need (Element 1);
- Species taxonomy, distribution, and designations (Element 1);
- Data gaps, quality, and uncertainty for RSGCN populations, habitats, and threats (Elements 1-3);
- Threats to RSGCN (Element 3);
- Relative condition of RSGCN populations, distribution, and habitat (Element 2-3);
- Prioritization of species, populations, and habitats in need of conservation action or monitoring (Element 4);
- Data to support development of Conservation Opportunity Areas (Element 2 &4).

NALCC will continue to develop formats and media for landscape environmental and species data that are relevant to SWAPs. NALCC will also convene Plan coordinators to review the data products and gather input on the best forms of delivery to states.

SPECIES OCCURRENCE MODELED

Species occurrence data will be mapped in PDF format at a very coarse 1:1 million scale. This scale provides a clear perspective on the regional context for species occurring (or not occurring) in each state, but it is too coarse to identify the true location of individual occurrences. NALCC has developed a series of GIS-based MaxEnt models using species occurrence data and habitat information to estimate potential distributions of individual RSGCN in the Northeast states. Figure 1.4 is a preliminary example of this modeling effort. Distribution maps available from NALCC can be found at: http://northatlanticlcc.org/groups/SWAPs-team/swap-synthesis-documents/species-distribution-maps

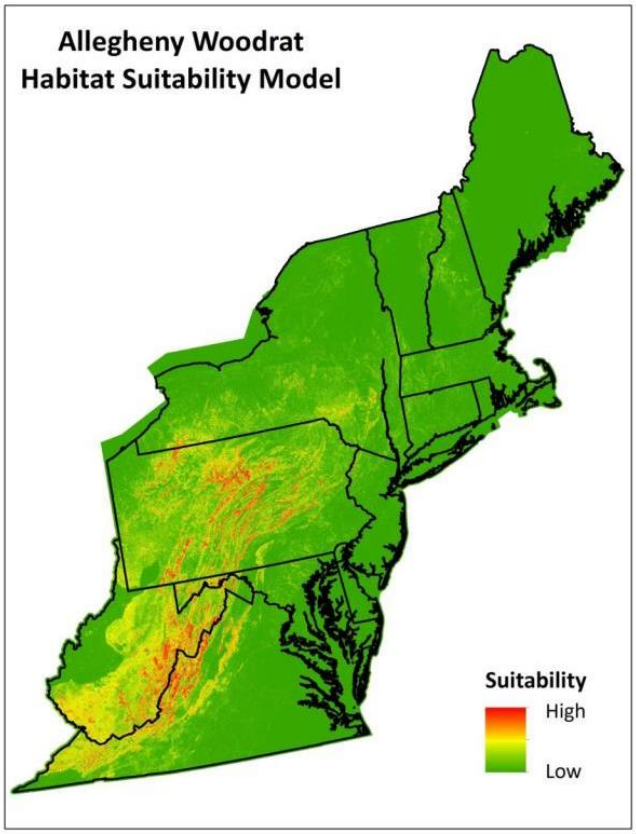


Figure 1.4. Sample Species Distribution Modeled by NALCC.

BASE ENVIRONMENTAL DATA LAYERS, DERIVED LAYERS, MODEL OUTPUTS

While each environmental data layer has stand-alone value, data derived by combining, processing, and modeling original data often have even more value. A next step to link together synthesized information on species and habitats is the development of species-habitat distribution models and maps. Specifically, for RSGCN that have been identified as priority species and for which there are adequate data, models that relate the distribution of known occurrences to a set of environmental variables can be developed. These resulting models show where these species are likely to occur due to the location of these environmental variables within the known range of the species. These RSGCN models should complement the 30 representative species models that have been developed by the NALCC for species that are thought to represent a host of other species with similar habitat needs.

REGIONAL CONSERVATION OPPORTUNITY AREAS

A next step for utilizing regional conservation planning information and tools developed through the RCN program and LCCs in the Northeast is the identification of Regional Conservation Opportunity Areas (RCOAs). These RCOAs can be developed through a process of selecting conservation features including species and habitats; agreeing on metrics for prioritizing these features; including species occurrences, habitat suitability, ecosystem integrity and ecosystem resiliency; and finally, combining and weighting these metrics to achieve goals.

DATA ACCESS AND DELIVERY TO STATES

The delivery of regionally-consistent and value-added spatial, graphic, and tabular data for the use in SWAPs is an essential component of this Regional Synthesis. This section describes the delivery methods being implemented to ensure that these needs are met in a timely fashion. The two primary components needed for effective data delivery are: 1) an external hard drive of all data to be delivered to each state's appointed point-of-contact person for spatial data; and 2) data access for all SWAP staff via the password-protected SWAPs Team project page on the NALCC website (http://northatlanticlcc.org/groups/SWAPs-team/swap-synthesis-data). In addition to offering these primary modes of data delivery, NALCC DataBasin portal will serve as a resource to conservation partners and stakeholders interested in viewing public data layers in a web map and downloading those layers of information, taking account of the user's download capacity.

RSGCN data, including all species and data overlapping the respective jurisdiction(s), will be returned to each state. For most states, the data compiled by NALCC from multiple sources will enhance or complement species location data available via state data tracking systems.

For each species, NALCC will summarize the state-by-state distribution, the regional pattern of status as tracked by S-Ranks, and the overall quality of data.

Data will be delivered by NALCC to a designated state representative, and will include complete metadata and any available guidance on recommended uses, as well as any known limitations of the data. NALCC will provide technical assistance to states on use and application of the data. Data uploaded to the secure SWAP Team website portal will include all data types with the exception of the point occurrence data.

- ✓ Species point occurrence GIS data by state: hard drive
- ✓ Species summaries: hard drive and secure website
- ✓ Species occurrence PDFs >1:1 million scale: hard drive and secure website
- ✓ Base data layers, derived layers, model outputs: hard drive, secure website and DataBasin
- ✓ Conservation Opportunity Areas: *ongoing*

HARD DRIVE

Data accessible through the hard drive delivery will differ from what is available via the SWAPs Team data download and the DataBasin offerings in one critical manner: only the hard drive delivery will contain species point-occurrence data. The data delivery on hard drive will encompass all components of the synthesis effort outlined within the report, including tabular summary statistics of the species point-occurrence data; graphical representation of species occurrences throughout the region at a scale greater than 1:1 million; "base" spatial data (vector and raster format) and derived products such as model outputs; and species point-occurrence GIS data. Data will be provided by the NALCC, and will include complete metadata and any available guidance on recommended uses, as well as any known limitations of the data.

SWAPS TEAM

Data uploaded to the password-protected SWAPs Team section of the NALCC website will include all contents of the hard drive delivery with the exception of the point-occurrence data. This mode of data access is aimed at SWAP Team partners who were not the direct recipients of the data drive delivery, and also as an up-to-date resource for those who did receive the data delivery via hard drive. In addition to hosting the latest versions and newest spatial products of environmental data for the Northeast region, the SWAPs Team section of the NALCC site will continue to host the latest notes and presentations from the NEFWDTC meetings and discussions.

DATABASIN

The NALCC DataBasin geospatial portal (http://nalcc.databasin.org), called a "Conservation Planning Atlas," will be the web mapping visualization platform for geospatial base data, as well as for analysis and modeling outputs. The web services used for the visualizations will be generated by and stored in ScienceBase, a USGS data management platform. These two tools are being implemented by at least 17 of the 22 LCCs nationwide. DataBasin will also enable downloading of these data sets. It is designed

primarily for individual downloads of data sets, which is why the NALCC is making a more centralized download location available on the website. Download links from DataBasin will point to the same location for many of these data sets, to avoid duplication.

REGIONAL COORDINATION FOR SPECIES CONSERVATION

The approach and case studies presented here highlight coordinated regional conservation efforts and provide examples of what can happen when state and federal agencies work together to plan conservation activities that attempt to avert listing under the federal Endangered Species Act. The states in the Northeast region have been able to develop these advanced conservation projects through the following process:

1. The NEFWDTC identifies and maintains a list of regional priority species, an effort that began in the 1980s as reported by French and Pence (2000) and Therres (1999) and that continues today as one of the NEFWDTC's standing charges from the NEAFWA. The Committee relies on state biologists and other experts working within taxonomic teams to update the list. As in the NEPARC process, species are grouped by level of responsibility and by level of concern or "need." The categories of species listed have different levels of need, and, therefore, different recommended actions to address these needs most effectively. For example, status assessment and conservation plans are not recommended for species of "high responsibility" but "low threat." Instead, these species may serve as good indicators of ecological community condition.
2. From this RSGCN list, the NEFWDTC begins with the highest concern/highest responsibility species and works down the list to species of lesser regional need. The RCN grant program provides the NEFWDTC with a means of funding assessments of highest priority species, such as the wood turtle and the brook floater mussel.
3. An individual state fish and wildlife agency then takes the lead in developing a funding package for the project, which may include a competitive SWG proposal. The state engages with other states, universities, non-profit organizations, and additional experts as needed. During this stage, each state identifies its role in the implementation process, and all states agree on performance measures and coordinated monitoring goals and objectives.
4. Lastly, a committee of experts may be formed to provide oversight and evaluation of performance. This committee translates the information resulting from the project into regional conservation and legal/regulatory recommendations.

It is important to point out that this process relies on the time and availability of state biologists who are often being supported by apportioned SWG Program dollars. Such collaborative efforts would not be possible without these funds.

NORTHEAST PRIORITY SPECIES CONSERVATION EFFORTS FUNDED BY THE RCN GRANT PROGRAM

The following case studies highlight several species that were identified as RCN priority regional species and funded through the RCN Grant Program. These examples show how the Northeast Regional Conservation Planning Framework can be applied to high priority or candidate species, and how this Framework can be used to fully develop a regional assessment and plan for conservation efforts by the states.

NEW ENGLAND COTTONTAIL

The New England cottontail (*Sylvilagus transitionalis*) is a species in severe decline in the Northeast. Its range has contracted by 86%, Vermont populations have been lost completely, and only five smaller populations occupy its historic New England range. The cottontail is recognized as a SGCN in multiple Wildlife Action Plans.

With funding from the RCN grant program, scientists from the University of New Hampshire, USFWS, and Maine Department of Inland Fisheries and Wildlife have developed new non-invasive tools for monitoring New England cottontail populations (Kovach 2012) and the effectiveness of conservation actions designed to enhance these populations. Funding from the RCN Grant Program also supported the development of a comprehensive range-wide recovery plan and conservation strategy (Fuller and Tur 2012). It identifies actions (called “objectives”) to address the threats to this species and prevent a listing under the federal Endangered Species Act. The strategy outlines sixty-four specific conservation actions grouped in nine broad categories: Coordination and Administration (11); Information Management (10); Monitoring (5); Landowner Recruitment (9); Population Management (10); Habitat Management (13); Research (6); Outreach and Education (5); and Land Protection (5). Each of the sixty-four actions has detailed information on performance measures, geographic scope, priority, duration, and implementation status (Fuller and Tur 2012).

The range-wide "Conservation Strategy for the New England Cottontail" was completed in 2012 by a multi-agency working group. State conservation summaries were completed for all six states and included in the regional conservation strategy, which was peer reviewed in June 2012. A comprehensive landscape analysis was completed to design landscapes to support New England cottontail populations, using models to analyze all parcels in the species range in order to identify target properties. Across six states, 12,439 parcels were ranked as most likely to be suitable. The highest-ranked parcels have been adopted as targets for range-wide New England cottontail conservation. The formation of a private lands working group has increased the number of private parcels that are visited for evaluation. It has also resulted in contracts with NRCS, WMI, and USFWS Partners for Fish and Wildlife. More than 950 acres have been treated on state lands across all six states since 2009. The target of 1200 acres will be met by May 2014. Work will be continued under two subsequent competitive State Wildlife Grant awards made in 2011 and 2013.

This native rabbit has long been identified as a regional priority (Therres et al. 1999). It provides an excellent example of the RCN process at work: identifying a priority conservation target, fully applying the Northeast Conservation Planning Framework, and culminating in conservation delivery via implementation of regional actions that may cross state boundaries but are focused at the local level (Fuller and Tur 2012). The full report can be found at http://www.newenglandcottontail.org/.

BLANDING'S TURTLE

Blanding's turtle (*Emydoidea blandingii*) is identified as a SGCN in several Northeast states, including Maine, Massachusetts, New Hampshire, New York, and Pennsylvania. It has also been a species of regional conservation concern since the 1990s. This turtle is particularly vulnerable because adults travel very long distances (often more than half a mile) during their active season, do not reproduce until late in life (14-20 yrs), and have low survivorship rates from nesting to adulthood. These traits make them extremely sensitive to even slight increases (1-2%) in adult mortality. Expansion of road networks presents the greatest challenges to adult Blanding's turtles. Roads are where the species incurs its highest rates of mortality. Blanding's turtles travel to multiple wetlands during the course of a single year, and adult females also travel to nesting habitats, crossing roads in the process (Marchand ongoing).

The Northeast Blanding's Turtle Working Group was formed by state and federal wildlife agency partners, working through the existing NEPARC partnership. This collaboration was an important first step towards assessing conservation priorities for the species and determining the degree of potential partner involvement. The partnership acquired funding from the USGS for a status assessment and habitat modeling.

The USGS Massachusetts Cooperative Fish and Wildlife Research Unit and the Northeast Blanding's Turtle Working Group have developed a coordinated regional monitoring strategy that can be implemented by turtle biologists working in each of the five participating states (ME, NH, MA, NY, PA). The monitoring strategy calls for an extensive two-year sampling effort with continued opportunistic sampling as resources and time permit. The group has proposed standardized monitoring protocols for the species and is developing a centralized, web-based data repository at the University of Massachusetts. A two-tier (rapid and long-term) assessment protocol has been developed. Criteria for site selection have been identified and field survey protocols and other implementation details have also been developed by the working group. This effort is funded by a USFWS competitive SWG awarded to the state of New Hampshire to support the cooperative efforts of the five states. For more information about the project, please visit: http://www.northeastparc.org/workinggroups/blandings.htm

WOOD TURTLE

The wood turtle (*Glyptemys insculpta*) is endemic to North America, with more than 50% of its existing range in the Northeast part of the continent. Similar to the Blanding's turtle, the wood turtle (*Glyptemys insculpta*) is identified as a SGCN in 12 Northeast states and as a high-priority species in 7 states. It has long been recognized as a priority species in the Northeast (Therres et al. 1999). Because it is included in more than 75% of regional SWAPs, the NEPARC has identified it as a "species of regional conservation concern."

Wood turtle populations are declining due to habitat fragmentation and degradation as well as heavy mortality from agricultural machinery and automotive traffic near streams. The wood turtle's late maturity and low reproductive potential make the species more vulnerable to threats of habitat degradation, high nest and hatchling depredation rates, and collection for pet markets.

These threats have led the International Union for Conservation of Nature (IUCN) to change the conservation status ranking of this species from Vulnerable to Endangered. Turtle experts have indicated that the wood turtle may warrant consideration for listing under the federal Endangered Species Act.

To prevent the further decline and listing of this species under the Endangered Species Act, the Northeast Wood Turtle Working Group was convened in 2009, leveraging the successful approach of the Blanding's Turtle Working Group. In 2011, the RCN Grant Program funded a proposal developed by the working group to formulate a conservation strategy for the wood turtle. The completed report provides a summary of ecological studies, an analysis of occurrence data, an assessment of monitoring protocols and the initiation of the first regional monitoring effort, modeling of habitat suitability throughout the region, and conservation recommendations and best management practices.

The conservation strategy gathers all available occurrence and population data for the wood turtle in the Northeast and conducts a series of spatial meta-analyses to evaluate region-wide trends in occurrence, occupancy, historic habitat loss, threats, and data deficiencies. In addition, the strategy identifies populations of region-wide significance; includes an assessment of the likely historic and current occurrence of wood turtles; critically reviews the listing status, S-rank, and protective measures in each state; articulates research and inventory priorities; and identifies data deficiencies.

A species distribution model based on corroborated occurrences and 7 stream attributes (elevation, gradient, sinuosity, flow accumulation, minimum January temperature, average July temperature, and precipitation) showed where suitable habitats could be found within the region.

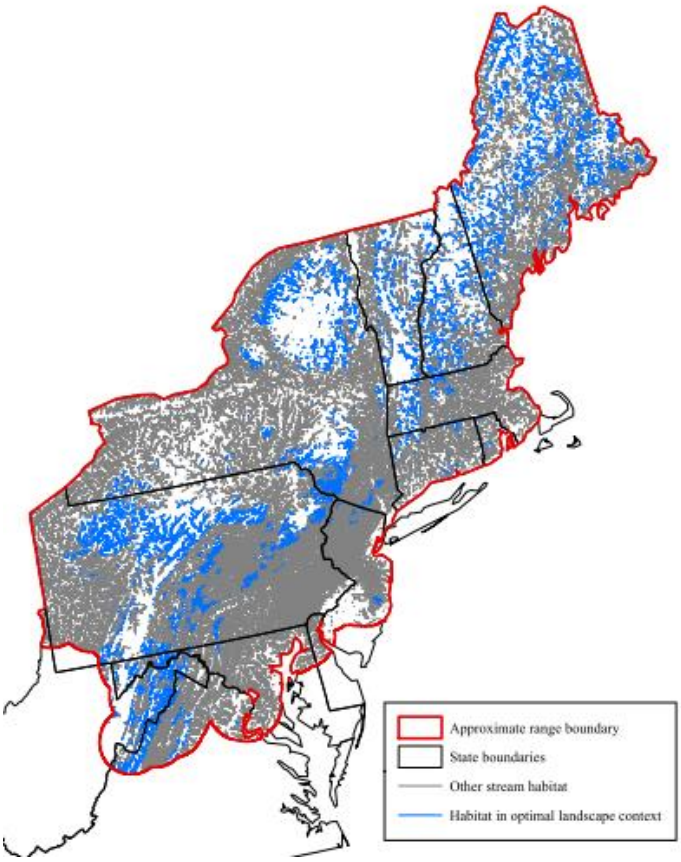


Figure 1.5. Distribution of wood turtle habitat in "optimal" landscape context is shown in blue. Potential wood turtle stream habitat not in an optimal landscape context is shown in gray.

The report provides specific recommendations about the conservation of wood turtles in the Northeast region. Importantly, the strategy presents conservation action recommendations for each of the 12 Northeast range states and for at least 12 major Northeastern watersheds (HUC-4 level). The Working Group also developed, evaluated, and incorporated best management practices and detection protocols for the wood turtle in the Northeast Region, and states have begun implementing the results of this work.

Specific Recommendations:

1. Launch a Formal Coordinating Organization (Wood Turtle Council)
2. Implement a Conservation Strategy that prioritizes significant populations and develops conservation plans at the state and regional scales
3. Protect and manage habitat by assigning site leaders at priority sites, implementing best management practices, expanding nesting habitat, and limiting active season mowing

4. Improve Regulatory Effectiveness by increasing habitat protection around significant populations.
5. Implement a Regional Research Strategy using the recommended monitoring protocols.
6. Conduct a Range-wide Genetic Analysis
7. Reduce Trade of Wild-Caught Adults
8. Coordinate Technical Assistance and Outreach Campaign

The strongest efforts should be made in sites with the highest probability of long term success with minimal reinvestment. Conservation actions should be taken within buffers around streams and nesting sites: 90 m buffer (for general protection) and 300 m buffer (maximum protection for significant populations). Best management practices include:

- Agricultural activities and residential development should be outside the buffer.
- Forestry activities should take place in the winter and should not result in new road construction within the buffer.
- Open canopy nesting areas 30-90 m from the stream are beneficial.
- Unfragmented, forested landscapes at large landscapes scales are valuable.

For more information about the project, please visit:
http://rcngrants.org/content/wood-turtle-glyptemys-insculpta-northeastern-united-states-status-assessment-and

EASTERN BLACK RAIL

The Eastern black rail (*Laterallus jamaicensis*) is now considered one of the most endangered bird species in the Northeast. Populations have declined by 85% region-wide since 1992, and the species has been identified as a SGCN in most of the region's Wildlife Action Plans. With funding from the RCN Grant Program, biologists from the College of William & Mary, Virginia Commonwealth University, and the Maryland Department of Natural Resources have initiated a project titled *Status Assessment and Conservation Action Plan for the Black Rail in Northeastern States*. They are collecting and synthesizing data from the consortium of agencies, biologists, academic institutions, and land managers participating in the Eastern Black Rail Conservation and Management Working Group (see http://www.ccb-wm.org/BlackRail for more information about the project) to identify conservation actions needed to reverse the decline in the species. The resulting Status Assessment report, Conservation Action Plan, and associated geo-referenced databases on status, distribution, and spatially explicit conservation priorities will provide states with a coordinated set of actions to be implemented for the conservation of this species.

EASTERN BROOK TROUT

For decades, this RSGCN has been the focus of an exemplary regional partnership—the Eastern Brook Trout Joint Venture (EBTJV; see http://easternbrooktrout.org/ for more information about the partnership). Although it is not the focus of the RCN or competitive SWG programs, each state within the range has supported the regional EBTJV initiative. Multiple partners, including state fish and wildlife agencies throughout the species' range, federal wildlife and natural resource management agencies, academic institutions, and private conservation organizations are working to conserve Eastern brook trout and their habitats. The EBTJV Fish Habitat Partnership's regional efforts aim to improve habitat condition and population size for the species. Recent accomplishments include a range-wide population assessment of brook trout; an assessment that identifies key threats to brook trout and their habitats; and a set of conservation strategies to protect, enhance and restore brook trout populations and their habitats.

Populations of Eastern brook trout (*Salvelinus fontinalis*) have declined significantly across their native range in the eastern United States. Today, it is estimated that fewer than 9% of the areas that historically supported brook trout in this region are intact. Most Eastern brook trout populations today are relegated to headwater streams, where forest cover is still prevalent. Due to their inability to survive in poor quality water or degraded habitats, Eastern brook trout serve as excellent indicators of water quality and the health of aquatic systems. Disappearance of these fish from a watershed indicates environmental degradation and habitat loss. Fortunately, simple conservation actions are available to restore habitat for brook trout. These include cleaning up acid mine drainage, restoring stream channels and improving fish passage, and planting trees to provide shade along trout streams. These and many other actions have been identified by the EBTJV and its partners, who are actively working to restore habitat for this species across the northeast.

EASTERN HELLBENDER

The Eastern hellbender *(Cryptobranchus alleganiensis*) is a large riverine salamander found historically throughout much of northeastern North America, in states from New York south to Georgia. It has experienced precipitous declines, and one subspecies, the Ozark hellbender, was listed under the federal Endangered Species Act in 2011. The hellbender is included in this report as an example of a species that will undoubtedly be the subject of regional conservation action by the Northeast states at some point in the very near future.

The hellbender's distribution is apparently determined in large part by its specialized requirements for high dissolved oxygen concentrations, low water temperature, and high flow rate. It is found primarily in swift water areas with large, irregularly-shaped and intermittent rocks. Human activities have negatively affected the hellbender throughout its range. Significant problems include water quality impairment (resulting from siltation, sedimentation, contaminants, and other pollutants), the construction of dams and other impediments to hellbender movements, and overharvesting for commercial and scientific purposes. The species is also highly susceptible to chytridiomycosis, the fungal disease that is responsible for substantial declines in frog species throughout the New World. Populations of the hellbender are reportedly in decline throughout its range. For more information about ongoing conservation efforts, please visit: http://www.northeastparc.org/workinggroups/hellbender.htm

INVERTEBRATES

Even though the RSGCN invertebrate list is not complete and continues to be updated, states are encouraged to include invertebrates on their state SGCN lists. This will, in turn, inform the RSGCN ranking process update with the completion of Wildlife Action Plans. In the meantime, additional references are available for certain groups of invertebrates such as pollinators. For example, the RCN program funded the Carnegie Museum of Natural History to develop a web-accessible database of invertebrate museum specimen records for the Northeast. The database will allow researchers or institutions to access and analyze data on invertebrate taxa (see: http://iz.carnegiemnh.org/sgcninverts/default.asp for more information).

Reports focusing on pollinators are available from the Xerces Society (see website http://www.xerces.org/pollinator-conservation/ for more information) and from the Heinz Center. These reports are intended for use by state fish and wildlife agencies in revising their State Wildlife Action Plans (The Heinz Center 2013a, 2013b). The Heinz Center report, available from the AFWA, describes methods and approaches for incorporating information about the conservation of animal pollinators into the SWAPs. Pollinators perform essential ecosystem services in both managed and wild ecosystems, benefiting humans as well as wildlife species. Funding and technical support are available for pollinator conservation projects in many states, including support in many areas through NRCS programs. The Heinz Center report describes strategies for managing and conserving populations of pollinator species

that can be implemented by the state wildlife agencies and their partners. Pollinator conservation actions can be included in the SWAPs, even in cases where the state wildlife agency does not have direct regulatory authority over pollinators. These actions can benefit many other plant and animal species in addition to pollinators. Working in collaboration, NRCS, the Heinz Center, and multiple Rhode Island partners and landowners have produced a report for incorporating pollinators in Rhode Island agriculture (The Heinz Center 2013b).

ODONATES

Odonates (dragonflies and damselflies) depend upon key wetland habitats in the Northeast. Many odonate species have small populations, limited distributions, and are facing known threats. Approximately 18% of the estimated 456 species of odonates in the United States are considered rare and vulnerable to extirpation or extinction. According to the RCN Grant Program website (see http://rcngrants.org/content/conservation-assessment-odonata-dragonflies-and-damselflies-northeastern-region for project description), nearly 200 species of Odonata (87% of the species known to occur in the Northeast) were identified as SGCN in at least one Northeast SWAP in 2005.

With funding from the RCN Grant Program, scientists at the New York Natural Heritage Program, Audubon Society of New Hampshire, and Maine Department of Inland Fisheries and Wildlife conducted the first northeast regional conservation assessment for a major invertebrate taxon, the order Odonata. About 230 species occupy a wide range of freshwater lentic and lotic habitats in the Northeast region. These insects are acutely sensitive to various forms of human disturbance and climate change, and the presence of certain species can be used to indicate habitat quality. This assessment improved methods for determining conservation status ranks. These rankings are used by states and the region as a whole to determine which species are most in need of actions to conserve habitat or otherwise support existing populations. To improve this process for Odonata, this project developed and tested a prioritization framework (Figure 1.6) based on species vulnerability and the responsibility of the region for protecting the species.

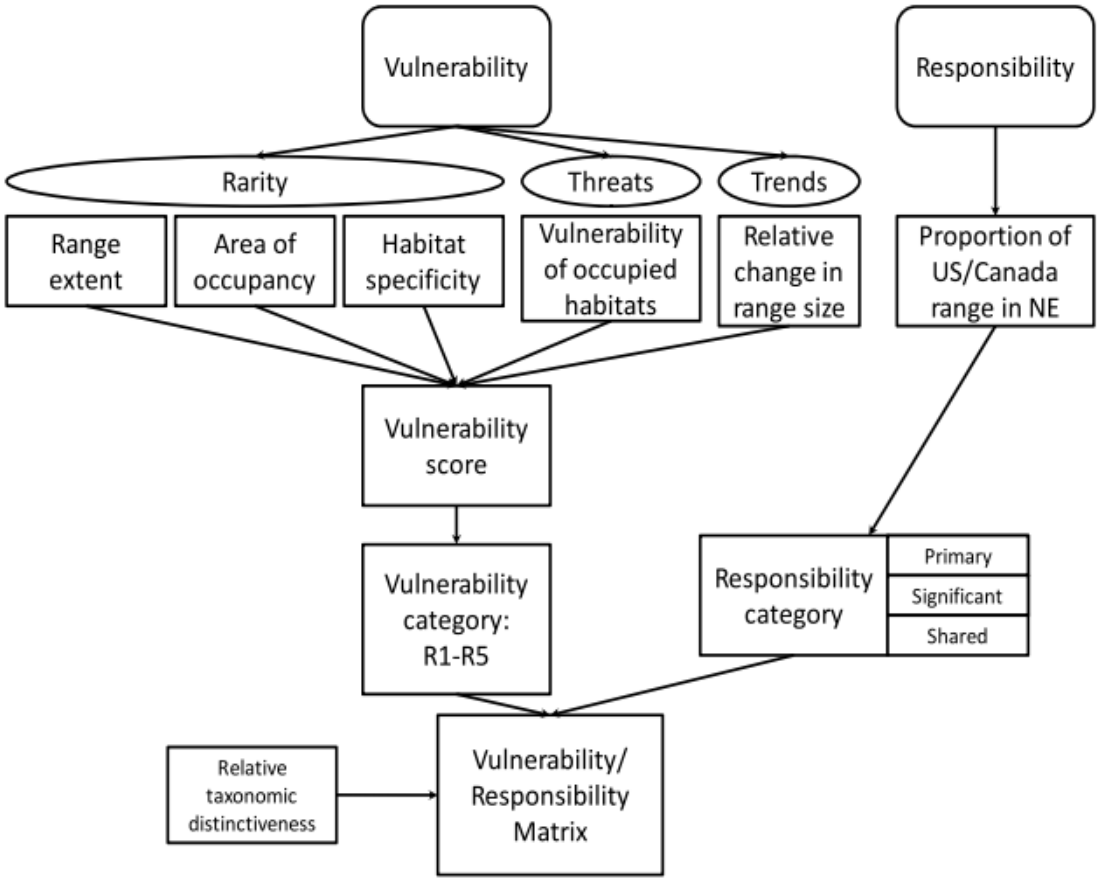


Figure 1.6. Schematic of prioritization scheme for odonates of the northeastern U.S.

The analysis was based on 248,059 records of 228 species derived at the county level from all states. Vulnerability scores and ranks (R1-R5) were based on five factors (r extent of range, area of occupancy, habitat specificity, vulnerability of occupied habitats, and relative change in range size). Responsibility is measured as the percentage of the U.S.-Canada range falling in the Northeast Region with "primary" indicating more than 50% is in the region, "significant" indicating 25-50% is in the region, and "shared" indicating less than 25% is in the region.

When this prioritization framework was applied, 41 (18%) of 228 regional Odonata species were found to be imperiled with ranks of R1 or R2.

High Vulnerability Species (R1-R2):

with Primary Regional Responsibility:

Cordulegaster erronea

Enallagma recurvatum

Gomphus rogersi

Gomphus septima delawarensis

Williamsonia lintneri

with Significant Regional Responsibility:

Calopteryx angustipennis

Cordulegaster bilineata

Ophiogomphus incurvatus

Somatochlora brevicincta

Recommendations:

Species with high vulnerability (R1 and R2) should receive targeted species-specific attention, with particular emphasis applied to the nine species with higher regional responsibility. The report also examines the degree of agreement between state species of greatest conservation need identified in State Wildlife Action Plans in 2005 and this new conservation assessment. Implementing a habitat-based approach for Odonata breeding habitats is a promising strategy. Targeted habitats include peatlands, low-gradient streams and seeps, high-gradient headwaters, larger rivers, and coastal plain ponds. A regional Odonata conservation working group could be formed to coordinate conservation of odonate species.

For more information, please see http://rcngrants.org/content/conservation-assessment-odonata-dragonflies-and-damselflies-northeastern-region).

PIPING PLOVER

A recent collaborative project of the NALCC will provide biologists and managers along the Atlantic coast with tools to predict effects of accelerating sea-level rise on the distribution of piping plover breeding habitat, test those predictions, and feed results back into the modeling framework to improve predictive capabilities. Immediate model results will be used to inform a coast-wide assessment of threats from sea-level rise and to provide related habitat conservation recommendations that can be implemented by land managers. The results will also inform recommendations to regulators. Case studies incorporating explicit measures to preserve resilience of piping plover habitat to sea-level rise into management plans for specific locations will demonstrate potential applications.

The piping plover is an example of an international migrant that requires coordinated conservation year round. Recovery plans list key actions for its full life cycle, from breeding to wintering (http://www.fws.gov/northeast/pipingplover/recovery.html and http://ecos.fws.gov/docs/recovery_plan/030916a.pdf), and an additional nonbreeding strategy provides focuses on the migratory and wintering areas http://www.fws.gov/midwest/EastLansing/te/pipl/index.html). AFWA provides guidance for full life cycle conservation and examples to help inform Wildlife Action Plan revisions (Hahn 2013).

MARINE BIRDS

This project will develop a series of maps depicting the distribution, abundance, and relative risk to marine birds from offshore activities (e.g., wind energy development) in the northwestern Atlantic Ocean. The goal of this effort is to develop and demonstrate techniques to document and predict areas of frequent use and aggregations of birds and the relative risk to marine birds within these areas. The resulting map products are intended to help inform decisions about siting offshore facilities; marine spatial planning; and other uses requiring maps of seabird distributions. This NALCC project is supporting several components of map and technique development by leveraging several large, ongoing projects funded by Bureau of Ocean Energy Management (BOEM), Department of Energy (DOE), USGS, and NOAA and involving research groups at the Biodiversity Research Institute, NC State University, CUNY-Staten Island, the USGS Patuxent Wildlife Research Center, and the NOAA National Centers for Coastal Ocean Science-Biogeography Branch. For more information about the project, please visit: http://www.northatlanticlcc.org/projects/mapping-the-distribution-abundance-and-risk-assessment-of-marine-birds-in-the-northwest-atlantic-ocean.

IDENTIFYING IMPORTANT MIGRATORY LANDBIRD STOPOVER SITES IN THE NORTHEAST

Dozens of species of land birds, such as warblers, hummingbirds, and orioles, migrate through the northeastern United States as they journey between their summer breeding grounds in the United States and Canada and their nonbreeding grounds as far south as South America. During the migration period, birds must find habitat where they can stop, rest, and replenish their energy reserves. The migration period is one of the most perilous stages in the life cycle for birds, and conservation efforts are

increasingly focused on identifying stopover sites that are important for sustaining migratory landbird populations. This project will build upon prior work by the University of Delaware and USGS to use weather surveillance data and field surveys to map and predict such areas.

This project will calibrate NEXRAD (Next-Generation Radar) weather surveillance radar data of bird stopover density by collecting ground survey data of bird identities and densities. It will improve NEXRAD-based models of important stopover sites for the Northeast by incorporating two more years of radar data, a more sophisticated modeling method, and better explanatory variables. This facilitates validation of the updated NEXRAD-based predictive statistical models for the Northeast using ground survey and (as available) National Aeronautics and Space Administration (NASA) radar observations. Finally, the project will assess habitat use of migrants in relation to food abundance, habitat and landscape features in the Mid-Atlantic Coastal Plain. For more information about the project, please visit: http://www.northatlanticlcc.org/projects/bird-radar-group/migratory-landbird-stopover-sites-in-the-northeast.

ASSESSING PRIORITY AMPHIBIAN AND REPTILE CONSERVATION AREAS (PARCAS) AND VULNERABILITY TO CLIMATE CHANGE IN THE NORTH ATLANTIC LANDSCAPE CONSERVATION COOPERATIVE

Amphibians and reptiles are experiencing severe habitat loss throughout North America. This threat to biodiversity can be mitigated by identifying and managing areas that serve a disproportionate role in sustaining herpetofauna. Identification of such areas must take into consideration the dynamic nature of habitat suitability. As climate changes rapidly it is possible that areas currently deemed suitable may no longer be so in the future. To address these needs, the project will generate spatially-explicit data that will 1) identify Priority Amphibian and Reptile Conservation Areas (PARCAs)—those discrete areas most vital to maintaining reptile and amphibian diversity, 2) project regions of current and future climatic suitability for a number of priority reptiles and amphibians in the NALCC, and 3) identify gaps in distributional data for these species that may prevent or inhibit the identification of species-level climatic suitability.

Collectively, these approaches will represent the assembling and processing of all necessary information for identifying PARCAs. They will also offer a long-term assessment of resiliency of PARCAs that may provide refuge as the climate changes.

For more information about the project, please visit: http://www.northatlanticlcc.org/projects/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc

REPRESENTATIVE SPECIES HABITAT CAPABILITY MODELS

Through the University of Massachusetts Amherst, the NALCC is assessing the capability of the landscape in the Northeast region to support sustainable wildlife populations under various climate change and urban growth scenarios. Reliable and informative species' climate niche and habitat capability models are being developed for a suite of representative species that represent the habitat needs of the broader set of priority species in the region. In assessing the overall resiliency of the landscape in response to human alterations, a species-based approach (for example, one that uses climate-habitat models) complements the coarse-fine filtered assessment provided by the ecological integrity analysis. About 30 representative species are being modeled under current and predicted future conditions. For more information, about the representative species that were identified please visit: http://www.northatlanticlcc.org/resources/contents/representative-species-summary

For more information about the habitat suitability models, please visit the Designing Sustainable Landscapes project website, which has links to models for 13 species:

- Moose
- Wood duck
- Prairie warbler
- Ruffed grouse
- American woodcock
- Louisiana waterthrush
- Eastern meadowlark
- Marsh wren
- Northern waterthrush
- American black bear
- Blackburnian warbler
- Blackpoll warbler
- Wood thrush

http://nalcc.databasin.org/galleries/dc2f56fa047144f0a9659c3709e022f2#expand=43917

NORTHEAST REGIONAL AND STATE TRENDS IN ANURAN OCCUPANCY FROM CALLING SURVEY DATA (2001-2011) FROM THE NORTH AMERICAN AMPHIBIAN MONITORING PROGRAM

A 2010 RCN project aimed to analyze data collected as part of the North American Amphibian Monitoring Program. Its results were published in October 2014 (Weir et al. 2014). The data was collected from road routes with 10 "stops" each which are visited 3-4 times per year. Observers spend 5 minutes at each stop and listen to frog calls to identify species and record whether there is a single call, a strong population, or a full chorus. With one exception, surveys were available in all 13 northeastern states from 2001-2011. New York began surveying in 2008 and therefore did not have sufficient data to be included in the report. The average regional trend for all species was -2.82%. Seven species show decreasing trends (*A. fowleri, A. crepitans, P. brachyphona, P. feriarum-kalmi* complex, *L. palustris, L. pipiens,* and *L. sphenocephalus*) and one exhibited an increasing trend (*H. versicolor-chrysocelis* complex). State results are also reported.

For more information please visit: http://www.northatlanticlcc.org/resources/contents/representative-species-summary

CHAPTER 2—REGIONAL HABITAT DESCRIPTION AND CONDITION

This chapter provides information about important wildlife habitats in the Northeast, particularly those that are in need of conservation consideration, as identified by the Northeast states and their partners through the State Wildlife Action Plans (SWAPs) and the Regional Conservation Needs (RCN) grant program. This document uses the term "habitat" to include ecological communities, vegetation communities, geographic features, and other discrete, mappable entities that support fish or wildlife species of regional conservation need. Information is provided about the extent and condition of major habitat groupings, as required in Element 2 for the SWAPs. Case studies and project summaries illustrate actions taken by the Northeast states to assess, monitor, and restore wildlife habitats. Habitat guides for each Northeast state can be found at https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/hg/Pages/default.aspx. Please see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC (2013) for additional information and links to each of the reports for habitat assessment and conservation projects that have been funded through the RCN Grant Program.

The Northeast is more than 60% forested, with an average forest age of 60 years. It also contains more than 200,000 miles of rivers and streams, 34,000 water bodies, and more than 6 million acres of wetlands. Eleven globally unique habitats in the region, from sandy barrens to limestone glade, support 2,700 restricted rare species. Habitat fragmentation is one of the greatest challenges to regional biodiversity, as the region is crisscrossed by more than 732,000 miles of roads. The Northeast also has the highest density of dams and other obstacles to fish passage in the country, with an average of 7 dams and 106 road-stream crossings per 100 miles of river (Martin and Apse 2011). Conversion to human use has also impacted much of the Northeast landscape, with one-third of forested land and one-quarter of wetlands already converted to other uses through human activity. Total wetland area has expanded slightly in the Northeast over the past twenty years, although 67% of wetlands are close to roads and thus have likely experienced some form of disruption, alteration, or species loss.

In the Northeast, 16 million acres of secured land is held by more than 6,000 fee owners and 2,000 easement holders, both private and public. One-sixth (16%) of the region is secured against conversion to development, and five percent of that land is intended explicitly for nature. State government is the largest public conservation land owner, with 12 million acres, followed by federal government, with 6 million

acres. Private lands held in easements account for 3 million acres, and land owned by private non-profit land trusts account for another 1.4 million acres. At the same time, land conversion outweighs land securement roughly 2:1 (28%:16%).

NORTHEAST HABITAT CONDITION AND CONNECTIVITY

Several RCN grant projects have compiled information about wildlife habitat conditions in the Northeast. Data and maps are available at multiple scales from the links provided in the project summaries below. Regional habitat data and maps can also be used at the state and local scale, and can be refined and enhanced by overlaying additional state and local data and map components, as shown in Figure 2.1.

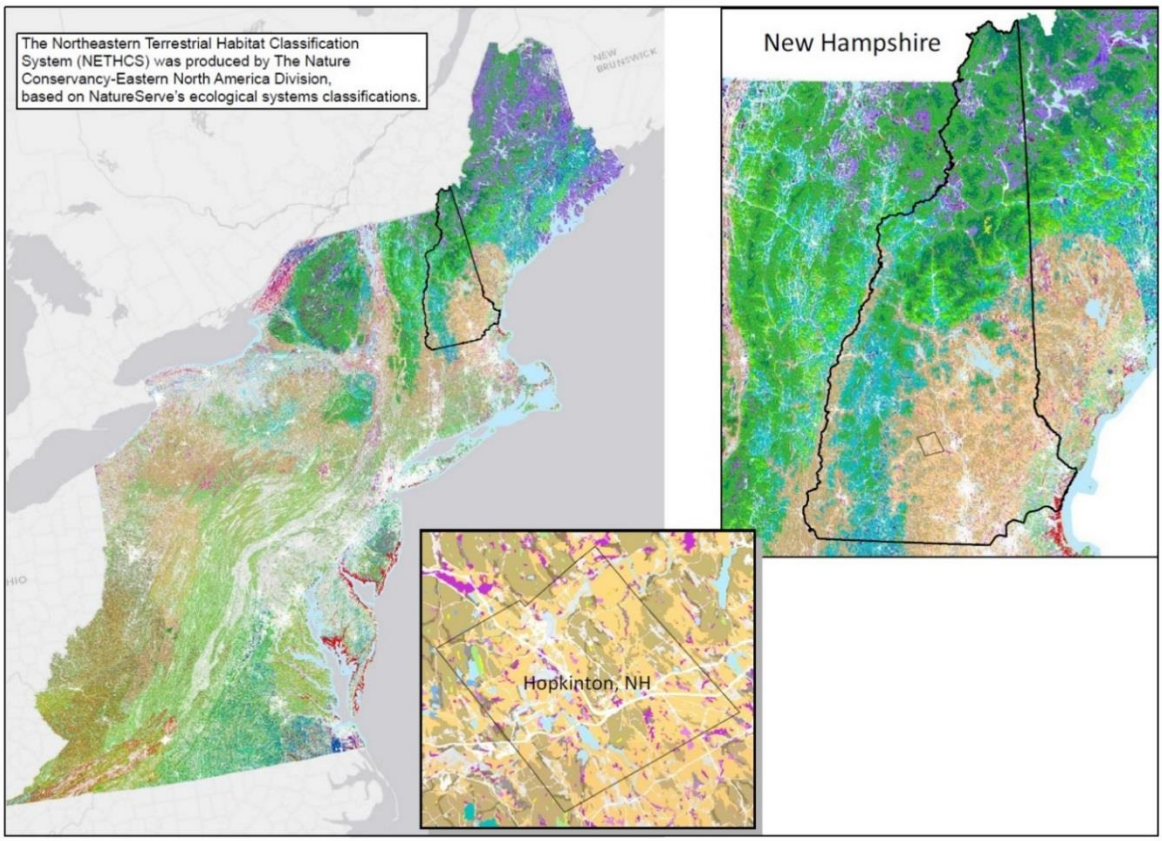


Figure 2.1. Example of habitat mapping at multiple scales using RCN project regional data (Anderson et al. 2013) enhanced by state and local level data. Source: NH Fish and Game.

CONSERVATION STATUS ASSESSMENT

A conservation status assessment of regionally significant fish and wildlife species and habitats was completed by The Nature Conservancy (TNC) in 2011 with support from the Northeast Association of Fish and Wildlife Agencies (NEAFWA) (Anderson and Olivero Sheldon 2011). TNC applied key indicators and measures for tracking wildlife status developed by the NEAFWA Monitoring and Performance Reporting Framework and detailed in their report "*Monitoring the Conservation of Fish and Wildlife in the Northeast: A Report on the Monitoring and Performance Reporting Framework for the Northeast Association of Fish and Wildlife Agencies"* (NEAFWA 2008) (see Chapter 5). The conservation status assessment reports the condition of key habitats and species groups (e.g., bird population trends) in the region, and this information is summarized below. http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf.

EASTERN FORESTS

The Northeast region was once 91% forested, supporting thousands of plant and animal species. Almost one-third of that original forested land, a total of 39 million acres, has since been converted. Converted forest land exceeds the amount of forested land conserved for nature by a ratio of 6 to 1, and conserved lands are spread unevenly across forest types. For example, upland boreal forests are 30% conserved with 12% secured for nature. Northern hardwoods are 23% secured with 8% primarily for nature. Oak-pine forests are only 17% secured with 5% primarily for nature.

Forests in the Northeast region are fragmented by 732,000 miles of permanent roads. On average, 43% of the forest occurs in blocks less than 5,000 acres that are completely encircled by major roads, resulting in an almost 60% loss of local connectivity. Current patterns indicate that securing land has been an effective strategy for preventing fragmentation as there is a high proportion of conserved land within most of the remaining big contiguous forest blocks.

Forests in the region average only 60 years old, regardless of forest type, and they are overwhelmingly composed of small trees 2" to 6" in diameter. Upland boreal forests are the most heavily logged, and they

differ from the other types in having fewer large-diameter trees. Out of almost 7,000 forest samples collected in this region by the U.S. Forest Inventory and Analysis program, no forest stands were dominated by old trees or had the majority of their canopy composed of trees more than 20" in diameter.

WETLANDS

Wetlands once covered 7 percent of the northeastern United States, and swamps, peatlands, and marshes are some of the most diverse wildlife habitat in the region. At least 2.8 million acres of wetlands, one-quarter of the original extent, has been converted to development or drained for agriculture. Conservation efforts have secured 25 percent of the remaining acres, including one-third of the largest tidal marshes. River-related wetlands, such as floodplain forests, have lost 27 percent of their historic extent and are only 6 percent conserved for nature, the lowest rate of any wetland type. Wetlands have expanded slightly over the past 20 years, but 67 percent of them have paved roads so close to them, and in such high densities, that they have probably experienced a loss of species. Sixty six percent have development or agriculture within their 100 meter buffer zones which can result in notable impacts on biodiversity.

UNIQUE HABITATS OF THE NORTHEAST

Eleven unique habitats, from sandy pine barren to limestone glade, support more than 2,700 regionally endemic, rare species. The unique habitats include:

- Limestone valleys, wetlands and glades (Calcareous settings)
- Soft sedimentary valleys and hills (Moderately calcareous settings)
- Acidic sedimentary pavements and ridges (Acidic sedimentary settings)
- Shale barrens and slopes (Shale settings)
- Granitic mountains and wetlands (Granite and Mafic settings)
- Serpentine outcrops (Ultramafic settings)
- Coarse sand barrens and dunes (Coarse-grained sediment settings)
- Silt floodplains and clayplain forests (Fine-grained sediment settings)
- Alpine meadows and krumholz (High elevation settings)
- Steep cliff communities (Cliff landforms)

Three geologic habitats have very high densities of rare species: coarse-grained sands, limestone bedrock, and fine-grained silts. They are also, unfortunately, the most converted, the most fragmented, and in two

cases, the least protected. These geologic, elevational, and landform settings have distinct ecological and biological expressions, and total species diversity in the region is highly correlated with the variety of geophysical settings.

For these unique regional habitats, the amount of land secured for nature was equal to, or greater than, the acreage converted on granite settings, on summits and cliffs, and at high elevations. In contrast, habitat conversion exceeds protection for nature 51:1 on calcareous settings, 29:1 on shale settings, 23:1 on dry flat settings, 19:1 on moderately calcareous settings and 18:1 on low elevations. These habitats need concerted conservation attention if the full range of biodiversity in the region is to be maintained. Fragmentation and loss of connectivity is pervasive at lower elevations across all geologic classifications. Even the least fragmented setting in the region, granite, retains only 43 percent of its local connectivity. The highest level of fragmentation, with more than an 80 percent loss of local connectivity, was found in calcareous settings, coarse-grained sands, fine-grained silts, and at elevations below 800 feet.

LAKES AND PONDS

Of the region's 34,000 water bodies, 13 percent are fully protected against conversion to development. Very large lakes, covering more than 10,000 acres, are the least (4 percent) secured. Forty percent of the region's water bodies have severe disturbance impacts in their shoreline buffer zones, reflecting high levels of development, agriculture, and roads in this ecologically sensitive area. Shoreline zones also have a high level of secured acreage, and in most lake types the amount of acreage secured exceeds the amount converted.

Lakes and ponds in this region are highly accessible; only seven percent are more than one mile from a road and 69 percent are less than one tenth of a mile from a road, suggesting that most are likely to have non-native species. Dams are fairly ubiquitous; 70 percent of the very large lakes, 52 percent of the large lakes, and 35 percent of the medium-sized lakes have dams and thus are likely to be somewhat altered in terms of temperature and water levels.

More than half of the small-to-large water bodies have lost 20 percent or more of their expected plankton and diatom taxa, and a third have lost more than 40 percent. In small lakes, this correlates roughly, but not

significantly, with the amount of shoreline conversion. Recently, the common loon, an indicator of high quality lake habitats, has been producing slightly fewer chicks than the estimated 0.48 per breeding pair needed to maintain a stable population.

RIVERS AND STREAMS

The region contains more than 200,000 miles of streams and rivers supporting more than 1,000 aquatic species, including 300 types of fish. The majority of the region's watersheds still retain 95-100 of their native fish species, but are also home to up to 37 non-indigenous species. The range of native brook trout, a species that prefers cold, high-quality streams, has been reduced by 60 percent. Direct indicators of biological integrity suggest that while 44 percent of the shallow streams are undisturbed, another 30 percent are severely disturbed, and this correlates with the amount of impervious surface in the watershed. Riparian areas, the narrow 100 meter zone flanking all streams and rivers, are important for stream function and habitat. Currently, conversion of this natural habitat exceeds protection by a ratio of 2 to 1, with 27 percent of riparian areas converted compared to 14 percent secured.

Historically, 41 percent of the region's streams were linked into huge interconnected drainage networks, each more than 5,000 miles long. Today none of those large networks remain, and even the smaller networks, more than 1,000 miles long, have been reduced by half. There has been a corresponding increase in short networks, less than 25 miles long, that now account for 23 percent of all stream miles—up from 3 percent historically. This highly fragmented pattern reflects the density of barriers, which currently averages 7 dams and 106 road-stream crossings per 100 miles of stream.

Water flow defines a stream. Currently 61 percent of the region's streams have flow regimes that have been altered enough to produce biotic impacts. One-third of all headwater streams have diminished minimum flows (they are subject to drying up) resulting in a reduction of habitat. Seventy percent of the large rivers have reduced maximum flows (smaller floods) that decrease the amounts of nutrient laden water delivered to their floodplains.

GEOSPATIAL CONDITION ANALYSIS

The recent geospatial condition analysis project (Anderson et al. 2013b) uses several important metrics to assess the condition of 116 terrestrial and aquatic habitats across the Northeast. This project uses the standardized region-wide habitat mapping data of streams and terrestrial ecosystems developed through the RCN Grant Program (Gawler 2008). The geospatial condition report is a companion to the Northeast Habitat Guides and presents additional information on the different levels of condition and human impact upon the habitats in the region http://nature.ly/habitatguides. Information is presented by habitat type and macrogroup, broadly defined as follows:

Upland Macrogroups

- Alpine
- Boreal Upland Forest
- Central Oak-Pine
- Central Oak-Pine/Longleaf Pine
- Cliff and Talus
- Coastal Grassland & Shrubland
- Glade, Barren and Savanna
- Northern Hardwood & Conifer
- Outcrop & Summit Scrub
- Rocky Coast
- Southern Oak-Pine

Wetland Macrogroups

- Central Hardwood Swamp
- Coastal Plain Peatland
- Coastal Plain Swamp
- Emergent Marsh
- Large River Floodplain
- Northern Peatland
- Northern Swamp
- Southern Bottomland Forest
- Tidal Marsh
- Wet Meadow / Shrub Marsh

Stream and river habitats are divided into types within the major macrogroups:

- Large Rivers Tidal Large Rivers
- Medium Rivers Tidal Small to Medium Rivers
- Small Rivers Tidal Headwaters and Creeks
- Headwaters and Creeks

The geospatial analysis also provides a geographic information system (GIS) tool for state agencies and conservation organizations to evaluate the condition of specific habitats within their state. The metrics follow the Northeast Monitoring and Performance Reporting Framework (NEAFWA 2008) and are calculated relative to each habitat type. Use of region-wide maps allows each habitat to be evaluated across its entire range. Each spatial dataset illustrates a facet of the region's ecological condition, such as predicted loss to development, securement from development, forest stand age, and number of dams, as well as datasets developed specifically for this assessment such as habitat patch size and amount of core area. Preliminary results of this analysis are excerpted and summarized below for each of the condition

metrics. This information is available by state as well. Please see https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Pages/geospatial.aspx (No password required. Wait for the web page to load.)

METRICS USED BY THE GEOSPATIAL CONDITION ANALYSIS TO DESCRIBE HABITAT CONDITION

Secured Land, or land and water permanently maintained in a natural state, remains one of the most effective, long lasting, and essential tools for conserving habitats. Approximately 16 million acres of land are secured in the Northeast. These lands represent the core efforts to protect the region's outstanding habitats and threatened species. They are increasingly understood as essential providers of ecosystem services and of terrestrial and aquatic biological resources. As the region's ecology responds to a changing climate, secured land plays a critical role in maintaining arenas for evolution and to provide people with the opportunities and rewards that come from direct contact with the land. Secured lands may not be developed, but their management varies widely and is governed by a variety of public and private stakeholders. The guides and table below refer to three categories of secured land based largely on management intent (Anderson and Olivero 2011, where GAP refers to the Gap Analysis Program of USGS: http://gapanalysis.usgs.gov/):

- GAP Status 1-Intended for Nature and Natural Processes
- GAP Status 2-Intended for Nature with Management
- GAP Status 3-Intended for Multiple Uses

Table 2.1. State Distribution of Secured Land Acreage in the Northeast. Source: Anderson et al. 2013.

State Distribution: CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV

Total Habitat Acreage: 566,276

Percent Conserved: 38.4%

State	State Habitat %	State Acreage	GAP 1&2 (acres)	GAP 3 (acres)	Unsecured (acres)
PA	55%	310,493	14,587	101,740	194,166
VA	17%	93,666	25,531	25,815	42,321
WV	12%	70,182	3,064	17,481	49,637
MD	5%	28,081	1,416	6,178	20,488
NY	4%	24,145	2,574	6,526	15,045
MA	2%	8,545	463	2,840	5,241
NJ	1%	8,243	3,245	1,440	3,558
NH	1%	7,739	286	1,353	6,099
VT	1%	6,188	192	377	5,619
CT	1%	4,918	653	957	3,309
ME	1%	4,009	321	233	3,455
RI	0%	38	0	5	33
DE	0%	24	1	10	14
DC	0%	4	0	0	4

One-sixth (16%) of the region is secured against conversion to development, and five percent of that land is intended explicitly for nature (GAP 1 or 2). State government is the largest public conservation land owner, with 12 million acres. The federal government owns another 6 million acres. Private lands held in easements account for 3 million acres, and land owned by private non-profit land trusts account for another 1.4 million acres. Land conversion, however, outweighs land securement roughly 2:1 (28%:16%).

Approximately 23% of the terrestrial habitats are secured, and mountain habitats collectively are 63% secured. A few low-elevation coastal habitats including the Central Atlantic Coastal Plain Maritime Forest (89%) and Great Lakes Dune and Swale (69%) are also well secured. Piedmont habitats are the least secured habitats in the region, especially Southern Piedmont Mesic Forest (3%), Southern Piedmont Dry Oak-Pine Forest (3%), Piedmont Hardpan Woodland and Forest (2%) and Southern Piedmont Glade and Barrens (0%). Among wetlands, the Atlantic Coastal Plain Peatland Pocosin and Canebrake (99%) and Atlantic Coastal Plain Northern Bog (72%) are well secured.

Stream and River Securement: More than 22,572 acres of riparian buffer have been permanently secured against conversion to development. This represents 15% of all the riparian area in the region. Five

percent of riparian area is secured primarily for nature (GAP 1-2), and 10% is secured for multiple uses. The vast majority of this secured acreage (83%) is associated with small headwaters and creeks, as these small streams make up most of the miles of stream and river systems in the region.

The amount of secured lands in the riparian buffer ranged from 12% to 18%. Tidal small and medium rivers had the highest percentages of secured lands in their riparian area followed by tidal large rivers. This highlights the focus of conservation efforts to protect the ecologically rich tidal wetlands and marshes that are found in these settings. Headwaters and creeks also have higher levels of securement than the small-to-large freshwater rivers. Large freshwater rivers have the lowest amount of riparian secured lands, as these settings are highly desirable as agricultural lands and as sites for roads and other development.

Local Connectedness: The Northeast and Mid-Atlantic region is crisscrossed by more than 732,000 miles of roads, making fragmentation a significant challenge for maintaining biodiversity in the region. Outcrops, summits, boreal forests and northern hardwood forest have the highest local connectedness of the upland habitat with the highest being Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest. At the low end were coastal plain, Piedmont and maritime communities. Piedmont Hardpan Woodland Forest and the very small-patch Serpentine Woodlands are the two habitats with the most fragmentation. Among wetlands, northern peatlands and northern swamps have the highest connectedness along with the coastal plain pocosins and the northern large river floodplains.

The local catchments of streams and rivers have a relatively low average local terrestrial connectedness. Connectedness scores are high in headwaters and creeks and low in tidal small and medium rivers, tidal large rivers, and large freshwater rivers. All six cold stream and river types had the most connected local catchments, reflecting the more intact terrestrial conditions in northern and high elevation areas. Warm and cool streams and rivers score lowest relative to other streams. Of these, moderate gradient cool headwaters and creeks score the lowest followed by warm large rivers.

Landscape Context Index: The local context of a habitat patch has a large influence on the viability, reproductive success, and quality of food and shelter available to the wildlife and plants within the patch. This index quantifies the degree of human conversion of natural land cover in the immediate neighborhood of every cell on the landscape ranging from unconverted to highly converted. Upland habitats have a slightly better average score than the wetland habitats. High elevation forests and patch

systems score the best, with alpine, outcrop, and summit and northern spruce fir habitats all having great context. The glade, barren, and savanna group score the lowest. Piedmont Hardpan Forest and Eastern Serpentine Woodland both score high, indicating very poor context. Peatlands score the best among wetlands. The habitats with the poorest scores include two of the limestone-related habitats: North-Central Interior and Appalachian Rich Swamp and Central Interior Highlands and Appalachian Sinkhole and Depression Pond and North-Central Interior Wet Flatwoods.

Stream and river local catchments have a relatively low overall value. The lowest scoring, most intact types are headwaters and creeks and tidal large rivers. In contrast, tidal headwaters and creeks, large rivers, and tidal small and medium rivers have the highest scores, indicating their local catchments are in settings more altered by roads, agriculture, and development. Moderate gradient cool headwaters and creeks reflect the greatest impact, followed by low gradient cool small rivers and low gradient warm headwaters and creeks. These types should be studied more intensively to determine how development in the local catchments adjacent to these streams and rivers is affecting aquatic organisms and stream health.

Predicted Development: The predicted development metric in the Northeast geospatial condition analysis estimates, by habitat, the number the acres predicted to be developed over the next 50 years. The five most threatened upland habitats are all in the coastal plain: The North Atlantic Coastal Plain Heathland and Grassland, Maritime Forest, and Coastal Plain Hardwood Forest. Tidal habitats, flatwoods, floodplains and swamps figure prominently among the most threatened wetland areas. The greatest absolute loss is predicted for the North-Central Appalachian Acidic Swamp. Mountain habitats and peatlands are mostly free from development pressure. Overall, uplands face less development pressure than wetlands.

The six habitats predicted to remain the most intact are all cold water systems, reflecting low development pressure in the northern and high-elevation areas of the region. Development in the local catchments is predicted to climb above 40% in tidal habitats, small to large warm rivers, and low or moderate gradient warm headwaters. Many of these warm habitat types currently have a low percentage of secured lands. Thus, they are also areas where the mitigation of future development, impervious surfaces, and agricultural runoff, combined with increased efforts to secure lands may be particularly warranted.

TERRESTRIAL METRICS OF HABITAT CONDITION

Patch Size: Habitats naturally occur at a variety of scales, from matrix-forming dominant forest types that define the character of an area to patch-forming systems that occupy particular landscape positions and have narrow ecological amplitudes. The size of an individual habitat patch partially determines the quality and quantity of wildlife habitat it provides and the degree to which it can sustain its internal ecological processes. The 15 matrix-forming forest habitats collectively covered 79% of the region, followed in total acreage by wetlands (11%), patch-forming forests (9%) and the edaphic, non-forest patch habitats (1%). Three matrix types had the majority of their acreage in large patches of more than 1000 acres: Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (81%), Laurentian-Acadian Northern Hardwood Forest (79%), and Appalachian (Hemlock)-Northern Hardwood Forest (50%). At the other end of the scale, seven matrix types had 10% or less of their acreage in large patches, and a maximum patch size of less than 5,000 acres. One type, the Southern Piedmont Dry Oak-Pine Forest, no longer has a single patch larger than 1,000 acres in this study area. Once the dominant matrix-forming forest of the Piedmont, this habitat is now composed of small patches of post-clearing successional forests.

Core Area: Core area is the amount of interior habitat in the central region of a minor road-bounded block. This sheltered, secluded habitat is preferred by many species for breeding. Edge effects may extend far into a habitat patch, depending on the shape and context of the patch, but typically they lessen at 100-300 m inward. Matrix forest types varied greatly in the percent and amount of core area. The three Acadian forest habitats had 78% to 96% of their acreage in core area. In contrast, all the coastal plain and Piedmont matrix habitats had much less acreage in core area (35% to 49%). Wetland habitats differed from the terrestrial habitats in that some coastal plain habitats, namely the coastal plain pocosin and canebrake (100%), and Virginia's embayed region freshwater tidal marsh (88%), both had substantial core area, as did the Boreal-Laurentian bog (97%), maritime bog (92%), and basin fen (90%). The wetland habitats varied greatly within their types and geographies with no consistent pattern.

Forest Stand Age: The proportion of various age classes of a forest or habitat type provides a picture of its ecosystem development. Older forests tend to have large-diameter trees, large standing snags with numerous cavities, big fallen logs, and dense shrubby understory layers and these structural features greatly increase a forest's value to many wildlife species. The average stand age for the forest types in the region was 51.4 years (based on a weighted average of each forested habitat type), and the maximum estimated age recorded in the dataset was 136 years. Boreal Upland Forest had the highest stand age of

the forest groups (57 years) followed by Northern Hardwood (52 years) then Central Oak Pine (49 years). Montane habitats and the forests surrounding cliffs and outcrops were the oldest types in the region (59 to 71 years). Piedmont and coastal plain forests were considerably younger (less than 45 years).

Landscape Complexity: This metric estimates the number of microclimates in a 100-acre area surrounding each cell of habitat created by an area's topography, the range of its elevation gradients, and the density of its wetlands. These factors increase a site's resilience by offering micro-topographic climate options to resident species, buffering them from changes in the regional climate. TNC measured this metric in standard deviations above or below the regional mean. The matrix forests of the Southern and Central Appalachians have the highest degree of landscape complexity. Four oak-dominated forests were among the highest: Southern Appalachian Oak Forest, Allegheny-Cumberland Dry Oak Forest and Woodland, Central Appalachian Dry Oak-Pine Forest, and Northeastern Interior Dry-Mesic Oak Forest. The low scoring forests were all in the coastal plain: North Atlantic Coastal Plain Hardwood Forest, Southern Atlantic Coastal Plain Mesic Hardwood Forest, and North Atlantic Coastal Plain Pitch Pine Barrens. Stream-related wetlands scored the highest among the wetland types.

AQUATIC METRICS OF HABITAT CONDITION

Impervious Surface: All indicators of stream quality relative to biotic condition, hydrologic integrity, and water quality decline with increasing watershed imperviousness. Across all streams and rivers, 53% of miles were undisturbed by impervious surface impacts and 30% were in the low-impact class. Conversely, 12% were in the moderately impacted class, and 5% were in the highly impacted class. Across habitat types, all types with more than 70% of their miles in the undisturbed class were cold types, highlighting the intact settings in the more northern and higher elevation areas of this region. Considering only stream habitats where the impacts of impervious cover have been most studied, in addition to cold streams, high-gradient cool, and high-gradient warm streams also had low impacts. The most highly impacted streams included tidal streams, low-gradient warm streams, and moderate-gradient warm streams.

Riparian Land Cover: The riparian zone is the land area directly adjacent to a stream or river and subject to its influence. Both agricultural and developed lands in the riparian area are associated with lower levels of aquatic biological integrity and water quality. Most (73%) of the riparian land in the region is in a natural condition, while 16% is in agricultural use, 10% in low-intensity development and

2% in high-intensity development. By stream and river habitat types, the six cold stream and river types have the most intact riparian areas. High-gradient cool and high-gradient warm types also have high levels of intact riparian areas. Very low-scoring habitat types include the warm large rivers, tidal large rivers, and tidal small and medium rivers, highlighting the development and agricultural pressure on the riparian areas of these large and coastal rivers. Other low-scoring types included moderate-gradient cool streams, warm medium rivers, moderate-gradient cool small rivers, and moderate-gradient warm small rivers.

Dam Types: Dams significantly alter the biological, chemical and physical properties of rivers, in addition to blocking the movement of stream biota. The region currently contains 13,824 known dams on streams and rivers with drainage areas of more than one square mile. On average, there were seven dams for every 100 miles of streams and rivers. The most common type of dam was recreational followed by water supply, hydroelectric, and flood control. The highest dams in the region were flood control dams, while hydroelectric dams had the highest normal and maximum storage capacity. Small and medium rivers had the highest dam density followed by tidal streams which had many head-of-tide dams. Hydroelectric dams had their highest density on cool large rivers and cool or cold medium rivers. Hydroelectric dams also had moderate-high densities on moderate-gradient cold and cool small rivers, warm large rivers, and medium rivers. The density of recreational dams was highest in the tidal and freshwater streams, while flood control and water supply dams were widely distributed across stream and river types.

Risk of Flow Alteration from Dam Storage: Flow alteration is among the most serious threats to freshwater ecosystems. Although flows can be altered by a variety of practices, dams are often responsible for a disproportionately large portion of all flow alteration in a basin. The water storage capacity of dams has been found to be highly correlated with measures of overall hydrologic alteration. The index of the potential risk of flow alteration from dam water storage showed streams were impacted much less than rivers. For example, 94% of all stream miles were in the very low risk category while only 51% of river miles were in this very low risk category. The percent of miles in the most highly impacted severe risk class showed warm medium rivers and cool medium rivers were most threatened, followed by moderate-gradient cool small rivers. Other types scoring high in the summary index include tidal large rivers, warm large rivers, and cool large rivers.

Network Size: A connected network is defined as the set of stream and river segments bounded by fragmenting features (dams) and/or the topmost extent of headwater streams. Long networks provide room for the daily and seasonal movements of the stream inhabitants. Results highlight longer networks in the Mid-Atlantic region and shorter networks throughout much of New England, New York, and New Jersey. Average network length was highest in high-gradient warm streams, warm large rivers, tidal large rivers, and moderate-gradient warm streams. Average network length was least in low-gradient cool streams, cool medium rivers, low-gradient cool small rivers and moderate-gradient cold streams. In addition, types with more than 25% of their lengths in small networks less than 25 miles in length included low-gradient warm streams, moderate-gradient cool streams, high-gradient cold streams and tidal streams.

Road Stream Crossings: Road-stream crossings are ubiquitous in any human-impacted landscape, and when improperly designed or maintained, can significantly impede organism passage and undermine the ecological integrity of river and stream systems. Results indicate there is an average of 114 road crossings for every 100 miles of stream habitat in the region. The least impacted stream habitats were low-gradient cold streams, tidal streams, and moderate-gradient cold streams. The most highly impacted types were moderate-gradient cool streams and high-gradient warm streams.

PERMEABLE LANDSCAPES FOR SPECIES OF GREATEST CONSERVATION NEED

Another important aspect of habitat for fish and wildlife is permeability, or the ability of a heterogeneous land area to provide for passage of animals (also referred to as "habitat connectivity"). A follow-up project by Anderson, *Permeable Landscapes for Species of Greatest Conservation Need*, evaluates and maps the relative landscape permeability across the thirteen states, and determines how permeability coincides with the locations and habitat of species of greatest conservation need. The project uses new analytical tools applied to the Northeast Regional Habitat Map, corroborated with species locations and land cover maps. The goal is to identify where the most important regional movement concentrations are, particularly those areas where movements may be funneled due to constriction in the landscape. The amount of flow, permeability, and resistance present in the region's developed areas and secured-lands network will also be measured. For project updates, please see: http://www.northatlanticlcc.org/projects/permeable-landscapes-for-species-of-greatest-conservation-need/permeable-landscapes-for-species-of-greatest-conservation-need.

INTEGRITY OF ECOLOGICAL SYSTEMS

The NALCC's Designing Sustainable Landscapes Project is developing a coarse filter ecological integrity approach to measuring the integrity of ecological systems in the Northeast. The project is based on a suite of ecological systems from the Northeast Terrestrial Habitat Classification System and on the concept of landscape ecological integrity. This concept refers to the ability of an area to sustain ecological functions; that is, to support biodiversity and the ecosystem processes necessary to sustain biodiversity over the long term. This definition thus accommodates the modification or adaptation of systems (in terms of composition and structure) over time to changing environments (e.g., as driven by climate change). Ecological integrity includes several measurable components, including diversity, connectivity, intactness, resiliency, and adaptive capacity that can be measured for ecological systems and the landscape as a whole. This coarse filter involves designing a landscape with a green infrastructure (i.e., undeveloped lands) containing a diversity of highly connected ecosystems with high levels of intactness, resiliency, and adaptive capacity. The ecological integrity assessment involves quantifying these five attributes to yield a combination of spatial and non-spatial results.

Spatial results include grids depicting the value of both the local index of ecological integrity (IEI, which is a weighted combination of intactness and resiliency metrics) and the adaptive capacity index. These grids provide continuous surfaces that are useful for visually depicting the consequences of alternative landscape change scenarios and for choosing sites for conservation action (e.g., protection) in the context of landscape design. Summary statistics for each of the five ecological integrity attributes will be provided for each ecological system and for the landscape as a whole, and these will be useful for quantitatively summarizing and comparing among scenarios. The ecological integrity assessment was first completed in pilot areas in the Northeast and was then made available for the entire region in June 2014.

The next phase of this project, an Assessment of Landscape Changes in the North Atlantic Landscape Conservation Cooperative (NALCC), assesses the capability of habitats to sustain wildlife populations in in the face of urban growth, changing climate, and other disturbances. It can also be used to predict the impacts of landscape-level changes on the future capability of these habitats to support wildlife populations. For more information and project updates, please see: http://www.northatlanticlcc.org/projects/designing-sustainable-landscapes-phase-2 or http://www.umass.edu/landeco/research/nalcc/nalcc.html.

RESILIENT SITES FOR SPECIES CONSERVATION IN THE NORTHEAST AND MID-ATLANTIC

Resilience is the ability of a living system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with consequences; in short, it is the capacity to adapt (IPCC 2007). This project identifies the most resilient examples of key geophysical settings (sand plains, granite mountains, limestone valleys, etc.) in relation to species of greatest conservation need. The intent is to provide conservationists with a view of the places where conservation is most likely to succeed. This was accomplished by measuring the landscape complexity and the permeability of every 30-by-30 meter square of land in the region, resulting in a set of maps of the individual and collective components of adaptive resilience. This information was applied to species sites representing the full spectrum of geophysical diversity in the region, and the scores were compared among sites with a similar geophysical composition. This process identifies a subset of sites that have the highest ecological resilience and that collectively represent all the ecological settings critical to maintaining diversity in the region. This project report provides maps, summaries and detailed charts of how information on individual species is captured by the sites. For more information, please see:
http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf

NORTHEAST HABITAT CLASSIFICATION SYSTEMS

The Northeast states and their partners supported and developed common terrestrial and aquatic habitat classification systems for the region. The Northeast Lexicon (NEFWDTC 2013b) recommends the use of these classifications in the Wildlife Action Plan revisions, as a way to ensure consistency and to advance applications of the Northeast Conservation Planning Framework. This section describes the sequential development of the classification systems, the data and spatial maps, and the supporting documents, including the habitat guides, which improve understanding and use of these classification systems and mapping tools. Further applications of these common habitat tools have resulted in additional analyses that provide regional information on habitat condition, connectivity, permeability, and resilience. Each of these projects is summarized below.

The Northeast Terrestrial Wildlife Habitat Classification System (NETWHCS) is a flexible framework for characterizing wildlife habitat that works on two levels: habitat systems and structural modifiers (Gawler 2008) http://rcngrants.org/content/northeastern-terrestrial-wildlife-habitat-classification. The habitat system corresponds to the Ecological Systems developed by NatureServe, with additional systems added to provide for altered habitats and land-use types. Because most habitat systems can incorporate substantial variation in vegetative species dominance, successional stage, and other characteristics that are relevant to wildlife use, the classification superimposes a set of structural modifiers. The combination of habitat system with structural modifiers provides a powerful tool for assessing multiple dimensions of "habitat" in a single analysis. The NETWHCS has been designed for compatibility with existing habitat classification efforts in the Northeast, including LANDFIRE and the GAP Analysis Program. The habitat classification, presented in an Excel workbook with seven worksheets, is hierarchical for habitat systems consistent with the Federal Geographic Data Committee vegetation standard and can be scaled to different applications.

The Northeast Aquatic Habitat Classification System (NEAHCS) is a standardized classification system and GIS dataset describing and mapping stream systems, lakes, and ponds across the Northeast (Olivero and Anderson 2008) http://rcngrants.org/content/northeastern-aquatic-habitat-classification-project. The system and data consistently represent the natural flowing-water aquatic habitat types across this region in a manner that is useful for conservation planning. It was designed to unify state classifications and promote an understanding of aquatic biodiversity patterns across the entire region. The system is not intended to override local stream classifications but to put them into a broader context. This approach can be applied across regional scales using GIS-modeled variables that shape aquatic habitats such as stream size, slope, elevation, climate, and geology. The GIS dataset of basic aquatic habitat using the NEAHCS can be downloaded for the entire or for individual Northeast states.

TERRESTRIAL AND AQUATIC HABITAT MAPS

The Regional Habitat Map (Ferree and Anderson 2012) is a raster GIS database of upland and wetland wildlife habitat in the Northeast classified using the NETWHCS (Gawler 2008). It provides a common framework and language for conservation planning and wildlife management across jurisdictional borders. Specifically, the map provides a standardized and consistent habitat and ecosystem classification at multiple scales across states; facilitates interstate communication about habitats; offers managers a tool for understanding regional biodiversity patterns; and allows for more effective and efficient habitat

conservation across the region, including the prioritization of habitat conservation activities. A fall 2014 update offers improvements in the mapping of floodplains, Allegheny wetlands, grass balds, and other systems, as well as an improved and simplified attribute table with page numbers that link directly to the habitat guides. This allows users to link the map information with the guides to find out about each habitat, understand its regional protection level, see a list of associated species, and find a crosswalk to the state names. All of these resources can be found at https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx

Similarly, The Aquatic Map (Olivero and Anderson 2008) includes a GIS database of all stream and river reaches in the Northeast, classified using the NEAHCS. It can be implemented across regional scales using GIS-modeled variables that shape aquatic habitats such as stream size, slope, elevation, climate, and geology. It can be downloaded for different scales, from the entire region to an individual state.

Recent revisions to this project have updated the 2008 NEAHCS to add a tidal component to the classification of streams and rivers. This update highlights the fact that tidal streams and rivers of the Northeast support a unique assemblage of aquatic biological communities and are utilized as nursery areas, refuges, and important food sources for a variety of coastal, marine, and diadromous species. Additional data including diadromous fish distributions, tidal and brackish wetland occurrences, and estuary chemistry information were collected and analyzed to map the landward extent of tidal stream and river habitats.

A new classification of lakes and ponds has also been completed. The system is based on temperature, trophic level, alkalinity (buffering capacity), and depth. Water body data contributed by the states and a random forest model were used to characterize all the water bodies based on these factors. The study investigated different ways of combining the factors, with up to 68 different classes possible using all four factors. Results can be browsed on the webmap at: http://tnc.maps.arcgis.com/apps/MapJournal/index.html?appid=5ef31a70fa4e40d19980beaf4766e448. The full report is posted on the TNC Gateway at: http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/freshwater/Pages/Northeast-Lakes.aspx

A lake dataset with multiple lake morphometry measurements and classification attributes was developed using the 2011 Environmental Protection Agency (EPA) data, National Hydrography Dataset (NHD), and the National Lake Assessment water chemistry data. Lake depth was also included because it is a critical variable related to lake stratification and the presence of permanent cold water habitats (Hollister et al. 2011). These additions were integrated into the GIS dataset and habitat guides. The reports and products can be accessed at (Terrestrial Map, Aquatic Classification System), by contacting TNC's Eastern Conservation Science office or http://www.northatlanticlcc.org/projects/aquatic-classification-revisions/revisions-to-the-northeastern-aquatic-habitat-classification.

MAP UPDATES AND EXTENSIONS IN THE NORTHEAST

The Northeast Terrestrial Habitat Map was recently updated by remapping the Virginia coastal plain and Piedmont. This methodology, updating the southeastern GAP data, is now fully consistent across all 13 states in the Northeast region (Maine to Virginia and West Virginia). For more information about the project, please visit: http://www.northatlanticlcc.org/projects/habitat-map-for-virginia-piedmont-and-coastal-plain/habitat-map-for-virginia-piedmont-and-coastal-plain. The link to the revised regional map is https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx.

The NALCC is extending the Northeast Terrestrial Habitat Map to Atlantic Canada and southern Quebec. This project will develop a comprehensive terrestrial habitat map for the expanded region. This GIS map will 1) provide a foundation upon which further research, such as species vulnerability analyses, can advance; 2) allow each state and province in the region to identify terrestrial habitats consistently across borders; 3) allow for analysis of regional connectivity; and 4) facilitate an understanding of terrestrial animal and plant populations in relation to climate change. The final map will be a composite of the individual models. http://www.northatlanticlcc.org/projects/extending-the-northeast-terrestrial-habitat-map-to-atlantic-canada

The NALCC also conducted a Rapid Update to the National Wetlands Inventory (NWI) for selected areas of intertidal wetlands in the Northeast. This included wetland mapping in 153 coastal areas (1:24,000 topographic quadrangles in ME, MD, MA, NY, PA, and VA) that were last updated prior to 2000. The updates were incorporated into the NWI and serve many applications in conservation analysis and coastal

planning http://www.northatlanticlcc.org/projects/rapid-update-to-coastal-nwi/coastal-update-to-the-national-wetlands-inventory.

COASTAL AND MARINE MAPS

The need for a regional standard for habitat classification extends to the marine environment. The NALCC applied the national Coastal and Marine Ecological Classification Standard (CMECS) version 4.0 to classify estuarine and marine environments in the Northwest Atlantic region (Maine to Virginia). This classification effort was informed by the habitat mapping approach that TNC developed for the Northwest Atlantic. Ensuring CMECS and the TNC classifications are compatible avoids redundancy and brings appropriate specificity to the application of CMECS to the region. Existing state marine classification systems were identified and crosswalked to CMECS. For more information about the project, please visit: http://www.northatlanticlcc.org/projects/reports-for-application-of-the-coastal-and-marine-ecological-classification-standards-cmecs-to-the-northeast-1.

The classification system used in TNC's Benthic Habitat Model from the 2010 Northwest Atlantic Marine Assessment will be applied at the regional scale (1:5,000,000). An intermediate-scale classification (1:250,000) will utilize datasets assembled for marine spatial planning efforts in Rhode Island, Massachusetts, and adjacent federal waters. Estuary-specific, high-resolution benthic information for Boston Harbor (1:5,000 scale) will also be developed. These will be available on the NALCC website in late 2014. For more information about the project, please visit: http://www.fws.gov/northeast/science/nalcc.html.

GUIDE TO HABITAT MAPS AND CLASSIFICATIONS

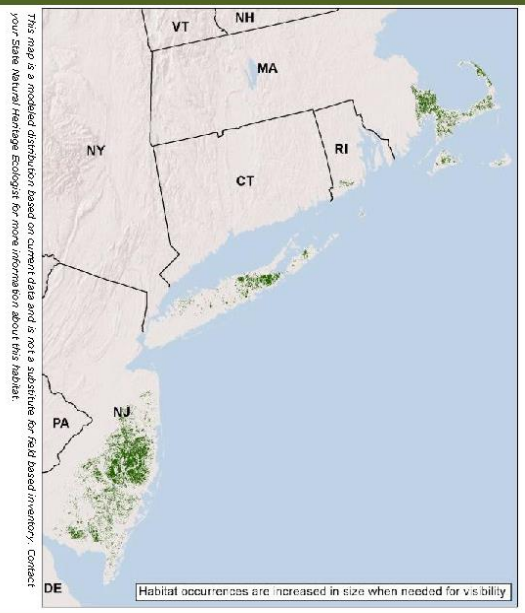
These guides take the habitat classification systems to the next level and provide states with the necessary tools to enhance the understanding of the Northeast Terrestrial Habitat map (Ferree and Anderson 2012, Gawler 2008) as well as the Northeast Aquatic Habitat classification systems (Olivero and Anderson 2008) and will promote their use throughout the region. A web-based guide and printable PDF includes a description of the habitat types; species composition and ecology of each habitat; sample photographs, wildlife associations and distribution patterns; guidance on crosswalking the habitats to other (state) classification schemes; and, where available, wildlife associations for Northeast fish and mussels

(Anderson et al. 2013) (see Figures 2.2 and 2.3). They have been compiled at the state level as well and can be found at: http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/hg/Pages/default.aspx. Each section of the habitat guide template is supported by extensive database entries, also available to states for their Wildlife Action Plan revisions from TNC. They have been sorted by state, and links to these state lists can be found at: http://rcngrants.org/content/guide-terrestrial-habitat-map.

A companion document that summarizes the methods used to create the Northeast Terrestrial Habitat Map (Ferree and Anderson 2013) is also available. The document includes sections on the classification system, mapping scale, data preparation, environmental variables, and samples of each habitat type, as well as the methods used to model and map the matrix forest types, the patch-scale upland habitats, and the wetland systems. A discussion of accuracy and recommended uses is included, along with appendices state-specific information and details on certain modeling procedures: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx.

North Atlantic Coastal Plain Pitch Pine Barrens

Macrogroup: Central Oak-Pine



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State Distribution: MA, NJ, NY, RI

Total Habitat Acreage: 491,551

Percent Conserved: 46.8%

State	State Habitat %	State Acreage	GAP 1&2 (acres)	GAP 3 (acres)	Unsecured (acres)
NJ	66%	326,469	82,234	86,207	158,029
MA	21%	101,284	8,984	36,076	56,224
NY	12%	60,016	7,303	8,204	44,509
RI	1%	3,782	656	284	2,842

Crosswalk to State Name Examples:

Pitch Pine-Oak Forest/Woodland (MA), Upland Forests - Pitch Pine-Oak Forest (NJ), Pitch Pine-Scrub Oak Barrens (NY), Pitch Pine Woodland/Barrens (RI)

Description:

A dry, fire-adapted forest with a variable canopy of pitch pine, a tall-shrub layer dominated by scrub oak, and a low-shrub layer characterized by blueberry and other heaths. Other oaks (scarlet, black, chestnut, white) are also sometimes present. Composition and structure vary with fire frequency. In general, tree oaks are more prevalent in those stands having a longer fire-return interval, while fire frequencies of eight to ten years foster the growth of "pine plains," dwarf pine stands one meter in height. Dwarf-shrubs such as lowbush blueberry, bearberry and golden-heather typify the field layer of pine plains. Scrub oak stands may occur without pine cover, particularly in low-lying areas where cold-air drainage inhibits pine growth.

Ecological Setting and Natural Processes:

This system favors low-nutrient, deep sandy soils in dry, flat settings on the coastal plain. Historically large occurrences in southeastern Massachusetts and on Long Island have been largely degraded or destroyed, but sizable and relatively intact examples still exist in New Jersey. Occasional small barrens peripheral to the main distribution occur from southern Maine to Maryland.

Similar Habitat Types:

On the coastal plain of New Jersey, the pitch pine lowland system often occurs immediately adjacent to the upland pitch pine barrens system, where the water table is close to the surface. These upland pitch pine barrens are similar in structure and composition to the Northeastern Interior Pine Barrens system, but each system has species not shared by the other.

Crosswalk to State Wildlife Action Plans:

Pitch Pine/Scrub Oak (MA), Upland forests - pitch pine-oak forest (NJ), Coastal Coniferous Barrens (NY), Pitch Pine Communities - Evergreen Forest Pitch Pine/Scrub Oak Barren (RI)

Places to Visit this Habitat:

Cape Cod National Seashore | MA
Myles Standish State Forest | MA
Brendan T. Byrne State Forest | NJ
Wharton State Forest | NJ
Rocky Point Natural Resource Management Area | NY

Associated Species: *Appendix lists scientific names*

BIRDS: brown thrasher, chipping sparrow, common yellowthroat, eastern towhee, field sparrow, ovenbird, pine warbler, prairie warbler, eastern whip-poor-will

HERPTILES: box turtle, eastern kingsnake, tiger salamander, northern pine snake, northern black racer, northern red-bellied cooter, red cornsnake, timber rattlesnake

INSECTS: comet darner, common sanddragon, cow path tiger beetle, pine woods underwing, spiny oakworm moth, The buckmoth

PLANTS: Few-flower Nutrush (Scleria pauciflora), Post Oak (Quercus stellata), Little Ladies'-tresses (Spiranthes tuberosa), Northern Blazingstar (Liatris scariosa var. novae-angliae), Butterfly Milkweed (Asclepias tuberosa), Purple Needlegrass (Aristida purpurascens), Nuttall's Milkwort (Polygala nuttallii)

Species of Concern (G1-G4): *Appendix lists scientific names*

BIRDS: long-eared owl (winter)

HERPTILES: pine barrens treefrog

INSECTS: barrens dagger moth, Barrens itame, Blueberry gray, Coastal barrens buckmoth, Frosted elfin, Karner blue butterfly, Pine barren bluet, Pine barren lycia, Pine barren underwing, Pine barren zale, Precious underwing

PLANTS: bicknell's hawthorn (Crataegus bicknellii), broom crowberry (Corema conradii), eastern silvery aster (Symphyotrichum concolor), pine barren gentian (Gentiana autumnalis), pine barrens boneset (Eupatorium resinosum), plymouth gentian (Sabatia kennedyana), sandplain flax (Linum intercursum), stiff tick-trefoil (Desmodium obtusum), tall bushclover (Lespedeza stuevei), white-bracted boneset (Eupatorium leucolepis)

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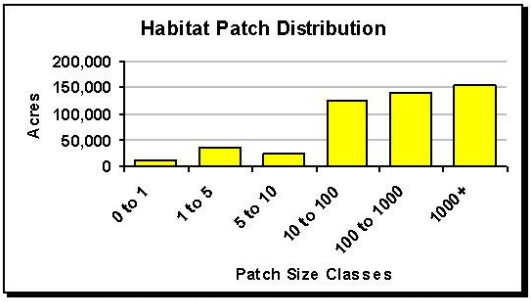
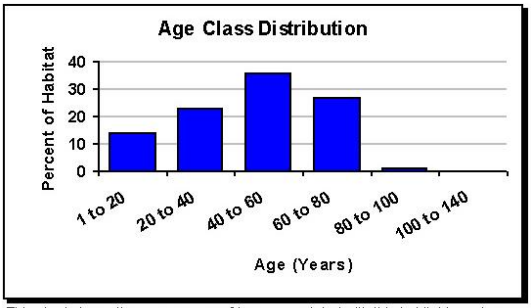
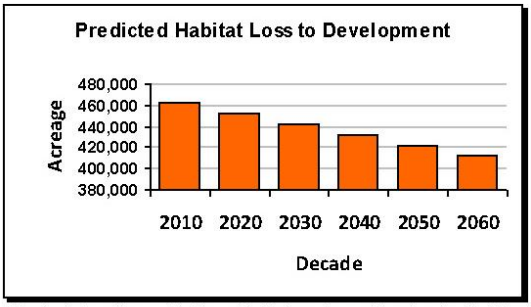


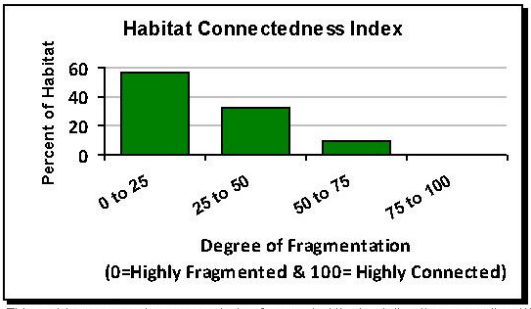
The average patch size for this habitat is 7 acres and the largest single patch is 6,876 acres. This chart shows the proportion of the habitat that is in each patch-size class.



This chart shows the average age of trees associated with this habitat based on forest Inventory data. For non-forested systems or small habitats the average age is influenced by the surroundings.



This chart shows the predicted loss of habitat over the next five decades (50,993 acres) if loss continues at the same rate as 1990-2000. The average rate of loss is 1,020 acres per year.



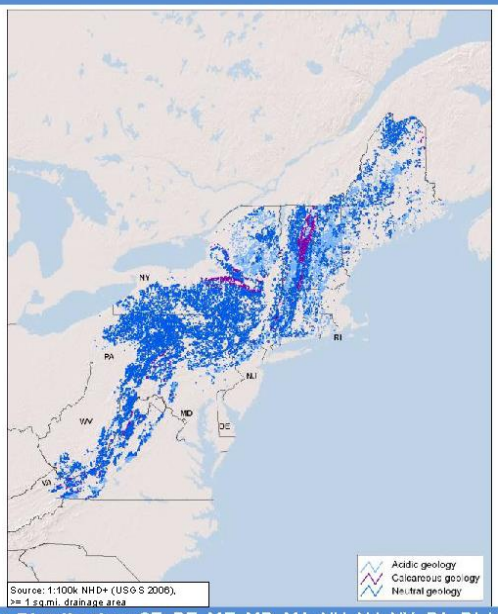
This metric measures how connected or fragmented the land directly surrounding (18 square miles) the habitat is, this the chart shows the proportion of the habitat in each connectedness class.

North Atlantic Coastal Plain Pitch Pine Barrens http://nature.ly/HabitatGuide 56

Figure 2.2. Example of a Terrestrial Habitat Guide Developed by The Nature Conservancy with Support from the RCN Grant Program. Source: Mark Anderson, The Nature Conservancy.

High Gradient, Cold, Headwaters and Creeks

Macrogroup: Headwaters and Creeks



©Josh Royte

State Distribution: CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, VA, WV

Total Habitat (mi): 36,183

% Conserved: 26.3 Unit = Acres of 100m Riparian Buffer

State	State Habitat %	Miles of Habitat	Acres GAP 1 - 2	Acres GAP 3	Total Acres Unsecured
NY	29	10443	1008	696	6458
PA	24	8847	293	1935	4756
ME	10	3799	180	454	2380
VT	10	3552	109	345	2313
NH	8	2868	265	594	1396
VA	6	2143	296	394	1004
WV	5	1692	58	273	1006
MA	3	1196	41	231	669
CT	2	816	37	74	526
NJ	1	403	65	28	224
MD	1	376	21	71	204
RI	0	47	1	9	28
DE	0	0	0	0	0

Description:

Cold, fast-moving headwaters and creeks of steeper slopes at moderate to high elevations. These small streams of northern regions or high elevations occur on steep slope in watersheds less than 39 sq.mi in size. The cold fast moving water has high water clarity and is well oxygenated. Instream habitats are dominated by riffles and cascade and step-pool systems. Channels are usually narrowly confined, high-gradient, and surrounded by upland forests. Bed materials often consist of bedrock, boulders, cobbles, and coarse gravel. The predominant source of energy to the stream is terrestrial leaf litter or organic matter (these are allochtonous streams). Permanent cold water temperatures in these streams means coldwater fish species, such as brook trout, likely represent over half of the fish community. Additional variation in the stream biological community is associated with acidic, calcareous, and neutral geologic settings where the pH of the water will limit the distribution of certain macroinvertebrates, plants, and other aquatic biota. The habitat can be further subdivided into 1) headwaters that drain watersheds less than 4 sq.mi, and have an average bankfull width of 16 feet or 2) Creeks that include larger streams with watersheds up to 39 sq.mi. and have an average bankfull width of 32 feet.

Similar Habitat Types:

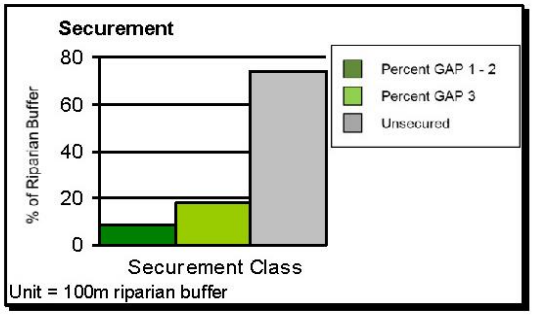
Headwaters and creeks may also occur at lower elevations but these tend to be warmer, flatter, and slower. Coastal examples of high gradient headwaters are rare. Cold high gradient streams typically flows into moderate or low gradient cold and cool rivers in areas of less topography.

Places to Visit this Habitat:

Dry Brook, Satans Kingdom WMA | MA Warner Creek, Phoenicia Wild Forest | NY Lamentation Run, Allegheny National Forest Non-Reserved | PA Dish Mill Brook, Victory State Forest | VT Leatherwood Creek, Monongahela National Forest | WV

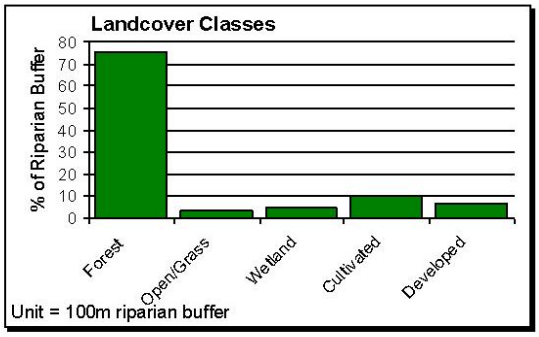
Associated Fish:

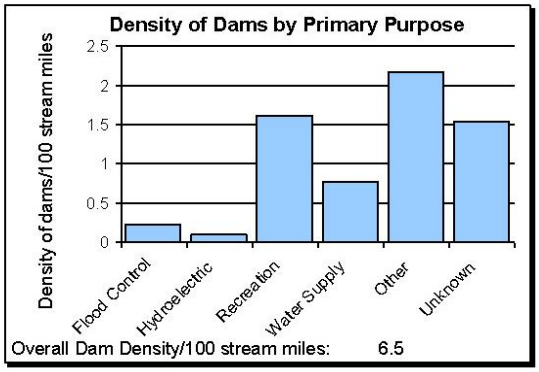
Most Abundant: brook trout, slimy sculpin, longnose dace, longnose sucker, eastern blacknose dace, creek chub Less Abundant: mottled sculpin, white sucker, fantail darter, common shiner, lake chub, fallfish, atlantic salmon.



Species of Concern (G1 - G4):

Fishes: black sculpin
Crayfish, Mussels, and Snails: eastern pearlshell
See Appendix 2 for scientific names





Crosswalk to State Names:

Vermont: Brook trout, Brook trout-slimy sculpin, Blacknose dace-Slimy sculpin. New Hampshire: High gradient, very cold streams; Very steep scour streams. New York: Rocky headwater stream. Maryland: Cold Water Streams. Pennsylvania: Atlantic Basin Fish Coldwater Community, Ohio-Great Lakes Basins Fish Coldwater Community.

Brook trout, © USFWS Southeast

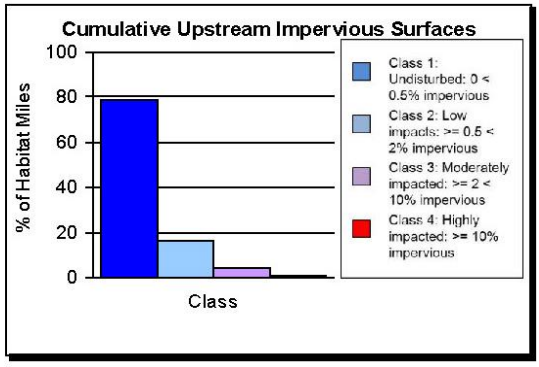


Figure 2.3. Example of an Aquatic Habitat Guide Developed by The Nature Conservancy with Support from the RCN Grant Program. Source: Mark Anderson, The Nature Conservancy.

HABITAT CONSERVATION OPPORTUNITIES SUPPORTED BY RCN FUNDING AND COLLABORATION

The following RCN case studies highlight conservation efforts identified by NEAFWA's Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) for key habitats with especially high value for wildlife species in Northeast states. Each of these habitats has benefited from dedicated regional conservation partnerships and RCN Grant Program funding in order to promote effective conservation activities designed to conserve, restore, or protect the habitats and their associated species. Please note that this chapter focuses on key habitats that have been the subject of RCN grants, competitive SWG, and NALCC program collaboration.

SHRUBLANDS AND YOUNG FORESTS

Shrublands and young forests were identified by the Northeast Monitoring and Performance Reporting Framework (NEAFWA 2008) as one of eight habitat types for monitoring the status of wildlife in the Northeast. At least 87 SGCN depend on shrubland habitats in one or more Northeastern states, including 40 birds, 16 mammals, 16 amphibians/reptiles, and 15 invertebrates. Active management is required to retain these habitats, and to maintain a certain proportion of early successional habitat within the overall landscape. Strategic planning and placement of these habitat patches, however, is critical to the ecological integrity of both early and mature, unfragmented forest ecosystems.

The Northeast Association of Fish and Wildlife Agencies further focused on shrubland conservation in the Appalachian portion of the states of Virginia, Maryland, West Virginia, Pennsylvania, and New York (McDowell 2011). These activities focused on Bird Conservation Region 28, where shrubland areas have declined over the last century due to loss of land to development, vegetation succession, suppression of natural disturbance regimes, and lack of active management. The project helped develop Best Management Practices (BMPs) for shrubland habitats, established shrubland BMP demonstration areas, and conducted outreach to public land managers and private landowners. Reports include:

Implementing Bird Action Plans for Shrubland Dependents in the Northeast
http://rcngrants.org/content/implementing-bird-action-plans-shrubland-dependents-northeast

Implementing the American Woodcock Conservation Plan
http://www.ruffedgrousesociety.org/UserFiles/File/American%20Woodcock%20Conservation%20Progress%20Report-070110.pdf

American Woodcock Habitat: Best Management Practices for the Central Appalachian Mountains Region
http://www.timberdoodle.org/sites/default/files/research_documents/Woodcock%20BMPs_Appalachians.pdf

Under Cover: Wildlife of Shrublands and Young Forest
http://www.youngforest.org/sites/default/files/Under_Cover-010412_FINAL.pdf

A website http://www.timberdoodle.org was also developed and populated including BMPs, demonstration areas and opportunities for technical assistance.

TIDAL MARSH

Tidal marshes were also identified by NEAFWA's NEFWDTC as a significant regional conservation priority. Marshes along the eastern North American shoreline have the highest levels of vertebrate biodiversity and endemism of any tidal marsh system worldwide. These diverse communities are under imminent threat of loss or severe degradation. With NEAFWA support, scientists from the University of Delaware, Audubon Maryland-DC, University of Connecticut, Maine Department of Inland Fish and Wildlife, and the University of Maine developed a long-term monitoring plan for tidal marsh birds based on a sample selection protocol for secretive marsh birds (Johnson et al. 2009) and the North American Marsh Bird Monitoring Protocol (Conway 2011). The survey was conducted in 2011 and 2012 to determine distribution and abundance of 5 tidal marsh birds: Clapper Rail, *Rallus crepitans*; Willet, *Tringa semipalmata*; Nelson's Sparrow, *Ammodramus nelsoni*; Saltmarsh Sparrow, *A. caudacutus*; and Seaside Sparrow, *A. maritimus.* Surveys were conducted at sampling points in tidal marsh habitat patches in nine subregions of the Northeastern U.S. coastline: Coastal Maine, Cape Cod-Casco Bay, Southern New England, Long Island, Coastal New Jersey, Delaware Bay, Coastal Delmarva, Eastern Chesapeake Bay, and Western Chesapeake Bay. Clapper Rail and Seaside Sparrow are found more often in the southern subregions, particularly in Coastal New Jersey, Delaware Bay, Coastal Delmarva, and Eastern Chesapeake Bay. Willet is found throughout the region, but particularly in Southern New England and

Long Island. Saltmarsh Sparrow is also found throughout the region, but particularly in Southern New England, Cape Cod-Casco Bay, and Coastal New Jersey. Nelson's Sparrow is found primarily in Coastal Maine and Cape Cod-Casco Bay. For additional information please see**:** http://rcngrants.org/content/identification-tidal-marsh-bird-focal-areas-bird-conservation-region-30

FRESHWATER AQUATIC SYSTEMS

Freshwater aquatic systems were identified as a regional conservation priority for monitoring in the Northeast Monitoring and Performance Reporting Framework (NEAFWA 2008; see http://rcngrants.org/content/regional-monitoring-and-performance-framework for more information about the project) and the RCN Grant Program. The Northeast states have the highest density of dams and other obstacles to fish passage in the country, with an average of 7 dams and 106 road-stream crossings per 100 miles of river (Martin and Apse 2011; see also https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/freshwater/stream/Pages/default.aspx).

With NEAFWA support, TNC launched the Northeast Aquatic Connectivity Project (Martin and Apse 2011) resulting in a series of products and outcomes that can be used by resource management agencies in the Northeast states to reconnect fragmented aquatic habitats. The project involves development of a regional network of professionals who are actively engaged in aquatic organism passage activities. It creates the first unified database of dams, impassable waterfalls, and anadromous fish habitat across the thirteen-state Northeast region and provides information needed for state wildlife agencies and their partners to move from opportunistic project selection to a more focused approach to dam removal and fish passage improvement. The project provides a tool that allows managers to rank the importance of dams at multiple scales (state, hydrologic unit code [HUC], etc.) or by using attribute filters (river size class, dam type, etc.) and to examine 72 ecologically-relevant metrics linked to dam locations. Finally the project compiles information about the ecological benefits of barrier mitigation to migratory fish and other organisms, and this information can then be used to inform river management decisions at local or regional scales. For more information about the project, please visit: http://rcngrants.org/content/northeast-aquatic-connectivity

Other related freshwater aquatic RCN and NALCC projects include**:** Northeast Aquatic Habitat Classification System, Northeast Aquatic Connectivity, Designing Sustainable Landscapes: Assessment

of Landscape Changes in the NALCC: Decision-Support Tools for Conservation: An Interactive, GIS-Based Application to Estimate Continuous, Unimpacted Daily Streamflow at Ungauged Locations in the Connecticut River Basin, and Forecasting Changes in Aquatic Systems and Resilience of Aquatic Populations in the NALCC: Decision-support Tools for Conservation. Please see Appendix 1 for additional information and links to these projects.

COASTAL AND MARINE SYSTEMS

Information on the spatial and temporal movement and occupancy patterns of wildlife resources in offshore habitats is the focus of the North- and Mid-Atlantic LCCs, in collaboration with researchers from Bureau of Ocean Energy Management (BOEM), Department of Energy (DOE), USGS, National Oceanographic and Atmospheric Administration (NOAA), The Biodiversity Research Institute, NC State University, CUNY-Staten Island, the USGS Patuxent Wildlife Research Center, and the NOAA National Centers for Coastal Ocean Science-Biogeography Branch. The goal is to identify seasonal distribution and abundance patterns, movement patterns, habitat-abundance associations, and the potential risk to species. Results include a map showing relative risk to marine birds based on patterns of use, abundance, and temporal variability. This information will inform current and future decisions by natural resource managers. Additional information and project updates can be found at: http://www.northatlanticlcc.org/projects/mapping-the-distribution-abundance-and-risk-assessment-of-marine-birds-in-the-northwest-atlantic-ocean

AQUATIC HABITATS AND THREATS IN NORTH ATLANTIC WATERSHEDS AND ESTUARIES

The NALCC and its partners, Downstream Strategies, are creating and implementing a flexible and dynamic aquatic assessment process that has been widely accepted by aquatic and fish experts across the country. This involves assembling data and analyzing conditions to better understand fish distribution, habitat and threats to aquatic species in streams, rivers, and estuaries across the NALCC region. Stakeholders will be engaged throughout all stages of the project to ensure compatibly of results with the specific goals of the NALCC. The project involves multiple models of different species or species groups to provide expected-species distribution maps, as well as identification and quantification of threats and stressors to the species modeled. Please see: http://www.northatlanticlcc.org/projects/downstream-strategies-project/decision-support-tool-to-assess-aquatic-habitats-and-threats-in-north-atlantic-watersheds

CHAPTER 3—THREATS TO NORTHEAST FISH, WILDLIFE, AND THEIR HABITATS

There are many challenges confronting fish and wildlife in the Northeast states. SWAPs are required to identify "problems which may adversely affect species of conservation need or their habitats." These "problems" include threats that stress wildlife species and habitats, as well as management challenges such as deficiencies in data or resources for particular species or habitats. Human activities and natural processes that affect wildlife species and habitats in negative or detrimental ways are threats or stressors, while the effects of these threats on particular wildlife species or habitats are known as stress responses. Threats may be direct, affecting a species or habitat directly; or indirect, affecting a species or habitat through one or more intermediary actors or processes. Management challenges such as deficiencies in data or resources for particular species or habitats can also threaten wildlife and their habitats. Although these terms are often used interchangeably, the word "threat" is used in this document as an umbrella term referring to all aspects of the process by which human actions or natural events may jeopardize fish and wildlife species and their habitats, including all of the terms described above.

This chapter summarizes information about key threats as identified through Regional Conservation Needs (RCN) collaborative efforts and projects. The next chapter then describes actions taken by the Northeast states through the RCN Grant Program collaboration to address these threats. More detailed accounts of the threats facing fish and wildlife species and their habitats in the Northeast states are available in the individual State Wildlife Action Plans (SWAPs). Please see Appendix 1 and the RCN Project Summary (Terwilliger Consulting, Inc. and NEFWDTC 2013) for additional information on any of the RCN Grant Program projects mentioned in this document. References to threats in this Chapter and in these companion documents follow the IUCN classification system which was selected by the Northeast States in the Northeast Lexicon (Crisfield and NEFWDTC 2013) and recommended by the National Best Practices for State Wildlife Action Plans (AFWA 2012). An Excel spreadsheet providing a crosswalk between IUCN and TRACS action classification systems is provided as a reference at: http://rcngrants.org/content/northeast-regional-conservation-synthesis-state-wildlife-action-plan-revisions-0

THREATS IN THE NORTHEAST: COMMON CONSERVATION CONCERNS

There is no comprehensive assessment of threats across the Northeast region. However, numerous threats to fish, wildlife, and their habitats have been identified by the Northeast states as part of their individual Wildlife Action Plans. After the completion of the 2005 SWAPs, a survey was conducted to identify common threats identified by states (AFWA 2011). These top threats are listed in Table 3.1 in descending order. The 13 Northeast states and the District of Columbia identified 37 common, recurring threats to Species of Greatest Conservation Need (SGCN) or their habitats (AFWA unpublished and 2011). The most frequently mentioned threats included invasive species (mentioned by 100% of Northeast states) and industrial effluents; commercial and industrial areas; housing and urban development; and agricultural and forestry effluents (all of which were mentioned by at least 83% of Northeast states). Other important challenges mentioned by 50% or more of the Northeast states included: dams and water management; habitat shifting and alteration; recreational activities; roads and railroads; storms and flooding; temperature extremes; logging and wood harvesting; problematic native species; harvest or collection of animals; lack of information or data gaps; and droughts. In addition to the specific threats mentioned in the 2005 Wildlife Action Plans, recent work by the Northeast states has emphasized the importance of additional, emerging threats such as climate change, exurban developments, new invasive species, and disease.

Table 3.1. Key Threats Identified by Northeastern States in Their Wildlife Action Plans (in descending order of listing recurrences).

Key Threats Identified by Northeastern States in their Wildlife Action Plans	IUCN Code
Invasive & Other Problematic Species & Genes: Invasive Non-Native/Alien Species	8.1
Pollution: Household Sewage & Urban Waste Water	9.1
Pollution: Industrial & Military Effluents	9.2
Pollution: Agricultural & Forestry Effluents	9.3
Residential & Commercial Development: Housing & Urban Areas	1.1
Residential & Commercial Development: Commercial & Industrial Areas	1.2
Human Intrusions & Disturbance: Recreational Activities	6.1
Natural System Modifications: Dams & Water Management/Use	7.2
Climate Change & Severe Weather: Habitat Shifting & Alteration	11.1
Climate Change & Severe Weather: Storms & Flooding	11.4

Key Threats Identified by Northeastern States in their Wildlife Action Plans	IUCN Code
Climate Change & Severe Weather: Temperature Extremes	11.3
Barriers/Needs: Lack of biological information/Data gaps	12.1
Climate Change & Severe Weather: Droughts	11.2
Transportation & Service Corridors: Roads & Railroads	4.1
Biological Resource Use: Harvesting/Collecting Terrestrial Animals	5.1
Biological Resource Use: Logging & Wood Harvesting	5.3
Natural System Modifications: Other Ecosystem Modifications	7.3
Invasive & Other Problematic Species & Genes: Problematic Native Species	8.2
Biological Resource Use: Harvesting Aquatic Resources	5.4
Pollution: Air-Borne Pollutants	9.5
Barriers/Needs: Natural Resource Barriers: Low population levels, insufficient habitat requirements, etc.	12.3
Pollution: Garbage & Solid Waste	9.4
Agriculture & Aquaculture: Wood & Pulp Plantations	2.2
Pollution: Excess Energy	9.6
Barriers/Needs: Lack of capacity/funding for conservation actions	15.4
Barriers/Needs: Lack of education/outreach with public and other stakeholders	14.2
Natural System Modifications: Fire & Fire Suppression	7.1
Agriculture & Aquaculture: Non-Timber Crops	2.1
Residential & Commercial Development: Tourism & Recreation Areas	1.3
Barriers/Needs: Lack of monitoring capacity/infrastructure	12.1
Barriers/Needs: Lack of capacity/infrastructure for data management	12.2.4
Barriers/Needs: Administrative/political barriers	15
Transportation & Service Corridors: Shipping Lanes	4.3
Biological Resource Use: Gathering Terrestrial Plants	5.2
Energy Production & Mining: Renewable Energy	3.3
Energy Production & Mining: Mining & Quarrying	3.2
Other: Non-IUCN Threat: Non-IUCN Threat	

THREATS FACING REGIONALLY SIGNIFICANT HABITATS AND SELECTED SPECIES GROUPS

The 2011 Conservation Status Assessment of regionally significant fish and wildlife species and their habitats (Anderson and Olivero Sheldon 2011) summarized information about the types of threats facing Northeastern wildlife and ecosystems. They are detailed in the final project report, and a summary is provided. For the final project report, please visit: http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf.

HABITAT LOSS AND DEGRADATION IN THE NORTHEAST

Since the beginning of European colonization four hundred years ago, the Northeast has always been the most densely populated region in the country. Moreover, the population in this region is projected to increase by nearly 6 million (10 %) between 2000 and 2030. It is not surprising, therefore, that housing/urban development (IUCN 1.1) is listed as a top threat to every state's key wildlife habitats and species of conservation concern (see Table 3.1 for a summary of key threats listed in Northeast SWAPs). Commercial and industrial development (IUCN 1.2) inevitably accompanies urban sprawl, compounding this threat. More recent trends in commercial land use include ridge-top development in the Appalachians for wind turbine and communication towers (IUCN 3.3), as well as the rise in "big box development" (e.g., superstores and regional distribution facilities) region wide. Even in northern New England, which is one of the most heavily forested regions in the country, most of the forest is fragmented by networks of scattered development and roads. Transportation infrastructure (roads, railways, tunnels) fragments habitat and interrupts wildlife travel corridors to breeding/spawning/wintering habitats.

Coastal development typically involves beach stabilization (IUCN 7.3) efforts designed to stop the coast from changing. It also interferes with natural stabilizing mechanisms, such as beach grass. Stabilization of cliffs deprives downstream beaches of their sediment supply, and jetties and groins interrupt shoreline drift of sediments. Trails, roads, and walkways (IUCN 1.3) exacerbate erosion by creating channels through the dunes where winds and waves can follow, overwashing interdunal areas with salt water.

Compared to other regions, the Northeast includes some of the smallest states, which also have the highest population densities. The combination of large metropolitan cities, bustling towns, and thriving industries results in significant human-generated waste (IUCN 9.4), including household sewage, solid

waste, and industrial effluents. Pollutants from these sources impair key riparian, aquatic, and terrestrial habitats throughout the region. Garbage and solid waste in particular are a major concern, and throughout the region many landfills are closing and seeking ways to make trash into energy. Changes in water quality (IUCN 9) and quantity (IUCN 7.2) now pose serious threats to all Northeastern aquatic systems, including rivers, streams, inland and coastal wetlands, lakes, and ponds.

The Northeast is not only the most populated area of the country, but its buildings and infrastructure reflect its older character, often containing out-of-date septic and wastewater systems. Household sewage (IUCN 9.1.1), garbage, solid waste, storm run-off, and other types of urban waste generated by the many Northeastern cities and towns leech residual contaminants into ground waters and riparian areas.

Since industries are generally located near populated areas with essential water and transport, the problem of industrial pollution (IUCN 9.2) is magnified in the densely populated Northeast, resulting in additional impairment of aquatic and terrestrial habitat throughout the region. Storm water runoff (IUCN 9.1.2) further degrades water quality through erosion, and the ever-increasing amount of impervious surfaces in drainage areas poses a major threat to small streams and the aquatic communities they support. Roadway runoff, acid mine drainage (IUCN 9.2.2), siltation/sedimentation, and even acid deposition (IUCN 9.5.1) and mercury originating in the industrial Midwest, all contribute to the degradation of soils in the Northeast region.

The Northeast contains 71 million people and 732,000 miles of permanent roads, but people and roads are not distributed randomly across the region. Permanent roads are the primary fragmenting features, providing access into interior regions and decreasing the amount of sheltered secluded habitat preferred by many species. Heavily-used paved roads create noisy disturbances that many species avoid, and the roads themselves may be barriers to the movement of small mammals, reptiles, and amphibians. Fragmentation subdivides contiguous area of natural land into smaller patches, resulting in each patch having more edge habitat and less interior. Because edge habitat contrasts strongly with the interior of these parcels, its increase tends to isolate the interior region and contribute to its degradation. Thus fragmentation can lead to an overall deterioration of ecological quality and a shift in associated species from interior specialists to edge generalists.

As the human population in the region continues to grow, the threat of loss and degradation of habitat continues to impact wildlife in the Northeast. The Conservation Status Assessment describes the impacts

of these anthropogenic affects, as 28 percent of the land in the Northeast region has already been converted to development or agriculture. Conversion outweighs total conservation by a factor of 2 to 1. Moreover, only 5 percent of the land is conserved primarily for nature, and 11 percent is conserved for multiple uses. This means that, five acres of land in the Northeast have been converted for every one conserved for nature. In spite of great successes, the pattern of protection reveals widespread and fundamental biases in the network of protected areas, with significant implications for biodiversity.

The following sections summarize the threats listed in the Conservation Assessment to key Northeast habitats and Regional Species of Greatest Conservation Need (RSGN) (Anderson and Olivero Sheldon 2011). For more information and detailed analysis, please see: http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf

THREATS TO NORTHEAST FORESTS

Habitat Loss to Development: The region was once 91 percent forest supporting thousands of species. Today, almost one-third of that area—a total of 39 million acres—has been developed (IUCN 1). Lost forest land exceeds forest land secured for nature by a factor of 6 to 1, and conservation is not spread evenly across forest types. Upland boreal forests are 30 percent secured with 12 percent secured for nature. Northern hardwoods are 23 percent secured with 8 percent primarily for nature. Oak-pine forests are only 17 percent secured with 5 percent primarily for nature.

Fragmentation: On average, 43 percent of the forest in the Northeast occurs in blocks less than 5,000 acres in size that are completely encircled by major roads, resulting in an almost 60 percent loss of local connectivity. Judging from current patterns, conservation has been an effective strategy for preventing fragmentation, as there is a high proportion of conserved land within most of the largest remaining contiguous forest blocks. Forests in the region average only 60 years old and are overwhelmingly composed of small trees 2” to 6” in diameter. Upland boreal forests are the most heavily logged. Out of almost 7,000 forest samples collected in this region by the U.S. Forest Service’s Forest Inventory and Analysis program, no forest stands were dominated by old trees or had the majority of their canopy composed of trees more than 20” in diameter.

THREATS TO NORTHEAST WETLANDS

Habitat Loss to Development or Agriculture (IUCN 1 or 2): Wetlands once covered 7 percent of the Northeast, and swamps, peatlands, and marshes are some of the most diverse wildlife habitat in the region. At least 2.8 million acres of wetlands, one-quarter of the original extent, have been converted to development or drained for agriculture. Conservation efforts have secured 25 percent of the remaining acres including one-third of the largest tidal marshes. River-related wetlands, such as floodplain forests, have lost 27 percent of their historic extent and are only 6 percent conserved for nature, the greatest discrepancy of any wetland type. The majority of individual wetlands have expanded slightly over the past 20 years, but 67 percent have likely experienced a loss of species due to the close proximity and high density of paved roads. Moreover, 66 percent have development or agriculture inside their 100 meter buffer zones, which can result in notable impacts on biodiversity.

THREATS TO NORTHEAST LAKES AND PONDS

Habitat Loss to Development (IUCN 1): Only 13 percent of the region's 34,000 water bodies are fully secured against conversion to development. Very large lakes—those more than 10,000 acres in size—have the least conservation (4 percent). More than half of the small-to-large water bodies have lost 20 percent or more of their expected plankton and diatom taxa, and a third have lost more than 40 percent. In small lakes this correlates roughly, but not significantly, with the amount of shoreline conversion.

Shoreline Conversion: Forty percent of the region's water bodies have severe disturbance impacts in their shoreline buffer zones, reflecting high levels of development (IUCN 1), agriculture (IUCN 2), and roads in these ecologically sensitive areas. On the other hand, shoreline zones also have a high level of securement, and in most lake types the amount of securement exceeds the amount of conversion.

Roads, Impervious Surfaces, and Dams: Lakes and ponds in this region are highly accessible; only seven percent are more than one mile from a road and 69 percent are less than one tenth of a mile from the nearest road, suggesting that most are likely to have non-native species. Dams (IUCN 7.2) are fairly ubiquitous; 70 percent of the very large lakes, 52 percent of the large lakes, and 35 percent of the medium-sized lakes, have dams associated with them and are therefore likely to be at least somewhat altered in their temperature and water levels.

THREATS TO NORTHEAST RIVERS AND STREAMS

Conversion and Conservation in the Riparian Zone: Riparian areas, the narrow 100 meter zone flanking all streams and rivers, are important for stream function and habitat. Currently, conversion of this natural habitat exceeds conservation by a margin of 2 to 1, with 27 percent of riparian areas converted and 14 percent secured.

Dams and Connected Networks: Historically, 41 percent of the region's streams were linked in huge interconnected networks, each more than 5,000 miles long. Today, none of those large networks remain, and those exceeding 1,000 miles in length have been reduced by half. There has been a corresponding increase in short networks, those less than 25 miles long, which now account for 23 percent of all stream miles—compared to 3 percent historically. This highly fragmented pattern reflects the density of barriers as described above.

Changes to Water Flow: Water flow defines a stream. Currently 61 percent of the region's streams have flow regimes that are altered enough to result in biotic impacts. One-third of all headwater streams have diminished minimum flows (they are subject to drying up), resulting in a reduction of habitat. Seventy percent of the large rivers have reduced maximum flows (smaller floods) that decreases the amount of nutrient-laden water delivered to their floodplains.

THREATS TO UNIQUE HABITATS OF THE NORTHEAST

Habitat Loss: Eleven unique habitats, from sandy pine barrens to limestone glade, support more than 2,700 restricted rare species. Three geologic habitats have very high densities of rare species: coarse-grained sands, limestone bedrock, and fine-grained silts. Unfortunately, they are also the most converted, the most fragmented; and in two cases, the least protected.

Conservation for nature equals or exceeds conversion on granite settings, on summits and cliffs, and at high elevations. In contrast, habitat conversion exceeds conservation for nature 51:1 on calcareous settings (prized by farmers for their rich soils), 29:1 on shale settings, 23:1 on dry flat settings, 19:1 on moderately calcareous settings, and 18:1 on low elevations. These habitats need concerted conservation attention if the full range of biodiversity in the region is to be maintained.

Fragmentation and Connectivity: Fragmentation and loss of connectivity is pervasive at lower elevations across all geology classes. Even the least fragmented setting in the region, granite, retains only 43 percent of its local connectivity. The highest level of fragmentation, with more than 80 percent loss of local connectivity, was found in calcareous settings composed of coarse-grained sands, fine-grained silts, and low elevations of less than 800 feet.

THREATS TO SELECTED SPECIES OF GREATEST CONSERVATION NEED

Among all species of greatest conservation need listed in SWAPs, 112 have their distributions centered in this region and occur across four or more states (Whitlock 2008). Because the Northeast represents the majority of their range, this region also bears the responsibility for their conservation. Important species of regional responsibility include Bicknell's thrush, blue spotted salamander, Atlantic sturgeon, dwarf wedgemussel, Eastern small-footed bat, and wood turtle. Currently, 25 percent of the known locations for these species are on conserved land, including 9 percent on land secured primarily for nature. Surprisingly, high-responsibility species are conserved at levels below those of low-responsibility species, at 25 % and 32%, respectively.

Thirty-two percent of the known locations for species of widespread or high concern are on conserved land, including 16% on land conserved primarily for nature. Species of concern include animals that are declining in many geographic regions, so conservation in this region is only one part of a larger approach to protection of these species. Examples include: Eastern spadefoot toad, American brook lamprey, cherrystone drop snail, Indiana bat, and Blanding's turtle. Among all species of concern, mammals had the highest percentage of land conserved for their needs (46 percent), followed by amphibians (40 percent), birds (36 percent), and reptiles (26 percent). Fish had the lowest level of habitat protection (14 percent).

THREATS TO TERRESTRIAL HABITATS: RESULTS OF THE GEOSPATIAL CONDITION ANALYSIS

Results of the Geospatial Condition Analysis (Anderson et al. 2013b) shed additional light on the extent of these threats in the Northeast and are summarized here. In general, high density development of natural habitats can change local hydrology, increase recreation pressure, introduce invasive species either by design or by accident with the introduction of vehicles, and bring significant disturbance to the area.

Urbanization and forest fragmentation are inextricably linked to the effects of climate change, since the dispersal and movement of forest plants and animals are disrupted by development and roads.

For all natural habitats the average estimated land conversion from 2010 to 2060 is nearly 5%. Uplands (5% loss) face less predicted development than wetlands (10% loss). The types of habitat affected reflect the general pattern of future development in the region, which is concentrated in the coastal plain, valley bottoms, and low elevations. The northeast habitat guides (Anderson et al. 2013a) present this information by actual acreage for each habitat.

The five most threatened upland habitats are all in the coastal plain. The North Atlantic Coastal Plain Heathland and Grassland (22% loss), Maritime Forest (23% loss), and Hardwood Forest (14% loss) are all projected to lose substantial acreage. Hardwood Forest is one of the dominant matrix-forming forest types with an extensive estimated actual acreage loss of 296,000 acres. Central Atlantic Coastal Plain Maritime Forest (20% loss) and the small-patch Serpentine Woodlands (17% loss) are also among the five most threatened. Conversely, most of the montane forest, small patch outcrop, summit, cliff, and flatrock habitats are estimated to experience minimal loss to development in the next 50 years.

The ten most threatened wetland habitats include tidal habitats, flatwoods, floodplains, and swamps. The greatest estimated loss (109,524 acres or 8% of the total area) is for the North-Central Appalachian Acidic Swamp. The tidal wetland on the south shore of the James River (North Atlantic Coastal Plain Brackish/Fresh and Oligohaline) is predicted to lose almost one-fifth (17%) of its current extent. Peatlands are mostly free from development pressure. Development estimates are lowest for the four types of Northern Peatland (0.2%–0.4% loss) and for the Coastal Plain Peatland, Atlantic Coastal Plain Peatland Pocosin and canebrake (each, 0.01% loss). For more information about the project, please visit: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Pages/geospatial.aspx.

The Landscape Context Index (LCI) is the relative amount of development, agriculture, quarries, roads, or other fragmenting features within an area directly surrounding each 30 meter cell of land as defined in the Geospatial Condition Analysis. The LCI also provides an estimate of the isolation of and current encroachments on each cell. The mean LCI score for the natural habitats in the region ranged from 1.1 to 140, (the lower the number, the better the score), with an average of 41. The score for all lands in the region, including developed and agricultural lands, was 68. Upland habitats (LCI=40) had a lower average score than the wetland habitats (LCI=55). High-elevation forests and patch systems scored the

best, with alpine, outcrops and summits, and northern spruce fir habitats all scoring below 10. The Glade, Barren, and Savanna macrogroup scored the worst with an average LCI of 62. The Piedmont Hardpan Forest (111) and Eastern Serpentine Woodland (103) were the only terrestrial habitats with scores higher than 100.

Peatlands scored the best among wetlands, with Atlantic Coastal Plain Peatland Pocosin and Canebrake (LCI=1), Boreal-Laurentian Bog (LCI=4), Boreal-Laurentian-Acadian Acidic Basin Fen (LCI=7), and Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (LCI=12) all with scores below 15. The habitats with the poorest scores included two of the limestone-related habitats: North- Central Interior and Appalachian Rich Swamp (LCI=92) and Central Interior Highlands and Appalachian Sinkhole and Depression Pond (LCI=140). Also scoring poorly were the North Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (LCI=92) and North-Central Interior Wet Flatwoods (LCI=122).

Roads also represent a significant conservation threat to biodiversity in the Northeast. The Northeast region has more than 732,000 miles of permanent major and minor roads. Nearly 63,880 miles of major roads form serious barriers to species and cause major fragmentation of habitat. These roads have caused shifts in the type and abundance of wildlife; including a decrease in forest interior species, a spike in the abundance of open habitat species, and an increase in forest generalists and game species. Roads affect forest systems primarily by providing access into forest interior regions, thus decreasing the amount of sheltered secluded habitat preferred by many species for breeding. Additionally, heavily-used paved roads create noisy edge habitat that many species avoid, and the roads themselves may form movement barriers to small mammals, reptiles, and amphibians (Anderson et al. 2013b).

THREATS IDENTIFIED IN RCN COLLABORATIVE PROJECTS

Certain threats to species and their habitats have been the focus of the RCN Grant Program and the North Atlantic Landscape Conservation Cooperative (NALCC) collaboration. This chapter provides summary information about these threats and Chapter 4 summarizes information about specific actions that have been identified in RCN projects to abate these threats.

CLIMATE CHANGE

Climate change (IUCN 11) has the potential to alter species distributions and ecological relationships across the Northeast (Manomet Center for Conservation Sciences and National Wildlife Federation 2012).

Species distribution shifts (IUCN 11.1) have already been documented as the regional climate has warmed significantly over the past century. In general, species distributions are moving up in latitude and elevation, as species respond to warmer climatic conditions. Habitat boundaries and ecological communities have also shifted. Several RCN and NALCC projects have addressed various aspects of climate change.

HABITAT VULNERABILITY TO CLIMATE CHANGE

The Manomet Center for Conservation Sciences and The National Wildlife Federation (2012) have assessed the vulnerability of Northeast fish and wildlife and their habitats to climate change, resulting in a series of seven published reports designed to help with planning conservation efforts at state and regional scales. Their work identifies species and habitats that may be especially vulnerable to climate change and predicts how these species and habitats will adapt under different climate scenarios. In addition, the projects outline potential adaptation options that can be used to safeguard these vulnerable habitats and species. Table 3.2 and Figure 3.1 present key results on climate vulnerability for major habitat types in the Northeast.

This collaborative work with Manomet, the National Wildlife Federation and NALCC focused on ten additional Northeast habitat types and their vulnerability to climate change. These included forests, wetlands, aquatic systems, and tidally-influenced habitats. A database (NEclimateUS.org) has been developed in collaboration with National Oceanographic and Atmospheric Administration (NOAA) and other partners (for more information, please visit: http://neclimateus.org/). The website is a searchable online database that provides a gateway to climate information for the eastern United States and Canada. It summarizes needs for climate information as articulated in publications; identifies available data, products and services; and captures planned as well as ongoing projects. It provides a tool to search for regionally relevant climate information, and to facilitate collaborative opportunities across the network of climate-focused programs and partners in the eastern United States. Since NeclimateUS.org is in an early stage of development, content will change with time to reflect developments in climate work within the region, and in response to individual sector needs.

Table 3.2. Estimated vulnerabilities of major habitat types to climate change in thirteen Northeastern United States. CV = Critically Vulnerable, HV = Highly Vulnerable, V = Vulnerable, LsV = Less Vulnerable; LtV = Least Vulnerable. Source: Manomet and National Wildlife Federation 2012.

Habitat	ME	NH	VT	NY	MA	CT	RI	NJ	MD	DE	PA	VA	WV
Tundra	HV	HV	HV	HV									
Montane Spruce-Fir Forest	V/HV	V/HV	V/HV	V/HV	HV								
Northern Hardwood Forest	LsV/V	LsV/V	LsV/V	LsV/V	V	V	V	V	HV	HV	V	HV	HV
Appalachian Northern Hardwood Forest									HV	HV	V	HV	HV
Central Oak-Pine Forest	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	V	V	LtV	V	V
Pitch Pine Barrens	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV	LtV
Southern Spruce-Fir Forest												CV	CV
White Cedar Swamp				LsV	LsV	LsV	LsV	LsV	LsV	LsV			
Boreal Bog/Fen/ Peatlands	HV/HV	HV/HV	HV/HV	HV/HV	HV	HV	HV				HV		
Shrub Swamps	LsV/LsV	LsV/LsV	LsV/LsV	LsV/LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV
Freshwater Marsh	LsV/LsV	LsV/LsV	LsV/LsV	LsV/LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV	LsV

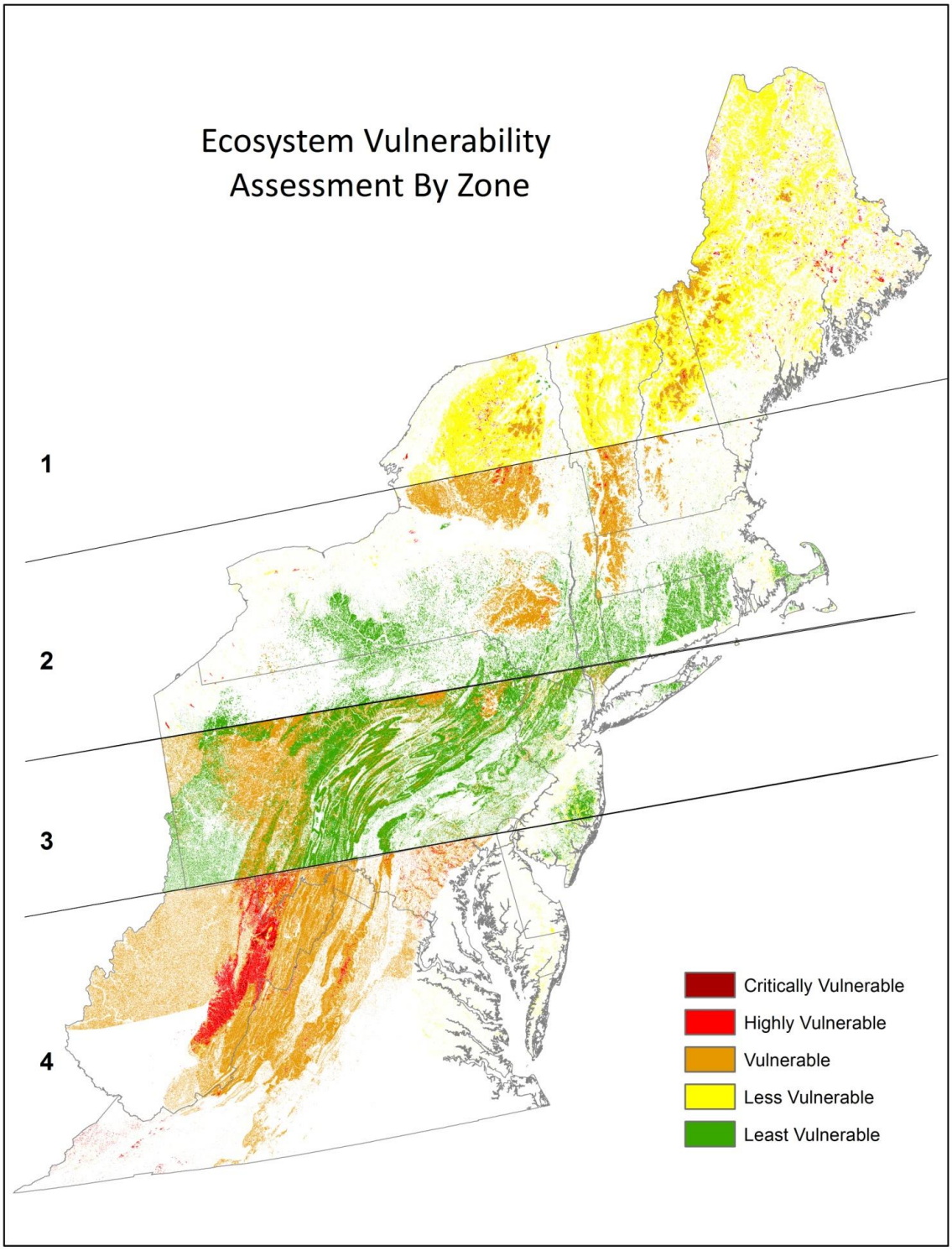


Figure 3.1. Ecosystem Vulnerability Assessment by Zone. Source: Galbraith et al. 2012 data enhanced by NALCC.

The Climate Change Vulnerability Index (CCVI) project reports describe the model, the panel of experts assembled for the project, and its impact on key northeast habitats including cold water streams (Manomet Center for Conservation Sciences and the National Wildlife Federation. 2012).

Final reports are available for download at: http://rcngrants.org/content/assessing-likely-impacts-climate-change-northeastern-fish-and-wildlife-habitats-and-species

- Climate Change and Cold Water Fish Habitat in the Northeast: A Vulnerability Assessment

  http://rcngrants.org/sites/default/files/final_reports/Cold_Water_Fish_Habitat_Vulnerability_2013.pdf

- The Vulnerability of Fish and Wildlife Habitats in the Northeast to Climate Change

  http://northatlanticlcc.org/projects/vulnerabilities-climate-change-northeast-fish-wildlife-habitats/document-the-vulnerabilities-of-northeastern-fish-and-wildlife-habitats-to-climate-change

- The Vulnerability of Northeastern Fish and Wildlife Habitats to Sea-level Rise

  http://rcngrants.org/sites/default/files/final_reports/Galbraith%202014%20-%20The%20vulnerabilities%20of%20northeastern%20fish%20and%20wildlife%20habitats%20to%20sea%20level%20rise.pdf

The NEAFWA Habitat Vulnerability Assessment Model is now being used by 6 states to complete their state vulnerability assessments. In addition, the model has been used as an important component in training courses for federal and non-governmental organization practitioners in the field of vulnerability assessment. For more information, please visit: http://www.northatlanticlcc.org/projects/vulnerabilities-to-climate-change-of-northeast-fish-and-wildlife-habitats-phase-ii/vulnerabilities-to-climate-change-of-northeast-fish-and-wildlife-habitats-phase-ii

REGIONAL FOCAL AREAS FOR SPECIES OF GREATEST CONSERVATION NEED BASED ON SITE ADAPTIVE CAPACITY, NETWORK RESILIENCE AND CONNECTIVITY

This RCN project integrates the most resilient examples of key geophysical settings with locations of SGCN to identify the places in the Northeast where conservation is most likely to succeed under altered climate regimes. Site resilience was estimated by measuring the topographic complexity, wetland density, and permeability of the landscape using a GIS. This information was combined with data on the known distribution of species to identify the most resilient sites for each geophysical setting. Further work assessing permeability gradients is also under way, analyzing areas where ecological flows and species movements potentially become concentrated. The results of both projects are maps that can be incorporated into land use planning and protection efforts at state and local scales. http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf

SPECIES CLIMATE CHANGE VULNERABILITY INDEX

NatureServe and its Heritage Program collaborators have developed the CCVI to provide a rapid, scientifically defensible assessments of species' vulnerability to climate change. The CCVI integrates information about exposure to altered climates with species-specific sensitivity factors known to be associated with vulnerability to climate change. This project, funded by NALCC and performed by NatureServe, investigated the climate vulnerability of 64 species using the CCVI. Foundation species, species of high regional concern, and representative species of plants, birds, invertebrates, mammals, fishes, reptiles, and amphibians were selected. The species were distributed among northeastern habitats. Comparisons were made with previous studies in NY and PA (2011).

In general, species found to be vulnerable to climate change were either coastal species affected by sea-level rise and/or increased storm severity, or species with specialized or restricted habitat. Species restricted to high elevation or cool climate habitats (red spruce, balsam fir, and spruce grouse) or isolated wetlands (black spruce, pitcher plant, barbed-bristle bulrush, and Hessel's hairstreak) are vulnerable due to restricted habitat requirements. Many species that are found throughout the region have lower vulnerabilities in the northern part of their range and higher vulnerability in the mid-Atlantic coast area. Birds were less vulnerable to climate change due to their dispersal abilities, but coastal birds were still vulnerable because the entire coastline is facing greater inundation and storm severity. Hessel's hairstreak (a butterfly inhabiting Atlantic white cedar swamps) was the only species determined to be "extremely

vulnerable" in the Northern Appalachians and Maritime Canada. Five species were rated as "Increase Likely" in at least one sub-region. These include red-shouldered hawk, cerulean warbler, moose, Northern goshawk, and sugar maple.

The conclusions of the report echo recommendations made by others: that actions should focus on habitat preservation rather than species, critical functions of ecosystems, connectivity of habitats, and reductions in non-climate-related stressors. A number of monitoring and data needs are also identified.

http://www.northatlanticlcc.org/projects/completing-northeast-regional-vulnerability-assessment-incorporating-the-natureserve-climate-change-vulnerability-index/completing-northeast-regional-vulnerability-assessment-incorporating-the-natureserve-climate-change-vulnerability-index

The CCVI assessment tool is found at:
https://connect.natureserve.org/science/climate-change/ccvi

FORECAST EFFECTS OF ACCELERATING SEA-LEVEL RISE ON THE HABITAT OF ATLANTIC COAST PIPING PLOVERS AND RESPONSIVE CONSERVATION STRATEGIES

The piping plover is a species of high concern and responsibility in the Northeast as the region encompasses all of the U.S. breeding range of the Atlantic population. A NALCC collaborative project with Virginia Tech researchers forecasts the effects of accelerating sea-level rise on the habitat of Atlantic coast piping plovers and further identifies responsive conservation strategies. This collaborative project of the NALCC provides biologists and managers along the Atlantic coast with tools to predict effects of accelerating sea-level rise on the distribution of piping plover breeding habitat, to test those predictions, and to feed results back into the modeling framework to improve predictive capabilities. Model results inform a coast-wide assessment of threats from sea-level rise and related habitat conservation recommendations that can be implemented by land managers and inform recommendations to regulators. Case studies show how measures to preserve resilience of piping plover habitat in the face of sea-level rise can be incorporated into management plans for specific locations. More detailed results can be accessed at**:** http://www.northatlanticlcc.org/projects/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies.

VULNERABILITY OF PRIORITY AMPHIBIAN AND REPTILE CONSERVATION AREAS TO CLIMATE CHANGE

The vulnerability of Priority Amphibian & Reptile Conservation Areas (PARCAs) to Climate Change is being assessed in a collaborative project with the NALCC, Association of Fish and Wildlife Agencies (AFWA), and the Northeast Partners for Amphibian and Reptile Conservation (NEPARC). As climate changes rapidly, certain areas that are currently deemed suitable for these species might undergo changes of their own. To address future shifts and conservation needs, this project identifies discrete areas most vital to reptile and amphibian diversity, as well as regions of current and future climatic suitability for a number of priority reptiles and amphibians. This project offers a long-term assessment of resiliency of PARCAs that may provide refuge as the climate changes. For project information and updates please see**:** http://www.northatlanticlcc.org/projects/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc

THREATS TO AQUATIC SYSTEMS

Changes in aquatic systems and the resilience of aquatic populations have been forecast for the Northeast. The effects of alternative management scenarios on local population persistence of brook trout can now be evaluated under different climate change scenarios via a web-based decision support system. Models for winter flounder are being finalized as of December 2014, and a model for river herring is being explored. Additional information and project updates can be accessed at: http://www.northatlanticlcc.org/projects/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation.

WATER MANAGEMENT AND USE

Water withdrawal and its impact on Instream Flow for the Great Lakes Basin of New York and Pennsylvania were investigated using the Ecological Limits of Hydrologic Alteration (ELOHA) framework. This project provides clear recommendations for Low/Seasonal/High flows in water bodies as small as headwaters and as large as rivers to avoid “cumulative adverse impacts,” a target set in the Great Lakes Compact. To implement its recommendations, the report names two tools: passby flows to preserve the vital minimum flows during periods of low water, and withdrawal limits to preserve the natural

variability in seasonal flows necessary for diverse aquatic life. The recommended flow requirements are based on the needs of 43 species of flow-sensitive fish and mussels and 5 guilds of other aquatic organisms. The life history requirements of target species were combined with typical hydrographs for streams of different types to frame 54 hypotheses suggesting how these species would respond to specific alterations in flow components. Aggregating these hypotheses generated 11 general flow needs that were further evaluated by reviewing more than 300 scientific publications.

For additional information please see: http://rcngrants.org/content/instream-flow-recommendations-great-lakes-basin-new-york-and-pennsylvania.

BARRIERS TO AQUATIC CONNECTIVITY

The Northeast has the highest density of dams and road crossings in the country, with an average of seven dams and 106 road-stream crossings per 100 miles of river (Anderson and Olivero Sheldon 2011). These barriers segment and fragment populations, and in some cases prevent migratory fish species from reaching their traditional spawning grounds. Dams also alter patterns of river flow, hydrology, and geomorphology. Legacy dams— those no longer used by humans—pose a particular threat to human health as well as aquatic organisms. Several Northeast states have programs in place to remove unwanted dams and restore habitat connectivity for aquatic organisms. With NEAFWA funding through the RCN Grant Program, The Nature Conservancy (TNC) prepared the first regional assessment of aquatic habitat connectivity (Martin and Apse 2011), described in more detail in Chapter 4. For more information about the project, please visit: http://rcngrants.org/content/northeast-aquatic-connectivity

THE GEOSPATIAL CONDITION ANALYSIS- AQUATIC STRESSORS

The Geospatial Condition Analysis (Anderson et al. 2013b) provides more detailed information on the condition of aquatic systems of the Northeast and their stressors. There is an average of 114 road crossings for every 100 miles of headwater and creek habitat in the region. The number of crossings per 100 miles varied across habitats. The least impacted habitats were low-gradient cold headwaters and creeks (30), tidal headwaters and creeks (86), and moderate-gradient cold headwaters and creeks (92). The most highly impacted types were moderate-gradient cool headwaters (167) and high-gradient warm headwaters (159). For more information about the project, please visit: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Pages/geospatial.aspx

Summarizing the patterns across all streams and rivers, there was an average of seven dams for every 100 miles of streams and rivers in the region. Small and medium rivers had the highest dam density along with tidal headwaters and creeks. Tidal headwaters and creeks had very high dam densities because dams were built at nearly every head of tide throughout New England and much of the Mid-Atlantic. The northern coastal states of Massachusetts, Connecticut, Rhode Island, and New Jersey also had higher densities of dams than other states. This is likely a reflection of the patterns of population density in the early dam-building era of the late 1880s–early 1900s when dams supplied power to many local farms and grist mills. New England and New York also have higher densities of hydroelectric dams, which likely reflects their steeper topography and potential for hydropower generation (Anderson et al. 2013b)

The proportion of stream miles in the moderate-to-severe risk category increased as the size of the freshwater system increased. In general, rivers were also much more impacted by upstream dam storage than were headwaters or creeks. For example, 94% of all headwater and creek miles were in the very low risk category while only 51% of river miles were in this category. This reflects the increasing occurrence of large storage dams as rivers grow in size. It also illustrates the cumulative effect of upstream water storage behind multiple dams in the streams and tributaries of larger rivers. The largest proportion of miles in the severe-risk category occur in medium sized rivers followed by large tidal rivers, tidal medium and small rivers, and small freshwater rivers. The charts in the Northeast Habitat Guides (Anderson et al. 2013a) present the risk of flow alteration from dam water storage information for each river type.

INVASIVE SPECIES THREATS IN THE NORTHEAST

Exotic invasive species (IUCN 8) pose significant threats to SGCN throughout the Northeast in a number of ways. Impacts may be direct (affecting individual health or productivity) or indirect (affecting habitat and/or ecosystem processes), or both. With NEAFWA funding through the RCN Grant Program, Klopfer (2012) identified 238 invasive species from 12 groups with a potential to adversely affect SGCN, while at the same time acknowledging that this is not a complete list of invasive species for the Northeast. The majority of the species identified are plants (68%). The majority of these species occurred in seven or more states (58%). There were 71 (30%) invasive species common to all states in the Northeast. The general habitat class with the greatest number of invasive species was “forest edge” with 115 species (48%) followed by pasture and grassland with 94 and 86 species respectively (39% and 36%).

For more information about the project, please visit: http://rcngrants.org/project-rcn-topics/id-invasive-species

WILDLIFE DISEASE

Wildlife diseases (IUCN 8.2) have the potential to impact a broad range of wildlife, including amphibians, bats, birds, and ungulates. Two emerging diseases that have received NEAFWA attention through the RCN Grant Program are white-nose syndrome in bats and fungal dermatitis in timber rattlesnakes. Since 2009, timber rattlesnakes from separate populations in eastern, central and western Massachusetts have been found to have a disease identified as fungal dermatitis. Fungal dermatitis has been previously documented as a cause of morbidity and mortality in both captive and free-ranging Viperidae snakes (Jessup and Seely 1981, McAllister et al. 1993, Cheatwood et al. 2003). With funding from the RCN Grant Program, researchers sampled 98 snakes in 9 populations and found a wide range of dermatitis prevalence from 0-53% and averaging 33% (McBride et al. 2015). Seventy-five percent of fungal lesions were attributed to *Ophidiomyces ophiodiicola*, which has been implicated by other researchers as a possible cause of dermatitis in snakes. Interestingly, dermatitis was more prevalent in the spring (53%) than in the fall (17%). Infected snakes were otherwise healthy based on analysis of blood samples and many biologists believe snakes recover from dermatitis over the warm summer months. In general, the report finds that dermatitis is unlikely to be a serious concern in timber rattlesnake populations in the northeast.

The RCN Grant Program funded two projects addressing the threat of white-nose syndrome (WNS) that has killed more than 5.7 million hibernating bats in the Northeast. The disease is named for its causative agent, a white fungus (*Geomyces destructans*) that invades the skin of hibernating or otherwise torpid bats. Results of the first research project showed that bats affected by WNS arouse from hibernation significantly more often than healthy bats. The severity of cutaneous fungal infection correlates with the number of arousal episodes from torpor during hibernation. The increased frequency of arousal from torpor likely contributes to WNS-associated mortality, but the question of how fungal infection induces increased arousals remains unanswered. For additional information on this project please see**:** http://static.rcngrants.org/sites/default/files/final_reports/Frequent%20Arousal%20from%20Hibernation%20Linked%20to%20Severity%20of%20Infection%20and%20Mortality%20in%20Bats%20with%20WNS.pdf

The other RCN project focused on the development of methodologies to combat WNS in bats. It tested potential treatments for efficacy against cultured *Geomyces destructans* (Gd, the fungal pathogen associated with WNS) under laboratory conditions, for safety in healthy bats, and for efficacy against Gd

in hibernating bats. For additional information please see: http://rcngrants.org/content/laboratory-and-field-testing-treatments-white-nose-syndrome-immediate-funding-need-northeast.

NEW ENERGY DEVELOPMENTS

The potential impacts of new energy development on wildlife in the Northeast states range widely, from effects of hydraulic fracturing and offshore drilling on aquatic systems to the direct mortality of birds and bats from wind turbines along mountain and coastal flyways. NEAFWA's RCN Grant Program funded a project to determine the potential effects of large-scale regional biomass energy developments (Klopfer 2011). The report outlines the costs and benefits that biomass energy systems pose for SGCN in the Northeast. The results show that biomass energy development will have variable impacts on SGCN at the state and regional levels. Generally, biomass systems that utilize wood from existing mature forests will result in a net negative impact to some SGCN as these forests are converted to younger seral stages. States with large areas of mature forest (e.g., Pennsylvania, New York, Virginia) are thus likely to experience changes in their SGCN associated with these forest systems. Biomass systems implemented on existing agricultural land, however, would result in a potential net benefit for some SGCN. These systems would produce conditions similar to those needed by early-successional species that require frequent disturbance. Wildlife biologists can use this information to recognize opportunities certain biomass energy applications present for managing SGCN and provide an impetus to work with biomass developers for mutual benefit. For more information about this project please visit: http://rcngrants.org/content/establishing-regional-initiative-biomass-energy-development-early-succession-sgcn-northeast

A Risk Assessment of Marine Birds in the Northwest Atlantic Ocean is under way as NALCC and various partners seek to develop a series of maps depicting the distribution, abundance and relative risk to marine birds from offshore activities (e.g., offshore drilling and wind energy development) in the northwestern Atlantic Ocean. The goal is to develop and demonstrate techniques to document and predict areas of frequent use and aggregations of birds and the relative risk to marine birds within these areas. This NALCC project is supporting mapping and technical development by leveraging several large, ongoing projects funded by the Bureau of Ocean Energy Management (BOEM), Department of Energy (DOE), USGS, and NOAA and involving research groups at the Biodiversity Research Institute, NC State University, CUNY-Staten Island, the USGS Patuxent Wildlife Research Center, and the NOAA National

Centers for Coastal Ocean Science-Biogeography Branch. For additional information and project updates please see: http://www.northatlanticlcc.org/projects/mapping-the-distribution-abundance-and-risk-assessment-of-marine-birds-in-the-northwest-atlantic-ocean

ADDITIONAL THREATS IDENTIFIED BY THE NORTHEAST FISH AND WILDLIFE DIVERSITY TECHNICAL COMMITTEE

The Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) identified additional threats that were not specifically captured in the RCN Grant Program reports, but that continue to affect Northeast fish and wildlife and their habitats. These threats, listed below, merit further regional attention:

- **Energy Extraction (IUCN Threat Category 3, particularly 3.1 Oil and Gas Drilling and 3.2 Mining and Quarrying)**

Energy extraction is becoming a more significant regional threat to SGCN and key habitats, particularly as larger areas of the Northeast are explored for new energy opportunities, resulting in large-scale habitat loss or degradation. Hydraulic fracturing ("fracking"), offshore drilling, and wind energy are all increasing, and more information is needed on their potential impacts.

- **Soil erosion and runoff (including pollution; IUCN Threat Category 9, particularly 9.1.2 Runoff and 9.3.2 Soil Erosion and Sedimentation)**

Another threat identified was soil erosion and runoff, which can have negative effects on water quality in the Northeast aquatic systems. Due to the number of aquatic RSGCN and their vulnerable habitats, additional information on these threats is warranted as well.

- **Lack of resources to address problems facing wildlife and their habitats**

While not a "threat" in the conventional sense, the lack of resources to support the conservation of fish and wildlife species and their habitats nonetheless threatens to undermine of the conservation efforts of state fish and wildlife agencies. More resources directed toward on-the-ground conservation and to help preempt listing will increase the effectiveness of conservation efforts overall.

PRELIMINARY RECOMMENDATIONS TO ADDRESS THREATS IN THE REGION

The conversation about regional threats summarized in this report has already resulted in the identification of some next steps and recommendations that will enable the region to better address threats to Northeast fish, wildlife, and their habitats. These include:

- The need for a more comprehensive regional threats assessment, especially for RSGCN. There is strong support for a more comprehensive threats assessment for the region. The Eastern Brook Trout Joint Venture (EBTJV) provides a good example of how this could be approached. Along with this threats assessment, there is a need to identify current versus future population sizes and distributions of species, as well as the current versus future extent of habitats.

- Future Desired Conditions for species and habitat should be identified. There is a need for an effective process to monitor the status and "success" of projects and the extent to which they address these priority threats and the desired future conditions are achieved. The NEFWDTC needs to be able to prioritize and update for an effective evaluation process.

- Threats need to be identified and "measured" in terms of scale, extent, urgency, etc. (using the Northeast common lexicon criteria developed for SWAP revisions).

- Land ownership issues need to be addressed, as the high proportion of private lands in the Northeast affects conservation actions on all lands.

- Early successional habitats and the "Young Forest Initiative" have been identified as a potentially controversial management issue. There is a need to better assess and evaluate regional objectives, needs and success measures associated with both younger and older forests.

- The results of climate change needs to be integrated in ways that can help guide conservation across the region and be applied and shared by states.

CHAPTER 4—CONSERVATION ACTIONS IN THE NORTHEAST

The 2005 State Wildlife Action Plans (SWAPs) identified and prioritized conservation actions for each state in the region. Priority actions were linked to and identified for each key threat (listed by International Union for Conservation of Nature [IUCN] category) as well as for overarching needs and barriers to conservation in the Northeast. Those actions serve as a solid framework for the development and monitoring of the SWAP revisions.

After the completion of the 2005 SWAPs, a survey was conducted as part of the Association of Fish and Wildlife Agencies (AWFA) National Synthesis to identify the key actions listed by each state in their Wildlife Action Plans (AFWA unpublished and 2011). A list of these key recurring actions is presented in Table 4.1.

Table 4.1. Key Actions Identified by Northeastern States Wildlife Action Plans (in descending order of listing recurrences).

Key Actions Identified by Northeastern State Wildlife Action Plans	% of States Identifying the Action
Land/Water Protection: Resource & Habitat Protection	100
Planning/Best Management Practices (BMPs): Planning	92
Data Gaps/Research: Monitoring	75
Land/Water Protection: Site/Area Protection	75
Education & Awareness: Awareness & Communications	75
External Capacity Building: Alliance & Partnership Development	75
Data Gaps/Research: Property assessment and prioritization	75
Data Gaps/Research: Research	67
Land/Water Management: Habitat & Natural Process Restoration	67
Data Gaps/Research: Threats assessment	58
Land/Water Management: Site/Area Management	58
Data Gaps/Research: Data collection and management	50
Law & Policy: Legislation	50
Education & Awareness: Training	42

Key Actions Identified by Northeastern State Wildlife Action Plans	% of States Identifying the Action
Law & Policy: Compliance & Enforcement	42
External Capacity Building: Conservation Funding	42
Law & Policy: Policies & Regulations	42
Land/Water Management: Invasive/Problematic Species Control	42
Livelihood, Economic & Other Incentives: Conservation Payments	42
Law & Policy: Private Sector Standards	33
Species Management: Species Management	33
Planning/BMPs: BMPs	33
Other: Non-IUCN Action: Other	25
Data Gaps/Research: Inventory	17
Data Gaps/Research: Exploratory Survey	17
Data Gaps/Research: Evaluation	17
Data Gaps/Research: Species assessment	17
Species Management: Species Recovery	17
Livelihood, Economic & Other Incentives: Conservation-related Livelihood	8
Livelihood, Economic & Other Incentives: Eco-friendly Alternatives	8
Livelihood, Economic & Other Incentives: Market-driven Incentives	8
Livelihood, Economic & Other Incentives: Non-Monetary (cultural, etc.) Values	8
Education & Awareness: Formal Education	8

This chapter identifies conservation strategies and actions that have been developed and implemented for priority Northeast fish and wildlife species and their habitats through the Regional Conservation Needs (RCN) program. Many of these actions can be linked directly to a specific threat to wildlife or habitats summarized in Chapter 3. Individual actions are addressed in more detail in the RCN Grant Program reports (see http://rcngrants.org/), and links are provided throughout this document and Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013. Additional actions have been identified by Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) members in the recommendation section of this chapter.

The term "Action" is used here as an umbrella for a wide range of activities that are intended to benefit fish and wildlife species and their habitats. As used here, "Action" applies to direct, on-the-ground conservation activities, as well as to a host of ancillary activities that are necessary and essential steps in the implementation of these on-the-ground activities, such as background research, monitoring, applied conservation planning, and the development of detailed conservation strategies.

Case studies of collaborative conservation actions that have been taken by NEFWDTC and partners through the RCN Grant Program are also provided in this chapter. These include planning and monitoring projects, projects to address the adverse effects of climate change on species and habitats, projects that address water quality and/or water quantity issues, and projects that address the effects of invasive species, emerging wildlife diseases, and new energy developments.

Figure 4.1 shows how the RCN Grant Program has strategically targeted specific activities to be funded in each year of the grant program.

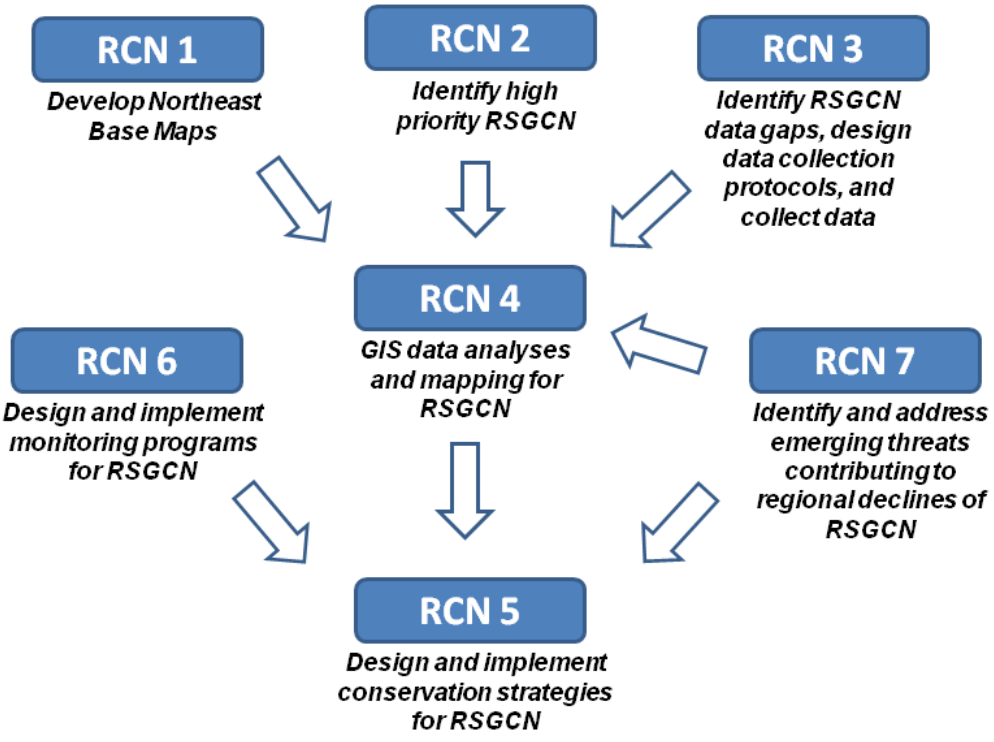


Figure 4.1. RCN Grant Program Priority Focus Areas. Source: NEAFWA's NEFWDTC.

The framework illustrated above describes a set of actions that the NEFWDTC has identified as high priorities for the conservation of fish and wildlife and their habitats across the Northeast. Specific RCN or competitive State Wildlife Grants (SWG) program projects that address these priorities are described in more detail in the RCN reports (compiled and accessible in Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013). Conservation actions identified through these regionally prioritized projects are compiled and coded using the Wildlife Tracking and Reporting Actions for the Conservation of Species (TRACS) database system. They have been crosswalked to the IUCN action categories in the RCN Summary Report to assist states in their Wildlife Action Plan revisions and are available on the RCN website: http://www.rcngrants.org. An Excel spreadsheet providing a crosswalk between TRACS and IUCN action classification systems is provided as a reference at: http://rcngrants.org/content/northeast-regional-conservation-synthesis-state-wildlife-action-plan-revisions-0.

The RCN planning process provides general guidance on the order and importance of certain conservation activities, but there has not yet been a comprehensive assessment and priority-setting exercise encompassing the full suite of possible conservation actions across the entire Northeast region. However, numerous conservation actions have been identified by the Northeast states as part of their individual SWAPs. A survey of the 13 Northeast states and the District of Columbia, requesting their list of the top 10 conservation actions identified in their SWAPs, identified 24 different types of actions that could benefit Species of Greatest Conservation Need (SGCN) or their habitats (AFWA 2011). Resource and habitat protection was listed by 100% of Northeast states. Planning, alliance and partnership development; awareness and communications, and site/area protection were all mentioned by at least 75% of the states. Other important actions (listed by 50% or more of the Northeast states) included: habitat and natural process restoration; site/area management; and legislation.

RCN GRANT PROJECT CASE STUDIES

The following case studies describe regional conservation actions identified and supported through the RCN Grant Program. By funding these actions, the RCN program and Northeast Association of Fish and Wildlife Agencies (NEAFWA) are implementing the Northeast Conservation Planning Framework described in detail in previous chapters. The order in which the projects have been funded and

implemented has been the subject of careful consideration and planning by the NEFWDTC and its partners. For example, the development of the NEAFWA Monitoring and Performance Reporting Framework preceded work on regional indicators of conservation status and trends. This work in turn was followed by regional tests of the indicators and by the first comprehensive regional conservation status assessment for species and habitats in the Northeast. This (as well as the subsequent projects developed by the North Atlantic Landscape Conservation cooperative [NALCC]) demonstrates NEAFWA's strategic approach in which each project builds on its predecessors to advance a unified agenda for collaborative fish and wildlife conservation in the region.

THE STAYING CONNECTED INITATIVE

The Staying Connected Initiative (SCI) (http://stayingconnectedinitiative.org/) is a 4-state, 21-member regional partnership of public agencies and non-profit organizations working to protect functional habitat linkages to help mitigate the impacts of habitat fragmentation and climate change for 41 SGCN across the Northern Forest (Maine, New Hampshire, New York, and Vermont).

Since 2009, SCI partners have completed permanent land protection projects on more than 50,000 acres, enhancing connectivity values in the linkage areas. Approximately 40,000 acres of important connectivity lands in various stages of development are also targeted for protection. SCI has provided direct assistance to at least 40 municipalities and six regional planning commissions, helping secure or instigate meaningful improvements in the land use plans and/or policies of nearly 20 communities and at least three regional planning commissions. SCI has also identified road segments important for landscape connectivity and is collaborating with state departments of transportation (DOTs) to improve connectivity during road maintenance/upgrade projects.

SCI implements top priority actions identified in the partner states' Wildlife Action Plans. The goal is to integrate conservation planning at the regional, state and local scales with land protection and technical assistance activities targeted to municipalities, where most land use decisions in the Northeast are made. Primary objectives are:

1. Developing conservation science information and analyses on the ecological features, wildlife movement zones, community conservation values, and wildlife road crossing locations. The

purpose is to inform land protection, land-use and transportation planning, and barrier mitigation, and to provide technical assistance for local groups and decision makers.

2. Protecting important habitat connectivity "stepping stones" at key road crossings and other high priority areas through technical and financial support to land trusts.

3. Supporting local land-use planning through technical assistance to municipalities, to improve town plans, land use planning and zoning ordinances.

4. Providing technical assistance to enhance the knowledge and skills of local groups, supporting their efforts to implement wildlife and connectivity conservation activities.

5. Increasing the permeability of key roads through technical assistance to state transportation agencies focused on incorporating connectivity retention and improvements as part of planned road maintenance/upgrades on priority linkage segments.

NEW ENGLAND COTTONTAIL CONSERVATION PLANNING TO ADDRESS PRIORITY NEEDS

Many of the RCN grant projects have involved some aspect of conservation planning, whether producing necessary data sets, providing tools for planners, or developing actual conservation plans. One of the most comprehensive planning efforts funded through the RCN Grant Program is the development of a conservation strategy for the New England cottontail (Fuller and Tur 2012). The New England cottontail (NEC) is the only rabbit native to the northeastern United States. The species ranges from the Hudson River Valley of New York eastward and is currently threatened throughout its range by development and forest succession. It may also be imperiled by encroachment of the introduced Eastern cottontail, which may be more effective than NEC in the use diverse and fragmented habitats and in avoiding predators. Biologists do not believe that NEC inter-breed with the Eastern cottontail; NEC and Eastern cottontail hybrids, if born, apparently do not survive.

In 2006 the U.S. Fish and Wildlife Service (USFWS) responded to conservationists concerned that the NEC was declining. The USFWS reviewed the status of the species and the factors threatening it, and designated NEC as a "candidate" for listing under the federal Endangered Species Act. Conservation partners throughout the Northeast joined together to develop a comprehensive conservation strategy to

address threats to NEC. The strategy is also designed to show how conservation partners are implementing those actions to ensure the presence of NEC into the future and also preclude the need to place the species on the federal Endangered Species List (Fuller and Tur 2012).

To restore the New England cottontail, the USFWS set a regional habitat restoration goal of 27,000 acres to support 13,500 rabbits. The six states where NEC are currently found set combined habitat restoration goals totaling 42,440 acres to support 21,650 rabbits. The NEC Technical Committee, representing all of the states in the species' range, set a goal of 51,655 acres of habitat and 28,100 rabbits. At each level, the sum of goals exceeds the preceding level, in order to account for localized uncertainties in the feasibility of conserving the species. The best available scientific evidence suggests that these conservation activities should be sufficient to prevent listing of the species under the federal Endangered Species Act. For more information about the conservation strategy, please visit: http://www.newenglandcottontail.org/sites/default/files/conservation_strategy_final_12-3-12.pdf

INTEGRATED MONITORING TO INFORM CONSERVATION AND MANAGEMENT

Monitoring of fish and wildlife species and their habitats plays an important role in the conservation and management of species and ecosystems. Monitoring programs provide managers with important information about the status and trends of fish and wildlife species, as well as the effectiveness of conservation activities and management interventions. Improving the quality of information regarding fish and wildlife species in the Northeast has been identified as a NEWFDTC priority, and many of the RCN grants have focused specifically on monitoring of fish and wildlife species and their habitats. Monitoring is required Element 5 for Wildlife Action Plans, and both Congress and the federal Office of Management and Budget have repeatedly asked states to justify funding for the SWG program by demonstrating its success. Unfortunately, SWG funds do not support the full cost of implementing Actions Plans, let alone monitoring their impacts.

In 2006-08, the Northeast states collaborated to develop the Monitoring and Performance Reporting Framework (NEAFWA 2008; see http://rcngrants.org/content/regional-monitoring-and-performance-framework for more information). This Framework is an effective and cost-efficient mechanism for reporting on the status of SGCN and their habitats within each state and across the Northeast region, as well as on the effectiveness of actions taken to conserve those resources. The Framework's monitoring

component served as the basis for the Regional Conservation Assessment conducted by The Nature Conservancy (TNC) and other partners with funding through another RCN grant. (Anderson and Olivero Sheldon 2011; see http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf for more information). The effectiveness component of the Monitoring and Performance Reporting Framework later informed the development of national performance measures for the SWG program, developed by the AFWA, the Northeast states, and other national conservation groups. More detailed information about this Framework is available in Chapter 5.

NEAFWA has also funded the development of integrated, cross-jurisdictional monitoring programs or methods for New England cottontail, wood turtle, Eastern black rail, dragonflies and damselflies (Order Odonata), tidal marsh birds, and frogs. These monitoring programs are discussed in more detail in Chapter 5, with links to programmatic reports that provide more information about these programs. By developing standardized methods and approaches for monitoring at a regional level, the RCN Grant Program helps to ensure that states are collecting data in a consistent manner. This means that data collected in one state can easily be compared with data collected in other states, thereby giving managers a more complete picture of the status of a species and a regional context for their species conservation efforts.

RCN PROJECTS IDENTIFY ACTIONS TO ADDRESS PRIORITY THREATS

As discussed in Chapter 3, wildlife conservation managers in the Northeast states have identified particular threats and management challenges that are of regional concern. With dedicated funding provided by each of the state fish and wildlife agencies in the Northeast, the RCN Grant Program has supported projects that take positive conservation actions designed to address these concerns. RCN Grant Program funding supports much of the planning, research, and documentation that are necessary to achieve effective on-the-ground conservation solutions for fish, wildlife, and habitats in the Northeast. The RCN Summary Report (Terwilliger Consulting, Inc. and the NEFWDTC 2013) compiles the complete list of actions addressed by RCN projects and provides summaries of these projects, as well.

ADDRESSING CLIMATE CHANGE IN THE NORTHEAST

Climate change poses significant challenges to the future conservation of fish, wildlife, and habitats in the Northeast (Manomet Center for Conservation Sciences and National Wildlife Federation 2012). To mitigate climate change impacts to wildlife, conservationists need to consider how to protect these natural resources, improve conservation tools, and modify management strategies within a changing climate. They need to identify which species and habitats are likely to be vulnerable to, or to benefit from, the changing climate; and then develop strategies that will enhance connectivity of sites that provide important habitats, even under changing climate conditions.

A 2009 Report by AFWA titled "Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans" offered specific and strategic recommendations for action planning in the context of climate change. In addition to emphasizing the importance of engaging diverse partners to improve the efficiency and effectiveness of actions, the report recommends prioritizing actions that are effective under current *and* future climates. As an example, actions that reduce the impact of non-climate threats and stressors are one of the most valuable and least risky conservation strategies. Furthermore, while Wildlife Action Plans tend to focus on species and their habitats, recognizing and managing for ecological function *underlying* the habitats of greatest conservation need can ensure the sustained impact of conservation actions. A consistent theme is the maintenance or restoration of landscape and habitat connectivity. Clearly defined goals, attention to spatial and temporal scales of action, consideration of future scenarios, and planned use of adaptive management are all smart planning strategies that are even more important in the context of climate change.

Over the past five years, significant progress has been made in assessing the vulnerabilities of wildlife and habitats to the changing climate. While the Northeast has pioneered and led much of this vulnerability assessment work, knowledge has not been shared between all states. The most effective conservation of many resources requires a regional view. Specifically, managers need to be able to evaluate the vulnerabilities of key habitats and species, and to understand how these vulnerabilities may vary across the region. The following projects help states plan conservation actions by assessing landscape vulnerability and resilience.

CLIMATE CHANGE HABITAT VULNERABILITY

NEAFWA, the North Atlantic Landscape Conservation Cooperative (NALCC), Manomet Center for Conservation Sciences (Manomet), and the National Wildlife Federation (NWF) collaborated with other major Northeastern stakeholders to assess vulnerability of fish, wildlife and their habitats to climate change. NEAFWA, NALCC, Manomet, and NWF have completed a three-year effort to evaluate the vulnerabilities of the Northeast's key habitats, and to help increase the capabilities of state fish and wildlife agencies to respond to these challenges. This regional effort is the first of its kind in the country and is an essential step toward the implementation of effective "climate-smart" conservation of ecosystems (Manomet and NWF 2012). The project sought to address important gaps in our knowledge by evaluating the vulnerabilities of fish and wildlife habitats.

The most vulnerable habitats are the Southern Spruce-Fir Forest, Appalachian Northern Hardwood Forest, Northern Hardwood Forest, Montane Spruce-Fir Forest, Tundra, and Boreal Bog/Fen/Peatlands. These habitats are found throughout the region, with the exception of New Jersey. Habitats were found to be less vulnerable to climate change if they extend far to the south of the Northeast Region, or if their dominant or foundational species are either not vulnerable to climate change or not sensitive to the ecological disruptions expected as a *result* of changing climate. This project identified the importance of addressing non-climate-related stressors and paying attention to interactions between existing stressors and climate change impacts.

To date, the project has completed 7 reports:
The vulnerabilities of fish and wildlife habitats in the northeast to climate change;
The vulnerabilities of northeastern fish and wildlife habitats to sea level rise;
Climate change and cold water fish habitat in the northeast, a vulnerability assessment;
Implementing climate-smart conservation in northeastern upland forests;
Forming the expert panel;
The habitat vulnerability model;
Exposure information

Additional information about the project and the full reports are available on the RCN Grant Program website, http://rcngrants.org/content/assessing-likely-impacts-climate-change-northeastern-fish-and-wildlife-habitats-and-species.

In addition to these reports, a coastal database (called NEclimateUS.org) has been developed in collaboration with NOAA and other partners (see project website for more information: http://neclimateus.org/). The website is a searchable online database that provides a gateway to climate information for the eastern United States. It summarizes needs for climate information as articulated in various publications; identifies available data, products and services; and captures planned and on-going projects. It provides a tool to search for regionally relevant climate information, and to facilitate collaborative opportunities across the network of climate-focused programs and partners in the eastern United States. Since NeclimateUS.org is in its early stages of development, content will change with time to reflect developments in climate work within the region, and in response to individual sector needs.

CLIMATE CHANGE SPECIES VULNERABILITY

An NALCC-funded project, titled "Climate Change Vulnerability Assessments of selected species in the North Atlantic LCC Region" followed the habitat vulnerability investigation by estimating CCVIs for 64 species in the Northeast (Sneddon and Hammerson, 2014). Foundation species, species of high regional concern, and representative species of plants, birds, invertebrates, mammals, fishes, reptiles, and amphibians were selected from diverse habitats throughout the region. In general, species found to be vulnerable to climate change were either coastal species affected by sea-level rise and/or increased storm severity, or species with specialized or restricted habitat. Examples of the latter include high elevation and cool climate habitats and isolated wetlands. While birds are generally not found to be vulnerable because they can disperse to new suitable habitats with relative ease, this capacity does not benefit shorebirds whose habitat is threatened by climate change across the entire region. The report proposes a familiar suite of actions focusing on preservation of habitat instead of particular species, critical functions of ecosystems, connectivity of habitats, and reductions in non-climate-related stressors. A number of monitoring and data needs are also identified.

CLIMATE CHANGE HABITAT RESILIENCE

The RCN Grant Program and NALCC have also supported work by Anderson and Sheldon (2011) to identify places in the Northeast where conservation of SGCN is most likely to succeed under climate change. The project identifies the most resilient sites for species and habitat conservation under altered climate regimes. Site resilience was estimated by measuring the complexity and permeability of the

landscape using a geographic information system (GIS). This information was combined with data on the known distribution of species to identify the most resilient sites for each geophysical setting. Broad east-west and north-south permeability gradients were also analyzed to identify areas where ecological flows and species movements potentially become concentrated. The results of this project are maps that could be incorporated into land use planning and protection efforts at state and local scales (Anderson and Olivero Sheldon 2011) http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf

FORECAST EFFECTS OF ACCELERATING SEA-LEVEL RISE ON THE HABITAT OF ATLANTIC COAST PIPING PLOVERS AND RESPONSIVE CONSERVATION STRATEGIES

This collaborative project of the NALCC provides biologists and managers along the Atlantic coast with tools to predict effects of accelerating sea-level rise on the distribution of piping plover breeding habitat, test those predictions, and feed results back into the modeling framework to improve predictive capabilities. Model results inform a coast-wide assessment of threats from sea-level rise and offer related habitat conservation recommendations that can be implemented by land managers and used in developing recommendations to regulators. Case studies on the resilience of piping plover habitat to sea-level rise can provide explicit measures that can then be incorporated into management plans for specific locations. More detailed results can be accessed at**:** http://www.northatlanticlcc.org/projects/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies

VULNERABILITY OF PRIORITY AMPHIBIAN AND REPTILE CONSERVATION AREAS TO CLIMATE CHANGE

This project identifies discrete areas most vital to reptile and amphibian diversity, as well as regions of current and future climatic suitability for a number of priority reptiles and amphibians. This project will offer a long-term assessment of resiliency of Priority Amphibian and Reptile Conservation Areas (PARCAs) identified with respect to those that may provide refuge as the climate changes. For project information and updates please see**:** http://www.northatlanticlcc.org/projects/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc

THREATS TO AQUATIC SYSTEMS

Changes in aquatic systems and the resilience of aquatic populations are forecast for the NALCC. The effects of alternative management scenarios on the persistence of local brook trout populations can now be evaluated under different climate change scenarios via a web-based decision support system. Additional information and project updates can be accessed at: http://www.northatlanticlcc.org/projects/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation.

EFFORTS TO ADDRESS WATER QUALITY, QUANTITY AND CONNECTIVITY IN THE NORTHEAST

Several RCN Grant projects have also addressed issues related to the quality, quantity, and connectivity of water bodies in the northeastern states.

INSTREAM FLOW FOR THE GREAT LAKES BASIN

Water withdrawal and its impact on Instream Flow for the Great Lakes Basin of New York and Pennsylvania were investigated using the Ecological Limits of Hydrologic Alteration (ELOHA) framework. This project provides clear recommendations for Low/Seasonal/High flows in water bodies as small as headwaters and as large as rivers to avoid "cumulative adverse impacts," a target set in the Great Lakes Compact. To implement the recommendations, the report identifies two tools: passby flows, to preserve the vital minimum flows during periods of low water; and withdrawal limits, to preserve the natural variability in seasonal flows necessary for diverse aquatic life. The recommended flow requirements are based on the needs of 43 species of flow-sensitive fish and mussels and five guilds of other aquatic organisms. The life history requirements of target species were combined with typical hydrographs for streams of different types to frame 54 hypotheses of how these species would respond to specific alterations in flow components. Aggregating these hypotheses generated 11 general flow needs which were further evaluated by reviewing more than 300 scientific publications. http://rcngrants.org/content/instream-flow-recommendations-great-lakes-basin-new-york-and-pennsylvania.

ADDRESSING FISH PASSAGE AND AQUATIC CONNECTIVITY

TNC's Northeast Aquatic Connectivity Project (NAC; Martin and Apse 2011) developed a set of tools and data products that will allow resource agencies in the northeastern United States to strategically reconnect fragmented aquatic habitats by targeting removal or bypass of key barriers to fish passage. The NAC has worked to make future connectivity restoration projects more efficient by providing the regional information to allow strategic selection of projects most likely to produce ecological benefits. Project tools include:

- A regional network among professionals engaged in aquatic organism passage and assessment of potential ecological benefits associated with barrier mitigation.
- The first unified database of dams, impassable waterfalls, and anadromous fish habitat across the thirteen-state Northeast region. This information is critical to the NAC and also has potential benefits for a range of Northeastern management and conservation initiatives conducted by states and their partners.
- A more "ecological-benefits" approach to dam removal and fish passage improvement.
- A tool that allows state fish and wildlife managers to re-rank dams at multiple scales (state, hydrologic unit code [HUC], etc.) or by using attribute filters (river size class, dam type, etc.), and to examine 72 ecologically-relevant metrics linked to dam locations.
- Information useful to state fish and wildlife managers regarding barrier mitigation and its relative ecological benefits to anadromous and resident fish. This information can be used to inform river restoration decisions at the dam or river network scale.

For more information about the project, please visit: http://rcngrants.org/content/northeast-aquatic-connectivity

ADDRESSING INVASIVE SPECIES

As discussed in Chapter 3, exotic invasive species pose a significant threat to SGCN throughout the Northeast (Klopfer 2012). Impacts may be direct (affecting individual health or productivity) or indirect (affecting habitat and/or ecosystem processes) or both. With RCN funding, scientists at Virginia Tech (Klopfer 2012) developed a list of invasive species that posed the most significant threat to SGCNs in the Northeast region. The value of this effort is in the assembled data, which can be customized by future users for their specific needs, generating lists that reflect their own importance criteria. There are a

number of different ways to evaluate the impacts of invasive species on SGCN. Several metrics were compiled to provide users with a way to develop ranked lists. These metrics can be taken individually or used together (e.g., sum of ranks). Please see Appendix 1 and Terwilliger Consulting Inc. and NEFWDTC 2013 or: http://rcngrants.org/content/identifying-relationships-between-invasive-species-and-species-greatest-conservation-need.

ADDRESSING WILDLIFE DISEASES

Wildlife diseases have the potential to imperil a broad range of wildlife species, including amphibians, bats, birds, and ungulates. The RCN Grant Program has supported two projects led by scientists at Bucknell University to address the ongoing crisis in Northeast bat populations called white-nose syndrome (WNS; Reeder et al. 2011). Researchers first studied the effects of the fungus that causes WNS on hibernating bats, and then demonstrated that bats infected by the fungus were aroused to normal body temperatures more frequently than uninfected bats (Reeder et al. 2011). These arousals depleted the bats' fat stores and likely contributed to their subsequent mortality. The number of arousal bouts significantly predicted the bats' longevity, and the severity of fungal infection correlated with the number of arousal events. For more information, please visit: http://rcngrants.org/content/exploring-connection-between-arousal-patterns-hibernating-bats-and-white-nose-syndrome

The second project is developing and implementing methodologies to combat WNS (Reeder ongoing). Specific goals include: 1) testing potential treatments for efficacy against cultures of the fungal pathogen associated with WNS under laboratory conditions; 2) testing potential treatments for safety in healthy bats; and 3) testing potential treatments for efficacy against fungal infection in hibernating bats. The project is ongoing and formulations of terbinafine and other anti-fungal compounds are being tested for effectiveness against the fungus that causes WNS (Reeder ongoing). Research on WNS has also received support through the competitive SWG program. For more information, please visit: http://rcngrants.org/content/laboratory-and-field-testing-treatments-white-nose-syndrome-immediate-funding-need-northeast

Regional support for tackling wildlife disease is not limited to WNS. In 2012, NEAFWA funded a project investigating ranavirus in amphibian populations and snake fungal dermatitis. For further information, see:
http://rcngrants.org/content/detecting-extent-mortality-events-ranavirus-amphibians-northeastern-us

ANALYZING NEW ENERGY DEVELOPMENTS

The RCN Grant Program supported a study at Virginia Tech (Klopfer 2011) that addressed the potential effects of large-scale regional biomass energy developments. It identified tradeoffs associated with biomass energy development, and found that some biomass energy systems have the potential to create habitat conditions favorable to certain SGCN, particularly those associated with early successional habitats. In general, biomass systems that use wood from existing mature forests will result in a net negative impact to SGCN, as these mature forests are lost and the landscape converted to early succession habitat. Thus, states with large forested areas such as Pennsylvania, Virginia, and New York may experience reductions in forest-dwelling SGCN. Biomass systems implemented on existing agricultural land would result in a large potential net positive for SGCN regardless of which biomass system is implemented. Some biomass systems may produce conditions similar to those needed by some early-successional species whose natural habitats are increasingly rare on the landscape. This is particularly true for species that utilize habitats maintained through frequent disturbance (Klopfer 2011). For more information, please visit: http://rcngrants.org/content/establishing-regional-initiative-biomass-energy-development-early-succession-sgcn-northeast

A Risk Assessment of Marine Birds in the Northwest Atlantic Ocean is under way through efforts by NALCC and partners to develop a series of maps depicting the distribution, abundance, and relative risk to marine birds from offshore activities (e.g., wind energy development) in the northwestern Atlantic Ocean. The resulting map products are intended to help inform decisions about siting offshore facilities, marine spatial planning, and other uses requiring maps of seabird distributions. This NALCC project is supporting multiple components of map and technique development by leveraging several large, ongoing projects funded by the Bureau of Ocean Energy Management (BOEM), Department of Energy (DOE), USGS, and the National Oceanographic and Atmospheric Administration (NOAA) and involving research groups at the Biodiversity Research Institute, NC State University, CUNY-Staten Island, the USGS Patuxent Wildlife Research Center, and the NOAA National Centers for Coastal Ocean Science-Biogeography Branch. For additional information and project updates, please see: http://www.northatlanticlcc.org/projects/mapping-the-distribution-abundance-and-risk-assessment-of-marine-birds-in-the-northwest-atlantic-ocean

DECISION SUPPORT TOOLS TO ADDRESS KEY THREATS IN THE NORTHEAST

Decisions about the use of land can have profound effects on wildlife species and their habitats throughout the Northeast. The Conservation Assessment provides summary statistics that demonstrate the need for improved planning and land use decisions in the Northeast (see http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf for more information). Land use planning often takes place at a local level, with many important decisions placed in the hands of town or county planning boards. Members of such boards often lack knowledge of wildlife species or their habitat requirements. They may also lack the time or skills needed to research these issues and apply the results effectively in the local political context.

NatureServe and its partners at Defenders of Wildlife, the Environmental Law Institute, the Pennsylvania Natural Heritage Program, and the Virginia Natural Heritage Program received funding through the RCN Grant Program to develop a simple toolkit for local land use planners (Sneddon 2012). The toolkit was designed to provide conservation information on SGCN and their habitats in a format that will support land use planning decisions at local and regional levels. The project provided information on: SGCN and their habitats; funding sources to aid wildlife resource planning; legal frameworks that address SGCN in each state; BMPs; and delivery mechanisms for these resources: http://rcngrants.org/content/development-model-guidelines-assisting-local-planning-boards-conservation-species-greatest.

This work builds on the Terrestrial Ecosystem and Habitat Map of the northeastern United States developed by TNC and NatureServe under a separate RCN grant (Gawler 2008; see http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/habitatmap/Pages/default.aspx for more information). The study also uses a wealth of information previously compiled by each partner, as well as an inventory of existing delivery mechanisms, legal requirements, BMPs, funding sources, and key networking and dissemination opportunities available in the Northeast region. Through in-depth interviews with state fish and wildlife agencies, as well as representatives of selected land trusts and municipalities, the study identifies gaps in the existing delivery system that may be filled through an expanded toolkit (Sneddon 2012). The NALCC is currently using this work as a starting point for developing approaches that will translate and deliver information and tools to partners working at multiple scales, including local communities and land trusts.

The multistate effort is a good example of how technical assistance can be provided to land use planners. It incorporates on-the-ground conservation actions at three scales:

- Municipalities
- Regional Planning Commissions
- State Highway Agencies

For more detailed information on this project, see: http://stayingconnectedinitiative.org/about/

TOOLS TO DESIGN SUSTAINABLE AND PERMEABLE LANDSCAPES

This NALCC and University of Massachusetts project assesses the capability of current and potential future landscapes to provide integral ecosystems and suitable habitat for a suite of representative species, as well as guidance for strategic habitat conservation. The project will:

1) Assess the current capability of habitats in the northeast region to support sustainable populations of wildlife;

2) Predict the impacts of landscape-level changes (e.g., from urban growth, conservation programs, climate change, etc.) on the future capability of these habitats to support wildlife populations;

3) Target conservation programs to effectively and efficiently achieve objectives in SWAPs and other conservation plans and to evaluate progress under these plans; and

4) Enhance coordination among partners during the planning, implementation and evaluation of habitat conservation through conservation design.

A Landscape Change, Assessment and Design (LCAD) model for the Northeast region will allow simulation of changes to the landscape under a variety of alternative future scenarios (e.g., climate change, urban growth). It will also allow users to assess the effects of those changes on ecological integrity and climate-habitat capability for representative species, and will inform the design of conservation strategies (e.g., land protection, management and restoration) to meet conservation objectives. For more information about this project and model, please visit: http://www.northatlanticlcc.org/projects/permeable-landscapes-for-species-of-greatest-conservation-need/permeable-landscapes-for-species-of-greatest-conservation-need.

Similar collaborative RCN projects undertaken by TNC evaluate and map the relative landscape permeability or "habitat connectivity," resilience, and site capacity across the thirteen-state region. The

projects determine how permeability and resilience coincide with the locations and habitat of species of greatest conservation concern. They will identify the most important regional conservation areas as well as movement concentrations, particularly those areas where movements may be funneled due to constriction in the landscape. Using this information, TNC is measuring the amount of flow, permeability and resistance present in the region's roads and secured-lands network. The projects are guided by a thirteen-state steering committee. For more information about these projects, please visit: http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf .

TOOLS TO ADDRESS AQUATIC HABITATS AND THREATS IN NORTH ATLANTIC WATERSHEDS AND ESTUARIES

Habitat assessment models and tools are under development for the NALCC region (North Atlantic Watershed and Estuaries), based on a stakeholder-driven process. GIS decision support tools will be developed to assist with resource planning efforts, at both the regional and site-specific scale. Stakeholders will be engaged throughout all stages of the project to ensure compatibly of local outcomes with the specific goals of the NALCC. The results will be a highly functional and user-friendly mechanism and tool for resource managers to visualize, rank, and manipulate inputs and to prioritize areas for conservation action. For more information, please visit: http://www.northatlanticlcc.org/projects/downstream-strategies-project/decision-support-tool-to-assess-aquatic-habitats-and-threats-in-north-atlantic-watersheds

CONSERVATION ACTIONS GUIDANCE IN THE NORTHEAST LEXICON AND IUCN-CODED RCN GRANTS PROJECT SUMMARY

The RCN Project Summaries report (Terwilliger Consulting, Inc. and the NEFWDTC 2013) lists the specific actions that can benefit fish and wildlife species and their habitats, as identified by projects supported through the Regional Conservation Needs Grants Program. These actions are arranged according to the classification developed for the Wildlife TRACS activities database by the USFWS and its partners. This classification of activities is more representative of the types of actions supported through the RCN program than the more general and internationally focused list of actions used by IUCN. The same is true of the activities of NEAFWA. Not all of the actions included in the more comprehensive

Wildlife TRACs classification were funded through the RCN Grant Program. Since the National Best Practices Guidance and the Northeast Lexicon (Crisfield and NEFWDTC 2013) recommends the use of IUCN and /or Wildlife TRACS, they are listed in the appendices of both these documents, to facilitate Wildlife Action Plan revisions.

ADDITIONAL REGIONAL ACTIONS IDENTIFIED

Members of NEAFWA's NEFWDTC reviewed the list of actions addressed in RCN projects and identified any gaps or key types of actions that were not included in the list. These additional committee efforts identified the following actions:

1. Activities designed to provide legal protection for species and habitats, including development of laws and regulations that need to be enhanced or improved for effectiveness.

2. Education activities that include staff training exercises for agency inreach, cross pollination, and continuing education of professional biologists within state conservation agencies and organizations.

3. Development and public dissemination of information about wildlife, and education of the general public about conservation issues facing fish and wildlife species. More effective outreach and communication are needed.

4. Water quality improvement activities, including stormwater improvements, actions aimed at reducing non-point source pollution, and other activities undertaken in compliance with the Clean Water Act.

The NEFWDTC recognizes that the RCN Grant Program focused more on regional planning and assessment projects in its early years, rather than on implementation of habitat or species conservation projects. There is a clear consensus that both are needed, but by applying the Northeast Conservation Planning Framework these implementation projects are often generated and guided by early regional planning, and then implemented by states to improve the status of species and their habitat at the local level.

Many projects that were funded by the RCN Grant Program represent initial, necessary steps that laid the foundation for future on-the-ground activities benefitting SGCN and their habitats. For example, the New England cottontail conservation strategy lists 64 discrete actions that could be taken to conserve the species (Fuller and Tur 2012). Listing these conservation actions and then establishing priorities among them are the first steps towards identifying the precise combination of on-the-ground actions needed to prevent further declines in the species and accelerate its process of restoration. These future actions will likely include manipulations of key habitat elements or individual cottontail sites, or both. These on-the-ground activities will hopefully prevent the species' listing under the federal Endangered Species Act.

CHAPTER 5—MONITORING OF RSGCN SPECIES AND KEY HABITATS IN THE NORTHEAST AND EVALUATION OF THE EFFECTIVENESS OF CONSERVATION ACTIONS

This chapter describes regional efforts to monitor the status and trends of Regional Species of Greatest Conservation Need (RSGCN) and their habitats and to evaluate the effectiveness of conservation actions in the Northeast states. Planning efforts by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) have led to several key monitoring projects funded by the Regional Conservation Needs (RCN) Grant Program. Examples include the Northeast Regional Monitoring and Performance Reporting Framework collaboratively funded by the National Fish and Wildlife Foundation (NWF, see (NEAFWA 2008) and its successors; the State Wildlife Grants Effectiveness Measures Project (AFWA 2012) (funded by the Doris Duke Foundation), the Northeast Lexicon Project (Crisfield and NEFWDTC 2013); and the national Wildlife TRACS (Tracking and Reporting Actions for the Conservation of Species) database (funded by the U.S. Fish and Wildlife Service [USFWS]). Many of these approaches have used results chains or similar tools such as logic models to articulate theories of change and identify status measures and effectiveness indicators. Several examples of results chains are provided here; more samples of results chains developed for monitoring projects in the Northeast can be downloaded from the RCN website, specifically from the report for the Northeastern Regional Monitoring and Performance Measures Framework and its appendices.

At the Albany I workshop, the NEFWDTC identified the development of a regional monitoring and performance measurement project as a high priority. Although Northeast states had developed their own monitoring programs to track the status and condition of wildlife species and habitats, the Committee recognized the importance of coordinating monitoring and evaluation activities across the entire Northeast region. Several key factors cited by the Committee in supporting the development of regional monitoring activities include the large number of shared priority species and habitats, the relatively limited funding available in any one state for monitoring and evaluation activities, and the presence of many regional experts who have knowledge of particular taxa or ecosystems throughout the Northeast.

The examples in this chapter are intended to show the breadth and diversity of regionally coordinated monitoring activities in the Northeast, especially those activities funded through the RCN Grant Program. The list of examples is by no means comprehensive or exhaustive. Additional monitoring activities and

programs are described in more detail in the Wildlife Action Plans developed by the individual Northeast states.

THE MONITORING AND PERFORMANCE REPORTING FRAMEWORK

The NEAFWA (Northeast Association of Fish and Wildlife Agencies) Monitoring and Performance Reporting Framework (NEAFWA 2008) is intended to help each Northeast state meet the expectations set by Congress and the USFWS for the Wildlife Action Plans and the State Wildlife Grants (SWG) programs. The goal of this framework is to assess the status and trends of Species of Greatest Conservation Need (SGCN) and their habitats across the Northeast states, and to evaluate the effectiveness of activities intended to conserve species and habitats across the Northeast. For more information and to review project reports, please visit: http://rcngrants.org/content/regional-monitoring-and-performance-framework.

The monitoring framework identified eight conservation targets (defined as species, landscape features, or vegetation communities important to fish and wildlife): forests, freshwater streams and river systems, freshwater wetlands, highly migratory species, lakes and ponds, managed grasslands and shrublands, regionally significant SGCN, and unique habitats in the Northeast. Each of these targets is discussed above under the appropriate chapter for species and habitats. For each target, key threats were identified, along with conservation actions that could help alleviate or eliminate the effects of that particular stressor. Indicators were proposed for tracking status and trends of each of the targets, and data sources were identified for each of the indicators (NEAFWA 2008). Table 5.1 from NEAFWA (2008) lists the indicators and threats that were selected by workshop participants for each of the eight conservation targets.

Table 5.1. List of Conservation Targets and Proposed Indicators. Source: NEAFWA 2008.

Targets	Proposed Indicators
1. Forests	1a. Forest area - by forest type 1b. Forest area - by reserve status 2. Forest composition and structure - by seral stage 3. Forest fragmentation index 4. Forest bird population trends

	5. Acid deposition index
2. Freshwater streams and river systems	1. % impervious surface 2. Distribution and population status of native Eastern brook trout 3. Stream connectivity (length of open river) and number of blockages 4. Index of biotic integrity 5. Distribution and population status of non-indigenous aquatic species
3. Freshwater wetlands	1. Size/area of freshwater wetlands 2. % impervious surface flow 3. Buffer area and condition (buffer index) 4a. Hydrology - upstream surface water retention 4b. Hydrology - high and low stream 5. Wetland bird population trends 6. Road density
4. Highly migratory species	1. Migratory raptor population index 2. Shorebird abundance 3. Bat population trends 4. Abundance of diadromous fish (indicator still under development) 5. Presence of monarch butterfly
5. Lakes and ponds	1. % impervious surface/landscape integrity 2. % shoreline developed (shoreline integrity) 3. Overall Productivity of Common Loons
6. Managed grasslands and shrublands	To be developed
7. Regionally Significant Species of Greatest Conservation Need	1. Population trends and reproductive productivity of federally listed species 2. State-listing status and heritage rank of highly imperiled wildlife 3. Population trends of endemic species
8. Unique habitats in the Northeast	1. Proximity to human activity/roads 2. Wildlife presence/absence 3. Wildlife population trends 4. Land use/land cover changes

The developers of the framework also recommended a results-chain approach for identifying performance measures and other management-relevant indicators. Results chains are a powerful tool that has recently been adopted by many conservation organizations to help them understand and visualize the linkages between conservation activities and results. As shown in the following illustration (Figure 5.1), results chains link an action to a conservation target through one or more intermediate objectives. Indicators can be selected at each step of the way to measure progress towards the project's goals and objectives (NEAFWA 2008).

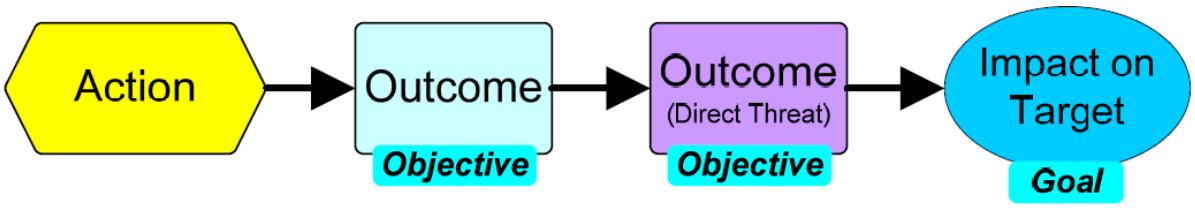


Figure 5.1. Results Chain General Schematic. Source: NEAFWA 2008.

Sample results chains were provided in the Appendices to the framework project report (NEAFWA 2008). These included results chains focused on species. The following example from NEAFWA (2008) (Figure 5.2) illustrates how protection of nesting sites benefits nesting success in piping plovers.

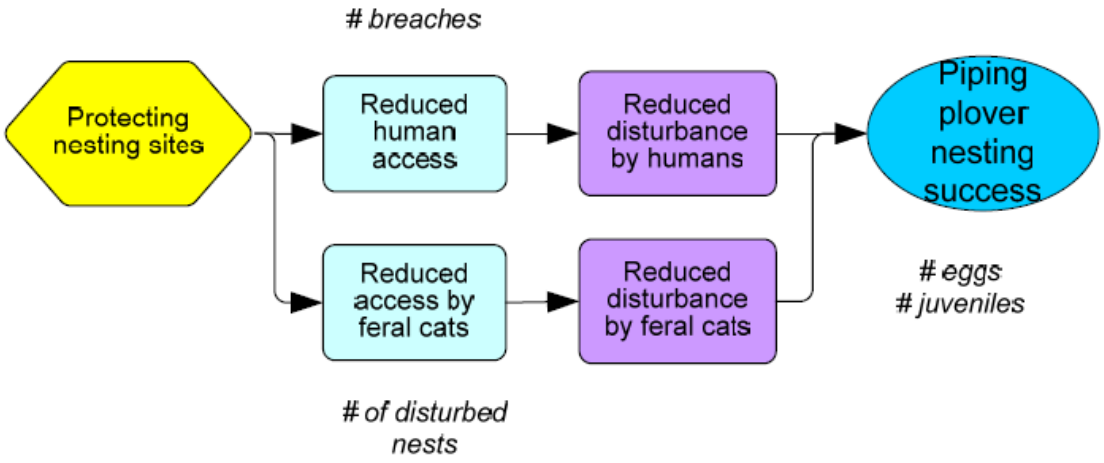


Figure 5.2. Results Chain for the Piping Plover. Source: NEAFWA 2008.

The examples also included results chains focused on habitats. The following diagram (Figure 5.3) shows how technical assistance to municipalities could eventually lead to wetland conservation activities that would benefit many RSGCN such as the Blanding's and wood turtles.

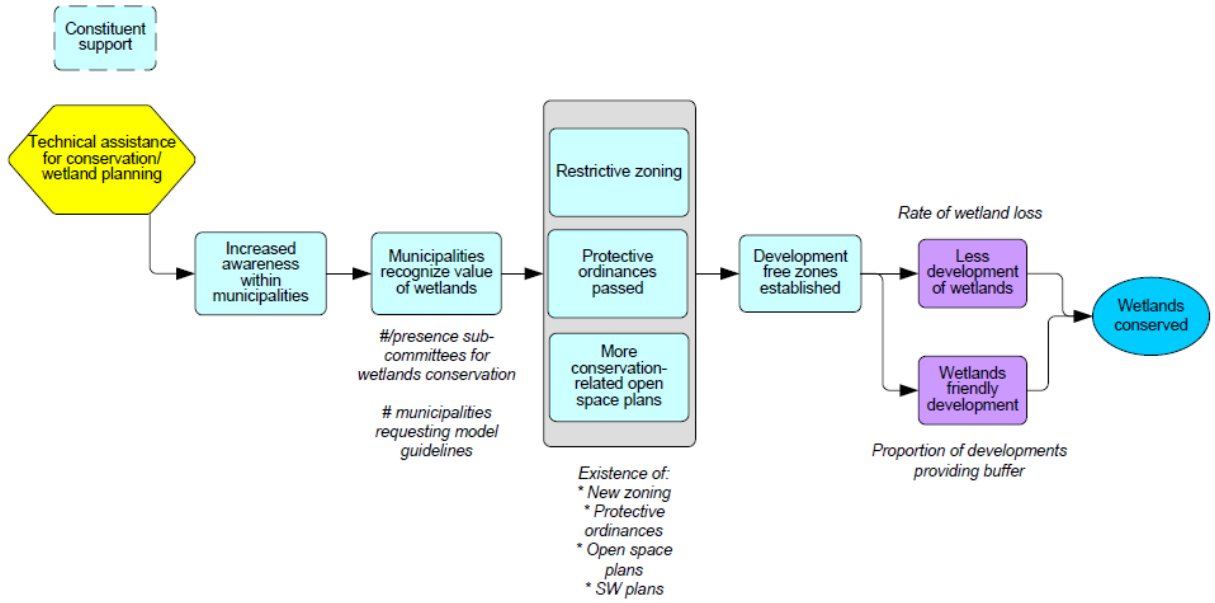


Figure 5.3. Results Chain for Wetland Protection. Source: NEAFWA 2008.

Results chains can also be used to illustrate the pathways by which basic research contributes towards habitat and species improvement. The following generalized results chain (Figure 5.4) from NEAFWA (2008) shows one logical progression between baseline research, decision-making, threat reduction, and species and habitat benefits.

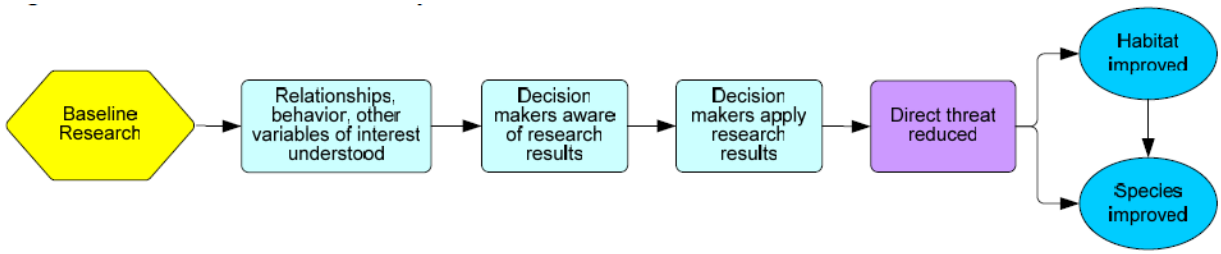


Figure 5.4. Results Chain for Basic Research Project. Source: NEAFWA 2008.

The conservation targets identified in the monitoring framework were put to practical use in the recent Conservation Status Assessment for Wildlife Species and Habitats in the Northeastern United States (Anderson and Olivero Sheldon 2011), which is discussed in more detail below. This report provided

updated status information on key indicators used to measure the condition of Species of Greatest Conservation Need and their habitats.

STATE WILDLIFE GRANTS EFFECTIVENESS MEASURES PROJECT

Building on the success of the Northeastern Regional Monitoring and Performance Measures Framework (NEAFWA 2008), the Association of Fish and Wildlife Agencies (AFWA) led an effort to develop an approach for measuring the effectiveness of wildlife conservation activities funded under the USFWS's SWG program. In September 2009, AFWA's Teaming with Wildlife Committee formed the Effectiveness Measures Working Group. This working group included representatives from state fish and wildlife agencies as well as private, academic, and non-governmental conservation partners with expertise in wildlife conservation and performance management.

In April, 2011, the working group released a final report that outlines a comprehensive approach to measuring the effectiveness of the activities funded under the SWG program. The report builds on the monitoring framework that was originally developed in the Northeast states and recommends a set of common indicators for measuring status, trends, and/or effectiveness of thirteen general types of conservation actions that are commonly supported by SWG. These actions include direct management of natural resources, species restoration, creation of new habitat, acquisition/easement/lease, conservation area designation, environmental review, management planning, land use planning, training and technical assistance, data collection and analysis, education, conservation incentives, and stakeholder involvement. The report includes sample templates and forms that could be used for reporting the results of conservation activities funded through SWG, as well as a discussion of the specific methods by which these reporting methods could be incorporated into in the USFWS's grants management database. For more information and to review the project's final report, please visit: http://www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf.

WILDLIFE TRACS

The State Wildlife Grants Effectiveness Measures Project has informed the development of Wildlife TRACS, a database designed by the USFWS to record information about conservation activities funded through the Wildlife and Sport Fish Restoration Program, including SWG. When fully functional,

Wildlife TRACS is intended to track and report project outputs, effectiveness measures, and species and habitat outcomes. Wildlife TRACS has the potential to track long-term outcomes for species and habitats, above and beyond the types of short-term output measures commonly tracked by funding agencies (e.g., number of publications, number of workshops, number of people contacted). Because it is designed to be responsive to the needs of the state agencies receiving SWG funding, Wildlife TRACS includes its own customized classifications of conservation actions and threats. These classifications are based, at least in part, on the classifications developed jointly by the International Union for the Conservation of Nature (IUCN) and the Conservation Measures Partnership (CMP, see Salafsky et al. 2008). In describing RCN grant projects, the IUCN classification of threats is generally more useful than the Wildlife TRACS classification of threats, while the Wildlife TRACS classification of actions is more useful than the IUCN classification of threats. For more information about the development of Wildlife TRACS please visit: http://wsfrprograms.fws.gov/Subpages/TRACS/TRACS.html.

NORTHEAST LEXICON FOR COMMON PLANNING AND STATE WILDLIFE ACTION PLAN DATABASE

Wildlife conservation planners in the Northeast states have long recognized a potential ambiguity in many of the terms that are used to describe fish and wildlife conservation activities. For example, a “target” may refer to a number, an area, a specific site, a species, a group or guild of species, a vegetation community, or an ecosystem type. There is an acute need to develop a standard lexicon that provides conservationists with a uniform terminology that accurately and adequately describes the work of state fish and wildlife agencies. Although lexicons have been developed by the IUCN and the CMP, they are designed primarily for international conservation and sustainable development projects, activities that differ in many important ways from fish and wildlife conservation activities in the Northeast states. Thus, the NEFWDTC is developing a regional conservation lexicon that can be used by state wildlife agencies and partners to describe their conservation projects (Crisfield and NEFWDTC 2013). The lexicon project will result in a set of common terms that can be used by state wildlife agencies and their partners to describe wildlife conservation activities in the Northeast.

REGION-WIDE TAXA-SPECIFIC SURVEYS AND MONITORING

In addition to NEAFWA's Monitoring and Performance Reporting Framework and the national framework for evaluating effectiveness of SWG, there are a number of taxa-specific surveys, inventory, or monitoring programs that have been developed and implemented with NEAFWA's support and through other regional collaborations. With RCN funding, surveys and assessments have been conducted or are in the process of being conducted and monitoring protocols have been developed for wood turtle, Eastern black rail, New England cottontail (Fuller and Tur 2012), shrubland birds (McDowell 2011), aquatic habitats (Gawler 2008), and frogs (assessment in progress, based on data collected during call surveys). Detailed avian indicators have also been developed for assessing the magnitude of threats and the effectiveness of conservation measures (Northeast Coordinated Bird Monitoring Partnership 2007). An online database of museum specimen records for SGCN invertebrates in the Northeast was developed by Fetzner (2012). More in-depth reports describing the methods and results of these surveys and associated data products are available at the RCN website (http://www.rcngrants.org).

REGIONAL MONITORING PROTOCOLS AND DATABASES

Northeast states have also developed monitoring protocols and databases through regional multi-state collaborative efforts. With funding from the RCN Grant Program, monitoring protocols have been developed, reviewed, or revised for several species of regional conservation interest, including New England cottontail (Fuller and Tur 2012), shrubland-dependent birds (McDowell 2011), freshwater aquatic habitats (Gawler 2008), and frogs (call surveys). Ongoing RCN projects are also developing monitoring protocols for wood turtle and Eastern black rail. The consistent and widespread use of common monitoring methodologies and survey protocols will help support regional assessments of the status and trends of SGCN and their habitats. In addition NEAFWA has also funded development of a database for regional invertebrate species of greatest conservation need, through a partnership with the Carnegie Museum of Natural History in Pittsburgh (Fetzner 2012). A more comprehensive database has been proposed that would include data on all species, habitats, actions, and threats from the individual Northeast State Wildlife Action Plans (SWAPs; for introductory information and a lexicon of terms that would be used in such a database, please see Crisfield and NEFWDTC 2013). Links to monitoring plans and tools developed through the RCN Grant Program follow:

New England cottontail

http://rcngrants.org/content/development-noninvasive-monitoring-tools-new-england-cottontail-populations-implications
http://www.newenglandcottontail.org/sites/default/files/conservation_strategy_final_12-3-12.pdf

Shrubland-dependent birds

http://rcngrants.org/content/implementing-bird-action-plans-shrubland-dependents-northeast

Freshwater aquatic habitats

http://rcngrants.org/content/northeast-aquatic-connectivity

Frogs

http://rcngrants.org/content/northeast-state-frogs-development-regional-analysis-frog-call-survey-data-north-american

Wood Turtle

http://rcngrants.org/content/wood-turtle-glyptemys-insculpta-northeastern-united-states-status-assessment-and

Eastern black rail

http://rcngrants.org/content/support-status-assessment-and-conservation-action-plan-eastern-black-rail-across-northeast

Odonates

http://rcngrants.org/content/conservation-assessment-odonata-dragonflies-and-damselflies-northeastern-region

Invertebrates Database

http://rcngrants.org/content/development-online-database-enhance-conservation-sgcn-invertebrates-northeastern-region

Tidal Marsh Birds

http://rcngrants.org/content/identification-tidal-marsh-bird-focal-areas-bird-conservation-region-30

CONSERVATION STATUS OF NORTHEAST FISH, WILDLIFE, AND NATURAL HABITATS

NEAFWA supported The Nature Conservancy (TNC) in an effort to assess the current condition of species and habitats in the Northeast through the Conservation Status Project. This project used a geographic information system (GIS) analysis to examine the relationship between species and habitat condition, land ownership and conservation management status. The original assessment project merged with another RCN-funded project, titled Regional Indicators and Measures: Beyond Conservation Land (Anderson and Olivero Sheldon 2011), which measured approximately 30 indicators of habitat condition and species and ecosystem health in the Northeast states. Together these projects, completed in September 2011, implemented approximately 75% of the Northeast Regional Monitoring and Performance Measures Framework (NEAFWA 2008), previously funded by the NFWF and the RCN Grant Program. Please see: http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf

CHAPTER 6—REGIONAL COORDINATION, REVIEW, AND PRIORITIES

Every state fish and wildlife agency in the United States is required to update its State Wildlife Action Plan (SWAP) at least once every ten years. This chapter provides suggestions for Northeast state fish and wildlife agencies to incorporate a regional perspective and information about regional conservation priorities into the revision of their SWAPs.

IMPORTANCE OF INCORPORATING A REGIONAL PERSPECTIVE INTO STATE WILDLIFE ACTION PLANS

Many pressing fish and wildlife conservation issues in the Northeast states cross state jurisdictional boundaries. In recognition of this fact, Northeast Association of Fish and Wildlife Agencies (NEAFWA) states have a long history of collaborative, cross-border partnerships between states and with other public and private partners. Some of these partnerships have focused on species of shared conservation interest, beginning lists of regional species of concern, developed by French (1985), Therres (1999), and Pence (2000, with more recent efforts focusing on the New England cottontail (Kovach 2012; Fuller and Tur 2012), black rail, and wood turtle. Other partnerships have focused on shared habitats such as rivers, grasslands, tidal marsh, and shrublands (McDowell 2011). Still others have focused on common threats and stressors, such as climate change (Anderson 2011; Manomet Center for Conservation Sciences and National Wildlife Federation 2012); on common programmatic needs such as monitoring and effectiveness measurement (NEAFWA 2008); or on collaborative efforts to develop the science and tools needed to make better conservation decisions in the face of change through the Landscape Conservation Cooperatives (LCCs). By including information about these cooperative conservation ventures in their SWAPs, individual states can provide a more robust picture of the full range of conservation planning activities focused on Northeast wildlife species and their habitats. Collaborative conservation planning efforts demonstrate partnerships that are broader than just the coalition of partners assembled in each state. Collaboration can also mean additional leverage and funding from competitive grants programs such as the Regional Conservation Needs (RCN) Grants Program and private funders such as the Doris Duke Charitable Foundation, and the National Fish and Wildlife Foundation (NFWF).

Regional information on status, distribution, and threats will allow states to focus on those species and habitats that are important from both state and regional perspectives. It will also allow states to avoid

expending limited resources on species and habitats that are more effectively conserved in other areas in the region.

HOW TO USE THIS SYNTHESIS AND REGIONAL PERSPECTIVE IN WILDLIFE ACTION PLAN REVISIONS AND OTHER PLANNING EFFORTS

States have the following options for using the information contained in this document:

- Incorporate it by reference;
- Append it to the revised Wildlife Action Plan as a chapter or appendix on regional conservation priorities (the entire document or any portion); or
- Excerpt any piece from this document and edit as needed to address any of the eight elements in the Wildlife Action Plan.

Since each chapter of this document addresses a different Wildlife Action Plan element, portions of each chapter can be pulled into the appropriate section of the Wildlife Action Plan to provide an introductory regional context. SWAP coordinators and others who are drafting Wildlife Action Plan revisions are welcome to include any and all parts of this document in their revised plans. The document was drafted with public funds, and any text or graphics from the document are in the public domain.

REGIONAL COORDINATION AND PARTNERSHIPS FOR THE FUTURE

This section describes several important mechanisms and approaches that can help to foster regional coordination, cooperation, and collaboration among the Northeast state wildlife agencies. These include funding opportunities such as the RCN Grant Program and the competitive State Wildlife Grants (SWG) program, as well as coordinating bodies such as the NEAFWA (Northeast Association of Fish and Wildlife Agencies), its NEFWDTC (Northeast Fish and Wildlife Diversity Technical Committee), and the U.S. Fish & Wildlife Service's LCCs.

These approaches to coordination and collaboration are the result of considerable cross-jurisdictional conversation and planning that has occurred in recent decades. Shared collaborative regional programs such as the RCN Grant Program have been built and continue to develop as a result of the careful

attention and planning of the dedicated membership of the NEFWDTC and the broad collaboration started more than fifty years ago by the NEAFWA.

The current section also highlights important collaborative, region-wide conservation projects that have been supported through the RCN Grant Program, such as the Northeast Monitoring and Effectiveness Reporting Framework (NEAFWA 2008), Northeastern Terrestrial Wildlife Habitat Classification (Gawler 2008), and the Northeastern Aquatic Habitat Classification Project (Olivero and Anderson 2008). The Northeast Lexicon provides the opportunity for states and Wildlife Action Plans to track their efforts and contribute to a regional reporting and review system (Crisfield and NEFWDTC 2013).

These projects have provided states with a regional guide to conservation priorities and a shared vision for conservation across the Northeast. Implementation of these priorities will be shared through mechanisms such as the RCN Grant Program, the LCCs, and competitive SWG program, with additional collaborative support from U.S. Fish and Wildlife Service (USFWS) Region 5.

The programs and funding sources described below can serve as mechanisms or sources of support for regional collaboration among state fish and wildlife agencies. At the end of the chapter, steps forward are discussed.

REGIONAL CONSERVATION NEEDS GRANT PROGRAM

One of the most important opportunities for regional collaboration is provided by the Regional Conservation Needs Grant Program. Beginning in 2007, the thirteen states in the NEAFWA partnership and the District of Columbia, each contributed 4% of their annual SWG funding to support projects of regional conservation interest. This funding is offered through an annual Request for Proposals administered by NEAFWA in collaboration with the Wildlife Management Institute (WMI). The financial support available from this program enables the Northeast states to address conservation priorities that are shared across multiple jurisdictions, including planning projects that focus at a larger, landscape or regional scale. See http://www.rcngrants.org for more information about this grants program. Each year, approximately $500,000 is provided to the RCN Grant Program by the NEAFWA states, leveraging another $500,000 or more from WMI and proposal applicants. The program thus represents a $1 million annual investment in coordinated wildlife conservation planning at a regional scale.

LANDSCAPE CONSERVATION COOPERATIVES

Another opportunity for regional and cross-jurisdictional conservation partnerships is provided by the network of 22 Landscape Conservation Cooperatives (LCCs). Each LCC provides a forum for states, tribes, federal agencies, non-governmental organizations, universities, and other groups to address increasing land use pressures and widespread resource threats and uncertainties amplified by a rapidly changing climate. Through the LCC, the partners can agree on common goals for land, water, fish, wildlife, plant and cultural resources. They can jointly develop the scientific information and tools needed to prioritize and guide more effective conservation actions by the individual partners toward those goals. The four LCCs that occur in the Northeast Region are: the Appalachian LCC, the Upper Midwest and Great Lakes LCC, and the North Atlantic LCC. By actively participating in the LCCs, the northeast states have the opportunity to leverage their efforts and work towards common goals, together with the partners represented in the LCCs. For more information about LCCs, please visit: http://lccnetwork.org/.

KEYSTONE AND FOCAL SPECIES FOR NFWF, NRCS, USFWS

Some organizations and agencies in the Northeast states have identified "keystone" or "focal" species that can serve as "umbrella taxa" for cross-jurisdictional partnerships. Moving forward, these organizations will be focusing their conservation investments on projects and partnerships that benefit these species. Funding organizations that have adopted this approach include the NFWF (http://www.nfwf.org) and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS; http://nrcs.usda.gov). The USFWS (http://www.fws.gov) is also adopting a focal species approach for many of its programs. Examples of focal species for NFWF in the Northeast include river herring, American oystercatcher, and brook trout. Examples of focal species for NRCS in the Northeast include woodcock, bobwhite, and New England cottontail.

COMPETITIVE STATE WILDLIFE GRANTS PROGRAM

SWG funding provides another opportunity for collaborative, cross-border partnerships between states. Since 2001, the USFWS has awarded State Wildlife Grants for "the development and implementation of programs for the benefit of wildlife and their habitat, including species that are not hunted or fished…." Congress appropriates funds for the SWG program on an annual basis to support implementation and

updating of the Wildlife Action Plans. The majority of these funds are apportioned non-competitively to the state fish and wildlife agencies through a formula based on population and geographic area.

Congress established the competitive SWG program in 2008 to promote and advance cooperative partnerships that result in large-scale landscape conservation. Applications to this program must address: 1) eligible issues identified in USFWS-approved Action Plans; 2) emerging issues (such as climate-change effects on Species of Greatest Conservation Need (SGCN) that are adequately documented in the grant application and that propose to improve the status of SGCN and their habitats; and/or 3) improvements to states that meet one or more of the themes described in the annual announcement released by the USFWS. Project eligibility is limited to projects that engage two or more contiguous states, except in the case of Alaska, Hawaii, and the insular jurisdictions. Approximately $5 million per year has been available in recent years through this grant competition.

COLLABORATIVE REGION-WIDE PROJECTS

Since its founding in 2007, NEAFWA's RCN Grant Program has supported collaborative projects that engage many or all of the Northeast states in addressing shared conservation planning priorities. Three of the most significant projects funded by this grant program to date include the Northeast Monitoring and Effectiveness Reporting Framework (NEAFWA 2008), Northeastern Terrestrial Wildlife Habitat Classification (Gawler 2008), and the Northeastern Aquatic Habitat Classification (Olivero and Anderson 2008). Together, these tools provide strong support for coordinated, collaborative conservation efforts in the Northeast.

THE FUTURE

Conservationists in the Northeast can be proud of a long history of cooperative, collaborative conservation efforts. As threats to wildlife and habitat have seemed to grow, state fish and wildlife agencies have banded together to address pressing regional conservation problems. With increasing demands on scarce federal and state funds, these types of coordinated activities appear to have an especially bright future. Collaboration provides states with opportunities to share funds, staff time, equipment and technical expertise, and other limited resources. Through collaborative efforts, the individual Northeast states can address shared conservation concerns and tackle larger-scale regional

priorities that would be difficult for any state to address alone. The NEAFWA and its partners provide a firm foundation for regional collaboration, and these continued efforts will help to ensure that the Northeast states continue to teem with fish and wildlife for generations to come.

In order to continue this collaboration and maximize its effectiveness as a region, the Synthesis Steering Committee recommends:

RECOMMENDATION 1: DEVELOP A REGIONAL THREATS ASSESSMENT

There has not yet been a comprehensive review of the threats and stressors that influence Regional Species of Greatest Conservation Need (RSGCN) and habitats in the Northeast states. A partial list of threats and stressors that affect Northeastern bird species has been developed, but it does not include all threats to all species. A comprehensive review of threats and stressors, undertaken at a regional level across state boundaries, could benefit wildlife conservation managers in the Northeast states by providing better information about threats and stressors and a framework for addressing them. It should include the updated information from each SWAP revision. This review would complement several projects funded by NEAFWA, including the recently-completed reviews of the conservation status of species and habitats in the Northeast states. It would also bring together many disparate data products on individual threats developed through the RCN Grant Program, SWG program, and through other sources. The process of conducting this review could serve as a useful catalyst for regional collaboration across state boundaries and would likely lead to further joint projects to address high-priority threats and stressors across the entire Northeast landscape. Funding for such a review could be provided through the RCN Grant Program, the competitive SWG program, or other funding sources.

RECOMMENDATION 2: MAINTAIN THE REGIONAL SYNTHESIS AS A DYNAMIC DOCUMENT AND WEB–BASED PLANNING TOOL

The synthesis should continue to incorporate new information and tools as they become available and should provide these to states electronically. This will save the individual states considerable time and effort in their Wildlife Action Plan revisions.

RECOMMENDATION 3: CONTINUE TO DEVELOP A REGIONAL LANDSCAPE CONSERVATION DESIGN APPROACH AND TOOLKIT TO PRIORITIZE WILDLIFE AND HABITAT CONSERVATION DECISIONS IN THE FACE OF CHANGE

To implement an effective approach to regional conservation, one that addresses broader threats and uncertainties, the states and their partners in the Northeast should continue to work together to develop new information, tools, and maps to guide habitat conservation decisions. Managers need to better understand the potential impact of climate change and other key threats. They also need decision support frameworks that will help them take the most effective conservation actions to address these threats.

RECOMMENDATION 4: WORK WITH THE NORTHEAST CLIMATE CHANGE WORKING GROUP TO COMPILE AND INTEGRATE REGIONAL CLIMATE CHANGE DATA AND DEVELOP CONSISTENT GUIDANCE AND CONTEXT FOR WILDLIFE ACTION PLAN REVISIONS

NEAFWA formed a working group to coordinate regionally on this important threat. Since climate change will be addressed in each state revision, this group can provide regionally consistent approaches and information as well as many other benefits to the states, including improved efficiency and economies of scale.

RECOMMENDATION 5: WORK WITH THE NORTHEAST CONSERVATION INFORMATION AND EDUCATION ASSOCIATION TO DEVELOP CONSISTENT GUIDANCE AND CONTEXT FOR SWAP REVISIONS AND IMPLEMENTATION

The support of partners, stakeholders, and the public is essential to both the revision process and the implementation of SWAPs. While states may differ in the resources they have available, the approaches used to communicate with each of them will be similar. Economies of scale, the use of common tools, and consistency in messaging and outreach will benefit all states and the region as a whole.

RECOMMENDATION 6: THE NORTHEAST FISH AND WILDLIFE DIVERSITY TECHNICAL COMMITTEE SHOULD MORE REGULARLY REVIEW AND EVALUATE ITS PROJECTS, PRODUCTS, AND THE RSGCN LIST

The charge to the Committee from NEAFWA is a formidable responsibility that requires significant coordination, research and evaluation of each state agency's staff and expertise. Since the status of SGCN and the threats they face are constantly changing, more regular updates to the RSGCN list are needed. The RSGCN species selection process itself continues to evolve as additional information becomes available and additional taxa can be fully evaluated. Additional scheduled time and coordination are required for the Committee to meet these important obligations.

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APPENDICES

Appendix 1- RCN Project List with Links

Appendix 2- RSGCN Species Table

APPENDIX 1 – REGIONAL PROJECT SUMMARY TABLE (INCLUDES RCN, SWG AND NALCC PROJECTS)

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
NETWHCS	Northeastern terrestrial wildlife habitat classification	2	2	All	VDGIF	closed	Main Excel spreadsheet of classification with supporting documents	Dec-08	http://rcngrants.org/content/northeastern-terrestrial-wildlife-habitat-classification
NEAHCS	Northeastern aquatic habitat classification	2	2	All	VDGIF	closed	GIS database, final report and supporting documents	Sep-08	http://rcngrants.org/content/northeastern-aquatic-habitat-classification-project
NERPMF	Regional monitoring and performance framework	5	5	All	NYDEC	closed	2 Final reports and appendices	2008	http://rcngrants.org/content/regional-monitoring-and-performance-framework
RCN 2007-01	Regional Habitat Maps: NE Terrestrial Habitat Class. System	2	2	All	TNC	closed	Terrestrial Ecosystem and Habitat Map of NE	Jun-12	http://conserveonline.org/workspaces/ecs/documents/ne-terrestrial-habitat-mapping-project

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Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2007-02	Northeast Regional Connectivity Assessment Project	2,3,4	2,3,4	All	TNC	closed	NE Aquatic Connectivity report and NCAT tool	Mar-12	http://rcngrants.org/content/northeast-aquatic-connectivity
RCN 2007-03	Identifying Relationships between Invasive Species and SGCN	3	3	All	CMI	closed	Final report, excel spreadsheets, example	Jan-12	http://rcngrants.org/content/identifying-relationships-between-invasive-species-and-species-greatest-conservation-need
RCN 2007-04	Development of Avian Indicators and Measures	5	5	All	ABC	closed	Protocol, SOP, and data for mtn, tidal and grassland birds	Mar-09	http://rcngrants.org/content/development-avian-indicators-and-measures-monitoring-threats-and-effectiveness-conservation
RCN 2007-05	Conservation Status of Key Habitats and Species	1,2,3,5	1,2,3,5	All	TNC	closed	Conservation Status report with maps and tables	Sep-11	http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2007-06	GIS based Application to Estimate Stream Flow	3	3	NH, VT, MA, CT	USGS	closed	Submitted manuscript (accepted and in-press Jan/2013), GIS-based Tool, User Manual	Apr-12	http://www.rcngrants.org/content/interactive-gis-based-application-estimate-continuous-unimpacted-daily-streamflow-ungaged
RCN 2007-07	Regional Initiative Biomass Successional SGCN	3,4	3,4	All	CMI	closed	Final report	Oct-11	http://static.rcngrants.org/sites/default/files/final_reports/2007-07%20FINAL%20REPORT_0.pdf
RCN 2007-08	Grassland/Shrubland Conservation Initiatives	None	None	All	NEAFWA	closed	4 final reports	2010-2011	http://rcngrants.org/content/implementing-bird-action-plans-shrubland-dependents-northeast
RCN 2007-09	WNS in Bats	1,3	1,3	All	Bucknell Univ	closed	Manuscript published	Jul-12	http://static.rcngrants.org/sites/default/files/final_reports/Frequent%20Arousal%20from%20Hibernation%20Linked%20to%20Severity%20of%20Infection%20and%20Mortality%20in%20Bats%20with%20WNS.pdf
RCN 2008-01	GIS Application to Estimate Target Fish Comm.	no	no	NA	Rushing Rivers	closed	No product		

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2008-02	Model Guidelines for Local Planning Boards	none	none	All	NatureServe	closed	Final report and excel spreadsheet of guidelines	Feb-12	http://rcngrants.org/content/development-model-guidelines-assisting-local-planning-boards-conservation-species-greatest
RCN 2008-03	Focal Area Resilience and Adaptive Capacity	3	3	All	TNC	closed	Final report	Oct-11	http://static.rcngrants.org/sites/default/files/final_reports/Resilient-Sites-for-Species-Conservation%281%29.pdf
RCN 2008-04	Implementation of Bird Monitoring	no	no	NA	ABC	closed	No product		
RCN 2008-05	Key Habitat and Species Indicators and Measures	1,2,3,5	1,2,3,5	All	TNC	closed	Project merged with 2007-05, one final report	Sep-11	http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf
RCN 2009-01	Assessing Impacts of Climate Change on SGCN	1,3	1,3	All	Manomet	closed	3 Final reports		http://rcngrants.org/content/assessing-likely-impacts-climate-change-northeastern-fish-and-wildlife-habitats-and-species
RCN 2009-02	Condition Analysis for NE Habitats	2,3	2,3	All	TNC	closed			http://rcngrants.org/content/geospatial-condition-analysis-northeast-habitats-based-northeast-sgcn-habitat-maps

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2009-03	Invertebrate Online Database	1	1	All	CMNH	closed	Web-accessible database	May-12	http://iz.carnegiemnh.org/sgcninverts/default.asp
RCN 2009-04	Noninvasive Monitoring Tools for NE Cottontail	5	5	ME, NH, MA, CT, RI, NY	UNH	closed	3 Final repots	May-12	http://rcngrants.org/content/development-noninvasive-monitoring-tools-new-england-cottontail-populations-implications
RCN 2010-01	Lab and Field Testing of Treatments for WNS	3	3	All	Bucknell Univ.	closed		June 2015	http://rcngrants.org/content/laboratory-and-field-testing-treatments-white-nose-syndrome-immediate-funding-need-northeast
RCN 2010-02	Instream Flow for Great Lakes Basin of NY and PA	3	3	NY, PA	TNC	closed			http://rcngrants.org/content/instream-flow-recommendations-great-lakes-basin-new-york-and-pennsylvania
RCN 2010-03	Identification of Tidal Marsh Bird Focal Areas BCR 30	1,2,3,4,5	1,2,3,4,5	NJ, DE, MD, DC, VA	U of DE	closed	Final report	June 2015	http://rcngrants.org/content/identification-tidal-marsh-bird-focal-areas-bird-conservation-region-30

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2010-04	Regional Analysis of Frog Monitoring	5	5		USGS	closed	Website completed, Final manuscript currently under internal review - not yet submitted to journal		http://rcngrants.org/content/northeast-state-frogs-development-regional-analysis-frog-call-survey-data-north-american
RCN 2011-01	Conservation Action Plan for the Eastern Black Rail	1,2,3,4,5	1,2,3,4,5	NY, NJ, PA, DE, MD	Ctr for Cons. Bio.	ongoing			
RCN 2011-02	Wood Turtle Conservation Strategy	1,2,3,4,5	1,2,3,4,5	All	UMass CRU	closed	Final report	January 2015	http://rcngrants.org/content/wood-turtle-glyptemys-insculpta-northeastern-united-states-status-assessment-and
RCN 2011-03	Conservation Assessment of Odonata	1,2,3,4,5	1,2,3,4,5	All	NY Nat. Heritage	closed	Final report	January 2015	http://rcngrants.org/content/conservation-assessment-odonata-dragonflies-and-damselflies-northeastern-region
RCN 2011-05	Terrestrial Map Guidance	2	2	All	TNC	closed			http://rcngrants.org/content/guide-terrestrial-habitat-map

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2011-06	Aquatic Habitat Map Guidance	2	2	All	TNC	closed			http://rcngrants.org/content/guide-aquatic-habitat-map
RCN 2011-07	RCN Regional Synthesis	1,2,3,4,5	1,2,3,4,5	All	Terwilliger	ongoing	Report continuously updated		http://rcngrants.org/content/northeast-regional-conservation-synthesis-state-wildlife-action-plan-revisions-0
RCN 2011-08	Northeast State Wildlife Action Plans: Database Framework for Common Elements		All	All	NJ DFW	ongoing	Report updated as needed		http://rcngrants.org/content/northeast-regional-conservation-synthesis-state-wildlife-action-plan-revisions-0
RCN 2012-01	Rana virus in amphibians	3	3	All	MD DNR	active			
RCN 2012-02	Conservation status of Brook Floater Mussel	1,2,3,4,5	1,2,3,4,5	All	Saint Anselm College	active			
RCN 2012-03	Fungal Dermatitis in New England Timber Rattlesnake	1, 3	1, 3	ME, NH, VT, MA	RI Zoological Soc	active			

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
RCN 2013-01	Hellbender Conservation		1		Smithsonian Institution	active			http://rcngrants.org/content/developing-coordinated-research-approach-hellbender-conservation-northeast-benefits-wild-1
RCN 2013-02	Northern Diamondback Terrapin Conservation Strategy		1		Conserve Wildlife Foundation of New Jersey	active			http://rcngrants.org/content/northern-diamondback-terrapin-malaclemys-terrapin-terrapin-ne-united-states-regional
RCN 2013-03	Leopard Frog in the Coastal NE		1		NY Natural Heritage Program	active			http://rcngrants.org/content/distribution-and-conservation-status-newly-described-species-leopard-frog-coastal-ne
RCN 2014-01	Sustaining Wildlife Populations in NE Forests		1,2			active			
SWG BLTU	Conservation of Blanding's Turtle and Associated Wetland SGCN in the Northeast		All	ME, NH, MA, NY, PA	NH FG	ongoing			

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
SWG NEC	Conservation Strategy for the New England cottontail (Sylvilagus transitionalis)	All	1,2,3,4,5	ME, NH, MA, CT, RI, NY	Wildlife Management Institute	closed			http://www.newenglandcottontail.org
LCC - 1	Virginia Piedmont and Coastal Plain Updates to Northeast Habitat Map			VA, MD	TNC	closed	Extension of the Terrestrial Ecosystem and Habitat Map of NE	Jun-12	http://www.northatlanticlcc.org/projects/habitat-map-for-virginia-piedmont-and-coastal-plain/habitat-map-for-virginia-piedmont-and-coastal-plain
LCC - 2	Extending the Northeast Terrestrial Habitat Map to Atlantic Canada			Canada - Quebec, New Brunswick, Prince Edward Island, Nova Scotia	TNC	ongoing			http://www.northatlanticlcc.org/projects/extending-the-northeast-terrestrial-habitat-map-to-atlantic-canada
LCC - 3	Revisions to the Northeastern Aquatic Habitat Classification			All	TNC	ongoing			http://www.northatlanticlcc.org/projects/aquatic-classification-revisions/revisions-to-the-northeastern-aquatic-habitat-classification

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
LCC - 4	Application of the Coastal and Marine Ecological Classification Standards (CMECS) to the Northeast			ME, NH, MA, CT, RI, NY, NJ, PA, DE, MD, DC,VA	TNC	ongoing			http://www.northatlanticlcc.org/projects/reports-for-application-of-the-coastal-and-marine-ecological-classification-standards-cmecs-to-the-northeast-1
LCC - 5	Rapid Update to the National Wetlands Inventory for Selected Areas of Intertidal Wetlands in the North Atlantic LCC			ME, MD, MA, NY, PA, and VA	Conservation Management Institute	ongoing			http://www.northatlanticlcc.org/projects/rapid-update-to-coastal-nwi/coastal-update-to-the-national-wetlands-inventory
LCC - 6	Vulnerabilities to Climate Change of Northeast Fish and Wildlife Habitats, Phase II			All	Manomet Center for Conservation Sciences	ongoing			http://www.northatlanticlcc.org/projects/vulnerabilities-to-climate-change-of-northeast-fish-and-wildlife-habitats-phase-ii/vulnerabilities-to-climate-change-of-northeast-fish-and-wildlife-habitats-phase-ii http://rcngrants.org/content/assessing-likely-impacts-climate-change-northeastern-fish-and-wildlife-habitats-and-species

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
LCC - 7	Completing Northeast Regional Vulnerability Assessment Incorporating the NatureServe Climate Change Vulnerability Index			All	NatureServe	ongoing			http://www.northatlanticlcc.org/projects/completing-northeast-regional-vulnerability-assessment-incorporating-the-natureserve-climate-change-vulnerability-index/completing-northeast-regional-vulnerability-assessment-incorporating-the-natureserve-climate-change-vulnerability-index http://www.natureserve.org/prodServices/climatechange/ccvi.jsp
LCC - 8	Permeable Landscapes for Species of Greatest Conservation Need			All	TNC	ongoing			http://www.northatlanticlcc.org/projects/permeable-landscapes-for-species-of-greatest-conservation-need/permeable-landscapes-for-species-of-greatest-conservation-need
LCC - 9	Designing Sustainable Landscapes: Assessment of Landscape Changes in the North Atlantic Landscape Conservation Cooperative: Decision-Support Tools for Conservation			All	University of Massachusetts, Amherst	ongoing			http://www.northatlanticlcc.org/projects/designing-sustainable-landscapes-phase-2 http://www.umass.edu/landeco/research/nalcc/nalcc.html

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
LCC - 10	Decision support tool to assess aquatic habitats and threats in North Atlantic watersheds and estuaries			All	Downstream Strategies	ongoing			http://www.northatlanticlcc.org/projects/downstream-strategies-project/decision-support-tool-to-assess-aquatic-habitats-and-threats-in-north-atlantic-watersheds
LCC - 11	Mapping the Distribution, Abundance and Risk Assessment of Marine Birds in the Northwest Atlantic Ocean			ME, NH, MA, CT, RI, NY, NJ, PA, DE, MD, VA	North Carolina State University	ongoing			http://www.northatlantic assessment-of-marine-birds-in-the-northwest-atlantic-ocean lcc.org/projects/mapping-the-distribution-abundance-and-risk-
LCC - 12	Forecasting Changes in Aquatic Systems and Resilience of Aquatic Populations in the NALCC: Decision-support Tools for Conservation			All	USGS/University of Massachusetts Amherst	ongoing			http://www.northatlanticlcc.org/projects/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation/forecasting-changes-in-aquatic-systems-and-resilience-of-aquatic-populations-in-the-nalcc-decision-support-tools-for-conservation

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
LCC - 13	Forecast Effects of Accelerating Sea-level Rise on the Habitat of Atlantic Coast Piping Plovers and Identify Responsive Conservation Strategies			ME, NH, MA, CT, RI, NY, NJ, DE, MD, VA	Virginia Tech	ongoing			http://www.northatlanticlcc.org/projects/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies/forecast-effects-of-accelerating-sea-level-rise-on-the-habitat-of-atlantic-coast-piping-plovers-and-identify-responsive-conservation-strategies
LCC - 14	Assessing Priority Amphibian & Reptile Conservation Areas (PARCAs) and Vulnerability to Climate Change in the North Atlantic Landscape Conservation Cooperative (LCC)			All	Association of Fish and Wildlife Agencies	ongoing			http://www.northatlanticlcc.org/projects/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc/assessing-priority-amphibian-reptile-conservation-areas-parcas-and-vulnerability-to-climate-change-in-the-north-atlantic-landscape-conservation-cooperative-lcc
LCC - 15	Identifying Important Migratory Landbird Stopover Sites in the Northeast			All	University of Delaware	ongoing			http://www.northatlanticlcc.org/projects/bird-radar-group/migratory-landbird-stopover-sites-in-the-northeast

Appendix 1 - RCN Project List with Links

Project ID	Brief Title	In Synthesis Chapters	8 SWAP Elements covered in plan	NE States included in plan	PI Org	Status	Final Product	Product Released	Product link
LCC - 16	Northeast Regional Conservation Design, Regional Synthesis and Delivery of Conservation Information and Tools for SWAP updates			All	North Atlantic LCC	ongoing			http://www.northatlanticlcc.org/groups/science-delivery-team http://nalcc.databasin.org/

APPENDIX 2 – NORTHEAST REGION RSGCN, BY MAJOR TAXONOMIC GROUP

RSGCN List: Mammals							
Scientific Name [B,M,W,A,E]=[Breeding, Migratory, Wintering, Atlantic, Eastern population]	Common Name	RSGCN Responsibility	RSGCN Concern	Expected States	State Data Coverage	Data QC Survey %Confident	Federal Status
Microtus chrotorrhinus carolinensis	Southern Rock Vole	High	V. High	3	100%	53%	—
Myotis leibii	Eastern Small-footed Myotis	High	V. High	11	91%	78%	—
Neotoma magister	Allegheny Woodrat	High	V. High	8	75%	80%	—
Sciurus niger cinereus	Delmarva Fox Squirrel	High	V. High	4	75%	74%	EE (PDL)
Sorex dispar	Long-tailed Shrew	High	V. High	10	70%	52%	—
Sorex palustris punctulatus	Southern Water Shrew	High	V. High	4	100%	50%	—
Sylvilagus transitionalis	New England Cottontail	High	V. High	8	75%	81%	C
Sorex palustris albibarbis	American Water Shrew (Eastern)	High	High	9	0%	0%	—
Sorex cinereus fontinalis	Maryland Shrew	High	Mod.	3	0%	0%	—
Sorex fumeus	Smoky Shrew	High	Mod.	12	17%	64%	—
Condylura cristata	Star-nosed Mole	High	Low	14	7%	71%	—
Napaeozapus insignis	Woodland Jumping Mouse	High	Low	12	8%	75%	—
Parascalops breweri	Hairy-tailed Mole	High	Low	11	9%	70%	—
Corynorhinus townsendii virginianus	Virginia Big-eared Bat	High	Limited	2	100%	67%	E
Glaucomys sabrinus fuscus	Virginia Northern Flying Squirrel	High	Limited	2	100%	58%	DL
Microtus breweri	Beach Vole	High	Limited	1	100%	44%	—
Microtus pennsylvanicus provectus	Block Island Meadow Vole	High	Limited	1	0%	0%	—
Microtus pennsylvanicus shattucki	Penobscot Meadow Vole	High	Limited	1	0%	0%	—
Peromyscus leucopus easti	Pungo White-footed Deermouse	High	Limited	1	0%	0%	—
Sorex longirostris fisheri	Dismal Swamp Southeastern Shrew	High	Limited	1	100%	56%	—
Eptesicus fuscus	Big Brown Bat	Low	High	14	29%	71%	—
Lynx rufus	Bobcat	Low	High	14	21%	50%	—
Martes americana	American Marten	Low	High	8	38%	50%	R
Phocoena phocoena	Harbor Porpoise	Low	High	5	40%	53%	—
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	Low	Limited	1	100%	44%	E
Myotis grisescens	Gray Myotis	Low	Limited	1	100%	56%	E
Balaenoptera borealis	Sei Whale	Low	V. High	4	0%	0%	E
Balaenoptera musculus	Blue Whale	Low	V. High	3	0%	0%	E
Balaenoptera physalus	Fin Whale	Low	V. High	6	33%	59%	E

Cryptotis parva	North American Least Shrew	Low	V. High	9	44%	68%	—
Eubalaena glacialis	North Atlantic Right Whale	Low	V. High	5	60%	67%	E
Lasionycteris noctivagans	Silver-haired Bat	Low	V. High	13	23%	70%	—
Lasiurus borealis	Eastern Red Bat	Low	V. High	14	21%	68%	R
Lasiurus cinereus	Hoary Bat	Low	V. High	13	38%	67%	—
Lynx canadensis	Canadian Lynx	Low	V. High	6	33%	73%	—
Megaptera novaeangliae	Humpback Whale	Low	V. High	5	40%	64%	E
Mustela nivalis	Least Weasel	Low	V. High	5	80%	56%	—
Myotis lucifugus	Little Brown Myotis	Low	V. High	14	36%	61%	R
Myotis septentrionalis	Northern Myotis	Low	V. High	14	43%	67%	—
Myotis sodalis	Indiana Myotis	Low	V. High	9	78%	76%	E
Perimyotis subflavus	Tricolored Bat	Low	V. High	14	36%	53%	R
Physeter macrocephalus	Sperm Whale	Low	V. High	2	0%	0%	E
Spilogale putorius	Eastern Spotted Skunk	Low	V. High	4	100%	71%	—
Sylvilagus obscurus	Appalachian Cottontail	Low	V. High	4	100%	65%	—
Synaptomys cooperi	Southern Bog Lemming	Low	V. High	13	46%	63%	—
RSGCN List: Birds							
Ammodramus caudacutus	Saltmarsh Sparrow	High	V. High	10	60%	85%	R
Calidris canutus [M]	Red Knot	High	V. High	8	38%	82%	PT,R
Catharus bicknelli	Bicknell's Thrush	High	V. High	6	83%	93%	PE,R
Charadrius melodus [A]	Piping Plover	High	V. High	11	82%	91%	ET,R
Falco peregrinus [E]	Peregrine Falcon	High	V. High	14	71%	100%	—
Hylocichla mustelina	Wood Thrush	High	V. High	14	50%	91%	R
Laterallus jamaicensis	Black Rail	High	V. High	7	86%	85%	—
Setophaga cerulea	Cerulean Warbler	High	V. High	13	54%	78%	—
Sterna dougallii	Roseate Tern	High	V. High	9	67%	86%	E,T
Vermivora cyanoptera	Blue-winged Warbler	High	V. High	14	50%	77%	R
Aquila chrysaetos [B,W]	Golden Eagle	High	High	12	83%	87%	—
Piranga olivacea	Scarlet Tanager	High	High	14	36%	92%	—
Passerculus sandwichensis princeps [M,W]	Ipswich Sparrow	High	Low	2	100%	55%	—
Melospiza georgiana nigrescens	Coastal Plain Swamp Sparrow	High	Limited	3	0%	0%	—
Accipiter gentilis	Northern Goshawk	Low	V. High	11	55%	79%	—
Ammodramus henslowii	Henslow's Sparrow	Low	V. High	13	69%	71%	—
Ammodramus maritimus	Seaside Sparrow	Low	V. High	10	40%	92%	—
Ammodramus savannarum	Grasshopper Sparrow	Low	V. High	14	71%	93%	R
Anas rubripes [B,W]	American Black Duck	Low	V. High	14	21%	93%	R
Antrostomus vociferus	Eastern Whip-poor-will	Low	V. High	14	36%	81%	R
Arenaria interpres [M,W]	Ruddy Turnstone	Low	V. High	10	10%	91%	—
Asio flammeus	Short-eared Owl	Low	V. High	13	77%	79%	—

Asio otus	Long-eared Owl	Low	V. High	14	50%	90%	—
Bartramia longicauda	Upland Sandpiper	Low	V. High	14	93%	86%	R
Botaurus lentiginosus	American Bittern	Low	V. High	14	71%	85%	R
Bubulcus ibis	Cattle Egret	Low	V. High	—	—	—	—
Calidris maritima [M,W]	Purple Sandpiper	Low	V. High	8	25%	89%	R
Cardellina canadensis	Canada Warbler	Low	V. High	13	23%	88%	—
Chlidonias niger	Black Tern	Low	V. High	—	—	—	—
Chordeiles minor	Common Nighthawk	Low	V. High	14	64%	83%	R
Circus cyaneus	Northern Harrier	Low	V. High	14	86%	95%	—
Cistothorus platensis	Sedge Wren	Low	V. High	13	85%	77%	R
Coccyzus erythropthalmus	Black-billed Cuckoo	Low	V. High	14	36%	90%	—
Colinus virginianus	Northern Bobwhite	Low	V. High	12	25%	87%	—
Contopus cooperi	Olive-sided Flycatcher	Low	V. High	12	33%	62%	—
Dolichonyx oryzivorus	Bobolink	Low	V. High	14	50%	83%	R
Egretta caerulea	Little Blue Heron	Low	V. High	10	70%	84%	—
Egretta thula	Snowy Egret	Low	V. High	12	67%	82%	R
Egretta tricolor	Tricolored Heron	Low	V. High	—	—	—	—
Euphagus carolinus [B,W]	Rusty Blackbird	Low	V. High	11	45%	80%	—
Falcipennis canadensis	Spruce Grouse	Low	V. High	—	—	—	R
Gavia immer	Common Loon	Low	V. High	—	—	—	R
Gelochelidon nilotica	Gull-billed Tern	Low	V. High	—	—	—	—
Geothlypis formosa	Kentucky Warbler	Low	V. High	10	50%	70%	R
Haematopus palliatus	American Oystercatcher	Low	V. High	9	44%	86%	R
Helmitheros vermivorum	Worm-eating Warbler	Low	V. High	11	45%	89%	R
Histrionicus histrionicus [E,W]	Harlequin Duck	Low	V. High	—	—	—	—
Ixobrychus exilis	Least Bittern	Low	V. High	14	86%	89%	R
Lanius ludovicianus	Loggerhead Shrike	Low	V. High	12	58%	65%	—
Limnothlypis swainsonii	Swainson's Warbler	Low	V. High	—	—	—	—
Melanerpes erythrocephalus	Red-headed Woodpecker	Low	V. High	—	—	—	—
Numenius phaeopus [M]	Whimbrel	Low	V. High	—	—	—	—
Nyctanassa violacea	Yellow-crowned Night-Heron	Low	V. High	11	64%	93%	—
Nycticorax nycticorax	Black-crowned Night-Heron	Low	V. High	14	57%	88%	—
Parkesia motacilla	Louisiana Waterthrush	Low	V. High	14	14%	87%	R
Picoides dorsalis	American Three-toed Woodpecker	Low	V. High	—	—	—	—
Pipilo erythrophthalmus	Eastern Towhee	Low	V. High	14	14%	93%	R
Podilymbus podiceps	Pied-billed Grebe	Low	V. High	14	79%	87%	—
Pooecetes gramineus	Vesper Sparrow	Low	V. High	14	57%	80%	—
Porzana carolina	Sora	Low	V. High	14	64%	72%	—
Protonotaria citrea	Prothonotary Warbler	Low	V. High	10	50%	82%	R
Rallus elegans	King Rail	Low	V. High	13	54%	84%	R

Rynchops niger	Black Skimmer	Low	V. High	—	—	—	R
Scolopax minor	American Woodcock	Low	V. High	—	—	—	R
Setophaga castanea	Bay-breasted Warbler	Low	V. High	—	—	—	—
Setophaga discolor	Prairie Warbler	Low	V. High	14	21%	88%	R
Spizella pusilla	Field Sparrow	Low	V. High	14	36%	83%	R
Sterna forsteri	Forster's Tern	Low	V. High	—	—	—	—
Sterna hirundo	Common Tern	Low	V. High	13	62%	90%	R
Sterna paradisaea	Arctic Tern	Low	V. High	—	—	—	—
Sternula antillarum	Least Tern	Low	V. High	11	82%	90%	R
Sturnella magna	Eastern Meadowlark	Low	V. High	14	43%	86%	R
Thryomanes bewickii	Bewick's Wren	Low	V. High	5	20%	100%	—
Toxostoma rufum	Brown Thrasher	Low	V. High	14	43%	92%	R
Tringa semipalmata	Willet	Low	V. High	11	18%	83%	R
Tyto alba	Barn Owl	Low	V. High	12	67%	88%	—
Vermivora chrysoptera	Golden-winged Warbler	Low	V. High	12	75%	83%	PE
Antrostomus carolinensis	Chuck-will's-widow	Low	High	—	—	—	—
Bonasa umbellus	Ruffed Grouse	Low	High	14	14%	92%	R
Buteo lineatus	Red-shouldered Hawk	Low	High	14	50%	83%	R
Buteo platypterus	Broad-winged Hawk	Low	High	14	43%	88%	—
Calidris alba [M,W]	Sanderling	Low	High	9	33%	88%	R
Calidris pusilla [M]	Semipalmated Sandpiper	Low	High	8	25%	85%	R
Catharus fuscescens	Veery	Low	High	—	—	—	—
Certhia americana	Brown Creeper	Low	High	—	—	—	—
Chaetura pelagica	Chimney Swift	Low	High	14	21%	88%	—
Cistothorus palustris	Marsh Wren	Low	High	14	36%	81%	R
Coturnicops noeboracensis [M]	Yellow Rail	Low	High	—	—	—	—
Empidonax traillii	Willow Flycatcher	Low	High	13	8%	93%	R
Empidonax virescens	Acadian Flycatcher	Low	High	—	—	—	—
Eremophila alpestris	Horned Lark	Low	High	—	—	—	—
Falco sparverius	American Kestrel	Low	High	14	36%	86%	—
Gallinago delicata	Wilson's Snipe	Low	High	—	—	—	—
Gallinula galeata	Common Gallinule	Low	High	14	50%	92%	—
Icteria virens	Yellow-breasted Chat	Low	High	—	—	—	—
Limosa fedoa [M]	Marbled Godwit	Low	High	—	—	—	—
Mniotilta varia	Black-and-white Warbler	Low	High	—	—	—	R
Phalaropus tricolor	Wilson's Phalarope	Low	High	—	—	—	—
Piranga rubra	Summer Tanager	Low	High	—	—	—	—
Rallus longirostris	Clapper Rail	Low	High	—	—	—	—
Riparia riparia	Bank Swallow	Low	High	14	29%	76%	R
Setophaga americana	Northern Parula	Low	High	14	36%	91%	—

Setophaga caerulescens	Black-throated Blue Warbler	Low	High	13	31%	88%	—
Setophaga citrina	Hooded Warbler	Low	High	—	—	—	—
Setophaga fusca	Blackburnian Warbler	Low	High	—	—	—	R
Setophaga tigrina	Cape May Warbler	Low	High	—	—	—	—
Setophaga virens	Black-throated Green Warbler	Low	High	—	—	—	—
Somateria mollissima	Common Eider	Low	High	—	—	—	R
Spiza americana	Dickcissel	Low	High	—	—	—	—
Vireo flavifrons	Yellow-throated Vireo	Low	High	14	21%	92%	—
RSGCN List: Reptiles and Amphibians							
Glyptemys insculpta	Wood Turtle	High	V. High	13	92%	78%	R
Glyptemys muhlenbergii	Bog Turtle	High	V. High	9	67%	84%	TS,R
Malaclemys terrapin terrapin	Northern Diamondback Terrapin	High	V. High	7	14%	0%	E,R
Plestiodon anthracinus anthracinus	Northern Coal Skink	High	V. High	4	75%	50%	—
Coluber constrictor constrictor	Northern Black Racer	High	High	6	17%	0%	—
Eurycea longicauda	Longtail Salamander	High	High	8	38%	79%	—
Pseudacris kalmi	New Jersey Chorus Frog	High	High	5	40%	61%	—
Pseudemys rubriventris	Northern Red-bellied Cooter	High	High	9	44%	68%	—
Pseudotriton ruber	Red Salamander	High	High	8	38%	74%	—
Desmognathus monticola	Seal Salamander	High	Mod.	4	25%	69%	—
Gyrinophilus porphyriticus porphyriticus	Northern Spring Salamander	High	Mod.	6	33%	67%	—
Plethodon hoffmani	Valley and Ridge Salamander	High	Mod.	4	25%	60%	—
Desmognathus fuscus	Northern Dusky Salamander	High	Low	14	14%	64%	—
Desmognathus ochrophaeus	Allegheny Mountain Dusky Salamander	High	Low	7	57%	50%	—
Diadophis punctatus edwardsii	Northern Ring-necked Snake	High	Low	6	33%	69%	—
Eurycea bislineata	Northern Two-lined Salamander	High	Low	14	21%	81%	—
Gyrinophilus porphyriticus	Spring Salamander	High	low	12	25%	100%	R
Gyrinophilus porphyriticus duryi	Kentucky Spring Salamander	High	Low	2	0%	0%	—
Plethodon cylindraceus	White-spotted Slimy Salamander	High	low	2	50%	70%	—
Plethodon glutinosus	Slimy Salamander	High	Low	8	50%	56%	—
Plethodon punctatus	White-spotted Salamander	High	Low	2	100%	58%	—
Plethodon wehrlei	Wehrle's Salamander	High	Low	5	40%	64%	—
Storeria dekayi dekayi	Brownsnake	High	Low	14	21%	64%	—
Thamnophis brachystoma	Short-headed Gartersnake	High	Low	2	50%	58%	—
Desmognathus orestes	Blue Ridge Dusky Salamander	High	Limited	1	100%	56%	—
Gyrinophilus subterraneus	West Virginia Spring Salamander	High	Limited	1	100%	64%	—
Plethodon hubrichti	Peaks of Otter Salamander	High	Limited	1	100%	56%	—
Plethodon kentucki	Cumberland Plateau Salamander	High	Limited	2	50%	56%	—
Plethodon nettingi	Cheat Mountain Salamander	High	Limited	1	100%	64%	T

Plethodon shenandoah	Shenandoah Salamander	High	Limited	1	100%	56%	E
Plethodon virginia	Shenandoah Mountain Salamander	High	Limited	2	0%	0%	—
Virginia pulchra	Mountain Earthsnake	High	Limited	4	100%	68%	—
Ambystoma laterale & jeffersonianum	Blue-spotted Salamander complex	Low	V. High	8	88%	79%	—
Ambystoma tigrinum	Tiger Salamander	Low	V. High	6	67%	70%	—
Aneides aeneus	Green Salamander	Low	V. High	4	100%	61%	—
Caretta caretta	Loggerhead	Low	V. High	9	67%	81%	ET,R
Cemophora coccinea copei	Northern Scarletsnake	Low	V. High	5	40%	67%	—
Chelonia mydas	Green Turtle	Low	V. High	9	56%	64%	ET
Clemmys guttata	Spotted Turtle	Low	V. High	14	79%	77%	R
Crotalus horridus	Timber Rattlesnake	Low	V. High	13	54%	80%	—
Cryptobranchus alleganiensis	Eastern Hellbender	Low	V. High	5	100%	78%	—
Dermochelys coriacea	Leatherback	Low	V. High	9	44%	65%	E
Emydoidea blandingii	Blanding's Turtle	Low	V. High	5	100%	77%	—
Eretmochelys imbricata imbricata	Atlantic Hawksbill	Low	V. High	4	0%	0%	E
Heterodon platirhinos	Eastern Hog-nosed Snake	Low	V. High	12	50%	72%	R
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Low	V. High	10	50%	64%	E
Lithobates virgatipes	Carpenter Frog	Low	V. High	4	100%	71%	—
Pantherophis guttatus	Red Cornsnake	Low	V. High	5	60%	67%	—
Pseudacris brachyphona	Mountain Chorus Frog	Low	V. High	4	75%	73%	—
Pseudotriton montanus montanus	Eastern Mud Salamander	Low	V. High	3	100%	55%	—
Regina septemvittata	Queen Snake	Low	V. High	8	63%	68%	—
Scaphiopus holbrookii	Eastern Spadefoot	Low	V. High	11	55%	83%	—
Terrapene carolina carolina	Eastern Box Turtle	Low	V. High	6	83%	72%	R
Thamnophis sauritus	Eastern Ribbonsnake	Low	V. High	14	50%	100%	—
Acris crepitans	Northern Cricket Frog	Low	High	8	50%	74%	—
Agkistrodon contortrix	Copperhead	Low	High	10	70%	70%	—
Ambystoma opacum	Marbled Salamander	Low	High	12	58%	70%	R
Anaxyrus fowleri	Fowler's Toad	Low	High	13	54%	70%	—
Apalone spinifera spinifera	Spiny Softshell	Low	High	7	57%	67%	—
Graptemys geographica	Common Map Turtle	Low	High	7	100%	60%	—
Liochlorophis vernalis	Smooth Greensnake	Low	High	12	58%	71%	—
Lithobates pipiens	Northern Leopard Frog	Low	High	11	45%	70%	—
Necturus maculosus	Mudpuppy	Low	High	8	75%	60%	—
Opheodrys aestivus	Rough Greensnake	Low	High	7	71%	76%	—
Plestiodon laticeps	Broad-headed Skink	Low	High	6	33%	64%	—
RSGCN List: Fishes							
Acipenser brevirostrum	Shortnose Sturgeon	High	V. High	12	58%	84%	E,R
Acipenser oxyrinchus	Atlantic Sturgeon	High	V. High	12	67%	71%	—
Ammodytes americanus	American Sand Lance	High	V. High	2	0%	0%	—

Enneacanthus obesus	Banded Sunfish	High	V. High	11	64%	78%	—
Fundulus luciae	Spotfin Killifish	High	V. High	6	50%	70%	—
Ichthyomyzon greeleyi	Mountain Brook Lamprey	High	V. High	4	75%	88%	—
Notropis bifrenatus	Bridle Shiner	High	V. High	13	54%	95%	—
Percina macrocephala	Longhead Darter	High	V. High	3	67%	87%	—
Alosa aestivalis	Blueback Herring	High	High	13	23%	90%	SC
Alosa mediocris	Hickory Shad	High	High	10	30%	67%	—
Alosa pseudoharengus	Alewife	High	High	12	42%	95%	SC,R
Etheostoma vitreum	Glassy Darter	High	High	4	75%	92%	—
Exoglossum laurae	Tonguetied Minnow	High	High	4	50%	83%	—
Notropis amoenus	Comely Shiner	High	High	8	38%	93%	—
Percina notogramma	Stripeback Darter	High	High	4	50%	92%	—
Percina peltata	Shield Darter	High	High	8	25%	93%	—
Apeltes quadracus	Fourspine Stickleback	High	Mod.	12	42%	64%	—
Cottus girardi	Potomac Sculpin	High	Mod.	4	50%	94%	—
Dasyatis centroura	Roughtail Stingray	High	Mod.	0	0%	0%	—
Etheostoma variatum	Variegate Darter	High	Mod.	4	50%	83%	—
Leucoraja garmani	Rosette Skate	High	Mod.	0	0%	0%	—
Microgadus tomcod	Atlantic Tomcod	High	Mod.	6	0%	0%	—
Notropis procne	Swallowtail Shiner	High	Mod.	8	25%	95%	—
Noturus flavus	Stonecat	High	Mod.	8	25%	93%	—
Opsanus tau	Oyster Toadfish	High	Mod.	1	0%	0%	—
Percina oxyrhynchus	Sharpnose Darter	High	Mod.	3	33%	89%	—
Pseudopleuronectes americanus	Winter Flounder	High	Mod.	2	0%	0%	—
Tautogolabrus adspersus	Cunner	High	Mod.	2	0%	0%	—
Alopias vulpinus	Common Thresher Shark	High	Low	0	0%	0%	—
Amblyraja radiata	Thorny Skate	High	Low	0	0%	0%	SC
Clupea harengus	Atlantic Herring	High	Low	2	0%	0%	—
Cottus caeruleomentum	Blue Ridge Sculpin	High	Low	5	40%	87%	—
Cyprinella analostana	Satinfin Shiner	High	Low	8	25%	94%	—
Exoglossum maxillingua	Cutlip Minnow	High	Low	10	30%	95%	—
Fundulus heteroclitus	Mummichog	High	Low	12	8%	94%	—
Fundulus majalis	Striped Killifish	High	Low	4	25%	86%	—
Hemitripterus americanus	Sea Raven	High	Low	1	0%	0%	—
Hybognathus regius	Eastern Silvery Minnow	High	Low	11	45%	94%	—
Isurus oxyrinchus	Shortfin Mako	High	Low	0	0%	0%	—
Lamna nasus	Porbeagle	High	Low	0	0%	0%	SC
Lepomis auritus	Redbreast Sunfish	High	Low	14	14%	96%	—
Leucoraja erinacea	Little Skate	High	Low	1	0%	0%	—
Leucoraja ocellata	Winter Skate	High	Low	1	0%	0%	—

Lophius americanus	Goosefish	High	Low	2	0%	0%	—
Malacoraja senta	Smooth Skate	High	Low	0	0%	0%	—
Menidia menidia	Atlantic Silverside	High	Low	5	40%	67%	—
Merluccius bilinearis	Silver Hake	High	Low	2	0%	0%	—
Paralichthys oblongus	Fourspot Flounder	High	Low	1	0%	0%	—
Peprilus triacanthus	Butterfish	High	Low	2	0%	0%	—
Prionace glauca	Blue Shark	High	Low	0	0%	0%	—
Prionotus carolinus	Northern Searobin	High	Low	2	0%	0%	—
Prionotus evolans	Striped Searobin	High	Low	2	0%	0%	—
Scomber scombrus	Atlantic Mackerel	High	Low	2	0%	0%	—
Scophthalmus aquosus	Windowpane	High	Low	2	0%	0%	—
Semotilus corporalis	Fallfish	High	Low	14	29%	96%	—
Sphyrna zygaena	Smooth Hammerhead	High	Low	0	0%	0%	—
Squalus acanthias	Spiny Dogfish	High	Low	2	0%	0%	—
Tautoga onitis	Tautog	High	Low	3	0%	0%	—
Umbra pygmaea	Eastern Mudminnow	High	Low	7	29%	88%	—
Urophycis chuss	Red Hake	High	Low	2	0%	0%	—
Zoarces americanus	Ocean Pout	High	Low	1	0%	0%	—
Dipturus laevis	Barndoor Skate	High	Limited	1	0%	0%	—
Myoxocephalus octodecemspinosus	Longhorn Sculpin	High	Limited	2	0%	0%	—
Sphoeroides maculatus	Northern Puffer	High	Limited	2	0%	0%	—
Squatina dumeril	Atlantic Angel Shark	High	Limited	2	0%	0%	—
Acipenser fulvescens	Lake Sturgeon	Low	V. High	4	75%	94%	—
Alosa sapidissima	American Shad	Low	V. High	13	23%	88%	R
Ammocrypta pellucida	Eastern Sand Darter	Low	V. High	4	75%	81%	—
Anguilla rostrata	American Eel	Low	V. High	14	36%	96%	R
Enneacanthus chaetodon	Blackbanded Sunfish	Low	V. High	5	80%	80%	—
Erimystax dissimilis	Streamline Chub	Low	V. High	4	75%	73%	—
Etheostoma camurum	Bluebreast Darter	Low	V. High	4	75%	94%	—
Etheostoma maculatum	Spotted Darter	Low	V. High	3	67%	93%	—
Etheostoma tippecanoe	Tippecanoe Darter	Low	V. High	3	67%	91%	—
Hiodon tergisus	Mooneye	Low	V. High	4	50%	73%	—
Ichthyomyzon bdellium	Ohio Lamprey	Low	V. High	4	75%	88%	—
Ichthyomyzon fossor	Northern Brook Lamprey	Low	V. High	4	75%	81%	—
Lampetra aepyptera	Least Brook Lamprey	Low	V. High	5	60%	94%	—
Lepomis gulosus	Warmouth	Low	V. High	4	50%	95%	—
Lethenteron appendix	American Brook Lamprey	Low	V. High	13	54%	92%	—
Moxostoma carinatum	River Redhorse	Low	V. High	4	75%	81%	—
Notropis chalybaeus	Ironcolor Shiner	Low	V. High	6	100%	75%	—
Noturus insignis	Margined Madtom	Low	V. High	9	11%	92%	R

Percina copelandi	Channel Darter	Low	V. High	5	80%	82%	—
Percina evides	Gilt Darter	Low	V. High	4	75%	81%	—
Polyodon spathula	Paddlefish	Low	V. High	4	50%	70%	—
Prosopium cylindraceum	Round Whitefish	Low	V. High	5	80%	84%	—
Salmo salar	Atlantic Salmon	Low	V. High	7	14%	93%	R
Salvelinus fontinalis	Brook Trout	Low	V. High	12	33%	96%	R
Acantharchus pomotis	Mud Sunfish	Low	High	6	67%	68%	—
Salvelinus alpinus oquassa	Arctic Char			3	NA	NA	—
Ameiurus melas	Black Bullhead	Low	High	5	40%	75%	—
Amia calva	Bowfin	Low	High	5	40%	91%	—
Catostomus catostomus	Longnose Sucker	Low	High	9	67%	86%	—
Coregonus clupeaformis	Lake Whitefish	Low	High	5	40%	60%	—
Cottus cognatus	Slimy Sculpin	Low	High	10	30%	83%	R
Etheostoma fusiforme	Swamp Darter	Low	High	12	50%	79%	—
Ichthyomyzon unicuspis	Silver Lamprey	Low	High	4	50%	75%	—
Lota lota	Burbot	Low	High	7	71%	94%	—
Salvelinus namaycush	Lake Trout	Low	High	5	0%	0%	—
Sander canadensis	Sauger	Low	High	5	40%	92%	—
RSGCN List: Tiger Beetles							
Cicindela ancocisconensis	Appalachian Tiger Beetle	high	high	9	78%	76%	—
Cicindela marginipennis	Cobblestone Tiger Beetle	high	high	8	88%	83%	—
Cicindela patruela consentanea	Northern Barrens Tiger Beetle	high	high	2	100%	81%	—
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	high	very high	7	86%	82%	T
Cicindela puritana	Puritan Tiger Beetle	high	very high	5	80%	86%	T,R
Cicindela rufiventris hentzi	Hentz's Red-bellied Tiger Beetle	high	very high	1	100%	88%	—
Cicindela abdominalis	Eastern Pinebarrens Tiger Beetle	low	high	4	75%	80%	—
Cicindela dorsalis media	White Tiger Beetle	low	high	4	50%	73%	—
Cicindela lepida	Ghost Tiger Beetle	low	high	8	63%	79%	—
Cicindela patruela	Barrens Tiger Beetle	low	high	13	46%	73%	—
Cicindela unipunctata	One-spotted Tiger Beetle	low	high	8	13%	0%	—
RSGCN List-Freshwater Mussels							
Alasmidonta heterodon	Dwarf Wedgemussel	High	V. High	11	91%	90%	E,R
Alasmidonta varicosa	Brook Floater	High	V. High	14	86%	82%	—
Elliptio fisheriana	Northern Lance	High	V. High	5	60%	82%	—
Lampsilis cariosa	Yellow Lampmussel	High	V. High	12	83%	86%	—
Lasmigona subviridis	Green Floater	High	V. High	7	100%	78%	—
Leptodea ochracea	Tidewater Mucket	High	V. High	11	91%	79%	—
Ligumia nasuta	Eastern Pondmussel	High	V. High	11	91%	84%	—

Alasmidonta undulata	Triangle Floater	High	High	14	57%	82%	—
Anodonta implicata	Alewife Floater	High	High	13	46%	95%	—
Lampsilis radiata	Eastern Lampmussel	High	Mod.	14	57%	76%	—
Epioblasma torulosa gubernaculum	Green Blossom	High	Limited	1	100%	0%	E
Pleurobema collina	James Spinymussel	High	Limited	2	100%	89%	E
Villosa perpurpurea	Purple Bean	High	Limited	1	100%	83%	E
Alasmidonta marginata	Elktoe	Low	V. High	6	67%	85%	—
Ligumia recta	Black Sandshell	Low	V. High	6	83%	94%	—
Truncilla truncata	Deertoe	Low	V. High	4	100%	69%	—
Anodontoides ferussacianus	Cylindrical Papershell	Low	High	5	100%	73%	—
Lampsilis fasciola	Wavyrayed Lampmussel	Low	High	4	100%	94%	—
Lampsilis ovata	Pocketbook	Low	High	6	100%	94%	—
Lasmigona compressa	Creek Heelsplitter	Low	High	5	80%	67%	—
Leptodea fragilis	Fragile Papershell	Low	High	6	100%	76%	—
Margaritifera margaritifera	Eastern Pearlshell	Low	High	9	67%	81%	—
Villosa iris	Rainbow	Low	High	4	100%	73%	—
RSGCN List-Other Federally Listed Invertebrate Taxa							
Nicrophorus americanus	American burying beetles	N/A	N/A	N/A	N/A	N/A	E
Lycaeides melissa samuelis	Karner blue butterfly	N/A	N/A	N/A	N/A	N/A	E
Neonympha mitchellii mitchellii	Mitchell's satyr butterfly	N/A	N/A	N/A	N/A	N/A	E
Microhexura montivaga	Spruce-fir moss spider	N/A	N/A	N/A	N/A	N/A	E
Succinea chittenangoensis	Chittenango ovate amber snail	N/A	N/A	N/A	N/A	N/A	T
Triodopsis platysayoides	Flat-spired three-toothed snail	N/A	N/A	N/A	N/A	N/A	T
Polygyriscus virginianus	Virginia fringed mountain snail	N/A	N/A	N/A	N/A	N/A	E
Stygobromus hayi	Hay's spring amphipod	N/A	N/A	N/A	N/A	N/A	E
Stygobromus kenki	Kenk's amphipod	N/A	N/A	N/A	N/A	N/A	C
Lirceus usdagalun	Lee County Cave Isopod	N/A	N/A	N/A	N/A	N/A	E
Antrolana lira	Madison Cave isopod	N/A	N/A	N/A	N/A	N/A	T

RSGCN Concern: Northeast conservation concern ranking. For Very High, High, Moderate, Low, >75%, >50%, >25%, and <25% of occupied states met criteria for conservation concern. Limited indicates 3 or fewer states occupied in the Northeast. **RSGCN Responsibility:** Northeast conservation responsibility ranking, where High indicates the region harbors >50% of species distribution, Low is <50%. **Expected States:** Northeast with species presence expected due to tracking or documentation by NatureServe, Natural Heritage member programs, or NALCC. Expected states may not agree with known species ranges due to gaps in data or tracking. **State Data Coverage:** Proportion of Northeast states represented by presence data compiled by NALCC from many sources. 100% coverage means data were acquired for all expected states. **Data QC %Confident:** Northeast states and NatureServe completed a data quality control survey for all RSGCN. %Confident is the proportion of survey responses, across all questions and respondents, where responses met data quality standards. **Federal Status:** C-Candidate; E-Listed endangered; ET-Listed endangered & listed threatened; EE-Listed endangered, nonessential experimental population; T-Listed threatened; TS-Listed threatened due to similar appearance; DL-Delisted; PDL-Proposed delisted; PE-Proposed endangered; SC-Species of concern; R-NALCC Representative Species.

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