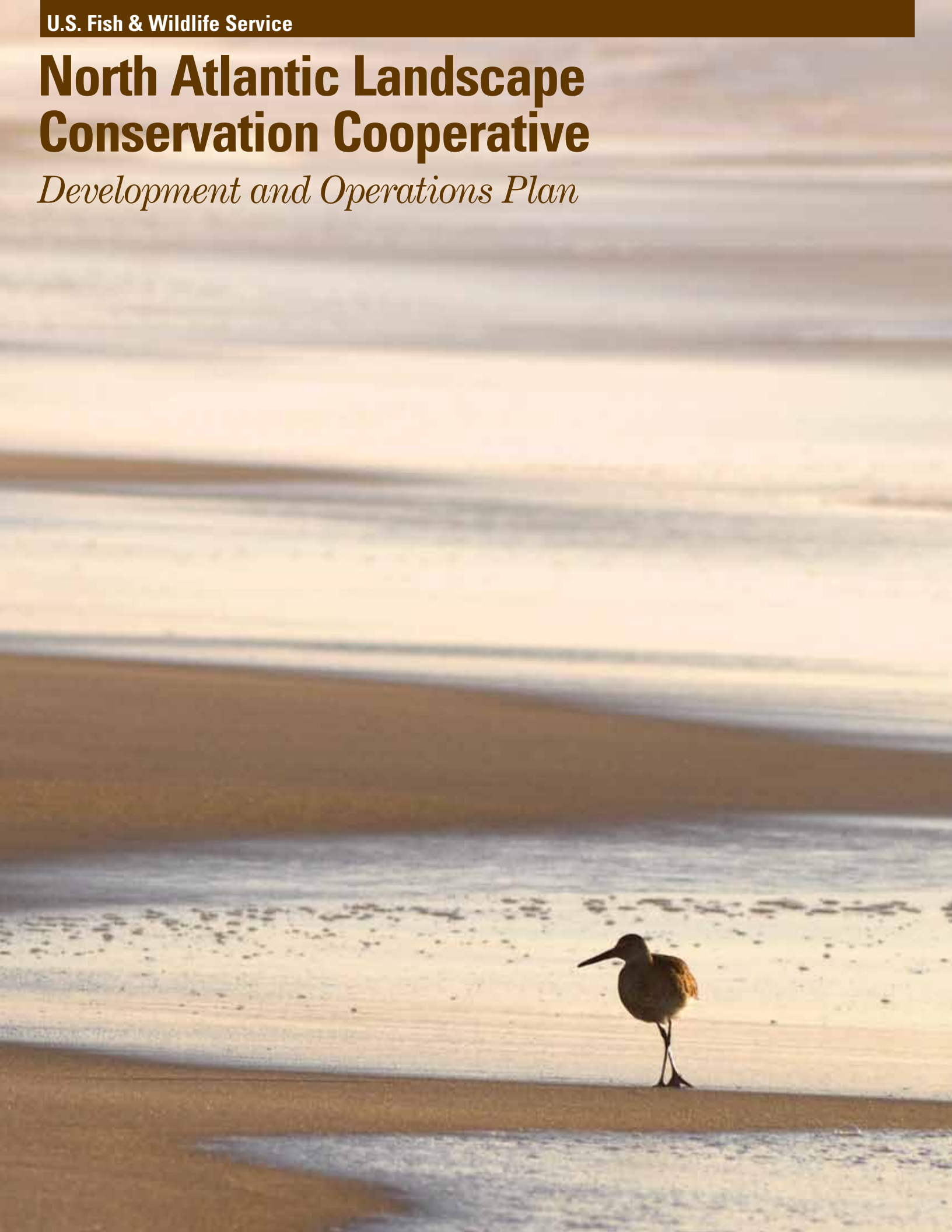


U.S. Fish & Wildlife Service

# North Atlantic Landscape Conservation Cooperative

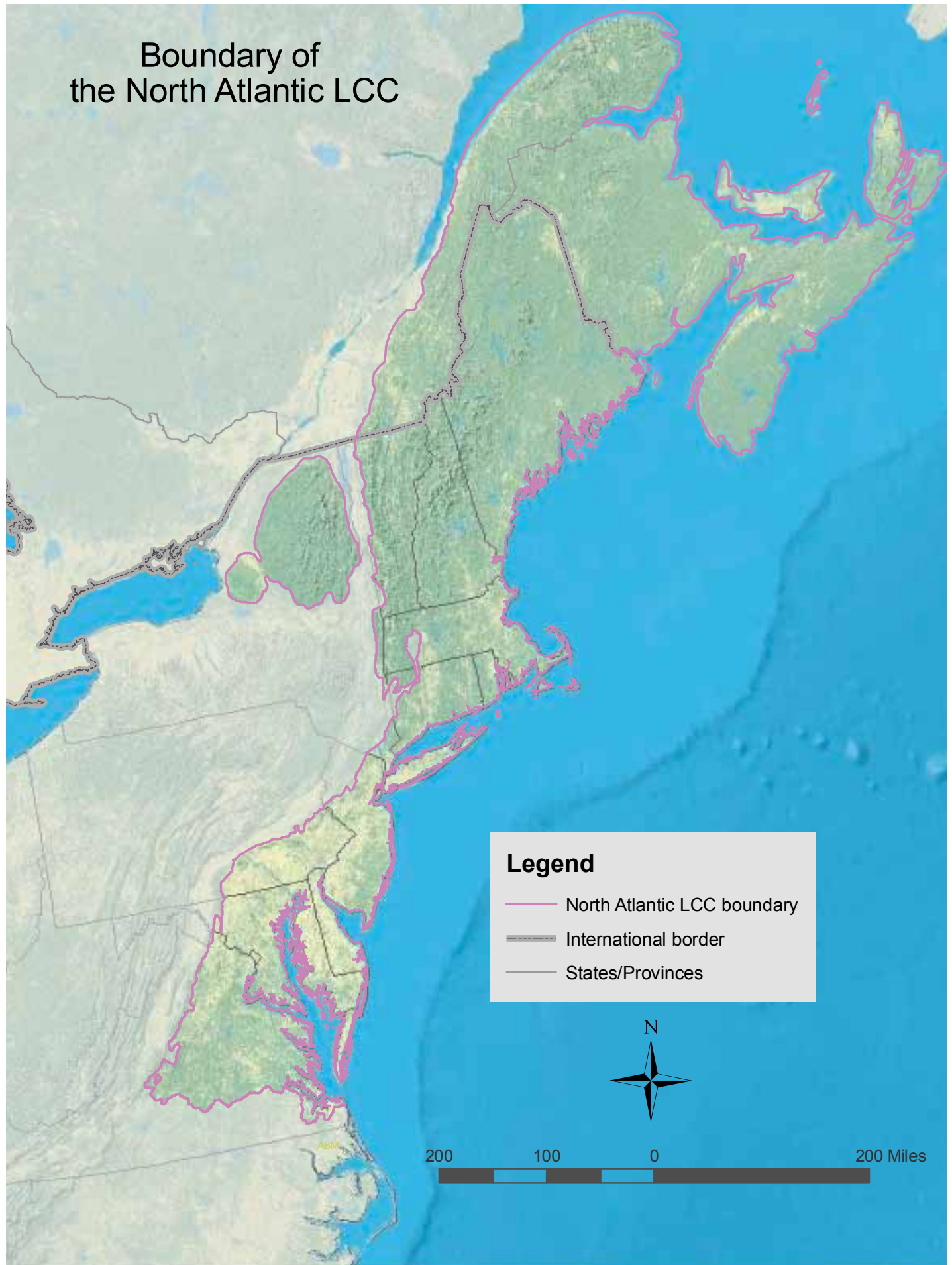
*Development and Operations Plan*



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# Boundary of the North Atlantic LCC



## Legend

- North Atlantic LCC boundary
- - - International border
- States/Provinces



200 100 0 200 Miles

## Introduction

Landscape conservation cooperatives (LCC) are envisioned as broad-based partnerships providing the science necessary to undertake strategic conservation efforts across large geographic areas, e.g., at landscape and regional scales. The Department of the Interior and U.S. Fish and Wildlife Service (USFWS) are developing a coordinated network of LCCs across the United States, in part to address major environmental and human-related factors that limit fish and wildlife populations at the broadest of scales, including developing adaptation strategies in response to climate change. The science provided by these partnerships will inform biological planning and conservation design, and help direct assumption-driven research and monitoring necessary to inform decisions about conservation delivery within an adaptive management framework.

The Northeast Region has elected to emphasize development of the North Atlantic LCC in 2010, while also supporting efforts to begin LCC development within the south Atlantic, Appalachian and Great Lakes geographic areas. The region is building upon strong partnerships to create the North Atlantic LCC, which, guided by the principles of strategic habitat conservation (SHC), will develop and communicate landscape-scale scientific information to shape conservation across the Eastern Seaboard south to Virginia. The North Atlantic LCC will be part of a network of LCCs initiated by USFWS in 2010 that covers the Atlantic and Gulf coasts of the United States, a geographic area that, when compared to other areas globally, is highly susceptible to impacts precipitated by climate change, including sea level rise and storm surge events.

The Northeast Region works cooperatively with Canada on the management and conservation of natural resource issues. The region will build upon and enhance the existing relationships with Canadian partners by integrating them fully into the North Atlantic LCC, ensuring cooperative conservation of natural resources important to both countries.

## Regional overview

The Northeast Region includes many political subdivisions –13 states, the District of Columbia and 17 federally recognized tribes – and shares a lengthy border with Canada (see title page figure). The region boasts enormous geographical and climatic diversity within a relatively small area, creating a great variety of habitat types and a similarly large diversity of living resources. Along with its wealth of natural resources, the region's complex environment is heavily influenced by human disturbances. While the 13 Northeast states comprise less than 7 percent of the U. S. landmass, almost 25 percent of the nation's population resides here. The Northeast's long history of agriculture, forestry, industrialization, resource extraction and urbanization has placed severe demands on the environment. In spite of more than 300 years of human settlement and consequent impacts on the native fauna and flora, the region is rich in living resources, although many are considerably lessened from their former levels of abundance and their habitats reduced in extent or markedly changed from pre-colonial conditions, making the protection of remaining habitats and populations critical to maintaining the region's biodiversity. Now climate change adds a growing threat to already imperiled habitats and species, with potentially vast environmental and economic consequences.



Art: Webster/USFWS

*Brigantine, New Jersey*

## *Risks and vulnerabilities in the Northeast Region*

### **A. Climate change**

The annual average temperature in the region has risen by 1.1°C (2°F) since 1970, and average winter temperatures have risen twice that amount. Other climate-related changes across the region include increased sea-surface temperatures, higher sea level, a longer growing season, more heavy precipitation events, reduced snowpack, earlier spring snowmelt and resulting earlier peak river flows, and earlier breakup of winter ice.

Continued warming and climate-related changes are expected. Over the next several decades, temperatures are projected to rise an additional 1.4 to 2.2°C (2.5 to 4°F) in winter and .8 to 1.9°C (1.5 to 3.5°F) in summer. Some anticipated conditions are:

- Relative sea level in this region is expected to rise more than the global average, with a rise of .6 to .9 meters (2 to 3 feet) likely along the mid-Atlantic coast, including Chesapeake Bay.
- The winter snow season is projected to be cut in half across northern New York and northern New England and be as short as 1 to 2 weeks in southern New England. Winters will see more precipitation, but less in the form of snow and more as rain.
- Short drought periods of 1 to 3 months are anticipated to occur as frequently as once per year in the mountains of New York and across New England.
- The summer season would last longer, being extended by as much as three weeks at both the beginning and end of the season. The number of days with extreme heat above 56°C (100°F) would increase significantly.

Climate change, in conjunction with other stressors, is exerting major influences on the habitats and biodiversity of the Northeast Region, and these influences are expected to grow with increased warming. Some examples are:

- Coastal and near-shore ecosystems will be vulnerable to numerous climate-change effects, including increasing air and water temperatures, changes in runoff, sea level rise and altered currents.
- Extensive shifts in the ranges and distributions of marine fish have been documented. Lobster populations are moving northward away from traditional Massachusetts and Rhode Island fishing grounds, and the cod fishery off Georges Bank is likely to be diminished as a result of thermal stress.
- Habitats of coldwater fish are contracting in response to warming. Climate change will likely exacerbate threats to populations of endangered Atlantic salmon. More than half of the wild trout populations are likely to disappear from the southern Appalachian Mountains because of the effects of rising stream temperatures.



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*Brook trout*

- Forest tree species are shifting their ranges northward and upslope, with the habitats of high-elevation mountain species contracting in response to warming. The distributions of mountain tree species in New England have shifted uphill by 107 meters (350 feet) in the last 40 years.
- The spring arrival in the Northeast of migratory birds wintering in the southern U.S. is now occurring an average of 13 days earlier than during the first half of the century.

### **B. Energy development**

Development of both carbon-based and renewable energy sources is on the rise in the Northeast Region, being driven by demand, energy prices and requirements for the use of renewable energy sources in most states. The activities associated with energy development pose risks to the region's fish and wildlife resources through direct impacts such as bird and bat collisions with wind turbines and barriers to fish migration from dams, as well as indirect impacts of habitat loss and fragmentation, such as from forest clearing for oil, gas and coal extraction. Development of the transmission infrastructure to deliver these new energy sources to consumers will also pose risks through additional habitat loss and barriers to movement and migration.

The Northeast Region is particularly well-suited to wind energy development, but its areas of high wind potential along the coast, including off-shore areas, and along mountain ridges are heavily used by migrating wildlife. Development of renewable energy must be planned carefully in order to avoid significant impacts to living resources.

### **C. Managing water resources**

Projected shifts in the Northeast Region in precipitation patterns due to climate change, continued urban and suburban growth, and other land use changes are likely to result in water management issues in the region in the coming decades. The Great Lakes, major river systems and tidal wetlands are anticipated to be heavily impacted by climate change. Precipitation is predicted to be heavier but more intermittent, which not only poses risks associated with increased peak flows in rivers and streams but also longer periods of limited flow.

A better understanding of the region's water resource quantity and quality requirements is needed in order to manage our fish and wildlife resources appropriately under future conditions.

#### **D. Forest management practices**

Significant forest resources occur in the Northeast Region, but mostly under private ownership. How these forest resources are managed for timber production and other asset values greatly impacts the quantity and quality of habitat for the forest-associated fish and wildlife resources in the region. Issues related to length of harvest rotation, harvest methods, tree species composition and financial goals of owners all play a role in determining both site-specific characteristics of stand age, structure and species composition, as well as landscape-scale characteristics such as patch size, connectivity and dispersion of different categories of forest type and age. All these characteristics influence the individual fish and wildlife species that will benefit from or be negatively impacted by forest management practices and the ability of these forests to sequester carbon. An important role that LCCs can fill will be characterizing the habitat needs of fish and wildlife resources and assessing the future habitat capacity in the region based on likely ecological and economic changes.



Kent Nickel/USFWS

*Canada warbler*

#### **E. Invasive species and emerging diseases**

Climate change will exacerbate expansion of invasive species' ranges and emergence of new diseases, with either direct consequences to fish and wildlife resources and their habitats, or through complex interactions resulting from multiple stressors. Climate-induced stress and crowding will occur as suitable habitats either shrink or migrate, and could reduce species' resistance to diseases and their ability to compete with invasive species. In addition, climate change will allow vector species and pathogens to expand from areas where they are currently limited by weather patterns such as low winter temperatures, mean high temperatures or changes in precipitation. This is of particular concern for species at risk because of their vulnerability to habitat loss and other limiting factors, which can negatively affect recovery efforts. The socio-economic concerns regarding wildlife

diseases and invasive species are also quite large, having negative impacts to agriculture, human health and outdoor recreation such as hunting and fishing. This, in turn, may have serious implications for state fish and wildlife agencies that are funded largely by equipment excise taxes and hunting and fishing license revenues. Disease vector species such as mosquitoes, ticks and snails can respond to small changes in climate, and can cause additional concerns regarding impacts to priority species and human populations. As temperatures warm and conditions become more humid, such disease vectors are likely to expand northward and pose additional threats to human health and fish and wildlife resources.

### **I. The North Atlantic Landscape Conservation Cooperative**

#### *Description of the planning area*

The Northeast Region has selected the north Atlantic geographic area for focused landscape conservation cooperative development in 2010, with recognition that all of the LCCs occurring in the region have significant resource issues that will also require attention.

The geographic area covered by the North Atlantic LCC extends from southeastern Virginia north along the mid-Atlantic coast through New England to Nova Scotia and the Gaspé Peninsula of Quebec. The boundaries for this LCC also include the northern Piedmont ecoregion immediately west of the mid-Atlantic coastal plain, as well as the Adirondack Mountains in New York. This LCC covers 50.5 million hectares (125 million acres); two-thirds is classified as forest, almost 15 percent as agricultural use, 5 percent as developed for urban and suburban residential and industrial uses, and 2 percent as emergent marsh. A stark contrast occurs in this LCC between the highly urban and suburban dominated landscapes of the coastal region, which support nearly one-quarter of the total U.S. population and includes large urban centers such as Washington, D.C., Philadelphia, New York City and Boston, and the very rural and heavily forested inland portions of the area. Coastal zone habitats are among those most likely to be heavily impacted by sea level rise due to climate change, and with the level of human development along the coast of the North Atlantic LCC, these coastal habitats are threatened to be trapped between rising water levels and human infrastructure.

The North Atlantic LCC area encompasses a wide diversity of coastal and inland ecosystems and habitat types, including large bays and estuary systems, beaches, coastal islands, salt marshes, major river systems such as the Connecticut, Hudson, and Delaware rivers, pine barrens, forested wetlands, extensive northern hardwood and conifer forests, and high elevation spruce-fir forests. These diverse ecosystems and habitat types support an



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*Gannet*

equally diverse set of fish and wildlife resources, including federally listed and candidate species such as Atlantic salmon, piping plover, red knot, Canada lynx, dwarf wedgemussel, Karner blue butterfly and New England cottontail, as well as other priority species of migratory birds, anadromous fish and species of greatest conservation need as identified in state wildlife action plans. Many of these natural resources are vulnerable to urbanization, energy development and forest management practices, which are not exclusive to the North Atlantic LCC and should be addressed within a conservation network in collaboration with the neighboring South Atlantic, Appalachian Mountain and Great Lakes LCCs.

Subunits of this LCC have not yet been designated for special emphasis. A natural physiographic division exists at Long Island and New York Harbor between the mid-Atlantic portion of the area to the south and the New England and northern Atlantic portion to the north. Active conservation partnerships already exist around major watersheds, such as Chesapeake Bay, Delaware Bay, Hudson River/New York Bight, Connecticut River/Long Island Sound and Gulf of Maine.

## II. Working with Partners in the North Atlantic LCC

In the North Atlantic LCC area, four powerful partnerships serve as the starting point for the North Atlantic LCC: the Atlantic Coast Joint Venture, the Eastern Brook Trout Joint Venture, the Atlantic Coastal Fish Habitat Partnership, and the Regional Conservation Needs Program. Partners participating in a November 20, 2009, LCC scoping session strongly supported building upon the template of these partnerships because their geographic scope promotes regional-scale conservation, and the funding that the partners bring to the table facilitates coordinated delivery and leverages additional funding.

This LCC will also benefit from the strong relationships and long history of cooperative work on regional conservation issues among the 13 states, District of Columbia and non-governmental partners

in the Northeast. Links with Canadian partners have been established through bird conservation planning in the Atlantic northern forest and for coastal and marine issues in the Gulf of Maine, and will continue to be developed given the recognized importance of securing avenues for northward migration of habitats and wildlife distributions under climate change scenarios.

Recent and ongoing activities will facilitate the development of the North Atlantic LCC. The Northeast Region has been working with partners, including state directors from Massachusetts, New York and Virginia, and the National Wildlife Federation, The Nature Conservancy and the Manomet Center for Conservation Sciences to cooperatively develop regional adaptation plans in response to climate change. Actions currently being implemented include:

- Establishing a Northeast Association of Fish and Wildlife Agencies climate change working group;
- Conducting vulnerability assessments, such as standardized data collection, that support state, federal and partner needs while also supporting regional planning efforts;
- Coordinating communications for consistent messages about climate change adaptation in the Northeast;
- Discussing how LCCs could provide science support and serve as a cornerstone for developing a regional climate change adaptation strategy and plan.

In June 2008, the region hosted a climate change workshop that focused on New England. The multiagency steering committee that planned the workshop included USFWS, states, National Park Service, U.S Geological Survey, Minerals Management Service, U.S. Forest Service and National Oceanic and Atmospheric Administration. The Northeast Region is planning another climate change workshop for the mid-Atlantic sub-region in March 2010, and the U.S. Environmental Protection Agency has joined the steering committee.

New England federal partners held an interagency meeting on climate change in the Northeast in June 2009 to start a dialogue among the federal agencies with climate-related responsibilities focused on how they could enhance cooperation and collaboration to address vulnerabilities and adaptation issues associated with climate change.

The region has engaged in meetings with the states of Maine, New York and Vermont, the Northeast Regional Ocean Council, Northeast States for Coordinated Air Use Management, Audubon Society and the Wildlife Society, emphasizing cooperative work on regional adaptation strategies and implementation actions and promoting LCCs as a mechanism for coordinating good biological planning, conservation design, coordinated implementation of on-the-ground actions, appropriate monitoring, and identifying and funding

key research needs to meet landscape conservation goals for habitats and species most vulnerable to climate change.

The “Report of the Blue Ribbon Commission on Land Conservation, A Lasting Legacy” was ordered and accepted in September 2009 by the New England Governors Conference. The plan calls for five regional collaborative goals across New England:

- keep forests as forests,
- keep farmlands in farming,
- connect people to the outdoors,
- protect wildlife habitat, and
- safeguard coastal and estuarine lands.



The region has ongoing relationships with many partners, and expects to expand the roles of these partners while engaging new partners in forming the North Atlantic LCC. To begin the process of creating the North Atlantic LCC, on November 20, 2009, the northeast regional director, deputy regional director and regional scientist met with key partners. Meeting participants included representatives from the state natural resource agencies of Maine, Massachusetts, Pennsylvania and Virginia; the federal Department of the Interior agencies U.S. Geological Survey (USGS), National Park Service, Office of Surface Mining, Minerals Management Service and Bureau of Indian Affairs; the Narragansett Native American Tribe; and the non-governmental organizations Manomet Center for Conservation Sciences, National Fish and Wildlife Foundation, National Wildlife Federation, Trust for Public Land and The Nature Conservancy. The number of participants was limited to maximize the likelihood of making significant progress during the one-day meeting; subsequent meetings will involve additional partners such as the Department of Agriculture, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, and Department of Defense. Partner perspectives gained at the November 20 meeting have been included in developing this plan.

The region expects to rely heavily on existing partnerships to inform and help implement conservation science developed by the North

Atlantic LCC. The joint ventures and fish habitat partnerships are at a similar scale as the LCCs, and the partners who met on November 20 recommended that these partnerships serve as models for an LCC. The multi-state Resource Conservation Needs Program is a regional approach to wildlife conservation by the Northeast fish and wildlife state directors who are pooling the individual state wildlife grant funds and applying them to regional conservation needs. The Northeast Regional Ocean Council and Mid-Atlantic Regional Council on the Oceans are partnerships among states from Maine to Virginia and federal agencies with marine responsibilities. In addition, geographic partnerships, which can implement conservation science targeted for their specific areas, are well-dispersed across the LCC area and include the Merrimack River Anadromous Fish Restoration Program, Connecticut River Anadromous Fish Restoration Program, Susquehanna River Basin Commission, Susquehanna River Anadromous Fish Restoration Program, Delaware River Basin Commission, Delaware Fish and Wildlife Management Cooperative, partnerships in the St. Lawrence and Gulf of Maine watersheds, and the EPA National Estuary Programs – Casco Bay, Piscataqua Region, Massachusetts Bay, Buzzards Bay, Narragansett Bay, Long Island Sound, Peconic Bay, New York/New Jersey Harbor, Barnegat Bay, Delaware Estuary, Delaware Inland Bays, and Maryland Coastal Bays. A key emerging geographic partnership is a result of the Chesapeake Bay Executive Order. Joint ventures, fish habitat partnerships, the NiSource Habitat Conservation Plan and the Chesapeake Bay Executive Order are described in more detail below.

### **Partnerships**

#### Northeastern States

States are primary partners in the development and operations of the North Atlantic LCC. State natural resource programs will be important users of conservation science provided by the LCC. The states of Maine, Massachusetts, Pennsylvania and Virginia were represented at the November 20, 2009, scoping meeting. The Northeast Association of Fish and Wildlife Agencies (NEAFWA) is composed of 21 Northeastern states and Canadian provincial fish and wildlife agencies, including all of the states of the North Atlantic LCC. The theme of the NEAFWA-sponsored Northeast Fish and Wildlife Conference taking place in April 2010, is *Climate Change and Wildlife Conservation - Adaptation and Mitigation*, with the objective of advancing the understanding of global climate change impacts to Northeast ecosystems to develop adaptation strategies for fisheries and wildlife conservation and respond to the challenges and opportunities offered by mitigation measures. Plans to form a NEAFWA climate change working group are in progress.

#### Atlantic Coast Joint Venture

The Atlantic Coast Joint Venture (ACJV) is a partnership of federal, regional and state agencies and organizations focused on planning, delivering



and evaluating habitat conservation for native bird species in the Atlantic Flyway region of the U.S. from Maine south to Puerto Rico, including all of the states in the North Atlantic, South Atlantic and Peninsular Florida LCCs as well as parts of the Great Lakes and Caribbean LCCs. The joint venture was originally formed in 1988 as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan and has since broadened its focus to the conservation of habitats for all birds consistent with major national and continental bird conservation plans. The joint venture also seeks out and collaborates in broader strategic habitat conservation approaches for all fish and wildlife species within its area when those collaborations advance its vision and mission. The ACJV has conserved over five million acres since its inception in 1988 and has completed or initiated a number of biological planning, conservation design, monitoring and research projects to guide and evaluate these conservation actions. ACJV partners and staff are willing to play a lead role in helping to establish LCCs in the North Atlantic, South Atlantic, South Florida and the Caribbean by building on existing ACJV projects and partnerships, including a number of science projects that can serve as initial priorities for the LCC. The ACJV Management Board met with USFWS leadership from Regions 4 and 5 in early December and affirmed its interest in helping to lead establishment of LCCs, provide consistency among the LCCs in its boundary, and incorporate and build upon existing ACJV science projects and needs.

The Northeast Region has also conferred with the Sea Duck Joint Venture and the Black Duck Joint Venture during their annual meetings, which were held in November 2009. Both species joint ventures are international partnerships formed under the North American Waterfowl Management Plan, and are equally represented by members from both the U.S. and Canada, including federal, state, provincial and non-governmental organizations.

*Northeast Coordinated Bird Monitoring Partnership*

This partnership promotes coordination among state, federal, non-governmental organizations and university biologists on the development,



*Common eider female on nest*

improvement and implementation of bird monitoring programs across the Northeast Region. It seeks opportunities to coordinate between biologists and biometricians, across management and political units, and among programs that target different avian taxa. The partnership works to provide support to the 13 states of the Northeast Region and the District of Columbia to fulfill the bird monitoring component of their wildlife action plans. It is implementing a coordinated bird monitoring framework for the region, including monitoring programs for species that are not well covered by any current program, and particularly those with restricted distributions, declining trends and known threats. The partnership is also developing a coordinated system for archiving and accessing bird monitoring data.

*Eastern Brook Trout Joint Venture*

The Eastern Brook Trout Joint Venture (EBTJV) was established in 2005 out of concern for the health of the many populations of the only native eastern trout species. Recognizing that many common threats exist across the trout's Georgia to Maine range, state fishery managers joined together with federal agency representatives, private conservation groups and scientists to assess the problem and plan action. The joint venture has developed a range-wide assessment of eastern brook trout, which has positioned it to do many scientific studies, including climate change assessments such as a direct monitoring approach across the EBTJV range to rank individual populations for resiliency to climate change. This monitoring approach is being piloted in Virginia, where climate change is predicted to eliminate brook trout from the state. The resulting resiliency ratings can be used for prioritizing protection and restoration efforts in landscape-scale conservation planning.

*Atlantic Coastal Fish Habitat Partnership*

The Atlantic Coastal Fish Habitat Partnership (ACFHP), approved in October 2009, is a collaborative effort catalyzed by the Atlantic States Marine Fisheries Commission to involve agencies from the 16 states that contain Atlantic coastal river drainages, plus federal agencies, tribes, local governments, non-governmental organizations and other entities, to conserve aquatic habitat along the Atlantic coast. The mission of the ACFHP is to accelerate the conservation, protection, restoration and enhancement of habitat for native Atlantic coastal, estuarine- dependent and diadromous fishes. On a watershed, ecosystem or regional scale, the ACFHP will focus on ecological connectivity, water quality and quantity, and habitat alterations and modifications such as the effects of land use, improvements to fish passage, advances in sediment management and aquatic and riparian habitat restoration and protection. The ACFHP is also developing a species-habitat matrix for evaluating the relative importance of a specific habitat type to a given life history stage for an individual species, which will provide important information for landscape-scale conservation planning.

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### Regional Conservation Needs Program

In recognition that natural resources can be most effectively conserved on a regional scale, the Northeast Association of Fish and Wildlife Agencies has been a strong partner in developing regional conservation efforts involving the 13 states in the Northeast and the District of Columbia, federal agencies and non-governmental partners. The Regional Conservation Needs Program was created in 2007 in a collaborative process that involved the Northeast Association of Fish and Wildlife Agencies, the Wildlife Management Institute and the USFWS Division of Wildlife and Sport Fish Restoration to address common issues, such as rare species, hard-to-count species and habitats that cross state boundaries. Much of the needed work requires tools and techniques that are too costly to be developed by a single state. The mechanism to share expertise and funding, as now exists with the program, greatly enhances collaborative opportunities and likelihood of success, resulting in more effective conservation of species and habitats.

### NiSource Habitat Conservation Plan

A 50-year habitat conservation plan (HCP) between the USFWS and NiSource, one of the largest natural gas companies in North America, will cover approximately 43 federally listed and candidate species. The planning area for this HCP includes roughly 24,140 kilometers (15,000 miles) of NiSource right-of-way and ancillary facilities and spans 14 eastern and central states, and the HCP includes approximately 3,642,171 hectares (9 million acres) of land and captures roughly 95 percent of future NiSource operation, maintenance and new construction projects. NiSource and the USFWS are also partnering with the Conservation Fund and The Nature Conservancy in developing a strategic conservation planning tool to guide the HCP mitigation program, and have developed a species conservation fund to receive monies from NiSource to finance mitigation necessary as compensation for the impacts of their HCP. The Federal Energy Regulatory Commission, U.S. Army Corps of Engineers, National Park Service and U.S. Forest Service serve as formal cooperating agencies on this HCP.

### Chesapeake Bay Executive Order

The Chesapeake Bay Protection and Restoration Executive Order established a federal leadership committee comprising the U.S. Environmental Protection Agency and the departments of Agriculture, Commerce, Defense, Homeland Security, Interior, Transportation and others. The committee released a draft strategy for Chesapeake Bay in November 2009, which contains a comprehensive package of federal initiatives to restore clean water, conserve treasured places, protect fish and wildlife, and adapt to the impacts of climate change. The draft strategy calls for the National Oceanic and Atmospheric Administration and U.S.G.S. to work closely with federal and state partners to coordinate existing state programs and regional climate programs to provide science and



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*Hail Cove in Maryland*

potential impacts of climate change on Chesapeake Bay and its watershed. The Department of the Interior will develop a Chesapeake Treasured Landscapes Initiative to support state and local efforts to conserve and restore the environmental, historic, cultural and recreational value of many of the region's wetlands, river corridors and open spaces. The department will look for opportunities to expand or create new units of the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System and National Historic Trails System.

### **Federal Department of the Interior Agencies**

In developing the North Atlantic LCC, the region expects to continue partnerships with sister Department of the Interior agencies, U.S.G.S. and National Park Service, and to develop stronger ties with Minerals Management Service, Office of Surface Mining, Bureau of Land Management and Bureau of Indian Affairs. USGS, National Park Service, Minerals Management Service, Office of Surface Mining and Bureau of Indian Affairs were represented at the November 20, 2009, North Atlantic LCC scoping meeting.

### U.S. Geological Survey

USGS has been a valued partner in strategic habitat conservation, and the region will work closely with this Department of the Interior partner in developing the North Atlantic LCC. One of the primary vehicles for working on landscape conservation issues will be through the new USGS National Climate Change and Wildlife Science Center, which will serve as a conduit between science and management by providing climate science information to federal, state, academic and non-governmental partners to support improved management of fish, wildlife and other natural resources affected by climate change. USGS expects to establish a Northeastern Regional Climate Impact Response Center to implement at the regional scale:

- downscaling global climate models;
- linking physical climate models with ecological and biological responses;
- forecasting population responses at temporal and spatial scales useful for resource management and policy development;
- establishing partnerships to link results

of adaptive management with policy and management planning.

The USGS Northeast Region, which has the same footprint as USFWS Region 5, is working with USFWS, Minerals Management Service and National Park Service on a multi-bureau leadership team to explore ways to better link USGS science and science projects to the needs for strategic habitat conservation. This effort provides:

- greater access to long-term data collection related to water availability and climate change;
- current research on coastal vulnerability and projections for sea level rise impacts to coastal processes;
- state-by-state benchmarks for phenology and extreme storm impacts, landscape-level analyses of geologic, biologic and hydrologic conditions;
- coordination of on-the-ground actions.

Through USGS's cooperative programs, there are strong connections with universities in the region and access to graduate education, technical support, in-kind support and university faculty.

#### National Park Service

The National Park Service's inventory and monitoring networks, cooperative ecosystem studies units, and experience and expertise in education and outreach will be important contributions to the work of the North Atlantic LCC. A primary role of the Inventory and Monitoring Program is to collect, organize and make available natural resource data and contribute to institutional knowledge by facilitating the transformation of data into information through analysis, synthesis and modeling. There are four National Park Service inventory and monitoring networks in the Northeast Region: the Northeast Temperate, Northeast Coastal and Barrier, Eastern Rivers and Mountains, and Mid-Atlantic.

The National Park Service has established a network of cooperative ecosystem studies units, which are collaborative research partnerships primarily among federal agencies and universities encompassing natural and cultural resources, and which provide a structure for quickly identifying research needs, obtaining technology and assistance from academic partners, and quickly funding projects. Two are included in the North Atlantic LCC area – the North Atlantic Coast Cooperative Ecosystem Unit and the Chesapeake Watershed Cooperative Ecosystem Unit.

#### Minerals Management Service

The Minerals Management Service's mission includes oversight of offshore energy development, and connects to the work of the North Atlantic LCC as it relates to migratory bird conservation and offshore wind energy development. Through a research program that funds studies to provide science in support of management decisions, the Minerals Management Service is currently funding a number of studies related to the distribution of

seabirds and the potential for the interaction of birds with offshore wind turbines. Should this theme become a focal point for the LCC, the Minerals Management Service is interested in partnering with stakeholders by participating in planning meetings and potentially providing funding for the collection of relevant environmental information. The Minerals Management Service is currently beginning the process of developing standardized protocols for monitoring the offshore environment for birds, and plans on working closely with USFWS in this effort.

#### Office of Surface Mining

The Office of Surface Mining has spent 4 to 5 years looking at bio-sequestration and reforestation. The upcoming focus of its applied science program will be mitigation, which incorporates climate change. Science needs identified by the LCC can be included in that program, which is implemented through requests for proposals.

#### Bureau of Land Management

The Bureau of Land Management plays a central role in fostering the management and conservation of public lands and resources, which span millions of acres of surface lands and subsurface federal mineral estate east of the Mississippi River. This subsurface acreage is extremely important for energy and mineral resources development. The surface acreage, while limited in the area of the North Atlantic LCC, is important for natural resource and recreation values in populated areas. The Bureau of Land Management was unable to participate in the November 20 meeting, but intends to be involved in the North Atlantic LCC.

#### Bureau of Indian Affairs

The Bureau of Indian Affairs is particularly interested in assisting with identification of cultural resources needing protection from climate change impacts.

### **Federal Department of Agriculture (USDA) Agencies**

#### Farm Bill programs

USDA Farm Bill conservation programs are important partners for conservation and climate change adaptation on private lands. Farm Bill conservation programs emphasize maintaining and restoring riparian buffers, removing or modifying dams and culverts, and protecting and restoring wetlands. Farm Bill program implementation frequently occurs in conjunction with the Partners for Fish and Wildlife Program (Section IV).

State conservationists for the six New England states, the USFWS Northeast Region regional directorate, and selected staff from both agencies convened in July 2009 to seek a common understanding and vocabulary of landscape-level conservation programs of the USFWS and USDA, especially for riparian, riverine and estuarine habitat. A New England Farm Bill Working Group was created to propose specific short- and long-term actions to help achieve shared priorities for fisheries

and aquatic resources in New England. This group is well-placed to help identify strategies to target Farm Bill programs for conservation delivery in the context of the North Atlantic LCC. A similar meeting will be held with state conservationists from mid-Atlantic states in 2010.

USDA is a partner in Chesapeake Bay Executive Order implementation and is facilitating Farm Bill implementation through availability of additional funding and streamlining Farm Bill applications in the Chesapeake Bay watershed.

Natural Resource Conservation Service (NRCS)  
The NRCS National Resources Inventory (NRI) is a statistical survey of land use and natural resource conditions and trends on non-federal lands. The NRI provides the scientific framework for the national assessment component of CEAP – the Conservation Effects Assessment Project – an interagency effort to quantify the natural resource benefits delivered through conservation actions on private land. There are two main components—a national assessment and watershed assessments. The national assessment conducts analyses of cropland, wetlands, wildlife and grazing lands. The watershed assessments provide long-term, coordinated research in specific watersheds across a variety of hydrologic and agronomic settings.

NRCS is focusing climate change efforts in several areas: quantifying the effects of conservation practices on greenhouse gas emissions and carbon sequestration; refining incentives in conservation programs to address the effects of climate change on agriculture; developing and encouraging the use of conservation practices and systems that reduce greenhouse gas emissions; and enhancing opportunities to increase farm profitability on the emerging voluntary emissions trading markets.

U.S. Forest Service  
The U.S. Forest Service manages national forests, provides technical assistance for state and private forest management, and conducts forest-related research and development. Within the North Atlantic LCC area, national forests are located in Maine, New Hampshire and Vermont. The Forest Service has developed a strategic framework for responding to climate change, which includes science, adaptation, mitigation, policy, sustainable operations, education and alliances. It has developed a global change research strategy, with the goal of increasing understanding of forest, woodland and grassland ecosystems to manage them in a way that sustains and provides ecosystem services for future generations. These will be key nexuses for the North Atlantic LCC.

A key Forest Service partner will be the the Eastern Forest Environmental Threat Assessment Center; an interdisciplinary resource that is actively developing new technology and tools to anticipate and respond to emerging forest threats, including climate change.

### **Native American Tribes**

The Narragansett Tribe was represented at the November 20 meeting; we plan to engage other Northeast tribes to coordinate with tribal resource management plans. The Northeast Region will engage United South and Eastern Tribes Inc. (USET), a non-profit, intertribal organization that represents 25 member tribes from Maine to Texas. Tribal leaders from USET member tribes meet annually in Washington, D.C., where they discuss significant policy issues. At the 2010 meeting in Washington, the Service will work with USET's Natural Resources Committee to discuss LCCs, and to ask USET to pass a resolution of support for LCCs and partnership with USET member tribes.

### **Non-governmental Organizations**

The Manomet Center for Conservation Sciences, the National Wildlife Federation, The Nature Conservancy and the Trust for Public Land participated in the November 20 meeting; all have resources to contribute to the development and function of the North Atlantic LCC. The region will engage other non-governmental organizations in the coming months.

#### Manomet Center for Conservation Sciences

The Manomet Center for Conservation Sciences climate change initiative focuses on adaptation and mitigation strategies for human communities and wildlife habitats, including work on sequestration, bio-mass, species conservation and habitat. Manomet and the National Wildlife Federation have collaboratively garnered significant funding for work on climate change adaptation in the Northeast, allowing them to bring considerable resources to the LCC effort.

#### National Wildlife Federation

In addition to the above-mentioned funding for work on climate change adaptation, the National Wildlife Federation expertise will help develop the knowledge base for how to solidify the LCC partnership by creating trust and breaking down barriers. National Wildlife Federation has considerable resources for education and outreach, and connects with a large network of members through its communication and network shops. It can also utilize its structure with state-based affiliates throughout the North Atlantic LCC to connect quickly on the local level.

#### The Nature Conservancy

The Nature Conservancy has developed extensive spatial data for the Northeast Region, which are being used to assess freshwater resiliency and freshwater connectivity. Consistent aquatic classification and mapping are complete. Consistent terrestrial habitat classification is complete, and consistent habitat mapping using this classification is expected to be completed during fiscal year 2010. An annually updated secured lands spatial database has been developed and is available to partners. Projects being planned include a geophysical condition analysis using this classification and a geophysical and resilient system approach to climate change adaptation.

### Trust for Public Land

The Trust for Public Land has three climate conservation initiatives: conservation of natural landscapes, conservation of lands that will help human and natural communities adapt to a changing climate, and creation of parks and open spaces for compact development. The Trust for Public Land plans to contribute funding and resources to create partnerships, develop policy, translate science into functional plans, and design and implement projects.

### **III. Highest Priority Species and Habitats within the North Atlantic Landscape Conservation Cooperative**

For this version of the North Atlantic LCC plan, priority species and habitats are based on existing information, plans and setting of priorities that have already taken place within this LCC area. The LCC partnership has not fully participated in developing specific priorities for this initial drafting of the North Atlantic LCC plan. However, the priorities described here reflect those that have been developed through various conservation partnership initiatives within the North Atlantic LCC area.

These existing priorities have been summarized for the Northeast Region by the region's SHC/Climate Change Team based on prioritizations completed by bird conservation region and joint venture initiatives, fish habitat partnerships, and the endangered species program. The migratory bird and fish species listed here occur within the North Atlantic LCC boundaries and were identified as highest priority for the Northeast Region by the SHC/Climate Change Team. This list of highest priority species also includes all the federally listed or candidate species within the North Atlantic LCC. This list provides an initial starting point for considering priority species in the North Atlantic LCC and will be further refined in conjunction with partners. In addition, USFWS is undertaking a project with partners to identify representative species for the major habitat types within the

Northeast Region to provide a set of species upon which to focus biological planning and conservation design work, with the assumption that conservation actions implemented for these species will benefit associated priority species within a given habitat type. In the following list, species are presented by common name with scientific name in parentheses. Endangered species are underlined and in bold, threatened species are in bold, and candidate species are underlined. Species with a \* after their common name are thought to be extirpated from the region.

#### Highest Priority Species for the North Atlantic LCC:

Alewife (*Alosa pseudoharengus*)  
American black duck (*Anas rubripes*)  
**American burying beetle (*Nicrophorus americanus*)**  
**American chaffseed (*Schwalbea americana*)**  
American oystercatcher (*Haematopus palliatus*)  
American shad (*Alosa sapidissima*)  
American woodcock (*Scolopax minor*)  
Atlantic brant (*Branta bernicla*)  
**Atlantic salmon (*Salmo salar*)**  
Barrows goldeneye (*Bucephala islandica*)  
Bay-breasted warbler (*Dendroica castanea*)  
Bicknell's thrush (*Catharus bicknelli*)  
Black rail (*Laterallus jamaicensis*)  
Blue-winged warbler (*Vermivora pinus*)  
**Bog asphodel (*Narthecium americanum*)**  
**Bog turtle (*Clemmys muhlenbergii*)**  
Brook trout (*Salvelinus fontinalis*)  
Brown-headed nuthatch (*Sitta pusilla*)  
Canada goose, Atlantic Population (*Branta canadensis*)  
**Canada lynx (*Lynx canadensis*)**  
Canada warbler (*Wilsonia canadensis*)  
**Canby's dropwort (*Oxyopolis canbyi*)**  
Common eider (*Somateria mollissima*)  
**Delmarva fox squirrel (*Sciurus niger cinereus*)**  
**Dwarf wedgemussel (*Alasmidonta heterodon*)**  
**Eastern cougar\* (*Felis concolor cougar*)**  
**Eastern prairie fringed orchid (*Platanthera leucophaea*)**  
**Furbish's lousewort (*Pedicularis furbishiae*)**



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**Gray wolf \* (*Canis lupus*)**  
 Great cormorant (*Phalacrocorax carbo*)  
 Greater shearwater (*Puffinus gravis*)  
 Gull-billed tern (*Gelochelidon nilotica*)  
 Harlequin duck (*Histrionicus histrionicus*)  
**Harperella (*Ptilimnium nodosum*)**  
**Hays spring amphipod (*Stygobromus hayi*)**  
 Hirst's panic-grass (*Dichantheium* (= *Panicum*)  
*hirstii*)  
 Horseshoe crab (*Limulus polyphemus*)  
**Indiana bat (*Myotis sodalist*)**  
 Ipswich savannah sparrow (*Passerculus*  
*sandwichensis*)  
**James spinymussel (*Pleurobema collina*)**  
**Jesup's milk-vetch (*Astragalus robbinsii* var.  
*jesupi*)**  
**Karner blue butterfly (*Lycaeides melissa*  
*samuelsis*)**  
 Knieskern's beaked-rush (*Rhynchospora*  
*knieskernii*)  
 Lake trout (*Salvelinus namaycush*)  
**Maryland squirrel (*Etheostoma sellare*)**  
 Nelson's sparrow (*Ammodramus nelsoni*)  
**New England cottontail rabbit (*Sylvilagus*  
*transitionalis*)**  
 Northeastern beach tiger beetle (*Cicindela*  
*dorsalis dorsalis*)  
**Northeastern bulrush (*Scirpus ancistrochaetus*)**  
**Northern redbelly cooter (*Pseudemys*  
*rubriventris*)**  
 Piping plover (*Charadrius melodus*)  
 Prairie warbler (*Dendroica discolor*)  
**Puritan tiger beetle (*Cicindela puritana*)**  
 Purple sandpiper (*Calidris maritima*)  
 Red knot (*Calidris canutus*)  
 Red-necked phalarope (*Phalaropus lobatus*)  
 Red-throated loon (*Gavia stellata*)  
**Roseate tern (*Sterna dougallii dougallii*)**  
 Ruddy turnstone (*Arenaria interpres*)  
 Saltmarsh sharp-tailed sparrow (*Ammodramus*  
*caudacutus*)  
 Sanderling (*Calidris alba*)  
**Sandplain gerardia (*Agalinis acuta*)**  
**Seabeach amaranth (*Amaranthus pumilis*)**  
 Seaside sparrow (*Ammodramus maritimus*)  
 Semipalmated sandpiper (*Calidris pusilla*)  
**Sensitive joint-vetch (*Aeschynomene virginica*)**  
**Shortnose sturgeon (*Acipenser brevirostrum*)**  
**Small-whorled pogonia (*Isotria meleoloides*)**  
 Spiny dogfish (*Squalus acanthias*)  
 Striped bass (*Morone saxatilis*)  
 Summer flounder (*Paralichthys dentatus*)  
**Swamp pink (*Helonias bullata*)**  
 Whimbrel (*Numenius phaeopus*)  
 Wood thrush (*Hylocichla mustelina*)

With these highest priority species as an initial starting point for biological planning and conservation design within the North Atlantic LCC, the following habitat types are priorities because of their importance to supporting populations of these priority species.

### Coastal Ecosystems

The eastern edge of the North Atlantic Coast

LCC is the coastline that extends from southeast Virginia to the Gulf of St. Lawrence in Quebec. The full coastline, including all bays, inlets and islands is much more extensive – just the U.S. portion of the LCC coast encompasses roughly 12,875 kilometers (8,000 miles). The nature of the coastal ecosystems varies within the LCC area, most notably in differences between the Atlantic Coastal Plain Physiographic Province that extends south of Cape Cod and the New England Province of the Highlands Physiographic Region that extends north from Cape Cod into Atlantic Canada. The coastal plain is a seaward-sloping plain of marine sands, clays and gravels that is characterized by low topographic relief, broad peninsular tracts, large drowned river estuaries and a series of coastal terraces that extend back almost to the fall line, the boundary between the Piedmont Province and Atlantic Coastal Plain Province. Much of the coastal plain coastline is characterized by an extensive narrow strip of elongated barrier beaches typically separated from the mainland by backbarrier bays and marshes. North of Cape Cod, the coastline is dominated by rocky coastline, glaciated uplands, and narrower rivers and estuaries. Tidal ranges increase in the northern part of the North Atlantic LCC in the Gulf of Maine and Bay of Fundy, resulting in extensive, productive tidal flats. These coastal ecosystems include a variety of interacting coastal habitats that support many priority fish, wildlife and plant species. Priority habitats include beaches, islands, coastal bays and estuaries, coastal marshes and tidal flats.

### Beaches

Beaches line much of the coastline of the North Atlantic LCC area, particularly the southern part of the LCC from Virginia Beach, Virginia, north to Cape Cod, Massachusetts, and interspersed with rocky coastline north of Cape Cod to the Gulf of St. Lawrence. Much of this beach habitat is barrier beach, the narrow linear system of islands and spits composed of unconsolidated sands that parallels the coast a few miles offshore and is separated from the mainland by open water (coastal lagoons and bays) or marshes. Many of the beaches in the North Atlantic have been developed and the shorelines and beach zones greatly altered.

There are a number of species closely or exclusively associated with beaches, many of which are rare or declining throughout their range. A number of these species are sensitive or vulnerable to direct human disturbances. Four beach species that occur in the North Atlantic LCC are, piping plover (*Charadrius melodus*), roseate tern (*Sterna dougallii*), northeastern beach tiger beetle (*Cicindela d. dorsalis*) and seabeach amaranth (*Amaranthus pumilis*) and all are listed as threatened or endangered under the Endangered Species Act.

There are five species of sea turtles that use the nearshore and offshore waters adjacent to these beaches and one species, the loggerhead sea turtle (*Caretta caretta*), that consistently nests in the

North Atlantic LCC as far north as New Jersey. Maritime woodlands and forests, which occur in the secondary dunes and backsides of barrier islands, are quite rare along the Atlantic coast, and several community types are considered globally imperiled by The Nature Conservancy.

Natural beach habitat is in critically short supply due to the loss and degradation of this habitat from development and shoreline stabilization. The demand for developmental and recreational uses of these areas is intense; the result is an alarmingly high rate of habitat loss and the range-wide decline of virtually all beach plant and animal species. Locations of both plant and bird populations shift from year to year, and it is therefore necessary to protect potential habitat as well as known locations in order to maintain these populations.

Climate change is already having or is predicted to have major impacts on coastal habitats through sea level rise, increased vulnerability to storm surges, and increased intensity and frequency of coastal storms. Areas considered at very high or high risk in the North Atlantic LCC, according to a National Assessment of Coastal Vulnerability to Sea-Level Rise, include the shorelines of Chesapeake Bay and the Delmarva Peninsula, the Atlantic and Delaware Bay coastlines of New Jersey, and parts of the south shore of Long Island and Cape Cod. One important question is how beaches, marshes and other coastal habitats will respond and adapt to sea level rise and how the fish, wildlife and plants using these habitats will be affected.



USFWS

*Razorbills*

### Islands

Islands are located throughout much of the North Atlantic LCC, and range from sandy, low-elevation barrier islands from the southern portion north to Cape Cod, to rocky islands with greater topographic relief from Cape Cod northward to the Gulf of St. Lawrence. In the Maine portion of the Gulf of Maine, there are 3,500 coastal islands and ledges, 377 of which are considered nationally significant islands based on the diversity or abundance of nesting birds, many of which are state, provincial and federally listed, such as piping plovers and Arctic, roseate and common terns. Islands also provide important nesting sites for waterfowl, including focal species

such as American black ducks and common eiders. Sea level rise and increasing storm frequencies will continue to impact many of the low elevation islands in the southern portion of the LCC. In the Chesapeake Bay, for example, researchers at the University of Maryland Laboratory for Coastal Research found that at least 13 islands have disappeared since the region was first mapped. Continued losses of island habitats will likely cause many species of colonial-nesting birds to become more concentrated, or shift to nesting in other areas along the coast, causing increased competition and predation.

### Bays and estuaries

Open-water habitats in bays and estuaries along the North Atlantic LCC are critically important for many species of fish, shellfish, migratory birds and plant communities. These protected bays support a variety of subtidal habitats, from deep water to shallow areas with beds of submerged aquatic vegetation. These bays and estuaries provide critical stopover and wintering habitat for more than one million migratory waterfowl, including many species of high conservation need such as black, surf and white-winged scoters, greater and lesser scaup, long-tailed ducks and American black ducks. Bays and estuaries are also important for wading birds such as great blue herons and snowy egrets, and provide important food resources and breeding areas for numerous songbird species, reptiles and amphibians. These areas also provide important habitats that support recreational and commercial fish and shellfish resources, supporting a multi-billion dollar industry for local and state economies along the U.S. portion of the Atlantic coast. Priority fin and shellfish species include alewife, menhaden, American shad and horseshoe crab. The disappearance of these habitats has had serious impacts on wildlife populations. For example, many waterfowl species such as canvasback and redhead ducks and tundra swan winter in the ACJV area and are dependent on the presence of submerged aquatic vegetation (SAV) beds along the coast of the mid-Atlantic region. SAV beds once covered more than 80,900 hectares (200,000 acres) of the Chesapeake Bay; as of 2003, an estimated 26,187 hectares (64,709 acres) of SAV beds remained in the bay – a loss of 70 percent. Such declines have had a dramatic impact on wintering waterfowl populations; for example, redhead numbers have shrunk from 80,000 to only a few thousand annually in Chesapeake Bay.

### Coastal marshes and flats

Salt, brackish and freshwater marshes are critical to many aquatic and terrestrial wildlife species along the Atlantic coast. Many species of fish and shellfish will be impacted by loss and shifts of coastal marshes and flats brought on by sea level rise and changes in water temperature. Changes to coastal marshes could have far-reaching effects on the region's food web as well. Decomposing vegetation in coastal marshes provides an important source of nutrition for numerous invertebrates and small fish, which

in turn provide food for rockfish, menhaden, blue crab and other species. Tidal flats include intertidal sand and mud flats that are particularly extensive and important in the areas with higher tidal range in the northern part of the North Atlantic LCC. These flats support habitat for worms, clams, snails and other species that are critical food sources for many species of fish and wildlife.



USFWS

*Chincoteague, Virginia*

### Other Aquatic Ecosystems

Though they occupy a relatively small proportion of the landscape, freshwater and estuarine wetland habitats are critical to biological diversity in the Northeast Region. More than one-quarter of the region's threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives. Since European colonization, freshwater and estuarine communities in the Northeast Region have suffered major losses or conversion and degradation from filling or draining, agriculture, erosion, pollution, invasive species, damming rivers, logging, and stocking lakes and streams with non-native fish. In recent decades, acid rain, suburban sprawl and stream channelization have further damaged or eliminated aquatic habitats. Climate change adds a new threat, as warmer conditions across the Northeast increase water temperatures, reduce winter snow and ice cover, and alter the timing, duration and volume of seasonal stream flow. Changing precipitation patterns will mean more frequent or severe storm events in some areas, leading to more serious runoff, erosion and bank scouring. In the future, some streams will flood more often, and others will dry up more often than in the past. These impacts will add to the long list of stresses to aquatic ecosystems.

### Freshwater wetlands

Inland wetlands such as forested swamps, emergent marshes or scrub-shrub wetlands have experienced serious and widespread losses and degradation from centuries of draining, filling, conversion, human development for roads, housing, industry, pollution and invasive species. Approximately 89.5 million hectares (220 million acres) of wetlands originally covered the conterminous United States at the time of European settlement, and by 1997 only an estimated 42.7 million hectares (105.5 million acres) of wetlands remained. Although rates of wetland loss have decreased in more recent decades, they have continued to be significant. From the 1970s to the 1990s, approximately 918,000 hectares (2,268,418 acres) of wetland habitat were lost or converted in the Atlantic Coast states, an average loss of approximately 45,900 hectares per year (113,421 acres/year). The magnitude of historic wetland losses is further compounded by the impacts of other stressors and their major negative influences on biotic communities. Climate change will add yet another major stressor to freshwater ecosystems.

Numerous listed species and other highest priority species like bog turtle, bog asphodel, swamp pink, and American black duck require inland wetlands for habitat. Maintaining their populations in the future will require suitable habitat throughout their annual cycles. It will become increasingly important to protect the highest-value wetland habitats and restore degraded wetland ecosystems that are most critical to populations of priority species. It also will be crucial to maintain the resiliency of wetland ecosystems, so that historic habitat losses and current stressors will not drive wetland-associated species to where their populations decline further.

### Marine, estuarine and riverine ecosystems

Marine Atlantic species also are undergoing declines. Catches of species such as herring, lobster, mollusks, perches, smelts and cod have steadily declined since 1977, and many scientists view this as indicating a downward spiral in abundance of marine life and the structure of marine ecosystems. Climate change is expected to further pressure marine life and fisheries. The marine zones offshore of the North Atlantic LCC are critical for a number of populations of marine birds and these populations may be at risk from nearshore and offshore wind energy development.



Susi Von Oettengen/USFWS

*Dwarf wedgemussel*



The North Atlantic LCC includes all or part of the Gulf of Maine rivers, Connecticut River and Long Island Sound, Hudson River and New York Bight, Delaware River and Delmarva coastal area, and Chesapeake Bay and Susquehanna River ecoregions. These systems collectively support many anadromous fish species, including river herrings, sturgeons and striped bass, and numerous freshwater mussel species. Several of the highest priority aquatic species to receive attention within the North Atlantic LCC occur in these systems, including endangered Atlantic salmon, American shad, eastern brook trout and dwarf wedgemussel.

The North Atlantic LCC, in consultation with its watershed-based partners, will identify priority habitat for these aquatic species within its boundary and will likely consider the many factors that continue to threaten aquatic ecosystems, including climate change. As one example, prolonged summer low-flow conditions resulting from water withdrawals and land and water management will be exacerbated as climate change reduces snowpack and hastens spring snowmelt. Maintaining groundwater recharge and thermal refugia and protecting riparian cover will be important strategies, along with increasing connectivity by removing barriers caused by dams and culverts.

## Forest Ecosystems

### Mountaintop conifer woodlands

Spruce-fir woodlands at high elevations form a specialized habitat across the North Atlantic LCC because of the extreme climatic and biophysical conditions, such as cold temperatures, high wind, greater precipitation and acidic poor soils that occur at high altitudes. This habitat type occurs from the Adirondack Mountains of New York and extends northeastward through the mountains of northern Vermont, New Hampshire, Maine and western New Brunswick into the Gaspé Peninsula of Quebec. Its distribution is naturally fragmented at the landscape level, forming islands of mountaintop conifer woodlands in a sea of mostly northern hardwood deciduous forest. Most patches of this habitat are estimated to be smaller than 1,012 hectares (2,500 acres) in extent. A recent estimate suggests that roughly 174,015 hectares (430,000 acres) of this habitat currently occur in the U.S. and 136,379 hectares (337,000) acres occur in Canada. The elevations at which this habitat occurs are lower in the north compared to the south because of the interaction between climate, altitude and latitude.



*Bicknell's thrush*

Numerous priority species utilize this restricted habitat type, including the Bicknell's thrush, a range-restricted neotropical migrant songbird endemic to the spruce-fir woodlands of the northeastern U.S. and Atlantic Canada. Other priority species occurring in this habitat type include Canada lynx, American marten, northern bog lemming, blackpoll warbler, bay-breasted warbler, purple finch and spruce grouse. All these species prefer or are limited to this habitat type within the U.S., which highlights their vulnerability due to the restricted nature of the habitat and potential impacts from several critical threats.

High-elevation areas are among the habitats most likely to be affected by climate change. Warmer temperatures during the growing season could gradually allow mountain ecotones to shift upward, shrinking the isolated high-elevation woodlands into progressively higher, smaller and more isolated patches, or even eliminating patches completely. An upward shift in the ecotone between northern hardwood forest and the mountaintop spruce-fir forest may be underway. In the northern Green Mountains of Vermont, a study has reported an upward shift of 91 to 119 meters (300 to 390 feet) in the hardwood-conifer ecotone at two high elevation locations over the past 40 years.

In addition to climate change, high-elevation habitat is threatened by atmospheric deposition of various elements and substances detrimental to the overall health and functioning of this ecological community. Specific concerns include deposition of atmospheric mercury, acid rain, and excess nitrogen, lead and other trace elements. Outright loss of habitat due to development associated with wind energy production, communication towers and recreational activities such as ski areas is another threat to this habitat type.

### Upland forests

Upland forests constitute the dominant habitat type across much of the North Atlantic LCC, particularly in the northern portion. Forests support more wildlife species than any other terrestrial habitat, and the diversity of breeding birds is higher in North Atlantic LCC forests than in any other part of the nation. Many serious issues threaten the long-term viability of forest-dwelling wildlife populations, including habitat loss, fragmentation and decreased habitat quality. Many species such as American woodcock, chestnut-sided warbler, New England cottontail rabbit and Canada lynx are dependent upon natural disturbances or forest management, i.e., timber harvesting, for suitable habitat; in large parts of the LCC area their populations are limited by low levels of forest disturbance. For species associated with mature forest conditions, such as bay-breasted warbler and American marten, some parts of the North Atlantic LCC are experiencing cutting levels that may be too high to sustain their populations at desirable levels.



©grippiecat

*Canada lynx*

Conifer (i.e., spruce, fir and pine) forests are one of the region's highest priority habitats for migratory birds. Conifer forests host a high diversity of species, including many species of continental concern such as olive-sided flycatcher, bay-breasted warbler and Canada warbler. Many conifer forest bird species have a significant portion, about 25 percent, of their global breeding population in the North Atlantic LCC area; such species include blue-headed vireo, northern parula and black-throated green warbler. Populations of many conifer forest bird species are centered in the boreal forests of Canada, with their entire U.S. population found in just a few states. For example, 90 percent of the U.S. population of bay-breasted warbler is found in Maine. Centuries of timber harvest practices in Maine, which preferentially cut spruce, fir and pine, have resulted in conversion of millions of acres of conifer-dominated forests to mixed-wood forests, and conversion of mixed-wood forests to primarily deciduous forests. Currently, the 40 percent proportion of Maine's forests that are dominated by conifers would have to increase by half to return to the state's natural and historic 60 percent proportion of forests that were dominated by conifers. Yet under most climate change predictions, the proportion of conifer forests in Maine is likely to further decrease.

Additional threats to priority species in forested habitats are linked to human development. For example, breeding productivity of forest birds is strongly related to landscape composition; when forested habitats are increasingly replaced by other habitats such as fields or suburbs, bird populations decline. In North America, the human development of highest density typically occurs along the coasts and river systems that are the most important migratory flyways for birds, and thus, severely degraded stopover habitat may be a limiting factor for some species.

#### Successional habitats

Although mature forests dominate much of the northeastern U.S., many high-priority wildlife species require successional habitats, which are either managed, that is, cut or cleared, or disturbed

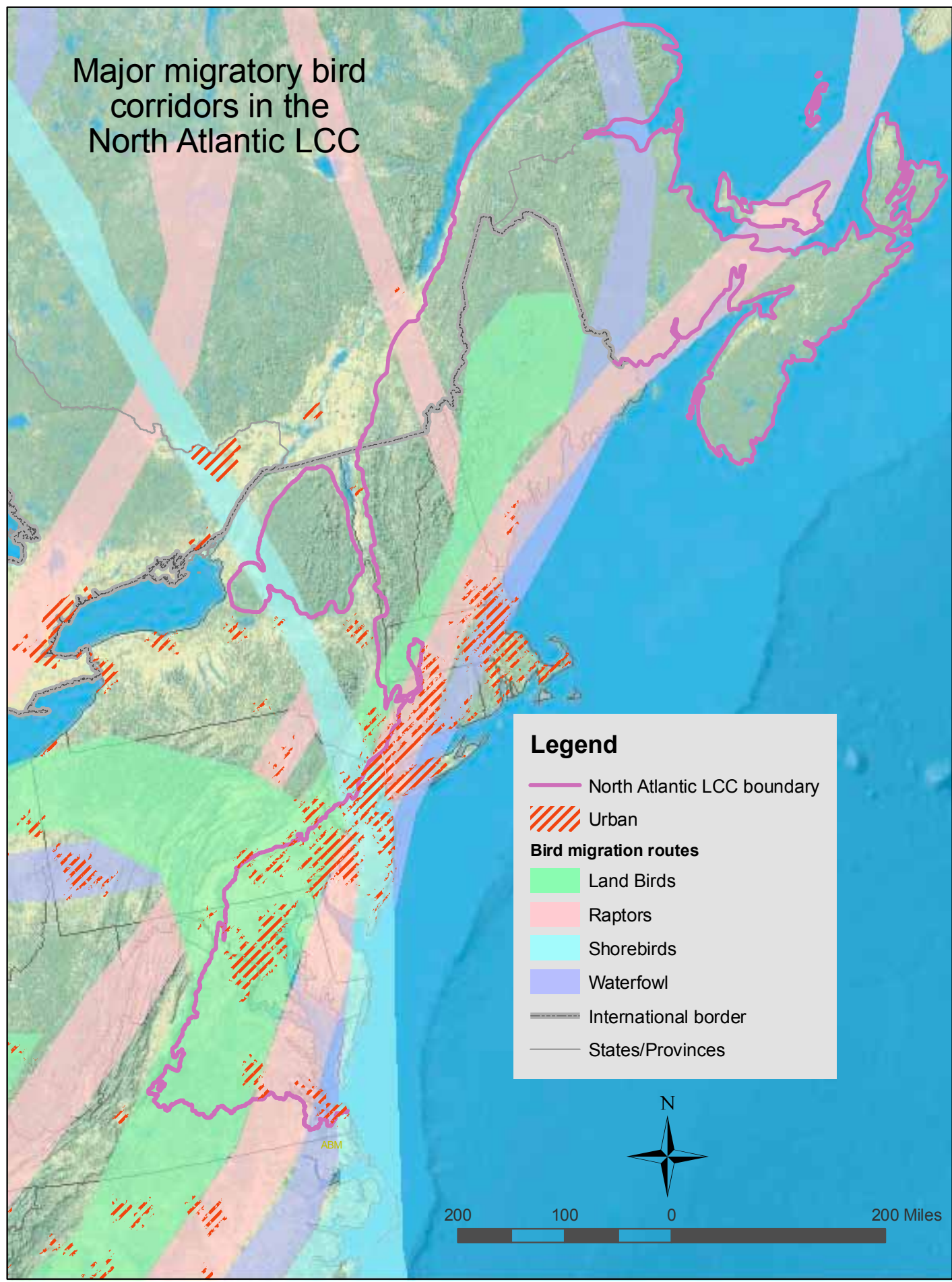
by fire, wind or insect outbreaks. Different suites of priority species are associated with barrens, grasslands, shrublands, young forests and pine-oak savannahs. Some highest-priority species such as prairie warbler may use all of these successional habitats. Historically, successional habitats were related to the frequency and distribution of natural disturbances across the landscape, with certain areas such as coastal zones and sand plains much more prone to frequent or extreme storms or fires, and therefore characterized by disproportionate amounts of successional habitats like grasslands and shrublands. However, human populations and the accompanying housing, agricultural and industrial development have been most concentrated in coastal zones and river valleys, resulting in severe losses of 90 to 99 percent of the successional habitats in much of the region. Because of this habitat loss and forest maturation across in the region, along with periods of limited natural disturbance (fire suppression), most wildlife and plant populations restricted to successional habitats are increasingly reliant upon managed areas such as relatively small protected barrens, power line right-of-ways or recent timber harvests. While certain kinds of disturbance, such as partial timber harvests in northern Maine are more common than ever before, other parts of the Northeast have very low timber harvest rates.

Maintaining viable populations of all native wildlife – including successional species – will likely require greater investments in biological planning and conservation design. By definition, successional habitats are temporary and patchy, which make them difficult to detect with remotely sensed data that are collected at large scales and only infrequently. Partners need to be able to estimate current habitat capacity in order to estimate populations and set meaningful population objectives that can be met by guiding conservation efforts to those landscapes and specific areas where management methods will have the greatest likelihood to succeed. Some of these efforts are already being developed in the region, but they will be particularly essential for understanding the effects of climate change, devising robust adaptation strategies, and applying adaptive management techniques.

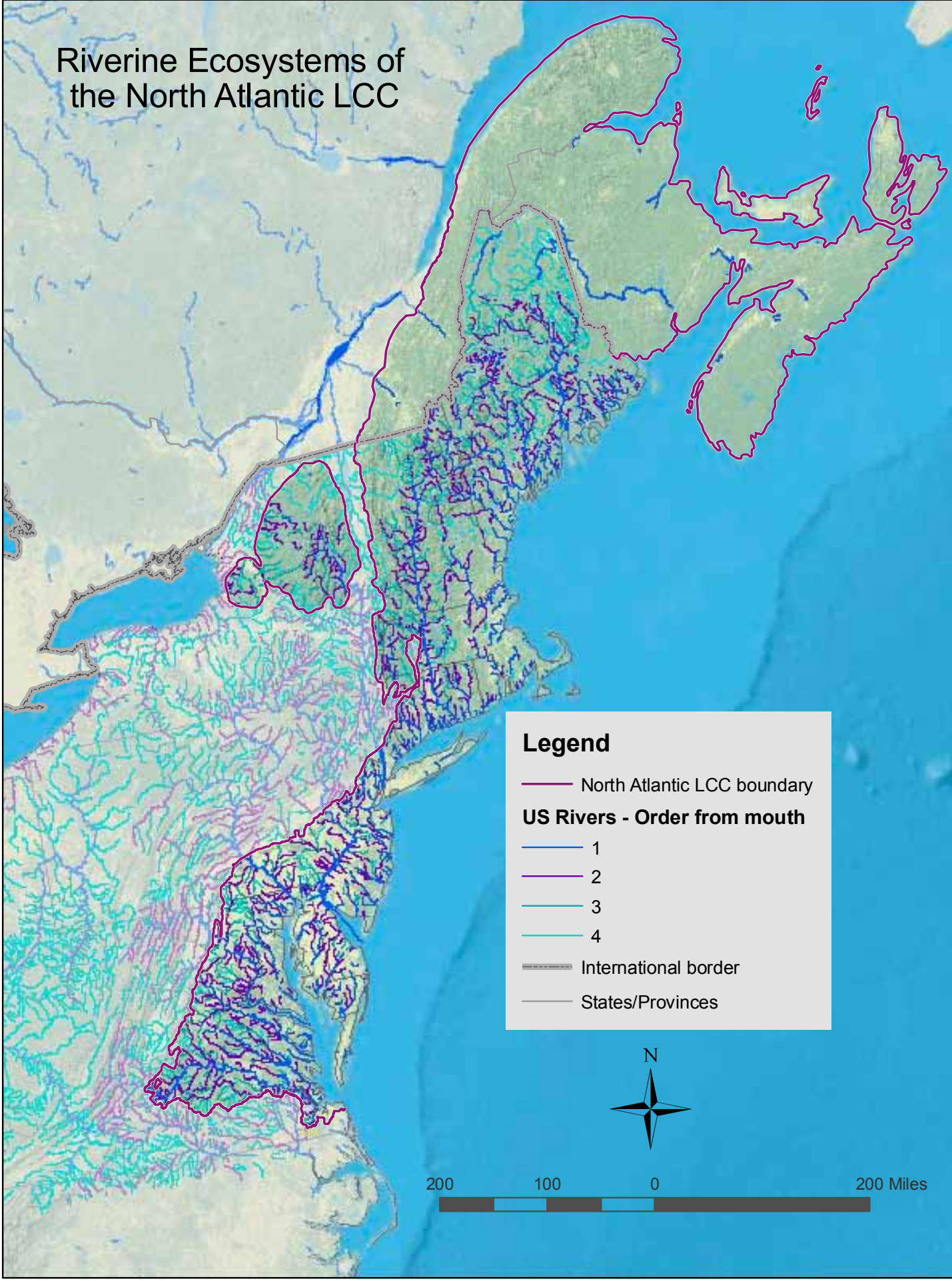
#### **IV. Anticipated Conservation Delivery Mechanisms and Results Related to Priority Species and Habitats**

Existing conservation providers, informed by North Atlantic LCC science, will deliver on-the-ground results. This will require that conservation providers have access to and be guided by North Atlantic LCC landscape-scale science, and that the LCC shapes its scientific products to respond to the science needs of conservation providers. The result will be coordinated implementation of actions on the ground to meet broad-scaled conservation goals that target priority habitats and species.

# Major migratory bird corridors in the North Atlantic LCC



# Riverine Ecosystems of the North Atlantic LCC



**Legend**

- North Atlantic LCC boundary
- US Rivers - Order from mouth**
  - 1
  - 2
  - 3
  - 4
- International border
- States/Provinces



## Landscape science translated into conservation delivery

Landscape-scale science can be translated into action on the ground, in part, by influencing grant and resource management programs. Major competitive grants programs for habitat conservation will be a primary target of North Atlantic LCC products. The North Atlantic LCC will relate to these programs by developing tools and information to determine the amount of individual habitat conservation actions that are needed in identified locations to sustain fish and wildlife populations impacted by climate change. This information will be used to help guide grant programs to highest priorities and focus partnership development and grant applications in areas that are identified as important. Several conservation delivery partnerships are outlined in Section II.

Competitive USFWS grant programs for habitat conservation focused on wetlands include the North American Wetlands Conservation Act and National Coastal Wetlands Conservation Grant Program; the Neotropical Migratory Bird Conservation Act Program is focused on all habitats for migratory birds. Other federal and foundation grant programs relevant to the North Atlantic LCC include NOAA Restoration Center Regional and National Partnership grants and National Fish and Wildlife Foundation grants.

The National Fish and Wildlife Foundation, which was represented at the November 20 meeting with partners, provides significant funding for on-the-ground projects in the Gulf of Maine, Long Island Sound and Chesapeake Bay, and can target these funds in response to North Atlantic LCC products. The North Atlantic LCC may serve to attract additional funding to these initiatives by demonstrating effective long-term planning and design.

States receive funding from the Wildlife and Sport Fish Restoration Programs and the State Wildlife Grant (SWG) Program. States in the Northeast Region use these funds to acquire and manage habitat, and conduct population assessments and monitoring of a wide range of bird, mammal and aquatic species.

Tribal Wildlife Grants are used to provide technical and financial assistance to federally recognized tribes for the development and implementation of programs that benefit fish and wildlife resources and their habitat. Activities may include planning for wildlife and habitat conservation, fish and wildlife conservation and management actions, fish and wildlife related laboratory and field research, natural history studies, habitat mapping, field surveys and population monitoring, habitat preservation, conservation easements, and public education.

The region is in the final phase of SHC implementation by transitioning from program-centric to resource-centric planning, budgeting

and operations in fiscal years 2010 and 2011. As a result, all USFWS natural resource programs will be using North Atlantic LCC science for conservation delivery. For example, the National Wildlife Refuge System's program for inventory and monitoring will utilize funding received under the fiscal year 2010 climate change initiative to create a nationally coordinated program of inventory and monitoring on the National Wildlife Refuge System to support science-based conservation planning and management at multiple spatial scales. This program will support the work of the LCCs through targeted monitoring in support of science-based decision-making at refuge and larger landscape scales, and also of long-term monitoring of non-climate stressors with impacts within and beyond refuge boundaries. The intent is also to include data management capacity and contributions to continental-scale monitoring of key fish and wildlife populations that transcend LCC boundaries. At regional and watershed scales, the program will support landscape-scale conservation planning by LCCs by providing data collection and database entry for refuges within LCC areas, collaborating with LCCs on variables to be monitored, developing modeling products in collaboration with LCCs, collaborating at the national level regarding monitoring aspects of adaptation planning, and assisting field stations with design and monitoring aspects of adaptive management programs that facilitate adaptation.



Stephanie Koch/USFWS

*Gulls on Monomoy, Massachusetts*

Scientific products developed through the North Atlantic LCC will help inform evaluations of the likely conservation benefits of proposed land acquisitions through the Land and Water Conservation Fund and Migratory Bird Conservation Fund. North Atlantic LCC products will be of particular value to refuge land managers, who must make daily decisions on how to help priority species adapt to climate change.

The USFWS Partners for Fish and Wildlife Program will use fiscal year 2010 Climate Change

Initiative funds to expand assistance to private landowners in the North Atlantic LCC area. The USFWS Partners for Fish and Wildlife and Coastal programs will work with U.S.D.A. Farm Bill programs to address the needs of grassland, wetland, forest, aquatic and riparian species in priority areas on private lands.

The 2010 Climate Change Initiative also provides funding for the National Fish Habitat Action Plan, which will be used to fund habitat assessment, stream and shoreline restoration, and fish passage barrier removal or modification projects of fish habitat partnerships. The relationship to climate change is a ranking criterion for such projects. The Fisheries Program, through the National Fish Habitat Action Plan, National Fish Passage Program and base programs will use LCC products to focus conservation activities on high-priority species and watersheds.

The North Atlantic LCC will help drive endangered species related activities by facilitating proactive landscape level conservation and recovery planning and catalyzing conservation planning efforts beyond the simple project level. The North Atlantic LCC will facilitate information sharing and will enable finer precision in identifying conservation and research needs. Landscape-level information is the foundation of habitat conservation plans, especially for species that are wide-ranging. Identified conservation needs can be implemented through grants programs under section 6, including conservation grants, recovery land acquisition, habitat conservation planning assistance and habitat conservation plan land acquisition. Large landscape-level information will benefit programmatic level section 7 consultations, which often involve activities proposed or planned over a larger geographic area. Developing sound jeopardy analysis within formal section 7 consultations often requires landscape-level information that the North Atlantic LCC will likely assist in providing.

Restoration planning for Natural Resource Damage Assessments will use scientific information provided by the North Atlantic LCC.

#### **Conservation providers identify science needs**

The North Atlantic LCC will shape its scientific products to respond to the science needs of



*New England cottontail*

conservation providers. Conservation efforts for the New England cottontail represent a prime example. The New England cottontail rabbit is a candidate species under the Endangered Species Act. Conservation actions will need to include protection and creation of shrub habitat sites with characteristics valuable to the rabbits in a variety of natural conditions across a six-state region with a mix of human-induced impacts. Science assessments are being developed to identify sites with the best potential to meet the conservation goals. This will increase the potential for limited field crews and funds from several partner organizations to be used with positive effect before the species numbers decline to levels requiring formal listing as an endangered species. Using GIS and statistical tools, science-support efforts will identify the habitat criteria most important to the species, help locate potentially undiscovered rabbit populations, and identify locations for creation of shrub habitat useful to this animal. Genetic testing of pellet samples will be used to confirm the difficult species identification, and may be used to generate and implement plans to maintain healthy genetic diversity in this species with a relatively small number of animals. Given its rarity, this animal is a focus species across a multi-state area, requiring coordination of planning, implementation and effects monitoring among many interested and authorized agencies and organizations. This example of conservation planning and implementation needs the strategic scientific support that planned LCCs could provide.

### **V. Developing Capacity to Support the Science Needs of the North Atlantic LCC**

*Positions and competencies to support LCC development in the Northeast Region*

The Northeast Region has identified the following positions and associated competencies as necessary to support LCC science needs beyond the positions of the LCC coordinator and science and technology coordinator. The region intends to develop these capacities as part of the implementation of LCCs. The workforce needs described below are believed to be beyond current capacity within the Northeast Region.

All new positions will be used to bring new capabilities that do not currently exist within USFWS or expand those in the biological planning and conservation design disciplines that are in great demand and short supply. These positions focus on skill sets necessary to conduct the steps of strategic habitat conservation involving biological planning, conservation design, and monitoring and research.

- 1. Population modeler(s)** – Simulation modeling, parameter estimation, population viability analyses and quantitative vulnerability assessments, and fitting established and appropriate models with empirical data.

## 2. Landscape ecologist / conservation biologist –

Large-systems ecology utilizing a systems approach to developing species-habitat and biotic-abiotic relationship models within which to apply conservation design, adaptive management and research; decision-support tools for field use and determining regional and ecoregional habitat objectives; integrating work of population modelers and GIS specialists.

## 3. GIS/spatial analyst(s) –

Spatial analysis and modeling associated with biological planning, conservation design and progress evaluation; spatial data development and management; technical support and consultation to field staff; maintenance of up-to-date biological, physical and cultural data layers for the ecoregion.

## 4. Applied statistician –

Expertise in development of statistical design of research projects, power analyses, sample size estimation, decision support tools, monitoring design and statistical analyses of results.

## 5. IT specialist / IT systems administrator / database manager / Web manager –

IT and network administration support for specialized hardware and software for population modelers and GIS analysts. Developing tools to analyze and post process output from population models. Developing and maintaining biological and spatial databases for all four phases of SHC; assisting field staff with development of databases. Web duties to assist with internal and external communication and outreach, and development of Web-based decision support tools.

### *Science capacity projects to fill science needs*

Input from USFWS programs and potential LCC partners within the Northeast Region yielded the following list of science capacity needs to support the work of the North Atlantic LCC. The first four needs are described in more detail in Section VI and Appendix B; these are high-priority science projects identified by the Northeast Region that would exceed the initial regional allocations for science capacity and also represent excellent opportunities for addressing national or cross-LCC science needs. The next five needs are described in detail in Appendix A, which provides specific project proposals that have already been developed for addressing these needs and have been identified by the Northeast Region's SHC/Climate Change Team as high priorities for implementing under the LCC. The remaining needs have been identified through input from USFWS programs and LCC partners.

- Identifying coastal habitats at risk due to climate change. (see Section VI and Appendix B)
- Designing sustainable landscapes in the eastern U.S. (see Section VI and Appendix B)
- Template for strategic habitat conservation implementation plan to meet waterbird management needs within Atlantic and Mississippi flyways. (see Section VI and Appendix B)



*Sanderlings and ruddy turnstones at Stone Harbor, New Jersey*

- Characterizing water resources and needs on and off USFWS lands for conservation of priority fish and wildlife resources
- Guidance on next steps for biological planning in the Northeast Region; identifying representative species and management objectives in geographic areas. (see Appendix A)
- A Web-based, GIS decision-support system for prioritizing management actions for stream fish based on sub-population persistence in stream networks in the face of climate change. (see Appendix A)
- Implement a geophysical and resilient system approach to climate change adaptation; identify specific geophysical settings, as determined by current species distribution patterns, to develop a conservation approach that protects diversity under current and future climate regimes.(see Appendix A)
- Model climate change influence on instream habitats for freshwater mussels in Atlantic slope and Appalachian river systems of the Northeast. (see Appendix A)
- Test for effects of stream network structure on salamander occupancy in streams throughout the central and northern Appalachians and Atlantic Coastal Plain and quantify the demographic contribution of dispersal from small tributaries to mainstem streams. (see Appendix A)
- Assess and synthesize existing science to identify major gaps in knowledge and science needs necessary to implement conservation through a strategic habitat conservation approach.
- Conduct regional assessments of high priority species' and habitats' vulnerability to climate change, urbanization, energy development and water resource issues; habitats include marine systems, tidal wetlands and coastal marshes, beaches and barrier islands, cold water stream and river habitats, high-elevation habitats.
- Project climate-induced shifts in vegetation, individual species ranges and ranges of invasive and exotic species through predictive modeling; develop models and maps that relate fish and wildlife populations to spatial habitat data and changes likely to occur due to climate change and other limiting factors.
- Identify corridors between currently occupied

and future potential habitat for high priority species to assess potential barriers to migration to new habitat. Issues to be addressed include systems movement studies, identifying and mitigating migration barriers, and assessing habitat connectivity of current and future landscapes.

- Test the adaptability and resiliency of high-priority species and their habitats and landscapes that are particularly at risk of climate change impacts; improve understanding of the underlying environmental and ecological factors that determine these species' current distributions and how they may be altered by climate change. Some examples of high-priority species for this need include eastern brook trout, Atlantic salmon, Atlantic sturgeon, red knot, American black duck and Bicknell's thrush.
- Incorporate landscape genetics approaches into population genetic studies to understand species interactions with habitat and how to plan for future management in response to climate change.
- Build on the monitoring and performance framework developed through the states' Regional Conservation Needs Program to establish comprehensive monitoring and evaluation programs to track changes in fish and wildlife populations and their habitats, assess population responses to conservation actions, and evaluate progress toward population and habitat objectives.
- Assess the impacts of climate change on cultural resources and develop strategies for addressing those impacts.
- Develop mitigation strategies for hazards from human structures and other human activities, particularly those related to energy development.
- Assess opportunities for and research the best methods for implementing bio-sequestration.
- Review the list of recommended but unfunded proposals submitted to the Regional Conservation Needs Program to evaluate opportunities for projects that meet a high standard for substance, quality and completeness and have a significant amount of buy-in from Northeast fish and wildlife agencies.
- Facilitate the transformation of data into information through analysis, synthesis and modeling, which includes the integration of data sets and sharing of information products such as maps, analyses, models and decision support tools with a variety of partners; develop a structured approach to assess, synthesize and share these various forms of data and information.

### ***6 to 12-month operations plan for the North Atlantic LCC***

In fiscal year 2010, the region is establishing the North Atlantic LCC by coordinating its organization, staffing, roles and responsibilities with partners. At the same time, the regional SHC/Climate Change Team is working to identify and begin addressing science needs. This dual track approach will ensure

that both the administrative actions and science delivery actions are coordinated and implemented in fiscal year 2010.

In addition to the specific capacities in positions, competencies and projects, the North Atlantic LCC will benefit from having an operations plan to support its development. The following outline provides a brief summary of how the North Atlantic LCC will operate in fiscal year 2010.

***Objective:*** initiate a conservation science partnership that seeks to provide applied science to inform conservation delivery within an adaptive management framework and strategic habitat conservation approach across a broad geographic area through collaboration and coordination among partners.

#### ***Strategies and approaches:***

- Establish a functional LCC partnership with clear rules of governance and operation.
- Hire a coordinator and science and technology coordinator for the North Atlantic LCC.
- In conjunction with partners, prioritize science capacity needs and initiate key projects to address highest priority needs.
- Complete high-priority projects that are already underway and support LCC development, such as identifying representative species and the classification and mapping of wildlife habitats across the Northeast Region.
- In conjunction with partners, prioritize additional staff capacity and competency needs and evaluate opportunities for filling those needs relative to available resources among all the partners.

#### ***Responsible parties:***

- USFWS – primary responsibilities will reside with the LCC coordinator, LCC science and technology coordinator, regional scientist and regional SHC/Climate Change Team.
- Partners – USFWS will engage partners who have expressed an interest in participating in the North Atlantic LCC

#### ***Key resources available:***

- USFWS has specific funding to develop an LCC in the Northeast Region, approximately \$2 million for capacity development and science projects. In addition, some programs within USFWS have additional funding specifically for addressing climate change issues, as discussed in Section IV. USFWS also has the expertise of its existing staff to contribute as appropriate.
- Other DOI bureaus: USGS will be developing a regional climate center and the National Park Service has inventory and monitoring networks across the region.
- The Northeast Association of Fish and Wildlife Agencies has the highly successful Regional Conservation Needs Grant Program and process, which has the potential to make substantial contributions to filling high priority science needs across the region.



- Non-governmental organizations have significant expertise and science capacity to contribute to collaborative efforts aimed at filling science needs.

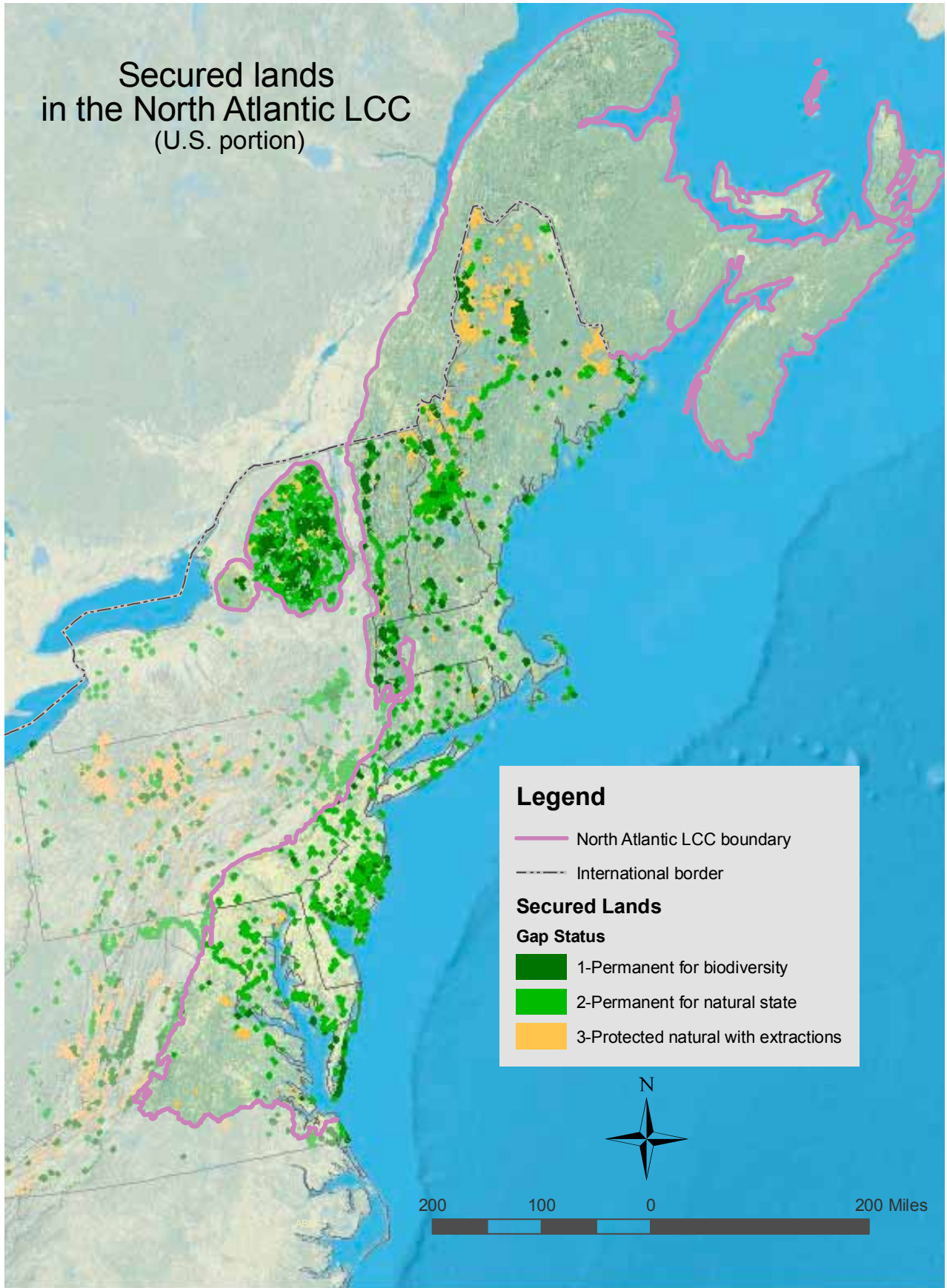
**Key resources needed:** the descriptions of positions, competencies, and projects presented at the beginning of this section represent the key resources needed in fiscal year 2010 to develop an effective North Atlantic LCC.

**Timeline:**

The following table outlines key organizational, management, outreach, and scientific activities that the North Atlantic LCC will implement in the next 12 months (December 2009 – September 2010).

Action	Description	Target Date
Draft NALCC governance structure and charter	Work with subset of November 20, 2009 scoping meeting participants to prepare draft NALCC governance structure and charter	1/2010
Review NALCC Plan with Scoping Team	Distribute NALCC Plan to partners that attended November 20, 2009 scoping meeting and incorporate feedback.	2/2010
Continue outreach to potential NALCC partners	Targeted outreach to additional key academic, NGO, local, state and federal conservation partners to provide information on goals and roles of NALCC and to gather information on capabilities and potential commitment levels.	1/2010 – 4/2010
Continue discussions and coordination with adjacent LCCs	Ensure that NALCC has mechanisms established for communicating and coordinating with any adjacent LCCs.	Ongoing
Finalize LCC governance structure and charter	Work with NALCC steering committee to finalize governance structure that addresses both Service and partner needs.	1/2010-3/2010
Implement NALCC FY2010 Priority Science Projects	Implement NALCC Priority Science (Biological Planning and Conservation Design) projects that are selected for funding in FY2010.	1/2010-2/2010
Hire LCC Coordinator	Hire NALCC Coordinator based on PD developed by WO	ASAP
Hire Science and Technology Coordinator	Hire NALCC Science and Technology Coordinator based on PD developed by WO	ASAP
Initiate NALCC climate change science gap analysis	Begin identification of key climate change science programs in place at the local, state, and regional level.	12/2009 – 8/2010
Data sharing infrastructure needs assessment	Work with regional GIS and IRM staff to identify broad infrastructure needs for NALCC data warehousing and analysis	12/2009 – 8/2010
Implement Representative Species Selection Process	Identify priority trust species in LCC Group regional terrestrial and aquatic habitat classifications into a reasonable number of categories for grouping species Develop database to associate species with habitat types Develop guidance for selection of representative species Compile supporting base data layers for use in final selection of representative species and development of species-habitat models Organize partner workshops to select a set of representative species and management objectives	12/2009 – 8/2010

# Secured lands in the North Atlantic LCC (U.S. portion)



## VI. Top Priority Science Needs Exceeding the Initial Regional Allocation for Science Capacity in the North Atlantic LCC

The following project narratives provide a general description of several high-priority science needs identified by the Northeast Region. These projects represent needs that would exceed the initial regional allocations for science capacity and also represent excellent opportunities for addressing national or cross-LCC science needs. These project descriptions are not to be viewed at this time as formal proposal submissions for any competitive funds available for national and cross-LCC projects; the region is waiting for guidance from the Washington, D.C. office that will be used for such submissions. More detailed descriptions, including costs, of these projects can be found in Appendix B.

**Project title:** Designing sustainable landscapes in the eastern U.S.

**SHC element addressed:** Conservation design

**Partners:** USFWS, U.S. Geological Survey, Atlantic Coast Joint Venture, U.S. Forest Service, State Fish and Wildlife Agencies in the eastern U.S., universities and Fish and Wildlife Cooperative Research Units in the Northeast, National Audubon Society

**Description:** This project would enhance the capacity of states, joint ventures and other partners to assess and design sustainable landscape conservation for wildlife across the eastern U.S. It would develop or refine wildlife-habitat relationship models based on current land cover and other habitat attributes representing major habitat types. It would also predict the impacts of landscape-level changes from climate change, urban growth, succession, and conservation programs on the future capability of habitats to support wildlife populations. Predicted impacts from climate change, including changing vegetation patterns, hydrology and sea level, will also be related to wildlife populations. These results will allow states and other partners the ability to conduct long-term planning to prevent species from falling below critical thresholds. Decision-support tools would be built to determine where conservation should be targeted to optimally achieve population objectives. Methods will be developed in cooperation with partners from multiple ecoregions and will be directly applicable to the entire set of ecoregions covered by Eastern Regional Gap Analysis. This project would be coordinated closely with the South Atlantic LCC. Pilot implementation of this methodology has already begun within the South Atlantic Coastal Plain ecoregion, and lessons learned through that effort would inform the efforts undertaken in the North Atlantic LCC.

**Project title:** Identifying coastal habitats at risk due to climate change

**SHC element addressed:** Biological planning

**Partners:** USGS, NASA, state fish and wildlife agencies, The Nature Conservancy and others working collaboratively with LiDAR and other tools



Edward Peter Steenstra/USFWS

*Blue Hill Harbor, Maine*

**Description:** Sea level rise will pose major conservation and management challenges at U.S. coastal sites, and it is important to develop management plans that incorporate future impacts if we are to successfully adapt and continue to conserve important ecological resources. This project would acquire necessary new remote sensing data, particularly light detection and ranging (or LiDAR) data, as well as utilize existing data to create an accurate digital elevation model to map the current distributions of important coastal habitats, identify areas of greatest impact from rising sea levels, quantify the rate of habitat change, and identify areas that are important for coastal wetland migration. Habitats at risk due to climate change will be identified and recommendations will be developed to guide future acquisitions that will concentrate on representing at-risk, uncommon, or important vegetative communities. Models of the impact of sea level rise on coastal beaches, marshes and other coastal habitats would be developed that account for ecoregional and local differences in relative sea level rise and account for the ability of coastal systems to respond (e.g., through increased marsh accretion and growth). This project could be applied to all coastal areas in the U.S.

**Project title:** Strategic habitat conservation implementation plan to meet waterbird management needs within the Atlantic and Mississippi flyways

**SHC element addressed:** Monitoring

**Partners:** USFWS, USGS, Atlantic Coast Joint Venture, Northeast Association of Fish and Wildlife Agencies, state of Missouri Department of Natural Resources

**Description:** Improved resource management for the benefit of waterfowl, shorebirds and marshbirds (hereafter referred to as waterbirds) may be realized by cross-scale integration of management actions across multiple spatial scales from the flyway scale down to local wetland management sites. This project would improve coordination of management actions across the Northeast, Southeast, and Midwest regions. Presently, little coordination occurs among managed sites across these regions, resulting in many disparate efforts that may not meet all waterbird needs at the appropriate spatial or temporal scales. The application of consistent

monitoring protocols across spatial scales that inform management decisions will increase the collective contribution of wetland management actions in all three regions to meet waterbird habitat needs.



USFWS

**Project title:** Characterizing water resources and needs on and off USFWS lands for conservation of priority fish and wildlife resources

**SHC element addressed:** Biological planning

**Partners:** State fish and wildlife agencies, Atlantic Coast Joint Venture, Atlantic Coast Fish Habitat Partnership, Eastern Brook Trout Joint Venture, Atlantic States Marine Fisheries Commission, Mid-Atlantic Northeast Maritimes Waterbird Conservation Partnership, and Atlantic Flyway Council, Manomet Center for Conservation Science, National Wildlife Federation, The Nature Conservancy

**Description:** The combined effects of climate change, urbanization, population growth and changes in land use are placing greater demands on the water resources in the Northeast. This increased demand creates a need for USFWS to better assess the water resources, including groundwater and surface water sources and quantity and quality, necessary to support our national wildlife refuges and national fish hatcheries. Additionally, we need to assess water needs for priority species to ensure their survival on and off USFWS lands. This project will project changes in hydrology and stream flow resulting from climate change in combination with permitted and non-permitted water withdrawals to assess impacts to the conservation of water dependent species. Understanding what water resources exist and the quantity and quality needed to manage resources on and off USFWS lands will assist managers in implementing effective conservation actions for priority resources, as well as position the USFWS to be effective in future debates on water rights issues in the East.

## VII. Anticipated Successes for the North Atlantic LCC in fiscal year 2010

The Northeast Region will establish a fully functional and operational LCC in the north Atlantic geographic area during fiscal year 2010. At least two positions, the LCC coordinator and a science and technology coordinator, will be filled to staff the LCC and the other identified needed capacities will be addressed. A charter and rules of governance will be developed in consultation with partners and formally approved by charter members of the North Atlantic LCC to establish clear rules of operation.

In collaboration with the North Atlantic LCC partners, the region will prioritize the science needs that have been identified to date to implement projects that address the top needs identified by the partnership. Addressing these top needs will involve working with existing staff within USFWS and LCC partners as well as establishing contracts for specific work, using the region's LCC funding to leverage as much work as possible in collaboration with partner funding or in-kind services.

Specific projects will be implemented to allow partners to guide conservation activities and conduct vulnerability assessments and adaptation strategies for major threats, such as climate change and urbanization, based on predictions of the future capability of habitats to support representative species of fish and wildlife. The mapping component of these projects involves creating a comprehensive and consistent wildlife habitat map across the entire Northeast Region. This map uses the ecological systems classification system and is consistent with mapping developed by regional gap analysis in the Southeast. The project is primarily funded through pooled state wildlife grant funds from the Northeast states. The USFWS is helping to guide this mapping project and fund a pilot effort focused on the Gulf of Maine watershed and other geographic areas. In this same area, The Nature Conservancy and others will be developing habitat models of several representative fish and wildlife species.

At the same time, the Northeast Region's SHC/Climate Change Team will be implementing a process with partners to select representative species in ecoregions in the Northeast and develop explicit population and management objectives associated with each representative species; these products will be organized by habitat type or other limiting factors. Outputs of this effort include priority species lists with selection criteria and methodology, range maps of priority species, tables of habitat types for clustering priority species and lists of priority species associated with these habitat types, and range-wide information, including population objectives (if available), status and trends, limiting factors, and data gaps for representative species. This approach will further science and conservation partnerships and direct the

USFWS to more strategic conservation delivery by taking into account population impacts from climate change and other threats.

The region will build upon the strengths of existing regional- and ecosystem-level partnerships, many of which were described under previous sections of this plan. Doing so will capitalize on and enhance science capacity surrounding these partnerships to effectively address science needs related to high priority issues across broad geographic areas facing multiple organizations. One example is the collaboration between the region and Manomet Center for Conservation Sciences on multiple projects:

- piloting development of site-specific climate change adaptation plans on state, USFWS (refuges) and private lands in fiscal years 2009 and 2010;
- designing habitat vulnerability assessments and identifying adaptation opportunities on refuges (Chincoteague, Edwin B. Forsythe and Monomoy) that are Western Hemisphere Shorebird Reserve Network sites;
- collecting LiDAR data at 0.5m resolution and combining it with habitat mapping to model vulnerabilities of habitats in response to sea level rise. Additional efforts will assess migratory bird use of vulnerable sites and project actions needed to plan for migratory bird stopover habitats in the future. This project is in cooperation with NASA, Manomet and the Marine Science Consortium, which represents 40 universities.

### VIII. Unique Characteristics of the North Atlantic LCC

Geographic, demographic, social and climatic factors all combine to shape the unique face of the North Atlantic LCC. Its lengthy shoreline with numerous estuaries and rivers traversed by major flyways, an educated and engaged public, and large areas of wild lands all combine to present opportunities and challenges to the future of fish and wildlife conservation.



William Kolodnicki/USFWS

*Cutler, Maine*

### *Geography and Physiography*

Among the most unique and defining features of the North Atlantic LCC is its coastline, the longest of any LCC in the continental U.S. The Canadian portions of the North Atlantic LCC in New Brunswick and Nova Scotia significantly add to this characteristic. Along this salt water interface is a vast and interconnected system of open ocean waters, fringing coastlands and estuaries, and extensive upland watersheds extending from the highest elevations and peaks of the Adirondacks and Appalachians to the coastal plain flatlands. It also includes the predominantly open water region of the Atlantic Ocean lying offshore.

The North Atlantic LCC coastline contains five nationally significant coastal water bodies: Chesapeake Bay, Delaware Bay, the New York Bight, Long Island Sound and Gulf of Maine. The Chesapeake Bay is North America's largest and most biologically diverse estuary, home to more than 3,600 species of plants and animals. Delaware Bay to the north hosts the largest spawning population of horseshoe crabs in the world, has the second largest population of migrating shorebirds in North America, and is one of the most important migratory stopovers in the world for land birds. Because of the Gulf Stream, the waters and marshes of Delmarva, on both the Atlantic and Chesapeake sides, teem with fish, crustaceans and waterfowl – trout, flounder, bluefish, crabs, oysters, clams, tarpon, muskrat, ducks and geese.

Further north, the New York Bight exhibits extraordinary physiographic diversity and geological complexity which, along with climatic and historical events, have contributed directly to the region's remarkable biological diversity and the current distribution patterns of its biota. The bight and its adjacent shorelands and uplands within the watershed are rich in living resources, including over 20 species of colonial nesting waterbirds, significant concentrations of wintering waterfowl, critical migratory shorebird concentration areas, spawning and nursery areas for anadromous fish, and rare wetland and upland communities and plants.

The Long Island Sound estuary and the Connecticut River watershed that feeds into it provide feeding, breeding, nesting and nursery areas for a diversity of plant and animal life, and contribute over \$5 billion per year to the regional economy from recreational activities. More than 8 million people live in the Long Island Sound watershed, and the associated development affects the habitat availability and quality, posing significant challenges to restoring and sustaining fish, wildlife and plant populations.

At the LCC's most northern extent lies the Gulf of Maine, one of the world's most biologically productive environments and one that encompasses an area of over 93,000 square kilometers (57,787 square miles). Its marine waters and shoreline habitats host some 2,000 species of plants and

animals. A diverse abundance of birds feed and breed in the gulf, including millions of migrating shorebirds that stop over each year to feed on the immense tidal flats surrounding the Bay of Fundy, including over 50 percent of the world's semipalmated sandpipers. The Gulf of Maine also supports hundreds of species of fish and shellfish, of which 52 species are commercially harvested.

Unique river systems, including the Delaware River, the longest undammed mainstem river east of the Mississippi, feed billions of gallons into the North Atlantic LCC's coastal waters. Many of the LCC's river systems are the focus of nationally significant restoration projects. One example is the Penobscot River Restoration Project, one of the largest, most creative river restoration projects in our nation's history. An unprecedented collaboration – hydropower company PPL Corporation, the Penobscot Indian Nation, six conservation groups, and state and federal agencies – working together to restore 11 species of sea-run fish to the Penobscot River while maintaining energy production. Successful implementation of the project will revive not only native fisheries but social, cultural and economic traditions of the Penobscot, New England's second largest river. Such projects generate interest and hope for restoring populations at landscape scales and serve as models for future work in the LCC.

The North Atlantic LCC's length creates a significant latitudinal gradient that stretches some 12 degrees from north to south. The LCC's latitudinal and topographic gradients create complexity and may contribute to resilience to climate change impacts.

#### *Demographics*

The North Atlantic LCC contains approximately 17 percent of the entire U.S. population; when populations in Nova Scotia and New Brunswick are included, the total is greater than 50 million people. While the LCC includes some of the nation's largest cities, portions such as the Northern Appalachian/Acadian ecoregion are sparsely populated and still wild. These areas include the Adirondack Mountains and Tug Hill Plateau of New York, northern Maine, the Gaspé Peninsula of Québec, and both the northern and southern tips of Nova Scotia. These large tracts of land remain wild as the majority of the human population is concentrated near coastal areas. According to U.S. census data, over 50 percent of the population of the North Atlantic LCC lives within 16 kilometers (10 miles) of the coast. Coastal habitats will be highly impacted by climate change and dense human populations will present a challenge for conservation design and delivery within the LCC. While the Northern Appalachian/Acadian ecoregion is still one of the most forested and wild ecoregions in eastern North America, it may be one of the most vulnerable simply because so much undeveloped land is unprotected and within reach of densely populated areas. Even in the face of large human population, severe environmental



*New York City*

shorelands and uplands continue to be rich in living resources, many of which are of significant economic and social value to the millions of people living in the region.

#### *Public awareness and engagement*

The North Atlantic LCC will be operating in a region characterized by a strongly engaged public aware of conservation and climate change issues and a long history of local, state, regional and international collaboration. An example of collaboration at the international level is Two Countries, One Forest, a major Canadian-U.S. collaborative of conservation organizations, researchers, foundations and conservation-minded individuals. The group recently completed an ecoregional assessment of the Northern Appalachian/Acadian region that covers a large portion of the North Atlantic LCC.

Evidence of public interest in climate change issues is evidenced by the fact that all 12 states located in the LCC have completed climate action plans. In addition, 10 Northeast and Mid-Atlantic states are signatories to the Regional Greenhouse Gas Initiative, a cooperative effort to limit greenhouse gas emissions that is the first mandatory, market-based CO<sub>2</sub> emissions reduction program in the United States. These ten states have capped CO<sub>2</sub> emissions from the power sector, and will require a 10 percent reduction in these emissions by 2018.

A strong cooperative and collaborative working relationship exists among states within the LCC; the Northeast Regional Conservation Needs grant program mentioned in Section II is an example. Its objectives are to address landscape-scale, regional, wildlife conservation issues by combining resources, leveraging funds and prioritizing conservation actions identified in state wildlife action plans. Many of the conservation needs identified in these plans are best addressed at a landscape-scale, which does not conform to state boundaries. Additionally, many conservation actions can be developed or implemented in one area of the Northeast with the results applicable and of benefit to the entire region. By combining financial resources, the Northeast states have created an efficient and effective mechanism to address landscape-scale and regional issues.

As a result of collaboration within state agencies and non-governmental organizations, a number of comprehensive datasets have been developed that cover the entire North Atlantic LCC area. These unique products include The Nature Conservancy's Northeast Fish Passage Initiative and Northwest Atlantic Marine ecoregional assessment, the Northeastern Terrestrial Habitat Classification System, and the Northeastern Aquatic Habitat Classification System. The latter two products provide a standardized habitat classification and mapping system that can serve as a valuable foundation for biological planning and conservation design in the North Atlantic LCC.

At the local level, the North Atlantic LCC leads the nation in the number of municipalities (226) that have signed U.S. Conference of Mayors Climate Protection Agreement. The goal and timeline of the agreement are reducing global warming emissions (CO<sub>2</sub>e) by 7 percent below 1990 levels by 2012. A total of 23 percent of all municipalities in the U.S. that have signed the agreement are located within the North Atlantic LCC.

While North Atlantic LCC contains some of the nation's lowest percentages of public land ownership, the region contains the nation's strongest network of land trusts. More than 350 local and regional land trusts partner with USFWS to protect important habitat within the North Atlantic LCC boundary. This figure represents almost 22 percent of all land trusts in the nation, and these organizations will play an important role in conservation delivery for the LCC. Finally, strong public support for fish and wildlife resource protection is indicated by a strong and widespread network of non-governmental conservation organizations.

#### *USFWS Northeast Region presence*

71 refuges, with 5.8 million visitors annually  
 25 hatcheries  
 92 threatened and endangered species and 11 candidates for protection  
 915 employees

### **IX. Additional Support that the Northeast Region will provide for LCC in fiscal year 2010**

The Northeast Region will collaborate and coordinate on LCCs with shared or overlapping areas of operation to ensure conformity of data development and science delivery.

#### *Appalachian LCC*

Although the North Atlantic LCC is targeted for full implementation in 2010, the Northeast Region also has great interest in initiating an LCC for the Appalachian area. The Northeast Region will be the lead for the Appalachian LCC and will coordinate closely with the Southeast and Midwest regions on its development. With existing partnerships, projects and USFWS offices moving forward with landscape-scale planning, this LCC has the opportunity to start immediately to build biological

planning and conservation design capacity that complement existing efforts, in addition to hosting partner meetings and developing contracts in fiscal year 2010. One of the key existing partnerships in the Appalachian area has already expressed a strong interest in helping to develop an Appalachian LCC. During its meeting in November 2009, the management board of the Appalachian Mountains Joint Venture agreed that it should embrace the opportunity afforded by LCC development, and therefore should play a role in developing the Appalachian LCC with USFWS Northeast, Southeast and Midwest regions and other partners within the conservation community. The Appalachian Mountains Joint Venture Management Board includes representatives from the USFWS, USGS, National Park Service, U.S. Forest Service, 10 state fish and wildlife agencies, The Nature Conservancy, American Bird Conservancy, National Audubon Society and the Wildlife Management Institute. Additional informal discussions have also occurred with partners associated with the Southern Appalachian Man and the Biosphere Program, including the National Park Service, USGS, U.S. Forest Service and The Nature Conservancy. These informal conversations with partners will be followed with a more formal process early in 2010. USFWS will be hosting a strategic habitat conservation workshop focused on the Appalachian region in January 2010, which will be an initial forum for discussing the development of an Appalachian LCC. Additionally, more formal conversations will be scheduled later in 2010, including key contacts from USFWS and partners in all three USFWS regions overlapping the Appalachian LCC area.



USFWS

*Wood thrush*

#### *South Atlantic LCC*

Most of the South Atlantic LCC area lies within the Southeast Region, which is the lead region for this LCC; however, a portion of the South Atlantic LCC lies in southern Virginia, which is part of the Northeast Region, and the Northeast Region has resource program offices operating there. The Southeast and Northeast regions have a history of coordination on topics of mutual concern through the Atlantic Coast Joint Venture, Atlantic Flyway Council and Atlantic Coastal Fish Habitat Partnership, whose boundaries include both the North Atlantic LCC and South Atlantic LCC areas, and these partnerships can serve as conduits for coordination between the two LCCs as well as with the Peninsular Florida LCC. The Northeast Region

has and will continue to provide significant support to South Atlantic LCC in a coordinated effort to most effectively and efficiently conserve migratory birds and other trust resources common to these congruent geographic areas.

Several resource program offices are located within the Northeast Region's portion of the South Atlantic LCC and have been heavily engaged in ongoing cross-regional and interagency conservation projects as part of the Eastern North Carolina/Southeastern Virginia Strategic Habitat Conservation Team. This team, whose membership includes representatives from the USGS and USFWS, has been instrumental in federal, state, local and private partner coordination within the northern sub-unit of this geographic area. Further, this team will be hosting a structured decision-making workshop in 2010 to further develop this broad-scale conservation partnership in support of the LCC. Additionally, several Northeast Region representatives serve on an internal South Atlantic LCC Advisory Group which, in conjunction with an Interagency Scoping Team, is playing a key role in the development of this LCC.



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*American oystercatcher*

#### *Great Lakes LCC*

The Midwest Region will be the lead region for the Great Lakes LCC, with the Northeast Region contributing significantly, particularly with respect to activities in Lakes Erie and Ontario. The Northeast Region has several resource program offices operating within the geographic framework for the Great Lakes LCC. After an initial organizational meeting in October 2009, the Midwest Region and the Northeast Region have formed a cross-regional team of project leaders to begin scoping the form and function of the Great Lakes LCC. Three project leaders from each region were identified to serve on the inter-regional planning team; they will begin their scoping task immediately after each region completes its initial plans for the LCCs being promoted for full functionality in 2010. The scoping document provided by this team will contribute significantly to the development and operations plan ultimately developed for the Great Lakes LCC. The scoping process will be initiated in December 2009, when USFWS will host a series of briefings by Web-conference with follow-up to elicit

input about perceived needs for science capacity within the Great Lakes LCC. Web-conferences will be set up for both partner input and input from USFWS project leaders, program supervisors and assistant regional directors who work within the Great Lakes LCC. The planning team will review the input from USFWS staff, partners and other sources, set objectives, construct alternatives and analyze tradeoffs. The team will present its analysis and findings during a meeting in late January or early February to select a preferred alternative for implementing the Great Lakes LCC.



USFWS

*Common goldeneye*

## Appendix A.

Project proposals that have been developed for addressing science needs and that have been identified by the Northeast Region's SHC/Climate Change Team as high priorities for implementing under the LCC in addition to those identified in Section VI.

**Project title:** Guidance on next steps for biological planning in the Northeast Region: identifying representative species and management objectives in geographic areas

**Cost:** \$65,000.00

**SHC element:** Biological planning

**Duration:** 1 year

**Partners:** USFWS, Northeast state fish and wildlife agencies, non-governmental organizations and other federal agencies

**Project description:** In an attempt to provide coordinated management direction to USFWS programs and partners in Region 5, we propose a five-step approach to biological planning, with the development of explicit management objectives for representative species by geographic area as an end product. These steps are consistent with the Northeast Region Strategic Habitat Conservation Concept Plan and the *SHC Handbook: A Guide to Implementing the Technical Elements of Strategic Habitat Conservation*.

In an ideal world, the conservation needs of all priority species would be evaluated and addressed. The selection and use of a smaller subset of species, hereafter referred to as representative species, is a necessary planning and design shortcut to simplify the complexity and reduce the list of priority species



to a more manageable subset (SHC Handbook).

While recognizing that all priority species are important, we reduced the overall list to facilitate more detailed planning, conservation design and evaluation based on fewer species. Work accomplished on representative species should benefit groups of species that have similar basic habitat needs and responses to management. The long-term goal is to address all priority species with appropriate levels of planning, conservation design, delivery and monitoring. In the meantime, representative species will help USFWS, states and other partners make better decisions about managing trust resource responsibilities. Single or multiple species may be selected to represent a larger group or guild of species using habitat types, such as species using freshwater emergent marshes, or ecosystem functions, such as species that respond to natural fire regimes (Hagan and Whitman 2006, Mills 2007).

Although biological planning takes place at multiple spatial scales from the range-wide down to the local scale, the steps proposed here can be applied within the geographic areas defined in the national geographic framework developed by USFWS in summer 2009. These geographic areas have been adopted by the USFWS directorate as the spatial units within which biological planning and conservation design will occur across the country. LCCs are being developed in each geographic area and will be the primary units responsible for biological planning and conservation design within the geographic area.

**Project title:** Dial-a-stream: a Web-based, GIS decision support system for prioritizing management actions based on sub-population persistence in the face of climate change

**Cost:** \$537,076.00

**SHC element:** Conservation design

**Duration:** 3 years

**Partners:** University of Massachusetts, The Nature Conservancy, National Fish and Wildlife Foundation, USGS Climate Change and Wildlife Center, U.S. Forest Service

**Project description:** We propose to combine the key components of our proposal “Hierarchical modeling of coupled physical/biological processes: climate change effects on persistence of eastern salmonids” with our dial-a-stream framework. This will improve the dial-a-stream proposal by providing state-of-the-art modeling of population processes in stream networks. In this amended proposal, we retain all components of the dial-a-stream concept and add the critical, innovative modeling components from the hierarchical modeling proposal.

In addition to developing and applying the modeling approach (described briefly below; please see the original ‘Hierarchical modeling...’ proposal for details) to our well-studied stream fish populations, we suggest that the approach will be an effective way to model climate change effects on population processes across a wide variety of systems. As amended, our approach will provide detailed modeling of a system of major

concern (stream salmonids) and will develop the dial-a-stream decision support tool. While this is an important advance, the broader value of the proposed research is the development of a statistical modeling approach that could be easily adapted to model climate change effects for any focal species.

**Products**

1. Web-based GIS tool for catchment prioritization and evaluation of conservation strategies in the face of climate change. This will be the major application developed for use by managers in this proposal. We will work iteratively with managers to improve functionality and ease of use.
2. Hierarchical modeling framework to account for multiple scales and sources of uncertainty in climate change predictions. This is the Bayesian hierarchical statistical model.
3. Statistical models to predict stream flow and temperature based on air temperature and precipitation. These models will be simple regression models of the relationships between stream temperature and air temperature and between stream flow and precipitation.
4. Downscaled global circulation models. Predictions of air temperature and precipitation for study areas and for input into the Web-based tool.
5. Scientific publications. We anticipate producing at least 8 scientific publications stemming from this work.

**Project title:** A geophysical and resilient system approach to climate change adaptation  
**Cost:** \$57,000.00 SHC element: Conservation design

**Duration:** 1 year

**Partners:** The Nature Conservancy, USFWS, U.S. Forest Service, Northeast state fish and wildlife agencies, University of Massachusetts

**Project description:** The changing climate has introduced a new set of questions for conservationists concerning how to manage for biodiversity in an unstable and dynamic world (Heller and Zavaleta 2009). Currently, the majority of published research has focused on modeling individual species distributions by linking their current distribution patterns to climate envelopes and projecting changes based on predictions about the climate (Guisan and Thuiller 2005). However, predicting the responses of every individual species to climate change is not feasible and would be hampered by uncertainty. Alternatively, it has long been known that rare species’ locations are highly correlated with bedrock geology, landforms and elevation. For example, in the Northeast over 151 rare species are 80 percent or more restricted to calcareous geology, and 141 rare species are restricted to coastal outwash sand (Table 1). Moreover the species richness of each state is highly correlated to the geology type, elevation range and central latitude within each state (Anderson and Ferree 2009 in prep).

Our working hypothesis is that, although the species and communities that currently characterize these settings will shift to novel assemblages in the future, the underlying importance of the geophysical setting will remain. The features and settings,

such as fine-sediment basins, subterranean caves, alpine summits or a limestone valley bottoms have supported a changing cast of species throughout history and remain critical in maintaining the diversity of the region. Thus, conserving specific geophysical settings, determined by current species distribution patterns, may offer an approach to conservation that protects diversity under both current and future climate regimes (Anderson and Ferree 2009, in prep). Moreover, connections between occurrences of the same setting may become increasingly important in maintaining diversity while adapting to the changing climate. Currently, the protection of many geophysical settings in the Northeast is highly skewed towards acidic bedrock, steep slopes and high elevations, creating risks for species associated with low elevation rich soil settings such as floodplains or limestone valleys (Anderson et al. 2006). This proposal approaches climate change adaptation by focusing on ecological resilience and the evaluation of key geophysical settings that underlie the biodiversity patterns of the region. Recent literature on conserving biodiversity in a changing climate has focused more on estimating the vulnerability of systems than on resilience. Vulnerability is defined as the degree to which a system is susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes (IPCC 2007). Resilience, the antonym of vulnerability, concerns the ability of a system to adjust to climate change with moderate potential damages, take advantage of opportunities, or cope with the consequences – the capacity to adapt (IPCC 2007). Identifying the most resilient examples of each key setting will give conservationists a nuanced picture of the places where conservation is most likely to succeed.

**Project title:** Modeling climate change influence on instream habitats for freshwater mussels in Atlantic slope and Appalachian river systems of the Northeast

**Cost:** \$305,000.00

**SHC element:** Conservation design

**Duration:** 3 years

**Partners:** USGS, USFWS, The Nature Conservancy, state fish and wildlife and water resource agencies

**Project description:** Aquatic species are particularly vulnerable to larger-scale impacts to water quality and habitat. Extended drought periods brought on by climate change will exacerbate existing water quality concerns and raise new concerns regarding water availability. Climate change increases the necessity of better water resource planning to meet the needs of communities, agricultural operations and natural resources. To date, state permitting agencies do not have quantitative projections of instream flow on which to base water withdrawal permit decisions, although withdrawal permits frequently span time periods of 30 to 50 years. State agencies will partner with USFWS, USGS, and The Nature Conservancy to improve knowledge of potential climate-induced

risks to mussel habitats, and implications for water resource planning ahead of major climate shifts.

All federal agencies, in coordination with USFWS, are responsible for section 7 consultation under the ESA to assess affects of water withdrawals, proposed development or other proposed actions that may effect federally listed species or their designated critical habitat. The proposed climate change and mussel habitat models would allow the USFWS to make more accurate determinations regarding impacts to listed species, and whether those impacts affect species survival and recovery over the long-term, which is a decision critical to both economic and conservation interests. Other areas of the U.S. are keenly aware of the potential for conflict when instream flows are inadequate to support multiple uses. Current consultation decisions are based on historic flow data and available site-specific species information, coupled with best professional judgment on climate change affects. Modern society and the risk of legal challenges require the ESA consultation process to be based on more sophisticated scientific analyses. Well-designed models grounded in standardized field data offer the best scientific approach to predicting economic and conservation outcomes resulting from changes to our climate. The proposed models would greatly improve regulatory agency decision-making; they would also increase the potential for innovative partnerships to develop strategies by which species and their habitats could be conserved to increase the likelihood of survival and recovery over the long-term. USFWS has non-regulatory mechanisms to work cooperatively with communities and industry to plan for and mitigate effects to listed species and their habitats. There are opportunities through the ESA to fund on-the-ground adaptations to local climate change impacts, and availability of the proposed models would increase the likelihood of getting community buy-in for these voluntary collaborative efforts. Recovery plans describe recovery challenges for mussel species as falling into three categories: the relative isolation of their remaining populations, their apparent sensitivity to common pollutants, and continued threats to their habitats. All of these will likely be exacerbated by the effects of climate change.

**Project title:** Changing landscapes and changing climate: can complex stream networks buffer salamander populations from decline?

**Cost:** \$379,408.00

**SHC element:** Research

**Duration:** 4 years

**Partners:** National Park Service, U.S. Forest Service, USFWS, USGS, University of Maryland, Hubbard Brook Experimental Forest

**Project description:** Amphibian populations living in stream networks are at risk of extinction, especially in the Northeast Amphibian Research and Monitoring Initiative region where large-scale landscape change is occurring (Price et al. 2006). Among vertebrates, amphibians are often cited as good indicator species and species of conservation concern because their life histories, dispersal

abilities and physiological tolerances make them potentially susceptible to environmental change (Welsh and Olivier 1998, Semlitsch 2003). Further, because these species are important components of the food web (Davic & Welsh 2004) and use both terrestrial and aquatic habitats, management actions designed to improve habitat quality for amphibians are likely to have ancillary benefits for other components of the ecosystem (Welsh and Olivier 1998). The branching geometry of stream networks may facilitate persistence of salamander populations, and both empirical data (Lowe and Bolger 2002, Grant et al. 2009) and theory (Fagan et al. 2009) indicate that streams with confluent branches have higher local population sizes, higher occupancy probability across sites, and decreased metapopulation extinction risk. The complexity of the network, particularly the number and position of small-order stream branches, has a great impact on metapopulation extinction risk (Fagan et al. 2008). Understanding and exploiting these benefits of connectivity in stream networks may be critical to prevent extinction of stream amphibians exposed to the impacts of climate change and land transformation (e.g., Fortuna et al. 2006). Because small side branches are often inaccessible to fish predators, survival and reproduction of stream amphibians can be very high in these sites (Peterman et al. 2008), increasing their importance as immigrant sources. Climate models predict substantial changes in precipitation in the Northeast region, with higher winter and lower summer precipitation (Hayhoe et al. 2007), leading to reduced runoff and lower base stream flows (Huntington 2003). Because base stream flows in side branches and headwaters are low under normal circumstances, these sites are especially vulnerable to the combined effects of climate change and landscape alteration, which may cause significant reductions in their length and overall density (Sophocleous 2007, Winter 2007). Our goal is to assess broadly how immigration from small tributary streams affects the persistence and dynamics of stream amphibian populations in larger stream systems. We will test for effects of network structure on salamander occupancy in streams throughout the central and northern Appalachians and Atlantic Coastal Plain and quantify the demographic contribution of dispersal from small tributary to mainstem streams.

## Appendix B.

Projects descriptions of high priority science needs that would exceed the initial regional allocations for science capacity. These projects also represent excellent opportunities for addressing cross-LCC science needs.

**Project title:** Designing sustainable landscapes in the eastern United States

**Cost:** \$800,000.00

**SHC element addressed:** Conservation design

**Duration:** 3 years

**Partners:** USFWS, U.S. Geological Survey, Atlantic

Coast Joint Venture, U.S. Forest Service, State Fish and Wildlife Agencies in the eastern U.S., Universities and Fish and Wildlife Cooperative Research Units in the Northeast, National Audubon Society

**Project description:** The overall goal of this proposal is to develop a consistent methodology and to enhance the capacity of states, joint ventures and other partners to assess and design sustainable landscape conservation for birds and other wildlife in the eastern United States. Specifically, this project would develop and implement a framework and tools to:

(1) Assess the current capability of habitats in ecoregions in the eastern United States to support sustainable wildlife populations. The project would develop and/or refine a set of habitat-relationship models based on the ecological systems land cover and other habitat attribute data developed by regional gap analysis and others representing major habitat types in ecoregions of the eastern United States. The set of species modeled would be derived partially from priority species and species-habitat suites from State Wildlife Action Plans and bird conservation plans. Methods and models will be developed in cooperation with partners from multiple ecoregions and will be directly applicable to the entire set of ecoregions covered by Eastern Regional Gap Analysis as those data become available.

(2) Predict the impacts of landscape-level changes (e.g., from urban growth, succession, climate change and conservation programs) on the future capability of these habitats to support populations of migratory birds. The project would model predicted changes in land use and land cover patterns to predict changes in the capability of habitats to support priority populations. For example, one output of urban growth models is the pattern of habitat patches across the landscape showing loss, fragmentation and conversion of habitats due to urbanization and suburbanization. These outputs can be used in species-habitat models developed in this project to predict any reduction or change in capability of landscapes to support populations and, thus, be used to determine whether populations can be sustained at different levels of urban growth. When available, predicted impacts from climate change including changing vegetation patterns, hydrology and sea level also can be related to populations. Success under this objective would be the completion of predicted habitat maps and data under future scenarios and associated habitat and population capabilities data. These results will allow states and other partners the ability to conduct long-term planning to prevent species falling below critical thresholds.

(3) Target conservation programs to most effectively and efficiently achieve habitat objectives in state wildlife action plans and conservation plans and evaluate progress under these plans. Decision support tools would be developed using habitat data layers from regional gap analysis and species-habitat models to determine where conservation should be targeted to optimally achieve population objectives.

These tools will allow managers to determine how to target and optimize habitat conservation for a single species, multiple species using similar habitats or multiple species using multiple habitats in a diverse, dynamic landscape using limited resources. These tools will allow managers to compare and evaluate the expected outcomes from potentially conflicting management alternatives benefiting some species but having negative effects on others (e.g., decisions about whether to manage an area as a grassland or shrubland). This project would be coordinated closely with the South Atlantic LCC. Pilot implementation of this methodology has already begun within the south Atlantic coastal plain ecoregion through a multistate conservation grant, and lessons learned through that effort would inform the efforts undertaken in the North Atlantic LCC.

**Project title:** Strategic habitat conservation (SHC) implementation plan to meet Waterbird management needs within Atlantic and Mississippi flyways

**Cost:** \$150,000.00

**SHC element addressed:** Monitoring

**Duration:** 3 years

**Partners:** USFWS, USGS, Atlantic Coast Joint Venture, Northeast Association of Fish and Wildlife Agencies, Southeast Association of Fish and Wildlife Agencies, State of Missouri Department of Natural Resources

**Project description:** Improved resource contributions toward waterfowl, shorebirds and marshbirds (hereafter referred to as waterbirds) may be realized by cross-scale integration of management actions across multiple spatial scales from the flyway scale down to local wetland management sites. Presently, little coordination occurs among management sites, resulting in many disparate efforts that may not meet all waterbird needs at the appropriate spatial or temporal scales. Additionally, management decisions are often made in the absence of supporting monitoring information. The application of consistent monitoring protocols across spatial scales that informs management decisions will increase the collective contribution of wetland management actions to meet waterbird habitat needs.

The following integrated management and monitoring template represents the results of three structured decision-making (SDM) workshops convened over the past 18 months to develop a framework for waterbird management and monitoring at the local, regional and flyway spatial scales. SDM is an organized approach to evaluate a set of alternatives to achieve management objectives. The process is designed to explicitly deal with uncertainties and help decision-makers develop transparent and defensible decisions. The key elements of a structured-decision process are clear and measureable objectives, a set of management actions from which to choose, and some expectation of consequences (a model) related to each potential management action. Having completed these three

independent SDM workshops, representatives from each SDM team are working to merge these efforts into this integrated implementation plan.

In addition to the spatial integration noted above, the proposed program also includes several other elements of integration. Taxonomic integration is accomplished by addressing the needs of the three bird groups that are often addressed separately. Population-habitat integration is accomplished by synthesizing information on the biology of waterbird species and habitat dynamics at different spatial scales, and making predictions about how populations respond to habitat management. Our proposed program will also accomplish integration of management agencies by working toward multiple land management objectives. Finally, we believe that the explicit integration of management and monitoring is essential for providing the information necessary to evaluate progress toward management objectives, improve future management decisions, and improve the efficiency of resource allocation.

**Project title:** Identifying coastal habitats at risk due to climate change

**Cost:** \$6.2 million

**SHC element addressed:** Biological planning

**Duration:** 4 to 6 years

**Partners:** USGS, NASA, state fish and wildlife agencies, The Nature Conservancy and others working collaboratively with LiDAR and other tools

**Project description:** Sea level rise will pose major conservation and management challenges at U.S. coastal sites, and it is important that the USFWS develop management plans that incorporate future impacts if we are to successfully adapt and continue to conserve important ecological resources. Specific plans must address several important questions: which habitat types are most threatened; how much habitat is in jeopardy; what is the potential for habitat migration; and are there management actions that can be taken to facilitate climate change adaptation and habitat migration. Project collaborators are using existing data and gathering new remote sensing (i.e., LIDAR = light detection and ranging) data to create an accurate digital elevation model to map the current distributions of important habitats, identify areas of greatest impact from rising sea levels, quantify the rate of habitat change, and identify areas that are important for coastal wetland migration. Areas and habitats that will become important to trust species in the future as climate change causes habitats to migrate and convert will be identified and targeted for future acquisition or conservation. Habitats at risk due to climate change will be identified and recommendation on where to target future acquisitions will concentrate on representing at-risk, uncommon, or important vegetative communities. Models of the impact of sea level rise on coastal beaches, marshes and other coastal habitats would be developed that account for ecoregional and local differences in relative sea level rise and account

for the ability of coastal systems to respond (e.g., through increased marsh accretion and growth). These models would build on ongoing work conducted by the U.S.G.S. and Atlantic Coast Joint Venture. This project could be applied to all coastal areas in the U.S.

**Project title:** Characterizing water resources and needs on and off USFWS lands for conservation of priority fish and wildlife resources

**Cost:** \$1,000,000

**SHC element addressed:** Biological planning

**Duration:** 3 years

**Partners:** State fish and wildlife agencies, Atlantic Coast Joint Venture, Atlantic Coast Fish Habitat Partnership, Eastern Brook Trout Joint Venture, Atlantic States Marine Fisheries Commission, Mid-Atlantic Northeast Maritimes Waterbird Conservation Partnership, and Atlantic Flyway Council, Manomet Center for Conservation Science, National Wildlife Federation, The Nature Conservancy

**Description:** The combined effects of climate change, urbanization, population growth and changes in land use are placing greater demands on the water resources in the Northeast. Competition for water is on the increase to support water supplies, industrial use, hydropower, snow making at ski resorts and natural resource management to name but a few. In response to the increased competition for water in the East, USFWS needs to better assess the water resources, including groundwater/surface water sources and quantity and

quality, necessary to support our national wildlife refuges and national fish hatcheries. Additionally, we need to assess water needs for priority species to ensure their survival. What changes in the hydrology/stream flow will result from climate change? How will changes in hydrology/stream flow in combination with permitted and non-permitted water withdrawals impact the conservation and management of water dependent species? Typical water withdrawal permits are issued for approximately 50 years and do not take into account changes in river hydrology and stream flow in response to climate change. For example, in the Upper Tennessee River Basin (UTRB) of southwest Virginia and northeast Tennessee understanding the water needs, i.e., water flow, quantity and quality necessary to support listed mussels and fish, the hydrologic impacts to the UTRB associated with climate change, and permitted and non-permitted water withdrawals is essential to guide resource management actions. This approach will be vital when examining long-term impacts to water availability in the Northeast due to climate change, increased population growth, urbanization and changes in land use patterns. Understanding what our water resources are and the quantity and quality needed to manage resources on and off USFWS lands will assist managers in implementing effective conservation actions for priority resources and position USFWS to be effective in future debates on water rights issues in the East.



USFWS

*Clean, clear water may become a dwindling resource*

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