



A Climate Change Impact Assessment for White Mountains (NH) & Mahoosuc Region (ME)

Facilitators: Tom Doak, Small Woodland Owners Association of ME
Bryan Wentzell, Appalachian Mountain Club
Robin Zinchuk, Bethel Area Chamber of Commerce

Highlighted Sectors: Forestry, Nature-based Recreation & Habitat Conservation

Geographic boundaries: The northern Presidential Mountain (ME), Carter, and Mahoosuc Mountain Ranges (NH and ME) and adjacent areas.

Description: This region is dominated by the Presidential Mountain (ME), Carter, and Mahoosuc Mountain Ranges and extends from the White Mountain National Forest north to the mountains near Andover, Maine. These highly scenic mountain ranges are broken up by the upper headwaters of the Androscoggin, Saco, and Connecticut Rivers. The major settlements are in the valleys and include in NH: Conway, North Conway, Gorham, Berlin, and Errol, and in ME: Fryeburg, Lowell, and Bethel. The region's highly productive timberlands feed industries ranging from large pulp and paper mills to small high-end wood products companies that use high-tech engineering. Hence, its forest products sector has the highest percentage of jobs of anywhere in New England. It is also famed for its wealth of recreational opportunities, including nationally acclaimed hiking (most notably on the Appalachian Trail), and a variety of rivers and streams, including the Androscoggin and Rapid Rivers, which provide opportunities for canoeing, boating, swimming and fishing. Hence the tourism industry may directly account for 20-50% of the jobs in many towns. The diverse landscape provides critical wildlife habitat ranging from expansive alpine ridges to the wetland complexes of the Umbagog National Wildlife Refuge and connects the White Mountain National Forest with the Maine Woods. Because of the region's natural amenities, development for second homes, especially in the southern portion of the region, has greatly accelerated and may account for over 10% of homes. Although the overall human population has slowly changed, there has been a 17% increase in human population and 21% increase in housing units from 1990 to 2000 in the LURC jurisdiction (unorganized towns in Maine) in this region (Bell 2007). A key challenge to sustainable development is to provide affordable housing, a challenge in this region that now affects both middle-income families as well as low-income families. An often sought solution is to seek housing where land costs make housing affordable (i.e., in undeveloped rural areas) which exacerbates the threat of sprawl.

Some Key Organizations.

Municipalities with planning capacity: Andover (ME), Berlin (NH), Bethel (ME), Conway (NH), Dummer (NH), Fryeburg (ME), Milan (NH), Gorham (NH), Shelburne (NH), Newry (ME), North Conway (ME).

Regional Planning Organizations: Androscoggin Valley Economic Recovery Corporation (ME), Androscoggin Valley Council of Governments (AVCOG), Coos County Planning Board (NH), Maine Land Use Regulation Commission (ME, unorganized towns)

Land Conservation Organizations: Upland Headwaters Alliance (ME & NH), Upper Saco Valley Land Trust (ME & NH), Mahoosuc Land Trust (ME), The Appalachian Trail Conference Land Trust, Ammonoosuc Conservation Trust (NH), The Conservation Fund, The Nature Conservancy – Maine Chapter, New England Forestry Foundation, Open Space Institute, Trust for Public Land.

Other Conservation Organizations: Androscoggin River Watershed Council, Carroll County Conservation District, Coos County Conservation District, Oxford County Soil and Water Conservation District, Eastern Brook Trout Joint Venture

Major Forest Landowners: Bayroot LLC, Bob Brown, Haskell, The Forestland Group, GMO, ME Bureau of Parks and Lands, Plum Creek Timber Company, Rene Benard, Inc., Sunday River, T.R. Dillion, Yankee Forest, Wagner Forest Management.

Recreational Organizations: The Appalachian Mountain Club, Appalachian Trail Conservancy, Androscoggin Valley Fish and Game Association, Bethel Area Trails Committee, Upper Andro Anglers Alliance, Mollyocket chapter of Trout Unlimited, three ATV clubs and a dozen snowmobile clubs

Educational Institutions: University of Maine at Farmington, and University of Maine at Orono, White Mountains Community College (Berlin, NH)

Other: Mahoosuc Initiative (ME-NH coalition), Small Woodland Owners Association of Maine

Select Natural Resource Attributes:

Forestry: The region is 98% forested and so the timber industry is a mainstay of the economy and by far the dominant land use. Large timberland owners are most common in the northern part of the region with small landowners less interested in harvesting timber occupying southern areas. About 63% of the forestland is in northern hardwood, 10% is in spruce-fir forest types, about 14% in oak and/or pine forest types, and the balance is in miscellaneous forest types. In Oxford County, 46% of the forest is pole timber and 42% is sawtimber with a balance in seedlings/saplings. About 750,000 cords are harvested annually from the northern half of the region (towns along the Androscoggin and north), roughly 1/3 is pulp, 1/3 is chips, and 1/3 is sawtimber. Over 20,000 acres are dually FSC and SFI certified and about 15,000 acres are SFI certified such that about 10% of the forest area is certified. Pulp and paper mills (in Rumford, Jay, Madison, and Skowhegan), over a dozen sawmills, a half-dozen secondary wood products manufacturing plants, and biomass plants provide essential markets for wood fiber of this region. The mix of primary mills and secondary manufacturing, and traditional and innovative wood industries, keeps this sector economically strong. Development-driven parcelization of large land parcels may be attracting new forest landowners uninterested in timber harvesting. Much of the White Mountains National Forest (a significant timberland owner) is not available for timber harvest. Weak global markets threaten viability of the forest products sector though outside investors have recently capitalized forest products plants. In Berlin, this has led to the shutting down of paper mills though there is a strong effort to re-create a vibrant wood product industry.

Nature-based Recreation: The White Mountains and Mahoosuc Ranges form the most rugged region in New England. The major settlements in the valleys provide lodging and jumping off points for recreationists. The mountains are sparsely settled and are where most recreation activities occur. They include over 60,000 acres of roadless areas. The region has over 286 nature-based sites including 14 golf courses, 8 winter sports areas, and over 100 water access points. It includes over 700 miles of ATV trail, 8 downhill ski resorts with 100% of trail with snow making ability, and over 8 x-country ski areas. Jericho Mountain State Park is the center piece for ATV riding in the region with over 100 miles of trails. White Mountain National Forest contains over 1200 miles of hiking trails and 1800 miles of snowmobile trails. Two ITS [Interconnected Trail System] snowmobile trails pass through the region. The increasing turnover of private landownership makes it increasingly challenging to maintain trail and access agreements on private lands. The region also includes two canoe trails, the Androscoggin River Canoe Trail (40 miles) and Northern Forest Canoe Trail. The Magalloway, Rapid, and upper Androscoggin Rivers offer superb opportunities for white water kayaking and canoeing. New Hampshire has identified two Watchable Wildlife Sites in the region: Pontook Reservoir and Thirteen Mile Woods.

Hunting and fishing access is high in the northern half of the region due to an extensive logging road network but reduced in the southern half due to a limited road network in the White Mountains NF. This region has high-quality trophy quality deer hunting despite poor habitat conditions and low deer densities. The highest bear harvest levels are found in the Bethel/Newry/Andover area. Moose harvest levels are higher in this region than adjacent areas to the south. Commercial forest areas offer good upland bird hunting. Lake Umbagog National Wildlife Refuge offers outstanding waterfowl hunting. Many streams support healthy coldwater fisheries. The Rapid River is well known for its trophy native brook trout (4-10 pounds) since the 19th century but is threatened by the introduction of small mouth bass. The upper Androscoggin also supports an exemplary coldwater fishery of native brook trout and stocked fish. Ice fishing is popular throughout the region including on Lake Umbagog, the Pontook Reservoir of the Androscoggin, Head Pond, South Pond, Jericho Lake, and Lower Richardson Lake. Anglers may catch smallmouth bass, northern pike, brook trout, yellow perch, and other fish. Posting on private lands is an increasing threat to public access and outdoor recreation.

Habitat Conservation:

Unique Features: The high mountains of this region include the greatest extent of alpine and sub-alpine forest plant communities in the northeast. They provide extensive habitat for many of the region's rare and endemic alpine plant species and rare boreal plant and animal species, such as the Bicknell's Thrush, and include over a half-dozen natural communities that are rare or exemplary state or region-wide. High elevation forests support population of many northern and boreal species (e.g. pine marten, blackpoll warbler). Many headwater streams are in excellent condition and support healthy populations of cold-water fish and other aquatic species. Private working forests contribute much of the wildlife habitat in the region but may threaten species requiring large (>1000 acre) blocks of mature forest (e.g., pine marten) and old forest species. Development disproportionately threatens low elevation natural communities. Exotic and invasive species are not considered a key threat to upland habitats in this region though introduction of warm water fish species may threaten cold water fish species. Unmanaged recreation and trail overuse may pose a threat to rare and high elevation plant communities (Maine Natural Areas Program 2008b). Poorly managed logging roads may potentially threaten wetland habitats that support global rare species (Beginning with Habitat 2009a, Maine Natural Areas Program 2008a).

Conservation Lands: About one-half of the region is under permanent conservation ownership or easement, most of which is in the southern half of the region. In the northern half, 16.6% is in conservation fee ownership and 2.2% is protected through conservation easement.

Federal Lands: Umbagog National Wildlife Refuge (26,000 acres in fee and about 20,000 acres in easement of wetland and forested upland habitat), Appalachian National Scenic Trail, White Mountain National Forest (about 200,000 acres).

State lands: The region has several key conservation areas including the Mahoosuc Public Reserved Land (ME, 27,000 acres which includes the 9,993 acre Mahoosuc Ecological Reserve of alpine ridge and sub-alpine forest), Grafton Notch State Park (ME, 3,000 acres), the Richardson Public Reserved Land (ME, 17,800 acres), Jericho Lake State Park (NH, 7200 acres), Milan Hill State Park (NH, 127 acres), Moose Brook State Park (NH, 770 acres), Nash Stream State Forest (NH, about 10,000 acres in this region).

Municipal Lands: Nine towns own about 10,000 acres of forest.

NGO lands: Upland Headwaters Alliance (ME & NH), Upper Saco Valley Land Trust (470 acres), Mahoosuc Land Trust (1349 acre), Ammonoosuc Conservation Trust (about 1000 acres).

Other High-value Areas (some lack permanent protection): Mahoosucs Focus Area (45,000 acres, mostly protected), Kezar Pond Fen Focus Area (1000 acres), Umbagog Wetlands to C Pond Focus Area (13,000 acres, partially protected), Upper Saco River Focus Area (partially in region, 30,000 acres in part), White Mountains Focus Area (37,000 acres, mostly protected).

References:

- Beginning with Habitat. 2009a. Focus Areas of Statewide Ecological Significance: Mahoosucs. Beginning with Habitat, Department of Inland Fish and Wildlife, Augusta, ME.
- Beginning with Habitat. 2009b. Focus Areas of Statewide Ecological Significance: Upper Saco River. Beginning with Habitat, Department of Inland Fish and Wildlife, Augusta, ME.
- Bell, K. 2007. Houses in the Woods: Lessons from the Plum Creek Concept Plan. Maine Policy Review, Winter 2007: 44-55.
- Keeping Maine's Forests Steering Committee. 2010. Keeping Maine's Forests: A Landscape Forest Conservation Initiative. Keeping Maine's Forests Initiative, Brunswick, ME.
- Maine Department of Conservation. 2009. Maine State Comprehensive Outdoor Recreation Plan 2009-2014. Maine Department of Conservation, Bureau of Parks and Lands, Augusta, ME
- Maine Natural Areas Program. 2005. Ecoreserve fact sheet for Mahoosucs Unit. Maine Natural Areas Program. Department of Conservation, Augusta, ME
- Maine Natural Areas Program. 2008a. Umbagog Wetlands to C Pond Focus Area Description. Maine Natural Areas Program. Department of Conservation, Augusta, ME.
- Maine Natural Areas Program. 2008b. White Mountains Focus Area Description. Maine Natural Areas Program. Department of Conservation, Augusta, ME.
- McWilliams, W.H., B.J., L.E. Caldwell, D.M. Griffith, M.L. Hoppus, K.M. Laustsen, A.J. Lister, T.W. Lister, J.W. Metzler, R.S. Morin, S.A. Sader, L.B. Stewart, J.R. Steinman, J.A. Westfall, D.A. Williams, A.A. Whitman, C.W. Woodall. 2005. The forests of Maine: 2003 Resour. Bull. NE-164. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 188 p.
- Ritchie, S. 2010. Noteworthy Hunting and Wildlife Management Information by Region: Region D – Rangeley Region. ME Department of Inland Fish and Wildlife, MDIF&W Regional Office, Machias, ME.
- Polak, M., J. List, K. G. Siegel. 2007. Mahoosuc Region Resources Report: Volume 1: Resource Values. Mahoosuc Land Trust, Androscoggin River Watershed Council, Tri-County Community Action Program, Bethel, ME.
- Polak, M., J. List, K. G. Siegel. 2007. Mahoosuc Region Resources Report: Volume 2: Tools for Conservation and Community Development. Mahoosuc Land Trust, Androscoggin River Watershed Council, Tri-County Community Action Program, Bethel, ME.

Society for the Protection of New Hampshire Forests. 2005. New Hampshire's Changing Landscape. Society for the Protection of New Hampshire Forests, Concord, NH

State of New Hampshire. 2007. New Hampshire Outdoors 2008-2013 Statewide Comprehensive Outdoor Recreation Plan. Department Of Resources and Economic Development. Concord, NH.

Wake, C.,E. Burakowski, and L. Goss. 2006. Winter Recreation and Climate Variability in New Hampshire: 1984-2006. Climate Change Research Center, Institute for the Study of Earth, Oceans and Space, University of New Hampshire, Durham, NH. Prepared For: The Carbon Coalition and Clean Air – Cool Planet Portsmouth, NH.

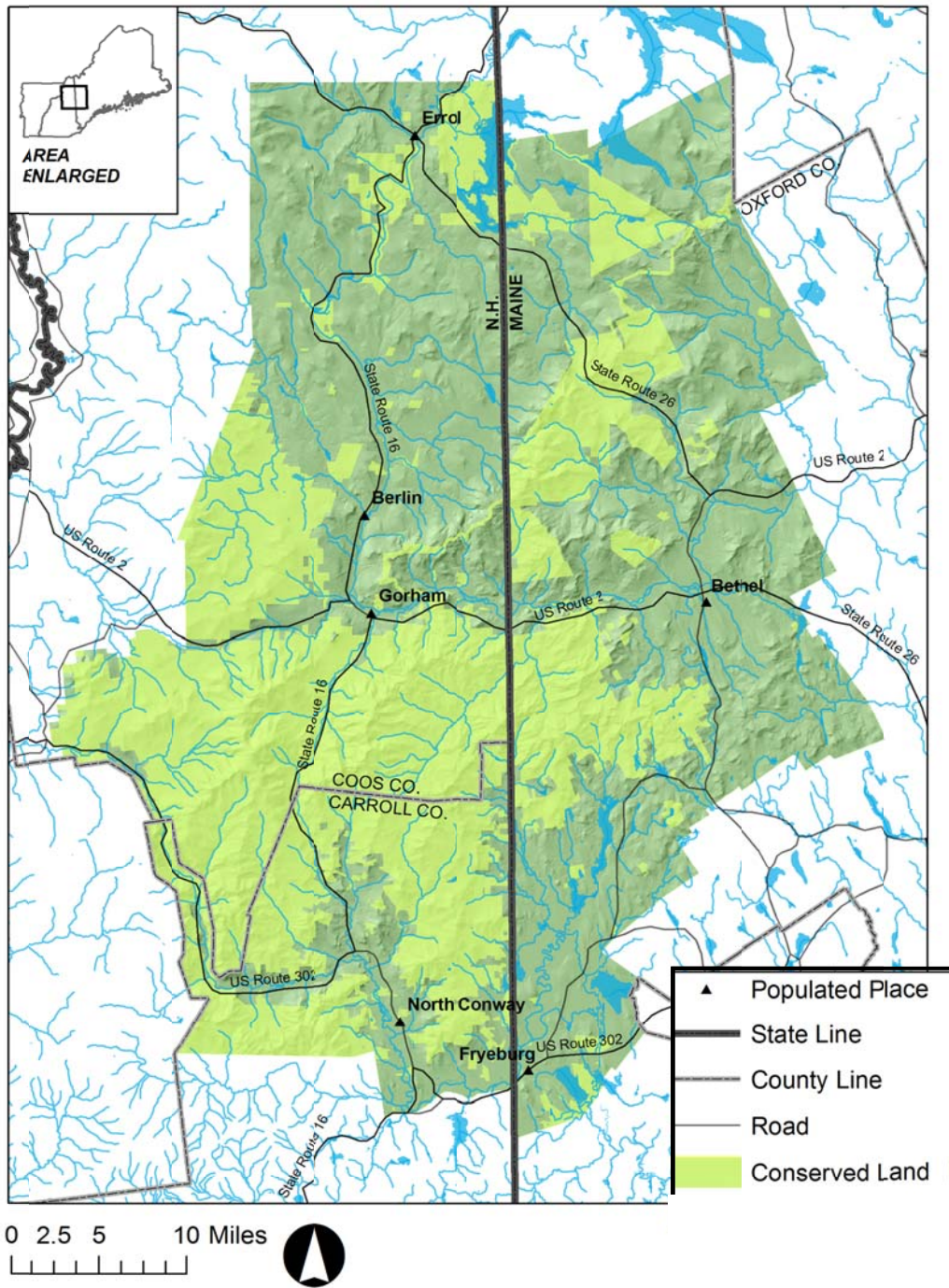
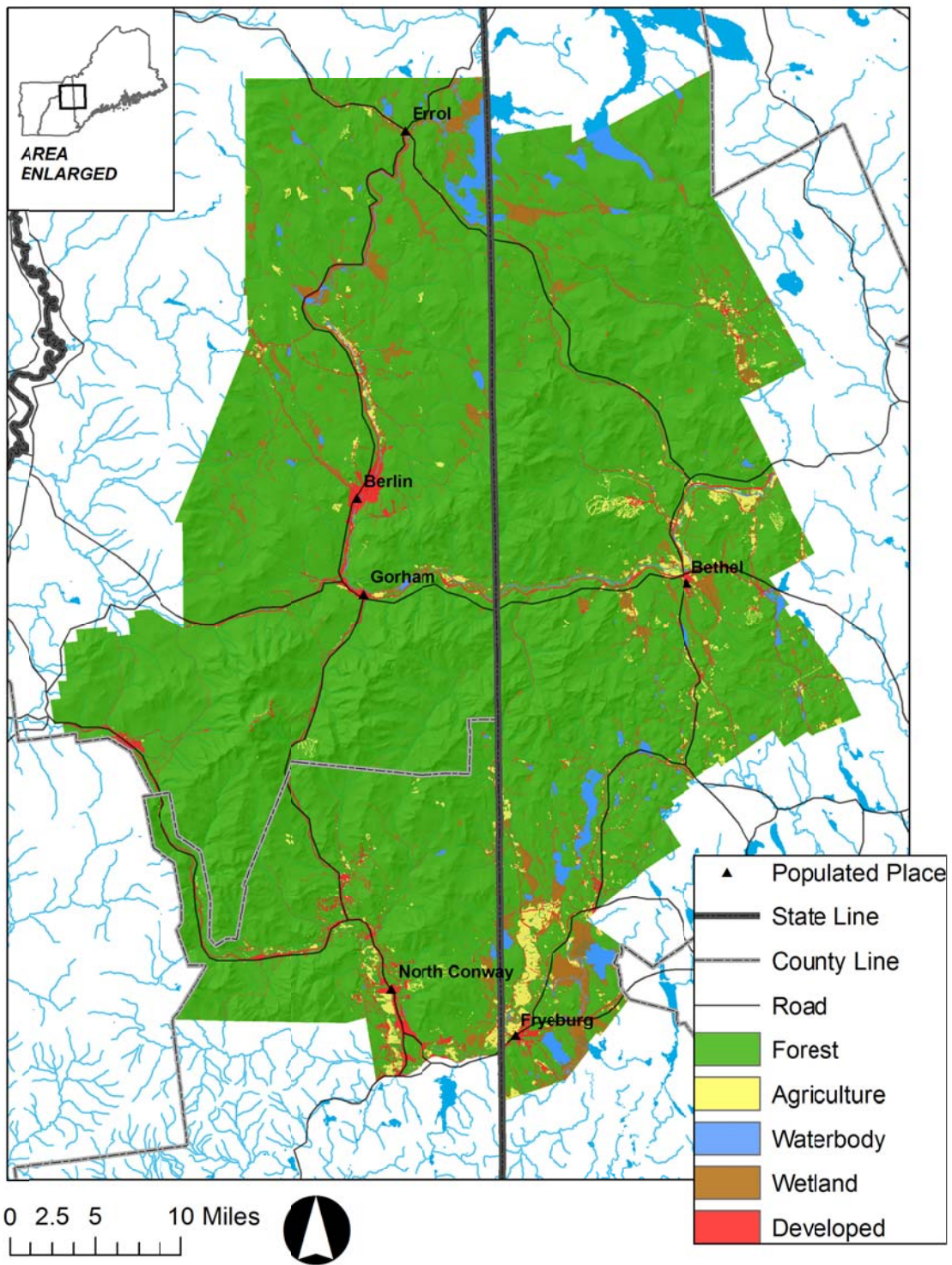


Fig. 1: Map of White Mountains (NH) & Mahoosuc Region (ME).



Projected Impacts and Strategies for Forestry

Component of Managed Forest System - Projected Climate changes	Projected Impacts	Size & likelihood of Potential Impact without action		Possible Strategies:	What type of actor can best implement the strategy*?	Other sectors to be engaged:
		2010-2040	2041-2100			
Logging Systems						
<u>Logging Operations</u> - more frequent extreme rainfall events - more frequent winter thaws/rains	- occasionally more frequent soil conditions that limit logging operations - shorter winter logging season - possible temporary wood shortages	Moderate	High			
- more frequent drought	- more harvesting of forested wetlands	Low	Moderate			
<u>Haul Roads</u> - more frequent extreme rainfall events - more frequent winter thaws	- more frequent stream crossing "bow outs" - more frequent haul road closings due to unfrozen or saturated soil	High	High			
Forest Health						
<u>Pests, pathogens, and invasive species</u> - warmer temperatures	- increase of populations of tree pests & pathogens leads to greater tree mortality	Low	Moderate			
	- Increased populations of invasive plants reduces tree recruitment	Low	Low			
	- increased deer populations reduce tree regeneration	Low	Moderate			
<u>Extreme weather events (including O₃)</u> - more frequent extreme heat events	- increased tree damage from ozone which reduces tree growth and recruitment	Low	Low			
- more frequent of droughts & flooding	- reduced tree growth and recruitment - greater tree mortality - greater frequency of forest fire	Low	Low			
- extended winter thaw	- dieback in spruce, birch, and other hardwood spp.	Moderate	Moderate			
<u>Productivity (CO₂ fertilization)</u> - increases in CO ₂ levels	- increased tree growth for aspen spp	Low	Moderate			
Forest tree species						
<u>Northern hardwood and conifer species</u> - warmer temperatures - more frequent late-growing season drought	- shift north of spp. distributions - reduction in tree regeneration - increased growth rates for some spp.	Low	Moderate			
	- reduction in abundance	Low	Moderate			
- warmer winters	- earlier period for maple syrup	Moderate	High			
<u>Southern tree species (Oak and Pine)</u> - warmer temperatures - more frequent late-growing season drought	- increase in regeneration - increased growth rates - shift north of spp. distributions	Low	Moderate			
	- increase in abundance	Low	Moderate			

* e.g., landowner, local/regional government, NGO, state government, and/or federal government.

Projected Impacts and Strategies for Nature-based Recreation

Recreation Activities - Projected Climate Changes	Projected Impacts	Size & likelihood of Potential Impact		Possible Strategies:	What type of actor can best implement the strategy*?	Other sectors to be engaged:
		2010-2040	2041-2100			
Water Recreation						
Fishing - warmer temps. - more frequent extreme heat events	- increased cold water fish mortality & decline in cold water fisheries - increase in warm water fisheries - greater eutrophication with negative impacts on fisheries	Moderate	Moderate			
- shorter season with ice	- shorter ice fishing season or loss of ice fishing season - longer open water fishing season	High	High			
Boating - more frequent drought	- boat launches may become seasonally high/dry and limit water access	Moderate	Moderate			
- warmer temperatures - more frequent extreme heat events	- longer boating season - increased boating	High	High			
Whitewater Boating - more frequent winter thaws - shorter season with ice	- more opportunities for winter whitewater boating	Moderate	Moderate			
- more frequent drought - less snow and lower/earlier spring runoff	- reduced spring whitewater conditions - less water for dam releases for summer season whitewater boating	Moderate	Moderate			
- more frequent extreme rainfall events	- unpredictable opportunities for white water boating during summer	High	High			
Land-based Recreation						
Winter sports (e.g., skiing, etc.) - warmer winters - more frequent winter thaws	- shorter season for winter trail sports, downhill skiing, & ice fishing (by 8-10 days in 2030, by 16-33 days in 2100) - less snow on trails/reduced trail quality - downhill ski season interruptions due to poor snow making conditions	Moderate	High			
- more frequent extreme rainfall events	- more frequent "blow outs" of constructed trail stream crossings	Moderate	Moderate			
Trail sports (ATVing, hiking, etc.) - warmer temperatures	- longer trail sport season	High	High			
- more frequent extreme rainfall events	- more frequent "blow outs" of trail stream crossings	Moderate	Moderate			
- warmer summer temperatures - more frequent extreme heat events	- hiking and mountain biking less popular in middle of summer	Low	Moderate			
Camping - warmer summer temperatures - more frequent extreme heat events	- mid-summer camping becomes less popular	Low	Moderate			
Hunting - prolonged warm weather in fall period	- best hunting times shift to later in year	Low	Moderate			

Recreation Activities - Projected Climate Changes	Projected Impacts	Size & likelihood of Potential Impact		Possible Strategies:	What type of actor can best implement the strategy*?	Other sectors to be engaged:
		2010-2040	2041-2100			
- warmer temperature	- increases in white-tailed deer population	Low	Moderate			
Wildlife Viewing - warmer temperatures - more frequent extreme heat events	*- northward range shifts of charismatic species (e.g., moose, loons, puffins) and boreal bird spp. and reduction in their populations *- decline in moose viewing due to pop. decline from ticks & heat stress *- more white-tailed deer viewing due to population increase	Moderate	High			
Fall foliage viewing - warmer temperatures	- declining in "leaf peeping" due to reduced abundance and extent of "leaf peeping" forest types (northern hardwood, birch, and aspen) with dramatic fall colors	Low	Moderate			
- prolonged warm weather in fall period	- declining fall leaf color intensity of northern hardwood, birch, & aspen spp. - extended fall tourism season	Moderate	High			

* e.g., landowner, local/regional government, NGO, state government, and/or federal government.

Projected Impacts and Strategies for Habitat Conservation

Biodiversity Component - Projected Climate Changes	Projected Impacts	Size & likelihood of Potential Impact without Action		Possible Strategies:	What type of actor can best implement the strategy*?	Other sectors to be engaged:
		2010-2040	2041-2100			
Landscape Elements						
<u>Large Blocks of Habitat & Habitat connectivity</u> - warmer temperatures - more frequent drought	- more frequent forest fires and forest pest outbreaks reduce block size by resulting in younger and/or open forest	Low	Low			
<u>Enduring features (e.g., soils, aspect etc.)</u> - more frequent late-growing season drought - more frequent drought	- more frequent forest fire increasing soil erosion	Low	Low			
Habitat						
<u>Northern hardwood forest & northern coniferous forest communities</u> - warmer temperatures - more frequent late-growing season drought - more frequent drought	- reduction in extent of northern hardwood forest and conifer forests due to less tree regeneration and increased mortality - northward shift of distribution of forest types	Low	Moderate			
	- more frequent forest fire in northern conifer types	Low	Low			
<u>Oak and pine forest communities</u> - warmer temperatures - more frequent late-growing season drought - more frequent drought	- increase in extent of oak and pine forests - increase levels of chronic stress due to greater populations of forest pests, pathogens, invasive spp., and deer populations	Low	Moderate			
<u>Freshwater wetlands</u> - drought - increased fluctuations in water levels - more frequent extreme rainfall events	- habitat area may decline in drought years - more frequent stream bank scouring - more frequent sediment inputs from storms - greater eutrophication due to runoff from extreme events	Moderate	Moderate			
Species						
<u>Northern species at s. edge of range</u> (e.g., American marten, Blackpoll warbler) - warmer temperatures	- reductions in population size	Low	Moderate			
<u>Southern species at n. edge of range</u> (e.g., white tailed deer, gray fox) - warmer temperatures - less severe winters	- increased population size, expanded range of spp.	Moderate	High			
<u>Wetland and Aquatic Species</u> - winter rain flooding - reduced spring flows - more frequent drought - warmer temperatures - more frequent extreme rainfall events	- reduces populations of cold-water species (e.g., trout, insects) due to increased temperature-related mortality - reduction in populations of wetland species (e.g., plants, low nesting marsh birds) due to more variable hydrology - increased stream sedimentation from storms	Low	Moderate			
<u>Alpine Species and Habitats</u> - warmer temperatures - more frequent drought	- reduction in extent of habitat	Low	Moderate			
<u>Wildlife Health</u> - warmer temperatures	- healthy winter population and increased deer population size - increased tick infestations and frequency of extreme heat reduces moose populations	Low	Moderate			