

## A Climate Change Impact Assessment for Unity, Maine Area

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**Highlighted Sectors:** Agriculture, Forestry, and Habitat Conservation

**Geographic boundaries:** Northwestern Waldo County and adjacent areas of Kennebec County in central Maine.

**Description:** This rural region is 78% forested and is a key area for dairy agriculture in Maine. This complex of streams, floodplain forests, bogs, woodlands, and farmland cover about 80 square miles in Waldo and Kennebec Counties and is about 30 percent wetlands. It includes some of developed Maine's largest unfragmented blocks of habitat. Development pressure is shifting from regional service centers in the west (Belfast) and east (Waterville and Augusta) along the transportation corridors. Hence, farmers face increasing pressure to supplement their income by selling woodlots and house lots. More than 98% of the land is privately owned.

### **Organizations that could contribute to climate change adaptation:**

Municipalities with climate change adaptation capacity:

Regional Planning Organizations: Kennebec Valley Council of Governments

Land Conservation Organizations: Maine Farmland Trust, New England Forestry Foundation, Inc., The Nature Conservancy – Maine chapter, Sebasticook Regional Land Trust

Other Conservation Organizations: Kennebec County Soil and Water Conservation District

Major Forest Landowners:

Educational Institutions: University of Maine at Orono, Unity College

Other: The Nature Conservancy and American Farmland Trust have programs in this region to help protect water quality of key wetlands and conserve farmland.

### **Some Key Sector Attributes:**

Agriculture: The region has over 5,600 acres of farmland covering about 20% of the land base. It is part of Maine's dairy belt and has about 40 dairy farms each milking 40 to 300 cows and managing an average of 200 acres of pasture and field crops. These farms are vital to the feed, seed, fertilizer and equipment suppliers that form central Maine's dairy infrastructure. There are also about 40 other farms raising vegetables, fruits and livestock. There are 1,975 Prime Farmland acres and 6,360 acres of Farmland of Statewide Importance. These soils are the best suited to produce food, feed, forage and fiber and are of strategic resource for regional agriculture.

Forestry: The landscape is dominated by small non-industrial private landowners. The forests are transitional from southern forests of oaks, pine, and mixed hardwood to more northern spruce-fir and northern hardwood forests. About 50% of the forestland is in northern hardwood, 18% is in spruce-fir forest types, about 12% in oak and/or pine forest types, and the balance is in miscellaneous forest types. In Waldo County, 42% of the forest is pole timber and 29% is sawtimber with a balance in seedlings/saplings. Although wood is processed elsewhere, there are log concentration yards in the region. Weak global markets threaten viability of the forest products sector.

Habitat Conservation:

**Unique Features:** The region is near the edge of an ecological transition zone as evidenced by being near the northern range limits of many plant, wetland types transitioning from southern red maple swamps to northern peatlands, and forest types

transitioning from oak and pine to northern hardwood and conifers. It is about 30 percent wetlands and has little private conservation or public land. It holds the largest concentration of wetlands in the Central Interior ecoregion, including an extensive mosaic of bogs, fens, and streamshore wetlands. A few of these large wetlands are greater than 2,000 acres, and several others are over 1,000 acres. They support other rare and exemplary plant communities such as Silver Maple Floodplain Forest, Kanokolus Bog (raise bog, a rare plant community in central and southern Maine), and Fowler Bog (an exemplary wooded fen), and rare aquatic species such as two state endangered mussels, the yellow lamp mussel and tidewater mucket. These wetlands also help to store floodwaters heading to the Sebasticook River and the Kennebec River. Unmanaged recreation may pose a threat to key wetland plant communities (Beginning with Habitat 2008). Unbuffered agricultural areas also may lead to eutrophication of wetlands and waterbodies.

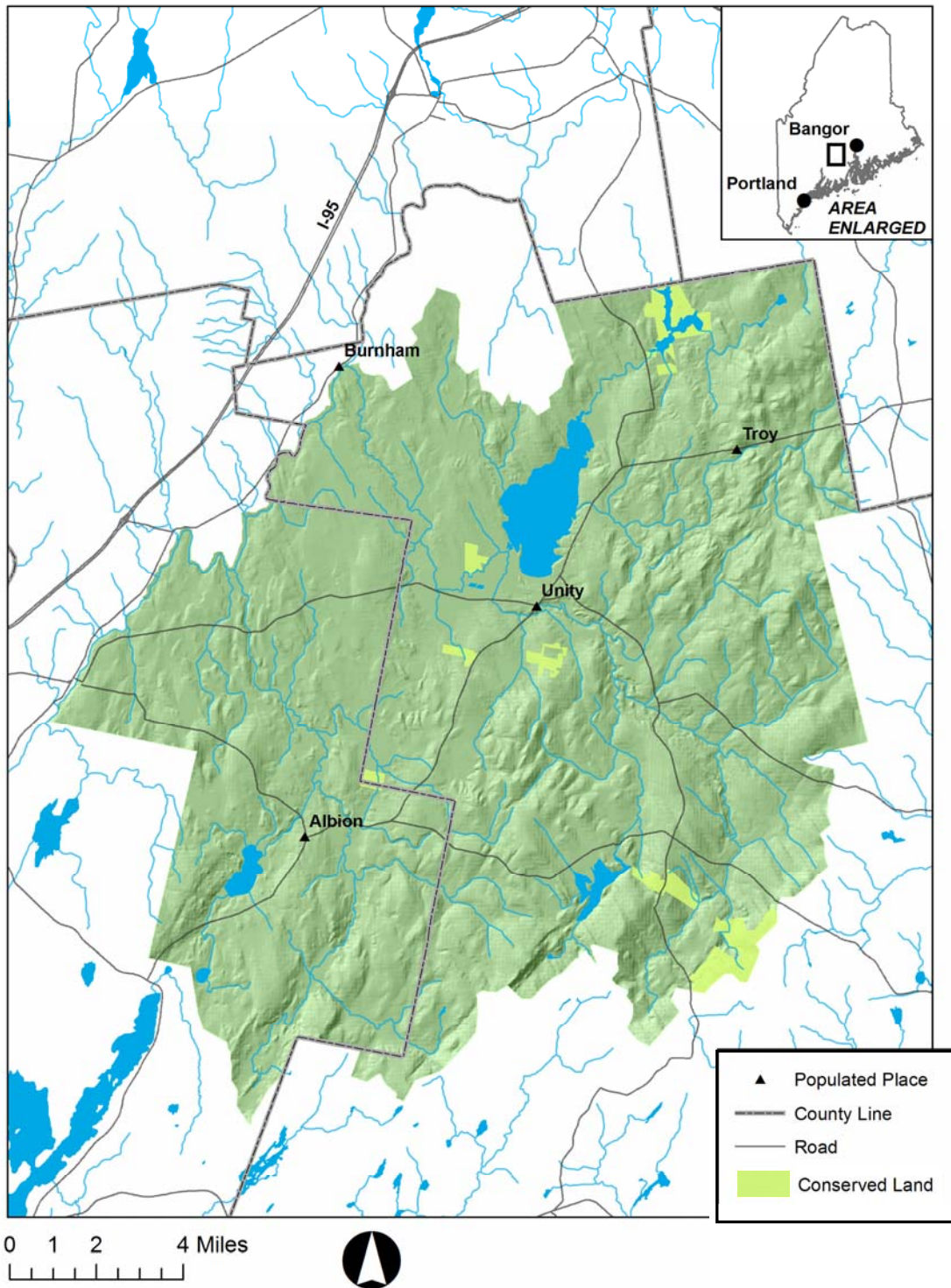
*State lands:* Carlton Pond Waterfowl Production Area (800 acres)

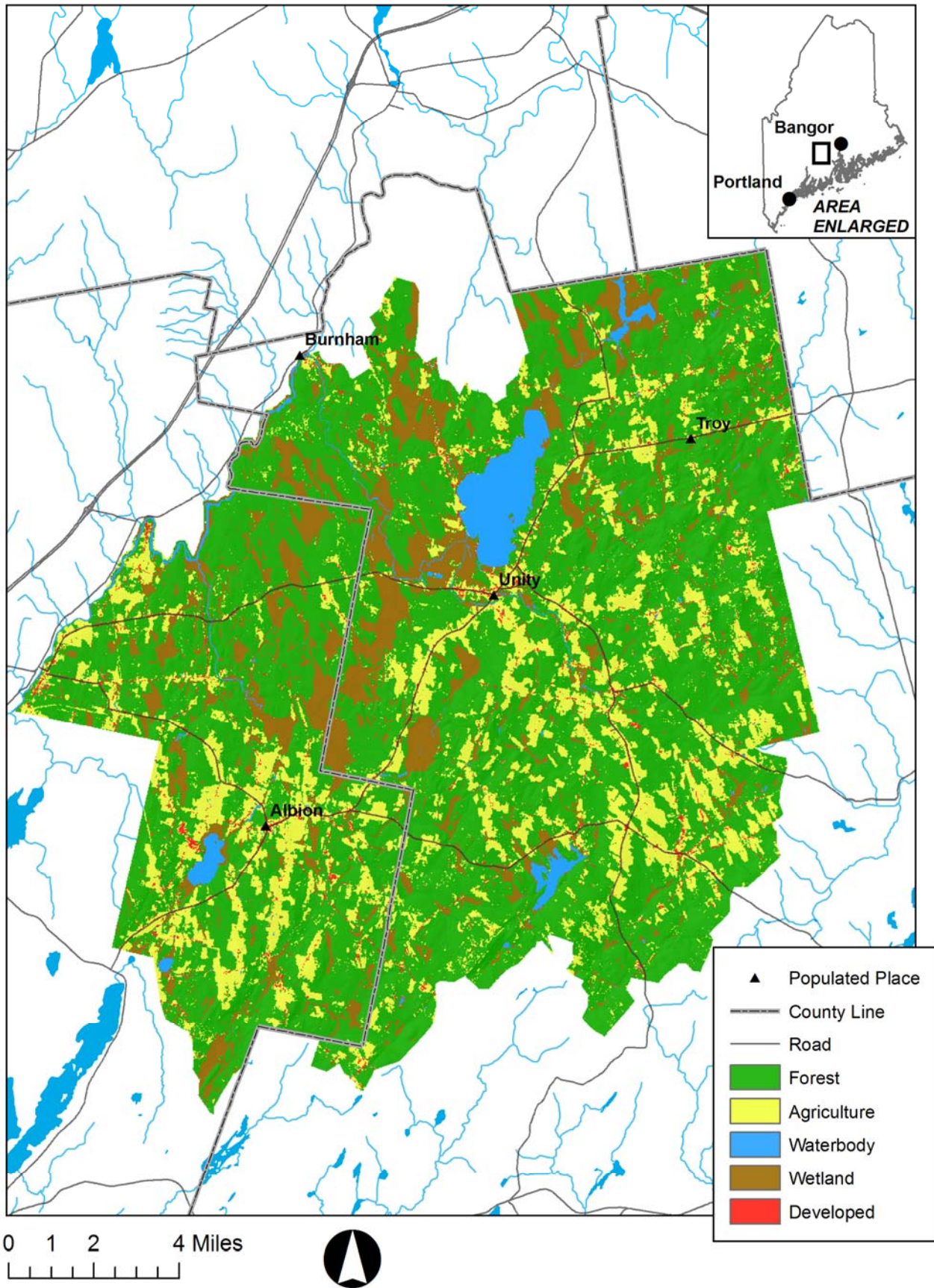
*NGO lands:* Lt. Clair Hall Thurston, Jr. Memorial Forest (150 acre forestland easement), Sebasticook Regional Land Trust (formerly Friends of Unity Wetlands; over 650 acres of freshwater wetlands, forest and agricultural lands)

*Other High-value Areas (largely unprotected):* Unity Wetlands Focus Area (44,000 acres), Carlton Pond North Focus Area (6616 acres).

## References:

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## Projected Impacts and Strategies for Habitat Conservation, Forestry, Agriculture & Nature-based Recreation

Climate Changes	Agriculture	Habitat Conservation	Forestry
<ul style="list-style-type: none"> <li>• Summer</li> </ul>			
<ul style="list-style-type: none"> <li>- warmer temperatures</li> <li>- more frequent late-season drought</li> </ul>	<ul style="list-style-type: none"> <li>- late season drought leads to reduced crop production</li> <li>- more frequent heat stress reduces milk production</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- increased fire danger and impact to forest habitats and streams</li> <li>- low water level impacts on aquatic and wetland species</li> <li>- greater mortality in cold water aquatic spp.</li> <li>- reduced fledging success of low nesting marsh birds</li> </ul> <p>Moderate likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- greater growth/yield</li> <li>- late season drought leading to reduced productivity and increase fire danger in some years</li> <li>- reduced red spruce seedlings establishment</li> </ul> <p>Moderate likelihood &amp; impact</p>
Possible Strategies			
What type of actor can best implement the strategy?*			
Other sectors to be engaged:			

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

Climate Changes	Agriculture	Habitat Conservation	Forestry
<ul style="list-style-type: none"> <li>• Fall</li> </ul>			
<ul style="list-style-type: none"> <li>- extended season of mild weather</li> </ul>	<ul style="list-style-type: none"> <li>- longer growing season</li> <li>- reduced production some years due to moisture stress in late season crops</li> </ul> <p>High likelihood &amp; impact</p>		<ul style="list-style-type: none"> <li>- longer period of “summer” logging</li> </ul> <p>High likelihood &amp; impact</p>
Possible Strategies			
What type of actor can best implement the strategy?*			

Climate Changes	Agriculture	Habitat Conservation	Forestry
Other sectors to be engaged:			

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Climate Changes	Agriculture	Habitat Conservation	Forestry
<ul style="list-style-type: none"> <li>• Winter</li> <li>- warmer temperatures</li> <li>- reduced snow fall</li> <li>- more frequent winter thaws</li> <li>- declining ice thickness</li> <li>- winter (instead of spring) peak flows</li> </ul>	<ul style="list-style-type: none"> <li>- winter kill on some forages and fruit-producing plants</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- increases in white-tailed deer population (as invasive spp.)</li> <li>- more ticks leads to greater moose mortality</li> <li>- increase in ice scour impacts on riparian communities and then loss of ice scouring</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- increases in white-tailed deer population reduces tree regeneration</li> <li>- thaw damage on some tree species</li> <li>- more frequent interruptions of winter harvest operations due to unfrozen ground</li> <li>- earlier cessation of winter logging</li> </ul> <p>Moderate likelihood &amp; impact</p>
Possible Strategies			
What type of actor can best implement the strategy?*			
Other sectors to be engaged:			

Climate Changes	Agriculture	Habitat Conservation	Forestry
<ul style="list-style-type: none"> <li>• Spring</li> <li>- warmer temperatures</li> <li>- earlier snowmelt</li> <li>- increased variability in spring frost</li> </ul>	<ul style="list-style-type: none"> <li>- earlier start of growing season</li> <li>- greater flower bud mortality due to late season frost</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- reduced and earlier peak spring flows which affect aquatic species</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- earlier start on “summer” logging</li> </ul> <p>High likelihood &amp; impact</p>
Possible Strategies			
What type of actor can best implement the strategy?*			
Other sectors to be engaged:			

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

Climate Changes	Agriculture	Habitat Conservation	Forestry
Year around			
- extreme rainfall events	<ul style="list-style-type: none"> <li>- some reduced productivity due to soil erosion</li> <li>- increase difficulty in accessing fields</li> </ul> <p>Low likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- increased levels of stream sedimentation</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- more frequent logging road washouts</li> </ul> <p>Moderate likelihood &amp; impact</p>
- warmer temperatures	<ul style="list-style-type: none"> <li>- longer growing season</li> <li>- greater crop productivity</li> <li>- ability to grow greater range of crop species</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- changes in plant communities including the increase of southern species</li> </ul> <p>High likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- changes in forest communities</li> <li>- increased growth and yield for temperate tree species (e.g., maple, oak, pine, etc.)</li> <li>- reduced growth and yield for northern species (e.g., birch, spruce, fir, aspen)</li> <li>- greater spread of hemlock wooly adelgid</li> </ul> <p>High likelihood &amp; impact</p>
- more frequent drought	<ul style="list-style-type: none"> <li>- reduction in crop and forest production in some years</li> </ul> <p>Moderate likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- mortality in aquatic species</li> <li>- reduction in extent of wetlands</li> <li>- slightly greater frequency of forest fire</li> </ul> <p>Moderate likelihood &amp; impact</p>	<ul style="list-style-type: none"> <li>- reduced productivity in some years</li> <li>- greater frequency of forest fires</li> </ul> <p>Moderate likelihood &amp; impact</p>
Possible Strategies			
What type of actor can best implement the strategy?*			
Other sectors to be engaged:			

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

## Agriculture

Major Agricultural Sector - climate changes	Potential Impact on agricultural sectors	Size & Likelihood of Potential Impact without action		Possible Strategies:	What type of actor can best implement the strategy?*	What other sectors should be engaged?
		2010-2040	2041-2100			
<b>Livestock (meat &amp; dairy)</b>						
- warmer temperatures	- reduction in livestock winter feed costs - reduction in summer productivity	Low	Low			
	- increase in mastitis as more of year is muddy due to unfrozen ground	Moderate	Moderate			
- more frequent extreme heat events	- reduction in milk and meat production efficiency	Low	Moderate			
- more frequent drought	- reduced water availability for livestock and increased production costs	Low	Low			
- longer growing season	- longer opportunity to use pasture-based systems	Moderate	High			
<b>Cropping (forages, vegetables, and orchard)</b>						
- warmer temperatures	- greater production for some forage, vegetable, and fruit varieties due to warmer growing season	Moderate	High			
	- reduced production for other forage, vegetable, and fruit varieties due to warmer growing season	Moderate	High			
	- increase in new crop pest and number of generations of current insect pests	High	High			
- warmer winters - less snowfall	- crop losses due winter deacclimatization and winter bud kill of some varieties of forages, blueberries, and fruit trees	Moderate	Moderate			
- more frequent extreme heat events	- more frequent problematic moisture stress to crops	Low	Moderate			
- more frequent drought	- reduction in crop productivity due to lower water availability	Low	Moderate			
- more frequent late growing season drought	- reduced productivity late in season	Low	Moderate			
- longer growing seasons	- more opportunities for additional harvests of forage - more opportunities for growing new, more productive crop and fruit varieties	Moderate	High			
- more frequent extreme rainfall events	- increased difficulty in accessing fields - increased soil erosion - more frequent weather-related crop losses	Moderate	Moderate			
- more variable first frost date	- more frequent weather-related crop losses due to increased flower/fruit mortality from irregular first frost	Low	Low			
- increased CO2 fertilization	- greater crop productivity	Moderate	Moderate			

Major Agricultural Sector - climate changes	Potential Impact on agricultural sectors	Size & Likelihood of Potential Impact without action		Possible Strategies:	What type of actor can best implement the strategy?*	What other sectors should be engaged?

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

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## Forestry

Component of Managed Forest System - Climate Changes	Potential Impact	Size & likelihood of impact w/o action		Possible Strategies:	What type of actor can best implement the strategy?*	What other sectors should be engaged?
		2010-2040	2041-2100			
<b>Logging Systems</b>						
• <b>Logging Operation</b>						
- slightly more frequent extreme rainfall events - more frequent winter thaws/rains	- additional infrequent saturated and/or unfrozen soil conditions that limit logging operations - shorter winter logging season - possible temporary wood shortages	Moderate	High			
- slightly more frequent drought	- more harvesting of forested wetlands	Low	Moderate			
• <b>Haul Roads</b>						
- slightly 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			
<b>Forest Health</b>						
<b>Pests, pathogens, and invasive species</b>						
- warmer temps. lead to increase of populations of tree pests & pathogens	- greater tree mortality	Low	Moderate			
- warmer temps. Increases populations of invasive plant species	- reduced tree recruitment	Low	Low			
<b>Extreme weather events (including ozone)</b>						
- Extreme heat increases O3 concentration and damages trees	- reduced tree growth and recruitment	Low	Low			
- increased frequency of droughts & flooding	- reduced tree growth and recruitment - greater tree mortality - greater frequency of forest fire	Low	Low			
- slightly more frequent extended winter thaws	- dieback in spruce, birch, and other hardwood spp.	Moderate	Moderate			
<b>Productivity (CO2 fertilization)</b>						
- increases in CO2 levels	- increased tree growth for aspen spp	Low	Moderate			
<b>Forest tree species</b>						
• <b>North hardwood and Conifer species</b>						
- warmer temp. - more frequent late growing season drought	- reduction in regeneration of northern hardwood and northern conifer spp. - slightly greater mortality of northern hardwood and northern conifer spp.	Moderate	High			
	- shift north of spp. distributions - reduction in abundance of northern hardwood and northern conifers	Low	Moderate			
• <b>Southern tree species (Oak and Pine)</b>						
- temp. increases - more frequent late growing season drought	-significant increase in abundance of oak and pine	Low	Moderate			

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

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## Habitat Conservation

Biodiversity Component - Climate Changes	Potential Impact	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			
<b>Landscape Elements</b>						
<b>Large Blocks of Habitat and Connectivity</b> - warmer temperatures - more frequent late-growing season drought - more frequent drought	- more frequent forest fire and widespread forest pest outbreaks reducing block size and connectivity	Low	Low			
<b>Enduring features (e.g., soils, aspect etc.)</b> - more frequent late-growing season drought - more frequent drought	- more frequent forest fire increasing soil erosion	Low	Low			
<b>Habitat</b>						
<b>Northern hardwood forest &amp; northern coniferous forest communities</b> - warmer temperatures - more frequent late-growing season drought - more frequent drought	- reduction in extent of northern hardwood forest and northern conifer forests due to less tree regeneration and increase mortality - northward shift of distribution of forest types - increase spread of hemlock woolly adelgid and reduction in hemlock dominated forest	Low	Moderate			
	- more frequent forest fire burning northern conifer types	Low	Low			
<b>Oak and pine forest communities</b> - 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, and invasive spp., and deer, and . levels of ozone	Low	Moderate			
<b>Freshwater wetlands, stream/river shore plant communities, and waterbodies</b> - drought - increase fluctuations in water levels - more frequent extreme rainfall events	- habitat area may decline in drought years - more frequent stream scouring and sedimentation events from storms - increased levels of eutrophication due to runoff from extreme rain events	Moderate	Moderate			
<b>Species</b>						
<b>Northern species at southern edge of range</b> (e.g., Canada lynx, American marten, Blackpoll warbler) - warmer temperatures	- reductions in population size	Low	Moderate			
<b>Southern species at northern edge of range</b> (e.g., deer, gray fox) - warmer temperatures - less severe winters	- increased population size, expanded range of spp.	Moderate	High			
<b>Wetland and Aquatic Species</b> - 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,) due to increased temperature-related mortality - reduction in populations of wetland species (e.g., plants, low nesting marsh birds) due to stress from more variable hydrology - increased stream sedimentation from storms	Low	Moderate			
<b>Wildlife Health</b>	- healthy winter population and increase population size of deer	Low	Moderate			

Biodiversity Component - Climate Changes	Potential Impact	Size & likelihood of Potential Impact without Action		Possible Strategies:	What type of actor can best implement the	Other sectors to be
- warmer temperatures	- tick infestations and freq. of extreme heat reduces moose populations					

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