Forestry and Climate Change Adaptation in New England

Introduction

New England's climate has changed considerably during the 20th century. Average annual temperatures increased by 0.08 degrees Celsius (°C) per decade and average winter temperatures have increased by 0.12°C. The rate of average temperature increase accelerated significantly during the period of 1970 to 2000 with average annual temperatures increasing by 0.25°C per decade and average winter temperatures increasing by 0.70°C. Driven by these changes growing seasons have lengthened, the number of days with snow on the ground has decreased for many locations and the timing of peak spring stream flow has shifted to earlier in the year.[1]

A recent study of the period from 1948 to 2007 found significant increases in both the occurrence and intensity of extreme precipitation with the most significant increases occurring most recently.[2]

The pace and extent of climate change will be dependent on global efforts to limit greenhouse gas emissions. The projections in Table 1 are derived from downscaled global climate models that examine the ramifications of two different greenhouse gas scenarios.[3] The B1 scenario assumes a stabilizing of atmospheric Carbon Dioxide (CO_2) levels at or above 550 ppm by year 2100. The A2 scenario assumes atmospheric CO_2 levels of 830 ppm by 2100 and the A1FI scenario assumes CO_2 levels of 970 ppm by 2100. Results for the B1 and A1FI scenarios for two of the modeled variables, temperature and precipitation are shown in the following table.

	UNITS	2035-2064		2070-2099	
Temperature	Degrees C	B1	A1FI	B1	A1FI
Annual		+2.1	+2.9	+2.9	+5.3
Winter		+1.1	+3.1	+1.7	+5.4
Summer		+1.6	+3.1	+2.4	+5.9
Precipitation	% change				
Annual		+5%	+8%	+7%	+14%
Winter		+6%	+16%	+12%	+30%
Summer		-1%	+3%	-1%	0%

The frequency and severity of heat waves and very heavy precipitation events are projected to increase. Sites on the coast will be exposed to sea level rise in the range of 1.5 to 6 feet by 2100 depending on greenhouse gas levels and ice melt rates.[4]

Forestry in New England

Forestry provides multiple benefits to New England. The forests of New England support over 100,000 jobs and contribute $20 billion each year to local and regional economies. Major components of the economic contribution include a $2.5 billion dollar hunting and angling economy and a $2.7 billion dollar wildlife watching economy.[5]

Vulnerabilities and Opportunities

Changes in climate will have significant implications for forests and how forests are managed in New England. As detailed below, alterations in temperature and precipitation patterns may:

- **Shift distributions of tree species and wildlife habitats northward or upslope** – Changing temperature and precipitation may shift the distributions of species at both global and local scales.[6] Forest types in the Northeast are predicted to significantly change in the next 100 years under every atmospheric emissions scenario.[7] Habitat for several important species in Maine are projected to decline including: sugar maple, red maple, black cherry, balsam fir, red spruce, yellow birch, paper birch, quaking aspen, eastern hemlock, American beech, and white ash.[8] A few "southern" species are expected to extend their ranges northward and upslope, including both red and white oak.[9] The distribution of white pine is expected to contract across New England primarily in the southern portion of the range.[10] For example, Maine is at the northern edge of the current distribution and white pine will likely grow and thrive for at least the next 100 years.

- **Increase the frequency and magnitude of disturbance events** – The distribution of forest habitats is expected to change slowly in response to climate change because canopy trees are long lived, slow to extend or contract their ranges, and can tolerate environmental stress. However, more rapid transformations could occur due to changes in disturbance regimes.[11,12] This includes the frequency and magnitude of storms, periods of extreme heat, droughts, fires, and insect or disease outbreaks that may increase under a changing climate.[13,14] These disturbance events can damage canopy trees resulting in their injury or death and loss of economic value. For instance, in the United States each year ice and wind storms damage 4.5 million acres of forests and costs landowners $860 million dollars.[15,16,17,18] As the frequency and intensity of disturbance events increases, the number of acres impacted and financial costs will also rise dramatically.

- **Introduce new invasive species and/or intensify the impacts of invasive and non-native plant and pest species** – Non-native plants, pests, and pathogens are a significant threat to the ecology and financial stability of forests. It is estimated introduced pests and pathogens result in the loss of $2.1 billion dollars of forest products per year in the United States.[19] Climate change is predicted to introduce new and/or intensify negative effects of existing non-native plants, pests, and pathogens.[20,21,22] For example, the frequency of extreme weather events can stress native plants and favor establishment and growth of invasive species;[23] increased temperatures will expand the geographic range of non-native species that were previously limited by climatic conditions;[24,25] and non-native species can out-compete native seedlings and saplings and quickly colonize areas more easily following timber harvests or natural disturbances.[26] These threats can result in direct mortality of trees and plants, and reductions in growth and fitness, putting forests across New England at risk of wide-spread disturbances in forest cover and associated alterations in plant community composition, reduced quality and quantity of wildlife habitat, and loss of timber revenue.

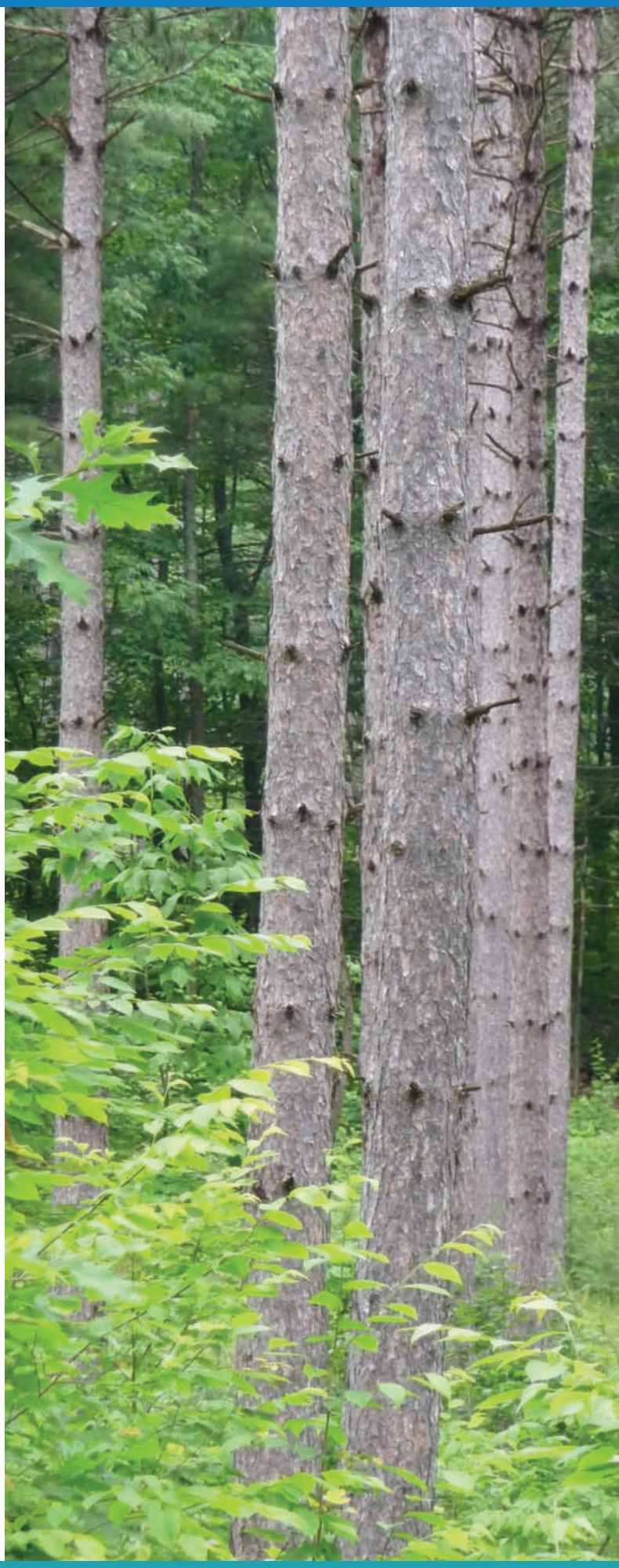
Adaptation Strategies

- **Maintain species, structural, and age class diversity.** Sustainable management strategies that maintain species, structural, or age class diversity are important in the face of climate change because they can create mosaics of habitats for existing wildlife species and new species that may move into the area, diversify stands with species and age classes that are less vulnerable to environmental stresses and disturbance events, reduce risk of damage and financial loss, and create economic opportunities by managing for species that are suited to the changing climatic conditions. Harvest strategies that retain some mature, canopy trees while creating cohorts of younger trees provide a sustainable supply of trees for habitat and timber markets.
- **Conduct sustainable timber harvests.** A shortened winter logging period, extended mud season, and increasingly frequent and severe storm events are likely to reduce the number of days with conditions favorable for low-impact logging, increase logging costs as machinery sits idle during marginal and unfavorable conditions, and increase pressure on managers to operate during marginal or unfavorable conditions, risking damage to soil and water quality.
- **Be aware of and plan for threats facing hemlock stands.** Hemlock is a common species in New England and, although it is not commercially valuable, it provides important habitat for wildlife. Infestations of Hemlock Wooly Adelgid (HWA) and Elongate Hemlock Scale (EHS) and temperature stress have profoundly negative implications for the long-term survival of hemlock in New England.
- **Encourage and Enhance Deer Management:** Continue to allow recreational access to hunters where feasible and support programs to educate the public about responsible use of private property to ensure continued access to those forest lands for recreation and hunting. State wildlife agencies should continue to monitor deer herds, be proactive in implementing management strategies to keep herds below densities at which Lyme transmission rates increase and browse damage to understory vegetation occurs, and educate the public about the relationship between deer herd size and forest and human health.

- **Incorporate Landscape Level Planning when possible:** Be aware of the need for cross-sector adaptation planning at landscape, state, and regional scales. Climate change impacts multiple economic sectors (e.g. natural resources, transportation, and public health), requiring coordination among government agencies, non-profits, and other stakeholders to effectively prepare for these changes. In addition, climate change adaptation must include regional and state-wide approaches to fully protect forestland.

- **Minimize negative impacts of disturbance events:** The frequencies and intensities of widespread disturbances are predicted to increase due to climate change, resulting in injury or death of canopy trees and loss of economic value. Identify stands most vulnerable to disturbance events. Consider the vulnerability of specific species (e.g., softwoods and other shallow-rooted species) and stand features (e.g., ridgelines, buffers, forest edges) to disturbance events when creating harvest plans and management strategies.

- **Promote regeneration of native tree species.** Invasive plants are expected to thrive under a changing climate, allowing these species to outcompete native trees and quickly colonize forestland. Track existing and emerging threats of invasive species. The USFS's Alien Forest Pest Explorer supports tracking the range and determining forest susceptibility of over 70 pest species. Develop an effective monitoring program for invasive species.



Endnotes

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