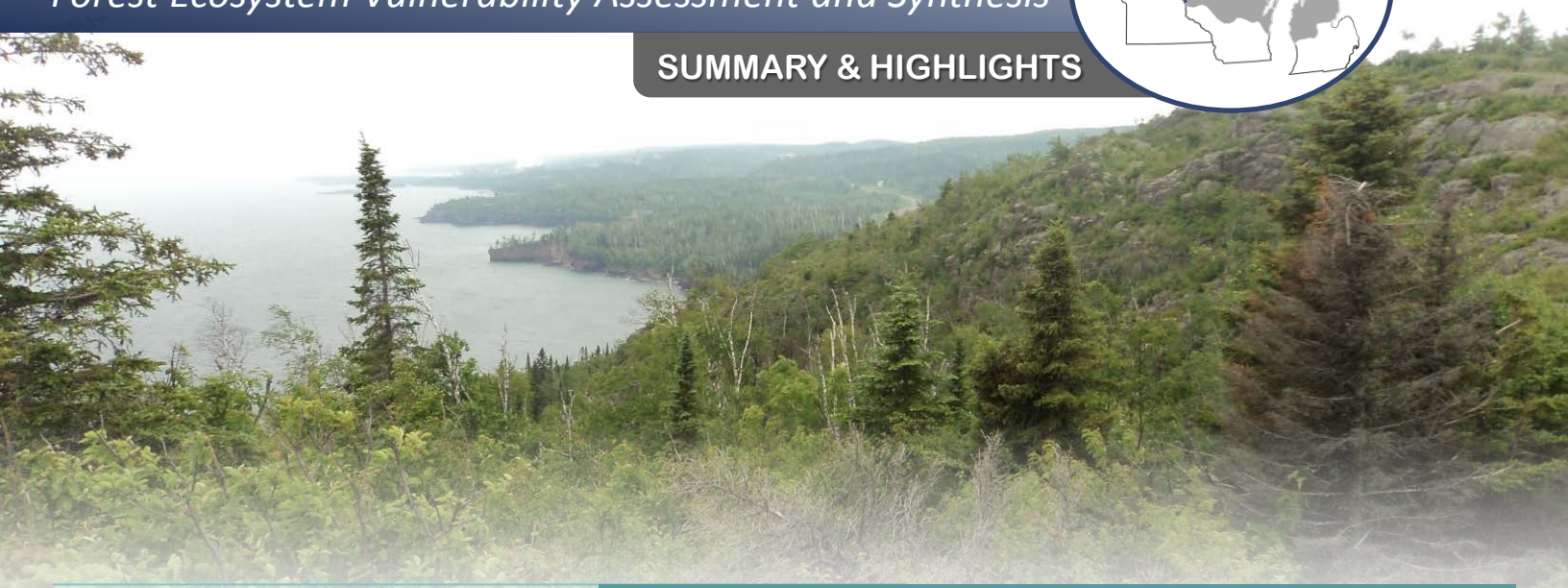
Northwoods: Minnesota

Forest Ecosystem Vulnerability Assessment and Synthesis

SUMMARY & HIGHLIGHTS



Forests are an essential part of northern Minnesota's landscape. The Laurentian Forest Province contains 85% of the state's forests, from iconic boreal forests to temperate hardwoods to peatlands and hardwood swamps. These diverse forests are valuable ecologically, economically, and culturally.

Minnesota's forests will increasingly be affected by a changing climate. Understanding these potential impacts is an important first step to sustaining healthy forests in the face of changing conditions.

As part of the Northwoods Climate Change Response Framework project, more than 30 scientists and forest managers collaborated to assess the vulnerability of forest ecosystems in this region to the likely range of climate change. Companion assessments address northern Wisconsin and Michigan. Learn more other project activities at:

www.forestadaptation.org/northwoods

The climate has changed

Over the past 100 years, the average annual temperature in northern Minnesota has increased 2.2 °F. Winter temperatures have increased by 3.5 °F, and minimum temperatures are increasing more rapidly than maximum temperatures across all seasons. Temperature records show that warming has accelerated in recent decades.

The assessment area is receiving 4.3 inches more precipitation per year than 100 years ago, particularly in the summer and fall. A greater percentage of precipitation is falling as heavy rainfall events of 3 inches or greater, especially over the past 30 years.

Average annual temperature increased by 2.2 °F since the turn of the last century, and heavy rainfall events have become more common.

Funded in part by the US Forest Service.
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Global climate models can help us understand how the climate may react given future changes in greenhouse gas emissions. In this assessment, we report climate projections over the next century for two global climate models under two contrasting greenhouse gas emissions scenarios (high and low). These projections are compared to the average over the last 30 years of the 20th century.

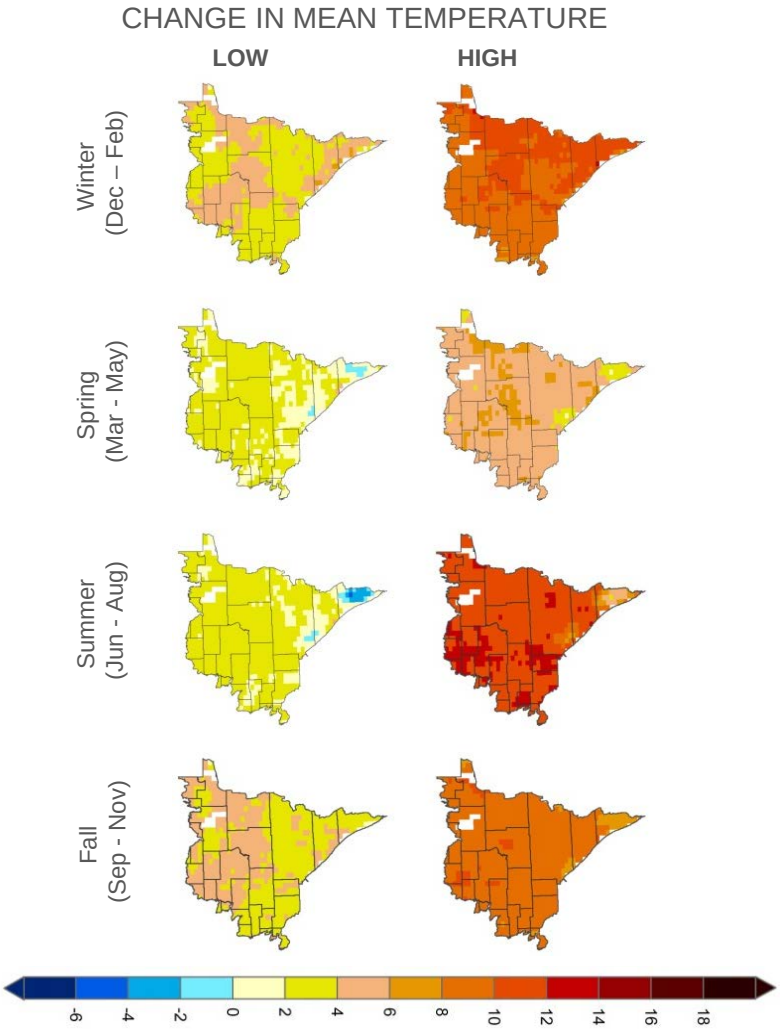
Temperatures will increase

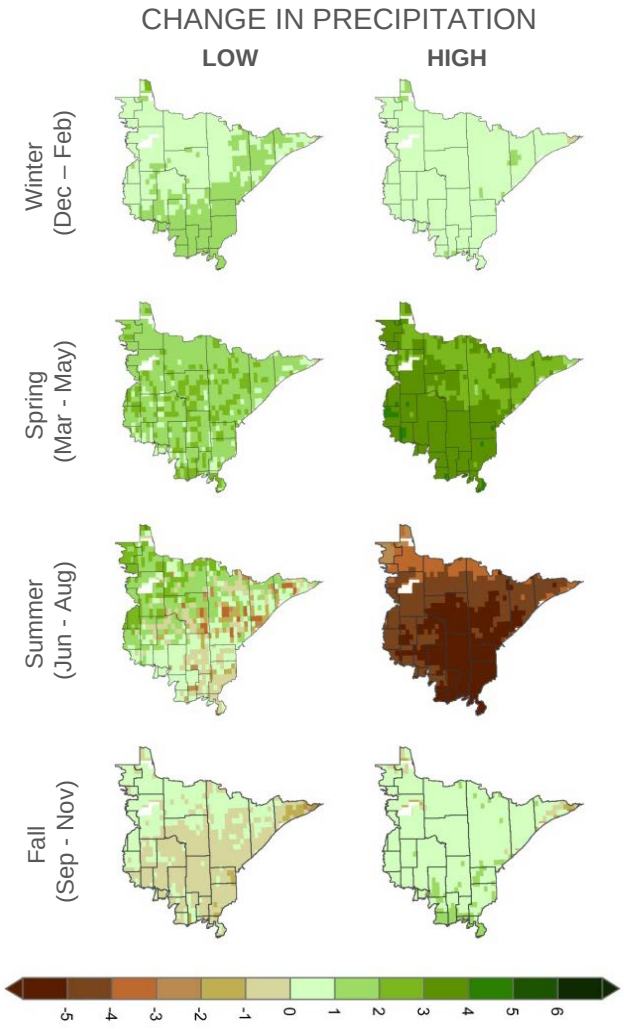
Climate models agree that temperatures will increase across all seasons in northern Minnesota over the next century. Projected change is on the order of 3 to 9 °F, with winters likely to continue warming faster than other seasons.

Evidence suggests that winter temperatures will increase in the area, even under low emissions, leading to reduced snowpack and soil frost. Growing seasons will continue to lengthen by 1 or 2 months by the end of the century.

Precipitation will change

Precipitation is projected to increase in winter and spring by about 2 to 4 inches across both seasons. The greatest uncertainty exists for summer precipitation, with slight increases or large decreases possible. Projections for fall precipitation are also mixed. There may be greater drought stress in summer or fall, because higher temperatures will lead to greater water loss from evaporation and transpiration.





This is a range of projected changes.

Projected difference in mean daily temperature and total seasonal precipitation at the end of the century (2070 through 2099) compared to 1971 through 2000 for two future climate scenarios. Low = PCM B1, High = GFDL A1FI.

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Forests will experience both direct and indirect impacts from a changing climate

Two global climate models, three forest impact models, hundreds of scientific papers, and forest manager expertise were combined to assess the effects of climate change on forest ecosystems in the assessment area. Based on this information, there is a large amount of evidence to suggest that the following impacts will occur in northern Minnesota.

Soil moisture patterns will change, with drier soil conditions later in the growing season.

Seasonal changes in precipitation are expected across the assessment area, and the trend toward more frequent heavy rainfall events is expected to continue. Warmer winters may lead to earlier snowmelt in the spring, and longer growing seasons combined with warmer temperatures may lead to more frequent moisture stress in summer and fall.

Boreal species will face increasing stress from climate change.

Impact models agree that boreal or northern tree species such as balsam fir, black spruce, paper birch, quaking aspen, and white spruce will have reduced suitable habitat and biomass across northern Minnesota. They may be less able to take advantage of longer growing seasons and warmer temperatures than temperate forest species.

Temperate species will be favored by climate change.

Impact models tend to agree that temperate or southern tree species such as American basswood, America elm, black cherry, green ash, red maple, sugar maple, white pine, and white oak will have increased suitable habitat and biomass across northern Minnesota. Several other minor species and species found further south of the assessment area are projected to increase, but fragmentation may limit natural migration of these species.

Low-diversity systems are at greater risk.

Studies have consistently shown that more-diverse systems are more resilient to disturbance, and low-diversity systems have fewer options to respond to change. There are many aspects to forest diversity – species, structural characteristics, and genetics – and each of these can generally help reduce risk and increase adaptability.

Species and forest types that are more tolerant of disturbance have less risk of declining across the landscape.

Climate change is generally expected to increase disturbances across northern Minnesota forests over the next century. As wildfires, floods, pest outbreaks, or other events become more frequent or damaging, tree species and forest types that are better able tolerate these disturbances may be favored. This idea holds true only to a point, because it still may be possible for disturbance-adapted systems to undergo too much disruption.

Download the full assessment:
www.nrs.fs.fed.us/pubs/45939

Download a copy of this summary:
www.forestadaptation.org/MN_FEVAS_Summary

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Vulnerability of Forest Communities

Climate change will not affect all forest species, communities, and parts of the landscape in the same way. A panel of experts from a wide range of organizations worked together to assess the vulnerability of different forest systems in the assessment area.

Vulnerability is the susceptibility of a system to the adverse effects of climate change. It is a function of potential climate change impacts and the adaptive capacity of the system. A system is vulnerable if it is at risk of a fundamental change in identity, or if the system is anticipated to suffer substantial declines in health or productivity.

Of eight forest systems assessed, **wet forests, forested rich peatlands, and acid peatlands were rated the most vulnerable** due to negative impacts on dominant species and narrow requirements for water table levels. **Floodplain forests were rated least vulnerable** because they contain more temperate tree species and are better able to withstand droughts and floods.

These vulnerability determinations are general across the landscape, and they will be influenced by local conditions, forest management, and land use. The assessment doesn't consider future changes in management, land use, fire suppression, or other social and economic factors that could affect forest health or productivity.

What can managers do?

Confronting the challenge of climate change presents opportunities for land managers to plan ahead, assess risk, and ensure that the benefits forests provide are sustained into the future.

Forest managers and landowners will naturally have different goals and objectives, and different opportunities and constraints for how they might respond to climate change risk. These factors will help determine the most appropriate actions to prepare for climate change.

Managers can use scientific information from this assessment, in combination with site-specific knowledge, to better understand how particular forests may be more or less vulnerable.

Resources are available to help forest managers and planners incorporate climate change considerations into forest management. A set of Forest Adaptation Resources is available at www.forestadaptation.org.

More information

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The Climate Change Response Framework is a core forest adaptation effort of the USDA Midwest and Northeast Climate Hubs.