Climate Wisconsin 2050

Wisconsin's climate is changing, and our forests will continue to experience direct and indirect impacts from these changes.

This publication provides guidance on how **forest managers and landowners are addressing these impacts, and how they are helping forests adapt and respond to change.**

Scenarios of a State of Change: Forestry

Wisconsin has more than 17 million acres of forest land, covering nearly 50% of the state's total land area. Over 55% of Wisconsin's forests are owned by families, and 32% are owned by public agencies (federal, state, or county). These forests help sustain the state ecologically, economically, and culturally. For example, the combined forest products industries in Wisconsin account for 65,000 jobs and an economic output of nearly $25 billion.

Look inside for a snapshot of what we can expect from Wisconsin's climate and weather by the year 2050, and how forest managers can help adapt to these changing conditions.

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Scenarios of a State of Change

TEMPERATURE – 2050

Annual **average** temperature will have **increased by 6°F.**

Future warming is projected to **be greatest during the winter** with increases of **5-11°F** by the mid-21st century.

The **duration of frozen soil has decreased** by about **two to three weeks** over the past 60 years.

PRECIPITATION – 2050

Annual average precipitation will **increase by +2" per year.**

Wisconsin will receieve **7-35% less winter snowfall,** instead receiving more winter rain.

Increased precipitation in winter and spring will result in **higher groundwater levels.**

Temperature and precipitation scenarios courtesy of the UW-Center for Climatic Research. Contact: Dan Vimont.

PHOTO CREDITS
Front cover: forest – WDNR; boardwalk – WDNR; CSA harvest – Jeff Miller; young deer – WDNR; forest – WDNR. Page 2: temperature display – Flickr, F. Delventhal; lake – WDNR. Page 3: winter Arboretum – WDNR; field fire – Jeffrey J. Strobel; forest – WDNR; forest – WDNR. Page 4: forest – WDNR; wetland – WDNR; forest – WDNR; bank erosion – Flickr, Cyndy Sims Parr. Page 5: all images - WDNR. Page 6: Northeast and Midwest seasonal patterns diagram – Ecological Drought in the Northeast United States newsletter, IAN Press. October 2016. Page 7: tree stump – WDNR. Back cover: tree sapling – WDNR.

Forest Health and Productivity

Climate Impacts

- The growing season will **be 16-32 days longer. Longer growing seasons** are a potential benefit because forests have more time for growth.

- **Trees will require more water and nutrients to fully take advantage of longer growing seasons**. Earlier springs may also lead to **more damage from spring frosts,** as trees break dormancy earlier and earlier.

- Many **tree species** are expected to have **reduced suitable habitat** across the state, particularly northern and boreal species such as paper birch, balsam fir, black spruce, and quaking aspen.

- **Increased risk of wildfire**, due to warmer and drier conditions, and also more "red flag" days.

- Wisconsin will receive **7-35% less winter snowfall**, instead receiving more winter rain. Snowpack is important for insulating shallow tree roots against cold snaps, and some species like sugar maple and yellow birch are particularly sensitive to root frost damage.

- Forests may experience **increased stress from forest pests, diseases, and non-native species.** Warmer winters may allow populations of insect pests to build more rapidly, and pests and diseases tend to be more damaging in situations where forests are already stressed due to drought or other factors.

- **Non-native species** are expected to have more opportunities to invade forests in the future.

- **Forests and other ecosystems** may be able to **grow faster and use water more efficiently with additional CO2 in the atmosphere.** The "CO2 fertilization" effect has been demonstrated in research trials lasting over a decade. This benefit may occur where water or nutrients aren't limiting, and hardwoods may benefit more than conifers. Pest outbreaks and other localized impacts may also limit this effect.

Forest Management Operations

Climate Impacts

- **Forestry professionals** may be exposed to more heat stress in the summertime, and may also have higher risk of disease exposure due to increased mosquito and tick activity. For example, **Lyme disease cases have already increased about 800% in the past 25 years**, and more cases are being reported in new areas of the state.

- The **duration of frozen soil has decreased** by about two to three weeks in Wisconsin over the past 60 years, and this trend is expected to continue. **Frozen ground** is necessary to conduct forest management operations in many lowland forests or other areas where conventional harvesting equipment could impact sensitive soils. Frozen ground conditions are also important for access to many forest stands and for transporting harvested wood, because forest roads are more durable when frozen. Less frozen ground and less predictable winter conditions will likely restrict the amount of time available for forest management in some areas and lead to more conflicts over road use.

- **Increased severity, frequency and persistence of flood events** will damage roads, culverts, trails, and other infrastructure necessary for forest management operations. These events cost a great deal to repair, and can delay forest management operations for weeks or months. The July 2016 rainstorm in northern Wisconsin is a recent example of what may be expected as heavy rainfall events become more common. Some areas received 8 to 10 inches of rain in a 24-hour period, and two districts of the Chequamegon-Nicolet National Forest experienced extreme damage, with multiple stream-crossing culverts, bridges, and roads damaged.

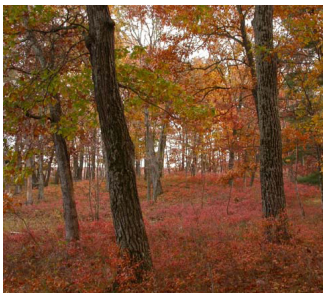
- **Road networks** will likely experience greater damage due to freeze-thaw events and high temperatures, in addition to floods. These events impact networks of forest roads as well as more established county and state-level roads.

- As species ranges narrow, mills and other facilities that rely on a **particular species or a narrow range of species** for their operations may be exposed to more risk. For example, mills that utilize a high percentage of paper birch or black spruce exclusively may face supply chain disruption as these boreal species are exposed to more climate-related stress.

Forest Adaptation

Adaptation Strategies

- **Sustain fundamental ecological functions.**
  - Reduce impacts to soil and nutrient cycling.
  - Maintain or restore hydrology.
  - Reduce competition for moisture, nutrients, and light.
  - Restore or maintain fire in fire-adapted ecosystems.



- **Maintain and enhance species and structural diversity.**
  - Promote diverse age classes.
  - Maintain and restore diversity of native species.
  - Retain biological legacies.

- **Promote landscape connectivity.**
  - Reduce landscape fragmentation.
  - Maintain and create habitat corridors through reforestation or restoration.

- **Reduce the impact of biological stressors.**
  - Maintain or improve the ability of forests to resist pests and pathogens.
  - Prevent the introduction and establishment of invasive plant species and remove existing invasive species.
  - Manage herbivory to promote regeneration of desired species.

- **Facilitate community adjustments through species transitions.**
  - Favor or restore native species that are expected to be adapted to future conditions.
  - Establish or encourage new mixes of native species.
  - Protect future-adapted seedlings and saplings.
  - Disfavor species that are distinctly maladapted.
- **Plan for and respond to disturbance**.

Northeast and Midwest seasonal patterns

Shifted season projected from increasing temperatures and precipitation changes

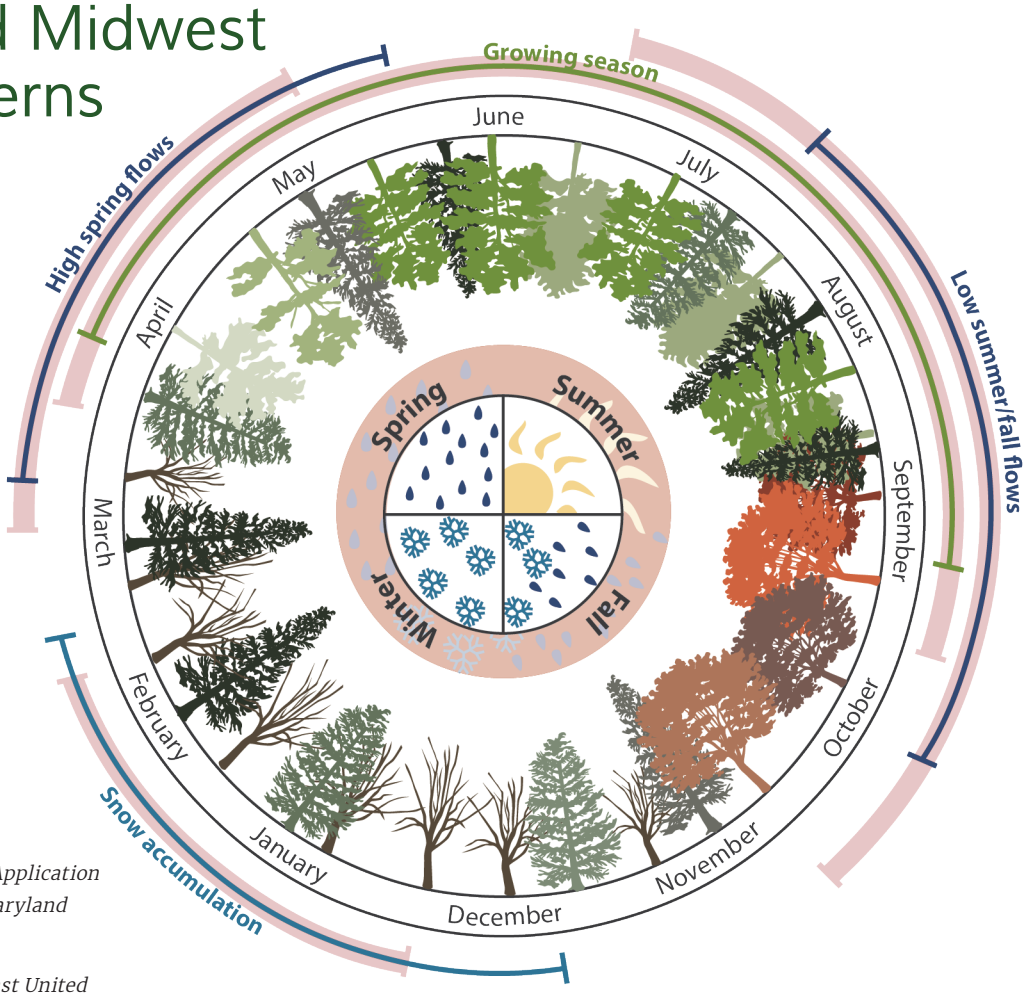


Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science.

Source: Ecological Drought in the Northeast United States newsletter, IAN Press. October 2016.

Adaptation in Action

Florence County Forestry and Parks – Florence, WI

Following a long-term drought and two-lined chestnut borer infestation, Florence County experienced high mortality in scrub oak forests across their land base. In some areas, mortality was as high as 95%. In a 400-acre block of recently salvaged scrub oak, Florence County implemented the following climate change adaptation actions.

- Re-planted the area to a combination of red, jack, and white pine. Designed to account for future expected droughts and the sandy, nutrient-poor soils on the site.
- Planted swamp white oak, juneberry, and other mast-producing trees and shrubs in clusters around the project area. Designed to provide food sources for wildlife, and to take advantage of species adapted to northern Wisconsin.
- Used wood-based biochar and wood ash as soil amendments in large test areas of the site. These soil amendments are designed to improve the water-holding capacity of the soil and reduce the impact of future drought stress.

Adaptation Scenarios

Problem →	Adaptation solution
A paper mill may face supply chain challenges if they rely on tree species that are anticipated to decline in the future, or if access or operability become more unpredictable with milder winters.	Develop new product lines or new chemical or manufacturing processes that allow the mill to accept a greater diversity of tree species, or particular species that are poised to hold steady or increase across the landscape.
A private landowner has an 80-acre property that is mostly aspen, all of which is 60 years old.	Break up the aspen into multiple age classes by harvesting in increments, and retain species that are expected to increase in order to provide a future seed source.
A private industrial landowner is responding to a fast-moving forest pest outbreak across a large section of their land base.	If salvage operations are necessary, include a percentage of future-adapted tree species in follow-up plantings by using the Climate Change Tree Atlas or other tools.
A public agency is responsible for maintaining a network of forest roads across their land base.	-Identify undersized or poorly functioning culverts and stream crossings, and implement a regular schedule of upgrades. -Decommission roads and stream crossings that may be unnecessary or impractical to maintain in the future.

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"Climate change is a game-changing issue for Wisconsin's forests, and we all have a stake in maintaining their health and sustainability. The WICCI Forestry Working Group helps put information into action by helping foresters and land managers adapt and prepare for future change."

– WICCI

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Please contact:

Wisconsin Initiative on Climate Change Impacts (WICCI) for more information.

Visit **wicci.wisc.edu/forestry-working-group.php** for details.

NIACS Northern Institute of Applied Climate Science

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