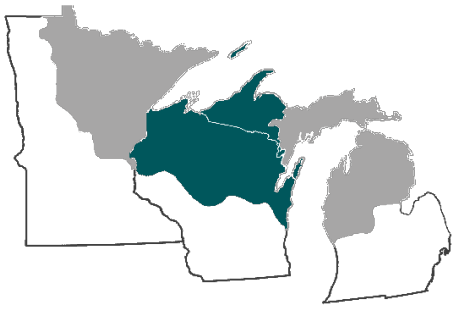
CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

NORTHERN WISCONSIN AND WESTERN UPPER MICHIGAN



This region's forests will be affected by a changing climate and other stressors during this century. A team of managers and researchers created an assessment that describes the vulnerability of forests in northern Wisconsin and western Upper Michigan (Janowiak et al. 2014). This report includes information on observed and future climate trends, and also summarizes key vulnerabilities for forested natural communities. The Landscape Change Research Group recently updated the Climate Change Tree Atlas, and this handout summarizes that information. Full Tree Atlas results are available online at www.fs.fed.us/nrs/atlas/. Two climate scenarios are presented to "bracket" a range of possible futures. These future climate projections (2070 to 2099) provide information about how individual tree species may respond to a changing climate. Results for "low" and "high" emissions scenarios can be compared on the reverse side of this handout.

The updated Tree Atlas presents additional information helpful to interpret tree species changes:

- Suitable habitat - calculated based on 39 variables that explain where optimum conditions exist for a species, including soils, landforms, and climate variables.
- Adaptability - based on life-history traits that might increase or decrease tolerance of expected changes, such as the ability to withstand different forms of disturbance.
- Capability - a rating of the species' ability to cope or persist with climate change in this region based on suitable habitat change (statistical modeling), adaptability (literature review and expert opinion), and abundance (FIA data). The capability rating is modified by abundance information; ratings are downgraded for rare species and upgraded for abundant species.
- Migration Potential Model - when combined with habitat suitability, an estimate of a species' colonization likelihood for new habitats. This rating can be helpful for assisted migration or focused management (see the table section: "New Habitat with Migration Potential").

Remember that models are just tools, and they're not perfect. Model projections can't account for all factors that influence future species success. If a species is rare or confined to a small area, model results may be less reliable. These factors, and others, could cause a particular species to perform better or worse than a model projects. Human choices will also continue to influence forest distribution, especially for tree species that are projected to increase. Planting programs may assist the movement of future-adapted species, but this will depend on management decisions. Despite these limits, models provide useful information about future expectations. It's perhaps best to think of these projections as indicators of possibility and potential change.

SOURCE: *This handout summarizes the full model results for northern Wisconsin and western Upper Michigan, available at* www.fs.fed.us/nrs/atlas/combined/resources/summaries. *More information on vulnerability and adaptation in the Northwoods region can be found at* www.forestadaptation.org/northwoods. *A full description of the models and variables are provided in Iverson et al. 2019 (*www.nrs.fs.fed.us/pubs/57857 *and* www.nrs.fs.fed.us/pubs/59105*) and Peters et al. 2019 (*www.nrs.fs.fed.us/pubs/58353*).*

CLIMATE CHANGE CAPABILITY

POOR CAPABILITY	
American hornbeam	Ohio buckeye
American mountain-ash	Pin cherry
Balsam fir	Red pine
Balsam poplar	River birch
Black ash	Serviceberry
Black maple	Striped maple
Black spruce	Tamarack (native)
Black willow	White sprice
Eastern hemlock	Yellow birch
Mountain maple	
FAIR CAPABILITY	
Eastern white pine	Paper birch
Jack pine	Quaking aspen
Northern white-cedar	
GOOD CAPABILITY	
American elm	Hackberry
Bitternut hickory	Ironwood
Black cherry	Northern pin oak
Black oak	Northern red oak
Black walnut	Red maple
Boxelder	Shagbark hickory
Bur oak	Silver maple
Easter redcedar	Sugar maple
Green ash	White oak
MIXED RESULTS	
American basswood	Pin oak
American beech	Slippery elm
Bigtooth aspen	Swamp white oak
Eastern cottonwood	White ash
Honeylocust	
NEW HABITAT WITH MIGRATION POTENTIAL	
Blackgum	Red mulberry
Chinkapin oak	Sassafras
Eastern redbud	Shingle oak
Mockernut hickory	Sycamore
Osage-orange	Yellow-poplar
Pignut hickory	

NIACS
Northern Institute of Applied Climate Science

www.forestadaptation.org

ADAPTABILITY: Life-history factors, such as the ability to respond favorably to disturbance, that are not included in the Tree Atlas model and may make a species more or less able to adapt to future stressors.

- \+ HIGH *Species may perform better than modeled*
- • MEDIUM
- – LOW *Species may perform worse than modeled*

HABITAT CHANGE: Projected change in suitable habitat between current and potential future conditions.

- ▲ INCREASE *Projected increase of >20% by 2100*
- ● NO CHANGE *Projected change of <20% by 2100*
- ▼ DECREASE *Projected decrease of >20% by 2100*
- ★ NEW HABITAT *Tree Atlas projects new habitat for species not currently present*

ABUNDANCE: Based on Forest Inventory Analysis (FIA) summed Importance Value data, calibrated to a standard geographic area.

- \+ ABUNDANT
- • COMMON
- – RARE

CAPABILITY: An overall rating that describes a species' ability to cope or persist with climate change based on suitable habitat change class (statistical modeling), adaptability (literature review and expert opinion), and abundance within this region.

- △ GOOD *Increasing suitable habitat, medium or high adaptability, and common or abundant*
- ○ FAIR *Mixed combinations, such as a rare species with increasing suitable habitat and medium adaptability*
- ▽ POOR *Decreasing suitable habitat, medium or low adaptability, and uncommon or rare*

SPECIES	ADAPT	ABUN	LOW CLIMATE CHANGE (RCP 4.5) HABITAT CHANGE	LOW CLIMATE CHANGE (RCP 4.5) CAPABILITY	HIGH CLIMATE CHANGE (RCP 8.5) HABITAT CHANGE	HIGH CLIMATE CHANGE (RCP 8.5) CAPABILITY
American basswood	•	•	▲	△	●	○
American beech	•	–	▲	○	▲	△
American elm	•	•	▲	△	▲	△
American hornbeam*	•	–	▼	▽	▼	▽
Balsam fir	–	+	▼	▽	▼	▽
Balsam poplar	•	–	▼	▽	▼	▽
Bigtooth aspen	•	•	▲	△	●	○
Bitternut hickory*	+	–	▲	△	▲	△
Black ash	–	•	●	▽	●	▽
Black cherry	–	•	▲	△	▲	△
Black hickory	•		★		★	
Black maple*	+	–	▼	▽	▼	▽
Black oak	•	–	▲	△	▲	△
Black spruce	•	•	▼	▽	▼	▽
Black walnut*	•	–	▲	△	▲	△
Black willow*	–	–	▼	▽	●	▽
Blackgum	+		★		★	
Blackjack oak	+		★		★	
Boxelder*	+	•	●	△	●	△
Bur oak	+	•	▲	△	▲	△
Cedar elm	–		★		★	
Chestnut oak	+		★		★	
Chinkapin oak	•		★		★	
Eastern cottonwood*	•	–	●	▽	▲	○
Eastern hemlock	–	•	●	▽	▼	▽
Eastern redbud*	•		★		★	
Eastern redcedar	•	–	▲	△	▲	△
Eastern white pine	–	•	▲	○	▲	○
Green ash*	•	•	▲	△	▲	△
Hackberry	+	–	▲	△	▲	△
Honeylocust*	+	–	●	○	▲	△
Ironwood*	+	•	▲	△	▲	△
Jack pine	+	•	▼	○	▼	○
Live oak	•		★		★	
Mockernut hickory	+		★		★	
Mountain maple*	+	–	▼	▽	▼	▽
Northern pin oak	+	•	▲	△	▲	△
Northern red oak	+	•	▲	△	▲	△
Northern white-cedar	•	•	●	○	●	○
Ohio buckeye*	•	–	●	▽	▼	▽
Osage-orange	+		★		★	
Paper birch	•	•	●	○	●	○
Pignut hickory	•		★		★	
Pin cherry*	•	–	▼	▽	▼	▽
Pin oak*	–	–	▲	▽	▲	○
Post oak	+		★		★	
Quaking aspen	•	+	▼	○	▼	○
Red maple	+	+	●	△	●	△
Red pine	–	•	●	▽	●	▽
River birch*	•	–	▼	▽	▼	▽
Sassafras*	•		★		★	
Scarlet oak	•		★		★	
Serviceberry*	•	–	▼	▽	▼	▽
Shagbark hickory	•	–	▲	△	▲	△
Shingle oak	•		★		★	
Silver maple*	+	•	●	△	●	△
Slippery elm*	•	–	●	▽	▲	○
Striped maple	•	–	▼	▽	▼	▽
Sugar maple	+	+	▼	△	▼	△
Swamp white oak*	•	–	▲	○	▲	△
Sweetgum	•		★		★	
Sycamore*	•		★		★	
Tamarack (native)	–	•	●	▽	●	
Virginia pine	•		★		★	▽
White ash	–	•	▲	○	▲	
White oak	+	•	▲	△	▲	△
Sweet birch	–		★		★	△
White spruce	•	•	▼	▽	▼	▽
Yellow birch	•	•	▼	▽	▼	▽
Yellow-poplar	+		★		★	

**Species with low model reliability based on five statistical metrics of the habitat models that affect change class. See maps and tables for more information (www.fs.fed.us/nrs/atlas/combined/resources/summaries).*

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