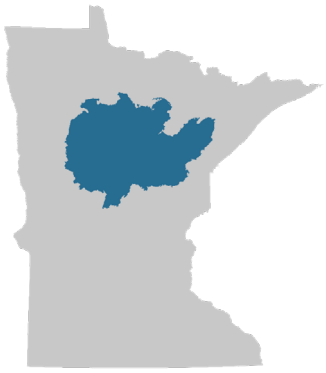
CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

NORTHERN MINNESOTA DRIFT & LAKE PLAINS (ECOLOGICAL SECTION 212N)



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 the region (*Handler 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 the Northern Minnesota Drift and Lake Plains (Ecological Section 212N), available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the 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	Mountain maple
American mountain-ash	Pin cherry
Balsam poplar	Serviceberry
FAIR CAPABILITY	
Balsam fir	Jack pine
Bigtooth aspen	Quaking aspen
Black ash	Red pine
Black cherry	Silver maple
Black spruce	
GOOD CAPABILITY	
American elm	Ironwood
Bitternut hickory	Northern pin oak
Boxelder	Nothern red oak
Bur oak	Red maple
Eastern cottonwood	Slippery elm
Eastern white pine	Sugar maple
Green ash	White oak
Hackberry	Yellow birch
MIXED RESULTS	
American basswood	Paper birch
Black willow	Tamarack (native)
Northern white-cedar	White spruce
NEW HABITAT WITH MIGRATION POTENTIAL	
American beech	Post oak
Black locust	Red mulberry
Black oak	Shagbark hickory
Black walnut	Shumard oak
Eastern hemlock	Swamp white oak
Eastern redcedar	Sweetgum
Honeylocust	Sycamore
Mockernut hickory	White ash
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*

			LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
SPECIES	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
American basswood	•	•	▲	△	●	○
American beech	•		★		★	
American elm	•	•	▲	△	▲	△
American hornbeam*	•	–	▼	▽	●	▽
American mountain-ash*	–	–	▼	▽	▼	▽
Balsam fir	–	+	▼	○	●	○
Balsam poplar	•	•	▼	▽	▼	▽
Bigtooth aspen	•	•	●	○	●	○
Bitternut hickory*	+	–	▲	△	▲	△
Black ash	–	+	●	○	●	○
Black cherry	–	–	▲	○	▲	○
Black locust*	•		★		★	
Black oak	•		★		★	
Black spruce	•	+	▼	○	▼	○
Black walnut*	•		★		★	
Black willow*	–	–	●	▽	▲	○
Boxelder*	+	–	▲	△	▲	△
Bur oak	+	+	▲	△	▲	△
Eastern cottonwood*	•	–	▲	△	▲	△
Eastern hemlock	–		★		★	
Eastern redcedar	•		★		★	
Eastern white pine	–	•	▲	△	▲	△
Green ash*	•	•	▲	△	▲	△
Hackberry	+	–	▲	△	▲	△
Honeylocust*	+		★		★	
Ironwood*	+	•	▲	△	▲	△
Jack pine	+	•	▼	○	▼	○

			LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
SPECIES	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
Mockernut hickory	+		★		★	
Mountain maple*	+	–	▼	▽	▼	▽
Northern pin oak	+	•	▲	△	▲	△
Northern red oak	+	•	▲	△	▲	△
Northern white-cedar	•	•	●	○	▲	△
Paper birch	•	+	●	△	▼	○
Pignut hickory	•		★		★	
Pin cherry*	•	–	▼	▽	▼	▽
Post oak	+		★		★	
Quaking aspen	•	+	▼	○	▼	○
Red maple	+	•	▲	△	▲	△
Red mulberry*	•		★		★	
Red pine	–	+	●	○	●	○
Serviceberry*	•	–	▼	▽	▼	▽
Shagbark hickory	•		★		★	
Shumard oak*	+		★		★	
Silver maple*	+	–	●	○	●	○
Slippery elm*	•	–	▲	△	▲	△
Sugar maple	+	•	▲	△	▲	△
Swamp white oak*	•		★		★	
Sweetgum	•				★	
Sycamore*	•		★		★	
Tamarack (native)	–	+	▲	△	●	○
White ash	–		★		★	
White oak	+	–	▲	△	▲	△
White spruce	•	•	●	○	▲	△
Yellow birch	•	–	▲	△	▲	△

**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).*