CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

MINNESOTA AND IOWA MORAINAL (SECTION 222M)

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 Minnesota and Iowa Morainal Section 222M, 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 basswood	Pin cherry
American hornbeam	Quaking aspen
American mountain-ash	Red mulberry
Balsam fir	Red pine
Balsam poplar	River birch
Bigtooth aspen	Serviceberry
Black ash	Slippery elm
Black maple	Tamarack (native)
Black spruce	White ash
Black willow	White spruce
Eastern white pine	Yellow birch
Mountain maple	
FAIR CAPABILITY	
American elm	Jack pine
Black cherry	Northern red oak
Eastern cottonwood	
GOOD CAPABILITY	
Bitternut hickory	Hackberry
Black locust	Honeylocust
Black oak	Red maple
Black walnut	Silver maple
Eastern redcedar	Sugar maple
Green ash	White oak
MIXED RESULTS	
Boxelder	Northern white-cedar
Bur oak	Paper birch
Ironwood	Shagbark hickory
Northern pin oak	
NEW HABITAT WITH MIGRATION POTENTIAL	
Black hickory	Pin oak
Chinkapin oak	Post oak
Common persimmon	Sassafras
Eastern redbud	Shingle oak
Mockernut hickory	Swamp white oak
Osage-orange	Sycamore

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 elm	•	•	●	○	●	○
American hornbeam*	•	–	▼	▽	▼	▽
American mountain-ash*	–	–	▼	▽	▼	▽
Balsam fir	–	–	●	▽	●	▽
Balsam poplar	•	–	▼	▽	▼	▽
Bigtooth aspen	•	•	▼	▽	▼	▽
Bitternut hickory*	+	–	▲	△	▲	△
Black ash	–	•	●	▽	▼	▽
Black cherry	–	•	▲	○	▲	○
Black hickory	•		★		★	
Black locust*	•	–	▲	△	▲	△
Black maple*	+	–	▼	▽	▼	▽
Black oak	•	–	▲	△	▲	△
Black spruce	•	–	▼	▽	▼	▽
Black walnut*	•	–	▲	△	▲	△
Black willow*	–	–	▼	▽	●	▽
Blackjack oak	+		★		★	
Boxelder*	+	•	●	△	▼	○
Bur oak	+	•	●	△	▼	○
Chinkapin oak	•		★		★	
Cittamwood*	+				★	
Common persimmon*	+		★		★	
Eastern cottonwood*	•	–	▲	○	▲	○
Eastern redbud*	•		★		★	
Eastern redcedar	•	–	▲	△	▲	△
Eastern white pine	–	–	●	▽	●	▽
Green ash*	•	•	▲	△	▲	△
Hackberry	+	–	▲	△	▲	△
Honeylocust*	+	–	▲	△	▲	△
Ironwood*	+	•	●	△	▼	○
Jack pine	+	–	●	○	●	○
Mockernut hickory	+		★		★	
Mountain maple*	+	–	▼	▽	▼	▽
Northern pin oak	+	•	●	△	▼	○
Northern red oak	+	•	▼	○	▼	○
Northern white-cedar	•	–	●	▽	▲	△
Osage-orange	+		★		★	
Paper birch	•	•	●	○	▼	▽
Pecan*	–		★		★	
Pin cherry*	•	–	▼	▽	▼	▽
Pin oak*	–		★		★	
Post oak	+		★		★	
Quaking aspen	•	•	▼	▽	▼	▽
Red maple	+	•	▲	△	▲	△
Red mulberry*	•	–	●	▽	●	▽
Red pine	–	•	●	▽	●	▽
River birch*	•	–	▼	▽	▼	▽
Sassafras*	•		★		★	
Serviceberry*	•	–	▼	▽	▼	▽
Shagbark hickory	•	–	▲	△	▲	○
Shingle oak	•		★		★	
Shumard oak*	+		★		★	
Silver maple*	+	•	▲	△	▲	△
Slippery elm*	•	–	●	▽	●	▽
Sugar maple	+	•	●	△	●	△
Sugarberry	•				★	
Swamp white oak*	•		★		★	
Sycamore*	•		★		★	
Tamarack (native)	–	•	●	▽	●	▽
White ash	–	–	●	▽	●	▽
White oak	+	•	●	△	●	△
White spruce	•	–	▼	▽	▼	▽
Winged elm	•				★	
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).*