Climate Change Projections for Individual Tree Species

South Central Great Lakes (Ecological Section 222J)

This region's forests will be affected by a changing climate and other stressors during this century. Researchers and managers created an assessment that describes the vulnerability of forests in the Northwoods region (Handler et al. 2014: doi.org/10.2737/NRS-GTR-129). This report includes information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest ecosystems. This handout summarizes data from the U.S. Forest Service's Climate Change Tree Atlas (doi.org/10.2737/Climate-Change-Tree-Atlas-v4). 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 Tree Atlas provides information to interpret tree species changes:

- **SUITABLE HABITAT** - calculated based on 45 variables that explain where 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 (inventory data). The capability rating is modified by abundance information; ratings are downgraded for rare species and upgraded for abundant species. Capability rating may not appropriately reflect the outlook for species with emerging severe forest health issues, such as ash species affected by emerald ash borer. See the table to the right for ratings.
- **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.

CLIMATE CHANGE CAPABILITY TABLE.
Capability is a rating of the species' ability to cope or persist with climate change. Species are organized into poor, fair, good, and mixed capability ratings. Species with new suitable habitat or low model reliability are excluded from this table. See the Tree Species Projections table legend on the following page for more information on ratings.

***NOTE:** Capability rating may not reflect severe forest health issues (e.g., emerald ash borer).*

POOR CAPABILITY	
Balsam poplar	Paper birch
Bigtooth aspen	Pignut hickory
Black ash	Quaking aspen
Chinkapin oak	Red pine
Eastern hemlock	Scarlet oak
Eastern white pine	Shingle oak
Flowering dogwood	Tamarack (native)
Jack pine	White spruce
Northern pin oak	Yellow birch
Northern white-cedar	
FAIR CAPABILITY	
Black cherry	White ash
Blackgum	Yellow-poplar
Bur oak	
GOOD CAPABILITY	
Black oak	Osage-orange
Eastern redcedar	Red maple
Hackberry	Sugar maple
Northern red oak	White oak
MIXED CAPABILITY	
American basswood	Loblolly pine
American beech	Mockernut hickory
American elm	Shagbark hickory

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.

CREDIT: *This handout summarizes the full model results for the South Central Great Lakes (Ecological Section 222J). Data provided by the USDA Forest Service (M.P. Peters, A.M. Prasad, S.N. Matthews, & L.R. Iverson) as part of the Climate Change Tree Atlas (doi.org/10.2737/Climate-Change-Tree-Atlas-v4). Models and variables are described in Iverson et al. 2019 and Peters et al. 2019 (available at fs.usda.gov/nrs/atlas/products/pubs). More information on vulnerability and adaptation in the region can be found at forestadaptation.org/northwoods.*

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Tree Species Projections Table

Information presented in the table is from the Climate Change Tree Atlas regional summaries, more details at fs.usda.gov/nrs/atlas/combined/resources/summaries.

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*
- ▼ **DECREASE** *Projected decrease of >20% by 2100*
- ● **NO CHANGE** *Projected change 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, adaptability, and abundance within this region. Capability may not reflect severe forest health issues.

- △ **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*	·	–	▼	▽	▼	▽
Balsam poplar	·	–	▼	▽	▼	▽
Bigtooth aspen	·	·	▼	▽	▼	▽
Bitternut hickory*	+	·	●	△	▲	△
Black ash	–	–	▼	▽	▼	▽
Black cherry	–	+	▼	○	▼	○
Black hickory	·		★		★	
Black locust*	·	–	●	▽	▲	○
Black maple*	+	–	▼	▽	▼	▽
Black oak	·	·	▲	△	▲	△
Black walnut*	·	·	▲	△	▲	△
Black willow*	–	·	▼	▽	●	▽
Blackgum	+	–	●	○	●	○
Blackjack oak	+		★		★	
Boxelder*	+	–	▲	△	▲	△
Bur oak	+	–	●	○	●	○
Cedar elm	–		★		★	
Chinkapin oak	·	–	●	▽	●	▽
Common persimmon*	+		★		★	
Eastern cottonwood*	·	·	▲	△	▲	△
Eastern hemlock	–	–	▼	▽	▼	▽
Eastern redbud*	·		★		★	
Eastern redcedar	·	–	▲	△	▲	△
Eastern white pine	–	·	▼	▽	▼	▽
Flowering dogwood	·	–	▼	▽	▼	▽
Green ash*	·	·	●	○	●	○
Hackberry	+	–	▲	△	▲	△
Honeylocust*	+	–	●	○	●	○
Ironwood*	+	–	▼	▽	▼	▽
Jack pine	+	–	▼	▽	▼	▽
Loblolly pine	·	–	●	▽	▲	△
Mockernut hickory	+	–	●	○	▲	△

			LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
SPECIES	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
Northern pin oak	+	–	▼	▽	▼	▽
Northern red oak	+	·	●	△	●	△
Northern white-cedar	·	–	▼	▽	▼	▽
Ohio buckeye*	·	–	▼	▽	▼	▽
Osage-orange	+	–	▲	△	▲	△
Paper birch	·	–	▼	▽	▼	▽
Pawpaw*	·	–	▼	▽	▼	▽
Pignut hickory	·	–	●	▽	●	▽
Pin cherry*	·	–	▼	▽	▼	▽
Pin oak*	–	–	●	▽	●	▽
Post oak	+		★		★	
Quaking aspen	·	·	▼	▽	▼	▽
Red maple	+	+	▼	△	▼	△
Red pine	–	·	▼	▽	▼	▽
Sassafras*	·	·	▲	△	▼	▽
Scarlet oak	·	–	▼	▽	▼	▽
Shagbark hickory	·	·	▲	△	▼	▽
Shingle oak	·	–	▼	▽	▼	▽
Shortleaf pine	·		★		★	
Shumard oak*	+	–	●	○	●	○
Silver maple*	+	·	▲	△	▲	△
Slippery elm*	·	·	▼	▽	▼	▽
Sugar maple	+	·	▲	△	●	△
Sugarberry	·		★		★	
Swamp white oak*	·	–	●	▽	●	▽
Sweetgum	·		★		★	
Sycamore*	·	–	▲	△	▲	△
Tamarack (native)	–	–	▼	▽	▼	▽
Virginia pine	·		★		★	
White ash	–	·	▲	○	▲	○
White oak	+	·	▲	△	●	△
White spruce	·	–	▼	▽	▼	▽
Winged elm	·		★		★	
Yellow birch	·	–	▼	▽	▼	▽
Yellow-poplar	+	–	●	○	●	○

**Species with low model reliability based on five statistical metrics of the habitat models that affect change class.*

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