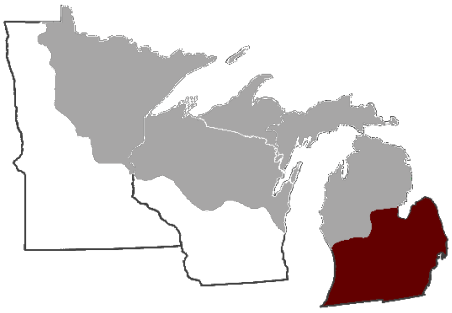
CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

SOUTHERN MICHIGAN



Midwestern forests will be affected by climate change during this century. Several reports describe the climate change risks to the region's forests and natural communities (Angel et al. 2018, Swanston et al. 2018). These reports include information on observed and future climate trends, and also summarize 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.

CLIMATE CHANGE CAPABILITY

POOR CAPABILITY	
American hornbeam	Paper birch
American mountain-ash	Pawpaw
Balsam poplar	Pignut hickory
Bigtooth aspen	Pin cherry
Black ash	Pin oak
Black maple	Quaking aspen
Black willow	Red mulberry
Chinkapin oak	Red pine
Eastern hemlock	Scarlet oak
Eastern white pine	Serviceberry
Flowering dogwood	Shingle oak
Ironwood	Slippery elm
Jack pine	Tamarack (native)
Northern white-cedar	White spruce
Ohio buckeye	Yellow birch
FAIR CAPABILITY	
Black cherry	Shumard oak
Blackgum	Swamp white oak
Bur oak	White ash
Mockernut hickory	Yellow-poplar
Northern pin oak	
GOOD CAPABILITY	
Bitternut hickory	Northern red oak
Black oak	Osage-orange
Black walnut	Red maple
Boxelder	Silver maple
Eastern cottonwood	Sugar maple
Eastern redcedar	Sycamore
Green ash	White oak
Hackberry	
MIXED RESULTS	
American basswood	Honeylocust
American beech	Loblolly pine
American elm	Sassafras
Black locust	Shagbark hickory
NEW HABITAT WITH MIGRATION POTENTIAL	
Common persimmon	Sweetgum
Eastern redbud	Virginia pine
Post oak	Winged elm
Shortleaf pine	

SOURCE: *This handout summarizes the full model results for Southern 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).*

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*	•	–	▼	▽	▼	▽
Ashe juniper	•		★		★	
Bigtooth aspen	•	•	▼	▽	▼	▽
Bitternut hickory*	+	•	▲	△	▲	△
Black ash	–	–	▼	▽	▼	▽
Black cherry	–	+	●	○	▼	○
Black hickory	•		★		★	
Black locust*	•	–	●	▽	▲	○
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	–	•	▼	▽	▼	▽
Green ash*	•	+	●	△	●	△
Hackberry	+	–	▲	△	▲	△
Honeylocust*	+	–	●	○	▲	△
Ironwood*	+	–	▼	▽	▼	▽
Jack pine	+	–	▼	▽	▼	▽
Live oak	•		★		★	
Loblolly pine	•	–	●	▽	▲	△
Mockernut hickory	+	–	●	○	●	○
Northern pin oak	+	•	▼	○	▼	○

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
Northern red oak	+	•	●	△	●	△
Northern white-cedar	•	–	▼	▽	▼	▽
Osage-orange	+	–	▲	△	▲	△
Paper birch	•	•	▼	▽	▼	▽
Pecan*	–		★		★	
Pignut hickory	•	–	●	▽	●	▽
Pin oak*	–	–	●	▽	●	▽
Post oak	+		★		★	
Quaking aspen	•	•	▼	▽	▼	▽
Red maple	+	+	▼	△	▼	△
Red mulberry*	•	–	●	▽	●	▽
Red pine	–	•	▼	▽	▼	▽
Sassafras*	•	•	▲	△	▼	▽
Scarlet oak	•	–	▼	▽	▼	▽
Serviceberry*	•	–	▼	▽	▼	▽
Shagbark hickory	•	•	●	○	▼	▽
Shingle oak	•	–	▼	▽	▼	▽
Shortleaf pine	•		★		★	
Shumard oak*	+	–	●	○	●	○
Silver maple*	+	•	▲	△	▲	△
Slippery elm*	•	–	▼	▽	▼	▽
Southern red oak	+		★		★	
Sugar maple	+	•	▲	△	●	△
Swamp white oak*	•	•	●	○	●	○
Sweetgum	•		★		★	
Sycamore*	•	–	▲	△	▲	△
Tamarack (native)	–	–	▼	▽	▼	▽
Virginia pine	•		★		★	
White ash	–	•	▲	○	▲	○
Sugarberry	•		★		★	
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. See maps and tables for more information (www.fs.fed.us/nrs/atlas/combined/resources/summaries).*

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