

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

SOUTH CENTRAL GREAT LAKES (SECTION 222J)



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 Michigan ([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 Michigan's South Central Great Lakes, 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	Paper birch
Balsam poplar	Pignut hickory
Bigtooth aspen	Pin oak
Black ash	Quaking aspen
Black willow	Red pine
Chinkapin oak	Scarlet oak
Eastern hemlock	Shingle oak
Eastern white pine	Slippery elm
Flowering dogwood	Swamp white oak
Ironwood	Tamarack (native)
Jack pine	White spruce
Northern pin oak	Yellow birch
Northern white-cedar	

FAIR CAPABILITY

Black cherry	Green ash
Blackgum	White ash
Bur oak	Yellow-poplar

GOOD CAPABILITY

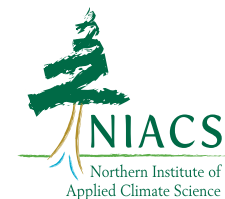
Bitternut hickory	Northern red oak
Black oak	Osage-orange
Black walnut	Red maple
Boxelder	Silver maple
Eastern cottonwood	Sugar maple
Eastern redcedar	White oak
Hackberry	

MIXED RESULTS

American basswood	Loblolly pine
American beech	Mockernut hickory
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	



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	LOW CLIMATE CHANGE (RCP 4.5)				HIGH CLIMATE CHANGE (RCP 8.5)			
	ADAPT	ABUN	HABITAT	CAPABILITY	ADAPT	ABUN	HABITAT	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	+	-	●	○	▲	△		
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. See maps and tables for more information (www.fs.fed.us/nrs/atlas/combined/resources/summaries).