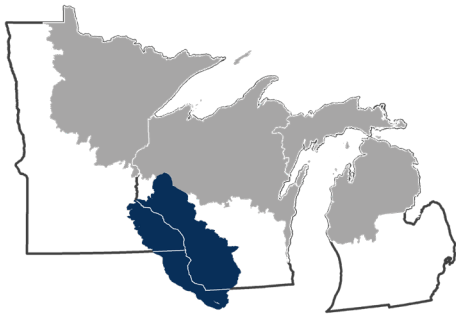


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES DRIFTLESS AREA (ECOLOGICAL SECTION 222L)



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 Driftless Area (Ecological Section 222L), available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the New England 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	Pin cherry
Balsam fir	Quaking aspen
Bigtooth aspen	Red pine
Black ash	River birch
Black maple	Serviceberry
Black spruce	Swamp white oak
Black willow	Tamarack (native)
Eastern white pine	White spruce
Paper birch	Yellow birch

FAIR CAPABILITY

Chinkapin oak	Red maple
Jack pine	Red mulberry
Northern pin oak	Slippery elm

GOOD CAPABILITY

American elm	Green ash
Bitternut hickory	Hackberry
Black oak	Honeylocust
Black walnut	Ironwood
Boxelder	Northern red oak
Bur oak	Silver maple
Eastern cottonwood	Sugar maple
Eastern redcedar	White oak

MIXED RESULTS

American basswood	Northern white-cedar
Black cherry	Shagbark hickory
Black locust	White ash

NEW HABITAT WITH MIGRATION POTENTIAL

American beech	Pignut hickory
Black hickory	Post oak
Blackgum	Sassafras
Blackjack oak	Scarlet oak
Cittamwood	Shingle oak
Common persimmon	Shumard oak
Eastern hemlock	Slash pine
Eastern redbud	Sugarberry
Flowering dogwood	Sycamore
Mockernut hickory	Virginia pine
Osage-orange	Yellow-poplar
Pecan	



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 CHANGE	CAPABILITY	SPECIES	LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)			
	HABITAT	ADAPT	HABITAT	ADAPT						HABITAT	ADAPT	HABITAT	ADAPT		
American basswood	•	•	●	○	▼		▼		Mockernut hickory	+	★		★		
American beech	•		★		★				Northern pin oak	+	•	▼	○	▼	○
American elm	•	+	●	▲	●		▲		Northern red oak	+	+	●	▲	▼	▲
American hornbeam*	•	-	▼	▼	▼		▼		Northern white-cedar	•	-	●	▼	▲	▲
Balsam fir	-	-	▼	▼	▼		▼		Osage-orange	+		★		★	
Bigtooth aspen	•	•	▼	▼	▼		▼		Paper birch	•	•	▼	▼	▼	▼
Bitternut hickory*	+	•	●	▲	●		▲		Pecan*	-		★		★	
Black ash	-	•	▼	▼	▼		▼		Pignut hickory	•		★		★	
Black cherry	-	•	▲	○	●		▼		Pin cherry*	•	-	▼	▼	▼	▼
Black hickory	•		★		★				Post oak	+		★		★	
Black locust*	•	•	●	○	▲		▲		Quaking aspen	•	•	▼	▼	▼	▼
Black maple*	+	-	▼	▼	▼		▼		Red maple	+	•	▼	○	▼	○
Black oak	•	•	▲	▲	▲		▲		Red mulberry*	•	•	●	○	●	○
Black spruce	•	-	▼	▼	▼		▼		Red pine	-	•	▼	▼	▼	▼
Black walnut*	•	•	▲	▲	▲		▲		River birch*	•	-	▼	▼	▼	▼
Black willow*	-	-	▼	▼	●		▼		Sassafras*	•		★		★	
Blackgum	+		★		★				Scarlet oak	•		★		★	
Blackjack oak	+		★		★				Serviceberry*	•	-	▼	▼	▼	▼
Boxelder*	+	+	●	▲	▼		▲		Shagbark hickory	•	•	●	○	▼	▼
Bur oak	+	•	▲	▲	●		▲		Shingle oak	•		★		★	
Chinkapin oak	•	-	▲	○	▲		○		Shumard oak*	+		★		★	
Cittamwood*	+				★				Silver maple*	+	•	▲	▲	▲	▲
Common persimmon*	+		★		★				Slippery elm*	•	•	●	○	●	○
Eastern cottonwood*	•	•	▲	▲	▲		▲		Sugar maple	+	•	▲	▲	▲	▲
Eastern hemlock	-		★		★				Sugarberry	•		★		★	
Eastern redbud*	•		★		★				Swamp white oak*	•	-	●	▼	●	▼
Eastern redcedar	•	•	▲	▲	▲		▲		Sycamore*	•		★		★	
Eastern white pine	-	•	▼	▼	▼		▼		Tamarack (native)	-	-	●	▼	●	▼
Flowering dogwood	•		★		★				Virginia pine	•		★		★	
Green ash*	•	•	▲	▲	▲		▲		White ash	-	•	▲	○	▲	▲
Hackberry	+	•	▲	▲	▲		▲		White oak	+	•	▲	▲	●	▲
Honeylocust*	+	-	▲	▲	▲		▲		White spruce	•	-	▼	▼	▼	▼
Ironwood*	+	•	▲	▲	●		▲		Yellow birch	•	-	▼	▼	▼	▼
Jack pine	+	•	▼	○	▼		○		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).