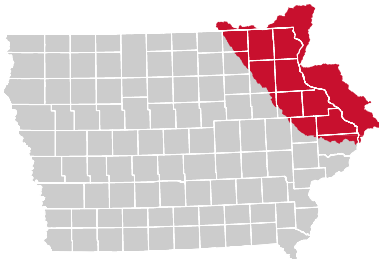


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES UPPER MISSISSIPPI-MAQUOKETA-PLUM WATERSHED IN IOWA



The region's forests will be affected by a changing climate and other stressors during this century. The National Climate Assessment describes how a changing climate can increase the vulnerability of forests in the Midwest (NCA 2018). This report includes information on the current landscape, observed climate trends, and a range of projected future climates.

The Landscape Change Research Group recently updated the Climate Change Tree Atlas, and this handout summarizes that information for select HUC 6 watersheds in Iowa. More Tree Atlas results are available online at www.fs.fed.us/nrs/atlas/. In this handout, 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 selected HUC 6 watersheds in the state of Iowa, available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in Iowa can be found at www.forestadaptation.org/iowa. 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
Black ash	Red pine
Eastern white pine	River birch
Northern pin oak	White spruce

FAIR CAPABILITY

American basswood	Chinkapin oak
Bigtooth aspen	Quaking aspen
Black maple	Swamp white oak

GOOD CAPABILITY

American elm	Green ash
Bitternut hickory	Hackberry
Black locust	Honeylocust
Black oak	Red maple
Black walnut	Red mulberry
Boxelder	Shagbark hickory
Bur oak	Silver maple
Eastern cottonwood	Slippery elm
Eastern hophornbeam	Sugar maple
Eastern redcedar	White ash
	White oak

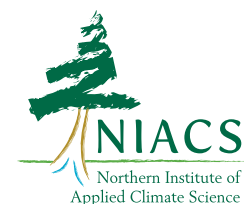
MIXED RESULTS

Black cherry	Black willow
Northern red oak	

NEW HABITAT WITH MIGRATION POTENTIAL

American beech	Pecan **
Black hickory	Pignut hickory
Common persimmon	Post oak
Eastern redbud	Sassafras
Flowering dogwood	Shingle oak
Mockernut hickory **	Sugarberry
Osage-orange	Sycamore
	Yellow-poplar

** Species is likely present but not currently included in the FIA database.



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)		HIGH CLIMATE CHANGE (RCP 8.5)	
			HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
American basswood	•	•	▼	●	▼	●
American beech	•	-	★		★	
American elm	•	+	▼	▲	▼	▲
American hornbeam; musclewood*	•	-	▼	▼	▼	▼
Bigtooth aspen	•	•	▼	●	▼	●
Bitternut hickory*	+	•	●	▲	●	▲
Black ash	-	-	▼	▼	▼	▼
Black cherry	-	•	●	▲	▼	●
Black hickory	•	-	★		★	
Black locust*	•	-	▲	▲	▲	▲
Black maple*	+	•	▼	●	▼	●
Black oak	•	-	▲	▲	▲	▲
Black walnut*	•	•	●	▲	●	▲
Black willow*	-	-	●	●	▲	▲
Boxelder*	+	•	●	▲	●	▲
Bur oak	+	•	▲	▲	●	▲
Chinkapin oak	•	-	●	●	●	●
Common persimmon*	+	-	★		★	
Eastern cottonwood*	•	•	●	▲	●	▲
Eastern hophornbeam; ironwood*	+	•	▲	▲	▲	▲
Eastern redbud*	•	-	▼		▼	
Eastern redcedar	•	•	▲	▲	▲	▲
Eastern white pine	-	-	▼	▼	▼	▼
Flowering dogwood	•	-	▼		▼	
Green ash*	•	•	▲	▲	▲	▲
Hackberry	+	•	▲	▲	▲	▲
Honeylocust*	+	-	▲	▲	▲	▲

SPECIES	ADAPT	ABUN	LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
			HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
Mockernut hickory**	+	-	★		★	
Northern pin oak	+	-	▼	▼	▼	▼
Northern red oak	+	•	●	▲	▼	●
Osage-orange	+	-	★		★	
Paper birch	•	-	▼	▼	▼	▼
Pecan* **	-	-	★		★	
Pignut hickory	•	-	★		★	
Post oak	+	-	★		★	
Quaking aspen	•	•	▼	●	▼	●
Red maple	+	-	▲	▲	▲	▲
Red mulberry*	•	-	▲	▲	▲	▲
Red pine	-	-	▼	▼	▼	▼
Sassafras*	•	-	★		★	
Shagbark hickory	•	•	●	▲	●	▲
Shingle oak	•	-	★		★	
Silver maple*	+	•	▲	▲	▲	▲
Slippery elm*	•	•	●	▲	●	▲
Sugar maple	+	•	▲	▲	▲	▲
Sugarberry	•	-	★		★	
Swamp white oak*	•	-	●	●	●	●
Sycamore*	•	-	★		★	
White ash	-	•	▲	▲	▲	▲
White oak	+	•	▲	▲	●	▲
White spruce	•	-	▼	▼	▼	▼
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).

** Species is likely present but not currently included in the FIA database.