

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

MISSOURI



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 (Brandt 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.

CLIMATE CHANGE CAPABILITY

POOR CAPABILITY

American basswood	River birch
Bald cypress	Sassafras
Black willow	Scarlet oak
Blue ash	Serviceberry
Bur oak	Shagbark hickory
Eastern cottonwood	Shellbark hickory
Eastern white pine	Shingle oak
Ohio buckeye	Swamp chestnut oak
Overcup oak	Swamp white oak
Pawpaw	Virginia pine
Pignut hickory	Water tupelo
Pin oak	

FAIR CAPABILITY

American hornbeam	Chinkapin oak
Black cherry	Flowering dogwood
Black oak	Pecan
Black walnut	Red mulberry
Boxelder	Silver maple
Cherrybark oak	

GOOD CAPABILITY

American beech	Osage-orange
American elm	Post oak
Bitternut hickory	Red maple
Black hickory	Shortleaf pine
Black locust	Shumard oak
Blackgum	Slippery elm
Blackjack oak	Southern red oak
Cittamwood	Sugar maple
Common persimmon	Sugarberry
Eastern hophornbeam	Sweetgum
Eastern redbud	Sycamore
Eastern redcedar	White ash
Green ash	White oak
Hackberry	Willow oak
Honeylocust	Winged elm
Mockernut hickory	Yellow-poplar
Northern red oak	

NEW HABITAT WITH MIGRATION POTENTIAL

Cedar elm	Sourwood
Chestnut oak	Water hickory

SOURCE: This handout summarizes the full model results for the Central Hardwoods region, available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the Central Hardwoods region can be found at www.forestadaptation.org/central-hardwoods. 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).

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)				SPECIES	LOW CLIMATE CHANGE (RCP 4.5)				HIGH CLIMATE CHANGE (RCP 8.5)			
	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY		ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY		
American basswood	•	-	▼	▼	▼	▼	▼	▼	Osage-orange	+	-	▲	▲	▲	▲		
American beech	•	-	▲	▲	▲	▲	▲	▲	Overcup oak	-	-	●	▼	●	▼		
American elm	•	•	▲	▲	▲	▲	▲	▲	Pawpaw*	•	-	▼	▼	▼	▼		
American holly	•	-					★		Pecan*	-	-	▲	○	▲	○		
American hornbeam*	•	-	●	▼	▲	○			Pignut hickory	•	•	▼	▼	▼	▼		
Bald cypress	•	-	●	▼	●	▼			Pin oak*	-	-	●	▼	●	▼		
Bitternut hickory*	+	•	▲	▲	▲	▲	▲	▲	Post oak	+	+	▲	▲	▲	▲		
Black cherry	-	•	▲	○	▲	○			Red maple	+	•	▲	▲	▲	▲		
Black hickory	•	•	▲	▲	▲	▲	▲	▲	Red mulberry*	•	•	●	○	●	○		
Black locust*	•	-	▲	○	▲	▲	▲	▲	River birch*	•	-	●	▼	●	▼		
Black oak	•	+	▼	○	▼	○			Sassafras*	•	•	▼	▼	▼	▼		
Black walnut*	•	•	●	○	●	○			Scarlet oak	•	•	▼	▼	▼	▼		
Black willow*	-	-	●	▼	●	▼			Serviceberry*	•	-	▼	▼	▼	▼		
Blackgum	+	•	▲	▲	▲	▲	▲	▲	Shagbark hickory	•	•	▼	▼	▼	▼		
Blackjack oak	+	•	▲	▲	▲	▲	▲	▲	Shellbark hickory*	•	-	▼	▼	●	▼		
Blue ash*	-	-	▼	▼	▼	▼	▼	▼	Shingle oak	•	•	▼	▼	▼	▼		
Boxelder*	+	-	●	○	●	○			Shortleaf pine	•	•	▲	▲	▲	▲		
Bur oak	+	-	▼	▼	▼	▼	▼	▼	Shumard oak*	+	•	●	▲	▲	▲		
Cedar elm	-	-	★		★				Silver maple*	+	-	●	○	●	○		
Cherrybark oak	•	-	●	▼	▲	○			Slippery elm*	•	•	▲	▲	▲	▲		
Chestnut oak	+	-	★		★				Sourwood	+	-	★		★			
Chinkapin oak	•	•	●	○	●	○			Southern red oak	+	-	▲	▲	▲	▲		
Cittamwood*	+	-	▲	▲	▲	▲	▲	▲	Sugar maple	+	•	●	▲	▲	▲		
Common persimmon*	+	•	▲	▲	▲	▲	▲	▲	Sugarberry	•	-	▲	▲	▲	▲		
Eastern cottonwood*	•	-	▼	▼	●	▼			Swamp chestnut oak*	•	-	●	▼	●	▼		
Eastern hophornbeam*	+	-	▲	▲	▲	▲	▲	▲	Swamp white oak*	•	-	▼	▼	▼	▼		
Eastern redbud*	•	-	▲	○	▲	▲	▲	▲	Sweetgum	•	-	▲	▲	▲	▲		
Eastern redcedar	•	+	▲	▲	▲	▲	▲	▲	Sycamore*	•	•	▲	▲	▲	▲		
Eastern white pine	-	-	▼	▼	▼	▼	▼	▼	Virginia pine	•	-	▼	▼	●	▼		
Flowering dogwood	•	•	●	○	●	○			Water hickory	•	-	★		★			
Green ash*	•	-	▲	▲	▲	▲	▲	▲	Water tupelo	-	-	▼	▼	▼	▼		
Hackberry	+	•	▲	▲	▲	▲	▲	▲	White ash	-	•	▲	○	▲	▲		
Honeylocust*	+	•	▲	▲	▲	▲	▲	▲	White oak	+	+	▼	▲	▼	▲		
Mockernut hickory	+	•	▲	▲	▲	▲	▲	▲	Willow oak*	•	-	▲	○	▲	▲		
Northern red oak	+	•	●	▲	●	▲	▲	▲	Winged elm	•	•	▲	▲	▲	▲		
Ohio buckeye*	•	-	▼	▼	▼	▼	▼	▼	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).