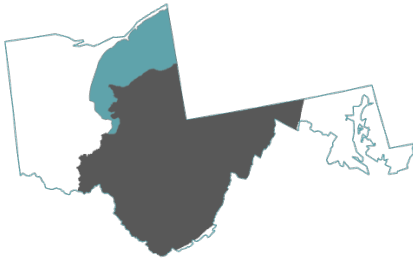


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES CENTRAL APPALACHIANS NORTHEAST OHIO



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 ([Butler et al. 2015](#)). 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 Central Appalachians region, available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the Central Appalachians region can be found at www.forestadaptation.org/central-appalachians. 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 basswood	Gray birch
American beech	Pin oak
American hornbeam	Quaking aspen
Balsam fir	Red pine
Bigtooth aspen	Scarlet oak
Black ash	Serviceberry
Black willow	Sourwood
Bur oak	Swamp white oak
Cucumbertree	Sweet birch
Eastern cottonwood	Virginia pine
Eastern hemlock	White ash
Eastern white pine	Yellow birch
Flowering dogwood	

FAIR CAPABILITY

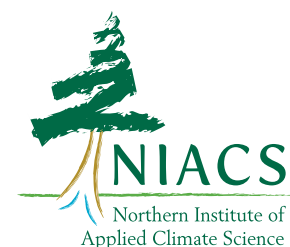
Black cherry	Osage-orange
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GOOD CAPABILITY

American elm	Northern red oak
Bitternut hickory	Pignut hickory
Black locust	Red maple
Black oak	Sassafras
Black walnut	Silver maple
Blackgum	Slippery elm
Boxelder	Sugar maple
Chinkapin oak	Sweetgum
Eastern hophornbeam	Sycamore
Green ash	White oak
Hackberry	Yellow-poplar
Mockernut hickory	

NEW HABITAT WITH MIGRATION POTENTIAL

Common persimmon	Shumard oak
Eastern redcedar	Southern red oak
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	ADAPT		LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)		SPECIES	ADAPT		LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
	ABUN	HABITAT	CHANGE	CAPABILITY	CHANGE	CAPABILITY		ABUN	HABITAT	CHANGE	CAPABILITY	CHANGE	CAPABILITY
American basswood	•	•	▼	▼	▼	▼	Osage-orange	+	-	●	○	●	○
American beech	•	•	▼	▼	▼	▼	Pignut hickory	•	-	▲	▲	▲	▲
American elm	•	•	●	○	▲	▲	Pin oak*	-	•	▼	▼	▼	▼
American hornbeam*	•	-	▼	▼	▼	▼	Post oak	+		★		★	
Balsam fir	-	-	▼	▼	▼	▼	Quaking aspen	•	•	▼	▼	▼	▼
Bigtooth aspen	•	•	▼	▼	▼	▼	Red maple	+	+	▼	▲	▼	▲
Bitternut hickory*	+	•	▲	▲	▲	▲	Red pine	-	-	▼	▼	▼	▼
Black ash	-	-	▼	▼	▼	▼	Sassafras*	•	•	▲	▲	▲	▲
Black cherry	-	+	▼	○	▼	○	Scarlet oak	•	-	●	▼	●	▼
Black locust*	•	•	▲	▲	▲	▲	Serviceberry*	•	-	▼	▼	▼	▼
Black oak	•	•	▲	▲	▲	▲	Shagbark hickory	•	•	▲	▲	●	○
Black walnut*	•	•	▲	▲	▲	▲	Shingle oak	•	-	▲	○	●	▼
Black willow*	-	•	▼	▼	▼	▼	Shortleaf pine	•		★		★	
Blackgum	+	•	●	▲	▲	▲	Shumard oak*	+		★		★	
Boxelder*	+	-	▲	▲	▲	▲	Silver maple*	+	•	●	▲	●	▲
Bur oak	+	-	▼	▼	▼	▼	Slippery elm*	•	•	▲	▲	▲	▲
Chinkapin oak	•	-	▲	▲	▲	▲	Sourwood	+	-	▼	▼	▼	▼
Common persimmon*	+		★		★		Southern red oak	+		★		★	
Cucumbertree*	•	-	▼	▼	▼	▼	Sugar maple	+	+	●	▲	▼	▲
Eastern cottonwood*	•	•	▼	▼	▼	▼	Swamp white oak*	•	•	▼	▼	▼	▼
Eastern hemlock	-	-	▼	▼	▼	▼	Sweet birch	-	-	▼	▼	▼	▼
Eastern hophornbeam*	+	-	▲	▲	▲	▲	Sweetgum	•	-	▲	▲	▲	▲
Eastern redcedar	•		★		★		Sycamore*	•	-	▲	▲	▲	▲
Eastern white pine	-	•	▼	▼	▼	▼	Virginia pine	•	-	●	▼	●	▼
Flowering dogwood	•	-	●	▼	●	▼	White ash	-	•	●	▼	●	▼
Gray birch*	•	-	▼	▼	▼	▼	White oak	+	•	▲	▲	▲	▲
Green ash*	•	•	▲	▲	▲	▲	Winged elm	•		★		★	
Hackberry	+	-	▲	▲	▲	▲	Yellow birch	•	-	▼	▼	▼	▼
Mockernut hickory	+	-	▲	▲	▲	▲	Yellow-poplar	+	•	▲	▲	●	▲
Northern red oak	+	•	▲	▲	●	▲							

*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).