

# CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES CENTRAL APPALACHIANS



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/](http://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](http://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](http://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](http://www.nrs.fs.fed.us/pubs/57857)) and [www.nrs.fs.fed.us/pubs/59105](http://www.nrs.fs.fed.us/pubs/59105)) and Peters et al. 2019 ([www.nrs.fs.fed.us/pubs/58353](http://www.nrs.fs.fed.us/pubs/58353)).

## CLIMATE CHANGE CAPABILITY

### POOR CAPABILITY

American basswood	Quaking aspen
American holly	Red pine
Bald cypress	Red spruce
Balsam fir	River birch
Bigtooth aspen	Serviceberry
Black ash	Shingle oak
Black willow	Striped maple
Bur oak	Swamp white oak
Eastern cottonwood	Sweet birch
Eastern hemlock	White ash
Eastern white pine	Yellow birch
Pin oak	Yellow buckeye
Pitch pine	

### FAIR CAPABILITY

Black cherry	Scarlet oak
Black locust	Shagbark hickory
Cucumbertree	

### GOOD CAPABILITY

American elm	Osage-orange
Bitternut hickory	Pignut hickory
Black oak	Post oak
Black walnut	Red maple
Blackgum	Sassafras
Blackjack oak	Shortleaf pine
Boxelder	Silver maple
Chestnut oak	Slippery elm
Chinkapin oak	Sourwood
Eastern hophornbeam	Southern red oak
Eastern redbud	Sugar maple
Eastern redcedar	Sugarberry
Flowering dogwood	Sweetgum
Green ash	Sycamore
Hackberry	Virginia pine
Loblolly pine	White oak
Mockernut hickory	Yellow-poplar
Northern red oak	

### NEW HABITAT WITH MIGRATION POTENTIAL

Cherrybark oak	Water oak
Longleaf pine	Winged elm
Slash 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)		SPECIES	LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY		ADAPT	ABUN	HABITAT CHANGE	CAPABILITY
American basswood	•	•	▼	▼	Osage-orange	+	-	●	○
American beech	•	•	●	○	Pignut hickory	•	•	▲	▲
American elm	•	•	●	○	Pin oak*	-	-	●	▼
American holly	•	-	▼	▼	Pitch pine	•	-	●	▼
American hornbeam*	•	-	▼	▼	Post oak	+	-	▲	▲
Bald cypress	•	-	▼	▼	Quaking aspen	•	-	▼	▼
Balsam fir	-	-	▼	▼	Red maple	+	+	▼	▲
Bigtooth aspen	•	•	▼	▼	Red pine	-	-	▼	▼
Bitternut hickory*	+	•	▲	▲	Red spruce	-	-	▼	▼
Black ash	-	-	▼	▼	River birch*	•	-	▼	▼
Black cherry	-	+	▼	○	Sassafras*	•	•	▲	▲
Black locust*	•	•	●	○	Scarlet oak	•	•	▲	▲
Black oak	•	•	▲	▲	Serviceberry*	•	-	▼	▼
Black walnut*	•	•	▲	▲	Shagbark hickory	•	•	●	○
Black willow*	-	-	▼	▼	Shingle oak	•	-	●	▼
Blackgum	+	•	▲	▲	Shortleaf pine	•	-	▲	▲
Blackjack oak	+	-	▲	▲	Silver maple*	+	•	●	▲
Boxelder*	+	•	●	▲	Slash pine	•		★	★
Bur oak	+	-	▼	▼	Slippery elm*	•	•	●	○
Cherrybark oak	•		★	★	Sourwood	+	•	▲	▲
Chestnut oak	+	+	●	▲	Southern red oak	+	-	▲	▲
Chinkapin oak	•	-	▲	▲	Striped maple	•	-	●	▼
Cucumbertree*	•	•	●	○	Sugar maple	+	+	●	▲
Eastern cottonwood*	•	-	▼	▼	Sugarberry	•	-	▲	▲
Eastern hemlock	-	•	●	▼	Swamp white oak*	•	-	▼	▼
Eastern hophornbeam*	+	-	●	○	Sweet birch	-	•	▼	▼
Eastern redbud*	•	-	▲	▲	Sweetgum	•	-	▲	▲
Eastern redcedar	•	-	▲	▲	Sycamore*	•	•	▲	▲
Eastern white pine	-	•	●	▼	Virginia pine	•	•	▲	▲
Flowering dogwood	•	-	▲	▲	Water oak	•		★	★
Green ash*	•	•	▲	▲	White ash	-	•	●	▼
Hackberry	+	-	●	○	White oak	+	+	▲	▲
Loblolly pine	•	-	▲	▲	Winged elm	•		★	★
Longleaf pine	•		★	★	Yellow birch	•	•	▼	▼
Mockernut hickory	+	•	▲	▲	Yellow buckeye*	-	•	▼	▼
Northern red oak	+	•	▲	▲	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](http://www.fs.fed.us/nrs/atlas/combined/resources/summaries)).