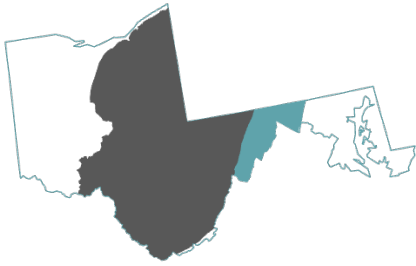


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES CENTRAL APPALACHIANS WESTERN MARYLAND



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

Bigtooth aspen	Red spruce
Cucumbertree	Serviceberry
Eastern hemlock	Striped maple
Eastern white pine	Sweet birch
Quaking aspen	Yellow birch
Red mulberry	

FAIR CAPABILITY

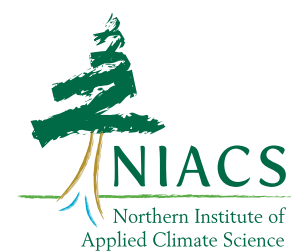
American basswood	Pitch pine
American beech	White ash
Pignut hickory	

GOOD CAPABILITY

American elm	Mockernut hickory
Bitternut hickory	Northern red oak
Black locust	Red maple
Black oak	Sassafras
Black walnut	Shagbark hickory
Blackgum	Shortleaf pine
Boxelder	Slippery elm
Chestnut oak	Sourwood
Chinkapin oak	Sugar maple
Eastern hophornbeam	Sycamore
Eastern redbud	Table Mountain pine
Eastern redcedar	Virginia pine
Flowering dogwood	White oak
Hackberry	Yellow-poplar
Loblolly pine	

NEW HABITAT WITH MIGRATION POTENTIAL

Blackjack oak	Sugarberry
Cherrybark oak	Sweetgum
Florida maple	Water oak
Pecan	Willow oak
Post oak	Winged elm
Shumard oak	Yellow buckeye



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		ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
American basswood	•	•	●	○	●	○	Post oak	+		★		★	
American beech	•	-	▲	○	▲	○	Quaking aspen	•	-	▼	▼	▼	▼
American elm	•	-	▲	△	▲	△	Red maple	+	+	●	△	●	△
Bigtooth aspen	•	-	▼	▼	▼	▼	Red mulberry*	•	-	▼	▼	▼	▼
Bitternut hickory*	+	-	▲	△	▲	△	Red spruce	-	-	▼	▼	▼	▼
Black cherry	-	•	●	▼	▲	○	Sassafras*	•	•	▲	△	▲	△
Black locust*	•	+	▼	○	●	△	Scarlet oak	•	•	●	○	▼	▼
Black oak	•	•	▲	△	▲	△	Serviceberry*	•	•	▼	▼	▼	▼
Black walnut*	•	•	●	○	▲	△	Shagbark hickory	•	•	▲	△	▲	△
Blackgum	+	•	●	△	▲	△	Shortleaf pine	•	-	▲	△	▲	△
Blackjack oak	+		★		★		Shumard oak*	+		★		★	
Boxelder*	+	•	▼	○	●	△	Silver maple*	+	-	▼	▼	●	○
Cherrybark oak	•		★		★		Slippery elm*	•	-	▲	○	▲	△
Chestnut oak	+	+	●	△	●	△	Sourwood	+	-	▲	△	▲	△
Chinkapin oak	•	-	▲	○	▲	△	Striped maple	•	-	▼	▼	▼	▼
Cucumber tree*	•	-	●	▼	●	▼	Sugar maple	+	+	●	△	●	△
Eastern hemlock	-	•	●	▼	●	▼	Sugarberry	•		★		★	
Eastern hophornbeam*	+	-	●	○	▲	△	Sweet birch	-	•	▼	▼	▼	▼
Eastern redbud*	•	-	▲	△	▲	△	Sweetgum	•		★		★	
Eastern redcedar	•	•	▲	△	▲	△	Sycamore*	•	•	▲	△	▲	△
Eastern white pine	-	•	●	▼	●	▼	Table Mountain pine*	+	•	●	△	●	△
Florida maple*	+		★		★		Virginia pine	•	+	●	△	▲	△
Flowering dogwood	•	-	▲	△	▲	△	Water oak	•		★		★	
Hackberry	+	•	▼	○	▲	△	White ash	-	•	▲	○	▲	○
Loblolly pine	•	•	▲	△	▲	△	White oak	+	+	●	△	●	△
Mockernut hickory	+	•	▲	△	▲	△	Willow oak*	•		★		★	
Northern red oak	+	+	●	△	▲	△	Winged elm	•		★		★	
Osage-orange	+	-	▼	▼	●	○	Yellow birch	•	-	●	▼	●	▼
Pecan*	-		★		★		Yellow buckeye*	-		★		★	
Pignut hickory	•	•	●	○	●	○	Yellow-poplar	+	•	▲	△	▲	△
Pitch pine	•	•	●	○	●	○							

*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).