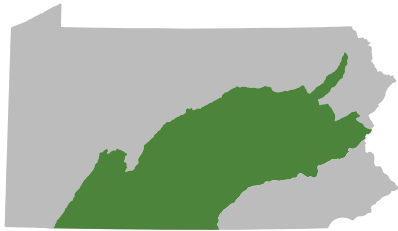


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES RIDGE AND VALLEY (PENNSYLVANIA SUBREGION 4)



Pennsylvania's forests will be affected by a changing climate and other stressors during this century. Researchers and managers created an assessment that describes the vulnerability of forests in the Mid-Atlantic region (Butler-Leopold et al. 2018: doi.org/10.2737/NRS-GTR-181). This report includes

information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest ecosystems. This handout summarizes data from the U.S. Forest Service's Climate Change Tree Atlas (fs.usda.gov/nrs/atlas/tree/). 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 Tree Atlas provides information 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.

CREDIT: This handout summarizes the full model results for Northern Allegheny Plateau (Pennsylvania Subregion 3). Data provided by the USDA Forest Service (M.P. Peters, A.M. Prasad, S.N. Matthews, & L.R. Iverson) as part of the Climate Change Tree Atlas (fs.usda.gov/nrs/atlas). Models and variables are described in Iverson et al. 2019 and Peters et al. 2019 (available at fs.usda.gov/nrs/atlas/products/pubs). More information on vulnerability and adaptation in the region can be found at forestadaptation.org/mid-atlantic.

CLIMATE CHANGE CAPABILITY

POOR CAPABILITY

Balsam poplar	Quaking aspen
Bigtooth aspen	Red pine
Black ash	Red spruce
Bur oak	Serviceberry
Cucumber tree	Slippery elm
Eastern hemlock	Striped maple
Eastern white pine	Sweet birch
Jack pine	Tamarack (native)
Northern pin oak	White ash
Paper birch	White spruce
Pin cherry	Yellow birch
Pitch pine	

FAIR CAPABILITY

Bitternut hickory	Boxelder
Black Cherry	

GOOD CAPABILITY

American basswood	Northern red oak
American beech	Pignut hickory
American elm	Red maple
Black locust	Sassafras
Black oak	Scarlet oak
Black walnut	Shagbark hickory
Blackgum	Sugar maple
Chestnut oak	Sycamore
Eastern redcedar	Virginia pine
Flowering dogwood	White oak
Loblolly pine	Yellow-poplar
Mockernut hickory	

MIXED CAPABILITY

Hackberry	Silver maple
Osage-orange	

NEW HABITAT WITH MIGRATION POTENTIAL

Blackjack oak	Shortleaf pine
Chinkapin oak	Sourwood
Common persimmon	Southern red oak
Florida maple	Sweetgum
Post oak	Winged elm



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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	ABUN	HABITAT CHANGE		HABITAT CHANGE			ABUN	ABUN	HABITAT CHANGE		HABITAT CHANGE	
			CHANGE	CAPABILITY	CHANGE	CAPABILITY				CHANGE	CAPABILITY	CHANGE	CAPABILITY
American basswood	•	•	▲	▲	▲	▲	Paper birch	•	-	▼	▼	▼	▼
American beech	•	•	▲	▲	▲	▲	Pignut hickory	•	•	▲	▲	▲	▲
American elm	•	-	▲	○	▲	▲	Pin cherry*	•	-	▼	▼	▼	▼
Balsam poplar	•	-	▼	▼	▼	▼	Pitch pine	•	•	▼	▼	▼	▼
Bigtooth aspen	•	•	▼	▼	●	○	Post oak	+	-	★		★	
Bitternut hickory*	+	-	●	○	●	○	Quaking aspen	•	-	▼	▼	▼	▼
Black ash	-	-	▼	▼	▼	▼	Red maple	+	+	▼	▲	▼	▲
Black cherry	-	+	●	○	▼	○	Red pine	-	-	▼	▼	▼	▼
Black locust*	•	•	▲	▲	▲	▲	Red spruce	-	-	▼	▼	▼	▼
Black oak	•	•	▲	▲	▲	▲	Sassafras*	•	•	▲	▲	▲	▲
Black walnut*	•	•	●	○	▲	▲	Scarlet oak	•	•	▲	▲	▲	▲
Blackgum	+	•	▲	▲	▲	▲	Serviceberry*	•	-	▼	▼	▼	▼
Blackjack oak	+	-	★		★		Shagbark hickory	•	•	▲	▲	▲	▲
Boxelder*	+	-	●	○	●	○	Shortleaf pine	•	-	★		★	
Bur oak	+	-	▼	▼	▼	▼	Silver maple*	+	-	▼	▼	●	○
Chestnut oak	+	+	●	▲	●	▲	Slippery elm*	•	-	●	▼	●	▼
Chinkapin oak	•	-	★		★		Sourwood	+	-	★		★	
Common persimmon*	+	-	★		★		Southern red oak	+	-	★		★	
Cucumbertree*	•	-	▼	▼	▼	▼	Striped maple	•	-	▼	▼	▼	▼
Eastern hemlock	-	•	▼	▼	▼	▼	Sugar maple	+	•	●	▲	●	▲
Eastern redcedar	•	-	▲	▲	▲	▲	Sweet birch	-	+	▼	▼	▼	▼
Eastern white pine	-	•	▼	▼	▼	▼	Sweetgum	•	-	★		★	
Florida maple*	+	-	★		★		Sycamore*	•	-	▲	○	▲	▲
Flowering dogwood	•	-	▲	○	▲	▲	Tamarack (native)	-	-	▼	▼	▼	▼
Hackberry	+	-	▼	▼	●	○	Virginia pine	•	•	▲	▲	▲	▲
Jack pine	+	-	▼	▼	▼	▼	White ash	-	•	●	▼	●	▼
Loblolly pine	•	-	▲	▲	▲	▲	White oak	+	•	▲	▲	▲	▲
Mockernut hickory	+	•	▲	▲	▲	▲	White spruce	•	-	▼	▼	▼	▼
Northern pin oak	+	-	▼	▼	▼	▼	Winged elm	•	-	★		★	
Northern red oak	+	+	●	▲	●	▲	Yellow birch	•	-	▼	▼	▼	▼
Osage-orange	+	-	▼	▼	▲	▲	Yellow-poplar	+	•	▲	▲	▲	▲

*Species with low model reliability based on five statistical metrics of the habitat models that affect change class. See tables for more information (fs.usda.gov/nrs/atlas/combined/resources/summaries).