

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

MID-ATLANTIC REGION



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-Leopold et al. 2018](#)). 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 Mid-Atlantic region, available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the Mid-Atlantic region can be found at www.forestadaptation.org/mid-atlantic. 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 holly	Pin oak
Atlantic white-cedar	Pitch pine
Balsam fir	Quaking aspen
Bigtooth aspen	Red pine
Black ash	Red spruce
Black spruce	Shingle oak
Bur oak	Striped maple
Eastern cottonwood	Swamp white oak
Eastern hemlock	Sweet birch
Eastern white pine	Tamarack (native)
Flowering dogwood	Virginia pine
Jack pine	White ash
Northern white-cedar	White spruce
Paper birch	Yellow birch

FAIR CAPABILITY

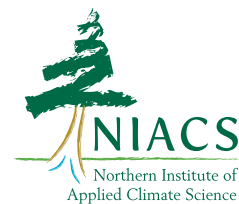
American beech	Pond pine
Black cherry	Silver maple
Boxelder	Sweetbay
Overcup oak	

GOOD CAPABILITY

American basswood	Northern red oak
American elm	Pignut hickory
Bald cypress	Post oak
Bitternut hickory	Red maple
Black locust	Scarlet oak
Black oak	Shagbark hickory
Black walnut	Shortleaf pine
Blackgum	Southern red oak
Blackjack oak	Sugar maple
Chestnut oak	Sweetgum
Chinkapin oak	Sycamore
Eastern redcedar	Water oak
Loblolly pine	White oak
Mockernut hickory	Yellow-poplar

NEW HABITAT WITH MIGRATION POTENTIAL

Loblolly-bay	Water tupelo
Longleaf pine	Winged elm



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	CHANG	HABITAT	CAPABILITY	HABITAT	CAPABILITY		ABUN	CHANG	HABITAT	CAPABILITY	HABITAT	CAPABILITY
American basswood	•	•	▲	▲	▲	▲	Overcup oak	-	-	▲	○	▲	○
American beech	•	•	●	○	●	○	Paper birch	•	-	▼	▼	▼	▼
American elm	•	•	▲	▲	▲	▲	Pignut hickory	•	•	▲	▲	▲	▲
American holly	•	-	●	▼	●	▼	Pin oak*	-	-	●	▼	●	▼
Atlantic white-cedar*	-	-	▼	▼	▼	▼	Pitch pine	•	•	▼	▼	▼	▼
Bald cypress	•	-	▲	▲	▲	▲	Pond pine	-	-	▲	○	▲	○
Balsam fir	-	-	▼	▼	▼	▼	Post oak	+	-	▲	▲	▲	▲
Balsam poplar	•	-	▼	▼	▼	▼	Quaking aspen	•	•	▼	▼	▼	▼
Bigtooth aspen	•	•	▼	▼	▼	▼	Red maple	+	+	▼	▲	▼	▲
Bitternut hickory*	+	•	●	▲	▲	▲	Red pine	-	-	▼	▼	▼	▼
Black ash	-	-	▼	▼	▼	▼	Red spruce	-	-	▼	▼	▼	▼
Black cherry	-	+	●	○	▼	○	Scarlet oak	•	•	▲	▲	▲	▲
Black locust*	•	•	▲	▲	▲	▲	Shagbark hickory	•	•	▲	▲	▲	▲
Black oak	•	•	▲	▲	▲	▲	Shingle oak	•	-	▼	▼	▼	▼
Black spruce	•	-	▼	▼	▼	▼	Shorleaf pine	•	-	▲	▲	▲	▲
Black walnut*	•	•	▲	▲	▲	▲	Silver maple*	+	-	●	○	●	○
Blackgum	+	•	▲	▲	▲	▲	Sourwood	+	-	▲	▲	▲	▲
Blackjack oak	+	-	▲	▲	▲	▲	Southern red oak	+	-	▲	▲	▲	▲
Boxelder*	+	-	●	○	●	○	Striped maple	•	-	▼	▼	▼	▼
Bur oak	+	-	▼	▼	▼	▼	Sugar maple	+	+	●	▲	▼	▲
Chestnut oak	+	•	▲	▲	▲	▲	Swamp tupelo	-		★		★	
Chinkapin oak	•	-	▲	▲	▲	▲	Swamp white oak*	•	-	●	▼	▼	▼
Eastern cottonwood*	•	-	●	▼	●	▼	Sweet birch	-	•	▼	▼	▼	▼
Eastern hemlock	-	•	▼	▼	▼	▼	Sweetbay	•	-	▲	○	▲	○
Eastern redcedar	•	-	▲	○	▲	▲	Sweetgum	•	•	●	○	▲	▲
Eastern white pine	-	•	▼	▼	▼	▼	Sycamore*	•	-	▲	○	▲	▲
Flowering dogwood	•	-	●	▼	●	▼	Tamarack (native)	-	-	▼	▼	▼	▼
Jack pine	+	-	▼	▼	▼	▼	Virginia pine	•	-	●	▼	●	▼
Laurel oak	•	-	▲	▲	▲	▲	Water oak	•	-	▲	▲	▲	▲
Loblolly pine	•	•	●	○	▲	▲	Water tupelo	-		★		★	
Loblolly-bay	•		★		★		White ash	-	•	●	▼	●	▼
Longleaf pine	•		★		★		White oak	+	•	▲	▲	▲	▲
Mockernut hickory	+	-	▲	▲	▲	▲	White spruce	•	-	▼	▼	▼	▼
Northern pin oak	+	-	▼	▼	▼	▼	Winged elm	•		★		★	
Northern red oak	+	•	●	▲	●	▲	Yellow birch	•	•	▼	▼	▼	▼
Northern white-cedar	•	-	▼	▼	▼	▼	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).