Climate Change Projections for Individual Tree Species

Massachusetts

Massachusetts' 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 New England region (Janowiak et al. 2018: doi.org/10.2737/nrs-gtr-173). 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 (doi.org/10.2737/Climate-Change-Tree-Atlas-v4). 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 (inventory data). The capability rating is modified by abundance information; ratings are downgraded for rare species and upgraded for abundant species. Capability rating may not appropriately reflect the outlook for species with emerging severe forest health issues, such as ash species affected by emerald ash borer. See the table to the right for ratings.
- **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.

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.

CLIMATE CHANGE CAPABILITY TABLE.
Capability is a rating of the species' ability to cope or persist with climate change. Species are organized into poor, fair, good, and mixed capability ratings. Species with new suitable habitat or low model reliability are excluded from this table. See the Tree Species Projections table legend on the following page for more information on ratings.

NOTE: *Capability rating may not reflect severe forest health issues (e.g., emerald ash borer).*

POOR CAPABILITY	
Balsam fir	Pitch pine
Black ash	Quaking aspen
Black spruce	Red pine
Bur oak	Red spruce
Eastern white pine	Sweet birch
Honeylocust	Tamarack (native)
Paper birch	

FAIR CAPABILITY	
Bigtooth aspen	White ash
Black cherry	Yellow birch
Shagbark hickory	

GOOD CAPABILITY	
American beech	Northern red oak
American holly	Pignut hickory
Black oak	Post oak
Blackgum	Red maple
Chestnut oak	Scarlet oak
Eastern redcedar	Sugar maple
Flowering dogwood	White oak
Mockernut hickory	Yellow-poplar

MIXED CAPABILITY	
American basswood	Eastern hemlock
American elm	

Tree Species Projections Table

Information presented in the table is from the Climate Change Tree Atlas regional summaries, more details at fs.usda.gov/nrs/atlas/combined/resources/summaries.

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*
- ▼ **DECREASE** *Projected decrease of >20% by 2100*
- ● **NO CHANGE** *Projected change 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, adaptability, and abundance within this region. Capability may not reflect severe forest health issues.

- △ **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	ABUN	LOW CLIMATE CHANGE (RCP 4.5) HABITAT CHANGE	LOW CLIMATE CHANGE (RCP 4.5) CAPABILITY	HIGH CLIMATE CHANGE (RCP 8.5) HABITAT CHANGE	HIGH CLIMATE CHANGE (RCP 8.5) CAPABILITY
American basswood	·	−	▲	○	▲	△
American beech	·	·	▲	△	▲	△
American elm	·	·	▼	▽	●	○
American holly	·	−	▲	△	▲	△
American hornbeam*	·	−	●	▽	▲	△
American mountain-ash*	−	−	▼	▽	▼	▽
Atlantic white-cedar*	−	−	●	▽	●	▽
Balsam fir	−	−	▼	▽	▼	▽
Bigtooth aspen	·	·	●	○	●	○
Bitternut hickory*	+	−	●	○	●	○
Black ash	−	−	▼	▽	▼	▽
Black cherry	−	·	▲	○	▲	○
Black hickory	·		★		★	
Black locust*	·	−	▲	△	▲	△
Black oak	·	·	▲	△	▲	△
Black spruce	·	−	▼	▽	▼	▽
Black walnut*	·	−	▼	▽	▼	▽
Black willow*	−	−	▼	▽	▼	▽
Blackgum	+	·	▲	△	▲	△
Blackjack oak	+		★		★	
Boxelder*	+	−	▼	▽	▼	▽
Bur oak	+	−	▼	▽	▼	▽
Cherrybark oak	·		★		★	
Chestnut oak	+	−	▲	△	▲	△
Chinkapin oak	·		★		★	
Cittamwood*	+		★		★	
Common persimmon*	+		★		★	
Eastern cottonwood*	·	−	▼	▽	▼	▽
Eastern hemlock	−	+	▼	○	▼	▽
Eastern redbud*	·		★		★	
Eastern redcedar	·	−	▲	△	▲	△
Eastern white pine	−	+	▼	▽	▼	▽
Flowering dogwood	·	−	▲	△	▲	△
Gray birch*	·	·	●	○	●	○
Green ash*	·	−	●	▽	▲	○
Honeylocust	+	−	▼	▽	▼	▽
Ironwood*	+	−	▼	▽	▲	△
Loblolly pine	·		★		★	
Longleaf pine	·		★		★	

SPECIES	ADAPT	ABUN	LOW CLIMATE CHANGE (RCP 4.5) HABITAT CHANGE	LOW CLIMATE CHANGE (RCP 4.5) CAPABILITY	HIGH CLIMATE CHANGE (RCP 8.5) HABITAT CHANGE	HIGH CLIMATE CHANGE (RCP 8.5) CAPABILITY
Mockernut hickory	+	−	▲	△	▲	△
Mountain maple*	+	−	▼	▽	▼	▽
Northern red oak	+	+	●	△	●	△
Paper birch	·	·	▼	▽	▼	▽
Pignut hickory	·	·	▲	△	▲	△
Pin cherry*	·	−	▼	▽	▼	▽
Pin oak*	−	−	▼	▽	▲	▽
Pitch pine	·	·	▼	▽	▼	▽
Post oak	+	−	▲	△	▲	△
Quaking aspen	·	·	▼	▽	▼	▽
Red maple	+	+	▼	△	▼	△
Red pine	−	−	▼	▽	▼	▽
Red spruce	−	·	▼	▽	▼	▽
River birch*	·		★		★	
Sassafras*	·	−	▲	△	▲	△
Scarlet oak	·	·	▲	△	▲	△
Serviceberry*	·	−	●	▽	●	▽
Shagbark hickory	·	−	▲	○	▲	○
Shortleaf pine	·		★		★	
Silver maple*	+	−	▼	▽	●	○
Slippery elm*	·	−	▼	▽	▼	▽
Sourwood	+		★		★	
Southern red oak	+		★		★	
Sugar maple	+	·	●	△	●	△
Sugarberry	·		★		★	
Swamp chestnut oak*	·	−	▼	▽	▲	△
Swamp white oak*	·	−	▼	▽	▼	▽
Sweet birch	−	·	●	▽	●	▽
Sweetgum	·		★		★	
Sycamore*	·		★		★	
Tamarack (native)	−	−	▼	▽	▼	▽
Virginia pine	·		★		★	
Water oak	·		★		★	
White ash	−	·	▲	○	▲	○
White oak	+	·	▲	△	▲	△
Willow oak*	·		★		★	
Winged elm	·		★		★	
Yellow birch	·	·	●	○	●	○
Yellow-poplar	+	−	▲	△	▲	△

Species with low model reliability based on five statistical metrics of the habitat models that affect change class.

UPDATED JUNE 2024