CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

INDIANA

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 (Brandt et al. 2014). 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.

CLIMATE CHANGE CAPABILITY

POOR CAPABILITY	
American basswood	Pignut hickory
American beech	Pin oak
Bald cypress	Red pine
Bigtooth aspen	River birch
Black ash	Sassafras
Black cherry	Scarlet oak
Black willow	Shagbark hickory
Blue ash	Shellbark hickory
Bur oak	Shingle oak
Eastern cottonwood	Swamp chestnut oak
Eastern white pine	Swamp white oak
Northern pin oak	Virginia pine
Ohio buckeye	White ash
Pawpaw	
FAIR CAPABILITY	
Chestnut oak	Flowering dogwood
Chinkapin oak	Pecan
Eastern redbud	Red maple
GOOD CAPABILITY	
American elm	Mockernut hickory
American hornbeam	Northern red oak
Bitternut hickory	Osage-orange
Black hickory	Post oak
Black locust	Shortleaf pine
Black oak	Shumard oak
Black walnut	Silver maple
Blackgum	Slippery elm
Blackjack oak	Sourwood
Boxelder	Sugar maple
Cherrybark oak	Sugarberry
Common persimmon	Sweetgum
Eastern hophornbeam	Sycamore
Eastern redcedar	White oak
Green ash	Winged elm
Hackberry	Yellow-poplar
Honeylocust	
NEW HABITAT WITH MIGRATION POTENTIAL	
Cittamwood	Water elm
Loblolly pine	Water oak
Overcup oak	Willow oak

SOURCE: *This handout summarizes the full model results for the Central Hardwoods region, available at www.fs.fed.us/nrs/atlas/combined/resources/summaries. More information on vulnerability and adaptation in the Central Hardwoods region can be found at www.forestadaptation.org/central-hardwoods. 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).*

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*

			LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
SPECIES	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
American basswood	•	–	▼	▽	▼	▽
American beech	•	•	▼	▽	▼	▽
American elm	•	•	▲	△	▲	△
American hornbeam*	•	–	▲		▲	△
Bald cypress	•	–	▼	▽	●	▽
Bigtooth aspen	•	–	▼	▽	▼	▽
Bitternut hickory*	+	•	▲	△	▲	△
Black ash	–	–	▼	▽	▼	▽
Black cherry	–	•	●	▽	●	▽
Black hickory	•	–	▲	△	▲	△
Black locust*	•	•	▲	△	▲	△
Black oak	•	•	▲	△	▲	△
Black walnut*	•	•	●	○	▲	△
Black willow*	–	•	●	▽	●	▽
Blackgum	+	•	▲	△	▲	△
Blue ash*	–	–	▼	▽	▼	▽
Boxelder*	+	•	▲	△	▲	△
Bur oak	+	–	▼	▽	▼	▽
Cherrybark oak	•	–	▲	△	▲	△
Chestnut oak	+	•	▼	○	▼	○
Chinkapin oak	•	•	●	○	●	○
Cittamwood*	+	–	★		★	
Common persimmon*	+	–	▲	△	▲	△
Eastern cottonwood*	•	–	▼	▽	●	▽
Eastern hophornbeam*	+	–	▲	△	▲	△
Eastern redbud*	•	–	●	▽	▲	○
Eastern redcedar	•	•	▲	△	▲	△
Eastern white pine	–	•	▼	▽	▼	▽
Flowering dogwood	•	•	▲	△	●	○
Green ash*	•	•	▲	△	▲	△
Hackberry	+	•	▲	△	▲	△
Honeylocust*	+	–	▲	△	▲	△
Loblolly pine	•	–	★		★	
Mockernut hickory	+	–	▲	△	▲	△
Northern pin oak	+	–	▼	▽	▼	▽
Northern red oak	+	•	●	△	●	△

			LOW CLIMATE CHANGE (RCP 4.5)		HIGH CLIMATE CHANGE (RCP 8.5)	
SPECIES	ADAPT	ABUN	HABITAT CHANGE	CAPABILITY	HABITAT CHANGE	CAPABILITY
Ohio buckeye*	•	–	▼	▽	▼	▽
Osage-orange	+	•	●	△	▲	△
Overcup oak	–	–	★		★	
Pawpaw*	•	–	▼	▽	▼	▽
Pecan*	–	–	▲	○	▲	○
Pignut hickory	•	•	●	○	▼	▽
Pin oak*	–	•	●	▽	●	▽
Post oak	+	–	▲	△	▲	△
Red maple	+	•	▼	○	▼	○
Red pine	–	–	▼	▽	▼	▽
River birch*	•	–	▼	▽	●	▽
Sassafras*	•	•	▼	▽	▼	▽
Scarlet oak	•	–	●	▽	▼	▽
Shagbark hickory	•	•	▼	▽	▼	▽
Shellbark hickory*	•	–	●	▽	●	▽
Shingle oak	•	•	●	○	▼	▽
Shortleaf pine	•	–	▲	○	▲	△
Shumard oak*	+	–	▲	△	▲	△
Silver maple*	+	•	●	△	●	△
Slippery elm*	•	•	▲	△	▲	△
Sourwood	+	–	▲	△	▲	△
Sugar maple	+	+	▼	△	▼	△
Sugarberry	•	–	▲	△	▲	△
Swamp chestnut oak*	•	–	▼	▽	▼	▽
Swamp white oak*	•	–	▼	▽	▼	▽
Sweetgum	•	•	▲	△	▲	△
Sycamore*	•	•	▲	△	▲	△
Virginia pine	•	•	▼	▽	▼	▽
Water elm*	•	–	★		★	
Water hickory		–	▼	▽	●	▽
Water oak	•	–	★		★	
White ash	–	•	●	▽	●	▽
White oak	+	•	●	△	●	△
Willow oak*	•	–	★		★	
Winged elm	•	–	▲	△	▲	△
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).

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