

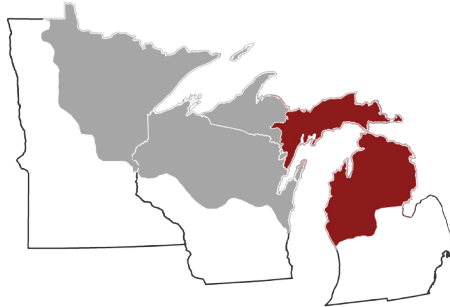


CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES



NORTHERN MICHIGAN

Northern forests will be affected by climate change during this century. A team of forest managers and researchers created a report that describes the vulnerability of forests in Michigan's eastern Upper Peninsula and northern Lower Peninsula (Handler et al. 2014). 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 types. This handout is summarized from the full report.



Remember that models are just tools, and they're not perfect. Models don't account for some factors that could be modified by climate change, like droughts, wildfire activity, and invasive species. If a species is rare or confined to a small area, Tree Atlas results may also 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.

TREE SPECIES INFORMATION:

This report uses two climate scenarios to "bracket" a range of possible futures. These future climate projections were used with two forest impact models (Tree Atlas and LANDIS) to provide information about how individual tree species may respond to a changing climate. More information on the climate and forest impact models can be found in the full report. This page shows the most common tree species in this local area, organized into general categories of future expectations. Results for all species can be compared side-by-side on page 2.

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. The model results presented here were combined with information from published reports and local management expertise to draw conclusions about potential risk and change in the state's forests.

SPECIES	ADDITIONAL CONSIDERATIONS
LIKELY TO DECREASE	
Balsam fir	Requires cold climate and susceptible to drought, fire, and insects
Balsam poplar	Early-sucessional colonizer, but susceptible to drought
Black ash	Emerald ash borer causes mortality
Black spruce	Requires cold climate, susceptible to insect pests and drought
Eastern hemlock	Hemlock woolly adelgid causes mortality
Jack pine	Tolerates drought and fire, but susceptible to insect pests
Northern white-cedar	Requires cold climate and susceptible to fire and herbivory
Paper birch	Early-sucessional colonizer, but susceptible to insects and drought
Red pine	Susceptible to insect pests and diseases, and limited dispersal.
Tamarack	Requires cold climate and susceptible to drought, fire, and insects
White spruce	Requires cold climate, susceptible to insect pests
Yellow birch	Good disperser, but susceptible to fire, insects, and disease
MAY DECREASE	
Quaking aspen	Early-sucessional colonizer, but susceptible to heat and drought

SPECIES	ADDITIONAL CONSIDERATIONS
MIXED MODEL RESULTS	
American basswood	Tolerates shade but susceptible to fire
American beech	Beech bark disease causes mortality
Bigtooth aspen	Early-sucessional colonizer, but susceptible to drought
Black cherry	Susceptible to insects and fire, tolerates some drought
Black oak	Tolerates drought, but susceptible to pests and diseases
Eastern white pine	Good disperser, but susceptible to drought and insects
Green ash	Emerald ash borer causes mortality
Northern red oak	Susceptible to some insect pests and oak wilt
Red maple	Competitive colonizer tolerant of disturbance and diverse sites
Sugar maple	Grows across a variety of sites and tolerates shade
MAY INCREASE	
American elm	Affected by Dutch elm disease, grows across a variety of sites
Eastern redcedar	Tolerates drought, but susceptible to fire and insect pests
Ironwood	Grows across a variety of sites and tolerates shade
Silver maple	Good disperser and tolerates wet soils, but vulnerable to drought
White ash	Emerald ash borer causes mortality
White oak	Fire-adapted and grows on a variety of sites



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FUTURE PROJECTIONS

Data for the end of the century are summarized for two forest impact models under two climate change scenarios. The Climate Change Tree Atlas (www.fs.fed.us/nrs/atlas) models future suitable habitat, while LANDIS models changes in forest growth over time (future biomass presented in this table).

- ▲ **INCREASE**
Projected increase of >20% by 2100
- **NO CHANGE**
Little change (<20%) projected by 2100
- ▼ **DECREASE**
Projected decrease of >20% by 2100
- ★ **NEW HABITAT**
Tree Atlas projects new habitat for species not currently present

ADAPTABILITY

Factors not included in the models, such as the ability to respond favorably to disturbance, 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

SPECIES	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		ADAPT
	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	
American basswood	●	▲	▲	▼	·
American beech	▲	▲	●	▼	·
American elm	▲	▲	▲	▲	·
American hornbeam	▲		▲		·
Balsam fir	▼	▼	▼	▼	-
Balsam poplar	▼	▼	▼	▼	·
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	▼		▲		+
Chestnut oak	●		▲		+
Chinkapin oak			★		·
Chokecherry	●		▼		·
Common persimmon			★		+
Eastern cottonwood	●		▲		·
Eastern hemlock	●	▼	▼	▼	-
Eastern redbud			★		·
Eastern redcedar	▲		▲		·
Eastern white pine	●	▲	▼	▼	·
Flowering dogwood	▲		▲		·
Green ash	▼	▲	▲	▼	·
Hackberry	★		★		+
Honeylocust	▲		▲		+
Ironwood	●		▲		+
Jack pine	▼	▼	▼	▼	·
Mockernut hickory	★		★		+
Mountain maple	▼		▼		+
Northern pin oak	●	▼	▲	▼	+

SPECIES	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		ADAPT
	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	
Northern red oak	▲	▲	●	▼	+
Northern white-cedar	▼	▼	▼	▼	·
Ohio buckeye	●		▲		·
Osage-orange	★		★		+
Paper birch	▼	▼	▼	▼	·
Pawpaw			★		·
Peachleaf willow	▼		●		·
Pignut hickory	★		★		·
Pin cherry	●		▼		·
Pin oak	●		▲		-
Post oak			★		+
Quaking aspen	▼	▲	▼	▼	·
Red maple	●	▲	▼	▼	+
Red mulberry	★		★		·
Red pine	●	▼	▼	▼	·
River birch	▼		▲		·
Rock elm	▼		▲		-
Sassafras	▲		▲		·
Scarlet oak	▲		▲		·
Shagbark hickory	▲		▲		·
Shellbark hickory			★		·
Shingle oak			★		·
Silver maple	▲		▲		+
Slippery elm	▲		▲		·
Striped maple	●		▼		·
Sugar maple	●	▲	▼	▲	+
Sugarberry			★		·
Swamp white oak	●		▲		·
Sweet birch	●		▲		-
Sycamore	▲		▲		·
Tamarack	▼		▼		-
White ash	▲	▲	▲	▲	-
White oak	▲	●	▲	●	+
White spruce	▼	▼	▼	▼	·
Wild plum			★		·
Yellow birch	●	▼	▼	▼	·
Yellow-poplar	★		★		+

SOURCE: Handler et al. 2014. Michigan forest ecosystem vulnerability assessment and synthesis. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. GTR-NRS-129. www.nrs.fs.fed.us/pubs/45688

