Forest Vulnerability

Project Brief

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship & Science
Climate Change Response Program

Climate, Trees, Pests, and Weeds: Change, Uncertainty, and Biotic Stressors at Hopewell Furnace National Historic Site

Background

Climate change and nonnative tree pests and plants affect forest composition, structure, and function, and the coming decades will likely bring accelerating changes due to these multiple global change factors. We investigated potential forest change in response to climate, differences in projections of change among climate scenarios (uncertainty), and levels of nonnative biotic stressor (tree pests and invasive plants) at 121 national park units in the eastern U.S. (see Fisichelli et al. 2014 for the full article and the project brief for a synthesis). For Hopewell Furnace National Historic Site, we provide here park-specific climate (Table 1) and tree habitat suitability projections (Table 2) for 2100 under two climate scenarios ("least change" and "major change"). These scenarios bracket a range of plausible future conditions based on greenhouse gas emissions and global climate model projections and facilitate assessment of uncertainty in future projections. We also report nonnative tree insects and diseases ("pests") with infestation areas that include the park (Table 3). Park-level nonnative vascular plant ("weeds") information is available from NPSpecies.

Adaptation to ongoing climate change requires revising existing strategies to meet traditional goals and will increasingly require revising goals and developing new strategies. Data presented here is intended to inform managers of potential future change (climate and forests) and exacerbating factors (nonnative species).

More Information

This project is part of ongoing work of the NPS Climate Change Response Program to support park adaptation to changing conditions (websites: for managers, for the public).

Source Publication

Fisichelli, N. A., S. R. Abella, M. P. Peters, and F. J. Krist Jr. 2014. Climate, trees, pests, and weeds: change, uncertainty, and biotic stressors in eastern U.S. national park forests. Forest Ecology and Management 327:31-39.

Contact

Nicholas Fisichelli, Ph.D.
Ecologist, Climate Change Response Program
National Park Service
970-225-3578
Nicholas_Fisichelli@nps.gov

Table 1. Baseline (1961-1990) and future (2070-2099) climates used in tree habitat suitability models for Hopewell Furnace National Historic Site. Future projections for the two climate scenarios ("Least Change" and "Major Change") illustrate a plausible range of future conditions and are shown as departures from baseline values. The Least Change scenario includes a major decrease in future greenhouse gas emissions while the Major Change scenario is a continuation of historical increases in emissions. Climate data are averaged across a roughly 6200 mi^2 (16000 km^2) area centered on the park.

Climate Variable	Baseline (1961-1990)	Least Change (2070-2099)	Major Change (2070-2099)
mean annual temperature	10.5 °C (50.9 °F)	+2.1 °C (+3.9 °F)	+7.3 °C (+13.1 °F)
mean January temperature	-1.8 °C (28.8 °F)	+1.8 °C (+3.2 °F)	+5.8 °C (+10.4 °F)
mean July temperature	22.7 °C (72.9 °F)	+1.9 °C (+3.5 °F)	+8.5 °C (+15.3 °F)
seasonality (July-January temp.)	24.5 °C (44.1 °F)	+0.2 °C (+0.3 °F)	+2.7 °C (+4.9 °F)
mean May-September temp.	19.6 °C (67.2 °F)	+2.2 °C (+3.9 °F)	+7.9 °C (+14.2 °F)
annual precipitation	1130 mm (44.5 in)	+10.6 %	+15.9 %
May-September precipitation	524 mm (20.6 in)	+7 %	+10 %

Table 2. Potential changes in habitat suitability (2100 compared with 1990) for tree species in Hopewell Furnace National Historic Site. Species are grouped into decreasing, no change, increasing, mixed results, and new habitat groups based on change class designations for two future climate scenarios (the "least change" scenario represents strong cuts in greenhouse gas emissions and modest climatic changes and the "major change" scenario represents continued increasing greenhouse gas emissions and rapid warming). Change class designations are based on the ratio of future (2100) to baseline (1990) habitat suitability and baseline habitat values, e.g., for common species, large decrease is ≤ 0.5, small decrease is > 0.5 and ≤ 0.8, no change is > 0.8 and ≤ 1.2, small increase is > 1.2 and ≤ 2.0, and large increase is > 2.0. Note: table below uses finer change classes (n=8) than was used in the original article (n=3) to designate uncertainty in habitat projections. Habitat suitability models from the US Forest Service Climate Change Tree Atlas. Contact author for further details on change class definitions.

Decreases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer pensylvanicum	striped maple	small decrease	extirpated
Acer rubrum	red maple	small decrease	large decrease
Betula alleghaniensis	yellow birch	large decrease	extirpated
Betula lenta	sweet birch	small decrease	large decrease
Catalpa speciosa	northern catalpa	large decrease	large decrease
Fraxinus americana	white ash	small decrease	large decrease
Liriodendron tulipifera	yellow-poplar	small decrease	large decrease
Picea glauca	white spruce	extirpated	extirpated
Pinus rigida	pitch pine	large decrease	large decrease
Pinus strobus	eastern white pine	small decrease	large decrease
Populus grandidentata	bigtooth aspen	extirpated	extirpated
Prunus serotina	black cherry	large decrease	large decrease
Quercus bicolor	swamp white oak	large decrease	extirpated
Quercus rubra	northern red oak	small decrease	large decrease
Tsuga canadensis	eastern hemlock	small decrease	small decrease

No Change in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Cornus florida	flowering dogwood	no change	no change
Nyssa sylvatica	blackgum	no change	no change
Quercus ilicifolia	bear oak	no change	no change

Increases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Carya cordiformis	bitternut hickory	large increase	large increase
Carya ovata	shagbark hickory	small increase	small increase
Carya tomentosa	mockernut hickory	small increase	small increase
Celtis occidentalis	hackberry	large increase	large increase
Diospyros virginiana	common persimmon	large increase	large increase
Ilex opaca	American holly	small increase	small increase
Juniperus virginiana	eastern redcedar	small increase	small increase
Liquidambar styraciflua	sweetgum	large increase	large increase
Nyssa sylvatica var. biflora	swamp tupelo	small increase	small increase
Ostrya virginiana	eastern hophornbeam	small increase	large increase
Pinus echinata	shortleaf pine	large increase	large increase
Pinus taeda	loblolly pine	large increase	large increase
Platanus occidentalis	sycamore	small increase	small increase

Increases in Potential Habitat (continued)

Scientific Name	Common Name	Least Change	Major Change
Quercus falcata var.falcata	southern red oak	large increase	large increase
Quercus muehlenbergii	chinkapin oak	small increase	large increase
Quercus palustris	pin oak	small increase	small increase
Quercus phellos	willow oak	large increase	large increase
Quercus stellata	post oak	large increase	large increase
Salix nigra	black willow	small increase	large increase
Ulmus rubra	slippery elm	small increase	small increase

Mixed Results

Scientific Name	Common Name	Least Change	Major Change
Acer negundo	boxelder	small increase	small decrease
Acer saccharinum	silver maple	no change	large increase
Acer saccharum	sugar maple	small increase	large decrease
Amelanchier spp.	serviceberry	no change	small decrease
Asimina triloba	pawpaw	large increase	large decrease
Betula populifolia	gray birch	large decrease	no change
Carpinus caroliniana	American hornbeam	small decrease	no change
Carya glabra	pignut hickory	small increase	small decrease
Cercis canadensis	eastern redbud	large increase	small decrease
Fagus grandifolia	American beech	no change	large decrease
Fraxinus pennsylvanica	green ash	no change	small increase
Juglans cinerea	butternut	no change	large decrease
Juglans nigra	black walnut	no change	large decrease
Maclura pomifera	osage-orange	small decrease	large increase
Magnolia virginiana	sweetbay	small decrease	large increase
Morus rubra	red mulberry	no change	large increase
Pinus virginiana	Virginia pine	no change	small decrease
Populus deltoides	eastern cottonwood	no change	large increase
Quercus alba	white oak	small increase	no change
Quercus coccinea	scarlet oak	no change	large decrease
Quercus prinus	chestnut oak	no change	large decrease
Quercus velutina	black oak	small increase	no change
Robinia pseudoacacia	black locust	no change	large decrease
Sassafras albidum	sassafras	no change	large decrease
Ulmus americana	American elm	no change	large increase

New Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Betula nigra	river birch	--	new entry
Carya illinoinensis	pecan	--	new entry
Carya texana	black hickory	new entry	new entry
Celtis laevigata	sugarberry	new entry	new entry
Gleditsia triacanthos	honeylocust	--	new entry
Nyssa aquatica	water tupelo	--	new entry

New Potential Habitat (continued)

Scientific Name	Common Name	Least Change	Major Change
Oxydendrum arboreum	sourwood	--	new entry
Pinus elliottii	slash pine	--	new entry
Pinus palustris	longleaf pine	new entry	new entry
Quercus falcata var.pagodifolia	cherrybark oak	new entry	new entry
Quercus imbricaria	shingle oak	new entry	new entry
Quercus laurifolia	laurel oak	--	new entry
Quercus macrocarpa	bur oak	--	new entry
Quercus marilandica	blackjack oak	new entry	new entry
Quercus nigra	water oak	new entry	new entry
Quercus shumardii	Shumard oak	--	new entry
Taxodium distichum	baldcypress	new entry	new entry
Ulmus alata	winged elm	new entry	new entry
Ulmus crassifolia	cedar elm	--	new entry

Table 3. Nonnative tree insects and diseases ("tree pests") with infestation areas that include Hopewell Furnace National Historic Site. Detection scale is the finest spatial scale at which infestation data were available for the park area. Data derived from the US Forest Service Alien Forest Pest Explorer (AFPE) Database.

Scientific Name	Common Name	Detection Scale
Acantholyda erythrocephala	pine false webworm	county
Adelges abietis	eastern spruce gall adelgid	state
Adelges tsugae	hemlock woolly adelgid	county
Anarsia lineatella	peach twig borer	state
Asterolecanium minus	oak pit scale	county
Asterolecanium variolosum	golden oak scale	state
Caliroa cerasi	pear sawfly	state
Callidellum rufipenne	Japanese cedar longhorn beetle	county
Carulaspis juniperi	juniper scale	county
Caulocampus acericaulis	maple petiole borer	state
Cephalcia lariciphila	European web-spinning larch sawfly	state
Coleophora laricella	larch casebearer	state
Contarinia baeri	European pine needle midge	state
Cronartium ribicola	white pine blister rust	county
Cryphonectria parasitica	chestnut blight	county
Cryptodiaporthe populea	Dothichiza canker of poplar	county
Cryptorhynchus lapathi	poplar-and-willow borer	state
Cyrtepistomus castaneus	Asiatic oak weevil	state
Diaspidiotus perniciosus	San Jose scale	state
Diprion similis	introduced pine sawfly	state
Discula destructiva	dogwood anthracnose	county
Dryocosmus kuriphilus	chestnut gall wasp	county
Epinotia nanana	European spruce needleminer	state
Eulecanium cerasorum	calico scale	state
Fenusa pusilla	birch leafminer	state

Table 3 (continued). Nonnative tree insects and diseases ("tree pests") with infestation areas that include Hopewell Furnace National Historic Site.

Scientific Name	Common Name	Detection Scale
Fiorinia externa	elongate hemlock scale	county
Gilpinia hercyniae	European spruce sawfly	state
Homadaula anisocentra	mimosa webworm	state
Hylastes opacus	European bark beetle	county
Kaliofenusa ulmi	elm leafminer	state
Lepidosaphes ulmi	oystershell scale	state
Lymantria dispar	gypsy moth	county
Matsucoccus resinosae	red pine scale	state
Nectria coccinea	beech bark disease	county
Neodiprion sertifer	European pine sawfly	state
Ophiostoma novo-ulmi	Dutch elm disease	state
Otiorhynchus ovatus	strawberry root weevil	state
Otiorhynchus sulcatus	black vine weevil	state
Periphyllus lyropictus	Norway maple aphid	state
Phyllaphis fagi	woolly beech aphid	state
Physokermes piceae	spruce bud scale	state
Phytophthora cinnamomi	littleleaf disease / phytophthora root rot	state
Plagiodera versicolora	imported willow leaf beetle	state
Popillia japonica	Japanese beetle	county
Pristiphora erichsonii	larch sawfly	county
Pristiphora geniculata	mountain-ash sawfly	state
Rhyacionia buoliana	European pine shoot moth	state
Scolytus multistriatus	smaller European elm bark beetle	state
Scolytus schevyrewi	banded elm bark beetle	state
Sirococcus clavigignenti juglandacearum	butternut canker	county
Taeniothrips inconsequens	pear thrips	county
Tomicus piniperda	pine shoot beetle	county
Trichiocampus viminalis	poplar sawfly	state
Venturia saliciperda	willow scab	state
Xanthogaleruca luteola	elm leafbeetle	state