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 Mississippi National River and Recreation Areas

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 Mississippi National River and Recreation Areas, 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.

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Table 1. Baseline (1961-1990) and future (2070-2099) climates used in tree habitat suitability models for Mississippi National River and Recreation Areas. 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	6.3 °C (43.3 °F)	+2.2 °C (+4 °F)	+7.3 °C (+13.2 °F)
mean January temperature	-11.1 °C (12.1 °F)	+2.4 °C (+4.3 °F)	+5.5 °C (+9.9 °F)
mean July temperature	21.8 °C (71.3 °F)	+1.5 °C (+2.7 °F)	+8.4 °C (+15.1 °F)
seasonality (July-January temp.)	32.9 °C (59.2 °F)	-0.9 °C (-1.6 °F)	+2.9 °C (+5.2 °F)
mean May-September temp.	18 °C (64.4 °F)	+2.1 °C (+3.8 °F)	+8 °C (+14.5 °F)
annual precipitation	757 mm (29.8 in)	+12.3 %	+10 %
May-September precipitation	478 mm (18.8 in)	+7.4 %	-3.6 %

Table 2. Potential changes in habitat suitability (2100 compared with 1990) for tree species in Mississippi National River and Recreation Areas. 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 nigrum	black maple	extirpated	extirpated
Acer saccharum	sugar maple	small decrease	large decrease
Betula papyrifera	paper birch	large decrease	large decrease
Fraxinus pennsylvanica	green ash	small decrease	small decrease
Juglans cinerea	butternut	small decrease	extirpated
Picea glauca	white spruce	large decrease	small decrease
Pinus banksiana	jack pine	small decrease	small decrease
Populus grandidentata	bigtooth aspen	large decrease	extirpated
Populus tremuloides	quaking aspen	large decrease	large decrease
Prunus pensylvanica	pin cherry	extirpated	extirpated
Prunus virginiana	chokecherry	small decrease	large decrease
Quercus rubra	northern red oak	small decrease	large decrease

No Change in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer rubrum	red maple	no change	no change
Carpinus caroliniana	American hornbeam	no change	no change
Quercus macrocarpa	bur oak	no change	no change
Ulmus rubra	slippery elm	no change	no change

Increases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer saccharinum	silver maple	large increase	small increase
Carya cordiformis	bitternut hickory	small increase	small increase
Carya ovata	shagbark hickory	large increase	large increase
Celtis occidentalis	hackberry	large increase	large increase
Fraxinus americana	white ash	small increase	small increase
Gleditsia triacanthos	honeylocust	large increase	large increase
Juglans nigra	black walnut	large increase	large increase
Juniperus virginiana	eastern redcedar	large increase	large increase
Maclura pomifera	osage-orange	large increase	large increase
Morus rubra	red mulberry	large increase	large increase
Pinus strobus	eastern white pine	small increase	small increase
Populus deltoides	eastern cottonwood	small increase	large increase
Prunus americana	wild plum	small increase	large increase
Quercus bicolor	swamp white oak	small increase	large increase
Quercus velutina	black oak	large increase	small increase

Increases in Potential Habitat (continued)

Scientific Name	Common Name	Least Change	Major Change
Robinia pseudoacacia	black locust	large increase	large increase
Salix nigra	black willow	small increase	small increase

Mixed Results

Scientific Name	Common Name	Least Change	Major Change
Acer negundo	boxelder	no change	large increase
Betula nigra	river birch	large increase	no change
Fraxinus nigra	black ash	no change	large decrease
Larix laricina	tamarack	small decrease	no change
Ostrya virginiana	eastern hophornbeam	no change	small decrease
Pinus resinosa	red pine	no change	small decrease
Populus balsamifera	balsam poplar	large decrease	large increase
Prunus serotina	black cherry	small increase	large decrease
Quercus alba	white oak	small increase	small decrease
Quercus ellipsoidalis	northern pin oak	no change	small decrease
Salix amygdaloides	peachleaf willow	small decrease	large increase
Tilia americana	American basswood	no change	small decrease
Ulmus americana	American elm	small increase	no change

New Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Aesculus glabra	Ohio buckeye	new entry	--
Carya glabra	pignut hickory	new entry	new entry
Carya illinoinensis	pecan	--	new entry
Carya tomentosa	mockernut hickory	--	new entry
Celtis laevigata	sugarberry	--	new entry
Cercis canadensis	eastern redbud	--	new entry
Fagus grandifolia	American beech	new entry	new entry
Platanus occidentalis	sycamore	--	new entry
Quercus imbricaria	shingle oak	--	new entry
Quercus marilandica	blackjack oak	--	new entry
Quercus muehlenbergii	chinkapin oak	new entry	new entry
Quercus palustris	pin oak	new entry	new entry
Quercus stellata	post oak	--	new entry
Sassafras albidum	sassafras	new entry	new entry
Ulmus alata	winged elm	--	new entry

Table 3. Nonnative tree insects and diseases ("tree pests") with infestation areas that include Mississippi National River and Recreation Areas. 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
Agrilus planipennis	emerald ash borer	county
Caliroa cerasi	pear sawfly	county

Table 3 (continued). Nonnative tree insects and diseases ("tree pests") with infestation areas that include Mississippi National River and Recreation Areas.

Scientific Name	Common Name	Detection Scale
Carulaspis juniperi	juniper scale	state
Caulocampus acericaulis	maple petiole borer	state
Ceratocystis fagacearum	oak wilt	county
Coleophora laricella	larch casebearer	county
Coleophora serratella	birch casebearer	state
Contarinia baeri	European pine needle midge	state
Cronartium ribicola	white pine blister rust	county
Cryphonectria parasitica	chestnut blight	state
Cryptodiaporthe populea	Dothichiza canker of poplar	state
Cryptorhynchus lapathi	poplar-and-willow borer	county
Cyrtepistomus castaneus	Asiatic oak weevil	state
Diaspidiotus perniciosus	San Jose scale	state
Diprion similis	introduced pine sawfly	state
Eulecanium cerasorum	calico scale	state
Fenusa pusilla	birch leafminer	county
Gilpinia hercyniae	European spruce sawfly	state
Hylastes opacus	European bark beetle	state
Kaliofenusa ulmi	elm leafminer	state
Lepidosaphes ulmi	oystershell scale	county
Neodiprion sertifer	European pine sawfly	state
Ophiostoma novo-ulmi	Dutch elm disease	county
Orchestes alni	European elm flea weevil	county
Otiorhynchus ovatus	strawberry root weevil	county
Otiorhynchus sulcatus	black vine weevil	state
Periphyllus lyropictus	Norway maple aphid	state
Physokermes piceae	spruce bud scale	county
Plagiodera versicolora	imported willow leaf beetle	state
Popillia japonica	Japanese beetle	county
Pristiphora erichsonii	larch sawfly	state
Pristiphora geniculata	mountain-ash sawfly	state
Profenusa thomsoni	Ambermarked Birch Leafminer	state
Rhyacionia buoliana	European pine shoot moth	state
Scolytus multistriatus	smaller European elm bark beetle	county
Scolytus schevyrewi	banded elm bark beetle	county
Sirococcus clavigignenti juglandacearum	butternut canker	county
Taeniothrips inconsequens	pear thrips	county
Thrips calcaratus	introduced basswood thrips	county
Tomicus piniperda	pine shoot beetle	county
Trichiocampus viminalis	poplar sawfly	state
Xanthogaleruca luteola	elm leafbeetle	state