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 Apostle Islands National Lakeshore

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 Apostle Islands National Lakeshore, 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 Apostle Islands National Lakeshore. 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	3.8 °C (38.8 °F)	+2.4 °C (+4.4 °F)	+6.9 °C (+12.4 °F)
mean January temperature	-12 °C (10.4 °F)	+2.9 °C (+5.3 °F)	+5.1 °C (+9.1 °F)
mean July temperature	18.8 °C (65.8 °F)	+1.5 °C (+2.7 °F)	+7.4 °C (+13.4 °F)
seasonality (July-January temp.)	30.8 °C (55.4 °F)	-1.4 °C (-2.6 °F)	+2.4 °C (+4.3 °F)
mean May-September temp.	14.9 °C (58.9 °F)	+2 °C (+3.7 °F)	+7.3 °C (+13.2 °F)
annual precipitation	815 mm (32.1 in)	+7.4 %	+13.3 %
May-September precipitation	482 mm (19 in)	+2.5 %	+2.3 %

Table 2. Potential changes in habitat suitability (2100 compared with 1990) for tree species in Apostle Islands National Lakeshore. 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
Abies balsamea	balsam fir	large decrease	large decrease
Acer saccharum	sugar maple	small decrease	large decrease
Acer spicatum	mountain maple	large decrease	extirpated
Betula alleghaniensis	yellow birch	small decrease	large decrease
Betula papyrifera	paper birch	small decrease	large decrease
Picea glauca	white spruce	large decrease	large decrease
Picea mariana	black spruce	large decrease	large decrease
Populus balsamifera	balsam poplar	large decrease	large decrease
Populus tremuloides	quaking aspen	small decrease	large decrease
Prunus pensylvanica	pin cherry	small decrease	extirpated
Prunus virginiana	chokecherry	small decrease	large decrease
Thuja occidentalis	northern white-cedar	small decrease	large decrease

No Change in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Pinus resinosa	red pine	no change	no change
Tilia americana	American basswood	no change	no change

Increases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer saccharinum	silver maple	small increase	large increase
Carpinus caroliniana	American hornbeam	large increase	large increase
Fagus grandifolia	American beech	large increase	large increase
Fraxinus americana	white ash	large increase	large increase
Prunus serotina	black cherry	large increase	large increase
Quercus alba	white oak	large increase	large increase
Quercus ellipsoidalis	northern pin oak	small increase	large increase
Quercus macrocarpa	bur oak	small increase	large increase
Quercus rubra	northern red oak	large increase	large increase
Quercus velutina	black oak	large increase	large increase
Salix nigra	black willow	small increase	large increase
Ulmus americana	American elm	small increase	large increase
Ulmus rubra	slippery elm	large increase	large increase

Mixed Results

Scientific Name	Common Name	Least Change	Major Change
Acer rubrum	red maple	no change	small decrease
Carya cordiformis	bitternut hickory	small decrease	large increase
Fraxinus nigra	black ash	no change	large decrease
Fraxinus pennsylvanica	green ash	no change	large increase
Larix laricina	tamarack	no change	small decrease
Ostrya virginiana	eastern hophornbeam	no change	large increase
Pinus banksiana	jack pine	no change	small decrease
Pinus strobus	eastern white pine	small increase	small decrease
Populus grandidentata	bigtooth aspen	no change	large decrease
Tsuga canadensis	eastern hemlock	small increase	small decrease

New Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer negundo	boxelder	new entry	new entry
Aesculus glabra	Ohio buckeye	--	new entry
Betula nigra	river birch	--	new entry
Carya glabra	pignut hickory	--	new entry
Carya ovata	shagbark hickory	new entry	new entry
Carya texana	black hickory	--	new entry
Carya tomentosa	mockernut hickory	--	new entry
Celtis occidentalis	hackberry	--	new entry
Cercis canadensis	eastern redbud	--	new entry
Cornus florida	flowering dogwood	--	new entry
Diospyros virginiana	common persimmon	--	new entry
Gleditsia triacanthos	honeylocust	--	new entry
Juglans nigra	black walnut	new entry	new entry
Juniperus virginiana	eastern redcedar	new entry	new entry
Liriodendron tulipifera	yellow-poplar	--	new entry
Maclura pomifera	osage-orange	--	new entry
Morus rubra	red mulberry	--	new entry
Platanus occidentalis	sycamore	--	new entry
Populus deltoides	eastern cottonwood	new entry	new entry
Prunus americana	wild plum	--	new entry
Quercus coccinea	scarlet oak	--	new entry
Quercus marilandica	blackjack oak	--	new entry
Quercus muehlenbergii	chinkapin oak	--	new entry
Quercus palustris	pin oak	--	new entry
Quercus prinus	chestnut oak	--	new entry
Quercus stellata	post oak	--	new entry
Robinia pseudoacacia	black locust	--	new entry
Sassafras albidum	sassafras	--	new entry

Table 3. Nonnative tree insects and diseases ("tree pests") with infestation areas that include Apostle Islands National Lakeshore. 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	state
Adelges abietis	eastern spruce gall adelgid	state
Caliroa cerasi	pear sawfly	state
Carulaspis juniperi	juniper scale	state
Caulocampus acericaulis	maple petiole borer	state
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	state
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	state
Lymantria dispar	gypsy moth	county
Neodiprion sertifer	European pine sawfly	state
Ophiostoma novo-ulmi	Dutch elm disease	state
Orchestes alni	European elm flea weevil	state
Otiorhynchus ovatus	strawberry root weevil	state
Otiorhynchus sulcatus	black vine weevil	state
Periphyllus lyropictus	Norway maple aphid	state
Physokermes piceae	spruce bud scale	state
Plagiodera versicolora	imported willow leaf beetle	state
Popillia japonica	Japanese beetle	state
Pristiphora erichsonii	larch sawfly	county
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	state
Scolytus schevyrewi	banded elm bark beetle	state
Sirococcus clavigignenti juglandacearum	butternut canker	county
Taeniothrips inconsequens	pear thrips	state
Thrips calcaratus	introduced basswood thrips	county

Table 3 (continued). Nonnative tree insects and diseases ("tree pests") with infestation areas that include Apostle Islands National Lakeshore.

Scientific Name	Common Name	Detection Scale
Tomicus piniperda	pine shoot beetle	county
Trichiocampus viminalis	poplar sawfly	state
Xanthogaleruca luteola	elm leafbeetle	state