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 Niobrara National Scenic River

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 Niobrara National Scenic River, 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 Niobrara National Scenic River. 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	8.2 °C (46.8 °F)	+2.3 °C (+4.2 °F)	+8 °C (+14.4 °F)
mean January temperature	-6.2 °C (20.9 °F)	+1.8 °C (+3.2 °F)	+6.3 °C (+11.3 °F)
mean July temperature	23.3 °C (73.9 °F)	+1.6 °C (+2.8 °F)	+9.9 °C (+17.9 °F)
seasonality (July-January temp.)	29.4 °C (53 °F)	-0.2 °C (-0.4 °F)	+3.7 °C (+6.6 °F)
mean May-September temp.	19.1 °C (66.4 °F)	+2.1 °C (+3.9 °F)	+9 °C (+16.2 °F)
annual precipitation	585 mm (23 in)	+18 %	-1.3 %
May-September precipitation	384 mm (15.1 in)	+12.1 %	-6.9 %

Table 2. Potential changes in habitat suitability (2100 compared with 1990) for tree species in Niobrara National Scenic River. 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
Juniperus virginiana	eastern redcedar	small decrease	small decrease
Prunus virginiana	chokecherry	large decrease	extirpated

No Change in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Populus deltoides	eastern cottonwood	no change	no change
Prunus serotina	black cherry	no change	no change
Quercus macrocarpa	bur oak	no change	no change

Increases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer saccharinum	silver maple	large increase	large increase
Celtis occidentalis	hackberry	large increase	large increase
Gleditsia triacanthos	honeylocust	large increase	large increase
Maclura pomifera	osage-orange	large increase	large increase
Morus rubra	red mulberry	large increase	small increase
Robinia pseudoacacia	black locust	large increase	large increase
Salix nigra	black willow	large increase	large increase
Ulmus americana	American elm	large increase	small increase
Ulmus rubra	slippery elm	large increase	large increase

Mixed Results

Scientific Name	Common Name	Least Change	Major Change
Acer negundo	boxelder	no change	small increase
Catalpa speciosa	northern catalpa	small decrease	large increase
Fraxinus americana	white ash	no change	small increase
Fraxinus pennsylvanica	green ash	small increase	no change
Juglans nigra	black walnut	large increase	no change
Ostrya virginiana	eastern hophornbeam	no change	large decrease
Pinus banksiana	jack pine	small decrease	large increase
Populus tremuloides	quaking aspen	large decrease	no change
Tilia americana	American basswood	no change	small decrease

New Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
Acer saccharum	sugar maple	new entry	--
Asimina triloba	pawpaw	new entry	new entry
Cercis canadensis	eastern redbud	new entry	new entry

New Potential Habitat (continued)

Scientific Name	Common Name	Least Change	Major Change
Pinus strobus	eastern white pine	new entry	--
Quercus marilandica	blackjack oak	new entry	new entry
Quercus muehlenbergii	chinkapin oak	new entry	new entry
Quercus rubra	northern red oak	--	new entry
Quercus stellata	post oak	new entry	new entry
Quercus velutina	black oak	--	new entry

Table 3. Nonnative tree insects and diseases ("tree pests") with infestation areas that include Niobrara National Scenic River. 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
Caliroa cerasi	pear sawfly	state
Cryptorhynchus lapathi	poplar-and-willow borer	state
Diaspidiotus perniciosus	San Jose scale	state
Eulecanium cerasorum	calico scale	state
Homadaula anisocentra	mimosa webworm	state
Kaliofenusa ulmi	elm leafminer	state
Lepidosaphes ulmi	oystershell scale	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
Popillia japonica	Japanese beetle	state
Scolytus multistriatus	smaller European elm bark beetle	state
Scolytus schevyrewi	banded elm bark beetle	county
Trichiocampus viminalis	poplar sawfly	state
Xanthogaleruca luteola	elm leafbeetle	state