



## Climate, Trees, Pests, and Weeds: Change, Uncertainty, and Biotic Stressors at New River Gorge National 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 New River Gorge National 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 New River Gorge National 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<sup>2</sup> (16000 km<sup>2</sup>) area centered on the park.

Climate Variable	Baseline (1961-1990)	Least Change (2070-2099)	Major Change (2070-2099)
mean annual temperature	10.4 °C (50.8 °F)	+1.9 °C (+3.4 °F)	+6.8 °C (+12.2 °F)
mean January temperature	-0.9 °C (30.4 °F)	+1.4 °C (+2.5 °F)	+4.4 °C (+7.9 °F)
mean July temperature	21.2 °C (70.2 °F)	+2 °C (+3.5 °F)	+8.4 °C (+15.1 °F)
seasonality (July-January temp.)	22.1 °C (39.8 °F)	+0.5 °C (+1 °F)	+4 °C (+7.2 °F)
mean May-September temp.	18.6 °C (65.6 °F)	+2 °C (+3.5 °F)	+7.8 °C (+14.1 °F)
annual precipitation	1111 mm (43.7 in)	+6 %	+14.5 %
May-September precipitation	516 mm (20.3 in)	+5.1 %	+8.5 %

**Table 2.** Potential changes in habitat suitability (2100 compared with 1990) for tree species in New River Gorge National 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  $\leq 0.5$ , small decrease is  $> 0.5$  and  $\leq 0.8$ , no change is  $> 0.8$  and  $\leq 1.2$ , small increase is  $> 1.2$  and  $\leq 2.0$ , 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
<i>Acer pensylvanicum</i>	striped maple	small decrease	large decrease
<i>Aesculus glabra</i>	Ohio buckeye	small decrease	small decrease
<i>Betula alleghaniensis</i>	yellow birch	small decrease	large decrease
<i>Betula lenta</i>	sweet birch	small decrease	large decrease
<i>Juglans cinerea</i>	butternut	extirpated	extirpated
<i>Pinus rigida</i>	pitch pine	small decrease	small decrease
<i>Prunus serotina</i>	black cherry	small decrease	small decrease
<i>Quercus rubra</i>	northern red oak	small decrease	small decrease
<i>Tilia americana</i>	American basswood	small decrease	large decrease

#### No Change in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
<i>Carpinus caroliniana</i>	American hornbeam	no change	no change
<i>Fraxinus americana</i>	white ash	no change	no change
<i>Magnolia acuminata</i>	cucumbertree	no change	no change
<i>Pinus pungens</i>	Table Mountain pine	no change	no change
<i>Tsuga canadensis</i>	eastern hemlock	no change	no change

#### Increases in Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
<i>Aesculus octandra</i>	yellow buckeye	small increase	small increase
<i>Carya cordiformis</i>	bitternut hickory	small increase	large increase
<i>Carya ovata</i>	shagbark hickory	small increase	large increase
<i>Cercis canadensis</i>	eastern redbud	small increase	large increase
<i>Diospyros virginiana</i>	common persimmon	large increase	large increase
<i>Fraxinus pennsylvanica</i>	green ash	small increase	large increase
<i>Juniperus virginiana</i>	eastern redcedar	large increase	large increase
<i>Liquidambar styraciflua</i>	sweetgum	large increase	large increase
<i>Pinus echinata</i>	shortleaf pine	large increase	large increase
<i>Pinus virginiana</i>	Virginia pine	small increase	small increase
<i>Platanus occidentalis</i>	sycamore	small increase	large increase
<i>Quercus alba</i>	white oak	small increase	small increase
<i>Quercus falcata var. falcata</i>	southern red oak	large increase	large increase
<i>Quercus stellata</i>	post oak	large increase	large increase

#### Mixed Results

Scientific Name	Common Name	Least Change	Major Change
<i>Acer negundo</i>	boxelder	no change	small increase
<i>Acer rubrum</i>	red maple	no change	large decrease

### Mixed Results (continued)

Scientific Name	Common Name	Least Change	Major Change
<i>Acer saccharinum</i>	silver maple	small decrease	large increase
<i>Acer saccharum</i>	sugar maple	no change	large decrease
<i>Amelanchier spp.</i>	serviceberry	no change	small decrease
<i>Asimina triloba</i>	pawpaw	no change	large decrease
<i>Carya glabra</i>	pignut hickory	no change	small decrease
<i>Carya tomentosa</i>	mockernut hickory	no change	small increase
<i>Castanea dentata</i>	American chestnut	no change	small decrease
<i>Celtis laevigata</i>	sugarberry	small decrease	large increase
<i>Celtis occidentalis</i>	hackberry	small decrease	large increase
<i>Cornus florida</i>	flowering dogwood	no change	small decrease
<i>Fagus grandifolia</i>	American beech	no change	small decrease
<i>Gleditsia triacanthos</i>	honeylocust	extirpated	large increase
<i>Juglans nigra</i>	black walnut	no change	small increase
<i>Liriodendron tulipifera</i>	yellow-poplar	no change	large decrease
<i>Morus rubra</i>	red mulberry	no change	large increase
<i>Nyssa sylvatica</i>	blackgum	no change	small increase
<i>Ostrya virginiana</i>	eastern hophornbeam	no change	small increase
<i>Oxydendrum arboreum</i>	sourwood	small increase	small decrease
<i>Pinus strobus</i>	eastern white pine	no change	small decrease
<i>Quercus coccinea</i>	scarlet oak	no change	large decrease
<i>Quercus macrocarpa</i>	bur oak	small decrease	large increase
<i>Quercus muehlenbergii</i>	chinkapin oak	no change	large increase
<i>Quercus phellos</i>	willow oak	small decrease	large increase
<i>Quercus prinus</i>	chestnut oak	no change	large decrease
<i>Quercus shumardii</i>	Shumard oak	small decrease	large increase
<i>Quercus velutina</i>	black oak	no change	small increase
<i>Robinia pseudoacacia</i>	black locust	no change	small decrease
<i>Salix nigra</i>	black willow	small decrease	large increase
<i>Sassafras albidum</i>	sassafras	no change	small decrease
<i>Ulmus americana</i>	American elm	no change	large increase
<i>Ulmus rubra</i>	slippery elm	no change	small increase

### New Potential Habitat

Scientific Name	Common Name	Least Change	Major Change
<i>Carya illinoensis</i>	pecan	--	new entry
<i>Carya texana</i>	black hickory	new entry	new entry
<i>Catalpa speciosa</i>	northern catalpa	--	new entry
<i>Gleditsia aquatica</i>	waterlocust	--	new entry
<i>Maclura pomifera</i>	osage-orange	--	new entry
<i>Pinus elliottii</i>	slash pine	--	new entry
<i>Pinus palustris</i>	longleaf pine	--	new entry
<i>Pinus taeda</i>	loblolly pine	new entry	new entry
<i>Populus deltoides</i>	eastern cottonwood	--	new entry
<i>Quercus marilandica</i>	blackjack oak	new entry	new entry

### New Potential Habitat (continued)

Scientific Name	Common Name	Least Change	Major Change
<i>Quercus nigra</i>	water oak	--	new entry
<i>Quercus nuttallii</i>	Nuttall oak	--	new entry
<i>Ulmus alata</i>	winged elm	new entry	new entry
<i>Ulmus crassifolia</i>	cedar elm	--	new entry

**Table 3.** Nonnative tree insects and diseases (“tree pests”) with infestation areas that include New River Gorge National 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
<i>Adelges abietis</i>	eastern spruce gall adelgid	state
<i>Adelges piceae</i>	balsam woolly adelgid	state
<i>Adelges tsugae</i>	hemlock woolly adelgid	county
<i>Agrilus planipennis</i>	emerald ash borer	county
<i>Caliroa cerasi</i>	pear sawfly	state
<i>Carulaspis juniperi</i>	juniper scale	state
<i>Caulocampus acericaulis</i>	maple petiole borer	state
<i>Ceratocystis fagacearum</i>	oak wilt	county
<i>Coleophora laricella</i>	larch casebearer	state
<i>Cronartium ribicola</i>	white pine blister rust	county
<i>Cryphonectria parasitica</i>	chestnut blight	county
<i>Cryptorhynchus lapathi</i>	poplar-and-willow borer	state
<i>Cyrtepidomus castaneus</i>	Asiatic oak weevil	county
<i>Diaspidiotus perniciosus</i>	San Jose scale	state
<i>Diprion similis</i>	introduced pine sawfly	state
<i>Discula destructiva</i>	dogwood anthracnose	county
<i>Dryocosmus kuriphilus</i>	chestnut gall wasp	state
<i>Eulecanium cerasorum</i>	calico scale	state
<i>Homadaula anisocentra</i>	mimosa webworm	state
<i>Hylastes opacus</i>	European bark beetle	state
<i>Kaliofenusa ulmi</i>	elm leafminer	state
<i>Lepidosaphes ulmi</i>	oystershell scale	state
<i>Ophiostoma novo-ulmi</i>	Dutch elm disease	state
<i>Otiorhynchus ovatus</i>	strawberry root weevil	state
<i>Otiorhynchus sulcatus</i>	black vine weevil	state
<i>Periphyllus lyropictus</i>	Norway maple aphid	state
<i>Phyllaphis fagi</i>	woolly beech aphid	state
<i>Phytophthora cinnamomi</i>	littleleaf disease / phytophthora root rot	state
<i>Plagioderma versicolora</i>	imported willow leaf beetle	state
<i>Popillia japonica</i>	Japanese beetle	county
<i>Pristiphora erichsonii</i>	larch sawfly	state
<i>Pristiphora geniculata</i>	mountain-ash sawfly	state
<i>Rhyacionia buoliana</i>	European pine shoot moth	state
<i>Scolytus multistriatus</i>	smaller European elm bark beetle	state

**Table 3 (continued).** Nonnative tree insects and diseases (“tree pests”) with infestation areas that include New River Gorge National River.

<b>Scientific Name</b>	<b>Common Name</b>	<b>Detection Scale</b>
<i>Sirococcus clavigignenti juglandacearum</i>	butternut canker	county
<i>Taeniothrips inconsequens</i>	pear thrips	state
<i>Tomicus piniperda</i>	pine shoot beetle	county
<i>Trichiocampus viminalis</i>	poplar sawfly	state
<i>Xanthogaleruca luteola</i>	elm leafbeetle	state