# 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 Cumberland Island National Seashore

## 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 Cumberland Island National Seashore, 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 Cumberland Island National Seashore. 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 | 19.1 °C (66.4 °F) | +1.8 °C (+3.3 °F) | +6.4 °C (+11.5 °F) |
| mean January temperature | 10.5 °C (50.9 °F) | +1.3 °C (+2.3 °F) | +4.8 °C (+8.6 °F) |
| mean July temperature | 27 °C (80.6 °F) | +2 °C (+3.6 °F) | +6.8 °C (+12.3 °F) |
| seasonality (July-January temp.) | 16.5 °C (29.7 °F) | +0.7 °C (+1.3 °F) | +2.1 °C (+3.7 °F) |
| mean May-September temp. | 25.1 °C (77.2 °F) | +2 °C (+3.6 °F) | +6.8 °C (+12.3 °F) |
| annual precipitation | 1310 mm (51.6 in) | +5.5 % | +12.9 % |
| May-September precipitation | 730 mm (28.7 in) | +10 % | +10.1 % |

**Table 2.** Potential changes in habitat suitability (2100 compared with 1990) for tree species in Cumberland Island National Seashore. 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 |
|---|---|---|---|
| *Nyssa ogeche* | Ogechee tupelo | large decrease | extirpated |
| *Nyssa sylvatica var. biflora* | swamp tupelo | small decrease | small decrease |
| *Pinus taeda* | loblolly pine | small decrease | small decrease |
| *Prunus serotina* | black cherry | small decrease | small decrease |

**No Change in Potential Habitat**

| Scientific Name | Common Name | Least Change | Major Change |
|---|---|---|---|
| *Acer rubrum* | red maple | no change | no change |
| *Cornus florida* | flowering dogwood | no change | no change |
| *Gordonia lasianthus* | loblolly-bay | no change | no change |
| *Liquidambar styraciflua* | sweetgum | no change | no change |
| *Magnolia grandiflora* | southern magnolia | no change | no change |
| *Persea borbonia* | redbay | no change | no change |
| *Pinus elliottii* | slash pine | no change | no change |
| *Pinus serotina* | pond pine | no change | no change |
| *Quercus nigra* | water oak | no change | no change |
| *Quercus phellos* | willow oak | no change | no change |

**Increases in Potential Habitat**

| Scientific Name | Common Name | Least Change | Major Change |
|---|---|---|---|
| *Fraxinus pennsylvanica* | green ash | small increase | small increase |
| *Nyssa sylvatica* | blackgum | small increase | large increase |
| *Pinus clausa* | sand pine | small increase | large increase |
| *Quercus incana* | bluejack oak | small increase | large increase |
| *Quercus laevis* | turkey oak | large increase | large increase |
| *Quercus stellata* | post oak | large increase | large increase |
| *Quercus virginiana* | live oak | small increase | large increase |
| *Taxodium distichum* | baldcypress | small increase | large increase |

**Mixed Results**

| Scientific Name | Common Name | Least Change | Major Change |
|---|---|---|---|
| *Carpinus caroliniana* | American hornbeam | no change | small increase |
| *Diospyros virginiana* | common persimmon | small decrease | large increase |
| *Fraxinus americana* | white ash | no change | small increase |
| *Ilex opaca* | American holly | small decrease | small increase |
| *Magnolia virginiana* | sweetbay | no change | small increase |
| *Nyssa aquatica* | water tupelo | large decrease | small increase |
| *Pinus palustris* | longleaf pine | no change | small increase |

**Mixed Results (continued)**

| Scientific Name | Common Name | Least Change | Major Change |
|---|---|---|---|
| *Quercus falcata var.falcata* | southern red oak | no change | small increase |
| *Quercus laurifolia* | laurel oak | no change | small increase |
| *Taxodium distichum var. nutans* | pondcypress | no change | large increase |

**New Potential Habitat**

| Scientific Name | Common Name | Least Change | Major Change |
|---|---|---|---|
| *Ulmus alata* | winged elm | new entry | new entry |

**Table 3.** Nonnative tree insects and diseases ("tree pests") with infestation areas that include Cumberland Island National Seashore. 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 |
|---|---|---|
| *Anarsia lineatella* | peach twig borer | state |
| *Caliroa cerasi* | pear sawfly | state |
| *Carulaspis juniperi* | juniper scale | state |
| *Coleophora serratella* | birch casebearer | state |
| *Cryphonectria parasitica* | chestnut blight | state |
| *Cyrtepistomus castaneus* | Asiatic oak weevil | state |
| *Diaspidiotus perniciosus* | San Jose scale | state |
| *Dryocosmus kuriphilus* | chestnut gall wasp | state |
| *Eulecanium cerasorum* | calico scale | state |
| *Homadaula anisocentra* | mimosa webworm | state |
| *Icerya purchasi* | cottony cushion scale | state |
| *Kaliofenusa ulmi* | elm leafminer | state |
| *Lepidosaphes ulmi* | oystershell scale | state |
| *Ophiostoma novo-ulmi* | Dutch elm disease | state |
| *Periphyllus lyropictus* | Norway maple aphid | state |
| *Phytophthora cinnamomi* | littleleaf disease / phytophthora root rot | state |
| *Plagiodera versicolora* | imported willow leaf beetle | state |
| *Popillia japonica* | Japanese beetle | state |
| *Pseudaonidia duplex* | camphor scale | state |
| *Raffaelea spp.* | laurel wilt | county |
| *Scolytus multistriatus* | smaller European elm bark beetle | state |
| *Xanthogaleruca luteola* | elm leafbeetle | state |