Climate Change Response Program
Natural Resources Stewardship and Science

National Park Service
U.S. Department of the Interior

Toklat East River Fire, Denali NP, 2013, Photo by Yasunori Matsui.

NPVuln: Vulnerability Assessment Needs - Overview for Park Professionals

Introduction

National parks have experienced significant climate change impacts and rapid, on-going changes are projected to continue. Climate change vulnerability assessments (CCVAs) identify what is at risk and why, providing a sound, scientific foundation to guide climate adaptation and inform hazard analyses. The NPVuln project assessed climate vulnerability factors across the NPS system to evaluate priority threats, identify parks and resources most at risk, and inform strategies to provide vulnerability assessments of resources and assets in parks. The analysis found that more than half of the parks across the NPS are at high risk from a potentially transformative, "high-impact" climate factor like sea level rise or fire, and nearly 75% of parks are at risk from a high-impact climate factor or cumulative effects of climate change. NPVuln also identified several strategic approaches to efficiently address the servicewide need for CCVAs to guide park planning and decisions for adaptation to climate change hazards and vulnerabilities.

NPVuln was designed to address a variety of questions such as: Which climate factors most threaten a particular resource type? Which parks are threatened by a high-impact factor? Where are locations with many parks facing high risks? How do the types of threats vary across the NPS system of parks? NPVuln assessed climate vulnerability of parks by evaluating and scoring, at a broad level, each park's exposure to climate impacts, park sensitivity to climate impacts, and landscape adaptive capacity (the ability to adjust to climate changes; Figure 1). NPVuln analyses included 47 indicators aggregated into 21 vulnerability factors relevant to one or more resource type. Of the 21 climate factors, four factors are recognized as "high-impact" because they may be transformative and result in highly consequential, long-term or permanent changes in park ecosystems and other resources. Park resources were categorized as terrestrial biotic resources, aquatic biotic resources, and non-biotic resources (e.g., infrastructure and non-biotic cultural resources such as archeological sites or museum collections).

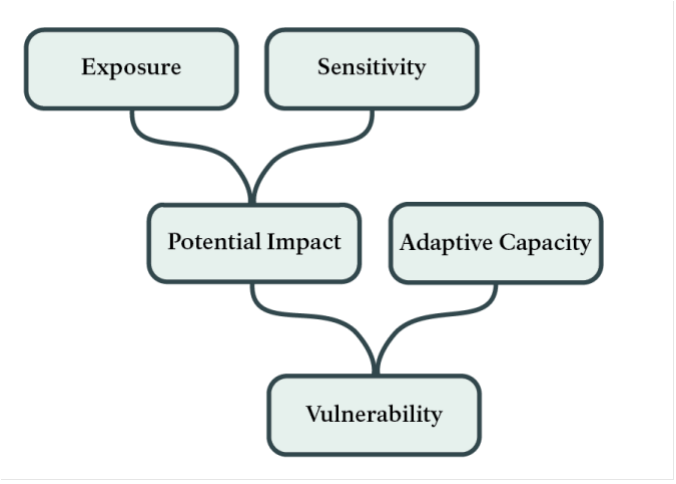

Figure 1 Climate vulnerability results from exposure to climate changes and sensitivity to those changes. The adaptive capacity of a landscape, such as through the degree of connected habitats promoting migration, can facilitate or impede more successful responses to climate impacts.

Parks at Risk

Parks are increasingly threatened by high-impact climate factors of fire, summer drought, sea level rise, and forest pests. The NPVuln analysis found that 57% of parks are at risk from at least one high-impact factor, and many parks are at risk from multiple factors (Figure 2). Data were insufficient to assess impacts from freshwater flooding or severe storms, and NPVuln did not include regional impacts such as melting permafrost or coral bleaching. These omissions suggest the findings underestimate potential vulnerability for many parks.

At the national scale, parks with the highest 25% overall vulnerability score are considered to warrant priority consideration for CCVAs. This includes parks with consistently high scores across a range of vulnerability factors. Results from the evaluation of overall scores identified that parks on the Atlantic and Gulf coasts, and river-based parks in the central U.S. face a broad range of climate threats (Figure 3). Many parks in the western continental US were ranked as a high priority due to high-impact factors, while a combination of climate factors – often in concert with existing threats from e.g., air pollution, invasive species, and/or migration barriers— threaten eastern parks.

We conduced similar analyses for legacy NPS regions and regions defined by ecological and biophysical characteristics (EPA level II ecoregions). These analyses helped to identify regional variation in the importance of different climate change threats. We grouped level II ecoregions with similar climate impact scores and then identified the 25% of parks with the highest scores within those ecoregional groups (Figure 4).

Vulnerability Assessment Needs

Climate vulnerability studies are most useful when they directly support planning and decisions. Vulnerability changes over time. Thus, it is particularly important for parks engaged in major planning exercises to have current climate vulnerability assessments. These findings provide an objective basis for a strategic, more efficient approach to provide climate change vulnerability information across the National Park System. Table 1 summarizes these strategies.

Details and Further Analysis

The NPVuln report fully describes the 47 indicators, 21 climate factors, data sources, and a much more comprehensive set of results and recommendations, as well as future research needs.

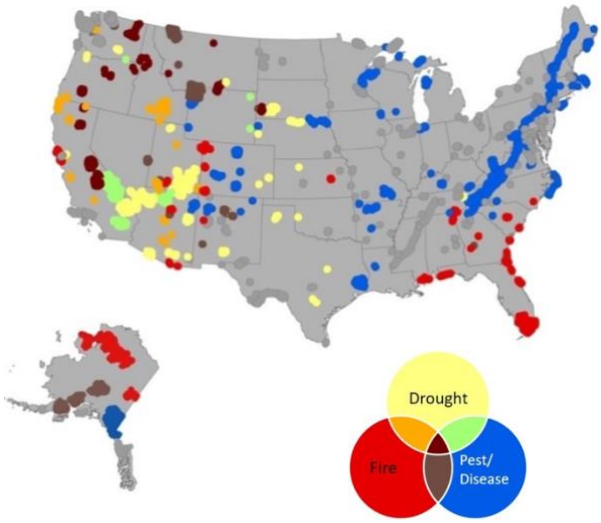

Figure 2 I&M parks with the highest vulnerability scores to three high-impact factors: fire, drought, and forest pest/disease risk. Sea-level rise and storm surge were also evaluated but are not shown here.

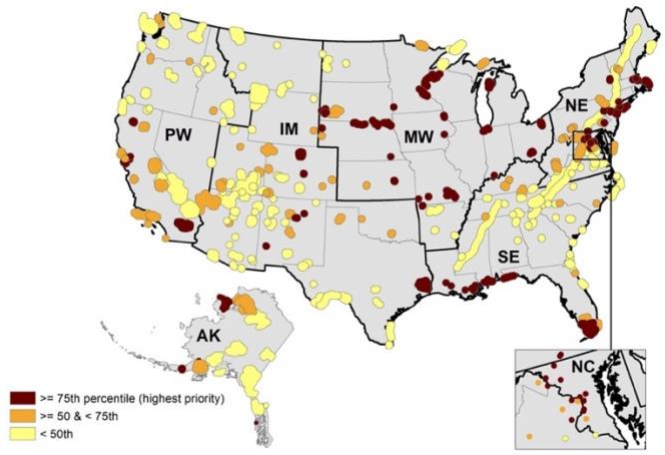

Figure 3 Parks with highest total vulnerability scores for terrestrial biotic resources are shown in brown.

Table 1. Summary of strategic approaches that may be used to efficiently design and conduct climate change vulnerability studies to meet high-priority park needs.

Approach	Description
Geography	Conduct CCVAs on groups of parks with similar settings, resources, and threats. Example: Great Lakes parks; SE coastal parks.
High-Impact Threat	Conduct CCVAs on groups of parks with similar complex threats (e.g., exposure), like fire, flood, or drought. Develop indicators for river floods and severe storms. Example: sea level rise and storm surge assessments; fire in CA parks.
Resource Focus	Conduct CCVAs on groups of parks with similar resource types (e.g., sensitivities), like forests, similar cultural resources or infrastructure, or water resources. Example: Cultural Resources Environmental Vulnerability Assessment Tool (CREVAT).
Park Focus	Conduct CCVAs on individual parks ranked by NPVuln analysis as at high risk at regional to national scales. Example: coastal parks on the Atlantic or Gulf coasts.
Data & Information	Address priority information gaps or other barriers that limit the ability to systematically conduct CCVAs. Example: improve asset location data in FMSS to permit sensitivity to floods; complete inventory of park water supplies.

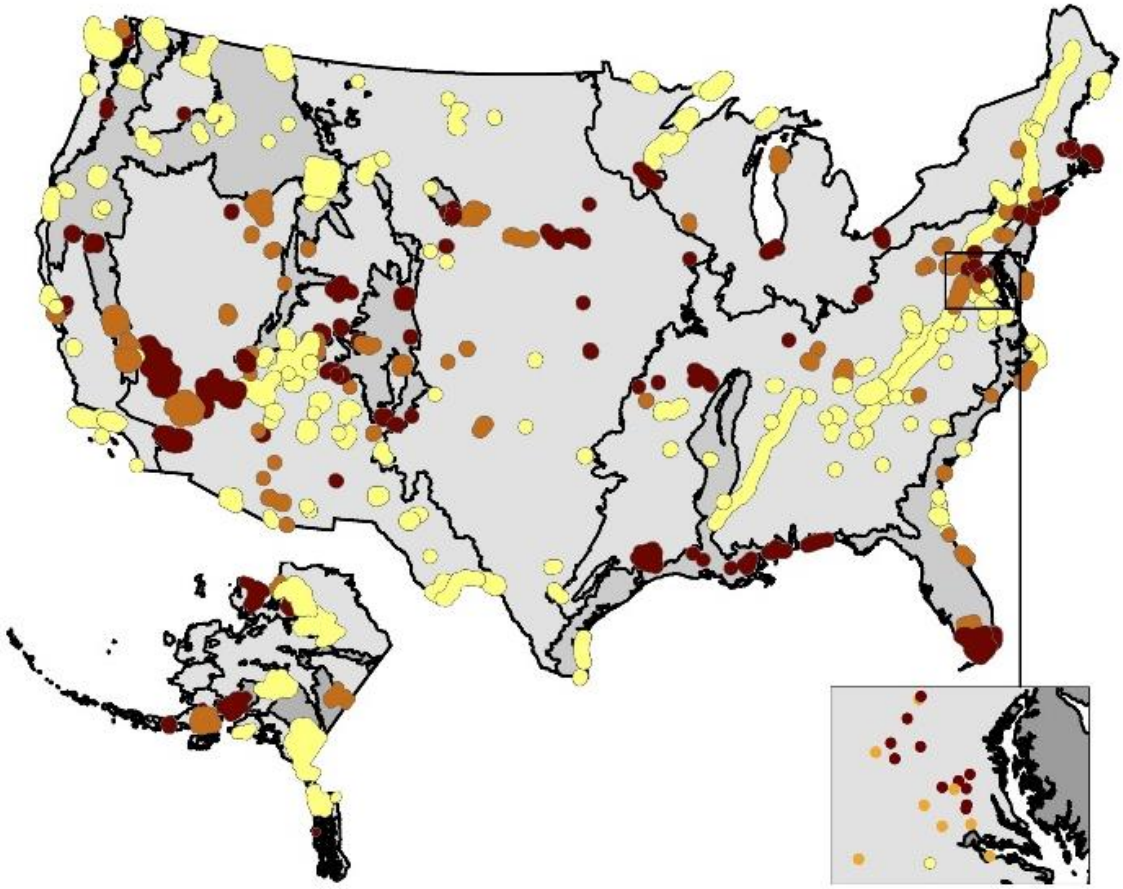

Fig. 4: Parks with highest total vulnerability scores for terrestrial resources within each ecoregional group (black outlines) are shown in brown.

Full report:

Michalak JL, Lawler JJ, Gross JE, Littlefield CE. 2021. A strategic analysis of climate vulnerability of national park resources and values. Natural Resource Report. NPS/NRSS/CCRP/NRR—2021/2293. National Park Service. Fort Collins, Colorado. https://doi.org/10.36967/nrr-2287214

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