Warming Temperatures Likely to Alter Visitation across the National Park System

Visitors enjoying the view from Mather Point, Grand Canyon National Park. NPS photo.

Introduction

Climate change will affect not only natural and cultural resources within national parks, but also visitation patterns. Where, when, and how many people visit parks is likely to change with continued warming. For example, visitors may avoid extremely warm months in low-latitude parks and the visitation season may extend across additional weeks to months at northern parks. Whether park visitors track climate change and shift their behavior will depend on multiple environmental and socioeconomic factors. However, understanding potential change in visitation based on historical trends and future patterns of temperature change is a crucial first step for park managers and local communities to anticipate, plan for, and proactively affect future visitation.

This recently published research (Fisichelli et al. 2015) sought to understand those relationships in 340 units of the U.S. national park system, from Guam, Hawai'i, and Alaska to the contiguous 48 states and islands in the Caribbean. We evaluated the historical relationship between long-term average monthly air temperature and visitation (1979-2013), and then modeled potential future visitation (2041-2060) based on two warming-climate scenarios and two visitation-growth scenarios.

In this project brief we report national trends; park-specific summaries are available at the National Park Service Science and Nature website.

Results

Historical Relationship between Visitation and Temperature

Across the national park system, long-term average monthly historical visitation and temperature were strongly associated (Figure 1). At relatively cool temperatures, visitation increased with temperature. Visitation peaked at around 20-25 °C (68-77 °F) and then rapidly decreased with very warm monthly temperatures above 25 °C (77 °F). Temperature alone explained 69% of the variation in visitation across the national park system.

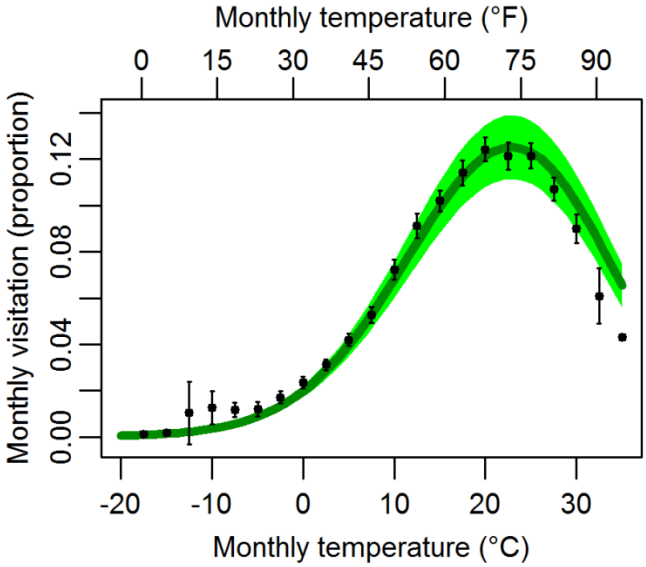

Figure 1. Relationship between historical (1979-2013) monthly average temperature and monthly park visitation (proportion of annual) across the U.S. national park system. Mean (black circles) and error bars (± twice the standard error) from observed data are based on 2.5 °C bins. Model estimate (dark green solid line) ± 1 standard error (light green shaded area), $R^2 = 0.69$.

Individual parks also showed strong relationships between historical monthly average temperature and visitation. Temperature was a significant predictor of visitation at 95% of parks (324 of 340), and temperature explained, on average, 79% of the variation in visitation at individual parks.

Future Potential Visitation

Potential future visitation (2041-2060) varied across parks, but numerous patterns emerged. Future warming is projected, on average, to cause an increase in potential total annual visits, an increase in visitation during all seasons, and an expansion of the visitation season (see box to the right). Future projections of annual visitation at individual parks varied from < 80% to > 140% of historical values (Figure 2).

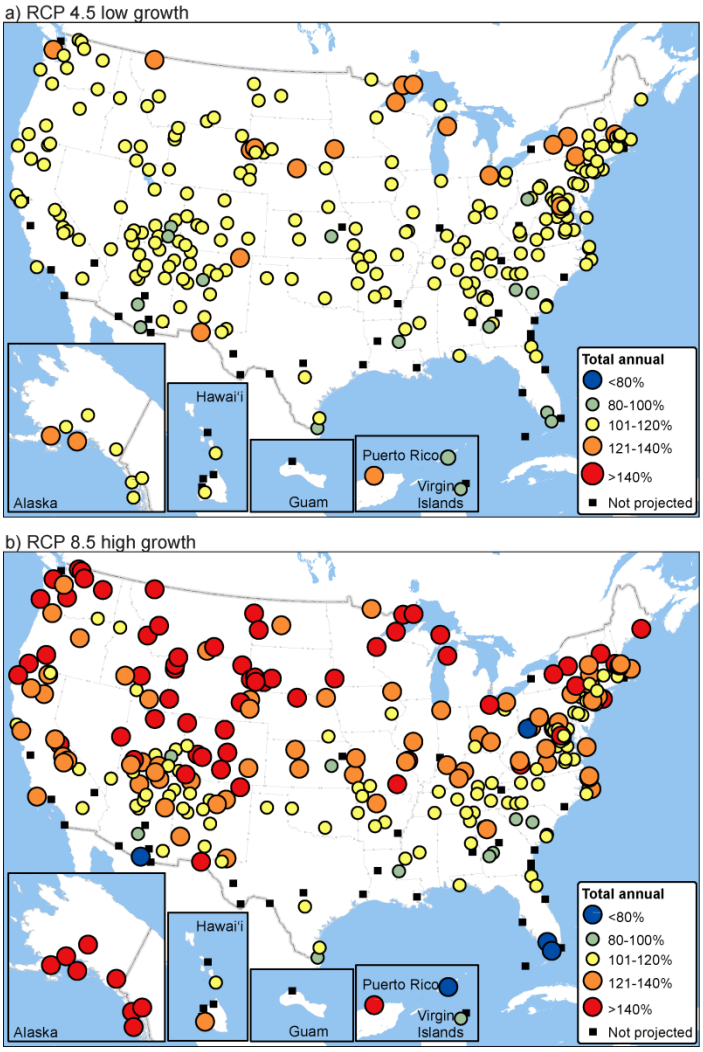

Figure 2. Potential future total annual visitation (2041-2060) expressed as a percentage of historical values (1979-2013). Future visitation for each park is based on modeled monthly visitation relationship to temperature. Future projections[a) minor warming and low growth and b) major warming and high growth, were limited to parks with temperature as an explanatory variable in the best-fit model and an adjusted $R^2 \geq 0.5$ (n = 282)].

Projected ranges of system-wide average potential future visitation change:

- 8-23% increase in annual visitation
- 5-19% increase in peak season visitation (3 busiest contiguous months)
- 9-24% increase in shoulder season visitation (2 months prior to and 2 months after peak season)
- 13-31% increase in low season visitation (3 contiguous months with least visitation)
- 13-31 day expansion of the visitation season (defined as beginning on the date when 10% of historical cumulative visitation was achieved and ending on the date when 10% of historical cumulative visitation remained for the year)

Implications – Adapting to Change

The research presented here is not a forecast of what the future will be but rather a projection of how visitation may change. The models are tools to help managers envision potential future changes and begin thinking about management implications. This study uses a single explanatory variable, monthly average air temperature, and yet captures a large amount of the variation in visitation patterns across the system as a whole and at many individual parks. Many factors will alter and constrain actual future visitation patterns, including population changes, economic trends, and leisure time availability.

The National Park Service is about to begin its second century of preserving America's natural and cultural heritage and providing for visitor enjoyment. The coming decades are likely to see changes in climate and changes in visitor use patterns and preferences. Parks and surrounding communities will need to adapt to both the challenges and opportunities posed by changing visitation.

More Information

This project is part of ongoing work of the National Park Service Climate Change Response Program and collaborators to support park adaptation to changing conditions. View more information online for NPS managers and for the public.

Source Publication

Fisichelli, N.A., Schuurman, G.W., Monahan, W.B., and Ziesler, P.S. 2015. Protected area tourism in a changing climate: will visitation at US national parks warm up or overheat?. PLOS ONE doi: 10.1371/journal.pone.0128226.

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