Birds and Climate Change

National Park Service
U.S. Department of the Interior

Rainbow Bridge National Monument

Background

Birds are useful indicators of ecological change because they are highly mobile and generally conspicuous. As climate in a particular place changes, suitability may worsen for some species and improve for others. These changes in climate may create the potential for local extirpation or new colonization. **This brief summarizes projected changes in climate suitability by mid-century for birds at Rainbow Bridge National Monument (hereafter, the Monument) under two climate change scenarios (see Wu et al. 2018 for full results, and Langham et al. 2015 for more information regarding how climate suitability is characterized).** The high-emissions pathway (RCP8.5) represents a future in which little action is taken to reduce global emissions of greenhouse gases. The low-emissions pathway (RCP2.6) is a best-case scenario of aggressive efforts to reduce emissions. These emissions pathways are globally standardized and established by the Intergovernmental Panel on Climate Change for projecting future climate change. The findings below are model-based projections of how species distributions may change in response to climate change. A 10-km buffer was applied to each park to match the spatial resolution of the species distribution models (10 x 10 km), and climate suitability was taken as the average of all cells encompassed by the park and buffer.

IMPORTANT

This study focuses exclusively on changing climatic conditions for birds over time. But projected changes in climate suitability are not definitive predictions of future species ranges or abundances. Numerous other factors affect where species occur, including habitat quality, food abundance, species adaptability, and the availability of microclimates (see Caveats). Therefore, managers should consider changes in climate suitability alongside these other important influences.

We report trends in climate suitability for all species identified as currently present at the Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument is projected to become suitable in the future (Figure 1 & Table 1). This brief provides park-specific projections whereas Wu et al. (2018), which did not incorporate park-specific species data and thus may differ from this brief, provides system-wide comparison and conclusions.

Results

Climate change is expected to alter the bird community at the Monument, with greater impacts under the high-emissions pathway than under the low-emissions pathway (Figure 1). Among the species likely to be found at the Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 0, remain stable for 0, and worsen for 1 species (Figure 2). Suitable climate does not cease to occur for any species in summer. Climate is projected to become suitable in summer for 23 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 0, remain stable for 1, and worsen for 0 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 41 species not found at the Monument today, potentially resulting in local colonization.

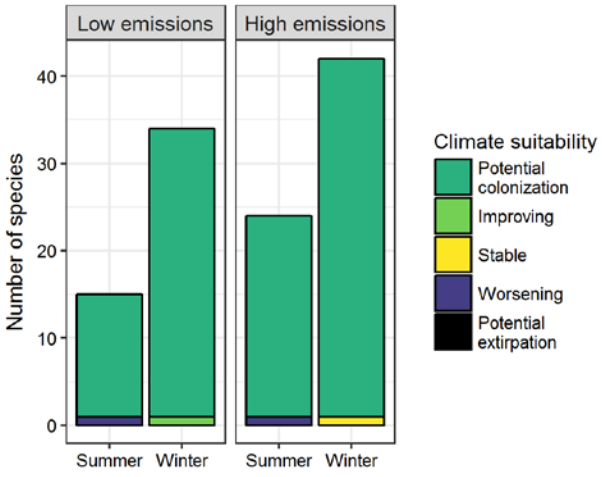

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.32 in summer (54th percentile across all national parks) and 0.21 in winter (29th percentile) under the high-emissions pathway. Potential species turnover declines to 0.21 in summer and 0.15 in winter under the low-emissions pathway. Turnover index was calculated based on the theoretical proportions of potential extirpations and potential colonizations by 2050 relative to today (as reported in Wu et al. 2018), and therefore assumes that all potential extirpations and colonizations are realized. According to this index, no change would be represented as 0, whereas a complete change in the bird community would be represented as 1.

Climate Sensitive Species

The Monument is home to one species, the Anhinga (*Anhinga anhinga*), that is highly sensitive to climate change across its range (i.e., it is projected to lose climate suitability in over 50% of its current summer range in North America by 2050; Table 1; Langham et al. 2015). Suitable climate is not projected to disappear for this species at the Monument; instead the Monument may serve as an important refuge for this climate-sensitive species.

Figure 2. Climate at the Monument in summer is projected to worsen for the Violet-green Swallow (*Tachycineta thalassina*) through 2050. Photo by Becky Matsubara/Flickr (CC BY 2.0).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Rainbow Bridge National Monument falls within the high turnover group.** Parks anticipating high turnover can focus on actions that increase species' ability to respond to environmental change, such as increasing the amount of potential habitat, working with cooperating agencies and landowners to improve habitat connectivity for birds across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 1 species that are highly sensitive to climate change across their range (Table 1; Langham et al. 2015) but for which the park is a potential refuge. Monitoring to identify changes in bird communities will inform the selection of appropriate management responses.

Caveats

The species distribution models included in this study are based solely on climate variables (i.e., a combination of annual and seasonal measures of temperature and precipitation), which means there are limits on their interpretation. Significant changes in climate suitability, as measured here, will not always result in a species response, and all projections should be interpreted as potential trends. Multiple other factors mediate responses to climate change, including habitat availability, ecological processes that affect demography, biotic interactions that inhibit and facilitate species' colonization or extirpation, dispersal capacity, species' evolutionary adaptive capacity, and phenotypic plasticity (e.g., behavioral adjustments). Ultimately, models can tell us where to focus our concern and which species are most likely to be affected, but monitoring is the only way to validate these projections and should inform any on-the-ground conservation action.

More Information

For more information, including details on the methods, please see the scientific publication (Wu et al. 2018) and the project overview brief, and visit the NPS Climate Change Response Program website.

References

eBird Basic Dataset (2016) Version: ebd_relAug-2016. Cornell Lab of Ornithology, Ithaca, New York.

Langham et al. (2015) Conservation Status of North American Birds in the Face of Future Climate Change. PLOS ONE.

Wu et al. (2018) Projected avifaunal responses to climate change across the U.S. National Park System. PLOS ONE.

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Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument is projected to become suitable in the future. "Potential colonization" indicates that climate is projected to become suitable for the species, whereas "potential extirpation" indicates that climate is suitable today but projected to become unsuitable. Omitted species were either not modeled due to data deficiency or were absent from the I&M and eBird datasets. Observations of late-season migrants may result in these species appearing as present in the park when they may only migrate through. Species are ordered according to taxonomic groups, denoted by alternating background shading.

*** Species in top and bottom 10th percentile of absolute change**

^ Species that are highly climate sensitive

- Species not found or found only occasionally, and not projected to colonize by 2050

x Species not modeled in this season

Common Name	Summer Trend	Winter Trend
Scaled Quail	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization^	-
Least Bittern	-	Potential colonization
Sora	-	Potential colonization
Spotted Sandpiper	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	Potential colonization	Potential colonization
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	-
Burrowing Owl	-	Potential colonization
Common Pauraque	-	Potential colonization
White-throated Swift	x	Potential colonization
Anna's Hummingbird	-	Potential colonization
Costa's Hummingbird	-	Potential colonization
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	Potential colonization	-
Ladder-backed Woodpecker	-	Potential colonization
Gilded Flicker	-	Potential colonization
Peregrine Falcon	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Beardless-Tyrannulet	Potential colonization	-
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	-	Potential colonization
Black Phoebe	-	Potential colonization
Vermilion Flycatcher	Potential colonization	Potential colonization
Brown-crested Flycatcher	Potential colonization	-
Bell's Vireo	Potential colonization	-
Chihuahuan Raven	Potential colonization	-
Northern Rough-winged Swallow	-	Potential colonization
Violet-green Swallow	Worsening*	-
Cave Swallow	Potential colonization	-
Verdin	Potential colonization	Potential colonization
Canyon Wren	x	Stable
Cactus Wren	Potential colonization	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Curve-billed Thrasher	Potential colonization	-
Sage Thrasher	-	Potential colonization
Northern Mockingbird	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Phainopepla	-	Potential colonization
Orange-crowned Warbler	-	Potential colonization
Green-tailed Towhee	-	Potential colonization
Canyon Towhee	Potential colonization	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	-	Potential colonization
Brewer's Sparrow	-	Potential colonization
Vesper Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Pyrrhuloxia	Potential colonization	Potential colonization
Blue Grosbeak	Potential colonization	-
Painted Bunting	Potential colonization	-
Eastern Meadowlark	-	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization