



Wupatki 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 Wupatki 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.

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 8, remain stable for 8 (e.g., Figure 2), and worsen for 4 species. Suitable climate ceases to occur for 9 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 27 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 13, remain stable for 5, and worsen for 8 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 47 species not found at the Monument today, potentially resulting in local colonization.

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.

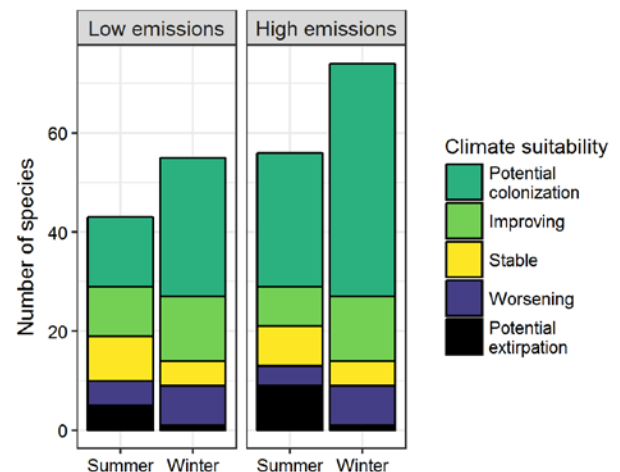


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.33 in summer (57th percentile across all national parks) and 0.23 in winter (32nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.19 in summer and 0.13 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 or may become home to 8 species that are highly sensitive to climate change across their range (i.e., they are projected to lose climate suitability in over 50% of their current range in North America in summer

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Wupatki 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

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

and/or winter by 2050; Table 1; Langham et al. 2015). While the Monument may serve as an important refuge for 6 of these climate-sensitive species, 2 might be extirpated from the Monument in at least one season by 2050.



Figure 2. Climate at the Monument in summer is projected to remain suitable for the Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

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 6 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.

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
Blue-winged Teal	-	Potential colonization
Hooded Merganser	-	Potential colonization [^]
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization [^]	-
Great Egret	-	Potential colonization
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	-	Worsening*
Northern Harrier	Potential extirpation [^]	Improving
Harris's Hawk	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Stable	Improving
Common Gallinule	-	Potential colonization
American Avocet	-	Potential colonization [^]
Spotted Sandpiper	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Dunlin	-	Potential colonization [^]
Western Sandpiper	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	-
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Improving*	-
Common Nighthawk	Stable	-
Common Pauraque	-	Potential colonization
White-throated Swift	-	Potential colonization
Anna's Hummingbird	-	Potential colonization
Costa's Hummingbird	Potential colonization	Potential colonization
Acorn Woodpecker	-	Potential colonization
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	Potential colonization	Potential colonization
Northern Flicker	Potential extirpation	Worsening
Gilded Flicker	Potential colonization	Potential colonization
American Kestrel	x	Improving
Peregrine Falcon	-	Potential colonization
Northern Beardless-Tyrannulet	Potential colonization	-
Western Wood-Pewee	Worsening^	-
Gray Flycatcher	-	Potential colonization
Black Phoebe	Potential colonization	-
Say's Phoebe	Improving	-
Vermilion Flycatcher	Potential colonization	Potential colonization
Ash-throated Flycatcher	Improving*	-

Common Name	Summer Trend	Winter Trend
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Stable	-
Western Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Improving	Improving
Hutton's Vireo	-	Potential colonization
Pinyon Jay	-	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	-
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Potential extirpation	Worsening*
Northern Rough-winged Swallow	-	Potential colonization
Violet-green Swallow	-	Potential colonization
Cave Swallow	Potential colonization	-
Bridled Titmouse	-	Potential colonization
Verdin	Potential colonization	-
White-breasted Nuthatch	Stable	Stable
Pygmy Nuthatch	Worsening	Worsening*^
Rock Wren	Worsening*	Improving
Canyon Wren	x	Stable
House Wren	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Stable
Mountain Bluebird	Potential extirpation	Worsening*
Townsend's Solitaire	Potential extirpation^	Worsening*

Common Name	Summer Trend	Winter Trend
Bendire's Thrasher	-	Potential colonization
LeConte's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	Improving*
Sage Thrasher	-	Improving
Northern Mockingbird	Stable	Improving*
Sprague's Pipit	-	Potential colonization
Phainopepla	-	Potential colonization
Orange-crowned Warbler	-	Potential colonization
Lucy's Warbler	Potential colonization	-
Yellow-rumped Warbler	Stable	-
Yellow-breasted Chat	Potential colonization	-
Spotted Towhee	Potential extirpation	-
Abert's Towhee	Potential colonization	-
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-chinned Sparrow	-	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	-	Potential colonization
Black-throated Sparrow	Stable	-
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Stable
Savannah Sparrow	-	Improving*
Henslow's Sparrow	-	Potential colonization
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	x	Worsening
Pyrrhuloxia	Potential colonization	-
Painted Bunting	Potential colonization	-
Eastern Meadowlark	Improving*	Potential colonization
Western Meadowlark	Worsening*	Stable
Bronzed Cowbird	Potential colonization	Potential colonization
Bullock's Oriole	Improving*	-
House Finch	Improving	Improving