Birds and Climate Change

National Park Service
U.S. Department of the Interior

Gila Cliff Dwellings 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 Gila Cliff Dwellings 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 19, remain stable for 30, and worsen for 12 species. Suitable climate ceases to occur for 6 species in summer, potentially resulting in extirpation of those species from the Monument (e.g., Figure 2). Climate is projected to become suitable in summer for 10 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 8, remain stable for 5, and worsen for 3 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.

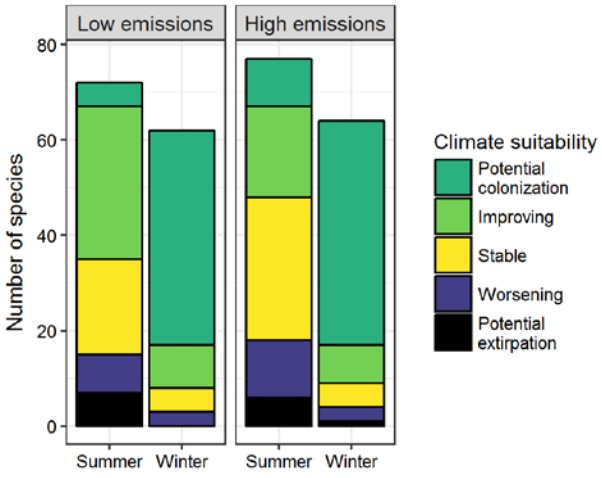

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.14 in summer (18th percentile across all national parks) and 0.21 in winter (28th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.19 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 4 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 and/or winter by 2050; Table 1; Langham et al. 2015). While the Monument may serve as an important refuge for 3 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Monument in summer by 2050.

Figure 2. Although currently found at the Monument, suitable climate for the Chipping Sparrow (*Spizella passerina*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Fyn Kynd/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, Gila Cliff Dwellings National Monument falls within the low change group.** Parks anticipating low change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 3 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.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

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
Mallard	Potential extirpation^	-
Cinnamon Teal	-	Potential colonization
Northern Pintail	Potential colonization	-
Lesser Scaup	-	Potential colonization
Gambel's Quail	Improving*	-
Northern Bobwhite	-	Potential colonization
Ring-necked Pheasant	-	Potential colonization
Wild Turkey	x	Potential colonization
Clark's Grebe	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
American White Pelican	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Great Blue Heron	Improving	-
Great Egret	Potential colonization	Potential colonization
Snowy Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Harris's Hawk	-	Potential colonization
Red-tailed Hawk	Stable	Stable
Common Gallinule	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Long-billed Dowitcher	-	Potential colonization
Band-tailed Pigeon	Stable	-
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	Improving*	-
Mourning Dove	Improving	Improving
Inca Dove	-	Potential colonization
Barn Owl	-	Potential colonization
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Worsening	-
White-throated Swift	x	Potential colonization
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Stable	-
Allen's Hummingbird	Potential colonization^	-
Belted Kingfisher	Stable	-
Acorn Woodpecker	Improving*	-
Red-naped Sapsucker	-	Stable
Hairy Woodpecker	Worsening	Worsening*
Northern Flicker	Worsening	Improving
Gilded Flicker	-	Potential colonization
Peregrine Falcon	-	Potential colonization
Western Wood-Pewee	Worsening^	-
Gray Flycatcher	Stable	Potential colonization
Dusky Flycatcher	-	Potential colonization
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	-
Eastern Phoebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Say's Phoebe	Worsening	-
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Improving	-
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Stable	Potential colonization
Bell's Vireo	Potential colonization	-
Hutton's Vireo	-	Potential colonization
Warbling Vireo	Stable	-
Pinyon Jay	Worsening*	-
Steller's Jay	Worsening*	Potential extirpation
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Worsening*
Common Raven	Worsening*	Stable
Northern Rough-winged Swallow	Stable	-
Purple Martin	Stable	-
Violet-green Swallow	Stable	-
Cliff Swallow	Stable	-
Mountain Chickadee	Worsening*	-
Bridled Titmouse	Stable	-
Juniper Titmouse	Stable	-
Verdin	Potential colonization	Potential colonization
Bushtit	Stable	-
White-breasted Nuthatch	Stable	-
Pygmy Nuthatch	Stable	-
Rock Wren	Worsening	-
Canyon Wren	x	Worsening*
House Wren	Potential extirpation	Potential colonization
Bewick's Wren	Improving	-

Common Name	Summer Trend	Winter Trend
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Stable	Potential colonization
California Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	-	Improving
Western Bluebird	Stable	-
Hermit Thrush	Stable	-
American Robin	Stable	Stable
California Thrasher	Potential colonization	-
Northern Mockingbird	Stable	-
Common Yellowthroat	Improving	-
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Potential extirpation	-
Grace's Warbler	Improving*	-
Black-throated Gray Warbler	Stable	Potential colonization
Red-faced Warbler	Stable	-
Yellow-breasted Chat	Improving*	-
Spotted Towhee	Improving*	x
Rufous-crowned Sparrow	x	Improving
Canyon Towhee	Worsening*	Stable
California Towhee	Potential colonization	-
Cassin's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Potential extirpation	-
Black-chinned Sparrow	-	Potential colonization
Lark Sparrow	Worsening*	Potential colonization
Swamp Sparrow	-	Potential colonization
White-throated Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Golden-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Hepatic Tanager	Stable	-
Summer Tanager	Improving	-
Western Tanager	Stable	-
Northern Cardinal	-	Potential colonization
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Improving	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving	-
Brown-headed Cowbird	Stable	Potential colonization
Bullock's Oriole	Improving*	-
House Finch	Stable	Improving
Pine Siskin	Potential extirpation	-
Lesser Goldfinch	Stable	Improving