Birds and Climate Change

National Park Service
U.S. Department of the Interior

Organ Pipe Cactus 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 Organ Pipe Cactus 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 22, remain stable for 15, and worsen for 11 species. Suitable climate ceases to occur for 2 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 18 species not found at the Monument today, potentially resulting in local colonization. Among the species likely to be found at the Monument today, climate suitability in winter under the high-emissions pathway is projected to improve for 26, remain stable for 23 (e.g., Figure 2), and worsen for 32 species. Suitable climate ceases to occur for 9 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 50 species not found at the Monument today, potentially resulting in local colonization.

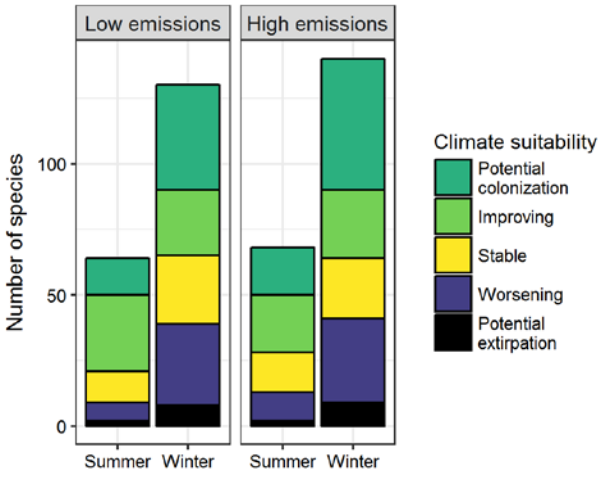

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.11 in summer (13th percentile across all national parks) and 0.16 in winter (19th percentile) under the high-emissions pathway. Potential species turnover declines to 0.10 in summer and 0.14 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 16 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). Suitable climate is not projected to disappear for these 16 species at the Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Monument in winter is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Organ Pipe Cactus 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 16 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
Gadwall	-	Improving
Mallard	Potential colonization^	-
Mottled Duck	-	Potential colonization
Cinnamon Teal	-	Improving
Redhead	Potential colonization^	-
Ring-necked Duck	-	Improving
Greater Scaup	-	Potential colonization^
Lesser Scaup	-	Potential colonization
Long-tailed Duck	-	Potential colonization
Bufflehead	-	Potential colonization
Common Goldeneye	-	Potential colonization
Barrow's Goldeneye	-	Potential colonization^
Red-breasted Merganser	-	Potential colonization^
Ruddy Duck	Potential colonization	Improving*
Gambel's Quail	Improving	Improving
Northern Bobwhite	Potential colonization	-
Pacific Loon	-	Potential colonization
Pied-billed Grebe	-	Potential extirpation
Horned Grebe	-	Potential colonization
Wood Stork	-	Potential colonization
Double-crested Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
Brown Pelican	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Great Egret	-	Improving*
Tricolored Heron	-	Potential colonization
Green Heron	Potential colonization	-
White Ibis	-	Potential colonization
Black Vulture	Potential extirpation	Worsening
Turkey Vulture	x	Improving*
White-tailed Kite	-	Potential colonization
Golden Eagle	-	Stable
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	x	Stable
Harris's Hawk	Improving*	Improving
Short-tailed Hawk	-	Potential colonization
Red-tailed Hawk	Improving	Worsening
American Coot	x	Worsening
American Oystercatcher	-	Potential colonization^
Black-bellied Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	Potential colonization	Worsening
Wandering Tattler	-	Potential colonization
Marbled Godwit	-	Potential colonization
Ruddy Turnstone	-	Potential colonization^
Red Knot	-	Potential colonization^
Sanderling	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Bonaparte's Gull	-	Potential colonization
Laughing Gull	Potential colonization^	Potential colonization
Mew Gull	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Western Gull	-	Potential colonization^
Iceland Gull (Thayer's)	-	Potential colonization
Glaucous-winged Gull	-	Potential colonization
Royal Tern	-	Potential colonization^
Black Skimmer	-	Potential colonization^
Rock Pigeon	-	Improving
White-crowned Pigeon	Potential colonization	-
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving	Stable
Mourning Dove	Worsening	Improving
Inca Dove	-	Stable
Greater Roadrunner	Improving	Worsening
Western Screech-Owl	x	Improving
Whiskered Screech-Owl	-	Potential colonization
Great Horned Owl	x	Potential extirpation
Northern Pygmy-Owl	-	Potential colonization
Lesser Nighthawk	Stable	-
White-throated Swift	x	Stable
Anna's Hummingbird	-	Improving
Costa's Hummingbird	Stable	Improving
Belted Kingfisher	-	Improving
Gila Woodpecker	Stable	Improving

Common Name	Summer Trend	Winter Trend
Ladder-backed Woodpecker	Stable	Stable
Northern Flicker	-	Potential extirpation
Gilded Flicker	Worsening*	Improving
Crested Caracara	Stable	Stable
American Kestrel	x	Worsening
Prairie Falcon	-	Stable
Gray Flycatcher	-	Worsening*
Black Phoebe	Improving	Stable
Say's Phoebe	-	Worsening
Vermilion Flycatcher	Improving	Worsening
Ash-throated Flycatcher	Worsening	x
Great Crested Flycatcher	-	Potential colonization
Brown-crested Flycatcher	Stable	-
Great Kiskadee	-	Potential colonization
Couch's Kingbird	Potential colonization	-
Cassin's Kingbird	-	Potential colonization
Western Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Stable	Worsening
Bell's Vireo	Improving	-
Warbling Vireo	Improving	-
Black-whiskered Vireo	Potential colonization	-
Pinyon Jay	-	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Potential colonization	-
Northern Rough-winged Swallow	Improving*	-
Purple Martin	Stable	-

Common Name	Summer Trend	Winter Trend
Cliff Swallow	Improving	-
Mountain Chickadee	-	Potential colonization
Bridled Titmouse	Potential colonization	-
Verdin	Worsening	Stable
Pygmy Nuthatch	-	Potential colonization^
Rock Wren	Improving	Stable
Canyon Wren	x	Worsening*
House Wren	-	Worsening*
Marsh Wren	-	Stable
Bewick's Wren	-	Potential extirpation
Cactus Wren	Stable	Worsening
Blue-gray Gnatcatcher	Improving	Stable
California Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	Worsening	Worsening
Ruby-crowned Kinglet	-	Worsening
Western Bluebird	-	Worsening
Mountain Bluebird	-	Potential extirpation
Townsend's Solitaire	-	Stable
Hermit Thrush	-	Potential extirpation
American Robin	-	Stable
Gray Catbird	-	Potential colonization
Curve-billed Thrasher	Stable	Worsening
LeConte's Thrasher	Improving	-
Crissal Thrasher	Improving*	Worsening*
Northern Mockingbird	Worsening	Worsening
European Starling	-	Improving
Cedar Waxwing	-	Potential extirpation
Phainopepla	Stable	Worsening

Common Name	Summer Trend	Winter Trend
Smith's Longspur	-	Potential colonization
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	-	Improving
Lucy's Warbler	Improving*	-
Yellow-rumped Warbler	-	Worsening
Red-faced Warbler	Potential colonization	-
Green-tailed Towhee	-	Stable
Rufous-crowned Sparrow	x	Worsening
Canyon Towhee	Stable	Worsening*
Abert's Towhee	-	Improving
Rufous-winged Sparrow	Improving	Improving
Chipping Sparrow	-	Worsening
Brewer's Sparrow	-	Stable
Black-chinned Sparrow	-	Worsening*
Vesper Sparrow	-	Improving
Lark Sparrow	Potential colonization	Improving
Black-throated Sparrow	Worsening*	Stable
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Worsening*
Lark Bunting	-	Improving*
Lincoln's Sparrow	-	Stable
White-crowned Sparrow	-	Worsening

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	-	Potential extirpation
Hepatic Tanager	Potential colonization	-
Western Tanager	Stable	-
Northern Cardinal	Worsening*	Stable
Pyrrhuloxia	Worsening*	Worsening*
Black-headed Grosbeak	Stable	-
Painted Bunting	-	Potential colonization
Red-winged Blackbird	Potential colonization	-
Western Meadowlark	Potential colonization	Worsening
Brewer's Blackbird	-	Stable
Great-tailed Grackle	-	Improving
Bronzed Cowbird	Improving	-
Brown-headed Cowbird	Stable	Worsening*
Hooded Oriole	Improving	-
Bullock's Oriole	Improving*	-
Altamira Oriole	-	Potential colonization
Scott's Oriole	Worsening*	-
House Finch	Worsening*	Worsening
Lesser Goldfinch	Improving	Worsening*
House Sparrow	x	Improving