Birds and Climate Change

National Park Service
U.S. Department of the Interior

Navajo 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 Navajo 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 8, remain stable for 26 (e.g., Figure 2), and worsen for 7 species. Suitable climate ceases to occur for 38 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 20 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 14, remain stable for 18, and worsen for 9 species. Suitable climate ceases to occur for 13 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.

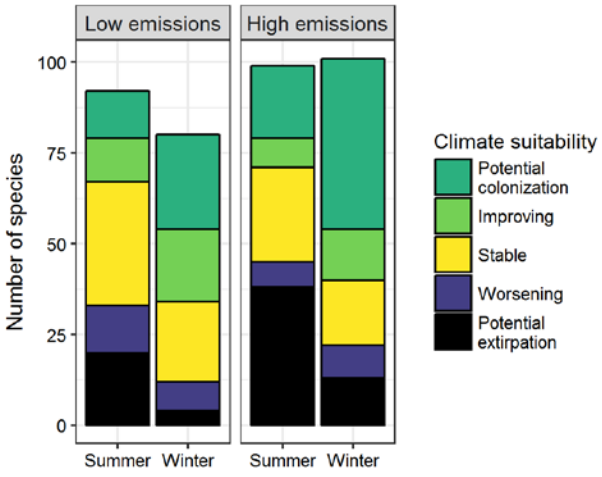

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.39 in summer (70th percentile across all national parks) and 0.29 in winter (45th percentile) under the high-emissions pathway. Potential species turnover declines to 0.22 in summer and 0.18 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). While the Monument may serve as an important refuge for 9 of these climate-sensitive species, 7 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Navajo 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 9 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
Cackling/Canada Goose	-	Worsening
Mallard	Potential extirpation^	Stable
Cinnamon Teal	-	Potential colonization
Green-winged Teal	-	Stable
Greater Scaup	-	Potential colonization^
Hooded Merganser	-	Potential colonization^
Scaled Quail	Potential colonization	Potential colonization
Gambel's Quail	Potential colonization	-
Northern Bobwhite	Potential colonization	Potential colonization
Horned Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
American Bittern	-	Potential colonization^
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
White-faced Ibis	-	Potential colonization^
Golden Eagle	x	Stable
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Stable
Northern Goshawk	x	Potential extirpation
Swainson's Hawk	Improving*^	-
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	Potential extirpation^	-
Killdeer	Stable	Improving

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Rock Pigeon	Potential extirpation	Potential extirpation
Band-tailed Pigeon	Improving	-
Mourning Dove	Stable	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Western Screech-Owl	x	Stable
Great Horned Owl	x	Worsening*
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Stable	-
Black-chinned Hummingbird	Stable	-
Broad-tailed Hummingbird	Potential extirpation	-
Belted Kingfisher	-	Worsening
Lewis's Woodpecker	x	Worsening
Golden-fronted Woodpecker	-	Potential colonization
Red-naped Sapsucker	-	Potential colonization
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Potential extirpation	Stable
American Kestrel	x	Improving
Merlin	-	Stable^

Common Name	Summer Trend	Winter Trend
Peregrine Falcon	x	Improving
Prairie Falcon	x	Stable
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Potential extirpation^	-
Willow Flycatcher	Potential extirpation	-
Gray Flycatcher	Stable	-
Dusky Flycatcher	Potential extirpation	-
Cordilleran Flycatcher	Potential extirpation	-
Say's Phoebe	Improving	Potential colonization
Ash-throated Flycatcher	Improving*	-
Cassin's Kingbird	Stable	-
Western Kingbird	Improving*	-
Scissor-tailed Flycatcher	Potential colonization	-
Bell's Vireo	Potential colonization	-
Pinyon Jay	Stable	Stable
Steller's Jay	Potential extirpation	Potential extirpation
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Improving
Clark's Nutcracker	Potential extirpation^	Potential extirpation
American Crow	Potential extirpation	Potential extirpation
Chihuahuan Raven	Potential colonization	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Worsening	-
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
Mountain Chickadee	Potential extirpation	Worsening*
Juniper Titmouse	Stable	-
Verdin	Potential colonization	Potential colonization
Bushtit	Stable	Stable
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Stable
Pygmy Nuthatch	Stable	Worsening^
Brown Creeper	Potential extirpation^	Potential extirpation
Rock Wren	Stable	Improving*
Canyon Wren	x	Improving
House Wren	Potential extirpation	-
Bewick's Wren	Improving*	Improving*
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Potential extirpation	Potential colonization
American Dipper	x	Potential extirpation
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	Potential extirpation	Improving
Western Bluebird	Potential extirpation	Stable
Mountain Bluebird	Potential extirpation	Improving
Townsend's Solitaire	Potential extirpation^	Stable
Hermit Thrush	Potential extirpation	Potential colonization
American Robin	Potential extirpation	Worsening
Curve-billed Thrasher	-	Potential colonization
Sage Thrasher	Potential extirpation	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Mockingbird	Potential colonization	Potential colonization
American Pipit	-	Potential colonization
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Stable	-
Black-throated Gray Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential extirpation	-
Green-tailed Towhee	Worsening^	Potential colonization
Spotted Towhee	Potential extirpation	x
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Potential colonization
Brewer's Sparrow	Worsening	-
Field Sparrow	-	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Stable	-
Black-throated Sparrow	Stable	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	Worsening^	Potential colonization
Lark Bunting	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	Potential extirpation	Potential colonization
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	x	Worsening
Western Tanager	Potential extirpation	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Improving*	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Potential colonization	Potential colonization
Western Meadowlark	Worsening*	Stable

Common Name	Summer Trend	Winter Trend
Brewer's Blackbird	Potential extirpation	Improving
Great-tailed Grackle	Potential colonization	-
Brown-headed Cowbird	Stable	Potential colonization
Bullock's Oriole	Stable	-
Scott's Oriole	Potential colonization	-
House Finch	Stable	Stable
Cassin's Finch	Potential extirpation	Worsening*
Red Crossbill	Potential extirpation^	x
Lesser Goldfinch	Improving	Potential colonization
American Goldfinch	-	Potential extirpation
Evening Grosbeak	-	Potential extirpation