Birds and Climate Change

National Park Service
U.S. Department of the Interior

Petroglyph 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 Petroglyph 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 21, remain stable for 31 (e.g., Figure 2), and worsen for 6 species. Suitable climate ceases to occur for 22 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 13 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 42, remain stable for 29, and worsen for 16 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 41 species not found at the Monument today, potentially resulting in local colonization.

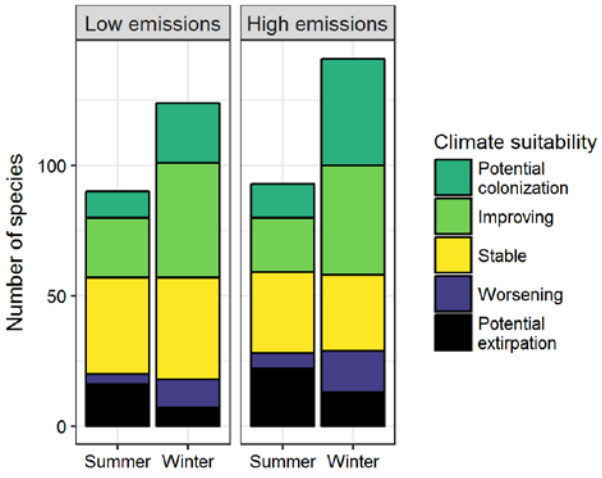

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.21 in summer (32nd percentile across all national parks) and 0.21 in winter (28th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.12 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 9 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 7 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Petroglyph National Monument falls within the intermediate change group.** Parks anticipating intermediate 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 7 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
Wood Duck	x	Worsening
Gadwall	-	Improving
Eurasian Wigeon	-	Stable
American Wigeon	-	Improving
Mallard	Potential extirpation^	Improving
Blue-winged Teal	-	Potential colonization
Cinnamon Teal	-	Improving
Northern Shoveler	-	Improving
Green-winged Teal	-	Stable
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Common Goldeneye	-	Improving
Hooded Merganser	-	Improving^
Common Merganser	-	Stable
Red-breasted Merganser	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Scaled Quail	Stable	Stable
Gambel's Quail	Improving*	Stable
Northern Bobwhite	Potential colonization	-
Ring-necked Pheasant	Stable	Stable
Pied-billed Grebe	-	Improving
Neotropic Cormorant	-	Potential colonization
Great Blue Heron	Potential extirpation	Improving
Great Egret	Improving	Potential colonization
Snowy Egret	x	Potential colonization
Cattle Egret	Improving	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	-	Stable
Northern Harrier	-	Stable

Common Name	Summer Trend	Winter Trend
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Stable
Bald Eagle	-	Potential extirpation
Harris's Hawk	-	Potential colonization
Gray Hawk	Potential colonization	-
Swainson's Hawk	Improving*^	-
Red-tailed Hawk	Stable	Improving
Ferruginous Hawk	-	Improving
Virginia Rail	-	Stable
Common Gallinule	-	Potential colonization
American Coot	x	Improving
Snowy Plover	-	Potential colonization
Killdeer	Stable	Improving
Long-billed Curlew	-	Potential colonization
Dunlin	-	Potential colonization^
Least Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	-	Improving
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Stable	Potential extirpation
Eurasian Collared-Dove	x	Stable
White-winged Dove	Improving	Improving*
Mourning Dove	Stable	Improving

Common Name	Summer Trend	Winter Trend
Common Ground-Dove	Potential colonization	-
Greater Roadrunner	Improving*	Improving
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Worsening*
Great Horned Owl	x	Worsening
Burrowing Owl	-	Improving*
Common Nighthawk	Stable	-
White-throated Swift	x	Potential colonization
Black-chinned Hummingbird	Improving	-
Anna's Hummingbird	Potential colonization	Potential colonization
Belted Kingfisher	-	Stable
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	-	Potential colonization
Ladder-backed Woodpecker	Improving*	Improving*
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Potential extirpation	Stable
Gilded Flicker	-	Potential colonization
American Kestrel	x	Stable
Merlin	-	Stable^
Peregrine Falcon	-	Improving
Prairie Falcon	x	Stable
Western Wood-Pewee	Potential extirpation^	-
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	-	Potential colonization
Black Phoebe	Stable	Improving*

Common Name	Summer Trend	Winter Trend
Eastern Phoebe	-	Potential colonization
Say's Phoebe	Stable	Improving
Vermilion Flycatcher	Potential colonization	Potential colonization
Ash-throated Flycatcher	Improving	-
Cassin's Kingbird	Worsening*	-
Western Kingbird	Stable	-
Loggerhead Shrike	Improving	Improving
Hutton's Vireo	-	Potential colonization
Warbling Vireo	Potential extirpation	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Worsening*
American Crow	Potential extirpation	Potential extirpation
Chihuahuan Raven	-	Improving
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Worsening*	Worsening
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	Potential colonization
Violet-green Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Mountain Chickadee	Stable	Worsening*
Bridled Titmouse	-	Potential colonization
Verdin	Potential colonization	-
Bushtit	Potential extirpation	Worsening*
White-breasted Nuthatch	Potential extirpation	Potential extirpation

Common Name	Summer Trend	Winter Trend
Brown Creeper	-	Potential extirpation
Rock Wren	Worsening*	Improving*
Canyon Wren	x	Stable
House Wren	-	Potential colonization
Marsh Wren	-	Improving
Bewick's Wren	Stable	Stable
Blue-gray Gnatcatcher	Stable	-
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Potential extirpation
Western Bluebird	Potential extirpation	Worsening
Mountain Bluebird	-	Worsening*
Hermit Thrush	-	Stable
American Robin	Potential extirpation	Worsening
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Improving*	Improving
Brown Thrasher	-	Potential colonization
Crissal Thrasher	Improving*	Improving*
Sage Thrasher	Potential extirpation	-
Northern Mockingbird	Stable	Improving*
European Starling	Potential extirpation	Stable
American Pipit	-	Improving
Cedar Waxwing	-	Stable
Phainopepla	-	Potential colonization
Orange-crowned Warbler	-	Potential colonization
Lucy's Warbler	Potential colonization	-
Common Yellowthroat	Improving	Potential colonization
Yellow-rumped Warbler	-	Improving

Common Name	Summer Trend	Winter Trend
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Stable^	-
Spotted Towhee	Potential extirpation	x
Rufous-crowned Sparrow	x	Stable
Canyon Towhee	Stable	Worsening*
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Improving*
Brewer's Sparrow	Stable	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Worsening*	Potential colonization
Black-throated Sparrow	Improving*	Improving
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Worsening*
Savannah Sparrow	-	Improving*
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Stable
White-throated Sparrow	-	Potential extirpation
White-crowned Sparrow	Stable	Improving
Golden-crowned Sparrow	-	Stable
Dark-eyed Junco	x	Worsening
Hepatic Tanager	Stable	-

Common Name	Summer Trend	Winter Trend
Summer Tanager	Stable	-
Western Tanager	Potential extirpation	-
Pyrrhuloxia	Potential colonization	-
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Stable
Western Meadowlark	Worsening*	Worsening
Brewer's Blackbird	-	Improving
Common Grackle	Stable	Potential colonization
Great-tailed Grackle	Improving*	Improving
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	-
Hooded Oriole	Potential colonization	-
Bullock's Oriole	Improving	-
House Finch	Improving	Improving
Cassin's Finch	-	Stable
Red Crossbill	Stable^	x
Pine Siskin	Stable	Worsening
Lesser Goldfinch	Stable	Stable
American Goldfinch	-	Potential extirpation
House Sparrow	x	Potential extirpation