Birds and Climate Change

National Park Service
U.S. Department of the Interior

City of Rocks National Reserve

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 City of Rocks National Reserve (hereafter, the Reserve) 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 Reserve based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Reserve 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 Reserve, 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 Reserve today, climate suitability in summer under the high-emissions pathway is projected to improve for 21, remain stable for 39 (e.g., Figure 2), and worsen for 13 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Reserve. Climate is projected to become suitable in summer for 8 species not found at the Reserve today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 20, remain stable for 6, and worsen for 5 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Reserve. Climate is projected to become suitable in winter for 36 species not found at the Reserve today, potentially resulting in local colonization.

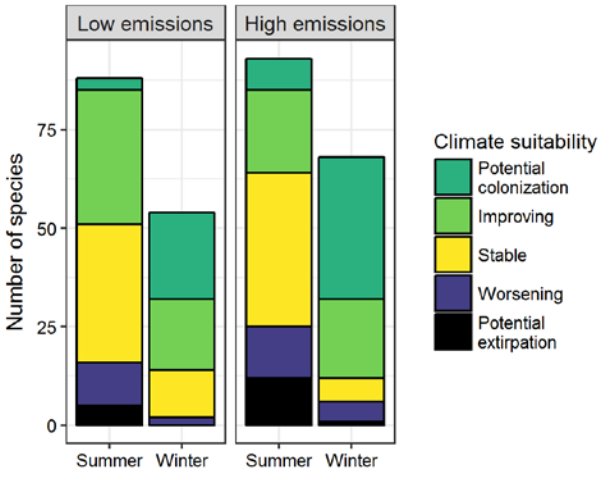

Figure 1. Projected changes in climate suitability for birds at the Reserve, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Reserve between the present and 2050 is 0.18 in summer (28th percentile across all national parks) and 0.29 in winter (44th percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 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 Reserve is or may become home to 12 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 12 species at the Reserve; instead the Reserve may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Reserve in summer is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) through 2050. Photo by Andy Reago & Chrissy McClarren/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, City of Rocks National Reserve falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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 12 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 Reserve based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Reserve 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	-	Potential colonization
Gadwall	-	Potential colonization
Mallard	Stable^	Improving
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Ruddy Duck	-	Potential colonization
Scaled Quail	Potential colonization	-
Gray Partridge	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Ring-necked Pheasant	Improving*	Improving
Wild Turkey	-	Potential colonization
Pied-billed Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization
Western Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization
American White Pelican	x	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Northern Harrier	Stable^	Improving
Sharp-shinned Hawk	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Potential colonization
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Worsening	Improving*
American Coot	-	Potential colonization
Killdeer	Stable	Improving
Rock Pigeon	Improving	Improving
Mourning Dove	Improving	Improving
Barn Owl	x	Potential colonization
Great Horned Owl	x	Stable
Common Nighthawk	Improving	-
Black-chinned Hummingbird	Improving*	-
Broad-tailed Hummingbird	Stable	-
Red-naped Sapsucker	Worsening^	-
Downy Woodpecker	Stable	Stable
Hairy Woodpecker	Stable	Stable
Northern Flicker	Worsening*	Improving
American Kestrel	x	Improving
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	Worsening	-
Gray Flycatcher	Stable	-
Dusky Flycatcher	Stable	-
Cordilleran Flycatcher	Stable	-
Say's Phoebe	Improving	Potential colonization
Ash-throated Flycatcher	Improving*	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Improving	Potential colonization
Warbling Vireo	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Pinyon Jay	Improving	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Improving*
Black-billed Magpie	Stable^	Stable
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Stable	Potential colonization
Chihuahuan Raven	Potential colonization	Potential colonization
Common Raven	Stable	Worsening
Horned Lark	Stable	Improving
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Stable	-
Barn Swallow	Improving*	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Stable	Worsening*
Mountain Chickadee	Stable	-
Juniper Titmouse	Improving	-
Bushtit	Improving	-
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
Rock Wren	Stable	Potential colonization
House Wren	Stable	-
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving*	-
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	Potential extirpation	Improving*
Mountain Bluebird	Worsening*	-
Townsend's Solitaire	Worsening^	Worsening*
Hermit Thrush	Stable	-

Common Name	Summer Trend	Winter Trend
American Robin	Potential extirpation	Improving
Gray Catbird	Stable	-
Curve-billed Thrasher	Potential colonization	Potential colonization
Sage Thrasher	Stable	Potential colonization
Northern Mockingbird	Potential colonization	-
European Starling	Improving	Improving
American Pipit	-	Potential colonization
Cedar Waxwing	Stable	-
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Stable	-
MacGillivray's Warbler	Worsening	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Stable	Potential colonization
Black-throated Gray Warbler	Improving	-
Wilson's Warbler	Potential extirpation	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Worsening*^	-
Spotted Towhee	Stable	x
Abert's Towhee	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	Stable	-

Common Name	Summer Trend	Winter Trend
Brewer's Sparrow	Worsening*	-
Vesper Sparrow	Worsening*	-
Lark Sparrow	Improving*	-
Fox Sparrow	Potential extirpation	-
Song Sparrow	Stable	Improving
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Stable	-
Lazuli Bunting	Stable	-
Red-winged Blackbird	Stable	Improving
Western Meadowlark	Stable	-
Brewer's Blackbird	Worsening*	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	-
Bullock's Oriole	Improving*	-
House Finch	Improving*	Potential colonization
Cassin's Finch	Stable	Worsening*
Red Crossbill	Worsening^	x
Pine Siskin	Stable	Stable
Lesser Goldfinch	-	Potential colonization
American Goldfinch	Stable	Improving
House Sparrow	x	Improving