Birds and Climate Change

National Park Service
U.S. Department of the Interior

Bighorn Canyon National Recreation Area

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 Bighorn Canyon National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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 Recreation Area, 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 Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 16, remain stable for 30 (e.g., Figure 2), and worsen for 19 species. Suitable climate ceases to occur for 13 species in summer, potentially resulting in extirpation of those species from the Recreation Area. Climate is projected to become suitable in summer for 20 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 38, remain stable for 5, and worsen for 13 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 34 species not found at the Recreation Area today, potentially resulting in local colonization.

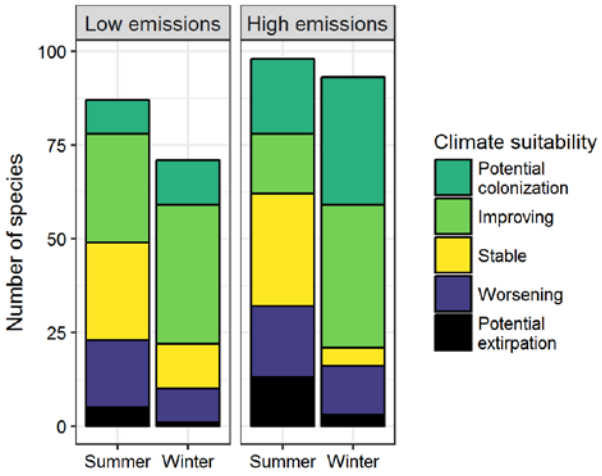

Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Recreation Area between the present and 2050 is 0.24 in summer (39th percentile across all national parks) and 0.33 in winter (53rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.20 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 Recreation Area is or may become home to 14 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 Recreation Area may serve as an important refuge for 12 of these climate-sensitive species, 2 might be extirpated from the Recreation Area in at least one season by 2050.

Figure 2. Climate at the Recreation Area 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, Bighorn Canyon National Recreation Area 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 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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	x	Improving
Wood Duck	-	Potential colonization
Gadwall	Worsening^	Improving*
American Wigeon	Potential extirpation^	Improving
Mallard	Worsening*^	Improving
Northern Shoveler	Worsening^	Potential colonization
Green-winged Teal	x	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Improving*
Lesser Scaup	-	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Barrow's Goldeneye	-	Worsening*^
Hooded Merganser	-	Improving^
Common Merganser	x	Improving
Ruddy Duck	Potential extirpation	-
Scaled Quail	Potential colonization	Potential colonization
California Quail	-	Potential colonization
Gambel's Quail	Potential colonization	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Ring-necked Pheasant	Improving*	Improving
Wild Turkey	x	Improving
Pied-billed Grebe	x	Potential colonization
Horned Grebe	-	Improving
Eared Grebe	x	Potential colonization
Western Grebe	x	Potential colonization
Clark's Grebe	x	Potential colonization

Common Name	Summer Trend	Winter Trend
American White Pelican	x	Potential colonization
Great Blue Heron	Improving	Improving*
Black-crowned Night-Heron	-	Potential colonization
Golden Eagle	x	Worsening*
Northern Harrier	Worsening^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	-	Potential colonization
Bald Eagle	-	Worsening
Red-tailed Hawk	Stable	Improving*
Rough-legged Hawk	-	Worsening
American Coot	x	Improving
Killdeer	Stable	Improving
Wilson's Phalarope	Worsening*^	-
Ring-billed Gull	Worsening*^	-
Iceland Gull (Thayer's)	-	Potential colonization
Rock Pigeon	Potential extirpation	Worsening
Mourning Dove	Improving	-
Barn Owl	-	Potential colonization
Great Horned Owl	x	Stable
Common Nighthawk	Improving	-
Calliope Hummingbird	Improving	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Potential colonization	-
Red-naped Sapsucker	-	Potential colonization
Downy Woodpecker	-	Worsening
Northern Flicker	Worsening	Improving
Gilded Flicker	Potential colonization	-
American Kestrel	x	Improving
Prairie Falcon	x	Improving

Common Name	Summer Trend	Winter Trend
Western Wood-Pewee	Worsening*^	-
Least Flycatcher	Potential extirpation	-
Gray Flycatcher	Potential colonization	-
Say's Phoebe	Stable	Potential colonization
Ash-throated Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Improving*	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Worsening	Potential colonization
Northern Shrike	-	Worsening*
Bell's Vireo	Potential colonization	-
Warbling Vireo	Improving	-
Pinyon Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Potential colonization
Black-billed Magpie	Worsening*^	Worsening*
Clark's Nutcracker	Potential extirpation^	Worsening*
American Crow	Stable	Improving
Chihuahuan Raven	-	Potential colonization
Common Raven	Stable	Potential extirpation
Horned Lark	Worsening*	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

Common Name	Summer Trend	Winter Trend
Mountain Chickadee	Worsening	Worsening
Bushtit	-	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Improving	Improving
Pygmy Nuthatch	Potential colonization	-
Rock Wren	Stable	Potential colonization
Canyon Wren	-	Potential colonization
House Wren	Stable	-
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Ruby-crowned Kinglet	-	Potential colonization
Mountain Bluebird	Stable	-
Townsend's Solitaire	Worsening^	Worsening*
American Robin	Stable	Improving
Gray Catbird	Stable	-
Brown Thrasher	Improving	-
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Potential colonization	-
European Starling	Stable	Improving
Cedar Waxwing	Stable	Improving
Chestnut-collared Longspur	-	Potential colonization
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Black-throated Gray Warbler	Potential colonization	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Stable^	-

Common Name	Summer Trend	Winter Trend
Spotted Towhee	Stable	-
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	Potential colonization	Potential colonization
Cassin's Sparrow	Potential colonization	-
American Tree Sparrow	-	Improving
Chipping Sparrow	Stable	-
Brewer's Sparrow	Worsening*	-
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving*	-
Black-throated Sparrow	Potential colonization	Potential colonization
Lark Bunting	Worsening*	-
Song Sparrow	Potential extirpation	Improving
White-crowned Sparrow	-	Improving*
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Stable	-
Dickcissel	Potential colonization	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Stable	Improving
Western Meadowlark	Worsening	-
Yellow-headed Blackbird	Worsening	-
Brewer's Blackbird	Worsening*	-
Common Grackle	Improving*	-
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	Potential colonization
Bullock's Oriole	Stable	-

Common Name	Summer Trend	Winter Trend
Baltimore Oriole	Improving	-
Pine Grosbeak	-	Potential extirpation
House Finch	Improving	Improving
Cassin's Finch	Stable	Stable
Pine Siskin	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Lesser Goldfinch	Potential colonization	Potential colonization
American Goldfinch	Stable	Improving
Evening Grosbeak	-	Worsening*
House Sparrow	x	Improving