Birds and Climate Change

National Park Service
U.S. Department of the Interior

Badlands National Park

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 Badlands National Park (hereafter, the Park) 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park 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 Park, 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 Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 31, remain stable for 18 (e.g., Figure 2), and worsen for 24 species. Suitable climate ceases to occur for 31 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 13 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 10, remain stable for 4, and worsen for 9 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 48 species not found at the Park today, potentially resulting in local colonization.

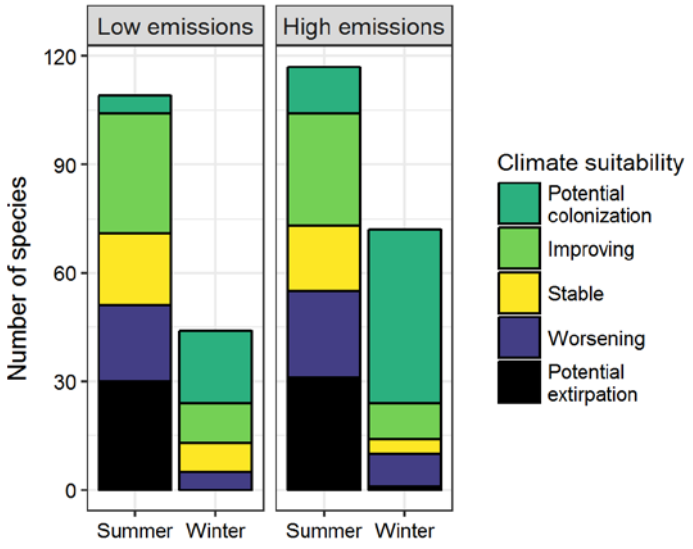

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.26 in summer (43rd percentile across all national parks) and 0.30 in winter (46th percentile) under the high-emissions pathway. Potential species turnover declines to 0.17 in summer and 0.15 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 Park is or may become home to 23 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 Park may serve as an important refuge for 16 of these climate-sensitive species, 7 might be extirpated from the Park in at least one season by 2050.

Figure 2. Climate at the Park 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, Badlands National Park 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 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park 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	Potential extirpation^	-
American Wigeon	Potential extirpation^	-
Mallard	Worsening*^	Improving
Blue-winged Teal	Worsening	-
Northern Shoveler	Worsening^	Potential colonization
Northern Pintail	Potential extirpation	-
Canvasback	x	Potential colonization
Redhead	Worsening^	-
Ring-necked Duck	x	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Ruddy Duck	Potential extirpation	-
Scaled Quail	Potential colonization	Potential colonization
Northern Bobwhite	Potential colonization	-
Ring-necked Pheasant	Improving	Worsening*
Sharp-tailed Grouse	Worsening^	-
Eared Grebe	x	Potential colonization
Great Blue Heron	Stable	Potential colonization
Great Egret	Improving	-
Cattle Egret	Potential colonization	-
Black-crowned Night-Heron	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-
White-faced Ibis	-	Potential colonization^
Golden Eagle	x	Stable
Mississippi Kite	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization	
Northern Harrier	Worsening*^	-
Bald Eagle	-	Worsening*
Swainson's Hawk	Improving^	-
Red-tailed Hawk	Stable	-
Ferruginous Hawk	Stable^	-
Rough-legged Hawk	-	Worsening
Semipalmated Plover	Stable	-
Killdeer	Stable	-
Greater Yellowlegs	-	Potential colonization
Willet	Potential extirpation^	-
Upland Sandpiper	Worsening*	-
Long-billed Curlew	Worsening^	-
Marbled Godwit	Potential extirpation^	-
Wilson's Phalarope	Worsening^	-
Bonaparte's Gull	-	Potential colonization
Franklin's Gull	Potential extirpation	-
Ring-billed Gull	-	Potential colonization
Herring Gull	-	Potential colonization^
Rock Pigeon	Stable	Potential extirpation
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving*
Inca Dove	-	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	-	Potential colonization
Barn Owl	-	Potential colonization
Great Horned Owl	x	Worsening*
Burrowing Owl	Worsening*^	-

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Improving	-
Chimney Swift	Improving	-
Red-headed Woodpecker	Improving*	-
Red-bellied Woodpecker	-	Potential colonization
Red-naped Sapsucker	Potential extirpation^	Potential colonization
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Improving	Worsening
Hairy Woodpecker	Improving	-
Northern Flicker	Potential extirpation	Improving
Gilded Flicker	Potential colonization	-
Prairie Falcon	x	Improving
Western Wood-Pewee	Potential extirpation^	-
Eastern Phoebe	Improving	-
Say's Phoebe	Worsening*	Potential colonization
Great Crested Flycatcher	Improving*	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Stable	-
Eastern Kingbird	Worsening	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Worsening	Potential colonization
Bell's Vireo	Stable	-
Warbling Vireo	Improving	-
Red-eyed Vireo	Improving	-
Blue Jay	Improving*	Stable
Black-billed Magpie	Worsening^	Worsening*
American Crow	Improving*	Improving
Chihuahuan Raven	Potential colonization	Potential colonization
Horned Lark	Worsening*	Stable

Common Name	Summer Trend	Winter Trend
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Stable	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Improving	-
Bushtit	-	Potential colonization
White-breasted Nuthatch	Improving	-
Pygmy Nuthatch	Potential colonization	-
Rock Wren	Worsening	Potential colonization
House Wren	Worsening	-
Sedge Wren	Potential extirpation	-
Bewick's Wren	Potential colonization	-
Blue-gray Gnatcatcher	Improving	Potential colonization
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	Potential colonization
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Improving^	Worsening*
Swainson's Thrush	Stable	-
American Robin	Stable	Improving
Curve-billed Thrasher	-	Potential colonization
Brown Thrasher	Improving	Potential colonization
Crissal Thrasher	-	Potential colonization
Sage Thrasher	Stable	Potential colonization
Northern Mockingbird	Improving*	Potential colonization

Common Name	Summer Trend	Winter Trend
European Starling	Potential extirpation	Worsening
Sprague's Pipit	Potential extirpation^	-
Cedar Waxwing	Potential extirpation	Worsening
Chestnut-collared Longspur	Worsening*^	-
Smith's Longspur	-	Potential colonization
Common Yellowthroat	Potential extirpation	-
American Redstart	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Potential colonization
Yellow-breasted Chat	Potential extirpation	-
Spotted Towhee	Potential extirpation	-
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
American Tree Sparrow	-	Stable
Chipping Sparrow	Potential extirpation	-
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Potential extirpation	Potential colonization
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Black-throated Sparrow	-	Potential colonization
Lark Bunting	Worsening*	Potential colonization
Savannah Sparrow	Potential extirpation	-
Grasshopper Sparrow	Stable	-

Common Name	Summer Trend	Winter Trend
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Potential colonization
Lincoln's Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Potential extirpation	-
Northern Cardinal	Potential colonization	Potential colonization
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Dickcissel	Improving*	-

Common Name	Summer Trend	Winter Trend
Bobolink	Potential extirpation	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving*	-
Western Meadowlark	Worsening	-
Yellow-headed Blackbird	Worsening	-
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving	Improving
Brown-headed Cowbird	Worsening	Potential colonization
Orchard Oriole	Stable	-
Bullock's Oriole	Worsening	-
Baltimore Oriole	Improving*	-
House Finch	Improving	-
American Goldfinch	Potential extirpation	Improving