Birds and Climate Change

National Park Service
U.S. Department of the Interior

Niobrara National Scenic River

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 Niobrara National Scenic River (hereafter, the River) 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 River based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the River 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 River, 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 River today, climate suitability in summer under the high-emissions pathway is projected to improve for 38 (e.g., Figure 2), remain stable for 23, and worsen for 12 species. Suitable climate ceases to occur for 27 species in summer, potentially resulting in extirpation of those species from the River. Climate is projected to become suitable in summer for 15 species not found at the River today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 16, remain stable for 12, and worsen for 2 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 48 species not found at the River today, potentially resulting in local colonization.

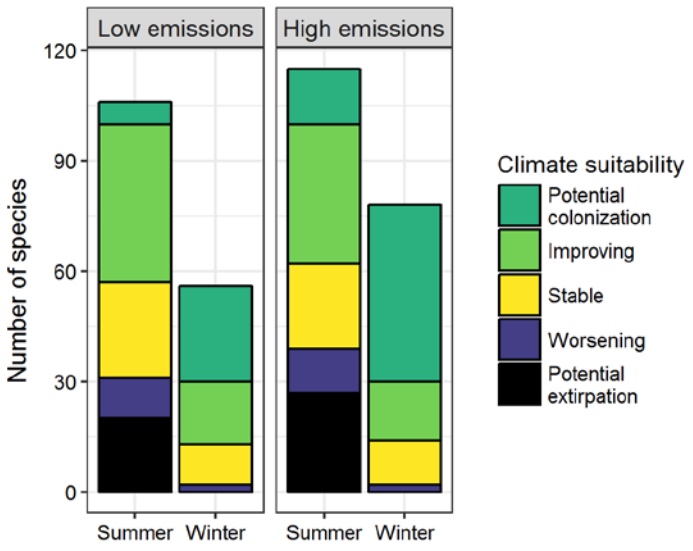

Figure 1. Projected changes in climate suitability for birds at the River, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the River between the present and 2050 is 0.30 in summer (52nd percentile across all national parks) and 0.33 in winter (52nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.22 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 River 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 River may serve as an important refuge for 13 of these climate-sensitive species, 3 might be extirpated from the River in at least one season by 2050.

Figure 2. Climate at the River 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, Niobrara National Scenic River 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 13 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 River based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the River 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
Gadwall	Worsening*^	-
Mallard	Potential extirpation^	Improving
Blue-winged Teal	Worsening*	Potential colonization
Northern Shoveler	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Greater Scaup	-	Potential colonization^
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Common Goldeneye	-	Improving
Hooded Merganser	-	Potential colonization^
Common Merganser	x	Stable
Red-breasted Merganser	-	Potential colonization^
Scaled Quail	Potential colonization	-
Northern Bobwhite	Improving*	-
Ring-necked Pheasant	Stable	-
Sharp-tailed Grouse	Worsening*^	-
Wild Turkey	x	Stable
Western Grebe	-	Potential colonization
Double-crested Cormorant	x	Potential colonization
Great Blue Heron	Improving	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Mississippi Kite	Potential colonization	-
Northern Harrier	Worsening*^	Improving
Cooper's Hawk	x	Potential colonization
Bald Eagle	x	Worsening*
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Improving	Stable
Ferruginous Hawk	Stable^	-
Rough-legged Hawk	-	Worsening*
Virginia Rail	x	Potential colonization
Killdeer	Stable	-
Mountain Plover	Potential colonization	-
Greater Yellowlegs	-	Potential colonization
Upland Sandpiper	Worsening*	-
Long-billed Curlew	Worsening^	-
Wilson's Snipe	Potential extirpation	-
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Herring Gull	-	Potential colonization^
Black Tern	Potential extirpation	-
Rock Pigeon	Stable	-
Mourning Dove	Stable	Improving
Yellow-billed Cuckoo	Improving*	-
Barn Owl	x	Improving
Great Horned Owl	x	Stable
Burrowing Owl	Stable^	-
Common Nighthawk	Improving	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Improving	-

Common Name	Summer Trend	Winter Trend
Belted Kingfisher	Improving	Improving
Red-headed Woodpecker	Improving	Potential colonization
Red-bellied Woodpecker	Improving*	-
Yellow-bellied Sapsucker	-	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Improving	Stable
Northern Flicker	Potential extirpation	Improving
Gilded Flicker	Potential colonization	-
Western Wood-Pewee	Potential extirpation^	-
Eastern Wood-Pewee	Improving	-
Willow Flycatcher	Potential extirpation	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving*	-
Great Crested Flycatcher	Improving*	-
Western Kingbird	Stable	-
Eastern Kingbird	Worsening	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Stable	Potential colonization
Bell's Vireo	Stable	-
Warbling Vireo	Improving	-
Red-eyed Vireo	Stable	-
Blue Jay	Improving*	Stable
Black-billed Magpie	Stable^	-
American Crow	Improving	Improving
Chihuahuan Raven	Potential colonization	-
Horned Lark	Worsening*	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving	-

Common Name	Summer Trend	Winter Trend
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	-
Black-capped Chickadee	Improving	Stable
Tufted Titmouse	Potential colonization	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Stable
White-breasted Nuthatch	Improving	Stable
Pygmy Nuthatch	-	Potential colonization^
Rock Wren	Improving	-
Canyon Wren	-	Potential colonization
House Wren	Stable	-
Pacific/Winter Wren	-	Potential colonization
Sedge Wren	Potential extirpation	-
Marsh Wren	x	Potential colonization
Carolina Wren	-	Potential colonization
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Potential colonization
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving*	Potential colonization
American Robin	Stable	Improving
Gray Catbird	Stable	-
Brown Thrasher	Stable	Potential colonization
Northern Mockingbird	Improving*	Potential colonization

Common Name	Summer Trend	Winter Trend
European Starling	Stable	-
Cedar Waxwing	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Black-and-white Warbler	Improving	-
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	-
Eastern Towhee	Stable	-
Rufous-winged Sparrow	Potential colonization	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	Potential extirpation	-
Field Sparrow	Stable	Potential colonization
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Lark Bunting	Worsening*	-
Savannah Sparrow	-	Potential colonization
Grasshopper Sparrow	Worsening	-
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Fox Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	-	Improving
Scarlet Tanager	Stable	-
Northern Cardinal	Improving*	Potential colonization
Black-headed Grosbeak	Potential extirpation	-
Blue Grosbeak	Improving	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving*	-
Dickcissel	Improving	-
Bobolink	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Improving*	Potential colonization
Western Meadowlark	Worsening	Improving
Yellow-headed Blackbird	Potential extirpation	-
Common Grackle	Improving	Improving
Great-tailed Grackle	Improving	Potential colonization
Brown-headed Cowbird	Stable	Potential colonization
Orchard Oriole	Worsening	-
Baltimore Oriole	Improving	-
House Finch	Stable	-
Red Crossbill	Potential extirpation^	-
Pine Siskin	Potential extirpation	-
American Goldfinch	Potential extirpation	Improving
House Sparrow	x	Stable