Birds and Climate Change

National Park Service
U.S. Department of the Interior

Missouri National Recreation 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 Missouri National Recreation 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 43, remain stable for 19, and worsen for 14 species. Suitable climate ceases to occur for 33 species in summer, potentially resulting in extirpation of those species from the River (e.g., Figure 2). Climate is projected to become suitable in summer for 12 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 46, remain stable for 22, and worsen for 8 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the River. Climate is projected to become suitable in winter for 33 species not found at the River today, potentially resulting in local colonization.

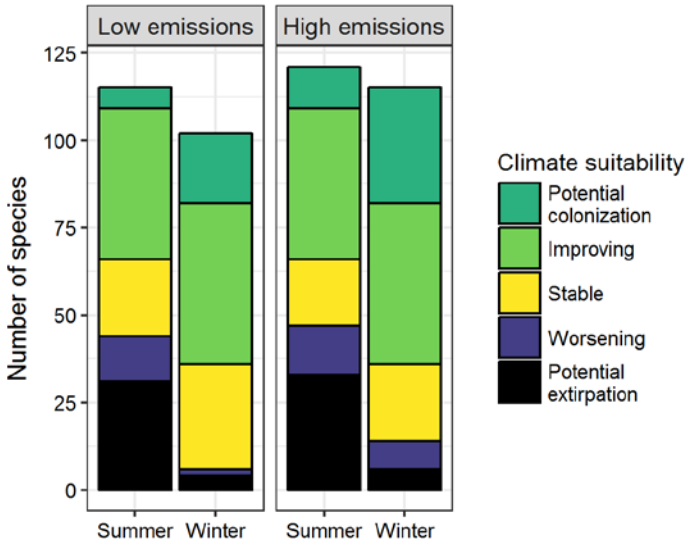

Figure 1. Projected changes in climate suitability for birds at the River, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the River between the present and 2050 is 0.32 in summer (55th percentile across all national parks) and 0.33 in winter (53rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.24 in summer and 0.23 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. Although currently found at the River, suitable climate for the American Goldfinch (*Spinus tristis*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by John Benson/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, Missouri National Recreation 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
Wood Duck	x	Improving
Gadwall	Potential extirpation^	Improving
American Wigeon	-	Improving
Mallard	Potential extirpation^	Stable
Blue-winged Teal	Worsening*	Potential colonization
Northern Shoveler	Worsening^	Improving
Northern Pintail	Potential extirpation	x
Green-winged Teal	x	Improving
Canvasback	-	Stable
Redhead	Worsening^	x
Ring-necked Duck	-	Improving
Greater Scaup	-	Improving^
Lesser Scaup	-	Improving
Long-tailed Duck	-	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Improving
Hooded Merganser	x	Improving^
Common Merganser	-	Stable
Red-breasted Merganser	-	Improving^
Ruddy Duck	Potential extirpation	-
Scaled Quail	Potential colonization	-
Northern Bobwhite	Improving*	Improving*
Gray Partridge	Potential extirpation	Potential extirpation
Ring-necked Pheasant	Worsening	Worsening*
Wild Turkey	x	Worsening*
Common Loon	Potential extirpation	Improving^
Double-crested Cormorant	x	Potential colonization
American White Pelican	x	Potential colonization

Common Name	Summer Trend	Winter Trend
Great Blue Heron	Improving	Improving
Great Egret	Improving	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Improving	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	-	Stable
Mississippi Kite	Potential colonization	-
Northern Harrier	Worsening*^	Improving
Sharp-shinned Hawk	-	Improving
Cooper's Hawk	x	Stable
Bald Eagle	x	Worsening*
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Improving	Stable
Ferruginous Hawk	-	Potential colonization
Rough-legged Hawk	-	Stable
American Coot	x	Stable
Killdeer	Improving	-
Greater Yellowlegs	-	Potential colonization
Willet	Potential extirpation^	-
Upland Sandpiper	Worsening	-
Wilson's Phalarope	Worsening^	-
Bonaparte's Gull	-	Improving
Franklin's Gull	Potential extirpation	x
Ring-billed Gull	Stable^	Improving
California Gull	x	Stable^
Herring Gull	Potential extirpation	Improving^
Iceland Gull (Thayer's)	-	Stable
Gull-billed Tern	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Black Tern	Potential extirpation	-
Rock Pigeon	Stable	Worsening
Eurasian Collared-Dove	x	Stable
Mourning Dove	Stable	Improving
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Barn Owl	x	Potential colonization
Eastern Screech-Owl	x	Improving
Great Horned Owl	x	Worsening
Snowy Owl	-	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Improving*	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Improving	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Potential extirpation	Improving
Red-headed Woodpecker	Improving	Improving
Red-bellied Woodpecker	Improving*	Improving
Yellow-bellied Sapsucker	-	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Improving	Stable
Northern Flicker	Potential extirpation	Improving
Gilded Flicker	Potential colonization	-
American Kestrel	x	Stable
Merlin	x	Improving^
Eastern Wood-Pewee	Improving	-
Willow Flycatcher	Potential extirpation	-
Least Flycatcher	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Eastern Phoebe	Improving*	-
Say's Phoebe	Potential extirpation	-
Great Crested Flycatcher	Improving*	-
Western Kingbird	Stable	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Improving	Potential colonization
Northern Shrike	-	Potential extirpation
Bell's Vireo	Improving	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Improving	-
Blue Jay	Improving	Stable
Black-billed Magpie	-^	Stable
American Crow	Improving	Improving
Horned Lark	Potential extirpation	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Stable	Stable
Tufted Titmouse	Potential colonization	Potential colonization
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Improving	Worsening
Brown Creeper	-	Stable
House Wren	Worsening*	-

Common Name	Summer Trend	Winter Trend
Pacific/Winter Wren	-	Potential colonization
Sedge Wren	Potential extirpation	-
Marsh Wren	x	Potential colonization
Carolina Wren	Improving	Improving*
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving*	Improving
Mountain Bluebird	-	Potential colonization
Swainson's Thrush	Stable	-
Wood Thrush	Potential extirpation	-
American Robin	Worsening	Improving
Gray Catbird	Stable	-
Brown Thrasher	Improving	Potential colonization
Northern Mockingbird	Improving*	Potential colonization
European Starling	Worsening	Stable
Cedar Waxwing	Potential extirpation	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Snow Bunting	-	Potential extirpation
Ovenbird	Potential extirpation	-
Blue-winged Warbler	Potential extirpation	-
Black-and-white Warbler	Improving	-
Common Yellowthroat	Worsening*	-

Common Name	Summer Trend	Winter Trend
American Redstart	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Improving*
Yellow-breasted Chat	Stable	-
Spotted Towhee	Potential extirpation	-
Eastern Towhee	Stable	-
Rufous-winged Sparrow	Potential colonization	Potential colonization
American Tree Sparrow	-	Improving
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	Improving	-
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	Potential extirpation	Potential colonization
White-throated Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Harris's Sparrow	-	Improving
White-crowned Sparrow	-	Improving
Dark-eyed Junco	-	Improving
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving*	Improving
Rose-breasted Grosbeak	Stable	-
Blue Grosbeak	Improving	-
Indigo Bunting	Improving*	-
Dickcissel	Improving	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Improving*	Potential colonization
Western Meadowlark	Worsening	Improving*
Yellow-headed Blackbird	Potential extirpation	-
Brewer's Blackbird	-	Potential colonization
Common Grackle	Improving	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	Potential colonization
Orchard Oriole	Worsening	-
Baltimore Oriole	Improving	-
House Finch	Stable	Potential extirpation
Purple Finch	-	Worsening*
Pine Siskin	-	Worsening*
American Goldfinch	Potential extirpation	Improving
House Sparrow	x	Stable