Birds and Climate Change

National Park Service
U.S. Department of the Interior

Buffalo National 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 Buffalo National 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 18, remain stable for 39, and worsen for 11 species. Suitable climate ceases to occur for 21 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 23 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 26, remain stable for 31, 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 58 species not found at the River today, potentially resulting in local colonization.

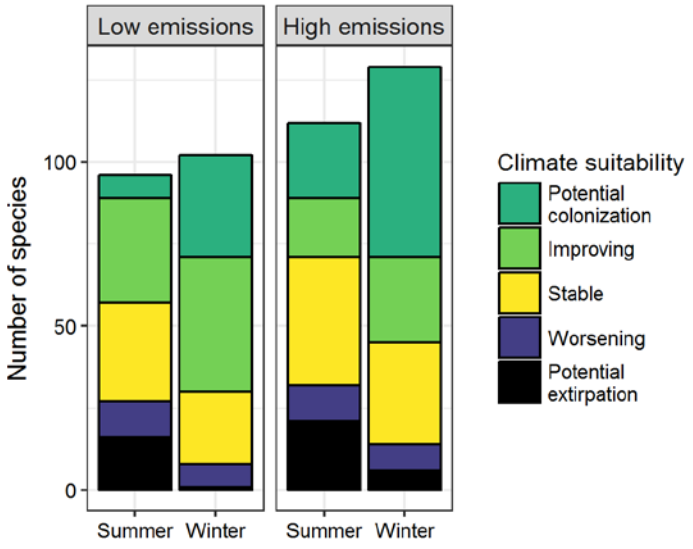

Figure 1. Projected changes in climate suitability for birds at the River, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the River between the present and 2050 is 0.27 in summer (45th percentile across all national parks) and 0.29 in winter (45th percentile) under the high-emissions pathway. Potential species turnover declines to 0.15 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 River is or may become home to 2 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 2 species at the River; instead the River may serve as an important refuge for these climate-sensitive species.

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, Buffalo National 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 2 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	Potential extirpation
Wood Duck	x	Stable
Gadwall	-	Improving
Mallard	-	Improving
Blue-winged Teal	-	Potential colonization
Cinnamon Teal	-	Potential colonization
Green-winged Teal	-	Improving
Gambel's Quail	-	Potential colonization
Northern Bobwhite	Stable	-
Wild Turkey	x	Potential extirpation
Pied-billed Grebe	-	Improving
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization^	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Stable	Stable
Great Egret	Improving	Potential colonization
Little Blue Heron	Improving*	Potential colonization
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Improving	-
White Ibis	Potential colonization	Potential colonization
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving
Osprey	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Golden Eagle	-	Stable
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Worsening*
Bald Eagle	x	Stable
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Worsening	Improving
Ferruginous Hawk	-	Potential colonization
Virginia Rail	-	Potential colonization
Sora	-	Potential colonization
Killdeer	Worsening	Improving
Spotted Sandpiper	x	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Wilson's Snipe	-	Improving
American Woodcock	-	Improving
Laughing Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Rock Pigeon	Potential extirpation	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Stable
Inca Dove	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Improving	Improving
Eastern Screech-Owl	x	Improving
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Stable	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	Stable
Lewis's Woodpecker	-	Potential colonization
Red-headed Woodpecker	Stable	-
Golden-fronted Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Improving
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	Potential extirpation	Potential extirpation
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Improving	Worsening
Pileated Woodpecker	Stable	Stable
Crested Caracara	-	Potential colonization
American Kestrel	-	Stable

Common Name	Summer Trend	Winter Trend
Eastern Wood-Pewee	Worsening*	-
Acadian Flycatcher	Worsening	-
Willow Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	Improving
Vermilion Flycatcher	Potential colonization	-
Great Crested Flycatcher	Stable	-
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
Scissor-tailed Flycatcher	Improving*	-
White-eyed Vireo	Stable	Potential colonization
Yellow-throated Vireo	Stable	-
Warbling Vireo	Potential extirpation	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Worsening
American Crow	Stable	Worsening
Fish Crow	Stable	Stable
Northern Rough-winged Swallow	Stable	-
Purple Martin	Stable	-
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Improving	Improving
Tufted Titmouse	Stable	Stable
Black-crested Titmouse	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Bushtit	-	Potential colonization
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown Creeper	-	Worsening*
Rock Wren	-	Potential colonization
Pacific/Winter Wren	-	Stable
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Stable	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Stable
Mountain Bluebird	-	Potential colonization
Hermit Thrush	-	Stable
Wood Thrush	Potential extirpation	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Worsening	-
LeConte's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Improving	Improving

Common Name	Summer Trend	Winter Trend
European Starling	Potential extirpation	Stable
American Pipit	-	Potential colonization
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-
Blue-winged Warbler	Stable	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Stable	-
Swainson's Warbler	Improving*	-
Orange-crowned Warbler	-	Improving*
Kentucky Warbler	Stable	-
Common Yellowthroat	Potential extirpation	Potential colonization
Hooded Warbler	Stable	-
American Redstart	Stable	-
Northern Parula	Stable	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	Stable^	-
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Stable	-
Prairie Warbler	Stable	-
Yellow-breasted Chat	Stable	-
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving*
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Worsening	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	Potential colonization
Savannah Sparrow	-	Improving
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Improving*
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Stable
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	-
Painted Bunting	Improving*	-
Red-winged Blackbird	Worsening	-
Eastern Meadowlark	Improving	Stable
Western Meadowlark	-	Potential colonization
Common Grackle	Worsening	-

Common Name	Summer Trend	Winter Trend
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Stable
Orchard Oriole	Stable	-

Common Name	Summer Trend	Winter Trend
House Finch	Potential extirpation	-
Purple Finch	-	Potential extirpation
Pine Siskin	-	Improving
American Goldfinch	Potential extirpation	Worsening
House Sparrow	x	Worsening