



Ozark National Scenic Riverways

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 Ozark National Scenic Riverways (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.

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 24, remain stable for 32, and worsen for 12 species. Suitable climate ceases to occur for 23 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 18 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 19, remain stable for 26, and worsen for 11 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the River. Climate is projected to become suitable in winter for 55 species not found at the River today, potentially resulting in local colonization.

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.

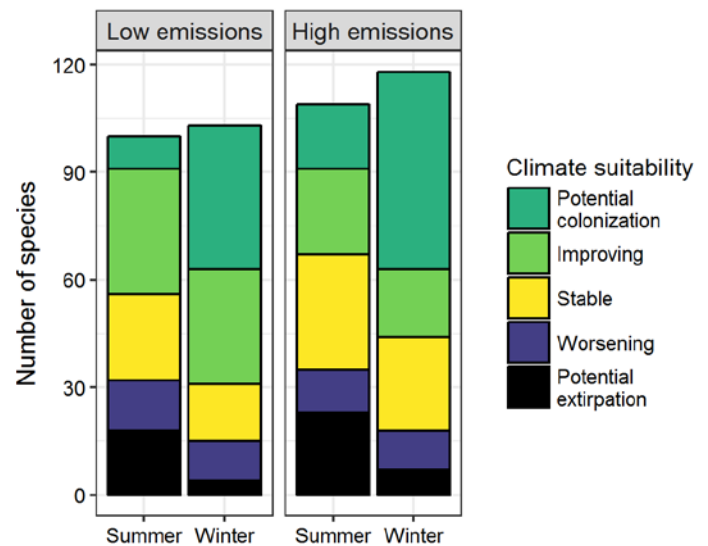


Figure 1. Projected changes in climate suitability for birds at the River, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the River between the present and 2050 is 0.22 in summer (35th percentile across all national parks) and 0.26 in winter (39th 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 River is or may become home to 6 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

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Ozark National Scenic Riverways 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

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

climate is not projected to disappear for these 6 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).

reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 6 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.

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	Stable
Wood Duck	x	Stable
Blue-winged Teal	-	Potential colonization
Cinnamon Teal	-	Potential colonization
Greater Scaup	-	Potential colonization [^]
Bufflehead	-	Potential colonization
Red-breasted Merganser	-	Potential colonization [^]
Northern Bobwhite	Improving	Stable
Wild Turkey	x	Worsening*
Eared Grebe	-	Potential colonization
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	Improving

Common Name	Summer Trend	Winter Trend
Great Egret	Potential colonization	Potential colonization
Little Blue Heron	Potential colonization	Potential colonization
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Improving	-
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving
Northern Harrier	Stable [^]	Stable
Cooper's Hawk	x	Potential extirpation
Bald Eagle	x	Stable
Red-shouldered Hawk	Improving	Stable
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Potential colonization
Virginia Rail	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Killdeer	Stable	-
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
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	Worsening
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Black-billed Cuckoo	Potential extirpation	-
Greater Roadrunner	Potential colonization	Potential colonization
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Stable
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Improving*	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	Stable

Common Name	Summer Trend	Winter Trend
Lewis's Woodpecker	-	Potential colonization
Red-headed Woodpecker	Stable	Stable
Golden-fronted Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Improving
Red-naped Sapsucker	-	Potential colonization
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	Potential extirpation	Worsening
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Improving	Stable
Pileated Woodpecker	Stable	Stable
American Kestrel	x	Worsening
Merlin	-	Improving [^]
Eastern Wood-Pewee	Worsening*	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	-
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
Bell's Vireo	Improving*	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Red-eyed Vireo	Potential extirpation	-
Pinyon Jay	-	Potential colonization
Blue Jay	Stable	Stable
American Crow	Stable	Worsening
Fish Crow	Stable	-
Northern Rough-winged Swallow	Improving*	-
Purple Martin	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Improving	Improving
Tufted Titmouse	Stable	Stable
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	-	Worsening
Rock Wren	-	Potential colonization
House Wren	Potential extirpation	-
Pacific/Winter Wren	-	Stable
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Stable	-

Common Name	Summer Trend	Winter Trend
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Stable
Mountain Bluebird	-	Potential colonization
Hermit Thrush	-	Stable
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Potential colonization
Brown Thrasher	Worsening	Improving*
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Improving
European Starling	Potential extirpation	Worsening
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	Improving	-
Swainson's Warbler	Improving	-
Orange-crowned Warbler	-	Potential colonization
Kentucky Warbler	Improving*	-
Common Yellowthroat	Potential extirpation	-
Hooded Warbler	Improving*	-

Common Name	Summer Trend	Winter Trend
American Redstart	Potential extirpation	-
Northern Parula	Stable	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	Stable^	-
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Stable	-
Prairie Warbler	Worsening	-
Yellow-breasted Chat	Stable	-
Eastern Towhee	Potential extirpation	x
Cassin's Sparrow	Potential colonization	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
American Tree Sparrow	-	Potential extirpation
Chipping Sparrow	Potential extirpation	-
Field Sparrow	Worsening	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Potential colonization
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
White-crowned Sparrow	-	Stable

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	-	Stable
Summer Tanager	Improving	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Stable	-
Indigo Bunting	Stable	Potential colonization
Painted Bunting	Potential colonization	-
Dickcissel	Improving	-
Red-winged Blackbird	Worsening	Stable
Eastern Meadowlark	Improving	Improving
Western Meadowlark	-	Potential colonization
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Orchard Oriole	Worsening	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation
American Goldfinch	Potential extirpation	Worsening
House Sparrow	x	Worsening