



Horseshoe Bend National Military 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 Horseshoe Bend National Military 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.

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 6, remain stable for 18, and worsen for 8 species. Suitable climate ceases to occur for 11 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 25 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 4, remain stable for 19, and worsen for 10 species. Suitable climate ceases to occur for 5 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 58 species not found at the Park 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 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.

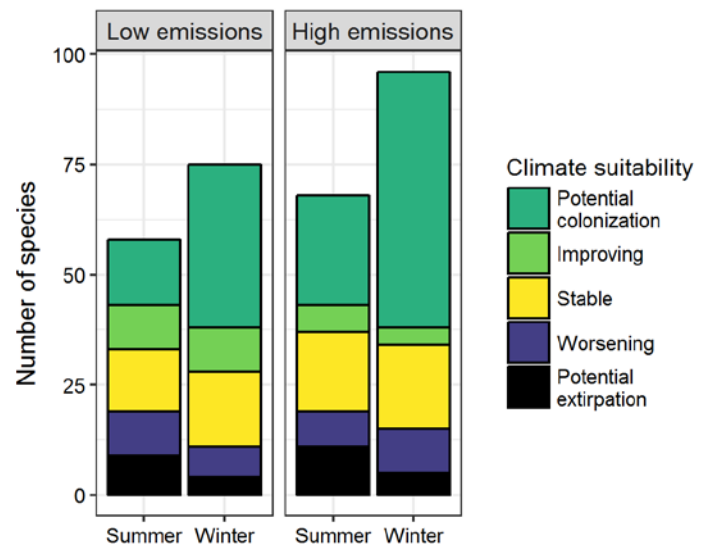


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.22 in summer (36th percentile across all national parks) and 0.27 in winter (40th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.17 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 5 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, Horseshoe Bend National Military Park falls within the high potential colonization group.** Parks anticipating high potential colonization 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

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 5 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.



Figure 2. Although currently found at the Park, 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).

across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 5 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 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Mottled Duck	Potential colonization	Potential colonization
Cinnamon Teal	-	Potential colonization
Northern Bobwhite	Worsening	Worsening*
Wild Turkey	x	Potential extirpation
Least Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization [^]	-
American White Pelican	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Brown Pelican	Potential colonization	-
Great Egret	-	Potential colonization
Little Blue Heron	-	Potential colonization
Tricolored Heron	Potential colonization [^]	-
Cattle Egret	-	Potential colonization
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	Potential colonization	Potential colonization
Glossy Ibis	-	Potential colonization
White-faced Ibis	-	Potential colonization [^]
Roseate Spoonbill	-	Potential colonization
Turkey Vulture	x	Stable

Common Name	Summer Trend	Winter Trend
Osprey	-	Potential colonization
White-tailed Kite	Potential colonization	-
Cooper's Hawk	x	Stable
Harris's Hawk	-	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Stable	Stable
Black-necked Stilt	-	Potential colonization
Spotted Sandpiper	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Laughing Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
White-winged Dove	-	Potential colonization
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Potential colonization	-
Allen's Hummingbird	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Lewis's Woodpecker	-	Potential colonization
Red-headed Woodpecker	Stable	Worsening*
Red-bellied Woodpecker	Stable	Stable
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Stable	-
Northern Flicker	Improving	-
Pileated Woodpecker	Improving	Worsening*
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Worsening*	-
Eastern Phoebe	Potential extirpation	Stable
Vermilion Flycatcher	Potential colonization	Potential colonization
Great Crested Flycatcher	Worsening	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Improving	-
Red-eyed Vireo	Stable	-
Green Jay	Potential colonization	-
Blue Jay	Stable	Worsening
American Crow	Worsening	Worsening
Fish Crow	Stable	Stable
Northern Rough-winged Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	-
Tufted Titmouse	Worsening	Worsening

Common Name	Summer Trend	Winter Trend
Black-crested Titmouse	Potential colonization	-
White-breasted Nuthatch	Potential extirpation	Potential extirpation
House Wren	-	Stable
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Worsening	-
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Mountain Bluebird	-	Potential colonization
Hermit Thrush	-	Stable
Gray Catbird	Potential extirpation	-
Long-billed Thrasher	Potential colonization^	Potential colonization
Sage Thrasher	-	Potential colonization
American Pipit	-	Stable
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Stable
Smith's Longspur	-	Potential colonization
Worm-eating Warbler	Stable	-
Prothonotary Warbler	Stable	-
Swainson's Warbler	Improving*	-
Orange-crowned Warbler	-	Improving
Common Yellowthroat	Potential extirpation	-
Hooded Warbler	Stable	-
American Redstart	Stable	-
Northern Parula	Stable	-

Common Name	Summer Trend	Winter Trend
Pine Warbler	Stable^	Stable
Yellow-rumped Warbler	-	Stable
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Worsening	-
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Field Sparrow	Potential extirpation	Worsening
Lark Sparrow	Potential colonization	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	-	Potential extirpation
Song Sparrow	-	Worsening
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization
Summer Tanager	Stable	-
Western Tanager	-	Potential colonization
Northern Cardinal	Improving	Stable
Pyrrhuloxia	-	Potential colonization
Indigo Bunting	-	Potential colonization
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Potential extirpation	Stable
Western Meadowlark	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Rusty Blackbird	-	Worsening*
Common Grackle	Potential extirpation	Improving
Great-tailed Grackle	-	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Hooded Oriole	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Altamira Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Worsening