



## Arkansas Post National Memorial

### 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 Arkansas Post National Memorial (hereafter, the Memorial) 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 Memorial, 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 Memorial today, climate suitability in summer under the high-emissions pathway is projected to improve for 11, remain stable for 30, and worsen for 17 species. Suitable climate ceases to occur for 17 species in summer, potentially resulting in extirpation of those species from the Memorial (e.g., Figure 2). Climate is projected to become suitable in summer for 28 species not found at the Memorial today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 8, remain stable for 27, and worsen for 6 species. Suitable climate ceases to occur for 8 species in winter, potentially resulting in extirpation from the Memorial. Climate is projected to become suitable in winter for 63 species not found at the Memorial 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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Memorial 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.

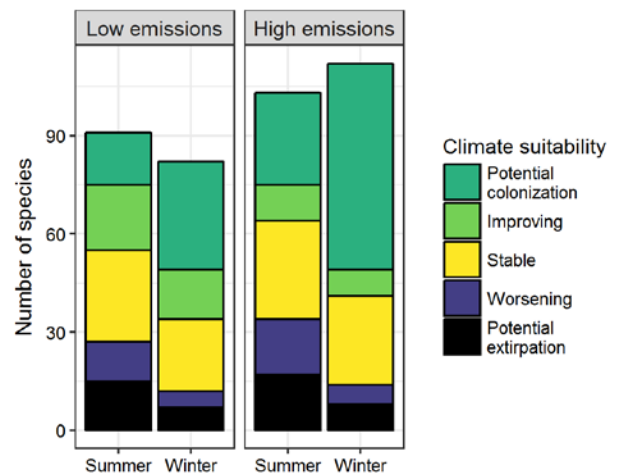


Figure 1. Projected changes in climate suitability for birds at the Memorial, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Memorial between the present and 2050 is 0.24 in summer (39<sup>th</sup> percentile across all national parks) and 0.26 in winter (40<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.19 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 Memorial 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

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Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Arkansas Post National Memorial 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 Memorial; instead the Memorial may serve as an important refuge for these climate-sensitive species.



**Figure 2. Although currently found at the Memorial, suitable climate for the Red-winged Blackbird (*Agelaius phoeniceus*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation.** Photo by Andy Reago & Chrissy McClarren/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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Memorial 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	Improving*	-
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	x	Potential extirpation
Muscovy Duck	-	Potential colonization
Gadwall	-	Improving
Mallard	-	Worsening
Mottled Duck	Potential colonization	Potential colonization
Cinnamon Teal	-	Potential colonization
Scaled Quail	Potential colonization	-
Northern Bobwhite	Worsening*	Stable
Chukar	-	Potential colonization
Wild Turkey	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Pacific Loon	-	Potential colonization
Least Grebe	-	Potential colonization
Pied-billed Grebe	x	Improving
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	-	Stable
Anhinga	Improving^	-
Brown Pelican	Potential colonization	-
Great Blue Heron	Stable	Stable
Great Egret	Stable	Improving
Snowy Egret	x	Potential colonization
Little Blue Heron	Stable	-
Tricolored Heron	Potential colonization^	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Cattle Egret	Improving*	-
Green Heron	Stable	-
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	Improving	Potential colonization
Roseate Spoonbill	-	Potential colonization
Osprey	-	Potential colonization
White-tailed Kite	Potential colonization	Potential colonization
Mississippi Kite	Worsening	x
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Stable	Improving
Ferruginous Hawk	-	Potential colonization
American Coot	-	Improving
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization <sup>^</sup>
Killdeer	Potential extirpation	-
Spotted Sandpiper	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Herring Gull	-	Worsening* <sup>^</sup>
Gull-billed Tern	-	Potential colonization
White-winged Dove	Potential colonization	Potential colonization
Mourning Dove	Stable	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Inca Dove	-	Potential colonization
Common Ground-Dove	-	Potential colonization
White-tipped Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Barn Owl	x	Stable
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
Common Nighthawk	Potential colonization	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Stable	-
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Potential extirpation	Worsening
Green Kingfisher	-	Potential colonization
Red-headed Woodpecker	Worsening	Worsening*
Red-bellied Woodpecker	Stable	Stable
Yellow-bellied Sapsucker	-	Improving
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Worsening	Stable
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Stable	Potential extirpation
Crested Caracara	Potential colonization	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Peregrine Falcon	-	Potential colonization
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Stable	-
Hammond's Flycatcher	-	Potential colonization
Eastern Phoebe	Stable	Stable
Say's Phoebe	-	Potential colonization
Vermilion Flycatcher	Potential colonization	Potential colonization
Great Crested Flycatcher	Worsening	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	-	Potential colonization
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Improving	Potential colonization
Bell's Vireo	Improving*	-
Yellow-throated Vireo	Improving*	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Stable	-
Blue Jay	Worsening	Stable
American Crow	Stable	Potential extirpation
Fish Crow	Stable	Stable
Chihuahuan Raven	Potential colonization	-
Horned Lark	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Worsening	Potential colonization
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Stable
Tufted Titmouse	Worsening	Stable
Verdin	-	Potential colonization
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown Creeper	-	Stable
Rock Wren	-	Potential colonization
House Wren	-	Stable
Carolina Wren	Stable	Stable
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Black-tailed Gnatcatcher	-	Potential colonization
Eastern Bluebird	Stable	Stable
Wood Thrush	Potential extirpation	-
American Robin	Potential extirpation	Worsening
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Potential extirpation	Stable
Long-billed Thrasher	Potential colonization <sup>^</sup>	-
Bendire's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Worsening	Stable
European Starling	Potential extirpation	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
American Pipit	-	Stable
Sprague's Pipit	-	Stable
Worm-eating Warbler	Stable	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Worsening*	-
Swainson's Warbler	Improving*	-
Kentucky Warbler	Improving*	-
Common Yellowthroat	Potential extirpation	-
Hooded Warbler	Stable	-
American Redstart	Stable	-
Northern Parula	Stable	Potential colonization
Pine Warbler	-	Stable
Yellow-throated Warbler	Improving	-
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Stable	-
Olive Sparrow	Potential colonization	-
Green-tailed Towhee	-	Potential colonization
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Lark Sparrow	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Black-throated Sparrow	Potential colonization	Potential colonization
Lark Bunting	-	Potential colonization
Grasshopper Sparrow	-	Potential colonization
White-throated Sparrow	-	Stable
Summer Tanager	Stable	-
Western Tanager	-	Potential colonization
Northern Cardinal	Stable	Stable
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening*	-
Indigo Bunting	Worsening*	Potential colonization
Red-winged Blackbird	Potential extirpation	Stable
Western Meadowlark	-	Potential colonization
Common Grackle	Potential extirpation	Stable
Great-tailed Grackle	-	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Worsening*	-
Hooded Oriole	Potential colonization	-
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization
Baltimore Oriole	Potential extirpation	-