Birds and Climate Change

National Park Service
U.S. Department of the Interior

George Washington Carver National Monument

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 George Washington Carver National Monument (hereafter, the Monument) 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 9, remain stable for 28, and worsen for 16 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Monument (e.g., Figure 2). Climate is projected to become suitable in summer for 16 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 13, remain stable for 17, and worsen for 6 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 46 species not found at the Monument today, potentially resulting in local colonization.

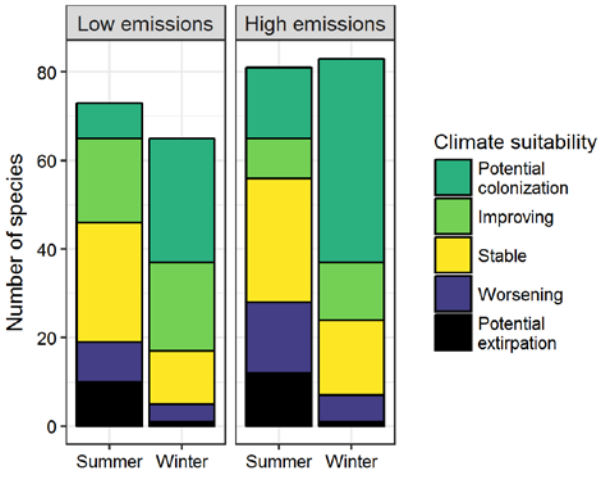

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.18 in summer (26th percentile across all national parks) and 0.21 in winter (29th percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.14 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 Monument 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 Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.

Figure 2. Although currently found at the Monument, 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, George Washington Carver National Monument falls within the low change group.** Parks anticipating low change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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
Cinnamon Teal	-	Potential colonization
Red-breasted Merganser	-	Potential colonization^
Northern Bobwhite	Stable	-
Least Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
Great Blue Heron	Stable	Improving
Great Egret	-	Potential colonization
Little Blue Heron	Potential colonization	Potential colonization
Green Heron	Improving	-
Black-crowned Night-Heron	-	Potential colonization
White Ibis	Potential colonization	-
Black Vulture	-	Potential colonization
Turkey Vulture	x	Potential colonization
Osprey	-	Potential colonization
Harris's Hawk	Potential colonization	-
Red-tailed Hawk	Worsening	Stable
Ferruginous Hawk	-	Potential colonization
Sora	-	Potential colonization
Killdeer	Worsening	-
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Least Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Rock Pigeon	Potential extirpation	-
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Stable
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-
Barn Owl	-	Potential colonization
Great Horned Owl	x	Potential extirpation
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chimney Swift	Stable	-
White-throated Swift	-	Potential colonization
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Red-headed Woodpecker	Stable	-
Red-bellied Woodpecker	Stable	Improving
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Hairy Woodpecker	Potential extirpation	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Worsening
Gilded Flicker	Potential colonization	-
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Worsening	-
Eastern Phoebe	Stable	-
Great Crested Flycatcher	Stable	-
Brown-crested Flycatcher	Potential colonization	-
Eastern Kingbird	Worsening	-
Scissor-tailed Flycatcher	Improving*	-
Loggerhead Shrike	Improving*	-
White-eyed Vireo	Stable	Potential colonization
Warbling Vireo	Potential extirpation	-
Blue Jay	Worsening	Stable
American Crow	Stable	Stable
Fish Crow	Stable	-
Purple Martin	Improving*	-
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Improving
White-breasted Nuthatch	Potential extirpation	Stable
Brown-headed Nuthatch	Potential colonization^	-
House Wren	Potential extirpation	-
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Carolina Wren	Worsening	Stable
Bewick's Wren	Stable	Improving
Blue-gray Gnatcatcher	Stable	-
Golden-crowned Kinglet	-	Stable
Eastern Bluebird	Stable	Stable
American Robin	Potential extirpation	Worsening
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Worsening*	-
Northern Mockingbird	Stable	Improving
European Starling	Worsening	-
American Pipit	-	Potential colonization
Sprague's Pipit	-	Potential colonization
Black-and-white Warbler	Stable	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Potential extirpation	Potential colonization
American Redstart	Stable	-
Northern Parula	Stable	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	-	Potential colonization
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Stable	-
Eastern Towhee	Potential extirpation	-
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
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Potential extirpation	Potential colonization
Field Sparrow	Worsening*	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	-	Potential colonization
Savannah Sparrow	-	Improving
Grasshopper Sparrow	Worsening*	-
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Improving
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Northern Cardinal	Improving	Improving
Pyrrhuloxia	Potential colonization	Potential colonization
Blue Grosbeak	Stable	-
Indigo Bunting	Worsening	-
Dickcissel	Stable	-
Red-winged Blackbird	Worsening	Stable
Eastern Meadowlark	Improving	Stable
Common Grackle	Worsening	Improving
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
Altamira Oriole	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
American Goldfinch	Potential extirpation	Stable
House Sparrow	x	Worsening