



George Washington Birthplace 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 Birthplace 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.

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 7, remain stable for 11, and worsen for 23 species. Suitable climate ceases to occur for 11 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 24 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 44, remain stable for 24, and worsen for 12 species. Suitable climate ceases to occur for 10 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 59 species not

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.

found at the Monument today, potentially resulting in local colonization.

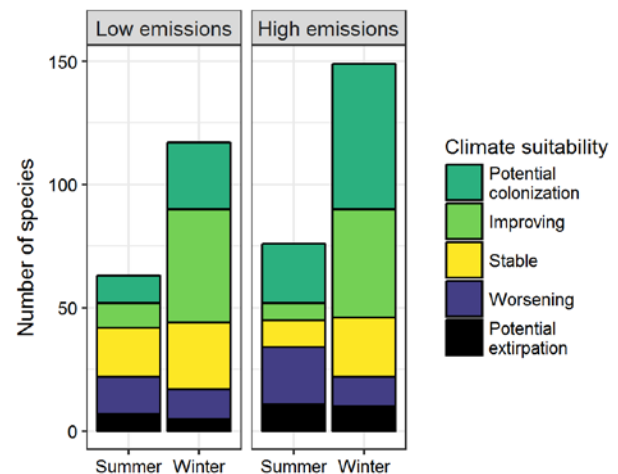


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.23 in summer (38th percentile across all national parks) and 0.26 in winter (40th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.15 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 15 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).

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 Birthplace National Monument falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance

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

While the Monument may serve as an important refuge for 12 of these climate-sensitive species, 3 might be extirpated from the Monument in at least one season by 2050.



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).

regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 12 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 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
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	x	Worsening*
Mute Swan	-	Potential extirpation
Gadwall	-	Improving
American Wigeon	-	Improving
American Black Duck	-	Potential extirpation
Mallard	-	Stable
Blue-winged Teal	-	Potential colonization
Green-winged Teal	-	Improving*
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Greater Scaup	-	Improving^
Lesser Scaup	-	Improving
Surf Scoter	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Long-tailed Duck	-	Potential extirpation
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Hooded Merganser	-	Stable^
Common Merganser	-	Stable
Red-breasted Merganser	-	Stable^
Ruddy Duck	-	Improving
Northern Bobwhite	Worsening	Worsening*
Wild Turkey	-	Potential extirpation
Red-throated Loon	-	Potential extirpation
Common Loon	-	Stable^
Pied-billed Grebe	-	Improving
Horned Grebe	-	Stable
Eared Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Gannet	-	Potential extirpation^
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Anhinga	Potential colonization^	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	-	Potential colonization^
Great Blue Heron	Stable	Improving
Great Egret	-	Potential colonization
Little Blue Heron	Potential colonization	-
Tricolored Heron	Potential colonization^	-
Cattle Egret	Potential colonization	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	Potential colonization
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving
Osprey	x	Potential colonization
Northern Harrier	-	Stable
Cooper's Hawk	-	Stable
Bald Eagle	x	Stable
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	-	Stable
King Rail	-	Potential colonization^
Virginia Rail	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Sora	-	Potential colonization
American Coot	-	Improving
Killdeer	Improving	Improving
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Dunlin	-	Potential colonization^
Least Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Ring-billed Gull	-	Improving
Herring Gull	-	Potential extirpation^
Great Black-backed Gull	-	Stable
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Improving*
Rock Pigeon	-	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Improving	Worsening
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	Potential colonization
Groove-billed Ani	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Great Horned Owl	-	Potential extirpation
Burrowing Owl	Potential colonization^	-
Common Nighthawk	Potential colonization	-
Common Pauraque	-	Potential colonization
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	Improving
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	-	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
American Three-toed Woodpecker	-	Potential colonization^
Northern Flicker	Stable	Stable
Pileated Woodpecker	Stable	Stable
American Kestrel	-	Stable
Merlin	-	Improving^
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	Improving
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Potential colonization	-

Common Name	Summer Trend	Winter Trend
White-eyed Vireo	-	Potential colonization
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Worsening	Worsening
Fish Crow	Worsening	Stable
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening	Improving
Tufted Titmouse	Worsening	Improving
Red-breasted Nuthatch	-	Improving
White-breasted Nuthatch	Potential extirpation	Worsening*
Brown Creeper	-	Worsening
House Wren	-	Potential colonization
Pacific/Winter Wren	-	Improving
Marsh Wren	-	Potential colonization
Carolina Wren	Worsening	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Stable
Hermit Thrush	-	Improving
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Stable
Brown Thrasher	Worsening	Improving
Northern Mockingbird	Stable	Improving

Common Name	Summer Trend	Winter Trend
European Starling	Worsening	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
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Potential extirpation	Potential colonization
Northern Parula	Worsening	-
Pine Warbler	Potential extirpation^	Improving*
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	-	Potential colonization
Prairie Warbler	Worsening	-
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	Potential colonization	-
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Worsening*	Stable
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	Potential colonization
Lark Bunting	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	-	Improving
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Worsening
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Worsening	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Worsening	Improving
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	Worsening	Improving
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential colonization
American Goldfinch	Potential extirpation	Worsening
House Sparrow	x	Worsening