Birds and Climate Change

National Park Service
U.S. Department of the Interior

Guilford Courthouse 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 Guilford Courthouse 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.

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.

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 10, remain stable for 22, and worsen for 17 species. Suitable climate ceases to occur for 17 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 17 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 28, remain stable for 33, and worsen for 7 species. Suitable climate ceases to occur for 4 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 53 species not found at the Park today, potentially resulting in local colonization.

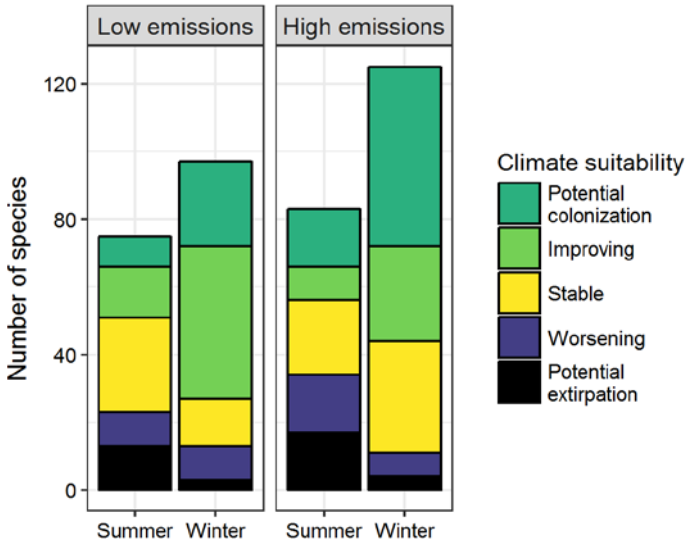

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.22 in summer (34th percentile across all national parks) and 0.23 in winter (33rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.13 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 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). While the Park may serve as an important refuge for 5 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Park in summer by 2050.

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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Guilford Courthouse National Military Park 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 reducing other stressors. 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.

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 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
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	x	Potential extirpation
Wood Duck	x	Improving
Gadwall	-	Improving
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Improving*
Green-winged Teal	-	Improving*
Ring-necked Duck	-	Improving
Bufflehead	-	Stable
Hooded Merganser	-	Stable^
Ruddy Duck	-	Improving
Pied-billed Grebe	-	Improving
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	-	Potential colonization^
Great Blue Heron	Improving	Improving
Great Egret	Improving*	Potential colonization
Snowy Egret	-	Potential colonization
Little Blue Heron	Improving*	-
Cattle Egret	Potential colonization	Potential colonization
Green Heron	Improving	-
Black-crowned Night-Heron	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-

Common Name	Summer Trend	Winter Trend
White Ibis	Improving	Potential colonization
Glossy Ibis	-	Potential colonization
Black Vulture	-	Stable
Turkey Vulture	x	Stable
Osprey	x	Potential colonization
Cooper's Hawk	x	Stable
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Stable	Improving
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Potential colonization
King Rail	-	Potential colonization^
Virginia Rail	-	Potential colonization
Sora	-	Potential colonization
Common Gallinule	-	Potential colonization
Killdeer	Stable	Improving
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Ring-billed Gull	-	Stable
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Rock Pigeon	-	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Worsening
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	-
Barn Owl	-	Potential colonization
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Potential colonization	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	Stable
Red-headed Woodpecker	-	Stable
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Stable
Downy Woodpecker	Worsening	Stable
Hairy Woodpecker	Potential extirpation	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Stable
Pileated Woodpecker	Stable	Stable
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Worsening	-

Common Name	Summer Trend	Winter Trend
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	Improving
Great Crested Flycatcher	Stable	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Stable	Potential colonization
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Worsening	Stable
Fish Crow	Stable	Improving
Common Raven	-	Potential extirpation
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving	-
Barn Swallow	Stable	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening	Improving
Tufted Titmouse	Worsening	Stable
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Potential extirpation	Worsening*
Brown-headed Nuthatch	Stable^	Stable
Brown Creeper	-	Worsening*
House Wren	Potential extirpation	-
Pacific/Winter Wren	-	Improving
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Stable

Common Name	Summer Trend	Winter Trend
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Stable
Hermit Thrush	-	Stable
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	-
Brown Thrasher	Worsening	Improving
Northern Mockingbird	Stable	Improving
European Starling	Potential extirpation	Stable
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Prothonotary Warbler	Stable	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Potential extirpation	Potential colonization
Hooded Warbler	Improving*	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	Worsening^	Improving
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	-	Potential colonization
Eastern Towhee	Worsening*	x
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential	Potential

Common Name	Summer Trend	Winter Trend
	colonization	colonization
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Worsening*	Stable
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	Potential colonization
Grasshopper Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Worsening*
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Worsening	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Stable
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Worsening
House Sparrow	-	Worsening*