Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Raleigh National Historic Site

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 Fort Raleigh National Historic Site (hereafter, the Site) 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Site 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 Site, 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 Site today, climate suitability in summer under the high-emissions pathway is projected to improve for 8, remain stable for 6, and worsen for 16 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 23 species not found at the Site today, potentially resulting in local colonization. Among the species likely to be found at the Site today, climate suitability in winter under the high-emissions pathway is projected to improve for 15 (e.g., Figure 2), remain stable for 11, and worsen for 10 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 60 species not found at the Site today, potentially resulting in local colonization.

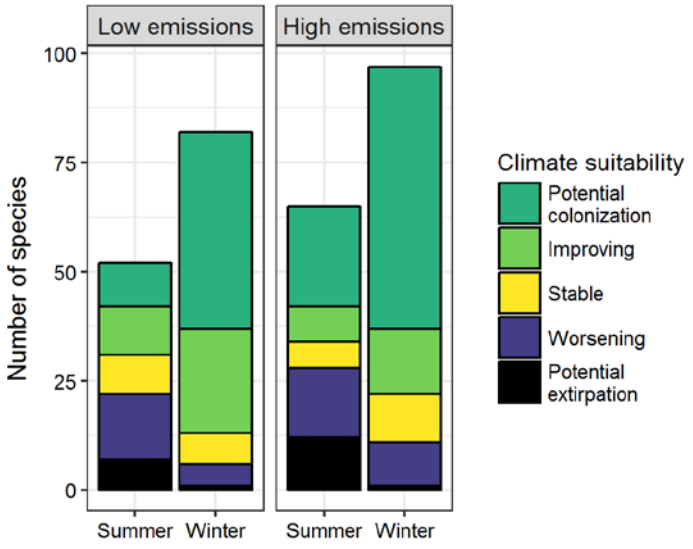

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.22 in summer (36th percentile across all national parks) and 0.20 in winter (26th percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.16 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 Site is or may become home to 11 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 Site may serve as an important refuge for 9 of these climate-sensitive species, 2 might be extirpated from the Site in at least one season by 2050.

Figure 2. Climate at the Site in winter is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) through 2050. Photo by Andy Reago & Chrissy McClarren/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, Fort Raleigh National Historic Site 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 9 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Site 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	-
Muscovy Duck	-	Potential colonization
Mottled Duck	Potential colonization	Potential colonization
Bufflehead	-	Worsening*
Least Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Anhinga	Potential colonization^	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	Stable	-
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	-
Tricolored Heron	Potential colonization^	-
Reddish Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	Improving*	-
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	-	Potential colonization
Black Vulture	-	Potential colonization
White-tailed Kite	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Swallow-tailed Kite	Potential colonization	-
White-tailed Hawk	-	Potential colonization
Red-tailed Hawk	-	Potential colonization
Ferruginous Hawk	-	Potential colonization
Limpkin	-	Potential colonization
Black-necked Stilt	-	Potential colonization
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Spotted Sandpiper	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Laughing Gull	Worsening^	-
Ring-billed Gull	Potential extirpation^	Worsening*
Herring Gull	Worsening*	Worsening*^
Great Black-backed Gull	-	Worsening*
Gull-billed Tern	-	Potential colonization
Caspian Tern	-	Potential colonization
Sandwich Tern	-	Potential colonization^
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	Potential colonization	Potential colonization
Mourning Dove	Improving	Improving
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Groove-billed Ani	-	Potential colonization
Barred Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Potential colonization	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Worsening	-
Allen's Hummingbird	-	Potential colonization
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	-	Improving
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Improving
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Stable
American Three-toed Woodpecker	-	Potential colonization^
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Worsening	-
Crested Caracara	Potential colonization	Potential colonization
Eastern Phoebe	-	Improving
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	-
Brown-crested Flycatcher	Potential colonization	-
Couch's Kingbird	-	Potential colonization
Western Kingbird	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Potential colonization
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Worsening	Improving
American Crow	Worsening	Stable
Fish Crow	Worsening*	-
Northern Rough-winged Swallow	-	Potential colonization
Purple Martin	Stable	-
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening	Improving
Brown-headed Nuthatch	Worsening*^	Worsening*
Carolina Wren	Worsening	Stable
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Potential extirpation	Potential colonization
Golden-crowned Kinglet	-	Worsening*
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Stable
Hermit Thrush	-	Stable
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Stable
Brown Thrasher	Potential extirpation	Worsening*
Northern Mockingbird	Improving	Improving
European Starling	-	Worsening
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Stable

Common Name	Summer Trend	Winter Trend
Smith's Longspur	-	Potential colonization
Northern Parula	Worsening	Potential colonization
Pine Warbler	Potential extirpation^	Stable
Yellow-rumped Warbler	-	Stable
Wilson's Warbler	-	Potential colonization
Eastern Towhee	Potential extirpation	x
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Worsening
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Western Tanager	-	Potential colonization
Northern Cardinal	Improving	Improving
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening*	-
Indigo Bunting	-	Potential colonization
Red-winged Blackbird	Improving	Improving
Common Grackle	Worsening	Improving

Common Name	Summer Trend	Winter Trend
Boat-tailed Grackle	Stable^	-
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Brown-headed Cowbird	Potential extirpation	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Improving