Birds and Climate Change

National Park Service
U.S. Department of the Interior

Charles Pinckney 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 Charles Pinckney 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 7, remain stable for 14, and worsen for 8 species. Suitable climate ceases to occur for 7 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 22 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 19 (e.g., Figure 2), remain stable for 23, and worsen for 16 species. Suitable climate ceases to occur for 10 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 49 species not found at the Site today, potentially resulting in local colonization.

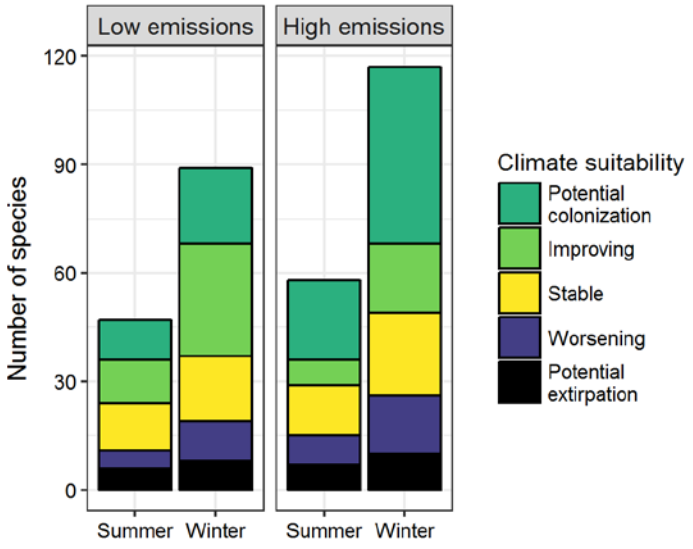

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.20 in summer (32nd percentile across all national parks) and 0.15 in winter (17th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.09 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 9 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 7 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 Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Charles Pinckney 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 7 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
Wood Duck	-	Stable
Mallard	-	Potential extirpation
Mottled Duck	Potential colonization	-
Cinnamon Teal	-	Potential colonization
Canvasback	-	Improving*
Hooded Merganser	-	Potential extirpation^
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	-
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Improving
Wood Stork	Improving	-
Magnificent Frigatebird	-	Potential colonization
Double-crested Cormorant	-	Improving
Anhinga	-	Improving*
Brown Pelican	Improving	Worsening^
Least Bittern	-	Potential colonization
Great Blue Heron	Stable	Improving
Great Egret	Improving	Improving
Snowy Egret	x	Stable
Little Blue Heron	-	Worsening*
Tricolored Heron	Improving*^	-
Cattle Egret	Improving	-
Green Heron	Improving*	-
Black-crowned Night-Heron	x	Worsening
Yellow-crowned Night-Heron	Stable	-

Common Name	Summer Trend	Winter Trend
White Ibis	Worsening*	Stable
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	-	Potential colonization
Black Vulture	Stable	Stable
Turkey Vulture	x	Improving
Osprey	x	Worsening
White-tailed Kite	-	Potential colonization
Mississippi Kite	Worsening	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	-	Stable
Bald Eagle	-	Potential extirpation
Harris's Hawk	Potential colonization	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening	Improving
Red-tailed Hawk	-	Stable
Ferruginous Hawk	-	Potential colonization
Clapper Rail	x	Worsening*
Limpkin	-	Potential colonization
Killdeer	-	Improving
Spotted Sandpiper	-	Improving*
Laughing Gull	Stable^	-
Ring-billed Gull	-	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	Potential colonization	-
Rock Pigeon	Potential colonization	-
White-winged Dove	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Mourning Dove	Stable	Stable
White-tipped Dove	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Lesser Nighthawk	Potential colonization	Potential colonization
Common Pauraque	-	Potential colonization
Allen's Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	-	Worsening
Red-bellied Woodpecker	Stable	Stable
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Worsening	Potential extirpation
Northern Flicker	-	Worsening
Gilded Flicker	-	Potential colonization
Pileated Woodpecker	-	Stable
Northern Beardless-Tyrannulet	Potential colonization	-
Eastern Phoebe	-	Improving
Say's Phoebe	-	Potential colonization
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	Potential colonization
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	Potential colonization	Potential colonization
Western Kingbird	Potential colonization	-
Green Jay	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Blue Jay	Stable	Worsening
American Crow	Potential extirpation	Potential extirpation
Fish Crow	Worsening*	Worsening*
Chihuahuan Raven	-	Potential colonization
Northern Rough-winged Swallow	-	Potential colonization
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Stable	Stable
Tufted Titmouse	Worsening	Improving
Brown-headed Nuthatch	-	Worsening*
Brown Creeper	-	Stable
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Potential extirpation	Worsening
Hermit Thrush	-	Stable
American Robin	-	Worsening
Gray Catbird	-	Stable
Curve-billed Thrasher	-	Potential colonization
Brown Thrasher	Potential extirpation	Improving
Long-billed Thrasher	Potential colonization^	Potential colonization
Bendire's Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Improving

Common Name	Summer Trend	Winter Trend
European Starling	-	Stable
Cedar Waxwing	-	Potential extirpation
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	-	Potential colonization
Orange-crowned Warbler	-	Improving
Common Yellowthroat	Potential extirpation	-
Northern Parula	Worsening	-
Pine Warbler	Potential extirpation^	Stable
Yellow-rumped Warbler	-	Improving
Black-throated Gray Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^
Olive Sparrow	-	Potential colonization
Green-tailed Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	-	Stable
Lark Bunting	-	Potential colonization
Song Sparrow	-	Potential extirpation
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Stable
Dark-eyed Junco	-	Potential extirpation
Northern Cardinal	Worsening	Improving
Pyrrhuloxia	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Painted Bunting	Stable	-
Red-winged Blackbird	Stable	Stable
Common Grackle	-	Worsening
Boat-tailed Grackle	Stable^	Worsening*^
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	-	Stable
Hooded Oriole	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Worsening
House Sparrow	-	Stable