Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Caroline National Memorial

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 Caroline National Memorial (hereafter, the Memorial) 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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Memorial 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 Memorial, 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 Memorial today, climate suitability in summer under the high-emissions pathway is projected to improve for 17 (e.g., Figure 2), remain stable for 24, and worsen for 19 species. Suitable climate ceases to occur for 9 species in summer, potentially resulting in extirpation of those species from the Memorial. Climate is projected to become suitable in summer for 22 species not found at the Memorial today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 28, remain stable for 43, and worsen for 48 species. Suitable climate ceases to occur for 14 species in winter, potentially resulting in extirpation from the Memorial. Climate is projected to become suitable in winter for 33 species not found at the Memorial today, potentially resulting in local colonization.

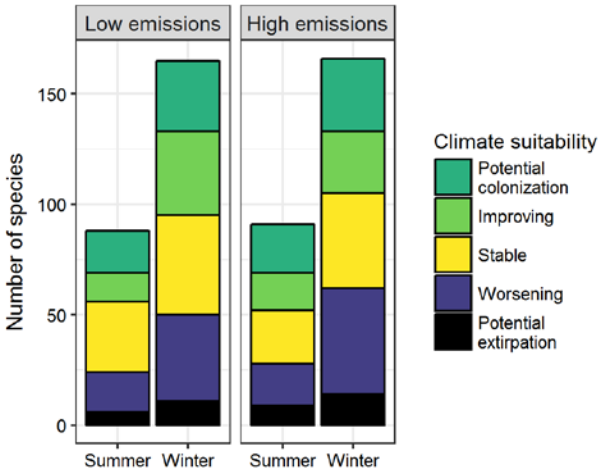

Figure 1. Projected changes in climate suitability for birds at the Memorial, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Memorial between the present and 2050 is 0.19 in summer (29th percentile across all national parks) and 0.12 in winter (12th percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.11 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 Memorial is or may become home to 26 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 Memorial may serve as an important refuge for 24 of these climate-sensitive species, 2 might be extirpated from the Memorial in at least one season by 2050.

Figure 2. Climate at the Memorial in summer 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 Caroline National Memorial falls within the high potential colonization group.** Parks anticipating high potential colonization can focus on actions that increase species' ability to respond to environmental change, such as increasing the amount of potential habitat, working with cooperating agencies and landowners to improve habitat connectivity for birds across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 24 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.

Contacts

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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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Memorial 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
Muscovy Duck	-	Improving*
Wood Duck	x	Worsening
Gadwall	-	Improving*
Mallard	Stable^	Improving
Mottled Duck	-	Improving*
Blue-winged Teal	Improving	-
Cinnamon Teal	-	Potential colonization
Northern Shoveler	-	Improving*
Green-winged Teal	-	Improving
Canvasback	-	Potential colonization
Ring-necked Duck	-	Improving
Bufflehead	-	Potential extirpation
Hooded Merganser	x	Potential extirpation^
Red-breasted Merganser	-	Worsening*^
Ruddy Duck	-	Stable

Common Name	Summer Trend	Winter Trend
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	Potential colonization
Common Loon	-	Worsening*^
Pied-billed Grebe	-	Stable
Horned Grebe	-	Worsening*
Wood Stork	Stable	Worsening
Northern Gannet	-	Worsening*^
Double-crested Cormorant	x	Worsening
Anhinga	Improving*^	Improving
American White Pelican	x	Improving*
Brown Pelican	Worsening	Stable^
American Bittern	-	Stable^
Great Blue Heron	Worsening	Stable
Great Egret	Stable	Improving
Snowy Egret	x	Improving
Little Blue Heron	Improving*	Worsening

Common Name	Summer Trend	Winter Trend
Tricolored Heron	Stable^	Stable
Cattle Egret	Stable	Improving*
Green Heron	Stable	Worsening
Black-crowned Night-Heron	x	Stable
Yellow-crowned Night-Heron	Stable	Stable
White Ibis	Stable	Stable
Roseate Spoonbill	x	Improving*
Black Vulture	Stable	Stable
Turkey Vulture	x	Improving
Osprey	x	Stable
White-tailed Kite	-	Potential colonization
Swallow-tailed Kite	Worsening	-
Mississippi Kite	Improving	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation
Harris's Hawk	Potential colonization	Potential colonization
Red-shouldered Hawk	Worsening	Improving
Short-tailed Hawk	-	Potential colonization
Red-tailed Hawk	Potential extirpation	Stable
Ferruginous Hawk	-	Potential colonization
Clapper Rail	x	Worsening*
Sora	-	Worsening
Common Gallinule	-	Improving*
American Coot	-	Stable
American Avocet	-	Stable^
Black-bellied Plover	-	Stable
Semipalmated Plover	Stable	Worsening^

Common Name	Summer Trend	Winter Trend
Killdeer	Improving*	Stable
Spotted Sandpiper	-	Improving
Greater Yellowlegs	Potential extirpation	Stable
Willet	Stable^	Worsening^
Lesser Yellowlegs	Stable^	Improving
Ruddy Turnstone	-	Worsening*^
Sanderling	-	Worsening*
Dunlin	-	Stable^
Least Sandpiper	-	Stable
Western Sandpiper	-	Stable
Short-billed Dowitcher	-	Worsening^
Long-billed Dowitcher	-	Improving*
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Potential extirpation
Laughing Gull	Worsening*^	Stable
Ring-billed Gull	-	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	-	Worsening^
Great Black-backed Gull	-	Potential extirpation
Caspian Tern	-	Stable
Forster's Tern	x	Worsening
Royal Tern	x	Worsening^
Black Skimmer	x	Worsening^
Rock Pigeon	Improving*	Improving
Eurasian Collared-Dove	x	Improving
White-winged Dove	Potential colonization	-
Mourning Dove	Improving	Improving
Inca Dove	-	Potential colonization
Common Ground-Dove	Improving*	Stable
White-tipped Dove	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Greater Roadrunner	Potential colonization	-
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Potential extirpation
Burrowing Owl	-	Potential colonization
Barred Owl	x	Worsening
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening*	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Improving	Worsening
Green Kingfisher	-	Potential colonization
Golden-fronted Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Stable	Worsening
Yellow-bellied Sapsucker	-	Stable
Downy Woodpecker	Worsening*	Potential extirpation
Northern Flicker	Stable	Potential extirpation
Gilded Flicker	Potential colonization	-
Pileated Woodpecker	Worsening	Worsening
American Kestrel	-	Stable
Northern Beardless-Tyrannulet	Potential colonization	-
Eastern Phoebe	-	Improving
Great Crested Flycatcher	Worsening	Potential colonization
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
White-eyed Vireo	Improving	Stable
Red-eyed Vireo	Potential extirpation	-
Green Jay	Potential colonization	Potential colonization
Blue Jay	Worsening	Worsening
American Crow	Stable	Potential extirpation
Fish Crow	Worsening*	Worsening
Chihuahuan Raven	Potential colonization	-
Northern Rough-winged Swallow	Improving	-
Purple Martin	Worsening	-
Tree Swallow	-	Worsening*
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Carolina Chickadee	Worsening*	Worsening
Tufted Titmouse	Worsening*	Stable
House Wren	-	Worsening
Sedge Wren	-	Worsening
Marsh Wren	x	Worsening
Carolina Wren	Worsening	Worsening
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving*	Worsening
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	-	Worsening
Eastern Bluebird	Potential extirpation	Worsening
Hermit Thrush	-	Worsening
American Robin	-	Potential extirpation
Gray Catbird	Stable	Worsening

Common Name	Summer Trend	Winter Trend
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Potential extirpation	Worsening
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Stable
European Starling	Stable	Improving
American Pipit	-	Improving*
Cedar Waxwing	-	Potential extirpation
Black-and-white Warbler	Stable	Worsening
Orange-crowned Warbler	-	Stable
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Potential extirpation	Stable
American Redstart	Improving	-
Northern Parula	Worsening	Stable
Palm Warbler	-	Stable^
Pine Warbler	Potential extirpation^	Worsening
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	Stable
Prairie Warbler	Potential colonization	-
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

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	-	Stable
Vesper Sparrow	-	Improving
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Worsening
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Worsening^
Seaside Sparrow	-	Worsening*^
Song Sparrow	-	Potential extirpation
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Worsening
White-throated Sparrow	-	Worsening
Summer Tanager	Potential extirpation	-
Northern Cardinal	Stable	Stable
Painted Bunting	Improving*	Improving
Red-winged Blackbird	Improving	Stable
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Potential colonization
Common Grackle	Worsening*	Worsening
Boat-tailed Grackle	Worsening^	Worsening*^
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Stable	Improving
Hooded Oriole	Potential colonization	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Stable
House Sparrow	x	Stable