Birds and Climate Change

National Park Service
U.S. Department of the Interior

Everglades National 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 Everglades National 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 39, remain stable for 27 (e.g., Figure 2), and worsen for 13 species. Suitable climate ceases to occur for 7 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 19 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 61, remain stable for 46, and worsen for 61 species. Suitable climate ceases to occur for 13 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 36 species not found at the Park today, potentially resulting in local colonization.

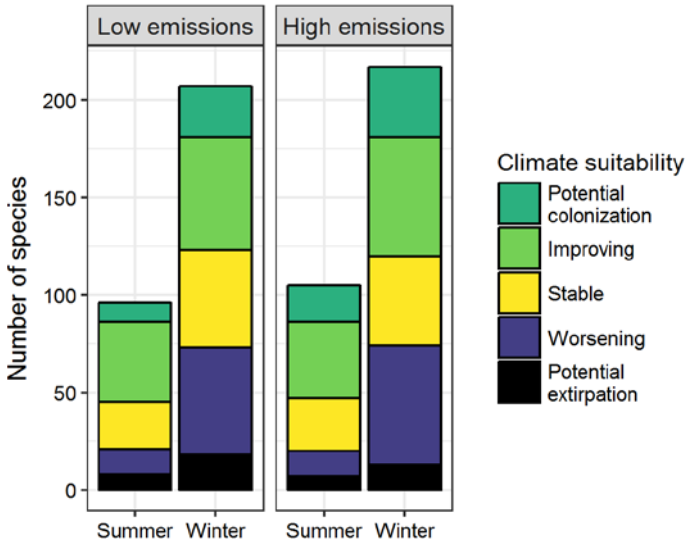

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.16 in summer (23rd percentile across all national parks) and 0.15 in winter (16th percentile) under the high-emissions pathway. Potential species turnover declines to 0.10 in summer and 0.12 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 37 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 35 of these climate-sensitive species, 2 might be extirpated from the Park in at least one season by 2050.

Figure 2. Climate at the Park 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, Everglades National Park 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 35 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 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
Black-bellied Whistling-Duck	Improving*	x
Brant	-	Improving
Muscovy Duck	x	Stable
Wood Duck	-	Improving
Gadwall	-	Improving*
American Wigeon	-	Improving
Mallard	-	Stable
Mottled Duck	Worsening	Worsening*
Blue-winged Teal	-	Improving
Cinnamon Teal	-	Potential colonization
Northern Shoveler	-	Improving*
Green-winged Teal	-	Improving*
Canvasback	-	Improving
Ring-necked Duck	-	Stable
Greater Scaup	-	Improving^
Lesser Scaup	-	Stable
Surf Scoter	-	Potential
		colonization
Black Scoter	-	Stable
Hooded Merganser	-	Improving*^
Red-breasted Merganser	-	Stable^
Ruddy Duck	-	Stable
California Quail	-	Potential colonization
Northern Bobwhite	Improving	Improving
Wild Turkey	-	Potential extirpation
Common Loon	-	Potential extirpation^
Pied-billed Grebe	x	Worsening
Horned Grebe	-	Improving*
Eared Grebe	-	Potential colonization
Black-vented Shearwater	-	Potential colonization
Wood Stork	Stable	Worsening*
Magnificent Frigatebird	x	Improving

Common Name	Summer Trend	Winter Trend
Northern Gannet	-	Worsening^
Brandt's Cormorant	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Stable
Great Cormorant	-	Potential colonization
Anhinga	Worsening^	Worsening
American White Pelican	x	Improving
Brown Pelican	Stable	Stable^
American Bittern	-	Stable^
Least Bittern	x	Worsening
Great Blue Heron	Improving	Stable
Great Egret	Improving	Worsening
Snowy Egret	x	Stable
Little Blue Heron	Improving*	Worsening
Tricolored Heron	Improving*^	Worsening
Reddish Egret	x	Stable
Cattle Egret	Worsening	Worsening*
Green Heron	Improving	Worsening
Black-crowned Night-Heron	x	Worsening
Yellow-crowned Night-Heron	Stable	Worsening
White Ibis	Improving	Worsening
Glossy Ibis	x	Worsening*
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	x	Worsening*
Black Vulture	Worsening*	Worsening*
Turkey Vulture	x	Worsening
Osprey	x	Worsening
White-tailed Kite	Improving	Improving
Swallow-tailed Kite	Improving	x
Northern Harrier	-	Improving
Sharp-shinned Hawk	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Improving
Bald Eagle	x	Potential extirpation
Harris's Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening*	Worsening
Gray Hawk	Potential colonization	-
Short-tailed Hawk	x	Worsening*
Red-tailed Hawk	Stable	Potential extirpation
Clapper Rail	x	Improving*
King Rail	x	Stable^
Virginia Rail	-	Improving
Sora	-	Worsening
Common Gallinule	x	Worsening*
American Coot	x	Stable
Limpkin	x	Worsening
Black-necked Stilt	x	Improving*
American Avocet	x	Improving*^
American Oystercatcher	-	Worsening^
Black-bellied Plover	x	Stable
Wilson's Plover	x	Improving*
Semipalmated Plover	Potential extirpation	Improving^
Piping Plover	-	Stable^
Killdeer	Improving	Worsening
Spotted Sandpiper	-	Stable
Greater Yellowlegs	Stable	Stable
Willet	Stable^	Improving^
Lesser Yellowlegs	Stable^	Worsening
Whimbrel	x	Improving*
Long-billed Curlew	-	Improving
Marbled Godwit	Potential extirpation^	Improving*
Ruddy Turnstone	x	Stable^
Black Turnstone	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Red Knot	x	Stable^
Stilt Sandpiper	-	Stable
Sanderling	x	Improving*
Dunlin	x	Improving^
Least Sandpiper	-	Improving
Western Sandpiper	-	Improving*
Short-billed Dowitcher	x	Stable^
Long-billed Dowitcher	x	Improving
Wilson's Snipe	-	Improving
American Woodcock	-	Improving
Pomarine Jaeger	-	Potential colonization^
Bonaparte's Gull	-	Improving
Laughing Gull	Improving*^	Stable
Ring-billed Gull	Improving^	Improving
Herring Gull	Stable	Worsening^
Great Black-backed Gull	-	Potential extirpation
Gull-billed Tern	-	Improving
Caspian Tern	x	Stable
Black Tern	Stable	-
Forster's Tern	x	Improving*
Royal Tern	x	Worsening^
Sandwich Tern	x	Worsening^
Black Skimmer	x	Stable^
Rock Pigeon	Improving	Stable
White-crowned Pigeon	Improving*	Worsening
Eurasian Collared-Dove	x	Stable
White-winged Dove	Improving*	Improving*
Mourning Dove	Improving*	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Improving*	Improving
White-tipped Dove	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	Potential colonization
Groove-billed Ani	-	Improving
Barn Owl	x	Improving*
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Stable
Burrowing Owl	Improving^	Worsening
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	Improving*
Common Nighthawk	Worsening*	-
Chuck-will's-widow	Stable	x
Chimney Swift	Improving	-
Ruby-throated Hummingbird	Improving	x
Anna's Hummingbird	Potential colonization	-
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Improving	Worsening
Gila Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Worsening	Worsening
Yellow-bellied Sapsucker	-	Worsening
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Potential extirpation	Potential extirpation
Arizona Woodpecker	-	Potential colonization
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Potential extirpation
Gilded Flicker	Potential colonization	Potential colonization
Pileated Woodpecker	Stable	Potential extirpation
Crested Caracara	-	Improving

Common Name	Summer Trend	Winter Trend
American Kestrel	x	Improving
Merlin	-	Worsening^
Peregrine Falcon	-	Improving*
Hammond's Flycatcher	-	Potential colonization
Eastern Phoebe	-	Worsening
Vermilion Flycatcher	-	Improving
Great Crested Flycatcher	Stable	Worsening
Couch's Kingbird	-	Potential colonization
Cassin's Kingbird	-	Potential colonization
Eastern Kingbird	Improving	-
Loggerhead Shrike	Worsening*	Worsening
White-eyed Vireo	Stable	Worsening
Red-eyed Vireo	Stable	-
Black-whiskered Vireo	Stable	-
Blue Jay	Potential extirpation	Potential extirpation
American Crow	Potential extirpation	Stable
Fish Crow	Stable	Stable
Northern Rough-winged Swallow	Improving	Improving
Purple Martin	Improving*	x
Tree Swallow	-	Stable
Violet-green Swallow	-	Potential colonization
Barn Swallow	Improving	x
Cave Swallow	Improving	x
Tufted Titmouse	Potential extirpation	x
Verdin	-	Potential colonization
Brown-headed Nuthatch	Improving^	Stable
House Wren	-	Worsening*
Sedge Wren	-	Improving
Marsh Wren	x	Stable

Common Name	Summer Trend	Winter Trend
Carolina Wren	Worsening*	Potential extirpation
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving*	Worsening
California Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	-	Potential colonization
Ruby-crowned Kinglet	-	Stable
Eastern Bluebird	Improving	Potential extirpation
Hermit Thrush	-	Stable
American Robin	-	Potential extirpation
Gray Catbird	-	Stable
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Stable	Worsening*
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	-
Northern Mockingbird	Improving	Worsening
European Starling	Stable	Stable
American Pipit	-	Improving*
Cedar Waxwing	-	Stable
Phainopepla	Potential colonization	-
Ovenbird	-	Worsening
Black-and-white Warbler	Improving	Worsening*
Prothonotary Warbler	Worsening	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Stable
Common Yellowthroat	Stable	Worsening
American Redstart	Improving	x
Northern Parula	Stable	Worsening
Yellow Warbler	Improving	x

Common Name	Summer Trend	Winter Trend
Palm Warbler	-	Worsening^
Pine Warbler	Stable^	Worsening*
Yellow-rumped Warbler	-	Worsening
Yellow-throated Warbler	Stable	Stable
Prairie Warbler	Improving	Worsening
Wilson's Warbler	-	Improving
Green-tailed Towhee	-	Potential colonization
Eastern Towhee	Potential extirpation	x
California Towhee	Potential colonization	Potential colonization
Abert's Towhee	Potential colonization	-
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	-	Improving
Vesper Sparrow	-	Improving
Lark Sparrow	Potential colonization	Improving
Black-throated Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Worsening*

Common Name	Summer Trend	Winter Trend
Grasshopper Sparrow	-	Worsening*
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Improving^
Seaside Sparrow	Stable^	Worsening^
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Improving
Swamp Sparrow	-	Improving
White-crowned Sparrow	-	Improving
Northern Cardinal	Worsening	Worsening
Pyrrhuloxia	Potential colonization	Potential colonization
Indigo Bunting	Stable	Worsening
Painted Bunting	-	Worsening
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Stable	Worsening*
Common Grackle	Worsening	Worsening*
Boat-tailed Grackle	Worsening*^	Worsening^
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Improving	-
Brown-headed Cowbird	Improving	Stable
Orchard Oriole	Improving	x
American Goldfinch	-	Improving*
House Sparrow	x	Stable