



## Biscayne 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 Biscayne 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.

### 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 26, remain stable for 21 (e.g., Figure 2), and worsen for 11 species. Suitable climate ceases to occur for 2 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 18 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 37, remain stable for 41, and worsen for 53 species. Suitable climate ceases to occur for 11 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 37 species not found at the Park today, potentially resulting in local colonization.

### 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.

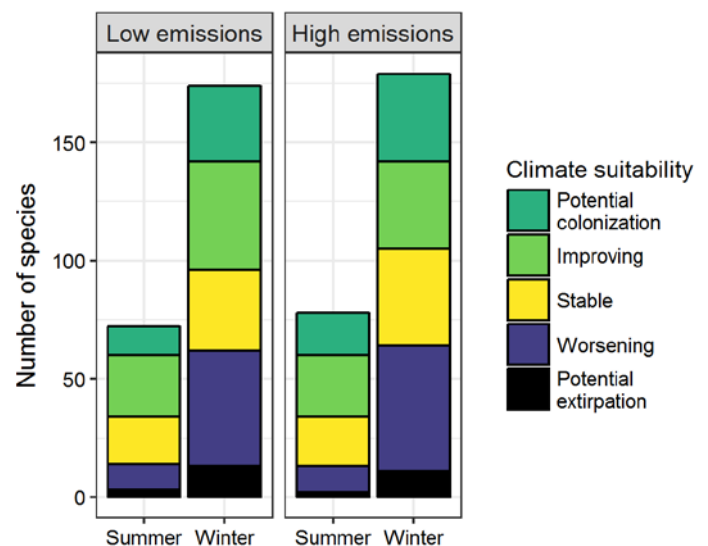


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Park between the present and 2050 is 0.17 in summer (25<sup>th</sup> percentile across all national parks) and 0.14 in winter (16<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 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 29 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 28 of these

### Management Implications

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Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Biscayne 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

### Caveats

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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

climate-sensitive species, one, the Common Loon (*Gavia immer*), might be extirpated from the Park in winter 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).

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 28 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.

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
Muscovy Duck	x	Stable
Gadwall	-	Improving*
American Wigeon	-	Improving
Mottled Duck	Improving	Worsening*
Blue-winged Teal	-	Stable
Cinnamon Teal	-	Potential colonization
Northern Shoveler	-	Improving*
Green-winged Teal	-	Improving*
Ring-necked Duck	-	Potential extirpation
Lesser Scaup	-	Stable
Surf Scoter	-	Potential colonization
Black Scoter	-	Stable
Red-breasted Merganser	-	Improving^
Northern Bobwhite	Potential colonization	Improving
Common Loon	-	Potential extirpation^

Common Name	Summer Trend	Winter Trend
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
Northern Gannet	Worsening^	Stable^
Brandt's Cormorant	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Stable
Great Cormorant	-	Potential colonization
Anhinga	Stable^	Worsening
American White Pelican	-	Stable
Brown Pelican	Stable	Improving^
American Bittern	-	Stable^

Common Name	Summer Trend	Winter Trend
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	Improving*
Cattle Egret	Worsening*	Worsening
Green Heron	Improving*	Worsening
Black-crowned Night-Heron	-	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	-	Potential colonization
Swallow-tailed Kite	Improving	x
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Improving
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	x	Improving
Bald Eagle	x	Potential extirpation
Harris's Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening*	Worsening
Short-tailed Hawk	-	Worsening
Red-tailed Hawk	-	Potential extirpation
King Rail	-	Worsening^
Sora	-	Worsening

Common Name	Summer Trend	Winter Trend
Common Gallinule	x	Worsening*
American Coot	x	Stable
Limpkin	-	Stable
Black-necked Stilt	x	Improving*
American Avocet	-	Improving^
Black-bellied Plover	x	Improving
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	-	Worsening
Ruddy Turnstone	x	Stable^
Red Knot	-	Improving^
Sanderling	x	Improving
Dunlin	-	Improving*^
Least Sandpiper	-	Improving
Western Sandpiper	-	Improving*
Short-billed Dowitcher	-	Stable^
Long-billed Dowitcher	-	Improving
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Improving
Laughing Gull	Stable^	Worsening
Heermann's Gull	-	Potential colonization
Ring-billed Gull	Improving^	Stable
Herring Gull	-	Stable^
Great Black-backed Gull	-	Worsening*
Caspian Tern	-	Stable
Forster's Tern	-	Improving*
Royal Tern	x	Stable^
Sandwich Tern	-	Stable^

Common Name	Summer Trend	Winter Trend
Black Skimmer	x	Improving*^
Rock Pigeon	Improving	Stable
White-crowned Pigeon	Improving*	Worsening
Eurasian Collared-Dove	x	Improving
White-winged Dove	Stable	Improving*
Mourning Dove	Improving	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Improving*	Improving
White-tipped Dove	Potential colonization	-
Yellow-billed Cuckoo	Stable	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Improving*
Eastern Screech-Owl	x	Stable
Great Horned Owl	-	Stable
Burrowing Owl	Potential colonization^	-
Lesser Nighthawk	Potential colonization	Improving*
Common Nighthawk	Worsening*	-
Chuck-will's-widow	Worsening	x
Chimney Swift	Stable	-
Anna's Hummingbird	Potential colonization	-
Costa's Hummingbird	Potential colonization	-
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Improving	Worsening
Golden-fronted Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Worsening	Worsening
Yellow-bellied Sapsucker	-	Worsening
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	-	Potential extirpation

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

Common Name	Summer Trend	Winter Trend
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving	Worsening
California Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	-	Potential colonization
Ruby-crowned Kinglet	-	Stable
Hermit Thrush	-	Stable
American Robin	-	Potential extirpation
Gray Catbird	-	Stable
Curve-billed Thrasher	Potential colonization	Potential colonization
Long-billed Thrasher	-	Potential colonization
Bendire's Thrasher	-	Potential colonization
Northern Mockingbird	Improving	Worsening
European Starling	Stable	Stable
Cedar Waxwing	-	Stable
Ovenbird	-	Worsening*
Black-and-white Warbler	Improving	Worsening*
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Stable
Common Yellowthroat	Improving	Worsening
American Redstart	Improving	x
Northern Parula	-	Worsening
Palm Warbler	-	Worsening^
Pine Warbler	-	Worsening*
Yellow-rumped Warbler	-	Worsening
Yellow-throated Warbler	Stable	Stable
Prairie Warbler	Worsening	Worsening
Hermit Warbler	-	Potential colonization^
Wilson's Warbler	-	Improving

Common Name	Summer Trend	Winter Trend
Green-tailed Towhee	-	Potential colonization
California Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Lark Sparrow	-	Potential colonization
Black-throated Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Worsening
Grasshopper Sparrow	-	Worsening
LeConte's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
Northern Cardinal	Stable	Worsening
Pyrrhuloxia	Potential colonization	Potential colonization
Indigo Bunting	Stable	Worsening
Painted Bunting	-	Worsening
Red-winged Blackbird	Stable	Stable
Eastern Meadowlark	Improving	Worsening*
Common Grackle	Stable	Potential extirpation
Boat-tailed Grackle	Worsening*^	Worsening*^
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Improving
Brown-headed Cowbird	-	Stable
Hooded Oriole	Potential colonization	-
House Finch	Stable	-
American Goldfinch	-	Stable
House Sparrow	x	Stable