



## Glacier Bay National Park and Preserve

### 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 Glacier Bay National Park and Preserve (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 34, remain stable for 26 (e.g., Figure 2), and worsen for 35 species. Suitable climate ceases to occur for 3 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 9 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 35, remain stable for 20, and worsen for 7 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 8 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.

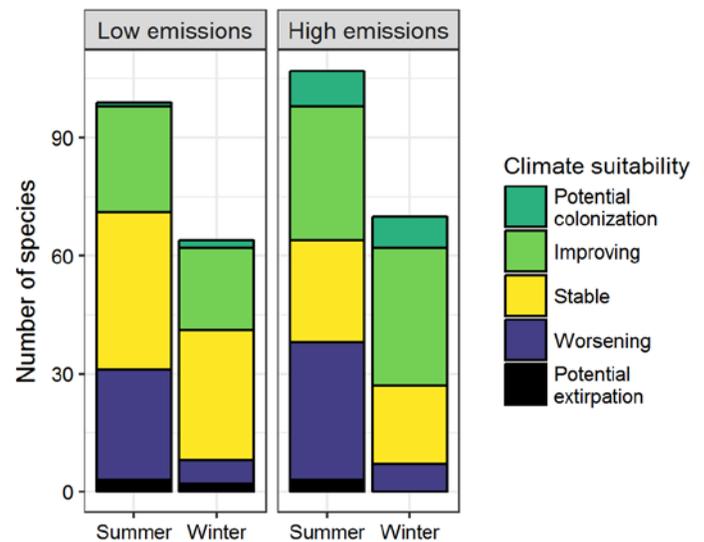


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Park between the present and 2050 is 0.08 in summer (7<sup>th</sup> percentile across all national parks) and 0.08 in winter (4<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.02 in summer and 0.05 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 24 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 23 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, Glacier Bay National Park and Preserve falls within the low change group.** Parks anticipating low change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing

### 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 Lesser Yellowlegs (*Tringa flavipes*), might be extirpated from the Park in summer by 2050.



**Figure 2.** Climate at the Park in summer is projected to remain suitable for the American Robin (*Turdus migratorius*) through 2050. Photo by Andy Reago & Chrissy McClarren/Flickr (CC BY 2.0).

other stressors. Furthermore, park managers have an opportunity to focus on supporting the 23 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.

## Contacts

Gregor Schuurman, Ph.D.  
Ecologist, NPS Climate Change Response Program  
970-267-7211, [gregor\\_schuurman@nps.gov](mailto:gregor_schuurman@nps.gov)

Joanna Wu  
Biologist, National Audubon Society  
415-644-4610, [science@audubon.org](mailto:science@audubon.org)

## 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
Brant	x	Potential colonization
Gadwall	-	Stable
American Wigeon	Stable <sup>^</sup>	Improving
Mallard	Improving <sup>^</sup>	Improving
Blue-winged Teal	Improving	-
Northern Shoveler	Stable <sup>^</sup>	-
Northern Pintail	Worsening	x
Green-winged Teal	x	Improving*
Greater Scaup	Worsening	Improving <sup>^</sup>
Harlequin Duck	x	Improving
Surf Scoter	x	Stable
White-winged Scoter	x	Improving
Black Scoter	x	Improving
Long-tailed Duck	Worsening	Stable
Bufflehead	x	Improving
Common Goldeneye	x	Improving
Barrow's Goldeneye	x	Improving <sup>^</sup>

Common Name	Summer Trend	Winter Trend
Hooded Merganser	x	Improving* <sup>^</sup>
Common Merganser	x	Improving
Red-breasted Merganser	Worsening	Improving <sup>^</sup>
Ring-necked Pheasant	Potential colonization	-
Ruffed Grouse	-	Potential colonization
Willow Ptarmigan	Worsening	-
Rock Ptarmigan	Worsening	-
Red-throated Loon	Worsening	Improving*
Pacific Loon	Worsening	Stable
Common Loon	Improving	Improving* <sup>^</sup>
Horned Grebe	x	Improving*
Red-necked Grebe	Improving	Improving <sup>^</sup>
Western Grebe	-	Improving
Northern Gannet	-	Potential colonization <sup>^</sup>
Brandt's Cormorant	-	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Double-crested Cormorant	x	Potential colonization
Pelagic Cormorant	x	Stable
American Bittern	Potential colonization	-
Great Blue Heron	Improving	Improving
Northern Harrier	Stable^	-
Bald Eagle	x	Improving
Red-tailed Hawk	Improving	-
Black Oystercatcher	x	Stable
Black-bellied Plover	-	Potential colonization
Semipalmated Plover	Worsening	-
Killdeer	Improving	Improving
Solitary Sandpiper	Worsening	-
Greater Yellowlegs	Worsening	-
Lesser Yellowlegs	Potential extirpation^	-
Black Turnstone	x	Stable
Sanderling	x	Improving
Dunlin	-	Improving^
Rock Sandpiper	-	Stable
Western Sandpiper	Worsening	-
Wilson's Snipe	Worsening*	-
Red-necked Phalarope	Worsening	-
Parasitic Jaeger	Potential extirpation	-
Long-tailed Jaeger	Worsening	-
Common Murre	x	Stable
Pigeon Guillemot	Stable	Stable
Marbled Murrelet	Stable	Stable
Bonaparte's Gull	Stable	-
Franklin's Gull	Potential extirpation	-
Mew Gull	Worsening*	Stable
Ring-billed Gull	Potential colonization^	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Herring Gull	Improving	Improving*^
Glaucous-winged Gull	Stable	Stable
Glaucous Gull	Worsening	-
Arctic Tern	Worsening	-
Band-tailed Pigeon	Potential colonization	-
Northern Pygmy-Owl	x	Worsening
Common Nighthawk	Improving	-
Anna's Hummingbird	-	Stable
Rufous Hummingbird	Stable	-
Belted Kingfisher	Improving*	Improving
Red-breasted Sapsucker	Improving*	-
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Improving	Improving
American Three-toed Woodpecker	x	Worsening*^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Yellow-bellied Flycatcher	Stable	-
Alder Flycatcher	Stable	-
Willow Flycatcher	Potential colonization	-
Hammond's Flycatcher	Stable	-
Pacific-slope Flycatcher	Improving*	-
Northern Shrike	x	Stable
Warbling Vireo	Improving*	-
Steller's Jay	Stable	-
Black-billed Magpie	Worsening^	Worsening*
Northwestern Crow	Improving*	Improving
Common Raven	Improving	Worsening
Tree Swallow	Improving	-
Violet-green Swallow	Improving	Potential colonization
Barn Swallow	Improving	-
Cliff Swallow	Improving	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Black-capped Chickadee	Improving	-
Chestnut-backed Chickadee	Improving	Stable
Red-breasted Nuthatch	Stable	-
Brown Creeper	Stable^	Stable
Pacific/Winter Wren	Improving*	Improving
Golden-crowned Kinglet	Stable	Improving
Ruby-crowned Kinglet	Worsening*	-
Townsend's Solitaire	Stable^	-
Gray-cheeked Thrush	Worsening*	-
Swainson's Thrush	Improving*	-
Hermit Thrush	Worsening	-
American Robin	Stable	Improving
Varied Thrush	Worsening^	Improving
European Starling	Improving*	-
American Pipit	Stable	-
Bohemian Waxwing	Worsening^	-
Cedar Waxwing	Improving	-
Snow Bunting	-	Worsening
Blue-winged Warbler	Potential colonization	-
Tennessee Warbler	Stable	-
Orange-crowned Warbler	Worsening	-
MacGillivray's Warbler	Improving	-
Common Yellowthroat	Stable	-
American Redstart	Improving	-
Yellow Warbler	Stable	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Yellow-rumped Warbler	Stable	-
Townsend's Warbler	Improving*	-
Wilson's Warbler	Worsening*	-
Spotted Towhee	Potential colonization	-
American Tree Sparrow	-	Stable
Savannah Sparrow	Worsening	-
Fox Sparrow	Worsening*	-
Song Sparrow	Improving*	Improving
Lincoln's Sparrow	Worsening*	-
Swamp Sparrow	Potential colonization	-
White-crowned Sparrow	Worsening*	-
Golden-crowned Sparrow	Worsening*	-
Dark-eyed Junco	x	Improving
Western Tanager	Improving*	-
Red-winged Blackbird	Improving	-
Rusty Blackbird	Worsening	-
Brewer's Blackbird	-	Potential colonization
Brown-headed Cowbird	Improving	-
Pine Grosbeak	Stable^	Worsening*
Purple Finch	Potential colonization	-
Red Crossbill	Stable^	x
White-winged Crossbill	Worsening	Worsening*
Common Redpoll	Worsening	Stable
Pine Siskin	Stable	Improving