Birds and Climate Change

National Park Service
U.S. Department of the Interior

Glacier 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 Glacier 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 43 (e.g., Figure 2), remain stable for 31, and worsen for 27 species. Suitable climate ceases to occur for 38 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 19, remain stable for 6, and worsen for 11 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 30 species not found at the Park today, potentially resulting in local colonization.

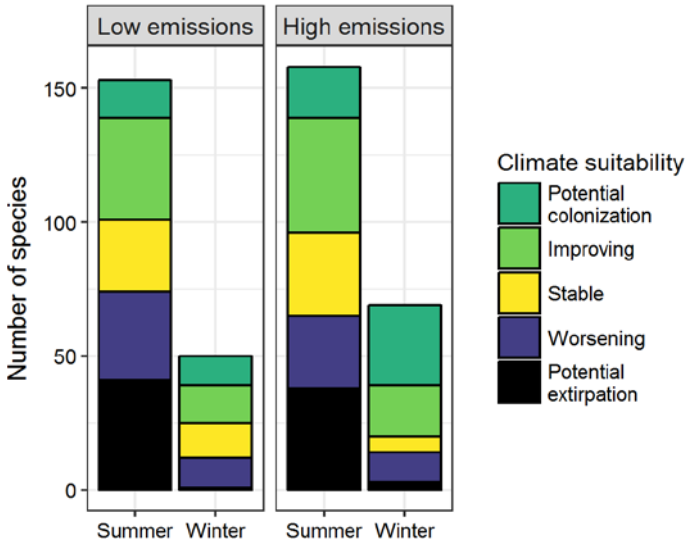

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.36 in summer (63rd percentile across all national parks) and 0.33 in winter (52nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.28 in summer and 0.24 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 32 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 19 of these climate-sensitive species, 13 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 American Goldfinch (*Spinus tristis*) through 2050. Photo by John Benson/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, Glacier National Park falls within the high turnover group.** Parks anticipating high turnover 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 19 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 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
Gadwall	Potential extirpation^	-
American Wigeon	Worsening^	Potential colonization
American Black Duck	-	Potential colonization
Mallard	Stable^	Improving
Blue-winged Teal	Potential extirpation	-
Northern Shoveler	Potential extirpation^	-
Redhead	Potential extirpation^	-
Greater Scaup	-	Potential colonization^
Common Eider	-	Potential colonization
Harlequin Duck	x	Potential colonization
White-winged Scoter	-	Potential colonization
Long-tailed Duck	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Bufflehead	x	Improving
Common Goldeneye	x	Improving
Barrow's Goldeneye	x	Worsening^
Hooded Merganser	x	Potential colonization^
Common Merganser	x	Improving
Red-breasted Merganser	Potential extirpation	-
Ruddy Duck	Potential extirpation	-
Ring-necked Pheasant	Improving	Potential colonization
Ruffed Grouse	x	Improving
Spruce Grouse	x	Potential extirpation
Sharp-tailed Grouse	Potential extirpation^	-
Wild Turkey	x	Potential colonization
Common Loon	Worsening	Improving^

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Potential colonization
Red-necked Grebe	Potential extirpation	Improving^
Great Cormorant	-	Potential colonization
American Bittern	Potential colonization	-
Great Blue Heron	Improving	-
Northern Harrier	Stable^	-
Bald Eagle	x	Stable
Swainson's Hawk	Potential extirpation^	-
Red-tailed Hawk	Stable	-
Ferruginous Hawk	Potential extirpation^	-
American Coot	x	Improving
Killdeer	Improving	-
Solitary Sandpiper	Potential extirpation	-
Willet	Potential extirpation^	-
Long-billed Curlew	Potential extirpation^	-
Marbled Godwit	Potential extirpation^	-
Purple Sandpiper	-	Potential colonization
Wilson's Snipe	Worsening*	Potential colonization
Wilson's Phalarope	Potential extirpation^	-
Black Guillemot	-	Potential colonization
Franklin's Gull	Potential extirpation	-
Ring-billed Gull	Stable^	Potential colonization
Herring Gull	-	Potential colonization^
Great Black-backed Gull	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Black Tern	Potential extirpation	-
Rock Pigeon	Improving	-
Mourning Dove	Improving*	Potential colonization
Northern Pygmy-Owl	x	Stable
Barred Owl	x	Improving
Common Nighthawk	Stable	-
Ruby-throated Hummingbird	Potential colonization	-
Black-chinned Hummingbird	Stable	-
Rufous Hummingbird	Stable	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Improving	Improving
Yellow-bellied Sapsucker	Potential colonization	-
Red-naped Sapsucker	Worsening^	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Improving	Stable
American Three-toed Woodpecker	x	Worsening*^
Northern Flicker	Worsening	Improving
Pileated Woodpecker	Improving	Improving
Olive-sided Flycatcher	Worsening	-
Western Wood-Pewee	Worsening*^	-
Eastern Wood-Pewee	Potential colonization	-
Alder Flycatcher	Stable	-
Willow Flycatcher	Improving	-
Least Flycatcher	Worsening	-
Hammond's Flycatcher	Worsening*	-
Dusky Flycatcher	Worsening*	-
Cordilleran Flycatcher	Stable	-
Eastern Phoebe	Potential colonization	-
Say's Phoebe	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Great Crested Flycatcher	Potential colonization	-
Western Kingbird	Improving	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	Stable	-
Warbling Vireo	Worsening	-
Red-eyed Vireo	Improving*	-
Gray Jay	Worsening*	Worsening*
Steller's Jay	Stable	Worsening*
Blue Jay	Improving*	Potential colonization
Black-billed Magpie	Potential extirpation^	Potential extirpation
Clark's Nutcracker	Stable^	-
American Crow	Improving*	Potential colonization
Common Raven	Stable	Worsening
Horned Lark	Stable	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Improving	-
Violet-green Swallow	Stable	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Improving	Worsening
Mountain Chickadee	Worsening*	Worsening*
Chestnut-backed Chickadee	Stable	Stable
Boreal Chickadee	Potential extirpation^	-
Tufted/Black-crested Titmouse	-	Potential colonization
Red-breasted Nuthatch	Worsening	Worsening
White-breasted Nuthatch	Improving*	Potential colonization
Pygmy Nuthatch	Stable	-
Brown Creeper	Stable^	Improving
Rock Wren	Potential extirpation	-
House Wren	Improving	-
Pacific/Winter Wren	Stable	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening	Improving
Ruby-crowned Kinglet	Worsening*	-
Western Bluebird	Stable	-
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Worsening^	Potential extirpation
Veery	Improving*	-
Swainson's Thrush	Worsening	-
Hermit Thrush	Stable	-
Wood Thrush	Potential colonization	-
American Robin	Stable	Improving*
Varied Thrush	Worsening*^	-
Gray Catbird	Improving*	-
Northern Mockingbird	Improving	-
European Starling	Improving*	Potential colonization
American Pipit	Potential extirpation	-
Cedar Waxwing	Improving*	Improving
Snow Bunting	-	Stable
Ovenbird	Improving*	-
Worm-eating Warbler	Potential colonization	-
Northern Waterthrush	Worsening	-
Blue-winged Warbler	Potential colonization	-
Black-and-white Warbler	Potential colonization	-
Tennessee Warbler	Potential extirpation	-
Orange-crowned Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Nashville Warbler	Improving	-
MacGillivray's Warbler	Worsening*	-
Common Yellowthroat	Improving	-
Hooded Warbler	Potential colonization	-
American Redstart	Stable	-
Northern Parula	Potential colonization	-
Blackburnian Warbler	Potential colonization	-
Yellow Warbler	Improving	-
Chestnut-sided Warbler	Potential colonization	-
Yellow-rumped Warbler	Stable	-
Townsend's Warbler	Worsening*	-
Black-throated Green Warbler	Potential colonization	-
Canada Warbler	Potential colonization	-
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Improving	-
Spotted Towhee	Stable	-
Eastern Towhee	Potential colonization	-
American Tree Sparrow	-	Potential colonization
Chipping Sparrow	Improving	-
Clay-colored Sparrow	Potential extirpation	-
Brewer's Sparrow	Potential extirpation	-
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Potential extirpation	-
Lark Bunting	Potential extirpation	-
Savannah Sparrow	Stable	-
Grasshopper Sparrow	Improving	-
LeConte's Sparrow	Potential	-

Common Name	Summer Trend	Winter Trend
	extirpation^	
Fox Sparrow	Potential extirpation	-
Song Sparrow	Improving	Potential colonization
Lincoln's Sparrow	Potential extirpation	-
White-throated Sparrow	-	Potential colonization
White-crowned Sparrow	Potential extirpation	-
Dark-eyed Junco	x	Improving
Scarlet Tanager	Potential colonization	-
Western Tanager	Worsening*	-
Rose-breasted Grosbeak	Improving	-
Black-headed Grosbeak	Stable	-
Lazuli Bunting	Stable	-
Bobolink	Improving	-
Red-winged Blackbird	Improving	-
Western Meadowlark	Potential extirpation	-
Yellow-headed Blackbird	Potential extirpation	-
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving*	-
Brown-headed Cowbird	Improving	-
Bullock's Oriole	Stable	-
Pine Grosbeak	Worsening^	Worsening*
House Finch	Improving*	-
Purple Finch	Potential colonization	Potential colonization
Cassin's Finch	Stable	-
Red Crossbill	Worsening^	x
White-winged Crossbill	Potential extirpation	-
Common Redpoll	-	Worsening
Pine Siskin	Worsening*	Improving

Common Name	Summer Trend	Winter Trend
American Goldfinch	Improving*	Potential colonization

Common Name	Summer Trend	Winter Trend
Evening Grosbeak	Improving	Stable