Birds and Climate Change

National Park Service
U.S. Department of the Interior

Apostle Islands National Lakeshore

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 Apostle Islands National Lakeshore (hereafter, the Lakeshore) 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 Lakeshore based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Lakeshore 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 Lakeshore, 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 Lakeshore today, climate suitability in summer under the high-emissions pathway is projected to improve for 33 (e.g., Figure 2), remain stable for 17, and worsen for 14 species. Suitable climate ceases to occur for 58 species in summer, potentially resulting in extirpation of those species from the Lakeshore. Climate is projected to become suitable in summer for 14 species not found at the Lakeshore today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 20, remain stable for 4, and worsen for 6 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Lakeshore. Climate is projected to become suitable in winter for 38 species not found at the Lakeshore today, potentially resulting in local colonization.

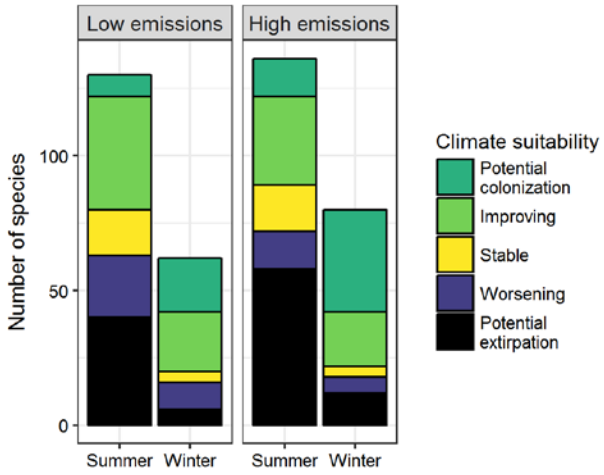

Figure 1. Projected changes in climate suitability for birds at the Lakeshore, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Lakeshore between the present and 2050 is 0.47 in summer (87th percentile across all national parks) and 0.52 in winter (89th percentile) under the high-emissions pathway. Potential species turnover declines to 0.29 in summer and 0.34 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 Lakeshore is or may become home to 12 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 Lakeshore may serve as an important refuge for 5 of these climate-sensitive species, 7 might be extirpated from the Lakeshore in at least one season by 2050.

Figure 2. Climate at the Lakeshore 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, Apostle Islands National Lakeshore 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 5 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 Lakeshore based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Lakeshore 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
Cackling/Canada Goose	x	Potential colonization
Mute Swan	-	Potential colonization
Wood Duck	x	Potential colonization
Gadwall	Potential extirpation^	Potential colonization
American Black Duck	x	Potential colonization
Mallard	Stable^	Potential colonization
Blue-winged Teal	Worsening	-
Canvasback	-	Potential colonization
Greater Scaup	-	Improving^
Lesser Scaup	-	Potential colonization
Long-tailed Duck	Stable	Improving
Common Goldeneye	-	Improving
Red-breasted Merganser	Potential extirpation	Improving^
Northern Bobwhite	Potential colonization	Potential colonization
Ruffed Grouse	x	Potential extirpation
Common Loon	Potential extirpation	-
American Bittern	Potential extirpation	-
Great Blue Heron	Improving	Improving*
Green Heron	Improving	-
Northern Harrier	Worsening^	Potential colonization
Sharp-shinned Hawk	x	Potential colonization
Cooper's Hawk	x	Potential colonization
Northern Goshawk	x	Potential extirpation
Bald Eagle	x	Stable

Common Name	Summer Trend	Winter Trend
Red-shouldered Hawk	Improving	-
Red-tailed Hawk	Improving	Potential colonization
Rough-legged Hawk	-	Stable
Killdeer	Improving	-
Upland Sandpiper	Stable	-
Wilson's Snipe	-	Potential colonization
Ring-billed Gull	Potential extirpation^	Potential colonization
Herring Gull	Potential extirpation	Improving^
Iceland Gull (Thayer's)	-	Potential colonization
Black Tern	Potential extirpation	-
Rock Pigeon	Improving	Improving
Mourning Dove	Improving	-
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Worsening	-
Eastern Screech-Owl	-	Potential colonization
Great Horned Owl	x	Improving
Snowy Owl	-	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Chimney Swift	Improving*	-
Ruby-throated Hummingbird	Worsening	-
Belted Kingfisher	Potential extirpation	Potential colonization
Red-headed Woodpecker	Improving*	Potential colonization
Red-bellied Woodpecker	Potential colonization	-
Yellow-bellied Sapsucker	Potential extirpation	Potential colonization
Downy Woodpecker	Improving	Improving

Common Name	Summer Trend	Winter Trend
Hairy Woodpecker	Potential extirpation	Stable
Black-backed Woodpecker	x	Potential extirpation
Northern Flicker	Stable	Improving*
Pileated Woodpecker	Potential extirpation	Worsening
American Kestrel	x	Potential colonization
Olive-sided Flycatcher	Potential extirpation	-
Eastern Wood-Pewee	Stable	-
Yellow-bellied Flycatcher	Potential extirpation	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Potential colonization	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Worsening	-
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Improving	-
Northern Shrike	-	Worsening
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Improving	-
Red-eyed Vireo	Potential extirpation	-
Gray Jay	Potential extirpation	Potential extirpation
Blue Jay	Stable	Improving
American Crow	Stable	Improving
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Potential colonization	Potential colonization
Northern Rough-winged Swallow	Improving*	-
Purple Martin	Improving	-

Common Name	Summer Trend	Winter Trend
Tree Swallow	Worsening	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Worsening	Worsening
Boreal Chickadee	Potential extirpation^	Potential extirpation
Tufted Titmouse	Potential colonization	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Worsening
White-breasted Nuthatch	Stable	Improving
Brown Creeper	Potential extirpation^	Improving
House Wren	Improving	-
Pacific/Winter Wren	Potential extirpation	-
Sedge Wren	Worsening	-
Carolina Wren	-	Potential colonization
Golden-crowned Kinglet	Potential extirpation	-
Ruby-crowned Kinglet	Potential extirpation	-
Eastern Bluebird	Improving*	Potential colonization
Veery	Potential extirpation	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	-
Wood Thrush	Stable	-
American Robin	Worsening	Potential colonization
Gray Catbird	Improving	-
Brown Thrasher	Improving*	-
Northern Mockingbird	Improving	Improving
European Starling	Improving	-
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Worsening	Improving
Snow Bunting	-	Worsening
Ovenbird	Potential extirpation	-
Northern Waterthrush	Potential extirpation	-
Blue-winged Warbler	Potential colonization	-
Golden-winged Warbler	Worsening	-
Black-and-white Warbler	Potential extirpation	-
Tennessee Warbler	Potential extirpation	-
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Potential extirpation	-
Common Yellowthroat	Worsening	-
American Redstart	Potential extirpation	-
Cape May Warbler	Potential extirpation	-
Northern Parula	Potential extirpation	-
Magnolia Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Stable	-
Chestnut-sided Warbler	Potential extirpation	-
Black-throated Blue Warbler	Potential extirpation	-
Palm Warbler	Potential extirpation	-
Pine Warbler	Potential extirpation^	-
Yellow-rumped Warbler	Potential extirpation	-
Black-throated Green Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Canada Warbler	Potential extirpation	-
Wilson's Warbler	Potential extirpation	-
Eastern Towhee	Improving	-
American Tree Sparrow	-	Improving
Chipping Sparrow	Stable	-
Clay-colored Sparrow	Potential extirpation	-
Field Sparrow	Potential colonization	-
Vesper Sparrow	Improving	-
Lark Sparrow	Potential colonization	-
Savannah Sparrow	Stable	-
Grasshopper Sparrow	Potential colonization	-
LeConte's Sparrow	Potential extirpation^	-
Song Sparrow	Stable	Potential colonization
Lincoln's Sparrow	Potential extirpation	-
Swamp Sparrow	Potential extirpation	Potential colonization
White-throated Sparrow	Potential extirpation	Potential colonization
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Scarlet Tanager	Worsening	-
Northern Cardinal	Improving*	-
Rose-breasted Grosbeak	Worsening	-
Indigo Bunting	Improving	-
Dickcissel	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Bobolink	Stable	-
Red-winged Blackbird	Improving	Potential colonization
Eastern Meadowlark	Improving*	-
Western Meadowlark	Potential colonization	-
Yellow-headed Blackbird	Potential extirpation	-
Rusty Blackbird	-	Potential colonization
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving	Potential colonization
Brown-headed Cowbird	Improving	Potential colonization
Orchard Oriole	Potential colonization	-
Baltimore Oriole	Improving	-
Pine Grosbeak	-	Potential extirpation
House Finch	Potential colonization	Potential colonization
Purple Finch	Potential extirpation	Stable
Red Crossbill	Potential extirpation^	x
White-winged Crossbill	Potential extirpation	Potential extirpation
Common Redpoll	-	Potential extirpation
Pine Siskin	Potential extirpation	Worsening
American Goldfinch	Improving	Improving
Evening Grosbeak	Potential extirpation	Potential extirpation
House Sparrow	x	Potential colonization
Eurasian Tree Sparrow	-	Potential colonization