Birds and Climate Change

National Park Service
U.S. Department of the Interior

Acadia 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 Acadia 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 40, remain stable for 29 (e.g., Figure 2), and worsen for 14 species. Suitable climate ceases to occur for 60 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 12 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 51, remain stable for 21, and worsen for 11 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 45 species not found at the Park today, potentially resulting in local colonization.

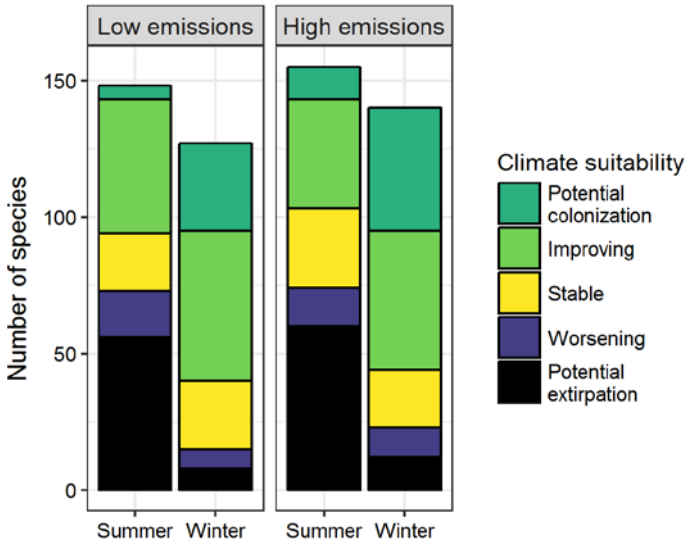

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.44 in summer (80th percentile across all national parks) and 0.46 in winter (78th percentile) under the high-emissions pathway. Potential species turnover declines to 0.36 in summer and 0.40 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 26 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 20 of these climate-sensitive species, 6 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, Acadia 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 20 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
Brant	-	Potential colonization
Cackling/Canada Goose	x	Improving
Mute Swan	-	Potential colonization
Wood Duck	x	Potential colonization
Gadwall	-	Potential colonization
Eurasian Wigeon	-	Potential colonization
American Wigeon	Potential extirpation^	Improving*
American Black Duck	x	Improving
Mallard	Stable^	Improving
Blue-winged Teal	Potential extirpation	-
Northern Shoveler	-	Potential colonization
Green-winged Teal	x	Potential colonization

Common Name	Summer Trend	Winter Trend
Canvasback	-	Potential colonization
Ring-necked Duck	x	Potential colonization
Greater Scaup	Stable	Improving^
Lesser Scaup	-	Potential colonization
Common Eider	x	Stable
Harlequin Duck	-	Worsening
Surf Scoter	x	Stable
White-winged Scoter	x	Stable
Black Scoter	x	Improving
Long-tailed Duck	Stable	Stable
Bufflehead	-	Improving
Common Goldeneye	x	Stable
Barrow's Goldeneye	-	Worsening^
Hooded Merganser	x	Improving^
Common Merganser	x	Stable
Red-breasted Merganser	Potential	Improving^

Common Name	Summer Trend	Winter Trend
	extirpation	
Ruddy Duck	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Ruffed Grouse	x	Potential extirpation
Wild Turkey	x	Stable
Red-throated Loon	Stable	Improving
Common Loon	Potential extirpation	Stable^
Pied-billed Grebe	x	Potential colonization
Horned Grebe	-	Improving
Red-necked Grebe	Potential extirpation	Worsening*^
Northern Gannet	Stable^	Improving^
Double-crested Cormorant	x	Improving
Great Cormorant	x	Improving
American Bittern	Potential extirpation	Potential colonization^
Great Blue Heron	Improving	Improving
Great Egret	Improving	-
Little Blue Heron	Stable	-
Green Heron	Improving	-
Black-crowned Night-Heron	x	Potential colonization
Black Vulture	-	Potential colonization
Turkey Vulture	x	Improving
Northern Harrier	Potential extirpation^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving
Northern Goshawk	x	Worsening*
Bald Eagle	x	Potential extirpation
Red-shouldered Hawk	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Improving*	Improving
Rough-legged Hawk	-	Worsening
Clapper Rail	-	Potential colonization
American Coot	-	Potential colonization
Black-bellied Plover	x	Potential colonization
Killdeer	Improving	-
Greater Yellowlegs	Potential extirpation	-
Willet	Stable^	-
Lesser Yellowlegs	Potential extirpation^	-
Upland Sandpiper	Potential extirpation	-
Ruddy Turnstone	x	Improving^
Dunlin	-	Potential colonization^
Purple Sandpiper	x	Stable
Wilson's Snipe	Potential extirpation	-
American Woodcock	x	Potential colonization
Red-necked Phalarope	Stable	-
Parasitic Jaeger	Improving	-
Common Murre	x	Stable
Black Guillemot	x	Worsening*
Bonaparte's Gull	Potential extirpation	Improving
Laughing Gull	Stable^	-
Ring-billed Gull	Worsening^	Improving
Herring Gull	Worsening	Stable^
Iceland Gull (Thayer's)	-	Potential colonization
Great Black-backed Gull	x	Stable
Black Tern	Potential extirpation	-
Arctic Tern	Stable	-

Common Name	Summer Trend	Winter Trend
Rock Pigeon	Stable	Stable
Mourning Dove	Improving	Worsening
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Worsening	-
Eastern Screech-Owl	-	Potential colonization
Great Horned Owl	x	Improving
Snowy Owl	-	Stable
Barred Owl	x	Stable
Common Nighthawk	Stable	-
Chimney Swift	Improving*	-
Ruby-throated Hummingbird	Worsening	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Improving*	Improving*
Yellow-bellied Sapsucker	Potential extirpation	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Worsening	Worsening
Black-backed Woodpecker	x	Potential extirpation
Northern Flicker	Stable	Improving
Pileated Woodpecker	Potential extirpation	Potential extirpation
American Kestrel	x	Potential colonization
Merlin	x	Improving^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Potential extirpation	-
Eastern Wood-Pewee	Improving	-
Yellow-bellied Flycatcher	Potential extirpation	-
Acadian Flycatcher	Potential colonization	-
Alder Flycatcher	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Willow Flycatcher	Improving*	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	-
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Stable	-
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Potential colonization	-
Yellow-throated Vireo	Potential colonization	-
Warbling Vireo	Improving	-
Philadelphia Vireo	Potential extirpation	-
Red-eyed Vireo	Worsening	-
Gray Jay	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Worsening	Stable
Fish Crow	Improving	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	-	Potential colonization
Northern Rough-winged Swallow	Improving*	-
Purple Martin	Improving*	-
Tree Swallow	Worsening	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	-
Black-capped Chickadee	Worsening*	Stable
Boreal Chickadee	Potential extirpation^	Potential extirpation
Tufted Titmouse	Improving*	Improving*
Red-breasted Nuthatch	Potential extirpation	Potential extirpation

Common Name	Summer Trend	Winter Trend
White-breasted Nuthatch	Improving	Improving
Brown Creeper	Potential extirpation^	Improving
House Wren	Stable	-
Pacific/Winter Wren	Potential extirpation	Potential colonization
Carolina Wren	Improving*	Potential colonization
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	Potential extirpation	Improving
Ruby-crowned Kinglet	Potential extirpation	Potential colonization
Eastern Bluebird	Improving	Potential colonization
Veery	Potential extirpation	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	Improving*
Wood Thrush	Improving*	-
American Robin	Improving	Improving
Gray Catbird	Improving	Potential colonization
Brown Thrasher	Stable	Potential colonization
Northern Mockingbird	Improving*	Improving*
European Starling	Improving	Improving
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Worsening	Improving
Snow Bunting	-	Worsening*
Ovenbird	Worsening*	-
Worm-eating Warbler	Potential colonization	-
Northern Waterthrush	Potential extirpation	-
Blue-winged Warbler	Improving	-
Golden-winged Warbler	Stable	-

Common Name	Summer Trend	Winter Trend
Black-and-white Warbler	Potential extirpation	-
Tennessee Warbler	Potential extirpation	-
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
American Redstart	Potential extirpation	-
Cape May Warbler	Potential extirpation	-
Northern Parula	Potential extirpation	-
Magnolia Warbler	Potential extirpation	-
Bay-breasted Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Worsening	-
Chestnut-sided Warbler	Potential extirpation	-
Blackpoll Warbler	Potential extirpation	-
Black-throated Blue Warbler	Potential extirpation	-
Palm Warbler	Potential extirpation	Potential colonization^
Pine Warbler	Stable^	Potential colonization
Yellow-rumped Warbler	Potential extirpation	Improving*
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Improving	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Wilson's Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Improving*	-
American Tree Sparrow	-	Worsening
Chipping Sparrow	Stable	Potential colonization
Field Sparrow	Improving*	Potential colonization
Vesper Sparrow	Improving	-
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Potential colonization	-
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	x	Potential colonization^
Seaside Sparrow	-	Potential colonization^
Fox Sparrow	-	Improving
Song Sparrow	Stable	Improving
Lincoln's Sparrow	Potential extirpation	-
Swamp Sparrow	Potential extirpation	Potential colonization
White-throated Sparrow	Potential extirpation	Improving
Dark-eyed Junco	x	Improving
Scarlet Tanager	Stable	-
Northern Cardinal	Improving*	Improving
Rose-breasted Grosbeak	Worsening	-

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