Birds and Climate Change

National Park Service
U.S. Department of the Interior

Katmai 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 Katmai 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.

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 16, remain stable for 11 (e.g., Figure 2), and worsen for 34 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 21 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 4, remain stable for 2, and worsen for 5 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 34 species not found at the Park today, potentially resulting in local colonization.

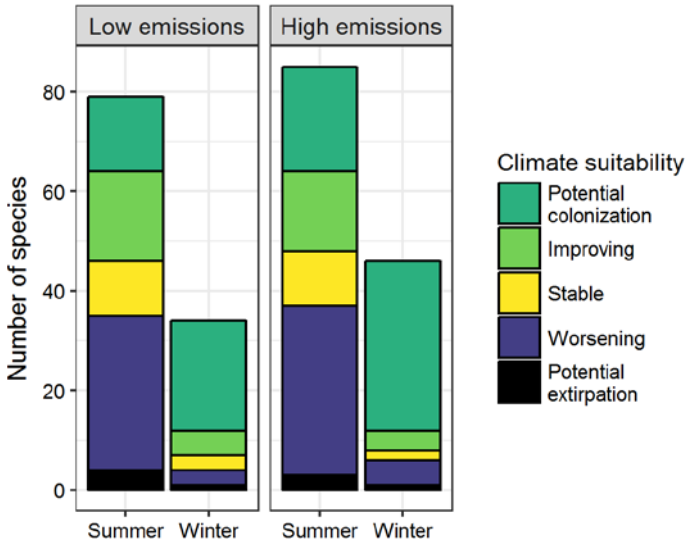

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (34th percentile across all national parks) and 0.25 in winter (37th percentile) under the high-emissions pathway. Potential species turnover declines to 0.15 in summer and 0.17 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 17 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 16 of these 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 Violet-green Swallow (*Tachycineta thalassina*) through 2050. Photo by Becky Matsubara/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, Katmai National Park and Preserve falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 16 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
Brant	x	Potential colonization
Tundra Swan	Worsening	-
Eurasian Wigeon	-	Potential colonization
American Wigeon	Worsening^	Potential colonization
Mallard	Improving^	-
Northern Pintail	Potential extirpation	-
Green-winged Teal	x	Potential colonization
Greater Scaup	Worsening	Potential colonization^
White-winged Scoter	x	Improving
Bufflehead	-	Potential colonization
Common Merganser	x	Stable
Red-breasted Merganser	Worsening	-
Ring-necked Pheasant	Potential colonization	-
Ruffed Grouse	-	Potential colonization
Willow Ptarmigan	Worsening	Worsening*
Rock Ptarmigan	Worsening	Stable
Red-throated Loon	Worsening	Potential colonization
Common Loon	Improving	-
Horned Grebe	-	Potential colonization
Red-necked Grebe	Worsening	Improving^
Northern Fulmar	-	Potential colonization
Brandt's Cormorant	-	Potential colonization
Great Cormorant	-	Potential colonization
American Bittern	Potential colonization	-
Northern Harrier	Stable^	-
Rough-legged Hawk	Worsening	-
Black Oystercatcher	x	Potential colonization

Common Name	Summer Trend	Winter Trend
Semipalmated Plover	Worsening	-
Greater Yellowlegs	Worsening	-
Lesser Yellowlegs	Potential extirpation^	-
Black Turnstone	x	Potential colonization
Surfbird	x	Potential colonization^
Sanderling	-	Potential colonization
Dunlin	-	Potential colonization^
Wilson's Snipe	Worsening	Potential colonization
Red-necked Phalarope	Worsening	-
Pomarine Jaeger	-	Potential colonization^
Parasitic Jaeger	Potential extirpation	-
Common Murre	x	Improving
Black Guillemot	-	Potential colonization
Pigeon Guillemot	Stable	-
Marbled Murrelet	Improving	-
Ancient Murrelet	-	Potential colonization
Bonaparte's Gull	Worsening	-
Mew Gull	Worsening*	-
Ring-billed Gull	Potential colonization^	-
Western Gull	Potential colonization	-
Herring Gull	Improving*	Potential colonization^
Iceland Gull (Thayer's)	-	Potential colonization
Glaucous-winged Gull	Worsening	-
Glaucous Gull	Worsening	-
Great Black-backed Gull	-	Potential colonization
Arctic Tern	Worsening	-

Common Name	Summer Trend	Winter Trend
Western Screech-Owl	-	Potential colonization
Northern Pygmy-Owl	-	Potential colonization
Belted Kingfisher	Improving	Potential colonization
Red-breasted Sapsucker	-	Potential colonization
Downy Woodpecker	Improving	Potential extirpation
Hairy Woodpecker	Potential colonization	-
Alder Flycatcher	Stable	-
Willow Flycatcher	Potential colonization	-
Pacific-slope Flycatcher	Potential colonization	-
Warbling Vireo	Potential colonization	-
Gray Jay	Worsening*	Worsening*
Black-billed Magpie	Stable^	-
Northwestern Crow	Improving	-
Common Raven	Stable	Worsening
Horned Lark	Stable	-
Tree Swallow	Improving	-
Violet-green Swallow	Stable	-
Black-capped Chickadee	Improving	-
Chestnut-backed Chickadee	Potential colonization	-
Boreal Chickadee	Worsening*^	-
Brown Creeper	Improving^	-
Pacific/Winter Wren	-	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Improving	Potential colonization
Ruby-crowned Kinglet	Stable	-
Gray-cheeked Thrush	Worsening*	-
Swainson's Thrush	Worsening	-
Hermit Thrush	Stable	-

Common Name	Summer Trend	Winter Trend
American Robin	Stable	-
Varied Thrush	Worsening^	-
American Pipit	Stable	-
Lapland Longspur	Worsening	-
Golden-winged Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening*	-
Nashville Warbler	Potential colonization	-
Mourning Warbler	Potential colonization	-
American Redstart	Potential colonization	-
Magnolia Warbler	Potential colonization	-
Yellow Warbler	Improving	-
Blackpoll Warbler	Worsening*	-
Yellow-rumped Warbler	Worsening	-
Black-throated Green Warbler	Potential colonization	-
Canada Warbler	Potential colonization	-
Wilson's Warbler	Worsening	-
American Tree Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	Improving	-
Fox Sparrow	Worsening	Potential colonization
Song Sparrow	Improving*	-
Swamp Sparrow	Potential colonization	-
White-throated Sparrow	Potential colonization	-
White-crowned Sparrow	Worsening*	-
Golden-crowned Sparrow	Worsening*	-
Dark-eyed Junco	x	Improving
Western Tanager	Potential colonization	-
Brewer's Blackbird	-	Potential colonization
Pine Grosbeak	Worsening^	-
Purple Finch	Potential colonization	-
Red Crossbill	Improving^	-
White-winged Crossbill	Worsening	-
Common Redpoll	Worsening*	Worsening*
Pine Siskin	Improving*	-
Evening Grosbeak	Potential colonization	Potential colonization