



Klondike Gold Rush National Historical 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 Klondike Gold Rush National Historical 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.

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 39, remain stable for 31 (e.g., Figure 2), and worsen for 25 species. Suitable climate ceases to occur for 5 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 22, remain stable for 23, and worsen for 10 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 13 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.

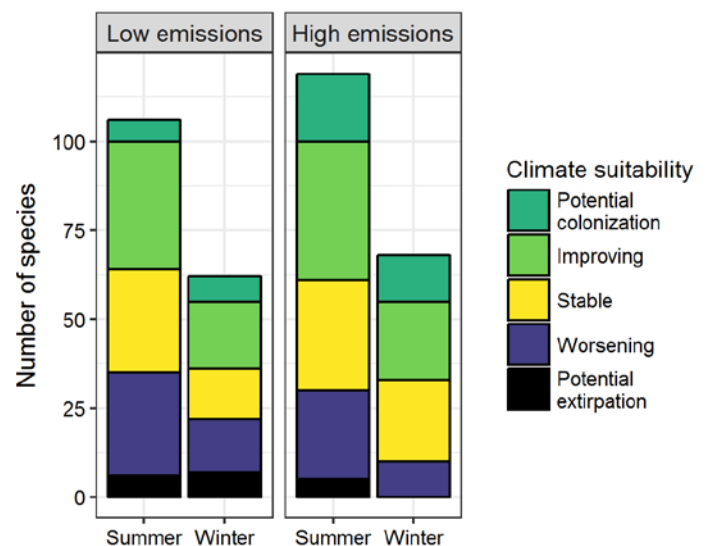


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.16 in summer (22nd percentile across all national parks) and 0.12 in winter (12th percentile) under the high-emissions pathway. Potential species turnover declines to 0.07 in summer and 0.10 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 27 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). Suitable

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Klondike Gold Rush National Historical Park 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

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 is not projected to disappear for these 27 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.



Figure 2. Climate at the Park in summer is projected to remain suitable for the American Redstart (*Setophaga ruticilla*) through 2050. Photo by Becky Matsubara/Flickr (CC BY 2.0).

other stressors. Furthermore, park managers have an opportunity to focus on supporting the 27 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.

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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 colonization [^]	-
American Wigeon	Improving [^]	-
Mallard	Improving [^]	Improving
Blue-winged Teal	Stable	-
Northern Shoveler	Improving [^]	-
Northern Pintail	Worsening	-
Greater Scaup	Worsening*	Improving* [^]
Harlequin Duck	x	Stable
Surf Scoter	x	Stable
White-winged Scoter	x	Potential colonization
Black Scoter	-	Potential colonization
Long-tailed Duck	Potential extirpation	-
Bufflehead	x	Stable
Common Goldeneye	x	Improving
Barrow's Goldeneye	x	Improving [^]

Common Name	Summer Trend	Winter Trend
Hooded Merganser	-	Improving [^]
Common Merganser	x	Improving
Red-breasted Merganser	Worsening	-
Ruddy Duck	Potential colonization	-
California Quail	Potential colonization	Potential colonization
Chukar	-	Potential colonization
Gray Partridge	Potential colonization	Potential colonization
Ring-necked Pheasant	Potential colonization	-
Ruffed Grouse	x	Stable
Spruce Grouse	x	Stable
Willow Ptarmigan	Potential extirpation	Improving*
Rock Ptarmigan	Potential extirpation	Worsening
Red-throated Loon	Worsening	Improving
Pacific Loon	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Common Loon	Improving*	Improving*^
Horned Grebe	x	Potential colonization
Red-necked Grebe	Improving*	Stable^
American Bittern	Potential colonization	-
Great Blue Heron	Improving	-
Golden Eagle	x	Stable
Northern Harrier	Stable^	-
Sharp-shinned Hawk	x	Improving
Northern Goshawk	x	Stable
Red-tailed Hawk	Improving	-
Semipalmated Plover	Worsening	-
Killdeer	Improving	-
Solitary Sandpiper	Worsening	-
Greater Yellowlegs	Improving*	-
Lesser Yellowlegs	Stable^	-
Red-necked Phalarope	Worsening	-
Common Murre	x	Stable
Black Guillemot	-	Potential colonization
Pigeon Guillemot	Worsening	Worsening
Marbled Murrelet	Worsening	Worsening*
Bonaparte's Gull	Improving	-
Mew Gull	Stable	Stable
Ring-billed Gull	Potential colonization^	-
California Gull	-	Potential colonization^
Herring Gull	Stable	Stable^
Iceland Gull (Thayer's)	x	Worsening*
Glaucous-winged Gull	Stable	Stable
Black Tern	Potential colonization	-
Arctic Tern	Stable	-
Rock Pigeon	Improving	-
Western Screech-Owl	x	Improving

Common Name	Summer Trend	Winter Trend
Great Horned Owl	x	Improving
Snowy Owl	-	Improving
Northern Hawk Owl	x	Worsening*^
Common Nighthawk	Improving	-
Rufous Hummingbird	Improving	-
Belted Kingfisher	Improving	-
Red-breasted Sapsucker	Stable	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Improving	Stable
American Three-toed Woodpecker	x	Improving^
Black-backed Woodpecker	-	Potential colonization
Northern Flicker	Stable	-
Merlin	x	Improving^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Improving	-
Western Wood-Pewee	Improving*^	-
Yellow-bellied Flycatcher	Potential colonization	-
Alder Flycatcher	Improving	-
Hammond's Flycatcher	Stable	-
Pacific-slope Flycatcher	Stable	-
Say's Phoebe	Worsening*	-
Northern Shrike	x	Improving*
Warbling Vireo	Stable	-
Gray Jay	Stable	Improving
Steller's Jay	Stable	Stable
Black-billed Magpie	Improving^	Worsening*
Clark's Nutcracker	Potential colonization^	-
Northwestern Crow	Worsening	Stable
Common Raven	Stable	Worsening
Horned Lark	Potential extirpation	-
Tree Swallow	Improving*	-

Common Name	Summer Trend	Winter Trend
Violet-green Swallow	Stable	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Stable	Stable
Chestnut-backed Chickadee	Improving	Worsening*
Red-breasted Nuthatch	Stable	Improving
Pygmy Nuthatch	-	Potential colonization^
Brown Creeper	Improving^	Stable
Pacific/Winter Wren	Stable	-
American Dipper	x	Worsening
Golden-crowned Kinglet	Improving	Stable
Ruby-crowned Kinglet	Worsening	-
Townsend's Solitaire	Stable^	-
Gray-cheeked Thrush	Stable	-
Swainson's Thrush	Stable	-
Hermit Thrush	Worsening*	-
American Robin	Stable	Stable
Varied Thrush	Worsening*^	-
European Starling	Improving*	-
American Pipit	Worsening	-
Bohemian Waxwing	Worsening^	Improving
Cedar Waxwing	Improving	-
Snow Bunting	x	Stable
Northern Waterthrush	Improving*	-
Tennessee Warbler	Improving	-
Orange-crowned Warbler	Worsening	-
Nashville Warbler	Potential colonization	-
MacGillivray's Warbler	Stable	-
Mourning Warbler	Potential colonization	-
Common Yellowthroat	Stable	-
American Redstart	Stable	-
Yellow Warbler	Improving	-

Common Name	Summer Trend	Winter Trend
Blackpoll Warbler	Improving*	-
Palm Warbler	Potential colonization	-
Yellow-rumped Warbler	Improving	-
Townsend's Warbler	Stable	-
Wilson's Warbler	Worsening*	-
Spotted Towhee	Potential colonization	-
American Tree Sparrow	Worsening*	-
Chipping Sparrow	Potential extirpation	-
Savannah Sparrow	Improving*	-
Fox Sparrow	Worsening*	-
Song Sparrow	Improving	-
Lincoln's Sparrow	Stable	-
White-crowned Sparrow	Worsening*	-
Golden-crowned Sparrow	Worsening*	-
Dark-eyed Junco	x	Stable
Western Tanager	Improving*	-
Lazuli Bunting	Potential colonization	-
Red-winged Blackbird	Improving*	-
Rusty Blackbird	Worsening	-
Brewer's Blackbird	Potential colonization	Potential colonization
Bullock's Oriole	Potential colonization	-
Pine Grosbeak	Improving^	Worsening
Purple Finch	Stable	-
Cassin's Finch	Potential colonization	-
Red Crossbill	Stable^	x
White-winged Crossbill	Stable	Stable
Common Redpoll	Improving*	Improving
Pine Siskin	Worsening	Potential colonization
Evening Grosbeak	Potential colonization	Potential colonization

