



Yellowstone 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 Yellowstone 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.

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 47 (e.g., Figure 2), remain stable for 40, and worsen for 32 species. Suitable climate ceases to occur for 17 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 5 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 20, remain stable for 29, and worsen for 9 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 5 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.

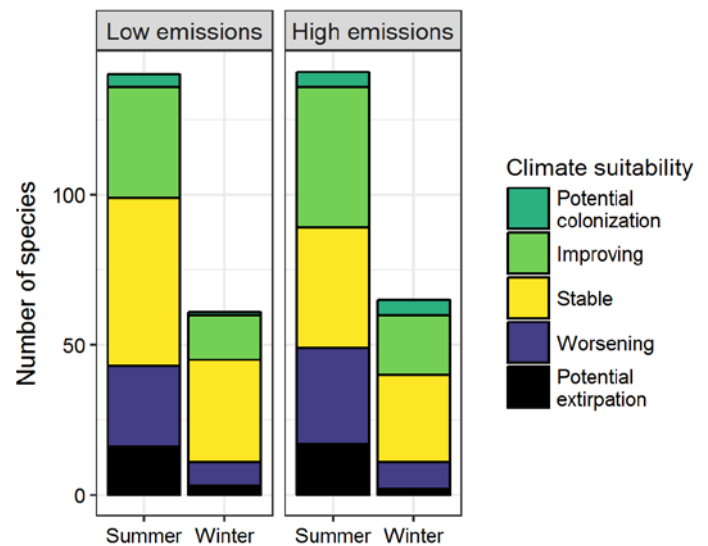


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (31st percentile across all national parks) and 0.12 in winter (13th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.07 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 33 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

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Yellowstone National Park falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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

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

Park may serve as an important refuge for 26 of these climate-sensitive species, 7 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 Chipping Sparrow (*Spizella passerina*) through 2050. Photo by Fyn Kynd/Flickr (CC BY 2.0).

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 26 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	Worsening [^]	-
American Wigeon	Worsening [^]	Stable
Mallard	Worsening [^]	Stable
Blue-winged Teal	Stable	-
Northern Shoveler	Worsening [^]	-
Northern Pintail	Potential extirpation	-
Green-winged Teal	x	Stable
Redhead	Stable [^]	-
Ring-necked Duck	x	Improving
Greater Scaup	Potential extirpation	-
Bufflehead	x	Stable
Common Goldeneye	x	Stable
Barrow's Goldeneye	x	Stable [^]
Hooded Merganser	x	Improving [^]
Common Merganser	x	Stable
Ruddy Duck	Stable	-

Common Name	Summer Trend	Winter Trend
Gambel's Quail	-	Potential colonization
Gray Partridge	Potential extirpation	Stable
Ring-necked Pheasant	Improving	-
Ruffed Grouse	x	Improving
Greater Sage-Grouse	x	Worsening [^]
Wild Turkey	x	Improving*
Common Loon	Stable	-
Pied-billed Grebe	x	Stable
American Bittern	Improving	-
Great Blue Heron	Improving	Stable
Cattle Egret	Stable	-
Golden Eagle	x	Stable
Northern Harrier	Stable [^]	-
Bald Eagle	x	Stable
Swainson's Hawk	Potential extirpation [^]	-
Red-tailed Hawk	Stable	Improving

Common Name	Summer Trend	Winter Trend
Ferruginous Hawk	Potential extirpation^	-
Rough-legged Hawk	-	Stable
Killdeer	Potential extirpation	Potential extirpation
Greater Yellowlegs	Stable	-
Willet	Potential extirpation^	-
Lesser Yellowlegs	Potential extirpation^	-
Long-billed Curlew	Worsening^	-
Marbled Godwit	Potential extirpation^	-
Wilson's Snipe	Worsening	Improving
Wilson's Phalarope	Potential extirpation^	-
Franklin's Gull	Potential extirpation	-
Ring-billed Gull	Stable^	-
Black Tern	Stable	-
Rock Pigeon	Improving	Improving
Mourning Dove	Improving*	-
Great Horned Owl	x	Stable
Northern Pygmy-Owl	x	Stable
Burrowing Owl	Stable^	-
Great Gray Owl	x	Worsening^
Common Nighthawk	Improving	-
Broad-tailed Hummingbird	Stable	-
Rufous Hummingbird	Improving	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Improving	Stable
Red-naped Sapsucker	Worsening^	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Improving	Stable
American Three-toed Woodpecker	x	Worsening^
Northern Flicker	Stable	Improving*

Common Name	Summer Trend	Winter Trend
Pileated Woodpecker	Improving*	-
American Kestrel	x	Improving
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Stable	-
Least Flycatcher	Stable	-
Hammond's Flycatcher	Worsening*	-
Dusky Flycatcher	Worsening*	-
Cordilleran Flycatcher	Improving*	-
Say's Phoebe	Potential extirpation	-
Ash-throated Flycatcher	Improving	-
Western Kingbird	Stable	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	Improving	-
Northern Shrike	-	Improving
Warbling Vireo	Worsening	-
Red-eyed Vireo	Improving*	-
Gray Jay	Worsening*	Worsening*
Pinyon Jay	Improving	Improving
Steller's Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Potential colonization
Black-billed Magpie	Worsening*^	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Improving*	Improving*
Common Raven	Improving	Stable
Horned Lark	Potential extirpation	Stable
Northern Rough-winged Swallow	Improving*	-
Tree Swallow	Improving	-
Violet-green Swallow	Stable	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Improving*	Worsening

Common Name	Summer Trend	Winter Trend
Mountain Chickadee	Worsening*	Stable
Juniper Titmouse	Potential colonization	-
Bushtit	-	Potential colonization
Red-breasted Nuthatch	Stable	Stable
White-breasted Nuthatch	Improving*	Potential colonization
Brown Creeper	Improving^	Improving
Rock Wren	Worsening	-
House Wren	Improving*	-
Pacific/Winter Wren	Potential colonization	-
Blue-gray Gnatcatcher	Improving	-
American Dipper	x	Stable
Golden-crowned Kinglet	Improving	Potential colonization
Ruby-crowned Kinglet	Worsening*	-
Mountain Bluebird	Worsening*	-
Townsend's Solitaire	Worsening**^	Stable
Veery	Improving*	-
Swainson's Thrush	Stable	-
Hermit Thrush	Stable	-
American Robin	Worsening	Improving*
Gray Catbird	Improving	-
Sage Thrasher	Stable	-
European Starling	Improving*	-
American Pipit	Worsening	-
Bohemian Waxwing	-	Improving*
Cedar Waxwing	Improving	-
McCown's Longspur	Potential extirpation^	-
Ovenbird	Stable	-
Northern Waterthrush	Potential colonization	-
Orange-crowned Warbler	Stable	-
Nashville Warbler	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization	
MacGillivray's Warbler	Worsening*	-
Common Yellowthroat	Improving	-
American Redstart	Improving	-
Magnolia Warbler	Potential colonization	-
Yellow Warbler	Improving	-
Yellow-rumped Warbler	Stable	-
Black-throated Gray Warbler	Stable	-
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Improving	-
Green-tailed Towhee	Improving^	-
Spotted Towhee	Improving	-
Chipping Sparrow	Improving	-
Clay-colored Sparrow	Potential extirpation	-
Brewer's Sparrow	Worsening*	-
Vesper Sparrow	Worsening	-
Lark Sparrow	Improving	-
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	-
Lark Bunting	Potential extirpation	-
Savannah Sparrow	Stable	-
Grasshopper Sparrow	Improving	-
Fox Sparrow	Stable	-
Song Sparrow	Improving	Improving
Lincoln's Sparrow	Worsening*	-
White-crowned Sparrow	Worsening*	Potential extirpation
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Stable	-
Lazuli Bunting	Stable	-
Bobolink	Improving	-
Red-winged Blackbird	Stable	Stable

Common Name	Summer Trend	Winter Trend
Western Meadowlark	Worsening*	-
Yellow-headed Blackbird	Worsening	-
Brewer's Blackbird	Worsening	Stable
Common Grackle	Improving	-
Brown-headed Cowbird	Stable	-
Bullock's Oriole	Stable	-
Gray-crowned Rosy-Finch	-	Stable^
Black Rosy-Finch	x	Stable^
Pine Grosbeak	Worsening^	Worsening*

Common Name	Summer Trend	Winter Trend
House Finch	Improving	-
Cassin's Finch	Stable	Stable
Red Crossbill	Worsening*^	x
White-winged Crossbill	Potential extirpation	-
Common Redpoll	-	Worsening*
Pine Siskin	Worsening	Improving
American Goldfinch	Improving*	-
Evening Grosbeak	Improving	-
House Sparrow	x	Improving