Birds and Climate Change

National Park Service
U.S. Department of the Interior

Crater Lake 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 Crater Lake 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 31, remain stable for 25 (e.g., Figure 2), and worsen for 20 species. Suitable climate ceases to occur for 8 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 6 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 11, remain stable for 6, 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 35 species not found at the Park today, potentially resulting in local colonization.

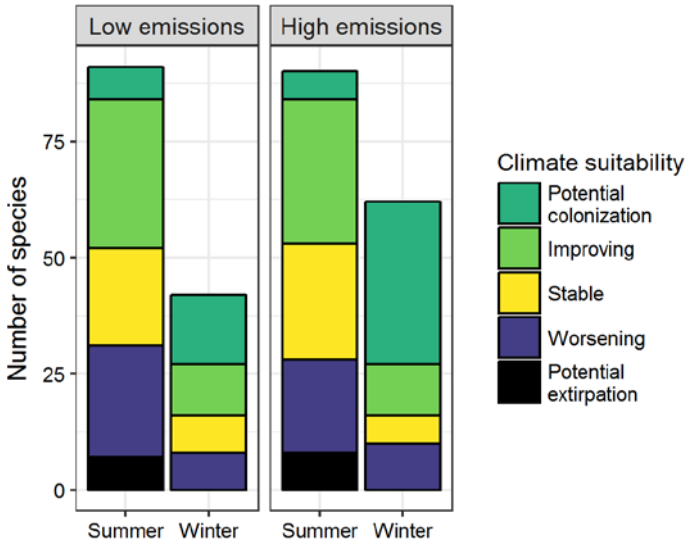

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.14 in summer (18th percentile across all national parks) and 0.20 in winter (26th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 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 16 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 climate is not projected to disappear for these 16 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 Chipping Sparrow (*Spizella passerina*) through 2050. Photo by Fyn Kynd/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, Crater Lake National 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 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
Cackling/Canada Goose	x	Potential colonization
Wood Duck	-	Potential colonization
Gadwall	-	Potential colonization
Mallard	Stable^	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Canvasback	-	Potential colonization
Lesser Scaup	-	Potential colonization
Hooded Merganser	-	Improving^
Ruddy Duck	Potential extirpation	Improving
Gambel's Quail	-	Potential colonization
Ring-necked Pheasant	Potential	Potential
	colonization	colonization
Wild Turkey	-	Potential colonization
Horned Grebe	-	Potential colonization
Great Blue Heron	Improving	-
Great Egret	Stable	-
Northern Harrier	Stable^	-
Sharp-shinned Hawk	x	Potential colonization
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Improving	Improving
Virginia Rail	-	Potential colonization
American Coot	-	Potential colonization
Killdeer	-	Potential colonization
Ring-billed Gull	Stable^	-
Rock Pigeon	Improving	-

Common Name	Summer Trend	Winter Trend
Mourning Dove	Improving*	Potential colonization
Great Horned Owl	x	Improving
Burrowing Owl	Potential colonization^	-
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Rufous Hummingbird	Improving	-
Acorn Woodpecker	Stable	Potential colonization
Red-naped Sapsucker	-	Potential colonization
Red-breasted Sapsucker	Stable	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Worsening	Stable
White-headed Woodpecker	Stable^	-
Black-backed Woodpecker	x	Worsening*
Northern Flicker	Worsening	Improving
Pileated Woodpecker	Stable	Potential colonization
American Kestrel	x	Potential colonization
Merlin	-	Potential colonization^
Prairie Falcon	x	Stable
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	Stable	-
Dusky Flycatcher	Worsening	-
Pacific-slope Flycatcher	Stable	-
Black Phoebe	-	Potential colonization
Say's Phoebe	-	Potential colonization
Hutton's Vireo	-	Potential colonization
Warbling Vireo	Improving	-
Gray Jay	Worsening	Worsening*

Common Name	Summer Trend	Winter Trend
Steller's Jay	Stable	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	-
Black-billed Magpie	Stable^	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Improving*	Potential colonization
Common Raven	Worsening	Worsening
Horned Lark	Potential extirpation	-
Northern Rough-winged Swallow	Potential colonization	-
Tree Swallow	Improving	-
Violet-green Swallow	Improving	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Improving	Potential colonization
Mountain Chickadee	Worsening*	Worsening*
Juniper Titmouse	Potential colonization	-
Red-breasted Nuthatch	Worsening	Worsening*
White-breasted Nuthatch	Improving	Potential colonization
Pygmy Nuthatch	Stable	-
Brown Creeper	Stable^	Stable
Rock Wren	Potential extirpation	Potential colonization
House Wren	Improving	-
Pacific/Winter Wren	Improving*	-
Bewick's Wren	Potential colonization	-
Golden-crowned Kinglet	Worsening	-
Ruby-crowned Kinglet	Potential extirpation	-
Western Bluebird	Stable	-
Mountain Bluebird	Potential extirpation	Stable
Townsend's Solitaire	Worsening*^	-

Common Name	Summer Trend	Winter Trend
Swainson's Thrush	Improving*	-
Hermit Thrush	Worsening	-
American Robin	Worsening	Improving
Varied Thrush	Improving^	Stable
European Starling	Improving*	Potential colonization
Orange-crowned Warbler	Improving	-
Nashville Warbler	Stable	-
MacGillivray's Warbler	Stable	-
Yellow Warbler	Improving	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Townsend's Warbler	Worsening*	-
Hermit Warbler	Stable	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Potential colonization	-
Spotted Towhee	Improving*	-
Chipping Sparrow	Stable	-
Vesper Sparrow	Potential extirpation	-
Fox Sparrow	Worsening*	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Song Sparrow	Improving*	Improving
Lincoln's Sparrow	Potential extirpation	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Worsening	-
Black-headed Grosbeak	Improving*	-
Lazuli Bunting	Improving	-
Red-winged Blackbird	Improving	Potential colonization
Western Meadowlark	Stable	-
Brewer's Blackbird	Stable	-
Brown-headed Cowbird	Stable	-
Gray-crowned Rosy-Finch	x	Worsening*^
House Finch	Improving	-
Purple Finch	Improving	Potential colonization
Cassin's Finch	Worsening*	Worsening
Red Crossbill	Worsening*^	x
Pine Siskin	Worsening*	Stable
American Goldfinch	Improving	Improving*
Evening Grosbeak	Worsening	-