Birds and Climate Change

National Park Service
U.S. Department of the Interior

North Cascades 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 North Cascades 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 27, remain stable for 30, and worsen for 29 species. Suitable climate ceases to occur for 2 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 4 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 13, remain stable for 8, and worsen for 4 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 18 species not found at the Park today, potentially resulting in local colonization.

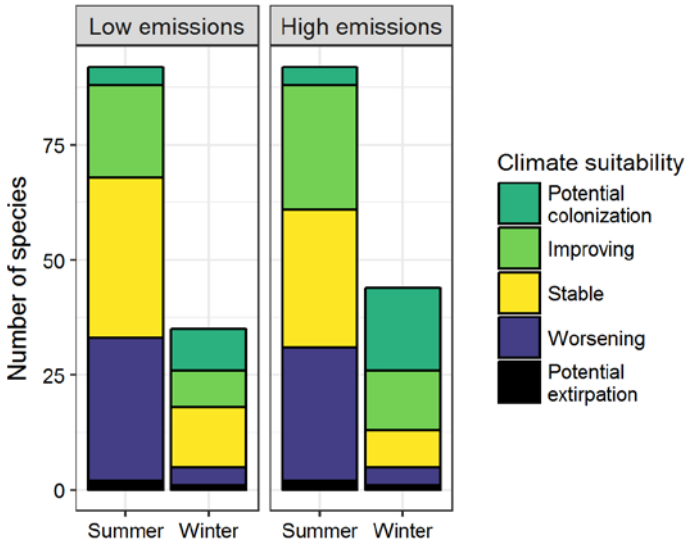

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.10 in summer (11th percentile across all national parks) and 0.14 in winter (16th percentile) under the high-emissions pathway. Potential species turnover declines to 0.06 in summer and 0.09 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 13 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 13 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Although currently found at the Park, suitable climate for the Chipping Sparrow (*Spizella passerina*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. 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, North Cascades 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 13 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	-	Potential colonization
Mallard	Improving^	Improving
Green-winged Teal	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Surf Scoter	-	Potential colonization
White-winged Scoter	-	Potential colonization
Long-tailed Duck	-	Potential colonization
Bufflehead	x	Improving
Common Goldeneye	x	Improving
Hooded Merganser	-	Potential colonization^
Common Merganser	x	Improving
Mountain Quail	Potential colonization	-
Ring-necked Pheasant	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization	
Common Loon	Stable	-
Pied-billed Grebe	-	Potential colonization
Great Blue Heron	Improving	Potential colonization
Bald Eagle	x	Worsening
Red-tailed Hawk	Improving	-
Rough-legged Hawk	-	Potential colonization
Killdeer	Improving	-
Western Gull	Potential colonization	-
Herring Gull	-	Potential colonization^
Band-tailed Pigeon	Stable	-
Mourning Dove	Improving	-
Western Screech-Owl	-	Potential colonization
Snowy Owl	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Barred Owl	x	Improving
Common Nighthawk	Stable	-
Rufous Hummingbird	Stable	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Stable	Improving
Red-naped Sapsucker	Worsening^	-
Red-breasted Sapsucker	Stable	-
Downy Woodpecker	Improving	-
Hairy Woodpecker	Improving	-
Northern Flicker	Worsening*	-
Pileated Woodpecker	Stable	-
Merlin	x	Potential colonization^
Olive-sided Flycatcher	Worsening	-
Western Wood-Pewee	Worsening*^	-
Willow Flycatcher	Stable	-
Hammond's Flycatcher	Worsening	-
Dusky Flycatcher	Worsening*	-
Pacific-slope Flycatcher	Worsening	-
Western Kingbird	Stable	-
Hutton's Vireo	Improving^	-
Warbling Vireo	Worsening	-
Red-eyed Vireo	Improving*	-
Gray Jay	Worsening	Worsening*
Steller's Jay	Stable	Stable
Clark's Nutcracker	Worsening^	-
American Crow	Improving*	Stable
Common Raven	Worsening	Worsening*
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Stable	-
Violet-green Swallow	Stable	Potential colonization
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-

Common Name	Summer Trend	Winter Trend
Black-capped Chickadee	Stable	Stable
Mountain Chickadee	Worsening*	-
Chestnut-backed Chickadee	Stable	Stable
Red-breasted Nuthatch	Worsening*	Worsening*
White-breasted Nuthatch	Improving	-
Brown Creeper	Stable^	Potential extirpation
House Wren	Improving	-
Pacific/Winter Wren	Improving	Stable
American Dipper	x	Stable
Golden-crowned Kinglet	Stable	Improving
Ruby-crowned Kinglet	Worsening	-
Townsend's Solitaire	Worsening*^	-
Swainson's Thrush	Stable	-
Hermit Thrush	Stable	-
American Robin	Worsening	Improving
Varied Thrush	Stable^	Improving
European Starling	Improving*	Improving
American Pipit	Potential extirpation	-
Cedar Waxwing	Improving	Improving
Blue-winged Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening*	-
Nashville Warbler	Worsening*	-
MacGillivray's Warbler	Worsening	-
Common Yellowthroat	Improving*	-
American Redstart	Stable	-
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Stable	-
Black-throated Gray Warbler	Improving*	-
Townsend's Warbler	Worsening	-
Wilson's Warbler	Stable	-
Spotted Towhee	Improving*	-

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Potential extirpation	-
Savannah Sparrow	Improving	-
Fox Sparrow	Worsening	Potential colonization
Song Sparrow	Improving	Stable
Lincoln's Sparrow	Worsening*	-
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	Stable	-
Golden-crowned Sparrow	Stable	-
Dark-eyed Junco	x	Improving
Western Tanager	Worsening	-
Black-headed Grosbeak	Improving	-
Lazuli Bunting	Worsening	-

Common Name	Summer Trend	Winter Trend
Red-winged Blackbird	Improving*	-
Brewer's Blackbird	Worsening	-
Brown-headed Cowbird	Stable	-
Bullock's Oriole	Stable	-
Pine Grosbeak	Worsening^	-
House Finch	Improving	Stable
Purple Finch	Improving*	Potential colonization
Cassin's Finch	Worsening	-
Red Crossbill	Worsening^	-
Pine Siskin	Worsening	Improving
American Goldfinch	Improving*	-
Evening Grosbeak	Stable	-