Birds and Climate Change

National Park Service
U.S. Department of the Interior

Mount Rainier 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 Mount Rainier 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 30 species. Suitable climate ceases to occur for 12 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 23, remain stable for 10, and worsen for 10 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 12 species not found at the Park today, potentially resulting in local colonization.

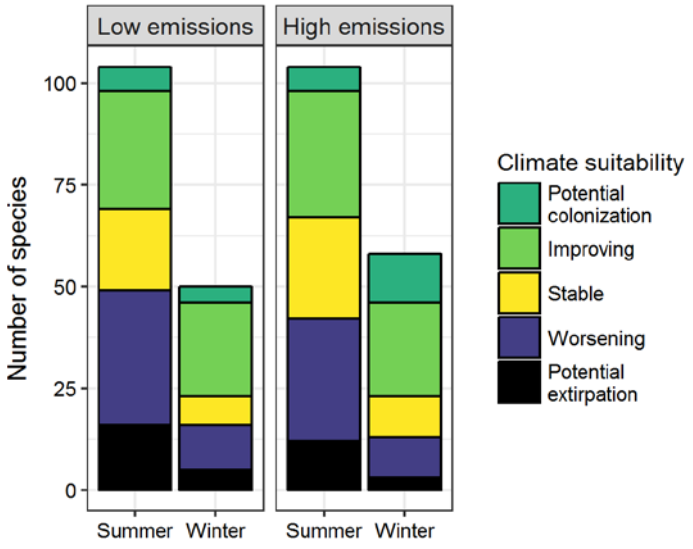

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (30th percentile across all national parks) and 0.13 in winter (13th percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 in summer and 0.11 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 15 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 13 of these climate-sensitive species, 2 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 American Robin (*Turdus migratorius*) through 2050. Photo by Andy Reago & Chrissy McClarren/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, Mount Rainier 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 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 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
Cackling/Canada Goose	x	Improving
Mallard	Stable^	Improving
Green-winged Teal	x	Stable
Canvasback	-	Potential colonization
Common Goldeneye	-	Worsening
Barrow's Goldeneye	x	Worsening*^
Hooded Merganser	x	Improving^
Mountain Quail	Potential colonization	-
California Quail	Stable	Stable
Ring-necked Pheasant	Potential colonization	Potential colonization
Ruffed Grouse	x	Improving
Double-crested Cormorant	x	Potential colonization
Great Blue Heron	Improving	-
Green Heron	-	Potential colonization
Northern Harrier	Improving^	Improving*

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Improving
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Improving	Potential colonization
Rough-legged Hawk	-	Improving
Virginia Rail	-	Potential colonization
Killdeer	Improving	Improving
Long-billed Dowitcher	-	Potential colonization
Ring-billed Gull	Improving^	-
California Gull	x	Stable^
Rock Pigeon	Improving	-
Band-tailed Pigeon	Stable	-
Mourning Dove	Improving*	-
Barn Owl	-	Potential colonization
Great Horned Owl	x	Improving
Barred Owl	x	Improving*

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Stable	-
Anna's Hummingbird	Improving	-
Rufous Hummingbird	Worsening*	-
Calliope Hummingbird	Potential extirpation	-
Belted Kingfisher	Improving	Improving
Red-breasted Sapsucker	Stable	-
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Worsening	Potential extirpation
Northern Flicker	Worsening	Improving
Pileated Woodpecker	Stable	-
American Kestrel	x	Improving
Peregrine Falcon	-	Potential colonization
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening^	-
Willow Flycatcher	Improving	-
Hammond's Flycatcher	Worsening	-
Dusky Flycatcher	Worsening	-
Pacific-slope Flycatcher	Worsening	-
Western Kingbird	Stable	-
Hutton's Vireo	Stable^	-
Warbling Vireo	Worsening	-
Gray Jay	Worsening	Worsening*
Steller's Jay	Worsening*	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	-
Clark's Nutcracker	Potential extirpation^	Worsening*
American Crow	Improving*	Improving
Common Raven	Worsening	Worsening
Horned Lark	Improving	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Stable	-
Violet-green Swallow	Worsening*	-

Common Name	Summer Trend	Winter Trend
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Improving	Stable
Mountain Chickadee	Potential extirpation	-
Chestnut-backed Chickadee	Worsening	Stable
Bushtit	Stable	-
Red-breasted Nuthatch	Worsening*	Potential extirpation
White-breasted Nuthatch	Improving	Improving*
Brown Creeper	Worsening^	Potential extirpation
House Wren	Improving	-
Pacific/Winter Wren	Worsening	Stable
Marsh Wren	-	Potential colonization
Bewick's Wren	Stable	-
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening*	Improving
Ruby-crowned Kinglet	Potential extirpation	-
Western Bluebird	Stable	-
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Potential extirpation^	-
Veery	Improving	-
Swainson's Thrush	Worsening	-
Hermit Thrush	Potential extirpation	Improving
American Robin	Stable	Improving
Varied Thrush	Worsening*^	Worsening
California Thrasher	Potential colonization	-
European Starling	Improving*	Potential colonization
American Pipit	Stable	-
Cedar Waxwing	Improving*	Improving

Common Name	Summer Trend	Winter Trend
Worm-eating Warbler	Potential colonization	-
Blue-winged Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening	-
Nashville Warbler	Potential extirpation	-
MacGillivray's Warbler	Worsening*	-
Common Yellowthroat	Improving*	-
Hooded Warbler	Potential colonization	-
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Stable	-
Black-throated Gray Warbler	Improving*	-
Townsend's Warbler	Worsening	-
Hermit Warbler	Worsening	-
Wilson's Warbler	Worsening	-
Spotted Towhee	Stable	x
Chipping Sparrow	Improving*	-
Savannah Sparrow	Improving	-
Fox Sparrow	Worsening	-
Song Sparrow	Improving*	Stable
Lincoln's Sparrow	Potential	-

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