Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fossil Butte National Monument

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 Fossil Butte National Monument (hereafter, the Monument) 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 20, remain stable for 29 (e.g., Figure 2), and worsen for 10 species. Suitable climate ceases to occur for 8 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 13 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 15, remain stable for 4, and worsen for 4 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 31 species not found at the Monument today, potentially resulting in local colonization.

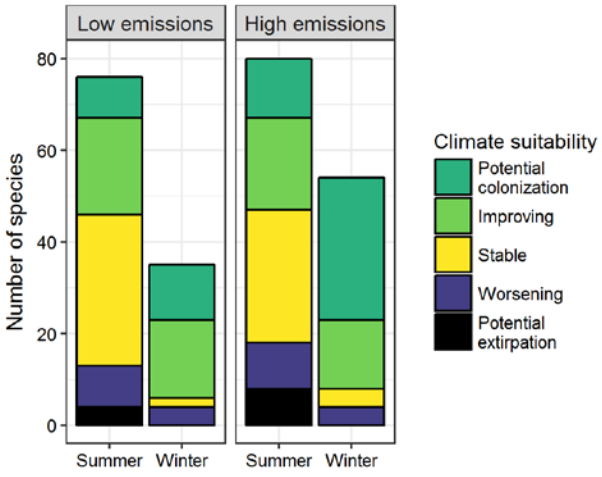

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.19 in summer (29th percentile across all national parks) and 0.29 in winter (45th percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.17 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 Monument is or may become home to 14 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 14 species at the Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Monument in summer is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) 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, Fossil Butte National Monument 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 14 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.

Contacts

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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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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
American Wigeon	Worsening^	Improving
Mallard	Worsening*^	-
Blue-winged Teal	Potential extirpation	-
Ring-necked Duck	-	Potential colonization
Scaled Quail	Potential colonization	-
Gambel's Quail	-	Potential colonization
Ring-necked Pheasant	Potential colonization	Potential colonization
Greater Sage-Grouse	x	Worsening*^
Wild Turkey	-	Potential colonization
Great Blue Heron	Improving	Potential colonization
Northern Harrier	Stable^	Improving
Sharp-shinned Hawk	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Swainson's Hawk	Worsening^	-
Red-tailed Hawk	Improving	Improving*
Killdeer	Stable	Improving
Ring-billed Gull	Worsening^	-
Rock Pigeon	Stable	Improving
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Improving	Improving*
Common Nighthawk	Improving*	-
Broad-tailed Hummingbird	Stable	-
Red-naped Sapsucker	-	Potential colonization
Downy Woodpecker	-	Potential colonization
Hairy Woodpecker	-	Potential colonization
Northern Flicker	Improving*	Improving
American Kestrel	x	Potential colonization

Common Name	Summer Trend	Winter Trend
Prairie Falcon	x	Stable
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	Potential extirpation	-
Dusky Flycatcher	Stable	-
Cordilleran Flycatcher	Stable	-
Say's Phoebe	Improving	Potential colonization
Ash-throated Flycatcher	Potential colonization	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Improving	Potential colonization
Warbling Vireo	Potential extirpation	-
Steller's Jay	Potential colonization	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential colonization	Potential colonization
Black-billed Magpie	Stable^	-
Clark's Nutcracker	Stable^	Stable
American Crow	Stable	Potential colonization
Chihuahuan Raven	-	Potential colonization
Common Raven	Stable	Worsening*
Horned Lark	Potential extirpation	Worsening*
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Stable	-
Violet-green Swallow	Stable	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Improving	-
Mountain Chickadee	Stable	Stable
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Bushtit	Potential colonization	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Stable
White-breasted Nuthatch	-	Potential colonization
Pygmy Nuthatch	-	Potential colonization^
Rock Wren	Worsening*	Potential colonization
Canyon Wren	-	Potential colonization
House Wren	Stable	-
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving*	-
Ruby-crowned Kinglet	Stable	-
Western Bluebird	Potential colonization	-
Mountain Bluebird	Stable	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential colonization	-
American Robin	Potential extirpation	Improving
Gray Catbird	Improving	-
Sage Thrasher	Worsening*	Potential colonization
European Starling	Stable	Potential colonization
Cedar Waxwing	Stable	Improving
Yellow Warbler	Worsening	-
Grace's Warbler	Potential colonization	-
Black-throated Gray Warbler	Potential colonization	-
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	Improving^	-
Chipping Sparrow	Improving*	-

Common Name	Summer Trend	Winter Trend
Brewer's Sparrow	Worsening*	-
Vesper Sparrow	Worsening*	-
Lark Sparrow	Improving*	-
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	-
Fox Sparrow	Potential extirpation	-
Song Sparrow	Stable	Improving
White-crowned Sparrow	Worsening*	-
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Improving*	-
Red-winged Blackbird	Stable	Improving
Western Meadowlark	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Brewer's Blackbird	Stable	Improving
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Improving	-
Black Rosy-Finch	x	Worsening*^
House Finch	Improving	Potential colonization
Cassin's Finch	Improving	Improving
Red Crossbill	Stable^	x
Pine Siskin	Stable	Improving
Lesser Goldfinch	Potential colonization	Potential colonization
American Goldfinch	Improving	Potential colonization
House Sparrow	-	Potential colonization