Birds and Climate Change

National Park Service
U.S. Department of the Interior

Florissant Fossil Beds 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 Florissant Fossil Beds 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 17 (e.g., Figure 2), remain stable for 26, and worsen for 16 species. Suitable climate ceases to occur for 7 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 12 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 14, remain stable for 3, and worsen for 3 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 30 species not found at the Monument today, potentially resulting in local colonization.

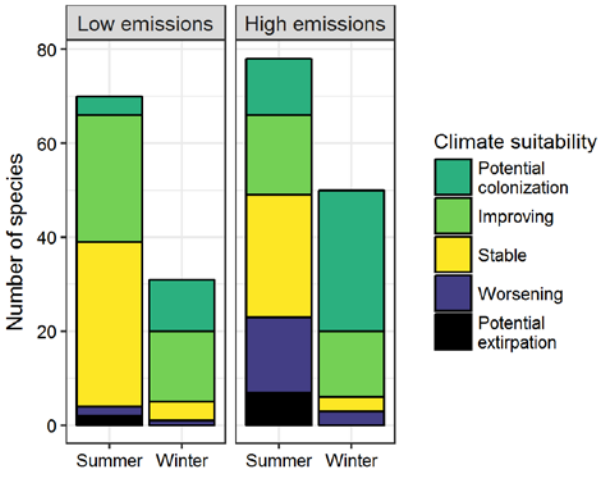

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.16 in summer (23rd percentile across all national parks) and 0.25 in winter (36th percentile) under the high-emissions pathway. Potential species turnover declines to 0.07 in summer and 0.12 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 12 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 12 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 Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Florissant Fossil Beds National Monument 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 12 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

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

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	-	Potential colonization
Mallard	Worsening^	Improving
Green-winged Teal	-	Potential colonization
Common Merganser	-	Potential colonization
Wild Turkey	x	Potential colonization
Eared Grebe	-	Potential colonization
American Bittern	Potential colonization	-
Great Blue Heron	Stable	-
Northern Harrier	-	Potential colonization
Sharp-shinned Hawk	-	Potential colonization
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Improving	Improving*
Killdeer	Stable	-
Upland Sandpiper	Potential colonization	-
Rock Pigeon	-	Potential colonization
Eurasian Collared-Dove	x	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Improving	Improving
Greater Roadrunner	-	Potential colonization
Common Nighthawk	Improving*	-
Broad-tailed Hummingbird	Worsening*	-
Belted Kingfisher	Stable	-
Gila Woodpecker	-	Potential colonization
Red-naped Sapsucker	Stable^	Potential colonization

Common Name	Summer Trend	Winter Trend
Ladder-backed Woodpecker	-	Potential colonization
Hairy Woodpecker	Improving	Improving
Northern Flicker	Worsening	Improving
American Kestrel	x	Improving*
Merlin	-	Potential colonization^
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	Potential extirpation	-
Gray Flycatcher	Potential colonization	-
Dusky Flycatcher	Worsening	-
Cordilleran Flycatcher	Stable	-
Say's Phoebe	Improving*	-
Ash-throated Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Loggerhead Shrike	Potential colonization	-
Warbling Vireo	Worsening*	-
Gray Jay	Potential extirpation	-
Steller's Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential colonization	-
Black-billed Magpie	Stable^	Worsening*
Clark's Nutcracker	Worsening^	-
American Crow	Stable	Improving
Chihuahuan Raven	Potential colonization	-
Common Raven	Improving	Worsening*
Tree Swallow	Worsening	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-

Common Name	Summer Trend	Winter Trend
Black-capped Chickadee	Improving	-
Mountain Chickadee	Stable	Worsening*
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization
Red-breasted Nuthatch	Potential extirpation	-
White-breasted Nuthatch	Improving*	Improving
Pygmy Nuthatch	Improving*	Stable^
Brown Creeper	Improving^	-
Rock Wren	Stable	Potential colonization
Canyon Wren	-	Potential colonization
House Wren	Stable	-
Bewick's Wren	Potential colonization	-
Ruby-crowned Kinglet	Worsening*	-
Western Bluebird	Improving*	Potential colonization
Mountain Bluebird	Stable	Improving
Townsend's Solitaire	Stable^	-
Hermit Thrush	Stable	-
American Robin	Worsening	Improving*
Curve-billed Thrasher	Potential colonization	Potential colonization
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	-	Potential colonization
European Starling	Stable	Potential colonization
MacGillivray's Warbler	Worsening	-
Yellow-rumped Warbler	Stable	-
Black-throated Gray Warbler	Potential colonization	-
Green-tailed Towhee	Worsening*^	Potential colonization
Cassin's Sparrow	Potential colonization	-
American Tree Sparrow	-	Stable

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Stable	-
Brewer's Sparrow	Stable	Potential colonization
Vesper Sparrow	Stable	-
Lark Sparrow	Improving*	-
Black-throated Sparrow	-	Potential colonization
Savannah Sparrow	Potential extirpation	-
Song Sparrow	Potential extirpation	Potential colonization
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Potential extirpation	-
Dark-eyed Junco	x	Improving
Western Tanager	Worsening*	-

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