Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Bowie National Historic Site

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 Fort Bowie National Historic Site (hereafter, the Site) 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Site 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 Site, 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 Site today, climate suitability in summer under the high-emissions pathway is projected to improve for 17 (e.g., Figure 2), remain stable for 15, and worsen for 4 species. Suitable climate ceases to occur for 4 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 19 species not found at the Site today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 9, remain stable for 17, and worsen for 8 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 49 species not found at the Site today, potentially resulting in local colonization.

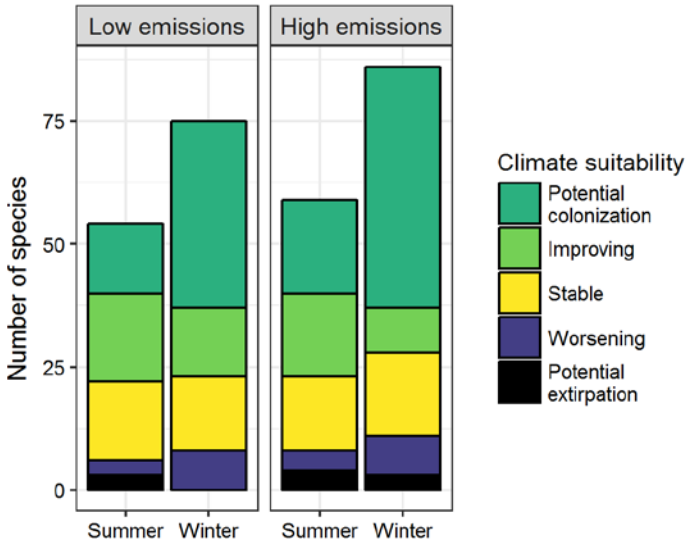

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.19 in summer (29th percentile across all national parks) and 0.17 in winter (22nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 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 Site is or may become home to 5 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 5 species at the Site; instead the Site may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Site in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Fort Bowie National Historic Site 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 5 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Site 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Wood Duck	-	Potential colonization
Blue-winged Teal	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Ruddy Duck	Potential colonization	-
Gambel's Quail	Improving	Stable
Northern Bobwhite	-	Potential colonization
Least Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Wood Stork	Potential colonization	-
Anhinga	Potential colonization^	-
Great Egret	-	Potential colonization
Snowy Egret	-	Potential colonization
Tricolored Heron	Potential colonization^	-
Cattle Egret	Potential colonization	Potential colonization
Green Heron	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Black Vulture	Potential colonization	Potential colonization
Osprey	-	Potential colonization
White-tailed Kite	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Harrier	-	Stable
Red-tailed Hawk	Stable	Stable
Limpkin	-	Potential colonization
Black-necked Stilt	-	Potential colonization
Snowy Plover	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Dunlin	-	Potential colonization^
Western Sandpiper	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
White-winged Dove	Improving	-
Mourning Dove	Stable	Improving
Common Ground-Dove	Improving	Potential colonization
Greater Roadrunner	Improving	-
Groove-billed Ani	-	Potential colonization
Common Pauraque	-	Potential colonization
White-throated Swift	x	Improving
Black-chinned Hummingbird	Improving	-
Costa's Hummingbird	-	Potential colonization
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	-	Potential colonization
Green Kingfisher	-	Potential colonization
Golden-fronted Woodpecker	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Red-naped Sapsucker	-	Worsening*
Ladder-backed Woodpecker	Improving	Stable
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Worsening*	Worsening
Crested Caracara	-	Potential colonization
Peregrine Falcon	-	Potential colonization
Eastern Phoebe	-	Potential colonization
Say's Phoebe	Stable	Stable
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	Worsening*	Potential colonization
Western Kingbird	Stable	-
Loggerhead Shrike	Worsening*	Stable
White-eyed Vireo	-	Potential colonization
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
Common Raven	Stable	Stable
Horned Lark	-	Potential extirpation
Northern Rough-winged Swallow	Potential colonization	Potential colonization
Purple Martin	Potential colonization	-
Tree Swallow	-	Potential colonization
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	-	Potential colonization
Black-crested Titmouse	Potential colonization	-
Verdin	Improving*	Improving

Common Name	Summer Trend	Winter Trend
Bushtit	Potential extirpation	-
Rock Wren	Improving	Stable
Bewick's Wren	Improving*	Worsening*
Cactus Wren	Stable	Stable
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Worsening*
Townsend's Solitaire	-	Worsening*
American Robin	-	Potential extirpation
Curve-billed Thrasher	Worsening*	-
Long-billed Thrasher	-	Potential colonization
LeConte's Thrasher	Potential colonization	Potential colonization
Crissal Thrasher	Improving	-
Northern Mockingbird	Stable	Improving
Phainopepla	Improving	Stable
Black-and-white Warbler	-	Potential colonization
Swainson's Warbler	Potential colonization	-
Lucy's Warbler	Improving*	-
Townsend's Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	-	Stable
Rufous-crowned Sparrow	x	Worsening*

Common Name	Summer Trend	Winter Trend
Canyon Towhee	Stable	Stable
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Brewer's Sparrow	-	Stable
Vesper Sparrow	-	Improving*
Black-throated Sparrow	Stable	Stable
Henslow's Sparrow	-	Potential colonization
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Improving*	-
Western Tanager	Potential extirpation	-
Northern Cardinal	Improving*	Improving
Blue Grosbeak	Improving	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Potential colonization	-
Western Meadowlark	-	Stable
Brown-headed Cowbird	Improving	Improving
Hooded Oriole	Improving	-
Bullock's Oriole	Stable	-
Scott's Oriole	Stable	-
House Finch	Stable	Worsening
Lesser Goldfinch	Stable	Stable