Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Larned 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 Larned 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 7, remain stable for 14 (e.g., Figure 2), and worsen for 9 species. Suitable climate ceases to occur for 7 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 25 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 3, remain stable for 4, and worsen for 7 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 67 species not found at the Site today, potentially resulting in local colonization.

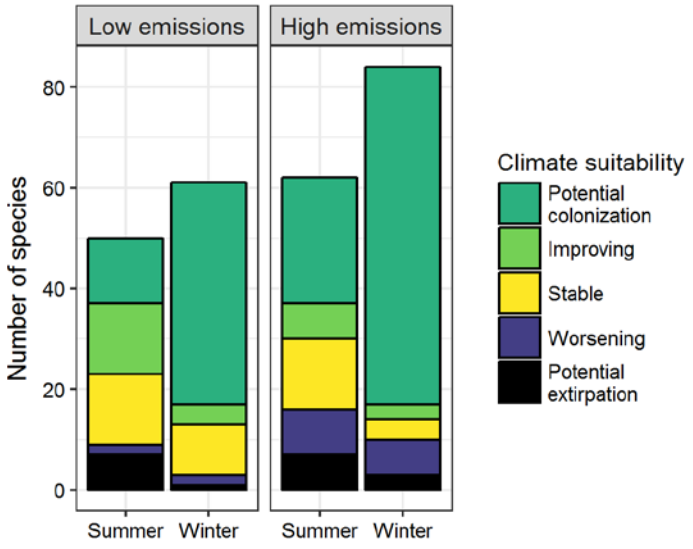

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.20 in summer (31st percentile across all national parks) and 0.31 in winter (48th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.20 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 4 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 4 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 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, Fort Larned National Historic Site falls within the high potential colonization group.** Parks anticipating high potential colonization 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 4 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 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
Blue-winged Teal	-	Potential colonization
Cinnamon Teal	-	Potential colonization
Greater Scaup	-	Potential colonization^
Bufflehead	-	Potential colonization
Red-breasted Merganser	-	Potential colonization^
Ruddy Duck	-	Potential colonization
Gambel's Quail	-	Potential colonization
Ring-necked Pheasant	Stable	Worsening*
Pied-billed Grebe	-	Potential colonization
Horned Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization
Great Egret	-	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Black-crowned Night-Heron	-	Potential colonization
Harris's Hawk	Potential colonization	Potential colonization
Red-tailed Hawk	Stable	Stable
Sora	-	Potential colonization
Common Gallinule	-	Potential colonization
American Avocet	-	Potential colonization^
Killdeer	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Herring Gull	-	Potential colonization^
Rock Pigeon	Stable	Potential extirpation
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Worsening	Stable
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	Potential colonization
Great Horned Owl	x	Worsening*
Burrowing Owl	-	Potential colonization
Barred Owl	-	Potential colonization
Common Nighthawk	Improving	-
Common Pauraque	-	Potential colonization
Chimney Swift	Potential colonization	-
Red-headed Woodpecker	Stable	-
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Potential colonization	-
Yellow-bellied Sapsucker	-	Potential colonization
Red-naped Sapsucker	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Stable	Potential extirpation
Red-cockaded Woodpecker	-	Potential colonization
Gilded Flicker	Potential colonization	Potential colonization
Peregrine Falcon	-	Potential colonization
Northern Beardless-Tyrannulet	Potential colonization	-
Gray Flycatcher	-	Potential colonization
Eastern Phoebe	Potential colonization	Potential colonization
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Potential colonization	-
Great Crested Flycatcher	Stable	-
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	-
Western Kingbird	Worsening	-
Eastern Kingbird	Stable	-
Warbling Vireo	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Improving	Stable
Chihuahuan Raven	-	Potential colonization
Northern Rough-winged Swallow	-	Potential colonization
Purple Martin	Potential colonization	-
Barn Swallow	Worsening	-
Carolina Chickadee	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted/Black-crested Titmouse	-	Potential colonization
Bushtit	-	Potential colonization
Rock Wren	Potential colonization	-
House Wren	Potential extirpation	-
Carolina Wren	-	Potential colonization
Blue-gray Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Eastern Bluebird	Improving*	-
American Robin	Potential extirpation	Worsening*
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Worsening*	Potential colonization
Bendire's Thrasher	-	Potential colonization
LeConte's Thrasher	Potential colonization	Potential colonization
Crissal Thrasher	Potential colonization	-
Sage Thrasher	-	Potential colonization
Northern Mockingbird	-	Potential colonization
European Starling	Stable	-
American Pipit	-	Potential colonization
Common Yellowthroat	Potential extirpation	-
Yellow Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Black-throated Gray Warbler	-	Potential colonization
Abert's Towhee	Potential colonization	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	-	Potential colonization
Brewer's Sparrow	-	Potential colonization
Vesper Sparrow	-	Potential colonization
Lark Sparrow	-	Potential colonization
Black-throated Sparrow	-	Potential colonization
Lark Bunting	Worsening*	Potential colonization
Savannah Sparrow	-	Potential colonization
Grasshopper Sparrow	Worsening	-
Henslow's Sparrow	-	Potential colonization
Northern Cardinal	Improving*	Improving
Pyrrhuloxia	Potential colonization	-
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Dickcissel	Improving	-
Red-winged Blackbird	Stable	Worsening
Eastern Meadowlark	Improving	-
Western Meadowlark	Worsening*	Worsening*
Common Grackle	Stable	Improving
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Stable	Improving
Orchard Oriole	Worsening*	-

Common Name	Summer Trend	Winter Trend
Hooded Oriole	Potential colonization	-
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Baltimore Oriole	Worsening	-
American Goldfinch	Stable	Worsening*
House Sparrow	x	Worsening*