Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Davis 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 Davis 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 29 (e.g., Figure 2), remain stable for 36, and worsen for 9 species. Suitable climate ceases to occur for 14 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 21 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 32, remain stable for 30, and worsen for 24 species. Suitable climate ceases to occur for 8 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 46 species not found at the Site today, potentially resulting in local colonization.

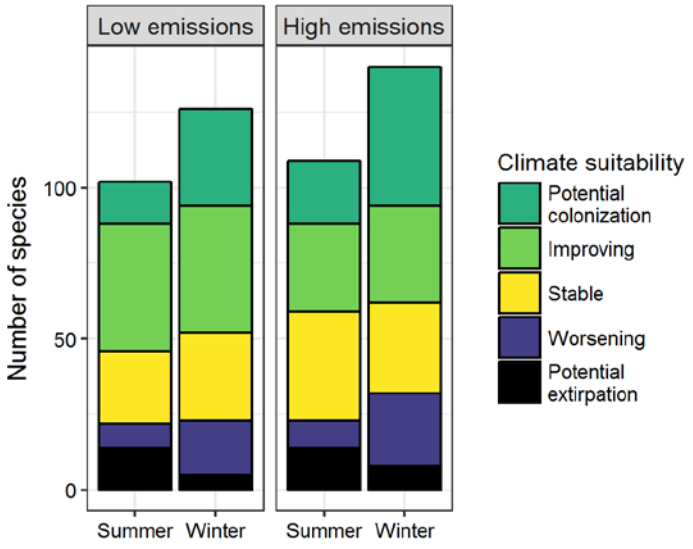

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.19 in summer (30th 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 8 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 Site may serve as an important refuge for 7 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Site in summer by 2050.

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 Davis 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 7 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
Gadwall	-	Improving*
American Wigeon	-	Improving
Mallard	Potential extirpation^	Potential extirpation
Blue-winged Teal	-	Potential colonization
Green-winged Teal	-	Improving
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Ruddy Duck	-	Potential colonization
Scaled Quail	Worsening*	Worsening*
Northern Bobwhite	Potential colonization	Potential colonization
Montezuma Quail	x	Worsening*
Wild Turkey	x	Stable

Common Name	Summer Trend	Winter Trend
Pied-billed Grebe	-	Potential colonization
Wood Stork	Potential colonization	Potential colonization
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization^	-
Great Blue Heron	Improving	Improving*
Great Egret	-	Potential colonization
Tricolored Heron	Potential colonization^	-
Cattle Egret	Potential colonization	Potential colonization
Green Heron	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	Potential colonization
White Ibis	Potential colonization	-

Common Name	Summer Trend	Winter Trend
White-faced Ibis	-	Potential colonization^
Black Vulture	Potential colonization	Potential colonization
Turkey Vulture	x	Improving*
Osprey	-	Potential colonization
Golden Eagle	x	Worsening*
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Improving
Gray Hawk	Improving	-
Swainson's Hawk	Worsening*^	-
Red-tailed Hawk	Stable	Stable
American Coot	-	Potential colonization
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Killdeer	Stable	Improving
Wandering Tattler	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Dunlin	-	Potential colonization^
Western Sandpiper	-	Potential colonization
Wilson's Snipe	-	Stable
Caspian Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Rock Pigeon	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Band-tailed Pigeon	Potential extirpation	-
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving	Stable
Mourning Dove	Stable	Improving
Inca Dove	Improving	Improving*
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Improving	Stable
Great Horned Owl	x	Worsening
Lesser Nighthawk	Improving*	-
Common Nighthawk	Worsening*	-
Chuck-will's-widow	Potential colonization	-
White-throated Swift	x	Stable
Black-chinned Hummingbird	Improving*	-
Broad-tailed Hummingbird	Potential extirpation	-
Rufous Hummingbird	Stable	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	-	Potential colonization
Green Kingfisher	-	Potential colonization
Acorn Woodpecker	Worsening*	Worsening*
Golden-fronted Woodpecker	Improving	-
Yellow-bellied Sapsucker	-	Stable
Red-naped Sapsucker	-	Worsening
Ladder-backed Woodpecker	Improving*	Stable
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Worsening
Gilded Flicker	Potential colonization	-
Crested Caracara	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
American Kestrel	x	Improving
Northern Beardless-Tyrannulet	Potential colonization	-
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Stable^	-
Gray Flycatcher	Stable	-
Black Phoebe	Improving	Improving
Say's Phoebe	Stable	Improving
Vermilion Flycatcher	Improving*	-
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	Worsening*	Potential colonization
Western Kingbird	Stable	-
Loggerhead Shrike	Worsening*	Improving
White-eyed Vireo	Potential colonization	Potential colonization
Bell's Vireo	Improving*	-
Steller's Jay	Stable	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Worsening*
Chihuahuan Raven	Stable	Stable
Common Raven	Stable	Stable
Horned Lark	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Improving	Potential colonization
Purple Martin	Potential colonization	-
Violet-green Swallow	Potential extirpation	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Cave Swallow	Stable	-
Carolina Chickadee	Potential colonization	Potential colonization
Mountain Chickadee	Stable	-
Black-crested Titmouse	Stable	x

Common Name	Summer Trend	Winter Trend
Verdin	Improving*	Stable
Bushtit	Stable	Worsening
White-breasted Nuthatch	Stable	Potential extirpation
Rock Wren	Stable	Stable
Canyon Wren	x	Stable
House Wren	Potential extirpation	Improving
Bewick's Wren	Improving	Stable
Cactus Wren	Stable	Stable
Blue-gray Gnatcatcher	Improving	Improving
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	-
Western Bluebird	Potential extirpation	Worsening
Mountain Bluebird	-	Worsening*
Townsend's Solitaire	-	Worsening*
Hermit Thrush	-	Stable
American Robin	Potential extirpation	Potential extirpation
Curve-billed Thrasher	Stable	Stable
Crissal Thrasher	-	Worsening
Sage Thrasher	-	Worsening
Northern Mockingbird	Stable	Stable
European Starling	Potential extirpation	Improving
American Pipit	-	Improving
Cedar Waxwing	-	Potential extirpation
Phainopepla	Improving*	Stable
Black-and-white Warbler	-	Potential colonization
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Improving*
Yellow-rumped Warbler	-	Improving
Wilson's Warbler	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Yellow-breasted Chat	Improving	-
Olive Sparrow	Potential colonization	-
Green-tailed Towhee	-	Stable
Spotted Towhee	Stable	x
Rufous-crowned Sparrow	x	Stable
Canyon Towhee	Improving	Worsening
Abert's Towhee	Potential colonization	-
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Worsening*	Worsening*
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Brewer's Sparrow	-	Worsening
Field Sparrow	-	Improving
Black-chinned Sparrow	x	Worsening*
Vesper Sparrow	-	Improving
Lark Sparrow	Worsening*	Improving*
Black-throated Sparrow	Stable	Stable
Lark Bunting	-	Worsening
Savannah Sparrow	-	Stable
Grasshopper Sparrow	-	Improving
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Improving
Lincoln's Sparrow	-	Improving
Swamp Sparrow	-	Potential colonization
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	x	Potential extirpation
Hepatic Tanager	Worsening	-
Summer Tanager	Improving*	-
Western Tanager	Potential extirpation	Potential colonization
Northern Cardinal	Improving*	Improving
Pyrrhuloxia	Stable	Worsening
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Stable	-
Indigo Bunting	-	Potential colonization
Painted Bunting	Improving	-
Red-winged Blackbird	-	Improving
Eastern Meadowlark	Potential extirpation	-
Western Meadowlark	Potential extirpation	Stable
Yellow-headed Blackbird	Stable	x
Brewer's Blackbird	-	Stable
Great-tailed Grackle	Improving	-
Bronzed Cowbird	Stable	Potential colonization
Brown-headed Cowbird	Improving	Improving
Orchard Oriole	Improving	-
Bullock's Oriole	Stable	-
Scott's Oriole	Stable	-
House Finch	Stable	Worsening
Cassin's Finch	-	Stable
Pine Siskin	Improving	Potential extirpation
Lesser Goldfinch	Improving	Stable
American Goldfinch	-	Potential extirpation
House Sparrow	x	Worsening