Birds and Climate Change

National Park Service
U.S. Department of the Interior

Palo Alto Battlefield National Historical Park

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 Palo Alto Battlefield National Historical Park (hereafter, the Park) 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park 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 Park, 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 Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 8, remain stable for 35 (e.g., Figure 2), and worsen for 15 species. Suitable climate does not cease to occur for any species in summer. Climate is projected to become suitable in summer for 6 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 17, remain stable for 28, and worsen for 45 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 17 species not found at the Park today, potentially resulting in local colonization.

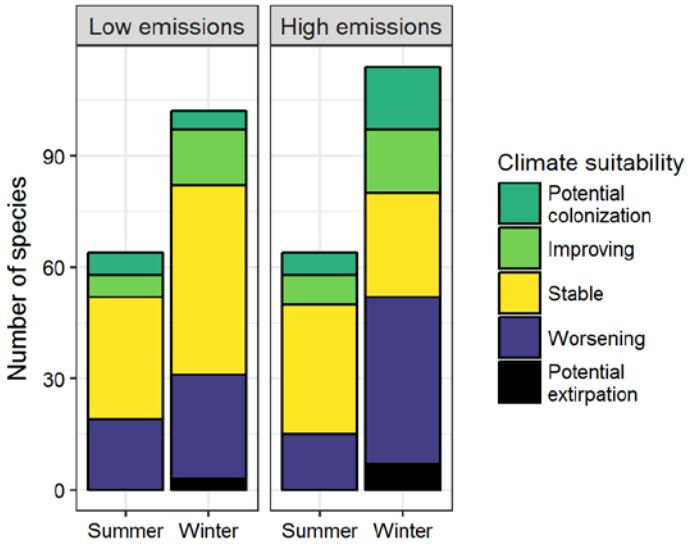

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.05 in summer (1st percentile across all national parks) and 0.07 in winter (2nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.04 in summer and 0.03 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 Park is or may become home to 3 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 3 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Park 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, Palo Alto Battlefield National Historical Park 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 3 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park 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	Stable	x
Mottled Duck	Worsening	Worsening
Blue-winged Teal	Stable	Worsening
Northern Shoveler	-	Improving
Lesser Scaup	-	Stable
California Quail	-	Potential colonization
Gambel's Quail	-	Potential colonization
Northern Bobwhite	Worsening	Worsening*
Pied-billed Grebe	-	Stable
Neotropic Cormorant	x	Stable
Double-crested Cormorant	-	Stable
Anhinga	-	Improving
American White Pelican	-	Stable
Great Blue Heron	Improving*	Improving
Great Egret	Stable	Stable
Snowy Egret	x	Stable

Common Name	Summer Trend	Winter Trend
Tricolored Heron	Worsening^	Improving
Cattle Egret	-	Stable
Green Heron	Stable	-
White Ibis	Stable	Improving*
Glossy Ibis	-	Potential colonization
Roseate Spoonbill	x	Worsening
Black Vulture	Stable	Worsening
Turkey Vulture	x	Improving
Osprey	-	Stable
White-tailed Kite	Stable	Worsening
Northern Harrier	-	Stable
Cooper's Hawk	-	Improving
Harris's Hawk	Stable	Stable
White-tailed Hawk	x	Worsening
Red-tailed Hawk	-	Potential extirpation
Sora	-	Worsening
Common Gallinule	x	Stable

Common Name	Summer Trend	Winter Trend
American Coot	x	Worsening
Black-necked Stilt	x	Worsening*
Killdeer	Worsening	Worsening
Spotted Sandpiper	-	Stable
Wandering Tattler	-	Potential colonization
Greater Yellowlegs	-	Worsening
Whimbrel	-	Improving*
Long-billed Curlew	-	Worsening
American Woodcock	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Laughing Gull	Stable^	Improving
Gull-billed Tern	x	Improving*
Forster's Tern	-	Improving
Rock Pigeon	Stable	Potential extirpation
White-crowned Pigeon	Potential colonization	Potential colonization
Eurasian Collared-Dove	x	Stable
White-winged Dove	Improving*	Worsening*
Mourning Dove	Worsening	Improving
Inca Dove	Stable	-
Common Ground-Dove	Stable	Worsening
White-tipped Dove	-	Worsening*
Yellow-billed Cuckoo	Improving*	-
Great Horned Owl	x	Potential extirpation
Lesser Nighthawk	Worsening	-
Common Nighthawk	Worsening*	-
Common Pauraque	x	Worsening*
Chimney Swift	Improving*	-
Buff-bellied Hummingbird	x	Worsening
Golden-fronted Woodpecker	Stable	Worsening
Red-bellied Woodpecker	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Ladder-backed Woodpecker	Stable	Stable
Northern Flicker	-	Potential extirpation
Gilded Flicker	-	Potential colonization
Crested Caracara	Stable	Stable
American Kestrel	-	Stable
Peregrine Falcon	-	Stable
Dusky Flycatcher	-	Potential colonization
Eastern Phoebe	-	Worsening
Vermilion Flycatcher	-	Worsening
Ash-throated Flycatcher	Improving	-
Brown-crested Flycatcher	Worsening*	-
Great Kiskadee	Worsening*	Stable
Couch's Kingbird	Stable	Worsening*
Western Kingbird	Stable	-
Scissor-tailed Flycatcher	Stable	-
Loggerhead Shrike	Worsening*	Worsening
White-eyed Vireo	Stable	Worsening
Green Jay	Improving*	Worsening*
Chihuahuan Raven	Stable	Stable
Northern Rough-winged Swallow	Potential colonization	-
Purple Martin	Stable	-
Tree Swallow	-	Improving*
Violet-green Swallow	-	Potential colonization
Black-crested Titmouse	Worsening	Worsening*
Verdin	Stable	Stable
Rock Wren	-	Potential colonization
House Wren	-	Worsening*
Carolina Wren	Improving*	Potential extirpation
Bewick's Wren	Stable	Worsening
Cactus Wren	Improving	Improving*

Common Name	Summer Trend	Winter Trend
Blue-gray Gnatcatcher	-	Worsening
California Gnatcatcher	-	Potential colonization
Ruby-crowned Kinglet	-	Worsening
Curve-billed Thrasher	Stable	Stable
Long-billed Thrasher	Worsening*^	Worsening*
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	-
Northern Mockingbird	Worsening	Stable
European Starling	Stable	Stable
Black-and-white Warbler	-	Worsening
Orange-crowned Warbler	-	Worsening
Common Yellowthroat	-	Stable
Yellow-rumped Warbler	-	Worsening
Prairie Warbler	Potential colonization	Potential colonization
Olive Sparrow	Worsening*	Stable
California Towhee	-	Potential colonization
Abert's Towhee	Potential colonization	-
Rufous-winged Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Cassin's Sparrow	Stable	Worsening
Chipping Sparrow	-	Worsening
Vesper Sparrow	-	Worsening
Lark Sparrow	Stable	Worsening
Black-throated Sparrow	Stable	Improving*
Savannah Sparrow	-	Worsening
Lincoln's Sparrow	-	Worsening*
Northern Cardinal	Stable	Stable
Pyrrhuloxia	-	Worsening
Blue Grosbeak	Stable	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Worsening	Worsening
Western Meadowlark	-	Improving*
Great-tailed Grackle	Stable	Worsening
Bronzed Cowbird	Stable	Worsening*
Brown-headed Cowbird	Stable	Worsening
House Finch	Stable	Stable
Cassin's Finch	-	Potential colonization
Lesser Goldfinch	-	Potential extirpation
House Sparrow	x	Potential extirpation