Birds and Climate Change

National Park Service
U.S. Department of the Interior

Tumacacori 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 Tumacacori 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 climate suitability projected to improve for some species and worsen for others (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 43 (e.g., Figure 2), remain stable for 35, and worsen for 10 species. Suitable climate ceases to occur for 5 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 13 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 30, remain stable for 53, and worsen for 33 species. Suitable climate ceases to occur for 9 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 49 species not found at the Park today, potentially resulting in local colonization.

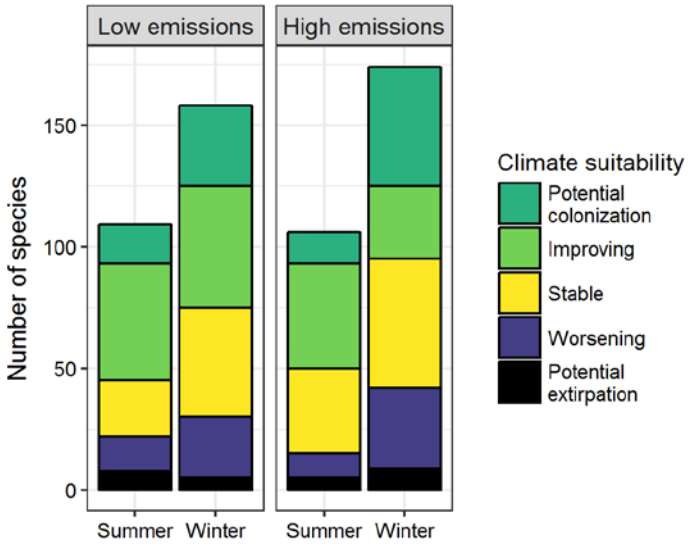

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.12 in summer (15th percentile across all national parks) and 0.15 in winter (18th percentile) under the high-emissions pathway. Potential species turnover increases to 0.14 in summer and declines to 0.10 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 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 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, Tumacacori 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 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.

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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 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	Improving	-
Fulvous Whistling-Duck	Potential colonization	-
Muscovy Duck	-	Potential colonization
Wood Duck	-	Stable
Gadwall	Improving^	Stable
Eurasian Wigeon	-	Improving
American Wigeon	-	Stable
Mallard	Stable^	Worsening
Mottled Duck	Potential colonization	-
Cinnamon Teal	x	Worsening*
Northern Shoveler	Stable^	Worsening
Green-winged Teal	-	Stable
Canvasback	-	Stable
Ring-necked Duck	-	Worsening
Lesser Scaup	x	Stable
Bufflehead	-	Improving*
Hooded Merganser	-	Improving*^
Ruddy Duck	Improving	Stable
Plain Chachalaca	-	Potential colonization
Gambel's Quail	Improving	Stable
Northern Bobwhite	-	Potential colonization
Wild Turkey	-	Potential extirpation
Least Grebe	-	Potential colonization
Pied-billed Grebe	x	Stable
Eared Grebe	-	Improving
Magnificent Frigatebird	-	Potential colonization
Anhinga	-	Potential colonization
Brown Pelican	Potential colonization	-
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	Stable

Common Name	Summer Trend	Winter Trend
Great Egret	-	Improving*
Little Blue Heron	Potential colonization	-
Tricolored Heron	Potential colonization^	-
Reddish Egret	-	Potential colonization
Green Heron	Improving	Stable
Yellow-crowned Night-Heron	-	Potential colonization
Roseate Spoonbill	-	Potential colonization
Black Vulture	Improving	Improving*
Turkey Vulture	x	Stable
Osprey	-	Stable
Golden Eagle	-	Worsening
Northern Harrier	-	Worsening
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Stable
White-tailed Hawk	-	Potential colonization
Gray Hawk	Improving	-
Swainson's Hawk	Worsening*^	-
Red-tailed Hawk	Worsening*	Stable
Ferruginous Hawk	-	Worsening*
Common Gallinule	x	Worsening
American Coot	x	Improving
Limpkin	-	Potential colonization
Black-necked Stilt	x	Potential colonization
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Killdeer	Stable	Stable
Spotted Sandpiper	-	Stable
Greater Yellowlegs	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Whimbrel	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Least Sandpiper	-	Stable
Wilson's Snipe	-	Improving*
Wilson's Phalarope	Stable^	-
Heermann's Gull	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Caspian Tern	-	Potential colonization
Black Tern	Improving	-
Forster's Tern	-	Potential colonization
Sandwich Tern	-	Potential colonization^
Black Skimmer	-	Potential colonization^
Rock Pigeon	Stable	Stable
Band-tailed Pigeon	Stable	-
Eurasian Collared-Dove	x	Stable
White-winged Dove	Stable	Worsening*
Mourning Dove	Stable	Improving
Inca Dove	Improving*	Improving
Common Ground-Dove	Improving*	Stable
White-tipped Dove	-	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Stable	Stable
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	-	Stable
Great Horned Owl	-	Stable
Lesser Nighthawk	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Common Pauraque	-	Potential colonization
White-throated Swift	-	Stable
Black-chinned Hummingbird	Improving	-
Anna's Hummingbird	-	Improving*
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	-	Stable
Gila Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Potential extirpation
Red-naped Sapsucker	-	Worsening*
Ladder-backed Woodpecker	Improving	Worsening
Northern Flicker	Stable	Worsening
Gilded Flicker	Improving*	Improving*
Crested Caracara	Improving	Potential colonization
American Kestrel	x	Improving
Merlin	-	Worsening^
Peregrine Falcon	x	Improving*
Northern Beardless-Tyrannulet	Improving*	x
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Improving	-
Hammond's Flycatcher	-	Stable
Gray Flycatcher	-	Worsening*
Dusky Flycatcher	-	Worsening*
Black Phoebe	Stable	Stable
Eastern Phoebe	-	Stable
Say's Phoebe	Stable	Stable
Vermilion Flycatcher	Worsening*	Stable
Ash-throated Flycatcher	Stable	x
Brown-crested Flycatcher	Improving*	-

Common Name	Summer Trend	Winter Trend
Great Kiskadee	Potential colonization	-
Couch's Kingbird	-	Potential colonization
Cassin's Kingbird	Worsening*	Stable
Western Kingbird	Worsening	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Stable
White-eyed Vireo	Potential colonization	Potential colonization
Bell's Vireo	Improving	-
Hutton's Vireo	-	Stable
Warbling Vireo	Stable	-
Green Jay	-	Potential colonization
Chihuahuan Raven	Worsening*	Worsening*
Common Raven	Stable	Potential extirpation
Northern Rough-winged Swallow	Improving*	Potential colonization
Purple Martin	Potential colonization	-
Tree Swallow	Potential extirpation	Potential colonization
Violet-green Swallow	Improving	-
Barn Swallow	Potential extirpation	-
Cliff Swallow	Improving	-
Carolina Chickadee	-	Potential colonization
Bridled Titmouse	Stable	Stable
Verdin	Improving	Worsening
White-breasted Nuthatch	Stable	Potential extirpation
Pygmy Nuthatch	Potential colonization	-
Brown Creeper	-	Potential extirpation
Canyon Wren	-	Improving*
House Wren	Stable	Improving

Common Name	Summer Trend	Winter Trend
Sedge Wren	-	Potential colonization
Bewick's Wren	Improving*	Worsening*
Cactus Wren	Stable	Stable
Blue-gray Gnatcatcher	-	Improving*
Black-tailed Gnatcatcher	Improving	-
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Stable
Mountain Bluebird	-	Worsening
Townsend's Solitaire	-	Worsening
Hermit Thrush	-	Improving
American Robin	Potential extirpation	Potential extirpation
Curve-billed Thrasher	Stable	Stable
Long-billed Thrasher	Potential colonization^	Potential colonization
LeConte's Thrasher	Potential colonization	Potential colonization
Crissal Thrasher	Stable	Worsening*
Northern Mockingbird	Worsening*	Stable
European Starling	Stable	Improving
American Pipit	-	Stable
Cedar Waxwing	-	Potential extirpation
Phainopepla	Stable	Improving
Black-and-white Warbler	-	Improving
Orange-crowned Warbler	-	Stable
Lucy's Warbler	Improving	-
Common Yellowthroat	Stable	Worsening*
Northern Parula	-	Potential colonization
Yellow Warbler	Improving	-
Pine Warbler	-	Potential colonization
Yellow-rumped Warbler	Improving	Improving

Common Name	Summer Trend	Winter Trend
Black-throated Gray Warbler	-	Stable
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Improving	-
Olive Sparrow	Potential colonization	Potential colonization
Green-tailed Towhee	-	Worsening
Rufous-crowned Sparrow	-	Stable
Canyon Towhee	Stable	Worsening*
Abert's Towhee	Improving*	Improving
Rufous-winged Sparrow	Stable	Stable
Cassin's Sparrow	Potential extirpation	-
Chipping Sparrow	-	Improving
Brewer's Sparrow	-	Stable
Vesper Sparrow	-	Stable
Lark Sparrow	Worsening	Improving
Black-throated Sparrow	Stable	Stable
Lark Bunting	-	Stable
Savannah Sparrow	-	Worsening
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Improving	Worsening
Lincoln's Sparrow	-	Worsening
White-throated Sparrow	-	Improving*
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Stable	-
Western Tanager	Improving	Potential colonization
Northern Cardinal	Improving*	Improving
Pyrrhuloxia	Stable	Stable

Common Name	Summer Trend	Winter Trend
Black-headed Grosbeak	Stable	x
Blue Grosbeak	Worsening	-
Lazuli Bunting	Stable	x
Indigo Bunting	Improving	Potential colonization
Red-winged Blackbird	Improving	Stable
Eastern Meadowlark	Stable	Worsening*
Western Meadowlark	-	Worsening
Yellow-headed Blackbird	Improving	x
Brewer's Blackbird	-	Stable
Great-tailed Grackle	Stable	Stable

Common Name	Summer Trend	Winter Trend
Bronzed Cowbird	Stable	-
Brown-headed Cowbird	Improving	Stable
Hooded Oriole	Improving	-
Bullock's Oriole	Improving	x
Audubon's Oriole	-	Potential colonization
House Finch	Worsening*	Worsening
Pine Siskin	-	Potential extirpation
Lesser Goldfinch	Improving*	Worsening
House Sparrow	x	Worsening