Birds and Climate Change

National Park Service
U.S. Department of the Interior

Pinnacles National 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 Pinnacles National 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 13 (e.g., Figure 2), remain stable for 17, and worsen for 32 species. Suitable climate ceases to occur for 9 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 19 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 38, remain stable for 31, and worsen for 25 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 26 species not found at the Park today, potentially resulting in local colonization.

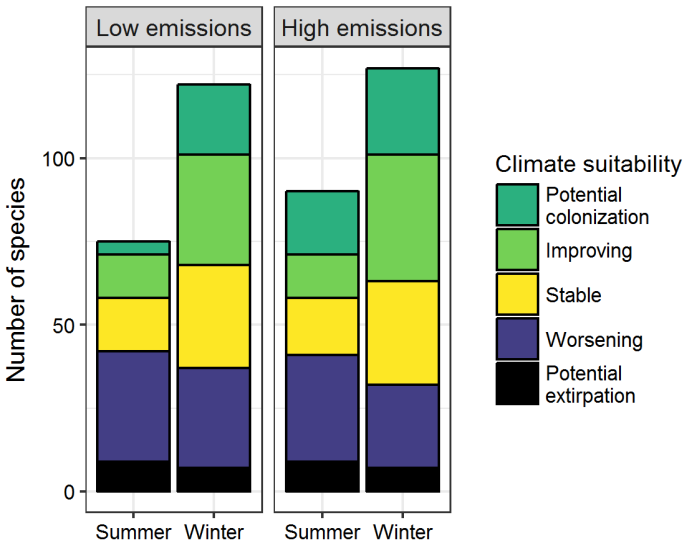

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.19 in summer (28th percentile across all national parks) and 0.09 in winter (5th percentile) under the high-emissions pathway. Potential species turnover declines to 0.10 in summer and 0.08 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 11 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 11 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, Pinnacles National 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 11 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
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	-	Potential colonization
Wood Duck	-	Potential colonization
Gadwall	-	Improving*
American Wigeon	-	Improving
Mallard	-	Improving
Blue-winged Teal	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Improving
California Quail	Worsening	Worsening
Wild Turkey	x	Potential extirpation
Horned Grebe	-	Potential colonization
Wood Stork	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Anhinga	Potential colonization^	-
Least Bittern	-	Potential colonization
Great Blue Heron	Potential colonization	Improving
Great Egret	-	Improving
Reddish Egret	-	Potential colonization
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Turkey Vulture	x	Improving
White-tailed Kite	Stable	Stable
Golden Eagle	x	Worsening*
Northern Harrier	-	Improving
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Stable
Bald Eagle	x	Stable

Common Name	Summer Trend	Winter Trend
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Worsening
American Coot	x	Improving
Black-bellied Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	-	Improving
Greater Yellowlegs	-	Improving
Lesser Yellowlegs	-	Potential colonization
Marbled Godwit	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization^
Pomarine Jaeger	-	Potential colonization^
Ring-billed Gull	-	Potential colonization
Herring Gull	-	Potential colonization^
Caspian Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Black Skimmer	-	Potential colonization^
Rock Pigeon	Improving*	Improving
Band-tailed Pigeon	-	Worsening
Eurasian Collared-Dove	x	Stable
White-winged Dove	Potential colonization	-
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	Potential colonization
Greater Roadrunner	Improving	Stable
Barn Owl	x	Worsening

Common Name	Summer Trend	Winter Trend
Western Screech-Owl	x	Stable
Great Horned Owl	x	Stable
Northern Pygmy-Owl	-	Worsening*
White-throated Swift	x	Improving*
Anna's Hummingbird	Worsening	Improving
Costa's Hummingbird	Improving	-
Belted Kingfisher	-	Improving*
Lewis's Woodpecker	-	Worsening*
Acorn Woodpecker	Worsening	Stable
Golden-fronted Woodpecker	Potential colonization	-
Red-breasted Sapsucker	-	Worsening*
Nuttall's Woodpecker	Worsening	Stable
Downy Woodpecker	Stable	Stable
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Worsening	Worsening
Gilded Flicker	Potential colonization	-
American Kestrel	x	Improving
Merlin	-	Improving^
Peregrine Falcon	x	Improving
Prairie Falcon	x	Worsening
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Worsening*^	-
Gray Flycatcher	-	Potential colonization
Pacific-slope Flycatcher	Worsening	-
Black Phoebe	Stable	Stable
Say's Phoebe	Worsening	Stable
Vermilion Flycatcher	Potential colonization	Potential colonization
Ash-throated Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Worsening	-

Common Name	Summer Trend	Winter Trend
Loggerhead Shrike	Improving*	Improving
Bell's Vireo	Potential colonization	-
Hutton's Vireo	Worsening^	Worsening*
Warbling Vireo	Potential extirpation	-
Steller's Jay	Worsening*	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Worsening	Worsening
Yellow-billed Magpie	Worsening*^	Stable^
American Crow	Stable	Improving
Common Raven	Potential extirpation	Worsening
Northern Rough-winged Swallow	Improving*	Potential colonization
Tree Swallow	Stable	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-
Chestnut-backed Chickadee	Potential extirpation	Potential extirpation
Oak Titmouse	Worsening*	Worsening*
Bushtit	Worsening	Worsening
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Worsening*	Worsening
Brown Creeper	-	Potential extirpation
Rock Wren	Worsening	Worsening
Canyon Wren	x	Improving*
House Wren	Worsening*	Improving*
Bewick's Wren	Worsening	Stable
Blue-gray Gnatcatcher	Stable	-
Ruby-crowned Kinglet	-	Improving
Wrentit	Stable	Stable
Western Bluebird	Worsening*	Worsening
Mountain Bluebird	-	Stable

Common Name	Summer Trend	Winter Trend
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	-	Improving
American Robin	Potential extirpation	Stable
Varied Thrush	-	Worsening*
Curve-billed Thrasher	Potential colonization	-
California Thrasher	Improving*	Worsening
Northern Mockingbird	Stable	Improving
European Starling	Stable	Stable
Cedar Waxwing	-	Improving
Phainopepla	Improving*	Stable
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening	Improving*
Yellow-rumped Warbler	Potential extirpation	Improving
Townsend's Warbler	-	Stable
Wilson's Warbler	Stable	-
Spotted Towhee	Worsening	x
Rufous-crowned Sparrow	x	Stable
California Towhee	Worsening	Stable
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	-
Lark Sparrow	Worsening	Stable
Sagebrush/Bell's Sparrow (Sage Sparrow)	Worsening^	Worsening*
Savannah Sparrow	-	Improving
Grasshopper Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	Stable	Improving
Lincoln's Sparrow	-	Improving

Common Name	Summer Trend	Winter Trend
White-throated Sparrow	-	Stable
White-crowned Sparrow	-	Stable
Golden-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Worsening
Western Tanager	Worsening	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Red-winged Blackbird	Improving	Improving
Tricolored Blackbird	-	Worsening
Western Meadowlark	Worsening	Improving

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