



Joshua Tree 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 Joshua Tree 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.

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 34, remain stable for 15, and worsen for 11 species. Suitable climate ceases to occur for 10 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 8 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 19, remain stable for 20, and worsen for 38 species. Suitable climate ceases to occur for 11 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 50 species not found at the Park today, potentially resulting in local colonization.

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.

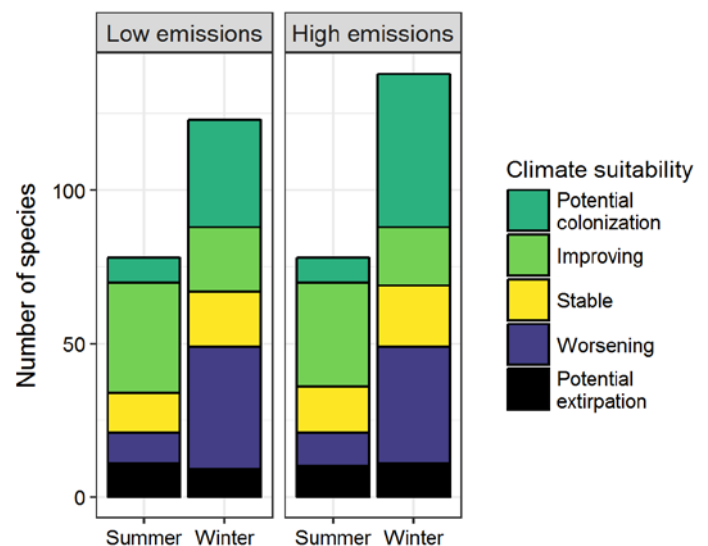


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.10 in summer (11th percentile across all national parks) and 0.15 in winter (17th percentile) under the high-emissions pathway. Potential species turnover declines to 0.09 in summer and 0.11 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 17 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 Park may serve as an important refuge for 16 of these climate-sensitive species, one, the Western Wood-Pewee

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Joshua Tree 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.

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

(*Contopus sordidulus*), might be extirpated from the Park in summer by 2050.



Figure 2. Although currently found at the Park, suitable climate for the Violet-green Swallow (*Tachycineta thalassina*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Becky Matsubara/Flickr (CC BY 2.0).

Furthermore, park managers have an opportunity to focus on supporting the 16 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.

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	Common Name	Summer Trend	Winter Trend
Muscovy Duck	-	Potential colonization			colonization [^]
Mallard	-	Potential extirpation	Pied-billed Grebe	-	Worsening
Cinnamon Teal	-	Improving	Horned Grebe	-	Potential colonization
Ring-necked Duck	-	Stable	Wood Stork	-	Potential colonization
Long-tailed Duck	-	Potential colonization	Magnificent Frigatebird	-	Potential colonization
Barrow's Goldeneye	-	Potential colonization [^]	Neotropic Cormorant	-	Potential colonization
Red-breasted Merganser	-	Potential colonization [^]	Brown Pelican	-	Potential colonization [^]
Ruddy Duck	Potential colonization	-	Tricolored Heron	-	Potential colonization
California Quail	Worsening*	Potential extirpation	Reddish Egret	-	Potential colonization
Gambel's Quail	Improving	Improving	Yellow-crowned Night-Heron	-	Potential colonization
Chukar	Worsening	-	White Ibis	-	Potential colonization
Pacific Loon	-	Potential colonization	Turkey Vulture	x	Improving*
Common Loon	-	Potential	Golden Eagle	x	Worsening*

Common Name	Summer Trend	Winter Trend
Northern Harrier	-	Worsening
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Worsening
Short-tailed Hawk	-	Potential colonization
Red-tailed Hawk	Improving	Worsening
Ferruginous Hawk	-	Worsening
Sora	-	Stable
American Coot	x	Worsening
Limpkin	-	Potential colonization
American Oystercatcher	-	Potential colonization [^]
Black-bellied Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization [^]
Piping Plover	-	Potential colonization [^]
Killdeer	Improving	-
Wandering Tattler	-	Potential colonization
Willet	-	Potential colonization [^]
Whimbrel	-	Potential colonization
Marbled Godwit	-	Potential colonization
Ruddy Turnstone	-	Potential colonization [^]
Sanderling	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization [^]
Bonaparte's Gull	-	Potential colonization
Laughing Gull	Potential colonization [^]	Potential colonization
Heermann's Gull	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Mew Gull	-	Potential colonization
Ring-billed Gull	-	Stable
Western Gull	-	Potential colonization [^]
Iceland Gull (Thayer's)	-	Potential colonization
Glaucous-winged Gull	-	Potential colonization
Royal Tern	-	Potential colonization [^]
Black Skimmer	-	Potential colonization [^]
Rock Pigeon	Improving	Stable
White-crowned Pigeon	Potential colonization	-
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving*	Improving*
Mourning Dove	Worsening	Stable
White-tipped Dove	Potential colonization	-
Greater Roadrunner	Improving	Worsening
Barn Owl	x	Worsening
Great Horned Owl	x	Potential extirpation
Lesser Nighthawk	Improving	-
White-throated Swift	x	Stable
Black-chinned Hummingbird	Improving	-
Anna's Hummingbird	Worsening	Improving
Costa's Hummingbird	Stable	Improving*
Red-naped Sapsucker	-	Stable
Red-breasted Sapsucker	-	Potential extirpation
Ladder-backed Woodpecker	Improving	Improving
Nuttall's Woodpecker	-	Worsening
Northern Flicker	-	Worsening
Crested Caracara	-	Potential colonization

Common Name	Summer Trend	Winter Trend
American Kestrel	x	Worsening
Merlin	-	Worsening^
Peregrine Falcon	-	Stable
Prairie Falcon	x	Worsening*
Western Wood-Pewee	Potential extirpation^	-
Willow Flycatcher	Improving	-
Hammond's Flycatcher	-	Potential colonization
Black Phoebe	Improving	Stable
Say's Phoebe	Improving	Stable
Vermilion Flycatcher	Improving	-
Ash-throated Flycatcher	Worsening*	-
Great Crested Flycatcher	-	Potential colonization
Couch's Kingbird	Potential colonization	-
Cassin's Kingbird	Improving	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Improving	Stable
Black-whiskered Vireo	Potential colonization	-
Pinyon Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
American Crow	Stable	-
Common Raven	Potential extirpation	Worsening
Horned Lark	Stable	Potential extirpation
Northern Rough-winged Swallow	Improving	Improving
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Cave Swallow	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization	
Mountain Chickadee	-	Worsening
Bridled Titmouse	-	Potential colonization
Oak Titmouse	Potential extirpation	Worsening
Verdin	Improving	Improving
Bushtit	Potential extirpation	Worsening*
White-breasted Nuthatch	-	Potential extirpation
Rock Wren	Improving	Worsening
Canyon Wren	x	Stable
House Wren	-	Stable
Bewick's Wren	Stable	Worsening*
Cactus Wren	Stable	Stable
Blue-gray Gnatcatcher	Stable	Improving
Black-tailed Gnatcatcher	Improving*	Improving
Ruby-crowned Kinglet	Stable	Worsening
Western Bluebird	-	Worsening*
Mountain Bluebird	-	Worsening*
Townsend's Solitaire	-	Improving
Swainson's Thrush	Stable	-
Hermit Thrush	-	Worsening*
American Robin	-	Potential extirpation
California Thrasher	Worsening	Worsening
LeConte's Thrasher	Stable	Stable
Sage Thrasher	-	Improving
Northern Mockingbird	Improving	Worsening
European Starling	Stable	Worsening
Phainopepla	Improving	Stable
Smith's Longspur	-	Potential colonization
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	-	Improving

Common Name	Summer Trend	Winter Trend
Lucy's Warbler	Improving*	-
Northern Parula	-	Potential colonization
Yellow Warbler	Improving	-
Yellow-rumped Warbler	-	Worsening
Townsend's Warbler	Stable	Potential colonization
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	-	Improving*
Spotted Towhee	Potential extirpation	x
California Towhee	Worsening	Worsening
Chipping Sparrow	Stable	Improving
Brewer's Sparrow	-	Improving*
Black-chinned Sparrow	x	Potential colonization
Black-throated Sparrow	Worsening*	Stable
Sagebrush/Bell's Sparrow (Sage Sparrow)	Worsening^	Stable
Grasshopper Sparrow	-	Potential colonization
Fox Sparrow	-	Potential extirpation
Song Sparrow	-	Worsening
Lincoln's Sparrow	-	Worsening
White-crowned Sparrow	-	Worsening
Golden-crowned Sparrow	-	Potential

Common Name	Summer Trend	Winter Trend
		extirpation
Dark-eyed Junco	x	Potential extirpation
Western Tanager	Potential extirpation	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Painted Bunting	-	Potential colonization
Red-winged Blackbird	Improving*	-
Western Meadowlark	Improving	Worsening*
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Potential extirpation	Worsening
Great-tailed Grackle	Improving*	Improving
Brown-headed Cowbird	Improving	-
Hooded Oriole	Improving	-
Bullock's Oriole	Improving*	-
Scott's Oriole	Worsening*	x
House Finch	Worsening*	Worsening
Purple Finch	-	Potential extirpation
Lesser Goldfinch	Improving	Worsening*
House Sparrow	x	Stable