Birds and Climate Change

National Park Service
U.S. Department of the Interior

Death Valley 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 Death Valley 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 29, remain stable for 28, and worsen for 13 species. Suitable climate ceases to occur for 38 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 9 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 42, remain stable for 35, and worsen for 27 species. Suitable climate ceases to occur for 13 species in winter, potentially resulting in extirpation from the Park (e.g., Figure 2). Climate is projected to become suitable in winter for 35 species not found at the Park today, potentially resulting in local colonization.

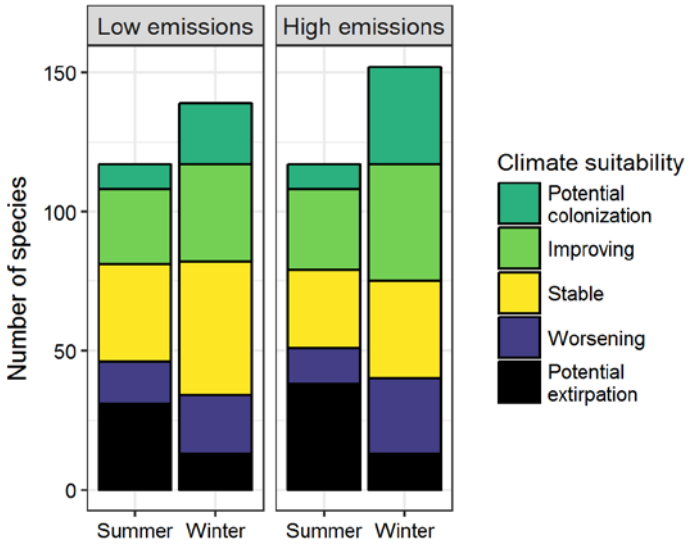

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.18 in summer (28th percentile across all national parks) and 0.13 in winter (14th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.09 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 20 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 12 of these climate-sensitive species, 8 might be extirpated from the Park in at least one season by 2050.

Figure 2. Although currently found at the Park, suitable climate for the American Robin (*Turdus migratorius*) may cease to occur here in winter by 2050, potentially resulting in local seasonal extirpation. 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, Death Valley National Park falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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 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.

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
Cackling/Canada Goose	x	Potential extirpation
Muscovy Duck	-	Potential colonization
Wood Duck	x	Improving
Gadwall	-	Stable
American Wigeon	-	Stable
Mallard	Stable^	Worsening
Blue-winged Teal	Stable	Improving
Cinnamon Teal	x	Improving
Northern Shoveler	Potential extirpation^	Stable
Northern Pintail	Worsening	x
Green-winged Teal	-	Improving
Canvasback	-	Improving
Redhead	Stable^	x
Ring-necked Duck	x	Improving
Lesser Scaup	-	Improving
Bufflehead	-	Worsening
Common Goldeneye	-	Stable
Hooded Merganser	-	Stable^
Common Merganser	-	Stable
Ruddy Duck	Stable	Stable
Mountain Quail	Worsening	-
Gambel's Quail	Improving*	Improving*
Chukar	Worsening*	Worsening
Pied-billed Grebe	x	Stable
Eared Grebe	x	Stable
Magnificent Frigatebird	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	-	Stable
Brown Pelican	Potential colonization	Potential colonization^
Great Blue Heron	Stable	Worsening
Great Egret	Stable	-
Tricolored Heron	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization^	
Reddish Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Green Heron	Improving	-
White Ibis	-	Potential colonization
Roseate Spoonbill	-	Potential colonization
Turkey Vulture	x	Improving*
Osprey	-	Potential colonization
Golden Eagle	x	Worsening*
Northern Harrier	Potential extirpation^	Worsening
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Stable
Bald Eagle	-	Stable
Red-shouldered Hawk	Stable	Potential extirpation
Red-tailed Hawk	Stable	Stable
Virginia Rail	-	Stable
Sora	-	Stable
Common Gallinule	x	Improving
American Coot	x	Stable
Limpkin	-	Potential colonization
Black-necked Stilt	x	Potential colonization
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	Stable	Improving
Greater Yellowlegs	-	Improving
Willet	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Lesser Yellowlegs	-	Potential colonization
Whimbrel	-	Potential colonization
Long-billed Curlew	Potential extirpation^	-
Marbled Godwit	-	Potential colonization
Western Sandpiper	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization^
Wilson's Snipe	-	Worsening
Wilson's Phalarope	Potential extirpation^	-
Ring-billed Gull	-	Stable
California Gull	x	Worsening*^
Caspian Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Royal Tern	-	Potential colonization^
Rock Pigeon	Improving	Potential extirpation
Eurasian Collared-Dove	x	Improving*
White-winged Dove	Improving*	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Improving	Improving*
Common Ground-Dove	-	Potential colonization
White-tipped Dove	Potential colonization	-
Greater Roadrunner	Improving*	Improving
Great Horned Owl	x	Worsening
Lesser Nighthawk	Improving*	Potential colonization
White-throated Swift	x	Improving*
Anna's Hummingbird	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Costa's Hummingbird	Stable	-
Lewis's Woodpecker	-	Improving
Red-naped Sapsucker	Potential extirpation^	Improving
Red-breasted Sapsucker	-	Potential extirpation
Hairy Woodpecker	Potential extirpation	-
Northern Flicker	Potential extirpation	Worsening
American Kestrel	x	Worsening
Prairie Falcon	x	Worsening*
Western Wood-Pewee	Potential extirpation^	-
Willow Flycatcher	Improving	-
Gray Flycatcher	Potential extirpation	-
Dusky Flycatcher	-	Potential colonization
Pacific-slope Flycatcher	Potential extirpation	-
Black Phoebe	Stable	Improving
Say's Phoebe	Improving*	Improving
Vermilion Flycatcher	Improving	Improving*
Ash-throated Flycatcher	Improving*	-
Brown-crested Flycatcher	Improving	-
Great Kiskadee	Potential colonization	-
Cassin's Kingbird	Improving	-
Western Kingbird	Improving	-
Eastern Kingbird	Stable	-
Loggerhead Shrike	Improving	Improving
Warbling Vireo	Potential extirpation	-
Black-whiskered Vireo	Potential colonization	-
Green Jay	Potential colonization	-
Pinyon Jay	Potential extirpation	Worsening

Common Name	Summer Trend	Winter Trend
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
Clark's Nutcracker	Potential extirpation^	-
American Crow	Potential extirpation	Potential extirpation
Common Raven	Worsening*	Worsening
Horned Lark	Worsening*	Worsening*
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Potential extirpation	Improving
Violet-green Swallow	Worsening	-
Barn Swallow	Potential extirpation	-
Cliff Swallow	Potential extirpation	-
Cave Swallow	Potential colonization	-
Mountain Chickadee	Potential extirpation	Worsening*
Juniper Titmouse	Stable	Worsening*
Verdin	Improving*	Improving*
Bushtit	Worsening	Worsening*
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	-	Potential extirpation
Rock Wren	Stable	Stable
Canyon Wren	x	Stable
House Wren	-	Potential colonization
Marsh Wren	x	Stable
Bewick's Wren	Improving	Stable
Cactus Wren	-	Improving*
Blue-gray Gnatcatcher	Stable	Improving*
Black-tailed Gnatcatcher	Improving*	Improving*
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Worsening

Common Name	Summer Trend	Winter Trend
Mountain Bluebird	Potential extirpation	Worsening*
Townsend's Solitaire	-	Worsening*
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	Potential extirpation
American Robin	Potential extirpation	Potential extirpation
Long-billed Thrasher	Potential colonization^	-
LeConte's Thrasher	Stable	Stable
Crissal Thrasher	-	Improving
Sage Thrasher	-	Stable
Northern Mockingbird	Stable	Improving
European Starling	Potential extirpation	Stable
American Pipit	-	Improving
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Stable	Potential extirpation
Phainopepla	Improving*	Improving*
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	Potential extirpation	Improving*
Lucy's Warbler	Improving	-
MacGillivray's Warbler	Potential extirpation	-
Common Yellowthroat	Improving	Improving
Northern Parula	-	Potential colonization
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Potential extirpation	Stable
Black-throated Gray Warbler	Potential extirpation	Potential colonization
Wilson's Warbler	Potential extirpation	Potential colonization

Common Name	Summer Trend	Winter Trend
Yellow-breasted Chat	Improving	-
Spotted Towhee	Potential extirpation	x
Canyon Towhee	-	Potential colonization
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	Potential extirpation	Improving*
Brewer's Sparrow	Worsening*	Improving*
Lark Sparrow	Stable	-
Black-throated Sparrow	Stable	Improving*
Sagebrush/Bell's Sparrow (Sage Sparrow)	Worsening*^	Stable
Savannah Sparrow	-	Stable
Fox Sparrow	Potential extirpation	Stable
Song Sparrow	Stable	Worsening
Lincoln's Sparrow	-	Stable
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Stable
White-crowned Sparrow	-	Improving
Golden-crowned Sparrow	-	Worsening*
Dark-eyed Junco	x	Potential extirpation
Western Tanager	Potential extirpation	-
Pyrrhuloxia	-	Potential colonization
Rose-breasted Grosbeak	Potential extirpation	-
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Worsening	-
Indigo Bunting	Stable	-
Red-winged Blackbird	Stable	Worsening
Western Meadowlark	Worsening*	Stable

Common Name	Summer Trend	Winter Trend
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Potential extirpation	Stable
Great-tailed Grackle	Improving*	Improving
Brown-headed Cowbird	Stable	Worsening
Hooded Oriole	Improving	-
Bullock's Oriole	Improving	-
Scott's Oriole	Stable	-
House Finch	Improving*	Stable

Common Name	Summer Trend	Winter Trend
Cassin's Finch	Potential extirpation	-
Red Crossbill	Potential extirpation^	-
Pine Siskin	Potential extirpation	-
Lesser Goldfinch	Improving	Stable
American Goldfinch	-	Potential extirpation
House Sparrow	x	Potential extirpation