Birds and Climate Change

National Park Service
U.S. Department of the Interior

Sequoia and Kings Canyon National Parks

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 Sequoia and Kings Canyon National Parks (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 28, remain stable for 47, and worsen for 30 species. Suitable climate ceases to occur for 7 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 17 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 12, remain stable for 33, and worsen for 14 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 43 species not found at the Park today, potentially resulting in local colonization.

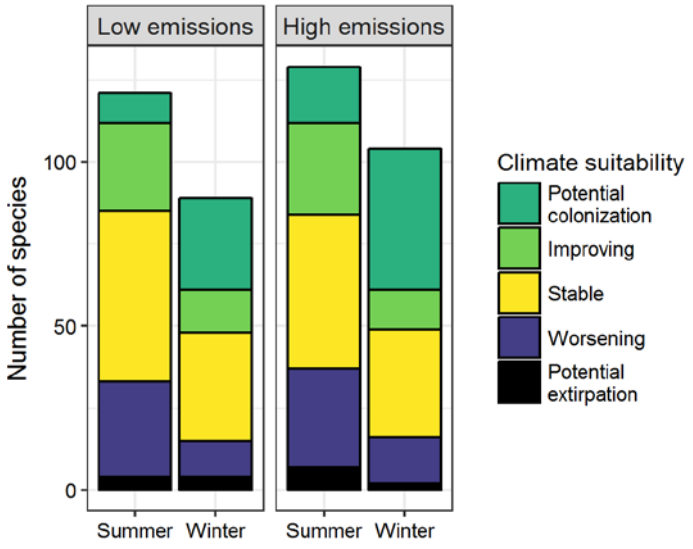

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.17 in summer (24th percentile across all national parks) and 0.18 in winter (22nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.09 in summer and 0.12 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 18 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 18 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Although currently found at the Park, suitable climate for the Chipping Sparrow (*Spizella passerina*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Fyn Kynd/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, Sequoia and Kings Canyon National Parks 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 18 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	-
Gadwall	-	Potential colonization
Mallard	Improving^	Improving*
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	x	Potential colonization
Greater Scaup	-	Potential colonization^
Bufflehead	-	Potential colonization
Common Goldeneye	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Ruddy Duck	Stable	-

Common Name	Summer Trend	Winter Trend
Mountain Quail	Stable	Worsening
California Quail	Improving*	Stable
Gambel's Quail	-	Potential colonization
Chukar	Stable	-
Ring-necked Pheasant	-	Potential colonization
Pacific Loon	-	Potential colonization
Pied-billed Grebe	x	Potential colonization
Horned Grebe	-	Potential colonization
Red-necked Grebe	-	Potential colonization^
Anhinga	Potential colonization^	-
Great Blue Heron	Improving	-
Green Heron	-	Potential colonization
Black-crowned Night-Heron	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Yellow-crowned Night-Heron	Potential colonization	-
White-tailed Kite	-	Potential colonization
Northern Harrier	Stable^	-
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential colonization
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Improving	Stable
Red-tailed Hawk	Improving	Potential extirpation
Sora	-	Potential colonization
Common Gallinule	-	Potential colonization
American Coot	x	Potential colonization
Killdeer	Improving*	Potential colonization
Dunlin	-	Potential colonization^
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Mew Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Band-tailed Pigeon	Stable	Worsening*
Mourning Dove	Improving*	Improving
Common Ground-Dove	Potential colonization	-
Greater Roadrunner	Potential colonization	-
Western Screech-Owl	x	Improving
Great Horned Owl	x	Stable

Common Name	Summer Trend	Winter Trend
Northern Pygmy-Owl	x	Stable
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Stable	-
White-throated Swift	x	Stable
Black-chinned Hummingbird	Stable	-
Anna's Hummingbird	Stable	Stable
Costa's Hummingbird	-	Potential colonization
Rufous Hummingbird	Stable	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Stable	-
Acorn Woodpecker	Stable	Stable
Gila Woodpecker	Potential colonization	Potential colonization
Red-breasted Sapsucker	Worsening	-
Ladder-backed Woodpecker	Potential colonization	-
Nuttall's Woodpecker	Stable	Stable
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Worsening	Worsening
White-headed Woodpecker	Worsening^	Stable
Northern Flicker	Worsening*	Improving
Gilded Flicker	-	Potential colonization
Pileated Woodpecker	Stable	Stable
American Kestrel	x	Worsening
Merlin	-	Potential colonization^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Stable	-
Hammond's Flycatcher	Worsening	-
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	Worsening	-

Common Name	Summer Trend	Winter Trend
Pacific-slope Flycatcher	Stable	-
Black Phoebe	Improving	Worsening
Say's Phoebe	Stable	-
Ash-throated Flycatcher	Improving	-
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Potential colonization	-
Northern Shrike	-	Potential colonization
Hutton's Vireo	Stable^	Stable
Warbling Vireo	Worsening	-
Steller's Jay	Worsening	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Worsening*
Clark's Nutcracker	Worsening^	Stable
American Crow	Improving*	-
Common Raven	Worsening*	Worsening
Horned Lark	Potential extirpation	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Improving	-
Violet-green Swallow	Improving*	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving*	-
Mountain Chickadee	Worsening*	Worsening*
Oak Titmouse	Stable	Worsening*
Verdin	Potential colonization	Potential colonization
Bushtit	Stable	Stable
Red-breasted Nuthatch	Worsening	Worsening
White-breasted Nuthatch	Improving	Stable
Pygmy Nuthatch	Improving	-
Brown Creeper	Stable^	Stable
Rock Wren	Stable	-

Common Name	Summer Trend	Winter Trend
Canyon Wren	x	Stable
House Wren	Stable	-
Pacific/Winter Wren	Stable	Stable
Bewick's Wren	Improving	Stable
Blue-gray Gnatcatcher	Stable	-
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening	Stable
Ruby-crowned Kinglet	Potential extirpation	Improving*
Wrentit	Stable	Stable
Western Bluebird	Stable	Stable
Mountain Bluebird	Stable	-
Townsend's Solitaire	Worsening*^	Worsening*
Swainson's Thrush	Stable	-
Hermit Thrush	Worsening*	Improving
American Robin	Potential extirpation	Improving
Varied Thrush	-	Improving
Curve-billed Thrasher	Potential colonization	-
Bendire's Thrasher	-	Potential colonization
California Thrasher	Stable	Stable
Crissal Thrasher	-	Potential colonization
European Starling	Improving*	-
American Pipit	Worsening	-
Cedar Waxwing	-	Improving
Phainopepla	Improving	-
Orange-crowned Warbler	Improving*	-
Lucy's Warbler	Potential colonization	-
Nashville Warbler	Worsening*	-
MacGillivray's Warbler	Stable	-
Yellow Warbler	Stable	-

Common Name	Summer Trend	Winter Trend
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Worsening	-
Townsend's Warbler	Stable	Potential colonization
Hermit Warbler	Worsening*	-
Wilson's Warbler	Stable	-
Green-tailed Towhee	Worsening^	-
Spotted Towhee	Worsening	x
Rufous-crowned Sparrow	x	Worsening*
California Towhee	Stable	Stable
Abert's Towhee	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	-
Brewer's Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Improving	-
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	-
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	Worsening*	Stable
Song Sparrow	Worsening	-
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Worsening*	Stable

Common Name	Summer Trend	Winter Trend
Golden-crowned Sparrow	-	Improving
Dark-eyed Junco	x	Stable
Western Tanager	Worsening	-
Black-headed Grosbeak	Stable	-
Lazuli Bunting	Worsening	-
Red-winged Blackbird	Stable	Potential colonization
Western Meadowlark	Stable	-
Brewer's Blackbird	Stable	-
Brown-headed Cowbird	Stable	-
Hooded Oriole	Potential colonization	-
Bullock's Oriole	Improving*	-
Pine Grosbeak	Stable^	-
House Finch	Improving*	Potential extirpation
Purple Finch	Stable	Stable
Cassin's Finch	Worsening*	Stable
Red Crossbill	Worsening^	-
Pine Siskin	Worsening	Stable
Lesser Goldfinch	Improving	Stable
Lawrence's Goldfinch	Stable	-
American Goldfinch	Improving*	-
Evening Grosbeak	Stable	-