Birds and Climate Change

National Park Service
U.S. Department of the Interior

Yosemite 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 Yosemite 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 49, remain stable for 35, and worsen for 32 species. Suitable climate ceases to occur for 8 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 7 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 32, remain stable for 24, and worsen for 14 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 29 species not found at the Park today, potentially resulting in local colonization.

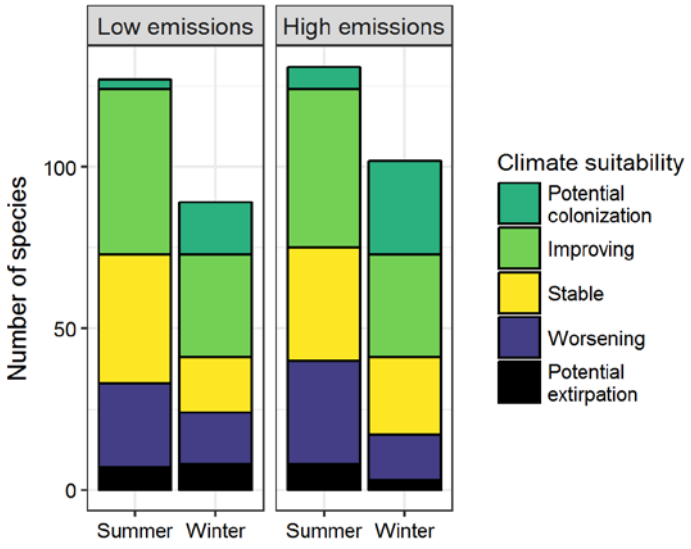

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.14 in summer (19th percentile across all national parks) and 0.16 in winter (20th 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 16 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 16 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, Yosemite 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 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.

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
Wood Duck	x	Potential colonization
Mallard	Improving^	Improving
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Bufflehead	x	Potential colonization
Hooded Merganser	-	Potential colonization^
Common Merganser	x	Improving
Mountain Quail	Worsening	Worsening*
California Quail	Improving*	-
Gambel's Quail	Potential colonization	Potential colonization
Gray Partridge	Potential colonization	-
Ring-necked Pheasant	Potential colonization	Potential colonization
Ruffed Grouse	-	Potential colonization
Wild Turkey	x	Improving
Common Loon	Stable	-
Pied-billed Grebe	-	Improving*
Great Blue Heron	Improving	Improving
Great Egret	-	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Turkey Vulture	x	Improving
White-tailed Kite	-	Potential colonization
Golden Eagle	x	Worsening*
Northern Harrier	Stable^	-
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Stable
Bald Eagle	x	Improving
Red-shouldered Hawk	Improving	Potential extirpation

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Improving	Potential extirpation
Sora	x	Potential colonization
Killdeer	Improving	Potential colonization
Spotted Sandpiper	x	Potential colonization
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Mew Gull	-	Potential colonization
Glaucous-winged Gull	-	Potential colonization
Rock Pigeon	Improving	-
Band-tailed Pigeon	Stable	Worsening*
Mourning Dove	Improving	Improving*
Greater Roadrunner	-	Potential colonization
Great Horned Owl	x	Potential extirpation
Northern Pygmy-Owl	x	Stable
Burrowing Owl	-	Potential colonization
Great Gray Owl	x	Improving^
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving	-
White-throated Swift	x	Improving
Black-chinned Hummingbird	Stable	-
Anna's Hummingbird	Stable	Improving
Costa's Hummingbird	-	Potential colonization
Rufous Hummingbird	Improving	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Improving	Improving
Acorn Woodpecker	Improving*	Improving
Gila Woodpecker	Potential colonization	-
Red-breasted Sapsucker	Worsening*	Stable
Nuttall's Woodpecker	Improving	Stable
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Stable	Stable
White-headed Woodpecker	Worsening*^	Stable
Black-backed Woodpecker	x	Stable
Northern Flicker	Worsening	Stable
Pileated Woodpecker	Stable	Stable
Merlin	-	Potential colonization^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Stable	-
Hammond's Flycatcher	Stable	-
Gray Flycatcher	Stable	-
Dusky Flycatcher	Worsening*	-
Pacific-slope Flycatcher	Stable	-
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	Improving
Say's Phoebe	Stable	-
Ash-throated Flycatcher	Improving	-
Western Kingbird	Improving*	-
Hutton's Vireo	Stable^	Improving
Warbling Vireo	Worsening	-
Steller's Jay	Worsening	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Improving	Improving*
Common Raven	Worsening	Worsening
Horned Lark	Potential extirpation	-
Northern Rough-winged Swallow	Improving	-

Common Name	Summer Trend	Winter Trend
Tree Swallow	Improving	-
Violet-green Swallow	Improving*	-
Barn Swallow	Improving	-
Cliff Swallow	Improving*	-
Mountain Chickadee	Worsening*	Stable
Chestnut-backed Chickadee	Stable	Improving*
Oak Titmouse	Improving	Worsening*
Verdin	-	Potential colonization
Bushtit	Improving	Worsening
Red-breasted Nuthatch	Worsening	Stable
White-breasted Nuthatch	Improving	Stable
Pygmy Nuthatch	Stable	-
Brown Creeper	Worsening^	Worsening
Rock Wren	Worsening	-
Canyon Wren	x	Stable
House Wren	Improving*	-
Pacific/Winter Wren	Stable	Improving
Bewick's Wren	Improving	-
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Improving	-
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening	Improving
Ruby-crowned Kinglet	Potential extirpation	Improving
Wrentit	Stable	Improving
Western Bluebird	Improving	Worsening
Mountain Bluebird	Worsening	Stable
Townsend's Solitaire	Worsening*^	Worsening*
Swainson's Thrush	Stable	-
Hermit Thrush	Worsening*	Improving
American Robin	Worsening	Stable
Varied Thrush	-	Improving

Common Name	Summer Trend	Winter Trend
California Thrasher	Stable	-
Crissal Thrasher	-	Potential colonization
Northern Mockingbird	Improving	-
European Starling	Improving*	-
American Pipit	Worsening	-
Cedar Waxwing	Improving	Improving
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Improving*	-
Nashville Warbler	Worsening	-
MacGillivray's Warbler	Worsening	-
Common Yellowthroat	Improving	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Stable
Black-throated Gray Warbler	Stable	-
Townsend's Warbler	Stable	-
Hermit Warbler	Worsening*	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Improving*	-
Green-tailed Towhee	Worsening*^	-
Spotted Towhee	Improving*	x
California Towhee	Improving	-
Abert's Towhee	-	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Brewer's Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Black-throated Sparrow	Potential extirpation	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	-
Savannah Sparrow	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Fox Sparrow	Worsening*	Improving
Song Sparrow	Stable	Improving
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Worsening*	Worsening*
Golden-crowned Sparrow	-	Improving
Dark-eyed Junco	x	Improving
Western Tanager	Worsening	-
Black-headed Grosbeak	Improving*	-
Lazuli Bunting	Improving	-
Indigo Bunting	Improving	-
Red-winged Blackbird	Stable	Improving*
Tricolored Blackbird	Stable	-
Western Meadowlark	Stable	-
Brewer's Blackbird	Stable	Improving
Great-tailed Grackle	Improving	-

Common Name	Summer Trend	Winter Trend
Brown-headed Cowbird	Stable	-
Hooded Oriole	Improving	-
Bullock's Oriole	Improving	-
Gray-crowned Rosy-Finch	x	Worsening^
Pine Grosbeak	Worsening^	-
House Finch	Improving*	Stable
Purple Finch	Stable	Stable
Cassin's Finch	Worsening*	Stable
Red Crossbill	Worsening^	x
Pine Siskin	Worsening	Stable
Lesser Goldfinch	Improving*	-
Lawrence's Goldfinch	Worsening	-
American Goldfinch	Improving	-
Evening Grosbeak	Stable	-
House Sparrow	x	Stable