Birds and Climate Change

National Park Service
U.S. Department of the Interior

Redwood 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 Redwood 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 27, remain stable for 36 (e.g., Figure 2), and worsen for 32 species. Suitable climate ceases to occur for 21 species in summer, potentially resulting in extirpation of those species from the Park. 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 49, remain stable for 37, and worsen for 55 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 33 species not found at the Park today, potentially resulting in local colonization.

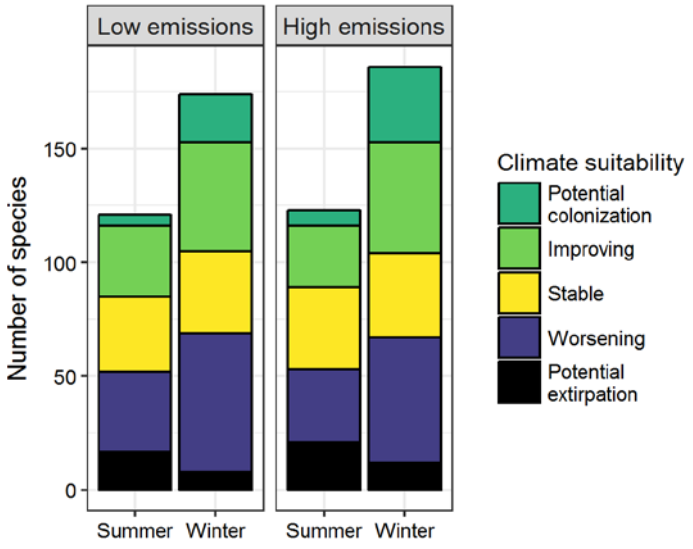

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (33rd percentile across all national parks) and 0.15 in winter (18th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 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 34 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 33 of these climate-sensitive species, one, the Varied Thrush (*Ixoreus naevius*), might be extirpated from the Park in summer by 2050.

Figure 2. Climate at the Park in summer is projected to remain suitable for the American Goldfinch (*Spinus tristis*) through 2050. Photo by John Benson/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, Redwood National Park falls within the intermediate change group.** Parks anticipating intermediate 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 33 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	x	Worsening
Wood Duck	x	Stable
Gadwall	-	Stable
American Wigeon	-	Worsening
Mallard	Stable^	Worsening
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Stable
Green-winged Teal	-	Worsening
Canvasback	-	Improving
Ring-necked Duck	-	Worsening
Greater Scaup	-	Worsening^
Lesser Scaup	-	Worsening
Surf Scoter	x	Stable
White-winged Scoter	x	Worsening
Black Scoter	x	Worsening

Common Name	Summer Trend	Winter Trend
Bufflehead	-	Worsening
Common Goldeneye	x	Potential extirpation
Hooded Merganser	-	Worsening^
Common Merganser	x	Worsening*
Red-breasted Merganser	Potential extirpation	Stable^
Ruddy Duck	-	Worsening
Mountain Quail	Worsening	-
California Quail	Stable	Worsening*
Ruffed Grouse	x	Potential extirpation
Wild Turkey	-	Potential colonization
Red-throated Loon	Potential extirpation	Worsening
Pacific Loon	Potential extirpation	Worsening*
Common Loon	Potential extirpation	Stable^
Pied-billed Grebe	x	Stable

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Improving
Red-necked Grebe	-	Worsening*^
Eared Grebe	-	Improving
Western Grebe	x	Stable
Clark's Grebe	x	Stable
Black-vented Shearwater	-	Stable
Wood Stork	Potential colonization	-
Brandt's Cormorant	x	Worsening
Double-crested Cormorant	x	Stable
Pelagic Cormorant	x	Worsening
Brown Pelican	Improving	Improving^
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	Worsening
Great Egret	Improving	Improving
Snowy Egret	x	Improving*
Tricolored Heron	Potential colonization^	-
Green Heron	Improving	-
Black-crowned Night-Heron	x	Improving*
Turkey Vulture	x	Improving*
Osprey	x	Improving
White-tailed Kite	Stable	Stable
Northern Harrier	Stable^	Worsening
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation
Red-shouldered Hawk	Improving*	Improving*
Red-tailed Hawk	Stable	Stable
Rough-legged Hawk	-	Potential extirpation
Clapper Rail	-	Potential colonization
Virginia Rail	x	Worsening
Common Gallinule	-	Potential colonization
American Coot	x	Worsening
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Black Oystercatcher	x	Stable
Snowy Plover	-	Stable
Semipalmated Plover	Potential extirpation	Improving^
Killdeer	Improving	Improving
Spotted Sandpiper	x	Improving
Greater Yellowlegs	Potential extirpation	Improving*
Willet	Improving^	Improving^
Lesser Yellowlegs	-	Potential colonization
Whimbrel	x	Improving
Long-billed Curlew	Stable^	-
Ruddy Turnstone	x	Potential colonization^
Black Turnstone	x	Worsening
Surfbird	-	Worsening*^
Sanderling	x	Stable
Dunlin	-	Stable^
Least Sandpiper	-	Improving
Western Sandpiper	Stable	Improving
Short-billed Dowitcher	x	Potential colonization^
Wilson's Snipe	-	Stable
Pomarine Jaeger	-	Potential colonization^
Common Murre	x	Worsening*
Pigeon Guillemot	Stable	Worsening
Marbled Murrelet	Stable	Worsening
Rhinoceros Auklet	x	Worsening
Bonaparte's Gull	-	Improving

Common Name	Summer Trend	Winter Trend
Laughing Gull	Potential colonization^	-
Heermann's Gull	x	Stable
Mew Gull	-	Improving
Ring-billed Gull	Stable^	Improving*
Western Gull	Stable	Worsening*^
California Gull	x	Improving*^
Herring Gull	-	Stable^
Iceland Gull (Thayer's)	-	Worsening
Glaucous-winged Gull	Stable	Stable
Gull-billed Tern	-	Potential colonization
Caspian Tern	x	Potential colonization
Forster's Tern	-	Potential colonization
Royal Tern	-	Potential colonization^
Rock Pigeon	Improving*	Improving
Band-tailed Pigeon	Worsening	Worsening*
Eurasian Collared-Dove	x	Improving
Mourning Dove	Improving*	Improving
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	x	Stable
Great Horned Owl	x	Improving
Northern Pygmy-Owl	x	Improving
Burrowing Owl	-	Improving
Barred Owl	x	Improving
Great Gray Owl	-	Stable^
Common Nighthawk	Stable	-
Chuck-will's-widow	Potential colonization	-
Anna's Hummingbird	Stable	Stable
Rufous Hummingbird	Stable	-
Allen's Hummingbird	Stable^	Potential colonization

Common Name	Summer Trend	Winter Trend
Belted Kingfisher	Improving	Stable
Lewis's Woodpecker	x	Stable
Acorn Woodpecker	Worsening	Improving*
Red-breasted Sapsucker	Worsening	Worsening
Downy Woodpecker	Improving*	Worsening
Hairy Woodpecker	Worsening	Potential extirpation
Northern Flicker	Worsening	Worsening
Pileated Woodpecker	Improving	Stable
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Worsening
Prairie Falcon	-	Stable
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening^	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Stable	-
Pacific-slope Flycatcher	Worsening	-
Black Phoebe	Worsening	Worsening*
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	-	Potential colonization
Western Kingbird	Improving	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	-	Potential colonization
Northern Shrike	-	Potential extirpation
Hutton's Vireo	Worsening*^	Improving
Warbling Vireo	Worsening	-
Gray Jay	Potential extirpation	Potential extirpation
Steller's Jay	Worsening	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving*	Improving
American Crow	Improving*	Improving

Common Name	Summer Trend	Winter Trend
Common Raven	Worsening	Worsening
Northern Rough-winged Swallow	Improving	Potential colonization
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	Potential colonization
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Stable	Potential extirpation
Chestnut-backed Chickadee	Worsening	Worsening
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization
Bushtit	Stable	Stable
Red-breasted Nuthatch	Stable	Potential extirpation
White-breasted Nuthatch	Improving	Improving*
Brown-headed Nuthatch	-	Potential colonization
Brown Creeper	Stable^	Potential extirpation
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	Potential extirpation	Worsening
Marsh Wren	x	Worsening
Bewick's Wren	Stable	Stable
Blue-gray Gnatcatcher	Potential colonization	Potential colonization
Black-tailed Gnatcatcher	-	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Potential extirpation	Worsening*
Ruby-crowned Kinglet	-	Stable
Wrentit	Worsening*	Stable
Western Bluebird	Stable	Stable
Townsend's Solitaire	Improving^	Potential extirpation

Common Name	Summer Trend	Winter Trend
Swainson's Thrush	Worsening	-
Hermit Thrush	Potential extirpation	Improving
American Robin	Worsening	Stable
Varied Thrush	Potential extirpation^	Worsening
Northern Mockingbird	Improving*	Potential colonization
European Starling	Improving*	Improving
American Pipit	-	Improving
Cedar Waxwing	Stable	Improving*
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	Worsening	Improving
Nashville Warbler	Potential extirpation	-
MacGillivray's Warbler	Worsening*	-
Common Yellowthroat	Improving*	Potential colonization
Northern Parula	Improving	-
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Worsening*	-
Townsend's Warbler	-	Worsening
Hermit Warbler	Worsening*	-
Wilson's Warbler	Worsening*	Potential colonization
Yellow-breasted Chat	Stable	-
Spotted Towhee	Stable	x
Rufous-crowned Sparrow	-	Potential colonization
Chipping Sparrow	Stable	Potential colonization
Savannah Sparrow	Potential extirpation	Improving*
Grasshopper Sparrow	Improving*	-
Seaside Sparrow	Potential colonization^	-

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

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