Birds and Climate Change

National Park Service
U.S. Department of the Interior

Whiskeytown-Shasta-Trinity National Recreation Area

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 Whiskeytown-Shasta-Trinity National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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 Recreation Area, 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 Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 13, remain stable for 21, and worsen for 29 species. Suitable climate ceases to occur for 15 species in summer, potentially resulting in extirpation of those species from the Recreation Area (e.g., Figure 2). Climate is projected to become suitable in summer for 41 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 16, remain stable for 31, and worsen for 27 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 52 species not found at the Recreation Area today, potentially resulting in local colonization.

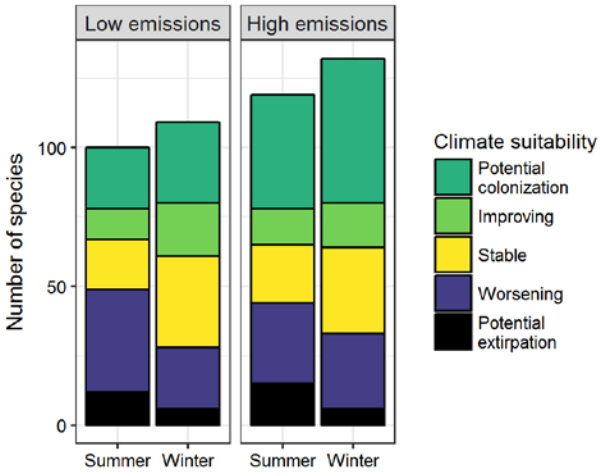

Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Recreation Area between the present and 2050 is 0.26 in summer (42nd percentile across all national parks) and 0.18 in winter (23rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 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 Recreation Area is or may become home to 15 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 Recreation Area may serve as an important refuge for 14 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Recreation Area in summer by 2050.

Figure 2. Although currently found at the Recreation Area, suitable climate for the American Robin (*Turdus migratorius*) may cease to occur here in summer 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, Whiskeytown-Shasta-Trinity National Recreation Area falls within the high potential colonization group.** Parks anticipating high potential colonization 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 14 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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	Potential extirpation
American Wigeon	-	Improving
Mallard	Potential extirpation^	Improving
Ring-necked Duck	x	Improving
Lesser Scaup	-	Worsening
Bufflehead	x	Worsening
Common Goldeneye	-	Worsening
Hooded Merganser	-	Worsening^
Common Merganser	x	Worsening*
Ruddy Duck	-	Stable
Mountain Quail	Worsening*	Worsening*
California Quail	Worsening	Worsening*
Gambel's Quail	-	Potential colonization
Common Loon	-	Stable^

Common Name	Summer Trend	Winter Trend
Pied-billed Grebe	x	Improving
Horned Grebe	-	Stable
Red-necked Grebe	-	Stable^
Eared Grebe	-	Stable
Wood Stork	Potential colonization	-
Double-crested Cormorant	x	Stable
Anhinga	Potential colonization^	Potential colonization
American Bittern	-	Potential colonization^
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	Stable
Great Egret	Potential colonization	Stable
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	-
Black Vulture	Potential colonization	-
Turkey Vulture	x	Improving*
Osprey	x	Improving
Golden Eagle	-	Worsening*
Mississippi Kite	Potential colonization	-
Northern Goshawk	-	Potential extirpation
Bald Eagle	x	Stable
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Improving*	-
Red-tailed Hawk	Stable	Stable
American Coot	x	Improving
American Avocet	-	Potential colonization^
Snowy Plover	-	Potential colonization
Killdeer	Stable	Improving*
Greater Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	-	Stable
California Gull	-	Stable^
Herring Gull	-	Stable^
Gull-billed Tern	-	Potential colonization
Band-tailed Pigeon	Stable	Stable
Mourning Dove	Improving*	Improving

Common Name	Summer Trend	Winter Trend
Common Ground-Dove	Potential colonization	-
Greater Roadrunner	Potential colonization	-
Western Screech-Owl	x	Stable
Great Horned Owl	x	Stable
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Potential colonization	-
Anna's Hummingbird	Worsening	Improving*
Rufous Hummingbird	Stable	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Improving	Worsening
Red-headed Woodpecker	Potential colonization	-
Acorn Woodpecker	Stable	Worsening*
Gila Woodpecker	Potential colonization	Potential colonization
Red-breasted Sapsucker	-	Worsening
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Nuttall's Woodpecker	Worsening	-
Downy Woodpecker	Improving*	Potential extirpation
Hairy Woodpecker	Worsening	Stable
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Worsening*	Worsening
Gilded Flicker	-	Potential colonization
Merlin	-	Worsening^
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening*^	-
Acadian Flycatcher	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	-	Potential colonization
Pacific-slope Flycatcher	Worsening	-
Black Phoebe	Stable	Stable
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Improving*	-
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Stable	-
Loggerhead Shrike	Potential colonization	-
White-eyed Vireo	Potential colonization	-
Hutton's Vireo	Stable^	Stable
Steller's Jay	Worsening*	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Worsening	Worsening*
American Crow	Improving*	-
Common Raven	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Improving	Potential colonization
Tree Swallow	Potential extirpation	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	Potential colonization
Mountain Chickadee	Worsening*	Worsening*
Bridled Titmouse	-	Potential colonization
Oak Titmouse	Stable	Stable
Verdin	Potential colonization	Potential colonization
Bushtit	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Red-breasted Nuthatch	Worsening*	Potential extirpation
White-breasted Nuthatch	Stable	Worsening
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	Worsening*^	Stable
House Wren	Potential extirpation	-
Sedge Wren	-	Potential colonization
Bewick's Wren	Stable	Worsening
Blue-gray Gnatcatcher	Improving*	Potential colonization
Black-tailed Gnatcatcher	-	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Potential extirpation	Worsening
Ruby-crowned Kinglet	Potential extirpation	Improving
Wrentit	Stable	Stable
Western Bluebird	Worsening	Stable
Townsend's Solitaire	Worsening^	-
Hermit Thrush	-	Improving
American Robin	Potential extirpation	Stable
Varied Thrush	-	Worsening*
Curve-billed Thrasher	Potential colonization	-
Bendire's Thrasher	-	Potential colonization
California Thrasher	Worsening	Stable
Crissal Thrasher	Potential colonization	Potential colonization
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Stable	-
Smith's Longspur	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	Stable	Potential colonization
Lucy's Warbler	Potential colonization	-
Nashville Warbler	Worsening*	-
MacGillivray's Warbler	Worsening	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	-	Potential colonization
Hooded Warbler	Potential colonization	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	-
Yellow-throated Warbler	Potential colonization	-
Black-throated Gray Warbler	Worsening	Potential colonization
Hermit Warbler	Worsening*	-^
Wilson's Warbler	Worsening	-
Yellow-breasted Chat	Improving*	-
Green-tailed Towhee	-	Potential colonization
Spotted Towhee	Worsening*	x
California Towhee	Stable	Worsening*
Abert's Towhee	Potential colonization	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	Potential extirpation	Potential colonization

Common Name	Summer Trend	Winter Trend
Brewer's Sparrow	-	Potential colonization
Vesper Sparrow	-	Potential colonization
Black-throated Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	Potential extirpation	Worsening
Song Sparrow	Potential extirpation	Stable
White-throated Sparrow	-	Potential colonization
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	Potential extirpation	Improving
Golden-crowned Sparrow	-	Worsening*
Dark-eyed Junco	x	Worsening
Summer Tanager	Potential colonization	-
Western Tanager	Worsening*	-
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Brewer's Blackbird	Worsening	Stable
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Stable	Improving
Hooded Oriole	Improving	-

Common Name	Summer Trend	Winter Trend
Bullock's Oriole	Worsening	-
Baltimore Oriole	Improving	-
House Finch	Stable	Stable
Purple Finch	Potential extirpation	Worsening
Cassin's Finch	-	Worsening

Common Name	Summer Trend	Winter Trend
Lesser Goldfinch	Stable	Stable
American Goldfinch	Potential extirpation	Improving
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Stable