Birds and Climate Change

National Park Service
U.S. Department of the Interior

Muir Woods National Monument

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 Muir Woods National Monument (hereafter, the Monument) 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 9, remain stable for 27, and worsen for 32 species. Suitable climate ceases to occur for 8 species in summer, potentially resulting in extirpation of those species from the Monument (e.g., Figure 2). Climate is projected to become suitable in summer for 21 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 21, remain stable for 23, and worsen for 24 species. Suitable climate ceases to occur for 9 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 24 species not found at the Monument today, potentially resulting in local colonization.

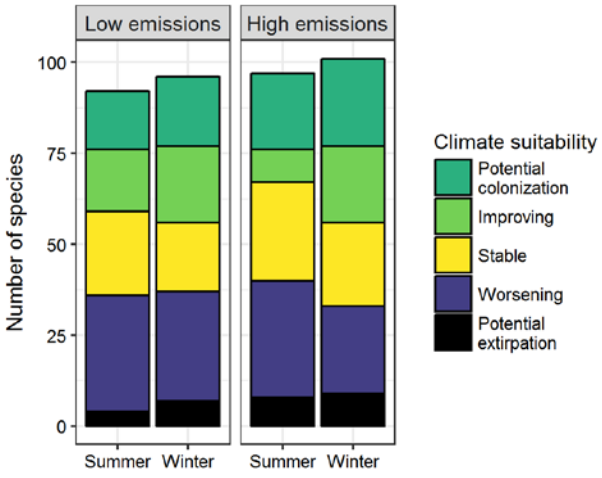

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.18 in summer (28th percentile across all national parks) and 0.09 in winter (7th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.07 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 Monument is or may become home to 13 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 13 species at the Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.

Figure 2. Although currently found at the Monument, 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, Muir Woods National Monument 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 13 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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	-	Potential colonization
Mallard	-	Worsening
Mottled Duck	Potential colonization	-
Surf Scoter	-	Stable
Plain Chachalaca	-	Potential colonization
California Quail	Worsening	Worsening
Ring-necked Pheasant	Potential colonization	-
Wild Turkey	x	Stable
Red-throated Loon	-	Stable
Western Grebe	-	Improving
Brandt's Cormorant	-	Worsening
Pelagic Cormorant	-	Stable
Anhinga	Potential colonization^	-
American White Pelican	-	Potential colonization
Brown Pelican	Improving	-
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	-
Tricolored Heron	Potential colonization^	-
Reddish Egret	-	Potential colonization
Green Heron	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	-
Turkey Vulture	x	Stable
White-tailed Kite	Stable	Worsening
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Worsening
Sharp-shinned Hawk	-	Improving

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Stable
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Stable	Improving
Red-tailed Hawk	Worsening	Improving
American Oystercatcher	-	Potential colonization^
Black Oystercatcher	x	Worsening*
Black Turnstone	-	Worsening
Surfbird	-	Worsening*^
Ring-billed Gull	-	Potential colonization
Western Gull	Stable	Stable^
Glaucous-winged Gull	-	Worsening
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Improving	Stable
Band-tailed Pigeon	Worsening*	Worsening
Mourning Dove	Improving	Improving
Common Ground-Dove	-	Potential colonization
Greater Roadrunner	-	Potential colonization
Great Horned Owl	x	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
White-throated Swift	x	Stable
Anna's Hummingbird	Stable	Stable
Allen's Hummingbird	Worsening^	-
Belted Kingfisher	Stable	-
Acorn Woodpecker	Worsening	Improving*
Red-breasted Sapsucker	-	Worsening
Nuttall's Woodpecker	Stable	Stable
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Worsening	Potential extirpation
Northern Flicker	Worsening	Worsening

Common Name	Summer Trend	Winter Trend
Pileated Woodpecker	Stable	Potential extirpation
American Kestrel	-	Improving
Peregrine Falcon	-	Stable
Northern Beardless-Tyrannulet	Potential colonization	-
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening^	-
Hammond's Flycatcher	-	Potential colonization
Gray Flycatcher	-	Potential colonization
Pacific-slope Flycatcher	Worsening*	-
Black Phoebe	Stable	Stable
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	-	Potential colonization
Hutton's Vireo	Worsening^	Worsening
Warbling Vireo	Potential extirpation	-
Steller's Jay	Worsening	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Improving
American Crow	Stable	Improving
Fish Crow	Potential colonization	-
Common Raven	Worsening	Worsening
Northern Rough-winged Swallow	Stable	Potential colonization
Purple Martin	Stable	-
Tree Swallow	Stable	-
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Mountain Chickadee	-	Potential colonization
Chestnut-backed Chickadee	Worsening*	Worsening*

Common Name	Summer Trend	Winter Trend
Oak Titmouse	Worsening	Stable
Bushtit	Stable	Stable
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	-
Pygmy Nuthatch	Worsening	Worsening^
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	Worsening^	Potential extirpation
Rock Wren	Potential colonization	-
Canyon Wren	-	Potential colonization
House Wren	Stable	-
Pacific/Winter Wren	Potential extirpation	Potential extirpation
Bewick's Wren	Worsening	Worsening
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving	Improving*
Black-tailed Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	Potential extirpation	Potential extirpation
Ruby-crowned Kinglet	-	Improving
Wrentit	Worsening	Stable
Western Bluebird	Worsening	Improving*
Swainson's Thrush	Worsening	-
Hermit Thrush	Potential extirpation	Improving
American Robin	Potential extirpation	Worsening
Varied Thrush	-	Worsening*
Northern Mockingbird	Improving*	-
European Starling	Stable	Improving
Cedar Waxwing	-	Improving*
Black-and-white Warbler	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening	Improving*
Common Yellowthroat	Improving*	-
Yellow Warbler	Improving	-
Pine Warbler	Potential colonization^	-
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Worsening*	-
Townsend's Warbler	-	Stable
Hermit Warbler	Worsening	-
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	-	Potential colonization
Spotted Towhee	Worsening	x
California Towhee	Worsening	Stable
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	Stable	Potential colonization
Savannah Sparrow	-	Improving
Fox Sparrow	-	Worsening
Song Sparrow	Worsening	Stable
Lincoln's Sparrow	-	Stable
White-crowned Sparrow	Stable	Stable
Golden-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Worsening
Western Tanager	Worsening	-
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Potential colonization	-
Indigo Bunting	-	Potential colonization
Red-winged Blackbird	Improving*	-
Western Meadowlark	-	Worsening

Common Name	Summer Trend	Winter Trend
Brewer's Blackbird	Stable	Stable
Boat-tailed Grackle	Potential colonization^	-
Brown-headed Cowbird	Stable	-
House Finch	Stable	Improving

Common Name	Summer Trend	Winter Trend
Purple Finch	Worsening*	Potential extirpation
Pine Siskin	Potential extirpation	Potential extirpation
Lesser Goldfinch	Stable	Improving
American Goldfinch	Stable	Improving