Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fort Point National Historic Site

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 Fort Point National Historic Site (hereafter, the Site) 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Site 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 Site, 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 Site today, climate suitability in summer under the high-emissions pathway is projected to improve for 10 (e.g., Figure 2), remain stable for 39, and worsen for 29 species. Suitable climate ceases to occur for 9 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 21 species not found at the Site today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 45, remain stable for 64, and worsen for 21 species. Suitable climate ceases to occur for 15 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 19 species not found at the Site today, potentially resulting in local colonization.

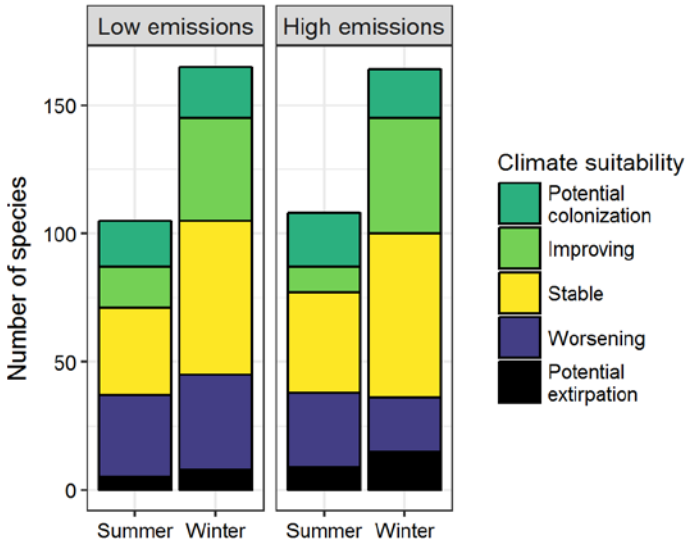

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.17 in summer (25th percentile across all national parks) and 0.08 in winter (3rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.06 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 Site is or may become home to 30 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 Site may serve as an important refuge for 29 of these climate-sensitive species, one, the Red-necked Grebe (*Podiceps grisegena*), might be extirpated from the Site in winter by 2050.

Figure 2. Climate at the Site in summer is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) through 2050. 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, Fort Point National Historic Site 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 29 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.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Site based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Site 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
Brant	-	Stable
Cackling/Canada Goose	x	Stable
Mute Swan	x	Improving
Wood Duck	-	Potential colonization
Gadwall	-	Improving
American Wigeon	-	Improving
Mallard	Improving^	Worsening
Mottled Duck	Potential colonization	-
Green-winged Teal	-	Stable
Canvasback	-	Stable
Ring-necked Duck	-	Improving
Greater Scaup	-	Worsening*^
Lesser Scaup	-	Improving
Surf Scoter	x	Stable
White-winged Scoter	-	Potential extirpation
Black Scoter	-	Stable

Common Name	Summer Trend	Winter Trend
Long-tailed Duck	-	Stable
Bufflehead	-	Stable
Common Goldeneye	-	Potential extirpation
Hooded Merganser	-	Stable^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	-	Improving^
Ruddy Duck	Stable	Stable
Plain Chachalaca	-	Potential colonization
California Quail	Worsening	-
Ring-necked Pheasant	Potential colonization	-
Red-throated Loon	Stable	Stable
Pacific Loon	Stable	Stable
Common Loon	Potential extirpation	Stable^
Pied-billed Grebe	x	Improving
Horned Grebe	-	Worsening

Common Name	Summer Trend	Winter Trend
Red-necked Grebe	-	Potential extirpation^
Eared Grebe	-	Stable
Western Grebe	x	Stable
Clark's Grebe	x	Stable
Northern Fulmar	-	Stable
Brandt's Cormorant	x	Improving
Double-crested Cormorant	x	Improving
Pelagic Cormorant	x	Stable
Anhinga	Potential colonization^	-
American White Pelican	-	Potential colonization
Brown Pelican	Improving	Improving^
Least Bittern	-	Potential colonization
Great Blue Heron	Stable	Improving
Great Egret	Stable	Improving
Snowy Egret	x	Improving*
Tricolored Heron	Potential colonization^	-
Reddish Egret	-	Potential colonization
Cattle Egret	Potential colonization	-
Green Heron	Stable	Improving*
Black-crowned Night-Heron	x	Improving*
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	-
Turkey Vulture	x	Stable
Osprey	x	Stable
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	-	Improving
Cooper's Hawk	x	Stable
Bald Eagle	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Worsening	Improving
American Coot	x	Improving
Black-necked Stilt	x	Stable
American Oystercatcher	-	Potential colonization^
Black Oystercatcher	x	Stable
Black-bellied Plover	-	Stable
Snowy Plover	-	Stable
Semipalmated Plover	-	Stable^
Killdeer	Stable	Stable
Spotted Sandpiper	-	Improving
Wandering Tattler	-	Stable
Greater Yellowlegs	Potential extirpation	Stable
Willet	Stable^	Improving*^
Whimbrel	x	Improving*
Long-billed Curlew	Stable^	Stable
Marbled Godwit	Stable^	Stable
Black Turnstone	-	Stable
Surfbird	-	Stable^
Sanderling	-	Stable
Least Sandpiper	-	Improving
Western Sandpiper	-	Stable
Short-billed Dowitcher	x	Stable^
Wilson's Snipe	-	Stable
Common Murre	x	Worsening*
Pigeon Guillemot	Stable	-
Ancient Murrelet	-	Worsening
Bonaparte's Gull	-	Improving
Heermann's Gull	x	Improving
Mew Gull	-	Stable
Ring-billed Gull	Stable^	Improving

Common Name	Summer Trend	Winter Trend
Western Gull	Stable	Stable^
California Gull	x	Stable^
Herring Gull	-	Worsening^
Iceland Gull (Thayer's)	-	Worsening*
Glaucous-winged Gull	Stable	Worsening
Forster's Tern	x	Stable
Rock Pigeon	Stable	Stable
Band-tailed Pigeon	Worsening*	Worsening
Eurasian Collared-Dove	x	Improving*
Mourning Dove	Improving	Improving
Common Ground-Dove	-	Potential colonization
Greater Roadrunner	-	Potential colonization
Great Horned Owl	x	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
Anna's Hummingbird	Stable	Stable
Allen's Hummingbird	Worsening^	-
Belted Kingfisher	Stable	Improving
Red-breasted Sapsucker	-	Worsening
Nuttall's Woodpecker	Stable	Stable
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Worsening	Potential extirpation
Northern Flicker	Worsening	Worsening
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Stable
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	-	Potential colonization
Gray Flycatcher	-	Potential colonization
Pacific-slope Flycatcher	Worsening*	-

Common Name	Summer Trend	Winter Trend
Black Phoebe	Stable	Stable
Say's Phoebe	-	Stable
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Worsening*	-
Great Crested Flycatcher	-	Potential colonization
Western Kingbird	Stable	-
Hutton's Vireo	Worsening*^	Worsening
Warbling Vireo	Potential extirpation	-
Steller's Jay	Worsening	Potential extirpation
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Stable
American Crow	Stable	Improving
Fish Crow	Potential colonization	-
Common Raven	Stable	Worsening
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Stable	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Potential extirpation	-
Cliff Swallow	Stable	-
Mountain Chickadee	Potential colonization	Potential colonization
Chestnut-backed Chickadee	Worsening*	Worsening*
Verdin	Potential colonization	-
Bushtit	Worsening	Stable
Red-breasted Nuthatch	-	Potential extirpation
Pygmy Nuthatch	Worsening	Worsening*^
Brown-headed Nuthatch	Potential colonization^	-
Brown Creeper	Worsening^	Potential extirpation

Common Name	Summer Trend	Winter Trend
House Wren	-	Improving*
Pacific/Winter Wren	Potential extirpation	Potential extirpation
Marsh Wren	-	Stable
Bewick's Wren	Worsening	Worsening
Black-tailed Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	-	Potential extirpation
Ruby-crowned Kinglet	-	Improving
Wrentit	Worsening	Stable
Western Bluebird	Worsening	Improving*
Swainson's Thrush	Worsening*	-
Hermit Thrush	-	Improving
American Robin	Potential extirpation	Stable
Varied Thrush	-	Worsening*
Northern Mockingbird	Improving*	Improving
European Starling	Stable	Improving
Cedar Waxwing	Potential extirpation	Improving*
Black-and-white Warbler	-	Potential colonization
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening	Improving*
Common Yellowthroat	Improving*	Improving
American Redstart	Improving	-
Northern Parula	Stable	-
Pine Warbler	Potential colonization^	-
Yellow-rumped Warbler	-	Improving
Townsend's Warbler	-	Stable
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Spotted Towhee	Worsening	x
California Towhee	Worsening	Stable
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	Potential extirpation	Improving
Fox Sparrow	-	Worsening
Song Sparrow	Worsening	Stable
Lincoln's Sparrow	-	Stable
White-throated Sparrow	-	Potential extirpation
White-crowned Sparrow	Stable	Stable
Golden-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Worsening
Summer Tanager	Improving	-
Western Tanager	Worsening	-
Rose-breasted Grosbeak	Improving	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Indigo Bunting	-	Potential colonization
Red-winged Blackbird	Improving*	Stable
Tricolored Blackbird	-	Stable
Western Meadowlark	-	Worsening
Brewer's Blackbird	Stable	Stable
Boat-tailed Grackle	Potential colonization^	-
Great-tailed Grackle	Stable	-
Brown-headed Cowbird	Stable	Stable
Hooded Oriole	Improving*	-
Bullock's Oriole	Worsening	x
House Finch	Stable	Improving

Common Name	Summer Trend	Winter Trend
Purple Finch	Worsening*	Potential extirpation
Red Crossbill	Stable^	x
Pine Siskin	Potential extirpation	Potential extirpation

Common Name	Summer Trend	Winter Trend
Lesser Goldfinch	Stable	Improving
American Goldfinch	Stable	Improving
House Sparrow	x	Improving