Birds and Climate Change

National Park Service
U.S. Department of the Interior

San Juan Island National Historical 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 San Juan Island National Historical 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 13 (e.g., Figure 2), remain stable for 29, and worsen for 28 species. Suitable climate ceases to occur for 14 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 19 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 26, remain stable for 28, and worsen for 43 species. Suitable climate ceases to occur for 9 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 54 species not found at the Park today, potentially resulting in local colonization.

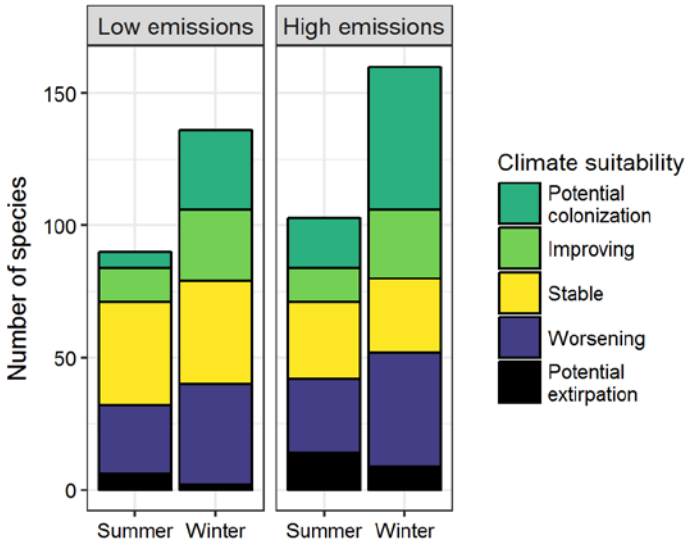

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.18 in summer (26th percentile across all national parks) and 0.24 in winter (35th percentile) under the high-emissions pathway. Potential species turnover declines to 0.05 in summer and 0.14 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 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 Park may serve as an important refuge for 28 of these climate-sensitive species, 2 might be extirpated from the Park in at least one season 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, San Juan Island National Historical 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 28 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
Gadwall	Stable^	Improving
American Wigeon	-	Worsening
Mallard	Stable^	Worsening
Mottled Duck	Potential colonization	-
Northern Shoveler	-	Stable
Green-winged Teal	-	Stable
Canvasback	-	Potential colonization
Ring-necked Duck	-	Worsening
Greater Scaup	-	Improving^
Lesser Scaup	-	Stable
Harlequin Duck	x	Worsening*
Surf Scoter	x	Worsening
White-winged Scoter	x	Worsening*
Black Scoter	-	Improving

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

Common Name	Summer Trend	Winter Trend
Red-necked Grebe	Potential extirpation	Worsening^
Western Grebe	x	Worsening
Wood Stork	Potential colonization	-
Brandt's Cormorant	x	Worsening
Double-crested Cormorant	x	Worsening
Pelagic Cormorant	x	Worsening
Brown Pelican	Potential colonization	Potential colonization^
American Bittern	-	Potential colonization^
Least Bittern	-	Potential colonization
Great Blue Heron	Improving*	Worsening
Great Egret	-	Potential colonization
Snowy Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Green Heron	Potential colonization	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Turkey Vulture	x	Potential colonization
Osprey	x	Potential colonization
White-tailed Kite	-	Potential colonization
Golden Eagle	-	Stable
Northern Harrier	Stable^	Improving
Sharp-shinned Hawk	-	Improving
Cooper's Hawk	-	Potential colonization
Northern Goshawk	-	Potential extirpation
Bald Eagle	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Red-shouldered Hawk	Potential colonization	-
Red-tailed Hawk	Improving	Stable
Ferruginous Hawk	-	Potential colonization
Rough-legged Hawk	-	Stable
Clapper Rail	-	Potential colonization
Sora	-	Potential colonization
Common Gallinule	-	Potential colonization
American Coot	-	Stable
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Black Oystercatcher	x	Worsening
Black-bellied Plover	-	Improving*
Snowy Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	Stable	Stable
Greater Yellowlegs	-	Improving*
Willet	Potential colonization^	Potential colonization^
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Marbled Godwit	-	Potential colonization
Black Turnstone	-	Worsening
Red Knot	-	Potential colonization^
Surfbird	-	Worsening*^
Sanderling	-	Improving
Dunlin	-	Improving*^
Rock Sandpiper	-	Stable

Common Name	Summer Trend	Winter Trend
Least Sandpiper	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization^
Red-necked Phalarope	Stable	-
Pomarine Jaeger	-	Potential colonization^
Common Murre	x	Worsening*
Pigeon Guillemot	Stable	Worsening*
Marbled Murrelet	Stable	Worsening*
Ancient Murrelet	-	Worsening*
Rhinoceros Auklet	x	Worsening*
Bonaparte's Gull	-	Stable
Laughing Gull	Potential colonization^	-
Mew Gull	Potential extirpation	Stable
Ring-billed Gull	Stable^	-
Western Gull	Stable	Stable^
Iceland Gull (Thayer's)	-	Stable
Glaucous-winged Gull	Worsening	Worsening
Gull-billed Tern	-	Potential colonization
Caspian Tern	x	Potential colonization
Forster's Tern	-	Potential colonization
Royal Tern	-	Potential colonization^
Rock Pigeon	Stable	Potential extirpation
Band-tailed Pigeon	Worsening	-
Eurasian Collared-Dove	x	Improving
Mourning Dove	Improving*	Improving*
Groove-billed Ani	-	Potential colonization
Great Horned Owl	x	Stable
Burrowing Owl	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Anna's Hummingbird	Improving	Improving
Rufous Hummingbird	Worsening*	-
Belted Kingfisher	Stable	Worsening
Downy Woodpecker	Improving*	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Stable	Potential extirpation
American Kestrel	-	Improving*
Merlin	-	Improving^
Peregrine Falcon	-	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Worsening	-
Pacific-slope Flycatcher	Worsening	-
Say's Phoebe	-	Potential colonization
Northern Shrike	-	Potential extirpation
Hutton's Vireo	Potential extirpation^	Stable
Warbling Vireo	Potential extirpation	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential colonization	Potential colonization
American Crow	Stable	Improving
Northwestern Crow	Worsening	Worsening*
Common Raven	Potential extirpation	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-

Common Name	Summer Trend	Winter Trend
Tree Swallow	Stable	Potential colonization
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Chestnut-backed Chickadee	Worsening	Worsening
Bushtit	Stable	Stable
Red-breasted Nuthatch	Worsening	Worsening
Brown Creeper	Worsening^	Potential extirpation
Rock Wren	-	Potential colonization
House Wren	Improving*	Potential colonization
Pacific/Winter Wren	Potential extirpation	Worsening*
Marsh Wren	x	Improving
Bewick's Wren	Stable	Improving
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	Worsening*	Worsening
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Potential colonization
Townsend's Solitaire	-	Potential extirpation
Swainson's Thrush	Worsening*	-
Hermit Thrush	-	Improving*
American Robin	Worsening	Stable
Varied Thrush	Potential extirpation^	Worsening
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Improving	Stable
American Pipit	-	Potential colonization
Cedar Waxwing	Worsening	-

Common Name	Summer Trend	Winter Trend
Orange-crowned Warbler	Worsening	Potential colonization
Common Yellowthroat	Stable	Potential colonization
Yellow Warbler	Potential extirpation	-
Palm Warbler	-	Potential colonization^
Yellow-rumped Warbler	Stable	Potential colonization
Black-throated Gray Warbler	Worsening	-
Townsend's Warbler	Worsening*	-
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Potential colonization	-
Spotted Towhee	Worsening	x
Chipping Sparrow	Improving	-
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Potential colonization	Potential colonization
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Potential colonization	-
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	Potential extirpation	Worsening
Song Sparrow	Worsening	Worsening
Lincoln's Sparrow	-	Stable
White-crowned Sparrow	Worsening*	Stable
Golden-crowned Sparrow	-	Stable
Dark-eyed Junco	x	Worsening
Western Tanager	Worsening*	Potential colonization
Black-headed Grosbeak	Stable	-
Red-winged Blackbird	Improving	Stable
Tricolored Blackbird	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Western Meadowlark	Potential colonization	Improving
Brewer's Blackbird	Stable	Stable
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Stable	-
House Finch	Improving	Stable
Purple Finch	Worsening	Worsening

Common Name	Summer Trend	Winter Trend
Red Crossbill	Worsening^	x
Pine Siskin	Worsening*	Worsening*
Lesser Goldfinch	Potential colonization	Potential colonization
American Goldfinch	Improving*	Improving
Evening Grosbeak	Potential extirpation	-
House Sparrow	x	Improving