



Ebey's Landing National Historical Reserve

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 Ebey's Landing National Historical Reserve (hereafter, the Reserve) 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.

Results

Climate change is expected to alter the bird community at the Reserve, 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 Reserve today, climate suitability in summer under the high-emissions pathway is projected to improve for 9, remain stable for 31 (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 Reserve. Climate is projected to become suitable in summer for 19 species not found at the Reserve today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 29, remain stable for 30, and worsen for 50 species. Suitable climate ceases to occur for 10 species in winter, potentially resulting in extirpation from the Reserve. Climate is projected to become suitable in winter for 52 species not found at the Reserve today, potentially resulting in local colonization.

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 Reserve based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Reserve 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.

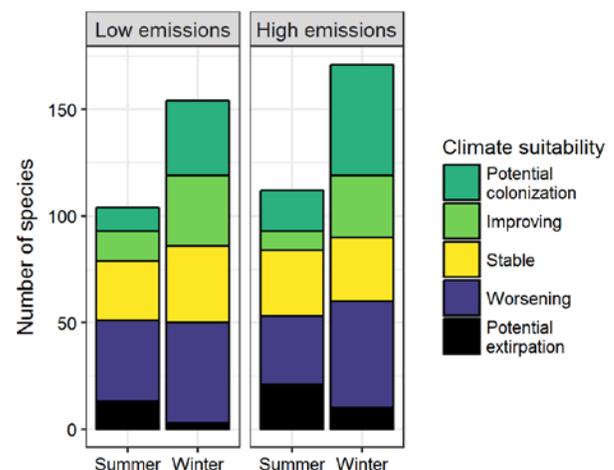


Figure 1. Projected changes in climate suitability for birds at the Reserve, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Reserve between the present and 2050 is 0.23 in summer (36th percentile across all national parks) and 0.24 in winter (34th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.17 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 Reserve is or may become home to 36 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 Reserve may serve as an important refuge for 34 of these climate-sensitive species, 2 might be extirpated from the Reserve in at least one season by 2050.



Figure 2. Climate at the Reserve 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, Ebey's Landing National Historical Reserve 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 34 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 Reserve based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Reserve 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	-
Brant	-	Stable
Cackling/Canada Goose	x	Worsening
Mute Swan	-	Potential colonization
Gadwall	Worsening [^]	Improving
Eurasian Wigeon	-	Worsening
American Wigeon	-	Worsening
Mallard	Stable [^]	Worsening
Mottled Duck	Potential colonization	-
Blue-winged Teal	Potential extirpation	Potential colonization
Northern Shoveler	Stable [^]	Stable
Northern Pintail	Potential extirpation	x
Green-winged Teal	x	Worsening
Ring-necked Duck	-	Worsening

Common Name	Summer Trend	Winter Trend
Greater Scaup	Stable	Stable [^]
Lesser Scaup	x	Worsening
Harlequin Duck	x	Worsening*
Surf Scoter	x	Stable
White-winged Scoter	x	Worsening
Black Scoter	x	Stable
Long-tailed Duck	-	Stable
Bufflehead	x	Worsening
Common Goldeneye	x	Worsening
Barrow's Goldeneye	-	Worsening* [^]
Hooded Merganser	x	Worsening [^]
Common Merganser	-	Worsening*
Red-breasted Merganser	-	Stable [^]
Ruddy Duck	Stable	Improving
California Quail	Worsening	Worsening*
Ring-necked Pheasant	Worsening	Potential extirpation

Common Name	Summer Trend	Winter Trend
Red-throated Loon	Stable	Worsening
Pacific Loon	Stable	Worsening
Common Loon	Potential extirpation	Worsening [^]
Pied-billed Grebe	x	Stable
Horned Grebe	x	Worsening
Red-necked Grebe	Potential extirpation	Worsening* [^]
Eared Grebe	-	Improving
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 [^]
Least Bittern	-	Potential colonization
Great Blue Heron	Improving*	Stable
Great Egret	Potential colonization	Potential colonization
Snowy Egret	-	Potential colonization
Tricolored Heron	Potential colonization [^]	-
Cattle Egret	-	Potential colonization
Green Heron	Potential colonization	Improving
Black-crowned Night-Heron	-	Potential colonization
Turkey Vulture	x	Potential colonization
Osprey	x	Potential colonization
White-tailed Kite	Potential colonization	Potential colonization
Northern Harrier	Worsening [^]	Stable
Sharp-shinned Hawk	x	Improving

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation
Red-shouldered Hawk	Potential colonization	-
Red-tailed Hawk	Worsening	Stable
Rough-legged Hawk	-	Potential extirpation
Clapper Rail	-	Potential colonization
Virginia Rail	x	Improving
Sora	x	Potential colonization
Common Gallinule	-	Potential colonization
American Coot	x	Stable
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization [^]
Black Oystercatcher	x	Stable
Black-bellied Plover	-	Improving*
Snowy Plover	-	Potential colonization
Semipalmated Plover	Stable	Potential colonization [^]
Killdeer	Stable	Improving
Greater Yellowlegs	Potential extirpation	Improving*
Willet	Potential colonization [^]	Potential colonization [^]
Lesser Yellowlegs	Potential extirpation [^]	Potential colonization
Long-billed Curlew	-	Potential colonization
Marbled Godwit	-	Potential colonization
Ruddy Turnstone	x	Potential colonization [^]
Black Turnstone	x	Worsening*

Common Name	Summer Trend	Winter Trend
Red Knot	-	Potential colonization^
Surfbird	x	Worsening^
Sanderling	x	Improving
Dunlin	x	Improving^
Least Sandpiper	x	Improving*
Western Sandpiper	Stable	Improving*
Short-billed Dowitcher	x	Potential colonization^
Wilson's Snipe	-	Worsening
Wilson's Phalarope	Stable^	-
Red-necked Phalarope	Stable	-
Common Murre	x	Worsening*
Pigeon Guillemot	Stable	Worsening*
Marbled Murrelet	Worsening	Worsening*
Ancient Murrelet	-	Stable
Rhinoceros Auklet	x	Worsening
Bonaparte's Gull	Potential extirpation	Improving
Laughing Gull	Potential colonization^	-
Mew Gull	Stable	Stable
Ring-billed Gull	Improving^	Improving
Western Gull	Stable	Stable^
California Gull	x	Stable^
Herring Gull	-	Stable^
Iceland Gull (Thayer's)	-	Worsening
Glaucous-winged Gull	Worsening*	Worsening
Gull-billed Tern	-	Potential colonization
Caspian Tern	x	Potential colonization
Forster's Tern	-	Potential colonization
Royal Tern	-	Potential colonization^
Black Skimmer	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
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	Improving
Burrowing Owl	-	Potential colonization
Anna's Hummingbird	Stable	Stable
Rufous Hummingbird	Worsening*	-
Belted Kingfisher	Stable	Worsening
Red-breasted Sapsucker	Potential extirpation	Worsening*
Downy Woodpecker	Improving*	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening	Worsening
Pileated Woodpecker	Improving	Potential extirpation
American Kestrel	x	Improving*
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening^	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Potential extirpation	-
Pacific-slope Flycatcher	Worsening	-
Say's Phoebe	-	Potential colonization
Western Kingbird	Stable	-
Northern Shrike	-	Potential extirpation
Hutton's Vireo	Potential extirpation^	-
Warbling Vireo	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Steller's Jay	Stable	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Potential colonization
Yellow-billed Magpie	-	Potential colonization^
American Crow	Stable	Improving
Northwestern Crow	Worsening	Worsening
Fish Crow	Potential colonization	-
Common Raven	Potential extirpation	Worsening
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving*	-
Tree Swallow	Worsening	Potential colonization
Violet-green Swallow	Worsening	-
Barn Swallow	Worsening	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Chestnut-backed Chickadee	Worsening	Worsening
Bushtit	Stable	Stable
Red-breasted Nuthatch	Stable	Worsening
Brown Creeper	Worsening^	Potential extirpation
Rock Wren	-	Potential colonization
House Wren	Improving*	Potential colonization
Pacific/Winter Wren	Potential extirpation	Worsening
Marsh Wren	x	Stable
Bewick's Wren	Worsening	Stable
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Golden-crowned Kinglet	Potential extirpation	Worsening
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Potential colonization
Swainson's Thrush	Worsening*	-
Hermit Thrush	-	Improving*
American Robin	Worsening	Stable
Varied Thrush	-	Worsening
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Improving	Stable
American Pipit	-	Potential colonization
Cedar Waxwing	Worsening	Improving
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
Prairie Warbler	Potential colonization	-
Townsend's Warbler	Potential extirpation	Stable
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Potential colonization	-
Spotted Towhee	Worsening	x
Lark Sparrow	-	Potential colonization
Savannah Sparrow	Potential extirpation	Improving*
Grasshopper Sparrow	Potential colonization	-
Seaside Sparrow	Potential colonization^	-

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

Common Name	Summer Trend	Winter Trend
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Potential colonization
Hooded Oriole	Potential colonization	-
House Finch	Improving	Stable
Purple Finch	Worsening	-
Red Crossbill	Worsening^	x
Pine Siskin	Potential extirpation	Worsening*
Lesser Goldfinch	-	Potential colonization
American Goldfinch	Stable	Improving*
House Sparrow	x	Improving