Birds and Climate Change

National Park Service
U.S. Department of the Interior

Olympic National 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 Olympic National 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 36 (e.g., Figure 2), remain stable for 23, and worsen for 36 species. Suitable climate ceases to occur for 19 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 12 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 44, remain stable for 32, and worsen for 38 species. Suitable climate ceases to occur for 5 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 22 species not found at the Park today, potentially resulting in local colonization.

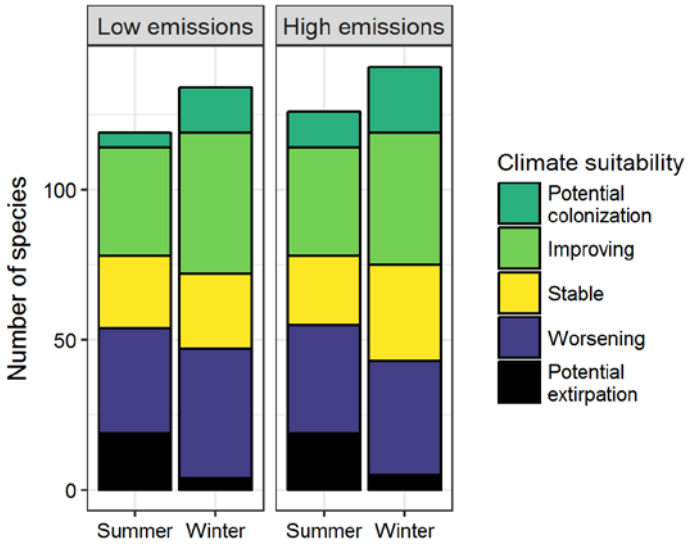

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.27 in summer (44th percentile across all national parks) and 0.17 in winter (22nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.15 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 Park is or may become home to 34 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 32 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, Olympic National Park falls within the high turnover group.** Parks anticipating high turnover 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 32 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	-
Brant	x	Stable
Cackling/Canada Goose	x	Improving
Wood Duck	x	Improving
Gadwall	Stable^	-
Eurasian Wigeon	-	Worsening
American Wigeon	-	Stable
Mallard	Improving^	Stable
Blue-winged Teal	Potential extirpation	-
Green-winged Teal	-	Stable
Canvasback	-	Potential colonization
Ring-necked Duck	x	Worsening
Greater Scaup	Worsening	Worsening^
Lesser Scaup	-	Improving
Harlequin Duck	x	Worsening*
Surf Scoter	x	Worsening
White-winged Scoter	x	Worsening*
Black Scoter	x	Worsening*
Long-tailed Duck	Potential colonization	Worsening*
Bufflehead	-	Stable
Common Goldeneye	-	Worsening
Barrow's Goldeneye	x	Worsening*^
Hooded Merganser	x	Improving^
Common Merganser	x	Worsening
Red-breasted Merganser	Stable	Stable^
Mountain Quail	Potential colonization	-
California Quail	Stable	-
Ring-necked Pheasant	Potential colonization	-
Ruffed Grouse	x	Improving
Red-throated Loon	Potential extirpation	Worsening
Pacific Loon	Potential extirpation	Worsening*

Common Name	Summer Trend	Winter Trend
Common Loon	Potential extirpation	Stable^
Pied-billed Grebe	x	Improving*
Horned Grebe	-	Stable
Red-necked Grebe	Potential extirpation	Worsening*^
Eared Grebe	-	Improving
Western Grebe	x	Worsening*
Brandt's Cormorant	x	Stable
Double-crested Cormorant	x	Improving
Pelagic Cormorant	x	Worsening*
Brown Pelican	Improving	Improving^
American Bittern	-	Potential colonization^
Great Blue Heron	Improving*	Improving
Great Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Green Heron	Improving	Potential colonization
White-tailed Kite	Potential colonization	Potential colonization
Northern Harrier	Improving^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving*
Bald Eagle	x	Worsening
Red-tailed Hawk	Improving	Improving
Virginia Rail	x	Stable
Sora	-	Potential colonization
Black Oystercatcher	x	Stable
Black-bellied Plover	-	Stable
Snowy Plover	-	Potential colonization
Semipalmated Plover	Potential extirpation	Potential colonization^
Killdeer	Improving*	Stable

Common Name	Summer Trend	Winter Trend
Spotted Sandpiper	x	Improving
Greater Yellowlegs	Worsening	Potential colonization
Willet	-	Potential colonization^
Whimbrel	x	Potential colonization
Long-billed Curlew	-	Potential colonization
Marbled Godwit	Potential extirpation^	Potential colonization
Ruddy Turnstone	x	Potential colonization^
Black Turnstone	x	Stable
Surfbird	x	Improving^
Sanderling	x	Stable
Dunlin	x	Worsening^
Rock Sandpiper	-	Worsening
Least Sandpiper	x	Potential colonization
Western Sandpiper	Stable	-
Wilson's Snipe	-	Stable
Red-necked Phalarope	Potential extirpation	-
Pomarine Jaeger	-	Potential colonization^
Parasitic Jaeger	Stable	-
Common Murre	x	Stable
Pigeon Guillemot	Stable	Stable
Marbled Murrelet	Worsening	Worsening
Ancient Murrelet	x	Stable
Rhinoceros Auklet	x	Improving
Bonaparte's Gull	Potential extirpation	Improving
Laughing Gull	Potential colonization^	-
Heermann's Gull	x	Stable
Mew Gull	Worsening	Worsening
Ring-billed Gull	Stable^	Improving

Common Name	Summer Trend	Winter Trend
Western Gull	Stable	Worsening*^
California Gull	x	Stable^
Herring Gull	-	Improving*^
Iceland Gull (Thayer's)	-	Worsening
Glaucous-winged Gull	Stable	Worsening
Rock Pigeon	Improving*	Improving
Band-tailed Pigeon	Worsening*	-
Eurasian Collared-Dove	x	Improving
Mourning Dove	Improving*	-
Barn Owl	-	Potential colonization
Northern Pygmy-Owl	x	Worsening
Burrowing Owl	-	Potential colonization
Barred Owl	x	Stable
Common Nighthawk	Worsening	-
Anna's Hummingbird	Stable	Worsening*
Rufous Hummingbird	Stable	-
Belted Kingfisher	Improving	Stable
Red-breasted Sapsucker	Worsening	Worsening*
Downy Woodpecker	Improving	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening	Improving
Pileated Woodpecker	Improving	Improving*
Merlin	x	Improving^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Worsening	-
Hammond's Flycatcher	Worsening*	-
Pacific-slope Flycatcher	Worsening*	-
Western Kingbird	Improving	-
Eastern Kingbird	Improving	-
Hutton's Vireo	Worsening^	Stable

Common Name	Summer Trend	Winter Trend
Warbling Vireo	Worsening*	-
Red-eyed Vireo	Improving	-
Gray Jay	Potential extirpation	Improving*
Steller's Jay	Worsening	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential colonization	-
Clark's Nutcracker	Potential extirpation^	-
American Crow	Improving*	Improving
Northwestern Crow	Stable	Worsening*
Common Raven	Worsening	Worsening
Horned Lark	Improving	Improving
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving	-
Tree Swallow	Improving	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-
Carolina Chickadee	Potential colonization	-
Black-capped Chickadee	Improving*	Stable
Chestnut-backed Chickadee	Worsening	Worsening
Bushtit	Improving	Worsening
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown Creeper	Worsening*^	Potential extirpation
Rock Wren	Potential extirpation	-
House Wren	Improving	-
Pacific/Winter Wren	Worsening	Worsening
Marsh Wren	x	Improving*
Bewick's Wren	Worsening	Stable
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening*	Stable

Common Name	Summer Trend	Winter Trend
Ruby-crowned Kinglet	Stable	Improving
Western Bluebird	Improving	-
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Stable^	Potential extirpation
Swainson's Thrush	Stable	-
Hermit Thrush	Potential extirpation	Improving*
American Robin	Stable	Improving
Varied Thrush	Worsening^	Worsening
European Starling	Improving*	Improving
American Pipit	Worsening	Improving
Cedar Waxwing	Improving*	-
Worm-eating Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening*	Improving
MacGillivray's Warbler	Worsening	-
Common Yellowthroat	Improving*	-
Yellow Warbler	Potential extirpation	-
Palm Warbler	-	Potential colonization^
Yellow-rumped Warbler	Potential extirpation	Improving*
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Potential colonization	-
Black-throated Gray Warbler	Worsening	-
Townsend's Warbler	Worsening*	Stable
Hermit Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Wilson's Warbler	Stable	-
Spotted Towhee	Worsening*	x
Chipping Sparrow	Improving	-
Savannah Sparrow	Improving	Potential colonization
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	Worsening	Improving
Song Sparrow	Improving	Worsening
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Worsening	Stable
Golden-crowned Sparrow	-	Stable
Dark-eyed Junco	x	Improving
Western Tanager	Worsening*	Potential colonization
Black-headed Grosbeak	Worsening	-
Lazuli Bunting	Stable	-
Red-winged Blackbird	Stable	Improving
Western Meadowlark	-	Stable
Brewer's Blackbird	Stable	Worsening
Brown-headed Cowbird	Improving	-
Pine Grosbeak	Worsening^	-
House Finch	Improving*	Improving*
Purple Finch	Improving*	Improving*
Red Crossbill	Worsening*^	x
Pine Siskin	Worsening	Worsening*
American Goldfinch	Improving*	Improving
Evening Grosbeak	Stable	Stable
House Sparrow	x	Improving