



Lewis and Clark 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 Lewis and Clark 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.

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 19 (e.g., Figure 2), remain stable for 22, and worsen for 31 species. Suitable climate ceases to occur for 20 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 18 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 22, remain stable for 40, and worsen for 54 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 40 species not found at the Park 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 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.

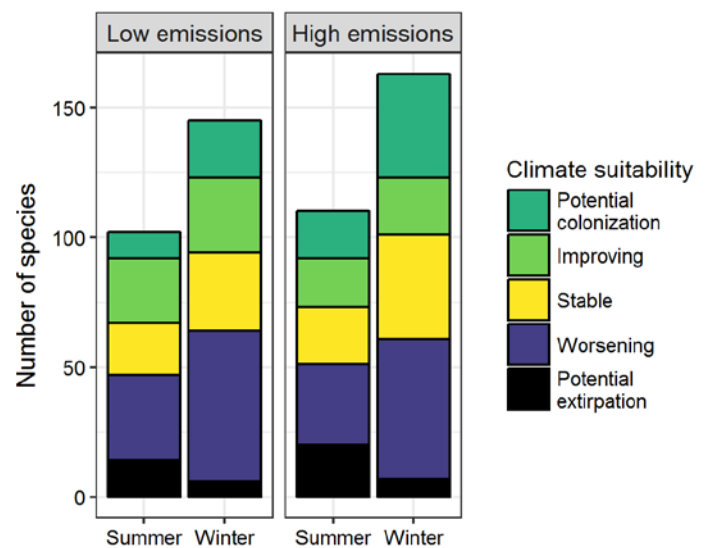


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.28 in summer (48th percentile across all national parks) and 0.15 in winter (18th percentile) under the high-emissions pathway. Potential species turnover declines to 0.23 in summer and 0.09 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 32 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 30 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, Lewis and Clark National Historical 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 30 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	Worsening*
Cackling/Canada Goose	x	Worsening
Wood Duck	x	Potential extirpation
Gadwall	Potential extirpation^	Worsening
Eurasian Wigeon	-	Worsening*
American Wigeon	-	Worsening
Mallard	Worsening^	Worsening
Blue-winged Teal	Potential extirpation	Potential colonization
Northern Shoveler	-	Worsening
Green-winged Teal	-	Worsening
Canvasback	-	Stable
Ring-necked Duck	-	Worsening
Greater Scaup	-	Stable^
Lesser Scaup	x	Worsening

Common Name	Summer Trend	Winter Trend
Harlequin Duck	x	Worsening
Surf Scoter	x	Stable
White-winged Scoter	x	Worsening*
Black Scoter	x	Stable
Long-tailed Duck	-	Worsening*
Bufflehead	-	Worsening
Common Goldeneye	-	Worsening
Hooded Merganser	x	Worsening^
Common Merganser	x	Worsening*
Red-breasted Merganser	-	Worsening^
Ruddy Duck	-	Improving
Ring-necked Pheasant	Potential extirpation	-
Red-throated Loon	Potential extirpation	Stable
Pacific Loon	Potential extirpation	Worsening*
Common Loon	Potential extirpation	Worsening^

Common Name	Summer Trend	Winter Trend
Pied-billed Grebe	x	Worsening
Horned Grebe	-	Stable
Red-necked Grebe	-	Stable^
Eared Grebe	-	Stable
Western Grebe	x	Worsening*
Clark's Grebe	x	Worsening
Wood Stork	Potential colonization	-
Northern Gannet	-	Potential colonization^
Brandt's Cormorant	x	Worsening*
Double-crested Cormorant	x	Stable
Pelagic Cormorant	x	Stable
Brown Pelican	Improving	-
Least Bittern	-	Potential colonization
Great Blue Heron	Improving*	Stable
Great Egret	-	Improving*
Snowy Egret	-	Potential colonization
Cattle Egret	-	Potential colonization
Green Heron	Improving	Improving*
Black-crowned Night-Heron	-	Potential colonization
Osprey	x	Potential colonization
White-tailed Kite	Potential colonization	Stable
Northern Harrier	Stable^	Stable
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Improving
Bald Eagle	x	Worsening
Red-shouldered Hawk	Improving*	Improving*
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Potential colonization
Rough-legged Hawk	-	Worsening

Common Name	Summer Trend	Winter Trend
Clapper Rail	-	Potential colonization
Virginia Rail	x	Stable
Common Gallinule	-	Potential colonization
American Coot	x	Stable
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Black-bellied Plover	-	Stable
Snowy Plover	-	Stable
Killdeer	Improving	Stable
Spotted Sandpiper	x	Improving
Greater Yellowlegs	Potential extirpation	-
Willet	Potential colonization^	Potential colonization^
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Marbled Godwit	Potential extirpation^	Improving
Ruddy Turnstone	x	Potential colonization^
Black Turnstone	x	Stable
Red Knot	-	Potential colonization^
Surfbird	x	Stable^
Sanderling	x	Worsening
Dunlin	-	Worsening^
Purple Sandpiper	-	Potential colonization
Western Sandpiper	Stable	Worsening
Short-billed Dowitcher	-	Potential colonization^
Wilson's Snipe	-	Stable
Red-necked Phalarope	Stable	-

Common Name	Summer Trend	Winter Trend
Pomarine Jaeger	-	Potential colonization [^]
Common Murre	x	Stable
Pigeon Guillemot	Worsening	Stable
Marbled Murrelet	Stable	-
Bonaparte's Gull	Potential extirpation	-
Laughing Gull	Potential colonization [^]	-
Mew Gull	Potential extirpation	Worsening
Ring-billed Gull	Improving [^]	Improving
Western Gull	Stable	Worsening* [^]
California Gull	x	Worsening [^]
Herring Gull	-	Improving [^]
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 [^]
Rock Pigeon	Improving	Potential extirpation
Band-tailed Pigeon	Worsening	-
Eurasian Collared-Dove	x	Improving
Mourning Dove	Improving*	Improving*
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	x	Stable
Great Horned Owl	x	Stable
Burrowing Owl	-	Potential colonization
Common Nighthawk	Stable	-
Anna's Hummingbird	Stable	Worsening*
Rufous Hummingbird	Worsening*	-

Common Name	Summer Trend	Winter Trend
Belted Kingfisher	Improving	Worsening
Acorn Woodpecker	-	Potential colonization
Red-breasted Sapsucker	-	Stable
Downy Woodpecker	Improving*	Stable
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening	Worsening
Pileated Woodpecker	Improving	-
American Kestrel	x	Improving
Merlin	-	Stable [^]
Peregrine Falcon	x	Stable
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable [^]	-
Willow Flycatcher	Potential extirpation	-
Pacific-slope Flycatcher	Worsening*	-
Black Phoebe	-	Stable
Eastern Phoebe	-	Potential colonization
White-eyed Vireo	Potential colonization	-
Hutton's Vireo	Worsening [^]	Improving*
Warbling Vireo	Potential extirpation	-
Steller's Jay	Worsening	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving*	Worsening*
American Crow	Improving	Stable
Common Raven	Stable	Worsening
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	Potential colonization
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
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	Potential extirpation	Potential extirpation
Brown Creeper	Worsening [^]	Potential extirpation
House Wren	-	Potential colonization
Pacific/Winter Wren	Worsening	Worsening
Marsh Wren	x	Worsening
Carolina Wren	Potential colonization	-
Bewick's Wren	Worsening	Worsening
Blue-gray Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	Worsening*	Worsening
Ruby-crowned Kinglet	Potential extirpation	Improving
Wrentit	Worsening	Stable
Western Bluebird	Stable	-
Swainson's Thrush	Worsening	-
Hermit Thrush	Improving	Stable
American Robin	Stable	Stable
Varied Thrush	Stable [^]	Worsening
Crissal Thrasher	-	Potential colonization
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Improving	Improving
American Pipit	-	Potential colonization
Cedar Waxwing	Worsening	Improving*
Worm-eating Warbler	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening*	Improving*
MacGillivray's Warbler	Worsening	-
Common Yellowthroat	Stable	Potential colonization
Yellow Warbler	Potential extirpation	-
Pine Warbler	Potential colonization [^]	-
Yellow-rumped Warbler	Improving	Improving
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Potential colonization	-
Black-throated Gray Warbler	Worsening	Potential colonization
Townsend's Warbler	Stable	Worsening*
Hermit Warbler	Potential extirpation	-
Wilson's Warbler	Worsening	Potential colonization
Spotted Towhee	Worsening	x
Eastern Towhee	Potential colonization	-
Savannah Sparrow	Potential extirpation	-
Grasshopper Sparrow	Potential colonization	-
Seaside Sparrow	Potential colonization [^]	-
Fox Sparrow	-	Worsening
Song Sparrow	Stable	Worsening
Lincoln's Sparrow	-	Worsening*
Swamp Sparrow	-	Improving
White-crowned Sparrow	Worsening*	Worsening
Golden-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Worsening
Western Tanager	Worsening*	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-headed Grosbeak	Worsening	-
Red-winged Blackbird	Stable	Stable
Eastern Meadowlark	-	Potential colonization
Western Meadowlark	-	Stable
Brewer's Blackbird	Worsening	Worsening
Brown-headed Cowbird	Potential extirpation	Potential colonization

Common Name	Summer Trend	Winter Trend
Hooded Oriole	Potential colonization	x
House Finch	Stable	Improving
Purple Finch	Worsening*	Stable
Red Crossbill	Worsening^	x
Pine Siskin	Worsening	Potential extirpation
American Goldfinch	Improving	Improving*
House Sparrow	x	Improving