



Indiana Dunes National Lakeshore

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 Indiana Dunes National Lakeshore (hereafter, the Lakeshore) 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 Lakeshore, 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 Lakeshore today, climate suitability in summer under the high-emissions pathway is projected to improve for 41, remain stable for 31 (e.g., Figure 2), and worsen for 10 species. Suitable climate ceases to occur for 46 species in summer, potentially resulting in extirpation of those species from the Lakeshore. Climate is projected to become suitable in summer for 16 species not found at the Lakeshore today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 59, remain stable for 17, and worsen for 15 species. Suitable climate ceases to occur for 16 species in winter, potentially resulting in extirpation from the Lakeshore. Climate is projected to become suitable in winter for 23 species not found at the Lakeshore 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 Lakeshore based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Lakeshore 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.

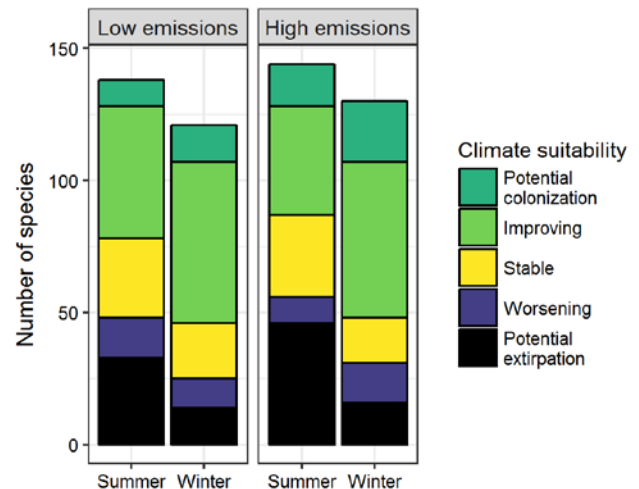


Figure 1. Projected changes in climate suitability for birds at the Lakeshore, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Lakeshore between the present and 2050 is 0.36 in summer (63rd percentile across all national parks) and 0.30 in winter (47th percentile) under the high-emissions pathway. Potential species turnover declines to 0.27 in summer and 0.25 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 Lakeshore is or may become home to 16 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Indiana Dunes National Lakeshore 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

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

While the Lakeshore may serve as an important refuge for 12 of these climate-sensitive species, 4 might be extirpated from the Lakeshore in at least one season by 2050.



Figure 2. Climate at the Lakeshore 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).

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 12 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.

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 Lakeshore based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Lakeshore 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	Common Name	Summer Trend	Winter Trend
Cackling/Canada Goose	x	Worsening	White-winged Scoter	-	Potential extirpation
Mute Swan	x	Potential extirpation	Black Scoter	-	Potential extirpation
Wood Duck	x	Improving	Long-tailed Duck	-	Stable
Gadwall	-	Improving	Bufflehead	-	Improving
American Wigeon	-	Improving	Common Goldeneye	-	Improving
American Black Duck	x	Potential extirpation	Hooded Merganser	x	Improving^
Mallard	Potential extirpation^	Stable	Common Merganser	-	Worsening*
Blue-winged Teal	Potential extirpation	Potential colonization	Red-breasted Merganser	Potential extirpation	Stable^
Northern Shoveler	-	Improving*	Ruddy Duck	Stable	Stable
Green-winged Teal	x	Improving	Northern Bobwhite	Improving*	Improving
Canvasback	-	Improving	Ring-necked Pheasant	Potential extirpation	-
Ring-necked Duck	-	Improving	Wild Turkey	x	Stable
Greater Scaup	-	Improving^	Red-throated Loon	-	Stable
Lesser Scaup	x	Improving	Common Loon	-	Improving^
Surf Scoter	-	Stable	Pied-billed Grebe	x	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Horned Grebe	-	Improving
Red-necked Grebe	-	Stable^
Eared Grebe	-	Potential colonization
Double-crested Cormorant	x	Improving*
American White Pelican	x	Potential colonization
American Bittern	Potential extirpation	-
Great Blue Heron	Improving	Improving
Great Egret	Improving*	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Potential colonization	-
Turkey Vulture	x	Improving
Mississippi Kite	Potential colonization	-
Northern Harrier	Potential extirpation^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Worsening
Bald Eagle	x	Improving
Red-shouldered Hawk	Improving	Improving*
Red-tailed Hawk	Improving	Stable
Rough-legged Hawk	-	Worsening*
American Coot	x	Stable
Killdeer	Stable	Improving
Greater Yellowlegs	Potential extirpation	-
Willet	Stable^	-
Lesser Yellowlegs	Stable^	-

Common Name	Summer Trend	Winter Trend
Marbled Godwit	Potential extirpation^	-
Purple Sandpiper	-	Potential extirpation
Least Sandpiper	-	Potential colonization
American Woodcock	x	Improving
Bonaparte's Gull	Stable	Improving
Laughing Gull	Improving^	-
Franklin's Gull	Stable	-
Ring-billed Gull	Potential extirpation^	Improving
Herring Gull	Stable	Worsening**^
Iceland Gull (Thayer's)	-	Potential extirpation
Great Black-backed Gull	x	Potential extirpation
Black Tern	Potential extirpation	-
Forster's Tern	x	Potential colonization
Rock Pigeon	Worsening	Worsening
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Worsening
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Greater Roadrunner	Potential colonization	Potential colonization
Eastern Screech-Owl	x	Worsening*
Great Horned Owl	x	Stable
Snowy Owl	-	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-

Common Name	Summer Trend	Winter Trend
Belted Kingfisher	Potential extirpation	Improving
Red-headed Woodpecker	Stable	Improving
Red-bellied Woodpecker	Improving	Improving
Downy Woodpecker	Improving	Worsening
Hairy Woodpecker	Improving	Worsening
Northern Flicker	Stable	Improving
Pileated Woodpecker	Improving	Improving
American Kestrel	x	Improving
Merlin	-	Improving [^]
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Stable	-
Eastern Wood-Pewee	Improving	-
Yellow-bellied Flycatcher	Potential extirpation	-
Acadian Flycatcher	Improving	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Potential extirpation	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving	Potential colonization
Great Crested Flycatcher	Improving	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Improving	-
Yellow-throated Vireo	Worsening	-
Warbling Vireo	Worsening	-
Philadelphia Vireo	Stable	-

Common Name	Summer Trend	Winter Trend
Red-eyed Vireo	Stable	-
Blue Jay	Improving	Improving
American Crow	Stable	Worsening
Fish Crow	Potential colonization	-
Horned Lark	Potential extirpation	Stable
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Improving	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving*	Improving
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Stable	Worsening
Brown Creeper	-	Improving
House Wren	Potential extirpation	-
Pacific/Winter Wren	-	Improving
Sedge Wren	Potential extirpation	Potential colonization
Carolina Wren	Improving*	Improving
Bewick's Wren	Potential colonization	-
Blue-gray Gnatcatcher	Improving*	-
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	Improving
Townsend's Solitaire	-	Stable
Veery	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Swainson's Thrush	Stable	-
Hermit Thrush	-	Potential colonization
Wood Thrush	Potential extirpation	-
American Robin	Worsening	Improving
Gray Catbird	Potential extirpation	-
Brown Thrasher	Stable	Potential colonization
Northern Mockingbird	Improving*	Improving*
European Starling	Worsening	Stable
American Pipit	-	Improving
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Potential extirpation	Improving
Snow Bunting	-	Potential extirpation
Ovenbird	Potential extirpation	-
Blue-winged Warbler	Stable	-
Golden-winged Warbler	Potential extirpation	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Improving	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Improving	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Stable	-
American Redstart	Potential extirpation	-
Northern Parula	Improving*	-
Magnolia Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Chestnut-sided Warbler	Potential extirpation	-
Pine Warbler	Stable^	-
Yellow-rumped Warbler	Potential extirpation	Improving
Yellow-throated Warbler	Improving	-
Prairie Warbler	Stable	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Improving*	-
Eastern Towhee	Stable	x
American Tree Sparrow	-	Worsening
Chipping Sparrow	Potential extirpation	Potential colonization
Field Sparrow	Improving	Improving*
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Stable	-
Henslow's Sparrow	x	Potential colonization
LeConte's Sparrow	-	Potential colonization
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White-crowned Sparrow	-	Improving
Dark-eyed Junco	-	Stable
Summer Tanager	Improving*	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Improving*	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Dickcissel	Improving	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving	Improving*
Yellow-headed Blackbird	Potential extirpation	-
Rusty Blackbird	-	Improving

Common Name	Summer Trend	Winter Trend
Brewer's Blackbird	Potential extirpation	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Improving*	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Worsening
Purple Finch	-	Stable
Common Redpoll	-	Potential extirpation
Pine Siskin	-	Potential extirpation
American Goldfinch	Worsening	Stable
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Worsening