Birds and Climate Change

National Park Service
U.S. Department of the Interior

Natchez Trace Parkway and National Scenic Trail

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 Natchez Trace Parkway and National Scenic Trail (hereafter, the Trail) 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 Trail based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Trail 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 Trail, 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 Trail today, climate suitability in summer under the high-emissions pathway is projected to improve for 15, remain stable for 35 (e.g., Figure 2), and worsen for 25 species. Suitable climate ceases to occur for 25 species in summer, potentially resulting in extirpation of those species from the Trail. Climate is projected to become suitable in summer for 34 species not found at the Trail today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 31, remain stable for 53, and worsen for 24 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Trail. Climate is projected to become suitable in winter for 66 species not found at the Trail today, potentially resulting in local colonization.

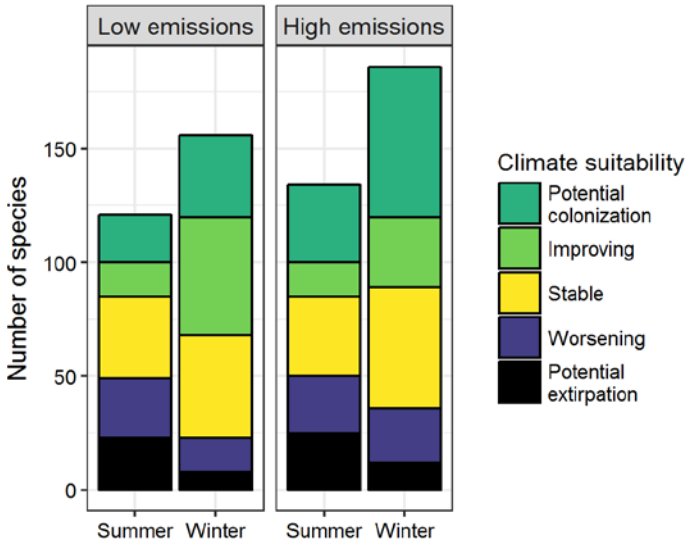

Figure 1. Projected changes in climate suitability for birds at the Trail, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Trail between the present and 2050 is 0.25 in summer (41st percentile across all national parks) and 0.26 in winter (38th percentile) under the high-emissions pathway. Potential species turnover declines to 0.17 in summer and 0.16 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 Trail is or may become home to 13 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). Suitable climate is not projected to disappear for these 13 species at the Trail; instead the Trail may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Trail in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Natchez Trace Parkway and National Scenic Trail falls within the high potential colonization group.** Parks anticipating high potential colonization 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 13 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 Trail based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Trail 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	x	Potential extirpation
Mute Swan	-	Potential extirpation
Wood Duck	x	Stable
Gadwall	-	Improving
American Wigeon	-	Improving
Mallard	Stable^	Stable
Mottled Duck	Potential colonization	Potential colonization
Blue-winged Teal	Potential extirpation	Improving
Cinnamon Teal	-	Potential colonization
Northern Shoveler	-	Stable
Green-winged Teal	-	Stable
Canvasback	-	Improving
Ring-necked Duck	-	Stable
Greater Scaup	-	Stable^
Lesser Scaup	-	Stable
Bufflehead	-	Potential extirpation
Common Goldeneye	-	Stable
Hooded Merganser	-	Worsening*^
Red-breasted Merganser	-	Stable^
Ruddy Duck	-	Stable
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	Potential colonization
Northern Bobwhite	Worsening*	Worsening*
Wild Turkey	x	Potential extirpation
Common Loon	-	Stable^
Least Grebe	-	Potential colonization
Pied-billed Grebe	x	Improving

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Worsening*
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Stable
Anhinga	Improving^	Improving
American White Pelican	-	Improving*
Great Blue Heron	Stable	Stable
Great Egret	Stable	Improving*
Snowy Egret	x	Potential colonization
Little Blue Heron	Improving*	Potential colonization
Tricolored Heron	Potential colonization^	-
Cattle Egret	Improving*	-
Green Heron	Stable	-
Yellow-crowned Night-Heron	Improving*	Potential colonization
White Ibis	Improving	-
Glossy Ibis	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	-	Potential colonization
Black Vulture	Improving	Improving*
Turkey Vulture	x	Improving
Osprey	x	Improving*
White-tailed Kite	Potential colonization	-
Mississippi Kite	Improving	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Harris's Hawk	Potential colonization	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Potential colonization
King Rail	-	Improving^
Virginia Rail	-	Stable
Sora	-	Improving
Common Gallinule	x	Stable
American Coot	x	Improving
Black-necked Stilt	-	Potential colonization
Killdeer	Potential extirpation	Stable
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Improving*
American Woodcock	-	Improving*
Bonaparte's Gull	-	Stable
Laughing Gull	-	Potential colonization
Ring-billed Gull	-	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	-	Stable^
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Stable
Rock Pigeon	Potential extirpation	Potential extirpation
Eurasian Collared-Dove	x	Improving

Common Name	Summer Trend	Winter Trend
White-winged Dove	Potential colonization	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	-	Potential colonization
White-tipped Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Eastern Screech-Owl	x	Improving
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Worsening	-
Black-chinned Hummingbird	Potential colonization	-
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Worsening	Stable
Lewis's Woodpecker	-	Potential colonization
Red-headed Woodpecker	Stable	Worsening*
Golden-fronted Woodpecker	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Red-bellied Woodpecker	Stable	Stable
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Worsening	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Improving	Worsening
Pileated Woodpecker	Stable	Worsening*
Crested Caracara	Potential colonization	Potential colonization
American Kestrel	x	Worsening
Peregrine Falcon	-	Stable
Eastern Wood-Pewee	Worsening*	-
Acadian Flycatcher	Stable	-
Eastern Phoebe	Potential extirpation	Stable
Say's Phoebe	-	Potential colonization
Vermilion Flycatcher	Potential colonization	Potential colonization
Great Crested Flycatcher	Worsening*	-
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	Potential colonization	Potential colonization
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Stable	Improving
White-eyed Vireo	Improving	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Potential extirpation	-
Red-eyed Vireo	Stable	-
Green Jay	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Blue Jay	Worsening	Worsening
American Crow	Worsening	Worsening
Fish Crow	Stable	Stable
Chihuahuan Raven	Potential colonization	-
Northern Rough-winged Swallow	Worsening	Potential colonization
Purple Martin	Stable	x
Tree Swallow	Potential extirpation	-
Barn Swallow	Worsening	-
Cliff Swallow	Stable	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Stable
Tufted Titmouse	Worsening	Stable
Verdin	Potential colonization	Potential colonization
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Stable^	Stable
Brown Creeper	-	Worsening
Rock Wren	-	Potential colonization
House Wren	Potential extirpation	Stable
Pacific/Winter Wren	-	Worsening*
Sedge Wren	-	Improving*
Marsh Wren	-	Improving*
Carolina Wren	Stable	Stable
Bewick's Wren	Improving	Potential colonization
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Worsening	Improving
Black-tailed Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	-	Worsening

Common Name	Summer Trend	Winter Trend
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Stable
Mountain Bluebird	-	Potential colonization
Hermit Thrush	-	Stable
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Worsening
Gray Catbird	Potential extirpation	Improving*
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Worsening*	Stable
Long-billed Thrasher	Potential colonization^	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Stable
European Starling	Potential extirpation	Worsening
American Pipit	-	Stable
Cedar Waxwing	-	Worsening*
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-
Blue-winged Warbler	Worsening	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Stable	-
Orange-crowned Warbler	-	Improving*
Kentucky Warbler	Stable	-
Common Yellowthroat	Potential extirpation	Stable
Hooded Warbler	Stable	-
American Redstart	Stable	-
Northern Parula	Stable	-
Yellow Warbler	Stable	-
Pine Warbler	Stable^	Stable
Yellow-rumped Warbler	-	Stable

Common Name	Summer Trend	Winter Trend
Yellow-throated Warbler	Stable	-
Prairie Warbler	Stable	-
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Worsening	-
Olive Sparrow	Potential colonization	Potential colonization
Green-tailed Towhee	-	Potential colonization
Eastern Towhee	Potential extirpation	x
Abert's Towhee	Potential colonization	-
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Improving	-
Chipping Sparrow	Potential extirpation	Stable
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Worsening*	Worsening
Lark Sparrow	Improving*	Potential colonization
Black-throated Sparrow	Potential colonization	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Stable
Grasshopper Sparrow	Potential extirpation	Improving
LeConte's Sparrow	-	Improving*
Fox Sparrow	-	Worsening*
Song Sparrow	Potential extirpation	Worsening
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Worsening
Summer Tanager	Worsening	-
Scarlet Tanager	Potential extirpation	-
Western Tanager	-	Potential colonization
Northern Cardinal	Stable	Improving
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening*	-
Indigo Bunting	Worsening	Potential colonization
Painted Bunting	Improving*	-
Dickcissel	Worsening	-
Red-winged Blackbird	Potential extirpation	Stable
Eastern Meadowlark	Stable	Worsening
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Worsening*
Brewer's Blackbird	-	Improving
Common Grackle	Potential extirpation	Stable
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Orchard Oriole	Worsening	-
Hooded Oriole	Potential colonization	-
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization
Baltimore Oriole	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Stable
House Sparrow	x	Worsening