Birds and Climate Change

National Park Service
U.S. Department of the Interior

Cape Hatteras National Seashore

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 Cape Hatteras National Seashore (hereafter, the Seashore) 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 Seashore based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Seashore 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 Seashore, 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 Seashore today, climate suitability in summer under the high-emissions pathway is projected to improve for 32 (e.g., Figure 2), remain stable for 23, and worsen for 26 species. Suitable climate ceases to occur for 43 species in summer, potentially resulting in extirpation of those species from the Seashore. Climate is projected to become suitable in summer for 13 species not found at the Seashore today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 79, remain stable for 57, and worsen for 38 species. Suitable climate ceases to occur for 16 species in winter, potentially resulting in extirpation from the Seashore. Climate is projected to become suitable in winter for 36 species not found at the Seashore today, potentially resulting in local colonization.

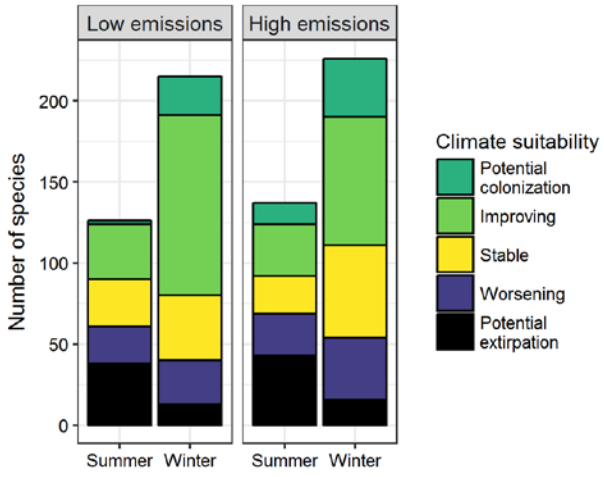

Figure 1. Projected changes in climate suitability for birds at the Seashore, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Seashore between the present and 2050 is 0.21 in summer (32nd percentile across all national parks) and 0.14 in winter (16th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 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 Seashore is or may become home to 44 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 Seashore may serve as an important refuge for 38 of these climate-sensitive species, 6 might be extirpated from the Seashore in at least one season by 2050.

Figure 2. Climate at the Seashore 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Cape Hatteras National Seashore falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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 38 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 Seashore based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Seashore 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	x
Brant	x	Worsening*
Cackling/Canada Goose	x	Potential extirpation
Mute Swan	x	Potential extirpation
Tundra Swan	Potential extirpation	x
Muscovy Duck	-	Potential colonization
Wood Duck	x	Stable
Gadwall	Improving^	Improving
Eurasian Wigeon	-	Potential extirpation
American Wigeon	-	Improving
American Black Duck	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Mallard	Potential extirpation^	Potential extirpation
Mottled Duck	Potential colonization	Potential colonization
Blue-winged Teal	Stable	Improving
Northern Shoveler	Improving^	Improving
Northern Pintail	Potential extirpation	x
Green-winged Teal	-	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Stable
Greater Scaup	-	Improving^
Lesser Scaup	-	Improving
Common Eider	x	Worsening*
Harlequin Duck	-	Potential extirpation
Surf Scoter	x	Worsening*
White-winged Scoter	-	Worsening*
Black Scoter	x	Worsening*

Common Name	Summer Trend	Winter Trend
Long-tailed Duck	-	Worsening*
Bufflehead	-	Worsening
Common Goldeneye	-	Improving
Hooded Merganser	x	Potential extirpation^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	Potential extirpation	Worsening^
Ruddy Duck	Improving	Stable
Northern Bobwhite	Worsening*	Worsening
Ring-necked Pheasant	Potential extirpation	Potential extirpation
Wild Turkey	-	Potential extirpation
Red-throated Loon	Potential extirpation	Worsening*
Pacific Loon	Stable	Stable
Common Loon	Potential extirpation	Worsening^
Least Grebe	-	Potential colonization
Pied-billed Grebe	x	Stable
Horned Grebe	x	Worsening*
Red-necked Grebe	-	Stable^
Eared Grebe	x	Improving*
Western Grebe	-	Stable
Northern Fulmar	-	Potential extirpation
Wood Stork	Stable	-
Northern Gannet	Worsening^	Worsening*^
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Great Cormorant	-	Worsening*
Anhinga	Improving^	-
American White Pelican	x	Improving*
Brown Pelican	Improving	Improving^

Common Name	Summer Trend	Winter Trend
American Bittern	Potential extirpation	Worsening^
Least Bittern	x	Improving
Great Blue Heron	Improving	Improving
Great Egret	Improving	Improving
Snowy Egret	x	Improving*
Little Blue Heron	Improving*	Improving
Tricolored Heron	Improving*^	Improving
Reddish Egret	x	Potential colonization
Cattle Egret	Improving*	Improving*
Green Heron	Stable	Stable
Black-crowned Night-Heron	x	Stable
Yellow-crowned Night-Heron	Improving*	Improving
White Ibis	Improving*	Improving
Glossy Ibis	x	Stable
White-faced Ibis	x	Potential colonization^
Roseate Spoonbill	x	Potential colonization
Black Vulture	Improving	Improving*
Turkey Vulture	x	Improving
Osprey	x	Improving*
White-tailed Kite	-	Potential colonization
Swallow-tailed Kite	Improving	-
Mississippi Kite	Improving*	-
Northern Harrier	Potential extirpation^	Stable
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Improving
Bald Eagle	x	Stable
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening	Improving
Red-tailed Hawk	Worsening	Improving*
Clapper Rail	x	Improving

Common Name	Summer Trend	Winter Trend
King Rail	x	Stable^
Virginia Rail	x	Worsening
Sora	-	Stable
Common Gallinule	x	Stable
American Coot	x	Stable
Limpkin	-	Potential colonization
Black-necked Stilt	x	Potential colonization
American Avocet	x	Improving*^
American Oystercatcher	x	Worsening*^
Black-bellied Plover	x	Stable
American Golden-Plover	Stable	-
Snowy Plover	x	Potential colonization
Wilson's Plover	x	Potential colonization
Semipalmated Plover	Potential extirpation	Stable^
Piping Plover	x	Stable^
Killdeer	Improving	Stable
Spotted Sandpiper	x	Improving*
Greater Yellowlegs	Potential extirpation	Improving
Willet	Stable^	Stable^
Lesser Yellowlegs	Stable^	Improving
Whimbrel	x	Improving
Long-billed Curlew	Improving^	-
Marbled Godwit	Potential extirpation^	Improving
Ruddy Turnstone	x	Stable^
Red Knot	x	Worsening*^
Stilt Sandpiper	x	Potential colonization
Sanderling	x	Worsening
Dunlin	x	Stable^
Purple Sandpiper	-	Worsening*

Common Name	Summer Trend	Winter Trend
Least Sandpiper	x	Improving
Western Sandpiper	Improving	Improving
Short-billed Dowitcher	x	Stable^
Long-billed Dowitcher	x	Improving*
Wilson's Snipe	-	Improving
American Woodcock	x	Worsening
Wilson's Phalarope	Stable^	-
Red-necked Phalarope	Stable	-
Pomarine Jaeger	x	Improving^
Parasitic Jaeger	Improving	x
Long-tailed Jaeger	Potential extirpation	-
Bonaparte's Gull	Potential extirpation	Improving
Laughing Gull	Worsening^	Stable
Franklin's Gull	Potential extirpation	-
Mew Gull	-	Improving
Ring-billed Gull	Potential extirpation^	Stable
California Gull	-	Stable^
Herring Gull	Worsening	Worsening^
Iceland Gull (Thayer's)	-	Worsening
Great Black-backed Gull	x	Worsening*
Gull-billed Tern	x	Potential colonization
Caspian Tern	x	Improving*
Black Tern	Improving	-
Forster's Tern	x	Improving
Royal Tern	x	Improving^
Sandwich Tern	x	Potential colonization^
Black Skimmer	x	Improving^
Rock Pigeon	Stable	Improving
Eurasian Collared-Dove	x	Improving*
White-winged Dove	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Mourning Dove	Improving	Improving
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Stable	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Barn Owl	-	Improving
Eastern Screech-Owl	x	Improving
Great Horned Owl	x	Stable
Barred Owl	x	Stable
Lesser Nighthawk	-	Potential colonization
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening*	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Worsening	x
Allen's Hummingbird	-	Potential colonization
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Potential extirpation	Improving
Red-headed Woodpecker	Stable	Stable
Red-bellied Woodpecker	Worsening	Improving
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Improving
Hairy Woodpecker	Potential extirpation	Stable
Northern Flicker	Improving	Worsening
Pileated Woodpecker	Potential extirpation	Stable
Crested Caracara	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
American Kestrel	x	Improving
Merlin	x	Stable^
Peregrine Falcon	-	Improving
Eastern Wood-Pewee	Potential extirpation	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	Improving
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	-
Brown-crested Flycatcher	Potential colonization	-
Eastern Kingbird	Improving*	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Improving*
White-eyed Vireo	Worsening	Stable
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Worsening	Stable
American Crow	Potential extirpation	Stable
Fish Crow	Worsening*	Worsening*
Horned Lark	-	Stable
Northern Rough-winged Swallow	Stable	Potential colonization
Purple Martin	Stable	x
Tree Swallow	Stable	Stable
Barn Swallow	Improving	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening*	Improving
Tufted Titmouse	Worsening*	x
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Brown-headed Nuthatch	Worsening*^	Stable
Brown Creeper	-	Stable
House Wren	Stable	Improving
Pacific/Winter Wren	-	Worsening
Sedge Wren	-	Improving
Marsh Wren	x	Improving
Carolina Wren	Worsening	Stable
Blue-gray Gnatcatcher	Potential extirpation	-
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Stable
Hermit Thrush	-	Stable
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Stable
Brown Thrasher	Potential extirpation	Stable
Northern Mockingbird	Improving	Improving
European Starling	Worsening	Worsening
American Pipit	-	Improving
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Stable
Snow Bunting	-	Potential extirpation
Ovenbird	Potential extirpation	Stable
Black-and-white Warbler	Potential extirpation	Stable
Prothonotary Warbler	Worsening	-
Orange-crowned Warbler	-	Improving
Common Yellowthroat	Stable	Worsening
American Redstart	Potential extirpation	-
Northern Parula	Worsening*	-

Common Name	Summer Trend	Winter Trend
Yellow Warbler	Potential extirpation	-
Palm Warbler	-	Worsening*^
Pine Warbler	Potential extirpation^	Improving
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	-
Prairie Warbler	Worsening	Worsening
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Worsening	-
Eastern Towhee	Potential extirpation	x
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Field Sparrow	Potential extirpation	Improving
Vesper Sparrow	-	Improving
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Worsening
Grasshopper Sparrow	Potential extirpation	-
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Improving^
Seaside Sparrow	Stable^	Improving*^
Song Sparrow	Potential extirpation	Worsening
Lincoln's Sparrow	-	Improving*
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Worsening*	-
Northern Cardinal	Improving	Improving

Common Name	Summer Trend	Winter Trend
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Potential extirpation	-
Indigo Bunting	Stable	Potential colonization
Painted Bunting	-	Improving
Red-winged Blackbird	Improving*	Improving
Eastern Meadowlark	Improving*	Worsening
Rusty Blackbird	-	Worsening
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Stable
Boat-tailed Grackle	Improving*^	Worsening*^
Great-tailed Grackle	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Stable
Orchard Oriole	Stable	-
Hooded Oriole	Potential colonization	-
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation
Common Redpoll	-	Improving
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Improving
House Sparrow	x	Stable