Birds and Climate Change

National Park Service
U.S. Department of the Interior

Cape Cod 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 Cod 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 45, remain stable for 48 (e.g., Figure 2), and worsen for 15 species. Suitable climate ceases to occur for 40 species in summer, potentially resulting in extirpation of those species from the Seashore. Climate is projected to become suitable in summer for 7 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 81, remain stable for 34, and worsen for 20 species. Suitable climate ceases to occur for 23 species in winter, potentially resulting in extirpation from the Seashore. Climate is projected to become suitable in winter for 17 species not found at the Seashore today, potentially resulting in local colonization.

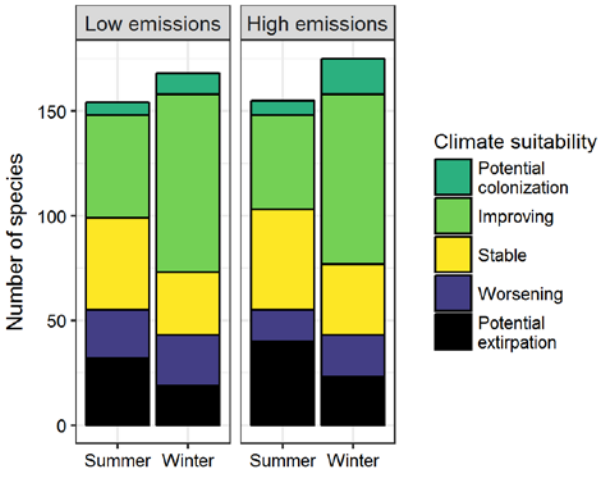

Figure 1. Projected changes in climate suitability for birds at the Seashore, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Seashore between the present and 2050 is 0.27 in summer (46th percentile across all national parks) and 0.22 in winter (30th percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 in summer and 0.15 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 36 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 32 of these climate-sensitive species, 4 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 Cod National Seashore 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.

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 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
Brant	x	Improving
Cackling/Canada Goose	x	Worsening
Mute Swan	x	Worsening*
Wood Duck	x	Improving
Gadwall	Stable^	Improving
Eurasian Wigeon	-	Improving
American Wigeon	-	Improving
American Black Duck	x	Stable
Mallard	Potential extirpation^	Worsening
Blue-winged Teal	Stable	-
Northern Shoveler	-	Improving*
Green-winged Teal	x	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Greater Scaup	Potential colonization	Improving^
Lesser Scaup	-	Stable

Common Name	Summer Trend	Winter Trend
Common Eider	x	Worsening*
Harlequin Duck	-	Stable
Surf Scoter	x	Improving
White-winged Scoter	x	Stable
Black Scoter	x	Improving
Long-tailed Duck	Stable	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Worsening
Barrow's Goldeneye	-	Stable^
Hooded Merganser	x	Improving^
Common Merganser	-	Worsening*
Red-breasted Merganser	Improving	Improving^
Ruddy Duck	-	Improving
Northern Bobwhite	Improving*	Improving
Ring-necked Pheasant	Potential extirpation	Potential extirpation
Wild Turkey	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Red-throated Loon	Stable	Improving
Pacific Loon	-	Stable
Common Loon	Potential extirpation	Improving^
Pied-billed Grebe	x	Improving
Horned Grebe	-	Improving
Red-necked Grebe	Potential extirpation	Worsening*^
Northern Fulmar	x	Stable
Northern Gannet	Improving^	Improving^
Double-crested Cormorant	x	Improving
Great Cormorant	x	Stable
Brown Pelican	-	Potential colonization^
American Bittern	Potential extirpation	Improving^
Great Blue Heron	Stable	Improving
Great Egret	Improving*	Improving*
Snowy Egret	x	Potential colonization
Little Blue Heron	Improving	Potential colonization
Tricolored Heron	Improving^	Potential colonization
Green Heron	Improving*	-
Black-crowned Night-Heron	x	Improving*
Yellow-crowned Night-Heron	Improving	-
Black Vulture	Improving	Improving
Turkey Vulture	x	Stable
Swallow-tailed Kite	Stable	-
Mississippi Kite	Improving	-
Northern Harrier	Stable^	Stable
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Worsening
Northern Goshawk	-	Potential extirpation
Bald Eagle	x	Stable

Common Name	Summer Trend	Winter Trend
Red-shouldered Hawk	Improving	Stable
Red-tailed Hawk	Improving	Worsening
Rough-legged Hawk	-	Potential extirpation
Clapper Rail	x	Improving*
Virginia Rail	x	Stable
American Coot	-	Stable
American Oystercatcher	x	Potential colonization^
Black-bellied Plover	x	Improving
American Golden-Plover	Stable	-
Semipalmated Plover	Improving	Improving^
Killdeer	Improving	Improving*
Greater Yellowlegs	Stable	Improving*
Willet	Improving^	Potential colonization^
Lesser Yellowlegs	Stable^	Potential colonization
Long-billed Curlew	Stable^	-
Marbled Godwit	Potential extirpation^	Improving
Ruddy Turnstone	x	Improving^
Red Knot	x	Improving^
Sanderling	x	Stable
Dunlin	x	Improving*^
Purple Sandpiper	-	Stable
Western Sandpiper	Stable	Improving
Short-billed Dowitcher	x	Potential colonization^
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Worsening
American Woodcock	x	Improving*
Wilson's Phalarope	Stable^	-
Red-necked Phalarope	Stable	-
Pomarine Jaeger	x	Potential colonization^

Common Name	Summer Trend	Winter Trend
Parasitic Jaeger	Stable	-
Long-tailed Jaeger	Stable	-
Common Murre	x	Stable
Black Guillemot	x	Worsening*
Bonaparte's Gull	Stable	Improving
Laughing Gull	Improving*^	Potential colonization
Ring-billed Gull	Stable^	Stable
Herring Gull	Improving	Stable^
Iceland Gull (Thayer's)	-	Stable
Glaucous Gull	Stable	x
Great Black-backed Gull	x	Improving
Black Tern	Potential extirpation	-
Arctic Tern	Improving	-
Forster's Tern	x	Improving
Rock Pigeon	Worsening	Potential extirpation
White-winged Dove	Improving	-
Mourning Dove	Worsening	Worsening
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Worsening	-
Barn Owl	-	Potential colonization
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Stable
Snowy Owl	-	Stable
Common Nighthawk	Stable	-
Chuck-will's-widow	Improving	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Improving	-
Red-bellied Woodpecker	Improving*	Stable
Yellow-bellied Sapsucker	-	Improving*

Common Name	Summer Trend	Winter Trend
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Potential extirpation	Stable
American Kestrel	x	Improving*
Merlin	x	Improving^
Peregrine Falcon	x	Improving
Eastern Wood-Pewee	Stable	-
Yellow-bellied Flycatcher	Potential extirpation	-
Acadian Flycatcher	Improving	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Worsening*	-
Eastern Phoebe	Potential extirpation	Improving*
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Stable	-
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Improving*	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Worsening	Worsening
American Crow	Worsening	Worsening
Fish Crow	Improving	Improving
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Stable	Worsening
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	Improving
Barn Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Potential extirpation
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown Creeper	Potential extirpation^	Stable
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Potential colonization
Marsh Wren	x	Improving
Carolina Wren	Improving	Improving
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Potential extirpation
Hermit Thrush	Potential extirpation	Improving
Wood Thrush	Worsening*	-
American Robin	Worsening	Improving
Varied Thrush	-	Stable
Gray Catbird	Worsening*	Improving
Brown Thrasher	Stable	Improving*
Northern Mockingbird	Improving*	Improving
European Starling	Worsening	Worsening
American Pipit	Improving	Improving
Sprague's Pipit	-	Improving
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Snow Bunting	-	Worsening*
Ovenbird	Stable	-
Northern Waterthrush	Potential extirpation	-
Black-and-white Warbler	Potential extirpation	-
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Tennessee Warbler	Potential extirpation	-
Orange-crowned Warbler	-	Improving
Nashville Warbler	Potential extirpation	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Stable	Improving
American Redstart	Potential extirpation	-
Northern Parula	Improving	-
Magnolia Warbler	Potential extirpation	-
Blackburnian Warbler	Stable	-
Yellow Warbler	Potential extirpation	-
Chestnut-sided Warbler	Potential extirpation	-
Blackpoll Warbler	Stable	-
Black-throated Blue Warbler	Stable	x
Palm Warbler	-	Improving*^
Pine Warbler	Improving*^	Stable
Yellow-rumped Warbler	-	Improving
Prairie Warbler	Improving	-
Black-throated Green Warbler	Stable	-
Canada Warbler	Stable	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Improving*	x

Common Name	Summer Trend	Winter Trend
Eastern Towhee	Improving	x
American Tree Sparrow	-	Potential extirpation
Chipping Sparrow	Potential extirpation	Improving
Clay-colored Sparrow	Stable	-
Field Sparrow	Stable	Stable
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	-	Improving
Savannah Sparrow	Potential extirpation	Improving*
Grasshopper Sparrow	Improving*	-
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	x	Improving*^
Seaside Sparrow	Improving^	Improving^
Fox Sparrow	-	Improving
Song Sparrow	Worsening	Stable
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	-	Improving
White-crowned Sparrow	-	Potential extirpation
Dark-eyed Junco	-	Worsening
Summer Tanager	Improving	-
Scarlet Tanager	Potential extirpation	-
Western Tanager	-	Improving
Northern Cardinal	Improving	Stable
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Stable	-

Common Name	Summer Trend	Winter Trend
Painted Bunting	-	Improving
Dickcissel	Improving*	x
Bobolink	Potential extirpation	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Stable	Improving*
Yellow-headed Blackbird	Potential extirpation	-
Common Grackle	Stable	Improving
Boat-tailed Grackle	Potential colonization^	Potential colonization^
Brown-headed Cowbird	Stable	Improving
Orchard Oriole	Improving*	-
Baltimore Oriole	Worsening*	x
Pine Grosbeak	-	Potential extirpation
House Finch	Worsening*	Potential extirpation
Purple Finch	Potential extirpation	Stable
Red Crossbill	Potential extirpation^	x
White-winged Crossbill	-	Potential extirpation
Common Redpoll	-	Potential extirpation
Pine Siskin	Potential extirpation	Stable
American Goldfinch	Worsening	Potential extirpation
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Worsening
Eurasian Tree Sparrow	-	Potential colonization