



## Cape Lookout 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 Lookout 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.

### 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 23 (e.g., Figure 2), remain stable for 18, and worsen for 15 species. Suitable climate ceases to occur for 24 species in summer, potentially resulting in extirpation of those species from the Seashore. Climate is projected to become suitable in summer for 24 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 21, remain stable for 37, and worsen for 27 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Seashore. Climate is projected to become suitable in winter for 46 species not found at the Seashore 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 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.

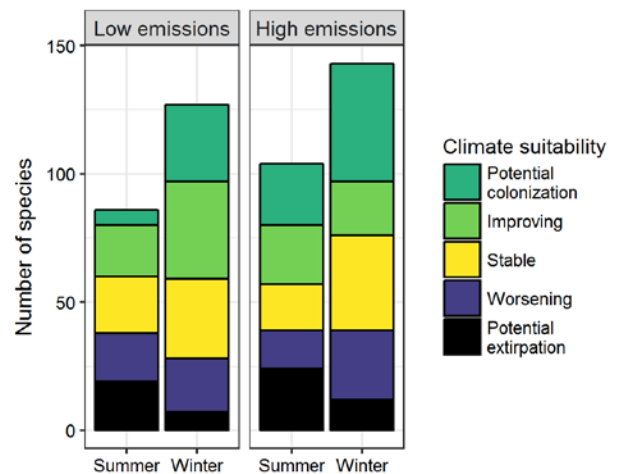


Figure 1. Projected changes in climate suitability for birds at the Seashore, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Seashore between the present and 2050 is 0.28 in summer (48<sup>th</sup> percentile across all national parks) and 0.16 in winter (20<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.11 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 33 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

### Management Implications

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

### Caveats

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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

Seashore may serve as an important refuge for 28 of these climate-sensitive species, 5 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).

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 28 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.

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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	-
Brant	-	Potential extirpation
Cackling/Canada Goose	x	Potential extirpation
Muscovy Duck	-	Potential colonization
Gadwall	Improving <sup>^</sup>	Improving
American Wigeon	-	Stable
American Black Duck	x	Potential extirpation
Mallard	Potential extirpation <sup>^</sup>	Potential extirpation
Mottled Duck	Potential colonization	Potential colonization
Green-winged Teal	-	Stable
Lesser Scaup	-	Stable

Common Name	Summer Trend	Winter Trend
Common Eider	-	Worsening
Harlequin Duck	-	Potential extirpation
Surf Scoter	x	Worsening*
White-winged Scoter	-	Stable
Black Scoter	x	Worsening*
Bufflehead	-	Potential extirpation
Hooded Merganser	x	Potential extirpation <sup>^</sup>
Red-breasted Merganser	-	Worsening <sup>^</sup>
Northern Bobwhite	Worsening*	-
Ring-necked Pheasant	Stable	-
Red-throated Loon	-	Potential extirpation
Common Loon	Potential extirpation	Worsening <sup>^</sup>
Least Grebe	-	Potential colonization
Horned Grebe	x	Worsening*

Common Name	Summer Trend	Winter Trend
Northern Gannet	Potential extirpation <sup>^</sup>	Worsening* <sup>^</sup>
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Great Cormorant	x	Worsening
Anhinga	Potential colonization <sup>^</sup>	-
Brown Pelican	Improving	Stable <sup>^</sup>
Least Bittern	-	Potential colonization
Great Blue Heron	Improving	Improving
Great Egret	Improving	Improving
Snowy Egret	x	Improving*
Little Blue Heron	Improving*	-
Tricolored Heron	Improving* <sup>^</sup>	-
Reddish Egret	x	Improving
Cattle Egret	Improving*	-
Green Heron	Stable	-
Black-crowned Night-Heron	x	Stable
Yellow-crowned Night-Heron	Improving	Potential colonization
White Ibis	Improving	Stable
White-faced Ibis	-	Potential colonization <sup>^</sup>
Roseate Spoonbill	-	Potential colonization
Turkey Vulture	x	Improving
White-tailed Kite	Potential colonization	Potential colonization
Swallow-tailed Kite	Potential colonization	-
Northern Harrier	Improving <sup>^</sup>	Stable
Sharp-shinned Hawk	-	Potential extirpation
Harris's Hawk	Potential colonization	-
White-tailed Hawk	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Ferruginous Hawk	-	Potential colonization
Clapper Rail	x	Stable
Virginia Rail	-	Worsening
Limpkin	-	Potential colonization
Black-necked Stilt	-	Potential colonization
American Oystercatcher	x	Worsening <sup>^</sup>
Black-bellied Plover	x	Worsening*
American Golden-Plover	Stable	-
Snowy Plover	-	Potential colonization
Wilson's Plover	x	Improving
Semipalmated Plover	Stable	Stable <sup>^</sup>
Piping Plover	x	Stable <sup>^</sup>
Killdeer	Improving	Improving
Greater Yellowlegs	Potential extirpation	Stable
Willet	Stable <sup>^</sup>	Stable <sup>^</sup>
Lesser Yellowlegs	Stable <sup>^</sup>	-
Whimbrel	x	Stable
Long-billed Curlew	Improving <sup>^</sup>	Improving
Marbled Godwit	Potential extirpation <sup>^</sup>	-
Ruddy Turnstone	x	Stable <sup>^</sup>
Red Knot	x	Worsening <sup>^</sup>
Stilt Sandpiper	-	Potential colonization
Sanderling	x	Worsening
Dunlin	x	Worsening <sup>^</sup>
Purple Sandpiper	-	Worsening
Least Sandpiper	x	Stable
Western Sandpiper	-	Stable
Short-billed Dowitcher	x	Stable <sup>^</sup>
Wilson's Phalarope	Stable <sup>^</sup>	-
Red-necked Phalarope	Stable	-

Common Name	Summer Trend	Winter Trend
Bonaparte's Gull	-	Stable
Laughing Gull	Stable^	Stable
Ring-billed Gull	Potential extirpation^	Worsening
Herring Gull	Worsening	Worsening^
Great Black-backed Gull	x	Worsening*
Black Tern	Improving	-
Arctic Tern	Potential extirpation	-
Forster's Tern	x	Stable
Royal Tern	x	Stable^
Sandwich Tern	x	Potential colonization^
Black Skimmer	x	Stable^
Rock Pigeon	Stable	Stable
Eurasian Collared-Dove	x	Potential colonization
White-winged Dove	Improving	Potential colonization
Mourning Dove	Improving	Improving
Inca Dove	Potential colonization	Potential colonization
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Lesser Nighthawk	Potential colonization	Potential colonization
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chimney Swift	Worsening	-
Allen's Hummingbird	-	Potential colonization
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Red-headed Woodpecker	Worsening	-
Red-bellied Woodpecker	Worsening	-
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	-
American Three-toed Woodpecker	-	Potential colonization^
Northern Flicker	Improving	Worsening
Crested Caracara	Potential colonization	Potential colonization
American Kestrel	x	Improving
Peregrine Falcon	-	Improving*
Eastern Wood-Pewee	Potential extirpation	-
Eastern Phoebe	-	Improving
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	-
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	-	Potential colonization
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Worsening	Stable
American Crow	Potential extirpation	-
Fish Crow	Worsening*	Worsening*
Northern Rough-winged Swallow	Stable	Potential colonization
Purple Martin	Worsening	-
Tree Swallow	Improving	Stable
Barn Swallow	Stable	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Cliff Swallow	Potential colonization	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening*	Improving
Tufted Titmouse	Potential extirpation	-
Red-breasted Nuthatch	-	Improving
House Wren	Stable	-
Marsh Wren	-	Stable
Carolina Wren	Worsening	Stable
Bewick's Wren	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Potential extirpation	Stable
American Robin	Potential extirpation	Worsening
Gray Catbird	Potential extirpation	Stable
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Potential extirpation	Stable
Long-billed Thrasher	Potential colonization^	Potential colonization
Northern Mockingbird	Stable	Improving
European Starling	Stable	Worsening
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Potential extirpation
Ovenbird	-	Stable
Black-and-white Warbler	Potential extirpation	-
Orange-crowned Warbler	-	Stable

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Common Yellowthroat	Potential extirpation	Worsening
Northern Parula	-	Potential colonization
Yellow-rumped Warbler	-	Stable
Prairie Warbler	Worsening	-
Wilson's Warbler	-	Potential colonization
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Worsening
Seaside Sparrow	Stable^	Stable^
Song Sparrow	Stable	Worsening
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	-	Potential extirpation
Northern Cardinal	Improving	Improving
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening*	-
Indigo Bunting	Potential extirpation	Potential colonization
Painted Bunting	Improving*	-
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Improving*	-
Common Grackle	Worsening	-
Boat-tailed Grackle	Improving*^	Worsening*^
Great-tailed Grackle	Potential colonization	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	-
Orchard Oriole	Worsening	-
Hooded Oriole	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	Potential extirpation	-