



Fort Frederica National Monument

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 Fort Frederica National Monument (hereafter, the Monument) 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 21 (e.g., Figure 2), remain stable for 30, and worsen for 19 species. Suitable climate ceases to occur for 15 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 17 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 25, remain stable for 63, and worsen for 34 species. Suitable climate ceases to occur for 18 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 37 species not found at the

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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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.

Monument today, potentially resulting in local colonization.

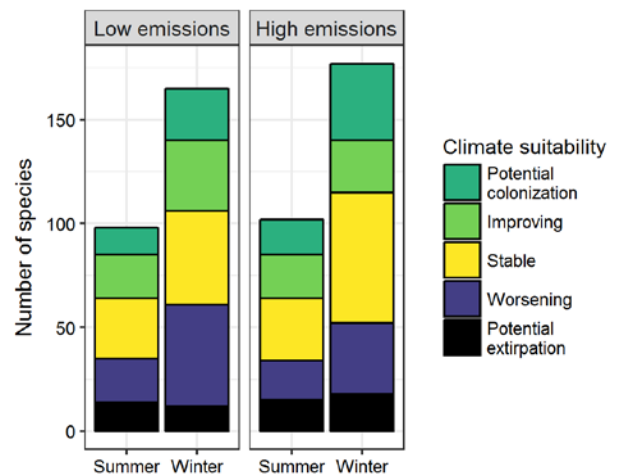


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.17 in summer (25th percentile across all national parks) and 0.12 in winter (12th percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.10 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 Monument 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Fort Frederica National Monument falls within the low change group.** Parks anticipating low change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors.

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 Monument may serve as an important refuge for 30 of these climate-sensitive species, 3 might be extirpated from the Monument in at least one season by 2050.



Figure 2. Climate at the Monument 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).

Furthermore, park managers have an opportunity to focus on supporting the 30 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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	Improving*	-
Wood Duck	-	Worsening
Mallard	-	Potential extirpation
Cinnamon Teal	-	Potential colonization
Green-winged Teal	-	Improving*
Ring-necked Duck	-	Improving
Greater Scaup	-	Stable^
Lesser Scaup	-	Stable
White-winged Scoter	-	Potential extirpation
Black Scoter	-	Worsening
Bufflehead	-	Potential extirpation
Hooded Merganser	x	Potential extirpation^
Red-breasted Merganser	Potential extirpation	Worsening*^

Common Name	Summer Trend	Winter Trend
Ruddy Duck	-	Stable
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	Potential colonization
Red-throated Loon	-	Potential extirpation
Common Loon	-	Worsening*^
Pied-billed Grebe	x	Stable
Horned Grebe	-	Worsening
Wood Stork	Improving	Potential extirpation
Magnificent Frigatebird	-	Potential colonization
Northern Gannet	-	Worsening*^
Double-crested Cormorant	x	Stable
Anhinga	Improving^	Improving*
American White Pelican	-	Improving*
Brown Pelican	Worsening	Stable^

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

Common Name	Summer Trend	Winter Trend
American Avocet	-	Improving [^]
American Oystercatcher	x	Worsening [^]
Black-bellied Plover	x	Stable
Wilson's Plover	x	Improving*
Semipalmated Plover	Stable	Stable [^]
Piping Plover	-	Worsening [^]
Killdeer	Improving*	Stable
Spotted Sandpiper	-	Improving
Greater Yellowlegs	Potential extirpation	Stable
Willet	Stable [^]	Stable [^]
Lesser Yellowlegs	Stable [^]	Improving*
Marbled Godwit	Improving [^]	Stable
Ruddy Turnstone	x	Stable [^]
Red Knot	x	Stable [^]
Sanderling	x	Stable
Dunlin	-	Stable [^]
Least Sandpiper	x	Stable
Western Sandpiper	-	Stable
Short-billed Dowitcher	x	Stable [^]
Bonaparte's Gull	-	Worsening
Laughing Gull	Worsening* [^]	Stable
Ring-billed Gull	Potential extirpation [^]	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	Stable	Worsening [^]
Great Black-backed Gull	x	Potential extirpation
Caspian Tern	x	Stable
Black Tern	Improving	-
Forster's Tern	x	Worsening
Royal Tern	x	Stable [^]
Black Skimmer	x	Stable [^]
Rock Pigeon	Improving*	Improving*
Eurasian Collared-Dove	x	Improving*

Common Name	Summer Trend	Winter Trend
White-winged Dove	Potential colonization	-
Mourning Dove	Improving	Improving
Common Ground-Dove	Stable	Stable
White-tipped Dove	-	Potential colonization
Yellow-billed Cuckoo	Stable	-
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
Common Nighthawk	Stable	-
Common Pauraque	-	Potential colonization
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Stable	Worsening
Red-headed Woodpecker	Worsening	Worsening
Red-bellied Woodpecker	Stable	Worsening
Yellow-bellied Sapsucker	-	Stable
Downy Woodpecker	Worsening	Potential extirpation
Hairy Woodpecker	Stable	Stable
American Three-toed Woodpecker	-	Potential colonization [^]
Northern Flicker	Improving	Potential extirpation
Gilded Flicker	Potential colonization	-
Pileated Woodpecker	Stable	Worsening
American Kestrel	-	Stable
Peregrine Falcon	-	Improving*
Northern Beardless-Tyrannulet	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Eastern Wood-Pewee	Stable	-
Eastern Phoebe	Improving	Improving
Say's Phoebe	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	Potential colonization
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	Potential colonization	Potential colonization
Western Kingbird	Potential colonization	x
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Improving*	Improving
White-eyed Vireo	Worsening	Stable
Red-eyed Vireo	Potential extirpation	-
Green Jay	Potential colonization	Potential colonization
Blue Jay	Worsening	Potential extirpation
American Crow	Stable	Potential extirpation
Fish Crow	Worsening*	Worsening
Chihuahuan Raven	Potential colonization	Potential colonization
Northern Rough-winged Swallow	Improving	-
Purple Martin	Worsening	-
Tree Swallow	-	Worsening*
Violet-green Swallow	-	Potential colonization
Barn Swallow	Worsening	-
Carolina Chickadee	Worsening*	Stable
Tufted Titmouse	Worsening	Worsening
Verdin	Potential colonization	-
White-breasted Nuthatch	Improving	Improving
Brown-headed Nuthatch	Worsening [^]	Worsening*

Common Name	Summer Trend	Winter Trend
Rock Wren	-	Potential colonization
House Wren	-	Stable
Sedge Wren	-	Stable
Marsh Wren	x	Worsening
Carolina Wren	Stable	Stable
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Improving	Stable
Black-tailed Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Stable
Eastern Bluebird	Potential extirpation	Worsening
Hermit Thrush	-	Stable
Wood Thrush	Stable	-
American Robin	Improving	Potential extirpation
Gray Catbird	Potential extirpation	Worsening
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Potential extirpation	Stable
Bendire's Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Stable
European Starling	Stable	Improving
Cedar Waxwing	-	Potential extirpation
Ovenbird	-	Potential colonization
Black-and-white Warbler	-	Worsening*
Orange-crowned Warbler	-	Stable
Common Yellowthroat	Potential extirpation	Stable
Hooded Warbler	Stable	-
Northern Parula	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Palm Warbler	-	Stable^
Pine Warbler	Potential extirpation^	Stable
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Worsening	Worsening
Prairie Warbler	Stable	-
Black-throated Gray Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^
Olive Sparrow	-	Potential colonization
Green-tailed Towhee	-	Potential colonization
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	-	Stable
Field Sparrow	-	Stable
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Stable
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Worsening^
Seaside Sparrow	Worsening*^	Worsening*^
Fox Sparrow	-	Stable
Song Sparrow	-	Potential extirpation
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Worsening
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Potential extirpation	-
Northern Cardinal	Stable	Stable

Common Name	Summer Trend	Winter Trend
Painted Bunting	Stable	-
Red-winged Blackbird	Improving*	Stable
Eastern Meadowlark	Improving*	Stable
Western Meadowlark	-	Potential colonization
Common Grackle	Worsening	Worsening
Boat-tailed Grackle	Worsening^	Worsening*^
Brown-headed Cowbird	Stable	Improving*

Common Name	Summer Trend	Winter Trend
Orchard Oriole	Potential extirpation	-
Hooded Oriole	Potential colonization	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Stable
House Sparrow	x	Stable