Birds and Climate Change

National Park Service
U.S. Department of the Interior

Point Reyes 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 Point Reyes 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 43 (e.g., Figure 2), remain stable for 46, and worsen for 39 species. Suitable climate ceases to occur for 32 species in summer, potentially resulting in extirpation of those species from the Seashore. Climate is projected to become suitable in summer for 18 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 49, remain stable for 73, and worsen for 59 species. Suitable climate ceases to occur for 24 species in winter, potentially resulting in extirpation from the Seashore. Climate is projected to become suitable in winter for 22 species not found at the Seashore today, potentially resulting in local colonization.

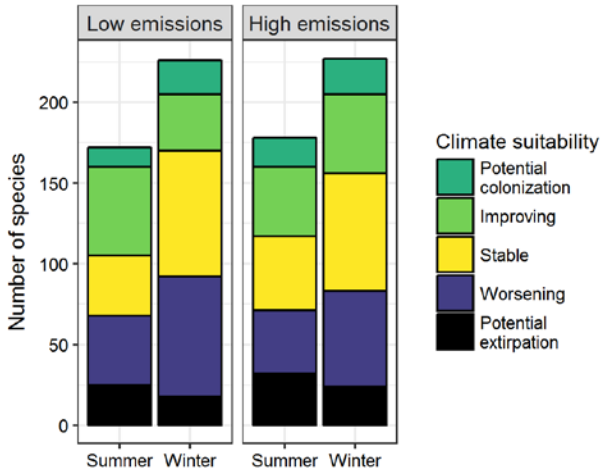

Figure 1. Projected changes in climate suitability for birds at the Seashore, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Seashore between the present and 2050 is 0.19 in summer (30th percentile across all national parks) and 0.10 in winter (8th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.09 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 49 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 41 of these climate-sensitive species, 8 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 American Goldfinch (*Spinus tristis*) through 2050. Photo by John Benson/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, Point Reyes National Seashore 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 41 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	Stable
Cackling/Canada Goose	x	Stable
Mute Swan	x	Improving
Wood Duck	x	Improving*
Gadwall	Potential extirpation^	Stable
Eurasian Wigeon	-	Stable
American Wigeon	Potential extirpation^	Stable
Mallard	Improving^	Worsening
Mottled Duck	Potential colonization	-
Blue-winged Teal	Stable	Improving
Cinnamon Teal	x	Stable
Northern Shoveler	Stable^	Stable
Northern Pintail	Potential extirpation	x
Green-winged Teal	-	Worsening
Canvasback	-	Stable
Ring-necked Duck	-	Stable
Greater Scaup	Stable	Worsening*^
Lesser Scaup	-	Improving
Harlequin Duck	x	Potential extirpation
Surf Scoter	x	Worsening
White-winged Scoter	x	Potential extirpation
Black Scoter	x	Worsening
Long-tailed Duck	Stable	Potential extirpation
Bufflehead	-	Stable
Common Goldeneye	-	Potential extirpation
Barrow's Goldeneye	-	Potential extirpation^
Hooded Merganser	-	Stable^
Common Merganser	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Red-breasted Merganser	Potential extirpation	Stable^
Ruddy Duck	Stable	Stable
Plain Chachalaca	-	Potential colonization
California Quail	Worsening	Worsening
Ring-necked Pheasant	Potential colonization	Potential extirpation
Wild Turkey	x	Stable
Red-throated Loon	Stable	Worsening*
Pacific Loon	Stable	Worsening
Common Loon	Potential extirpation	Stable^
Pied-billed Grebe	x	Improving
Horned Grebe	x	Worsening
Red-necked Grebe	Potential extirpation	Potential extirpation^
Eared Grebe	x	Stable
Western Grebe	x	Stable
Clark's Grebe	x	Worsening
Northern Fulmar	-	Worsening
Black-vented Shearwater	-	Stable
Brandt's Cormorant	x	Worsening
Double-crested Cormorant	x	Stable
Pelagic Cormorant	x	Worsening*
Anhinga	Potential colonization^	-
American White Pelican	x	Stable
Brown Pelican	Improving	Worsening^
American Bittern	-	Improving^
Least Bittern	-	Potential colonization
Great Blue Heron	Improving*	Improving
Great Egret	Improving	Stable
Snowy Egret	x	Stable
Tricolored Heron	Potential colonization^	-

Common Name	Summer Trend	Winter Trend
Reddish Egret	-	Potential colonization
Cattle Egret	-	Improving
Green Heron	Improving*	Improving*
Black-crowned Night-Heron	x	Improving*
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	-
Black Vulture	Improving	-
Turkey Vulture	x	Stable
Osprey	x	Stable
White-tailed Kite	Worsening	Worsening
Golden Eagle	x	Potential extirpation
Northern Harrier	Stable^	Worsening
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Stable	Improving
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Worsening	Improving
Ferruginous Hawk	-	Stable
Rough-legged Hawk	-	Potential extirpation
Virginia Rail	x	Worsening
Sora	x	Worsening
Common Gallinule	x	Improving*
American Coot	x	Stable
Black-necked Stilt	x	Stable
American Avocet	x	Stable^
Black Oystercatcher	x	Worsening*
Black-bellied Plover	x	Stable
Snowy Plover	x	Stable

Common Name	Summer Trend	Winter Trend
Semipalmated Plover	-	Stable^
Killdeer	Improving*	Improving
Spotted Sandpiper	-	Stable
Wandering Tattler	x	Worsening
Greater Yellowlegs	Potential extirpation	Stable
Willet	Stable^	Stable^
Lesser Yellowlegs	Potential extirpation^	-
Whimbrel	x	Improving
Long-billed Curlew	Stable^	Worsening*
Marbled Godwit	Potential extirpation^	Stable
Ruddy Turnstone	-	Stable^
Black Turnstone	x	Worsening*
Red Knot	x	Stable^
Surfbird	x	Worsening*^
Sanderling	x	Stable
Dunlin	x	Worsening^
Least Sandpiper	x	Improving
Western Sandpiper	Stable	Stable
Short-billed Dowitcher	x	Stable^
Long-billed Dowitcher	x	Stable
Wilson's Snipe	-	Stable
Wilson's Phalarope	Stable^	-
Red-necked Phalarope	Stable	-
Common Murre	x	Worsening*
Pigeon Guillemot	Stable	Worsening
Marbled Murrelet	Worsening	Potential extirpation
Ancient Murrelet	x	Worsening
Rhinoceros Auklet	x	Worsening
Bonaparte's Gull	Potential extirpation	Stable
Laughing Gull	-	Improving
Heermann's Gull	x	Worsening

Common Name	Summer Trend	Winter Trend
Mew Gull	-	Stable
Ring-billed Gull	Stable^	Improving*
Western Gull	Stable	Worsening^
California Gull	x	Stable^
Herring Gull	-	Worsening^
Iceland Gull (Thayer's)	-	Worsening*
Glaucous-winged Gull	Improving	Worsening
Gull-billed Tern	-	Potential colonization
Forster's Tern	x	Stable
Black Skimmer	-	Potential colonization^
Rock Pigeon	Improving	Stable
Band-tailed Pigeon	Worsening*	Worsening
Eurasian Collared-Dove	x	Improving*
Mourning Dove	Stable	Improving
Common Ground-Dove	-	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	-	Potential colonization
Barn Owl	x	Worsening
Western Screech-Owl	-	Stable
Great Horned Owl	x	Worsening
Northern Pygmy-Owl	-	Worsening
Burrowing Owl	-	Worsening
Lesser Nighthawk	Potential colonization	Potential colonization
White-throated Swift	x	Stable
Anna's Hummingbird	Stable	Stable
Rufous Hummingbird	Stable	-
Allen's Hummingbird	Worsening^	-
Belted Kingfisher	Worsening	Improving
Acorn Woodpecker	Worsening	Improving
Yellow-bellied Sapsucker	-	Improving
Red-breasted Sapsucker	-	Stable

Common Name	Summer Trend	Winter Trend
Nuttall's Woodpecker	Stable	Stable
Downy Woodpecker	Improving	Potential extirpation
Hairy Woodpecker	Worsening*	Potential extirpation
Northern Flicker	Worsening	Worsening
Pileated Woodpecker	Worsening	Potential extirpation
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Stable
Prairie Falcon	-	Stable
Northern Beardless-Tyrannulet	Potential colonization	-
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Worsening^	-
Eastern Wood-Pewee	Stable	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	-	Improving
Gray Flycatcher	-	Potential colonization
Dusky Flycatcher	Potential colonization	-
Pacific-slope Flycatcher	Worsening*	-
Black Phoebe	Stable	Worsening
Say's Phoebe	-	Worsening
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Worsening*	-
Western Kingbird	Stable	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	Improving	Improving
White-eyed Vireo	Improving	-
Hutton's Vireo	Worsening*^	Worsening
Warbling Vireo	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Philadelphia Vireo	Potential extirpation	-
Red-eyed Vireo	Improving	-
Steller's Jay	Worsening*	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Improving
American Crow	Improving*	Improving
Fish Crow	Potential colonization	-
Common Raven	Worsening	Stable
Horned Lark	Potential extirpation	Stable
Northern Rough-winged Swallow	Improving	Potential colonization
Purple Martin	Worsening	-
Tree Swallow	Improving*	Stable
Violet-green Swallow	Worsening	Stable
Barn Swallow	Potential extirpation	x
Cliff Swallow	Stable	-
Mountain Chickadee	-	Potential colonization
Chestnut-backed Chickadee	Worsening*	Worsening*
Oak Titmouse	Stable	Stable
Bushtit	Stable	Stable
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	-
Pygmy Nuthatch	Worsening	Potential extirpation^
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	Worsening*^	Potential extirpation
Rock Wren	Improving	Improving*
Canyon Wren	-	Potential colonization
House Wren	Stable	Improving*

Common Name	Summer Trend	Winter Trend
Pacific/Winter Wren	Potential extirpation	Worsening
Marsh Wren	x	Worsening
Bewick's Wren	Worsening	Worsening
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving*	Improving*
Black-tailed Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	Potential extirpation	Potential extirpation
Ruby-crowned Kinglet	-	Improving
Wrentit	Worsening	Worsening
Western Bluebird	Stable	Improving
Townsend's Solitaire	Improving^	-
Swainson's Thrush	Worsening	-
Hermit Thrush	Potential extirpation	Improving
American Robin	Potential extirpation	Worsening
Varied Thrush	Potential extirpation^	Worsening*
Gray Catbird	Improving	-
Brown Thrasher	Improving	-
Northern Mockingbird	Improving*	Improving
European Starling	Stable	Improving
American Pipit	-	Stable
Cedar Waxwing	Potential extirpation	Improving*
Phainopepla	Improving	-
Ovenbird	Stable	-
Northern Waterthrush	Stable	-
Black-and-white Warbler	Improving	Potential colonization
Prothonotary Warbler	Improving	-
Swainson's Warbler	Potential colonization	-
Tennessee Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Orange-crowned Warbler	Worsening	Improving*
MacGillivray's Warbler	Potential extirpation	-
Mourning Warbler	Stable	-
Common Yellowthroat	Improving*	Improving*
Hooded Warbler	Improving	-
American Redstart	Improving	-
Cape May Warbler	Potential extirpation	-
Northern Parula	Improving	Potential colonization
Magnolia Warbler	Potential extirpation	-
Bay-breasted Warbler	Potential extirpation	-
Yellow Warbler	Improving	-
Chestnut-sided Warbler	Improving	-
Blackpoll Warbler	Potential extirpation	-
Palm Warbler	-	Stable^
Pine Warbler	Potential colonization^	-
Yellow-rumped Warbler	Stable	Improving
Yellow-throated Warbler	Improving	-
Black-throated Gray Warbler	Potential extirpation	-
Townsend's Warbler	-	Worsening
Hermit Warbler	Worsening	Worsening^
Black-throated Green Warbler	Improving	-
Wilson's Warbler	Worsening*	Improving*
Yellow-breasted Chat	Improving*	-
Spotted Towhee	Worsening	x
Rufous-crowned Sparrow	x	Stable
California Towhee	Worsening	Stable
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Brewer's Sparrow	Stable	-
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential extirpation	Improving*
Sagebrush/Bell's Sparrow (Sage Sparrow)	Improving^	Worsening
Savannah Sparrow	Potential extirpation	Improving
Grasshopper Sparrow	Improving*	Potential colonization
LeConte's Sparrow	-	Stable
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Stable^
Fox Sparrow	-	Worsening
Song Sparrow	Worsening	Stable
Lincoln's Sparrow	Potential extirpation	Stable
Swamp Sparrow	-	Potential extirpation
White-throated Sparrow	-	Potential extirpation
Harris's Sparrow	-	Stable
White-crowned Sparrow	Stable	Stable
Golden-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Worsening
Western Tanager	Worsening*	-
Rose-breasted Grosbeak	Improving	-
Black-headed Grosbeak	Worsening	-

Common Name	Summer Trend	Winter Trend
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Indigo Bunting	Improving	Potential colonization
Red-winged Blackbird	Improving*	Worsening
Tricolored Blackbird	Stable	Worsening*
Western Meadowlark	Worsening	Worsening
Brewer's Blackbird	Stable	Stable
Boat-tailed Grackle	Potential colonization^	-
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Stable	Improving
Hooded Oriole	Improving	-
Bullock's Oriole	Worsening	-
House Finch	Stable	Improving
Purple Finch	Worsening*	Potential extirpation
Red Crossbill	Stable^	x
Pine Siskin	Worsening*	Potential extirpation
Lesser Goldfinch	Stable	Improving
American Goldfinch	Improving*	Improving
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Improving