



Lake Mead National Recreation Area

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 Lake Mead National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area, with climate suitability projected to improve for some species and worsen for others (Figure 1). Among the species likely to be found at the Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 39, remain stable for 39 (e.g., Figure 2), and worsen for 1 species. Suitable climate ceases to occur for 4 species in summer, potentially resulting in extirpation of those species from the Recreation Area. Climate is projected to become suitable in summer for 6 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 29, remain stable for 55, and worsen for 46 species. Suitable climate ceases to occur for 17 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 34 species not found at the Recreation Area 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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.

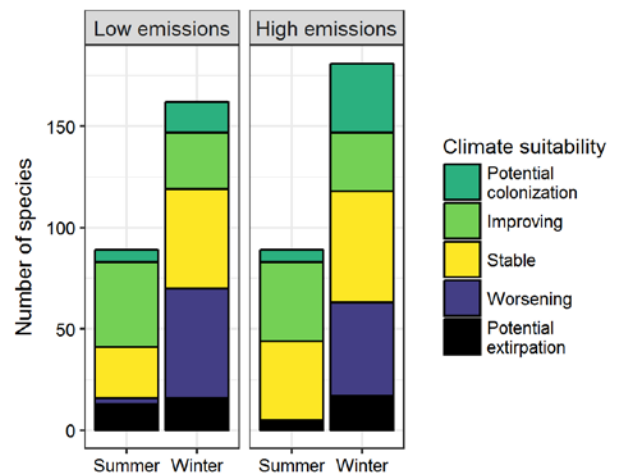


Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Recreation Area between the present and 2050 is 0.08 in summer (7th percentile across all national parks) and 0.13 in winter (13th percentile) under the high-emissions pathway. Potential species turnover increases to 0.09 in summer and declines to 0.07 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 Recreation Area is or may become home to 32 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.

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Lake Mead National Recreation Area 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

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

2015). While the Recreation Area may serve as an important refuge for 29 of these climate-sensitive species, 3 might be extirpated from the Recreation Area in at least one season by 2050.



Figure 2. Climate at the Recreation Area in summer is projected to remain suitable for the Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

other stressors. Furthermore, park managers have an opportunity to focus on supporting the 29 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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
Cackling/Canada Goose	x	Potential extirpation
Muscovy Duck	-	Potential colonization
Wood Duck	x	Stable
Gadwall	Stable^	Worsening
American Wigeon	-	Stable
Mallard	Improving^	Potential extirpation
Cinnamon Teal	x	Worsening
Northern Shoveler	Stable^	Stable
Green-winged Teal	x	Improving
Canvasback	-	Stable
Redhead	Improving^	x
Ring-necked Duck	-	Improving
Greater Scaup	-	Worsening^
Lesser Scaup	-	Worsening
Surf Scoter	-	Improving

Common Name	Summer Trend	Winter Trend
White-winged Scoter	-	Stable
Long-tailed Duck	-	Potential colonization
Bufflehead	-	Stable
Common Goldeneye	-	Worsening
Barrow's Goldeneye	-	Improving*^
Hooded Merganser	-	Stable^
Common Merganser	x	Worsening
Red-breasted Merganser	-	Improving*^
Ruddy Duck	Improving	Stable
Gambel's Quail	Improving*	Improving
Greater Sage-Grouse	-	Potential colonization^
Wild Turkey	x	Stable
Red-throated Loon	-	Stable
Pacific Loon	-	Improving
Common Loon	Stable	Worsening*^
Pied-billed Grebe	x	Worsening

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Improving*
Red-necked Grebe	-	Improving^
Eared Grebe	x	Worsening
Western Grebe	x	Stable
Clark's Grebe	x	Stable
Double-crested Cormorant	x	Worsening
American White Pelican	x	Stable
Brown Pelican	Improving	Potential colonization^
Great Blue Heron	Stable	Worsening
Great Egret	Stable	Worsening*
Snowy Egret	x	Stable
Reddish Egret	-	Potential colonization
Cattle Egret	Stable	-
Green Heron	Stable	Worsening
Black-crowned Night-Heron	x	Worsening*
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	-	Potential colonization
White-faced Ibis	x	Stable^
Turkey Vulture	x	Improving*
Osprey	x	Stable
Golden Eagle	-	Worsening
Northern Harrier	Stable^	Worsening
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	-	Worsening
Bald Eagle	-	Improving
Harris's Hawk	-	Potential colonization
Red-shouldered Hawk	-	Potential extirpation
Red-tailed Hawk	Improving	Worsening
Ferruginous Hawk	-	Stable
Rough-legged Hawk	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Virginia Rail	x	Stable
Sora	x	Worsening
Common Gallinule	-	Improving
American Coot	x	Worsening
Limpkin	-	Potential colonization
Black-necked Stilt	x	Potential colonization
American Avocet	x	Stable^
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	Stable	Worsening
Spotted Sandpiper	x	Stable
Wandering Tattler	-	Potential colonization
Greater Yellowlegs	Stable	Stable
Willet	Stable^	Potential colonization^
Lesser Yellowlegs	Stable^	Potential colonization
Whimbrel	-	Potential colonization
Long-billed Curlew	Stable^	-
Marbled Godwit	Potential extirpation^	Potential colonization
Least Sandpiper	-	Stable
Western Sandpiper	-	Stable
Short-billed Dowitcher	-	Potential colonization^
Long-billed Dowitcher	x	Stable
Wilson's Snipe	-	Worsening
Wilson's Phalarope	Improving^	-
Bonaparte's Gull	-	Improving
Laughing Gull	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Mew Gull	-	Stable
Ring-billed Gull	Potential extirpation [^]	Worsening*
California Gull	x	Worsening* [^]
Herring Gull	-	Potential extirpation [^]
Iceland Gull (Thayer's)	-	Improving
Glaucous-winged Gull	-	Stable
Royal Tern	-	Potential colonization [^]
Sandwich Tern	-	Potential colonization [^]
Black Skimmer	-	Potential colonization [^]
Rock Pigeon	Stable	Potential extirpation
White-crowned Pigeon	Potential colonization	-
Eurasian Collared-Dove	x	Improving*
White-winged Dove	Improving*	Improving
Mourning Dove	Stable	Stable
Inca Dove	Stable	Improving*
White-tipped Dove	Potential colonization	-
Greater Roadrunner	Improving*	Stable
Barn Owl	x	Potential extirpation
Great Horned Owl	x	Potential extirpation
Burrowing Owl	Improving [^]	Worsening
Lesser Nighthawk	Improving*	-
White-throated Swift	x	Stable
Black-chinned Hummingbird	Improving	-
Anna's Hummingbird	Stable	Improving*
Costa's Hummingbird	Stable	Improving*
Allen's Hummingbird	-	Potential colonization
Belted Kingfisher	-	Worsening
Red-naped Sapsucker	-	Improving*

Common Name	Summer Trend	Winter Trend
Ladder-backed Woodpecker	Stable	Improving*
Northern Flicker	Stable	Worsening
American Kestrel	x	Worsening
Merlin	-	Worsening [^]
Peregrine Falcon	x	Stable
Prairie Falcon	x	Worsening*
Northern Beardless-Tyrannulet	Potential colonization	-
Western Wood-Pewee	Stable [^]	-
Willow Flycatcher	Improving	-
Black Phoebe	Stable	Improving*
Say's Phoebe	Improving*	Improving
Vermilion Flycatcher	Potential colonization	Improving*
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	Improving	-
Western Kingbird	Improving	-
Loggerhead Shrike	Improving	Worsening
Bell's Vireo	Improving	-
Hutton's Vireo	-	Potential colonization
Black-whiskered Vireo	Potential colonization	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Worsening
American Crow	-	Potential extirpation
Common Raven	Stable	Stable
Horned Lark	Stable	Potential extirpation
Northern Rough-winged Swallow	Stable	Stable
Tree Swallow	Potential extirpation	Stable
Violet-green Swallow	Stable	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
Juniper Titmouse	Potential colonization	-
Verdin	Improving	Improving
Bushtit	-	Stable
Pygmy Nuthatch	-	Potential colonization^
Rock Wren	Improving	Stable
Canyon Wren	x	Stable
House Wren	-	Potential extirpation
Marsh Wren	x	Stable
Bewick's Wren	Stable	Worsening*
Cactus Wren	Stable	Worsening*
Blue-gray Gnatcatcher	Improving	Stable
Black-tailed Gnatcatcher	Improving*	Stable
Ruby-crowned Kinglet	Stable	Worsening
Western Bluebird	-	Stable
Mountain Bluebird	-	Stable
Hermit Thrush	Improving	Potential extirpation
American Robin	Potential extirpation	Potential extirpation
Gray Catbird	-	Potential colonization
LeConte's Thrasher	-	Stable
Crissal Thrasher	Improving*	Worsening
Sage Thrasher	-	Improving
Northern Mockingbird	Improving	Worsening
European Starling	Stable	Stable
American Pipit	-	Worsening
Cedar Waxwing	-	Potential extirpation
Phainopepla	Improving	Stable
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	-	Stable
Lucy's Warbler	Improving	-

Common Name	Summer Trend	Winter Trend
Common Yellowthroat	Stable	Stable
Northern Parula	-	Potential colonization
Yellow Warbler	Improving	-
Yellow-rumped Warbler	-	Worsening
Townsend's Warbler	-	Potential colonization
Yellow-breasted Chat	Improving	-
Olive Sparrow	-	Potential colonization
Green-tailed Towhee	-	Improving
Spotted Towhee	Improving	x
Abert's Towhee	Improving	Stable
Chipping Sparrow	Stable	Stable
Brewer's Sparrow	-	Improving*
Black-throated Sparrow	Worsening*	Stable
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Stable
Savannah Sparrow	-	Worsening
Grasshopper Sparrow	-	Potential colonization
Song Sparrow	Stable	Worsening
Lincoln's Sparrow	-	Worsening*
White-crowned Sparrow	-	Worsening
Dark-eyed Junco	x	Potential extirpation
Western Tanager	-	Potential colonization
Blue Grosbeak	Improving	-
Red-winged Blackbird	Improving*	Worsening
Eastern Meadowlark	-	Potential colonization
Western Meadowlark	Stable	Worsening*
Yellow-headed Blackbird	Stable	x
Brewer's Blackbird	Improving	Stable
Great-tailed Grackle	Improving	Improving
Brown-headed Cowbird	Improving	Worsening*

Common Name	Summer Trend	Winter Trend
Bullock's Oriole	Improving*	-
Scott's Oriole	Improving	-
House Finch	Stable	Stable
Pine Siskin	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Lesser Goldfinch	Improving	Stable
American Goldfinch	-	Potential extirpation
House Sparrow	x	Stable