

## Lassen Volcanic National Park

### 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 Lassen Volcanic National Park (hereafter, the Park) 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.

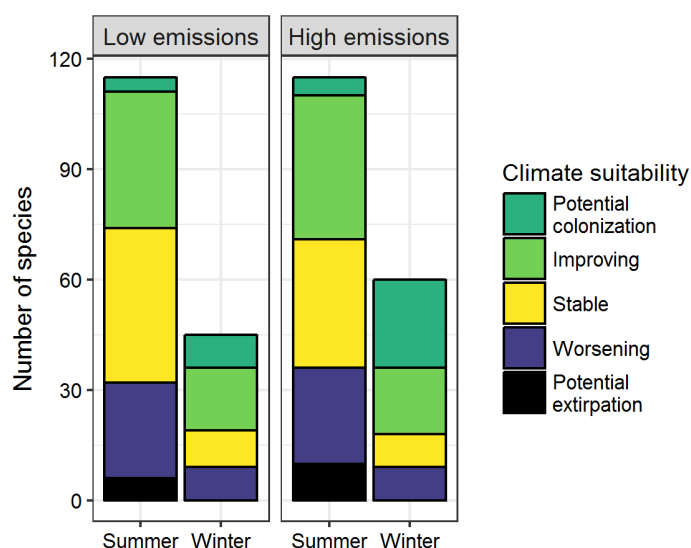
#### Important

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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park 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 Park, 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 Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 39, remain stable for 35 (e.g., Figure 2), and worsen for 26 species. Suitable climate ceases to occur for 10 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 5 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 18, remain stable for 9, and worsen for 9 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 24 species not found at the Park today, potentially resulting in local colonization.



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

## Results (continued)

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### Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.15 in summer (21<sup>st</sup> percentile across all national parks) and 0.18 in winter (23<sup>rd</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 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 Park is or may become home to 16 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 Park

may serve as an important refuge for 13 of these climate-sensitive species, 3 might be extirpated from the Park in at least one season by 2050.



**Figure 2. Climate at the Park in summer is projected to remain suitable for the Chipping Sparrow (*Spizella passerina*) through 2050.** Photo by Fyn Kynd/Flickr (CC BY 2.0).

## 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, Lassen Volcanic National Park 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. Furthermore, park managers have an opportunity to focus on supporting the 13 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

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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 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

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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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park 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	Improving
Wood Duck	x	Potential colonization
Gadwall	Stable^	-
American Wigeon	Potential extirpation^	-
Mallard	Stable^	Improving
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Bufflehead	x	Stable
Ruddy Duck	Stable	-
Mountain Quail	Worsening*	Stable
California Quail	Stable	-
Gambel's Quail	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Ring-necked Pheasant	Improving*	Potential colonization
Wild Turkey	x	Potential colonization
Pied-billed Grebe	x	Improving
Horned Grebe	-	Potential colonization
Great Blue Heron	Improving	-
Great Egret	Stable	Potential colonization
Black-crowned Night-Heron	x	Potential colonization
White-tailed Kite	-	Potential colonization
Northern Harrier	Stable^	-
Red-shouldered Hawk	Improving	-
Red-tailed Hawk	Improving	-

Common Name	Summer Trend	Winter Trend
Sora	x	Potential colonization
American Coot	x	Improving
Killdeer	Improving	Improving
Wilson's Snipe	Potential extirpation	-
Wilson's Phalarope	Potential extirpation^	-
Band-tailed Pigeon	Stable	-
Mourning Dove	Stable	Potential colonization
Common Nighthawk	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Anna's Hummingbird	Worsening	Improving
Rufous Hummingbird	Improving	-
Calliope Hummingbird	Worsening	-
Belted Kingfisher	Improving	Improving
Acorn Woodpecker	Stable	-
Red-naped Sapsucker	Potential extirpation^	-
Red-breasted Sapsucker	Worsening*	Stable
Nuttall's Woodpecker	Worsening	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Stable	Stable
White-headed Woodpecker	Worsening^	Worsening*
Northern Flicker	Worsening	Improving
Pileated Woodpecker	Improving	Improving*
Merlin	-	Potential colonization^
Olive-sided Flycatcher	Worsening*	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Improving	-
Hammond's Flycatcher	Stable	-
Gray Flycatcher	Stable	-

Common Name	Summer Trend	Winter Trend
Dusky Flycatcher	Worsening*	-
Pacific-slope Flycatcher	Stable	-
Black Phoebe	Worsening	-
Say's Phoebe	-	Potential colonization
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Stable	-
Hutton's Vireo	Stable^	Potential colonization
Warbling Vireo	Stable	-
Gray Jay	Potential extirpation	-
Steller's Jay	Worsening	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving*	-
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Improving*	-
Common Raven	Stable	Worsening
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Improving*	-
Violet-green Swallow	Improving*	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Mountain Chickadee	Worsening*	Worsening
Bushtit	Improving	-
Red-breasted Nuthatch	Worsening	Worsening
White-breasted Nuthatch	Improving	Improving
Pygmy Nuthatch	Stable	Worsening**
Brown Creeper	Worsening**	Worsening
Rock Wren	Worsening	-
House Wren	Improving*	-
Bewick's Wren	Improving	-

Common Name	Summer Trend	Winter Trend
Blue-gray Gnatcatcher	Improving	-
American Dipper	x	Worsening*
Golden-crowned Kinglet	Worsening*	Stable
Ruby-crowned Kinglet	Stable	Improving
Western Bluebird	Stable	-
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Worsening**	Worsening
Swainson's Thrush	Improving	-
Hermit Thrush	Stable	Potential colonization
American Robin	Worsening	Improving
Crissal Thrasher	Potential colonization	Potential colonization
European Starling	Improving*	Potential colonization
Cedar Waxwing	Improving	-
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Improving	-
Nashville Warbler	Stable	-
MacGillivray's Warbler	Stable	-
Common Yellowthroat	Improving	-
Yellow Warbler	Improving	-
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Improving*	-
Townsend's Warbler	-	Potential colonization
Hermit Warbler	Stable	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	Worsening**	-

Common Name	Summer Trend	Winter Trend
Spotted Towhee	Improving*	x
California Towhee	Stable	-
Chipping Sparrow	Stable	-
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	Potential colonization
Savannah Sparrow	Potential extirpation	-
Fox Sparrow	Worsening*	Potential colonization
Song Sparrow	Improving*	Improving
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Worsening	-
Dark-eyed Junco	x	Improving
Western Tanager	Worsening	-
Black-headed Grosbeak	Improving*	-
Lazuli Bunting	Improving	-
Red-winged Blackbird	Improving	Improving*
Western Meadowlark	Stable	-
Brewer's Blackbird	Stable	Improving
Brown-headed Cowbird	Stable	-
Bullock's Oriole	Improving	-
House Finch	Improving	Potential colonization
Purple Finch	Stable	Potential colonization
Cassin's Finch	Worsening*	Stable
Red Crossbill	Worsening*	x
Pine Siskin	Stable	Stable
Lesser Goldfinch	Improving	-
American Goldfinch	Improving	-
Evening Grosbeak	Worsening	Stable