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## Using Citizen Science to Examine the Range Expansion of Bewick's Wren and Lesser Goldfinch into Idaho

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### Abstract

Animal species are known to change or expand their range in order to adapt to changes in habitat, niche, or climate. Since thorough record keeping began in the 1970's multiple species without historical ranges in Idaho have begun occurring in increasing abundance within the state. Here we examine the range expansion of two passerine species: Bewick's Wren (*Thyromanes bewickii*) and Lesser Goldfinch (*Spinus psaltria*). We reviewed records from the Idaho Bird Records Committee and eBird to investigate the range and relative abundance of the two species within Idaho. We found that both species have expanded their range into Idaho significantly since 1990 and the relative abundance is growing at an increasing rate. We tested hypotheses for the cause of this range expansion including habitat change, change in realized niche, and change in climate and weather patterns. Citizen science projects such as eBird, which was used for this investigation, are increasingly accessible and important for future conservation.



# Using Citizen Science to Examine the Range Expansion of Bewick's Wren and Lesser Goldfinch Into Idaho



BOISE STATE UNIVERSITY

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## INTRODUCTION

- Bewick's Wren (*Thryomanes bewickii*; Below) and Lesser Goldfinch (*Spinus psaltria*; Right) are polytypic, primarily non-migratory passerines (Order: Passeriformes) whose historical range did not include Idaho.<sup>1</sup>
- Both species have distinct populations and have primarily seen expansion in the subspecies occurring in regions with cooler climates and lush vegetation.<sup>1</sup>
- Both species have expanded East from Oregon (Fig. 1 and 2) and more recently from the South and Southeast.<sup>1</sup>
- Both species have increased in relative abundance within Idaho throughout the last decade.
- Here we compare population growth data from eBird with climate data from NOAA to investigate correlation between shifts in Bewick's Wren and Lesser Goldfinch populations and potential causal factors such as climate change.

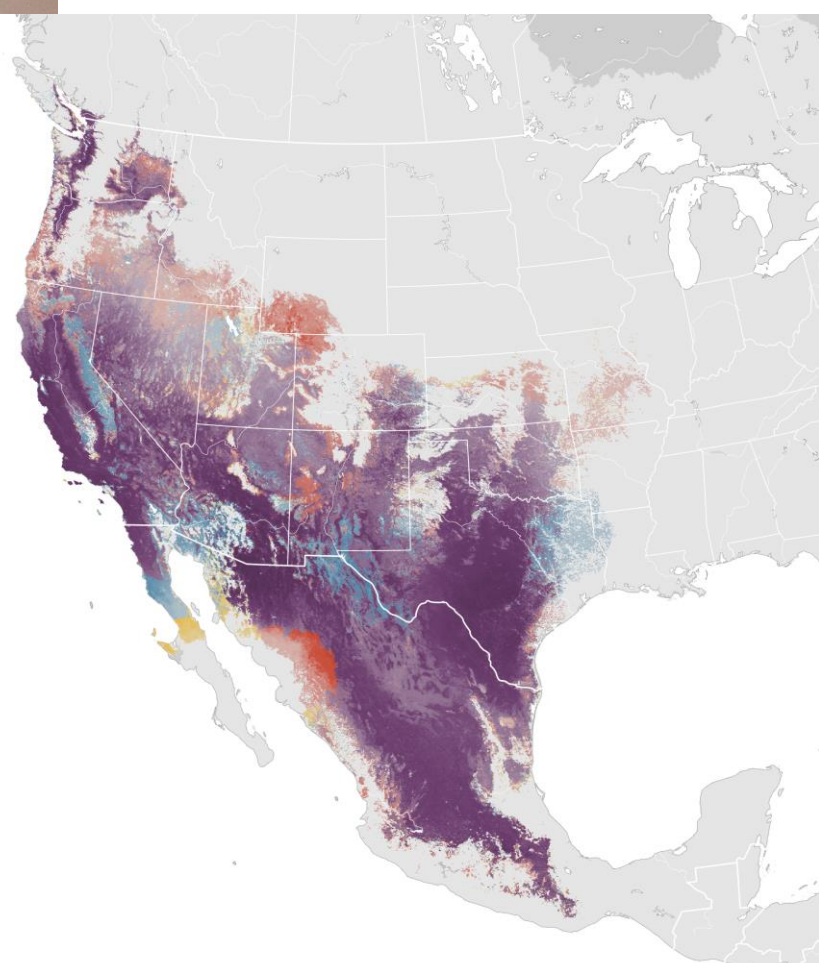
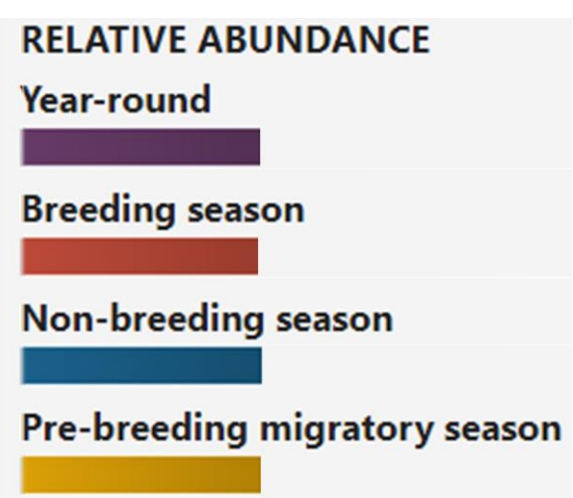


Fig. 1. Seasonally-averaged estimated relative abundance of Bewick's Wren across its range based on eBird data 2014-18<sup>1</sup>

## Methods and Findings

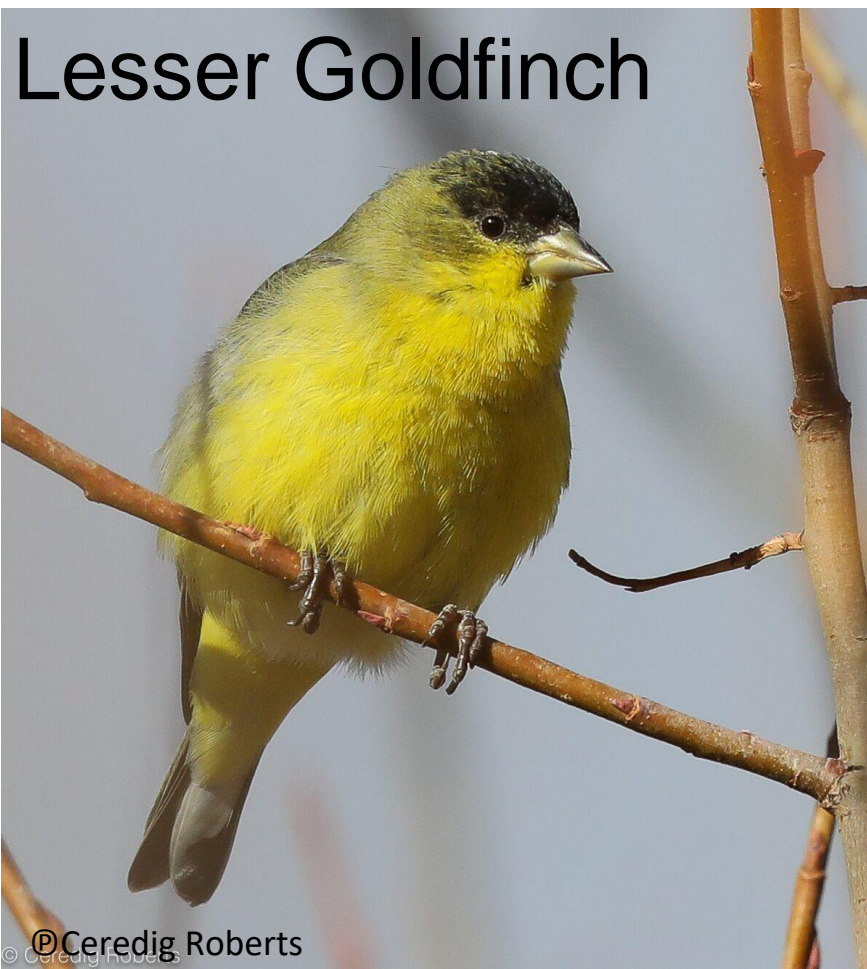
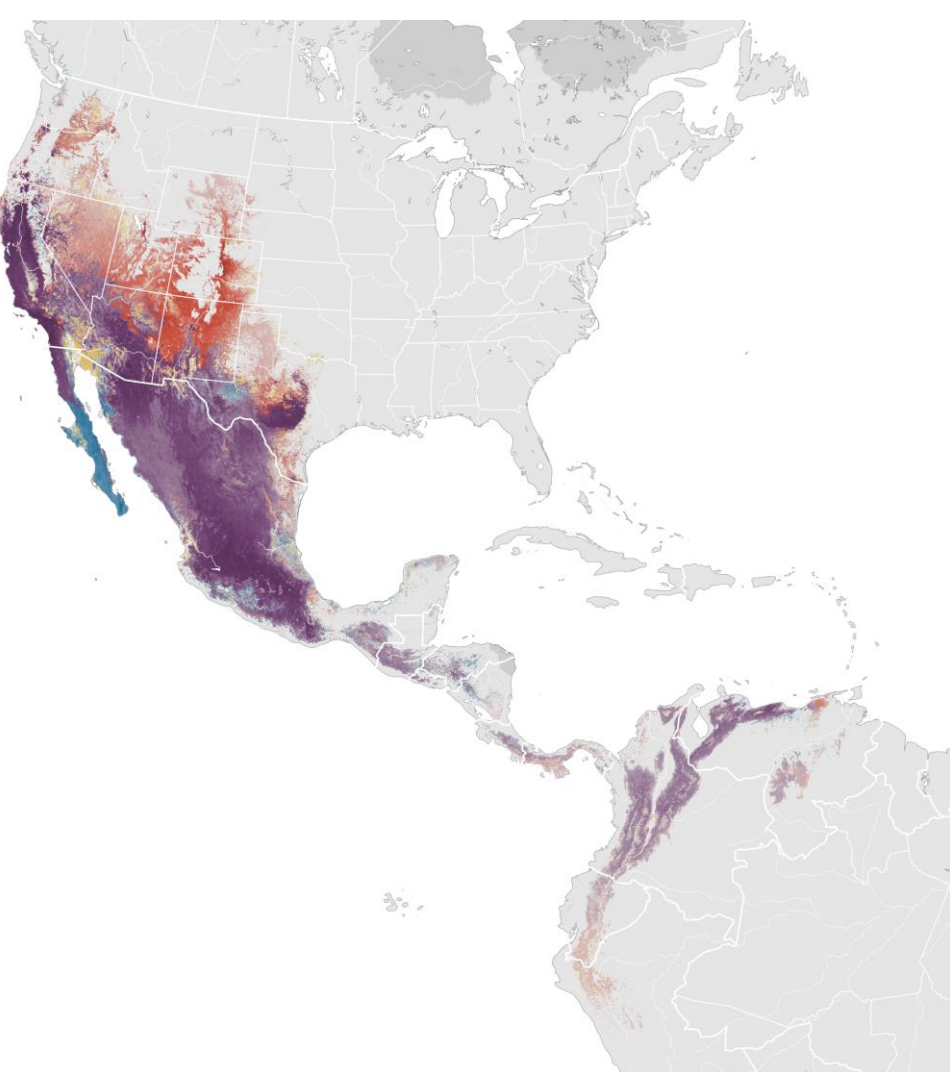


Fig. 2. Seasonally-averaged estimated relative abundance of Lesser Goldfinch across its range based on eBird data 2014-18<sup>1</sup>



## Methods

We calculated an index of relative abundance of Bewick's Wren and Lesser Goldfinch from the eBird Basic Dataset corrected for total effort data in Idaho from 1977 to present. We used exponential trendlines to visualize the rapid and exponential increase in abundance throughout the state.

eBird is the largest biodiversity-related citizen science project in the world with over 100 million sightings reported each year and is run by the Cornell Lab of Ornithology.

We then plotted historical climate data from the AgACIS database of NOAA Regional Climate Centers and the Boise Air Terminal including minimum, maximum, and average temperatures as well as yearly precipitation from 1976 to 2019.

We then visually compared trends in relative abundance to trends in climate data to investigate potential correlations.

## Results

- Both species populations have grown exponentially in Idaho since 1999 (Fig. 3).
- Climate data has shown only gradual change over the same period of time (Fig. 4, 5, and 6).

## Data

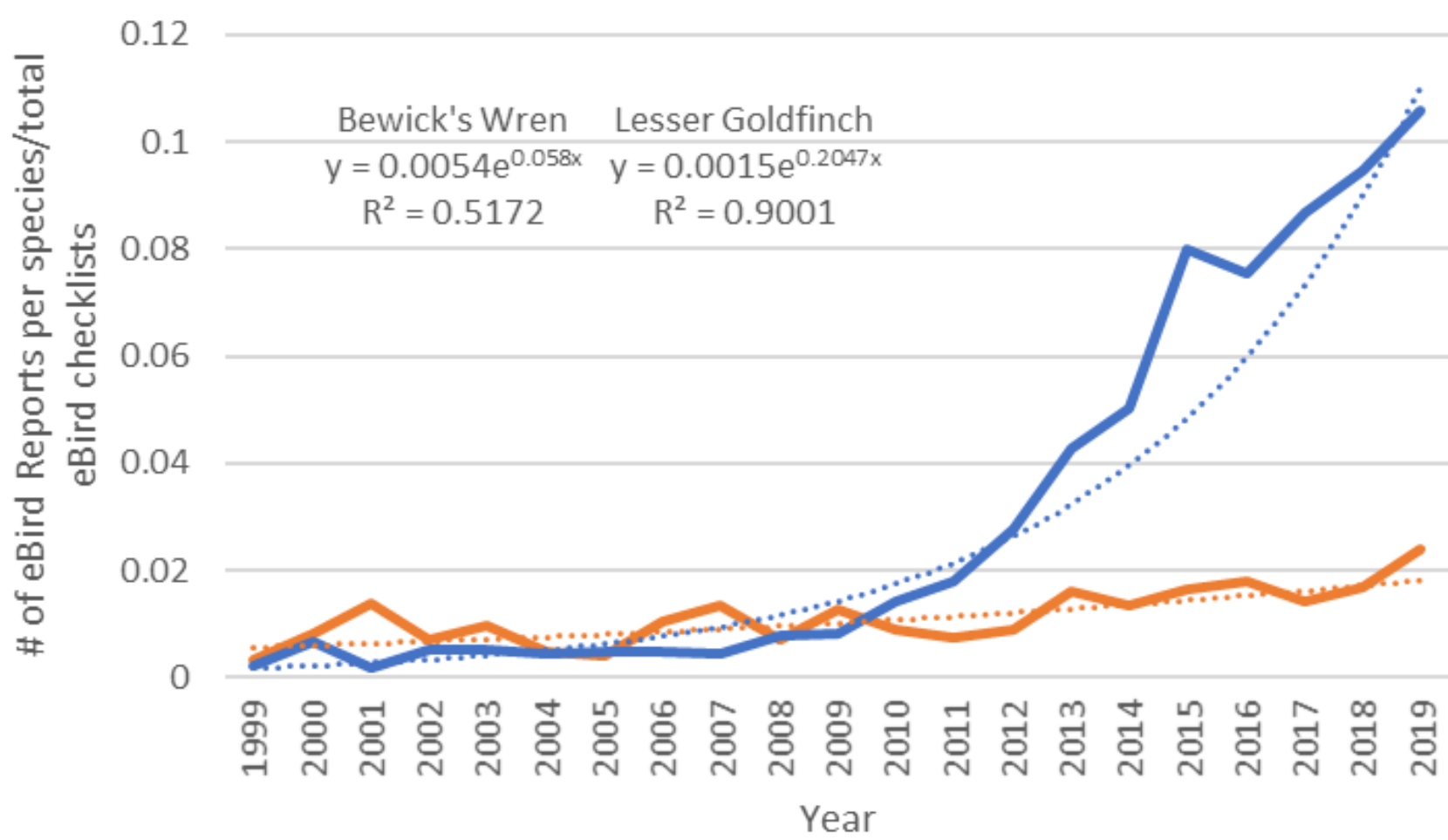


Fig. 3: Index of Bewick's Wren (orange) and Lesser Goldfinch (blue) abundance in Idaho. To correct for varying levels of annual effort, an index was calculated using the number of eBird reports for each species per the total number of eBird checklists submitted each year. Abundance of both species has increased exponentially in the state since the early 2000's. Lesser Goldfinch  $R^2=0.9001$ , Bewick's Wren  $R^2=0.5172$

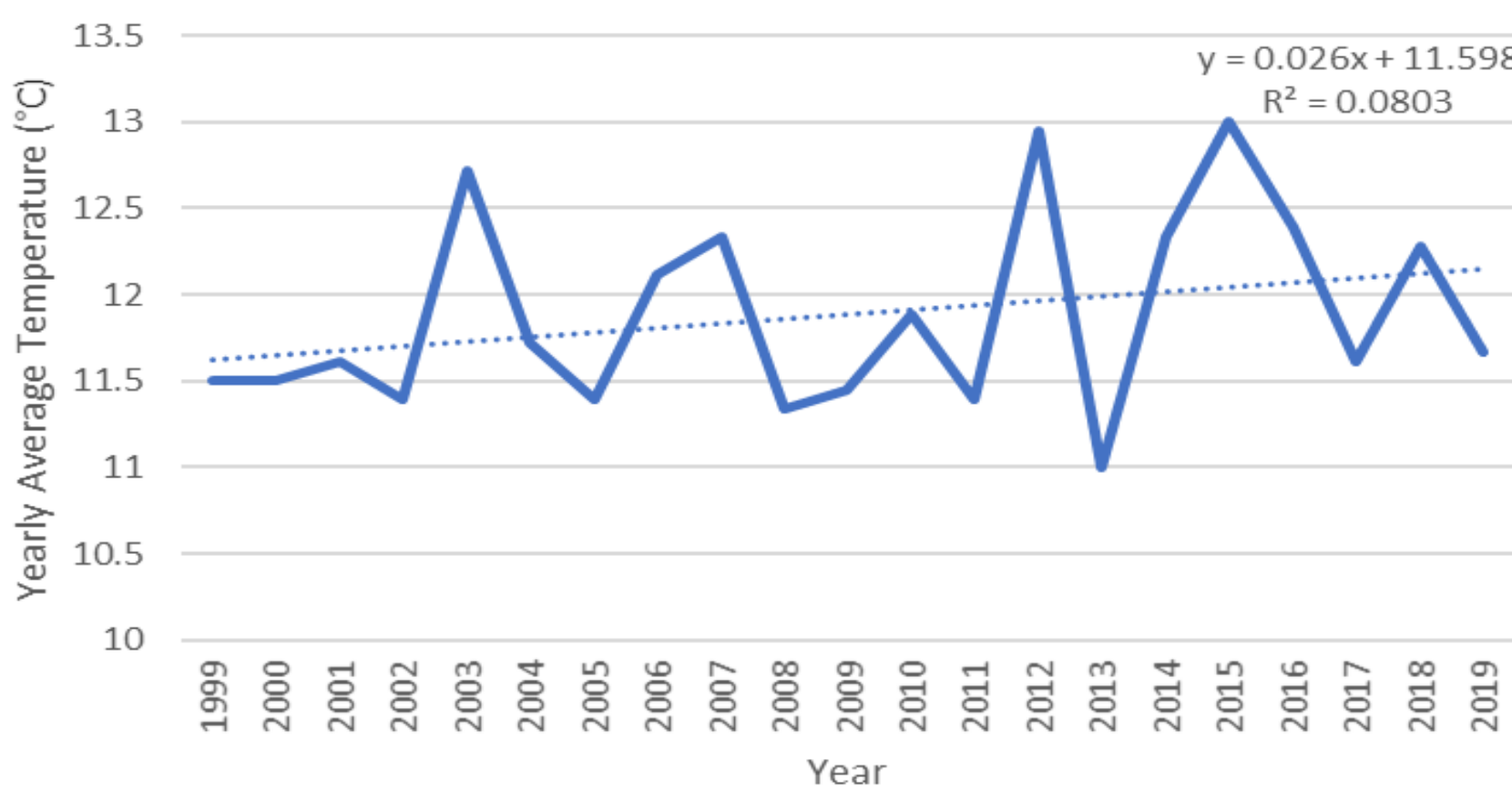


Fig. 4: Yearly average temperature (°C) measured at the Boise Air Terminal NOAA Regional Climate Center between 1999 and 2019. The 20 year trend shows a weak ( $R^2=0.0803$ ) increase in maximum temperature

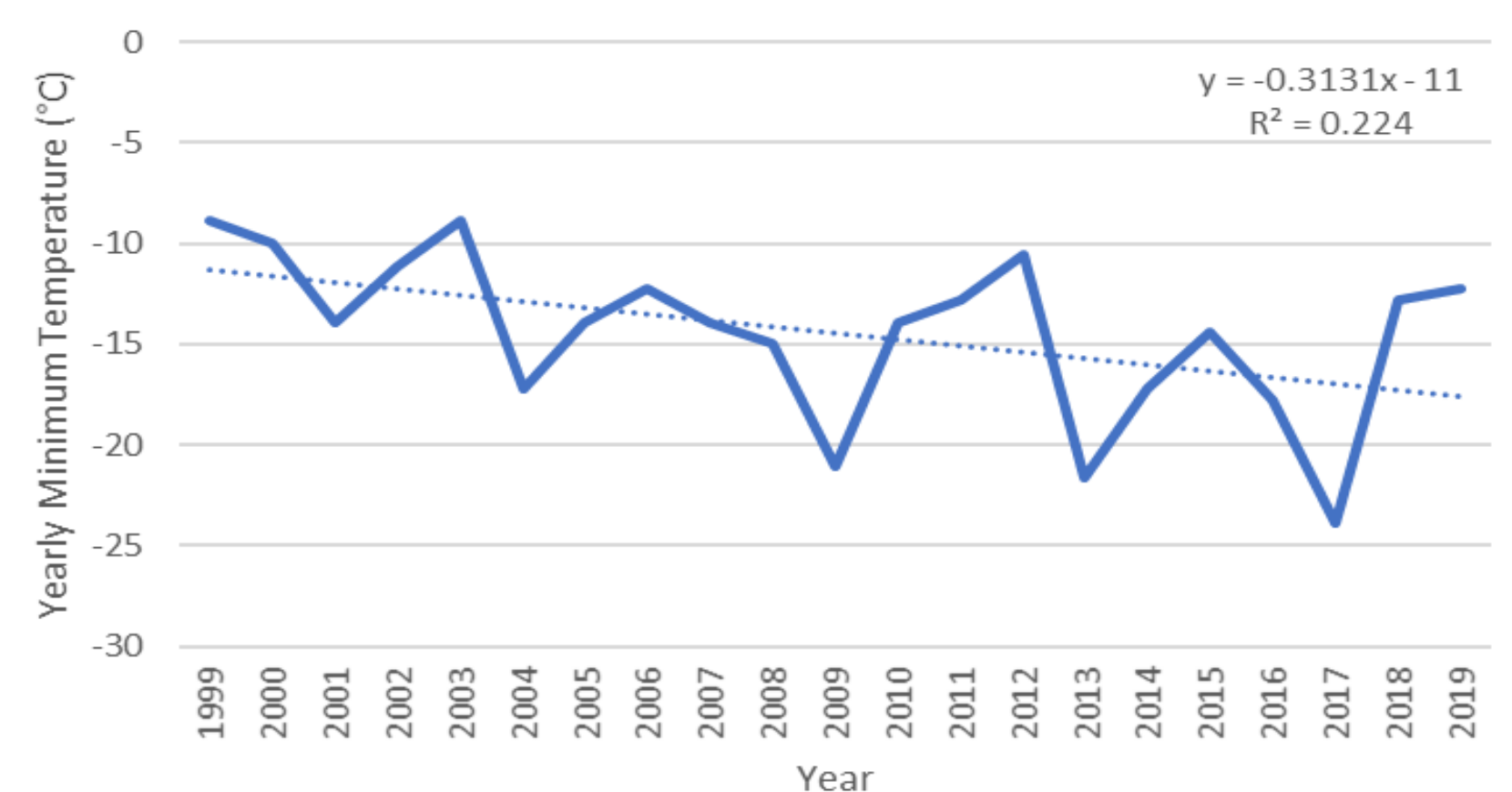


Fig. 5: Yearly minimum temperature (°C) measured at the Boise Air Terminal NOAA Regional Climate Center between 1999 and 2019. The 20 year trend shows a moderate ( $R^2=0.224$ ) decrease in minimum temperature.

## CONCLUSIONS

- Although both average temperature and total annual precipitation have increased in Idaho (Fig. 4 and 6), these changes are more gradual and do not appear to explain changes in species abundance.
- In support of our preliminary investigation, previous research on a species with similar population changes, Anna's Hummingbirds (*Calypte anna*), also found that climate change alone was not enough to explain the rate of range expansion<sup>2</sup>. Greig et al. found that Anna's range expansion is likely due to a combination of climate change, urbanization, and supplemental feeding<sup>2</sup>.
- Further investigations should include analysis of changes in habitat and realized niche within the expanded range.
- eBird and other citizen science projects such as Project Feederwatch allow us to examine trends in avian species that would be otherwise impossible.<sup>3</sup>

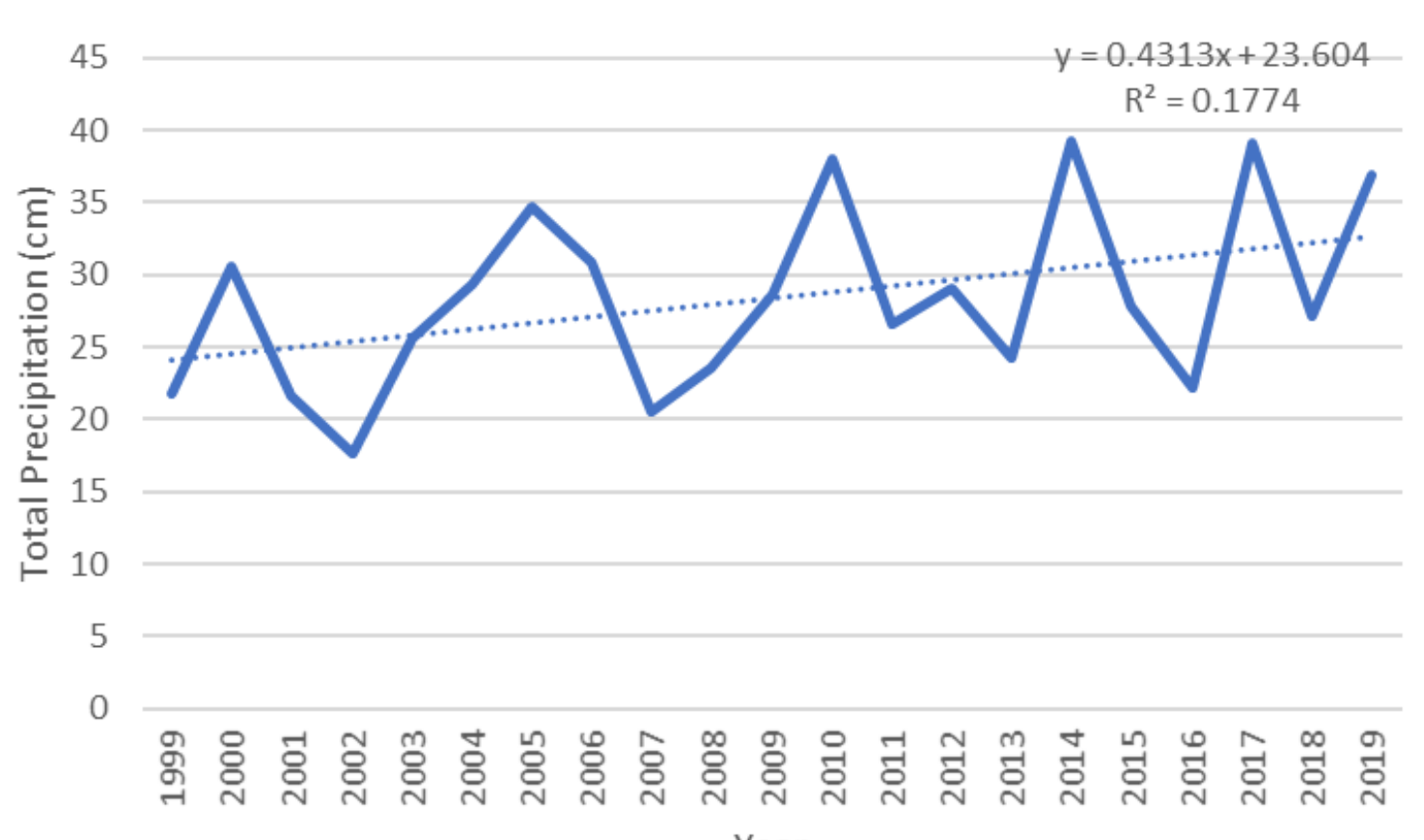


Fig. 6: Total Precipitation (cm) measured at the Boise Air Terminal NOAA Regional Climate Center between 1999 and 2019. The 20 year trend shows a slight ( $R^2= 0.1774$ ) increase in total precipitation

### Literature Cited:

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3. Jobidon, and Rodolphe, D.A. (2014). Wrens on the edge: factors predict Carolina wren, *Thryomanes ludovicianus* abundance at the northern edge of their range. Journal of Avian Biology. 42: 16-24. doi:10.1111/j.1369-048X.2010.05242.x