



*Ron Larson photo*

# Mono Lake and phalaropes: past, present, and future

California State Water Resources Control Board Workshop  
June 25th, 2026  
By Ryan Carle, Science Director  
Oikonos Ecosystem Knowledge



## Phalaropes at Mono Lake

Much of our info about phalaropes at Mono Lake comes from Dr. Joseph Jehl Jr. and Dr. Margaret Rubega's work in the 1980s and 1990s

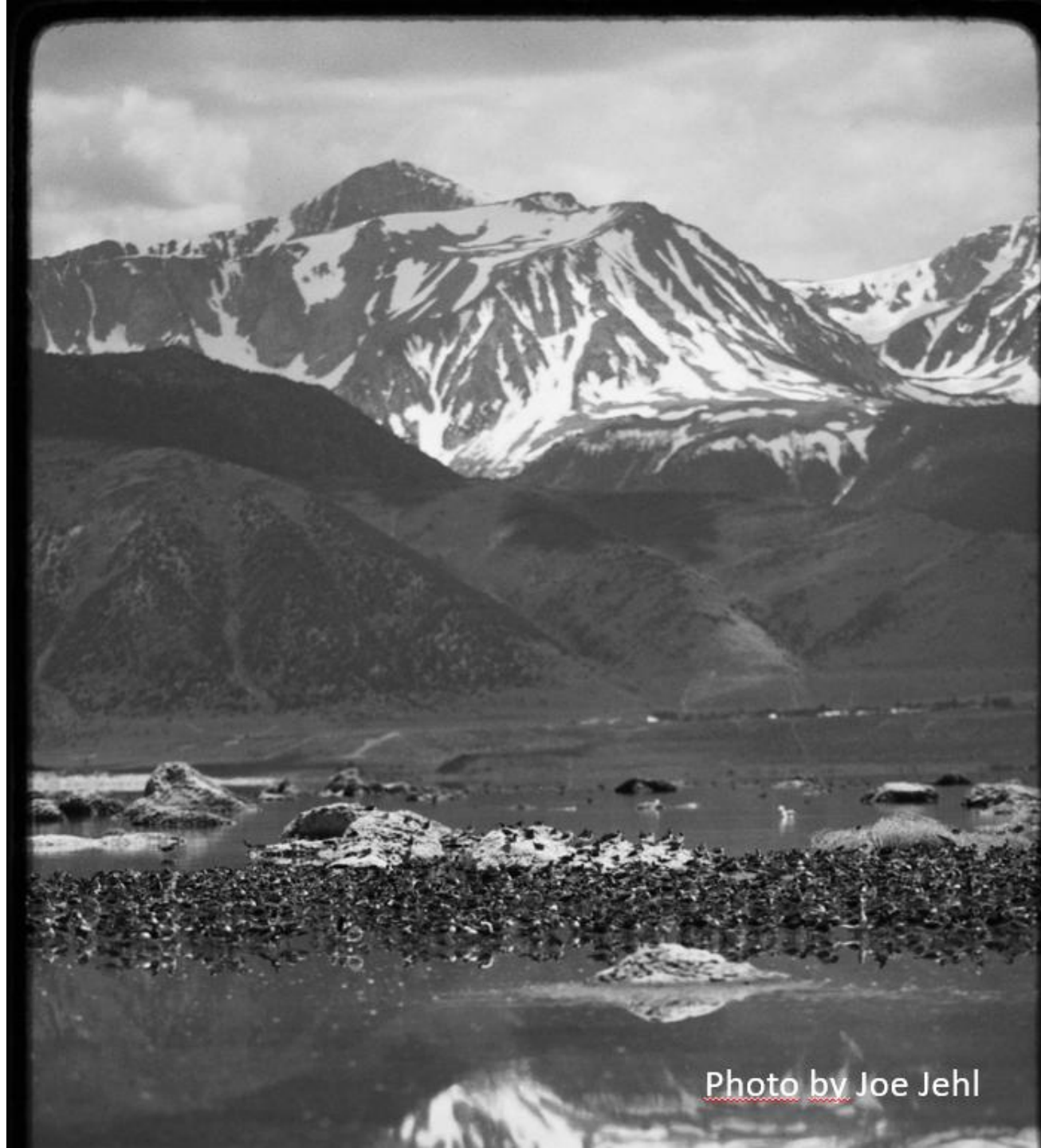
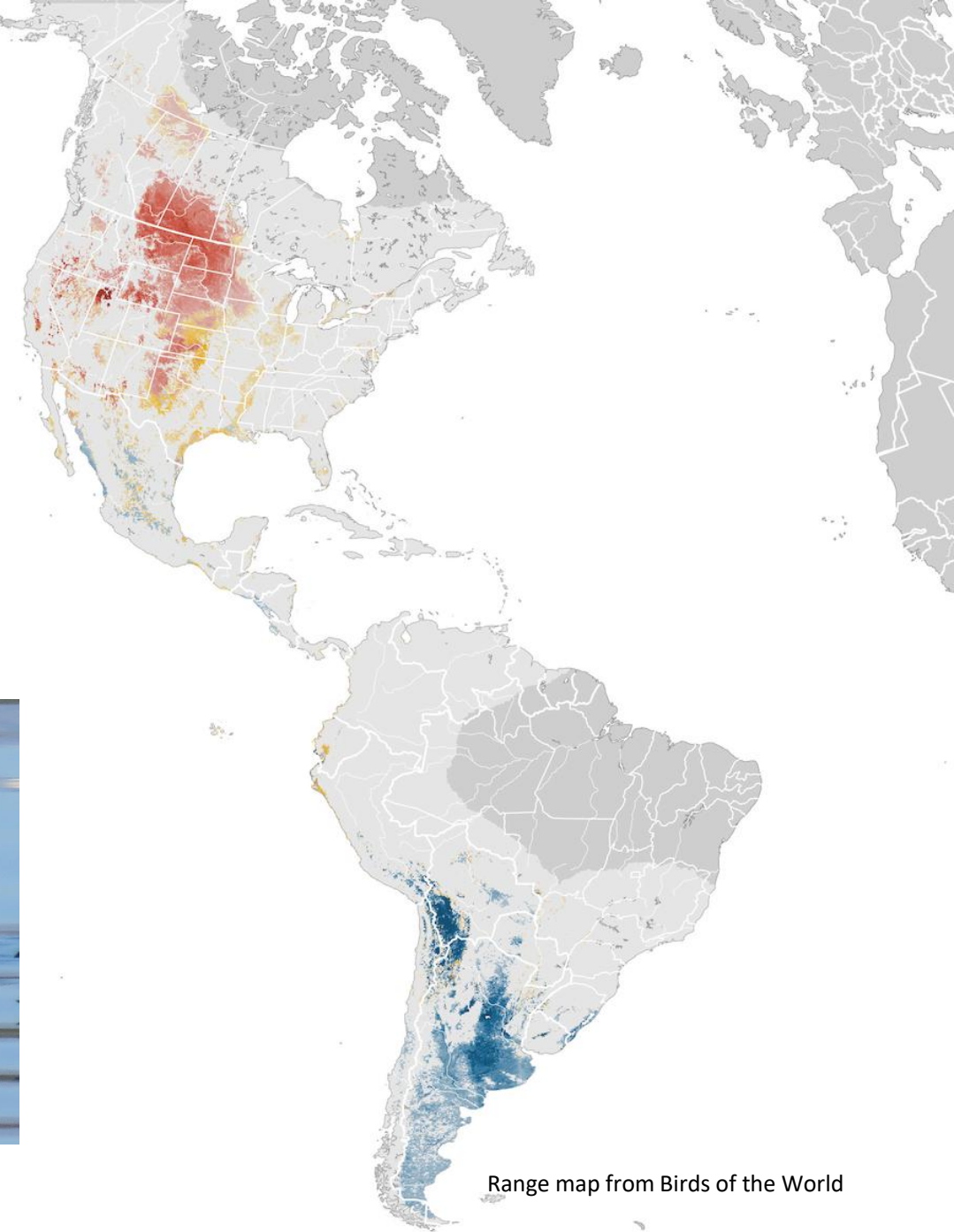


Photo by [Joe Jehl](#)

## Wilson's Phalarope

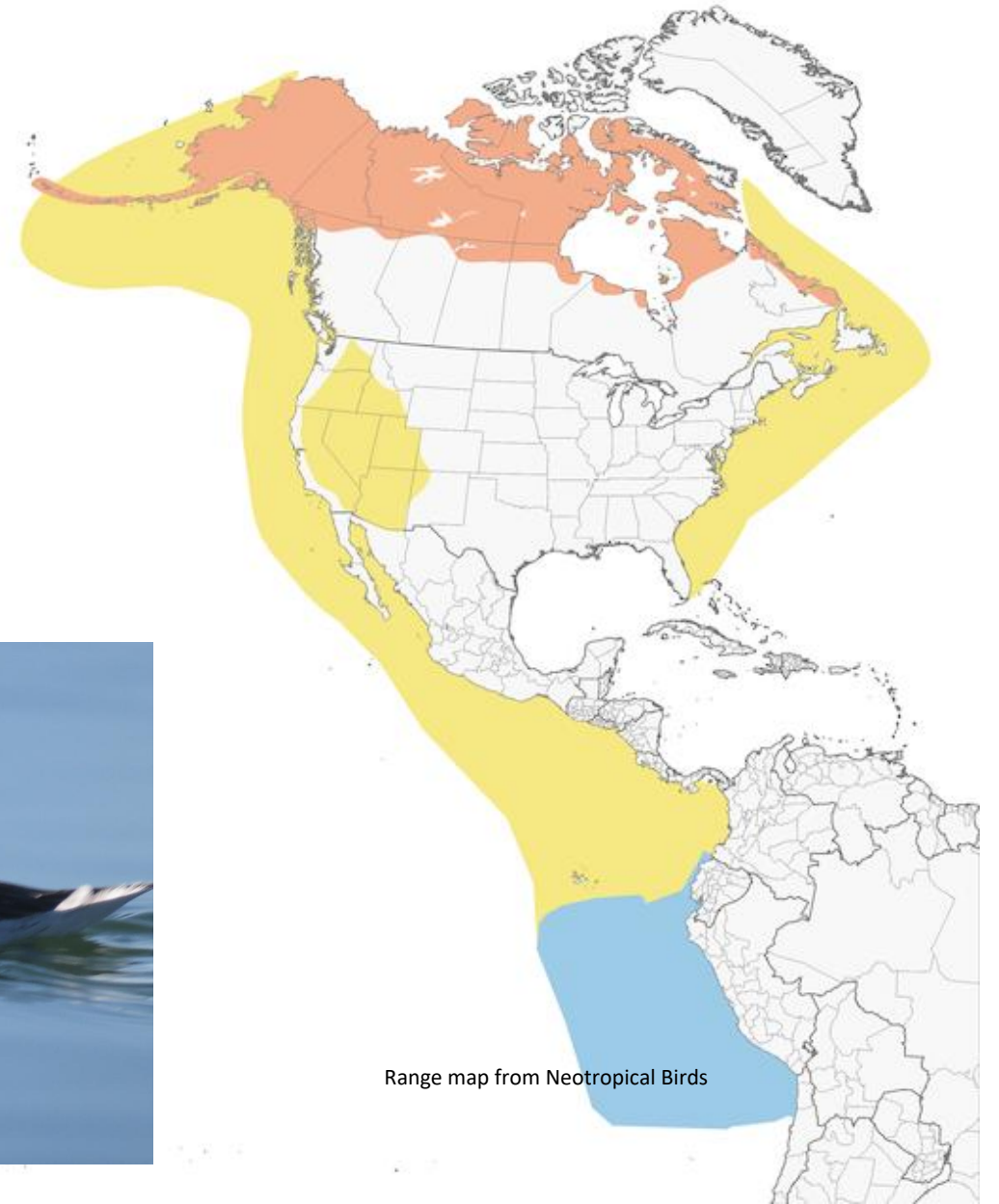
- Breeds in interior wetlands
- Migratory staging at saline lakes
- Non-breeding range in South American interior
- ~5,000 mile migration to sites in South America



Range map from Birds of the World

# Red-necked Phalaropes

- Breeds in arctic
- Migrates along coasts and to interior saline lakes
- Non-breeding range in ocean off South America



# Wilson's Phalaropes rely on a hemispheric network of saline lakes

Mono Lake, USA



Great Salt Lake, USA



Salar de Surire, Chile



Chaplin Lake, Canada

Ecuasal Salt Ponds, Ecuador



Laguna Mar Chiquita, Argentina

## Phalaropes at Mono Lake: Overview

- Mono Lake is a key migratory “staging” stop
- Wilson’s phalaropes double their body weight and grow almost all new feathers in ~6 weeks at Mono Lake
- After staging, both phalaropes migrate 1,000s of miles to non-breeding areas

Citations: Jehl 1986, Jehl 1999

*Halie Cook photo*

© Halie Cook



## “Staging” vs. “stopping”

Staging sites have

- Superabundant, reliable food resources
- Birds refuel at a high rate, building fat for migration
- High proportions of the population concentrate there

*Citations: Jehl 1999, Warnock 2010*

## Phalarope diet at Mono Lake

- *Wilson's phalarope*: Alkali flies + some shrimp
- *Red-necked phalarope*: almost exclusively alkali flies; can't survive on only shrimp

*Citations: Boula 1986, Jehl 1986, Jehl 1988, Rubega & Inouye 1994, Frank & Conover et al. 2021*

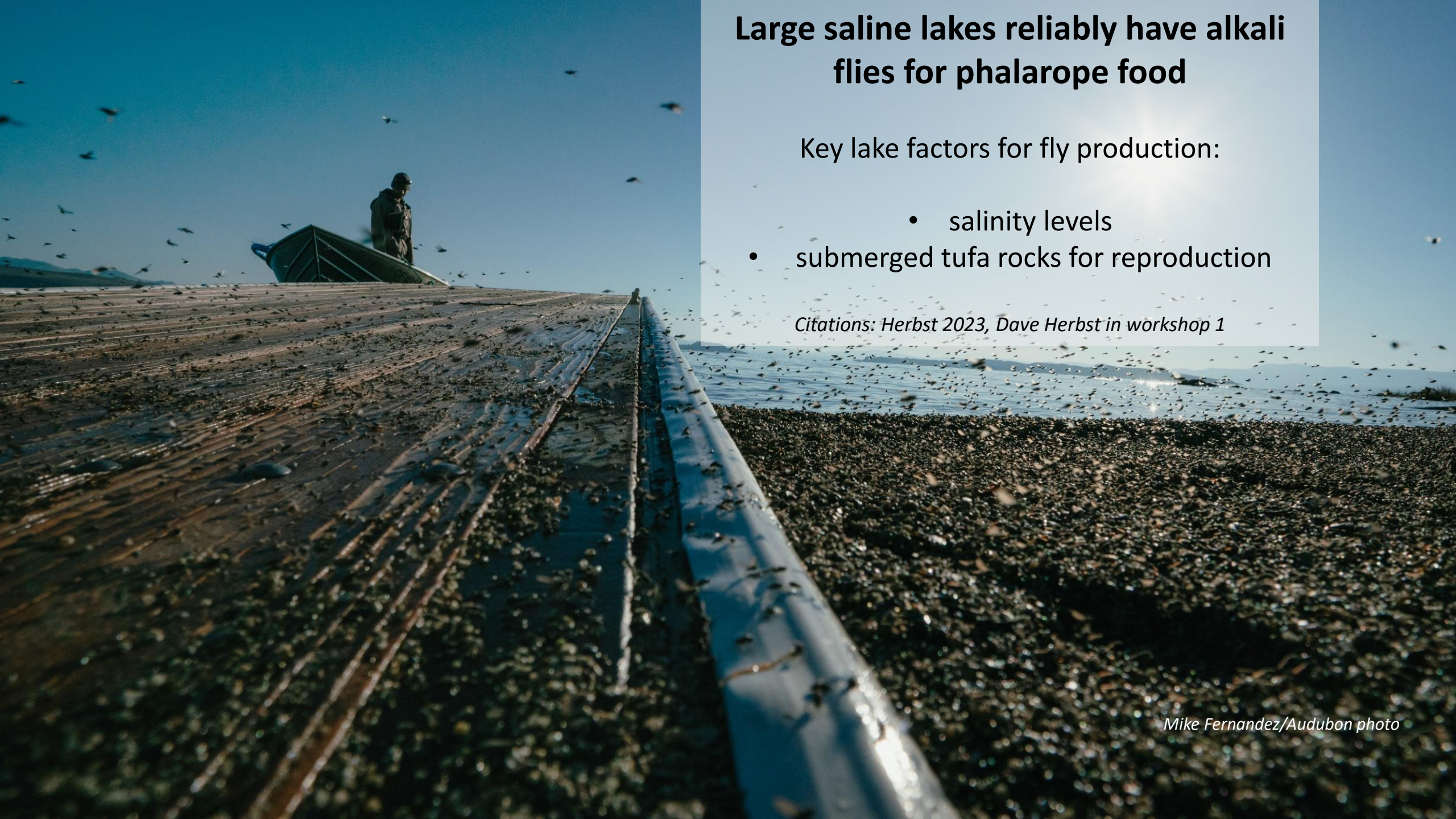


## Phalaropes at Mono Lake: Overview

- Only large saline lakes provide the abundance of flies needed for phalarope staging
- Mono, Great Salt, & Abert Lakes can host >60% of the world population of Wilson's phalaropes at once
- These sites can host 90% of adult Wilson's phalaropes at once

*Citations: Jehl 1988, Jehl 1999*





# Large saline lakes reliably have alkali flies for phalarope food

Key lake factors for fly production:

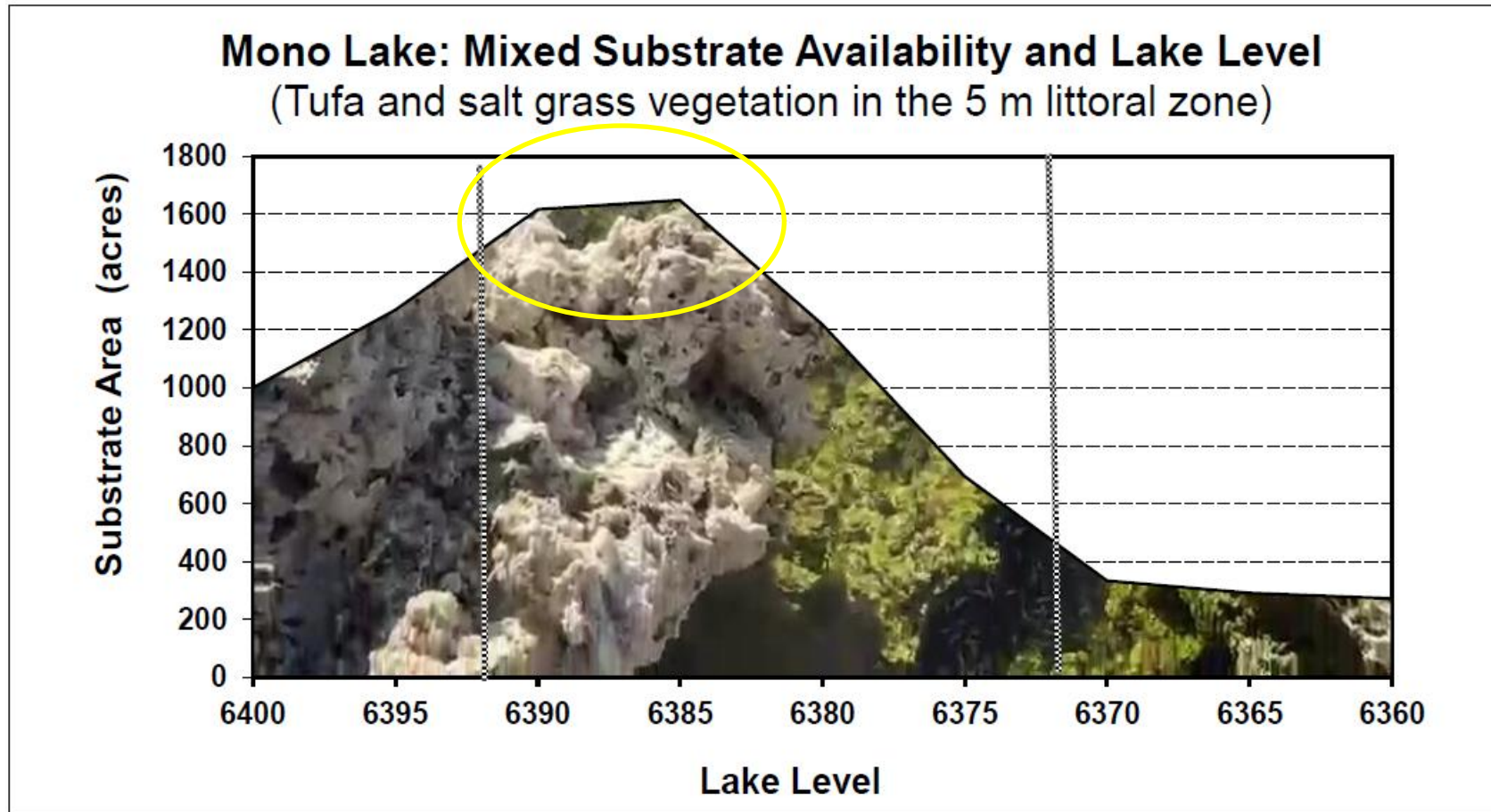
- salinity levels
- submerged tufa rocks for reproduction

*Citations: Herbst 2023, Dave Herbst in workshop 1*

*Mike Fernandez/Audubon photo*

*Figure from Dr. Herbst's presentation in previous workshop*

**Submerged tufa at correct depth for flies is maximized between 6,385 and 6,390 lake level**

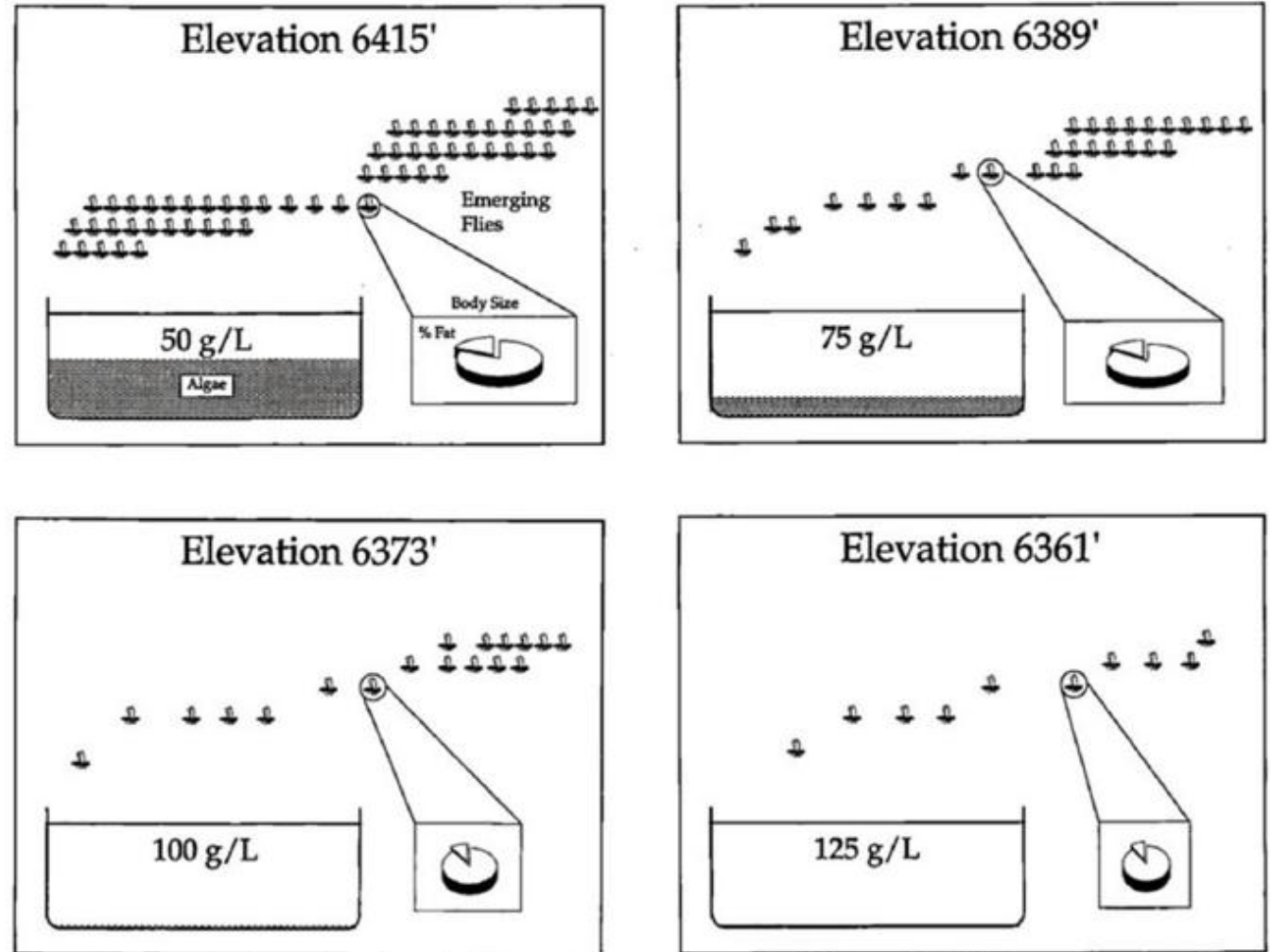


**< Markers at 6392 and 6372 >**

## Salinity is most important factor for fly production

- Lower salinities result in greater fly survival, reproduction, growth, and nutritional content
- 50% salinity is the optimal salinity for flies, achieved at 6,415' lake level

Figure: Herbst experiments on fly production at different salinities



# Phalaropes and Mono Lake

What has *not* changed since 1994

- Mono Lake is critical to global Wilson's phalarope population
- Mono Lake in top three sites with highest migratory abundances of both phalarope species
- Many thousands of Wilson's and red-necked phalaropes use Mono Lake each year

*Citations: Carle et al. 2024, Castellino et al. 2024, Carle et al. 2026*



*Ryan Carle photo*

# Phalaropes and Mono Lake

What *has* changed since 1994

- Population declines in Wilson's phalaropes
- Other key saline lakes are threatened with ecosystem collapse, increasing Mono's importance
- Wilson's phalaropes under consideration for listing under federal Endangered Species Act



*Halie Cook photo*

**Western North American phalarope  
staging sites surveyed six times annually  
2019-2025**



Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image Landsat / Copernicus  
US Dept of State Geographer  
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**Western North American phalarope  
staging sites surveyed six times annually  
2019-2025**

Chaplin Lake

Environment and Climate Change Canada

East Cascades Bird Alliance  
Oregon Natural Desert Association  
Kellerman Lab, Oregon Tech

Lake Abert

Great Salt Lake

Oikonos

Utah Division of Wildlife

San Francisco Bay

SF Bay Bird Observatory

Mono Lake

Owens Lake

LA Department of Water and Power  
Eastern Sierra Bird Alliance

Google Earth

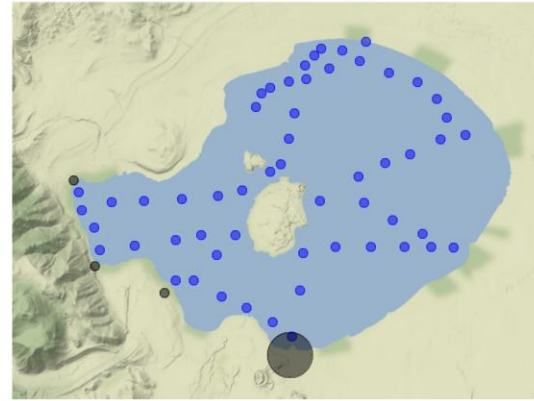
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image Landsat / Copernicus  
US Dept of State Geographer  
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# Wilson's Phalarope Mono Lake Surveys 2020 results

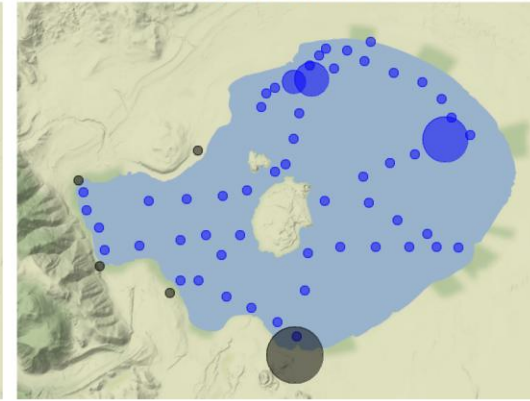


Submerged tufa areas  
with lots of flies!

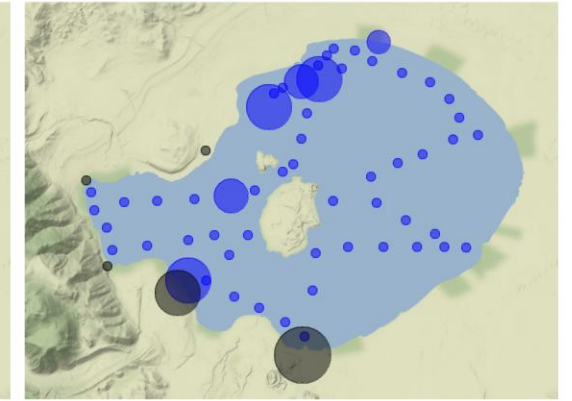
Wilson's Phalarope  
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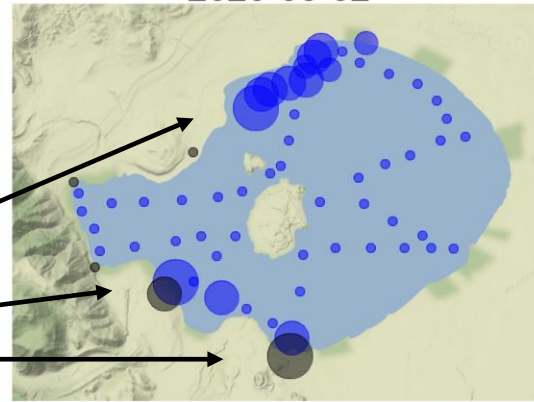
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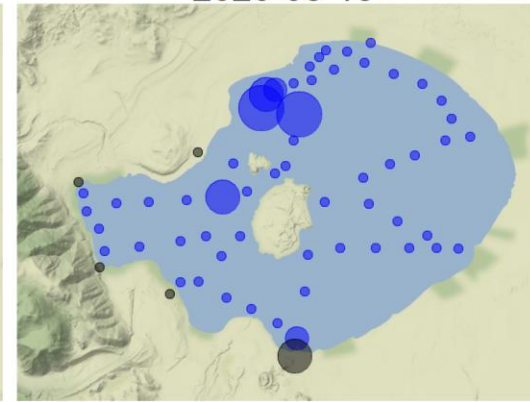
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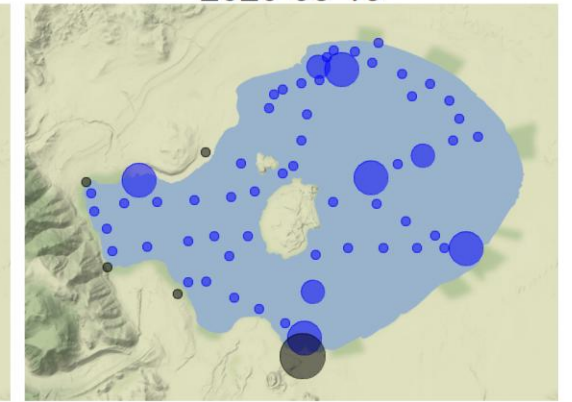
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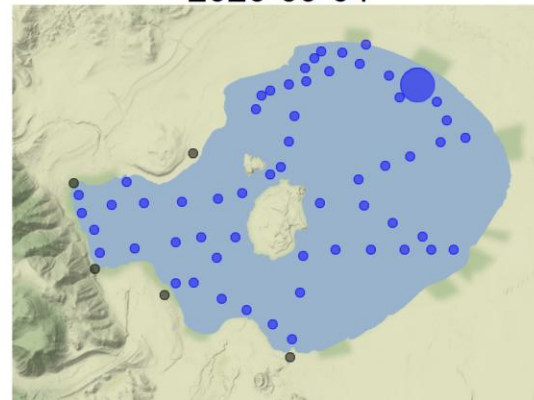
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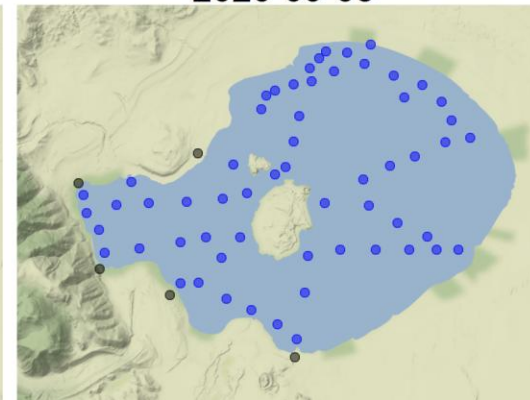
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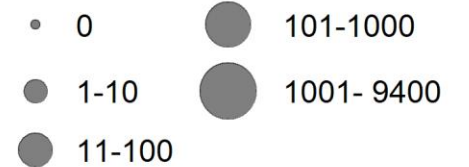
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2020-09-05



Count



Survey\_type

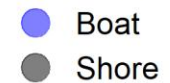
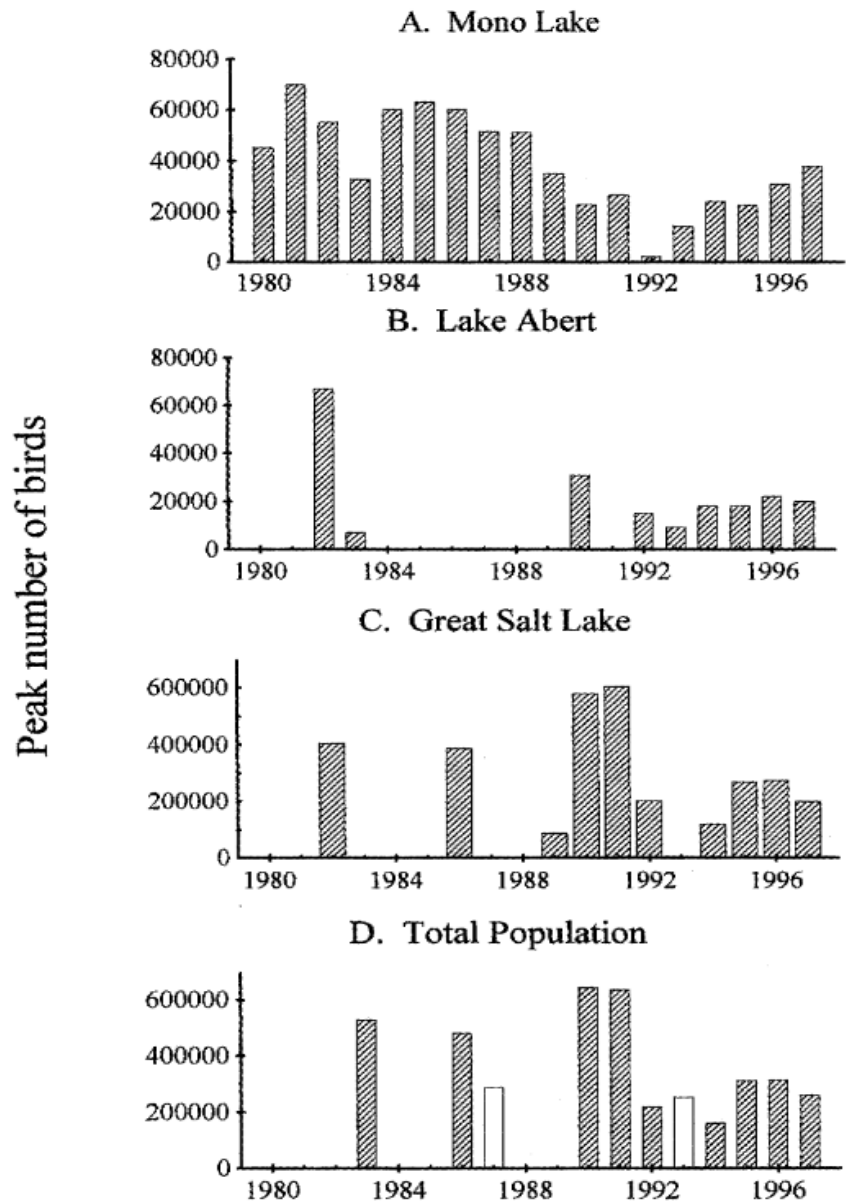


Figure from Carle & Rubega 2021

Wilson's phalarope peak counts 1980-1997 (Jehl 1999)



David Carle photo

Figure from Jehl 1999

### Maximum single-window counts of Wilson's/unidentified Phalaropes, 2019-2025

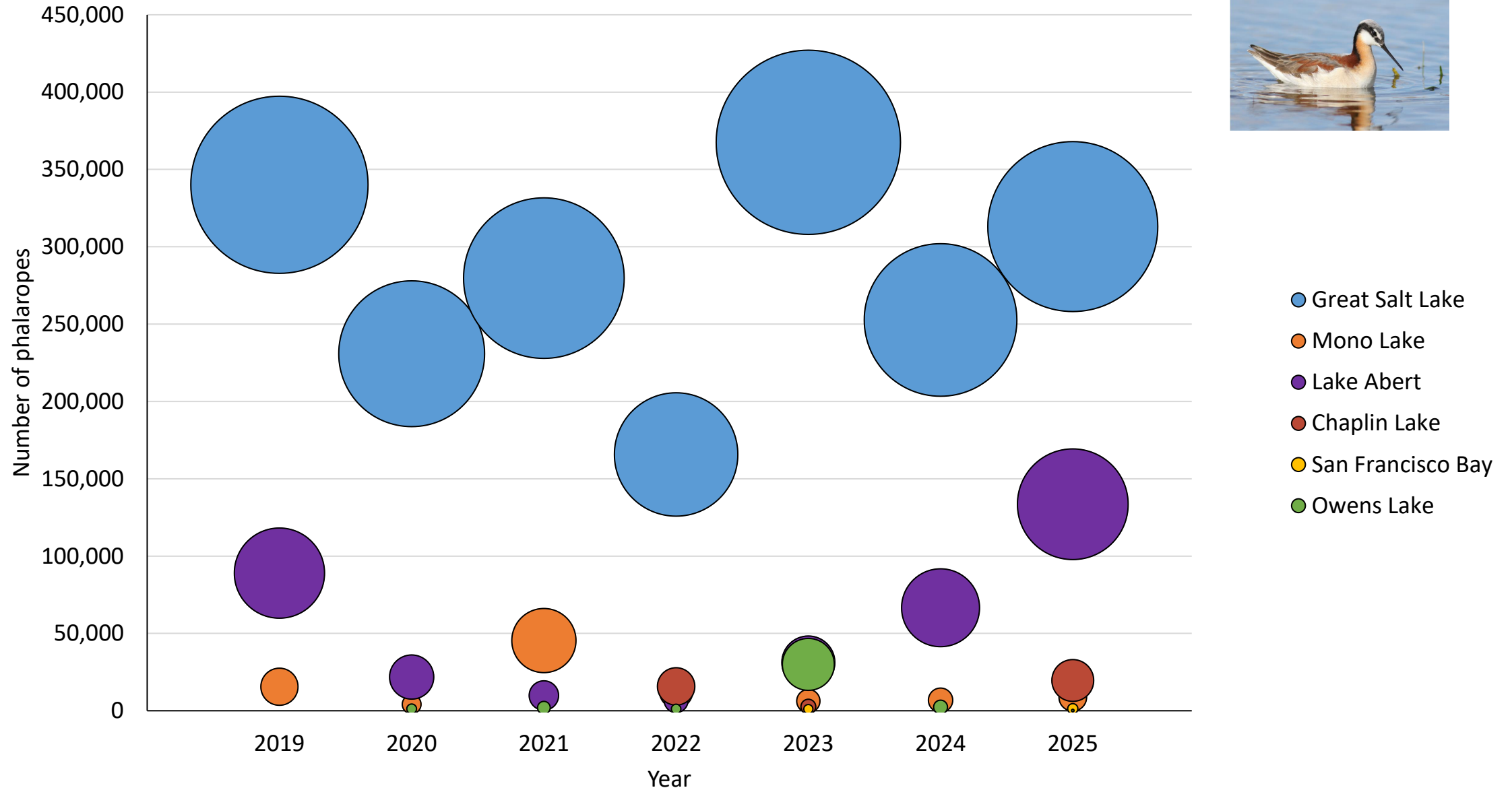


Figure modified from Carle et al. 2024, updated with unpublished data

### Maximum single-window counts of Wilson's/unidentified Phalaropes, 2019-2025

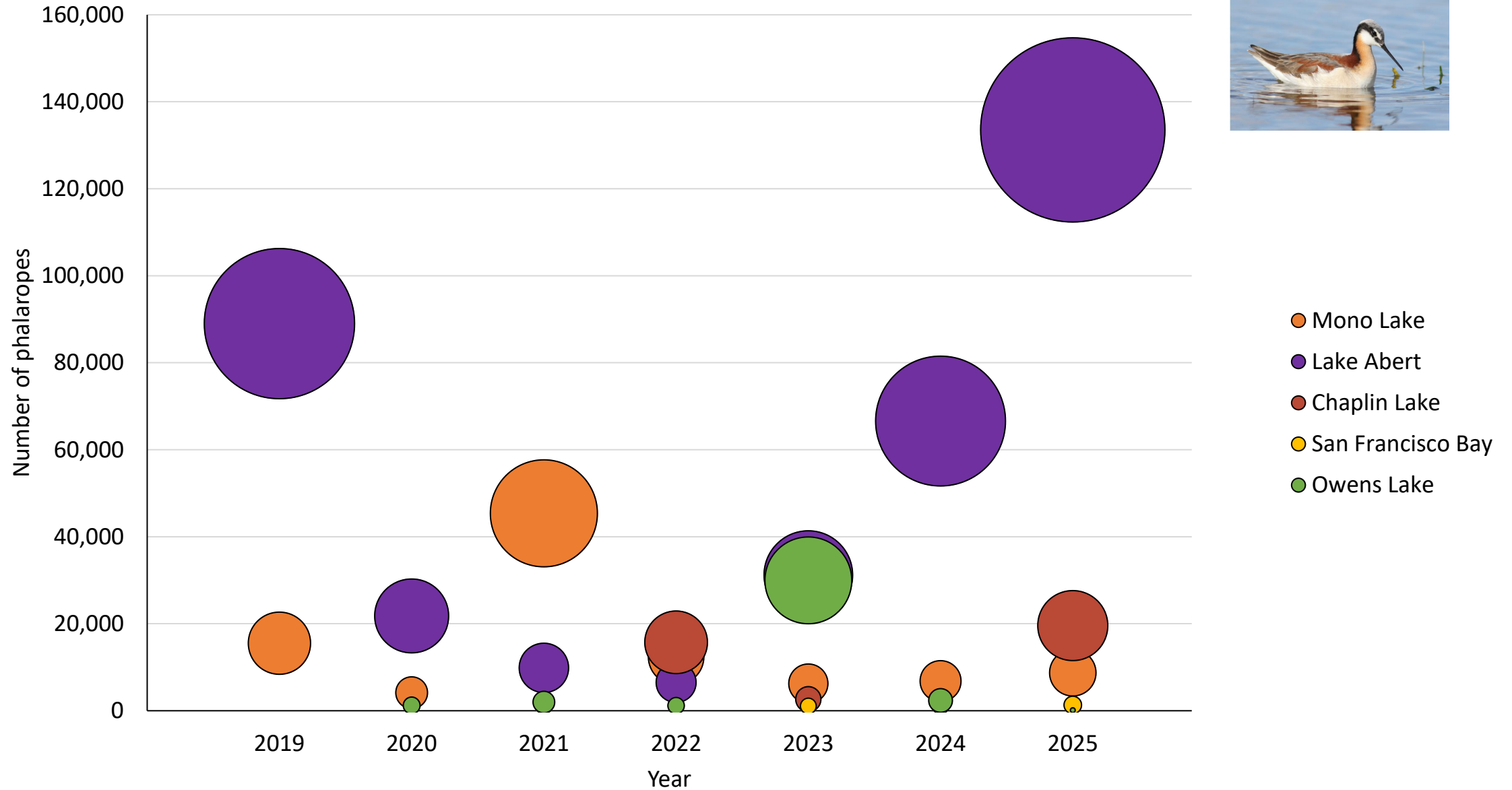


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### Maximum single-window counts of Wilson's/unidentified Phalaropes, 2019-2025

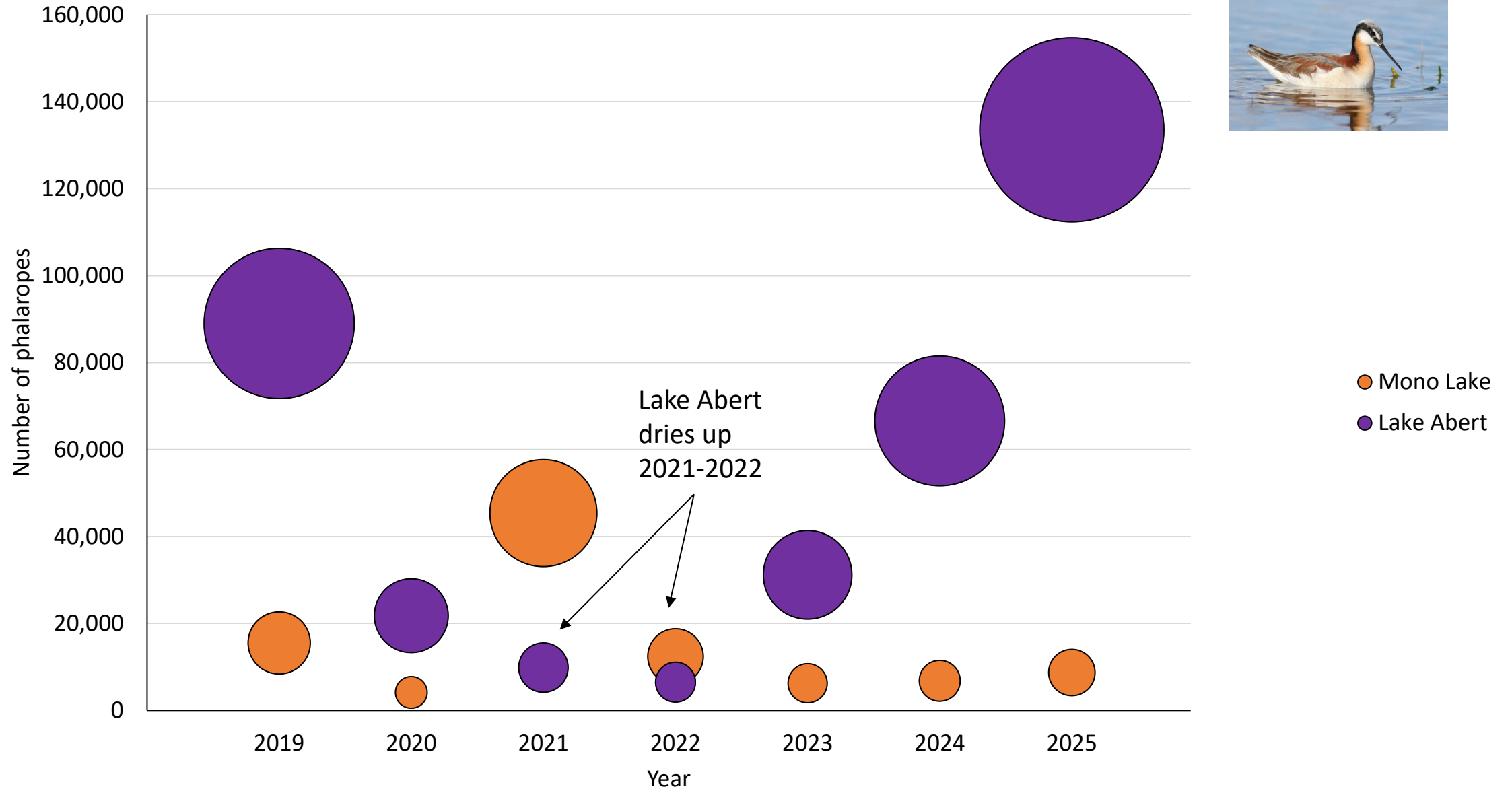
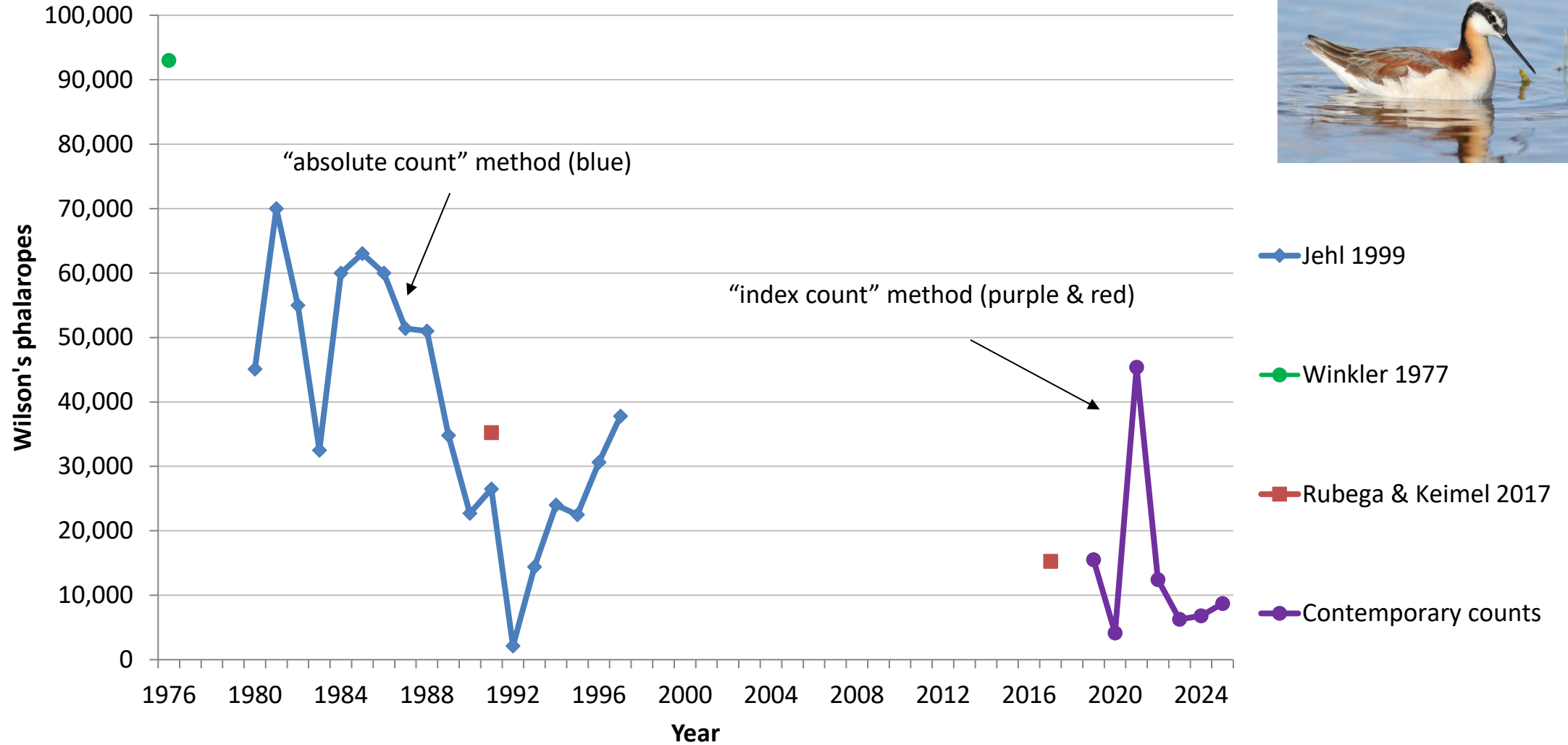
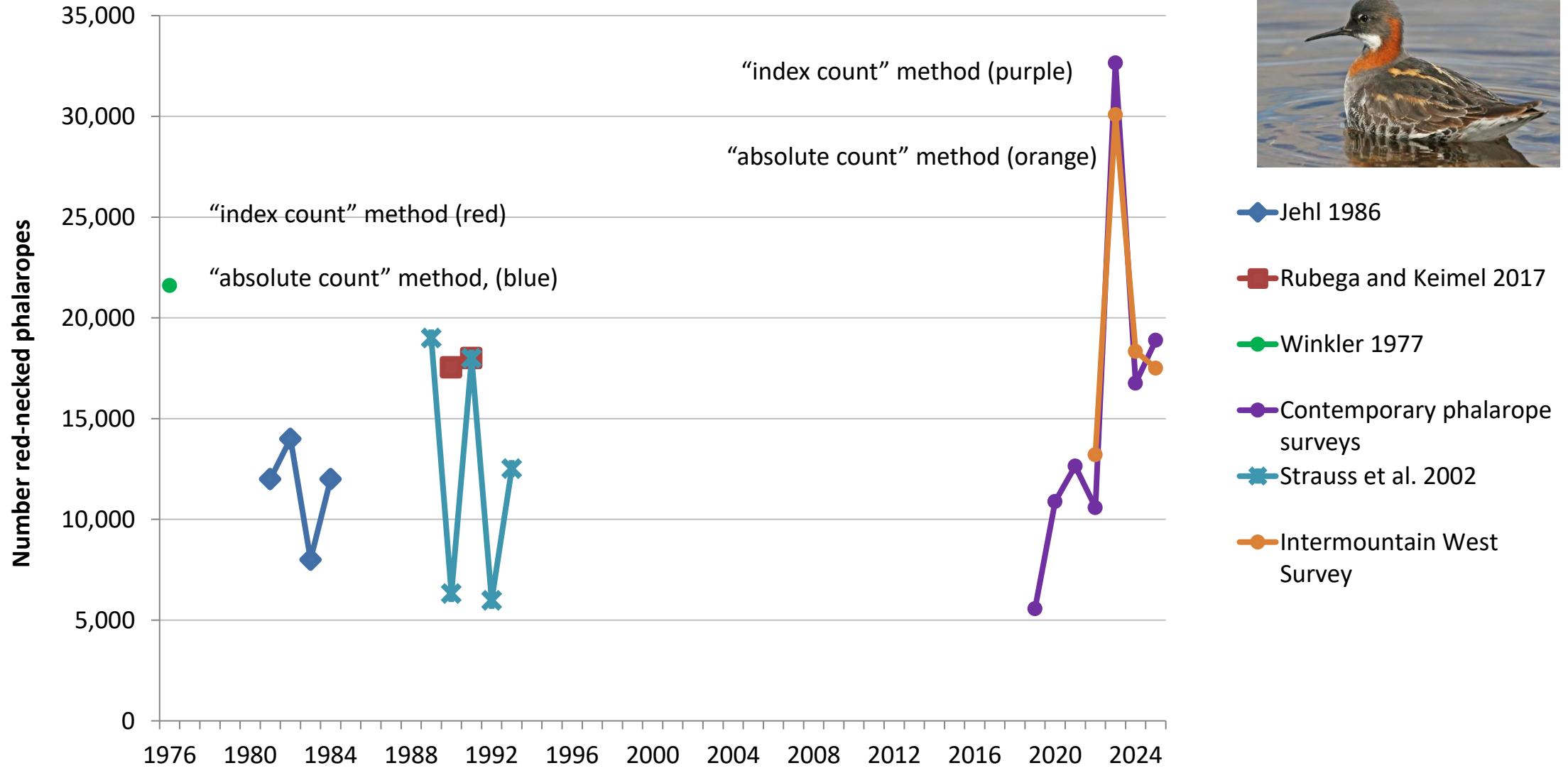


Figure modified from Carle et al. 2024, updated with unpublished data

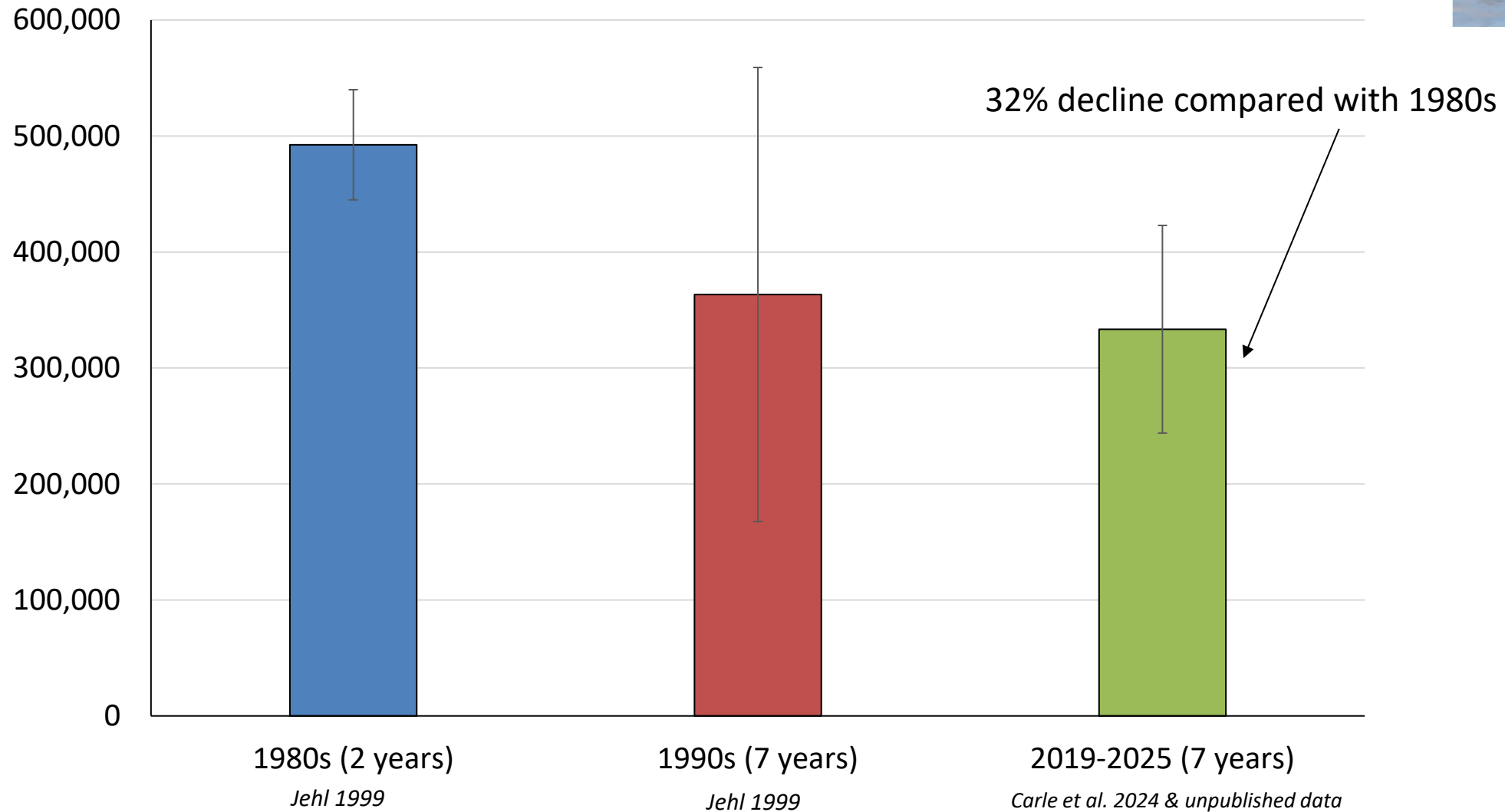
# Annual peak counts of Wilson's/unidentified phalaropes at Mono Lake 1976-2025



# Annual peak counts of Red-necked/unidentified phalaropes at Mono Lake 1976-2025



Annual Wilson's/unidentified phalarope peak counts at  
Mono Lake, Lake Abert, and Great Salt Lake combined  
(Average  $\pm$  1 standard deviation)



# Wilson's Phalarope North American Population Trends

Approximately 70% decline in abundance since 1980

Major decline occurred from 1980s to 1990s, more stable since

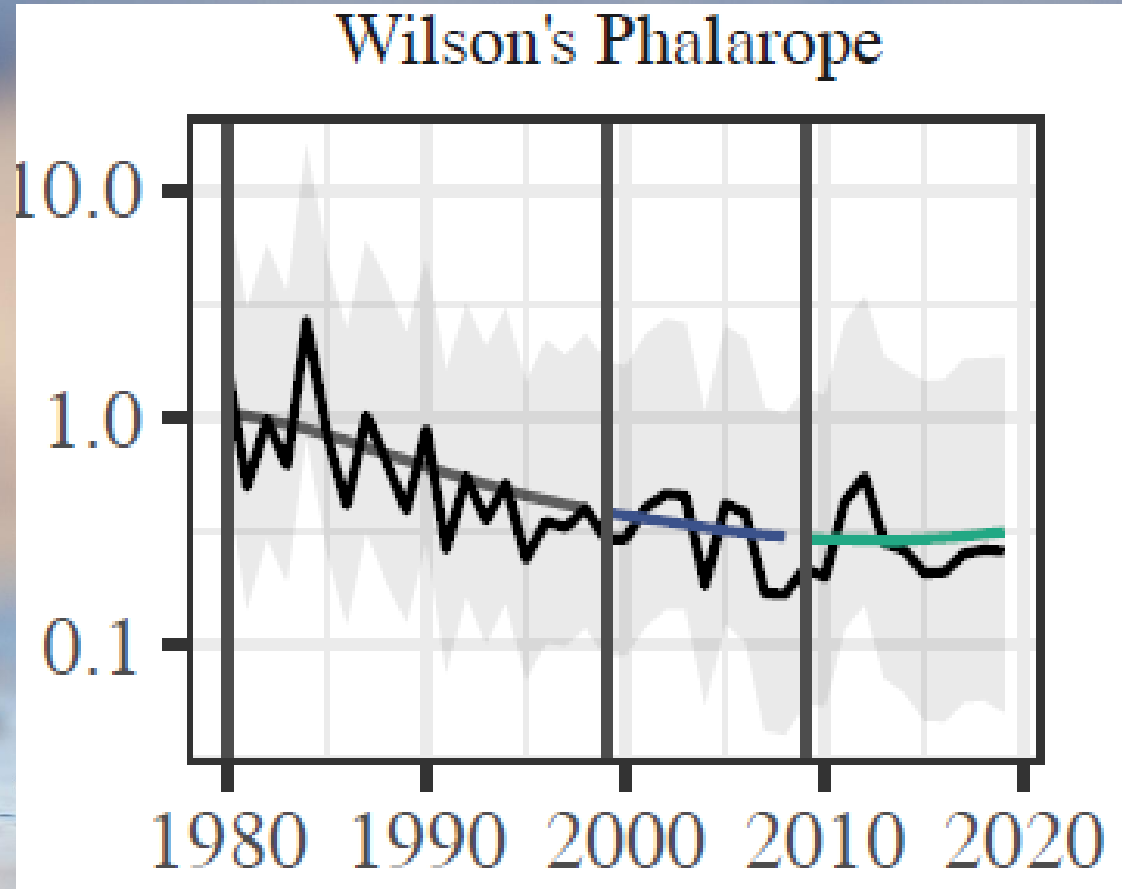
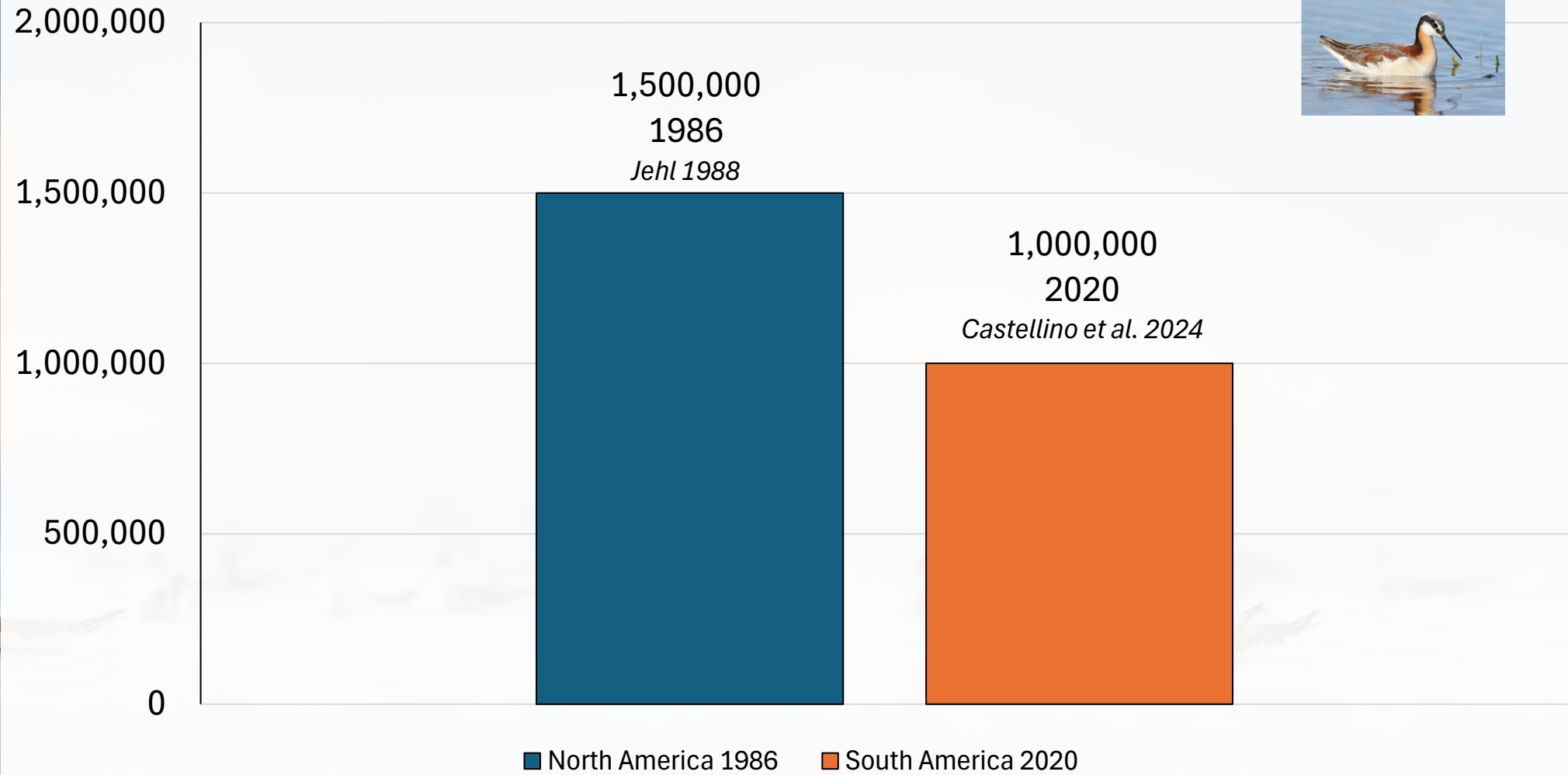


Figure from Smith et al. 2023

Janice Gardner photo

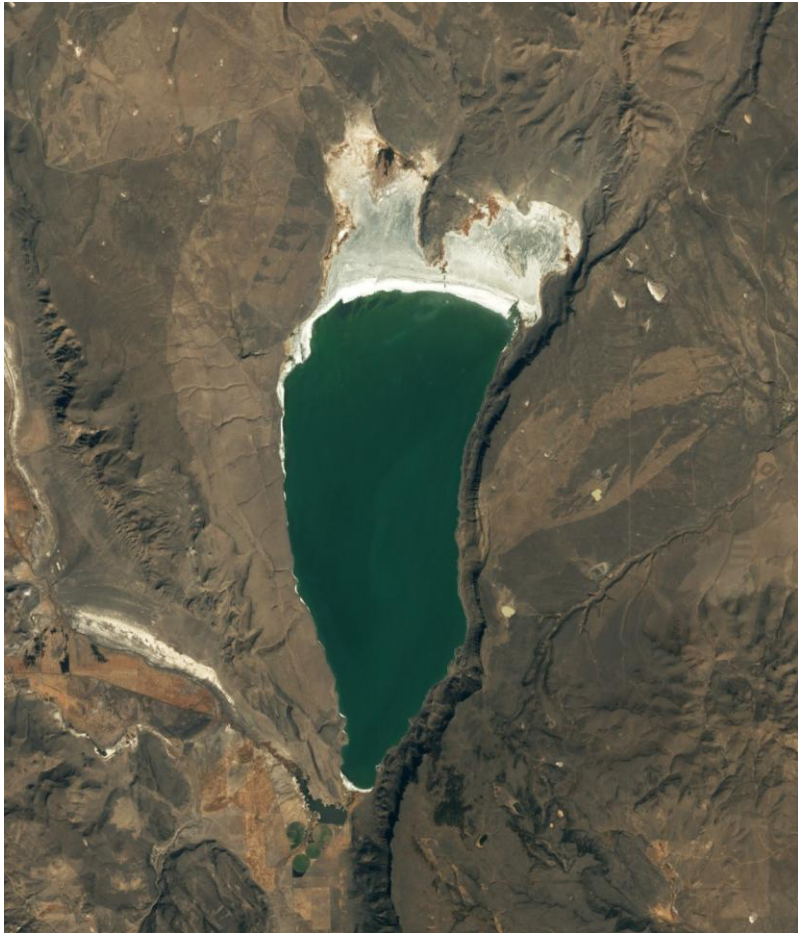
## Wilson's Phalarope World Population Estimates



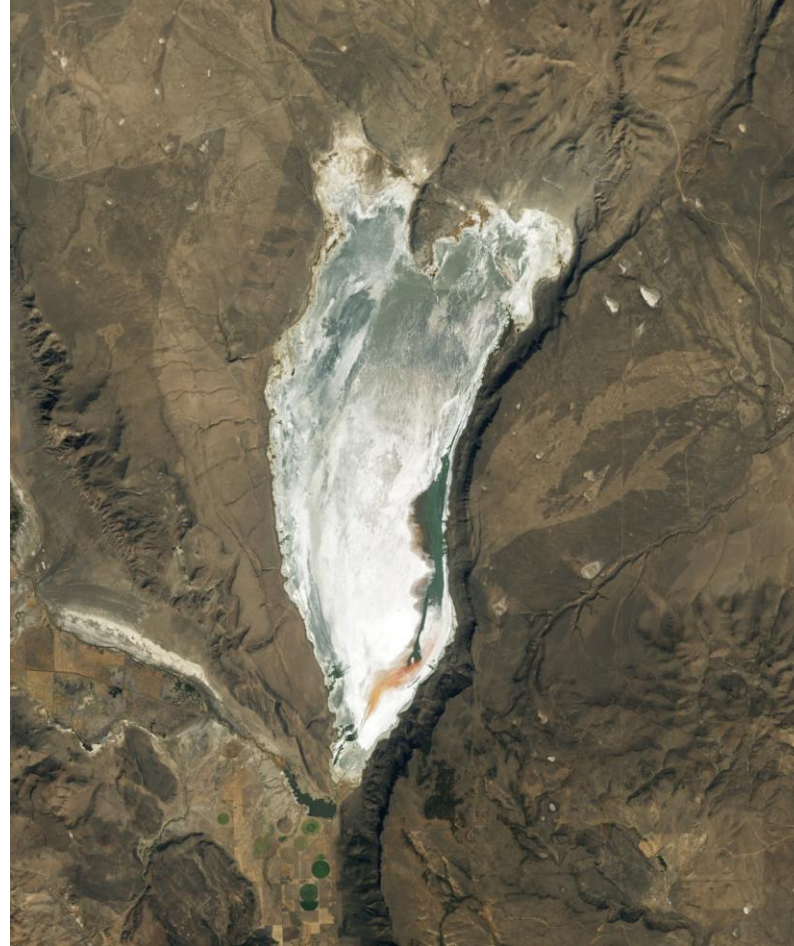
# Habitat loss at other key saline lakes

Saline lakes are one of the most threatened habitat types on Earth

October 2002



October 2022

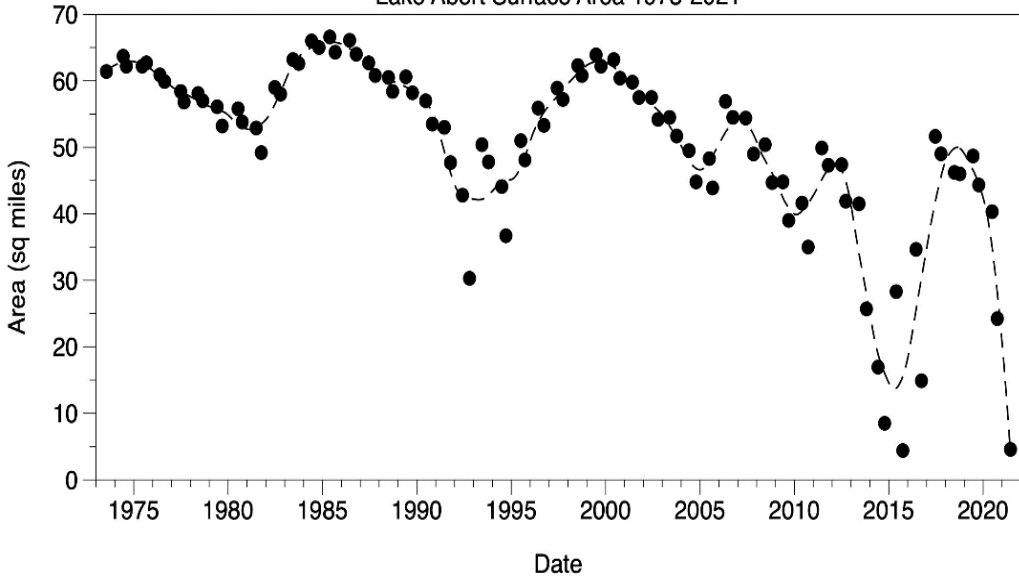


*Images from Voiland & Larson 2023*

*Citation for info:  
Wurtsbaugh et al. 2017*

# Lake Abert in Crisis

Lake Abert Surface Area 1973-2021



Photos by Ron Larson

Figure from Center for Biological Diversity et al. 2024

# Great Salt Lake in Crisis

Record low lake level November 2022

Volume shrunk by >50% and salinity exceeded tolerances of invertebrates

## GREAT SALT LAKE ELEVATION



RECORD HIGH  
**4211.65 FEET**

AVERAGE  
**4202.2 FEET**

**NEW RECORD LOW** CURRENT  
**4191.3 FEET**

# Microbialites at Great Salt Lake

40% of the microbialites rocks were exposed in 2022



*Citation: Frantz et al. 2023*

## Great Salt Lake's importance to phalaropes

- 60% of the Wilson's Phalarope world population and 90% of adults can be at Great Salt Lake at once
- Great Salt Lake rose because of the large snowpack in 2022-2023
- Lake level is currently declining again



*Citations: Jehl 1988, 1999, Castellino et al. 2024, USGS Great Salt Lake Hydrotracker*



# Wilson's Phalarope

## Federal Endangered Species Act Proposal

Petitioned for listing at *Threatened* in 2024

Due to

- *imminent loss of habitat across a major portion of its range*
- *and lack of regulatory mechanisms to protect the species & habitat*
- 

Citation: Center for Biological Diversity et al. 2024





*Halie Cook photo*

## **Wilson's Phalarope Endangered Species Act Proposal**

- Positive 90-day finding in 2025, USFWS is now doing a full review
- Mono Lake, Great Salt Lake, and Lake Abert proposed as "Critical Habitat"

*Citation: Center for Biological Diversity et al. 2024*

Can conditions at staging sites  
leading to population crashes  
in shorebirds?

Yellow Sea mudflats in  
China: A key shorebird  
staging area in the  
Australasian Flyway



# Major shorebird population declines were linked to staging habitat loss at the Yellow Sea mudflats

Species most reliant on the Yellow Sea staging sites declined more than others using the flyway

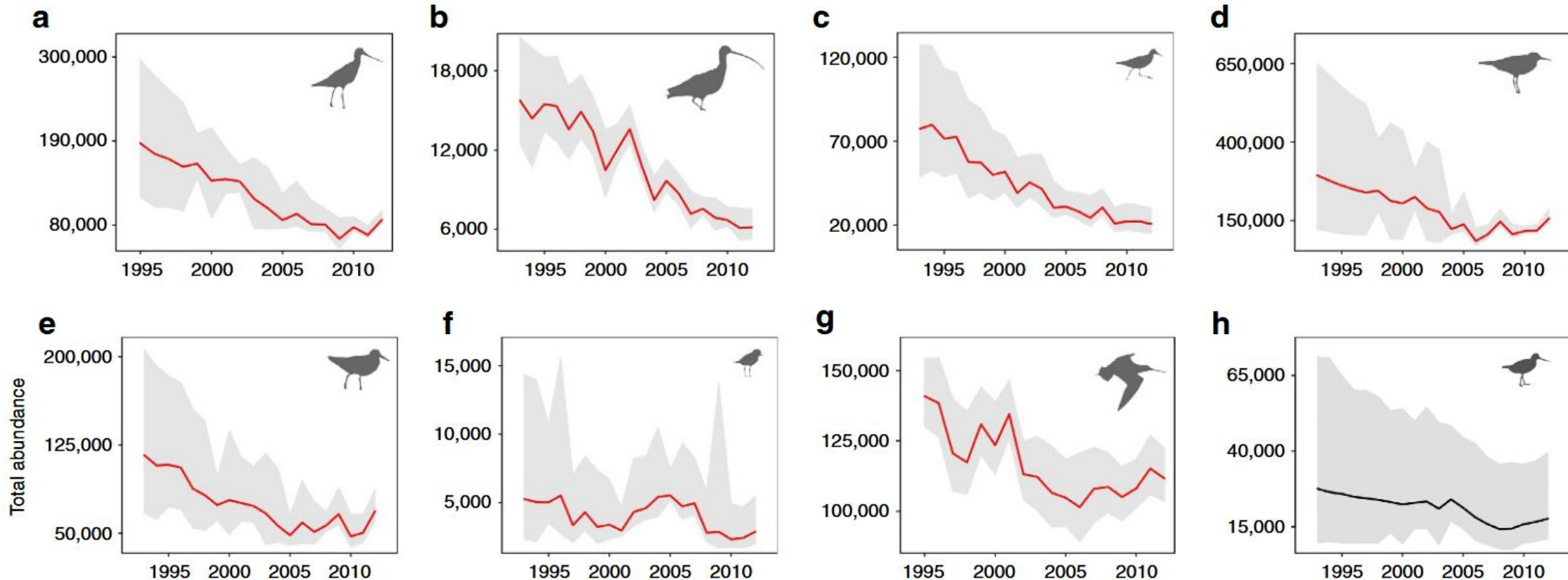
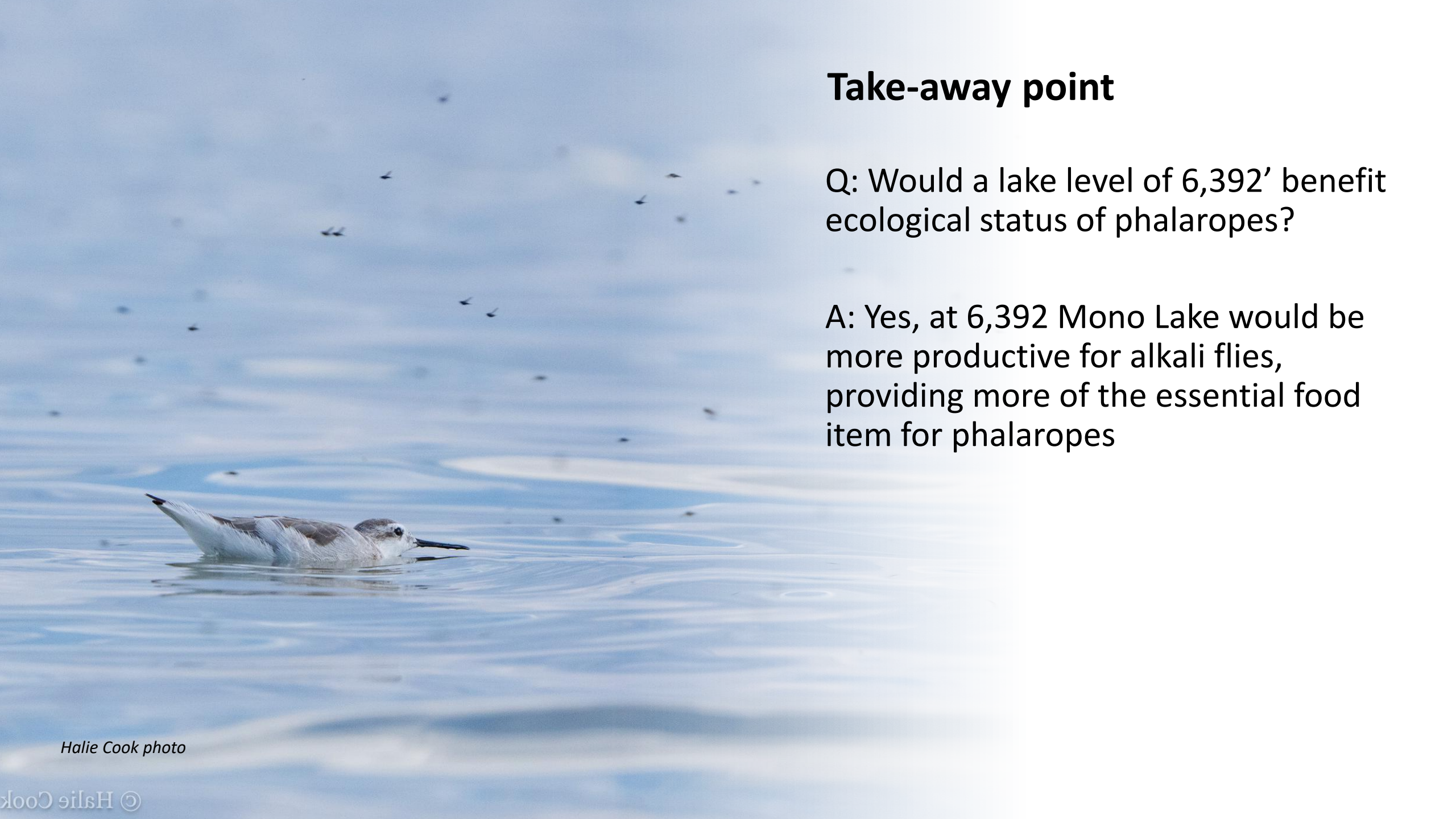


Figure from Studds et al. 2017, results from Studds et al. 2017, Murray et al. 2018, Aharon-Rotman et al. 2016



## Take-away point

Q: Would a lake level of 6,392' benefit ecological status of phalaropes?

A: Yes, at 6,392 Mono Lake would be more productive for alkali flies, providing more of the essential food item for phalaropes

## Take-away point

**Q:** Would accelerated progress to 6,392' benefit the ecological status of phalaropes?

**A:** Yes, because other vitally important staging sites could collapse soon, leaving Mono as the primary reliable large staging site



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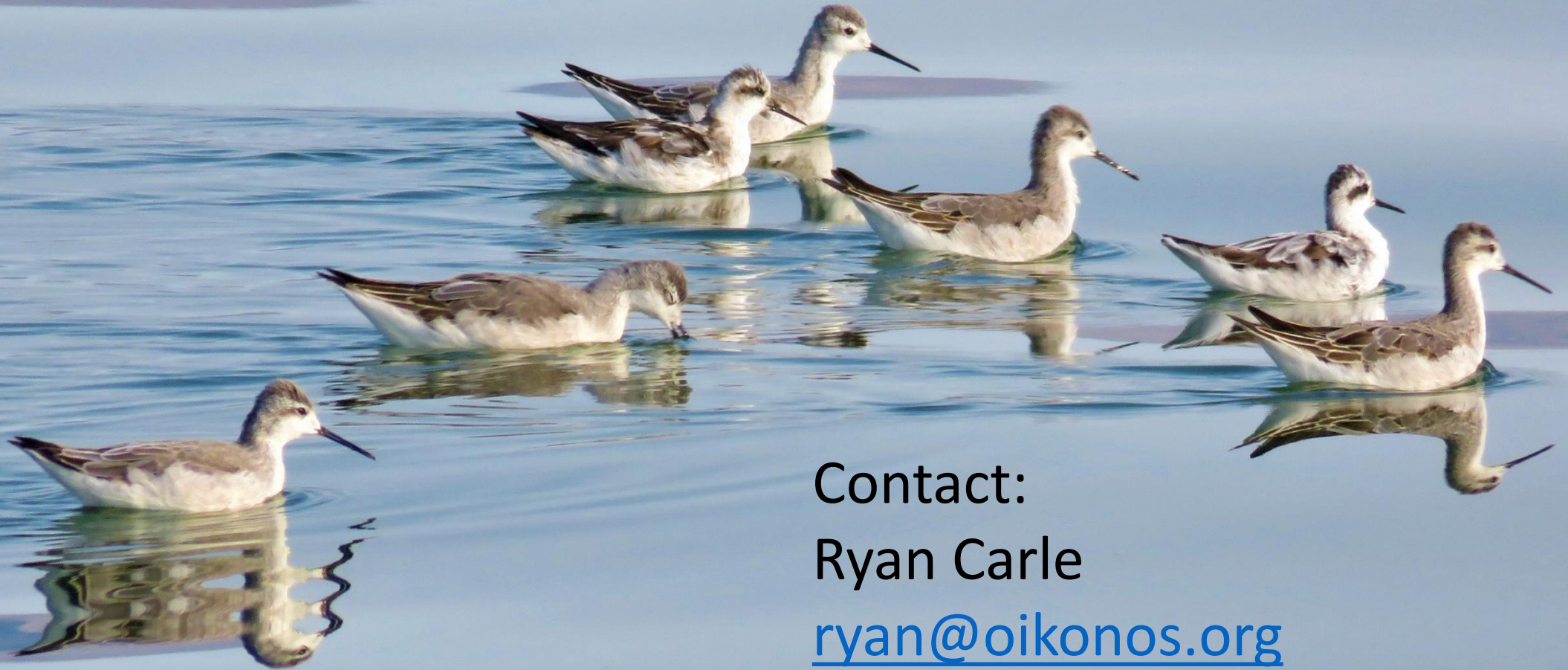
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Unpublished data from the following partners was also shown in figures 18-22: Oikonos, Los Angeles Department of Water and Power, San Francisco Bay Bird Observatory, East Cascades Bird Alliance, Eastern Sierra Bird Alliance, Environment and Climate Change Canada, Point Blue Conservation Science, National Audubon Society, Oregon Natural Desert Association, Jherime Kellerman (Oregon Tech), and Margaret Rubega (U. Conn).

# Thank you



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