SAN FRANCISCO BAY
BIRD OBSERVATORY

Spin Cycle

Decoding population dynamics of phalaropes and other waterbirds of the Pacific Flyway

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Contributors to this research

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Amy Parsons

Max Tarjan

Josh Scullen

USGS science for a changing world

And many more!

SAN FRANCISCO BAY BIRD OBSERVATORY

A satellite map of California …in 1851

A satellite map of California ...in 2002

The Transformation of the San Francisco Estuary

Condition of marsh

Mostly pristine since date of creation

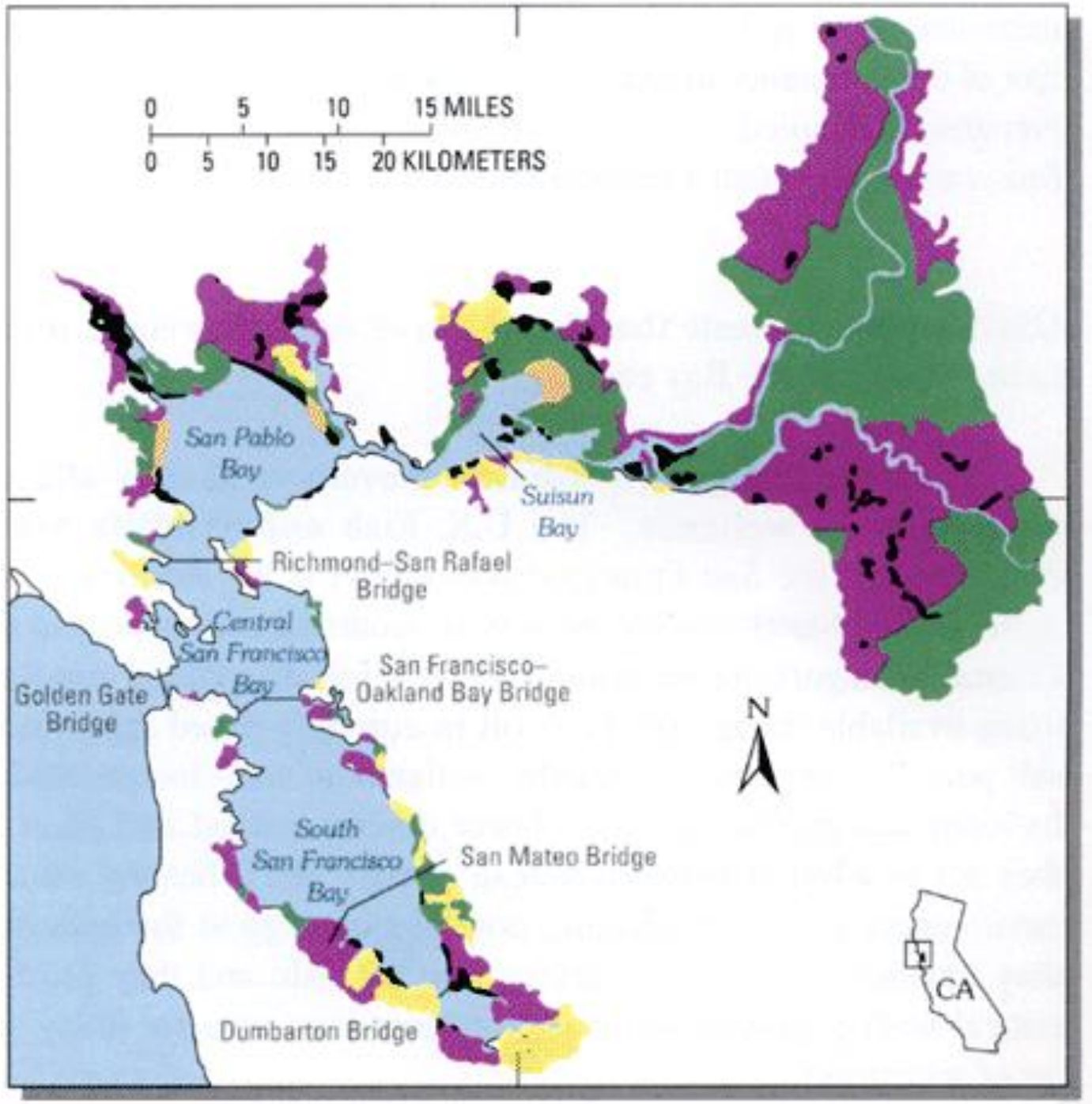
Mostly leveed or filled by people during the indicated period of time:

1860–1970

1940–1970

1900–1940

1860–1900

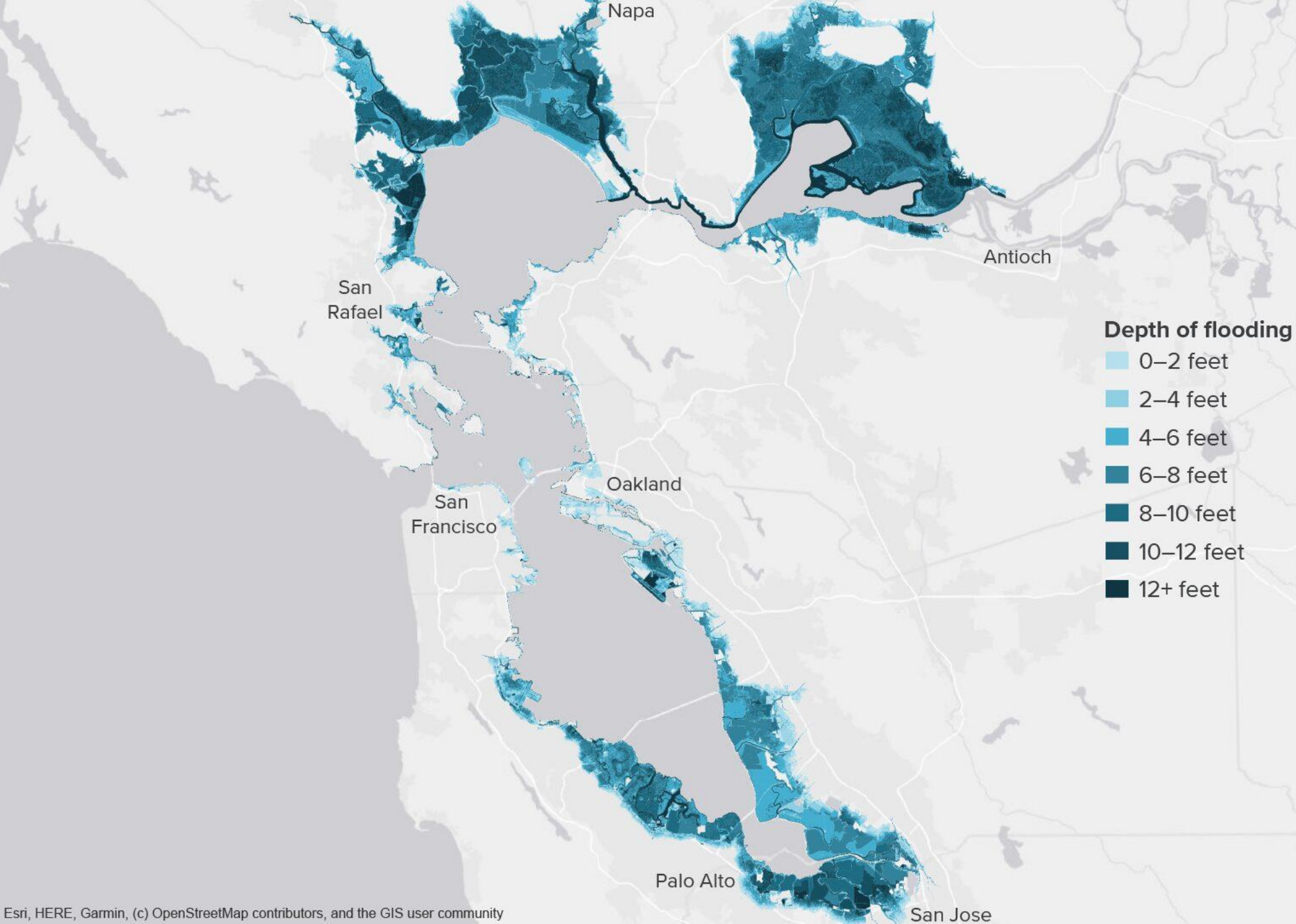


Ridgway’s Rail

California Black Rail

Salt Marsh Harvest Mouse

(dubiously ornithological)


Napa
Antioch
San Rafael
Oakland
San Francisco
Palo Alto
San Jose
Depth of flooding
0–2 feet
2–4 feet
4–6 feet
6–8 feet
8–10 feet
10–12 feet
12+ feet
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

nature

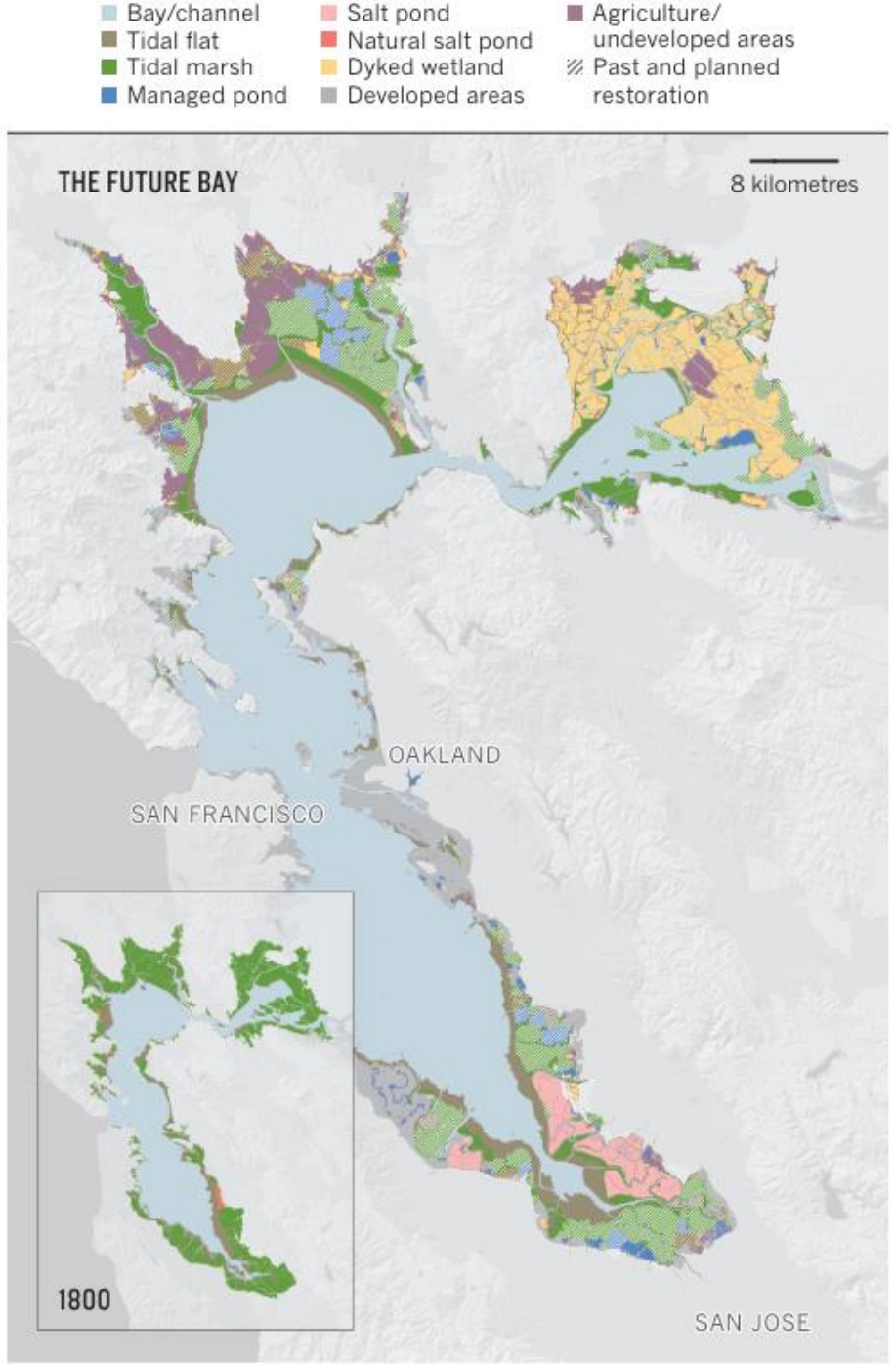
FORTRESSES OF MUD

Rising seas threaten the San Francisco Bay Area, home to one of the largest estuaries in North America. But marsh-restoration efforts could hold back the high water.

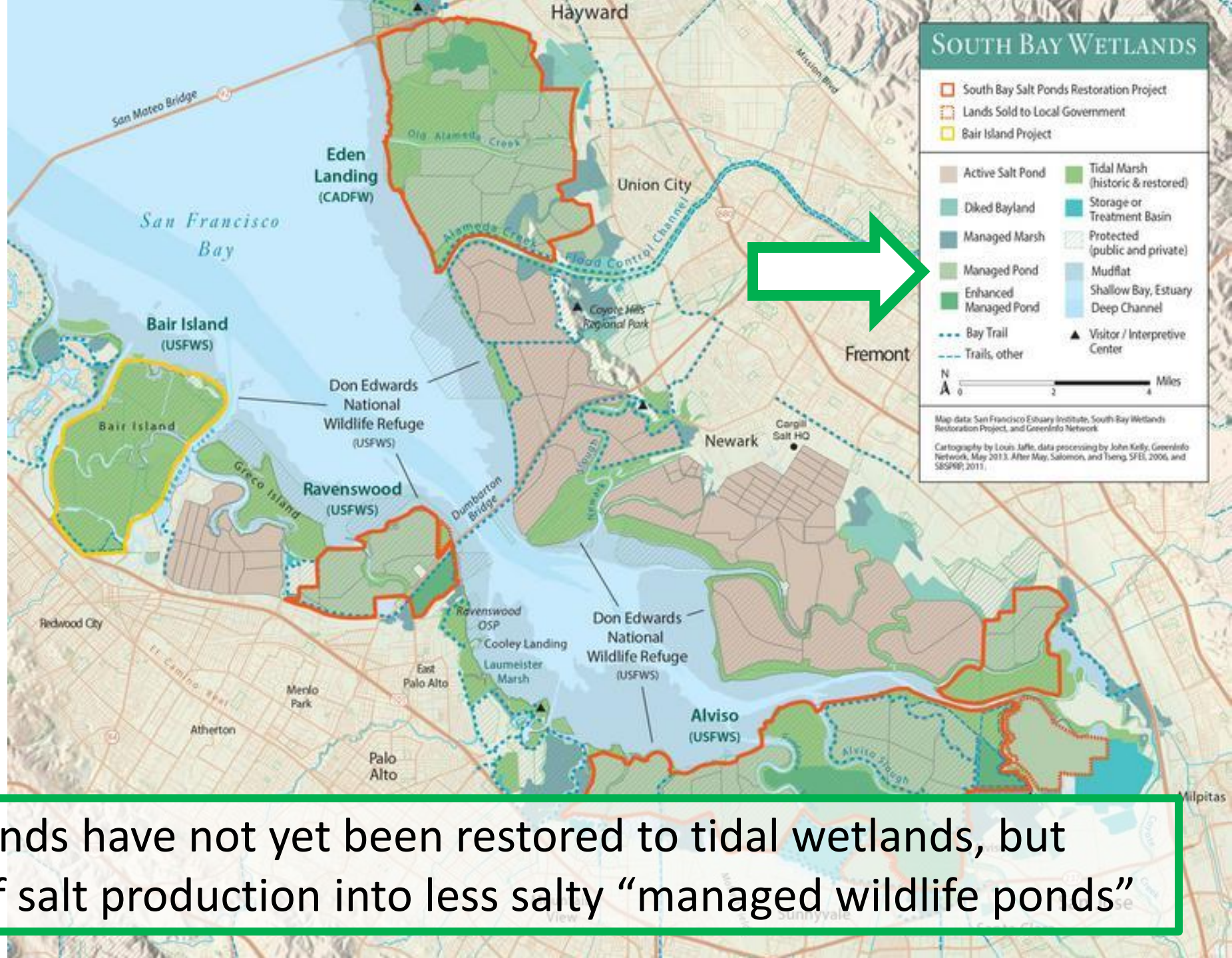
in marsh restoration, moving into high gear after a groundbreaking plan published in 1998. In recent years, local leaders have tackled these efforts with a new-found sense of urgency. Sea levels here could rise by as much as 2.1 metres by 2100, the California Natural Resources Agency estimates, and that would threaten electricity plants, transportation infrastructure and drinking-water facilities in the region — many of which lie low and close to the bay.

A view of a wetlands restoration project in Menlo Park, California.

CD CHRONICLE/POLARIS/EYEVINE



The South Bay Salt Pond Restoration Project



So far, most ponds have not yet been restored to tidal wetlands, but transitioned out of salt production into less salty “managed wildlife ponds”

Eventually, 50-90% of ponds will be breached to restore ponds to historical tidal marsh ecosystem

→ sediment is deposited → vegetation regrows → less habitat for some waterbirds

The Pacific Flyway

Each year, over 1 million waterbirds use San Francisco Bay as migratory or winter habitat – many in the salt ponds


Small Shorebirds


Medium Shorebirds


Herons & Egrets


Fisheaters


Diving Ducks


Dabbling Ducks


Terns

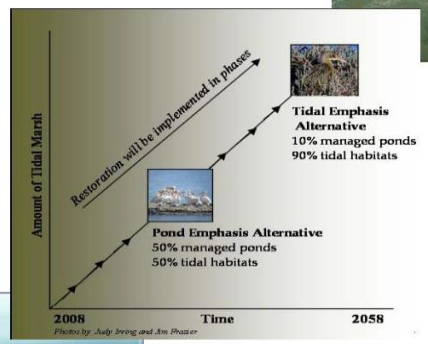

Gulls


Phalaropes


Eared Grebes

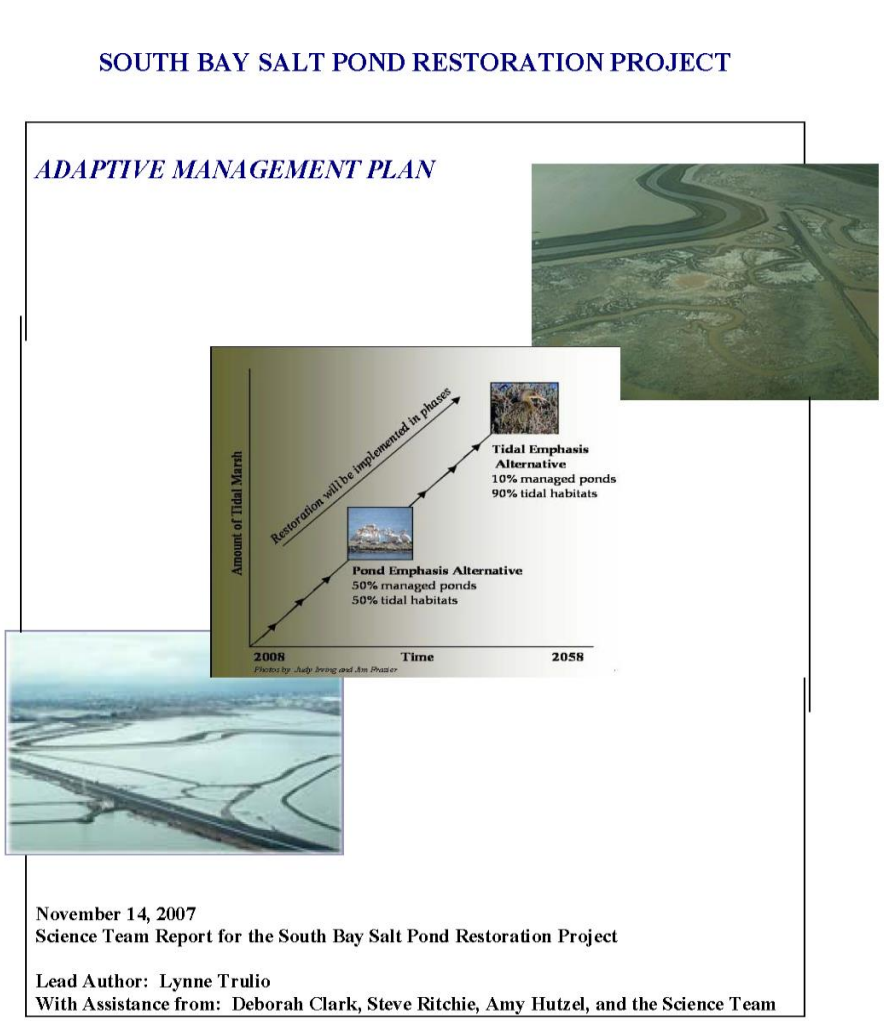
SOUTH BAY SALT POND RESTORATION PROJECT

ADAPTIVE MANAGEMENT PLAN



November 14, 2007
Science Team Report for the South Bay Salt Pond Restoration Project

Lead Author: Lynne Trulio
With Assistance from: Deborah Clark, Steve Ritchie, Amy Hutzel, and the Science Team



Waterbird Triggers:

2+ years of population X% below baseline

Species/Guild	Season	2005-2007 Baseline	AMP Threshold	NEPA/CEQA Threshold[B]
Diving ducks	Winter	39,645	-1%	-20%
Ruddy Ducks	Winter	12,602	-1%	-15%
Small shorebirds	Fall	60,623	-1%	-20%
	Spring	73,728	-1%	-20%
Least Terns	Summer	63	-1%	-1%
Eared Grebes	Winter	5,640	-25%[A]	-50%
Phalaropes	Summer	3,225	-25%[A]	-50%
Bonaparte's Gulls	Winter	1,270	-25%[A]	-50%

[A] Or <50% below the baseline in a single year

[B] Only if the decline is caused by Project actions

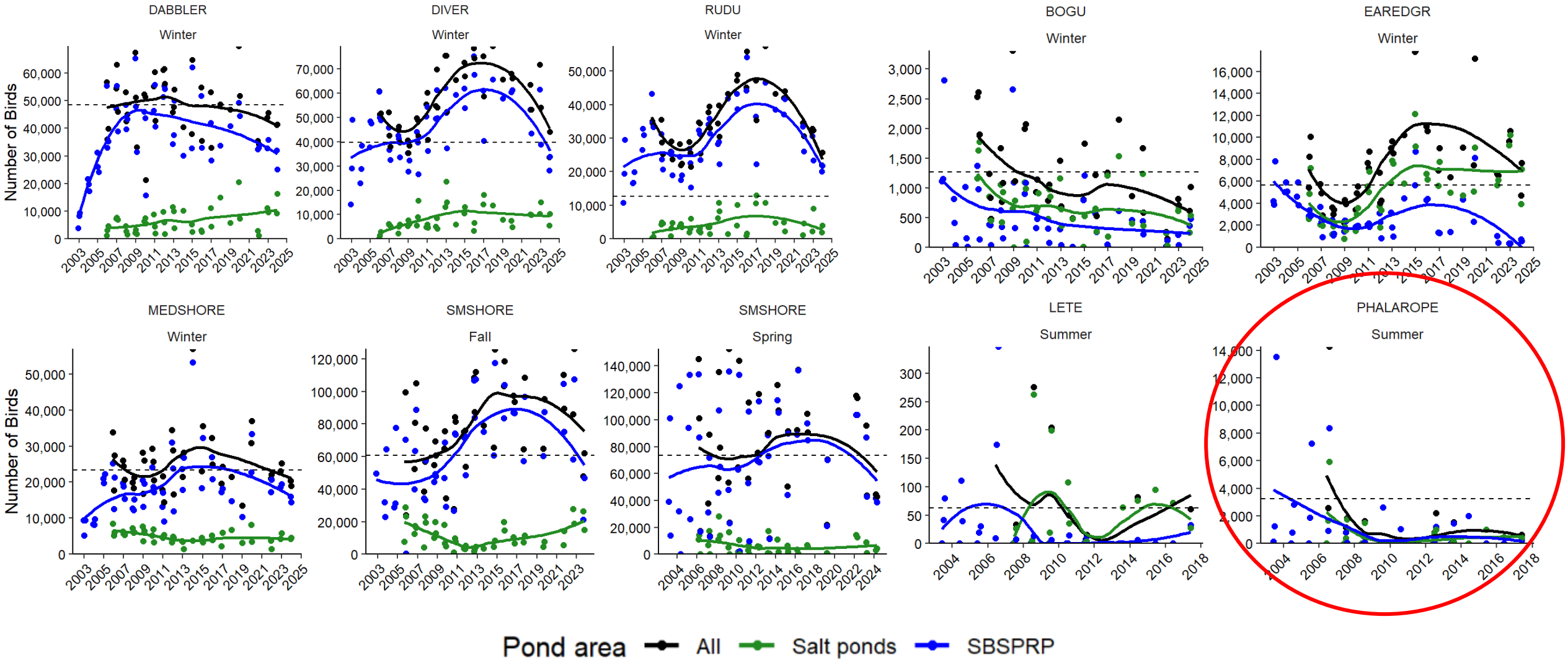
Waterbird Surveys

Count all waterbirds on each pond 2-3 times each season since 2003

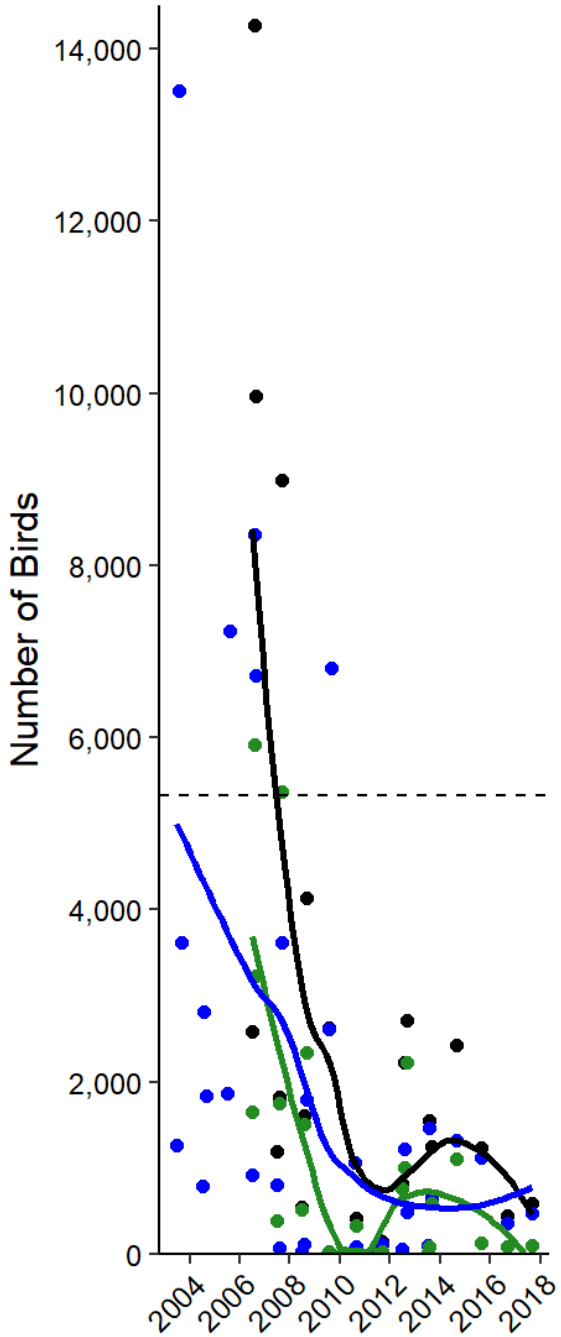
Conducted year-round
(summer surveys are now exclusively for target species)

Analysis is focused on each guild's "main" season(s)

Long-term trends for 9 species/guilds



Phalarope counts declined >50% from 2005-2007 baselines as early as 2010, exceeding both AMP and NEPA/CEQA thresholds



Black = total counts
Blue = restoration project
Green = active salt ponds

Wilson’s Phalarope
(*Phalaropus tricolor*)

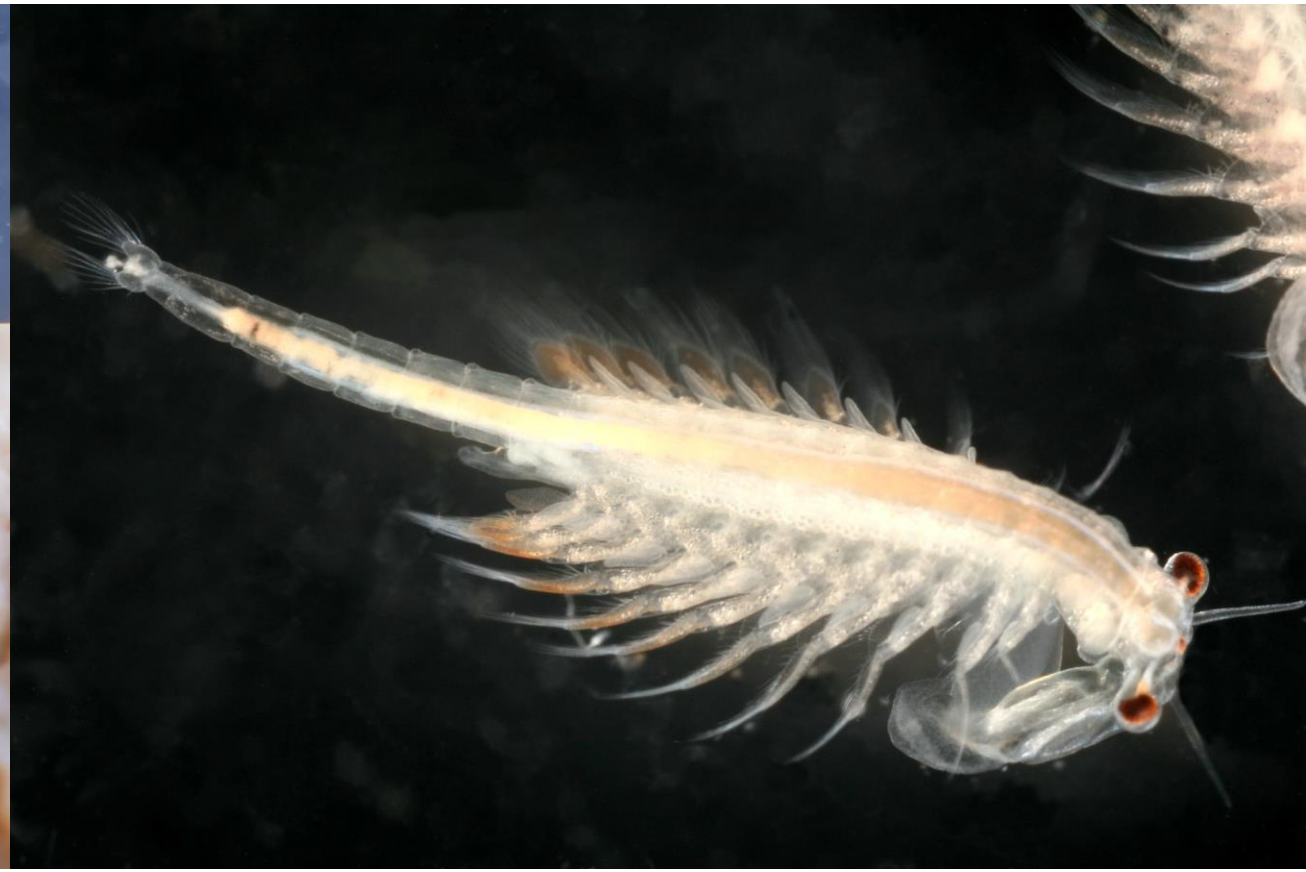
Red-necked Phalarope
(*Phalaropus lobatus*)

Phalaropes Foraging

Presumed Phalarope Prey

Brine Flies

(*Ephydra* spp.)



Brine Shrimp

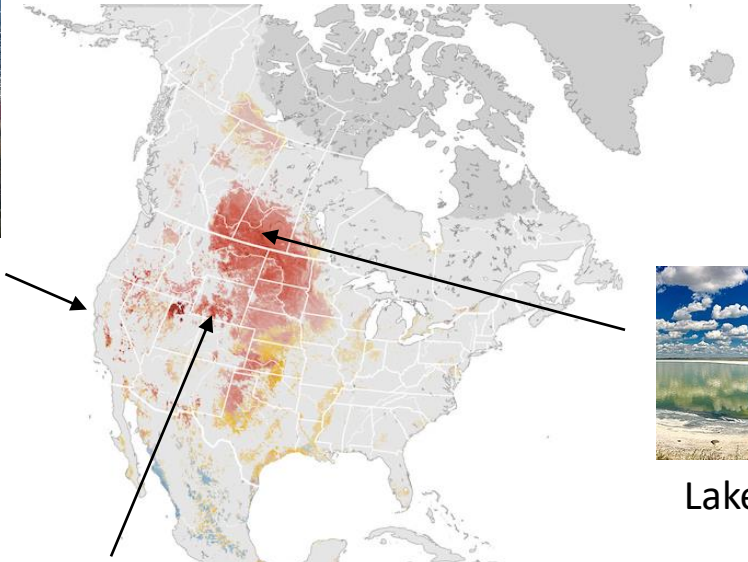
(*Artemia* spp.)

Wilson's Phalarope

Saline lake specialist during migration and in winter habitats

→ connects saline lakes in a hemispheric network

San Francisco Bay



Lake Chaplin, Canada

Great Salt Lake, USA

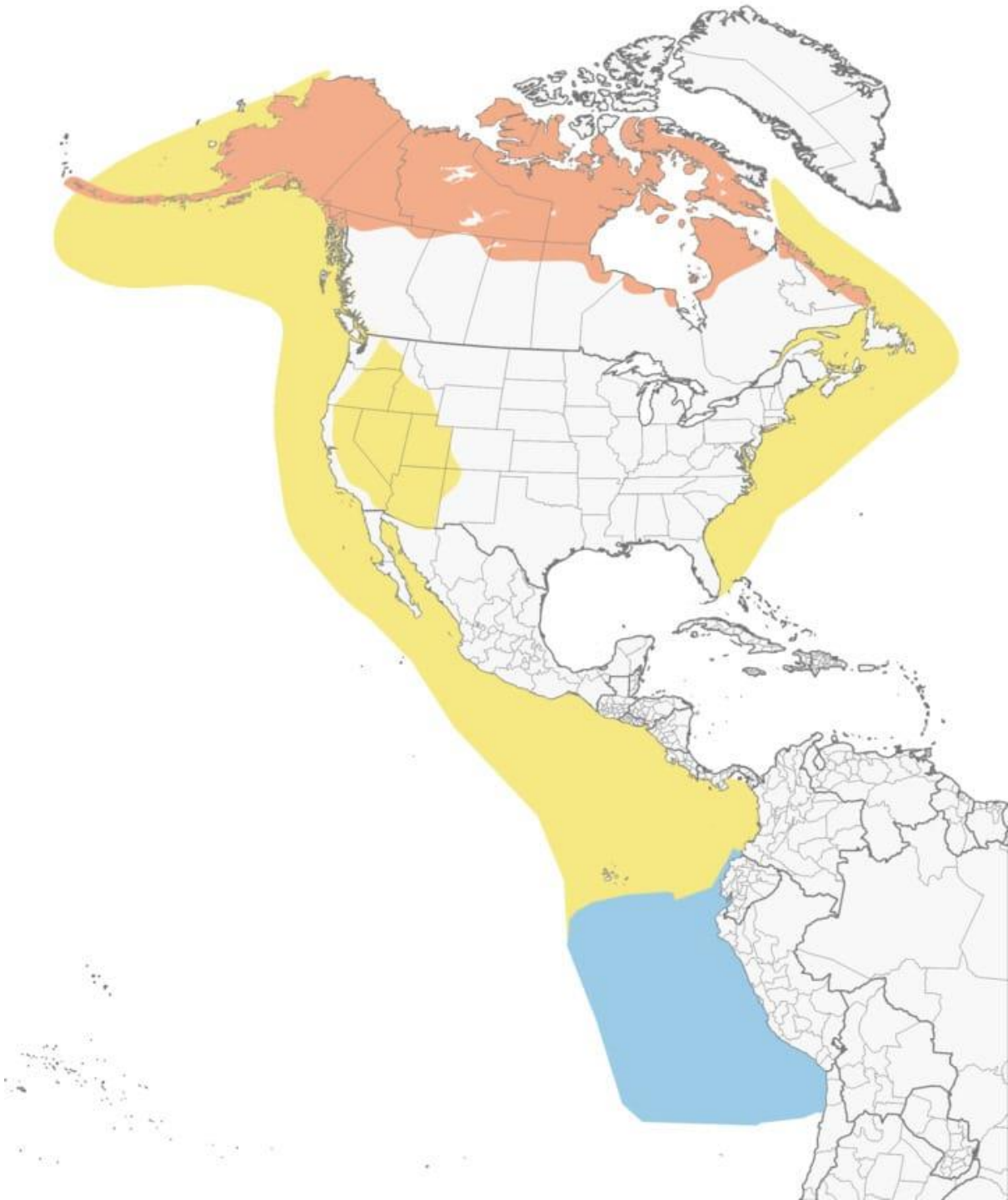
Laguna Santa Rose, Chile

Laguna Mar Chiquita, Argentina

Red-necked Phalarope

(*Phalaropus lobatus)*

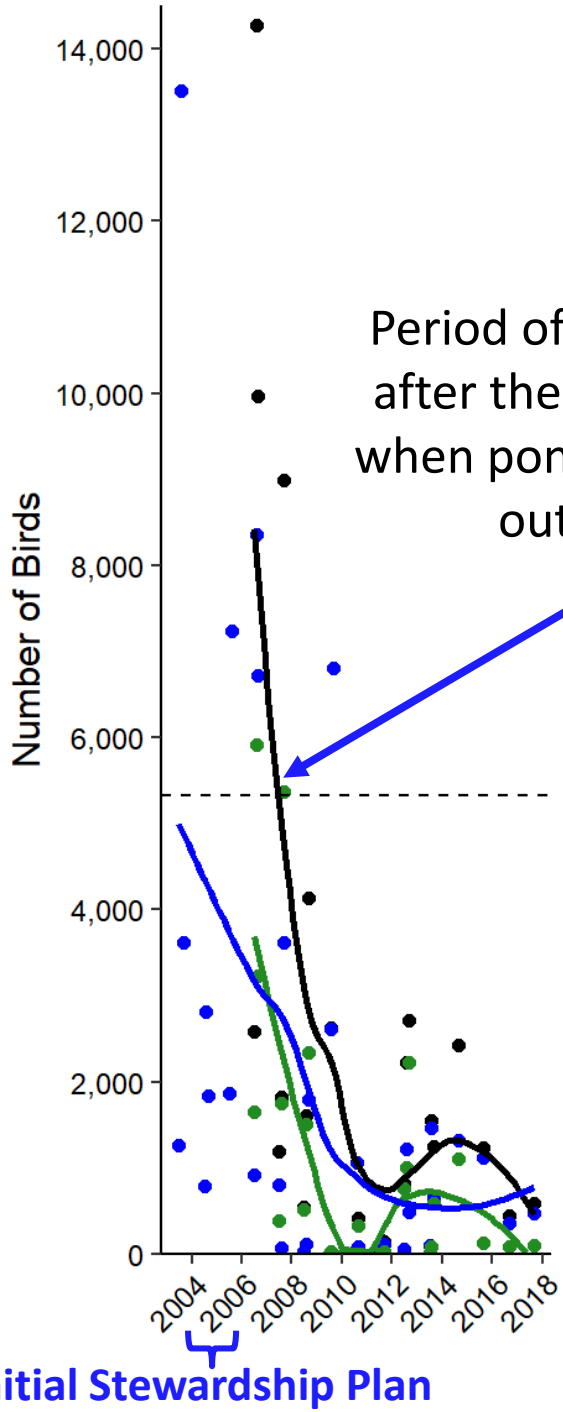
Uses saline lakes and coastal habitats during migration; over-winters in coastal waters



Phalarope counts declined >50% from 2005-2007 baselines as early as 2010, exceeding both AMP and NEPA/CEQA thresholds

Big question:

Was the decline caused by Restoration Project management actions?



Period of severe decline was right after the *Initial Stewardship Plan*, when ponds were first transitioned out of salt production **(salinity ↓)**

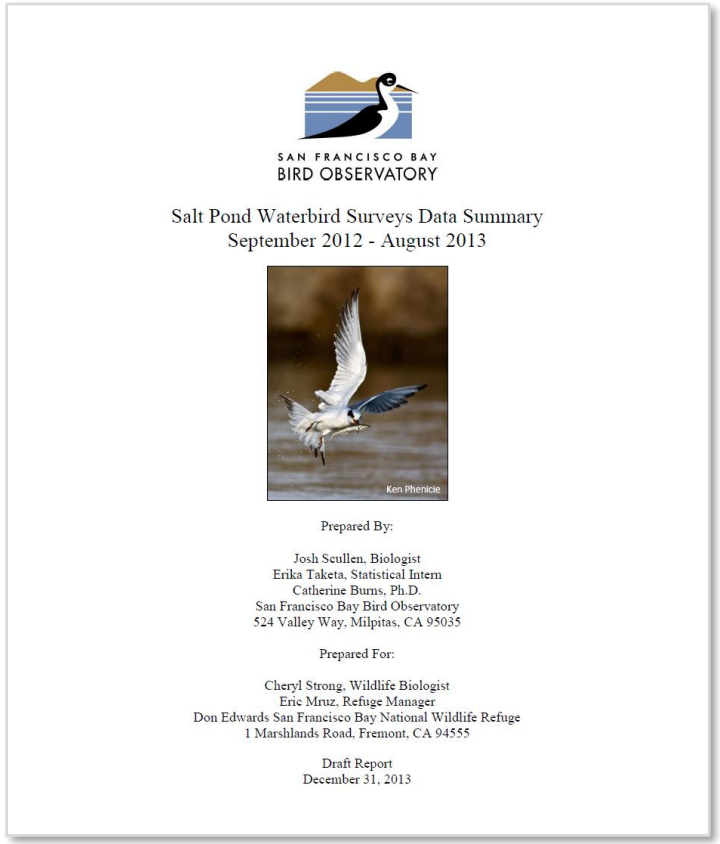
Black = total counts
Blue = restoration project
Green = active salt ponds

But phalaropes also declined very steeply within the remaining salt ponds

Past studies of habitat use

- Modeled abundance as a function of pond habitat characteristics
- Excelled at identifying what makes a pond good or bad habitat
- But didn't directly test what drives *declines* or *increases* over time

Scullen et al. 2013


SAN FRANCISCO BAY
BIRD OBSERVATORY

Salt Pond Waterbird Surveys Data Summary
September 2012 - August 2013

Ken Phenicie

Prepared By:

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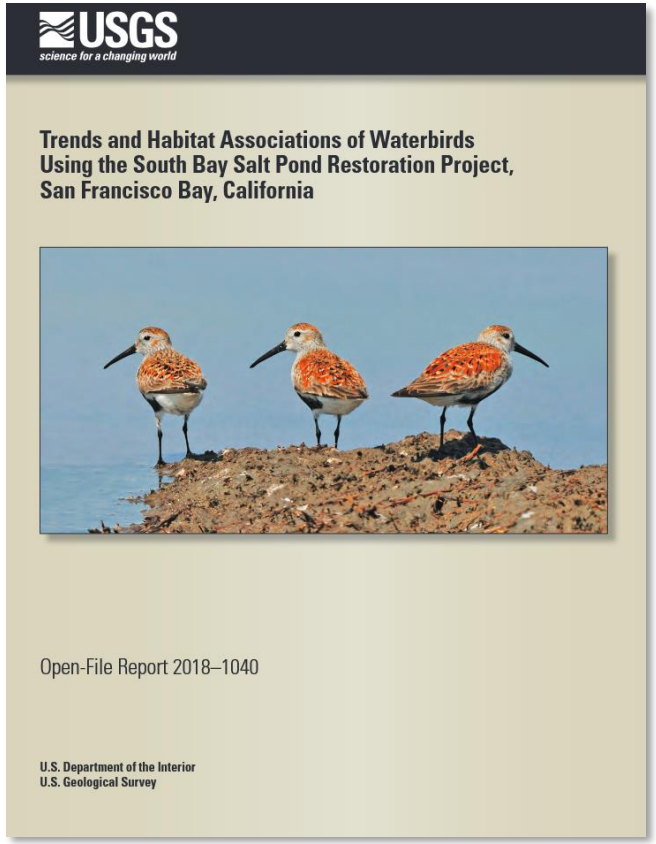
1 Marshlands Road, Fremont, CA 94555

Draft Report
December 31, 2013

Remaining salt ponds

De La Cruz et al. 2018

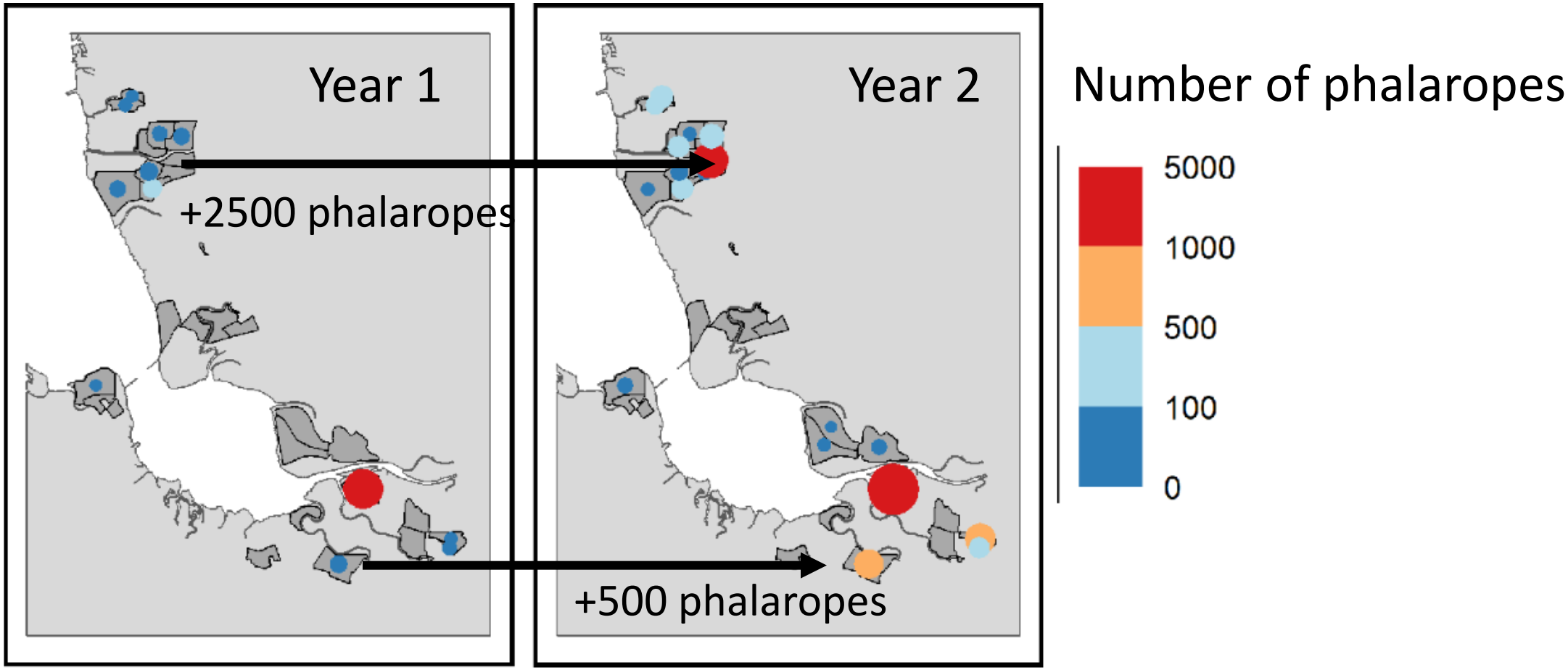

USGS
science for a changing world

Trends and Habitat Associations of Waterbirds Using the South Bay Salt Pond Restoration Project, San Francisco Bay, California

Open-File Report 2018–1040

U.S. Department of the Interior
U.S. Geological Survey

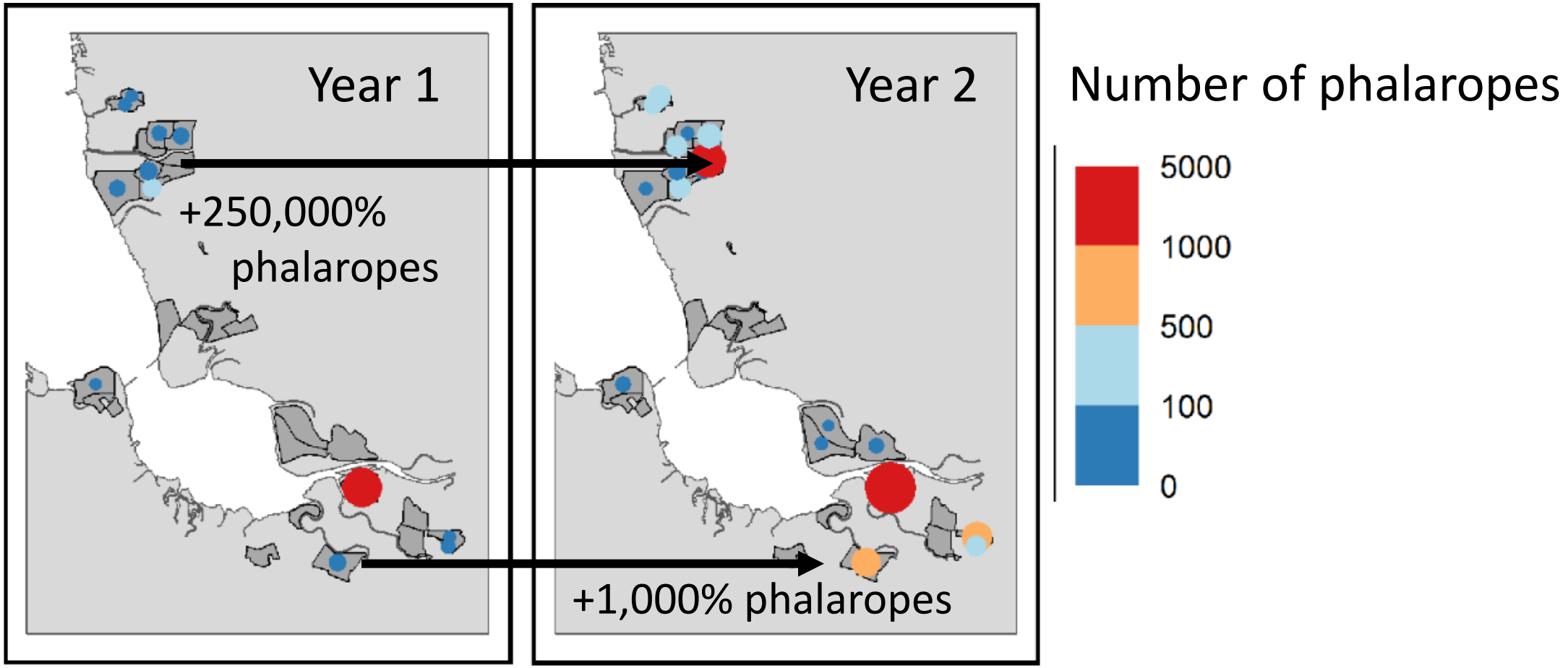
SBSPRP ponds (mostly)



Regression model: change in site-specific counts from year to year based on *changes* in habitat conditions

Change = $Year_2$ - $Year_1$

Change ~ β0 + β1* Salinity + β2 * ΔSalinity + …



Regression model: percent change in site-specific counts from year to year based on *changes* in habitat conditions

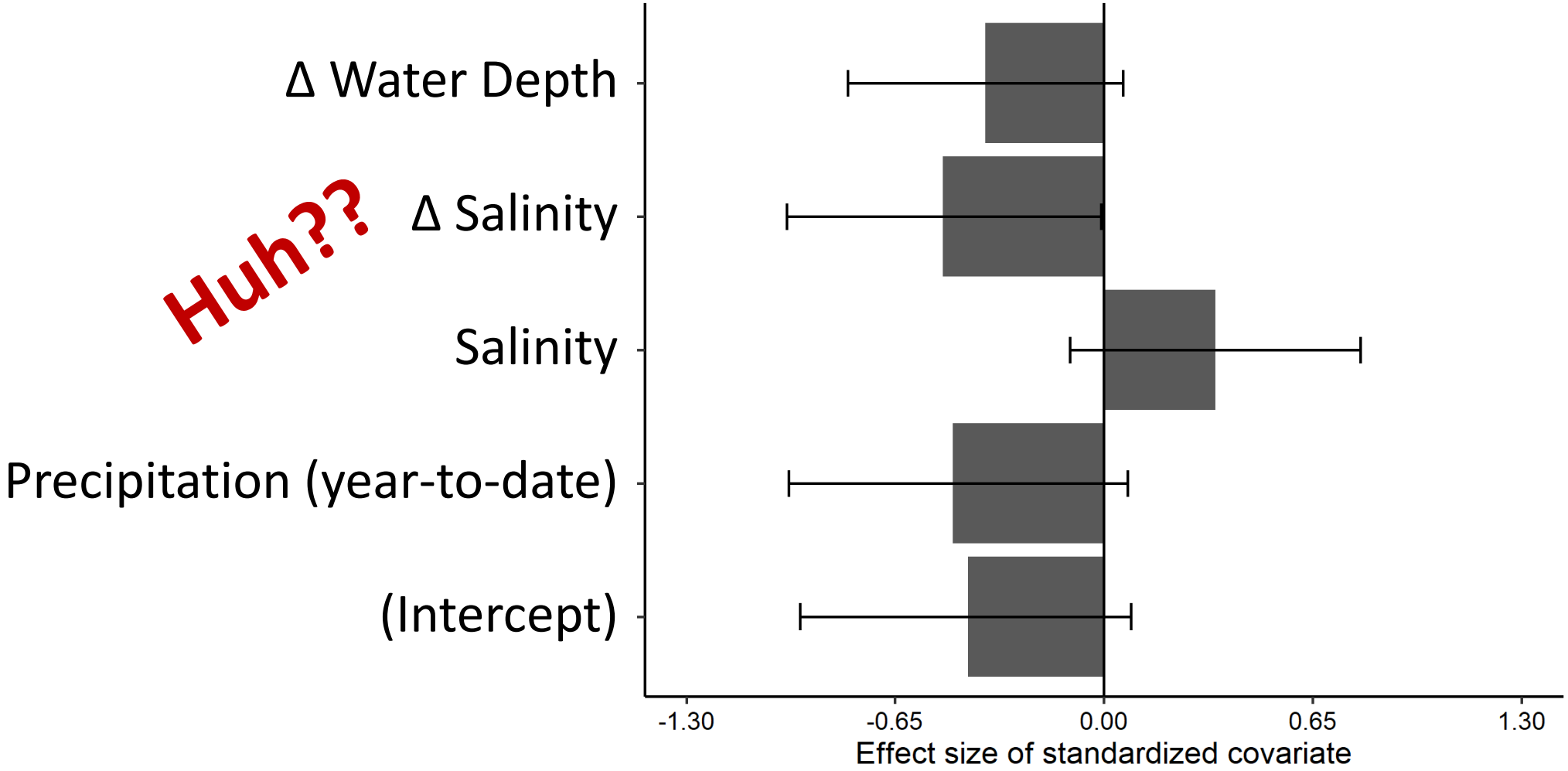
$$\text{PctChange} = \text{Ln}((\text{Year}_2 - \text{Year}_1) / (\text{Year}_1 + 1))$$

$$\text{PctChange} \sim \beta 0 + \beta 1 * \text{Salinity} + \beta 2 * \Delta\text{Salinity} + \ldots$$

Variables Assessed

Class	Name	Description	Change model
Pond characteristics	Area_km2	Pond area	Static
	Islands_num	Number of islands	Static
	OpenPublic_pct	Maximum % of levees open to public across all years	Static
	OpenHunting_pct	Maximum % of levees open for hunting across all years	Static
	BayDist_km	Distance to San Francisco Bay	Static
	CreekDist_km	Distance to creek/slough	Static
	LandfillDist_km	Distance to Tri-cities Landfill	Static
Hydrology	Breached	Breached to restore tidal wetland	Annual
	WaterElev_m	Mean water depth	Change
Water quality	Salinity	Mean salinity	Annual + Change
	pH	Mean pH	Annual + Change
	LDO_mgL	Mean dissolved oxygen	Annual + Change
	Temp_C	Mean water temperature	Annual + Change
Climate	PPT0	Cumulative annual precipitation – year-to-date	Annual
	PPT1	Cumulative annual precipitation – last year's only	Annual
	PPT3	Cumulative annual precipitation – last three years	Annual
	TMX	Mean daily maximum temperature for the season	Annual
	TMN	Mean daily minimum temperature for the season	Annual

Drivers of change in phalarope counts (2003-2018)



Huh??

Relationship: ↑↓ or ↓↑ ↑↑ or ↓↓

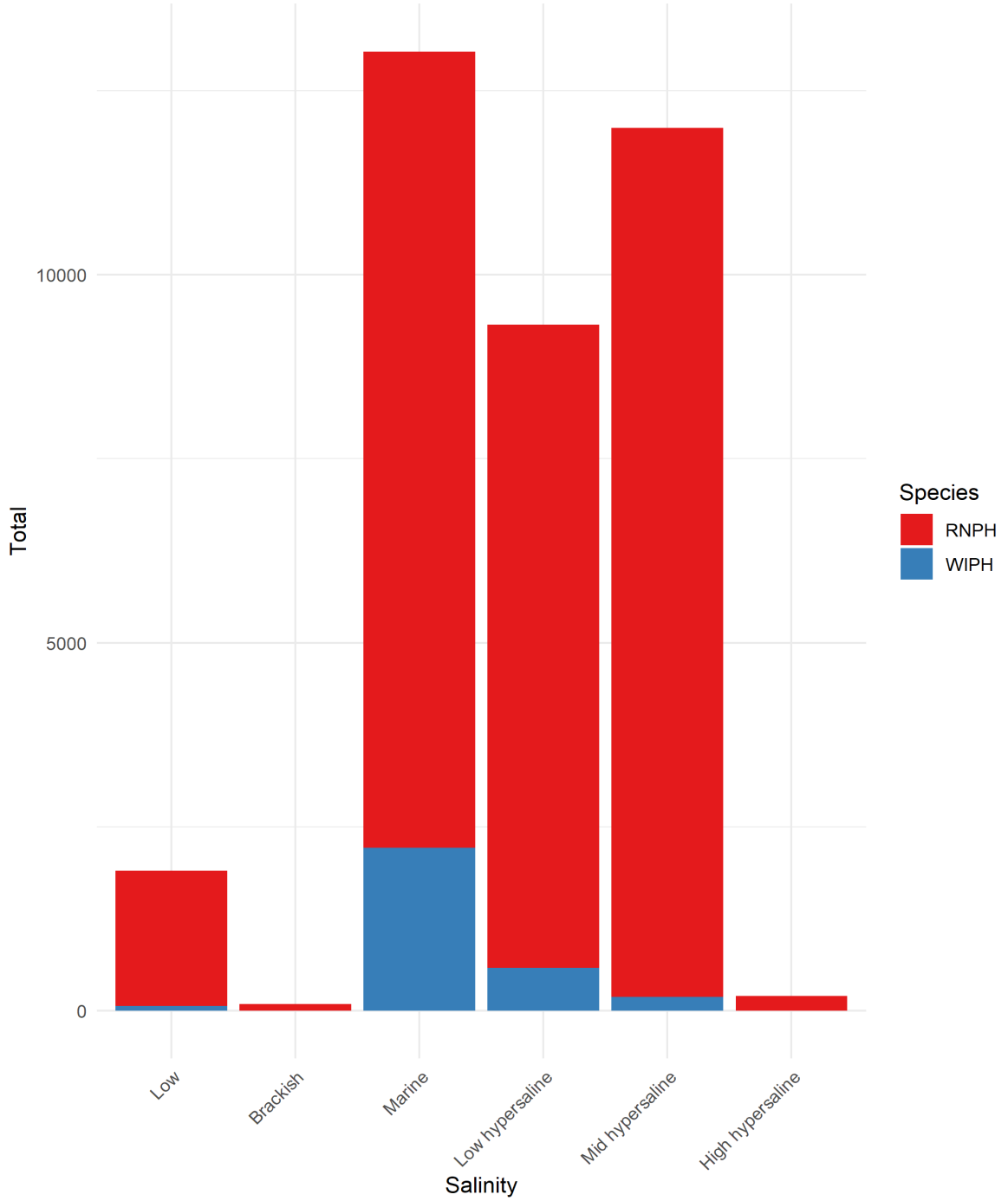
Salinity Ranges for Phalarope Prey Items

Lower	Upper	Name	Notes
0	2	Near-fresh	Freshwater up to the range of irrigation water
2	30	Brackish	Typical range observed in estuarine systems
30	50	Marine	Lower optimal limit for *Ephydra* and *Artemsia*; 42 ppt is the upper limit for *E. millbrae*
50	80	Low hypersaline	Upper optimal limit for *Ephydra* and *Artemsia*
80	150	Mid hypersaline	Fish generally absent; high range may be upper limit for *Ephydra* and *Lipochaeta slossonae*
150	+	High hypersaline	Increasingly only *Artemia* survive, which reach tolerances by 200 ppt

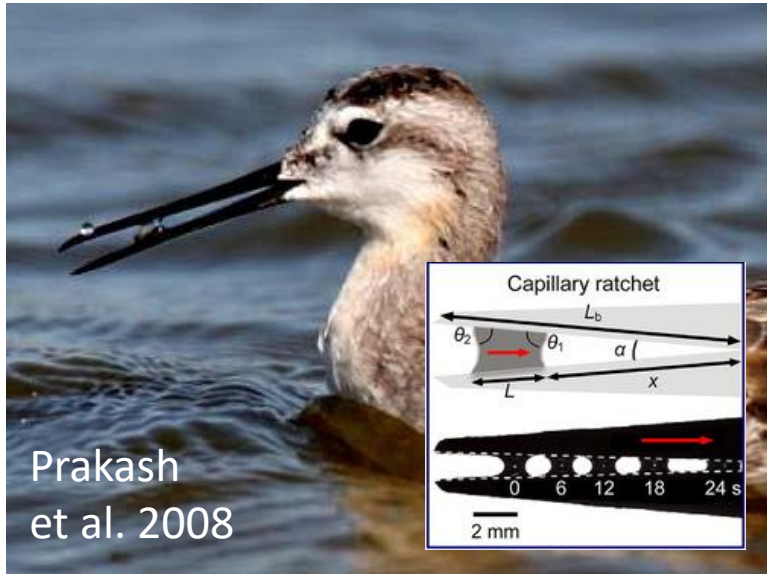
Adapted Takekawa et al. 2006 (adjusted with other sources)

Phalarope abundance is highest at marine to moderately hypersaline (30 – 150 ppt)

Extremely hypersaline ponds (>150 ppt) avoided



Foraging Observations

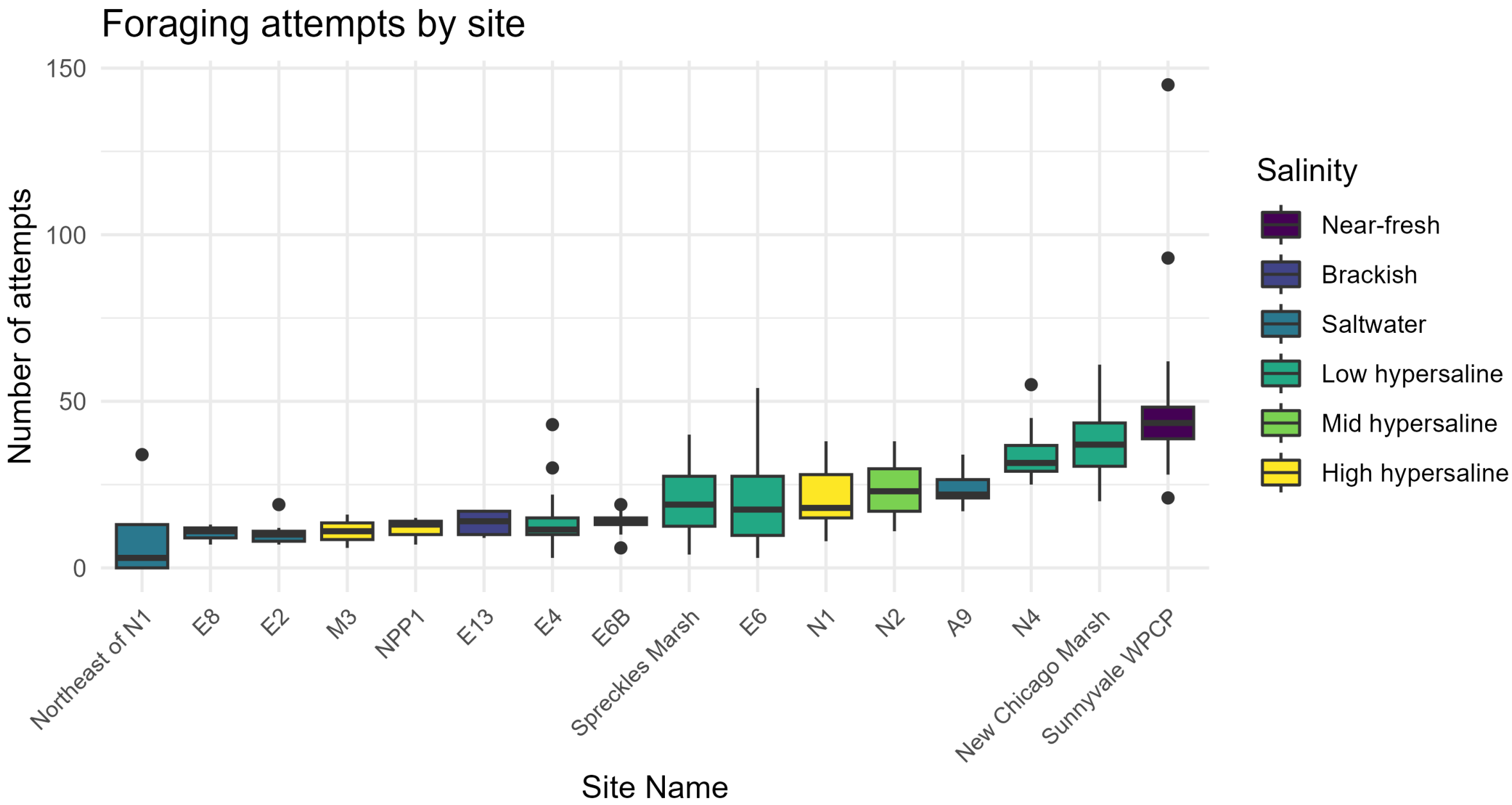


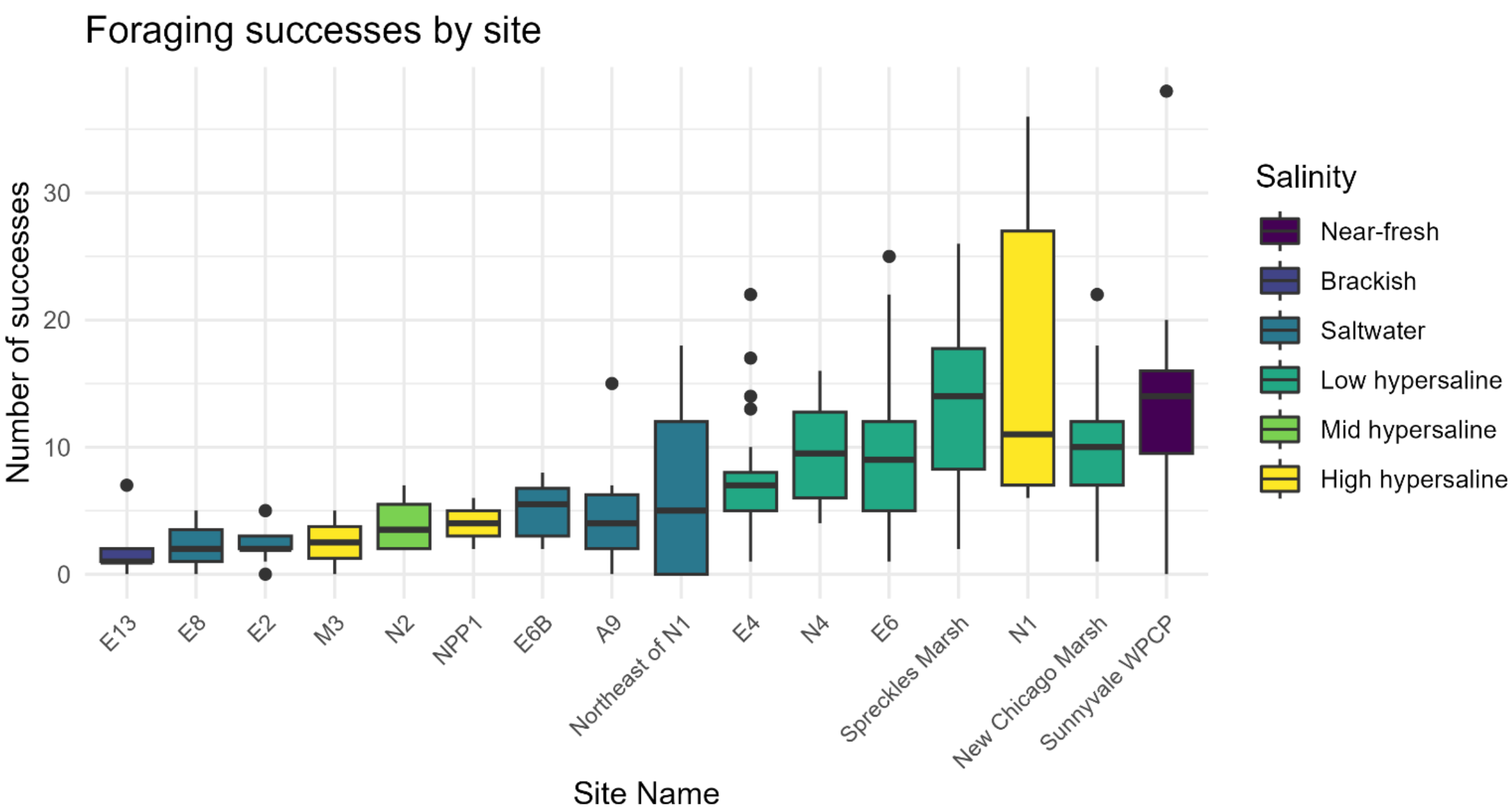
<u>Recorded</u>

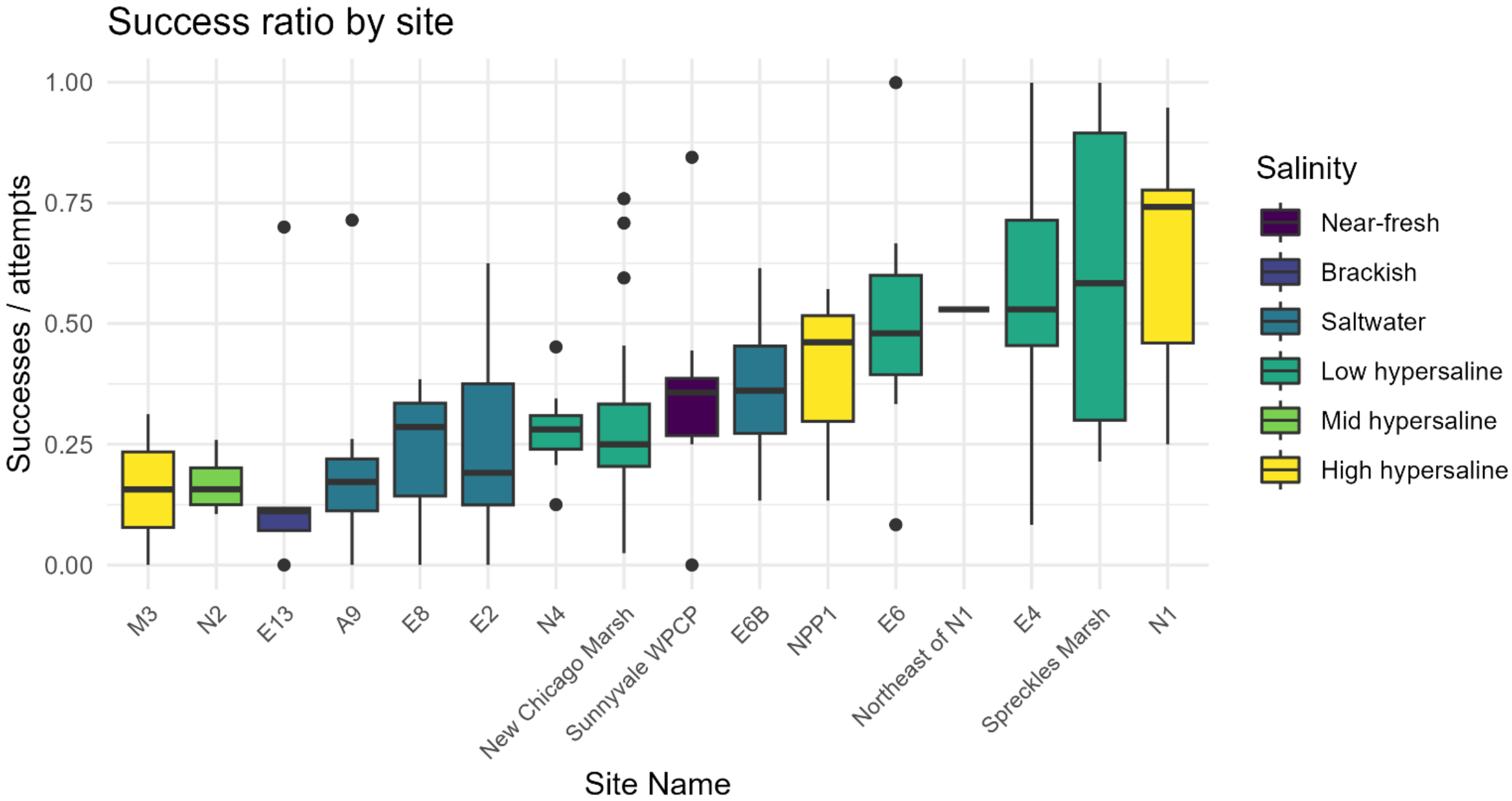
of *attempts* (pecks)

of *succesess* (beak opens)

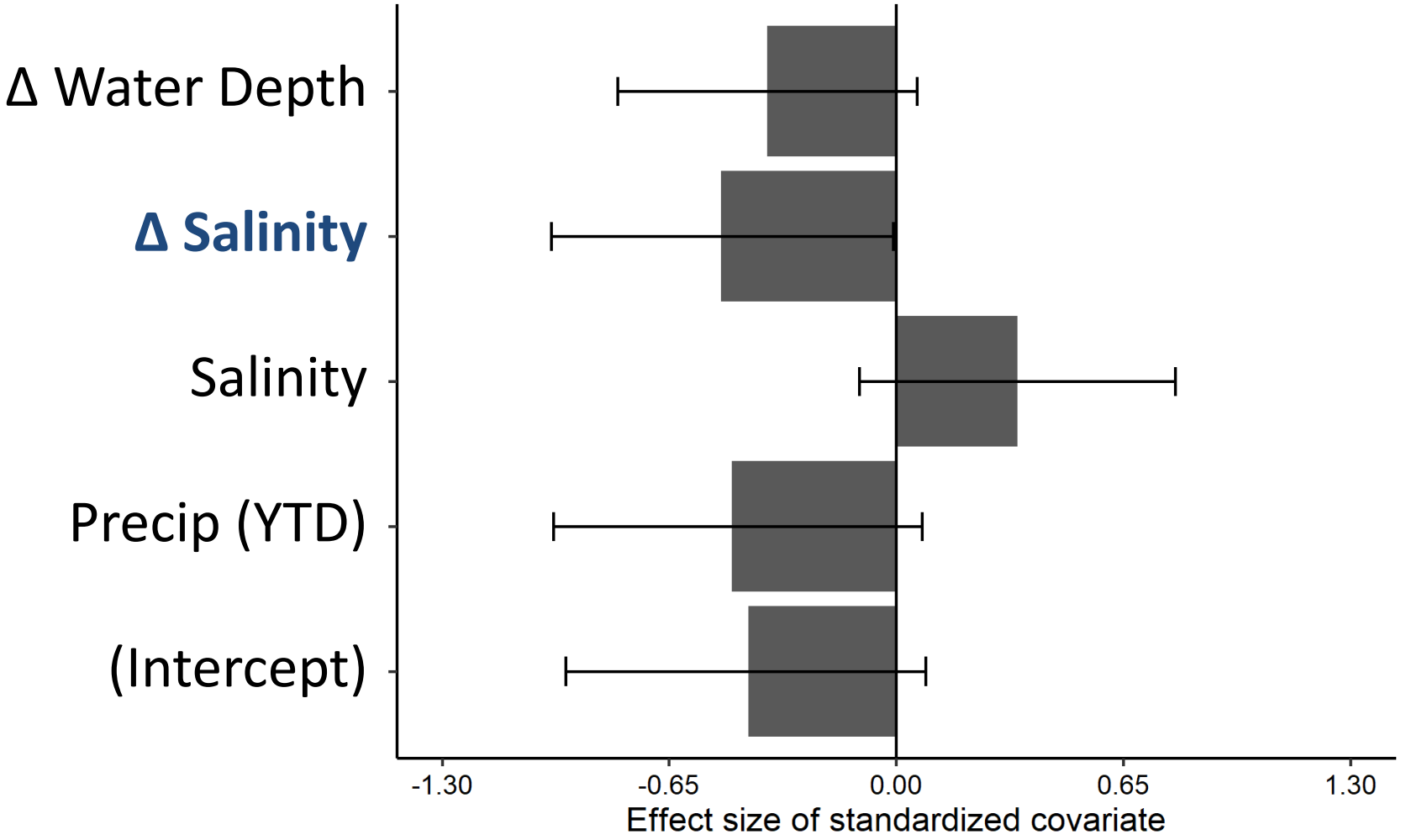
Rubega & Obst 1993

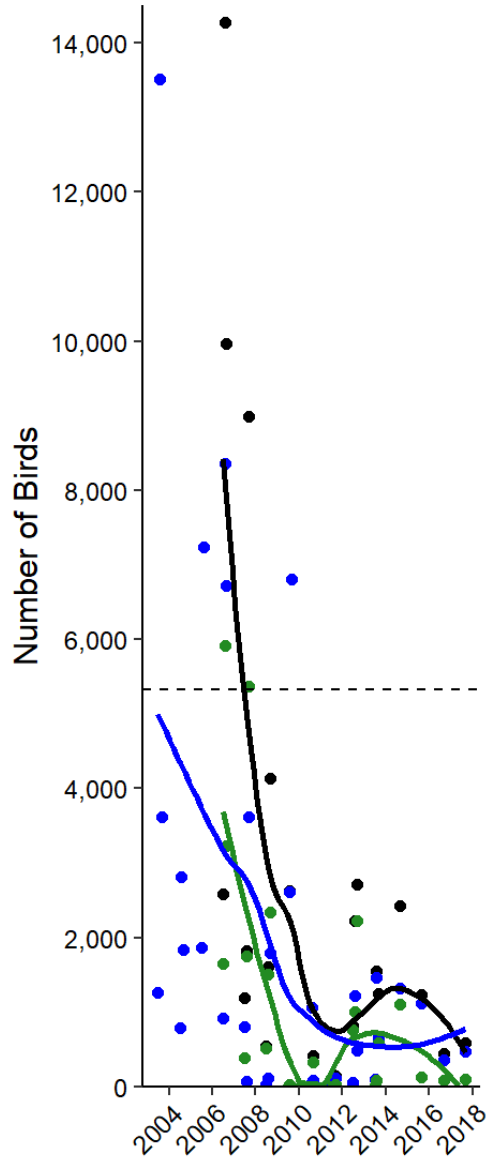

Foraging attempts by site
150
100
50
0
Number of attempts
Northeast of N1
E8
E2
M3
NPP1
E13
E4
E6B
Spreckles Marsh
E6
N1
N2
A9
N4
New Chicago Marsh
Sunnyvale WPCP
Site Name
Salinity
Near-fresh
Brackish
Saltwater
Low hypersaline
Mid hypersaline
High hypersaline

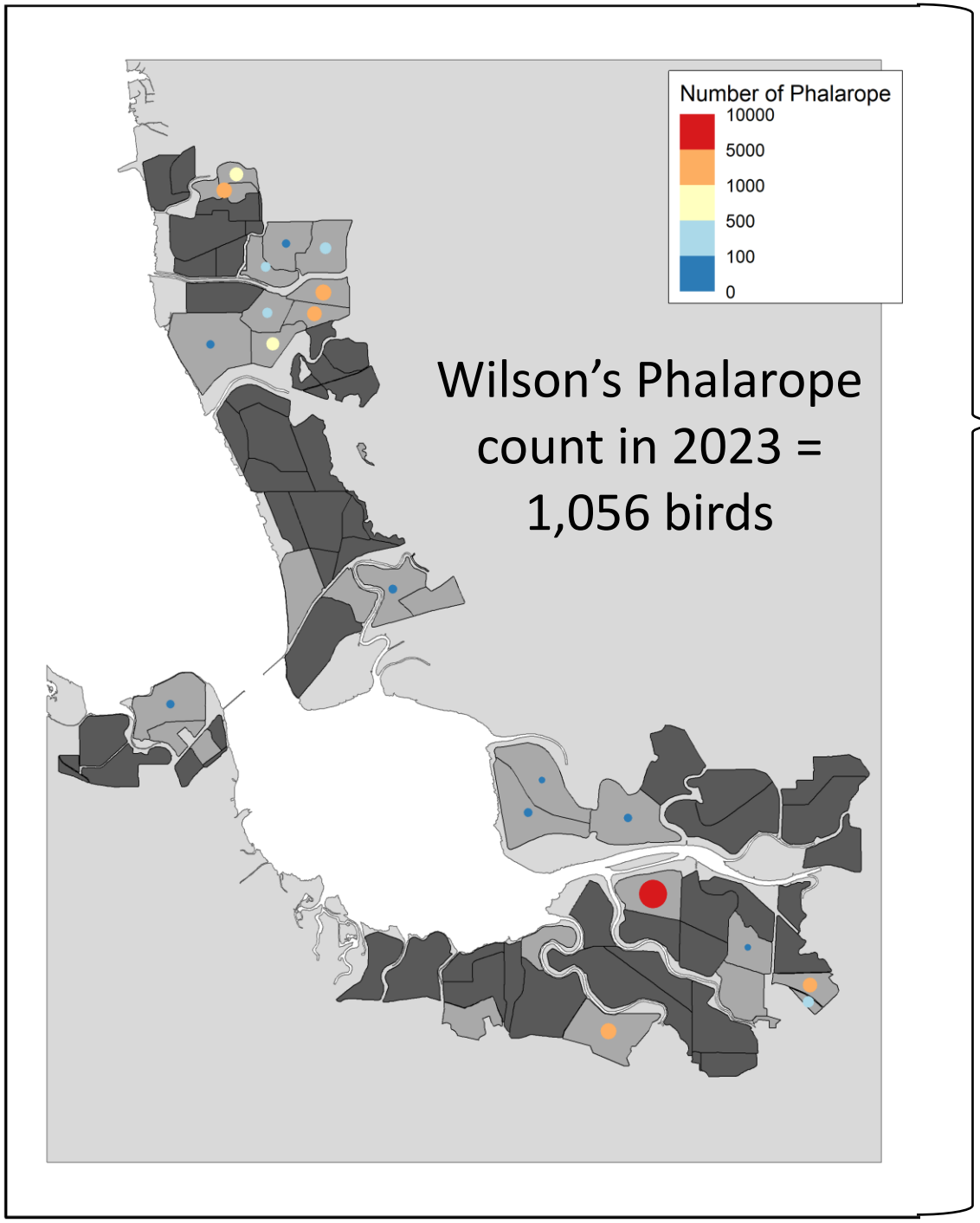

Foraging successes by site
Number of successes
0
10
20
30
E13
E8
E2
M3
N2
NPP1
E6B
A9
Northeast of N1
E4
N4
E6
Spreckles Marsh
N1
New Chicago Marsh
Sunnyvale WPCP
Site Name
Salinity
Near-fresh
Brackish
Saltwater
Low hypersaline
Mid hypersaline
High hypersaline


Success ratio by site
Successes / attempts
1.00
0.75
0.50
0.25
0.00
M3
N2
E13
A9
E8
E2
N4
New Chicago Marsh
Sunnyvale WPCP
E6B
NPP1
E6
Northeast of N1
E4
Spreckles Marsh
N1
Site Name
Salinity
Near-fresh
Brackish
Saltwater
Low hypersaline
Mid hypersaline
High hypersaline

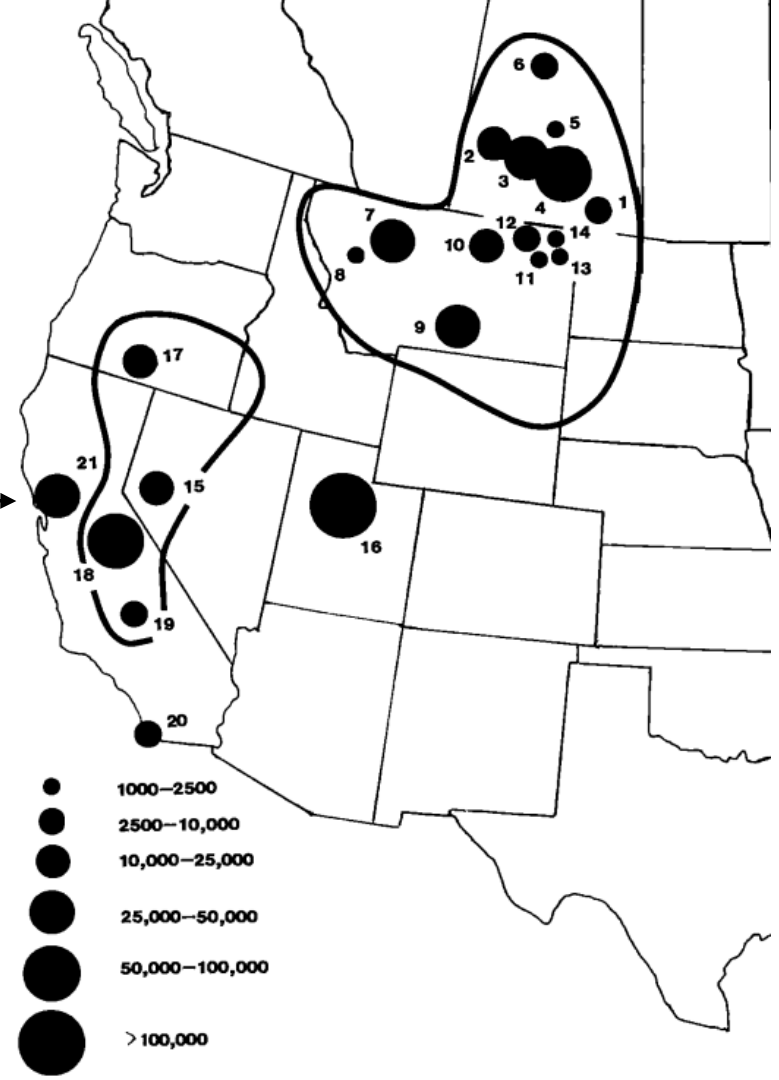
That might explain this… **but then what about this?**



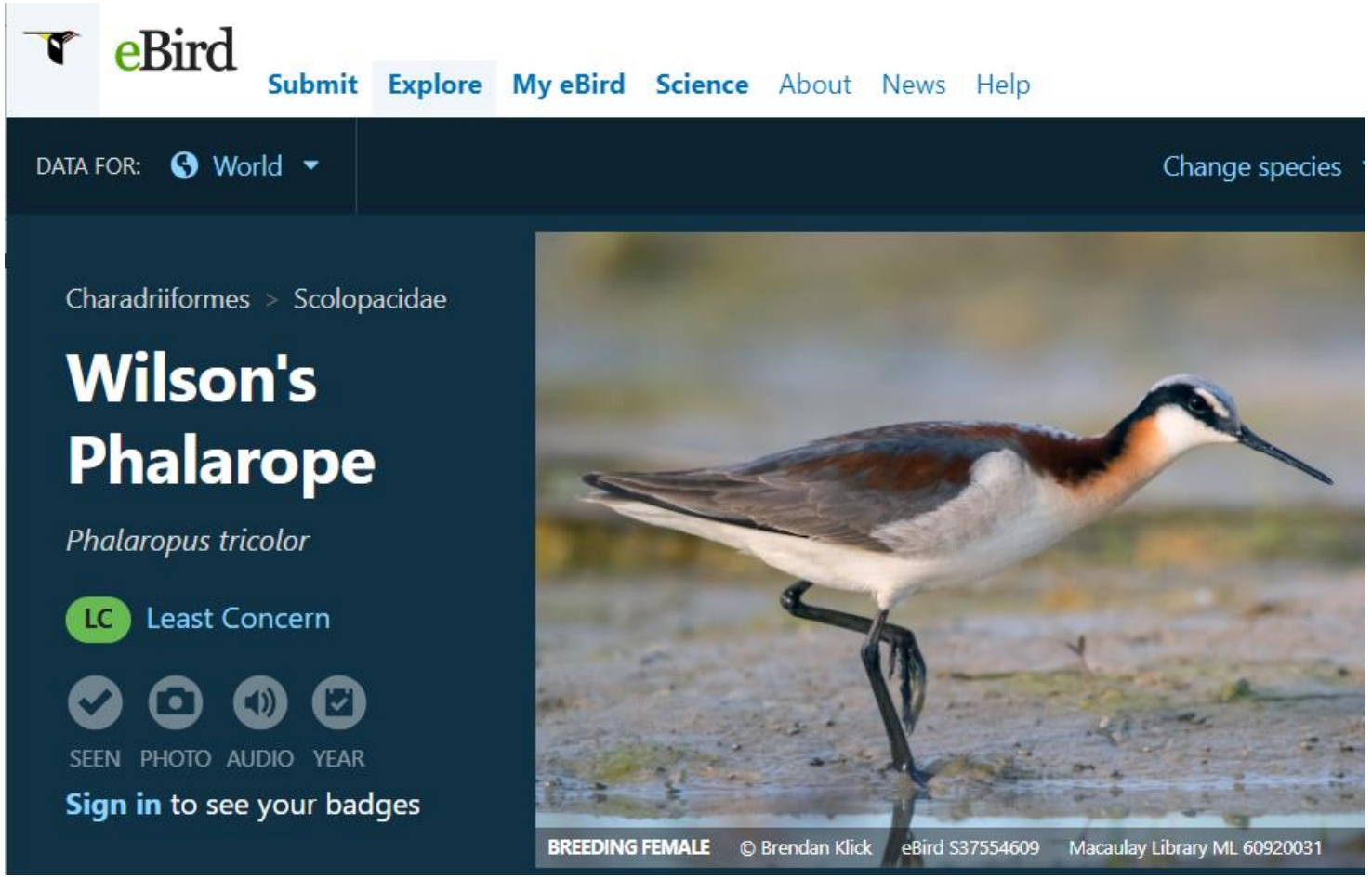




Wilson's Phalarope count in 2023 = 1,056 birds



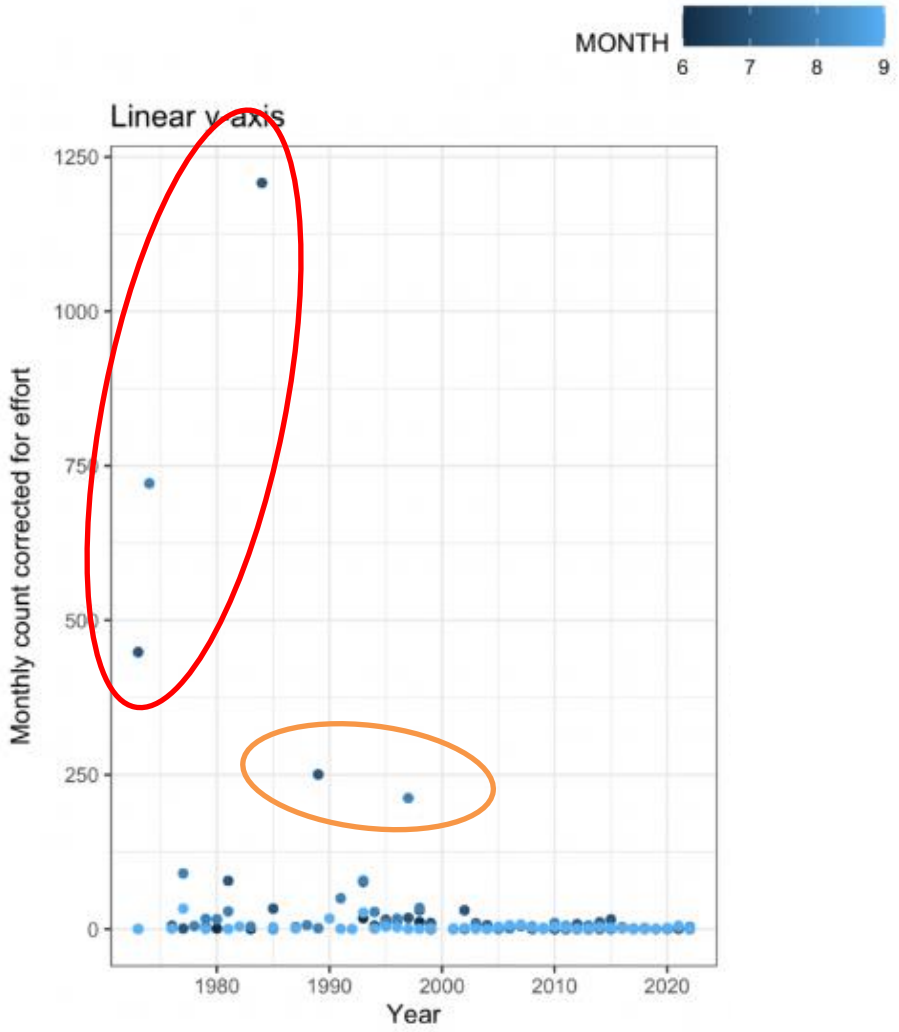
SFB Wilson's Phalarope count in 1986 = 40,000 birds (Jehl 1988)



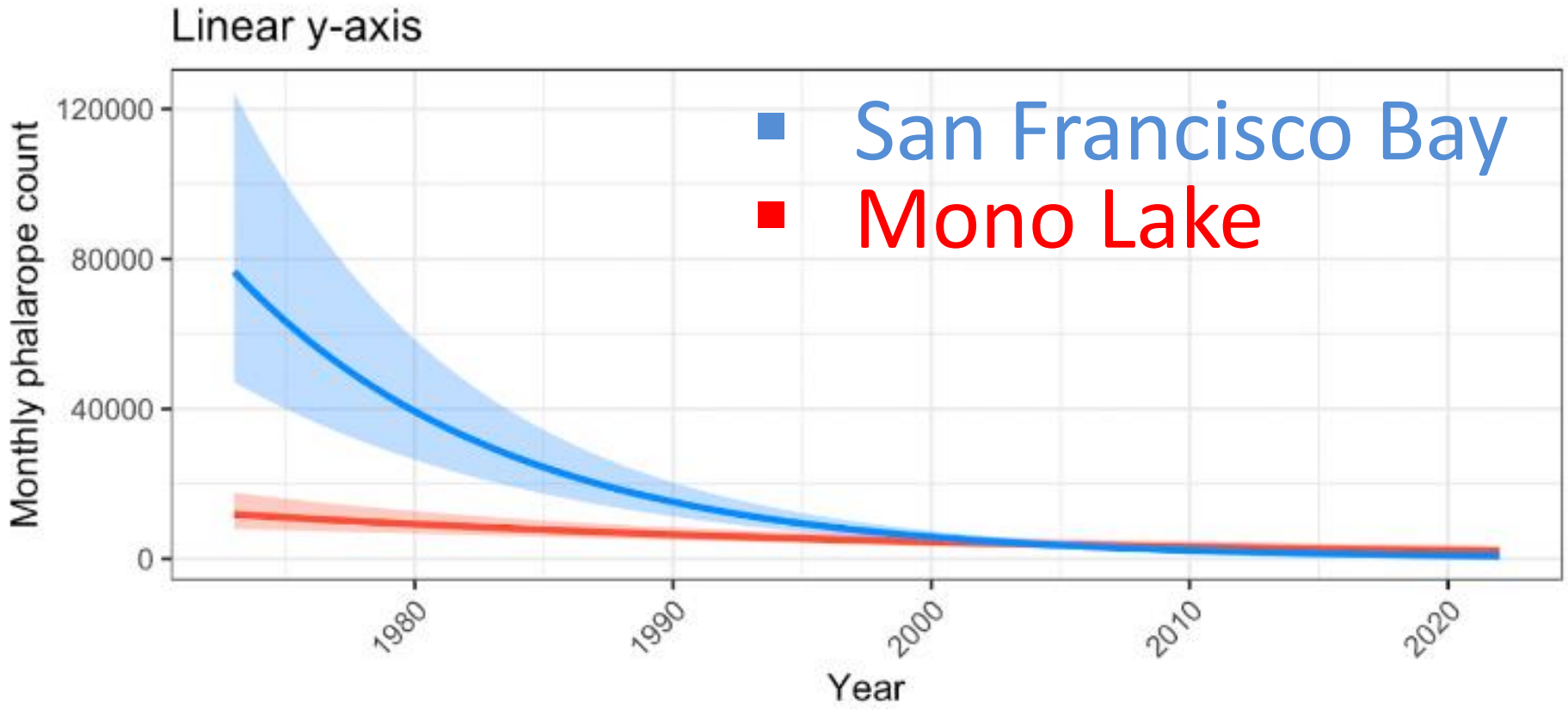
Because there were no scientific surveys of phalaropes in SF Bay from 1986-2003, we looked at eBird data to see if the decline predated the Restoration Project

eBird phalarope data (SFB)

- Lots of variability in counts from year to year, but repeated **high counts** up to late 1990s
- Linear scale shows some **very high counts** in 1970s-1980s
- Log scale shows consistent decline

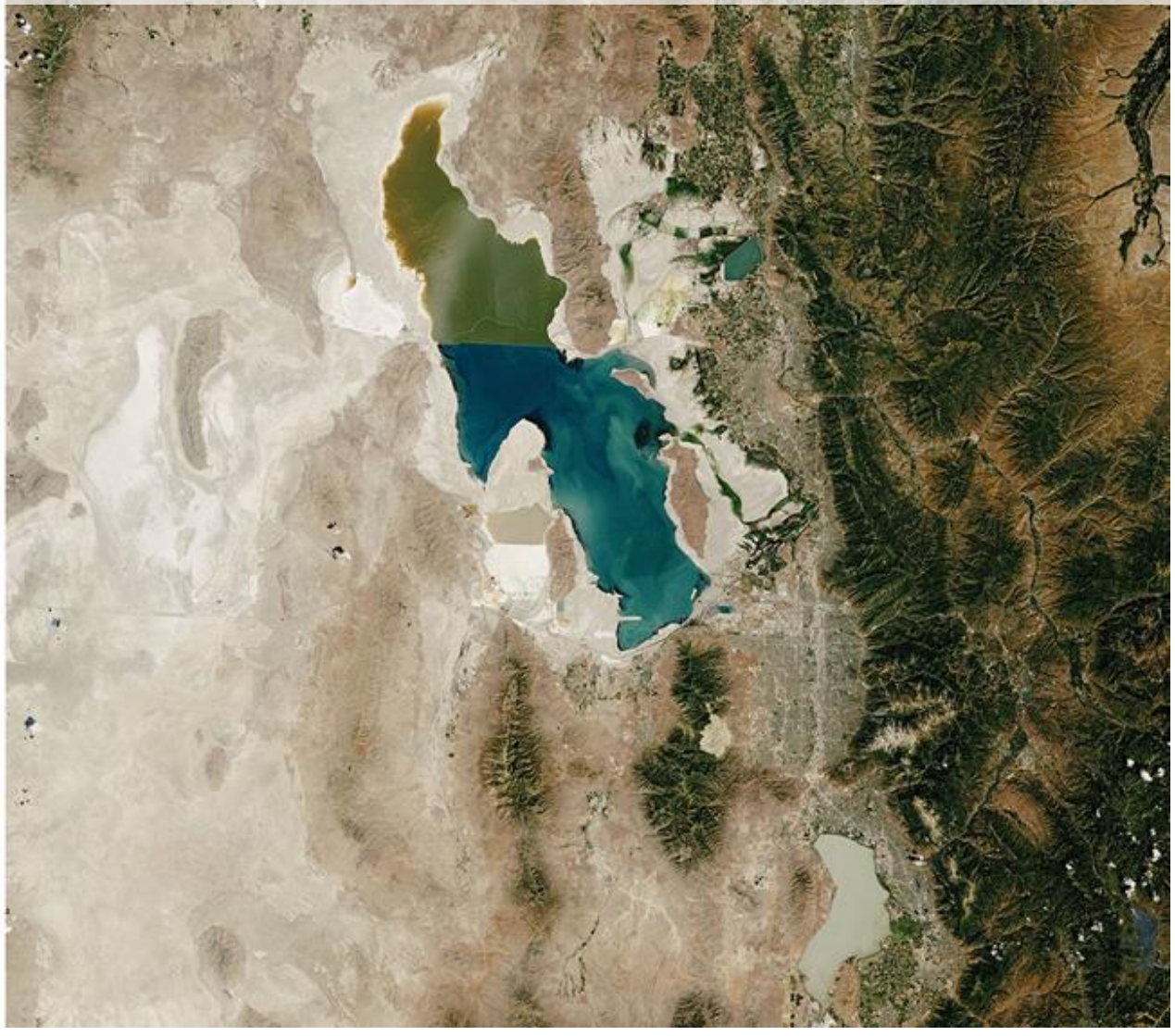


eBird Model with trendline (linear scale)



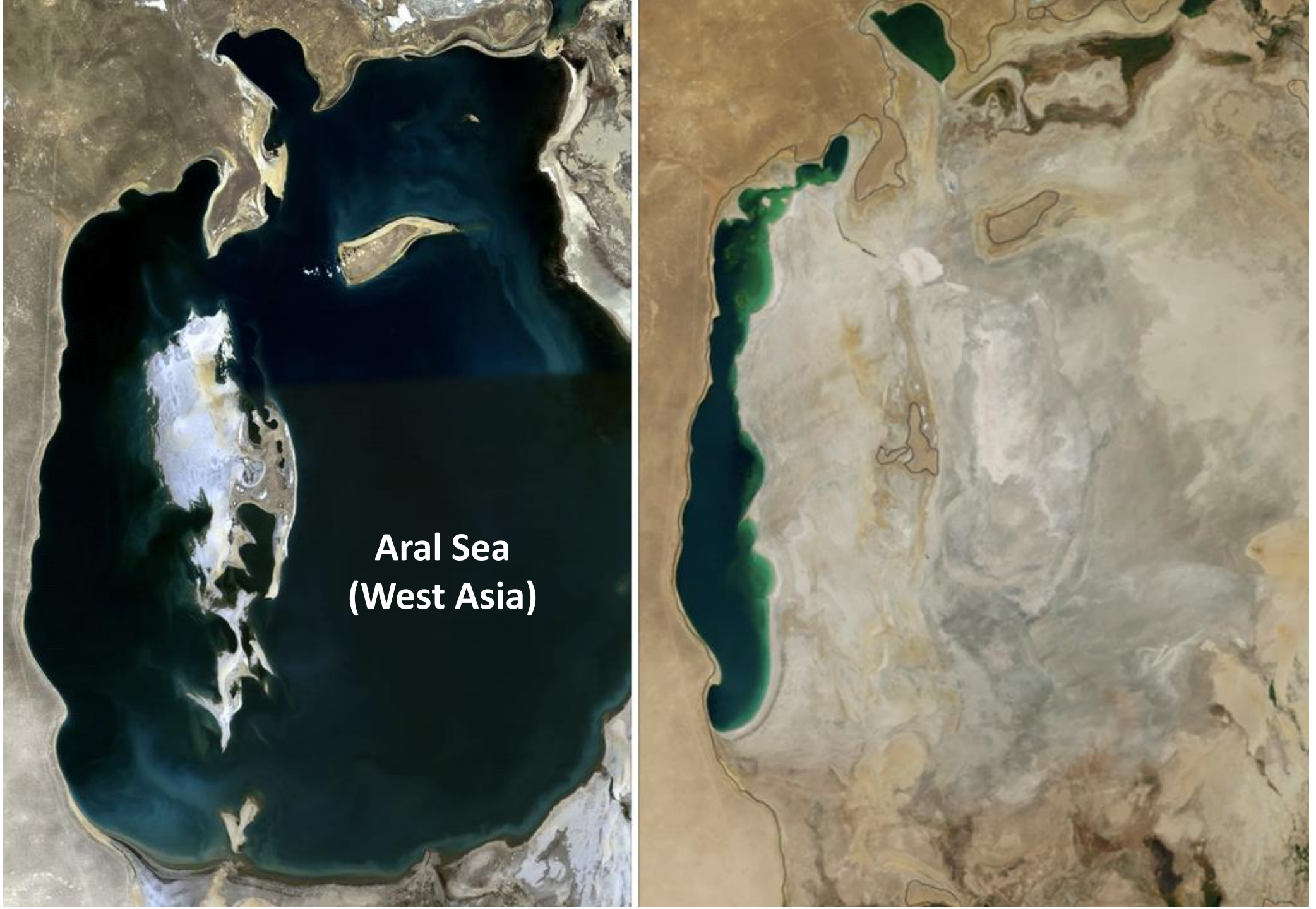
Annual trendline indicates steepest decline occurred prior to 2000 – before the start of the Restoration Project

Saline Lakes: in Danger of Collapse Worldwide

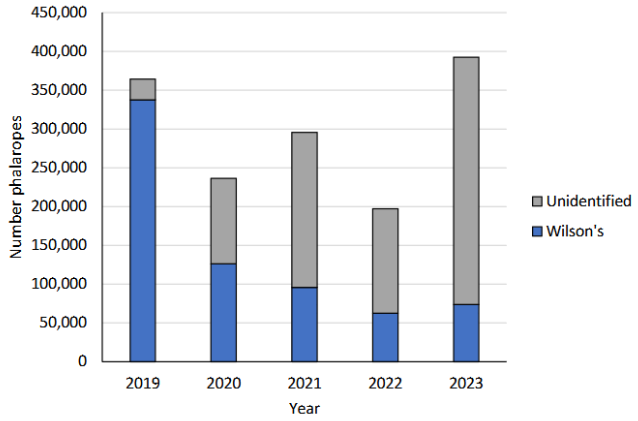


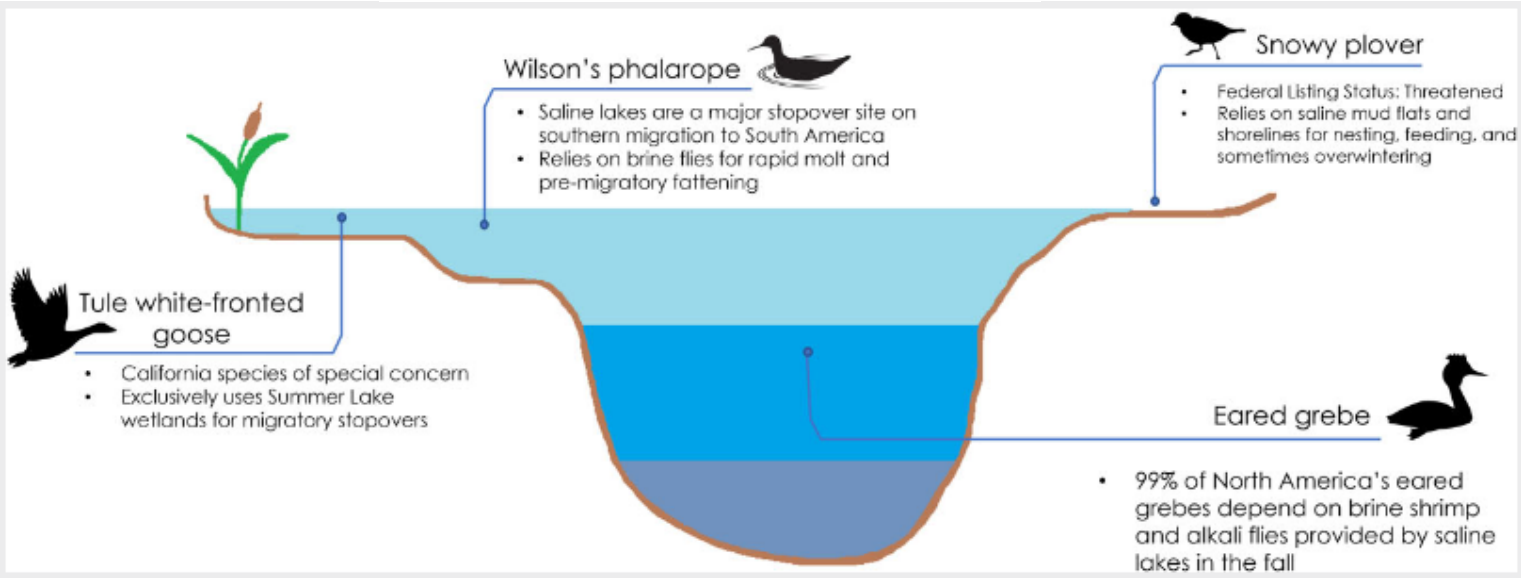

Lake Abert
2.5 km
Lake Abert
2.5 km


Paisley
31
31
31
31
31
31
Lake Abert
395
395
395


Aral Sea
(West Asia)

A Canary in the Salt Pond?





BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO THE U.S. FISH AND WILDLIFE SERVICE TO LIST WILSON'S PHALAROPE (PHALAROPUS TRICOLOR) UNDER THE ENDANGERED SPECIES ACT AS A THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

CENTER FOR BIOLOGICAL DIVERSITY
RYAN CARLE
TERRY TEMPEST WILLIAMS
BENJAMIN W. ABBOTT, PH.D.
RON LARSON, PH.D.
NATHAN D. VAN SCHMIDT, PH.D.
UTAH PHYSICIANS FOR A HEALTHY ENVIRONMENT
UTAH YOUTH ENVIRONMENTAL SOLUTIONS
MONO LAKE COMMITTEE
KYRIANA TARR

March 28, 2024

Small Shorebirds

Medium Shorebirds

Herons & Egrets

Fisheaters

Diving Ducks

Dabbling Ducks

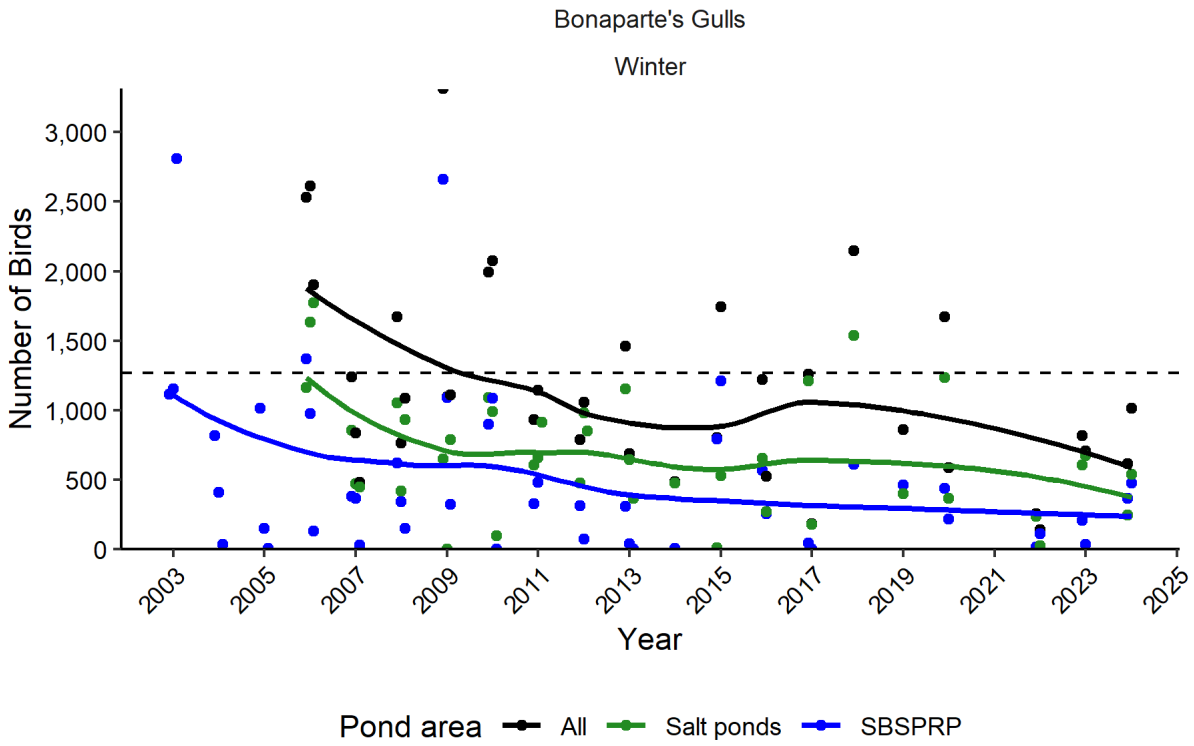
Terns

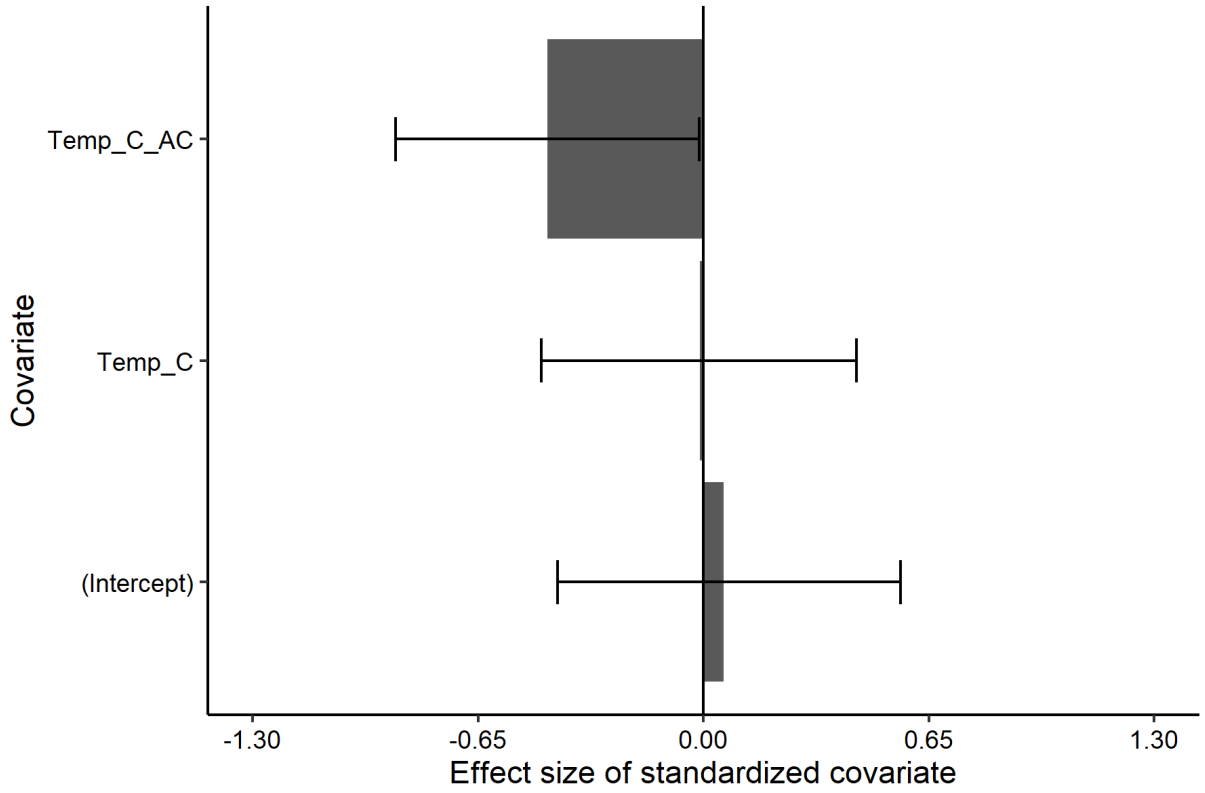
(Bonaparte's) Gulls

Phalaropes

Eared Grebes

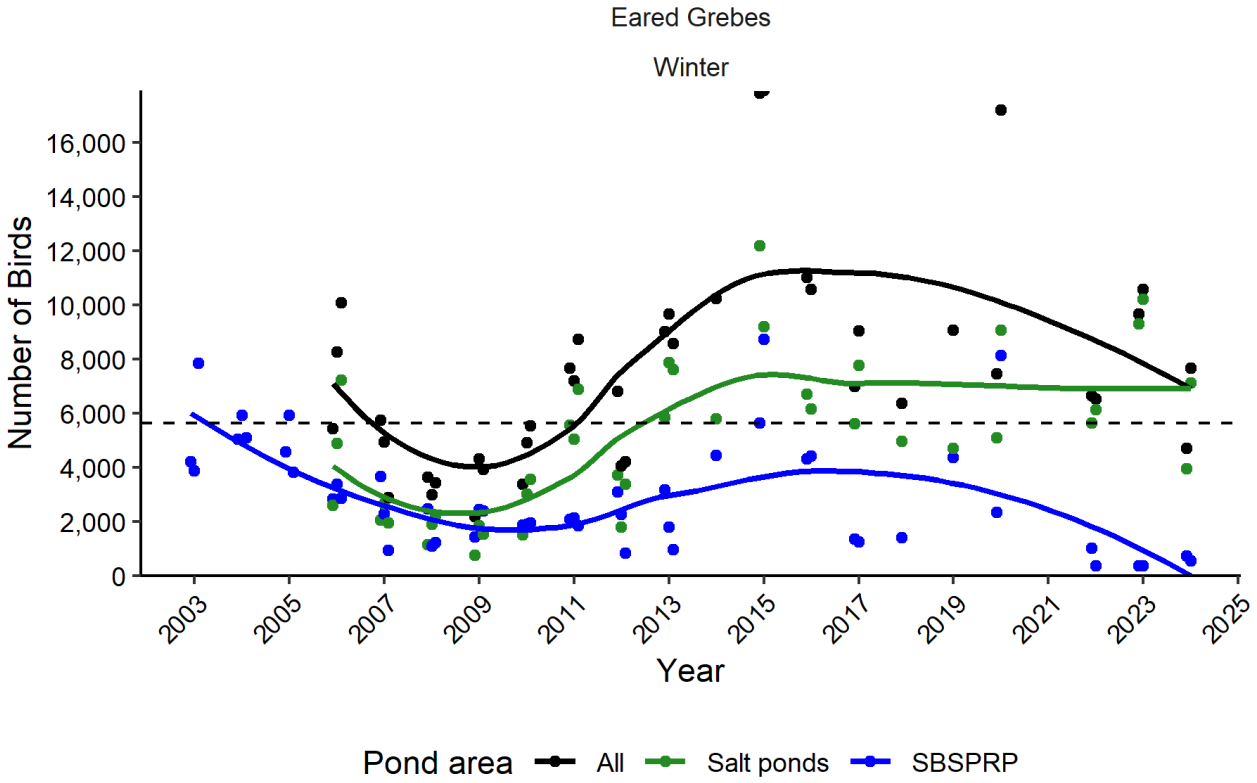
Bonaparte’s Gull

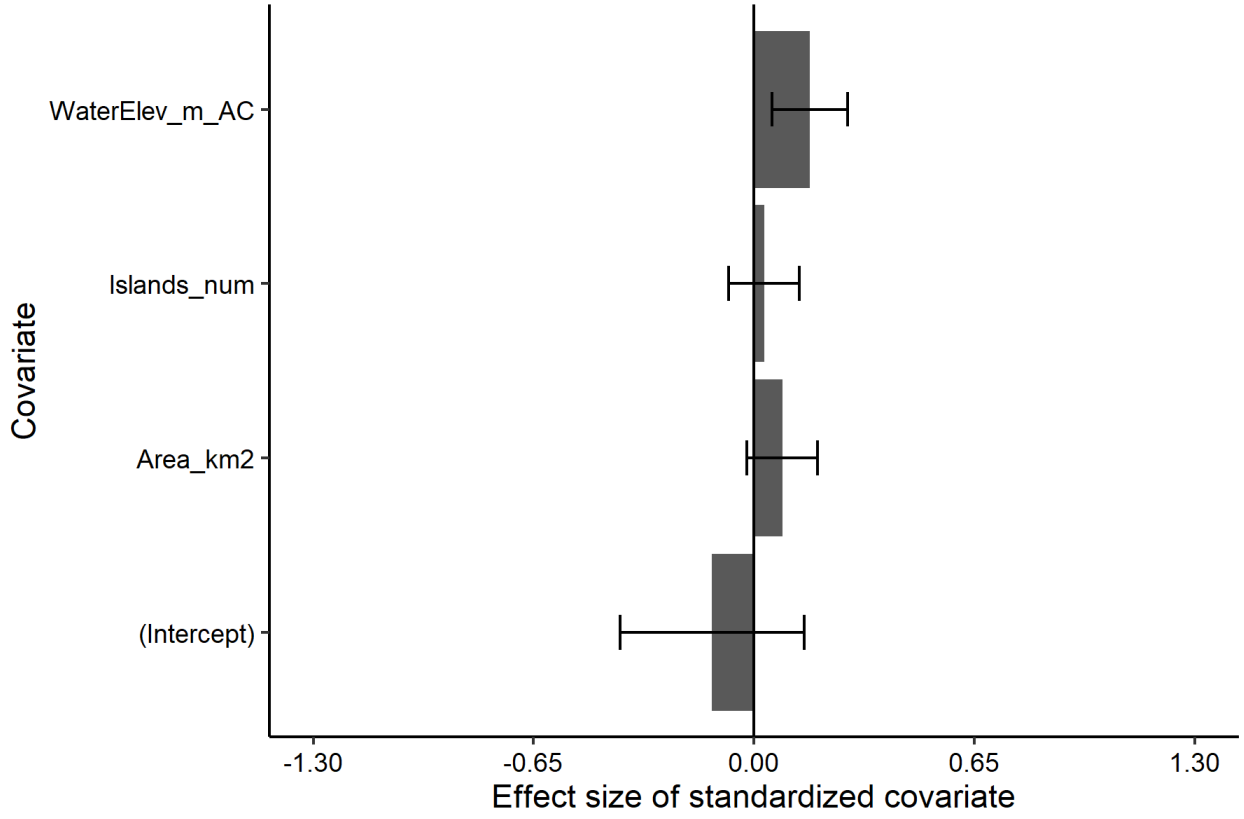




AMP thresholdpassed in 2014, NEPA/CEQA IN 2023

Eared Grebe





Population up overall –

but almost extirpated from SBSPRP area

Snowy Plover Habitat

Rangewide

- Dune-backed sandy beaches
- River bars
- Salt panne

San Francisco Bay

- Salt panne in salt ponds
- Levees
- Dredge material

Small Shorebirds

Medium Shorebirds

Herons & Egrets

Fisheaters

Diving Ducks

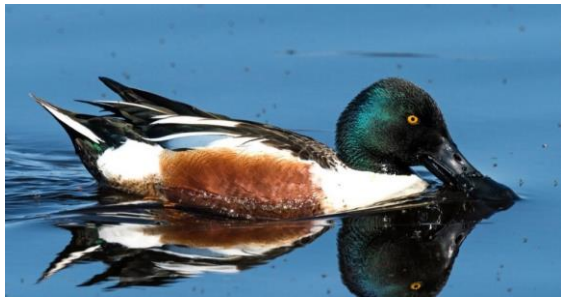
Dabbling Ducks

Terns

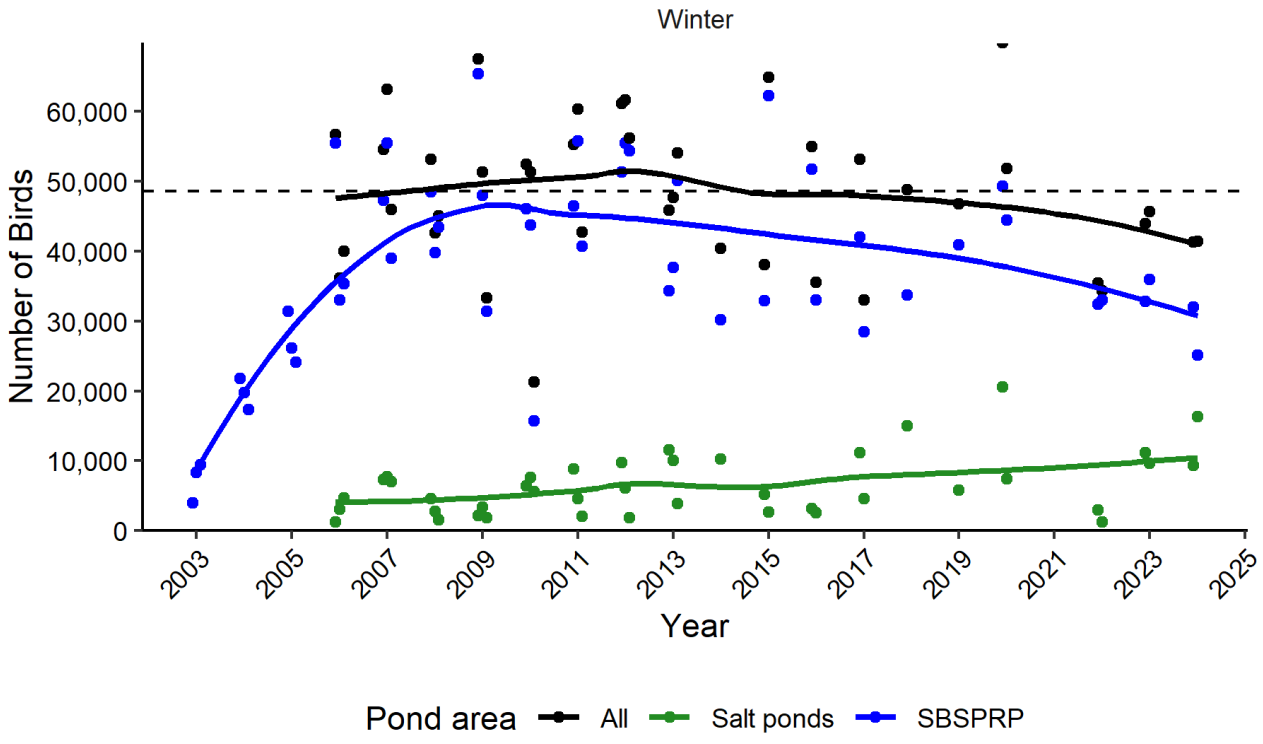
Gulls

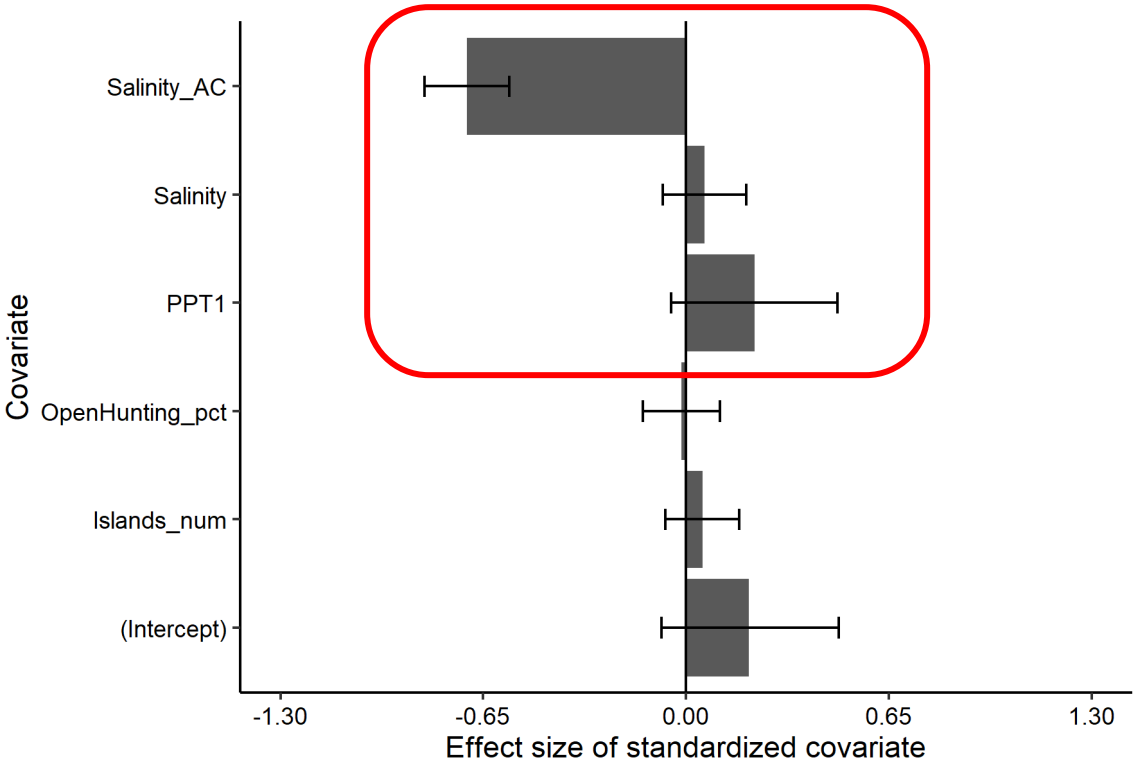
Phalaropes

Eared Grebes

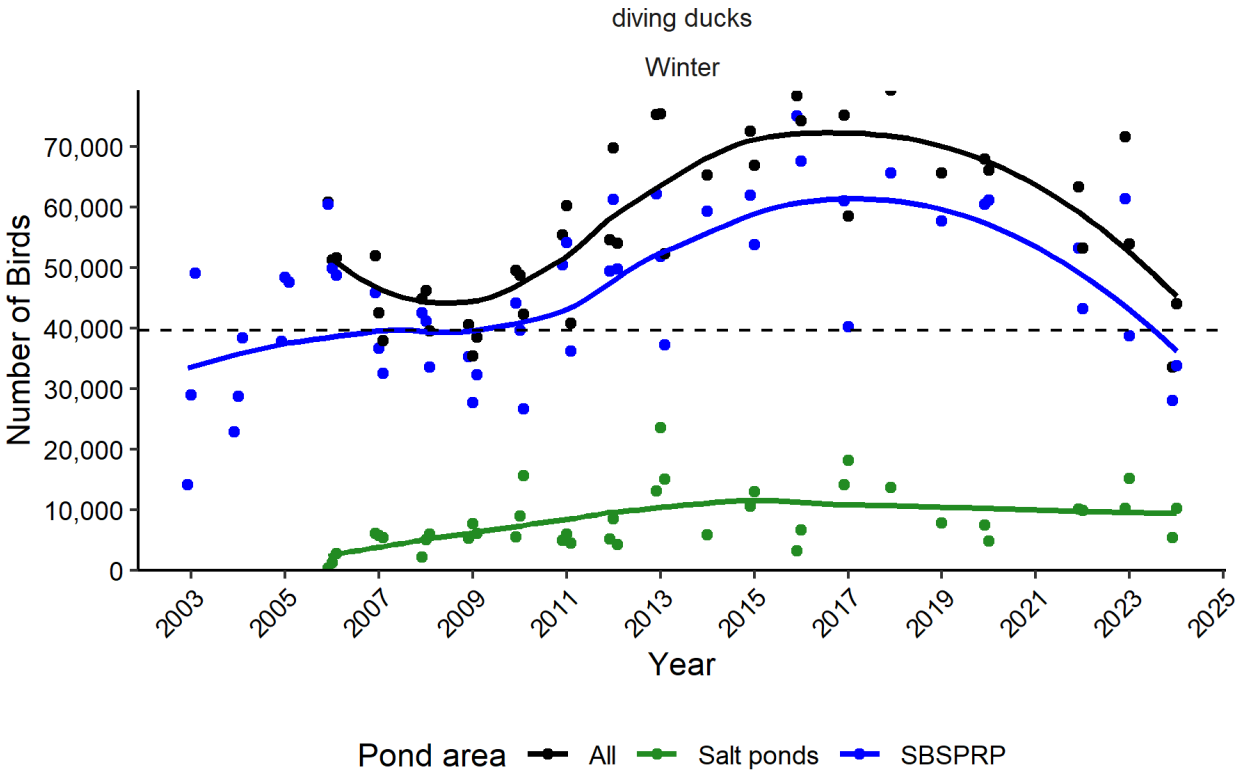


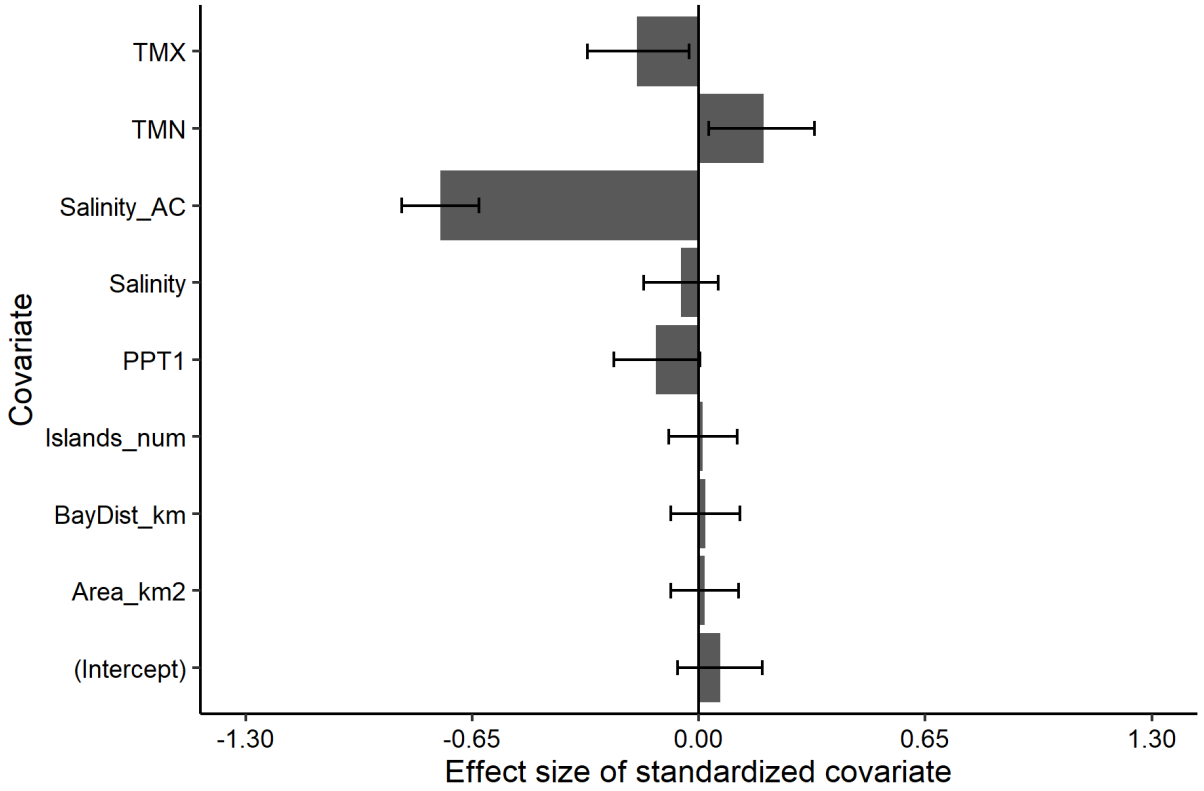
Dabbling Ducks



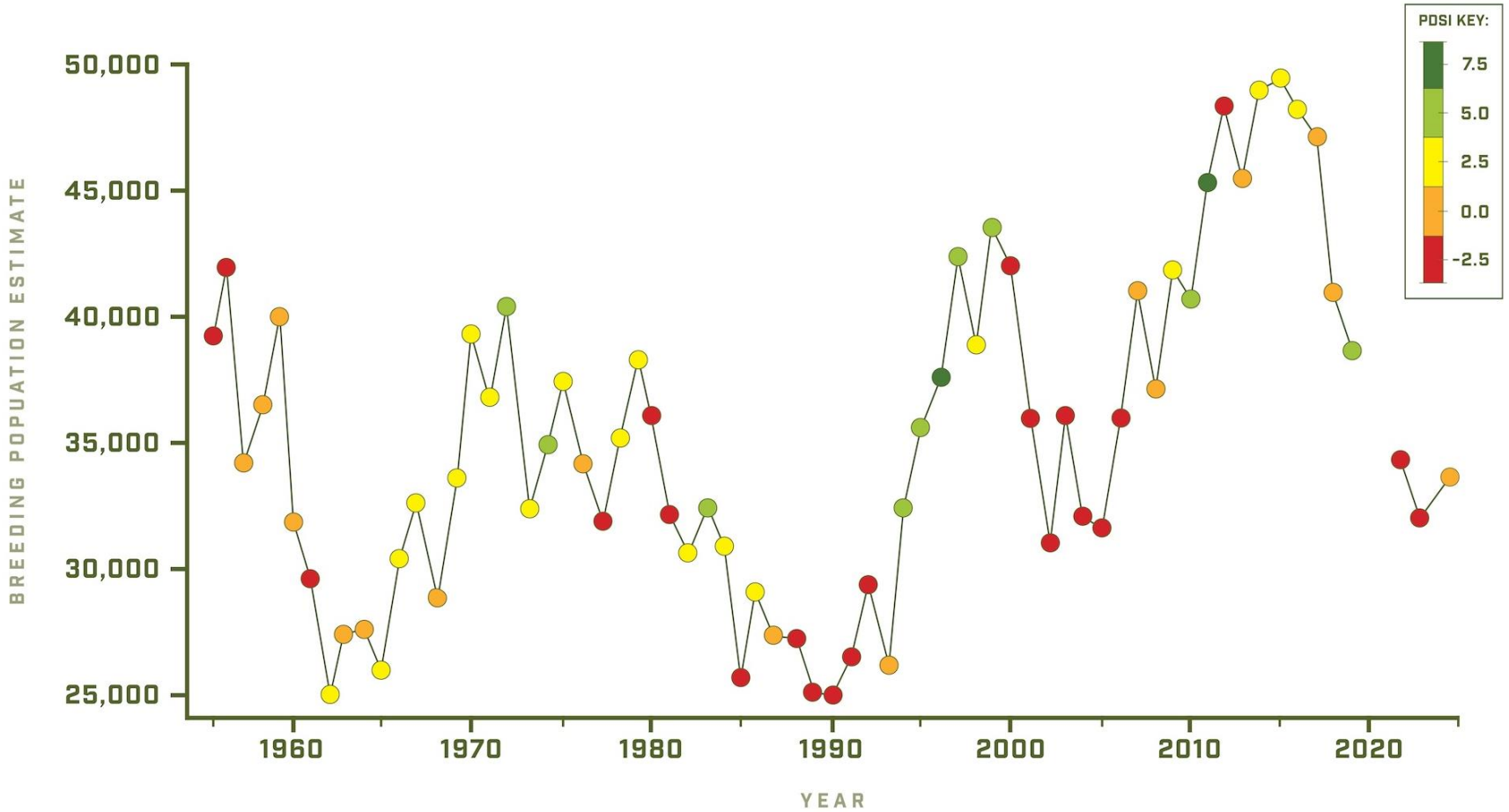


Diving Ducks





Duck Population Trends Track Drought



Ducks Unlimited (2025)

Small Shorebirds

Medium Shorebirds

Herons & Egrets

Fisheaters

Diving Ducks

Dabbling Ducks

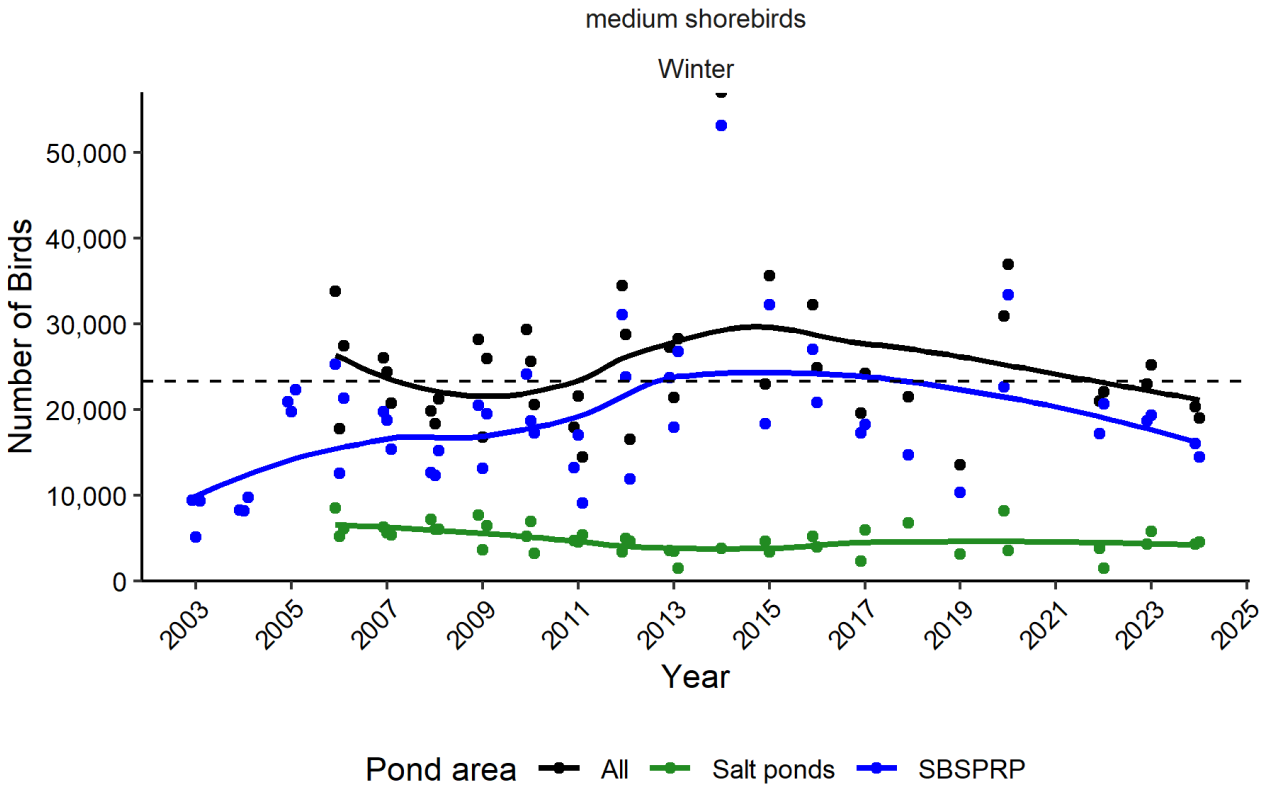
Terns

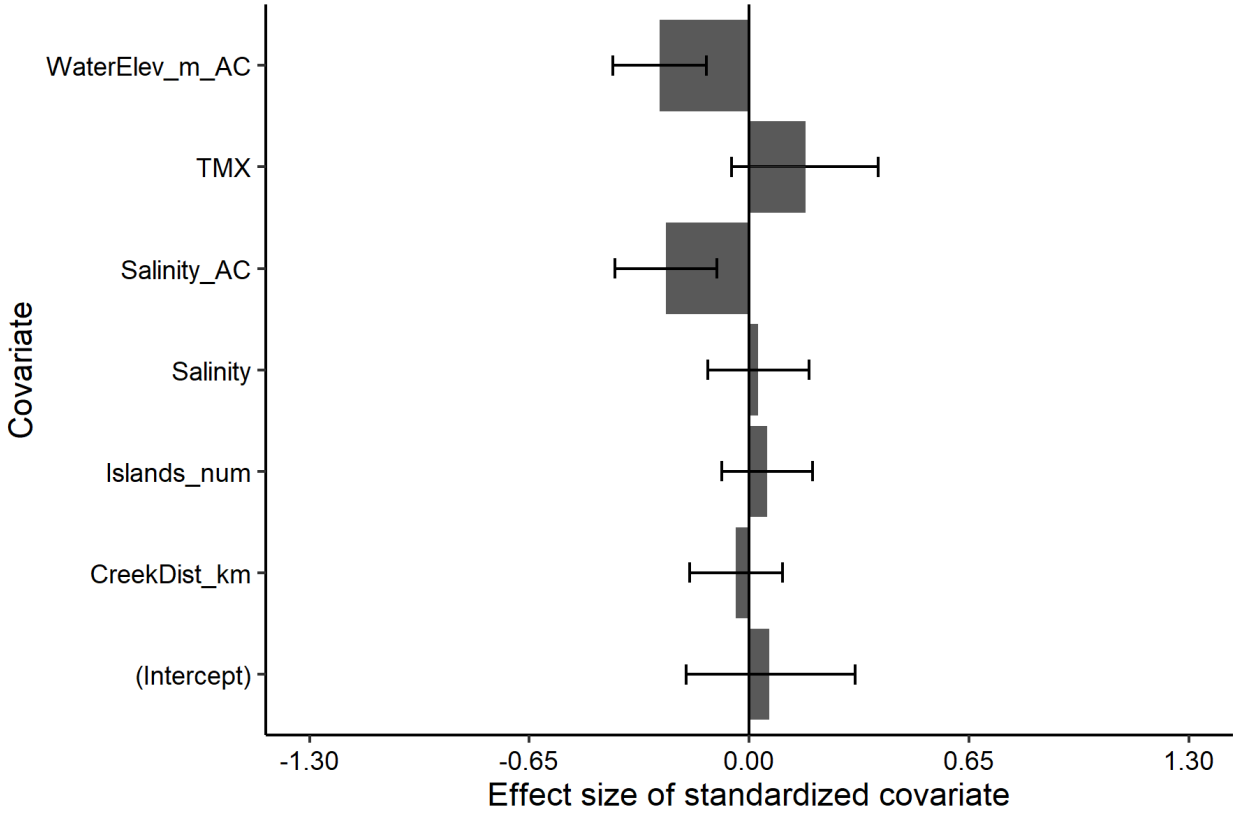
Gulls

Phalaropes

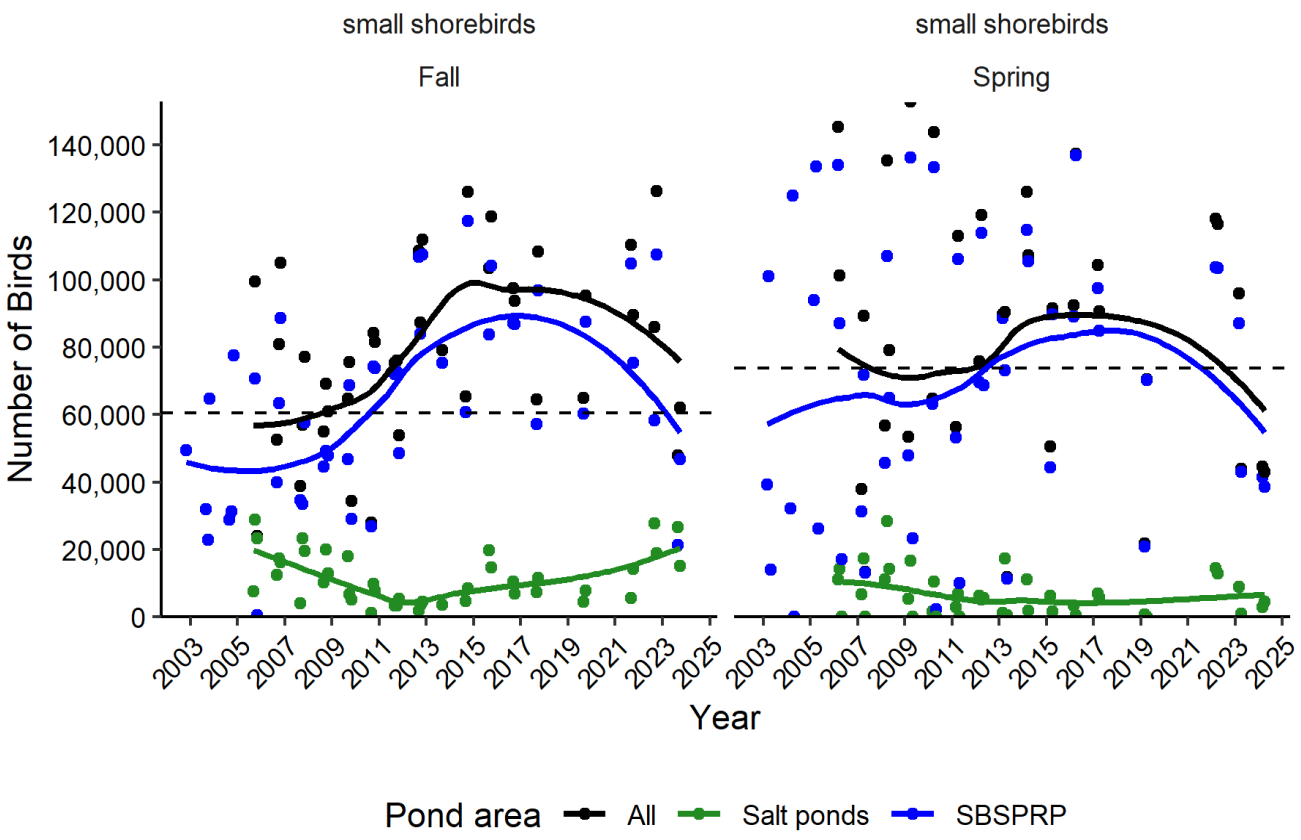
Eared Grebes

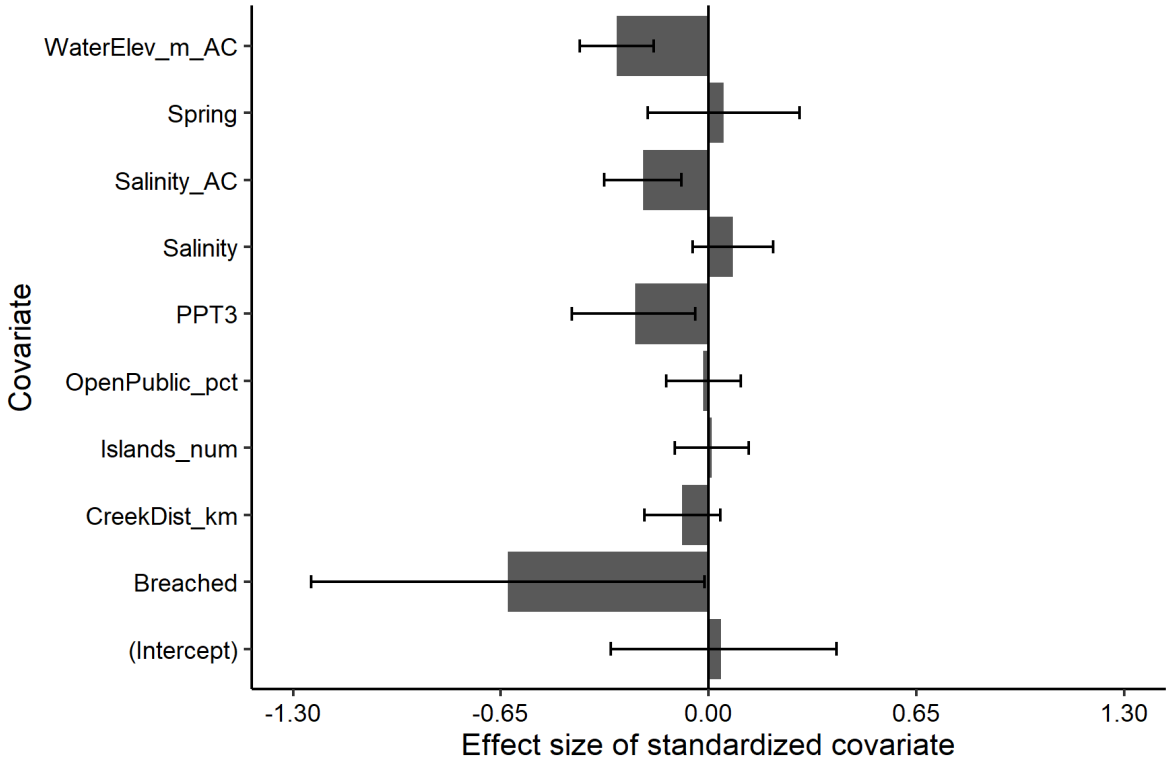
Medium Shorebirds



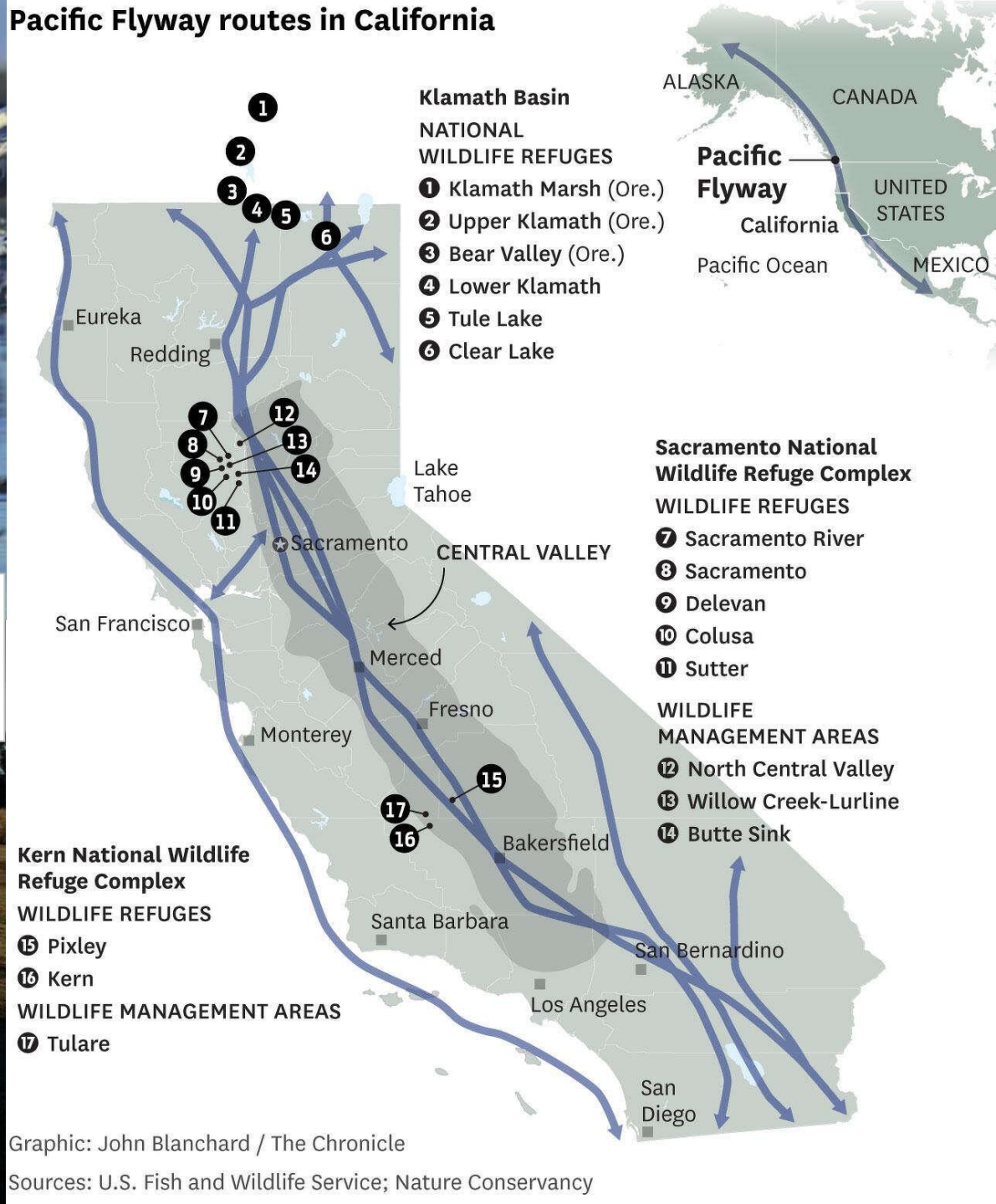


Small Shorebirds





Population trends and movement respond synchronously to drought (Barbaree et al. 2020)



Summary of Threshold Status

Species/Guild	Season	2005-2007 Baseline	AMP Threshold	NEPA/CEQA Threshold[B]	% Change	Years Below	Decline Trigger
Diving ducks	Winter	39,645	-1%	-20%	+35%	1	FALSE
Ruddy Ducks	Winter	12,602	-1%	-15%	+136%	0	FALSE
Small shorebirds	Fall	60,623	-1%	-20%	+44%	1	PRIOR
	Spring	73,728	-1%	-20%	+4%	2	TRUE
Least Terns	Summer	63	-1%	-1%	+21%	1	PRIOR
Eared Grebes	Winter	5,640	-25%[A]	-50%	+35%	0	FALSE
Phalaropes	Summer	3,225	-25%[A]	-50%	-78%	3	TRUE
Bonaparte's Gulls	Winter	1,270	-25%[A]	-50%	-53%	3	TRUE
Dabbling ducks	Winter	48,524			-17%	3	TRUE
Medium shorebirds	Winter	23,312			-6%	2	TRUE

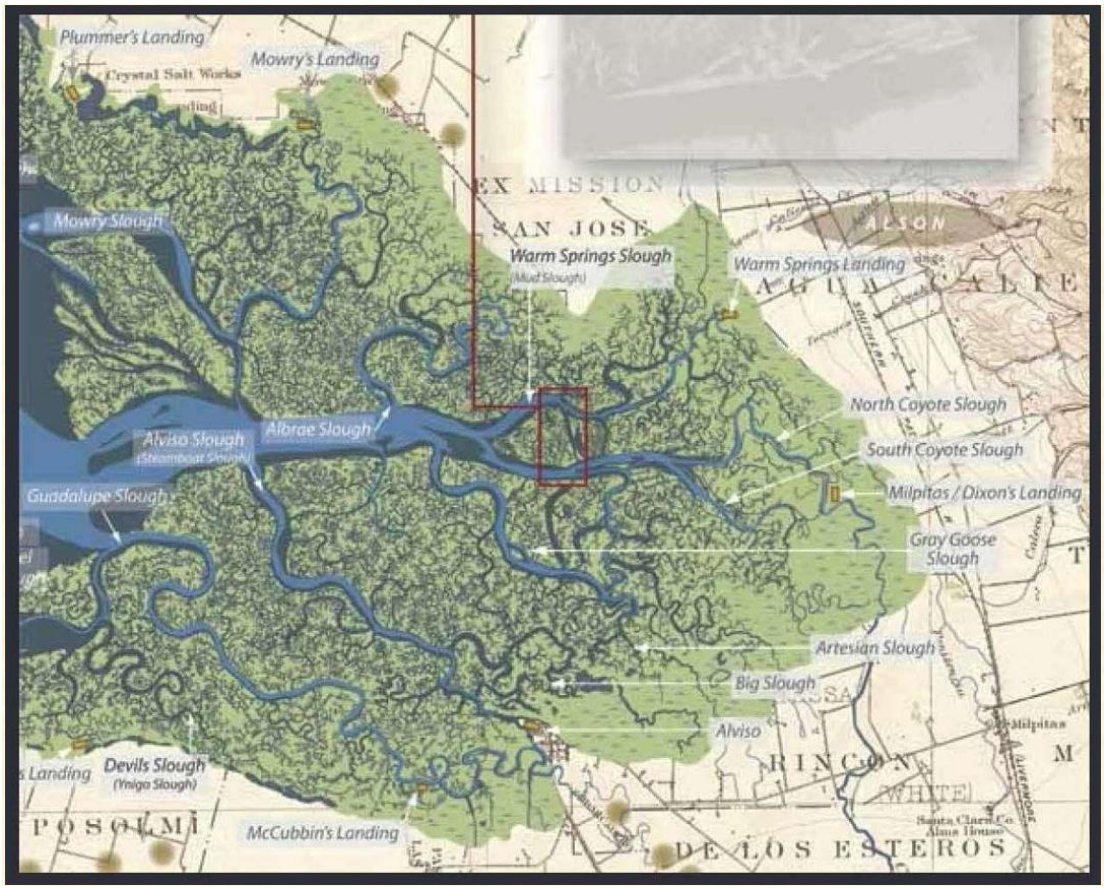
NATIONAL GEOGRAPHIC

San Francisco's Financial District sits atop what was once Yerba Buena Cove. After the Gold Rush of 1849 the harbor was choked with abandoned ships that had carried people from around the world to the city. Rapid development followed, and the shallow cove was filled in and built up. An estimated 70 ships are buried under these skyscrapers.

How the Bay Area Is Restoring Nature's Delicate Balance

As rising seas and demands for fresh water threaten San Francisco-area shorelines, the focus is on building tidal marsh.

Beyond the "Balance of Nature"



Funders

California Wildlife Foundation

Coastal Conservancy

U.S. Fish & Wildlife Service

California Department of Fish & Wildlife

Cargill Salt

Thank you!