# Fish and Fish Habitats in South Bay Wetlands

**Levi S. Lewis, OGFL, UCD**

*lslewis@ucdavis.edu , www.ogfishlab.com*

UCDAVIS
DEPARTMENT OF WILDLIFE, FISH AND CONSERVATION BIOLOGY

OGFL UCD
Otolith Geochemistry & Fish Ecology Laboratory

South Bay Salt Pond Restoration Project

# Acknowledgements: Collaborators & Funders

## UC Davis

UCDAVIS WILDLIFE, FISH, & CONSERVATION BIOLOGY

Center for Watershed Sciences

UCDAVIS Fish Conservation and Culture Laboratory

## Federal

United States Environmental Protection Agency

National Oceanic and Atmospheric Administration, U.S. Department of Commerce

U.S. Fish & Wildlife Service, Department of the Interior

USGS science for a changing world

## State

Department of Water Resources, State of California

California Department of Fish & Wildlife

Sea Grant California

California Water Boards, State Water Resources Control Board

## Local

South Bay Salt Pond Restoration Project

SFEI Aquatic Science Center, San Francisco Estuary Institute & the Aquatic Science Center

San José-Santa Clara Regional Wastewater Facility

San Francisco Estuary Partnership, Wetlands Regional Monitoring Program

Stillwater Sciences

Valley Water, Santa Clara Valley Water District

# Otolith Geochemistry & Fish Ecology Laboratory

www.ogfishlab.com

UC DAVIS
UNIVERSITY OF CALIFORNIA

## Current Members











## Current Interns





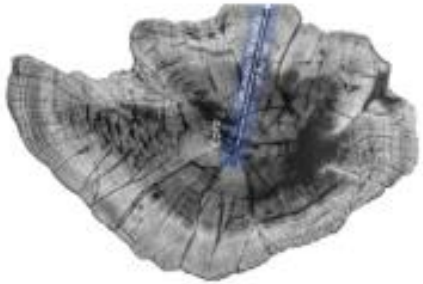
# Scientific Approach

### Surveys and monitoring

Long-term fish, invertebrate, and water quality surveys in the San Francisco Estuary

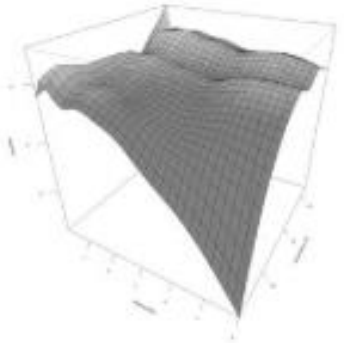
### Otolith analyses

Otolith microstructure (age and growth) and microchemistry (trace elements, strontium isotopes, oxygen isotopes)



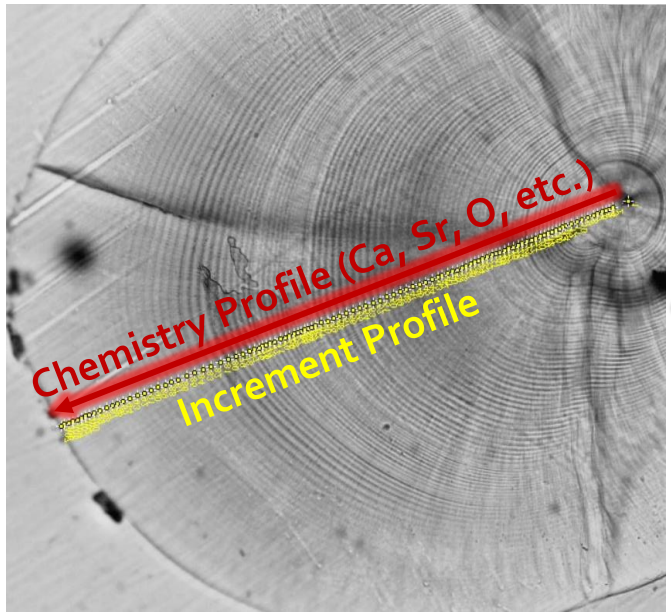
### Ecological modelling

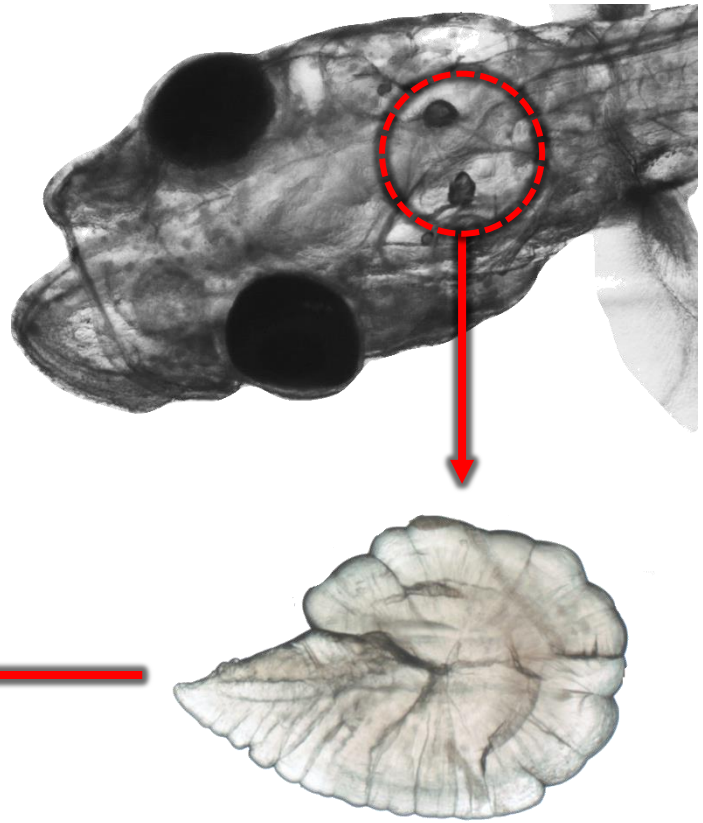
Quantifying community and population dynamics, and variation in life-history traits, in relation to water quality and environmental change

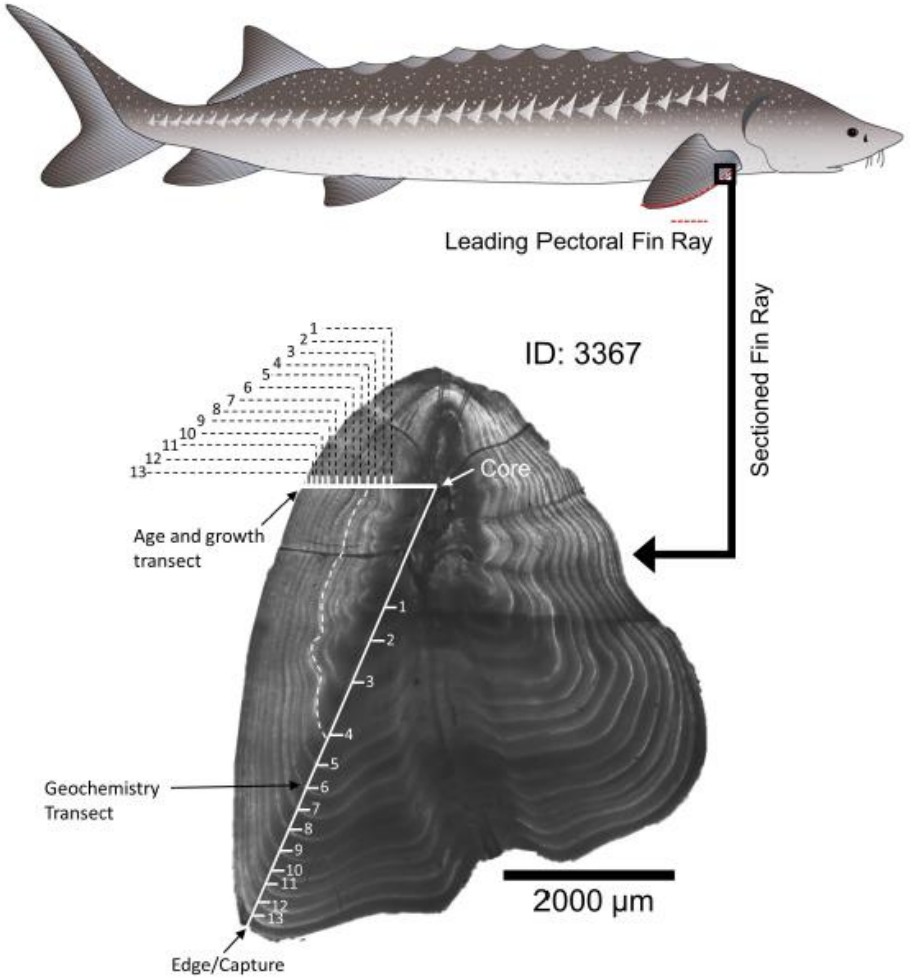


# Surveys and Monitoring

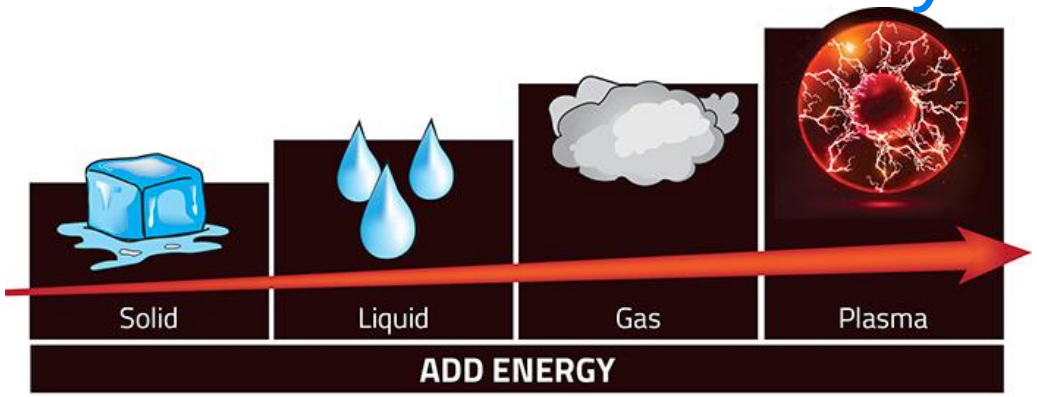

# Otolith & Fin Ray Schlerochronology

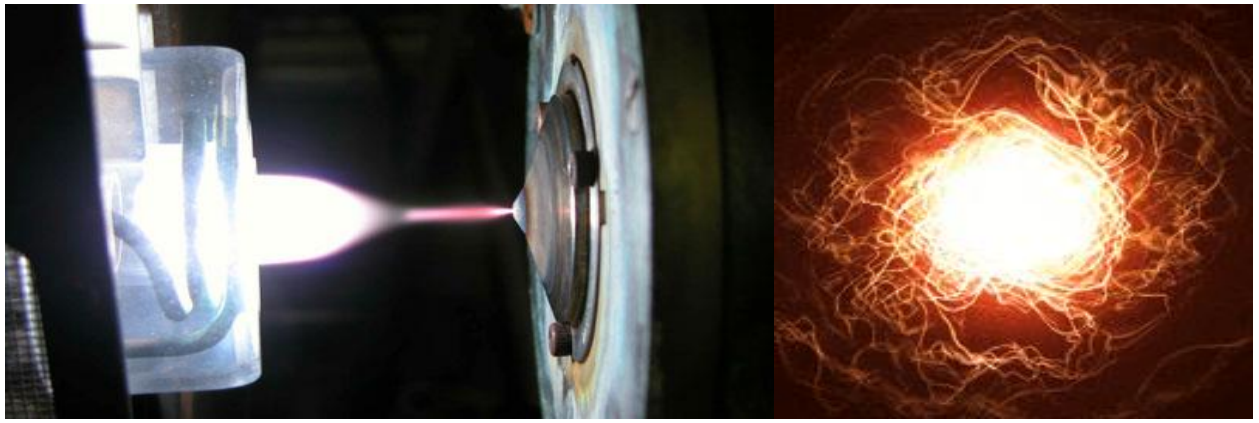


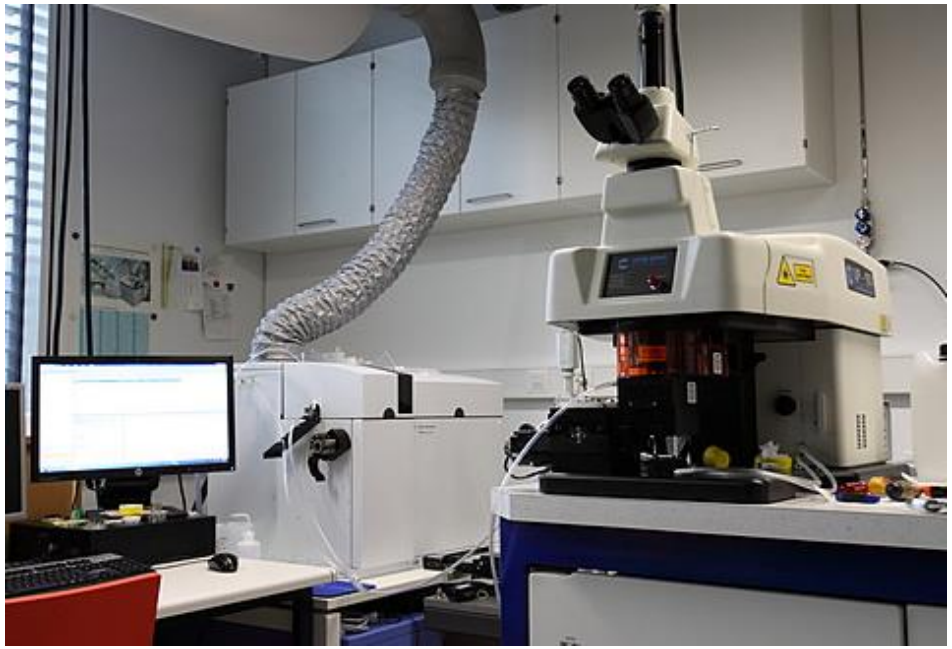



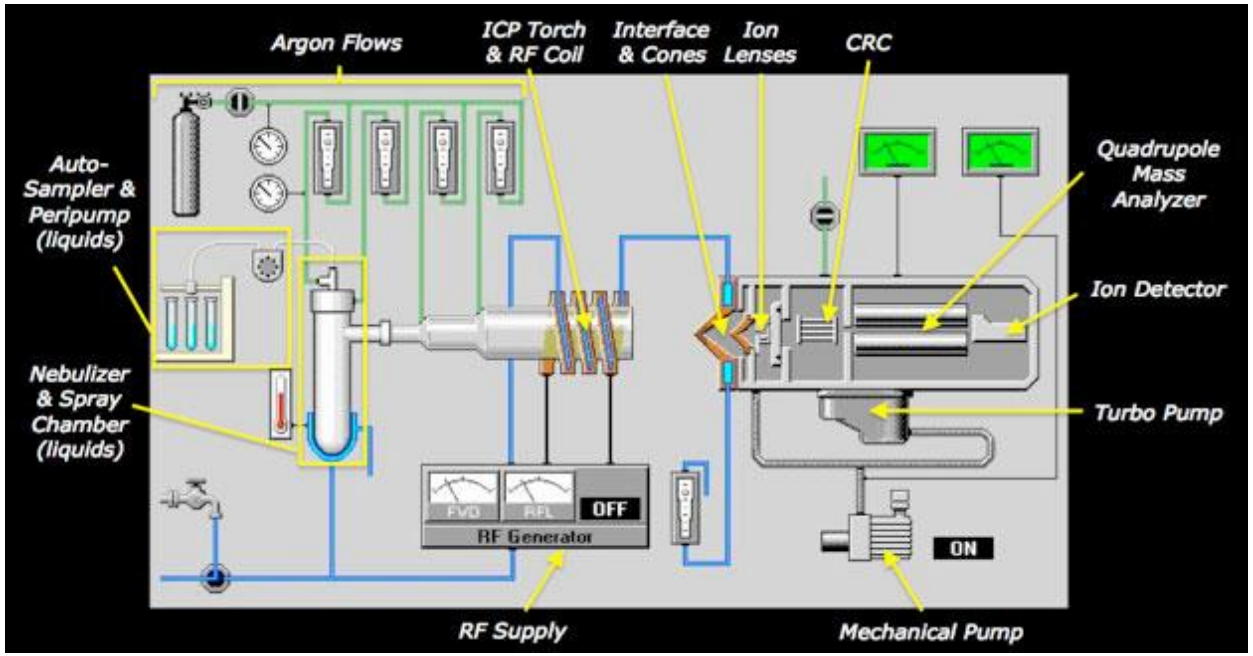


# LA-ICP-MS Geochemistry

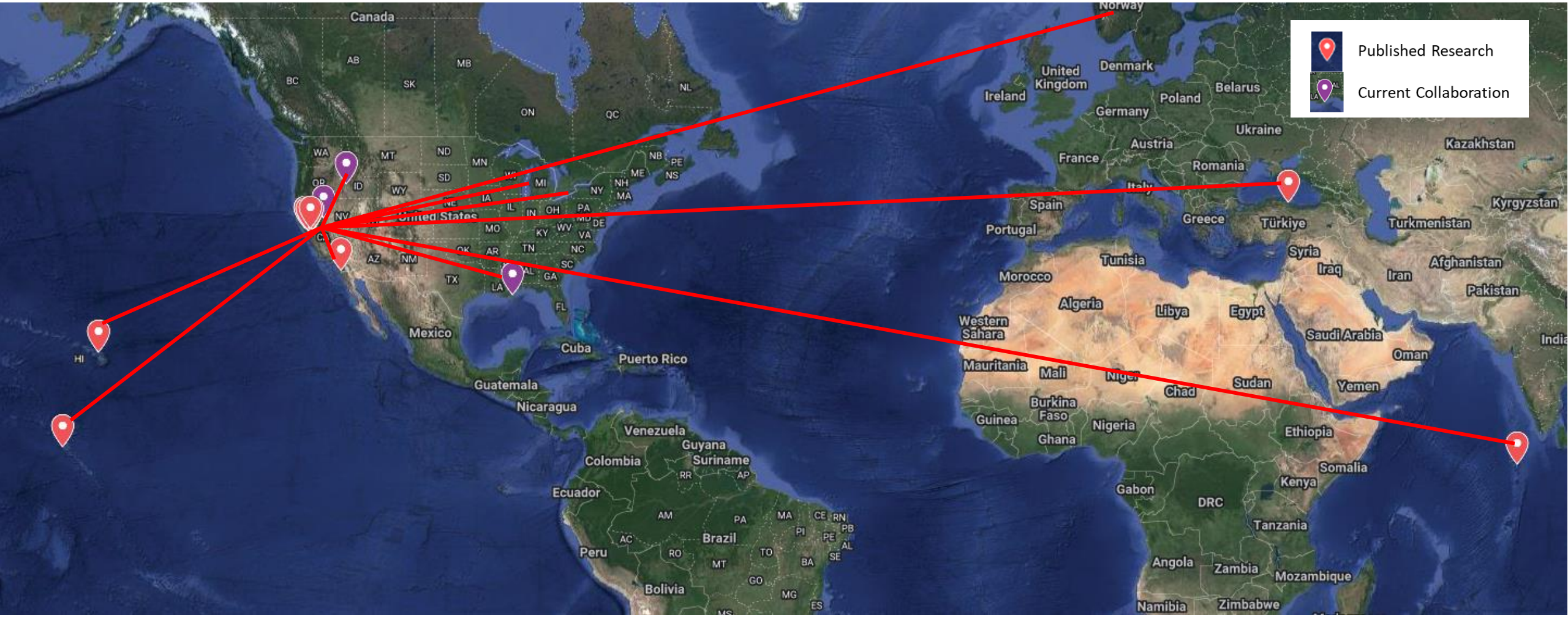


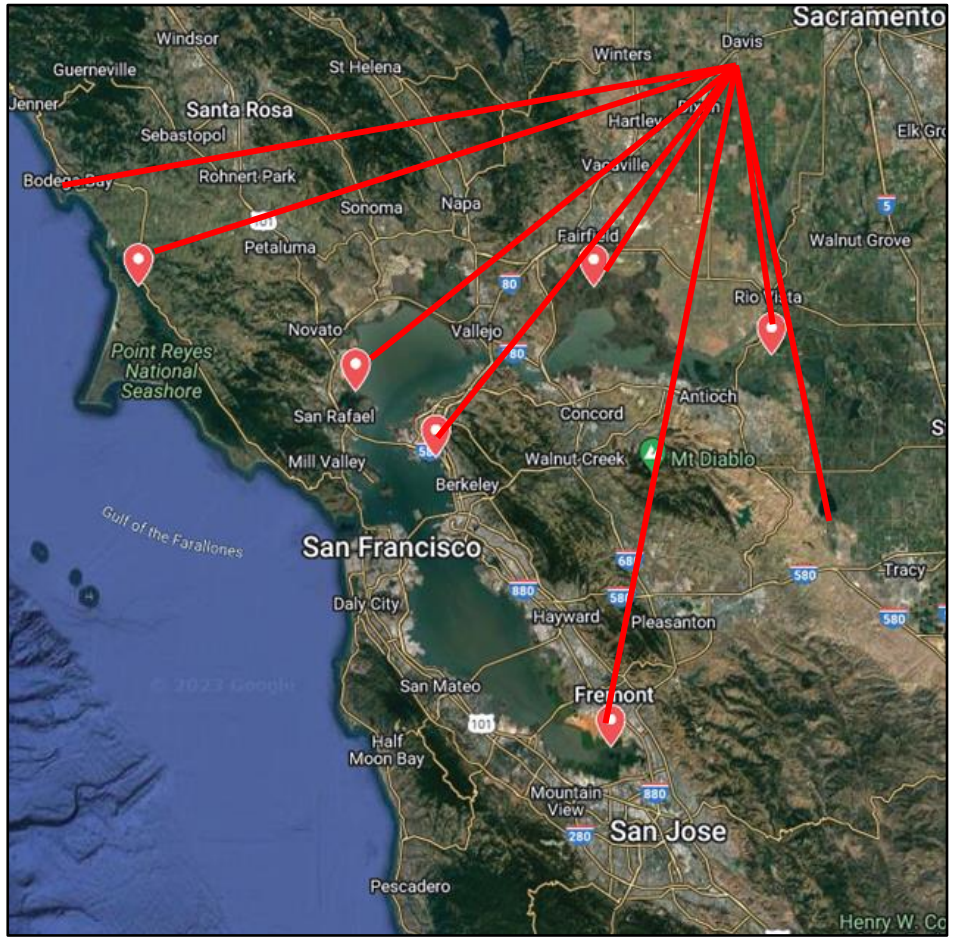




# Global Reach (collaborations across continents)



# Local Focus (San Francisco Bay/Estuary)




# **Today**: Fish and Fish Habitats in South Bay Wetlands

### Surveys and monitoring

Long-term fish, invertebrate, and water quality surveys in the San Francisco Estuary

# **Today**: Fish and Fish Habitats in South Bay Wetlands


# Outline

**I. Intro: Wetland Fishes & Fish Habitats**

**II. Past FFH Monitoring in South Bay Wetlands**

**III. Recent, Ongoing, & Future Studies**

**IV. Lessons Learned, Forward Thinking**

"A society grows great when old men plant trees in whose shade they shall never sit."
— **Greek** Proverb

"An estuary grows great when old managers restore wetlands whose veg. they may never view."
— ***Geek*** Proverb

"Ecological knowledge grows great when old scientists initiate monitoring whose trends they may never track."
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# I. Introduction

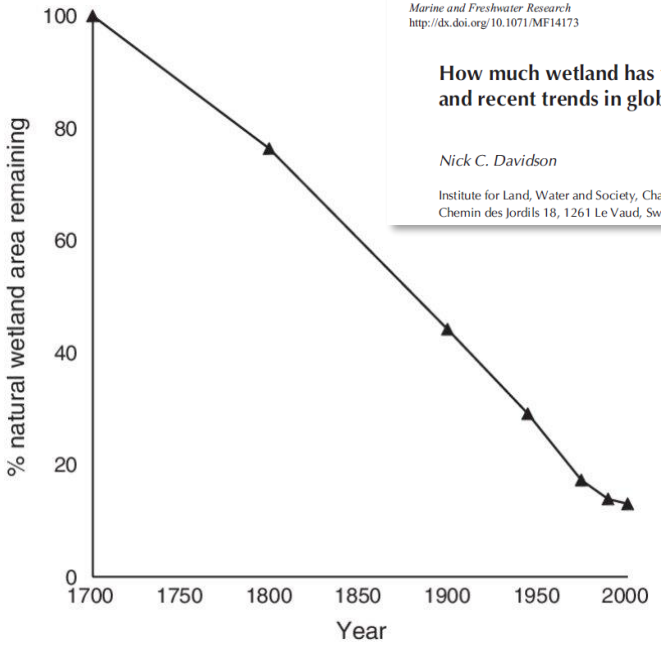
**Wetlands**

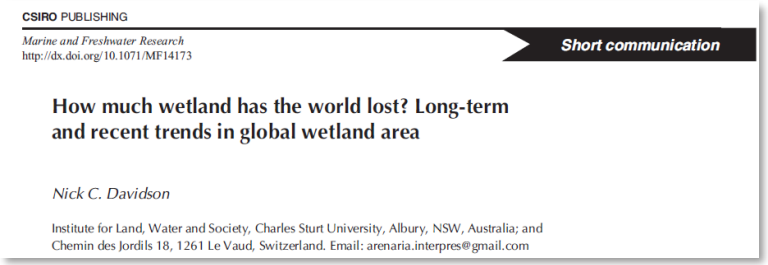
Definition

Ecology

Value

Conservation



CSIRO PUBLISHING

*Marine and Freshwater Research*
http://dx.doi.org/10.1071/MF14173

**Short communication**

**How much wetland has the world lost? Long-term and recent trends in global wetland area**

*Nick C. Davidson*

Institute for Land, Water and Society, Charles Sturt University, Albury, NSW, Australia; and Chemin des Jordils 18, 1261 Le Vaud, Switzerland. Email: arenaria.interpres@gmail.com

**The Modification of an Estuary**

FREDERIC H. NICHOLS, JAMES E. CLOERN, SAMUEL N. LUOMA, DAVID H. PETERSON

"Of the original 2200 km$^2$ of tidal marsh, only about 125 km$^2$ of undiked marsh remains today“ (**95% degraded**)

# I. Introduction

**Wetlands**

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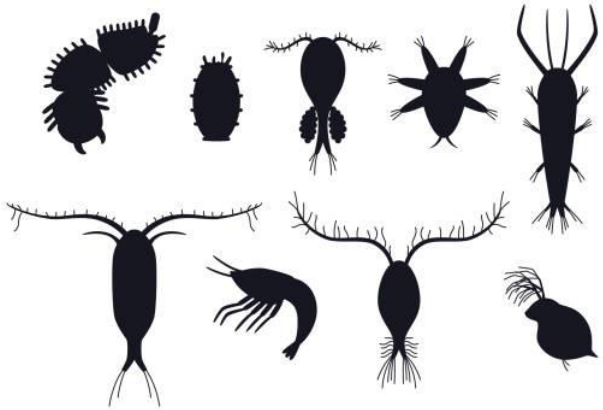

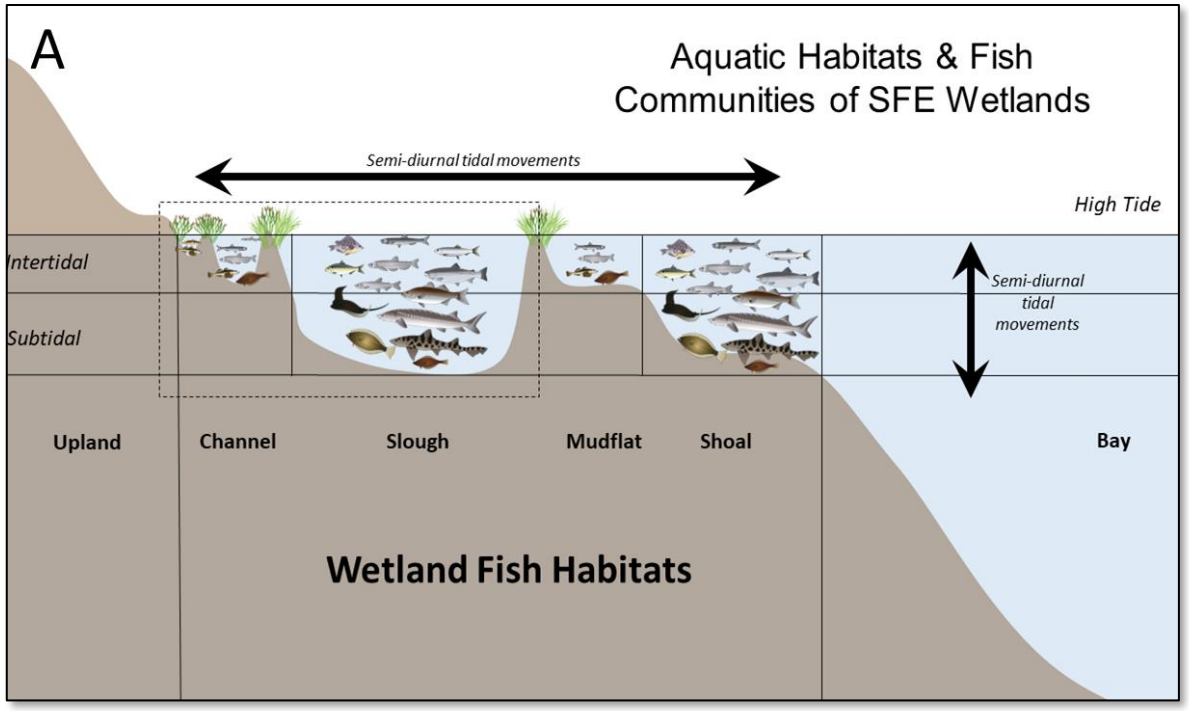

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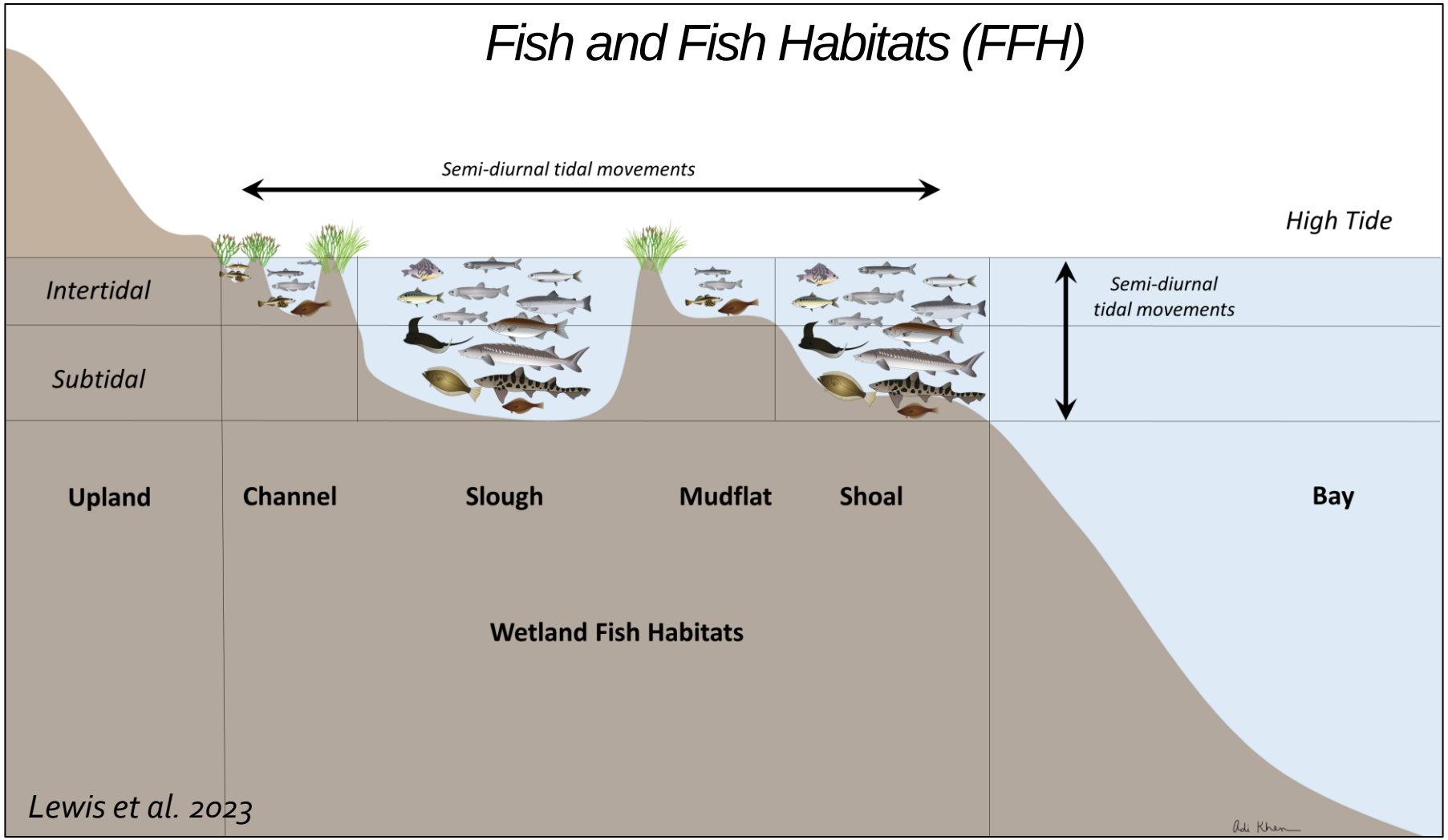
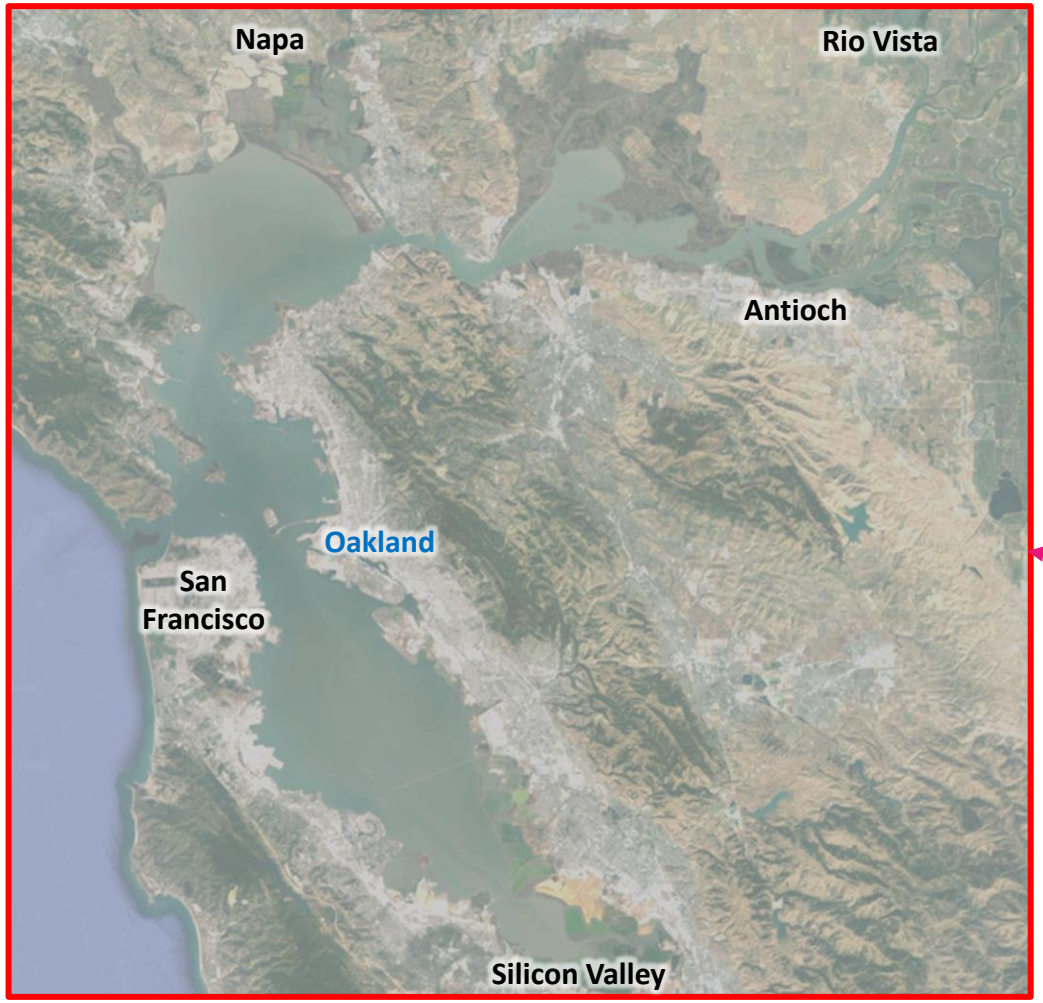
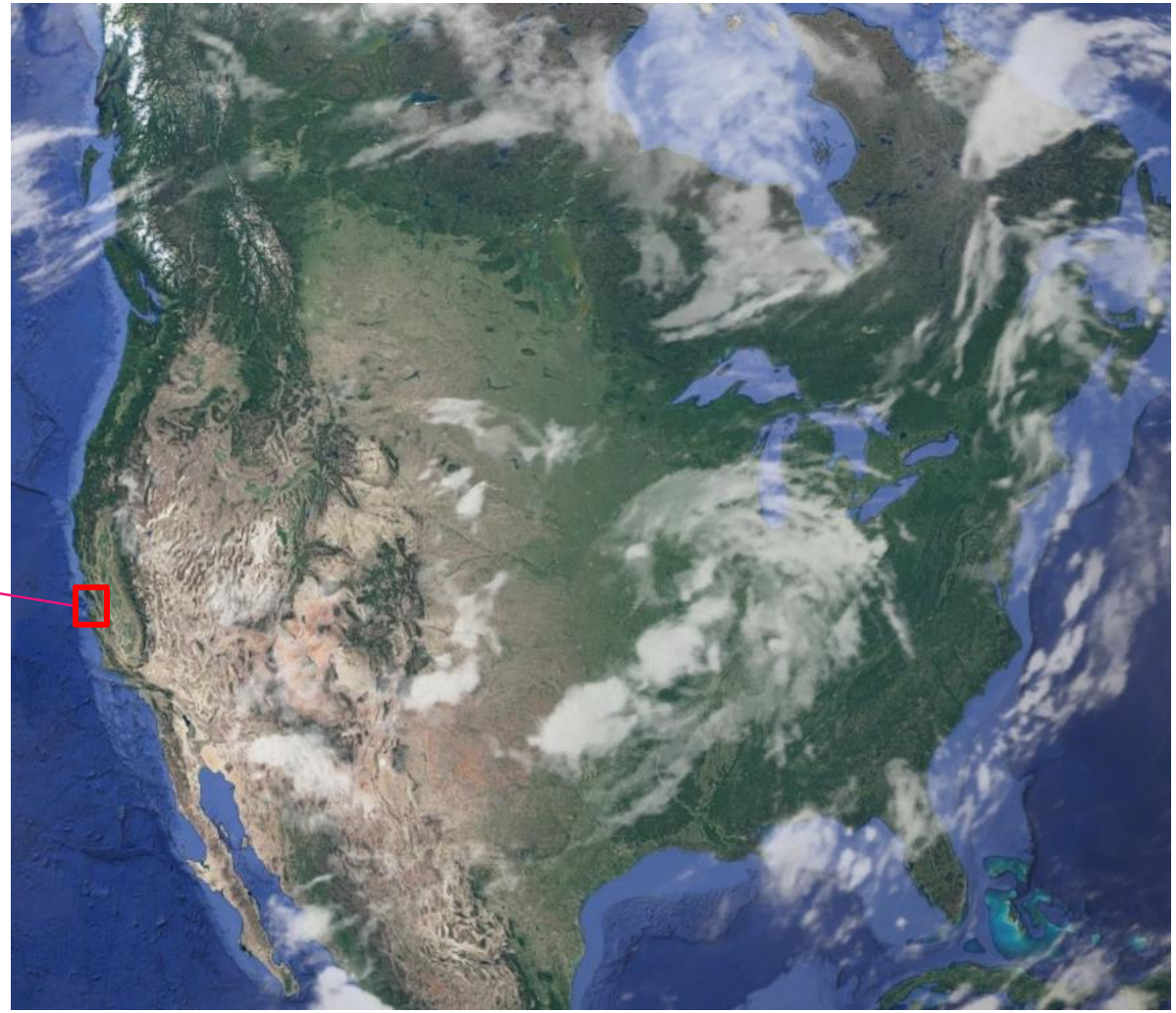


# The San Francisco Estuary



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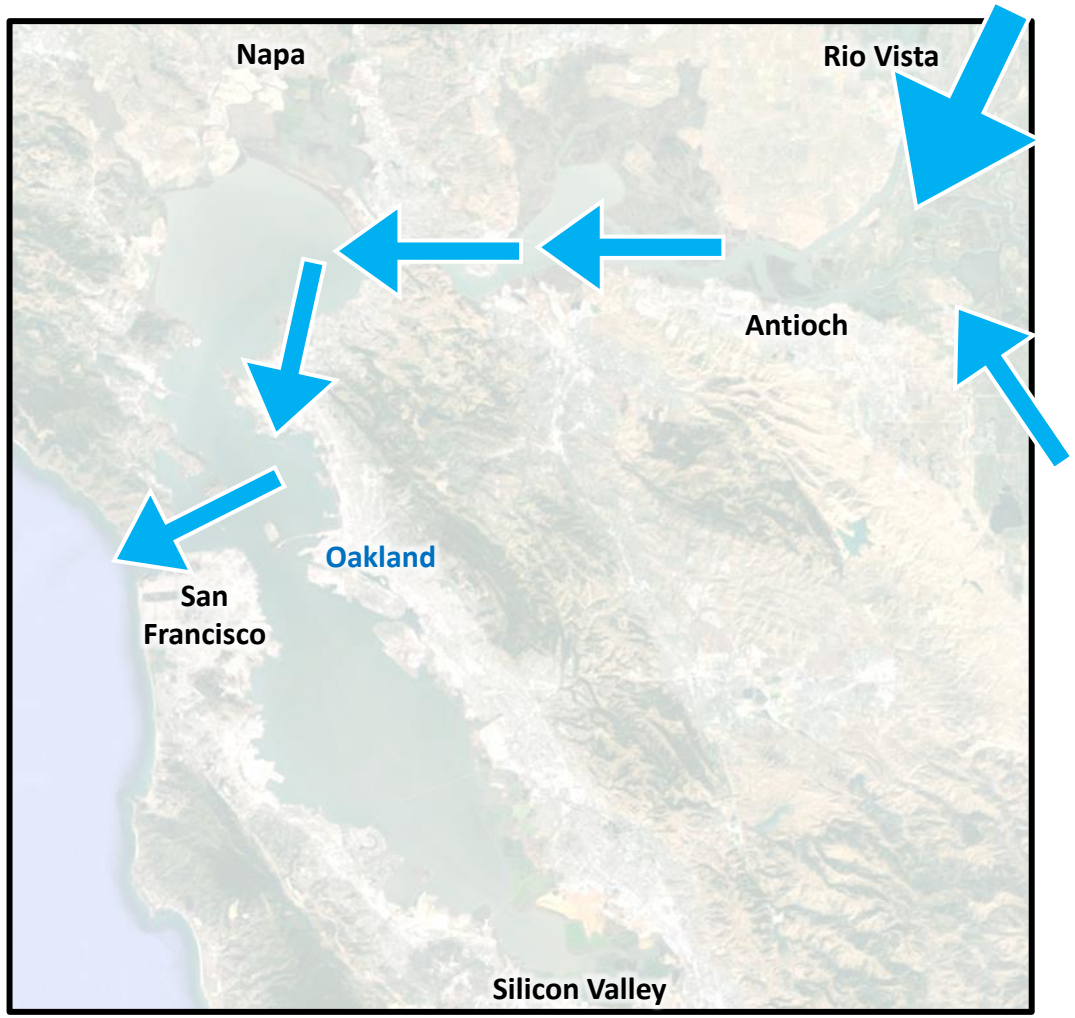


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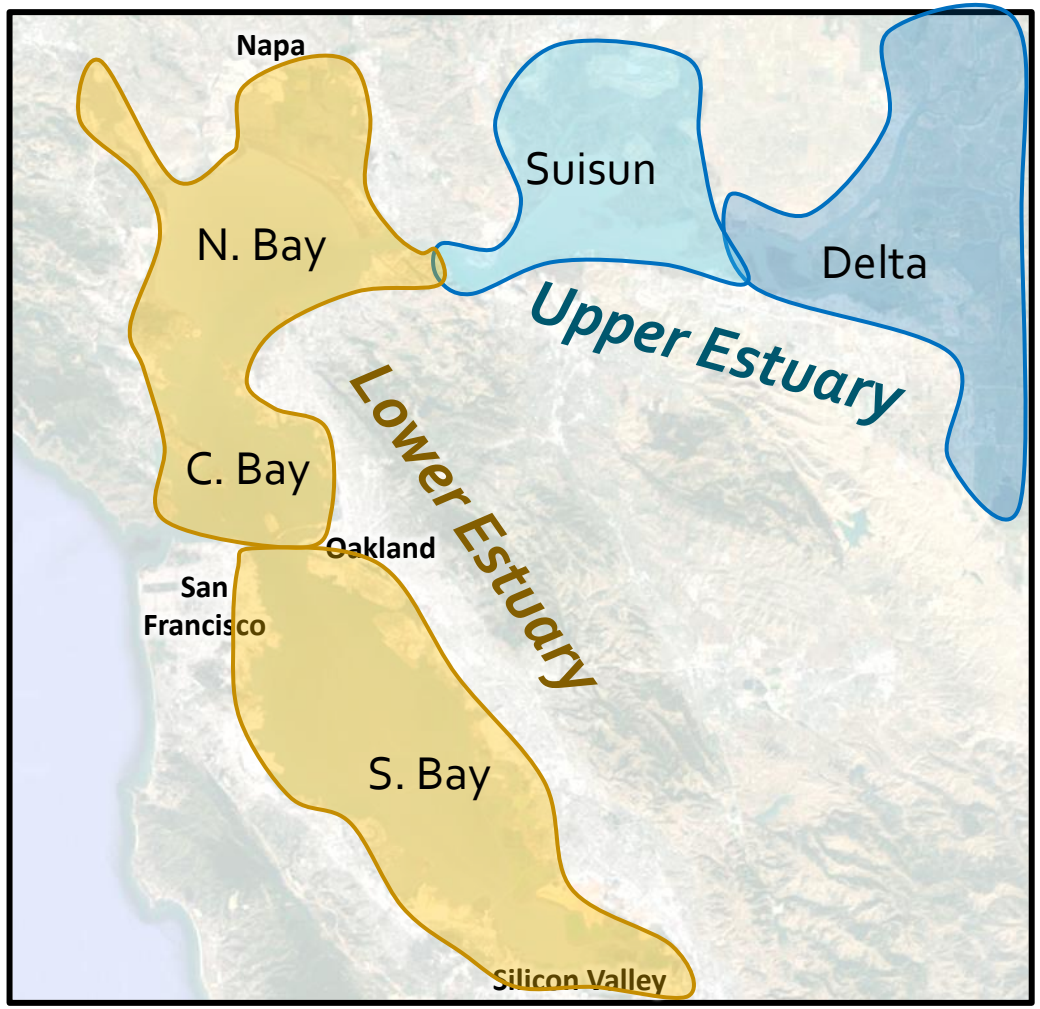
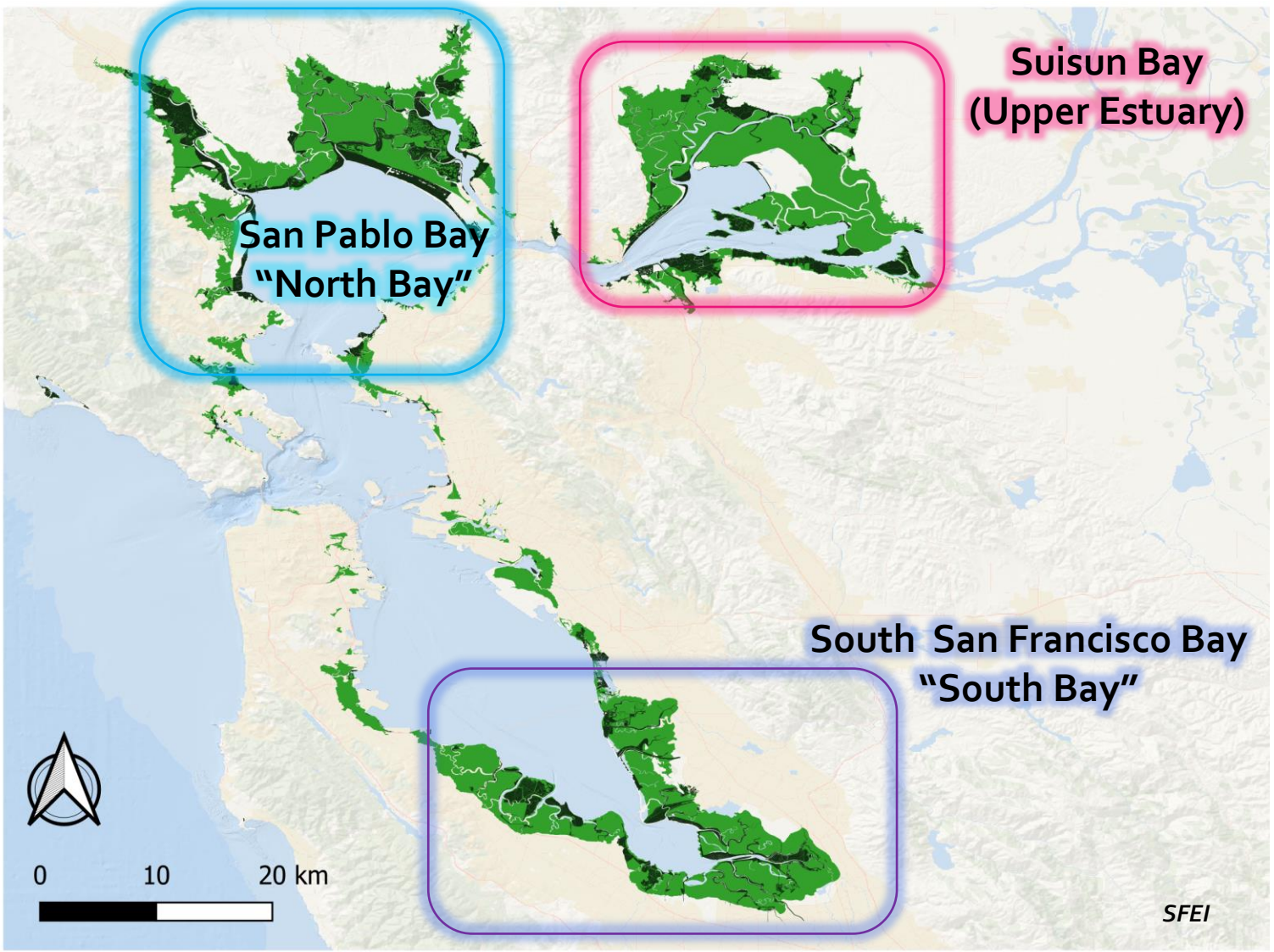


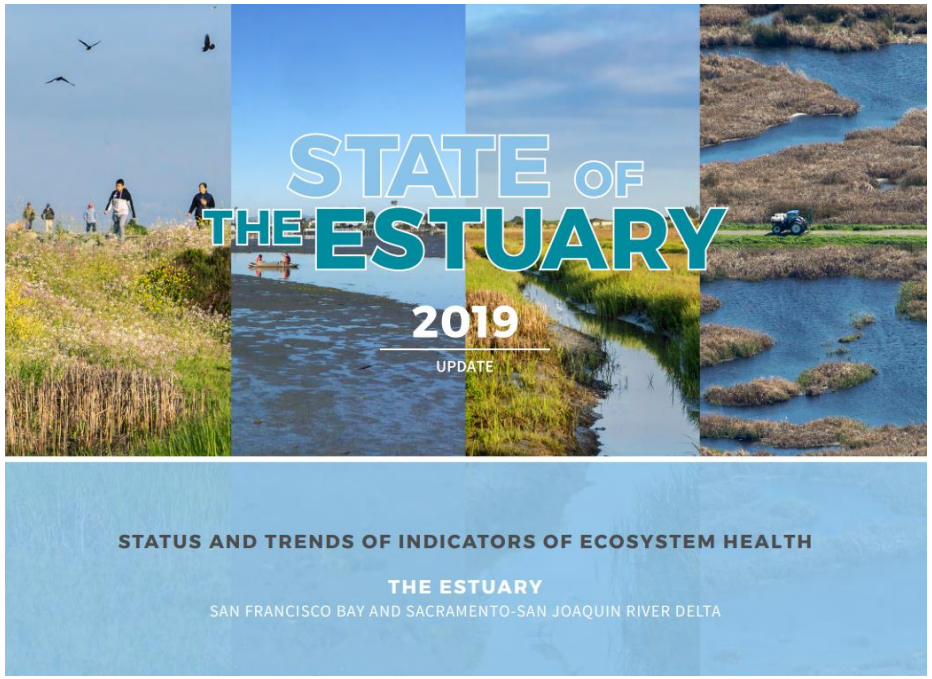

# The San Francisco Estuary

*Brackish Wetlands*



# The San Francisco Estuary

*Wetland Fishes*




"An abundant, diverse community of fish that is dominated by native species, which in turn are widespread throughout their native range, **is an indicator of a healthy Estuary**."

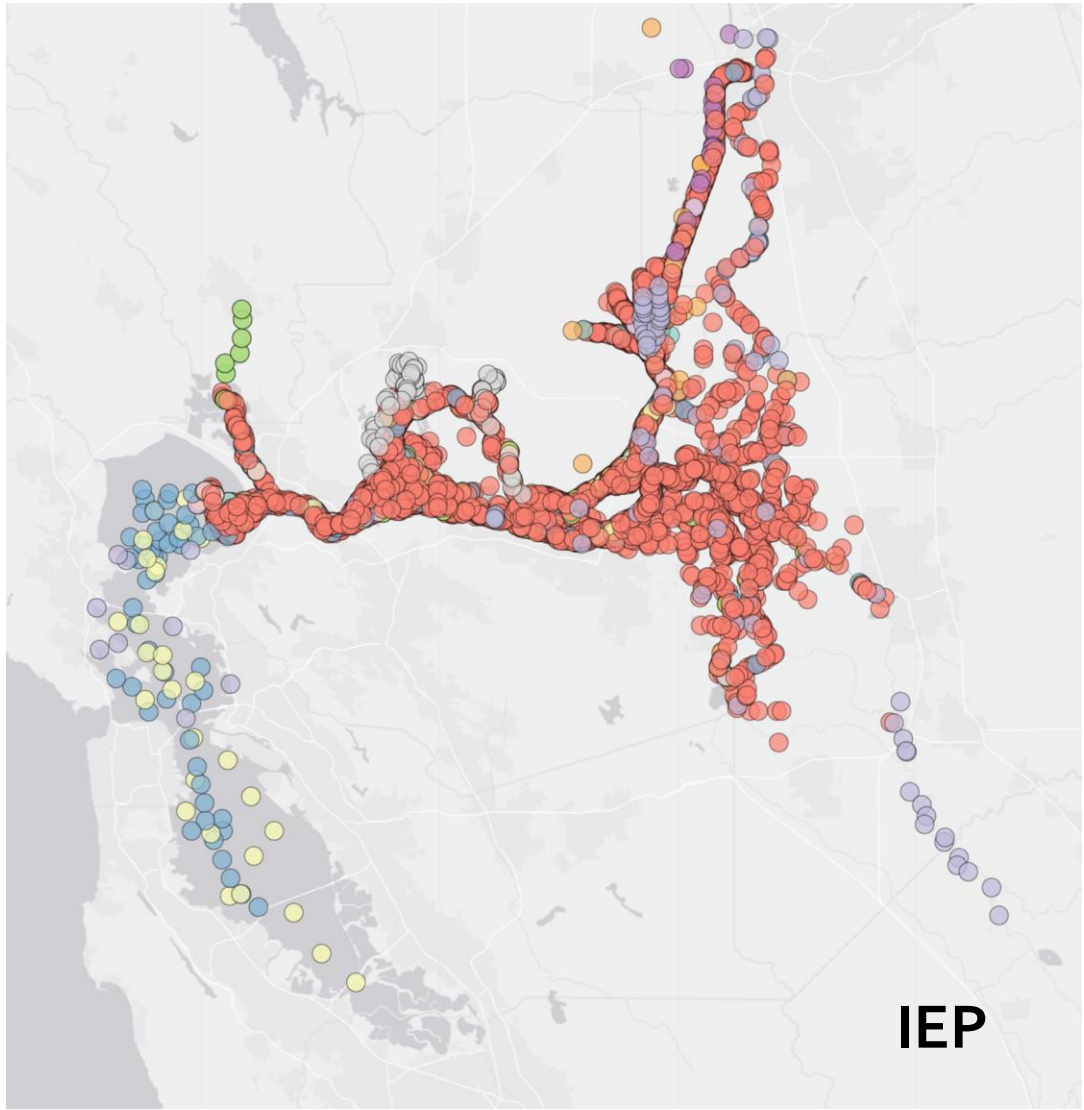
"In San Francisco and San Pablo Bays, this long-term data set is from sampling only the offshore areas of the bay **and may not reflect benefits to fish populations from recent wetland restoration.**

| UPPER ESTUARY FISH COMMUNITIES | | | |
|---|---|---|---|
| UPPER ESTUARY INDICATORS | SUBREGION | STATUS | TREND |
| Native Fish Abundance | Suisun Marsh | Fair | Declining |
| | Suisun Bay Pelagic | Very Poor | Declining |
| | Central-West Delta Pelagic | Very Poor | Declining |
| | Delta Beach Zone | Very Poor | Declining |
| Percent Native Fish | Suisun Marsh | Poor | Improving |
| | Suisun Bay Pelagic | Poor | Stable |
| | Central-West Delta Pelagic | Very Poor | Stable |
| | Delta Beach Zone | Very Poor | Declining |
| Percent Native Species | Suisun Marsh | Poor | Stable |
| | Suisun Bay Pelagic | Fair | Stable |
| | Central-West Delta Pelagic | Very Poor | Declining |
| | Delta Beach Zone | Very Poor | Stable |



## FFH Monitoring in the SFE

- **Only Suisun Marsh has been included in long-term monitoring**
- **No long-term monitoring in most North Bay and South Bay Wetlands**
- **Limited habitat & species coverage**




https://deltascience.shinyapps.io/Home/

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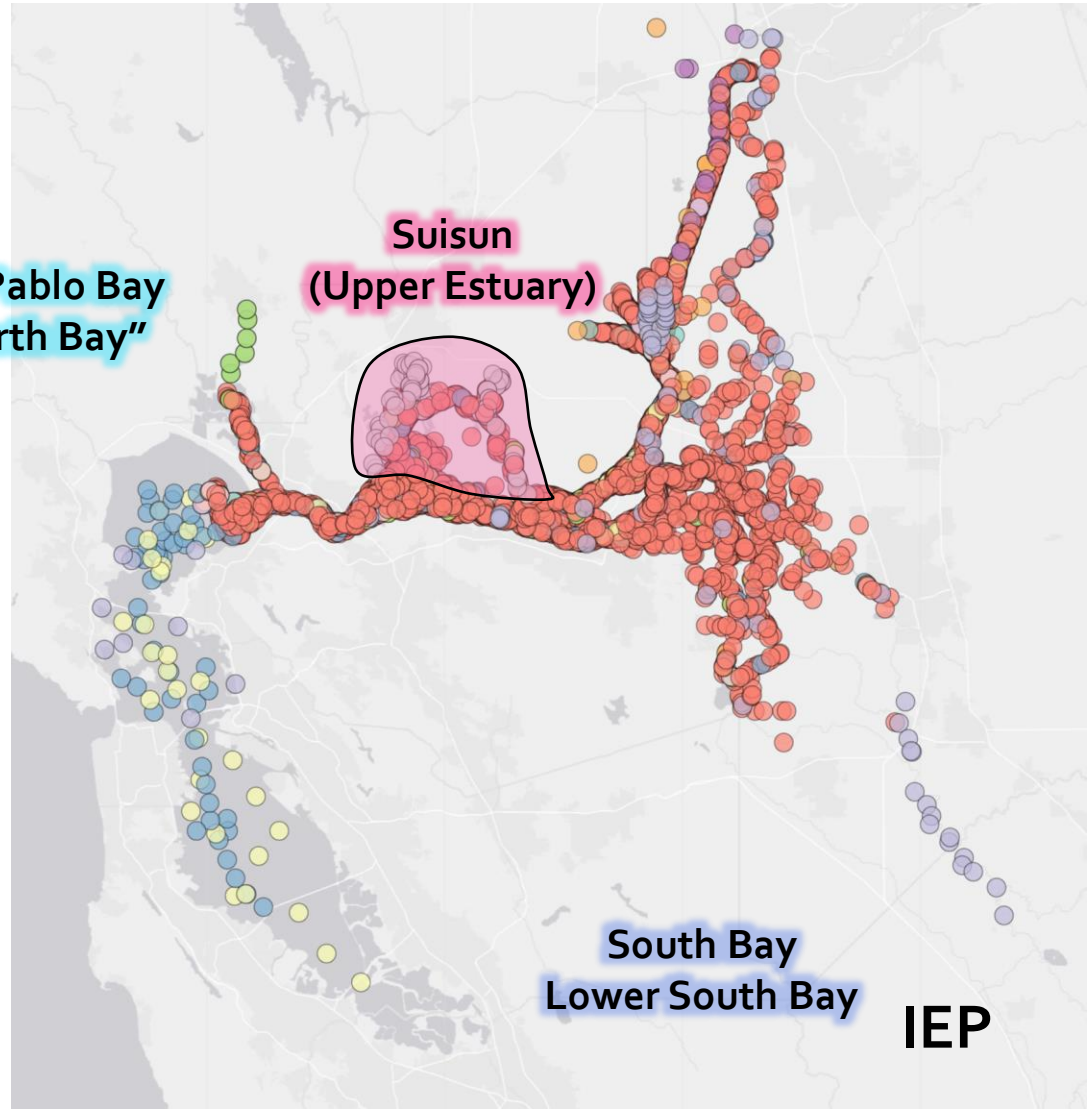


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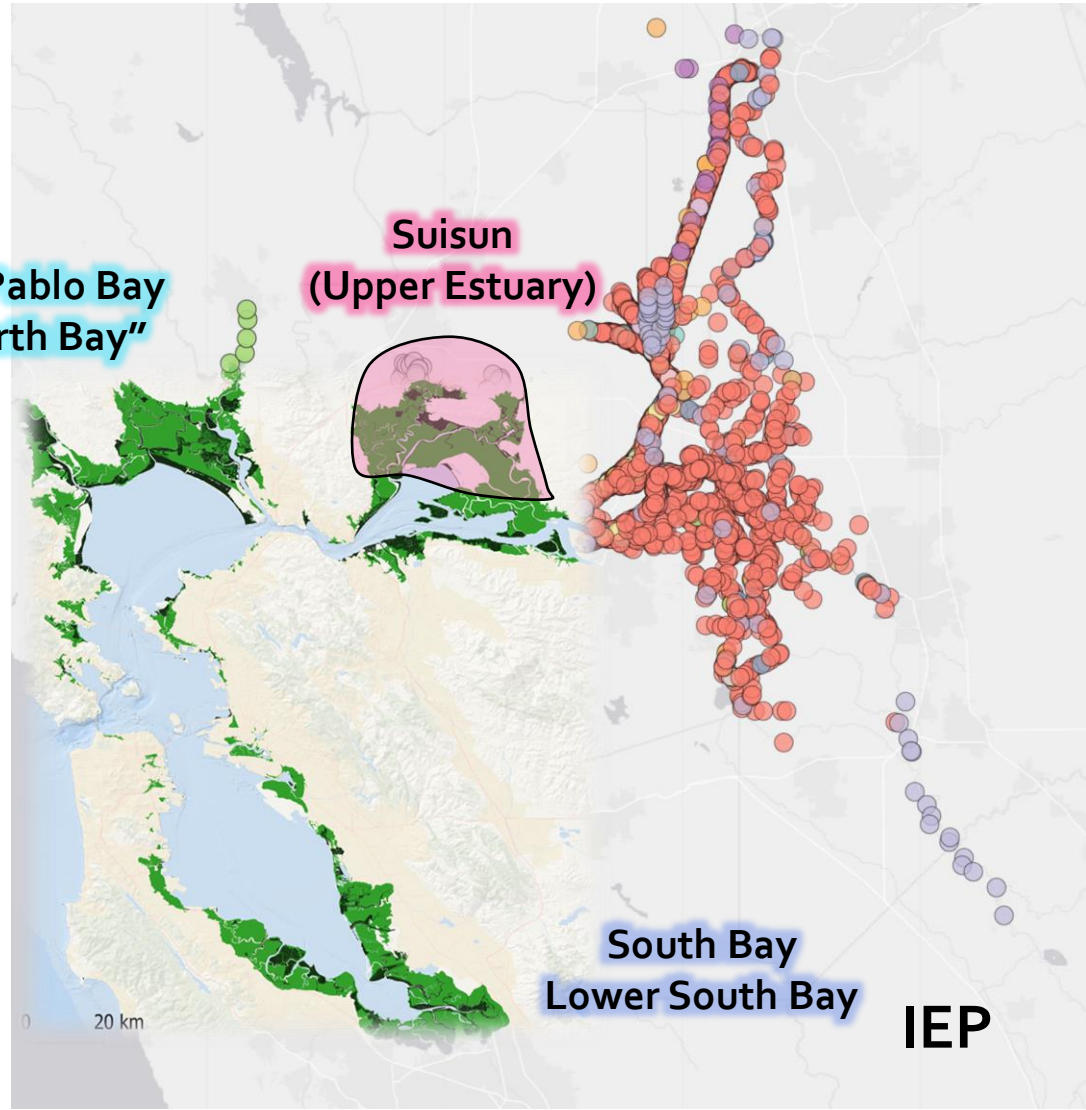


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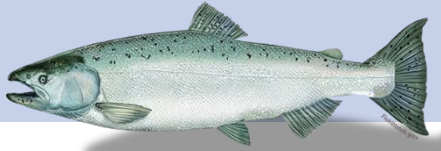


# FFH Monitoring in the SFE

## State

INTERAGENCY ECOLOGICAL PROGRAM TECHNICAL REPORT

**Effects of Tidal Wetland Restoration on Fish**

A Suite of Conceptual Models

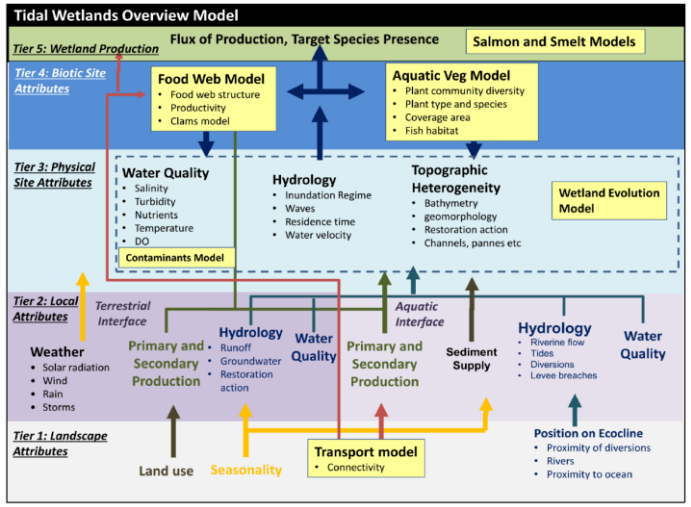
Edited by Stacy Sherman, Rosemary Hartman, and Dave Contreras

California Department of Fish & Wildlife
Bay Delta Region, Fish Restoration Program
2109 Arch Road, Suite 100, Stockton, CA 95206
November 2, 2017

Fish Restoration Program

Interagency Ecological Program
Cooperative Ecological Investigations Since 1970

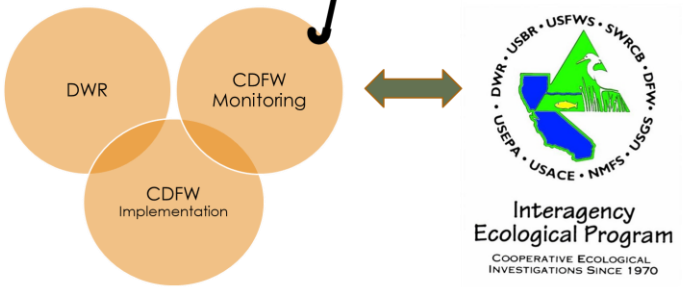
Suggested citation: Sherman, S., R. Hartman, and D. Contreras, editors. 2017. Effects of Tidal Wetland Restoration on Fish: A Suite of Conceptual Models. IEP Technical Report 91. Department of Water Resources, Sacramento, California.




Fish Restoration Program

IEP

IEP Tidal Wetland Monitoring Project Work Team




Interagency Ecological Program
Cooperative Ecological Investigations Since 1970

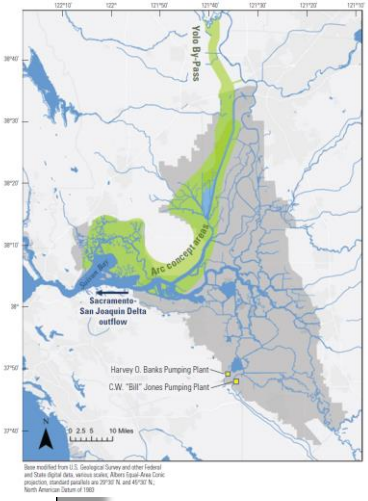
## Federal

USGS science for a changing world

Water Availability and Use Science Program

Prepared in cooperation with the Bureau of Reclamation

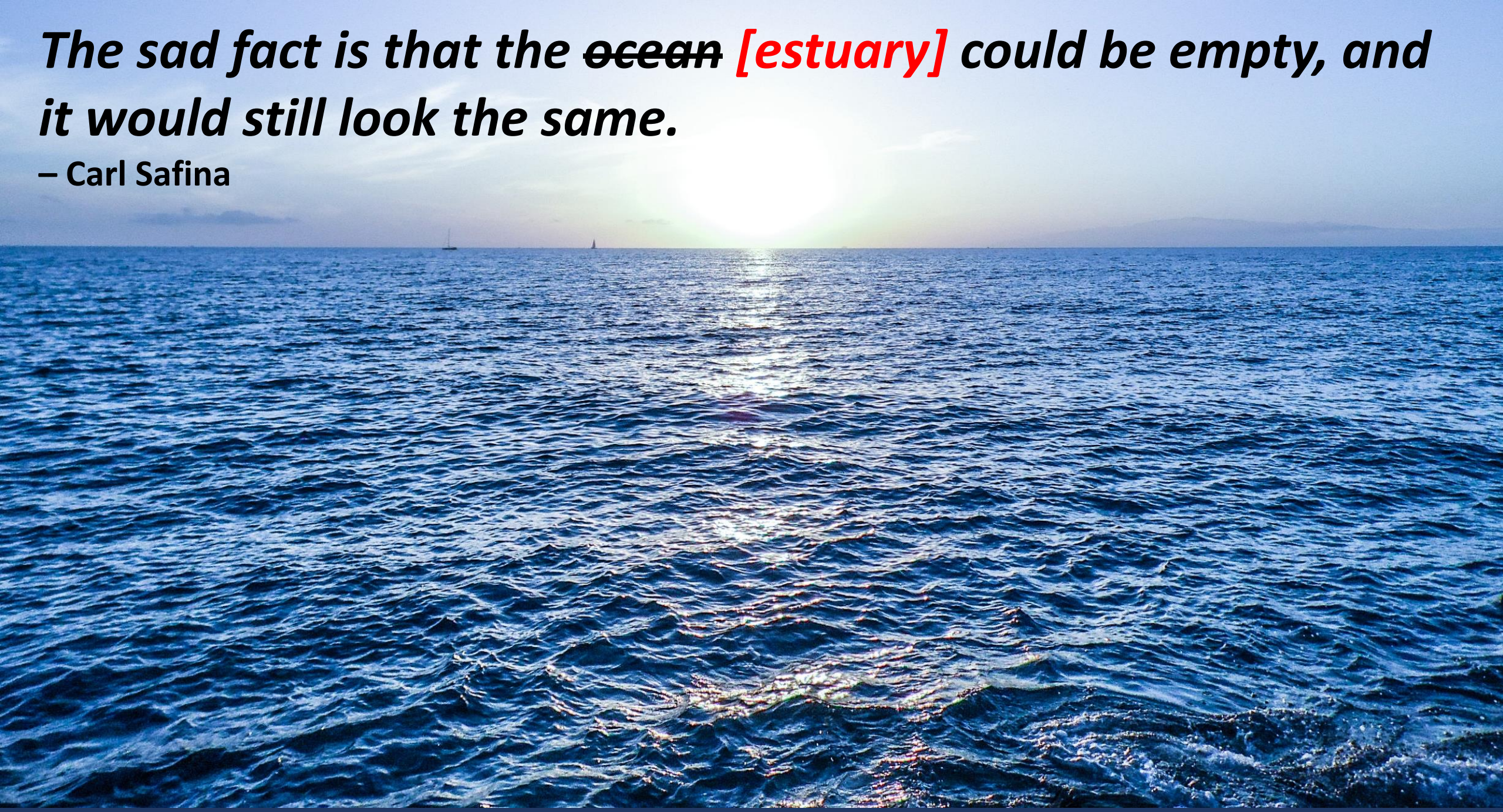
**Physics to Fish: Understanding the Factors that Create and Sustain Native Fish Habitat in the San Francisco Estuary**




Open-File Report 2023–1087

By Larry R. Brown, David E. Ayers, Brian Bergamaschi, Jon R. B
Evan T. Dailey, Bryan Downing, Maureen Downing-Kunz, Freder
Brock M. Huntsman, Tamara Kraus, Tara Morgan, Jessica R. La
Francis Parchaso, Catherine A. Ruhl, Elizabeth Stumpner, Paul S
Janet Thompson, and Matthew J. Young

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


*The sad fact is that the ~~ocean~~ [estuary] could be empty, and it would still look the same.*
**– Carl Safina**

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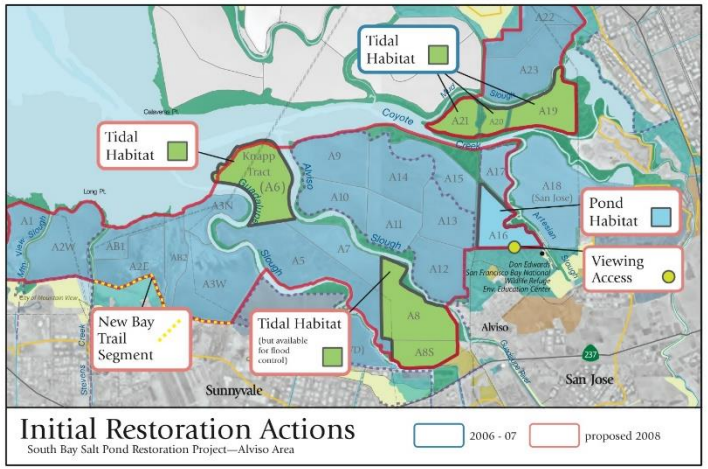
# II. FFH Monitoring in South Bay Wetlands

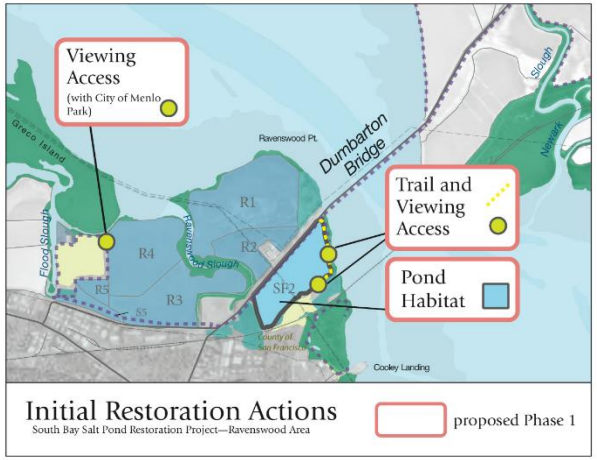
## South Bay FFH Studies

South Bay Salt Pond Restoration Project

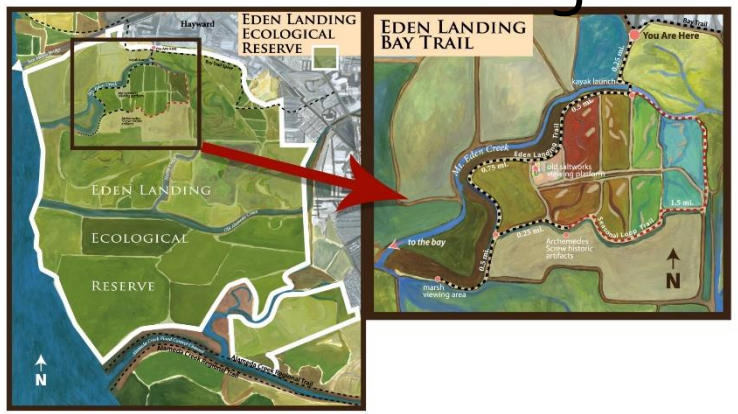

### Alviso




### Ravenswood

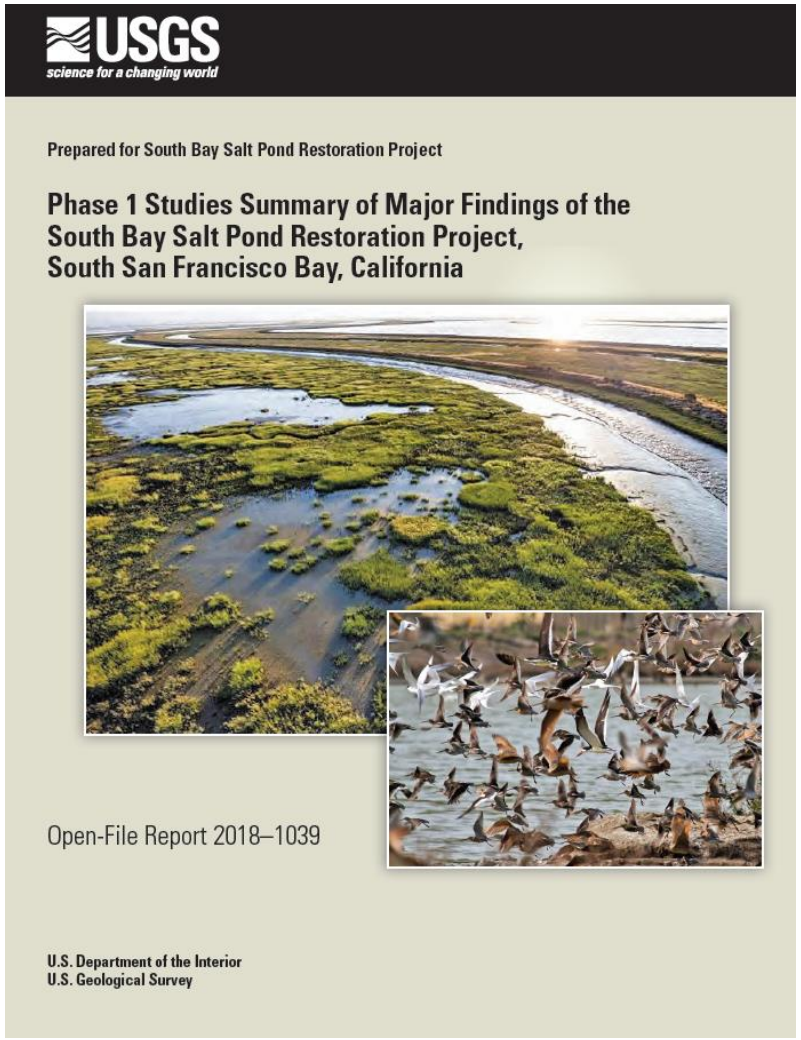


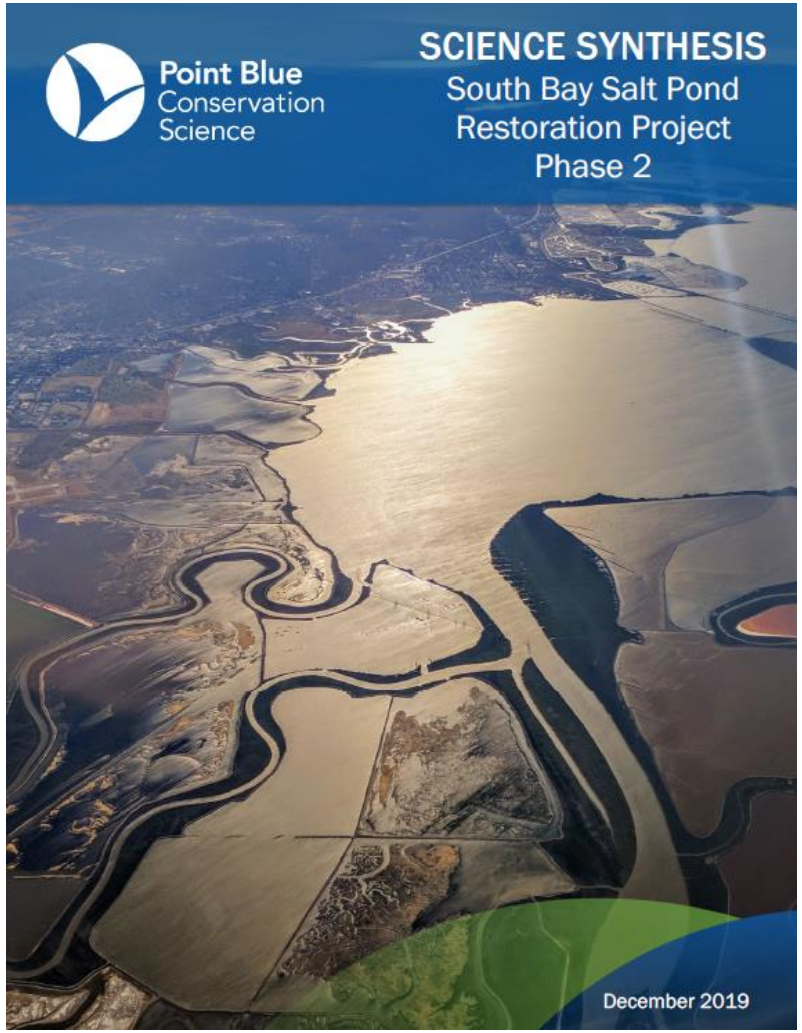

### Eden Landing

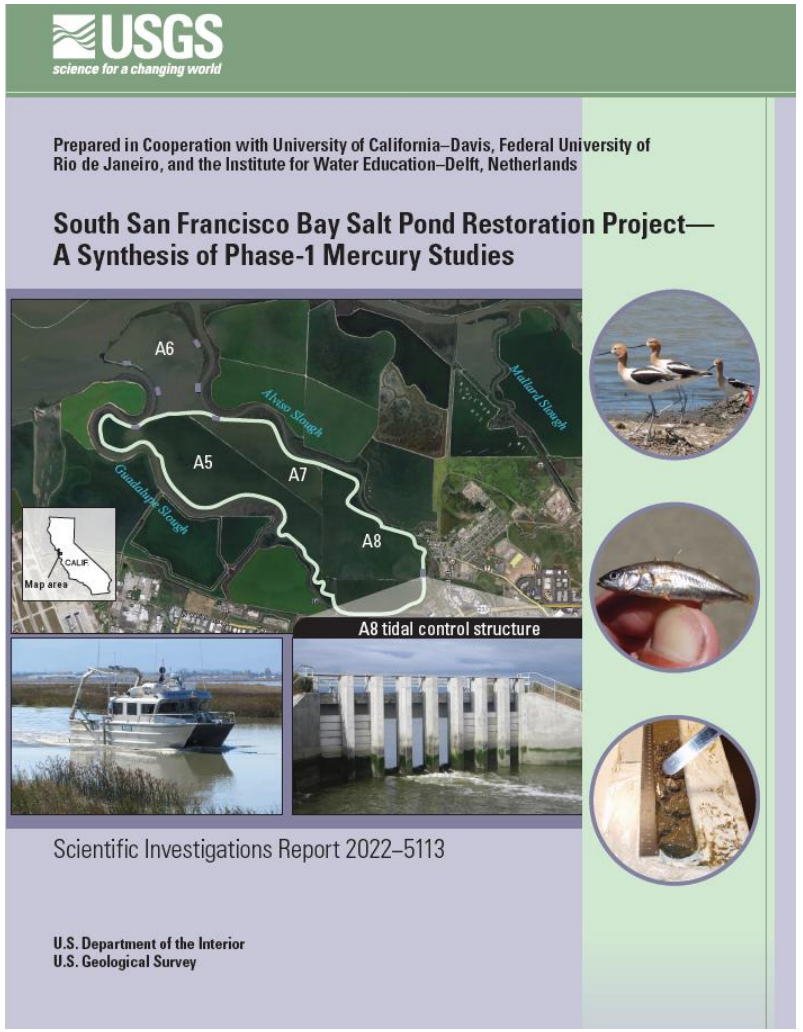


# II. FFH Monitoring in South Bay Wetlands

## South Bay FFH Studies



# II. FFH Monitoring in South Bay Wetlands

## South Bay FFH Studies

### HISTORICAL

- Schmitt, W. 1978 (1912-1914)
- Carpelan, L 1957 (1951)
- Alpin 1967 (1963-1966)
- De Vlaming 1972 (1970)
- Pearson 1989 (1973-1982)
- SBDA 1983 (1981-1986)
- Saiki & Meija 2006 (2006-7)
- Meija & Saiki 2007 (2006-7)

### OGFL-UCD

- Hobbs 2012 (sentinel sp study 1, LJM)
- Hobbs 2014 (RBT PIT study)
- Hobbs 2014 (sentinel sp study 2, PSS)
- Buckmaster & Hobbs 2014 (invert communities)
- Cook & Hobbs 2016 (pond fish communities)
- Hobbs 2015 (Gillnet/LEOSHA study)
- Hobbs 2017 (sbda vs sbots 1)
- Hobbs 2018 (Hg study)
- Lewis & Hobbs 2018 (sjscrwf-fish)
- Lewis & Hobbs 2019 (sfei do 1)
- Lewis & Hobbs 2019 (bay tribs, larval LFS)
- Lewis & Hobbs 2021 (sbots 2 - fish)
- Lewis & Hobbs 2021 (sjscrwf – mysids)
- Lewis 2024 (Intensive OT Study, sfei do 2)

### FUTURE

- Gast & Assoc. (in prep). Ravenswood
- Lewis (in prep). Calabazas San Tomas
- Lewis (in prep). CWS Regional Analysis
- Lewis (future). WRMP FFH (regional)

### REVIEWS

- Valoppi, L. 2018
- Wood et al. 2019
- Marvin-DiPasquale et al. 2022

# II. FFH Monitoring in South Bay Wetlands

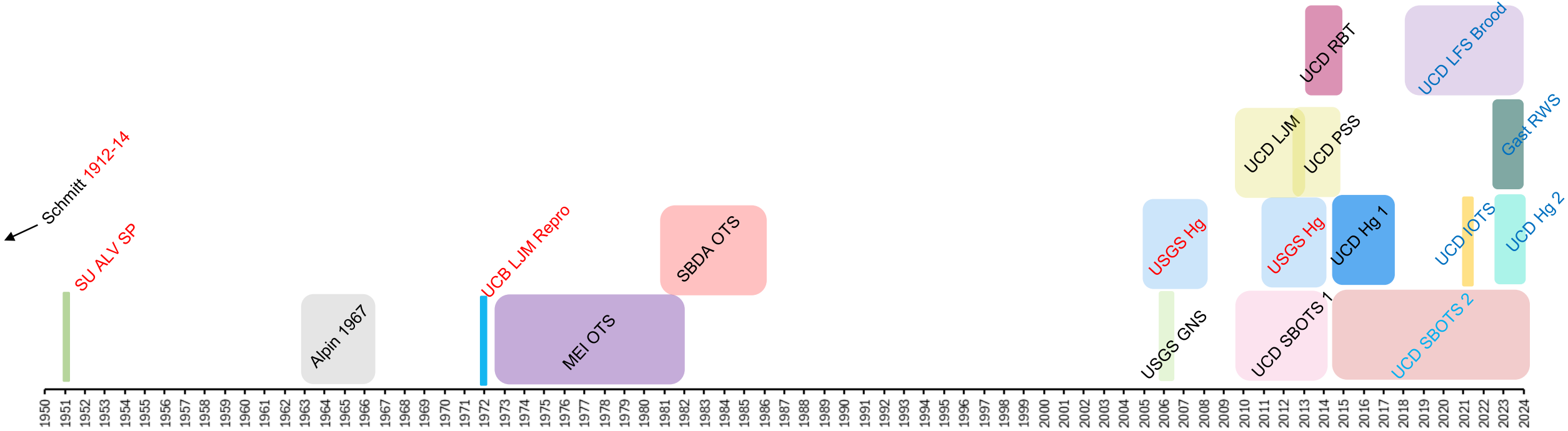
## South Bay FFH Studies

| No. | Code | Description | Gears | Sponsor | Author/PI | Affiliation | Study Dates | Report Date | Report Acquired | Data Acquired | Data Types | Report-MS Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH | | | | | | | | | | | | |
| 1 | Schmitt 1978 | Biological Survey of San Francisco Bay, 1912-1914. Notes, data on collections made, and maps | | | Schmitt, Waldo | | 1912-1914 | 1978* | | | | https://www.biodiversitylibrary.org/search?searchTerm=%22Waldo%20L.%20Schmitt%20Papers,%201907-1978%22&stype=C |
| 2 | SU ALV SP | "Hydrobiology of the Alviso Salt Ponds" [*Observations of environmental and biological characteristics* ] | Dip Net | Leslie Salt Co. | Carpelan, L | Stanford U. | 1951 | 1957 | X | | env, fish, inv (obs) | https://www.jstor.org/stable/1929880 |
| 3 | Alpin 1967 | "Biological survey of San Francisco bay 1963-1966" | | | Aplin, JA | | 1963-1966 | 1967 | | X | | |
| 4 | UCB LJM Repro | Observations of reproductive patterns of Longjaw Mudsuckers in Alviso Ponds | Beach Seine | Sigma Xi, UC, NIH | De Vlamming, V | UC Berkeley | 1970 | 1972 | X | | env, fish (LJM reprod) | https://www.jstor.org/stable/1442489 |
| 5 | MEI OTS | Survey of fishes and water properties of South San Francisco Bay, California, 1973-82 [*open water* ] | Otter Trawl | Marine Ecological Institute (NGO), sampling | Pearson, DE | NOAA | 1973-1982 | 1989 | X | | fish, env | https://repository.library.noaa.gov/view/noaa/5878 |
| 6 | SBDA OTS | Comparison of contemporary data (SBOTS 1) with historical data from the South Bay Discharge Authority fish surveys in Coyote Slough | Otter Trawl | SBDA | Hobbs, SBDA* | UC Davis, SBDA* | 1981-1986 | 2017 | X | X | fish, inv, env | http://dx.doi.org/10.13140/RG.2.2.14047.47522 |
| 7 | USGS GNS | USGS study of fish communities inside and outside of recently restored salt ponds | Gill Net | SBSPRP | Saiki & Meija | USGS | 2006 | 2009 | X | | fish, env | https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47342 |
| 8 | UCD SBOTS 1 | UCD South Bay Otter Trawl Survey - Phase 1 | Otter Trawl | SBSPRP | Cook, Hobbs | UC Davis-OGFL | 2010-2014 | 2016 | X | X | fish, inv, env | https://www.proquest.com/dissertations-theses/spatial-temporal-trends-fishes-aquatic/docview/1807638287/se-2?accountid=14505 |
| 9 | UCD LJM | UCD Sentinel Species Study 1 (LJM) | Minnow Trap | SBSPRP | Hobbs | UC Davis-OGFL | 2010-2012 | 2012 | X | X | fish, inv, env | http://dx.doi.org/10.13140/RG.2.2.15859.34083/1 |
| 10 | UCD LEOSHA | UCD Leopard Shark Study | Gill Net, Angling | SBSPRP | Hobbs | UC Davis-OGFL | 2010-2014 | 2015 | X | X | fish, diet, env | https://www.southbayrestoration.org/sites/default/files/documents/011615_leopard_shark_chapter_final_report.pdf |
| 11 | UCD PSS | UCD Sentinel Species Study 2 (PSS) | Otter Trawl, Beach Seine, Trap | SBSPRP | Hobbs | UC Davis-OGFL | 2012-2014 | 2014 | X | X | fish, diet, env | http://dx.doi.org/10.13140/RG.2.2.19214.78400 |
| 12 | UCD RBT | UCD Rainbow Trout - Steelhead RFID PIT Tag Study | RFID PIT Tag | SBSPRP, NMFS | Hobbs | UC Davis-OGFL | 2013-2014 | 2014 | X | X | PIT detections | https://www.southbayrestoration.org/document/steelhead-smolt-outmigration-and-survival-study-pond-a8-a7-a5-entrainment-and-escapement |
| 13 | UCD Hg 1 | UCD Mercury Study 1 | Beach Seine (& fyke) | SBSPRP | Hobbs | UC Davis-OGFL | 2015-2017 | 2018 | X | X | fish, inv, env | https://www.southbayrestoration.org/sites/default/files/documents/hobbs_nekton_ponds-slough_06-29-18.pdf |
| 14 | UCD IOTS | UCD Intensive Otter Trawl Survey | Otter Trawl | SFEI | Lewis | UC Davis-OGFL | 2021 | 2024 | X | X | fish, inv, env | |
| 15 | UCD SBOTS 2 | UCD South Bay Otter Trawl Survey - Phase 2 | Otter Trawl | SJSCRWF, NOAA | Lewis, Hobbs | UC Davis-OGFL | 2015-present | *in progress* | *in progress* | *in progress* | fish, inv, env | *in progress* |
| 16 | UCD LFS Brood | UCD Longfin Smelt Broodstock Collection Survey | Otter Trawl | CDWR | Lewis, Hobbs | UC Davis-OGFL | 2018-present | *in progress* | *in progress* | *in progress* | fish, inv, env | *in progress* |
| 17 | UCD Hg 2 | UCD Mercury Study 2 | Otter trawl, Beach Seine | EPA, SCVW, Stillwater Sci. | Lewis | UC Davis-OGFL | 2023-present | *in progress* | *in progress* | *in progress* | fish, inv, env, Hg | *in progress* |
| 18 | CWS | UCD Regional FFH Comparisons between Suisun Marsh & Alviso Marsh | Otter Trawl | UCD-CWS | Lewis | UC Davis-OGFL | 2015-present | *in progress* | *in progress* | *in progress* | fish, inv, env | *in progress* |
| 19 | Gast RWS | T. Gast & Associates Ravenswood FFH Monitoring | | Helix, Ducks Unlimited) | Gast | UC Davis-OGFL | 2022-present* | *in progress* | *in progress* | *in progress* | fish, inv, env* | *in progress* |
| 20 | WRMP FFH | Wetland Regional Monitoring Program FFH Survey - Phase 1 | Otter Trawl | EPA, SFEI | Lewis | UC Davis-OGFL | 2025-2027* | *planned* | *planned* | *planned* | fish, inv, env | *planned* |
| ZOOPS | | | | | | | | | | | | |
| 1 | N/A [ZOOP] | Barros Longfin Smet Diet & Zooplankton Study | Plankton Nets (20-mm, CB) | USFWS, CDWR | Barros, Lewis | UC Davis-OGFL | 2017 | *2022* | X | X | larval LFS, zoops | https://doi.org/10.1007/s12237-021-01024-y |
| 2 | N/A [ZOOP] | UCD Bay-Tribs | Plankton Nets (SLS, 20-mm) | CDWR | Lewis, Hobbs | UC Davis-OGFL | 2016-2019* | *2019* | X | X | fish, env | http://dx.doi.org/10.13140/RG.2.2.12944.33280 |
| 3 | N/A [ZOOP] | UCD Mysid & Copepod Study | Plankton Net (Mysid Net) | SJSCRWF, CDFW | Hobbs | UC Davis-OGFL | 2016-2019* | *2021* | X | X | zoops, env | |
| SYNTHESES | | | | | | | | | | | | |
| 1 | SBSPRP P1 | USGS:"Phase 1 studies summary of major findings of the South Bay Salt Pond Restoration Project, South San Francisco Bay, California" | n/a | CA Coastal Conservancy | Valoppi | SBSPRP | 2009-2016 | 2018 | X | n/a | n/a | https://doi.org/10.3133/ofr20181039 |
| 2 | SBSPRP P2 | Point Blue: "South Bay Salt Pond Restoration Project - Phase 2 Science Synthesis Report" | n/a | SFBRA, CWF | Wood et al. | Point Blue | n/a | 2019 | X | n/a | n/a | https://www.southbayrestoration.org/sites/default/files/documents/pointblue_sbsp_science_synthesis_report_final_dec2019_wsfbralogo_0.pdf |
| 3 | USGS Hg | USGS "South San Francisco Bay Salt Pond Restoration Project—A Synthesis of Phase-1 Mercury Studies" | Minnow Trap, Beach Seine | CA Coastal Conservancy | Marvin-DiPasquale, Slotton | USGS, UC Davis | 2011-2017 | 2022 | X | n/a | Tissue Hg content, env.; no fish data | https://pubs.usgs.gov/publication/sir20225113 |

*requires confirmation

# II. FFH Monitoring in South Bay Wetlands

## South Bay FFH Studies Through Time



# II. FFH Monitoring in South Bay Wetlands

## Carpelan (Fish, Inverts, Environment (1951)

ECOLOGY

Vol. 38 JULY, 1957 No. 3

### HYDROBIOLOGY OF THE ALVISO SALT PONDS

Lars H. Carpelan[1]
*Hopkins Marine Station, Stanford University*

#### Introduction

The Alviso ponds of the Leslie Salt Company border San Francisco Bay, California, where former salt marsh has been reclaimed for salt production by solar evaporation of sea water. Organisms enter the artificial ponds by natural means of dispersal; since plants and animals do not interfere with salt production, nothing is done to curb their growth. The organisms able to tolerate the environment are present in such numbers that algae and chromogenic bacteria color the water, and arthropods are conspicuous.

In the techniques associated with salt production (Tressler and Lemon 1951), ponds are used in series with increased salinity in successive ponds. Studies such as that of Ferroniére (1901) on similar ponds in France showed that as the salt content increases the number of animal species decreases due to selection of types able to withstand the increasingly difficult environment. The presence of dense populations of relatively few species would seem to make the ponds favorable for study of the interaction of a salt water environment and the organisms in it. However, although certain ecological aspects of ponds of high salinity have been reported by Peirce (1914) and Baas-Becking (1925), California salt ponds of relatively low salt content do not seem to have been subjected to intensive study, especially with reference to the physical and chemical factors. The first six ponds of the Alviso Plant were selected for investigation. They provide a specialized marine habitat in which the salinity ranges from brackish bay water (pond 1) to about four times that of ocean water (pond 6).

The distribution of organisms within the ponds and the environmental factors presumably influencing their distribution were investigated by routine sampling at approximately weekly intervals during 1951 and less frequently during 1952.

[1] Current Address: Division of Life Sciences, University of California, Riverside, California.

The same general trends were observed during the second year. With the few exceptions noted, the data presented were obtained in 1951.

The Alviso ponds (Figs. 1 and 2) lie between the estuaries (sloughs) of intermittent streams and are, therefore, of irregular size and shape. Levees protect them from tides and from land drainage. Areas of individual ponds are: No. 1—310 acres; 2—960; 3—1190; 4—280; 5—900; 6—600. Water from the Bay can be taken into pond 1 at high tide over a flood gate across Charleston Slough. When evaporation in the ponds lowers their surface levels, water flows by gravity through ponds 1, 2, and 3 via siphons and canals between them. Pond 4 is now by-passed, and since it is not used in the series, it is ignored in the following discussion. Water is pumped from pond 3 into 5, from which it flows into pond 6. Since each pond is supplied with water from the one preceding it, there is increased salinity in each pond of the series.

#### Acknowledgments

The advice and encouragement of Professor L. R. Blinks is gratefully acknowledged. The author is indebted to T. N. Fast, who laid the groundwork for the investigation. For taxonomic assistance thanks are due Drs. D. P. Abbott, R. Bolin, G. F. Ferris, M. W. Johnson, and C. B. van Niel. The Leslie Salt Company financed the study by its support of a fellowship conceived by Dr. Ludwig Rosenstein, whose sponsorship is acknowledged with thanks for his efforts and kindness.

#### Physical and Chemical Factors

*Rainfall*

*Method.*—Rainfall data were obtained from the Naval Air Station, Moffett Field, California, which borders the ponds.

*Results.*—During a fourteen year period for which records are available, the average (normal)

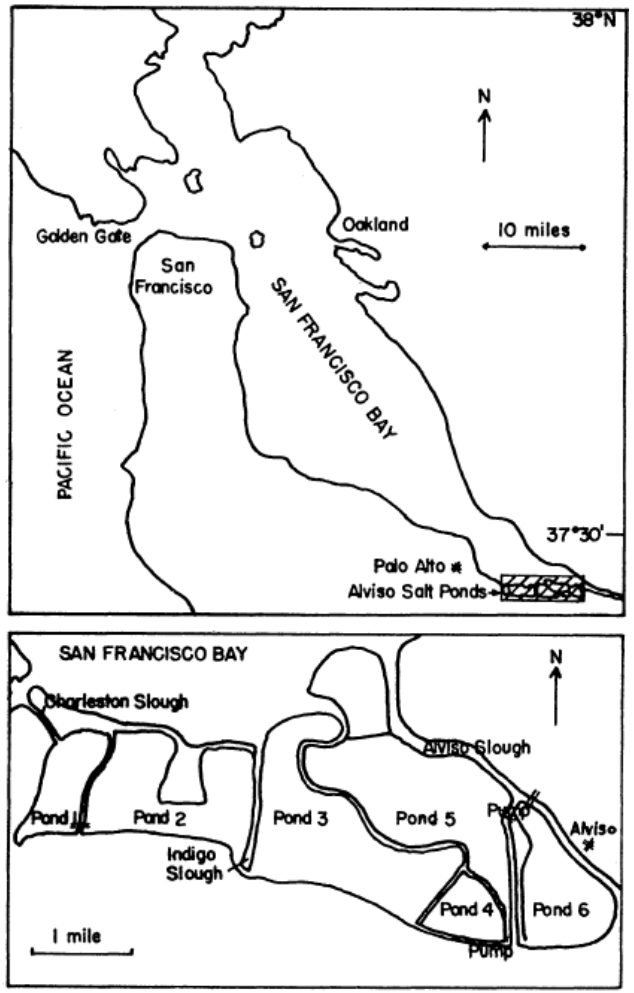
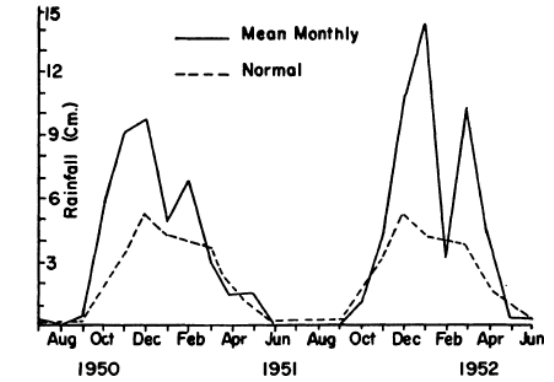



Fig. 1. Southern San Francisco Bay.
Fig. 2. Ponds 1-6, Alviso plant, Leslie Salt Company.





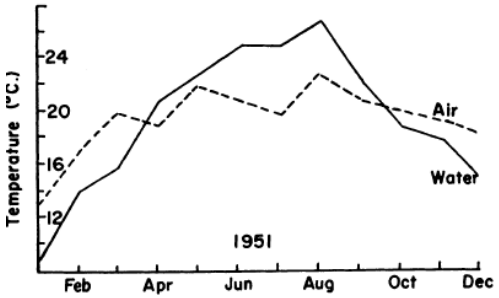




Fig. 3. Mean monthly and normal rainfall, Moffett Field, Calif.
Fig. 4. Mean monthly air and water temperatures.

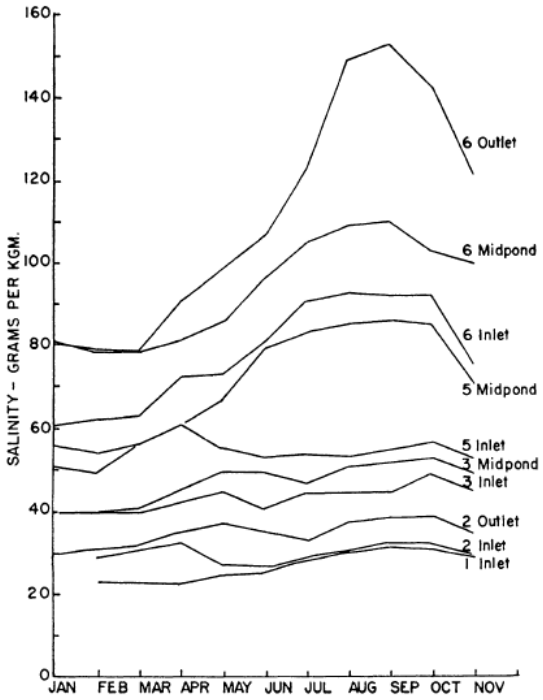
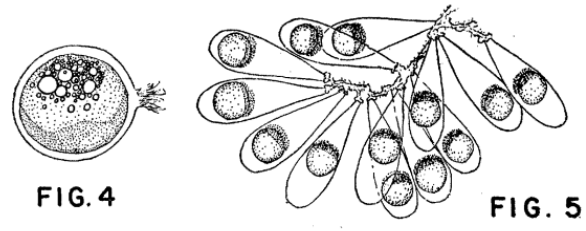



Fig. 5. Mean monthly salinity at stations indicated.

# II. FFH Monitoring in South Bay Wetlands

## De Vlamming Longjaw Mudsucker Study (1972)




Reproductive Cycling in the Estuarine Gobiid Fish, *Gillichthys mirabilis*

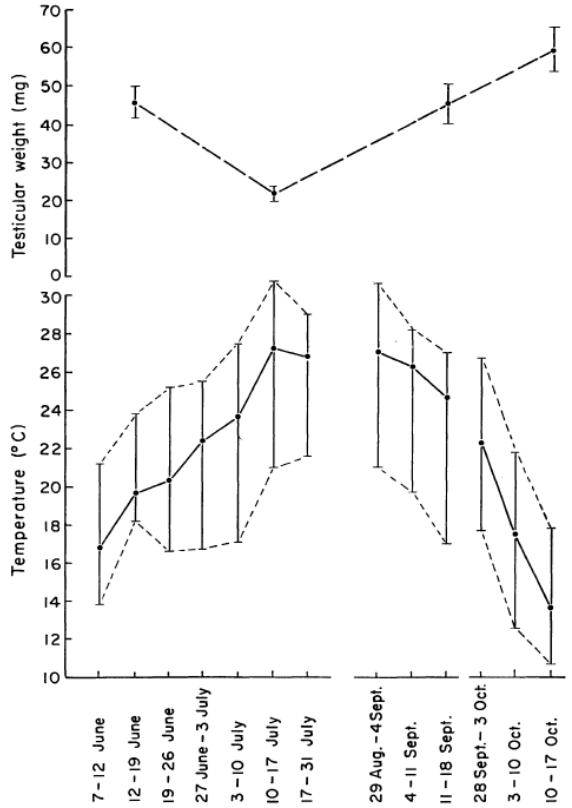
VICTOR L. DE VLAMING

**Seasonal changes in the gonads of two populations of the estuarine goby, *Gillichthys mirabilis*, were described. Histological and gravimetric data were obtained from the Alviso population (37° 27′ N) between May 1967 and October 1970 and from the Scammons Lagoon population (27° 48′ N) between April and October 1970. The spawning period of the Alviso population is protracted, extending from December to June. Each individual spawns more than once, and the population does not spawn synchronously as a unit. Gonadal regression occurs rather abruptly in July in the Alviso population, and in May and June in the Scammons Lagoon population. The gonads of fish in the Alviso population remain regressed during August and September, and the gonads of fish in the Scammons Lagoon population remain involuted in July and August. Gonadal recrudescence in the Alviso population begins in late September, reaching completion in males by early- to mid-November and in females by early-December. In the Scammons Lagoon population gonadal recrudescence is more rapid, occurring during the month of September; spawning begins in late-September or early-October.**

INTRODUCTION

KNOWLEDGE of the breeding seasons of fishes is relatively limited; for example, cyclical histological changes in the gonads of teleosts have been examined in only a few dozen species. Due to this paucity of data, meaningful ecological and phylogenetic comparisons of seasonal gametogenic changes are not possible. Furthermore, data concerning adaptation to latitude of breeding







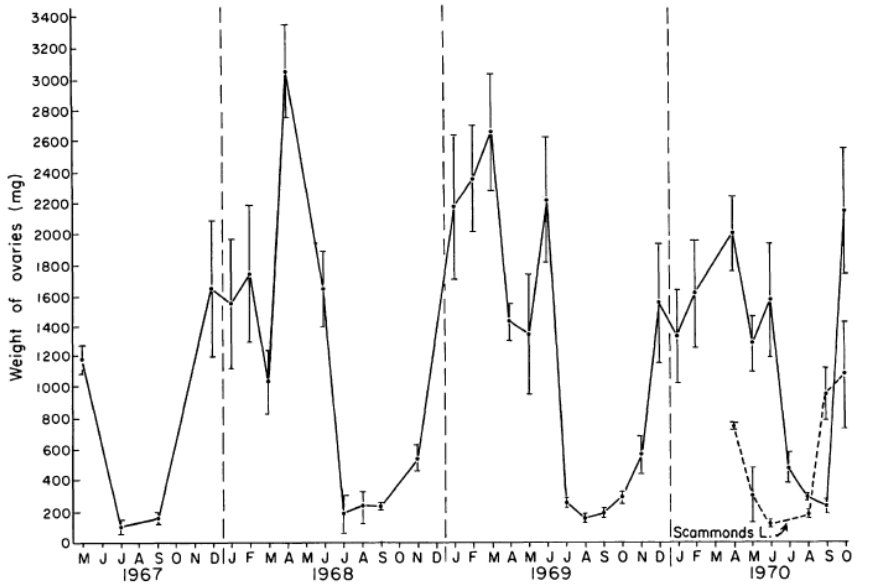
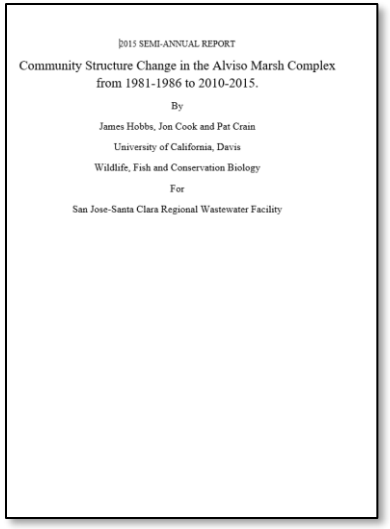




Fig. 6. Seasonal variation in ovarian weight of the Alviso population (shown by solid line) and Scammons Lagoon population (shown by broken line) in *G. mirabilis*. Mean ovarian weight is bracketed by one standard error. For sample size, see Fig. 7.

# II. FFH Monitoring in South Bay Wetlands

## SBDA Otter Trawl Survey (1982-1986)



2015 SEMI-ANNUAL REPORT

Community Structure Change in the Alviso Marsh Complex from 1981-1986 to 2010-2015.

By

James Hobbs, Jon Cook and Pat Crain

University of California, Davis

Wildlife, Fish and Conservation Biology

For

San Jose-Santa Clara Regional Wastewater Facility

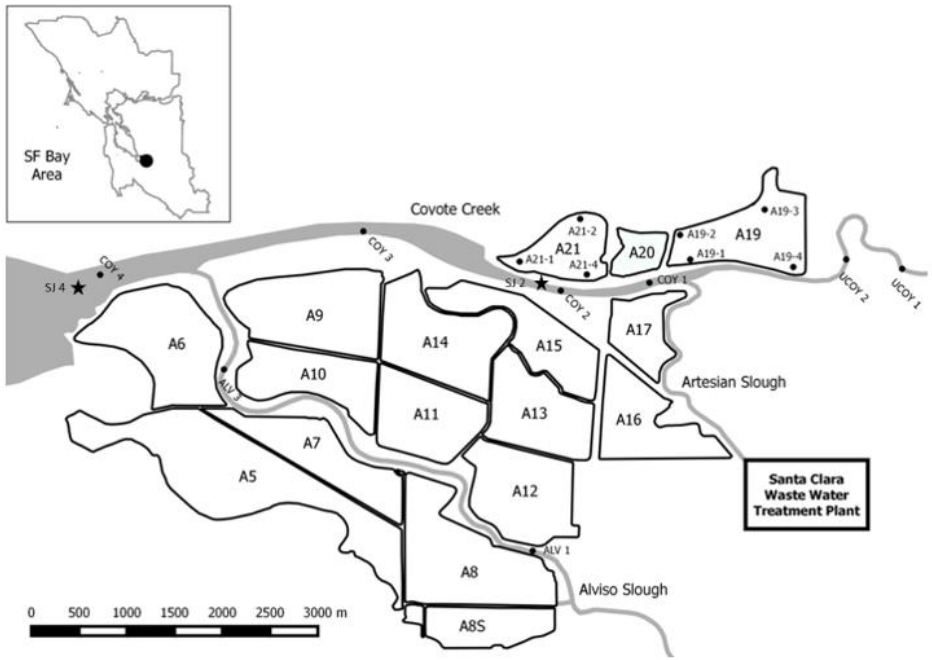



Figure 1. Map of the Alviso Marsh Complex (AMC). Circles depict stations sampled by the University of California, Davis Survey (UCD) and the stars depict the stations sampled by the South Bay Discharge Authority Survey (SBDA) used for this report.

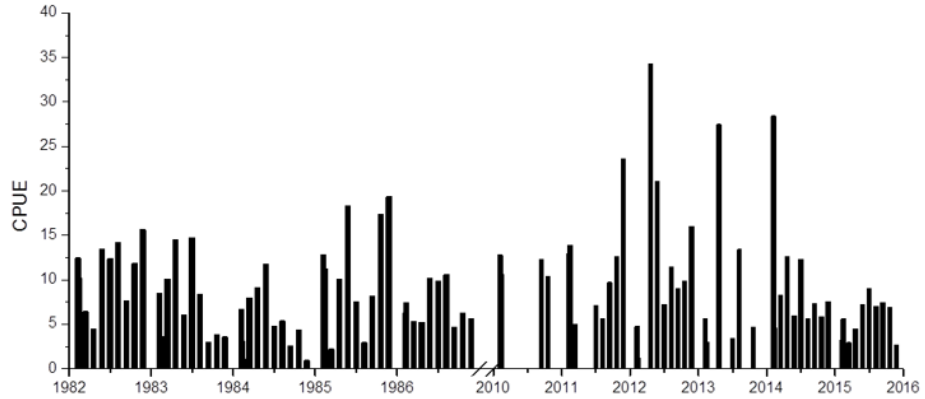
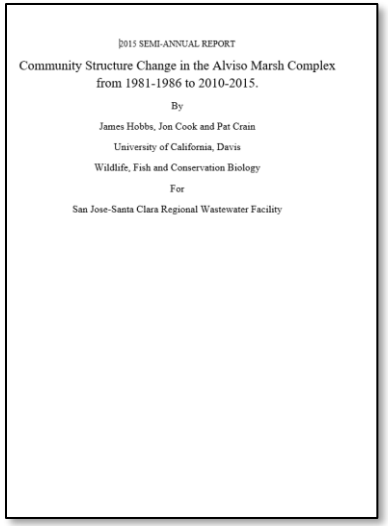




Figure 4. Monthly mean CPUE of all fish in the AMC from Jan 1982-Nov 1986 (SBDA) and July 2010-Dec 2015 (UCD)

# II. FFH Monitoring in South Bay Wetlands

## SBDA Otter Trawl Survey (1982-1986)

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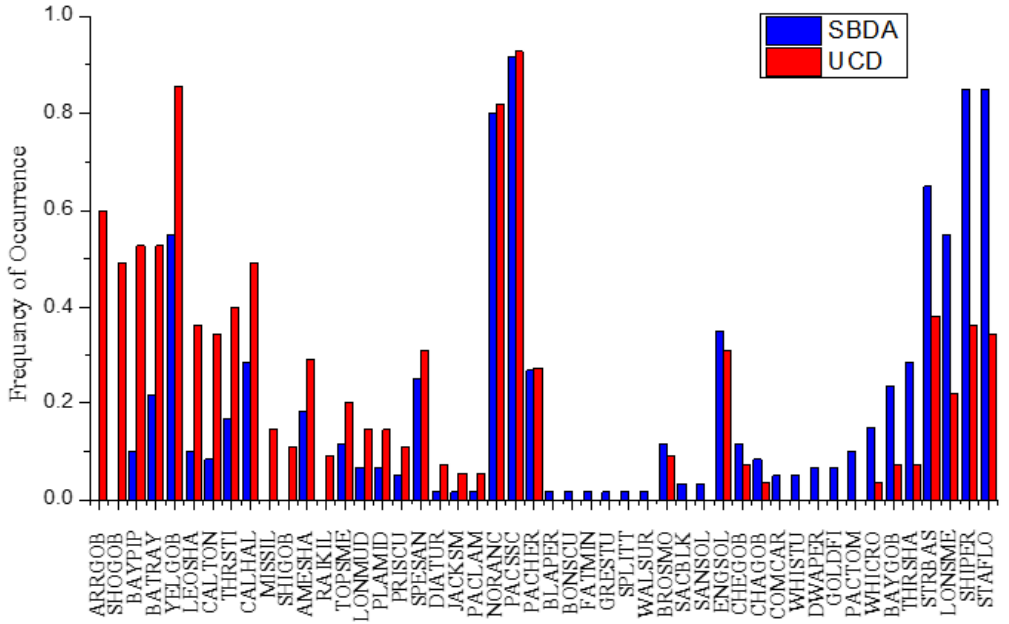



Figure 3. Frequency of occurrence for fish collected during the SBDA survey and UCD Survey.

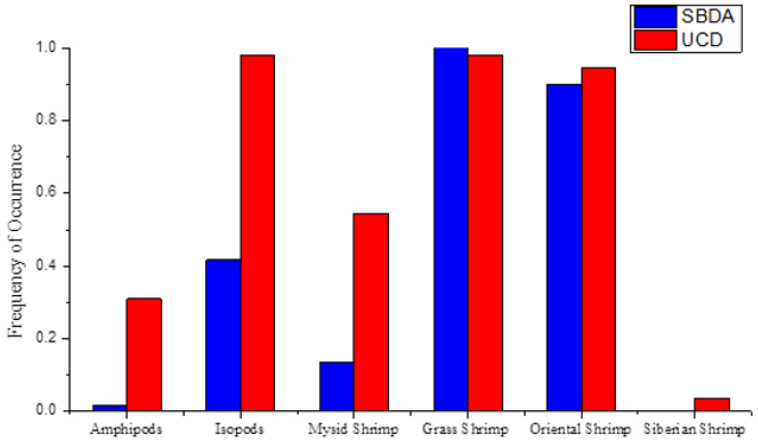
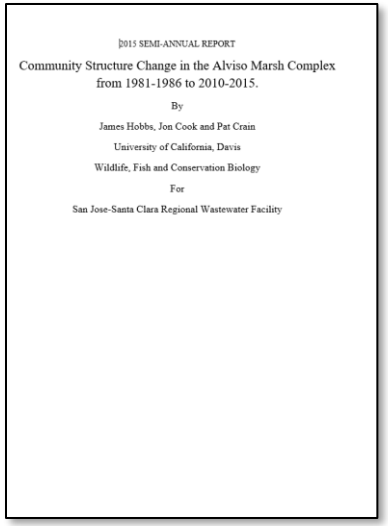



Figure 5. Frequency of occurrence of invertebrates quantified by either rank counts or weight.

# II. FFH Monitoring in South Bay Wetlands

## SBDA Otter Trawl Survey (1982-1986)

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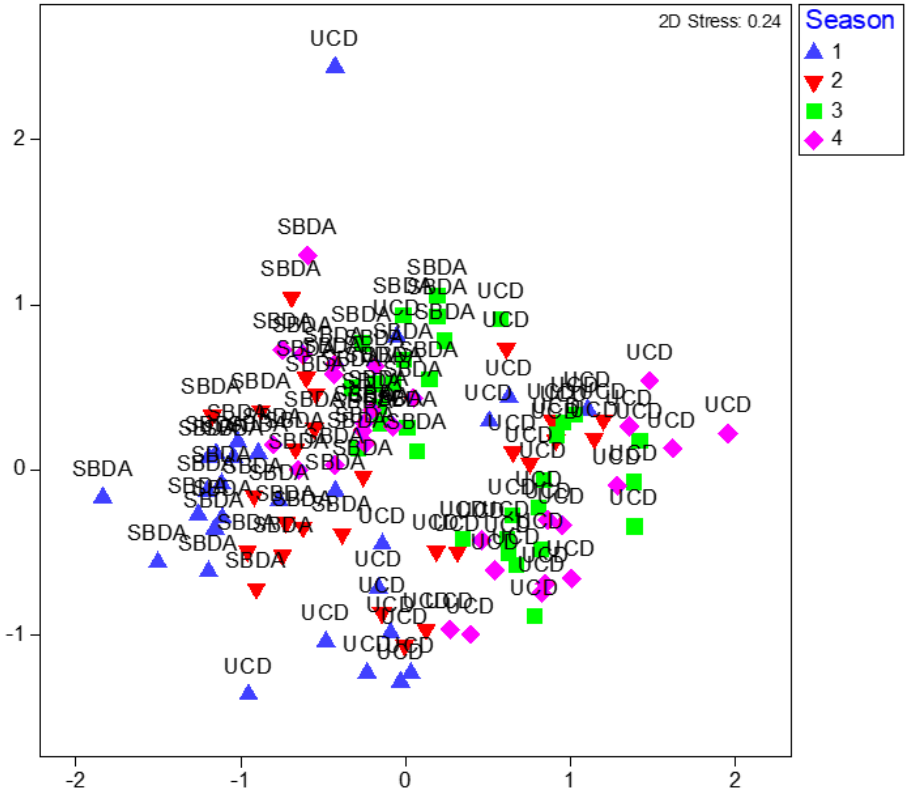
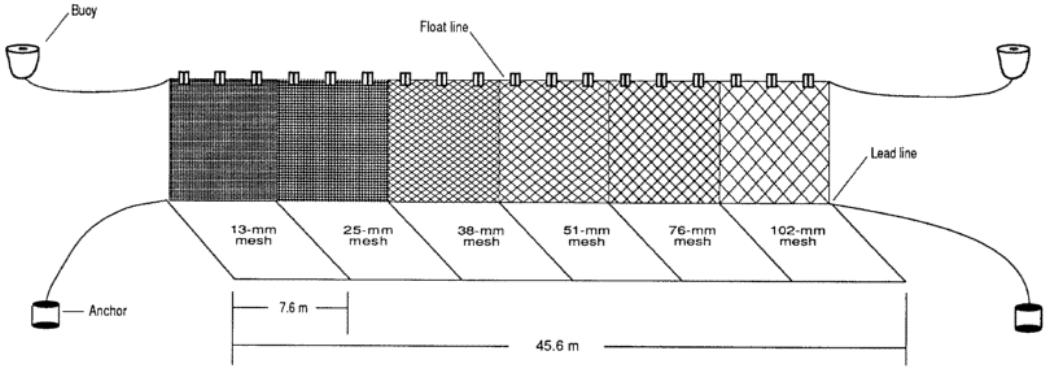
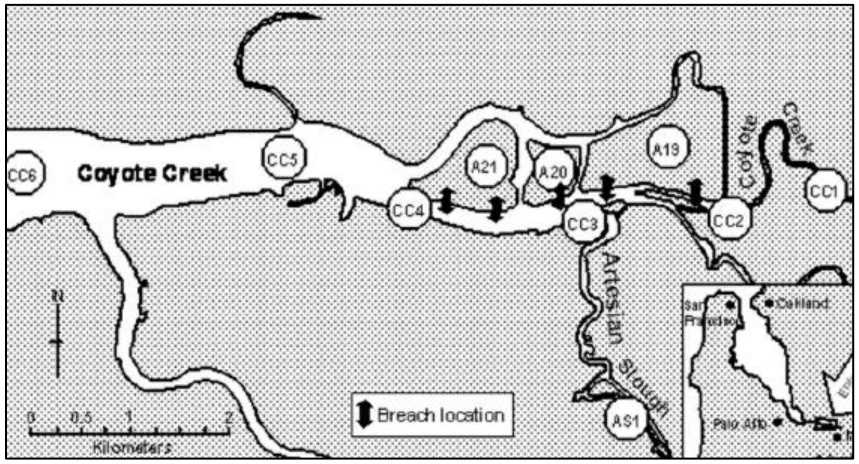



Figure 6. nMDS Ordination of taxa collected by otter trawl in Coyote Creek by Survey (UCD, present study) and South Bay Discharge Authority Study (SBDA Dec 1981-Nov 1986. Symbols represent the seasons (1 = Dec-Feb, 2 = Mar-May, 3 = Jun-Aug, 4 = Sep-Nov).

# II. FFH Monitoring in South Bay Wetlands

## USGS Gill Net & Trap Study (2006, SBSPRP)



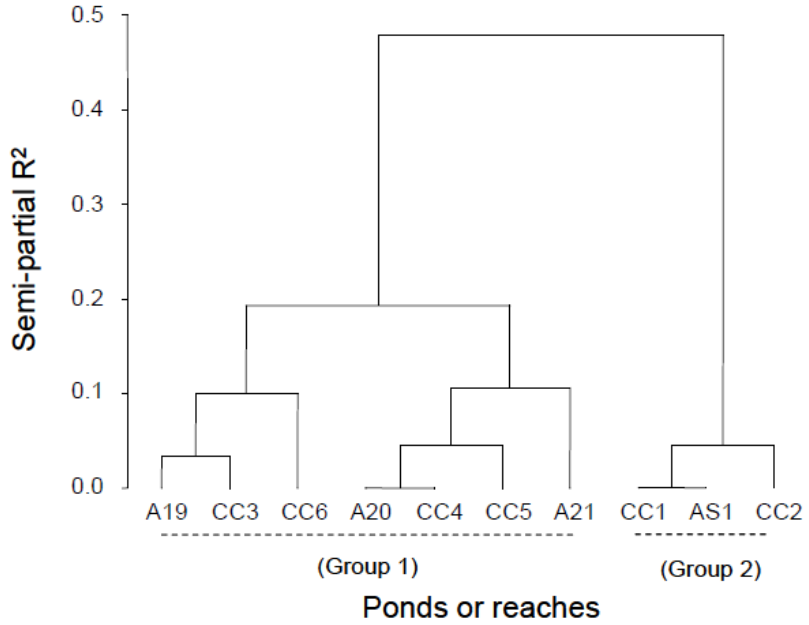
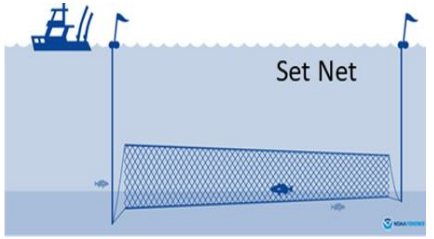




Figure 3. Dendrogram for cluster analysis (Ward's minimum variance method) of three Alviso Island ponds (A19, A20, and A21), five reaches of Coyote Creek (CC1 to CC5), and one reach of Artesian Slough (AS1). Each pond or reach constitutes a sampling unit.

USGS science for a changing world

# II. FFH Monitoring in South Bay Wetlands

## UCD Leopard Shark Study (2013-2014)

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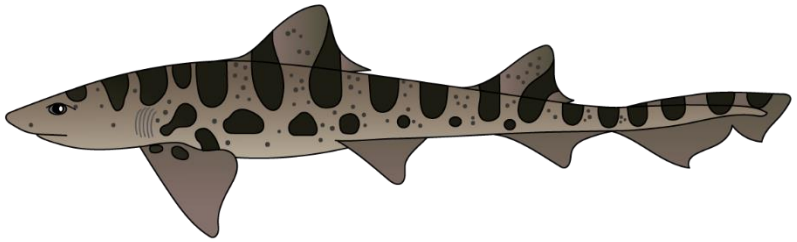
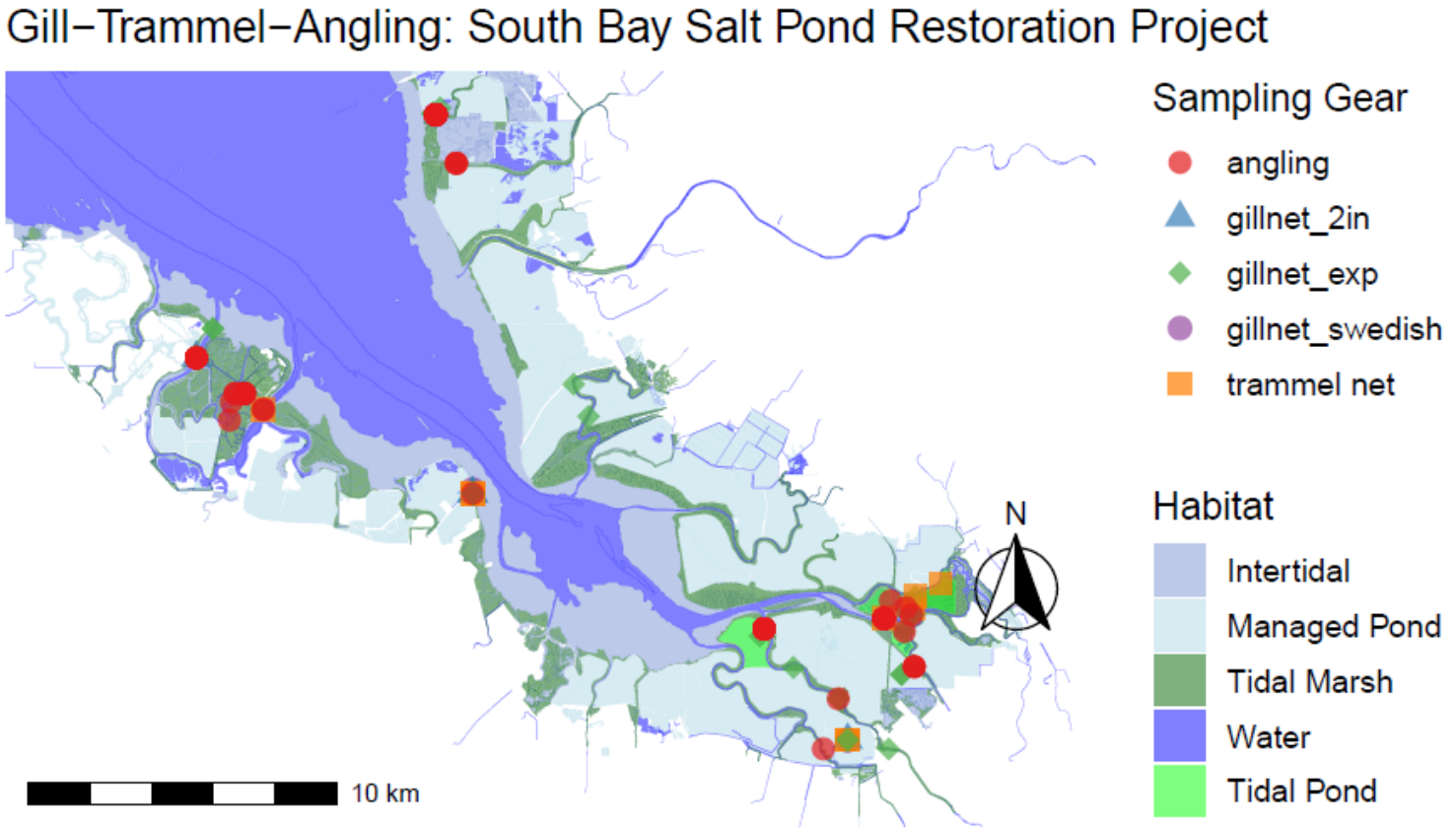
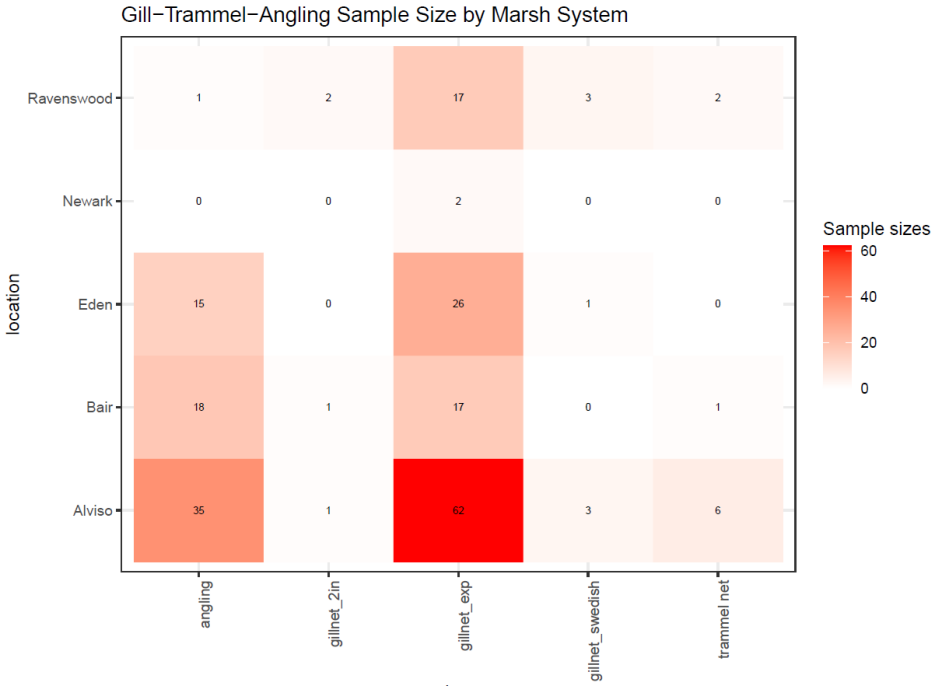
# II. FFH Monitoring in South Bay Wetlands

South Bay Salt Pond Restoration Project

## UCD Leopard Shark Study (2013-2014)



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# II. FFH Monitoring in South Bay Wetlands

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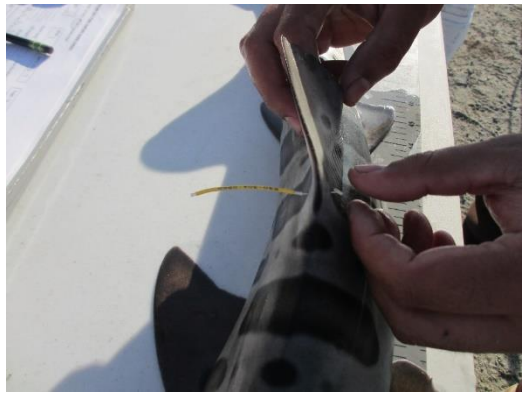

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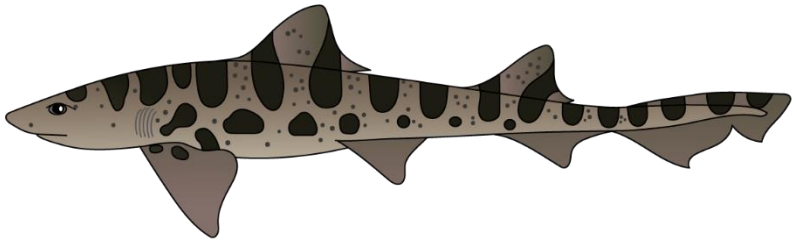
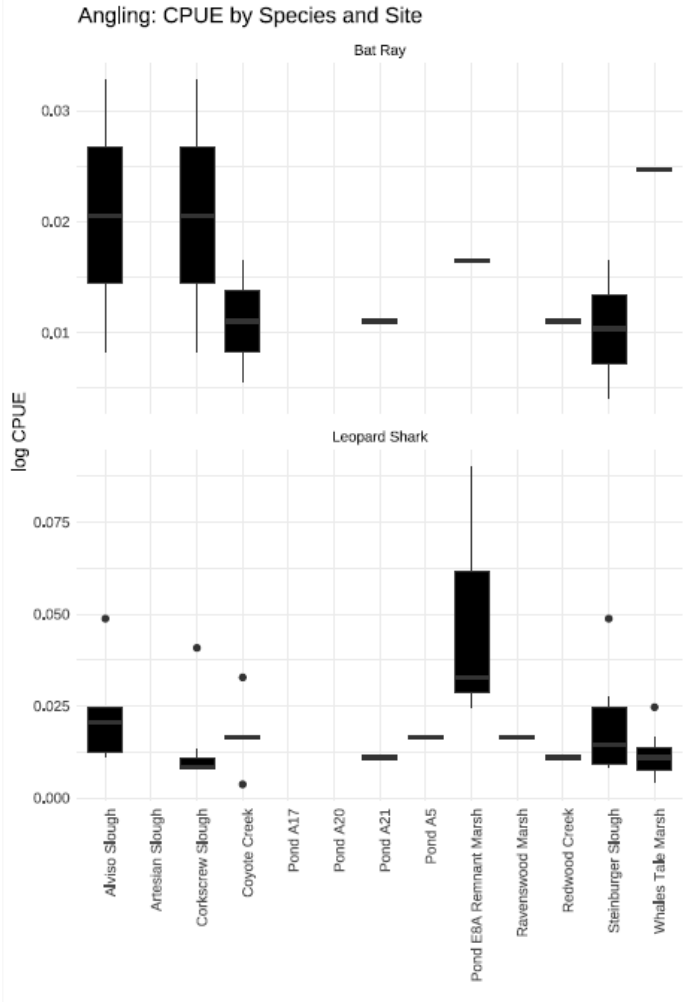
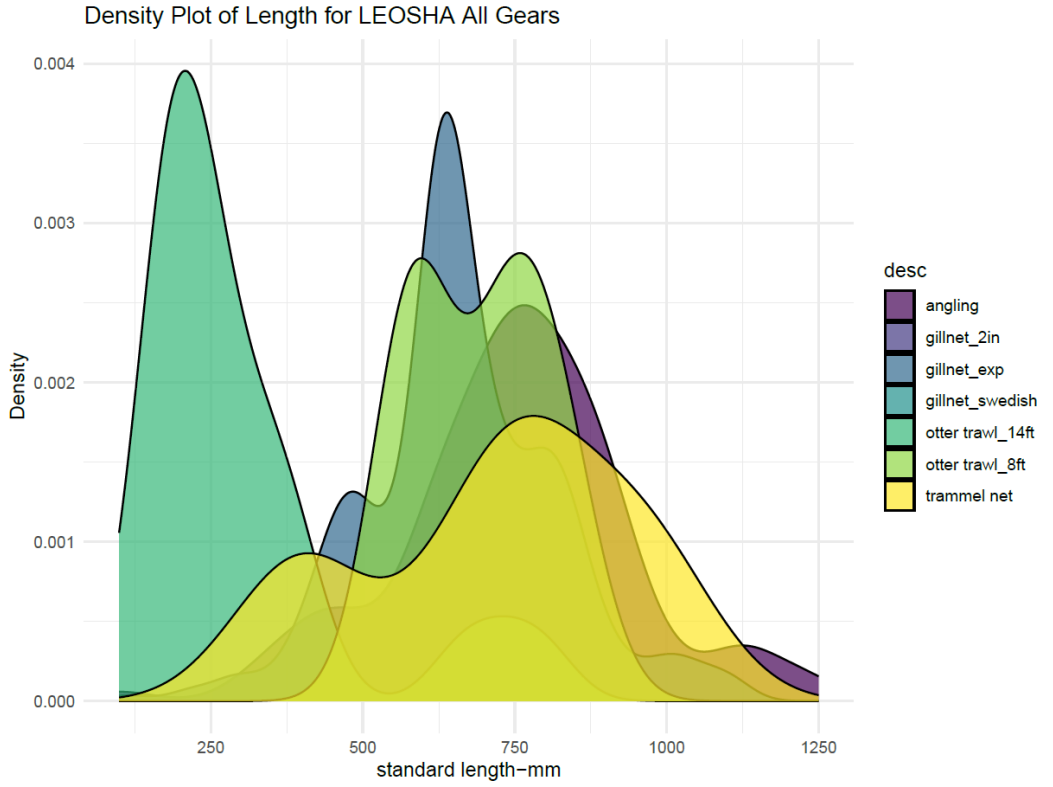
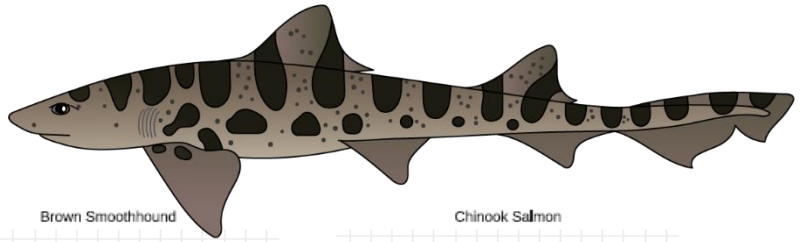


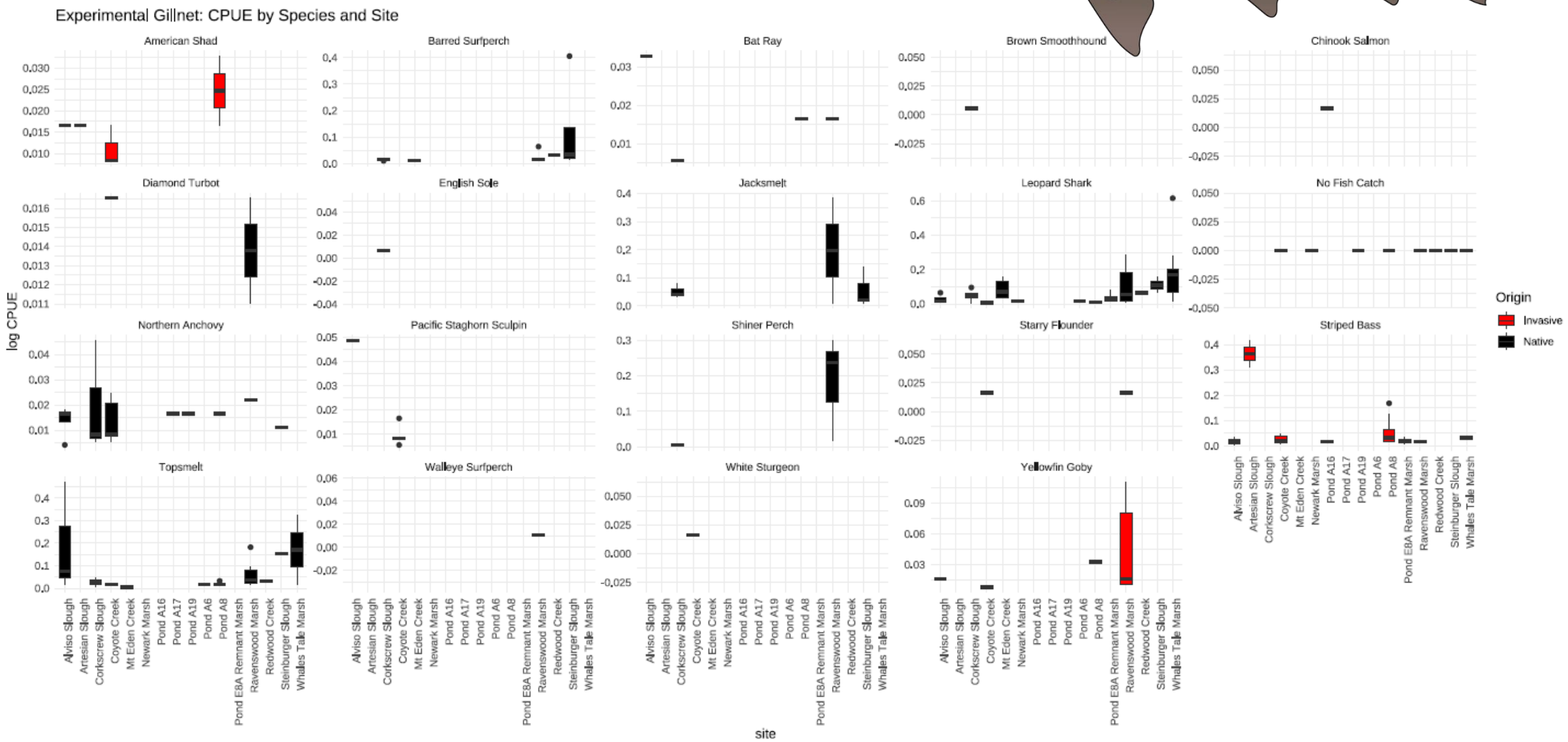


# II. FFH Monitoring in South Bay Wetlands

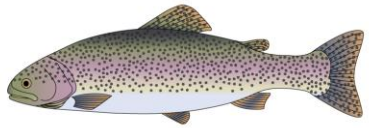
## UCD Leopard Shark Study (2013-2014)

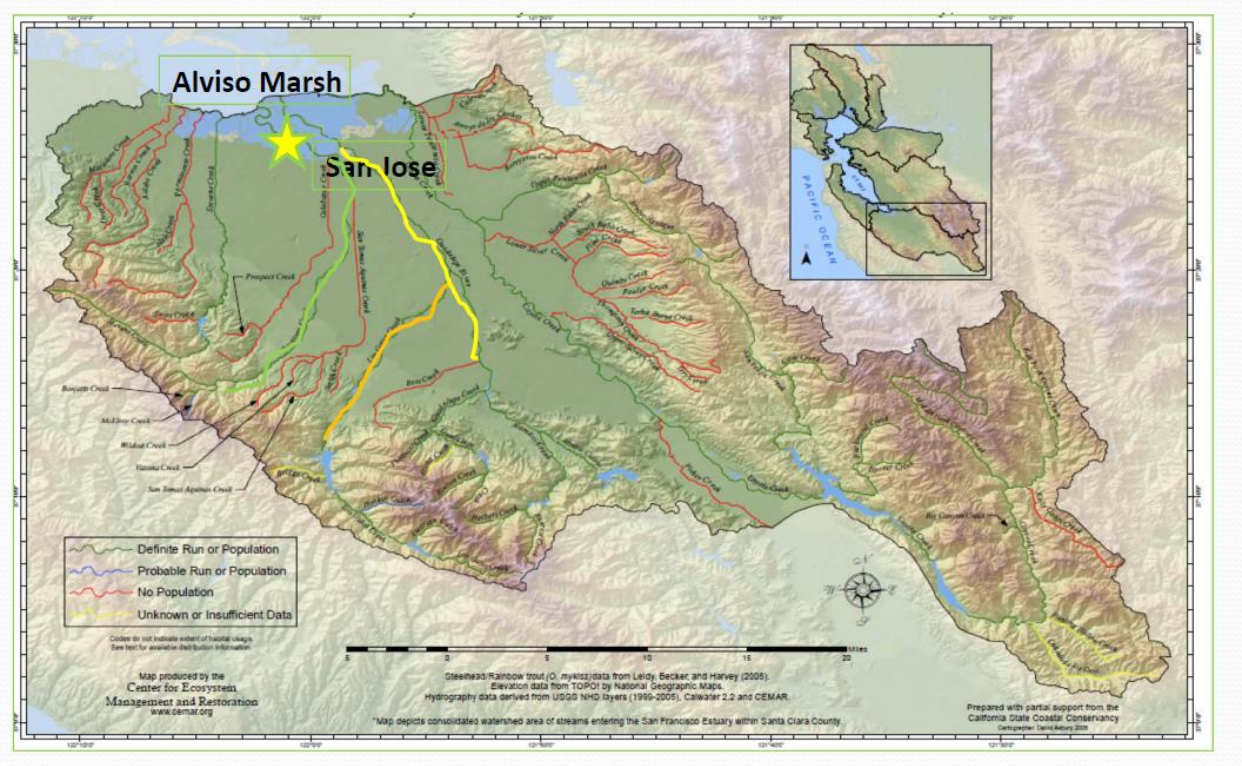




# II. FFH Monitoring in South Bay Wetlands

## UCD Steelhead Tagging Study (2013-2014, SCVWD)





# II. FFH Monitoring in South Bay Wetlands

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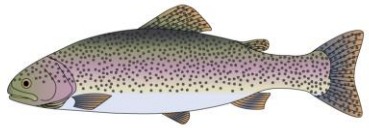

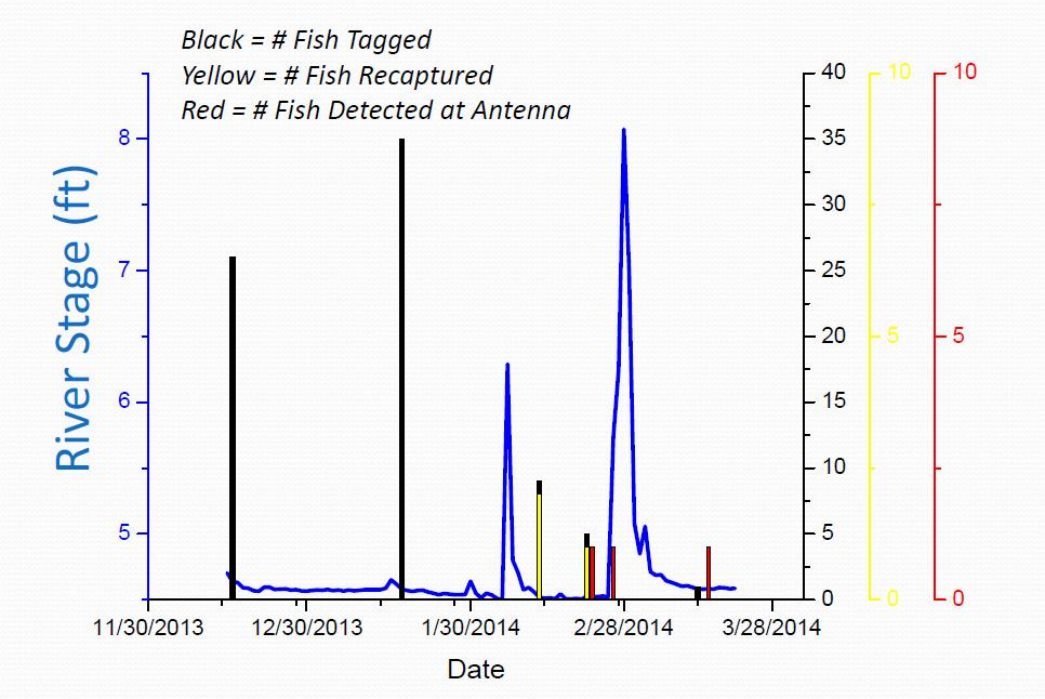

# II. FFH Monitoring in South Bay Wetlands

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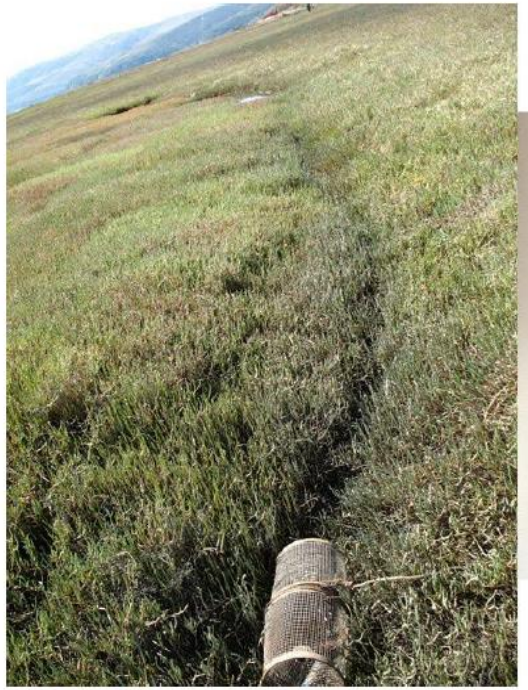

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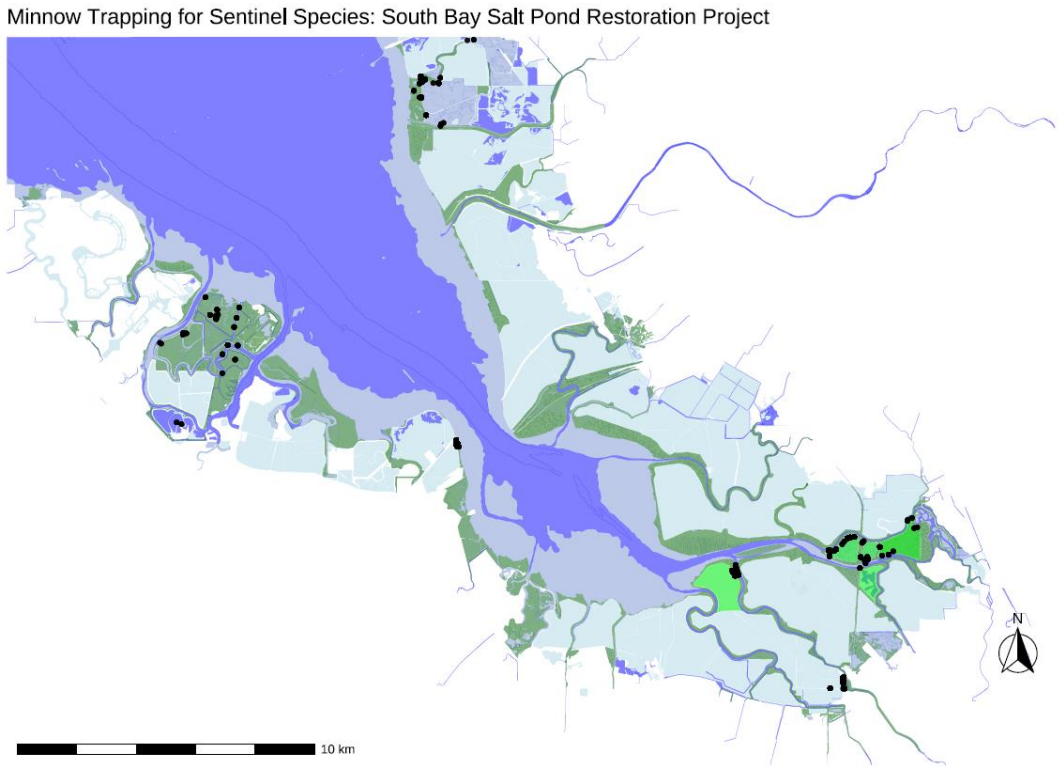


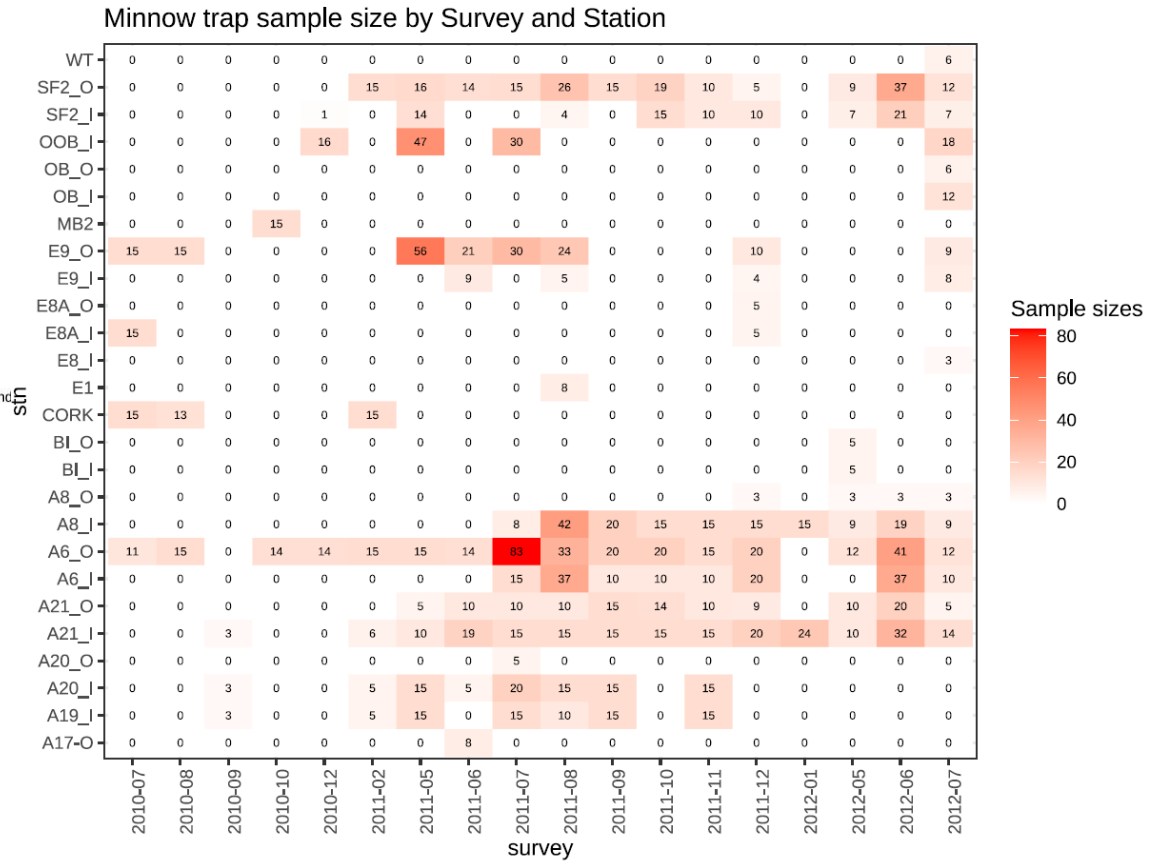

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South Bay Salt Pond Restoration Project

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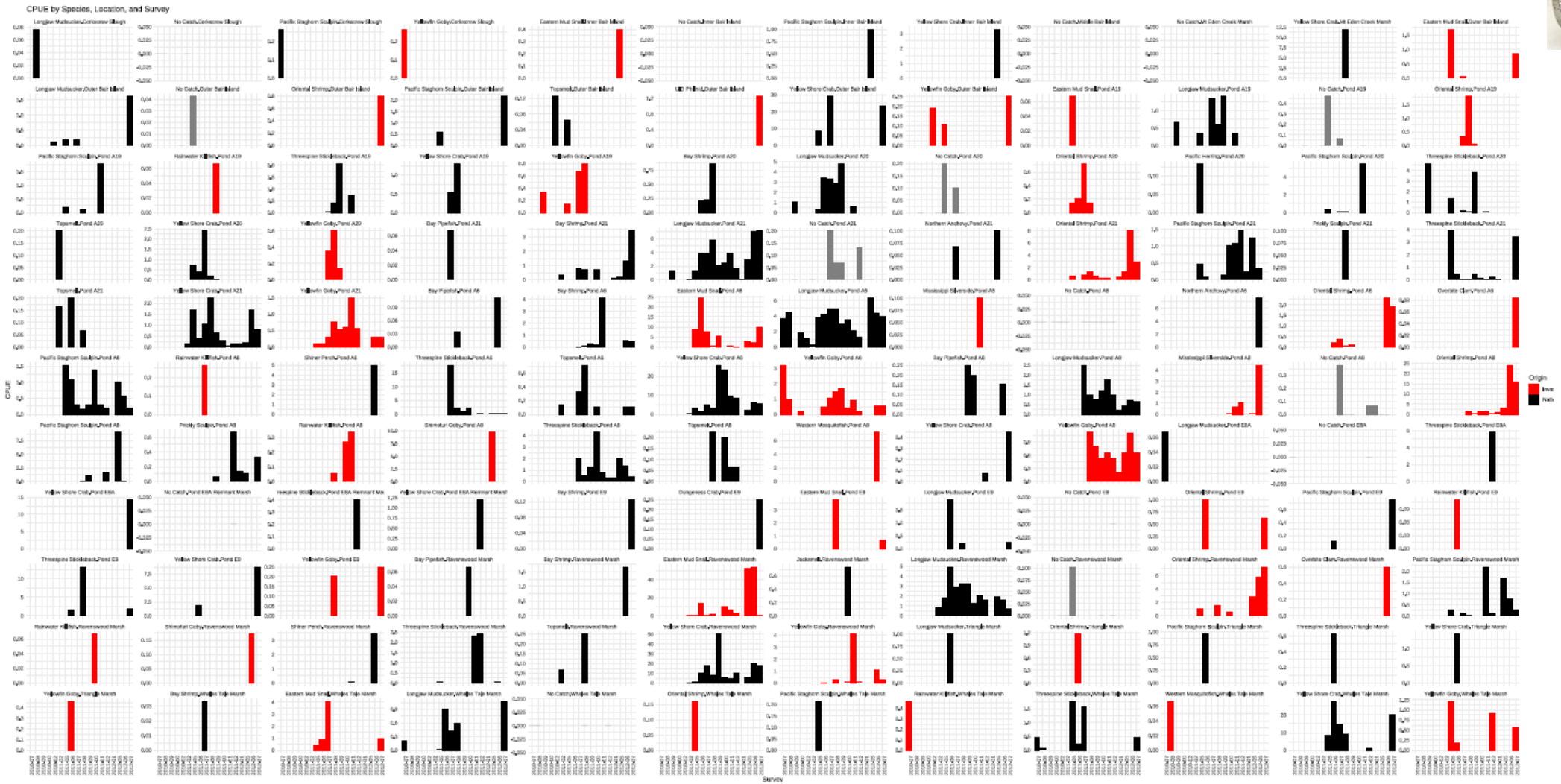

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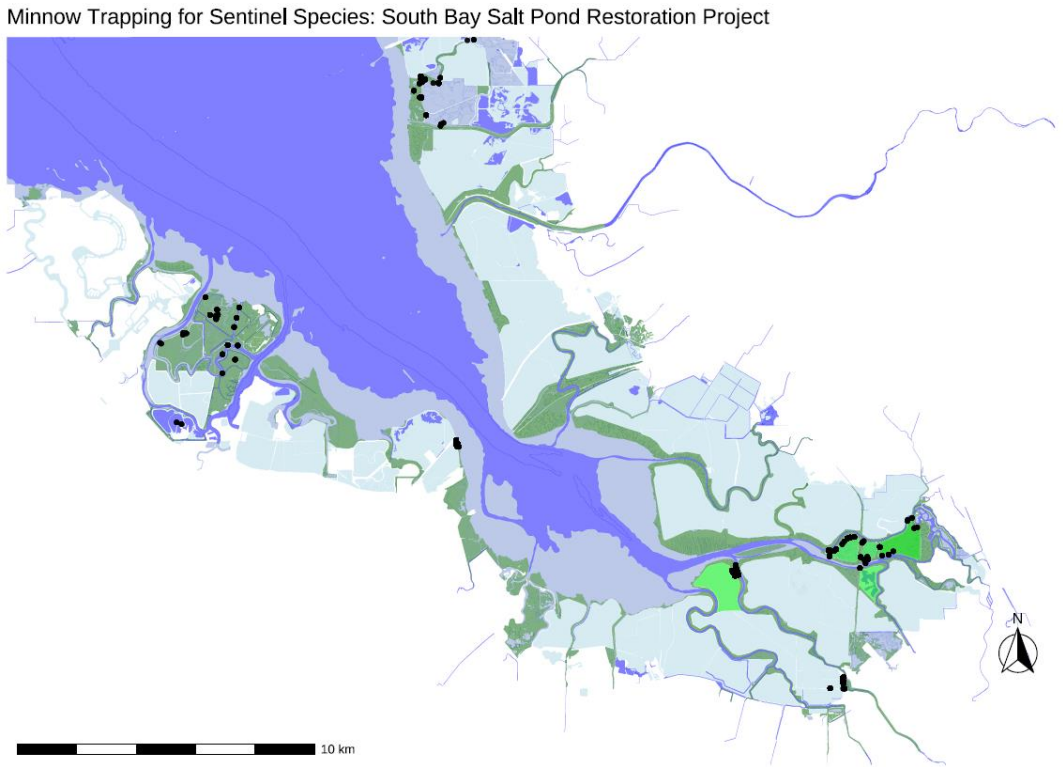


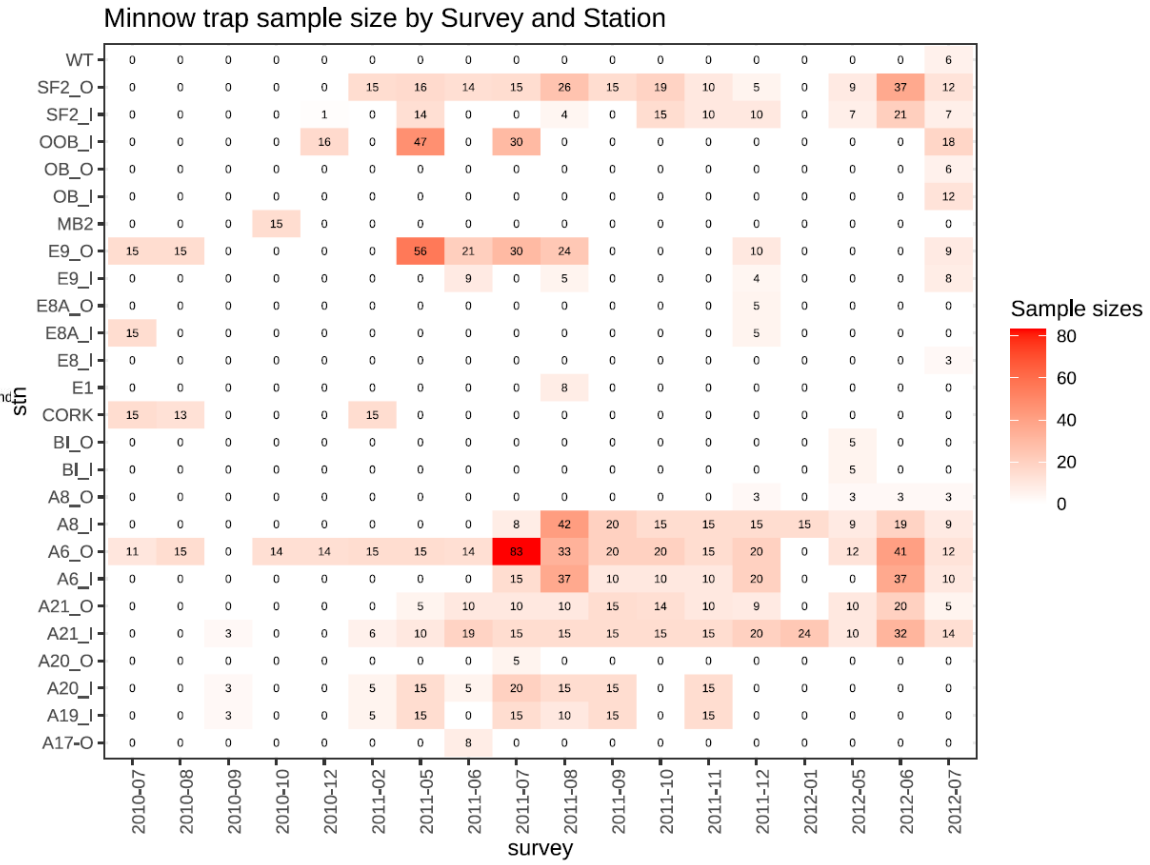

# I. FFH Monitoring in South Bay Wetlands

## UCD Longjaw Mudsucker Minnow Trap Study (2012-2014, SBSPRP)


**The Use of a Sentinel Species to Assess Restoration Benefits to Fish in the South Bay Salt Pon Restoration Project**

Prepared by:

James Hobbs
Department of Wildlife, Fish, and Conservation Biology
University of California-Davis

Prepared for:

Resource Legacy Fund
555 Capitol Mall, Suite 1095
Sacramento, Ca 95814
&
South Bay Salt Pond Restoration Program
Don Edwards San Francisco Bay NWR
1 Marshlands Rd.
Fremont, CA 94555

Sentinel Species Health Monitoring-Final Report 2010-2012 Page 1

*In support of Task 1f and Task 2e-Sentinel species health* *RLF Grant No. 2009-0080*

**The Use of a Sentinel Species to Assess Restoration Benefits to Fish in the South Bay Salt Pond Restoration Project**

Prepared by:

James Hobbs, Jonathan Cook, & Felipe La Luz,
Department of Wildlife, Fish, and Conservation Biology
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South Bay Salt Pond Restoration Project

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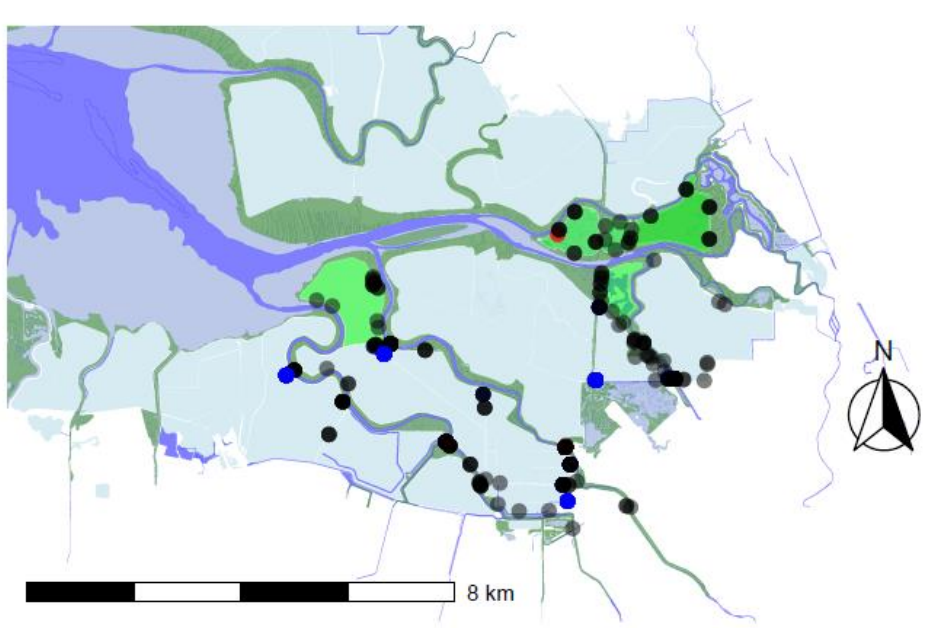
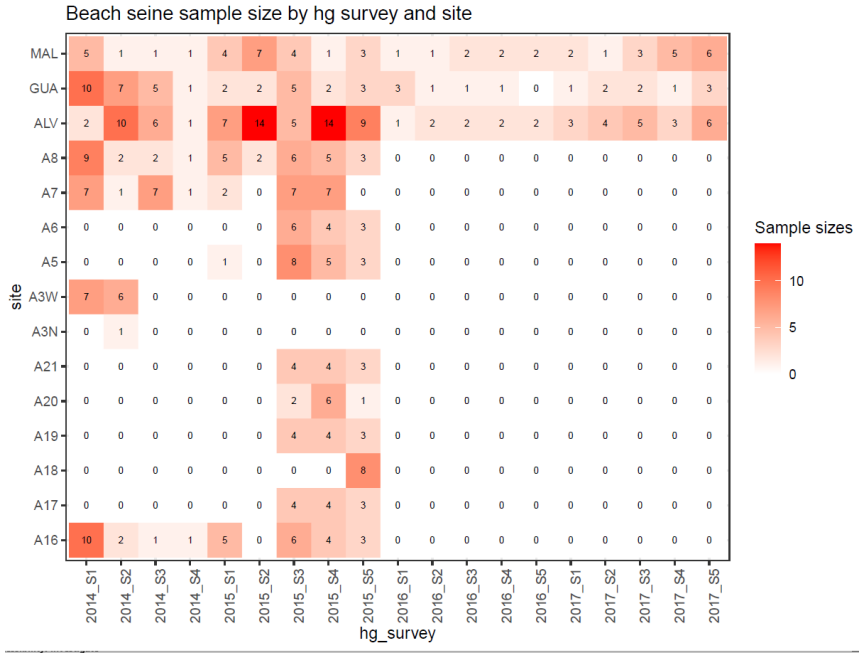



Sampling Gear
- Fyke
- Seine
- Trapping

Habitat
- Intertidal
- Managed Pond
- Tidal Marsh
- Water
- Tidal Pond



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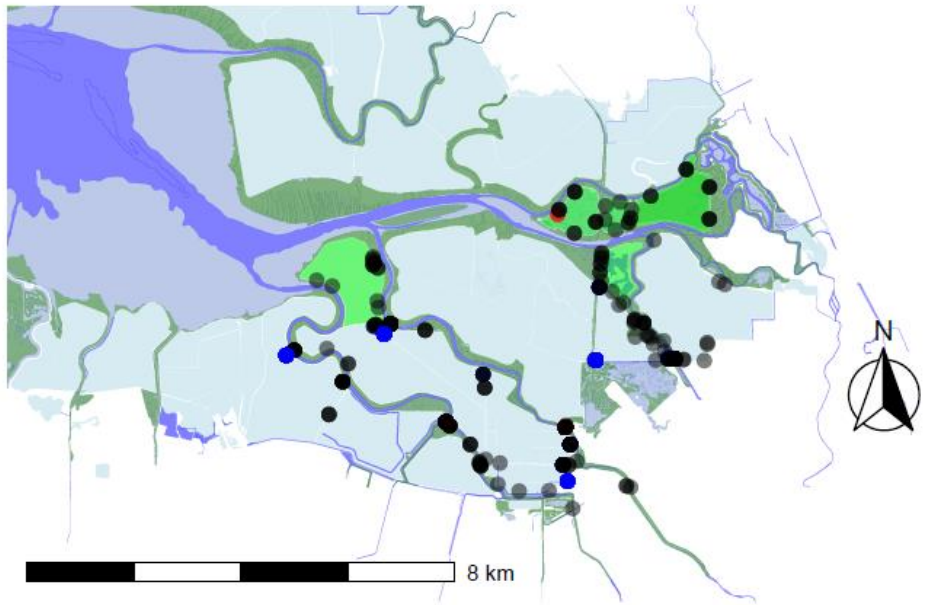


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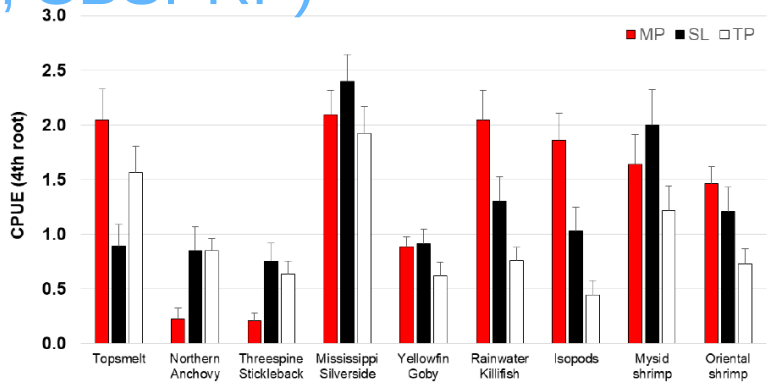
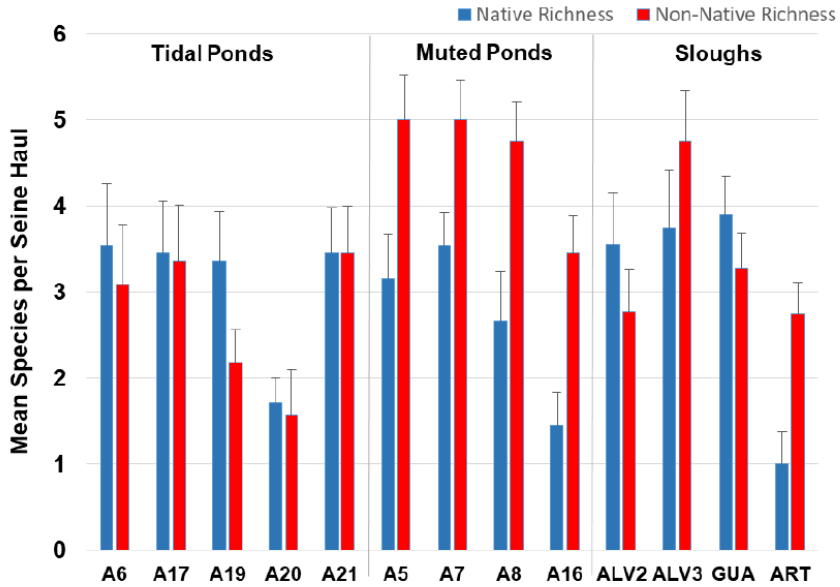



336 *Figure 3 Catch per unit effort for the nine taxa identified in the BVStep routine that were most*
337 *correlated with dissimilarity among sites in the Alviso Marsh.*



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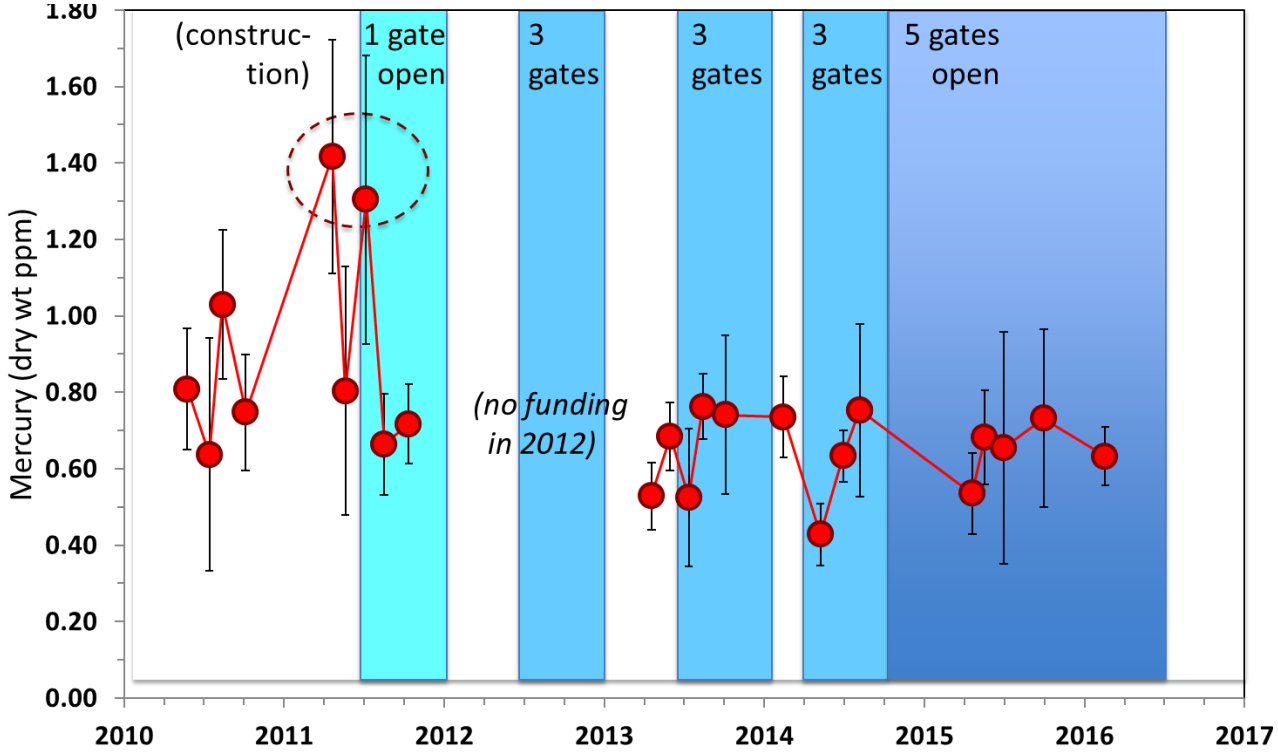
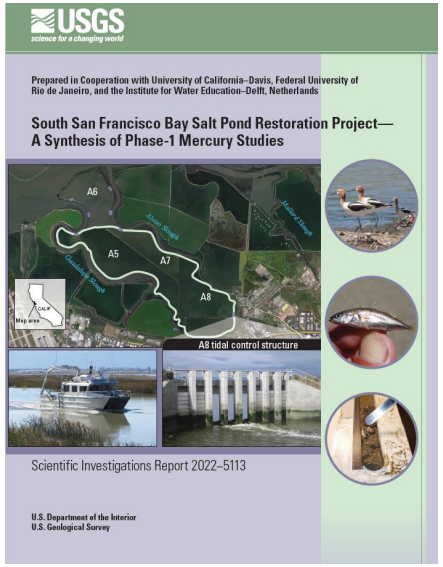



D. Slotton & J. Hobbs (UC Davis)



# II. FFH Monitoring in South Bay Wetlands

South Bay Salt Pond Restoration Project

## UCD South Bay Otter Trawl Survey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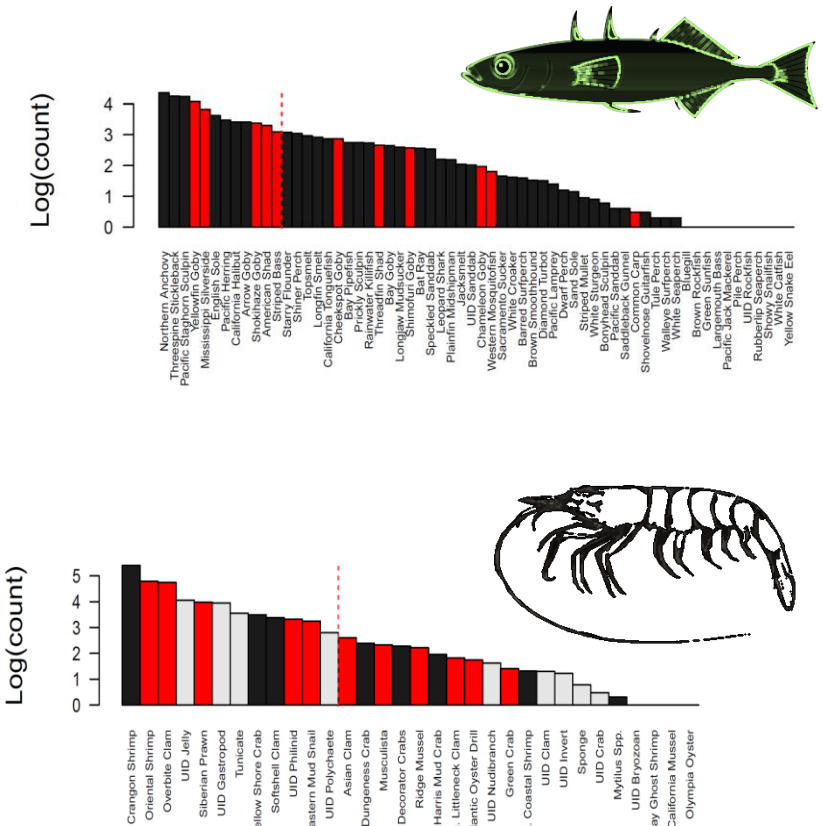
South Bay Salt Pond Restoration Project

## UCD South Bay Otter Trawl Survey



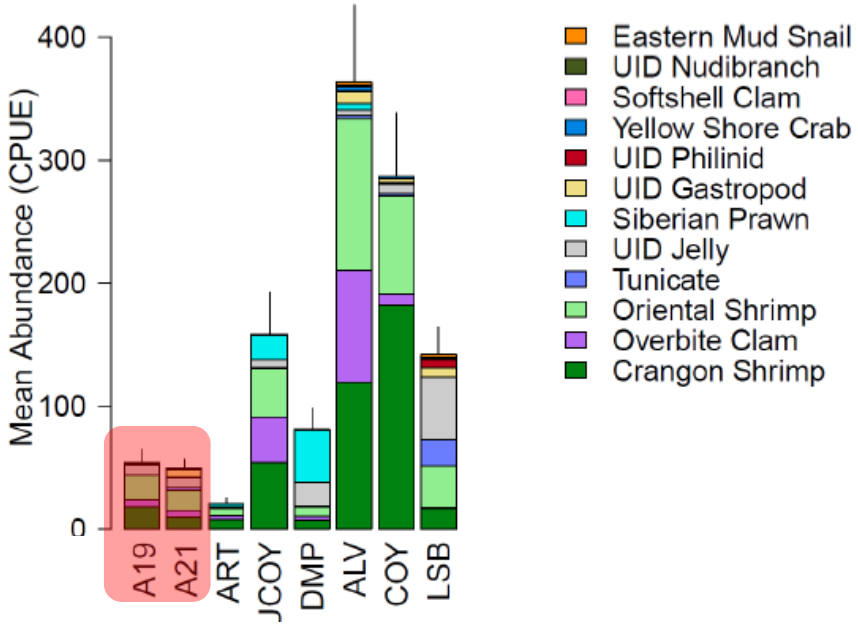


# II. FFH Monitoring in South Bay Wetlands

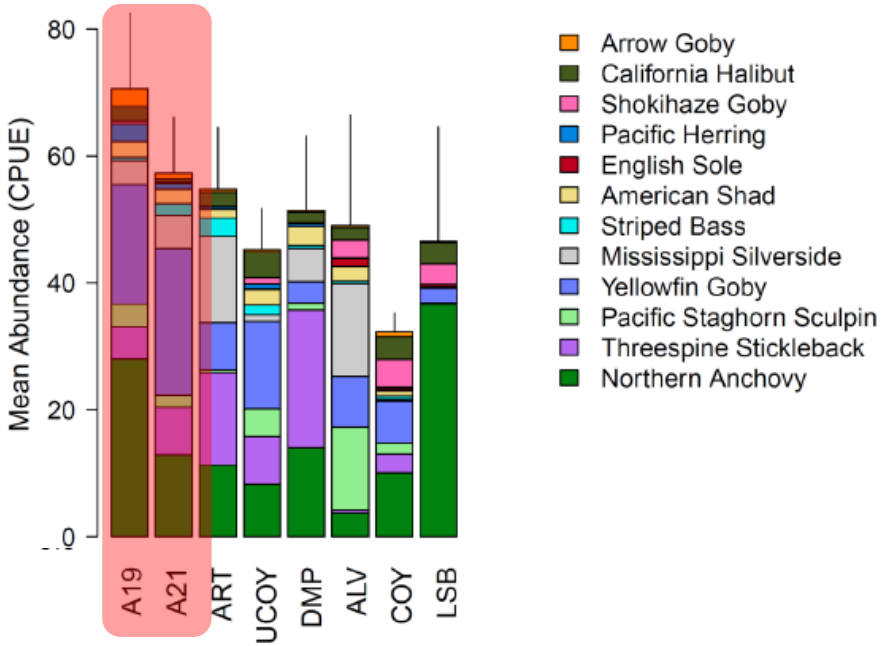
## UCD South Bay Otter Trawl Survey

Restoration Ponds


### Macro-invertebrates



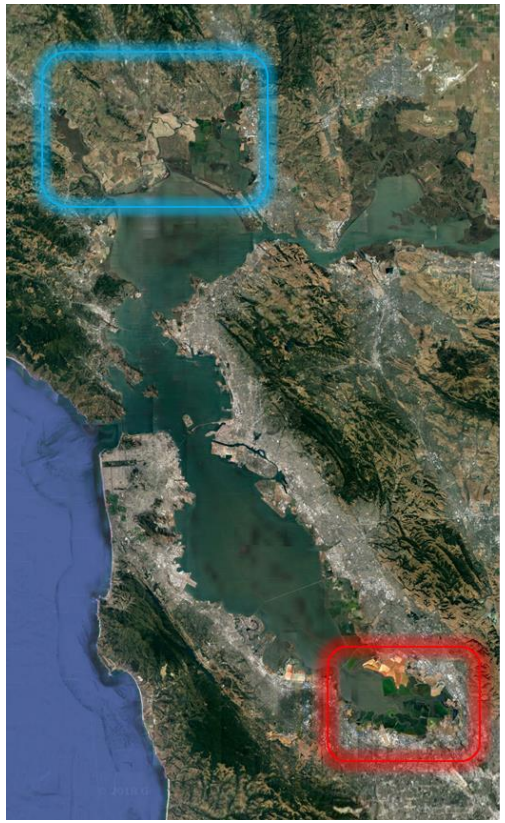

### Fishes

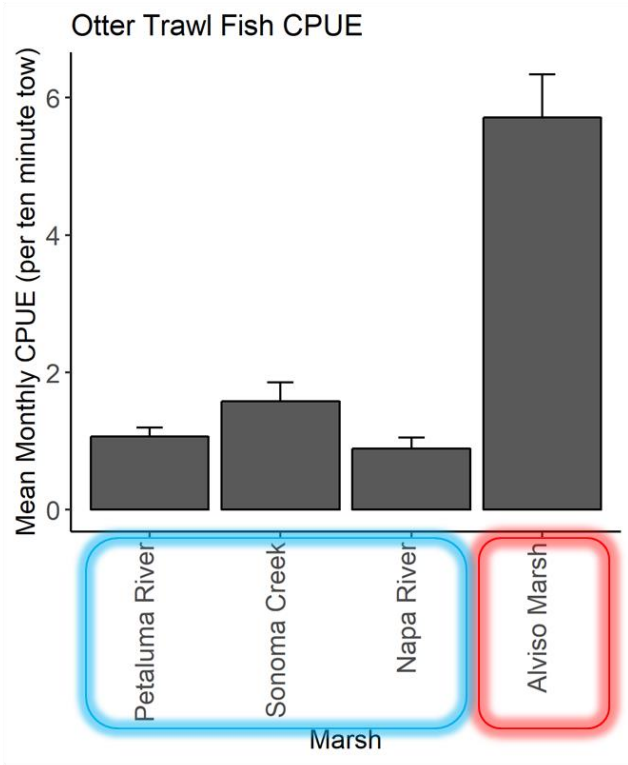


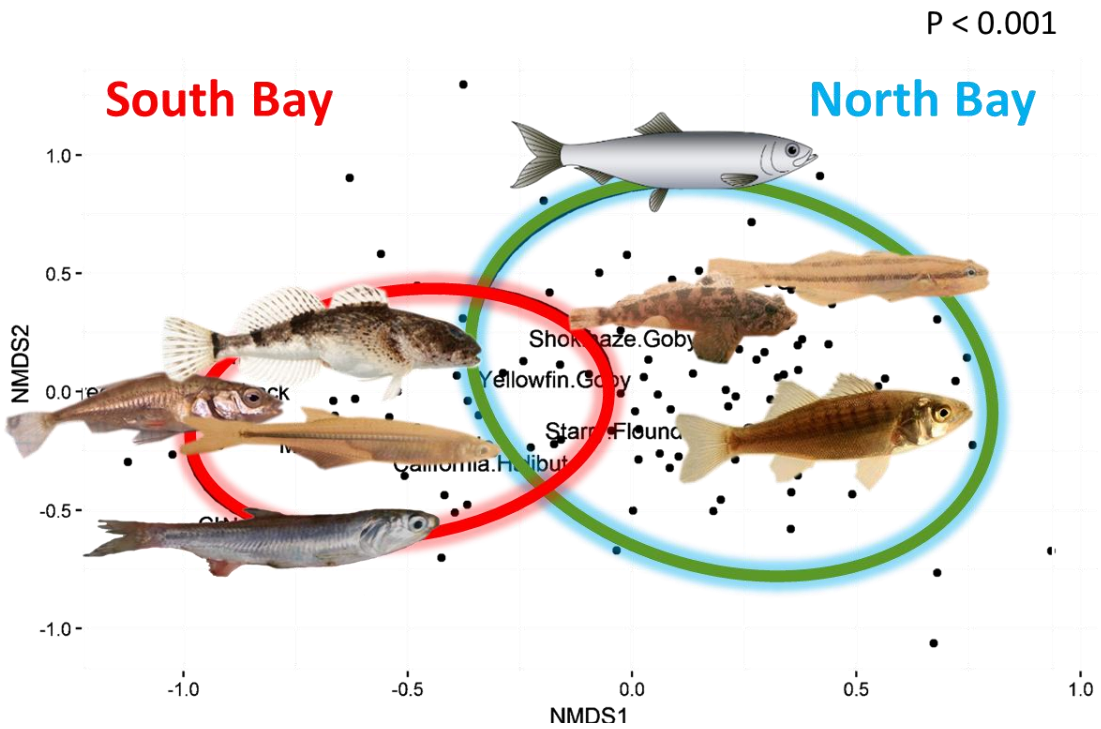
# II. FFH Monitoring in South Bay Wetlands


## UCD South Bay Otter Trawl Survey

Regional Patterns





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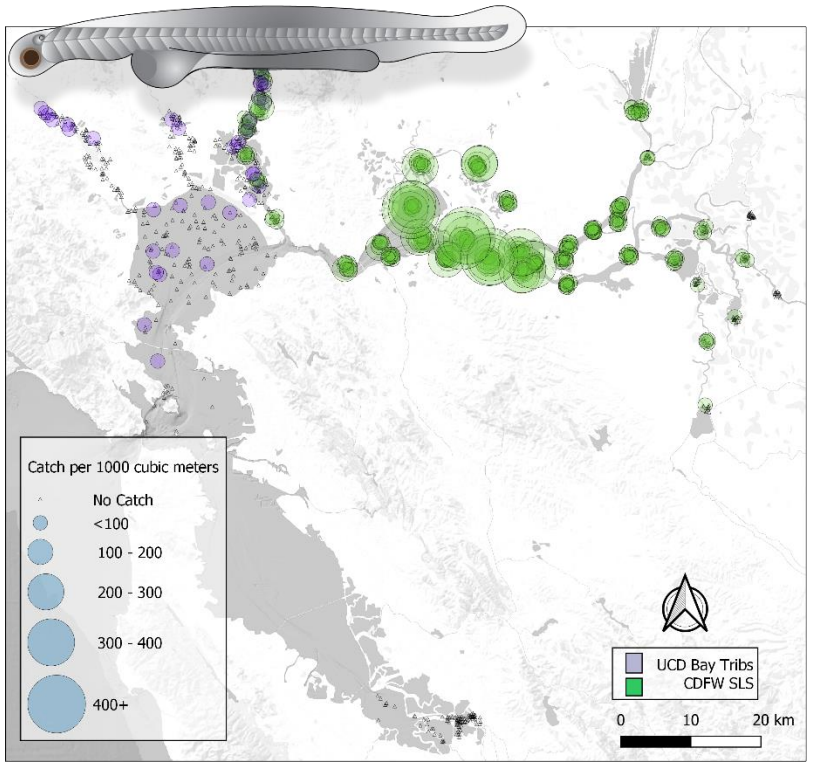
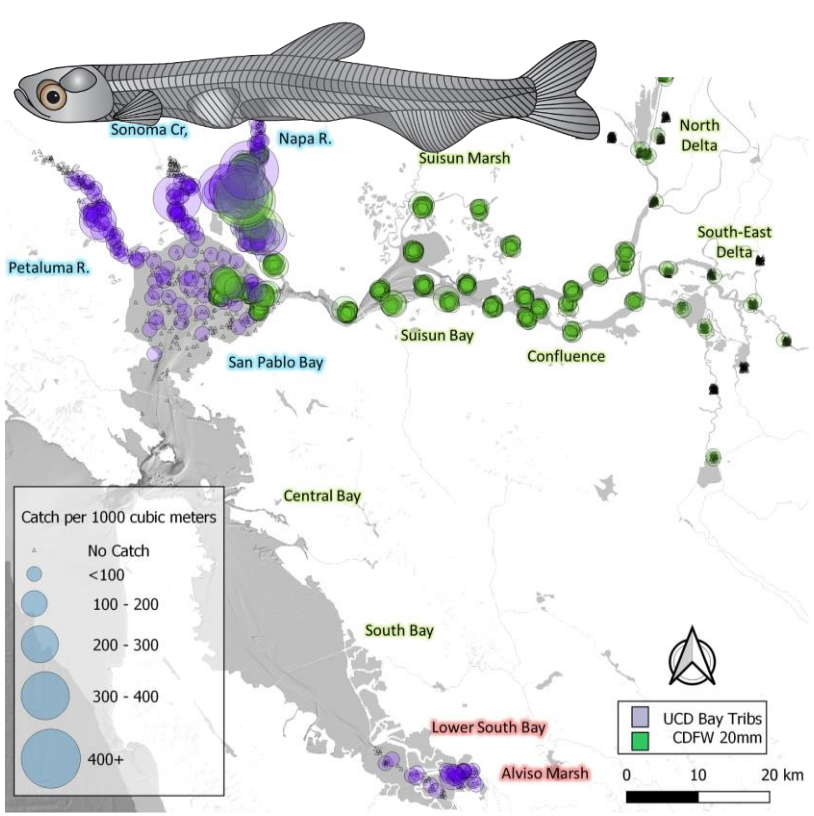
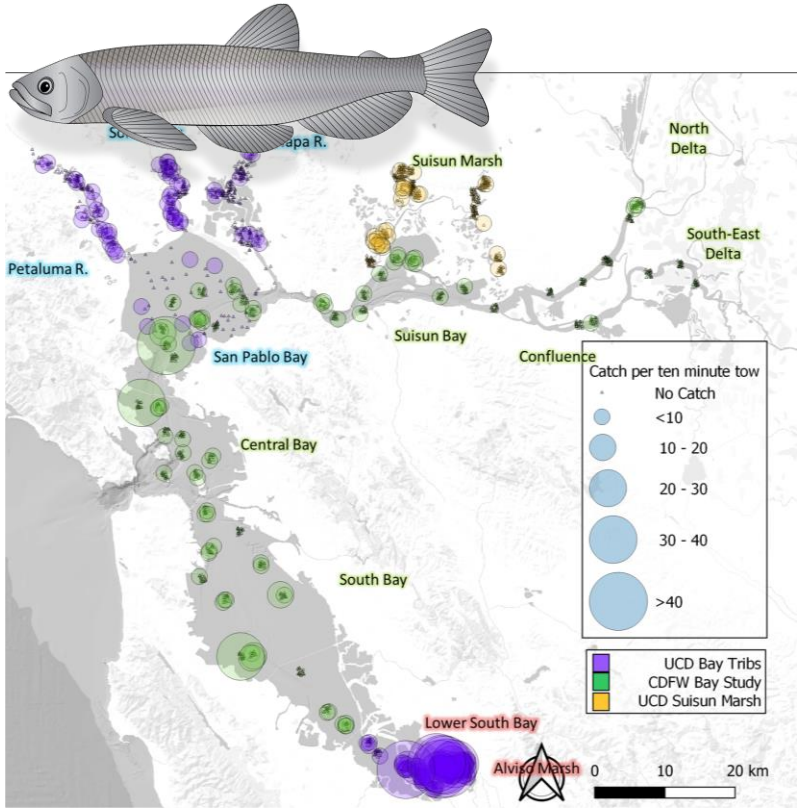
## UCD South Bay Otter Trawl Survey

Longfin Smelt (Endangered)



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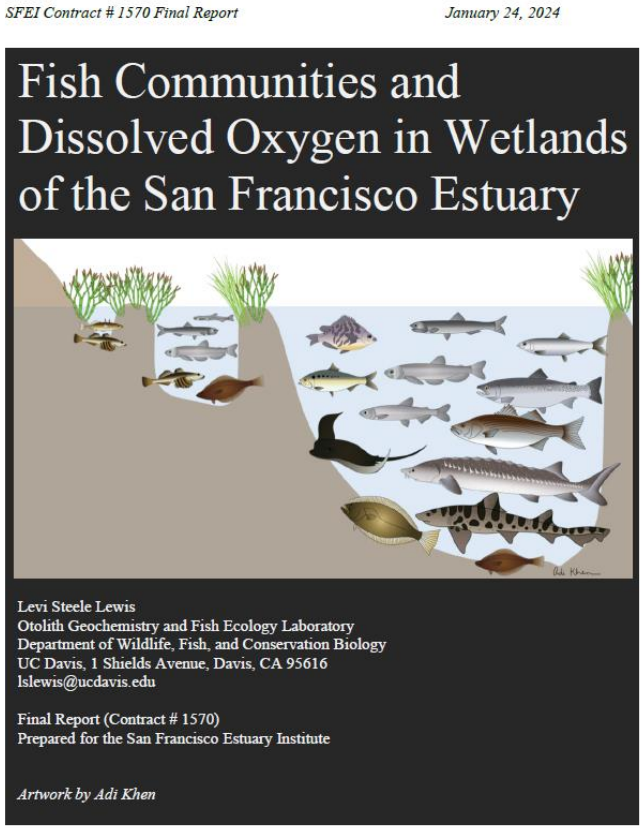

*SFEI Contract # 1570 Final Report* *January 24, 2024*

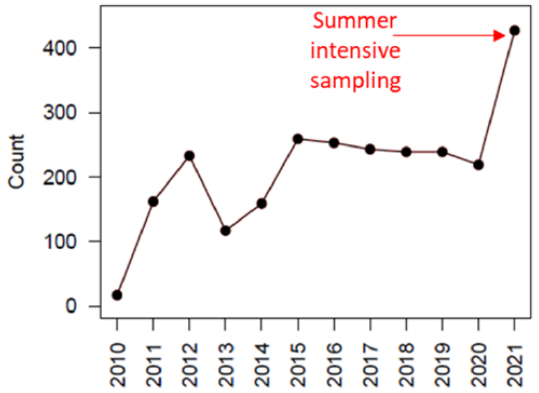
Fish Communities and Dissolved Oxygen in Wetlands of the San Francisco Estuary

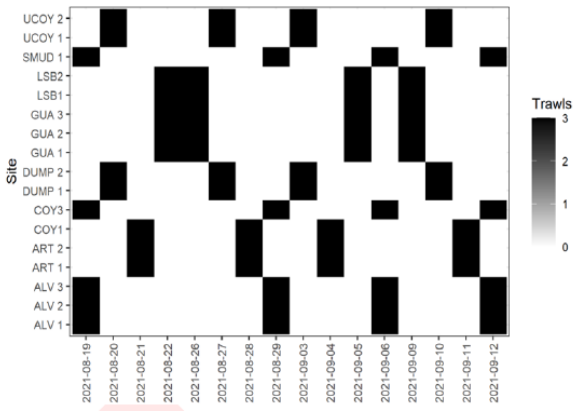
Levi Steele Lewis
Otolith Geochemistry and Fish Ecology Laboratory
Department of Wildlife, Fish, and Conservation Biology
UC Davis, 1 Shields Avenue, Davis, CA 95616
lslewis@ucdavis.edu

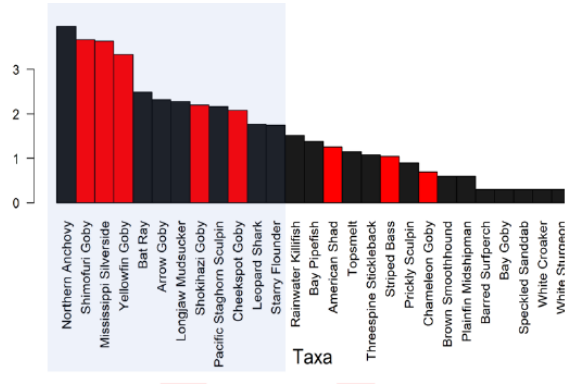
Final Report (Contract # 1570)
Prepared for the San Francisco Estuary Institute

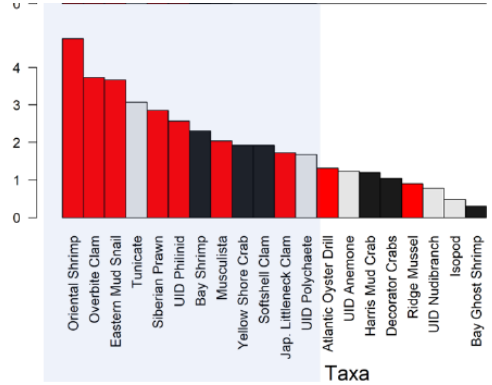
*Artwork by Adi Khen*

Recommended citation:
*Lewis, LS. 2023. Fish communities and dissolved oxygen in wetlands of the San Francisco Estuary. Final report submitted to the San Francisco Estuary Institute, CA. 214 pp.*



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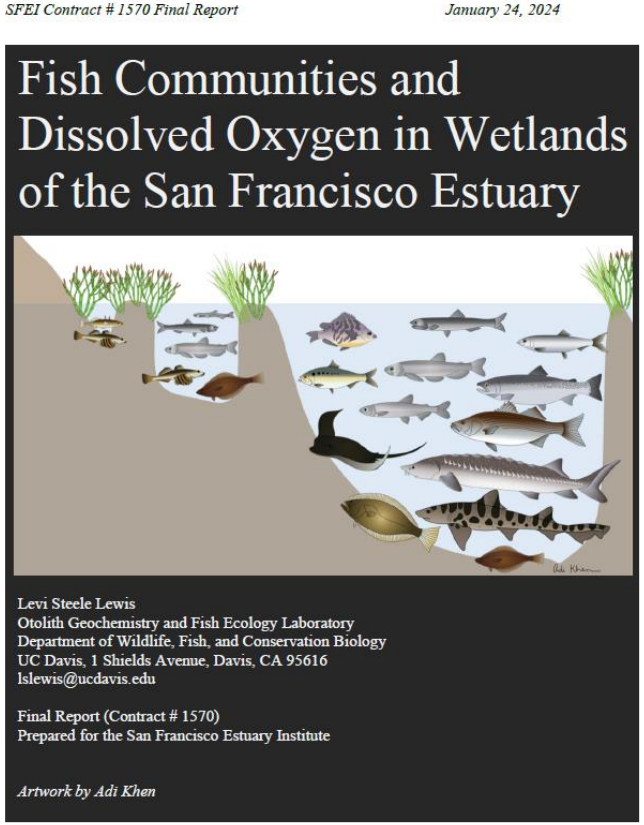
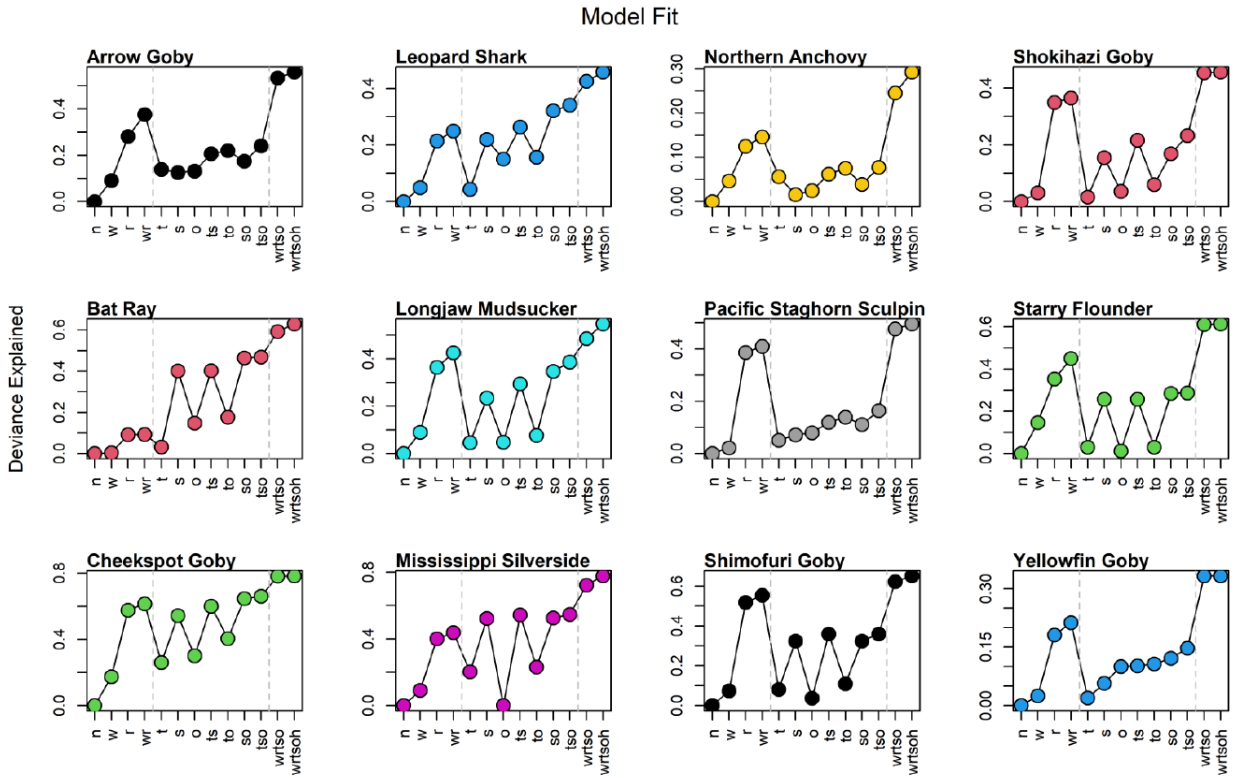



Habitat Suitability (Dissolved Oxygen)



# II. FFH Monitoring in South Bay Wetlands

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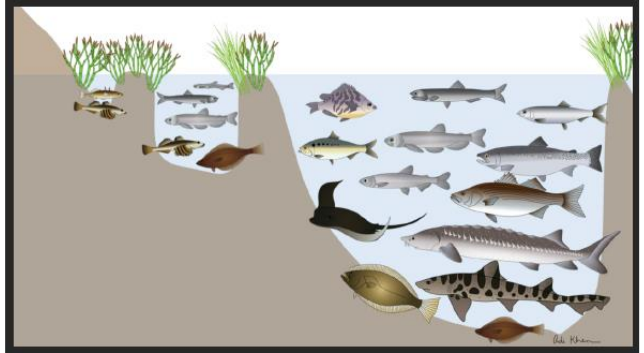
*SFEI Contract # 1570 Final Report* *January 24, 2024*

**Fish Communities and Dissolved Oxygen in Wetlands of the San Francisco Estuary**



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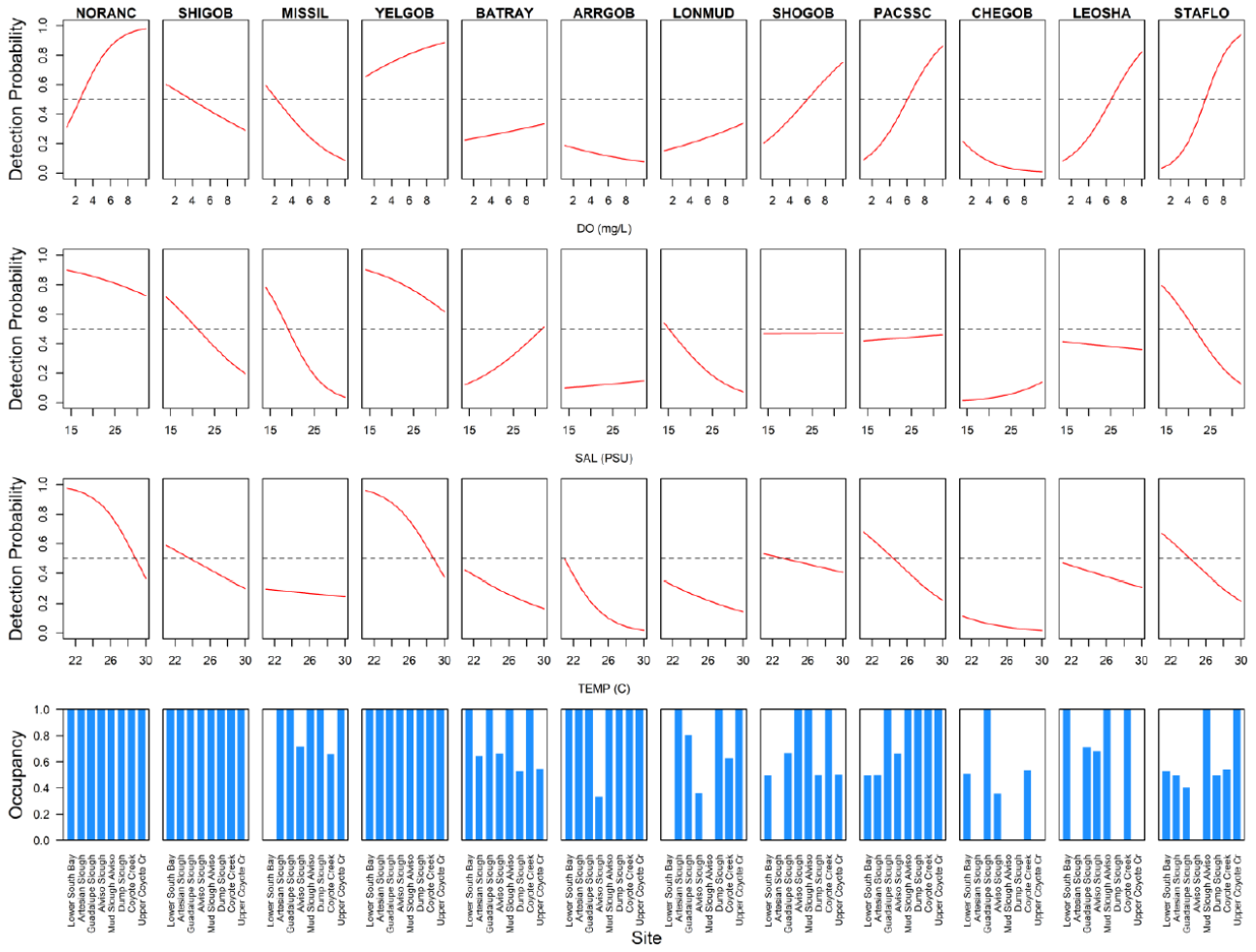

# Outline

I. Intro: Wetland Fishes & Fish Habitats

II. Past FFH Monitoring in South Bay Wetlands

**III. Recent, Ongoing, & Future Studies**

IV. Lessons Learned, Forward Thinking

"A society grows great when old men plant trees in whose shade they shall never sit."
— **Greek** Proverb

"An estuary grows great when old managers restore wetlands whose veg. they may never view."
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# 3. Recent, Ongoing, Future Studies

## Recent & Ongoing

- **Ravenswood Fish Monitoring Study** (Ducks Unlimited, Helix, T. Gast & Associates)

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Valley Water
SANTA CLARA VALLEY WATER DISTRICT
Stillwater Sciences

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Valley Water
SANTA CLARA VALLEY WATER DISTRICT
Stillwater Sciences

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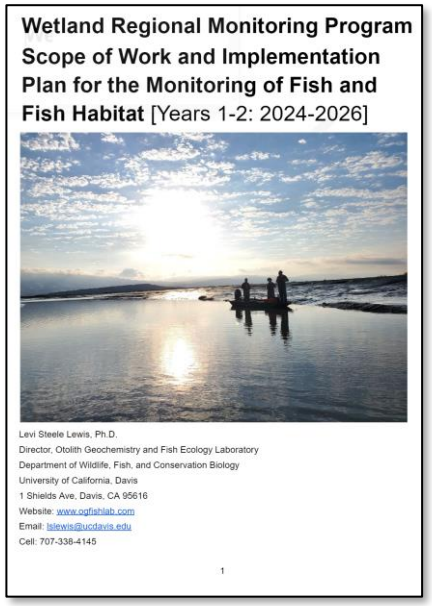
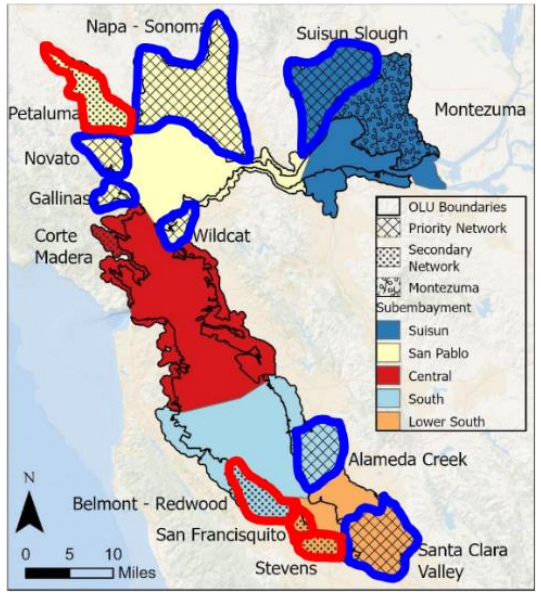
## Future

- **Wetlands Regional Monitoring Program** – Phase 1 Fish & Fish Habitat Survey (2025-2027)


Wetland Regional Monitoring Program
Scope of Work and Implementation Plan for the Monitoring of Fish and Fish Habitat [Years 1-2: 2024-2026]

Levi Steele Lewis, Ph.D.
Director, Otolith Geochemistry and Fish Ecology Laboratory
Department of Wildlife, Fish, and Conservation Biology
University of California, Davis
1 Shields Ave, Davis, CA 95616
Website: www.ogfishlab.com
Email: lslewis@ucdavis.edu
Cell: 707-338-4145



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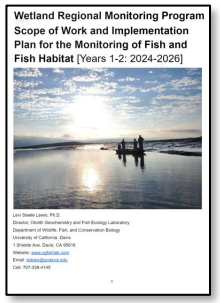
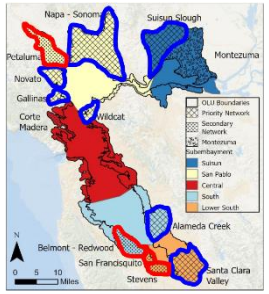
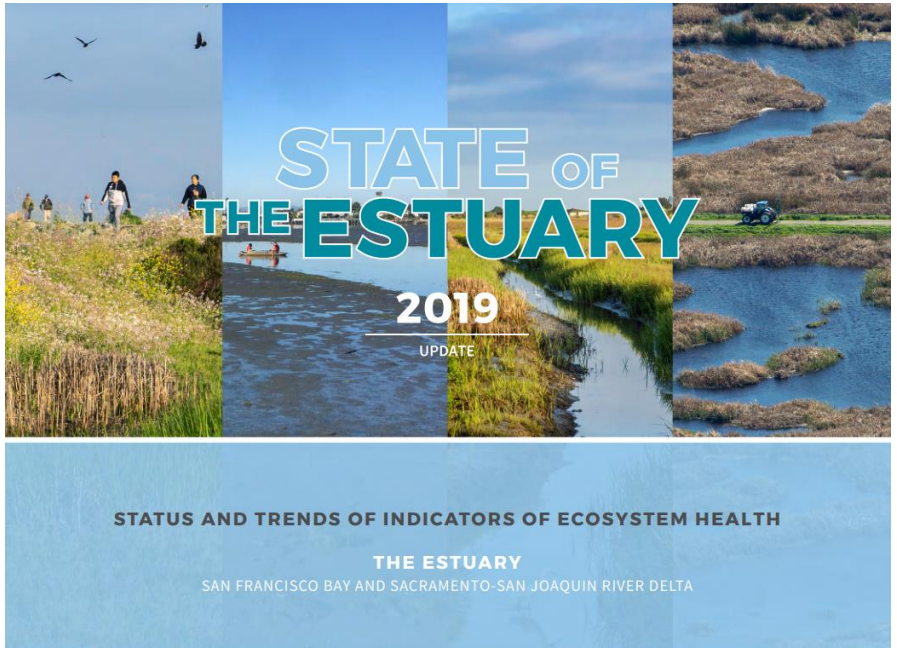



- **State of Our Estuary Report (2025)**



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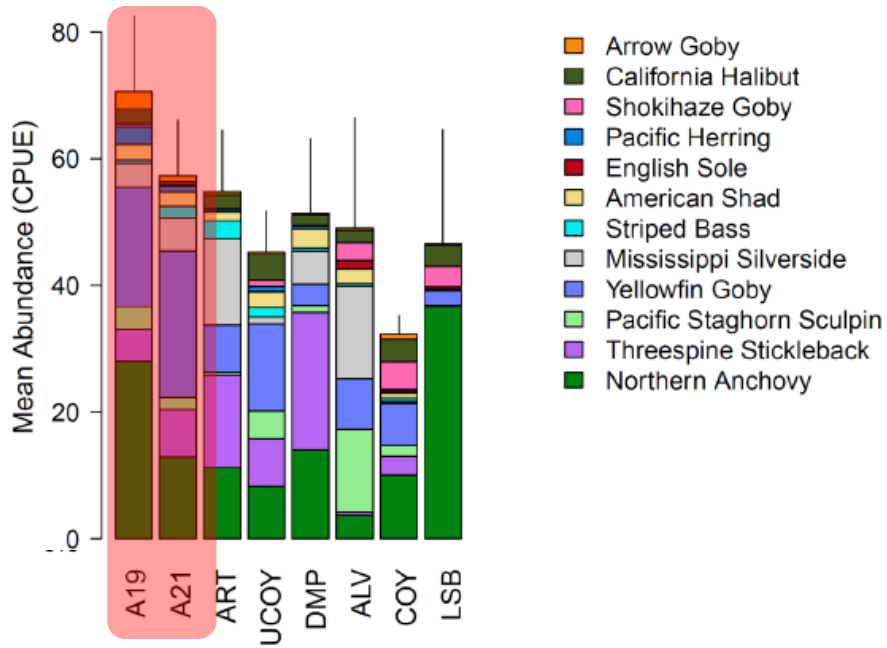
# IV. Lessons Learned, Forward Thinking

## Lessons Learned

1. **Ecological Baselines:** Restored habitats are used by native fishes, similar to adjacent slough & natural wetlands (*restoration creates valuable habitat for native fishes*)

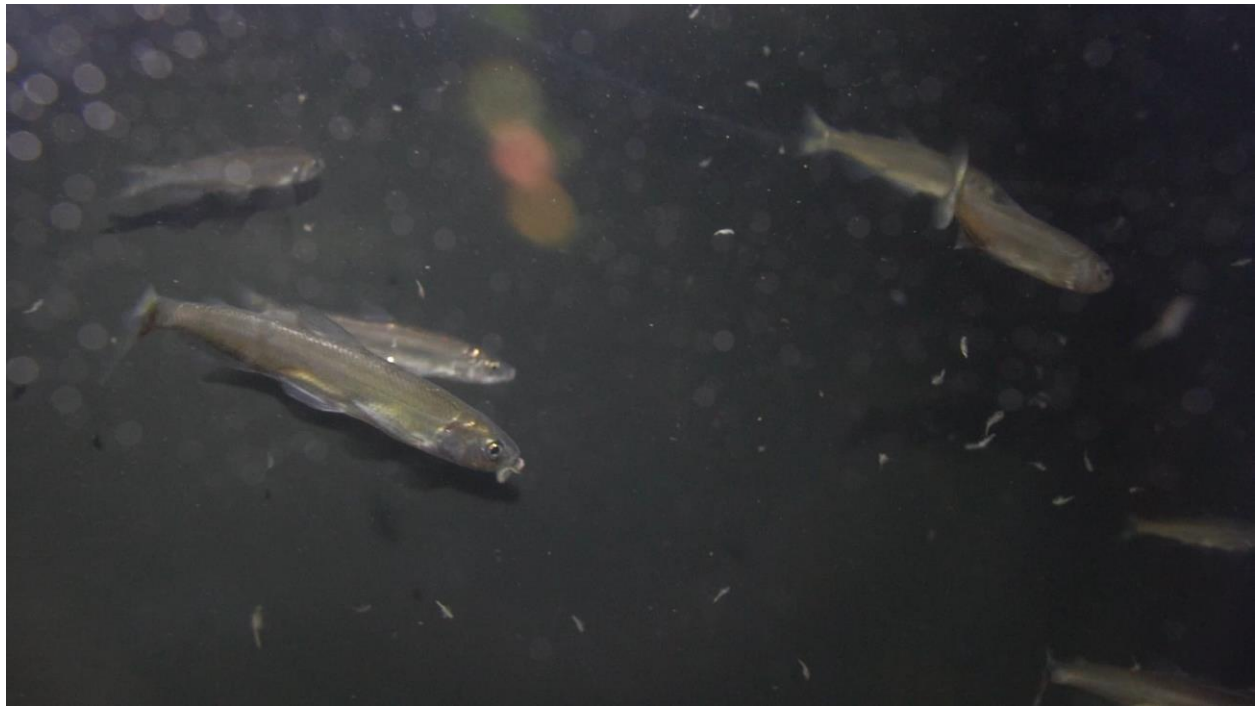


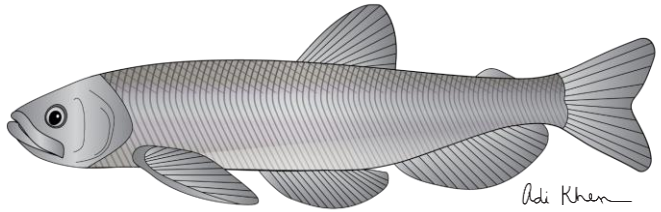

# IV. Lessons Learned, Forward Thinking

## Lessons Learned

1. **Ecological Baselines:** Restored habitats are used by native fishes, similar to adjacent slough & natural wetlands (*restoration creates valuable habitat for native fishes*)

2. **Endangered Species:** Restored tidal ponds heavily used by Longfin Smelt (all age classes) annually.

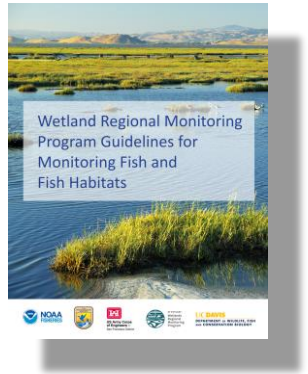




# IV. Lessons Learned, Forward Thinking

## Forward Thinking

vs


1. **Approaches:** Sentinel Species vs Aquatic Communities (tradeoffs)
2. **Methods:** Otter Trawl, Beach Seine, Minnow Trap, Fyke, Gill Net (WRMP Guidelines)
3. **Standardization:** Lacking in lower SFE; needed to assess changes due to restoration activities and climate change
4. **Repositories:** Needed to inform future monitoring and restoration (IEP, EDI, SFEI, WRMP)
5. **Regional Monitoring, Integration & Quantitative Analysis:** Needed and planned (CWS, WRMP)

SF ESTUARY Wetlands Regional Monitoring Program

# Fish and Fish Habitats in South Bay Wetlands

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