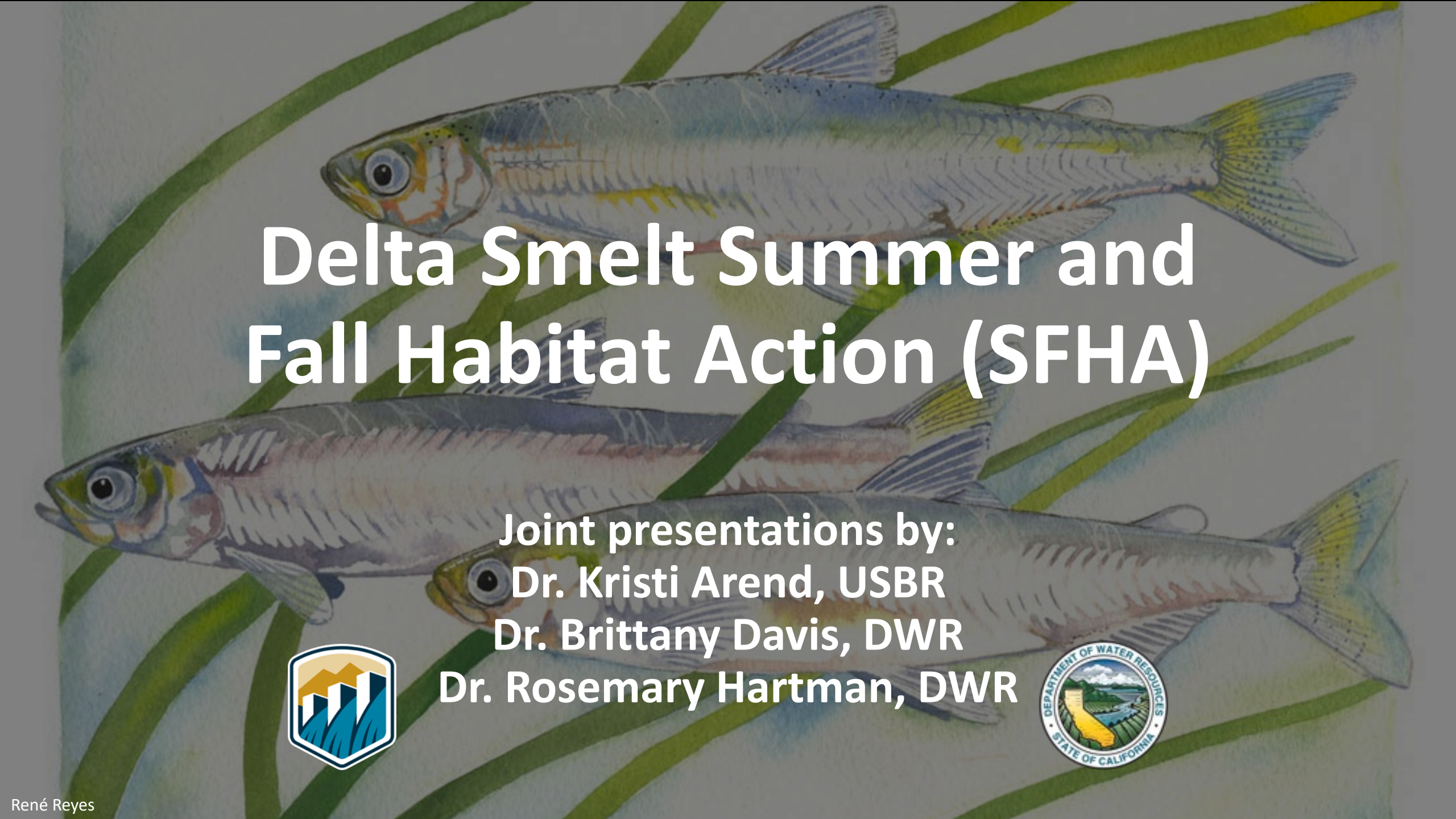


# Delta Smelt Summer and Fall Habitat Action (SFHA)

Joint presentations by:
Dr. Kristi Arend, USBR
Dr. Brittany Davis, DWR
Dr. Rosemary Hartman, DWR

René Reyes

# Overview

Conceptual Model

Objectives

Performance metrics

Actions and operations

Science Issues

Planning and evaluation

# Delta Smelt (*Hypomesus transpacificus*)

## Basic Biology

- Endemic; small, pelagic
- Shoal; weak swimming ability
- Annual life cycle
  - Migratory within Bay-Delta

## Prey

- Copepods, cladocerans, amphipods

## Habitat

- Cool, turbid, low salinity-fresh water

## Status: ESA, threatened; CESA, endangered

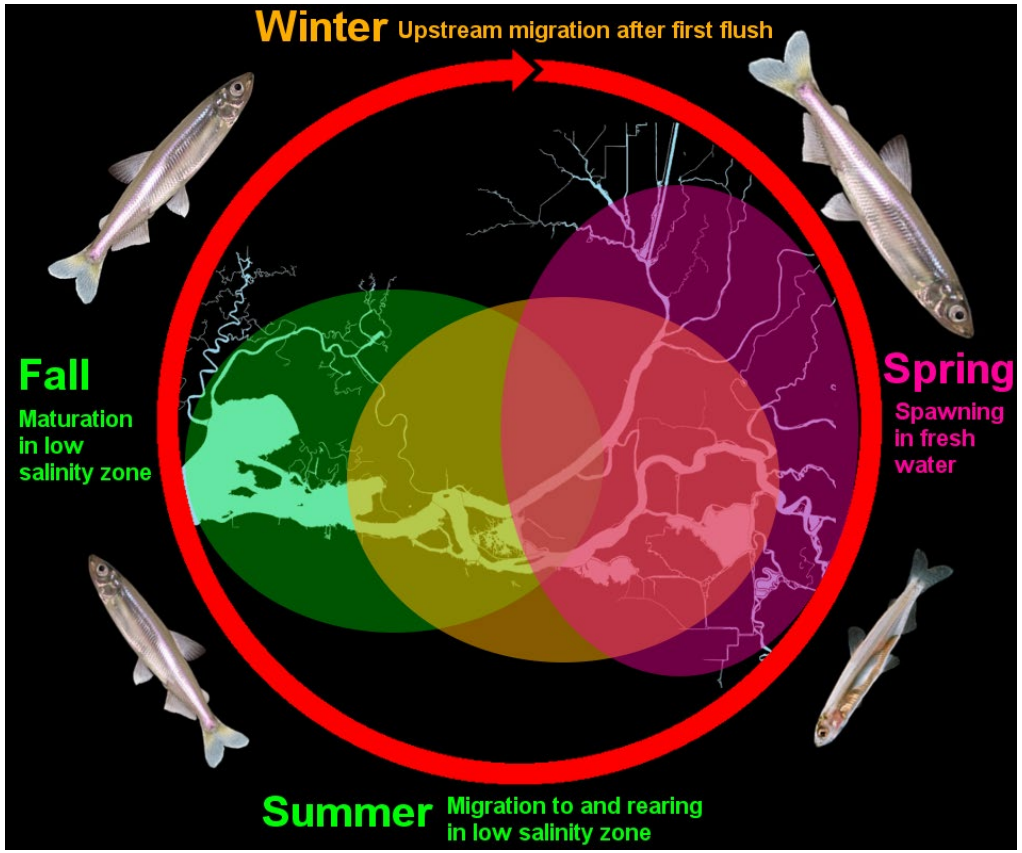



Image from wildlife.ca.gov modified from IEP MAST Technical Report 90 (2015)

# Delta Smelt Summer and Fall Habitat

Focus: transition from juvenile → subadult → adult life stages

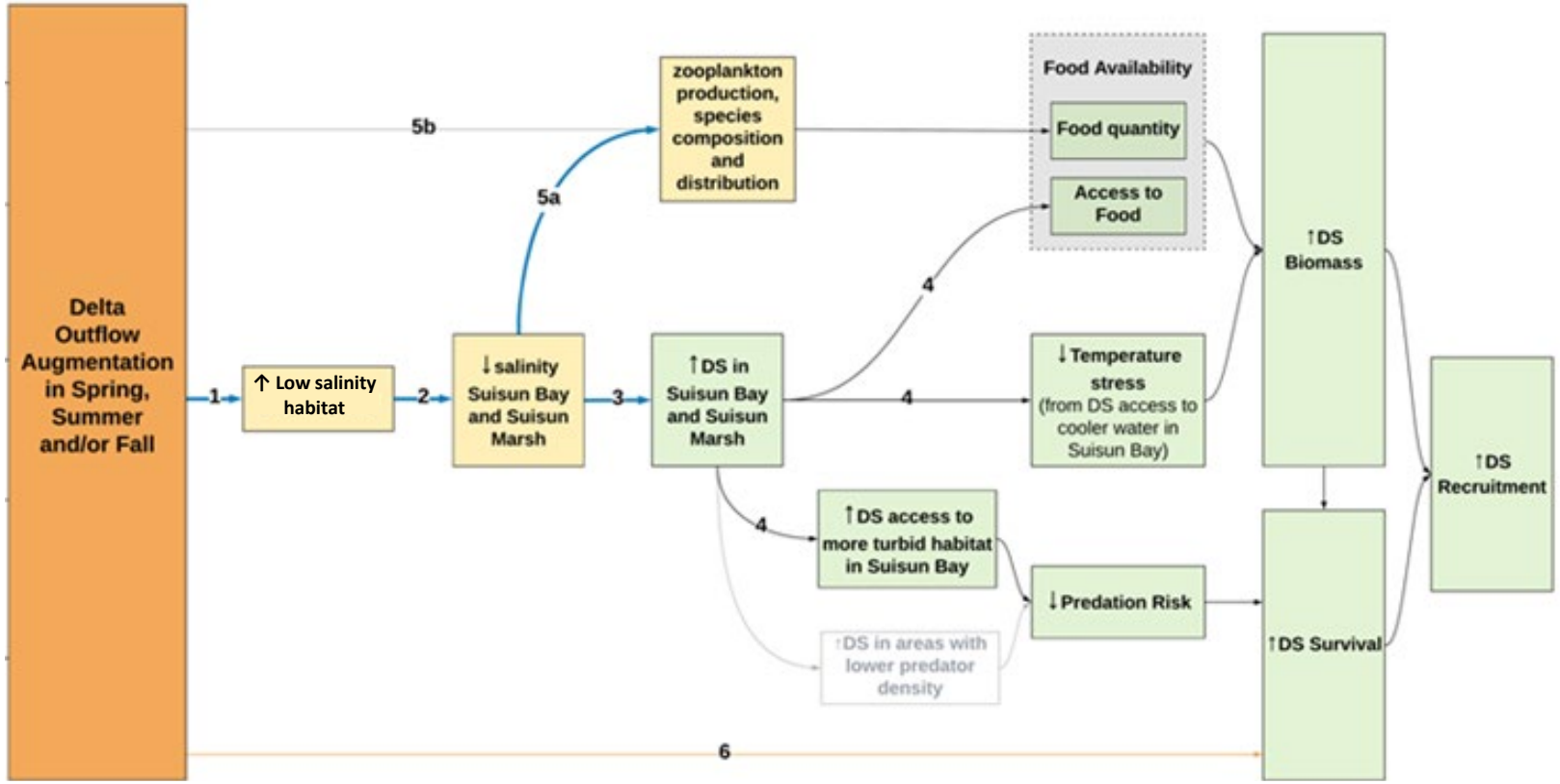
- June – December
- Bottleneck in population growth

Key drivers

- Size and location of low salinity habitat
- Habitat quality
- Food availability

# MAST Conceptual Model*

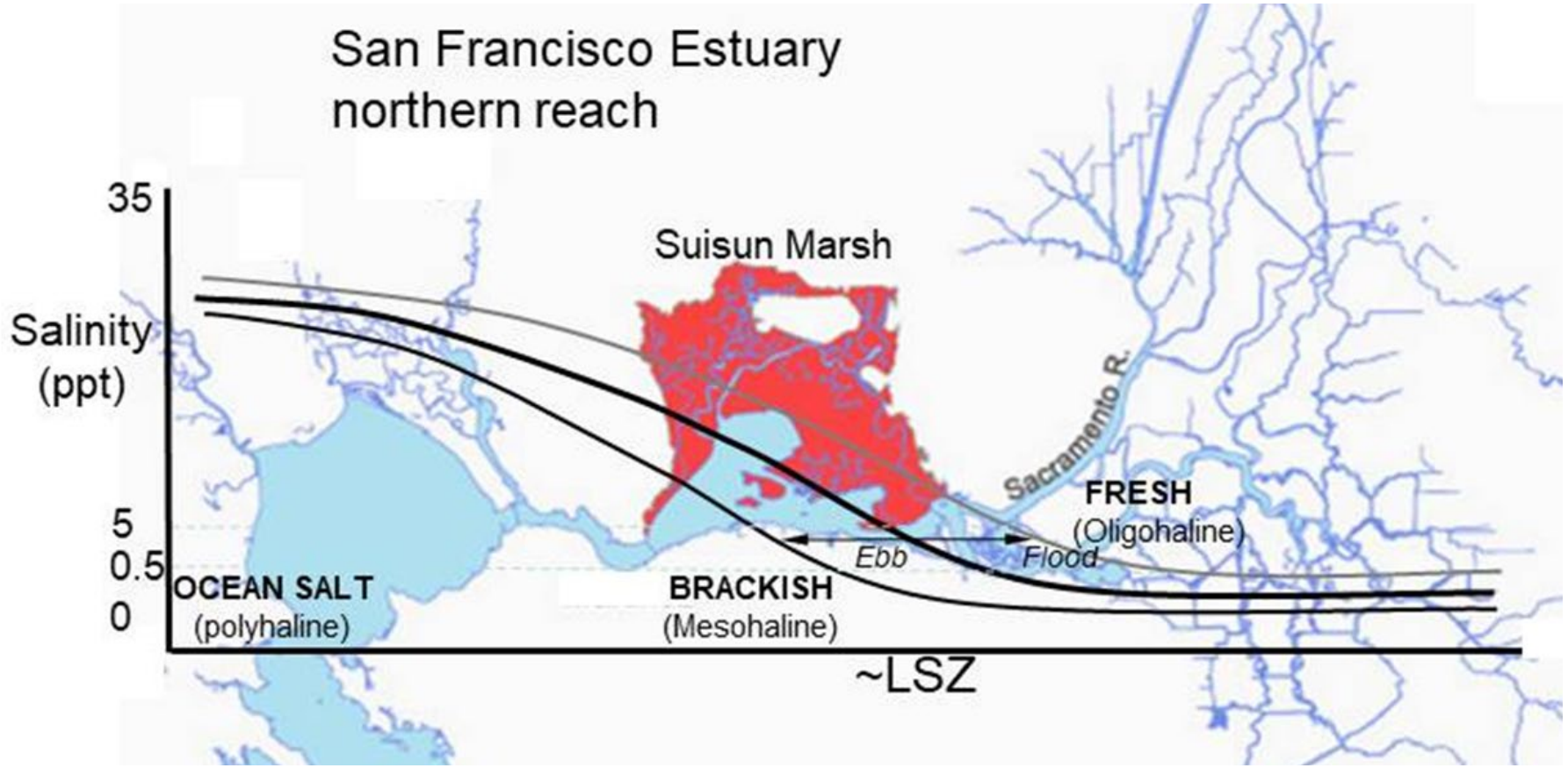
Increase low salinity habitat → maximize area of suitable habitat → higher growth and survival




*Interagency Ecological Program Management, Analysis, and Synthesis Team (MAST) Technical Report 90 (2015)
Image modified from the Collaborative Science and Adaptive Management Program / Compass Delta smelt structured decision-making technical working group

# Low Salinity Zone (LSZ)

Area where depth-averaged salinity = 0.5 – 6 PSU

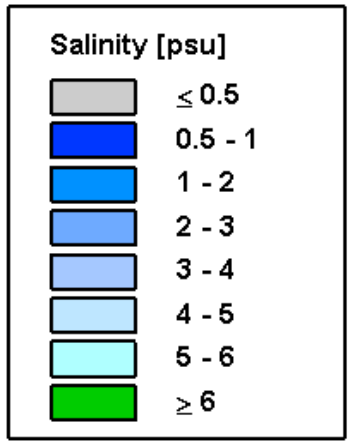



Chris Enright

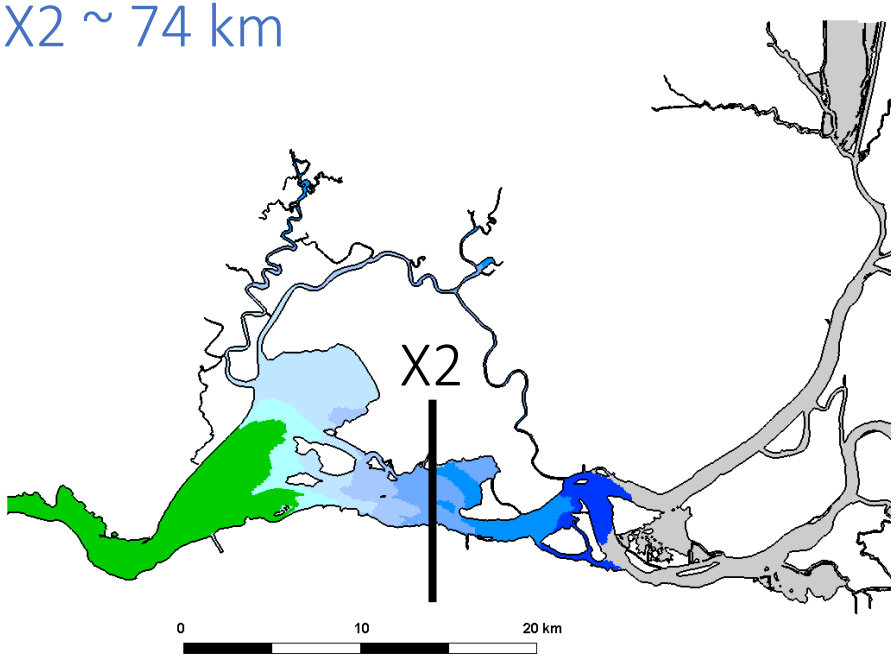
# X2 determines LSZ location and size

X2: distance from Golden Gate Bridge (river kilometers) where daily-averaged bottom salinity = 2 PSU (practical salinity units)

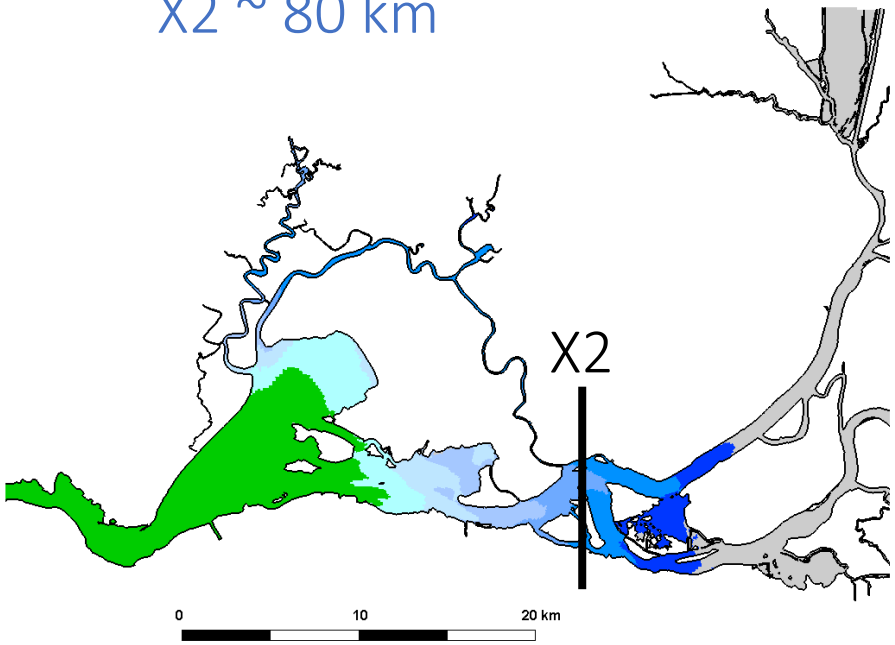
Daily depth-averaged salinity




X2 ~ 74 km




X2 ~ 80 km




Delta Monitoring Associates (2014)

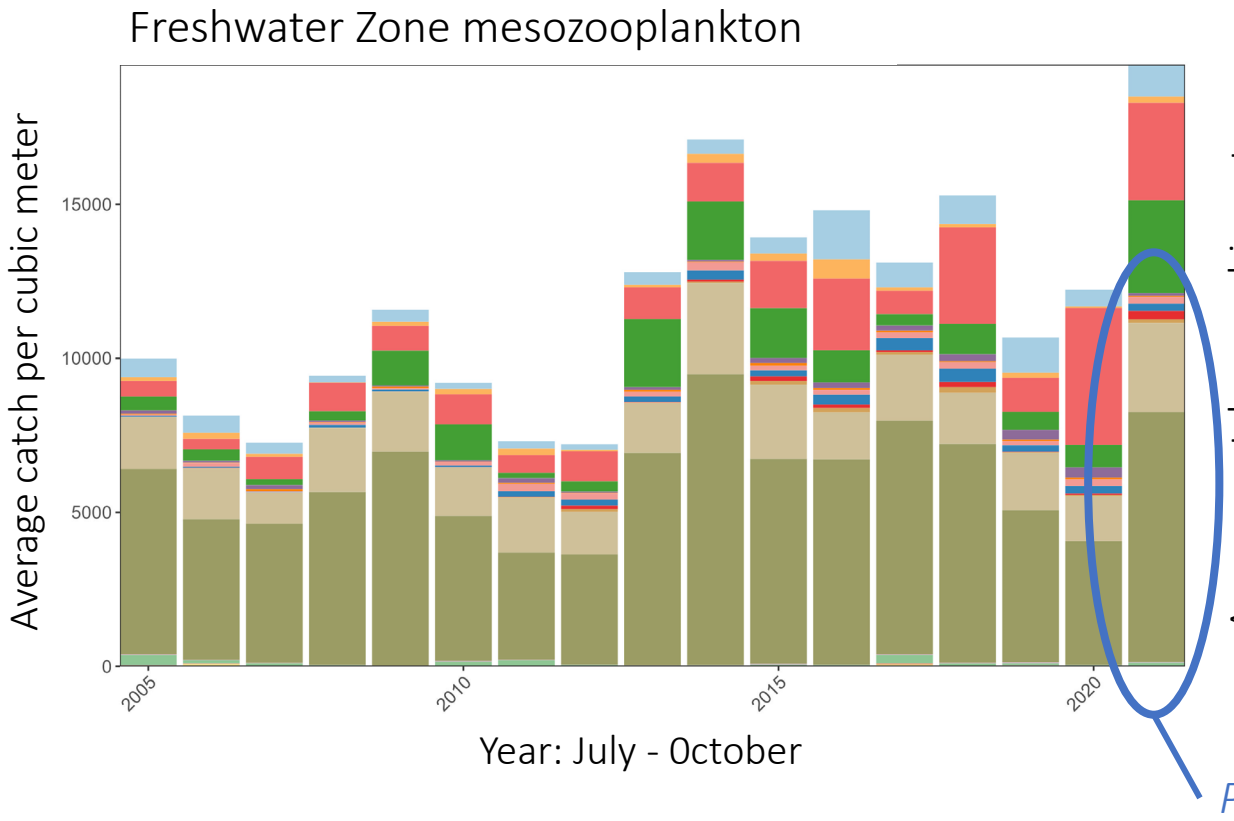
# Food Availability

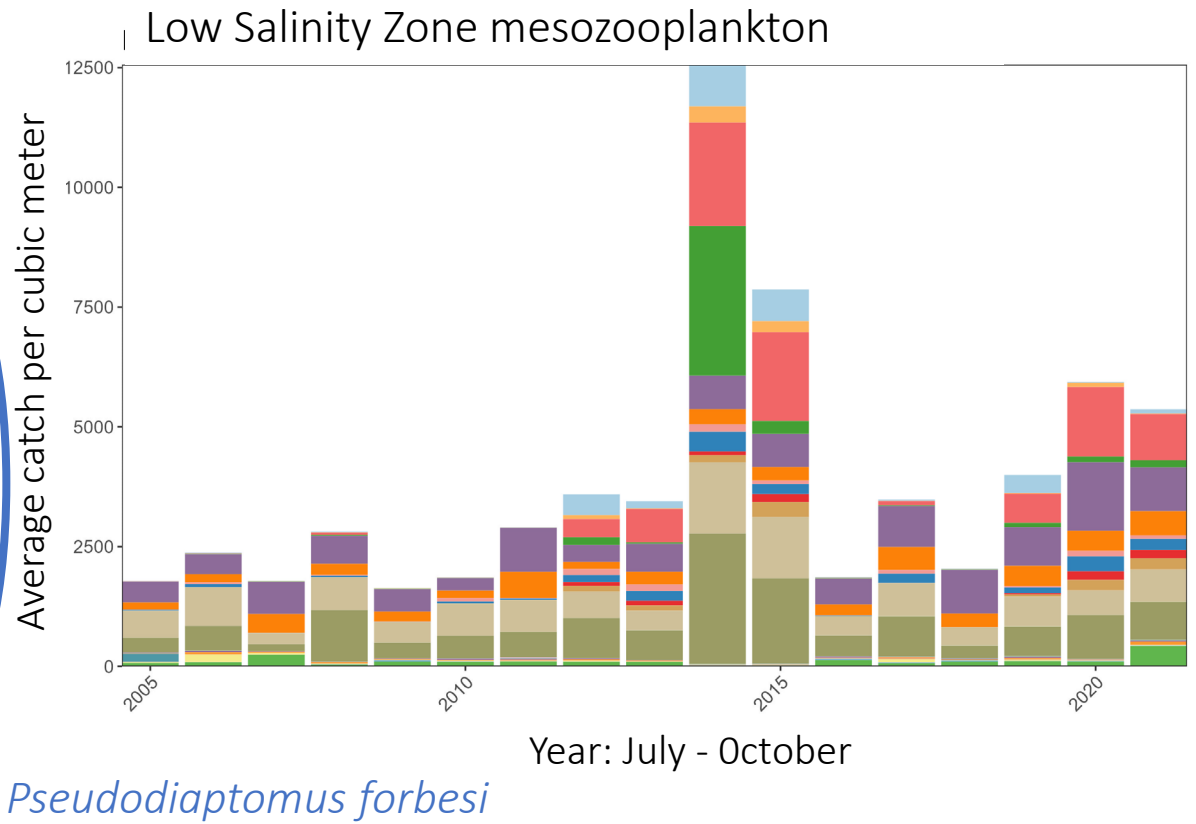
Evidence for food limitation during this time period

- Clam grazing
- Freshwater subsidies of preferred prey

# Food Availability

Upstream subsides of calanoid copepods → LSZ



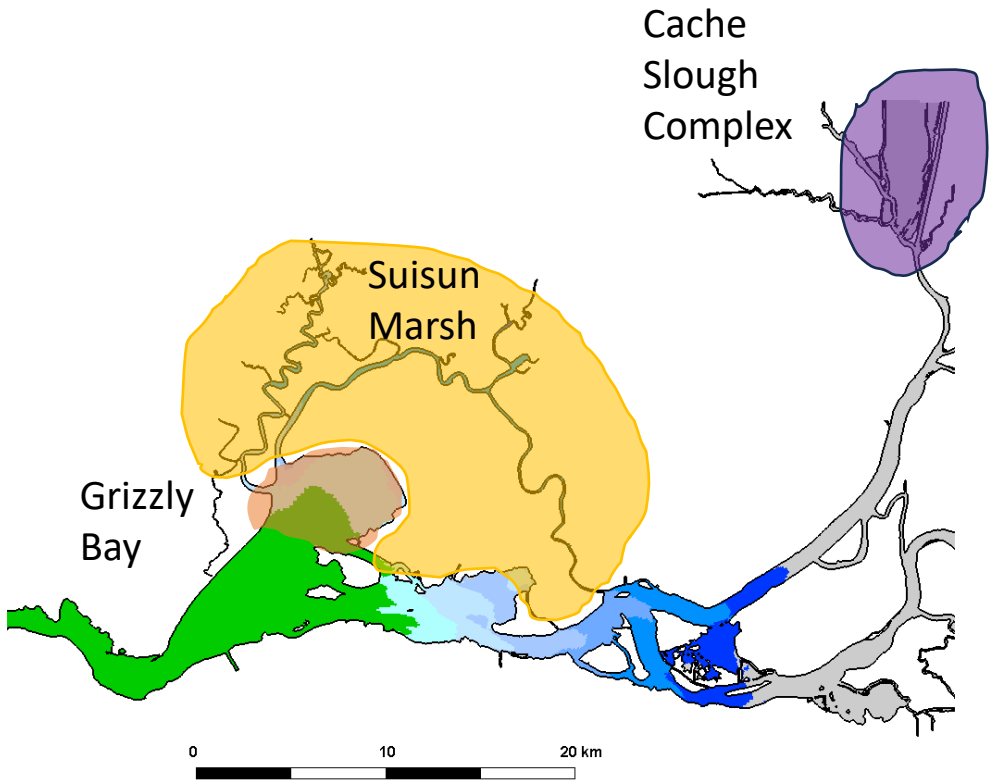




*Pseudodiaptomus forbesi*

# Goal and Objectives

Improve habitat conditions and food supply

- Maintain low salinity habitat in Suisun Marsh and Grizzly Bay when water temperatures are suitable
- Manage the LSZ to overlap with turbid water and available food supplies
- Establish contiguous low salinity habitat from Cache Slough Complex to Suisun Marsh




X2 ~ 80 km

Delta Monitoring Associates (2014)

# Performance Metrics

## Structured Decision-Making

### Objectives

↑ Delta Smelt recruitment

↑ individual Delta Smelt survival

↑ individual Delta Smelt growth and condition

### Performance Metrics

Area of suitable abiotic habitat

Prey biomass and composition

Contaminant exposure

Delta Smelt growth

Effects on other native species

Resource costs (water, $)

Learning

# Overview

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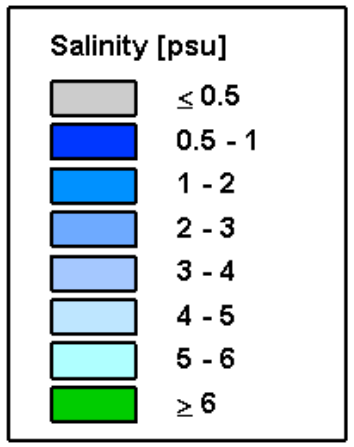
# Summer Fall Habitat Actions

Focus: LSZ position and habitat conditions

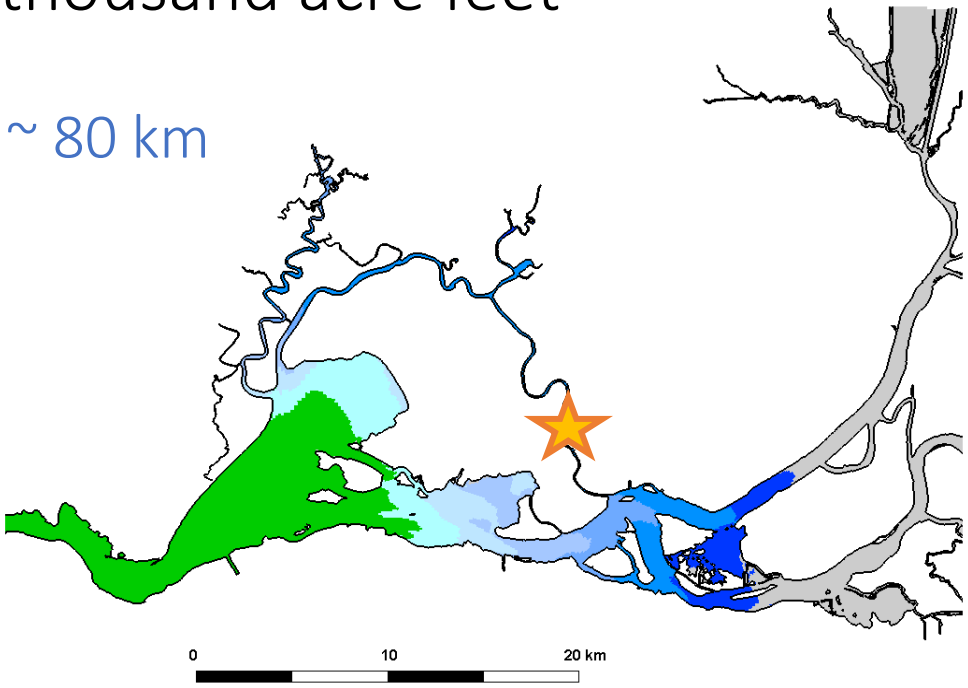
Actions: Fall X2

Suisun Marsh Salinity Control Gates

Additional 100 thousand acre feet




X2 ~ 80 km




Delta Monitoring Associates (2014)

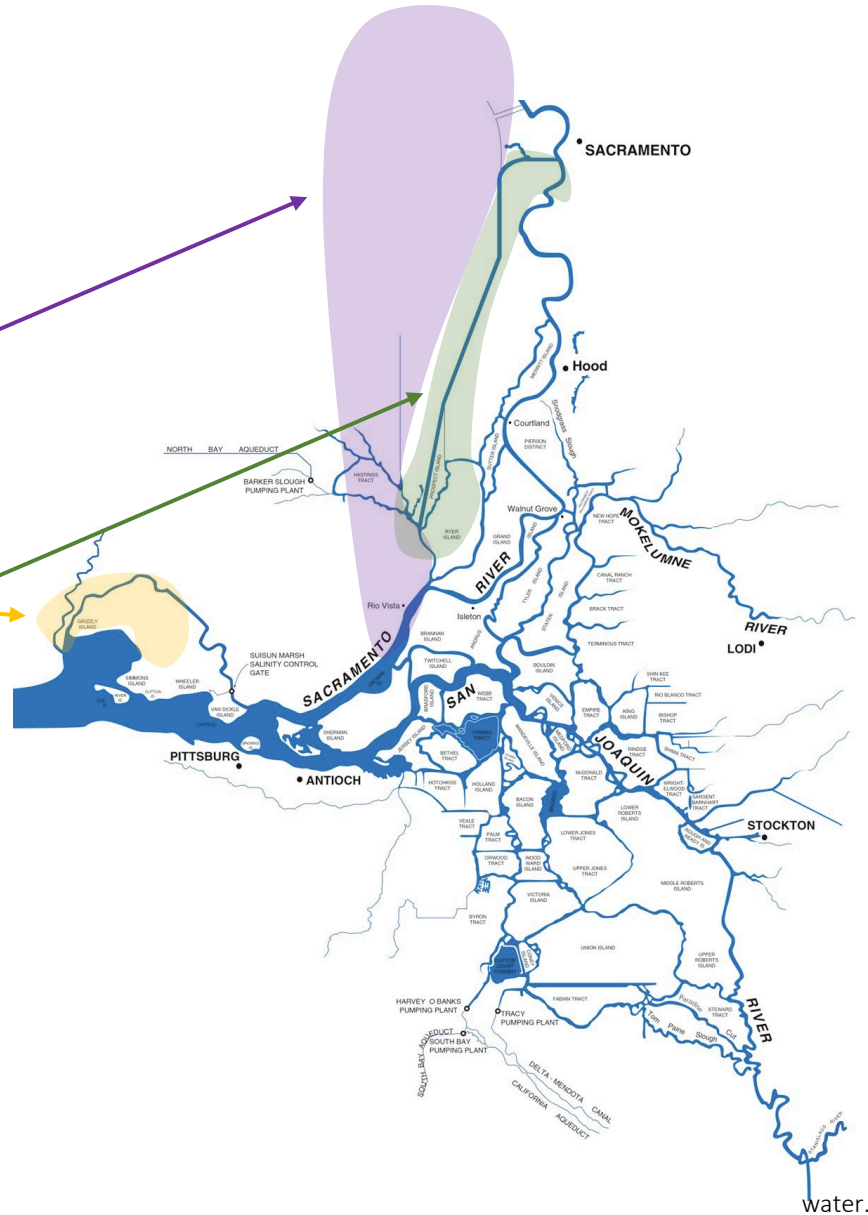
# Summer Fall Habitat Actions

Focus: Stimulate / subsidize primary and secondary production

Actions:

- North Delta Food Subsidy Study
- Managed Wetlands
- Sacramento Deep Water Ship Channel

Action implementation depends on water year type



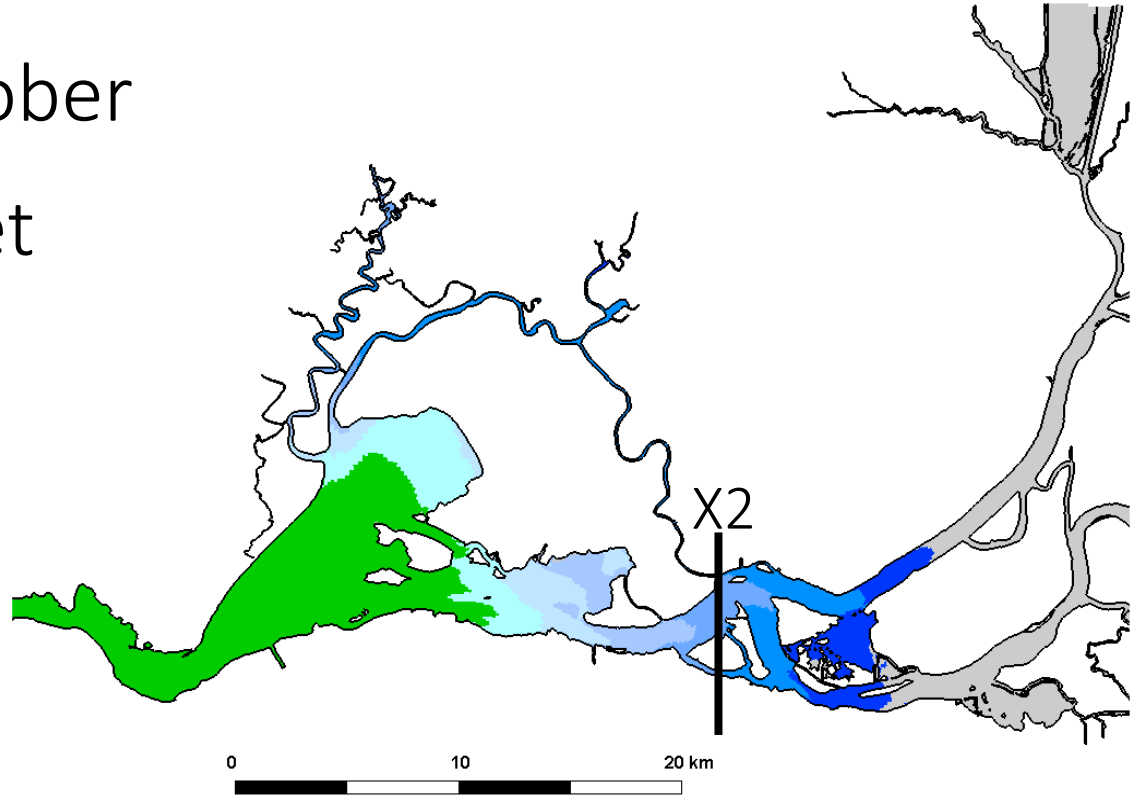
# Fall X2

Objective: Maintain X2 at 80 km to increase LSZ area

Operation: export reduction, reservoir releases

Timing: September – October

Water years: above normal, wet




Delta Monitoring Associates (2014)

# Fall X2

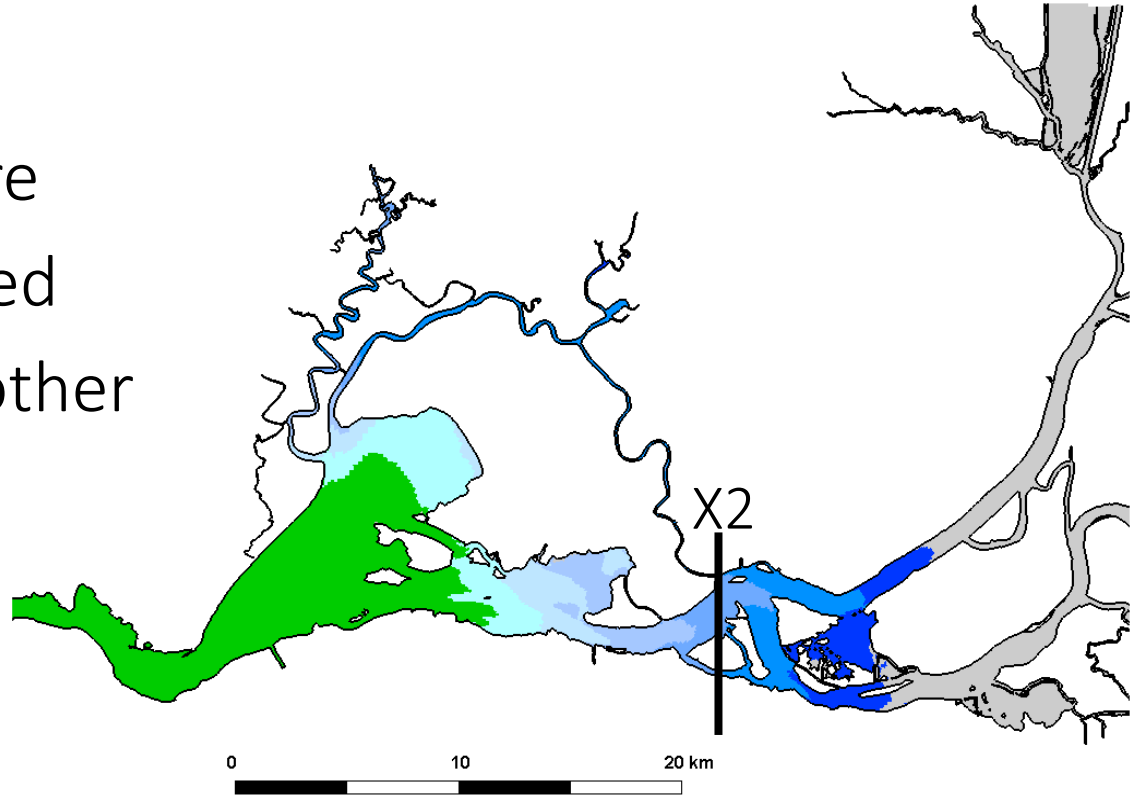
Previous implementation

- 2017, 2019 managed to 74 km; 2023 managed to 80 km

Conclusions (2017*)

- ↑ turbidity; ↓ water temperature
- Zooplankton: no increase observed
- Delta Smelt: similar or less than other regions

Difficult to tease apart from effects of wet water year




*Schultz et al. (2019)

Delta Monitoring Associates (2014)

# Suisun Marsh Salinity Control Gates

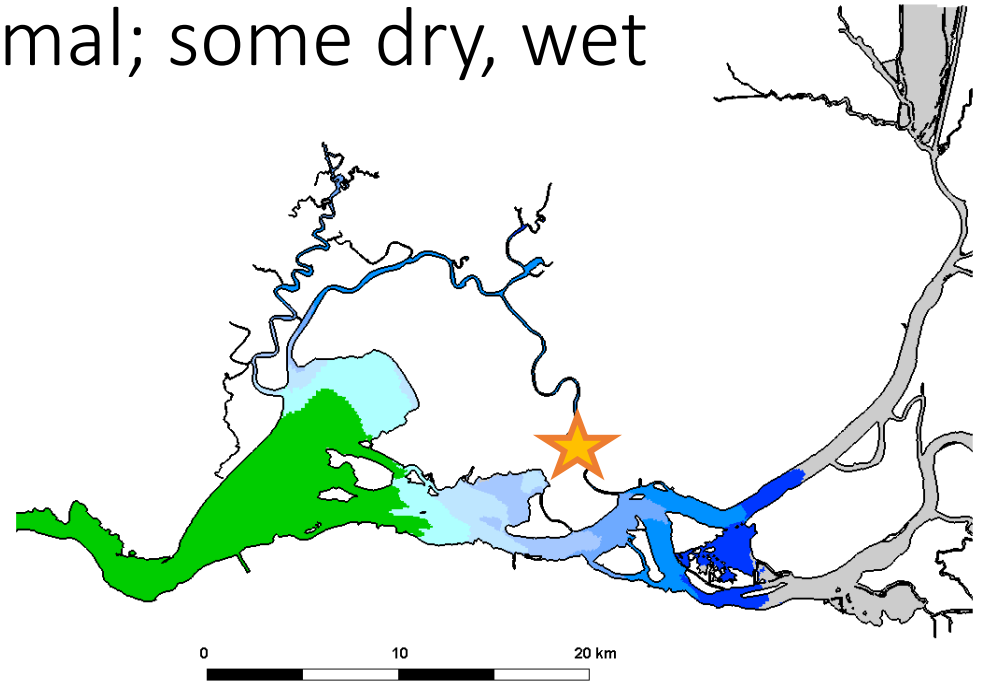
Objective: Maintain low salinity in Suisun Marsh

Operation: freshwater conveyance into Suisun Marsh

Timing: June – October, 60 days (consecutive or staggered)

Water years: below and above normal; some dry, wet

Water Education Foundation




Delta Monitoring Associates (2014)

# Suisun Marsh Salinity Control Gates

Previous Implementation

- 2018, 2023

Conclusions (2018*)

- ↑ area of low salinity habitat
- Suisun Marsh turbidity, chlorophyll a >  in lower Sacramento River
- No difference in zooplankton relative abundance
- Small numbers of Delta Smelt observed in Suisun Marsh during action

Anticipate effects to vary based on annual hydrologic and salinity conditions

*Sommer et al. (2020)

# Additional 100 Thousand Acre Feet*

| | |
|---|---|
| Objective: | Increase freshwater habitat in Suisun Marsh and Grizzly Bay |
| Operation: | Outflow or Suisun Marsh Salinity Control Gates |
| Timing: | June – October; or deferred and redeployed the following March-October to supplement outflow |
| Water years: | above normal, wet |

*CA Incidental Take Permit only; implemented at the discretion of CA Dept of Fish and Wildlife

# Additional 100 Thousand Acre Feet*

Previous Implementation

- 2023

Conclusions (2023)

- Greater area of freshwater

Risk of deferring vs implementing during a wet year

- Water may not be available the following year

*CA Incidental Take Permit only; implemented at the discretion of CA Dept of Fish and Wildlife

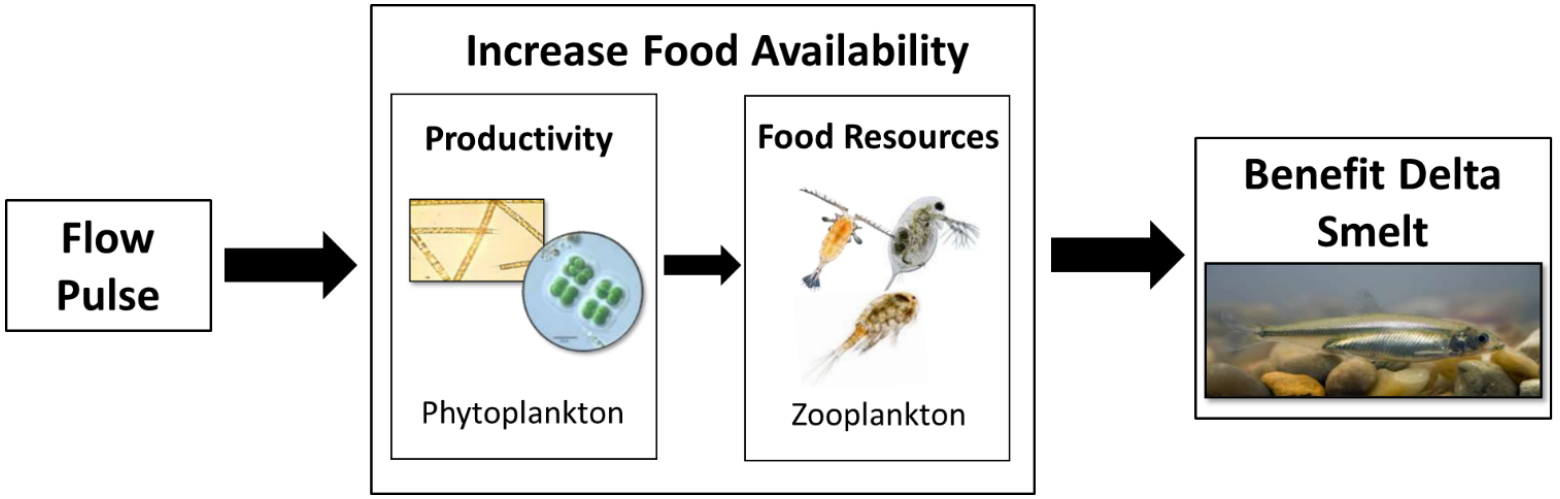
# North Delta Food Subsidy Study

Objective: Create positive flow to stimulate and transport primary and secondary production

Operation: managed flow pulse, Sacramento River or agricultural

Timing: Sac River, July; agricultural, September

Water years: some dry, below normal, above normal

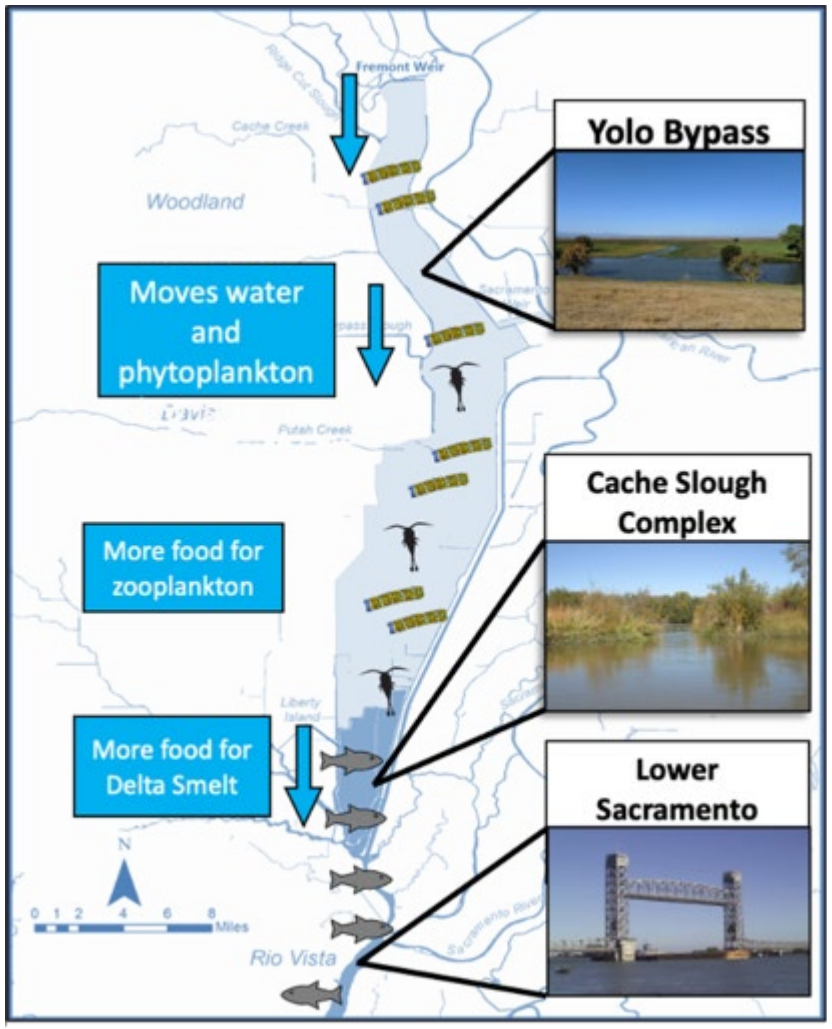



Twardochleb et al. (2023), Figures 1-1

# North Delta Food Subsidy Study

Previous implementation

- Agricultural pulses
  - 2012, 2018, 2019
- Sacramento River pulse
  - 2016




Twardochleb et al. (DWR)

# North Delta Food Subsidy Study

## Conclusions*

- Phytoplankton response in some years
- Low statistical power to detect a zooplankton response
- Relatively high contaminant concentrations with potentially negative effects on Delta Smelt
- Temperatures approach and can exceed thermal tolerance limits

*Davis et al. (2022)

# Managed Wetlands Study

Objective: Increase primary and secondary production in Suisun Marsh

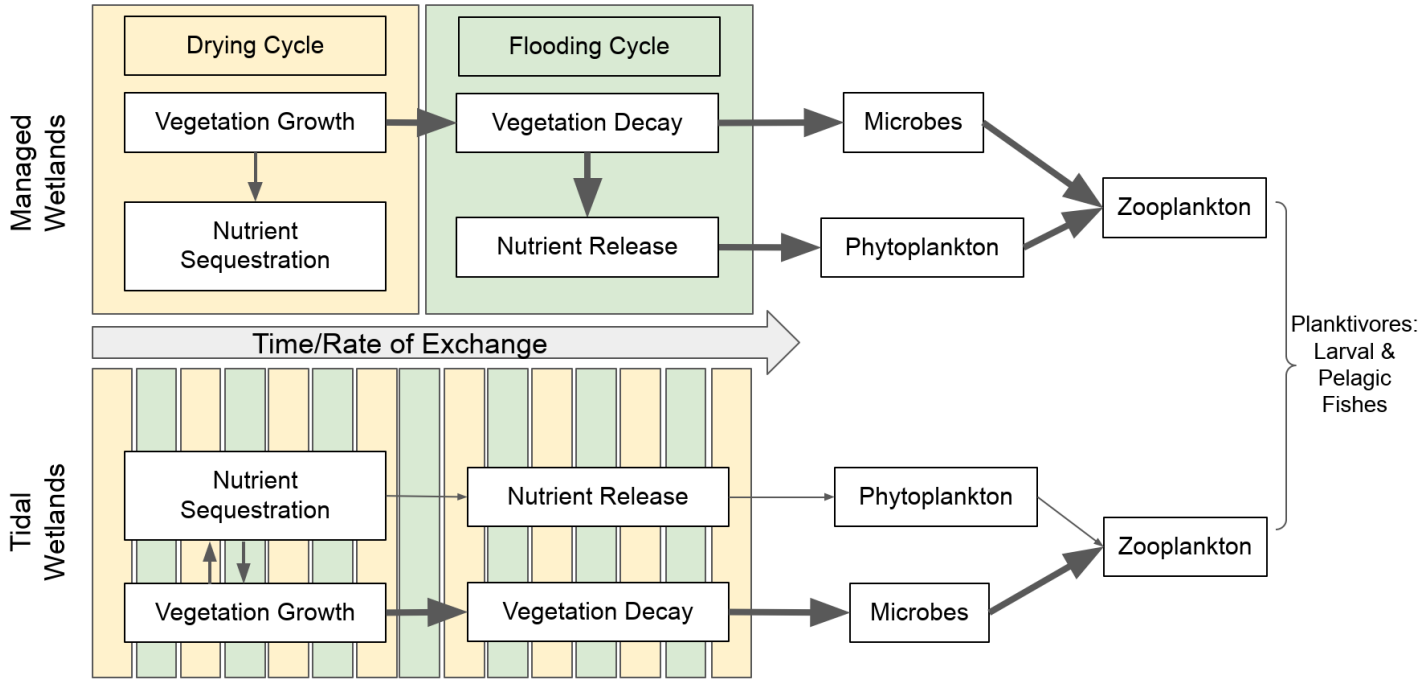
Operation: drain/fill cycle

Timing:

seasonal: dry summer flood fall

perennial: flooded

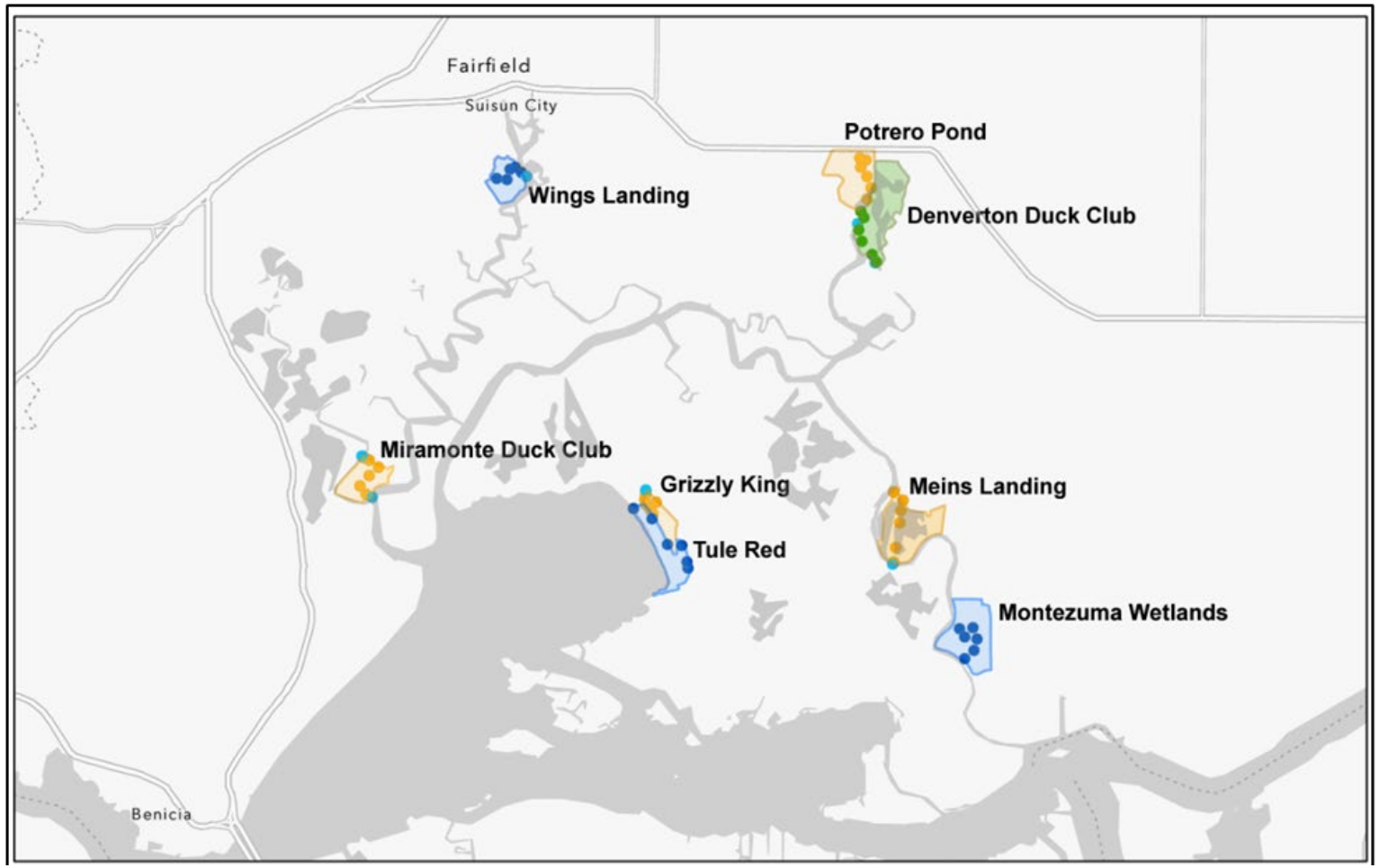
Water years: NA




Durand et al. (2023), proposed study, Figure 1

# Managed Wetlands Study

## Pilot Research: began 2022




Seasonally managed

Perennially managed

Tidally restored

Reference slough

John Durand and Alice Tung, UC Davis

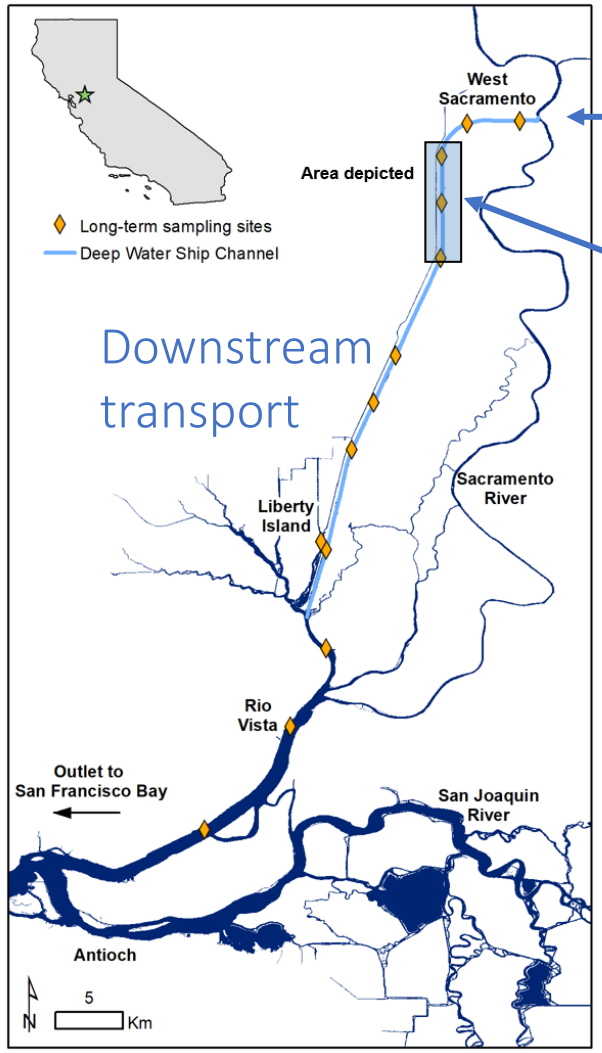
# Sacramento Deepwater Ship Channel

Objective: stimulate plankton production in the main stem Sacramento River

Operation: managed flow pulse + nutrient enrichment

Timing: July

Water year types: NA

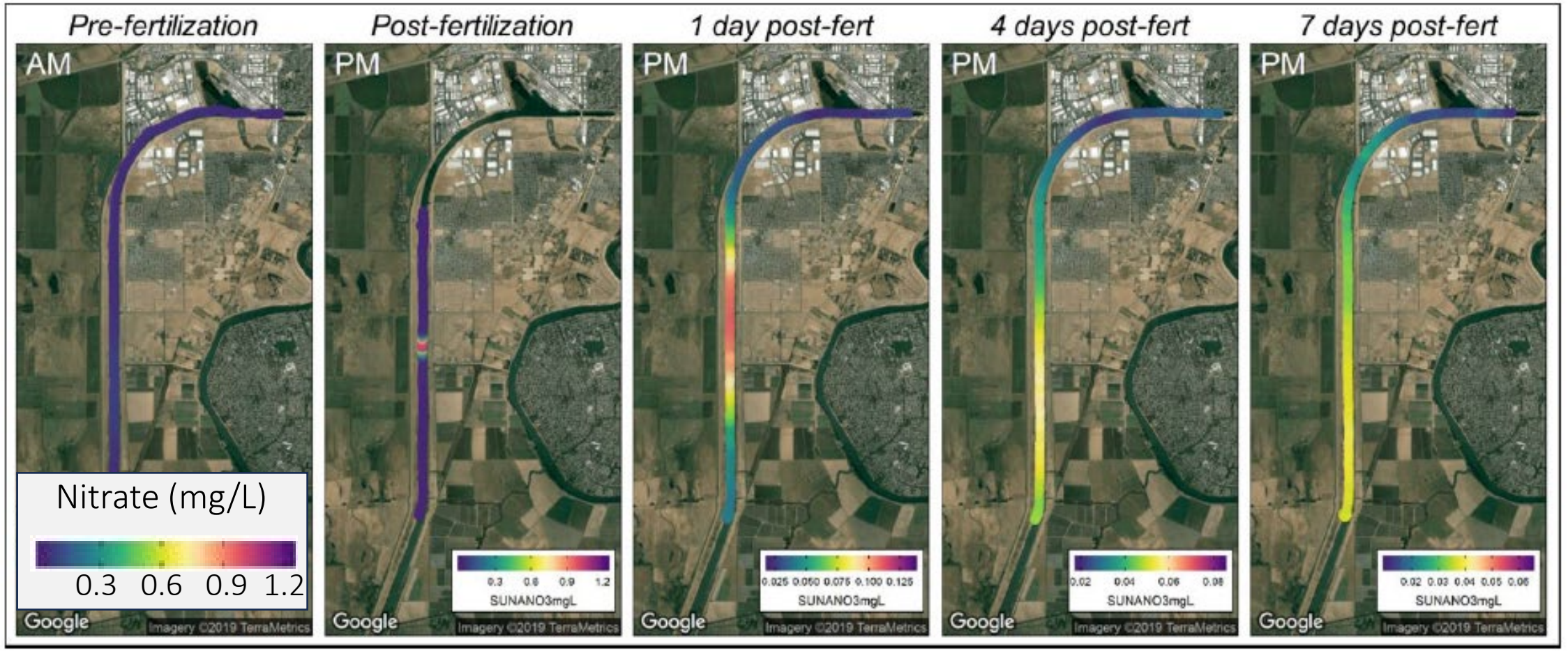



Flow pulse

Fertilizer application

# Sacramento Deepwater Ship Channel

Pilot Study, 2018-2019: 400 m segment fertilized



# Sacramento Deepwater Ship Channel

## Pilot Study Conclusions*

- Nitrate addition → temporary increase in nitrate concentration → substantial, short-lived increases in chlorophyll concentration
- Chlorophyll concentrations higher when the water column was thermally stratified
- Evidence for nitrogen limitation in the upper channel, due to greater light penetration and longer water residence times
- Stimulation and export of phytoplankton production will require both enhanced nutrient supply and increased net flow

*Loken et al. (2022)

# Overview

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# Adaptive Management

## North Delta Food Subsidies Study

- Low statistical power for detecting a food web effect
  - Stable isotope pilot study: track carbon sources and uptake
- Small footprint unlikely to increase primary and secondary production in the lower Sacramento River
- Hydrodynamics not as expected and anticipated to change due to restoration projects
- Shift in focus due to high contaminant and temperature concerns
  - Evaluate thermal suitability throughout the Cache Slough Complex

# Adaptive Management

## Fall X2 and Suisun Marsh Salinity Control Gates

- Trade-offs between reservoir releases and cold-water pool management for other native and ESA / CESA-listed species
- Gate operation to maximize freshwater habitat over space vs time
- Limited statistical power to detect a zooplankton response
- Relative benefit of using or deferring 100 TAF

# Uncertainties

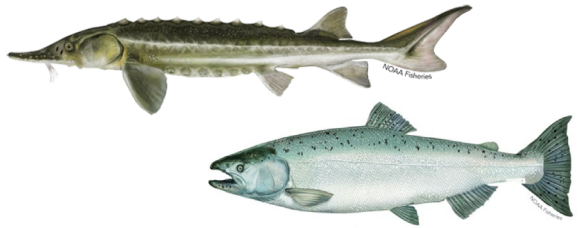
- Will Delta Smelt migrate to higher quality habitat?
- How can we improve models of phytoplankton and zooplankton transport /subsidization?


- How can we improve the individual-based Delta Smelt model?
  - Delta Smelt specific re-parameterization of bioenergetics model
  - Incorporating movement into the individual-based model
- Can flow actions result in detectable food web effects and population-level benefits for Delta Smelt?
- What other approaches could be used to facilitate population transition through this bottleneck period?

# Information and Synthesis Needs

- What have we learned since the MAST conceptual model was developed?
- To what extent do some food subsidy actions increase contaminants and impact Delta Smelt growth and condition?


- Do and, if so, how do actions impact other native species, particularly ESA and CESA-listed species?
- What is the relative role of temperature with respect to other habitat conditions now and in the future?



NOAA Fisheries

# Planning, Reporting, and Evaluation

## Action Plan

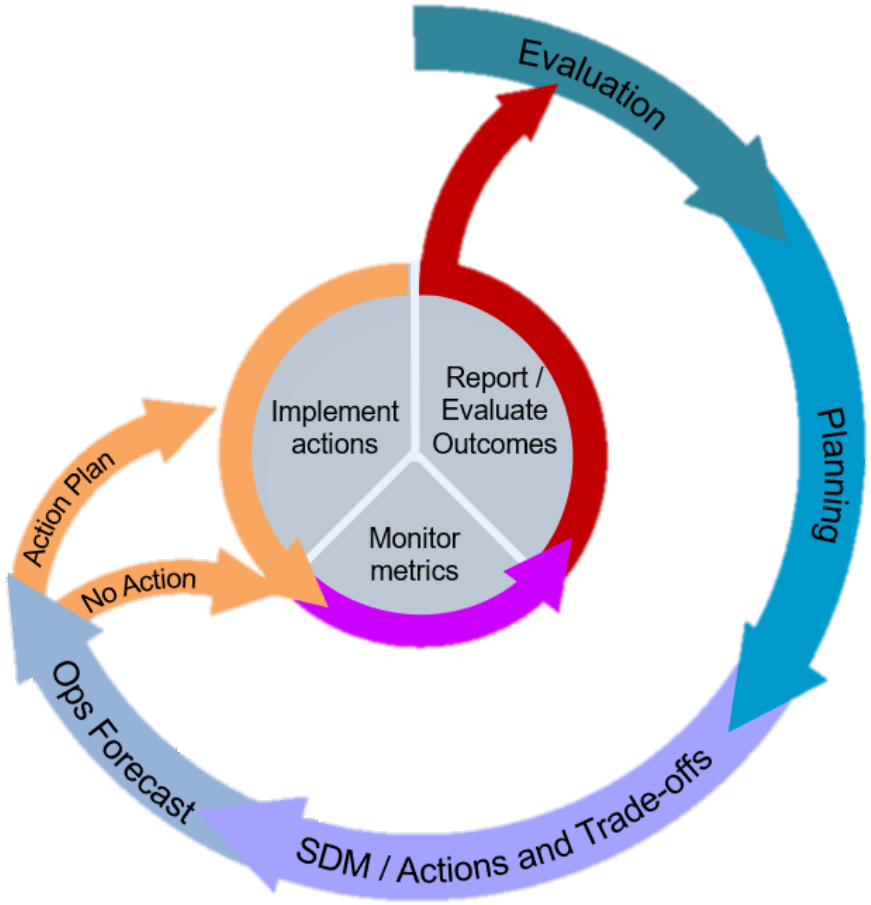
- Recommendations resulting from structured decision-making

## Science and Monitoring Plan

- Monitoring and modeling activities

## Seasonal report

- Action implementation; monitoring and modeling results



# Planning, Reporting, and Evaluation

Peer-reviewed publications

- Fall X2, Suisun Marsh Salinity Control Gate, and North Delta Food Subsidy Study

4-year independent review for the CA Incidental Take Permit

- Inform how well the Science Plans and SDM approach are being integrated into the adaptive management of Delta Smelt summer-fall habitat
- Recommendations to improve certainty in metrics and confidence in decision-making
- Anticipated completion: June 2024

Delta Stewardship Council

A CALIFORNIA STATE AGENCY

# Discussion

René Reyes