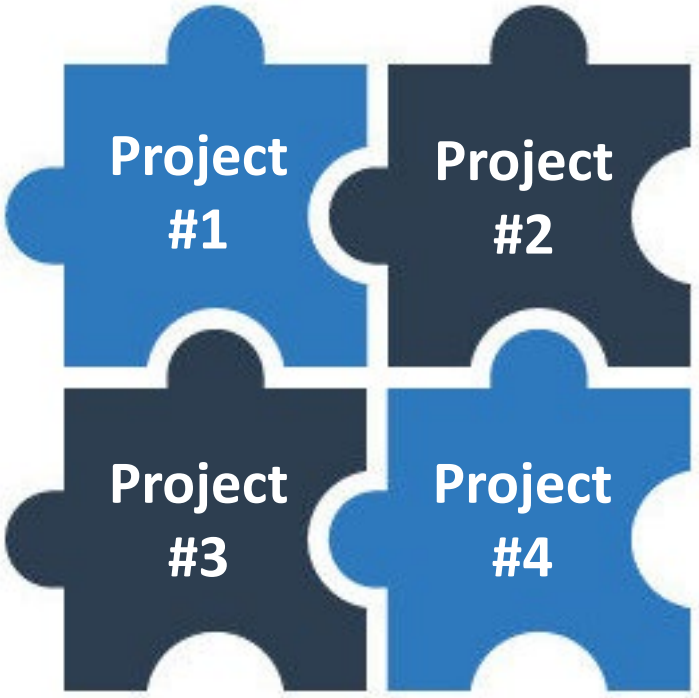
January 2023

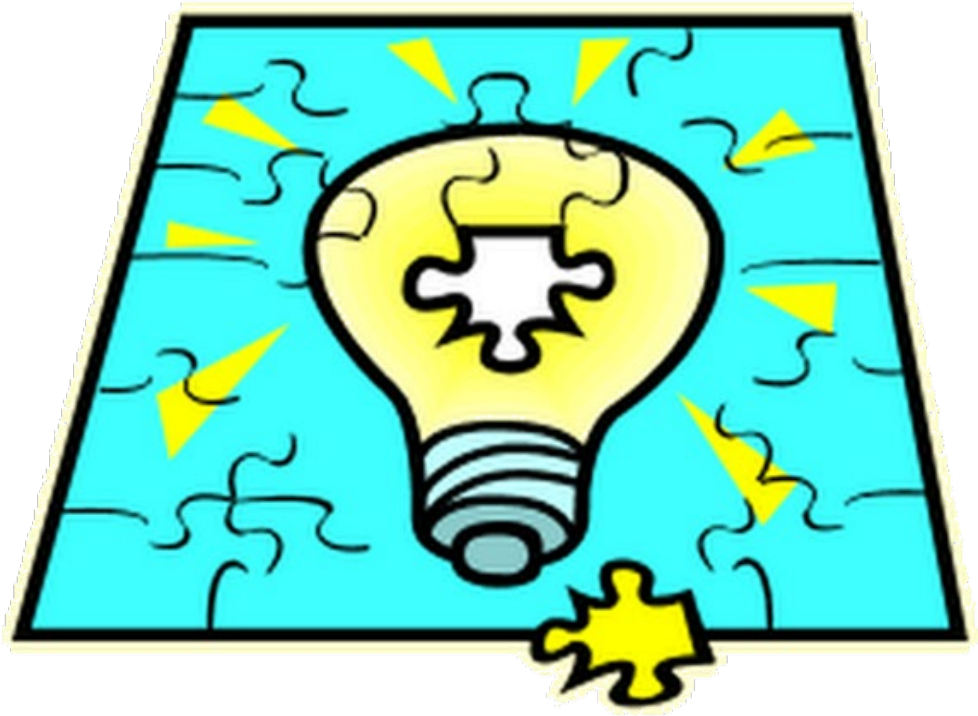
# Delta Science Program Scientific Synthesis

Delta Stewardship Council

A CALIFORNIA STATE AGENCY

# What is scientific synthesis?



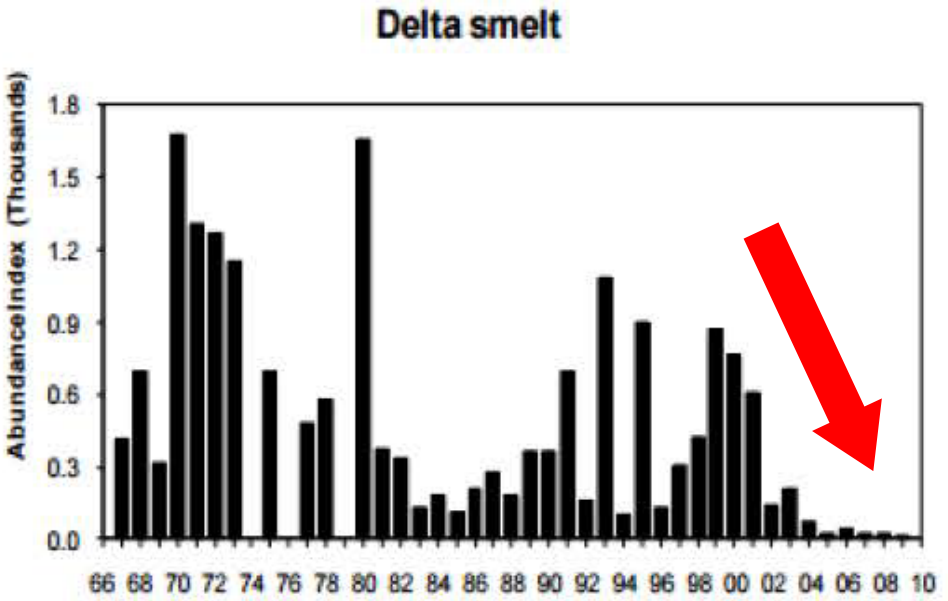



**The process of combining** disparate data, information…

…to see the **bigger picture** and gain **new insights**

# Why does synthesis matter?

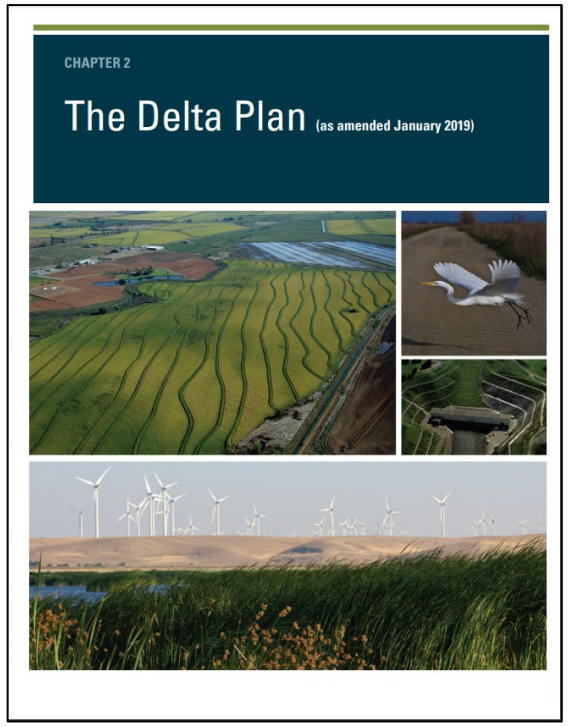
- **Critical to decision-making**
  - **"Pelagic Organism Decline"** synthesis led to changes in management
  - **Delta Plan Ecosystem Amendment**
- **The Delta is data-rich**
  - **Scientific monitoring** started in 1960s
- **Cost-effective**
  - 4% (or $4.4M) of all FY20-21 Science Expenditures (Delta Budget Crosscut)
- **Increasing capacity to do synthesis**
  - computing, data availability

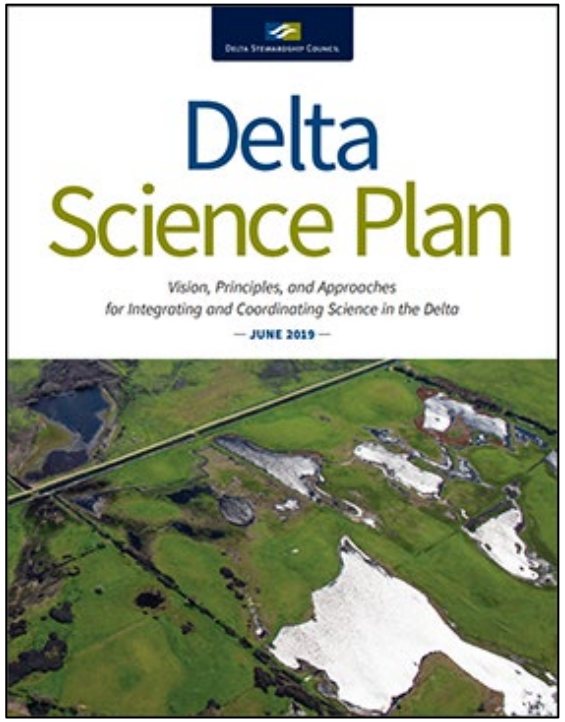



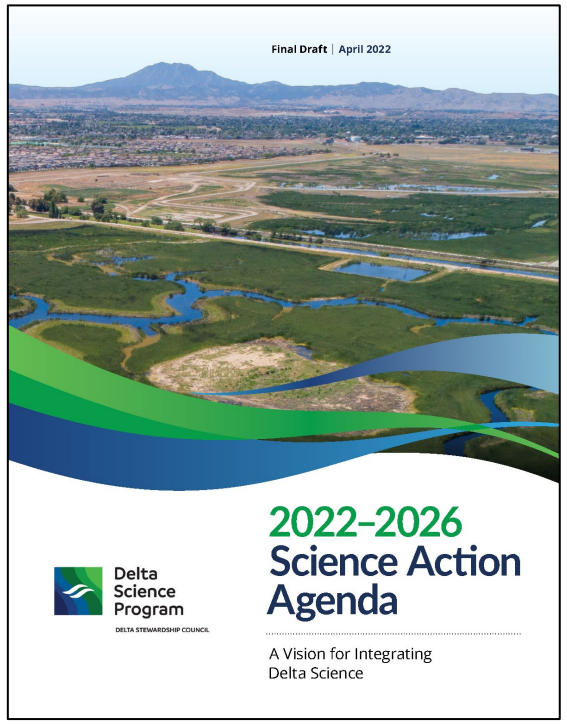

Baxter et al. 2010

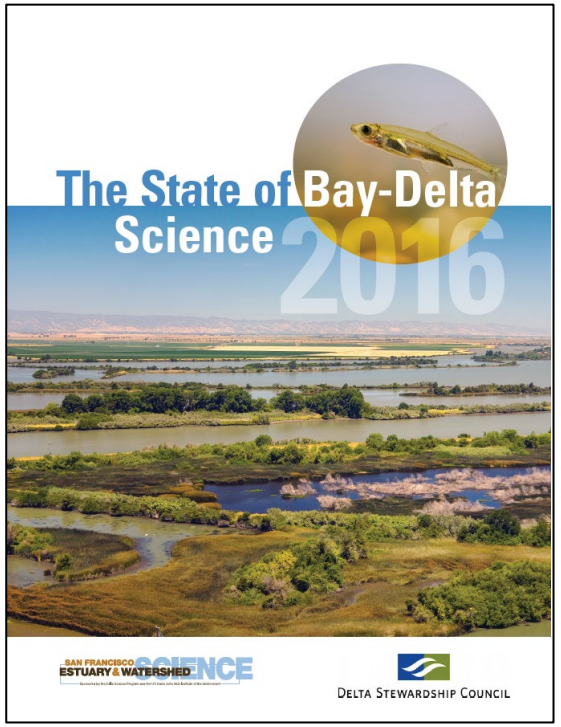
# Why does DSP do synthesis?

***Delta Science Strategy***




***HOW*** **we do science…**

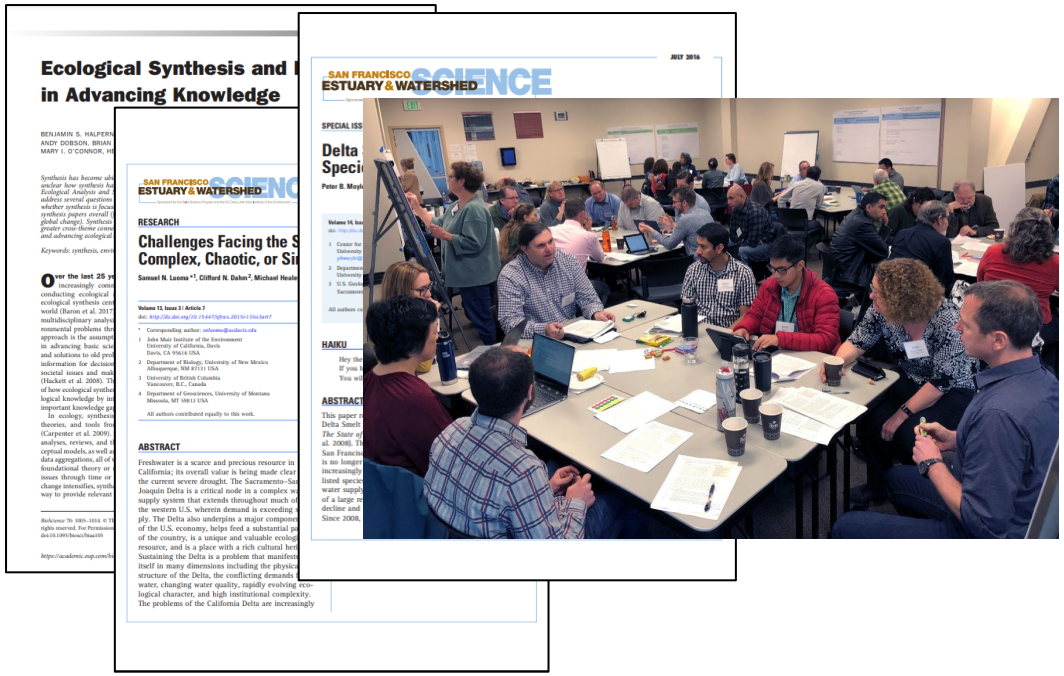
***WHAT*** **science we prioritize…**

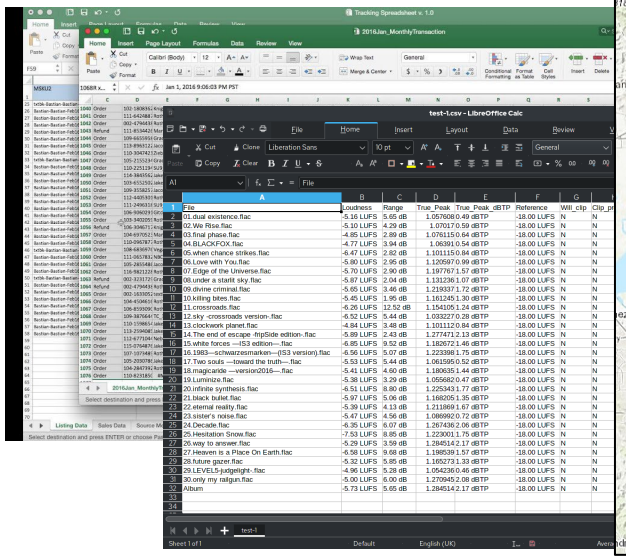
***WHAT*** ***we've*** **learned…**

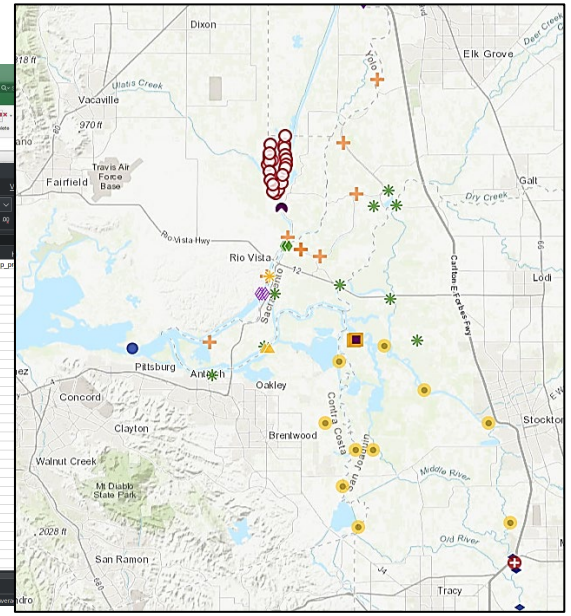
# Types of synthesis led by DSP

- **Knowledge-driven:**
  - State of Bay-Delta Science
  - Synthesis Workshops

- **Data-driven:**
  - NCEAS and Delta Science Program
  - “Shiny” applications





Jan 2023

# State of Bay-Delta Science 2022

Delta Science Program

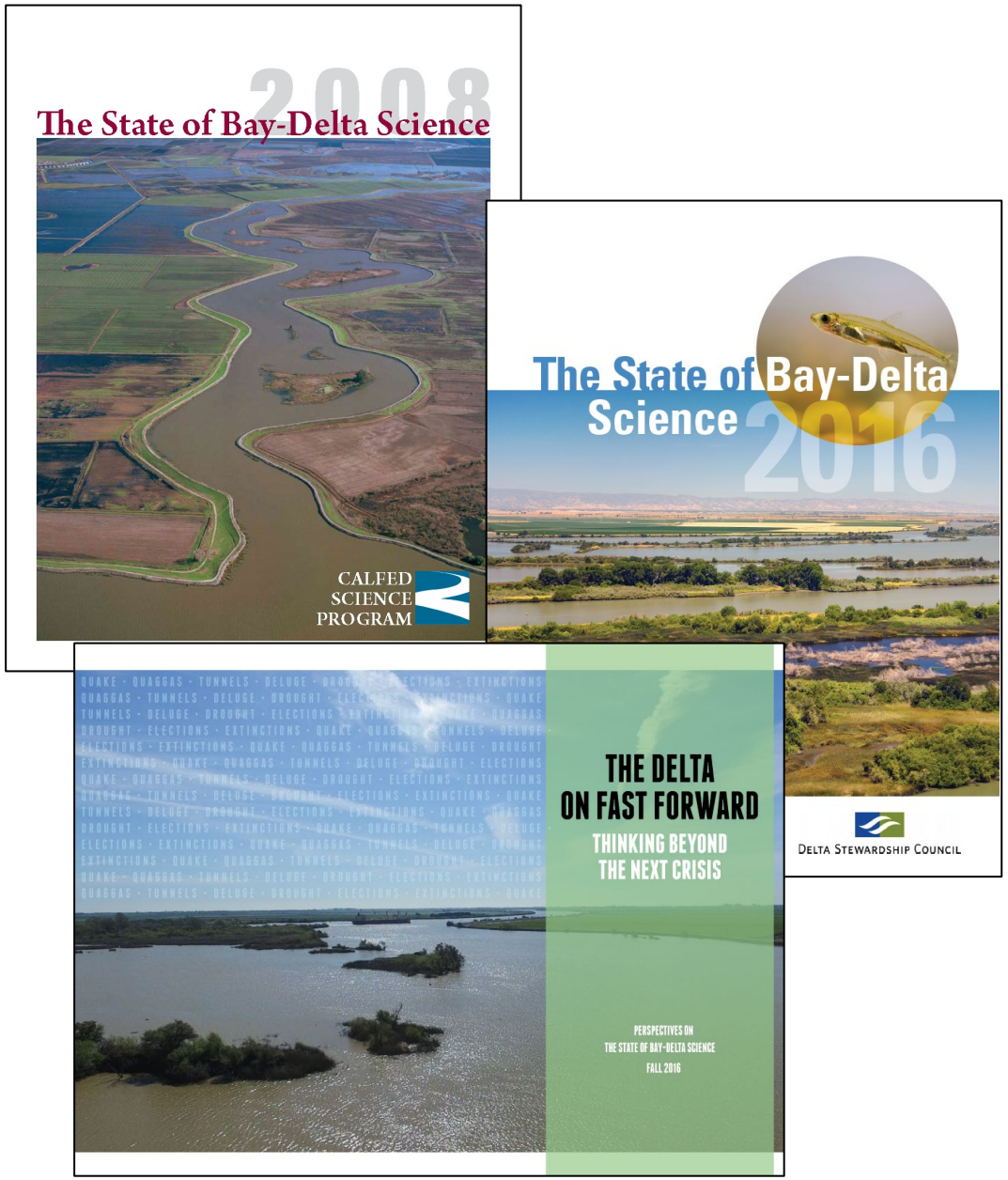
DELTA STEWARDSHIP COUNCIL

# What is SBDS?

An ongoing synthesis and communication effort led by the Delta Science Program

3 completed editions (2008, 2016, 2022) with > 30 publications

Future editions released every ~2 years



# SBDS 2022

## “Ecosystem services and disservices of plants and algae”

**“Primary producers…”**

- generate energy for food webs,
- provide habitat to fish and wildlife,
- influence carbon and sediment cycles with local, regional, and global implications,
- and influence human health, recreation, and livelihoods.

# SBDS 2022 articles

## 1 Intro: How Plants and Algae Affect Ecosystems and Respond to Management of the Estuary and Its Watershed

Laurel G. Larsen, Samuel M. Bashevkin, Maggie Christman, J. Louise Conrad, Clifford N. Dahm, Janet Thompson

## 2 Primary Production of Aquatic Vegetation

Katharyn E. Boyer, Samuel M. Safran, Shruti Khanna, Melissa V. Patten

## 3 Ecology and Impacts of Aquatic Vegetation

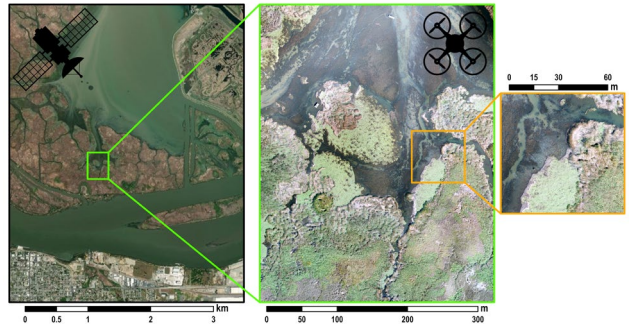
Maggie A. Christman, Shruti Khanna, Judith Z. Drexler, Matthew J. Young

## 4 The History and Science of Control Efforts

Louise Conrad, Madison Thomas, Karen Jetter, John Madsen, Paul Pratt, Patrick Moran, John Takekawa, Gina Skurka Darin, Lydia Kenison

## 5 Remote Sensing Applications

Erin Hestir, Iryna Dronova



## 6 Harmful Algal Blooms

Raphael M. Kudela, Meredith D. A. Howard, Stephen Monismith, Hans W. Paerl

## 7 Carbon Sequestration & Subsidence Reversal

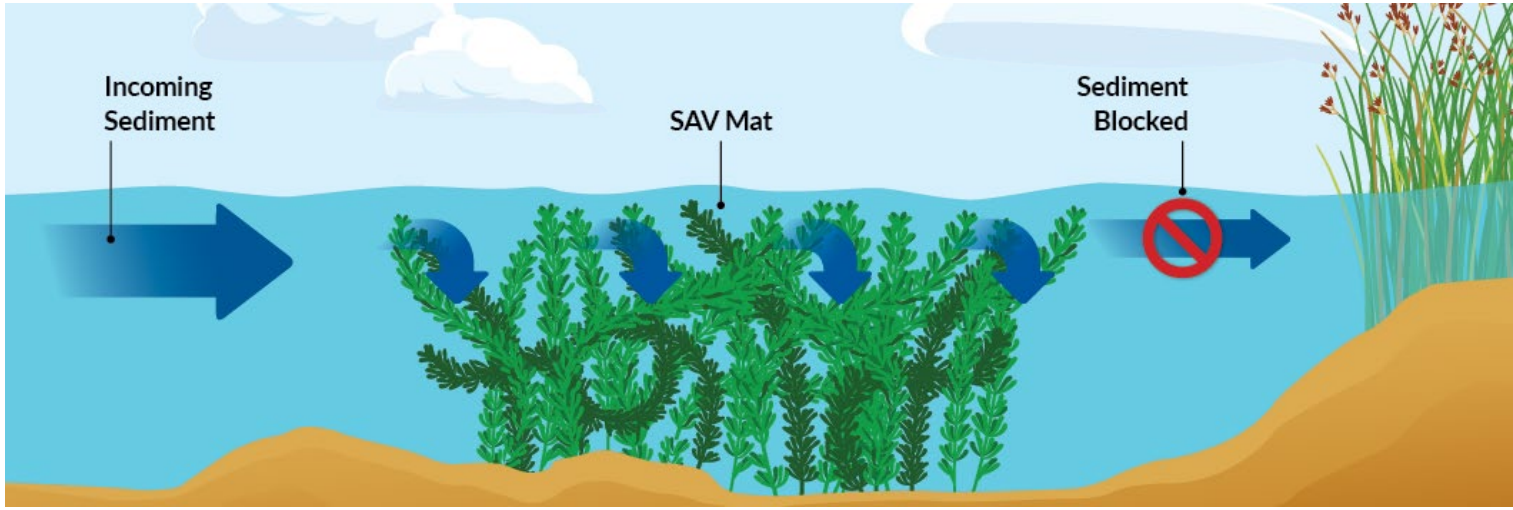
Lisamarie Windham–Myers, Patty Oikawa, Steve Deverel, Dylan Chapple, Judith Z. Drexler, Dylan Stern

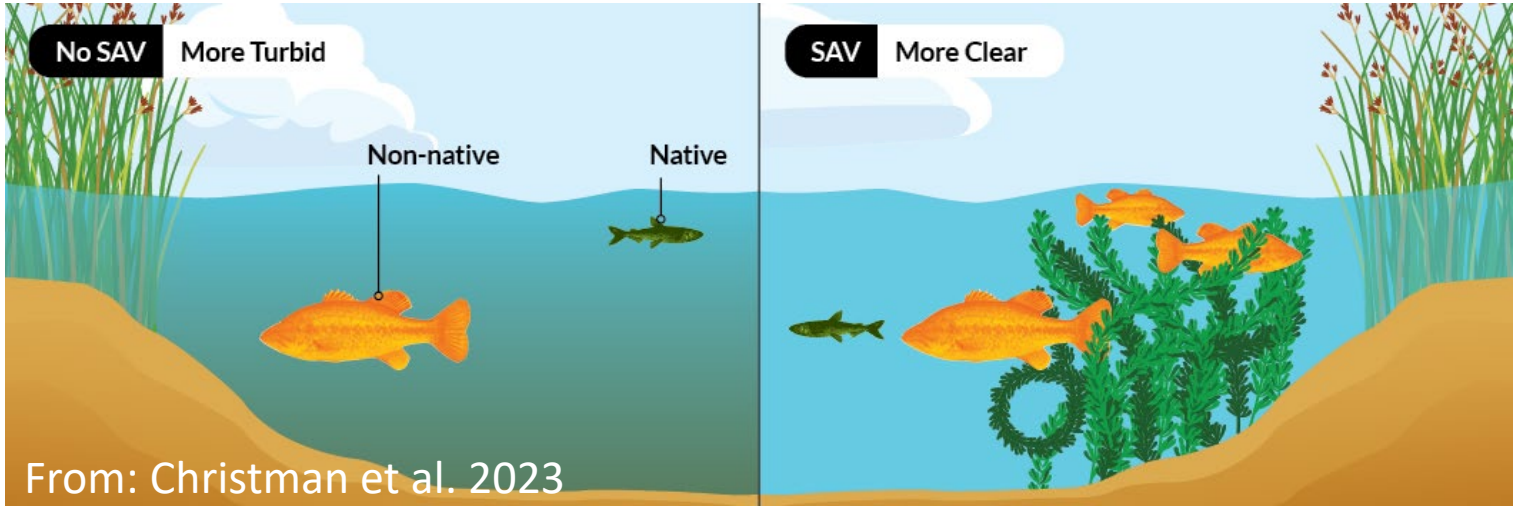
# Ecosystem services and disservices: Carbon and sediment

Beneficial ecosystem services of aquatic vegetation **include carbon storage at the landscape scale**

**Dense beds can block sediment**

- This prevents marsh land elevations from keeping pace with rising water levels, **threatening resilience to sea-level rise**
- Increased water clarity can lead to **enhanced predation of native fish** by non-native fish species




From: Christman et al. 2023

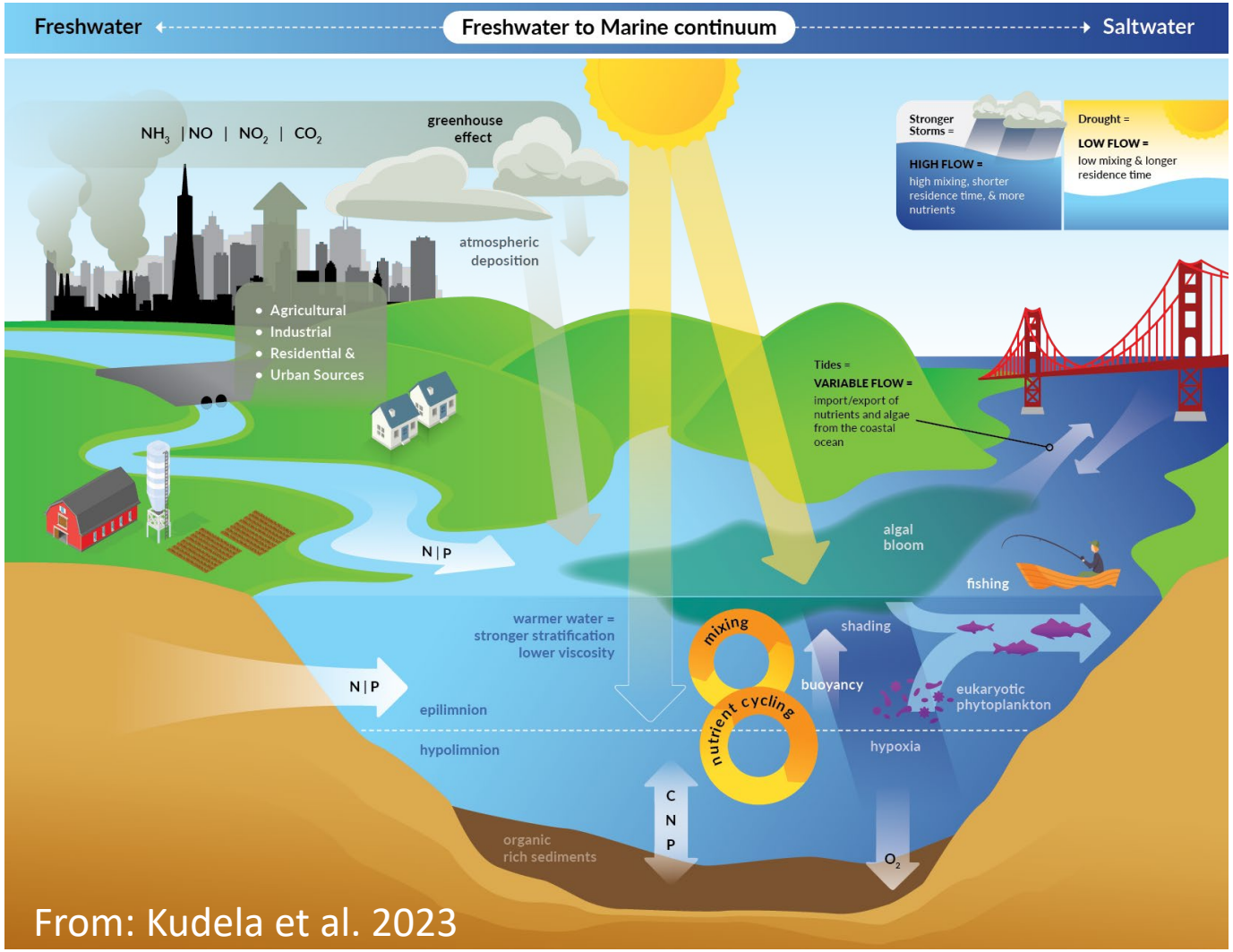
# Harmful Algal Blooms Along the Freshwater to Marine Gradient

**Potentially harmful organisms have long been present**

**Harmful algal blooms (HABs)** and associated toxins have emerged as a concern relatively recently

- This chapter summarizes what is known for **environmental drivers of HABs along the freshwater to marine continuum**

Monitoring and mitigation in a changing climate requires better **coordination** among researchers and agencies and a **focus** on restoring/ maintaining ecosystem resilience.




From: Kudela et al. 2023

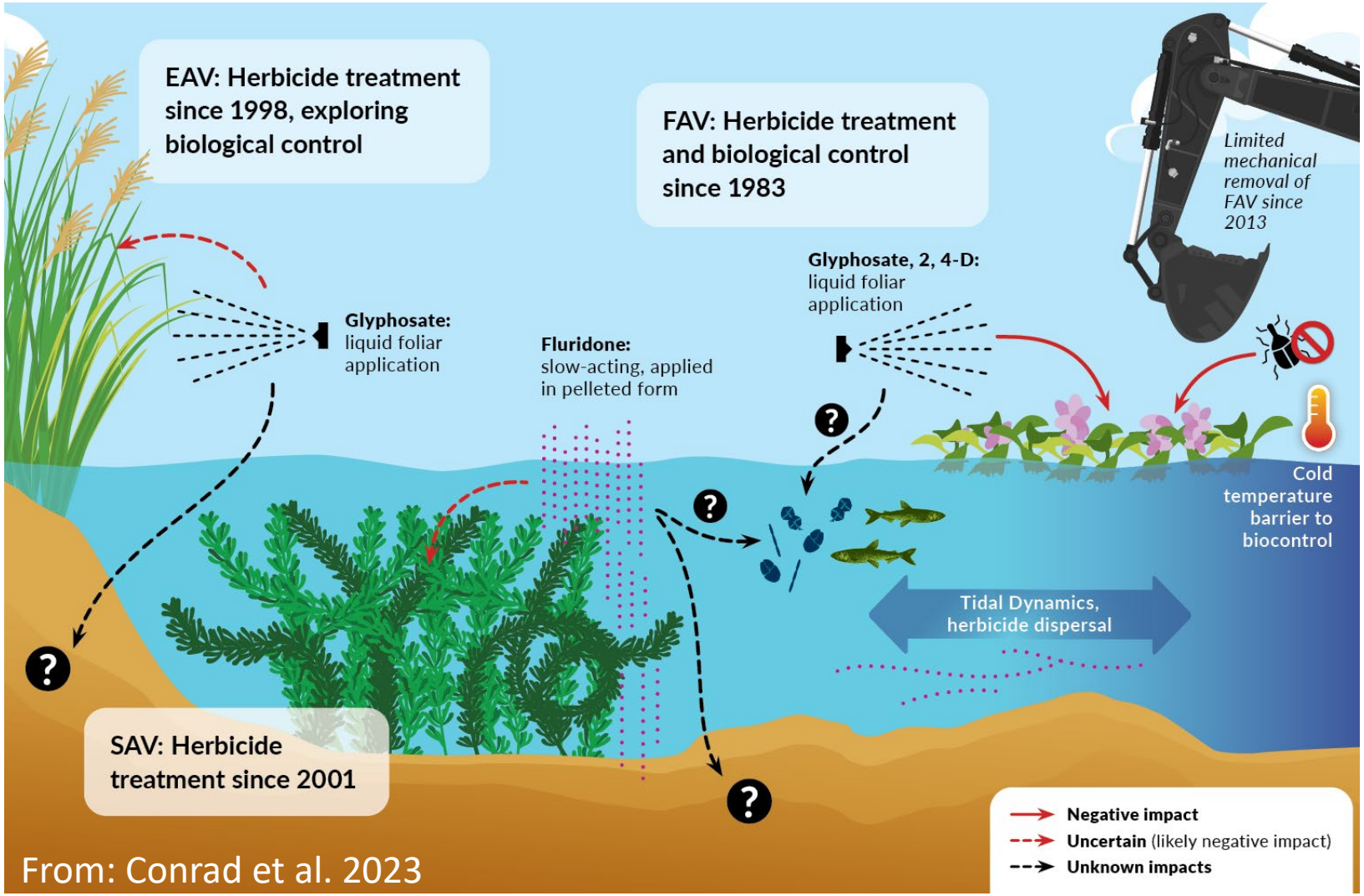
# Invasive Aquatic Vegetation Control

**$12.5 million/year** is spent on invasive weed control in the Delta

The **science is nascent** for assessing target and non-target impacts of control efforts

**Setting quantitative targets** informed by social and ecological assessments is critical

A **robust monitoring** program is lacking



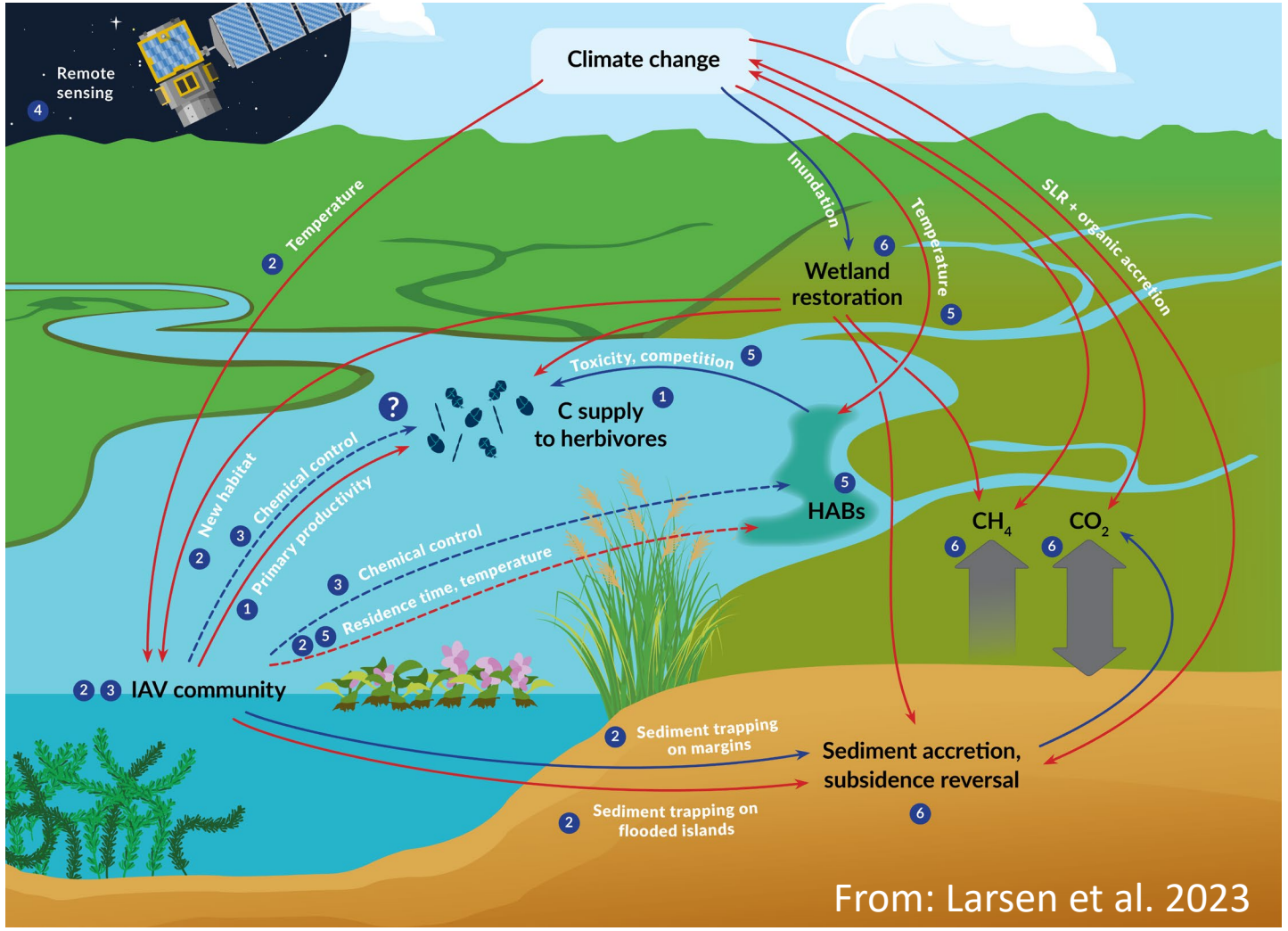

From: Conrad et al. 2023

# SBDS 2022: Release dates and upcoming outreach

**San Francisco Estuary and Watershed Science Journal – Volume 20, Issue 4**

**Upcoming this spring:**

- Lay summary of all chapters (in progress, anticipated release March 2023)
- "Ask Me Anything" about SBDS with Dr. Laurel Larsen
- Lunch seminars with SBDS 2022 authors



# SBDS 2024: Extreme Events

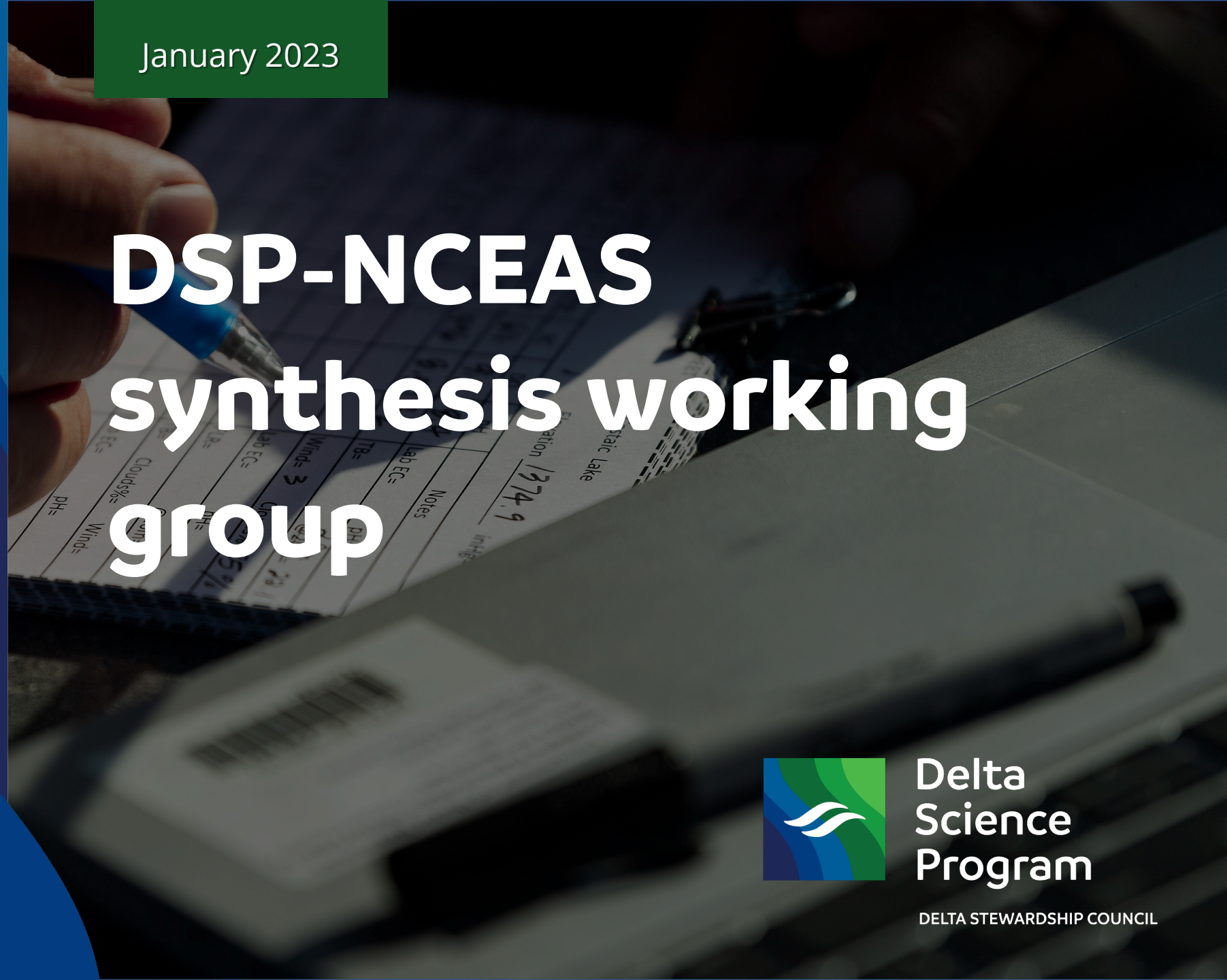
**“Extreme climatic and weather events affecting the California Delta, San Francisco Bay and watershed”**

**5 individual articles focus on:**

- Droughts
- Atmospheric rivers and floods
- Heat waves
- Catastrophic wildfires and impacts to water quality
- Governance

January 2023

# DSP-NCEAS synthesis working group



Delta Science Program

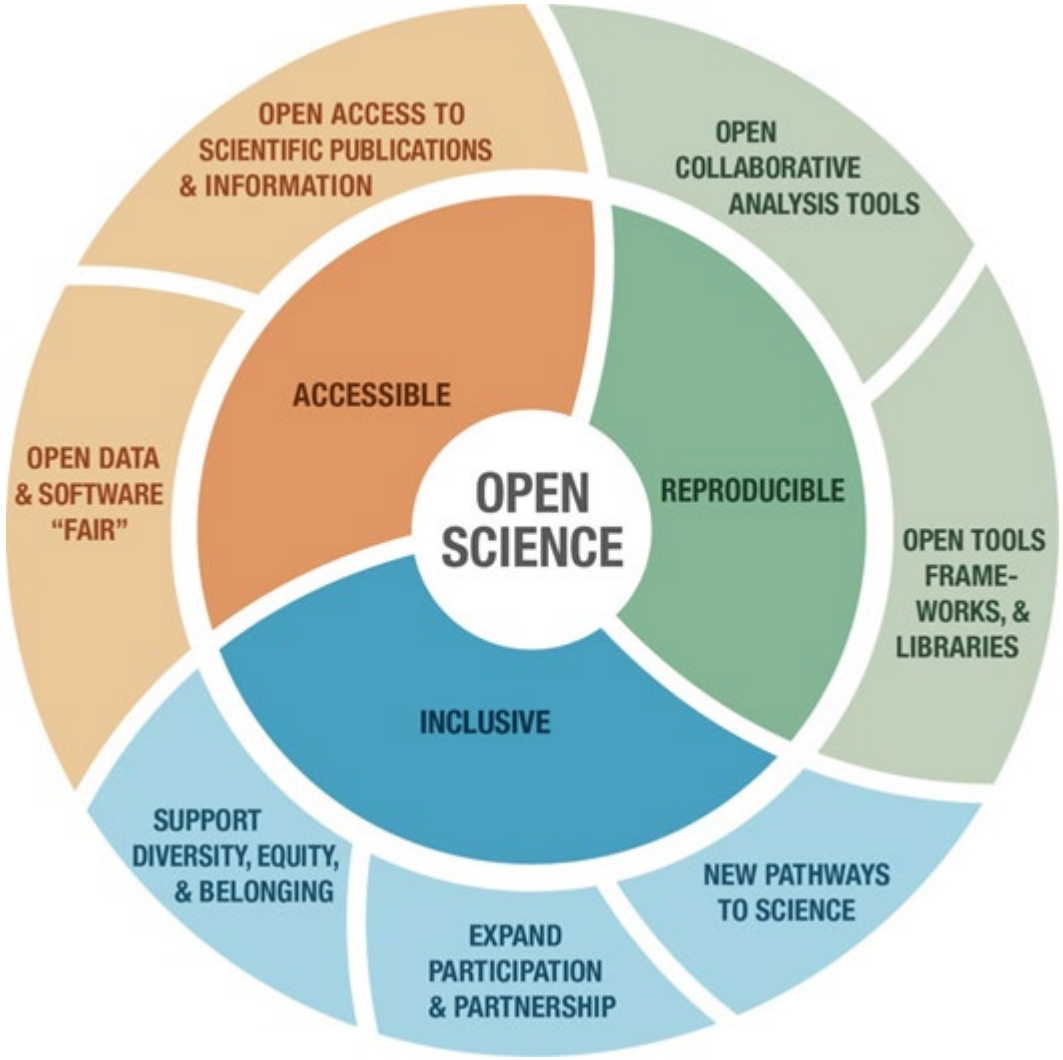
DELTA STEWARDSHIP COUNCIL

## Why is this synthesis working group important?

- Synthesis is a critical component of **ecosystem-based management** and **informed decision-making**, both of which are tools for achieving the **coequal goals**.
- The **need for increased capacity, dedicated time, and coordinated synthesis is widely recognized** and included as an action in the Delta Science Plan, Science Action Agenda, and Interagency Ecological Program Science Strategy.

# What was the 2021 synthesis working group?

- This effort, led by the Delta Science Program in partnership with the National Center for Ecological Analysis and Synthesis (NCEAS), provided innovative and **high-quality training** in data science and statistics and an **opportunity for enhanced collaboration** among agency and academic scientists in a focused working group in fall 2021.
- The ongoing synthesis projects supplied an **immediate use of those newly acquired skills** to synthesis available data and produce relevant research.




*earthdata.nasa.gov*

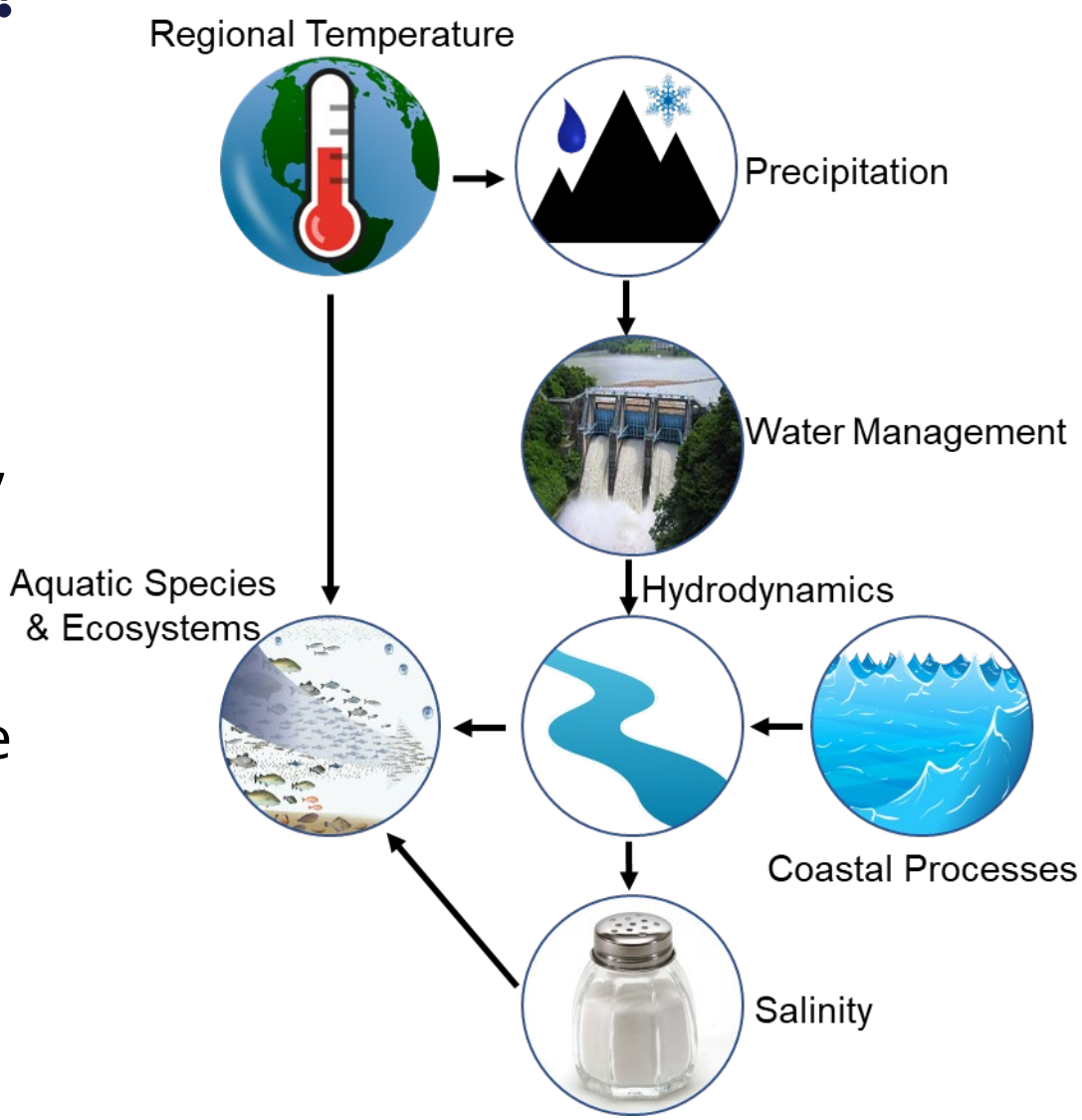
# Who participated?

- 18 participants from 9 agencies and universities
  - Experience in the statistical computer language R
  - 3 DSP staff served as leads and ensure continuity and delivery of products
- 3-week hybrid event in September, October, and November 2022, with ongoing synthesis subgroups

# What was the synthesis topic?

- Drivers of the Estuary Food Supply
- Goals: (1) to improve predictions biological communities, (2) serve broad interagency goals, such as ecosystem function, resilience, and sustainability, and (3) guide investments in restoration, species recovery, management of invasive species, and inform targeted flow actions.

1. How flood management influences the aquatic food supply?
2. What drives pelagic food web dynamics?



# What was produced?



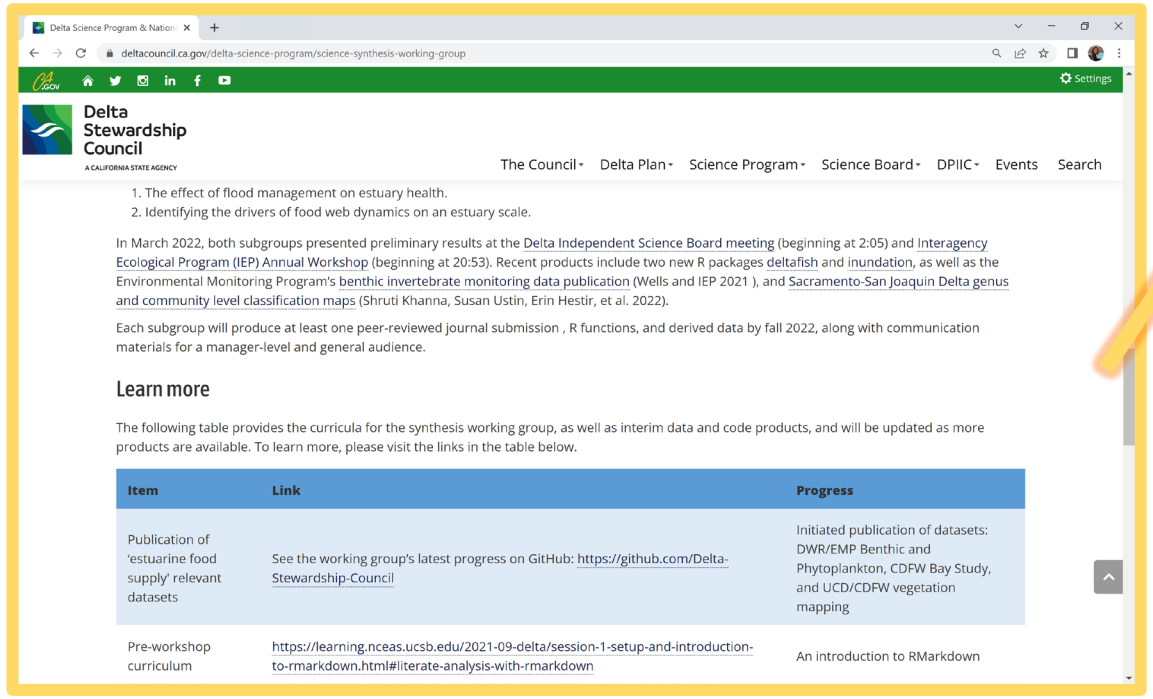
WEBPAGE
BRIEFINGS
& SOCIAL MEDIA

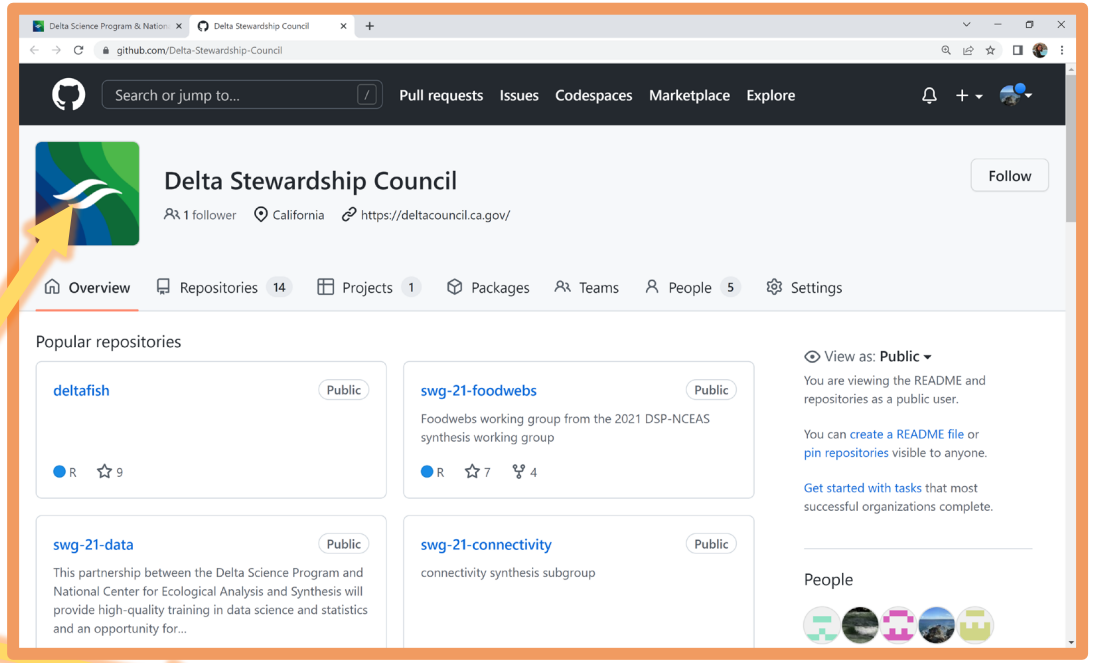
R CODE & DATA
PUBLICATIONS

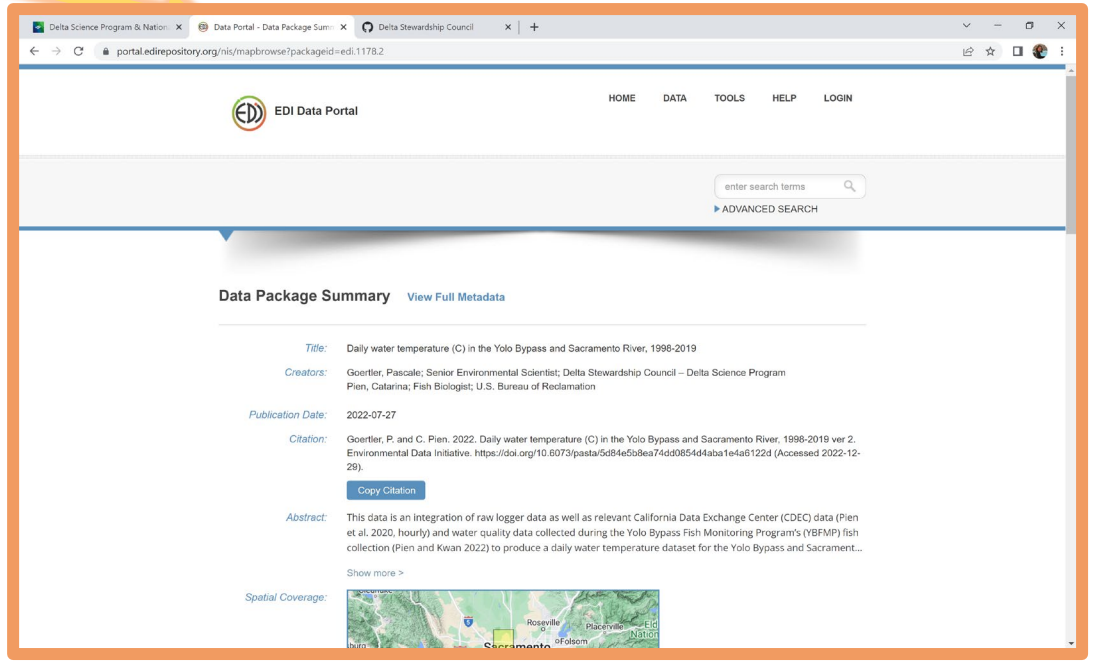
PEER-REVIEW
PUBLICATIONS

SURVEY
EVALUATION

# What was produced?



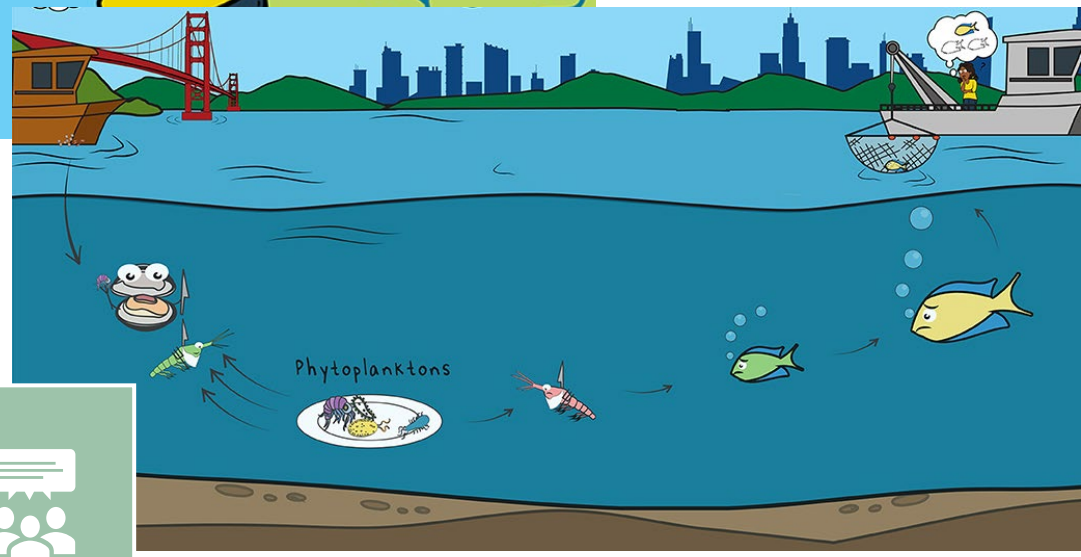

**WEBPAGE BRIEFINGS & SOCIAL MEDIA**

**R CODE & DATA PUBLICATIONS**

**https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group**

# What was produced?

1. How flood management influences the aquatic food supply?
2. What drives pelagic food web dynamics?




*Twardochleb et al. 2022.*
*Winder et al. 2022.*
*Frontiers for Young Minds*

**WEBPAGE BRIEFINGS & SOCIAL MEDIA**

**R CODE & DATA PUBLICATIONS**

**PEER-REVIEW PUBLICATIONS**

# What was produced?

- Prior to this activity most individuals had not participated in large research collaborations.
- By the end of the activity, participants reported greater confidence in management of collaborative research.
- Participants reported high levels of professional development in synthesis research skills, professional networking skills and collaboration skills.
- Learning and applying GitHub as a collaboration tool emerged as an area of high value to participants.

Figure 25. Free text responses to the survey question: What is the most valuable thing you learned?


WEBPAGE BRIEFINGS & SOCIAL MEDIA

R CODE & DATA PUBLICATIONS

PEER-REVIEW PUBLICATIONS

SURVEY EVALUATION

# What is being proposed for 2023?

- This working group will focus on expanding multi-benefit approaches to managing the Delta as a **social-ecological system** and investigate the **integration of human dimension data** into research and management decision making (Science Action Agenda, Management Need 3).
- This may include the development of integrated frameworks, data visualization tools, and models of the Delta social-ecological system that evaluate,
    1. how ecosystem restoration projects benefit and burden human communities, with an emphasis on environmental justice,
    2. the costs and benefits of different strategies for managing invasive species while balancing recreational uses, and
    3. the sensitivity of social metrics to different socio-political or environmental scales.

# Thank you

Connect with us

Scan the QR code to subscribe to our listserv

Deltacouncil.ca.gov

@DeltaCouncil

@deltastewardshipcouncil

Delta Stewardship Council

@deltastewardshipcouncil