

January 2023

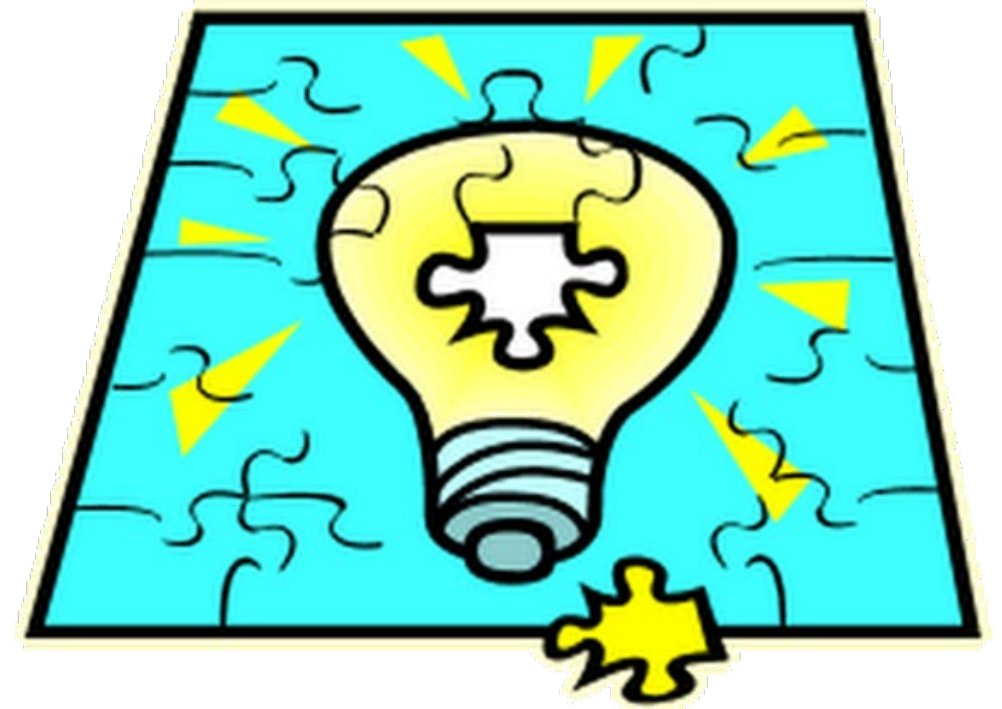
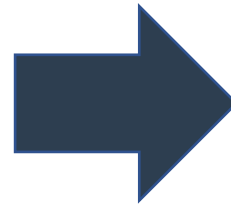
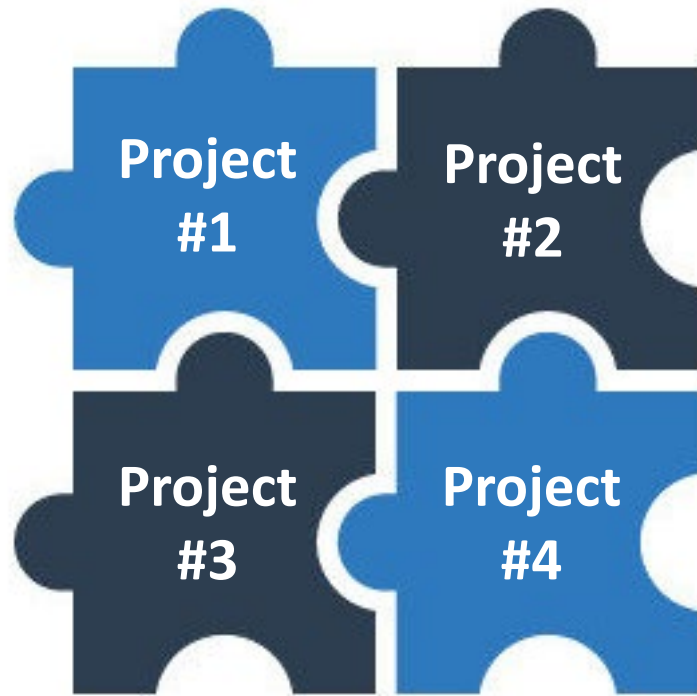
Delta Science Program Scientific Synthesis



Delta
Stewardship
Council

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What is scientific synthesis?

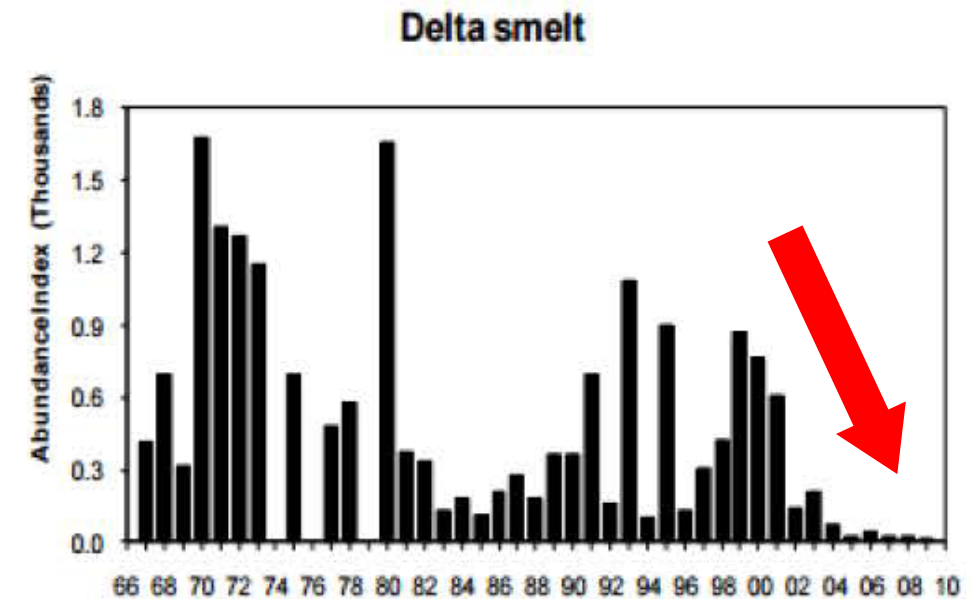


The process of combining
disparate data, information...

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

Why does synthesis matter?

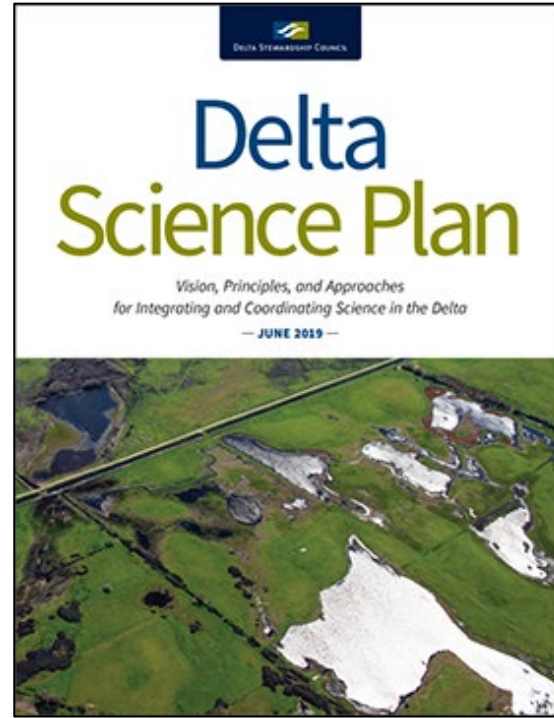
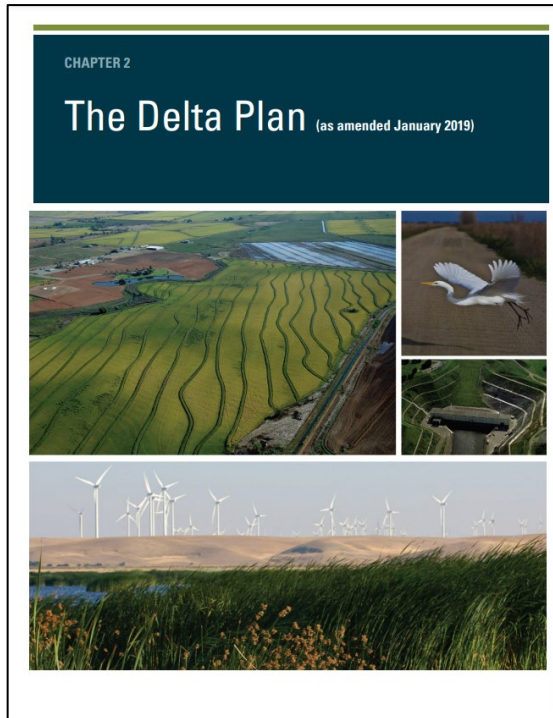
- **Critical to decision-making**
 - “Pelagic Organism Decline” synthesis led to changes in management
 - Delta Plan Ecosystem Amendment
- **The Delta is data-rich**
 - Scientific monitoring started in 1960s
- **Cost-effective**
 - 4% (or \$4.4M) of all FY20-21 Science Expenditures (Delta Budget Crosscut)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



Baxter et al. 2010

Why does DSP do synthesis?

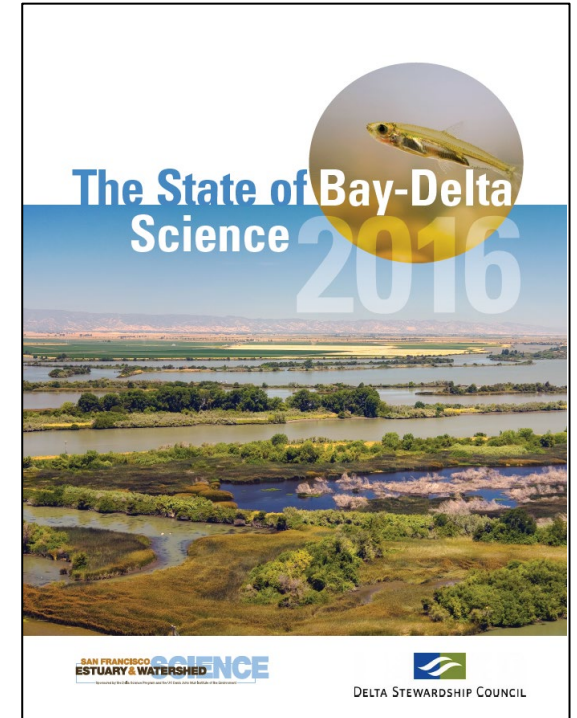
Delta Science Strategy



HOW we do science...



WHAT science we prioritize...



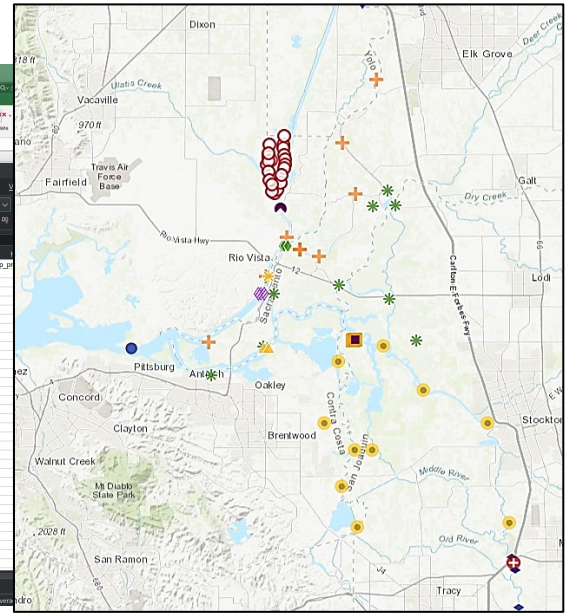
WHAT we've learned...

Types of synthesis led by DSP

- **Knowledge-driven:**
 - State of Bay-Delta Science
 - Synthesis Workshops
- **Data-driven:**
 - NCEAS and Delta Science Program
 - “Shiny” applications



File	Lowness	Range	True_Peak	True_Peak_dBTP	Reference	Wd_clip_clip
1.01 dual existence fac	-5.38 LUPS	5.45 dB	1.0576040.40	-18.00 LUPS	N	N
1.02 New Blue fac	-5.38 LUPS	4.29 dB	1.07017.06	-18.00 LUPS	N	N
1.03 final phase fac	-4.80 LUPS	5.89 dB	1.078115.64	-18.00 LUPS	N	N
1.04 BLACKFOX fac	-4.77 LUPS	3.84 dB	1.06004.04	-18.00 LUPS	N	N
1.05 when chance strikes fac	-4.47 LUPS	2.82 dB	1.101115.04	-18.00 LUPS	N	N
1.06 Love with You fac	-5.80 LUPS	2.56 dB	1.120507.00	-18.00 LUPS	N	N
1.07 Edge of the Universe fac	-5.70 LUPS	2.80 dB	1.18787.57	-18.00 LUPS	N	N
1.08 under a start sky fac	-5.87 LUPS	2.04 dB	1.131239.07	-18.00 LUPS	N	N
1.09 chene central fac	-5.80 LUPS	3.46 dB	1.21837.17	-18.00 LUPS	N	N
1.10 hitting bites fac	-5.40 LUPS	1.99 dB	1.181245.30	-18.00 LUPS	N	N
1.11 crossroads fac	-4.90 LUPS	3.32 dB	1.154503.14	-18.00 LUPS	N	N
1.12 sky crossroads version fac	-4.52 LUPS	5.44 dB	1.03327.08	-18.00 LUPS	N	N
1.13 sky crossroads fac	-4.84 LUPS	3.46 dB	1.101120.04	-18.00 LUPS	N	N
1.14 The end of escape impled edition fac	-5.80 LUPS	2.43 dB	1.277471.13	-18.00 LUPS	N	N
1.15 white force -103 edition - fac	-4.80 LUPS	8.52 dB	1.12827.16	-18.00 LUPS	N	N
1.16 1000 - schenckman - 033 version fac	-4.80 LUPS	5.07 dB	1.22398.17	-18.00 LUPS	N	N
1.17 Two roads - toward the truth - fac	-5.53 LUPS	5.44 dB	1.061095.02	-18.00 LUPS	N	N
1.18 magnum - westside - fac	-5.41 LUPS	4.40 dB	1.180031.44	-18.00 LUPS	N	N
1.19 Lumina fac	-5.38 LUPS	3.20 dB	1.055682.07	-18.00 LUPS	N	N
1.20 infinite synthesis fac	-4.53 LUPS	9.40 dB	1.225543.17	-18.00 LUPS	N	N
1.21 black bullet fac	-5.91 LUPS	3.06 dB	1.186205.18	-18.00 LUPS	N	N
1.22 eternal reality fac	-5.20 LUPS	4.13 dB	1.211090.10	-18.00 LUPS	N	N
1.23 sister's noise fac	-5.47 LUPS	4.56 dB	1.088992.02	-18.00 LUPS	N	N
1.24 Decade fac	-4.80 LUPS	5.07 dB	1.207430.06	-18.00 LUPS	N	N
1.25 Neutron Snow fac	-7.83 LUPS	8.80 dB	1.222901.17	-18.00 LUPS	N	N
1.26 way to answer fac	-5.20 LUPS	3.59 dB	1.284512.17	-18.00 LUPS	N	N
1.27 known is a Place On Earth fac	-4.90 LUPS	3.68 dB	1.188283.17	-18.00 LUPS	N	N
1.28 future great fac	-5.32 LUPS	5.85 dB	1.162773.13	-18.00 LUPS	N	N
1.29 LEV3-juggler fac	-4.80 LUPS	5.28 dB	1.042360.40	-18.00 LUPS	N	N
1.30 only my intaps fac	-5.00 LUPS	5.00 dB	1.270945.08	-18.00 LUPS	N	N
1.31 Album	-5.73 LUPS	5.65 dB	1.284512.17	-18.00 LUPS	N	N



Jan 2023

State of Bay-Delta Science 2022



Delta
Science
Program

DELTA STEWARDSHIP COUNCIL

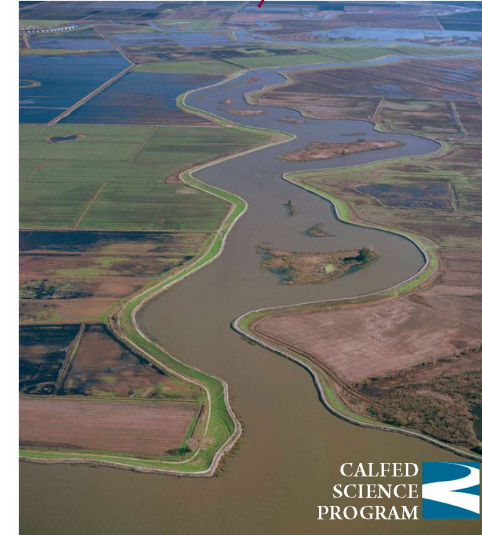
What is SBDS?

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

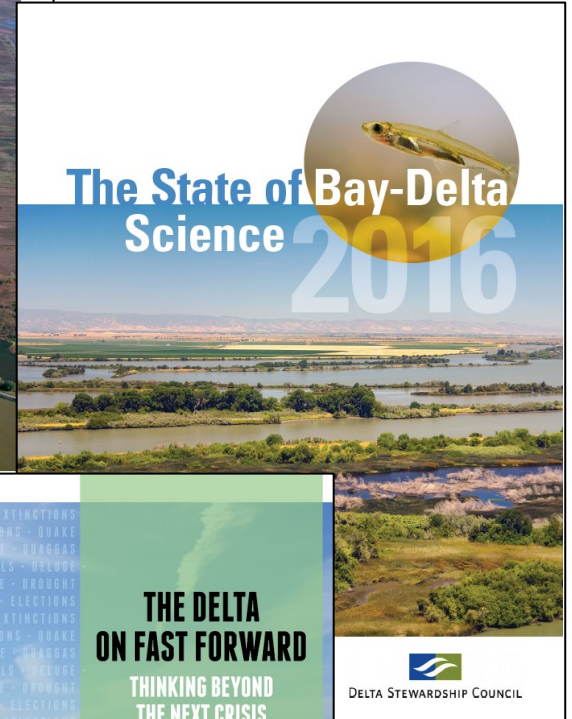
3 completed editions (2008, 2016, 2022)
with > 30 publications

Future editions released every ~2 years

The State of Bay-Delta Science



The State of Bay-Delta Science



THE DELTA ON FAST FORWARD THINKING BEYOND THE NEXT CRISIS

PERSPECTIVES ON
THE STATE OF BAY-DELTA SCIENCE
FALL 2016



“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

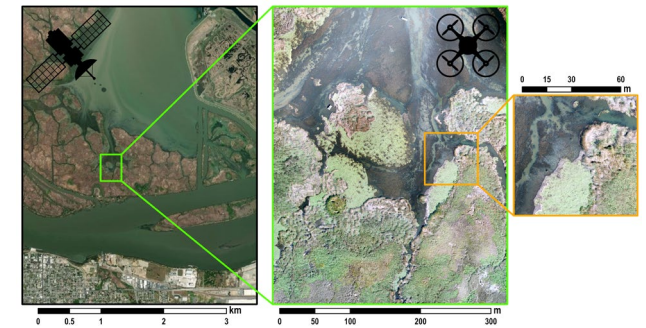


4 The History and Science of Control Efforts

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

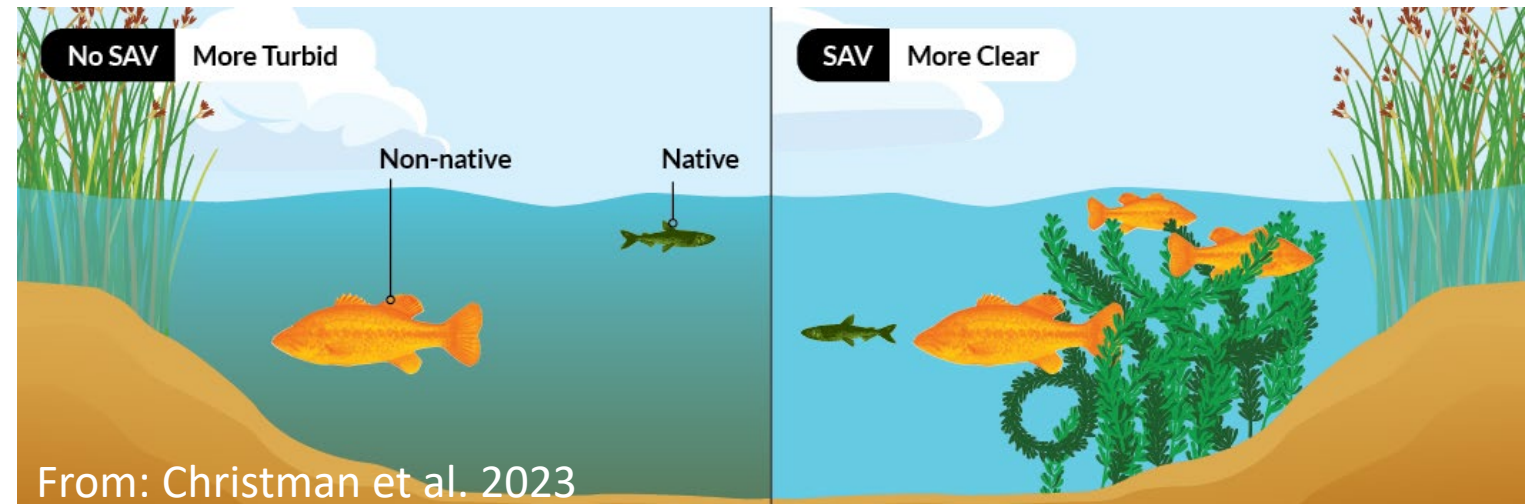
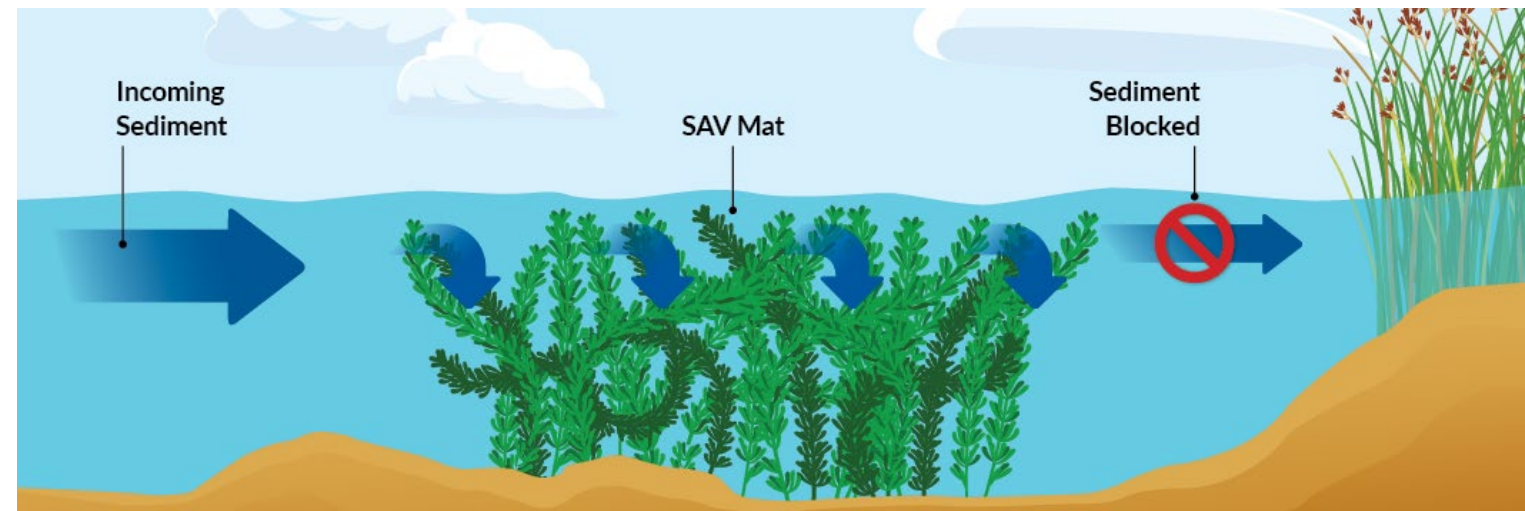


Ecosystem services and disservices: Carbon and sediment

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

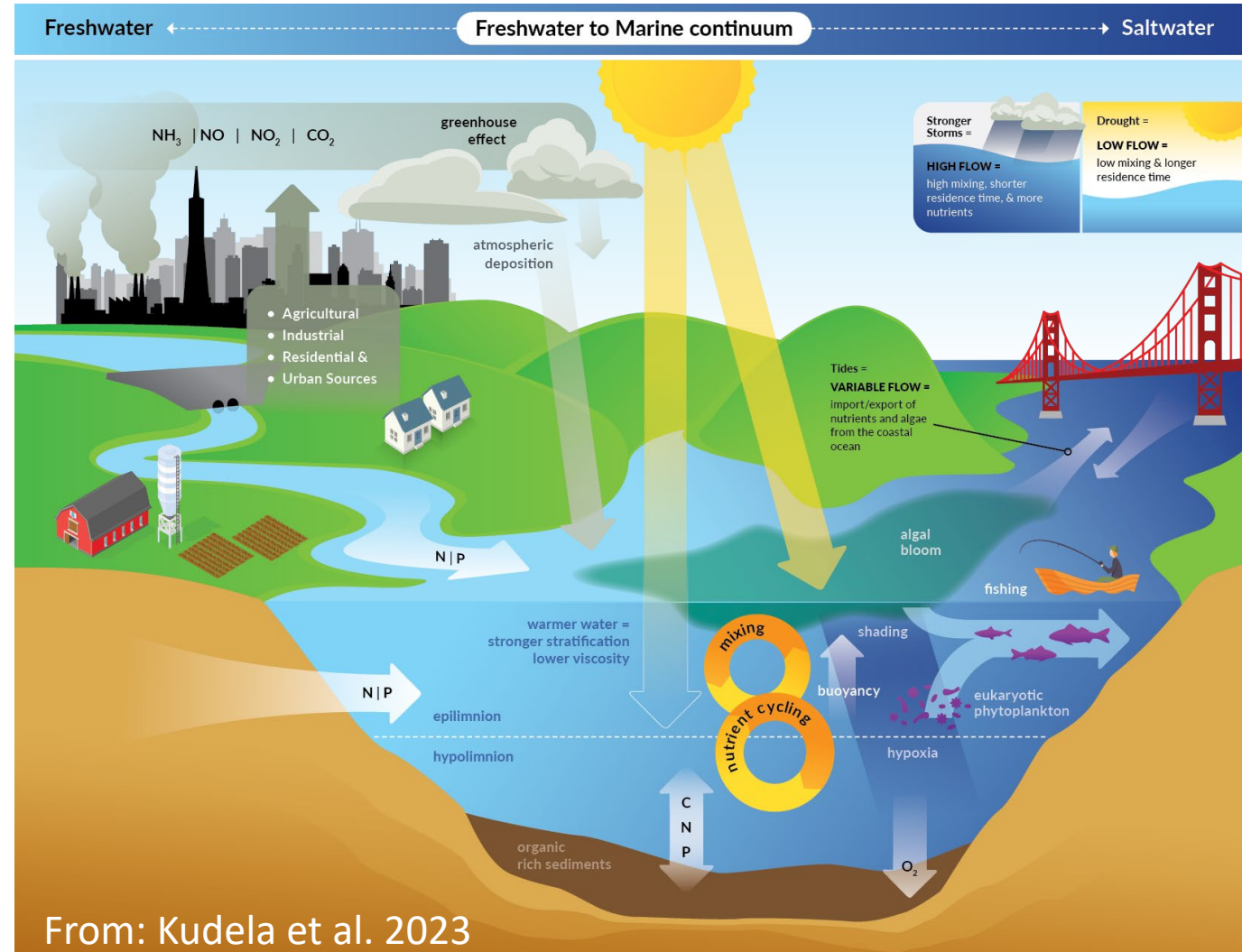
Harmful Algal Blooms Along the Freshwater to Marine Gradient

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.



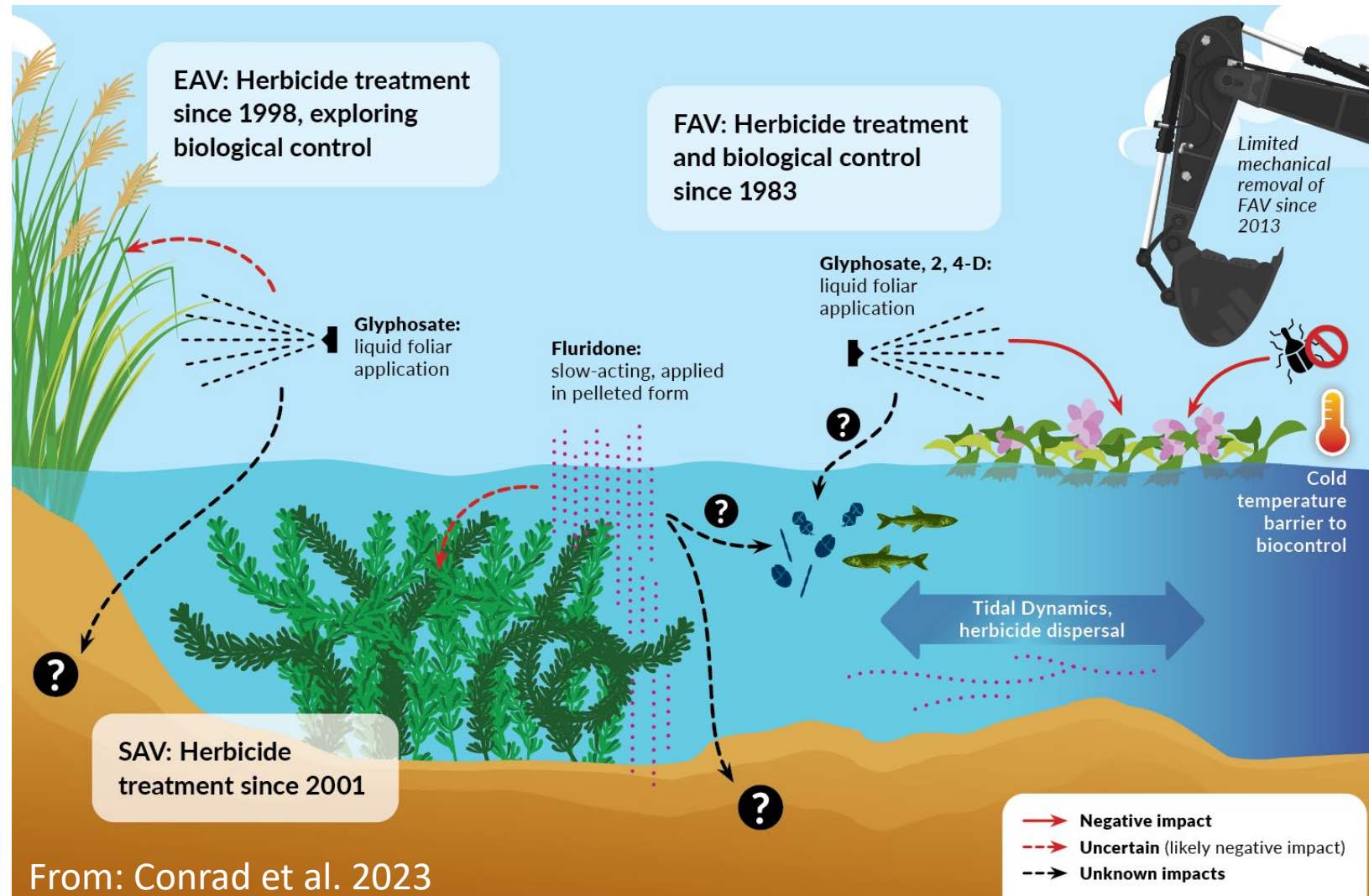
Invasive Aquatic Vegetation Control

\$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

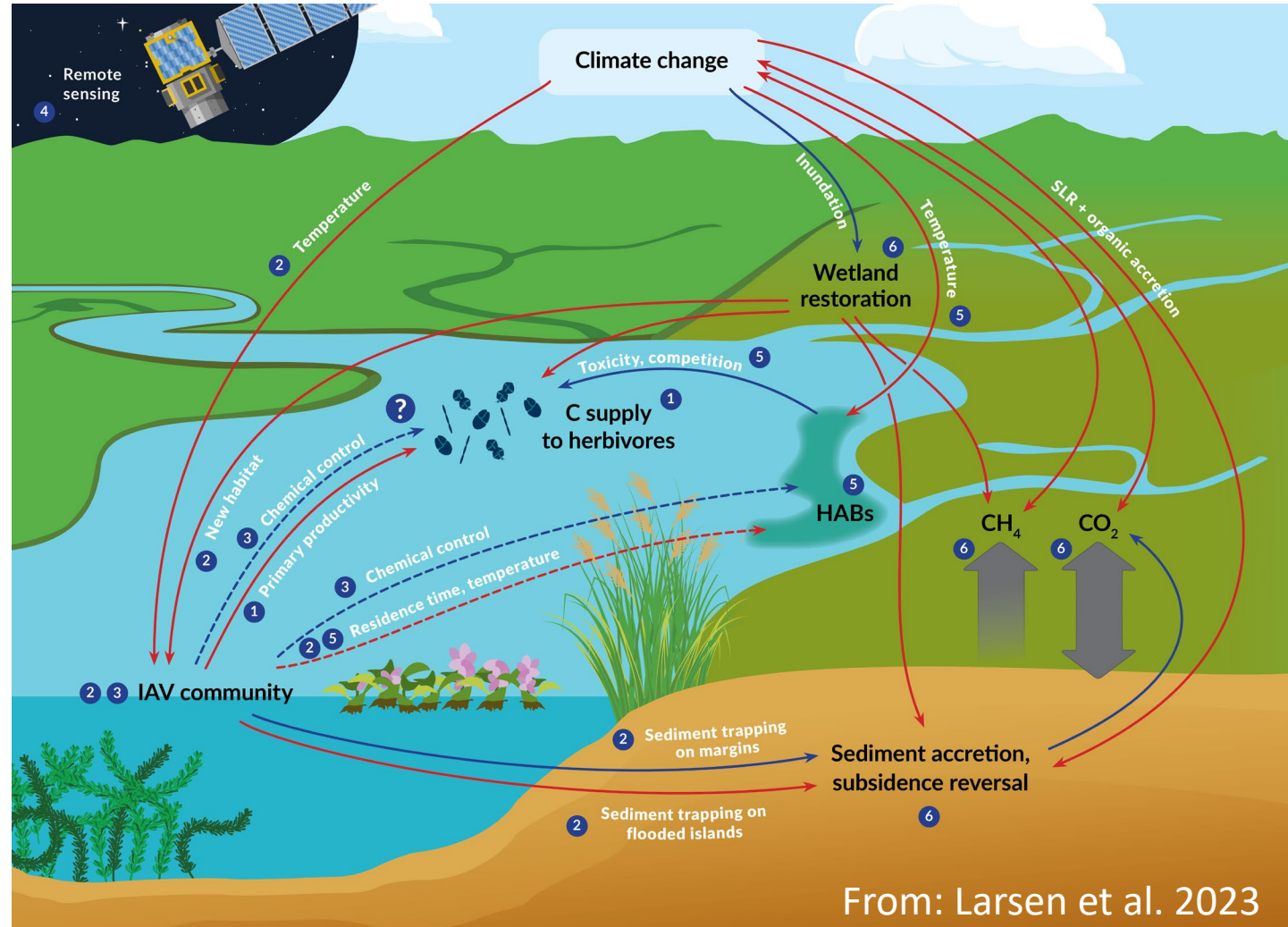


SBDS 2022: Release dates and upcoming outreach

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



From: Larsen et al. 2023

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



Photo credit: DWR

January 2023

DSP-NCEAS synthesis working group



Delta
Science
Program

DELTA STEWARDSHIP COUNCIL

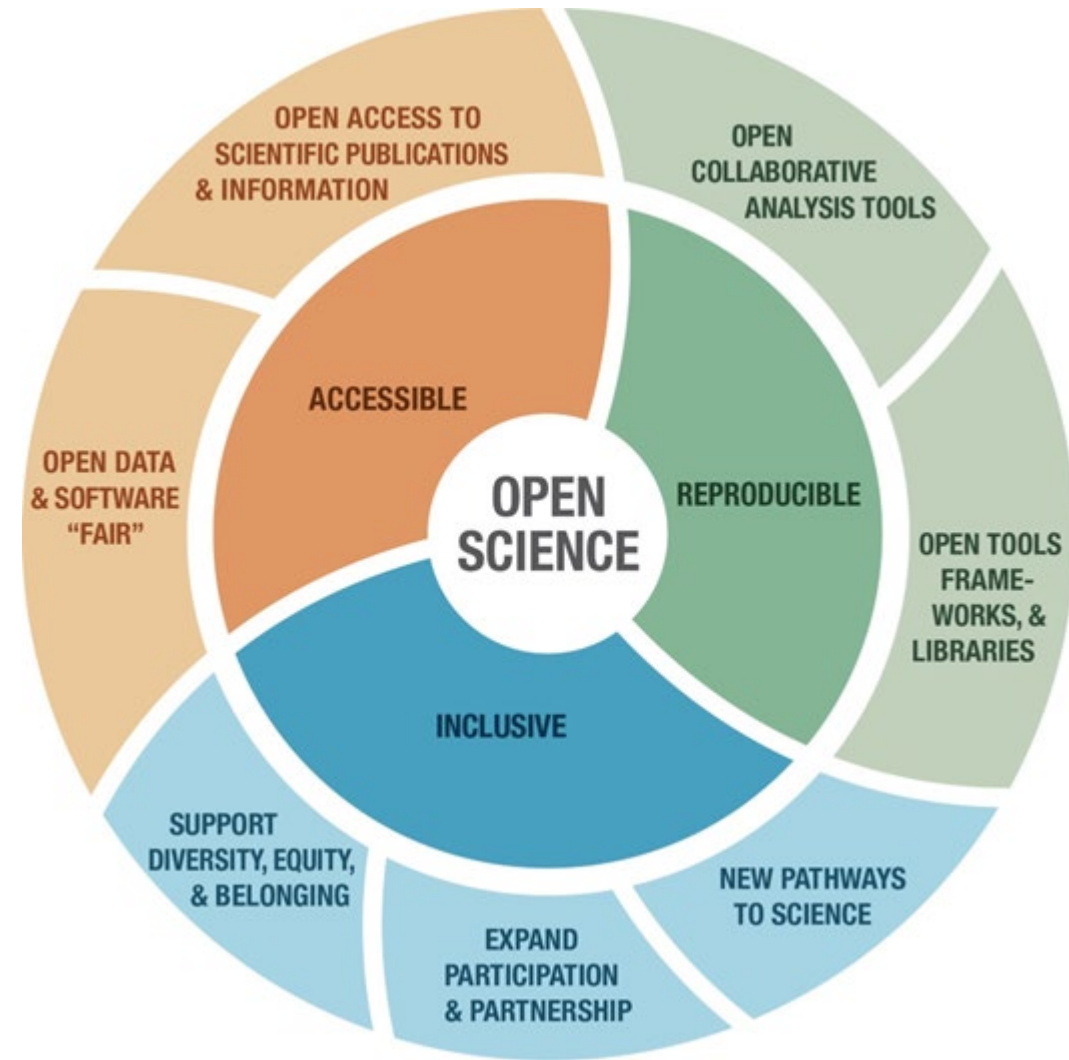
Why is this synthesis working group important?

- 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.



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



— BUREAU OF —
RECLAMATION



UC DAVIS
UNIVERSITY OF CALIFORNIA



**NOAA
FISHERIES**



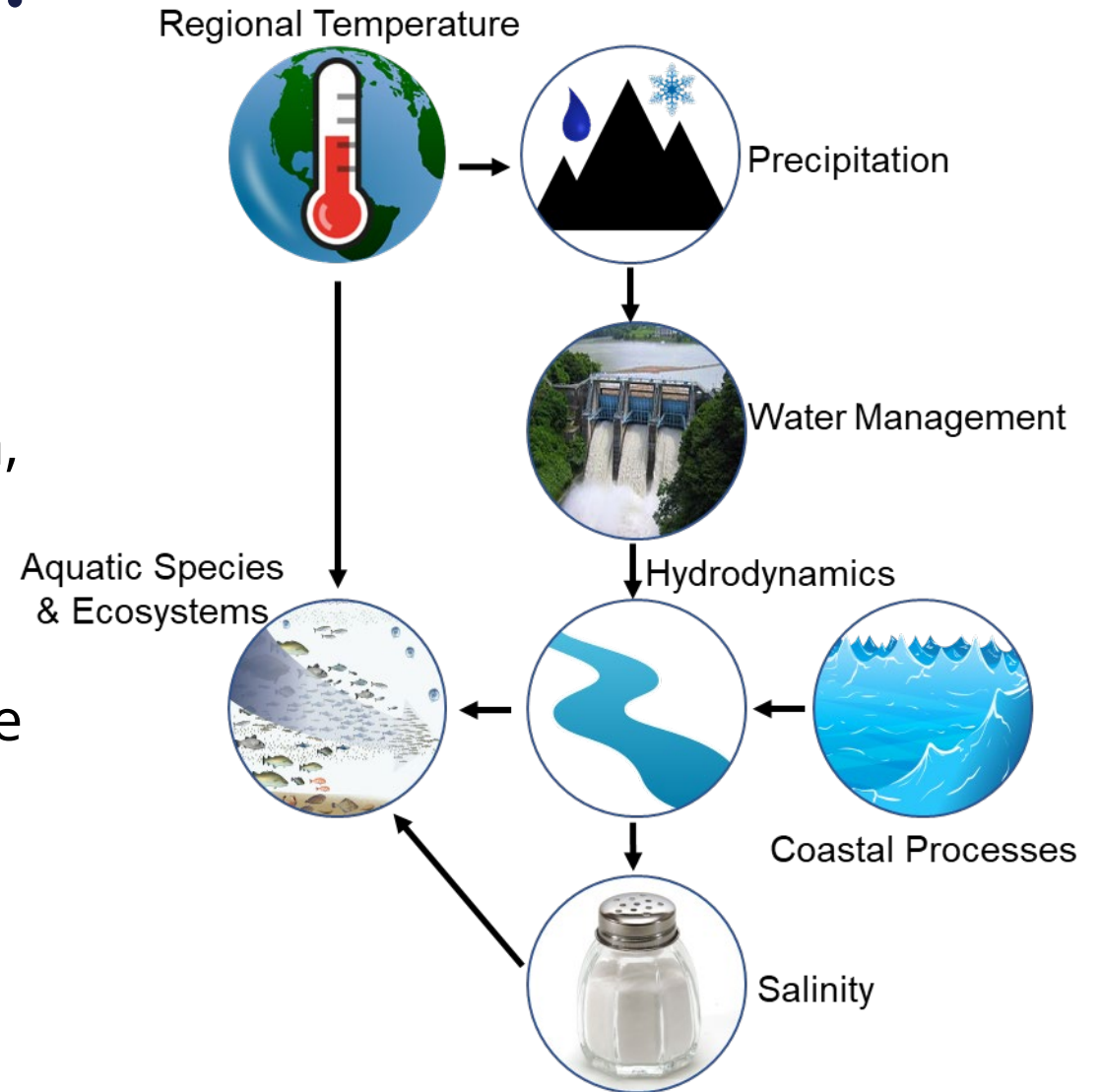
**Delta
Stewardship
Council**
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UC SANTA CRUZ



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**

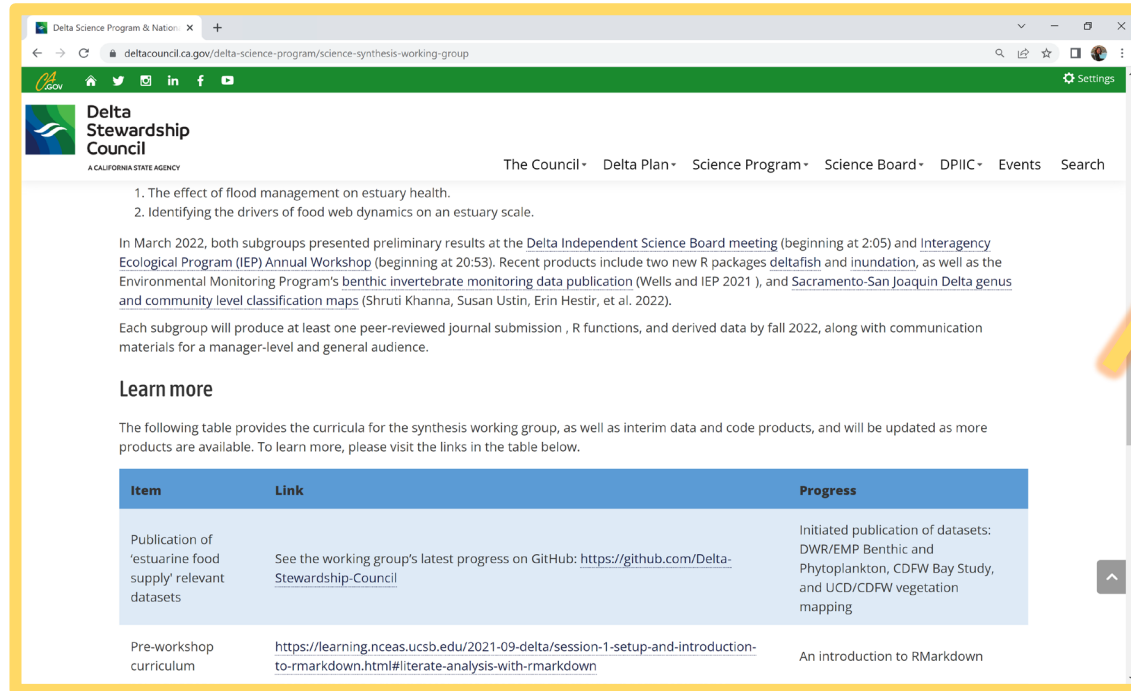


**PEER-REVIEW
PUBLICATIONS**



**SURVEY
EVALUATION**

What was produced?



The screenshot shows the Delta Stewardship Council website. The header includes the council's logo and navigation links: The Council, Delta Plan, Science Program, Science Board, DPIC, Events, and Search. The main content area lists two topics: "1. The effect of flood management on estuary health." and "2. Identifying the drivers of food web dynamics on an estuary scale." Below this, a paragraph describes preliminary results from a March 2022 meeting. A "Learn more" section follows, with a table providing a curriculum for the synthesis working group.

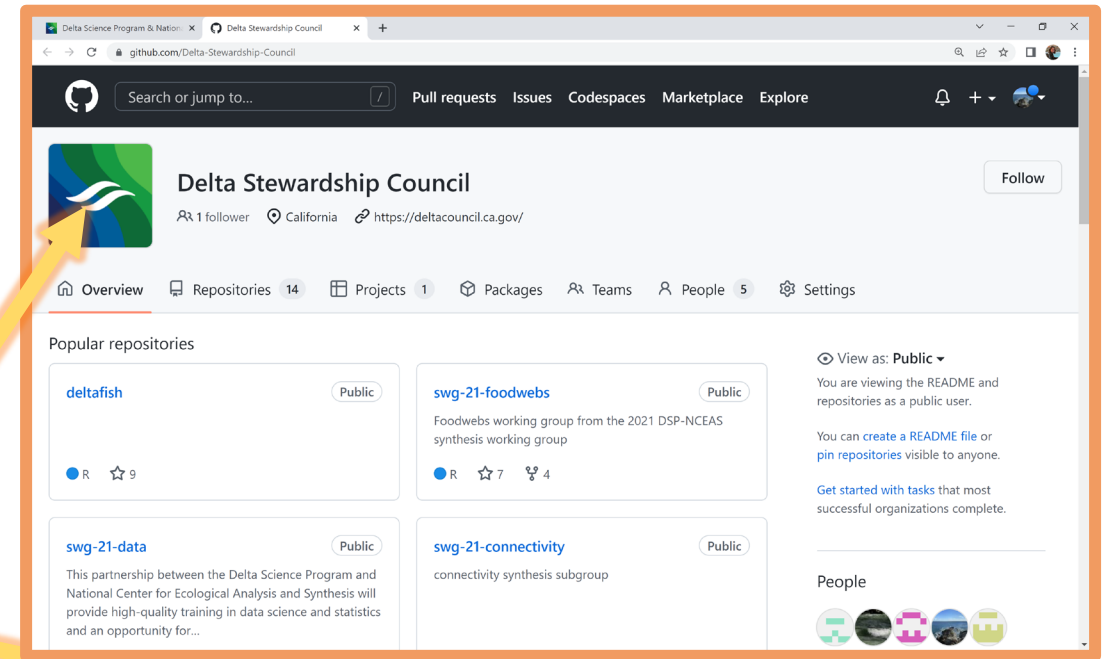
Item	Link	Progress
Publication of 'estuarine food supply' relevant datasets	See the working group's latest progress on GitHub: https://github.com/Delta-Stewardship-Council	Initiated publication of datasets: DWR/EMP Benthic and Phytoplankton, CDFW Bay Study, and UCD/CDFW vegetation mapping
Pre-workshop curriculum	https://learning.nceas.ucsb.edu/2021-09-delta/session-1-setup-and-introduction-to-rmarkdown.html#iterate-analysis-with-rmarkdown	An introduction to RMarkdown



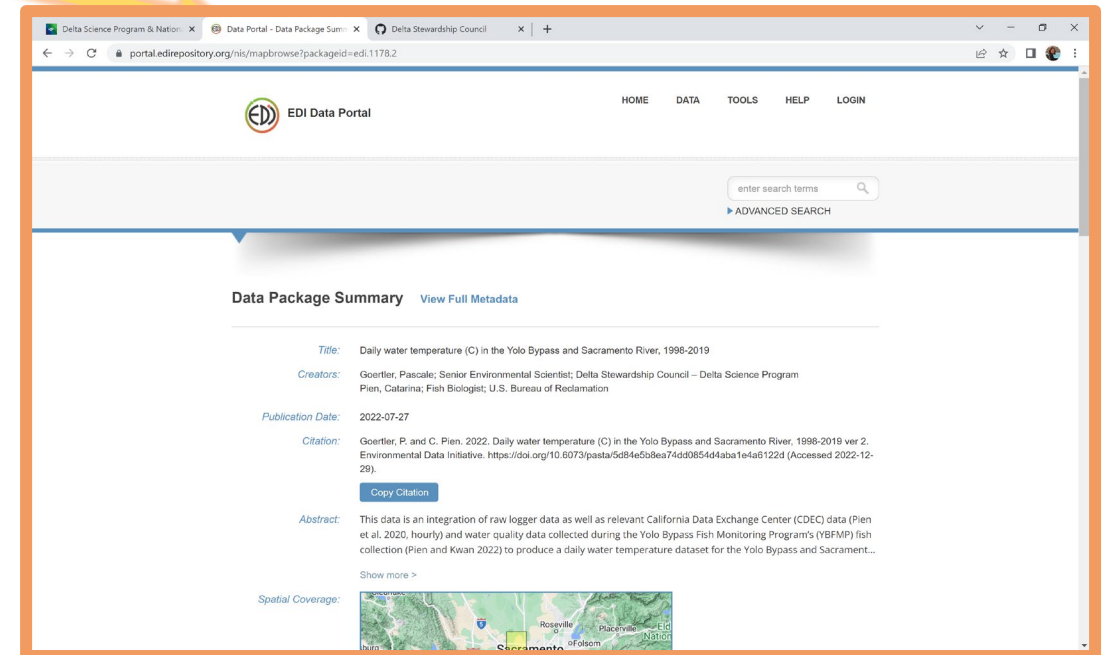
WEBPAGE
BRIEFINGS
& SOCIAL MEDIA



R CODE & DATA
PUBLICATIONS



The screenshot shows the Delta Stewardship Council GitHub profile. The header includes the council's logo, name, and a "Follow" button. Below the header, there are tabs for Overview, Repositories (14), Projects (1), Packages, Teams, People (5), and Settings. The "Popular repositories" section lists four repositories: "deltafish", "swg-21-foodwebs", "swg-21-data", and "swg-21-connectivity". Each repository has a "Public" label and a star count. The "swg-21-data" repository has a description: "This partnership between the Delta Science Program and National Center for Ecological Analysis and Synthesis will provide high-quality training in data science and statistics and an opportunity for..."



The screenshot shows the EDI Data Portal. The header includes the EDI logo and navigation links: HOME, DATA, TOOLS, HELP, and LOGIN. Below the header, there is a search bar and an "ADVANCED SEARCH" link. The main content area displays a "Data Package Summary" for a dataset titled "Daily water temperature (C) in the Yolo Bypass and Sacramento River, 1998-2019". The summary includes the creators (Goertler, Pascale; Senior Environmental Scientist; Delta Stewardship Council - Delta Science Program; Pien, Catarina; Fish Biologist; U.S. Bureau of Reclamation), the publication date (2022-07-27), the citation (Goertler, P. and C. Pien. 2022. Daily water temperature (C) in the Yolo Bypass and Sacramento River, 1998-2019 ver 2. Environmental Data Initiative. <https://doi.org/10.6073/pasta/5d84e5b8ea74dd985444aba1e4a6122d> (Accessed 2022-12-26)), and the abstract (This data is an integration of raw logger data as well as relevant California Data Exchange Center (CDEC) data (Pien et al. 2020, hourly) and water quality data collected during the Yolo Bypass Fish Monitoring Program's (YBMP) fish collection (Pien and Kwan 2022) to produce a daily water temperature dataset for the Yolo Bypass and Sacramento...). A "Copy Citation" button is also present. The "Spatial Coverage" section shows a map of the Yolo Bypass and Sacramento River area.

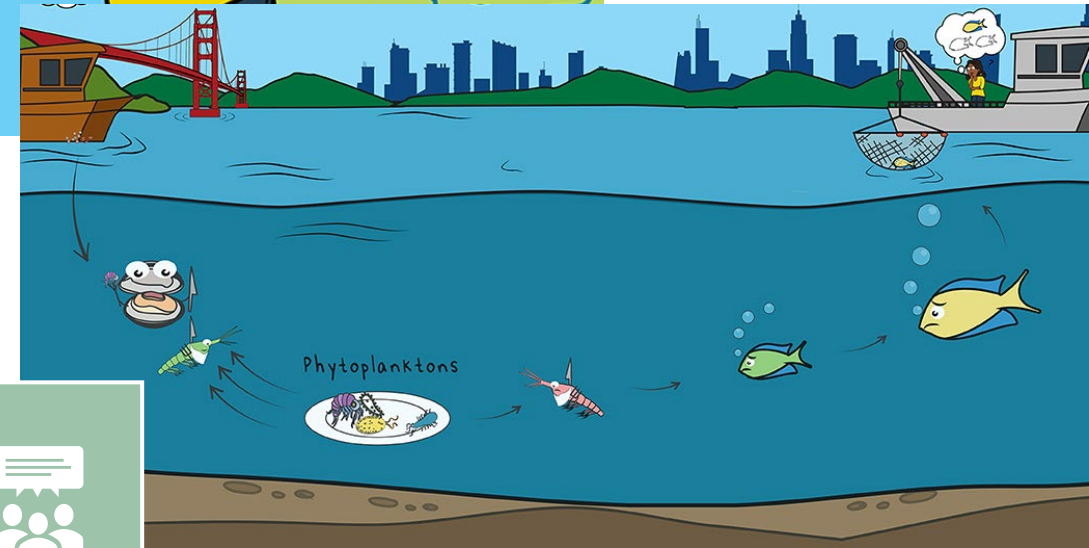
<https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group>

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.

WEBPAGE BRIEFINGS & SOCIAL MEDIA



R CODE & DATA PUBLICATIONS



PEER-REVIEW PUBLICATIONS



SURVEY EVALUATION

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



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.



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