



APRIL 2023

Delta Breeze

A newsletter by the Delta Science Program

Delta Lead Scientist “Dear Colleagues”



Earth Day is all about how people interact with the planet: both how we impact it and how we can care for it. In celebration of Earth Week, this issue of the Delta Breeze highlights efforts at the Delta

Stewardship Council to better connect people to the science and management of the Sacramento- San Joaquin Delta. One of the first things that a student of any water class in California learns is that **it is impossible to divorce water from people here**. Probably more of us can recall the map of California’s water infrastructure than that of its riverways. And the geography only scratches the surface. The Delta is often described as a “wicked problem,” alluding to the high degree of uncertainty and

What’s inside...

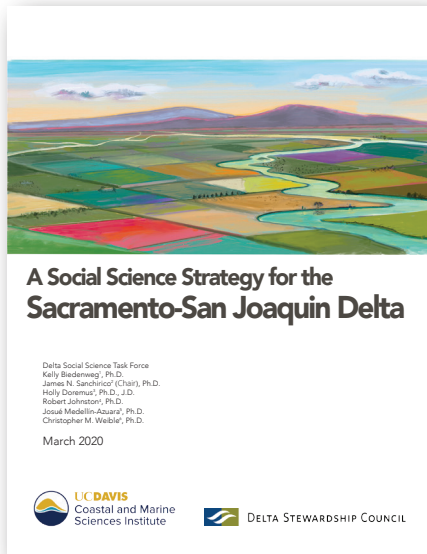
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**Delta
Science
Program**

DELTA STEWARDSHIP COUNCIL

divergent perspectives and values associated with management decisions. Water stewards are often at odds about how our most precious — and most mercurial — resource should be governed. Even when agreement is at hand, decisions must be navigated through the tangle of more than 100 agencies and interagency groups with jurisdiction over the region.



Given the importance of people to the Delta, it is rather surprising that, for decades, little funding has been dedicated to the social sciences. In recognition of this imbalance, the Delta Science Program convened a six-person, independent Social Science Task Force (SSTF) in 2018 to develop a strategy for strengthening and integrating social sciences into the science, management, and policy landscape. Following two years of work that included two workshops, reviews of strategic documents, and interviews, the SSTF produced a [strategy for the Delta](#). Motivated by the recognition that “overlooking the human component... often leads to unintended consequences and management ineffectiveness,” the report issues eight core recommendations associated with three main findings.

To implement these recommendations, the Council formed a Social Science Integration Team in 2020. **We dedicate this issue of the Delta Breeze Newsletter to the progress made because of this Team’s initiative.** The topics herein are responsive to the SSTF’s social science recommendations to invest funding in studies, build external networks, monitor indicators, advance interdisciplinary sciences, and evaluate institutional barriers to learning. While impressive, this work represents only the first steps in social science integration and highlights the value that can result from these investments.

Meaningful integration starts with meaningful investment in funding, a charge that we take seriously. Through [directed actions](#) and [competitive solicitations](#), our funding of social science research is growing while we adaptively manage the most effective strategies for soliciting research projects. On that front, stay tuned for an announcement about the 2023 Proposal Solicitation Notice in an upcoming edition.

Happy Earth Week!

A handwritten signature in blue ink that reads "Laurel E. Larsen". The signature is fluid and cursive, with a long horizontal stroke at the end.

Dr. Laurel Larsen
Delta Lead Scientist

Crossing Disciplinary Boundaries in the Bay-Delta

Author: Jill Harris, Senior Environmental Scientist, Delta Science Program

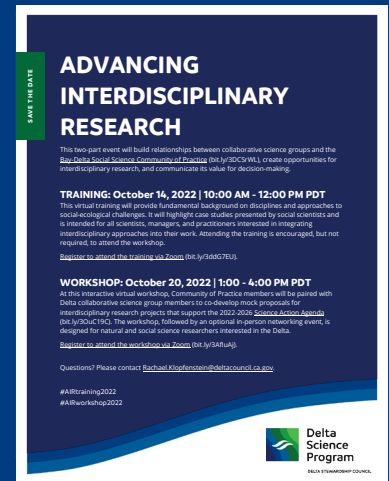
In October 2022, the Delta Science Program and the Bay-Delta Social Science Community of Practice hosted a two-part training and workshop on interdisciplinary research. The event aimed to (1) share knowledge across the social and natural science communities, (2) provide examples of interdisciplinary research that could advance useable science in the Delta, and (3) overcome barriers by building new relationships across disciplines and exploring innovative solutions to the Delta's entrenched challenges. The event was part of the Council's ongoing efforts to better integrate social science into decision-making in the Delta.

The audience comprised over 80 participants from diverse agencies and academia. Two-thirds had backgrounds in natural science and over half had training in interdisciplinary or social sciences. During the training part of the event, keynote speaker Dr. Edy MacDonald, who recently returned to California following a stint leading the New Zealand Department of Conservation's social science team, introduced methodologies and perspectives from several disciplines. A series of invited speakers from across the country presented case studies that demonstrate how integrating social science into natural resource management leads to more effective and equitable policy solutions:

- Dr. Jessica Bolson, Florida International University: *Barriers and bridges to integrated water management (One Water solutions) in urban areas across the U.S.*
- Dr. Robyn S. Wilson, Ohio State University: *Increasing motivation and promoting persistence in farmer conservation.*
- Deniss Martinez, University of California, Davis: *We shape the land: Fire governance and Indigenous climate justice.*

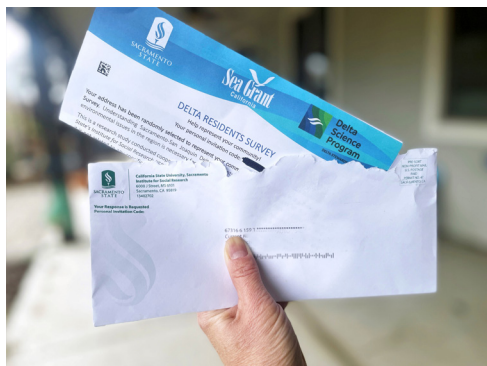
During the workshop, attendees worked in small groups to develop mock research proposals for hypothetical interdisciplinary projects that would be responsive to the [2022-2026 Science Action Agenda](#). Participants reported that the activity was useful, and they appreciated having the time and attention dedicated to interdisciplinary work. Participants also noted that developing a robust interdisciplinary proposal requires sustained collaboration among researchers. This event was a starting point for igniting new interests and professional relationships that will benefit future interdisciplinary research on and in the Delta.

Links to recordings of speakers, the agenda, a workshop summary, and other event materials are available on the [Community of Practice website](#).



Just Launched: The Inaugural Delta Residents Survey

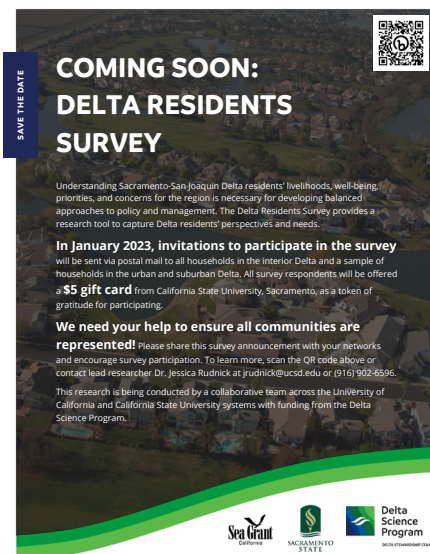
Author: Jill Harris, Senior Environmental Scientist, Delta Science Program



In January 2023, the inaugural Delta Residents Survey was sent to every household in the rural Delta and a sample of households in the urban and suburban Delta. This landmark effort, funded by the Delta Science Program, is a collaboration between the California Sea Grant, Sacramento State University, and the Bay-Delta Social Science Community of Practice. The survey is led by Dr. Jessica Rudnick, Sea Grant social science extension specialist at the Delta Stewardship Council.

The survey aims to measure people's beliefs, values, sense of place, stewardship behaviors, and experience with local environmental change. Results will inform decision-makers of local community members' perspectives on key regional environmental issues. For example, survey respondents were asked how recent flooding and drought have affected them and how they would like these changing conditions to be addressed in the future.

The project is an effort to remedy the long-standing shortage of social science data in environmental decision-making. Effective, equitable environmental management requires understanding both the human and non-human components of the environment, but that human perspective is often lacking.



The survey closed at the end of March 2023, and by summer 2023 results will be shared widely with state and local agencies and community-based organizations and made available on the Council's [social science integration web page](#). For more information, email JRudnick@ucsd.edu.

Uncovering the Role of Science Governance in the Sacramento-San Joaquin Delta

Authors: Tara Pozzi, Ph.D. Student at the UC Davis Center for Environmental Policy and Behavior, 2022 Delta Science Fellow; Dr. Mark Lubell, Director of the UC Davis Center for Environmental Policy and Behavior



How does scientific knowledge translate into environmental policy and decision-making in the Delta?

In the context of the California Delta, this is a crucial question regarding the potential for adaptive management, that is, institutions' ability to dynamically link scientific findings to policy. Scientific knowledge in the Delta emerges from what has been called the *science enterprise*: "the collection of science programs and activities that exist to serve managers and stakeholders."¹ The science enterprise's goal is to create and utilize science-based knowledge for the adaptive management of the California Delta's changing social-ecological system. The way a science enterprise achieves that goal is called *science governance*.

Our research into the critical components of Delta science governance started in 2020 with a team of researchers from UC Davis, the University of Arizona, and the University of Colorado at Denver. The work began with a science governance workshop and a virtual focus group with participants in the Delta science community. Following these events, in 2021 we distributed a survey to measure stakeholder perceptions of how effective science forums are at achieving adaptive management goals.

We received 180 responses from people within government, non-government organizations, and academia, who engage in various science forums. We found science forums with higher levels of effective leadership, trust, representative engagement, and coordination, were perceived by members as more effective at achieving adaptive management goals. Respondents reported that forums were most effective during parts of the *planning* stage of adaptive management and the least effective during the *do* stage. There were varying results for the third stage of the adaptive management cycle, *evaluate and respond*; however, respondents felt that within this stage, forums were most effective at communicating science to decision-makers and analyzing and synthesizing data to evaluate management.

¹ Delta Stewardship Council, Delta Science Program. 2019. Delta Science Plan: Vision, principles, and approaches for integrating and coordinating science in the Delta. <https://deltacouncil.ca.gov/pdf/2019-delta-science-plan.pdf>.

With funding provided by the Delta Science Program, this research has expanded in 2022-2023 to include interviews across the science network. These interviews will be used to analyze the survey findings further and inform a comparative analysis of science governance in the Delta and the Colorado River Basin.

The science governance research on the Delta thus far exemplifies how formal social science methods can uncover key drivers of effective adaptive management, while also bringing a more nuanced perspective to the social, structural, and functional barriers that participants face. Looking forward, effective management of complex social-ecological systems like the Delta will require concerted investment in understanding the social processes that shape how the system changes over time.

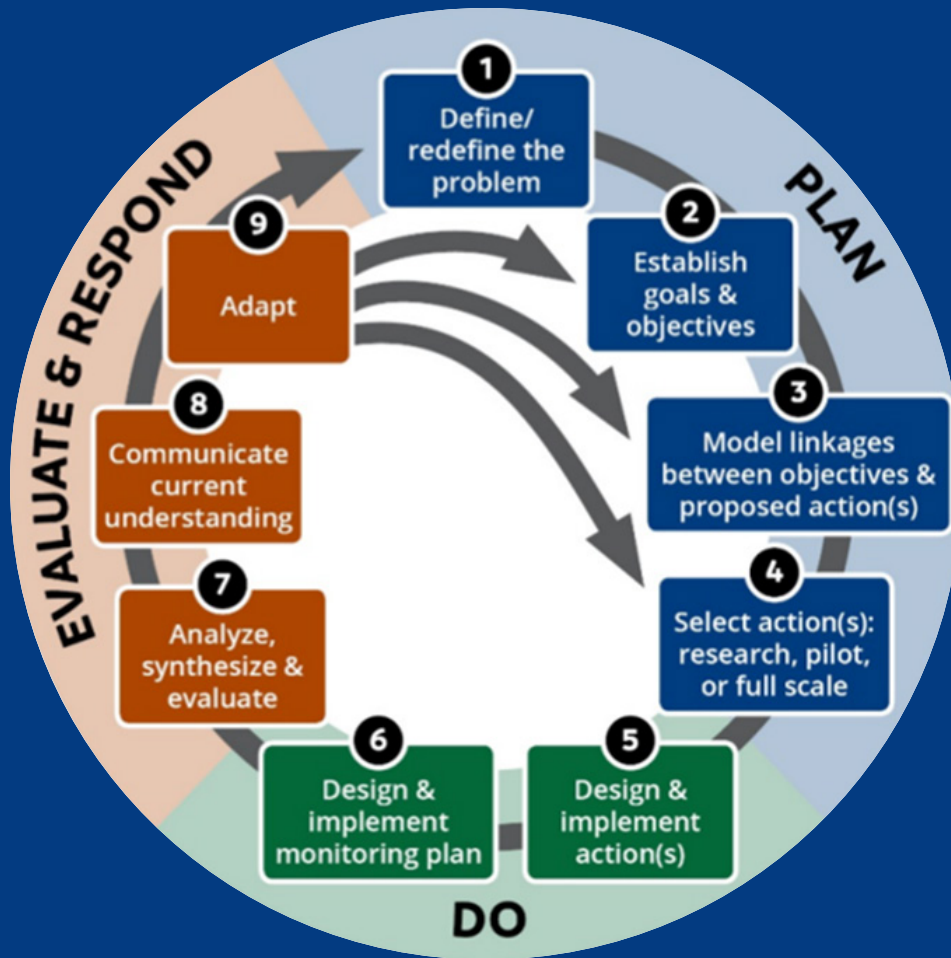


Figure 1. Nine-step Adaptive Management Framework from the Delta Plan.

Connecting Delta Communities with Science

Author: Chris Kwan, Senior Environmental Scientist, Delta Stewardship Council



As part of its efforts to foster connections among Delta scientists and the community, the Council held the first Science for Communities Workshop in October 2022 at Big Break Visitor Center in Oakley, CA. The workshop was an opportunity for those who live, work, and recreate in the Delta to contribute to science and for scientists to contribute to communities. A [recording](#) is archived on YouTube. It was positively received and generated an understanding of cross-sectional, interdisciplinary perspectives among the

participants. Around 50 people attended in person and 30 participated virtually.

Leading up to the workshop, Council staff paired community-based organizations with academic and agency scientists to address important social and environmental science issues. Project ideas that emerged included surveying Delta residents about public health under climate change, efforts to achieve the human right to water for unhoused people, and communicating the risk of harmful algal blooms to youth (see the table on the next page for more details).

One goal for the workshop was to boost Delta communities' awareness of and access to environmental data and technical tools that are available to them. Likewise, many scientists who want to help communities often lack connections within communities and an awareness of priority needs. This workshop was an opportunity for communities and scientists to connect and gain a better understanding of each other's needs.

The Council plans to continue engaging with partners from the event on ongoing projects, including performance measure reporting, social science integration, and the environmental justice initiative. There is also a desire to continue with this initiative and potentially organize a follow-up workshop or training in 2024. Additionally, some partners have shown interest in pursuing the Delta Science Program's research funding opportunities.



The table below shows the community-based and science organizations that participated in the workshop as well as the topics covered.

Community-Based Organizations	Science Organizations	Topic
Little Manila Rising (Stockton, CA)	<ul style="list-style-type: none"> California Department of Water Resources State Water Resources Control Board UC Davis UC Santa Cruz State Water Resources Control Board 	Making water quality data more accessible and useful; equity in flood protection planning, preparedness, and response
Restore The Delta (Stockton, CA)	<ul style="list-style-type: none"> Central Valley Regional Water Quality Control Board Delta Stewardship Council Delta Science Program Interagency Ecological Program UC Berkeley 	Increasing harmful algal blooms education; data sharing and reporting
California Indian Environmental Alliance (El Cerrito, CA)	<ul style="list-style-type: none"> California Department of Fish and Wildlife California State University-Water Advocacy Towards Education and Research State Water Resources Control Board 	Contaminants; water quality data privacy and sharing
Sacramento Regional Coalition to End Homelessness (Sacramento, CA)	<ul style="list-style-type: none"> California Department of Water Resources Central Valley Regional Water Quality Control Board State Water Resources Control Board UC Berkeley 	Homelessness in the Delta and <i>E. coli</i> in water; water quality and drinking water
Public Health Advocates (Stockton, CA)	<ul style="list-style-type: none"> University of Arizona California Department of Water Resources Central Valley Regional Water Quality Control Board 	Socioeconomic and public health of disadvantaged communities; impacts of climate change
Sustain our Abilities (Oakland, CA), California Governor's Office of Emergency Services (Sacramento, CA)	<ul style="list-style-type: none"> Delta Stewardship Council Delta Science Program 	Climate change impacts to people with disabilities and older people



Coming Soon: An Environmental Justice Issue Paper

Author: Viet-Long Nguyen, Executive Fellow, Delta Stewardship Council



This year, the Council will reach a milestone in its efforts to address environmental justice (EJ) with the release of a draft issue paper. The paper will identify issues relevant to the Council's work and policy recommendations to address these issues.

EJ refers to the disproportionate burden of environmental impacts borne by certain communities and calls for equity in the development of laws, programs, and policies that affect the environment. EJ was identified as a key emerging issue in the Council's [2019 Five-Year Review of the Delta Plan](#), which recommended the preparation of

an issue paper to provide guidance for how the Council can address EJ and better serve disadvantaged communities. Examples of EJ issues affecting Delta communities include air and water pollution, harmful algal blooms, and flood risk.

To inform this issue paper, collaboration with community members has been essential. Since 2021, Council staff performed [22 in-depth interviews](#) with community-based organizations working on EJ, participated in multiple community events, and convened an expert group that includes representatives from Little Manila Rising, Restore the Delta, the California Indian Environmental Alliance, and the Sacramento Regional Coalition to End Homelessness. This issue paper is part of the Council's broader efforts to integrate social science into its work. EJ issues are wide-reaching and immensely interrelated. As such, an interdisciplinary approach that integrates both the natural and social sciences is crucial to gaining a better understanding of how people live, work, and recreate in the Delta and their relationship with the environment.

A draft of the issue paper is anticipated for public review in mid-2023.

Recent Publications from the Delta Science Program

This roundup of new scientific journal articles features the latest edition of the State of Bay-Delta Science, in addition to other publications funded by the Delta Science Program and authored by our staff. Funding scientific research is one of the ways that we carry out our mission to provide the best possible scientific information for decision-making in the Delta. Since our inception, the Delta Science Program has funded hundreds of research projects that advance our fundamental understanding of the Bay-Delta social-ecological system. Highlighted author names below indicate current or former DSP staff.

The State of Bay-Delta Science in 2022



The State of Bay-Delta Science (SBDS) is an ongoing synthesis effort to inform science and policy audiences about the “state of science” for topics relevant to the management of the Bay-Delta system. The Delta Science Program leads an interdisciplinary editorial board that includes the Delta Lead Scientist, Delta Science Program staff, and distinguished scientists. The latest edition of SBDS was published in February 2023 in a special issue of *San Francisco Estuary & Watershed Science*, with a focus on ecosystem services and disservices of primary producers

- Boyer KE, Safran SM, Khanna S, & Patten M V (2023) **Landscape Transformation and Variation in Invasive Species Abundance Drive Change in Primary Production of Aquatic Vegetation in the Sacramento-San Joaquin Delta.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art2>
- **Christman MA**, Khanna S, Drexler JZ, & Young MJ (2023) **Ecology and Ecosystem Effects of Submerged and Floating Aquatic Vegetation in the Sacramento-San Joaquin Delta.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art3>
- **Conrad JL**, Thomas M, Jetter K, Madsen J, Pratt P, Moran P, Takekawa J, Darin GS, & Kenison L (2023) **Invasive Aquatic Vegetation in the Sacramento-San Joaquin Delta and Suisun Marsh: The History and Science of Control Efforts and Recommendations for the Path Forward.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art4>
- Hestir E & Dronova I (2023) **Remote Sensing of Primary Producers in the Bay-Delta.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art5>
- Kudela RM, Howard MD, Monismith S, & Paerl HW (2023) **Status, Trends, and Drivers of Harmful Algal Blooms Along the Freshwater-to-Marine Gradient in the San Francisco Bay-Delta System.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art6>
- **Larsen LG, Bashevkin SM, Christman MA, Conrad JL**, Dahm CA, & Thompson J (2023) **Ecosystem Services and Disservices of Bay-Delta Primary Producers: How Plants and Algae Affect Ecosystems and Respond to Management of the Estuary and Its Watershed.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art1>
- Windham-Myers L, Oikawa P, Deverel S, **Chapple D**, Drexler JZ, & **Stern D** (2023) **Carbon Sequestration and Subsidence Reversal in the Sacramento-San Joaquin Delta and Suisun Bay: Management Opportunities for Climate Mitigation and Adaptation.** *San Francisco Estuary and Watershed Science*, 20(4). <http://dx.doi.org/10.15447/sfews.2023v20iss4art7>

Other Publications Authored by DSP Staff

- **Bashevkin SM (2022) A Framework for Evaluating the Effects of Reduced Spatial or Temporal Monitoring Effort.** *San Francisco Estuary and Watershed Science*, 20(3). <http://dx.doi.org/10.15447/sfews.2022v20iss3art5>
- Nelson PA, Baerwald M, Burgess O, **Bush E**, Collins A, Cordoleani F, **DeBey H**, Gille D, **Goertler PAL**, Harvey B, Johnson RC, Kindopp J, Meyers E, Nortch J, Phillis CC, Singer G, & Sommer T (2022) **Considerations for the Development of a Juvenile Production Estimate for Central Valley Spring-Run Chinook Salmon.** *San Francisco Estuary and Watershed Science*, 20(2). <http://dx.doi.org/10.15447/sfews.2022v20iss2art2>

Publications Supported with DSP Funding

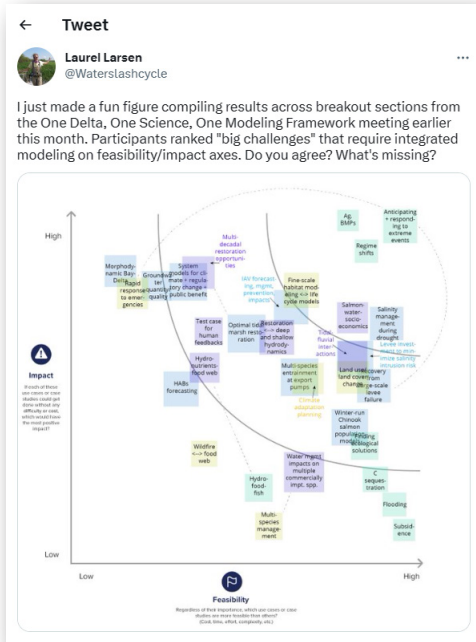
*Publications marked with an asterisk were funded through a partnership with the U.S. Bureau of Reclamation

- Glibert PM, Wilkerson FP, Dugdale RC, & Parker AE (2022) **Ecosystem Recovery in Progress? Initial Nutrient and Phytoplankton Response to Nitrogen Reduction from Sewage Treatment Upgrade in the San Francisco Bay Delta.** *Nitrogen*, 3(4):569-591. <https://doi.org/10.3390/nitrogen3040037>
- *Hause CL, Singer GP, Buchanan RA, Cocherell DE, Fanguie NA, & Rypel AL (2022) **Survival of a Threatened Salmon is Linked to Spatial Variability in River Conditions.** *Canadian Journal of Fisheries and Aquatic Sciences*, 79(12): 2056-2071. <https://doi.org/10.1139/cjfas-2021-0243>
- *Hendrix AN, Fleishman E, Zillig MW, & Jennings ED (2023) **Relations Between Abiotic and Biotic Environmental Variables and Occupancy of Delta Smelt (*Hypomesus transpacificus*) in Autumn.** *Estuaries and Coasts*, 46:149-165. <https://doi.org/10.1007/s12237-022-01100-x>
- Hutton SJ, Siddiqui S, Pedersen EI, Markgraf CY, Segarra A, Hladik ML, Connon RE, & Brander SM (2023) **Comparative Behavioral Ecotoxicology of Inland Silverside Larvae Exposed to Pyrethroids Across a Salinity Gradient.** *Science of the Total Environment*, 857(3). <https://doi.org/10.1016/j.scitotenv.2022.159398>
- Lewis LS, Huang JL, Willmes M, Fichman RA, Hung TC, Ellison L T, Stevenson TA, Teh SJ, Hammock BG, Schultz AA, Grimsich JL, Huyskens MH, Yin Q-Z, Cavole LM, Botto NW & Hobbs, JA (2022) **Visual, Spectral, and Microchemical Quantification of Crystalline Anomalies in Otoliths of Wild and Cultured Delta Smelt.** *Scientific Reports*, 12(1): 20751. <https://doi.org/10.1038/s41598-022-22813-w>
- Nakamoto BJ, Jeffres CA, Corline NJ, Ogaz M, Bradley CJ, Viers JH, & Fogel ML (2023) **Multiple Trophic Pathways Support Fish on Floodplains of California's Central Valley.** *Journal of Fish Biology*, 102(1): 155-171. <https://doi.org/10.1111/jfb.15248>
- Richardson CM, Fackrell JK, Kraus TE, Young M, & Paytan A (2022) **Nutrient and Trace Element Contributions from Drained Islands in the Sacramento-San Joaquin Delta, California.** *San Francisco Estuary and Watershed Science*, 20(2). <https://dx.doi.org/10.15447/sfews.2022v20iss2art5>
- Shahan J, Chu H, Windham-Myers L, Matsumura M, Carlin J, Eichelmann E, Stuart-Haentjens E, Bergamaschi B, Nakatsuka K, Sturtevant C, & Oikawa P (2022) **Combining Eddy Covariance and Chamber Methods to Better Constrain CO₂ and CH₄ Fluxes Across a Heterogeneous Restored Tidal Wetland.** *JGR Biogeosciences*, 127(9). <https://doi.org/10.1029/2022JG007112>
- *Sturrock AM, Ogaz M, Neal K, Corline NJ, Peek R, Myers D, Schluep S, Levinson M, Johnson RC, & Jeffres CA (2022) **Floodplain Trophic Subsidies in a Modified River Network: Managed Foodscapes of the Future?** *Landscape Ecology*, 37, 2991-3009. <https://doi.org/10.1007/s10980-022-01526-5>

#SciComm Corner

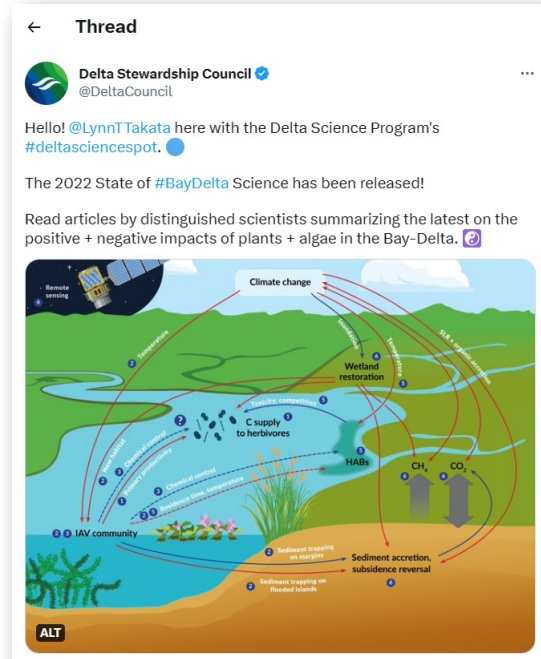
Laurel Larsen (@waterslashcycle) reflects on the [Integrated Modeling Framework Workshop](#).

Delta Stewardship Council (@deltacouncil) announces the [Delta Science Tracker](#).



The California Department of Water Resources (@CA_DWR) celebrates [women in science](#).

Lynn Takata took over the Council's Twitter (@deltacouncil) for a Delta Science Spot about the [2022 State of Bay-Delta Science](#).



California Department of Water Resources (@CA_DWR) promotes the [DELTA Education Program](#).



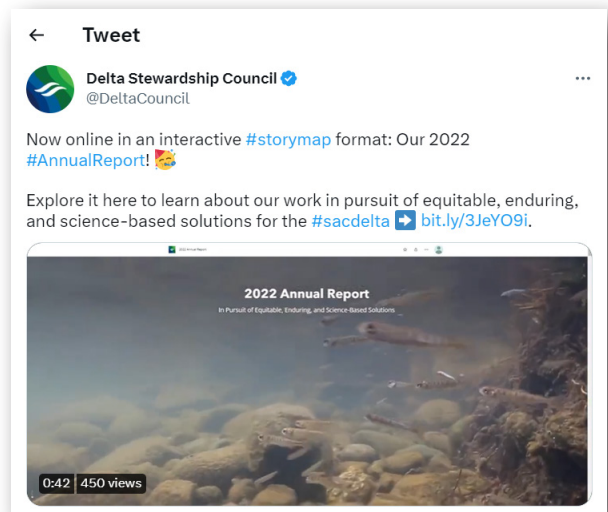
California Council on Science & Technology (@CCSTorg) celebrates [Science Day](#) with the California Natural Resources Agency.



San Francisco Estuary Partnership (@SFEstuary) promotes the [Delta Residents Survey](#).



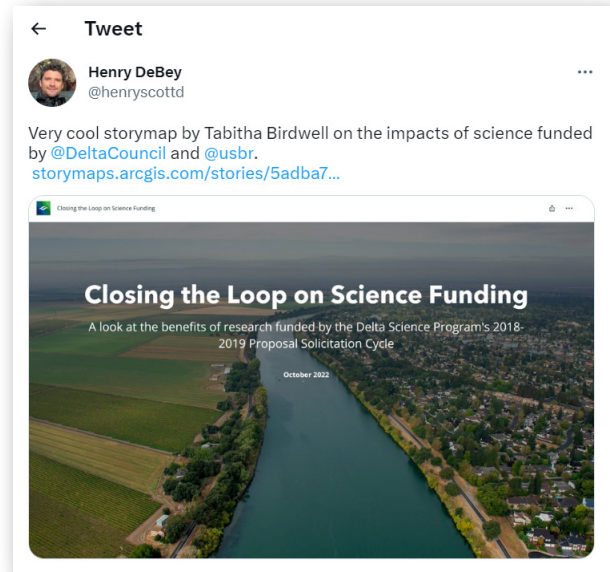
Delta Stewardship Council (@deltacouncil) publishes its [2022 Annual Report storymap](#).



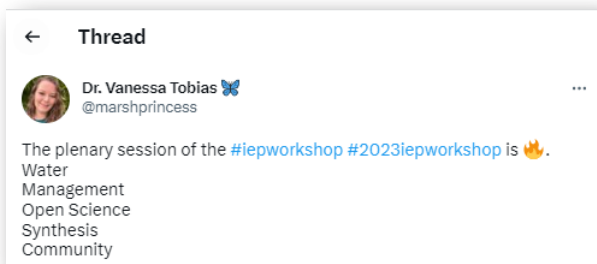
California Sea Grant (@caseagrants) shares a blog about searching for [a more inclusive and effective approach to biology](#).



Henry DeBey (@henryscott) shares a [storymap about science funding](#) by California Sea Grant State Fellow Tabitha Birdwell.



Dr. Vanessa Tobias (@marshprincess) live-tweets from the [2023 Interagency Ecological Program Workshop](#).



EarthDay.org (@EarthDay) asks how you are [investing in our planet](#) this year?





Events on the Horizon

April

- Delta Independent Science Board Meeting
April 26
- Kickoff of the DISB seminar series on decision-making under deep uncertainty
April 26

May

- Adaptive Management Forum
May 4
- Delta Independent Science Board Meeting
May 17-19
- Joint DSP/UC Davis Coastal and Marine Science Institute Symposium on Implications of Rising Temperatures for Coastal, Marine, and Estuarine Ecosystems
May 19

June

- Delta Independent Science Board Meeting
June 15

Recordings of Past Events

- [Advancing Interdisciplinary Research Training & Workshop](#)
- [Delta Harmful Algal Blooms Workshop](#)
- [Integrated Modeling Framework Workshop](#)

Visit our [event web page](#) for more.