



OCTOBER 2022

Delta Breeze

A newsletter by the Delta Science Program

Delta Lead Scientist “Dear Colleagues”



Recently, I shared a drink with an academic colleague who candidly asked me, “So, what is it that you really do in the Delta Science Program?” I love this question because there are so many exciting things

underway, and it is all too rare to have an opening to highlight more than just a few.

Today’s newsletter highlights a diverse portfolio of activities in different branches of the funding operations that the Delta Science Program (DSP) manages, illuminating DSP functions that many of our funded researchers might not be aware of. After the spring newsletter’s feature on the work of past Delta Science Fellows, it is probably no surprise that this edition starts with an announcement of the new class of Fellows for 2022.

What’s inside...

- Delta Science Fellows (p. 3-4)
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- Rapid Response Funding to Study Salmon Fry Deaths (p. 6-7)
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Delta Science Program

DELTA STEWARDSHIP COUNCIL

We further spotlight research that the DSP funded through a [directed action](#), which is a noncompetitive mechanism deployed here to commission time-sensitive research on a rapidly evolving new problem impacting species survival.

It should also be no surprise that herein you will find a list of recent publications that have come out of DSP-funded research. But did you know that DSP staff are also active in research? In fact, performing science synthesis is a part of our core mission, helping to fill gaps in understanding trends and ecosystem functions that are inherent when monitoring programs are funded to meet narrowly focused goals and objectives. Some of the latest publications in the list are products authored by DSP scientists that leverage over half a century of monitoring records to understand ecological trends, their drivers, and how those drivers might be managed.

Disseminating DSP-funded research outcomes and products to those who ultimately fund (e.g., the legislature) or express support for funding (e.g., stakeholders, managers) science research in the Sacramento-San Joaquin Delta is an important step in the science funding cycle. This step of “closing the loop” more effectively has been a growing priority within the DSP. The forthcoming Delta Science Tracker highlighted in this edition represents an important tool for helping us do so. To maximize its potential benefits, though, the Tracker needs the community’s participation to populate it and keep it updated, which should bear dividends in the form of enhanced findability of research and products by funders, managers, and other researchers.

On the other end of the funding pipeline, many of our readers will likely be familiar with the independent peer review process used to evaluate all research proposals that we receive, whether for competitive solicitations or directed actions. But did you also know that DSP performs broader peer-review services for the community? This activity is typically sponsored by requesting agencies to help them improve the scientific underpinnings of their products or projects and build public trust in those products. Here we highlight an ongoing peer-review panel that is evaluating a precedent-setting water temperature modeling platform for the U.S. Bureau of Reclamation (USBR).

I wish I could be sharing that drink and having that conversation about what the DSP does with each of you, but since I can’t, pour yourself a cold one, sit back, and enjoy this autumn missive instead. Congratulations to all the new Delta Science Fellows and, for all of you readers out there, I wish you the best start to fall and whatever this season may bring for you.

Sincerely,

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

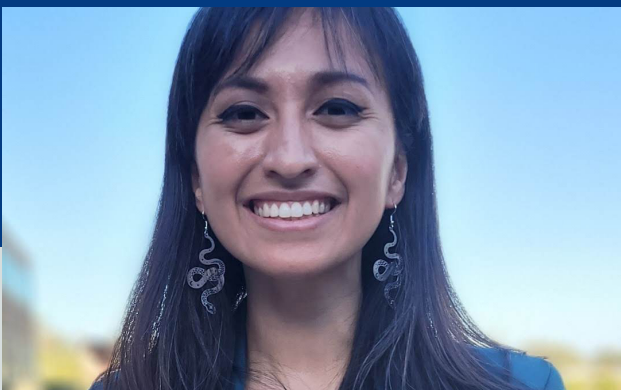
Dr. Laurel Larsen
Delta Lead Scientist

Announcing the 2022 Delta Science Fellows

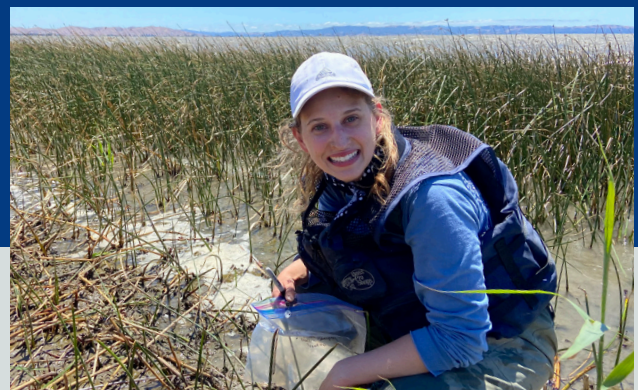
In July, the DSP announced the 2022 recipients of the Delta Science Fellowships, a competitive funding program offered every two years in partnership with California Sea Grant. The fellowships enable graduate students and post-doctoral researchers to conduct up to two years of high-priority research in the Delta relevant to management needs identified in the [Science Action Agenda](#). Fellows are paired with academic mentors from their home institutions and community mentors from public agencies, including the California Department of Fish and Wildlife (CDFW), California Department of Water Resources, California Department of Pesticide Regulation, and U.S. Geological Survey (USGS), thereby strengthening the link between science and management.



This year was especially competitive. Biophysical and social science research projects were evaluated by two separate expert review panels. Fellows were selected based on their research proposals' scientific merit, relevance to the Science Action Agenda, and the degree to which their research will benefit the broader Delta community. The 2022 Fellows comprise one master's student, four PhD students, and three post-doctoral scientists from academic institutions in the University of California and California State University systems. Their research in the natural and social sciences covers a broad range of topics including wetland restoration, water quality, fish and predator ecology, pesticides, and harmful algal blooms.



Elsie Carrillo, UC Santa Cruz, PhD Student
Functional diversity and predator dynamics
along the Sacramento-San Joaquin River Delta



Megan Pagliaro, UC Berkeley, PhD Student
Restoring tidal marsh food webs: assessing
restoration effects on trophic interactions and
energy flows in the San Francisco Bay-Delta



Andreja Kust, *UC Berkeley, Postdoctoral Scholar*
Identification of environmental conditions driving cyanobacterial multi-species blooms and their toxicity using genome resolved metagenomics



Nicol Parker, *UC Santa Barbara, PhD Student*
Harmonizing pesticide risk management of the Bay-Delta watershed



Garfield Kwan, *Scripps Institution of Oceanography, Postdoctoral Scholar*
Fish out of breath: Assessing, developing, and validating physiological bioindicators of hypoxia across the Delta



Tara Pozzi, *UC Davis, PhD Student*
Mapping the adaptation governance network of the Delta



Maiyah Matsumura, *CSU East Bay Master's Student*
Using high frequency flux measurements to constrain dissolved inorganic carbon in a tidal wetland carbon budget



Parsa Saffarinia, *UC Berkeley, Postdoctoral Scholar*
Examining the relationship between Longfin Smelt, zooplankton, and flow in the San Francisco Bay-Delta

Peer Review

Part 1 of the Water Temperature Modeling Platform Peer Review Now Complete



The Water Temperature Modeling Platform (WTMP) effort is on the right track! That was the central message communicated to the USBR-led model development team at the July 19-20 public meeting. The meeting was held at a mid-point in the WTMP development process, focused on the Shasta/Keswick Reservoirs and the linked Sacramento River system.

In January, the USBR requested that the DSP facilitate a review of the temperature models, model framework, and implementation of the WTMP Project, which will result in modeling tools that predict water temperatures downstream of dams for real-time water operations, development of temperature management plans, and planning studies. Collectively, these tools will help manage water temperatures critical for the survival and health of the Endangered Species Act-listed Chinook Salmon.

Attendees, including representatives from water agencies and federal and State agencies, heard presentations from the WTMP team about the project, data management and development, model selection, calibration and validation. Those presentations are available on the DSP's [WTMP web page](#). The independent peer review panel, consisting of prominent modeling experts from across the country, was impressed by the effort and offered some constructive feedback to improve the large collaborative modeling effort.

The panel's report will soon be available on the DSP's WTMP web page, and will provide detailed feedback and recommendations to improve the WTMP effort. Next year, the WTMP Project team and the panel will meet again to conduct a final review of the WTMP for the entire project, including the American River and Stanislaus River systems.

This two-part independent review is just one example of many coordinated by the DSP. Like the WTMP Project, peer reviews are typically conducted at the request of State and federal agencies to help build trust; provide rigorous, transparent, and objective feedback; and ensure credible and legitimate science can be used by water and environmental decision-makers. The DSP has coordinated other [independent scientific peer reviews](#) that cover topics such as mercury and biological goals to inform the update to the Bay-Delta Plan.



Funded Delta Science

How is a Large Boom in the Ocean Anchovy Population Connected to a Decline in Central Valley Chinook Salmon Survival?

It is difficult to overstate the importance and sensitivity of California's salmon populations: fall and late-fall salmon runs are the dominant salmon in California's commercial fishery; winter run salmon are federally listed as endangered; and the spring run is threatened. These last two populations are supplemented by multiple Central Valley Chinook salmon hatcheries where, in 2020, biologists observed salmon fry acting strangely, with odd swimming behavior, ultimately leading to death.

Concerned, scientists explored the causes behind the issue and found connections between anchovy consumption, thiamine, and salmon. Anchovies are typically part of a balanced diet for salmon during their time in the ocean, along with krill, squid, juvenile rockfish, and sardines.



In 2018-2019, anchovy abundances off the coast of central California were at an all-time high and dominated the diet for salmon. Anchovies also naturally contain thiaminase, an enzyme that breaks down thiamine in consumers like salmon. Thiamine (or vitamin B1) is an essential nutrient for people, plants, and animals. Thiamine Deficiency Complex (TDC) occurs when thiamine levels are low enough to impair nerve, muscle, and heart function.

In 2020, the DSP rapidly responded to this emerging issue by reviewing and funding a directed action proposal for an experiment to explore the prevalence of TDC and potential solutions beyond the hatchery: Dr. Rachel Johnson (NOAA Fisheries/UC Davis) and her team (including scientists from NOAA Fisheries, U.S. Fish and Wildlife Service, CDFW, USGS, and academic partners UC Davis and SUNY Brockport) treated half of a group of adult winter run female salmon with thiamine and half with a placebo. The eggs and fry from the thiamine-treated females thrived, in contrast to the placebo group. This project demonstrated the effectiveness of supplementing thiamine for the troubled salmon populations. The research team also emphasized the importance of documenting Chinook salmon ocean diets, which can provide an advanced warning about diet shifts that may cause TDC in their offspring.

This problem is not unique to the Delta – in fact, similar thiamine deficiency problems have been documented for lake trout in the Great Lakes (1960s), for Chinook salmon in Alaska (mid-2010s), multiple species (i.e. egg-laying birds) in Sweden (Lennart Balk, Baltic Sea), and wild populations of other animals (i.e., fish, mussels, birds, moose, wolves) across the world. Thiamine deficiency has been identified as a possible driver of wildlife population declines as mass extinctions are occurring on a global scale. Therefore, many have called on scientists to gather more baseline data on thiamine levels in the environment. While establishing this baseline will be a topic of ongoing investigation, the ability to issue rapid-response funding enabled the DSP to contribute to a straightforward management solution to a rapidly developing crisis that headed off major losses to vital salmon hatcheries.

Science Coordination

The New Delta Science Tracker: Connecting Science Across the Estuary



There is a dizzying array of science happening in the Delta. Projects ranging from foundational research to policy-driven and agency-mandated projects are led by government agencies at various levels, cooperatives, academic institutions, non-governmental organizations, and many others. While all of this valuable work

can be leveraged to inform management, the expansive and somewhat disconnected science landscape makes it hard, if not impossible for practitioners to get a handle on the information and expertise available to them.

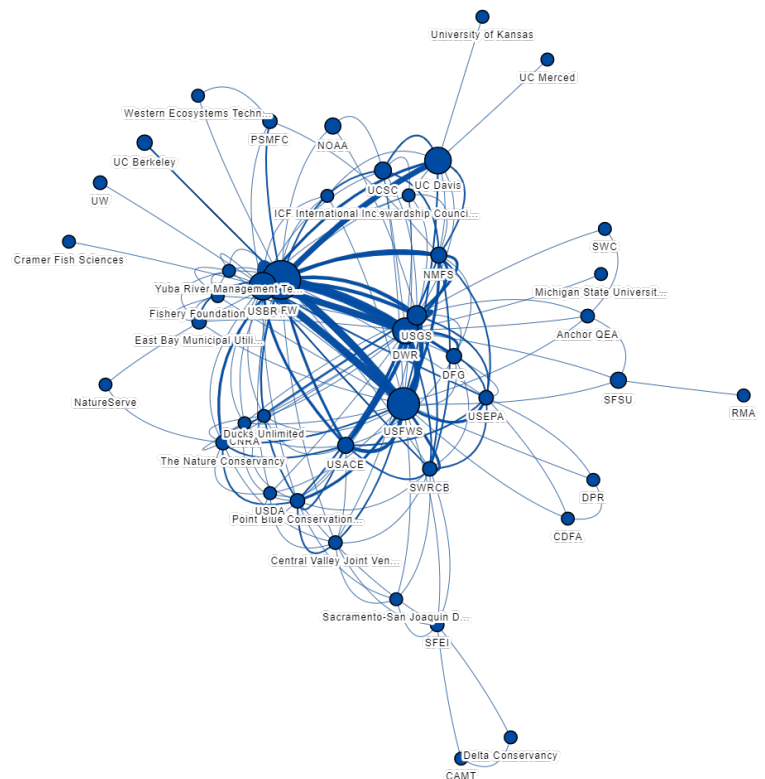
Enter the Delta Science Tracker scheduled to go live this fall. Funded and spearheaded by the DSP, the Tracker will be a publicly available web-based hub designed to centralize information about science activities throughout the system. Project leads upload information about themselves and their work, and users can search and aggregate science by categories that include topic, geography, entity, and more. The Tracker will also generate information-rich summary visualizations, including connective network diagrams and funding stream graphs.

As uncertainties about the climate, water supply, and the fate of the Delta's ecosystem grow, multi-institutional collaboration is becoming increasingly important. The Tracker will help connect managers and policymakers to the science they need to inform decisions, document the outcomes of science funding, connect scientists across geographies and disciplines, and improve connectivity across the vast Delta science enterprise.

Be on the lookout for announcements about the Tracker's release in the coming weeks!

[Subscribe to the Delta Stewardship Council listserv](#) to receive email announcements

about the Tracker and other topics.



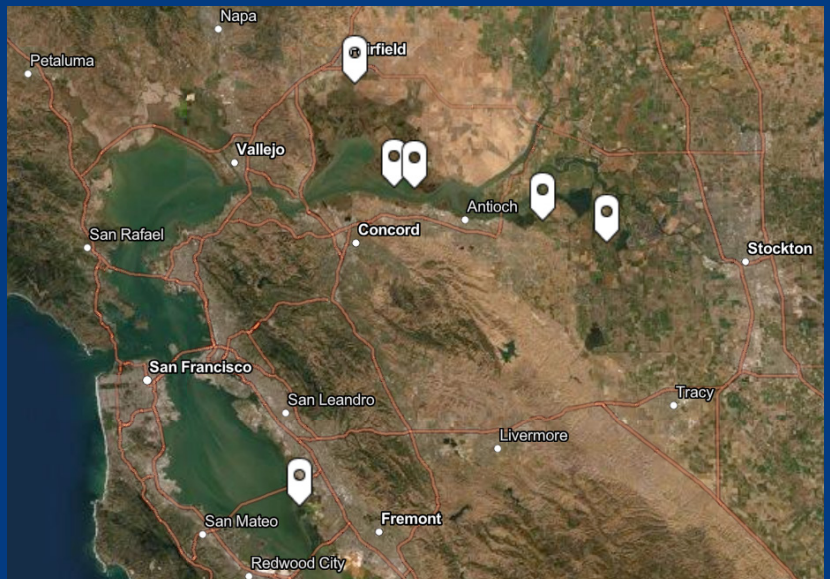
Science Communication

A Science Program StoryMap: Closing the Loop on Science Funding



This fall, the Delta Stewardship Council's 2022 California Sea Grant State Fellow Tabitha Birdwell released an ArcGIS StoryMap focused on the Delta Science Research Awards from the 2018-2019 Delta Science Proposal Solicitation cycle funded by the Council and its partners. It takes readers on an immersive virtual tour across the Delta, summarizing the research and mapping where the 14 funded research teams focused their efforts from 2019-2022. The StoryMap summarizes key points of each project, including the catalyst

behind the research, key research steps, and resulting management implications or public benefits. It further draws connections between research and management priorities for each project by highlighting their contributions to the 2017-2021 Science Action Agenda's five Action Areas. Each Action Area aligns science actions to management needs by filling information gaps, promoting science collaboration, building science infrastructure, and more. The StoryMap is a part of a growing initiative at the DSP to close the loop on science funding by ensuring the impacts of scientific research don't end when the results come in. Instead, the initiative puts the science into the hands of those impacted by or charged with addressing the problems that facilitated the research. The StoryMap is hosted on the DSP's Research Funding and Fellowships web page, and can be accessed directly here.





Recent Publications from the Delta Science Program

It's been a productive year for new scientific journal articles at the Delta Science Program. Funding scientific research is one of the ways that the Delta Science Program carries out its mission. Since its inception, DSP has funded hundreds of research projects that address key knowledge gaps and advance our fundamental understanding of the Bay-Delta's dynamic socio-ecological system. The DSP is proud to share this list of recent peer-reviewed publications authored by researchers financially supported by the DSP and peer-reviewed publications authored by our own DSP staff.

Research Funded by the DSP

- Ade C, Khanna S, Lay M, Ustin SL, & Hestir EL (2022) **Genus-level mapping of invasive floating aquatic vegetation using Sentinel-2 satellite remote sensing.** *Remote Sensing*, 14(13): 3013. <https://doi.org/10.3390/rs14133013>
- Campbell MA, Joslin SE, Goodbla AM, Willmes M, Hobbs JA, Lewis LS, & Finger AJ (2022) **Polygenic discrimination of migratory phenotypes in an estuarine forage fish.** *G3 Genes | Genomes | Genetics*, 12(8). <https://doi.org/10.1093/g3journal/jkac133>
- Colborne SF, Sheppard LW, O'Donnell DR, Reuman DC, Walter JA, Singer GP, Kelly JT, Thomas MJ, & Rypel AL (2022) **Intraspecific variation in migration timing of green sturgeon in the Sacramento River system.** *Ecosphere*, 13(6): e4139. <https://doi.org/10.1002/ecs2.4139>

Publications by DSP Staff

- **Bashevkin SM**, Hartman R, Thomas M, Barros A, Burdi CE, Hennessy A, Tempel T, & **Kayfetz K** (2022) **Five decades (1972–2020) of zooplankton monitoring in the upper San Francisco Estuary.** *PLoS ONE*, 17(3): e0265402. <https://doi.org/10.1371/journal.pone.0265402>
- **Bashevkin SM**, Mahardja B, & Brown LR (2022) **Warming in the Upper San Francisco Estuary: Patterns of Water Temperature Change from Five Decades of Data.** *Limnology and Oceanography*, 67(5): 1065–80. <https://doi.org/10.1002/lno.12057>
- **Bashevkin SM** & Mahardja B (2022) **Seasonally Variable Relationships between Surface Water Temperature and Inflow in the Upper San Francisco Estuary.** *Limnology and Oceanography*, 67(3): 684–702. <https://doi.org/10.1002/lno.12027>

- Coleman L, Johnson R, Cordoleani F, Phillis C, & Sturrock A (2022) **Variation in juvenile salmon growth opportunities across a shifting habitat mosaic.** *San Francisco Estuary and Watershed Science*, 20 (1). <https://doi.org/10.15447/sfews.2022v20iss1art1>
- Colombano DD, Carlson SM, Hobbs JA, & Ruhi A (2022) **Four decades of climatic fluctuations and fish recruitment stability across a marine-freshwater gradient.** *Global Change Biology* 28(17): 5104-5120. <https://doi.org/10.1111/gcb.16266>
- Eichelmann E, Mantoani MC, Chamberlain SD, Hemes KS, Oikawa PY, Szutu D, Valach A, Verfaillie J, and Baldocchi DD (2022) **A novel approach to partitioning evapotranspiration into evaporation and transpiration in flooded ecosystems.** *Global Change Biology* 28(3): 990-1007. <https://doi.org/10.1111/gcb.15974>
- Hause CL, Singer GP, Buchanan RA, Cocherell DE, Fanguie NA, & Rypel A (2022) **Survival of a threatened salmon is linked to spatial variability in river conditions.** *Canadian Journal of Fisheries and Aquatic Sciences*. <https://doi.org/10.1139/cjfas-2021-0243>
- Herbold B, Bush E, Castillo G, Colombano D, Hartman R, Lehman P, Mahardja B & Sommer, T (2022) **Climate change effects on San Francisco Estuary aquatic ecosystems: A review.** *San Francisco Estuary & Watershed Science*, 20(2). <https://doi.org/10.15447/sfews.2022v20iss2art1>
- Holleman RC, Gross ES, Thomas MJ, Rypel AL, & Fanguie NA (2022) **Swimming behavior of emigrating Chinook Salmon smolts.** *PLoS ONE* 17(3): e0263972. <https://doi.org/10.1371/journal.pone.0263972>
- Johnston SE, Finlay K, Spencer RG, Butman DE, Metz M, Striegl R, & Bogard MJ 2022. **Zooplankton release complex dissolved organic matter to aquatic environments.** *Biogeochemistry*, 157(3): 313-325. <https://doi.org/10.1007/s10533-021-00876-7>
- Cruz S, **Batavia C**, Spalding A, Arismendi I & Nelson M (2022) **Diversity Beyond Demographics: Environmental Worldviews of Forestry and Natural Resource Undergraduate Students.** *Ecology and Evolution*. 12(8): e9203. <https://doi.org/10.1002/ece3.9203>
- **Goertler PAL**, Holley KS & Kwan NA (2022) **Murky Mysteries of Young Lamprey in the San Francisco Estuary.** *Frontiers for Young Minds*. 10:612614. <https://doi.org/10.3389/frym.2022.612614>
- Herbold B, **Bush E**, Castillo G, Colombano D, Hartman R, Lehman P, Mahardja B & Sommer T (2022) **Climate Change Effects on San Francisco Estuary Aquatic Ecosystems: A Review.** *San Francisco Estuary and Watershed Science*, 20:2. <http://dx.doi.org/10.15447/sfews.2022v20iss2art1>
- Huntsman BM, Mahardja B & **Bashevkin SM** (2022) **Relative Bias in Catch Among Long-Term Fish Monitoring Surveys Within the San Francisco Estuary.** *San Francisco Estuary and Watershed Science*, 20(1). <https://doi.org/10.15447/sfews.2022v20iss20art3>
- Keeley, ATH, **Bush E**, & **Chapple DE** (2022) **Helping Nature in the San Francisco Estuary Cope with Climate Change.** *Frontiers for Young Minds*, 10:569350. <https://doi.org/10.3389/frym.2022.569350>
- Keeley, ATH, Fremier AK, **Goertler PAL**, Huber PR, Sturrock AM, **Bashevkin SM**, Barbaree BA, Grenier JL, Dilts TE, Gogol-Prokurat M, Colombano DD, **Bush EE**, Laws A, Gallo JA, Kondolf M & Stahl AT. (2022) **Governing Ecological Connectivity in Cross-Scale Dependent Systems.** *BioScience*, 72(4): 372-386. <https://doi.org/10.1093/biosci/biab140>

- Nagarajan, RP, Bedwell M, Holmes AE, Sanches T , Acuña S, Baerwald M, Barnes MA et al. (2022) **Environmental DNA methods for ecological monitoring and biodiversity assessment in estuaries. *Estuaries and Coasts*.** <https://doi.org/10.1007/s12237-022-01080-y>
- Nelson PA, Baerwald M, Burgess OT, Bush E, Collins A, Cordoleani F, ... & 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).** <https://doi.org/10.15447/sfews.2022v20iss2art2>
- O’Connell CS, Anthony TL, Mayes MA, Pérez T, Sihi D, & Silver WL (2022) **Utilizing novel field and data exploration methods to explore hot moments in high-frequency soil nitrous oxide emissions data: Opportunities and challenges. *Frontiers in Forests and Global Change*, 5: 674348.** <https://doi.org/10.3389/ffgc.2022.674348>
- Yelton R, Slaughter AM, & Kimmerer WJ (2022) **Diel behaviors of zooplankton interact with tidal patterns to drive spatial subsidies in the northern San Francisco Estuary. *Estuaries and Coasts* 45: 1728-2748.** <https://doi.org/10.1007/s12237-021-01036-8>
- McPhearson T, Cook EM, Berbés-Blázquez M, Cheng C, Grimm NB, Andersson E, Barbosa O, Chandler DG, Chang H, Chester MV, Childers DL, **Elser SR**, ... & Troxler TG (2022) **A social-ecological-technological systems framework for urban ecosystem services. *One Earth*, 5(5): 505–518.** <https://doi.org/10.1016/j.oneear.2022.04.007>
- Mahardja BM, **Bashevkin SM**, Pien C, Nelson, M, Davis BE & Hartman R (2022) **Escape from the Heat: Thermal Stratification in a Well-Mixed Estuary and Implications for Fish Species Facing a Changing Climate. *Hydrobiologia*, 849: 2895–2918.** <https://doi.org/10.1007/s10750-022-04886-w>
- Nelson PA, Baerwald M, Burgess, OT, **Bush E**, Collins E, Cordoleani F, **DeBey H**, Gille D, **Goertler PAL**, Harvey B, Johnson RC, Kindopp J, Meyers E, Notch 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>
- **Stern D, Chapple C & Copeland C** (2022) **The Dangerous Disappearance of Delta Dirt. *Frontiers for Young Minds: Where the river meets the ocean — Stories from San Francisco Estuary*, 20:1.** <https://doi.org/10.3389/frym.2022.613190>



#SciComm Corner

Delta Stewardship Council (@deltacouncil) announces [Henry DeBey](#) as its deputy executive officer for science.



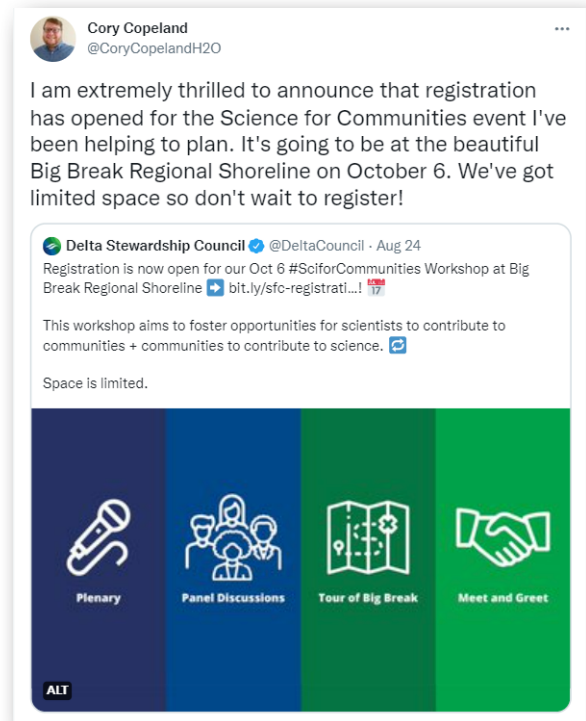
San Francisco Estuary Partnership (@SFEstuary) launches the [2022 Estuary Blueprint](#) and accompanying [video](#).



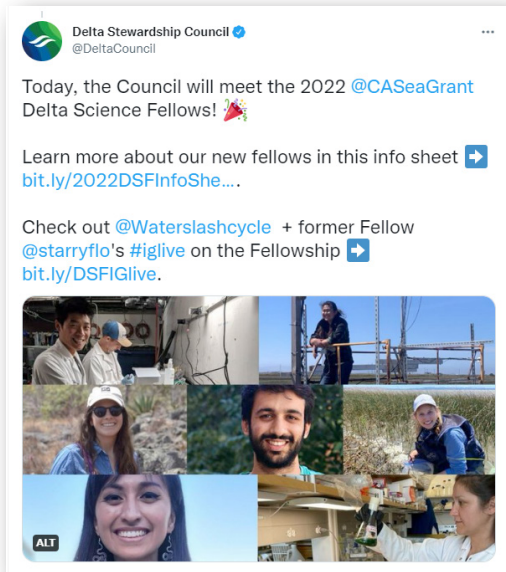
Dr. Jay Lund (@JayLund113) shares his blog, [Smarter Gambling with California's Water Challenges](#), which he co-authored with fellow Delta Independent Science Board Member Dr. Thomas Holzer.



Cory Copeland (@CoryCopelandH2O) encourages [registration](#) for the October 6 Science for Communities Workshop.



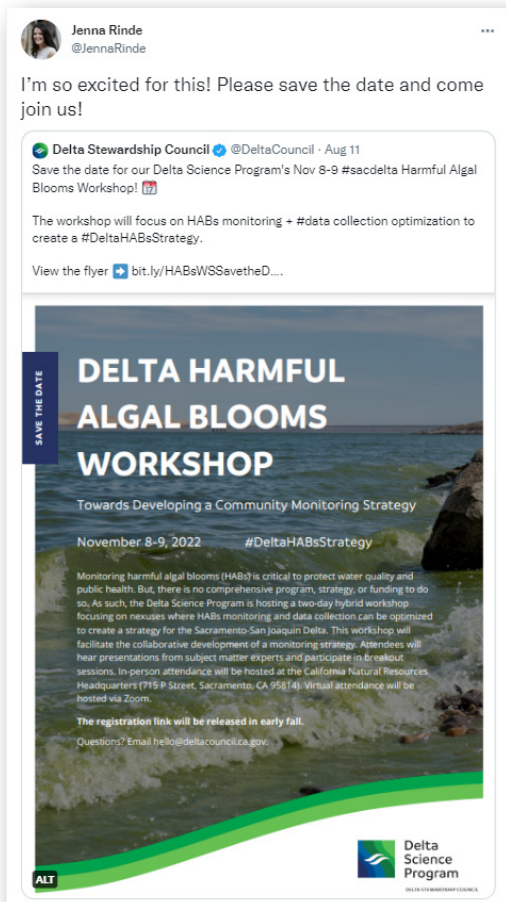
Delta Stewardship Council (@deltacouncil) announces the introduction of the [2022 Delta Science Fellows](#) at the July Council meeting.



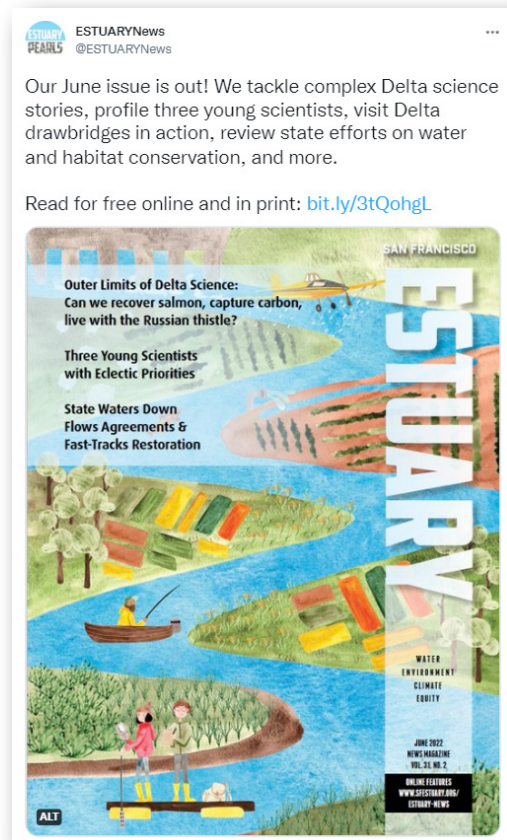
San Francisco Estuary Watershed Sciences (@SFEWS) drops [Volume 20, Issue 2](#) with articles on SF Estuary climate change impacts, spring run Chinook salmon juvenile production estimates, endangered salmonoids, and drained islands.



Jenna Rinde (@JennaRinde) shares the [save the date flyer](#) for the November 8-9 Delta Harmful Algal Blooms Workshop.



Estuary News Magazine (@ESTUARYNews) releases the [June issue](#) of the publication, which included [an interview with California Sea Grant Social Science Extension Specialist Jessica Rudnick](#).





Join Us: Events on the Horizon

October

- Science for Communities Workshop
Big Break Regional Shoreline
October 6
- Delta Independent Science
Board Meeting
October 13
- Advancing Interdisciplinary
Research Training
October 14
- Advancing Interdisciplinary
Research Workshop
October 20

November

- Delta Independent Science
Board Meeting
November 2-4
- Harmful Algal Blooms Workshop
November 8-9

December

- Delta Independent Science
Board Meeting
December 8

Visit the Council's [event web page](#).