




MAY 2022

Delta Breeze

A newsletter by the Delta Science Program

Delta Lead Scientist "Dear Colleagues"

This past Earth Day, April 22, was particularly special for us at the Delta Science Program because it was the day the 2022-2026 Science Action Agenda (SAA) was released, wrapping up nearly two years of intense work by the whole Sacramento-San Joaquin Delta (Delta) science community. For those who may be new to this community, the SAA is a pivotal part of our Delta Science Strategy. Its purpose is to identify science priorities for focused action at the four- to five-year timescale, where "action" encompasses funded research, events and other coordination, synthesis, and communication activities. For example, all research funded through the Delta Science Program's regular Proposal Solicitations and California Sea Grant Delta Science Fellowship Program must directly align with the SAA.

What's inside...

Delta Science Program

DELTA STEWARDSHIP COUNCIL

Other agencies, such as the California Department of Fish and Wildlife (CDFW), State Water Contractors, and U.S. Bureau of Reclamation (Reclamation) have also leveraged the SAA in their funding calls. **A principal objective of the SAA is to identify science that can address urgent Delta management gaps.** It is a road map that helps managers identify the science most needed for near-term investment, and helps scientists design research projects that can inform management. The Science Actions in the 2022-2026 SAA were developed through intensive community engagement, in which the most urgent management questions and science needs were collaboratively identified by workshop participants and survey contributors who included government, academic, nonprofit, and industry managers and scientists.

Earth Day is a day that imbues environmentally-minded people with hope, and this year's theme was Investing in Our Planet. For me, the release of the 2022-2026 SAA on Earth Day was particularly apt, because the document outlines exactly where our science needs to head to equip the Delta community with the capacity for resilience in the face of the increasingly rapid environmental change. **The challenges of increasingly frequent weather extremes, sea-level rise, warming temperatures, and ever-threatening species invasions require forward-thinking science that anticipates conditions never previously seen in the Delta and their impacts on ecosystems and the Delta as a place where people live, work, and recreate.** Anticipating future conditions requires complicated, integrative considerations: How will changes in the upstream watershed and downstream estuary impact water quantity, water quality, and biota in the Delta? How will management for one objective (e.g., increasing habitat) impact other management objectives (e.g., maintaining appropriate salinity)? How can models be developed that are compatible with other models and data to allow for a more complete assessment of the tradeoffs of different management actions? In short, it requires integration across institutions, geographic boundaries, disciplines, models and data that have heretofore been siloed. The 2022-2026 SAA embraces this multifaceted vision of integration; hence it gives me hope.

The SAA also gives me hope because of the collaborative way in which it was developed and has been used. It is a call for a more inclusive approach to science. The process of leveraging community engagement to set the priorities and objectives for scientific endeavors can go a long way toward developing trust in those endeavors, which is an essential prerequisite for the use of science in management decisions. In a recent communication I had with UC Davis Professor Dr. Mark Lubell about a Delta science governance survey he and collaborators recently conducted, he said the results revealed that the efficacy of adaptive management is highly correlated with indicators of leadership, trust, and engagement. **I hope that the trust built throughout the SAA process and the fulfillment of the SAA actions will accelerate the pace of Delta science and its incorporation into management.**

Finally, given the accomplishments of the previous 2017-2021 SAA, I feel particularly hopeful and excited about the future outcomes of the new 2022-2026 SAA. **In addition to directing over $35 million in science funding, the 2017-2021 SAA was cited in Governor Newsom's Water Resilience Portfolio (2020) as a model for the entire state on how to engage with diverse stakeholders to prioritize scientific questions surrounding management of water supplies, water quality, and flood risk.** Science findings from those funded investments help link management actions to outcomes for Chinook salmon populations; mobilization and transport of salt, nutrients, and mercury; and invasive aquatic vegetation species — just a few examples highlighted in this issue.

In this edition of the Delta Breeze, you will find information about how the 2022-2026 SAA came to fruition, the implementation of the SAA through competitive research proposals (some of which are spotlighted), and how progress on the 2017-2021 SAA was tracked and measured. Thanks to all of you out there who helped with the SAA process. I can't wait to see what it produces!

Dr. Laurel Larsen
Delta Lead Scientist

The Science Action Agenda: A Road Map for the Delta Science Community

The Delta is a large, complex estuary with many different habitats, plants, and animals and over 27 million people who rely on it for water, food, culture, recreation, and more. Consequently, a broad array of entities is tasked with managing the different needs of the ecosystem in balance with the needs of the people who rely on it. Universities, collaboratives, municipalities, non-governmental organizations, and government agencies conduct science throughout the system, all with unique mandates, goals, and scopes. The work is all important; rapidly changing climactic conditions and the interconnected nature of the estuary call for a more coordinated approach to science and science-based management.

Developed *by and for* the Delta science community, the SAA is a tool for unifying science in the Delta and furthering the vision of One Delta, One Science.

Scientists can use the SAA to determine what science activities are critical to informing management and, in turn, what actions may be eligible for science funding.

Managers can use the SAA to identify what science and management priorities are of shared interest across the Delta and to help shape organizational priorities.

Policymakers can use science outcomes from the SAA to inform decision-making.

The newly released 2022-2026 SAA was co-produced by the Delta Science Program and members of the Delta science community through a nearly two-year collaborative, inclusive, and transparent process. Input was received through public workshops, surveys, presentations, public comments, and at meetings with over 30 collaborative venues in the Delta. The 1,279 management questions initially compiled were organized, streamlined, distilled, and prioritized by Delta Science Program staff with feedback and review from the Delta community. Ultimately, more than 100 participants across nearly 50 entities dedicated their time and expertise to co-produce the SAA's final six Management Needs, 66 management questions, and 25 top science actions.

The Science Action Agenda in Practice: Competitively-Funded Research Projects

Because the SAA reflects the shared science priorities of the Delta scientific community, it can serve as a road map for anyone working in the Delta to help make decisions about science funding, coordinate multi-agency efforts, and strategic planning efforts for individual science programs. The Delta Science Program uses the SAA as a cornerstone for its competitive science funding program. The 2017-2021 SAA guided the selection of proposal solicitation awards totaling $10 million in collaboration with Reclamation and the State Water Contractors in 2021 and $17 million in collaboration with Reclamation and CDFW in 2019. Updates from three of the research projects funded through the 2019 solicitation are profiled below along with the 2017-2021 SAA Science Action Area(s) they address.

Project 1:
An improved genomic tool for characterizing life history diversity and promoting resilience in Central Valley Chinook salmon

Mariah Meek[1], Melinda Baerwald[2], Pascale Goertler[3], Shannon O'Leary[4], Tasha Thompson[5]

A school of juvenile chinook salmon

A scientist measuring a juvenile Chinook salmon during the Chipps Island trawl survey

Life history trait diversity is decreasing in Central Valley (CV) Chinook salmon, particularly with respect to juvenile migration timing. Migration timing is becoming more homogeneous, which decreases population resilience and buffering against environmental change. A major roadblock to identifying Chinook salmon caught in the CV is that few of the current methods allow for the identification of natal tributary or river basin of origin. This hampers the development of reliable run-specific abundance estimates and assessments of Chinook salmon life history diversity across the region. Using molecular high-throughput sequencing (for more information, see the preprint article "Every cog and wheel: Unraveling biocomplexity at the genomic and phenotypic level in a population complex of Chinook salmon"), Dr. Mariah Meek and her team at Michigan State University have genotyped thousands of juvenile

Chinook salmon tissue samples collected at Chipps Island and obtained from the CDFW CV Tissue Archive. These individuals are being assigned to their run and tributary or river basin of origin. This information will be used, in combination with environmental data on water temperature and river flows, to determine the relationship between environmental conditions and yearly juvenile life history diversity. **The information generated by this work will provide managers with the ability to accurately monitor the effect of key management actions on specific CV Chinook salmon populations.**

[1]Michigan State University
[2]California Department of Water Resources
[3]Delta Science Program (non-funded collaborator)
[4]Saint Anselm College
[5]University of California, Davis

Primary Science Action Area 4: Interactions between stressors, managed species, and communities
Secondary Science Action Area 3: Develop tools to support and evaluate habitat restoration

Project 2:
Integrated science and management of nutrient, salt, and mercury export from San Joaquin River wetland tributaries to the Delta

Peggy O'Day[1], Marc Beutel[1], Stephen C. Hart[1], Liying Zhao[1], Danielle Jones[1], Stefanie Helmrich[1], Mariana Estrada[1], Stephanie Segura[1], Nigel Quinn[2], Peter Nico[2], Vi Tran[2], Andrew Gordus[3], Carol DiGiorgio[4]

A scientist collecting water samples in a vegetated wetland pond

A scientist preserving a water sample collected in the field

The San Joaquin River (SJR) supplies about a third of the Delta's water. While salinity has been monitored and managed in tributaries to the upper SJR for several decades, factors that control the inputs of mercury and nutrients are not well known. This project builds on prior and ongoing work in real-time

environmental monitoring and decision-support modeling in the 140,000-acre Grasslands Ecological Area, which comprises State and federal refuge lands and private duck clubs. The main goal is to achieve adaptive co-management of multiple water quality stressors (salt, nutrients, mercury, and methylmercury) in managed seasonal wetlands.

Monitoring and sampling of seasonal wetlands within the Los Banos Wildlife Area has contributed to an improved understanding of mercury and nutrient cycling and export at the pond scale. Watershed modeling at the regional scale using the Watershed Risk Management Framework has focused on improving hydrologic simulations and salinity forecasting to inform pond management practices and expanding modeling to include mercury and methylmercury. In addition, the project team has created customized, automated scripts for use with a publicly available data management and visualization platform (HEC-DSSVue) that adds quality assurance capabilities for real-time flow and water quality data.

[1]University of California, Merced
[2]Lawrence Berkeley National Laboratory
[3]CDFW
[4]California Department of Water Resources

Science Action Area 5: Monitoring, data management, and modeling

Project 3:
Low-cost satellite remote sensing of the Sacramento-San Joaquin Delta to enhance mapping for invasive and native aquatic vegetation

Susan Ustin[1], Shruti Khanna[2], Erin Hestir[3]

Researchers conducting field vegetation surveys to inform satellite imagery analyses.

Invasive aquatic vegetation is widespread across the Delta but understanding how vegetation changes over time is limited by the frequency and regularity with which remote sensing data is collected (e.g., spectroscopy data is typically collected once per year by a single aerial flight). This study aims to fill temporal gaps in our understanding of vegetation dynamics using data collected from a recently launched satellite mission called Sentinel-2, which passes over the same location every 5 days. Data from Sentinel-2 is free to access, and the project team is developing algorithms and an effective workflow that can process the data as it becomes available so that effective and automated monitoring of aquatic and marsh plant communities year-round is possible. These methods provide a low-cost option for evaluating management questions related to restoration, vegetation responses to high- or low-flow events, as well as responses to control efforts for invasive plant species. In addition to studying vegetation dynamics, the project team is also evaluating the use of Sentinel-2 data to monitor the duration and extent of floodplain inundation in the Yolo Bypass. Ultimately, **this research will contribute to an improved understanding of vegetation dynamics while supporting agencies responsible for wetland restoration and management by providing a user-friendly Google Earth Engine interface that enhances the accessibility of remote sensing analysis. These efforts will support restoration site monitoring for years to come.**

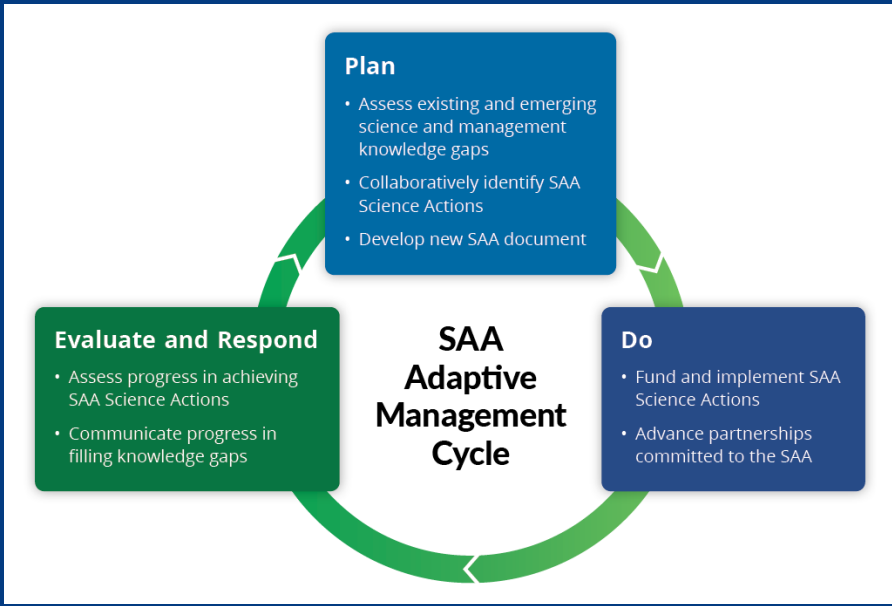
[1]University of California, Davis
[2]CDFW
[3]University of California, Merced

Primary Science Action Area 5: Monitoring, data management, and modeling
Secondary Science Action Area 3: Support and evaluate habitat restoration

The Road to Success: Measuring Science Action Agenda Progress

If the SAA is our road map to impactful collaborative science, how can we tell how far we've traveled? **The same way a GPS shows us our trip progress, the SAA Progress Summary tracks how far we've come since 2017.** It helps us answer the question, "to what extent have Science Actions been addressed?"

By working with the Delta science community to answer that question for each Science Action, we determined that the science community made significant progress, and progress was variable across SAA emphasis areas. Out of the 25 Science Actions, nine actions saw significant progress, thanks to a unifying



agenda and over $35 million in science investments. Some Science Actions saw less progress, which in turn influenced the development of the top 25 Science Actions included in the 2022-2026 SAA. For example, 2017-2021 Science Action A1A ("Implement studies to understand socio-economic adaptations to climate change") remained a major outstanding gap because very few studies have investigated human adaptations to climate change. To address this gap, Science Action 6D ("Identify how human communities connected to the Delta watershed are adapting to climate change, what opportunities and tradeoffs exist for climate adaptation approaches [i.e., agricultural practices, carbon sequestration, nature-based solutions/green infrastructure], and how behaviors vary with adaptive capacity") was included in the new SAA.

Equally important to knowing how far we've traveled is determining when to change course and adapt to new conditions. The previous iteration of the SAA took a gaps-and-glue approach, emphasizing actions that fell between the foci of a single program or agency but were otherwise recognized as multi-group priorities ripe for collaborative progress. In contrast, **the 2022-2026 SAA emphasizes integration** responsive to the complexity of Delta Management Needs shared across the Delta science community so that any progress will inherently benefit multiple entities. **Its six Management Needs focus on improving coordination across the system, enhancing monitoring and modeling, expanding multi-benefit approaches, building knowledge on human communities, acquiring new knowledge to support species recovery, and understanding and adapting to climate change.** The criteria used to prioritize the 2022-2026 SAA Science Actions within these six Management Needs — including scientific relevance, impact, and cost of no action — were updated from the 2017-2021 SAA and were vetted by participants of the SAA development process.

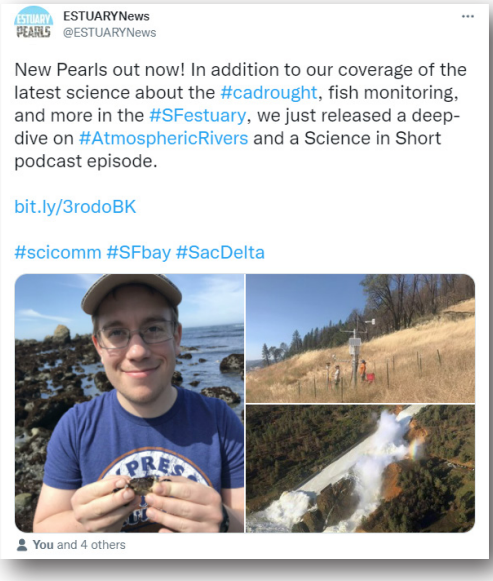
Moving forward, we will consider the benefit of more frequently assessing progress to enhance and adaptively manage the implementation of the 2022-2026 SAA (see SAA Adaptive Management Cycle figure above). This new approach and the 2022-2026 SAA's theme of integration seek to be more responsive to the complexity of management and challenges in the Delta that change quickly, span multiple disciplines, and cross geographic and regulatory boundaries. With this approach, the SAA can serve as a road map for more effective, focused, and coordinated action.

#SciComm Corner

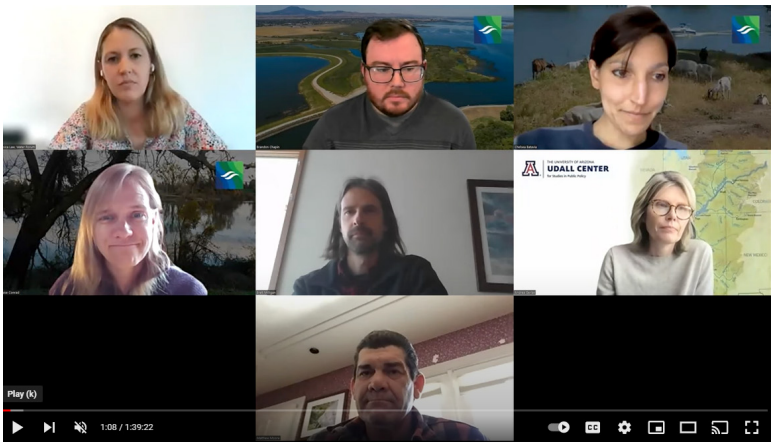
Cory Copeland (@CoryCopelandH20) promotes his new blog, "Building Bridges with Science for Communities," ahead of an upcoming workshop that will connect those who live, work, and recreate in and around the Delta with scientists who work in the region.

Delta Stewardship Council (@DeltaCouncil) announces the 2022-2026 SAA, which builds on the progress of the 2017-2021 iteration and toward a vision of integration.

Estuary News Magazine (@ESTUARYNews) announces a new edition of Estuary News Pearls and a new Science in Short Podcast episode, "Daylighting Delta Data," featuring Delta Science Program Sr. Environmental Scientist, Sam Bashevkin.



San Francisco Estuary Watershed Science (@SFEWS) drops SFEWS Volume 20, issue 1 with articles on salmon growth, Steelhead monitoring, relative bias among monitoring surveys, molecular pathogen screening assays, and identifying organic matter sources.



Event Recordings

- **Governance brown bag webinar series:**
  Environmental Governance
  Collaborative Governance
  Adaptive Governance

- **Interagency Ecological Program 2022 Workshop:**
  Welcome & Sessions (available until June 30th)

- **Delta lead scientist Instagram live sessions:**
  The Delta Science Tracker
  Science Synthesis
  The SAA

- **Salinity Management Workshop #1:**
  Day 1
  Day 2

Events on the Horizon

June

- Delta Independent Science Board meeting
  June 8–10

July

- Delta Independent Science Board meeting
  July 14

August

- Delta Independent Science Board meeting
  August 10–12

Fall

- Salinity Management Workshop #2
  TBD
- Science for Communities Workshop
  TBD
- Harmful Algal Bloom Workshop #1
  November 8–9

To learn more, view the Events Calendar web page.