Interagency Ecological Program
2026 Annual Workshop

ABSTRACTS

March 16-18, 2026

Interagency
Ecological Program

COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

Oral presentation abstracts are organized in order they appear in the program and poster abstracts are organized by category and alphabetized by poster author's first name.

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2026 IEP Workshop Oral Presentations

Plenary and oral sessions and speakers.

- **Session 1: Plenary 1**
  - Guest Speaker Dr. Carl Boettiger

- **Session 2: New Technologies (including AI) (3 speakers)**
  - Kai Ross
  - Bobbie Flores
  - Lucy Andrews

- **Session 3: Management, Policy, and Social Science (4 speakers)**
  - Brian Mahardja (*not recording presentation*)
  - Brian Healy (*not recording presentation*)
  - Ash Zemenick
  - Chase Ehlo
  - Autumn Fisher (*early career award candidate*)

- **Session 4: Salmon (5 speakers)**
  - Derrick Alcott
  - Christopher Diviney
  - Ryan Kok
  - Crystal Rigby (*early career award candidate*)
  - Benjamin P. Burford

- **Session 5: Lightning Talks 1 (5 speakers)**
  - Hollis Jones
  - Ching-Fu Chang
  - Deirdre Des Jardins
  - Kim Brewitt

- **Session 7: Plenary 2**
  - Guest Speaker Trinh Nguyen
  - Guest Speaker Dr. Joseph E. Merz

- **Session 8: Delta or Longfin Smelt (Part 1) (3 speakers)**
  - Florian Mauduit
  - Sebastian Gonzales (*early career award candidate)*
  - Claudia Macfarlane

- **Session 9: Delta or Longfin Smelt (Part 2) (3 speakers)**
  - Leo Polanksy
  - Morgan Gilbert
  - Christina E. Burdi

- **Session 10: Physical and Biological Effects of Flow (4 speakers)**
  - Wim Kimmerer
  - Angelika Kurthen

    - Rosemary Hartman
    - Kelly Hannan

- **Session 11: Zooplankton and Other Invertebrates (3 speakers)**
    - Kyle Phillips
    - Daniel Ellis
    - Bryan Barney

- **Session 13: Plenary 3**
    - Guest Speaker Ted Flynn

- **Session 14: Lightning Talks 2 (5 speakers)**
    - Meghan Holst (*early career award candidate)*
    - Lee Murai
    - Ravi Nagarajan
    - Jonathan Huang (*early career scientist)*
    - Lu Han

- **Session 15: Wetland Habitats (5 speakers)**
    - Kimberly Evans (*early career award candidate)*
    - Elsie Platzer (*early career award candidate)*
    - Bailey D. Morrison
    - Anthony Donahue (early career award candidate)
    - Kristen Dybala

- **Session 16: Contaminants, Nutrients and Water Quality (3 speakers)**
    - Amelie Segarra
    - Hadis Miraly
    - Michelle Stern

- **Session 17: Phytoplankton, Algae, or Harmful Algal Blooms (5 speakers)**
    - Kyle Leathers (early career award candidate)
    - Ellen Preece
    - Alice Tung (*early career award candidate; not recording presentation*)
    - Nicholas Framsted (*early career award candidate*)
    - Keith Bouma-Gregson

- **Session 18: Delta or Longfin Smelt (Part 3) (2 speakers)**
    - Veronica Violette (not recording presentation)
    - Matt Young

Oral presentation abstracts are organized in the order they appear in the program.

Sessions 1, 7, and 13 are the opening plenary talks on each day of the workshop. Sessions 6 and 12 (not shown above) are dedicated Poster Sessions on days 1 and 2 of the workshop in rooms 2-221 B-C.

Session 1: Plenary I

AI Without Data Centers? Local Models and Agentic Tools in Conservation

- Dr. Carl Boettiger*, U.C. Berkeley, Rausser College of Natural Resources, Dept. of Environmental Science, Policy & Management, cboettig@berkeley.edu

**Invited Plenary Speaker*

Environmental organizations face a devil's bargain with Artificial Intelligence: the desire for transformative insights weighed against the massive carbon footprint, water consumption, and centralized power of corporate data centers. Some have responded with outright bans, but an alternative path is emerging—one that decouples AI from the data center through the synergy of local models and specialized tool-use.

This talk explores how the moat of massive computing requirements is being bridged by high-performance, open-weights models (such as DeepSeek, Llama, and Qwen) that run on modest, local hardware. These models prioritize efficiency and privacy, allowing researchers to retain absolute control over sensitive environmental data. Rather than rely on brute force of large models that seek to memorize everything, I will discuss the emerging approach of simply teaching models to use tools.

I will demonstrate this paradigm through a practical application in conservation decision-making. By integrating local LLMs with an MCP data server and dynamic web mapping, I illustrate how researchers can build sophisticated, agentic workflows that query real-world spatial data without sending information to a central cloud. This approach shifts the focus from bigger models to smarter integrations, empowering the scientific community to develop specialized AI tools that are ecologically responsible, secure, and tailored to the unique demands of biodiversity and land management.

Research Background:

Dr. Carl Boettiger works on problems in ecological forecasting and decision making under uncertainty, with applications for global change, conservation and natural resource management. He is particularly interested in how we can predict or manage ecological systems that may experience regime shifts: sudden and dramatic changes that challenge both our models and available data. The rapid expansion in both computational power and the available ecological and environmental data enable and requires new mathematical, statistical and computational approaches to these questions. Ecology has much to learn about what are and are not useful from advances in informatics & computer science, just as it has from statistics and mathematics. Traditional approaches to ecological modeling and resource management such as stochastic dynamic systems, Bayesian inference, and optimal control theory must be adapted both to take advantage of all available data while also dealing with its imperfections. His approach blends ecological theory with the synthesis of heterogeneous data and the development of software -- a combination now recognized as data science.

Session 2: New Technologies (including AI)

An AI Pipeline for Faster-Than-Real-Time Fish Passage Video Processing: Increasing Efficiency to Provide Timely Passage Data

- Kai Ross*, Cramer Fish Sciences, kai.ross@fishsciences.net
- Andrew Veary±, Cramer Fish Sciences
- Matt Saldate, East Bay Municipal Utility District, Fisheries & Wildlife Division

**Presenting author, ± Co-Presenting Author*

Manual analysis of video footage at anadromous fish passage facilities requires thousands of hours of expert time, creating a major bottleneck for environmental monitoring. To automate and improve this process, we developed a novel artificial intelligence (AI) pipeline that provides faster than real-time, high-throughput analysis of fish passage footage (e.g., 24 hours of footage processed in ~5 hours) at a fish ladder on the lower Mokelumne River, California, a stream that supports both natural and hatchery production of Chinook Salmon and steelhead. Our system uses a combination of deep learning and machine learning models to automatically detect fish, classify species, and assess fin-clip status, sex, and fork length. The pipeline also tracks individual fish to estimate abundance and passage rates, producing objective and standardized outputs that directly mirror metrics from manual review. When tested on manually processed video footage, the system achieved 97.7% accuracy on total count, while identifying fish by species, sex, and fin clip status. The software's modular design allows it to be rapidly adapted for new monitoring sites and species by retraining on local image data, making the approach scalable and transferable across regions. By delivering high efficiency, consistency, and scalability, this AI-driven workflow transforms fish passage monitoring into an automated process with reduced bias that enables biologists to shift their focus from data collection to high-level data interpretation.

An Engineered Ecosystem: Productivity and Food Web Function in the Sacramento Deep Water Shipping Channel

- Bobbie Flores*, Cramer Fish Sciences, bobbie.flores@fishsciences.net
- Lis Cordner±, Cramer Fish Sciences, lis.cordner@fishsciences.net
- Kai Ross, Cramer Fish Sciences
- Jesse Anderson, Cramer Fish Sciences
- Joseph E. Merz, Cramer Fish Sciences

**Presenting author, ± Co-Presenting Author*

The Sacramento Deep Water Shipping Channel (DWSC), originally built for commerce, has become a surprisingly productive ecosystem that supports native fish, including the imperiled Delta Smelt (*Hypomesus transpacificus*). These observations challenge assumptions about the ecological role of modified waterways and suggest that the DWSC may contribute meaningfully to regional food web dynamics.

It was recently hypothesized that the DWSC functions as a "productivity reservoir"- a zone where channel morphology and water dynamics interact to enhance nutrient cycling and phytoplankton growth and zooplankton abundance. It was further hypothesized that this localized productivity can be strategically mobilized through managed channel operations to benefit downstream habitats, providing a potential tool for ecosystem-based management.

To investigate these hypotheses, we conducted an integrated field study from 2021 to 2024 using the patented Aquatic Habitat Sampling Platform capable of passively collecting concurrent data on juvenile fish, zooplankton, depth, vegetation, and water quality. We also integrated publicly available data on tidal stage and wind. This approach allows us to directly link biological and environmental patterns in the DWSC and to evaluate how channel conditions influence aquatic food webs through space and time.

This presentation will outline the study design, present results, and explore opportunities to leverage existing infrastructure to support Delta ecosystem objectives. By viewing the DWSC as an active ecological component rather than solely a navigation corridor, this work aims to inform management strategies of the potential to utilize engineered systems to sustain productivity and native fish populations in the San Francisco Estuary.

Using LLMs and Automated Data Science Workflows to Inventory DWR's Contributions to Scientific Literature

- Lucy Andrews*, California Department of Water Resources, lucy.andrews@water,ca,gov
- Louise Conrad[±], California Department of Water Resources

**Presenting author, [±] Co-Presenting Author*

The California Department of Water Resources (DWR) supports peer-reviewed research across diverse scientific disciplines through both authorship and funding. To evaluate DWR's contributions to scientific literature over the past five years and to pilot generative artificial intelligence tools in data science, we developed an automated workflow that retrieves DWR-authored and DWR-funded publications from online catalogs, cleans and standardizes the data, identifies the nature of DWR's contributions, classifies publications by scientific field, and generates an interactive and searchable inventory. The workflow harnesses large language models to classify abstracts and parse and normalize unstructured text. This presentation will describe DWR's workflow for creating a publication inventory, highlight what we can observe about DWR's science through the inventory, introduce the open-source R package we developed to enable others to build similar inventories, and share insights about the capabilities and limitations of large language models for this type of analysis.

Session 3: Management, Policy, and Social Science

Application of a Rapid Structured Decision-Making Approach to Inform Delta Smelt Freshwater Outflow Management - Part I

- Brian Mahardja*#, Metropolitan Water District of Southern California, Bmahardja@mwdh2o.com (current affiliation; former affiliation U.S. Bureau of Reclamation)
- Brian D. Healy, U.S. Geological Survey
- Corey Phillis, Metropolitan Water District of Southern California

**Presenting author, #This presentation will not be recorded during the workshop.*

Freshwater management in California, USA, has long been a complex and controversial issue. While the state's extensive network of reservoirs and water diversions is vital to its economy, these systems have also contributed to the decline of many native species. In an effort to aid the recovery of the endemic and endangered Delta Smelt (*Hypomesus transpacificus*), a specific action—increasing freshwater outflow through the Delta in the fall—has been implemented in wet years since 2011. This action requires either releasing water from storage reservoirs or curtailing diversions meant to support human consumptive uses. The effectiveness and timing of this action have recently been questioned due to new findings from an analysis using an updated life-cycle model. Any decision to alter or replace this management action requires careful consideration of the trade-offs between various water uses. We will present a case study focused on Central Valley water management using Structured Decision Making (SDM), a collaborative approach to solving complex, multi-objective problems. We will provide an overview of the SDM framework before delving into a specific application that occurred in the spring of 2025 concerning the Delta Smelt fall flow action. This will include a summary of the decision context and the shared objectives developed by the decision-makers and interest holders during the process.

Application of a Rapid Structured Decision-Making Approach to Inform Delta Smelt Freshwater Outflow Management - Part II

- Brian D. Healy*#, U.S. Geological Survey, bhealy@usgs.gov
- Corey Phillis, Metropolitan Water District of Southern California

**Presenting author, #This presentation will not be recorded during the workshop.*

Managers of the Central Valley Project (CVP) and State Water Projects (SWP) in the Central Valley of California, United States, are confronted with contentious and difficult tradeoffs between beneficial uses affected by water management decisions. These decisions involve altering the timing and magnitude of water releases from an extensive network of dams and reservoirs affecting habitat for economically important federally- and state-listed endangered fishes, water deliveries for agriculture or municipalities, and water quality. Declines in federally endangered fishes and mandates to maximize water deliveries for human uses triggered a structured decision-making (SDM) process to assist management agencies in confronting these tradeoffs while gathering input from cooperating agencies and interested parties (hereafter participants) through workshops in spring of 2025. Within a multicriteria decision analysis context, we used a water planning simulation model (CalSim3) and species-specific life cycle models to predict consequences and analyze tradeoffs between water management alternatives, which were ranked based on four individual participating organizations' objective weights. The three highest ranking water management alternatives performed poorly for Delta Smelt but performed best for CVP and SWP water exports and objectives related to coldwater pool operations for salmonids. While an optimum strategy that would maintain persistence of Delta Smelt was elusive, insights gained from the rapid prototype decision analysis suggested non-flow actions and other conservation actions benefitting Delta Smelt, including in drier years, could be beneficial when curtailment of water exports to implement freshwater flow management for Delta Smelt is not possible.

Assessing the Impact of Delta Science Program Funded Research on Decision Making in the Sacramento-San Joaquin Delta

- Ash Zemenick*, Delta Stewardship Council, ash.zemenick@deltacouncil.ca.gov
- Audrey Cho[1], Maggie Christman[2], Henry DeBey[2], Lauren Hastings[2], Rachael Klopfenstein[2], Kim Luke[2], Megan Nguyen[2], Xoco Shinbrot[2], Vivian Sieu[3], Dylan Stern[2], Lisamarie Windham-Myers[2, 4]

[1] Delta Stewardship Council
[2] Delta Science Program
[3] California Sea Grant
[4] U.S. Geological Survey

**Presenting author*

The mission of the Delta Science Program (DSP) is to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Sacramento-San Joaquin Delta (Delta). One avenue to achieve this mission is to fund research that aids in decision-making in the Delta. However, how DSP-funded science impacts decision making in the Delta is currently not well defined. Therefore, we are utilizing research impact assessment (RIA) framework to assess the impacts of the DSP-funded research, beginning with the 2019 Delta Research Awards and 2020 Delta Science Fellows, as it commonly takes up to nine years for management and policy impacts to arise from research. RIA is similar to assessing return on investment, but instead of assessing financial returns of funded research we instead focus on broader societal benefits of funded research. While there is no single process or checklist for evaluating research impact, one established method is to utilize a logic model to break down the impact process. To do this, we defined a logic model that outlines inputs, activities, outputs, outcomes, and impacts of DSP-funded research. For each step of the logic model, we identified key metrics that measure progress towards impact in the Delta. For example, for each project we tracked the money allocated, scientists funded, institutional affiliations, project topic, presentations, publications, reports, media, broader impacts, whether the funded research influenced Delta restoration projects, policy, or management, and more. Overall, we believe that the RIA framework allows the DSP to track the ultimate impacts of funded research and demonstrate the DSP's benefits to the Delta. Measuring the impact of DSP-funded research will not only document the benefits of funding research but will also help the DSP to adaptively manage funding solicitations to maximize impacts to the Delta in the future.

Protecting Central Valley Steelhead: How Reactive Management Misses the Bigger Picture

- Chase Ehlo*, Cramer Fish Sciences, chase.ehlo@fishsciences.net (current affiliation; former affiliation U.S. Bureau of Reclamation)
- Brian Mahardja, Metropolitan Water District of Southern California (current affiliation; former affiliation U.S. Bureau of Reclamation)
- Josh Israel, U.S. Bureau of Reclamation

**Presenting author*

The species *Oncorhynchus mykiss* (*O. mykiss*) exhibits remarkable life history diversity, allowing populations to persist across a range of environmental conditions, contributing to the species' broad geographic distribution around the world. In the Central Valley of California, a distinct population of anadromous *O. mykiss*, the Central Valley steelhead (CCV steelhead), have been impacted by human development resulting in listing under the Endangered Species Act in 1998. To complete their anadromous life cycle, CCV steelhead must outmigrate through the heavily modified Sacramento- San Joaquin Delta (Delta) where freshwater is exported south at large pumping facilities. Mortality of fish associated with these export facilities has been implicated as a driver of decline of multiple native fish species including the CCV steelhead. However, no quantitative estimates exist to assess population-level effects of these operations on CCV steelhead, and doing so requires understanding environmental drivers of steelhead loss at the export facilities. CCV steelhead typically spend 1–3 years in freshwater before outmigrating, with the expression of anadromy versus residency strongly shaped by environmental conditions like flow and temperature in early freshwater years. We developed a negative binomial model to evaluate steelhead entrainment in the context of these environmental conditions and found that tributary conditions from previous years are as important as, or more important than, contemporary Delta hydrodynamics shaped by water exports. These findings suggest that management strategies focused solely on same-year operational changes to reduce mortality of CCV steelhead may not adequately reflect interannual variability in steelhead entrainment risk and highlights the importance of incorporating multi-year environmental data into decision-making frameworks specific to the species.

Comparison of Fish Species Catch between Beach Seine and Boat Electrofishing Methods of Near Shore Sites

- Autumn Fisher*†, U.S. Fish and Wildlife Service, autumn_fisher@fws.gov
- Jacob Stagg, U.S. Fish and Wildlife Service
- Bryan Matthias, U.S. Fish and Wildlife Service

**Presenting author, †Early Career Award candidate*

The Lodi Fish and Wildlife Office (LFWO) performs fisheries monitoring sampling of the Sacramento-San Joaquin River Delta (Delta) using a standardized beach seine survey to determine juvenile fish species abundance in the Delta. In recent years, boat electrofishing has been added to LFWO sampling to supplement beach seine data and extend sampling coverage into habitats unsuitable for beach seining. Starting in 2024 a directed study was initiated to compare the two surveys. The study builds upon the existing beach seine and boat electrofishing surveys by sampling the same geographic location on consecutive days. This paired survey design allows for the direct comparison of fish assemblages and identifies potential limitations in each sampling method. Fish catch will be compared at each site by total fish counts, fork length size, and fish species as they correspond to each survey. This approach enables us to determine which species are caught by both methods at the same site, and whether those species can serve as indicators of occurrence in the corresponding survey. These results will highlight the complementary strengths of electrofishing and beach seining in characterizing fish assemblages within the Delta.

Session 4: Salmon

Chinook Salmon Floodplain Usage and Behavior in the Lower Sacramento River

- Derrick Alcott*, California Department of Fish and Wildlife, derrick.alcott@wildlife.ca.gov
- Alexandra Wampler, University of California, Davis
- Eric Holmes, California Department of Water Resources
- Nann Fangue, University of California, Davis
- Carson Jeffres, University of California, Davis
- Andrew Rypel, Auburn University

**Presenting author*

Following widespread infrastructure development in the early 20th century, the Sutter and Yolo Bypasses now represent the majority of floodplain habitat acreage in the Sacramento River system that is accessible to migrating juvenile Chinook salmon. Access to these flood bypasses is largely thought to be provided via weir overtopping events. However, we analyzed recent acoustic telemetry data from two experimental receiver locations within Sutter Bypass and found that many more fish may access the Sutter Bypass via "backfilling" than via weir overtopping. Backfilling occurs when high river stage in the Sacramento River at the Feather River confluence causes flow to reverse and flow upstream into the lower Sutter Bypass. These in-bypass sites also allowed us to explore spatiotemporal habitat usage within the bypass. We found a variety of habitat usage behaviors, with utilizing the upper portion of the bypass for the majority of residency being most common. Finally, while off-channel habitat acreage is severely limited in the Sacramento River below Tisdale, there is evidence to suggest considerable stopovers do occur dispersed throughout these regions. These findings have important implications for resource managers and restoration efforts.

Monitoring Record Numbers of Adult Spring-Run Chinook in the Lower Tuolumne River

- Christopher Diviney*, California Department of Fish and Wildlife, Christopher.diviney@wildlife.ca.gov

**Presenting author*

Central Vallet Spring-run Chinook (SR) have been extirpated from the San Joaquin River (SJR) and its tributaries in the last century. Heavy winter and spring flows bring SR upstream to areas accessible only with elevated river levels. After migrating far upstream these fish hold in deep pools with cold temperatures throughout the summer until spawning in late September into October. Since 2014, the San Joaquin River Restoration Program (SJRRP) has continually released SR upstream of the Merced River to reintroduce salmon to the SJR. Small numbers have been found in the Tuolumne River in the years following the SJRRP release. High spring flows in April of 2025 attracted over 1000 SR into the lower Tuolumne River. These fish were observed at the base of La Grange Dam and downstream for roughly three miles. After flows receded there were large numbers of SR observed in a pool just below the dam with no access to upstream or downstream habitat. 410 salmon were captured and transported to the pool directly downstream where they can access spawning habitat further downstream in the fall. Throughout the summer California Department of Fish and Wildlife (CDFW) monitored temperatures and flows to better understand what conditions the SR are encountering in the lower Tuolumne River. Temperatures throughout the summer in areas holding SR remained optimal for SR to persist until spawning in late September. Spawning is being documented on the lower Tuolumne River by CDFW, and efforts continue to estimate abundance, retrieve samples and recover coded-wire tags from hatchery fish to determine which river they originated from. The presence of SR in record numbers in the lower Tuolumne River has been the best opportunity to understand and gain knowledge of SR habitat and sustainability in any tributary to the SJR.

Steelhead Spawning and Distribution During Five Years of Redd Surveys on the Stanislaus River

- Ryan Kok*, California Department of Fish and Wildlife, ryan.kok@wildlife.ca.gov

**Presenting author*

Dedicated steelhead monitoring in the San Joaquin River and its tributaries has historically been very limited apart from the annual steelhead fishing report cards that were implemented by the California Department of Fish and Wildlife (CDFW) in 1991. To improve management decisions, additional long-term studies were needed to better understand the fishery and populations. In 2021 the CDFW began a steelhead redd survey on the Stanislaus River to evaluate the amount and distribution of steelhead spawning as one component of the steelhead life cycle monitoring program. We evaluated the timing, distribution, and redd sizes of different species across five years of surveys. These findings will help us to better understand the life histories of some under studied fish species on the Stanislaus River and provide additional considerations for future management decisions.

Evaluating Patterns of Juvenile Chinook Salmon Out-Migration During Pulse Flow Events in California's Sacramento River to Minimize Fish Screen Exposure at the Location of a Newly Proposed Water Infrastructure Project

- Crystal Rigby*†, California Department of Fish and Wildlife, crystal.rigby@wildlife.ca.gov

**Presenting author, †Early Career Scientist*

Large-scale water infrastructure projects (i.e., dams, export facilities, and water conveyance structures) are necessary for human development but often come at the expense of native fish species. A new water infrastructure project has been proposed in California's Sacramento River (a tributary of the San Francisco Estuary), the Delta Conveyance Project, which has the potential to further affect threatened and endangered Chinook Salmon (Oncorhynchus tshawytscha) populations by exporting water during juvenile out-migration, thereby, exposing juvenile salmon to an increased risk of impacts associated with intake structures. We use a Bayesian mixed effects hurdle model to evaluate whether out-migrating juvenile Chinook Salmon catch at monitoring sites near the proposed location of the Delta Conveyance Project intakes differs on the ascending or descending limb of pulse flow events in an effort to inform future water infrastructure practices. Specifically, we evaluate whether out-migrating juveniles move with the ascending limb and are, therefore, flushed out of the system near the location of the intakes during the descending limb, suggesting exporting water during the descending limb will minimize impacts associated with intake structures. We determined that Chinook Salmon catch increases with proximity to peak flow (i.e., increases throughout the ascending limb of the hydrograph and decreases throughout the descending limb of the hydrograph) with significantly higher catch in the descending limb relative to the ascending limb. Our results indicate that increasing water exports during any period of pulse flow events, particularly during the descending limb, will increase risks to Chinook Salmon and highlight the need to protect pulse flow events to maximize species and ecosystem protections.

Facilitated Migration Could Bolster Migrant Passage Through Anthropogenically Altered Ecosystems

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- Jeremy Notch, University of California, Santa Cruz and NOAA NMFS SWFSC Santa Cruz
- William Poytress, U.S. Fish and Wildlife Service
- Cyril Michel, University of California, Santa Cruz and NOAA NMFS SWFSC Santa Cruz

**Presenting author*

Anthropogenic habitat change frequently outpaces the adaptive capacity of migratory taxa, placing many species and populations at risk of extirpation or extinction due to the mismatch of natural migration phenology and suitable conditions. While dynamic protection can greatly benefit migratory species, it is contingent on the flexibility of relevant management actions. For regulated ecosystems where advanced management planning is required, we present a new framework—facilitated migration—for actively matching natural migration phenology with suitable conditions for successful migrant passage. Using a case study of juvenile Chinook salmon (Oncorhynchus tshawytscha) oceanward migration in the Sacramento River, a major bottleneck to the recovery of imperiled populations in California, we show how the conditions associated with migration preparation, migration initiation, and successful migrant passage could be regulated to benefit migrants. Thermally shifted preparation, flow pulse-mediated initiation, and passage protection via increased flow, all accomplished by controlling the release of water from storage reservoirs, could increase the number of natural-origin Chinook salmon populations successfully migrating to the ocean by 43%–479% compared to the status quo management scenario. To further inform expected outcomes, we find that the temporal scope and diversity of juvenile salmon lifestages studied via acoustic telemetry should be expanded, and that the range of flows and flow changes that juvenile salmon experience should be increased. Facilitated migration works by synchronizing migration—thus, a prudent course of action when implementing this strategy would be to favor event quality over event quantity. In forcing scientists and managers to critically evaluate how migrations can be supported and manipulated, facilitated migration will help migratory species persist in anthropogenically altered ecosystems.

Session 5: Lightning Talks 1

2026 Delta Science Plan: Vision, Principles, and Approaches for Coordinating, Conducting, and Communicating Science in the Delta

- Hollis Jones*, Delta Stewardship Council, hollis.jones@deltacouncil.ca.gov

**Presenting author*

The Sacramento-San Joaquin Delta is a complex socio-ecological system, reshaped by over a century of human-driven modifications to convey water across the state. In alignment with the coequal goals of the Delta Reform Act—to ensure a more reliable water supply for California and to protect, restore, and enhance the Delta ecosystem—the Delta Stewardship Council, in collaboration with the Delta science community, has updated the Delta Science Plan. The Delta Science Plan aims to provide the vision, principles, and approaches for coordinating, conducting, and communicating science in the Sacramento-San Joaquin Delta. This update is composed of 24 actions structured around four Grand Challenges facing the Delta; inspired by the National Research Council's Grand Challenges in Environmental Science. Grand Challenge #1 – Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today. Grand Challenge #2 – Environmental change is outpacing the traditional pace of science. Grand Challenge #3 – Flows of scientific information remain decentralized and poorly connected to communities and decision-makers. Grand Challenge #4 – Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making. In addition to the core content, the Delta Science Plan also includes eight Resources that provide practical and useful information for the Delta science community and are responsive to the actions within. Two new resources have been added to this iteration: 1) Making Science Whole – Embedding Social Science in Natural Science Workflows; and 2) Data Governance, Portals, and Online Resources. To involve the broader Delta community, the draft 2026 Delta Science Plan was released for public comment in November 2025 to receive feedback and the final version is expected in Spring 2026.

Models of Physical Transport and Salmonid Responses to Aid Delta Operations and Large-scale Analyses

- Ching-Fu Chang*, Contra Costa Water District, cchang@ccwater.com

**Presenting author*

The Delta Simulation Model II (DSM2) includes a suite of useful modules for simulating hydrodynamics, physical transport, as well as salmonid responses, all of which are valuable information when reviewing historical conditions, managing real-time operations, or planning projects and studies. However, one of the practical challenges to incorporating DSM2 analyses is its computational demand, especially for simulating particle transport and movement.

In this study, we established several models to emulate the transport of positional particles and the responses of salmonid particles. In addition, we defined a suite of hydraulic footprint indices that are simplified indicators of the underlying hydrodynamic transport in central and south Delta.

The models and the hydraulic footprint indices provide practical advantages compared to DSM2, such as simple input structure and low computational demand. We also purposedly developed the models and indices with a wider range of operational limits than recent and current permits and regulations, which makes them more reliable in planning studies or when facing atypical operation scenarios.

The models and hydraulic footprint indices were applied in hindcast analyses to demonstrate their potential usefulness. We demonstrated how the models and indices provide a direct linkage from changes in flows and operations to the extent of hydrodynamic transport, which, when combined with survey observations and environmental conditions, could provide insight for species entrainment management. Finally, a dashboard for easy implementation of these tools will be provided.

Forced Shifts in California Hydroclimate

- Deirdre Des Jardins*, Climate Action California, California Water Research, ddj@cah2oresearch.com

**Presenting author*

Integrating Decadal-Scale Climate Shifts into Bay-Delta Ecosystem Analysis

Recent paleo-climatological research has redefined California's climate history, identifying the period from 1978 to 1999 as the wettest megapluvial in the last 1,200 years, which was immediately followed by the 2000-2022 megadrought—the driest period in that same record. These dramatic swings correspond to major Pacific climate shifts documented in 1976-77 and 1998-99, which profoundly altered Sacramento and San Joaquin River flows and the Delta ecosystem.

Crucially, groundbreaking attribution science now demonstrates that these may no longer be purely natural cycles. The persistent negative phase of the Pacific Decadal Oscillation (PDO), a key driver of the recent megadrought, could be significantly forced by human emissions of aerosols and greenhouse gases.

Nonlinear analysis techniques can help with understanding the impact of these forced shifts on California hydroclimate, as well as nonlinear increases in temperature in watersheds associated emergence from the warming hiatus in 2013. This context may help with understanding how ecological signals in long term datasets have been impacted by these anthropogenically forced regimes.

Using Echosounders to Estimate Northern Anchovy Abundance and Associated Predation Risk to Longfin Smelt in the San Francisco Bay-Delta

- Kim Brewitt*, ICF, kim.brewitt@icf.com
- Jason Hassrick, ICF

**Presenting author*

Longfin smelt (*Spirinchus thaleichthys*) abundance in the San Francisco Estuary has declined dramatically over the past five decades, and the species is now listed as endangered by the U.S. Fish and Wildlife Service. Longfin smelt abundance is highly responsive to freshwater outflow from the Delta, yet the underlying mechanisms for decline remain unknown. Our study investigates the risk of predation by northern anchovy at higher salinities. We hypothesize that higher flow (lower X2), which results in strong estuarine circulation with a landward bottom flowing layer, decreases the time that bottom-oriented longfin smelt larvae are exposed to high salinity and associated predation by anchovies. We combined active sonar surveys for northern anchovy with sampling for larval longfin smelt using depth-stratified tows taken by day and night in the spring of 2024 and 2025. Longfin smelt larvae showed the highest catches near the bottom, implying downward movement that enhances retention. Active sonar surveys indicate anchovies overlap with post-larval longfin smelt at the high end of their salinity range, especially in May and June when X2 shifted upstream, with higher salinities in Carquinez Strait. Anchovy densities also overlapped with longfin smelt near the bottom by day, while anchovies were spread throughout the water column by night. In addition, comparison of concurrent echosounder and trawl data demonstrates the echosounder's ability to capture accurate densities in an estuarine environment and generate more precise abundance estimates than trawling.

Session 7: Plenary 2 (Trinh Nguyen)

The Augmented Biologist: Using Generative AI for Technical Workflows and Exploration

- Trinh Nguyen*, California Department of Fish and Wildlife, trinh.nguyen@wildlife.ca.gov

**Presenting author*

Modern IEP science sits at an increasingly complex intersection of biology, statistics, and computer science, which often creates barriers between our biological questions and potential insights. In this talk, I will explore how Generative AI can help overcome these obstacles in our technical work through the lens of *Intelligence Augmentation* (IA), i.e., the use of these systems as tools to extend, rather than replace, human expertise. These tools provide benefits in two key areas: efficiency (rapidly debugging code and wrangling data) and exploration (brainstorming logic and analytical frameworks). Generative AI provides IEP scientists with a critical opportunity to reduce technical bottlenecks in our work allowing us to refocus our cognitive resources on more intimately understanding the Bay-Delta ecosystem.

Session 7: Plenary 2 (Joseph E. Merz)

AI in Estuary Monitoring: Practical Tools and Emerging Trends

- Joseph E. Merz*, Cramer Fish Sciences, jmerz@fishsciences.net

**Presenting author*

Estuaries are vital ecosystems that support fisheries, biodiversity, and coastal resilience, yet they remain some of the most challenging environments to monitor. Artificial Intelligence (AI) is beginning to change that. Dr. Merz will introduce practical ways AI is helping resource managers today, such as automating species identification from underwater imagery, improving water quality predictions, and integrating data from cameras, acoustic sensors, and environmental DNA for a clearer picture of estuarine health. He will also highlight emerging tools that are on the near horizon, including systems that combine multiple data types for better decision support and approaches that reduce the time and cost of monitoring without sacrificing accuracy. While these technologies promise efficiency and new insights, they also raise important questions about data quality, ethics, and the role of human expertise. This talk will focus on what's real now, what's coming soon, and what managers need to know to prepare for these changes using recent experiences.

Biography for Guest Plenary Speaker Joseph E. Merz, Ph.D.
President and Principal Scientist, Restoration Ecology Cramer Fish Sciences

Research Associate: University of California Davis and Santa Cruz

Dr. Merz has over 30 years of experience in fisheries science and stream restoration, specializing in habitat assessment, river rehabilitation, and fish population monitoring. He has led and participated in many largescale restoration projects and authored numerous peer-reviewed studies on river and estuary ecology and species conservation. Recently, his team has developed an innovative Sampling Platform and advanced AI-driven video processing for fish passage monitoring and tidal habitat restoration monitoring and habitat typing, transforming data collection and analysis to inform aquatic resource management.

Session 8: Delta or Longfin Smelt (Part 1)

Exploring Scalable Supplementation Strategies for Delta Smelt Recovery: Field Trials and Operational Insights

- Florian Mauduit*, University of California, Davis, fmauduit@ucdavis.edu
- Dennis E. Cocherell, University of California, Davis
- Trishelle Tempel, California Department of Water Resources
- Shawn Acuña, Metropolitan Water District of Southern California

**Presenting author*

The Fish Conservation and Culture Laboratory (FCCL) currently produces approximately 125,000 Delta Smelt annually, with plans to scale to 500,000 by Water Year 2030. To support this effort and address the low recapture rates observed in traditional release strategies, we explored two complementary supplementation approaches aimed at increasing production capacity, reducing handling stress, and enhancing post-release survival. River-based early-life stage release trials tested whether embryos could be hatched directly in river enclosures, bypassing intensive hatchery labor and transport-related stress. Results showed that embryos successfully hatched in mesh enclosures without manual intervention; however, post-hatch survival was highly sensitive to temperature and resource availability, highlighting the need for winter - early spring deployments (Jan-Mar) to avoid seasonal thermal stress. Impoundment-based rearing was evaluated as a parallel culture system outside the hatchery. Using floating cages in Bouldin Island impoundments, Delta Smelt were reared from fall through spring under ambient conditions. Fish demonstrated strong survival and natural growth without supplemental feeding, suggesting this low-input approach can supplement FCCL while improving ecological fitness prior to release. These strategies provide scalable, cost-effective pathways to supplement current hatchery operations and improve the viability of Delta Smelt recovery efforts. Ongoing studies will further assess whether impoundment-reared fish exhibit improved fitness traits critical to post-release survival.

Feasibility of Acoustic Telemetry in Delta Smelt: Lessons After Two Years of Progress

- Sebastian Gonzales*†, University of California, Davis, sggonzales@ucdavis.edu

**Presenting author, †Early Career Award candidate*

Fish movement and survival are key metrics for evaluating the success of supplementary releases of cultured Delta smelt. In addition to net sampling, acoustic telemetry offers an independent and non-lethal way to gather course-scale information on survival, movement, and distribution, as well as fine-scale information on habitat use and movement behavior under various water operation scenarios. Prior to implementing acoustic tagging of Delta smelt in natural waterways, it is imperative to understand mortality and tag retention rates associated with tagging, transport, and release, as well as sublethal impacts associated with a tag burden. Using cultured adult Delta smelt we evaluated whether a newly miniaturized acoustic transmitter (0.05g) developed by the Pacific Northwest National Laboratory can be surgically implanted while minimizing mortality and adverse effects on Delta smelt. We evaluated various modifications to traditional salmonid handling, tagging, and post-surgical recovery protocols, and identified a minimum size threshold for tagging. These data will inform future studies using acoustic tagged Delta smelt to provide wildlife and water resource managers key information about movement behavior, survival, and habitat use. Such information has the potential to inform the refinement of supplemental release strategies, boost the efficiency of agency monitoring programs and identify habitat restoration locations in order to aid in the recovery of this critically endangered species.

Mapping Spatial and Temporal Changes in Wakasagi Abundance and Distribution

- Claudia Macfarlane*, U.S. Fish and Wildlife Service, Claudia_macfarlane@fws.gov
- Evan Carson[±], U.S. Fish and Wildlife Service

**Presenting author, [±] Co-Presenting Author*

Wakasagi (*Hypomesus nipponensis*), an annual smelt native to Japan, was introduced to California reservoirs in the late 1950s. Following its 1990 Estuary detection, Wakasagi gained a wide but patchy distribution and was found to hybridize with Delta Smelt. Catch remained rare, though, and apparently dependent on periodic reservoir flushes, which tempered concerns about potential ecological interactions with the congeneric Delta Smelt. Although Wakasagi were recruiting locally by 2000, detections remained uncommon and concentrated in the Deepwater Ship Channel through 2020. Meanwhile, Delta Smelt declined to near extirpation, an outcome averted by the implementation of annual releases of hatchery stock to the wild (supplementation) in water year 2022. Since 2021, however, the Enhanced Delta Smelt Monitoring (EDSM) program began catching Wakasagi more regularly, in greater numbers, in more areas, and year-round, raising concerns about the potential for increased ecological and genetic interaction with supplementation-reliant Delta Smelt.

We used EDSM program data to quantify apparent changes in Wakasagi abundance and spatiotemporal distribution. Wakasagi catch data were compiled from EDSM Phase 1 (adult) and Phase 3 (juvenile and adult) surveys conducted from December 2016 through July 2025. Phase 2 (larval) data were excluded due to the inability to identify larval *Hypomesus* to species. Phase 1 and Phase 3 data were analyzed separately each year, with individuals mapped by EDSM Phase and life stage. For relative comparison, we included all Delta Smelt (wild-born and hatchery-released) captured in Phases 1 and 3 over the same period.

Total Wakasagi catch increased nearly tenfold from 2017 (n=254) to 2021 (n=2173) and has remained elevated through 2025. Catch consistently exceeded that of Delta Smelt, which included 30 wild-born and 177 hatchery-releases captured in total since 2021. This study quantifies Wakasagi abundance and spatiotemporal distribution, highlighting potential ecological interactions with Delta Smelt and implications for the Supplementation Program.

Session 9: Delta or Longfin Smelt (Part 2)

A Longfin Smelt Population Model to Identify Factors Impacting Recruitment, Survival, and Population Growth Rates

- Leo Polansky*, U.S. Fish and Wildlife Service, leo_polansky@fws.gov
- Lara Mitchell, U.S. Fish and Wildlife Service
- Scott Meyer, California Department of Water Resources
- Joseph J. Miller, U.S. Fish and Wildlife Service
- William E. Smith, U.S. Fish and Wildlife Service
- Vanessa D. Tobias, U.S. Fish and Wildlife Service

**Presenting author*

The longfin smelt (*Spirinchus thaleichthys*) population in the San Francisco Estuary (SFE) and Sacramento-San Joaquin rivers delta has appreciably declined in the recent half century. Despite many changes to the SFE and delta ecosystems, links between longfin smelt distribution and abundance with delta freshwater outflows have been persistently documented for over 40 years. These findings have generally relied on analyses of annual or semi-annual abundance indices, have not clearly distinguished between different life stages, and lacked a time series perspective with which to scale up understanding about what is good and bad for recruitment and survival of a given life stage to population growth rate implications. This talk describes a stage-based model that additionally tracks ages within stages, fit within a Bayesian hierarchical state-space framework. The model is designed to identify more precisely within the year when delta outflow and other salient ecosystem metrics are most associated with life stage specific recruitment, survival, and population growth rates. The increased model resolution is accomplished with synthesis of data collected at daily to monthly time steps from 1991-2023 by multiple long-term monitoring programs. This data integration allows estimation of monthly recruitment and survival rates throughout the life cycle. Some findings on when delta outflow is most associated with longfin smelt recruitment, survival, and growth rates, are shown. The relationship of recruitment and survival to several other habitat metrics of ecological and management relevance are also discussed. Some of the challenges encountered, primarily related to differences in monitoring program efficiency and bias, are discussed, along with how overcoming these provide insights into currently unmodeled larger scale movements of longfin smelt. Shortcomings and applications of the model, and its link with efforts on using causal inference, are touched on.

LES Talk, More Fieldwork!

- Morgan Gilbert*, California Department of Fish and Wildlife, morgan.gilbert@wildlife.ca.gov
- Tim Malinich, California Department of Fish and Wildlife

**Presenting author*

Longfin Smelt (*Spirinchus thaleichthys*) in the San Francisco Bay-Delta have experienced steep declines in recent decades. One potential contributing factor in this continued decline is the influence of large water export facilities in the South Delta and their potential to negatively affect the species population dynamics through entrainment. Recognizing this, the 2020 Incidental Take Permit for the Long Term Operation of the State Water Project identified a need for improved quantitative estimates of larval (<20mm) Longfin Smelt at risk of entrainment. To address this need, the Larval [Smelt] Entrainment Study (LES) began in 2022. Here we summarize the LES 2025 sampling season, beginning with changes to our sampling methodology, including the addition of a downstream control station to support further analysis, a special study comparing bottom, surface, and oblique tows, and co-sampling with the Department of Water Resources Genetic Monitoring Lab. We will share our thoughts on use of a new data quality control process, a double entry system for efficiently detecting and correcting errors.

It's a Convoy! Co-Sampling via eDNA and Trawling Methods to Improve Detections of Larval Smelt

- Christina E. Burdi*, California Department of Water Resources, christina.burdi@water.ca.gov
- Sera Perry, University of California, Davis
- Daphne Gille, California Department of Water Resources
- Brian Schreier, California Department of Water Resources

**Presenting author*

Environmental DNA (eDNA) is a robust tool for monitoring rare species because detection is sensitive and non-lethal. Robust detection of larval Longfin Smelt and Delta Smelt entrainment in the south Delta is challenging which complicates the assessment of impacts from SWP operations. To improve detection of larval smelt, we tested the utility of eDNA when paired with traditional trawl monitoring by the California Department of Fish and Wildlife's (CDFW) Larval Entrainment Survey (LES). Our aim was to develop an eDNA sampling method to use in conjunction with traditional trawl monitoring without contamination. To test this, we used a sampling convoy consisting of three boats: 1) a boat towing a positive control (i.e. Ballyhoo), 2) a 'clean' boat sampling via Sterivex filtering and a tow net, and 3) a 'contaminated' boat sampling eDNA via passive samplers and water from the cod end in addition to larval fish trawling. We compared eDNA sampling from both methods on the LES boat to the fish caught in the cod end and other monitoring in the area as well as to clean boat samples. We found that 1) passive eDNA samplers can be successfully deployed in conjunction with a traditional larval trawl net without contamination, 2) eDNA samples from both boats matched detections of fish caught in the trawl net and by other monitoring surveys, and 3) accurate eDNA sampling from the net cod end is not possible without substantial risk of contamination. These results showed that eDNA sampling via passive samplers on the LES boat was successful, easy to implement, and lacked contamination, which allows us to move forward with co-sampling on the trawl vessels without the additional need for separate clean boats. For the 2026 season, we plan to continue to refine co-sampling methods with a focus on passive eDNA sampler sampling.

Session 10: Physical and Biological Effects of Flow

Variable Freshwater Flow, Estuarine Circulation, and Foodweb Interactions Regulate Abundance of the Endangered Longfin Smelt

- Wim Kimmerer*, San Francisco State University, kimmerer@sfsu.edu
- Edward Gross, RMA, Inc.
- Jason Hassrick, ICF

**Presenting author*

The heterogeneity and dynamics of the San Francisco Estuary pose a challenge for understanding how small pelagic organisms maintain populations. We are investigating the movement and distribution of larval longfin smelt, *Spirinchus thaleichthys*, and its copepod prey. Abundance of this endangered fish declined by over 100-fold since 1967, and abundance varies by 100-fold across the 45-fold interannual range of spring freshwater flow. Females spawn in fresh to brackish water during December-February, and their larvae drift with tidal and net seaward flow until they reach salinity ~1-5. There, they consume copepods, mainly *Eurytemora carolleeae*, until May, when this copepod declines and the fish can eat larger prey. We undertook a series of day and night surveys during the springs of 2024 and 2025 to determine the distribution of longfin smelt larvae and their prey by season, day vs. night, depth, and salinity. Larvae of all sizes were more abundant in low salinity. At night, they were uniformly distributed in the water column. During the day, they were generally more abundant in deep tows, suggesting vertical migration that would retain the fish in stratified parts of the estuary. Our study uses particle-tracking modeling to investigate the consequences of alternative larval behaviors for retention, field survey data to inform the behaviors used in the model, data from previous studies of longfin smelt and their prey, and a wealth of long-term monitoring data. Our findings will shape recommendations to focus existing flow standards to better support longfin smelt.

How Complex is Too Complex? Probing Flow-Abundance Relationships in the San Francisco Bay-Delta

- Angelika Kurthen*, University of California, Berkeley, akurthen@berkeley.edu
- Sam Bashevkin, California State Water Resources Control Board
- Laura Twardochleb, California State Water Resources Control Board
- Albert Ruhi, University of California, Berkeley

**Presenting author*

Estuarine ecosystems are uniquely dynamic: their spatial environmental gradients change seasonally and interannually with river flows, and this mosaic of environmental conditions largely controls food-web structure responses. In the San Francisco Bay-Delta, freshwater inputs and Delta outflows are known to influence zooplankton and fish populations. However, there are still uncertainties in the specific mechanisms connecting flow to abundance. At least two reasons may have contributed to this challenge. First, many flow-ecology models in the past have not explicitly considered biotic interactions, potentially confounding direct responses of focal taxa to flow with flow-mediated responses of competitors and predators. Second, in a non-stationary environment, some relationships could be more accurately modeled with time-variant modeling methods. We assess the value of information provided by increasing biotic complexity (i.e., inclusion of multi-trophic levels of biotic interactions) and abiotic complexity (i.e., allowing for a time-varying strength of flow-ecology relationships) to flow-ecology models in the San Francisco Bay-Delta. To this end, we developed single-taxon and multi-taxa models for zooplankton and fish assemblages. For each level of biotic complexity, we fitted a multivariate autoregressive state-space model, which assumes a static relationship between flow and the taxa, and a dynamic linear model, which allows for a time-varying relationship between flow and taxa. All models were fed the same data, combining Delta outflows and spatially-replicated time series data from the Bay Study, Fall Midwater Trawl, Delta Juvenile Fish Monitoring Program, and Environmental Monitoring Program. We compared these four model structures representing different levels of ecological complexity to evaluate the value of including biotic interactions and time-varying relationships in models of flow-ecology relationships. Including time-varying abiotic processes and biotic interactions in models could help academics and practitioners seeking to understand and forecast estuarine dynamics in the San Francisco Bay-Delta.

A Place to Call Home (Again) – The Effects of X2 Position on Delta Smelt Habitat, Food Supply, Growth, and Condition in the Summer and Fall Over the Past 15 Years

- Rosemary Hartman*, California Department of Water Resources, rosemary.hartman@water.ca.gov
- Delta Coordination Group Science and Monitoring Group

**Presenting author*

Since 2008, regulations have been in place to enhance habitat for Delta Smelt in the summer and fall to help this endangered fish through this critical period. Fall X2 actions have occurred in 2011, 2017, 2019, 2023, and 2024, and Suisun Marsh Salinity Control Gate (SMSCG) actions have occurred in 2018, 2023, 2024, and 2025; both of which are intended to expand the quantity and quality of low salinity zone habitat. However, new research indicates that higher outflow during the summer may be more important than higher outflow during the fall for maximizing Delta Smelt population growth. We examined data on water quality, zooplankton, wild smelt growth rates, smelt population trends, enclosure experiments, and bioenergetic modeling to evaluate if the location of X2 or salinity in Suisun Marsh during 2011-2024 have resulted in benefits for Delta Smelt.

We found that physical habitat area increased significantly with lower X2 in both summer and fall, with X2 and SMSCG actions increasing physical habitat area and quality, though temperatures frequently limited the effectiveness of the actions. Abundance of the important smelt food species *Pseudodiaptomus forbesi* also increased in Suisun Bay and Suisun Marsh with lower X2 or lower salinity in Suisun Marsh, and this relationship was stronger in summer than in fall. Individual smelt condition and growth rates (estimated from both otoliths and bioenergetic models) also increased with lower X2 in summer, but less so in fall. Enclosure experiments provided conflicting results, which may have been more indicative of enclosure effects than overall habitat suitability. Taken together, these analyses support results from Polansky et al (2024) indicating higher Delta outflow has greater benefits to Delta Smelt in summer than in fall. These analyses could contribute to future management of Delta Smelt during their juvenile life stage.

Endurance Swimming to Inform Entrainment Risk for Native California Fishes

- Kelly Hannan*, University of California, Davis, kdhannan@ucdavis.edu
- Sammuel Huang, University of California, Davis
- Celia Gonzalez, University of California, Davis
- Mikayla Debarros, University of California, Davis
- Anna Steel, University of California, Davis
- Dave Smith, ERDC, Army Corps of Engineers
- Nann Fangue, University of California, Davis

**Presenting author*

The San Francisco–San Joaquin watershed is one of the most heavily managed aquatic systems in California, where thousands of water diversions, annual dredging operations, and large-scale pumping facilities alter natural flow regimes. These anthropogenic activities can lead to the entrainment of sensitive native species, including juvenile Green and White Sturgeon (*Acipenser medirostris, A. transmontanus*), Chinook Salmon (*Oncorhynchus tshawytscha*), and Delta Smelt (*Hypomesus transpacificus*).

To better understand species and life stage vulnerability to entrainment, we conducted fixed-velocity endurance swimming trials at several temperatures and fish life stages. From these trials, we developed endurance curves describing time-to-fatigue (min) across multiple test velocities. We then integrated these data with observed swimming behaviors (e.g., rheotaxis, benthic orientation) to estimate entrainment risk across a range of anthropogenic intake flow velocities.

Results indicate that cooler temperatures increase the risk of entrainment in both sturgeon species compared to warmer test conditions, while Chinook Salmon of comparable size to sturgeon and Delta Smelt demonstrate stronger swimming abilities overall. These differences highlight the importance of species- and size-specific thresholds when developing operational guidance for flow management.

By linking laboratory-derived swimming performance data with hydraulic conditions in the field, this work provides a quantitative framework for estimating entrainment risk. These findings can inform management decisions regarding flow rates at water diversions, pumping facilities, and dredging operations to minimize entrainment of threatened native fishes and support their conservation.

Session 11: Zooplankton and Other Invertebrates

Flood Pulses in Seasonal Managed Wetlands Enhance Zooplankton Abundances in Suisun Marsh

- Kyle Phillips*, University of California, Davis, kaphillips@ucdavis.edu
- Alice Tung, University of California, Davis
- Elsie Platzer, University of California, Davis
- Teejay O'Rear, University of California, Davis
- Sharon Lawler, University of California, Davis
- John Durand, University of California, Davis

**Presenting author*

Much of the land area in Suisun Marsh is dominated by managed wetlands, which are diked and culverted ponds that are seasonally flooded for migratory waterfowl and recreational hunting. Managed wetlands have recently been shown to support high densities of zooplankton, a critical resource for pelagic fishes declining region wide, but little is known about the mechanisms that drive increased abundances in these novel habitats. We sampled zooplankton in managed wetlands and tidal habitats spread across Suisun Marsh over a 6-year period to assess (1) when managed wetlands support high zooplankton abundances, (2) how zooplankton assemblages vary between managed and tidal habitats, and (3) how abundances respond to seasonal flood operations. When flooded, managed wetlands supported zooplankton abundances up to ten-fold higher than adjacent tidal habitats. Managed wetlands supported increased densities of *Acanthocyclops spp.*, *Eurytemora affinis*, and *Daphnia magna* relative to tidal habitats, while other taxa were not strongly associated with either habitat type. On average, peak copepod abundances in managed wetlands occurred two months after flood onset while peak cladoceran abundances occurred after four months. Findings suggest that managed wetlands function as floodplain analogues whereby primary and secondary production is driven by seasonal flood pulses. Flood operations in managed wetlands could likely be timed to enhance fish-food production at known critical periods. Future work will explore whether flood operations implemented in summer could provide localized plankton subsidy for smelt and other pelagic fishes when food is otherwise scarce in the estuary.

Zooplankton Monitoring Review: Gaps, Strengths, and Redundancies

- Daniel Ellis*, California Department of Fish and Wildlife, daniel.ellis@wildlife.ca.gov
- Rosemary Hartman, California Department of Water Resources
- Kristi Arend, (formerly) U.S. Bureau of Reclamation, (currently) U.S. Fish and Wildlife Service
- Cat Pien, (formerly) U.S. Bureau of Reclamation
- Sam Bashevkin, California State Water Resources Control Board

**Presenting author*

Zooplankton availability is an important contributor to native fish populations in the San Francisco Estuary. Over five decades of monitoring, sampling effort has expanded to inform emerging management needs, with the resulting data widely used by researchers to answer scientific questions and by agencies to manage the estuary. Despite this, no holistic investigation into the gaps and strengths of the integrated zooplankton dataset has occurred. Here, we assessed the dataset's ability to detect changes to abundance in the zooplankton community by evaluating statistical power and potential sampling redundancies. We used a combination of analytical approaches: first, we identified sub-assemblages that frequently occur together within the zooplankton community; then, we selected representative taxa from each sub-assemblage; finally, we used two different methods to assess the statistical power and redundancy of the data in answering management questions about changes in abundance over time at different spatial scales. We will discuss the strengths and weaknesses of the resulting dataset in order to inform any future alterations to sampling.

A Model for Multi-Lab Proficiency Testing for eDNA Monitoring of the Invasive Golden Mussel (*Limnoperna fortunei*)

- Bryan Barney*, California Department of Fish and Wildlife, bryan.barney@wildlife.ca.gov
- Emily Kulig±, California Department of Fish and Wildlife
- Melinda Baerwald, California Department of Water Resources
- Yale Passamaneck, U.S. Bureau of Reclamation
- Susanna Theroux, Southern California Coastal Water Research Project
- Adam Sepulveda, U.S. Geological Survey
- George DiGiovanni, Metropolitan Water District of Southern California

**Presenting author, ± Co-Presenting Author*

Monitoring the spread and extent of aquatic invasive species is one of the hallmark uses of environmental DNA (eDNA). Employing eDNA monitoring serves as an early warning system, where positive eDNA detections direct more costly and intensive monitoring activities to areas with a higher likelihood of presence of the target organism. For successful implementation of eDNA monitoring of a target species, the laboratory should demonstrate that the assay chosen or designed is reproducible, target-specific, and appropriately sensitive prior to implementation. However, eDNA assay methods and protocols can vary between testing laboratories monitoring the same organism, introducing variability that may affect the detection or non-detection of target species, even when the same eDNA assay is employed across laboratories. Due to the current invasion of the Golden Mussel (*Limnoperna fortunei*) in California, an invasive species of current special concern, multiple agencies are employing eDNA testing for their individual mandates and management goals. Here we highlight the process of multi-laboratory proficiency testing and provide a framework for ensuring comparability of eDNA analysis results across participating laboratories, without assay harmonization.

Session 13: Plenary 3 (Ted Flynn)

Change is Hard: Integrating Generative AI into Your Workflow Without Losing Your Mind (or Your Soul)

- Ted Flynn*, California Department of Water Resources, ted.flynn@water.ca.gov

**Presenting author*

Generative artificial intelligence (GenAI) has grown in only a few years from a curious novelty for creating viral videos into a full-blown revolution with the potential to rewrite the playbook for how human beings interact with computers. Between endless headlines predicting massive, AI-fueled job loss and alarming reports of the massive environmental footprint of the data centers and server farms that power GenAI's algorithms, many scientists, researchers, and managers may find themselves oscillating between feelings of excitement and skepticism or even outright hostility towards GenAI. Furthermore, the "black box" nature of many GenAI tools can feel at odds with the rigor required for regulatory science. Yet as public servants and stewards of environmental data, we have a duty to employ technological advances to better manage the many complex ecological issues faced by California. Many valid concerns exist over the use of GenAI tools, including threats to data privacy, algorithmic bias, and the potential for sidelining genuine human expertise. Drawing on more than 20 years of experience as both a researcher and a manager, I will discuss how integrating GenAI mindfully into your daily workflow can provide a multi-functional tool for synthesizing complex datasets, streamlining routine tasks, and managing technical information without putting your own work or that of others at risk.

Session 14: Lightning Talks 2

Modeling Contaminant Detections and Toxicity as a Function of Outflow in the Delta

- Meghan Holst*†, University of California, Davis, mholst@ucdavis.edu
- Shawn Acuña, Metropolitan Water District of Southern California
- Cecilia Ma Li, University of California, Davis
- Bruce G. Hammock, University of California, Davis

**Presenting author, †Early Career Award candidate*

An understudied question in ecotoxicology is the influence of water-year type and outflow on contaminant detections and toxicity. Two conflicting mechanisms make predictions based on first-principles difficult. On one hand, increased precipitation dilutes contaminants in waterways, potentially resulting in decreased contaminant detections and toxicity (e.g., waste-water effluent). On the other hand, increased precipitation will increase runoff of contaminants from structures, crops, and pavement, potentially increasing contaminant detections and toxicity. Given these conflicting mechanisms, here we present an empirical study that seeks to understand how water year and season influences contaminant dynamics. We analyze analytical chemistry data collected consistently since the year 2000 from the Sacramento-San Joaquin River Delta (the Delta) by the United States Geological Survey (USGS). The analytical chemistry data was merged with hydrodynamic data from Dayflow into a relational database. For each detected contaminant at a site, we developed a “toxicity score” by dividing the contaminant concentration by its respective U.S. EPA aquatic life benchmark for chronic toxicity for vertebrates. We summed the toxicity score across all detected contaminants to generate a total toxicity score for each site, month and trophic level, which represents the overall toxicity level to vertebrates. Then we modeled toxicity score for vertebrates, as well as detections, as a function of outflow and several covariables. We use the results to address three major questions: 1) How outflow influences detections and toxicity score; 2) what is the functional form of the relationships between detections and toxicity score as a function of flow; and 3) what are the most problematic contaminants tested for in each watershed, based on toxicity score? Overall, the results will inform water quality management actions, conservation and restoration efforts aimed at preserving and restoring habitat of aquatic species inhabiting the Delta and improve the general understanding relationships between contaminants and flow.

Delta's Hidden Underwater World

- Lee Murai*, California Department of Water Resources, shawn.mayr@water.ca.gov
- Thomas Handley[±], California Department of Water Resources
- Shawn Mayr, California Department of Water Resources
- Scott Flory, California Department of Water Resources

**Presenting author, ± Co-Presenting Author*

For nearly six decades, the Department of Water Resources' North Central Region Office has conducted bathymetric surveys across Delta waterways. Building on this long-standing tradition, we aim to advance understanding of the Delta ecosystem through the collection and analysis of detailed water depth and habitat data across a range of spatial and temporal scales.

While most existing aquatic habitat maps emphasize terrestrial areas adjacent to waterways, our focus is on the submerged landscape—the 240,000 acres of the Delta concealed beneath the water's surface. Leveraging modern technology and technical expertise, we seek to illuminate this unseen portion of the ecosystem to better inform resource management and restoration efforts.

This presentation will provide an overview of:

- The DeltaWide Bathymetry Program
- Current technology, equipment, and capabilities
- Findings from a pilot study mapping submerged aquatic vegetation and sediment composition (coarse and fine fractions)

We invite collaboration to:

- Design underwater habitat maps that maximize their scientific and management value
- Identify data collection approaches that best support ecosystem enhancement objectives
- Define the substrate detail and species resolution most useful for integration with complementary studies.

Comparing Single-Species and Multispecies Environmental DNA Monitoring at Restored Tidal Wetlands

- Ravi Nagarajan*, University of California, Davis, rpnagarajan@ucdavis.edu
- Leigh Sanders, University of California, Davis
- Grace Rosburg-Francot, University of California, Davis
- Emily Funk, University of California, Davis
- Diana Muñoz, University of California, Davis
- Emma Murray, California Department of Fish and Wildlife
- Andrea Schreier, University of California, Davis

**Presenting author*

Restoration of tidal wetlands in Suisun Marsh and the Sacramento–San Joaquin Delta is expected to benefit at-risk and listed fishes, including winter- and spring-run Chinook Salmon (*Oncorhynchus tshawytscha*). Regular monitoring is performed to evaluate restoration progress, but detecting listed fishes is challenging due to low densities, intermittent habitat usage, and monitoring method limitations (e.g., gear bias). Environmental DNA-based (eDNA) monitoring can sensitively detect fish species, does not incur “take” or require permits, and can be performed under varied conditions including at shallow tidal wetlands. However, the relative sensitivity of single-species and multispecies eDNA methods is not well studied. Here we compare species-specific qPCR with metabarcoding, which detects multiple fish species simultaneously, focusing on Chinook salmon (species-level). Paired restoration and reference wetlands were sampled with spatial and temporal replication, with 153 eDNA extracts analyzed from 17 sampling events. Chinook eDNA was detected by at least one eDNA method at 14/17 (82%) of sampling events. At three of the eDNA-positive sites, physical Chinook salmon were caught with lampara nets. qPCR and metabarcoding data agreed except for one qPCR-only and two metabarcoding-only positive eDNA detections. Our results suggest that single- and multispecies approaches both provide sensitive detection for Chinook eDNA. To improve eDNA applicability beyond species-level detections, we will present data from preliminary experiments testing the ability of existing Chinook run-type molecular assays (SHERLOCK) to detect different run-types in eDNA samples. If successful, a two-step workflow is envisioned, with initial identification of Chinook species-positive eDNA samples using qPCR or metabarcoding, followed by run-type identification on that sample subset. Sensitive, non-invasive detection of listed Chinook would aid in monitoring at restoration sites and throughout the Bay-Delta and its watershed.

Examining Pesticide Use and Monitoring in the Delta to Inform an ISB Review

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- Inge Werner, Delta Independent Science Board
- Tanya Heikkila, Delta Independent Science Board
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- Kenneth Rose, Delta Independent Science Board
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**Presenting author, †Early Career Scientist (not participating in Early Career Awards)*

Thousands of chemical contaminants, often at levels that can impact both ecosystem processes and human health, enter the Delta's waterways through urban and agricultural runoff, irrigation return flows, industrial and municipal wastewater discharges, and atmospheric deposition. These contaminants include metals, pesticides, pharmaceuticals, industrial chemicals, tire-wear particles, and microplastics. Many are known to pose ecological risks to aquatic and riparian environments.

The large number of chemicals and the complexity of assessing their ecological impacts pose significant challenges for monitoring, risk assessment, and chemical management. In response and as part of its legislative mandate, the Delta Independent Science Board (ISB) is conducting a review of contaminant monitoring programs in the Delta. The review will discuss strengths and areas for improvement in how data can provide the information needed by managers to make informed decisions regarding ecological risk. It will also review promising advanced and emerging methods and approaches that are candidates for advancing current monitoring programs.

As part of this effort, the Delta ISB is specifically examining pesticide monitoring. This exercise synthesizes information on pesticide use and toxicity, and looks at which pesticides are tracked to determine how widespread the use of highly toxic pesticides is in the Delta, and whether current monitoring reflects patterns of use and toxicity. This presentation will share preliminary findings from that work to inform the broader review.

When do Golden Mussels spawn in the Delta?

- Lu Han* Contra Costa Water District, lhan@ccwater.com
- Lucinda Shih, Contra Costa Water District
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**Presenting author*

The invasive golden mussel (*Limnoperna fortunei*) is a high-priority biofouling threat to California's water infrastructure. While international literature identifies a spawning threshold of 16-17ºC and our analysis of six decades of historical Delta temperature data (1959–2022) indicates that while the region is thermally suitable for reproduction for approximately half of the year, actual phenology in this new habitat remains poorly understood. Preliminary field observations from 2025 highlight this uncertainty: despite Delta temperatures reaching the 16ºC threshold in early spring, no veligers were detected until late June, a 2-month gap. This discrepancy suggests that temperature alone may be an insufficient predictor for spawning success in the Delta environment. To address these unknowns, we have developed a collaborative research proposal to synthesize biological tolerances, optimize early detection techniques, and develop 3D predictive fate and transport models using Bay-Delta SCHISM. We are presenting these preliminary observations to engage with parties interested in supporting this research to improve our collective ability to understand, monitor and respond to this new threat.

Session 15: Wetland Habitats

Into the Sloughs of Suisun: The 2025 Annual Trends in Species Composition and Abiotic Variables

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- Abigale Deen, University of California, Davis
- John Durand, University of California, Davis

**Presenting author, †Early Career Award candidate*

Suisun Marsh is a dynamic landscape located at the interface of the Sacramento-San Joaquin Delta and the San Francisco Bay Estuary. Suisun Marsh is not only the largest tidal wetland on the West Coast of North America; it acts as a model system for observing the impacts of environmental changes. Eastwards, the management and outflow of freshwater from the Delta largely determines species distributions. Yet, this tidal wetland has notably created a refuge where fishes have faced lower declines in abundances relative to surrounding areas (Stompe 2024). Thus, there is great value in continued monitoring of the abiotic variables and fish communities in such a dynamic system. We analyze the trends in fishes and water quality variables in Suisun Marsh for the year 2025 and contextualize it compared to recent years. We deployed otter trawls in 24 sites throughout Suisun Marsh, supplemented by 3 sites where seines are additionally used to sample the nearshore environment. Samples were taken at each site once a month, including salinity, dissolved oxygen, turbidity, depth, temperature, and biota, which were compared alongside calculations of Delta Outflow (DOF) at Chipps Island (CA Department of Water Resources). Sampling efforts for 2025 are still ongoing at time of abstract submission; however, DOF (a primary variable influencing conditions in the Marsh) thus far seems to mimic the high magnitude flows of 2023 and the seasonality of 2024, which could lead to more variable species caught.

Quantifying Primary Production in the San Francisco Estuary's Tidal Wetlands

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Throughout the San Francisco Estuary (SFE), regional authorities are pursuing tidal wetland restoration as a tool to augment pelagic production and improve food availability for threatened native fishes. However, production exports from tidal wetland sites have yet to be quantified, and dynamics controlling on-site production are not thoroughly understood. We seek to assess the pelagic production between four SFE tidal wetlands and their adjoining waterways over the course of a tidal cycle. At the breaches of three restored and one reference wetland site, we collected water grabs throughout the flood-ebb cycle 2-4 times per tide, per site. Nutrients, organic matter, chlorophyll a, and other water quality parameters with the potential to affect production outputs were sampled concurrently. We then conducted oxygen depletion incubations to estimate net primary production (NPP), gross primary production (GPP), and community respiration (R) at each sampling event. We observed notable differences in NPP and GPP between flood and ebb tide, though the directionality and magnitude of these differences varied by site and season. Forthcoming data on nutrients, organic matter, and chlorophyll will provide insight into potential drivers of observed production rates. Future research directions will include relating production outcomes to site design and management variables, including channel morphology, vegetation type, and/or vegetation density. This study will offer key insights into wetland ecosystem metabolism within the SFE, allowing practitioners better understanding of how to best implement restoration for maximal food web benefits.

Advancing Invasive Aquatic Vegetation Monitoring in the Delta with Sentinel-2

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- Shruti Khanna, California Department of Fish and Wildlife
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**Presenting author*

Since 2004, near-annual airborne imaging spectroscopy at 3 m resolution has provided detailed maps of invasive aquatic vegetation (IAV) across the Sacramento–San Joaquin Delta, supporting both research and management at the genus and species level. While these products have been critical, they are expensive and not consistently available, creating gaps that limit long-term monitoring capacity. To address this, we have partnered with the Delta Stewardship Council, California Department of Water Resources, California Department of Fish and Wildlife, and the Interagency Ecological Program to implement the first sustainable mapping effort for IAV using orbital remote sensing. By leveraging Sentinel 2 (S2) satellite imagery and its frequent revisit cycle, we are operationalizing near-monthly community level IAV maps at 10 m resolution, enabling consistent monitoring at scales relevant to management. Preliminary models have already achieved accuracies comparable to the airborne products, while offering the advantage of routine coverage across the Delta. To ensure these maps directly support decision-making in the Delta, we are actively developing code and tools co-designed with agency partners to meet management needs and enhance coordination across programs. This contribution will highlight the class maps and their potential applications for multi-agency IAV management. This sustained, satellite-driven mapping effort represents a major step toward operational monitoring of IAV in the Delta, strengthening the ability of managers to track vegetation dynamics and make proactive, informed decisions in support of the region’s co-equal goals.

Larval Fish Dietary DNA as Indicators of Food Web Dynamics in Tidal Wetland Restoration

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Fish populations in the San Francisco Estuary (SFE) have been declining for decades due to multiple interacting factors, including a reduction in tidal wetlands and a decline in zooplankton abundance throughout the estuary. Tidal wetlands in the SFE are being restored to enhance fish populations by providing beneficial habitat and food web resources, such as a richer zooplankton assemblage than in open waters. Longfin smelt (LFS; *Spirinchus thaleichthys*) is a declining native fish and an endangered species. Copepod abundance in wetlands directly affects LFS populations, since larval LFS rely on copepods as their primary food source. This research identified food web resources in close proximity to wetland restoration sites, compared them with ecological indicators in wetlands at different stages of restoration (early, intermediate, mature), and identified zooplankton indicator species associated with beneficial habitat for LFS. High-throughput sequencing (HTS) was utilized to identify the diversity of prey available in the water column, including calanoid and cyclopoid copepods, rotifers, and indicator species in diets of three larval fishes: LFS, Pacific herring (*Clupea pallasii*), and Prickly sculpin (*Cottus asper*), which use wetlands as nursery grounds during the same time of year. HTS was advantageous for diet analysis as it identified DNA of the most abundant prey consumed by larval fishes —*Eurytemora carolleeae*, *Acanthocyclops americanus*, and *A. robustus*— and zooplankton prey species at wetland restoration sites. Analysis of Similarity indicated that prey taxa were significantly similar between larval fish diets and beta dispersion indicated minimal differences. Differential abundance analysis indicated that the larval fishes generally consumed the most abundant zooplankton in similar proportions to their availability in the environment. DNA from all three larval fishes was present in each other's diets, which may indicate consuming detritus, fecal pellets, or egg fragments. This research provided a comparison between dry vs wet years and exhibits the benefits of using molecular methods for analyzing larval fish diets and the zooplankton assemblage at wetland restoration sites, which will ultimately benefit declining fish populations in the SFE.

Projecting the Benefits of Tidal Marsh Restoration for Bird Habitat in the Delta

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- Hilary Allen, Point Blue Conservation Science
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**Presenting author*

The Sacramento–San Joaquin Delta supports an abundant and diverse bird community and providing bird habitat is included among the goals for protecting, restoring, and enhancing the Delta ecosystem. However, ongoing changes to the landscape–such as those driven by sea level rise, crop conversions, or restoration efforts–are likely to affect the extent of suitable habitat. Identifying areas that currently provide the most valuable habitat for multiple species and forecasting the expected impacts of landscape changes can inform conservation strategies and priorities. To support these science needs and build on similar recent analyses for riparian landbirds and waterbirds, we developed distribution models for 7 bird species associated with tidal marsh habitat: Black Rail, Least Bittern, American Bittern, Yellow-breasted Chat, Marsh Wren, Song Sparrow, and Common Yellowthroat. We drew on extensive recent bird survey data collected throughout the Delta and Suisun Marsh, combining point count surveys, secretive marsh bird surveys, and detections from automated recording units (ARUs). We used these models to predict the current distribution of each species on the landscape and applied a Zonation spatial prioritization algorithm to identify important areas to protect, enhance, and manage to provide the most benefit to tidal marsh birds in the Delta. We then used these models to evaluate the potential effect of future tidal marsh restoration scenarios on the extent of suitable habitat for each species. The results provide insights into the expected magnitude of the additional habitat gained by meeting tidal marsh habitat targets. Our models are being incorporated into the "DeltaMultipleBenefits" R package, where they can be readily applied to evaluate customized scenarios and expand multi-benefit approaches to managing the Delta.

Session 16: Contaminants, Nutrients and Water Quality

Toxicity of Fire Retardant Runoff to Early Life Stages of Chinook Salmon

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- Susanne Brander, Oregon State University
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**Presenting author*

Increasing wildfire activity across the western United States has led to widespread use of ammonium phosphate-based fire retardants such as Phos-Chek. These chemicals can enter nearby waterways through runoff or aerial drift, posing potential risks to aquatic ecosystems. In salmon-bearing systems, early life stages of Chinook salmon (*Oncorhynchus tshawytscha*) are often present during the first major rainfall events, when fire retardants are most likely to be washed into streams. Despite this overlap, little is known about the effects of these chemicals on Chinook embryos, which represent a particularly sensitive developmental stage. This study investigates the acute and sublethal effects of Phos-Chek on Chinook salmon early life stage exposed to both freshly applied and UV-weathered retardant, simulating conditions immediately following application and after environmental exposure. Embryos were exposed to a range of concentrations over 96 hours to mimic first-flush events. Endpoints included mortality (LC_{50}), hatching success, morphology abnormalities and changes in larval behavior. Preliminary results indicate that UV-weathered Phos-Chek exhibits greater toxicity than freshly applied retardant, suggesting that environmental transformation can enhance its harmful effects. These findings highlight the vulnerability of early salmonid life stages to fire retardant contamination and emphasize the importance of fire management practices that minimize runoff into critical salmon habitats.

Tracking Pesticide Accumulation in Juvenile Chinook Salmon During Outmigration Through the Sacramento River Delta

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- Jacob Stagg, U.S. Fish and Wildlife Service
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- Shawn Acuña, Metropolitan Water District of Southern California
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**Presenting author*

Chinook salmon (*Oncorhynchus tshawytscha*) populations in the Sacramento–San Joaquin Delta have declined due to multiple environmental stressors, including habitat alteration and hydrologic modification. The Delta receives pesticide inputs from agricultural and urban runoff which can disrupt salmonid physiology and behavior. This study quantified pesticide residues in hatchery-origin juvenile Chinook salmon during their early ocean outmigration (2022–2025) to evaluate how migration route, residency duration, and release origin influence contaminant accumulation. Juvenile salmon originating from five Central Valley hatcheries were released from multiple sites and subsequently recaptured downstream during routine annual surveys. Baseline concentrations were established using pre-release fish from each hatchery. Five target analytes, 4,4′-DDE, 4,4′-DDX (sum of 4,4′-DDT, 4,4′-DDE, 4,4′-DDD), bifenthrin, fipronil, and fipronil sum (sulfone, sulfide, desulfinyl degradates), were extracted from fish tissue and quantified using gas chromatography-mass spectrometry. Fall-run salmon exhibited significantly higher concentrations of bifenthrin, 4,4′-DDE, and 4,4′-DDX than late fall-run individuals, suggesting that intra-annual hydrologic variability influences contaminant exposure. Residency time was a primary predictor of pesticide accumulation; individuals residing in the Delta for >20 days exhibited elevated concentrations of DDE, DDX, and bifenthrin than those with shorter residency, likely due to bioaccumulation through diet and prolonged exposure. Release origin also affected residue profiles, with salmon released from the Feather River exhibited the highest 4,4′-DDE, 4,4′-DDX, and bifenthrin concentrations, likely reflecting agricultural pesticide inputs within Feather River watershed, a major tributary of the Sacramento River that flows through a highly agricultural region. Fish collected at Chipps Island, exhibited elevated 4,4′-DDE, 4,4′-DDX relative to those from upper collection site, Sherwood Harbor. Overall, results demonstrate that pesticide accumulation in juvenile Chinook salmon during outmigration is driven by the combined effects of residency duration, migration timing, and watershed characteristics, with implications for contaminant exposure assessments across variable flow conditions in the Delta ecosystem.

Laying the Foundation for a Delta Modeling Collaboratory: A Project-Based Collaborative Modeling Approach to Complex Management Challenges

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**Presenting author*

The Delta is a complex social-ecological system subject to a range of interacting environmental and social drivers (e.g., precipitation, tides, climate change; and agriculture, reservoir and pumping operations, urban water). This complex system requires assembling and interpreting vast amounts of data using techniques such as modeling, synthesis science, and decision-support tools. Many existing models are already used for predicting and managing a multitude of Delta resources from fish to flows. In 2025, the Delta Science Program launched use-case projects to assess the feasibility and value of applying an integrated modeling approach to three important management themes: 1) predicting cyanobacterial harmful algal blooms; 2) evaluating salinity intrusion and associated management actions; and 3) restoring tidal wetland food webs. For each of the three projects, diverse teams of participants from academic institutions, government, and NGOs created project “profiles” that identify potential modeling approaches, existing resources that could be leveraged, and critical resources that are currently lacking. Critically, these profiles outline how specific approaches and resources would lead to key project outcomes, such as modeled future scenario data and communication products like Shiny apps and academic papers. Furthermore, the profiles specify the relevant interested parties to engage further. Operating the three projects in parallel provides unique benefits by highlighting synergies between projects, facilitating resource sharing, and allowing for the prioritization of activities that support multiple initiatives. This holistic approach not only generates benefits from—and for—each individual project, but it also lays the foundation for the Delta Modeling Collaboratory, an intentional community of modelers and modeling resources designed to support integrated modeling projects. The overarching vision of the Collaboratory is to establish a geographically based community centered on collaboration, innovation, and resource sharing.

Session 17: Phytoplankton, Algae, or Harmful Algal Blooms

Spatial and Ecological Responses to a Wastewater Treatment Plant Upgrade in the Sacramento-San Joaquin Delta

- Kyle Leathers*†, U.S. Geological Survey, kleathers@usgs.gov
- Tamara Kraus, U.S. Geological Survey
- Keith Bouma-Gregson, U.S. Geological Survey
- Katy O'Donnell, U.S. Geological Survey
- Crystal Sturgeon, U.S. Geological Survey
- Kyle Nakatsuka, U.S. Geological Survey
- Brian Bergamaschi, U.S. Geological Survey

**Presenting author, †Early Career Award candidate*

Anthropogenic nutrient enrichment of estuaries and river deltas is widespread, potentially degrading water quality and ecosystem health. Wastewater treatment plants (WWTPs) are an important point source of nutrients to many aquatic ecosystems that are targeted by regulatory efforts to reduce nutrient loading. However, quantifying the ecological effectiveness of upgrades to reduce nutrients can be muddled by the complex hydrology and biogeochemistry of estuaries. In California's Sacramento-San Joaquin Delta (hereafter, Delta), a major WWTP upgrade was implemented in 2021 that reduced effluent ammonium concentrations. Some researchers predicted this change would bolster the pelagic food web via a more abundant and nutritious phytoplankton community. Here, we evaluated the spatial extent of the WWTP effluent influence on nutrient concentrations across the Delta (before and after the upgrade) and assessed phytoplankton responses to changes in nutrient inputs. To accomplish this, we used water quality data from 22 Delta sites in the four years preceding and three years following the upgrade. Prior to the upgrade, generalized additive models found that effluent nutrient (i.e., ammonium, nitrate, and phosphate) inputs affected Delta nutrient concentrations up to approximately 80 kilometers downstream. Following the upgrade, effluent ammonium concentrations declined to non-detectable levels, eliminating previously observed ammonium relationships. Furthermore, the spatial extent of effluent dissolved inorganic nitrogen and phosphate relationships declined. Finally, we found that ammonium and nitrate concentrations downstream of the WWTP were positively associated with chlorophyll levels and the proportion of diatoms in the phytoplankton community. These initial findings suggest that nutrient reductions from WWTP upgrades can alter nutrient regimes in a complex estuary with implications for primary producers.

Spatial and Temporal Patterns of Cyanobacterial Harmful Algal Blooms in the Sacramento–San Joaquin Delta: Implications for Monitoring

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- Mine Berg, Coastal Conservation Research
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- Tricia Lee, Delta Stewardship Council
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**Presenting author*

Cyanobacterial harmful algal blooms (CHABs), often dominated by Microcystis, are a major water quality concern in the hydrologically complex Sacramento–San Joaquin Delta (Delta). We analyzed historical monitoring data from 2014 to 2022 to identify temporal and spatial patterns of CHAB occurrence and to inform future monitoring strategies. Data compiled from routine programs and special studies—including chlorophyll-a, Microcystis abundance (microscopy and qPCR), microcystin concentrations, and the Microcystis Visual Index (MVI)—indicate July–September/October as the peak bloom season. The most severe impairment occurred in the South Delta, Central Delta, and San Joaquin River, whereas blooms and toxins were rarely detected in the Sacramento River, Cache Slough Complex, and East Delta. Although Microcystis cells were occasionally observed in these regions, microcystin concentrations were typically below the detection limit (0.15 µg/L) and always below the California recreational warning threshold (0.8 µg/L). Dead-end channels, including Discovery Bay, Big Break, and the Stockton Waterfront, exhibited significantly higher microcystin concentrations than main channels, flooded islands, and side channel habitats. These findings underscore the need to prioritize CHAB monitoring in dead-end habitats, where risks are greatest but routine monitoring is currently lacking. Continued CHAB-specific monitoring will help to elucidate regional trends and improve risk forecasts under various climate scenarios, including rising water temperatures earlier in the season and higher overall temperatures during the summer.

Elevated Phytoplankton Production in Seasonally Managed Wetlands

- Alice Tung*†#, University of California, Davis, amatung@ucdavis.edu
- Kyle Phillips, University of California, Davis
- Peggy Lehman, California Department of Water Resources (Retired)
- Steve Sadro, University of California, Davis
- John Durand, University of California, Davis

**Presenting author, †Early Career Award candidate, #This presentation will not be recorded during the workshop.*

Suisun Marsh is an ecological hotspot, serving as a refuge for numerous native flora and fauna. It contains over 150 managed wetlands that are diked and seasonally flooded–to promote waterfowl habitat and recreational hunting. These novel wetlands are connected by a network of tidal marsh habitats. The UC Davis Ponds Project aims to identify potential synergies between management of aquatic food web and waterfowl habitat. Between 2018 and 2024, we monitored spatio-temporal trends of water quality and phytoplankton concentrations (chl-a as a proxy) in seasonally managed wetlands, tidally restored wetlands, and reference sloughs throughout Suisun Marsh. Managed wetlands often produced large phytoplankton blooms (chl a > 300 ug/L) in response to managed floods, followed by high zooplankton abundances. High concentrations were typical throughout the managed wetlands with no clear spatial trends. Tidally restored wetlands and the reference sloughs were similar to each other and supported low chl a concentrations compared to managed counterparts. Phytoplankton blooms in the managed wetlands were observed across the marsh landscape and persisted into the winter months and fueled secondary production. Based on these results, managed wetlands present opportunities to actively manage plankton production, supplement aquatic food webs in tidal waterways, and support native fish during known critical feeding periods. Through continued research in this area, managed wetlands could become an important tool for supporting the imperiled aquatic food web of the San Francisco Estuary.

Assessing Drivers of Phytoplankton Blooms in the South Delta

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- Crystal Sturgeon, U.S. Geological Survey
- Tamara Kraus, U.S. Geological Survey
- Keith Bouma-Gregson, U.S. Geological Survey

**Presenting author, †Early Career Award candidate*

Anthropogenic modifications to estuaries have been linked to shifts in phytoplankton communities from beneficial taxa that fuel food webs to harmful taxa that can form blooms and degrade water quality. The U.S. Geological Survey, in cooperation with the California Department of Water Resources, analyzed monitoring data from 2000-2023 in the heavily modified southern portion of the Sacramento-San Joaquin Delta (California, USA) to determine the status and drivers of phytoplankton abundance and community composition along the riverine to freshwater tidal transition. Initial results indicate that diatoms and green algae dominated the phytoplankton community, especially when chlorophyll *a* (chl-*a*) concentrations were elevated. Common riverine diatoms (e.g. *Cyclotella* and *Aulacoseira*) dominated at upstream riverine stations, while taxa associated with deltaic conditions (e.g., colonial cyanobacteria and Cryptophytes) were more prevalent at the western, freshwater tidal stations. The potentially toxigenic cyanobacterium, *Microcystis,* was present each summer, but was not associated with elevated chl-*a* or cyanotoxin concentrations (microcystins were detected in 12% of all samples, but all detections were < 4 micrograms per liter). Initial Bayesian ordinal model results showed that mean prior week water speeds below 0.18 meters per second and water temperatures above 22 degrees Celsius were associated with the presence of *Microcystis.* Random forest modeling to assess factors associated with phytoplankton blooms (chl-*a* > 16 micrograms per liter) found that the region, inflows from the San Joaquin River, mean prior week turbidity, and mean prior week water temperature were important drivers of blooms. Associations between hydrodynamics and phytoplankton communities show the importance of physical processes in controlling the lower food web in lowland rivers and tidal deltas, offering insights for water management, food web integrity, and harmful algal bloom prevention.

Designs for Cyanobacterial Harmful Algal Bloom Monitoring in the Sacramento-San Joaquin Delta

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**Presenting author*

Cyanobacterial harmful algal blooms (CHABs) are a growing concern in freshwater environments. These blooms can lead to degraded water quality, ecosystem disruptions, and threats to public health particularly due to the production of cyanotoxins. The Sacramento–San Joaquin Delta (California, USA; the Delta) has experienced CHABs since 1999, including blooms that produce cyanotoxins at concentrations exceeding recreational advisory threshold levels. In response to the CHAB monitoring needs in the Delta, a CHAB monitoring strategy for the Sacramento–San Joaquin Delta was released in 2024, which recommended the development and implementation of a comprehensive monitoring program aligned with regional priorities. Addressing this recommendation, in December 2025 a U.S. Geological Survey report was published that describes three example monitoring designs: 1) environmental drivers monitoring, 2) ambient monitoring of status and trends, and 3) public health monitoring. To develop these designs, the report outlines key components and considerations for implementing a CHAB monitoring program in the Delta, including: background on monitoring and modeling approaches, a summary of existing monitoring programs, guidance for selecting monitoring locations, key water quality monitoring indicators, and sampling frequencies. The overarching goal of the report is to help agencies and stakeholders move from high-level recommendations to practical, actionable designs that are tailored to the Delta's physical, anthropogenic, and ecological landscape.

Session 18: Delta or Longfin Smelt (Part 3)

Predation on Delta Smelt During Experimental Releases: Evidence from Gill Nets and Gastric Lavage

- Veronica Violette*#, U.S. Geological Survey, vviolette@usgs.gov
- Matt Young±, U.S. Geological Survey
- Jeff Gronemyer, U.S. Geological Survey
- Trishelle Tempel, California Department of Water Resources
- Brian Schreier, California Department of Water Resources
- Katie Osborn, California Department of Water Resources
- Fred Freyer, U.S. Geological Survey

**Presenting author, ± Co-Presenting Author, #This presentation will not be recorded during the workshop.*

Predation is an important factor affecting the survival of hatchery-released Delta Smelt (*Hypomesus transpacificus*) released during supplementation efforts. While past studies have examined interactions between Delta Smelt and piscivorous fish, direct consumption in the wild has generally been low and difficult to measure. Recent experimental releases provide a unique opportunity to assess predation under real-world conditions and inform both short-term management and long-term understanding of top-down controls. To quantify predator abundance and consumption, we combined Adaptive Resolution Imaging Sonar (ARIS) to detect large, predator-sized fish at release sites with gill nets and gastric lavage to identify piscivorous species and confirm predation events. Observations revealed that the number of predators at release sites is highly variable, but multiple species consume hatchery-released Delta Smelt. Striped Bass was the primary predation concern, responsible for the majority of consumption, and predation frequency on released smelt was high. These findings indicate that while smelt tolerate the release process well, early post-release survival is strongly influenced by the present and activity of predators. By combining sonar-based monitoring with field sampling and gut-content analysis, this study provides the first focused assessment of post-release predation pressure on hatchery-reared Delta Smelt. The results offer actionable insights for refining release strategies to reduce early mortality, improve survival outcomes, and support recovery efforts.

Using Bioenergetics Modeling to Link Estuarine Physics to a Rare Estuarine Fish

- Matt Young*, U.S. Geological Survey, mjyoung@usgs.gov
- Rosemary Hartman, California Department of Water Resources
- Brock M. Huntsman, U.S. Geological Survey
- Steven Sadro, University of California, Davis
- Brian Mahardja, (current affiliation) Metropolitan Water District of Southern California; (former affiliation U.S. Bureau of Reclamation)
- Christina Burdi, California Department of Water Resources
- William E. Smith, U.S. Fish and Wildlife Service
- Adrianne P. Smits, University of California Davis
- Matthew L. Nobriga, U.S. Fish and Wildlife Service

**Presenting author*

For pelagic fishes, habitat suitability can be a function of abiotic habitat (temperature, turbidity, salinity, etc.), and food supply, which are frequently driven by hydrodynamic processes in predictable ways. When species are rare, it becomes increasingly difficult to assess contemporary habitat use, and thus quantify how conservation actions are affecting habitat suitability. In the case of Delta Smelt *Hypomesus transpacificus*, this conundrum is pronounced. To better understand drivers of habitat suitability in complex estuarine habitats, we used a bioenergetic model to look at spatial and temporal differences in potential juvenile growth rate of Delta Smelt. This study highlights the importance of tidal hydrodynamics in driving local differences in habitat suitability for pelagic fish and provides a template for evaluating habitat restoration efficacy when a target species is too rare to quantitatively sample.

Posters

There are ten categories of poster presentations:

1. **Contaminants, Nutrients & Water Quality (4 posters)**
    a. Abigale Deen (*early career candidate*)
    b. Frances Wilkerson
    c. Matthew Taylor (*early career candidate*)
    d. Michael Lydy

2. **Delta or Longfin Smelt (11 posters)**
    a. Andres Mendoza (*early career candidate*)
    b. Dominic Terrusa (*early career candidate*)
    c. Gershom Bigham
    d. Jeff Gronemyer
    e. Kendall Ashley (*early career candidate*)
    f. Lalayna Hablutzel (*early career candidate*)
    g. Lauren Sique (*early career candidate*)
    h. Savannah Valdez
    i. Selena Cao (*early career candidate*)
    j. Vanessa Mora
    k. Virginia Afentoulis

3. **Management, Policy, and Social Science (5 posters)**
    a. Celeste M. Dodge
    b. Edmund Yu
    c. Megan Nguyen (*early career candidate*)
    d. Nicholas Rowlands (*early career scientist*)
    e. Nicholas Veal (*early career candidate*)

4. **New Technologies (including AI) (2 posters)**
    a. Eric Chapman
    b. Pachia Lee (*early career candidate*)

5. **Other Fish (3 posters)**
    a. Gabriela Garcia (*early career candidate*)
    b. Jessica Falcon (*early career candidate*)
    c. Shanna Kowalewski (*early career candidate*)

6. **Physical and Biological Effects of Flow (3 posters)**
    a. Ching-Fu Chang
    b. Kiana Lindblad (*early career candidate*) *(poster withdrawn)*
    c. Magdalena Ramos (*early career candidate*)

7. **Phytoplankton, Algae, or Harmful Algal Blooms (5 posters)**
    a. Alek Hernes (*early career candidate*)
    b. Amelia Ayers (*early career candidate*)
    c. Ellen Preece
    d. Reed Hoshovsky

e. Timothy Baxter (*early career candidate*)

8. **Salmon (10 posters)**
    a. Adriana Arrambide
    b. Alex Xiong
    c. Alisa Dahl
    d. Eric Louwerens (*early career candidate*)
    e. Gregory Dooman (*early career candidate*)
    f. Hannah Richter (*early career candidate*)
    g. Isabella Ferruzzi (*early career candidate*)
    h. Samantha Downs (*early career candidate*)
    i. Sarah McCulloch
    j. Tariq Celeste (*early career candidate*)

9. **Wetland Habitats (4 posters)**
    a. Levi Lewis
    b. Lynette Williams Duman (*early career candidate*)
    c. Nicholas Aragon (*early career scientist*)
    d. Rachel D. Wigginton

10. **Zooplankton and Other Invertebrates (3 posters)**
    a. Caroline Tracy Shaw *(poster withdrawn)*
    b. Nicholas Elsberg (*early career candidate*)
    c. Toni Ignoffo

Poster Abstracts are organized alphabetically by category and then alphabetically by poster author's name.

Contaminants, Nutrients & Water Quality

The Influence of Wastewater Effluent on Water Quality in the Suisun Marsh, San Francisco Estuary, CA

- Abigale Deen*†, University of California, Davis, adeen@ucdavis.edu
- Mason Rogers, University of California, Davis
- Yuexuan Liu, University of California, Davis
- John R. Durand, University of California, Davis

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The Fairfield-Suisun Wastewater Treatment Plant (WWTP) cleans sewer water from public sewers of Fairfield, Suisun City, and Travis Air Force Base. The treated water is pumped into Boynton Slough in Suisun Marsh in the San Francisco Estuary. Suisun Marsh is a region of high importance for native biota and contains much of the remaining wetland habitat in Northern California. The San Francisco Estuary has experienced more harmful algal blooms and greater areas of oxygen depletion in recent years. Through water quality analysis and stable isotopic ratios, we will determine the effluent concentrations of nitrogen and phosphorus as they travel throughout the estuary. Whole water-grabs were taken for nutrient analysis at the point of effluent discharge, upstream for reference, and downstream. Biota was collected outside of the effluent discharge site for stable isotope analysis of Nitrogen-15. The results from this study show that nutrients from the effluent diminish as they reach Grizzly Bay, the most southern part of Suisun Marsh. The nutrients found in the effluent of the Fairfield-Suisun Wastewater Treatment Plant are not contributing to harmful algal blooms in the SFE. Stable isotope analysis showed no significant uptake of nitrogen. More sampling occasions or seasonal sampling could shed light on the exact nature of the influence of effluent through stable isotope analysis.

Measuring Nutrients on Appropriate Timescales to Understand Phytoplankton Response

- Frances Wilkerson*, San Francisco State University, fwilkers@sfsu.edu
- Richard Dugdale±, San Francisco State University
- Sara Blaser, San Francisco State University
- Vince Kelly, Green Eyes/SePRO Corporation

**Presenting author, ± Co-Presenting Author*

San Francisco (SF) Bay Delta receives high nutrient loads that influence the occurrence of phytoplankton and algal blooms (nuisance, harmful and beneficial); there is a management need for nutrient data. The timescale of these data is an important consideration since phytoplankton growth typically responds to nutrients on the order of days. Yet for logistical reasons, most monitoring of nutrients is done on a monthly basis (e.g., EMP - Environmental Monitoring program and USGS programs), although some real-time nitrate data are collected by USGS Water Center on some of the fixed station sites they maintain, some in collaboration with SFEI. USGS also conducts high-speed mapping of both nitrate and ammonium on cruises - typically 2-3 times a year or more often in South SF Bay. Nitrate is measured using a SeaBird SUNA V2 which is based on the absorption characteristics of nitrate in the UV light spectrum and provides voltage output to match the expected nitrate range. Onboard a Timberline ammonium analyzer is used for ammonium analyses of pumped water samples and requires chemical reagents. To date (to our knowledge) no real-time phosphate measurements have been made in SF Bay Delta. Here we describe an automated online water nutrient analyzer, the NuLAB that measures phosphate and ammonium concentrations in real-time, using wet chemistry on pumped samples. We have been testing this system from a fixed location in Central SF Bay to explore application of this instrument for other SF Bay Delta locations in parallel with SUNA measurements of nitrate.

Impact of Hydrophobic Organic Contaminant Mixtures in the Sacramento Deepwater Ship Channel on Early Life Stage Delta Smelt

- Matthew Taylor*†, University of California, Davis, mastaylor@ucdavis.edu
- Maxime Debources, University of California, Davis
- Zoha Siddiqua, University of California, Davis
- Michael Lydy, Southern Illinois University
- Amelie Segarra, University of California, Davis

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The close proximity of the Sacramento Deepwater Ship Channel to the historic ranges of the endangered Delta Smelt (*Hypomesus transpacificus*), particularly to their critical spawning grounds, has raised concerns about how this habitat may be affecting the health of their early life stages. Delta Smelt are native to the Sacramento-San Joaquin Delta and have seen their populations decline dramatically over the past 50 years. While the direct reasons for their decline are numerous, one agreed upon factor is the impact of harmful contaminants such as hydrophobic toxicants on Delta Smelt health and behavior. Hydrophobic toxicants, including organochlorine pesticides and polycyclic aromatic hydrocarbons, which often enter the water system through agricultural runoff, have a tendency to accumulate in aquatic environments both in the bottom sediment and organisms. These harmful contaminants are known to be found in the deepwater ship channel and are consistently redistributed throughout the water column though sediment disturbance by a passing ship, routinely exposing early life stage Delta Smelt to potentially harmful levels of contaminants that accumulate in both the sediment and in the water column. To assess the effects that these toxicants could have on early life stage Delta Smelt, larvae were exposed for 96 hours to lab-made mixtures replicating environmentally relevant contaminant levels and compositions, based on concentrations estimated from field sediment samples and measurements of suspended solids in the water column. Therefore, three contaminant mixtures were designed to reflect HOC concentrations in SDWSC: SS (suspended solids), SBIO (bioaccessible sediment compounds), and SED (total sediment compounds). Each mixture was prepared at low, medium (environmentally relevant concentration) and high (worst case-senario) concentrations. Behavioral endpoints were evaluated through swimming activity assays, which revealed alterations in movement patterns across all three mixture types, indicating disruptions in behaviors critical to the survival of larval Delta Smelt.

Contaminant Uptake by Pelagic Organisms in Northern California

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- Kara E. Huff Hartz, Southern Illinois University
- Nick Hettel, Southern Illinois University
- Giovanni Molinari, Southern Illinois University
- Emerson Feddor, University of California, Davis
- Shawn Acuña, Metropolitan Water District of Southern California
- Jacob Stagg, U.S. Fish and Wildlife Service
- Amelie Segarra, University of California, Davis
- Hailee Richesin, Southern Illinois University

**Presenting author*

In the Sacramento Deep Water Ship Channel (SDWSC), multiple legacy contaminants like polyaromatic hydrocarbons (PAHs) and organochlorine pesticides (OCPs) have been ubiquitously detected throughout the channel, alongside frequent detections of current use pyrethroid insecticides. Exposure to these compounds through contaminated sediments, suspended solids, and zooplankton via direct ingestion, respiration, and dermal contact may increase injury (e.g. DNA adducts, lesions, reduced fecundity) to aquatic organisms including Delta smelt. Our current study quantified hydrophobic organic contaminant (HOC) concentrations directly in fish tissue to assess HOC presence in pelagic organisms and the potential bioavailability of HOCs from food items such as zooplankton, and exposures to suspended solids and sediments. Wild-caught Wakasagi (*Hypomesus nipponensis*) were used as a surrogate species for chemical analysis in place of other pelagic organisms like Delta smelt. Provisional data showed that of the 63 compounds analyzed, 70% were detected in the fish samples, with highest concentrations of sum (∑) OCPs, largely attributed to high 4,4’ dichlorodiphenyldichloroethene (DDE) concentrations, followed by ∑ PAHs, ∑ PCBs, and ∑ pyrethroids. The detection of OCPs and PAHs in fish aligned well with detections in all matrices sampled, showing probable exposure to HOCs from all matrices. No PCBs were detected in sediments, while fish, zooplankton, and suspended solids all had similar PCB chemical signatures, which indicate that these two matrices are likely routes of exposure. The high concentrations of OCPs and PAHs measured in the fish tissue pose potential concern for adverse health effects and may explain the presence of lesions on previously wild-caught Delta smelt within the SDWSC. These elevated concentrations highlight the importance in considering contaminant exposures when assessing the health of pelagic organisms through the SDWSC.

Delta or Longfin Smelt

Catch Me If You Can: An Exploration of Species-Specific Net Avoidance for Kodiak Trawl Efforts

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- Vanessa Tobias, U.S. Fish and Wildlife Service

**Presenting authors, †Early Career Award candidate*

Accurately estimating fish catch per unit effort (CPUE) is essential to ensure that trawl sampling represents the true species composition and abundance within the Delta. Kodiak trawls are effective for sampling fish populations, yet it is unclear how many fish avoid capture due to visually detecting and escaping the net. This poster investigates species-specific net avoidance capabilities during Kodiak trawl sampling by exploring the relationship between fish behavior and environmental conditions. A Gear Avoidance Behavior Simulation (GABS) model was used to predict the likelihood of escape for different fish species. This model uses existing Kodiak trawl datasets from the U.S. Fish and Wildlife Service Delta monitoring programs and peer-reviewed estimates of species swim speeds to predict the probability of capture. Additional key variables, such as turbidity, fish size, location of fish within the net, angle of escape and swim speeds are also incorporated to evaluate how they influence net avoidance rates. Special attention will be given to comparing native fish (Chinook Salmon, Steelhead trout, Delta Smelt, Longfin Smelt, Splittail, Sacramento Hitch) and non-native fish (Wakasagi Smelt, Striped Bass, Threadfin Shad, American Shad, Mississippi Silverside) species to assess whether environmental factors, such as turbidity, provide differential advantages in avoiding capture. The results of this analysis will help identify potential biases in trawl efficiency and inform future sampling protocols to improve data accuracy and representativeness across the Delta.

Tracking the Key Prey of a Declining Native Fish: Quantifying *Eurytemora Carolleeae* in Longfin Smelt Diets

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For over two decades scientists have aimed to determine the mechanisms for declining native fish and zooplankton in the upper San Francisco Estuary, including the longfin smelt (*Spirinchus thaleichthys*). Shifts in food webs and prey resources available to these fish during their sensitive larval and early juvenile stages have been identified as a key factor that may be limiting their populations. Recent dietary DNA metabarcoding studies supported prior evidence that the copepod *Eurytemora carolleeae* is potentially the most important contributor to the diets of larval longfin smelt, but these methods are not quantitative. Visual analysis of diets can provide prey quantities, but species-level identification of partly digested prey can be difficult or impossible. This study builds upon previous work and couples visual gut content analyses, where all prey taxa are identified and counted, with quantitative polymerase chain reaction (qPCR, targeting *E. carolleeae*) to identify and quantify prey in longfin smelt diets. The gut fullness estimates using this visual analysis of prey will provide a measure of feeding success that can then be related to fish growth rates; collaborators on this study are determining fish growth rates through otolith geochemistry analyses. Early-stage (age-0, larval and juvenile) longfin smelt were collected in channels from San Pablo to Suisun Bay from February to June of 2024 and 2025 during the day and night as part of a larger multi-institutional collaboration. The esophagus, stomach, and intestines were excised for gut fullness by visual identification or for qPCR to measure *E. carolleeae* biomass in the diets. We will present progress on the development and application of the qPCR assay for *E. carolleeae* and preliminary results on the spatial and temporal distribution of longfin smelt larvae observed during field sampling.

Are Established Morphometrics Appropriate for Identifying Larval, Hatchery Delta Smelt?

- Gershom Bigham*, U.S. Fish and Wildlife Service, Gershom_bigham@fws.gov
- Denise Goodman, U.S. Fish and Wildlife Service
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**Presenting author*

The Delta Smelt (*Hypomesus transpacificus*), a species native to California's Sacramento-San Joaquin Delta (Delta), is a federally (threatened) and state listed (endangered) species. Proper identification of Delta Smelt at all life stages is paramount to better estimate and assess population abundance and spatial distribution of Delta Smelt within the Delta, which is a primary focus of U.S. Fish and Wildlife Service's Enhanced Delta Smelt Monitoring Program (EDSM). To date, larval Delta Smelt have been preserved in formalin and identified primarily based on phenotypic characteristics. Since Delta Smelt reintroduction efforts began in December 2021, when cultured fish were experimentally released into the Delta to support the wild population, EDSM has observed increased phenotypic variation in larval specimens of wild-origin Delta Smelt and increased phenotypic overlap between larval Wakasagi (*Hypomesus nipponensis*). This raises growing uncertainty regarding the phenotypic attributes historically used to identify larval Delta Smelt and whether these attributes can be reliably used for present-day larval fish identification.

For this presentation, we will assess two key characteristics often used in identifying the early life stages of Delta Smelt, specifically pigmentation and development of the air bladder and surface area of the gut. We will characterize these features in cultured larval Delta Smelt provided by the UC Davis Fish Conservation and Culture Laboratory to determine if the phenotypic attributes of these hatchery Delta Smelt align with those recorded in the literature for wild Delta Smelt. Our preliminary results on cultured Delta Smelt are a first step in providing a baseline to improve identification of larval Delta Smelt caught in the wild. Next steps will include assessing a wider suite of characteristics on cultured Delta Smelt and on wild-origin Delta Smelt and Wakasagi (*Hypomesus nipponensis*).

Cameras and Nets: Linking Methods to Inform the Community Composition of Fish at Delta Smelt Release Sites

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**Presenting author*

Conservation efforts to supplement the population of wild Delta Smelt (*Hypomesus transpacificus*) by releasing cultured fish from a refugial conservation population are ongoing. To assess the risk of post-release predation, extensive surveys using Acoustic Resonance Imaging Sonar (ARIS) cameras have documented variability in large fish (>200 millimeters total length) at release locations. Although this technology allows the ability to continuously sample across a range of conditions with minimal disturbance to fishes, this information is inherently restricted as it provides limited data on species composition. Conversely, traditional sampling methods, such as gillnetting, allow for direct observations of species composition and size structure of fish communities on a narrower timescale. By utilizing both ARIS cameras and traditional fisheries methods, we collected complementary datasets featuring the strengths of both methodologies. In this study, the U.S. Geological Survey, in collaboration with the California Department of Water Resources, used direct-capture sampling with gill nets in conjunction with ARIS camera observations to provide insights into the fish communities present at the time and location of cultured Delta Smelt releases.

Building Capacity for Longfin Smelt Recovery: Collaborative Culture Efforts Across UC Davis Facilities

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**Presenting author, †Early Career Award candidate*

Longfin Smelt (*Spirinchus thaleichthys*), once one of the most abundant osmerids in the San Francisco Estuary, was listed as endangered under the Endangered Species Act in July 2024. Today, the population stands at less than 1% of historical levels due to habitat degradation, altered freshwater flows, food limitation, climate change, and small population dynamics. To address this decline, the UC Davis Longfin Smelt Conservation and Culture Program (LFSCCP), supported by the California Department of Water Resources, integrates four specialized facilities to advance full life-cycle culture and recovery. The Otolith Geochemistry and Fish Ecology Laboratory (OGFL) leads broodstock collection from South Bay and Alviso Marsh, ensuring genetic diversity and healthy spawner acquisition. The Fish Conservation and Culture Laboratory (FCCL) focuses on spawning and early life stages, refining fertilization, incubation, and larval rearing protocols. The Putah Creek Facility (PCF) provides large-scale capacity for juvenile and adult culture, with recirculating aquaculture systems (RAS) supporting all life stages. Finally, the Bodega Marine Laboratory (BML) supports rearing of Longfin Smelt under full-strength seawater conditions, with new systems under construction to expand capacity. This poster presents the integrated culture framework developed by the LFSCCP, highlighting protocols for broodstock transport and conditioning, fertilization and larval rearing methods, and system design innovations supporting all life stages. Cross-facility coordination strategies and genetic management approaches will also be described to inform future recovery efforts. Results from 2024-2025 demonstrate the effectiveness of this framework: increased broodstock collections and improved transport survival from OGFL, higher hatching and larval success at FCCL, successful rearing of age-2 F1 fish at PCF, successful spawning of wild age-2 adults at BML, and new infrastructure at both PCF and BML to expand capacity. Together, these facilities form a collaborative network advancing Longfin Smelt culture science, increasing captive capacity, and building the foundation for long-term species recovery.

Phenology of Longfin Smelt (*Spirinchus thalieichthys*) in the South Delta

- Lalayna Hablutzel*†, California Department of Fish and Wildlife, Lalayna.hablutzel@wildlife.ca.gov
- Virginia Afentoulis, California Department of Fish and Wildlife
- Walter Kyle Griffiths, California Department of Fish and Wildlife
- Morgan Gilbert, California Department of Fish and Wildlife
- Tariq Celeste, California Department of Fish and Wildlife
- Tim Malinich, California Department of Fish and Wildlife

**Presenting author, †Early Career Award candidate*

Longfin Smelt (*Spirinchus thalieichthys*) are a protected species in their southernmost range in the Sacramento – San Joaquin Delta (Delta) of California. The observed decline of the Longfin Smelt (LFS) population is attributed to factors such as decreased food availability, increasing temperatures, changes in flow within the estuary, and entrainment to the federal and state water projects. Entrainment is the redirection of LFS by exported water diversions out of the estuary by water projects located in the south Delta, and researchers are attempting to determine what proportion of the LFS population is vulnerable to entrainment. The California Dept. Of Fish and Wildlife and the Interagency Ecological Program (IEP) monitors the spatial distribution and presence of larval LFS across the Delta with the Smelt Larva Survey (SLS) and the Larval Entrainment Study (LES). Both were established to improve our understanding of factors influencing larval LFS entrainment. Here, we aim to measure the start and end of spawning periods by examining trends in the timing of larval LFS presence and abundance in the south Delta. We estimate spawning starts using the developmental rate of LFS eggs in conjunction with larval LFS observations. We compare data from LES to those of SLS, specifically focusing on the south Delta region. We expect LFS with yolk sacs to appear in clusters throughout each sampling season in the south Delta with corresponding abundances of growing LFS later in the season. Furthermore, spawning periods are expected to vary in length across years in response to environmental variables such as precipitation and river temperatures. Preliminary work suggests that recently hatched larvae are still present, and at risk of entrainment, in the south Delta following the end of the SLS season. A clearer understanding of LFS spawning trends, presence, and abundance will improve monitoring efforts and inform management of LFS.

From Marsh to Mouth: Larval Longfin Smelt Diet in Tidal Wetlands

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- Michelle Avila±, California Department of Fish and Wildlife
- Darian Dungey, California Department of Fish and Wildlife

**Presenting author, †Early Career Award candidate, ± Co-Presenting Author*

The California Department of Fish and Wildlife's Fish Restoration Program (FRP) conducts sampling for fish, macroinvertebrates, and zooplankton at wetland restoration and reference sites throughout the Sacramento-San Joaquin Delta and Suisun Marsh. Staff monitor sites to evaluate the FRP goal of restoring altered wetland habitats to a beneficial state for native fish species of interest, including Longfin Smelt (*Spirinchus thaleichthys*). While invertebrate species composition and density from regular sampling provide information on food availability, diet studies give insight into prey selection and foraging success. In 2019, Tule Red, a FRP restoration site in Suisun Marsh, was breached to Grizzly Bay. This re-established natural tidal action to a 460-acre parcel previously managed for duck hunting.

Our study examined differences in larval Longfin Smelt diet between a restoration site, Tule Red; a reference site, Ryer Island; and the adjacent water body, Grizzly Bay in April 2023 and April 2024. We used permutational multivariate analysis of variance (PERMANOVA) to examine differences in larval Longfin Smelt diet between sites. In addition, we compared gut contents of fish with species composition of zooplankton samples from the same time periods for evidence of prey selectivity. Finally, we measured feeding incidence to assess overall foraging success across sites. This study provides critical information concerning the role of tidal wetlands in supporting foraging success as well as variability in diet. Moreover, our research elucidates food source preferences and generally deepens our understanding of beneficial habitat.

The Feasibility of Incorporating Ethanol into 20mm Sampling for the USFWS Enhanced Delta Smelt Monitoring Program

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- Vivian Peck±, U.S. Fish and Wildlife Service
- Mia Adreani, U.S. Fish and Wildlife Service
- Denise Goodman, U.S. Fish and Wildlife Service

**Presenting author, ± Co-Presenting Author*

During the 2024 U.S. Fish and Wildlife Service's Enhanced Delta Smelt Monitoring (EDSM) larval fish sampling season, the program observed significant morphological ambiguity between larval Delta Smelt *(Hypomesus transpacificus*) and Wakasagi (*Hypomesus nipponensis*). This ambiguity has been increasing since Delta Smelt reintroduction efforts began in 2021, adding to the challenge of morphology-based identification. In previous sampling seasons larval fish were fixed and preserved in formalin, a chemical that preserves morphological features but degrades DNA, resulting in limited genetic verification. This inability to reliably identify *Hypomesus* species ultimately led to a pause in EDSM larval sampling in 2025.

Recognizing the need for more reliable methods of identifying *Hypomesus spp.*, EDSM reevaluated its larval monitoring approach prior to the 2026 sampling season, including finding an alternative preservation method to formalin. Although previous studies have shown that ethanol as a preservative can cause tissue shrinkage and pigment loss, its ability to preserve DNA made it the most suitable alternative.

To test the feasibility of incorporating ethanol into EDSM larval fish sampling, two days of qualitative testing were conducted in May 2025. The evaluation focused on the practicality of ethanol fixation in the field, the preservation of morphological features in ethanol, and long-term storage effectiveness between formalin and ethanol.

EDSM found that incorporating ethanol into its current protocol was feasible and has decided that 2026 EDSM larval fish sampling will continue with initial fixation in formalin, followed by a transfer to ethanol within 24 hours for long-term preservation.

This poster describes the components and results of the qualitative ethanol testing and how it supported modifications to EDSM larval sampling in 2026.

Investigating Spatial Distribution and Effect of Water Temperature Increase on Longfin Smelt Larval Timing Using EDSM Data

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- Vanessa Tobias, U.S. Fish and Wildlife Service, vanessa_tobias@fws.gov

**Presenting author, †Early Career Award candidate*

Increasing water temperatures have been documented in the San Francisco Estuary over the last 50 years. Throughout the Delta, different regions experience temperature change differently—some reach high temperatures faster, some slower and later. Other environmental factors, such as X2, are also variable with water year. These changes have implications for all fish, but especially for recently ESA-listed Longfin smelt (*Spirinchus thaleichthys*; LFS), who have experienced catastrophic decline in the last decade. LFS spawning is temperature-dependent, typically occurring between 7° and 14° C water temperatures, while temperatures of 15 °C and above are detrimental to egg and larval survival. Variable environmental conditions could change where it is habitable and suitable for spawning for LFS. During April – June, the Enhanced Delta Smelt Monitoring Program samples these areas using 20mm nets to monitor larval Delta Smelt but catch often also includes larval Longfin Smelt. This project intends to repurpose EDSM data to investigate how environmental factors affect the spatial distribution of Longfin Smelt larvae in the Delta and Suisun. Although EDSM's larval sampling usually occurs too late in the LFS life cycle to detect the timing of LFS hatch, initial results suggest that EDSM monitoring captures the end of LFS larval season and that timing varies by year and region. Thus, it can be useful for investigating factors that contribute to larval LFS' absence from EDSM catch across different regions in late spring. Results currently show that LFS larval distribution shifts with X2 shifts yearly. Ongoing work is investigating adult cohort contribution to catch and the relationship between larval LFS occurrence and temperature. Creating these diagnostics in their distribution and temperature preference will assist in predicting Longfin Smelt abundances and help us determine the viable conditions for larval LFS.

NAPA: Longfin Smelt in a Production Hotspot

- Vanessa Mora*, California Department of Fish and Wildlife, vanessa.mora@wildlife.ca.gov
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- Jennifer Oceguera Zavala, California Department of Fish and Wildlife
- Colin Brennan, California Department of Fish and Wildlife

**Presenting author*

Longfin Smelt (*Spirinchus thaleichthys*), a CESA-listed threatened species, faces persistent population declines and high interannual variability in recruitment throughout the San Francisco Estuary. Recent data from CDFW Smelt Larva (SLS) and 20-mm Surveys reveal the Napa River can be a production hotspot, where catches of larval and juvenile Longfin Smelt far surpass those observed in other strata of the upper San Francisco Estuary. However, this abundance is not consistent across years. This poster investigates the drivers of this interannual variability in the Napa River.

Factors affecting Larval Longfin Smelt Catch and Location, the Influence of Outflow and Precipitation Events

- Virginia Afentoulis*, California Department of Fish and Wildlife, virginia.afentoulis@wildlife.ca.gov
- Kyle Griffiths[±], California Department of Fish and Wildlife
- Morgan Gilbert, California Department of Fish and Wildlife
- Tim Malinich, California Department of Fish and Wildlife

**Presenting author, [±] Co-Presenting Author*

Larval Longfin Smelt (LFS) were collected as part of a 5-year pilot study, first referred to as the Larval Entrainment Pilot Study (LEPS) and then developed into the Larval Entrainment Study (LES). LEPS and LES were conducted to determine the risk of larval entrainment in the lower San Joaquin River and South Delta area near Byron, CA, during the months January through April when larval LFS are most likely to be present. Longfin Smelt can be advected and transported by flows and affect the location of larvae in the Sacramento-San Joaquin Delta (Delta) and San Francisco Estuary regions. We looked at the effects of Delta hydrology, weather, time of day, and day of year on catch during January through April for the years 2022 (LEPS), 2023 and 2024 (LES). To look at the spatial component, we included Smelt Larva Survey (SLS) data in the analyses with LES since the SLS survey covers more of the Delta and San Francisco Estuary areas and, in some regions like the Napa River, has higher catches than LES. Using the combined LES and SLS datasets we expect to see regional shifts in catch over the season and in response to changes in hydrology and weather on a finer temporal scale. This in turn may help inform management of larval Longfin Smelt through incorporation of larval movement in response to environmental cues and preferred habitats.

Management, Policy, and Social Science

Methods for Defining the Sample Frame and Estimating Habitat Volumes for Juvenile Pelagic Fish Studies in the San Francisco Estuary

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- Steven B. Slater, California Department of Fish and Wildlife
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**Presenting author*

This poster presents the methods and data products of the Monitoring Survey Design Team (Design Team) that form the geographic basis for the design and analysis of the California Department of Fish and Wildlife (CDFW) long-term monitoring studies conducted in the San Francisco Estuary (SFE). These products are intended to serve as a foundation for a spatial design to standardize methods for estimating regional fish abundance across CDFW pelagic fish monitoring studies conducted in the SFE, including Smelt Larval Survey, 20mm, Summer Townet, Fall Midwater Trawl, and the San Francisco Bay Study, which are all part of the Interagency Ecological Program (IEP). Here, we present the methods behind new data resources intended to standardize the approach to defining spatial extents and the inputs used to determine critical catch per unit of effort (CPUE) estimates, including design-based abundance (DBA) indices with units and uncertainty. The spatial extent and methods for calculating expansion factors (water volume and surface area) provide an improved means to estimate pelagic fish abundance consistently across CDFW surveys in the SFE. Using the latest bathymetric data for the SFE (DWR & USGS, 2025), we have updated and increased standardization for volume and surface area expansion factors for CPUE, including implementing a spatially variable water surface elevation, making sample frame refinements, and creating a new hydrologic footprint for the SFE. We define the sample frame as the continuous geographic area containing the SFE, subdivided into smaller nested areas we term regions (n=7), strata (n=12), and subregions (n=35). Our operational footprint differs from the U.S. Fish & Wildlife Service (USFWS) Enhanced Delta Smelt Monitoring (EDSM) program, but our method for defining the hydrological footprint and geographic regions, are adaptations of EDSM's. Our hydrological footprint is a customized selection of USFWS National Wetlands Inventory (NWI) features, including estuarine, marine, riverine, and lake features.

Decision-Making Under Deep Uncertainty: What Is It and Why Is It Useful (Or Is It)?

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**Presenting author*

Uncertainty about future environmental, social, and economic conditions significantly influences decision-making and how well decisions remain effective over time. When decisions are made without sufficient insight into how changing factors will affect systems, they can lead to unpreparedness and increased vulnerability to disruption. The Bay-Delta system, including its watersheds, faces particular challenges due to climate change, which introduces rapidly shifting and difficult-to-predict conditions. In addition, evolving social, policy, and economic contexts can substantially alter resource use and management priorities. In such dynamic settings, decision-makers may need to act quickly, often without full consideration of all options or stakeholder input.

While scientific tools, such as simulation models, can help reduce some uncertainty by improving the accuracy and resolution of predictions, other uncertainties remain deeply unpredictable. Events such as global pandemics, fish population collapses, or invasive species outbreaks often occur without reliable warning, even with advanced research. These challenges represent Deep Uncertainty, conditions that cannot be well defined using current data, models, or scientific understanding.

Under Deep Uncertainty, there is often little consensus about system behaviors or the likelihood, timing, and interaction of disruptive events. These uncertainties, especially those that are extreme, novel, or compounding, are critical to Bay-Delta management. To strengthen the ability to anticipate and adapt to these conditions, the Delta Independent Science Board (Delta ISB) launched a review in spring 2023 on Decision-Making Under Deep Uncertainty (DMDU). This effort explores tools and strategies that could help better characterize uncertainty and improve decision-making across the Bay-Delta system. This poster will share insights from the Delta ISB's review by explaining what is DMDU, its benefits, how scenarios are being used in the Delta region to prepare for change, and opportunities to advance scenario analysis to improve their practical uses for managing uncertainty during decision making.

Science Investments that Strengthen Bay-Delta Knowledge and Collaboration

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Amid environmental change that outpaces traditional science, the Delta Science Program (DSP) closes the gap between research and decision-making by proactively funding management-relevant work prescribed by the collaboratively developed 2022-2026 Science Action Agenda. Our solicitations target issues that often go unfunded under regulatory mandates and prioritize partnerships among researchers, agencies, communities, and Tribes so that diverse perspectives can shape research questions, methods, and products.

A growing share of Delta Research Awards center marginalized voices, recognizing that Delta science affects lives and livelihoods in a highly managed system. Social science, which is vital for understanding behaviors, institutions, and equity, remains underfunded; DSP invests to fill this gap and connect scientific inquiry with other ways of knowing, including traditional knowledge. Co-produced research links scientists with affected communities to address on-the-ground needs and the questions that matter most to communities.

The 2025 Delta Research Awards build on earlier successes, emphasizing management relevance, collaboration, and integration of biophysical and social science. Funded projects span habitat restoration, species dynamics, water quality, data integration, and community-engaged science, including topics such as harmful algal blooms, eco-cultural restoration, Tribal Knowledge, subsidence, hydrology, acoustic telemetry, and endangered species.

Outcomes from prior cycles show measurable gains: improved monitoring design, accelerated synthesis, restoration planning informed by new science, and expanded access to environmental data and tools. Even as funds have declined, DSP maximizes impact through inclusive and robust prioritization processes, strong partnerships, and a commitment to actionable science. We invite researchers, managers, and community partners to explore funded work, build connections, and advance the next wave of Delta research.

Delta Science Tracker

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The Sacramento–San Joaquin Delta is home to a broad range of scientific and management efforts led by government agencies, academic institutions, non-governmental organizations, and private research groups. To support transparency, accountability, and opportunities for collaboration concerning these efforts, the Delta Science Program created the Delta Science Tracker as a publicly accessible, web-based platform to organize and share information on Delta-focused research, monitoring, and management projects. Designed to support the vision of "One Delta, One Science," the Tracker enables those involved in the Delta to easily find activities, discover new connections, and communicate outcomes. The Delta Science Tracker acts as a catalyst for collaboration, connecting scientists, managers, and decision-makers across disciplines and regions. Early use of the Tracker has revealed gaps and overlaps in research, helped funders and managers monitor investments toward Science Action Agenda priorities, and promoted communication among different partners. By fostering this kind of transparency and coordination, the Tracker enhances our capacity to support resilient decision-making and effective stewardship of the greater Delta and estuary. Going forward, the Delta Science Tracker will continue to play a key role in providing access to information about and outcomes of critical science activities aimed at informing decision-making needs for the Delta's water, ecosystems, and communities in the face of climate change and other mounting challenges.

Taking the (New) Seine-ic Route: Recharting Sampling Runs on the Lower Sacramento River

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Juvenile chinook salmon begin to out-migrate through the Sacramento River to the Sacramento-San Joaquin River Delta in the early fall, coinciding with heavy rainfall and high-water levels. Erosion and flooding of historical seine sites on the Lower Sacramento hinder sampling during this period, necessitating the addition of new seine sites to increase successful seining efforts and address these data gaps. Earlier this year, Delta Juvenile Fish Monitoring Program (DJFMP) staff scouted for new seine sites along the Sacramento River and proposed seining this stretch of river by boat rather than by truck during peak salmon season (October-May).

The DJFMP seine data used in this project is from the 2022 – 2026 water years (August – July), which includes both the historic seine protocol (pre-2025 water year) and an updated seine protocol. Historic seine sampling frequency on the Lower Sacramento will be compared to the updated DJFMP seine protocol and against a boat seine run that would sample new beaches and historical sites along the same route to assess boat sampling efficacy. The additional sites and hypothesized improvement provided by the implementation of a Lower Sacramento boat run could provide key insights into the migration of protected salmon runs when truck access is restricted.

New Technologies (include AI)

Hydraulic Egg Injection, A Novel Methods for Instream Incubation of Salmonid Eggs

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In the face of climate change, actions taken below rim dams alone will not likely result in long-term salmon conservation. The effect of warming temperatures is expected to intensify with increased water demands, necessitating the evaluation of putting salmon above known barriers into thermally suitable habitats. Accordingly, a study is being conducted on the feasibility of returning spring-run Chinook salmon to historically available, high-quality habitat in the North Fork Feather River watershed above Lake Almanor (NFFAA). This study evaluated two instream incubation methods, Whitlock-Vibert (WV) egg boxes and hydraulic egg injections, to determine survival of eggs in the NFFAA. In 2023, triploid Chinook salmon eggs (150k) were reared to the eyed stage and transported to historic Chinook spawning habitat in the NFFAA. The novel use of hydraulic egg injection in California was conducted side-by-side with WV boxes. The primary difference between the two methods is that the WV boxes require eggs to be incubated and hatch inside perforated plastic cages, whereas hydraulic injection places eggs directly into the gravel. Parentage-based tagging confirmed that hydraulic egg injection was far more successful than egg boxes in the NFFAA. This method can be applied to restoration and reintroduction projects for other salmonids (including trout) in California.

Cold, Quick, and CRISPR-Clear: Freezing SHERLOCK for Faster Genetic Detection

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SHERLOCK (Specific High-sensitivity Enzymatic Reporter unLOCKing) is a CRISPR-based genetic method used to detect specific DNA or RNA sequences with high sensitivity. In conservation, SHERLOCK is used to quickly and accurately detect invasive and endangered species. DWR's Genetic Monitoring (GeM) Lab uses SHERLOCK for diverse projects, including Chinook Salmon Spring-Run Juvenile Production Estimate and to estimate take of listed Chinook Salmon runs at water export facilities. This work is sometimes extremely time-sensitive and informs real-time water operations. Therefore, we need to produce results quickly to provide information to water operators. Typically, SHERLOCK reactions are prepared fresh each day. To minimize SHERLOCK processing time, and increase work efficiency, it would be ideal to deploy pre-frozen SHERLOCK reactions for sample testing. Through experimentation, we tested how long, after reactions are prepared, can they be frozen before results become unreliable. We found that reactions can be prepared and frozen 90 days in advance with minimal decrease in sensitivity, which saves considerable time compared to fresh preparation. We can also pre-freeze positive and negative controls into reactions, further increasing efficiency. Therefore, for time-sensitive samples we can simply thaw the frozen reactions and add only the samples, streamlining the entire process. Study findings help improve the efficiency and flexibility of SHERLOCK workflows, making both high-throughput and field-based sample processing faster and more practical, without compromising accuracy.

Other Fish

Echoes in the Estuary: Thirteen Years of White Sturgeon Movements

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White Sturgeon (*Acipenser transmontanus*) are large, slow-growing, and late-maturing fish that move between river spawning grounds and downstream feeding areas. The southernmost population of the species, found in the Sacramento-San Joaquin system (i.e., Lower Sacramento River, San Joaquin River, and San Francisco Estuary), appears to be in decline. In November 2023, this population was petitioned for listing under both the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). To better understand how White Sturgeon use the system, we analyzed 13 years (2013–2025) of acoustic detections from fish collected and tagged in the San Joaquin River (n = 107). Data from the U.S. Fish and Wildlife Service (Lodi) were combined with detections from the Pacific Aquatic Telemetry Hub (PATH) across the Sacramento–San Joaquin system. Over the study period, 50 tagged White Sturgeon (46%) were detected only in the San Joaquin River, 49 used both the Lower Sacramento and San Joaquin rivers, three were found only in the Lower Sacramento River (aside from the tagging year), one that was not detected above the confluence of the Sacramento-San Joaquin, and four were never detected after tagging. Thirteen fish (12%) moved below Alfred Zampa Memorial Bridge, 37 (34%) were observed in both the Sacramento and San Joaquin rivers within the same water-year, and 42 (40%) were detected in the Southern Delta. Four individuals were also detected in the Calaveras River, roughly 12 miles upstream of its confluence with the San Joaquin River. We explore these patterns further using age, sex, Delta inflow and outflow, and other environmental conditions to better understand the factors influencing these movements. Our findings help clarify how and when White Sturgeon use different parts of the Sacramento-San Joaquin system and provide useful information for future management and recovery efforts.

Distribution and Factors Affecting Hybridization of Black Bass in the Sacramento-San Joaquin Delta

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The Sacramento-San Joaquin Delta has many centrarchid species, notably black bass such as red-eye, largemouth, spotted, and smallmouth bass. Black bass species are morphologically similar, so special care is taken to identify them. Recent observations of characteristics that are inconsistent with existing identification guidance have raised questions about whether these species could be hybridizing. A first step toward addressing these questions is to investigate the overlap in geographic range and habitat use for these species. This study analyzes the past 10 years of black bass catch data from the U.S. Fish and Wildlife Service's Delta Juvenile Monitoring Program datasets to 1) map the ranges of these species in DJFMP's dataset and 2) examine relationships between water quality parameters and species distribution with a goal of identifying possible areas of hybridization. Some of these factors may include water quality parameters, such as salinity, dissolved oxygen, turbidity, and temperature. Understanding how and why various black bass species may be distributed throughout the Delta and how they may be hybridizing can increase our understanding of what factors lead to differences in distribution as well as strengthen understanding in how to more accurately identify black bass to species. The results of this study may also inform future studies such as genetic studies, vegetation studies, or more advanced morphometric studies on black bass physical characteristics that increase understanding of complex black bass physical variation.

Log Jam! Bigscale Logperch in the Sacramento-San Joaquin River Delta

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Bigscale Logperch (*Percina macrolepida*) are a nonnative perch species found throughout the Sacramento-San Joaquin River Delta system. Logperch are understudied in the Delta, and little is known about their breeding behavior, habitat use, or species to species interaction within the system. The Lodi Fish and Wildlife Office's Delta Juvenile Fish Monitoring Program (DJFMP) has encountered this species since the beginning of sampling efforts in 1976. The present study examines the spatial and temporal prevalence of adult and juvenile logperch within the Delta and how those patterns vary across years. Adult logperch are caught year-round by DJFMP—with the highest catch occurring in the Lower Sacramento and Upper San Joaquin Rivers. DJFMP begins to detect juvenile logperch in May and June. We hypothesize that environmental conditions influence the timing and abundance of juvenile logperch catch. This research provides more context for nonnative Logperch in the delta system. The location and timing of logperch spawning may coincide with other native species; the impact on habitat use and availability of Bigscale Logperch in the Delta system would be valuable to research further.

Physical and Biological Effects of Flow

Models of Physical Transport and Salmonid Responses to Aid Delta Operations and Large-Scale Analyses

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**Presenting author*

The Delta Simulation Model II (DSM2) includes a suite of useful modules for simulating hydrodynamics, physical transport, as well as salmonid responses, all of which are valuable information when reviewing historical conditions, managing real-time operations, or planning projects and studies. However, one of the practical challenges to incorporating DSM2 analyses is its computational demand, especially for simulating particle transport and movement.

In this study, we established several models to emulate the transport of positional particles and the responses of salmonid particles. In addition, we defined a suite of hydraulic footprint indices that are simplified indicators of the underlying hydrodynamic transport in central and south Delta.

The models and the hydraulic footprint indices provide practical advantages compared to DSM2, such as simple input structure and low computational demand. We also purposedly developed the models and indices with a wider range of operational limits than recent and current permits and regulations, which makes them more reliable in planning studies or when facing atypical operation scenarios.

The models and hydraulic footprint indices were applied in hindcast analyses to demonstrate their potential usefulness. We demonstrated how the models and indices provide a direct linkage from changes in flows and operations to the extent of hydrodynamic transport, which, when combined with survey observations and environmental conditions, could provide insight for species entrainment management. Finally, a dashboard for easy implementation of these tools will be provided.

Going with the Flow: Assessing How Fish Community Structures Change with the Tide at Chipps Island *(poster withdrawn)*

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The Sacramento-San Joaquin Delta is a tidally influenced environment where salinity, water temperature, water volume, and turbidity change hourly. These environmental variables have a strong influence on fish community structures and may be imposing temporal patterns on the biological communities found within the delta (Dunson & Travis, 1991). In the 1970s, the U.S. Fish and Wildlife Service (USFWS) established the Delta Juvenile Monitoring Program (DJFMP) to monitor juvenile salmonids throughout the Sacramento-San Joaquin Delta. As part of this monitoring, DJFMP has been conducting year-round midwater trawls to target pelagic fish off the coast of Chipps Island. Using the Chipps Island data and water level station data provided by the National Oceanic and Atmospheric Administration (NOAA), we performed a community comparison to examine how pelagic fish communities change over time with respect to various environmental variables.

Tidal Turbulence at Paradise Beach

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Tides influence abiotic and biotic factors including fish community structures, food and habitat availability, water turbidity, salinity, and dissolved oxygen. Eelgrass beds (*Zostera marina*) are an ecologically important habitat that are highly susceptible to the influence of tidal activity. Eelgrass beds are known to provide shelter and camouflaging opportunities for juvenile fish, improve water quality, trap sediment, stabilize the substrate, and produce food and oxygen.

As our understanding of estuarine dynamics grows, it becomes increasingly clear that tidal behavior influences the habitat and encountered fish assemblages actively being sampled by the Delta Juvenile Fish Monitoring Program (DJFMP). We used data from the DJFMP and tidal data provided by the National Oceanic Atmospheric Administration to create a fish assemblage from habitat we delineated.

This study could have immediate applications towards enhancing the ecological relevance of our monitoring data, interpreting seine data, and capturing a more accurate depiction of the region of interest.

Phytoplankton, Algae, or Harmful Algal Blooms

Visualizing Long-Term Raw and Modeled Water Quality Data in the San Francisco Bay and Sacramento-San Joaquin Delta Estuary

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For the last 50 years, the U.S. Geological Survey has conducted monthly monitoring surveys of a 145 kilometer transect of the San Francisco Bay and Sacramento-San Joaquin Delta estuary system (hereafter, San Francisco estuary) from the lower South Bay to Rio Vista, and bi-monthly surveys from the lower South Bay to Angel Island in the center of San Francisco Bay. These surveys collect discrete water samples at over 30 locations to evaluate water quality, nutrient conditions, and phytoplankton dynamics, providing data to inform estuary management and support habitat sustainability for fish and lower trophic level organisms. Data collection includes salinity, turbidity, chlorophyll *α*, nitrate, nitrite, ammonium, and phosphate, among other parameters. While this 50-year effort has resulted in a substantial database of historic water quality data, it has been difficult to locate and interact with this large data set. We are introducing a new tool that helps solve this problem: the San Francisco Estuary Generalized Additive Model web application, which acts as a seamless interface that allows users to visualize these data on the web in both a raw and modeled format, as well as download it for personal use. Visualizing long-term, discrete data can be difficult, as it is often noisy and non-continuous. For that reason, this application also presents the data with a generalized additive model (GAM) applied. GAMs are an extension of generalized linear models and are specifically appropriate for modeling time-series data in complex systems for the purpose of trend analysis, while remaining relatively simple and easy to understand. This web tool is intended to be useful to practitioners studying the dynamic San Francisco estuary, especially when assessing historic trends to better understand current emerging patterns.

Go with the Flow: Assessing Potential Transport of Harmful Algae and Toxins in San Francisco Bay and Sacramento-San Joaquin Delta Estuary

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- Crystal Sturgeon[1], Zoë Siman-Tov[1], Leslie Troutman[1], Heidi Bockisch[1], Spencer Fern[2], Alek Hernes[1], Alexandra Johannsen[3], Raphael Kudela[4], Kendra Negrey[4], Erica Nejad[1], Tim Otten[5], Alex Parker[3], Alexandra Yokomizo[2], Ellen Preece[6], Keith Bouma-Gregson[1]

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Algal toxins are present both in the fresh and marine water of the San Francisco Bay and Sacramento-San Joaquin Delta (hereafter, the Delta) estuary and can pose health risks to fauna and humans, particularly through the consumption of shellfish with toxins in tissue. Freshwater toxins from the Delta can flow downstream into San Francisco Bay, but due to the tides, toxigenic marine cells or dissolved toxins can also move up-estuary towards the Delta. The goal of our study was to investigate the spatial and temporal patterns of harmful algal cells and toxins between the Carquinez Strait and the confluence of the Sacramento and San Joaquin Rivers to generate insights about how toxins and toxigenic organisms may be transported throughout the estuary.

In the study, three different sampling methods were used: invertebrates were collected with baited minnow traps, discrete water samples were collected, and passive solid phase adsorption toxin tracking (SPATT) samplers were deployed. The algal toxins microcystins, domoic acid, and saxitoxins were analyzed in animal tissue, filters from water samples, and SPATT samplers. Additionally, water samples were analyzed for toxin biosynthesis genes with quantitative polymerase chain reaction (qPCR). Sampling took place approximately monthly in the winter (November-April) and twice per month in the summer (May-October) during 2024 and 2025.

Preliminary results showed concentrations of microcystins were consistently higher than domoic acid at all sites. Domoic acid tended to increase in winter months, while microcystin increased in summer months. Sampling was completed in December 2025, and data analyses are ongoing. This project highlights the connectivity between different regions of the estuary and the potential for transport processes to expand the spatial extent of algal toxin impacts. These results are likely to inform future harmful algae monitoring programs in the San Francisco Bay and Delta estuary.

Developing a Coordinated HAB Monitoring and Management Strategy Across the San Francisco Estuary

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- Ariella Chelsky, San Francisco Estuary Institute
- Meredith Howard, Delta Conservancy
- Raphe Kudela, U.C. Santa Cruz
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- Kevin Lunde, San Francisco Bay Regional Water Quality Control Board
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San Francisco Estuary receives high nutrient loads, primarily from wastewater dischargers, yet it has been historically resistant to eutrophication. However, in August 2022, a *Heterosigma akashiwo* bloom, which caused widespread hypoxia and massive harmful algal bloom (HAB)-related fish kills, was a sign that this nutrient resistance could be waning. At the time, there was no sustained, coordinated program for monitoring HABs in the system. The HAB event spurred the initiation of a National Oceanic and Atmospheric Administration (NOAA) Monitoring and Event Response for Harmful Algal Blooms (MERHAB) funded project to develop a system-wide HAB detection and monitoring framework for the Estuary. The initiative focuses on four core components: enhancing monitoring, integrating data streams, resolving data gaps about landward and seaward algal toxin transport, and developing a coordinated management strategy. Current monitoring efforts are leveraging new tools and technologies for HAB detection and tracking, including remote sensing, molecular DNA-based methods, and community science monitoring. These distinct data streams will then be integrated into a data dashboard that will deliver real-time information and serve as a decision support tool. A group of regional managers, regulators, and stakeholders will be convened to provide input on the monitoring strategy and guide the development of management-relevant tools.

Drone-Based Multispectral Imaging: An Emergent Tool for Mapping and Monitoring Aquatic Vegetation and Phytoplankton Biomass in Narrow Channels

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Multispectral imaging of the Earth's surface via satellite (i.e. Sentinel-2) has been an emergent technique for monitoring changes to terrestrial and aquatic systems in response to natural and anthropogenic events. The resolution of satellite data (10m x 10m), however, is insufficient for assessing the relatively narrow sloughs and channels of aquatic systems. The resulting normalized difference indexes for measures like water surface, turbidity, aquatic vegetation and phytoplankton biomass are often too coarse to differentiate the surrounding riparian zone from channels and wetland sloughs. Small Unmanned Aircraft Systems (drones) present an opportunity to capture high-resolution multispectral imagery for the purpose of monitoring changes in this landscape of narrow channels. We propose a pilot study utilizing drones in the Delta for the following: (1) we intend to quantify the seasonal change in floating aquatic vegetation in Old River resulting from both environmental cues and anthropogenic activities with the aim to compare this drone imagery to Sentinel-2 imagery to demonstrate the benefit of utilizing drones in narrow channels. (2) We intend to report out the process of implementing drone technology in a government monitoring group and the process of developing flight plans in a mosaic of private and public properties. (3) Under guidance from the Delta Stewardship Council's Cyanobacterial Harmful Algal Bloom (CHAB) Monitoring Strategy §2.1.2, this pilot study is also intended to inform procedures and build capacity for future work that utilizes high-resolution, drone-based multispectral imagery to monitor the distribution of CHABs in the Central and South Delta.

Evaluation of the Effectiveness of In Situ Chlorophyll Sensors for Detecting Cyanobacterial Colonies

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This poster reports laboratory tests to assess the effectiveness of in situ chlorophyll fluorescence sensors to detect Microcystis colonies. The effect of distance from the sensor face was assessed, to see how sensitive instruments were as colonies increased their distance from the sensor. The effect of sampling rate was also assessed, to determine how quickly sensors could respond to the presence of a colony in flowing waters. Colony size was also assessed, by making measurements with intact colonies and by breaking up colonies into <1 mm diameters. The chlorophyll content of colonies was also measured with lab-extracted methods to compare with the in situ sensor values.

Salmon

Exploring Detection of Acoustically Tagged Steelhead Under Varying Flows on the Stanislaus River from 2024

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- Bryan Matthias, U.S. Fish and Wildlife Service
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As part of a collaborative effort to inform salmonid life cycle and juvenile production estimate modeling, the U.S. Fish and Wildlife Service Lodi Office has been working to estimate the survival and outmigration rates of wild juvenile Oncorhynchus mykiss (steelhead) in the Lower Stanislaus River using acoustic telemetry and multi-state mark-recapture approaches. Since 2023, steelhead have been captured using hook-and-line methods, surgically implanted with Juvenile Salmon Acoustic Telemetry Systems (JSATS) technology, and then tracked with mobile and stationary acoustic receivers.

One challenge in applying these techniques is that estimates of survival and outmigration are linked to acoustic receiver detection probability, which itself may be influenced by environmental conditions. In riverine systems, flow is a driver of habitat availability and sediment transport, both of which may influence a receiver's ability to detect tags. Accounting for flow-specific effects on detection could therefore yield more accurate estimates of steelhead survival and movement. In this study, we investigated how flow affected detection by acoustic receivers. To do this, we analyzed detections of known present tags during 2024 between Knights Ferry and Orange Blossom Recreation Area as a function of flow. Known tags included both 'fixed tags' representing resident tagged fish that could be detected during tracking floats with mobile receivers, and 'mobile tags' representing moving tagged fish that could be detected by a stationary receiver. Flow data were obtained from the California Data Exchange Center. By assessing how varying flows influence detection rates, our study aims to improve the timing and effectiveness of future monitoring efforts, while providing more robust estimates of juvenile steelhead survival and movement rates.

Effects on Age-Class Composition of Adult Chinook Salmon (*Oncorhynchus tshawytscha*) in the San Joaquin River Basin in Response to Fishery Closure

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The closure of commercial and recreational salmon fishing in California for 2023 and 2024 eliminated fishing pressure on Chinook salmon (Oncorhynchus tshawytscha). This action was a result of low abundance estimations and a conservation strategy implemented to help salmon populations recover. For decades the California Department of Fish and Wildlife, La Grange Field Office, has conducted escapement surveys on the Merced, Stanislaus, and Tuolumne Rivers. As part of the survey protocols, scales are collected from individual carcasses and analyzed to estimate the age at death. Fish age estimation is completed through the identification of patterns formed by seasonal growth rates resulting in varying distances between circuli. The patterns formed by circuli are then used to identify annuli, each representing one year of growth. This study was designed to evaluate if the commercial fishery closures resulted in a shift of age-class composition in returning adult salmon in the San Joaquin River basin. This study aims to compare age class differences in the San Joaquin River basin salmon escapement in 2023 and 2024 to historical data.

Lesson Learned from the Tuolumne River Spring Run Salmon Rescue

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On May 15, 2025, a Turlock Irrigation District (TID) biologist notified La Grange California Department of Fish and Wildlife (CDFW) staff that Chinook salmon (*Oncorhynchus tshawytscha*) were stranded in a pool below the La Grange Dam. Drone footage captured by TID confirmed that over 100 adult Chinook salmon were stranded in the pool. These fish were isolated from the main channel without access to suitable spawning habitat. Agencies met and determined relocation was necessary to allow these fish a chance at reproduction.

CDFW, TID, National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), and FISHBIO coordinated and prepared a rescue plan. Five separate rescue efforts were made using a variety of capture methods including seine, gill nets, and trammel nets. We also used snorkelers, divers, and an underwater Remote Operated Vehicle (ROV) to count fish and herd them into the nets. Fish were captured, removed from the nets, and transported via landing nets to a “fish slide”, which was engineered and assembled by FISHBIO, TID, and CDFW to transport the fish to the main river channel.

After three days of effort utilizing gill, trammel, and block nets, we concluded using a trammel net as a seine to corral the fish to be the most effective method. However, the depth of the pool was greater than the depth of the net so CDFW staff created a “mega net” by joining two trammel nets together, making it 24’ in depth. This net was used as a purse seine by snorkelers, corralling and crowding the fish toward the bank to be removed from the net and transported down the fish slide. A total of 410 salmon were relocated to the main channel of the Tuolumne River where they have access to favorable spawning habitat.

Fish at Chipps? It's More Likely Than You Think! Comparing Acoustic and Trawl Detection of *O. Mykiss* at Chipps Island

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Since the introduction of dams and other large-scale water redirection methods into the Sacramento-San Joaquin Delta , Central Valley Steelhead (*Oncorhynchus mykiss*) have become listed as threatened. The US Fish and Wildlife Service (USFWS) Lodi office has developed the Delta Juvenile Fish Monitoring Program (DJFMP) as a program designed to monitor the status and migration of Chinook salmon (*Oncorhynchus tshawytscha*) as they move through and exit the Delta. While the Chipps Island midwater trawl is successful at catching *O. tshawytscha*, it is not nearly as successful at monitoring for *O. mykiss*. DJFMP's Chipps Island midwater trawl has historically low detection for *O. mykiss* , although acoustic receivers have consistently detected *O. mykiss* tagged by the USFWS. We explored why the catch of the two species by DJFMP's Chipps Island trawl is so different. Analysis indicates that while *O. mykiss and O. tshawytscha* are detected primarily at the same receiver locations, *O. tshawytscha* are caught in significantly greater numbers (between 13 and 50 times more). One notable difference between the two species is residence time, with a large proportion of *O. mykiss* spending less than an hour in the detection area. We will also investigate and compare the size distribution of the two species, as *O. mykiss* may have the size necessary to avoid the trawl designed to catch smaller, juvenile salmonids. We will also compare the date and time of acoustic detections between the two species to assess if there is a disparity in detection timing with Chipps Island sampling.

5-Year Summary of Juvenile Salmon Outmigration in the San Joaquin River Basin

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Every year, thousands of Chinook salmon (Oncorhynchus tshawytscha) smolt emigrate through the San Joaquin River in an attempt reach the Pacific Ocean. The Mossdale trawl located at the southernmost point of the interior Delta (River Mile 54) directly upstream of the Old River confluence. This site has served as a key San Joaquin basin salmon monitoring location for over 30 years. Using data collected from Kodiak trawl surveys over the past five years (2021-2025), we examine how year-to-year variation in environmental conditions affect smolt out-migration. Mark recapture and catch per unit effort methods are employed to estimate the total Chinook smolt outmigration to this key location. The study period saw highly variable environmental conditions, with four different water year types in five years along with a wide range of different river conditions. These estimates provide insight into how such factors affect smolt out-migration. Analysis of this data further reveals relationships between spring flow conditions and smolt migration timing and magnitude, providing insight to help inform future salmon management strategies in the San Joaquin River basin.

Examining Age- and Size-at-Maturity Trends of Chinook Salmon in the San Joaquin River Basin

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Over the past decades, multiple geographically diverse populations of Chinook salmon have had decreases in the mean age and size of adults returning to spawn. This phenomenon has yet to be investigated in spawning populations of the San Joaquin River basin. For the past two decades, CDFW has collected scale samples and fork lengths of spawners returning to the Stanislaus, Tuolumne, and Merced Rivers, the primary tributaries to the Sam Joaquin River. Using this data, we will investigate overarching trends in the age structure and size-at-maturity of returning cohorts. Given San Joaquin salmon populations have historically been understudied, understanding these basic population level trends could help inform management decisions and direct avenues of future research.

Long Distance Straying of Central Valley Hatchery Chinook Salmon into Pacific Northwest Watersheds

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While more is known about short-distance salmonid straying, long-distance straying - especially along the West Coast- remains less studied. Hatchery Chinook Salmon (*Oncorhynchus tshawytscha*) originally released in the California Central Valley have been found in the Columbia River Basin and other Pacific Northwest watersheds. However, no formal analysis has been conducted to the best of our knowledge. In this study, we obtained data from the Regional Mark Processing Center's Regional Mark Information System Standard Reporting website to explore long-distance straying from the Central Valley to Pacific Northwest watersheds. We found that 334 Chinook Salmon from brood years 1973–2022 were recovered in the Pacific Northwest. Of these, approximately 75% originated from Sacramento basin hatcheries and 25% from San Joaquin basin hatcheries. Fall-run individuals were the most common, accounting for over 80% of all recoveries. While changes in tagging and recovery efforts over time limit interpretations, strong positive correlations between annual recoveries in marine and brackish/freshwater habitats suggest that straying into Pacific Northwest watersheds is highest during periods of favorable ocean growth and survival conditions. We discuss the potential mechanisms of such long-distance straying and its implications for the management and conservation of Pacific Northwest Chinook Salmon populations.

When do the Salmon Run?: A Study on Salmon Migration Trends in the Central Valley

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Four runs of Chinook Salmon (Oncorhynchus tshawytscha) are present in the Sacramento-San Joaquin Delta: Fall, Late-Fall, Winter, and Spring. We will examine Chinook catch data at a key site used by Central Valley Chinook salmon, known as Chipps Island. Chipps Island is located at the confluence of the Sacramento and San Joaquin rivers and acts as a major migration checkpoint for salmon between the Delta and the ocean. As anadromous fish, the timing of migration is a critical part of their life cycle, affecting survival, access to habitat, and long-term population health as a species. Understanding how this migration phenology may be shifting in response to environmental changes is key to determining effective management.

We will analyze long-term midwater trawl data collected at Chipps Island by the Delta Juvenile Fish Monitoring Program. We will evaluate potential changes in migration timing in relation to key environmental covariates: water temperature, dissolved oxygen (DO), specific conductivity, and water year type. We also will analyze key migration milestones, such as the dates when 5, 10, 25, 50, 75, 90, and 95% of fish are observed, and if these dates have shifted in time. Statistical modeling in R will be used to assess the relationship between these covariates and Chinook catch dates.

We hypothesize that increased water temperatures, decreased DO levels, and drier water years are associated with earlier migrations. Through identifying which environmental factors most strongly influence migration timing, our goal is to support improved forecasting, restoration planning, and adaptive management strategies. This study contributes to a growing body of research on salmonid responses to environmental variability and may help identify priority areas for conservation in the face of climate change and altered flow regimes in the Central Valley.

Salmon Outmigration and Flow Tuolumne vs Stanislaus Rivers

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We explored how flow affects juvenile Chinook salmon outmigration using river flow, and data collected from both adult and juvenile salmon monitoring projects.

We focused on river flows during the time period December through June on the Tuolumne and Stanislaus Rivers during different water year types.

Water operation on the Tuolumne and Stanislaus Rivers is regulated based on the water year type. During wet years, the Tuolumne River releases more than twice the amount of water than the Stanislaus River does. While in critically dry years, the Tuolumne releases less than half than that of the Stanislaus River. We compared rotary screw trap estimates for juvenile salmon on both rivers during different water year types.

Comparing the Length-at-Date and Genetic Processing Results for Chinook Salmon Run

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Entrainment is the influence of a fish facility on fish pulled by the flow of water. Once fish are entrained, they are subject to fish loss. Loss at the facilities includes numerous factors such as consumption by predators, lost through louvers, or moved into sub-optimal habitat. Tracy Fish Collection Facility and Skinner Delta Fish Protective Facility, reduce fish loss from exported water particularly for Federal and State listed species such as Chinook Salmon, (*Oncorhynchus tshawytscha*). Chinook Salmon exhibit four life history strategies which creates four distinct populations or "runs": Fall, Late Fall, Winter, and Spring run. To determine the run of each Chinook Salmon, two procedures are used, Length-at-Date (LAD) measurements and genetic identification. LAD processing determines a Chinook Salmon's run based on the individual's standard length and the Julian date it was caught. Genetic identification requires a fin clip from a collected Chinook Salmon that is processed at a genetics laboratory. While these two methods of processing are widely used, each one has limitations. LAD processing is efficient, but less accurate while genetic results are more accurate, but time consuming and costly. We compared these methods for their accuracy on Chinook Salmon data by comparing Chinook Salmon run data from 2018-2024 from the Fish Salvage Monitoring database to determine if the run identification from the LAD and genetic processes align. Here we summarize the results which indicate large discrepancies throughout the seasons between the two methods, especially during March and April. Throughout the months, the runs with the most discrepancies are Fall and Late Fall runs with no more than 35% similarity. These results show that there is a need to examine factors such fish lengths and corresponding runs to improve the LAD model so that it becomes both accurate and efficient.

Wetland Habitats

Revising the Life Cycle of Longfin Smelt: Age Structure, Maturation, Fecundity, and Life History

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The genetically distinct southern population of Longfin Smelt (*Spirinchus thaleichthys*) in the San Francisco Estuary (SFE) has undergone marked declines in recent decades, elevating concerns about its risk of local extinction. Effective conservation strategies for this imperiled population require robust population models informed by accurate estimates of life history parameters such as age-at-maturity, size-at-maturity, and size-specific fecundity. To fill this knowledge gap, our lab collaborated with the California Department of Fish and Wildlife to collate an archive of >2000 Longfin Smelt collected from across the estuary by multiple surveys over the past two decades. We then developed and applied otolith-based methods to assess age, growth, and life history, and combined results with measures of gonad maturation and fecundity to assess ontogenetic, temporal, and spatial patterns in these key demographic traits. Females with mature ovaries were 70–128 mm FL and contained 300–18,000 oocytes, with an average of 95 mm FL and ~5000 oocytes. Ovaries generally exhibited synchronous development, but the presence of ovaries with both atrophied and developing oocytes provided evidence of multiple spawning events either within or across seasons. Longfin Smelt exhibited a variety of early life-history patterns, with rapid movement to higher salinities around 150 days post-hatch, and substantial size overlap between ages 1-3. Collectively, these results help to refine our understanding of the life cycle of Longfin Smelt in the San Francisco Estuary with the goal of enhancing future population models and conservation strategies.

Waterbird Community Assemblages and Behavioral Ecology in Managed Wetlands and Tidal Restorations in Suisun Marsh, CA

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Suisun Marsh, a brackish region of the San Francisco Estuary, is a mosaic of wetland types that provide habitat for migratory birds and fishes. Managed wetlands, originally designed for waterfowl hunting with a controlled hydrologic regime via gates and levees, are being converted to tidal wetlands due to interest in increased fish habitat, ecosystem processes, and habitat connectivity. We assessed how bird communities and benthic foraging opportunities are altered when managed wetlands are converted to tidal wetlands. Twice a month from April 2023 to June 2024 we surveyed waterbird and macroinvertebrate assemblages and abundance, as well as habitat structure, in two tidal and two managed wetlands in Suisun Marsh. In addition, we recorded the behaviors of waterbirds in the different wetland types to assess habitat usage and prevalence of foraging. We found that the presence of tidal cycles in tidal wetlands allowed for consistent habitat for migratory waterbirds, while flood cycling in managed wetlands, when aligned with key migration periods, showed high waterbird use. Foraging occurred at a higher rate in tidal wetlands, while roosting was more prevalent in managed wetlands, suggesting a temporal division in habitat use. Waterfowl showed significant relationships with managed wetlands, while larger shorebirds and cryptic marsh birds showed a significant relationship with tidal wetlands. We also found that presence of mud habitat was a strong predictor for bird density in tidal systems, but not in managed systems. Overall, we found that the different wetland types showed distinct bird communities and that birds found in both wetland types may be partitioning their use of the wetlands by behavior and tidal cycle. This study helps inform how widespread wetland landscape conversion in a brackish estuary may impact waterbird community assemblage and behavior.

Interannual Shifts of Seasonal Macroinvertebrate Bycatch Abundance in the Upper San Francisco Estuary

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The Upper San Francisco Estuary contains multiple restored tidal wetland sites that are intended to benefit native fish species; however, many non-native species also utilize the habitat and likely affect its function. Monitoring of these sites has been done by the California Department of Fish and Wildlife's Fish Restoration Program (FRP) Effectiveness Monitoring Team through various sampling methods that target fish and their food webs. Larger invertebrates, such as crayfish, shrimps, clams, and jellies are less well characterized in these habitats, but occur as bycatch in fish sampling. Our fish sampling dataset spanning from 2018 to 2023 was used to measure the abundance of invertebrate bycatch from seasonal beach seine, otter trawl, and lampara net sampling. A linear mixed effect model was chosen to examine the seasonal fluctuations of abundance and how factors such as temperature, salinity, and water year type affect the results. This research can provide valuable insight into the variability in community composition of large invertebrates such as crayfish, shrimp, or invasive clams. Furthermore, our results leverage existing bycatch data assist in furthering our understanding of macroinvertebrate communities.

Developing Guidance for Managing Invasive Aquatic Vegetation in Tidal Wetland Sites

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Though wetlands cover a relatively small portion of the global land surface, many of the most harmful weeds are invaders of wetland habitats. This is true of wetlands in the Sacramento-San Joaquin Delta and Suisun Marsh. Invasive aquatic vegetation (IAV) is a particular concern for Delta managers of tidal wetland habitat, especially on restoration sites. As tidal wetland restoration continues across the landscape, new and existing sites experience invasion pressure once tidal reconnection occurs. There is no singular lead entity for managing invasive species in the Delta and Suisun Marsh, so interagency coordination is critical. To serve this need, the Delta Interagency Invasive Species Coordination (DIISC) Team was established in 2013 to provide a forum for agency collaboration on research and management needs related to invasive species. Through collaborative conversation, land managers and restoration practitioners identified a need for guidance on managing IAV. In response to their request, DIISC Team members developed a quick start guide for management of IAV in tidal wetland sites, including species of concern, prioritization approaches, control methods, budgeting recommendations, funding opportunities, and links to comprehensive resources. The final guide will be available on the DIISC website.

Zooplankton and Other Invertebrates

Amphipods in the Water Column, Mud, and Fish Stomachs *(poster withdrawn)*

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Amphipods are collected by two components of the Environmental Monitoring Program (EMP); in pelagic mysid tows by the Zooplankton Study and in benthic ponar grabs by the Benthic Invertebrate Monitoring program. Amphipods are also identified in pelagic fish stomachs by the California Department of Fish and Wildlife (CDFW) Diet and Condition Study. Amphipods collected in the upper SFE are not holoplanktonic. They are described as infaunal or epifaunal, suggesting they should be on or in sediment, in burrows on hard substrates, or associated with aquatic vegetation. A few genera are known to enter the water column at night (*Ampelisca, Ampithoe, Corophium*) but their presence in EMP zooplankton samples indicates they are within the depth range of net tows during the day. They may also be associated with floating vegetation caught in nets. From 1996 through 2013 the Zooplankton Study classified amphipods into two families - "*Gammaridae*" (laterally compressed) or "*Corophiidae*" (dorsoventrally compressed). This was simple and quick for laboratory processing but also meant amphipods that did not belong to either family were lumped together based on gross morphology. Since 2014, amphipods have been identified to lower taxonomic levels: species (*Ampelisca abdita, Americorophium spinicorne, Americorophium stimpsoni, Corophium alienense, Gammarus daiberi , Grandidierella japonica*), genus (*Ampithoe, Crangonyx, Hyalella, Monocorophium*), or family (*Caprellidae, Oedicerotidae, Pleustidae*), which provides more detail but is also more time-consuming.

We will use these datasets to address three questions: 1) How similar are amphipod species assemblages in pelagic and benthic samples? 2) How closely do these assemblages resemble what fish are eating? 3) How does identification to lower taxonomic levels contribute to our understanding of amphipods in the SFE?

Examining Shifts in Penicillate Jelly (*Polyorchis pencillatus*) and Estuarine Jellyfish (*Maeotias marginata*) Population Distributions in the San Francisco Estuary

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Several species of native and non-native hydromedusae are found in the San Francisco Bay and Sacramento-San Joaquin Delta. Although their ecological role is not fully understood, these organisms are often characterized by highly seasonal population growth, and may prey upon or compete with the larvae of native fishes for zooplankton. Research exists studying the distribution and abundance of the invasive Estuarine Jellyfish (*Maeotias marginata*) while the native hydromedusa *Polyorchis penicillatus* is currently understudied, and its distribution and ecological impact on other species has not been well characterized. The Lodi Fish & Wildlife Office's (LFWO) year-round Midwater Trawls capture these species within the Sacramento-San Joaquin Delta; in addition, the California Division of Fish & Wildlife's (CDFW) Fall Midwater Trawl provides annual catch data throughout the Delta and into San Pablo Bay.

Using data from LFWO and CDFW Midwater Trawls, we intend to investigate the spatial and temporal distributions of *M. marginata* and *P. penicillatus* within the San Francisco estuary, calculating catch per unit effort (CPUE) to estimate where "blooms" are greatest, and when populations are at their highest and lowest throughout the year. We plan to use a generalized linear model to examine CPUE as a function of temperature, specific conductance, and turbidity.

Flexible Vertical Migration Behavior in Copepods Can Affect Their Distribution

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The calanoid copepods *Pseudodiaptomus forbesi* and *Eurytemora carolleeae* exhibit two disparate vertical migration behaviors depending on habitat. In deep, large tidal channels their migration is synchronous with tides, which retains them in low-salinity waters. In shallow, off-channel habitats they undergo demersal migration by which part of the population is on the bottom by day. Previous work in a small wetland in the Cache Slough Complex (CSC) showed that demersal behavior by adult *P. forbesi* can transport them landward, opposite the direction needed to subsidize open estuarine waters. Therefore, we conducted a study to determine how general this pattern is. During 2023-2025 we performed 15 sampling events throughout the CSC to better characterize the migration behavior of these copepods. Sampling began one hour before sunset, with consecutive net tows taken until two hours after sunset to identify migrating life stages along with migration timing and duration. In 2023, samples were taken just below the surface while in 2024 we switched to alternating tows between near bottom and subsurface to clarify copepod distribution within the water column. Preliminary results show that nauplii and copepodites of both species were abundant near-surface by day and night, while adult females of both species showed a strong demersal migration. Light level and turbidity data were recorded to assess their effects on migration, and samples were collected for DNA metabarcoding-based analysis of copepod feeding. Results from this study will be used in a particle-tracking model analysis to assess the effect of demersal migration on transport of copepods into and out of the Cache Slough Complex.