



INFORMATION ITEM

REVISED Lead Scientist Report

Summary

There are many reasons to conduct wetland restoration. These include reducing greenhouse gas emissions, preventing flooding, enhancing habitat, and promoting recreation. Another reason is to recover the health of Delta food webs. Pagliaro et al. (2025) find that restoring tidal marsh habitat does not automatically equate to restoring a healthy tidal wetland food web, even after 100-plus years. Restoration strategies such as marsh revegetation and channel excavation might help, and long-term monitoring that focuses explicitly on food webs is key to tracking the recovery of ecosystem functions over time. More targeted research is needed to understand how tidal wetland restoration affects food webs across the Delta.

The effect of tidal marsh restoration on food webs

Pagliaro, M. D., De La Cruz, S. E. W., Woo, I., Sousa, J., Rich, N., Grimaldo, L., Colombano, D., & Ruhí, A. (2025). Does tidal marsh restoration lead to the recovery of trophic pathways that support estuarine fishes? *Ecological Applications*, 35(7), e70110. <https://doi.org/10.1002/eap.70110>

Historically, the Delta was a vast expanse of tidal wetlands with meandering channels. Due to widespread changes in land use following European colonization, approximately 95% of this habitat has been lost. To address this habitat loss, the 2022 update to the Delta Plan set targets for large-scale wetland restoration across the Delta. As described in the September 2025 Lead Scientist Report about methane emissions from a restored Delta wetland, there are many reasons to conduct wetland restoration. These include reducing greenhouse gas emissions, preventing flooding, enhancing habitat, and promoting recreation. Another reason is to recover the health of Delta food webs—the complex set of relationships between plants and animals that live in an area and consume each other. In the

Delta, restoring tidal wetland food webs is also a high priority for the conservation of the federally protected Delta Smelt.

Scientists often use the term “trophic pathways” to refer to the flows of energy through food webs—in other words, the way that energy is passed on from plants to bugs to fish as they feed upon each other. A single path in the food web can be referred to as a food chain. The recent paper "Does tidal marsh restoration lead to the recovery of trophic pathways that support estuarine fishes" (Pagliaro et al. 2025) explores the impact of tidal marsh restoration on food web health. The study compared food web pathways in three restored tidal marshes in the Delta of different ages with each other and to neighboring historic “natural” marshes for reference. Based on some 1,000 samples of plants, algae, and fish in two different water years (wet year 2020 and dry year 2021), they found that:

- Food chains were shorter in restored marshes. The shorter food chains indicate that these restored marsh ecosystems, regardless of age, are not operating at the same level as the historic “natural” marshes—the restored ecosystems produce less energy and are less balanced.
- Fish food sources and feeding strategies were generally less diverse in restored marshes. However, there was a surprising surge of food web activity immediately following an initial restoration, reflecting the uneven rate of food web recovery over time.
- Fish generally relied more on food webs derived from detritus (decomposing plant matter from tidal wetlands) rather than algae (found in open waters), especially in the historic “natural” marshes.
- Resident fish species, which live in marshes year-round, relied more on food webs derived from detritus than transient fish, which use marshes more opportunistically.
- Non-native fish and transient fish could exploit a wider range of food resources than native fish and resident fish, including many of those relied on by native and resident fish.

The key takeaway for Delta management is that restoring tidal marsh habitat does not immediately equate to restoring a healthy tidal wetland food web. The results presented in the paper suggest that focusing solely on the number of acres restored to tidal flow may not reflect other important ecological dynamics, such as robust and diverse feeding opportunities for native fishes. Restoration project designs could consider a marsh revegetation strategy, especially given how important the detritus-based food web is to resident fish. Tidal marsh restoration projects could also incorporate channel excavation to boost connectivity and capitalize on the initial energy surge when the site is reconnected to the tides. More targeted research is needed into how tidal wetland restoration impacts food webs across the entire Delta. Finally, long-term monitoring that focuses explicitly on food webs is key to tracking the recovery of ecosystem functions—as well as habitat—over time.

The paper's lead author, Megan Pagliaro, is a PhD candidate at UC Berkeley and a 2022 Delta Science Fellow with USGS community mentors.

(https://caseagrant.ucsd.edu/sites/default/files/DSF_Final_FactSheet_Pagliaro.pdf).

The Delta Science Fellows Program is funded by the Delta Stewardship Council through its Delta Science Program and administered by California Sea Grant. Fellowships provide early-career scientists with up to two years' funding for research on high-priority science impacting management of the Sacramento-San Joaquin Delta system. For more information on the tidal marsh food webs project, see its entry in the Delta Science Tracker:

<https://sciencetracker.deltacouncil.ca.gov/node/52341>.

Delta Science Program Activities

Adaptive Management Forum

The Delta Science Program hosted its fourth Adaptive Management Forum on October 14–15. Adaptive management is a structured, scientific approach to environmental management that uses lessons learned from management actions to inform future decisions. This year's Forum focused on the immense progress that we've made on adaptive management in the Delta and ways to keep that

momentum going into the future. More than 160 people attended the first day of the Forum (in person and online), and 40 people attended the second day, which was a site visit to the Lookout Slough Tidal Restoration and Flood Improvement Project. Day 1 featured presentations and panel discussions from 25 different speakers, sharing their insights on adaptive management successes, gaps, and opportunities. The topics included on-the-ground perspectives on adaptive management implementation, how to handle risk and uncertainty, new methods to help environmental decision-makers keep pace with change, the need for collective advocacy, and the significance of collaboration across organizations and disciplines. You can watch a recording of Day 1 on the Council's YouTube channel here: https://www.youtube.com/watch?v=7_SOWbKSsBU. Day 2 featured presentations from staff involved with the acquisition, design, implementation, and ecological monitoring of Lookout Slough. The next Adaptive Management Forum will be held in 2027.

2025 State of the San Francisco Estuary Conference

The 2025 State of the Estuary Conference was held on October 28–29 at the Scottish Rite Center in Oakland, CA. Organized by the San Francisco Estuary Partnership, this biennial event highlights activities aimed at sustaining and improving the estuary's habitats, living resources, water quality, community resilience, and environmental stewardship. The conference is a key venue for sharing knowledge about the health of the estuary.

The Delta Stewardship Council is a major sponsor of the event, contributing funding and staff support to planning efforts. More than 700 participants from government, academia, private, non-profit, tribal, community, and local school organizations attended the event this year. Council staff shared information about key agency-led initiatives in several sessions of the conference, including the:

- **Science, Management, and Governance in the Era of Extreme Weather Events** oral session, which highlighted emerging science on extreme weather events and adaptation strategies for water and conservation in the Bay-Delta. Presenters included three authors of **2025 State of Bay-Delta Science** articles, one Delta Independent Science Board member, and two representatives from the Public Policy Institute of California.

- **Aligning Science with Action: Setting Regional Priorities** session, in which staff gave presentations about ecosystem services and benefits of habitat restoration in the Bay-Delta and shared a 5-year review of how social science integration has advanced in the Delta.
- **Conference poster session**, which was part of an evening reception that also featured an art exhibition and community tables hosted by tribes and community-based organizations. Posters presentations by staff covered:
 - o the 2025 update to the **Delta Science Plan**,
 - o the **Science Action Agenda** snapshot summary,
 - o A Delta Science Program assessment of impacts of research funded through recent **Delta Research Awards** and **Delta Science Fellowships**,
 - o a case study for using the **Delta Science Tracker** to learn about carbon research in the Delta,
 - o emerging outcomes of three projects coordinated through the **Delta Modeling Collaboratory** initiative,
 - o the **Delta Plan performance measures** report cards, and
 - o outcomes of the **Delta Independent Science Board** food webs review.

Other notable sessions and presentations at the conference explored indicators of ecosystem health, collaborations to build resilience, celebrating ‘wins’ for restoration in the estuary, strategies for effectively communicating with decision-makers (including getting their attention), and participatory scenario planning for adaptation and salinity management.

[North American Invasive Species Management Association Annual Conference](#)

The North American Invasive Species Management Association (NAISMA) is a professional organization that advances invasive species management by developing standards, offering training, and fostering collaboration. The NAISMA Annual Conference took place November 3–6 in Stateline, Nevada. At the conference, Dr. Elizabeth Brusati from the Delta Science Program presented a poster entitled “A Framework to Improve Early Detection and Rapid Response in the

Sacramento-San Joaquin Delta and Suisun Marsh.” The poster was co-authored with Dr. Rachel Wigginton of the Delta Conservancy. The conference was co-sponsored by the Invasive Species Council of California.

On Your Radar

Delta Invasive Species Symposium, December 4

Registration is open for the sixth biennial Delta Invasive Species Symposium, which will take place on December 4, 2025, at the California Natural Resources Agency building in Sacramento. This year’s theme is “Modeling and Managing Invasive Species for Tomorrow’s Delta.” Sessions will include “Management Paradigms,” “Invasive Mussels in the Delta,” “New Tools for New Conditions,” and lightning talks. Organized by the Delta Interagency Invasive Species Coordination (DIISC) Team, the Symposium is a forum for managers, researchers, and decision-makers to share and synthesize information, best practices, and lessons learned. It is free to attend and open to anyone interested in the impacts of invasive species in the Sacramento-San Joaquin Delta region. Council staff are part of the organizing team for the Symposium. The Symposium will be held in person with a virtual attendance option. See here for more information and for registration:

<https://deltaconservancy.ca.gov/diisc-team-activities/>.

By the Numbers

Science Program staff will summarize current numbers related to Delta water and environmental management. The summary (Attachment 2) will inform the Council of recent counts, measurements, and monitoring figures driving water and environmental management issues.

List of Attachments

~~Attachment 1: Visual summary of article~~

Attachment 2: By the Numbers

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