



**Delta
Science
Program**

DELTA STEWARDSHIP COUNCIL

RESEARCH IMPACT REPORT

Highlighting the initial science and management impacts of the Delta Science Program's 2019 Delta Research Awards and 2020 Delta Science Fellowships

2026



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Acknowledgments

Unless otherwise noted, photos used throughout this report are courtesy of the featured researchers and the California Department of Water Resources.

Recommended Citation

Delta Stewardship Council, Delta Science Program. 2026. Research Impact Report: Highlighting the initial science and management impacts of the Delta Science Program’s 2019 Delta Research Awards and 2020 Delta Science Fellowships.

Introduction

Since 2010, the [Delta Stewardship Council's Delta Science Program](#) has funded scientific research to further our mission of providing the best possible unbiased scientific information to inform water and environmental decision-making in California's Sacramento-San Joaquin Delta. Although the impacts of research are known to take years to become apparent and can be difficult to track, here, we share a new framework to highlight the initial science and management impacts of two previous funding solicitations – the 2019 Delta Research Awards and 2020 Delta Science Fellowships. Read on to learn about the exciting ways these research projects are already influencing management in the region, and about our plans to continue this important work.



“The Delta Stewardship Council recognizes that sound science is fundamental to our ability to fulfill our agency's mission. California depends on the Delta in countless ways, and understanding this vital region requires continual scientific discovery across a wide variety of disciplines. An investment in science is an investment in informed decision-making – helping us protect the Delta while supporting California's water reliability, environment, and communities.”

– **Delta Stewardship Council Executive Officer
Jessica R. Pearson**

“The complex challenges facing the Delta cannot be solved in isolation, and neither can the science that informs those solutions. My hope is that readers see how strategic investments in science create lasting benefits that extend far beyond any one agency, strengthening the collective work of our partners across California.”

– **Delta Lead Scientist Dr. Lisamarie Windham-Myers**



The Delta Science Program

Mission-Relevant Science

The Delta Science Program is a division of the Delta Stewardship Council, an independent California state agency working to advance the coequal goals for the Delta – a more reliable statewide water supply and a healthy and protected ecosystem – in a manner that protects and enhances the Delta as an evolving place. One of our core responsibilities, as identified in the 2009 Delta Reform Act, is to fund scientific research. In doing so, the Delta Science Program uses resources effectively to support impactful research and strengthen the Delta science community.

The goal of this inaugural Research Impact Report is to begin to highlight the science and management impacts of Delta Science Program-funded research.

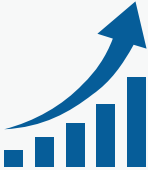


Scientific Research Funding

The Delta Science Program funds competitive research solicitations through the [Delta Research Awards](#) (for established scientists) and [Delta Science Fellowships](#) (for graduate students and postdoctoral researchers, administered through California Sea Grant). Awarded projects must align with one or more Science Actions identified in the [Science Action Agenda](#) to ensure we are funding management-relevant research efforts.

The Delta Science Program provides regular funding opportunities for targeted research and synthesis efforts.

From the time the Council was formed in 2010 through 2025:



\$50.2 million has been invested in
162 research projects.

We have demonstrated a commitment to supporting actionable, management-relevant science and are now well-positioned to document the impacts of our funded research on water and environmental decision-making in the Delta.

The Foundation for Funding Critical Science Investigations

The Science Action Agenda (SAA) is a collaboratively developed document that prioritizes and aligns science actions to inform management decisions, identifies major knowledge gaps, and promotes collaboration. The SAA functions as the implementation portion of the three-part [Delta Science Strategy](#). A primary way that the SAA is implemented is by guiding competitive and non-competitive research and fellowship solicitations, funding science in the Delta. We encourage funding partners to grow the number of awards by leveraging these solicitations or to use the SAA to guide their own research funding efforts.

“The State Water Contractors (SWC) recognize that sound water management depends on sound science, which is why we fund up to \$2 million annually in research guided by SWC Science Program objectives and management questions. We developed our objectives to align with the Delta Science Program’s Science Action Agenda, ensuring that SWC-funded science contributes to a shared science framework in the Bay-Delta.”

– **State Water Contractors Science Manager Darcy Austin**



Goals of the Research Impact Report

In this Research Impact Report, we highlight the science and management impacts of the projects funded through the 2019 Delta Research Awards and 2020 Delta Science Fellowships, which concluded in 2022 and 2023. The impact of science and management of research may take several years or even decades to come to fruition ([Morgan, 2014](#)). Therefore, this report only captures the initial impacts of science and management that will arise from these funded projects.

Beyond identifying and communicating the impacts of funded research, we can apply key results and takeaways of this assessment to:



Adapt future funding solicitations and project requirements to maximize research impacts.



Increase transparency of the use of public funds.



Support projects that have yet to produce measurable management or policy impacts.



Impact and Key Numbers

Our Approach to Assessing Research Impact

To investigate the impacts of funded research, we implemented a widely used approach for evaluating scientific research impacts, drawn from the field of Research Impact Assessment. We first developed a model to conceptualize and track the process through which Delta Science Program-funded research may impact science and management. This Research Impact Pathway model comprises five stages that break down the pathway to impact, starting with inputs and ending with demonstrable impacts on science and management (Table 1; [Fryirs et al., 2019](#)).

Table 1: Delta Science Program-Funded Research Impact Pathway Model

Stage	Description	Metrics for Documenting Progress
Inputs 	Resources utilized to implement research funding	Research funds, staff time, and the Science Action Agenda
Activities 	Actions of the funding program	Number of projects, scientists, and multi-agency collaborations funded
Outputs 	Direct results and products of the funded research that communicate the best available science to diverse audiences	Published papers and associated metrics, reports, datasets, conference presentations, and media coverage
Outcomes 	Engagement arising from funded research, resulting in land managers and decision makers becoming aware of the best available science	Community engagement and communication with outside agencies and organizations about funded research
Impacts 	Science, management, and decision-making have been informed by funded research	Management documents and efforts that were based on funded research projects (e.g., science plans, Biological Opinions, and modeling efforts)

Beginning in 2025, we gathered data relevant to metrics associated with each step of the Research Impact Pathway model (Table 1) by:

- Searching the fifteen 2019 Delta Research Awards and the ten 2020 Delta Science Fellowship project contracts to inform inputs and activities of funded research.
- Surveying primary investigators of funded projects to gather information about outputs, outcomes, and impacts.
- Compiling metrics about peer-reviewed publications.
- Searching relevant management documents for citations of these publications.

Data is presented for 22 out of the 25 projects based on survey response rate.

Impact Highlights

Inputs

\$9M

from the Council's
Delta Science Program

+

\$1.75M

from the U.S. Bureau
of Reclamation

+

\$423K

from the State Water
Contractors

Activities

25 research projects

led by 51 primary investigators and co-primary investigators from

22 institutions

7 projects

involved collaborative teams from multiple institutions

Outputs

47 peer-reviewed publications that have been:



Cited by other peer-reviewed publications

810

times



Viewed/accessed online more than

105,000

times*

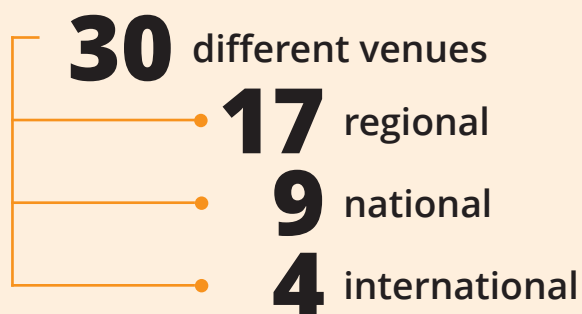


Downloaded more than

19,900

times**

66 conference talks and presentations at:



17

blog post features



6

news releases

**data available for only 40/47 publications*

***data available for only 16/47 publications*

11 projects

had purposeful and meaningful engagement with community members, which may have included information sharing, consultations, research involvement, or other forms of collaboration.

It was common for funded researchers to communicate with other agencies and organizations involved in management about their research projects. Specifically, the following:



11

projects communicated
with **FEDERAL**
government agencies



13

projects communicated
with **STATE** government
agencies



4

projects communicated
with **LOCAL**
governments



10

projects communicated
with **NON-GOVERNMENTAL**
organizations



2

projects communicated
with **COMMUNITY-BASED**
organizations

Impacts

State-Level Management Impacts



TRACKING GREENHOUSE GASES IN WETLANDS

Understanding how different ecosystems and restoration activities influence carbon storage is essential to combating climate change. With support from a 2019 Delta Research Award, Dr. Patty Oikawa developed a new model to track greenhouse gases in natural and restored tidal wetlands in the Bay-Delta. The California Air Resources Control Board is now using this model in its Natural and Working Lands Carbon Inventory to inform California's climate actions.



PREDATION RISK OF FISH IN RESTORED TIDAL WETLANDS

Tidal restoration projects are typically designed to improve habitat quality for fish. However, the way that restored wetlands are designed can affect how vulnerable fish are to predators. 2020 Delta Science Fellow Dr. Dave Ayers developed a novel framework to predict predation risk in tidal wetlands, which informed the development and monitoring plans outlined in the California Department of Water Resources' Healthy Rivers and Landscapes Science Plan.

Federal-Level Management Impacts



PYRETHROIDS AND DELTA SMELT

Pyrethroids are widely used insecticides that can enter our waterways and harm aquatic wildlife. Their use is regulated by the Central Valley Water Resources Control Board. 2019 Delta Research Award recipient Dr. Susanne Brander and colleagues investigated how pyrethroids affect young Delta smelt – an endangered fish – and how these effects vary based on salinity. The 2024 Biological Opinion by the United States Fish and Wildlife Service cited these findings, specifically regarding how Old and Middle River management may influence contaminants and their impacts on Delta smelt.



TEMPERATURE IMPACTS ON SALMON BEHAVIOR AND PREDATION

Warming waters may be stressful to fish, including the imperiled Chinook salmon. 2020 Delta Science Fellow Dr. Alexandra McInturf researched how warming temperatures influence the swimming behavior and predation susceptibility of juvenile Chinook salmon. Her work was cited in the 2024 Biological Opinion issued by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, outlining how Folsom Dam operations may impact salmon and steelhead in the lower American River.



Photo credit: Thomas Dunklin

GREEN STURGEON RECOVERY PLAN AND LISTING STATUS

The southern distinct population of green sturgeon is a long-lived fish that is listed as threatened under the Federal Endangered Species Act. Dr. Peter Dudley, a 2019 Delta Research Award recipient, worked to improve monitoring methods for studying this population and its movements. His research informed the National Oceanic and Atmospheric Administration's 5-Year Review of the Southern Distinct Population Segment of North American Green Sturgeon, which directly informs the species listing status and the Green Sturgeon Recovery Plan.

Highlights and Case Studies

Delta Research Award Highlight: Tracking Greenhouse Gases in Wetlands

Dr. Patty Oikawa, a professor at California State University (CSU), East Bay, and colleagues* received a 2019 Delta Research Award to develop a groundbreaking model to estimate greenhouse gas fluxes in wetlands.

The PEPRMT (“peppermint”) model, which stands for Peatland Ecosystem Photosynthesis, Respiration, and Methane Transport, is designed to estimate daily carbon dioxide and methane exchange in restored wetlands (freshwater peatlands and coastal tidal wetlands). PEPRMT can be used to measure how rising sea levels, salinity changes, and soil temperatures may affect greenhouse gas flux in wetlands, and whether wetlands tend to act as a carbon source or sink. This model is a novel approach that will help scientists assess wetlands’ ability to combat climate change.

Notably, PEPRMT will be used by the [California Air Resources Control Board](#) in their [Natural and Working Lands Inventory](#) (Inventory), which estimates carbon stocks across California ecosystems, including wetlands. The Inventory is an important tool for informing how California’s natural lands contribute to the state’s air quality and climate goals, including achieving carbon neutrality by 2045.

Dr. Oikawa indicated that the 2019 Delta Research Award was “an incredible [resource] to get all this work started.” [Dr. Oikawa’s lab at CSU, East Bay](#) continues to be a leader in understanding how land management influences greenhouse gas emissions. Understanding these relationships is essential for sustainable land management and developing informed carbon offset policies.



* Colleagues include 2020 Delta Science Fellow Julie Shahan, 2022 Delta Science Fellow Maiyah Matsumura, and the current Delta Lead Scientist, Dr. Lisamarie Windham-Myers.



Fellowship Highlight: Predation Risk of Fish in Restored Tidal Wetlands

Dr. Dave Ayers received a 2020 Delta Science Fellowship while a doctoral student at the University of California (UC), Davis, studying how restored tidal wetlands function as habitat for rearing young fish and providing refuge from predation. His research focused on native fish species, including the endangered Delta smelt and juvenile Chinook salmon.

His project involved a more detailed and multifaceted approach for characterizing wetlands, including restored tidal wetlands, and assessing fish communities in such complex habitats.

These methods have informed the [Healthy Rivers and Landscapes](#) (HRL) Science Plan, which provides the guiding framework for evaluating the biological and ecological outcomes of the HRL Program. The [HRL Science Plan](#) cites Dr. Ayer's expert knowledge on assessing communities of fish predators in the North Delta's tidal wetlands and informs the HRL Science Plan's call for continued research on how restored wetlands may increase or decrease predation on native fish.

Dr. Ayers shared that the Delta Science Fellowship propelled his research and career forward by providing the time and resources needed to develop well-informed hypotheses and, ultimately, generate relevant management insights.

The Delta Science Fellowship led to a follow-up project that Dr. Ayers is currently managing, which involves developing open-source code (an R statistical programming package) to help describe habitat suitability for tidal wetland fishes. Now a postdoctoral researcher at the UC Davis Center for Watershed Sciences, he is part of a new cooperative training program with Reclamation and is focused on understanding spatially explicit predation risk for juvenile Chinook salmon in the Delta.



Insights and the Path Forward

Key Takeaways

In this inaugural effort to document the science and management impacts of research funded by the Delta Science Program through the 2019 Delta Research Awards and the 2020 Delta Science Fellowships, we utilized a Research Impact Pathway model and found that **scientists funded by the Delta Science Program are producing rigorous, action-oriented science.**

It has only been a few years since the 2019 Delta Research Awards and 2020 Delta Science Fellowship contracts ended (and the science and management impacts of research can take several years or even decades to come to fruition), but they have already begun to influence regional management. As many of the funded researchers in this cohort continue to publish and communicate the results of their research projects, we expect these projects to continue to impact science and management for years to come.



Looking Ahead

Moving forward, the Delta Science Program is committed to regularly tracking research impacts and refining this research-backed assessment process along the way. In addition to providing regular status updates, we will publish initial and final impact reports for all competitively funded research. Initial impact reports will help maintain communication between funded scientists and the Delta Science Program and may uncover opportunities to influence project impacts. Final impact reports will allow more time for the progression from outputs to impacts.



Our goal is to be methodical and transparent in assessing and reporting funded research by utilizing findings from this (and future) research impact assessment to inform requirements and processes for research awardees to enhance impact. Importantly, some requirements for the Delta Research Awards have shifted over time, including prioritizing social science and co-production, enhanced communication and engagement efforts, and seminar series presentations for the science community. With continual research impact reporting, we can elucidate how different requirements influence research outputs, outcomes, and the science and management impacts of research funded by the Delta Science Program and adapt future solicitations accordingly.

With these important efforts, the Delta Science Program will continue to use funds responsibly and efficiently to benefit the management, environment, and people of the Delta, as well as those who depend on it.



**Delta
Science
Program**

DELTA STEWARDSHIP COUNCIL

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Scan the QR code to learn about research funding and fellowships, and check out the **Delta Science Tracker** for more information on all projects.

