

April 2021

Science Action Agenda Draft Progress Summary

Reporting Progress on the 2017-2021
Science Action Agenda

Public Review Draft



**Delta
Science
Program**

DELTA STEWARDSHIP COUNCIL

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Why track progress on the 2017-2021 Science Action Agenda?

The Delta Science Program is committed to providing the best possible unbiased scientific information to inform water and environmental decision-making in the Delta. Critical to the success of this mission is funding research, communicating scientific progress, and coordinating with Delta agencies and entities. The Delta Science Program is tracking progress on the 2017-2021 [Science Action Agenda \(SAA\)](#) to further this mission and inform the SAA update for 2022-2026. The SAA for the Sacramento-San Joaquin Delta, is a collaboratively developed document that prioritizes and aligns science actions to meet management needs. The SAA is used to guide science funding—over \$36 million during the lifespan of the 2017-2021 SAA—and is updated every four to five years.

The overarching goal of this Progress Summary (Summary) is to determine what progress has been made to address the 25 science actions identified in the 2017-2021 SAA. More specifically, this Summary provides three key benefits: 1) it serves to document progress made on 2017-2021 SAA Science Actions and relevant activities—part of the “evaluation” phase in the adaptive management cycle; 2) the progress documented helps to inform the “response” phase of identifying new actions in the 2022-2026 SAA; and 3) it offers a gauge of the return on investment from the Delta Science Program’s and its partners’ funding efforts, which are guided by the SAA.

This is the first attempt to formally track progress in addressing the Science Actions outlined in the SAA and feedback is much appreciated. Those interested in submitting input on the draft Summary are invited to complete this [survey](#) by **Monday, May 10, 2021**.

2017-2021 SAA

The [2017-2021 SAA](#) was developed collaboratively in 2016 and includes 25 Science Actions grouped into the following five Action Areas:

Action Area 1: Invest in assessing the human dimensions of natural resource management decisions.

Action Area 2: Capitalize on existing data through increasing science synthesis.

Action Area 3: Develop tools and methods to support and evaluate habitat restoration.

Action Area 4: Improve understanding of interactions between stressors and managed species and their communities.

Action Area 5: Modernize monitoring, data management, and modeling.

Summary approach

Information needed to assess progress

Progress was assessed based on the relevant activities addressing the Science Actions and the status of those activities. Types of activities included funded research (e.g., through Delta Science Program Proposal Solicitation, California Department of Fish and Wildlife's Prop 1 Restoration Grant Program), monitoring (e.g., efforts collecting needed information), modeling and synthesis (e.g., integrated models), programs (e.g., new or existing programs specifically or indirectly informing an action), projects (e.g., Delta Adapts, CSAMP Structured Decision Making), reviews (e.g., Delta Independent Science Board), publications, and outreach/communications (e.g., symposium). In addition to the type of activity, the Delta Science Program also compiled what part(s) of the Science Action the activity was addressing, the timeline for completion, current status of the activity, and the primary entity performing the work.

Status of progress made

The 25 Science Actions were assigned to one of four general status categories. While in reality there is a gradient of progress, not discrete categories, the progress bins here provide an approach to distill observations from the inventory of completed and ongoing activities.

- Significant progress with management impact: 5+ activities; and/or results from activities are leading to significant gains in knowledge regarding the Science Action and actively informing management decisions.
- Significant progress: 5+ activities; and/or results from activities are leading to significant gains in knowledge regarding the Science Action.
- Moderate progress: 3-4 activities; and/or results from activities are leading to moderate gains in knowledge regarding the Science Action, but important knowledge gaps remain.
- Early progress: 1-2 activities; and/or progress on the action is in early stages, or results from activities are leading to incremental gains in knowledge regarding the Science Action.

Outreach

The Delta Science Program drafted an initial Summary in early 2021, which included the list of activities contributing to the Science Actions and relevant project details. The draft list of activities was circulated for targeted input from relevant entities and program leads throughout the Bay-Delta and this step added substantially to the list of completed and ongoing activities. The Delta Science Program then synthesized the feedback to generate this draft Summary for broader public review. After tallying the activities, considering their contributions to the Science Actions, and assigning a progress status for each of the 25

Science Actions, the general progress for each of the five major Action Areas was also evaluated.

Disclaimer

It is worth noting that this Summary is an imperfect process and we acknowledge the following caveats: not all activities and activity types are equally comparable; the progress status definitions are used as guides; San Francisco (SF) Bay projects were critical to include in this review, but did not contribute to the Science Action status unless directly impacting the Delta (e.g., Suisun Marsh) or providing tools and applicable knowledge for the Delta.

Next steps

Public comments will be considered in finalizing the Summary of progress made on the 2017-2021 SAA. The Summary will be used to inform a workshop, to be held July 13-14, 2021, focused on identifying science actions for the 2022-2026 SAA. [Registration is now open.](#)

Visit the Delta Stewardship Council's [SAA webpage](#) or contact SAA@deltacouncil.ca.gov for any questions or to learn more about the Summary and SAA update.

Action Area 1: Invest in assessing the human dimensions of natural resource management decisions

Moderate progress has been made in investing in assessing the human dimensions of natural resource management decisions as shown in Table 1 and Figure 1.

Table 1. Action Area 1 Summary table of Science Action progress to date.

SCIENCE ACTION	STATUS
1A: Investigate the most cost-effective methods to improve species habitat on working lands	Moderate Progress
1B: Develop tools to assist adaptive management in the Delta	Significant Progress
1C: Initiate a research program on the Delta as an evolving place that integrates the physical and natural sciences with the social sciences	Moderate Progress
A1A: Implement studies to understand socio-economic adaptations to climate change (e.g., human behavioral response in the agriculture sector to changes in water prices)	Early Progress
A1B: Develop methodology for assessing the long-term costs and benefits of managed wetlands and ponds	Moderate Progress
A1C: Initiate Delta levee risk assessment studies that address individualized levee fragility curves, identify levee sections most subject to earthquake-induced liquefaction, clarify attenuation of ground motions from Bay Area earthquakes, monitor land-level changes adjacent to levees post-earthquakes, hydrodynamic studies to project magnitude of levee breaches, duration, and severity of disruption	Early Progress

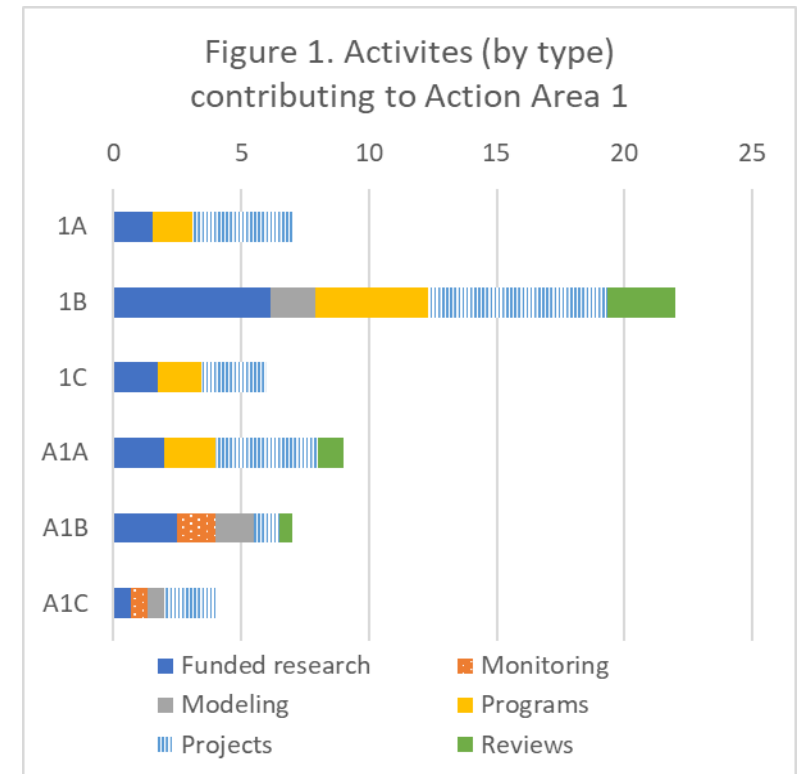


Figure 1. Activities (by type) contributing to Action Area 1

Primary Science Actions

- Most activity on investigating the most cost-effective methods to improve **species habitat on working lands (1A)** is from projects, with some funded research and programs. Few activities directly consider and analyze monetary costs or accrued benefits, but do provide tools for evaluation of tradeoffs, best management practices for grazing and pesticide management on working lands in the SF Bay and Delta, carbon sequestration benefits, and more. Many projects are still in progress or not yet completed.
- Many activities provide examples or results to inform **adaptive management (1B)** of resources such as longfin smelt growth and invasive species control, or document progress made in the SF Bay. Some provide tools (e.g., structured decision-making for Delta Smelt, winter run life-cycle model, Adaptation Atlas) more broadly to support adaptive management in the Delta. Most activities are funded research efforts and projects, many of which anticipate outreach and publications.
- A few activities, mostly programs and projects, support the development of **social science** understandings of the Delta as an evolving place, with multiple completed and anticipated publications and outreach efforts. A few activities catalyzed and provided the groundwork for an initiated, but early stage, effort to build a more coordinated social and interdisciplinary science **research program (1C)** to understand the Delta as an evolving place and the people within the system.

Additional Science Actions

- Most progress made to implement studies to understand socio-economic **adaptations to climate change (A1A)** are from completed or ongoing projects and programs (e.g., Delta Adapts, Adapting to Rising Tides). Funded research efforts are contributing to adaptation of greenhouse gas emissions and perceptions of risk of Delta levees. Most activities include an outreach component and half have produced or will produce a publication.
- Progress to develop methodology for assessing the long-term **costs and benefits of managed wetlands and ponds (A1B)** include funded research on ecosystem services of restoration, climate benefits and ecosystem functions of managed wetlands, and best management practices for managed wetland habitats throughout the Bay and Delta. A majority of activities have completed or will complete a publication.
- Progress to initiate **Delta levee risk assessment studies (A1C)** and other impacts to earthquake-induced risks include a Delta-wide levee investment strategy, Delta levee risk assessment research, and initial support to incorporate disaster recovery and hazard mitigation planning into the SF Bay Area.

Action Area 2: Capitalize on existing data through increasing science synthesis

Significant progress has been made in capitalizing on existing data through increasing science synthesis as shown in Table 2 and Figure 2.

Table 2. Action Area 2 Summary table of Science Action progress to date.

SCIENCE ACTION	STATUS
2A: Strategically build the capacity to do collaborative science synthesis by implementing the science synthesis mechanisms outlined in the Delta Science Plan	Significant Progress
2B: Identify and prioritize important data sources that should be interconnected to promote collaboration and provide the technology necessary to easily access this information	Significant Progress
A2A: Develop improved sturgeon abundance estimates through modeling and synthesizing data from cohort abundances studies, surveys, and report cards	Early Progress
A2B: Produce a system-wide analysis of existing telemetry results to provide an understanding of fish movement and predation	Early Progress

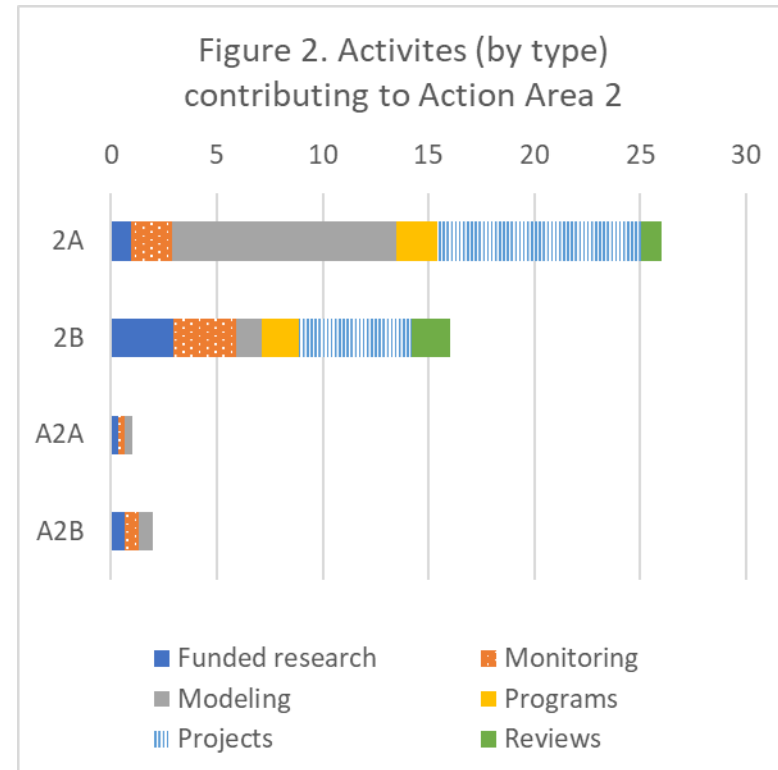


Figure 2. Activities (by type) contributing to Action Area 2

Primary Science Actions

- Building the capacity to do **collaborative science synthesis (2A)** has progressed significantly. Some synthesis efforts are topic-specific and provide examples of how to build capacity (e.g., primary production, fish community resilience, lamprey, nutria forecasting, striped bass, salmon salvage), while others are more comprehensive and cross-cutting across topics and disciplines (e.g., coordinated flow action synthesis, State of Bay-Delta Science). Activities include modeling and projects, and most have produced or anticipate producing publications. Programmatic actions that add general capacity for synthesis work in the form of increased scientific staff resources or established coordination groups (responsive to Delta Science Plan Action 3.11) has seen major progress.
- Significant progress has been made in identifying and prioritizing important **data sources** for **interconnection (2B)**, collaboration, and sharing. Many activities (primarily funded research, synthesis of monitoring data, and projects) are ongoing, completed or partially complete and include integration of multiple large datasets (e.g., fish and zooplankton sampling, nutrients), topical reviews (non-native species, monitoring enterprise), symposia (e.g., salinization), and online platforms for data sharing (e.g., steelhead). Most activities will produce or have produced publications and contain outreach components (e.g., conferences, workshops, meeting presentations).

Additional Science Actions

- Progress to develop improved **sturgeon abundance estimates (A2A)** is ongoing and supported by a funded research effort analyzing existing acoustic telemetry data for improving population size estimates for green sturgeon and helping with the recovery and management of this species. This work is supported by an additional synthesis effort focused on sturgeon and salmon in the Delta, but more work and participation is needed to bring this Science Action to the level of informing management or altering long-term monitoring programs. Existing projects anticipate publications.
- Progress in producing a **system-wide analysis** of **telemetry (A2B)** data to understand fish movement is ongoing and supported by one focused synthesis effort of existing telemetry data. The work of a collaborative group focused on telemetry and integrated studies that utilize telemetry data is also furthering this Science Action. Existing projects anticipate publications. None have focused explicitly on predation.

Action Area 3: Develop tools and methods to support and evaluate habitat restoration

Moderate progress has been made in developing methods to support and evaluate habitat restoration as shown in Table 3 and Figure 3.

Table 3. Action Area 3 Summary table of Science Action progress to date.

SCIENCE ACTION	STATUS
3A: Develop methods for evaluating long-term benefits of habitat restoration based on current understanding of how species use restored areas and how use changes over time as habitats evolve.	Significant Progress
3B: Estimate and assess the system-wide effects of location and sequence of tidal marsh habitat restoration projects in regions where sea level is rising and climate is changing	Early Progress
A3A: Review effort to examine effectiveness of habitat restoration	Early Progress
A3B: Collect environmental, social, and economic baseline data and develop a database of pre-project habitat conditions at the landscape scale (e.g., native species presence/condition, water quality, current food and predator densities, condition in adjacent channels, and socio-economic valuations of management practices and environmental stewardship)	Moderate Progress

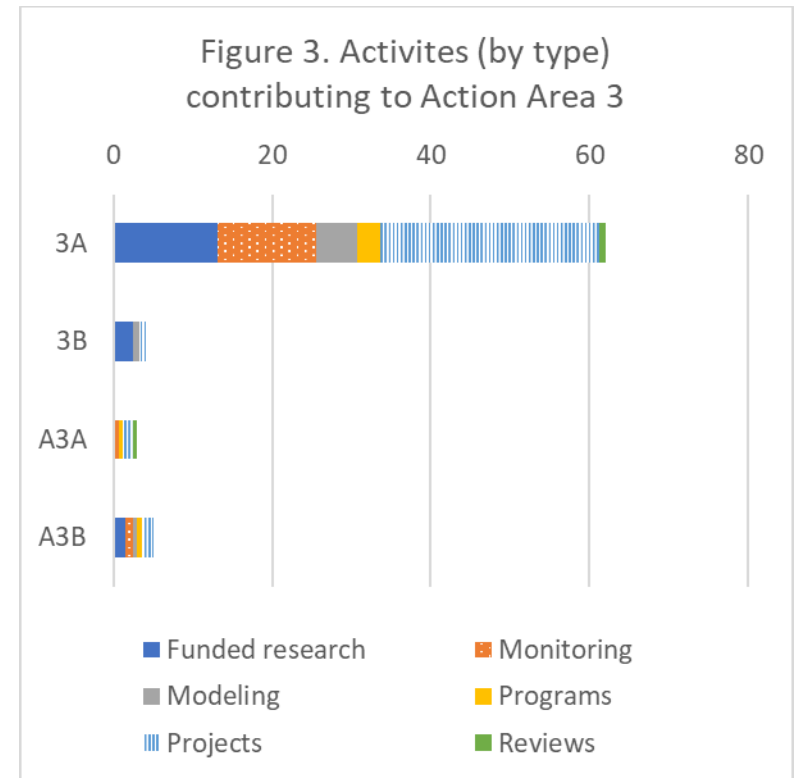


Figure 3. Activities (by type) contributing to Action Area 3

Primary Science Actions

- Efforts to develop methods for **evaluating the long-term benefits of habitat restoration (3A)** have progressed significantly, owing in large part to the completion of five particularly relevant activities, consisting of the Delta Landscapes Scenario Planning Tool, EcoAtlas, Delta Landscapes Primary Production, and the Chinook salmon quantification tool, and the conceptual and methodological framework to assess the effectiveness of restoration efforts. A large portion of other activities consist of on-the-ground restoration projects or programs (at varying levels of completion), with a smaller subset of these including funded research and monitoring. Another portion of activities is aimed largely at answering key questions about restoration, including about agricultural floodplain habitat, upstream habitat for salmon, ecological functions of tidal marshes and more, accounting for at least 23 publications (completed or forthcoming).
- With four activities primarily contributing to this science action (all ongoing or initiated), progress toward estimating and assessing the **system-wide effects of tidal marsh habitat restoration projects (3B)** in the context of climate change and sea-level rise has been minimal. While there is a good mix in the type of activities (funded research, monitoring, modeling, etc.) and these activities will undoubtedly help to inform this science action (e.g., better understanding marsh accretion, effects of phragmites in Suisun Marsh, assessing nutrient storage and release in the Delta), few directly address this Science Action.

Additional Science Actions

- With three ongoing activities primarily contributing to this science action, and two activities contributing secondarily, progress reviewing efforts to examine **effectiveness of habitat restoration (A3A)** can be characterized as minimal. Of the activities, only one synthesis of restoration in the Delta and Suisun Marsh specifically addresses the Science Action, while the other activities—relating to fish restoration monitoring, wetlands monitoring, Yolo Bypass tributary flow monitoring—indirectly inform the Science Action. Notably, few restoration projects have been completed and available for evaluation during this period of time evaluated.
- Five activities directly contribute to the **collection of a wide-range of environmental, social and economic baseline data (A3B)** (e.g., Delta Aquatic Resource Inventory for Landscape Scale Evaluation of Wetlands in the Delta and Suisun Marsh, microplastics) across a range of types of activities—including three expected or completed publications—with three of those five activities arguably qualifying as specific examples of a **database of pre-project habitat conditions at the landscape scale** (e.g., Chinook salmon rearing habitat mapping, Ecosystem Enhancement Tool in Coyote Creek). Given the nature and number of these activities and the appreciable gains of knowledge associated with them, the progress in achieving this Science Action can be characterized as moderate.

Action Area 4: Improve understanding of interactions between stressors and managed species and their communities

Significant progress has been made in improving understanding of interactions between stressors and managed species and their communities as shown in Table 4 and Figure 4.

Table 4. Action Area 4 Summary table of Science Action progress to date.

SCIENCE ACTION	STATUS
4A: Implement studies to better understand the ecosystem response before, during, and after major changes in the amount and type of effluent from large point sources in the Delta including water treatment facilities	Significant Progress
4B: Identify areas that act as refugia for species of concern during extreme conditions , particularly drought and flood, to inform management decisions and priorities during extreme climate events	Significant Progress
4C: Understand mechanisms for observed relationships between flows and aquatic species	Significant Progress
4D: Evaluate the effects of toxicity (e.g., contaminant mixtures, mercury, pharmaceutical products, HABs) on aquatic species survival including possible effects on predation	Significant Progress
A4A: Better understand salmonid temperature tolerances in streams and rivers	Moderate Progress
A4B: Identify effective mechanical and biological control strategies for established non-native clams and potential invasive mussels , including developing effective prevention measures for potential invaders	Early Progress

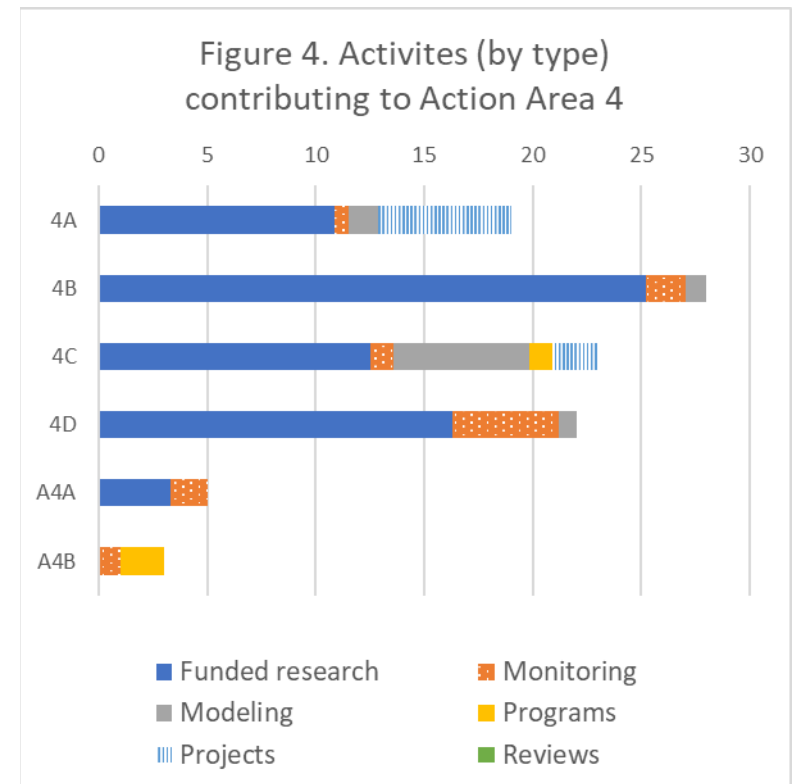


Figure 4. Activities (by type) contributing to Action Area 4

Primary Science Actions

- Most activity to better **understand the ecosystem response to changes in the amount and type of effluent from large point sources in the Delta (4A)** is ongoing. Most completed activities are part of a research effort to establish a baseline before the wastewater treatment facility upgrade. Ongoing activities include synthesis and model development for nutrient sources, sinks and transformations, copepod feeding, reproduction, growth and habitat preferences, and extensive monitoring before and during a regional wastewater facility upgrade.
- Activities to identify **areas that act as refugia for species of concern during extreme conditions (4B)** are evenly split between complete and ongoing. Activities (primarily funded research) address refugia, drought, flow, and toxicity effects for different life stages of smelt and salmon, but also rare terrestrial studies (i.e., salt marsh harvest mouse and transition zones).
- Activities to understand mechanisms for observed **relationships between flows and aquatic species (4C)** are completed and ongoing. Many activities involve synthesis and modeling. Specific topics include longfin smelt/ flow study, salvage model for Delta smelt, climate change effects on estuarine fish, salinity tolerance of overbite clam, plant diversity for waterfowl management, a steelhead behavior model, and more.
- Activities to evaluate the **effects of toxicity on aquatic species survival (4D)** are mostly ongoing. Activities (primarily funded research) are investigating toxicity alone and in combination with temperature, drought, spring outflow, cyanobacteria presence, and herbicide and pesticide stress to species, among others. Additional activities include developing a web-based tool for pesticide contribution, monitoring for harmful algal blooms and contaminants of emerging concern, and developing a model quantifying contaminant group exposure.

Additional Science Actions

- Activities to better understand **salmonid temperature tolerances in streams and rivers (A4A)** are evenly split between complete and ongoing. Activities investigated range from temperature effects on salmon at egg stage to the impact of disease and diet availability.
- Three ongoing projects all address invasive species in general, but do not identify **effective mechanical and biological control strategies for** established **non-native clams and potential invasive mussels (A4B)** in particular.

Action Area 5: Modernize monitoring, data management, and modeling

Moderate progress has been made in modernizing monitoring, data management, and modeling, particularly for innovative technologies and cost-effective methods for scientific monitoring and analysis as shown in Table 5 and Figure 5.

Table 5. Action Area 5 Summary table of Science Action progress to date.

SCIENCE ACTION	STATUS
5A: Advance integrated modeling through efforts such as an open Delta collaboratory (physical or virtual) that promotes the use of models in guiding policy	Moderate Progress
5B: Explore innovative technologies and cost-effective methods for scientific monitoring and analysis of flow, water quality, and ecosystem characteristics (e.g., improved tools for fish monitoring, LiDAR, high-resolution bathymetry technology, new measurements for Delta levee hazards, and citizen scientist monitoring programs)	Significant Progress
A5A: Build on existing models to integrate fish and water quality monitoring data to report, simulate, and forecast distribution of salmon runs in time and space. These actions should be coordinated with tagging studies and other monitoring data to provide accurate and consistent interpretation of information to support decision-makers (e.g., coupling 3-D hydrodynamic modeling of the Delta with juvenile salmon behavior and survival)	Moderate Progress
A5B: Conduct baseline surveys throughout spawning habitat , map egg collection and larval rearing habitat, and quantify availability using various characteristics identified through egg sampling (water temperature, depth, velocity, substrate, etc.)	Early Progress
A5C: Develop and implement a Bay Area and Delta regional wetland monitoring program	Moderate Progress

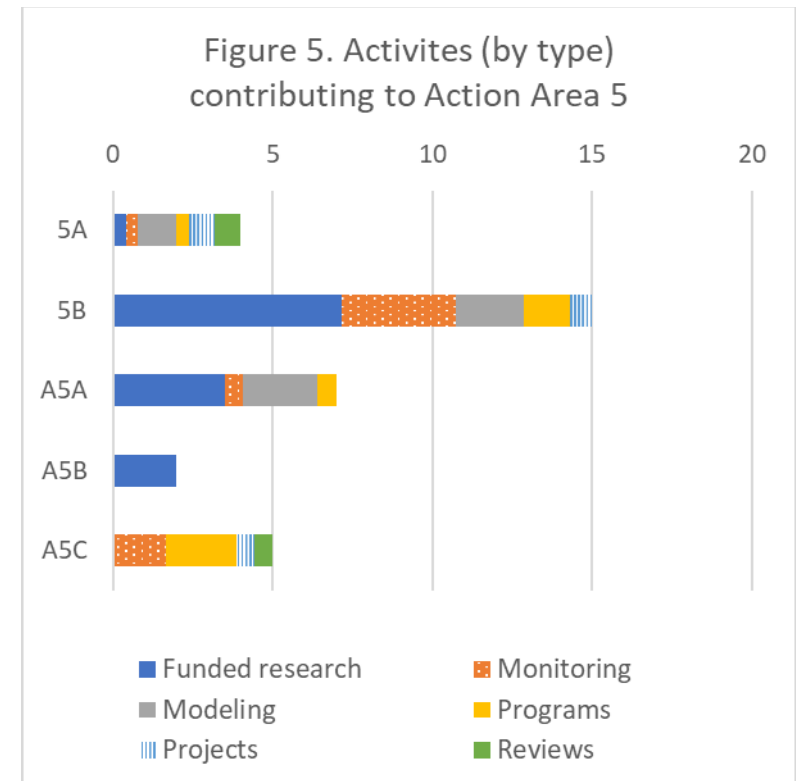


Figure 5. Activities (by type) contributing to Action Area 5

Primary Science Actions

- Most activities contributing to **integrated modeling (5A)** are ongoing or partially complete. Activities directly informing the Science Action include helping to advance integrated modeling by supporting a virtual (or physical) Delta Collaboratory, reviewing the effectiveness of monitoring, and supporting model integration to enhance Delta management. Specific integrated modeling activities (e.g., nutria forecasting, wastewater treatment upgrade effects, and picoplankton baseline data) are supporting this Science Action. All activities have produced or anticipate producing publications.
- Most activities contributing to **innovative monitoring and analysis (5B)** are funded research efforts that are ongoing, completed, or partially complete. Activities range from isotopic food web models and improved methods for supporting life cycle models and eDNA barcoding, to understanding pathogens, mapping aquatic vegetation, and piloting a citizen science project. Most activities anticipate or have produced a publication. A symposium focused on remote sensing for invasive species management was hosted in 2019.

Additional Science Actions

- Primarily funded research and modeling efforts, ranging from initiated to complete, contributed to **models that integrate fish and water quality monitoring data (A5A)**. These activities are helping to inform Science Action A5A by monitoring and modeling salmonid migration and habitat effects, pathogen exposure, and more.
- The efforts (primarily ongoing funded research) helping to address **spawning habitat baseline surveys (A5B)** include the development of a tool for high accuracy identification of juvenile Chinook salmon and monitoring Delta rearing contributions for salmonids.
- Efforts to inform **regional wetland monitoring (A5C)** include ongoing activities to monitor existing and sentinel sites, compile and share data, and synthesize information for wetlands, streams, and water quality throughout the SF Bay and Delta.

Appendix: List of activities contributing to each Action Area

The below list is sorted alphabetically by activity title. Activities are only listed once in the below list but may be contributing to multiple Action Areas/Science Actions.

Action Area 1: Invest in assessing the human dimensions of natural resource management decisions.

- A review of the Interagency Ecological Program's ability to provide science supporting management of the Delta
- Adaptation Atlas
- Adapting to Rising Tides Report (part of CCMP Action 15, Task 15.3)
- American Carbon Registry protocol for Delta wetlands
- Assessing the carbon and climate benefit of restoring degraded agricultural peat soils to managed wetlands
- Education and communication of CCMP (part of CCMP Action 32, Task 32.1)
- Initiate CCMP update (part of CCMP Action 32, Task 32.4b)
- Report on progress on CCMP (part of CCMP Action 32, Task 32.4a)
- CSAMP Structured Decision-making model
- CVPIA Science Integration Team (SIT)
- Defining the architecture and recurrence interval for faults in the Sacramento-San Joaquin Delta: Assessing potential geohazards
- Best practices for nature-based shorelines (part of CCMP Action 14, Task 14.3)
- Pilot projects for nature-based shorelines to increase resiliency (part of CCMP Action 14, Task 14.4a)
- Assessment of drought planning (part of CCMP Action 19, Task 19.1)
- Delta Levees Investment Strategy (part of CCMP Action 16, Task 16.1)
- Economic Sustainability Plan update
- Effect of temperature and salinity on physiological performance and growth of longfin smelt: Developing a captive culture for a threatened species in the Sacramento/San Joaquin Delta
- Environmental Justice White Paper
- Hold meetings to collaborate and expand use of recycled water (part of CCMP Action 22, Task 22.2)
- Promote existing outreach activities and info sharing for educating the public about recycled water (part of CCMP Action 22, Task 22.1)
- Facilitation support for CSAMP/CAMT
- Fisheries biologist expertise for Phase II of Delta Smelt Structured Decision Making for CAMT
- Franks Tract Futures

- Grazing best practices for seasonal wetland protection (part of CCMP Action 8, Task 8.3)
- Human Dimensions Research in Delta Environments
- Evaluate BMPs for Suisun to improve water quality (part of CCMP Action 27, Task 27.2)
- Implementation of Best Management Practices in the Delta: A Comprehensive Pesticide Management Project to Improve Water Quality
- Multi-benefit climate adaptation projects recommendations report (part of CCMP Action 17, Task 17.3a)
- Technical assistance; disaster recovery plan development (part of CCMP Action 16, Task 16.3)
- Technical assistance; hazard mitigation plan development (part of CCMP Action 16, Task 16.2)
- Integrated science and management of nutrient, salt, and mercury export from San Joaquin River wetland tributaries to the Delta
- Landscape Visioning Pilot Application for Staten Island
- Managing agricultural soils for carbon and water benefits in the California Delta: Understanding influences on decision-making and practice adoption of in-Delta farmers
- Methodology for assessing the long-term costs and benefits of managed wetlands and ponds (part of CCMP Action 6, Task 6.4)
- Study of managed wetland functions (part of CCMP Action 6, Task 6.3)
- Next Generation Multi-Hazard Levee Risk Assessment
- Perceptions of Risk and Management of the Delta Levee System
- Recreational hunting as an ecosystem service of restoration in the Bay-Delta watershed
- Re-establish vernal pool stewardship to protect, restore, and enhance seasonal wetlands (part of CCMP Action 8, Task 8.1)
- Reevaluating ecosystem functioning and carbon storage potential of a coastal wetland through integration of lateral and vertical carbon flux estimates
- Assistance for climate change planning and adaptation (part of CCMP Action 15, Task 15.1)
- Resiliency update for Plan Bay Area (part of CCMP Action 15, Task 15.2)
- Assist with multi-benefits projects (part of CCMP Action 12, Task 12.1)
- Sacramento River Winter-run Chinook salmon life cycle model
- Simulating methylmercury production and transport at the sediment-water interface to improve the water quality in the Delta
- Social Science Strategy for the Sacramento-San Joaquin Delta
- Socioeconomic Indicators Report

- Soil type as a driver of agricultural climate change response in the Sacramento San Joaquin Delta
- Support for NGO technical staff participation in the Delta Smelt Structured Decision Making Technical Working Group for CAMT
- The effectiveness of a water hyacinth weevil as a biological control agent of the invasive water hyacinth.
- Trade-offs and Co-benefits of Landscape Change Scenarios on Human and Bird Communities in the Sacramento-San Joaquin River Delta
- Urban Nature Lab
- Wetland carbon sequestration and impacts of climate change

Action Area 2: Capitalize on existing data through increasing science synthesis

- Biotic homogenization study
- Carbon contribution from different food web groups
- Central Valley Steelhead Monitoring Inventory
- Changes in and controls on biogeochemistry in the SF Bay-Delta
- Climate Change and the Delta: A Synthesis
- Climate change effects on extent of inundation in Yolo Bypass
- Climate Change Management, Analysis, and Synthesis Team
- Contaminants of Emerging Concern Strategy (part of CCMP Action 25, Task 25.1)
- Cyprinid synthesis
- Delta Data Festival
- Delta Ecosystem Stressors - A Synthesis
- Delta Science Funding and Governance Initiative
- Delta Smelt Conditions Report
- Drought Resistance and Resilience
- Ocean acidification conceptual model and convene scientific experts (part of CCMP Action 29, Task 29.1)
- Evaluation of fluridone treatment on SAV to enhance habitat for Delta Smelt
- Flow Alteration Team, Management, Analysis, and Synthesis Team (MAST)
- Forecasting Nutria presence in the Delta
- Improving Green Sturgeon Population and Migration Monitoring
- Interagency Telemetry Advisory Group (ITAG): Project work team for acoustic telemetry coordination
- Lamprey synthesis
- Landscape-scale efficacy analysis for aquatic vegetation control
- Leveraging Delta Smelt Data for Juvenile Chinook Salmon Monitoring in the San Francisco Estuary
- Longfin Smelt MAST
- Ludwigia project

- Microcystis and phytoplankton community composition DWR/UCD
- Monitoring enterprise review
- NCEAS Working Group to Understand Drivers of the Estuarine Food Supply
- Nutrient Management Program
- Phytoplankton Synthesis
- Track and reduce trash input into the Estuary (part of CCMP Action 30, Task 30.2)
- Review of water supply reliability estimation related to the Sacramento-San Joaquin Delta
- Salinization symposium
- Salmon and Sturgeon Assessment of Indicators by Life Stage
- Salmon salvage model
- State of Bay-Delta Science: Services and Disservices of Plants and Algae
- State of the Estuary Report
- Striped Bass Migration Timing Synthesis
- Synchrony of native fish movements: synthesis science towards adaptive water management in the Central Valley
- Towards the Protection, Restoration, and Enhancement of the Delta Ecosystem: A Synthesis
- Use of the Enhanced Delta Smelt Monitoring survey to improve Chinook Salmon monitoring
- Wakasagi synthesis
- Zooplankton Synthesis

Action Area 3: Develop tools and methods to support and evaluate habitat restoration

- A Delta Renewed
- Bay Point Restoration Project
- Bees Lakes Habitat Restoration Plan
- Blacklock Restoration: Phragmites Control Study
- Changes in organic carbon and food resources in response to historical events in the Sacramento-San Joaquin Delta: A synthesis project
- Chinook Salmon Quantification Tool
- Chinook salmon rearing habitat with CAMT
- Complex Tidal Marsh Dynamics Structure Fish Foraging Patterns in the San Francisco Estuary
- Consequences of Phragmites invasion for community function in Suisun Marsh
- Coyote Creek Native Ecosystem Enhancement Tool (CCNEET)
- Delta Adapts Climate Vulnerability Assessment
- Delta Aquatic Resource Inventory for Landscape Scale Evaluation of Wetlands in the Delta and Suisun Marsh

- Delta Landscape Planning Tool
- Delta Landscape Scenario Planning Tool
- Delta Landscapes Primary Production
- Delta Waterways Habitat Restoration Planning
- Delta Wetlands and Resilience: blue carbon and marsh accretion
- Developing a methodological framework to assess the effectiveness of previous restoration efforts to inform future restoration planning
- Dutch Slough Tidal Marsh Restoration Project: Phase 2 (Revegetation)
- EcoAtlas
- Ecosystem Amendment
- Ecosystem Engineering Impacts of Water Primrose in the Delta
- Effects of Phragmites in Suisun Marsh
- Elk Slough Fish Passage and Flood Improvement
- Estuarine-terrestrial habitat gradients enhance nursery function for resident and transient fishes in the San Francisco Estuary
- Farm to Fish: Lessons from a Multi-Year Study on Agricultural Floodplain Habitat
- Fish Friendly Farming Certification Program for the Sacramento-San Joaquin Delta
- Floodplains, Tidal Wetlands, and Dark Carbon: Determining Heterotrophic Carbon Contribution to Higher Level Consumers
- FRP Monitoring Program
- Grizzly Slough Floodplain Restoration Project at the Cosumnes River Preserve
- Hydrodynamic Influences on the Food Webs of Restoring Tidal Wetlands
- Create regional inventory of transition zones (part of CCMP Action 4, Task 4.2)
- Revise policies for multi-benefit climate adaptation projects (part of CCMP Action 17, Task 17.3b)
- Improve regulatory review, permitting, and monitoring processes for multi-benefit climate adaptation projects (CCMP Action 17)
- Investigations of restoration techniques that limit invasion of tidal wetlands
- Juvenile salmon distribution, abundance, and growth in restored and relic Delta marsh habitats
- Knightsen Wetland Restoration and Flood Protection Project
- Lower Marsh Creek and Sand Creek Watershed Riparian Restoration Planning Project
- Lower San Joaquin Riparian Corridor
- Mapping and Prioritization of Sites for Biological and Integrated Control of Arundo in the Sacramento-San Joaquin Delta
- Mapping of suitable upstream habitat for Chinook salmon
- Marsh Creek Channel Restoration
- Conduct bird surveys, analyze wetland use, and effectiveness of enhancement efforts (part of CCMP Action 6, Task 6.1)

- Study the ability of managed ponds to sustain waterbird numbers in the Bay (part of CCMP Action 6, Task 6.2)
- McCormick Williamson
- Mello-Jensen Heirs Sandhill Crane Preserve Conservation Easement
- Microplastics
- Nutria Eradication Project
- Nutria Eradication Project, Phase 2
- Oakley Creekside Park Restoration
- Paradise Cut Conservation and Flood Management Plan
- Paradise Cut Conservation and Flood Management Project, Phase 2
- Petersen Ranch: Working Waterway Habitat Enhancement Project
- Phase I San Joaquin River Floodplain Restoration and Floodway Enhancement at Banta-Carbona
- Problems and Promise of Restoring Tidal Marsh to Benefit Native Fishes in the North Delta during Drought and Flood
- Reconnecting Delta food webs: evaluating the influence of tidal marsh restoration on energy flow and prey availability for native fishes
- Restoration of Priority Freshwater Wetlands for Endangered Species at the Cosumnes River Preserve
- Restoration Planning at River Garden Farms
- Risk of fish predation within and across tidal wetland complexes
- Sediment for Survival
- Seedling Emergence from Seed Banks in *Ludwigia hexapetala*-Invaded Wetlands: Implications for Restoration
- Sentinel marsh monitoring and stream gauge network as part of WRMP (part of CCMP Action 2, Task 2.4 and 2.5)
- Sherman Island Wetland Restoration Project Phase III
- Spatiotemporal variation of floodplain habitat for restoration management
- Stone Lakes Restoration Project
- Synthesis of Ecosystem Restoration in the Delta and Suisun Marsh
- The ecological functions of tidal marsh for estuarine and migratory fishes in the Suisun Marsh
- The role of wetlands in pelagic food webs: metagenomics reveals how wetland plant detritus may promote zooplankton growth and survival
- Three Creeks Parkway #2: Request for additional funds to implement an expanded version of a project previously funded by the Delta Conservancy
- Three Creeks Parkway Restoration Project
- Tidal wetland support of pelagic food web
- Toward Salt Marsh Harvest Mouse Recovery: A Review
- Tule Red monitoring

- Wildlife Corridors for Flood Escape on the Yolo Bypass Wildlife Area Project
- Yolo Bypass Wildlife Area Habitat and Drainage Improvement Project

Action Area 4: Improve understanding of interactions between stressors and managed species and their communities

- A Data Synthesis to Calibrate and Validate Linked Hydrological-Biogeochemical Models
- An evaluation of sublethal and latent pyrethroid toxicity across a salinity gradient in two Delta fish species
- Application of cutting-edge tools to retrospectively evaluate habitat suitability and flow effects for Longfin Smelt
- Aquatic Toxicity and Current Use Pesticides Monitoring Using a Rotating Basin Probabilistic Design
- Assessing sediment nutrient storage and release in the Delta: linking benthic nutrient cycling to restoration, aquatic vegetation, phytoplankton productivity, and harmful algal blooms
- Assessment of Nutrient Status and Trends in the Delta in 2001-2016: Effects of drought on ambient concentrations and trends
- Biological Goals Scientific Advisory Panel
- Brackish Tidal Marsh Management and the Ecology of a Declining Freshwater Turtle
- Central Valley Pilot Study for Monitoring Constituents of Emerging Concern (CECs)
- Climate change implications for tidal marshes and food web linkages to estuarine and coastal nekton
- Conceptual Model of Ecological Outcomes from the Regional San WWTP Upgrade (Operation Baseline 1.0)
- Contaminant Effects on Two California Fish Species and the Food Web That Supports Them
- Counting the Small Guys: Ensuring Picocyanobacteria and Other Small Phytoplankton are Measured Prior to, During, and Following the Sacramento Wastewater Treatment Plant Upgrade
- Cyanotoxin Monitoring in the Delta: Leveraging existing USGS and DWR field efforts to identify cyanotoxin occurrence, duration, and drivers
- Defining habitat quality for young-of-year longfin smelt: Historical otolith-based reconstructions of growth and salinity history in relation to geography, climate, and outflow
- Defining the fundamental niche of Longfin Smelt (*Spirinchus thaleichthys*): Physiological mechanisms of environmental tolerance
- Delta Cross Channel Study 2020
- Delta RMP Mercury Monitoring

- Do light, nutrient, and salinity interactions drive the "bad Suisun" phenomenon? A physiological assessment of biological hotspots in the San Francisco Bay-Delta
- Drought-Related High Water Temperature Impacts Survival of CA Salmonids through Disease, Increasing Predation Risks
- Effects of copper exposure on the olfactory response of Delta smelt (*Hypomesus transpacificus*): Investigating linkages between morphological and behavioral anti-predator response
- Effects of Multiple Environmental Stressors on Ecological Performance of Early Life Stage Sturgeon
- Environmental geochemistry and tidal wetland support of pelagic food webs
- Estimation of Adult Delta Smelt Distribution for Hypothesized Swimming Behaviors Using Hydrodynamic, Suspended Sediment, and Particle-Tracking Models
- Estuarine fish community responses to climate, flow, and habitat
- Evaluating Juvenile Salmonid Behavioral Responses to Hydrodynamic Conditions in the Sacramento-San Joaquin Delta
- Evaluating the effects of wastewater-derived nutrients on phytoplankton abundance and community structure in the San Francisco Estuary and Delta
- Evaluation of a large-scale flow manipulation to the upper San Francisco Estuary: Response of habitat conditions for an endangered native fish
- Expand invasive species prevention programs (part of CCMP Action 9, Task 9.1)
- External reviewer for the IEP monitoring survey review
- Factors associated with salvage
- Hydrodynamics of backwater conditions at Fremont Weir
- Identifying Cyanobacterial Harmful Algal Bloom Toxins in Delta Invertebrates: Implications for Native Species and Human Health
- Impact of Climate Variability on Surface Water Quality: Cyanobacteria and Contaminants
- Impact of Temperature and Contaminants on Chinook Salmon Survival: A Multi-Stressor Approach
- Impacts of climate change on pesticide bioavailability and sublethal effects on juvenile Chinook salmon in the Delta: Potential benefits of floodplain rearing
- Impacts of Spatial and Temporal Dynamics of Water Flows on Migratory Behavior of Chinook Salmon Smolts in the South Delta
- Impacts of Storm-Driven Contaminants on Larval Delta Smelt and the Community Scale Adaptive Capacity
- Impacts of Storm-Driven Contaminants on Larval Delta Smelt and the Community Scale Adaptive Capacity
- In search of refuge: Investigating the thermal life history of Delta Smelt through in-situ oxygen isotope ratio analysis of otolith
- Increase EDRR programs (CCMP Action 9, Task 9.2)

- Invasive species review
- Investigating the Factors that Affect Distribution, Abundance, and Recruitment of Age-0 Longfin Smelt in the Upper San Francisco Estuary
- Investigation of the resilience of the salt marsh harvest mouse and best management practices in response to climate change
- Large-Scale Flow Management Action Drives Estuarine Ecological Response
- Longfin Smelt Science Plan
- Long-Term Surveys Show Invasive Overbite Clams (*Potamocorbula amurensis*) are Spatially Limited in Suisun Marsh, California
- Mechanisms underlying the flow relationship of longfin smelt: I. Movement and feeding
- Modeling of Longfin Smelt distribution in the coastal ocean
- Multiple Stressors in the San Francisco Estuary and Watershed: Effects of high temperature and low oxygen on the survival and physiology of early life stage Chinook salmon
- Nitrogen cycling and ecosystem metabolism before and after regulatory action
- Nutrients mitigate the impacts of extreme drought on plant invasions
- Operation Baseline 1.0 (Pilot Studies)
- Pesticide risk analyses and management actions, chemical fate, and transport
- Phytoplankton and cyanobacteria growth and response to stressors
- Primary Production for Operation Baseline
- Primary Productivity, Nutrient Uptake, and Nitrogen Kinetics by Resident Phytoplankton under Reduced Nutrient Loads and Changed Nitrogen Forms in Response to the Sacramento Wastewater Treatment Plant Upgrade
- Quantifying Genetic and Epigenetic Variation in Delta Smelt that may Enable Adaptation to Future Environments
- Quantifying the contribution of tidal flow variation to survival of juvenile Chinook salmon
- Rapid response to increase our understanding of the origins of thiamine deficiency in Central Valley Chinook salmon
- Real time tool to detect salmon entrainment
- Relative contributions of contaminant groups to environmental risk in the upper SFE
- Resolving contradictions in food web support for native pelagic fishes
- Revise raw sewage discharges ordinances in SF Estuary (part of CCMP Action 26, Task 26.1)
- Role of freshwater floodplain-tidal slough complex in the persistence of the endangered delta smelt
- Sacramento River Nutrient Change Study
- Sacramento River Phytoplankton Bioassay 2016
- Sacramento River Phytoplankton Study 2016

- Sacramento River winter-run Chinook salmon life history diversity, growth, and habitat use among varying hydroclimatic regimes
- Salinity and inundation effects on productivity of brackish tidal marsh plants in the San Francisco Bay-Delta Estuary
- Sampling in small coastal Northern California streams for the presence of Longfin Smelt
- Science communication of findings on Longfin Smelt
- Science communication of findings on the Delta Outflow Project
- Seasonal impoundment alters patterns of tidal wetland plant diversity across spatial scales
- Source characterization and biogeochemical consequences of wastewater and agricultural C, N, and P inputs to the Sacramento-San Joaquin Delta region
- Source Tracking of Cyanobacteria Blooms in the Sacramento-San Joaquin Delta
- Statistical Evaluation of Particle-Tracking Models Predicting Proportional Entrainment Loss for Adult Delta Smelt in the Sacramento-San Joaquin Delta
- Steering committee and TAC for transition zones around the SF Estuary (part of CCMP Action 4, Task 4.1)
- Synthesis of juvenile salmon growth, condition, and Delta habitat use among extreme hydrologic conditions
- The Effect of Drought on Delta Smelt Vital Rates
- The effect of temperature on predation of juvenile salmonids
- The effects of early hypersaline acclimation due to climate change on the toxicity of pyrethroid, an insecticide, in salmonids
- Tidal effects on marsh habitat use by three fishes in the San Francisco Estuary
- Time-lagged impacts of extreme, multi-year drought on tidal salt marsh plant invasion
- Tracking toxicity in spring for comparison to fall outflow project toxicity
- Water quality science in the Sacramento-San Joaquin Delta: chemical contaminants and nutrients
- Waterfowl Management and Diet of the Salt Marsh Harvest Mouse

Action Area 5: Modernize monitoring, data management, and modeling

- A Next-generation Model of Juvenile Salmon Migration through the Sacramento-San Joaquin Delta
- An improved genomics tool for characterizing life history diversity and promoting resilience in Central Valley Chinook salmon
- Assessing the spatial variability of nutrients, phytoplankton, and related water quality constituents in the California Sacramento-San Joaquin Delta at the landscape scale: 2018 high resolution mapping surveys

- Complete CARI for Delta and upload inventories to EcoAtlas (part of CCMP Action 2, Task 2.3)
- Delta Hydrodynamic-Biogeochemical Monitoring Development
- Delta Regional Monitoring Program
- Developing a new molecular isotopic tool to examine Delta food webs
- Developing an eDNA metabarcoding protocol to improve fish and mussel monitoring in the San Francisco Estuary
- Development of a tool to track conservative constituents based on hydrodynamics (Constituent Tracker)
- Development of monitoring program to support the Sacramento River Spring-Run Juvenile Production Estimate
- DIISC Symposium - Remote Sensing for Invasive Species Management
- Enhancing Predictive Capability for Phytoplankton Response to Natural and Operational Induced Variability of Phytoplankton Blooming in the Delta
- Evaluating contributions of hatchery-origin fish to conservation of endangered Sacramento River winter-run Chinook salmon during a drought
- Eyes and Ears: Using Lens and Otolith Isotopes to Quantify Critical Rearing Habitats for Salmon Viability
- Green infrastructure work
- High Resolution Temporal and Spatial Mapping of Mercury in Surface Waters of the San Francisco Estuary
- IMSC efforts on modeling collaboratory
- Interagency Ecological Program: Long-term Monitoring Element Review: Pilot approach and methods development (2020)
- Interior Delta Export Effects Study
- Low-cost satellite remote sensing of the Sacramento-San Joaquin Delta to enhance mapping for invasive and native aquatic vegetation
- Monitoring and Modeling Pathogen Exposure in Salmon Migrating to the Delta
- Pathogen Screening and Health Status of Outmigrating Chinook Salmon in the California Delta
- Probabilistic Length at Date to distinguish different races of Chinook salmon
- Pumpout Nav pilot program to decrease raw sewage discharge into the SF Estuary (part of CCMP Action 26, Task 26.4a)
- Quantifying Biogeochemical Processes through Transport Modeling: Pilot Application in the Cache Slough Complex
- Reconstructing juvenile salmon growth, condition, and Delta habitat use in the 2014-15 drought and beyond
- Regional Monitoring Program for water quality
- Revealing the invisible contributors to the diets of larval longfin smelt and striped bass in the San Francisco Estuary

- Science Needs Assessment
- Seasonal floodplain-tidal slough complex supports size variation for juvenile Chinook salmon (*Oncorhynchus tshawytscha*)
- SFEI Regional Data Center (for SWAMP)
- Tidal wetland restoration in the Bay-Delta Region: Developing tools to measure carbon sequestration, subsidence reversal, and climate resilience 2021
- Wetlands Regional Monitoring Program in the Bay
- Yolo Bypass Westside Tributaries Flow Monitoring Project