Delta Monitoring Enterprise Review Update (March 2020)

Taking Stock of Monitoring To Date

The Sacramento-San Joaquin Delta and Suisun Marsh are a focal point for many of the water-related challenges that confront California. Climate change, aging water and levee infrastructure, growing human population, threatened native species, exotic species invasions, and balancing human and ecosystem needs for water are major roadblocks to achieving the Delta's coequal goals.

A comprehensive and integrated network of monitoring, with open access to data, and strong linkages to decision-making are important for reliably measuring and detecting changes in the Delta, and collectively understanding how to respond to rapid transitions facing the region.

An initial phase of the Delta Independent Science Board's review of the "monitoring enterprise" has been completed to document and evaluate activities, and develop recommendations around how data collection can better meet the needs of agencies and support adaptive management. The work is described in three reports. A comprehensive monitoring inventory was also developed.

- **REPORT #1** establishes a method for the review
- **REPORT #2** provides an overview of the monitoring enterprise
- **REPORT #3** synthesizes and analyzes the enterprise to extract broad insights about the nature and extent of current monitoring
- A monitoring inventory database stores metadata about monitoring so users can search and query current activities

This brochure provides a brief overview of key outputs from this review.

Three reports and an online monitoring inventory database to explore results

Guiding Questions and Themes

MANAGEMENT THEMES

- Water Supply Management
- Flood Management
- Habitat Management
- Native Species Management
- Invasive / Non-native Species Management
- Water Quality Management
- Land Use Management

The initial phase of the review was focused on compiling, synthesizing, and developing insights around the monitoring enterprise as guided by the following questions:

- Are there potential gaps / redundancies in serving the relevant needs of decision makers?
- What is the level of coordination of data collection across different organizations?
- Are there other opportunities to increase efficiencies in monitoring?
- What is the data quality of monitoring to address purposes and needs for data?
- Are data accessible to the public, decision makers, and other scientists?
- What resources are being dedicated to monitoring?

To answer these questions, metadata were collected for more than 150 monitoring activities focusing on those with active data collection since 2014 and occurring within the legal Delta and Suisun Marsh (and in some cases upstream or downstream areas). These activities serve the needs of decision makers, as represented by the **7 management themes** inherent in the Delta Plan (see left), and provide data about **23 monitoring themes**, as reflected by the many specific socio-economic, environmental, habitat, and species components of the Delta (see below).

MONITORING THEMES

Direct Socio-Economic Drivers

- Hydrologic changes
- Habitat changes
- Biological resource use
- Land use & human activities
- Transportation & service corridors

Environmental Drivers / Conditions

- Hydrology & hydrodynamics
- Landform & natural disturbance
- Weather & climate
- Nutrients, energy & food web
- Sediment
- Water quality

Habitats

- Tidal wetlands
- Channelized
- Aquatic vegetation
- Floodplain
- Riparian
- Terrestrial

Species

- Fish
- Mammals
- Birds
- Amphibians & reptiles
- Invertebrates
- Invasive / non-native species

Monitoring Needs Profiles by Management Theme

Water Supply Management

Direct Socio-Economic Drivers

- Water conveyance / infrastructure
- Water operations / exports
- Water storage
- Water use / demand

Environmental Drivers / Conditions

- Conductivity
- Groundwater
- Salinity
- Subsidence
- Surface water / flow
- Turbidity
- Water quality (other constituents)
- Water temperature

Land Use Management

Direct Socio-Economic Drivers

- Agriculture
- Forest harvesting
- Recreation & tourism
- Urban development

Habitats

- Channelized
- Terrestrial
- Tidal wetlands

Environmental Drivers / Conditions

- Carbon
- Sediment Erosion
- Subsidence
- Toxicity of Sediments

Invasive / Non-native Species Management

Direct Socio-Economic Drivers

- Agriculture
- Docks & ports
- Rail lines
- Recreation & tourism
- Roads & bridges
- Urban development
- Vessels & shipping channels

Species

- Invasive plants (Water hyacinth, Brazilian waterweed, spongeplant, giant reed, yellow star thistle)
- Invasive fish (Striped bass)

Environmental Drivers / Conditions

- Water quality (Herbicides, dissolved oxygen)

Flood Management

Direct Socio-Economic Drivers

- Dredging
- Levees
- Recreation and tourism
- Stormwater runoff / drainage
- Water conveyance / infrastructure
- Water storage

Environmental Drivers / Conditions

- Groundwater
- Sea level rise
- Snowpack
- Stage

Habitats

- Floodplain (seasonally flooded, open water, and managed ponds)

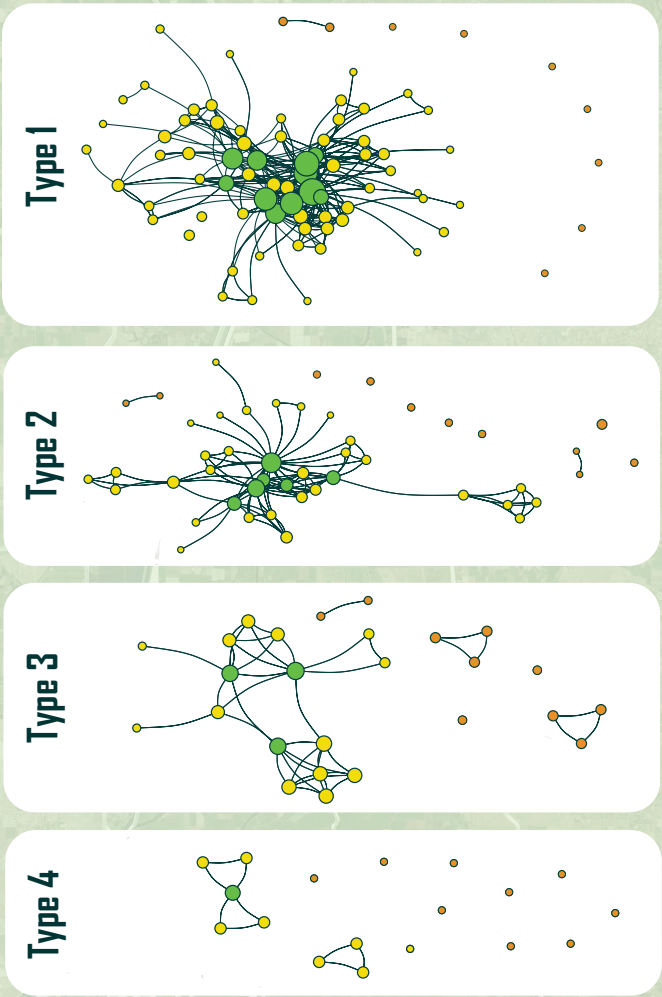
The monitoring inventory includes 157 unique monitoring activities, with 170 sampling activities at over 4,000 sampling locations representing 128 unique monitoring parameters. “Monitoring needs profiles” were developed for each of the 7 management themes of relevance to the Delta to understand potential gaps (monitoring with few activities) or redundancies (monitoring with many activities). Sample profiles for 4 management themes are provided above. Developing these profiles required clarifying the monitoring parameters, places, and timeframes of relevance to important management drivers for different management themes (i.e., the plans, strategies, operational, decision-making, and legislative needs). The monitoring inventory was then analyzed to highlight broad patterns of information availability based on the regional coverage, total number of activities, sampling frequency of data collection, and number of years of sampling for each parameter. Examples of some of the cross-cutting insights that emerged are:

- Many monitoring activities sample parameters at irregular intervals, which may pose challenges for time series analyses seeking to understand trends over time or causal relationships.
- Many sampling activities represent long-term programs that have been operating over decades, but there has been new monitoring within the last 5 years that has tended to focus on water quality and aquatic habitats.
- Monitoring related to hydrologic changes, hydrology, a subset of water quality parameters, aquatic and terrestrial habitats, as well as the Delta’s focal species (e.g., Chinook salmon, steelhead, Delta smelt, green sturgeon) tend to be relatively well represented.
- There are notable limitations in monitoring some contaminants, invasive species, and socio-economic drivers.

Although useful, the coarse resolution and breadth of this analysis for 128 parameters across the entire monitoring enterprise did not lend itself to drawing definitive inferences about whether monitoring is occurring at exactly the right times or places to meet all management needs. Results can, however, be viewed as a starting point for scientists and decision makers to better understand and prioritize current monitoring efforts so they can verify whether potential gaps or redundancies translate to actual opportunities that need to be addressed.

Types of Collaborative Networks

Core Influencers Collaborators Associates



Levels of Coordination Vary

Monitoring activities across the monitoring enterprise are implemented, funded, and / or supported by 132 organizations. The 9 most frequently involved organizations include:

- California Department of Fish and Wildlife
- California Department of Water Resources
- California State Water Resources Control Board
- National Oceanic and Atmospheric Administration
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

A network analysis characterized the structure, level of interaction, and influence of those involved in different networks of monitoring. Each node in the network represents an organization, while ties represent one or more interactions between organizations on a common monitoring activity (illustrated to the left). Organizations have different roles and influence depending on the type of monitoring being conducted.

Monitoring networks are structured in one of four ways. Types 1, 2, and 3 are of varying sizes, involve organizations interacting in a centralized network of collaborators and within which a smaller group of core influencers have the most influence. Within these broader networks, there are often a relatively small number of associates who monitor independently of others. Type 4 networks tend to be small and fragmented with limited coordination.

These findings can't be used to prescribe improvements to monitoring networks, but are useful for understanding their structure and exploring ways to strengthen support and coordination among organizations with common information needs.

Potential Opportunities for Increasing Efficiency

To focus on areas with the greatest potential for efficiencies, the full list of monitoring parameters was prioritized based on those with the greatest number of monitoring activities across different monitoring categories, from which the following insights emerged:

Socio-Economic

Opportunities were explored for monitoring of land use & human activities, as well as hydrologic changes. Opportunities are limited due to the disparate nature of socio-economic monitoring. There are also fewer activities compared to other types of monitoring, a much wider range of needs for information, and limited activities specifically focused on the Delta.

Environmental

Most environmental monitoring is focused on water quality, specifically water temperature, turbidity, salinity, conductivity, and dissolved oxygen. For these parameters, there may be opportunities for increasing comparability of data by standardizing use and calibration of equipment, employing consistent sampling protocols, and centralizing data management.

Habitats

Channelized and tidal wetland habitats are commonly represented across the monitoring enterprise. There may be opportunities for greater coordination of monitoring of habitat and species components since habitat monitoring tends to be driven by species needs. This coordination could be further improved if guided by standardized habitat classification schemes.

Species

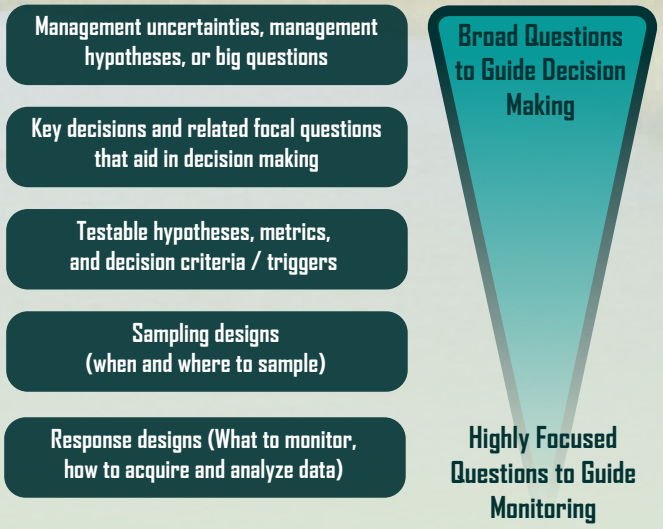
The most recurrent species in the monitoring inventory are Chinook salmon, steelhead, green sturgeon, waterfowl, and crustaceans. Fish monitoring tends to be relatively well coordinated, though efficiencies may exist for improving telemetry data collection. There may be opportunities to improve data management for waterfowl. Crustacean monitoring needs tend to be highly variable.

Emerging Needs for Monitoring and Adaptive Management

This brochure briefly highlights a few key results. Because incremental changes will not likely result in major improvements to monitoring in the Delta, three "big moves" have been proposed to represent the need for more transformative changes. These "big moves" are fundamental to the ultimate success of monitoring and adaptive management. Although potentially more difficult to implement the complexity, urgency, and long-standing nature of many challenges facing the Delta dictate an urgent need for doing things differently.

Big Move #1: Synthesize, standardize, and focus on priority science and management needs

Successful monitoring and adaptive management need to be guided by a clear purpose since it fundamentally determines how data are collected and decisions are made. The Delta is a complex social-ecological system over which many decision authorities have influence, and it is difficult to discern the focus and clarity through this complexity. More syntheses and standardization of science and management needs are required so there is a common understanding of priorities. Describing and organizing these needs can involve varying levels of specificity (see right). Syntheses of the science and management enterprises developed through this review can be leveraged to facilitate further discussions and clarity around these needs.



Big Move #2: Reimagine monitoring designs for priority monitoring needs

Efficient and effective monitoring programs tend to leverage principles of experimental design. There has been a massive investment in monitoring across a wide range of parameters for the Delta, although the review was unable to compile costs of monitoring owing to the diverse ways that monitoring is funded. Despite a large investment, most monitoring has not been designed and/or implemented with the intent of explicitly supporting adaptive management. Achieving improvements in coordination, ensuring sufficiency of coverage, and identifying other opportunities for efficiency will likely best be served by reimagining monitoring designs for priority monitoring needs, as opposed to finding piecemeal ways of adjusting existing monitoring activities.

Big Move #3: Strengthen organizational structure and integration to support monitoring and adaptive management

An effective organizational structure is essential for enabling success of complex monitoring and adaptive management programs. This structure is necessary for ensuring that a program is guided by the appropriate decision authorities, that monitoring is serving the needs of decision making, and that insights are used to improve decisions. Effective structures include five components each with distinct, though integrated, roles and responsibilities (see right). Results from this review describe how monitoring networks currently interact, which can be used to explore opportunities for strengthening coordination and integration among many of the components that already exist.

Delta Independent Science Board

For more information on this work, please contact the Delta Independent Science Board via email at disb@deltacouncil.ca.gov