Delta Independent Science Board and Delta Plan Interagency Implementation Committee

Science Needs Assessment Pre-Workshop Discussion Seminar Series (Part 3 of 4) A Summary

July 28, 2020

If you need assistance interpreting the content of the document, please e-mail disb@deltacouncil.ca.gov. For those with a printed copy, an electronic copy of this summary can be found on the Delta Plan Interagency Implementation Committee's meetings web page: https://deltacouncil.ca.gov/dpiic/meetings.

Background

The Delta Plan Interagency Implementation Committee (DPIIC) and the Delta Independent Science Board (Delta ISB) are planning a Science Needs Assessment Workshop to explore the rapid environmental change facing the Delta relative to climate and other change impacts. The goal of the workshop is to develop a science needs assessment that will inform a long-range science strategy for the Delta. To help make progress with the science needs assessment, a four-part discussion seminar series was designed to generate dialogue around key questions that serve as the workshop's foundation.

The third part of this series occurred on July 28 and was facilitated by Dr. John Callaway, the Delta Lead Scientist of the Delta Science Program. Dr. Stephen Brandt of the Delta ISB shared the origins and purpose of the science needs assessment followed by a summary of the first two seminars in the series. He highlighted climate change impacts in the Delta and discussion points from Delta managers and decision-makers about what science they need so they can prepare for those impacts. Three panelists: Ms. Stephanie Fong, coordinator chair for the Interagency Ecological Program (IEP), Dr. Louise Conrad, deputy executive officer for the Delta Science Program, and Mr. Mike Chotkowski, science coordinator for the U.S. Geological Survey addressed the following questions to provide a scientist's perspective on preparing for rapid environmental change in the Delta:

- What science is needed to support future decisions?
- How is your science program preparing for future changes?
- What would you do differently?
- Do you have strategic research goals or products that you're working on to meet managers' strategic needs?

Panelists Discussion Summary

Stephanie Fong opened the panel session by first recognizing that the difficult decisions managers need to make are not about ranking management priorities but deciding whether priorities have ramped up to become emergency situations that

require redirected focus and resources. There will always be emergencies, so addressing them promptly will require a better understanding of biotic and abiotic mechanisms and relationships in the Delta. Some examples include relationships among species and communities, species and habitat types, across different water year types, seasonality life history, and life stages. If we can make significant progress to understand these types of mechanisms and relationships, we can be more informed about how management actions will affect specific outcomes, and potentially choose the most opportune path. Learning more about these mechanisms and relationships will require advanced tools such as quantitative models and machine learning. Models are growing more complex and they are able to assess a greater number of variables, but we also need to consider the data being used in these models. If we want models to answer our specific questions, we need to make sure that the right kinds of data at the right frequencies and locations are being collected and provided.

Biotic relationships need to be understood within the context of sublethal effects on behaviors in fish such as disorientation and the ability to track or detect females otherwise, some of our efforts might just be wasted. We would particularly like to reduce take of listed species when we monitor the communities and habitats they live in, so focusing on advancing our ability to detect and count organisms in non-lethal ways is important to consider. Reaching that advancement requires better understanding of their life history or natal origin selection.

IEP is preparing for the future by building up our infrastructure. We are focusing on science communication, data stewardship, and curation synthesis. During our workshops, we emphasize the need for short courses, and we are trying to provide on the job training and mentorship opportunities for our synthesis and review efforts. We are finding new ways to use our vast long-term monitoring data set, and we hope to coordinate our efforts with other programs to help advance technologies and data science and to pair those together.

IEP has identified the following priorities for the next five years in our annual work plan: resilience to climate change, restoring native fishes, assessing the effects of flow alteration, habitat for species of concern, food web dynamics. Contaminants and aquatic weeds were identified as unmet science needs in our science strategy.

Louise Conrad began by explaining that our science needs to span a spectrum from basic data science capabilities to building predictive and integrated models. She went on to highlight four items that would serve the Delta science enterprise well if we could focus on making them more nimble to compliment nimble management decisions in a rapidly changing environment.

- First, we need to advance our data science techniques by positioning ourselves to manipulate big data quickly. We need the capacity to rapidly use the large data sets that we have in our system.

- Second, we need a broad and deep understanding of our species communities. Deep knowledge of specific species like delta smelt exists but moving towards thinking about communities that range from phytoplankton to fish will be important in developing robust predictive models.
- Third, we need to keep a sharp eye out for invasive species because they can cause shifts in biotic communities, thus compounding on the impact of other rapid environmental changes like temperature and salinity. The arrival of newcomers to our system is inevitable, so we need to think proactively about how we will respond for certain invasive species that are in other systems.
- Finally, communities in the Delta include humans, so we need a robust understanding of the human dimension of our system. The scope of our thinking should be broad to include people living in the system, consumers of Delta water, the footprint of the Delta throughout the state, and the management of the Delta. A cultural shift in the Delta science enterprise is occurring as we hire more scientists with social science expertise. However, regardless of discipline, we need to be inquisitive and inclusive of considering the human response to change.

Lastly, Dr. Conrad lauded the synthesis scientists working in the Delta. They are critical members of the Delta science enterprise as their work informs our management decisions. At the Delta Science Program, we are working towards facilitating major synthesis working groups every other year. Groups would include scientists from the entire science community and work in conjuncture with partnering major synthesis centers. The first effort will take place in 2021.

Mike Chotkowski outlined his answer to the first question with three main points. First, we should focus our resources towards developing a better understanding of underlying processes of the estuary. That means we should understand how natural elements of the estuary, which are important to various stakeholders, respond to environmental and management changes. Science from the last three decades has made it clear that any single species responds to multiple environmental factors, so it is important for us to understand the interplay between those factors. This deeper understanding will allow us to make better predictions about the estuary's response to management decisions we need to make in a changing environment.

Second, we need to develop better tools to bridge the gap between scientific findings and management decisions. While we've done a good job of learning what managers need, we have a ways to go in terms of providing information in a form that managers can use. Bridging the gap will require greater teamwork and collaboration between those who are doing the research and those making management decisions.

Third, improving the Delta science enterprise will require better coordination among science programs. Working closely together can reduce duplication of efforts, allow us to extend ourselves farther in research areas by refining resource allocation, and build up a broader system of science governance in the Delta.

Moving forward we will need to change our emphasis in order to meet upcoming challenges. Coordination and cooperative planning were mentioned before, but bear repeating because they are crucial in making sure we are covering our bases. Together we can continue reacting to immediate needs, but also work proactively to address needs down the road. Improved forecasting and modeling tools will be key as our understanding of the system expands and grows more complex. We will become more reliant on them to make the best use of our knowledge for management decisions. The data we produce should be accessible through easy to use data platforms so interested groups can make use of the growing volume of information we collect in our system. Finally, we could put more effort into sharing knowledge between similar systems across the country. Learning from other estuaries can bring new perspectives to challenges we face in our system.

Strategic goals for future science include greater teamwork; we can expect better outcomes through collaboration. Achieving our longer-term goals is dependent on committing resources to near term actions that work towards those goals on a consistent basis. Lastly, a long-term strategy does not necessarily require increased funding. Rather, the strategy requires creative and coordinated planning for science so we do a better job of preparing for the future.

Mentimeter Questions

There was a total of 91 participants during this seminar. Participants engaged with the discussion hosts and panelists by sharing the information and feedback presented below. Answers shown for questions 3 and 4 have been modified for brevity and repetition.

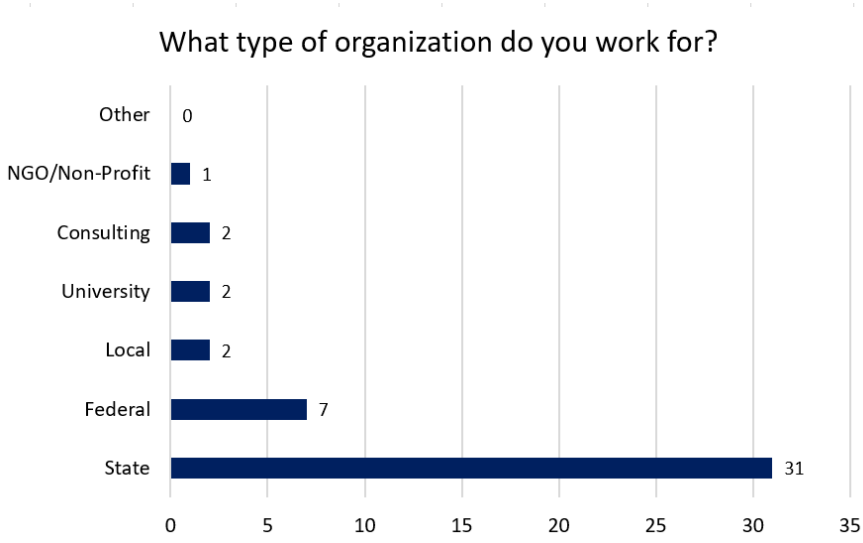

Figure 1. This question was used to learn the demographic of participants. Most participants were affiliated with state organizations, similar to part 1 and 2 of this discussion series. N = 45.

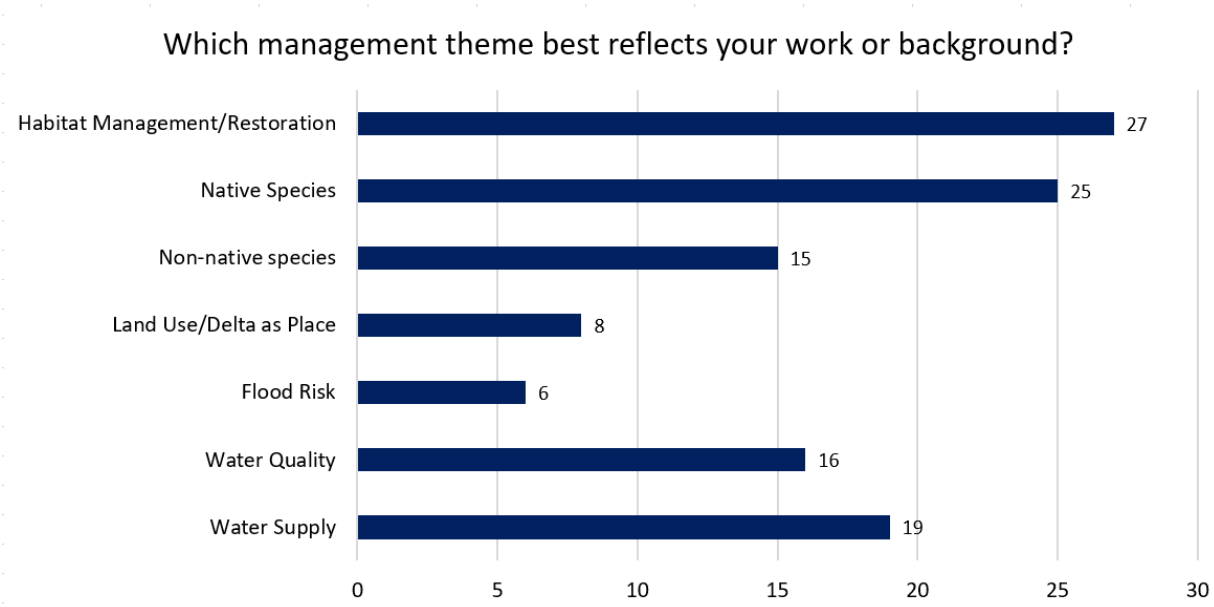

Figure 2. Participants indicated which of these management themes based off the Delta Plan best reflected their work or background. N = 50. Participants had the opportunity to select multiple categories.

Participant responses to question 3 are below: What are the major research gaps related to assessing and predicting rapid environmental change driven by climate change? Responses are binned into five research gap themes. N = 32.

Tools We Need

- Clunky public-facing databases (federal and state)
- Integrated modeling tools
- Forecasting tools
- Rapid downscaling of climate data and integrated modeling
- Passive monitoring tools for endangered species
- Visualization tools
- Automated protocols to QA/QC of “big” data
- Machine learning
- Mechanistic integrated models linked to management actions
- Improved model “time steps” for short durations rather than monthly
- Difficulty doing mechanistic experiments that can effectively be scaled up
- Synthesis of existing long-term datasets
- What constitutes change in a variable regional environment?

Ecological Knowledge

- Lack of understanding the food web and its drivers

- How invasive species respond
- Small-scale habitat use of native species
- Understanding how temperature affects species maturation and reproduction
- Drivers of harmful algal blooms
- Species (of interest) competitive interactions
- Role of the microbial community
- History of invasive species spread in the region
- Physiology, behavior, and ecology of resident species
- Understanding mechanisms that influence estuary's ecological health

Management Concerns

- Ability to manage invasive species
- How sub-seasonal to seasonal (S2S) forecasting can be used in water and environmental management
- How will climate impact our ability to "control" the environment?
- Experimenting under "out of date" regulations
- Effective control of invasive aquatic plants

Social Concerns

- Local economic impacts
- Connectivity between social and ecological systems
- Socio-economic drivers or factors related to climate change
- What social (governance, community) barriers exist to adapting?
- Human response to increasingly dramatic environmental change
- Translating synthesized data into policy and communicating effectively

Future Impacts

- Projected accretion of wetland restoration sites under sea level rise (SLR)
- How will temperature change in different habitats?
- How will increasing temperature impact ecosystem regime change in the Delta?
- Long-term impacts of short-term events (e.g. floods, levee failures)
- Impacts of climate change on physical processes driven by coupled watershed hydrology (SLR)
- Magnitudes of change and their rates – sea level and climate
- Not being able to conduct science with increasing rates of environmental change
- Impacts on evapotranspiration from wetland and aquatic vegetation

Participant responses to question 4 are below: What do you see as major strategic research products for the science enterprise, such as forecast tools, technology, methods, models? Responses are binned into four research product themes. N = 17.

Data Infrastructure

- Cloud computing infrastructure
- Online platforms for data-sharing and real-time decision-making

Forecasting Tools

- Forecast tools for flow and habitat
- Annual conditions forecasts for habitats of concern
- Process-based forecasting tools
- Water temperature forecast tools that researchers in other field can apply to research and modeling

Technology Advancement

- Improvements in acoustic telemetry technologies
- Continue improving our ability to use eDNA as a quantitative metric
- ArcPro access and training
- Accelerated species identification for understanding lower trophic food web

Models

- Decision tools
- Coordinated estuary-wide monitoring generating data for regional models
- Models allowing assessment of alternative management decisions
- Landscape scenario planning tool
- Improved integration of models and peer review of models
- Integrated modeling tools for water quality and temperature
- Linking hydrodynamic models with ecological ones

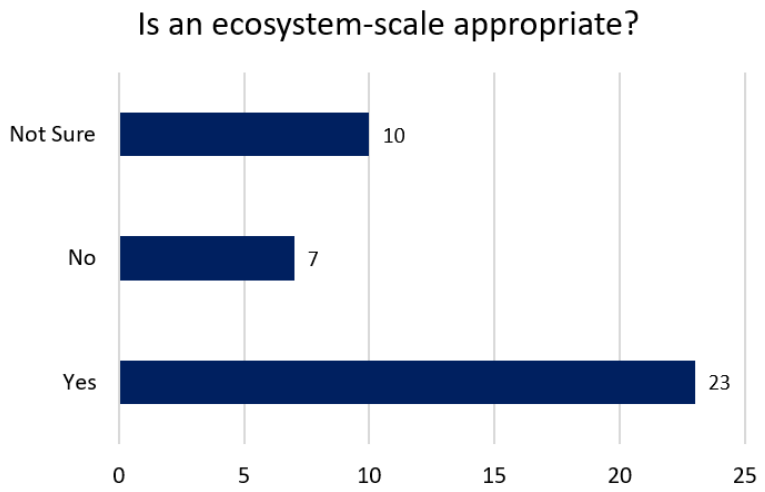

Figure 5. Participants indicated whether an ecosystem-wide scale, such as the Bay-Delta region, is appropriate for strategically researching the management topic. N = 40.

Discussion Seminar Q & A

Question 1: Is the Bay-Delta an appropriate scale for forward thinking science needs given that climate change is on a much broader scale than just the Bay-Delta alone?

Chotkowski: It depends on the question being asked. Some questions are inherently watershed scale while other are not. We need to be able to address questions at the watershed scale, and that comes with its own challenges including administrative hurdles to surmount.

Question 2: There was a lot of discussion about mechanisms, modeling, and communities. Is anyone working on developing a comprehensive delta food-web model?

Conrad: There has been some work on food webs under Dr. Larry Brown in the past at USGS. The collaboration that the Delta Science Program has with the National Center for Ecological Synthesis, which will happen in 2021,will focus on the drivers of estuarine food supply. We hope to develop a broad suite of species distribution models that could inform how you would go about modeling food webs and communities.

Fong: We've had a lot of conceptual models in the past that would likely help develop quantitative models. However, there is still more work to be done.

Question 3: The changes to the ecosystem are so rapid, and with climate change things seem to be increasing even faster. I wonder how do we get ahead of it and be proactive instead of just reactive? It takes us a while to see the change, and then what do we do about it? It just seems like by the time we figure it out, the next invasive species arrives. So, how can research help us get ahead of it?

Conrad: The need for advancements and more focus on data science includes the need to become faster and actually use automated techniques built into the platforms for visualizing data. We need to develop a habit of having a suite of data sets that are showing us trends, and create habits of looking at those trends even if we do not have specific management questions. More effort should be going into proactively following status and trends.

Fong: In addition to looking at status and trends, we need to pay attention to the extreme cases. We cannot operate under the notion that situations or events are too far down the road to worry about now. If we proactively look into the extreme changes that accompany climate change, we might be better poised to address them when they occur.

Chotkowski: It is hard to get ahead of things, especially when they are complicated or contentious. We can do more to streamline the process of working through data to help people draw appropriate and justified inferences.

Conrad: It is important to have collaborative groups who can implement the practice and habit of watching status and trends. Especially now, while everyone works remotely, it is key that we make space to talk about what we are seeing in the data. It is important that the teams doing this collaborative work represent multiple interests, backgrounds, and expertise to expand the discussions.

Question 4: Expand on reallocation of resources; from where (studies on smelt?) to where (floodplain food webs?). No agenda, just wanted to see where the panel would suggest we begin to contemplate.

Chotkowski: We should be making those decisions as a team because it's inevitable when you reallocate resources, somebody's project will be affected. Talking to one another will help us make rational decisions. At the present, we are on a good track, but we could use refinements and making those specific choices will require a group dialogue.

Conrad: The current process to update our program's Science Action Agenda is identifying science priorities based on management questions through a collaborative effort that draws on outreach we're doing throughout the community. The process and updated report can help with this question of where we need to direct our resources.

Fong: IEP's long-term monitoring review effort has shown that we are able to quantify pieces of information that support some of what we already know but the data leads us to understand more about underlying mechanisms that can inform us of the cost-benefit of potential choices when we're faced with tradeoffs.

Question 5: Louise, you were discussing a status and trends of report, and you said making those sorts of things more accessible would be a good next step. I'm curious what you exactly mean by that. How can we make these tools more accessible?

Conrad: There has been challenges with web accessibility. We need to have all of our reports, such as the status and trends report, meet the stringent compliance standards for web accessibility so they can be available online.

Question 6: Is there currently any effort to catalog the range of long-term data sets that exist in the Delta science enterprise, and to develop some type of relational model to see where the data sets connect, any thoughts?

Conrad: The Delta ISB's monitoring enterprise review is actually looking at how over 150 long-term data sets in the Delta system are related to each other. So more will come on that as that effort moves towards completion in the next year or so.

Next Steps

The next and final discussion seminar will occur on September 9, 2020.

Key Links

- Workshop and Virtual Discussion Series Flyer

- Science Needs Assessment Pre-Workshop Discussion Part 1 Recording
- Science Needs Assessment Pre-Workshop Discussion Part 2 Recording
- Science Needs Assessment Pre-Workshop Discussion Part 3 Recording
- Briefing Paper for the 2020 Science Needs Assessment Workshop