Summary Report: Delta Science Enterprise Governance Workshop

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Introduction

This memo summarizes the findings from the Delta Science Enterprise Governance workshop held on January 29, 2020. The workshop involved approximately 20 Delta Science Enterprise stakeholders (representing federal, state, and local agencies, universities and NGOs). The goals of the workshop were to 1) provide a venue for reflecting on catalysts and barriers to policy learning within the Delta Science Enterprise; and then 2) explore how those ideas can inform research on these catalysts and barriers. From a social science perspective, the workshop represented the first stage of a participatory research project, where stakeholders are integrated from the very start to inform research questions, hypotheses, and methods. The findings from the workshop may also support the near-term development of various science reports produced by the Delta Science Program.

To provide a foundation for the workshop discussion, Profs. Heikkila and Lubell presented an overview of social science approaches that can inform how the structure and function of the Delta Science Enterprise shapes policy learning. Following this overview, the workshop participants engaged in a discussion of the nature of the scientific enterprise and examples of learning in the Delta. The points in this memo represent a combination of insights gained from the workshop, along with ideas from the academic research on policy learning, governance, adaptive management, and the role of science in policy.

What is the Delta Science Enterprise?

In some respects, the concept of the "science enterprise" in the context of managing large-scale ecosystems like the California Delta is a new idea. In academic literature, there is a lot of work on policy learning, adaptive management, and linking science to policy. But Delta science stakeholders, and stakeholders in other regions, have been using the term "science enterprise" to describe the system of knowledge generation that is intentionally set up to link science and policy decisions.

According to the 2016 Delta Science Enterprise Final Report, the term science enterprise "refers to the collection of science programs and activities that exist to serve managers and stakeholders in a regional system. The elements of an enterprise range from in-house programs within single agencies or other organizations to large-scale collaborative science programs funded by governments, to academic research that may operate independently of management and stakeholder entities. Science enterprises can vary greatly in the degree to which resources are concentrated in collaborative programs and produce publicly-available results. The differences among regional systems can reflect historical factors, depth and persistence of conflict regarding resource issues, governmental guidance and engagement, the range of agencies and interests involved, and other factors." Table 1 summarizes the potential goals of the science enterprise, as articulated in the 2019 Delta Science Plan, as well as our summary of some key ideas from the broad academic literature on adaptive management, policy learning, and the role of science in policy.

Table 1: Potential Goals of the Science Enterprise for Adaptive Management	
Delta Science Plan	Academic Perspectives on Science and Policy
1. Strengthen science-management interactions. 2. Coordinate and integrate Delta science in a transparent manner. 3. Enable and promote science synthesis. 4. Manage and reduce unnecessary scientific conflict. 5. Support effective adaptive management. 6. Maintain, communicate, and advance understanding of the Delta.	1. Identify "best available science". 2. Forge agreement among stakeholders about "what is real". 3. Deliver scientific knowledge to the right people, at the right place, at the right time. 4. Sustainably fund scientific research. 5. Allow innovation and capacity to research new problems, methods. 6. Translate science into policy terms 7. Integrate diverse types of sources of knowledge and data across networks. 8. Maintain legitimacy of science as a neutral party.

The science enterprise encompasses both structure and function. From a structural process, the Delta Science enterprise is the network of science venues and stakeholder organizations that participate in those venues. Each venue is governed by a set of formal and informal rules that influence how stakeholders interact and communicate, what types of information they use, how they allocate money, and other decisions. Some organizations and individuals participate in only one venue, while others participate in multiple venues and help link across the system. Different stakeholders have different management needs, goals, and resources. Figure 1 is a representation of the Delta Science Enterprise developed by the Delta Science Program.

The science enterprise itself is "polycentric", involving multiple centers of decision-making that are interconnected through the diverse organizations and individuals involved and the issues they address. Within this polycentric structure, there is no single science venue in which all science is coordinated and decided. Different venues exist for different purposes, and involve different organizations. This is a natural outcome of policymaking in any complex social-ecological system, and has both desirable and undesirable properties. The relative fragmentation and integration of any science enterprise will vary across social and ecological contexts (e.g. Chesapeake Bay compared to Everglades, or the California Delta, etc.). Figure 1 shows the network diagram of the Delta science enterprise that was included in the 2019 Delta Science Plan. It illustrates the co-existence of multiple venues with different histories and origins, along with a network of diverse participants involved in these venues.

Figure 1: The Polycentric Structure of the Delta Science Enterprise

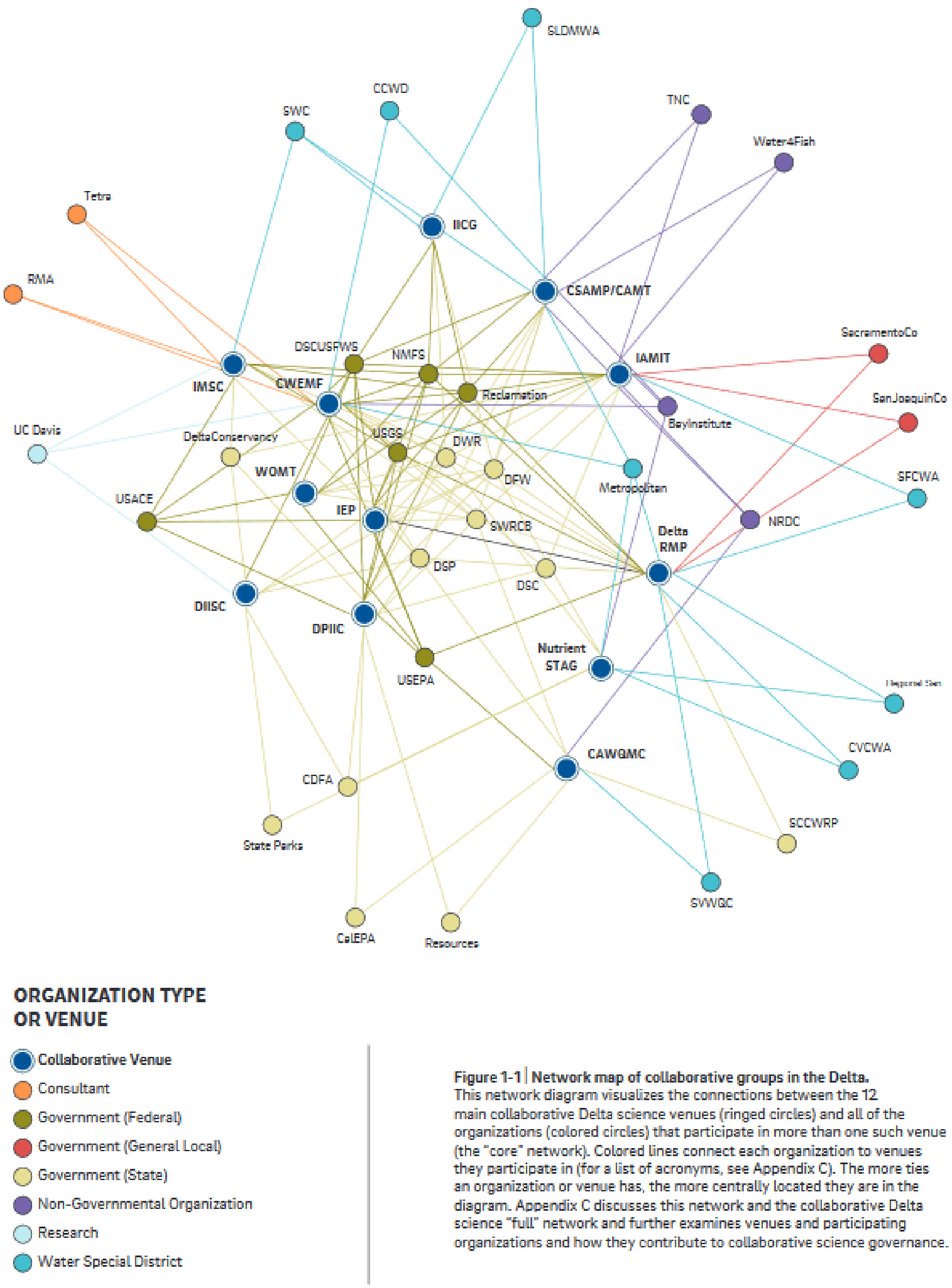


Figure 1-1 | Network map of collaborative groups in the Delta. This network diagram visualizes the connections between the 12 main collaborative Delta science venues (ringed circles) and all of the organizations (colored circles) that participate in more than one such venue (the "core" network). Colored lines connect each organization to venues they participate in (for a list of acronyms, see Appendix C). The more ties an organization or venue has, the more centrally located they are in the diagram. Appendix C discusses this network and the collaborative Delta science "full" network and further examines venues and participating organizations and how they contribute to collaborative science governance.

The science enterprise is nested within the broader polycentric governance system where management decisions are made, including planning/administrative processes, legislation, litigation, local community decisions, and many others. The knowledge and data in the science enterprise is expected to effectively link to the broader governance and policy process, and the knowledge, needs, and values of stakeholders should also effectively feedback to the science enterprise.

Within this structure, stakeholders engage in the scientific process. They collect and observe data, use scientific methods from multiple disciplines to make sense of that data and understand the causal processes driving the system (social and ecological outcomes) of interest, and design possible interventions to achieve those desired states. The result of this process, at the level of individuals and shared understanding, is the development of scientific knowledge (which is distinct from observation, and the scientific process itself). The science enterprise also seeks to communicate that knowledge in an actionable way to decision makers and the public.

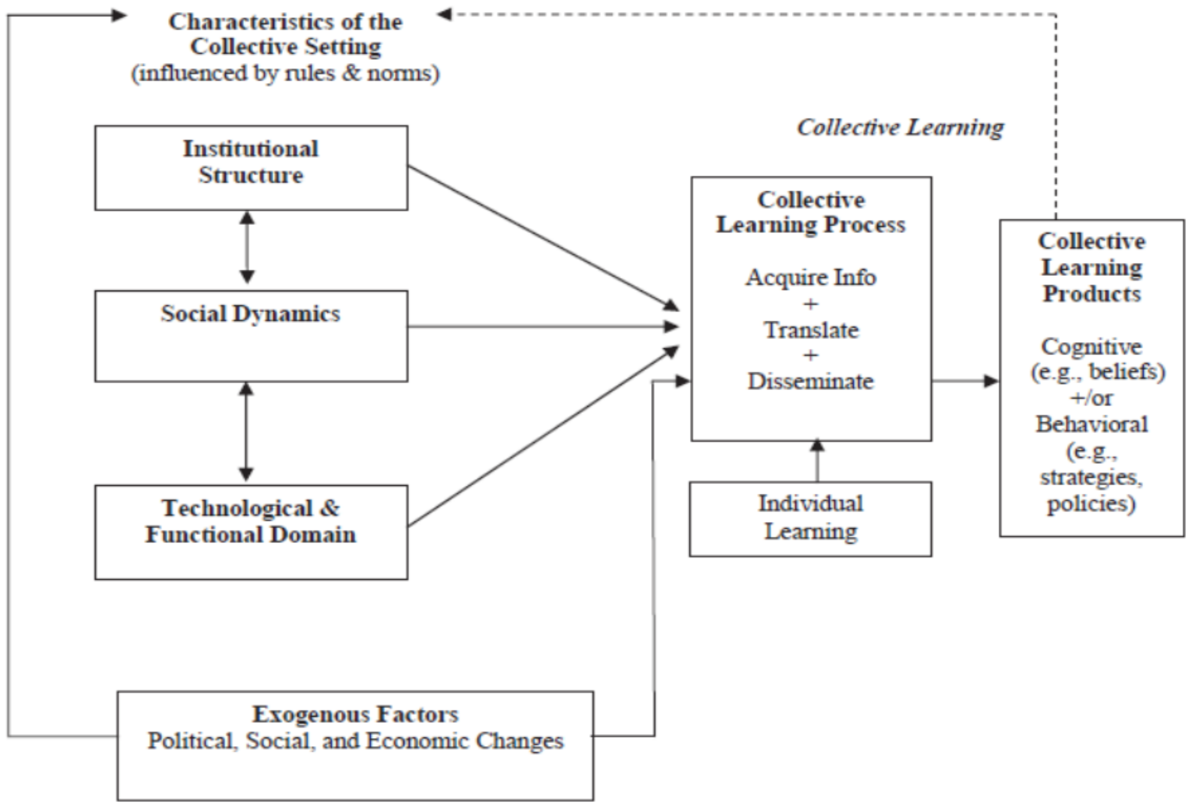
The science enterprise operates at multiple spatial and temporal scales. Some of the knowledge applies to the entire Delta and extended watershed, while other knowledge might be at the level of a particular place like Suisun Marsh or even a particular subpopulation of a species like the Delta smelt. It must also operate at multiple timescales--understanding the evolution of the Delta from the past going as far back as possible (e.g. pre-European Delta), what is happening right now in order to support real time decision-making (how much water is coming this year, and how should we operate the gates, weirs, dams, etc.), and what is coming in the future (e.g.; climate change).

From the broadest perspective, the science enterprise is an example of a complex adaptive system, and is much like the human brain. It contains specialized scientific endeavors of multiple types, yet needs to have networks and processes that link across the system in order to adapt to change over time. The science enterprise needs to maintain memories, react to events happening now, and plan for the future.

What is Policy Learning? Policy Learning for Adaptive Management

The science enterprise in the Delta has emphasized the importance of adaptive management as a guiding principle. In theory, adaptive management involves an iterative process of discovery of problems or issues, analysis of the causes of the problems, identification of potential solutions, implementing solutions to test their performance, monitoring the performance of those solutions, and then modifying the solutions based on the performance data. In practice, however, adaptive management can be challenging and difficult to implement effectively, particularly in a complex and dynamic system, where multiple issues and problems interact, causes are highly uncertain, and the producers and sources of information knowledge are diffused or fragmented. To help diagnose and assess whether and how adaptive management processes are working, and ultimately how we can improve them, it is helpful to borrow insights from research on policy learning.

Figure 2: Policy Learning Framework (Heikkila and Gerlak 2013)



Research on policy learning has looked at both learning processes and learning products. (See Figure 2 above.) Policy learning processes include the acquisition, translation, and dissemination of new information within collective groups, such as venues in the Delta Science Enterprise. Typically, policy learning processes, especially around complex Delta issues, are long-term and incremental. Additionally, to reach common understanding or shared learning outcomes across a governance system such as the Delta, policy learning processes have to be devised to focus on sub-parts of the system, around specific issues with a focus on real-time data, in combination with a focus on learning across issues, over time, and learning to predict future conditions. They may also require integration of learning processes at different scales, from individuals to groups to governance systems.

Learning processes may or may not lead to collective learning products. Learning products can include changes in the understanding of policy problems and potentially changed strategies or policies to address those problems. These products may be more instrumental or technical (e.g., improved understanding of the mechanisms that drive ecosystem outcomes). They may also focus on political learning, such as new knowledge about the types of strategies processes that are most effective in influencing human behavior. They can also include social learning about the values and interests of different people or groups in a policy system.

As we see in Figure 2, policy learning can be influenced by several characteristics of the governance setting. This might include the institutional structure of the science enterprise (e.g.;

number of venues), the social dynamics of involved participants (e.g.; levels of trust), the technical nature of the issues, and the psychological characteristics of different individuals (e.g.; social values). External events, such as environmental crises, or major political or socio-economic changes can also influence the capacity for policy learning.

What is Science Governance?

The Delta Science Enterprise, as we previously described, embraces the idea of policy learning, particularly through the lens of adaptive management, supporting decisions at multiple time scales, and helping stakeholders develop a systems-level view of the social-ecological system. To understand the context within which learning happens, and what might enable the institutional, social, and technological factors that could drive learning in the Delta, it is important to unpack what we mean by science governance. Science governance refers to how we intentionally structure the science enterprise to facilitate the desired policy learning processes.

Science governance influences the basic structure of the system in terms of what science venues exist, and who participates in those venues. Rules for participation may mandate or forbid participation by certain types of actors, or be more open and inclusive. The rules also govern how decisions are made within venues, the types of data and information that people work on, and how funding flows to the venue. For example, within any particular venue, there are rules about how people vote and deliberate, share data, and take on different responsibilities for collecting, analyzing, and reporting scientific information along with other aspects of the scientific process. Different types of structural interventions, such as the creation of a Joint Powers Authority to integrate different venues, the destruction or reshaping of different venues, will influence how the process of policy learning occurs within and across venues in the system.

Governance is not just about formal rules. It is also about the informal social norms and relationships that develop among participants. One important norm is a tolerance of uncertainty and openness to a diversity of viewpoints and hypotheses regarding key scientific questions in the Delta. Adherence to this norm may vary--scientists are more comfortable with uncertainty, while policymakers often desire a more specific answer. Trust among actors is also a product of science governance, and emerges from processes of repeated interactions, shared values, perceived competence, and history of fulfilling promises and commitments.

Science governance can influence the timing of interactions between scientists and stakeholders, and the extent to which different values are incorporated into the scientific process. Many scholars of environmental policy would argue that the science enterprise was more of a top-down style during the environmental era of 1970s, with scientists and agencies working together to identify problems and best solutions, and then notifying stakeholders. More modern approaches to the science enterprise recognize the importance of “co-production” for supporting adaptive management. From a science governance perspective, this means providing diverse stakeholders opportunities to participate in the science enterprise from an earlier stage in order to help guide the scientific process to what is hopefully a more useful outcome to decision-making over time.

Science governance also depends on the capacity of stakeholders to navigate the complex system. No matter what structural changes might occur, the science enterprise will always be polycentric and “messy”. Stakeholders need to gain an awareness of the overall system: who participates and what are their needs and preferences, what science venues exist, what data and models exist, how are different environmental problems related to each other, and other system level aspects. Then stakeholders need to develop strategies for effectively navigating the system to achieve their management needs. Some stakeholders have narrow, specialized goals that might be achieved by operating within only a small part of the science enterprise or only one venue. Others seek to integrate across the system to ensure knowledge is coordinated and effectively “steer” the system towards more desired outcomes.

Learning Moments in the Delta

Following a discussion of the nature of the science enterprise and policy learning, we asked the workshop participants to reflect on “learning moments” in the Delta, or where some particular issue appeared to have successful policy learning, and what factors were in place to impede or catalyze that learning. Alternatively, one could think of learning failures, and consider variables that contributed to the failure. One immediate reaction to this idea was that stakeholders mostly viewed learning as an incremental, cumulative process of knowledge generation that occasionally experienced major events or breakthroughs.

Also, participants seemed to have an easier time nominating “successful” learning moments rather than failures, although there is not always unanimous agreement on the level of success versus failure. Nevertheless, we think the “learning moments” below are good candidate case studies for more in-depth investigation. Further discussion with a broader range of stakeholders will surely discover more potential case studies of learning successes and failures. Participants recognized that these moments are not likely to be short-term in the Delta. That is “moments” build over a long time period and may even be seen as “learning decades”.

<u>Floodplain Reactivation</u>

Many Delta stakeholders have been working on the broad idea of “floodplain reactivation” as an approach to re-introducing some of the dynamic complexity of the Delta watershed in a way that supports multiple ecosystem services. There appeared to be some agreement that awareness of the potential benefits of floodplain reintroduction was an unintended consequence of air pollution regulations on rice fields, which stopped burning of crop residue and forced growers to decompose in the field with flooding. Scientists and stakeholders began to observe ecosystem response in terms of bird biodiversity and abundance on the Pacific Flyway, anadromous fish viability as floodplains provided food and refuge for juvenile fishes, and groundwater recharge. This policy learning catalyzed not only the further investment in science to understand how the system is responding to reactivated floodplains, but also active management processes and action to accelerate the reintroduction of floodplain dynamics.

Pelagic Organism Decline and Delta in Alternative Stable State

One of the most controversial issues in the Delta has been the population viability of the Delta's pelagic species, such as the Delta smelt, longfin smelt, splitttail, American shad, and threadfin shad. Many of these species are listed state and federal endangered species, and have been the subject of litigation and biological opinions that tightly control water management. The population of many of these species remain at historically low levels, with some scientists arguing they are functionally extinct.

The crucial policy learning response to the POD has been trying to figure out why the species is declining and effectively monitor their population status. Several science programs have been developed to answer these questions. Two key ideas that have emerged from this policy learning process is the idea of "multiple stressors", and the Delta shifting to an "alternative stable state". The multiple stressors idea is that the POD is not just about water flows, but is also about nutrients, predation and other interacting factors. Thus the POD requires an "ecosystem management" type of response. In addition, most scientists agree that the Delta has entered an alternative stable state as a managed system, which is much different from the historical Delta that featured extreme temporal and spatial dynamics that supported the evolution of native species population. Instead, the modern Delta is a simplified and managed system that supports many economic uses, and faces external changes from invasive species and climate change. Thus effective management requires "reconciling" the desired ecosystem conditions, with the new stable state.

Nutrient Management/Sewage Treatment Plants

The role of nutrient pollution from point and non-point sources was a more recent discovery in terms of a primary stressor on the Delta. In response, a new science venue was created, and it has simulated a major upgrade of a regional Sewage Treatment plan, and investment in monitoring the response of the system to the change in nutrient inputs.

Importance of Human Dimensions

The majority of the investment in the science enterprise in the past has focused on the biophysical processes and key ecological outcomes in the Delta. Less attention has been paid to the human dimensions and social science analysis of Delta management. The science enterprise is now shifting to include more social science in efforts to understand the Delta as a social-ecological system. Monitoring how various social outcomes respond to Delta management outcomes is just as important as monitoring environmental outcomes for ascertaining the benefits and costs of management actions, and how those actions might be sustainable in terms of political support and participation from stakeholders. The role of social science is also being recognized for analyzing the overall governance system and science enterprise, as exemplified by this workshop and memo. The Delta Science Program also convened a Social Science Task Force in 2019 to evaluate and make recommendations about the role of social science in the Delta. In 2020, the DSP is taking further steps to integrate human dimensions by hiring new social scientist positions.

Policy Constipation: Learning Barriers in the Delta

Insights from our dialogue on science and learning in the Delta highlighted several factors that can constrain policy learning. Social dynamics, such as distrust, lack of communication, or the inability to translate science to policy makers, are common impediments to learning. Other barriers are more institutional or structural in nature. For instance, fragmented or siloed scientific efforts often occur through the various organizations and venues that produce data and/or analyze and synthesize that data. These silos can result from the different missions, management questions, regulatory or compliance mandates underlying the diverse organizations and venues in the Delta.

Practical challenges that are common to any public policy or governance endeavor, such as limited resources, budgetary cycles, and political cycles can also stymie the capacity for investing in long-term or system-wide learning approaches. Another challenge to learning that was recognized in the Delta is the tendency not to invest in long-term monitoring or assessments of major policy, infrastructure or other interventions that have been implemented to potentially improve the system. The sunk costs of such major policy or management actions could dampen the political will to learn if those strategies are not working, especially over the long term. At the same time, when significant resources are dedicated to those decisions, often the budgetary resources available are too meager to allow for the type of robust science needed to assess and evaluate their impacts.

Finally, lack of alignment of the goals of the scientific enterprise with management and decision-making needs was recognized as a perennial challenge in the Delta. In part, this can stem from the difficulty of focusing science toward identifying or anticipating future policy questions or issues. It can also arise when the time frame of the needs of managers or decision-makers does not align with the time frame needed to produce the science.

Policy Laxatives: Learning Catalysts

The catalysts to policy learning mirror the barriers in many ways. For instance, building trusting relationships between individual scientists and decision-makers can be critical in fostering ongoing dialogue needed for building shared knowledge of the Delta system. Trust is also important for aligning values and priorities for the science that is needed to answer key management questions. Another lesson for fostering learning in the Delta is the value of institutional mechanisms that support cross-system communication of science, along with individuals who are effective at navigating the system – i.e., knowing what institutions exist, what the preferences are, and how they interrelate. This may require more ongoing dialogue across the venues of the overarching mission of the science enterprise as a whole in order to have a common vision of how the sub-parts of the science enterprise can inform one another (e.g., “one estuary, one science” idea). In other words, political learning about the institutional design, combined with social learning about values, can reinforce and support ongoing efforts at more technical learning of the system.

Some of the examples of learning moments discussed in the workshop further illustrated the value of having intentional scientific efforts that support social learning and political learning. These allow for identifying “win-win” strategies that can support both ecosystem needs and the interests of the stakeholders. Learning about these win-win opportunities is facilitated by intentional communication structures with diverse stakeholders, and investments in social science and interdisciplinary research.

Another lesson from the workshop discussion around learning moments was the importance of being nimble or responsive to new or emerging problems in innovative ways. In essence, this requires a willingness to tolerate uncertainty and a capacity to experiment, often at smaller scales, and then potentially to scale up after learning from experimental approaches.

Scaling up these learning opportunities requires targeted long-term funding and potentially investing in tools such as synthesis models. Building more systematic scientific efforts that explore the connections across the interrelated spatial, social, and ecological subparts of the system. Facilitating this system-wide learning may be when we integrate objectives or think intentionally about consideration of co-benefits of particular management actions.

Conclusion: Paths Forward to Governing the Science Enterprise

A clear conclusion from this workshop is the need for more social science research on the Delta Science Enterprise, and the concept of science enterprises more generally. There are many different ideas and experiences about how to evaluate the performance of the science enterprise, and then make recommendations about effective structure and navigation. We need to go beyond anecdotes and personal viewpoints to a more general and common understanding. The stakeholders involved in this small workshop, as well as more broadly within the Delta science enterprise, have a rich set of experience to draw upon for qualitative research. The “learning moments” identified above are good potential targets for more qualitative research, which can provide evidence about how the science enterprise contributed to the overall evolution of knowledge and policy with respect to those specific issues. As discussed in this workshop, we are also planning a more quantitative science enterprise survey to be fielded in 2020.

It will also be important to continue comparing the Delta science enterprise to those in other large-scale ecosystem management programs like the Great Lakes, Puget Sound, Chesapeake Bay, the Everglades, Colorado River, and others. Comparative research will be able to identify which features of the science enterprise are common across social-ecological systems, versus which are unique given the ecological and social context of a particular place. Such cross-fertilization of ideas should also involve communication among practitioners and stakeholders, so they can learn from each other. The Delta Science Program could potentially take the lead in establishing a virtual “community of practice” for the science enterprise, which could hold information sharing meetings once per month to update on current events. A similar model is being used by the California State Coastal Conservancy with a “county-information sharing” call on sea level rise adaptation.

Of course, while more research is needed, it is also important to consider whether any action could be taken in the short or medium term. Such actions could involve creating new science forums for specific problems, integrating existing forums under some type of more centralized structure (e.g., a JPA), eliminating forums that are no longer useful, identifying more sustainable funding from the legislature or other sources, integrating existing data across forums for more synthetic analysis, and better reporting back to stakeholders about the results of the various science efforts already underway. All of these actions are being actively considered by the Delta Science Program during 2020, through processes such as the ongoing Delta Science Funding and Governance Initiative that was initiated in 2018, as well as the forthcoming 2020 Science Needs Assessment Workshop (SNAW) and report.

Participants in January 2020 Delta Science Enterprise Governance Workshop

- Mark Lubell (UC Davis)
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- Michael George (Delta Water Master)
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- Lauren Hastings (DSP)
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