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# Adaptive Management and Science for the Delta Ecosystem

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*“In California, we hate government so much that we have thousands of them.”*

—Anonymous

Using science to guide management adaptively for the Sacramento–San Joaquin Delta is widely talked about as good public policy. Almost every agency, stakeholder, and planning process professes support and has its own adaptive management and science efforts. But highly fragmented adaptive management and science cannot solve such urgent complex problems. California’s 2009 Delta Reform Act recognized that meeting the co–equal goals of a sustainable ecosystem and water supply reliability in the Delta required major changes in governance, planning, and management. Such changes also require major changes in how science is organized and employed in management. Here is a straw proposal for integrating the many separate science and adaptive management programs for the Delta.

## Problems

Adaptive management and science for the Delta suffer from three major problems (Lund et al. 2011):

**A. Fragmentation of Management and Science.** Decentralized finance and management can support local accountability and incremental innovations, but fragmentation that is incoherent can reduce the overall effectiveness of management and science. As the controversy over the Bay–Delta Conservation Plan (BDCP) shows, it is difficult for dozens of agencies to agree on strategy for complex systems such as the Delta (Madani and Lund 2012). This problem applies to both regulation and project management. Without strong state and federal leadership, strategic decisions can become mired in interagency and intra–agency conflicts.

**B. Disorganized Public Science Leads to Combat Science.** Instead of developing strong, strategically oriented public science, agencies and stakeholders have typically developed science programs focused on their individual missions. This science is often developed, deployed, or curtailed based on advocacy needs of stakeholders

and public agencies alike. Syntheses, organized information and forums to explore realistic solutions are rarely the emphasis in such an environment.

**C. Poor Development and Use of Science for Policy and Management.** Public decision-making processes have not used science as well in their deliberations as they could, and have inadequately supported development of scientific insights and syntheses. Policy forums should cultivate the use of science in their deliberations to provide independent insights for both long-term and short-term problems. Few agencies have long-term science plans or explicitly integrate science into policy discussions.

### A Proposal

While fragmented management and science programs will not be effective for the Delta, a monolithic program is likely to be too cumbersome. An integrated approach is needed to organize scientific and adaptive management activities, so each activity is focused enough to be effective. Below is a proposal for organizing science and adaptive management for the Delta across project sites, local areas, and Delta-wide scales. The BDCP, State Water Resources Control Board (SWRCB), and other planning, management, and regulatory efforts might benefit from participating in or requiring such a common organization of scientific and adaptive management activities for the Delta.

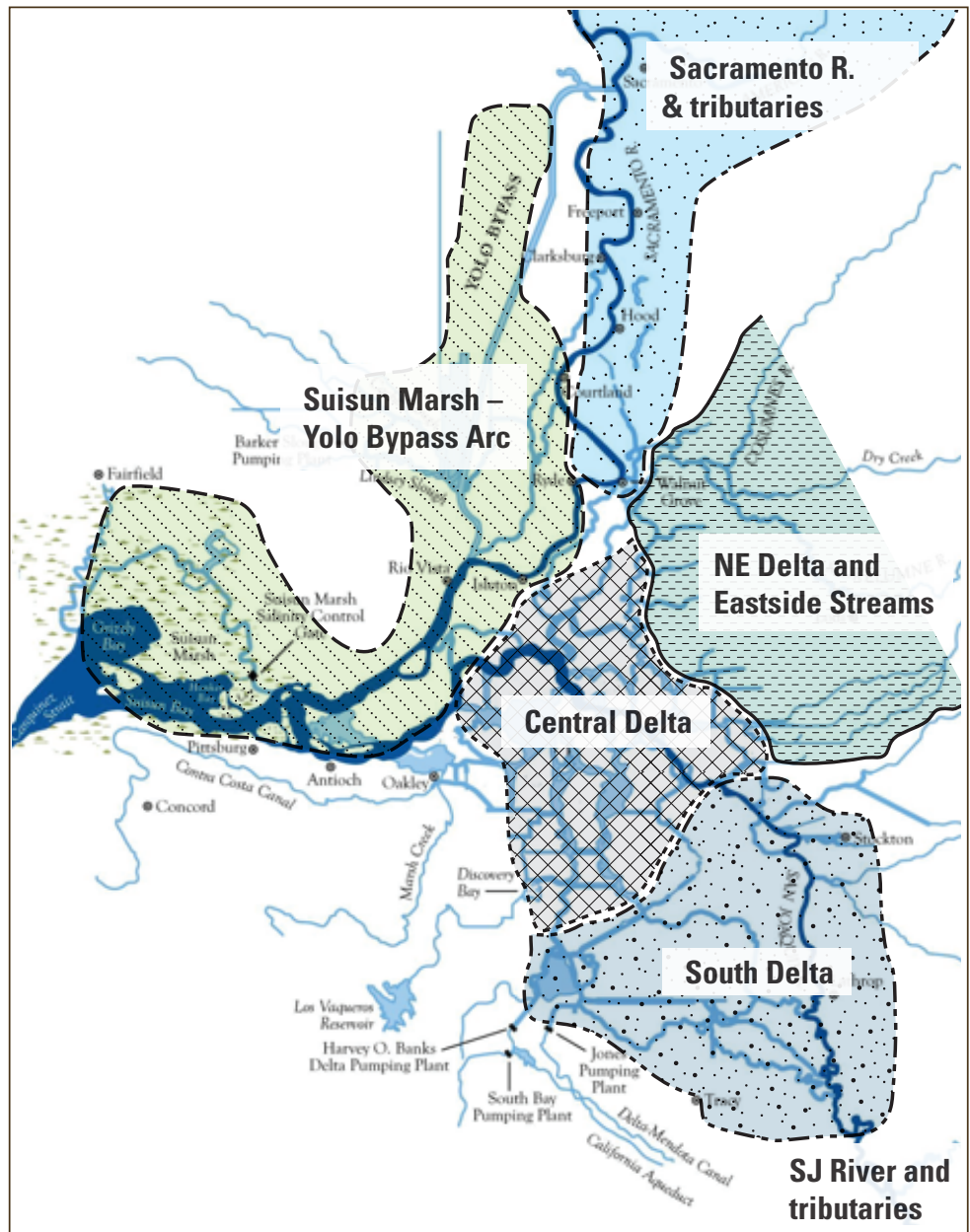
### Some Principles for Science and Adaptive Management for the Delta

- 1. Adaptive management is mostly having management evolve with evolving science.** Science and adaptive management programs should be separated to buffer scientific work against political interests, but these programs must be related so the science can provide timely and relevant information. Science and adaptive management structures should be parallel and separate, but interact. Efforts that separate adaptive management from management usually are adaptive in name only (Walters 2007).
- 2. Management of different areas of the Delta should reflect their different ecological conditions and objectives.** Historically, the Delta consisted of several regions that were distinct in their ecology and physical structure (Whipple et al. 2012). Today, these same regions still have very different ecological conditions (Figure 1; Moyle et al. 2012). The northwestern Delta and lower Yolo Bypass areas have elevation and flow characteristics most suitable for native fish species. The central Delta supports a world-class fishery for non-native bass but has habitats unsuitable for native fishes; management efforts here might focus on the fishery or on ways to speed passage of native fishes through the region. The southern Delta has unfavorable inflows and lacks mixing tidal energy for native fishes, but could be suitable for waterfowl and recreational fisheries. The northeastern Delta has tributary inflows that support native fishes, although in less abundance than in the northwestern Delta.

*“The secret of getting ahead is getting started.*

*The secret of getting started is breaking your complex, overwhelming tasks into small, manageable tasks, and then starting on the first one.”*

—attributed to Mark Twain



**Figure 1** Ecologically specialized parts of the Delta (Sources: Moyle et al. 2012; Whipple et al. 2012)

- 3. One coherent program of Delta science with geographic sub-programs will be more effective for long-term management.** Each Delta sub-area should have a research program focusing on desired ecosystem functions within the area. Sub-area programs would include science and monitoring for local restoration, water facilities, and concerns, with dedicated interagency teams and outreach involving area governments. An overall Delta program would address connections among areas, and overall water operations, research findings, overall oversight, and synthesis.
- 4. One adaptive management program, with geographic sub-programs and site-specific projects will more effectively achieve reasonable results.** The different areas of the Delta would have separate programs, in parallel, to manage adaptively for area ecological goals and local objectives. A Delta-wide adaptive management program, organized under an interagency implementation committee, would balance and integrate area programs, with substantial authority and funding. The nature of adaptive management is likely to differ between site, area, and Delta-wide scales. Site-scale experimental management actions are likely to be less expensive, less controversial, and more reversible than management experiments for larger areas of the Delta. For larger and Delta-wide scales, computer modeling, supplemented by field data, will be needed to explore and evaluate management experiments. Lead agencies supported by inter-agency teams should run each area program and the overall program.
- 5. A Delta-wide regulatory framework will reduce conflicts between regulators and managers.** Diverse and fragmented regulatory decisions and structures often make regulators the *de facto* managers, though they have much less ability or desire to manage adaptively. The state and federal governments should jointly sponsor serious discussions among regulators to develop a regulatory framework to better guide Delta management (Gray et al. 2013).

Using these principles, Delta management and science programs would have parallel interacting structures, organized geographically (Figure 1). Site-specific research and management projects could be organized in each area, contributing to the regional effectiveness of each site. For both programs, a Delta-wide management level provides high-level synthesis and balances resources and efforts among geographic areas and across topical areas of broad concern.

## Leadership and Management

**Adaptive Management.** Ideally, Delta-wide adaptive management should be overseen by a Delta Director and a small interagency committee, with each specialized geographic area having a similar structure. Area entities would seek advice from local governments and people, and focus on local success in a Delta-wide context. Such simplification of lines of authority might be politically unlikely, but could serve as a model for thinking about how to improve management.

**Science.** The science effort must have sufficient independence to be broadly credible, enough focus to be useful, and nimble business and contracting capabilities. Such a program would be organized under a Joint Powers Authority (JPA) affiliated with the Delta Stewardship Council's (DSC) science program. Today's Southern California Coastal Water Research Project (SCCWRP) and San Francisco Estuary Institute/Aquatic Science Center (SFEI) perform this science function and resolve technical controversies for regional wastewater discharges. Each specialized geographic area would have a lead scientist, reporting to an overall Delta lead scientist, who would assume the combined authority of the lead scientists from the Interagency Ecological Program and DSP and be advised by scientists from stakeholder groups. The lead scientist would set the science agenda, direct funding, and lead efforts in information synthesis.

**Annual Operation and Implementation Plans.** Annual operation and implementation plans would be developed for each sub-area and Delta-wide, in the context of longer term plans and under DSC authority. The plans would be developed in consultation with local sub-area and Delta-wide interests. An annual implementation plan process would make integration routine and in-depth, rather than rare and rhetorical.

**External Review.** External scientific review should be expected in Delta science, using the online open-access journal *San Francisco Estuary and Watershed Science* and other means, such as regular posting of reports with external scientific comments. The existing Delta Independent Science Board (DISB) would provide periodic overall review of Delta science and management programs, including specialized area programs and major programmatic efforts. Some reviews could be done by panels managed by the DISB. A National Research Council review of the overall scientific and ecosystem management enterprise should be considered every 4 to 10 years.

**Raising New Science and Management Leaders.** Most science, management, and regulatory agencies involved in the Delta face a shortage of new energetic leaders for long-term science and management. Creative new leaders seem more likely to emerge from efforts that accomplish forward-looking objectives than from continuation of entrenched conflicts in a deteriorating system. We need a program to actively encourage development of new leaders.

**Funding.** Long-term science requires long-term, predictable funding, which can be achieved through various means. For example, one way is to assess all agency expenditures and revenues related to the Delta (levees, tunnels, restoration, channel dredging, water sales, etc.) to fund Delta science (at 4%) and adaptive management (at 10%). Whatever the other sources, state and federal agencies that currently fund Delta science would continue to be responsible for at least 60% of science budgets in the overall Delta science program. Most Delta science efforts would be funded under the common program.



## Conclusion: Adaptive Management and Muddling Through

In the literature on managing difficult (“wicked”) problems, the art and science of “muddling through” is often cited (Lindblom 1979). Effective adaptive management will have similarities to effective forms of muddling through. These problems are inherently messy, so an organized approach to near-term management with an eye to long-term objectives is likely to be most effective. Using a strategic framework like the one proposed here should help California muddle through the Delta’s problems more effectively.

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