PRELIMINARY DRAFT FOR DISCUSSION PURPOSES ONLY

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Preliminary findings from DISB review of science programs that deal with habitat restoration in the Sacramento - San Joaquin Delta and Suisun Marsh

NOTE

This document synthesizes initial findings from the DISB's review of habitat restoration in the Delta and Suisun Marsh based on meetings conducted between August and December 2012. Because the review is still underway and additional meetings and interviews are planned, the views expressed in this document should be viewed as preliminary

SUMMARY

The scale of habitat restoration envisioned for the Delta presents both formidable challenges and tremendous opportunities. There are many issues and uncertainties that should be considered carefully during the planning and early implementation phases, so that habitat restoration may be more comprehensive, more cost-effective, and more successful. At the same time, both environmental and anthropogenic changes are certain to alter the future settings and dynamics in which restoration is conducted. It is not an oxymoron to suggest that habitat restoration should be proactive rather than reactive. The Delta ecosystem has been altered and degraded, and there is an urgent need to mitigate the effects of current and planned water projects on listed species as well as on the habitats and ecosystems that *are* the Delta. But without a scientifically based consideration of how climate change and land-use change are likely to affect the Delta and its management, with all the attendant uncertainties, habitat restoration will not realize its full potential.

Planning for habitat restoration is in full swing, and some projects are already underway. On the basis of our review of these programs, we offer the following recommendations; collectively, these may help to integrate science into management and policy in the Delta, bolster the application of adaptive management, enhance the effectiveness of habitat restoration efforts, and forestall investments that could be overridden by future environmental changes. There are certain guidelines that there appears to be viewed in general agreement among the members of the DISB and many of the individuals interviewed in preparation of this review:

- Restoration goals should be clear, coordinated among restoration projects, and developed through a collaborative process.

- Restoration projects should include consideration of the landscape context, linkages to other restoration activities, and relationships to other management actions in the Delta.
- Restoration activities should be prioritized based on costs, benefits, feasibility, and linkages with other projects or management activities in the Delta.
- Restoration projects should incorporate consideration of environmental changes and uncertainties in their design and implementation, employing modeling tools where possible.
- Adaptive management should be part of every restoration project.
- Monitoring should be designed to evaluate the short- and long-term outcomes of restoration actions; this will require secure long-term funding.
- One or more independent bodies should be created to provide objective, third-party evaluation, coordination, and guidance for restoration projects, including monitoring, adaptive management, and the integration of science.
- Communication and collaboration among scientists in different organizations should be enhanced; to guide these efforts, the Delta Science Program should be bolstered and provided with secure, long-term funding.

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INTRODUCTION

Habitat restoration is central to the current and long-term plans for enhancing the ecological integrity and functioning of the Delta while undertaking actions to ensure the availability of water from the Delta to water users in California—the co-equal goals of the 2009 Delta Reform Act. *This paragraph could go on to contrast the acreages "completed" thus far with the acreages targeted under the Fish Restoration Program Agreement and envisioned under BDCP. The FRPA and BDCP figures could be expressed additionally as average annual rates.*

The 2009 Delta Reform Act states that the Delta Independent Science Board (DISB) "shall provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic reviews of each of those programs that shall be scheduled to ensure that all Delta scientific research, monitoring, and assessment programs are reviewed at least once every four years." The term "Delta", in this case, refers to the Statutory Delta (e.g. Yolo Bypass up through Fremont Weir) but our review included habitat restoration efforts in Suisun Marsh . The Act further requires DISB to provide the Delta Stewardship Council with "a report on the results of each review" and to include "recommendations for any changes in the programs" that the DISB reviews (Water Code §85280 (a), parts (3) and (4)).

The DISB began reviewing restoration activities in summer 2012 after completing multiple reviews of the Delta Plan, considering flow criteria for the San Joaquin River and its tributaries, and addressing several other requests. At the time, the DISB had 9 members, 8 of whom remain on today's 10-person board. We chose to review programs by thematic area because Delta science, like the human activities that need it, cuts across boundaries among government agencies, universities, consultants, and interest groups. Selecting habitat restoration

as a first theme, we embarked on an overview of various habitat restoration activities—past, ongoing, and planned; riverine, wetland, and riparian—and paid particular attention to how the restorations would be managed adaptively in the face of climate change.

METHODS

To evaluate the science that is being used or projected to be used in support of habitat-restoration efforts and climate-change considerations in the Delta, we met with, listened to, and interviewed representatives of many of the entities involved as well as those charged with implementing the restoration (Table 1 [spelling out the scope of our efforts]). We read documents describing current and planned restoration efforts, and we attended many presentations at the 2012 Bay–Delta Science Conference. Several of us were also able to draw on prior experience with habitat restoration in a variety of ecological settings.

FINDINGS

Instead of evaluating each current or planned restoration project separately, we summarize here our general observations and findings with respect to several major aspects of habitat restoration in the Delta. Overall, however, it is apparent that the habitat-restoration projects we heard about, most of which deal with restoration of tidal wetlands or the maintenance and upgrading of levees, are generally well-conceived and based on good science. The agency administrators charged with planning and/or carrying out habitat restoration recognize the enormity of the task and the many challenges involved, and they also exhibit a dedication to doing things right and working with stakeholders to ensure that plans recognize public concerns.

Restoration goals

To be effective, restoration requires that the goals, objectives, and desired endpoints be clearly specified and agreed upon at the outset, even though these goals and objectives may later be modified on the basis of new knowledge (i.e., adaptive management). Goals should also be ecologically realistic and feasible. Although the goals of most projects we evaluated were clearly stated, in many instances these goals were framed in terms of acreage to be converted to a particular vegetation or habitat type. A focus solely on the amount of habitat restored without considering whether the area, condition, or location of habitat is suitable for target organisms may be inefficient and ineffective and lead to the failure of a project.

There was a general recognition that information on the historical Delta (Whipple et al. 2012) may be useful in defining a context for habitat restoration, but that the historical conditions can no longer be attained. Consequently, attempts to re-create historical conditions are likely to be misguided and ineffective. As an alternative, the National Research Council (NRC) has proposed that the goals of rehabilitation (rather than “restoration”) of habitats should emphasize ecosystem functions and resilience (National Research Council 2012). This may result in a system with a different composition and structure than that in the present or past. The difficulty here is in deriving operational ways of identifying and assessing “ecosystem functions” and “resilience.”

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In the regulatory context of BDCP, the goals of many habitat restoration projects are strongly influenced by the Endangered Species Act and associated Biological Opinions. The responsibility of Federal agencies is to enforce and ensure compliance with the regulations. It is important to remember, however, that the regulations are means to an end, with the end being the viability of targeted populations and maintenance or improvement of the ecological integrity of the Delta ecosystem.

There is considerable ambiguity about restoration goals for the Delta as a whole. Should the goals be framed in terms of acres of a vegetation type, patterns of hydrologic flows, ecosystem function, resilience, recovery targets for threatened species, ecosystem services, or something else? Clearly, there is no single goal or target that will apply to all projects and plans, yet without a comprehensive consideration of how different goals relate to (or conflict with) one another, the goals for individual projects may be achieved without improving the overall health of Delta ecosystems. Restoration priorities may differ, for example, if restoring particular native species is the restoration goal rather than (or in addition to) restoring habitats.

There is also concern about the process by which habitat restoration activities are "credited" towards meeting the requirements of the Biological Opinions and BDCP. Some agency representatives have suggested that crediting should happen in stages, for example as when project proponents demonstrate success. This could be problematic because restoration efforts need to develop geomorphic features, which will take time to become established. Others suggest that crediting should occur when the land acquisition occurs. In either case, there is a need to understand the crediting process better and establish guidelines that are based on best available science.

Connectivity and landscapes

Restoration projects are being planned and implemented largely independently of one another and of their landscape context. Nothing happens in just one place, however; to paraphrase John Donne, no restoration project is an island, entire of itself. Restoration in aquatic systems is affected by events or management upstream and affects what happens downstream, including other restoration projects. Restoration of wetland habitats along waterways or levees is affected by the environment and land uses in the surrounding landscape. Connectivity among habitats to be restored depends on multiple factors, including the ability to acquire lands, navigate the permitting process, and secure funding for the restoration. The long-term success or failure of restoration projects may rest on how well the linkages and connectivity are incorporated into the planning and implementation of individual projects.

Future changes

Now and in the future, the Delta will be subjected to an array of changes in climate, hydrology, land use, economics, sea-level effects, potential levee failures, and public and political perceptions and agendas. Management of the Delta to attain the co-equal goals will require dealing with multiple uncertainties. "Business as usual" is not an option. It is likely that some habitat restoration projects will not turn out as planned.

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All agencies report that climate change and sea-level rise are being incorporated into habitat restoration plans, although it is not clear how the potential effects will be incorporated into the actual restoration actions. Agencies indicated that they are mandated to include these considerations, although few specific details were provided. When models were described, the same ones seemed to be used over and over again and it was unclear whether the models used had been subject to peer review. Moreover, it is unclear whether there is a regional consensus about climate change and its probable effects.

Because climate change will influence both water supply reliability and ecosystem structure and function, trade-offs and priorities in water allocations will need to be considered (especially during dry years); restoration plans will need to incorporate responses to both anticipated and unintentional changes.

The dynamics of every ecosystem are at some point nonlinear, and the more complex the ecosystem the greater the array of nonlinearities. In practical terms, this means that as the Delta undergoes changes it will be beset by thresholds (the Pelagic Organism Decline, POD, is but one example). In some cases the system may change in composition, structure, and/or function in ways that make it virtually impossible to return to a former condition. The recent analysis of the environmental history of the Delta (Whipple et al. 2012) indicates that this has already happened, perhaps several times. With climate change and other future environmental shifts, thresholds will be encountered more often. These thresholds will confound habitat restoration programs based on assumptions of a continuation of current conditions and processes and of linearity (NRC 2012). There are few indications that nonlinear, threshold dynamics are being included in restoration plans (although several people seemed to be aware of the difficulties they might pose).

Adaptive management and monitoring

The many changes that the biological and physical environments of the Delta are undergoing now and the prospects of increased extreme events and thresholds in the future will create increasing uncertainty, making it difficult to predict the outcomes of specific habitat-restoration activities. Consequently, habitat restoration must be conducted in the framework of adaptive management. Indeed, adaptive management is mandated in the 2009 Delta Reform Act. Every agency and group that we interviewed talked about adaptive management, and every plan for the Delta addresses adaptive management, with an outline of how it will be implemented. It is not clear, however, that there is a unified perception of what the adaptive management process entails.

Monitoring is the lynchpin of adaptive management. Without long-term monitoring, targeted on key variables that can indicate the effectiveness of actions and/or reduce critical areas of uncertainty, adaptive management will not be possible. While the need for monitoring is recognized in most projects and plans, there is insufficient attention given to selection of the best targets for monitoring, the appropriate frequency or duration of monitoring, or the use of methods and data management that will enable sharing and synthesis among projects. Monitoring also requires reliable sources of long-term funding as well as ways to collect monitoring data in a common format and make them easily available, synthesize the results and

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inculcate them into the ongoing planning process. Coordination of ongoing monitoring activities is a critical need as is the need to collate data in a common format at a single location.

Because there have been so few ongoing and effective monitoring programs and evaluations of restoration efforts in the Delta, it is difficult to determine the success of past programs. The challenges and restoration goals differ among sites and projects, so adaptive management will need to be specific in its applications, while at the same time being broadly coordinated among sites. Clearly, there is no one-size-fits-all rule that will apply to specific adaptive management and restoration programs.

Coordination and collaboration among public and private entities

All of the entities involved in management of the Delta ecosystem recognize that restoration of the Delta cannot be done piecemeal. Program and agency administrators do talk with each other; although the collaborations are not as deep-rooted as one might wish, the intent is clearly there. Certainly, there is a recognition that entities must work together to achieve the co-equal goals. Field staff in some programs (notably DWR's Floodsafe Environmental Stewardship Statewide Resources Office, FESSRO) are working across program boundaries in a true interdisciplinary fashion, and take pride in these collaborations.

Nonetheless, the lack of linkages among projects is exacerbated by the overall lack of coordination among the multiple entities involved in planning, conducting, monitoring, or regulating the restoration. Sharing of plans at an administrative level is a good start, but real coordination involves collaboration and teamwork among the scientists and staff conducting the restorations at multiple locations.

The need for coordination and collaboration extends beyond the scope of habitat restoration projects and planning. The success (or failure) of restoration actions, individually and collectively, will be affected by decisions made about other aspects of Delta management. How flows are regulated, for example, will affect both the establishment and permanence of wetland and floodplain vegetation and the value of such habitats to fish and wildlife. How levees are managed and prioritized for strengthening or abandonment will determine the long-term fate of many restoration projects (NRC 2012). These broader influences do not appear to figure prominently in most habitat restoration projects or plans.

We also detected a certain amount of tension between the science, management, and regulatory communities. To be effective, all of these must overcome past history and work together. Adaptive management, for example, will require flexibility from regulatory entities, particularly in expediting the permitting process and allowing for changes in permit specifications as changing environmental conditions warrant.

Capabilities and capacity of state agencies

One of the clearest impressions emerging from our review is the high level of dedication, enthusiasm, and knowledge of the staff most directly involved in restoration. This is particularly impressive given the formidable challenges of conducting habitat restoration in the Delta and the limited funding available to do it. Nonetheless, levels of science staffing in the entities responsible for habitat restoration are inadequate, and work is frequently contracted to external

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consultants. There are advantages to this: consultants are able to get the work done in a timely fashion, can mobilize more people and resources, and can go away when a contract ends, which is advantageous when specific expertise is needed for only a short time. On the other hand, consultants are often more expensive than hiring state employees (particularly when overhead is taken into account), the state doesn't get the benefits of career development and training from the resources that are invested, and there is no long-term investment in people to build the in-house expertise that will be needed for the long time frame of many projects in the Delta.

PRELIMINARY FINDINGS

[*Note: these are some initial thoughts that need more attention; perhaps they can be made actionable by referring, as much as possible, to the entities that would carry them out.*]

1. While the **goals** of individual restoration projects may be specific to the projects, the goals should be integrated and coordinated among projects to capitalize on potential synergies among projects. Goals should be realistically attainable, clearly stated, and developed through a transparent process that includes scientists, managers, administrators, policy makers, regulators, and key stakeholders. Goals should be framed to go beyond the requirements of regulatory compliance.

2. Individual restoration projects should be planned and implemented in the **context** of (a) broader environmental factors that may affect the restoration (e.g., the surrounding landscape, land uses, hydrologic flows); (b) complementarities and connectivity to other restoration projects; and (c) other management activities in the Delta (e.g., water diversions, levee improvement or abandonment).

3. Restoration projects should be **prioritized**, based on their potential benefits, costs, feasibility, and linkages with other projects or management activities in the Delta. For example, a comparison of potential restoration sites with potentially vulnerable levee locations could indicate where restoration efforts might be secure or insecure. Multi-layer mappings of current and proposed conditions and actions are a foundation of spatial planning and should be developed. This should begin with a map showing current and planned habitat restoration projects, coded by the form of habitat restoration proposed.

4. Restoration projects should include **change and uncertainty** in their design and implementation. Tools such as simulation or scenario modeling or risk analysis should be used to bracket a range of future possibilities and weight different scenarios by their uncertainty, potential benefits, costs, and costs of being wrong. Threshold dynamics and the potential for irreversible change in key system attributes should be considered in planning and modeling efforts.

5. **Adaptive management** should be part of every restoration plan and project. In a dynamic environment, the ability to revise approaches as conditions change is a key to success. Whenever possible, the adaptive-management process should follow the nine-

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step procedure outlined in the Delta Science Plan. Sufficient resources (personnel and funding) should be provided to ensure that science-based adaptive management can actually be carried out, and steps should be taken to bridge the science-policy communications gap so that the scientific information can be incorporated into policy and management decisions. Permitting and regulatory procedure should be revised to allow changes in previously approved actions as changing environmental conditions warrant.

6. **Monitoring** the responses of key variables to habitat restoration actions should be included in every restoration plan and project. Monitoring targets should be chosen to provide the most accurate information related to the specific goals of the restoration, and monitoring should be designed to assess both short-term and long-term effects of the restoration. This will require dedicated and secure long-term funding.

7. There is a critical need for **integration and coordination** at multiple levels—monitoring, adaptive management, restoration planning and implementation, among projects—and synthesizing the science needed to support these activities. Multiagency steering or coordinating groups have been proposed. Such groups must include scientists and stakeholders as well as people charged with representing their agencies. It is even more important that such coordinating bodies be independent, to provide objective, third-party assessments, and that they have the authority and resources to achieve real integration and coordination.

8. The need for **coordination of scientific activities and expertise** is especially acute. Although the various entities dealing with the co-equal goals collectively have considerable scientific expertise, institutional barriers and agendas make it difficult to fully capitalize on this expertise. Efforts should be made to foster greater collaboration and communication among scientists in different organizations. The Delta Science Program (DSP) sponsors several activities with this aim. To be successful in bringing the best available science to bear on issues in the Delta, the DSP requires more science staff and, particularly, more certain long-term funding.

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