Summary of the Delta Vision Ecological Geography Workshop

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The Ecological Geography Workshop was designed to help the Blue Ribbon Task Force and Stakeholder Coordination Group develop their visions. The proposed workshop objectives were (1) to have a panel of scientists produce a list of the structural elements that they believe are central to meeting specific conservation objectives in different regions of the Delta-Suisun ecosystem; and (2) to have the panelists provide information for a map with possible geographical configurations of structural elements for each area that they believe would meet the conservation objectives. The following summary describes key results of the workshop. The panel was given the current Bay Delta Conservation Plan conservation objectives as a starting point (see list at end).

Determining Objectives

As much as people ask scientists to tell them the answer, no magic number exists for how much water or smelt or salmon the Delta ecosystem "needs". Management objectives must be chosen, and then one can begin to ask questions about the flow regimes necessary to meet objectives.

There are several important things to consider when formulating objectives. First, the scope of objectives matters. Panelists felt that the BDCP conservation objectives, for example, focus on the conservation of threatened and endangered fish species, and that this is a more narrow scope than Delta Vision's, which encompasses recreation and tourism. For this reason it may be useful for stakeholders to focus their management objectives on "desirable" rather than "native" species.

Second, the scale of objectives matters. Management objectives can focus on individual species, habitat types, or ecological processes. However, in practice these scales are nested – species exist within habitats that exist within ecosystems. For this reason, objectives that target the landscape scale provide greater flexibility to respond to changing conditions and changing knowledge over the long-term (in the workshop, participants identified the Suisun Marsh-Cache Slough-Liberty Island-Yolo Bypass complex as the best place for such large-scale objectives).

Equally important, the ecological relationships that cross scales are complex, and objectives should not assume that intervening at one scale – restoring riparian habitat, for example – will necessarily have a beneficial effect at another scale – a fish population, for example. One useful approach to designing objectives is to focus on a suite of target species, and then structure habitat to include the elements that support these species.

Third, limiting factors matter. Restoration interventions must occur in parallel with the management of stressors and other limiting factors in the environment. Without this the ability of restoration interventions to meet objectives may decrease greatly.

Finally, timing matters. The timescale of restoration interventions must match the timescale of a problem, because a significant time lag may exist between when actions are taken and when the outcomes of these actions become apparent. For example, restoring a subsided tidal marsh may take 20 or 30 years, and thus is a long-term investment that should not be expected to resolve an immediate crisis.

Delineating Aquatic Habitat

Delineating habitat in aquatic systems is challenging for two reasons. First, aquatic habitats are located in different parts of the landscape at different times of the year (and across years) as flows and tides change. Second, the species that populate these shifting habitats also need different things at different times of the year, and many move between different habitats over the course of weeks and months to meet these needs (and this makes habitat connectivity important, see below). As a result, drawing a hard line on a map is antithetical to the movement and spatio-temporal dynamism inherent in aquatic habitats.

A more useful approach to managing aquatic systems focuses on alternative ways of characterizing habitat. These include, for example, hydrology and hydrodynamics, the combination of elevation and tidal inundation cycles, and topographic variability, as well as plant communities, freshwater-saltwater mixing zones, food diversity and availability, and habitat connectivity.

Tidal Marsh in the Future

The greatest potential for tidal marsh restoration exists in the periphery of the Delta, where land elevations allow for tidal inundation. Overlaying projected tidal ranges for today or 50 or 100 years in the future on current or projected elevation data could constitute a working map for *potential* tidal marsh areas. The interior of the Delta has much less potential for tidal marsh restoration, because the land has subsided so significantly that tidal inundation would create deepwater habitat (unless large amounts of money and time are invested). In these areas, restoration activities that focus on creating terrestrial habitat and freshwater wetlands for migratory birds and other species are more appropriate.

In planning for possible tidal marsh restoration, three considerations are important. First, where are the proposed restoration areas? If they are near hard edges (levees or urban areas) or adjacent elevations are steep, the marsh will have little opportunity to move over time as sea levels rise or other conditions change. Second, how are these areas connected with other habitat in the Delta? The connectivity between habitat influences important ecological characteristics and processes like water residence time, flushing, exposure time, and the contribution of site-specific productivity to the larger estuary foodweb. Third, will restoration interventions create desired benefits at the right time? For example, will an intervention increase productivity at the time of year when it is most useful to a particular fish species?

Restoration in the Delta

1. The Cache Slough, Liberty Island, and Yolo Bypass Complex

This region has areas at the appropriate elevation for tidal inundation, and is an example of where passive marsh and riparian restoration is occurring. Adjacent low gradient uplands allow for habitat to move with sea level rise. The area has high habitat diversity, and perhaps the highest potential for habitat connectivity in the Delta. Delta smelt and other native fish utilize this area.

As currently managed for flood control, the Yolo Bypass provides seasonal floodplain habitat for splittail spawning and rearing and salmon rearing. It also serves as a significant food source. There are opportunities to improve the habitat value by augmenting flood flows. Note that there are concerns about enhancing mercury methylation and food chain exposure to methyl mercury.

2. The East Side of the Sacramento River

The mainstem of the Sacramento River is somewhat of a biological desert, with virtually no nearshore habitat, and minimal riparian vegetation on the levees. There is not much opportunity for restoring wetlands here, but reconnecting river sloughs which have more riparian vegetation to the Sacramento River could improve fish passage and habitat.

3. The Mokelumne River

Fish spawn and rear on the seasonal floodplain areas of the Mokelumne and Cosumnes Rivers. Habitat enhancement and restoration opportunities exist along these rivers.

4. The San Joaquin River

Historically there was a large amount of floodplain in the area, and some native fishes do very well in very high flow years when the San Joaquin behaves somewhat like a floodplain. However, like the Sacramento River mainstem, the river currently lacks riparian cover and is a constrained channel, which limits restoration opportunities. The elevations here are appropriate for tidal wetlands. There is documented poor water quality in the San Joaquin River at times.

5. The Central Delta

Significant land subsidence in this area means that at present you do not have elevations suitable for restoring habitat through breaching levees. The greatest potential for restoration, therefore, involves managing developed or agricultural lands as wildlife habitat, ideally in ways that keep the soil wet to prevent or reverse subsidence.

Experiments with subsidence reversal through biomass accretion (also known as "growing peat" in non-scientific terms) are ongoing. Interventions to reverse subsidence should consider (1) How much can be achieved within the next 100 years? and, (2) Given that timeframe, do assumptions about the benefits change – e.g., will sea level rise or a big earthquake occur before benefits are realized?

One possibility for improving aquatic habitat in the central Delta is to increase the heterogeneity of habitat conditions by changing the area's geometry. One way of doing this would be to remove connections between Old and Middle Rivers, not use Old River for water deliveries, and manage the area to the west for the ecosystem while still bringing freshwater down to the pumps.

6. The Suisun Marsh

Suisun Marsh would be a good place to start restoration because it embodies two salinity gradients: the east-west gradient which stretches 25 km with the tides, and north-south gradient which remains strong even in the summertime. This combination encompasses significant variability and generates a diversity of habitats. Existing restoration activities focus on tidal wetland restoration, but there are also many dead-end sloughs, which have a significant potential for supporting fish. On the east and north side there is a fairly low elevation gradient along the edges of the marsh, so there is a high potential for the habitat to move over time and for connection across different habitats.

Nonetheless, the marsh is more subsided than people think, with about 20-25% is below the tidal frame right now. Invasive plant species also present a significant challenge to habitat restoration.

7. The West-Northwestern Complex

The lower Sacramento River between Suisun Marsh and Cache Slough, combined with the Yolo Bypass, would likely create an ecological complex that provides a combination of desirable physical, chemical, and biological features, including several areas for delta smelt. This complex would be large enough to incorporate landscape-level change.

Water Exports and Flow Regimes

It is critical to recognize that exports are not a "natural" phenomenon, but rather exist in relation with inflows: when exports go up, inflows from upstream reservoirs are increased to supply this. Furthermore, there is no point of "zero-impact" – exporting water will always have some effect on the ecosystem, whether on fish species or habitats or food supplies.

In considering changes to water operations, it is important to recognize that all exports are not equal: exports have very different effects depending on the rest of the flow environment. For example, high exports during a high outflow event are different than during low outflows.

It is also important to recognize that flow regimes do not have simple cause-effect relationships with habitats, species, and the landscape. This is because where water is coming from and how fast it goes somewhere depends on the geometry through which you pull or push the water.

Water quality concerns are another important consideration. For example, dissolved organic carbon (DOC) can be good for an ecosystem, but makes harmful byproducts when disinfected for drinking water.

Finally, In-Delta diversions are also a critical consideration, because they take water out and then put it back in with DOC and very different quality.

Diversion Points and Delta Operations

If water were diverted from the north with the aid of some sort of peripheral canal, the Delta could be managed for multiple purposes rather than just for getting freshwater to the pumps. This would generate a range of management options, and many new questions about potential interventions and their possible effects.

At the same time, management would still involve controlling water and removing it from the Delta.

In considering management objectives, one option would be to optimize exports, i.e., alter the timing and volume of exports to minimize impacts on the ecosystem.

Proposed Modeling

The DRMS team has proposed forming a small team of biologists and engineers to use the Research Modeling Associates (a consulting company) model to examine the relative impacts of different water operations on the ecosystem by late June or early July.

BDCP Conservation Objectives used in the Workshop

1. Reduce species mortality attributable to non-natural mortality sources.
2. Provide water quality conditions necessary to enhance species production, abundance, and distribution.
3. Increase habitat quality, quantity, accessibility, and diversity to enhance and sustain species production, abundance, and distribution, and to improve the resiliency of species populations to environmental conditions.
4. Increase food quality, quantity, and accessibility to enhance species production.
5. Reduce the abundance of non-native competitors and predators to increase the production abundance, and distribution of native species.