Building a Landscape Perspective for Ecosystem Planning: Lessons from Historical Ecology

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Considerable effort is currently dedicated to planning large-scale restoration in the Delta that achieves a more functional ecosystem for native species. Developing a landscape perspective to help inform what restoration could look like requires an understanding of natural patterns and processes. Historical ecology research contributes to this important foundation. In the recently completed three-year Delta Historical Ecology Study, we synthesized numerous disparate historical sources (e.g., maps, textual accounts, photographs) using GIS and conceptual models to reconstruct the land cover types of the early 1800s Delta and to describe associated physical processes. We found complex habitat mosaics were arranged in distinct patterns across broad physical gradients. Substantial differences existed between the north, central, and south Delta landscapes, distinguished by characteristics such as relative proportion of habitat types, size and position of features, and hydrologic connectivity. In the central Delta, myriad sinuous tidal channels wove within a tidal wetland plain of freshwater emergent vegetation (predominantly tule) and willows. Northward along the Sacramento River, wide riparian forest bordered flood basins consisting of broad zones of tidal wetland transitioning into non-tidal wetland. In the south Delta along the San Joaquin River, a maze of active and abandoned channels were part of a floodplain characterized by locally-complex habitat patterns with riparian forest, patches of willow thicket, seasonal wetlands, and grassland intermixed with expanses of tule and perennial and intermittent ponds. Understanding such patterns and related processes is especially relevant in places like the Delta that have been profoundly altered. With limited land and resources today, successful ecological planning in the Delta will depend upon knowledge of what functional elements future landscapes can and should contain. Rather than a template to rebuild the past, historical ecology contributes valuable information concerning how different elements within the future Delta might best fit together to support ecosystem health.

Keywords: Delta, landscape, large-scale, historical ecology, habitat restoration, ecosystem, reconciliation

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Envisioning a Reconciled Delta Based on Empirical Data from Healthy Landscapes

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The Delta Landscapes project contributes a needed dimension to Delta planning by providing a landscape-scale perspective on restoration opportunities and recommendations that is founded in a sound understanding of ecological functions provided by the Delta prior to substantial human modification. Using historical data indicates both how the Delta system tends to function in response to physical processes and the conditions to which native species are adapted. This information is critical to planning for a future Delta that is reconciled to support as much native biodiversity as possible with minimal management effort. This information is also important for establishing landscape units with sufficient scale, diversity, and connectivity along physical gradients to adapt to future changes. Detailed, spatially explicit early 1800s habitat information from the Delta Historical Ecology Study is being examined through a lens of key ecological functions that supported Delta wildlife historically. With a team of experts in ecology and physical process, we are interpreting the historical Delta landscapes to define these with quantifiable metrics that represent different suites of functions provided by the different physical settings within the larger Delta. Conceptual models and other planning tools will demonstrate how the functions and metrics are related. These models can then be applied to the current Delta to identify areas where similar functions might be restored and maintained over time. Landscapes will not necessarily be reestablished in the same places or at the same scale as they were historically, but with similar metrics such that functionality is regained. The approach of drawing key functions and metrics from the historical landscape – and then applying those to contemporary and future conditions through landscape-scale conceptual models – can help maximize the value of contemporary restoration, beginning to reconcile the past with the future.

Keywords: ecological functions, historical ecology, landscape, Delta, physical gradients, restoration

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The Pre-Export Delta: How Flow and Water Quality Changed Over the Last 60 years

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While many changes had already occurred within the Delta by 1950, the ecosystem was still supporting fisheries. Many more changes have occurred since federal pumping started in 1951 and state pumping in 1968. Physical bathymetry changes include deepening of the Stockton Deep water Ship Channel and the creation of the Sacramento Deep Water Ship Channel. Suisun Marsh Gates were installed to help keep the Suisun Marsh area fresh, and the Delta Cross Channel and gates were installed to facilitate moving fresh water south through the Delta to the export pumps. Temporary agricultural barriers have been seasonally installed in the south Delta to control water quality and water levels, and the fish barrier at the head of old river is seasonally installed to encourage a more successful path for salmon out-migration. Other more natural changes have also occurred including the permanent flooding of Little Franks Tract, Liberty, Mildred and Little Sherman Islands. The current Delta network bathymetry has been changed to represent the best understanding of the 1950 Delta. A modeling study examined the changes in flow and water quality from pre- to post-exports. The results provide some insights to why pre-export conditions, while significantly modified from natural conditions, still provided better ecological conditions than today's operations.

Keywords: modeling, pre-exports, historical changes

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Managing a Reconciled Future Delta Ecosystem

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The Delta presents a major challenge for water resource and ecosystem management due to its novel characteristics. In our publication *Where the Wild Things Aren't: Making the Delta a Better Place for Native Species*, we propose a reconciliation approach that addresses the multiple stressors impacting the Delta. Management guided by reconciliation ecology involves acknowledging and adapting to ecosystem change, rather than just attempting to reverse it. It includes improving conditions for native species, while recognizing that the Delta is irrevocably altered and managed to support multiple human goals. Managing a reconciled Delta will require the following: 1) Recognition that natural processes place limits on all water and land management goals. Not all habitats can be created everywhere and not all water resource demands can be met all the time. 2) Different parts of the Delta should be specialized for different functions. An arc of connected habitat should link Suisun Marsh to the northwestern Delta. Conversely, non-tidal marsh and riparian habitat should be created in the south Delta. Riparian and seasonal floodplain habitat is most appropriate for the eastern and northeastern Delta. Deep-water estuarine lakes are best for the deeply-subsided portions of the central and western Delta. 3) Levees, channels and flow management are essential tools that can improve conditions in vital habitats while steering native species away from bad conditions. 4) Acknowledge the fact that it will take decades to achieve biological goals and objectives, and that some may prove impossible to achieve, requiring course corrections. 5) All efforts should be based on an integrated, rather than coordinated, scientific and adaptive management program that does not over-negotiate the details up front and provides flexibility for future action. There is one certainty in the uncertainty of managing the Delta: there will be surprises.

Keywords: Reconciliation, ecosystem management, restoration, flow management

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