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Where the Wild Things Aren't

Making the Delta a Better Place for Native Species

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Summary

Management of the Sacramento–San Joaquin Delta is one of California’s greatest challenges, because the lands and water resources of the system serve a multiplicity of conflicting purposes. The native wetlands of the estuary have been dredged and diked to support farming, transportation, commerce, and housing development. Diversions from the Delta watershed now provide water for much of California’s population and economy. The development of the Delta’s lands, the channelization of its waterways, the discharge of pollutants, the introduction of non-native species, the alteration of flows, and the diversions of water from the system have combined to degrade the quality of water and habitat. These stressors, singly and in combination, have harmed native species that inhabit or pass through the estuary. In addition, accelerating sea-level rise, warming temperatures, increased frequency of extreme flood events, longer droughts, and other manifestations of climate change will be changing the environment, making management even more difficult.

This report proposes a reconciliation approach for addressing 160 years of accumulated problems and for managing the Delta’s ecosystem in the future. Reconciliation ecology seeks to improve conditions for native species while recognizing that most ecosystems have been altered irrevocably by human use and will continue to be used to support human goals. Improving ecosystem conditions for native species must therefore happen in a context of continuing use of land and water by humans and continuing physical and biological change.

The “Reconciled Delta” described in this report represents our collective judgment on how to approach the management of the Delta’s water and land resources in a manner that might *realistically* achieve the California legislature’s co-equal goals of water supply reliability and ecosystem protection for the Delta as an evolving place (Delta Reform Act of 2009, Water Code § 85054). We focus on the most technically vexing aspect of this problem: defining and maintaining essential ecosystem functions so that populations of endangered or threatened aquatic species will recover to sustainable levels and other native species will continue to thrive. The decline of native fish species that depend on the Delta ecosystem has been a central management challenge for this region for several decades, with numerous adverse ramifications for human users of water and land resources. Improving environmental outcomes is necessary to sustain the local Delta economy and to support more reliable water supplies for regions beyond the Delta.

Our conclusions were informed by a broad investigation of scientific literature and a series of energetic and stimulating discussions with experts on the hydrology, biology, and ecology of the Delta. We take as given several points for which there is considerable scientific support:

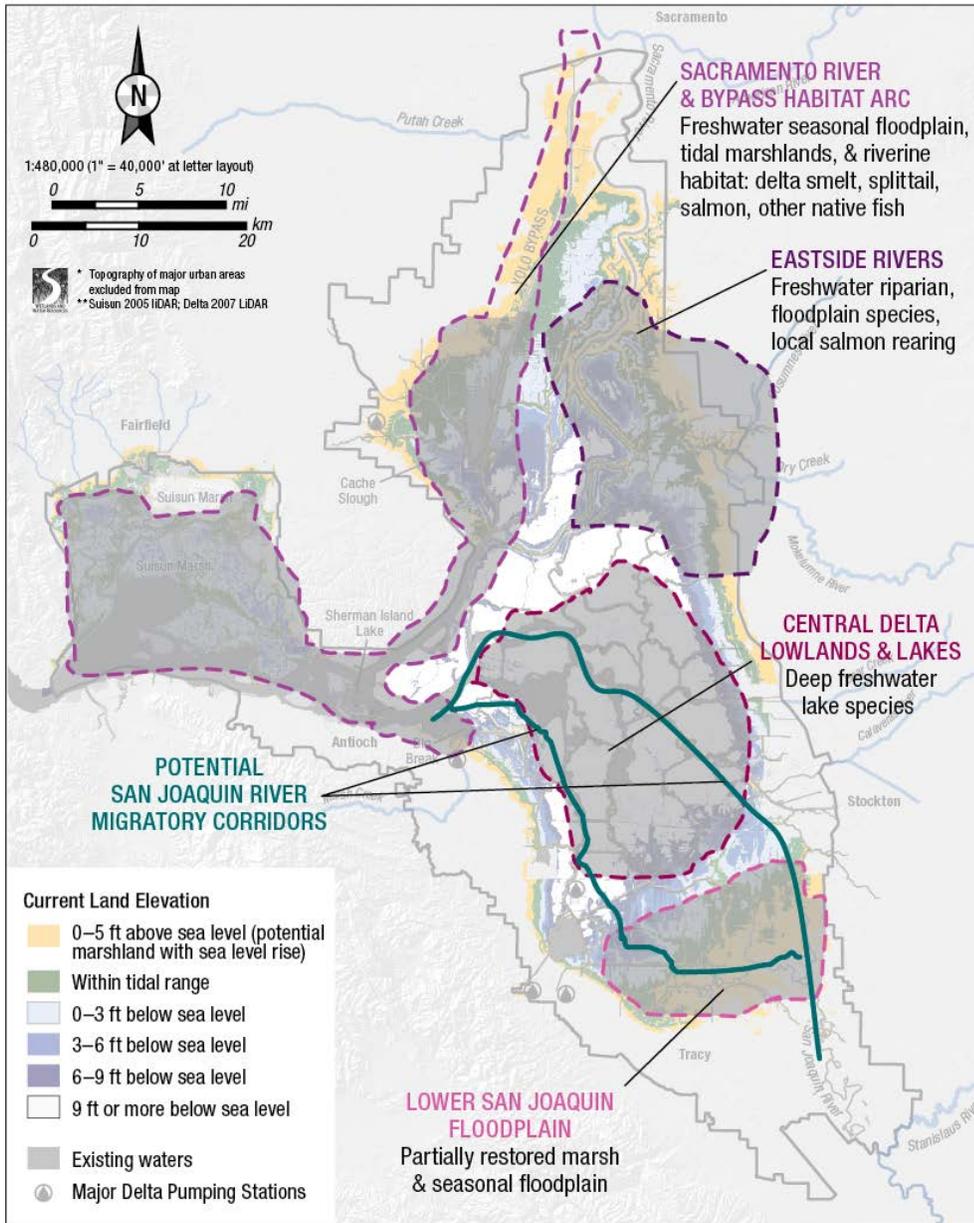
1. **The Delta ecosystem will continue to experience major changes.** Land subsidence, sea-level rise, earthquakes, floods, climate change, new invasive species, land development, and the inability of landowners and governments to protect Delta islands from flooding will all shape the future Delta.
2. **Numerous constraints limit environmental management options.** The most restrictive constraints are physical and biological, including widespread land subsidence, limits on the availability of fresh water, and the domination of the ecosystem by invasive species. Economic, financial, legal, and institutional constraints also restrict human ability to manage the Delta ecosystem.
3. **Society has some capacity to improve Delta ecosystem conditions and support sustainable populations of the native species that inhabit or pass through the Delta.** However, restoration of abundant populations of *all* native species is unlikely, and some may become extinct in the wild even with extraordinary efforts to sustain them.

4. **Managers will need to address multiple sources of stress to the ecosystem within and upstream of the Delta.** These include altered flows and sediment, degraded physical habitat, contaminants and nutrients, invasive species, and hatchery policies.
5. **The physical environment can be managed to aid populations of native aquatic species (as well as some desirable alien species).** To achieve this, physical habitats and flows can be managed, where possible, to provide conditions that native estuarine species need at different stages in their lives.

These conditions and projected trends lead to the following conclusions regarding a reconciled aquatic ecosystem in the Delta:

1. **Natural processes place limits on all water and land management goals.** For instance, roughly 95 percent of the Delta's tidal marshland – the primary pre-development habitat in which native species thrived – is now gone. But most of the central and western Delta is too deeply subsided to be restored to marshland, and the permanent flooding of islands in this region may diminish the tidal energy needed for tidal marshland development elsewhere. Tidal marshes can be recovered over time in much of Suisun Marsh and the periphery of the western and northern Delta. Restored lowlands adjacent to rivers in upstream areas can provide seasonal riparian and floodplain habitat for native species.
2. **Specializing different parts of the Delta for different functions is the most promising way to accommodate native species and support other desired uses of the Delta.** Although much of the historical diversity in Delta habitat has been lost, important regional differences persist. A reconciliation strategy should capitalize on these differences (Figure S1):
 - An arc of connected habitats extending from Suisun Marsh and Big Break to parts of the northwestern Delta and the Yolo Bypass is most suitable for the Delta's native estuarine species (e.g., delta smelt, salmon, and splittail). This region would consist of both brackish and freshwater tidal marshland and shallow subtidal habitat as well as open water channel habitat.
 - Given the likely reduction in tidal energy with island flooding, habitat re-creation in the southern Delta would be primarily non-tidal, with seasonal floodplains, flood bypasses, and marshes fed by the San Joaquin River. This habitat could support migratory birds and the rearing of migratory fish, including Chinook salmon.
 - Riparian and seasonal floodplain habitat would be developed in the eastern and northern Delta, supporting spawning and rearing of migratory species.
 - Some deeply subsided islands in the central Delta are destined to become flooded deep-water "lakes," which will likely benefit primarily non-native recreational fish species (e.g., largemouth bass). Migratory fishes and ships will continue to need passage through this region. Islands with high economic and strategic value would continue to be protected.

FIGURE S1
Habitat area specialization is a key to shaping a reconciled Delta



SOURCE: Base elevation map adapted from Stuart Siegel, Wetlands and Water Resources, Inc., 2009.

NOTE: This map shows ecosystem areas as regions. As described in the text, these regions would continue to support most urban and agricultural land uses as well as transportation functions. Islands within the central Delta whose economic value (including for strategic uses like roads and rail lines) justifies the expense would continue to be protected.

3. **Levees, channels, and flow alteration are essential tools for managing the Delta’s physical structure.** These tools were initially used to facilitate the farming and habitation of Delta lands, and later to enhance flood control and navigation. Since the 1950s they have also been used to facilitate the transport of water from the Sacramento River to Central Valley Project and State Water Project pumps in the south Delta. In a reconciled Delta, these tools would be used to work more *with* nature to benefit native estuarine species, as well as to provide long-term benefits to humans. A more native fish-friendly flow regime and an appropriately modified system of levees, channels, barriers, diversions, and islands should help shape and support a reconciled Delta by

- Allowing for natural processes to develop various forms of habitat (e.g. tidal marshes and seasonal floodplains).
 - Supporting migration of salmon and other native fish species by creating rearing habitat for juveniles and by directing them away from lethal areas in the central Delta and near the south Delta pumps.
 - Protecting existing development, infrastructure, and high-value agriculture.
4. **It may take decades before the Delta can once again support sustainable populations of most native species.** In the interim, sustaining some native species may require unconventional measures, such as hatcheries managed for genetic diversity.
 5. **The Delta needs an effective, adequately funded system of adaptive management.** This system would integrate modeling, experimentation, and feedback into management decisions. Over-negotiation of details in advance is unlikely to enable adequate responsiveness and flexibility. However, we must recognize that even the most well-informed, scientifically based management will encounter surprises and make mistakes. Such surprises and mistakes are increasingly likely as climate change adds an additional element of unpredictability to management.

This vision of a reconciled Delta is compatible with key federal and state environmental laws governing the Delta. It also proposes a path to create a Delta in which humans and native species successfully co-exist and respond positively to change. Although this framework seeks to accommodate sustainable human and environmental uses of water and land in the Delta, some additional societal sacrifices will be required to support the environment, whose needs have been underserved since humans first began significantly altering the lands and waters of the Delta ecosystem in the 1850s. Mitigation may be appropriate to help groups that experience direct and significant changes to their livelihoods as a result of these changes, such as those who live and work on lands that are appropriate for habitat development or that will be subject to permanent flooding. Ecological reconciliation may be expensive, but it is likely to be less costly and more environmentally effective over the long term than a series of reactive responses to continuing crises in the Delta. Ecological investments in the Delta will ultimately benefit California's economy by securing higher-quality, more reliable water for agriculture and urban use, averting expensive responses to natural disasters, and expanding recreational opportunities. Ecosystem and economic objectives are mutually dependent. Laying out a strategic direction that recognizes this interdependence is necessary to guide effective plans and policies.

Companion reports

This report presents results from two surveys conducted in summer 2012 regarding ecosystem management in the Sacramento-San Joaquin Delta. It is part of a wide-ranging study on the management of multiple ecosystem stressors in the Delta. For a summary of overall study findings, see *Stress Relief: Prescriptions for a Healthier Delta Ecosystem* (Hanak et al. 2013). Several companion papers address related topics in greater depth: (1) *Aquatic Ecosystem Stressors in the Sacramento-San Joaquin Delta* (Mount et al. 2012) summarizes the science of Delta ecosystem stressors for a policymaking audience; (2) *Costs of Ecosystem Management Actions for the Sacramento-San Joaquin Delta* (Medellin-Azuara et. al. 2013) provides cost estimates for a suite of management actions addressing various sources of ecosystem stress; (3) *Integrated Management of Delta Stressors: Institutional and Legal Options* (Gray et al. 2013) presents our proposals for institutional reform of science, management, and regulation; (4) *Scientist and Stakeholder Views on the Delta Ecosystem* (Hanak et al. 2013b) presents the results of surveys of scientific experts and engaged stakeholders and policymakers on Delta stressors and management actions. All of these reports are available on PPIC's website at www.ppic.org.

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