Ecosystem Restoration at the Landscape Scale:
The North Delta and Suisun Marsh

Workshop Summary

November 18-19, 2009

The CALFED Science Program hosted a workshop on large-scale restoration with a focus on the North Delta and Suisun Marsh. Five panel members experienced with large-scale restoration efforts throughout the United States interacted with local scientists working on restoration planning in the North Delta and Suisun Marsh. The five panelists were Nick Aumen (Everglades National Park), John Wiens (Point Reyes Bird Observatory), John Teal (Delaware Bay Salt Marsh Restoration), Karen Rodriguez (USEPA – Great Lakes Restoration Initiative), and Jim Cloern (USGS – San Francisco Bay Long-Term Research Program). John Teal served as chair of the panel and the panel's final report is posted on the web site for the workshop.

The workshop consisted of fifteen talks over the first day and one-half from the five panelists and ten local scientists engaged in large-scale restoration efforts in the North Delta and Suisun Marsh. The talks from the participants are available at the workshop web site. The second half of the second day included a facilitated discussion between workshop attendees, panel feedback from their participation in the workshop, and public comment. A brief synopsis of the fifteen presentations and the facilitated discussion and panel discussion are included in this summary.

Robin Grossinger and Alison Whipple presented their ongoing efforts to develop a better understanding of the historical ecology of the California Delta. Clear hydrological sub-regions are to be found within the historical Delta. The emerging concepts from their work include that 1) the physical gradients translate into complex habitat mosaics 2) a complex channel geometry reflected diverse tidal routing, variable sediment and nutrient transport, and longer water residence time, 3) seasonal flood events affected tidal marsh characteristics (e.g. open water features, sediment, temperature, salinity), and 4) winter flows were held and released through the dry season in freshwater marsh basins, lakes/ponds, and groundwater.

Chris Enright examined hydrodynamic characteristics and transport processes in the historic and current Delta and discussed the landscape characteristics important to fish species and restoration activities. Important take-home points included 1) the historical Delta was narrower, longer, with way more edges and interfaces (ecotones), 2) structural relationships produced a gradient rich system, 3) native species need multiple forage, refuge, ontogeny options, 4) restored marshes should be productive and accessible at multiple scales, 5) learn how to use the levee breach "knob" to restore diverse structures, processes, and

disturbances, and 6) we know enough to proceed boldly, watch closely, adapt if needed, and teach the kids what we learn.

Jon Burau emphasized that large-scale restoration will change the hydrodynamics of the Delta; change will occur and the details matter. Some preliminary modeling suggests that large-scale restoration in the north Delta leads to reductions in bidirectional flows in Steamboat and Sutter sloughs and pushes fluvial influences on the Sacramento River further downstream. There is finite tidal energy to expend and Jon recommends that restoration proceed from west to east (northeast) so that restored regions in the northeast Delta aren't eventually left high and dry. Jon suggests that staged restoration be done so that evolution from initial conditions (large tidal prism) to new conditions (smaller tidal prism) takes place to reduce competition for tidal energy from multiple large-scale restoration projects.

John Wiens provided five general landscape ecology principles important for planning large-scale restoration. Those principles are 1) patch context matters, 2) patches differ in quality, 3) patch boundaries affect flows, 4) connectivity is critical, and 5) scale matters. John also highlighted the dilemma of at-risk species. He highlighted that ~80% of listed species are conservation reliant where management actions alone are insufficient for recovery. Two additional important points were the critical role of climate change as a determinant for future outcomes and the importance of adaptive management in moving forward with actions linked to effective monitoring and timely decision-making.

Bill Fleenor presented a progress report on his efforts to evaluate environmental flow needs for the Delta. The goals of his talk were to 1) examine methods that have provided insight into water needs, 2) identify sustainable goals for the 'future' Delta, and 3) initiate systematic conversation on Delta flow. Bill highlighted efforts at setting flow criteria for estuaries in Florida and Texas, and he presented unimpaired flow conditions, flows from 1949-1968, and flows from 1986-2005 for the Sacramento and San Joaquin rivers. Bill concluded his talk with some potential examples at applying prescribed flow methods for 1) the Sacramento River and Yolo bypass, 2) San Joaquin River and eastside streams, and 3) net Delta outflows.

Betty Andrews showed recent published research on hydrology and floodplain restoration along the lower Sacramento River. Her talk focused on activated floodplains and presented the floodplain activation flow approach. This approach uses stage and floods to find and define the floodplain. Examples from various reaches of the lower Sacramento were shown. Three conclusions from her talk were that 1) negligible flood-activated floodplains presently exist along the lower Sacramento River except for the Yolo Bypass reach, 2) tremendous physical potential exists within the Yolo Bypass to increase activated floodplain area, and 3) flow releases, changes to hydraulic control structures, levee modification

and/or floodplain excavation would be needed to increase the extent of flood activated floodplain.

Steve Crooks presented an overview of the BREACH III project that will be evaluating and predicting 'restoration thresholds' in evolving freshwater tidal marshes. The scientific goal of BREACH III is to "provide through a combination of observation, experiments and modeling a predictive level of understanding about biotic and the abiotic controls on vegetation colonization and expansion in restoring wetlands, and the ecological response of native fish and wildlife species of concern to the evolving wetland features at the landscape scale."

Karen Rodriguez of the US EPA Great Lakes Restoration Initiative presented an overview of the Great Lakes Interagency Task Force (IATF) and its attempt to restore the Great Lakes at the landscape scale. There is a multiple agency and tribe regional working group from Canada and the US that coordinates restoration activities. The Great Lakes restoration initiative action plan was published in 2009 that considers toxics, invasive species, non-point pollution, habitat restoration, and education monitoring and evaluation. The action plan includes 80 performance indicators and targets with an emphasis on restoring trajectories. The report also emphasizes novel solutions in the context of what is possible given the current system state. This includes a suite of localized restoration master plans, developed with local communities with local leadership and landowner support.

Cliff Dahm of the Delta Science Program presented a summary of the National River Restoration Science Synthesis (NRRSS) program. The program characterizes modern river restoration practices, the role of scientific method in river restoration, and identifies common elements of successful restorations as well as critical gaps in the knowledge base. The projects cost 15-17 billion dollars and were dominated by water quality management and riparian management projects but covered a wide range of other topics including fish passage and flow modification. Dr. Dahm also summarized the Kissimmee River restoration project in South Florida. This is a successful large-scale restoration based on a conceptual model that restoration of geomorphic and hydrologic processes improves abiotic processes including dissolved oxygen and hydroperiod, and leads ultimately to biotic function improvements. The program emphasized clear expectations of restoration outcomes, metrics, targets, and methods. The project planning merited a special issue in the journal of Restoration Ecology in September 1995. The project also benefited from demonstration projects prior to full restoration that garnered political support for the full buildout.

Ted Sommer of the California Department of Water Resources presented restoration lessons from the Yolo Bypass floodplain. Yolo Bypass is used to divert flood water from the Sacramento River for flood control. Several years of research show that the Yolo Bypass floodplain is a source, not sink, for salmon production. Floodplain hydrology controls the production. In years when water is

available, feeding is greater on the floodplain than in the river. Production generally increases with duration of flooding. Salmon are found in all flooded substrates; splittail more commonly rely on shallow water in shore habitats. Upstream fish passage is still very poor suggesting relatively simple restoration would provide great value for fish production. Restoration priorities include fish passage structure at the weirs, managed inundation for habitat and provision (approximately 3000 cfs appears to be a threshold for a large jump in inundated area), and net downstream flows to carry productivity down to Cache Slough.

Beginning Day 2 of the workshop, Nick Aumen of Everglades National Park summarized restoration efforts and observations in the South Florida ecosystem. He cited common threats to the Everglades and the Bay Delta ecosystem including changing hydrology, water quality, invasives, land use threats, and climate change. In Florida, the premise was if they could get hydrology right, then ecology would follow. The big omission was lack of understanding of physical movement of water across the landscape. The natural landscape utilized sheet flow rather than point inputs. Obstacles to adaptive management in Florida include regulatory agency and budget process timelines that don't align well with the political system. He recommended that we initially pick straightforward projects to establish ecological and political success. Also, we should anticipate non-linear responses to climate change, that is, expect step changes. He also suggested that we not have high expectations for water quality and landscape modeling. Finally, considering mistakes made in Everglades restoration, he recommended

- Don't assume critical problems will be solved later
- Don't ignore Endangered Species Act (ESA) issues
- Don't let new science money replace existing agency budgets: not a zero-sum game
- Don't let projects languish and die from bureaucracy – enormous amounts of money can be spent with very little action or improvement on the ground.

John Teal of the Woods Hole Oceanographic Institute outlined wetland restoration principles based on his work in Delaware Bay. The principles are:

- Define goals with stakeholder input that are specific and realistic based on possible restoration trajectories.
- Restore degraded sites rather than create new ones.
- Consider landscape ecology framework in selecting sites.
- Use ecological engineering (self design).
- Design restored sites to be self-sustaining and guided by adaptive management.
- Plan, implement, and continue site monitoring until success is achieved.
- Include functional as well as structural components and performance criteria.
- Consider people and property adjacent to the restoration site.
- Put restoration sites under conservation restrictions to ensure their protection in perpetuity.

- Encourage public awareness and education through access to restoration sites

Peter Moyle of UC Davis presented a wide-ranging discussion of fish and regime shifts for the future of Suisun Marsh. His laboratory at UC Davis has been studying Suisun Marsh for 30 years. Data indicate wide variability in salinity, turbidity, temperature and dissolved oxygen. DO is regularly below 5 mg per liter in smaller sloughs in the fall. Four major invasions have occurred since the program began: Siberian prawn, shimofuri goby, overbite clam, and jellyfish. Higher productivity areas without clams typically record 25-100 ug/L Chl a. It is not clear yet why clams are not in all the more distal sloughs. Native species have generally been reduced since the study began whereas invasives tend to have far greater fluctuations in abundance. He believes this could be because they are still “learning” the environment. Native fish population trends have mirrored the Delta in some ways although the pelagic organism decline appears not to have occurred in Suisun Marsh. He believes that this is because there is more zooplankton and fewer clams in Suisun Marsh, which he attributes to presence of more natural tidal systems. There also has been a regime shift in fish species since 1980 including more common alien species.

Stuart Siegel of Wetlands and Water Sources presented a "restoration recipe" that suggests improved and resilient ecosystem function results from a combination of restored habitats, processes, and stressor removal. Success depends on an adequately funded science-based adaptive management program though success is not guaranteed. He suggests that restoration priorities flow from "reading" landscape including understanding topography, hydrology and landscape mosaics. Aligned with our understanding of natural processes, we should put restoration where key native species will benefit, face constraints including infrastructure, conveyance, land ownership issues, and anticipate sea level rise. Ultimately we must learn more primarily through the process of doing restoration. Adaptive management must structure learning.

Jim Cloern presented 10 scientific principles for restoration along with key questions and uncertainties.

1) Don’t expect quick fixes; take a long-term perspective.
2) Bold actions are required because the Delta is a hyper-disturbed ecosystem.
3) Recognize constraints on restoration outcomes including the fact that the Delta is a low productivity ecosystem.
4) Connectivity is a key to ecosystem productivity.
5) Expect the unexpected--monitor and adapt because ecosystems always surprise us.
6) Nutrient reductions might be necessary considering that the Delta is highly enriched in N and P.
7) Design restorations from a large-scale systems perspective-- ocean to watershed.

8) Take climate change and climate oscillations into account with long-term perspectives. We can expect species abundance shifts because they are linked to global climate forcing processes.
9) Plan for increased frequency and intensity of extreme events.
10) Use model-based scenarios to assess restoration outcomes. We can link climate-watershed-hydrodynamic-sediment-biological models (e.g. Computational Assessments of Scenarios of Change for the Delta Ecosystem - CASCaDE).

Cloern also discussed several key questions and uncertainties including:

- Trajectories of recovery have multiple possible modes (e.g. linear, threshold, hysteresis).
- How will target species respond to increased frequency and intensity of extreme events?
- What are the causes of the pelagic organism decline?
- What is the sustainability of native species on the verge of extinction including Delta smelt considering that water temperature and clarity are increasing?
- Will restored habitats be colonized by invasives?
- Growing problem of cyanobacterial blooms. Cyanobacteria like warm water and long residence time.
- Can we raise the money and exert a requisite political will?

After the formal presentations, Cliff Dahm facilitated a discussion with the audience. Some of the comments are summarized here.

Bruce Herbold asked why, in general, planning processes seems to wholly lack anticipation of sudden events (e.g. invasions, levee failures, etc.). Leo Winternitz suggested that there is stress between the political situation and “the exchange” which embodies restoration outcome expectations. It boils down to stress between short-term outcome expectations and long-term reality of restoration outcomes. Bruce Herbold said that Public Policy Institute of California (PPIC) and Delta Risk Management Strategy (DRMS) reports should provide ample motivation to bridge theses gaps since the consequences of inaction will be felt in our lifetime. Scientific and engineering responses and strategies are available though it is human nature to sometimes miss the biggest potential drivers of change. Herbold argued that we need conceptual models for what drives clam colonization and establishment—the same for Quagga or Zebra mussels. Stuart Siegel brought up the concept of variability in connectivity, gradients and residence time as another key focus. Marianne Kirkland reminded the group that Prospect Island has high potential for demonstrating connectivity at the landscape scale. Dave Harlow pointed out that there is a recent Actions Synthesis Report from the Bay Delta Conservation Plan (BDCP) utilizing the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) that calls for near-term five thousand (5K) acres of restoration in Suisun, 5K in the Yolo basin, and 2K in the western Delta. He asked if there is a coherent strategy for

Suisun yet. Dennis McEwan pointed out that other restorations had “guiding plans” which seem to be in short supply here. He said that he felt the Delta Habitat Conservation and Conveyance Plan (DHCCP) is moving too fast to establish a coherent plan. He asked the group how we could get such a plan within such a tight schedule. Several people agreed that the process has been programmatically difficult. Stuart Siegel said that it may be more possible to establish coherence more informally through participation on restoration opportunity area teams if elements that would comprise a coherent plan are shared and planned together. Overall, many are thinking about effective restorations and the need to consider processes at the landscape scale.

After retreating for a few hours together, the expert panel returned to offer summary recommendations. Each panel member spoke in turn:

John Teal said that the number one issue is to get started and do something! He said that if we are not moving dirt within two years then forget the entire effort. He said that we know enough to start and that we should select places to begin. Initial projects should allow for learning, be robust to climate change, and be representative of what we would like to do at larger scales. He encouraged us to not allow large committees to oversee projects because it would lead to failure. Instead, he suggested that good leadership is very important. There should be one person in authority to run a project with support from an advisory committee. He said that we must clearly define and articulate goals, conceptual models, and monitoring programs. That is, conduct "real adaptive management" aimed to ecosystem functions. We should also make sure that we complete the full loop of Adaptive Management (AM) including re-examining goals. He suggested that we not focus all our attention on endangered species. Rather, focus on ecosystems. Ecosystems change over time and such change needs to be allowed rather than assuming it is bad because it doesn’t support endangered species. Allow for change in expectations as reality applies itself. Adaptive management is both art and science; therefore, be judicious and realistic about goals and aim for those that reflect system properties rather than "bean counting." Let systems restore themselves as opposed to recurrent ongoing interventions.

Nick Aumen expressed amazement that funding has not been pulled due to lack of progress! The issue of negative precedent is of great concern to him. Therefore, he suggested that we be ready when funding arrives and use it expeditiously. On governance, he said that stakeholder-steeped processes consume enormous amount of funds that could be used for on-the-ground restoration. Minimize organizational complexity wherever possible.

There was much discussion about public involvement and education. John Teal said there is a need to educate the general public about what is planned. Current documents about the planning process are not aimed for this audience. We need to produce such material with topics and in language relevant to them. Karen Rodriguez mentioned that Lake St. Claire planning committees planted the idea of biodiversity by developing a regional resources atlas. Production was carried

out as a grassroots project such that many of the ideas came from local participants. The product became the "glue" that brought the group together to take action. It became known as the Biodiversity Action Plan. Karen Rodriguez also said that our existing materials are not what's needed for our landowners. She believes it will be important to engage them directly. Overall, she believes that stewardship groups are ultimately needed. Get the public involved early. John Teal cited Jim Cloern's CASCaDE work in which climate condition score cards are being developed for thirds of centuries. He suggested that we translate this material so that it is accessible to the public so they can begin to grasp future conditions.

Jim Cloern provided a summary of the CASCaDE project. They are using four scenarios of climate change, downscaled to a 12 km grid on California from a 250 km GCM model grid. Soil moisture, temperature, snow melt, and runoff processes ultimately are being stimulated to link to the statewide reservoir planning model CALSIM. Sea level rise projections are being incorporated at the Golden Gate bridge boundary within a hydrodynamics model. The project will soon produce a short synthesis paper that explains, in 30-yr increments, the projected effects of climate change on the Bay-Delta system under four scenarios. Topics will include mean annual air temperature, mean annual water temperature, groundwater and surface water input to the Delta, and frequency of extreme sea level heights at the Golden Gate. Cloern suggested that restoration planning should take advantage of CASCaDE outputs. Cliff Dahm offered the use of the CALFED Science Program science writer to help get out the word. Carl Wilcox expressed a desire to get model output information to the BDCP planning effort now.

Cliff Dahm facilitated a final session that provided the opportunity for members of the public in the audience to comment.

One participant suggested that Puget Sound is an example of how different people differentially understand science information. For example, people there listen and seem to trust University of Washington researchers. He suggested that we get social scientists involved to figure out best approaches in this region for developing public ownership and positive perceptions of restoration. Another participant asked how to deal with the linkages being established between a peripheral canal and ecosystem restoration. Karen Rodriguez cited the example of Lake Ontario water level management and associated environmental effects of that water level management. She said an International Joint Commission has spent two years with no conclusion or decision. Her reading of the Delta water supply and ecosystem materials leads her personally to see no reason to support a peripheral canal! John Cain of American Rivers suggested that a near-term success might be a restored wetland with a trail for public access. Frances Brewster encouraged us to be clear and realistic on expectations. Don't set unachievable targets but instead set realistic ones. Steve Crooks of Phil

Williams Associates cited an example from Britain where a lack of due diligence by restoration managers resulted in lack of trust in the messenger.

Another audience participant said he is getting the sense that delta smelt may be past its ability to survive and therefore building a “Two-Gates” project to sustain them may be viewed as wasting money. John Teal responded to this by saying that restoration projects should have far broader goals than just Delta smelt. Jody Cassell of CA Sea Grant said she felt there had been a terrible presentation of BDCP to the public. She felt that communication is compounding the problem.

Chris Enright asked the science panel to address how to maintain scientific independence and public perception of this independence? Nick Aumen reflected on the science challenges in Florida. He believes the answer is to keep quality high, publish in peer review journals, and be active in the peer review process (e.g. a 400-person list of pre-qualified reviewers is kept for science-related issues in Florida). Karen Rodriguez said there should be strict quality assurance (QA) guidelines, and peer review guidelines. Do this because it ultimately comes down to trust in the process.

Many of the expert panel members said that leadership is a key ingredient. Karen Rodriguez lauded Linda Jackson (the current EPA Director) for making direct and timely up-down calls on key issues. She believes that California needs strong leadership. Nick Aumen said that much of the success he witnessed in Florida was largely the result of one strong leader. It often “made all the difference." John Teal agreed, saying much of the Delaware-based success came about because of one staff-level engineer.

The workshop adjourned in the late afternoon of November 19, 2009. The panel report that is a primary product of the workshop can be found at:

http://www.science.calwater.ca.gov/pdf/workshops/workshop_eco_report_final_121609.pdf