980 Ninth Street, Suite 1500
Sacramento, CA 95814
www.deltacouncil.ca.gov

Lead Scientist's Report

Summary: This report covers 5 items:

Collaborative Science Activities: (1) Low Intensity Chemical Dosing Seminar;

Science Communication: (2) Summary of journal article on forest fire activity; (3) One synthesis article from the *San Francisco Estuary and Watershed Science* (*SFEWS*) *Journal* on Delta-Suisun food webs; (4) Brown Bag seminar on changing Delta landscapes; and (5) the "By the Numbers" summary.

Collaborative Science Activities

Low Intensity Chemical Dosing Seminar: Opportunities to Improve Delta Water Quality Leveraging Hybrid Coagulation and Wetland Treatment Systems

The Delta Science Program supported a seminar on Oct. 26, 2016 that showcased the research and findings from the Low Intensity Chemical Dosing Project, which investigated the feasibility of using chemical treatment in constructed wetlands to improve Delta water quality and mitigate subsidence. This project was funded by the Department of Water Resources, U.S. Environmental Protection Agency, and the U.S. Geological Survey (USGS) in collaboration with Bachand & Associates, UC Davis, and the USGS.

Low-intensity chemical dosing is the process of using metal-based salts (called coagulants), commonly used in the drinking water industry, to remove pollutants. It is called "low intensity" as the amount of coagulant used is just enough to remove constituents to the desired concentration.

The initial study objectives were to assess the effectiveness and feasibility of 1) treating Delta island drainage water with low concentrations of chemicals to remove pollutants that can interfere with drinking water treatment downstream; and 2) to use constructed wetlands to settle-out the resulting material and polish-treated water prior to discharge into Delta channel waters. A mercury component was added to the study to assess the effects of coagulation on mercury concentrations, bioaccumulation, and cycling in the wetland systems. The seminar presented findings from extensive laboratory and field studies conducted between 2008 – 2015 that looked at water quality, plant growth, mercury bioaccumulation, and the accretion, composition, and stability of the material that settled in the wetlands. These studies show that properly designed low intensity chemical dosing and wetland treatment systems could remove mercury and other pollutants from Delta island drainage water and build peat soil to help reverse subsidence.

Science Communication

Increasing western U.S. forest wildfire activity: sensitivity to changes in the timing of spring

Anthony LeRoy Westerling. Sierra Nevada Research Institute, University of California, Merced. May 2016. Philosophical Transactions of the Royal Society B.

Wildfires in western U.S. forests have grown in frequency and severity since the 1980s. This increase has led to federal spending of $2 billion for fire suppression in 2015; a dramatic increase from the $1 billion spent in 2000. A recent article published in May 2016 asked if wildfire activity in the region has continued to increase. The author also asked if there are fire "hot spots", and what are possible causes of the increased fire frequency and severity.

The research found that large fires in the western U.S. (Sierra Nevada, Southwest, Pacific Northwest, and northern and southern Rockies) are continuing to grow in number and severity. Large fires between 2003 and 2012 were 556 percent more frequent than between 1973 and 1982. Additionally, the forest area burned between 2003 and 2012 was more than 1,200 percent greater than the area burned between 1973 and 1982. The "hot spots" for increased fires were particularly strong in mid-elevation northern U.S. Rocky Mountain forests.

What are the causes of the increases in fire number and size? The length of the fire season has increased 84 days in the last four decades. The fires are also burning for longer durations. The average burn time for individual fires between 2003 and 2012 was 52 days – in contrast to just six days for fires between 1973 and 1982. In summary, the increases in numbers and intensity of wildfires are strongly associated with dryer, warmer temperatures along with earlier spring snowmelt. Global warming is projected to increase this drying in the West. This suggests that we can expect even more wildfire activity in the future.

2016 Volume 14 Issue 3 of the *SFEWS Journal:* Special Section on the *State of Bay-Delta Science*

San Francisco Estuary and Watershed Science (*SFEWS*) is an open access journal, funded by the Council, and is a key venue for publishing the latest research addressing Delta scientific questions. The current issue of the *SFEWS* journal includes a special edition section that also is the second part of the *State of Bay-Delta Science* (*SBDS*). The next issue of the journal will include the rest of the *SBDS* papers.

SBDS is a synthesis of the best available science about the Delta, emphasizing progress made on key research questions and remaining knowledge gaps. The first edition of *SBDS*, edited by CALFED Bay-Delta Program lead scientist Michael Healey, Michael Dettinger of the USGS and Scripps Institution of Oceanography, and Richard Norgaard of UC Berkeley was published in 2008. Topics for this edition of *SBDS* address the most relevant scientific issues for the Delta identified by senior scientists

and managers. One article from the *SBDS 2016* Special Issue, Part 2, is summarized below.

Food Webs of the Delta, Suisun Bay, and Suisun Marsh: An Update on Current Understanding and Possibilities for Management

Larry R. Brown; Wim Kimmerer; J. Louise Conrad; Sarah Lesmeister; Anke Mueller–Solger

Over the last 150 years, numerous native species, originally inhabiting the region from the legal Delta to Suisun Marsh, have declined following substantial changes in the ecosystem. One of the proposed causes for these species' lack of recovery is a deficient (i.e., low production) food web, which is not fulfilling the nutritional needs of native species. To better understand why the Delta-Suisun estuary might have a low productivity food web, this contributed paper reviews the most recent research on how food webs work and vary within the Delta-Suisun estuary. Understanding the processes that shape the food web provides potential avenues for reestablishing a beneficial food web for species of concern.

The authors begin by describing changes in the landscape from the era predating the Gold Rush through the large scale development of the landscape in the 1960s, which cut off rivers from flood plains and changed patterns of flow. At this same time, several non-native species were introduced that may have acted as competitors for food and resources or predators on native species. The effects from these introductions, however, were often undocumented, occurring prior to regular monitoring. Despite some change in the amount of available algae at the base of the food web during times of water diversion, the composition of algae species was relatively stable. Diatom blooms (good algae) were common in the western and southern Delta and in Suisun Bay during the spring and summer.

A dramatic shift in the food web was brought about with the invasion of the overbite clam beginning in 1987. As a result, from 1987 to 2000, algae decreased by fivefold in Suisun Bay and the western Delta, the composition of algae shifted away from nutritious diatoms and to small species, and many zooplankton species declined. The concurrent decrease in all of these pelagic (water surface dwelling) organisms were, in retrospect, indicative of a broader "regime shift" in the estuarine ecosystem, particularly in the low salinity zone. The ecosystem shifted away from a relatively productive food web, and toward a regime characterized by a reduced, less productive pelagic food web and dominated by benthic (bottom-dwelling) grazers (e.g., the overbite clam). Many fish populations, including striped bass, longfin smelt, and delta smelt, declined or shifted in distribution in the early 2000s (known as the "pelagic organism decline"). Another potential cause of the decline in the food web is associated with the ammonium paradox, which describes the inhibition of good algae production by ammonium, which is present in wastewater discharged by sewage treatment plants. More studies are needed to determine the relative contribution of these various factors to the decline in food web productivity.

The authors also focus on how food webs work, vary, and interact throughout a variety of important habitats in the Delta-Suisun. For example, reestablishing tidal wetlands is often a goal of habitat restoration because of their importance as feeding grounds for resident and transient fish, including juvenile salmon. In addition, the contributions to the food web of submerged aquatic vegetation (SAV), which consists of both native and invasive species, are being reexamined. Rather than only being a nuisance, recent study indicates that some fish might feed upon invertebrates that benefit from SAV. More research on SAV and the less-studied floating aquatic vegetation are needed. Variation in food web processes and gaps in knowledge are also associated with larger geographic regions. The authors argue that such a regional analysis, supported by long-term monitoring and experiments must be done to fully understand the factors affecting food web dynamics.

Brown Bag Seminar – <u>The Delta as Changing Landscapes</u>

The landscape of the Delta has changed dramatically since the 1800s. What was once an extensive wetland with ponds and riparian-lined rivers surrounded by tidal marsh, is now a highly channelized system surrounded by working landscapes and relatively little tidal marsh. Dr. Letitia Grenier, Resilient Landscapes Program director for the San Francisco Estuary Institute (SFEI), discussed the transformation of the Delta, focusing on those aspects that support healthy ecologies. Studying change informs us on how to more effectively restore landscapes and ecological functions. Dr. Grenier emphasized that the desire for a landscape view has been apparent in the policies and documents that guide management of the Delta, including the Water Code and the Delta Plan. She drew from her recent report “The Delta as Changing Landscapes”, included in *SBDS 2016*, and from the Delta Landscapes project (SFEI), which examines how Delta ecosystems functioned from the 1800s to present day – and how they might function in a renewed Delta of the future.

Because of large changes in the landscape, habitat diversity, and associated physical processes, a number of ecological functions have been lost. Collaborators with Dr. Grenier determined which functions would be most important to restore, including habitats that support healthy fish and wildlife populations, a productive food web, and allow for species to adapt. They also came up with ways to measure landscape changes associated with the loss of these ecological functions.

Dr. Grenier emphasized that simple restoration of static habitats will not necessarily assure the continued existence and functioning of that habitat, particularly with climate change. Instead, there is a need to restore the processes that shape the habitat and make it resilient. For example, restoring a marsh requires reestablishing the supply of sediment and tidal action so that the marsh can gain sediment as sea level rises.

Tidal flooding - specifically seasonal long duration flooding from river overflow and inundation during tidal action – is now also almost completely absent. Some of the short term seasonal duration flooding remains over the Yolo Bypass and Cosumnes River

Preserve, which has greatly increased the food and habitat available for fish and wildlife populations.

Dr. Grenier suggested that the lesson learned from this and other studies is that small regions of preserved or restored landscapes can provide huge ecological benefits, even in the absence of restoring the full historical landscape. Current efforts focus on developing a framework for those doing restoration projects to ensure the resulting landscape achieves desired ecological functions now and into the future.

By the Numbers
Delta Science Program staff will give a summary of current numbers related to Delta water and environmental management. The summary (Attachment 1) will inform the Council of recent counts, measurements, and monitoring figures driving water and environmental management issues within the Delta and the Delta catchment.

Attachments

Attachment 1: By the Numbers Summary *(report to be provided at the Council meeting)*

Contact

Dr. Cliff Dahm Phone: (916) 445-0463
Lead Scientist