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Lead Scientist's Report

Summary: This report covers 6 items:

Collaborative Science Activities: (1) Delta Science Program staff field trip; (2) Mercury Strategy synthesis workshop.

Science Communication: (3) Summary of conference plenary talk on the Australian Millenial Drought; (4) Research article from San Francisco Estuary and Watershed Science (SFEWS) Journal on multi-purpose optimization within Yolo Bypass; (5) One poster from the Revisiting the 2003 Mercury Strategy technical workshop; and (6) the "By the Numbers" summary.

Collaborative Science Activities

Delta Science Program Staff Field Trip

Visits to Lundberg Family Farms, the Oroville Dam and spillway, and the adjacent Feather River Fish Hatchery on May 19, 2016, provided staff with an opportunity to learn first-hand about the water conveyance system and hatchery operations in the northern Central Valley, and their impacts on Delta water supplies and fisheries. At Lundberg Family Farms, staff heard about the company's innovative approach to rice farming, the historical framework for establishing water rights, and the rewards and challenges of organic farming under different water regimes. From employees of the Department of Water Resources, staff learned about rearing and spawning procedures for hatchery salmonids, the changing roles of the Oroville Dam during high-flow and drought years, and State Water Project operations. Through these on-site interactions, staff gained a better understanding of the complex operations associated with different water uses and the needs of local stakeholders.

Revisiting the 2003 Mercury Strategy Synthesis Workshop

A workshop was held June 2-3, 2016, to synthesize results from the three-day technical workshop titled, "Revisiting the 2003 Mercury Strategy for the Bay-Delta Ecosystem" convened in January. The purpose of this technical workshop series is to create a shared understanding of the current knowledge of mercury sources and effects, critical uncertainties, and priorities for research and monitoring to address the challenges of mercury in the Delta ecosystem.

Highlights from the workshop with particular relevance to decision making and management in the Delta include:

- **Mercury concentrations in fish and birds are still above levels of concern.** Mercury in some birds has been found to increase subsequent to their arrival in the San Francisco Estuary. This has been found to affect survival of eggs and nestlings.

- **Several factors affect methylmercury exposure and concentrations in organisms.** The time of year and where these organisims are within the foodweb and physically within a habitat are key factors that impact exposure to methylmercury. These variations need to be taken into account when designing monitoring programs and sampling methods.

- **The amount and source of mercury affects its potential to become methylmercury.** Mercury that is chemically bound to dissolved organic compounds can be easily taken up by microbes that turn mercury into a bioavailable form. Mercury from one source may be more easily turned into bioavailable mercury depending on what the mercury is bound to.

- **Wetland restoration and new reservoirs do not necesarily result in a permanent increase of mercury.** Documented cases of restoration efforts around the Bay-Delta region, such as the South-Bay Salt Ponds, have experienced an initial peak in mercury concentration that have returned back to reference conditions after a few years. This fluctuation in mercury concentration depends on the type of wetland. More monitoring data of mercury concentrations before and after wetland restoration is needed.

Science Communication

Of Droughts and Flooding Rains: Innovative Responses to Water Scarcity in Temperate Australia

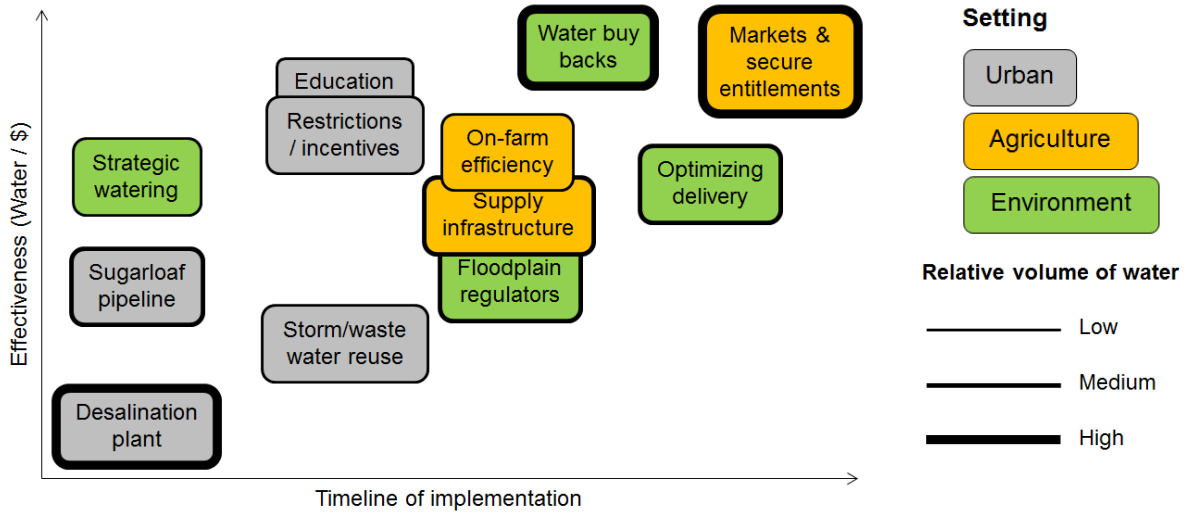
Dr. Angus Webb, University of Melbourne, Melbourne, Victoria, Australia
Keynote presentation, Society for Freshwater Science Annual Meeting, May 25, 2016, Sacramento.

Dr. Webb told the story of Australia's millennial drought (1999-2009). The drought affected southeastern Australia including the Murray-Darling Basin, bread basket for the country, for the first decade of this century. Dr. Webb discussed the effects of the drought as well as the responses that reduced the drought's impacts upon humans and nature. During the drought, rainfall in the eastern and southeastern part of Australia was extremely low, often the lowest on record. The lack of precipitation led to water inflows that were at times not much more than 1/10 of the long-term average. Ecological impacts during the drought were severe and wide-ranging, affecting plant life, animal life, and water quality. The drought heavily impacted the Murray-Darling Basin, which produces 40 percent of Australia's agricultural output. For example, rice production decreased to just 1.5 percent of the 1990-2000 average.

In the words of Dr. Webb: "*The rains stopped, the dams emptied. Native fish populations were decimated, redgums that had been seedlings during the renaissance died by the thousands. Farms went under, and too often took the farmer with them. How could this possibly be a good news story? ...It led to a lot of innovation*". The

government, communities, and individuals responded to the drought. This led to 1) reductions in the environmental impacts of the drought; 2) a more resilient agricultural sector; and 3) a country more prepared for the next major drought (which may be just around the corner).

Dr. Webb developed a diagram that showed a range of responses to water scarcity during the drought:



This graph represents Dr. Webb's opinions. The colors of the boxes show what sector the response applies to (urban, agricultural, or environmental). The thickness of the box border illustrates the volume of water saved or generated relative to the volume used. The x-axis represents relative time over which the response was conceived and implemented. The y-axis indicates the monetary value of that investment. The take home message is that "*The most effective responses, that also delivered major water savings, are those that were in planning and implementation the longest."*

Does the Australian response to drought provide lessons to help California? Often times yes, but not always. The experience in Australia does show that change is possible especially if investments are made in long-term projects and solutions.

March 2016 Issue of the SFEWS Journal

The March issue of the SFEWS Journal is currently available online. This open access journal, funded by the Council, is a key venue for publishing the latest research addressing Delta scientific questions. This edition includes one essay and five research papers. One of these articles is highlighted here.

Multi-Purpose Optimization for Reconciliation Ecology on an Engineered Floodplain: Yolo Bypass, California
Suddeth Grimm, Robyn and Lund, Jay R.

Reconciliation ecology aims to balance human land uses with ecosystem needs. To this end, an important tool available in service of reconciliation ecology is

multi-purpose optimization, which evaluates the relative value of different decisions that incorporate compromises among conflicting management objectives. Current Yolo Bypass flood management considers beneficial uses for flood control, agriculture, and bird habitat, but not habitat for sensitive fish species like Chinook salmon and splittail. The Bypass is thought to be important rearing and/or spawning habitat for these species from February through April. In this study, Suddeth Grimm and Lund (2016) explored the application of a multi-purpose optimization framework to allow for greater inundation of Yolo Bypass at key times. They found that during late January to early February, three weeks of flooding could increase fish and bird habitat without significantly decreasing farming profits. In addition, increased use of land for rice and wild rice would be economically and ecologically beneficial, and planting a greater percentage of these crops could be incentivized. While further model refinement is needed, multi-purpose optimization could provide valuable management advice for ecosystem reconciliation of Yolo Bypass and other engineered floodplains.

Poster Summary from the Revisiting the 2003 Mercury Strategy for the Bay-Delta Ecosystem Workshop

The following poster, from the January technical workshops, was selected because of its potential relevance for Delta wetland restoration.

Hydrological Controls on Methylmercury Distribution and Flux in a Tidal Marsh

H. Zhang, K.B. Moffett, L. Windham-Myers, and S.M. Gorelick

Methylmercury (MeHg) is a toxic mercury compound that becomes increasingly concentrated in the tissues of organisms at higher trophic levels through a process called biomagnification. Tidal marshes have characteristics that make them potential “hotspots” for MeHg production – a concern for both sensitive marsh species and human consumers of Delta fish. Although much is known about the biological and geochemical processes that favor the generation of MeHg, little is known about the role of hydrology in MeHg transport within tidal marshes or between marshes and the estuary. Researchers from Stanford, the University of Texas at Austin, and the U.S. Geological Survey therefore examined the hydrological processes affecting MeHg through field measurements and modeling for marsh sites in the San Francisco Estuary, and estimated MeHg exports. They found that groundwater had a greater concentration of MeHg than surface water, and thus sites with persistent shallow ponds tended to have lower MeHg than sites with subsurface sources of water. In areas with groundwater, the presence of vegetation together with clay soil created below-ground pockets that were not fully saturated with water and, at these sites, MeHg concentrations were higher. Low tide further increased MeHg concentrations in tidal channels. Estimation of MeHg exported from such tidal wetlands indicates that tidal wetlands could contribute to higher MeHg concentrations in the Delta food web.

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.

List of Attachments

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

Contact

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