

INFORMATION ITEM

State of Bay-Delta Science Report

Summary: *The State of Bay-Delta Science, 2016 (SBDS, 2016)* is a collection of scientific papers that synthesize the current scientific understanding of the Bay and Delta, with an emphasis on progress made since the first edition of *SBDS* was published in 2008. Subsets of the papers have been published this year in the *San Francisco Estuary and Watershed Science* online journal in July and October, with the final volume scheduled for December. The *SBDS, 2016* summary for policymakers, *The Delta on Fast Forward: Thinking beyond the Next Crisis* distills key findings and presents new perspectives for managing the Delta.

Background

The State of Bay-Delta Science (SBDS) synthesizes the current scientific understanding of the Bay and Delta, emphasizing progress made on key research questions and remaining knowledge gaps. *SBDS* is a key element in the overall Delta science strategy that includes the *Delta Science Plan* and the Science Action Agenda, and it is intended to inform the science and policy audiences about the state of science of the Bay-Delta system. The first edition, (Healey et al. 2008; http://www.science.calwater.ca.gov/pdf/publications/sbds/sbds_final_update_122408.pdf), provided a system-wide baseline for the state of scientific knowledge of the system, and a reframing of the interaction between policy and science.

For the 2016 edition, an editorial board comprised of Michael Healey (University of British Columbia), Michael Dettinger (US Geological Survey), and Richard Norgaard (Emeritus, UC Berkeley) chose topics based on a survey of senior scientists and managers working in the Delta that identified the most relevant science issues. The topical papers cover issues ranging from contaminants in the Delta to levee stability, and from Delta food webs to recent discoveries about salmon migration (see below for full list of chapters).

These papers are written for a scientific audience and are being published in three issues of the *San Francisco Estuary and Watershed Science* online journal. Additionally, *SBDS, 2016* includes an introductory essay that sets the stage for the topic-focused papers that follow by providing a brief description of the Delta and its ecology, linking issues to individual papers where appropriate, a previously published paper, *Challenges facing the Sacramento-San Joaquin Delta: Complex, chaotic, or simply cantankerous?* (Luoma et al. 2015; <http://deltacouncil.ca.gov/sites/default/files/2015/10/DeltaChallenges-v18r1.pdf>) that describes the challenges facing water and environmental managers in the Delta, and a final paper (Healey et al., in press) that synthesizes *SBDS, 2016* and summarizes key advances in scientific understanding over the past decade and their policy implications.

In order to distill key findings in *SBDS, 2016* for a policymaker audience, two members of the editorial board prepared a summary for policymakers: *The Delta on Fast Forward: Thinking Beyond the Next Crisis*. This summary presents perspectives on *SBDS, 2016*, including seven new perspectives, a suite of tools that are advancing Delta science, and eight priority actions that are take-home messages. It is a forward-looking take on managing the Delta that pushes our collective thinking beyond the status quo. A hard copy of *The Delta on Fast Forward* (Attachment 1) is included in the meeting materials.

What we learned

The *SBDS, 2016* editorial board assessed the level of influence of *SBDS, 2008* on the Delta Stewardship Council and other Delta management initiatives. They found that the 2009 Delta Reform Act, the 2013 Delta Plan, and the 2013 Delta Science Plan are all consistent with the seven 2008 perspectives (see the summary for policymakers). Some of the uncertainty and complexity acknowledged in the 2008 perspectives was also recognized in the “Delta Challenges” report. The editorial board wrote the *SBDS, 2016* synthesis paper entitled, *Perspectives on Bay Delta Science and Policy*, which offered seven perspectives on *SBDS, 2016*. The perspectives, which are included in the summary for policymakers, are summarized below.

1. *Nutrients are important.* Whereas in the past we considered nutrients to be relatively unimportant in Delta productivity, we now understand that the absolute and relative concentrations of different nutrients in the Delta can be drivers of Delta ecology, including inhibition of phytoplankton growth by ammonium and promotion of the expansion of invasive *Microcystis* and invasive water weeds.
2. *Delta waters are contaminated.* The complex cocktail of contaminants that enters the Delta from agriculture, urban, and industrial discharges has the potential to cause serious damage to the ecosystem and human health.
3. *Aquatic food webs no longer sustain native species.* Food webs in the Delta now bear little resemblance to those that supported communities of native organisms prior to European colonization. Driven by physical and chemical changes in the Delta and invasions by alien species, the aquatic ecosystem has gone through a regime shift that probably cannot be reversed. The present food web appears stable but is much less able to support native fishes than in the past.
4. *Species declines are a result of multiple stressors acting together.* There are few instances in which a single stressor can be identified as the primary cause of any species’ decline. Effective conservation of aquatic species requires a holistic approach to improve habitat quantity and quality.
5. *Future water management will be driven more by extreme events* (of all types) than by long-term averages, even as those averages change. As California’s climate changes due to global greenhouse gas emissions, more frequent and more extreme storms and droughts will occur. Management will have to restructure to respond to these changes.

6. *Delta habitats work together as a landscape scale mosaic.* The success of local restoration is dependent on what happens in adjacent habitats and vice versa. Any habitat restoration, therefore, has cascading effects that propagate far beyond the restored habitat. Landscape ecology provides a set of tools and concepts for identifying and taking account of these cascading effects.
7. *The situation for native species is dire.* The ecological regime shift coupled with the emerging effects of climate change in the Delta are creating conditions that will likely accelerate the current downward spiral of native species. This situation makes it urgent that the scientific foundations for new management responses be developed.

The 2016 *SBDS* editorial board also extracted the following forward-thinking actions from *Perspectives on Bay-Delta Science and Policy*.

1. Incorporate long-range (50-year) thinking into Delta science and management. Acknowledge the accelerating rates of change ahead, and the inability to return to past conditions, in evaluating and planning feasible options for the future.
2. Incorporate more exploratory and forward-looking science into government science programs at all levels, including science not tied to any current policy or crisis. Start planning now for about 15 percent of the overall Delta science budget or personnel to transition into more forward-thinking science.
3. Widen science career paths in State agencies so that scientists are not forced to abandon science to advance their careers.
4. Plan for variability and extremes in the decades ahead, as well as long-term change. Bolster the ecosystem's capacity to absorb both drought and deluge by continuing to reduce the State's demand for water supply from the Delta, as required by the Delta Reform Act of 2009. Replenish Central Valley groundwater reservoirs and promote agricultural practices more resilient to drought. Adjust water management practices to accommodate less predictable sources of supply and more variable inflows.
5. Adapt management practices to take advantage of any ecological, recreational, and economic values to be gained from various invasive species in habitats no longer suitable for native species. Manage current plant and animal communities to increase ecosystem services.
6. Begin the scientific and societal groundwork needed to seriously explore alternatives to conservation in place for endangered species. Continue all reasonable efforts to provide for these species, including reducing water demand on the Delta, but recognize that the time has come to develop the science and policy foundations for more radical approaches, including assisted relocation, assisted evolution, and cryopreservation.

7. Invest now to develop models of the Delta system, analogous to global climate models, that more fully integrate physical, ecological, and social sciences. Use these models to forecast likely outcomes from changing climate and other external forces acting on the Delta, as well as likely effects of various management policies.
8. Weave “Delta as an Evolving Place” in all science, planning and management programs.

As the effort comes to completion, staff are identifying potential next steps, which include integration of priority items into the 2017 Science Action Agenda, as well as any other prospective means for implementation. These potential next steps also are being guided by the SFEI report, “*A Delta Renewed*,” the Delta Plan Interagency Implementation Committee and Delta Agency Science Workgroup, the Department of Fish and Wildlife’s Delta Conservation Framework, the Delta Plan amendments on Ecosystem Restoration, Conveyance, Storage and Operations, and levee investments and the Delta Science Plan.

The following is a list of *SBDS, 2016* Papers:

Volume I – June, 2016

(https://escholarship.org/uc/search?entity=jmie_sfews;volume=14;issue=2)

The State of Bay Delta Science 2016 – An Introduction: Michael Healey, Peter Goodwin, Michael Dettinger, Richard Norgaard

Challenges Facing the Sacramento-San Joaquin Delta: Complex, Chaotic, or Simply Cantankerous?: Sam Luoma, Cliff Dahm, Michael Healey, Johnnie Moore

Delta Smelt: Life History and Decline of a Once Abundant Species in the San Francisco Estuary: Peter Moyle, Larry Brown, John Durand, James Hobbs

Anadromous salmonids in the Delta: New Science 2006-2016: Russ Perry, Rebecca Buchanan, Pat Brandes, Jon Burau, Josh Israel

Predation on Fishes in the Sacramento-San Joaquin Delta: Current Knowledge and Future Directions: Gary Grossman

The Delta as Changing Landscapes: John Wiens, Letitia Grenier, Robin Grossinger, Michael Healey

Volume II – October, 2016

(http://escholarship.org/uc/search?entity=jmie_sfews;volume=14;issue=3)

Food Webs of the Delta, Suisun Bay, and Suisun Marsh: An Update on Current Understanding and Possibilities for Management: Larry Brown, Wim Kimmerer, Louise Conrad, Sarah Lesmeister, Anke Mueller-Solger

Climate Change and the Delta: Michael Dettinger, Jamie Anderson, Michael Anderson, Larry Brown, Daniel Cayan, Edwin Maurer

California's Agricultural and Urban Water Supply Reliability and the Sacramento-San Joaquin Delta:
Jay Lund

Volume III – December, 2016 (in press)

Recent advances in understanding flow dynamics and transport of water-quality constituents in the Sacramento-San Joaquin River Delta: David Schoellhamer, Scott Wright, Stephen Monismith, Brian Bergamaschi

An overview of multi-dimensional models of the Sacramento-San Joaquin Delta: What they can tell us about the distribution and movement of fish and food organisms and how future Delta conditions will affect fish and water supply: Michael MacWilliams, Eli Ateljevich, Stephen Monismith, Chris Enright

Contaminant Effects on California Bay-Delta Species and Human Health: Stephanie Fong, Stephen Louie, Inge Werner, Jay Davis, Richard Connon

Factors and Processes Affecting Delta Levee System Vulnerability: Steven Deverel, Sandra Bachand, Scott Brandenburg, Cathleen Jones, Jonathan Stewart, Paolo Zimmaro

Nutrient Dynamics of the Delta: Effects on Primary Producers: Clifford Dahm, Alexander Parker, Anne Adelson, Mairgareth Christman, Brian Bergamaschi

Perspectives on Bay-Delta Science and Policy: Michael Healey, Michael Dettinger, Richard Norgaard

Summary for Policymakers – November, 2016

The Delta on Fast Forward: Thinking Beyond the Next Crisis: Michael Healey, Richard Norgaard, Ariel Rubissow Okamoto, Editor

Fiscal Information

Not applicable.

List of Attachments

Attachment 1: The State of Bay-Delta Science 2016 Summary for Policymakers, *The Delta on Fast Forward: Thinking Beyond the Next Crisis (To be provided at Council meeting)*

Contact

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