INFORMATION ITEM

Lead Scientist's Report

Summary: Delta Lead Scientist Dr. Laurel Larsen will discuss a paper by Ghalambor et al. (2021). This paper is a summary review of discussions and presentations from the 2018 "Ecological and Physiological Impacts of Salinization of Aquatic Systems from Human Activities" Symposium, which was funded in part by the Delta Stewardship Council. Published in the San Francisco Estuary and Watershed Science Journal, the paper reviews, 1) the processes and human activities that alter salinity throughout the estuary, 2) the ecological consequences of altered salinity patterns, 3) management actions that can mitigate increased salinity intrusion, and 4) future research priorities to better understand the outcomes of altered salinization patterns.

ECOLOGICAL EFFECTS OF CLIMATE-DRIVEN SALINITY VARIATION IN THE SAN FRANCISCO ESTUARY: CAN WE ANTICIPATE AND MANAGE THE COMING CHANGES? SAN FRANCISCO ESTUARY AND WATERSHED SCIENCE. GHALAMBOR ET AL. 2021.

Maintaining salinity that meets the regulatory targets specified in federal Biological Opinions for listed species and maintains fresh water at the intake to the Central Valley Project and State Water Project is one of the most complex and expensive water management challenges for the Delta. Challenges of maintaining appropriate salinity during the present drought foreshadow the challenges forthcoming with sea level rise. In 2018, the Delta Stewardship Council funded the "Ecological and Physiological Impacts of Salinization of Aquatic Systems from Human Activities" Symposium, which highlighted the emerging problem of increased salt intrusion to estuarine systems. The paper profiled here is a synthesis of the presentations and discussions that took place at the symposium, as well as the body of literature in which they are grounded. The paper reviews the processes and human activities shaping salinity intrusion, the ecological consequences of these altered salinity patterns, management actions to control salinity, and possible research priorities to understand and combat the consequences of salinization.

The authors first reviewed historic salinity patterns in the San Francisco estuary to better understand contemporary changes. Historically, freshwater flow into the system was the primary driver of salinity patterns. Flows used to be more variable, resulting in a more variable salinity regime. Human modification of freshwater inputs through activities such as agriculture and levee construction has changed

those historic patterns by altering the amount and timing of freshwater flow. Climate change will also compound these effects. For example, climate change induced sea level rise will bring high-salinity water further inland and shifting precipitation and snowmelt patterns will change the timing and volume of freshwater inflow. Already, contemporary sea level rise has shifted the salinity associated with particular inflow volumes to higher levels than historically.

The paper also reviews the ecological consequences of salinity intrusion into the estuary. For instance, many coastal and estuarine organisms must regulate their internal salt concentrations to survive, and many are adapted to a specific range of salinity levels. As salinity changes in the estuary, species that cannot move to more favorable habitat, acclimate, or adapt will be at a disadvantage. For example, while the endangered Delta Smelt may be able to survive at higher salinities, they show reduced overall body condition when compared to individuals living in low salinities. Increased salinity will also negatively affect aquatic plants, some of which form the foundation of the estuary food chain. This may result in a domino effect that reaches other species.

While regulations and water diversion structures are currently in place to aid salinity management, the authors identify additional management options that could help regulate salinity into the future. For example, they suggest that future restoration projects be designed to mitigate changing salinity due to factors such as flooding or sea level rise. Further details about suggested management options can be found in "How to Respond? An Introduction to Current Bay–Delta Natural Resources Management Options."

The paper ends with a discussion of research priorities that would increase our understanding of salinity impacts. First, the authors suggest investing in improvements to physical models, particularly those that integrate different management and climate change scenarios. Next, the authors recommend prioritizing studies aimed at understanding the ecological and biological responses to increased salinity. They propose research that combines lab and field studies should take precedence over field-only or lab-only work. Lastly, the authors recommend that water-management projects such as reoperation of the Delta Cross Channel, novel operations of the Suisun Marsh salinity gates, or use of the salinity barrier at False River be leveraged as scientific experiments, with adaptable goals that can evolve with the science. This approach will not only advance management goals but also advance the science of management so we can design better actions for the future.

This paper is particularly relevant to the Delta Adapts initiative, as it suggests modeling needs associated with forecasting salinity changes, possible strategies for adapting to increasing levels of salinity, and approaches for assessing the vulnerability of Delta fishes. It is also relevant to Chapters 4 and 6 of the Delta Plan, which focuses on the improvement of water quality to protect human health and the environment, and salinity management to maintain a healthy water supply. The research priorities suggested are additionally relevant to Chapter 4 of the Delta Science Plan, which focuses on supporting effective decision-making through science-based adaptive management and decision support tools.

RECENT ACTIVITIES

Delta Lead Scientist "Ask Me Anything" Office Hours Series

The Delta Lead Scientist "Ask Me Anything" (AMA) office hour sessions, held monthly on Instagram Live (@deltastewardshipcouncil), serve to spread awareness of the Delta Science Program and its activities, as well as provide a regular forum for engagement with the Delta science community. In July, the Delta Lead Scientist continued a discussion on science funding that was initiated in the June session. The July session focused on highlighting specific projects funded through the Delta Science Program's PSN. It was co-hosted by one of the principal investigators funded through the 2021 Delta Science Solicitation.

Science Actions Workshop

The Science Action Agenda (SAA) constitutes a key part of the Delta Science Strategy, together with the Delta Science Plan and State of Bay-Delta Science. Collaboratively developed across a spectrum of stakeholders, the four-year SAA document defines key science actions associated with priority management needs and establishes priorities for within- and cross-agency science funding. Development of the 2022-2026 SAA is underway. As part of the update process, the Delta Science Program hosted a virtual workshop July 13-14, 2021. The goal of the workshop was to identify science actions that responded to six pressing management needs. The management needs built off of the collaboratively developed list of 65 top management questions for the Delta (from 2020) and the 2017-2021 SAA progress summary, providing a framework for science funding for the Delta Stewardship Council and its partners. Breakout sessions at the workshop allowed for focused and collaborative discussion of science actions for each of the six Management Needs. Over 90 scientists, managers, planners, engineers, and more registered for the workshop. The identification of science actions was the final component needed for the update to the SAA for 2022-2026. In the coming

months, the Delta Science Program will release a draft 2022-2026 SAA for public review, including from the Delta Independent Science Board. Visit https://scienceactionagenda.deltacouncil.ca.gov/ or contact saa@deltacouncil.ca.gov for more information about the SAA.

ON YOUR RADAR

Frontiers for Young Minds special issue on the San Francisco Estuary

Frontiers for Young Minds (FYM) is a peer-reviewed journal that is part of the prestigious *Frontiers* family of journals. It publishes peer-reviewed STEM (Science, Technology, Engineering, and Mathematics) papers targeted at 8 to 15-year-old youth, which are edited "for kids, by kids." Delta Science Program staff have been engaged in editing and contributing papers for a special issue in *FYM* that is entitled "Where the River Meets the Ocean: Stories from San Francisco Estuary." There are 35 papers in the collection contributed by Interagency Ecological Program agencies in conjunction with local consultants and university collaborators (totaling over 65 authors) that cover a broad spectrum of topics on the estuary, from mice to hydrodynamic modeling. Thirty-three of the papers are now in press or published (See, for example, "Powering Life in the Water: Phytoplankton in the San Francisco Estuary.")

BY THE NUMBERS

Delta Science Program staff will provide 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 (provided at the Council Meeting)

Attachment 2: Visual Abstract of Article Summary 1

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