INFORMATION ITEM

Lead Scientist Report

Summary

This month's Lead Scientist Report provides a summary of a recent publication from Preece et. al. concerning management of harmful algal blooms (HABs) in the Delta. HABs, especially from blue green algae, called cyanobacteria, can generate toxins that affect the health of fish, wildlife and humans as well. The study focuses on how nutrient loading affected blooms in the Deep Water Ship Channel and the Stockton waterfront in the summer of 2022 and presents four categories of management actions to mitigate the occurrence and impacts of these cyanobacteria blooms.

Recent Delta Science: Managing a cyanobacteria harmful algae bloom "hotspot" in the Sacramento – San Joaquin Delta, California

Ellen P. Preece, Janis Cooke, Haley Plaas, Alexandrea Sabo, Leah Nelson, Hans W. Paerl. 2024. Managing a cyanobacteria harmful algae bloom "hotspot" in the Sacramento – San Joaquin Delta, California. Journal of Environmental Management, Volume 351, 119606. *https://doi.org/10.1016/j.jenvman.2023.119606*

Cyanobacterial harmful algal blooms (CHABs) have become an increasingly persistent problem within the San Francisco Estuary due to the effects of increased temperatures, extreme climate events, and over-enrichment of nutrients in water. CHABs are harmful to ecosystems and can result in large fish kills when they occur. Large estuarine systems, such as the San Francisco Estuary, can be prone to hotspots due to a variety of reasons, such as sources of nutrients, freshwater stagnation or pulses related to storm related hydrologic events. This study focused on the area within the Deep Water Ship Channel and the Stockton waterfront with the most severe CHABs and where a CHAB event occurred during the study in the summer of 2022. Within this area, the study looked at nitrogen (N) and

phosphorus (P) concentrations in the surface water and whether the algal bloom distribution in this region was responding to these as growth-limiting nutrients. They also tested whether P in the sediment and especially the water within the sediment (pore waters) could help predict HAB distributions. These measurements during the large HAB event of 2022 were characterized in time and space to identify potential management actions that could be implemented to reduce HAB intensity and/or frequency in a tidally influenced estuary.

A *Microcystis* bloom occurred in the summer of 2022, and even though other species were present, *Microcystis* was the most abundant. It was found that nutrient concentrations in the Stockton Channel were particularly high even for this region and were tied to both the static water flow, and likely a combination of sources. There was also a large nutrient pool in the sediments and pore waters in the Stockton Channel that also potentially was diffusing into the overlying water column. Although there were high concentrations of *Microcystis* at all 8 sites in the study, Waterfront 3 (near the Morelli boat ramp) had the highest density and most severe bloom. Waterfront 3 was consistently the shallowest (~4m) and mostly the warmest site, and *Microcystis* can grow well under these conditions. The bloom led not only to toxin production (reported in their next paper) but high pH and high dissolved oxygen, likely creating a positive feedback loop that sustained the bloom by keeping nutrients available through the consistently high pH and increasing the amount of organic matter in the sediment. All of these events together created both internal and external nutrient loading that created the ideal environment for this cyanobacteria to grow exponentially, with the bloom lasting until December 2022.

To reduce the intensity and frequency of CHABs, there is no one perfect solution for any waterbody. This paper outlines 4 main categories of management tools to mitigate against CHABs, and whether they would likely make a difference in the Stockton Channel. They are 1) external nutrient control, 2) chemical controls (such as algaecides or barley straw), 3) introducing aquatic vegetation as a biological control to compete against the cyanobacteria for nutrients or light resources, and 4) physical/mechanical controls by using water flows to disrupt the life cycle of the cyanobacteria and prevent the accumulation of colonies or dredging that removes the seedstock of cyanobacteria. For example, even though reducing the nutrients added to the system would be ideal for long term mitigation, in short term, increasing the recirculation of water, particularly in the Waterfront 3 site could help reduce CHABs in that area. The authors note that a series of oxygen diffusing bubblers along the waterfront have been used for alleviating low dissolved oxygen concentrations but haven't provided enough turbulence to break up algal colonies and recirculate the water.

The Delta Science Program hosted a HABs monitoring workshop in November 2022 and has been facilitating the development of an interagency monitoring strategy since that time. The authorship team is releasing the draft HABs monitoring strategy for public comment this spring and will host a Delta Agency Science Workgroup meeting to discuss shared community implementation of the strategy.

Delta Science Program Activities

2024 Bay-Delta Science Conference

Save the date! The Delta Science Program is excited to announce that the 12th biennial Bay-Delta Science Conference will be held in person at the Safe Credit Union Convention Center in Sacramento, CA, from September 30 to October 2, 2024. The Delta Stewardship Council's Delta Science Program and United States Geological Survey have jointly co-sponsored this event approximately biennially since 2000. This year's theme - "Cultivating Connections in a Dynamically Changing Environment" - recognizes the need for diverse perspectives to confront the multiple challenges in a dynamically changing environment such as the Sacramento-San Joaquin Delta. To cultivate this more holistic approach for conservation, the conference will include talks and sessions that encompass a wide variety of disciplines such as the use of traditional knowledge, identifying contaminants within and around the watershed, identifying needs of a variety of species, and exploring ways to mitigate climate change impacts, among other topics. Registration and a call for sessions/abstracts will open later this spring. Stay tuned to the Council's listserv for updates.

2022 State of Bay-Delta Science Executive Summary

The Delta Science Program has recently released an executive summary for the 2022 edition of the State of Bay-Delta Science (SBDS). For this edition, seven peer-reviewed articles exploring the latest scientific understanding of the ecosystem role of plants and algae in the Bay-Delta were published in the open-access San Francisco Estuary and Watershed journal. The full edition emphasized the benefits and negative impacts of these species on the region's ecosystems and human uses. This executive summary offers a condensed version of the edition and provides a snapshot of the main topics covered in each individual article, highlighting key takeaways and summarizing the next steps to consider for future science and management actions.

Topics explored in this edition include:

- Ecosystem services and disservices of plants and algae (Larsen et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art1

- Primary production (Boyer et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art2
- Ecology of aquatic vegetation (Christman et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art3
- Aquatic vegetation control (Conrad et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art4
- Remote sensing methods (Hestir & Dronova 2023) https://doi.org/10.15447/sfews.2023v20iss4art5
- Harmful algal blooms (HABs; Kudela et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art6
- Carbon sequestration and subsidence reversal (Windham-Myers et al. 2023) https://doi.org/10.15447/sfews.2023v20iss4art7

Visit the SBDS website to access the executive summary and learn more about this ongoing synthesis effort (https://sbds.deltacouncil.ca.gov).

On Your Radar

March 12-13, 2024: State of the Estuary Conference

The next biennial State of the Estuary Conference will be held March 12-13, 2024 in Oakland, CA at the Henry J. Kaiser Center for the Arts. The San Francisco Estuary Partnership (SFEP) organizes this event every two years to highlight the current management and ecological health of the San Francisco Bay-Delta Estuary. The conference provides a critical venue for drawing deeper connections across individuals and institutions working on climate adaptation, environmental justice, and region-wide watershed stewardship. Attendees include regional scientists, community organizers, students, legislators, resource managers, planners, and many more others working on issues related to improving, conserving, and monitoring the health of the estuary. Organized sessions and posters will focus on living resources, water quality, climate resilience, and environmental stewardship. Additional pre-conference workshops will take place on March 11. More information will be made available soon about the 2024 State of the Estuary Conference on the SFEP website (https://www.sfestuary.org/state-of-the-estuary-conference).

March 26-27, 2024: Salinity Management Workshop

The Delta Science Program is hosting a two-day virtual workshop to discuss tools and strategies, identify knowledge gaps, and build shared goals for adaptively managing ocean saltwater intrusion in the Sacramento-San Joaquin Delta. This free workshop will include

presentations from researchers on the human dimensions of salinity management and on modeling tools to assess the impacts of various management actions. It will feature interactive sessions to share ideas and gather input from participants about the impacts of management actions, their tradeoffs, and ways to improve modeling tools. The workshop will be held virtually on March 26 and March 27, from 9am-3:30pm. Day one of the workshop will focus on tradeoffs involved with salinity management and who is impacted, while Day two will focus on discussing modeling results that compare scenarios with different management actions and amounts sea level rise. A full agenda will be released in February.

By the Numbers

Science Program staff will summarize 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

Attachment 2: Visual Summary of Article

Contact

Dr. Lisamarie Windham-Myers

Delta Lead Scientist

Phone: (916) 275-6888