INFORMATION ITEM

Lead Scientist Report

Summary

Previous studies conducted by investigators funded by the Delta Stewardship Council have demonstrated that inundated floodplains such as the Yolo Bypass can be excellent rearing habitat for native fish species, but questions remain about whether inundated floodplains and wetlands have positive effects for fish downstream, and if so, through what mechanisms. This pair of studies, funded by the Delta Stewardship Council, addresses questions about how inundated floodplains and wetlands impact food webs. They show that inundated floodplains boost Chinook salmon populations by serving as a source of zooplankton, while floodplains and wetlands can also infuse food webs with organic debris, which is traceable upward to consumers. These studies respond to science action 3D in the 2022-2026 Science Action Agenda (*Test and monitor the ability of tidal, nontidal, and managed wetlands and inundated floodplains to achieve multiple benefits over a range of spatial scales*).

Floodplain trophic subsidies in a modified river network: managed foodscapes of the future?

Anna M. Sturrock, Mollie Ogaz, Kelly Neal, Nicholas J. Corline, Ryan Peek, Dana Myers, Sierra Schluep, Marissa Levinson, Rachel C. Johnson, and Carson A. Jeffres. Lanscape Ecology (2022). https://doi.org/10.1007/s10980-022-01526-5.

The Yolo Bypass, west of Sacramento, has long been operated as a managed floodplain that serves as a major flood control mechanism for the Sacramento Valley during dry years. More recently, studies that received funding from the Delta Stewardship Council have tested whether managed inundation could also benefit juvenile chinook salmon, with the finding that floodplain inundation is linked to

exceptionally high growth rates of salmon. High growth rates and large size are important because they indicate the likelihood of long-term survival in the ocean. In this study, the investigators expanded on previous studies, addressing the question of whether floodplain inundation could also positively impact salmon in downstream habitats. They hypothesized that cladocerans—large-bodied zooplankton that grows preferentially on floodplains—would be more abundant in wet years when floodplains are inundated and in the vicinity of floodplains and that they would constitute an important source of food for chinook salmon when and where they are available.

To address their research questions, the investigators sampled zooplankton and the gut content of chinook salmon downstream of the Yolo Bypass and a floodplain that is naturally inundated most years (the Cosumnes River), as well as more distant locations throughout the Delta. They found that salmon stomachs were fuller during wet years and downstream of floodplains when cladocerans were more abundant and constituted a larger proportion of the fishes' diet. This effect extended downstream to the West Delta and Chipps Island in wet years. The study suggested that floodplain inundation has large-scale benefits for zooplankton populations, food webs, and chinook salmon.

Multiple trophic pathways support fish on floodplains of California's Central Valley

Bobby J. Nakamoto, Carson A. Jeffres, Nicholas J. Corline, Mollie Ogaz, Christina J. Bradley, Joshua H. Viers, and Marily L. Fogel. Journal of Fish Biology (2022). https://doi.org/10.1111.jfb.15248.

Enhancing zooplankton production is not the only way through which inundated floodplains and wetlands may enhance food supply to native fish; these landscapes also produce considerable amounts of detritus—partially-decayed plant material. Given that tidal wetlands tend to be the world's most productive ecosystems, detritus production can potentially be an important component of carbon and energy cycles. However, the extent to which detritus contributes to Delta food webs is unknown. Accounting for the role of detritus in food webs could help link

floodplain and wetland habitat to native fish abundance—a critical missing piece of information in the scientific basis of the Voluntary Agreements and in understanding the relative roles of habitat vs. flows in native fish populations generally.

In this study, the investigators used a relatively new set of methods to trace the original source material (i.e., the material coming from the base of the food web) to tissues within consumers such as salmon, rainbow trout, and American shad. The method identifies the source of amino acids (i.e., components of proteins) within tissues by quantifying carbon isotope "markers" that can be uniquely linked to algae, bacteria, fungi, and plant material through statistical models. As basal sources of amino acids, bacteria, and fungi, which break down detritus, are indicators of detrital contributions to food webs. Findings indicated that while algae were the dominant basal food-web source of amino acids within the tissues of most consumers, bacteria, fungi, and plant material were the dominant sources for some individuals. Furthermore, there was strong evidence that bacteria and fungi serve as important secondary basal food-web sources across the tissues sampled.

Although more work is needed to quantify precisely how inundated floodplains and wetlands enhance native fish abundance, this study was important for demonstrating that detrital supply to food webs is important to account for. Ongoing studies funded through the Delta Science Program's 2021 Proposal Solicitation Notice are further investigating this issue.

Delta Science Program Activities

2023 California Water and Environmental Modeling Forum

The Delta Stewardship Council is one of the member organizations of the California Water and Environmental Modeling Forum (CWEMF), which convened its 29th annual meeting on April 17-April 19. CWEMF was founded to facilitate an open exchange of information on California water issues, resolve technical disagreements in a non-adversarial setting, and ensure that technical work considers the needs of stakeholders and decision-makers. Dr. Larsen attended the meeting to network and advance planning for a modeling collaboratory. Program manager Dylan Stern also represented the Delta Stewardship Council, with a presentation on Council-funded research and modeling.

The key takeaway from Stern's presentation was that the Council's investments in modeling biogeochemistry and ecological dynamics are paying dividends. The modeling community has been embracing linked hydrodynamic-biogeochemical models, and these models are close to becoming operational tools that can be used to better manage nutrients, aquatic vegetation, and more. Some of those models were used to estimate the likely effects of the upgrade to the Sacramento Regional Sanitation District's wastewater treatment plant. With the completion of that project, the science community is beginning to witness the outcomes, leveraging the Science Program's investment in high-frequency data collection. These investments and the resulting datasets can be leveraged to continue improving the models for other imminent resource management needs (e.g., better managing harmful algal blooms and inform restoration, climate change resilience, and/or future infrastructure projects).

Other presentations at CWEMF were relevant to current independent peer review panels facilitated by the Delta Science Program. These presentations included talks on the US Bureau of Reclamation's Water Temperature Modeling Platform and on the Department of Water Resources' climate change analyses conducted for long-term operations planning for the State Water Project.

Decision-making Under Deep Uncertainty Seminar Series

The Decision-making Under Deep Uncertainty seminar series, an activity of the Delta Independent Science Board (DISB) with support from the Delta Science Program, kicked off on April 26 with a seminar titled "Navigating Deep Uncertainty: Insights on Climate Resilience Planning". The inaugural seminar featured an introduction to the concept of decision-making under deep uncertainty by DISB chair Lisa Wainger and Delta Lead Scientist Laurel Larsen, followed by an extended conversation with Alice Hill, currently the David M. Rubenstein senior fellow for energy and the environment at the Council on Foreign Relations. Key takeaways were that the California state government can provide leadership at a national scale in preparing for climate change; that risk mitigation efforts can be highly cost-effective, but to prioritize investments, equity, and other policy-informed factors should be considered as well as economic factors; that exploring a range of risks is valuable for building relationships across agencies that can improve their response to extreme events; and that more applied science investigations are needed to help

communities manage risk. The seminar was well attended, with questions from Alf Brandt (General Counsel to the California Assembly Speaker), the Delta Watermaster, and others. An archived version of the seminar can be accessed on the Council's YouTube channel at https://www.youtube.com/watch?v=zfGNAvRkqhg&list=PLqTHCliW1HhqsTsop-iDwwDTPIZ694UT6.

The next scheduled seminar in the series will take place on June 14 at 1 pm and will feature Robert Lempert, principal researcher at the RAND Corporation and director of the Frederick S. Pardee Center for Longer Range Global Policy and the Future Human Condition, along with Andrew Schwarz, the State Water Project climate action coordinator for the California Department of Water Resources. The seminar will focus on available tools for decision-making under deep uncertainty and their applications in California. The seminar series, which will occur approximately monthly, will lay the foundation for an Independent Science Board Review on the same topic. Seminars are part of the DISB meetings and are accessible through the DISB meeting link.

2023 Adaptive Management Forum

The 2023 Adaptive Management Forum took place on May 4, 2023, with a thematic focus on governance for adaptive management. An archive of the forum is available at https://www.youtube.com/@DeltaCouncil/videos and a detailed report will be provided in a forthcoming Lead Scientist's report.

UC Davis Coastal and Marine Sciences Institute/DSP Joint Symposium: Implications of Rising Temperatures for Coastal, Marine, and Estuarine Ecosystems

On Friday, May 19, 2023, the UC Davis Coastal and Marine Science Institute and Delta Science Program jointly hosted a symposium on the influence of extreme heat on organisms, communities, and socio-ecological systems. An archive of the meeting is available at <placeholder>, and a detailed report will be provided in a forthcoming Lead Scientist's report.

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 Floodplain-Fish Articles

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