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The Response of Phytoplankton and Nutrient Composition at Rio Vista, CA to an Upgrade of a Major Wastewater Treatment Plant

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How will nutrient composition and chlorophyll concentration at Rio Vista, CA respond to the Regional San Wastewater Treatment Plant (RSWWTP) upgrade?

Rio Vista, CA is located downstream from RSWWTP and upstream from the northern San Francisco Estuary (nSFE), a high nutrient low chlorophyll (HNLC) system that provides essential low salinity habitat for endangered pelagic fish such as the Delta Smelt. As such, Rio Vista is an advantageous site to monitor how RSWWTP's recent "EchoWater" upgrade affects the nutrient regime and chlorophyll content of water that is delivered to the nSFE. This data will provide data that can help elucidate the broader ecological impacts of management actions like the EchoWater upgrade in complex estuarine systems.

Background – RSWWTP

- Anthropogenic nitrogen (N) loading from RSWWTP - major source of nutrient for the nSFE
- Recent EchoWater upgrade in Nov. 2020 and Apr. 2021 added tertiary treatment to RSWWTP
- Tertiary treatment removes ammonium-N through nitrification and denitrification
- Predicted to reduce effluent ammonium-N by ~93% and total DIN by ~65%

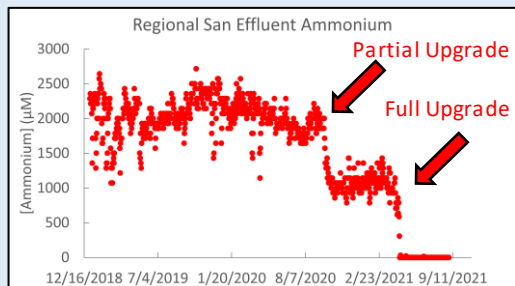


Figure 1: Ammonium concentration in Regional San effluent

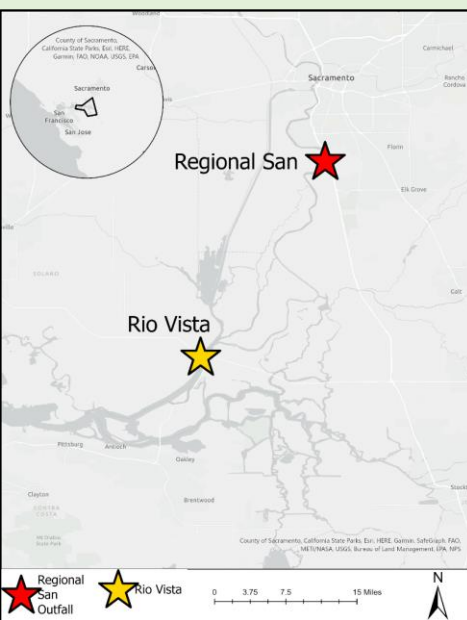


Figure 2: (Top) Rio Vista, CA. (Bottom) Study site map

Methods

- Time series of nutrients and chlorophyll-*a* data at Rio Vista generated using data from USGS (Schrage et al. 2020), Wilkerson/Dugdale lab, and biweekly field surveys by car
- Chlorophyll and nutrients analyzed according to Wilkerson et al. (2015)
- Nitrate, ammonium and carbon uptake by phytoplankton also measured, data not shown

Source	Dates	Data
USGS	1 & 2/2020, 9-12/2021	Nitrate, Ammonium, Chlorophyll
Wilkerson/Dugdale Lab	3/2020 - 2/2022	Nitrate, Ammonium, Chlorophyll

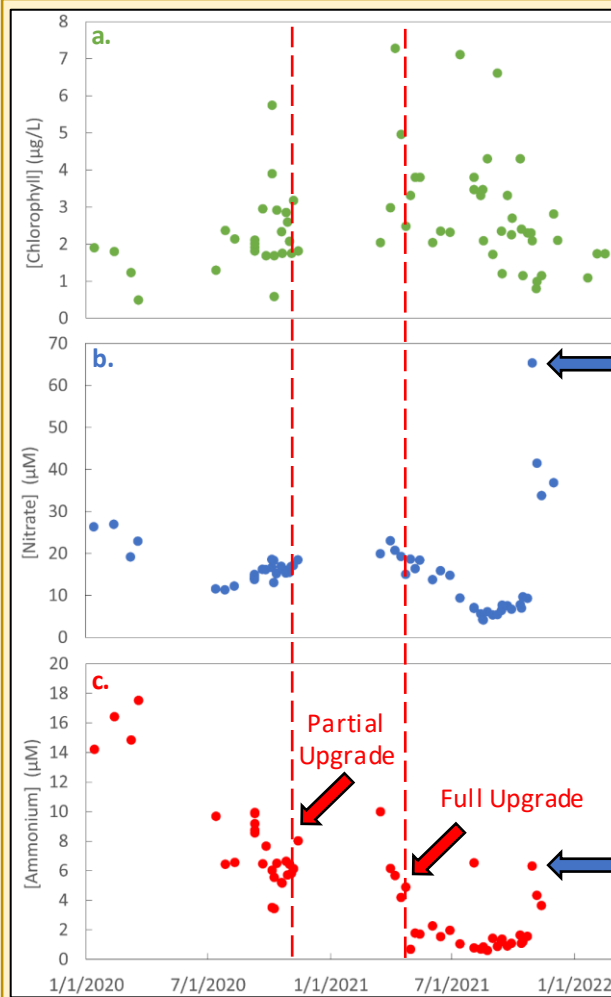


Figure 3: Time series of chlorophyll, nitrate and ammonium at Rio Vista covering the partial (11/2020) and full (4/2021) WWTP upgrades and atmospheric river.

Results

- Chlorophyll-*a* (a.) concentration at Rio Vista, CA doesn't show an immediate response following the EchoWater upgrade
- Nitrate-N (b.) concentration declined after the full upgrade, then increased during the atmospheric river in late October 2021
- Ammonium-N (c.) concentration declined immediately following the full upgrade
- Ammonium-N (c.) concentration remained low (~1µM) until the atmospheric river in late October 2021
- Gaps in nutrient and chlorophyll data highlight importance of consistent sampling to observe fine scale temporal trends

Next Steps

- This is part of my master's thesis research in progress that will include phytoplankton nutrient uptake in the Rio Vista time series – these samples have yet to be analyzed
- The larger work will also characterize phytoplankton nutrient uptake kinetics at Rio Vista, CA with incubation experiments
- Continue biweekly time series of nutrient and chlorophyll data

References
 1. Schraga, T.S., Nejad, E.S., Martin, C.A., and Cloern, J.E., 2020. USGS measurements of water quality in San Francisco Bay (CA), beginning in 2016 (ver. 3.0, March 2020): U.S. Geological Survey data release. <https://doi.org/10.5066/77021WGF>.
 2. Wilkerson, F.P., Dugdale, R.C., Parker, A.E., Blaser, S.B., Pimental, A., 2015. Nutrient uptake and primary production in an urban estuary: using rate measurements to evaluate phytoplankton response to different hydrological and nutrient conditions. *Aquatic Ecology* 49(2): 211-233

Acknowledgements
 This material is based upon work supported by the National Science Foundation under Grant No. (NSF 1633336), the CSU Council on Ocean Affairs, Science and Technology (COAST) Graduate Student Research Award, financial support from CA DFW Agreement Number Q1996035. Special thanks to Tim Mussen from Regional San for providing effluent data.