

# How do nutrient and phytoplankton conditions in Sacramento River and Suisun Bay compare before and after Echowater implementation by Regional San?



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## Background and Rationale

- “EchoWater” is the upgrade made to the Regional San wastewater treatment plant, completed in April, 2021 that added tertiary treatment that removed ammonium in the effluent through nitrification and denitrification.
- Was this reduction in ammonium and nitrate reflected downstream? Answer - Yes. More data for different seasons and conditions needed.

## Study Site and Methods

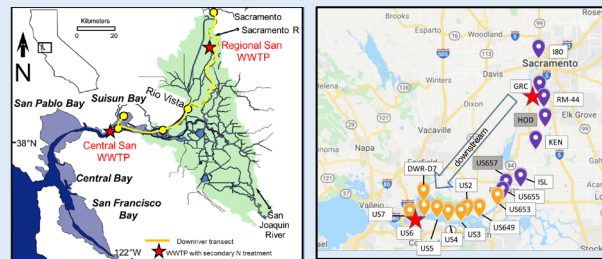


Fig. 1: Downstream transect and details of station locations. Purple stations sampled on 22 Sept 2021 and orange stations on 23 September. Experimental enclosures filled at grey stations.

- In September 2021, a downstream Sacramento River-Bay Delta transect was sampled for measurement of nutrients, chlorophyll (Fig. 2), photosynthetic response and to fill experimental enclosures (Fig. 5).
- Photosynthetic yields (Fv/Fm) and light responses (P vs I curves) of diatoms and chlorophytes (dominant algal signals) were measured using a PhytoPAM II fluorometer (Walz Instruments) (Fig. 3).
- P<sub>max</sub> (as the relative electron transport rates, rETR<sub>max</sub>) were calculated from the rETR versus irradiance curves.
- A subset of samples was also enriched for an hour with a gradient of ammonium (15, 30 and 60 μmol/L), and the maximum photosynthetic rates measured (Fig. 4).

## Downstream Comparison Sept 2021 vs Sept 2013 and 2014

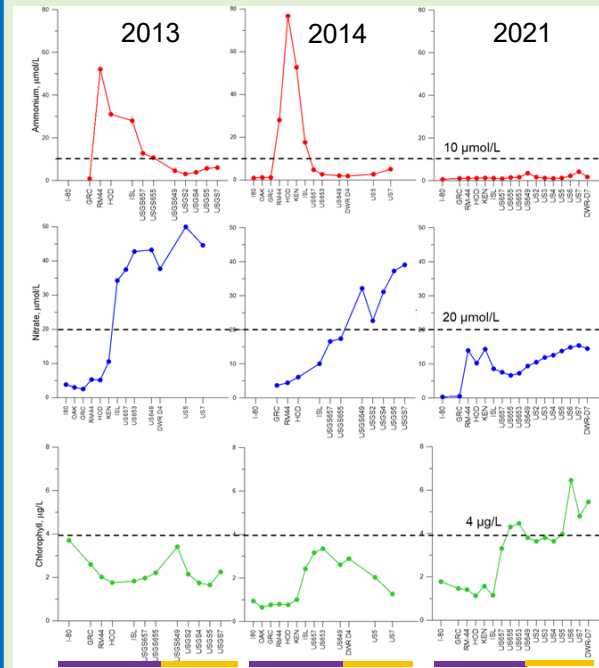


Fig. 2: Downstream transect data of concentrations of ammonium, nitrate and chlorophyll measured in September 2013 and September 2021 by same personnel with same methods, purple indicates upper river and orange lower and Suisun Bay

- Ammonium and nitrate were lower in 2021 than 2013
- No ammonium spike at RM44 (Regional San) in 2021 (following upgrade).
- Dip in nitrate mid transect in 2021.
- Downstream chlorophyll concentrations were slightly higher (> 4 μg/L) during the 2021 transect although they did not reach bloom conditions.

## Phytoplankton Condition Sept 2021

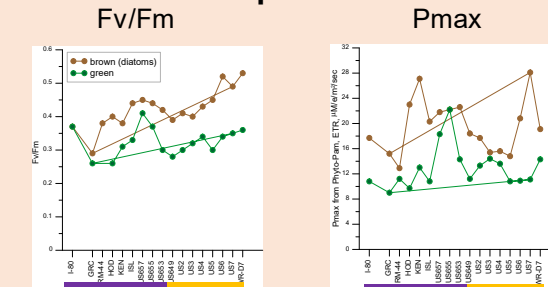


Fig. 3: Downstream transect data of quantum yield of PSII (Fv/Fm) and light saturated photosynthesis (Pmax) measured in September 2021 for diatoms and chlorophytes, purple indicates upper river and orange lower and Suisun Bay

- Fv/Fm values for the diatom group were higher (indicating better condition) than those of the chlorophytes.
- Highest values of Fv/Fm (>0.5) in Suisun at US6, US7 and DWR-D7, where NO<sub>3</sub> was higher.
- Pmax, higher for diatoms than chlorophytes.

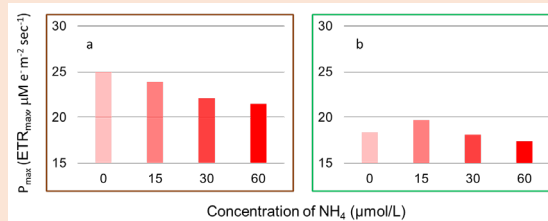


Fig. 4: Pmax measured using PhytoPAM II for two dominant algal groups, a) brown algae (diatoms) and b) chlorophytes, following amendments of ammonium up to 60 μmol/L

When ammonium was added to water from RM444, Pmax of diatoms declined (a) as ammonium increased, whereas for green algae (b), no consistent response was observed, and even a slight increase was observed at 15 μmol/L. Diatoms more sensitive.

## Enclosures with added Nutrients and Effluent -Sept 2021

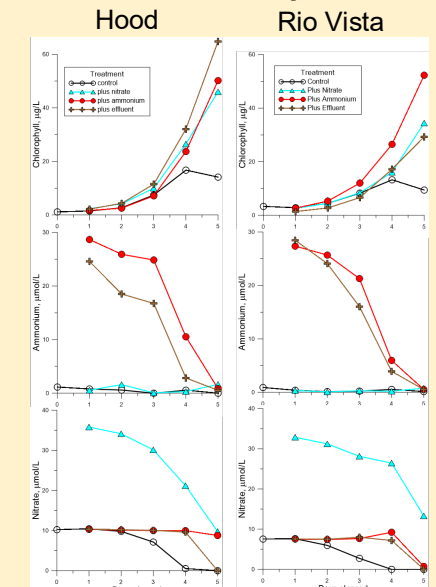


Fig. 5: Chlorophyll increase (upper panel), NH<sub>4</sub> and NO<sub>3</sub> decrease (center and lower) in enclosures filled with water from Hood (left) and Rio Vista (right) and tracked for 5 days. Experimental enrichments were made – plus nitrate, plus ammonium and plus effluent diluted to match ammonium enrichment

- Water from below Regional San (Hood) and Rio Vista was held for 5 days at ambient conditions and amended with ammonium and nitrate or Regional San effluent (from frozen aliquots provided in 2013).
- Phytoplankton used all sources on N and grew in all cases (top panel), with more biomass in Hood enclosures.
- Nitrate not used until ammonium drawn down.

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