

IEP Workplan

Send to Anke Mueller-Solger, Kelly Souza, and Gregg Erickson as well as the IEP staff person(s) assigned to your project by November 30, 2012.

Project Title: Nitrogen Dynamics Along the Sacramento River and Links to Phytoplankton Dynamics: Resolving Spatial and Temporal Variability Using In-Situ, High Frequency Measurements and Other Tools

Point person(s): Anke Mueller-Solger, in coordination with Ewrin VanNieuwenhuysse, Karen Gehrts, and Louise Conrad.

Lead IEP Agency: [Leave blank]

Questions:

- How do nutrient concentrations (nitrate, ammonium, phosphate) and phytoplankton abundance, activity and composition vary as water travels down the Sacramento River into the Delta in the presence and absence of effluent discharges from the Sacramento Wastewater Treatment Plant?
- What is the impact of wastewater effluent on these parameters? Is it likely that reductions in NH₄ additions to the Sacramento River due to changes in SRWWTP treatment processes will lead to higher concentrations of phytoplankton and improved species composition?
- Can we gain additional insight into nutrient and phytoplankton dynamics using in-situ, high-frequency measurements and a Lagrangian-based approach that cannot be resolved using traditional discrete sampling approaches?

Description:

Profiling a river using a Lagrangian-based approach – moving at the same velocity as the river – allows the tracking of a parcel (mass) of water as it makes downstream. This approach is particularly beneficial in hydrodynamically complex, tidally influenced ecosystems with temporally varying inputs. In this study, longitudinal transects of the 67 km (42 mile) reach of the Sacramento River approximately between the I-80 Bridge and Isleton will be conducted during two seasons. During each season, a pair of transects will be conducted: one when wastewater effluent is being discharged from the Sacramento Regional WWTP into the river, and another immediately following that when wastewater outflows are halted for up to 12 hours. Comparison of river conditions in the presence and absence of SRWWTP will allow us to evaluate the effects of effluent discharges on nutrient and phytoplankton dynamics in the Sacramento River as it enters the Bay-Delta.

The river will be navigated by a boat equipped with a suite of in-situ sensors designed to measure and record continuous, real-time water quality data. Discrete water samples will be collected approximately every two hours during each transect in order to validate and calibrate the instrument packages. In addition, discrete samples will be collected at approximately five specified stations and analyzed to measure constituent concentrations, identify algal species composition, determine phytoplankton primary production, estimate NH₄-N and NO₃-N uptake rates, and to obtain a full suite of isotopic measurements.

Time period: January 2013 to December 2013

Resources and permits required:

Cost: \$100,000 from IEP, \$50,000 from Sac. Regional, approximately \$46,000 from USGS Matching Funds for a total cost of \$196,000.

PI(s):

Tamara Kraus, Brian Bergamaschi, Bryan Downing - USGS California Water Science Center (CAWSC)

Kurt Ohlinger – Sacramento Regional County Sanitation District (SRCSD)

Kurt Carpenter - USGS Oregon Water Science Center (ORWSC)

Carol Kendall, Megan Young – USGS National Research Program (NRP)

Alex Parker – Romberg Tiburon Center, San Francisco State University (SFSU)

Contract needed / in place: [Leave blank]

Contract manager: [Leave blank]

Term of contract: [Leave blank]

Personnel:

Name	Title	Affiliation
Tamara Kraus	Soil Scientist	USGS CAWSC
Bryan Downing	Hydrologist	USGS CAWSC
Bryan Bergamaschi	Chemist	USGS CAWSC
Scott Nagel	Hydrologic Technician	USGS CAWSC
Paul Kreun	Hydrologic Technician	USGS CAWSC
Katy O'Donnell	Hydrologic Technician	USGS CAWSC
Angela Hansen	Physical Science Technician	USGS CAWSC
Kurt Carpenter	Hydrologist	USGS ORWSC
Carol Kendall	Hydrologist	USGS NRP
Megan Young	Hydrologist	USGS NRP
Steve Silva	Hydrologist	USGS NRP
Darius Briar	Hydrologic Technician	USGS NRP
Ying Tu	Hydrologic Technician	USGS NRP
Christa Arthur	Hydrologic Technician	USGS NRP
Alex Parker	Research Scientist	SFSU

Equipment: none planned, equipment will be provided by the USGS

Endangered species take: not applicable

Endangered species take permit(s) and conservation benefit: not applicable

Deliverables and dates:

- Memorandum describing the methods, data processing, analysis, and interpretation (draft complete by February 31, 2014, assuming project starts January 2013)
- Presentations at IEP meetings and workshops, and other scientific meetings (dates TBD).
- Dependent on study findings, one or more journal articles focused on specific aspects of the work (December, 2014)

● **Which priority research topics and questions listed in the 2012 Call for Study Concepts does this project address?**

This study addresses *Priority Research Topic 2: Physical and chemical habitat effects on fish populations*, and specific questions relating to 2A, 2C, 2E. Both abiotic and biotic effects on nutrient concentrations and phytoplankton amount and speciation will be characterized by location and season. We will specifically address the question of how contaminants (NH₄, wastewater effluent) affect POD. We will also address *Priority Research Topic 3: Food web effects on fish populations (bottom-up effects)*. Both dynamic and stationary habitat components

will be measured. Results from this study will address questions about temporal and spatial variability in food supply, and identify factors that enhance or inhibit phytoplankton populations in the Sacramento River as it enters the Delta. This project also supports priority research questions previously identified by the CALFED Science Program and the Fall Outflow Adaptive Management Plan aimed at understanding ammonium (NH₄) sources, sinks, and transformations in the Delta – and their effects on the amount, type, and growth of algae.

Expected contribution to improving basic scientific understanding:

Results from this study will address uncertainties about ecological processes (e.g., nutrient impacts on phytoplankton health) and management actions (e.g., changes in Sacramento Regional wastewater treatment processes, the timing and amount of effluent releases).

The overall project objective is to further our understanding of the link between nutrient and phytoplankton dynamics and to elucidate effects of wastewater treatment plant (WWTP) effluent on food web dynamics. By using a combination of in-situ, high frequency measurements and discrete sample analyses to track parcels of water as they travel past WWTP inflows, we will be able to provide a more robust understanding of the relationship between phytoplankton, ammonia, nitrate and phosphate than possible using traditional monitoring programs based on grab sample data. Results from this study will provide general information about the benefits of using in-situ, high-frequency measurements to resolve processes in a complex environment.

Expected contribution to improving the scientific basis for Bay-Delta policy and management:

Current understanding of the Bay-Delta ecosystem attributes historical declines in phytoplankton blooms and shifts in species composition to high concentrations of ammonia entering the Sacramento River from the Sacramento Regional WWTP (SRWWTP). A new 2010 Discharge Permit for the SRWWTP requires modifications to the treatment process to reduce effluent ammonium concentrations. Results from this study will help us predict how changes in SRWWTP operations (e.g., reductions in effluent ammonium concentrations) will impact phytoplankton dynamics in the Sacramento River as it enters the Bay-Delta.

Use of recently developed in situ, high-frequency tools to monitor nutrients, particles, and algae will provide insight into nutrient and phytoplankton dynamics that cannot be resolved using traditional discrete sampling approaches. This information will help managers determine what additional monitoring and special studies are needed to inform important and potentially costly management decisions aimed at reducing nutrient loads to the Delta.

Comments:

- This study relates to two other projects funded during this IEP 2012 proposal call: see proposals by Dugdale and Kudela.
- Pellerin/Bergamaschi: USGS monitoring stations at Liberty (current and proposed)
- Dugdale/Parker: SWC-funded Project studies
- Dugdale/Mueller-Solger: CALFED Two Rivers Project
- Dugdale: SWAMP (RMP funded) Suisun Phytoplankton study
- Foe: RWB-funded NH₄ Monitoring Project
- Kendall: SWC-funded Project
- Kendall: two POD-oriented IEP/BOR 2010 Studies
- Lehman: DWR-funded Microcystis Projects
- Kendall/Guerin FLaSH projects
- Parker: IEP funded “Fall Habitat” Study
- Parker: FLaSH phytoplankton project
- X2/FLaSH Studies