Point person: Erwin van Niewenhuyse
Lead IEP Agency:
Questions:

- What biogeochemical and biological processes regulate the sediment-water exchange of nutrients in sediment and animal communities?
- How does changing salinity affect the delivery of phosphorus and nitrogen from sediments to the water column?
- Is pH a key factor in sediment nutrient balances, particularly where cyanobacterial production increases pH on diel bases?
- Are benthic animals such as *Potamocorbula* altering benthic nutrient recycling?
- Is dissimilatory reduction of nitrate to ammonium (DNRA) an important process for the retention of fixed nitrogen within sediments?
- Is sediment nitrogen fixation important to the overall nutrient balance?

Description:

This study will examine the controls of sediment-water exchange of nutrients along the gradient of salinity in the Bay-Delta complex. This proposed study aims to continue to build our knowledge of nutrient fluxes from sediments in the Bay Delta, to extend sediment flux studies in the Bay Delta that were initiated in September 2011 in order to provide an interannual comparison set of observations and to conduct experimental manipulations to allow us to understand both abiotic and biotic controls on these fluxes. Ultimately our goal is to integrate these rates and processes into a broader understanding of nutrients available to support the food web of the Bay Delta. We hypothesize that sediments play an important role in nutrient transformations in the estuary, that nutrient fluxes from sediments not only help to sustain high biomass during algal blooms, but that these fluxes are significantly altered by the synergistic feedbacks of biologically-driven pH alterations, abiotic salinity intrusions, biotic organismal presence and associated biogeochemical processes. Inclusion of knowledge of these fluxes and their controls will be fundamental to broader ecosystem understanding, management of nutrients and their loads, and ecosystem models.

Sampling will be undertaken during two seasons, spring and late summer. During each sampling period, a transect of up to 12 cores will be collected from the flooded island to Suisun Bay. Sediment cores will be incubated in both dark and illuminated conditions and changes in the concentrations of overlying nutrients will be determined over time to assess nutrient flux rates. In addition, measurements of oxygen exchange and denitrification and nitrogen fixation will also be made. On a subset of samples, measurements will also be made of the process of dissimilatory nitrate reduction to ammonium (DNRA). Experimental manipulations will also be conducted to assess effects of changes in both abiotic (e.g., salinity, pH) and biotic (e.g., clam abundance) conditions. Pore water and solid phase chemical profiles will also be provided.

Time period: January 2013 to December 2013
Resources and permits required:

Cost: $135,476
PI(s): Patricia Glibert
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Contract needed / in place:
Contract manager:
Term of contract:
Personnel: Michael Owens, Senior Faculty Research Assistant
Jeffrey Alexander, Senior Faculty Research Assistant
Equipment: none
Endangered species take: none
Endangered species take permit(s) and conservation benefit: none

Deliverables and dates:

- IEP conference presentation, April 2013
- Final Report, January 2014
- Manuscript, January 2014
- IEP newsletter summary, January 2014

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

This research directly addresses *Topic 2E* (How do interacting dynamic and stationary habitat components affect seasonal nutrient patterns in the estuary?), but has bearing on *Topics 2D* (What are the distribution, transport, fate, concentration, and effects of contaminants including pesticides, ammonia, and metals that may have lethal or sublethal effects on fishes and their food items in the estuarine low-salinity zone, and how are these affected by the interaction of stationary and dynamic habitat components?; *and 3F* (How do interacting dynamic and stationary habitat components affect the occurrence, distribution, and intensity of harmful algal blooms and their effects on fishes?)

Expected contribution to improving basic scientific understanding:

This project aims to advance our understanding of nutrient cycling in the Bay Delta, with particular emphasis on sediment nutrient processes in Suisun Bay and the low salinity region. In addition to providing fundamental information on seasonal sediment nutrient exchange rates, this project aims to experimentally address key processes that may regulate nutrient exchange, such as changes in abiotic factors including salinity and pH, and biotic factors including benthic community composition. In addition to regenerative fluxes, this project will quantify the rates of denitrification, dissimilatory nitrate reduction to ammonium (DNRA) and nitrogen (N_2) fixation. The effect of benthic fluxes on overlying algal community composition will also be addressed.

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

In the Sacramento-San Joaquin Delta area, nutrients are now gaining attention as important stressors. The Bay Delta has long been recognized to receive high nutrient loading while it sustains comparative low pelagic productivity. The sediment reservoir of nutrients relative to new point and non-point source loads is not well understood. Additionally, the extent to which sediments processes serve to alter the amount or form of nutrients in the water column is far from understood. Thus, despite the intensity of study of the myriad of environmental pressures in the Sacramento- San Joaquin Delta

ecosystem, an accurate accounting of nutrient sources and sinks is not available. Measurements of nutrient fluxes in the sediment allow an assessment of how important the water column processes are relative to those in the sediment and will provide the requisite data for modeling frameworks and will ultimately be relevant to nutrient criteria development.

Comments:

This work builds on our previous (Sept 2011, March 2012) sediment flux measurements in several ways. Fall 2011 was an unusually wet season, and it would be helpful to be able to compare a year when salt water intrusion was more typical. This work adds the additional dimension of understanding abiotic and biotic controls on flux rates. It complements a project pending funding by the State and Federal Contractors Water Agency that will help to support the experimental manipulations described herein, allowing additional complexity and sampling sites to be built into the experimental program. This project adds a sediment component to ongoing intensive studies on NH_4^+ in Suisun Bay by Dugdale, Wilkerson et al. and to nutrient-related studies being undertaken by Glibert, Wilkerson, Dugdale and Parker with Delta Stewardship Council support. Moreover, this project will aim to coordinate with any other ongoing nutrient efforts focused in Suisun Bay, such as those proposed by Berg and Kudela on phytoplankton uptake of various N forms.