Kearney Foundation Fellowship
Final Report Summary

Fellowship Recipient's Name: James Chang

Project Title: The contribution of redox sensitive phosphorus to the total bioavailable phosphorus

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Reporting Period: July 1 – September 30, 2007

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General Background

Most of the degradation of water quality in natural systems is contributed by non-point sources (Baker 1992, cited by Mitsch et al. 1995). The degradation of water includes eutrophication in rivers, lakes, and marine ecosystems. The abundance of nutrients such as nitrogen and phosphorus can also encourage the growth of invasive plant species (Vymazal 2007). Constructed wetlands are an applied system to improve the water quality of non-point source waste water, such as agricultural tailwater, before discharging into a natural system.

The study took place in at a privately owned constructed wetland (W1) occupying 7.3 hectares located directly adjacent to the San Joaquin River near the city of Modesto. W1 has an open water design, similar to a pond. The wetland is 3 years old and has been used for treating agricultural tailwater from about 4,000 acres of contributing farm land and for recreational duck hunting by the owner. Agricultural tailwaters entering this wetland are primarily contributed by farms growing deciduous nuts and fruits. W1 is a seasonal wetland that is flooded between mid-spring and early fall.

Objectives

The objectives of the project were to investigate the contribution of redox sensitive phosphorus (RSP) within the total phosphorus by tracing RSP in the water column, in the suspended sediment, and in sediment cores. Another objective was to show the spatial distribution of RSP within W1 soils and relate this distribution to diurnal studies of dissolved oxygen (DO). We expect to see a lower concentration of RSP where DO is higher. The results from the sediment traps are predicted to be larger than the values found in the sediment cores, as the RSP will decrease in anoxic soils.

General methods

Grab samples were collected on a weekly basis at the input and output locations for the entire season (March-September 2007). RSP was extracted using the dithionite extraction method on an unfiltered sample. The sample must be unfiltered to include the iron bound

phosphorus or any precipitated forms of phosphorus. The concentration of RSP was analyzed colormetrically, using the ammonium molybdate method after an autoclave digestion.

Suspended sediment samples were collected in 25 detachable sediment traps in the wetland. These samples and the sediment cores were collected monthly. The sediment cores were purged with nitrogen gas to keep the soil under anoxic conditions. Bicarbonate diothionite extraction methods were used to determine the concentration of RSP in the soil from the sediment traps. The concentration of RSP was analyzed colormetrically using the ammonium molybdate method after an autoclave digestion.

Sediment core samples have not yet been extracted. They were kept frozen until thawed and extracted for RSP.

Results

The average concentration of RSP in grab samples was 0.21 ± 0.07 ppm in the input and 0.22 ± 0.12 ppm in the output, which isn't significantly different. The concentrations of RSP in grab samples in the diurnal study are yet to be analyzed.

The concentrations of RSP in the sediment traps ranged from 60 to 200 mg P/kg (Fig 1). The spatial distribution of RSP is highly variable. Samples analyzed on June 12th were high in concentration mostly likely due to an error in the procedure. This error was associated failing to homogenize the sediment and performing the bicarbonate dithionite extraction primarily on clay particles.

The sediment core samples are yet to be analyzed. No conclusion can be made about the data at this point as the results are still in progress. Potentially, future results can be drawn together to further depict the biogeochemical processes within this wetland and how they may influence phosphorus availability.

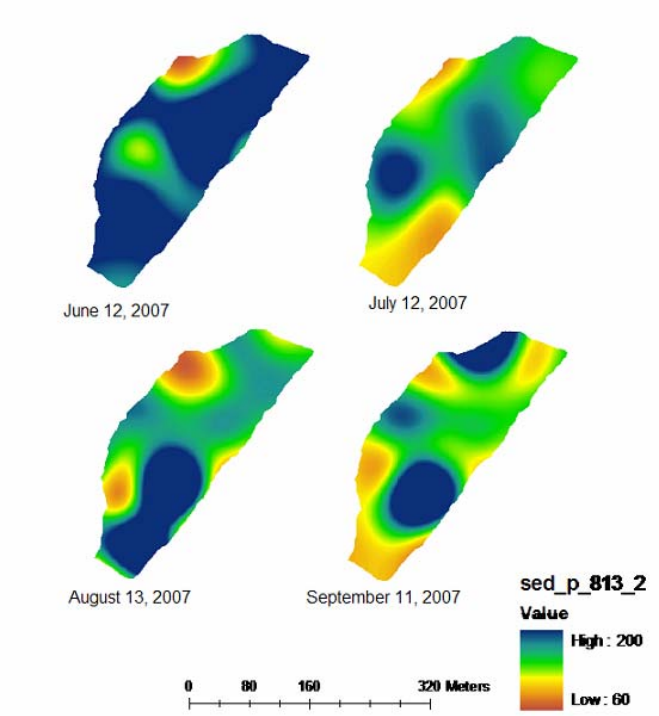

Figure 1. Isopleths of RSP in the suspended sediment from sediment traps.

References:

Vymazal, J. 2007. Removal of nutrients in various types of constructed wetlands. Science of the Total Environment 380:48-65.

Mitsch, W.J., J.K Cronk, X. Wu, R.W. Nairn, and D.L. Hey.1995. Phosphorus Retention in Constructed Freshwater Riparian Marshes. Ecological Applications, Vol. 5, No. 3, pp. 830-845.