Implications of Seasonal Anoxia and Sediment Resuspension on Nutrient Loading and HAB Initiation

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USACE Harmful Algal Bloom Research & Development Initiative

Delivering scalable freshwater HAB prevention, detection, and management technologies through collaboration, partnership, and cutting-edge science.

Problem

This work unit addresses two tasks. First, project partners at Texas A&M University Galveston (TAMUG) require water quality analysis for a large-scale limnology study examining nutrient cycling in multiple Texas reservoirs in order to develop a comprehensive harmful algal bloom (HAB) risk model. Second, sediment resuspension and vertical mixing of nutrient-rich bottom-waters release nutrients that play a key role in HAB outbreak initiation, but internal nutrient loadings associated with sediments in reservoirs of the south central US are poorly understood. As a result, ERDC will conduct sediment nutrient experiments to inform develoment of the TAMUG HAB risk model.

Objective

The objective is to (1) complete water quality analysis for our TAMUG partners, and (2) determine the magnitude and stoichiometry of nutrient loading from sediments during seasonal water column mixing and resuspension events. Both data sets will be incorporated into a model useful for lake and watershed scale HABs management.

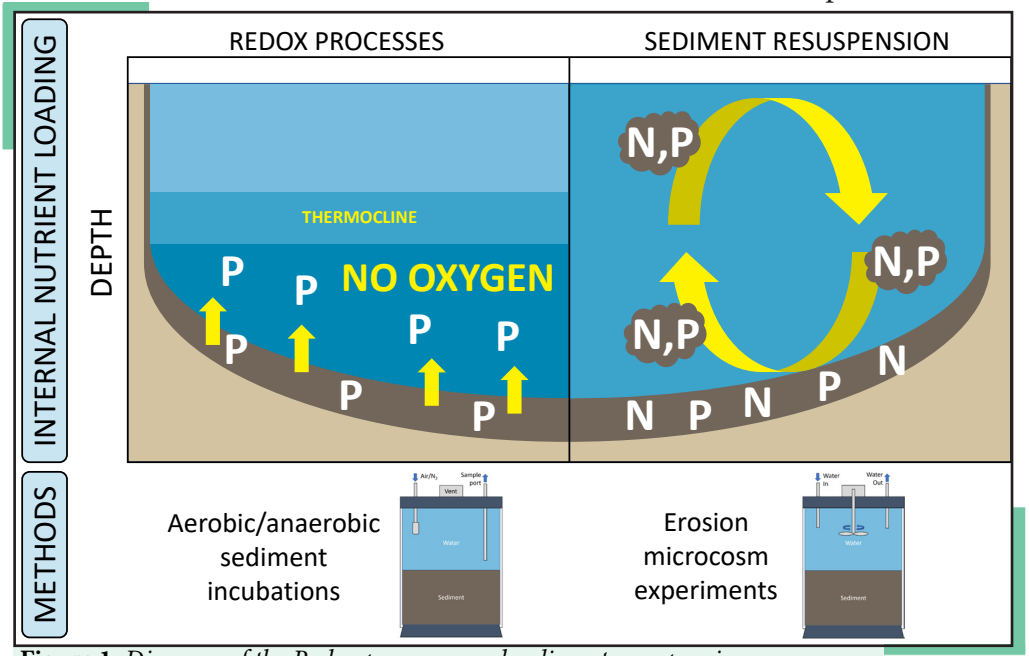

Figure 1. *Diagram of the Redox processes and sediment resuspension (note: P = phosphorous, N = nitrogen)*

Approach

(1) Characterize standard water quality parameters from several hundred seasonally stratified water quality samples collected by project partners at TAMUG; (2) evaluate sediment morphology, available nutrients, and relevant solid phases in eight Texas reservoirs; (3) quantify nutrient concentrations in surface water, bottom water, and sediment pore water; (4) determine magnitude of potential nutrient release from sediment to anoxic bottom waters using sediment incubations; and (5) investigate nutrient release from sediment due to sediment resuspension using an erosion microcosm system.

Results

Nutrient analysis has been completed on 560 water quality samples and data shared with TAMUG partners for continued development of our HAB risk model. Despite logistical challenges, sediment cores were collected from five reservoirs in Texas and incubation experiments are ongoing to determine the magnitude of nutrient loading during seasonal anoxia events (Figure 2). Following these incubation experiments, erosion microcosm experiments will begin to determine the contribution of particulate-phase nutrients to internal nutrient loading.

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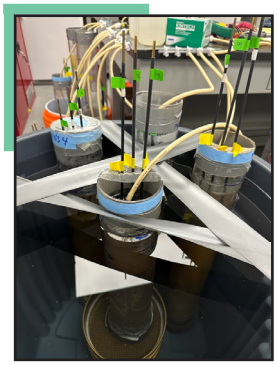

Figure 2. *(Left) Aerated sediment cores simulating the oxygenated lake bottom during the summer; and (right) intact sediment core collected using a vibra-corer for use in incubation and erosion microcosm experiments.*

Major Milestones

Delivered	Description
Publications	**Journal Article:** Kneer et al. In prep. "Impact of Sediment Characteristics and Seasonal Anoxia on Importance of Nutrient Loading in Warm Monomictic Reservoirs." *Journal of Lake and Reservoir Management.* **Journal Article:** Kieley et al. In prep. "Quantitative Model for HAB Prediction in Reservoirs of Southcentral TX." *Ecological Modeling.*
Tech Transfer	**Instruction Manual:** Kieley et al. In prep. "Quantitative Model for HAB Prediction in Reservoirs of Southcentral TX."
Products	**Quantitative Model** for HAB Prediction in Reservoirs of Southcentral TX.

Partnership/Leveraging Opportunities

This work is leveraging a collaboration wth research project partners from TAMUG (PI: Roelke). The collabortion will contribute to development of a comprehensive quantitative model to quantify HAB outbreak risk.

Value to USACE Mission

Characterization of sediments and quantification of sediment nutrient loading will improve lake-scale nutrient management strategies and contribute to watershed HAB risk model development.