Category II - Aquatic Ecosystems

Metal Cycling and Bioavailability During Phytoplankton Blooms in South San Francisco Bay

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EXECUTIVE SUMMARY:

Pollution and eutrophication, or biological changes that result from inputs of excessive inputs of human wastes, are two interrelated problems impacting estuaries. San Francisco Bay, the largest estuary on the continental west coast of the United States, is polluted with many heavy metals. These include mercury, which is so concentrated in some fish within the Bay that there are both (1) fish consumption advisories for humans and (2) concerns that endangered species within the Bay (e.g., clapper rail) are being exposed to toxic levels of mercury. Concurrently, San Francisco Bay has high concentrations of nutrients from human sources that may cause both (1) eutrophication and (2) alterations in the cycling of metals and their bioaccumulation in organisms within the Bay.

Therefore, this research is focused on the interaction between eutrophication and metal contamination in South San Francisco Bay. In that embayment, there is a highly predictable spring phytoplankton bloom, where microscopic plants at the base of the food chain rapidly increase in number. Excessive nutrients in the Bay help to sustain this bloom, and recent research has shown that blooms may play an important role in the mobilization and bioavailability of trace metals within the estuary. For example, if the phytoplankton uptake methyl mercury, one of the most toxic forms of mercury, during the bloom, it could introduce a pulse of bioavailable mercury to the food chain. Blooms may also serve as mechanisms to retain metals in estuaries, contributing to an increase in pollutant levels over time. Accordingly, this reach is important for managers who must regulate the amount of nutrients entering the bay.

To evaluate the impact of the nutrient enriched spring bloom in South San Francisco Bay on the uptake and bioavailability of trace metals, this research will measure dissolved and total metal concentrations before, during, and after spring blooms. Our preliminary results from spring 2003 have shown that the growth of the bloom causes uptake of nickel, and that its decay releases cobalt. Further laboratory and field studies will result in three papers. The first paper will address changes in the concentrations of cobalt, copper, nickel, lead, and zinc during blooms. The second will describe interactions between phytoplankton species composition and metal concentrations. The final paper will describe the uptake of methyl and total mercury during the bloom. These papers will be integrated with existing monitoring work in San Francisco Bay to better describe the processes that govern metal concentrations and bioavailability in the estuary.