Heavy Metal: Phytoplankton Interactions in San Francisco Bay

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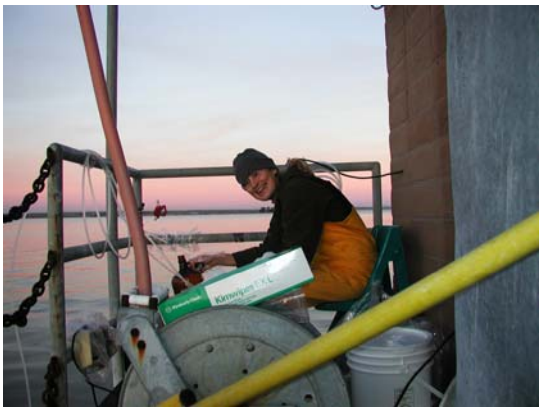
A study is being conducted to determine the interactions of heavy metals with phytoplankton blooms in San Francisco Bay, because some metals (notably copper) approach maximum water quality criteria and may be controlling primary productivity. Results from this study concur with previous copper speciation studies and indicate that most of the copper in the Bay is not available to the plankton, and is therefore not limiting its growth. Phytoplankton blooms, however, have been found to deplete other metals from the water (manganese, lead and nickel), and may thus help entrain those metals within the estuary.

This project addresses one of the principal concerns with the health of San Francisco Bay: whether its primary productivity, or algal growth, is controlled by toxic levels of copper or other metals. Copper has been of special concern, since its concentrations in the Bay have been found to approach and sometimes even exceed both state and federal water quality criteria. Consequently, the influence of copper on algal blooms in the Bay is being analyzed.

Results from those analyses indicate that while copper levels in the Bay may be relatively high, they do not adversely impact primary productivity. This apparent inconsistency is attributed to the presence of dissolved organic material that strongly binds with the copper and makes it unavailable to phytoplankton. These findings are consistent with previous studies of the organic speciation of copper in the Bay. Consequently, this study adds to the evolving understanding that current water quality criteria for copper in estuarine waters need to modified for San Francisco Bay.

Conversely, the study has shown that algal blooms decrease, at least temporarily, dissolved concentrations of other potentially toxic elements, including manganese, lead and nickel. Lead appears to be sorbed onto the plankton surfaces during a bloom, rather than assimilated within the plankton. However, after the algal bloom ends and the plankton decay, lead, manganese, cobalt, and zinc are released back to Bay waters. Consequently, the cycling of those and other heavy metals within the Bay are closely intertwined with the growth and decay of phytoplankton within the Bay.

Information being developed in this study will be of use in determining what factors are regulating both the primary productivity and the concentrations of toxic metals in San Francisco Bay.



Graduate student, Allison Luengen, sampling in San Francisco Bay.

Publications

Luengen, Allison, Peter Raimondi, and Arthur Flegal, Contrasting biogeochemistry of six trace metals during the rise and decay of a spring phytoplankton bloom in San Francisco Bay. *Limnology and Oceanography*, (in press).

Collaborative Efforts

The research is being conducted in collaboration with researchers at the United States Geological Survey, who provide ship time and in kind sampling and analyses, as well as comments on the interpretation of our results. Complementary data on trace metals in the Bay are being provided by the San Francisco Regional Monitoring Program, which is administered by the San Francisco Estuary Institute with guidance and support provided by the California State Water Resources Control Board, other state and federal agencies, industry, and environmental organizations.

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San Francisco Bay