

Final Report Summary

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This study provides an extensive dataset of dissolved trace metals (silver, cadmium, copper, nickel, lead, iron, and zinc), inorganic (ammonia, nitrate, phosphate and silicates), and organic (urea, dissolved organic nitrogen, carbon and phosphorous, as well as particulate carbon and nitrogen) constituents during high and low riverine flow conditions in surface waters of the Long Island Sound. Analysis of the data showed that the mechanisms influencing the biogeochemistry of the Sound are very complex. However, a few preliminary conclusions could be drawn:

- There are two distinct biogeochemical regimes within the Long Island Sound: an area of relatively high metal levels in the East River/Narrows and an area in the eastern region of the Sound that had comparatively lower levels.
- During low flow conditions, the East River was the most dominant external source of most trace metals, while during high flow conditions; the most important external source was the Connecticut River.
- Large internal sources of copper, nickel and zinc were detected under low flow conditions implicating the importance of internal processes such as remobilization from contaminated sediments within the Sound.
- The mechanisms controlling the biogeochemistry of the Long Island Sound were different under different river flow. During high flow conditions, the system was most influenced by biological activity. During low flow conditions, the Long Island Sound was influenced by the remobilization of metals from contaminated sediments. Future work (such as the actual measurement of diffusive benthic fluxes) is needed to substantiate these preliminary findings.

Objectives:

Objective 1:

Establish levels of metals, organic carbon and nutrients in surface waters of the Long Island Sound. Establish the relative importance of natural and anthropogenic sources of dissolved constituents to the Long Island Sound. Water samples were collected at 40 stations beginning at the Battery of the East River, progressing east to the Race in the Long Island Sound, in July 2000 and in April 2001. Additional samples were collected at stations along the salinity gradients of the Thames, Connecticut, Quinnipiac and Housatonic rivers. All of the samples collected in both cruises have been analyzed for salinity, POC, PON, DOC, inorganic nutrients (NO_4 , NH_4 , PO_4 , SiO_4), organic nutrients (urea, DON, DOP) and size-fractionated chlorophyll a (whole, $> 20 \mu\text{m}$, $5\text{-}20 \mu\text{m}$, & $< 5 \mu\text{m}$), as well as for trace metals. Additional parameters measured at each location were salinity, pH, temperature, and dissolved oxygen. Consistent with the location of the anthropogenic sources in the NYC region, the levels of inorganic nutrients were about 2-3 times higher in the East river and western Long Island Sound compared to the Race in the eastern part of the Sound. Our trace metal results were consistent with the nutrient distributions; the highest levels of metals were also detected in the East River-Western LIS.

Objective 2:

Evaluate the ability of nutrients and copper to control the intensity of the phytoplankton blooms in the Long Island Sound. Nutrient addition experiments were conducted at three stations in the western Long Island Sound, and at single locations in the East River and eastern Long Island Sound. Our preliminary results indicated that Western Long Island Sound and East River phytoplankton communities appeared to be nutrient replete, and did not respond to additions of phosphate, nitrate, ammonium, silicate, copper or EDTA. This contrasts starkly with the phytoplankton communities in Central and Eastern Long Island Sound, which displayed a strong growth response to nitrogen additions (nitrate and ammonium). Moreover, we observed species-specific differences to the additions of nitrogenous nutrients in Central

and Eastern Long Island Sound. For example, while the growth of smaller picoplankton, such as *Synechococcus* sp., was not affected by N-additions, larger diatoms species increased in biomass. Since larger cells are more likely to sink to the bottom of Long Island Sound, and contribute to hypoxia, these experimental results imply that increased N-loading to Long Island Sound could spread the hypoxia problem from Western Long Island Sound to central and eastern Long Island Sound waters. During our April 2001 cruise, we found only the Central Long Island Sound phytoplankton to be nutrient-depleted (N-limited). The absence of nutrient limitation of phytoplankton in Eastern Long Island Sound in spring contrasts with our summer experiments. This difference suggests that during the spring freshet, the Connecticut River, which supplies Long Island Sound with 70% of its freshwater, provides phytoplankton in Eastern Long Island Sound with a copious supply of nutrients. When flow rates diminish during summer months, Eastern Long Island Sound phytoplankton communities transition to a nutrient limited state.