Final Report Summary

Understanding the patterns and processes of phytoplankton biodiversity in relation to primary production is fundamentally important for sustainable management of coastal ecosystems such as Long Island Sound (LIS). Limited data exist that accurately describe phytoplankton physiological processes associated with natural, internally driven mortality. In fact, most extrapolations are inferred by comparing nutrient levels and the abundance of various population structures; however, such analyses do not examine the actual affect upon the physiology of phytoplankton, which would be a much better indicator of "cause and effect."

In this study, we have been developing flow-cytometric/immunochemical methods to examine phytoplankton assemblages of the western, central and eastern LIS, studying how nutrient concentrations affect the physiological condition of these cells. Results suggest that seasonal temperatures, turbidity, dissolved oxygen and salinity affect the composition and abundance of phytoplankton in the Sound less than do nutrient loads. Concentrations of nutrients (e.g. phosphate, nitrate, ammonia) in the summers of 2002 and 2003 generally increased from eastern to western LIS. The presence or absence of phytoplankton genera appears to be influenced by concentrations of nutrients in the Sound. For example, decreased nutrient concentrations observed in the central and western sound are associated with an increase in Asterionella, Rhizosolenia, Thalassiothrix species. Subsequently, increased concentrations of Pseudocalanus occurred in all regions (summer 2003) as well as increases in Chaetognatha, barnacle, and fish larvae in the western sound.

Flow cytometry (FC) coupled with biochemical labeling has shown that whereas many biochemical probes are useful for homogenous laboratory controlled experimentation, some probes (e.g. detection of nitrate and phosphate reductase, increased lipids) are better than others when examining heterogeneous, field-collected samples. Because the cell diversity associated with heterogeneous field samples result in the overlap of natural and biochemical signatures, detection of the physiological process of individual cells is proving difficult. The methods we have developed to compare and contrast a heterogeneous population of cells require physical sorting (using FC), followed by the addition of selected biochemical probes and finally sample analyses. This procedure is time consuming, and therefore not yet suitable for general screening of many environmental samples. However, the application of enzyme probes coupled with sorting and analytical flow cytometry permit assessment of some aspects of the physiological status of phytoplankton populations in mixed, natural assemblages. We continue to refine our newly developed techniques which will help reveal the presence of physiological capacities that allow phytoplankton to thrive under a particular set of environmental conditions.