



MONITORING PHYTOPLANKTON GROWTH IN SUISUN BAY

What is it?

Phytoplankton (algae that live suspended in the water column) are important components of the aquatic ecosystem; they are primary producers, providing food energy at the base of the food web. In Suisun Bay, a considerable decline in phytoplankton has been observed since the late 1980s. There has also been a shift in species composition from diatoms to other, less nutritious, algae species (green algae, blue-green algae and miscellaneous flagellate species). There is also evidence that the growth rate of diatoms is lower in Suisun than in other areas of the Estuary and that growth may be inhibited by high concentrations of ammonium. These changes cause concern because they can affect food availability for fish and other organisms.

Suisun Bay is part of the Bay-Delta Estuary. It is located below the confluence of the Sacramento and San Joaquin rivers and drains to the upper San Francisco Bay via the Carquinez straight. The Suisun marsh, just north of Suisun Bay, is the largest contiguous brackish marsh on the West Coast. The Suisun Bay and Marsh provide habitat for many fish and other wildlife species, including the state endangered delta smelt.

In 2010, the San Francisco Regional Water Board conducted a study with Romberg Tiburon Center to: 1) Test the hypothesis that ammonium was limiting phytoplankton blooms in Suisun Bay; and 2) Identify sources of ammonium. Ammonium is a nutrient that stimulates plant growth, but if present in high enough concentrations it can interfere with the uptake of nitrate, another important nutrient, and actually inhibit growth. During this study, Suisun Bay experienced the first phytoplankton blooms since 2000. Two blooms were measured, both dominated by diatoms, in April and May. Both blooms occurred when ammonium was below 4 μ M. For most of the period before and after the blooms the ammonium was above 4 μ M. Sources of ammonium were

identified coming into Suisun Bay from the Sacramento River and from western Suisun. In both of these areas wastewater treatment plants discharge high loads of ammonium. These blooms occurred despite the presence of *Corbula*, an invasive clam that consumes phytoplankton, at historic densities. As a result of these blooms, increases of zooplankton that are fed on by the endangered delta smelt were observed. In addition, larval delta smelt increased dramatically over the previous year.

A more intensive study is being conducted in 2011 and 2012 that will measure phytoplankton growth and nutrient uptake rates. Pesticides, metals, basic water quality parameters, and several measures of phytoplankton biomass are being made. In addition, in 2011 toxicity tests and TIE procedures were developed so that if growth inhibition is observed, a cause and effect relationship can be developed between inhibition and the toxicant that is inhibiting growth. Due to the intense interest generated by the 2010 study, several partners have been added to collaborate on this expanded study including the San Francisco Bay Regional Water Board's SWAMP team, SFSU's Romberg Tiburon Laboratory, the State and Federal Water Contractors Agency, Bay Area Clean Water Agency (BACWA) and the Central Contra Costa Sanitary District.

During the 2011 sampling period, Delta outflow was extremely high. Therefore, contaminants that may be inhibiting growth were highly diluted. In addition, there was not enough residence time in Suisun Bay for a bloom to become established. In 2012, this study will be continued with newly developed toxicity test and TIE protocols so that if measure growth inhibition is measured, a cause can be identified.

Why is it important?

The Bay-Delta Estuary is the largest estuary on the Pacific Coast. It provides habitat for 750 species of plants, fish and other wildlife, water for cities and agriculture, as well as many recreational opportunities. Declines in phytoplankton, the populations of certain fish species, and other changes in Suisun Bay and the rest of the Bay-Delta Estuary are indicative of a stressed ecosystem. Steps must be taken to keep this ecosystem healthy so that everyone can enjoy its multiple benefits. Beginning in 2002 scientists began to observe a rapid decline in four pelagic (open water) fish species (delta smelt, longfin smelt, juvenile striped bass, and threadfin shad) in the upper San

Francisco Estuary (the Delta and Suisun Bay). Since then, the Pelagic Organism Decline (POD) has become an issue of concern for state environmental agencies and others. The reasons for the POD are not fully understood, but the decline in phytoplankton has been identified as a potential factor. This study is one of many that seeks to shed light on this complex problem.

How will this information be used?

The data from this study will address key questions regarding the phytoplankton decline in Suisun Bay and contribute to effective management actions to address this ecological problem. This data has already been used to assist the Central Valley Water Board in determining permit requirements for the Sacramento Regional Wastewater Treatment Plant. The new permit requires treatment to drastically reduce ammonium discharge to the Sacramento River.