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ANNUAL UPDATE OF TAMPA BAY CHLOROPHYLL-A CONCENTRATIONS

2000

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The amount of phytoplankton present in Tampa Bay waters can be estimated from measurements of the green plant pigment chlorophyll-a. Phytoplankton is one of several major forms of plants that exist in Tampa Bay and most other estuaries. Other major plant types are submerged seagrass, macro-algae and benthic micro-algae. The different plants can be viewed as being in competition with each other for required resources, such as light and nutrients. Studies conducted in urbanized estuaries have shown that excessive loading of nitrogen generally is accompanied by an increase of phytoplankton and macro-algae, including epiphytic and drift macro-algae, and by a reduction of seagrass. Relatively little is known about the response of benthic micro-algae to changes in nutrient availability. From a resource perspective, the loss of seagrass means a loss of essential habitat for a multitude of marine animal species. Therefore, the amount of chlorophyll-a present in the water column not only measures phytoplankton biomass, but the amount present also gives a general understanding of resource competition within the Tampa Bay ecosystem.

Chlorophyll-a Targets

Recognizing that chlorophyll-a can be used as an effective means to monitor water quality in Tampa Bay and to protect natural resources such as seagrass, the ABM Task Force on Resource-Based Water Quality in 1989 established yearly average chlorophyll-a target concentrations for the four major subdivisions of Tampa Bay. The targets chosen for the four subdivisions were based on monthly measurements by the Hillsborough County Environmental Protection Commission (EPC).

In 1996, the Tampa Bay Estuary Program (TBEP) adopted modified chlorophyll-a targets for the major subsections of Tampa Bay (Table 1). These targets were calculated from model predictions that related chlorophyll-a, water column light transparency and seagrass depth distribution. The targets reflect the chlorophyll-a concentration which will support the TBEP goal for restoration and protection of seagrass to near 1950's levels which has been estimated at about 38000 acres. Targets will also be developed for Boca Ciega Bay, Terra Ciea Bay and the estuarine portion of the Manatee River when sufficient data is available. Table 1 shows the TBEP target concentrations for the four major subsections of Tampa Bay as well as the EPC measured annual concentrations since 1992 and the average annual concentrations for the nine year period, 1992 through 2000.

**TABLE 1**

Table 1. TBEP Chlorophyll-a targets and EPC measured annual average concentrations (ug/l) for the major subdivisions of Tampa Bay (HB=Hillsborough Bay; OTB=Old Tampa Bay; MTB=Middle Tampa Bay; LTB=Lower Tampa Bay).
The measured annual chlorophyll-a concentrations are generally below the TBEP targets for all years except 1994, 1995 and 1998. The elevated values for these three years were most probably caused by an increased supply of nutrients (specifically nitrogen) to the bay as a result of a period of increased rainfall. River discharge and runoff from the land, as well as rain falling directly over the bay, are important sources of nutrients to the bay.

Chlorophyll-a concentrations decreased substantially in 1999 and 2000. In fact, the annual averages for the four major bay segments for these two years were all below the TBEP targets (Table 1). The low values apparently resulted from the relatively dry weather in 1999 and 2000. The total annual rainfall in 1999 and 2000 at Tampa International Airport was about 34 and 29 inches, respectively, which in year 2000 almost 19 inches below the long-term average for this station. Although the data needed to calculate nitrogen loading to the bay for 1999 and 2000 are not yet available, it can be assumed, based on rainfall amounts, that nitrogen loading has been relatively low during the last recent two years.

Long-Term Chlorophyll-a Record

The long-term chlorophyll-a record for Tampa Bay starts in 1953 (Figure 1). The record is based on measurements by several organizations using different sampling frequency and station locations, but generally similar methodologies. However, sections of the record shown in Figure 1 have been adjusted to account for potentially underestimated measurements caused by methodological shortcomings. It is believed at this time that the data shown in this figure best describes the long-term Tampa Bay chlorophyll-a record. Generally, relatively low concentrations were found in all major sections of Tampa Bay prior to the late 1960's. After an elevated period of approximately 15 years, values decreased dramatically between 1982 and 1984 in all subdivisions of the bay. The recent concentrations appear similar to levels found during the early portion of the long-term record.

FIGURE 1

Figure 1. Annual average chlorophyll-a concentrations for the major subdivisions of Tampa Bay, 1953-1999 (HB=Hillsborough Bay; OTB=Old Tampa Bay; MTB=Middle Tampa Bay; LTB=Lower Tampa Bay).

The cause of the large chlorophyll-a reduction in the early 1980's is not completely understood, but it is almost certainly linked to a substantial reduction in nitrogen loading from anthropogenic sources. This reduction was the result of management actions taken, within the past two decades, specifically to reduce the impact by domestic wastewater and fertilizer industry effluents. In addition, recent nitrogen loading reductions from fertilizer storage facilities and ship loading
terminals located in Hillsborough Bay and from domestic wastewater plants in Old Tampa Bay should also have contributed to the continued downward chlorophyll-a trend. Also, in-bay chlorophyll control processes may have become increasingly important as a result of the anthropogenic nitrogen reductions and improved bay conditions. These "natural control processes" include, among others, utilization of the phytoplankton population by benthic filter feeders and benthic denitrification.

The scenario of reduced loadings agrees with the nitrogen loading/chlorophyll-a concept established in other estuaries and laboratories. The substantial reduction of chlorophyll-a concentrations suggests a recovery of Tampa Bay water quality and the potential for significant natural seagrass recolonization.

Ecological Considerations

The demonstrated trend of decreasing phytoplankton biomass, as well as a recent reduction of drift macro-algae biomass in upper portions of Tampa Bay, should benefit seagrass growth and allow for the expansion of seagrass meadows, ultimately resulting in a more abundant seagrass dependent animal community. Although both phytoplankton and macro-algae are important components of the Tampa Bay ecosystem, the current standing crop of these algae may better resemble the biomass found prior to the period when algal biomass was artificially elevated through high anthropogenic nitrogen discharges to the bay. For more information on this subject please contact Roger Johansson, City of Tampa Bay Study Group, at 813-247-3451.