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A plan of study submitted to the Florida Department of Environmental Regulation Southwest District

Department of Sanitary Sewers Bay Study Group

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NUTRIENT ENRICHMENT STUDIES OF TAMPA BAY PHYTOPLANKTON

A PLAN OF STUDY SUBMITTED TO

THE FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
SOUTHWEST DISTRICT

ON

JUNE 15, 1992

BY

THE CITY OF TAMPA
DEPARTMENT OF SANITARY SEWERS
BAY STUDY GROUP
NUTRIENT ENRICHMENT STUDIES OF TAMPA BAY PHYTOPLANKTON

INTRODUCTION

The Florida Department of Environmental Regulation (DER) is requiring the City of Tampa to submit a plan of study for algal assays on waters of Tampa Bay prior to issuing Permit Number D029-184532A for the Hookers Point AWWTP (Specific Condition No. 11). The Hillsborough Environmental Protection Commission concurs with this condition. In response to the requirement by DER, the City of Tampa, Department of Sanitary Sewers, submits this study plan for nutrient enrichment experiments of the Tampa Bay phytoplankton population.□

The proposed study will examine effects of nutrient limitation on phytoplankton growth rates in Tampa Bay. The response of growth rate to changes in nutrient additions will be indicated through changes in algal biomass (chlorophyll-a) and fixation of CO₂ (C-14 uptake). The selected method is similar to methods currently used by the states of Maryland and Virginia for determination of nutrient limitation in Chesapeake Bay waters (Fisher et al. 1992a and b). The proposed study will, therefore, not only yield valuable information about nutrient limitation in Tampa Bay, but will also allow for comparison of information between Tampa Bay and Chesapeake Bay.

METHODS

Field Sampling:

The nutrient enrichment experiments will start in January, 1993 and continue on a monthly basis through December 1993 (12 samplings). Surface water (upper 0.5meters) will be collected each month at locations in Hillsborough Bay (COT4), Old Tampa Bay (EPC40), Middle Tampa Bay (COT13) and Lower Tampa Bay (EPC95) (Figure 1). The samples will be screened through 202um mesh to remove larger zooplankton and a large volume (20liters) from each station will be brought back to the laboratory and used for nutrient enrichment bioassays as described below. The samples will be shaded from direct sunlight and temperature controlled during transport and preparation for bioassay experiments.

Ancillary water collections and field measurements will be taken at each sampling location for the determination of:

1. Temperature, salinity, dissolved oxygen, and pH (Hydrolab readings at each meter interval from surface to near bottom.
2. Nutrient concentrations (Nitrogen series, PO₄-P, TP, and SiO₄-Si at surface, mid and near bottom.

3. Chlorophyll concentrations, turbidity units, and suspended solids weights at surface, mid and near bottom.
4. General descriptions of phytoplankton and zooplankton taxonomic composition and density at surface.
5. General descriptions of benthic invertebrate composition and density, and sediment composition.
6. Secchi disk depth and station depth.
7. Surface irradiance and light attenuation at two levels in the water column (Licor 4pi PAR sensors).
8. General description of sea-state, wind speed and direction, wave height cloud cover, and water color.

It is anticipated that all field sampling and measurements of the parameters listed above will be performed by City of Tampa Bay Study Group personnel, with the exception for laboratory analyses of nutrient concentrations. These analyses will be contracted to an outside laboratory.

Nutrient Enrichment Bioassays:

The laboratory work associated with the nutrient enrichment experiments is anticipated to be contracted to an outside laboratory. Therefore, exact procedures for these experiments will not be available until a contractor has been designated. However, it is the intention of the City of Tampa that the laboratory procedures for these experiments will follow as closely, as possible, the procedures described by Fisher et al. (1992a and b) and currently used in Chesapeake Bay. A short description of these procedures follows below.

Just prior to the start of the bioassay experiment, duplicate chlorophyll-a samples will be taken from each of the 4 screened large volume surface samples.

At the start of the bioassay, four 3 liter subsamples from each of the screened large volume surface samples will be placed in 4 liter cubetainers. One subsample will not receive any addition of nutrients and will serve as a control. The remaining 3 subsamples will receive additions of NH_4 (as NH_4Cl), PO_4 (as KH_2PO_4), or NH_4+PO_4 . Nutrients will be added in sufficient amounts to saturate nutrient uptake and relieve nutrient limitation.

The subsamples will be incubated for 24 hours at 60% of ambient sunlight in a water-cooled, outside placed, incubator. Sunlight will be reduced by layers of neutral density screen. At the termination of the incubation period, two subsamples from each cubetainer will be taken for duplicate chlorophyll-a measurements. In addition at this time, two clear 125ml BOD bottles will be filled with remaining water from each cubetainer. The BOD bottles will be inoculated with NaH₂C-1403 solution and incubated for 1hr at approximately 200uE/m-2s in an, inside placed, temperature controlled incubator.

Interpretation of Bioassay Results:

The responses of the bioassay experiments to the different nutrient additions (excluding the Hookers Point effluent experiment for Lower Tampa Bay waters) will be categorized into 5 classes defined by Fisher et al. (1992a and b). The following definitions of categories are quoted (with modifications) from these sources.

Class 1: 'Exclusive' N limitation of phytoplankton growth rates is defined as: (1) the addition of P induced no response relative the control, and (2) the addition of N alone had virtually the same effect as the addition of both N and P.

Class 2: 'Exclusive' P limitation of phytoplankton growth rates is defined as: (1) the addition of N induced no response relative the control, and (2) the addition of P alone had virtually the same effect as the addition of both N and P.

Class 3: 'Primary' N limitation of phytoplankton growth rates is defined as: (1) the addition of P alone induced little response relative the control, (2) the addition of N alone induced a significant response, and (3) the addition of both N and P induced the largest response.

Class 4: 'Primary' P limitation of phytoplankton growth rates is defined as: (1) the addition of N alone induced little response relative the control, (2) the addition of P alone induced a significant response, and (3) the addition of both N and P induced the largest response.

Class 5: No response to any nutrient addition.

Results from the bioassay experiments will be evaluated on a seasonal basis using appropriate non-parametric or parametric statistics. Two main seasons, the wet season (June through September) and the dry season (remaining months) will be discussed and compared in relation to nutrient limitations measured during these experiments. Only limited conclusions will be drawn from individual monthly results.

Ancillary information collected during this study, as well as information from other sources, such as the EPC and City of Tampa monitoring programs, may be used in addition to the bioassay results to evaluate nutrient limitation of the Tampa Bay phytoplankton population. Further, nutrient limitation measured during these experiments may be discussed in relationship to the current status and trend of Tampa Bay water quality and biological indicators, such as chlorophyll-a, macroalgae and seagrasses.

Quality Assurance/Quality Control:

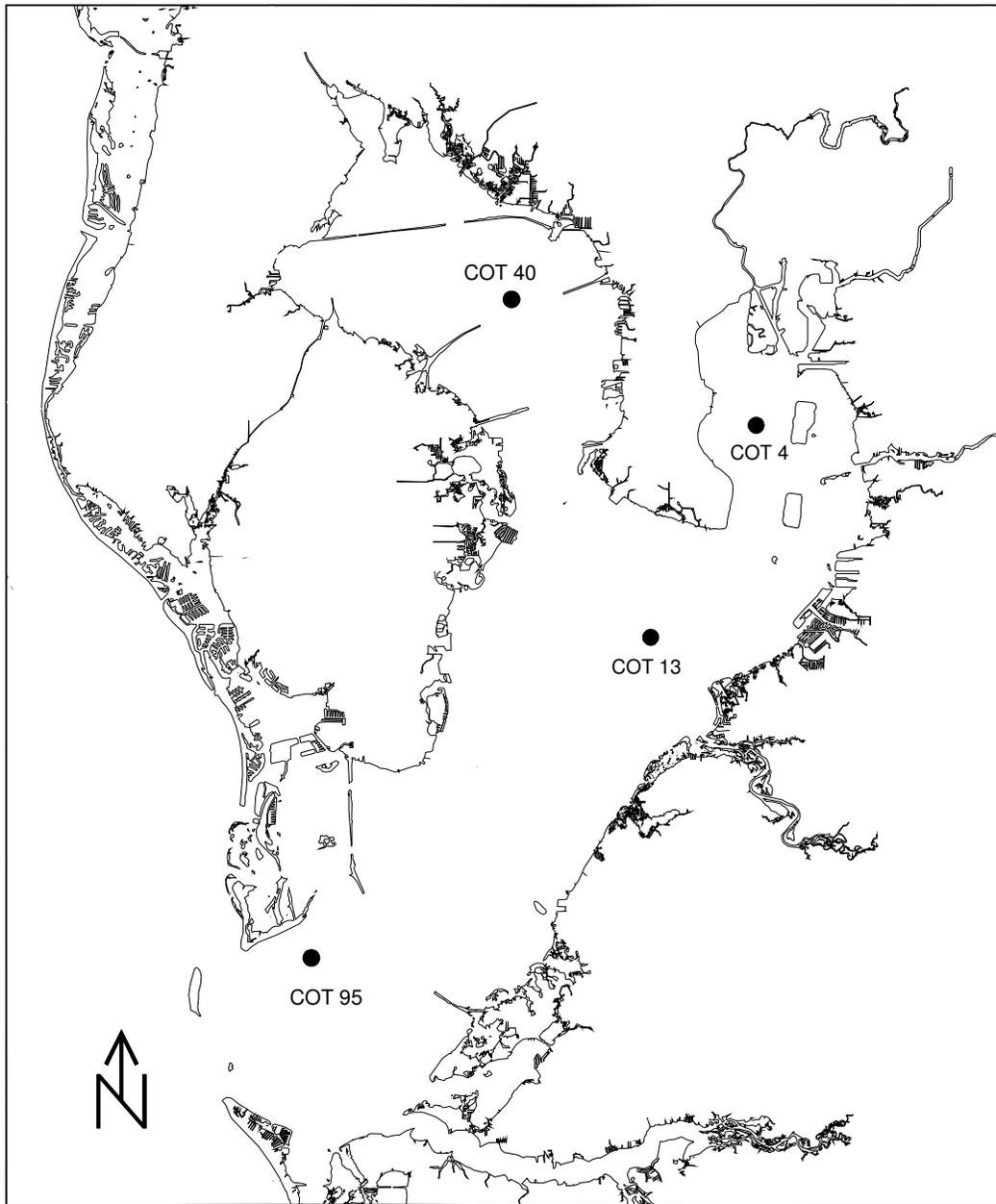
All water collections, field determinations, and laboratory analyses conducted by the City of Tampa Bay Study Group will follow the City of Tampa Department of Sanitary Sewers Generic Quality Assurance Plan.

Contractors selected for nutrient analyses and bioassay experiments will be required to supply a DER approved QA/QC plan.

REFERENCES

Fisher, T.R., A.B. Gustafson, K.G. Sellner, and R.B. Lacouture. 1992a. Nutrient bioassays in Chesapeake Bay to assess nutrients limiting algal growth. Progress Rep. MD Dept. of the Environment, Jan. 1992, Baltimore

Fisher, T.R., E.R. Peele, J.W. Ammerman, and L.W. Harding, Jr. 1992b. Nutrient limitation of phytoplankton in Chesapeake Bay. Mar. Ecol. Prog. Ser. in press



Phytoplankton nutrient bioassay monitoring stations
in Tampa Bay sampled by the COT-BSG.

Figure 1. Locations of proposed stations to be used for
nutrient enrichment experiments.