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**NUTRIENT ENRICHMENT STUDIES OF NATURAL PHYTOPLANKTON
POPULATIONS IN TAMPA BAY**

**A SUMMARY OF RESULTS
JUNE 1993 TO AUGUST 2009**

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NUTRIENT ENRICHMENT STUDIES OF NATURAL PHYTOPLANKTON
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INTRODUCTION

The Bay Study Group (BSG) has been conducting nutrient enrichment studies (bioassays) on natural phytoplankton populations at four locations in Tampa Bay since 1993 (Figure 1). This report will summarize findings for all tests that have been performed to date, from June 1993 through August 2009.

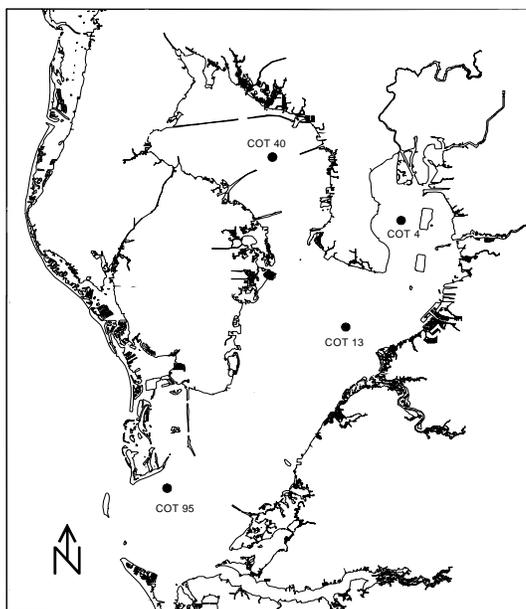


Figure 1. Phytoplankton nutrient bioassay monitoring stations in Tampa Bay.

METHODS

The bioassays have been performed on the natural phytoplankton population collected from surface waters of the four stations, with one station located in each of the four major segment of Tampa Bay, as shown below:

- Hillsborough Bay - COT4
- Old Tampa Bay - COT40
- Middle Tampa Bay - COT13
- Lower Tampa Bay - COT95

Bioassay measurements were performed on a quarterly schedule from June 1993 through August 1995 for all stations except COT95. At this station monthly tests were conducted during the first year of the program. From February 1996 to the present, bioassays have been performed twice per year, during late winter and late summer.

The bioassay method used is similar to a method used in Chesapeake Bay waters (see Fisher et al. 1992a and b). An outline of the specific method used by the BSG is provided here.

A large volume of surface water is collected for the following nutrient treatments. Each treatment is conducted in duplicate on 3l samples:

- Controls (no nutrient addition).
- N-additions (NH₃-N added to reach a final concentration in the sample of near 50uM).
- P-additions (PO₄-P added to reach a final concentration in the sample of near 5uM).
- N+P-additions (combination of the N-additions and P-additions).

The treatment samples are incubated under natural sunlight in ambient bay water temperatures for an appropriate incubated period (usually 48h for the late winter and 24h for the late summer tests).

The growth response of the natural phytoplankton community to the different treatments is determined through measurements in changes of algal biomass, measured as chlorophyll-a.

Paired t-test statistics ($p < 0.05$) and non-statistical evaluations of treatment responses are used to interpret the bioassay results and to group the growth response to the nutrient additions into the following response categories:

- Exclusive N limitation: (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 N+P.
- Primary N limitation: (1) the addition of P alone induced little response relative the control, (2) the addition of N alone induced a response, and (3) the addition of N+P induced the largest response.
- Balanced NP limitation: (1) the addition of N and P alone induced no response relative the control, (2) the addition of N+P induced a large response.
- Exclusive P limitation: (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 N+P.
- Primary P limitation: (1) the addition of N alone induced little response relative the control, (2) the addition of P alone induced a response, and (3) the addition of N+P induced the largest response.
- No response to any nutrient addition, indicating nutrient saturation, light limitation, and/or insufficient incubation time.

RESULTS

A total of 152 bioassay experiments have been conducted since the start of the program in June 1993.

The growth response of the natural phytoplankton community to the different nutrient treatments were grouped into the response categories described above. The result of these analyses is summarized in Table 1.

Table 1. Results from natural phytoplankton nutrient bioassays in the four major subsections of Tampa Bay, 1993 – 2009.

Bioassay response	Hillsborough Bay COT4	Old Tampa Bay COT40	Middle Tampa Bay COT13	Lower Tampa Bay COT95
Exclusive N limitation	29	25	28	39
Primary N limitation	2	2	2	1
Balanced	0	0	0	0
Exclusive P limitation	0	0	0	0
Primary P limitation	0	0	0	0
No response	0	3	0	0

DISCUSSION AND CONCLUSION

One-hundred-fifty-two natural phytoplankton community nutrient limitation experiments have been conducted in Tampa Bay by the BSG from 1993 to the present. The strong nitrogen dependence by the Tampa Bay phytoplankton community is obvious in all four bay segments; of the 152 bioassay tests conducted to date, 149 indicate that nitrogen was the stronger limiting nutrient. None of the 152 tests have indicated that phosphorous was the stronger limiting nutrient. However, three tests in OTB have shown a lack of phytoplankton growth response by either N or P additions.

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, MD.

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