

5-1-2004

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RESULTS OF THE CITY OF TAMPA SURFACE WATER COMPLIANCE MONITORING
PROGRAM FOR THE YEAR 2003 AND EXAMINATION OF LONG-TERM WATER
QUALITY AND BIOLOGICAL INDICATOR TRENDS IN HILLSBOROUGH BAY

SUBMITTED TO

THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHWEST DISTRICT

MAY 1, 2004

BY

CITY OF TAMPA
WASTEWATER DEPARTMENT
BAY STUDY GROUP

RESULTS OF THE CITY OF TAMPA SURFACE WATER COMPLIANCE MONITORING PROGRAM FOR THE YEAR 2003 AND EXAMINATION OF LONG-TERM WATER QUALITY AND BIOLOGICAL INDICATOR TRENDS IN HILLSBOROUGH BAY

INTRODUCTION

This report is submitted to the Florida Department of Environmental Protection (FDEP) to satisfy the requirements set forth in Reclaimed Water and Effluent Limitations and Monitoring Requirements condition No. 10 of the Howard F. Curren WWTP operation permit FL0020940-001-DW1P. The report is based on data obtained by the City of Tampa (COT) surface water compliance monitoring program approved on August 14, 2000 by the FDEP. The report includes examination of long-term trends for water quality parameters and biological indicators collected by the City of Tampa Bay Study Group and the Environmental Protection Commission of Hillsborough County (EPC). Results from these studies are discussed in four sections: 1) Compliance monitoring of Hillsborough Bay water quality by the COT, 2) long-term monitoring of Hillsborough Bay water quality by the EPC, 3) comparison between COT compliance monitoring stations and selected EPC stations in the upper portion of Hillsborough Bay and 4) long-term monitoring of Tampa Bay water quality and biological indicators by the COT.

Results from the compliance monitoring include data collected monthly by the COT at three stations in the upper portion of Hillsborough Bay (COT15, COT16 and COT17; Figure 1). Sampling of these stations started in January 1990. From these collections, the EPC laboratory analyzes sub-samples for carbonaceous biological oxygen demand (5-day), total phosphorus, ortho-phosphate, total nitrogen, total Kjeldahl nitrogen, nitrite+nitrate-nitrogen and ammonia-nitrogen. In addition, the COT Bay Study Group measures chlorophyll-a and several field measured water quality parameters including dissolved oxygen, salinity, temperature and Secchi depth. Additionally, pH values are reported for station COT151 located approximately 70m south of the Howard F. Curren WWTP outfall (Figure 1).

The long-term water quality data base maintained by the EPC is discussed as trends of annual averages for the parameters specified in the study plan entitled "City of Tampa Surface Monitoring Plan of Hillsborough Bay." This discussion includes all 14 EPC stations in Hillsborough Bay (Figure 2) and the group of EPC stations close to the Howard F. Curren WWTP outfall (EPC2, EPC6, EPC44, EPC52 and EPC70; Figure 1). However, station EPC44 was not included in Figures 19 through 27 prior to 2001.

The comparison between COT compliance monitoring stations (COT15, COT16 and COT17; Figure 1) and the group of EPC stations close to the Howard F. Curren WWTP discharge (EPC2, EPC6, EPC44, EPC52 and EPC70; Figure 1) includes examination of averages and standard errors for the year 2003 for the parameters specified in the study plan.

Examination of the COT, multi-disciplinary, long-term water quality and biological indicator monitoring program includes discussion of annual averages for parameters specified in the study plan. The first part of this section reports on results from the water quality and phytoplankton monitoring conducted at two stations located in Hillsborough Bay (COT4 and COT12; Figure 3) and one station located in Middle Tampa Bay (COT13; Figure 3). The second part presents results from the drift macro-algae monitoring conducted at five transects in Hillsborough Bay (Figure 4).

METHODS

Field and laboratory methods are described in the Plan of Study for Annual Water Quality and Biological Indicator Report dated August 19, 1999 and approved by the FDEP Tampa office on August 14, 2000.

RESULTS

Compliance Water Quality Monitoring in Hillsborough Bay by the COT

Results from the monthly COT compliance monitoring program of Hillsborough Bay stations COT15, COT16, COT17 and COT151 (Figure 1) for the year 2003 are listed in Appendix Tables A, B and E. Results for the measured parameters for the years 1990 through 2003 are discussed in the text below and illustrated in Figures 5 through 18.

Temperature (Figure 5):

There is little variation in water temperatures among the three stations. The expected seasonal variation is evident.

Salinity (Figure 6):

There is generally little variation in salinity among the three stations. Salinity was substantially reduced at all stations during late summer or early fall in 1991, 1994, 1995 and 2003. In addition, a marked reduction in salinity occurred during the winter and spring of 1998. The highest salinity for the period of record was measured during a period of elevated levels at the three stations that lasted from the summer of 2000 to the summer of 2001.

Secchi Disc Depth (SD; Figure 7):

Secchi disc depths show considerable month-to-month variation and although a distinct seasonal pattern is not apparent, annual maxima of water column light penetration generally occurs at all stations during the winter. Further, a long-term trend is not apparent.

Surface Dissolved Oxygen (SDO; Figure 8):

The highest SDO concentrations are generally noted for all stations during the winter and the lowest concentrations are measured during the late summer and early fall. The month-to-month variation between the stations is generally similar and a long-term trend is not apparent.

Middle Dissolved Oxygen (MDO; Figure 9):

Variations in MDO concentrations are similar to those seen for SDO.

Bottom Dissolved Oxygen (BDO; Figure 10):

BDO concentrations are strongly dependent on site specific parameters such as depth and benthic composition. A comparison among the three stations is, therefore, not valid. In general, a strong seasonal pattern is evident with peaks during winter and lows during summer and fall. A long-term trend is not apparent for any of the three stations.

Total Nitrogen (TN; Figure 11):

TN concentrations are often similar at the three stations and a seasonal pattern is not apparent. Concentrations measured in 1994, 1995 and 2000 appear elevated in comparison to concentrations measured for other periods of the record. The TN concentrations in 2003 are among the lowest measured during the period of record.

Total Kjeldahl Nitrogen (TKN; Figure 12):

Variations in TKN concentrations are virtually identical to those seen in TN concentrations.

Ammonia Nitrogen (NH₃; Figure 13):

There is generally little variation in NH₃ concentrations among the three stations and a seasonal pattern is not apparent. NH₃ concentrations measured since 1991 are considerably lower in comparison to concentrations found in 1990, the first year of this study. Low concentrations of NH₃ were found in 2003.

Nitrite + Nitrate Nitrogen (NO₂+NO₃; Figure 14):

Considerable month-to-month and station-to-station variation is evident in the NO₂+NO₃ measurements. A seasonal or long-term trend is not apparent for this parameter. The measured values for this parameter are generally very low, however, a substantial increase in NO₂+NO₃ concentration occurred during the winter 1997/1998 season. Intermediate to slightly elevated concentrations were measured in 2003.

Total Phosphorus (TP; Figure 15):

TP concentrations are generally similar at the three stations. A seasonal pattern is lacking for the early portion of the record; however, the recent record generally exhibits the highest concentrations in the summer and fall and the lowest in winter and spring. A relatively steady trend of decreasing values over the period of record is evident. TP concentrations increased slightly in 2003 but remain relatively low when compared to the early portion of record.

Ortho-Phosphorus (PO₄; Figure 16):

Variations in PO₄ concentrations are similar to those seen for TP. Concentrations recorded during the most recent years are substantially lower than the concentrations that were measured during the first two years of the study.

Carbonaceous Biological Oxygen Demand (CBOD₅; Figure 17):

CBOD₅ is generally similar for all stations. Seasonal or long-term trends are not evident. An unusually high value was observed at COT17 in May 2003.

Chlorophyll-a (CHLA; Figure 18:)

CHLA concentrations at the three stations are often very similar. However, considerable monthly differences between stations have been observed on three occasions (1991, 1994 and 1995). A strong seasonal pattern is evident, with maximum concentrations generally recorded in late summer and fall. The lowest concentrations are most often found during the coldest winter months. A long-term trend is not apparent.

Long-Term Trends of Hillsborough Bay Water Quality Parameters Sampled by the EPC

Annual averages for parameters measured by the EPC and specified in the study plan (DO, CBOD5, TP, PO4, TN, TKN and CHLA) are discussed in the text below and illustrated in Figures 19 through 27. The annual averages of all 14 Hillsborough Bay EPC stations (Figure 2), as a group, are compared to the annual averages for the group of EPC stations close to the Howard F. Curren WWTP outfall (EPC2, EPC6, EPC44, EPC52 and EPC70; Figure 1). Additionally, station EPC44 was not included in Figures 19 through 27 prior to 2001.

TN (Figure 19):

TN concentrations are very similar between the two station groups. A long-term trend in Hillsborough Bay TN concentrations is not evident, however, concentrations during the most recent years are relatively low compared to the levels observed during the early portion to the record. The TN concentrations measured in 2003 for the two station groups were the lowest for the period of record. EPC does not report nitrogen data prior to 1980.

TKN (Figure 20):

See the comments for TN.

TP(Figure 21):

TP concentrations have decreased from near 2mg/l in 1974 to current concentrations of approximately 0.24mg/l. The "All Stations" group consistently has higher concentrations than the upper Hillsborough Bay station group, reflecting the influence of the high phosphorus discharges from the Alafia River on the lower and mid portions of Hillsborough Bay. The Alafia River appears to be a major source of TP to the bay (see Figure 31). The concentrations measured for both station groups during the period 1999 through 2003 were the lowest recorded during the period of record.

PO4 (Figure 22):

See the comments for TP. In addition, PO4 information is based on a much smaller amount of samples than TP.

CBOD5 (Figure 23):

CBOD5 concentrations peaked at approximately 5mg/l during the period 1975 through 1977 and declined to current levels of approximately 2mg/l. The influence of the Howard F. Curren WWTP prior to the conversion to advanced wastewater treatment (AWT) in 1979 may be indicated by the higher values for the upper Hillsborough Bay station group during the period 1973 through 1978.

DO (Figures 24-26):

There are no consistent spatial or temporal trends for either SDO, MDO or BDO concentrations, with the exception that DO concentrations were generally elevated at all depths for both station groups during 1976 through 1981.

CHLA (Figure 27):

CHLA concentrations were highest in Hillsborough Bay from the mid 1970's through the early 1980's. During that period values ranged from approximately 25 to 37ug/l. Concentrations then decreased relatively steadily to about 10ug/l in 1993. Since 1994, annual CHLA concentrations have ranged between approximately 10 and 20ug/l. There is no consistent difference between the two station groups, except for the period of 1973-1977, when the upper Hillsborough Bay station group had substantially higher concentrations than the "All Stations" group. CHLA concentrations

for both station groups during the period 1999 through 2003 are among the lowest for the period of record.

Comparison Between COT Compliance Monitoring Stations and Selected EPC Stations in Upper Hillsborough Bay

The 2003 annual average values of the parameters specified in the study plan (DO, CBOD5, TP, PO4, TN, TKN and CHLA) are discussed in the text below and illustrated in Figures 28 through 38. The annual average of each individual station from the COT compliance monitoring stations (COT15, COT16 and COT17; Figure 1) and the annual average of each individual EPC station close to the Howard F. Curren WWTP outfall (EPC2, EPC6, EPC44, EPC52 and EPC70; Figure 1) are used in this comparison. Summary statistics for each station and parameters listed above are shown in Table 1.

TN (Figure 28):

All COT compliance stations had TN concentrations lower or within one standard error of the mean (1 SE) of the EPC stations. Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter.

TKN (Figure 29):

All COT compliance stations had TKN concentrations lower or within one standard error of the mean (1 SE) of the EPC stations. Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter.

TP (Figures 30 and 31):

All COT compliance stations had TP concentrations similar to EPC stations EPC2, EPC44 and EPC70 (Figure 30). Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter. In addition, when comparing TP concentrations for the COT compliance monitoring stations and all EPC stations in Hillsborough Bay (Figure 31) it is evident that station EPC74, at the mouth of the Alafia River, has by far the greatest concentration, suggesting that the Alafia River is a major source of TP to Hillsborough Bay.

PO4 (Figures 32 and 33):

All COT compliance stations had PO4 concentrations similar to the EPC stations, with the exception of EPC6 (Figure 32). Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter. In addition, when comparing PO4 concentrations for the COT compliance monitoring stations and all EPC stations in Hillsborough Bay (Figure 33) it is evident that EPC74, at the mouth of the Alafia River, has by far the greatest concentration, suggesting that the Alafia River is a major source of PO4 to Hillsborough Bay.

CBOD5 (Figure 34):

All COT compliance stations had CBOD5 concentrations lower or similar to the EPC stations. Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter.

DO (Figures 35, 36 and 37):

All COT compliance stations had intermediate SDO and MDO concentrations (Figures 35 and 36) compared to the EPC upper Hillsborough Bay stations. Therefore, no significant impact from the Howard F. Curren WWTP is apparent for this parameter. Further, BDO concentrations (Figure 37) are not only a function of possible discharges, but are also greatly dependent on water depth and benthic conditions. Therefore, no attempt is made to relate this parameter to the Howard F. Curren WWTP discharge.

CHLA (Figure 38):

All COT compliance stations had CHLA concentrations similar to the EPC stations. Discharges from the Howard F. Curren WWTP do not appear to have a significant impact on this parameter.

Long-Term Trends of Tampa Bay Water Quality and Biological Indicators Sampled by the COT

Results from the long-term, multi-disciplinary, COT water quality and biological indicator monitoring program are discussed in the text below and illustrated in Figures 39 through 45. The parameters SD, DO, CHLA, phytoplankton production rates, the blue-green alga Schizothrix calcicola *sensu* Drouet filament concentrations and total phytoplankton cell concentrations are presented as annual averages for the study period for two stations located in Hillsborough Bay (COT4 and COT12) and one station located in Middle Tampa Bay (COT13; see Figure 3). It should be noted that the annual average for the blue-green alga is calculated as the average concentration for the period it is present in the samples. Drift macro-algae biomass is shown as the annual average biomass for each of the five transects in Hillsborough Bay (see Figure 4). Appendix Tables C and D list the field and laboratory results which include temperature, pH, salinity, DO, turbidity, CHLA, primary production, Secchi depth, alkalinity and photosynthetic active radiation (PAR). The PAR values listed are the average extinction coefficient (Kd) values from depths of 1m to 3m, or less if the water column was not deeper than 3.5m. Additionally, Appendix F explains missing data points in Appendix Tables C and D.

The growth of submerged seagrass and the attached benthic alga Caulerpa prolifera in Hillsborough Bay is discussed in the COT report submitted to FDEP on May 1, 2004, provided under a separate cover.

SD (Figure 39):

SD depth increased at station COT13 in the Middle Tampa Bay from approximately 2m in the early 1980's to a depth between 2.5m and 3m for the period 1985 through 1997. However, in 1998 and 2001, SD was substantially reduced in this bay segment to approximately 2m. In 2002, the SD increased to approximately 3.7m, the highest water transparency recorded during the period of record. SD remained high at station COT13 in 2003. A long-term SD trend is not apparent for the Hillsborough Bay stations COT4 and COT12. Although major reductions of phytoplankton biomass (CHLA) have occurred both in Middle Tampa Bay and Hillsborough Bay during the study period (see Figure 41), these reductions are not reflected in the Hillsborough Bay SD trend. Apparently, other factors such as sediment resuspension and water color are important in influencing water column light penetration (SD) in Hillsborough Bay.

DO (Figure 40):

SDO concentrations for the three stations have remained relatively stable over the period of record. BDO concentrations at COT4 and COT12 in Hillsborough Bay have significant variation, but do not exhibit a long-term trend.

CHLA (Figure 41):

Surface CHLA concentrations were relatively high from 1979 through 1982, however, concentrations decreased sharply in 1983 for stations COT4 and COT12 and for station COT13 in 1985. This decline continued to 1989 when average annual concentrations of approximately 15, 10 and 6ug/l were recorded for stations COT4, COT12 and COT13, respectively. Following 1989, CHLA concentrations remained relatively constant at stations COT12 and COT13. CHLA concentrations at station COT4 have generally decreased since the late 1980's, however, relatively high concentrations were recorded in 1995 and 1998. The lowest concentration for the period of record for COT4 occurred in 1999 (8.9 ug/l) and in 2002 for COT12 and COT13; 7ug/l and 3.7ug/l, respectively. In 2003, the CHLA concentrations remained relatively low. The current CHLA concentrations, since 1999, are very low in comparison to concentrations found during the late 1970's and early 1980's, indicating that eutrophic conditions in Tampa Bay have been greatly reduced.

Phytoplankton Production (Figure 42):

Annual primary production rates decreased almost steadily at all three stations over the period of record from near 250 mgC/m²/hr in the early 1980's to approximately 100 mgC/m²/hr during the recent years. Similar to CHLA, the large reduction in phytoplankton production seen over the study period indicates that eutrophic conditions in Tampa Bay have been greatly reduced.

Schizothrix calcicola sensu Drouet Abundance (Figure 43):

The abundance of this blue-green alga has decreased substantially since 1983. Concentrations during the last 15 years have been approximately one-third or less of the pre-1984 levels. This blue-green was virtually absent from Hillsborough Bay and Middle Tampa Bay during the recent six-year period.

Total Phytoplankton Abundance (Figure 44):

The two Hillsborough Bay stations, COT4 and COT12 have almost consistently higher phytoplankton abundance than the Middle Tampa Bay station. Peak concentrations of abundance for the Hillsborough Bay stations occurred in 1987, the same year ambient Hillsborough Bay TN concentrations were high (see Figure 19). Recent phytoplankton abundance for the three stations is substantially lower than that recorded during the early portion of the record.

Macro-Algae Standing Crop (Figure 45):

Drift macro-algae biomass in Hillsborough Bay, prior to 1998, was generally higher at transect B in northeastern Hillsborough Bay and transect E in northwestern Hillsborough Bay than that found at the other three transects. Prior to 1998, the current Hillsborough Bay macro-algae biomass is at study record lows and several transects consistently lack substantial amounts of macro-algae.

DISCUSSION

There are no indications, either from the compliance monitoring program or from the comparison between the COT compliance monitoring stations and the group of EPC stations close to the discharge site, that the discharge from the Howard F. Curren WWTP, during the year 2003, had a negative impact on water quality and biological indicators in Hillsborough Bay.

Long-term trends of water quality and biological indicators monitored in Hillsborough Bay by both the EPC and the COT programs have shown substantial improvements since the late 1970's and early 1980's. It is apparent that several important indicators of estuarine health, such as CHLA, blue-green alga abundance and seagrass growth (discussed in the report submitted to FDEP on May 1, 2004), have improved since the Howard F. Curren WWTP converted from primary treatment to AWT in 1979. These findings agree with the recently acquired understanding of the nutrient, specifically nitrogen, loading history of Hillsborough Bay (Johansson 1991).

Statistical relationships have been developed between external nitrogen loading to Hillsborough Bay and the response of phytoplankton biomass (Johansson 1991; Wade and Janicki 1995). These relationships suggest that the reduction in external nitrogen loading to the bay that occurred when the Howard F. Curren WWTP converted from primary treatment to AWT caused a substantial reduction of phytoplankton biomass in Hillsborough Bay. Therefore, the conversion of the Howard F. Curren WWTP from primary treatment to AWT has, without doubt, had a substantial beneficial long-term effect on water quality and biological indicators in Hillsborough Bay. Further, it is reasonable to assume that the recent water quality improvements seen in other major sections of Tampa Bay (Boler 1999), such as Middle Tampa Bay and Lower Tampa Bay, are at least partly related to the conversion of the Howard F. Curren WWTP.

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- Johansson, J.O.R. 1991. Long-term trends of nitrogen loading, water quality and biological indicators in Hillsborough Bay, Florida. pp. 157-176. In: Treat, S.F. and P.A. Clark (eds.), Proceedings, Tampa Bay Area Scientific Information Symposium 2. 1991 Feb. 27 - March 1; Tampa, FL. Text, Tampa, Fl.
- Wade, D. and A.J. Janicki. 1995. Estimating critical nitrogen loads for the Tampa Bay estuary: An empirically based approach to setting management targets. Tampa Bay National Estuary Program, Tech. Publ. #03-95.

Table 1. Summary statistics for COT compliance monitoring stations and selected EPC monitoring stations in the upper portion of Hillsborough Bay for the year 2003.

Station	Statistics	TN mg/l	TKN mg/l	TP mg/l	PO4 mg/l	SDO mg/l	MDO mg/l	BDO mg/l	CBOD5 mg/l	CHLA ug/l
COT15	N of cases	12	12	12	12	12	12	12	12	12
	Minimum	0.43	0.42	0.14	0.09	4.21	2.26	0.13	0.85	2.50
	Maximum	0.88	0.83	0.35	0.31	7.51	7.76	7.49	1.90	20.68
	Mean	0.64	0.59	0.25	0.19	5.95	5.52	3.96	1.32	9.81
	Standard Dev	0.13	0.11	0.08	0.07	1.09	1.73	2.59	0.33	4.79
COT16	N of cases	12	12	12	12	12	12	12	12	12
	Minimum	0.50	0.48	0.20	0.14	5.10	3.82	1.38	1.10	3.91
	Maximum	0.87	0.84	0.41	0.36	8.18	8.15	8.09	2.30	31.85
	Mean	0.64	0.60	0.28	0.21	6.39	5.95	4.50	1.66	12.51
	Standard Dev	0.13	0.10	0.07	0.07	1.12	1.61	2.26	0.33	7.30
COT17	N of cases	12	12	12	12	12	12	12	12	12
	Minimum	0.45	0.45	0.20	0.13	4.57	4.50	0.81	1.25	5.24
	Maximum	0.84	0.82	0.51	0.45	9.68	8.40	8.17	6.40	25.76
	Mean	0.65	0.63	0.29	0.21	6.67	6.29	4.96	2.11	14.00
	Standard Dev	0.13	0.12	0.09	0.09	1.50	1.28	2.46	1.40	6.70
EPC2	N of cases	12	12	12	12	12	12	12	12	11
	Minimum	0.48	0.46	0.16	0.12	2.80	1.50	0.20	0.00	1.08
	Maximum	1.42	1.42	0.33	0.26	9.28	7.70	6.20	8.00	73.54
	Mean	0.94	0.83	0.26	0.20	5.24	4.53	3.71	1.58	9.94
	Standard Dev	0.30	0.28	0.05	0.04	1.96	1.78	2.00	2.07	21.27
EPC6	N of cases	11	12	12	11	12	12	12	10	12
	Minimum	0.42	0.41	0.03	0.06	4.40	3.74	0.22	1.00	4.28
	Maximum	0.79	0.79	0.42	0.22	8.70	7.85	7.83	3.00	20.59
	Mean	0.58	0.57	0.20	0.13	6.81	6.31	3.85	1.80	12.37
	Standard Dev	0.11	0.11	0.11	0.06	1.17	1.26	2.82	0.79	5.57
EPC44	N of cases	11	12	12	11	12	12	12	11	12
	Minimum	0.48	0.47	0.19	0.10	3.40	3.20	0.74	1.00	4.00
	Maximum	0.91	0.90	0.42	0.34	8.73	8.73	8.75	5.00	25.99
	Mean	0.68	0.65	0.26	0.19	6.51	6.28	4.44	2.18	11.93
	Standard Dev	0.13	0.13	0.07	0.08	1.52	1.71	2.28	1.25	6.13
EPC52	N of cases	11	12	12	11	12	12	12	11	12
	Minimum	0.46	0.41	0.17	0.11	5.40	1.71	0.75	1.00	4.27
	Maximum	0.87	0.85	0.31	0.50	11.50	8.90	7.70	3.00	20.64
	Mean	0.59	0.56	0.23	0.19	7.73	5.39	4.82	1.36	10.34
	Standard Dev	0.12	0.12	0.05	0.11	2.05	2.07	2.12	0.67	5.12
EPC70	N of cases	11	12	12	11	12	12	12	3	12
	Minimum	0.46	0.45	0.18	0.12	5.30	4.89	0.81	2.00	4.20
	Maximum	0.76	0.75	0.37	0.28	8.70	8.70	7.70	3.00	28.39
	Mean	0.63	0.60	0.26	0.19	6.59	6.36	4.58	2.33	12.16
	Standard Dev	0.10	0.10	0.06	0.05	0.93	1.03	2.48	0.58	6.09

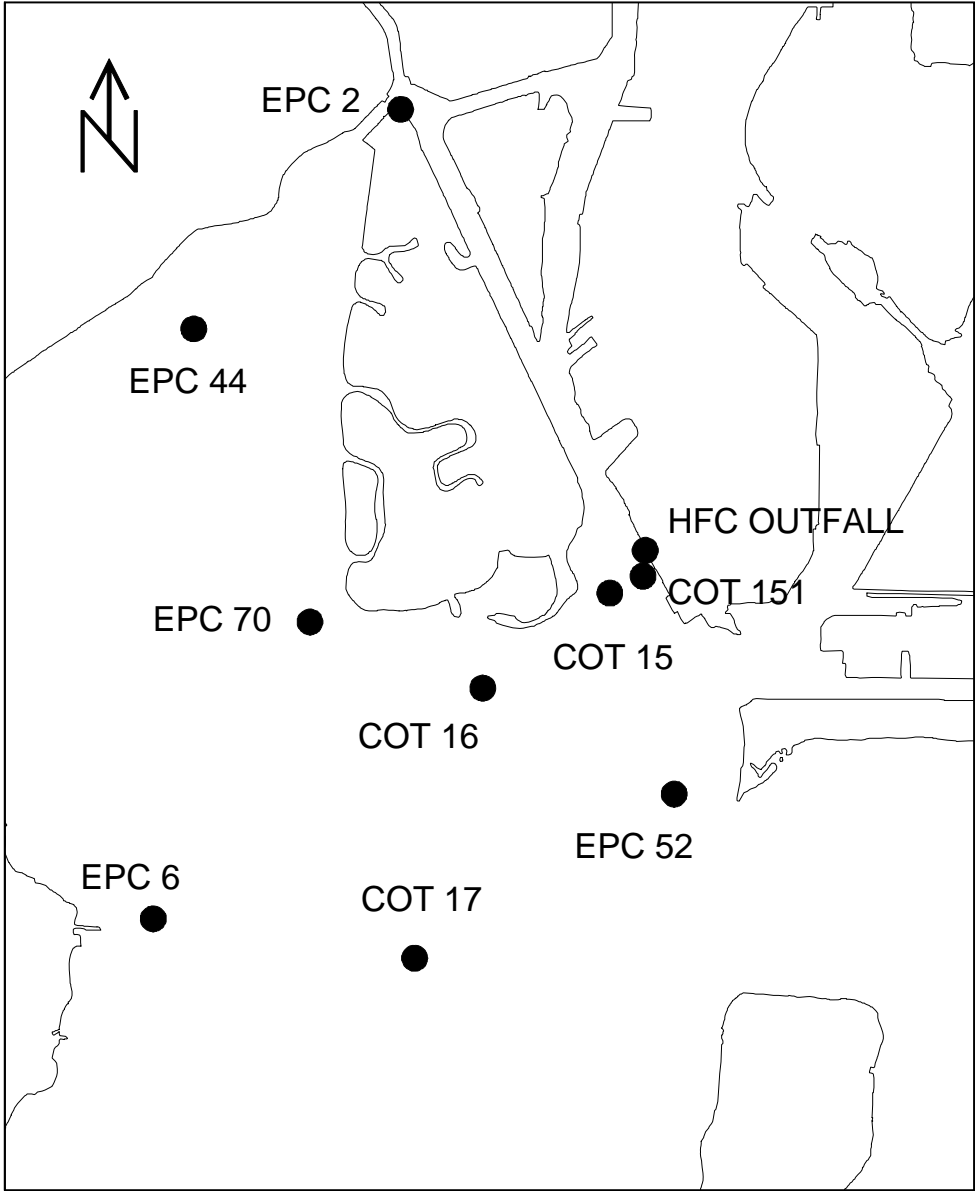


Figure 1. The Howard F. Curren WWTP discharge site, COT compliance monitoring stations and selected EPC stations in upper Hillsborough Bay.

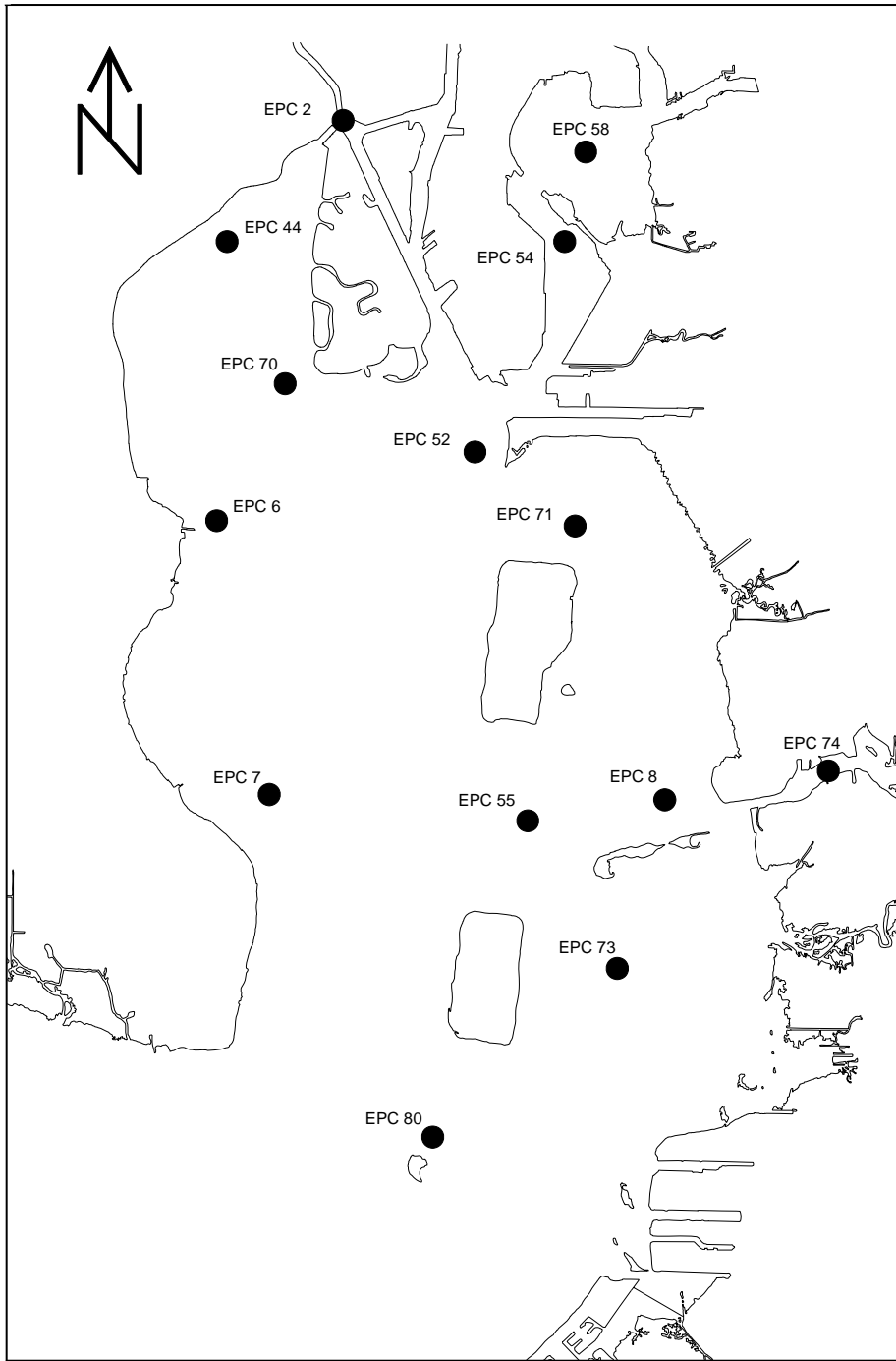


Figure 2. Water quality monitoring stations in Tampa Bay sampled by the EPC (modified from Boler 1999).

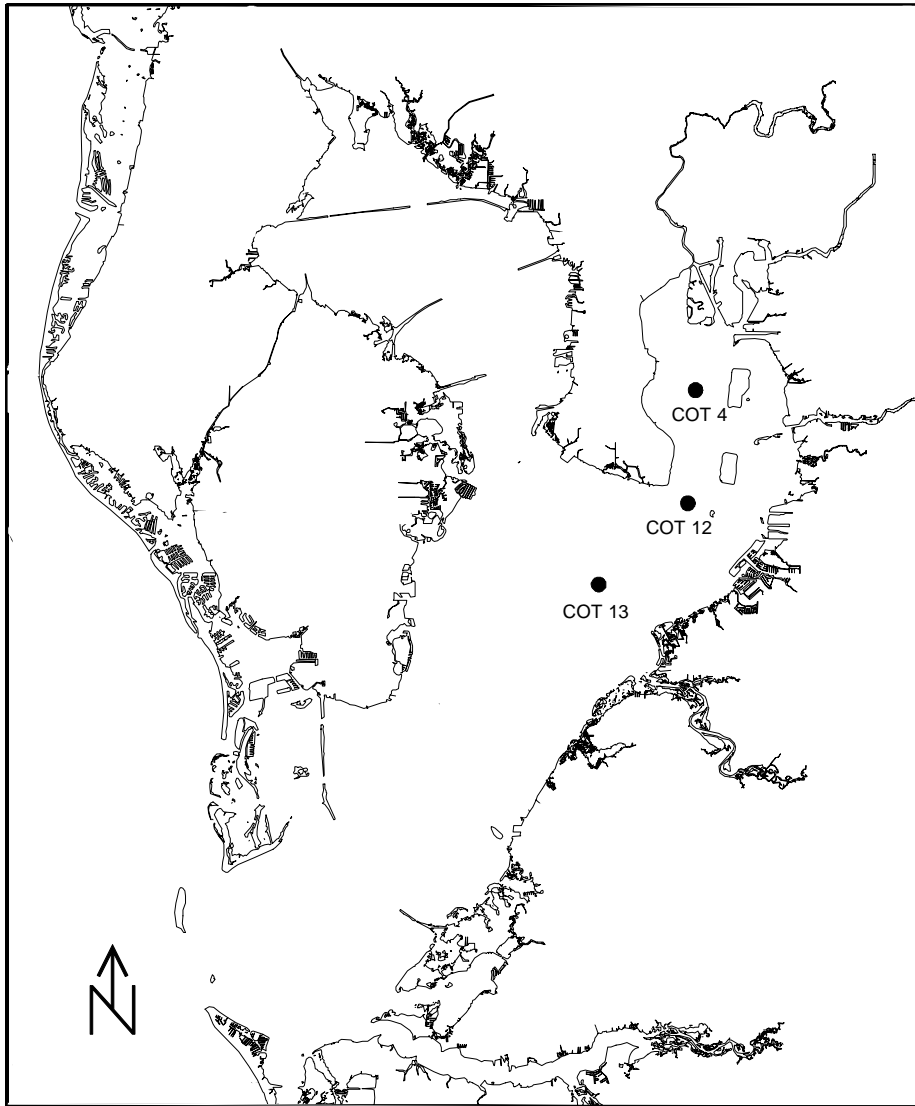


Figure 3. Water quality and phytoplankton monitoring stations in the Tampa Bay sampled by the COT.

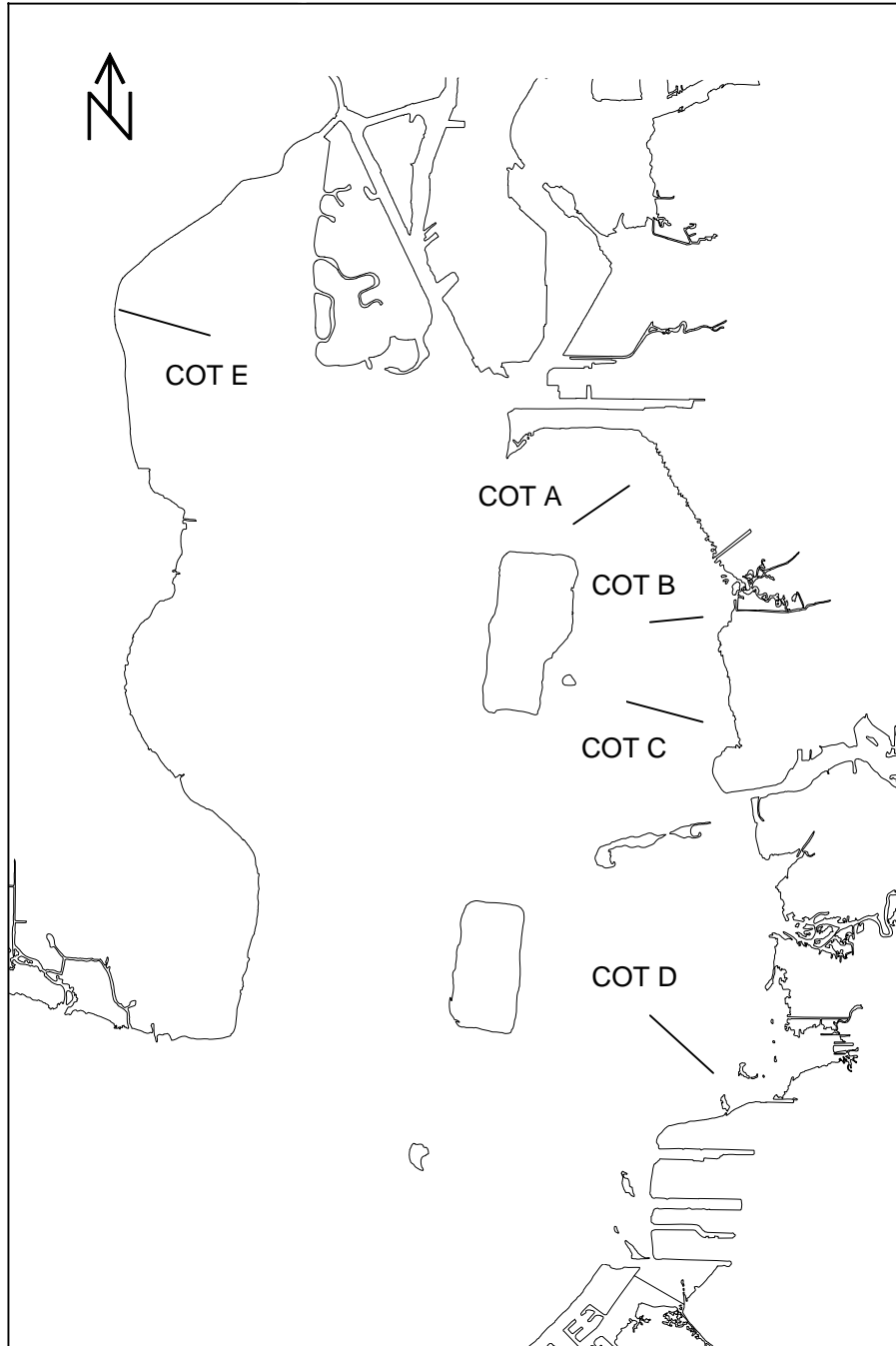


Figure 4. Macro-algae monitoring transects in Hillsborough Bay sampled by the COT.

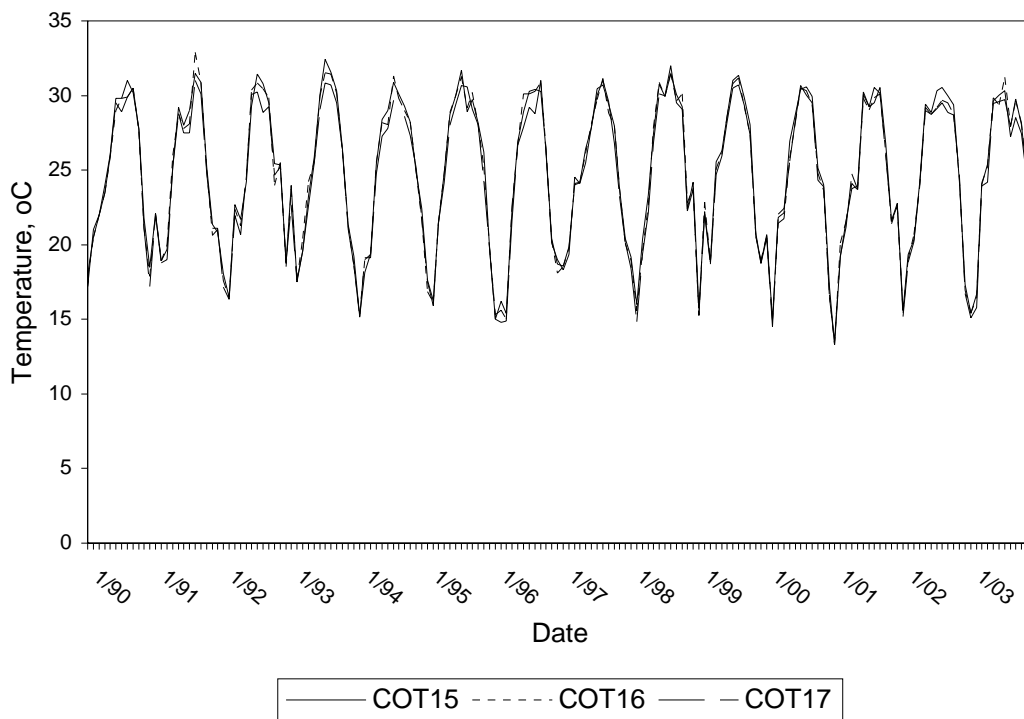


Figure 5. Monthly mid-depth temperatures at the COT compliance monitoring stations.

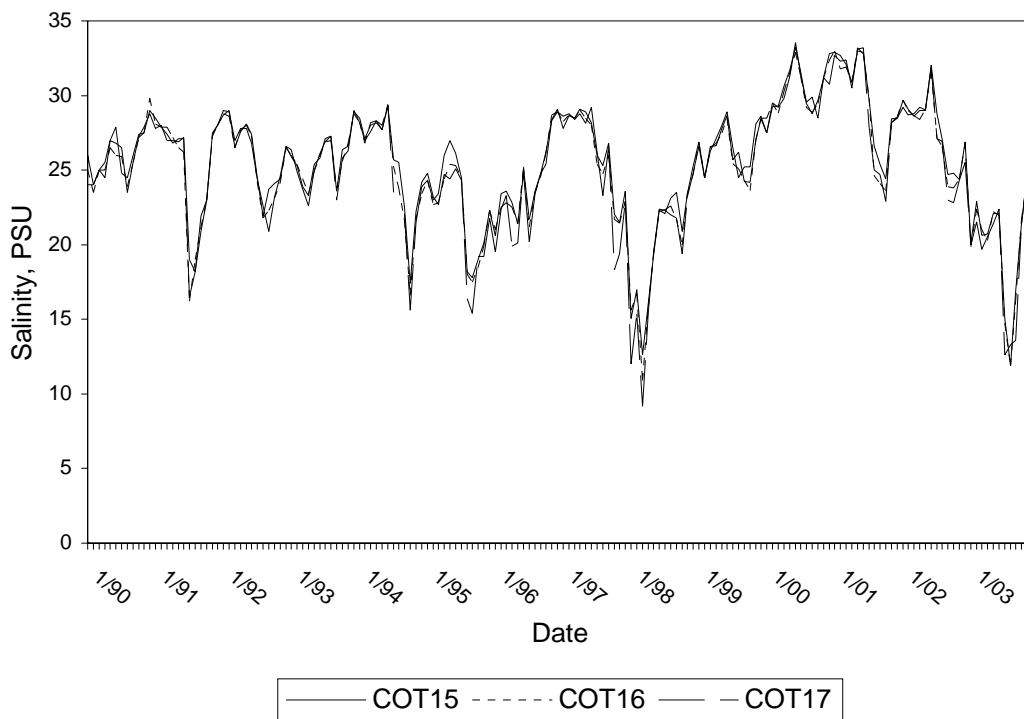


Figure 6. Monthly mid-depth salinities at the COT compliance monitoring stations.

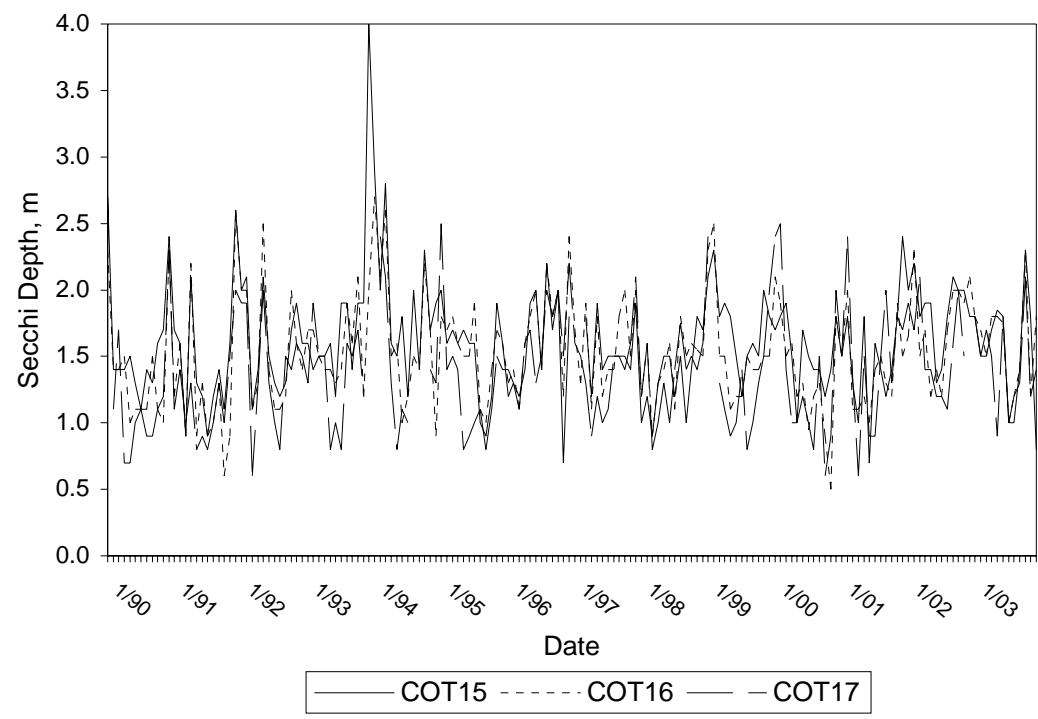


Figure 7. Monthly SD depths at the COT compliance monitoring stations.

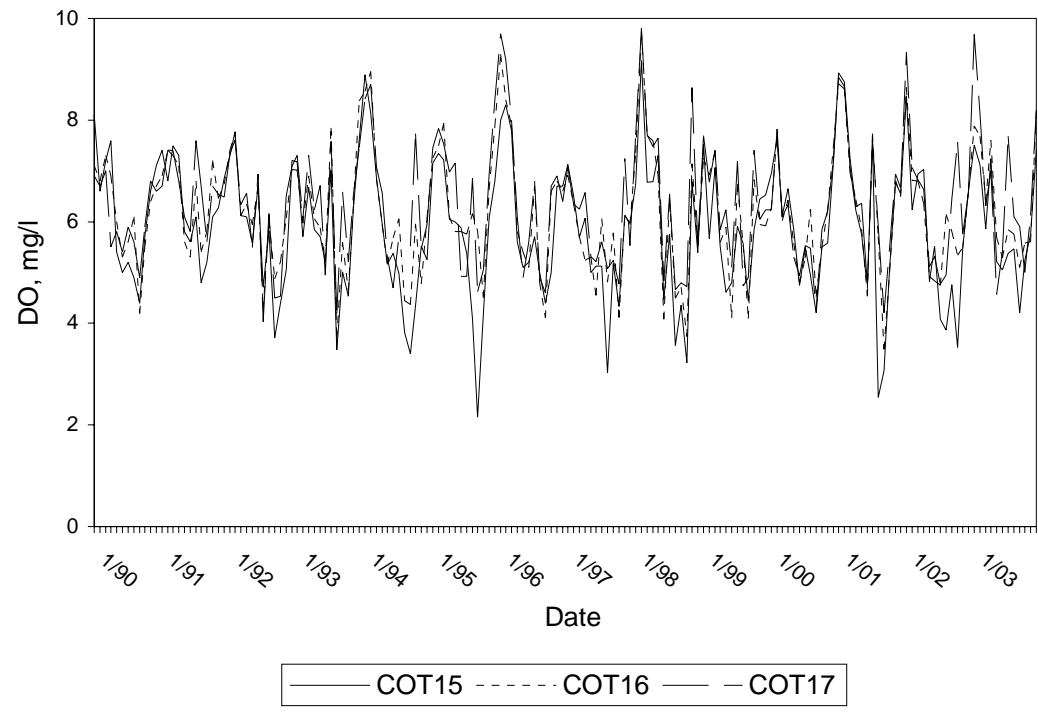


Figure 8. Monthly SDO concentrations at the COT compliance monitoring stations.

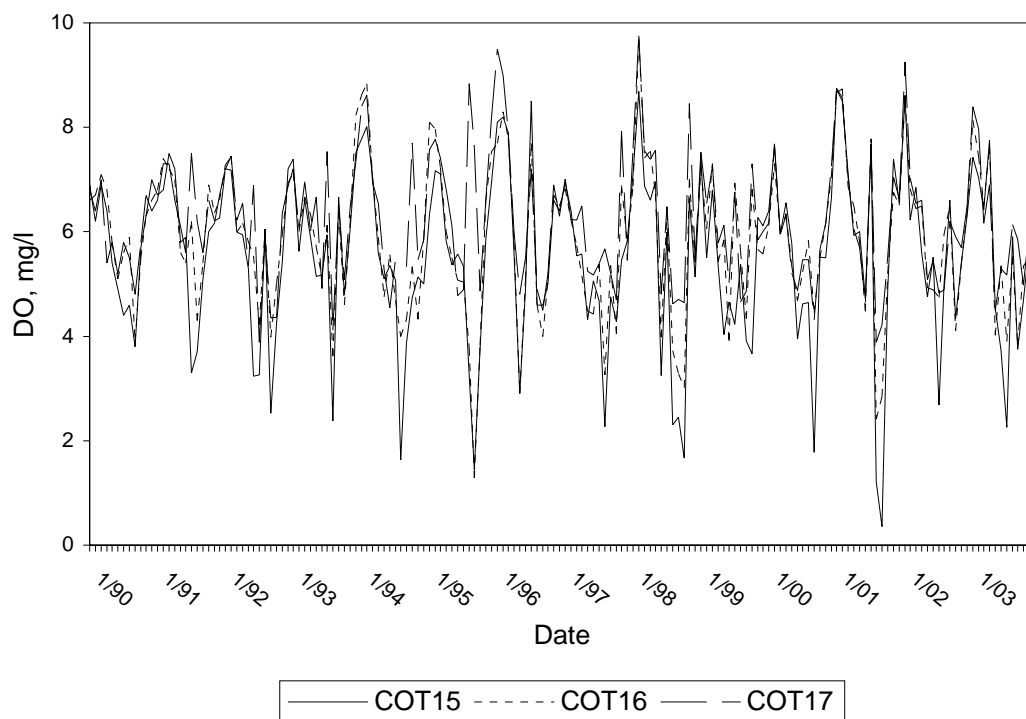


Figure 9. Monthly MDO concentrations at the COT compliance monitoring stations.

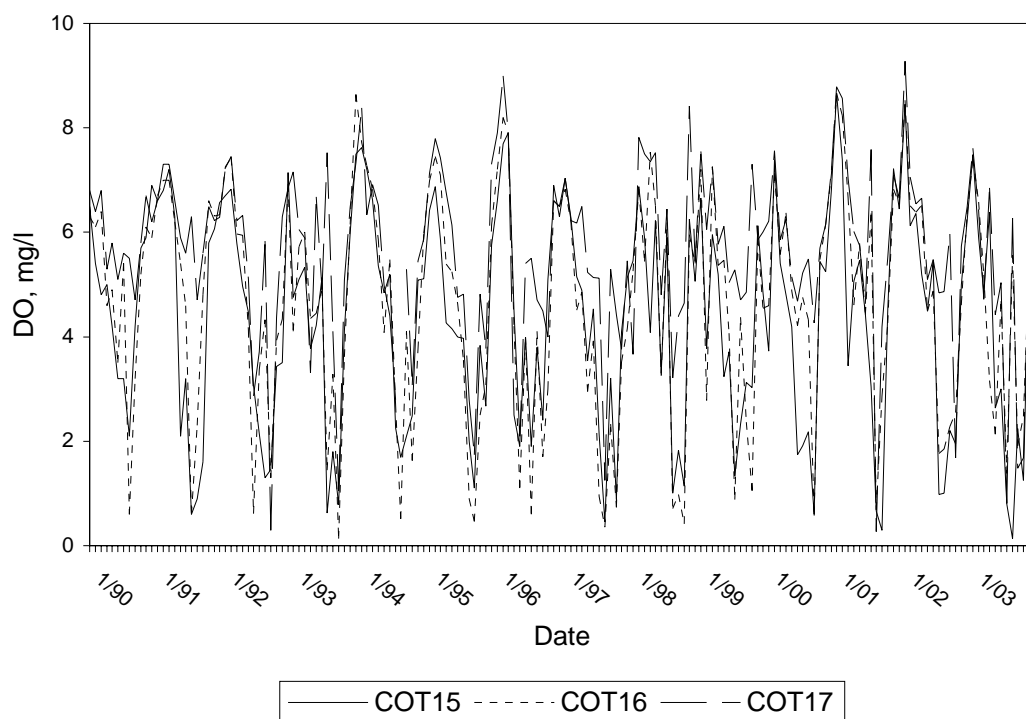


Figure 10. Monthly BDO concentrations at the COT compliance monitoring stations.

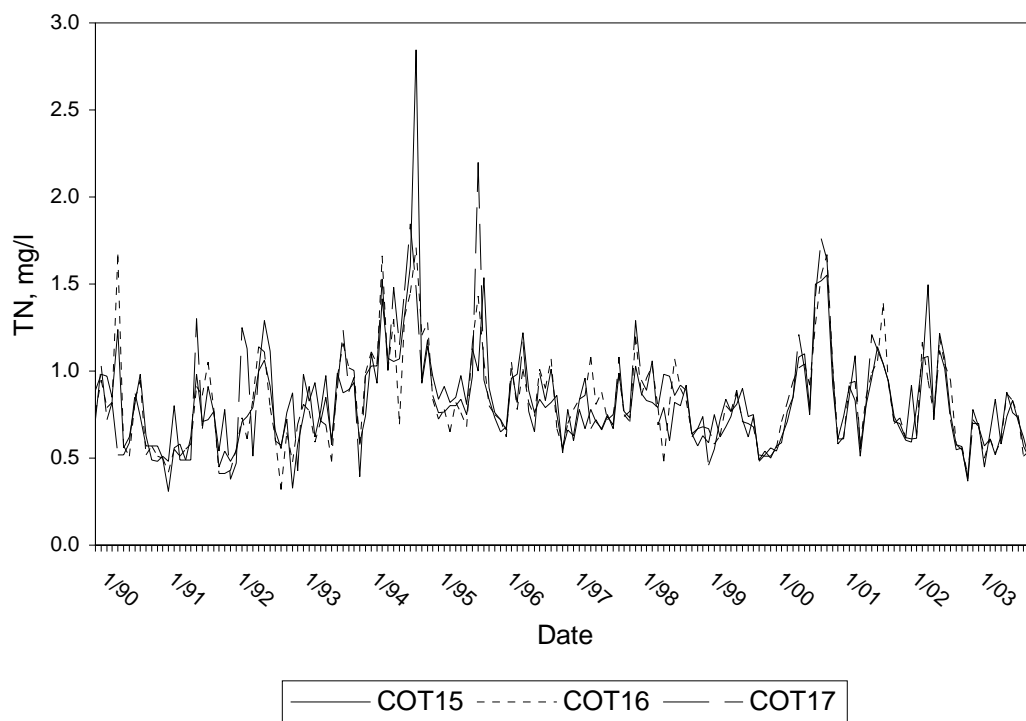


Figure 11. Monthly mid-depth TN concentrations at the COT compliance monitoring stations.

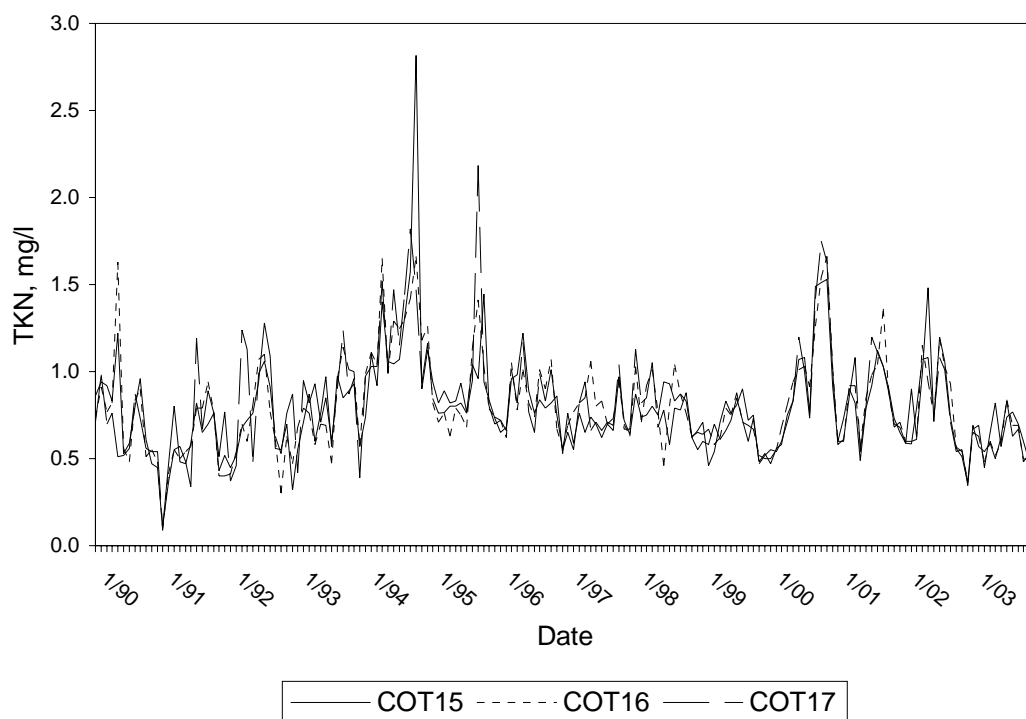


Figure 12. Monthly mid-depth TKN concentrations at the COT compliance monitoring stations.

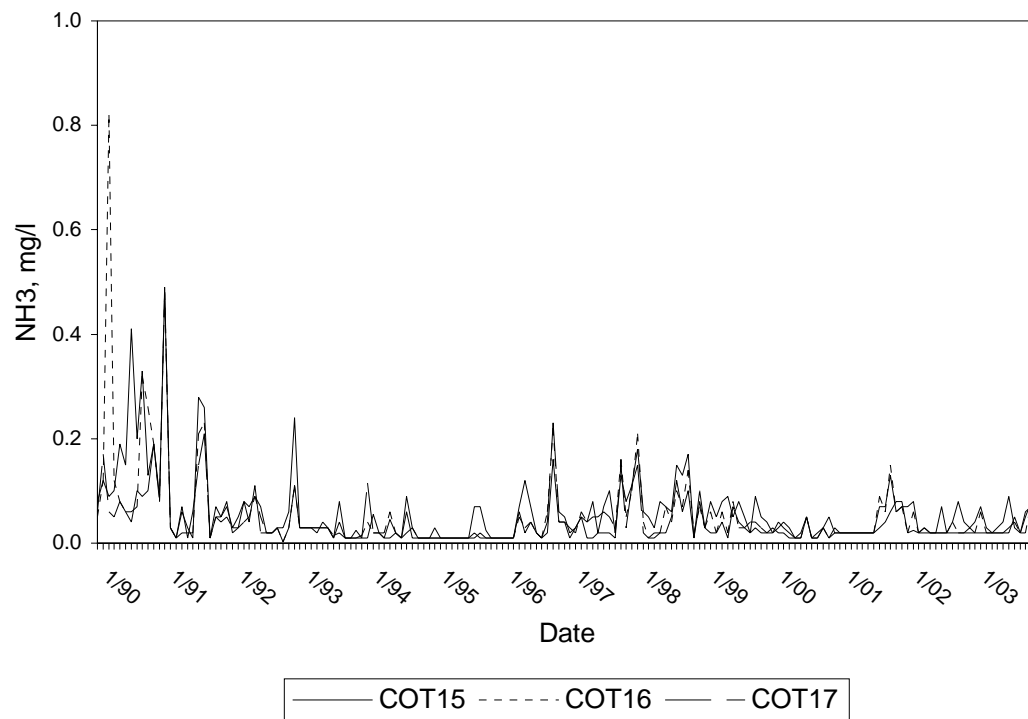


Figure 13. Monthly mid-depth NH₃ concentrations at the COT compliance monitoring stations.

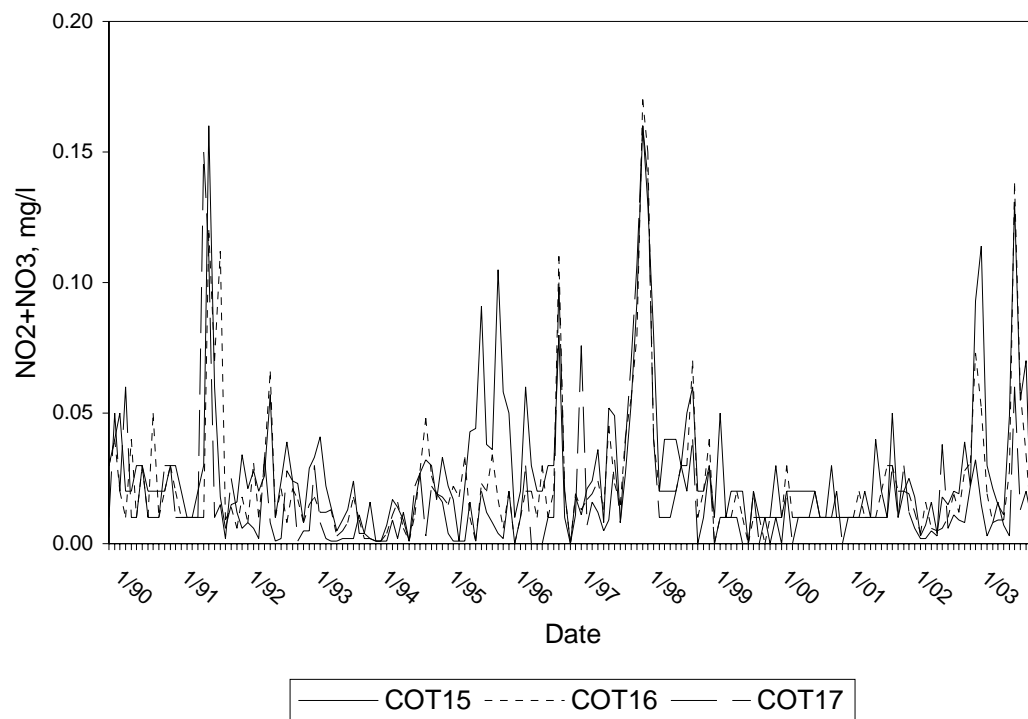


Figure 14. Monthly mid-depth NO₂+NO₃ concentrations at the COT compliance monitoring stations.

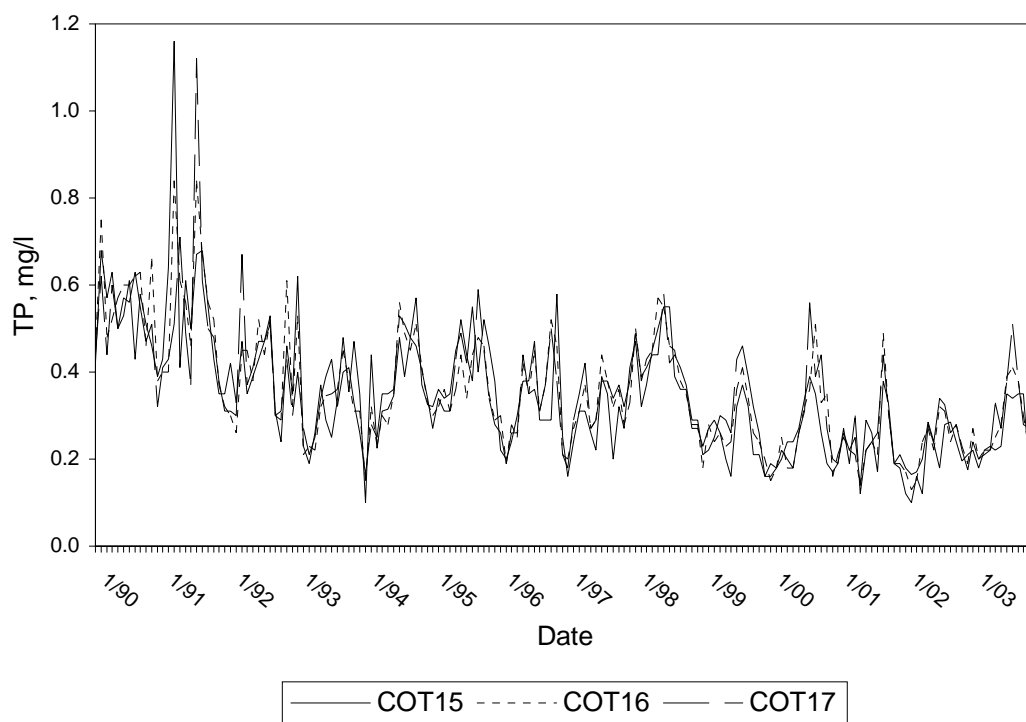


Figure 15. Monthly mid-depth TP concentrations at the COT compliance monitoring stations.

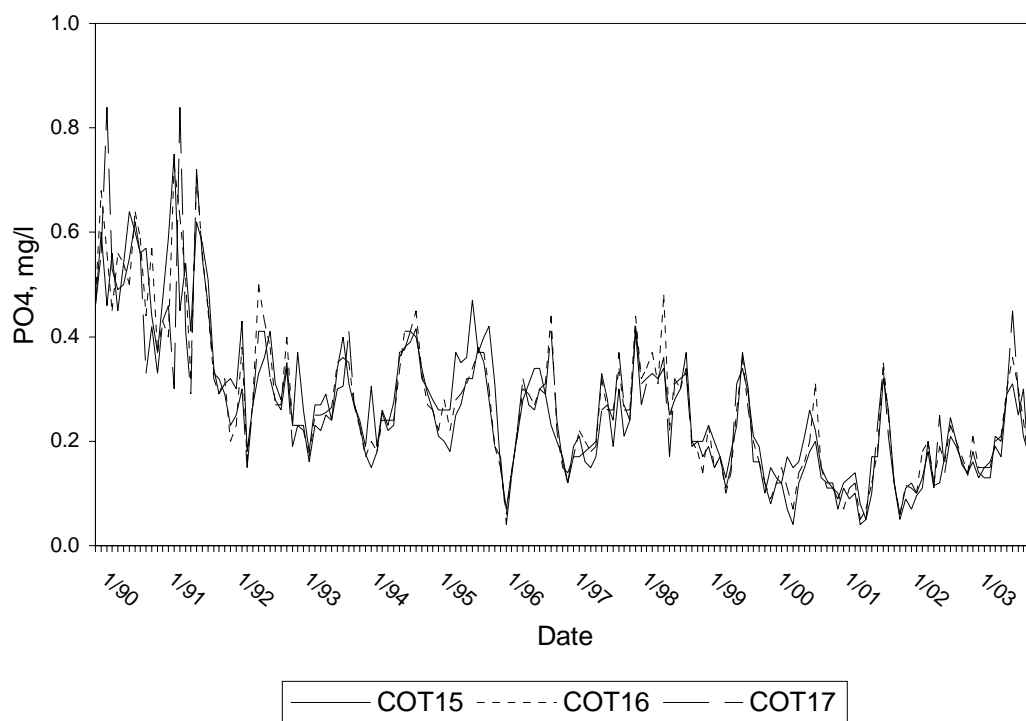


Figure 16. Monthly mid-depth PO₄ concentrations at the COT compliance monitoring stations.

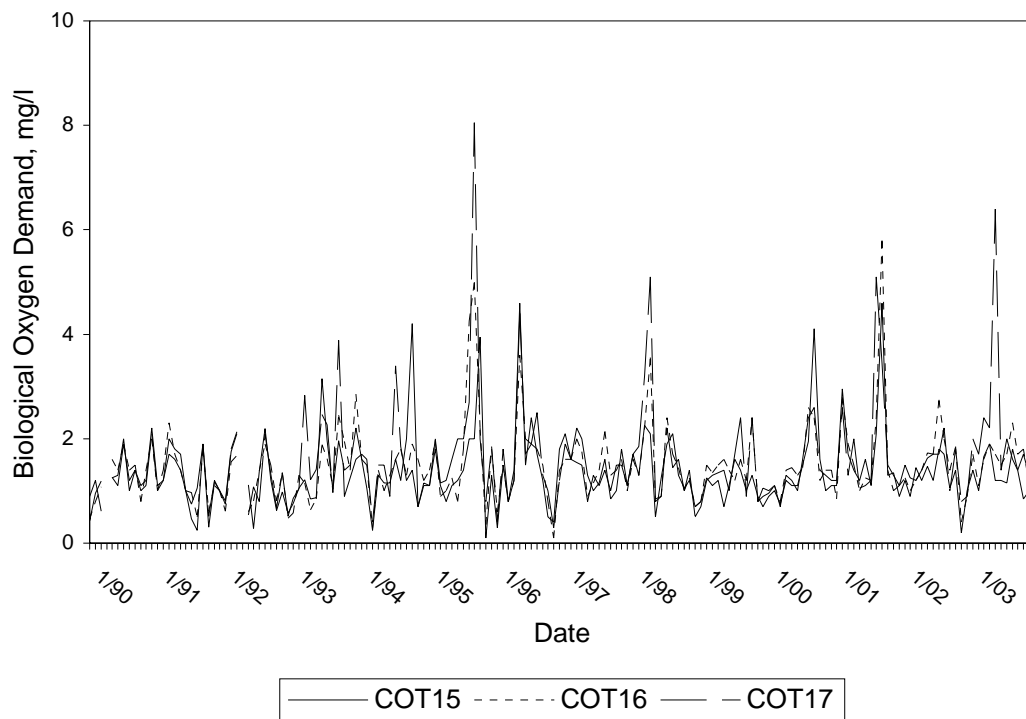


Figure 17. Monthly mid-depth CBOD5 concentrations at the COT compliance monitoring stations.

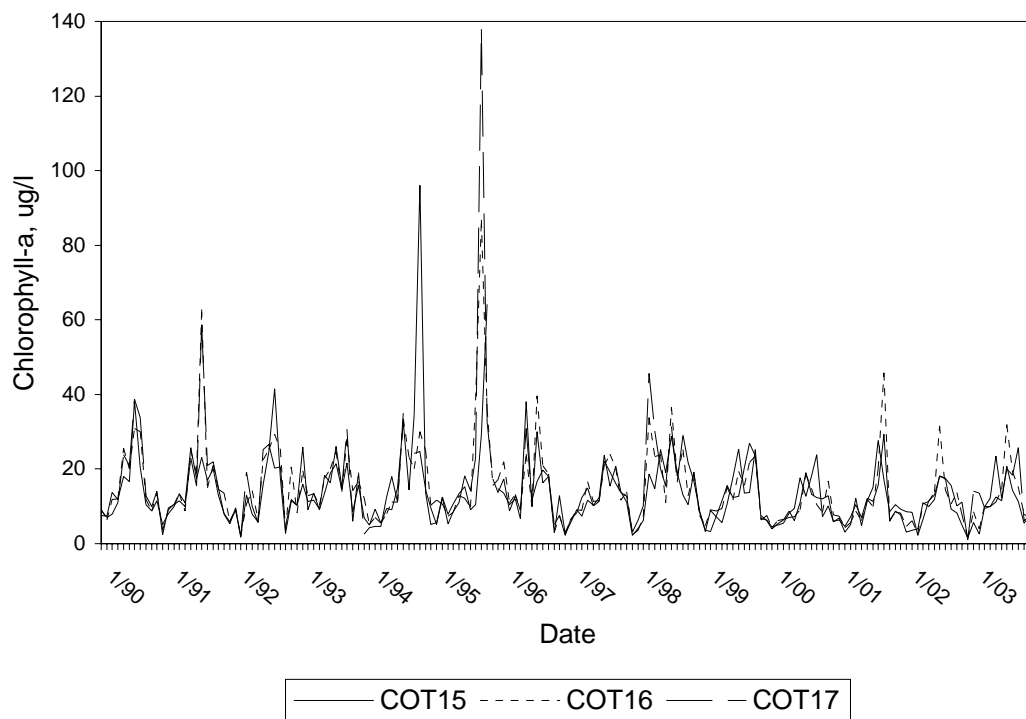


Figure 18. Monthly mid-depth CHLA concentrations at the COT compliance monitoring stations.

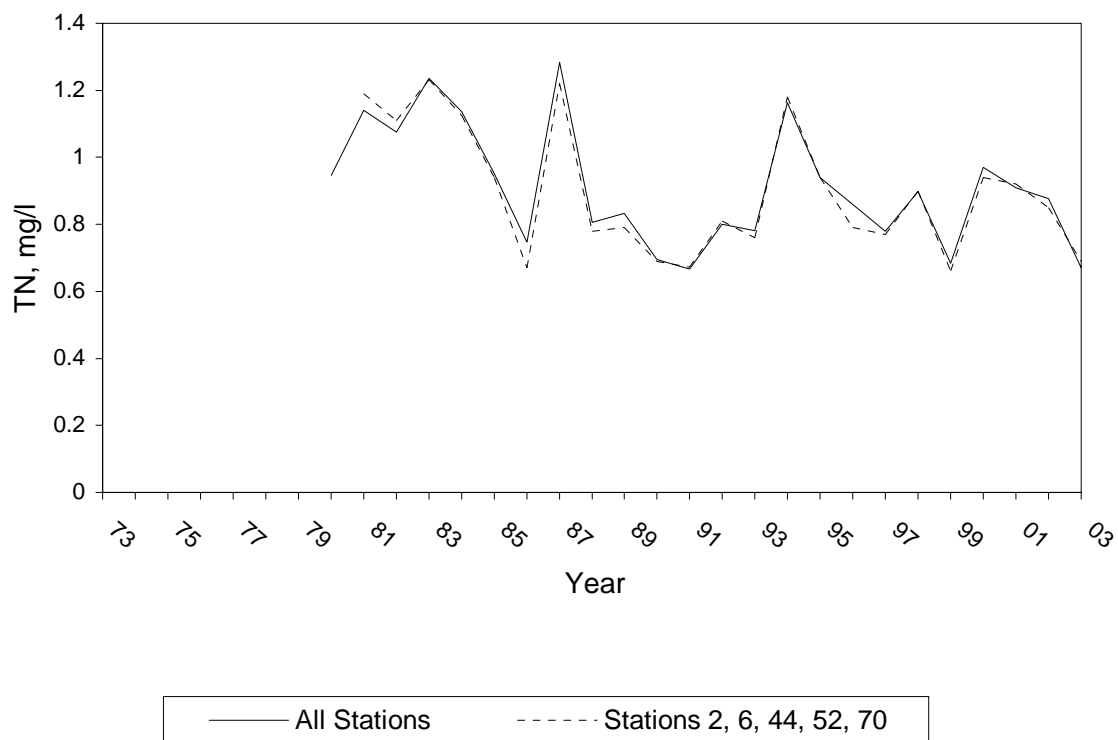


Figure 19. Long-term trend of TN concentrations for stations sampled in Hillsborough Bay by the EPC.

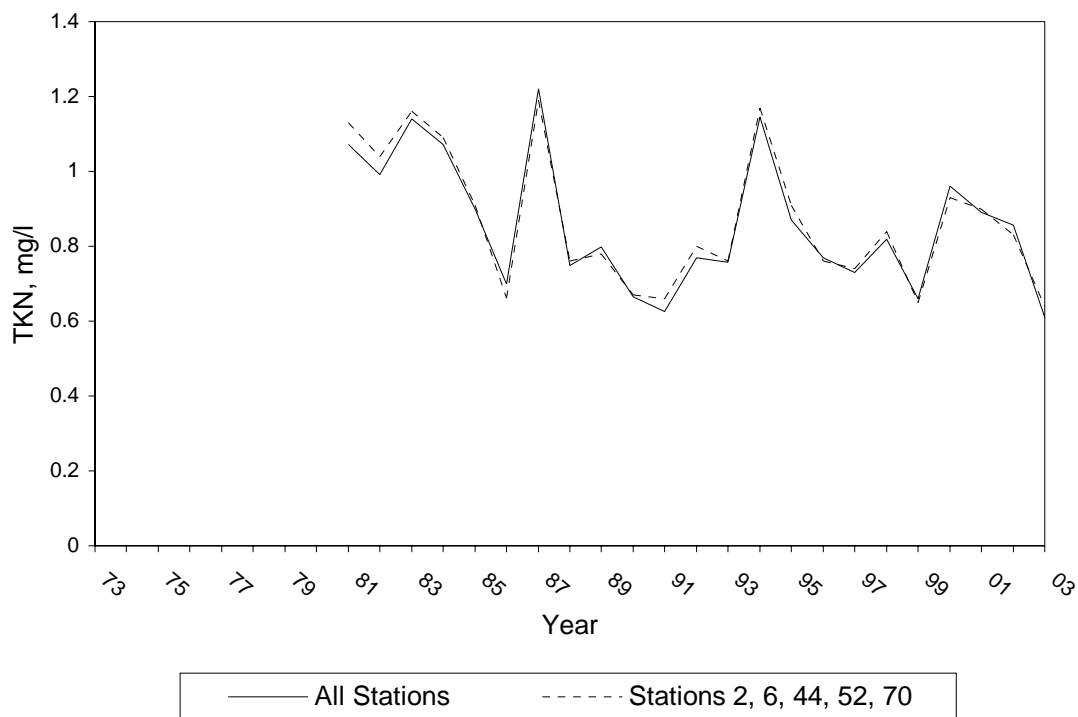


Figure 20. Long-term trend of TKN concentrations for stations sampled in Hillsborough Bay by the EPC.

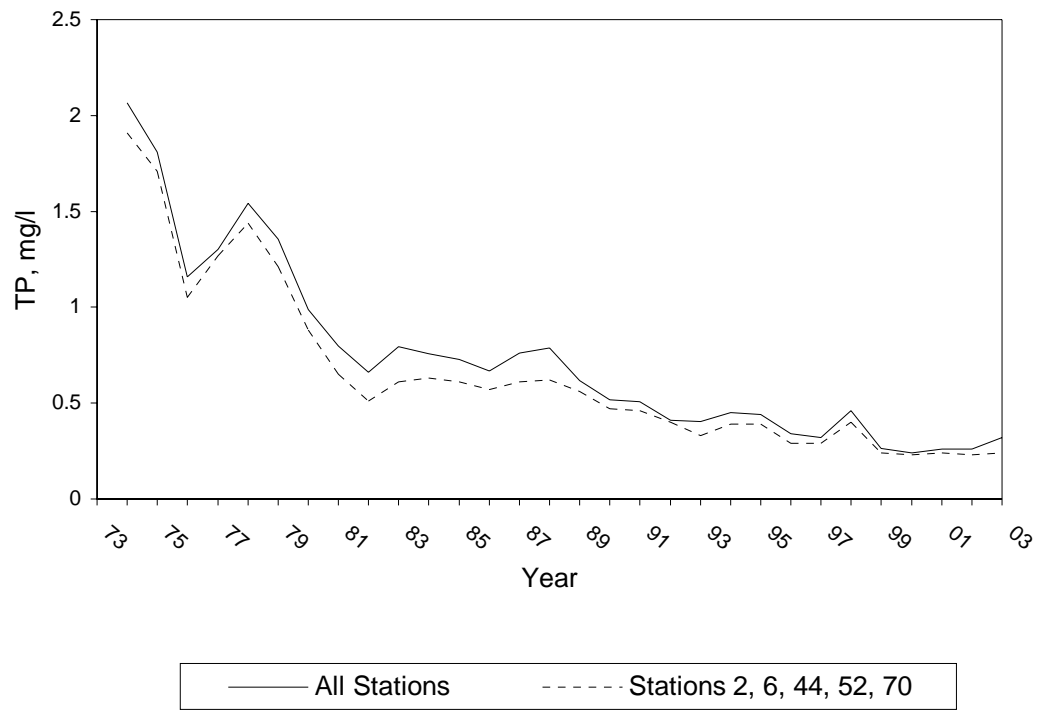


Figure 21. Long-term trend of TP concentrations for stations sampled in Hillsborough Bay by the EPC.

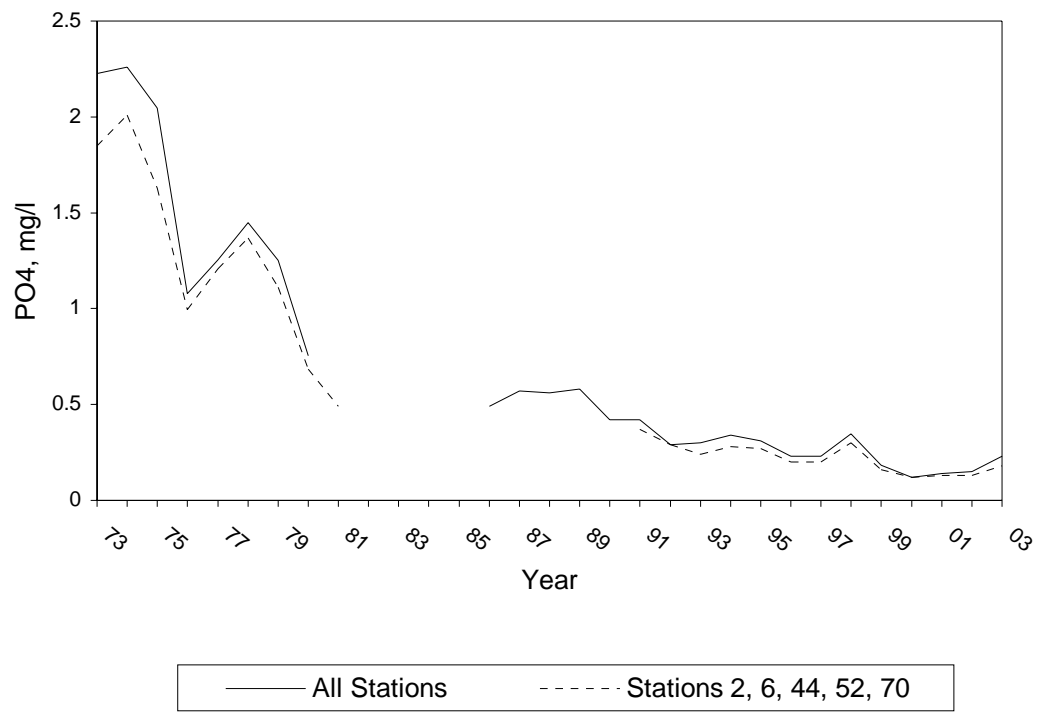


Figure 22. Long-term trend of PO4 concentrations for stations sampled in Hillsborough Bay by the EPC.

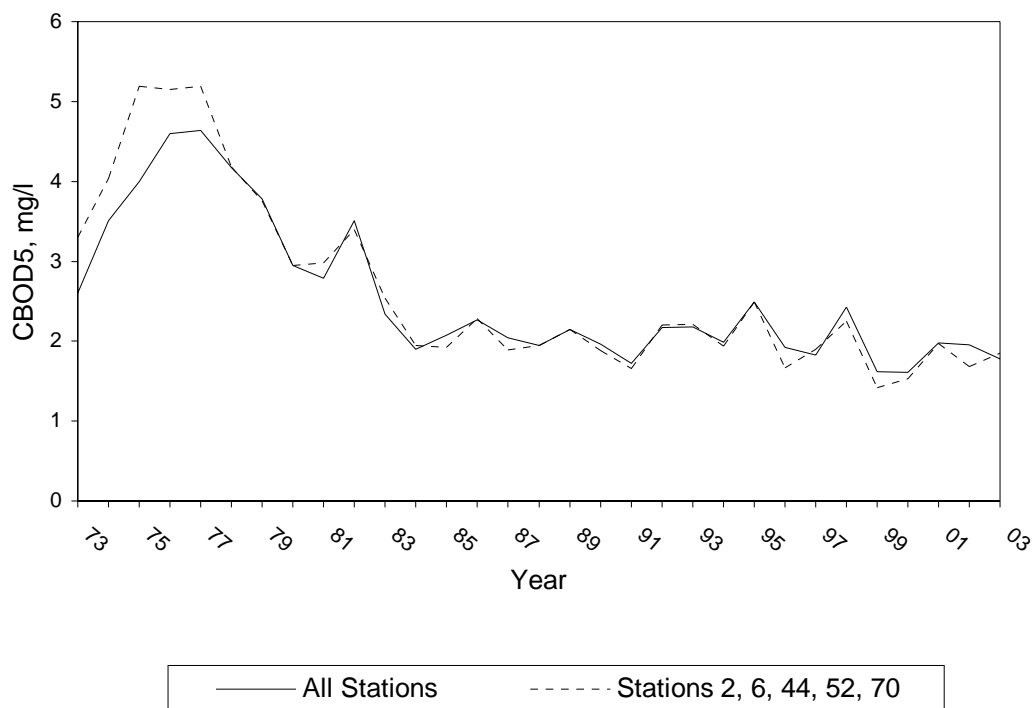


Figure 23. Long-term trend of CBOD5 concentrations for stations sampled in Hillsborough Bay by the EPC.

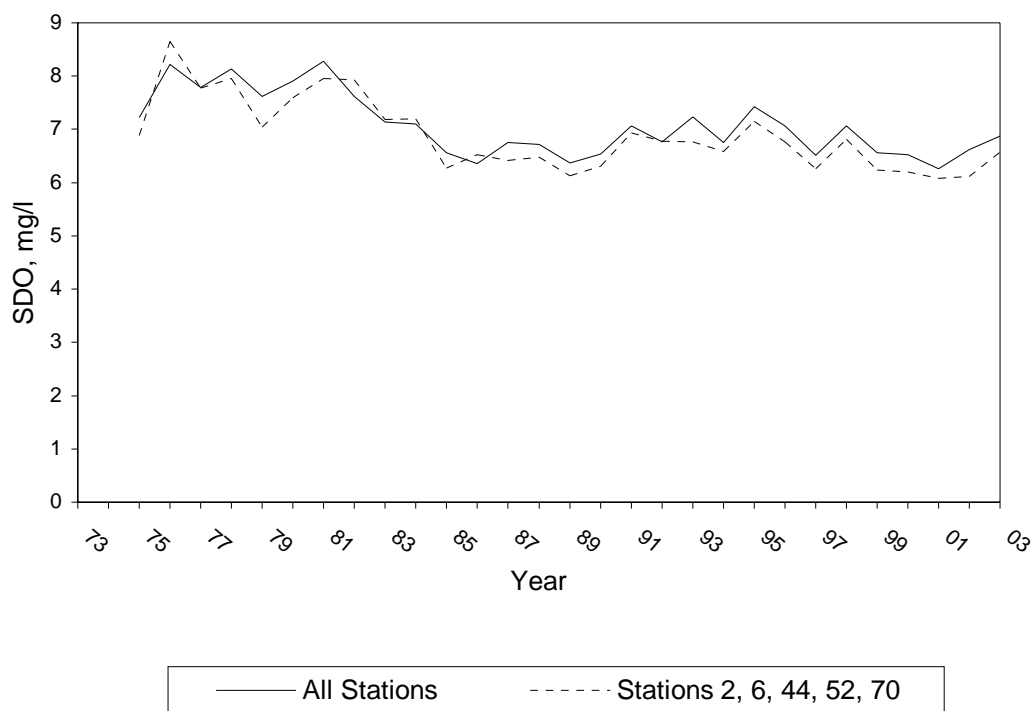


Figure 24. Long-term trend of SDO concentrations for stations sampled in Hillsborough Bay by the EPC.

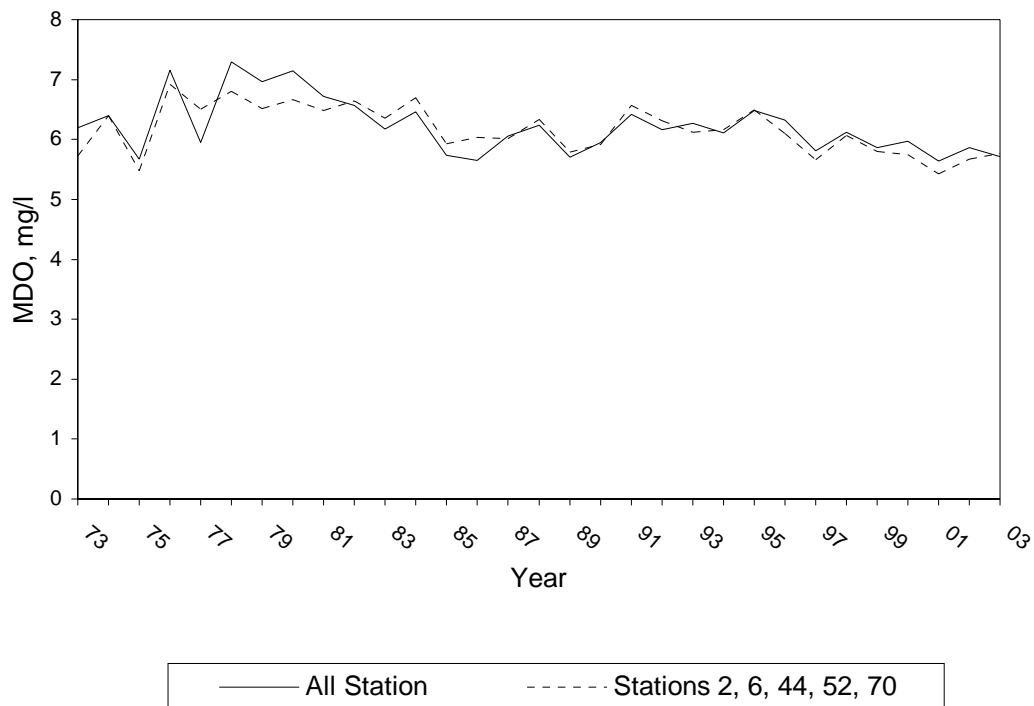


Figure 25. Long-term trend of MDO concentrations for stations sampled in Hillsborough Bay by the EPC.

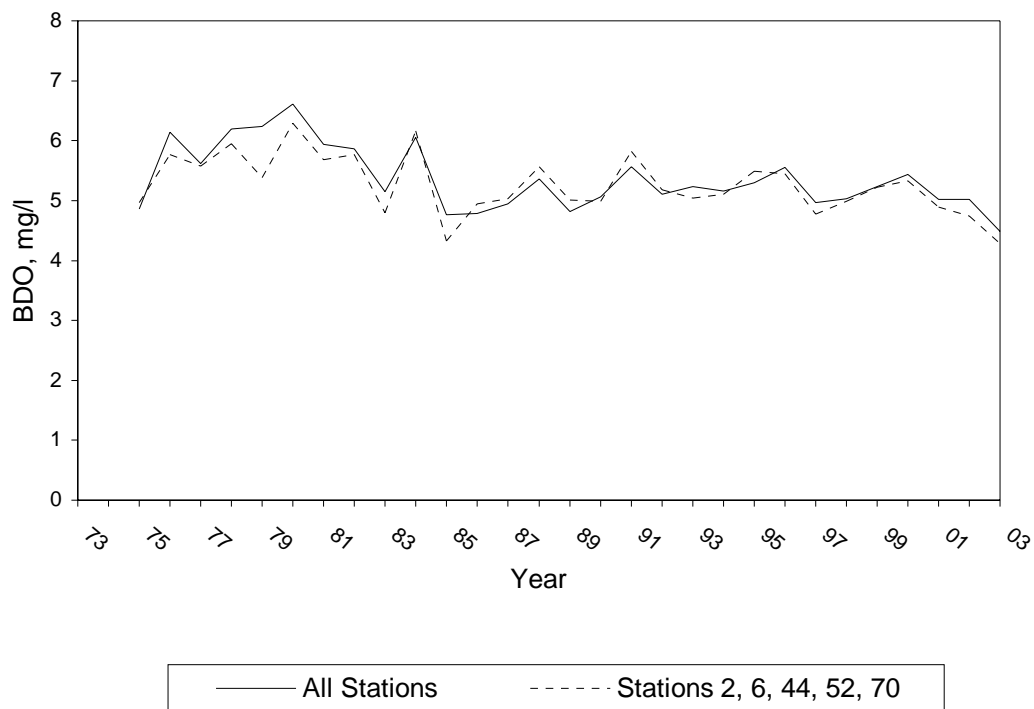


Figure 26. Long-term trend of BDO concentrations for stations sampled in Hillsborough Bay by the EPC.

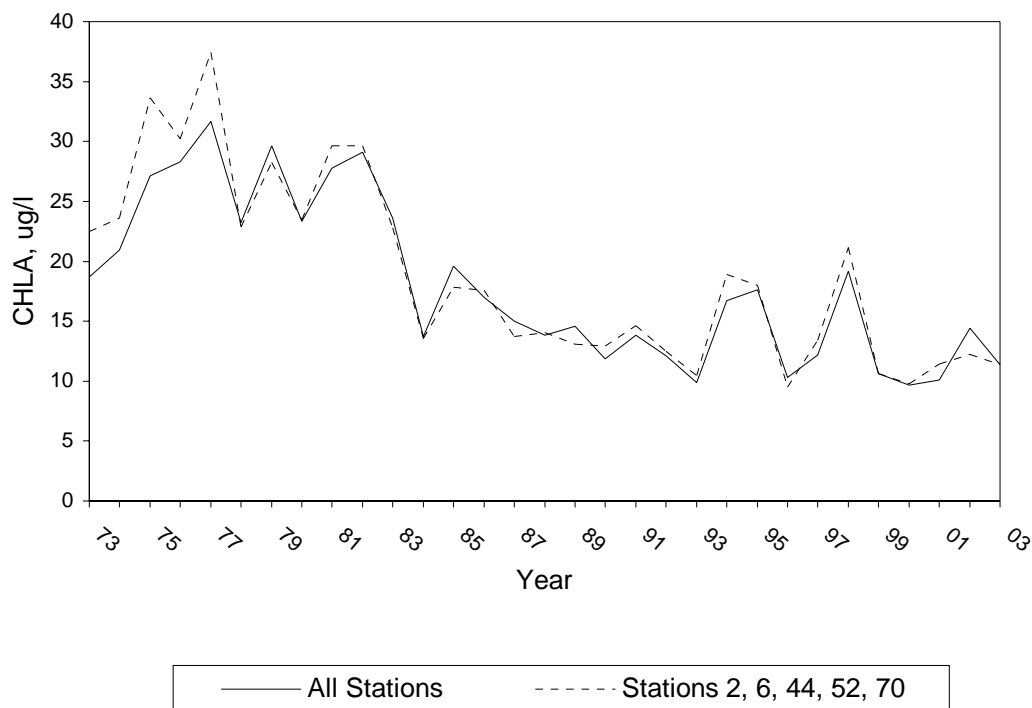


Figure 27. Long-term trend of CHLA concentrations for stations sampled in Hillsborough Bay by the EPC.

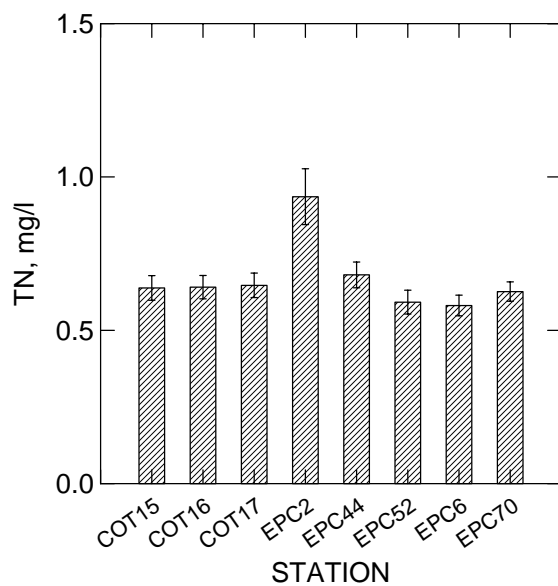


Figure 28. Comparison of mean values and standard errors for TN concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

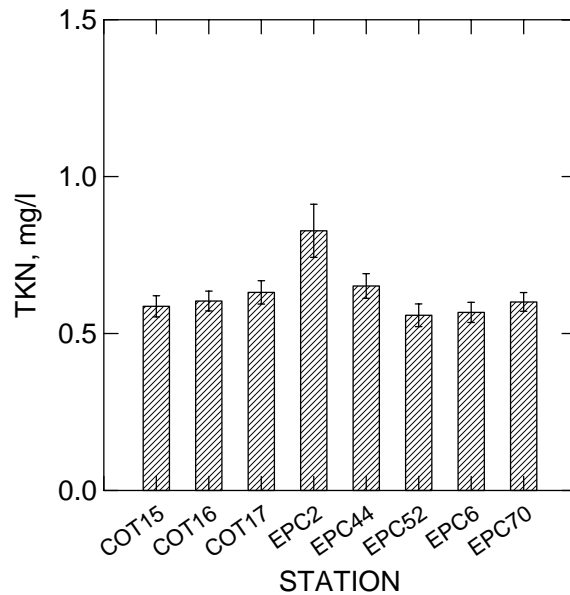


Figure 29. Comparison of mean values and standard errors for TKN concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

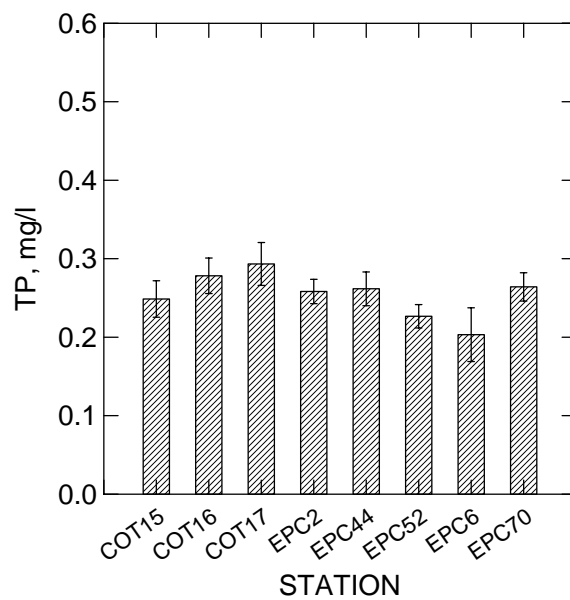


Figure 30. Comparison of mean values and standard errors for TP concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

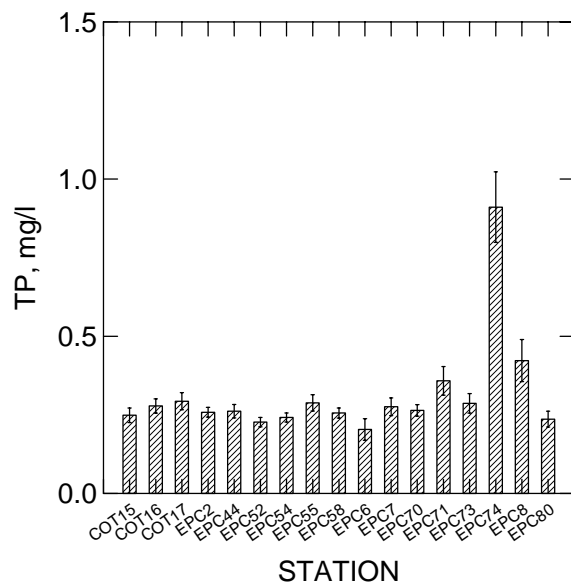


Figure 31. Comparison of mean values and standard errors for TP concentrations measured at the COT compliance monitoring stations and all EPC stations in Hillsborough Bay for the year 2003.

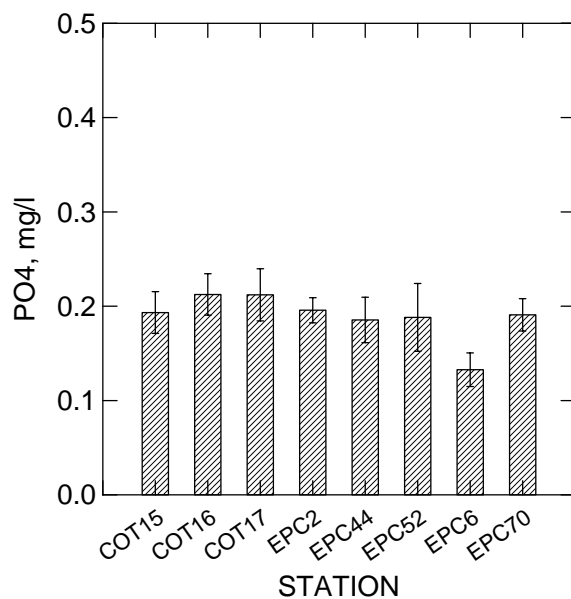


Figure 32. Comparison of mean values and standard errors for PO4 concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

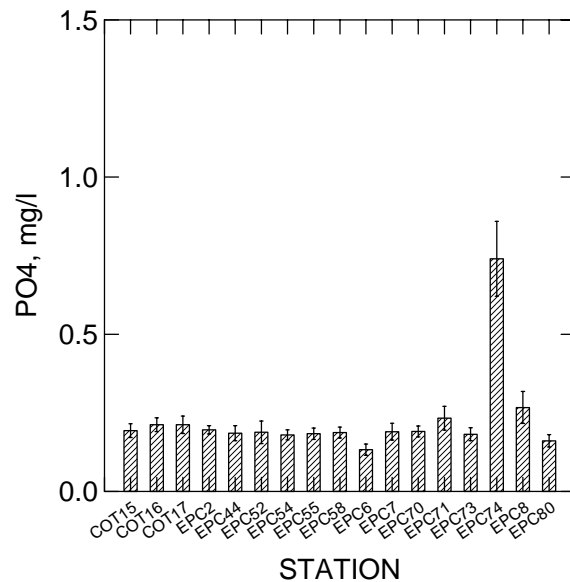


Figure 33. Comparison of mean values and standard errors for PO₄ concentrations measured at the COT compliance monitoring stations and all EPC stations in Hillsborough Bay for the year 2003.

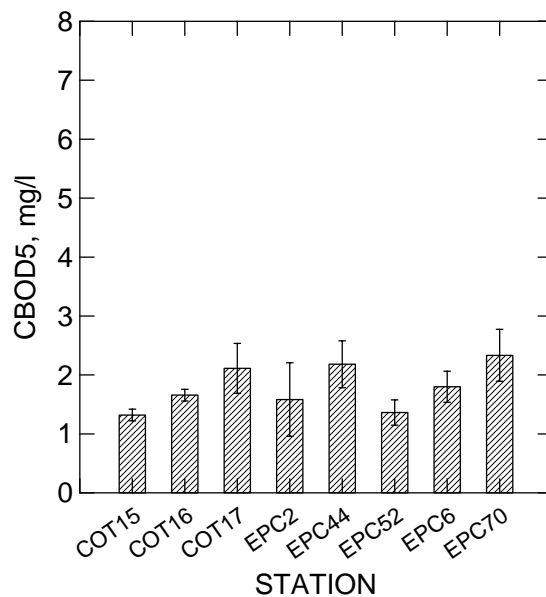


Figure 34. Comparison of mean values and standard errors for CBOD₅ concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

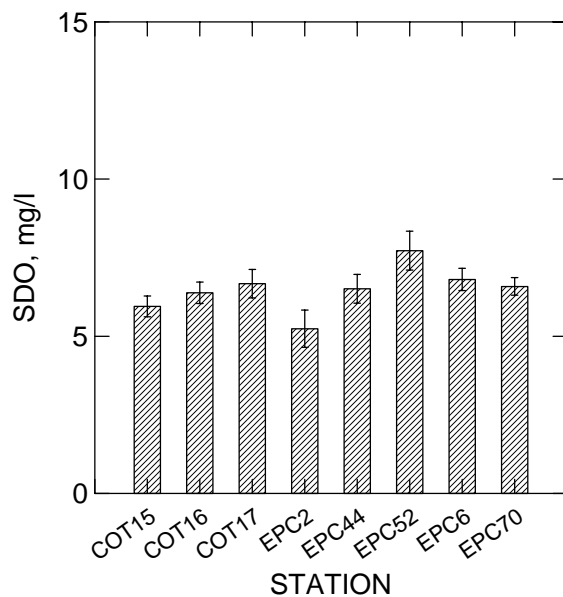


Figure 35. Comparison of mean values and standard errors for SDO concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

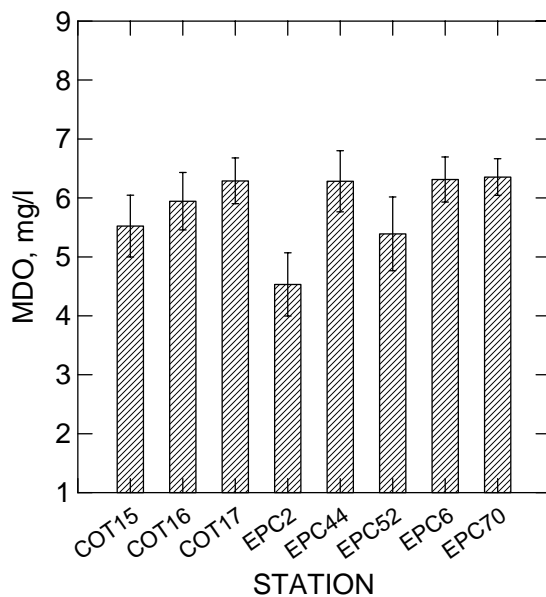


Figure 36. Comparison of mean values and standard errors for MDO concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

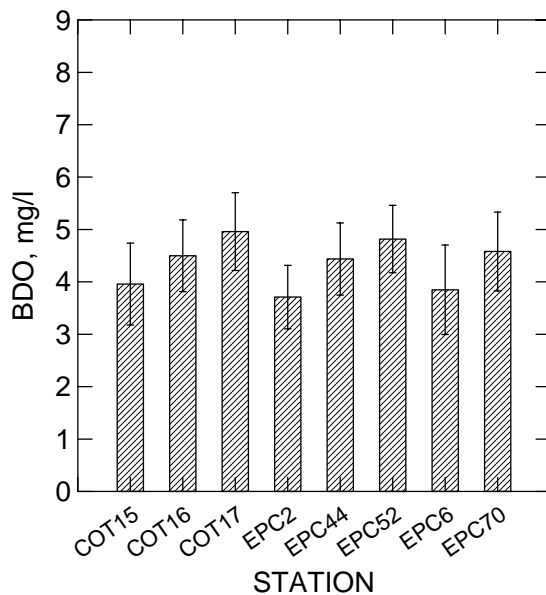


Figure 37. Comparison of mean values and standard errors for BDO concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.

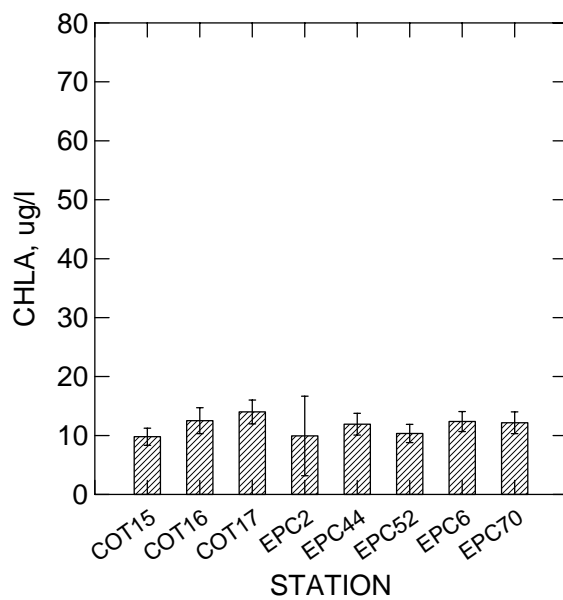


Figure 38. Comparison of mean values and standard errors for CHLA concentrations measured at the COT compliance monitoring stations and the group of EPC stations close to the Howard F. Curren WWTP discharge site for the year 2003.



Figure 39. Long-term trend of SD depth measured by the COT in Tampa Bay.

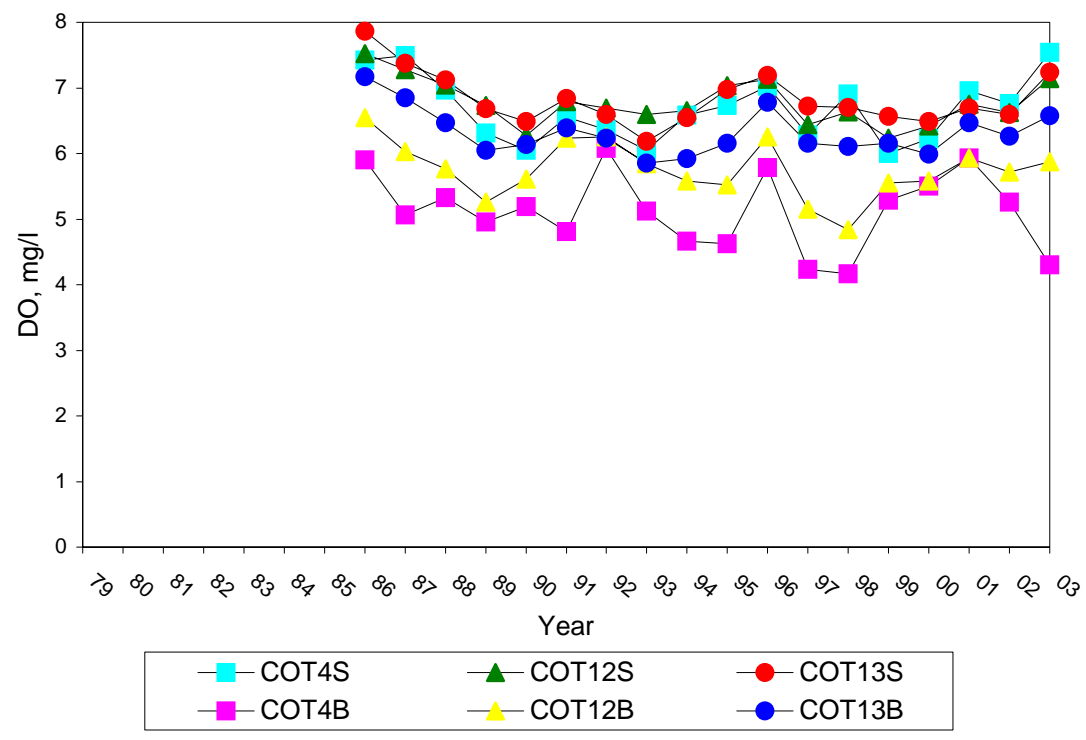


Figure 40. Long-term trend of DO concentrations measured by the COT in Tampa Bay.

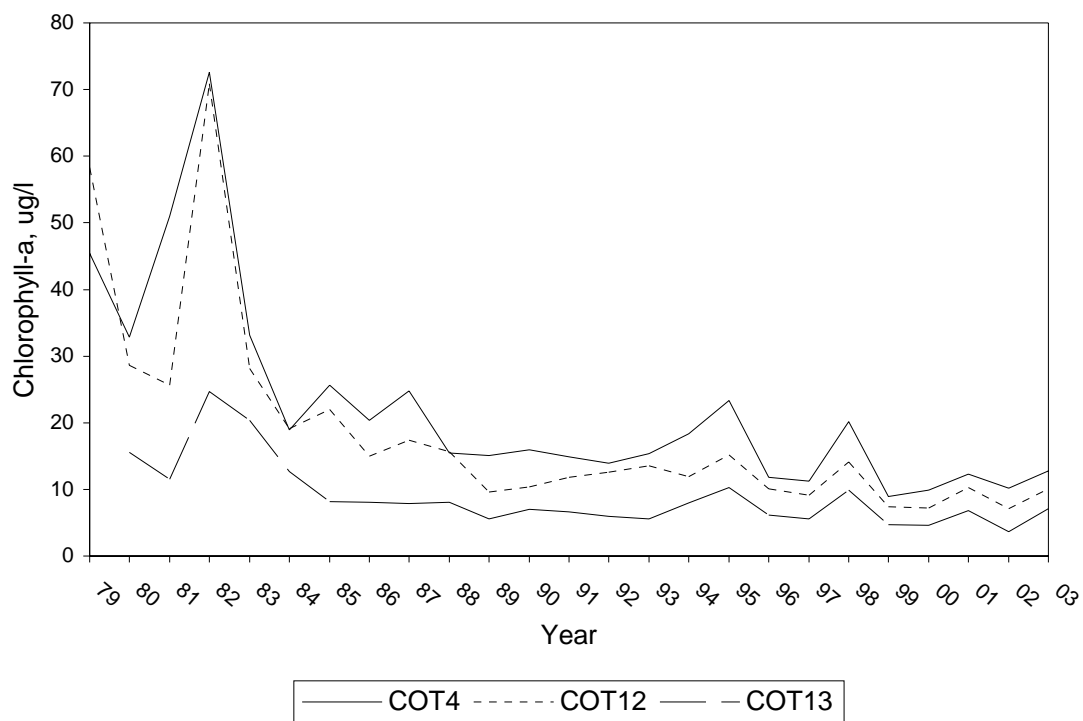


Figure 41. Long-term trend of surface CHLA concentrations measured by the COT in Tampa Bay.

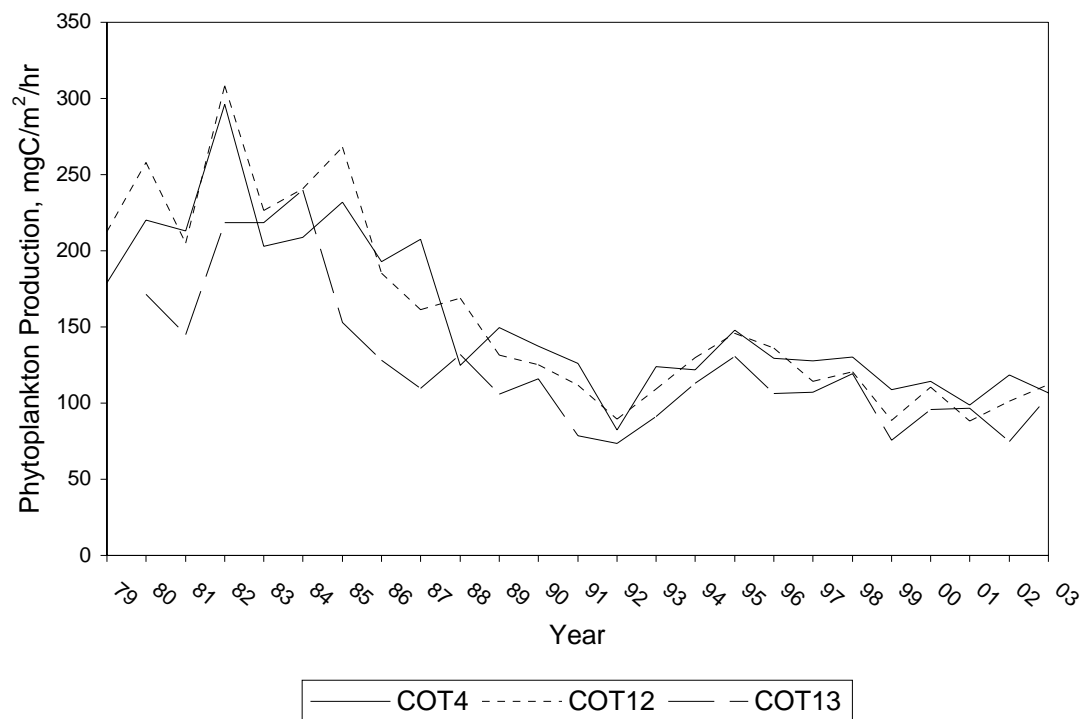


Figure 42. Long-term trend of depth integrated phytoplankton production measured by the COT in Tampa Bay.

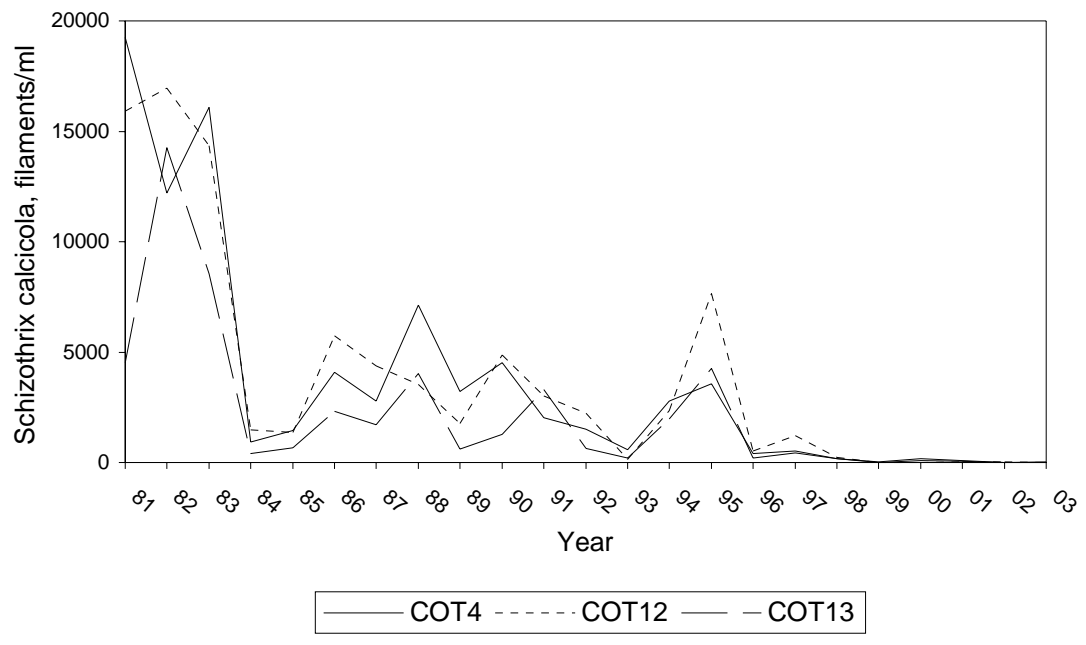


Figure 43. Long-term trend of *Schizothrix calcicola sensu* Drouet concentrations measured by the COT in Tampa Bay.

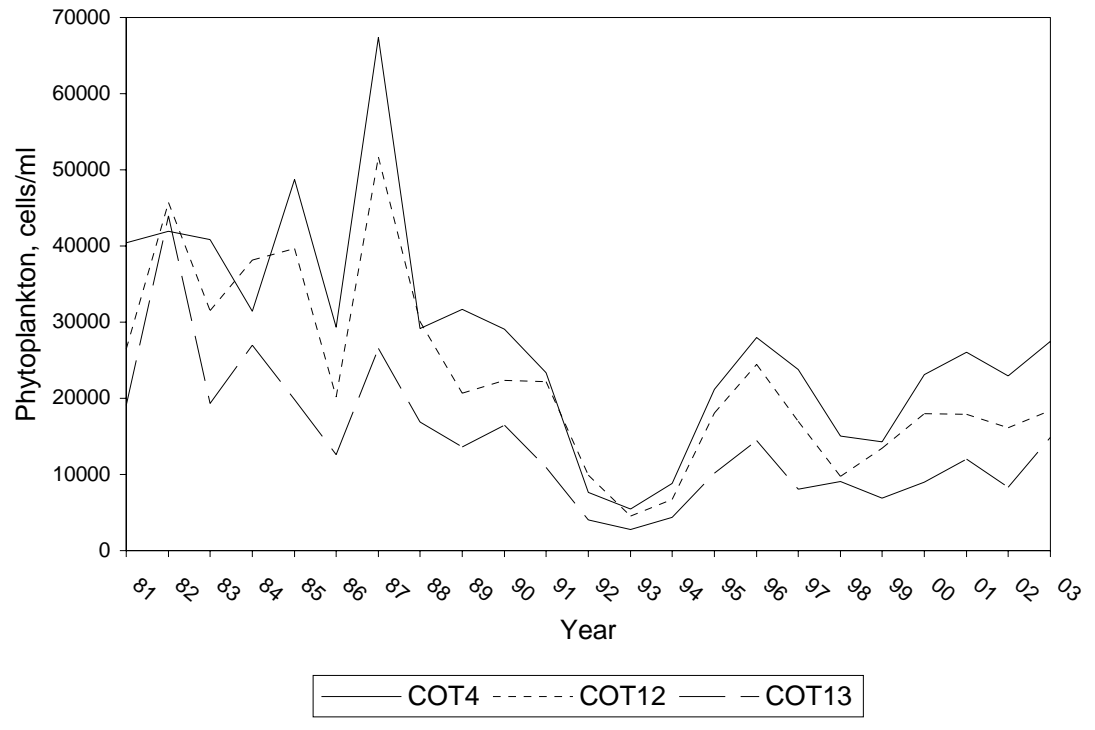


Figure 44. Long-term trend of total phytoplankton concentrations measured by the COT in Tampa Bay.

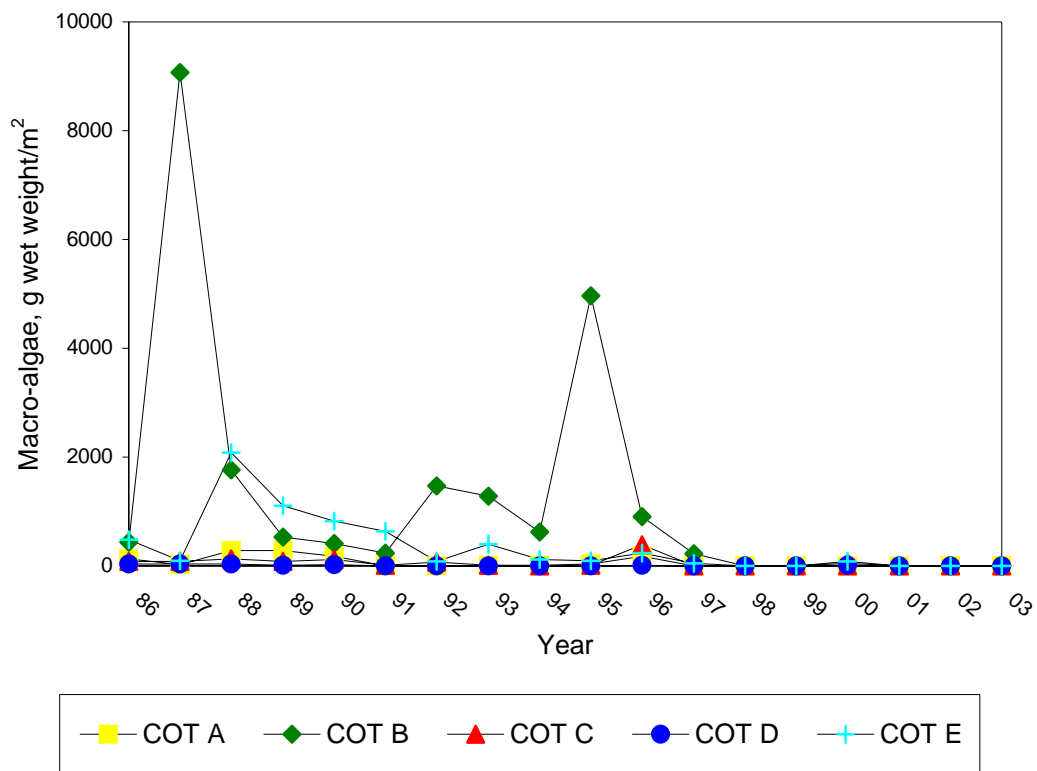


Figure 45. Long-term trend of Hillsborough Bay drift macro-algae biomass collected at five transects by the COT.

Appendix A

Appendix Table A. Results from the City of Tampa compliance monitoring in Hillsborough Bay for station COT15, COT16, and COT17 for the year 2003.

DATE	STATION	TN mg/l	TKN mg/l	TP mg/l	PO4 mg/l	CBOD5 mg/l	NO2+NO3 mg/l	NH3 mg/l	SDO mg/l	MDO mg/l	BDO mg/l	CHLA ug/l
22-Jan-03	COT15	0.78	0.69	0.22	0.16	1.40	0.093	0.04	7.5	7.4	7.5	5.65
11-Feb-03	COT15	0.68	0.57	0.18	0.13	1.00	0.114	0.07	7.1	7.0	5.9	2.50
10-Mar-03	COT15	0.57	0.54	0.22	0.15	1.65	0.030	0.03	5.9	6.4	4.8	9.44
07-Apr-03	COT15	0.61	0.59	0.23	0.16	1.90	0.021	0.02	7.2	7.8	6.4	10.00
13-May-03	COT15	0.52	0.50	0.22	0.19	1.20	0.015	0.03	5.2	4.5	2.6	12.45
10-Jun-03	COT15	0.63	0.62	0.23	0.17	1.20	0.011	0.04	5.1	3.7	3.0	11.53
08-Jul-03	COT15	0.88	0.83	0.35	0.29	1.15	0.049	0.09	5.4	2.3	0.8	20.68
12-Aug-03	COT15	0.76	0.63	0.34	0.31	1.80	0.131	0.03	5.5	5.9	0.1	14.19
08-Sep-03	COT15	0.73	0.67	0.35	0.25	1.40	0.055	0.02	4.2	3.8	2.2	11.33
14-Oct-03	COT15	0.57	0.50	0.35	0.30	0.85	0.070	0.05	5.2	4.7	1.3	5.46
12-Nov-03	COT15	0.50	0.49	0.17	0.14	1.00	0.006	0.08	5.7	5.7	5.7	7.40
08-Dec-03	COT15	0.43	0.42	0.14	0.09	1.30	0.009	0.02	7.4	7.1	7.1	7.05
22-Jan-03	COT16	0.72	0.65	0.27	0.21	1.70	0.073	0.02	7.9	8.1	7.4	8.63
11-Feb-03	COT16	0.68	0.63	0.20	0.15	1.10	0.052	0.06	7.7	7.4	6.6	3.91
10-Mar-03	COT16	0.50	0.48	0.22	0.15	1.60	0.019	0.02	6.4	6.5	5.2	9.95
07-Apr-03	COT16	0.61	0.60	0.22	0.15	1.90	0.008	0.02	7.6	7.6	3.2	9.91
13-May-03	COT16	0.53	0.52	0.25	0.20	1.70	0.009	0.02	5.7	4.0	2.1	11.18
10-Jun-03	COT16	0.60	0.59	0.28	0.21	1.50	0.009	0.02	5.3	5.4	4.7	14.61
08-Jul-03	COT16	0.87	0.84	0.39	0.30	1.70	0.028	0.03	5.8	3.9	1.4	31.85
12-Aug-03	COT16	0.83	0.69	0.41	0.36	2.30	0.138	0.04	5.8	5.5	5.6	19.15
08-Sep-03	COT16	0.74	0.69	0.38	0.30	1.70	0.058	0.02	5.1	3.8	1.9	15.04
14-Oct-03	COT16	0.51	0.48	0.30	0.24	1.80	0.034	0.02	5.6	5.3	2.5	7.81
12-Nov-03	COT16	0.54	0.53	0.22	0.15	1.10	0.008	0.08	5.6	5.5	5.5	7.10
08-Dec-03	COT16	0.56	0.55	0.21	0.14	1.80	0.005	0.02	8.2	8.2	8.1	11.02
22-Jan-03	COT17	0.70	0.67	0.24	0.18	2.00	0.032	0.02	9.7	8.4	7.6	14.04
11-Feb-03	COT17	0.70	0.69	0.20	0.14	1.70	0.015	0.02	8.1	8.0	6.4	13.54
10-Mar-03	COT17	0.45	0.45	0.21	0.13	2.40	0.003	0.02	6.3	6.2	4.7	9.71
07-Apr-03	COT17	0.65	0.65	0.22	0.13	2.20	0.008	0.02	7.0	6.9	6.9	12.11
13-May-03	COT17	0.84	0.82	0.33	0.21	6.40	0.016	0.02	4.6	4.5	4.4	23.50
10-Jun-03	COT17	0.58	0.57	0.27	0.20	1.40	0.007	0.02	5.4	5.3	5.0	12.15
08-Jul-03	COT17	0.74	0.74	0.38	0.29	2.00	0.003	0.02	7.7	5.2	0.8	20.04
12-Aug-03	COT17	0.83	0.77	0.51	0.45	1.60	0.060	0.05	6.1	6.1	6.3	18.44
08-Sep-03	COT17	0.71	0.70	0.38	0.29	1.40	0.013	0.02	5.9	5.9	1.5	25.76
14-Oct-03	COT17	0.62	0.60	0.28	0.21	1.70	0.020	0.06	5.0	5.0	1.7	6.10
12-Nov-03	COT17	0.49	0.48	0.27	0.17	1.30	0.010	0.07	6.1	6.1	6.1	7.39
08-Dec-03	COT17	0.46	0.45	0.24	0.16	1.25	0.003	0.04	8.2	8.0	8.2	5.24

Appendix B

Appendix Table B. Results of pH measurements and other water quality parameters from the City of Tampa compliance monitoring in Hillsborough Bay at station COT151, located 70m south of the outfall of the Howard F. Curren Wastewater Treatment Plant for year 2003.

Date	Station	Depth	Time	Temp	pH	Salin	Do
		meter	hms	Celsius		PSU	mg/l
22-Jan-03	COT151	0.1	65538	16.1	7.54	18.4	7.6
22-Jan-03	COT151	1.0	65612	15.8	7.60	19.0	7.5
22-Jan-03	COT151	2.0	65703	15.4	7.71	20.0	7.3
22-Jan-03	COT151	3.0	65749	15.4	7.76	20.0	7.6
11-Feb-03	COT151	0.2	55908	16.5	7.63	21.8	7.2
11-Feb-03	COT151	1.0	55944	16.3	7.71	22.7	7.2
11-Feb-03	COT151	2.0	60027	16.2	7.71	22.7	7.1
11-Feb-03	COT151	3.0	60053	16.2	7.72	23.0	7.1
10-Mar-03	COT151	0.2	61457	23.9	7.64	18.7	6.2
10-Mar-03	COT151	1.0	61605	23.8	7.69	19.1	6.1
10-Mar-03	COT151	1.9	61638	23.7	7.80	20.8	6.1
10-Mar-03	COT151	3.0	61731	23.7	7.81	21.2	6.1
07-Apr-03	COT151	0.3	65137	25.0	7.86	18.8	7.4
07-Apr-03	COT151	1.2	65220	25.5	8.00	20.4	7.7
07-Apr-03	COT151	2.2	65252	25.3	7.98	20.7	7.4
07-Apr-03	COT151	3.1	65337	25.2	7.98	20.8	7.3
13-May-03	COT151	0.3	62413	29.4	7.59	20.3	4.2
13-May-03	COT151	1.0	62503	29.4	7.62	21.1	4.1
13-May-03	COT151	2.0	62529	29.1	7.67	21.3	4.3
13-May-03	COT151	3.0	62605	29.3	7.68	22.5	4.0
10-Jun-03	COT151	0.2	60533	29.7	7.66	21.2	4.3
10-Jun-03	COT151	1.0	60602	29.9	7.77	21.9	4.4
10-Jun-03	COT151	2.0	60702	29.7	7.60	22.5	3.9
10-Jun-03	COT151	3.0	60744	29.7	7.65	22.8	4.3
08-Jul-03	COT151	0.3	61149	28.4	7.19	5.5	4.0
08-Jul-03	COT151	1.0	61223	29.6	7.24	11.5	3.3
08-Jul-03	COT151	2.0	61337	29.6	7.33	14.5	2.4
08-Jul-03	COT151	3.0	61424	29.5	7.42	17.0	1.7
12-Aug-03	COT151	0.3	62715	26.6	7.25	5.3	5.0
12-Aug-03	COT151	1.0	62815	27.3	7.43	8.7	5.2
12-Aug-03	COT151	2.0	62923	27.9	7.40	10.9	4.3
12-Aug-03	COT151	3.0	63019	28.6	7.32	13.0	2.2
08-Sep-03	COT151	0.3	63119	28.2	7.32	9.1	4.1
08-Sep-03	COT151	1.0	63143	29.0	7.42	15.5	3.3
08-Sep-03	COT151	2.0	63224	28.9	7.57	16.8	3.2
08-Sep-03	COT151	3.0	63259	28.8	7.59	17.9	2.8
14-Oct-03	COT151	0.3	70638	27.9	7.59	19.8	4.2
14-Oct-03	COT151	1.0	70718	27.9	7.60	19.9	4.1
14-Oct-03	COT151	2.0	70810	28.0	7.69	20.4	4.6
14-Oct-03	COT151	3.1	70852	28.0	7.79	21.5	4.6
12-Nov-03	COT151	0.3	61103	24.7	7.92	24.4	5.9
12-Nov-03	COT151	1.0	61149	24.5	7.94	24.6	5.7
12-Nov-03	COT151	2.0	61231	24.5	7.94	24.7	5.5
12-Nov-03	COT151	3.1	61257	24.6	7.94	24.9	5.7
08-Dec-03	COT151	0.2	64921	18.0	7.91	25.5	8.3
08-Dec-03	COT151	1.0	65005	17.8	7.94	26.3	7.5
08-Dec-03	COT151	2.1	65048	17.8	7.96	26.6	7.5

Appendix C

Appendix Table C. Field results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Hydrolab Depth	Time	Temp	pH	Salin	DO
		meter	hms	Celsius		PSU	mg/l
01/06/03	4	0.2	73537	14.0	7.45	10.0	9.0
01/06/03	4	1.0	73624	16.9	7.58	13.8	7.9
01/06/03	4	2.0	73725	17.0	7.66	16.6	7.1
01/06/03	4	3.0	73919	17.3	7.57	18.0	5.7
01/06/03	4	3.7	73956	17.3	7.55	18.2	5.3
01/06/03	12	0.2	80910	15.3	7.69	12.2	9.1
01/06/03	12	1.0	81020	15.7	7.64	13.4	8.1
01/06/03	12	2.0	81150	16.2	7.76	17.4	7.8
01/06/03	12	3.0	81300	16.2	7.76	18.3	7.5
01/06/03	12	4.0	81417	16.2	7.77	18.6	7.5
01/06/03	12	4.7	81439	16.1	7.78	18.8	7.5
01/06/03	13	0.2	84040	15.1	7.86	15.1	9.4
01/06/03	13	1.0	84150	15.6	7.86	15.7	9.1
01/06/03	13	2.0	84244	16.1	7.85	19.5	8.4
01/06/03	13	3.0	84346	16.1	7.85	20.2	8.1
01/06/03	13	4.0	84451	16.1	7.85	20.3	8.0
01/06/03	13	5.0	84617	16.1	7.85	20.3	8.0
01/06/03	13	6.0	84716	16.1	7.85	20.3	8.0
02/03/03	4	0.1	73903	15.0	7.82	22.6	8.4
02/03/03	4	1.0	73945	15.0	7.82	22.6	8.3
02/03/03	4	2.0	74056	15.0	7.83	22.6	8.3
02/03/03	4	3.0	74208	15.2	7.80	22.9	7.5
02/03/03	4	3.4	74309	15.2	7.79	22.9	7.4
02/03/03	12	0.1	81843	14.8	7.86	22.3	8.3
02/03/03	12	1.0	81937	14.8	7.86	22.5	8.2
02/03/03	12	2.0	82030	14.8	7.87	22.5	8.2
02/03/03	12	2.9	82200	14.8	7.87	22.5	8.1
02/03/03	12	3.9	82246	14.8	7.87	22.6	8.1
02/03/03	12	4.6	82325	14.8	7.87	22.5	8.0
02/03/03	13	0.1	90059	14.6	7.89	23.6	8.5
02/03/03	13	1.0	90146	14.6	7.89	23.7	8.5
02/03/03	13	1.9	90236	14.6	7.89	24.0	8.5
02/03/03	13	3.0	90352	14.6	7.90	24.3	8.5
02/03/03	13	3.9	90455	14.6	7.90	24.4	8.5
02/03/03	13	5.0	90620	14.6	7.90	24.7	8.4
02/03/03	13	5.4	90743	14.6	7.90	24.8	8.4
03/05/03	4	0.0	71522	21.0	7.85	N.D.	7.2
03/05/03	4	1.0	71611	21.1	7.87	21.6	6.6
03/05/03	4	2.0	71731	21.1	7.88	22.1	6.5
03/05/03	4	3.0	71818	21.3	7.87	22.5	5.7
03/05/03	4	3.6	71852	21.1	7.77	22.5	4.7
03/05/03	12	0.1	75014	20.9	7.91	N.D.	7.5
03/05/03	12	1.0	75044	21.0	7.92	22.4	6.5
03/05/03	12	2.0	75124	20.9	7.92	22.8	6.3
03/05/03	12	3.0	75210	20.9	7.91	22.9	6.1
03/05/03	12	4.0	75243	20.9	7.90	23.2	6.0
03/05/03	12	4.8	75341	20.9	7.91	22.3	6.0
03/05/03	13	0.2	82707	20.8	7.95	24.4	6.7
03/05/03	13	1.0	82809	20.8	7.96	24.7	6.5
03/05/03	13	2.0	82858	20.8	7.97	24.4	6.5
03/05/03	13	3.0	83014	20.8	7.98	24.6	6.5
03/05/03	13	3.9	83108	20.7	8.00	25.3	6.6
03/05/03	13	4.9	83156	20.7	8.01	25.6	6.6
03/05/03	13	5.8	83308	20.7	8.02	25.6	6.6
04/03/03	4	0.1	65556	20.9	7.92	20.8	8.9
04/03/03	4	1.0	65639	20.9	7.92	20.9	8.7
04/03/03	4	2.0	65727	21.2	7.85	21.7	6.7
04/03/03	4	3.0	65817	21.0	7.81	21.9	6.5

Appendix C

Appendix Table C. Field results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Hydrolab Depth	Time	Temp	pH	Salin	DO
		meter	hms	Celsius		PSU	mg/l
04/03/03	4	3.5	65941	21.0	7.81	21.9	6.4
04/03/03	12	0.2	73218	20.3	8.04	21.3	9.6
04/03/03	12	1.0	73316	20.3	8.04	21.4	9.3
04/03/03	12	2.0	73410	20.3	8.04	22.5	9.2
04/03/03	12	3.0	73519	20.3	8.04	22.9	9.0
04/03/03	12	4.0	73616	20.5	8.00	23.2	8.4
04/03/03	12	4.1	73705	20.5	7.99	23.3	8.3
04/03/03	13	0.2	80736	20.5	8.07	23.3	9.5
04/03/03	13	1.0	80835	20.5	8.07	23.3	9.3
04/03/03	13	2.0	80928	20.5	8.07	23.6	9.2
04/03/03	13	3.0	81008	20.7	8.02	24.9	8.6
04/03/03	13	4.0	81100	20.7	8.04	25.1	8.8
04/03/03	13	5.0	81229	20.7	8.03	25.9	8.8
04/03/03	13	6.0	81322	20.7	8.02	26.4	8.5
04/03/03	13	6.2	81355	20.7	8.01	26.5	8.4
05/05/03	4	0.2	75055	27.4	7.97	22.1	6.5
05/05/03	4	1.0	75151	27.4	7.97	22.1	6.4
05/05/03	4	2.0	75240	27.4	7.97	22.1	6.3
05/05/03	4	2.9	75339	27.3	7.83	22.6	4.7
05/05/03	4	3.7	75449	26.9	7.54	22.9	2.1
05/05/03	12	0.2	83341	26.8	7.93	23.4	5.9
05/05/03	12	1.0	83424	26.9	7.93	23.5	5.7
05/05/03	12	2.0	83513	27.4	7.96	23.7	5.8
05/05/03	12	3.0	83556	27.8	7.95	24.0	5.8
05/05/03	12	4.0	83652	27.6	7.93	24.2	5.5
05/05/03	12	5.0	83846	27.2	7.89	24.2	5.0
05/05/03	13	0.2	91218	27.0	7.97	25.7	6.2
05/05/03	13	1.0	91258	27.1	7.97	25.7	6.0
05/05/03	13	2.0	91414	27.1	7.97	25.7	6.0
05/05/03	13	3.0	91515	27.1	7.97	25.8	5.9
05/05/03	13	4.0	91601	27.1	7.96	25.8	5.9
05/05/03	13	5.0	91652	27.0	7.96	25.8	5.8
05/05/03	13	6.0	91750	27.0	7.96	25.8	5.7
06/02/03	4	0.1	72839	28.3	7.91	23.8	5.2
06/02/03	4	1.0	72951	28.3	7.92	23.8	5.0
06/02/03	4	2.0	73048	28.3	7.91	23.8	5.1
06/02/03	4	3.0	73205	28.3	7.91	23.8	5.0
06/02/03	4	3.8	73300	28.3	7.90	23.9	5.0
06/02/03	12	0.2	81857	28.2	7.98	24.7	5.4
06/02/03	12	1.0	81931	28.3	7.98	24.7	5.4
06/02/03	12	2.0	82000	28.3	7.99	24.9	5.4
06/02/03	12	3.0	82043	28.3	8.00	25.1	5.5
06/02/03	12	3.9	82116	28.3	8.00	25.4	5.5
06/02/03	12	5.0	82153	28.3	7.99	25.4	5.4
06/02/03	13	0.2	90540	28.4	8.03	26.4	5.7
06/02/03	13	1.1	90614	28.4	8.03	26.3	5.6
06/02/03	13	2.0	90652	28.4	8.03	26.5	5.6
06/02/03	13	2.9	90734	28.4	8.03	26.6	5.6
06/02/03	13	4.0	90805	28.4	8.03	26.5	5.6
06/02/03	13	5.2	90843	28.5	8.03	26.8	5.5
06/02/03	13	6.1	90917	28.5	8.03	27.0	5.5
06/02/03	13	6.5	90950	28.5	8.03	27.0	5.5
07/07/03	4	0.1	73013	29.6	8.25	12.5	7.3
07/07/03	4	1.0	73115	29.7	8.25	13.3	7.2
07/07/03	4	2.1	73217	29.7	8.24	13.3	7.1
07/07/03	4	3.0	73344	30.5	7.87	15.6	4.4
07/07/03	4	4.0	73429	29.7	7.28	17.5	0.5
07/07/03	4	4.1	73503	29.6	7.27	17.5	0.3
07/07/03	12	0.1	81146	29.3	7.95	17.5	5.5

Appendix C

Appendix Table C. Field results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Hydrolab Depth	Time	Temp	pH	Salin	DO
		meter	hms	Celsius		PSU	mg/l
07/07/03	12	1.1	81255	29.3	7.95	17.6	5.3
07/07/03	12	2.1	81429	29.6	7.88	18.4	4.6
07/07/03	12	3.0	81541	29.8	7.86	18.9	4.4
07/07/03	12	4.1	81650	29.7	7.80	20.3	3.6
07/07/03	12	5.0	81813	29.7	7.82	20.5	3.7
07/07/03	12	5.1	82009	29.6	7.83	20.6	3.7
07/07/03	13	0.2	85038	29.3	8.02	20.8	6.0
07/07/03	13	1.1	85138	29.3	8.02	20.7	5.9
07/07/03	13	2.1	85324	29.4	8.01	20.9	5.7
07/07/03	13	3.0	85410	29.5	8.00	20.6	5.6
07/07/03	13	4.2	85452	29.7	7.98	21.7	5.4
07/07/03	13	4.9	85543	29.7	7.98	21.5	5.3
07/07/03	13	6.1	85629	29.7	7.96	22.5	5.0
07/07/03	13	6.5	85910	29.7	7.97	23.1	4.9
08/04/03	4	0.1	75624	29.7	8.11	16.4	7.4
08/04/03	4	1.0	75716	29.8	8.10	16.4	6.6
08/04/03	4	2.0	75758	29.8	8.08	16.5	6.3
08/04/03	4	3.0	75859	30.5	7.85	17.2	3.8
08/04/03	4	4.0	80051	30.5	7.43	18.6	0.3
08/04/03	4	4.2	80108	30.5	7.43	18.7	0.3
08/04/03	12	0.2	83612	29.7	8.09	18.5	5.6
08/04/03	12	1.0	83648	29.7	8.09	18.5	5.5
08/04/03	12	2.0	83729	29.7	8.08	18.6	5.4
08/04/03	12	2.9	83821	30.2	7.96	19.8	3.9
08/04/03	12	4.0	83903	30.3	7.93	20.4	3.7
08/04/03	12	5.1	83953	30.3	7.91	20.6	3.4
08/04/03	12	5.4	84047	30.3	7.90	20.5	3.3
08/04/03	13	0.3	91311	30.2	8.08	21.8	5.7
08/04/03	13	1.0	91412	30.2	8.08	21.8	5.5
08/04/03	13	2.0	91506	30.3	8.07	21.9	5.4
08/04/03	13	3.0	91555	30.2	8.07	22.3	5.4
08/04/03	13	4.0	91641	30.2	8.07	22.5	5.4
08/04/03	13	5.0	91725	30.1	8.07	22.7	5.5
08/04/03	13	5.8	91820	30.0	8.08	22.8	5.5
09/02/03	4	0.0					
09/02/03	4	1.0					
09/02/03	4	2.0					
09/02/03	4	3.0					
09/02/03	12	0.0					
09/02/03	12	1.0					
09/02/03	12	2.0					
09/02/03	12	3.0					
09/02/03	13	0.0					
09/02/03	13	1.0					
09/02/03	13	2.0					
09/02/03	13	3.0					
09/02/03	13	4.0					
09/02/03	13	5.0					
10/06/03	4	0.1	81814	26.8	8.14	20.7	8.7
10/06/03	4	1.0	81901	26.8	8.14	20.7	8.6
10/06/03	4	2.0	81937	26.9	8.14	20.7	8.6
10/06/03	4	3.0	82014	26.9	8.11	20.8	8.1
10/06/03	4	4.0	82116	26.9	7.51	22.1	1.6
10/06/03	12	0.2	85847	26.3	8.06	21.1	6.8
10/06/03	12	1.0	85931	26.4	8.02	21.3	6.3
10/06/03	12	2.0	90006	26.5	7.93	22.2	5.2
10/06/03	12	3.0	90115	26.5	7.88	22.7	4.5
10/06/03	12	4.0	90152	26.5	7.86	23.1	4.2
10/06/03	12	5.0	90232	26.5	7.85	23.5	4.0

No Data

Appendix C

Appendix Table C. Field results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Hydrolab Depth	Time	Temp	pH	Salin	DO
		meter	hms	Celsius		PSU	mg/l
10/06/03	13	0.2	93423	26.6	8.13	22.7	7.2
10/06/03	13	1.1	93505	26.6	8.14	22.7	7.2
10/06/03	13	2.0	93540	26.6	8.13	22.7	7.1
10/06/03	13	3.1	93628	26.5	8.12	22.8	6.9
10/06/03	13	4.0	93732	26.5	8.08	24.6	6.3
10/06/03	13	5.0	93816	26.6	8.02	25.8	5.8
10/06/03	13	6.0	93903	26.6	8.01	25.9	5.7
10/06/03	13	6.1	93931	26.6	8.01	25.7	5.7
11/05/03	4	0.3	72011	24.6	8.07	23.4	6.7
11/05/03	4	1.1	72125	24.7	8.07	23.4	6.7
11/05/03	4	2.1	72210	24.6	8.07	23.4	6.6
11/05/03	4	3.0	72324	24.7	8.08	23.4	6.6
11/05/03	4	3.8	72417	24.7	8.07	23.4	6.6
11/05/03	12	0.4	81244	24.4	8.07	24.0	6.6
11/05/03	12	1.1	81346	24.4	8.07	24.0	6.5
11/05/03	12	2.1	81451	24.7	8.06	24.4	6.2
11/05/03	12	3.0	81642	24.7	8.04	24.8	6.1
11/05/03	12	3.5	81829	24.7	8.04	24.8	6.2
11/05/03	13	0.4	85322	24.5	8.08	25.4	6.6
11/05/03	13	1.0	85439	24.5	8.08	25.4	6.6
11/05/03	13	2.0	85516	24.5	8.08	25.4	6.6
11/05/03	13	3.1	85607	24.5	8.08	25.4	6.5
11/05/03	13	4.0	85654	24.5	8.07	25.5	6.5
11/05/03	13	5.0	85742	24.5	8.05	26.5	6.1
11/05/03	13	6.0	85829	24.5	8.04	27.1	6.0
11/05/03	13	6.9	85912	24.5	8.04	27.3	6.0
12/04/03	4	0.4	72523	18.8	7.99	25.7	7.8
12/04/03	4	1.1	72725	18.9	8.01	25.7	7.7
12/04/03	4	2.0	72826	18.9	8.02	25.7	7.7
12/04/03	4	3.0	72910	18.9	8.03	25.7	7.8
12/04/03	4	4.0	72954	18.9	8.04	25.7	7.7
12/04/03	12	0.3	84642	18.3	8.11	25.9	8.2
12/04/03	12	1.1	84718	18.5	8.08	26.3	7.9
12/04/03	12	2.1	84814	18.6	8.07	26.6	7.4
12/04/03	12	3.0	84904	18.7	8.07	26.7	7.3
12/04/03	12	3.4	84934	18.7	8.07	26.7	7.1
12/04/03	13	0.3	91647	18.5	8.12	26.9	8.2
12/04/03	13	1.0	91729	18.5	8.12	26.9	8.3
12/04/03	13	2.0	91818	18.5	8.12	26.9	8.2
12/04/03	13	3.1	91920	18.5	8.12	27.0	8.2
12/04/03	13	4.0	92042	18.5	8.11	27.3	8.1
12/04/03	13	5.1	92200	18.5	8.11	27.6	8.0
12/04/03	13	6.0	92309	18.5	8.10	27.8	7.8
12/04/03	13	6.6	92346	18.5	8.10	27.9	7.8

Appendix D

Appendix Table D. Field and laboratory results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Sample Depth	Turbidity	Chlorophyll-a	Primary Production	Secchi Depth	Total Alkalinity	Kd (PAR)
		meter	NTU	ug/l	mgC/m ³ /hr	meter	mg/l	meter ⁻¹
01/06/03	4	0.2	3.0	3.85	17.20	1.1	71.3	No Data
01/06/03	4	1.0	2.6	4.04	3.15			
01/06/03	4	2.0	2.6	4.42	0.65			
01/06/03	4	3.0	2.9	4.15	0.25		83.0	
01/06/03	12	0.2	3.7	3.80	17.77	1.4	67.6	-1.94
01/06/03	12	1.0	2.9	3.45	4.44			
01/06/03	12	2.0	2.4	3.43	1.07			
01/06/03	12	3.0	2.6	3.15	0.34		83.0	
01/06/03	13	0.2	2.7	7.24	36.41	1.8	76.5	-1.57
01/06/03	13	1.0	2.2	6.63	15.91			
01/06/03	13	2.0	1.8	4.68	4.18			
01/06/03	13	3.0	1.6	3.83	1.26			
01/06/03	13	4.0	1.8	3.83	0.51			
01/06/03	13	5.0	1.7	2.79	0.34		88.9	
02/03/03	4	0.1	1.0	5.14	25.02	2.2	102.6	-1.26
02/03/03	4	1.0	1.0	5.09	18.79			
02/03/03	4	2.0	1.2	5.20	8.88			
02/03/03	4	3.0	1.0	5.36	3.25		102.6	
02/03/03	12	0.1	2.1	4.03	18.48	1.6	102.6	-1.57
02/03/03	12	1.0	3.2	4.13	15.02			
02/03/03	12	2.0	3.0	4.42	6.47			
02/03/03	12	2.9	3.2	3.98	2.49		102.6	
02/03/03	13	0.1	0.8	3.13	15.35	2.7	102.6	-1.08
02/03/03	13	1.0	0.4	2.54	11.53			
02/03/03	13	1.9	0.6	3.48	8.13			
02/03/03	13	3.0	0.9	3.45	3.98			
02/03/03	13	3.9	1.1	3.14	2.08			
02/03/03	13	5.0	0.5	3.45	1.28		102.6	
03/05/03	4	0.0	2.5	11.69	73.75	2.0	108.7	-1.23
03/05/03	4	1.0	2.3	12.14	58.82			
03/05/03	4	2.0	2.5	12.26	30.49			
03/05/03	4	3.0	2.0	11.16	11.07		109.6	
03/05/03	12	0.1	2.1	6.10	37.16	2.2	107.7	-1.38
03/05/03	12	1.0	2.2	5.32	26.07			
03/05/03	12	2.0	1.8	5.60	16.32			
03/05/03	12	3.0	2.4	5.32	6.36		107.7	
03/05/03	13	0.2	0.6	2.48	8.38	5.8	108.7	-0.82
03/05/03	13	1.0	0.5	2.16	7.65			
03/05/03	13	2.0	0.6	2.16	7.12			
03/05/03	13	3.0	0.5	2.41	5.70			
03/05/03	13	3.9	0.7	2.54	3.77			
03/05/03	13	4.9	0.8	3.74	3.11		109.6	
04/03/03	4	0.1	3.4	11.17	77.70	1.4	109.6	-1.81
04/03/03	4	1.0	3.3	11.71	50.10			
04/03/03	4	2.0	2.9	12.11	16.86			
04/03/03	4	3.0	3.3	12.23	4.54		108.7	
04/03/03	12	0.2	2.8	6.89	35.70	1.5	108.7	-1.35
04/03/03	12	1.0	2.8	6.79	27.24			
04/03/03	12	2.0	3.6	6.43	11.63			
04/03/03	12	3.0	3.2	6.62	3.75		109.6	
04/03/03	13	0.2	2.1	3.86	18.89	2.2	109.6	-0.86
04/03/03	13	1.0	2.4	3.55	14.85			
04/03/03	13	2.0	2.4	4.16	12.34			
04/03/03	13	3.0	2.0	4.68	6.84			
04/03/03	13	4.0	2.6	5.36	4.72			
04/03/03	13	5.0	2.9	5.43	2.55		111.4	
05/05/03	4	0.2	2.9	5.97	49.26	1.5	109.6	-1.23
05/05/03	4	1.0	2.5	6.36	44.98			
05/05/03	4	2.0	2.3	5.93	30.82			

Appendix D

Appendix Table D. Field and laboratory results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Sample Depth	Turbidity	Chlorophyll-a	Primary Production	Secchi Depth	Total Alkalinity	Kd (PAR)
		meter	NTU	ug/l	mgC/m ³ /hr	meter	mg/l	meter ⁻¹
05/05/03	4	2.9	2.5	6.38	14.60		111.4	
05/05/03	12	0.2	4.4	5.72	59.92	1.4	112.3	-1.44
05/05/03	12	1.0	2.6	6.34	54.38			
05/05/03	12	2.0	3.6	5.03	30.38			
05/05/03	12	3.0	4.3	4.39	12.61		113.2	
05/05/03	13	0.2	1.2	1.96	19.93	4.4	113.2	-1.02
05/05/03	13	1.0	0.8	2.48	18.30			
05/05/03	13	2.0	0.8	2.36	15.50			
05/05/03	13	3.0	1.0	1.95	10.88			
05/05/03	13	4.0	0.7	2.30	7.15			
05/05/03	13	5.0	0.9	2.46	4.60		113.2	
06/02/03	4	0.1	4.1	7.71	64.17	1.3	114.8	-1.58
06/02/03	4	1.0	5.4	8.17	45.68			
06/02/03	4	2.0	5.7	8.61	18.38			
06/02/03	4	3.0	5.3	7.88	5.20		115.6	
06/02/03	12	0.2	3.5	7.61	67.79	2.0	114.8	-1.16
06/02/03	12	1.0	3.4	7.93	56.10			
06/02/03	12	2.0	3.1	7.18	35.63			
06/02/03	12	3.0	2.8	7.00	20.36		114.8	
06/02/03	13	0.2	1.0	3.43	19.20	5.0	114.8	-0.64
06/02/03	13	1.1	0.8	2.66	21.25			
06/02/03	13	2.0	0.9	3.50	21.46			
06/02/03	13	2.9	0.8	3.21	16.91			
06/02/03	13	4.0	0.8	2.69	12.55			
06/02/03	13	5.2	0.8	3.50	9.97		115.6	
07/07/03	4	0.1	4.0	24.88	181.74	1.0	82.6	-2.28
07/07/03	4	1.0	4.0	23.26	36.39			
07/07/03	4	2.1	4.3	23.99	5.76			
07/07/03	4	3.0	4.1	24.16	1.95		86.4	
07/07/03	12	0.1	2.8	17.05	182.99	1.5	94.4	-1.07
07/07/03	12	1.1	2.8	17.91	72.48			
07/07/03	12	2.1	3.3	18.24	17.05			
07/07/03	12	3.0	3.7	13.66	4.05		96.8	
07/07/03	13	0.2	1.8	9.96	115.90	2.2	99.2	-0.87
07/07/03	13	1.1	1.7	10.64	78.48			
07/07/03	13	2.1	1.7	10.51	40.61			
07/07/03	13	3.0	2.1	12.30	20.26			
07/07/03	13	4.2	2.9	12.74	9.34			
07/07/03	13	4.9	4.4	13.10	4.67		101.5	
08/04/03	4	0.1	3.0	21.89	134.93	1.4	100.7	-1.36
08/04/03	4	1.0	3.4	21.52	71.51			
08/04/03	4	2.0	2.5	20.40	17.48			
08/04/03	4	3.0	2.5	21.29	5.46		101.8	
08/04/03	12	0.2	4.0	10.29	111.44	1.4	105.1	-1.60
08/04/03	12	1.0	4.1	9.04	62.51			
08/04/03	12	2.0	4.5	10.22	21.77			
08/04/03	12	2.9	4.8	9.36	5.66		106.9	
08/04/03	13	0.3	4.4	13.36	103.74	1.7	108.8	-1.53
08/04/03	13	1.0	3.5	12.76	63.80			
08/04/03	13	2.0	3.9	14.26	36.58			
08/04/03	13	3.0	4.5	12.67	13.45			
08/04/03	13	4.0	3.3	13.03	5.32			
08/04/03	13	5.0	3.6	12.14	3.04		108.8	
09/02/03	4	0.0	3.6	42.25	204.41	0.9	No Data	-2.82
09/02/03	4	1.0	3.3	38.06	25.44			
09/02/03	4	2.0	3.0	32.83	4.14			
09/02/03	4	3.0	3.9	40.91	1.75		No Data	
09/02/03	12	0.0	2.9	32.15	245.06	1.2	No Data	-2.20
09/02/03	12	1.0	2.2	27.46	58.98			

Appendix D

Appendix Table D. Field and laboratory results from the COT water quality and biological indicator monitoring program for stations COT4 and COT12 in Hillsborough Bay and COT13 in Middle Tampa Bay for year 2003.

Date	Station	Sample Depth	Turbidity	Chlorophyll-a	Primary Production	Secchi Depth	Total Alkalinity	Kd (PAR)
		meter	NTU	ug/l	mgC/m ³ /hr	meter	mg/l	meter ⁻¹
09/02/03	12	2.0	3.4	33.32	10.97			
09/02/03	12	3.0	2.8	26.09	2.78		No Data	
09/02/03	13	0.0	4.2	18.46	133.26	1.4	No Data	-1.68
09/02/03	13	1.0	3.8	18.84	62.17			
09/02/03	13	2.0	3.3	17.66	21.88			
09/02/03	13	3.0	2.9	16.69	6.47			
09/02/03	13	4.0	3.0	14.99	2.71			
09/02/03	13	5.0	2.6	13.75	2.05		No Data	
10/06/03	4	0.1	3.5	30.31	233.61	1.4	100.3	-1.28
10/06/03	4	1.0	2.7	31.85	91.41			
10/06/03	4	2.0	3.6	33.57	29.18			
10/06/03	4	3.0	3.5	33.53	9.07		101.5	
10/06/03	12	0.2	4.8	28.82	259.05	1.2	103.6	-1.51
10/06/03	12	1.0	3.8	29.61	92.00			
10/06/03	12	2.0	4.0	28.70	24.35			
10/06/03	12	3.0	5.2	25.57	6.18		104.7	
10/06/03	13	0.2	3.5	19.11	104.68	1.6	103.6	-1.26
10/06/03	13	1.1	4.4	19.89	72.43			
10/06/03	13	2.0	3.4	19.99	49.11			
10/06/03	13	3.1	3.0	20.47	22.31			
10/06/03	13	4.0	3.5	17.91	9.25			
10/06/03	13	5.0	3.0	17.21	3.92		105.7	
11/05/03	4	0.3	4.7	13.88	84.17	1.3	107.7	-0.47
11/05/03	4	1.1	5.6	15.93	39.54			
11/05/03	4	2.1	6.0	16.57	10.79			
11/05/03	4	3.0	5.6	16.09	2.89		111.4	
11/05/03	12	0.4	3.3	13.59	84.48	1.7	110.5	-0.90
11/05/03	12	1.1	3.4	13.56	73.96			
11/05/03	12	2.1	2.6	12.23	43.61			
11/05/03	12	3.0	3.4	12.63	22.69		112.3	
11/05/03	13	0.4	1.5	10.91	84.98	2.7	111.4	No Data
11/05/03	13	1.0	2.0	10.33	69.45			
11/05/03	13	2.0	1.5	11.72	53.71			
11/05/03	13	3.1	1.6	11.61	28.45			
11/05/03	13	4.0	1.0	11.89	14.70			
11/05/03	13	5.0	1.4	11.74	7.76		112.3	
12/04/03	4	0.4	2.0	4.13	15.07	2.8	110.5	-1.10
12/04/03	4	1.1	2.1	4.77	20.18			
12/04/03	4	2.0	1.4	4.45	13.24			
12/04/03	4	3.0	1.8	4.82	6.29		111.4	
12/04/03	12	0.3	2.2	7.32	14.96	3.0	113.2	-0.57
12/04/03	12	1.1	2.2	8.15	22.31			
12/04/03	12	2.1	2.7	10.09	21.56			
12/04/03	12	3.0	2.4	8.81	17.33		113.2	
12/04/03	13	0.3	1.2	2.34	9.17	4.2	113.2	-0.42
12/04/03	13	1.0	1.8	2.36	10.88			
12/04/03	13	2.0	1.2	2.34	10.58			
12/04/03	13	3.1	1.2	2.28	9.00			
12/04/03	13	4.0	1.5	2.57	6.52			
12/04/03	13	5.1	1.3	2.55	4.42		113.2	

Appendix F

Missing data points, noted as “No Data” in Appendix C and D for the 2003 sampling period are discussed below.

- Appendix C: March 5, 2003, stations COT4 and COT12: Surface salinities were not recorded due to operator error using the Hydrolab datasonde.
September 2, 2003, stations COT4, COT12, and COT13: The Hydrolab datalogger malfunctioned resulting in lost Hydrolab parameters.
- Appendix D: January 6, 2003, station COT4: Incident radiation was below the threshold needed to calculate a reliable $K_d(\text{PAR})$ value.
November 5, 2003, station COT13: Incident radiation was below the threshold needed to calculate a reliable $K_d(\text{PAR})$ value.
September 2, 2003, stations COT4, COT12, and COT13: Total alkalinity was not calculated due to missing pH values resulting from Hydrolab datalogger failure.