1999

An Integrated Surface Water Quality Monitoring Program for South Florida Coastal Waters

Ronald Jones
Southeast Environmental Research Center, Florida International University

Joseph N. Boyer
Southeast Environmental Research Center, Florida International University, boyerj@fiu.edu

AN INTEGRATED SURFACE WATER QUALITY MONITORING PROGRAM FOR SOUTH FLORIDA COASTAL WATERS

Including:

FLORIDA BAY
WHITEWATER BAY
TEN THOUSAND ISLANDS
BISCAYNE BAY
SOUTHWEST FLORIDA SHELF
CAPE ROMANO/MARCO ISLAND
NAPLES/ROOKERY BAY
ESTERO BAY/SAN CARLOS BAY
PINE ISLAND SOUND

1999 Cumulative Report to:

Everglades National Park
and
South Florida Water Management District

Prepared by:
Southeast Environmental Research Center
Florida International University
Miami, FL 33199
http://serc.fiu.edu/wqmnetwork/

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EXECUTIVE SUMMARY

One of the primary purposes for conducting long-term monitoring projects is to be able to detect trends in the measured parameters over time. These programs are usually initiated as a response to public perception (and possibly some scientific data) that "the river-bay-prairie-forest-etc. is dying". In the case of Florida Bay, the major impetus was the combination of a seagrass die-off, increased phytoplankton abundance, sponge mortality, and a perceived decline in fisheries beginning in 1987. In response to these phenomena, a network of water quality monitoring stations was established in 1989 to explicate both spatial patterns and temporal trends in water quality in an effort to elucidate mechanisms behind the recent ecological change.

This report summarizes the existing data from the South Florida Estuarine Water Quality Monitoring Network. This includes water quality data collected 28 stations in Florida Bay, 22 stations in Whitewater Bay to Lostmans River, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, 49 stations on the Southwest Florida Shelf (Shelf), and 28 stations in the Cape Romano-Pine Island Sound area. Each of the stations in Florida Bay were monitored on a monthly basis with monitoring beginning in March 1991 at stations 1 through 24 (monitoring began at stations 14, 19, 22, and 23 in April 1991). In July 1992, stations 25 through 28 were added in Florida Bay. Monthly sampling of stations 29 through 50 in Whitewater Bay were added to the monitoring program in September 1992. Biscayne Bay monthly monitoring began September 1993 for stations 100-125. In May 1996 an analysis of the data was performed to address the adequacy of spatial coverage. At that time, 10 station locations in the Biscayne Bay monitoring network were moved to provide coverage of North Biscayne Bay. The Shelf was sampled quarterly beginning in spring 1995; the Cape Romano-Pine Island Sound area started Jan. 1999.

We have begun the systematic analysis and interpretation starting with the most extensive dataset: Florida Bay. We have analyzed the data for spatial trends, temporal trends, and for freshwater loading effects. Spatial trend analysis can be performed on data of relatively short period of record (POR); however, time series analysis requires a minimum 5 year POR before significant trends can be recognized over the background noise of interannual variability. Therefore, the type of analysis performed on each estuary is determined by the length of the POR.

Trend analysis is an ongoing process; ecosystems change with climate and management strategy, therefore, analytical results may change as more data is collected. It is also important to understand that trend analysis alone will not necessarily provide cause and effect relationships. One of the purposes of any monitoring program should be to use the data gained by routine sampling to extend our understanding of the system by developing new hypotheses as to the underlying processes which drive it. Much inference into the behavior of South Florida estuaries can be made from the observed magnitude and distribution of water quality parameters. This type of multivariate approach should prove useful to scientists and managers faced with the task of interpreting large water quality datasets.

ACKNOWLEDGMENTS

We thank all of our many field and laboratory technicians and chemists for their diligence and perseverance in this ongoing program. This project was possible due to the continued funding of the South Florida Water Management District through the Everglades National Park (SFWMD/NPS Cooperative Agreement #C-7919, NPS/SERC Cooperative Agreement #5280-2-9017 and SFWMD/SERC Cooperative Agreement #C-10244). We also thank Rookery Bay NERR/FDEP for their field support.

This report is contribution #T-132 of the Southeast Environmental Research Center at Florida International University.

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1. PROJECT DESCRIPTION

1.1. Background

One of the primary purposes for conducting long-term monitoring projects is to be able to detect trends in the measured parameters over time. These programs are usually initiated as a response to public perception (and possibly some scientific data) that “the river-bay-prairie-forest-etc. is dying”. In the case of Florida Bay, the major impetus was the combination of a seagrass die-off, increased phytoplankton abundance, sponge mortality, and a perceived decline in fisheries beginning in 1987. In response to these phenomena, a network of water quality monitoring stations was established in 1989 to explicate both spatial patterns and temporal trends in water quality in an effort to elucidate mechanisms behind the recent ecological change.

This report summarizes the existing data from the South Florida Estuarine Water Quality Monitoring Network (Fig. 1.1). This includes water quality data collected 28 stations in Florida Bay, 22 stations in Whitewater Bay to Lostmans River, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, 49 stations on the Southwest Florida Shelf (Shelf), and 28 stations in the Cape Romano-Pine Island Sound area. Each of the stations in Florida Bay were monitored on a monthly basis with monitoring beginning in March 1991 at stations 1 through 24. (Except monitoring began at stations 14, 19, 22, and 23 in April 1991). In July 1992, stations 25 through 28 were added in Florida Bay. Monthly sampling of stations 29 through 50 in Whitewater Bay were added to the monitoring program in September 1992. Biscayne Bay monthly monitoring began September 1993 for stations 100-125. In May 1996 an analysis of the data was performed to address the adequacy of spatial coverage. At that time, 10 station locations in the Biscayne Bay monitoring network were moved to provide coverage of North Biscayne Bay. The Shelf was sampled quarterly beginning in spring 1995; the Cape Romano-Pine Island Sound area started Jan. 1999. A summary of station locations and sampling POR is shown in Table 1.

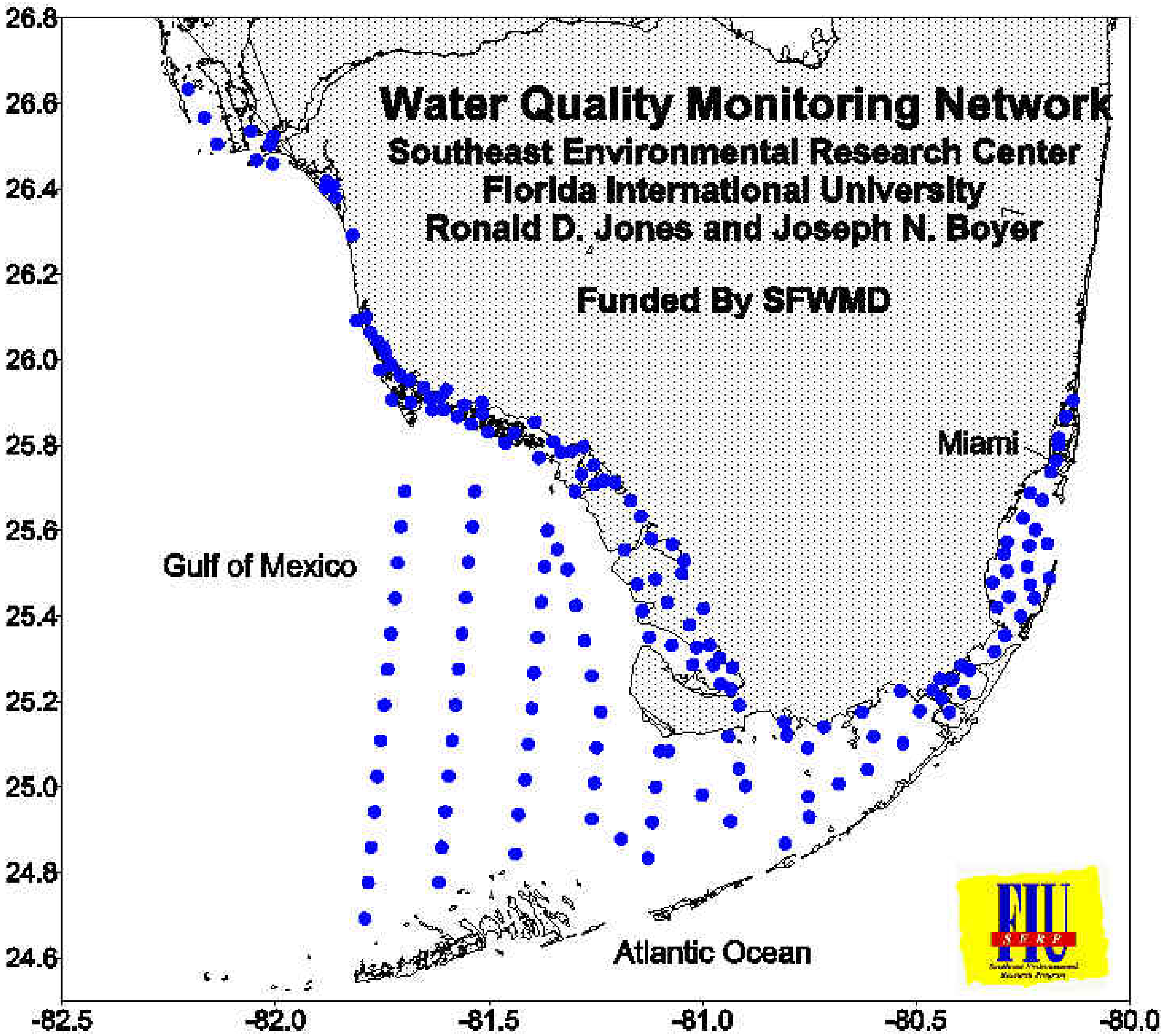

Figure 1.1. Fixed station locations for the SFWMD funded portion of the SERC water quality monitoring network.

1.2. Field and Analytical Methods

Water samples were analyzed by SERC personnel using standard methodology outlined in the Quality Assurance Project Plan (QAPP) with prior approval from SFWMD and FDEP. Salinity (ppt) and temperature (°C) were measured 10 cm below the surface and 10 cm above the bottom using a combination salinity-conductivity-temperature probe (Orion model 140). Surface and bottom dissolved oxygen (DO, mg l^{-1}) was measured using an oxygen electrode (Orion model 840), corrected for salinity and temperature.

Duplicate, unfiltered water samples were collected from 10 cm below the surface using sample rinsed 120 ml HDPE bottles and kept at ambient temperature in the dark during transport. Duplicate water samples for dissolved nutrient analysis were collected using sample rinsed 150 ml syringes. Samples were filtered (25 mm glass fiber GF/F) by hand into acetone-washed and sample rinsed 60 ml HDPE bottles, which were capped and immediately placed on ice in the dark for transport. The wet filters, used for chlorophyll *a* (Chl *a*) analysis, were placed in 2 ml plastic centrifuge tubes to which 1.5 ml of 90% acetone was added; they were then capped and put into a dark bottle on ice for transport (APHA 1999).

Unfiltered water samples were analyzed for total organic carbon (TOC), total nitrogen (TN), total phosphorus (TP), alkaline phosphatase activity (APA), and turbidity. TOC was measured by direct injection onto hot platinum catalyst in a Shimadzu TOC-5000 after first acidifying to pH<2 and purging with CO_2-free air. TN was measured using an ANTEK 7000N Nitrogen Analyzer using O_2 as carrier gas instead of argon to promote complete recovery of the nitrogen in the water samples (Frankovich and Jones 1998). TP was determined using a dry ashing, acid hydrolysis technique (Solorzano and Sharp 1980). The APA assay measures the activity of alkaline phosphatase, an enzyme used by bacteria to mineralize phosphate from organic compounds (Hashimoto et al. 1985). The assay is performed by adding a known concentration of an organic phosphate compound (o-methylfluorescein phosphate) to an unfiltered water sample. Alkaline phosphatase in the water sample cleaves the phosphate, leaving o-methylfluorescein, a highly fluorescent compound. The fluorescence of initial and 2 hr incubations were measured using a Gilford Fluoro IV spectrofluorometer (excitation = 430 nm, emission = 507 nm) and subtracted to give APA (μM h^{-1}). Turbidity was measured using an HF Scientific model DRT-15C turbidimeter and reported in NTU.

Filtrates were analyzed for soluble reactive phosphorus (SRP), nitrate + nitrite (NO_x), nitrite (NO_2), ammonium (NH_4), and silicate ($Si(OH)_4$) by flow injection analysis (Alpkem model RFA 300). Filters for Chl *a* content (μg l^{-1}) were allowed to extract for a minimum of 2 days at -20° C before analysis. Extracts were analyzed using a Gilford Fluoro IV Spectrofluorometer (excitation = 435 nm, emission = 667 nm) and compared to a standard curve of pure Chl *a* (Sigma).

Some parameters were not measured directly, but were calculated by difference. Nitrate (NO_3) was calculated as NO_X - NO_2. Dissolved inorganic nitrogen (DIN) was calculated as NO_X + NH_4. Total organic nitrogen (TON) was defined as TN - DIN. Concentrations for each of these parameters are reported in this report in units of milligrams per liter (mg l^{-1}) or the equivalent parts per million (ppm), except where noted. All nutrient concentrations are based on the atomic weight of primary nutrient species (ppm-N, ppm-P, and ppm-C), not the molecular weight. All N:P ratios discussed are calculated on a molar basis.

1.3. References

APHA. 1999. Standard Methods for the Examination of Water and Wastewater.

EPA Methods for Chemical Analysis of Water and Wastes, Revised March 1983.

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Hashimoto, Kitao, and Keiichiro. 1985. Relationship between alkaline phosphatase activity and orthophosphate in the present Tokyo Bay. *Environ. Sci. Health* **A20**: 781-908)

Solorzano, L., and J. H. Sharp. 1980. Determination of total dissolved phosphorus and particulate phosphorus in natural waters. *Limnol. Oceanogr*. **25**: 754-758.

2. OVERVIEW OF WATER QUALITY OF FLORIDA BAY

Overall Period of Record

One of the primary purposes for conducting long-term monitoring projects is to be able to detect trends in the measured variables over time. These programs are usually initiated as a response to public perception (and possibly some scientific data) that 'the river-bay-prairie-forest-etc. is dying'. In the case of Florida Bay during 1987, the impetus was the combination of a seagrass die-off, increased phytoplankton abundance, sponge mortality, and a perceived decline in fisheries. In response to these phenomena, a network of water quality monitoring stations was established in 1989 to explicate both spatial patterns and temporal trends in water quality in an effort to elucidate mechanisms behind the recent ecological change.

A spatial analysis of data from our monitoring program resulted in the delineation of 3 groups of stations which have robust similarities in water quality (Fig. 2.1). We have argued that these spatially contiguous groups of stations are the result of similar loading and processing of materials, hence we call them 'zones of similar influence'. The Eastern Bay zone (FBE) acts most like a 'conventional' estuary in that it has a quasi-longitudinal salinity gradient caused by the mixing of freshwater runoff with seawater. In contrast, the Central Bay (FBC) is a hydrographically isolated area with low and infrequent terrestrial freshwater input, a long water residence time, and high evaporative potential. The Western Bay zone (FBW) is the most influenced by the Gulf of Mexico tides and is also isolated from direct overland freshwater sources.

Climactic changes occurring over the data collection period of record had major effects on the health of the bay. Precipitation rebounded from the drought during the late 80's being greater than the long term average (9.2 cm mo^{-1}) for the last 7 of 10 years (Fig. 2.2). The heavy line in Fig. 2 and others is a 12 month moving average which shows interannual trends and oscillations. Over this period, salinity and total phosphorus (TP) concentrations declined baywide while turbidity (cloudiness of the water) increased dramatically. The salinity decline in Eastern, Central and Western Florida Bay was 13.6, 11.6, and 5.6 ppt, respectively (Fig. 2.3). Some of this decrease in Eastern Bay could be accounted for by increased freshwater flows from the Everglades but declines in other areas point to the climactic effect of increased rainfall during this period. The Central Bay continues to experience hypersaline conditions (>35 ppt) during the summer but the extent and duration of the events is much smaller.

As mentioned previously, TP concentrations have declined baywide over the 10 year period. The Eastern Bay has the lowest concentrations while the Central Bay is highest (Fig. 2.4). Unlike most other estuaries, increased terrestrial runoff may have been partially responsible for the decrease in TP concentrations in the Eastern Bay. This is because the TP concentrations of the runoff are at or below ambient levels in the bay. The elevated TP in the Central Bay is mostly due to concentration effect of high evaporation. It is important to understand that almost all the phosphorus measured as TP is in the form of organic matter which is much less accessible to plants and algae than inorganic phosphate (fertilizer).

Turbidity in Eastern Bay increased 2-fold from 1991-98, while Central and Western Bays increased by factors of 20 and 4, respectively (Fig. 2.5). Generally, the Eastern Bay has the clearest water which is due to a combination of factors such as high seagrass cover, more protected basins, low tidal energy, and shallow sediment coverage. Turbidity in the Central and Western Bays have increased tremendously since 1991. We are unsure as to the cause but the loss of seagrass coverage may have destabilized the bottom so that it is more easily disturbed by wind events.

Chlorophyll *a* concentrations (Chl *a*), a proxy for phytoplankton biomass, were particularly dynamic and spatially heterogeneous. In the Eastern Bay, which makes up roughly half of the surface area of Florida Bay, chlorophyll *a* declined by 0.9 $\mu g\ l^{-1}$ or 63% (Fig. 2.6). The isolated Central Bay zone underwent a 5-fold increase in Chl *a* from 1989-94, then rapidly declined to previous levels by 1996. In Western Florida Bay, there was a significant increase in chlorophyll *a*, yet median concentrations of chlorophyll *a* in the water column remained modest (~2 $\mu g\ l^{-1}$) by most estuarine standards.

Ammonium (NH_4^+) levels displayed large variability over the period of record and was much higher in the Central Bay than anywhere else (Fig. 2.7). Only in Central Bay did the NH_4^+ pool increase substantially over time (3-6 fold). Trends in nitrate (NO_3^-) concentrations (Fig. 2.8) mirrored those of NH_4^+ and were mostly due to the biological conversion of NH_4^+ to NO_3^- (nitrification) under aerobic conditions.

Total organic carbon concentrations (TOC) vary widely among the different zones and show significant intra-annual cycles (Fig. 2.9). Highest TOC levels occur in the Central Bay during summer as a result of evaporative concentration and low mixing with the rest the highest TOC

It is important to note that these changes in turbidity and chlorophyll *a* happened after the poorly-understood seagrass die-off in 1987. It is likely that the death and decomposition of large amounts of seagrass biomass can at least partially explain some of the changes in water quality of Florida Bay but the connections are temporally disjoint and the processes indirect and not well understood.

<u>1999 Alone</u>

Trends in water quality during 1999 generally followed earlier patterns. Salinity remained within normal bounds, turbidity was lower than previous years. There was a moderate phytoplankton bloom in the Central Bay during winter 1998-99. All this changed with the passing of Hurricane Irene on October 15, 1999. Post-Irene sampling events showed significant, baywide depression in salinity which persisted into December. In addition to salinity effects, we observed significant increases in TP in Central and Western Bay, increases in turbidity and Chl a baywide, increased NO_3^- in Eastern Bay, and increased TOC in Western Bay.

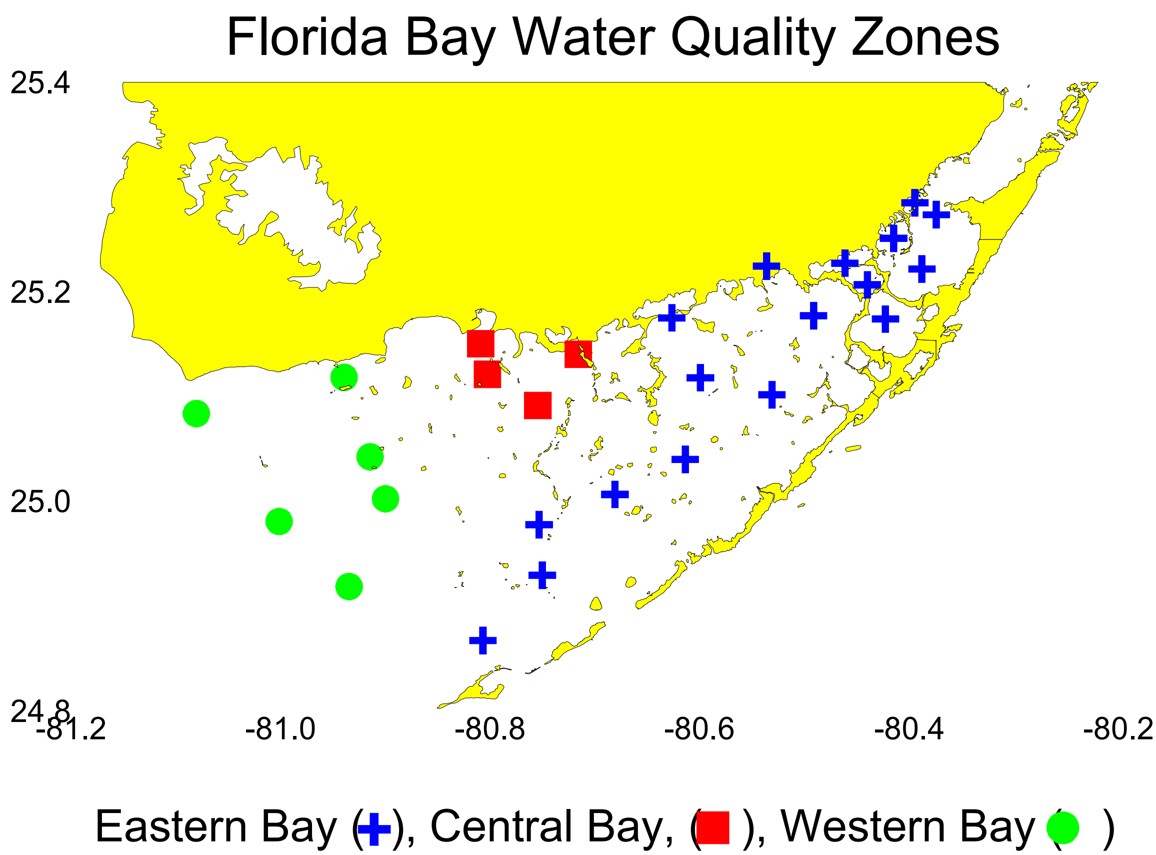

Figure 2.1. Zones of similar water quality in Florida Bay

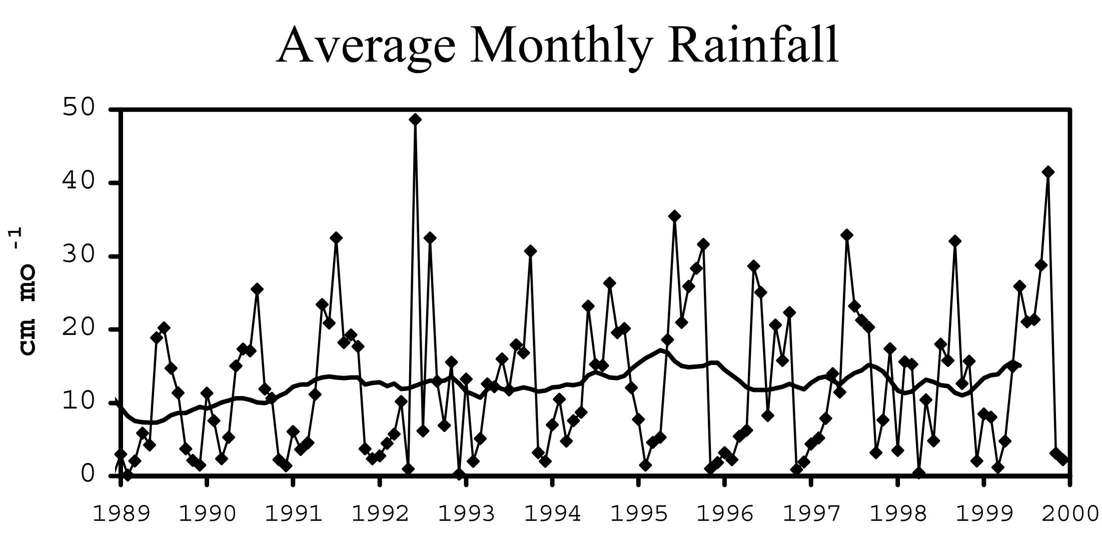

Figure 2.2. Monthly average rainfall in the Florida Bay area.

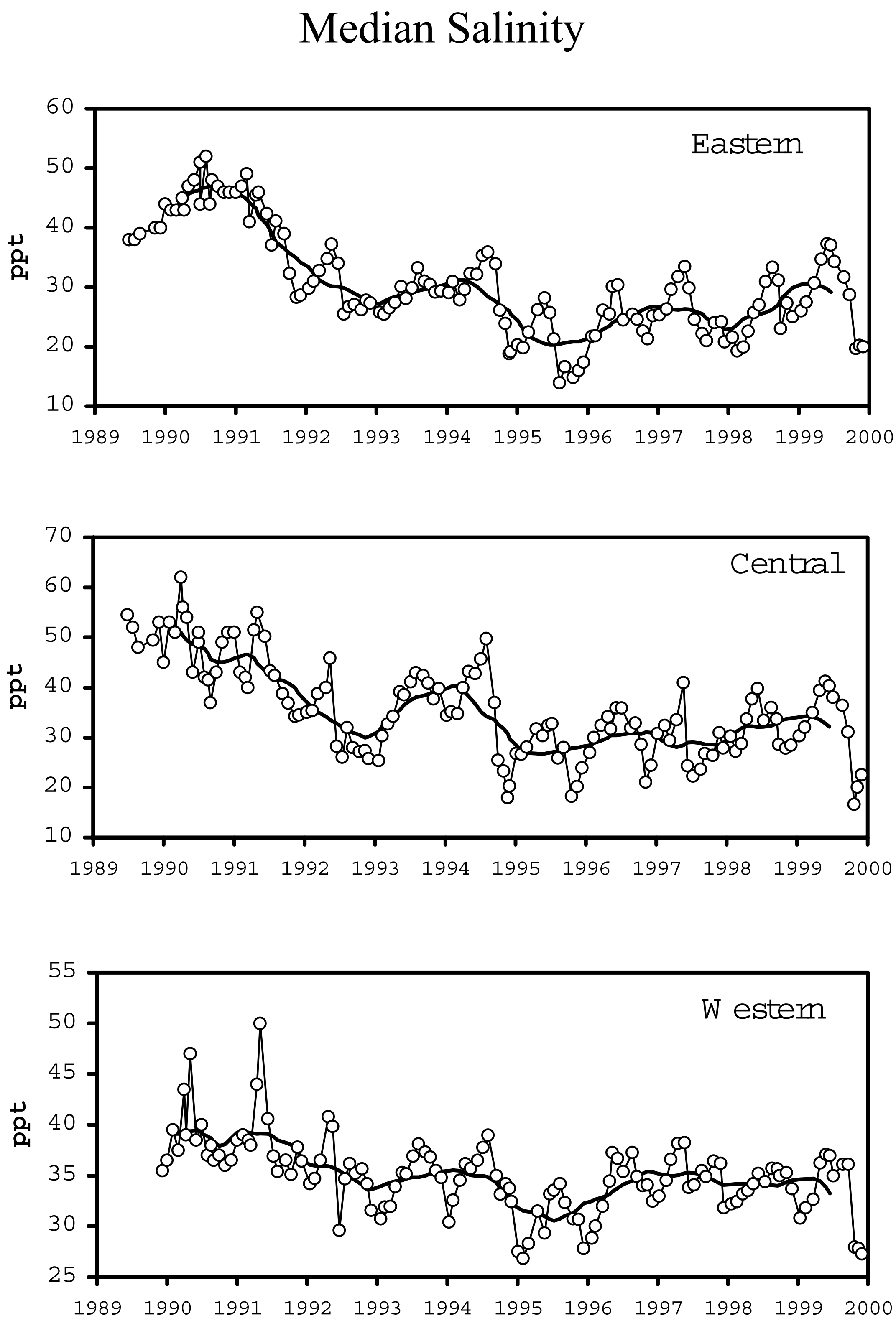

Figure 2.3. Monthly median salinity in the three Florida Bay zones.

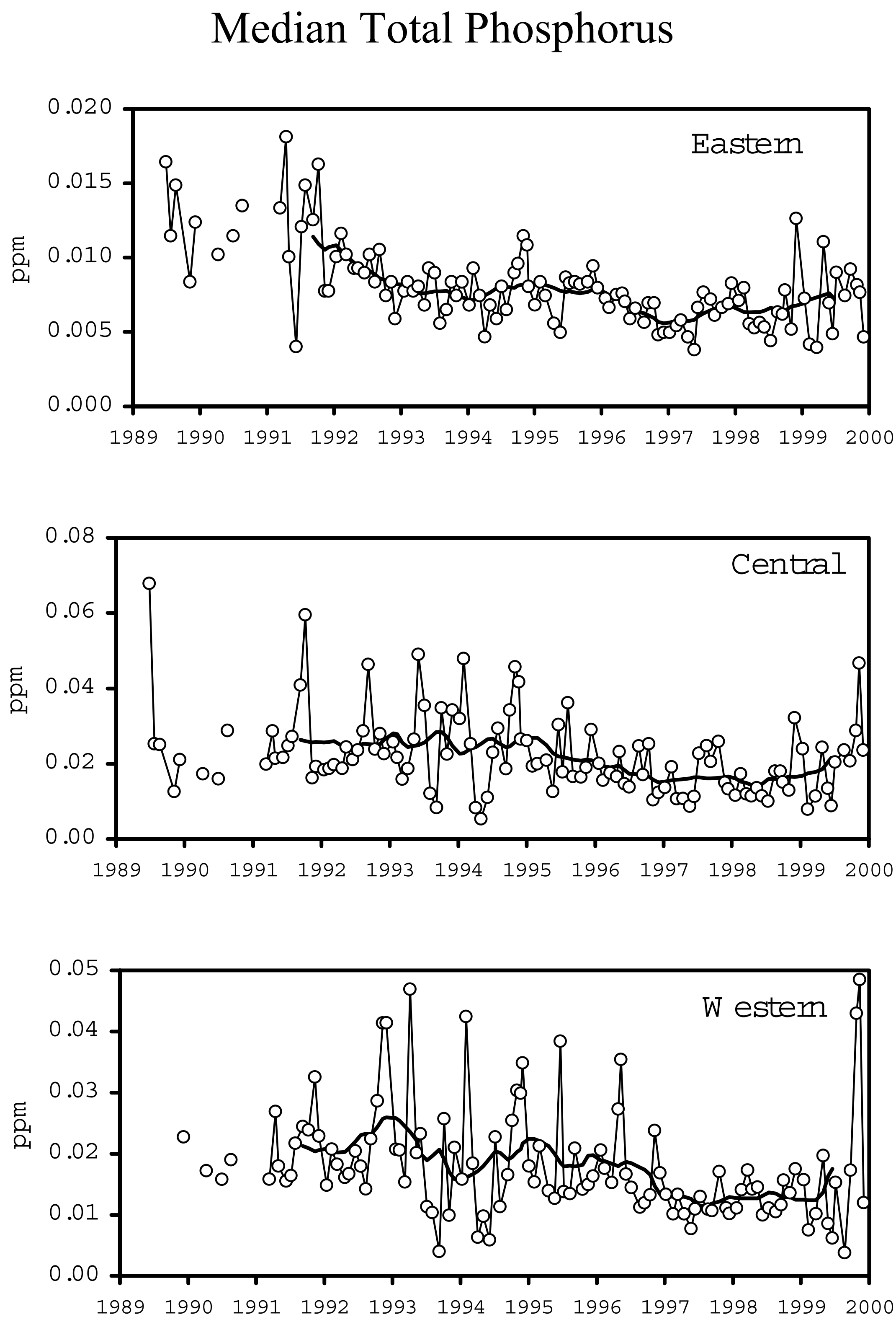

Figure 2.4. Monthly median total phosphorus concentration in the three Florida Bay zones.

Median Turbidity

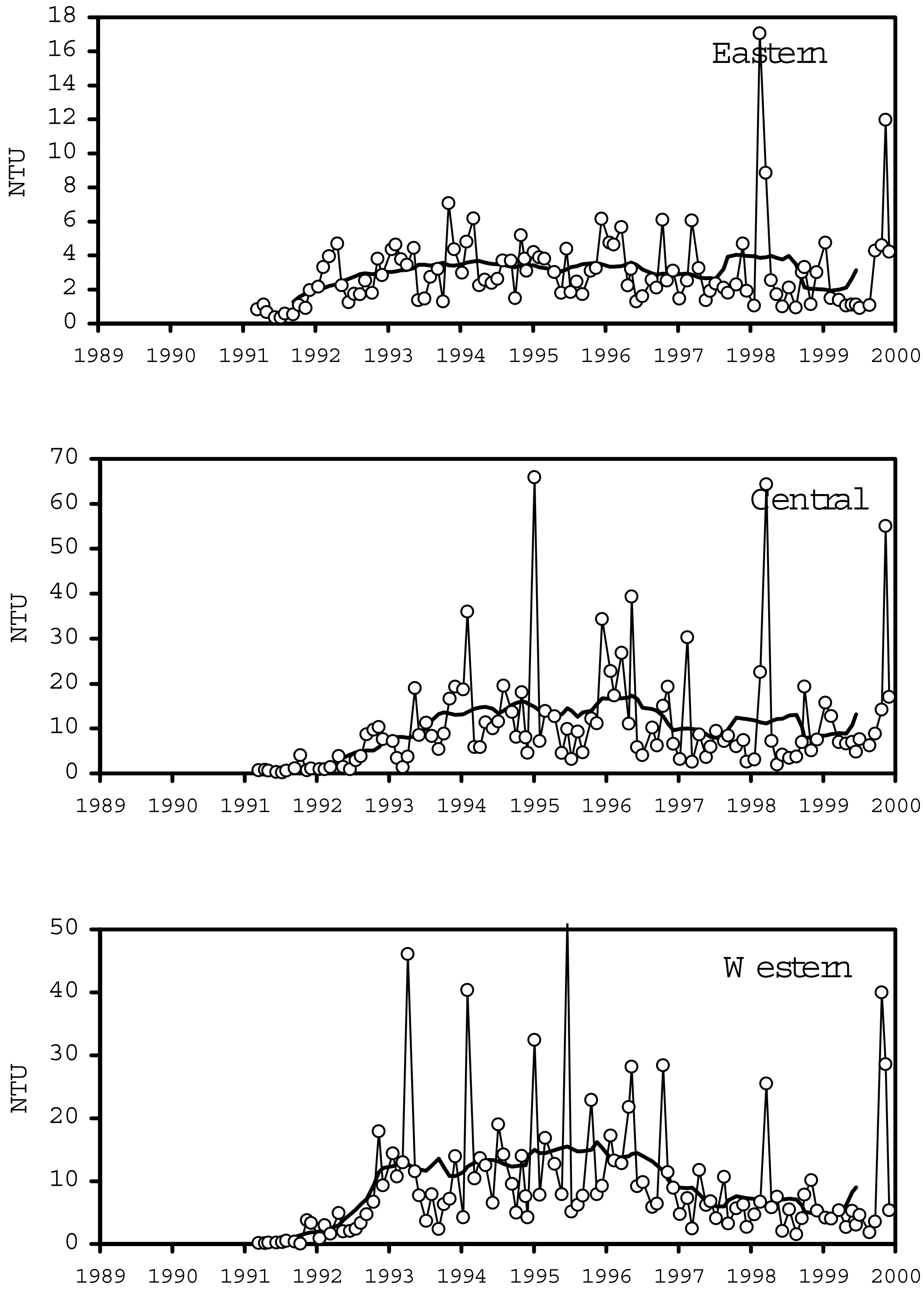

Figure 2.5. Monthly median turbidity levels in the three Florida Bay zones.

Median Chlorophyll *a* (Chl *a*)

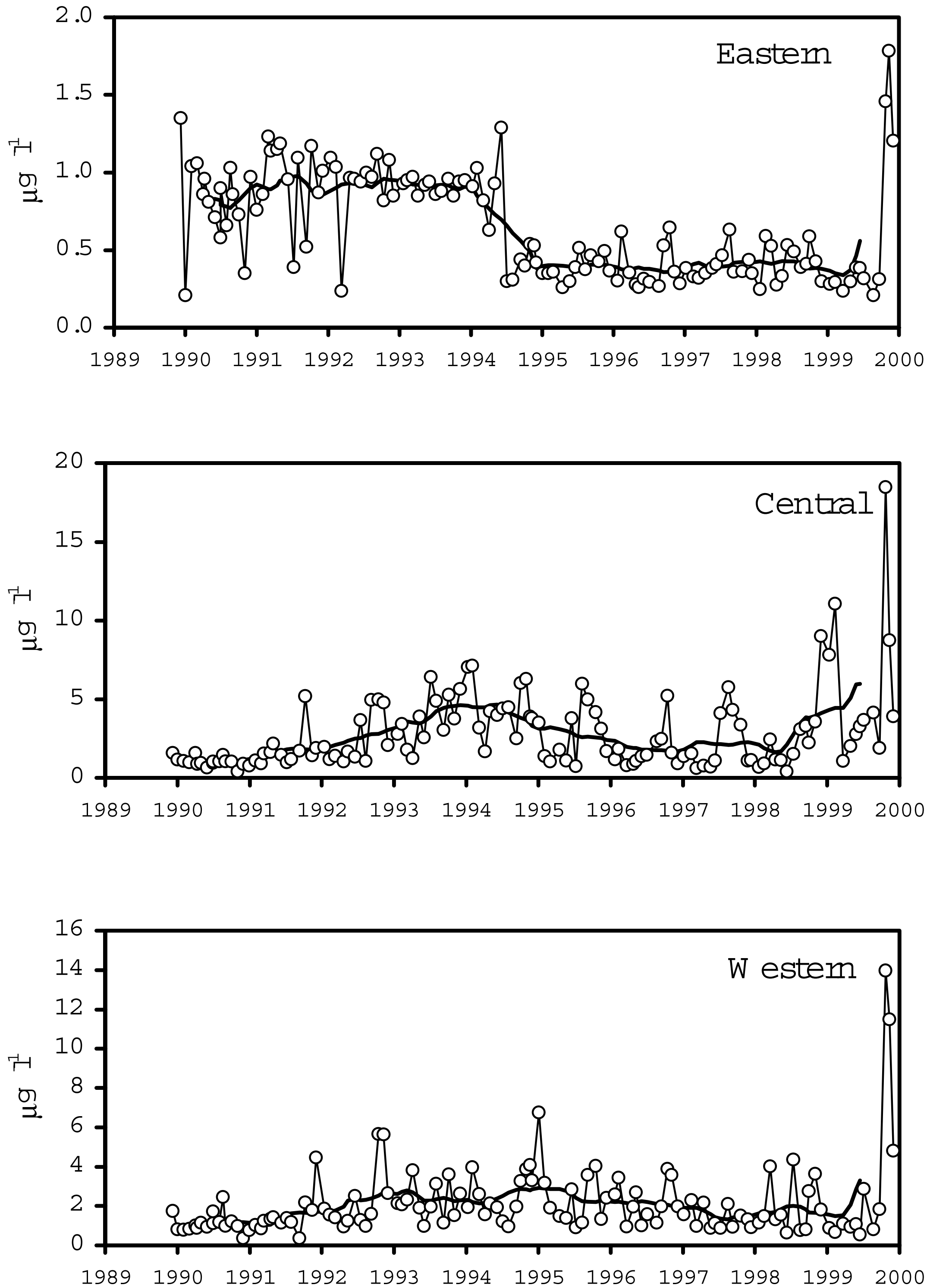

Figure 2.6. Monthly median chlorophyll *a* concentrations in the three Florida Bay zones.

Median Ammonium (NH_4^+)

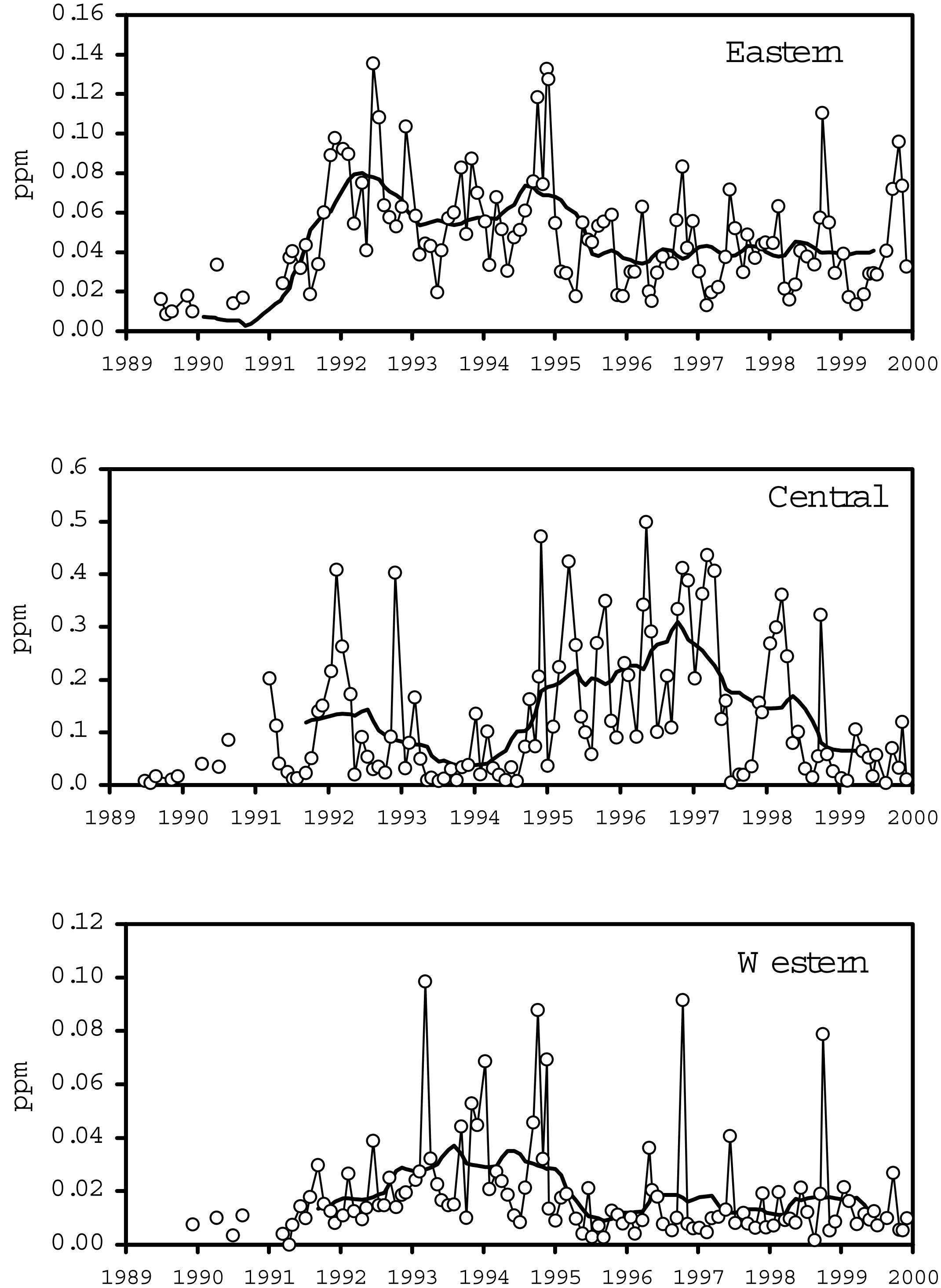

Figure 2.7. Monthly median ammonium concentrations in the three Florida Bay zones.

Median Nitrate (NO_3^-)

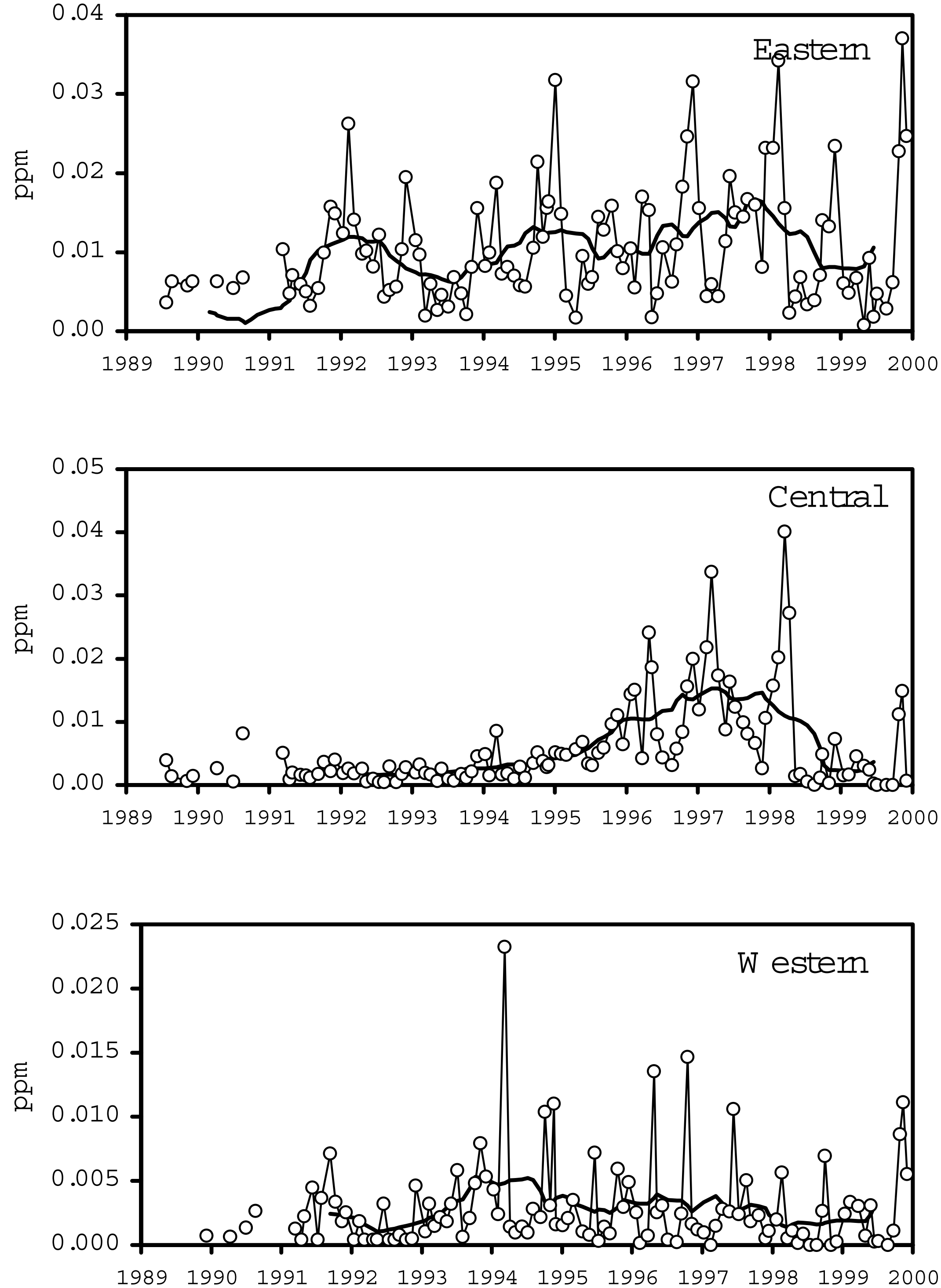

Figure 2.8. Monthly median nitrate concentrations in the three Florida Bay zones.

Median Total Organic Carbon (TOC)

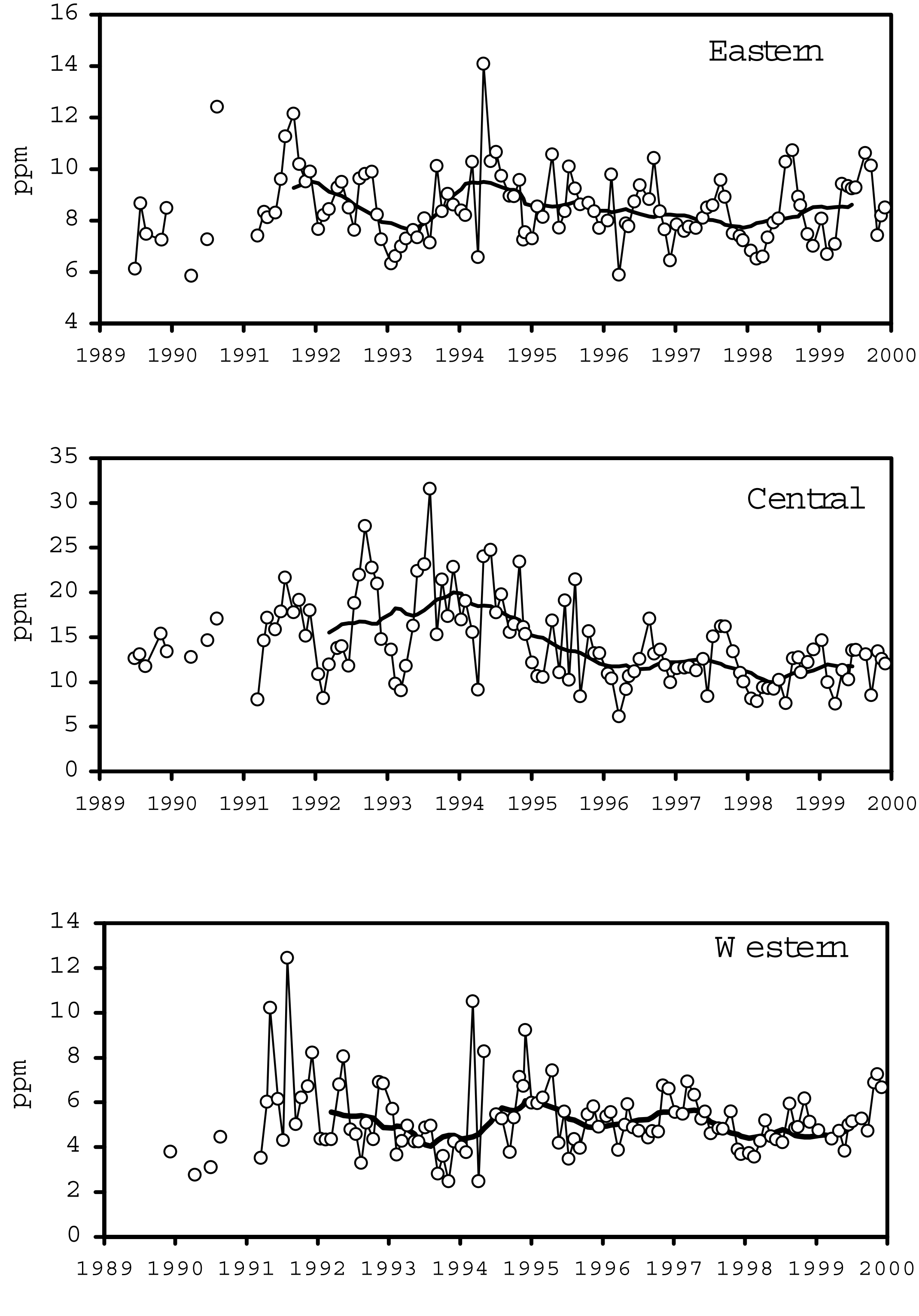

Figure 2.9. Monthly median total organic carbon concentrations in the three Florida Bay zones.

3. OVERVIEW OF WATER QUALITY OF WHITEWATER BAY-TEN THOUSAND ISLANDS COMPLEX

Using the same statistical approach as above, the TTI-WWB complex was partitioned into 6 distinct zones of similar water quality (Fig. 3.1). The first cluster was composed of 13 stations in and around the Shark, Harney, Broad, and Lostmans Rivers and is called the Mangrove River (MR) group. This cluster also included a sampling station just off the Faka Union Canal. The second cluster was made up of the 8 stations enclosed within Whitewater Bay proper (WWB). Twelve stations situated mostly in and around the coastal islands of TTI-WWB formed the Gulf Island group (GI). The water quality characteristics at the Coot Bay site were sufficiently different so as to be a cluster of its own. The next cluster contained the northernmost 2 stations in the Blackwater River estuary (BLK). Finally, the Inland Wilderness Waterway zone (IWW) included 11 stations distributed throughout the inside passage as well as the Chatham River and the station off Everglades City.

Marked differences in physical, chemical, and biological characteristics among zones were illustrated by this technique. The general spatial trend is one of relatively high APA, TON, and TOC in the south declining northward along the coast (Fig. 3.2) while salinity, turbidity, TP, and SRP increased (Fig. 3.3). The net effect is the formation of a gradient with strong phosphorus limitation occurring in the southern region shifting to a more balanced N:P ratio in the northern area around the Blackwater River.

We believe these gradients are the result of coastal geomorphology and watershed characteristics in the region. The width of the mangrove forest is widest in the south (15 km) but grades to only 4 km wide in the northern TTI; this being a function of elevation and sediment type. Whitewater Bay is an semi-enclosed body of water with a relatively long residence time which receives overland freshwater input from the Everglades marsh. The long water residence time may explain the very low P concentrations (from biological uptake), while the high evaporation rate would tend to concentrate dissolved organic matter (DOM). The Mangrove Rivers are directly connected to the Shark River Slough and therefore have a huge watershed relative to their volume. Freshwater inputs from this source are very low in P while the extensive mangrove forest contributes much DOM. The Inner Waterway is an intermediate zone in all respects; having extensive channelization but low freshwater input. The Gulf Island zone has very low freshwater input due to the poorly drained watershed of the Big Cypress Basin. Instead of mangrove river channels there are many mangrove islands set in low tidal energy environment situated behind the Cape Romano Shoals. Finally there is the Blackwater River cluster with highest salinity and P. There is much agriculture (tomatoes, etc.) in the Blackwater River watershed which may contribute significant amounts of P to the system via drainage ditches. Further analysis of this relationship is planned.

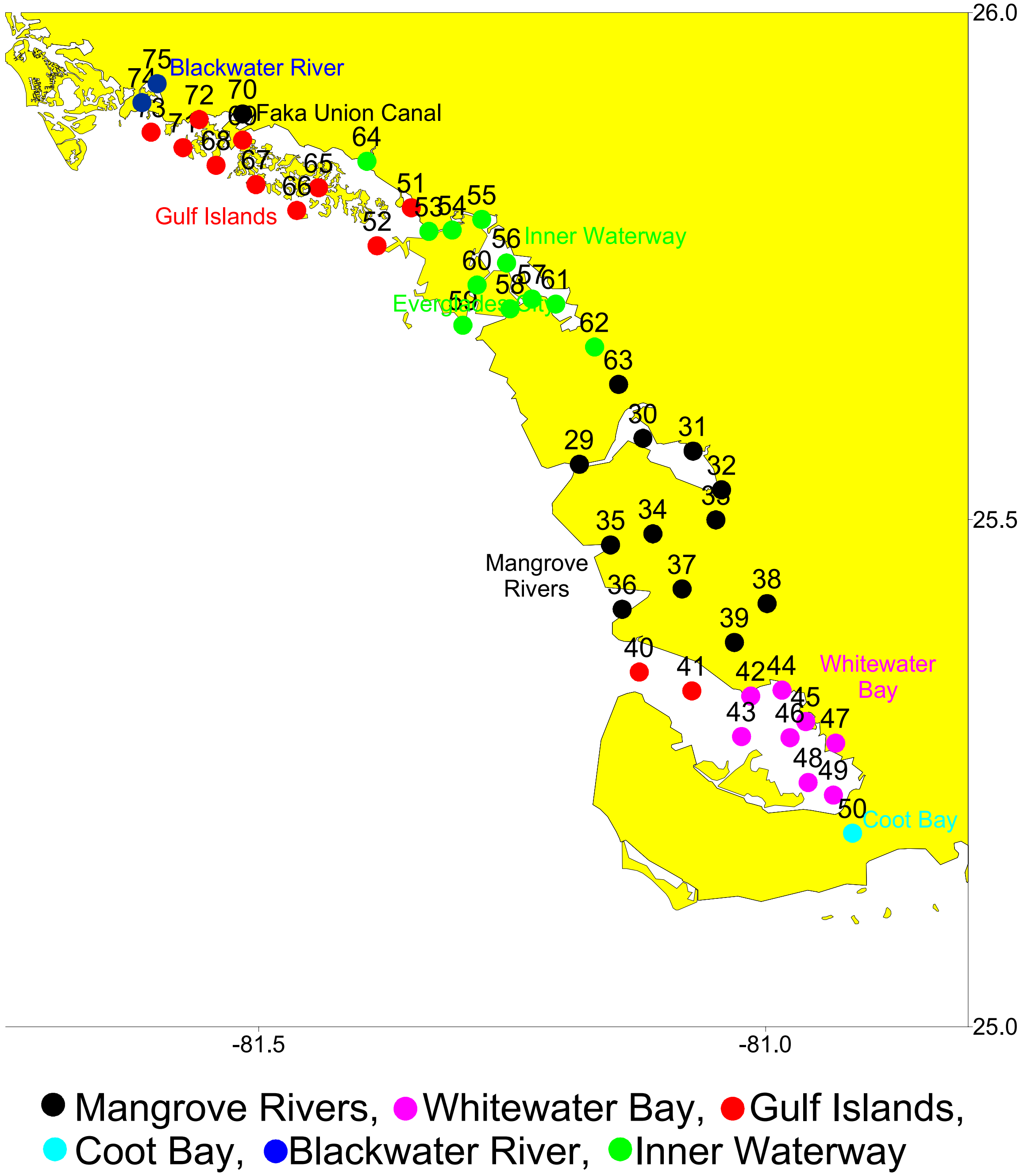

Figure 3.1. Zones of similar water quality in Whitewater Bay-Ten Thousand Islands complex:

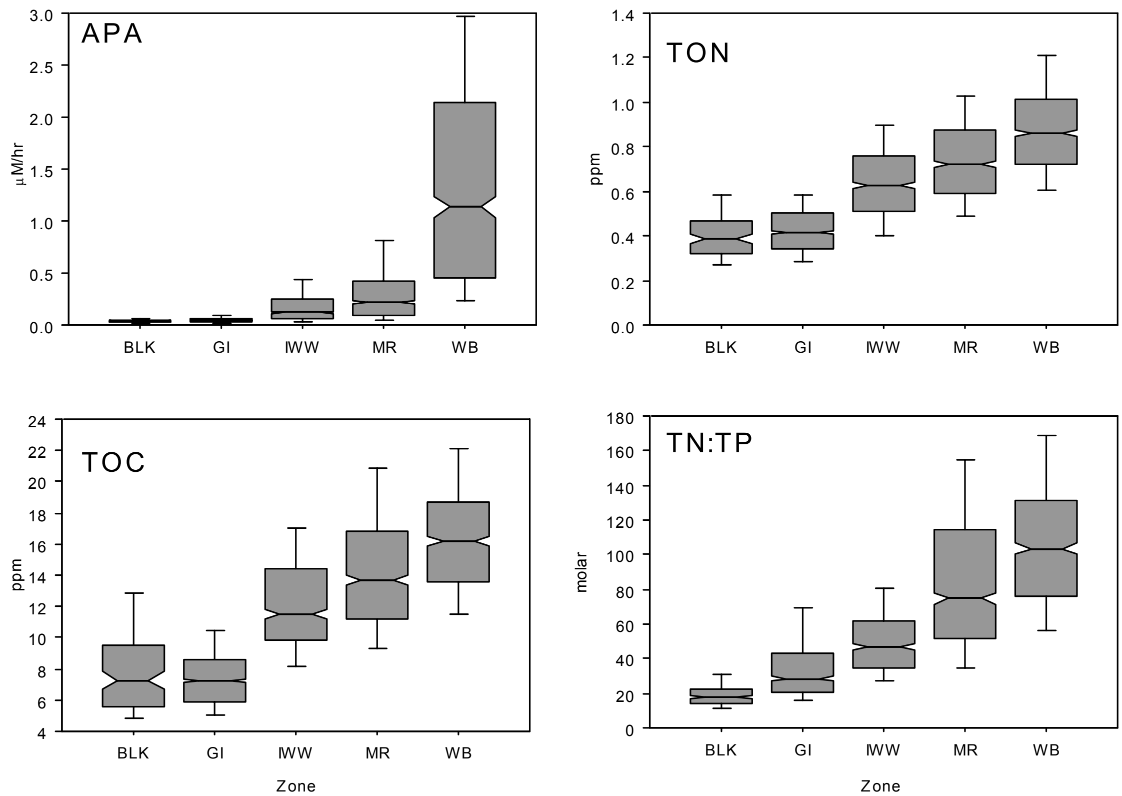

Figure 3.2. Box-and-whisker plots of alkaline phosphatase activity (APA), total organic nitrogen (TON), total organic carbon (TOC), and the total nitrogen:total phosphorus ratio (TN:TP) for the zones. A significant decreasing trend in all variables is observed with northward direction.

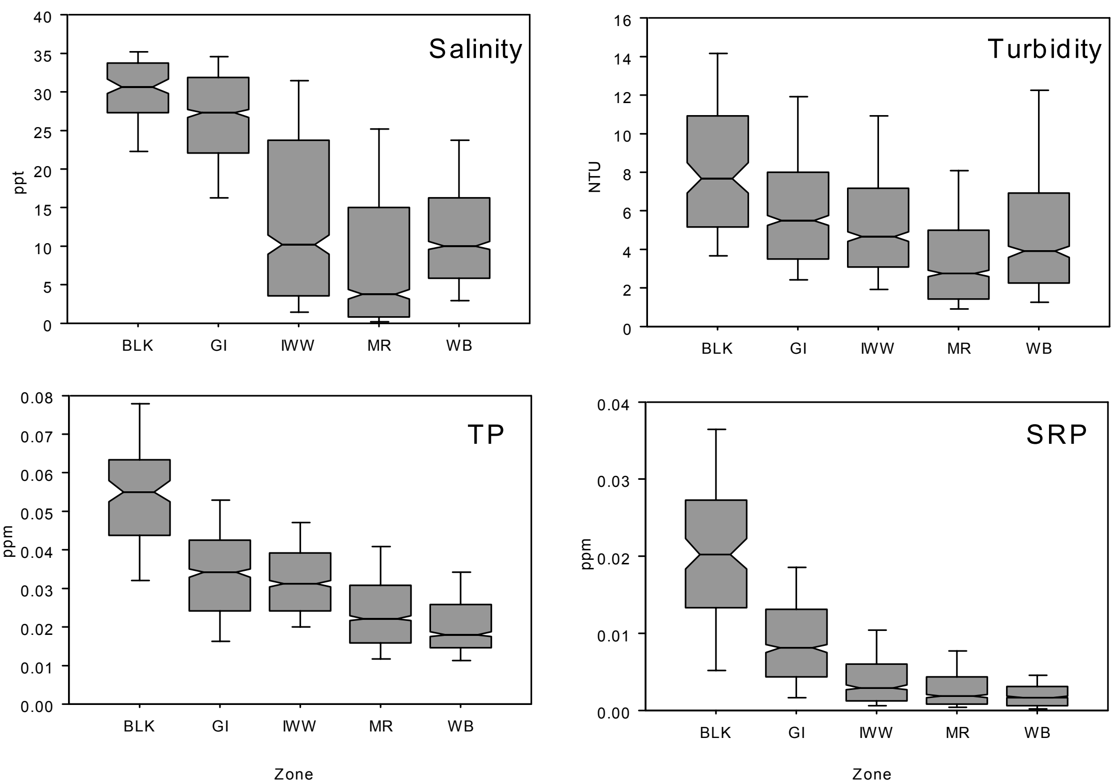

Figure 3.3. Box-and-whisker plots of salinity, turbidity, total phosphorus (TP), and soluble reactive phosphorus (SRP) for the zones. A significant increasing trend in all variables is observed with northward direction.

4. OVERVIEW OF WATER QUALITY OF BISCAYNE BAY

Biscayne Bay was partitioned into 6 distinct ZSI using the above statistical analysis. The first cluster was composed of 2 stations closest to the shore in the south Bay (Fig. 4.1); they were called the Alongshore group (AS). These are stations most influenced by the Goulds, Military and Mowry Canals. The second cluster was made up of the 5 stations farther from the coast called Inshore (IS). Thirteen stations situated mostly in the bay proper were called the main Bay (MAIN) group. The next cluster contained 3 stations situated in areas of great tidal exchange (ocean channel, not shown). Two stations in Card Sound grouped together SCARD. Finally, the Turkey Point station comprised its own cluster (not shown). As mentioned previously, 10 stations were selected for their status as being either redundant (as in some of the Main Bay stations) or as outliers (Turkey Point and the ocean channel sites) and redistributed throughout the Bay to provide us with more complete coverage. For purposes of this report, the stations added to the area north of the Rickenbacker Causeway are defined, a priori, as a distinct cluster, North Bay (NBAY).

It is clear that there is a gradient of increased salinity with decreased nutrient concentration with distance from the west coast of the Bay (Fig. 4.2). For AS, IS, and MAIN clusters, highest concentrations of NO_3, NO_2, NH_4, and TP were observed in the AS stations (Fig. 4.3). NBAY showed NH_4 levels comparable to the high concentrations seen AS but had a higher median salinity. In addition, NBAY had the highest median TP concentration of any ZSI. SCARD had relatively high NH_4 concentration relative to the other nutrients. Some of this may be attributed to the long water residence time of this basin as evidence by near ocean salinities. APA as well as TON and TOC concentrations were highest in AS > IS > MAIN, denoting a freshwater source. It is interesting to note the northwards decreasing gradient of TON and TOC along the coast. Concentrations of SRP were so low so as be undetectable in many instances. The relationship between SRP and Chl a was very weak and may have been influenced by other factors yet determined. This is a preliminary analysis and will be repeated after more data collection.

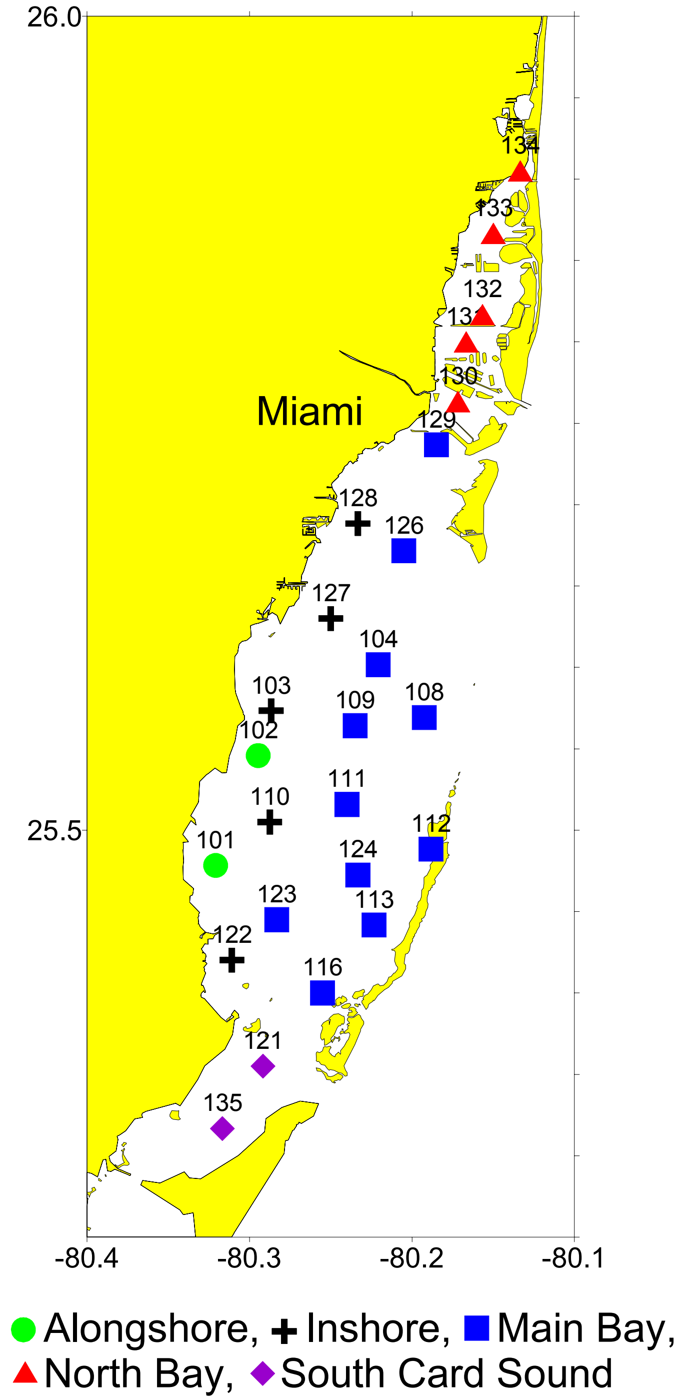

Figure 4.1. Zones of similar water quality in Biscayne Bay.

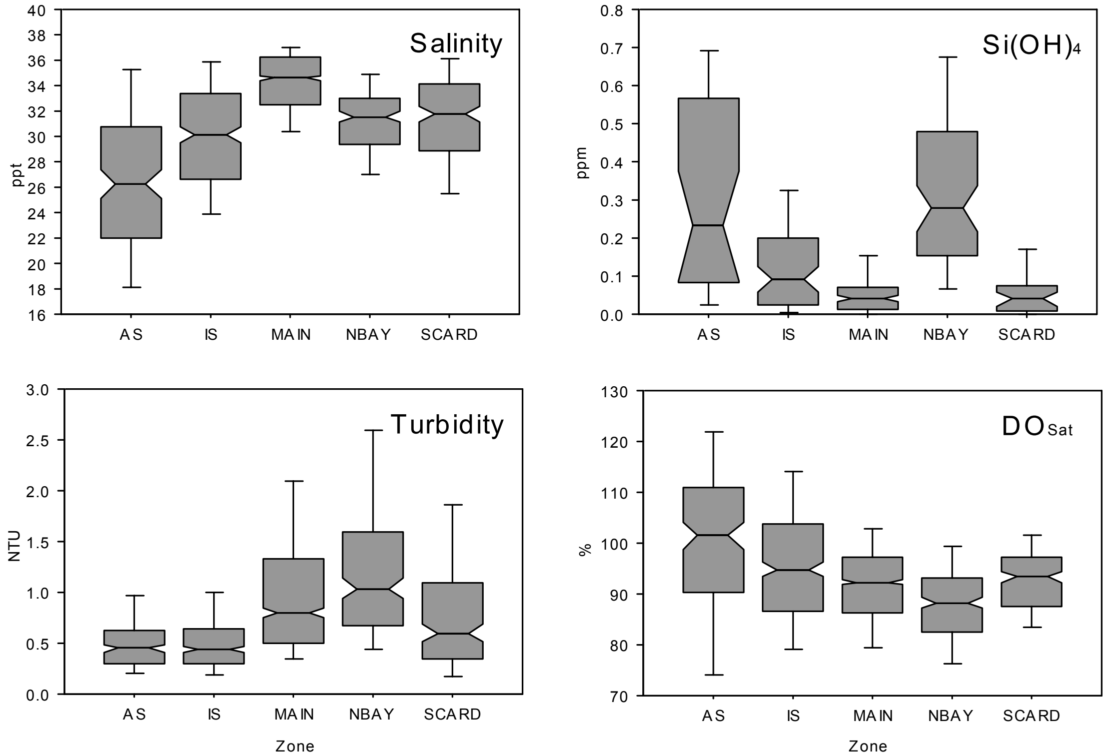

Figure 4.2. Box-and-whisker plots of salinity, silicate ($Si(OH)_4$), turbidity, and dissolved oxygen saturation (DO_{sat}) by zone. A significant increasing trend in salinity and turbidity is observed with distance offshore with concomitant decline in $Si(OH)_4$and DO_{sat}.

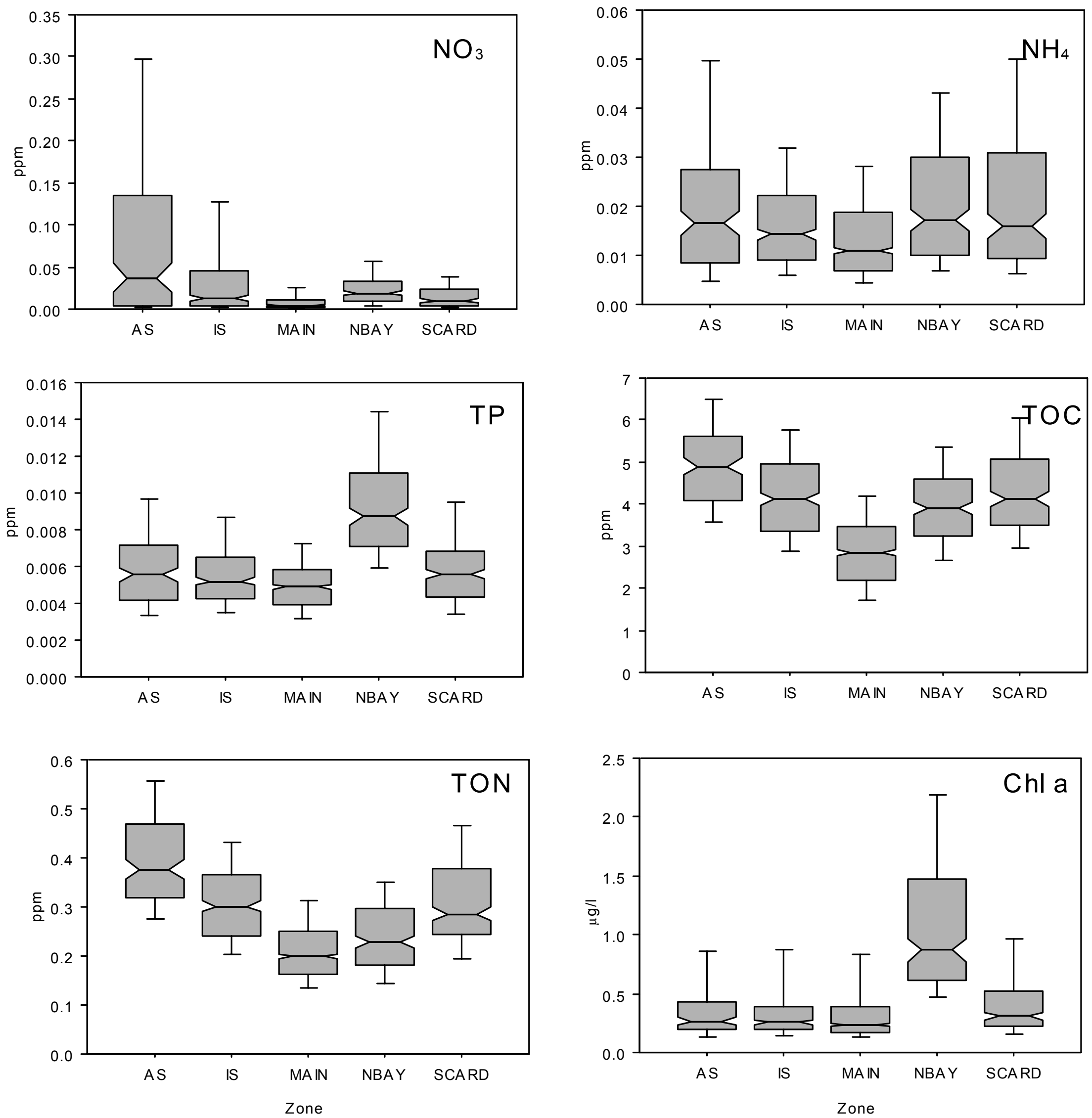

Figure 4.3. Box-and-whisker plots of nitrate (NO3), ammonia (NH4), total phosphorus (TP), total organic carbon (TOC), total organic nitrogen (TON), and chlorophyll *a* (Chl a) for the zones. A significant decreasing trend in these variables (except Chl a) is observed with distance offshore.

5. OVERVIEW OF WATER QUALITY OF SOUTHWEST FLORIDA SHELF

The above statistical analysis objectively classified the 49 Shelf sampling sites into 3 zones having similar water quality (Fig. 5.1). The first cluster was composed of only 2 stations which were closest to the shore off Cape Sable; they were called the SABLE group. The second cluster was made up of the 7 more northerly stations nearest the coast and called SHARK after the Shark River, the main source of freshwater to the region. The remaining stations were called the SHELF group.

It is clear that the SABLE stations have higher concentrations of NO_3, NO_2, NH_4, and SRP while the SHARK and SHELF stations were similar (Fig. 5.2). In addition, there is a decreasing concentration gradient of SABLE>SHARK>SHELF for TP, Chl a and turbidity (Fig. 5.3). Finally, the inverse relationship between salinity and $Si(OH)_4$ is evident for all ZSI. The source of $Si(OH)_4$ in this area of carbonate sediments is from silicate sands and siliceous periphyton (diatoms) found in the Shark River watershed (Everglades). $Si(OH)_4$ is can therefore be used as a freshwater tracer in this system.

Although these analyses are very preliminary (only 18 sampling events) it is possible to speculate that the clusters are formed as a function of hydrology and circulation patterns. We believe that the SABLE stations clearly show the input of freshwater from Shark River being transported south and east around the Cape. Water overlying the SHARK stations probably originates somewhere in or north of the Ten Thousand Islands. Our level of resolution is very low due to the limited numbers of sampling events and by the relatively large spatial gap between coastal and Shelf sampling sites. A better understanding of local circulation patterns in addition to increased density and frequency of sampling in the nearshore region may help define the coupling between freshwater inflow and Shelf water quality. This is a preliminary analysis and will be repeated after a few more years of data have been collected.

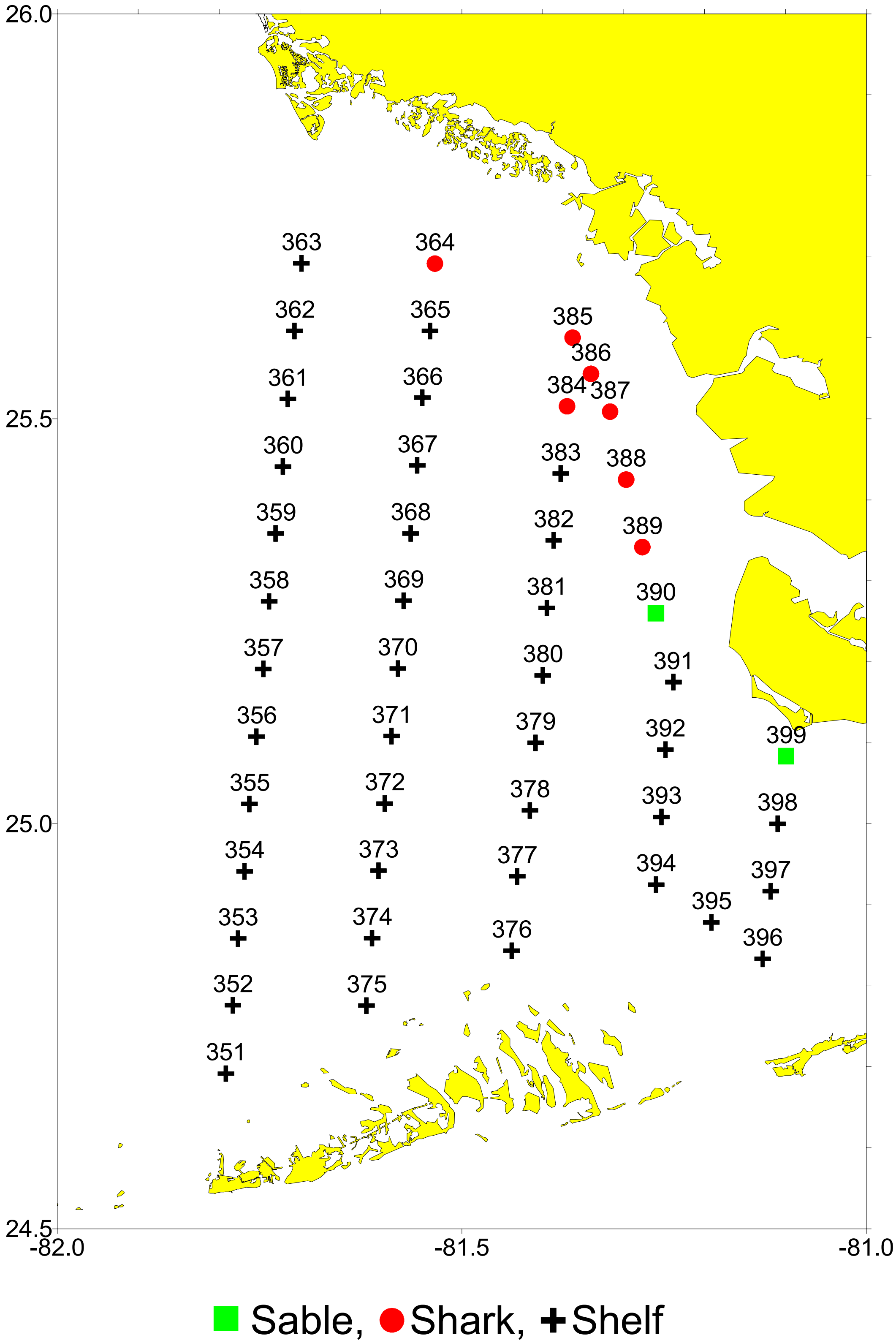

Figure 5.1. Zones of similar water quality on the Shelf.

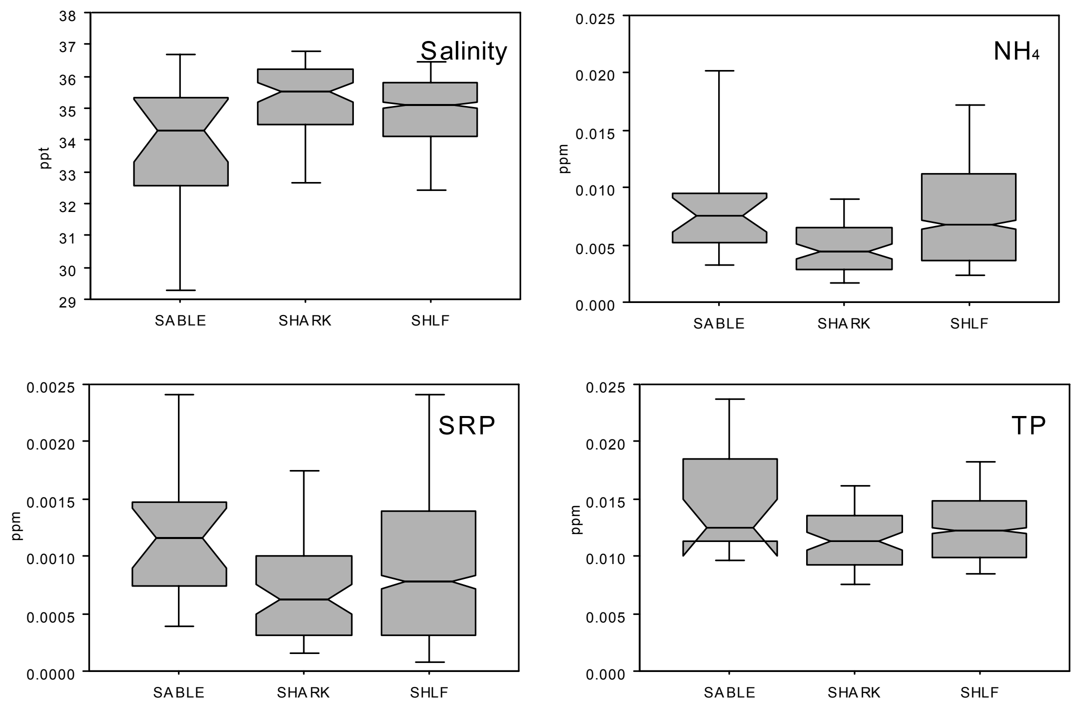

Figure 5.2. Plot of salinity showing influence of freshwater source from Everglades to stations south of Shark River (SABLE).

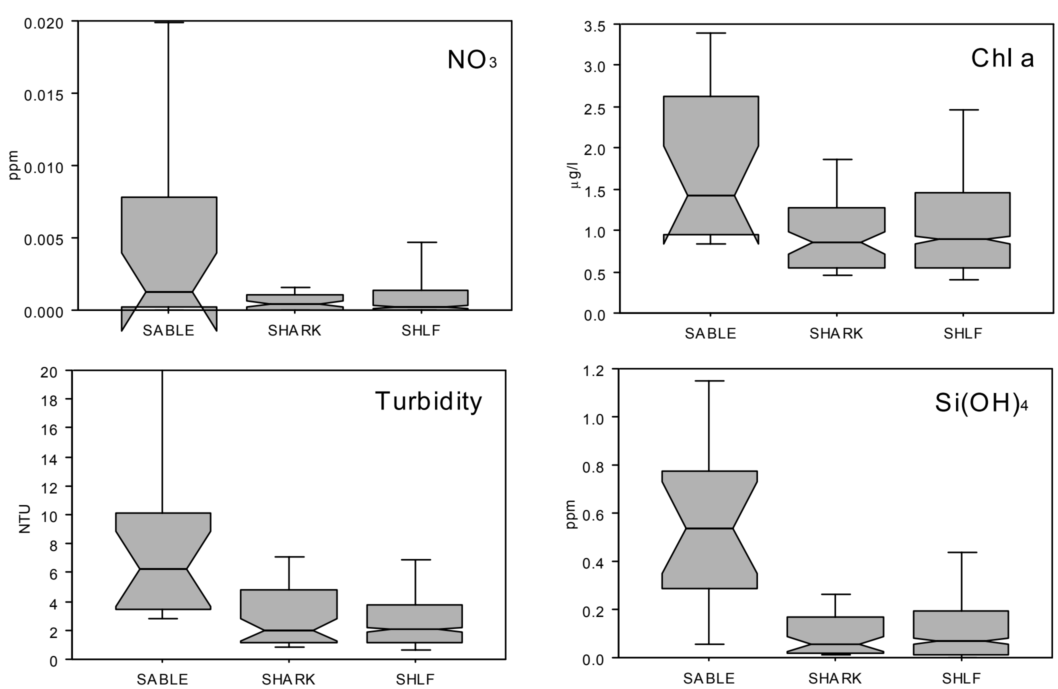

Figure 5.3. Plots showing variables most affected by freshwater inputs from Everglades.

6. OVERVIEW OF WATER QUALITY OF CAPE ROMANO-PINE ISLAND SOUND AREA

Sampling in this area began Jan. 1999 so there is only one year of data available. This makes it unfeasible to perform a spatial statistic analysis. Therefore we will use generally accepted geomorphological characteristics to group the stations (Fig. 6.1). These groupings are Estero Bay (EST), Cape Romano-Marco Island (MARC), Naples Bay (NPL), Pine Island Sound (PIS), Rookery Bay (RB), and San Carlos Bay (SCB).

San Carlos Bay is located at the mouth of the Caloosahatchee River, a major managed outlet for freshwater from Lake Okeechobee. The SCB sites experienced the lowest median salinity and had the largest range in salinity as well. SCB also had highest concentrations of NO_3^-, TP, SRP, and TOC (Fig. 6.2 & 6.3). Estero Bay also exhibited lower salinities than the other areas, most probably as a result of freshwater input from the Estero and Imperial Rivers as well as Hendry Creek. EST is relatively enclosed, has a long water residence time, and is bordered on the north by the city of Ft. Meyers. These facts may account for the elevated Chl a, NO_3^-, and TP.

Overall, this area has significantly higher concentrations of TP, SRP, NO_3^-, and Chl a than the bulk of the TenThousand Islands stations. Much of this is due to geological changes from carbonates to silicates which facilitates transport of phosphorus and to major landuse changes from the Big Cypress National Preserve to suburban and agricultural uses.

The combined efforts of Collier County Pollution Control and SERC, FIU are shown in Fig. 6.4-6.11. Water quality sampling by Collier County was modified in 1999 to provide a more integrated picture of the connections between watershed and estuary. Significant watershed influences in the Faka Union Basin were observed including elevated TP, NO_3^-, NH_4^+, and lower DO. These trends were also evident for the Gordon River – Naples Bay and Cocohatchee River – Wiggins Pass. This is a preliminary analysis and will be repeated after more data collection.

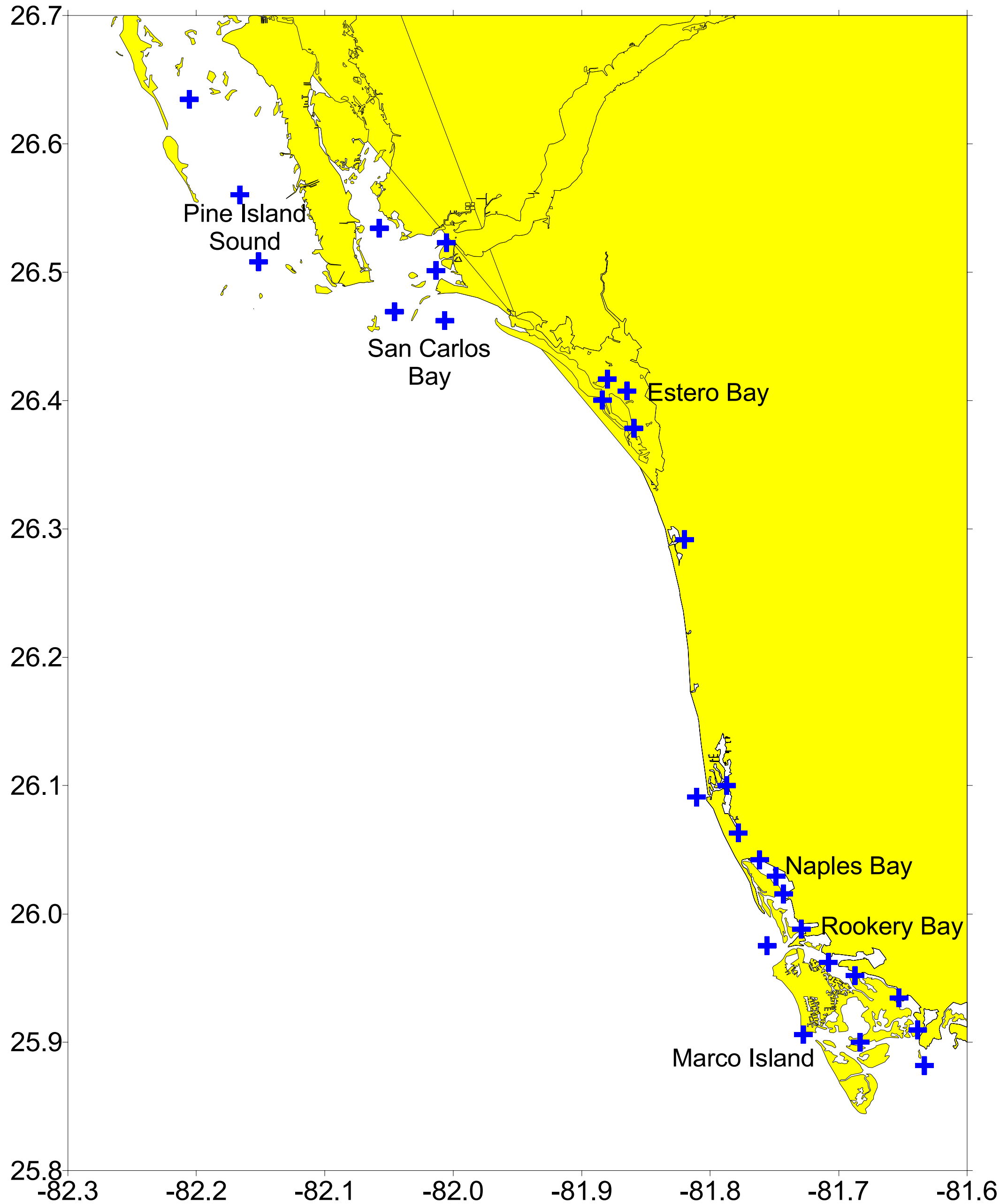

Figure 6.1. Map of station locations in Cape Romano-Pine Island Sound area.

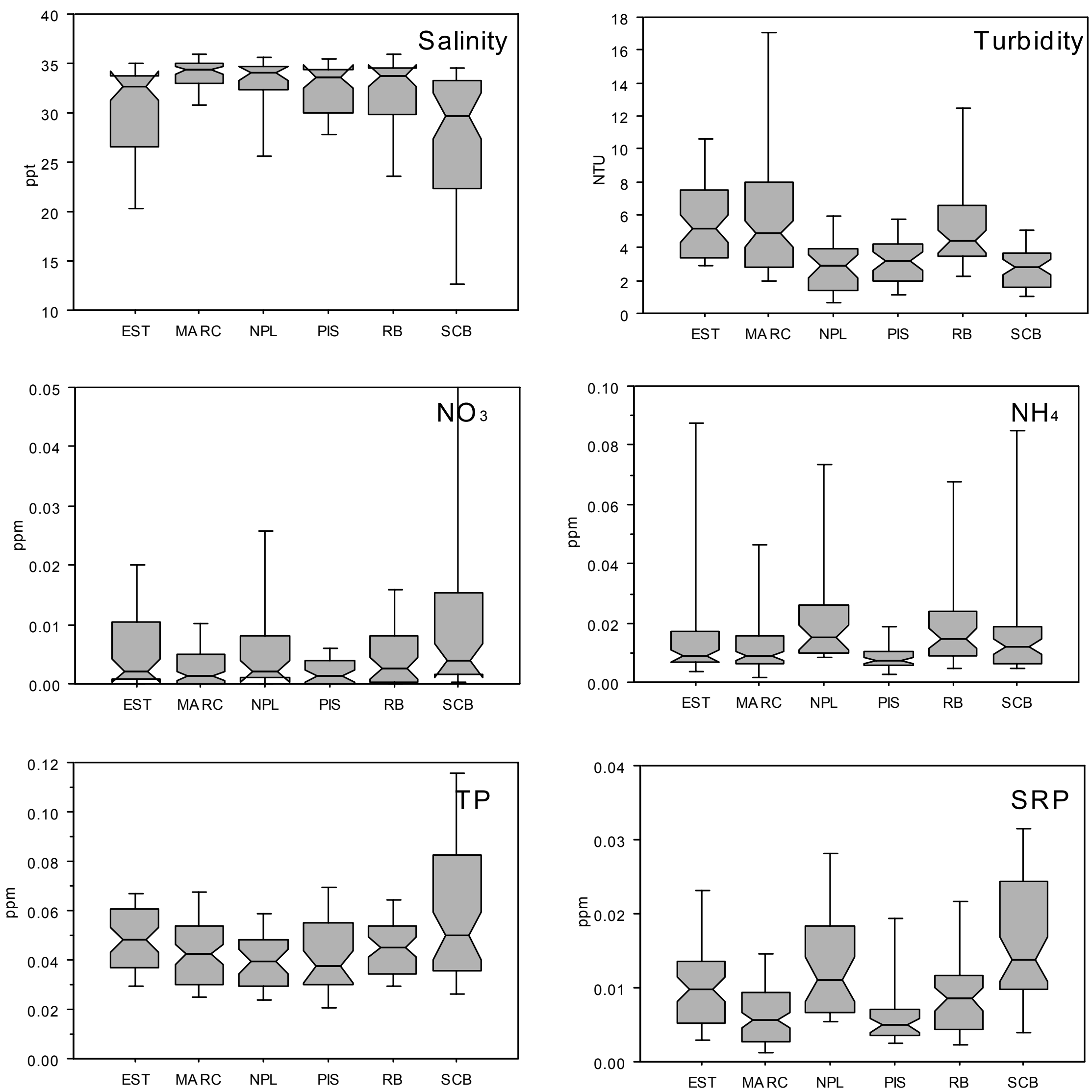

Figure 6.2. Box-and-whisker plots of salinity, turbidity, nitrate (NO_3), ammonia (NH_4), total phosphorus (TP), and soluble reactive phosphorus (SRP) for the various water bodies.

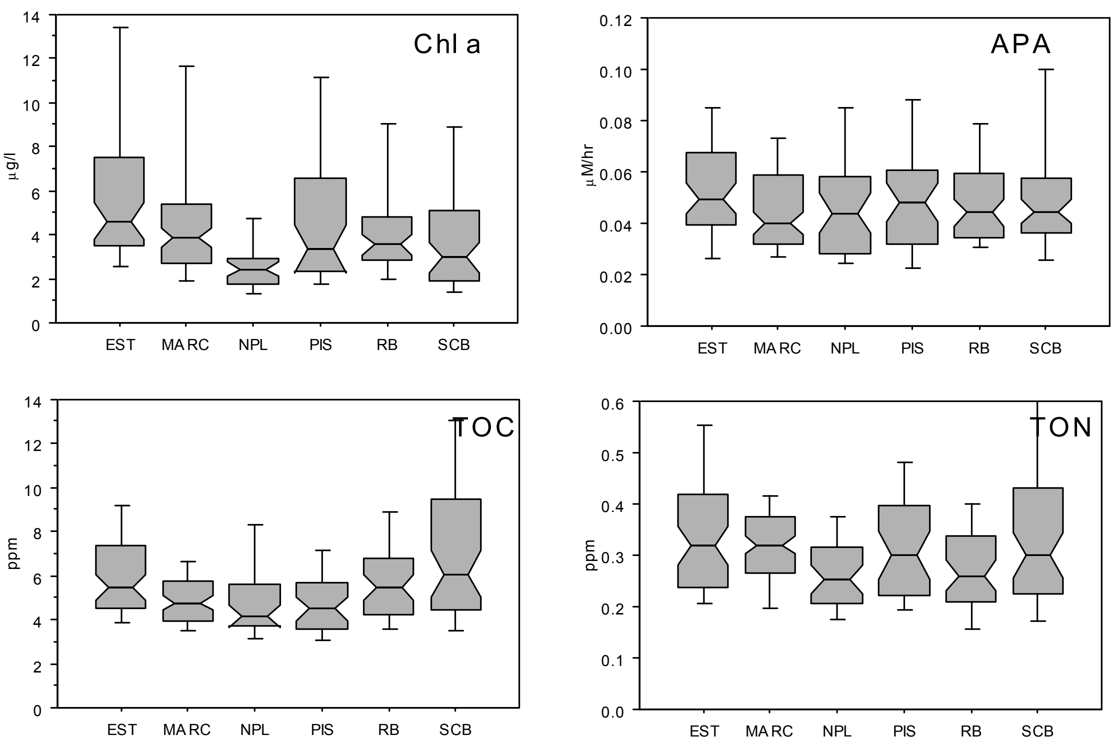

Figure 6.3. Box-and-whisker plots of chlorophyll *a* (Chl *a*), alkaline phosphatase activity (APA), total organic carbon (TOC), and total organic nitrogen (TON) for the various water bodies.

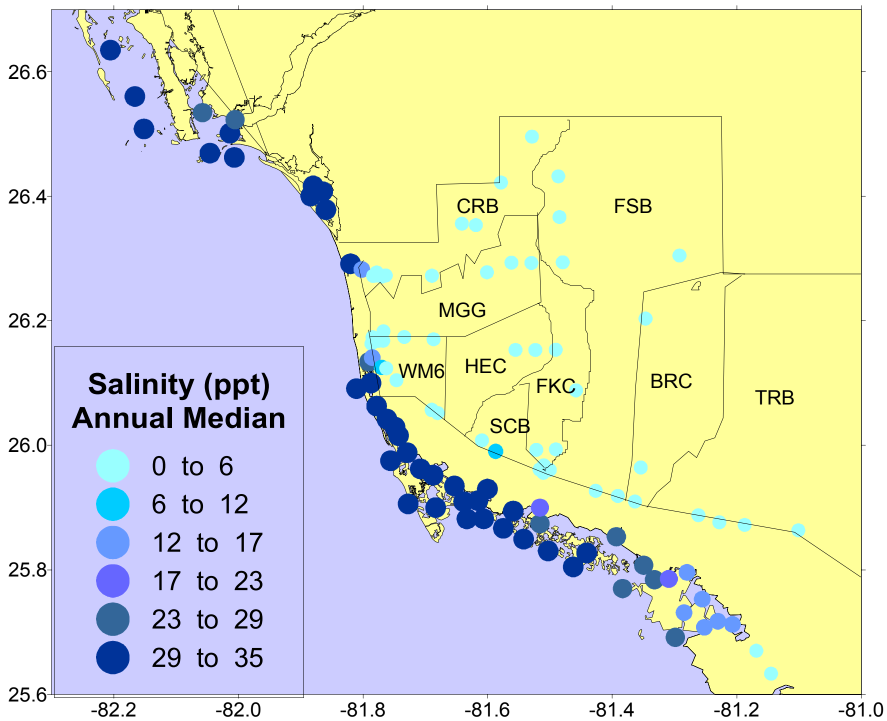

Figure 6.4. Combined median salinity data from Collier County and FIU.

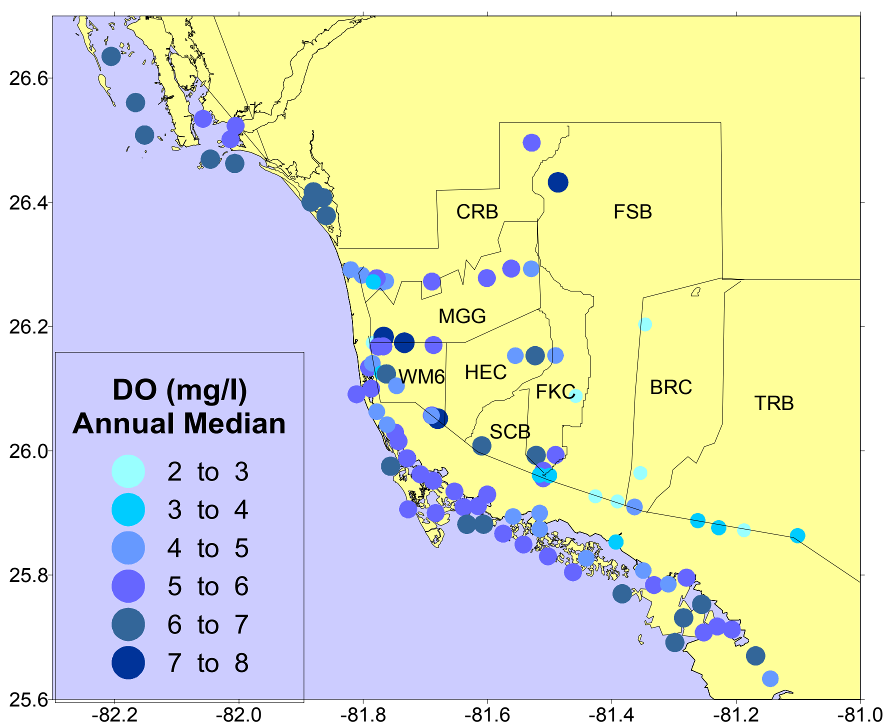

Figure 6.5. Combined median dissolved oxygen data from Collier County and FIU.

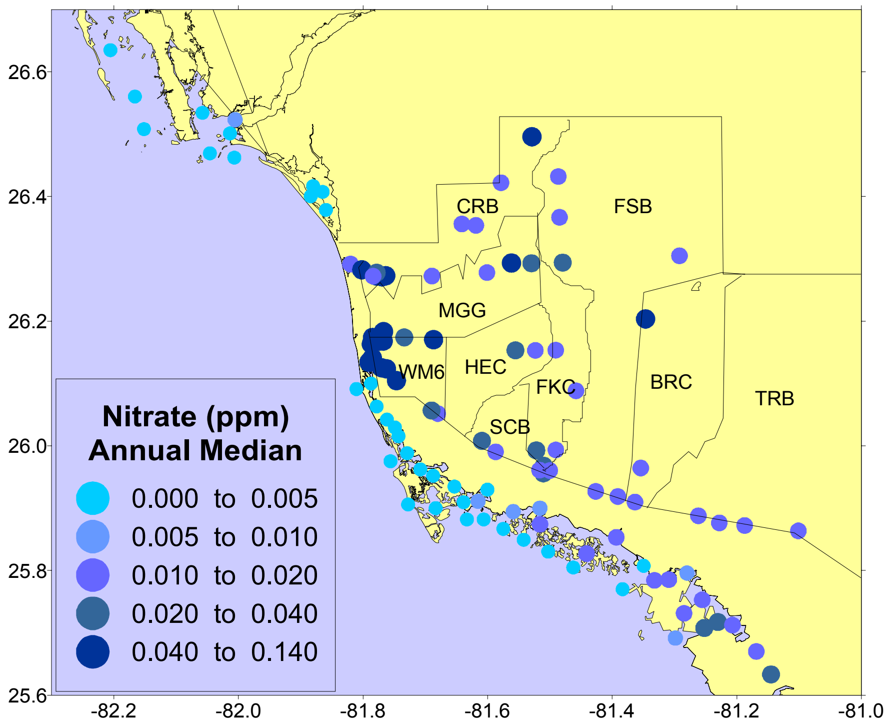

Figure 6.6. Combined median nitrate data from Collier County and FIU.

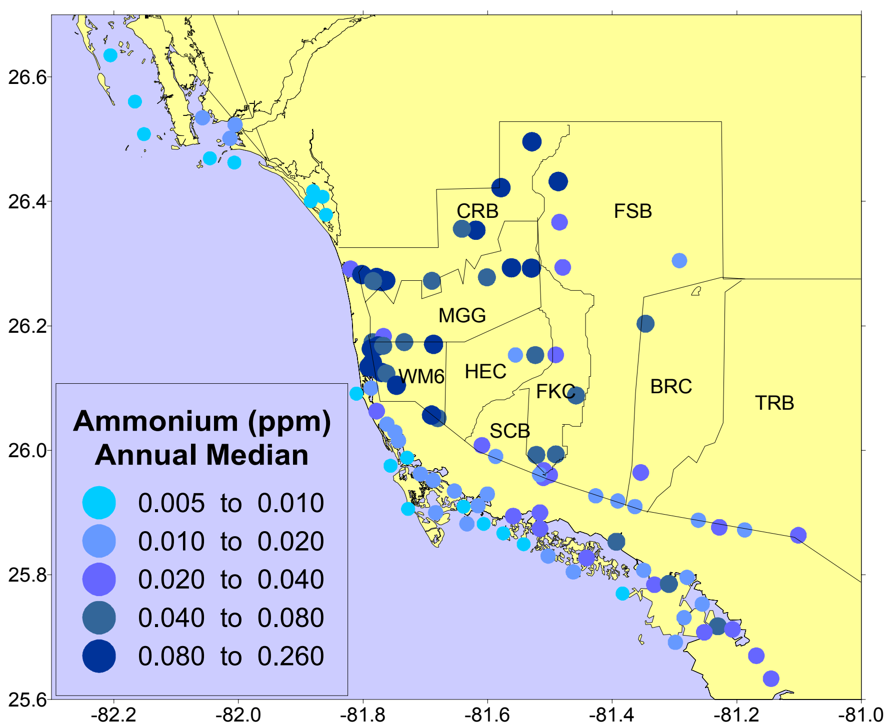

Figure 6.7. Combined median ammonium data from Collier County and FIU.

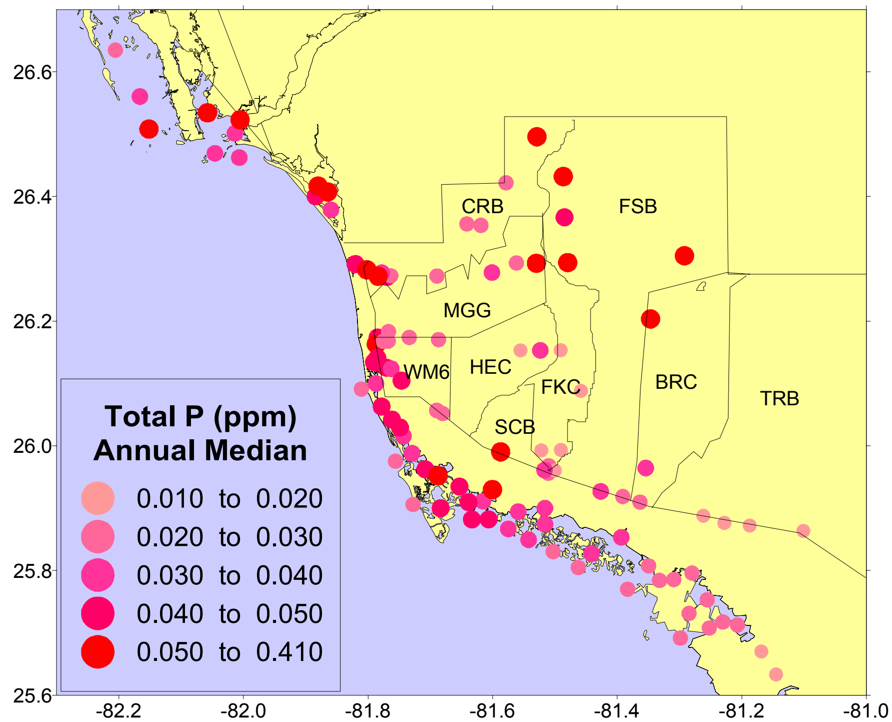

Figure 6.8. Combined median total phosphate data from Collier County and FIU.

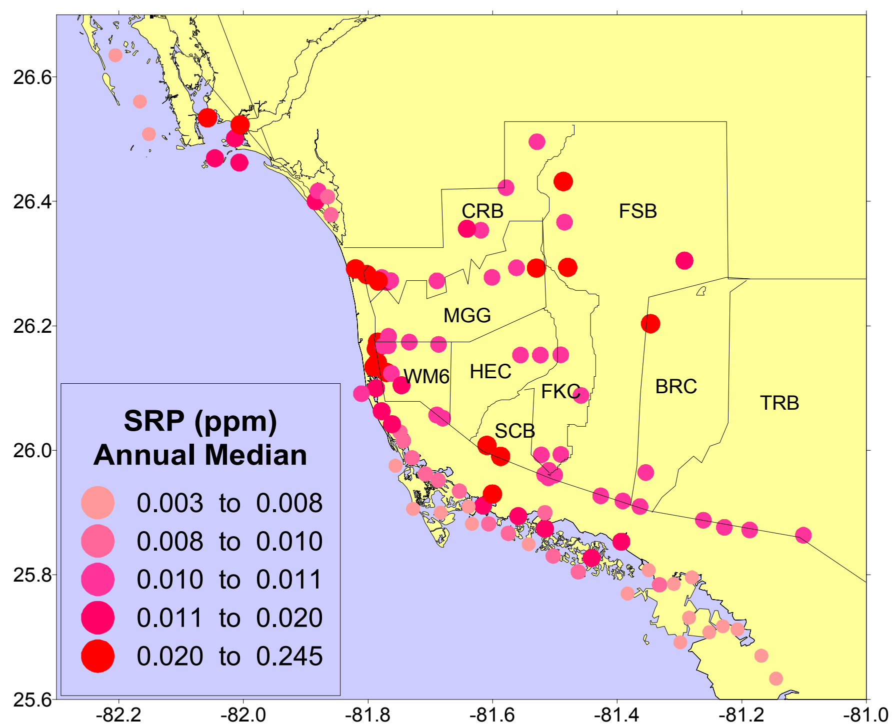

Figure 6.9. Combined median soluble reactive phosphate data from Collier County and FIU.

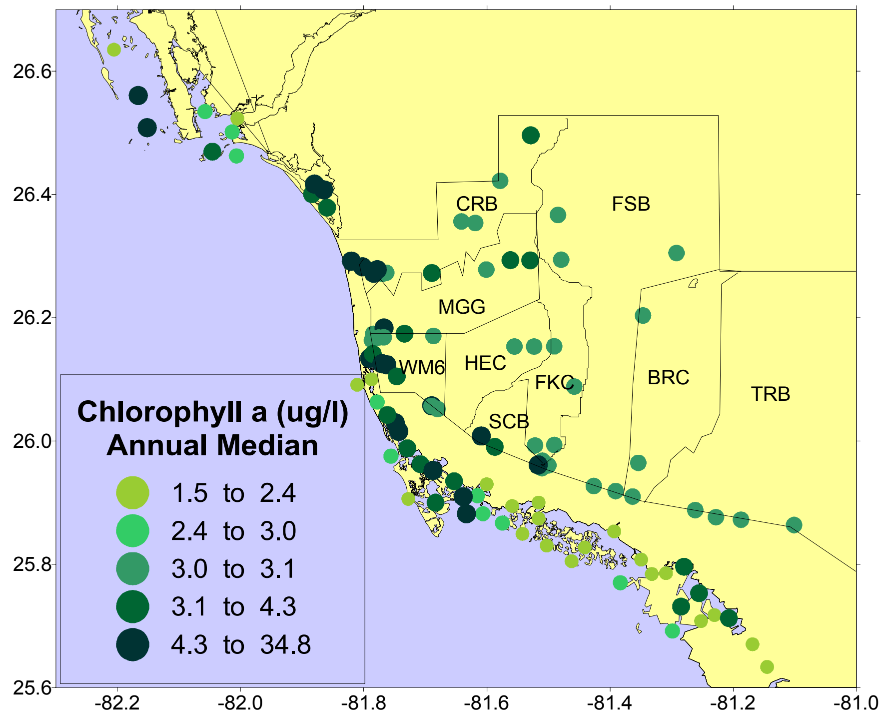

Figure 6.10. Combined median chlorophyll *a* data from Collier County and FIU.

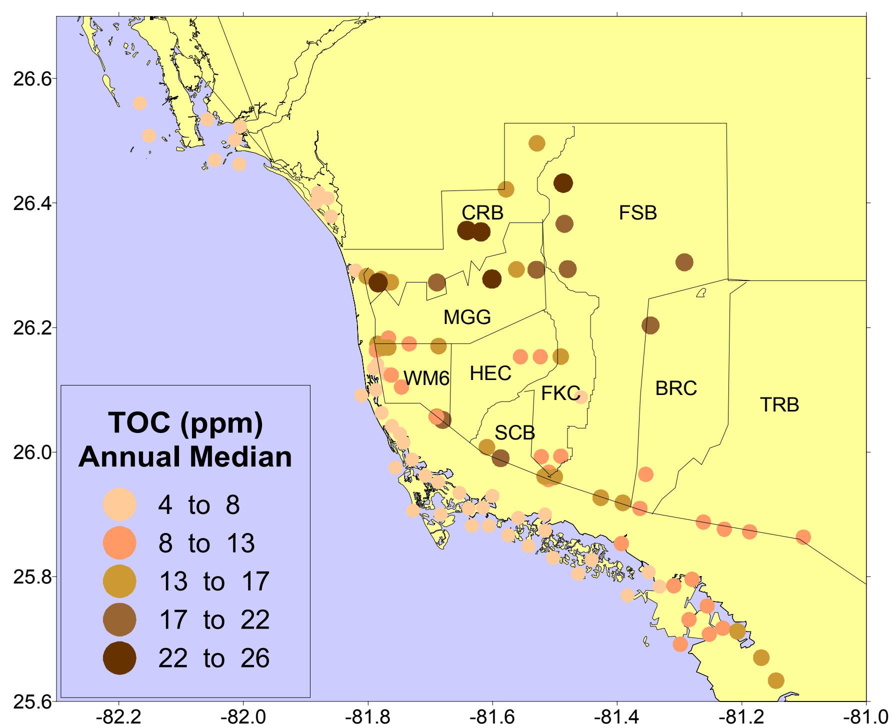

Figure 6.11. Combined median total organic carbon data from Collier County and FIU.

7. PUBLICATIONS DERIVED FROM THIS PROGRAM

1. Lu, X., J. N. Boyer, and R. Jaffe. (in prep.) Source characterization of dissolved organic matter in Southwest Florida Estuaries by UV-visible and synchronous fluorescence analysis.
2. Fourqurean, J. W., J. N. Boyer, and M. J. Durako. (in prep.) The influence of water quality on seagrass distribution and abundance in Florida Bay: predictive models from long-term monitoring programs.
3. Boyer, J. N., and R. D. Jones. (in prep.) Influence of coastal geomorphology and watershed characteristics on the water quality of mangrove estuaries in the Ten Thousand Islands-Whitewater Bay complex, Florida.
4. BOYER, J. N., AND R. D. JONES. (in press) A view from the bridge: External and internal forces affecting the ambient water quality of the Florida Keys National Marine Sanctuary, p. #-#. *In* J. W. Porter and K. G. Porter (eds.), Linkages between ecosystems: the South Florida Hydroscape. St. Lucie Press.
5. Boyer, J. N. and R. D. Jones. 1999. Trends in water quality of Florida Bay (1989-1999). State of Florida Bay. NPS - Everglades National Park Report.
6. Boyer, J. N., P. Sterling, and R. D. Jones. 1999. Maximizing information from estuarine and coastal water quality monitoring networks by diverse visualization approaches. *Estuarine, Coastal Shelf Science* 50: 39-48.
7. BOYER, J. N., AND R. D. JONES. 1999. Effects of freshwater inputs and loading of phosphorus and nitrogen on the water quality of Eastern Florida Bay, p. 545-561. *In* K. R. Reddy, G. A. O'Connor, and C. L. Schelske (eds.) Phosphorus biogeochemistry in sub-tropical ecosystems: Florida as a case example. CRC/Lewis Publishers, Boca Raton.
8. BOYER, J. N., J. W. FOURQUREAN, AND R. D. JONES. 1999. Seasonal and long-term trends in water quality of Florida Bay (1989-97). *Estuaries* 22: 417-430.
9. RUDNICK, D., Z. CHEN, D. CHILDERS, T. FONTAINE, AND J. N. BOYER. 1999. Phosphorus and nitrogen inputs to Florida Bay: the importance of the Everglades watershed. *Estuaries* 22: 398-416.
10. PENNOCK, J. R., J. N. BOYER, J. A. HERERRA-SILVIERA, R. L. IVERSON, T. E. WHITLEDGE, B. MORTAZAVI, AND F. A. COMIN. 1999. Nutrient behavior and pelagic processes, p. 109-162. *In* T. S. Bianchi, J. R. Pennock, and R. R. Twilley (eds.), Biogeochemistry of Gulf of Mexico Estuaries. Wiley, New York.
11. BOYER, J. N., J. W. FOURQUREAN, AND R. D. JONES. 1997. Spatial characterization of water quality in Florida Bay and Whitewater Bay by principal component and cluster analyses: Zones of similar influence (ZSI). *Estuaries* 20:743-758.

8. PRESENTATIONS AND ABSTRACTS IN 1999

1. Boyer, J. N. and R. D. Jones 1999. Relative influence of Florida Bay on the water quality of the Florida Keys National Marine Sanctuary. 1999 Florida Bay Science Conference, Key Largo.
2. Boyer, J. N. et al. 2000. What we already know about the water quality of the Florida Coastal Everglades LTER. NSF-LTER all scientists meeting, Snowbird, UT.
3. Childers, D. L., J. Boyer, J. Fourqurean, R. Jaffe, R. Jones, J. Trexler W. Anderson, R. Chambers, D. Genereaux, E. Gaiser, C. McIvor, J. Meeder, J. Richards L. Scinto, F. Sklar, and R. Twilley. 2000. Regional Controls of Population and Ecosystem Dynamics in an Oligotrophic Wetland-dominated Coastal Landscape - Introducing a New LTER in the Coastal Everglades. International Association of Landscape Ecologists, Ft. Lauderdale.
4. Lu, X., J. N. Boyer, and R. Jaffe. 2000. Source characterization of DOM in southwest Florida estuaries by UV-Visible and fluorescence analysis. South Florida ACS Meeting, Orlando.
5. Fourqurean, J., and J. N. Boyer. 2000. Seagrass species react independently to water quality in South Florida. ASLO, Orlando.
6. Boyer, J. N., and R. D. Jones. 1999. An ecotone of estuaries? Influence of watershed characteristics on the mangrove estuaries in southwest Florida. ERF, New Orleans, LA.
7. BOYER, J. N., AND R. D. JONES. 1998. A view from the bridge: the influence of Biscayne Bay, Florida Bay, and the Southwest Shelf on the reefs in the Florida Keys National Marine Sanctuary. ASLO/ESA, St. Louis, MO.
8. FOURQUREAN, J. W., M. J. DURAKO, J. C. ZIEMAN, AND J. N. BOYER. 1998. Seagrass beds respond to the magnitude and location of nutrient sources in the south florida hydroscape. ASLO/ESA, St. Louis, MO.
9. BOYER, J. N., AND R. D. JONES. 1998. Influence of coastal geomorphology and watershed characteristics on the water quality of mangrove estuaries in the Ten Thousand Islands - Whitewater Bay complex, Florida. Florida Bay Science Conference, Miami, FL.
10. JONES, R. D., AND J. N. BOYER. 1998. An overview of water quality in Florida Bay and surrounding waters: current status and trends. Florida Bay Science Conference, Miami, FL.
11. BOYER, J. N., J. W. FOURQUREAN, AND R. D. JONES. 1997. Temporal trends in water chemistry of Florida Bay (1989-1995): Influence of water management activities. ASLO Aquatic Sciences Meeting, Santa Fe, NM.
12. BOYER, J. N. AND R. D. JONES. 1996. The Florida Bay water quality monitoring program: assessing status and trends. Florida Bay Science Conference - Key Largo, FL.
13. BOYER, J. N., J. W. FOURQUREAN, AND R. D. JONES. 1995. Spatial analysis of long term water quality data from Florida Bay. Estuarine Research Federation - Corpus Christi, TX.

9. TABLES

9.1. List of fixed station location and sampling period of record.

9.2. Statistical summary of Florida Bay water quality variables by zone.

9.3. Statistical summary of Whitewater Bay-Ten Thousand Islands water quality by zone.

9.4. Statistical summary of Biscayne Bay water quality variables by zone.

9.5. Statistical summary of Southwest Florida Shelf water quality variables by zone.

9.6. Statistical summary of Cape Romano-Pine Island Sound water quality variables by zone.

Table 9.1. List of fixed station location and sampling period of record.

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Card Sound Bridge	1	FB	25 16.413	-80 22.475	Mar 91 - Dec 99	1-106
Middle Key	2	FB	25 17.102	-80 23.702	Mar 91 - Dec 99	1-106
Manatee Bay	3	FB	25 15.062	-80 24.910	Mar 91 - Dec 99	1-106
Barnes Sound	4	FB	25 13.304	-80 23.299	Mar 91 - Dec 99	1-106
Blackwater Sound	5	FB	25 10.443	-80 25.385	Mar 91 - Dec 99	1-106
Little Blackwater Sound	6	FB	25 12.401	-80 26.424	Mar 91 - Dec 99	1-106
Highway Creek	7	FB	25 15.216	-80 26.649	Mar 91 - Dec 99	1-106
Long Sound	8	FB	25 13.642	-80 27.700	Mar 91 - Dec 99	1-106
Duck Key	9	FB	25 10.624	-80 29.494	Mar 91 - Dec 99	1-106
Joe Bay	10	FB	25 13.468	-80 32.195	Mar 91 - Dec 99	1-106
Little Madeira Bay	11	FB	25 10.510	-80 37.615	Mar 91 - Dec 99	1-106
Terrapin Bay	12	FB	25 08.422	-80 42.967	Mar 91 - Dec 99	1-106
Whipray Basin	13	FB	25 05.485	-80 45.287	Mar 91 - Dec 99	1-106
Garfield Bight	14	FB	25 09.029	-80 48.553	Apr 91 - Dec 99	2-106
Rankin Lake	15	FB	25 07.283	-80 48.173	Mar 91 - Dec 99	1-106
Murray Key	16	FB	25 07.096	-80 56.379	Mar 91 - Dec 99	1-106
Johnson Key Basin	17	FB	25 02.548	-80 54.889	Mar 91 - Dec 99	1-106
Rabbit Key Basin	18	FB	25 00.145	-80 54.006	Mar 91 - Dec 99	1-106
Twin Key Basin	19	FB	24 58.660	-80 45.211	Apr 91 - Dec 99	2-106
Peterson Keys	20	FB	24 55.770	-80 45.028	Mar 91 - Dec 99	1-106
Porpoise Lake	21	FB	25 00.396	-80 40.876	Mar 91 - Dec 99	1-106
Captain Key	22	FB	25 02.405	-80 36.843	Apr 91 - Dec 99	2-106
Park Key	23	FB	25 07.078	-80 35.983	Apr 91 - Dec 99	2-106
Butternut Key	24	FB	25 06.105	-80 31.884	Mar 91 - Dec 99	1-106
East Cape	25	FB	25 05.022	-81 04.835	July 92 - Dec 99	17-106
Oxfoot Bank	26	FB	24 58.844	-81 00.098	July 92 - Dec 99	17-106
Sprigger Bank	27	FB	24 55.116	-80 56.092	July 92 - Dec 99	17-106
Old Dan Bank	28	FB	24 52.032	-80 48.429	July 92 - Dec 99	17-106
First Bay	29	WWB	25 33.272	-81 11.020	Sept 92 - Dec 99	19-106
Third Bay	30	WWB	25 34.810	-81 07.256	Sept 92 - Dec 99	19-106
Big Lostmans Bay	31	WWB	25 34.055	-81 04.288	Sept 92 - Dec 99	19-106
Cabbage Island	32	WWB	25 31.764	-81 02.603	Sept 92 - Dec 99	19-106
Broad River Bay	33	WWB	25 29.984	-81 02.939	Sept 92 - Dec 99	19-106
Middle Broad River	34	WWB	25 29.163	-81 06.669	Sept 92 - Dec 99	19-106
Broad River Mouth	35	WWB	25 28.501	-81 09.176	Sept 92 - Dec 99	19-106
Harney River Mouth	36	WWB	25 24.701	-81 08.487	Sept 92 - Dec 99	19-106
Harney Rivers Junction	37	WWB	25 25.901	-81 04.943	Sept 92 - Dec 99	19-106
Tarpon Bay	38	WWB	25 25.037	-80 59.906	Sept 92 - Dec 99	19-106
Gunboat Island	39	WWB	25 22.735	-81 01.844	Sept 92 - Dec 99	19-106
Ponce de Leon Bay	40	WWB	25 20.983	-81 07.474	Sept 92 - Dec 99	19-106
Oyster Bay	41	WWB	25 19.869	-81 04.360	Sept 92 - Dec 99	19-106
North Marker 36	42	WWB	25 19.560	-81 00.873	Sept 92 - Dec 99	19-106
West Marker 34	43	WWB	25 17.168	-81 01.419	Sept 92 - Dec 99	19-106
Watson River Chickee	44	WWB	25 19.912	-80 59.022	Sept 92 - Dec 99	19-106
North River Mouth	45	WWB	25 18.054	-80 57.620	Sept 92 - Dec 99	19-106
Midway Keys	46	WWB	25 17.102	-80 58.548	Sept 92 - Dec 99	19-106
Roberts River Mouth	47	WWB	25 16.779	-80 55.846	Sept 92 - Dec 99	19-106
West Marker 18	48	WWB	25 14.448	-80 57.476	Sept 92 - Dec 99	19-106

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Southeast Marker 12	49	WWB	25 13.704	-80 55.980	Sept 92 - Dec 99	19-106
Coot Bay	50	WWB	25 11.452	-80 54.848	Sept 92 - Dec 99	19-106
Chokoloskee	51	TTI	25 48.450	-81 20.970	Sept 94 - Dec 99	43-106
Rabbit Key Pass	52	TTI	25 46.200	-81 23.000	Sept 94 - Dec 99	43-106
Lopez Bay	53	TTI	25 47.050	-81 19.930	Sept 94 - Dec 99	43-106
Lopez River	54	TTI	25 47.130	-81 18.550	Sept 94 - Dec 99	43-106
Sunday Bay	55	TTI	25 47.760	-81 16.800	Sept 94 - Dec 99	43-106
Huston Bay	56	TTI	25 45.180	-81 15.330	Sept 94 - Dec 99	43-106
Upper Chatham River	57	TTI	25 43.050	-81 13.830	Sept 94 - Dec 99	43-106
Watson Place	58	TTI	25 42.470	-81 15.130	Sept 94 - Dec 99	43-106
Gun Rock Point	59	TTI	25 41.500	-81 17.920	Sept 94 - Dec 99	43-106
Huston River	60	TTI	25 43.880	-81 17.080	Sept 94 - Dec 99	43-106
Chevalier Bay	61	TTI	25 42.750	-81 12.420	Sept 94 - Dec 99	43-106
Alligator Bay	62	TTI	25 40.210	-81 10.120	Sept 94 - Dec 99	43-106
Lostmans Five Bay	63	TTI	25 38.000	-81 08.700	Sept 94 - Dec 99	43-106
Barron River	64	TTI	25 51.196	-81 23.602	Sept 94 - Dec 99	43-106
Indian Key Pass	65	TTI	25 49.631	-81 26.465	Sept 94 - Dec 99	43-106
Indian Key	66	TTI	25 48.290	-81 27.750	Sept 94 - Dec 99	43-106
West Pass	67	TTI	25 49.820	-81 30.170	Sept 94 - Dec 99	43-106
Panther Key	68	TTI	25 50.960	-81 32.530	Sept 94 - Dec 99	43-106
Faka Union Pass	69	TTI	25 52.450	-81 30.960	Sept 94 - Dec 99	43-106
Faka Union Bay	70	TTI	25 54.000	-81 30.960	Sept 94 - Dec 99	43-106
White Horse Key	71	TTI	25 52.007	-81 34.489	Sept 94 - Dec 99	43-106
Dismal Key	72	TTI	25 53.668	-81 33.532	Sept 94 - Dec 99	43-106
Long Rock	73	TTI	25 52.920	-81 36.380	Sept 94 - Dec 99	43-106
Shell Key	74	TTI	25 54.670	-81 36.920	Sept 94 - Dec 99	43-106
Blackwater River	75	TTI	25 55.788	-81 36.019	Sept 94 - Dec 99	43-106
Convoy Point	101	BB	25 28.700	-80 19.250	Sept 93 - Dec 99	31-106
Black Point	102	BB	25 32.750	-80 17.680	Sept 93 - Dec 99	31-106
Near Black Ledge	103	BB	25 34.400	-80 17.200	Sept 93 - Dec 99	31-106
BNP Marker C	104	BB	25 36.100	-80 13.250	Sept 93 - Dec 99	31-106
Biscayne Channel	105	BB	25 39.252	-80 11.202	Sept 93 - May 96	31-63
White Marker	106	BB	25 38.052	-80 07.800	Sept 93 - May 96	31-63
Fowey Rocks	107	BB	25 35.400	-80 06.000	Sept 93 - May 96	31-63
Marker G-1B	108	BB	25 34.150	-80 11.550	Sept 93 - Dec 99	31-106
North Midbay	109	BB	25 33.850	-80 14.100	Sept 93 - Dec 99	31-106
Fender Point	110	BB	25 30.300	-80 17.250	Sept 93 - Dec 99	31-106
Featherbed Bank	111	BB	25 30.950	-80 14.400	Sept 93 - Dec 99	31-106
Sands Cut	112	BB	25 29.300	-80 11.300	Sept 93 - Dec 99	31-106
Elliott Key	113	BB	25 26.500	-80 13.400	Sept 93 - Dec 99	31-106
Caesar Creek	114	BB	25 23.100	-80 11.502	Sept 93 - May 96	31-63
Adams Key	115	BB	25 24.252	-80 14.448	Sept 93 - May 96	31-63
Rubicon Keys	116	BB	25 24.000	-80 15.300	Sept 93 - Dec 99	31-106
Totten Key	117	BB	25 23.100	-80 15.900	Sept 93 - May 96	31-63
Broad Creek	118	BB	25 20.898	-80 15.300	Sept 93 - May 96	31-63
Pumpkin Key	119	BB	25 19.098	-80 18.198	Sept 93 - May 96	31-63
Card Bank, G-17	120	BB	25 18.852	-80 20.598	Sept 93 - May 96	31-63
North Card Sound	121	BB	25 21.300	-80 17.500	Sept 93 - Dec 99	31-106
West Arsenicker	122	BB	25 25.210	-80 18.650	Sept 93 - Dec 99	31-106

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Pelican Bank	123	BB	25 26.700	-80 17.000	Sept 93 - Dec 99	31-106
South Midbay	124	BB	25 28.350	-80 14.000	Sept 93 - Dec 99	31-106
Turkey Point	125	BB	25 28.200	-80 16.998	Sept 93 - May 96	31-63
BNP Marker B	126	BB	25 40.300	-80 12.300	June 96 - Dec 99	64-106
Shoal Point	127	BB	25 37.800	-80 15.000	June 96 - Dec 99	64-106
Matheson Beach	128	BB	25 41.300	-80 14.000	June 96 - Dec 99	64-106
Marker G-71	129	BB	25 44.200	-80 11.100	June 96 - Dec 99	64-106
South Dodge Island	130	BB	25 45.800	-80 10.300	June 96 - Dec 99	64-106
North Venetian Basin	131	BB	25 48.000	-80 10.000	June 96 - Dec 99	64-106
North I-195 Basin	132	BB	25 49.000	-80 10.000	June 96 - Dec 99	64-106
North Normandy Isle	133	BB	25 52.000	-80 09.000	June 96 - Dec 99	64-106
Oleta River Park	134	BB	25 54.300	-80 08.000	June 96 - Dec 99	64-106
South Card Sound	135	BB	25 19.000	-80 19.000	June 96 - Dec 99	64-106
Lower Harbor Keys	351	SHELF	24 41.500	-81 47.500	May 95 - Dec 99	1-18
	352	SHELF	24 46.550	-81 46.980	May 95 - Dec 99	1-18
	353	SHELF	24 51.500	-81 46.600	May 95 - Dec 99	1-18
	354	SHELF	24 56.480	-81 46.120	May 95 - Dec 99	1-18
	355	SHELF	25 01.480	-81 45.750	May 95 - Dec 99	1-18
	356	SHELF	25 06.460	-81 45.230	May 95 - Dec 99	1-18
	357	SHELF	25 11.470	-81 44.720	May 95 - Dec 99	1-18
	358	SHELF	25 16.480	-81 44.290	May 95 - Dec 99	1-18
	359	SHELF	25 21.500	-81 43.800	May 95 - Dec 99	1-18
	360	SHELF	25 26.470	-81 43.260	May 95 - Dec 99	1-18
	361	SHELF	25 31.480	-81 42.900	May 95 - Dec 99	1-18
	362	SHELF	25 36.520	-81 42.400	May 95 - Dec 99	1-18
Off Cape Romano	363	SHELF	25 41.520	-81 41.900	May 95 - Dec 99	1-18
	364	SHELF	25 41.500	-81 32.000	May 95 - Dec 99	1-18
	365	SHELF	25 36.510	-81 32.360	May 95 - Dec 99	1-18
	366	SHELF	25 31.560	-81 32.930	May 95 - Dec 99	1-18
	367	SHELF	25 26.550	-81 33.300	May 95 - Dec 99	1-18
	368	SHELF	25 21.510	-81 33.800	May 95 - Dec 99	1-18
	369	SHELF	25 16.530	-81 34.320	May 95 - Dec 99	1-18
	370	SHELF	25 11.510	-81 34.750	May 95 - Dec 99	1-18
	371	SHELF	25 06.500	-81 35.210	May 95 - Dec 99	1-18
	372	SHELF	25 01.500	-81 35.720	May 95 - Dec 99	1-18
	373	SHELF	24 56.530	-81 36.180	May 95 - Dec 99	1-18
	374	SHELF	24 51.530	-81 36.650	May 95 - Dec 99	1-18
Off Johnson Key	375	SHELF	24 46.540	-81 37.070	May 95 - Dec 99	1-18
Harbor Key Bank	376	SHELF	24 50.600	-81 26.300	May 95 - Dec 99	1-18
	377	SHELF	24 56.100	-81 25.900	May 95 - Dec 99	1-18
	378	SHELF	25 01.000	-81 24.950	May 95 - Dec 99	1-18
	379	SHELF	25 06.000	-81 24.530	May 95 - Dec 99	1-18
	380	SHELF	25 11.000	-81 24.000	May 95 - Dec 99	1-18
	381	SHELF	25 16.000	-81 23.700	May 95 - Dec 99	1-18
	382	SHELF	25 21.000	-81 23.200	May 95 - Dec 99	1-18
	383	SHELF	25 25.950	-81 22.670	May 95 - Dec 99	1-18
	384	SHELF	25 30.930	-81 22.200	May 95 - Dec 99	1-18
	385	SHELF	25 36.010	-81 21.790	May 95 - Dec 99	1-18
	386	SHELF	25 33.330	-81 20.430	May 95 - Dec 99	1-18

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
	387	SHELF	25 30.530	-81 19.010	May 95 - Dec 99	1-18
	388	SHELF	25 25.500	-81 17.820	May 95 - Dec 99	1-18
	389	SHELF	25 20.500	-81 16.620	May 95 - Dec 99	1-18
	390	SHELF	25 15.600	-81 15.610	May 95 - Dec 99	1-18
	391	SHELF	25 10.500	-81 14.320	May 95 - Dec 99	1-18
	392	SHELF	25 05.500	-81 14.900	May 95 - Dec 99	1-18
	393	SHELF	25 00.500	-81 15.200	May 95 - Dec 99	1-18
	394	SHELF	24 55.500	-81 15.600	May 95 - Dec 99	1-18
Off Bluefish Bank	395	SHELF	24 52.700	-81 11.500	May 95 - Dec 99	1-18
Off Bullard Bank	396	SHELF	24 50.000	-81 07.700	May 95 - Dec 99	1-18
	397	SHELF	24 55.000	-81 07.100	May 95 - Dec 99	1-18
	398	SHELF	25 00.000	-81 06.600	May 95 - Dec 99	1-18
Off East Cape	399	SHELF	25 05.000	-81 05.960	May 95 - Dec 99	1-18
Coon Key Pass, G3	451	ROOK	25 54.626	-81 38.309	Jan 99 - Dec 99	97-106
Coon Key Light	452	ROOK	25 52.918	-81 37.954	Jan 99 - Dec 99	97-106
Fred Key, G5	453	ROOK	25 53.978	-81 41.027	Jan 99 - Dec 99	97-106
Caxambas Pass, R4	454	ROOK	25 54.360	-81 43.733	Jan 99 - Dec 99	97-106
Capri Pass, R2A	455	ROOK	25 59.285	-81 43.740	Jan 99 - Dec 99	97-106
Rt. 951 Bridge, R26	456	ROOK	25 57.737	-81 42.524	Jan 99 - Dec 99	97-106
Big Marco River, R24	457	ROOK	25 57.122	-81 41.243	Jan 99 - Dec 99	97-106
Goodland Bridge, G15	458	ROOK	25 56.080	-81 39.204	Jan 99 - Dec 99	97-106
Johnson Bay	459	ROOK	25 59.291	-81 43.748	Jan 99 - Dec 99	97-106
Hall Bay	460	ROOK	26 00.941	-81 44.566	Jan 99 - Dec 99	97-106
Rookery Bay	461	ROOK	26 01.755	-81 44.888	Jan 99 - Dec 99	97-106
First National	462	ROOK	26 02.441	-81 45.955	Jan 99 - Dec 99	97-106
Keywaydin Channel, G55	463	ROOK	26 03.611	-81 46.713	Jan 99 - Dec 99	97-106
Dollar Bay, G73	464	ROOK	26 06.000	-81 47.213	Jan 99 - Dec 99	97-106
Outer Gordon Pass, G1	465	ROOK	26 05.480	-81 48.686	Jan 99 - Dec 99	97-106
New Pass	466	ROOK	26 22.692	-81 51.508	Jan 99 - Dec 99	97-106
Wiggins Pass Bridge	467	ROOK	26 17.441	-81 49.105	Jan 99 - Dec 99	97-106
Big Carlos Pass Bridge	468	ROOK	26 24.146	-81 52.850	Jan 99 - Dec 99	97-106
Coon Key, R2A	469	ROOK	26 25.422	-81 52.400	Jan 99 - Dec 99	97-106
Central Estero Bay, R2	470	ROOK	26 24.459	-81 51.885	Jan 99 - Dec 99	97-106
Point Ybel, R8	471	ROOK	26 27.492	-82 00.444	Jan 99 - Dec 99	97-106
San Carlos Bay, R4	472	ROOK	26 28.013	-82 02.723	Jan 99 - Dec 99	97-106
Kitchel Key, G13	473	ROOK	26 30.070	-82 00.789	Jan 99 - Dec 99	97-106
Shell Point	474	ROOK	26 31.368	-82 00.417	Jan 99 - Dec 99	97-106
Reckems Point	475	ROOK	26 32.108	-82 03.548	Jan 99 - Dec 99	97-106
Sanibel	476	ROOK	26 30.472	-82 09.113	Jan 99 - Dec 99	97-106
Pine Island Sound	477	ROOK	26 33.702	-82 09.934	Jan 99 - Dec 99	97-106
Cayo Costa	478	ROOK	26 38.150	-82 12.517	Jan 99 - Dec 99	97-106

Table 9.2. Statistical summary of Florida Bay water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase	All	0.39	0.01	6.44	2874
Activity (μM hr^{-1})	FBC	1.70	0.13	6.44	436
	FBE	0.37	0.01	6.11	1823
	FBW	0.21	0.01	4.93	615
Chlorophyll *a*	All	0.91	0.04	35.61	2964
(μg l^{-1})	FBC	2.00	0.19	35.61	446
	FBE	0.64	0.04	11.35	1876
	FBW	1.66	0.18	22.08	642
Surface	All	6.6	0.4	12.3	3012
Dissolved Oxygen	FBC	6.3	2.8	12.3	453
(mg l^{-1})	FBE	6.7	0.4	11.7	1898
	FBW	6.3	3.0	11.5	661
Bottom	All	6.5	1.4	13.4	2793
Dissolved Oxygen	FBC	6.3	1.5	12.2	422
(mg l^{-1})	FBE	6.6	1.4	13.4	1783
	FBW	6.2	3.0	11.1	588
Ammonium	All	0.035	0.000	1.681	2944
(ppm)	FBC	0.068	0.000	1.681	439
	FBE	0.044	0.000	1.149	1869
	FBW	0.013	0.000	0.342	636
Nitrite	All	0.003	0.000	0.111	2949
(ppm)	FBC	0.002	0.000	0.111	443
	FBE	0.003	0.000	0.037	1870
	FBW	0.002	0.000	0.025	636
Nitrate	All	0.005	0.000	0.154	2932
(ppm)	FBC	0.003	0.000	0.080	441
	FBE	0.008	0.000	0.154	1860
	FBW	0.002	0.000	0.101	631
Surface Salinity	All	31.80	0.20	63.00	3043
(ppt)	FBC	33.15	8.70	63.00	458
	FBE	28.80	0.20	54.30	1916
	FBW	34.90	16.50	52.00	669
Bottom Salinity	All	31.00	0.20	63.00	2755
(ppt)	FBC	32.35	11.90	63.00	418
	FBE	28.30	0.20	54.30	1749
	FBW	34.50	16.60	51.00	588
Silicate	All	0.453	0.001	4.060	432
(ppm)	FBC	1.210	0.002	4.060	64
	FBE	0.366	0.001	3.426	272
	FBW	0.419	0.004	2.932	96
Soluble Reactive	All	0.001	0.000	0.026	2932
Phosphorus (ppm)	FBC	0.001	0.000	0.026	441
	FBE	0.001	0.000	0.016	1861
	FBW	0.001	0.000	0.012	630

Variable	Zone	Median	Min.	Max.	*n*
Surface Temperature	All	26.6	16.0	35.3	3042
(^{o}C)	FBC	26.6	16.2	35.3	458
	FBE	26.7	16.0	33.5	1915
	FBW	26.5	17.6	34.7	669
Bottom Temperature	All	26.5	1.8	35.3	2813
(^{o}C)	FBC	26.5	16.2	35.3	426
	FBE	26.6	1.8	33.9	1793
	FBW	26.3	17.6	34.7	594
Total Organic	All	8.196	0.000	58.043	2921
Carbon (ppm)	FBC	13.655	4.518	42.872	436
	FBE	8.385	0.000	58.043	1860
	FBW	4.944	1.199	20.216	625
Total Organic	All	0.593	0.048	4.355	2926
Nitrogen (ppm)	FBC	1.026	0.151	4.355	437
	FBE	0.604	0.048	3.098	1859
	FBW	0.373	0.095	1.680	630
Total Phosphorus	All	0.010	0.001	0.131	2951
(ppm)	FBC	0.019	0.004	0.131	442
	FBE	0.008	0.001	0.070	1871
	FBW	0.015	0.002	0.127	638
Turbidity	All	3.64	0.01	178.55	2819
(NTU)	FBC	6.95	0.15	134.85	427
	FBE	2.40	0.01	172.95	1799
	FBW	6.80	0.07	178.55	593

Table 9.3. Statistical summary of Whitewater Bay-Ten Thousand Islands water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase	All	0.15	0.00	6.00	3483
Activity (μM hr^{-1})	BLK	0.04	0.02	0.28	125
	COOT	1.74	0.08	6.00	86
	GI	0.04	0.00	3.23	804
	IW	0.12	0.00	3.53	690
	MR	0.21	0.00	3.70	1082
	WWB	1.14	0.02	5.96	696
Chlorophyll *a*	All	2.88	0.12	45.11	3483
(μg l^{-1})	BLK	3.33	0.25	17.02	126
	COOT	6.88	1.21	27.77	86
	GI	2.65	0.12	23.78	804
	IW	3.65	0.20	45.11	690
	MR	2.59	0.19	28.76	1082
	WWB	2.73	0.33	23.03	695
Surface	All	5.9	0.3	13.9	3485
Dissolved Oxygen	BLK	5.6	1.8	10.3	126
(mg l^{-1})	COOT	7.1	0.3	10.1	87
	GI	5.8	2.9	12.1	804
	IW	5.9	1.8	11.8	690
	MR	5.1	0.8	13.9	1082
	WWB	6.9	2.2	11.1	696
Bottom	All	5.8	0.0	12.3	3485
Dissolved Oxygen	BLK	5.5	1.9	9.8	126
(mg l^{-1})	COOT	6.8	0.0	10.2	87
	GI	5.8	2.2	11.8	804
	IW	5.8	1.2	11.9	690
	MR	5.0	0.7	12.3	1082
	WWB	6.8	0.4	11.1	696
Ammonium	All	0.015	0.000	1.046	3485
(ppm)	BLK	0.022	0.001	0.189	126
	COOT	0.021	0.003	1.046	87
	GI	0.012	0.000	0.165	804
	IW	0.018	0.001	0.285	690
	MR	0.017	0.000	0.402	1082
	WWB	0.012	0.000	0.301	696
Nitrite	All	0.003	0.000	0.139	3485
(ppm)	BLK	0.003	0.000	0.017	126
	COOT	0.003	0.001	0.139	87
	GI	0.002	0.000	0.015	804
	IW	0.003	0.000	0.036	690
	MR	0.003	0.000	0.012	1082
	WWB	0.002	0.000	0.086	696

Variable	Zone	Median	Min.	Max.	*n*
Nitrate (ppm)	All	0.010	0.000	0.268	3485
	BLK	0.008	0.000	0.080	126
	COOT	0.005	0.000	0.238	87
	GI	0.007	0.000	0.135	804
	IW	0.011	0.000	0.133	690
	MR	0.015	0.000	0.142	1082
	WWB	0.005	0.000	0.268	696
Surface Salinity (ppt)	All	13.5	0.0	38.5	3483
	BLK	30.7	1.4	37.5	126
	COOT	10.7	4.4	25.9	87
	GI	27.2	1.3	38.5	804
	IW	10.2	0.1	37.9	690
	MR	3.7	0.0	38.5	1080
	WWB	10.1	0.3	33.1	696
Bottom Salinity (ppt)	All	15.0	0.0	38.5	3483
	BLK	30.9	1.4	37.5	126
	COOT	10.8	4.2	26.5	87
	GI	27.8	1.0	38.3	804
	IW	11.4	0.2	37.9	690
	MR	4.7	0.0	38.5	1080
	WWB	10.3	0.3	33.6	696
Silicate (ppm)	All	1.671	0.000	4.880	700
	BLK	1.690	0.000	3.657	28
	COOT	2.847	0.017	4.166	16
	GI	1.508	0.000	4.705	170
	IW	1.776	0.000	4.629	154
	MR	2.032	0.000	4.367	204
	WWB	1.425	0.002	4.880	128
Soluble Reactive Phosphorus (ppm)	All	0.003	0.000	0.066	3484
	BLK	0.020	0.002	0.066	126
	COOT	0.002	0.000	0.023	87
	GI	0.008	0.000	0.044	803
	IW	0.003	0.000	0.036	690
	MR	0.002	0.000	0.034	1082
	WWB	0.002	0.000	0.026	696
Surface Temperature (^{o}C)	All	26.8	12.5	35.0	3485
	BLK	27.5	18.1	33.3	126
	COOT	27.0	14.5	35.0	87
	GI	27.0	15.0	33.3	804
	IW	27.1	15.2	33.9	690
	MR	26.5	13.6	34.4	1082
	WWB	26.6	12.5	34.2	696

Variable	Zone	Median	Min.	Max.	*n*
Bottom Temperature (^oC)	All	26.7	11.8	33.9	3485
	BLK	27.3	18.1	33.8	126
	COOT	27.2	14.5	33.9	87
	GI	26.9	15.0	33.3	804
	IW	27.0	15.2	33.3	690
	MR	26.5	13.6	33.3	1082
	WWB	26.3	11.8	33.5	696
Total Organic Carbon (ppm)	All	12.090	3.805	64.008	3483
	BLK	7.258	3.805	21.385	125
	COOT	23.602	16.260	39.632	86
	GI	7.227	3.808	27.170	804
	IW	11.503	5.187	22.403	690
	MR	13.686	5.579	64.008	1082
	WWB	16.154	6.143	31.680	696
Total Organic Nitrogen (ppm)	All	0.645	0.108	2.989	3483
	BLK	0.386	0.210	0.937	125
	COOT	1.283	0.300	2.120	86
	GI	0.415	0.108	1.748	804
	IW	0.628	0.150	1.566	690
	MR	0.721	0.131	2.989	1082
	WWB	0.860	0.268	2.535	696
Total Phosphorus (ppm)	All	0.027	0.003	0.112	3478
	BLK	0.055	0.005	0.098	124
	COOT	0.037	0.017	0.101	86
	GI	0.034	0.004	0.112	801
	IW	0.031	0.006	0.092	690
	MR	0.022	0.006	0.092	1081
	WWB	0.018	0.003	0.094	696
Turbidity (NTU)	All	4.25	0.06	107.81	3483
	BLK	7.70	1.84	40.50	125
	COOT	6.68	1.39	94.15	86
	GI	5.47	0.55	68.00	804
	IW	4.65	0.06	43.60	690
	MR	2.77	0.17	47.65	1082
	WWB	3.90	0.21	107.81	696

Table 9.4. Statistical summary of Biscayne Bay water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (µM hr^{-1})	All	0.125	0.008	3.209	1870
	AS	0.330	0.093	3.209	150
	IS	0.197	0.036	2.119	308
	MAIN	0.105	0.008	0.894	890
	NBAY	0.098	0.017	0.902	208
	SCARD	0.135	0.041	0.942	183
Chlorophyll *a* (µg l^{-1})	All	0.28	0.04	9.18	1849
	AS	0.27	0.06	2.46	148
	IS	0.26	0.06	6.37	304
	MAIN	0.23	0.04	5.89	879
	NBAY	0.87	0.18	9.18	205
	SCARD	0.31	0.06	3.61	181
Surface Dissolved Oxygen (mg l^{-1})	All	6.4	2.8	11.6	1870
	AS	7.4	3.1	11.6	148
	IS	6.7	4.0	11.5	308
	MAIN	6.3	2.8	10.2	890
	NBAY	6.1	4.3	10.2	210
	SCARD	6.4	4.0	8.2	183
Bottom Dissolved Oxygen (mg l^{-1})	All	6.5	2.8	12.9	1870
	AS	7.7	3.7	12.9	148
	IS	6.9	3.9	11.8	308
	MAIN	6.4	2.8	10.6	890
	NBAY	6.2	4.2	10.4	210
	SCARD	6.5	3.3	8.8	183
Ammonium (ppm)	All	0.013	0.000	0.228	1875
	AS	0.016	0.002	0.228	150
	IS	0.014	0.001	0.095	309
	MAIN	0.011	0.000	0.083	891
	NBAY	0.017	0.003	0.114	210
	SCARD	0.016	0.002	0.121	183
Nitrite (ppm)	All	0.002	0.000	0.060	1875
	AS	0.004	0.000	0.032	150
	IS	0.002	0.000	0.021	309
	MAIN	0.001	0.000	0.010	891
	NBAY	0.003	0.000	0.060	210
	SCARD	0.002	0.000	0.019	183
Nitrate (ppm)	All	0.007	0.000	1.082	1875
	AS	0.037	0.000	1.082	150
	IS	0.012	0.000	0.672	309
	MAIN	0.004	0.000	0.295	891
	NBAY	0.018	0.000	0.174	210
	SCARD	0.010	0.000	0.129	183

Variable	Zone	Median	Min.	Max.	*n*
Surface Salinity (ppt)	All	33.1	12.3	42.3	1875
	AS	26.3	12.3	42.3	150
	IS	30.1	15.1	42.2	309
	MAIN	34.6	22.5	40.4	891
	NBAY	31.6	19.3	37.9	210
	SCARD	31.7	21.0	39.0	183
Bottom Salinity (ppt)	All	33.8	3.4	42.2	1874
	AS	27.4	12.8	42.2	150
	IS	30.7	3.4	42.2	309
	MAIN	34.8	24.2	40.3	890
	NBAY	33.2	25.2	37.9	210
	SCARD	32.5	20.9	39.0	183
Silicate (ppm)	All	0.070	0.000	1.287	350
	AS	0.232	0.000	0.851	28
	IS	0.093	0.000	0.828	70
	MAIN	0.041	0.000	0.720	154
	NBAY	0.277	0.001	1.287	70
	SCARD	0.040	0.000	0.260	28
Soluble Reactive Phosphorus (ppm)	All	0.000	0.000	0.011	1875
	AS	0.001	0.000	0.007	150
	IS	0.001	0.000	0.011	309
	MAIN	0.000	0.000	0.010	891
	NBAY	0.000	0.000	0.007	210
	SCARD	0.000	0.000	0.008	183
Surface Temperature (^{o}C)	All	26.6	10.2	32.8	1875
	AS	27.1	10.2	32.8	150
	IS	26.6	15.9	32.8	309
	MAIN	26.5	15.5	32.8	891
	NBAY	26.3	16.5	32.5	210
	SCARD	27.0	17.4	32.5	183
Bottom Temperature (^{o}C)	All	26.6	10.3	33.8	1875
	AS	27.1	10.3	32.9	150
	IS	26.6	15.9	32.8	309
	MAIN	26.5	15.6	32.4	891
	NBAY	25.9	16.5	32.9	210
	SCARD	27.3	17.3	33.8	183
Total Organic Carbon (ppm)	All	3.364	0.326	9.330	1874
	AS	4.895	1.379	9.330	150
	IS	4.135	1.463	9.168	308
	MAIN	2.834	0.326	6.522	891
	NBAY	3.904	1.518	8.208	210
	SCARD	4.127	1.968	7.572	183

Variable	Zone	Median	Min.	Max.	*n*
Total Organic Nitrogen (ppm)	All	0.234	0.048	1.229	1874
	AS	0.376	0.091	0.825	150
	IS	0.301	0.081	0.656	308
	MAIN	0.199	0.054	1.010	891
	NBAY	0.229	0.048	0.652	210
	SCARD	0.286	0.068	1.229	183
Total Phosphorus (ppm)	All	0.005	0.001	0.030	1874
	AS	0.006	0.002	0.025	150
	IS	0.005	0.002	0.026	308
	MAIN	0.005	0.001	0.030	891
	NBAY	0.009	0.004	0.020	210
	SCARD	0.006	0.002	0.030	183
Turbidity (NTU)	All	0.69	0.00	50.60	1872
	AS	0.45	0.05	3.52	150
	IS	0.44	0.00	3.75	308
	MAIN	0.80	0.00	19.00	890
	NBAY	1.04	0.15	22.35	210
	SCARD	0.60	0.00	3.80	183

Table 9.5. Statistical summary of Southwest Florida Shelf water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase	All	0.061	0.004	12.017	704
Activity (μM hr^{-1})	SABLE	0.054	0.029	0.503	13
	SHARK	0.045	0.013	0.609	47
	SHLF	0.064	0.004	12.017	644
Chlorophyll *a*	All	0.908	0.000	10.400	882
(μg l^{-1})	SABLE	1.430	0.684	3.560	20
	SHARK	0.855	0.240	3.409	70
	SHLF	0.886	0.000	10.400	792
Surface	All	6.3	3.5	8.3	877
Dissolved Oxygen	SABLE	6.3	5.1	8.3	20
(mg l^{-1})	SHARK	6.3	4.1	7.3	70
	SHLF	6.3	3.5	8.0	787
Bottom	All	6.3	4.3	7.9	181
Dissolved Oxygen	SABLE	6.7	6.3	7.2	4
(mg l^{-1})	SHARK	6.5	6.3	7.1	14
	SHLF	6.1	4.3	7.9	163
Ammonium	All	0.007	0.000	0.129	882
(ppm)	SABLE	0.008	0.003	0.038	20
	SHARK	0.004	0.001	0.023	70
	SHLF	0.007	0.000	0.129	792
Nitrite	All	0.000	0.000	0.008	882
(ppm)	SABLE	0.001	0.000	0.006	20
	SHARK	0.000	0.000	0.001	70
	SHLF	0.000	0.000	0.008	792
Nitrate	All	0.000	0.000	0.078	882
(ppm)	SABLE	0.001	0.000	0.031	20
	SHARK	0.000	0.000	0.010	70
	SHLF	0.000	0.000	0.078	792
Surface Salinity	All	35.1	24.4	38.9	880
(ppt)	SABLE	34.3	26.0	38.9	20
	SHARK	35.5	27.9	37.5	70
	SHLF	35.1	24.4	38.0	790
Bottom Salinity	All	34.9	26.0	36.7	184
(ppt)	SABLE	30.7	26.0	33.7	4
	SHARK	35.2	31.9	35.6	14
	SHLF	34.9	27.8	36.7	166
Silicate	All	0.070	0.000	2.238	779
(ppm)	SABLE	0.539	0.024	1.199	16
	SHARK	0.056	0.000	1.038	55
	SHLF	0.068	0.000	2.238	708
Soluble Reactive	All	0.001	0.000	0.011	882
Phosphorus (ppm)	SABLE	0.001	0.000	0.003	20
	SHARK	0.001	0.000	0.005	70
	SHLF	0.001	0.000	0.011	792

Variable	Zone	Median	Min.	Max.	*n*
Surface Temperature	All	26.8	17.6	32.7	880
(°C)	SABLE	28.1	21.7	31.7	20
	SHARK	28.3	20.9	31.8	70
	SHLF	26.8	17.6	32.7	790
Bottom Temperature	All	28.9	20.9	30.3	184
(°C)	SABLE	25.9	21.9	29.6	4
	SHARK	25.9	20.9	29.5	14
	SHLF	28.9	21.1	30.3	166
Total Organic	All	2.997	1.606	10.790	882
Carbon (ppm)	SABLE	4.195	2.651	5.716	20
	SHARK	2.917	1.606	5.864	70
	SHLF	2.985	1.653	10.790	792
Total Organic	All	0.214	0.043	1.021	873
Nitrogen (ppm)	SABLE	0.289	0.216	0.377	19
	SHARK	0.226	0.154	0.511	70
	SHLF	0.212	0.043	1.021	784
Total Phosphorus	All	0.012	0.000	0.190	882
(ppm)	SABLE	0.013	0.008	0.059	20
	SHARK	0.011	0.006	0.022	70
	SHLF	0.012	0.000	0.190	792
Turbidity	All	2.09	0.00	66.25	784
(NTU)	SABLE	6.28	2.45	66.25	16
	SHARK	2.02	0.30	20.70	56
	SHLF	2.05	0.00	27.45	712

Table 9.6. Statistical summary of Cape Romano-Pine Island Sound water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase	All	0.045	0.015	0.292	334
Activity (μM hr^{-1})	EST	0.049	0.021	0.126	57
	MARC	0.040	0.023	0.292	95
	NPL	0.044	0.022	0.179	36
	PIS	0.048	0.015	0.117	36
	RB	0.044	0.024	0.103	48
	SCB	0.045	0.017	0.130	57
Chlorophyll *a*	All	3.491	0.410	28.471	333
(μg l^{-1})	EST	4.603	0.410	24.682	56
	MARC	3.879	0.448	19.016	95
	NPL	2.437	1.082	13.309	36
	PIS	3.374	1.213	21.764	36
	RB	3.551	1.087	12.562	48
	SCB	2.971	1.057	28.471	57
Surface	All	6.1	2.3	11.5	334
Dissolved Oxygen	EST	6.1	2.9	9.4	57
(mg l^{-1})	MARC	5.9	2.8	9.3	95
	NPL	5.8	2.3	11.5	36
	PIS	6.6	4.2	8.8	36
	RB	5.8	3.0	7.8	48
	SCB	6.2	3.8	11.1	57
Bottom	All	6.0	2.1	11.7	326
Dissolved Oxygen	EST	6.2	4.2	9.1	51
(mg l^{-1})	MARC	5.8	2.8	9.3	95
	NPL	5.8	2.1	11.7	36
	PIS	6.5	4.6	9.1	36
	RB	5.8	2.3	7.7	48
	SCB	6.0	3.6	8.2	57
Ammonium	All	0.010	0.000	0.239	334
(ppm)	EST	0.009	0.001	0.215	57
	MARC	0.009	0.000	0.194	95
	NPL	0.015	0.006	0.170	36
	PIS	0.007	0.000	0.077	36
	RB	0.015	0.002	0.239	48
	SCB	0.012	0.000	0.184	57
Nitrite	All	0.001	0.000	0.013	334
(ppm)	EST	0.001	0.000	0.011	57
	MARC	0.001	0.000	0.010	95
	NPL	0.002	0.000	0.009	36
	PIS	0.001	0.000	0.004	36
	RB	0.001	0.000	0.009	48
	SCB	0.001	0.000	0.013	57

Variable	Zone	Median	Min.	Max.	*n*
Nitrate (ppm)	All	0.002	0.000	0.405	334
	EST	0.002	0.000	0.112	57
	MARC	0.001	0.000	0.029	95
	NPL	0.002	0.000	0.054	36
	PIS	0.001	0.000	0.019	36
	RB	0.003	0.000	0.034	48
	SCB	0.004	0.000	0.405	57
Surface Salinity (ppt)	All	33.5	1.6	39.9	334
	EST	32.7	1.6	36.5	57
	MARC	34.3	21.2	37.4	95
	NPL	34.0	20.1	35.9	36
	PIS	33.7	20.3	36.3	36
	RB	33.8	18.9	39.9	48
	SCB	29.7	3.6	35.2	57
Bottom Salinity (ppt)	All	33.7	3.6	37.4	326
	EST	33.3	10.1	36.5	51
	MARC	34.4	21.9	37.4	95
	NPL	34.3	19.6	35.9	36
	PIS	33.8	25.8	36.1	36
	RB	33.9	20.0	36.5	48
	SCB	31.9	3.6	35.6	57
Silicate (ppm)	All	0.713	0.018	4.175	110
	EST	0.904	0.422	2.637	19
	MARC	0.474	0.018	2.872	31
	NPL	0.677	0.413	1.591	12
	PIS	0.324	0.110	1.156	12
	RB	0.666	0.142	1.859	16
	SCB	0.831	0.076	4.175	19
Soluble Reactive Phosphorus (ppm)	All	0.008	0.000	0.087	334
	EST	0.010	0.001	0.041	57
	MARC	0.006	0.000	0.032	95
	NPL	0.011	0.001	0.039	36
	PIS	0.005	0.001	0.032	36
	RB	0.008	0.000	0.029	48
	SCB	0.014	0.001	0.087	57
Surface Temperature (^{o}C)	All	27.2	18.8	32.7	334
	EST	27.5	20.3	32.7	57
	MARC	27.5	19.1	31.3	95
	NPL	26.7	19.9	31.4	36
	PIS	26.8	19.5	31.5	36
	RB	27.1	18.8	31.7	48
	SCB	27.3	20.2	31.6	57

Variable	Zone	Median	Min.	Max.	*n*
Bottom Temperature (^oC)	All	27.2	18.9	32.7	326
	EST	27.5	20.4	32.7	51
	MARC	27.5	19.1	31.3	95
	NPL	26.6	19.9	31.5	36
	PIS	26.9	19.3	31.5	36
	RB	27.1	18.9	31.7	48
	SCB	27.3	20.1	31.2	57
Total Organic Carbon (ppm)	All	5.041	2.226	19.688	334
	EST	5.474	3.293	16.598	57
	MARC	4.774	3.060	8.851	95
	NPL	4.179	2.226	9.283	36
	PIS	4.514	2.514	9.607	36
	RB	5.463	3.313	10.775	48
	SCB	6.085	3.162	19.688	57
Total Organic Nitrogen (ppm)	All	0.301	0.057	0.832	333
	EST	0.320	0.161	0.653	57
	MARC	0.320	0.142	0.818	95
	NPL	0.252	0.131	0.410	36
	PIS	0.300	0.144	0.646	36
	RB	0.261	0.104	0.500	48
	SCB	0.300	0.057	0.832	56
Total Phosphorus (ppm)	All	0.044	0.000	0.160	334
	EST	0.048	0.022	0.101	57
	MARC	0.042	0.000	0.084	95
	NPL	0.039	0.017	0.099	36
	PIS	0.037	0.014	0.084	36
	RB	0.045	0.020	0.083	48
	SCB	0.050	0.023	0.160	57
Turbidity (NTU)	All	3.80	0.25	38.65	334
	EST	5.17	1.70	15.32	57
	MARC	4.84	1.01	38.65	95
	NPL	2.87	0.25	27.25	36
	PIS	3.18	0.77	12.70	36
	RB	4.40	0.90	35.25	48
	SCB	2.84	0.30	10.09	57