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South Florida Coastal Water Quality Monitoring Network July - Sept. 2007 Quarterly Report for SFWMD Contract 4600000352

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12 May 2008

Michael Wright
SFWMD
Water Quality Analysis Division
1480 Skees Road
West Palm Beach, Florida 33411-2642

Re: South Florida Coastal Water Quality Monitoring Network July – Sept. 2007 Quarterly Report for SFWMD Contract #4600000352

Dear Mr. Wright:

This letter serves to transmit the **REVISED** South Florida Coastal Water Quality Monitoring Network Quarterly Report as per SFWMD Contract #4600000352. This report consists of this letter along with corresponding tables, figures, and data.

1. Activities Performed

This report includes water quality data collected monthly during the annual period of record July – Sept. 2007 from 28 stations in Florida Bay, 22 stations in Whitewater Bay, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, and 28 stations in Cape Romano-Rookery Bay-Pine Island Sound. A total of 49 stations were also collected on the SW Florida Shelf on a quarterly basis. Figure 1 shows the location of the fixed sampling stations.

Water quality parameters monitored at each station include the dissolved nutrients nitrate + nitrite (NO_x), nitrite (NO_2), nitrate (NO_3), ammonium (NH_4), inorganic nitrogen (DIN), and soluble reactive phosphorus (SRP). Silicate (SiO_2) was analyzed at all stations on a quarterly basis in conjunction with SW Shelf sampling. Total concentrations of nitrogen (TN), organic nitrogen (TON), phosphorus (TP), and organic carbon (TOC) were also measured. All concentrations for each of these parameters are reported as parts per million (ppm) except where noted. Phytoplankton biomass was measured using chlorophyll *a* (CHLA, $\mu\text{g l}^{-1}$). Field parameters measured at both surface and bottom of the water column include salinity, dissolved oxygen (DO; mg l^{-1}), and temperature ($^{\circ}\text{C}$). Turbidity (NTU) of the surface water was also measured.

2. Problems Encountered

The following QA report describes any problems in field collection and chemical analysis for this reporting period.

3. Attest to Validity of Data

The Nutrient Analysis Core Lab of the Southeast Environmental Research Center, FIU is focused mainly on water quality nutrients (nitrogen and phosphorus), which are important influences to South Florida's ecosystem. In support of interpreting the nutrient data, the Lab also measures other water quality and physiochemical parameters such as salinity, temperature, turbidity and chlorophyll. The Lab attests to have collected accurate, high quality, and reproducible/verifiable data, which can only be obtained through strict internal and external QA assurance practices. The Nutrient Analysis Core Lab of SERC, FIU views data reliability and validity as critically important in the planning and assessment of its performance. As such, the Lab makes every effort to constantly improve the completeness and reliability of its performance. As a university research facility, SERC is committed to obtaining the most accurate measurements as well as obtaining the lowest possible method detection limits for these nutrients. The QAP plan has been prepared in accordance with the Florida Department of Environmental Protection (FDEP) guidelines and SERC lab is NELAC Certified for non-potable water-General Chemistry under State Lab ID E76930.

4. Water Quality Conditions

A previous spatial analysis of data from Florida Bay resulted in the delineation of 3 groups of stations which have robust similarities in water quality (Fig. 2). 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. Station #7 - Highway Creek did not cluster out with any of the Florida Bay stations and was considered separately.

Using the same statistical approach as above, the TTI-WWB complex was partitioned into 6 distinct zones of similar water quality (Fig. 3). 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.

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); 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. 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).

The above statistical analysis objectively classified the 49 Shelf sampling sites into 3 zones having similar water quality (Fig. 5). The first cluster was composed of only 2 stations which were closest to the shore off Cape Sable; they were called the SHARK group, after the Shark River, the main source of freshwater to the region. The second cluster was made up of the 7 more northerly stations nearest the coast and called SHOAL. The remaining stations were called the SHELF group.

Sampling in the Rookery Bay area began Jan. 1999. Because of the very heterogeneous nature of the area, we will continue to use generally accepted geomorphological characteristics to group the stations (Fig. 6). These groupings are Cocohatchee River (COCO), Estero Bay (EST), Cape Romano-Marco Island (MARC), Naples Bay (NPL), Pine Island Sound (PIS), Rookery Bay (RB), and San Carlos Bay (SCB).

Data are also reported as box-and-whiskers plots (Figs. 7-29). The center horizontal line in the box is the median of the data, the top and bottom of the box are the 25th and 75th percentiles (quartiles), and the ends of the whiskers are the 5th and 95th percentiles.

Summary statistics of all water quality parameters by ecosystem are shown in Table 1. The median was chosen because it is a more accurate measure of central tendency in non-normally distributed water quality data. The range is expressed as the minimum (Min.) and maximum (Max.) values for the POR, and *n* is the number of data points used in the analysis.

Eastern Florida Bay continues to be plagued by a persistent cyanobacterial bloom (Fig.7). Neither TP nor CHLA levels have returned to pre-bloom conditions. We will continue to analyze this and other data in conjunction with other agency scientists in an effort to provide an explanation. Otherwise, normal wet season conditions were observed across the region.

Other Required Files

The following files are included on the quarterly report CD.

- 5. QA Report**
- 6. QA Data**
- 7. Chain Of Custody Scans**
- 8. Field Equipment Calibrations**
- 9. Field Equipment Maintenance**
- 10. ADaPT EDD**

If you have any questions about the content of this report, please do not hesitate to contact me at 305-348-4076 or boyerj@fiu.edu.

Sincerely,



Joseph N. Boyer, Ph.D.
Associate Director and Scientist



Henry O. Briceño, Ph.D.
Assistant Scientist

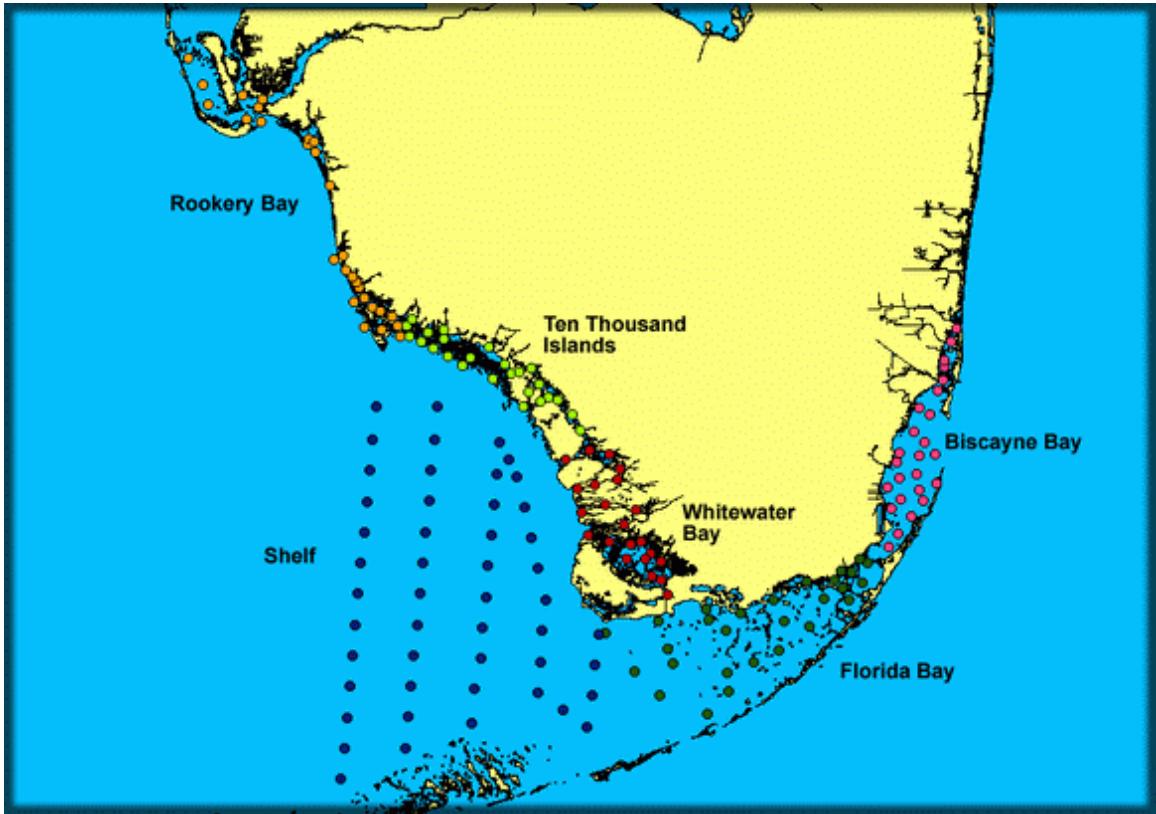
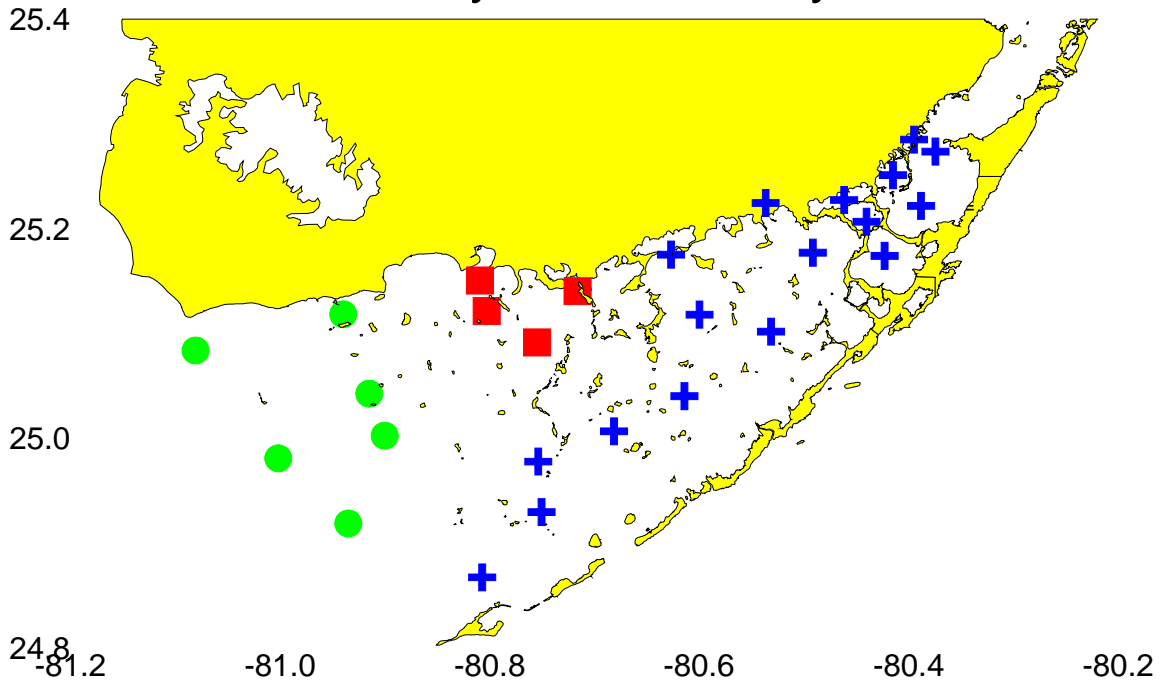


Figure 1: All fixed water quality stations funded by this SFWMD project.

Florida Bay Water Quality Zones



Eastern Bay (+), Central Bay, (■), Western Bay (●)

Figure 2. Florida Bay zones.

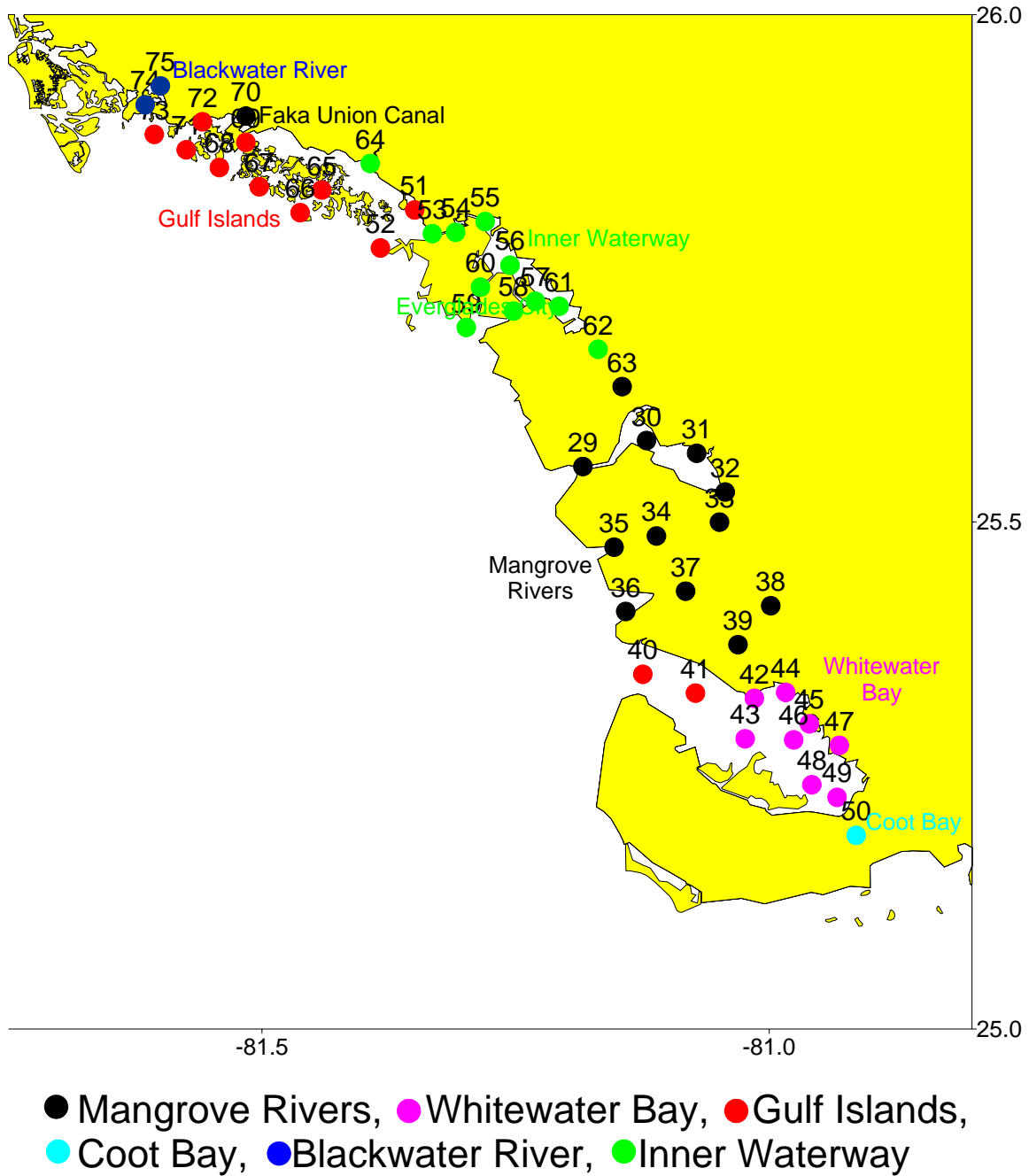


Figure 3. WWB-TTI water quality zones.

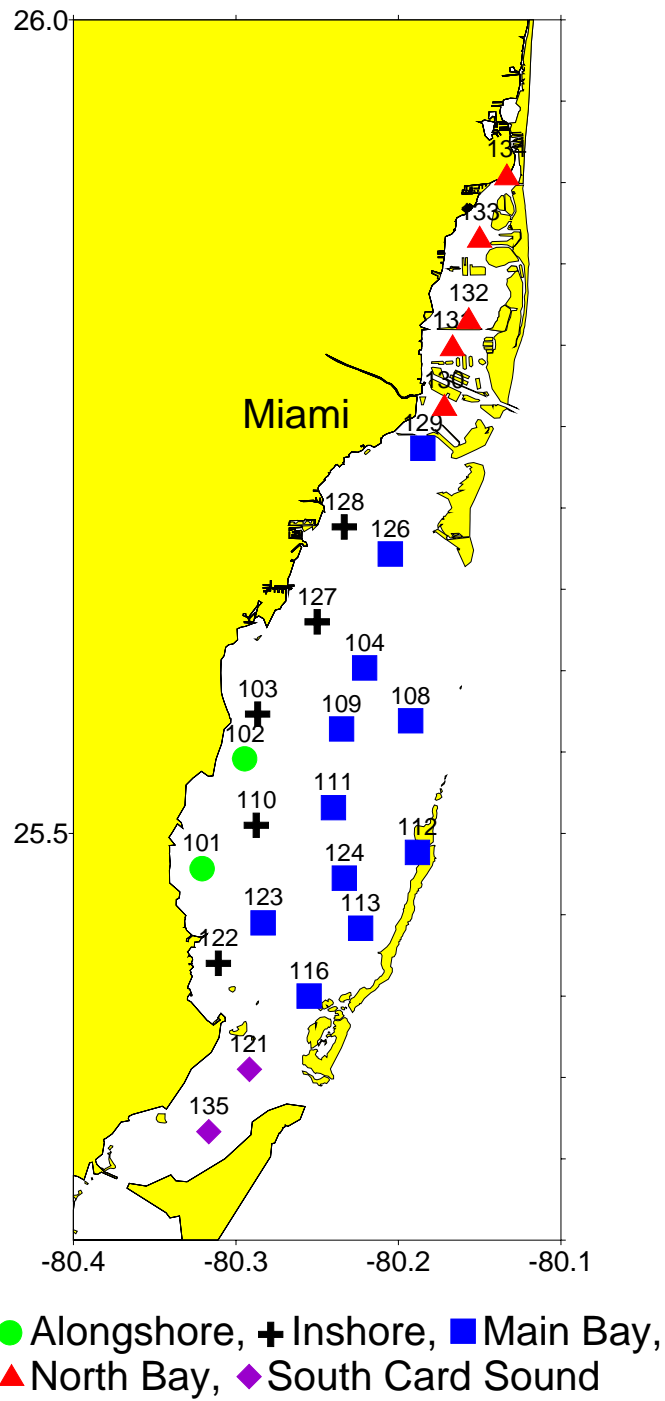


Figure 4. Biscayne Bay water quality zones.

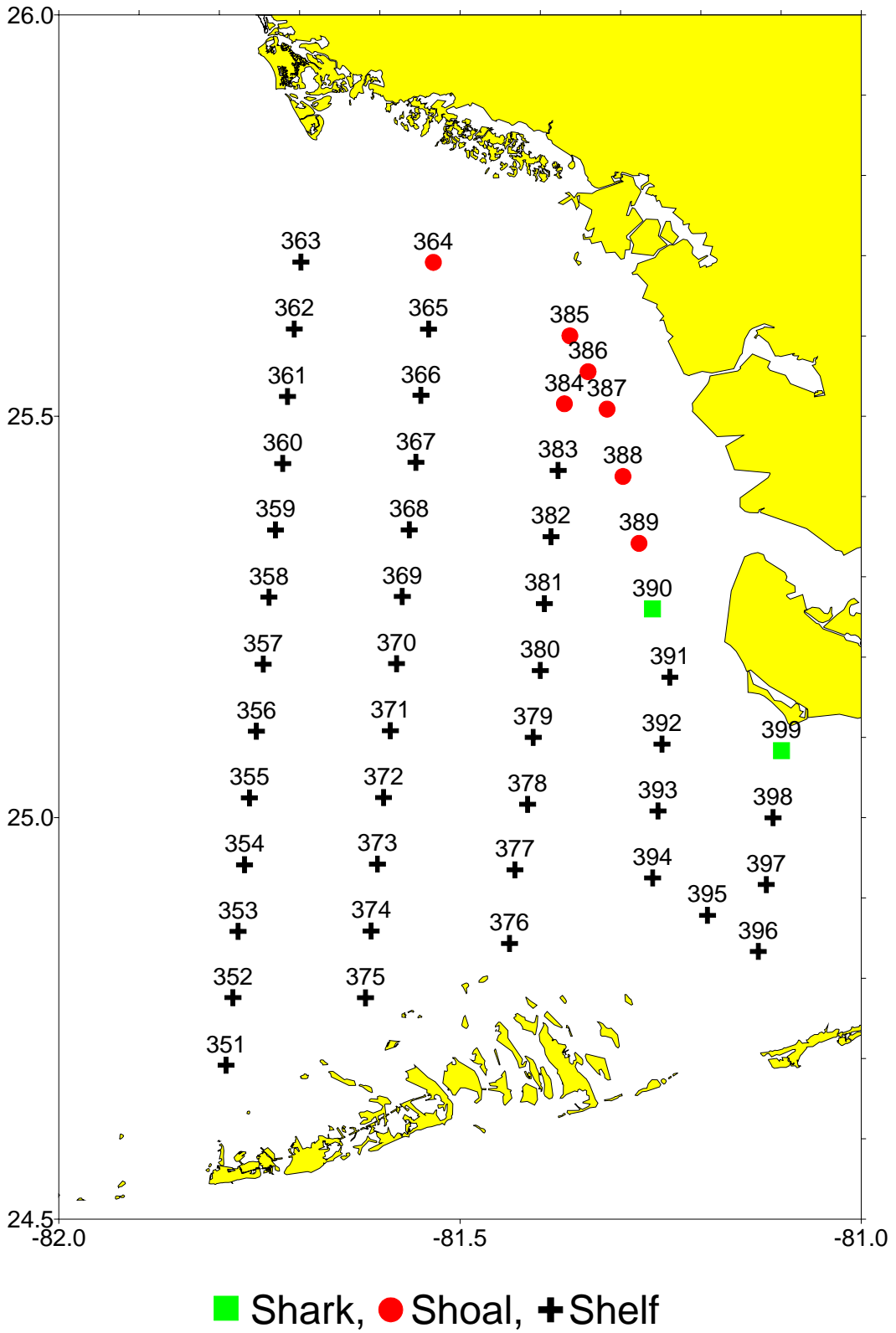


Figure 5. SW Florida Shelf water quality zones.

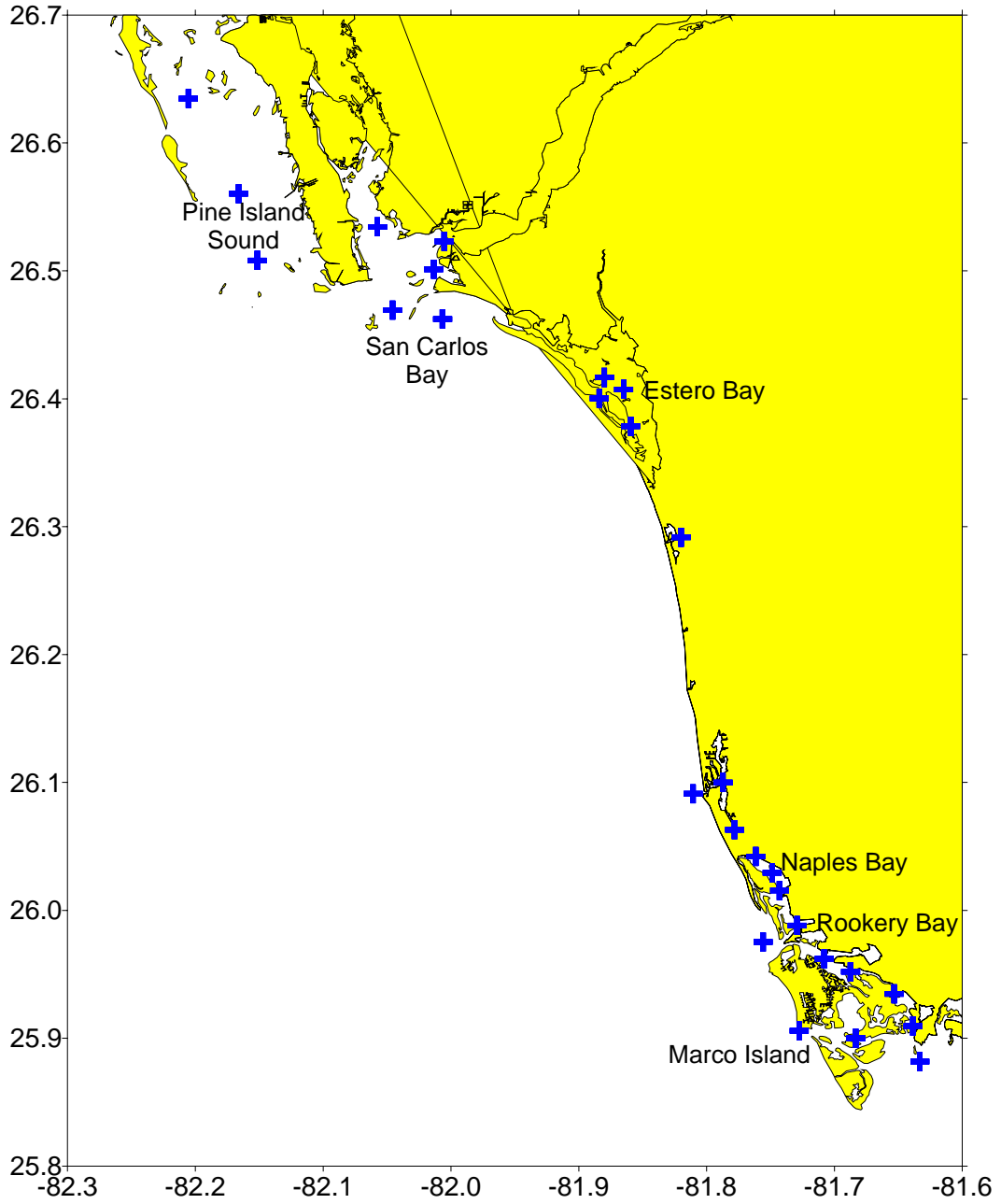


Figure 6. SW estuaries.

Eastern Florida Bay Zone

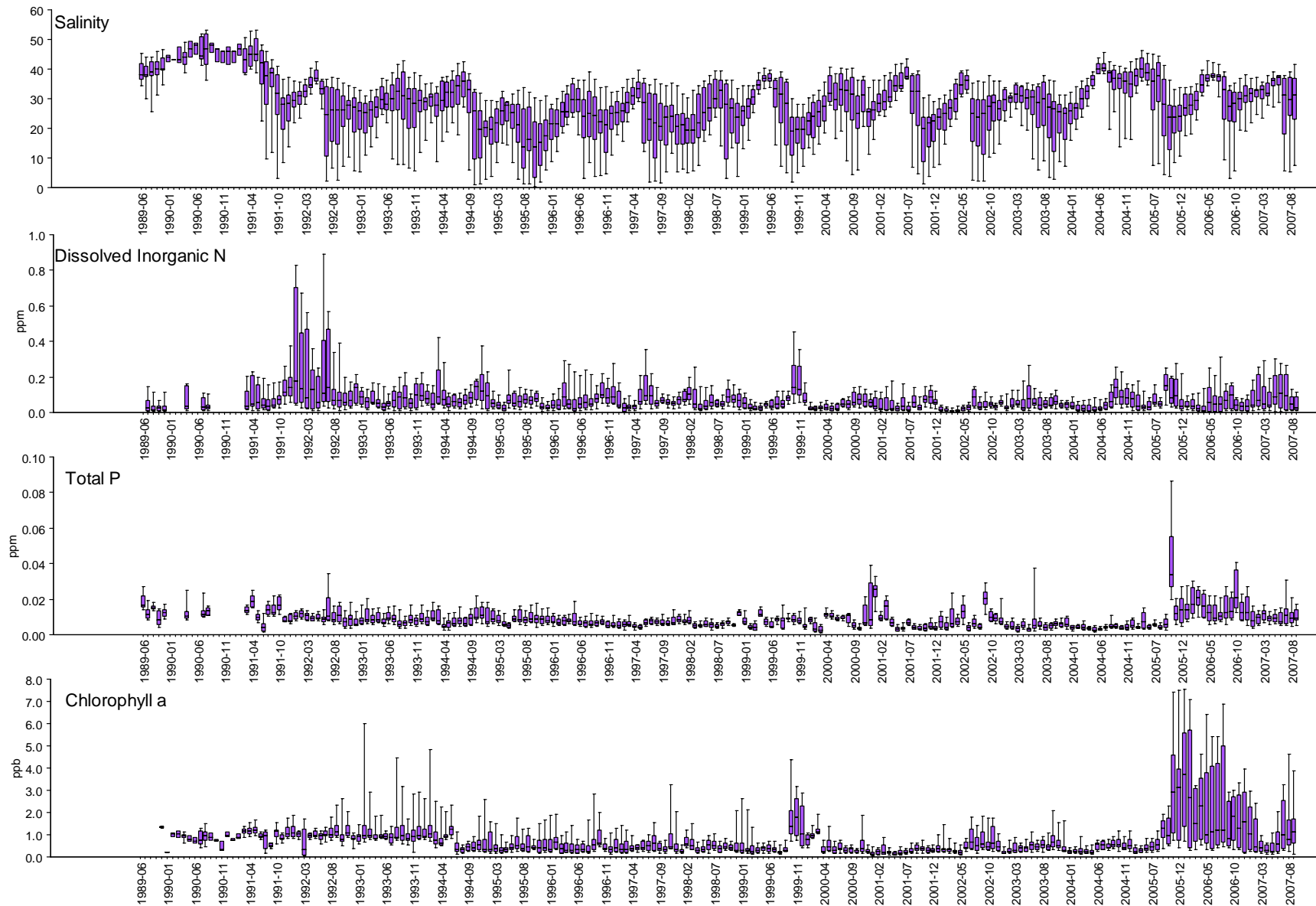


Figure 7. Box-and-whisker plots of water quality in Eastern Florida Bay by survey.

Central Florida Bay Zone

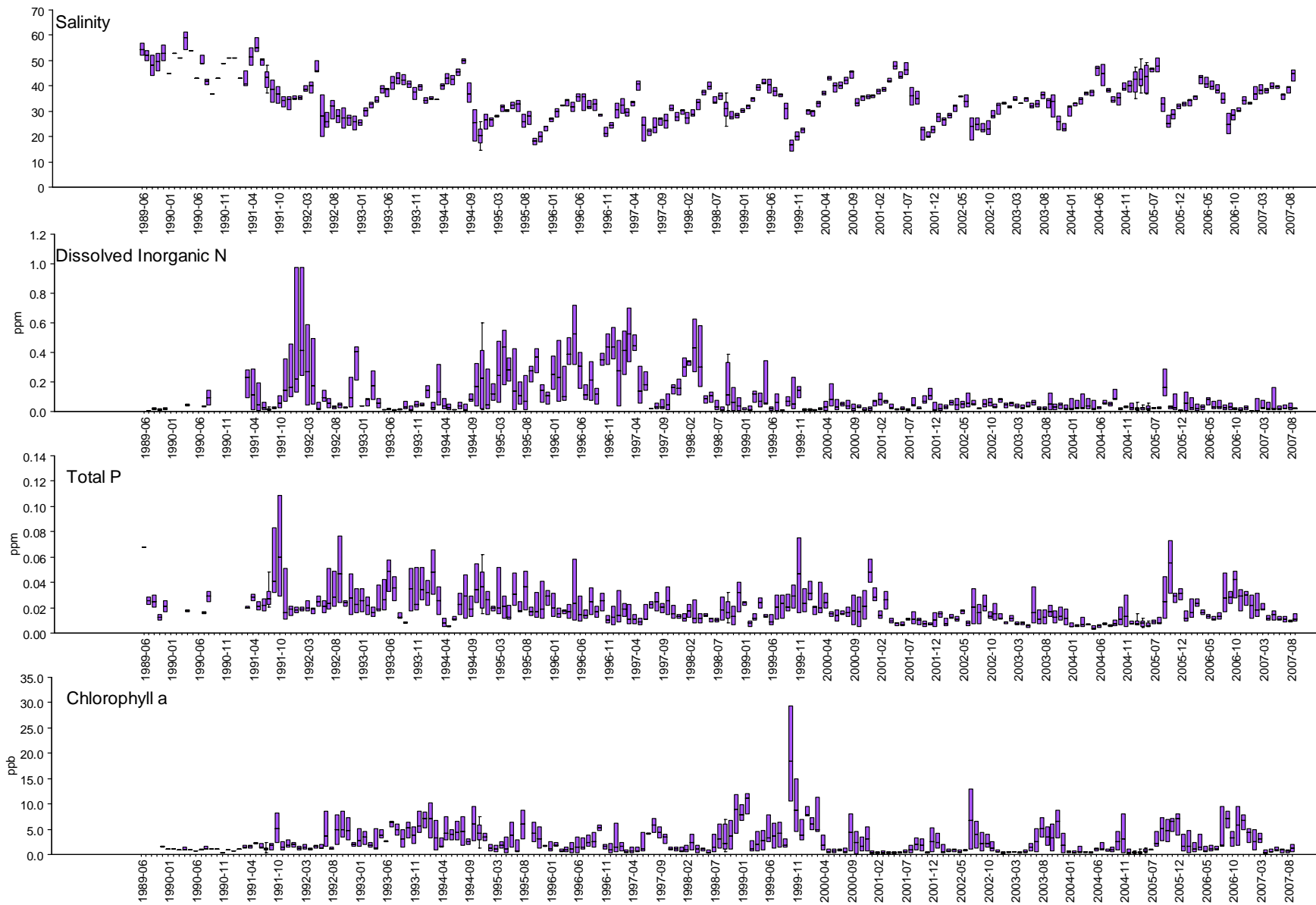


Figure 8. Box-and-whisker plots of water quality in Central Florida Bay by survey.

Western Florida Bay Zone

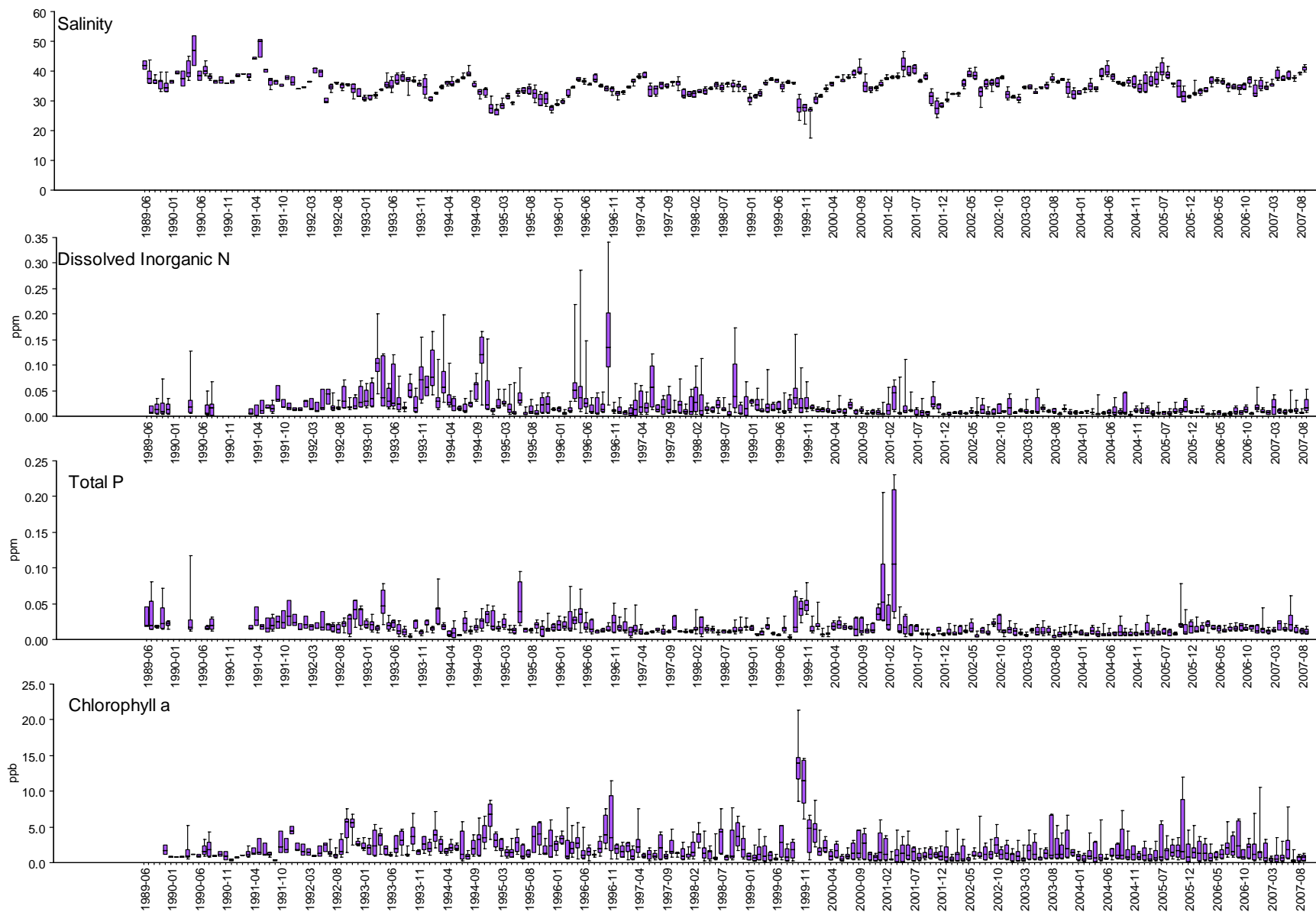


Figure 9. Box-and-whisker plots of water quality in Western Florida Bay by survey.

Whitewater Bay Zone

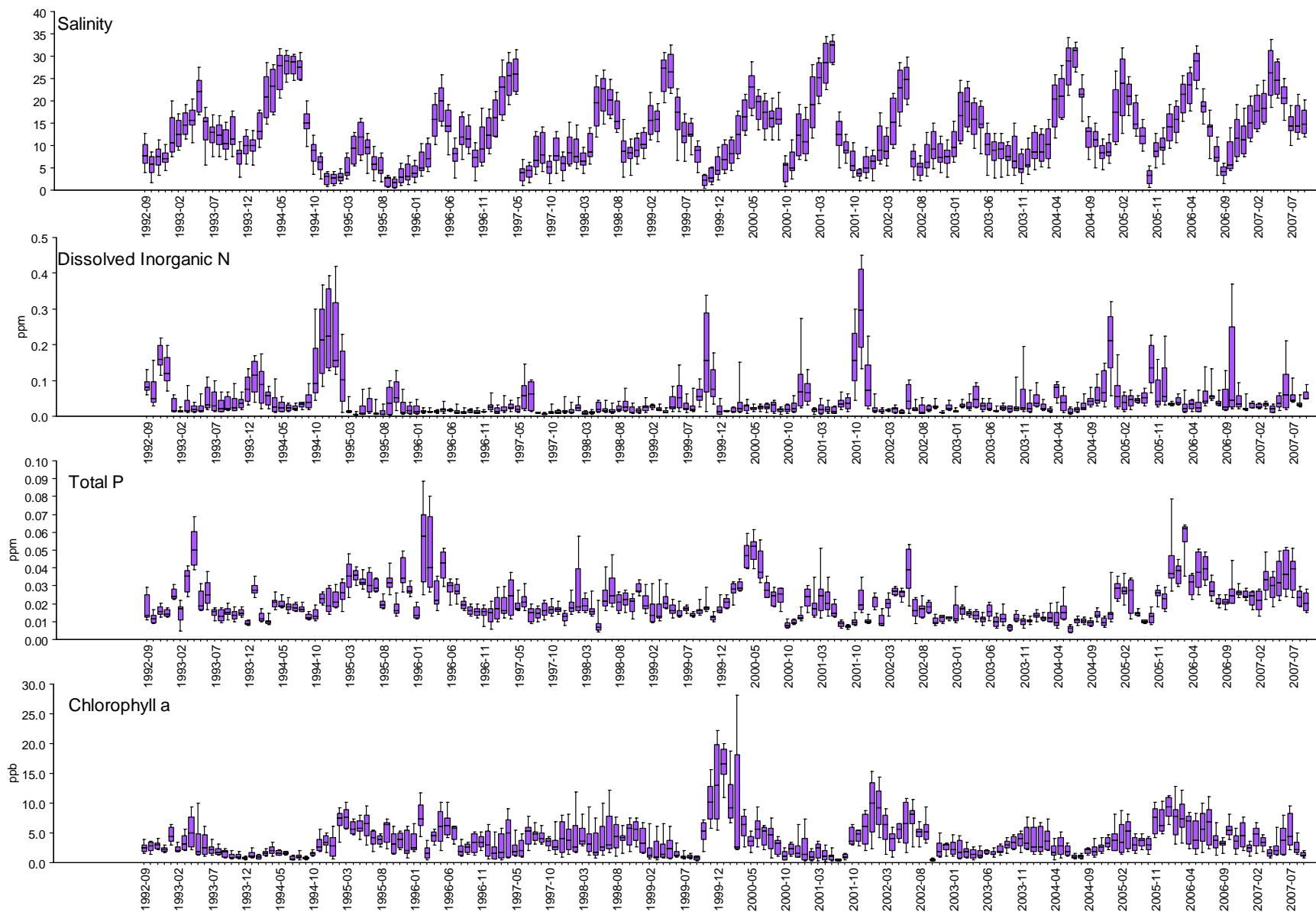


Figure 10. Box-and-whisker plots of water quality in WWB-TTI by survey.

Mangrove Rivers Zone

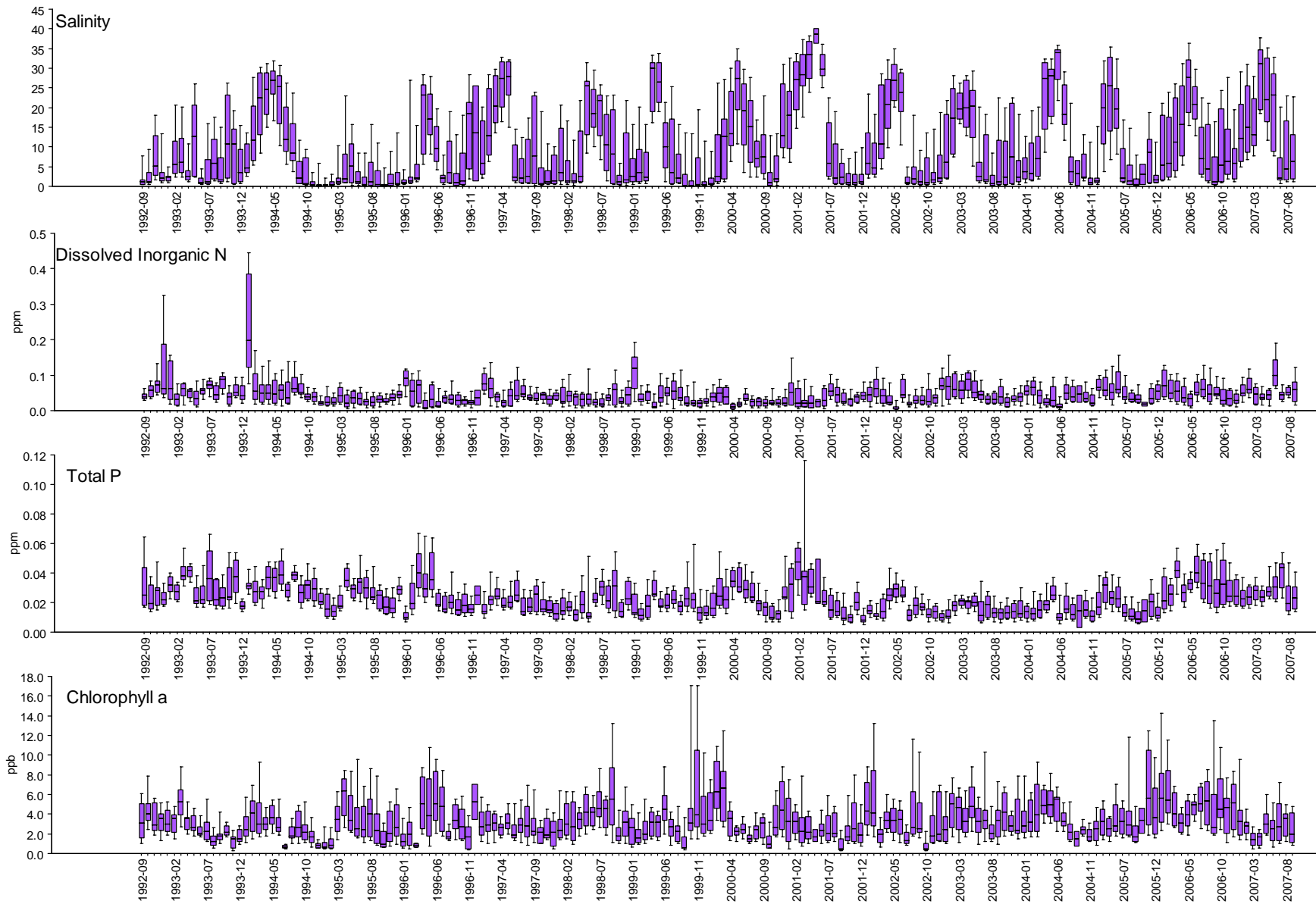


Figure 11. Box-and-whisker plots of water quality in WWB-TTI by survey.

Gulf Islands Zone

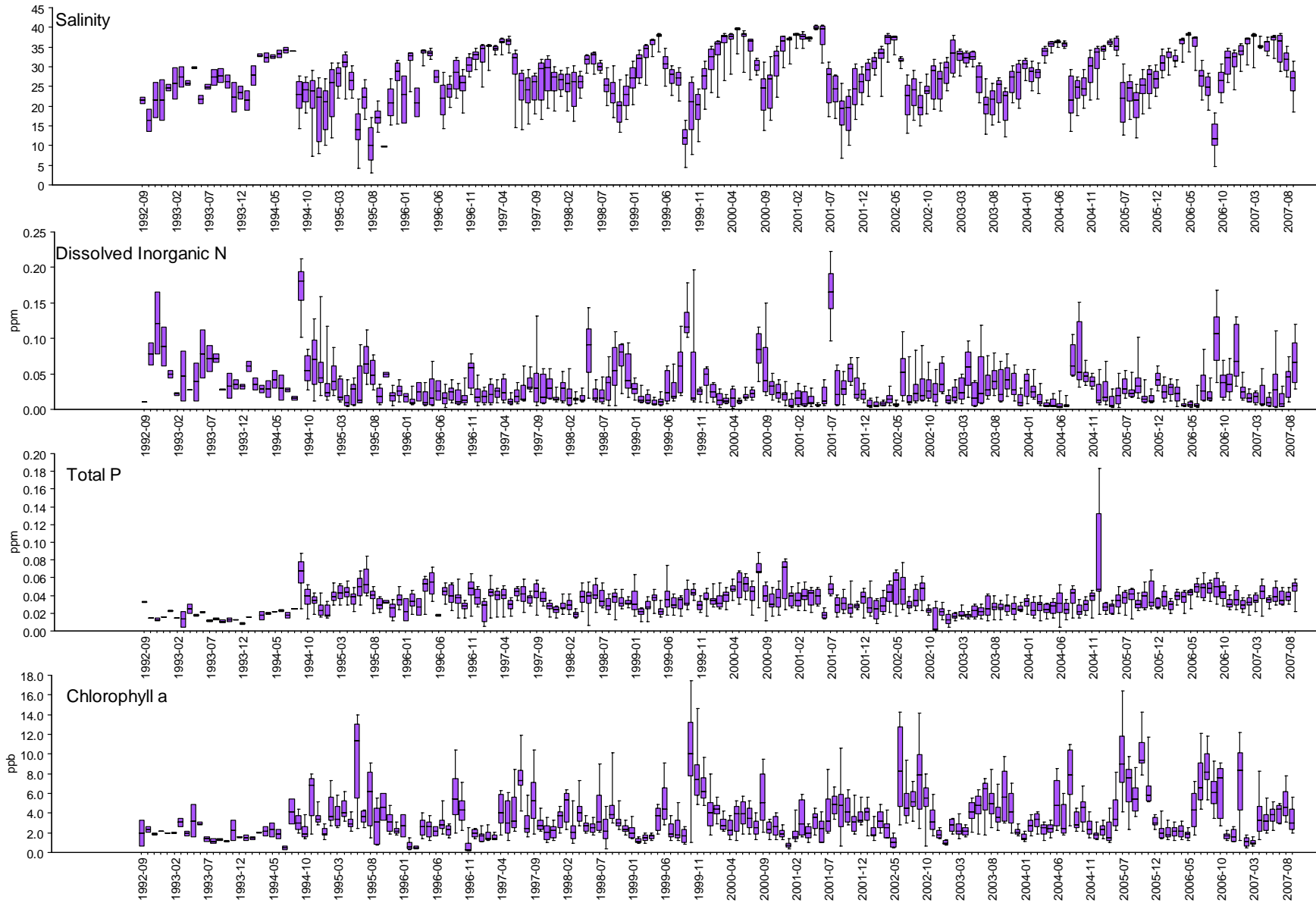


Figure 12. Box-and-whisker plots of water quality in WWB-TTI by survey.

Inner Waterway Zone

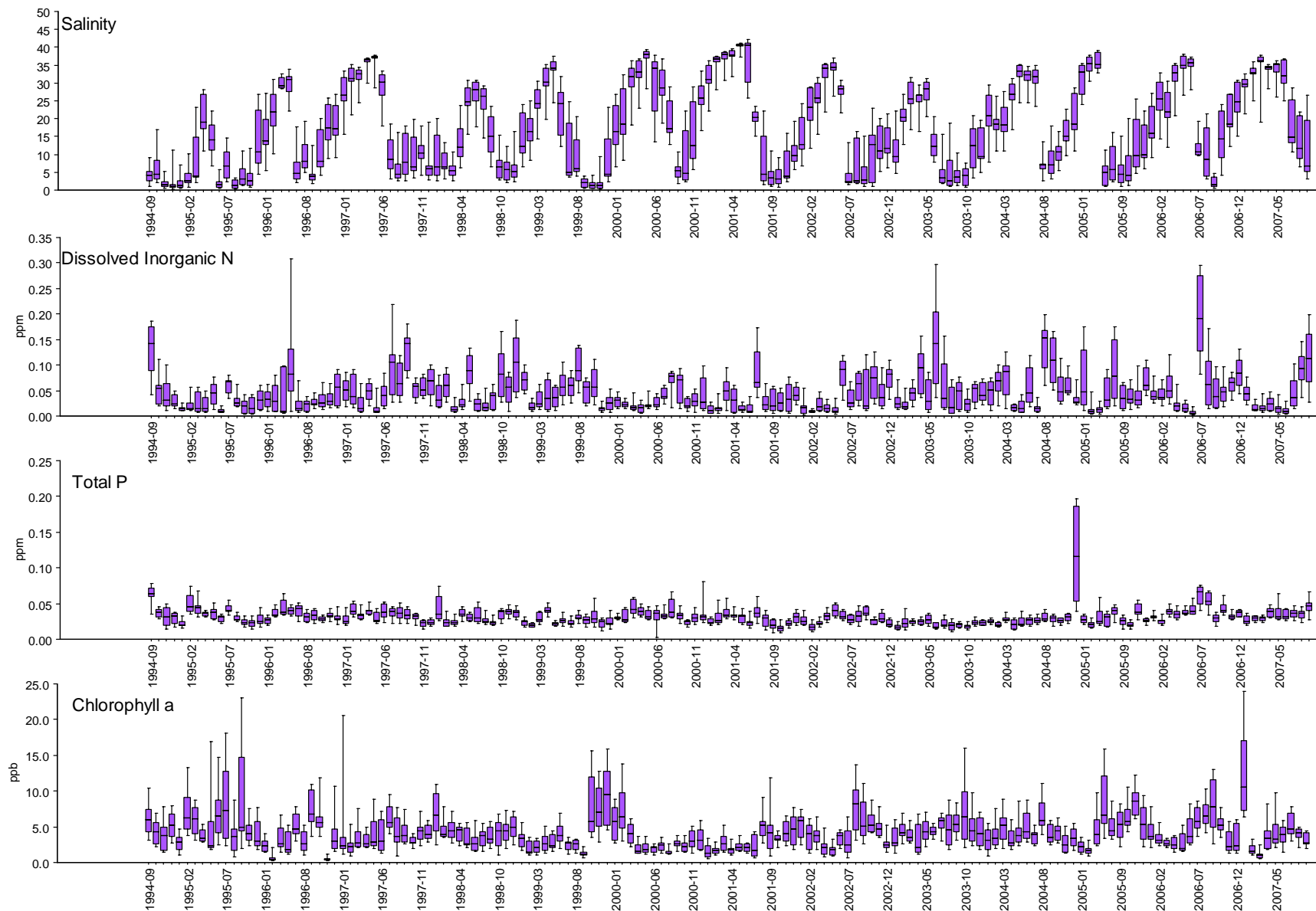


Figure 13. Box-and-whisker plots of water quality in WWB-TTI by survey.

Blackwater River Zone

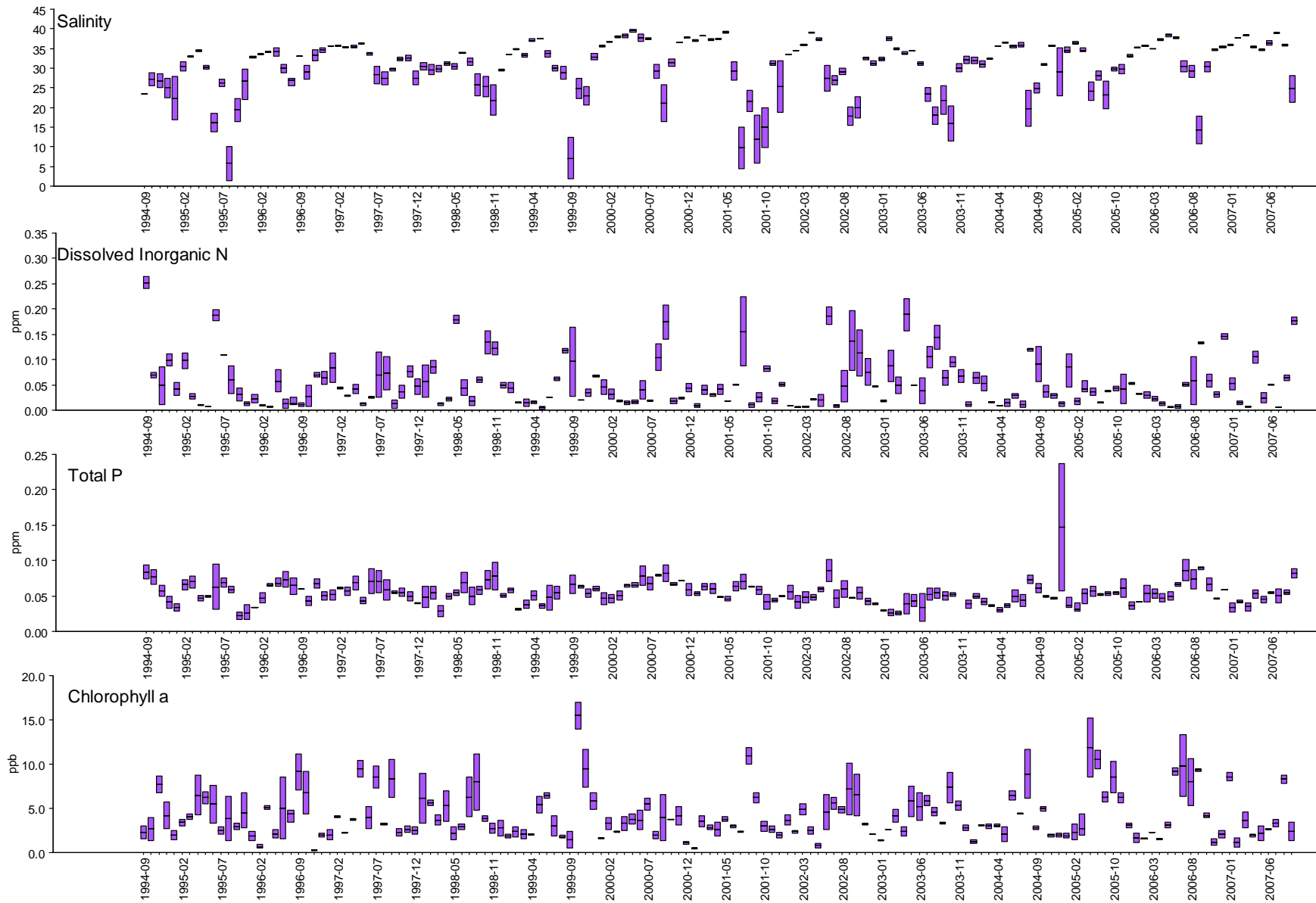


Figure 14. Box-and-whisker plots of water quality in WWB-TTI by survey.

Alongshore Zone

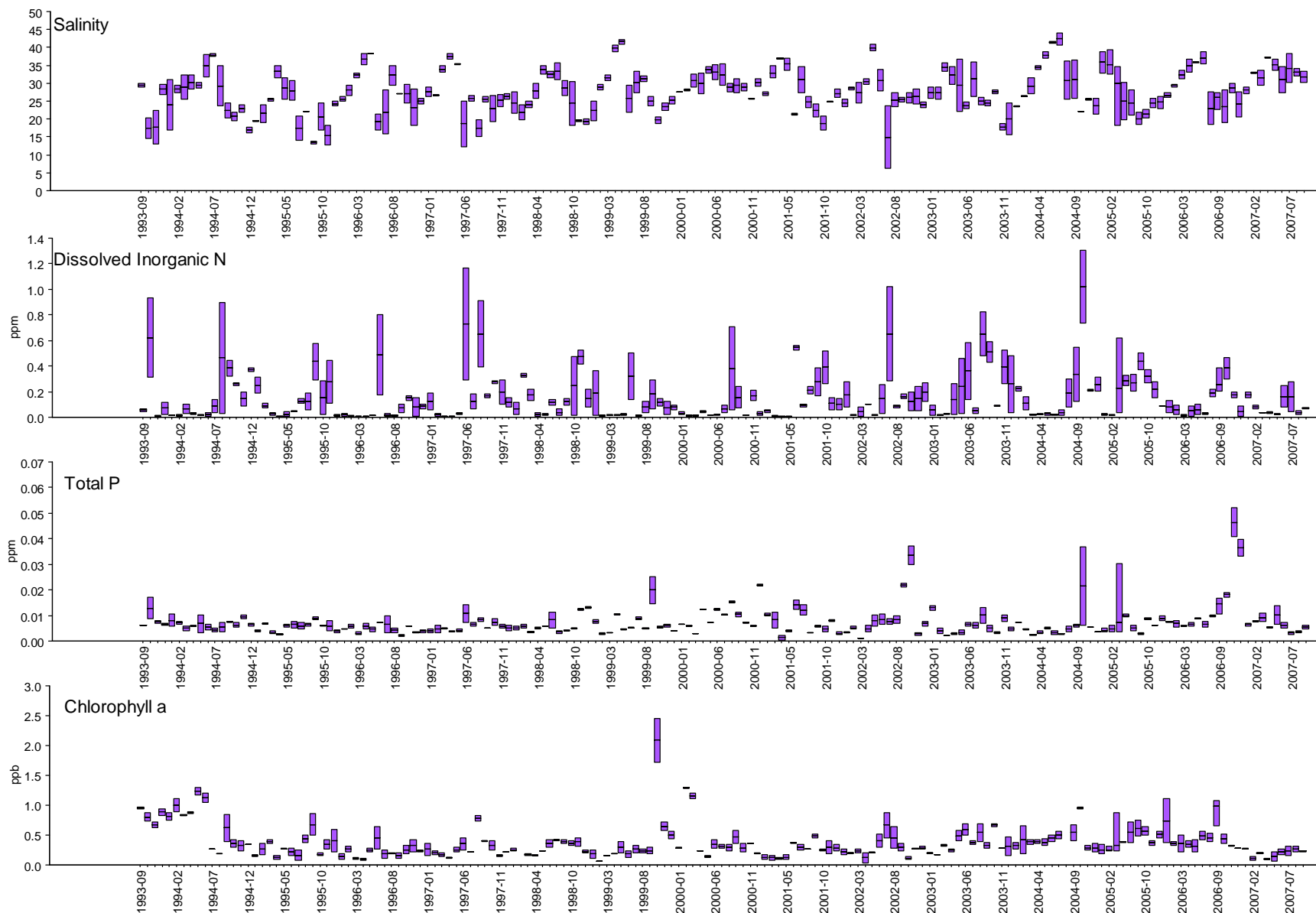


Figure 15. Box-and-whisker plots of water quality in Biscayne Bay by survey.

Inshore Zone

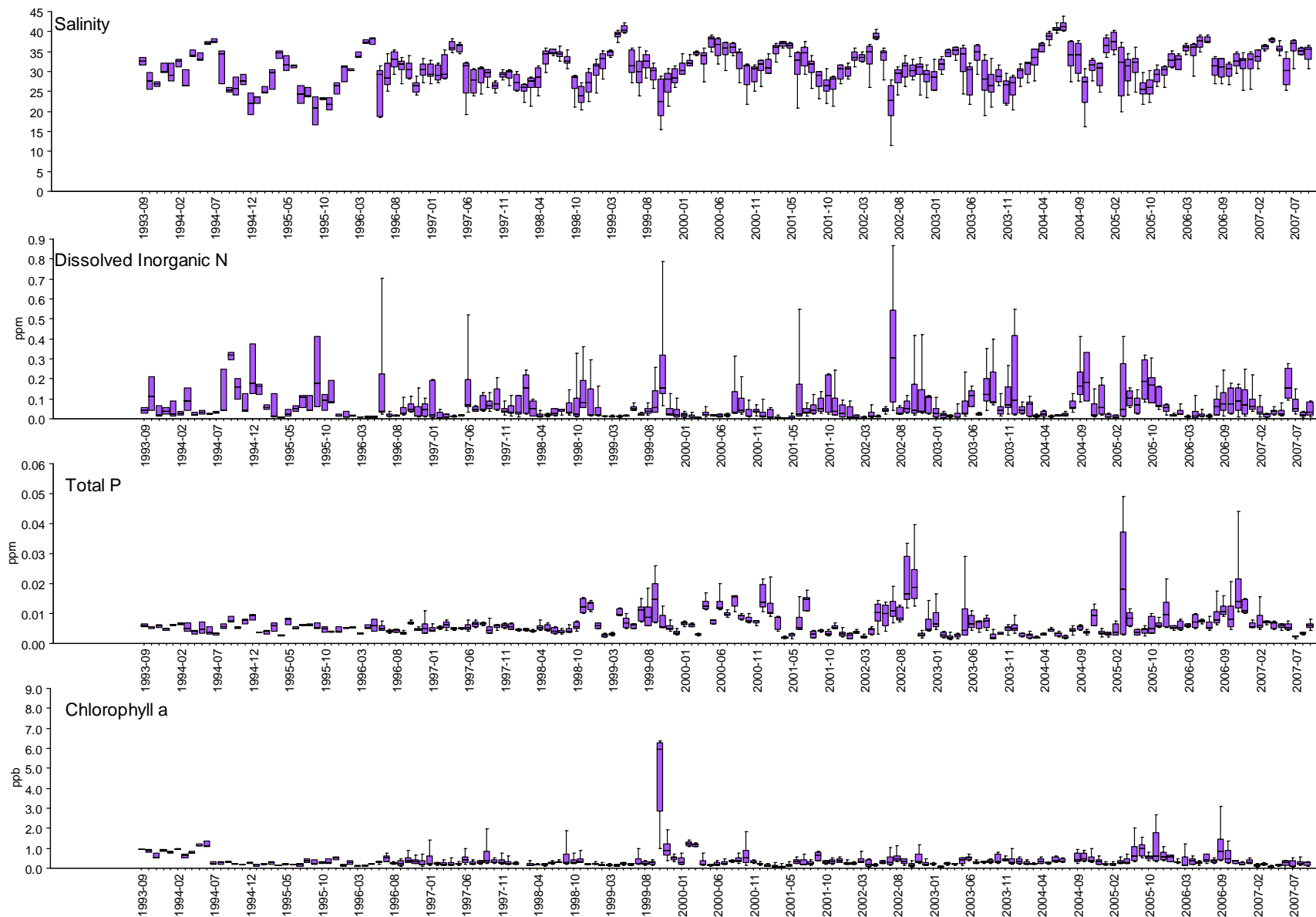


Figure 16. Box-and-whisker plots of water quality in Biscayne Bay by survey.

Main Bay Zone

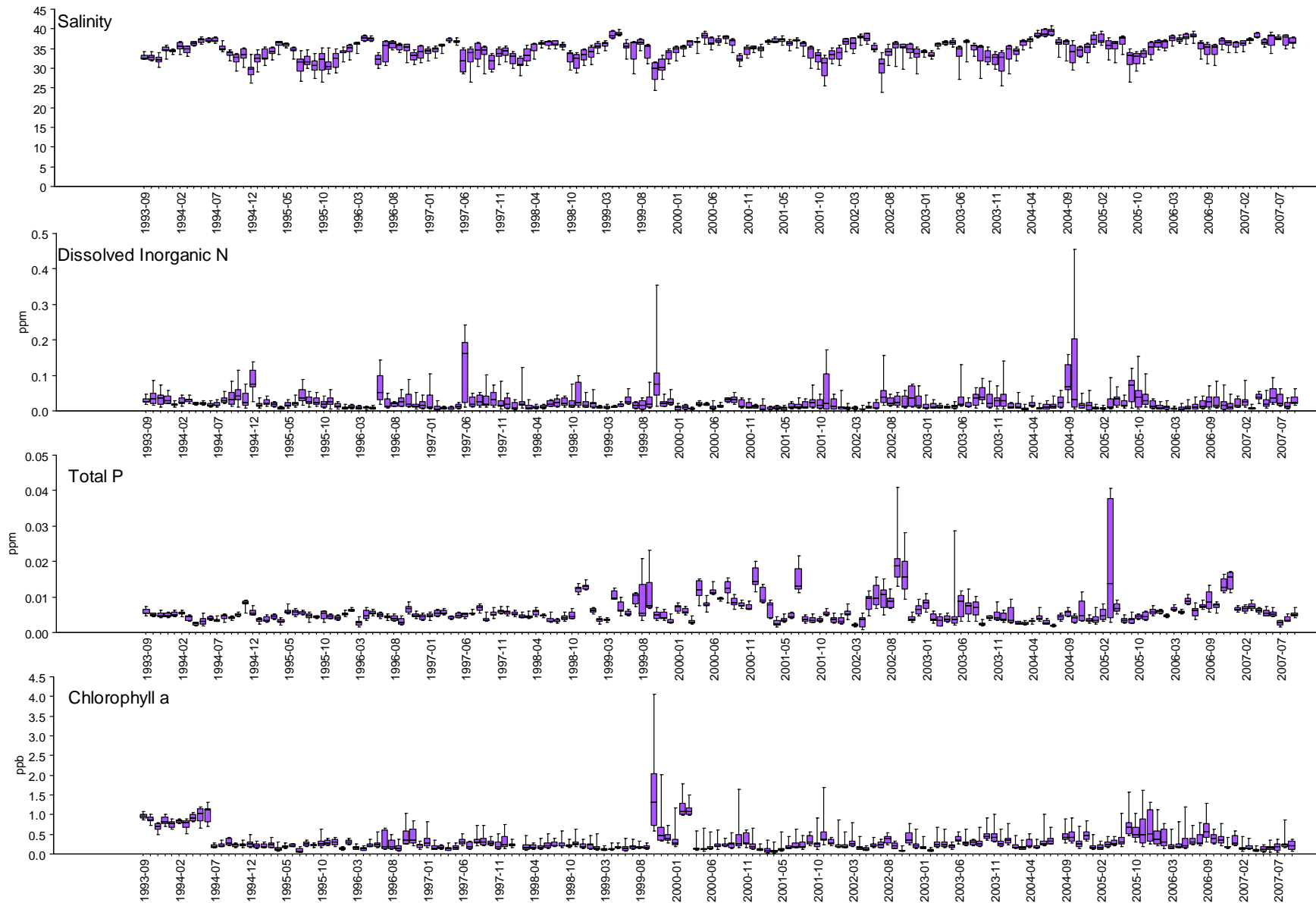


Figure 17. Box-and-whisker plots of water quality in Biscayne Bay by survey.

South Card Sound Zone

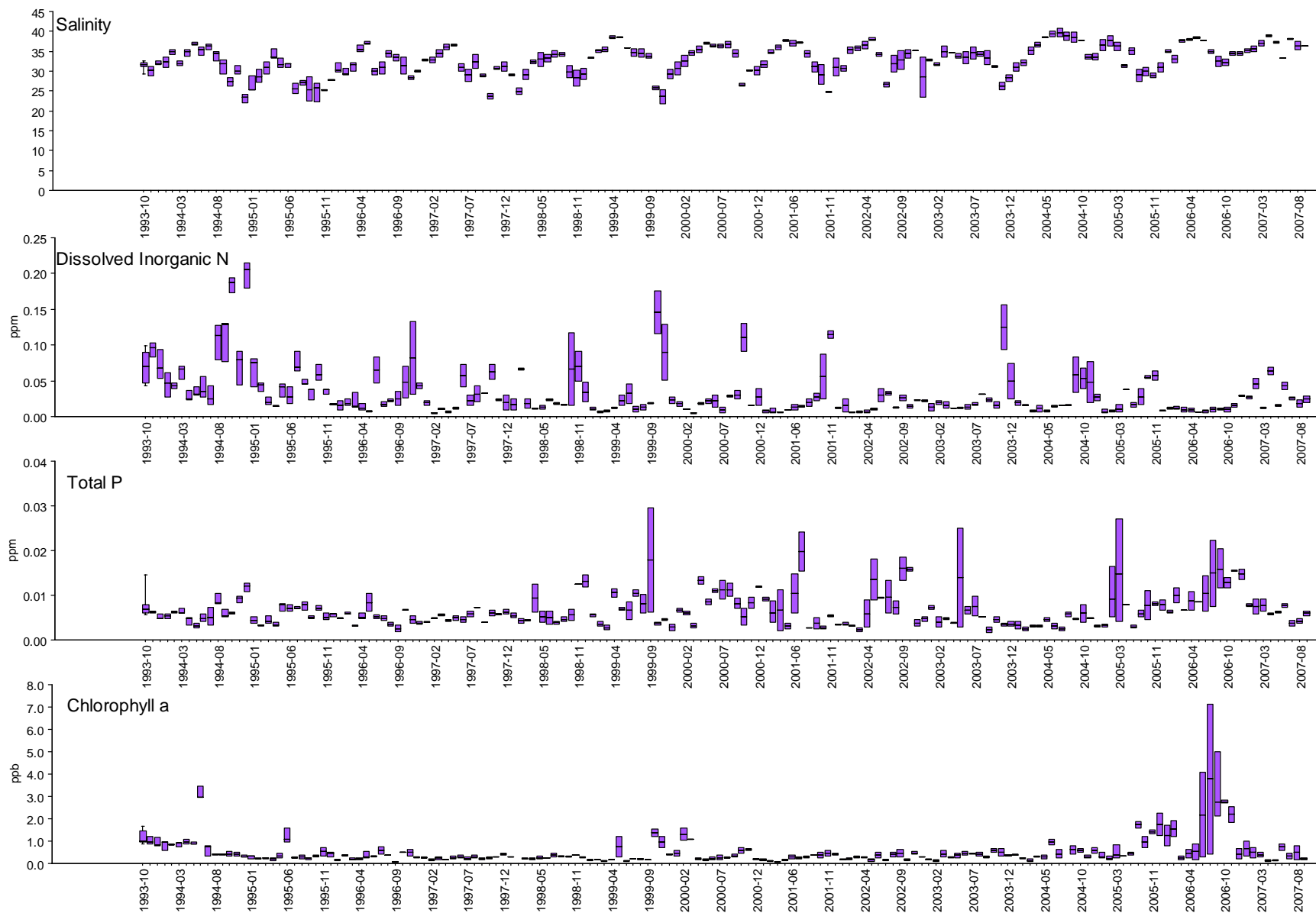


Figure 18. Box-and-whisker plots of water quality in Biscayne Bay by survey.

North Bay Zone

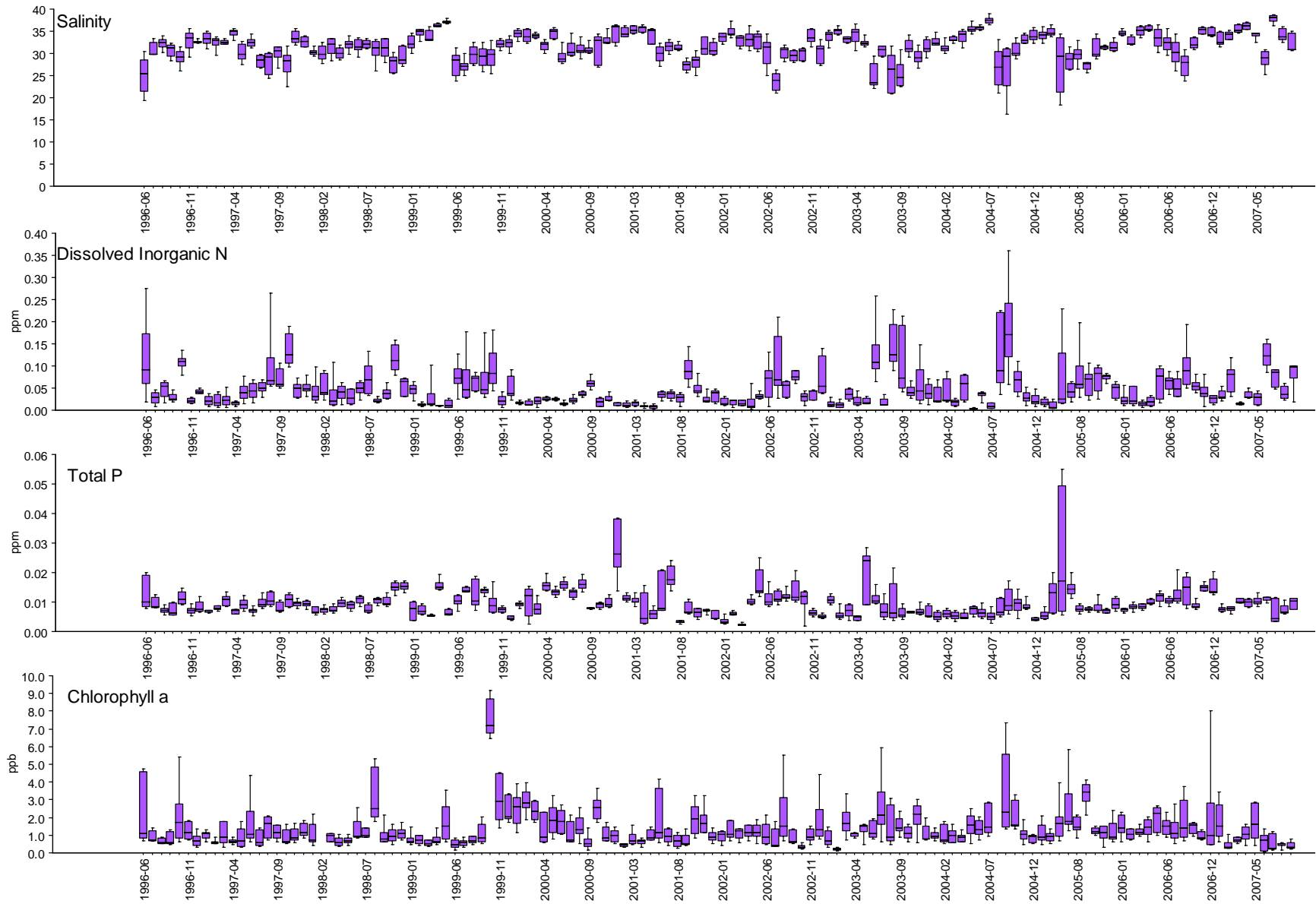


Figure 19. Box-and-whisker plots of water quality in Biscayne Bay by survey.

Shelf Zone

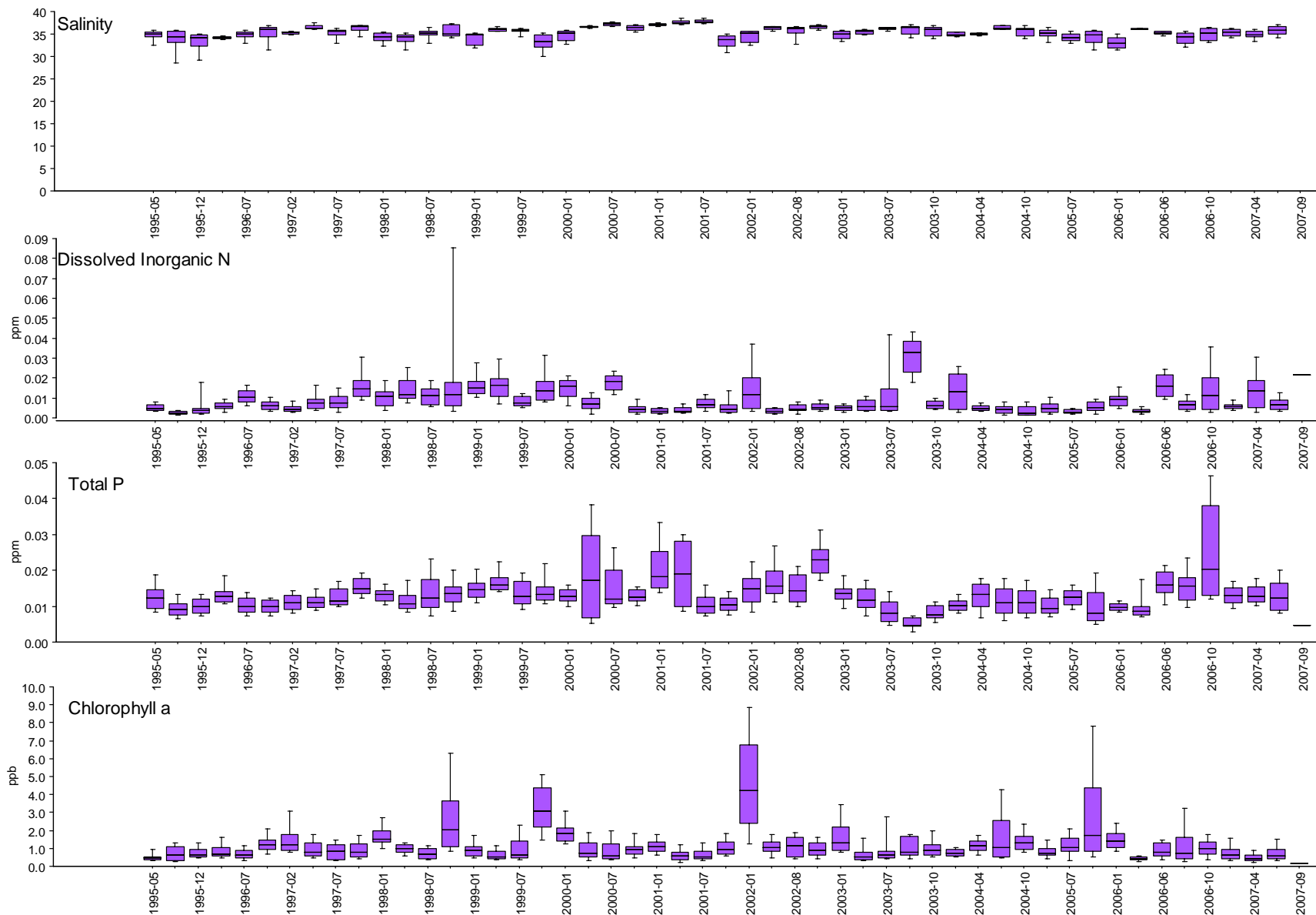


Figure 20. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

Shark Zone

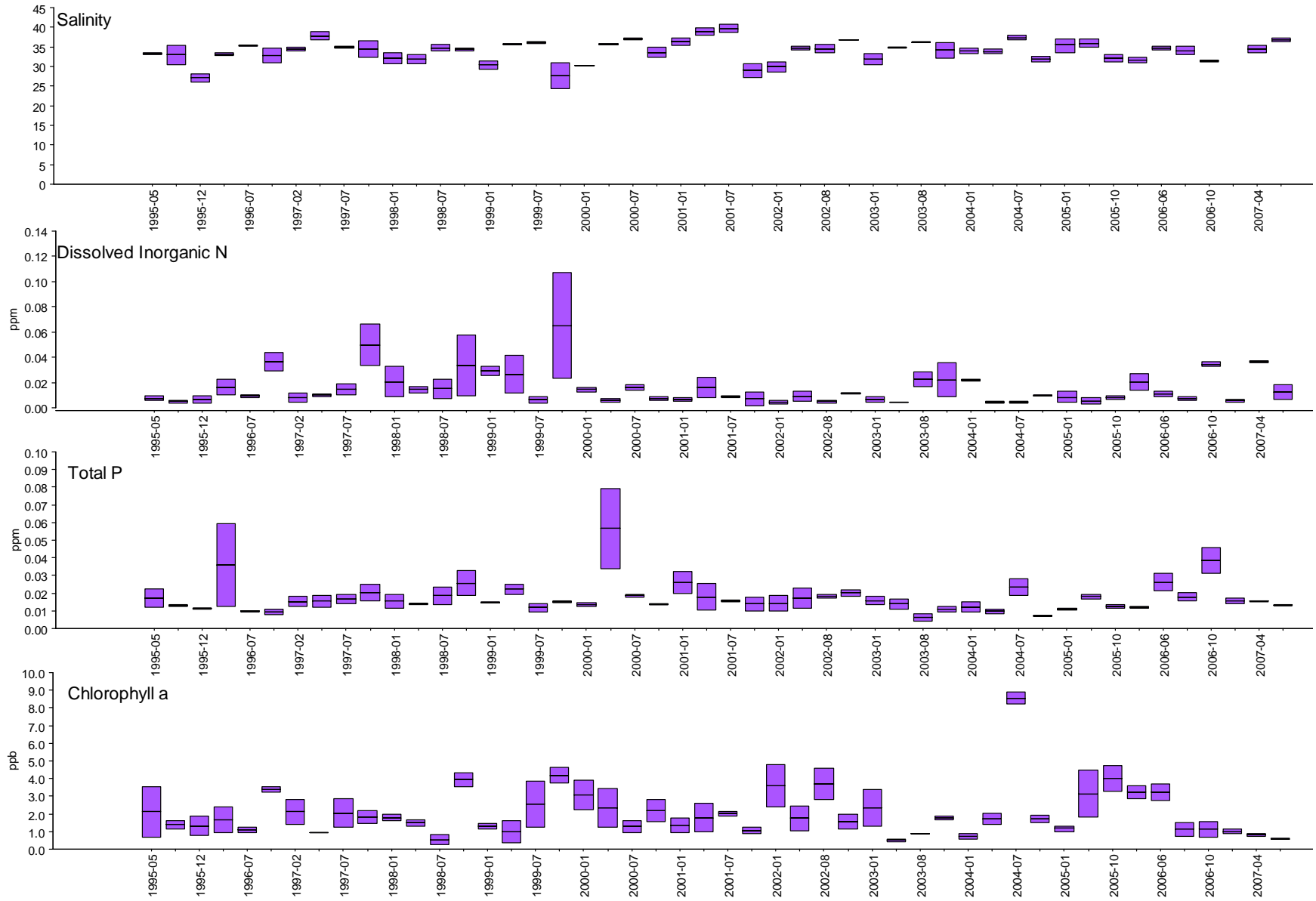


Figure 21. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

Shoal Zone

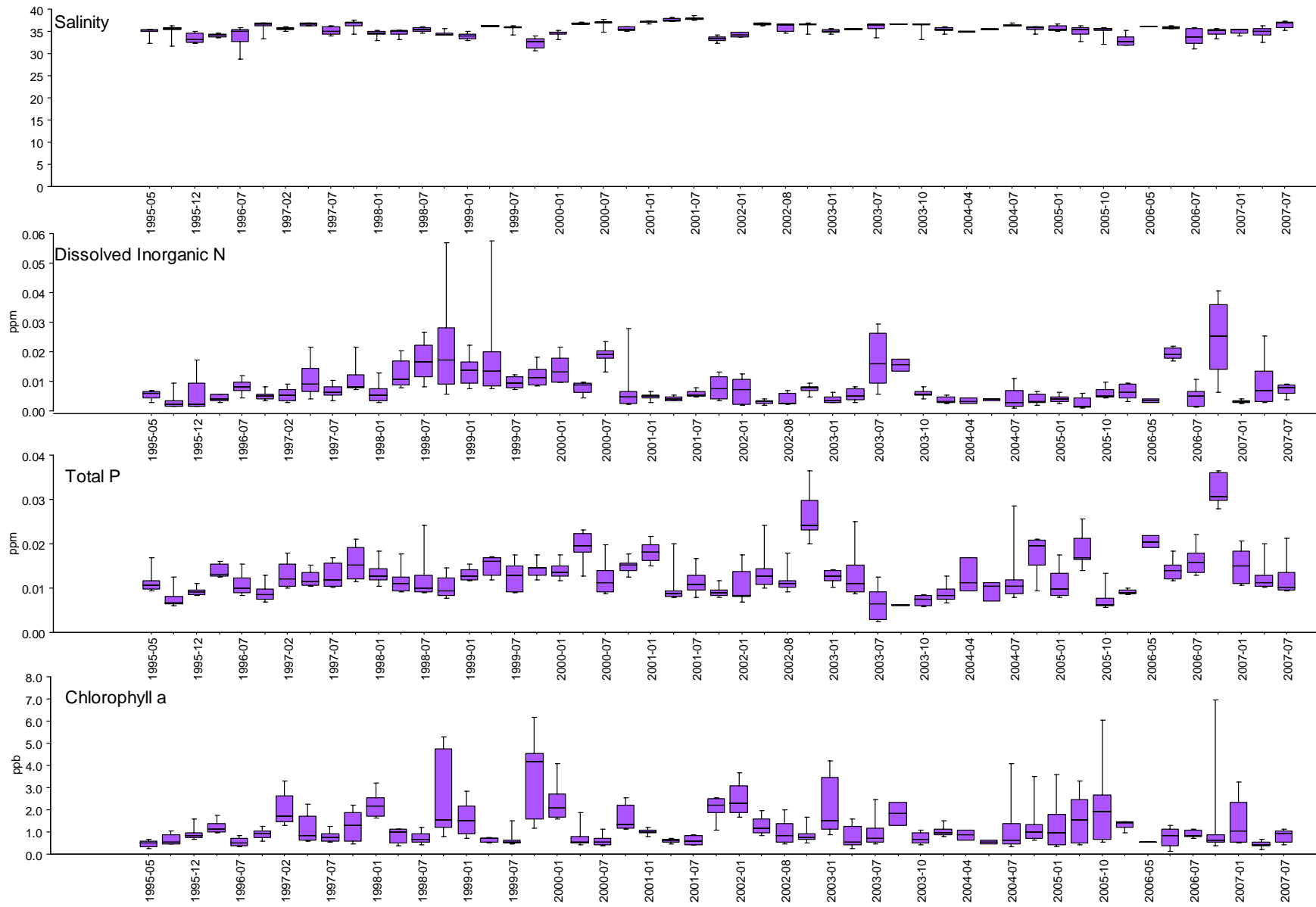


Figure 22. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

Marco Zone

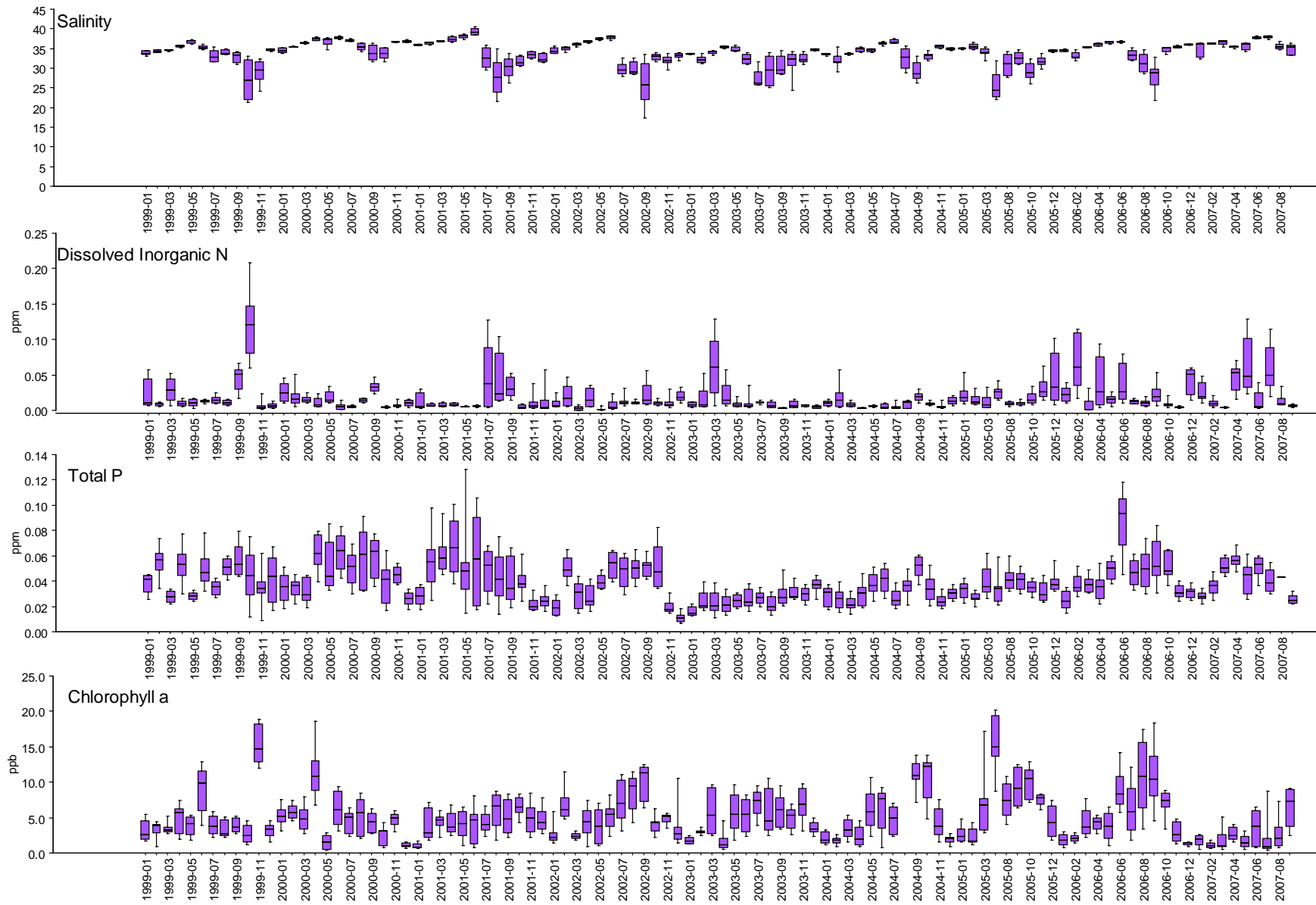


Figure 23. Box-and-whisker plots of water quality in RB-PIS by survey.

Rookery Bay Zone

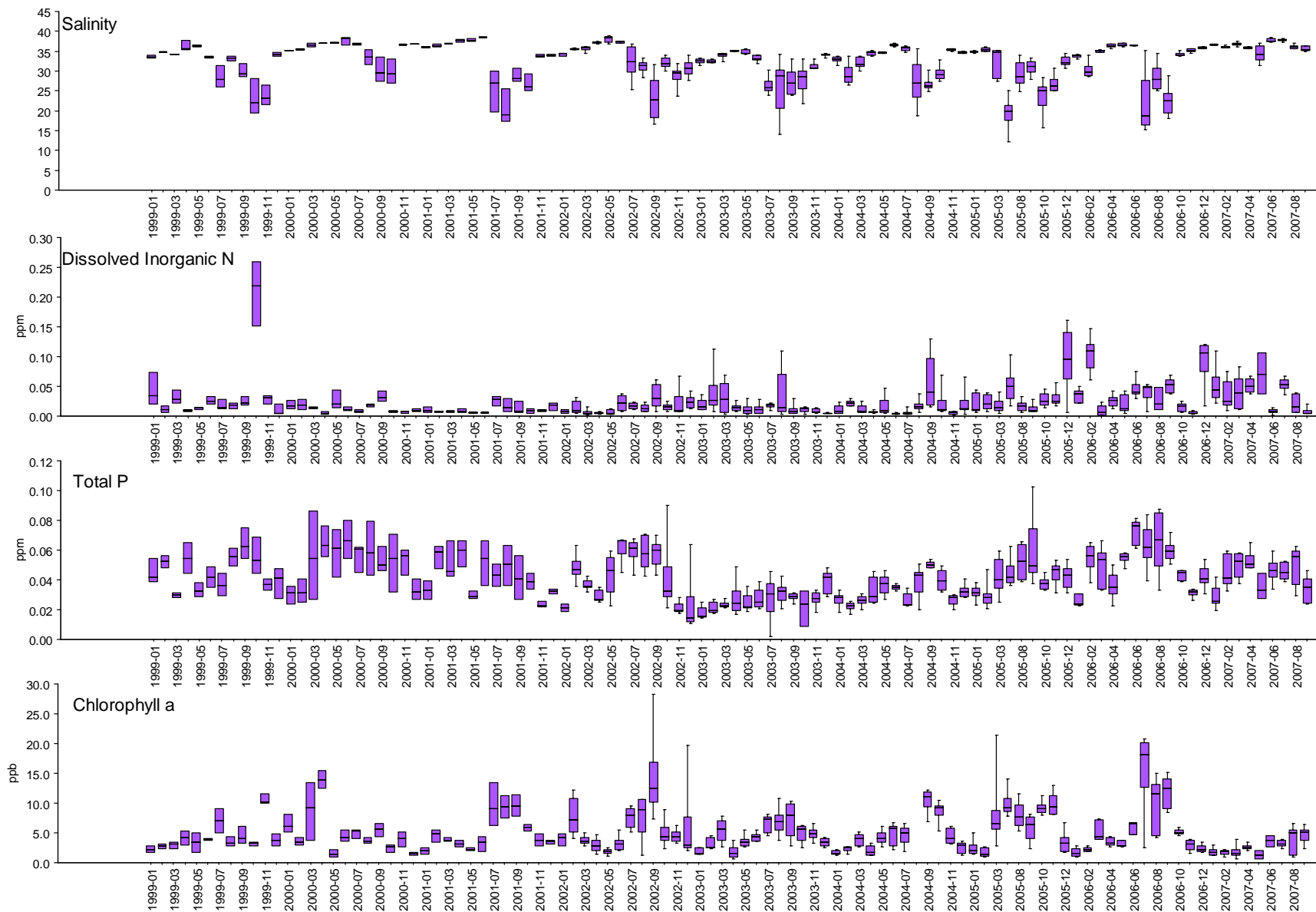


Figure 24. Box-and-whisker plots of water quality in RB-PIS by survey.

Naples Zone

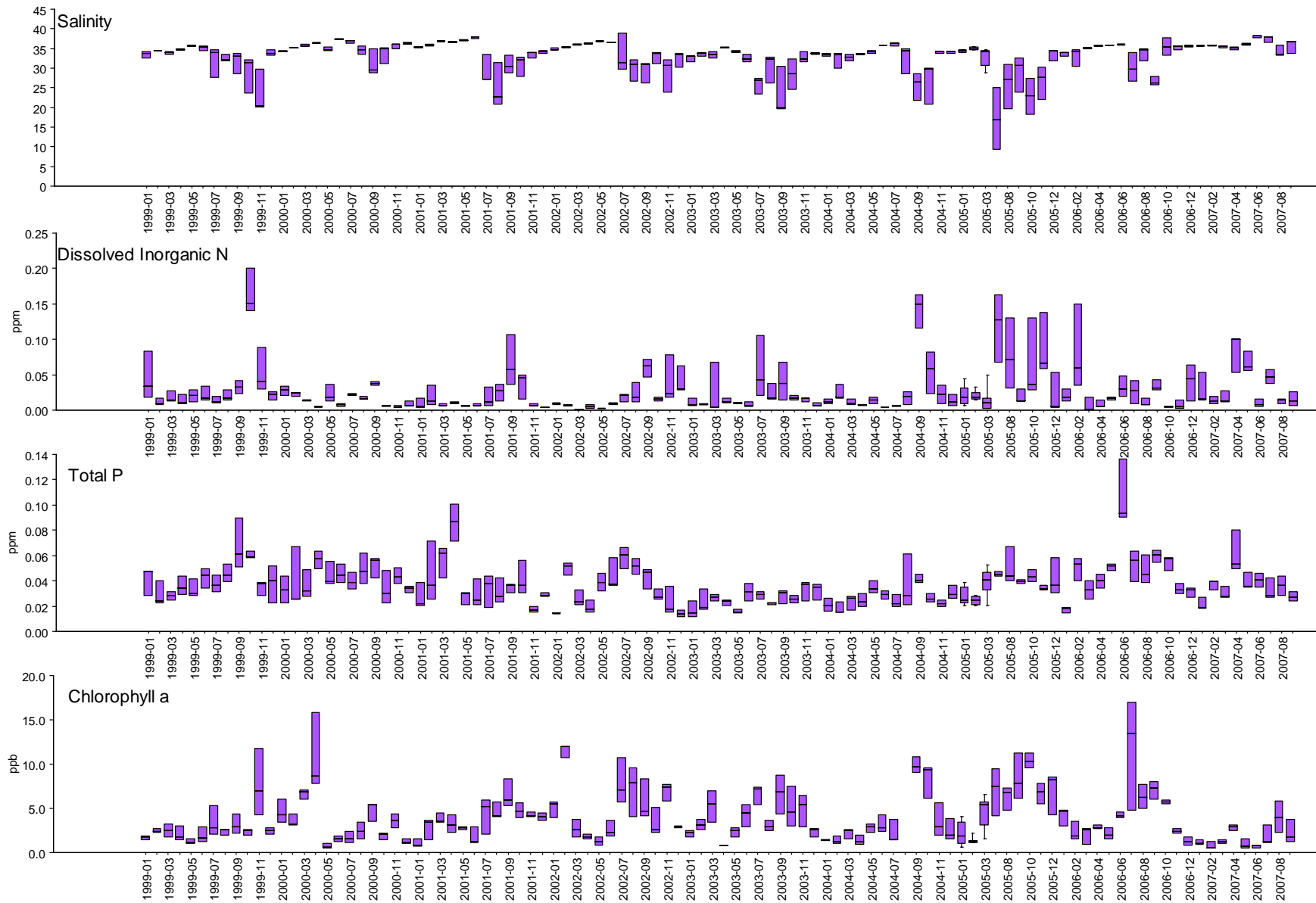


Figure 25. Box-and-whisker plots of water quality in RB-PIS by survey.

San Carlos Bay Zone

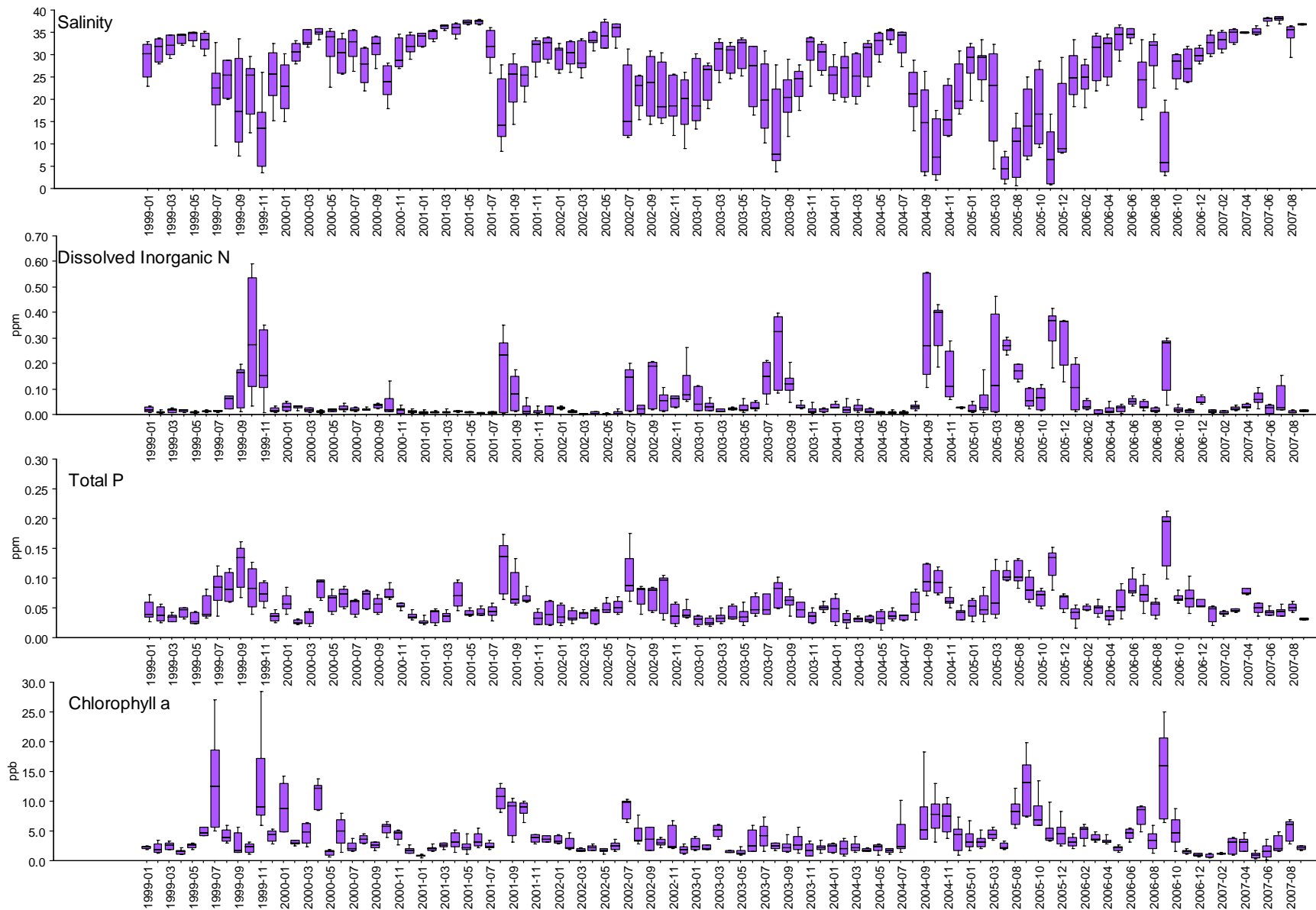


Figure 26. Box-and-whisker plots of water quality in RB-PIS by survey.

Estero Bay Zone

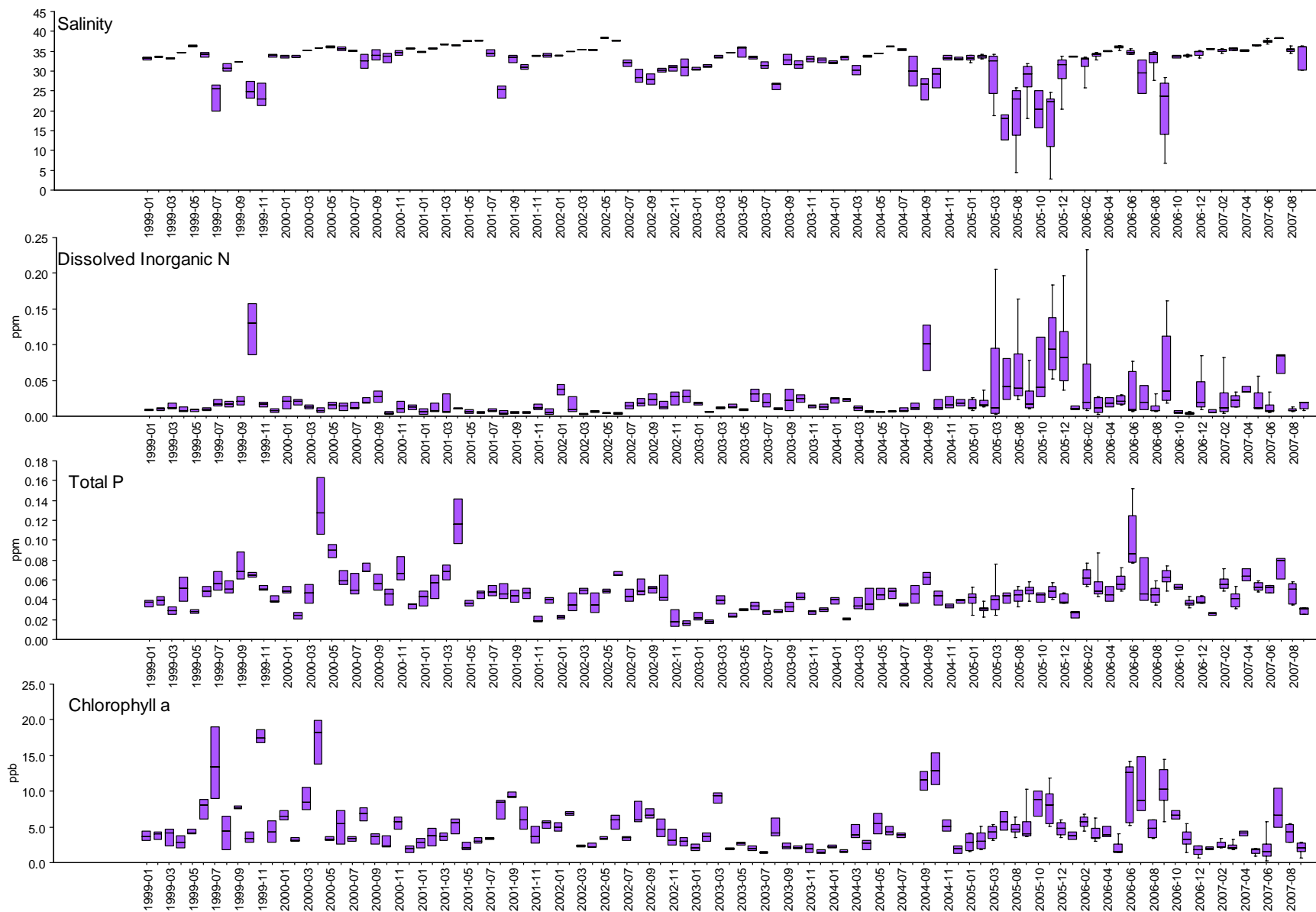


Figure 27. Box-and-whisker plots of water quality in RB-PIS by survey.

Pine Island Sound Zone

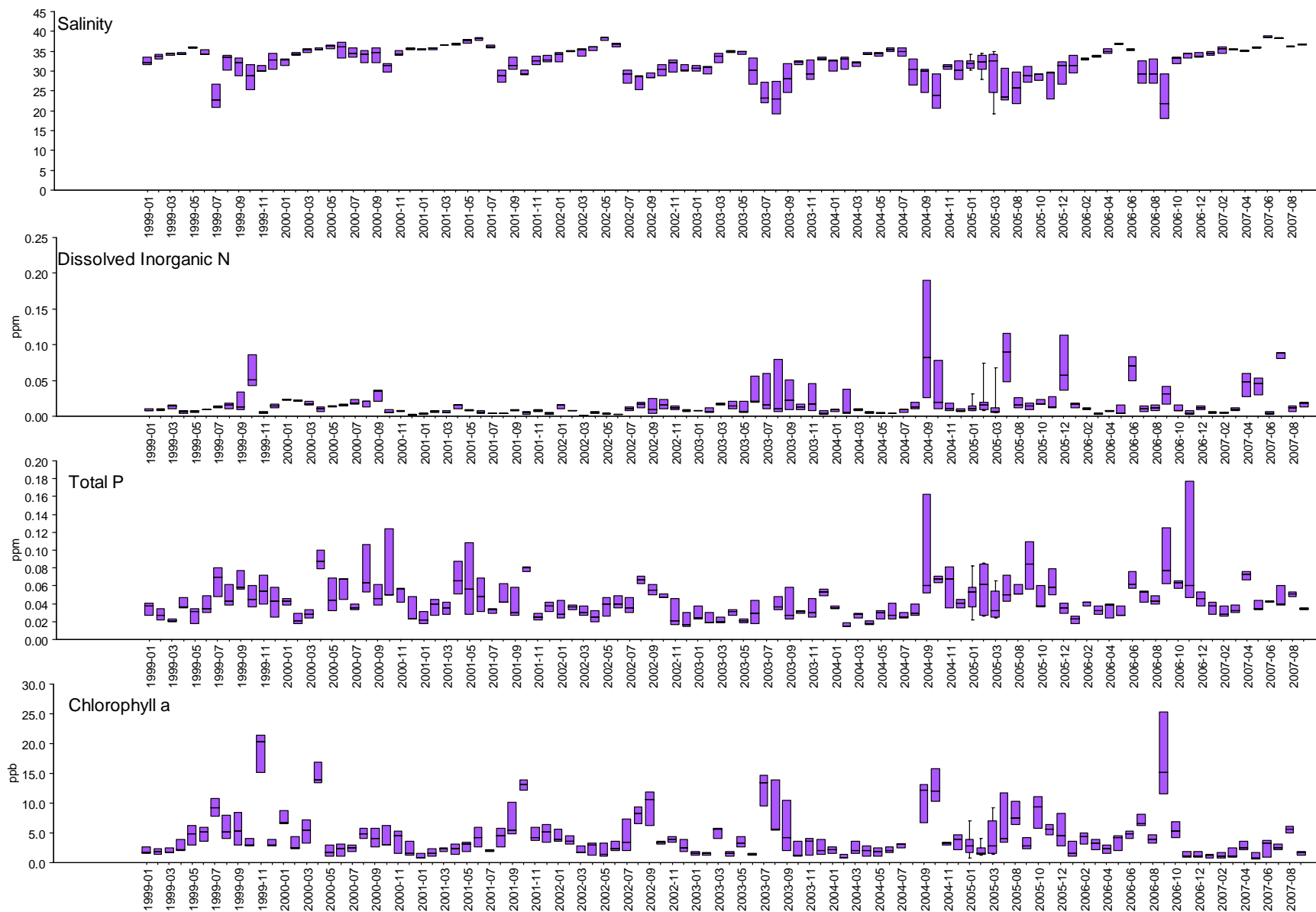


Figure 28. Box-and-whisker plots of water quality in RB-PIS by survey.

Cocohatchee River at Wiggins Pass

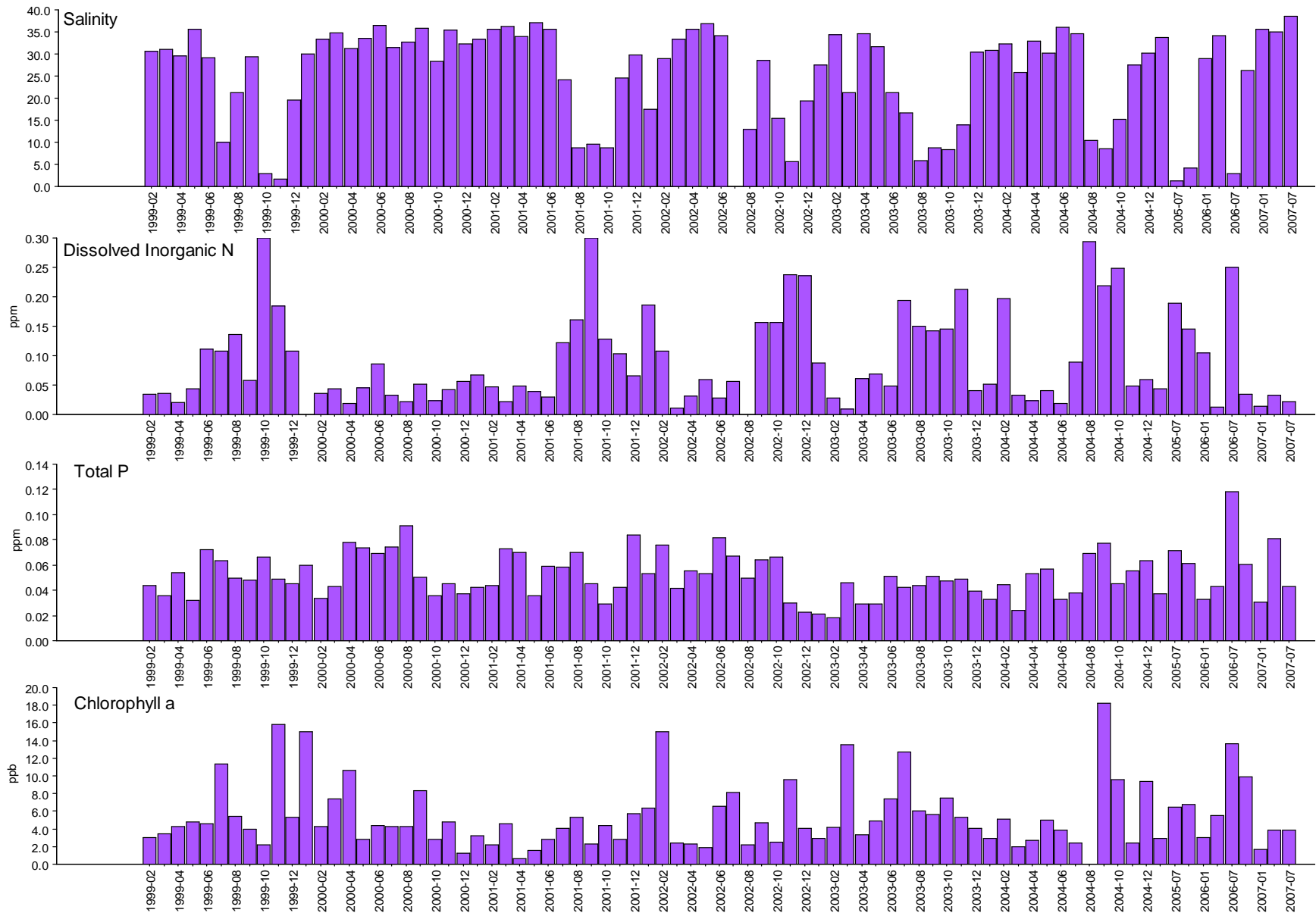


Figure 29. Bar chart of water quality in RB-PIS by survey.

Table 1.

Parameter	Zone	Median	Min.	Max.	<i>n</i>
Chlorophyll <i>a</i> ($\mu\text{g l}^{-1}$)	Biscayne Bay	0.226	0.012	1.213	75
	Florida Bay	0.787	0.108	9.002	84
	Rookery Bay	2.921	0.319	13.455	87
	SW Shelf	0.595	0.157	1.704	49
	Ten Thousand Is.	4.154	1.159	8.891	78
	Whitewater Bay	2.727	0.622	12.791	66
Surface Dissolved Oxygen (mg l^{-1})	Biscayne Bay	5.89	4.71	7.96	75
	Florida Bay	6.21	3.38	7.83	84
	Rookery Bay	5.94	4.00	6.98	87
	SW Shelf	2.95	2.08	4.61	45
	Ten Thousand Is.	5.27	2.83	7.62	78
	Whitewater Bay	5.67	2.01	7.91	66
Bottom Dissolved Oxygen (mg l^{-1})	Biscayne Bay	5.88	4.62	7.28	75
	Florida Bay	5.94	2.48	8.27	84
	Rookery Bay	5.94	3.77	7.02	87
	SW Shelf	3.17	2.90	3.42	47
	Ten Thousand Is.	5.10	2.33	7.64	78
	Whitewater Bay	4.85	1.90	8.09	66
NH_4^+ (ppm)	Biscayne Bay	0.0210	0.0030	0.0810	75
	Florida Bay	0.0170	0.0020	0.3320	84
	Rookery Bay	0.0110	0.0020	0.1490	87
	SW Shelf	0.0050	0.0010	0.0210	48
	Ten Thousand Is.	0.0260	0.0020	0.1540	78
	Whitewater Bay	0.0250	0.0050	0.1380	56
NO_2^- (ppm)	Biscayne Bay	0.0020	0.0002	0.0130	75
	Florida Bay	0.0010	0.0000	0.0170	84
	Rookery Bay	0.0010	0.0001	0.0030	87
	SW Shelf	0.0010	0.0001	0.0020	48
	Ten Thousand Is.	0.0040	0.0002	0.0110	78
	Whitewater Bay	0.0030	0.0001	0.0070	66

Parameter	Zone	Median	Min.	Max.	<i>n</i>
NO ₃ ⁻ (ppm)	Biscayne Bay	0.0060	0.0000	0.1860	75
	Florida Bay	0.0070	0.0003	0.0580	84
	Rookery Bay	0.0020	0.0000	0.0100	87
	SW Shelf	0.0010	0.0000	0.0070	48
	Ten Thousand Is.	0.0160	0.0005	0.1230	72
	Whitewater Bay	0.0180	0.0030	0.0540	66
pH	Biscayne Bay	8.000	0.000	8.290	75
	Florida Bay	8.190	7.950	8.840	84
	Rookery Bay	8.010	7.700	8.190	87
	SW Shelf				0
	Ten Thousand Is.	7.770	7.440	7.970	78
	Whitewater Bay	7.865	0.000	8.430	66
Surface Salinity	Biscayne Bay	36.49	30.19	38.78	75
	Florida Bay	36.34	0.29	46.98	84
	Rookery Bay	36.39	29.45	38.68	87
	SW Shelf	35.95	32.00	37.42	45
	Ten Thousand Is.	24.73	0.46	39.05	78
	Whitewater Bay	13.37	0.51	32.77	66
Bottom Salinity	Biscayne Bay	36.49	30.20	38.78	75
	Florida Bay	36.40	0.29	46.99	84
	Rookery Bay	36.37	29.45	38.68	87
	SW Shelf	37.05	35.90	37.65	47
	Ten Thousand Is.	25.56	1.13	39.12	78
	Whitewater Bay	13.71	1.24	32.80	66
Si(OH) ₄ (ppm)	Biscayne Bay	0.0930	0.0010	0.6650	25
	Florida Bay	1.4790	0.1620	6.8290	28
	Rookery Bay	0.7830	0.0320	2.9890	27
	SW Shelf	0.1010	0.0010	1.0600	48
	Ten Thousand Is.	2.9230	0.6740	4.0070	26
	Whitewater Bay	3.2730	1.4000	5.0270	22
Soluble Reactive Phosphorus (ppm)	Biscayne Bay	0.0010	0.0000	0.0030	75
	Florida Bay	0.0020	0.0004	0.0070	84
	Rookery Bay	0.0040	0.0003	0.0190	83
	SW Shelf	0.0010	0.0000	0.0030	48
	Ten Thousand Is.	0.0100	0.0005	0.0580	78
	Whitewater Bay	0.0020	0.0003	0.0140	66

Parameter	Zone	Median	Min.	Max.	<i>n</i>
Surface Temperature (°C)	Biscayne Bay	30.78	28.24	37.41	75
	Florida Bay	31.06	28.67	33.93	84
	Rookery Bay	30.29	27.24	36.87	87
	SW Shelf	31.25	29.79	32.00	45
	Ten Thousand Is.	30.39	28.26	33.59	78
	Whitewater Bay	30.29	27.57	32.89	66
Bottom Temperature (°C)	Biscayne Bay	30.74	28.24	32.22	75
	Florida Bay	31.06	29.01	34.27	83
	Rookery Bay	30.29	27.22	36.87	87
	SW Shelf	31.44	30.76	31.91	47
	Ten Thousand Is.	30.27	28.22	33.40	78
	Whitewater Bay	30.21	0.00	32.56	66
Total Nitrogen (ppm)	Biscayne Bay	0.229	0.135	2.185	75
	Florida Bay	0.358	0.087	0.945	83
	Rookery Bay	0.285	0.147	0.596	87
	SW Shelf	0.166	0.141	0.319	49
	Ten Thousand Is.	0.412	0.185	1.026	78
	Whitewater Bay	0.554	0.304	1.436	66
Total Organic Carbon (ppm)	Biscayne Bay	2.608	1.072	775.349	75
	Florida Bay	8.303	1.919	23.067	84
	Rookery Bay	3.759	1.233	6.777	87
	SW Shelf	1.906	0.000	3.486	49
	Ten Thousand Is.	9.371	3.577	953.676	71
	Whitewater Bay	12.985	5.611	22.317	66
Total Organic Nitrogen (ppm)	Biscayne Bay	0.196	0.112	2.165	75
	Florida Bay	0.303	0.033	0.929	83
	Rookery Bay	0.252	0.085	0.589	87
	SW Shelf	0.160	0.136	0.316	48
	Ten Thousand Is.	0.330	0.181	0.857	72
	Whitewater Bay	0.514	0.273	1.118	56
Total Phosphorus (ppm)	Biscayne Bay	0.004	0.001	0.012	73
	Florida Bay	0.010	0.004	0.038	84
	Rookery Bay	0.037	0.021	0.082	80
	SW Shelf	0.012	0.005	0.023	49
	Ten Thousand Is.	0.042	0.008	0.096	78
	Whitewater Bay	0.027	0.013	0.082	64

Parameter	Zone	Median	Min.	Max.	<i>n</i>
Turbidity (NTU)	Biscayne Bay	0.56	0.09	2.24	75
	Florida Bay	2.26	0.11	9.90	84
	Rookery Bay	3.06	0.61	117.20	87
	SW Shelf	1.80	0.34	5.07	48
	Ten Thousand Is.	5.03	0.38	13.40	78
	Whitewater Bay	3.86	0.78	12.50	66