6-25-2008

South Florida Coastal Water Quality Monitoring Network Jan. - Mar. 2008 Quarterly Report for SFWMD Contract 4600000352

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25 June 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 Jan. – Mar. 2008 Quarterly Report for SFWMD Contract #4600000352

Dear Mr. Wright:

This letter serves to transmit the 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 Jan. – Mar. 2008 from 28 stations in Florida Bay, 18 stations in Whitewater Bay, 21 stations in Ten Thousand Islands, 18 stations in Biscayne Bay, and 28 stations in Cape Romano-Rookery Bay-Pine Island Sound. 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). 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, µg l^{-1}). Field parameters measured at both surface and bottom of the water column include salinity, dissolved oxygen (DO; mg l^{-1}), and temperature (^oC). Turbidity (NTU) and pH were measure in surface water only.

2. Problems Encountered

The attached **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.

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).

Because of the very diverse nature of the Rookery Bay area, we will continue to use generally accepted geomorphological characteristics to group the stations (Fig. 5). 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. 6-25). 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.6). Neither TP nor CHLA levels have fully 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. The drought in the northern end of the system is evident in San Carlos Bay and Cocohatchee River (Figs. 22 & 25). As a consequence salinities remain high and nutrient input low.

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

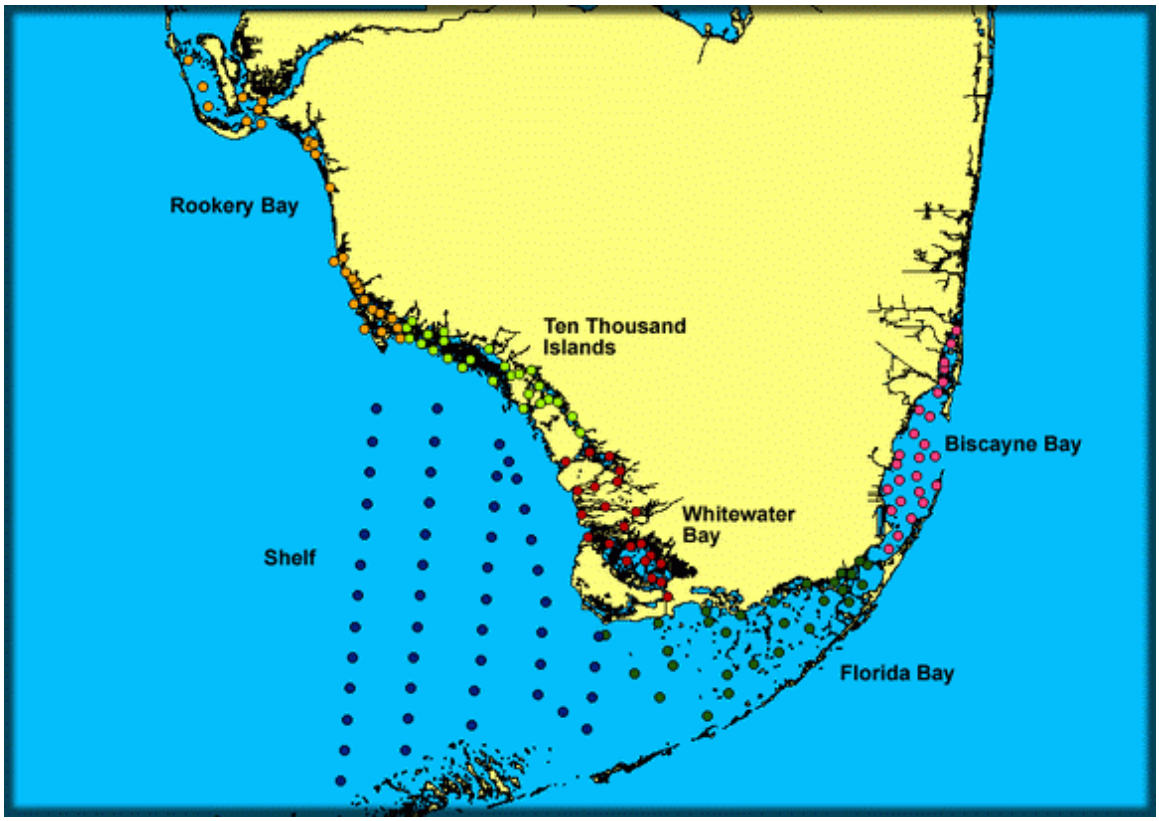

Figure 1: All fixed water quality stations funded by this SFWMD project (note that the SW Shelf stations are no longer included in the monitoring project).

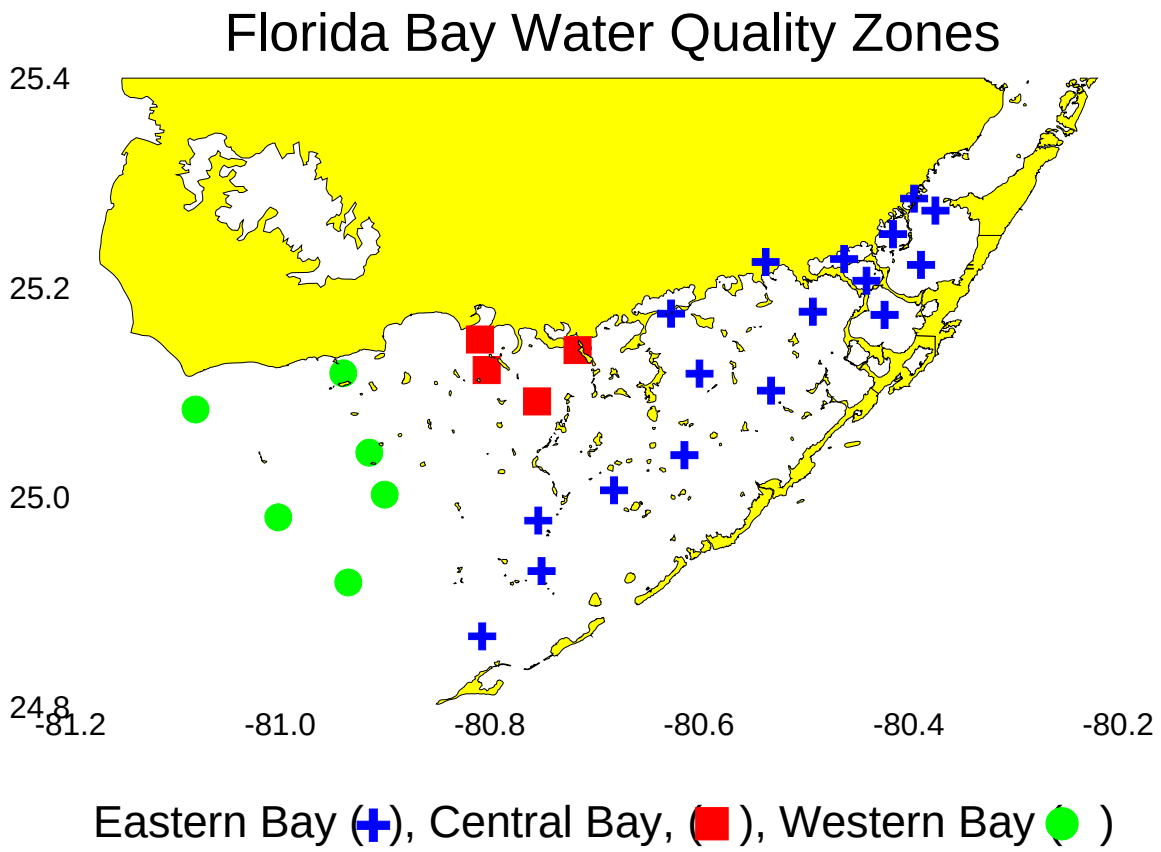

Figure 2. Florida Bay zones.

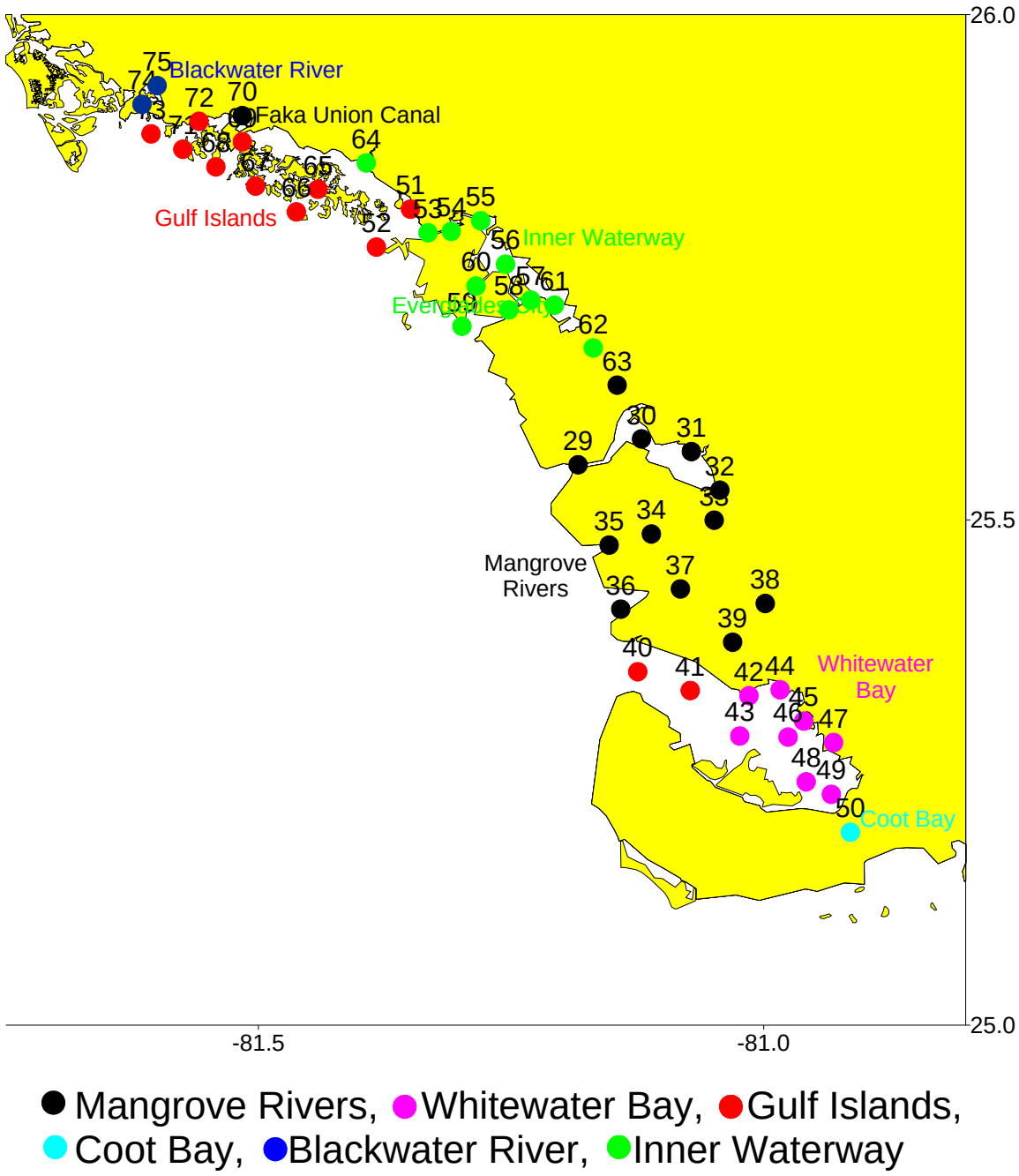

Figure 3. WWB-TTI water quality zones.

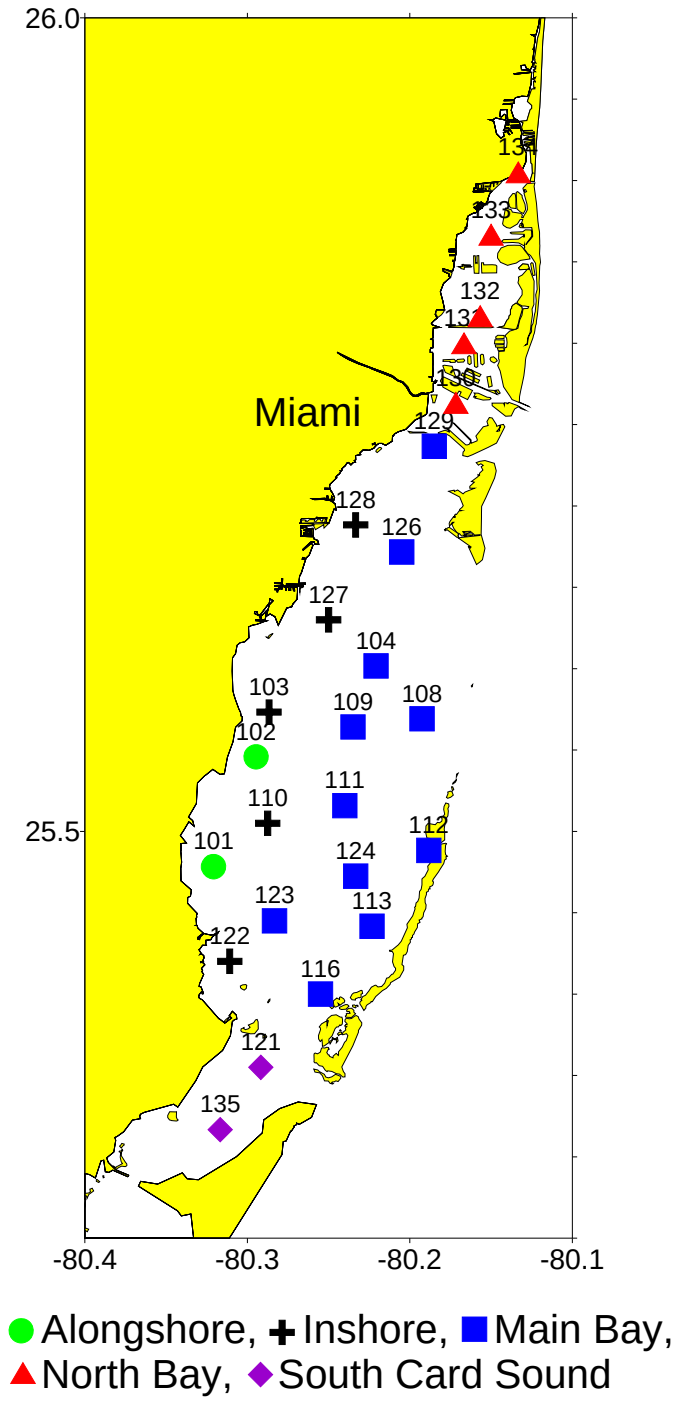

Figure 4. Biscayne Bay water quality zones.

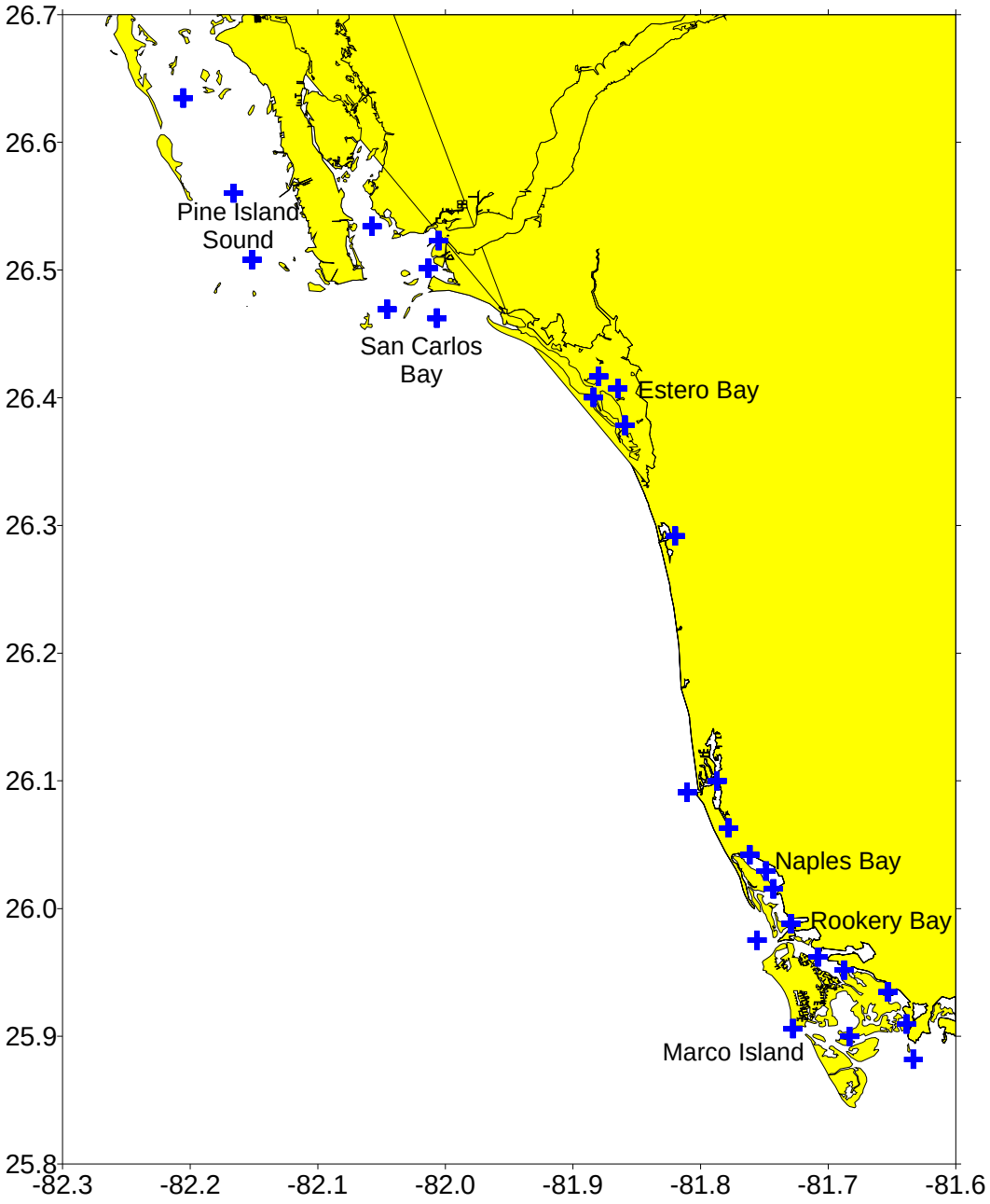

Figure 5. SW estuaries.

Eastern Florida Bay Zone

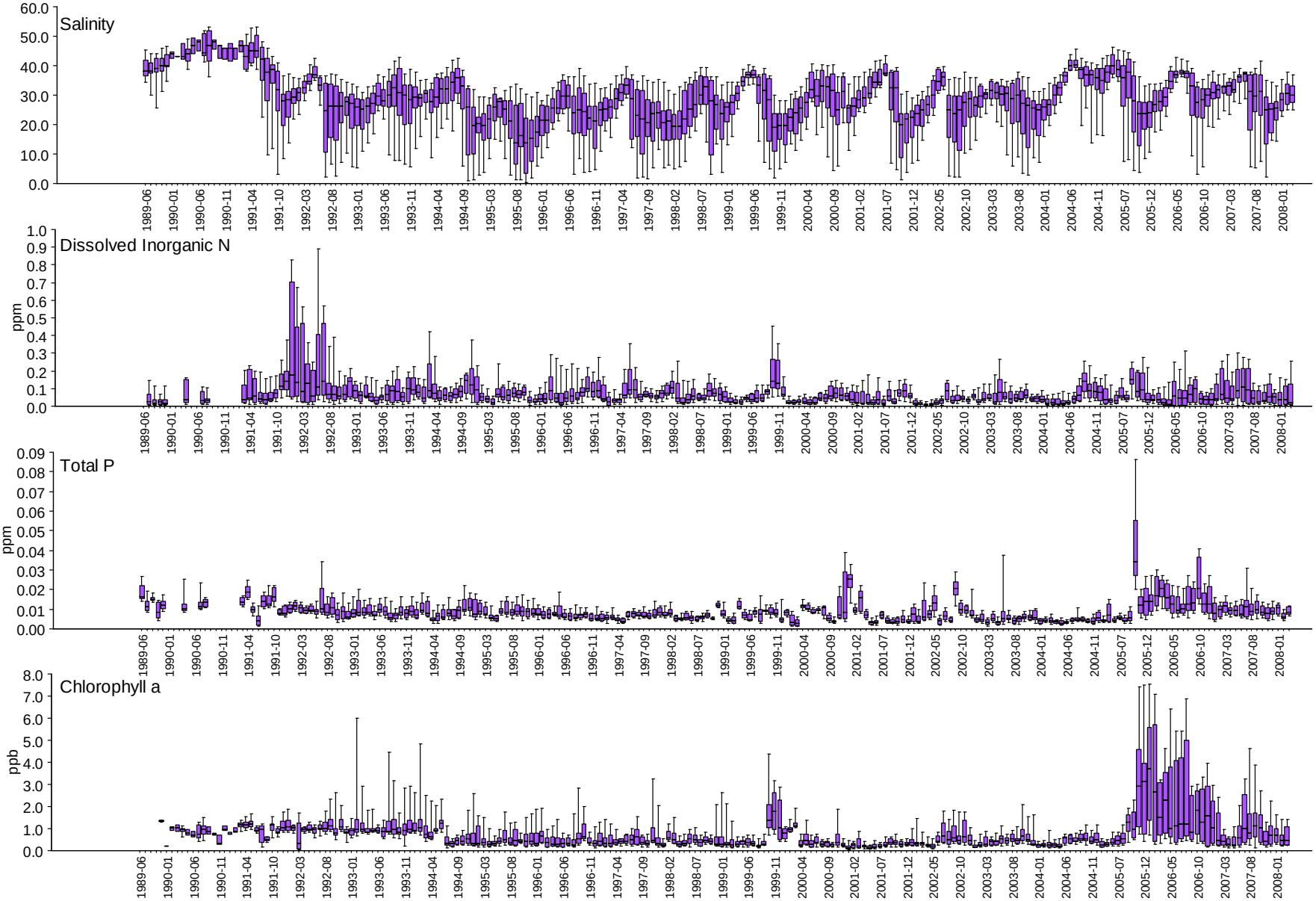

Figure 6. Box-and-whisker plots of water quality in Eastern Florida Bay by survey.

Central Florida Bay Zone

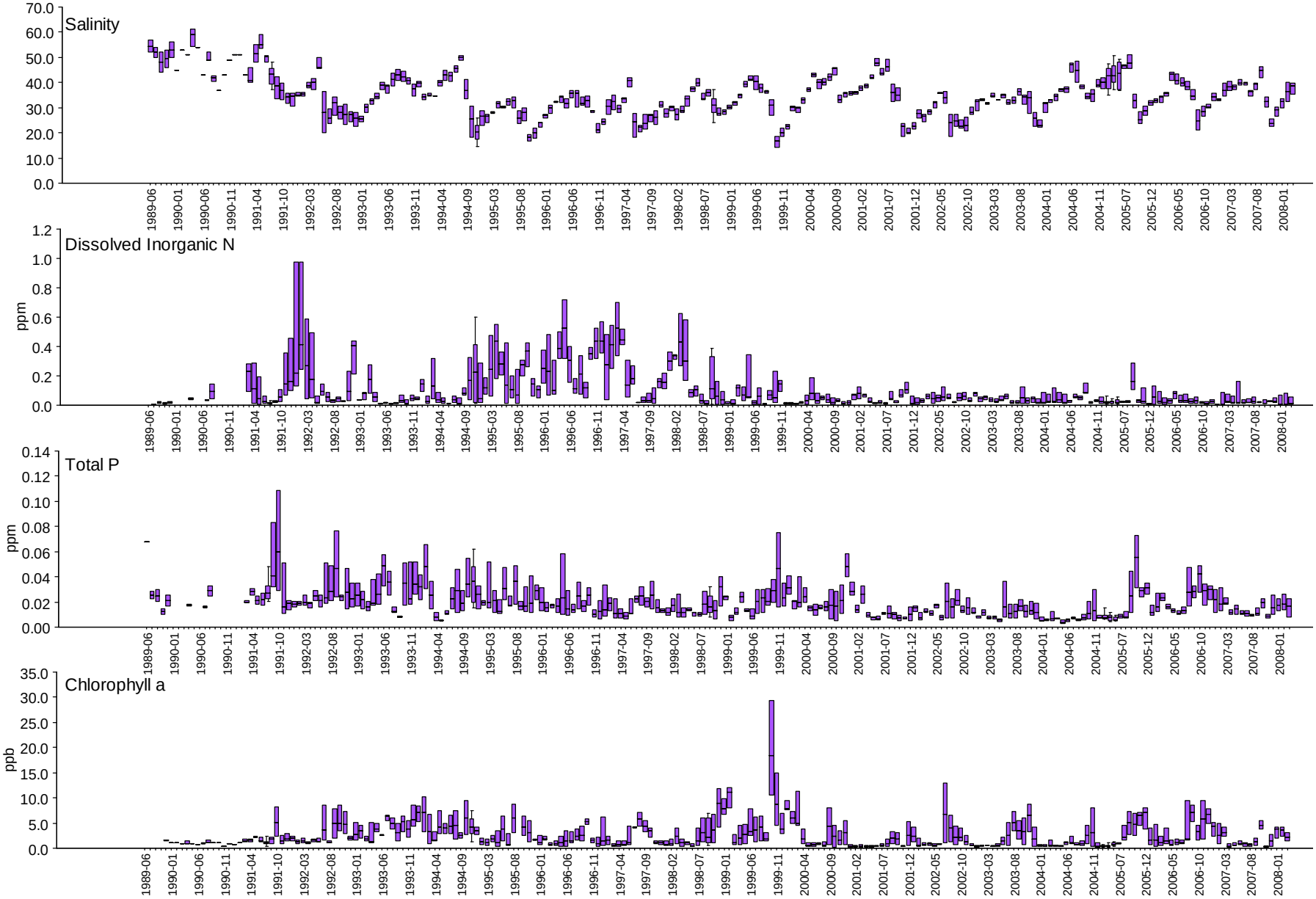

Figure 7. Box-and-whisker plots of water quality in Central Florida Bay by survey.

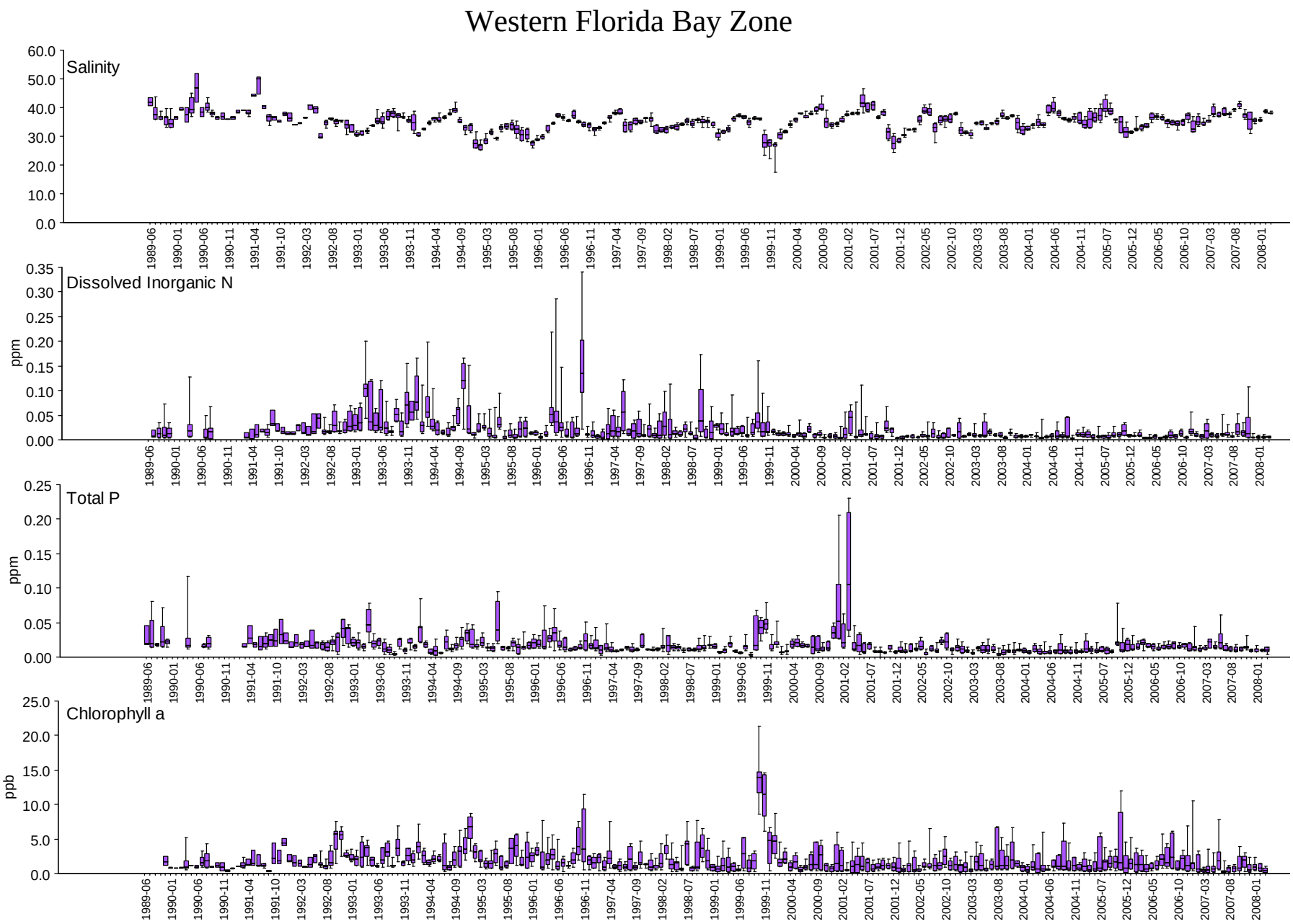

Figure 8. Box-and-whisker plots of water quality in Western Florida Bay by survey.

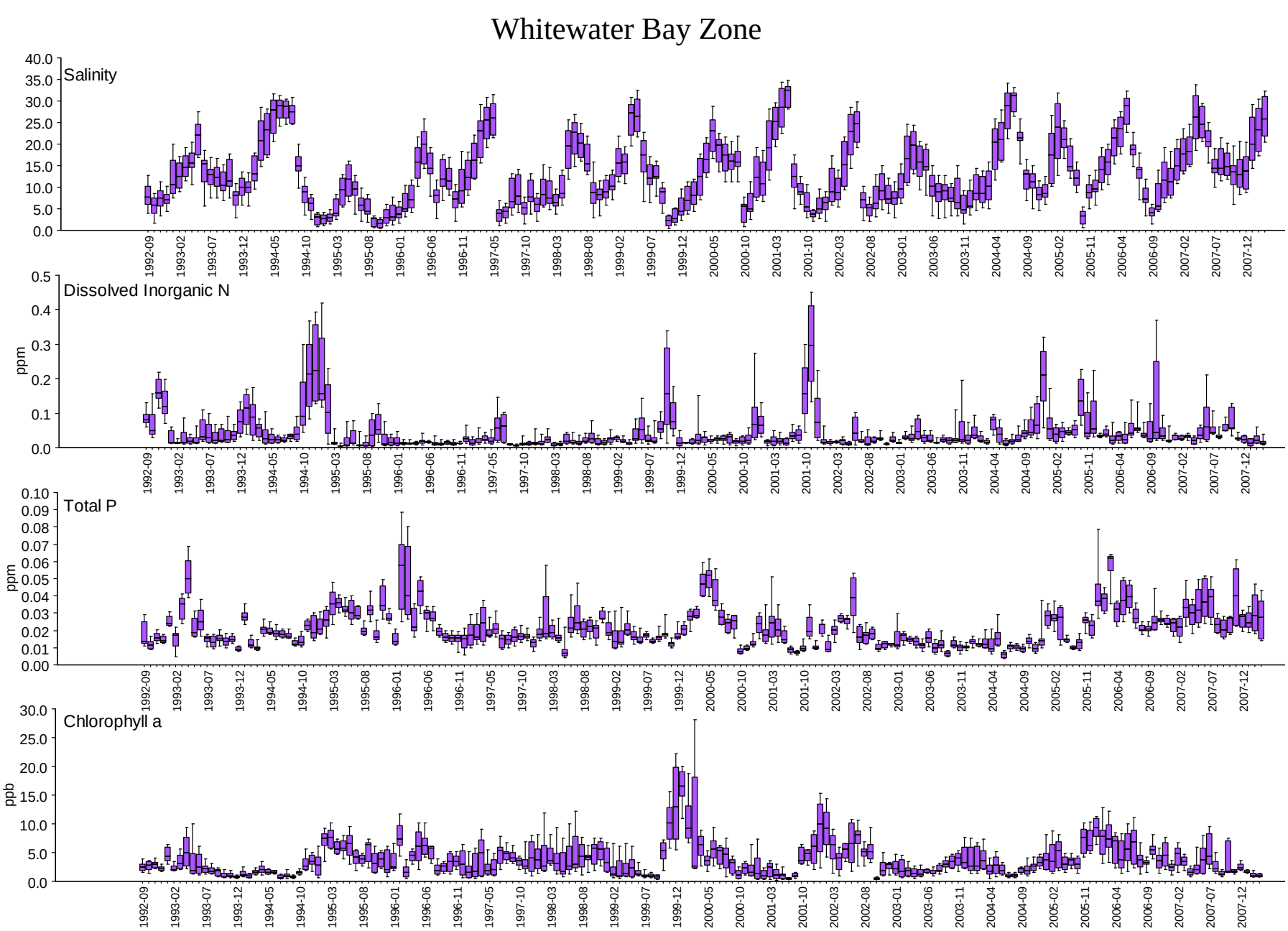

Figure 9. Box-and-whisker plots of water quality in WWB-TTI by survey.

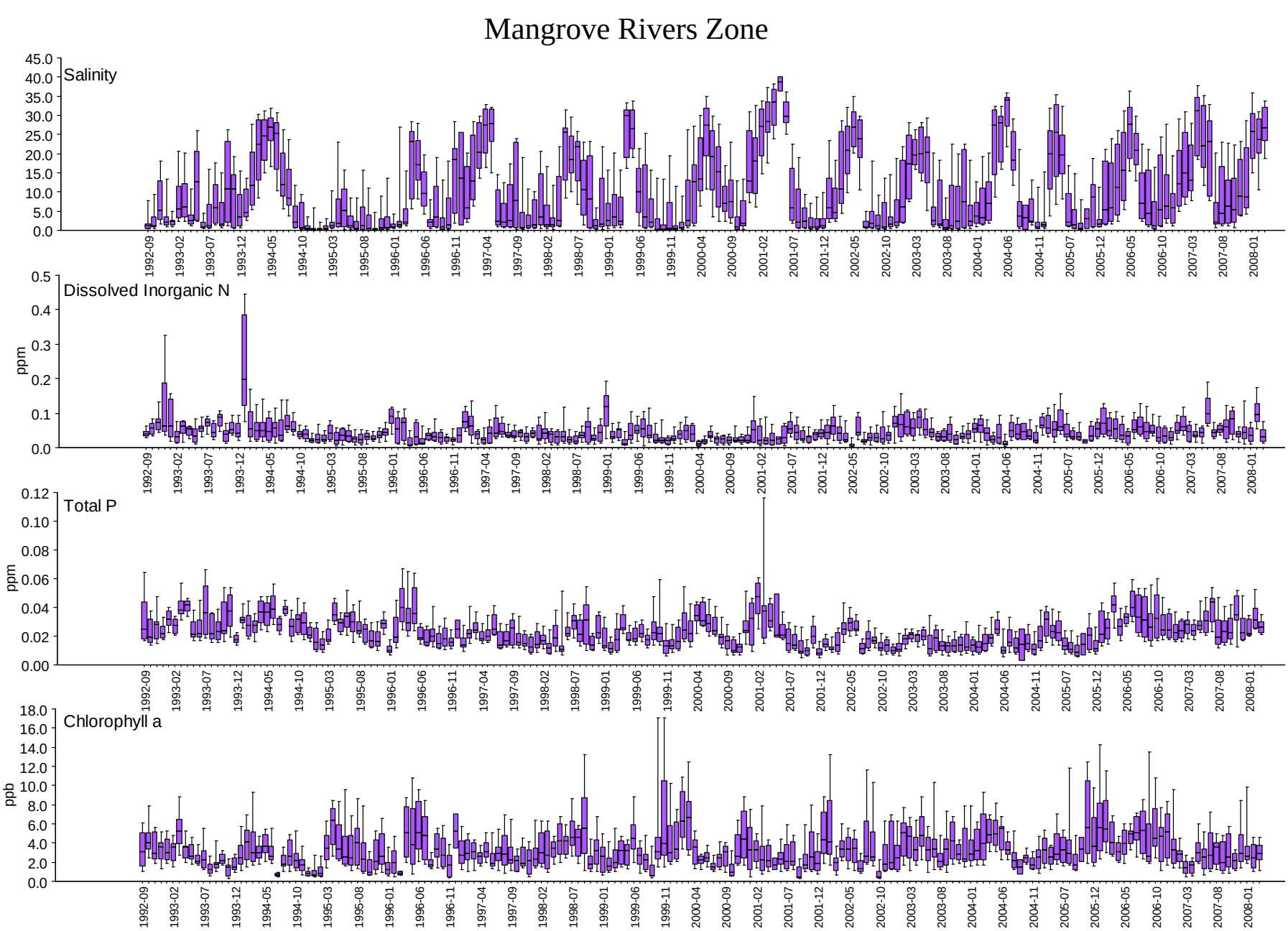

Figure 10. Box-and-whisker plots of water quality in WWB-TTI by survey.

Gulf Islands Zone

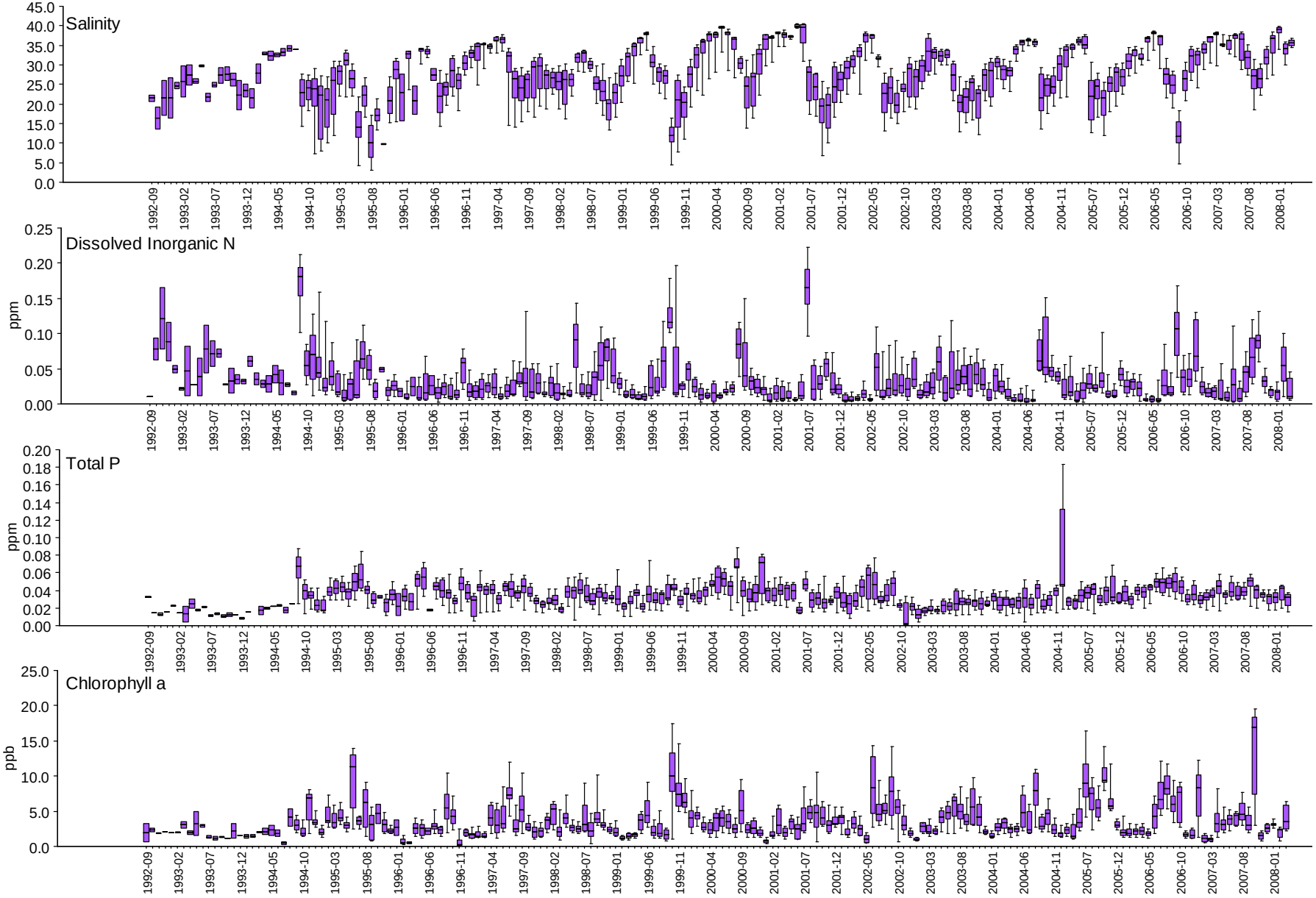

Figure 11. Box-and-whisker plots of water quality in WWB-TTI by survey.

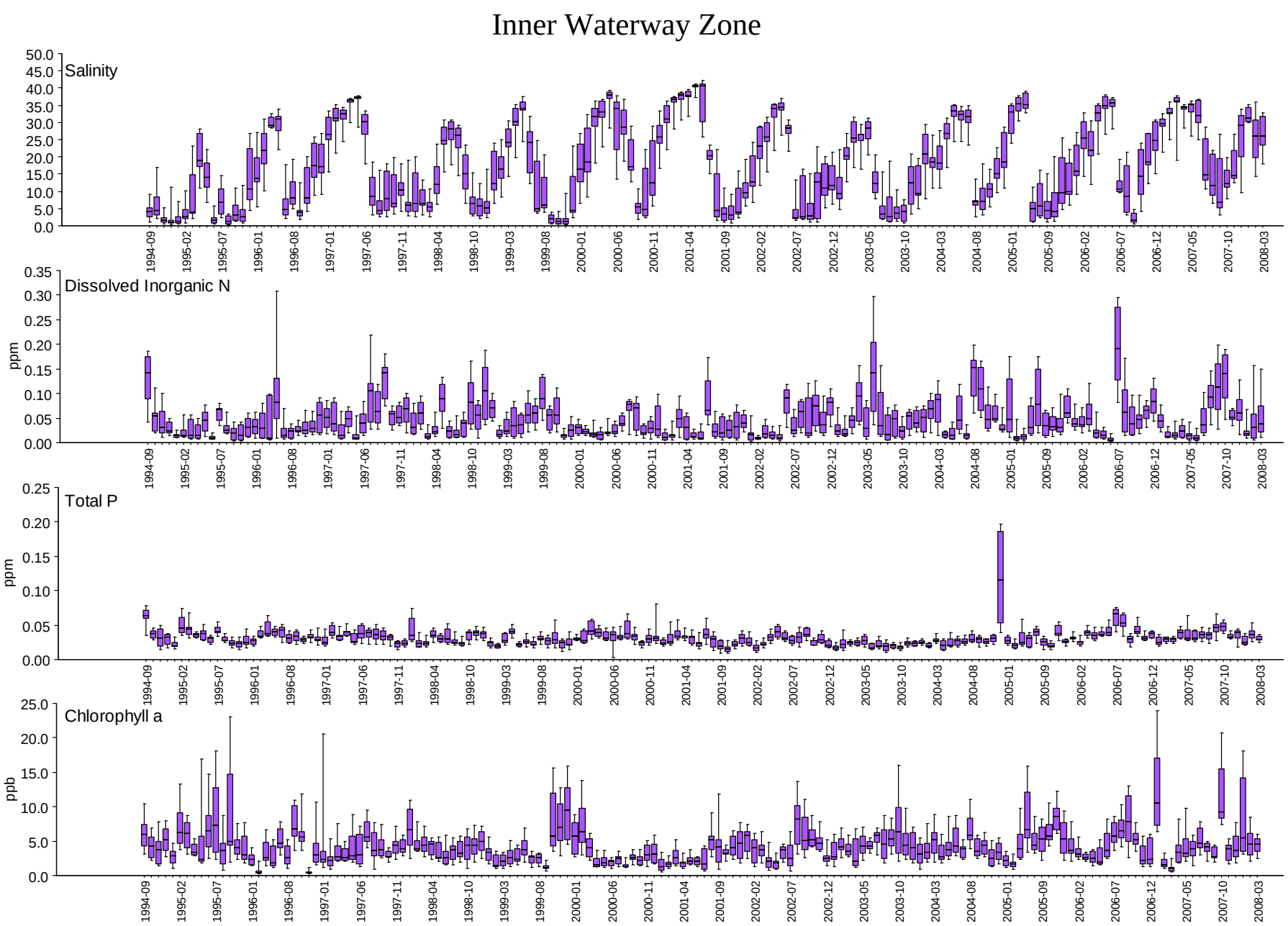

Figure 12. Box-and-whisker plots of water quality in WWB-TTI by survey.

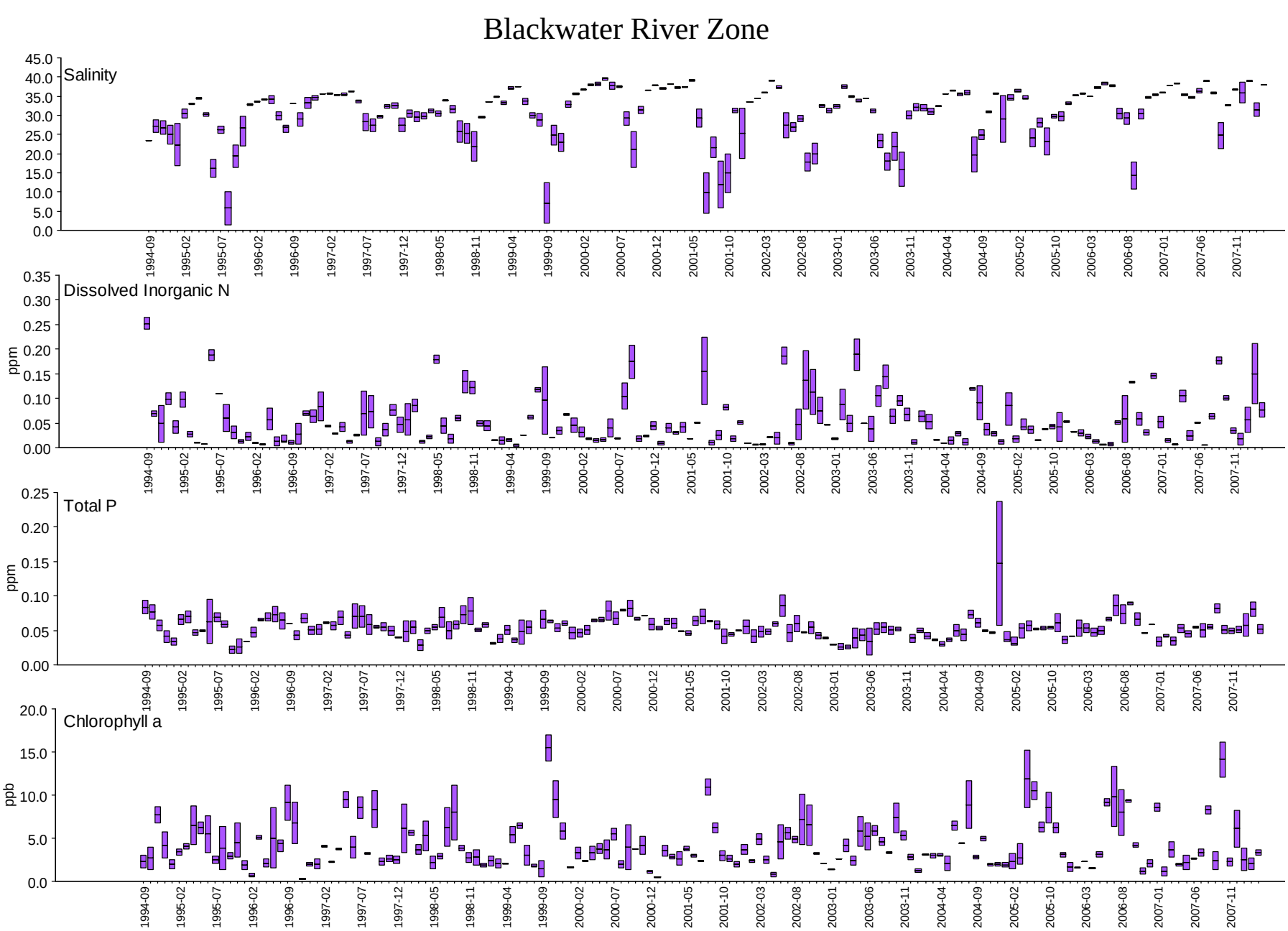

Figure 13. Box-and-whisker plots of water quality in WWB-TTI by survey.

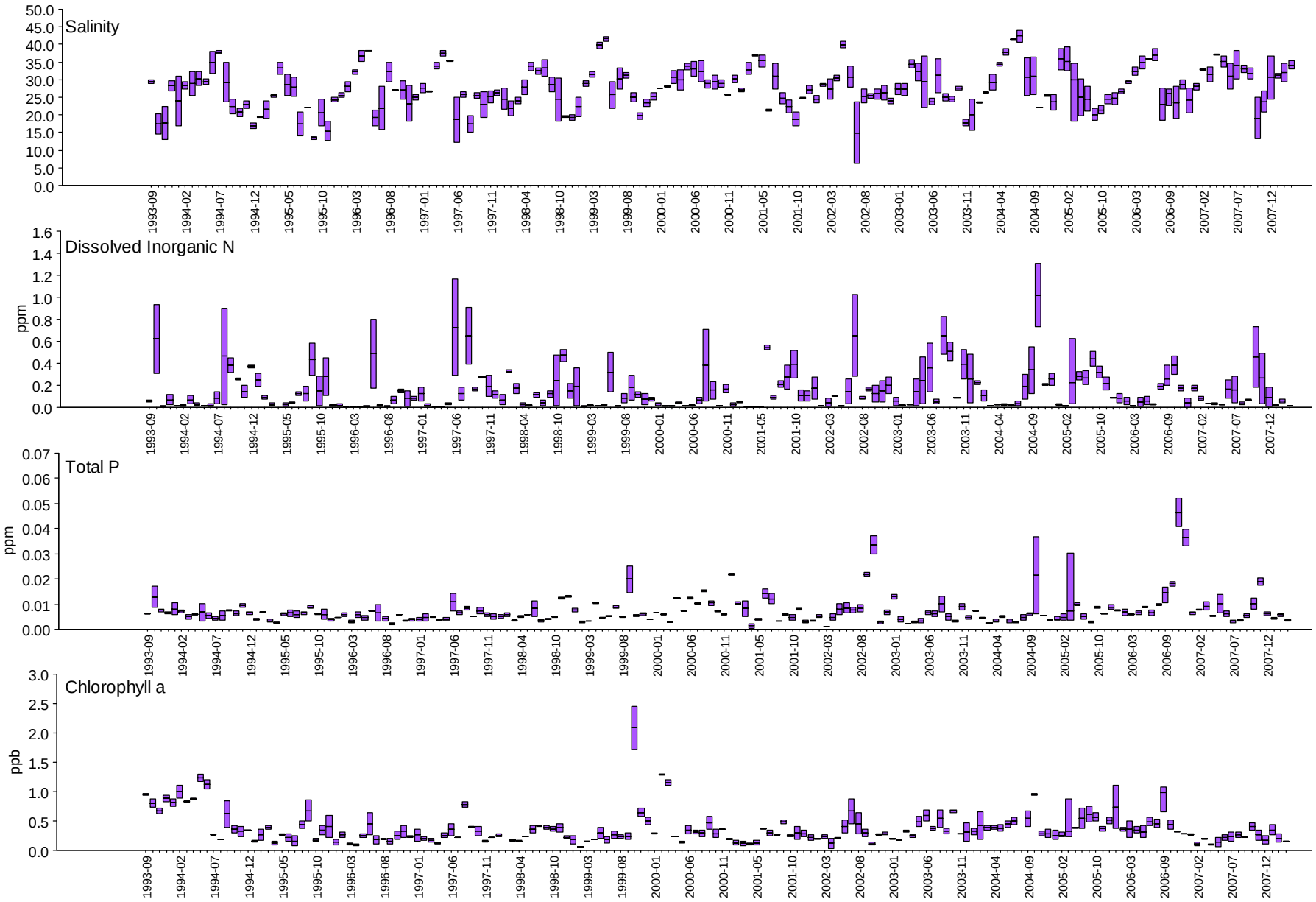

Figure 14. Box-and-whisker plots of water quality in Biscayne Bay by survey.

BB Inshore Zone

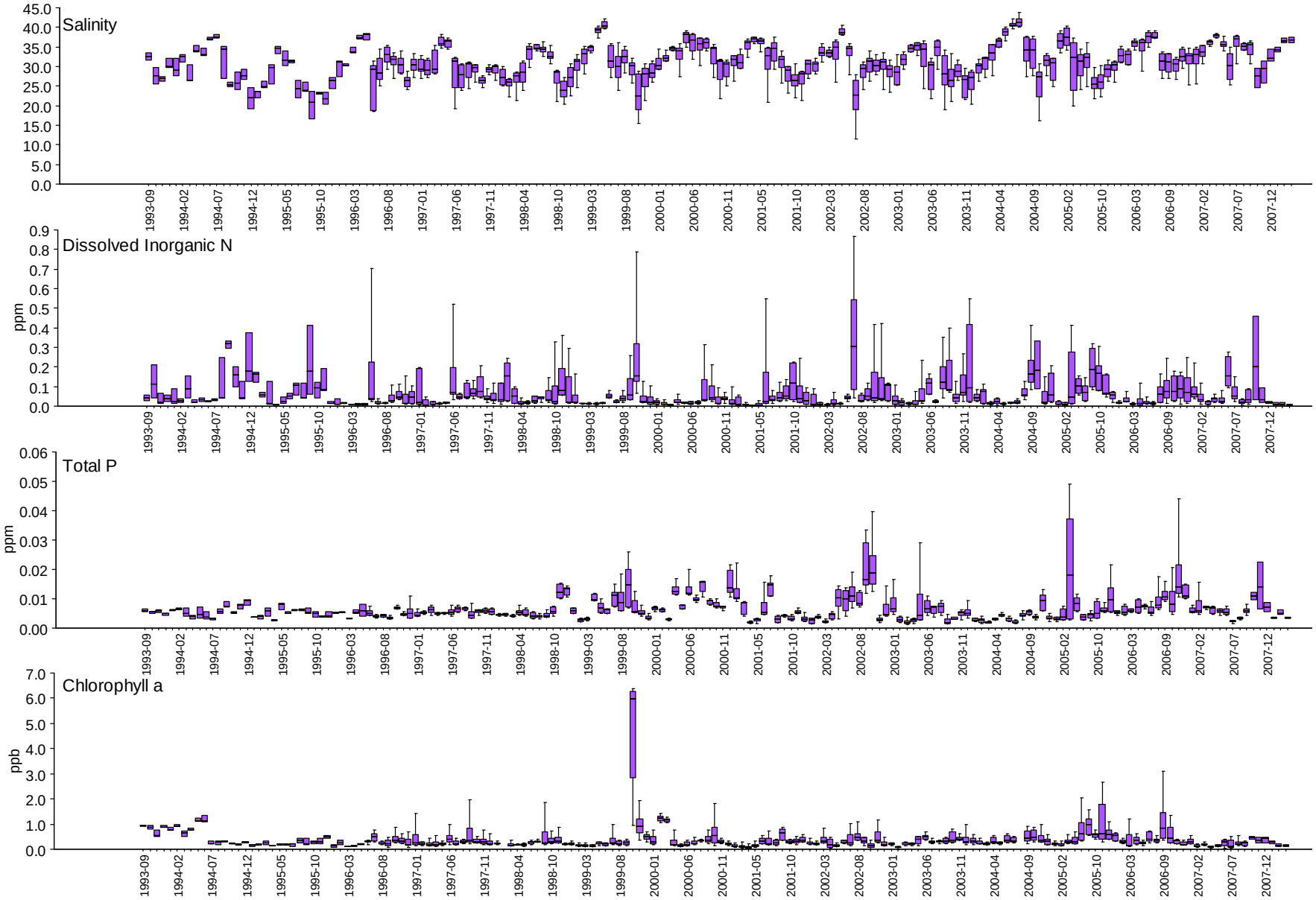

Figure 15. Box-and-whisker plots of water quality in Biscayne Bay by survey.

Main Bay Zone

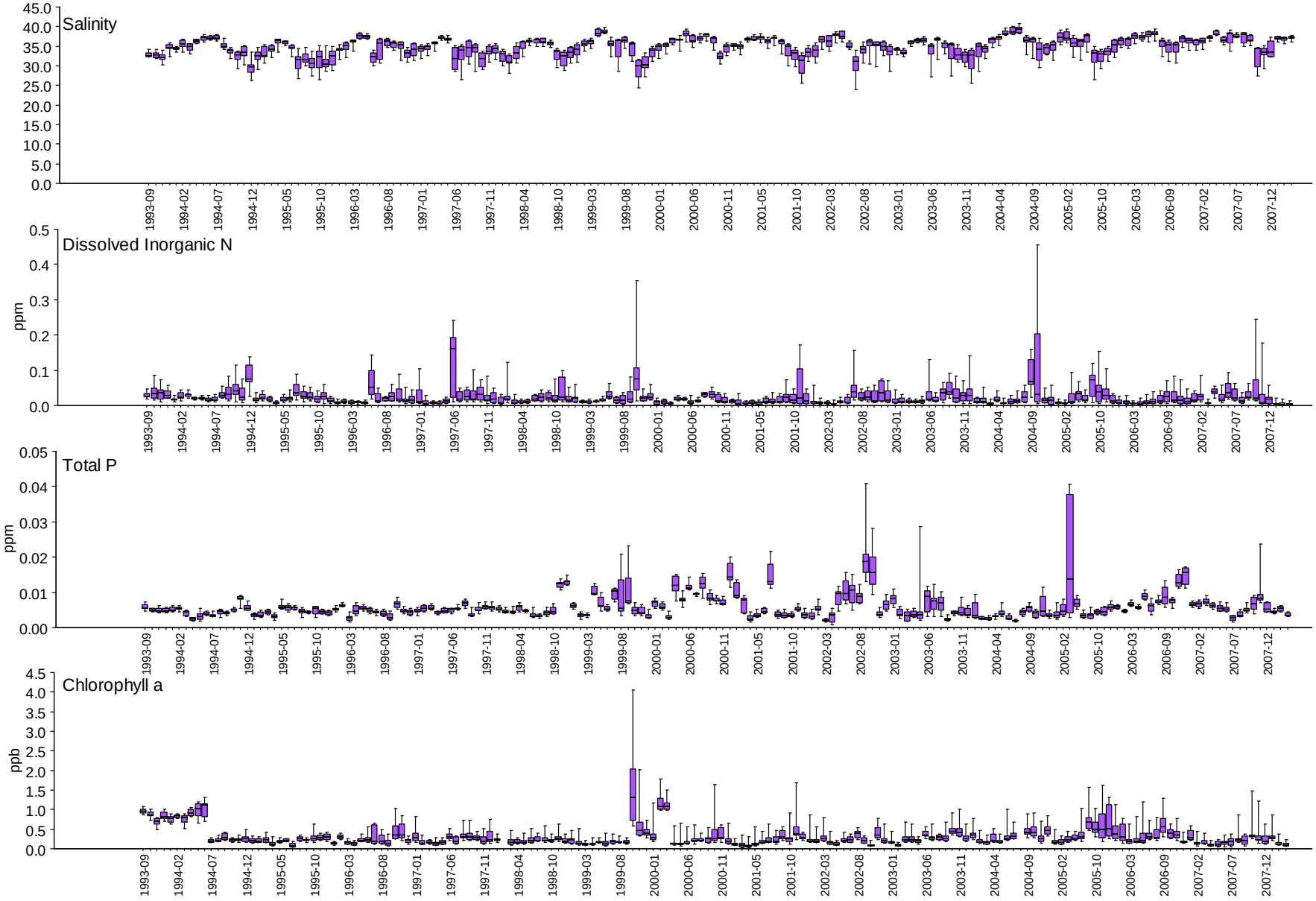

Figure 16. Box-and-whisker plots of water quality in Biscayne Bay by survey.

South Card Sound Zone

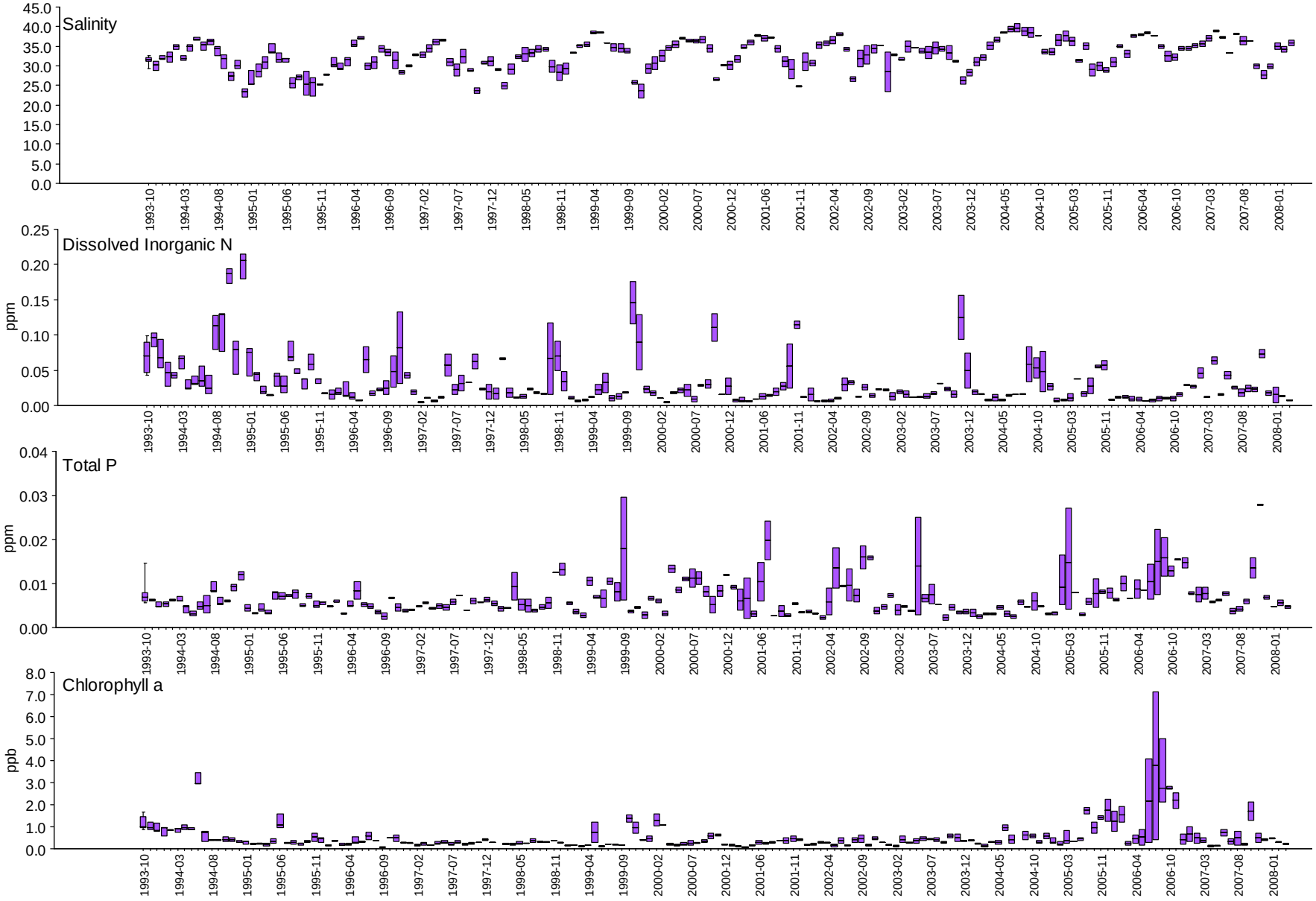

Figure 17. Box-and-whisker plots of water quality in Biscayne Bay by survey.

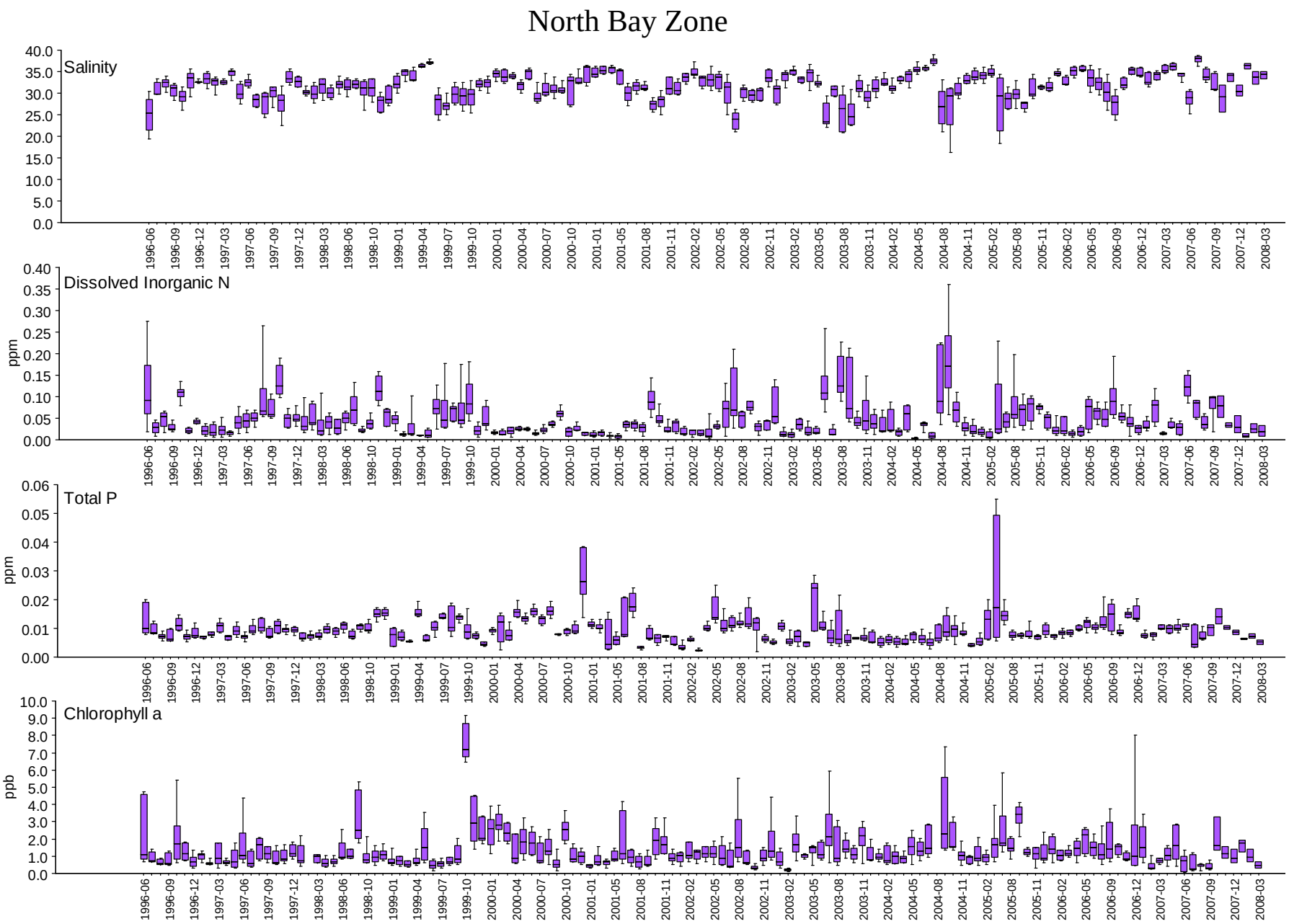

Figure 18. Box-and-whisker plots of water quality in Biscayne Bay by survey.

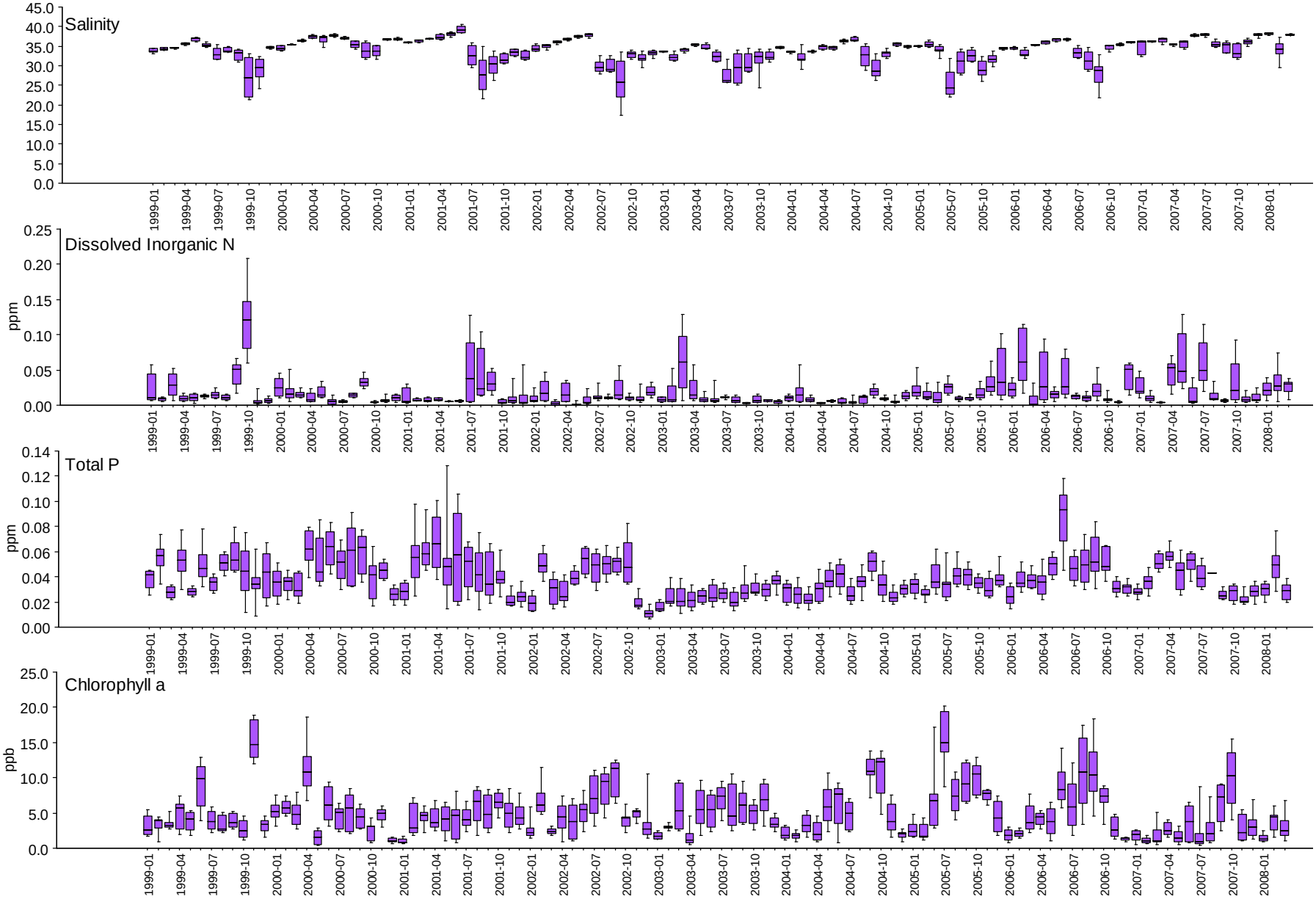

Figure 19. Box-and-whisker plots of water quality in RB-PIS by survey.

Rookery Bay Zone

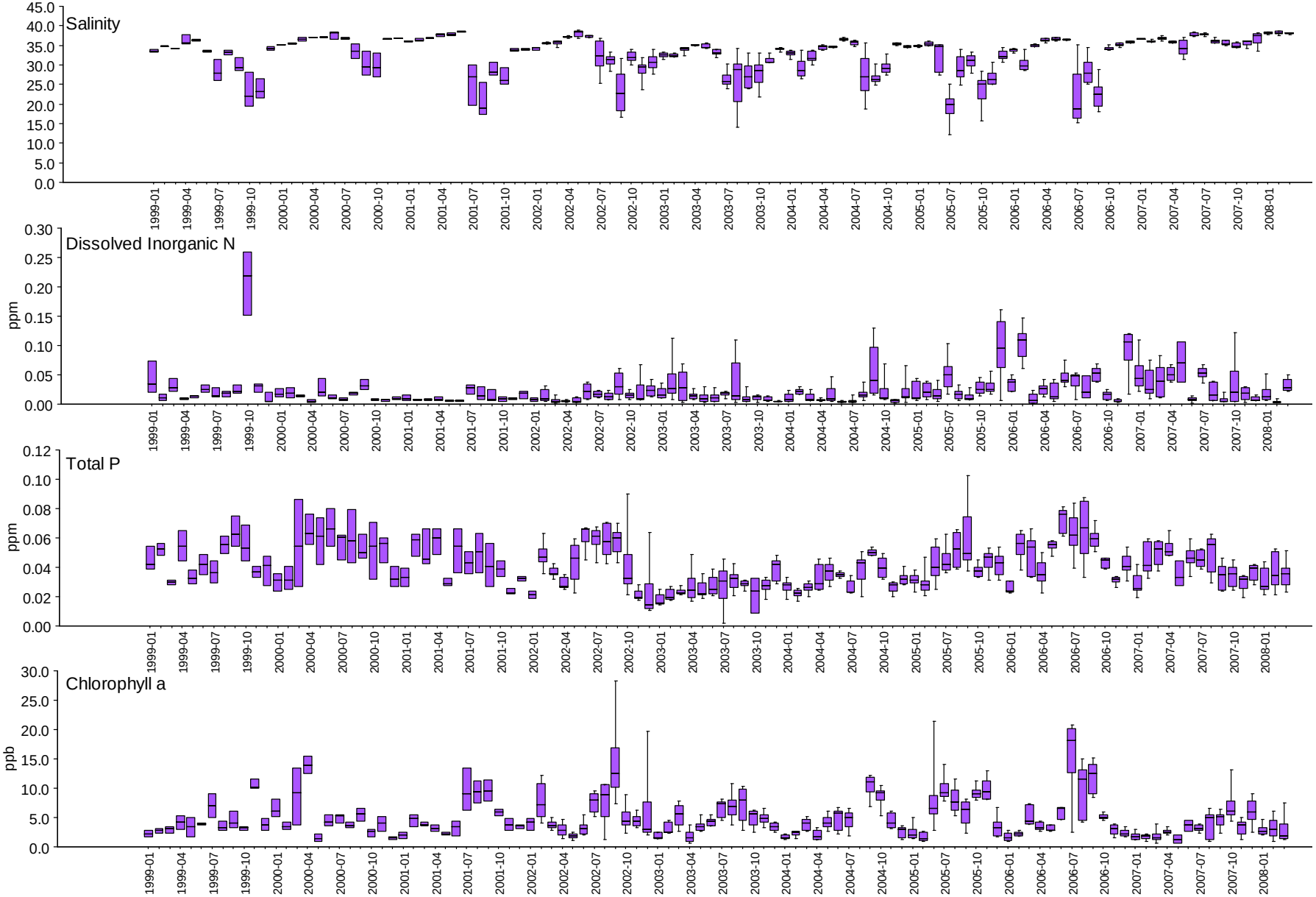

Figure 20. Box-and-whisker plots of water quality in RB-PIS by survey.

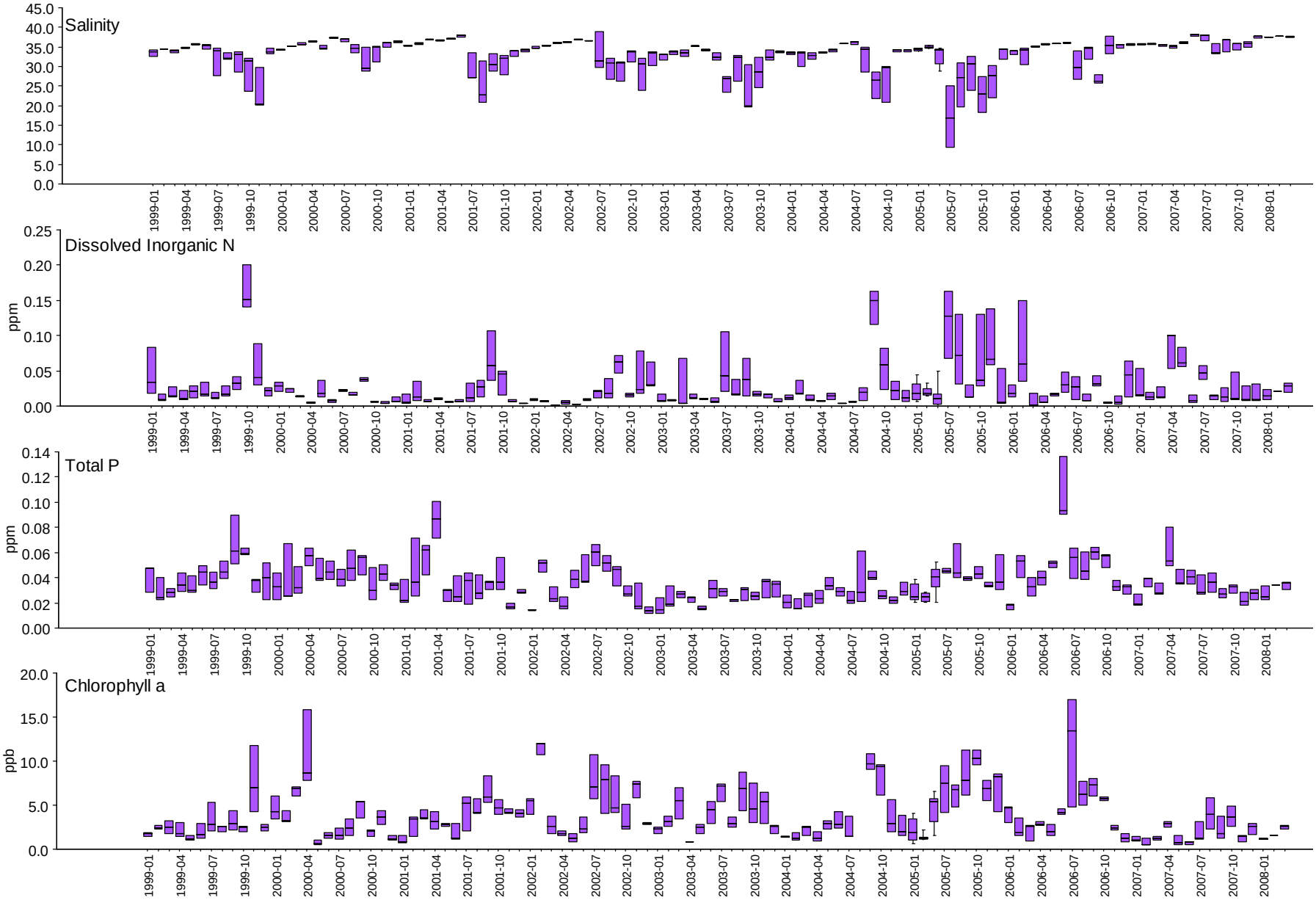

Figure 21. Box-and-whisker plots of water quality in RB-PIS by survey.

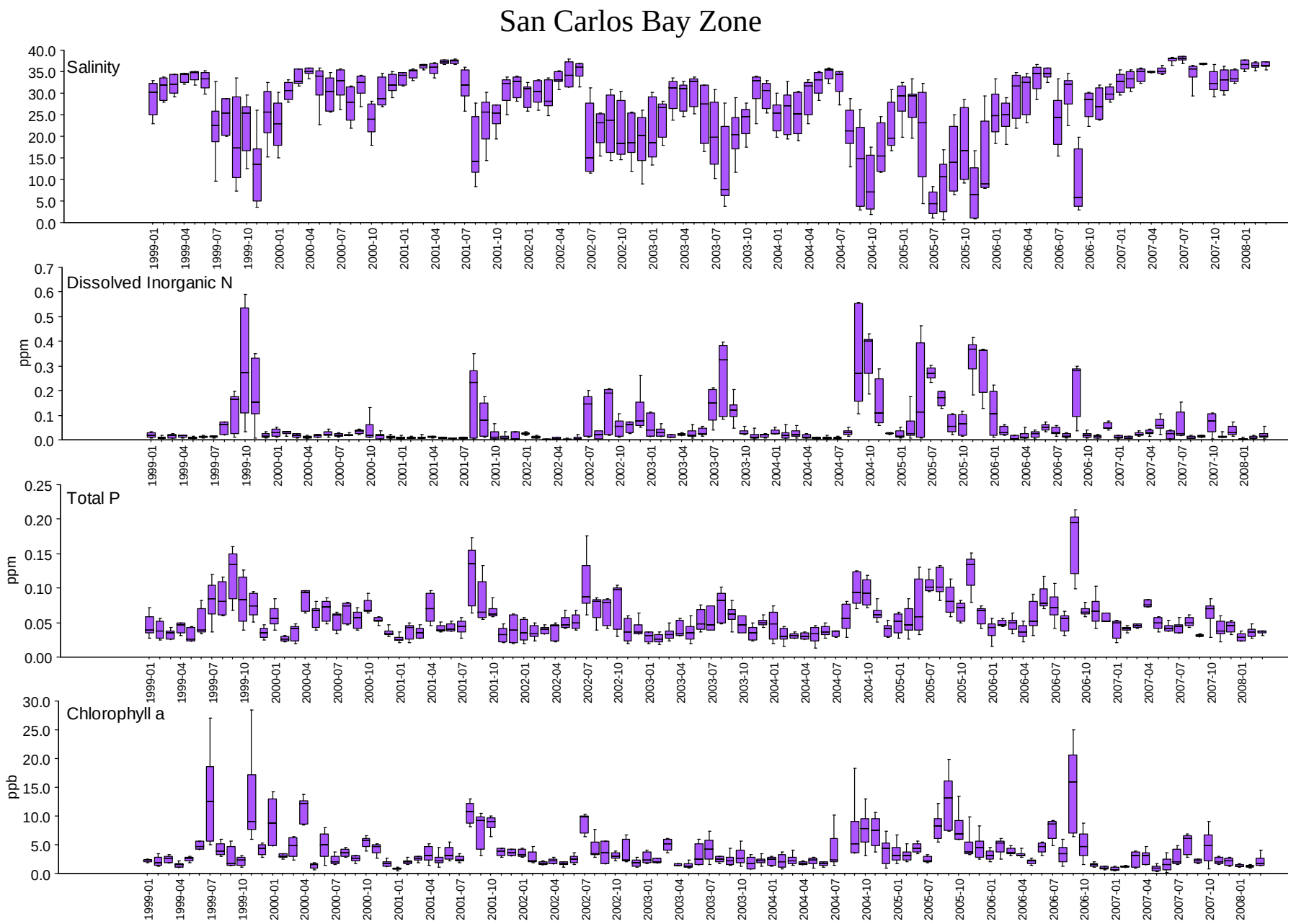

Figure 22. Box-and-whisker plots of water quality in RB-PIS by survey.

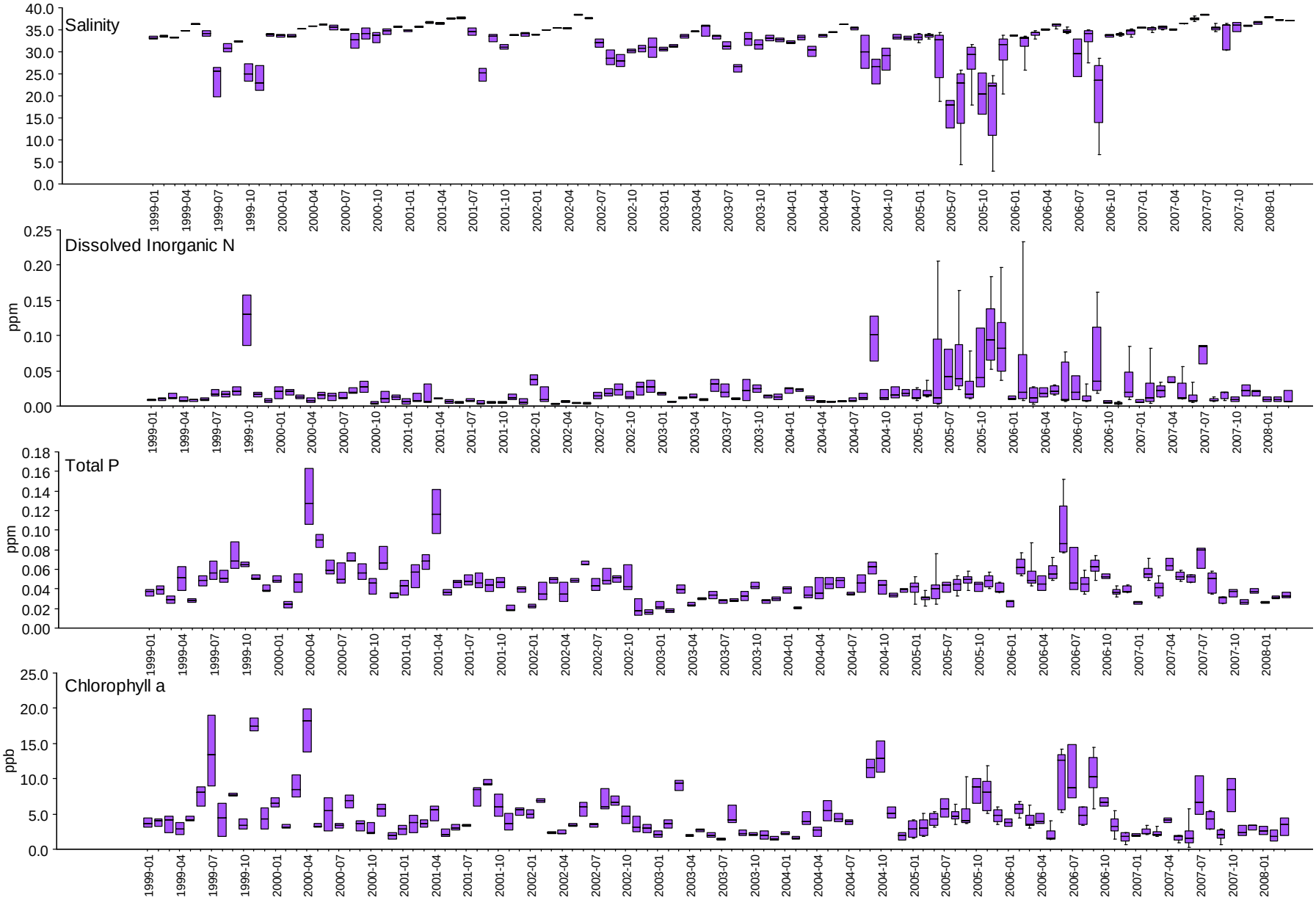

Figure 23. Box-and-whisker plots of water quality in RB-PIS by survey.

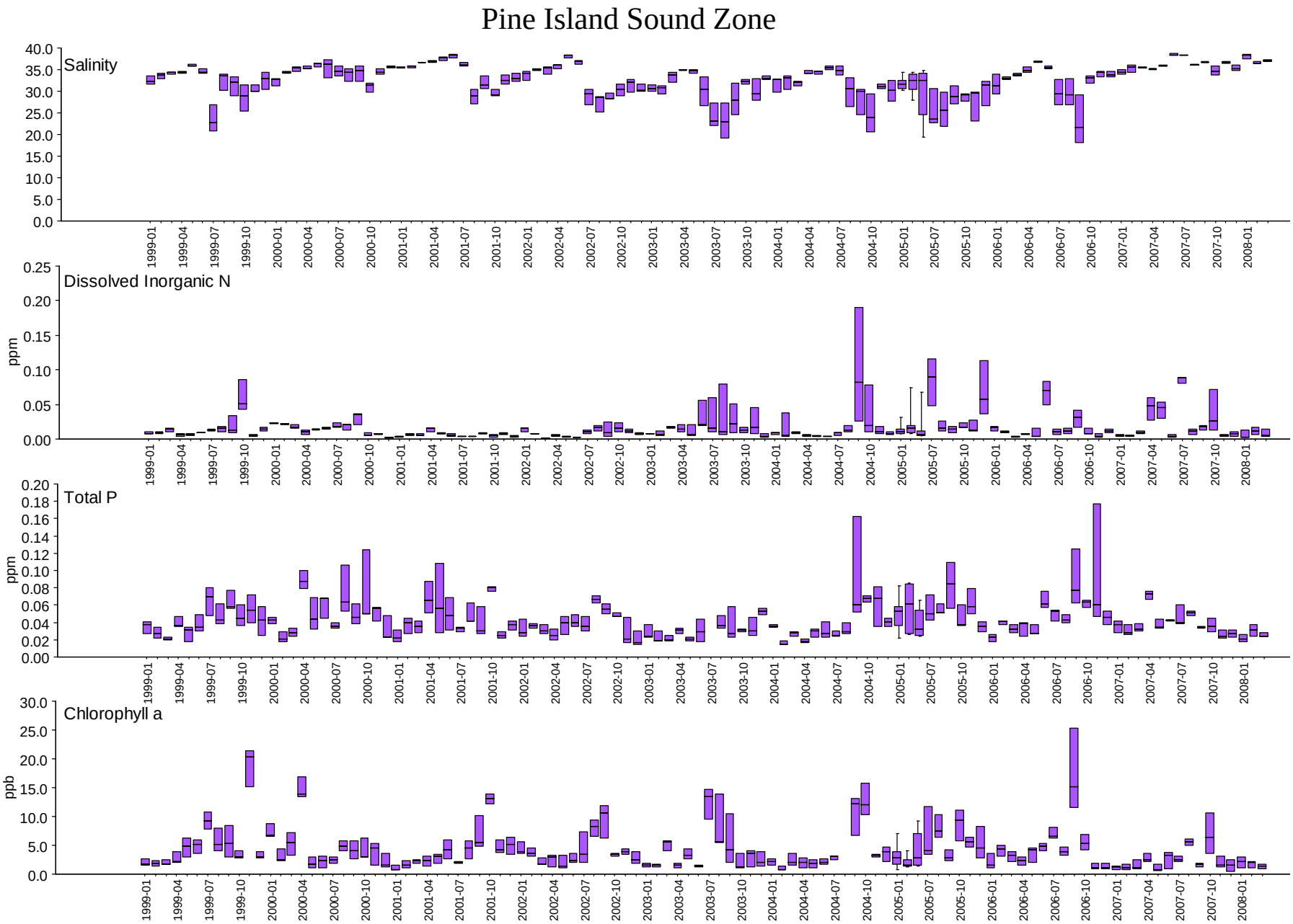

Figure 24. Box-and-whisker plots of water quality in RB-PIS by survey.

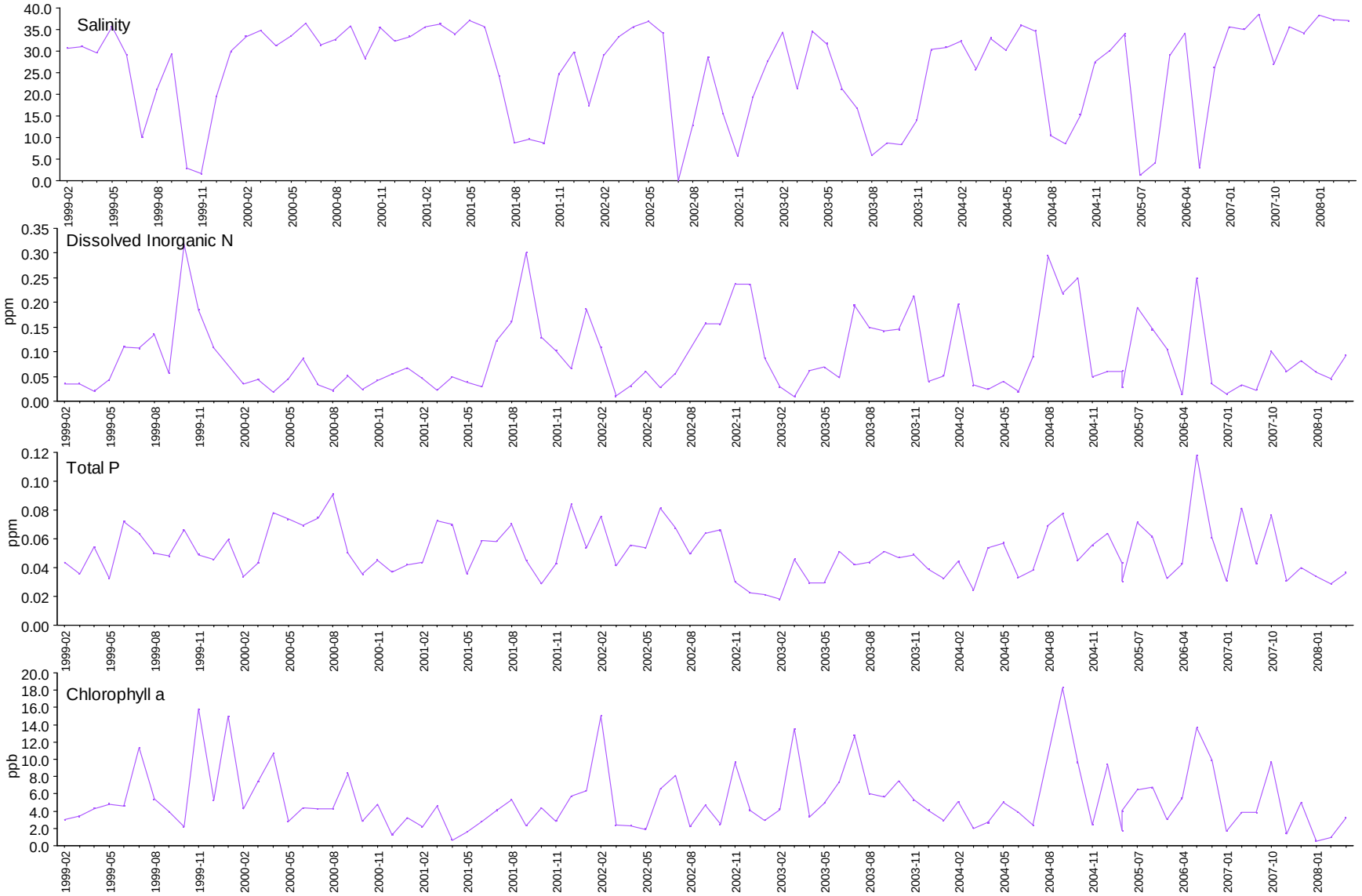

Figure 25. Line chart of water quality in RB-PIS by survey (only one site).

Table 1.

Parameter	Zone	Median	Min.	Max.	*n*
Chlorophyll *a*	Biscayne Bay	0.261	0.062	1.979	54
($\mu g\ l^{-1}$)	Florida Bay	0.676	0.143	4.364	83
	Rookery Bay	2.018	0.533	7.632	85
	Ten Thousand Is.	3.437	1.276	18.355	62
	Whitewater Bay	1.977	0.409	7.693	54
Surface	Biscayne Bay	7.28	4.73	9.08	54
Dissolved	Florida Bay	8.01	4.53	9.71	84
Oxygen	Rookery Bay	7.56	5.60	9.81	72
($mg\ l^{-1}$)	Ten Thousand Is.	6.76	2.89	8.59	62
	Whitewater Bay	6.38	3.42	9.65	54
Bottom	Biscayne Bay	7.23	4.53	9.12	54
Dissolved	Florida Bay	7.83	3.93	9.55	84
Oxygen	Rookery Bay	7.38	4.75	9.77	71
($mg\ l^{-1}$)	Ten Thousand Is.	6.46	2.88	8.60	62
	Whitewater Bay	6.32	3.25	9.98	54
NH_4^+	Biscayne Bay	0.0056	0.0016	0.0306	53
(ppm)	Florida Bay	0.0108	0.0016	0.3014	80
	Rookery Bay	0.0104	0.0006	0.0663	73
	Ten Thousand Is.	0.0215	0.0018	0.1577	62
	Whitewater Bay	0.0125	0.0029	0.0585	54
NO_2^-	Biscayne Bay	0.0008	0.0003	0.0033	54
(ppm)	Florida Bay	0.0008	0.0000	0.0185	80
	Rookery Bay	0.0011	0.0001	0.0041	73
	Ten Thousand Is.	0.0024	0.0004	0.0067	62
	Whitewater Bay	0.0016	0.0002	0.0075	54
NO_3^-	Biscayne Bay	0.0022	0.0001	0.0544	53
(ppm)	Florida Bay	0.0018	0.0000	0.1456	75
	Rookery Bay	0.0024	0.0000	0.0235	73
	Ten Thousand Is.	0.0096	0.0000	0.0748	62
	Whitewater Bay	0.0068	0.0002	0.1317	54

Parameter	Zone	Median	Min.	Max.	*n*
pH	Biscayne Bay	8.138	7.920	8.405	54
	Florida Bay	8.130	7.690	8.840	84
	Rookery Bay	8.000	3.955	8.190	87
	Ten Thousand Is.	7.840	7.200	8.040	62
	Whitewater Bay	7.883	6.980	8.515	54
Surface Salinity	Biscayne Bay	35.95	29.54	37.69	54
	Florida Bay	32.05	19.36	40.94	84
	Rookery Bay	37.54	28.30	38.59	87
	Ten Thousand Is.	33.64	5.56	39.91	62
	Whitewater Bay	26.61	14.13	35.90	54
Bottom Salinity	Biscayne Bay	36.07	30.49	37.69	54
	Florida Bay	32.06	19.38	42.20	84
	Rookery Bay	37.58	31.38	38.61	85
	Ten Thousand Is.	33.64	7.77	39.95	62
	Whitewater Bay	26.77	14.08	36.27	54
Soluble Reactive Phosphorus (ppm)	Biscayne Bay	0.0011	0.0001	0.0022	54
	Florida Bay	0.0012	0.0002	0.0057	80
	Rookery Bay	0.0075	0.0010	0.0310	73
	Ten Thousand Is.	0.0100	0.0004	0.0596	62
	Whitewater Bay	0.0019	0.0002	0.0177	54
Surface Temperature (^{o}C)	Biscayne Bay	22.76	20.49	26.95	54
	Florida Bay	24.23	18.46	27.62	84
	Rookery Bay	20.26	16.93	22.71	87
	Ten Thousand Is.	21.04	18.96	33.82	62
	Whitewater Bay	25.43	22.18	27.19	54
Bottom Temperature (^{o}C)	Biscayne Bay	22.88	20.49	26.95	54
	Florida Bay	24.21	18.47	27.62	84
	Rookery Bay	20.19	16.91	22.62	85
	Ten Thousand Is.	21.02	18.93	28.95	62
	Whitewater Bay	25.44	22.19	27.18	54
Total Nitrogen (ppm)	Biscayne Bay	0.167	0.066	0.606	54
	Florida Bay	0.474	0.128	1.042	84
	Rookery Bay	0.201	0.112	0.792	58
	Ten Thousand Is.	0.286	0.170	0.582	62
	Whitewater Bay	0.366	0.151	0.751	54

Parameter	Zone	Median	Min.	Max.	*n*
Total Organic Carbon (ppm)	Biscayne Bay	2.269	1.069	5.150	35
	Florida Bay	5.775	2.399	14.715	83
	Rookery Bay	2.537	1.559	5.386	86
	Ten Thousand Is.	6.283	1.853	12.650	59
	Whitewater Bay	9.803	4.745	21.350	53
Total Organic Nitrogen (ppm)	Biscayne Bay	0.153	0.063	0.576	54
	Florida Bay	0.407	0.092	1.010	84
	Rookery Bay	0.182	0.089	0.789	81
	Ten Thousand Is.	0.248	0.131	0.521	62
	Whitewater Bay	0.330	0.143	0.720	54
Total Phosphorus (ppm)	Biscayne Bay	0.005	0.003	0.009	54
	Florida Bay	0.010	0.003	0.053	83
	Rookery Bay	0.031	0.017	0.081	87
	Ten Thousand Is.	0.035	0.021	0.091	54
	Whitewater Bay	0.025	0.014	0.048	37
Turbidity (NTU)	Biscayne Bay	0.60	0.00	4.51	52
	Florida Bay	4.21	0.47	38.40	84
	SW Shelf	4.28	0.86	13.80	87
	Ten Thousand Is.	3.31	0.80	22.70	61
	Whitewater Bay	4.52	1.94	21.00	53