FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university
Southeast Environmental Research Center
OE-148 Florida International University, Miami, FL 33199
305-348-3095, 305-348-4096 fax, http://serc.fiu.edu

20 December 2005

Patrick Martin
SFWMD
8894 Belvedere Road
West Palm Beach, FL 33411

Re: South Florida Coastal Water Quality Monitoring Network – 7-9/05 Quarterly Report (C-15397)

Dear Mr. Martin:

This letter serves to transmit the South Florida Coastal Water Quality Monitoring Network Quarterly Report as per our SFWMD/SERC Cooperative Agreement #C-15397. This report consists of this letter along with corresponding tables and figures.

Project Background

This report includes water quality data collected monthly during the annual period of record (POR) July – Sept. 2005 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 ($Si(OH)_4$) 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.

Biological parameters monitored included chlorophyll a ($\mu g\ l^{-1}$) and alkaline phosphatase activity (APA; $\mu M\ hr^{-1}$). 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) of the surface water was also measured.

Data Results

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, so we now have 5 years of data available. But 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. 7-28). 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.

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

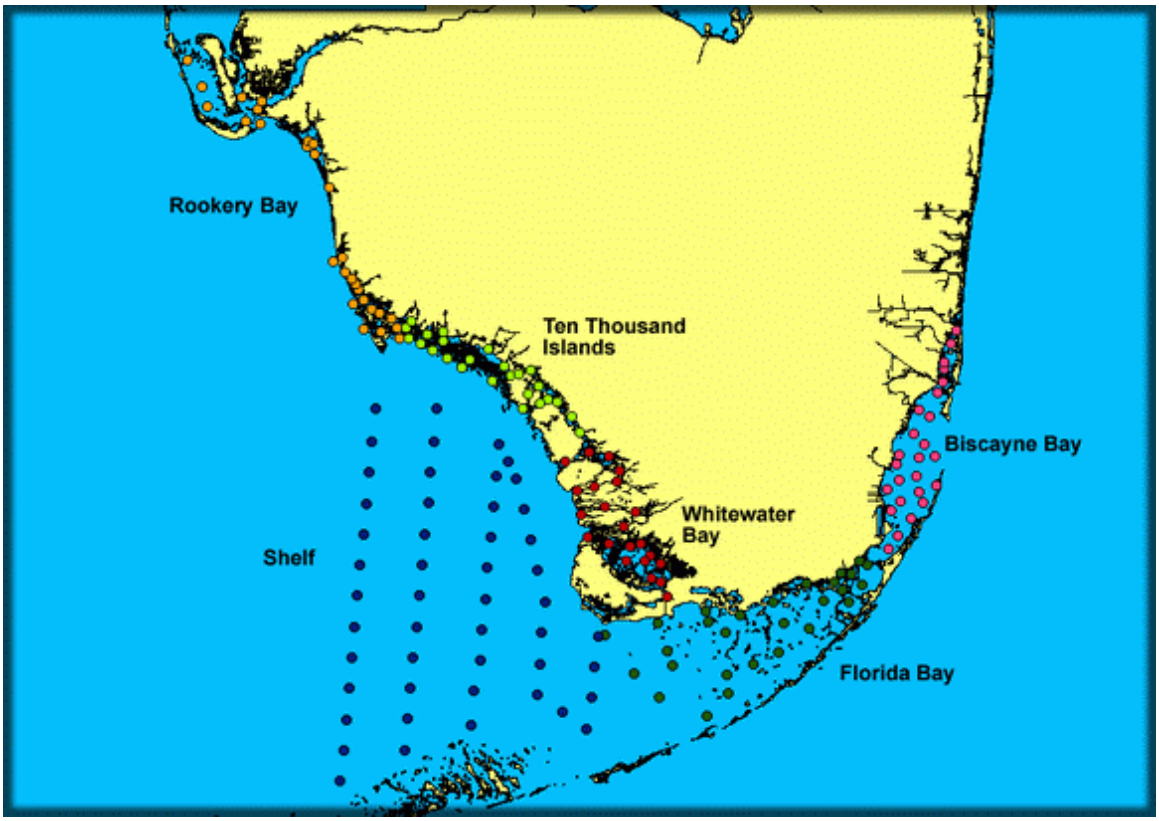

Figure 1: All fixed water quality stations funded by this SFWMD project.

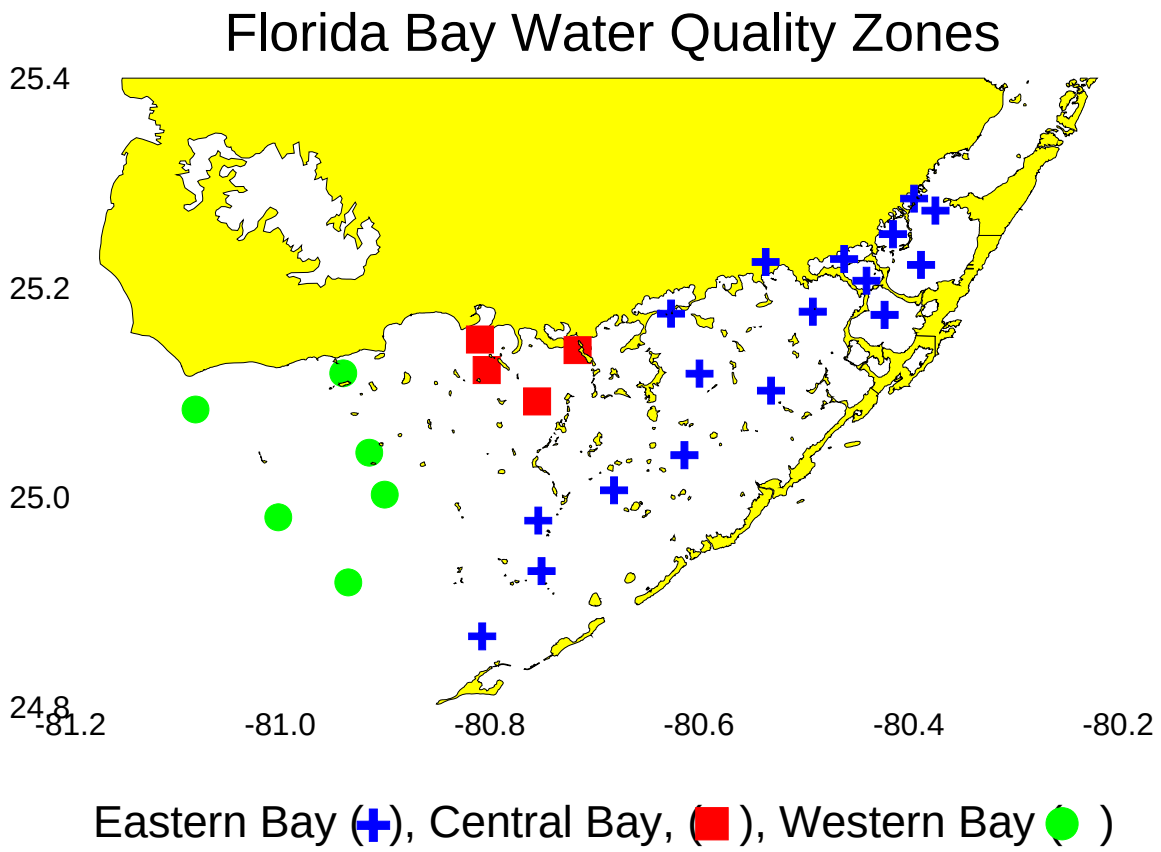

Figure 2. Florida Bay zones.

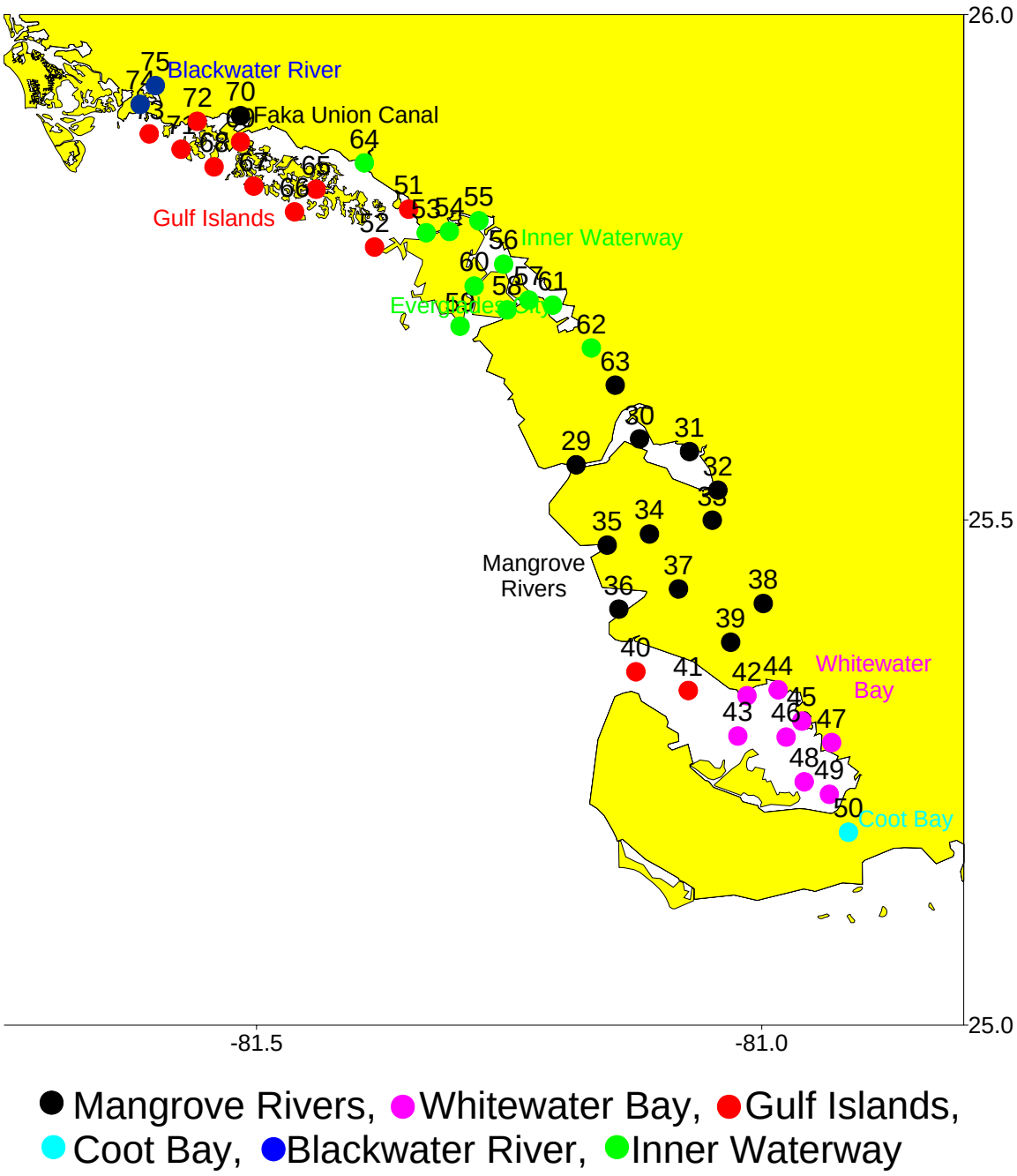

Figure 3. WWB-TTI water quality zones.

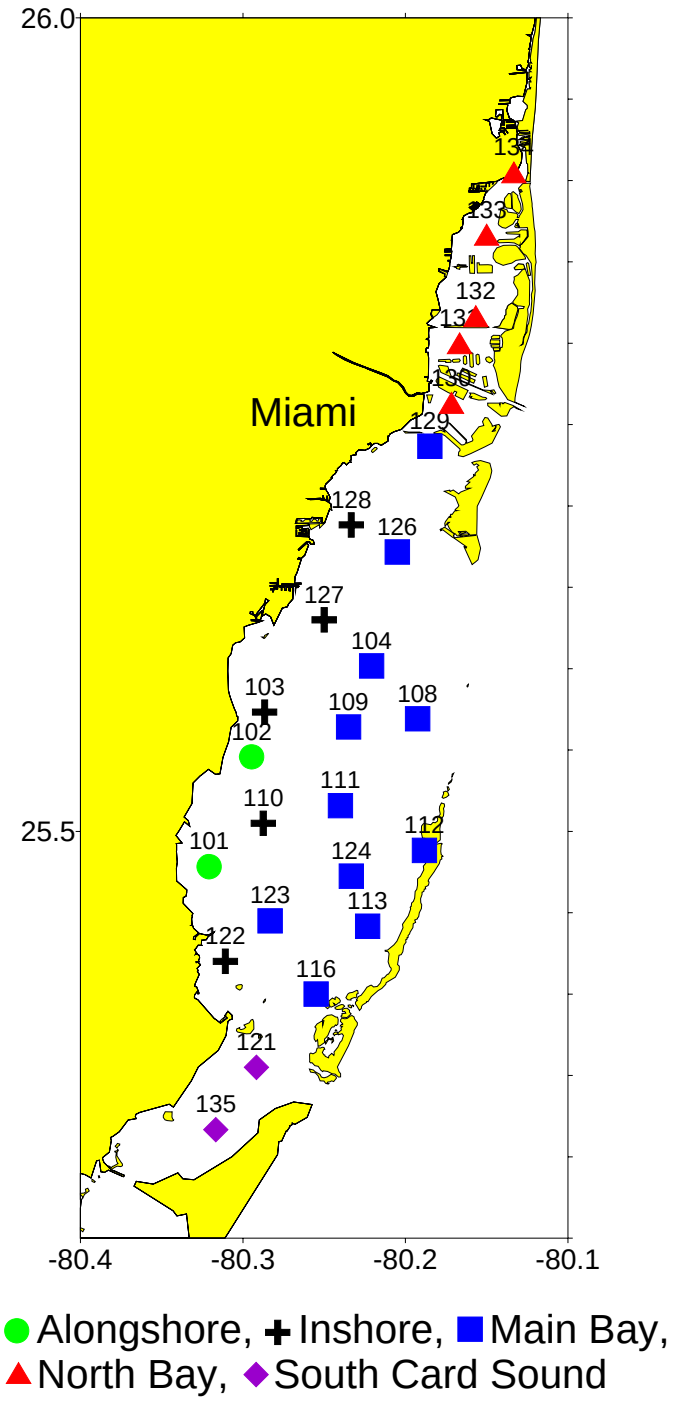

Figure 4. Biscayne Bay water quality zones.

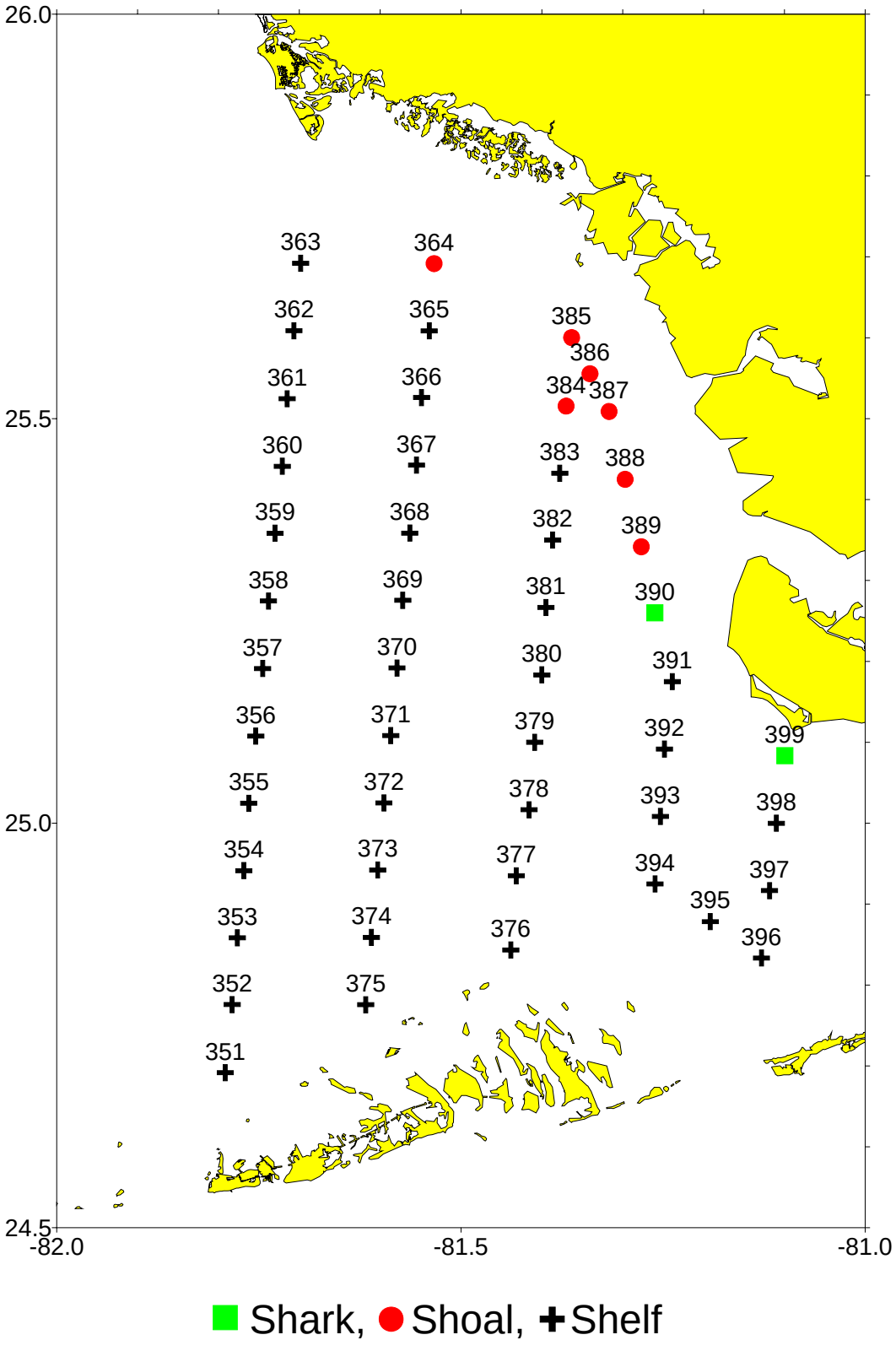

Figure 5. SW Florida Shelf water quality zones.

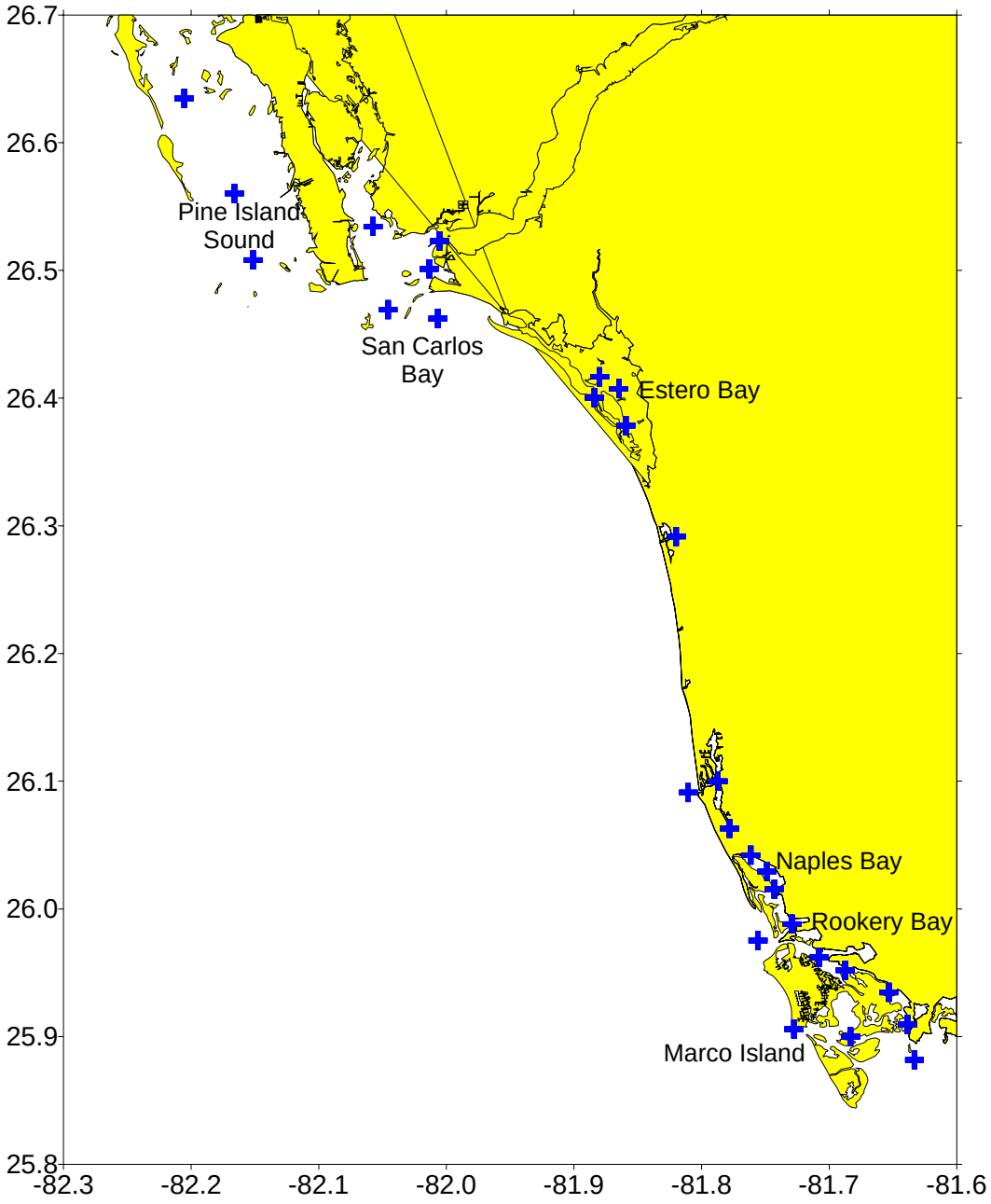

Figure 6. SW estuaries.

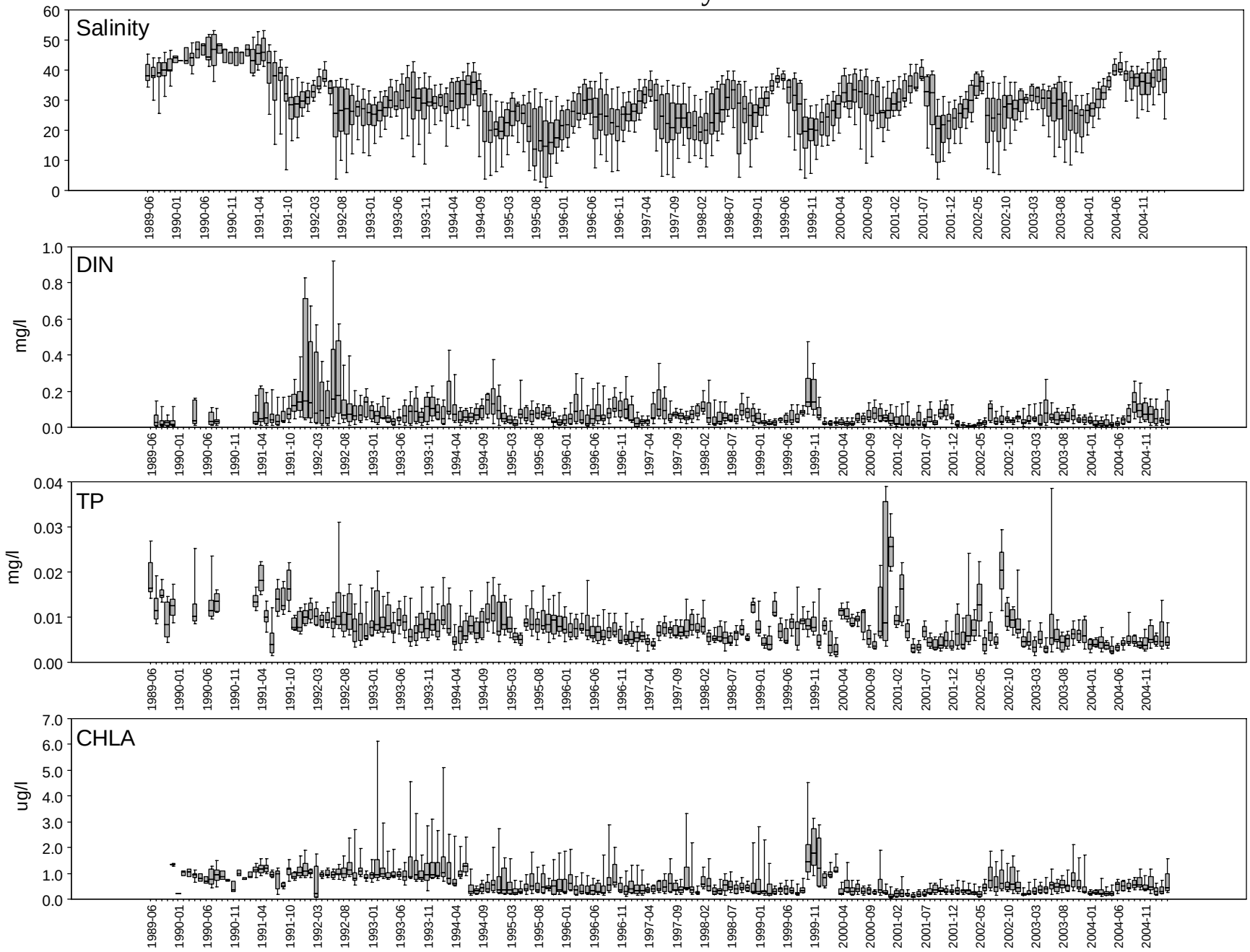

Figure 7. Box-and-whisker plots of water quality in Eastern Florida Bay by survey.

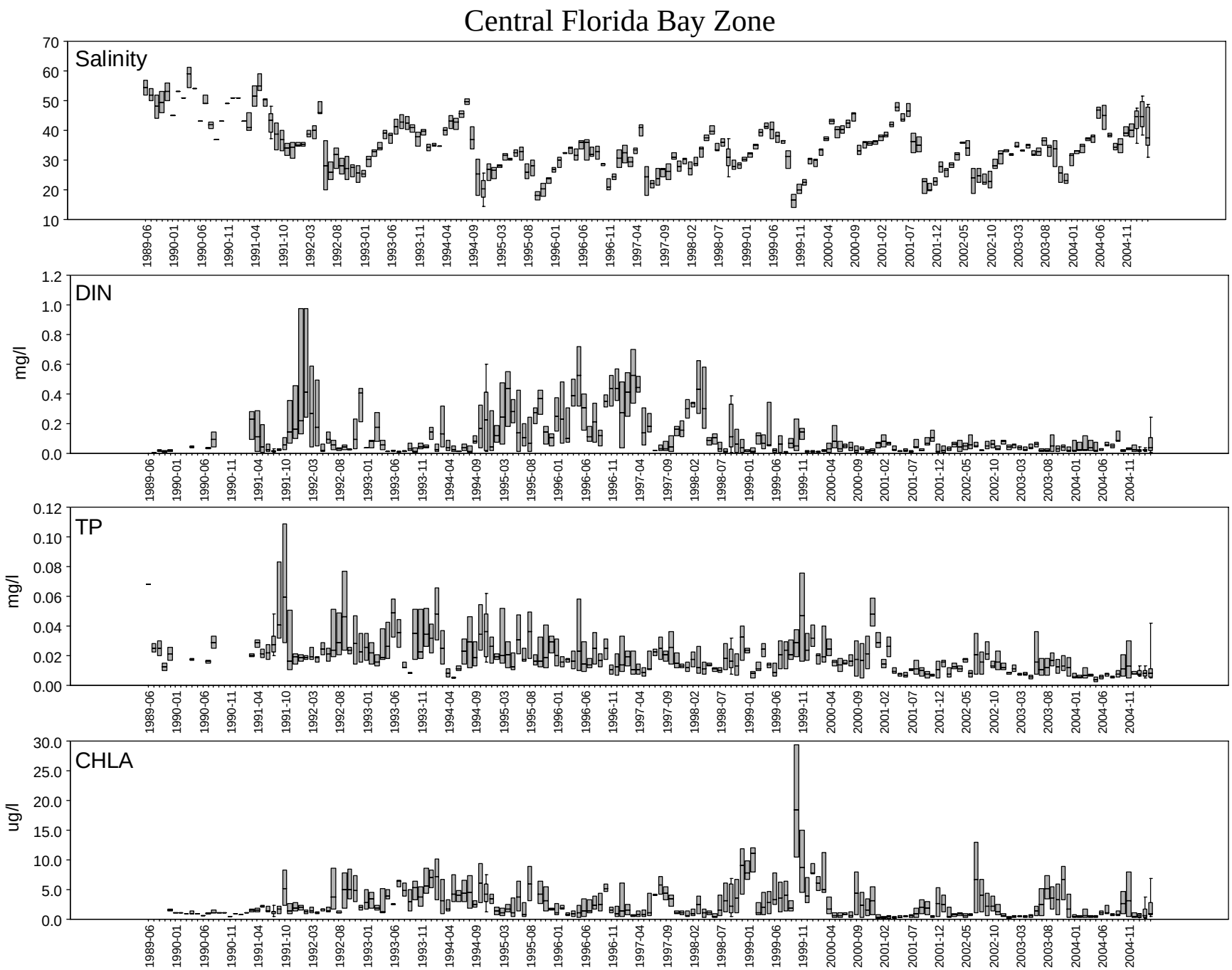

Figure 8. Box-and-whisker plots of water quality in Central Florida Bay by survey.

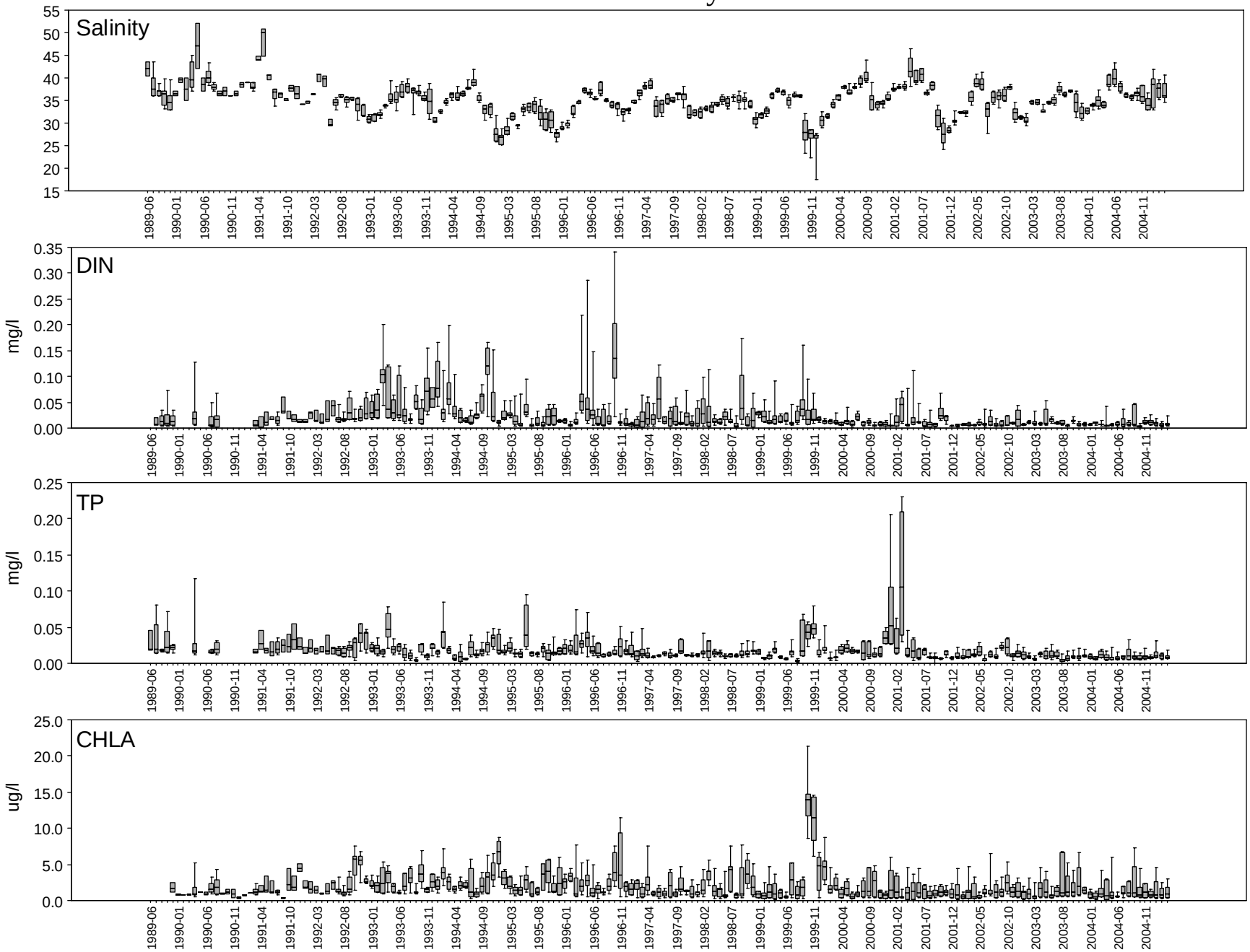

Figure 9. Box-and-whisker plots of water quality in Western Florida Bay by survey.

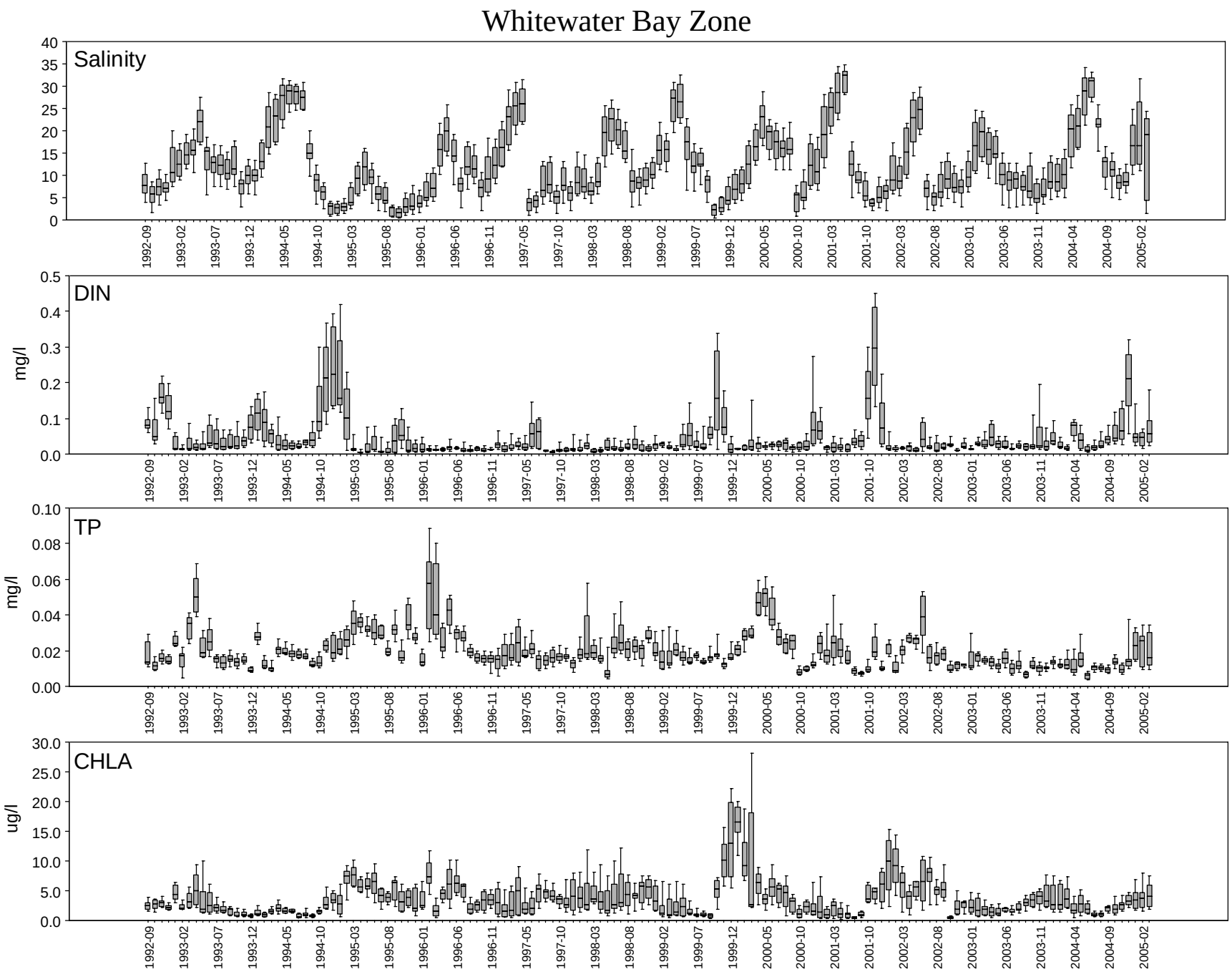

Figure 10. Box-and-whisker plots of water quality in WWB-TTI by survey.

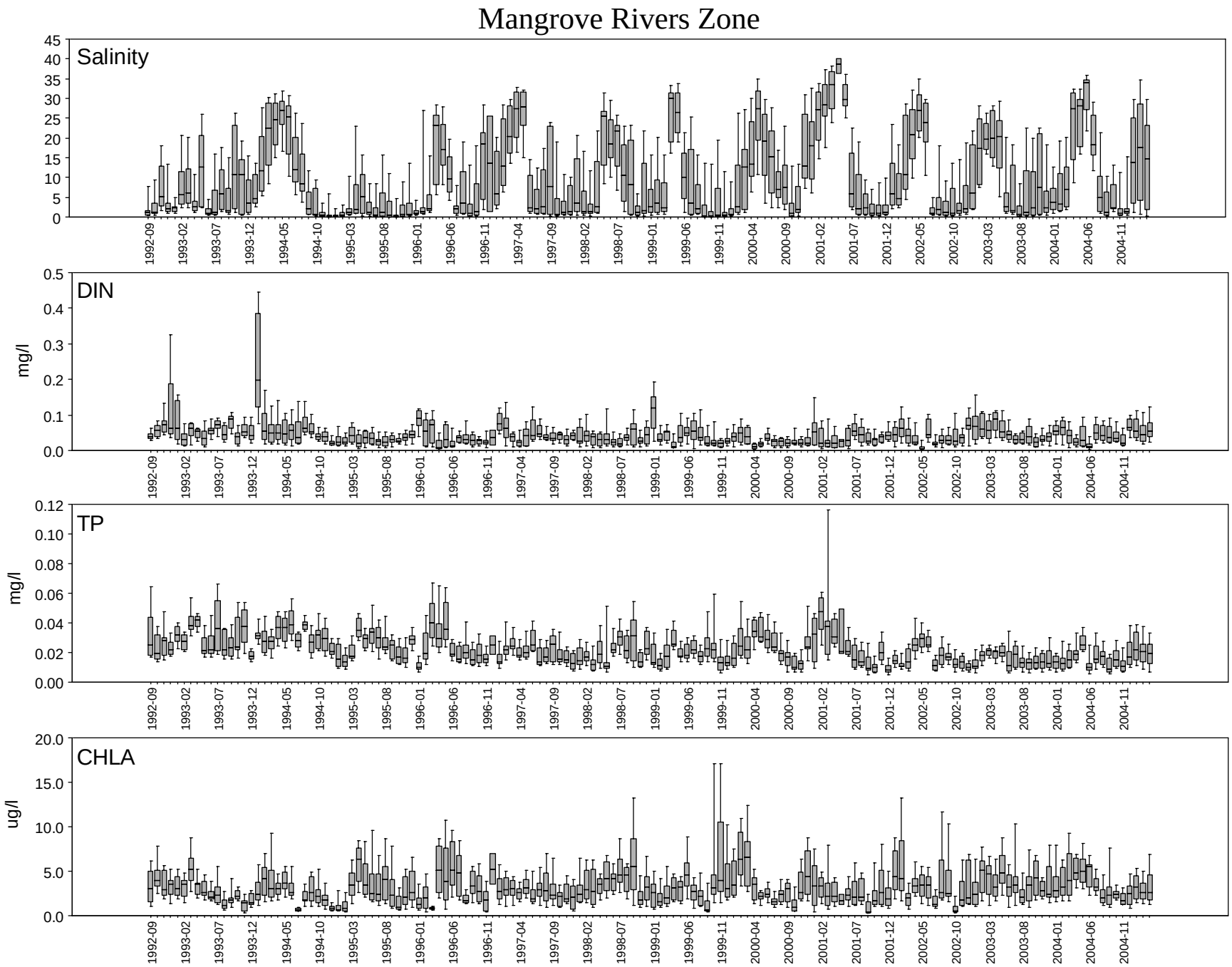

Figure 11. Box-and-whisker plots of water quality in WWB-TTI by survey.

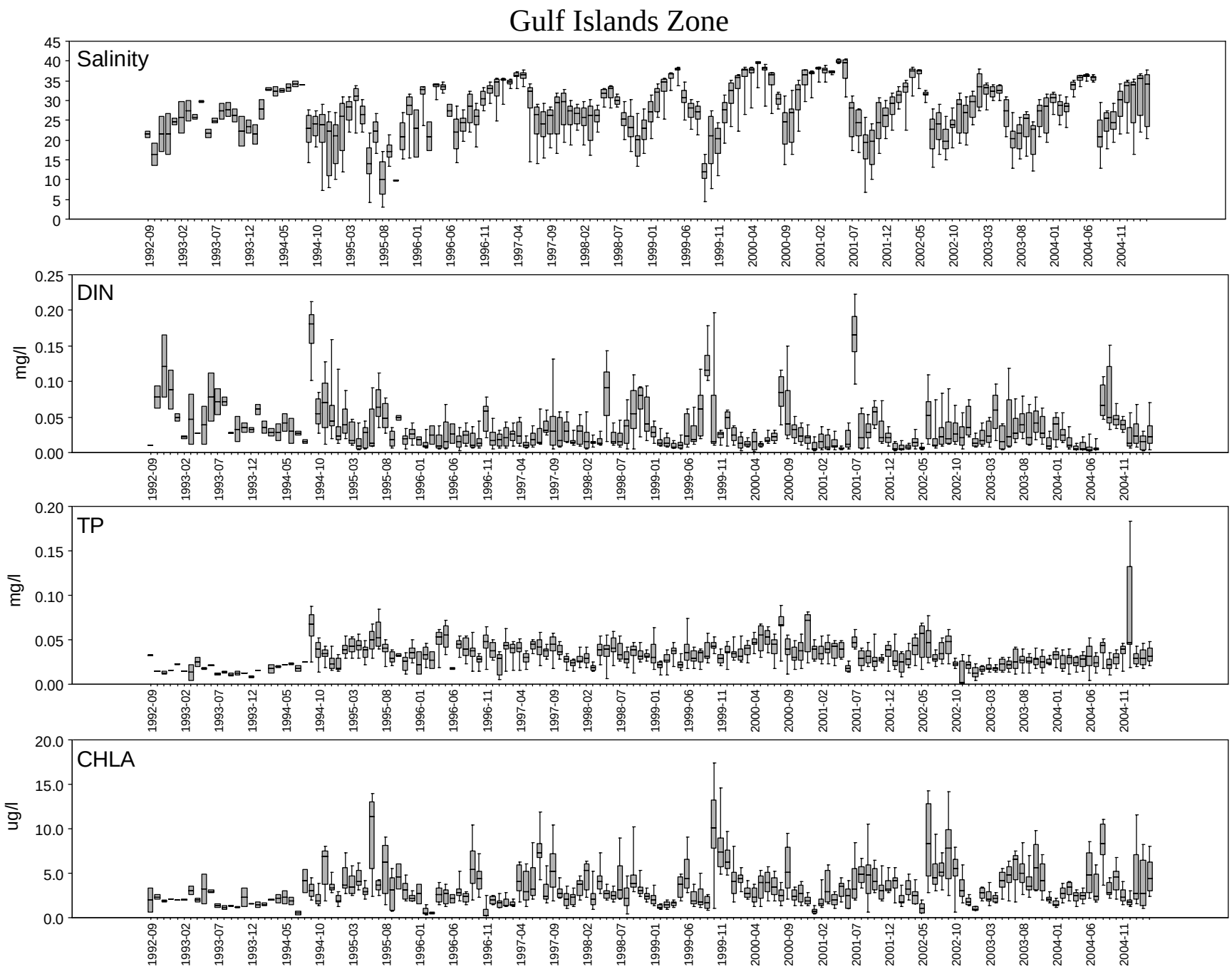

Figure 12. Box-and-whisker plots of water quality in WWB-TTI by survey.

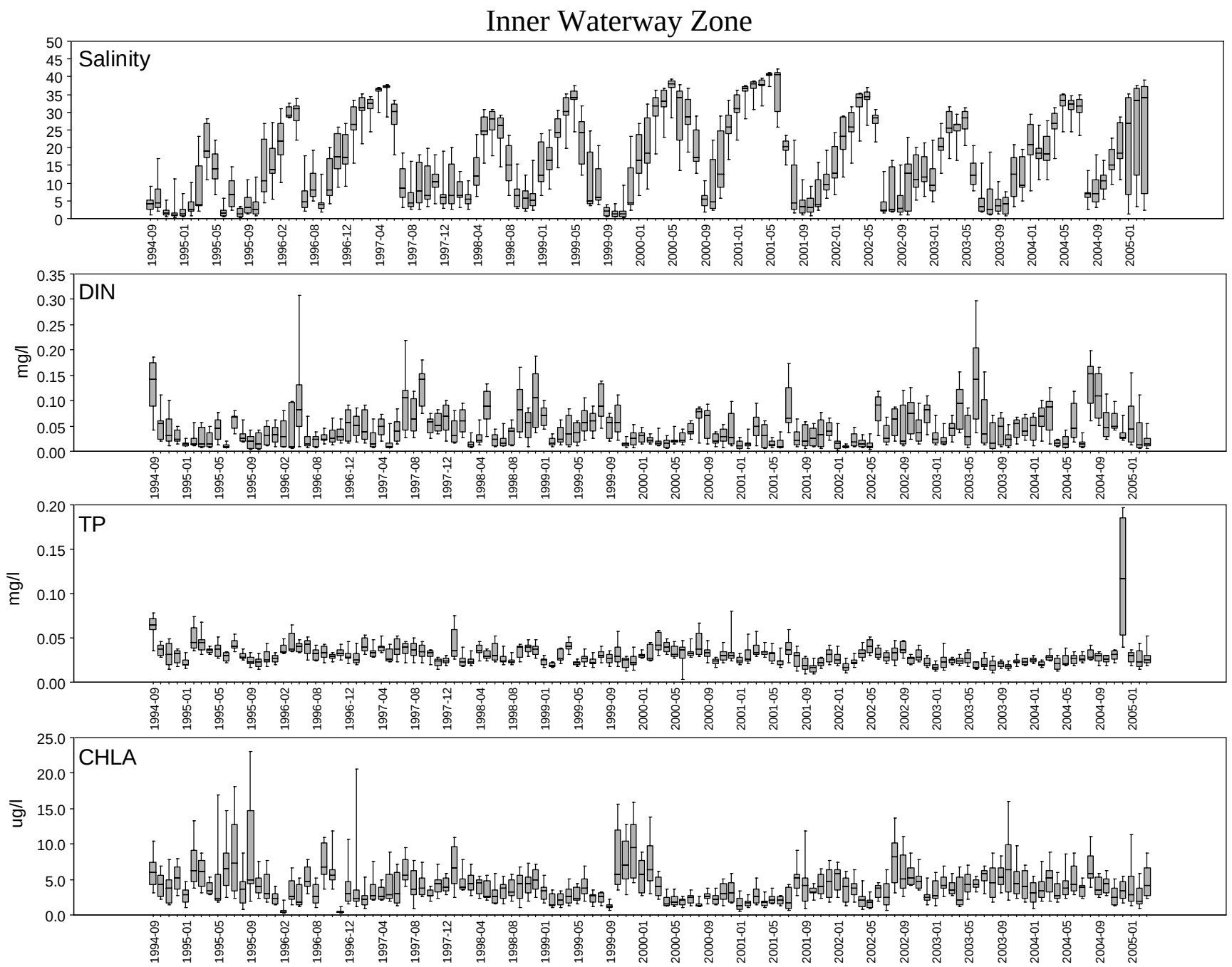

Figure 13. Box-and-whisker plots of water quality in WWB-TTI by survey.

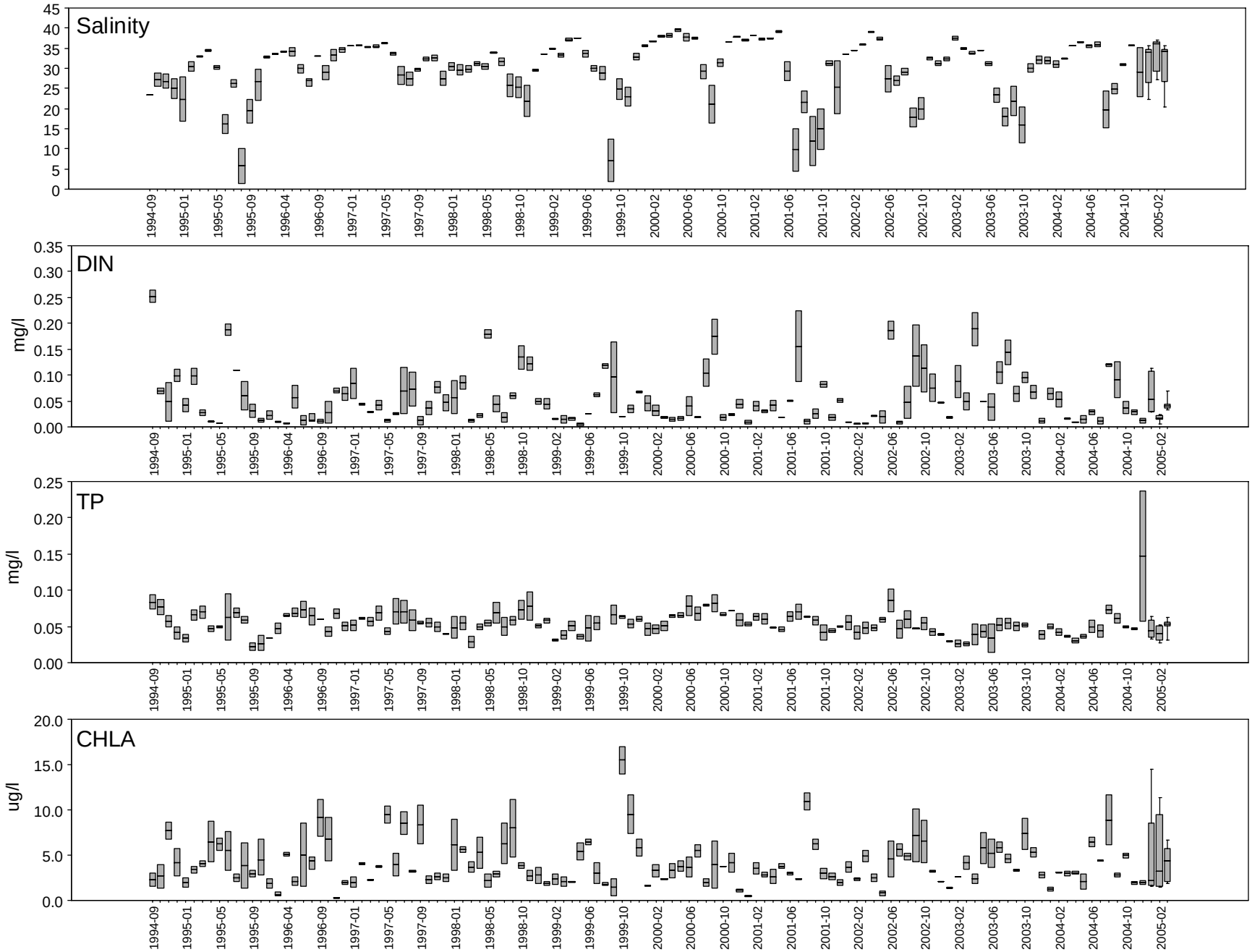

Figure 14. Box-and-whisker plots of water quality in WWB-TTI by survey.

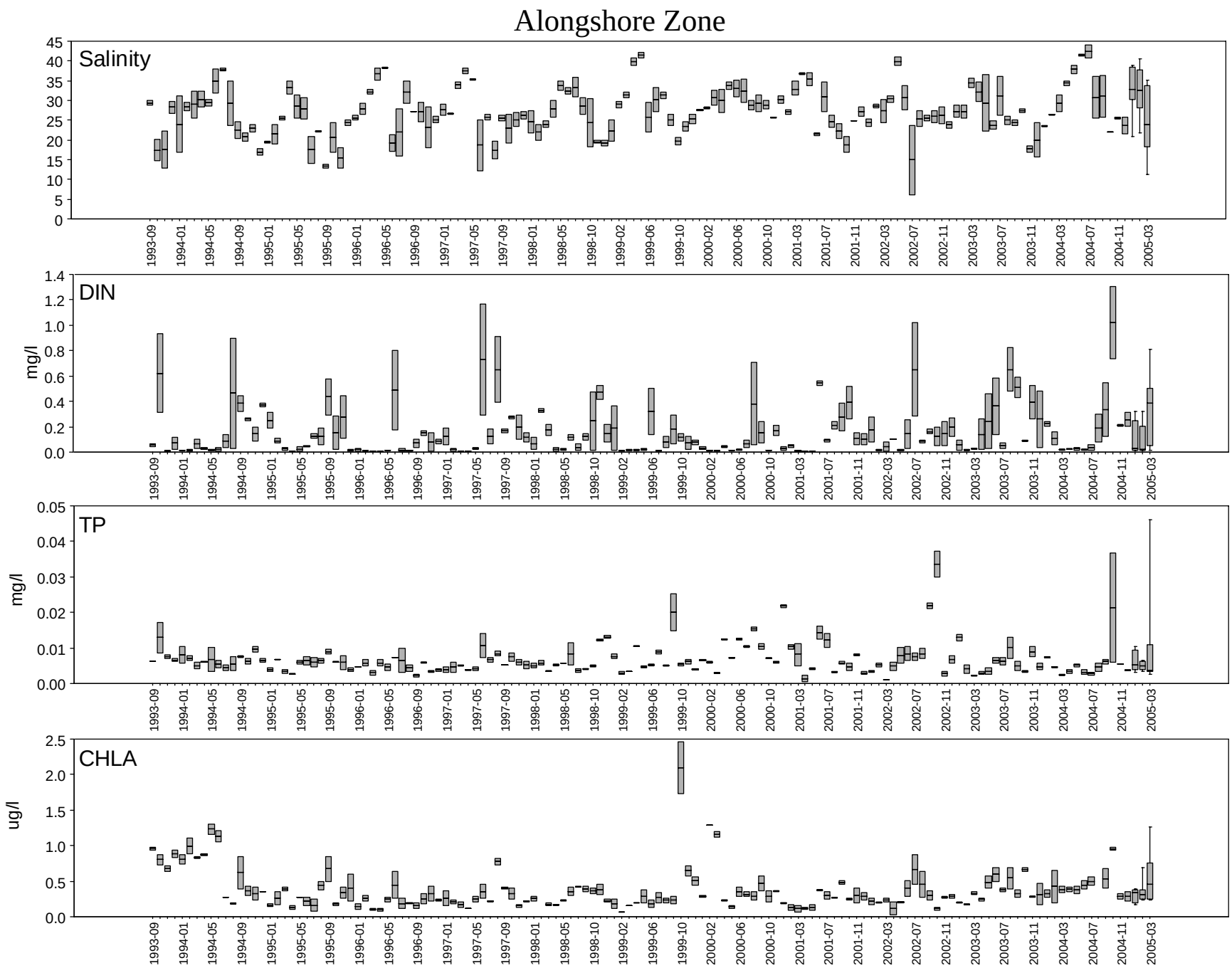

Figure 15. Box-and-whisker plots of water quality in Biscayne Bay by survey.

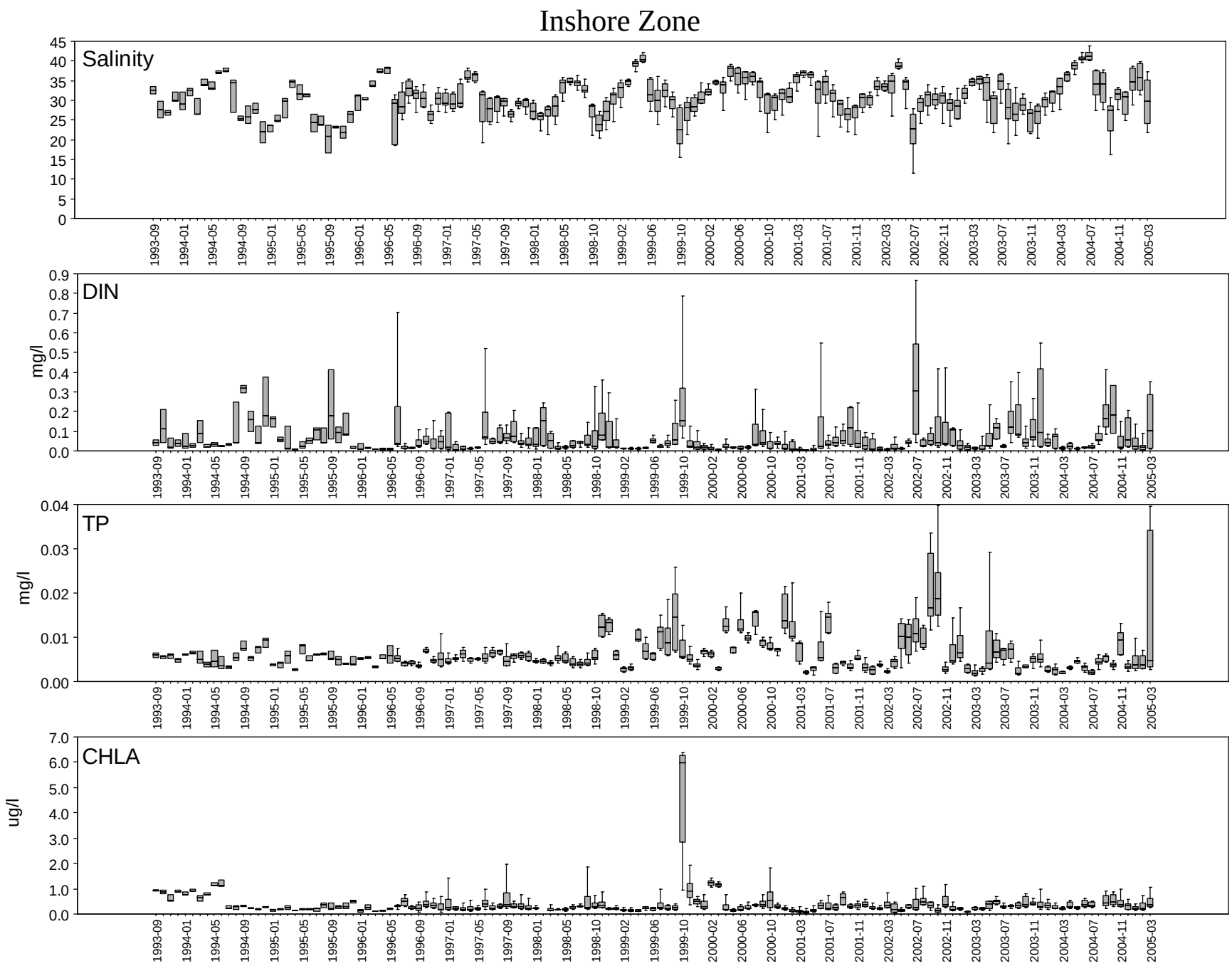

Figure 16. Box-and-whisker plots of water quality in Biscayne Bay by survey.

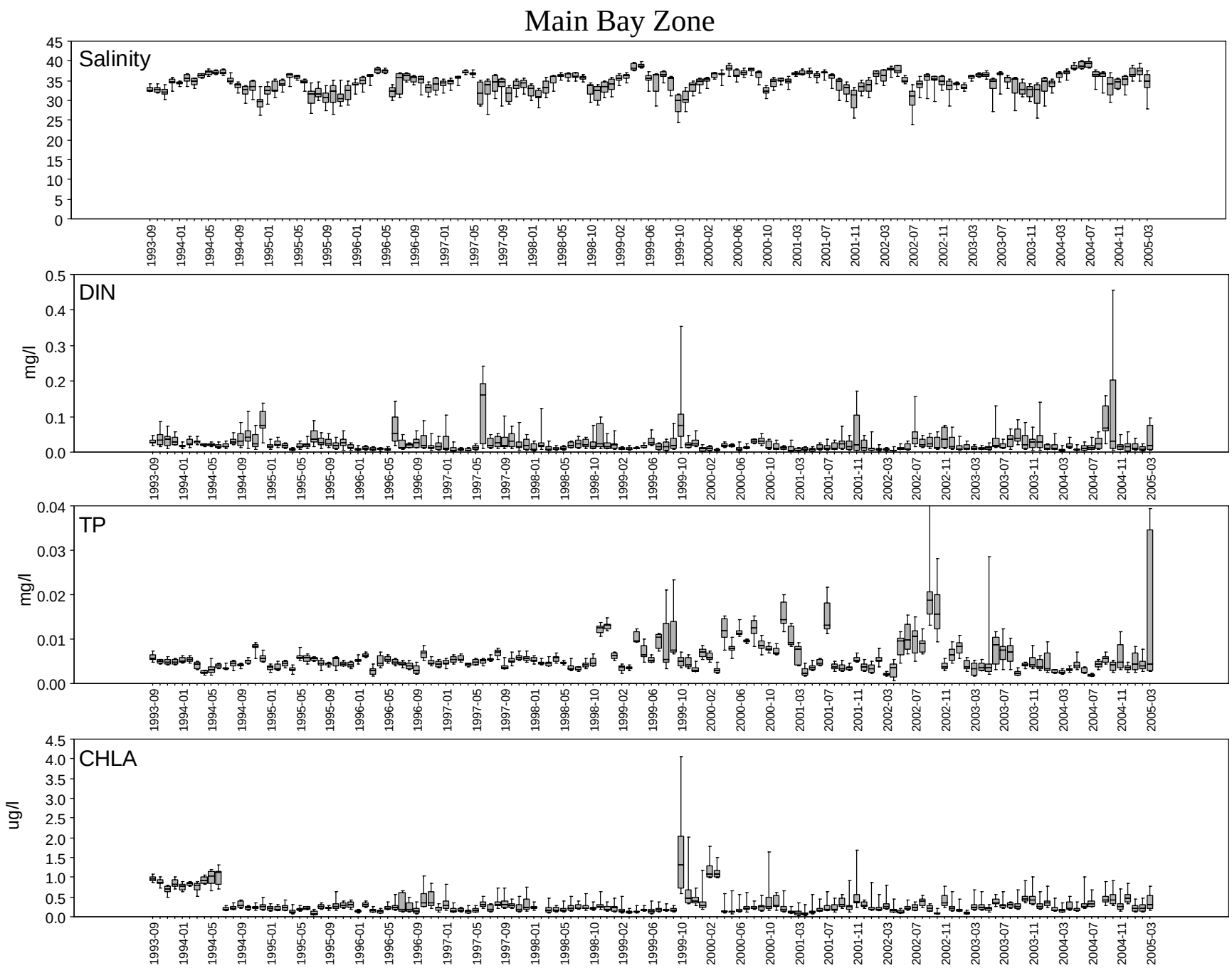

Figure 17. Box-and-whisker plots of water quality in Biscayne Bay by survey.

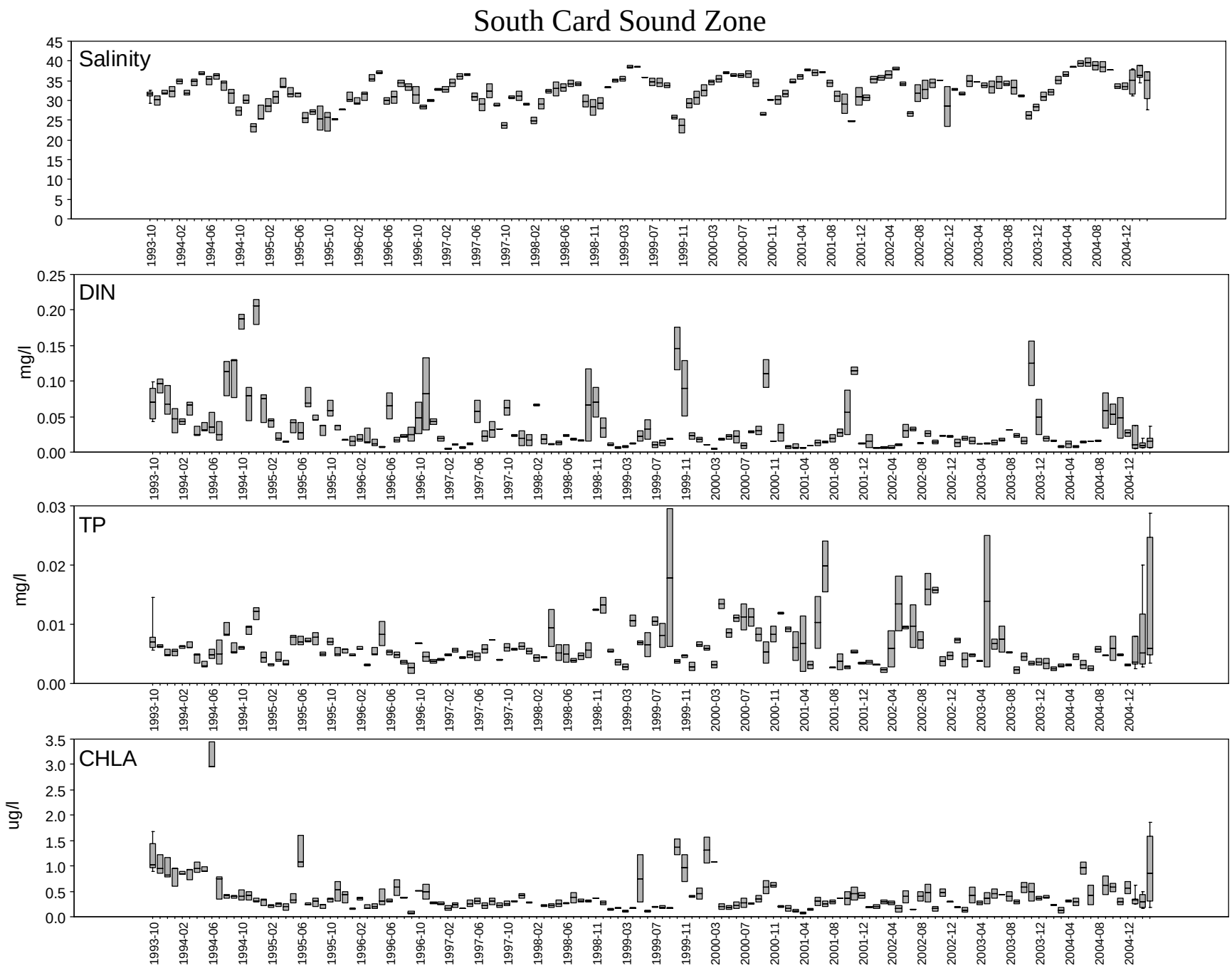

Figure 18. Box-and-whisker plots of water quality in Biscayne Bay by survey.

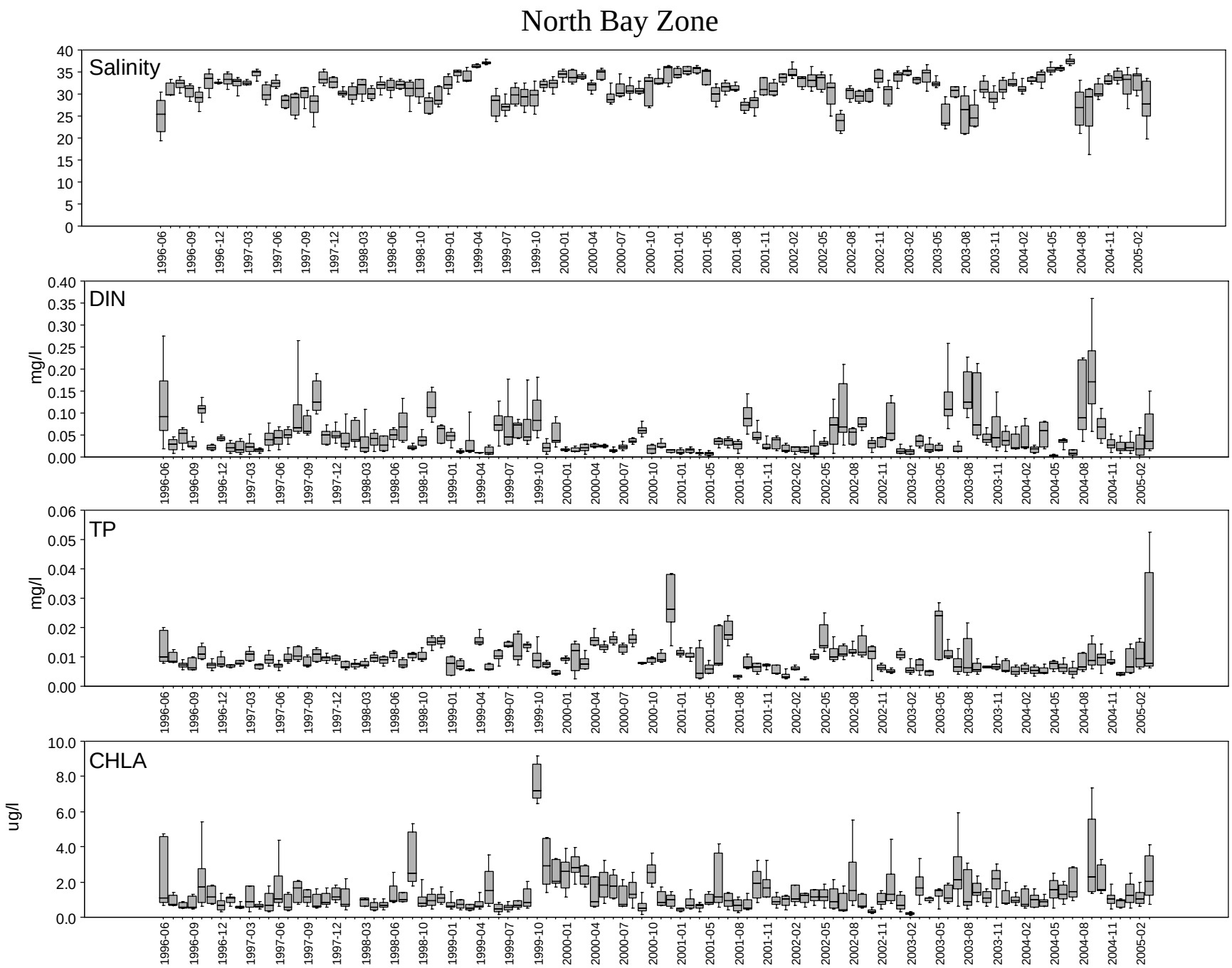

Figure 19. Box-and-whisker plots of water quality in Biscayne Bay by survey.

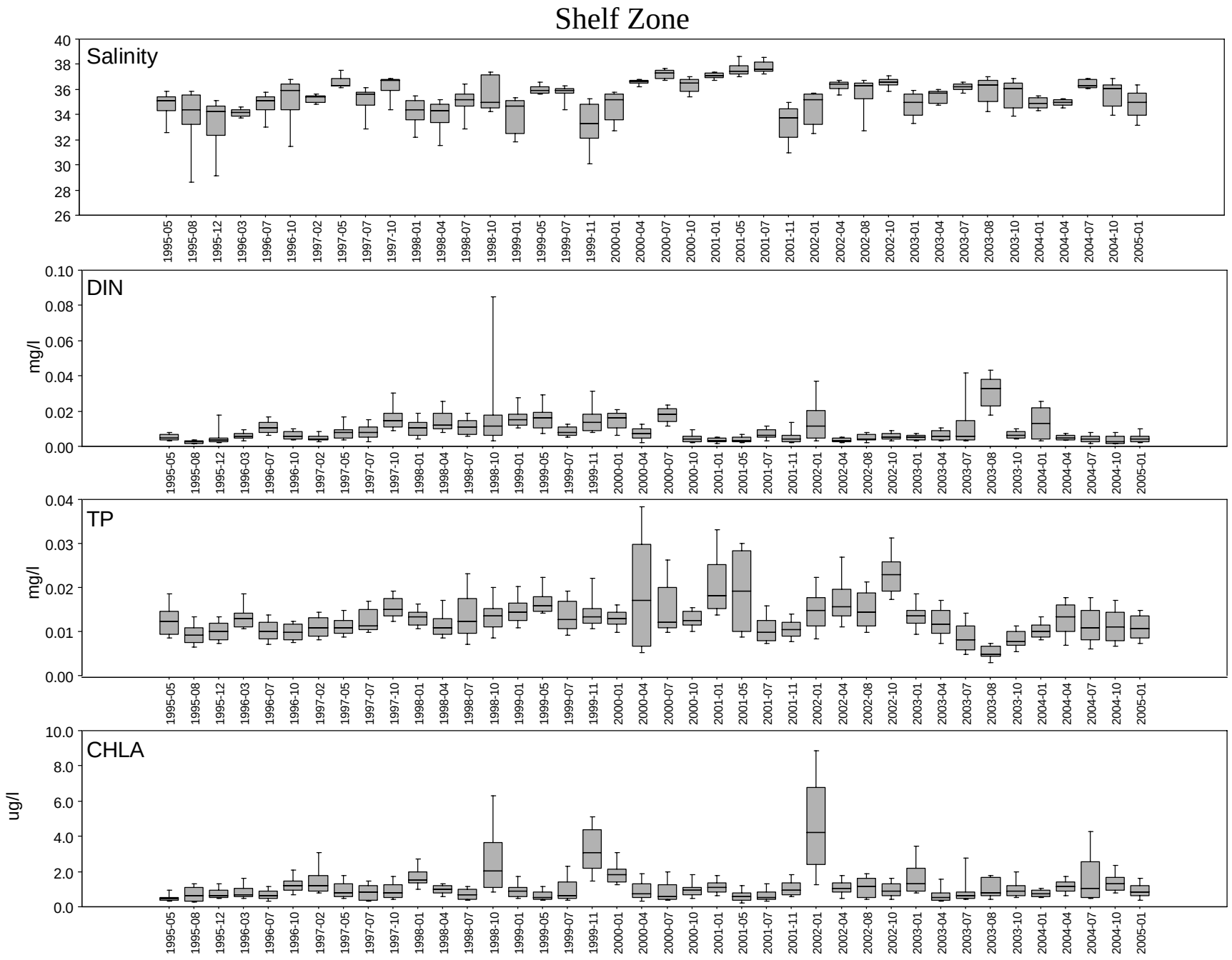

Figure 20. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

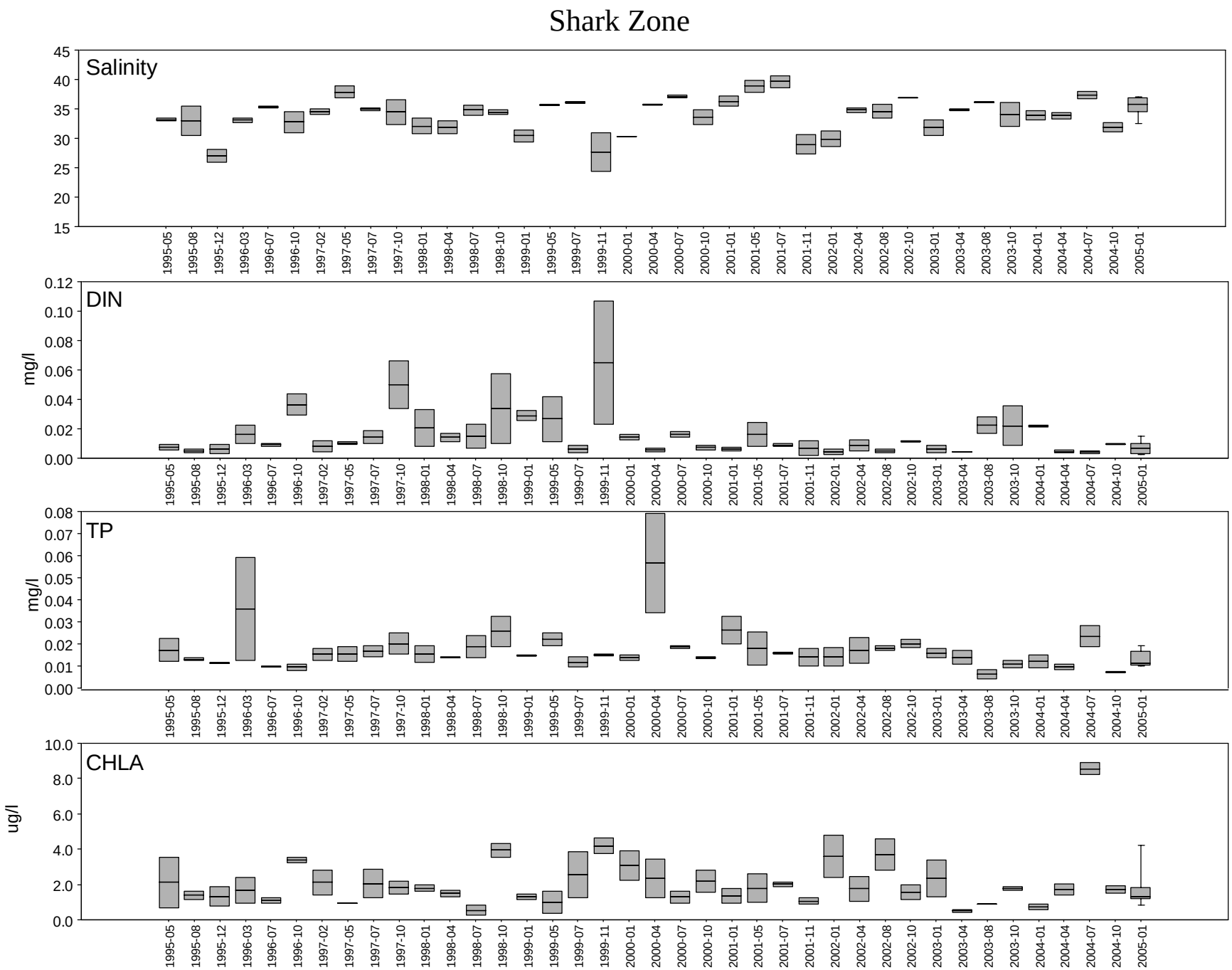

Figure 21. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

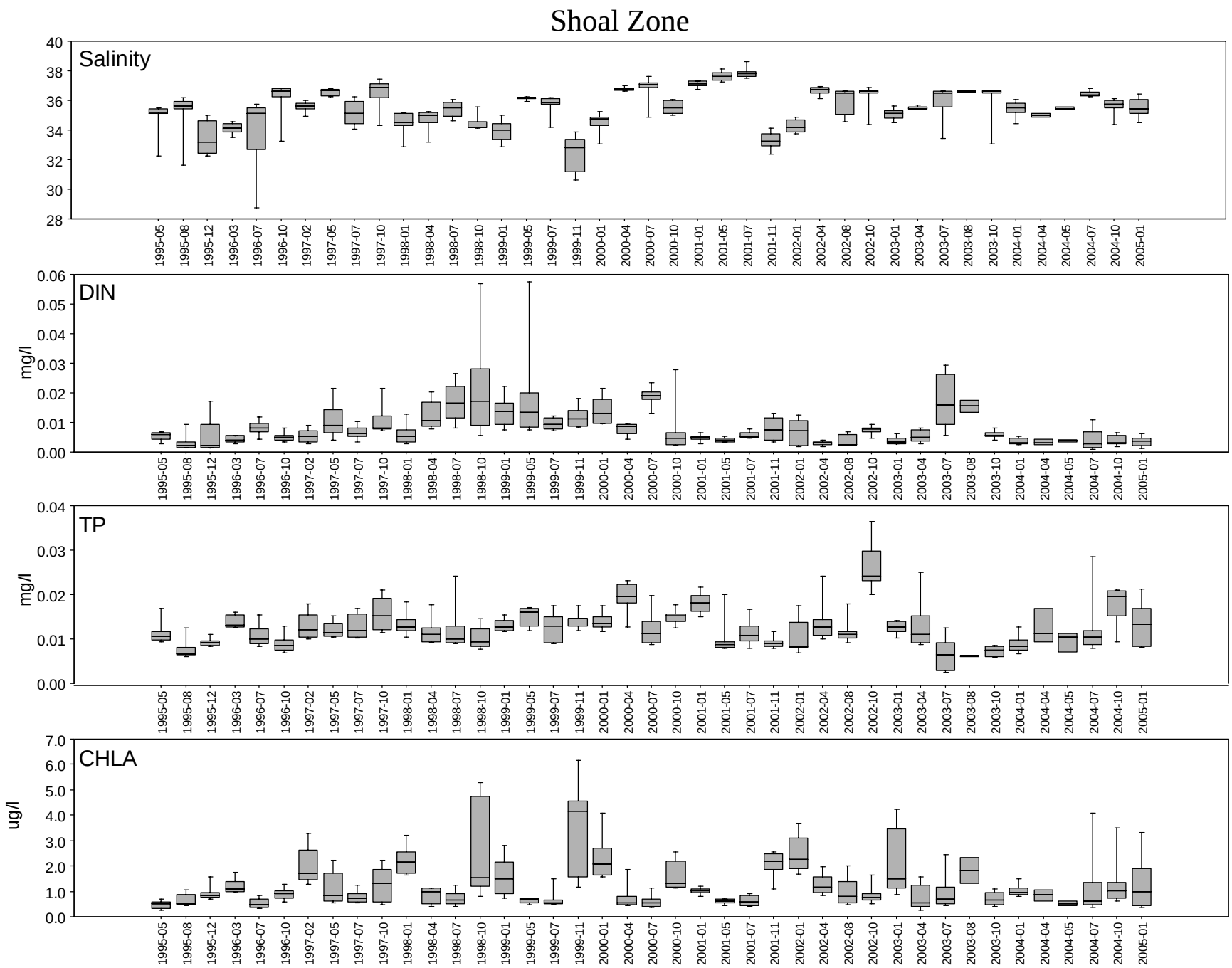

Figure 22. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

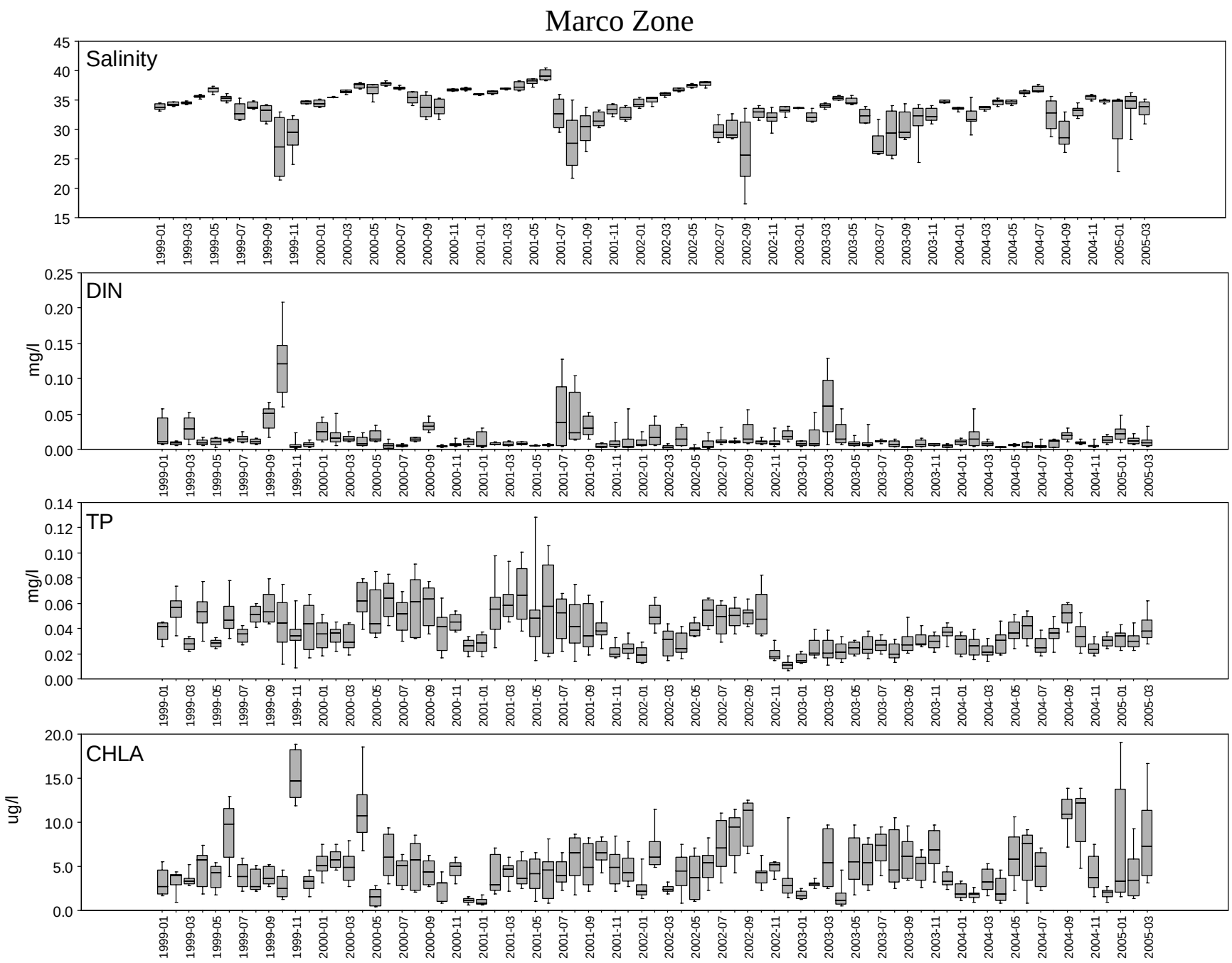

Figure 23. Box-and-whisker plots of water quality in RB-PIS by survey.

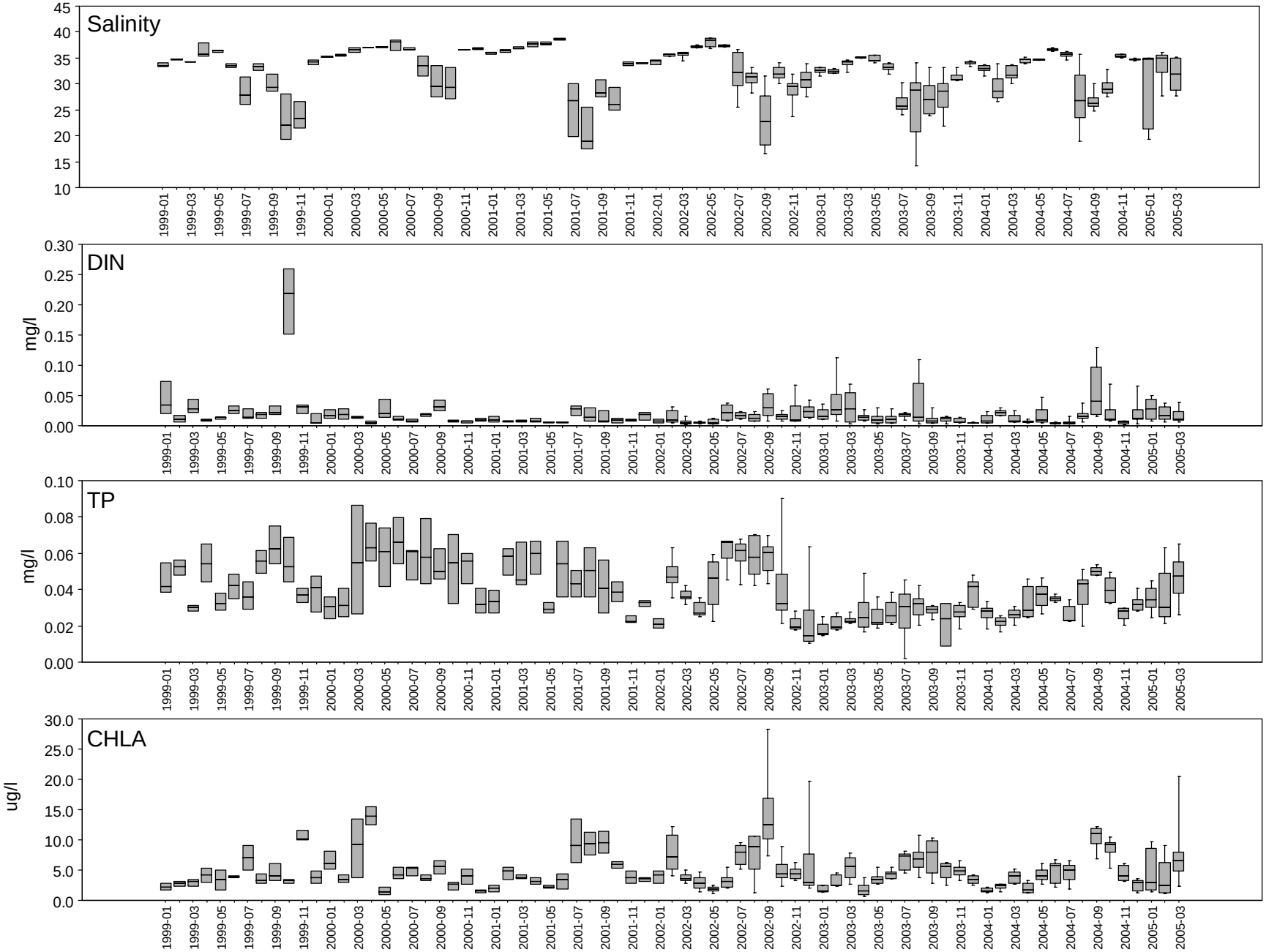

Figure 24. Box-and-whisker plots of water quality in RB-PIS by survey.

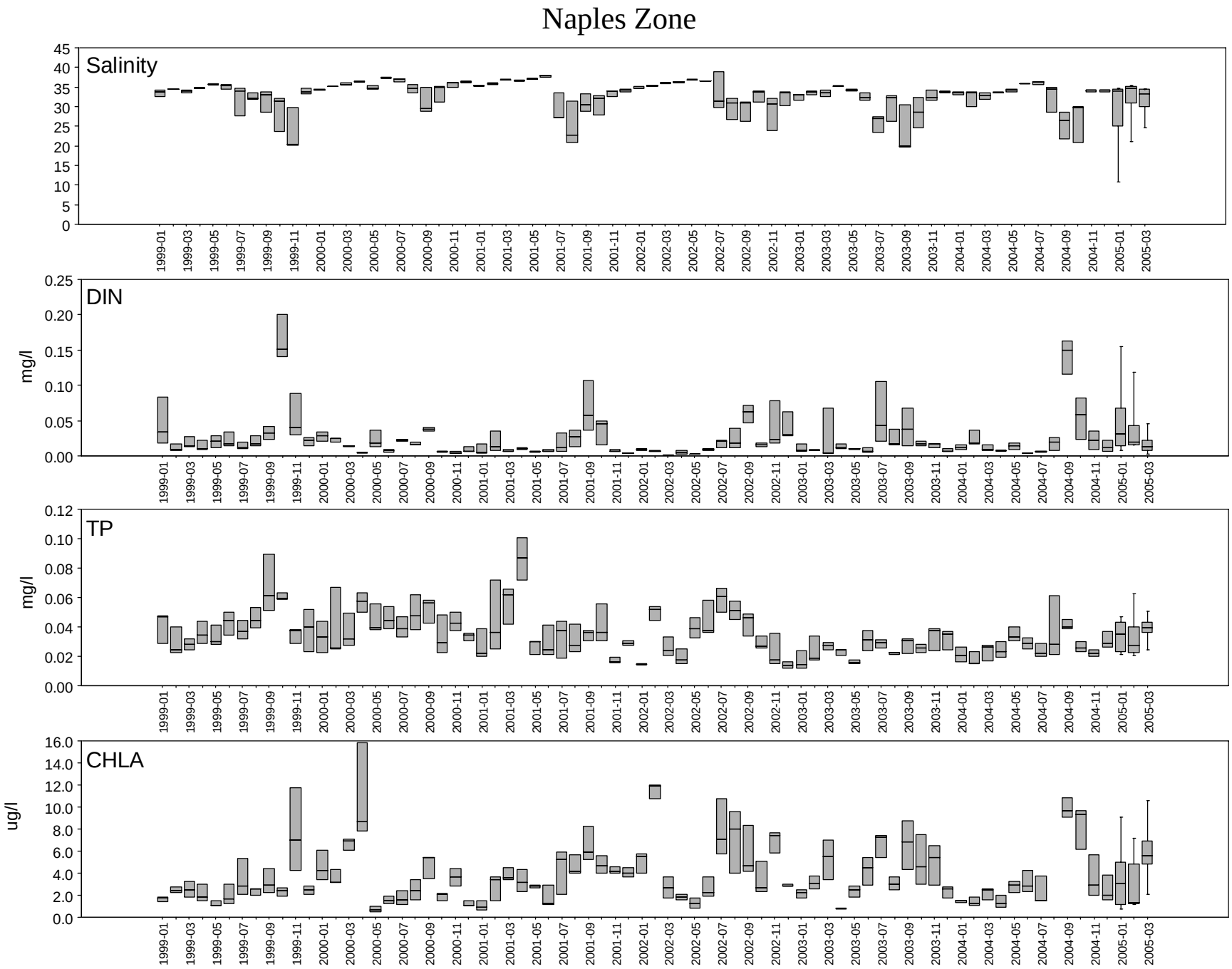

Figure 25. Box-and-whisker plots of water quality in RB-PIS by survey.

San Carlos Bay Zone

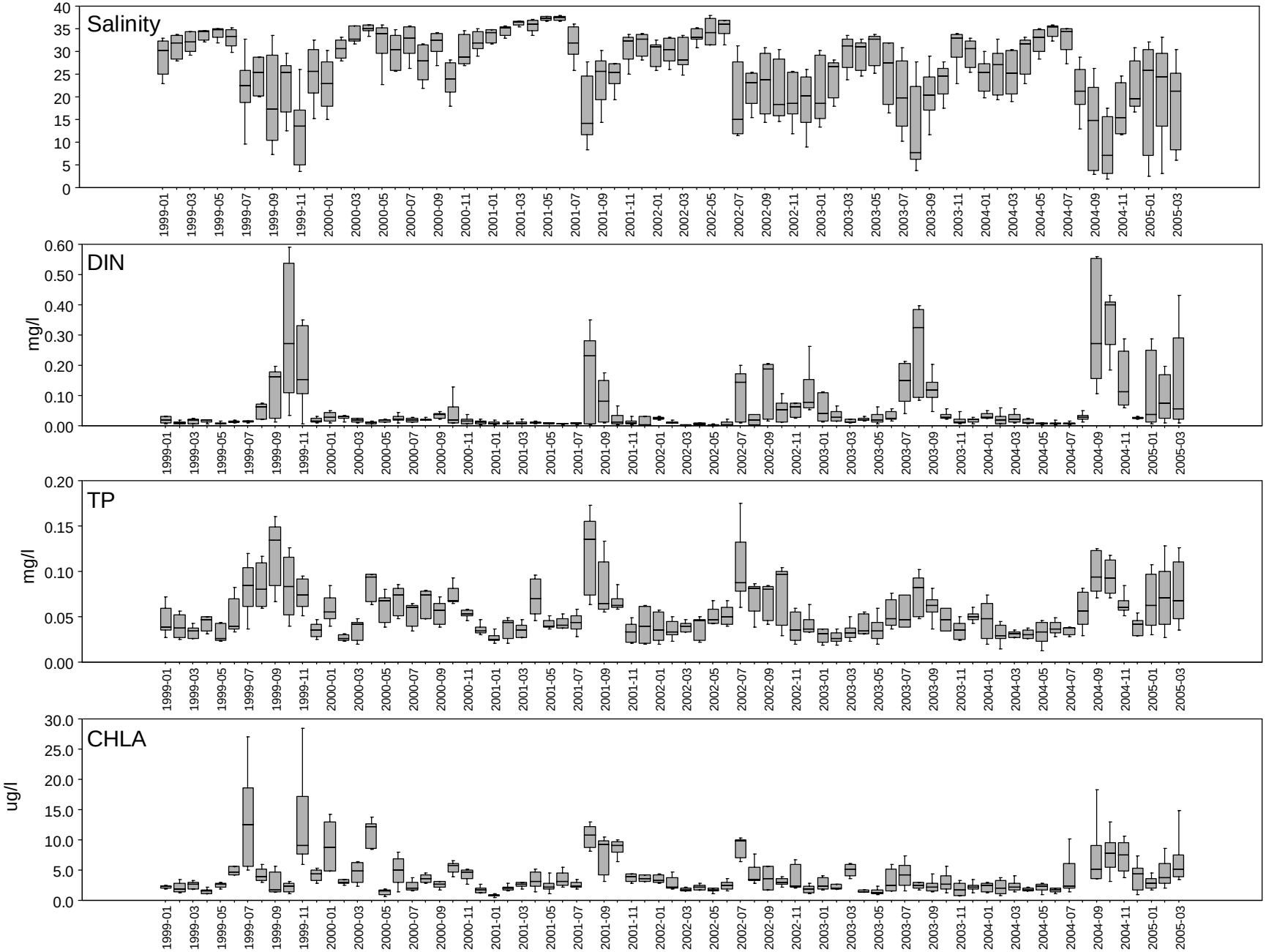

Figure 26. Box-and-whisker plots of water quality in RB-PIS by survey.

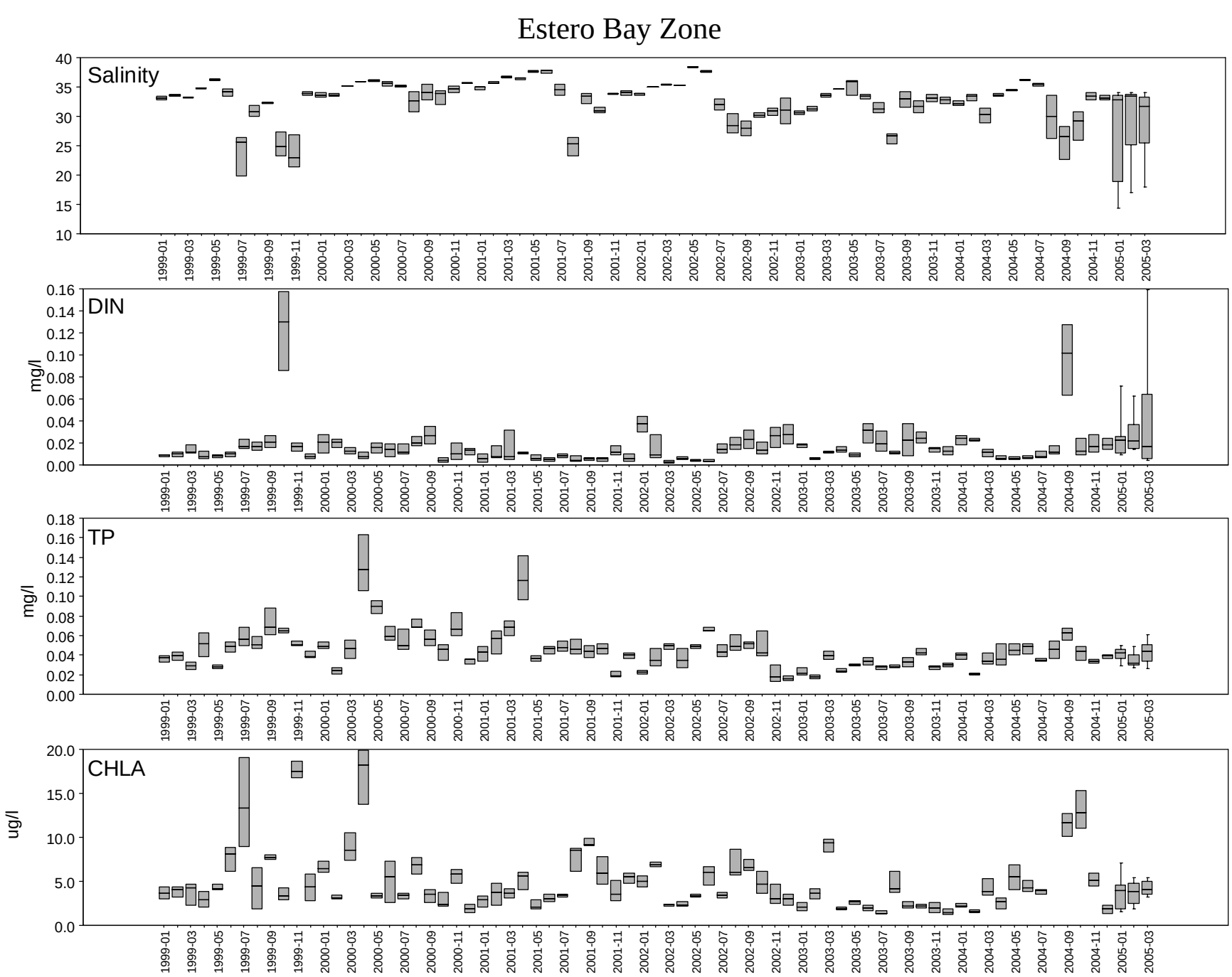

Figure 27. Box-and-whisker plots of water quality in RB-PIS by survey.

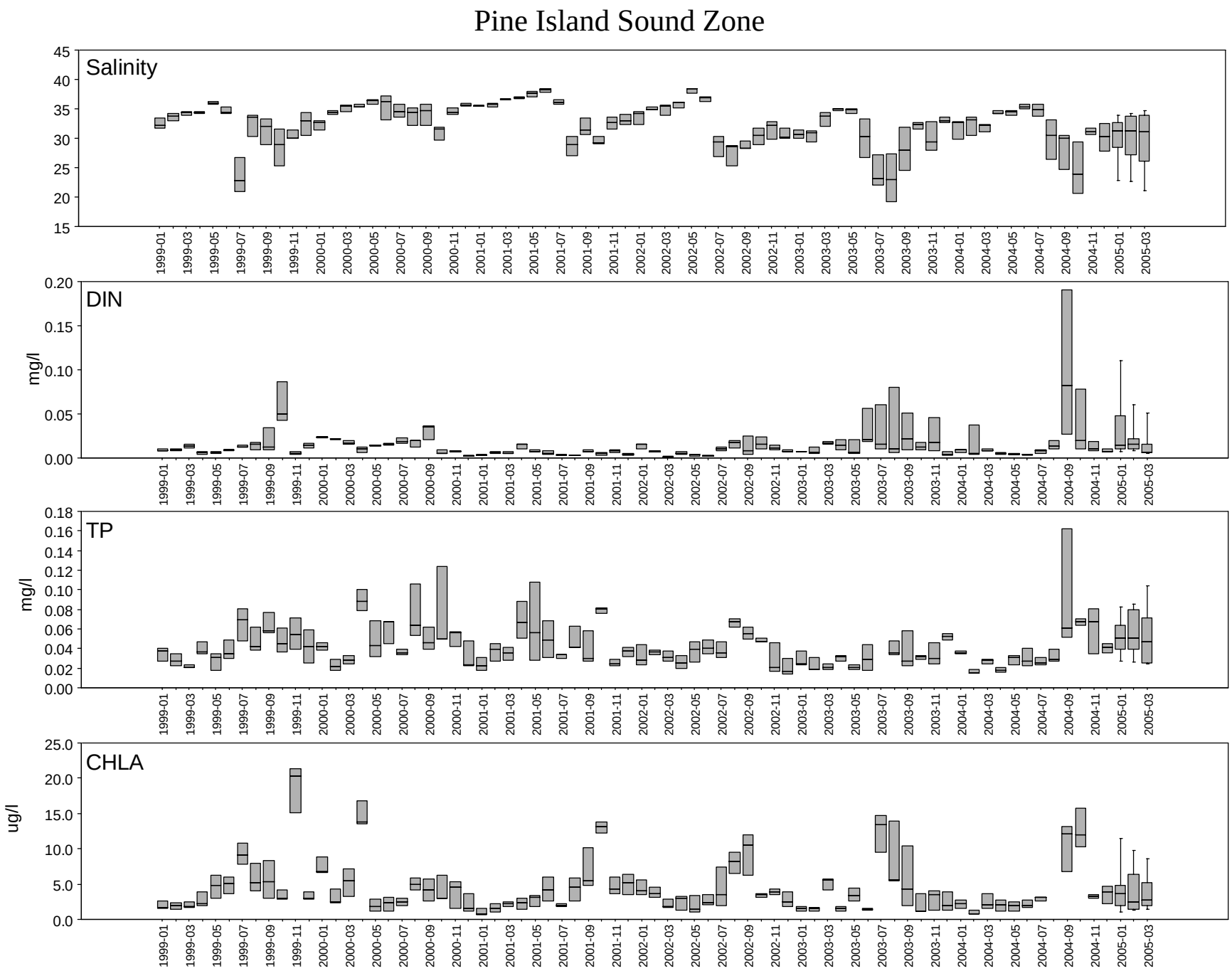

Figure 28. Box-and-whisker plots of water quality in RB-PIS by survey.

Table 1.

Parameter	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity ($\mu M\ h^{-1}$)	Biscayne Bay	0.201	0.013	1.093	75
	Florida Bay	0.576	0.075	2.906	84
	Rookery Bay	0.077	0.039	0.260	87
	SW Shelf	0.045	0.024	0.612	49
	Ten Thousand Is.	0.099	0.043	1.178	78
	Whitewater Bay	0.398	0.061	2.792	66
Chlorophyll *a* ($\mu g\ l^{-1}$)	Biscayne Bay	0.508	0.194	5.817	75
	Florida Bay	0.900	0.083	8.239	84
	Rookery Bay	7.348	1.847	20.208	87
	SW Shelf	1.178	0.218	5.639	49
	Ten Thousand Is.	6.414	1.256	23.293	78
	Whitewater Bay	3.180	0.962	24.003	66
Surface Dissolved Oxygen ($mg\ l^{-1}$)	Biscayne Bay	5.92	3.93	8.27	75
	Florida Bay	6.17	2.74	8.16	84
	Rookery Bay	6.01	4.31	8.26	87
	SW Shelf	4.66	2.87	5.43	49
	Ten Thousand Is.	5.31	2.94	8.33	78
	Whitewater Bay	5.03	2.04	7.50	66
Bottom Dissolved Oxygen ($mg\ l^{-1}$)	Biscayne Bay	5.80	3.66	7.96	75
	Florida Bay	6.25	0.39	9.16	84
	Rookery Bay	5.54	4.05	7.97	87
	SW Shelf	4.90	3.68	5.44	49
	Ten Thousand Is.	5.02	2.68	7.35	78
	Whitewater Bay	4.98	1.71	7.77	66
NH_4^+ ($mg\ l^{-1}$)	Biscayne Bay	0.025	0.003	0.188	75
	Florida Bay	0.038	0.001	0.393	84
	Rookery Bay	0.009	0.002	0.068	87
	SW Shelf	0.002	0.001	0.009	49
	Ten Thousand Is.	0.015	0.003	0.137	78
	Whitewater Bay	0.029	0.005	0.590	66

Parameter	Zone	Median	Min.	Max.	*n*
NO_2^-	Biscayne Bay	0.003	0.001	0.038	75
(mg l^{-1})	Florida Bay	0.003	0.000	0.012	84
	Rookery Bay	0.002	0.000	0.013	87
	SW Shelf	0.000	0.000	0.001	49
	Ten Thousand Is.	0.003	0.000	0.014	78
	Whitewater Bay	0.004	0.000	0.024	66
NO_3^-	Biscayne Bay	0.019	0.001	0.280	75
(mg l^{-1})	Florida Bay	0.007	0.000	0.097	84
	Rookery Bay	0.012	0.001	0.251	87
	SW Shelf	0.001	0.000	0.003	49
	Ten Thousand Is.	0.012	0.000	0.110	78
	Whitewater Bay	0.013	0.000	0.061	66
pH	Biscayne Bay	7.995	7.815	8.240	75
	Florida Bay	8.122	7.670	8.610	84
	Rookery Bay	7.900	7.220	8.215	87
	SW Shelf	7.870	7.750	8.030	49
	Ten Thousand Is.	7.773	7.205	8.085	78
	Whitewater Bay	7.688	7.055	8.500	66
Surface	Biscayne Bay	31.70	18.38	38.14	75
Salinity	Florida Bay	36.78	0.32	51.90	84
	Rookery Bay	25.71	0.56	34.84	87
	SW Shelf	34.37	32.42	37.25	49
	Ten Thousand Is.	12.92	0.36	29.38	78
	Whitewater Bay	7.24	0.17	32.69	66
Bottom	Biscayne Bay	33.01	19.68	38.14	75
Salinity	Florida Bay	37.09	0.31	51.92	84
	Rookery Bay	29.15	1.39	34.83	87
	SW Shelf	35.98	34.01	37.29	49
	Ten Thousand Is.	15.34	0.44	29.40	78
	Whitewater Bay	9.43	0.17	33.06	66
$Si(OH)_4$	Biscayne Bay	0.170	0.035	1.194	24
(mg l^{-1})	Florida Bay	0.816	0.064	4.883	28
	Rookery Bay	1.514	0.273	3.773	29
	SW Shelf	0.084	0.000	0.770	49
	Ten Thousand Is.	2.807	0.840	3.751	26
	Whitewater Bay	2.749	0.564	4.299	22

Parameter	Zone	Median	Min.	Max.	*n*
Soluble Reactive Phosphorus ($mg\ l^{-1}$)	Biscayne Bay	0.001	0.000	0.004	75
	Florida Bay	0.001	0.000	0.005	84
	Rookery Bay	0.007	0.001	0.101	87
	SW Shelf	0.001	0.001	0.004	49
	Ten Thousand Is.	0.003	0.001	0.025	78
	Whitewater Bay	0.002	0.000	0.008	66
Surface Temperature (^oC)	Biscayne Bay	31.28	28.79	32.97	75
	Florida Bay	30.99	27.93	33.01	84
	Rookery Bay	30.49	28.32	33.10	87
	SW Shelf	30.12	29.10	31.57	49
	Ten Thousand Is.	31.03	28.73	33.80	78
	Whitewater Bay	30.62	28.42	34.37	66
Bottom Temperature (^oC)	Biscayne Bay	31.26	29.27	32.66	75
	Florida Bay	31.05	27.97	34.38	84
	Rookery Bay	30.19	28.39	32.23	87
	SW Shelf	30.19	29.45	31.04	49
	Ten Thousand Is.	30.93	28.73	32.63	78
	Whitewater Bay	30.44	28.34	32.81	66
Total Nitrogen ($mg\ l^{-1}$)	Biscayne Bay	0.254	0.085	0.727	75
	Florida Bay	0.406	0.079	0.931	84
	Rookery Bay	0.253	0.055	0.839	87
	SW Shelf	0.177	0.119	0.620	49
	Ten Thousand Is.	0.323	0.211	0.972	78
	Whitewater Bay	0.389	0.154	1.712	66
Total Organic Carbon ($mg\ l^{-1}$)	Biscayne Bay	3.072	1.489	5.762	75
	Florida Bay	6.831	1.400	18.005	84
	Rookery Bay	5.962	2.003	16.333	87
	SW Shelf	1.554	1.009	2.936	49
	Ten Thousand Is.	9.967	4.539	16.137	78
	Whitewater Bay	11.635	5.027	23.598	66
Total Organic Nitrogen ($mg\ l^{-1}$)	Biscayne Bay	0.177	0.070	0.533	75
	Florida Bay	0.315	0.070	0.926	84
	Rookery Bay	0.226	0.045	0.587	87
	SW Shelf	0.174	0.116	0.618	49
	Ten Thousand Is.	0.291	0.118	0.901	78
	Whitewater Bay	0.298	0.121	1.668	66

Parameter	Zone	Median	Min.	Max.	*n*
Total Phosphorus ($mg\ l^{-1}$)	Biscayne Bay	0.005	0.002	0.020	75
	Florida Bay	0.006	0.002	0.051	84
	Rookery Bay	0.047	0.021	0.133	87
	SW Shelf	0.013	0.008	0.026	49
	Ten Thousand Is.	0.036	0.008	0.064	78
	Whitewater Bay	0.013	0.005	0.048	66
Turbidity (NTU)	Biscayne Bay	0.63	0.22	9.19	75
	Florida Bay	1.85	0.46	18.71	84
	Rookery Bay	4.80	0.73	17.83	87
	SW Shelf	2.20	0.30	13.65	49
	Ten Thousand Is.	6.08	0.64	18.36	78
	Whitewater Bay	2.28	0.67	9.11	66