Appendix C - Long-term trends in Phytoplankton Bioindicators

Appendix C - Section A. Long-term trends in phytoplankton index of biotic integrity (IBI) primary productivity and selected indicators in the James River, for the period of 1985 through 2009. See the method section of the report for definitions of Seasons. “N.E.” in the Percent Change column indicates “No Estimate” was made for the percent change due to a zero value for the parameter baseline.

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
TF5.5	ANNUAL	Phytoplankton IBI	0.4569	0.00	1.60	0.00	No Trend	0.3220
TF5.5	ANNUAL	Total Abundance	0.0451	426763	21243084	48.21	No Trend	0.0056
TF5.5	ANNUAL	Total Biomass	0.0000	34942664	509107199	164.72	Increasing	0.3186
TF5.5	ANNUAL	Margalef Diversity Index	0.8735	0.00	2.39	-0.85	No Trend	0.7717
TF5.5	ANNUAL	C14 Productivity *	0.0001	3.16	32.33	195.73	Degrading	0.7061
TF5.5	ANNUAL	Diatom Biomass	0.3972	2974119	343870864	20.76	No Trend	0.1064
TF5.5	ANNUAL	Dinoflagellate Biomass	0.2468	0	700211	0.00	No Trend	0.5258
TF5.5	ANNUAL	Cyanobacteria Biomass	0.0001	888552	16209464	131.56	Degrading	0.6509
TF5.5	ANNUAL	Chlorophyte Biomass	0.0000	14130324	13674242	2480.05	Improving	0.8534
TF5.5	ANNUAL	Procaryote Biomass	0.3350	0	0	16.63	No Trend	0.9790
TF5.5	ANNUAL	Picoplankton Biomass	0.0006	-1375250	76800000	-37.60	Improving	0.0562
TF5.5	ANNUAL	Cryptophyte Biomass	0.4553	-132976	10266340	-31.09	No Trend	0.0526
TF5.5	ANNUAL	Cyanobacteria Abundance	0.0000	111934	4511922	59.54	Degrading	0.2655
RET5.2	ANNUAL	Phytoplankton IBI	0.6881	0.00	2.50	0.00	No Trend	0.3380
RET5.2	ANNUAL	Total Abundance	0.2657	-143379	7429901	-46.31	No Trend	0.0345
RET5.2	ANNUAL	Total Biomass	0.1991	6165506	168028570	88.06	No Trend	0.0241
RET5.2	ANNUAL	Margalef Diversity Index	0.0001	-0.02	1.65	-30.79	Degrading	0.5366
RET5.2	ANNUAL	C14 Productivity *	0.0361	-1.29	125.14	-20.56	Improving	0.083
RET5.2	ANNUAL	Diatom Biomass	0.8640	-407079	117653325	-8.30	No Trend	0.0228
RET5.2	ANNUAL	Dinoflagellate Biomass	0.9292	0	478731	0.00	No Trend	0.3416
RET5.2	ANNUAL	Cyanobacteria Biomass	0.8910	-7606	3577520	-5.10	No Trend	0.3750
RET5.2	ANNUAL	Chlorophyte Biomass	0.0023	1205118	1762185	1641.30	Improving	0.0215
RET5.2	ANNUAL	Procaryote Biomass	0.9454	0	0	-2.69	No Trend	0.7060
RET5.2	ANNUAL	Picoplankton Biomass	0.0000	-2322847	113625000	-42.93	Improving	0.3298
RET5.2	ANNUAL	Cryptophyte Biomass	0.9932	0	14385423	0.00	No Trend	0.7019
RET5.2	ANNUAL	Cyanobacteria Abundance	0.3552	-19940	714837	-66.95	No Trend	0.1743
LE5.5	ANNUAL	Phytoplankton IBI	0.8517	0.00	2.49	0.00	No Trend	0.6559
LE5.5	ANNUAL	Total Abundance	0.3310	27844	5066591	13.74	No Trend	0.1708
LE5.5	ANNUAL	Total Biomass	0.6168	-1105770	235110748	-11.76	No Trend	0.0438
LE5.5	ANNUAL	Margalef Diversity Index	0.2468	-0.01	2.50	-5.70	No Trend	0.3436
LE5.5	ANNUAL	C14 Productivity *	0.0985	0.84	62.05	27.2	No Trend	0.2721
LE5.5	ANNUAL	Diatom Biomass	0.9544	-38115	161454403	-0.59	No Trend	0.0146
LE5.5	ANNUAL	Dinoflagellate Biomass	0.4233	178786	20753674	21.54	No Trend	0.8015
LE5.5	ANNUAL	Cyanobacteria Biomass	0.0000	9073	508	44694.20	Degrading	0.2295
LE5.5	ANNUAL	Chlorophyte Biomass	0.7794	0	5826	0.00	No Trend	0.6656
LE5.5	ANNUAL	Procaryote Biomass	0.0000	0	0	110694.63	Degrading	0.1003
LE5.5	ANNUAL	Picoplankton Biomass	0.0803	-204104	68925000	-6.22	No Trend	0.6185
LE5.5	ANNUAL	Cryptophyte Biomass	0.0000	-465011	20197572	-57.56	Decreasing	0.4341
LE5.5	ANNUAL	Cyanobacteria Abundance	0.0000	4292	14288	750.91	Degrading	0.5348

*Primary productivity trends are for the period of 1990 through 2008.

Appendix C - Section B. Long-term trends in phytoplankton index of biotic integrity (IBI) primary productivity and selected indicators in the Elizabeth River, for the period of 1985 through 2009. See the method section of the report for definitions of Seasons. “N.E.” in the Percent Change column indicates “No Estimate” was made for the percent change due to a zero value for the parameter baseline.

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
SBE5	ANNUAL	Phytoplankton IBI	0.8409	0.00	1.40	0.00	No Trend	0.2516
SBE5	ANNUAL	Total Abundance	0.3026	-28251	2554411	-23.23	No Trend	0.4449
SBE5	ANNUAL	Total Biomass	0.0084	-2457611	76329377	-67.61	Decreasing	0.5324
SBE5	ANNUAL	Margalef Diversity Index	0.6532	0.00	2.40	-2.37	No Trend	0.6211
SBE5	ANNUAL	C14 Productivity *	0.3313	0.35	57.37	10.89	No Trend	0.5705
SBE5	ANNUAL	Diatom Biomass	0.0006	-2106136	44433057	-99.54	Degrading	0.2461
SBE5	ANNUAL	Dinoflagellate Biomass	0.5201	-45281	8659873	-10.98	No Trend	0.3469
SBE5	ANNUAL	Cyanobacteria Biomass	0.0072	13379	103136	272.42	Degrading	0.8576
SBE5	ANNUAL	Chlorophyte Biomass	0.0425	-1682	276008	-12.80	No Trend	0.5552
SBE5	ANNUAL	Procaryote Biomass	0.0002	0	0	237.13	Degrading	0.7004
SBE5	ANNUAL	Picoplankton Biomass	0.0964	122575	26850000	9.59	No Trend	0.0058
SBE5	ANNUAL	Cryptophyte Biomass	0.0015	-354150	13747694	-54.10	Decreasing	0.9404
SBE5	ANNUAL	Cyanobacteria Abundance	0.0221	2599	7868	693.59	No Trend	0.1139

*Primary productivity trends are for the period of 1990 through 2008.

Appendix C - Section C. Long-term trends in phytoplankton index of biotic integrity (IBI) primary productivity and selected indicators in the York River, for the period of 1985 through 2009. See the method section of the report for definitions of Seasons. “N.E.” in the Percent Change column indicates “No Estimate” was made for the percent change due to a zero value for the parameter baseline.

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
TF4.2	ANNUAL	Phytoplankton IBI	0.7358	0.00	3.00	0.00	No Trend	0.0295
TF4.2	ANNUAL	Total Abundance	0.0223	65297	3316370	45.29	No Trend	0.9947
TF4.2	ANNUAL	Total Biomass	0.1726	1636311	100121180	37.59	No Trend	0.8155
TF4.2	ANNUAL	Margalef Diversity Index	0.6844	0.00	1.85	1.66	No Trend	0.4631
TF4.2	ANNUAL	C14 Productivity *	0.0065	0.38	10.29	73.39	Degrading	0.2681
TF4.2	ANNUAL	Diatom Biomass	0.9352	40454	86661160	1.07	No Trend	0.9940
TF4.2	ANNUAL	Dinoflagellate Biomass	0.5594	0	155268	0.00	No Trend	0.7455
TF4.2	ANNUAL	Cyanobacteria Biomass	0.0012	61568	364833	388.14	Degrading	0.0580
TF4.2	ANNUAL	Chlorophyte Biomass	0.0000	344559	871272	909.57	Improving	0.6408
TF4.2	ANNUAL	Procaryote Biomass	0.0120	0	0	196.27	No Trend	0.0089
TF4.2	ANNUAL	Picoplankton Biomass	0.8521	-22088	38400000	-1.21	No Trend	0.9039
TF4.2	ANNUAL	Cryptophyte Biomass	0.8566	-12855	8547560	-3.46	No Trend	0.2957
TF4.2	ANNUAL	Cyanobacteria Abundance	0.0171	7974	58370	314.19	No Trend	0.0459
RET4.3	ANNUAL	Phytoplankton IBI	0.3906	0.00	1.50	0.00	No Trend	0.3066
RET4.3	ANNUAL	Total Abundance	0.1947	88035	7856296	26.89	No Trend	0.2819
RET4.3	ANNUAL	Total Biomass	0.0974	4149272	329829759	30.19	No Trend	0.5461
RET4.3	ANNUAL	Margalef Diversity Index	0.6864	0.00	1.61	2.65	No Trend	0.3353
RET4.3	ANNUAL	C14 Productivity *	0.0007	1.61	34.81	92.27	Degrading	0.7536
RET4.3	ANNUAL	Diatom Biomass	0.3067	1542526	185043140	20.01	No Trend	0.2695
RET4.3	ANNUAL	Dinoflagellate Biomass	0.2603	147136	19948221	17.70	No Trend	0.8947
RET4.3	ANNUAL	Cyanobacteria Biomass	0.0037	97928	901456	260.72	Degrading	0.8126
RET4.3	ANNUAL	Chlorophyte Biomass	0.0000	156798	1404	268000.55	Improving	0.2185
RET4.3	ANNUAL	Procaryote Biomass	0.0222	0	0	64.65	No Trend	0.6856
RET4.3	ANNUAL	Picoplankton Biomass	0.3388	-219589	42525000	-10.84	No Trend	0.4196
RET4.3	ANNUAL	Cryptophyte Biomass	0.1947	-282466	19348050	-35.04	No Trend	0.0121
RET4.3	ANNUAL	Cyanobacteria Abundance	0.0003	16512	194361	203.89	Degrading	0.8292
WE4.2	ANNUAL	Phytoplankton IBI	0.0602	0.02	2.39	17.43	No Trend	0.0619
WE4.2	ANNUAL	Total Abundance	0.8967	4041	6089918	1.66	No Trend	0.8503
WE4.2	ANNUAL	Total Biomass	0.1125	-3252645	358999358	-22.65	No Trend	0.6142
WE4.2	ANNUAL	Margalef Diversity Index	0.0012	-0.02	2.61	-16.60	Degrading	0.2282
WE4.2	ANNUAL	C14 Productivity *	0.0157	1.09	50.54	43.23	Degrading	0.4133
WE4.2	ANNUAL	Diatom Biomass	0.6443	-531088	183248326	-7.25	No Trend	0.2559
WE4.2	ANNUAL	Dinoflagellate Biomass	0.6757	118487	51821394	5.72	No Trend	0.2884
WE4.2	ANNUAL	Cyanobacteria Biomass	0.0000	16477	0		Degrading	0.2275
WE4.2	ANNUAL	Chlorophyte Biomass	0.7375	0	71432	0.00	No Trend	0.4699
WE4.2	ANNUAL	Procaryote Biomass	0.0000	0	0		Degrading	0.2551
WE4.2	ANNUAL	Picoplankton Biomass	0.3370	-185742	56850000	-6.86	No Trend	0.2413
WE4.2	ANNUAL	Cryptophyte Biomass	0.0000	-774342	23280456	-83.15	Decreasing	0.5072
WE4.2	ANNUAL	Cyanobacteria Abundance	0.0000	6175	1536	10049.93	Degrading	0.3848

*Primary productivity trends are for the period of 1990 through 2008.

Appendix C - Section D. Long-term trends in phytoplankton index of biotic integrity (IBI) primary productivity and selected indicators in the Rappahannock River, for the period of 1985 through 2009. See the method section of the report for definitions of Seasons. "N.E." in the Percent Change column indicates "No Estimate" was made for the percent change due to a zero value for the parameter baseline.

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
TF3.3	ANNUAL	Phytoplankton IBI	0.0387	0.00	2.00	0.00	No Trend	0.0010
TF3.3	ANNUAL	Total Abundance	0.0000	1005512	4890501	493.45	Increasing	0.7479
TF3.3	ANNUAL	Total Biomass	0.0000	27214849	94304280	692.61	Increasing	0.8517
TF3.3	ANNUAL	Margalef Diversity Index	0.3325	0.00	1.54	6.86	No Trend	0.9031
TF3.3	ANNUAL	C14 Productivity *	0	4.62	51.88	178.25	Degrading	0.6408
TF3.3	ANNUAL	Diatom Biomass	0.0000	14976977	72419559	496.34	Improving	0.7458
TF3.3	ANNUAL	Dinoflagellate Biomass	0.0027	31171	881362	84.88	Degrading	0.6608
TF3.3	ANNUAL	Cyanobacteria Biomass	0.0000	1452737	1358370	2566.73	Degrading	0.2981
TF3.3	ANNUAL	Chlorophyte Biomass	0.0000	3565479	1749939	4889.97	Improving	0.9291
TF3.3	ANNUAL	Procaryote Biomass	0.0000	0	0	296.84	Degrading	0.0132
TF3.3	ANNUAL	Picoplankton Biomass	0.6984	150500	71700000	4.41	No Trend	0.6424
TF3.3	ANNUAL	Cryptophyte Biomass	0.2398	-225389	12445860	-43.46	No Trend	0.1604
TF3.3	ANNUAL	Cyanobacteria Abundance	0.0000	312864	171100	4388.52	Degrading	0.8278
RET3.1	ANNUAL	Phytoplankton IBI	0.6273	0.00	2.25	0.00	No Trend	0.3106
RET3.1	ANNUAL	Total Abundance	0.0000	552268	6640168	199.61	Increasing	0.5476
RET3.1	ANNUAL	Total Biomass	0.0000	14990340	201242741	178.77	Increasing	0.7783
RET3.1	ANNUAL	Margalef Diversity Index	0.3440	0.00	1.77	-5.25	No Trend	0.1969
RET3.1	ANNUAL	C14 Productivity *	0	4.11	65.84	124.97	Degrading	0.3669
RET3.1	ANNUAL	Diatom Biomass	0.0265	3851426	117569989	78.62	No Trend	0.8213
RET3.1	ANNUAL	Dinoflagellate Biomass	0.3384	-50376	20778928	-5.82	No Trend	0.9116
RET3.1	ANNUAL	Cyanobacteria Biomass	0.0000	809208	1936906	1002.68	Degrading	0.3288
RET3.1	ANNUAL	Chlorophyte Biomass	0.0000	975184	1492127	1568.53	Improving	0.6795
RET3.1	ANNUAL	Procaryote Biomass	0.0000	0	0	245.71	Degrading	0.5214
RET3.1	ANNUAL	Picoplankton Biomass	0.2013	-461438	119700000	-8.10	No Trend	0.7876
RET3.1	ANNUAL	Cryptophyte Biomass	0.2633	-223013	21408468	-25.00	No Trend	0.2565
RET3.1	ANNUAL	Cyanobacteria Abundance	0.0000	127810	169424	1810.51	Degrading	0.7529
LE3.6	ANNUAL	Phytoplankton IBI	0.0086	0.03	2.88	21.74	Degrading	0.9511
LE3.6	ANNUAL	Total Abundance	0.0310	81456	5063581	40.22	No Trend	0.8840
LE3.6	ANNUAL	Total Biomass	0.0608	-5104120	377739520	-33.78	No Trend	0.8178
LE3.6	ANNUAL	Margalef Diversity Index	0.1048	-0.01	2.23	-7.54	No Trend	0.4230
LE3.6	ANNUAL	C14 Productivity *	0.0171	0.86	34.88	49.33	Degrading	0.8597
LE3.6	ANNUAL	Diatom Biomass	0.0718	-2714214	225079575	-30.15	No Trend	0.6231
LE3.6	ANNUAL	Dinoflagellate Biomass	0.0843	632637	23164503	68.28	No Trend	0.0302
LE3.6	ANNUAL	Cyanobacteria Biomass	0.0000	66588	643	258816.45	Degrading	0.8789
LE3.6	ANNUAL	Chlorophyte Biomass	0.8056	0	186621	0.00	No Trend	0.6622
LE3.6	ANNUAL	Procaryote Biomass	0.0000	0	0	336104.74	Degrading	0.6256
LE3.6	ANNUAL	Picoplankton Biomass	0.0000	-1309757	106500000	-25.83	Improving	0.6133
LE3.6	ANNUAL	Cryptophyte Biomass	0.0000	-614354	27224033	-56.42	Decreasing	0.2579
LE3.6	ANNUAL	Cyanobacteria Abundance	0.0000	19117	256	186691.67	Degrading	0.9054

*Primary productivity trends are for the period of 1990 through 2008.

Appendix C - Section E. Long-term trends in phytoplankton index of biotic integrity (IBI) primary productivity and selected indicators in the Mainstem, for the period of 1985 through 2009. See the method section of the report for definitions of Seasons. “N.E.” in the Percent Change column indicates “No Estimate” was made for the percent change due to a zero value for the parameter baseline.

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
CB6.1	ANNUAL	Phytoplankton IBI	0.0872	0.01	3.25	7.69	No Trend	0.9387
CB6.1	ANNUAL	Total Abundance	0.0246	59558	5316407	28.01	No Trend	0.5080
CB6.1	ANNUAL	Total Biomass	0.0346	-5189369	422147678	-30.73	No Trend	0.0787
CB6.1	ANNUAL	Margalef Diversity Index	0.2339	-0.01	2.33	-6.03	No Trend	0.4757
CB6.1	ANNUAL	C14 Productivity *	0.2942	0.32	23.89	27.18	No Trend	0.9069
CB6.1	ANNUAL	Diatom Biomass	0.1854	-1472153	228810663	-16.08	No Trend	0.1614
CB6.1	ANNUAL	Dinoflagellate Biomass	0.6988	147134	32128541	11.45	No Trend	0.0350
CB6.1	ANNUAL	Cyanobacteria Biomass	0.0000	42346	653	162172.01	Degrading	0.2970
CB6.1	ANNUAL	Chlorophyte Biomass	0.5805	0	140324	0.00	No Trend	0.7055
CB6.1	ANNUAL	Procaryote Biomass	0.0000	0	0	766748.47	Degrading	0.4020
CB6.1	ANNUAL	Picoplankton Biomass	0.0000	-1453733	81975000	-37.24	Improving	0.4770
CB6.1	ANNUAL	Cryptophyte Biomass	0.0000	-778066	25735449	-75.58	Decreasing	0.9312
CB6.1	ANNUAL	Cyanobacteria Abundance	0.0000	12580	9978	3151.79	Degrading	0.4763
CB6.4	ANNUAL	Phytoplankton IBI	0.2774	0.01	2.74	6.74	No Trend	0.7695
CB6.4	ANNUAL	Total Abundance	0.0211	73961	3712028	49.81	No Trend	0.9036
CB6.4	ANNUAL	Total Biomass	0.3373	-2146675	221864754	-24.19	No Trend	0.6266
CB6.4	ANNUAL	Margalef Diversity Index	0.0021	-0.01	2.19	-15.71	Degrading	0.1026
CB6.4	ANNUAL	C14 Productivity *	0.0091	0.92	30.47	60.45	Degrading	0.8394
CB6.4	ANNUAL	Diatom Biomass	0.1999	-1494771	161577654	-23.13	No Trend	0.8018
CB6.4	ANNUAL	Dinoflagellate Biomass	0.0728	676674	31861194	53.10	No Trend	0.4390
CB6.4	ANNUAL	Cyanobacteria Biomass	0.0000	20171	0		Degrading	0.9829
CB6.4	ANNUAL	Chlorophyte Biomass	0.7724	0	82373	0.00	No Trend	0.5483
CB6.4	ANNUAL	Procaryote Biomass	0.0000	0	0		Degrading	0.9937
CB6.4	ANNUAL	Picoplankton Biomass	0.0000	-906600	92512500	-20.58	Improving	0.8959
CB6.4	ANNUAL	Cryptophyte Biomass	0.0001	-475836	16798536	-70.82	Decreasing	0.0299
CB6.4	ANNUAL	Cyanobacteria Abundance	0.0000	7147	0		Degrading	0.9599
CB7.3E	ANNUAL	Phytoplankton IBI	0.3402	0.01	2.67	6.96	No Trend	0.9361
CB7.3E	ANNUAL	Total Abundance	0.3081	23142	3428481	16.87	No Trend	0.3093
CB7.3E	ANNUAL	Total Biomass	0.1060	-3010013	297662958	-25.28	No Trend	0.3022
CB7.3E	ANNUAL	Margalef Diversity Index	0.0004	-0.02	2.46	-17.96	Degrading	0.7766
CB7.3E	ANNUAL	C14 Productivity *	0.0772	0.4	20.48	39.46	No Trend	0.9523
CB7.3E	ANNUAL	Diatom Biomass	0.1950	-1525428	193693507	-19.69	No Trend	0.5667
CB7.3E	ANNUAL	Dinoflagellate Biomass	0.7820	-68946	31423533	-5.49	No Trend	0.2435
CB7.3E	ANNUAL	Cyanobacteria Biomass	0.0000	17477	9326	4684.90	Degrading	0.9924
CB7.3E	ANNUAL	Chlorophyte Biomass	0.3470	0	1569	0.00	No Trend	0.6977
CB7.3E	ANNUAL	Procaryote Biomass	0.0000	0	0	6860.51	Degrading	0.9868
CB7.3E	ANNUAL	Picoplankton Biomass	0.1172	-379775	83062500	-9.60	No Trend	0.9023
CB7.3E	ANNUAL	Cryptophyte Biomass	0.0000	-462777	18016468	-64.22	Decreasing	0.3452
CB7.3E	ANNUAL	Cyanobacteria Abundance	0.0000	5681	8294	1712.23	Degrading	0.9873
CB7.4	ANNUAL	Phytoplankton IBI	0.2246	0.01	3.15	8.19	No Trend	0.4503
CB7.4	ANNUAL	Total Abundance	0.0050	59858	2535640	59.02	Increasing	0.6076
CB7.4	ANNUAL	Total Biomass	0.4340	1417590	163322672	21.70	No Trend	0.8011
CB7.4	ANNUAL	Margalef Diversity Index	0.0000	-0.03	2.85	-29.94	Degrading	0.9792
CB7.4	ANNUAL	C14 Productivity *	0.0021	0.56	15.95	70.5	Degrading	0.6604
CB7.4	ANNUAL	Diatom Biomass	0.4597	763259	135076476	14.13	No Trend	0.7852
CB7.4	ANNUAL	Dinoflagellate Biomass	0.1373	278140	18234240	38.13	No Trend	0.5951
CB7.4	ANNUAL	Cyanobacteria Biomass	0.0000	2324	0		Degrading	0.6081
CB7.4	ANNUAL	Chlorophyte Biomass	0.6561	0	29864	0.00	No Trend	0.0297
CB7.4	ANNUAL	Procaryote Biomass	0.0000	0	0		Degrading	0.6344
CB7.4	ANNUAL	Picoplankton Biomass	0.4194	-143786	97800000	-3.09	No Trend	0.5459

Station	Season	Parameter	P value	Slope	Baseline	Percent Change	Direction	Homogeneity test P value
CB7.4	ANNUAL	Cryptophyte Biomass	0.0031	-215349	7805429	-68.97	Decreasing	0.2448
CB7.4	ANNUAL	Cyanobacteria Abundance	0.0000	4037	240	42053.62	Degrading	0.1199

*Primary productivity trends are for the period of 1990 through 2008.

Appendix D - Scatterplots of phytoplankton bioindicators

List of Figures

Figure 1. Plot of above pycnocline phytoplankton IBI scores against time at station TF5.5 for the period of 1985 through 2009. 1

Figure 2. Plot of above pycnocline total phytoplankton biomass against time at station TF5.5 for the period of 1985 through 2009. 2

Figure 3. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF5.5 for the period of 1985 through 2009. 3

Figure 4. Plot of above pycnocline Margalef diversity index against time at station TF5.5 for the period of 1985 through 2009. 4

Figure 5. Plot of above pycnocline diatom biomass against time at station TF5.5 for the period of 1985 through 2009. 5

Figure 6. Plot of above pycnocline dinoflagellate biomass against time at station TF5.5 for the period of 1985 through 2009. 6

Figure 7. Plot of above pycnocline cyanobacteria biomass against time at station TF5.5 for the period of 1985 through 2009. 7

Figure 8. Plot of above pycnocline chlorophyte biomass against time at station TF5.5 for the period of 1985 through 2009. 8

Figure 9. Plot of above pycnocline picoplankton biomass against time at station TF5.5 for the period of 1985 through 2009. 9

Figure 10. Plot of above pycnocline cryptophyte biomass at station TF5.5 for the period of 1985 through 2009 10

Figure 11. Plot of above pycnocline cyanophyte abundance at station TF5.5 for the period of 1985 through 2009. 11

Figure 12. Plot of above pycnocline phytoplankton IBI scores against time at station RET5.2 for the period of 1985 through 2009. 12

Figure 13. Plot of above pycnocline total phytoplankton biomass against time at station RET5.2 for the period of 1985 through 2009. 13

Figure 14. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET5.2 for the period of 1985 through 2009. 14

Figure 15. Plot of above pycnocline Margalef diversity index against time at station RET5.2 for the period of 1985 through 2009. 15

Figure 16. Plot of above pycnocline diatom biomass against time at station RET5.2 for the period of 1985 through 2009. 16

Figure 17. Plot of above pycnocline dinoflagellate biomass against time at station RET5.2 for the period of 1985 through 2009. 17

Figure 18. Plot of above pycnocline cyanobacteria biomass against time at station RET5.2 for the period of 1985 through 2009. 18

Figure 19. Plot of above pycnocline chlorophyte biomass against time at station RET5.2 for the period of 1985 through 2009. 19

Figure 20. Plot of above pycnocline picoplankton biomass against time at station RET5.2 for the period of 1985 through 2009. 20

Figure 21. Plot of above pycnocline cryptophyte biomass at station RET5.2 for the period of 1985 through 2009. 21

Figure 22. Plot of above pycnocline cyanophyte abundance at station RET5.2 for the period of 1985 through 2009. 22

Figure 23. Plot of above pycnocline phytoplankton IBI scores against time at station LE5.5 for the period of 1985 through 2009. 23

Figure 24. Plot of above pycnocline total phytoplankton biomass against time at station LE5.5 for the period of 1985 through 2009. 24

Figure 25. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station LE5.5 for the period of 1985 through 2009. 25

Figure 26. Plot of above pycnocline Margalef diversity index against time at station LE5.5 for the period of 1985 through 2009. 26

Figure 27. Plot of above pycnocline diatom biomass against time at station LE5.5 for the period of 1985 through 2009. 27

Figure 28. Plot of above pycnocline dinoflagellate biomass against time at station LE5.5 for the period of 1985 through 2009. 28

Figure 29. Plot of above pycnocline cyanobacteria biomass against time at station LE5.5 for the period of 1985 through 2009. 29

Figure 30. Plot of above pycnocline chlorophyte biomass against time at station LE5.5 for the period of 1985 through 2009. 30

Figure 31. Plot of above pycnocline picoplankton biomass against time at station LE5.5 for the period of 1985 through 2009. 31

Figure 32. Plot of above pycnocline cryptophyte biomass at station LE5.5 for the period of 1985 through 2009. 32

Figure 33. Plot of above pycnocline cyanophyte abundance at station LE5.5 for the period of 1985 through 2009. 33

Figure 34. Plot of above pycnocline phytoplankton IBI scores against time at station SBE5 for the period of 1985 through 2009. 34

Figure 35. Plot of above pycnocline total phytoplankton biomass against time at station SBE5 for the period of 1985 through 2009. 35

Figure 36. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station SBE5 for the period of 1985 through 2009. 36

Figure 37. Plot of above pycnocline Margalef diversity index against time at station SBE5 for the period of 1985 through 2009. 37

Figure 38. Plot of above pycnocline diatom biomass against time at station SBE5 for the period of 1985 through 2009. 38

Figure 39. Plot of above pycnocline dinoflagellate biomass against time at station SBE5 for the period of 1985 through 2009. 39

Figure 40. Plot of above pycnocline cyanobacteria biomass against time at station SBE5 for the period of 1985 through 2009. 40

Figure 41. Plot of above pycnocline chlorophyte biomass against time at station SBE5 for the period of 1985 through 2009. 41

Figure 42. Plot of above pycnocline picoplankton biomass against time at station SBE5 for the period of 1985 through 2009. 42

Figure 43. Plot of above pycnocline cryptophyte biomass at station SBE5 for the period of 1985 through 2009. 43

Figure 44. Plot of above pycnocline cyanophyte abundance at station SBE5 for the period of 1985 through 2009. 44

Figure 45. Plot of above pycnocline phytoplankton IBI scores against time at station TF4.2 for the period of 1985 through 2009. 45

Figure 46. Plot of above pycnocline total phytoplankton biomass against time at station TF4.2 for the period of 1985 through 2009. 46

Figure 47. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF4.2 for the period of 1985 through 2009. 47

Figure 48. Plot of above pycnocline Margalef diversity index against time at station TF4.2 for the period of 1985 through 2009. 48

Figure 49. Plot of above pycnocline diatom biomass against time at station TF4.2 for the period of 1985 through 2009. 49

Figure 50. Plot of above pycnocline dinoflagellate biomass against time at station TF4.2 for the period of 1985 through 2009. 50

Figure 51. Plot of above pycnocline cyanobacteria biomass against time at station TF4.2 for the period of 1985 through 2009. 51

Figure 52. Plot of above pycnocline chlorophyte biomass against time at station TF4.2 for the period of 1985 through 2009. 52

Figure 53. Plot of above pycnocline picoplankton biomass against time at station TF4.2 for the period of 1985 through 2009. 53

Figure 54. Plot of above pycnocline cryptophyte biomass at station TF4.2 for the period of 1985 through 2009. 54

Figure 55. Plot of above pycnocline cyanophyte abundance at station TF4.2 for the period of 1985 through 2009. 55

Figure 56. Plot of above pycnocline phytoplankton IBI scores against time at station RET4.3 for the period of 1985 through 2009. 56

Figure 57. Plot of above pycnocline total phytoplankton biomass against time at station RET4.3 for the period of 1985 through 2009. 57

Figure 58. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET4.3 for the period of 1985 through 2009. 58

Figure 59. Plot of above pycnocline Margalef diversity index against time at station RET4.3 for the period of 1985 through 2009. 59

Figure 60. Plot of above pycnocline diatom biomass against time at station RET4.3 for the period of 1985 through 2009. 60

Figure 61. Plot of above pycnocline dinoflagellate biomass against time at station RET4.3 for the period of 1985 through 2009. 61

Figure 62. Plot of above pycnocline cyanobacteria biomass against time at station RET4.3 for the period of 1985 through 2009. 62

Figure 63. Plot of above pycnocline chlorophyte biomass against time at station RET4.3 for the period of 1985 through 2009. 63

Figure 64. Plot of above pycnocline picoplankton biomass against time at station RET4.3 for the period of 1985 through 2009. 64

Figure 65. Plot of above pycnocline cryptophyte biomass at station RET4.3 for the period of 1985 through 2009. 65

Figure 66. Plot of above pycnocline cyanophyte abundance at station RET4.3 for the period of 1985 through 2009. 66

Figure 67. Plot of above pycnocline phytoplankton IBI scores against time at station WE4.2 for the period of 1985 through 2009. 67

Figure 68. Plot of above pycnocline total phytoplankton biomass against time at station WE4.2 for the period of 1985 through 2009. 68

Figure 69. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station WE4.2 for the period of 1985 through 2009. 69

Figure 70. Plot of above pycnocline Margalef diversity index against time at station WE4.2 for the period of 1985 through 2009. 70

Figure 71. Plot of above pycnocline diatom biomass against time at station WE4.2 for the period of 1985 through 2009. 71

Figure 72. Plot of above pycnocline dinoflagellate biomass against time at station WE4.2 for the period of 1985 through 2009. 72

Figure 73. Plot of above pycnocline cyanobacteria biomass against time at station WE4.2 for the period of 1985 through 2009. 73

Figure 74. Plot of above pycnocline chlorophyte biomass against time at station WE4.2 for the period of 1985 through 2009. 74

Figure 75. Plot of above pycnocline picoplankton biomass against time at station WE4.2 for the period of 1985 through 2009. 75

Figure 76. Plot of above pycnocline cryptophyte biomass at station WE4.2 for the period of 1985 through 2009. 76

Figure 77. Plot of above pycnocline cyanophyte abundance at station WE4.2 for the period of 1985 through 2009. 77

Figure 78. Plot of above pycnocline phytoplankton IBI scores against time at station TF3.3 for the period of 1985 through 2009. 78

Figure 79. Plot of above pycnocline total phytoplankton biomass against time at station TF3.3 for the period of 1985 through 2009. 79

Figure 80. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF3.3 for the period of 1985 through 2009. 80

Figure 81. Plot of above pycnocline Margalef diversity index against time at station TF3.3 for the period of 1985 through 2009. 81

Figure 82. Plot of above pycnocline diatom biomass against time at station TF3.3 for the period of 1985 through 2009. 82

Figure 83. Plot of above pycnocline dinoflagellate biomass against time at station TF3.3 for the period of 1985 through 2009. 83

Figure 84. Plot of above pycnocline cyanobacteria biomass against time at station TF3.3 for the period of 1985 through 2009. 84

Figure 85. Plot of above pycnocline chlorophyte biomass against time at station TF3.3 for the period of 1985 through 2009. 85

Figure 86. Plot of above pycnocline picoplankton biomass against time at station TF3.3 for the period of 1985 through 2009. 86

Figure 87. Plot of above pycnocline cryptophyte biomass against time at station TF3.3 for the period of 1985 through 2009. 87

Figure 88. Plot of above pycnocline cyanophyte abundance at station TF3.3 for the period of 1985 through 2009. 88

Figure 89. Plot of above pycnocline phytoplankton IBI scores against time at station RET3.1 for the period of 1985 through 2009. 89

Figure 90. Plot of above pycnocline total phytoplankton biomass against time at station RET3.1 for the period of 1985 through 2009. 90

Figure 91. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET3.1 for the period of 1985 through 2009. 91

Figure 92. Plot of above pycnocline Margalef diversity index against time at station RET3.1 for the period of 1985 through 2009. 92

Figure 93. Plot of above pycnocline diatom biomass against time at station RET3.1 for the period of 1985 through 2009. 93

Figure 94. Plot of above pycnocline dinoflagellate biomass against time at station RET3.1 for the period of 1985 through 2009. 94

Figure 95. Plot of above pycnocline cyanobacteria biomass against time at station RET3.1 for the period of 1985 through 2009. 95

Figure 96. Plot of above pycnocline chlorophyte biomass against time at station RET3.1 for the period of 1985 through 2009. 96

Figure 97. Plot of above pycnocline picoplankton biomass against time at station RET3.1 for the period of 1985 through 2009. 97

Figure 98. Plot of above pycnocline cryptophyte biomass at station RET3.1 for the period of 1985 through 2009. 98

Figure 99. Plot of above pycnocline cyanophyte abundance at station RET3.1 for the period of 1985 through 2009. 99

Figure 100. Plot of above pycnocline phytoplankton IBI scores against time at station LE3.6 for the period of 1985 through 2009. 100

Figure 101. Plot of above pycnocline total phytoplankton biomass against time at station LE3.6 for the period of 1985 through 2009. 101

Figure 102. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station LE3.6 for the period of 1985 through 2009. 102

Figure 103. Plot of above pycnocline Margalef diversity index against time at station LE3.6 for the period of 1985 through 2009. 103

Figure 104. Plot of above pycnocline diatom biomass against time at station LE3.6 for the period of 1985 through 2009. 104

Figure 105. Plot of above pycnocline dinoflagellate biomass against time at station LE3.6 for the period of 1985 through 2009. 105

Figure 106. Plot of above pycnocline cyanobacteria biomass against time at station LE3.6 for the period of 1985 through 2009. 106

Figure 107. Plot of above pycnocline chlorophyte biomass against time at station LE3.6 for the period of 1985 through 2009. 107

Figure 108. Plot of above pycnocline picoplankton biomass against time at station LE3.6 for the period of 1985 through 2009. 108

Figure 109. Plot of above pycnocline cryptophyte biomass at station LE3.6 for the period of 1985 through 2009. 109

Figure 110. Plot of above pycnocline cyanophyte abundance at station LE3.6 for the period of 1985 through 2009. 110

Figure 111. Plot of above pycnocline phytoplankton IBI scores against time at station CB6.1 for the period of 1985 through 2009. 111

Figure 112. Plot of above pycnocline total phytoplankton biomass against time at station CB6.1 for the period of 1985 through 2009. 112

Figure 113. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB6.1 for the period of 1985 through 2009. 113

Figure 114. Plot of above pycnocline Margalef diversity index against time at station CB6.1 for the period of 1985 through 2009. 114

Figure 115. Plot of above pycnocline diatom biomass against time at station CB6.1 for the period of 1985 through 2009. 115

Figure 116. Plot of above pycnocline dinoflagellate biomass against time at station CB6.1 for the period of 1985 through 2009. 116

Figure 117. Plot of above pycnocline cyanobacteria biomass against time at station CB6.1 for the period of 1985 through 2009. 117

Figure 118. Plot of above pycnocline chlorophyte biomass against time at station CB6.1 for the period of 1985 through 2009. 118

Figure 119. Plot of above pycnocline picoplankton biomass against time at station CB6.1 for the period of 1985 through 2009. 119

Figure 120. Plot of above pycnocline cryptophyte biomass at station CB6.1 for the period of 1985 through 2009. 120

Figure 121. Plot of above pycnocline cyanophyte abundance at station CB6.1 for the period of 1985 through 2009. 121

Figure 122. Plot of above pycnocline phytoplankton IBI scores against time at station CB6.4 for the period of 1985 through 2009. 122

Figure 123. Plot of above pycnocline total phytoplankton biomass against time at station CB6.4 for the period of 1985 through 2009. 123

Figure 124. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB6.4 for the period of 1985 through 2009. 124

Figure 125. Plot of above pycnocline Margalef diversity index against time at station CB6.4 for the period of 1985 through 2009. 125

Figure 126. Plot of above pycnocline diatom biomass against time at station CB6.4 for the period of 1985 through 2009. 126

Figure 127. Plot of above pycnocline dinoflagellate biomass against time at station CB6.4 for the period of 1985 through 2009. 127

Figure 128. Plot of above pycnocline cyanobacteria biomass against time at station CB6.4 for the period of 1985 through 2009. 128

Figure 129. Plot of above pycnocline chlorophyte biomass against time at station CB6.4 for the period of 1985 through 2009. 129

Figure 130. Plot of above pycnocline picoplankton biomass against time at station CB6.4 for the period of 1985 through 2009. 130

Figure 131. Plot of above pycnocline cryptophyte biomass at station CB6.4 for the period of 1985 through 2009. 131

Figure 132. Plot of above pycnocline cyanophyte abundance at station CB6.4 for the period of 1985 through 2009. 132

Figure 133. Plot of above pycnocline phytoplankton IBI scores against time at station CB7.3E for the period of 1985 through 2009. 133

Figure 134. Plot of above pycnocline total phytoplankton biomass against time at station CB7.3E for the period of 1985 through 2009. 134

Figure 135. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB7.3E for the period of 1985 through 2009. 135

Figure 136. Plot of above pycnocline Margalef diversity index against time at station CB7.3E for the period of 1985 through 2009. 136

Figure 137. Plot of above pycnocline diatom biomass against time at station CB7.3E for the period of 1985 through 2009. 137

Figure 138. Plot of above pycnocline dinoflagellate biomass against time at station CB7.3E for the period of 1985 through 2009. 138

Figure 139. Plot of above pycnocline cyanobacteria biomass against time at station CB7.3E for the period of 1985 through 2009. 139

Figure 140. Plot of above pycnocline chlorophyte biomass against time at station CB7.3E for the period of 1985 through 2009. 140

Figure 141. Plot of above pycnocline picoplankton biomass against time at station CB7.3E for the period of 1985 through 2009. 141

Figure 142. Plot of above pycnocline cryptophyte biomass at station CB7.3E for the period of 1985 through 2009. 142

Figure 143. Plot of above pycnocline cyanophyte abundance at station CB7.3E for the period of 1985 through 2009. 143

Figure 144. Plot of above pycnocline phytoplankton IBI scores against time at station CB7.4 for the period of 1985 through 2009. 144

Figure 145. Plot of above pycnocline total phytoplankton biomass against time at station CB7.4 for the period of 1985 through 2009. 145

Figure 146. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB7.4 for the period of 1985 through 2009. 146

Figure 147. Plot of above pycnocline Margalef diversity index against time at station CB7.4 for the period of 1985 through 2009. 147

Figure 148. Plot of above pycnocline diatom biomass against time at station CB7.4 for the period of 1985 through 2009. 148

Figure 149. Plot of above pycnocline dinoflagellate biomass against time at station CB7.4 for the period of 1985 through 2009. 149

Figure 150. Plot of above pycnocline cyanobacteria biomass against time at station CB7.4 for the period of 1985 through 2009. 150

Figure 151. Plot of above pycnocline chlorophyte biomass against time at station CB7.4 for the period of 1985 through 2009. 151

Figure 152. Plot of above pycnocline picoplankton biomass against time at station CB7.4 for the period of 1985 through 2009. 152

Figure 153. Plot of above pycnocline cryptophyte biomass at station CB7.4 for the period of 1985 through 2009. 153

Figure 154. Plot of above pycnocline cyanophyte abundance at station CB7.4 for the period of 1985 through 2009. 154

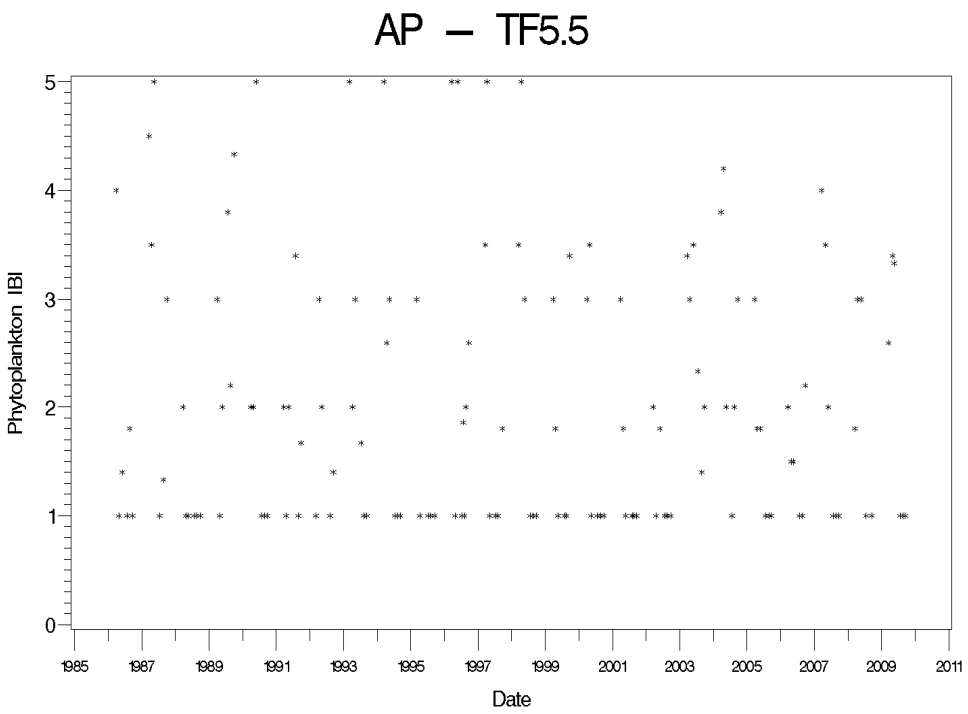


Figure 1. Plot of above pycnocline phytoplankton IBI scores against time at station TF5.5 for the period of 1985 through 2009.

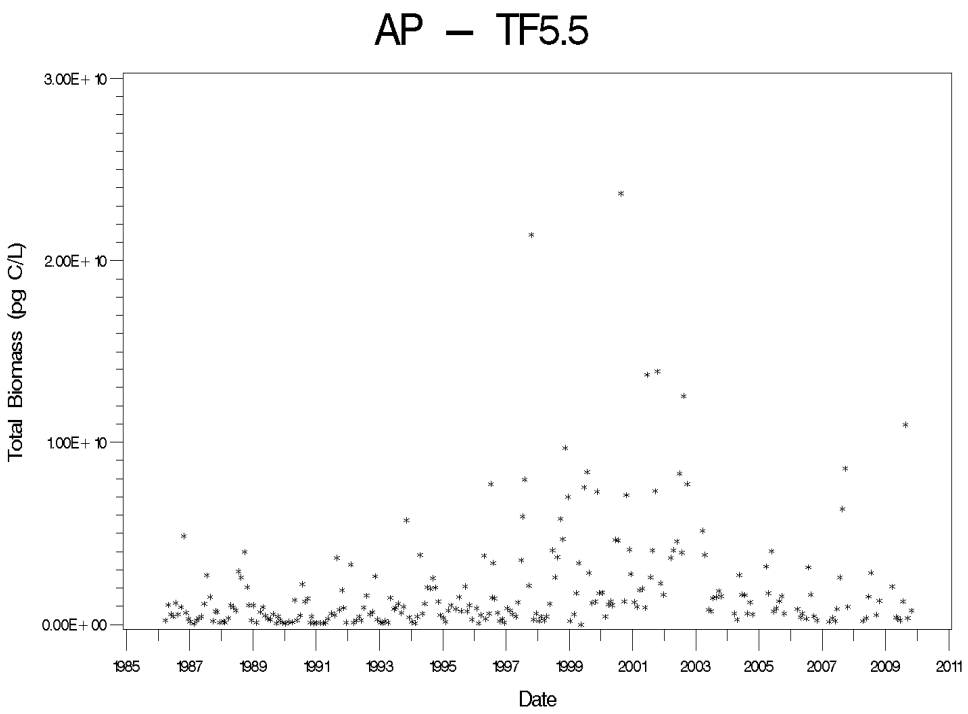


Figure 2. Plot of above pycnocline total phytoplankton biomass against time at station TF5.5 for the period of 1985 through 2009.

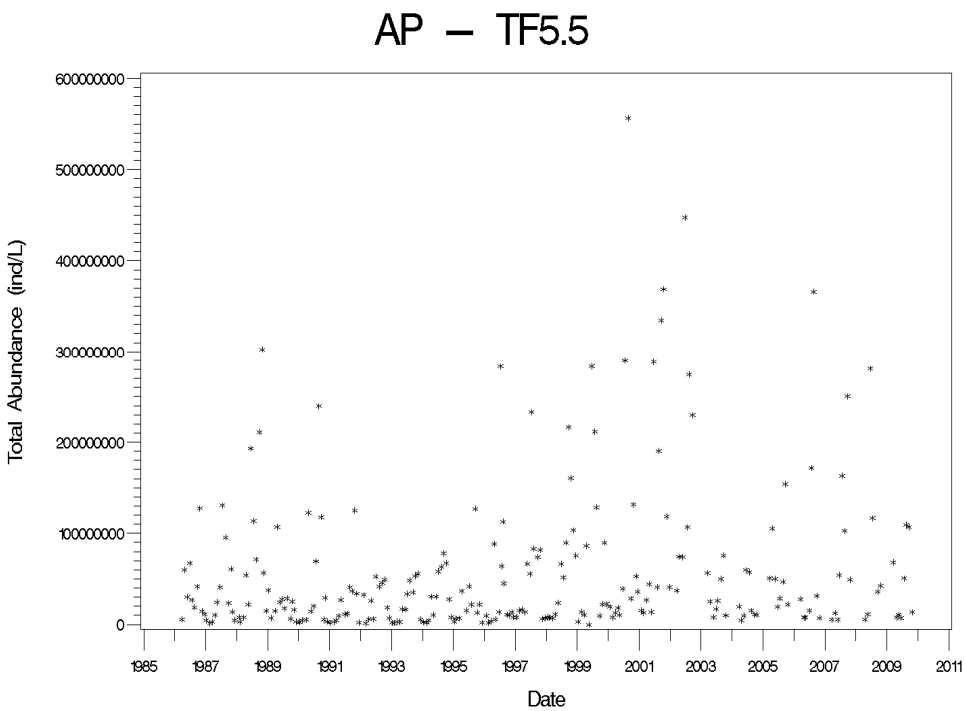


Figure 3. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF5.5 for the period of 1985 through 2009.

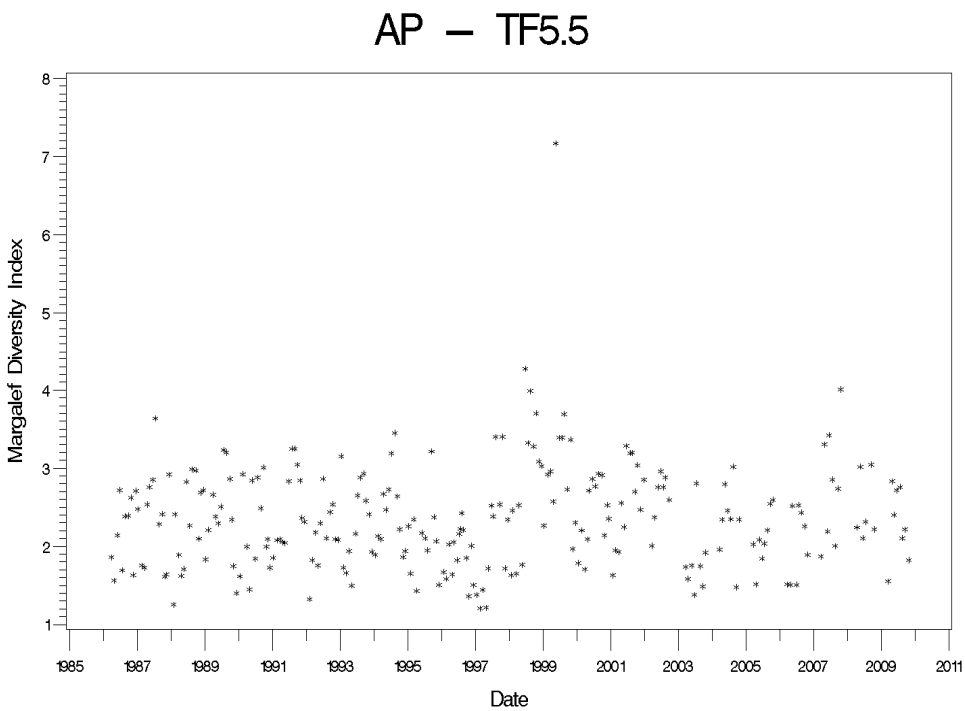


Figure 4. Plot of above pycnocline Margalef diversity index against time at station TF5.5 for the period of 1985 through 2009.

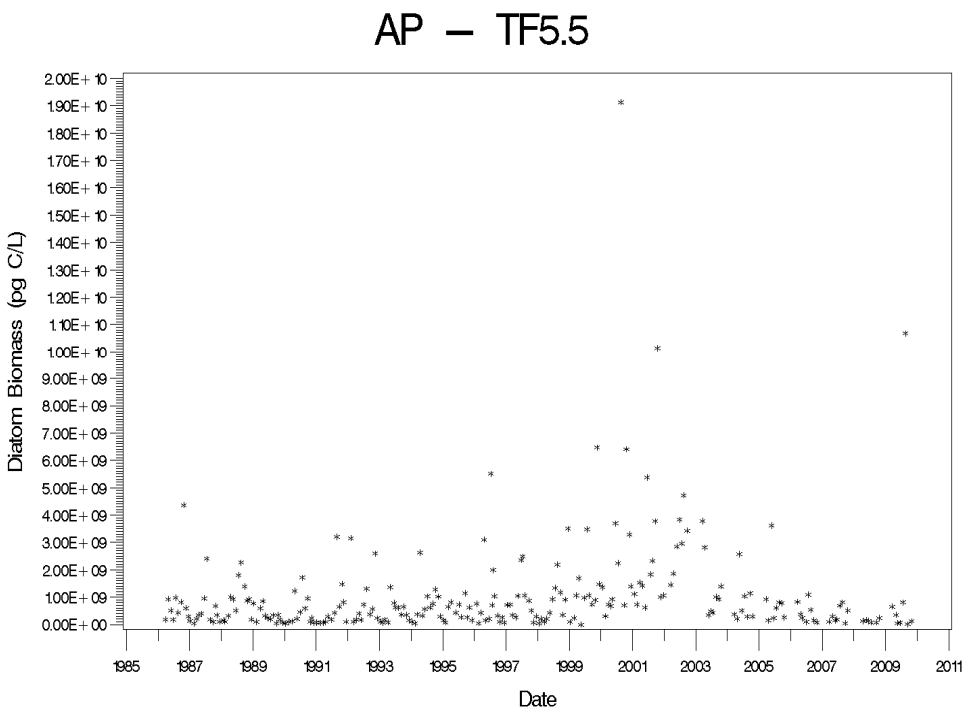


Figure 5. Plot of above pycnocline diatom biomass against time at station TF5.5 for the period of 1985 through 2009.

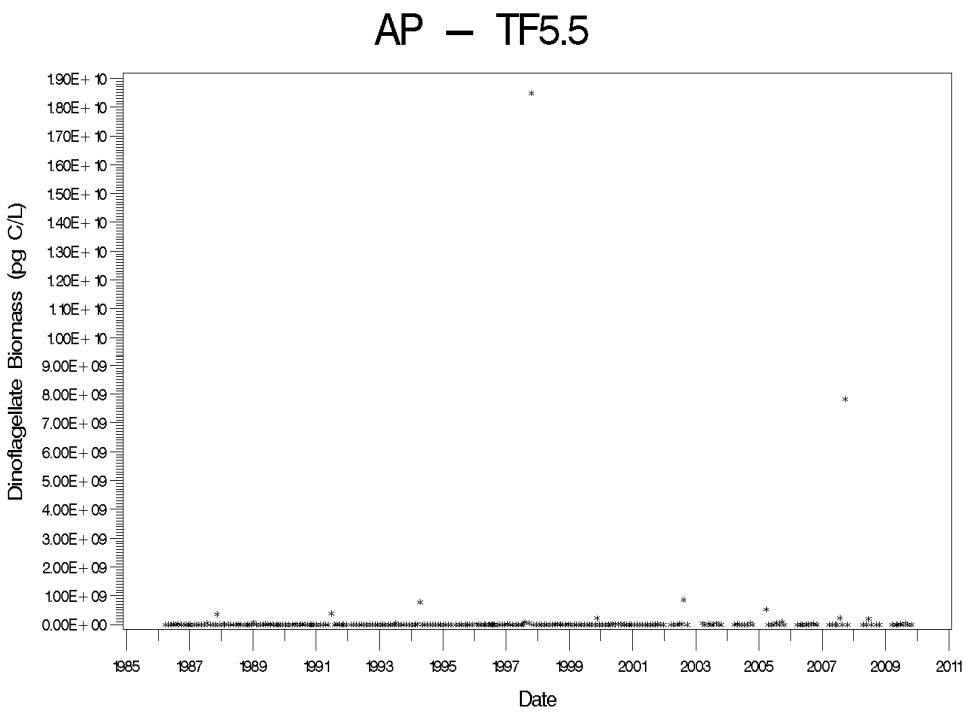


Figure 6. Plot of above pycnocline dinoflagellate biomass against time at station TF5.5 for the period of 1985 through 2009.

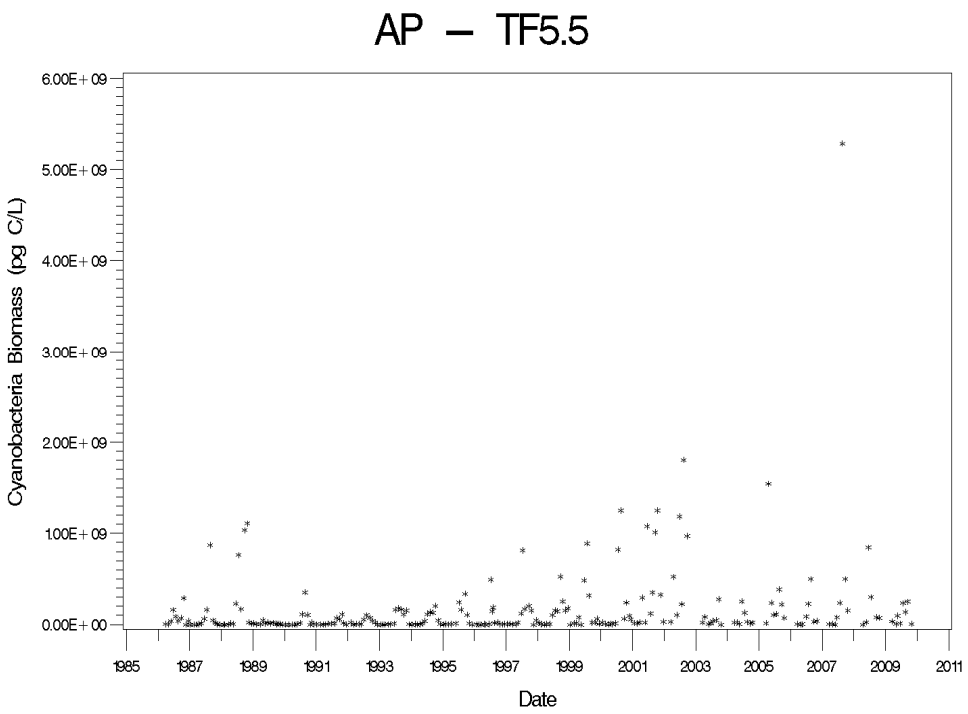


Figure 7. Plot of above pycnocline cyanobacteria biomass against time at station TF5.5 for the period of 1985 through 2009.

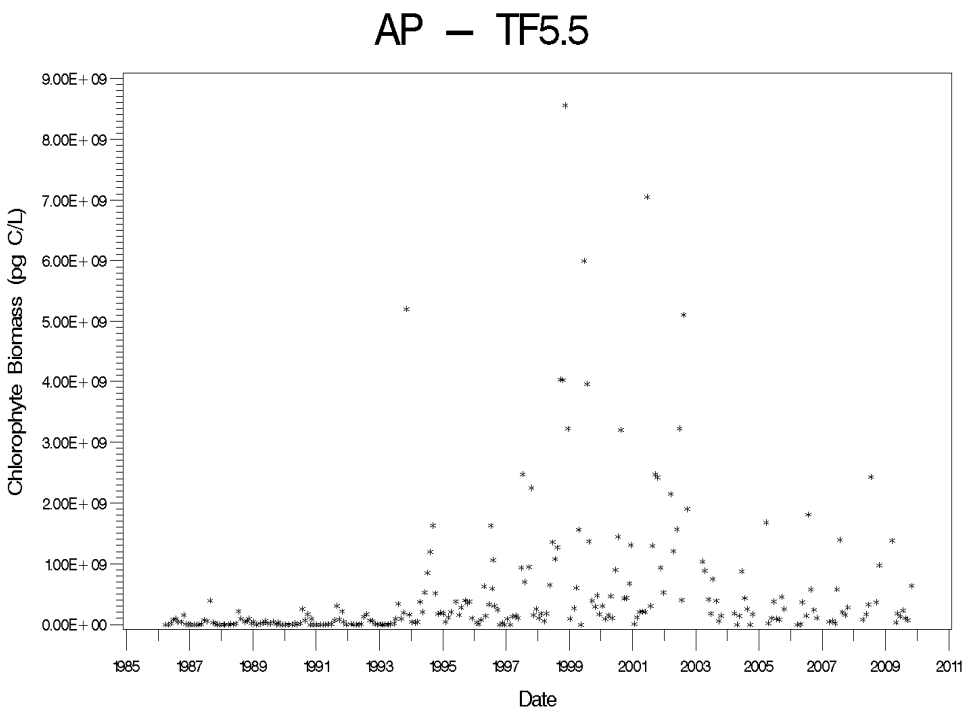


Figure 8. Plot of above pycnocline chlorophyte biomass against time at station TF5.5 for the period of 1985 through 2009.

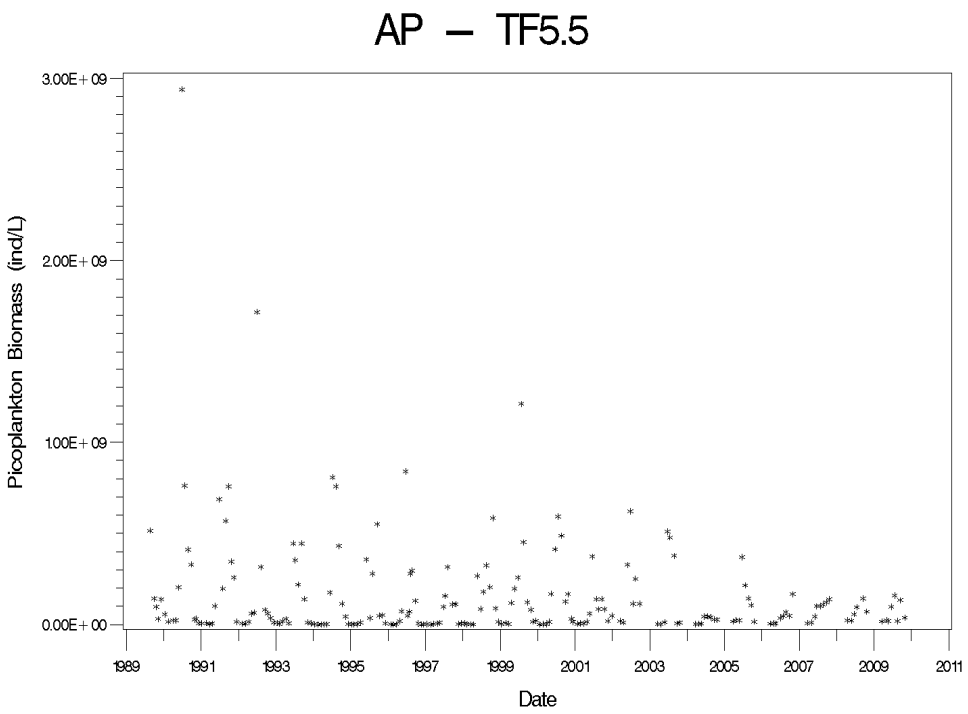


Figure 9. Plot of above pycnocline picoplankton biomass against time at station TF5.5 for the period of 1985 through 2009.

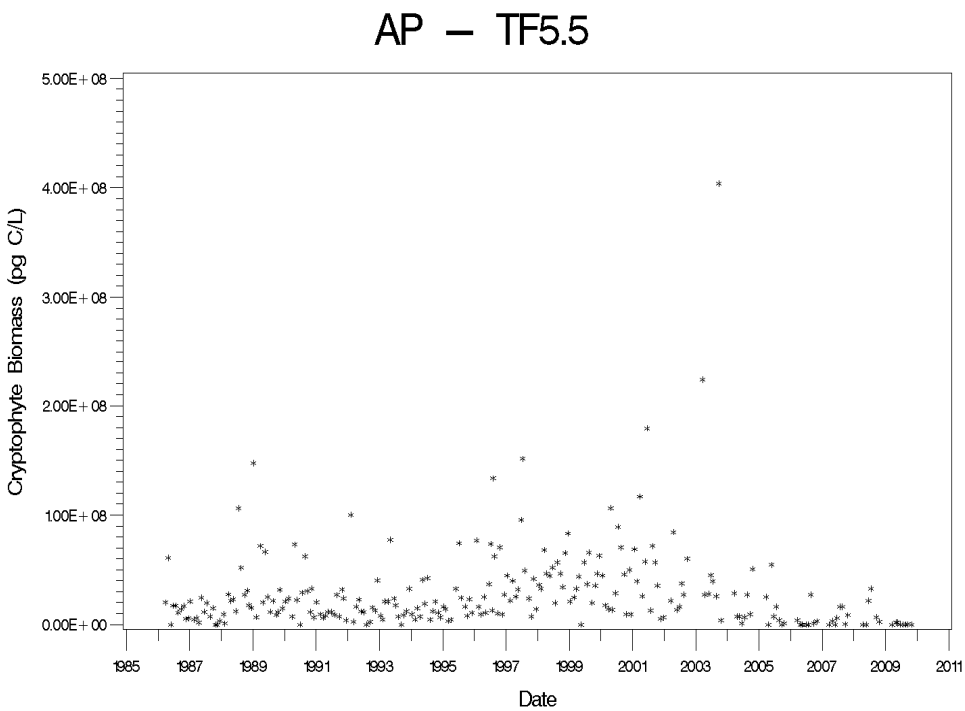


Figure 10. Plot of above pycnocline cryptophyte biomass at station TF5.5 for the period of 1985 through 2009

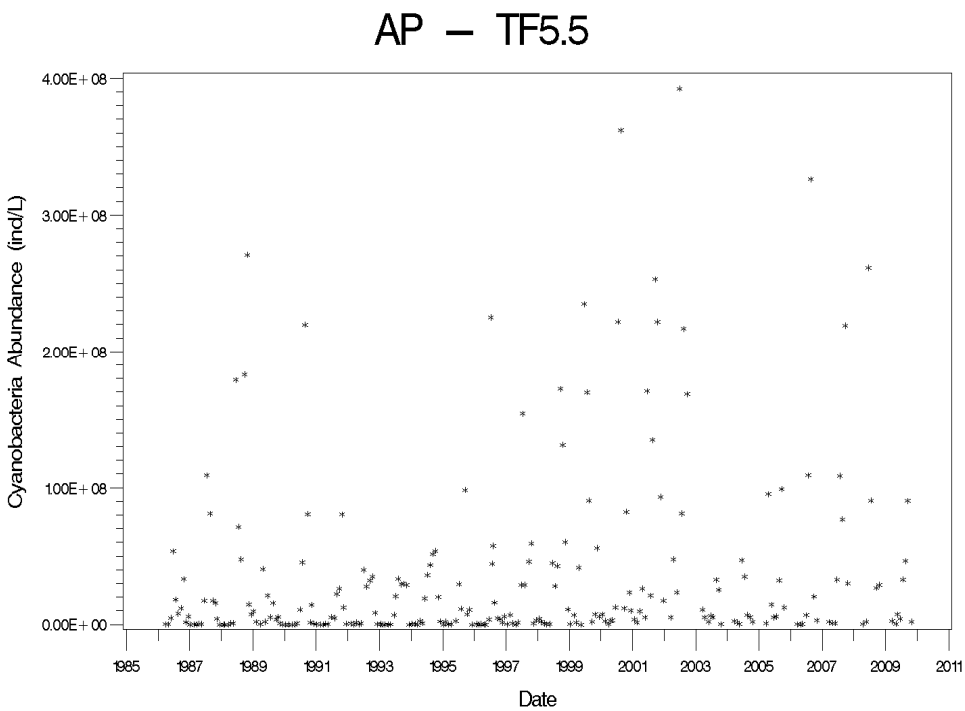


Figure 11. Plot of above pycnocline cyanophyte abundance at station TF5.5 for the period of 1985 through 2009.

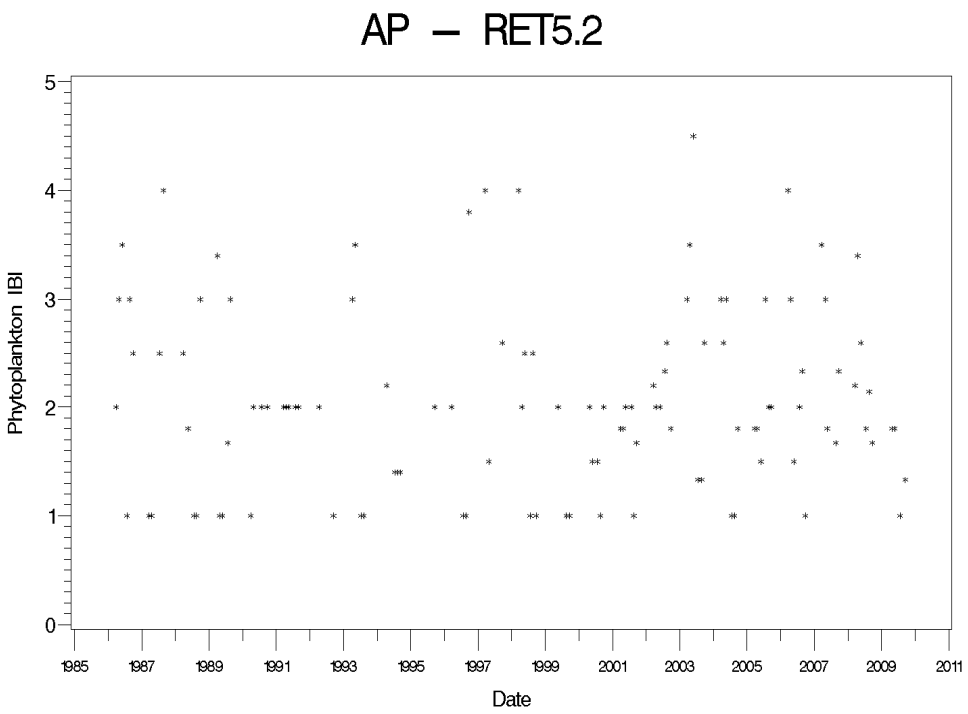


Figure 12. Plot of above pycnocline phytoplankton IBI scores against time at station RET5.2 for the period of 1985 through 2009.

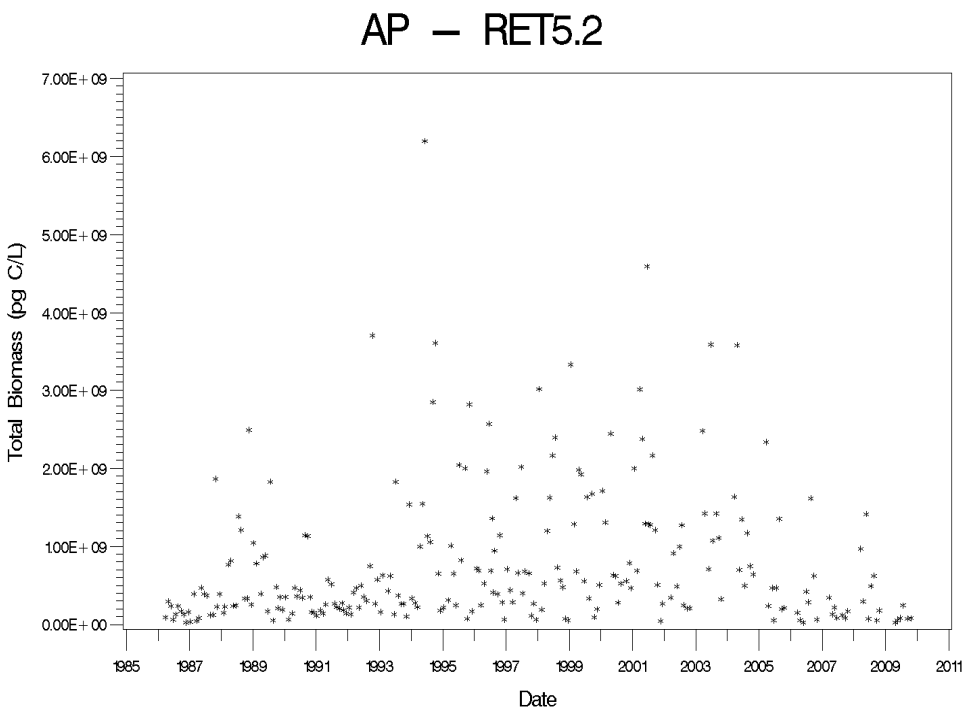


Figure 13. Plot of above pycnocline total phytoplankton biomass against time at station RET5.2 for the period of 1985 through 2009.

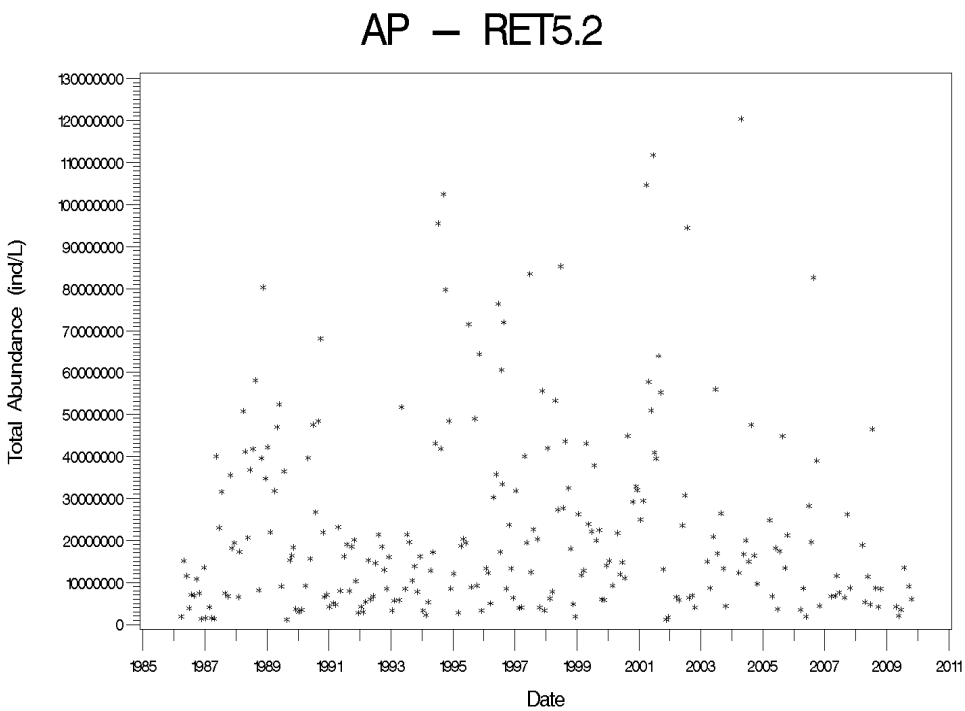


Figure 14. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET5.2 for the period of 1985 through 2009.

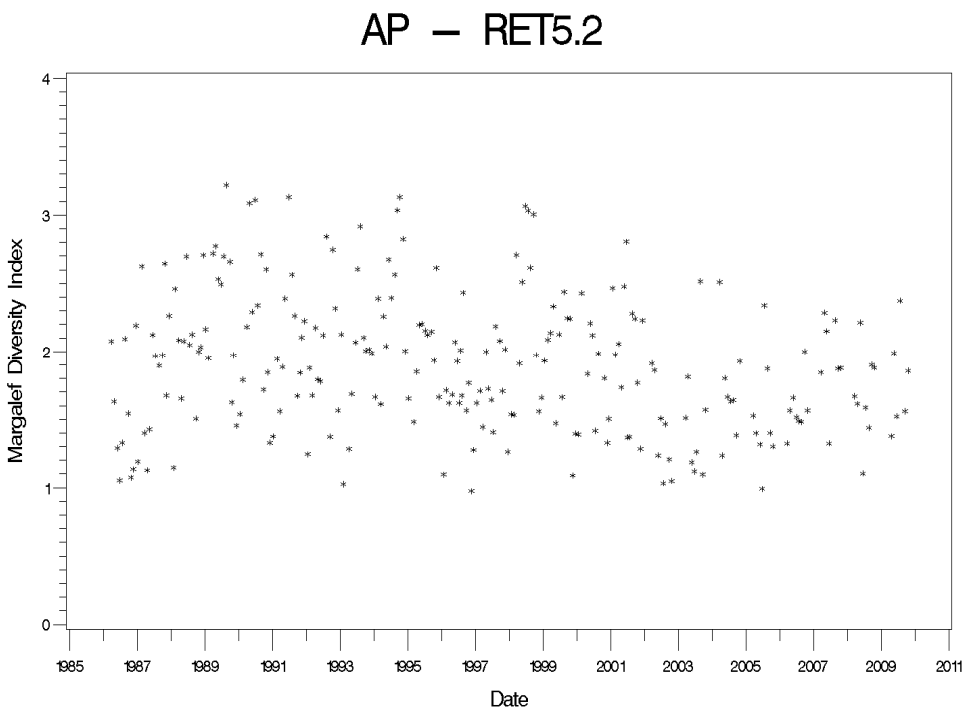


Figure 15. Plot of above pycnocline Margalef diversity index against time at station RET5.2 for the period of 1985 through 2009.

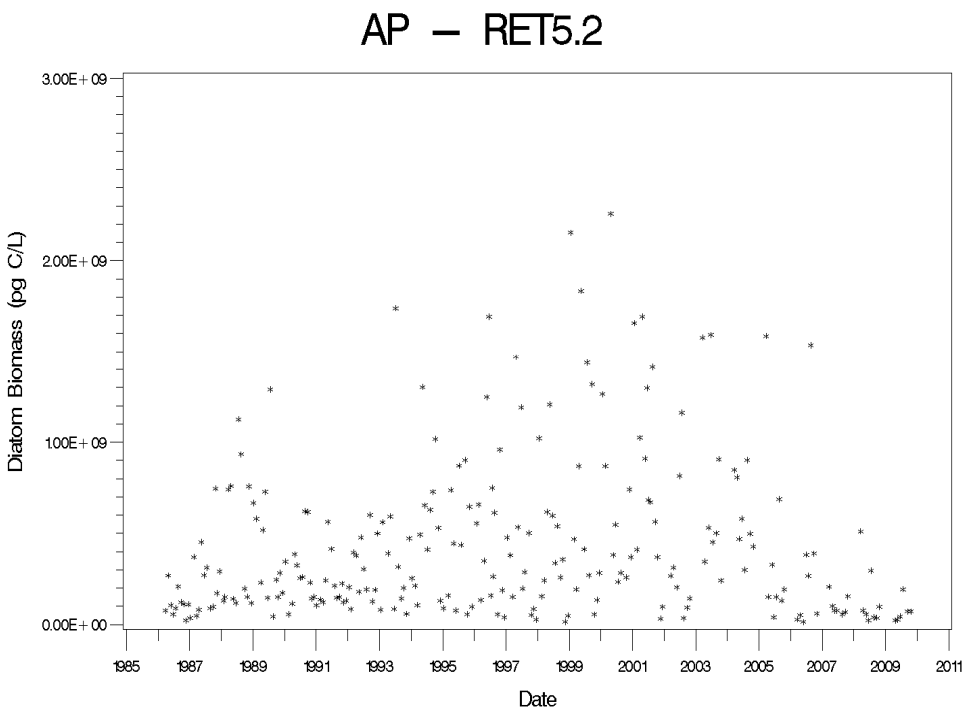


Figure 16. Plot of above pycnocline diatom biomass against time at station RET5.2 for the period of 1985 through 2009.

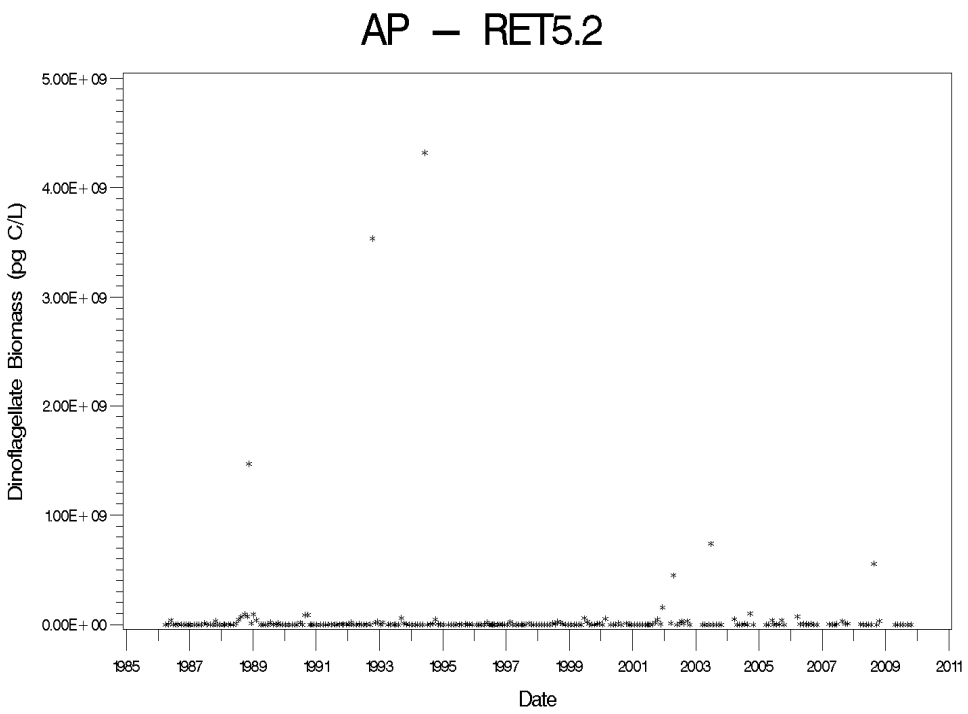


Figure 17. Plot of above pycnocline dinoflagellate biomass against time at station RET5.2 for the period of 1985 through 2009.

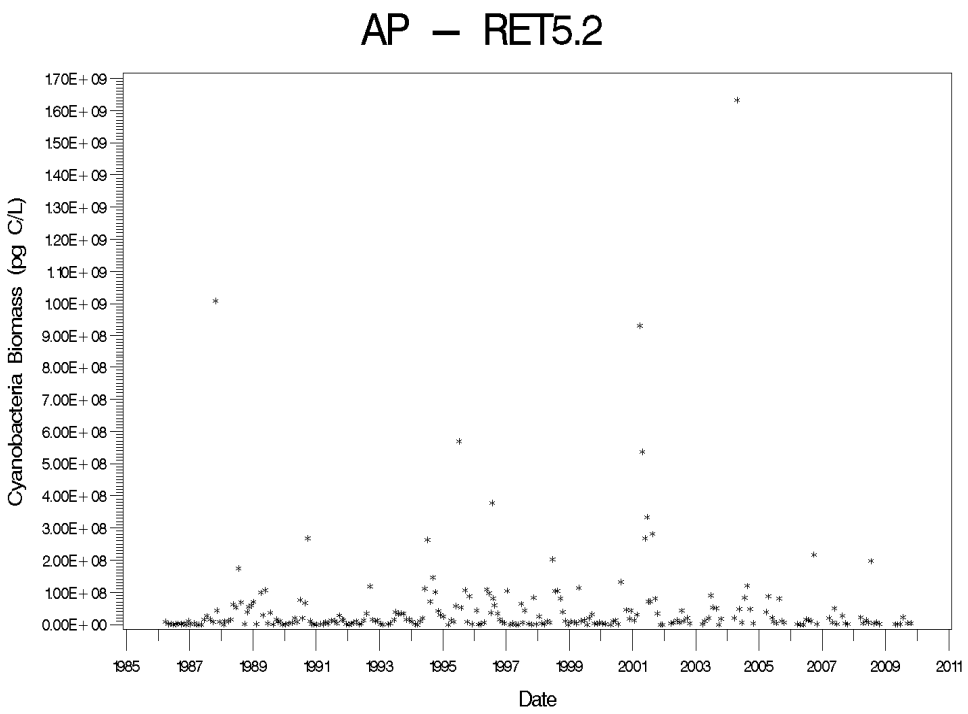


Figure 18. Plot of above pycnocline cyanobacteria biomass against time at station RET5.2 for the period of 1985 through 2009.

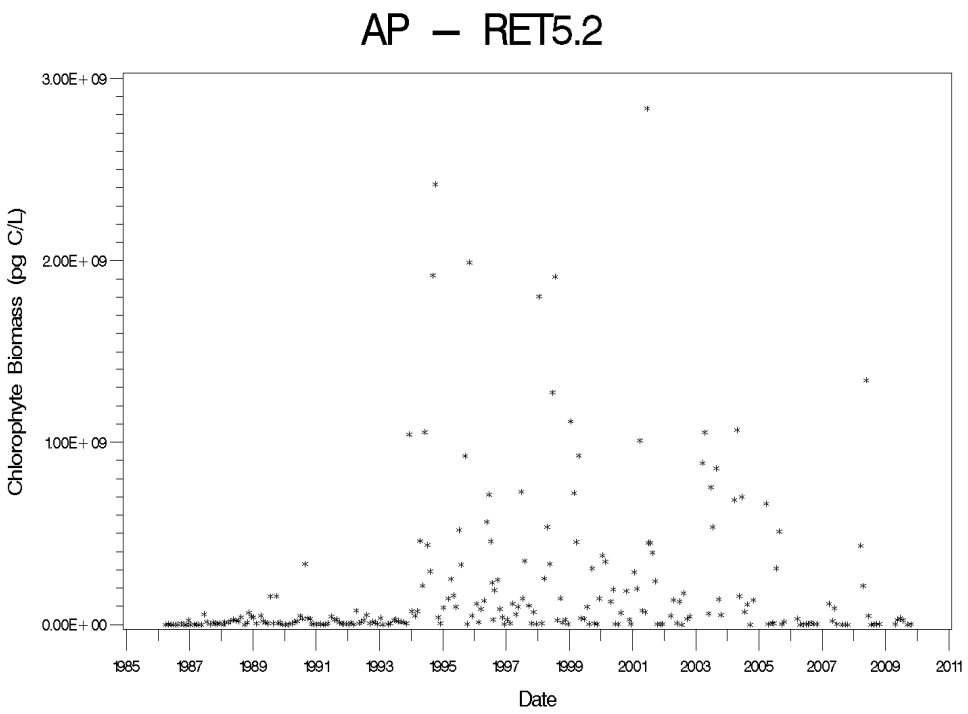


Figure 19. Plot of above pycnocline chlorophyte biomass against time at station RET5.2 for the period of 1985 through 2009.

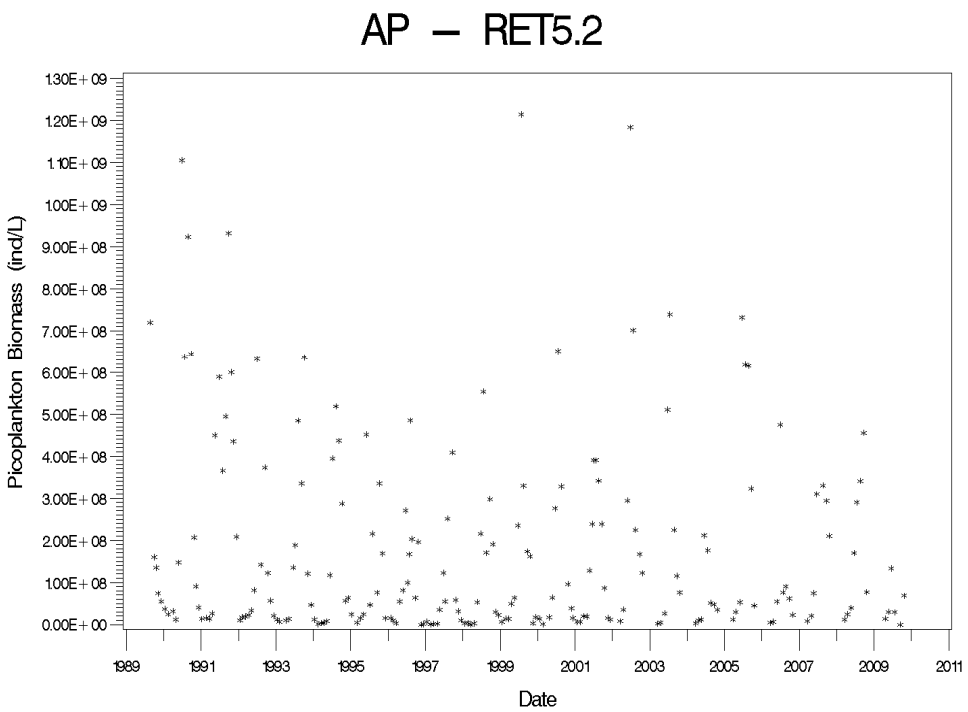


Figure 20. Plot of above pycnocline picoplankton biomass against time at station RET5.2 for the period of 1985 through 2009.

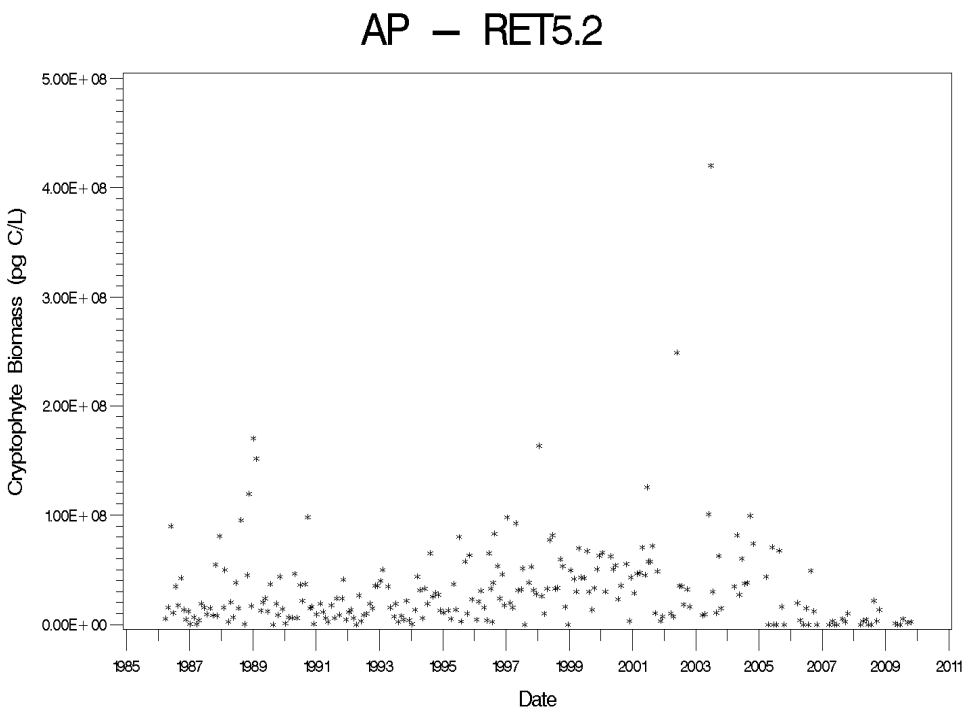


Figure 21. Plot of above pycnocline cryptophyte biomass at station RET5.2 for the period of 1985 through 2009.

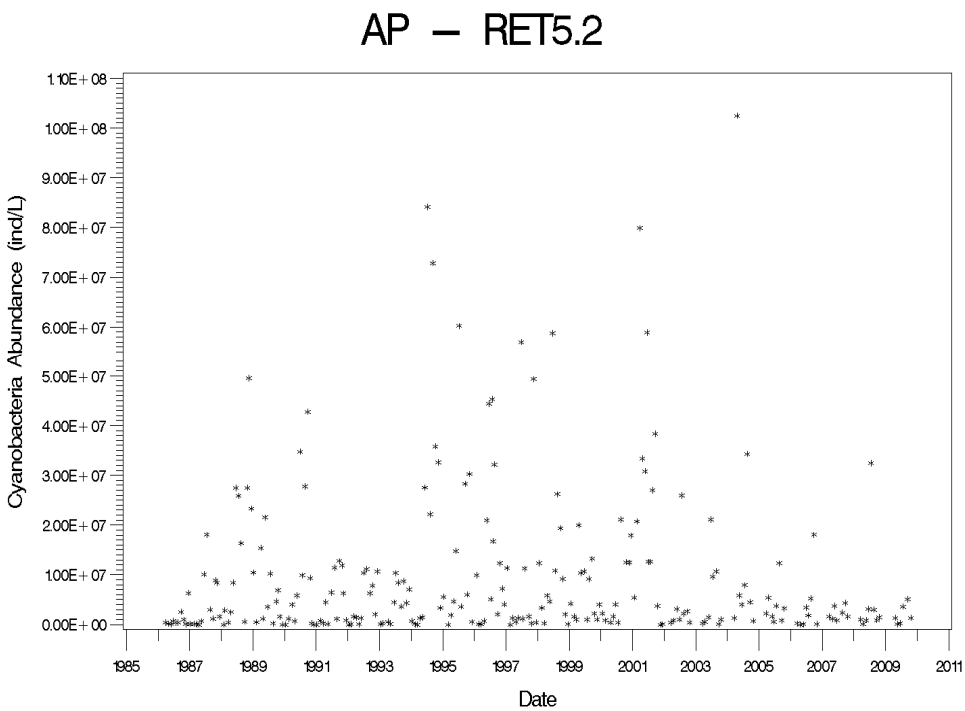


Figure 22. Plot of above pycnocline cyanophyte abundance at station RET5.2 for the period of 1985 through 2009.

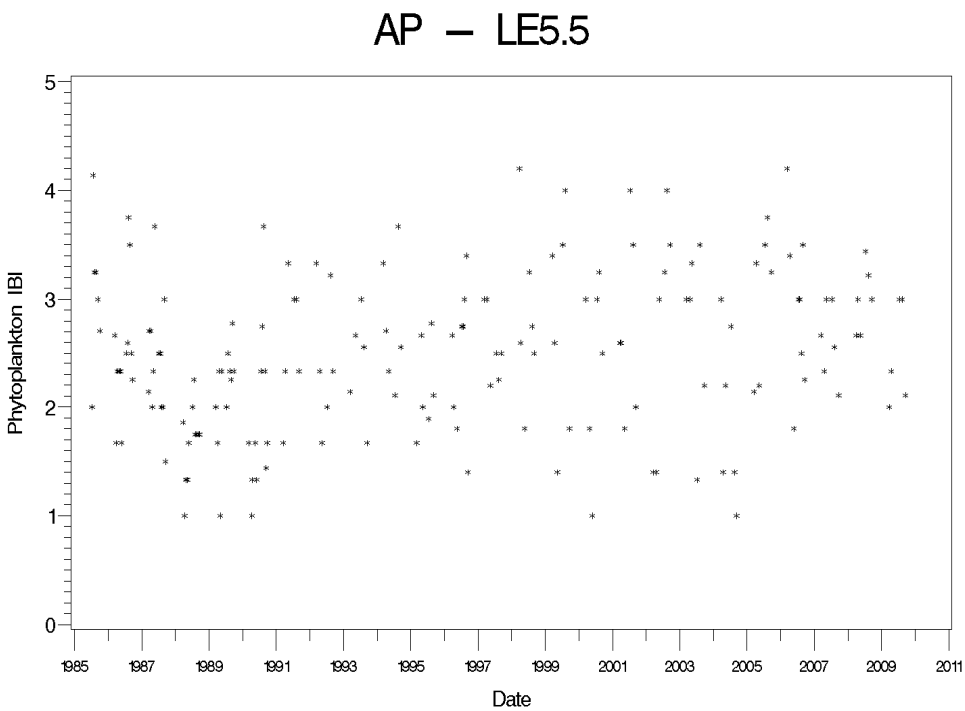


Figure 23. Plot of above pycnocline phytoplankton IBI scores against time at station LE5.5 for the period of 1985 through 2009.

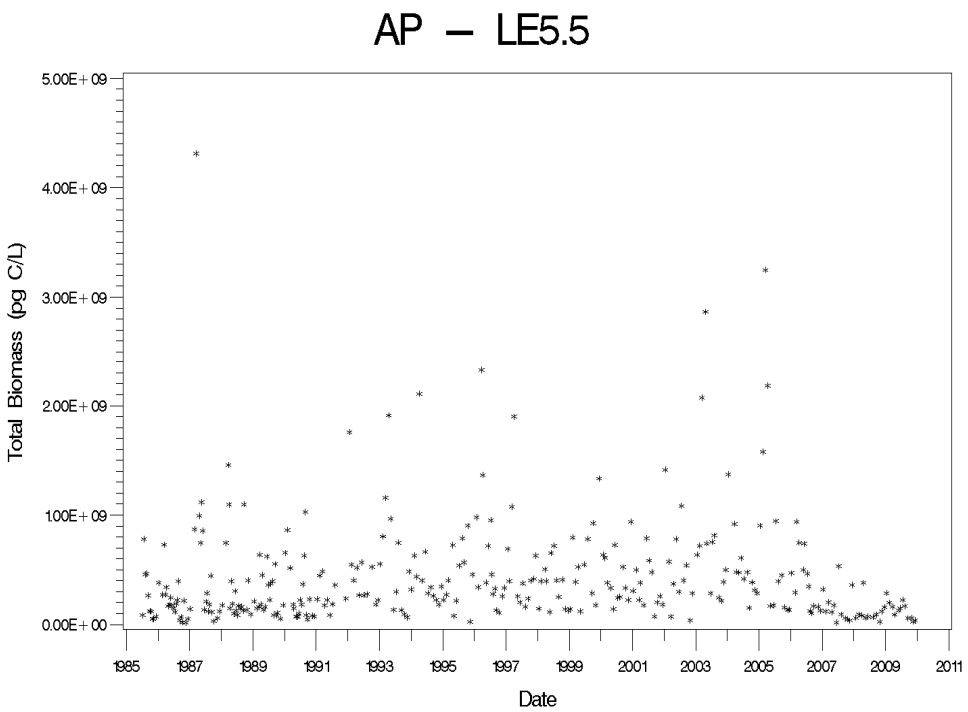


Figure 24. Plot of above pycnocline total phytoplankton biomass against time at station LE5.5 for the period of 1985 through 2009.

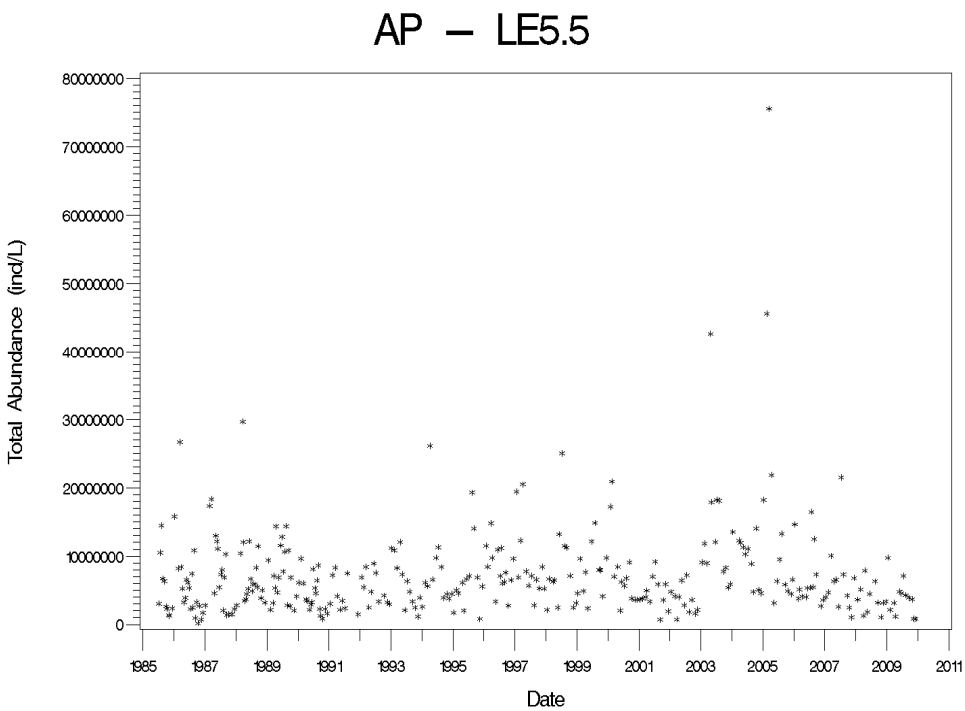


Figure 25. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station LE5.5 for the period of 1985 through 2009.

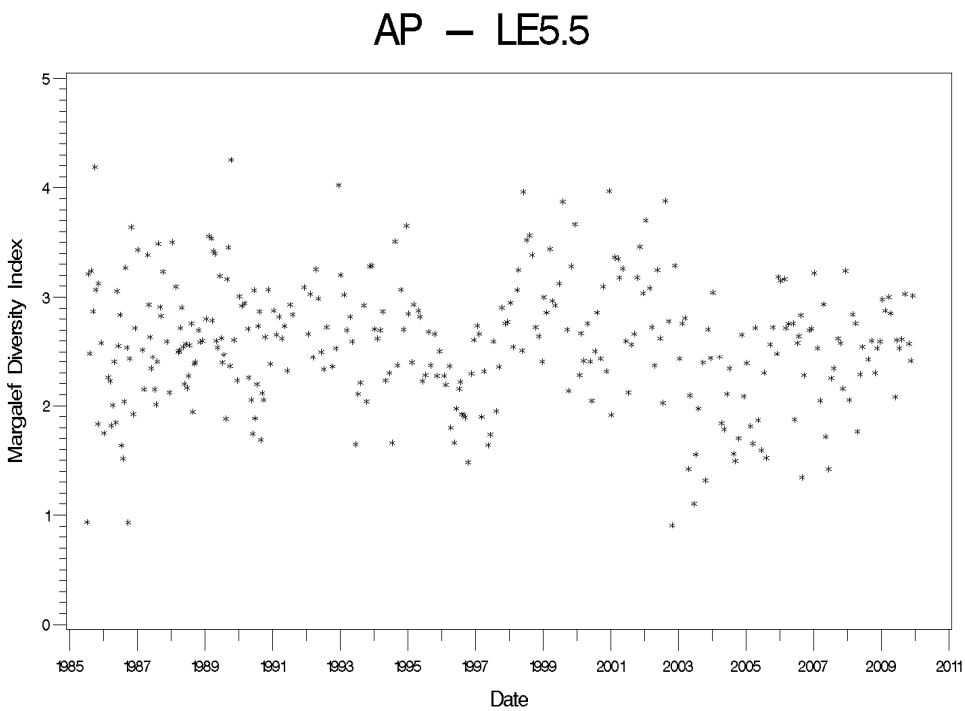


Figure 26. Plot of above pycnocline Margalef diversity index against time at station LE5.5 for the period of 1985 through 2009.

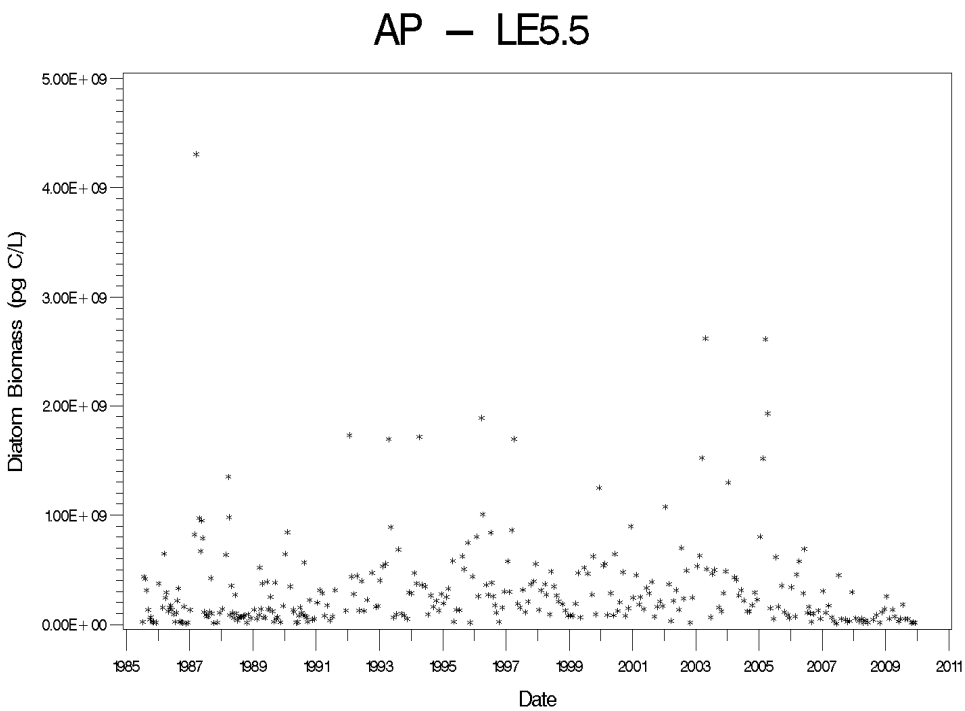


Figure 27. Plot of above pycnocline diatom biomass against time at station LE5.5 for the period of 1985 through 2009.

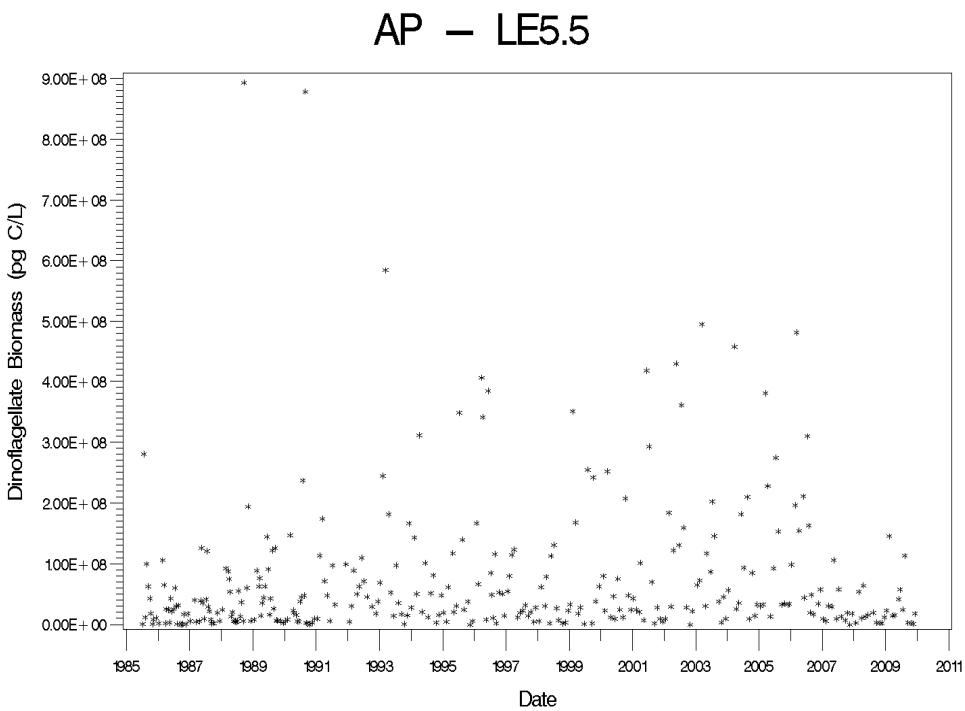


Figure 28. Plot of above pycnocline dinoflagellate biomass against time at station LE5.5 for the period of 1985 through 2009.

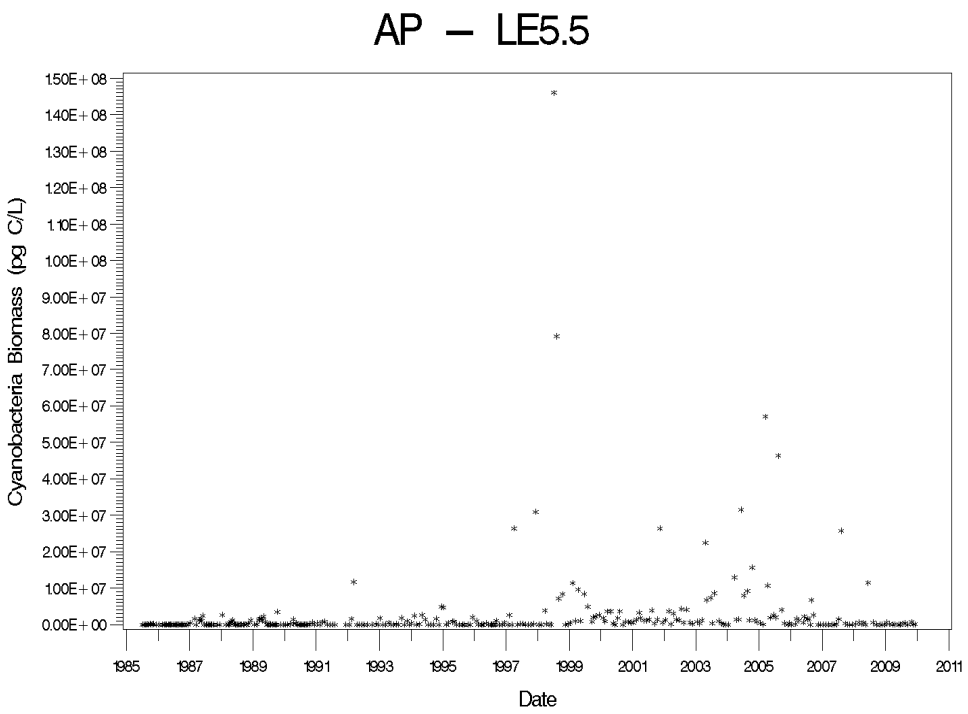


Figure 29. Plot of above pycnocline cyanobacteria biomass against time at station LE5.5 for the period of 1985 through 2009.

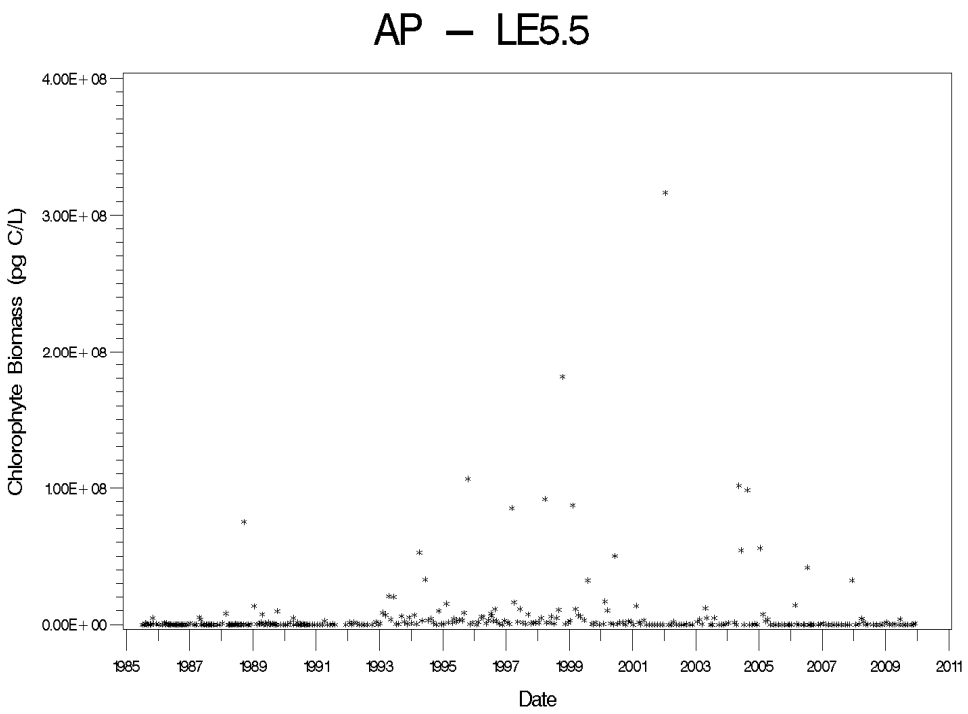


Figure 30. Plot of above pycnocline chlorophyte biomass against time at station LE5.5 for the period of 1985 through 2009.

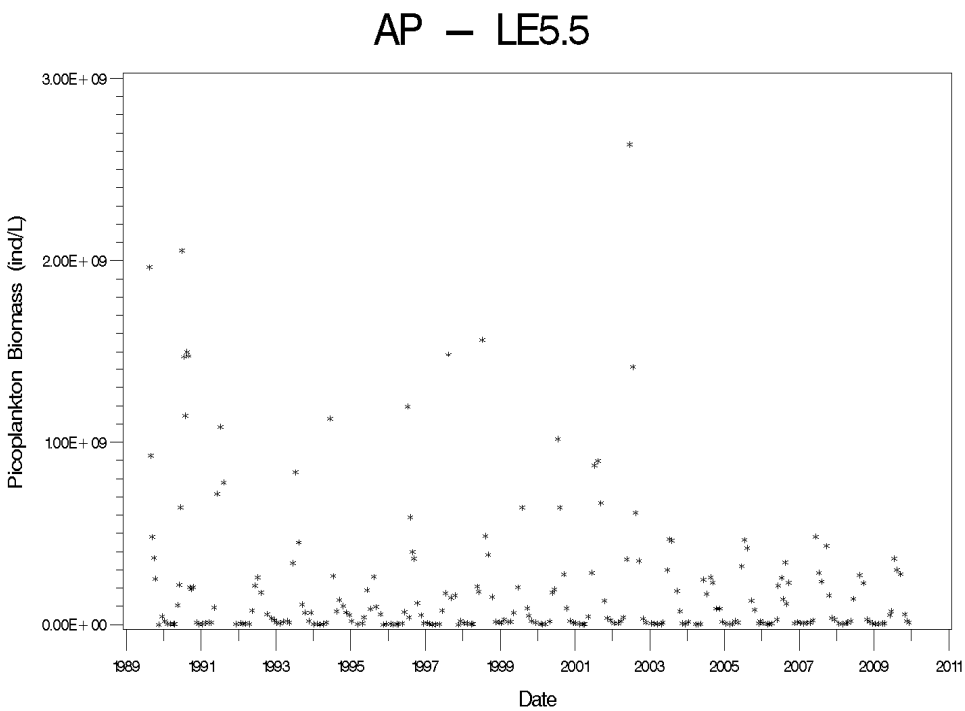


Figure 31. Plot of above pycnocline picoplankton biomass against time at station LE5.5 for the period of 1985 through 2009.

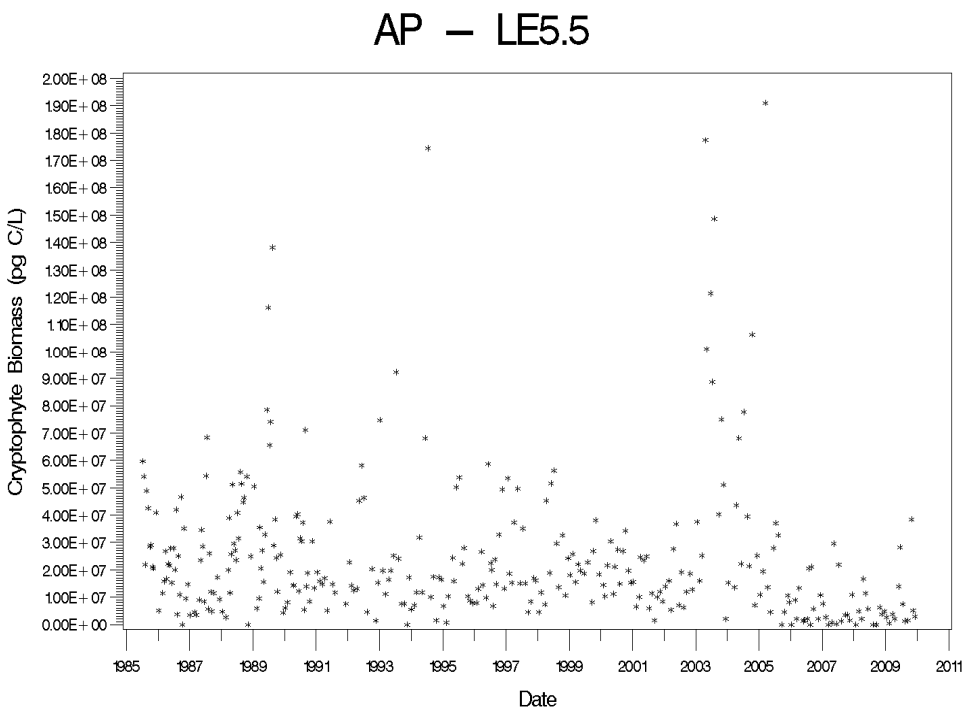


Figure 32. Plot of above pycnocline cryptophyte biomass at station LE5.5 for the period of 1985 through 2009.

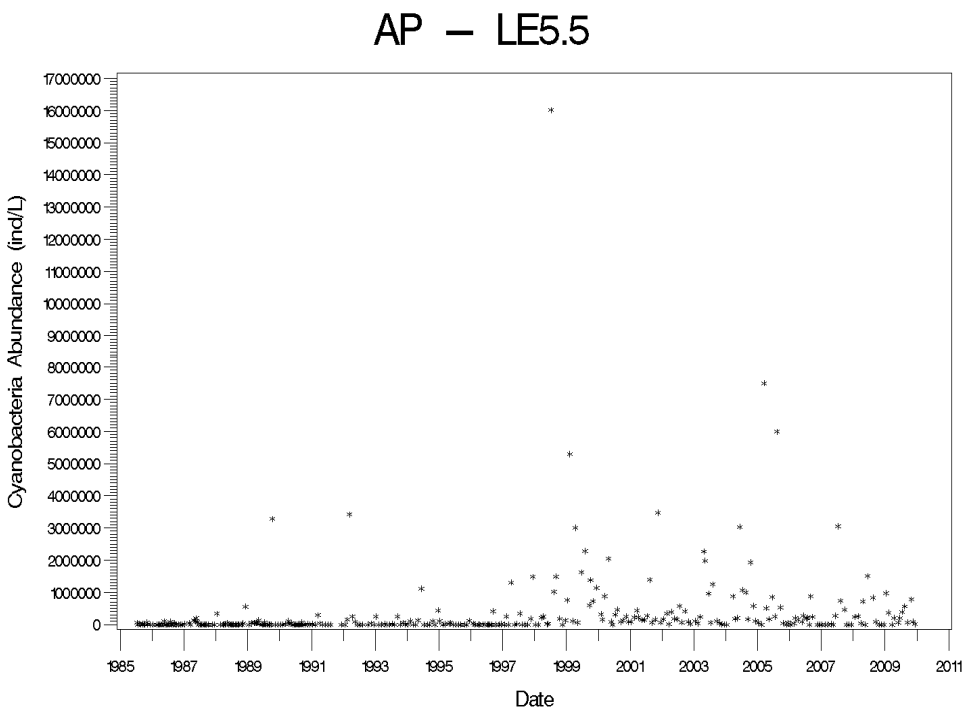


Figure 33. Plot of above pycnocline cyanophyte abundance at station LE5.5 for the period of 1985 through 2009.

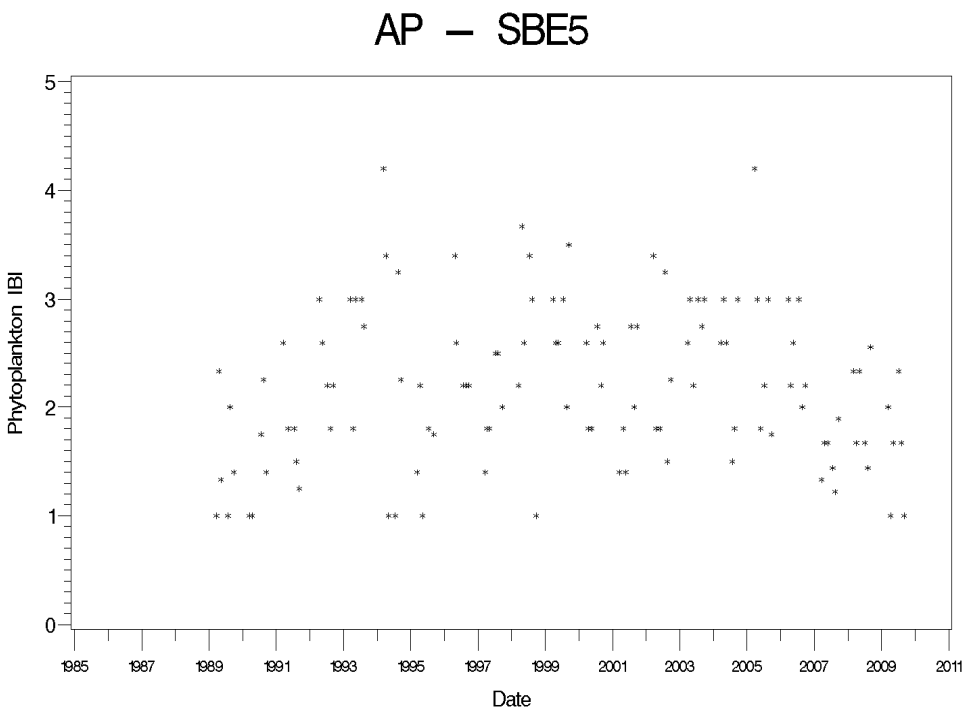


Figure 34. Plot of above pycnocline phytoplankton IBI scores against time at station SBE5 for the period of 1985 through 2009.

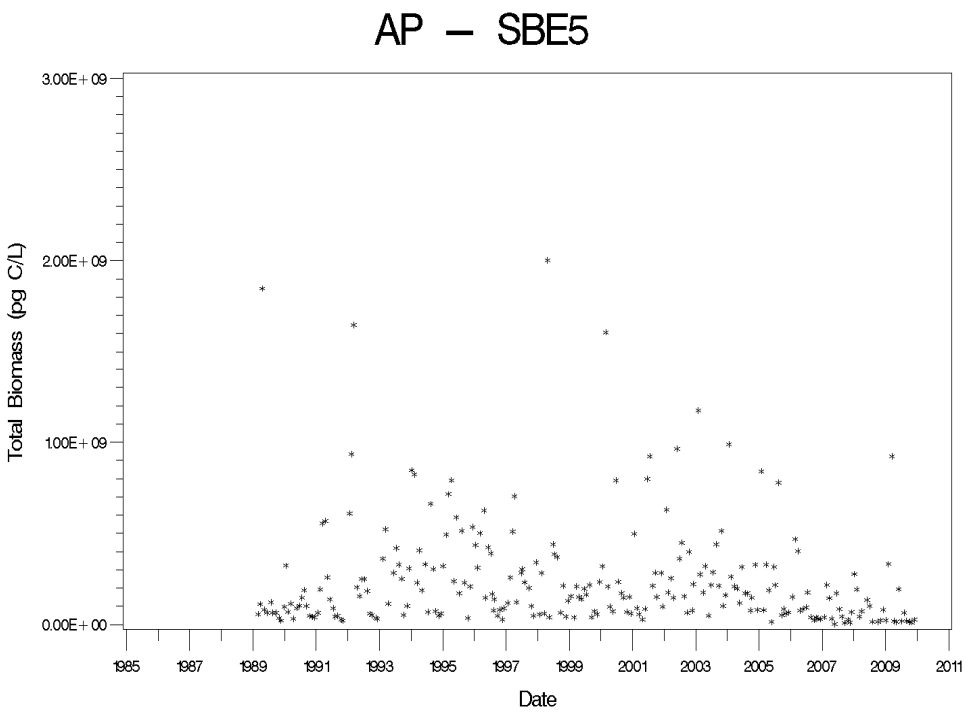


Figure 35. Plot of above pycnocline total phytoplankton biomass against time at station SBE5 for the period of 1985 through 2009.

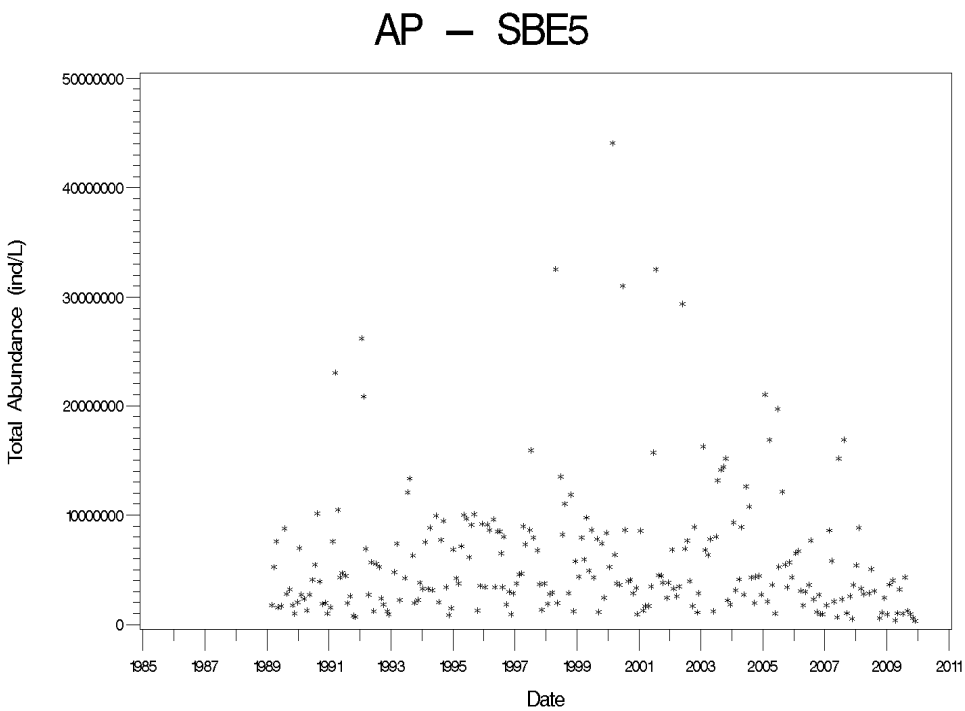


Figure 36. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station SBE5 for the period of 1985 through 2009.

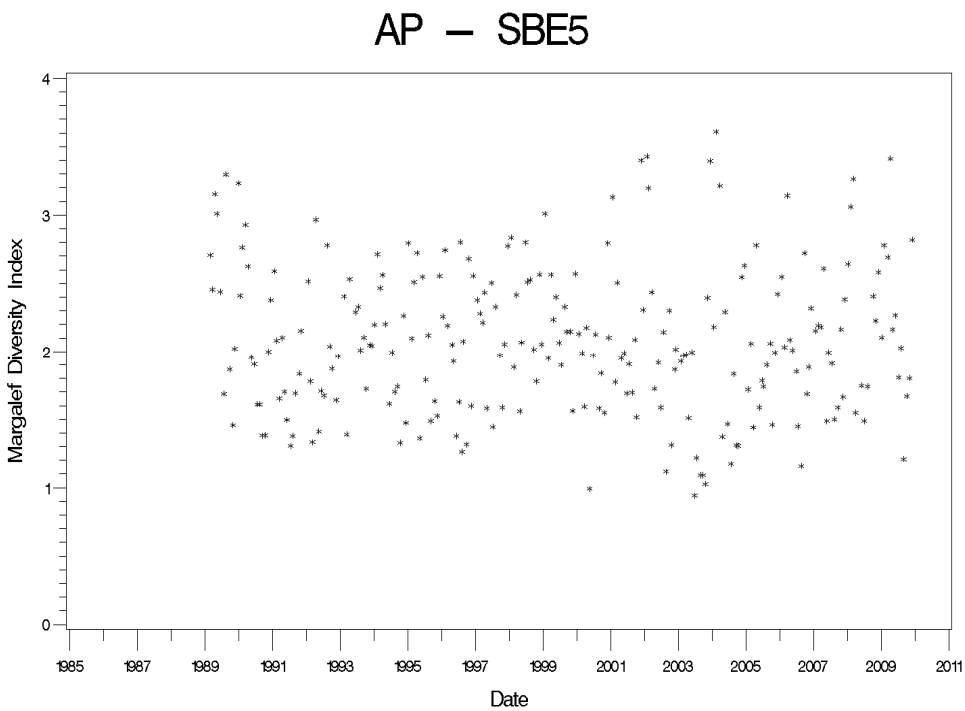


Figure 37. Plot of above pycnocline Margalef diversity index against time at station SBE5 for the period of 1985 through 2009.

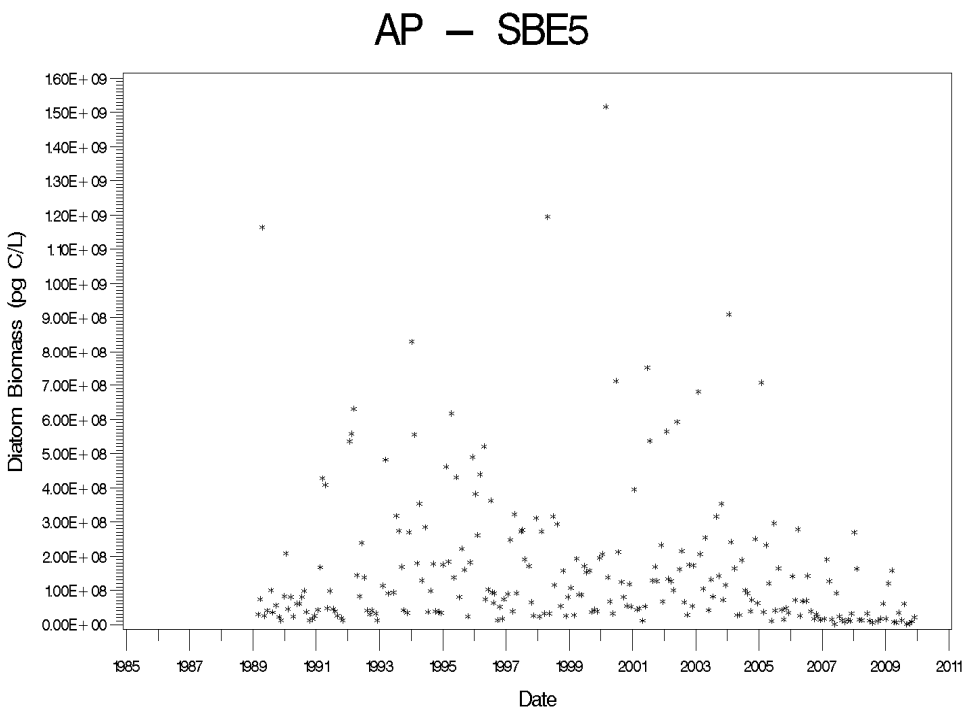


Figure 38. Plot of above pycnocline diatom biomass against time at station SBE5 for the period of 1985 through 2009.

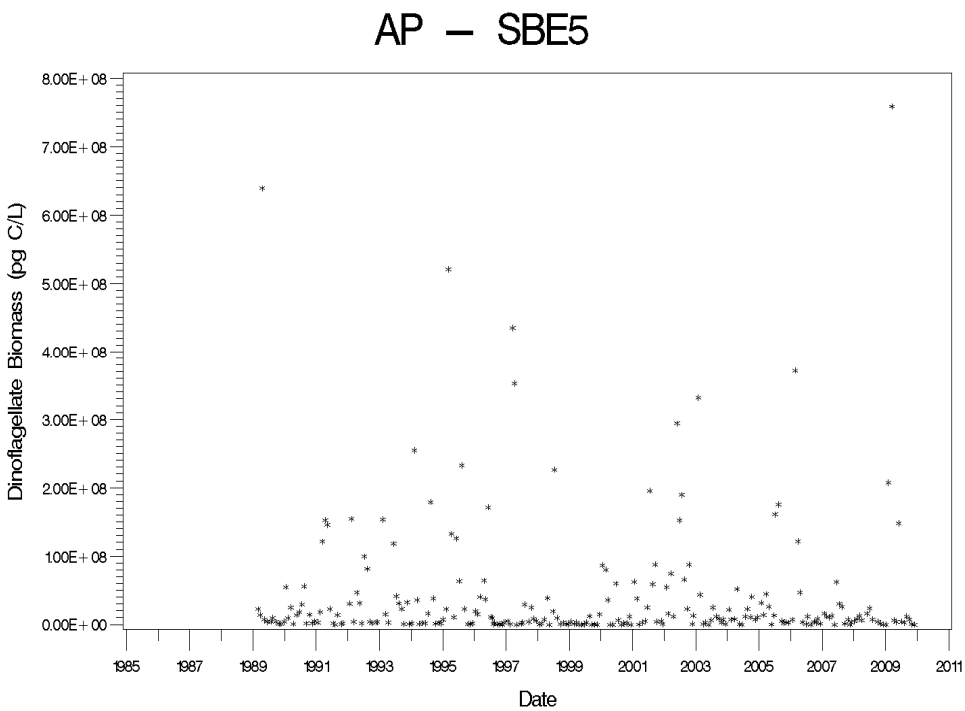


Figure 39. Plot of above pycnocline dinoflagellate biomass against time at station SBE5 for the period of 1985 through 2009.

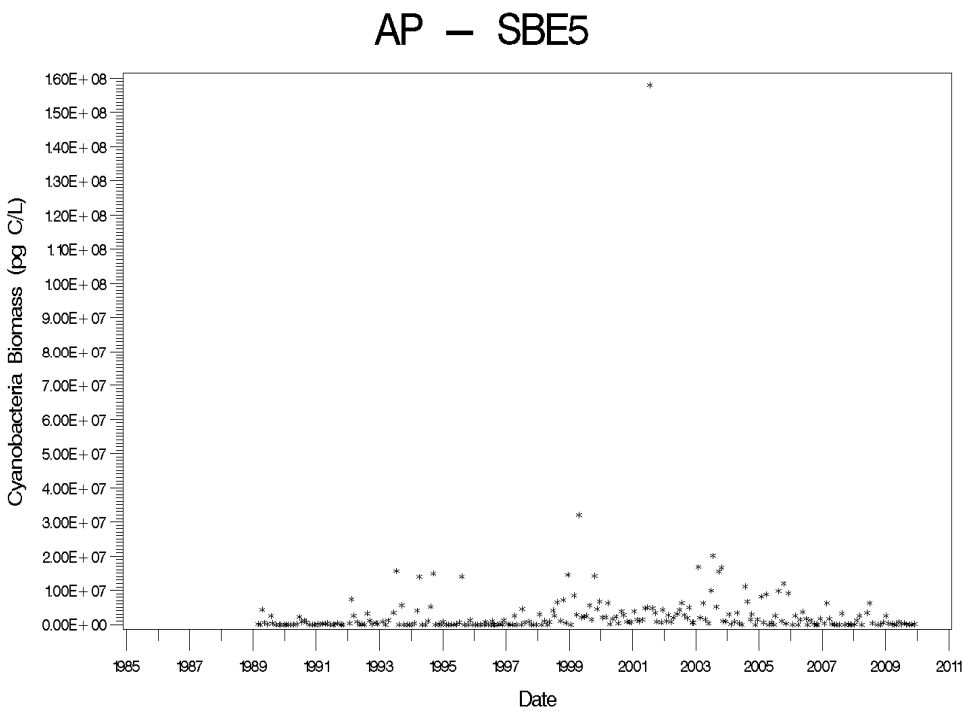


Figure 40. Plot of above pycnocline cyanobacteria biomass against time at station SBE5 for the period of 1985 through 2009.

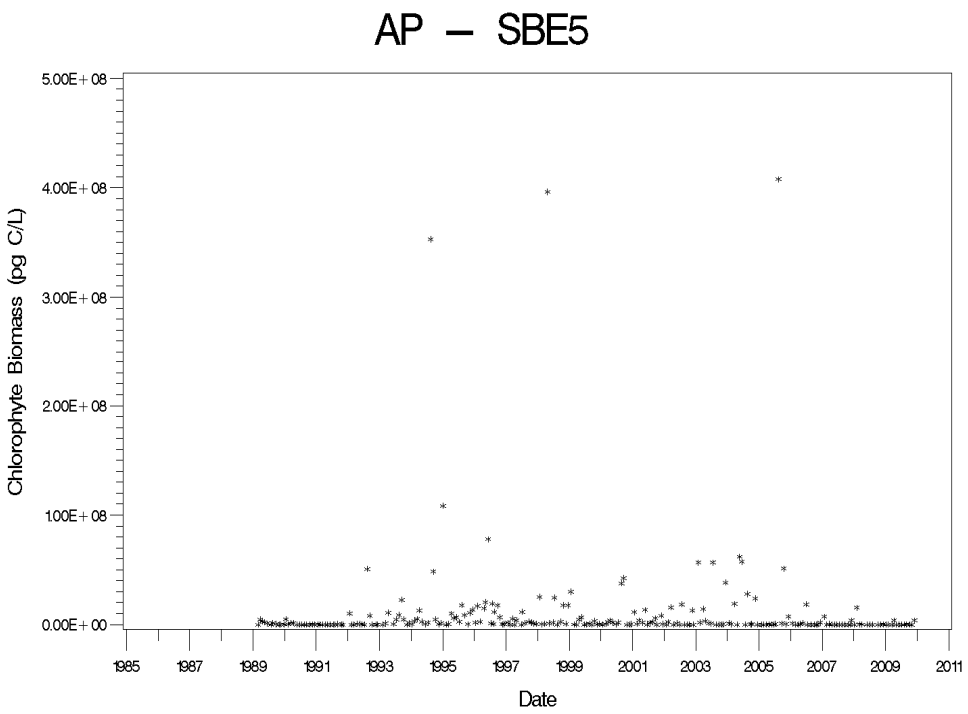


Figure 41. Plot of above pycnocline chlorophyte biomass against time at station SBE5 for the period of 1985 through 2009.

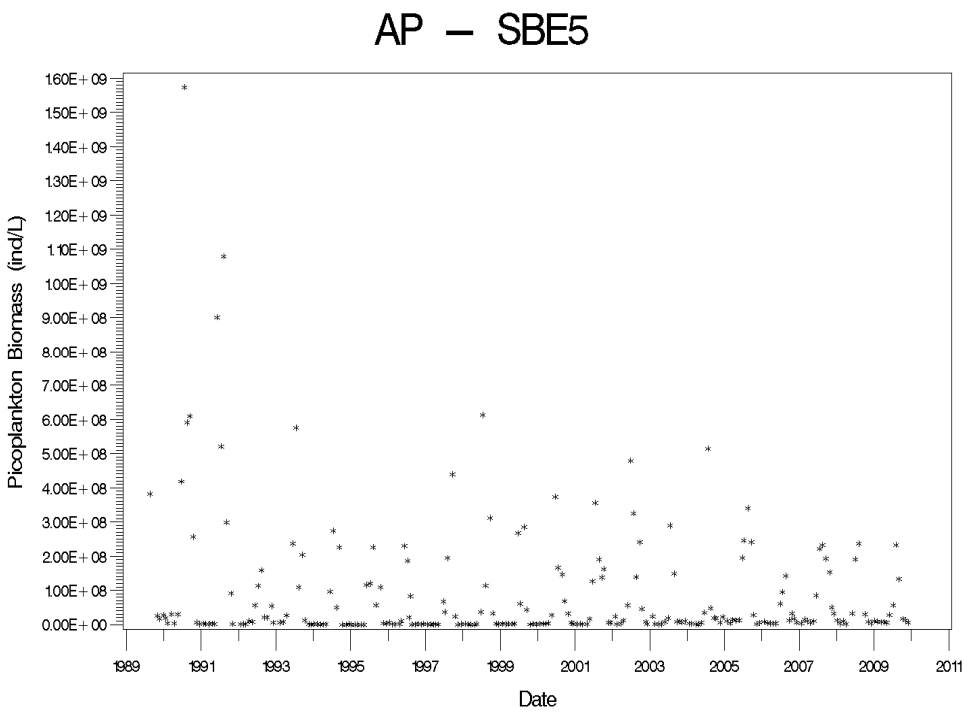


Figure 42. Plot of above pycnocline picoplankton biomass against time at station SBE5 for the period of 1985 through 2009.

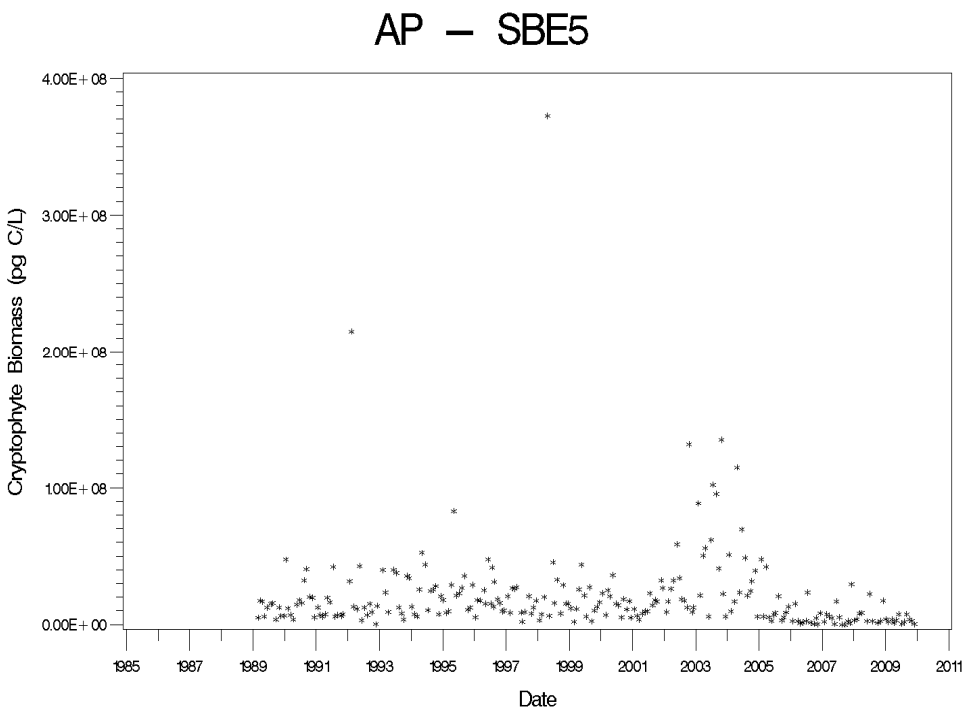


Figure 43. Plot of above pycnocline cryptophyte biomass at station SBE5 for the period of 1985 through 2009.

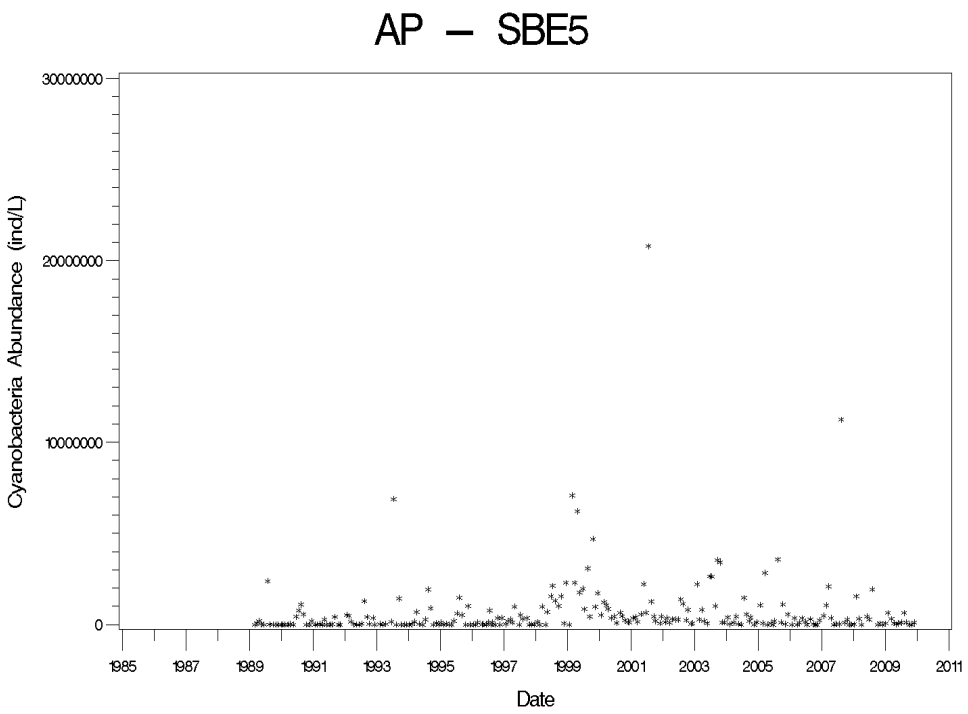


Figure 44. Plot of above pycnocline cyanophyte abundance at station SBE5 for the period of 1985 through 2009.

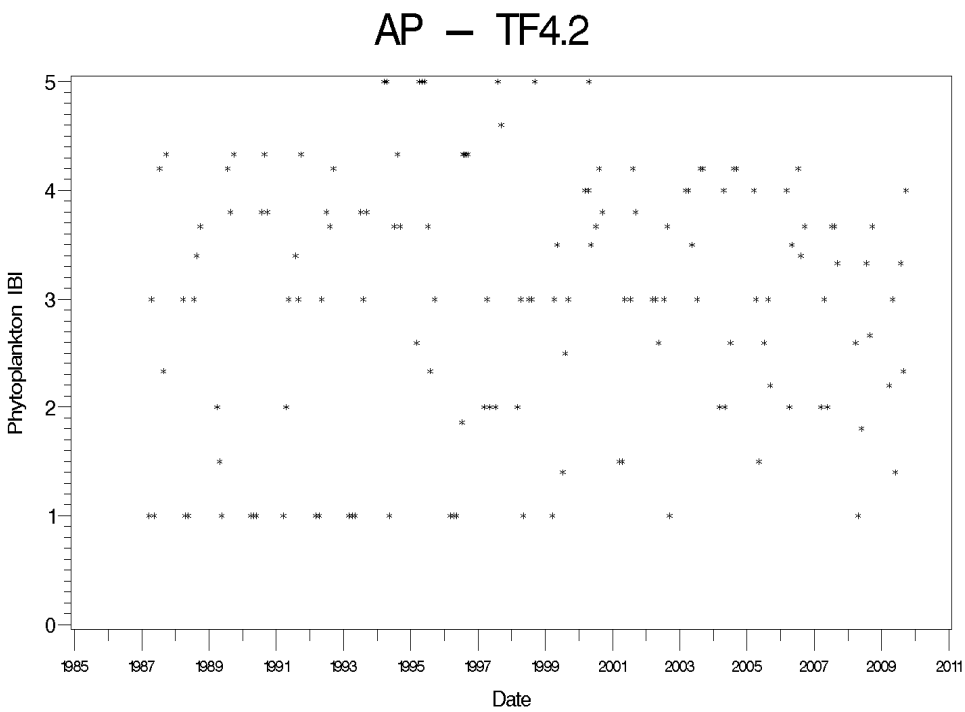


Figure 45. Plot of above pycnocline phytoplankton IBI scores against time at station TF4.2 for the period of 1985 through 2009.

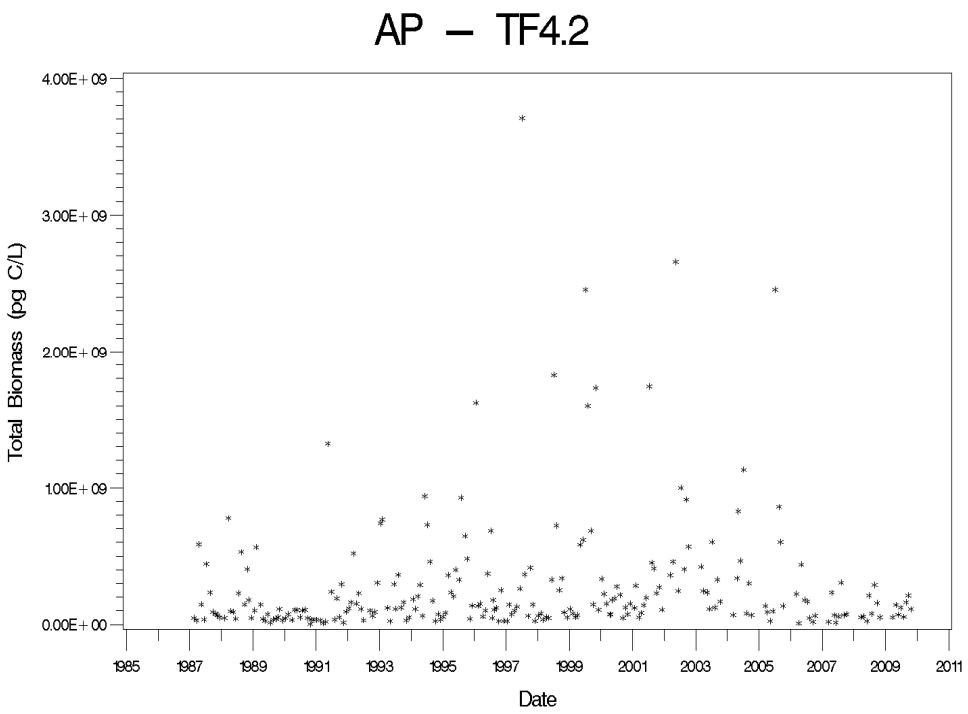


Figure 46. Plot of above pycnocline total phytoplankton biomass against time at station TF4.2 for the period of 1985 through 2009.

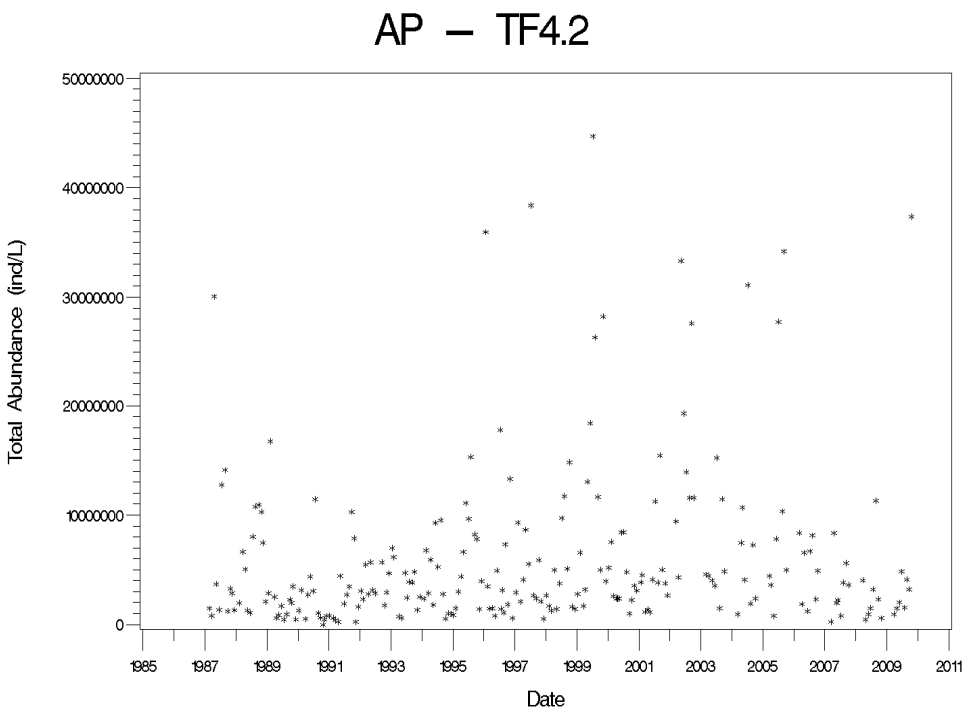


Figure 47. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF4.2 for the period of 1985 through 2009.

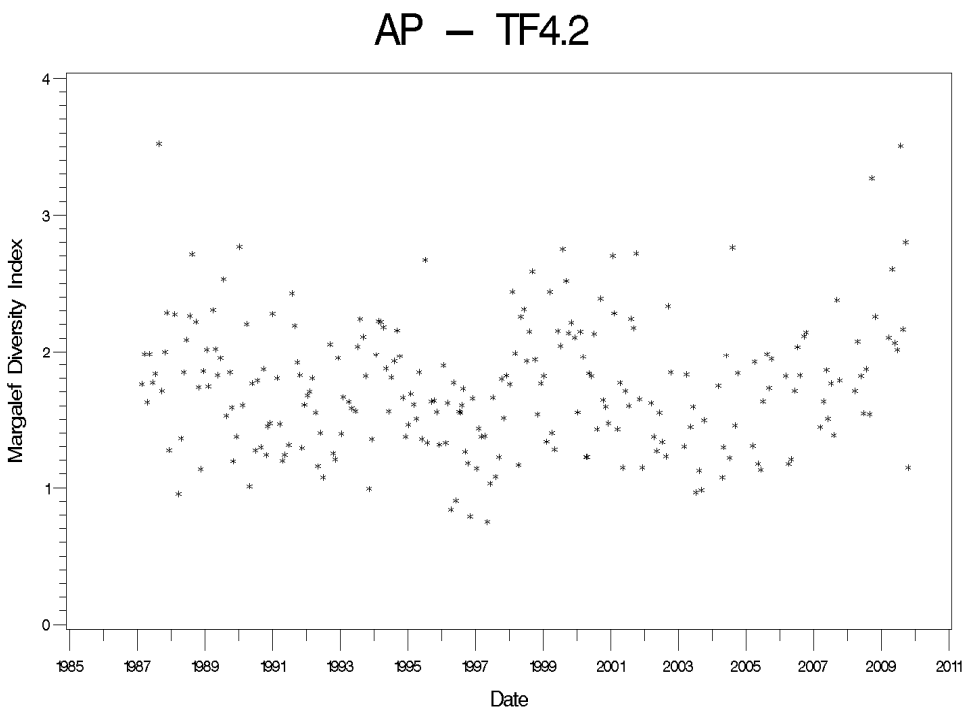


Figure 48. Plot of above pycnocline Margalef diversity index against time at station TF4.2 for the period of 1985 through 2009.

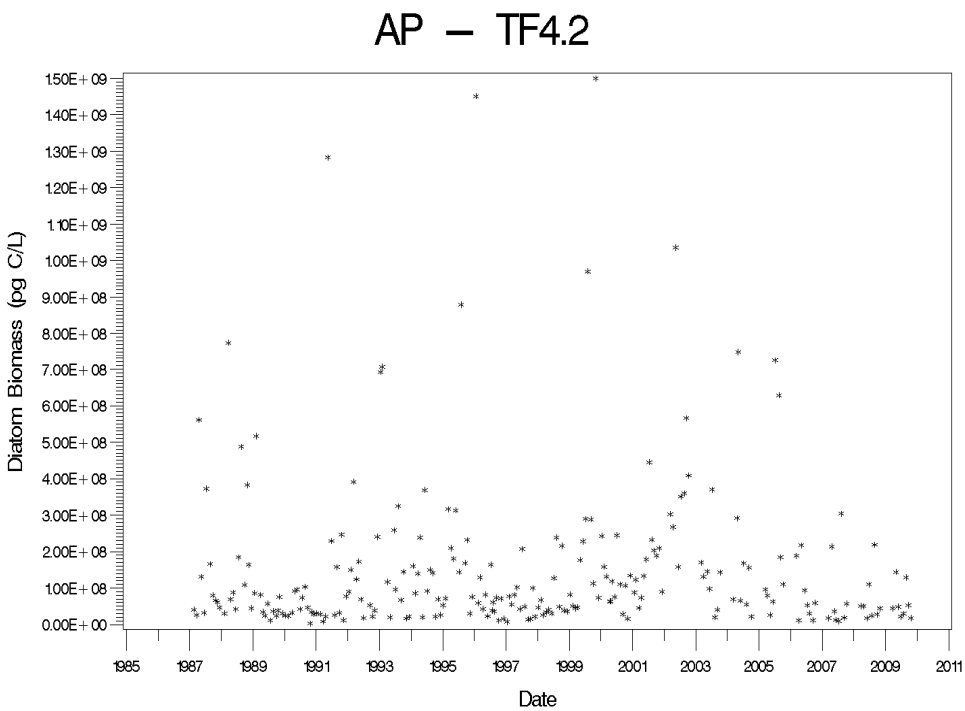


Figure 49. Plot of above pycnocline diatom biomass against time at station TF4.2 for the period of 1985 through 2009.

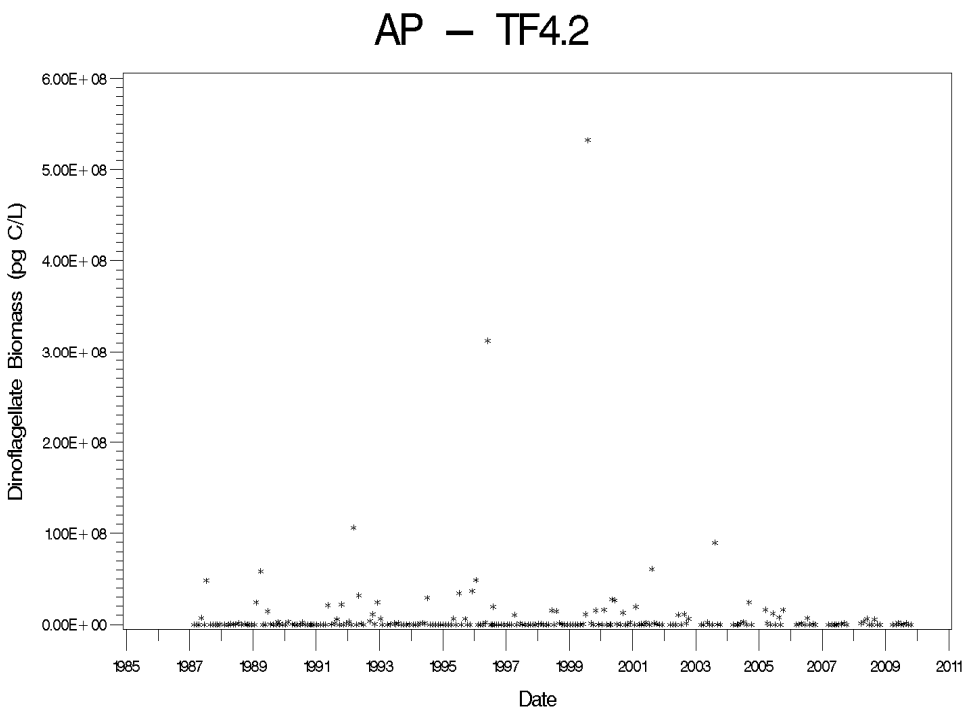


Figure 50. Plot of above pycnocline dinoflagellate biomass against time at station TF4.2 for the period of 1985 through 2009.

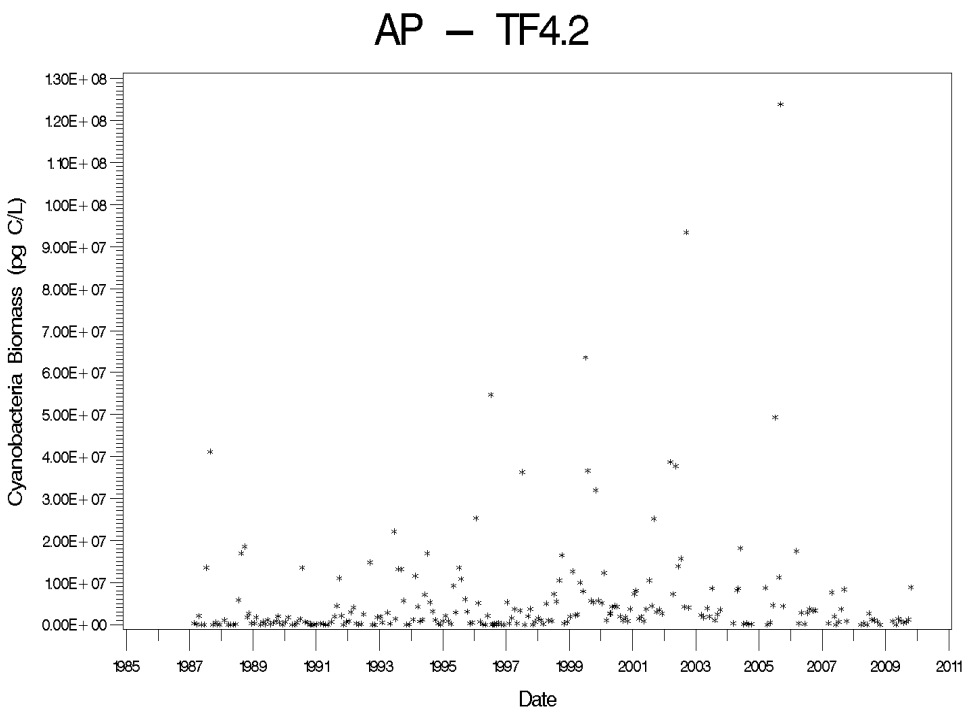


Figure 51. Plot of above pycnocline cyanobacteria biomass against time at station TF4.2 for the period of 1985 through 2009.

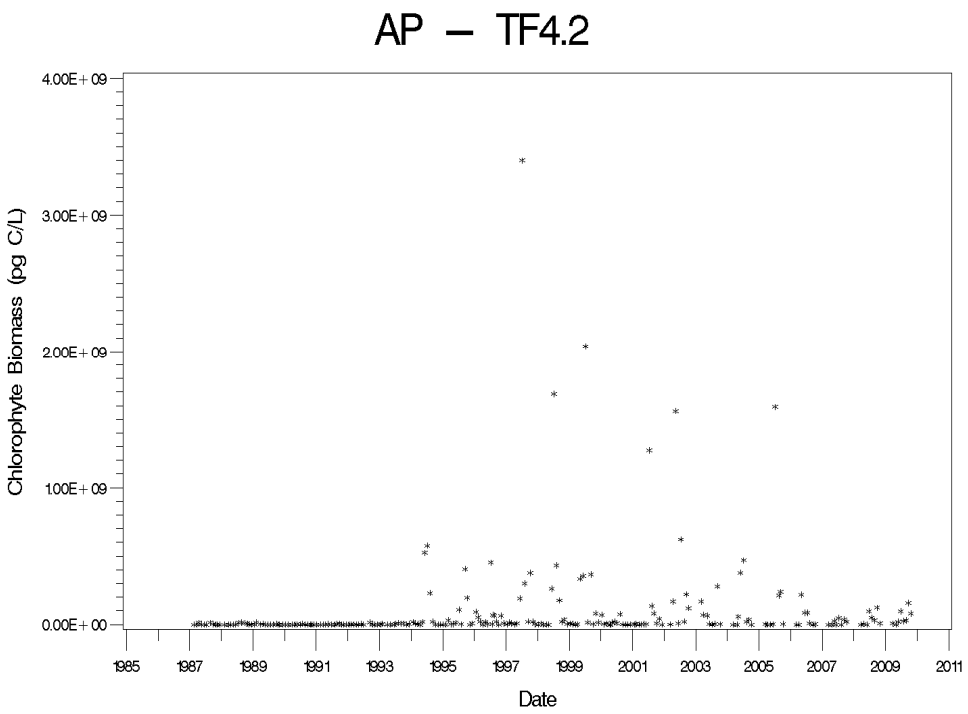


Figure 52. Plot of above pycnocline chlorophyte biomass against time at station TF4.2 for the period of 1985 through 2009.

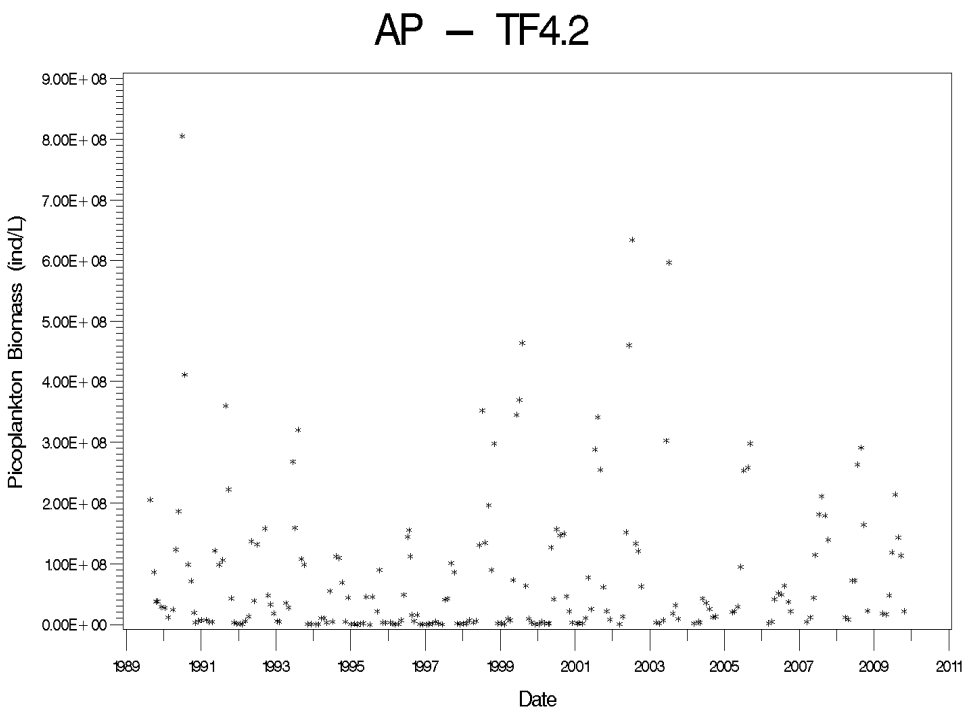


Figure 53. Plot of above pycnocline picoplankton biomass against time at station TF4.2 for the period of 1985 through 2009.

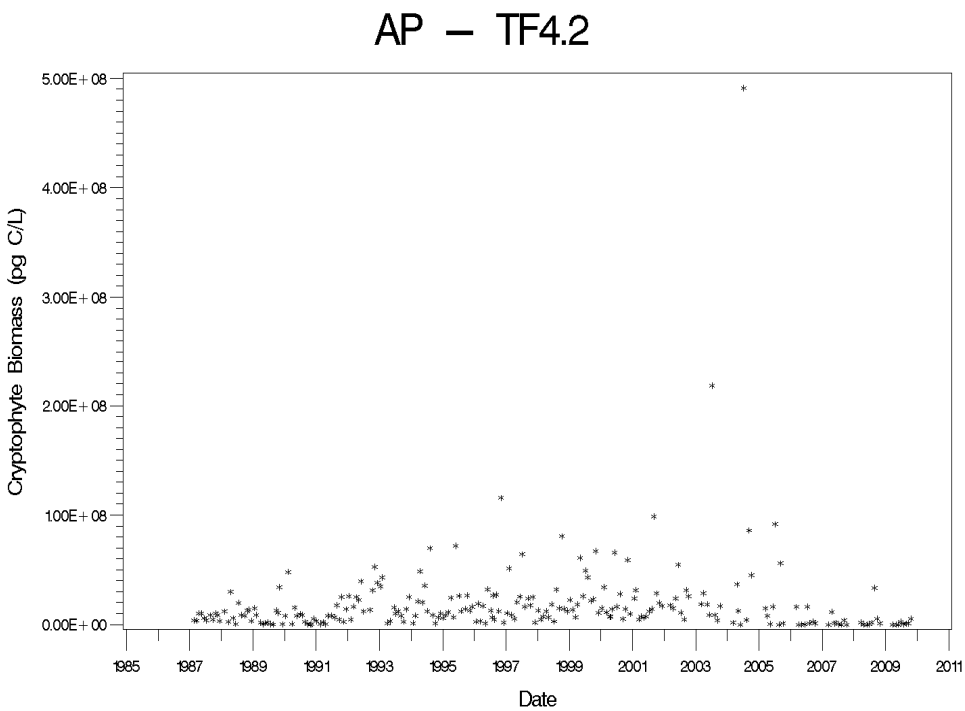


Figure 54. Plot of above pycnocline cryptophyte biomass at station TF4.2 for the period of 1985 through 2009.

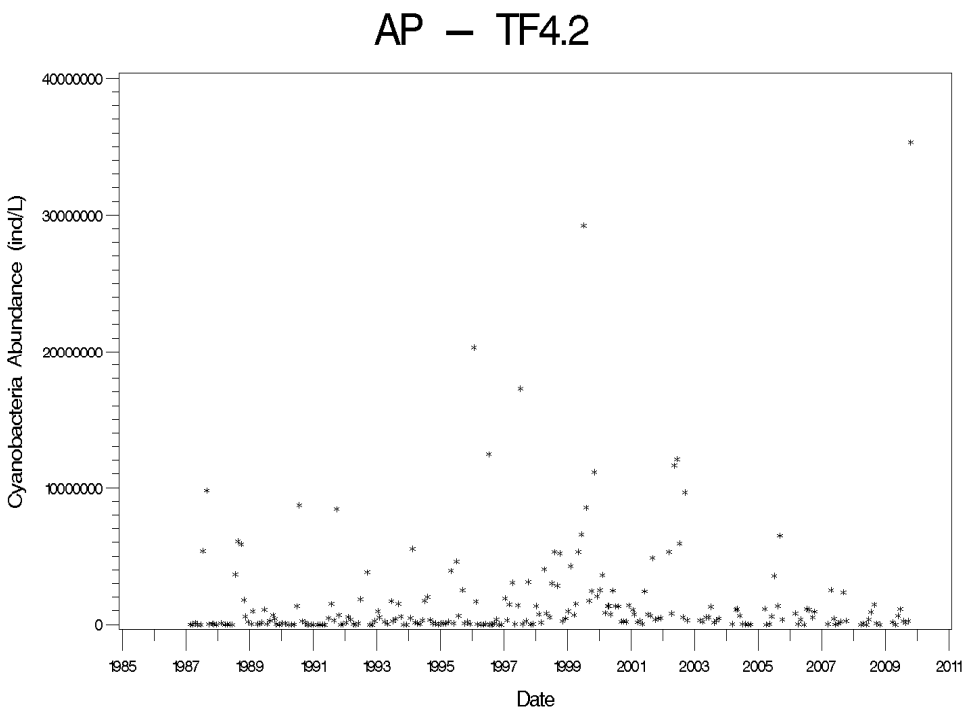


Figure 55. Plot of above pycnocline cyanophyte abundance at station TF4.2 for the period of 1985 through 2009.

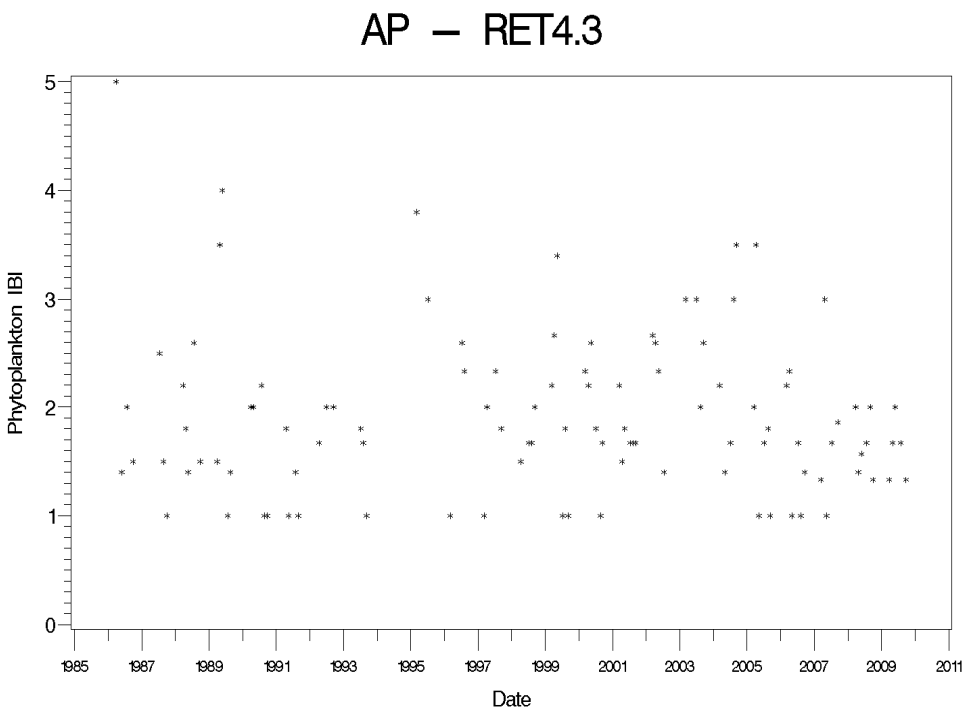


Figure 56. Plot of above pycnocline phytoplankton IBI scores against time at station RET4.3 for the period of 1985 through 2009.

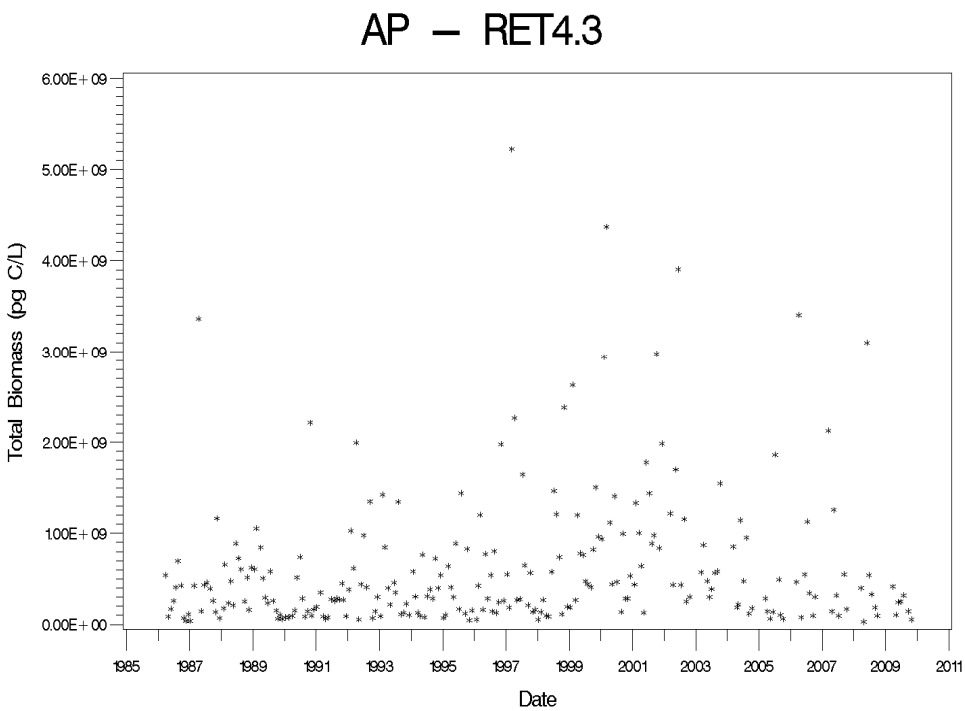


Figure 57. Plot of above pycnocline total phytoplankton biomass against time at station RET4.3 for the period of 1985 through 2009.

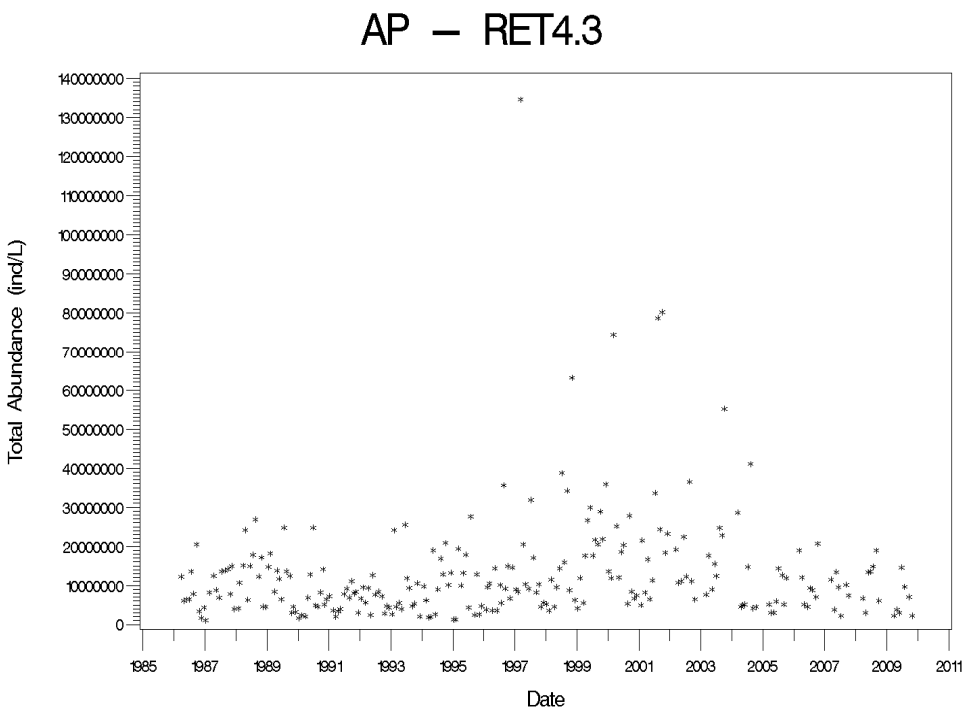


Figure 58. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET4.3 for the period of 1985 through 2009.

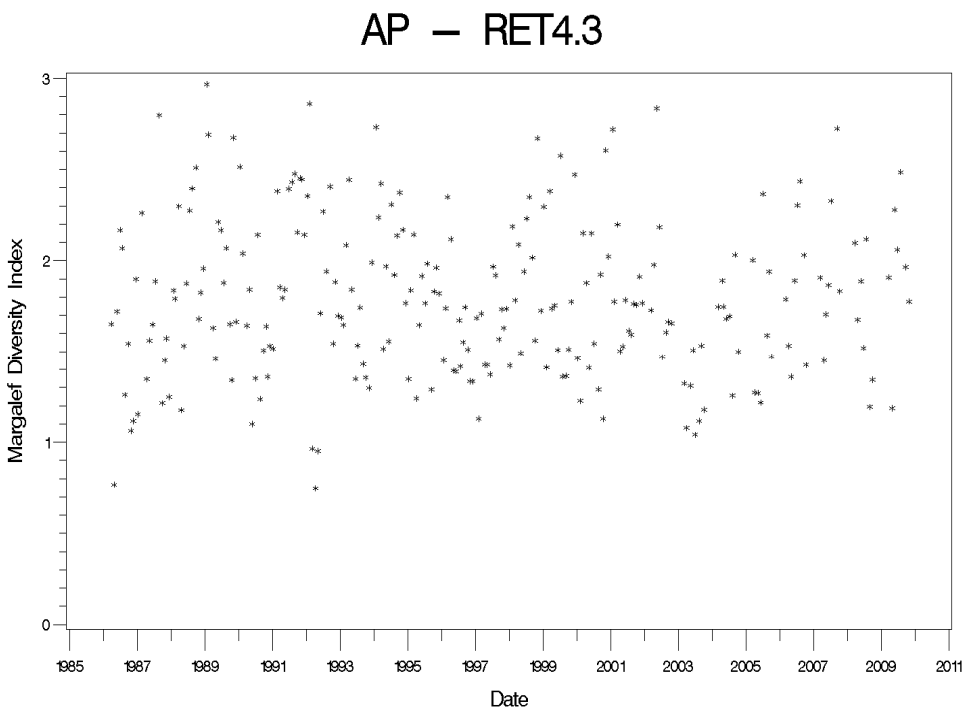


Figure 59. Plot of above pycnocline Margalef diversity index against time at station RET4.3 for the period of 1985 through 2009.

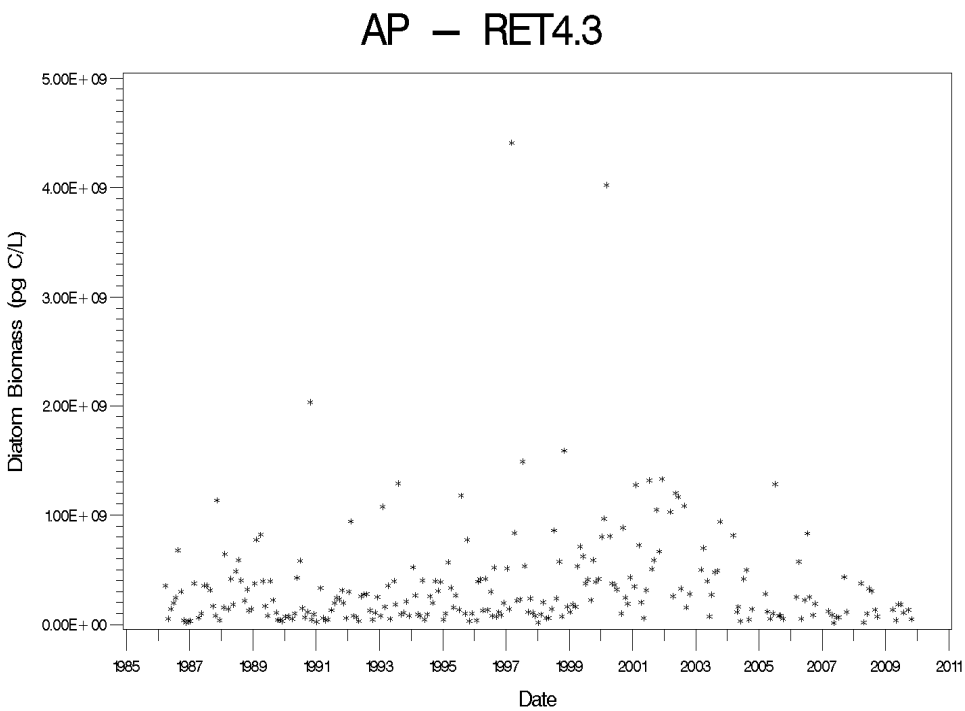


Figure 60. Plot of above pycnocline diatom biomass against time at station RET4.3 for the period of 1985 through 2009.

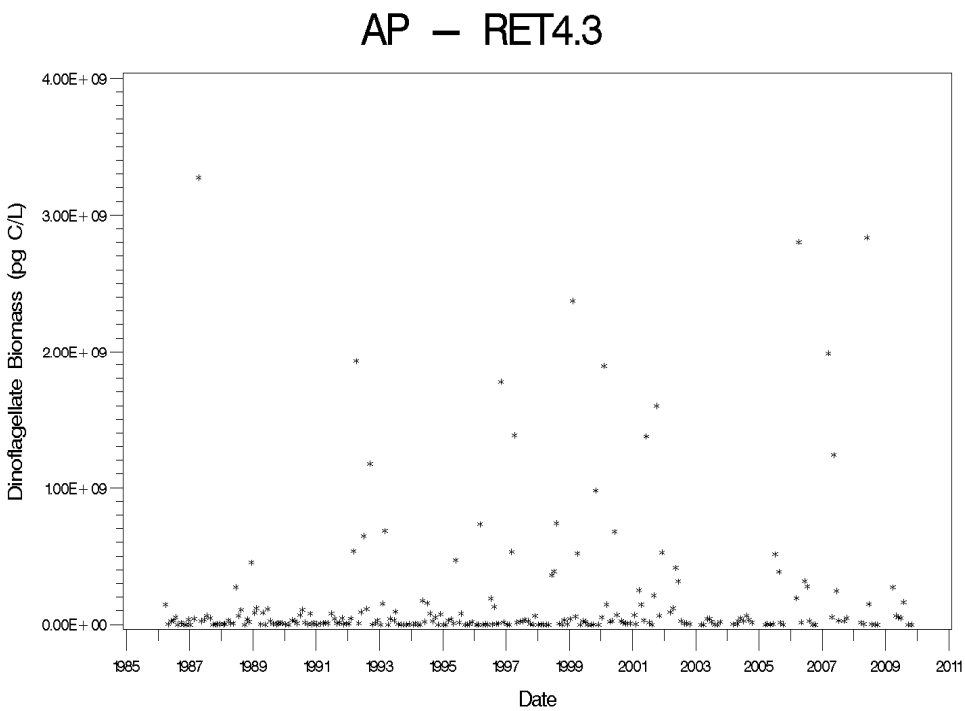


Figure 61. Plot of above pycnocline dinoflagellate biomass against time at station RET4.3 for the period of 1985 through 2009.

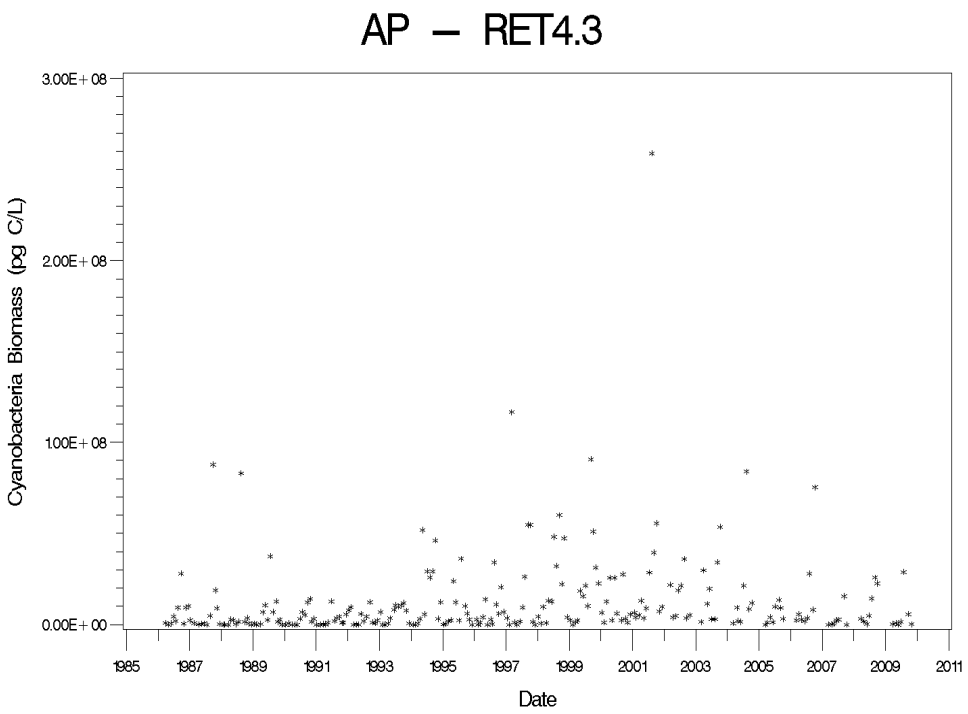


Figure 62. Plot of above pycnocline cyanobacteria biomass against time at station RET4.3 for the period of 1985 through 2009.

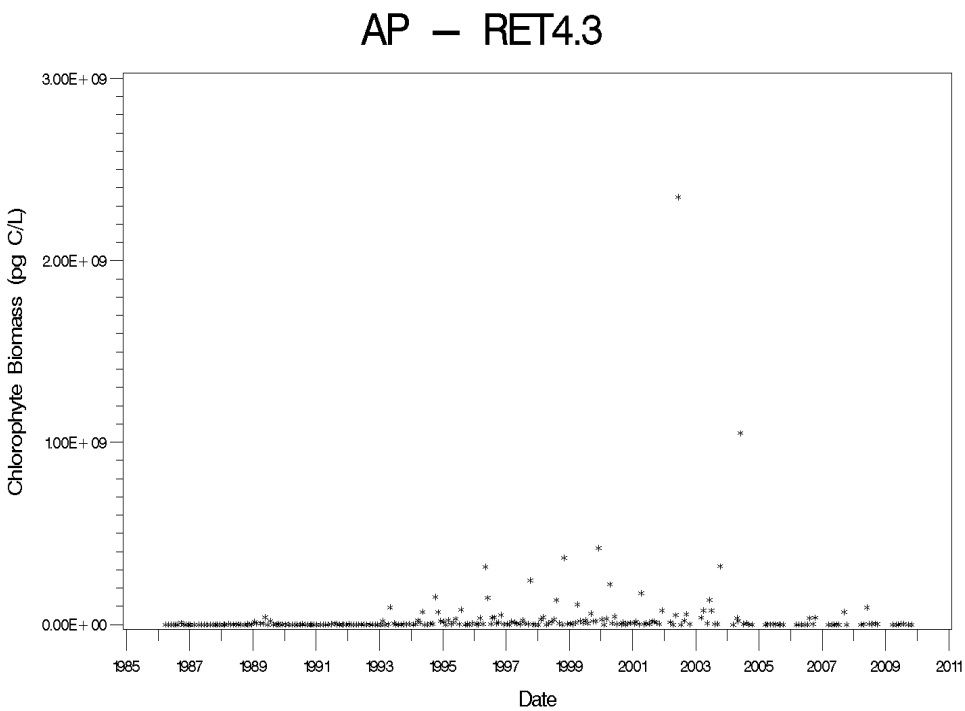


Figure 63. Plot of above pycnocline chlorophyte biomass against time at station RET4.3 for the period of 1985 through 2009.

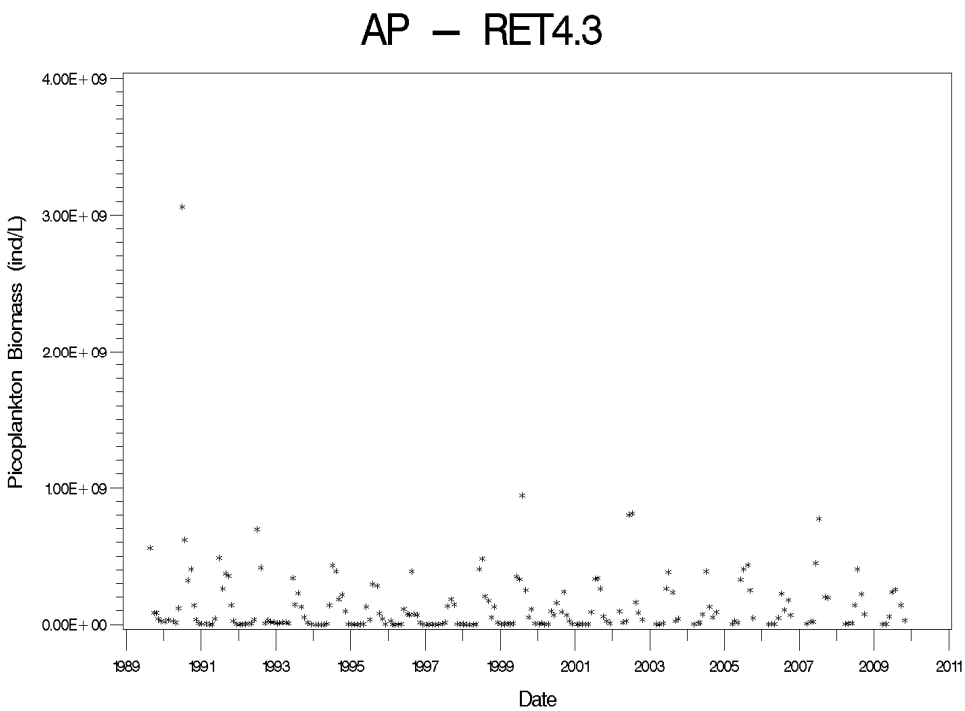


Figure 64. Plot of above pycnocline picoplankton biomass against time at station RET4.3 for the period of 1985 through 2009.

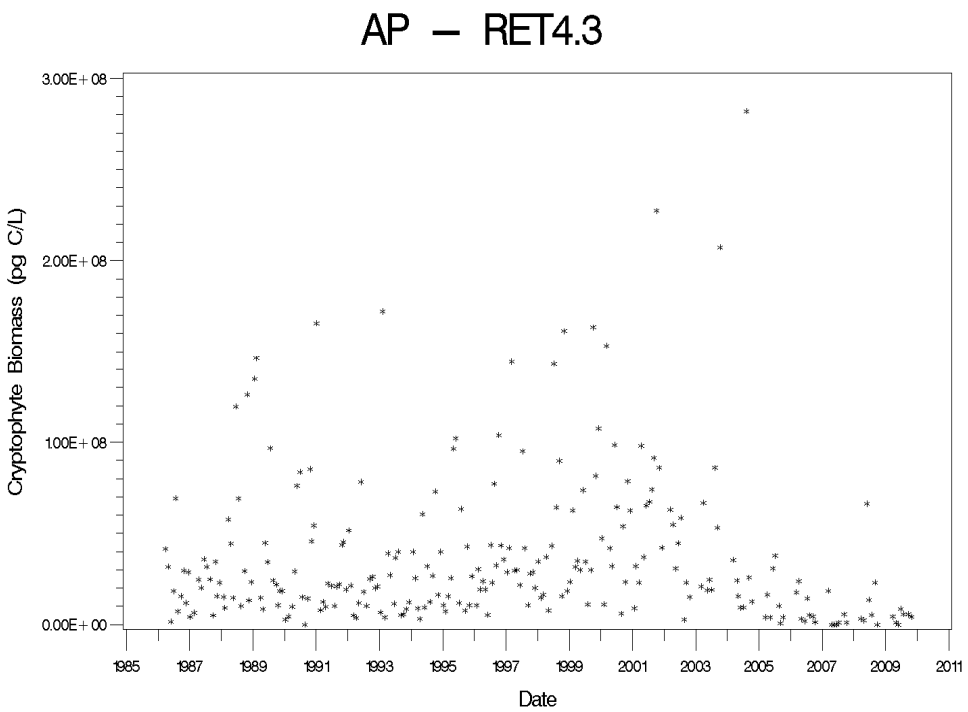


Figure 65. Plot of above pycnocline cryptophyte biomass at station RET4.3 for the period of 1985 through 2009.

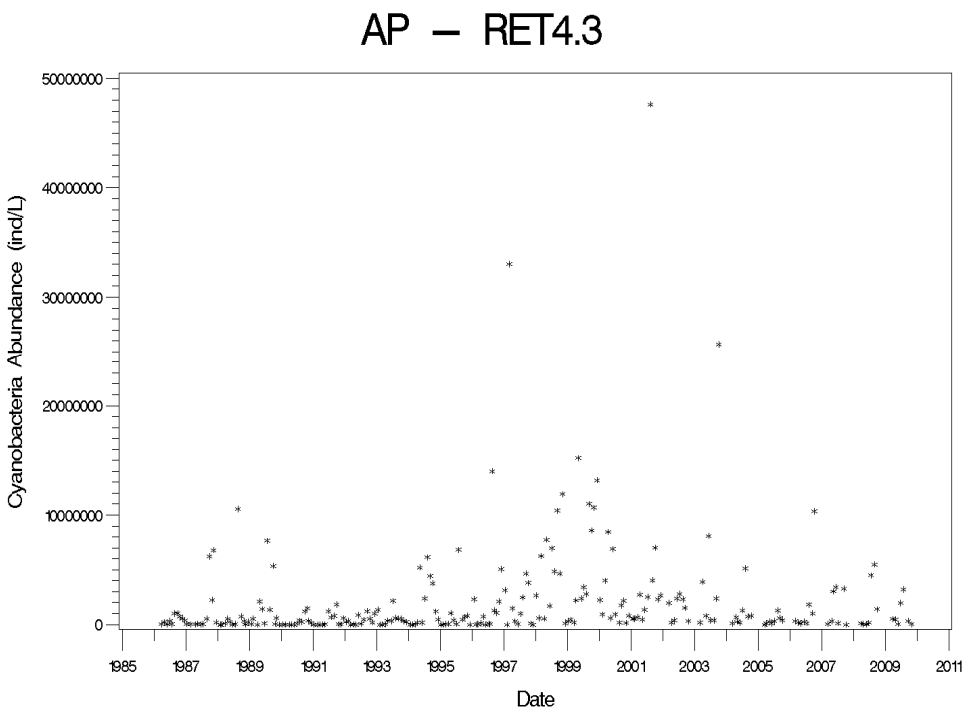


Figure 66. Plot of above pycnocline cyanophyte abundance at station RET4.3 for the period of 1985 through 2009.

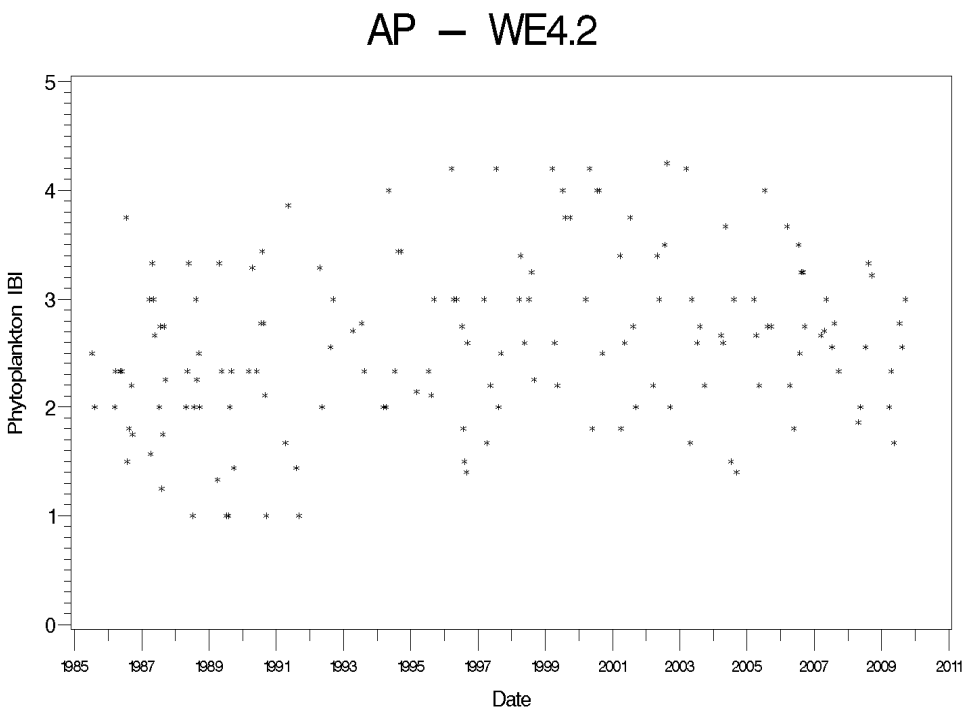


Figure 67. Plot of above pycnocline phytoplankton IBI scores against time at station WE4.2 for the period of 1985 through 2009.

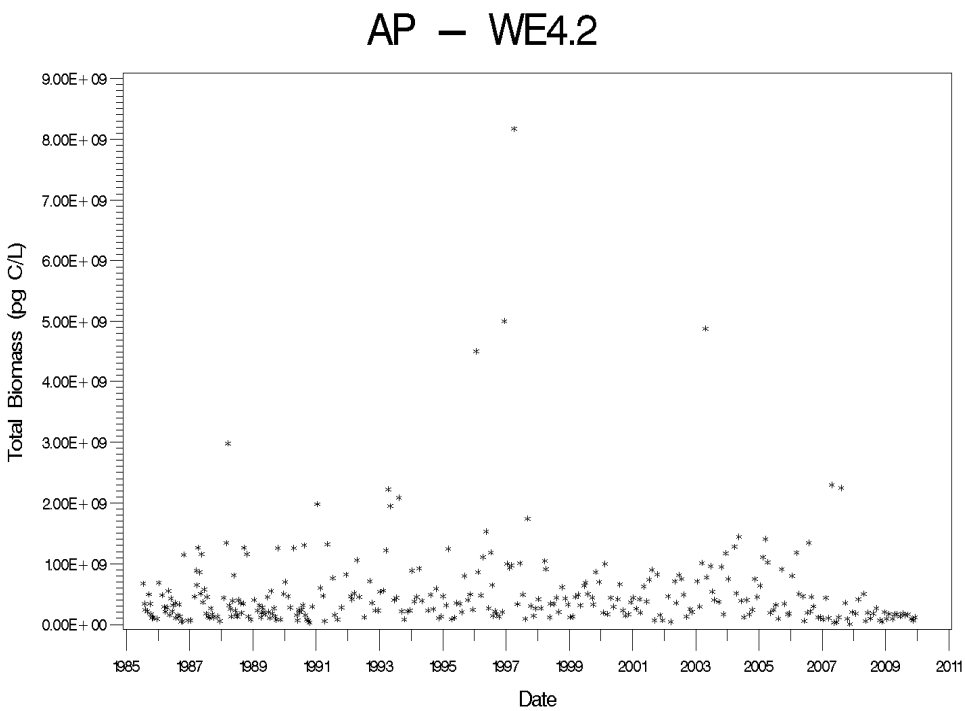


Figure 68. Plot of above pycnocline total phytoplankton biomass against time at station WE4.2 for the period of 1985 through 2009.

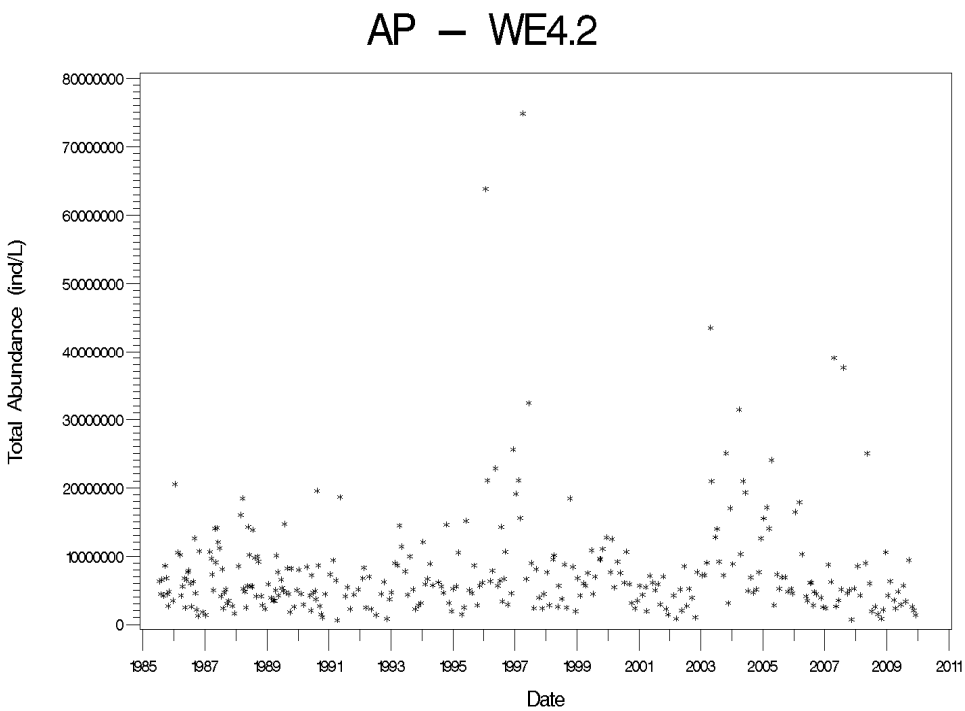


Figure 69. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station WE4.2 for the period of 1985 through 2009.

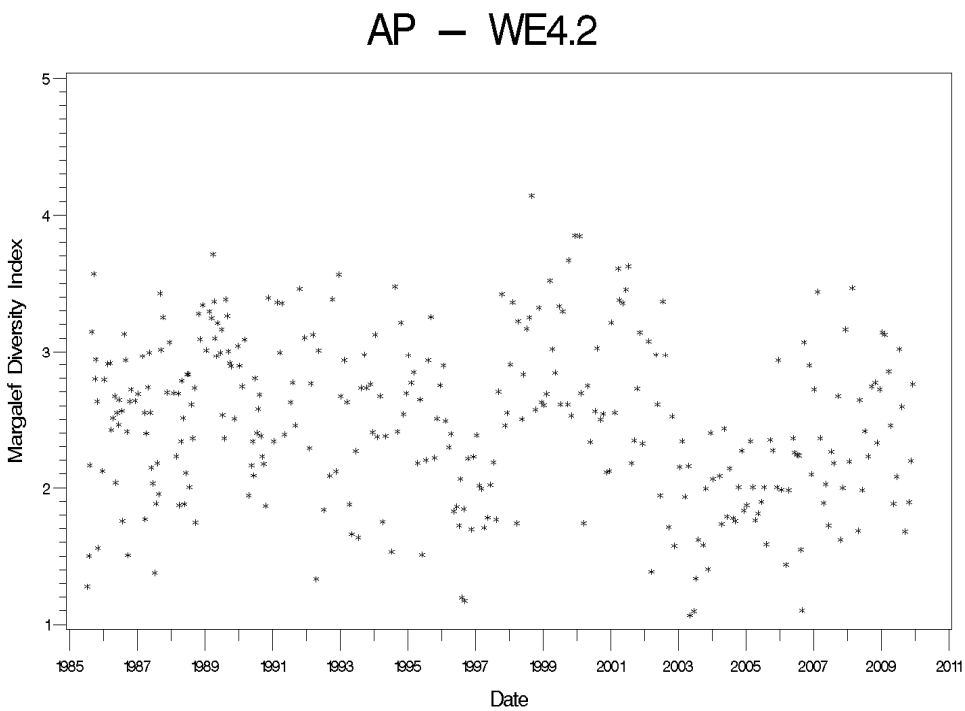


Figure 70. Plot of above pycnocline Margalef diversity index against time at station WE4.2 for the period of 1985 through 2009.

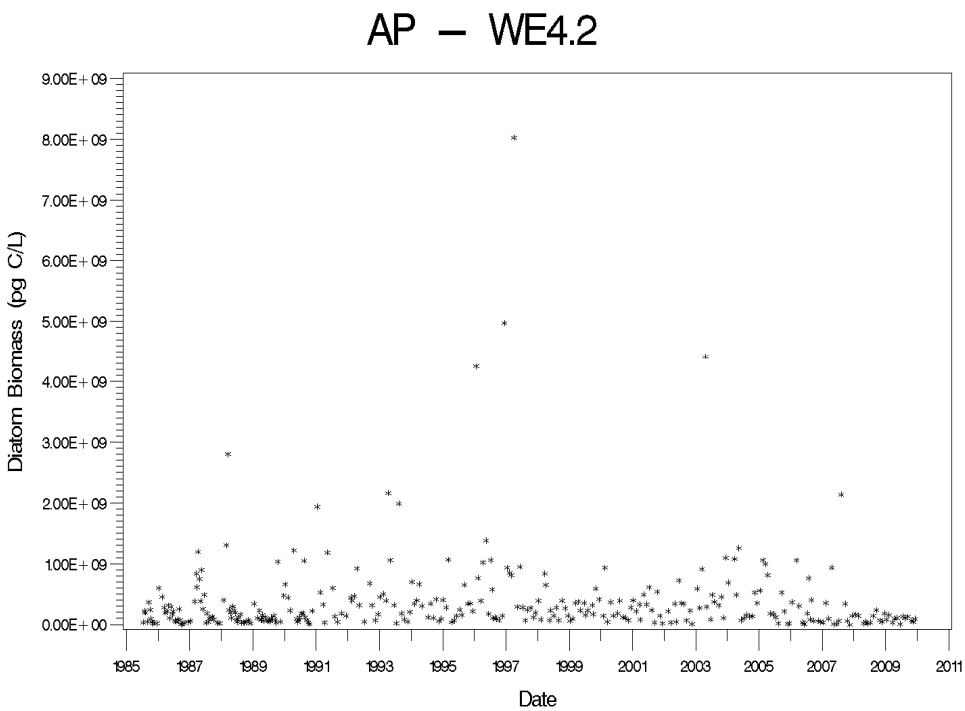


Figure 71. Plot of above pycnocline diatom biomass against time at station WE4.2 for the period of 1985 through 2009.

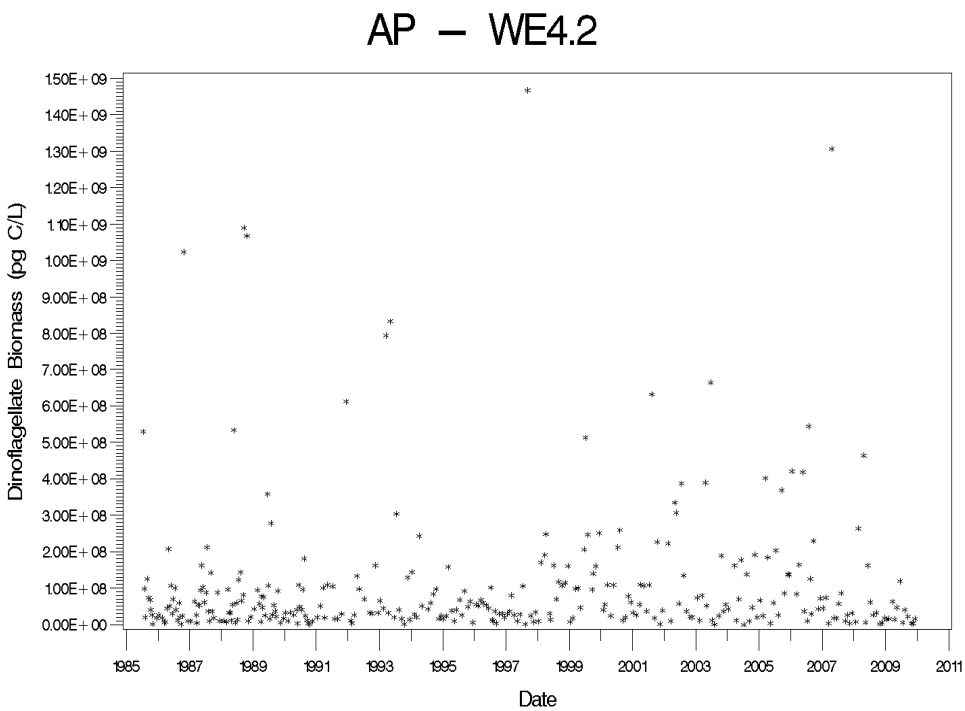


Figure 72. Plot of above pycnocline dinoflagellate biomass against time at station WE4.2 for the period of 1985 through 2009.

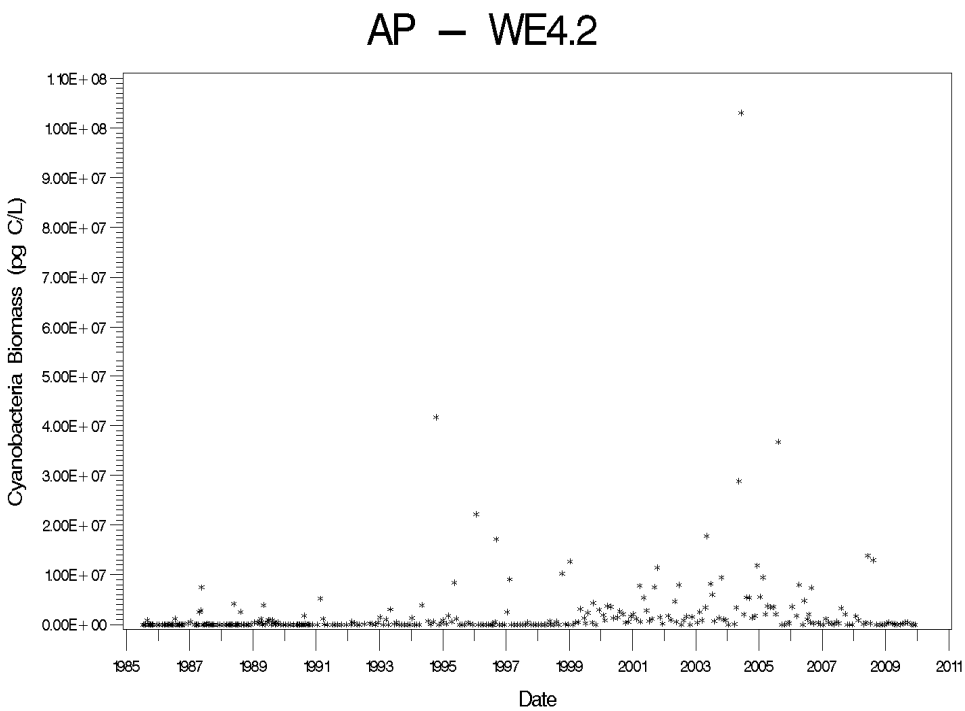


Figure 73. Plot of above pycnocline cyanobacteria biomass against time at station WE4.2 for the period of 1985 through 2009.

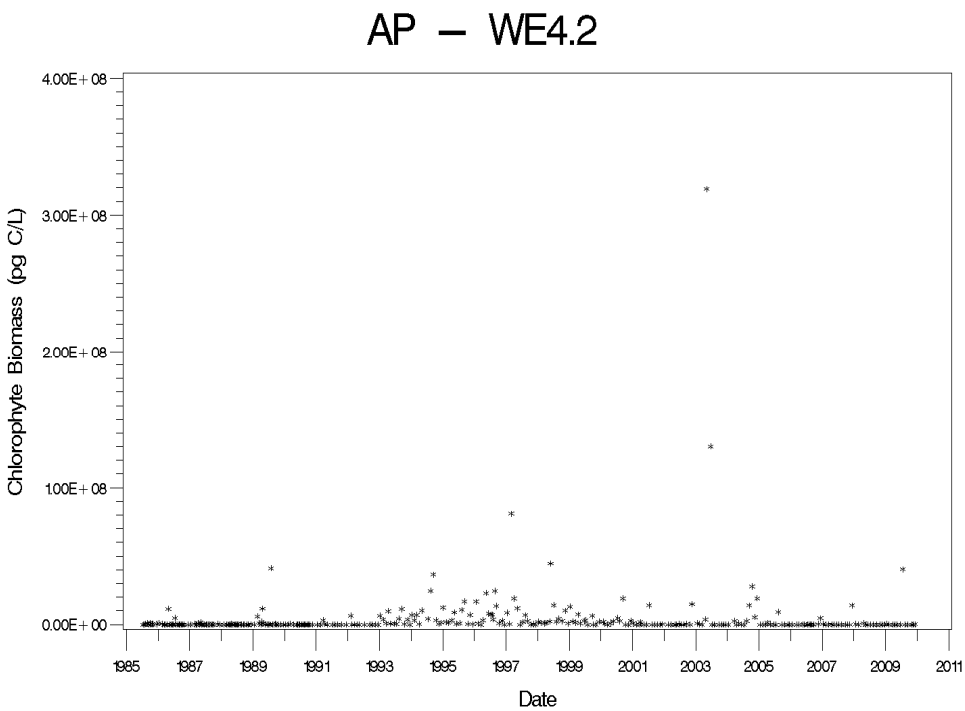


Figure 74. Plot of above pycnocline chlorophyte biomass against time at station WE4.2 for the period of 1985 through 2009.

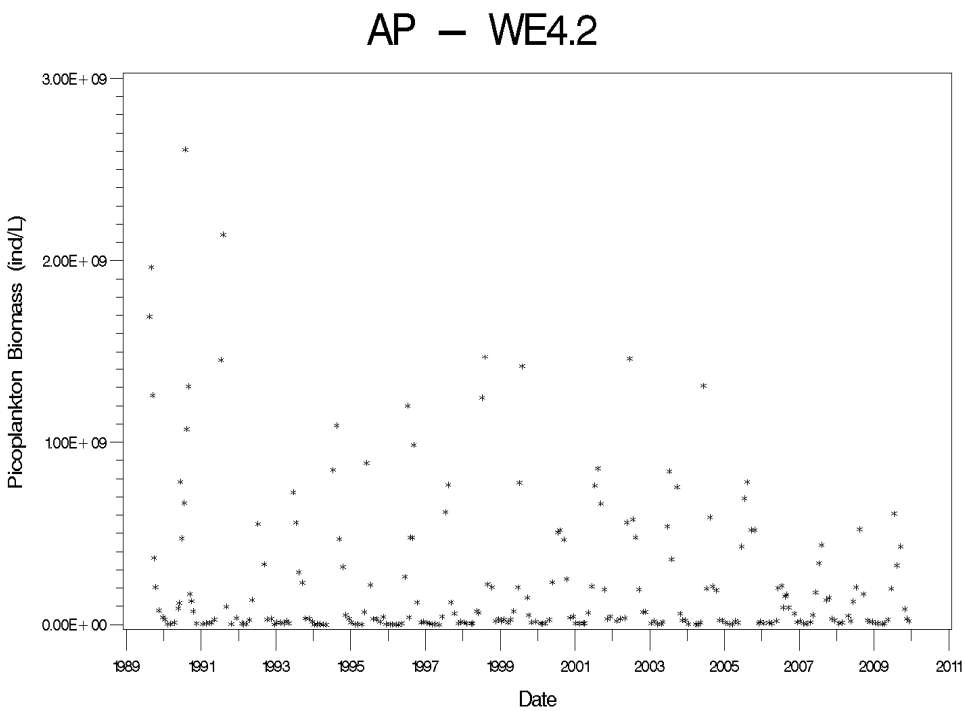


Figure 75. Plot of above pycnocline picoplankton biomass against time at station WE4.2 for the period of 1985 through 2009.

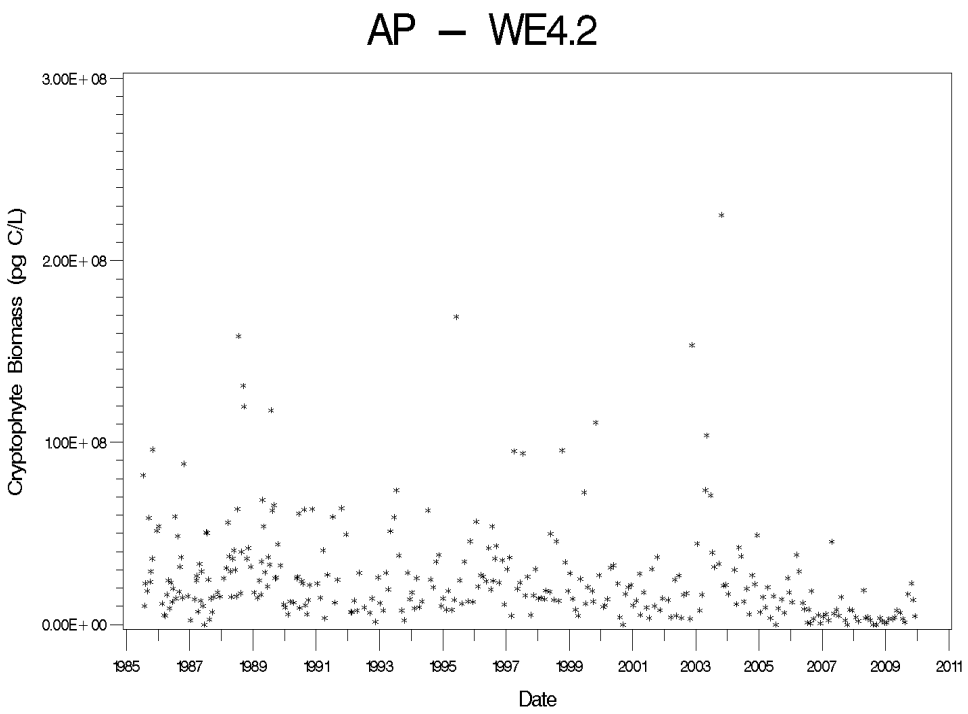


Figure 76. Plot of above pycnocline cryptophyte biomass at station WE4.2 for the period of 1985 through 2009.

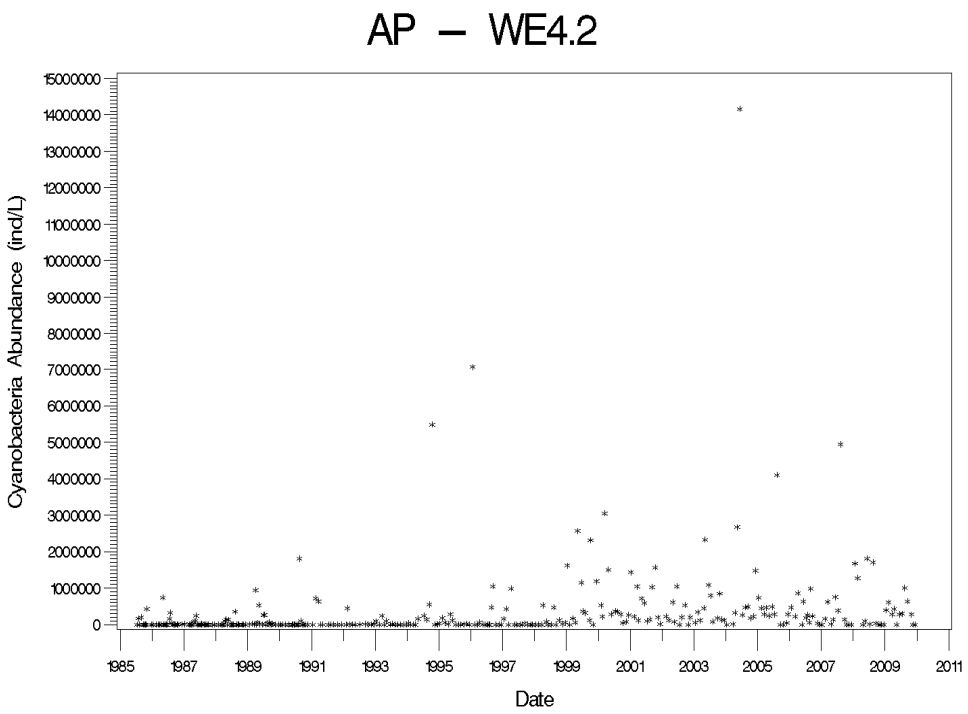


Figure 77. Plot of above pycnocline cyanophyte abundance at station WE4.2 for the period of 1985 through 2009.

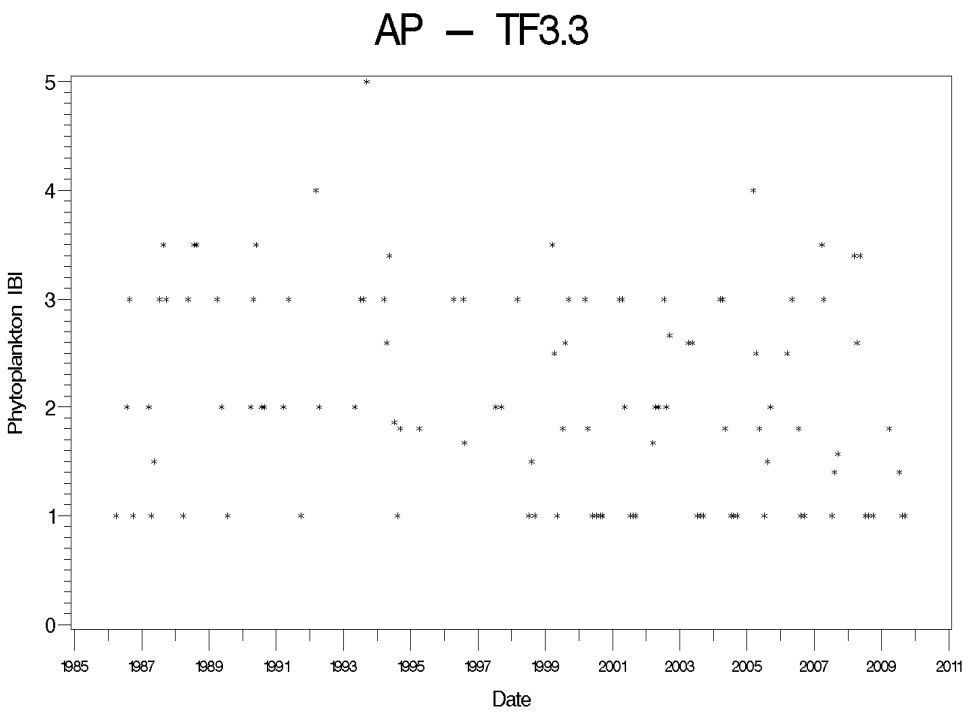


Figure 78. Plot of above pycnocline phytoplankton IBI scores against time at station TF3.3 for the period of 1985 through 2009.

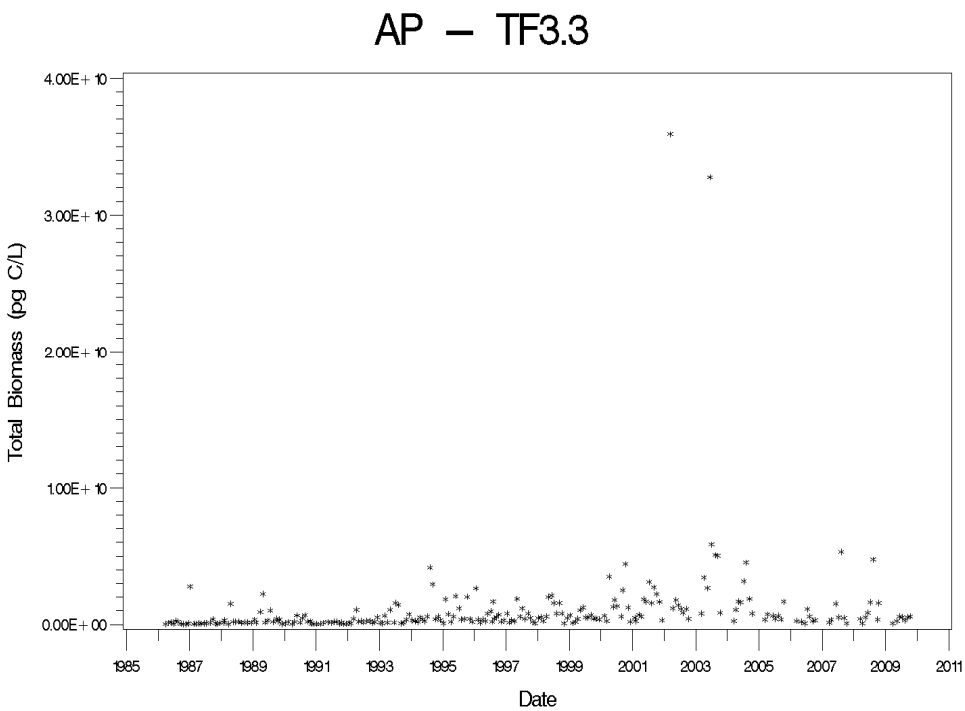


Figure 79. Plot of above pycnocline total phytoplankton biomass against time at station TF3.3 for the period of 1985 through 2009.

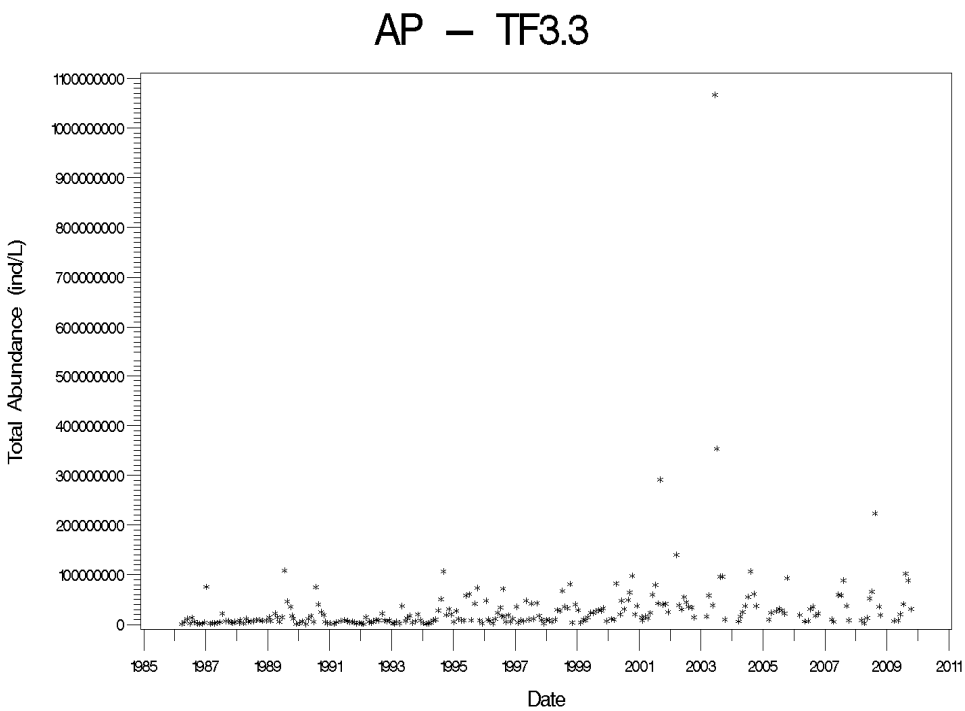


Figure 80. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station TF3.3 for the period of 1985 through 2009.

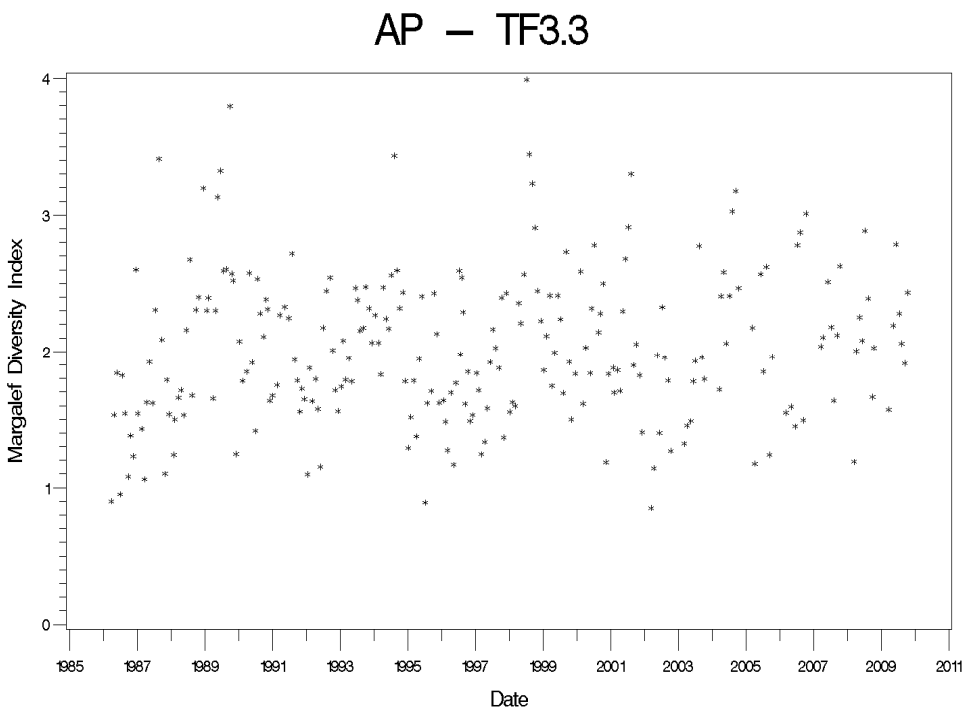


Figure 81. Plot of above pycnocline Margalef diversity index against time at station TF3.3 for the period of 1985 through 2009.

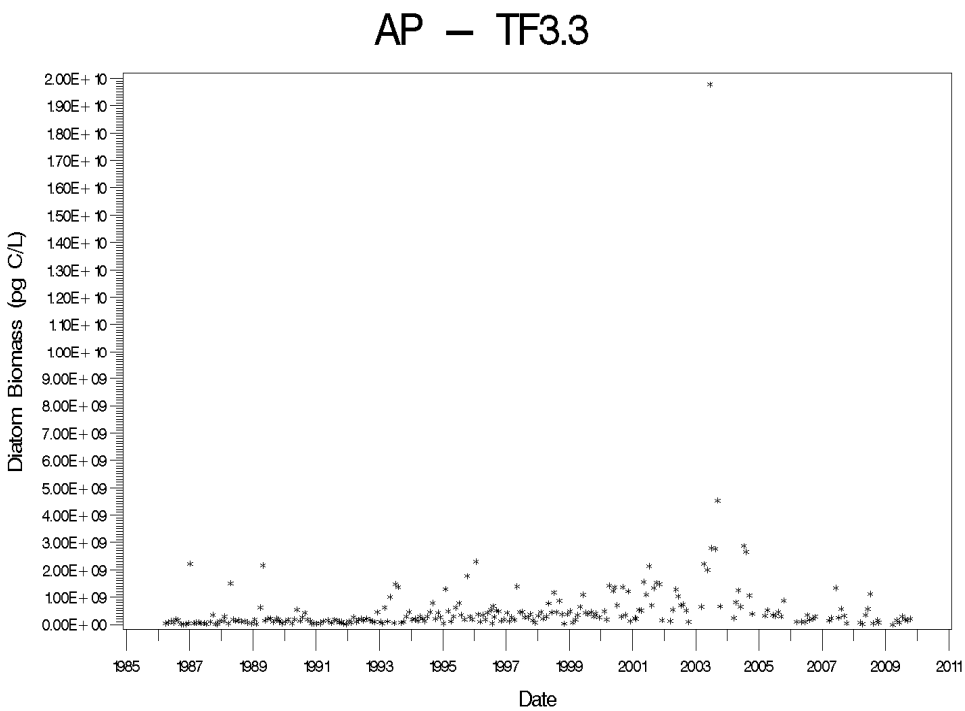


Figure 82. Plot of above pycnocline diatom biomass against time at station TF3.3 for the period of 1985 through 2009.

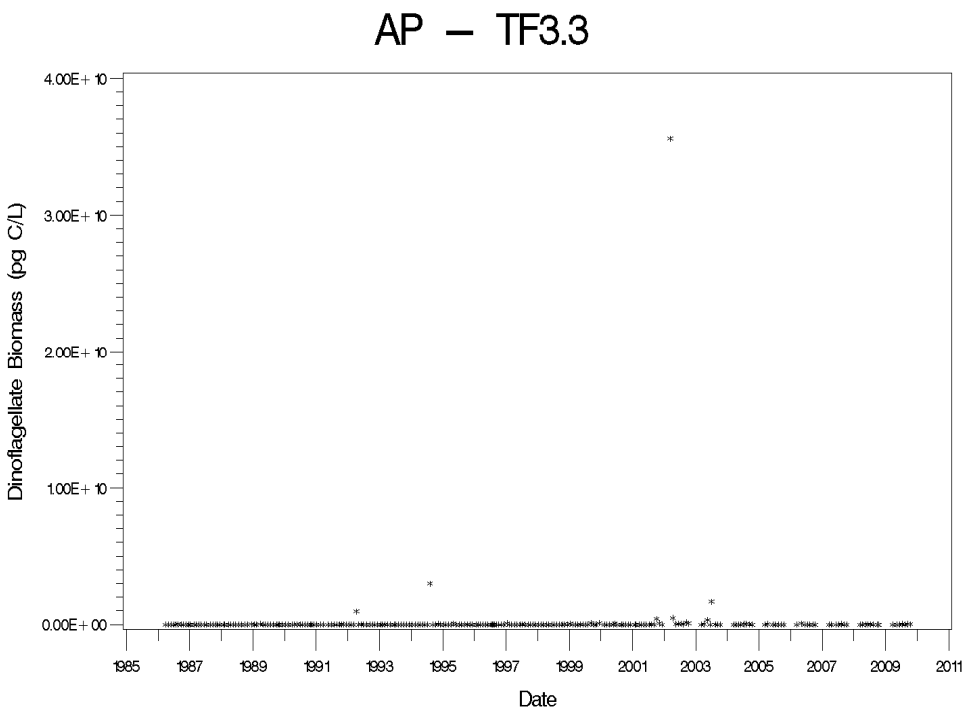


Figure 83. Plot of above pycnocline dinoflagellate biomass against time at station TF3.3 for the period of 1985 through 2009.

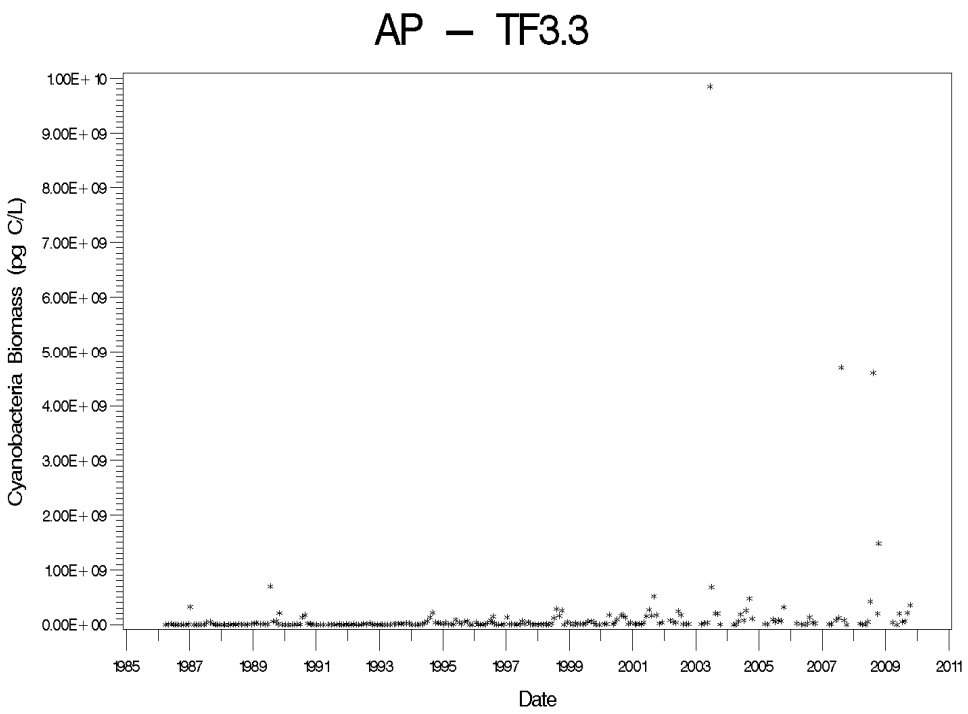


Figure 84. Plot of above pycnocline cyanobacteria biomass against time at station TF3.3 for the period of 1985 through 2009.

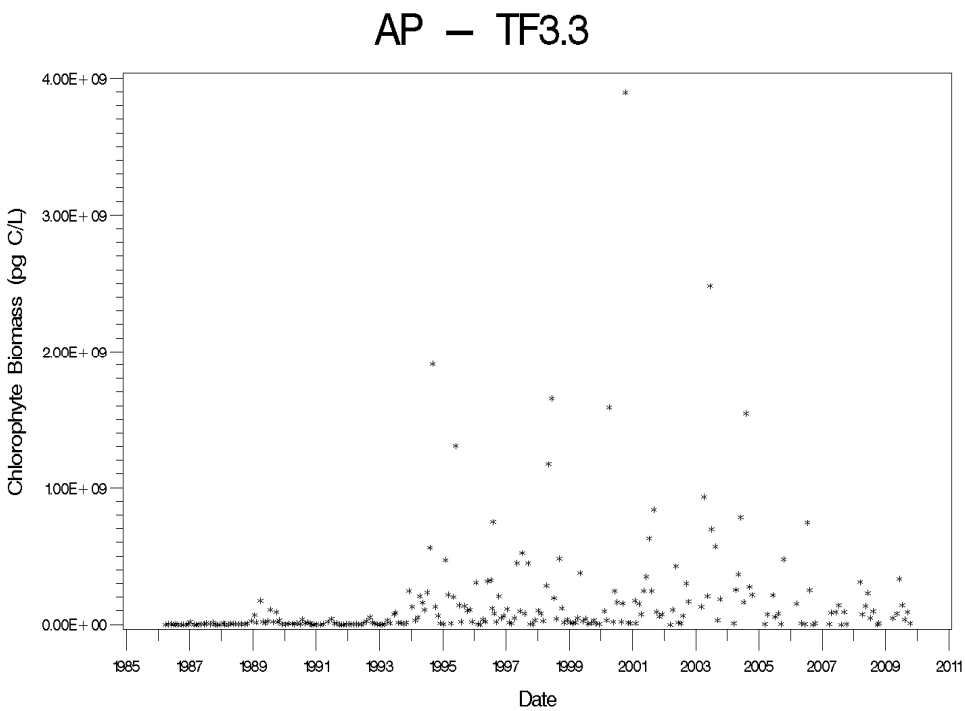


Figure 85. Plot of above pycnocline chlorophyte biomass against time at station TF3.3 for the period of 1985 through 2009.

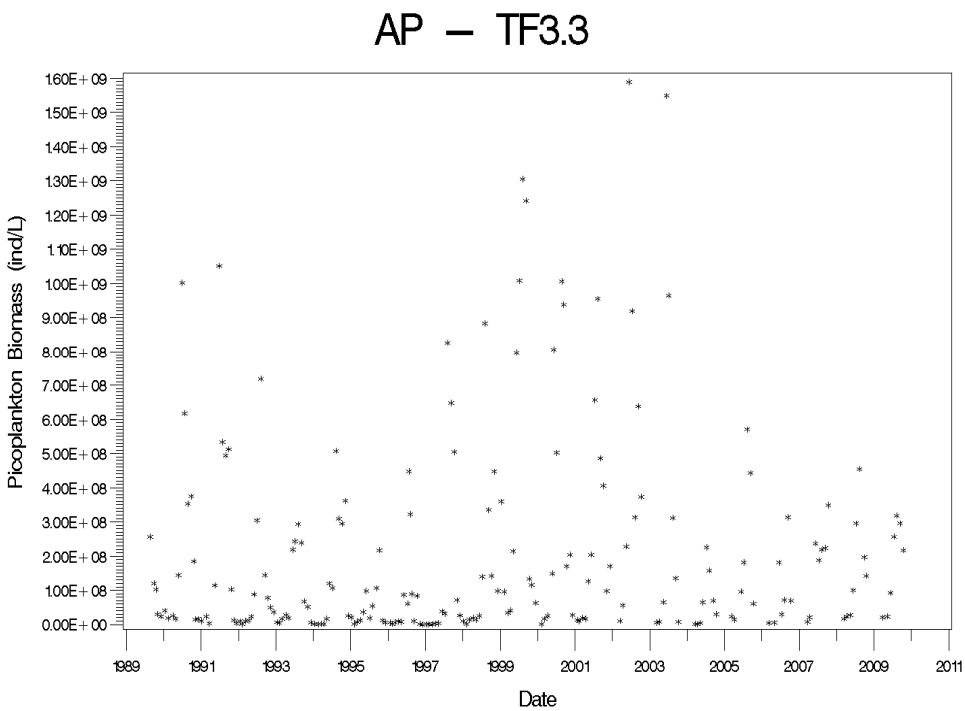


Figure 86. Plot of above pycnocline picoplankton biomass against time at station TF3.3 for the period of 1985 through 2009.

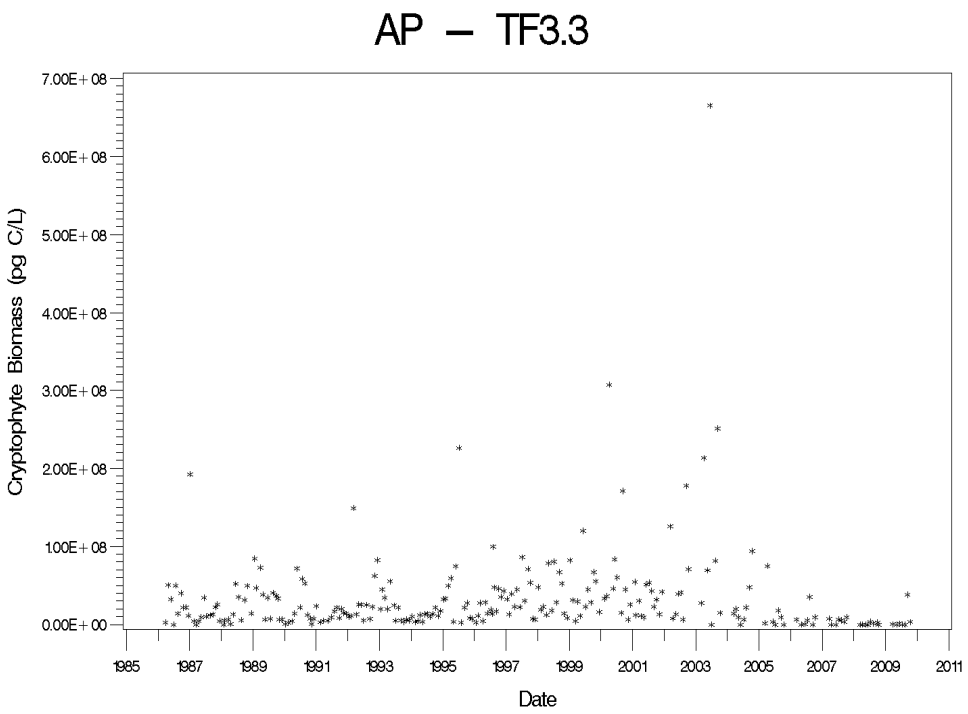


Figure 87. Plot of above pycnocline cryptophyte biomass against time at station TF3.3 for the period of 1985 through 2009.

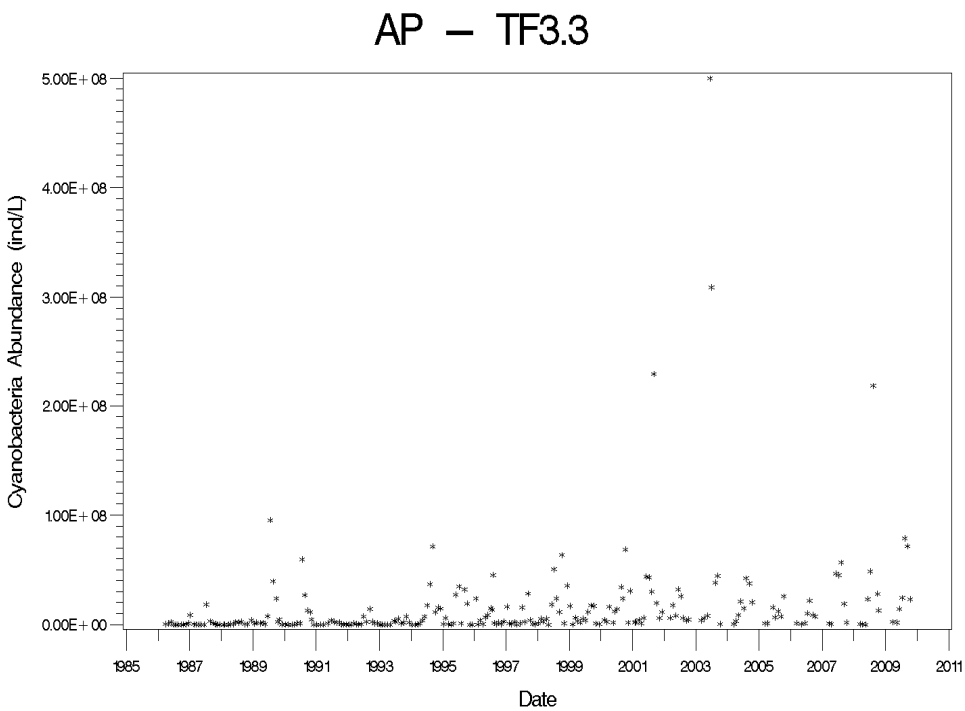


Figure 88. Plot of above pycnocline cyanophyte abundance at station TF3.3 for the period of 1985 through 2009.

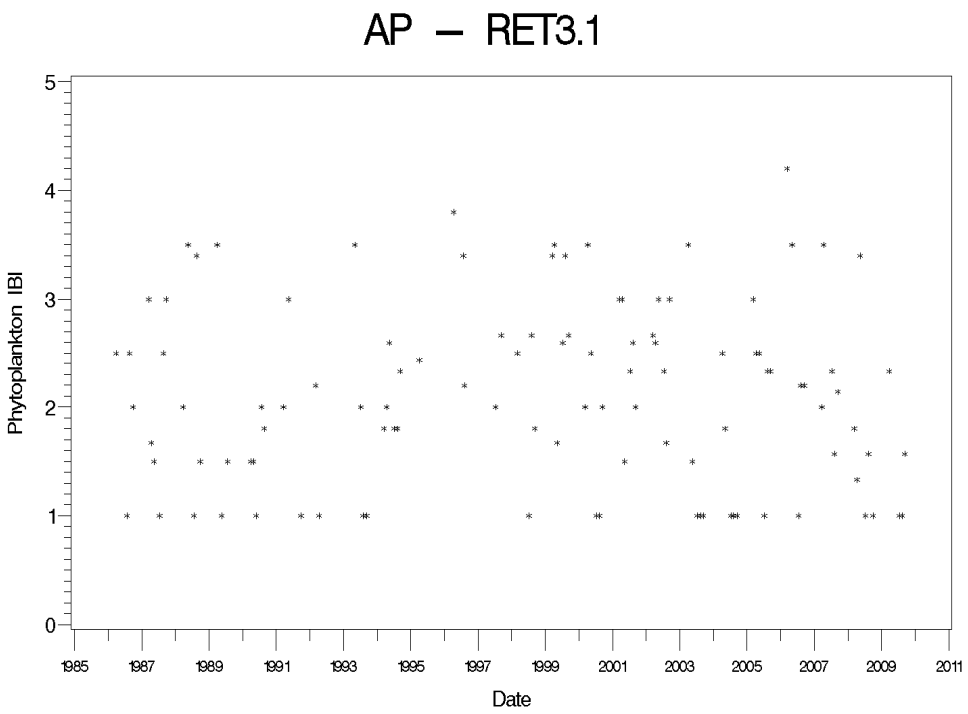


Figure 89. Plot of above pycnocline phytoplankton IBI scores against time at station RET3.1 for the period of 1985 through 2009.

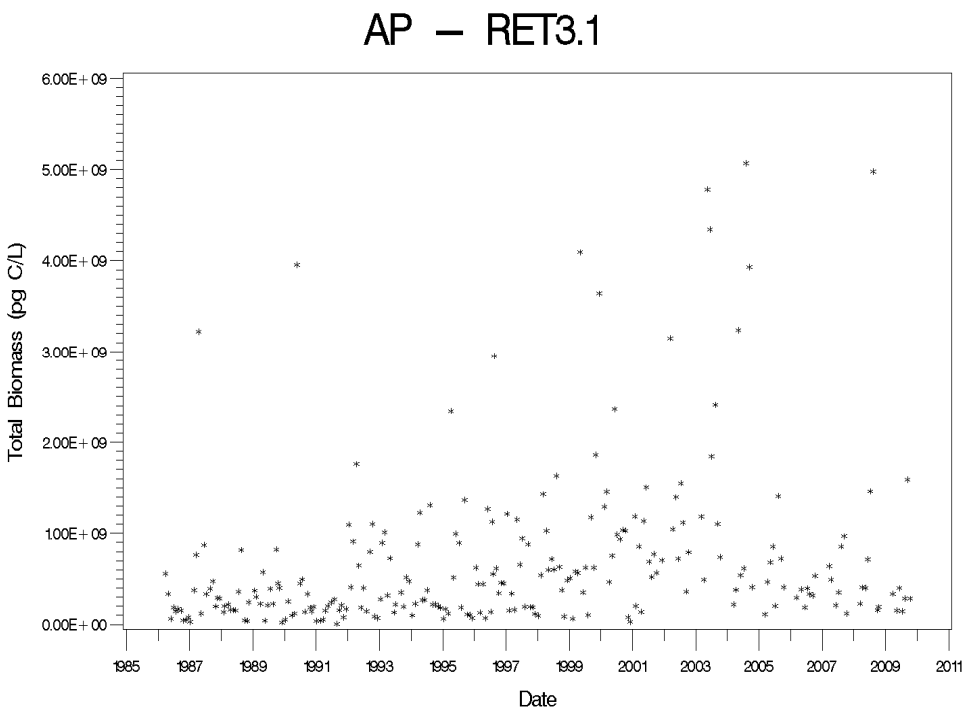


Figure 90. Plot of above pycnocline total phytoplankton biomass against time at station RET3.1 for the period of 1985 through 2009.

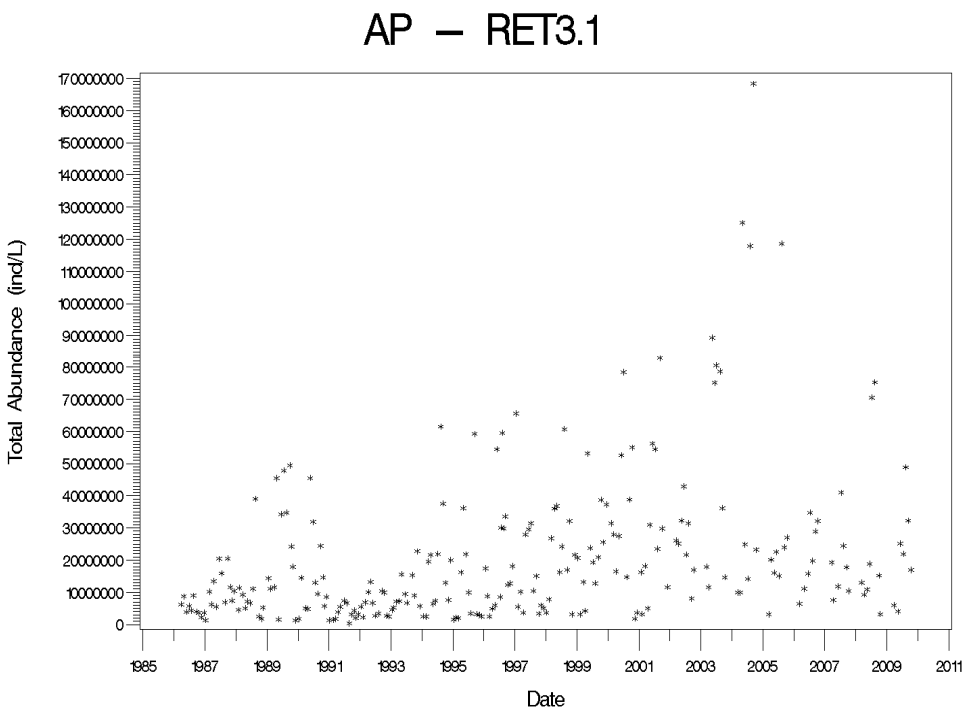


Figure 91. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station RET3.1 for the period of 1985 through 2009.

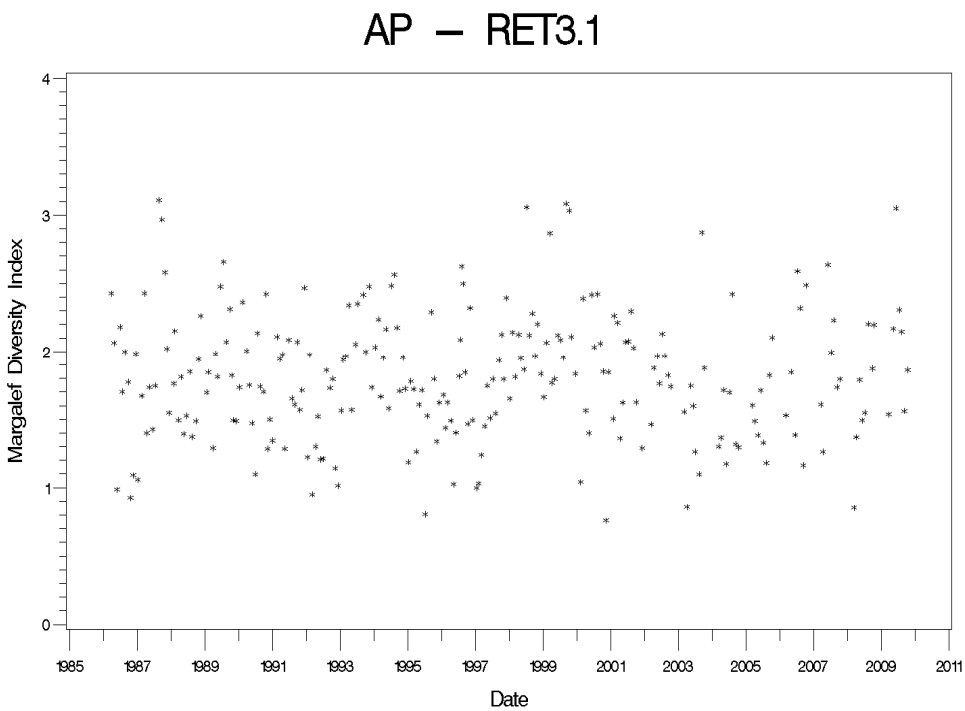


Figure 92. Plot of above pycnocline Margalef diversity index against time at station RET3.1 for the period of 1985 through 2009.

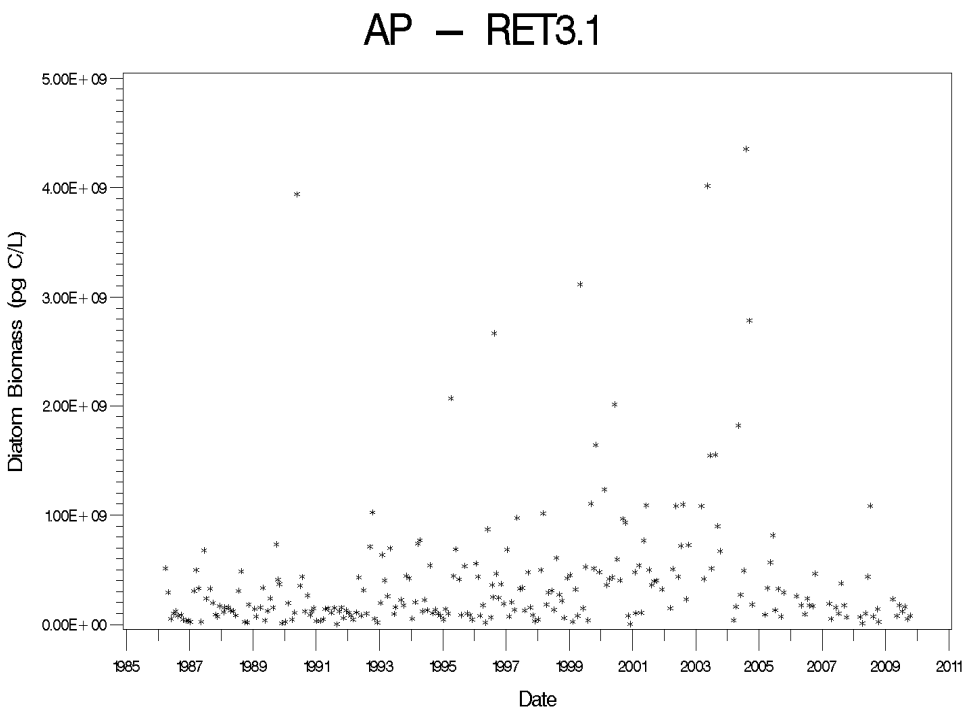


Figure 93. Plot of above pycnocline diatom biomass against time at station RET3.1 for the period of 1985 through 2009.

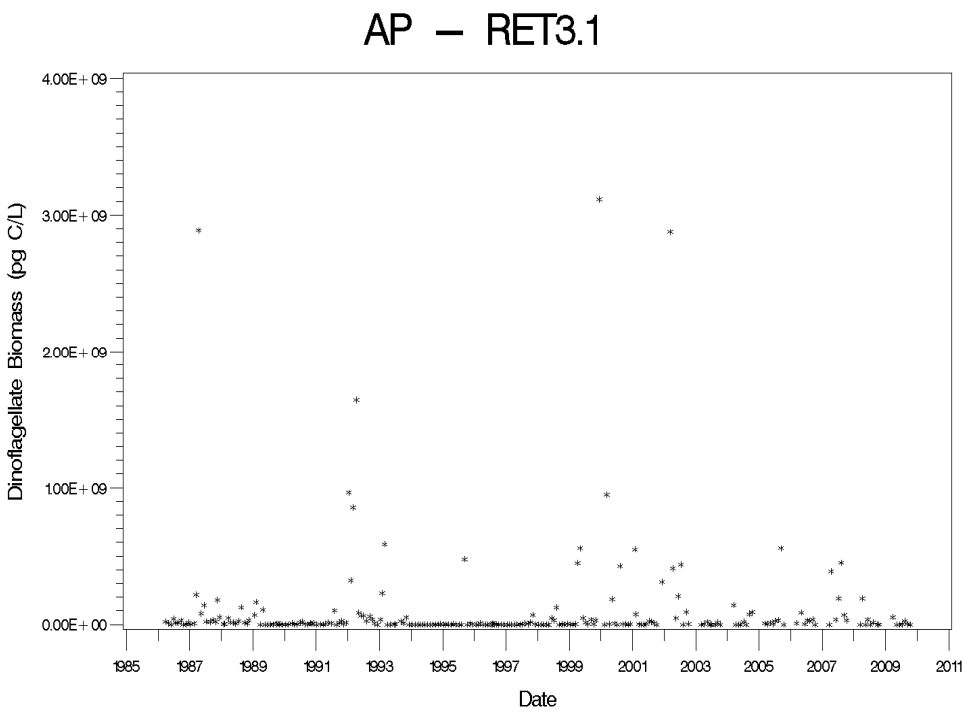


Figure 94. Plot of above pycnocline dinoflagellate biomass against time at station RET3.1 for the period of 1985 through 2009.

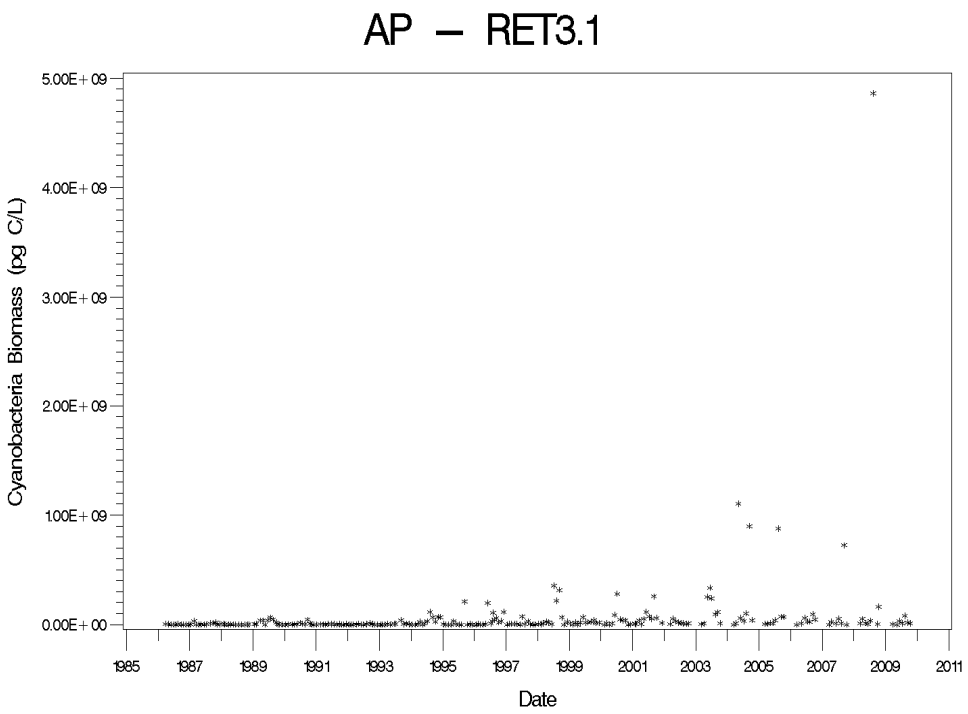


Figure 95. Plot of above pycnocline cyanobacteria biomass against time at station RET3.1 for the period of 1985 through 2009.

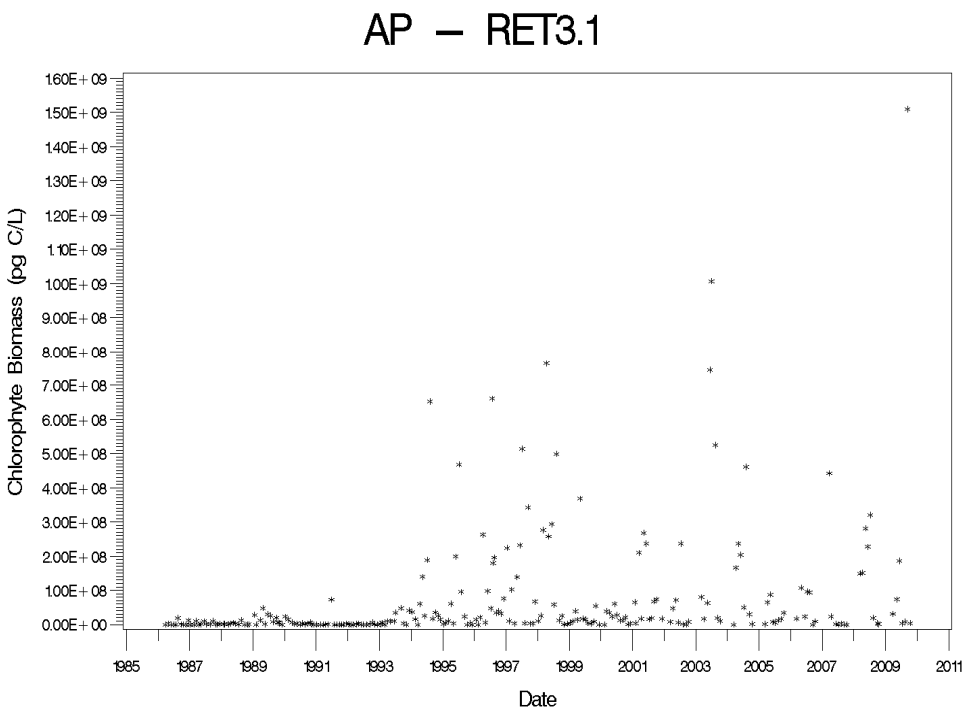


Figure 96. Plot of above pycnocline chlorophyte biomass against time at station RET3.1 for the period of 1985 through 2009.

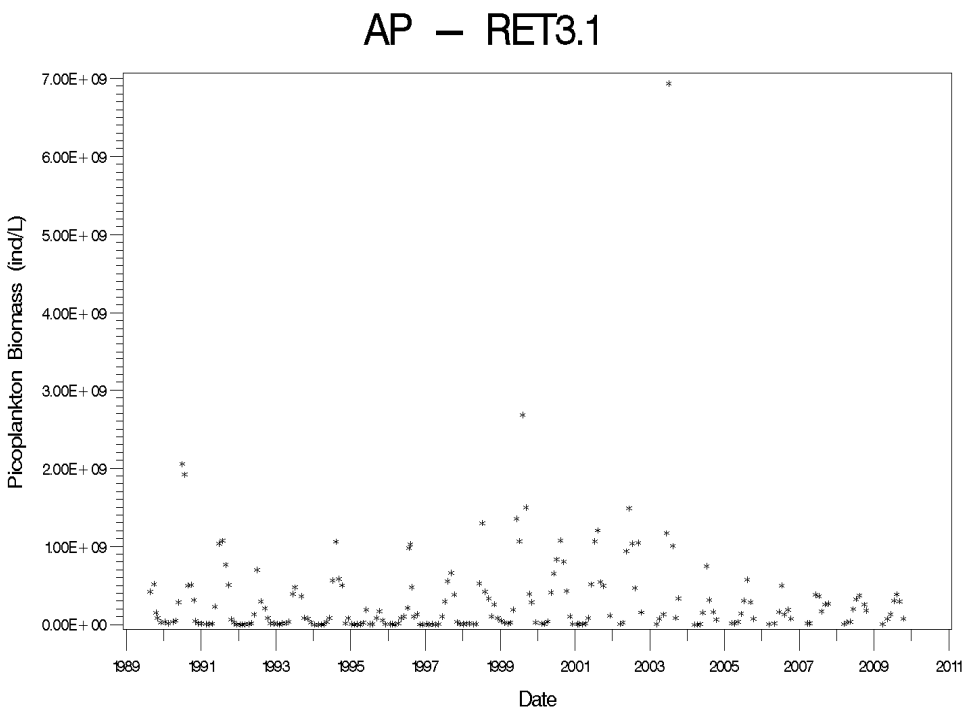


Figure 97. Plot of above pycnocline picoplankton biomass against time at station RET3.1 for the period of 1985 through 2009.

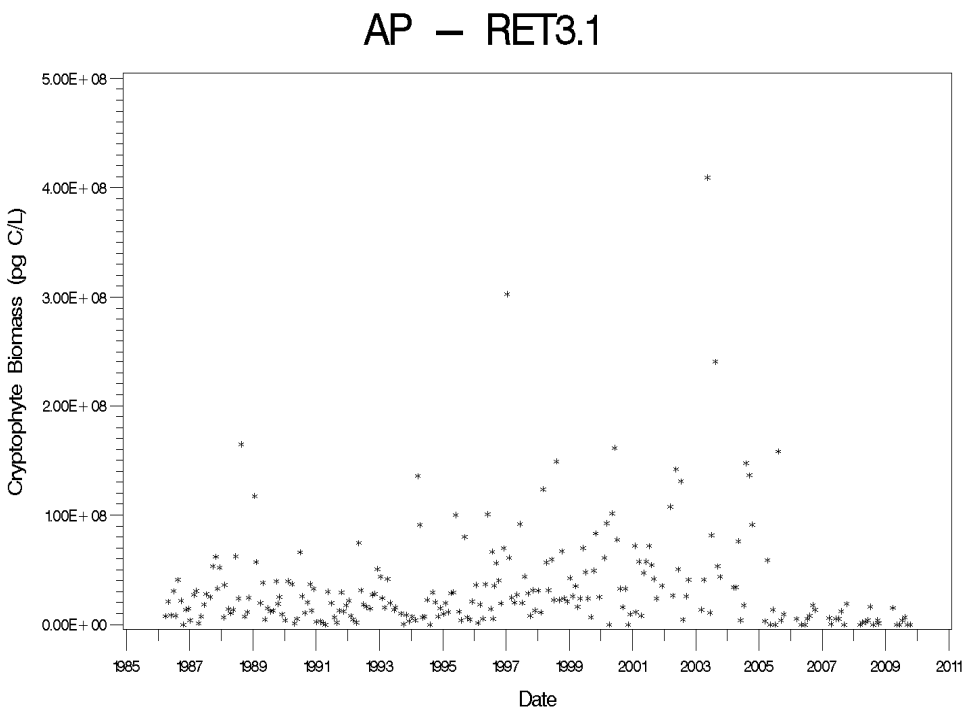


Figure 98. Plot of above pycnocline cryptophyte biomass at station RET3.1 for the period of 1985 through 2009.

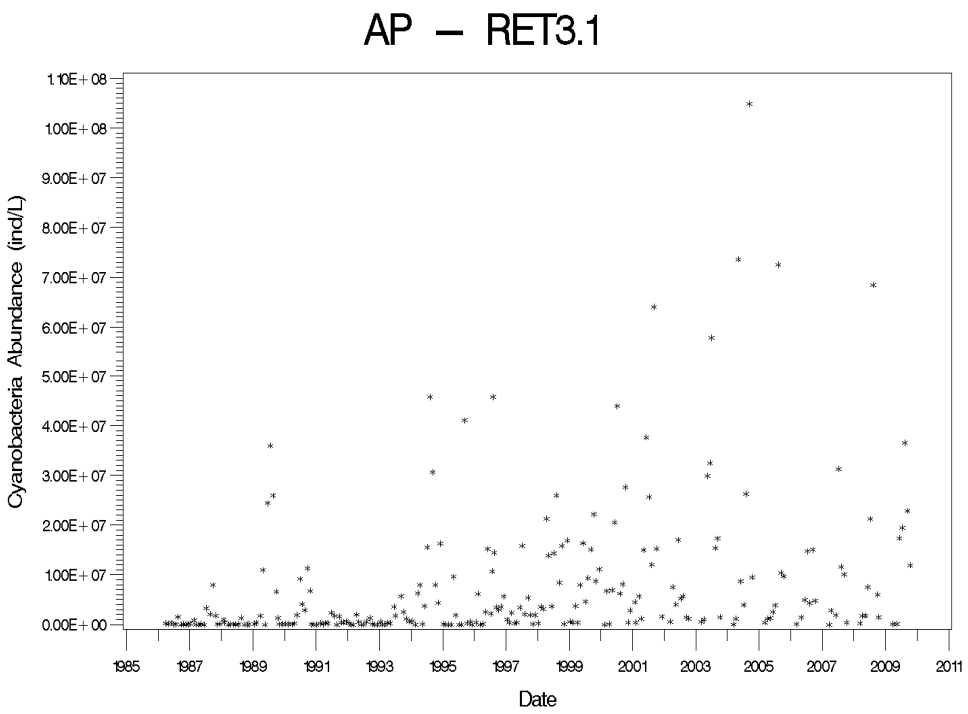


Figure 99. Plot of above pycnocline cyanophyte abundance at station RET3.1 for the period of 1985 through 2009.

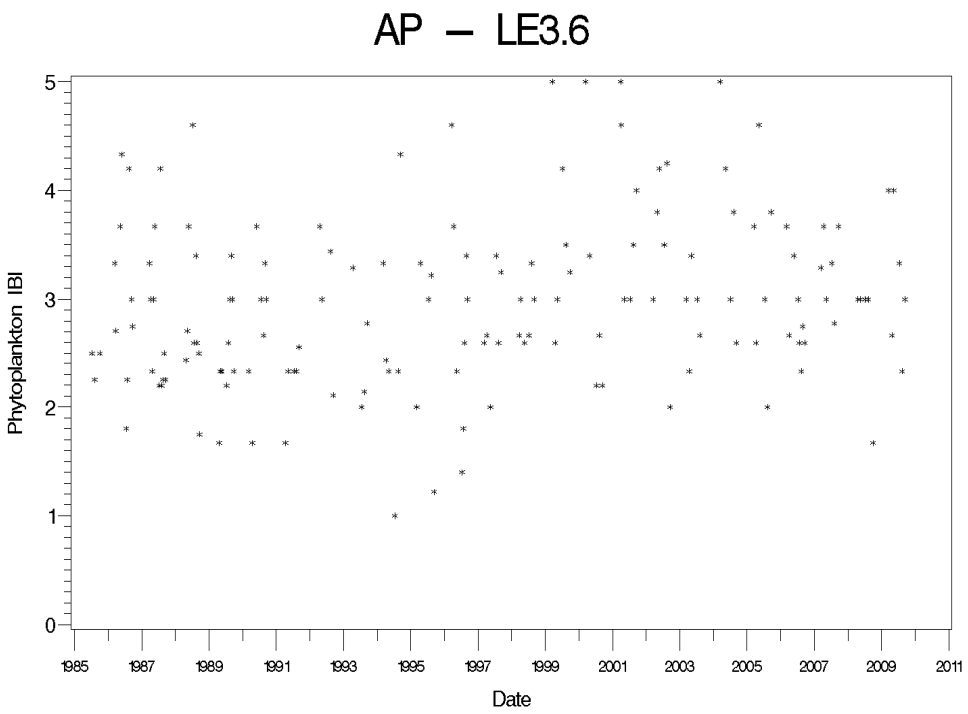


Figure 100. Plot of above pycnocline phytoplankton IBI scores against time at station LE3.6 for the period of 1985 through 2009.

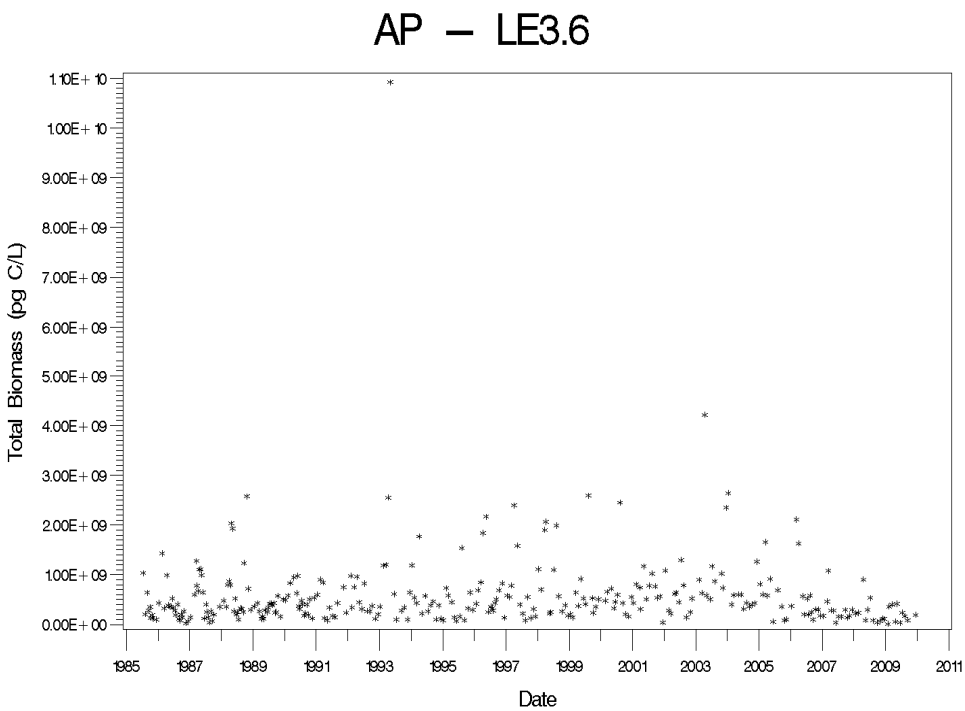


Figure 101. Plot of above pycnocline total phytoplankton biomass against time at station LE3.6 for the period of 1985 through 2009.

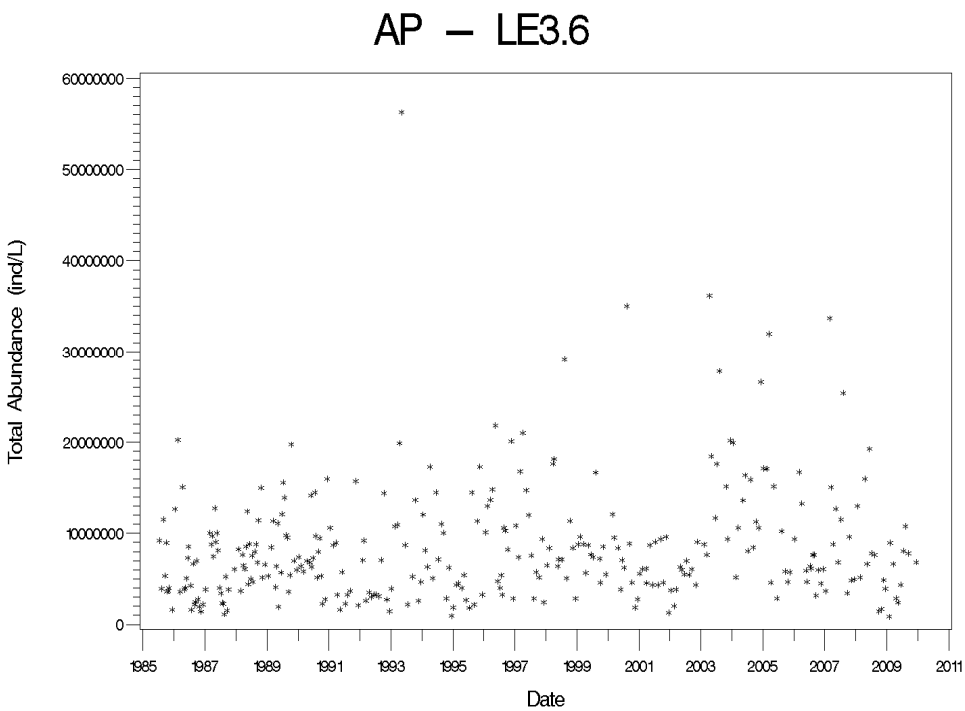


Figure 102. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station LE3.6 for the period of 1985 through 2009.

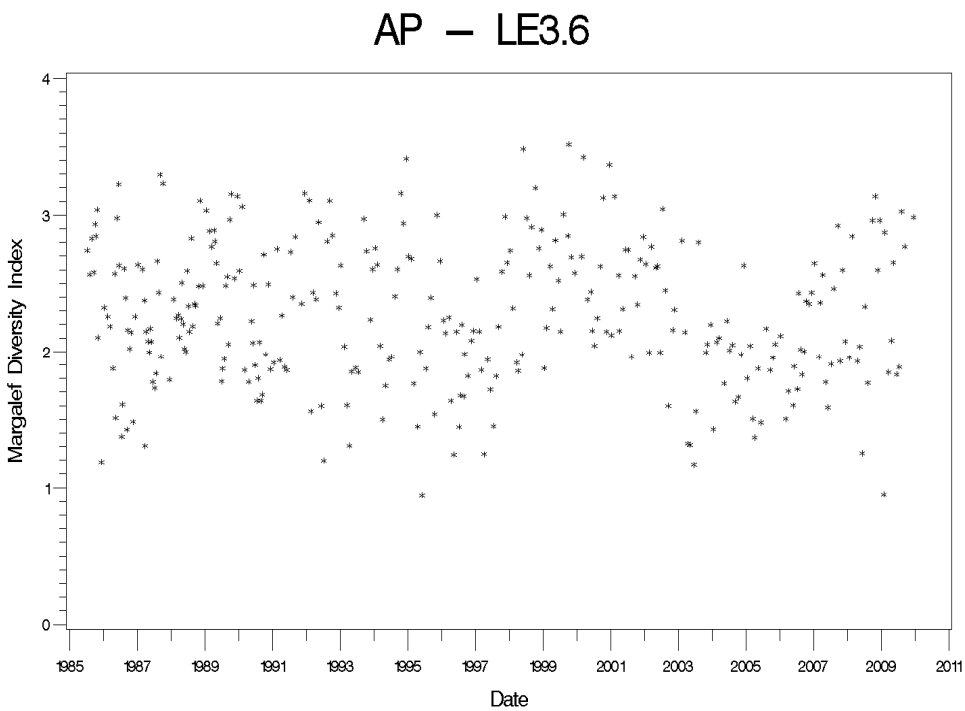


Figure 103. Plot of above pycnocline Margalef diversity index against time at station LE3.6 for the period of 1985 through 2009.

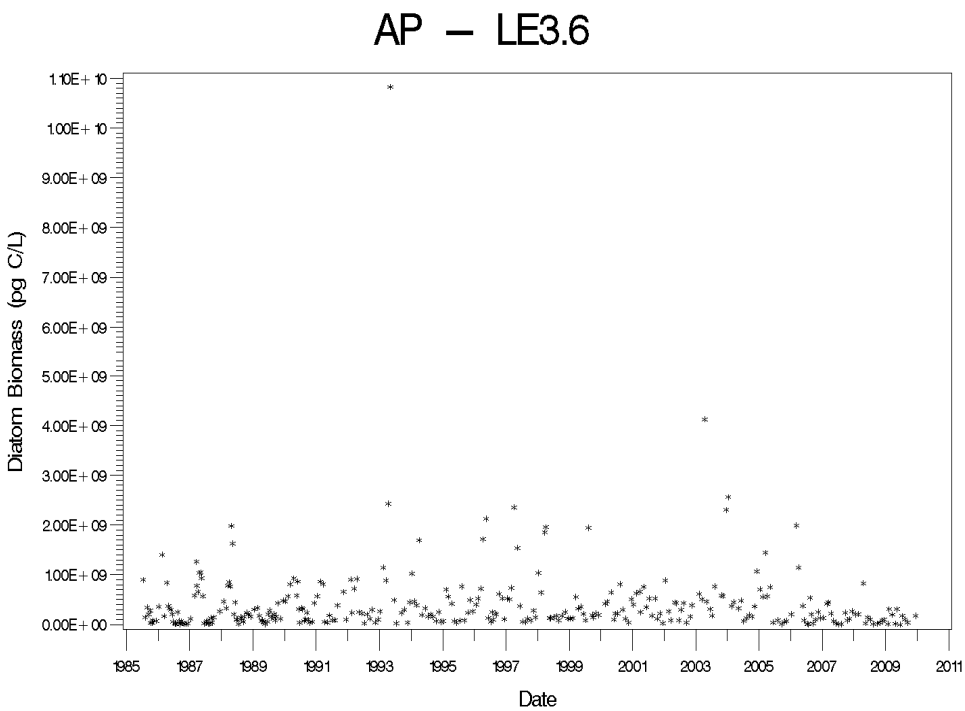


Figure 104. Plot of above pycnocline diatom biomass against time at station LE3.6 for the period of 1985 through 2009.

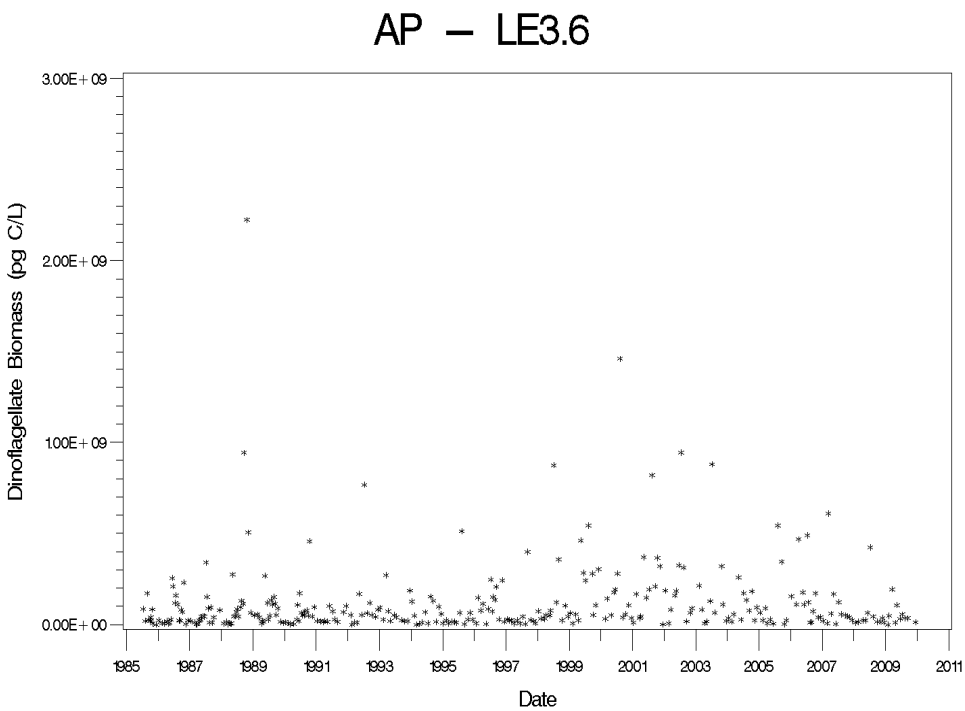


Figure 105. Plot of above pycnocline dinoflagellate biomass against time at station LE3.6 for the period of 1985 through 2009.

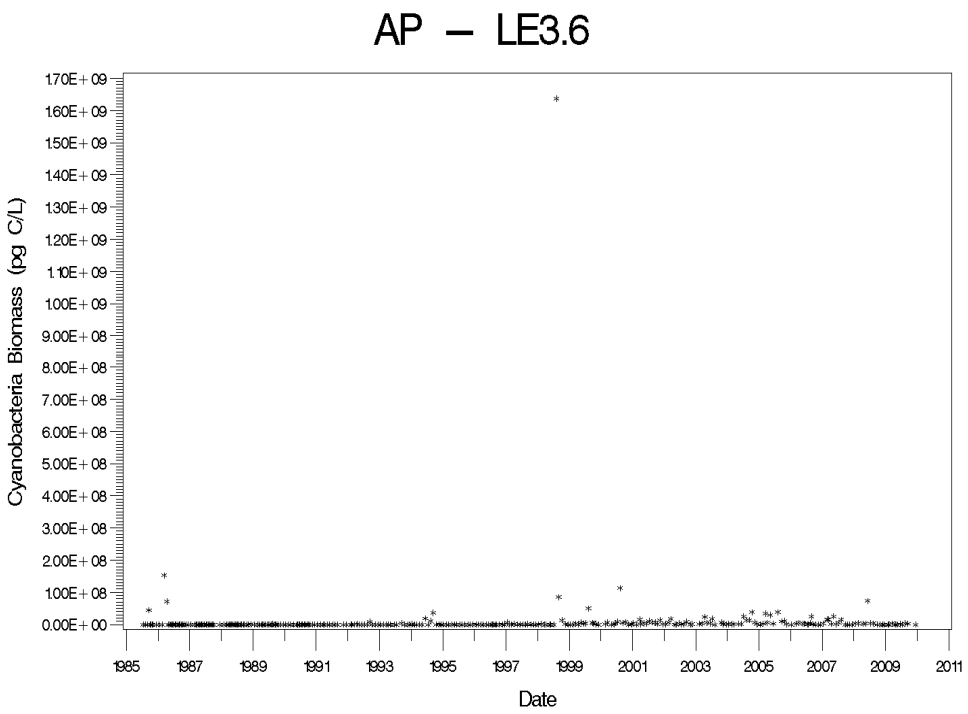


Figure 106. Plot of above pycnocline cyanobacteria biomass against time at station LE3.6 for the period of 1985 through 2009.

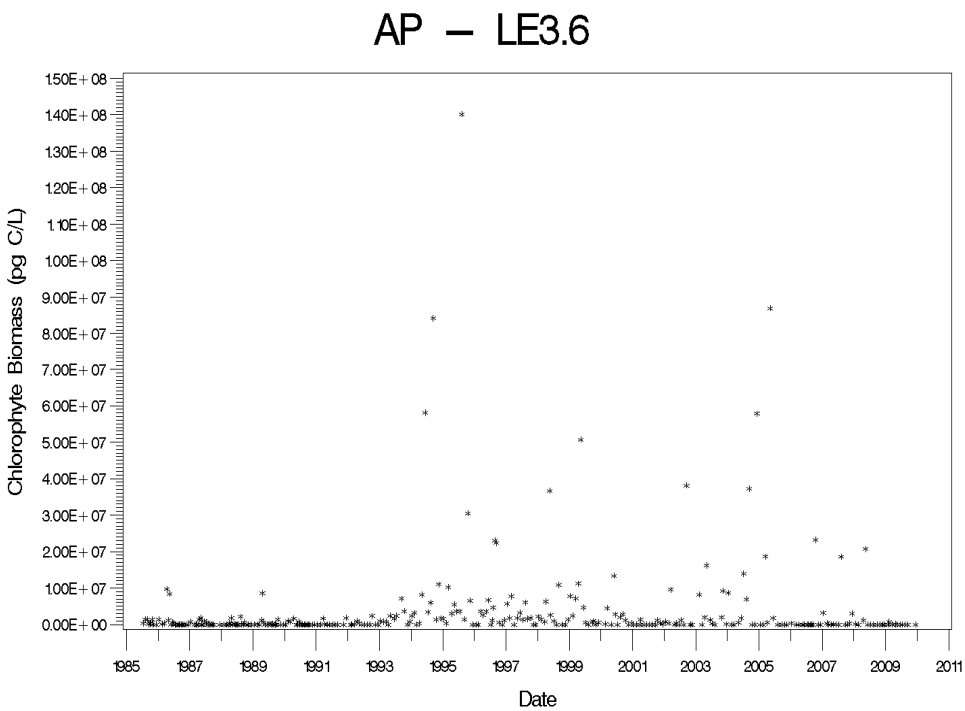


Figure 107. Plot of above pycnocline chlorophyte biomass against time at station LE3.6 for the period of 1985 through 2009.

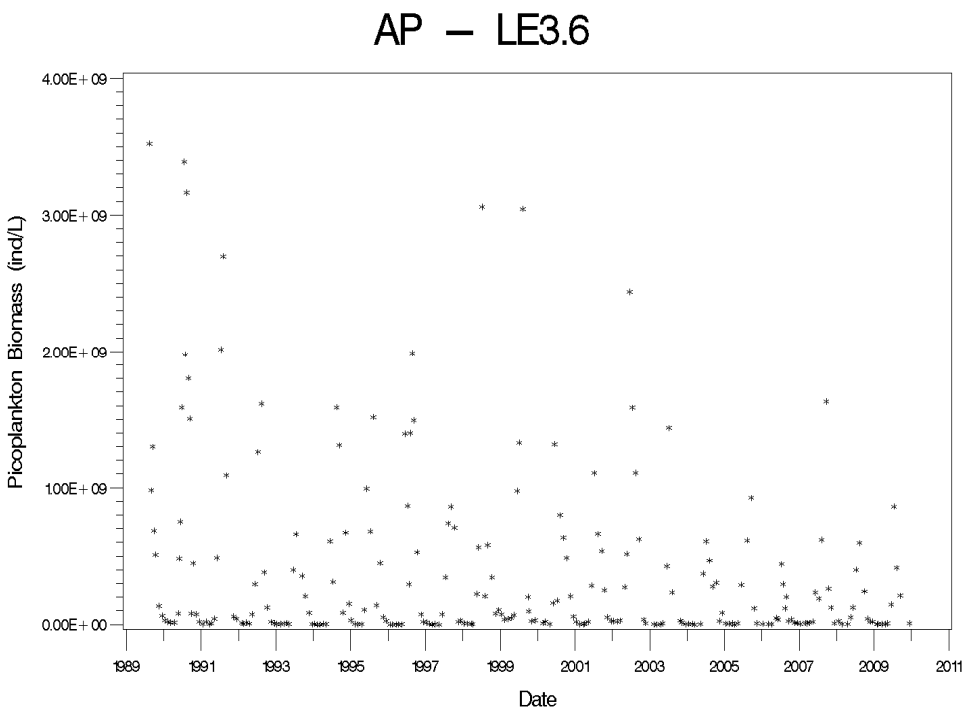


Figure 108. Plot of above pycnocline picoplankton biomass against time at station LE3.6 for the period of 1985 through 2009.

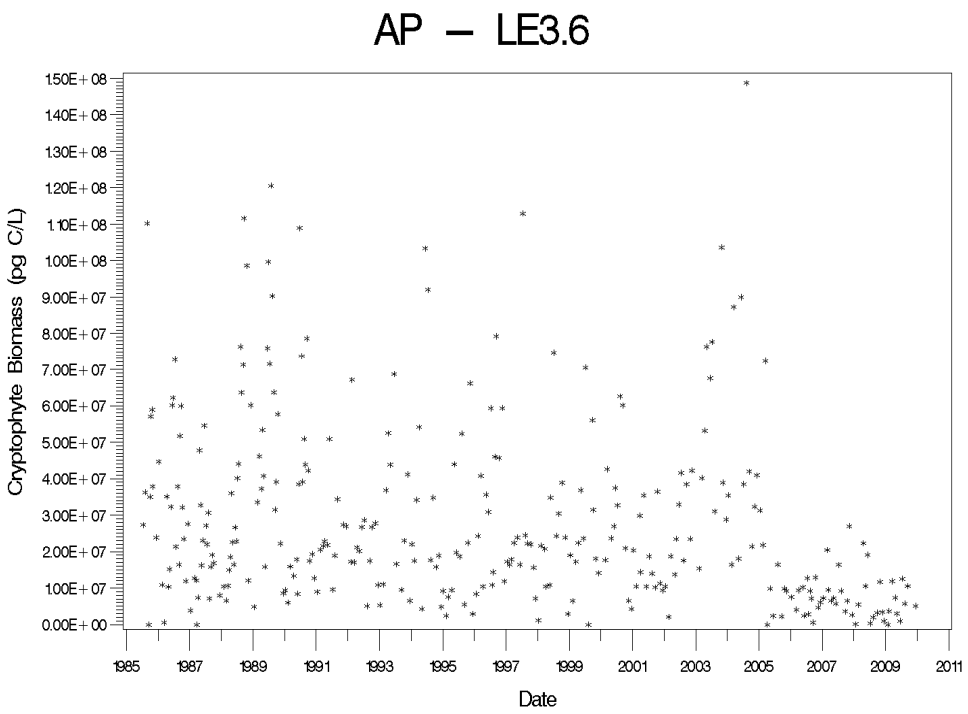


Figure 109. Plot of above pycnocline cryptophyte biomass at station LE3.6 for the period of 1985 through 2009.

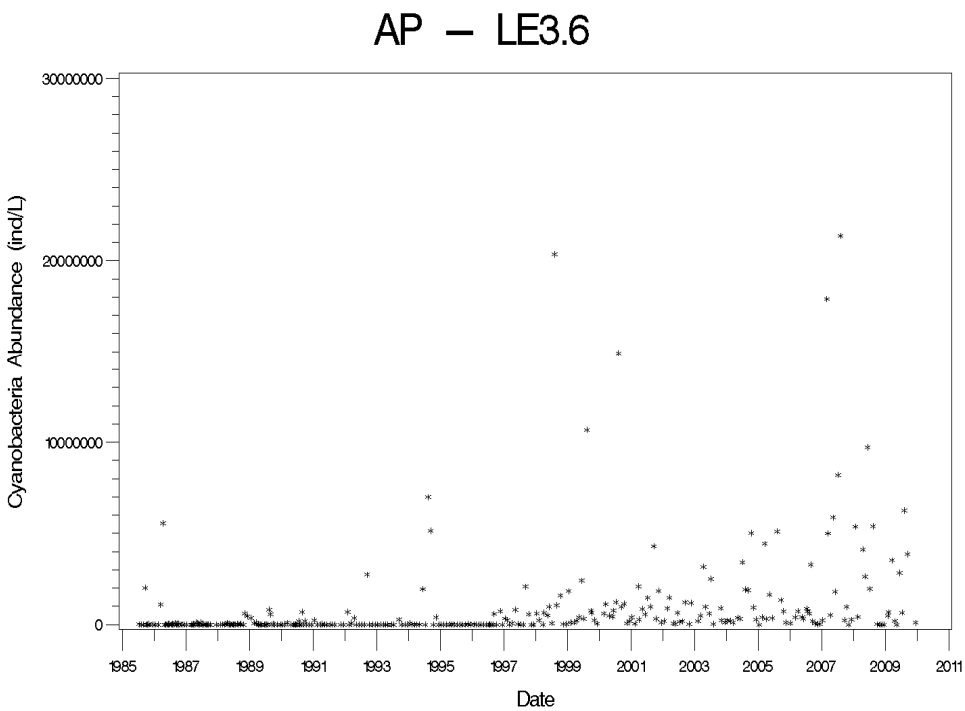


Figure 110. Plot of above pycnocline cyanophyte abundance at station LE3.6 for the period of 1985 through 2009.

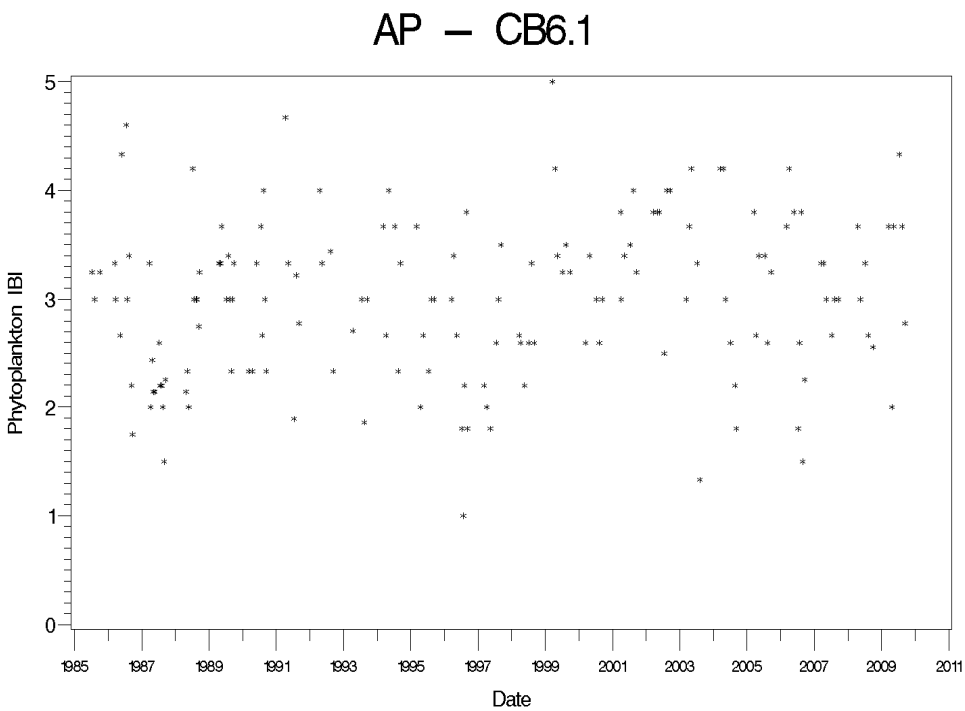


Figure 111. Plot of above pycnocline phytoplankton IBI scores against time at station CB6.1 for the period of 1985 through 2009.

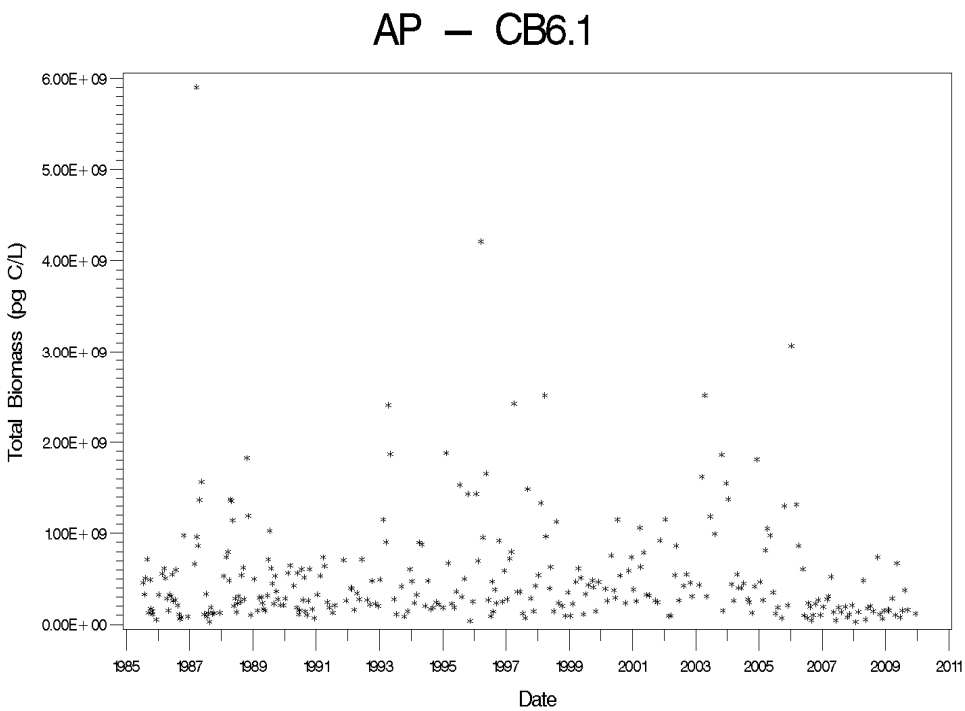


Figure 112. Plot of above pycnocline total phytoplankton biomass against time at station CB6.1 for the period of 1985 through 2009.

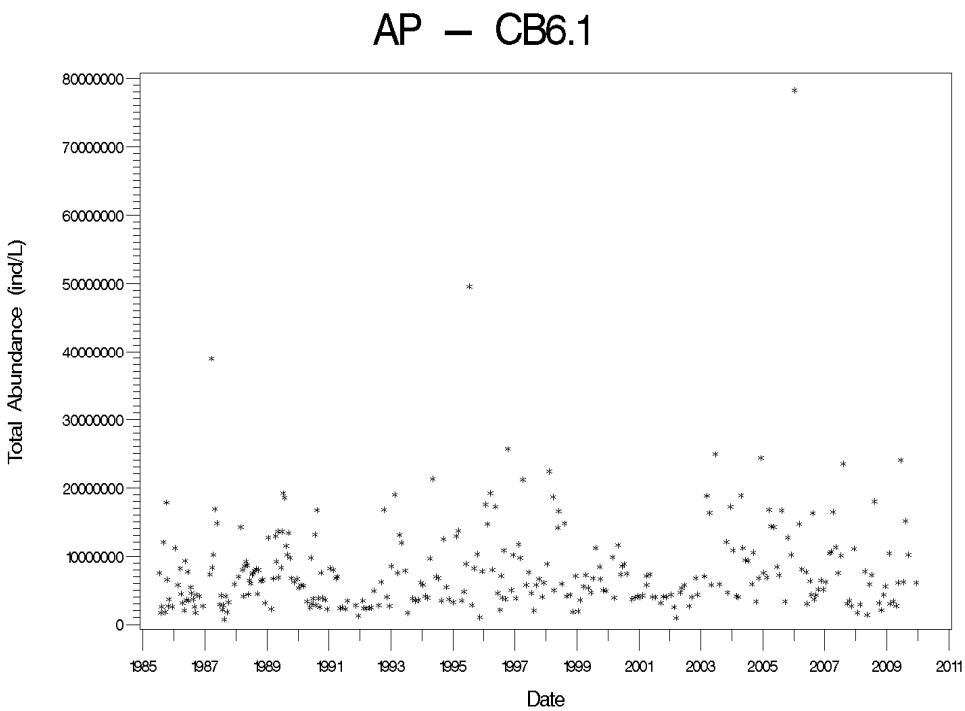


Figure 113. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB6.1 for the period of 1985 through 2009.

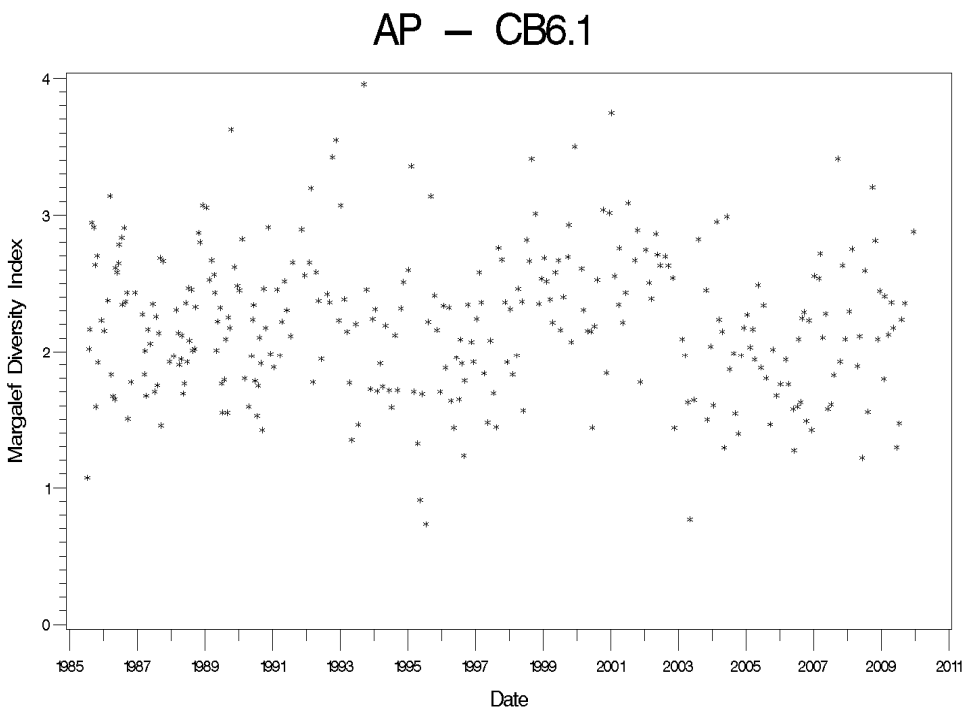


Figure 114. Plot of above pycnocline Margalef diversity index against time at station CB6.1 for the period of 1985 through 2009.

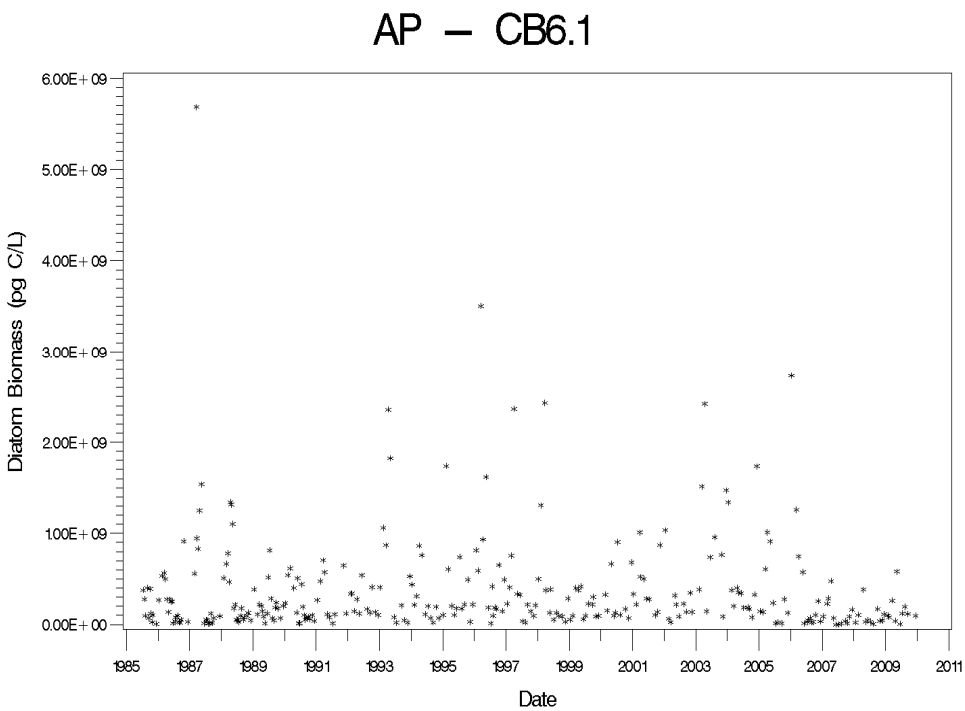


Figure 115. Plot of above pycnocline diatom biomass against time at station CB6.1 for the period of 1985 through 2009.

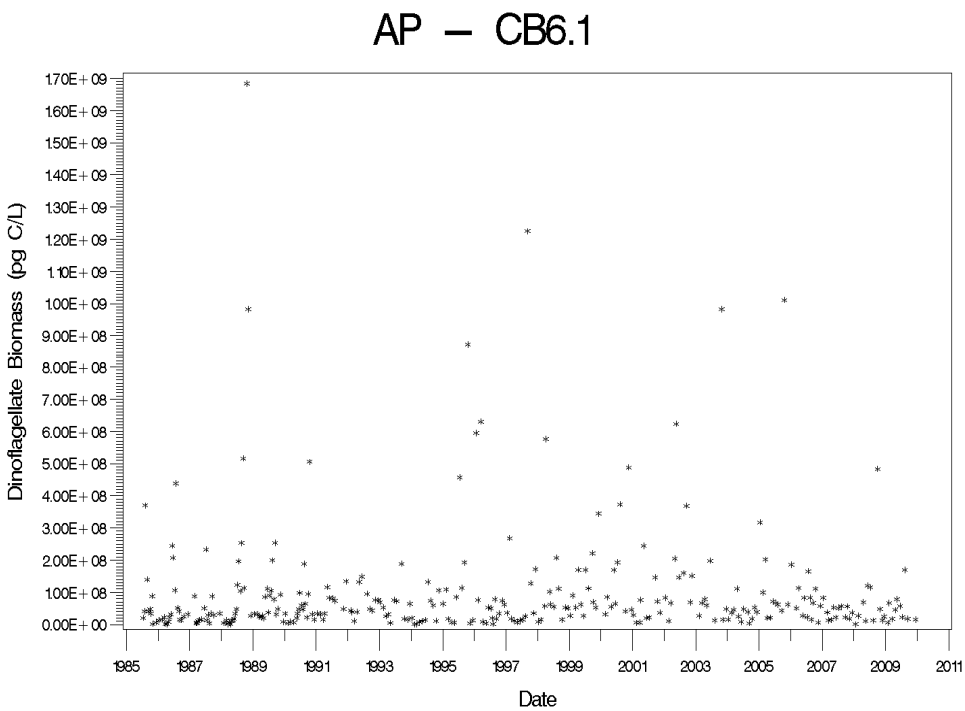


Figure 116. Plot of above pycnocline dinoflagellate biomass against time at station CB6.1 for the period of 1985 through 2009.

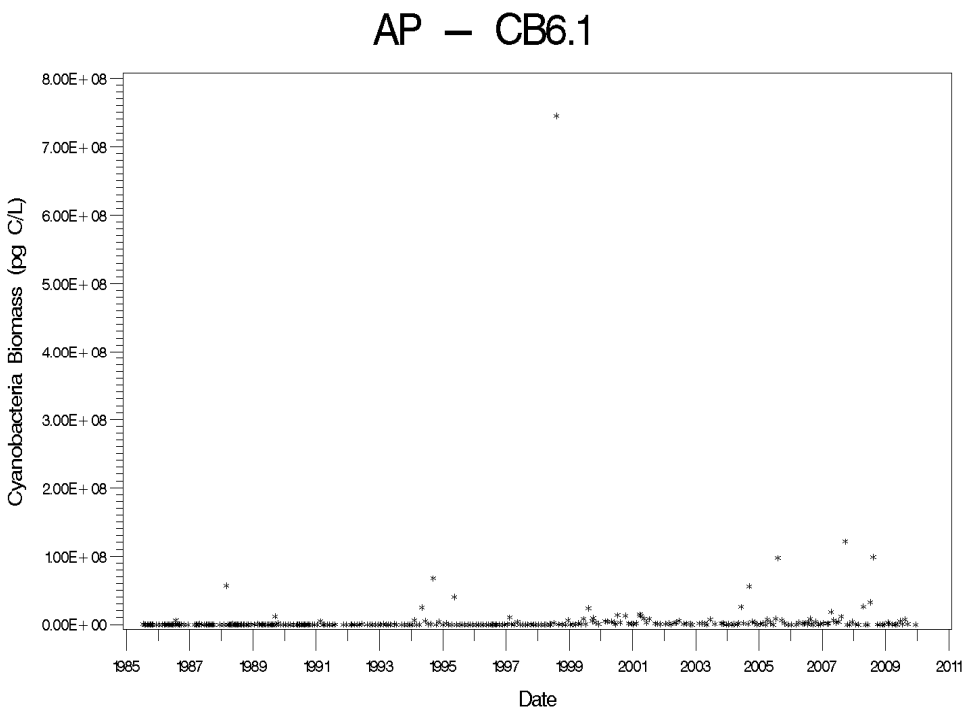


Figure 117. Plot of above pycnocline cyanobacteria biomass against time at station CB6.1 for the period of 1985 through 2009.

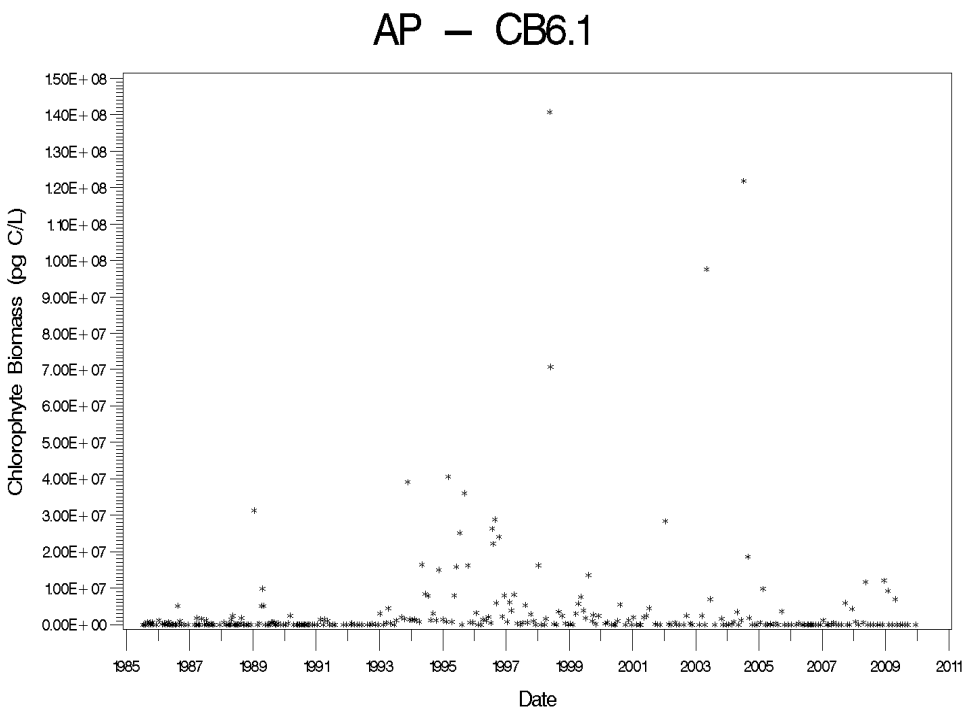


Figure 118. Plot of above pycnocline chlorophyte biomass against time at station CB6.1 for the period of 1985 through 2009.

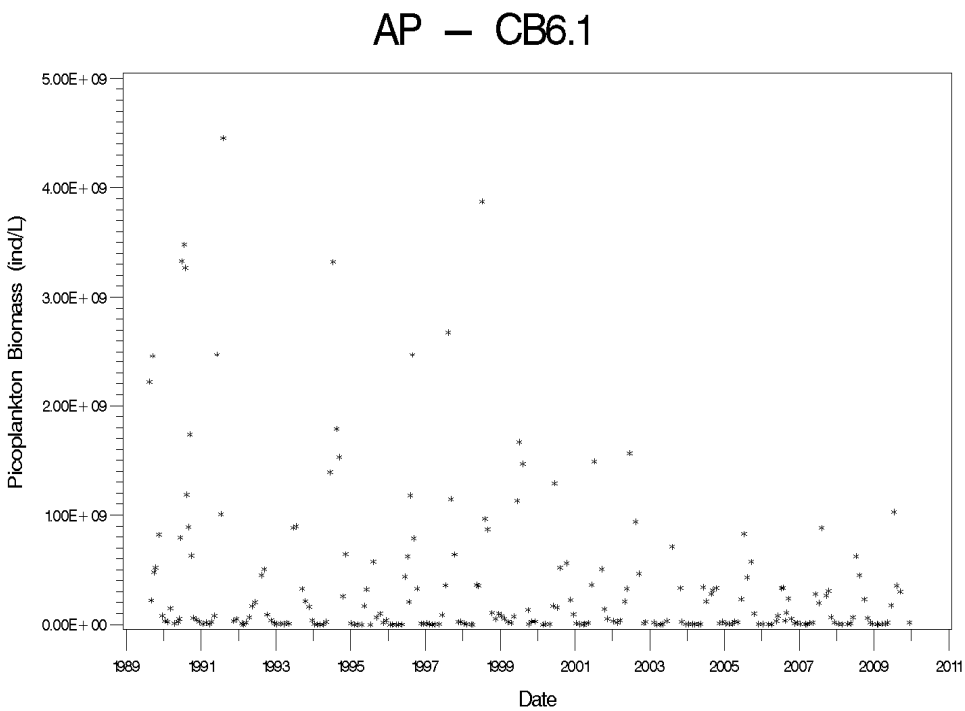


Figure 119. Plot of above pycnocline picoplankton biomass against time at station CB6.1 for the period of 1985 through 2009.

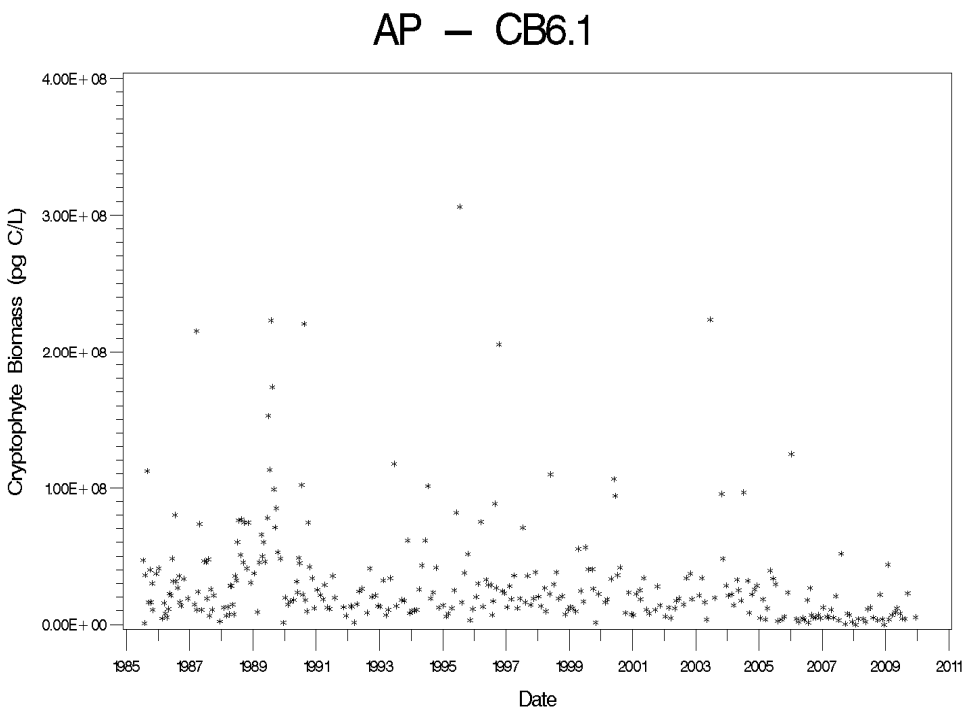


Figure 120. Plot of above pycnocline cryptophyte biomass at station CB6.1 for the period of 1985 through 2009.

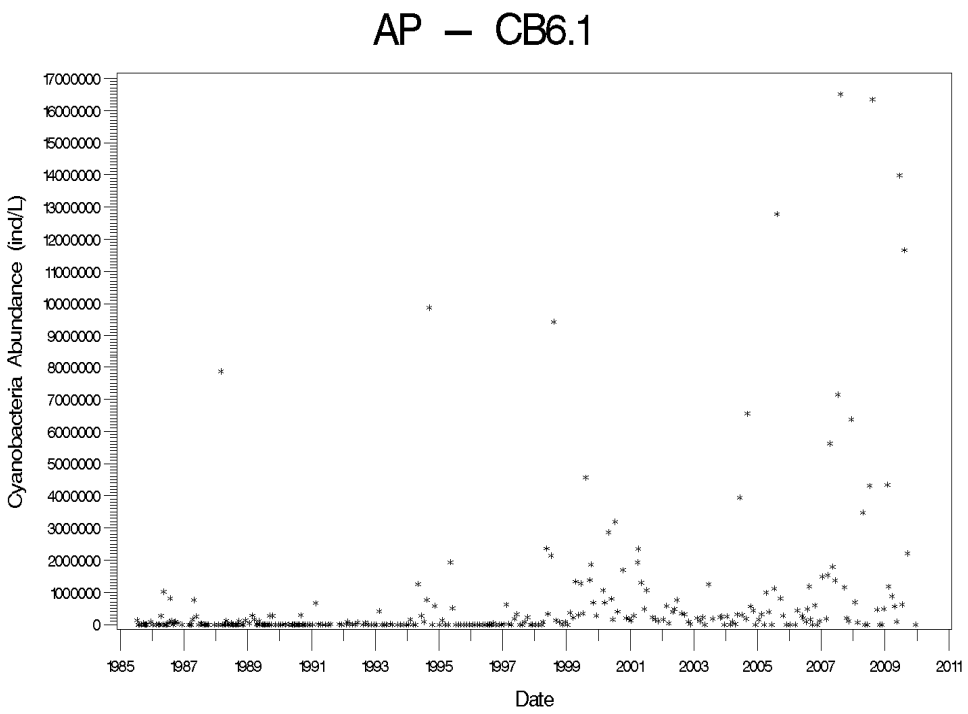


Figure 121. Plot of above pycnocline cyanophyte abundance at station CB6.1 for the period of 1985 through 2009.

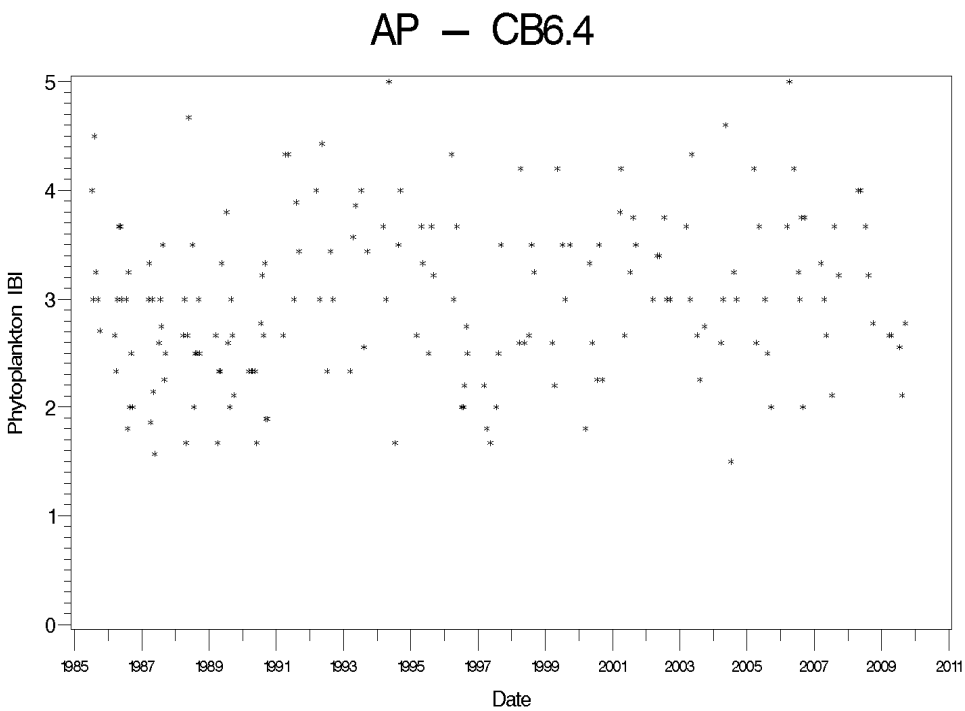


Figure 122. Plot of above pycnocline phytoplankton IBI scores against time at station CB6.4 for the period of 1985 through 2009.

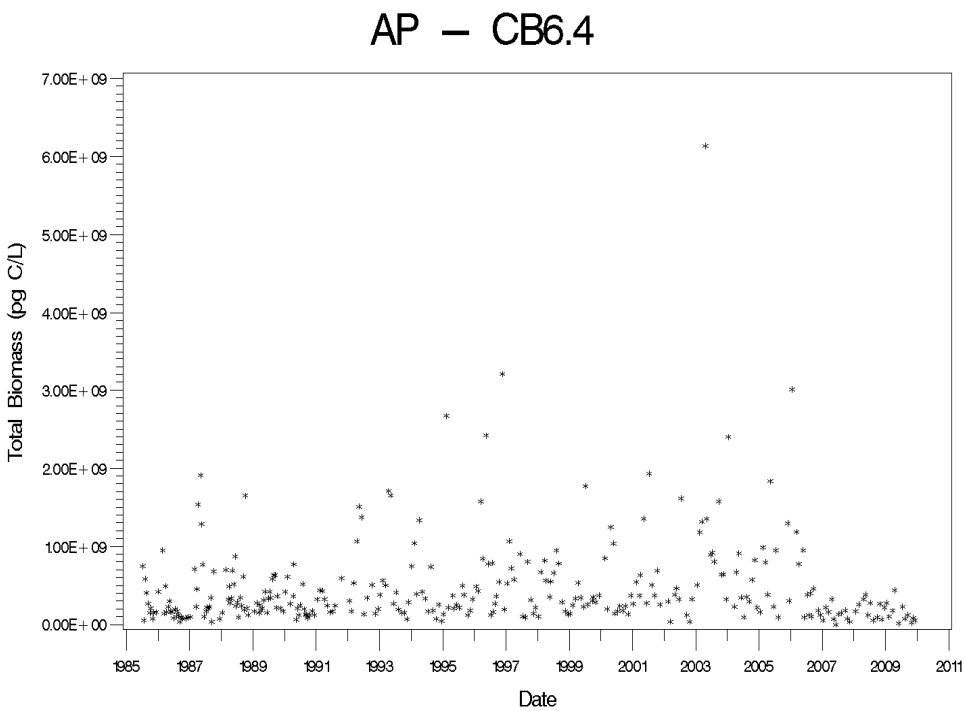


Figure 123. Plot of above pycnocline total phytoplankton biomass against time at station CB6.4 for the period of 1985 through 2009.

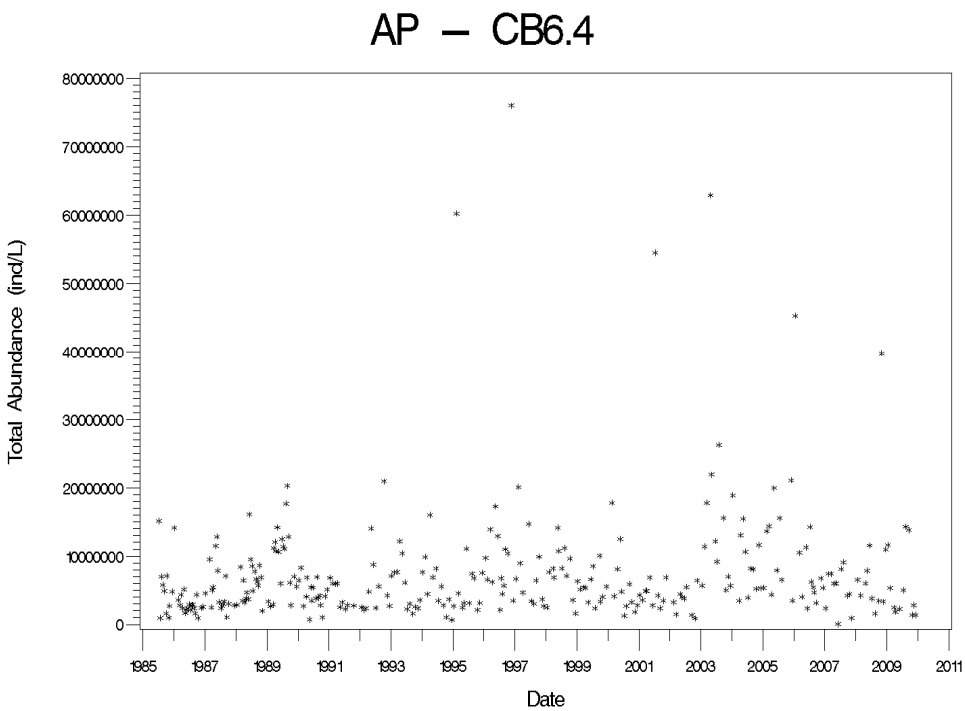


Figure 124. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB6.4 for the period of 1985 through 2009.

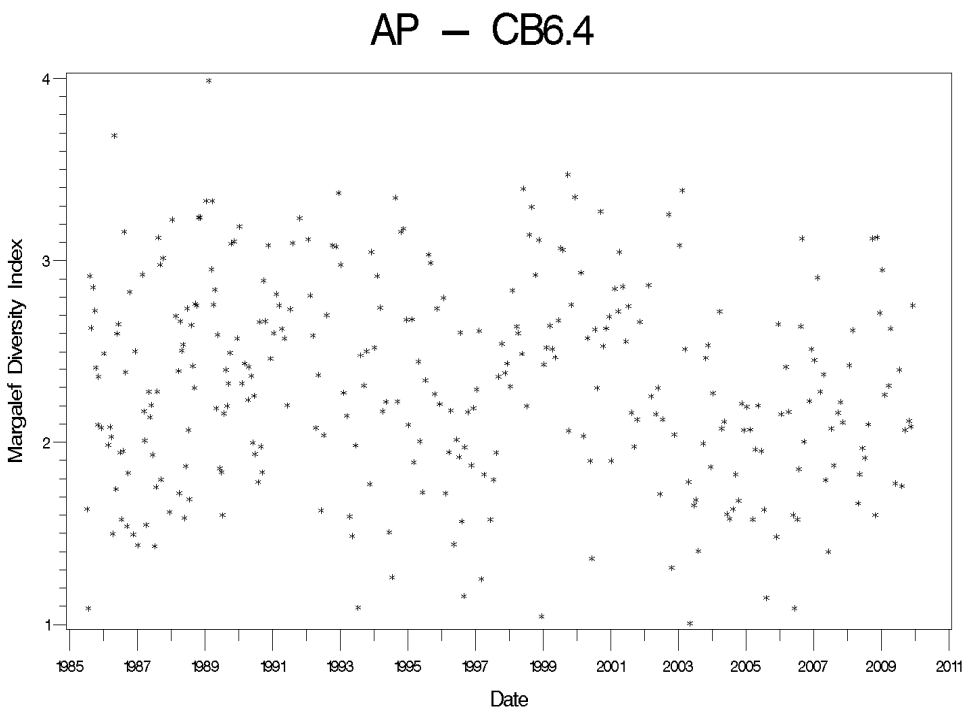


Figure 125. Plot of above pycnocline Margalef diversity index against time at station CB6.4 for the period of 1985 through 2009.

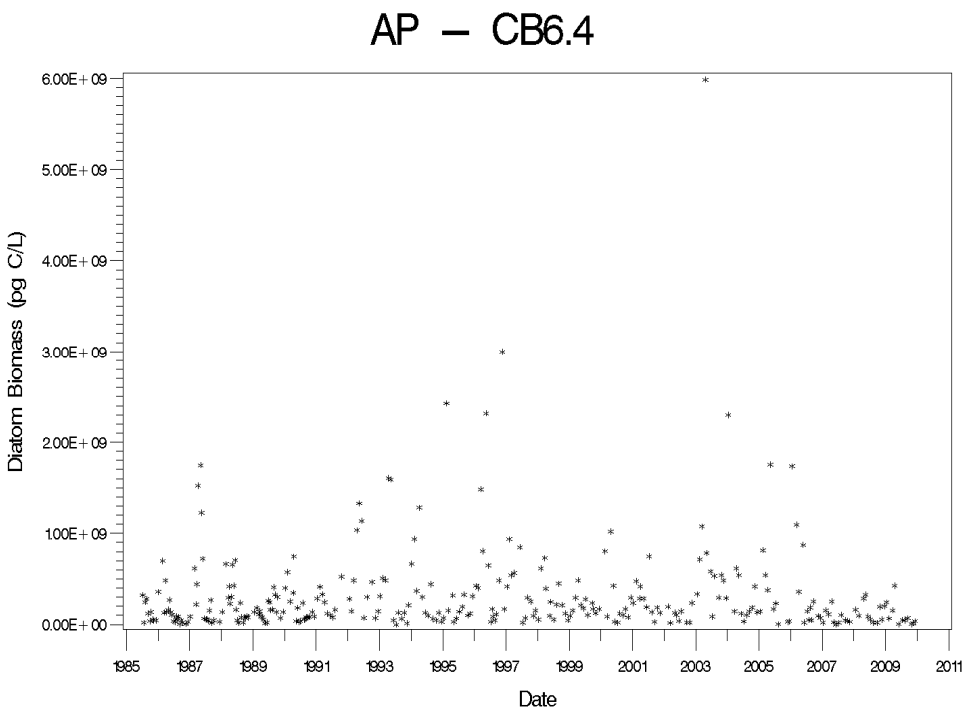


Figure 126. Plot of above pycnocline diatom biomass against time at station CB6.4 for the period of 1985 through 2009.

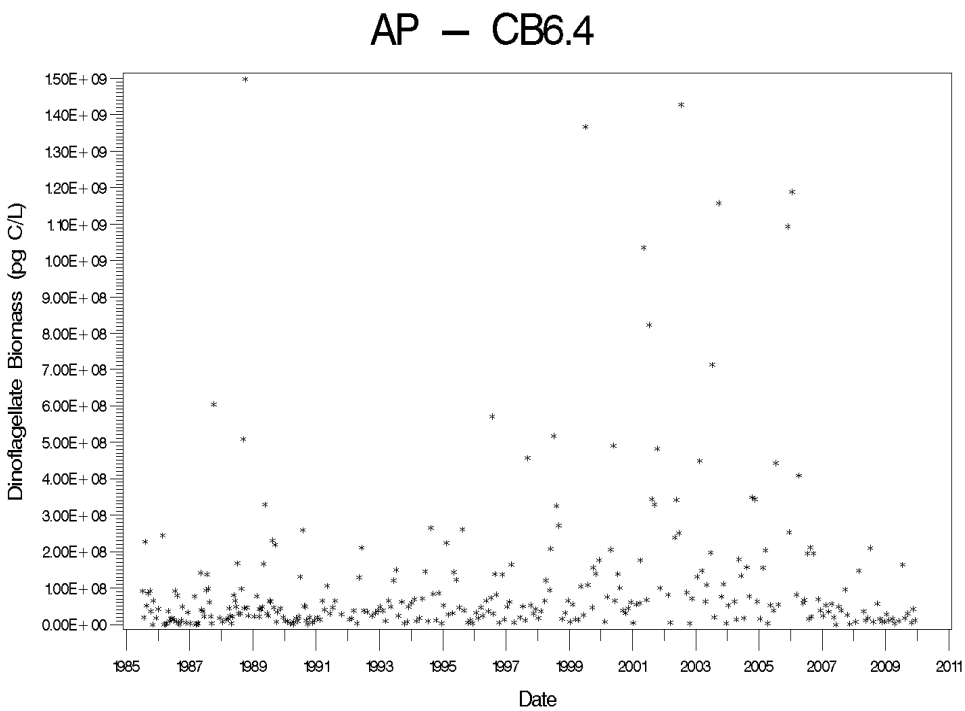


Figure 127. Plot of above pycnocline dinoflagellate biomass against time at station CB6.4 for the period of 1985 through 2009.

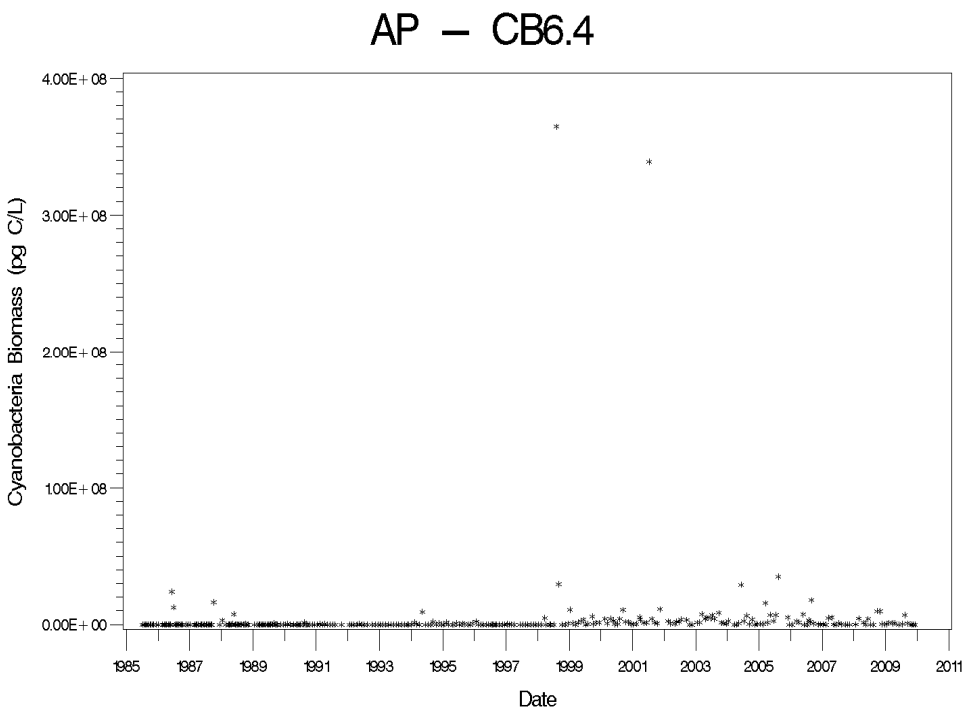


Figure 128. Plot of above pycnocline cyanobacteria biomass against time at station CB6.4 for the period of 1985 through 2009.

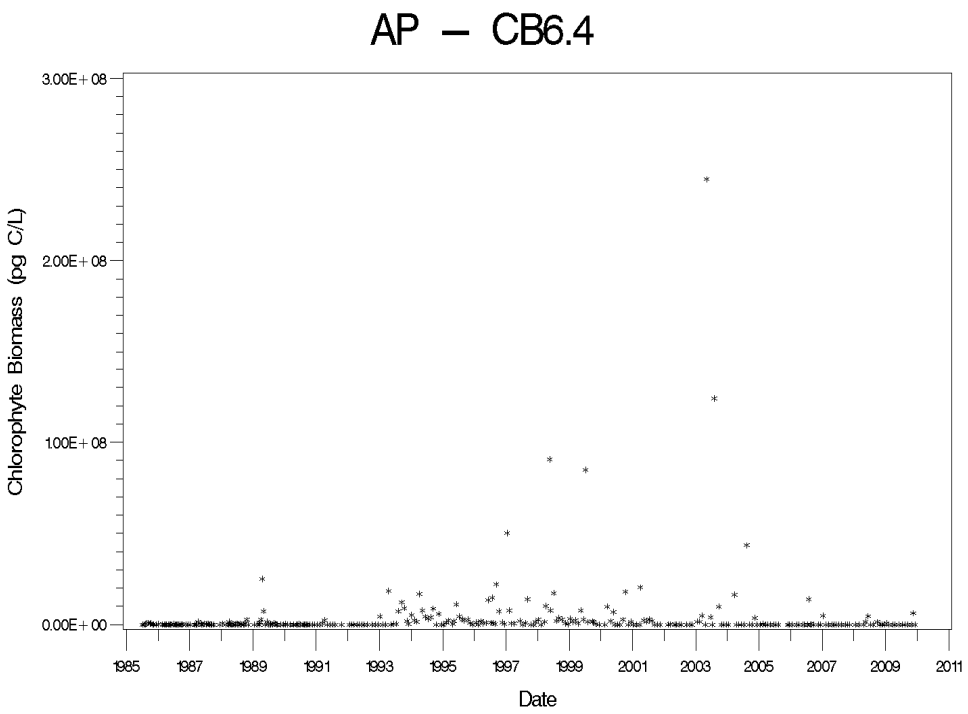


Figure 129. Plot of above pycnocline chlorophyte biomass against time at station CB6.4 for the period of 1985 through 2009.

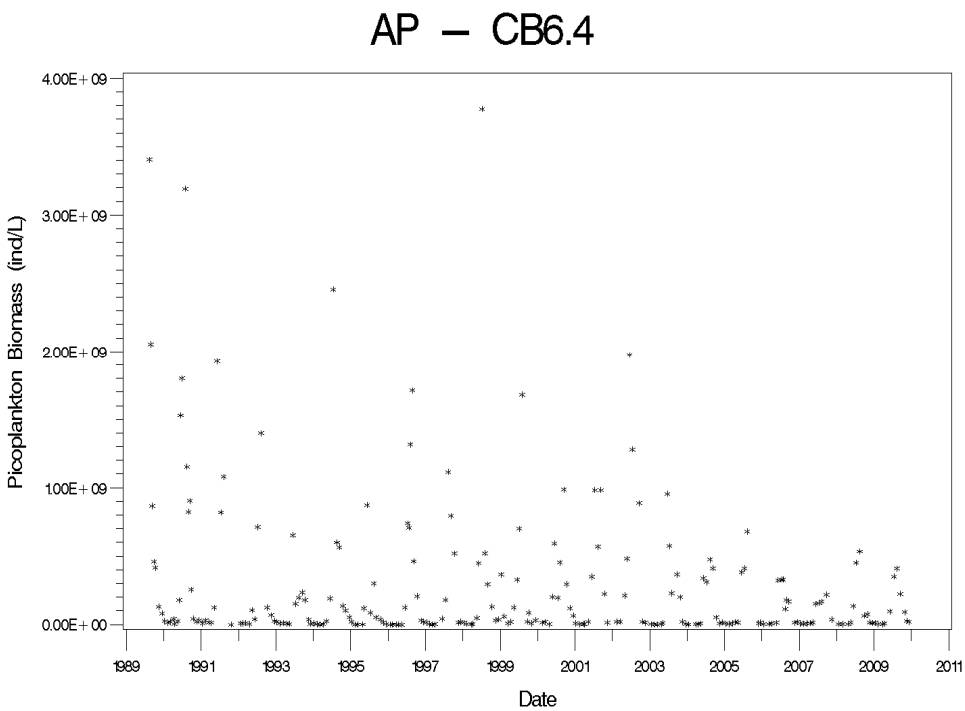


Figure 130. Plot of above pycnocline picoplankton biomass against time at station CB6.4 for the period of 1985 through 2009.

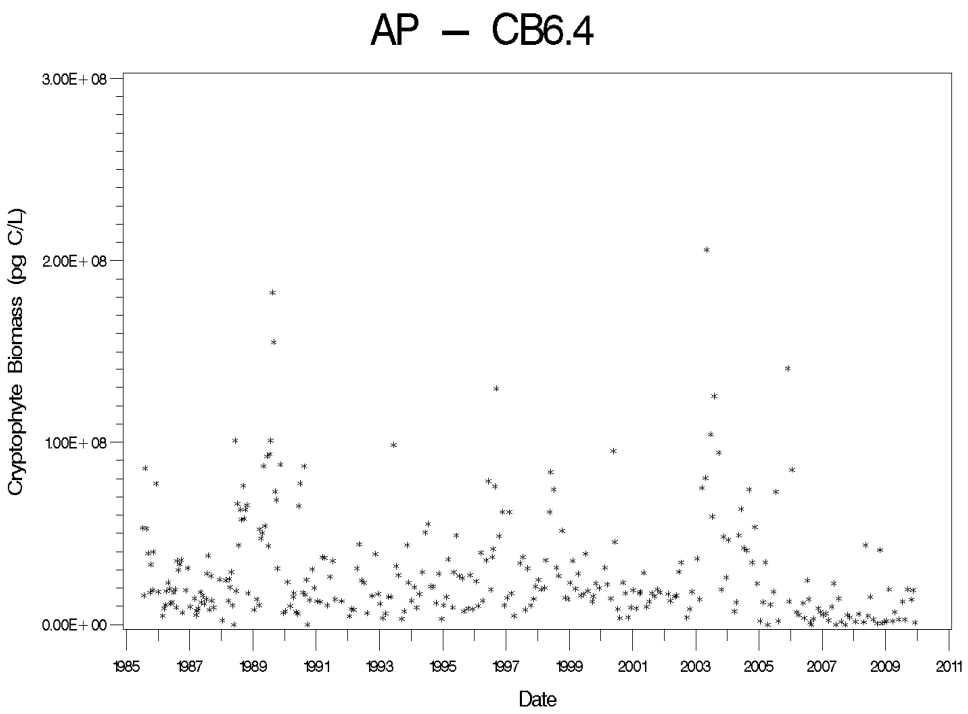


Figure 131. Plot of above pycnocline cryptophyte biomass at station CB6.4 for the period of 1985 through 2009.

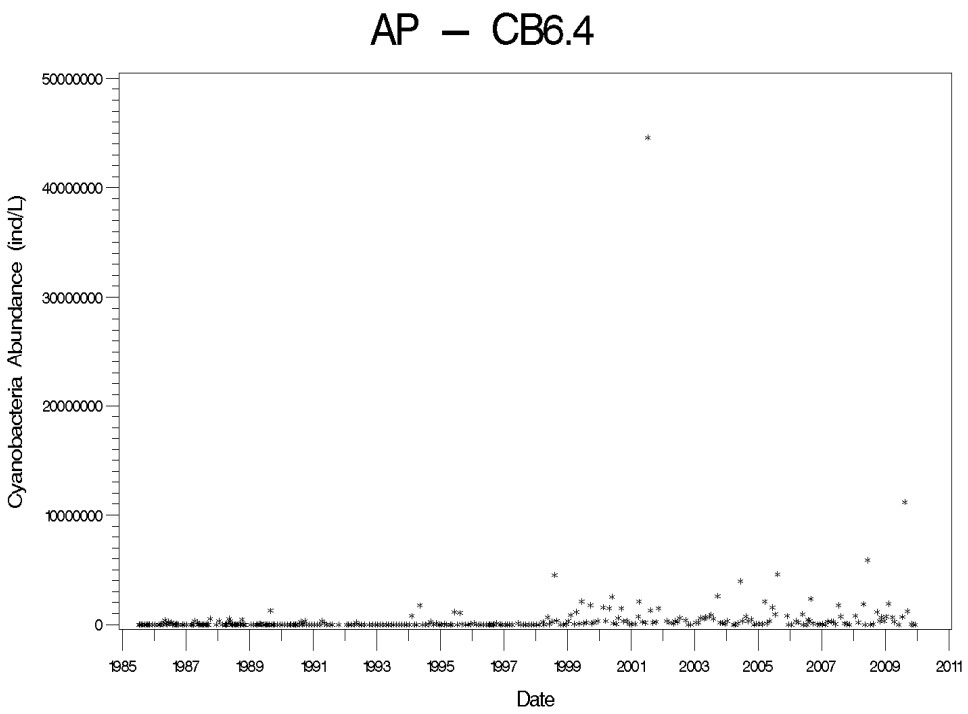


Figure 132. Plot of above pycnocline cyanophyte abundance at station CB6.4 for the period of 1985 through 2009.

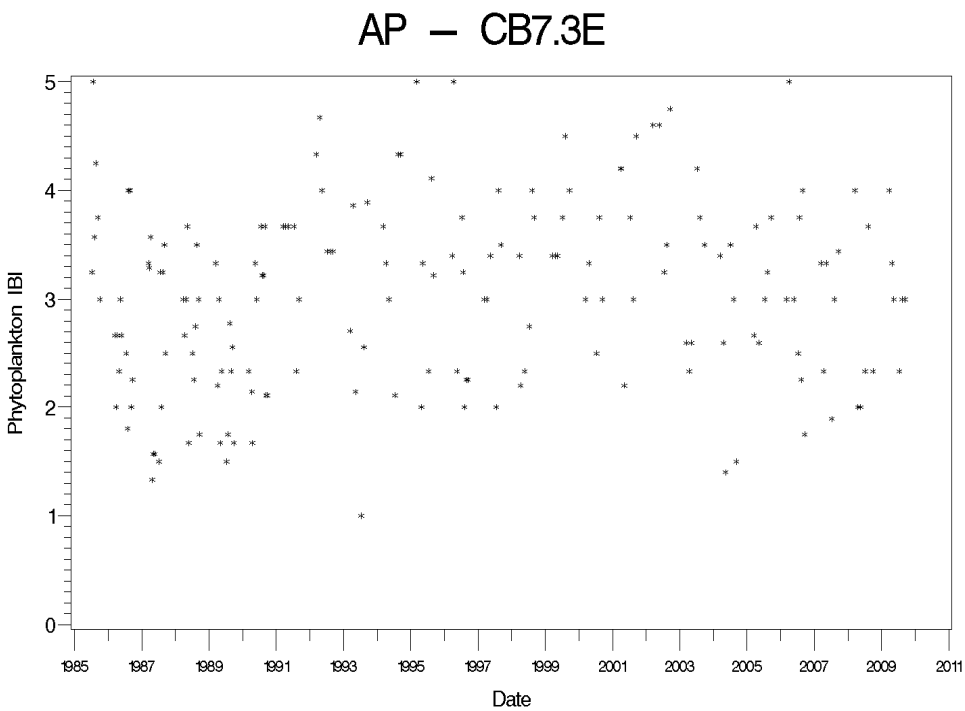


Figure 133. Plot of above pycnocline phytoplankton IBI scores against time at station CB7.3E for the period of 1985 through 2009.

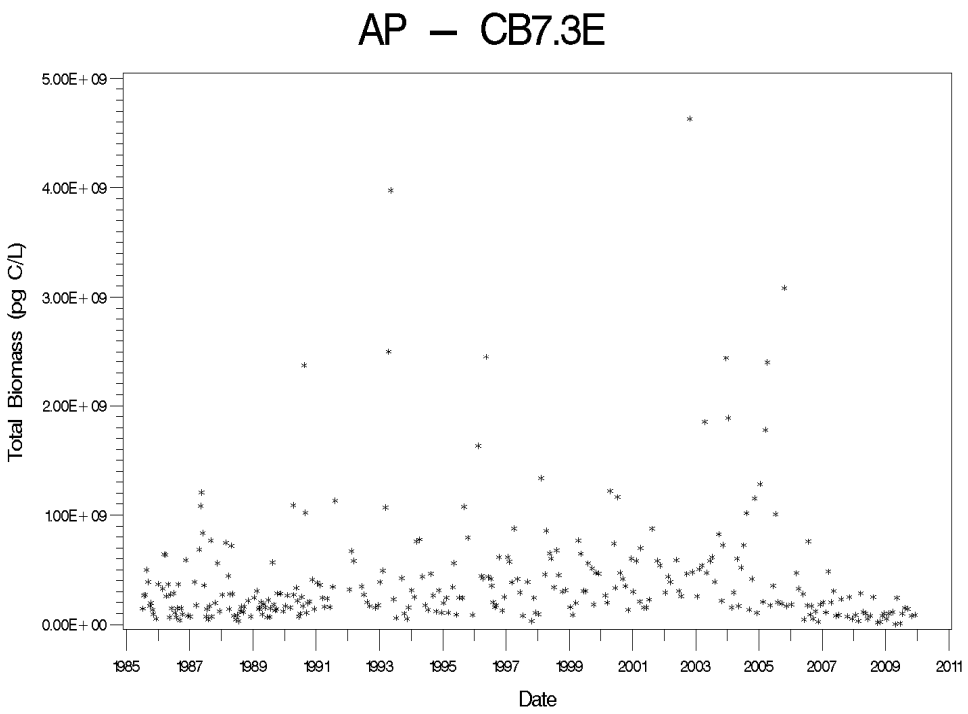


Figure 134. Plot of above pycnocline total phytoplankton biomass against time at station CB7.3E for the period of 1985 through 2009.

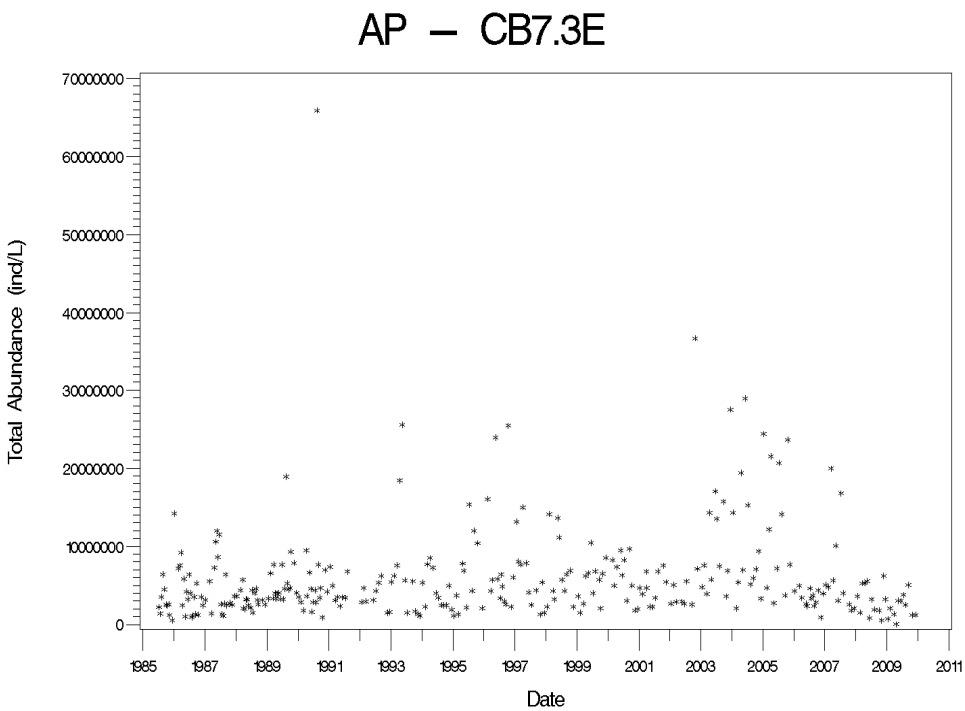


Figure 135. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB7.3E for the period of 1985 through 2009.

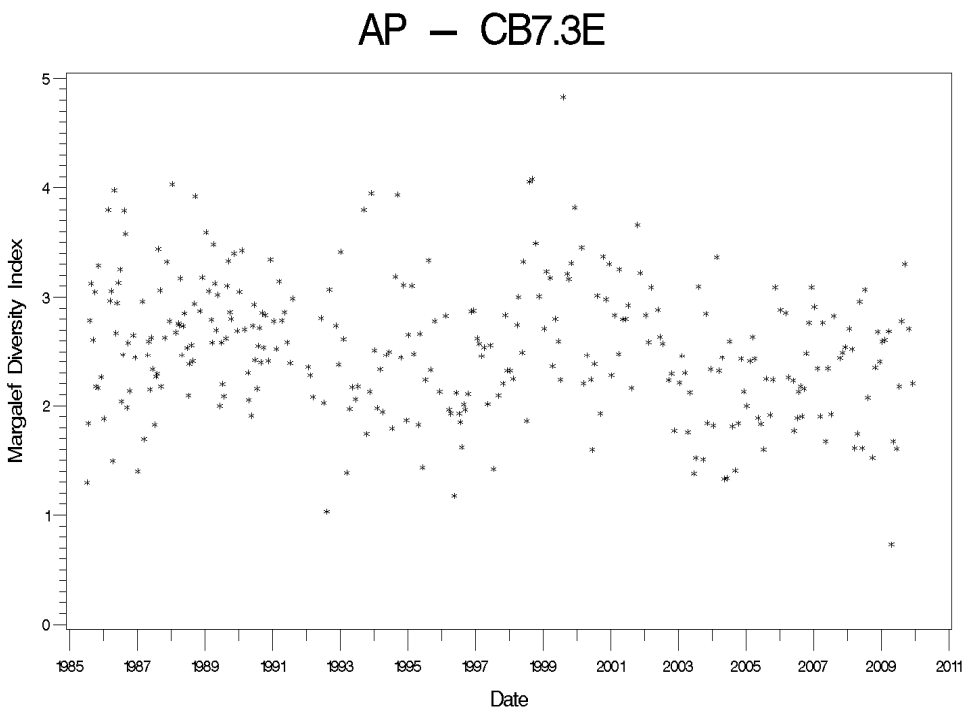


Figure 136. Plot of above pycnocline Margalef diversity index against time at station CB7.3E for the period of 1985 through 2009.

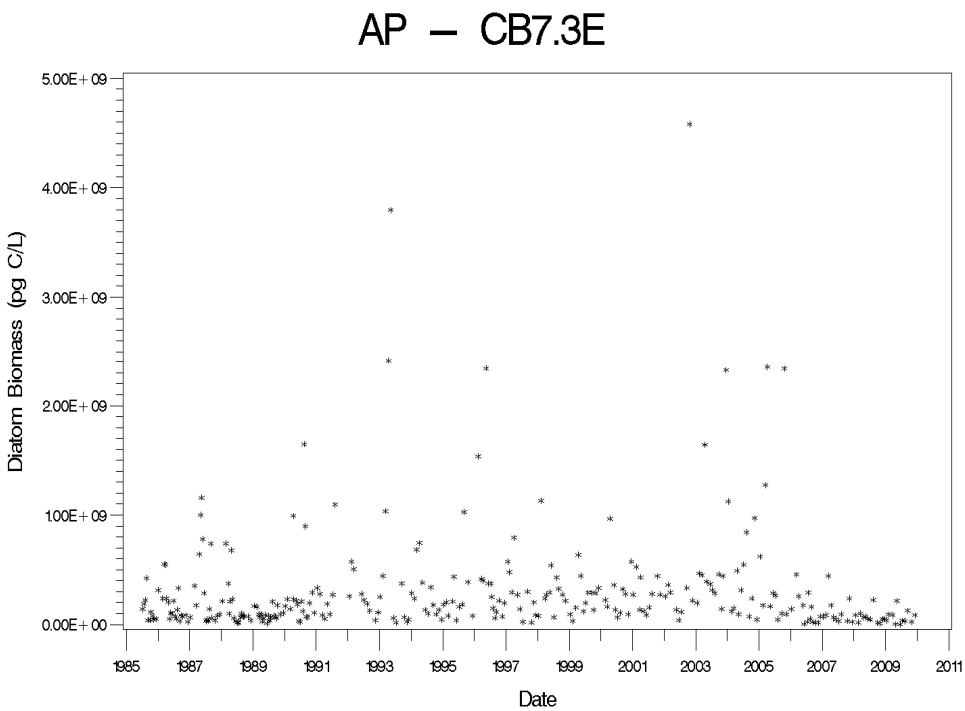


Figure 137. Plot of above pycnocline diatom biomass against time at station CB7.3E for the period of 1985 through 2009.

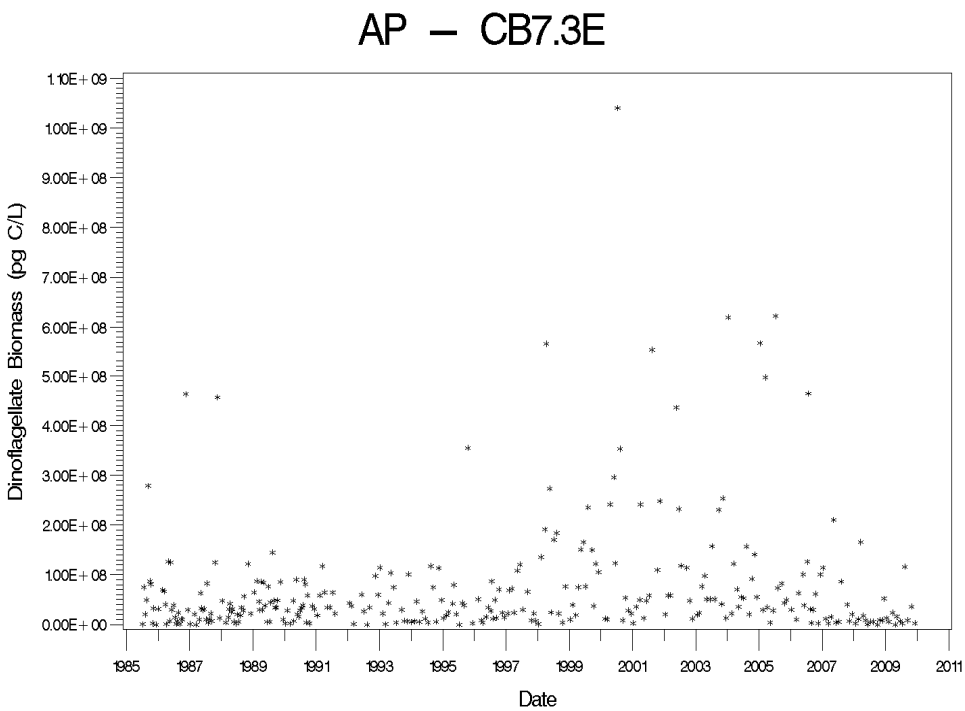


Figure 138. Plot of above pycnocline dinoflagellate biomass against time at station CB7.3E for the period of 1985 through 2009.

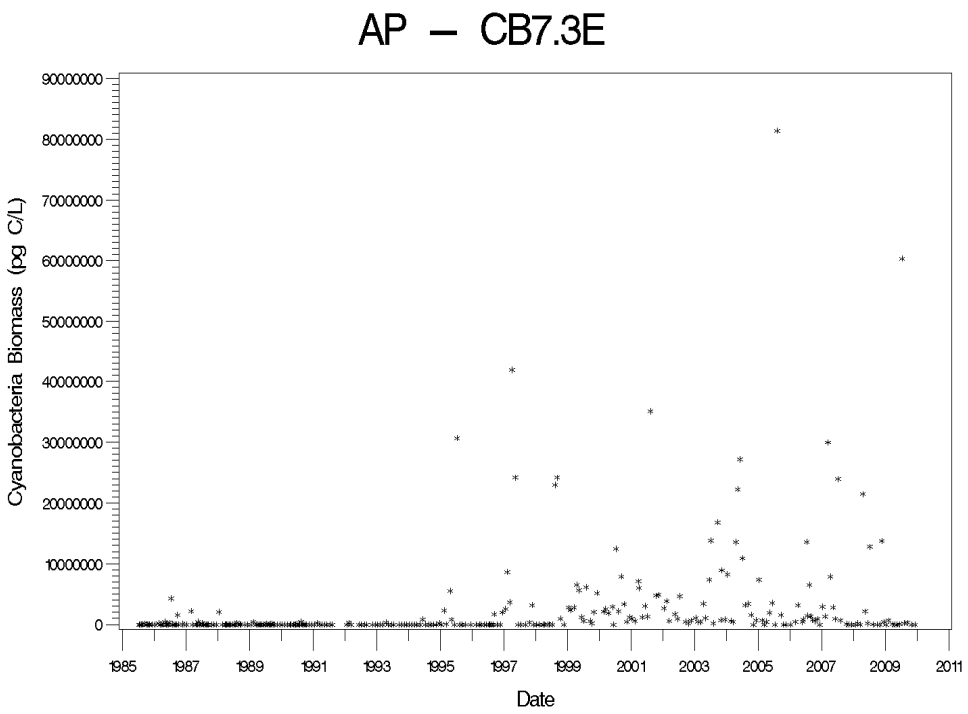


Figure 139. Plot of above pycnocline cyanobacteria biomass against time at station CB7.3E for the period of 1985 through 2009.

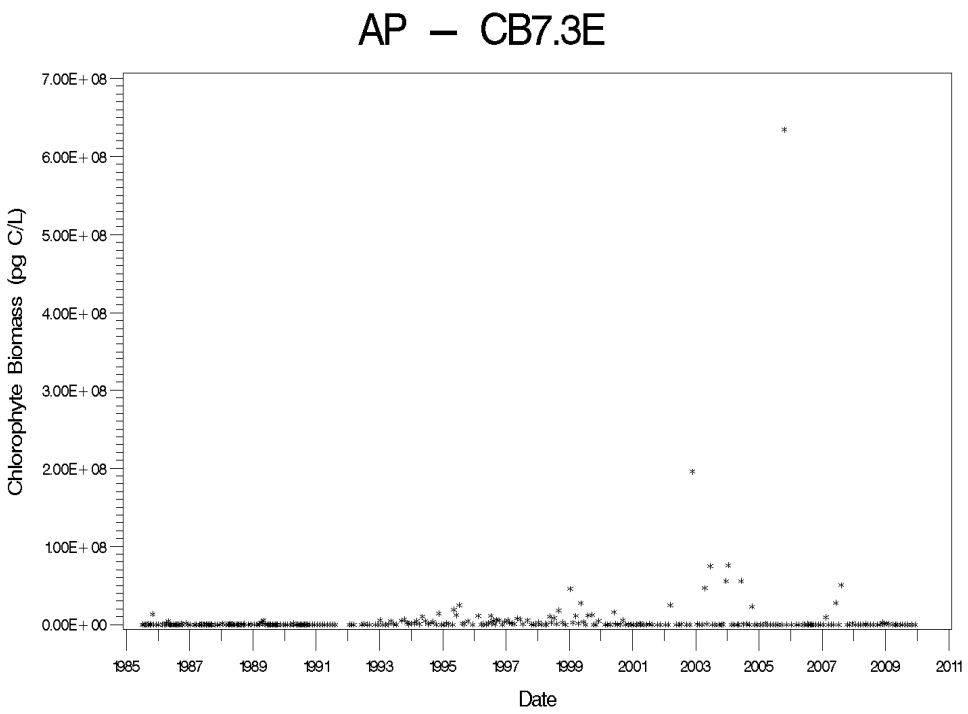


Figure 140. Plot of above pycnocline chlorophyte biomass against time at station CB7.3E for the period of 1985 through 2009.

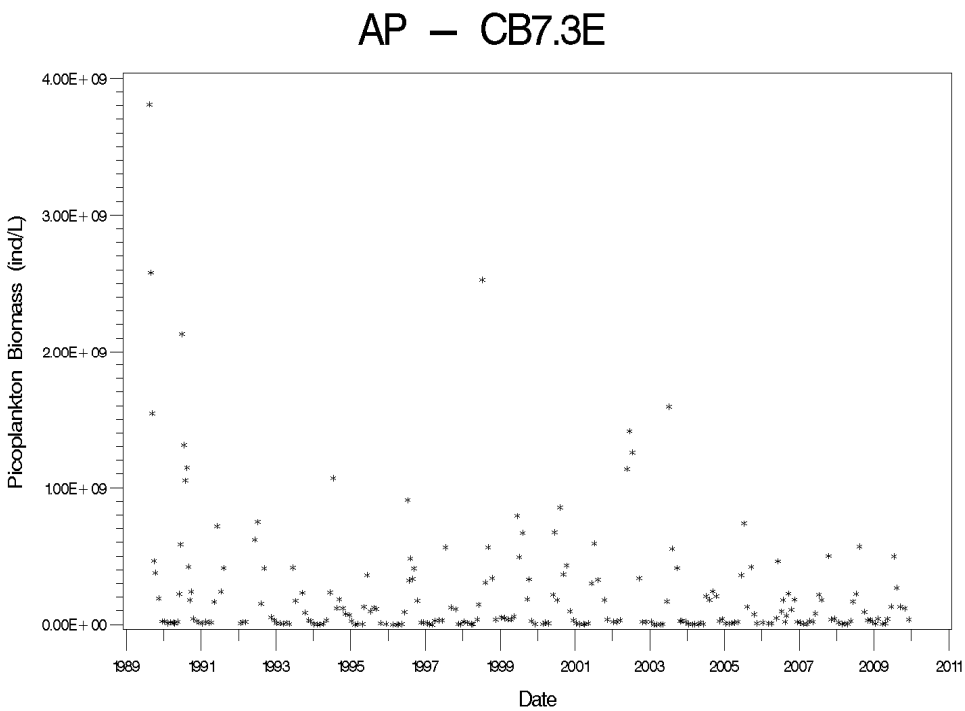


Figure 141. Plot of above pycnocline picoplankton biomass against time at station CB7.3E for the period of 1985 through 2009.

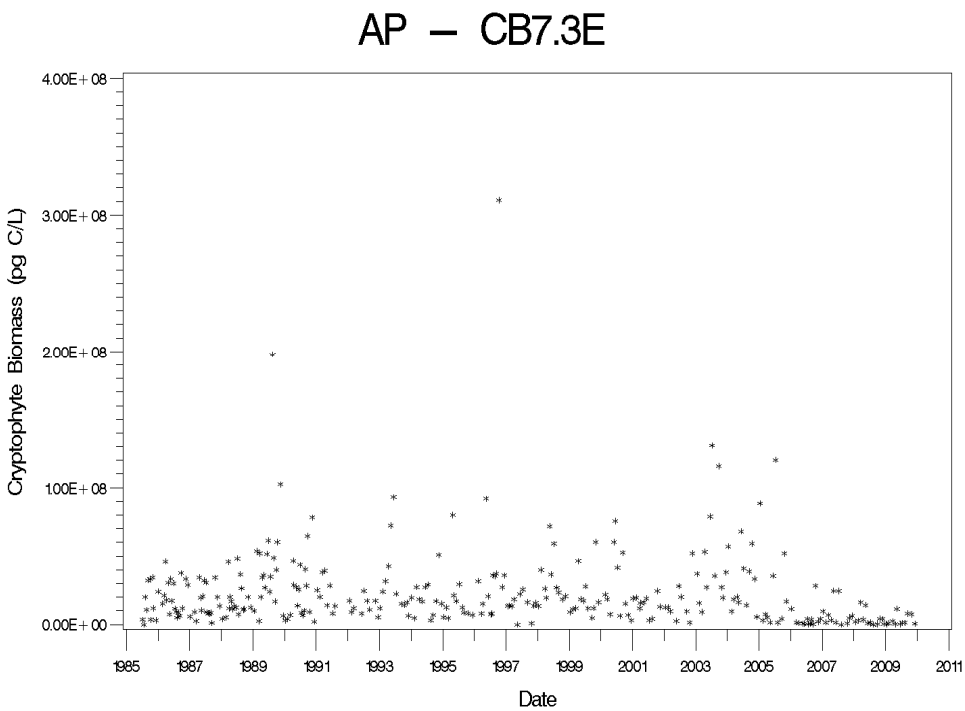


Figure 142. Plot of above pycnocline cryptophyte biomass at station CB7.3E for the period of 1985 through 2009.

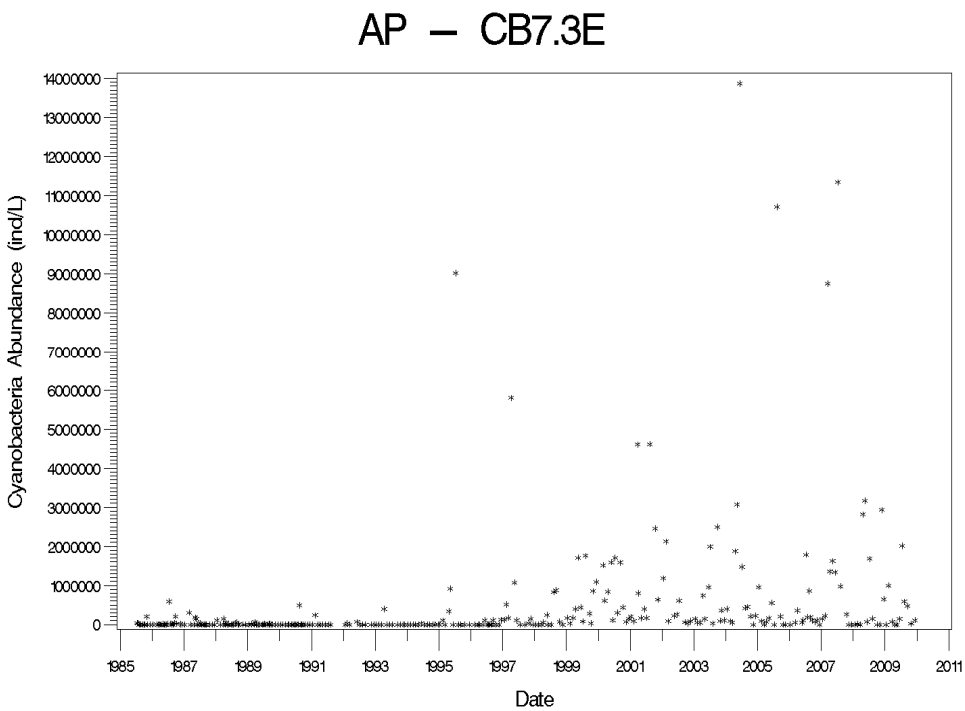


Figure 143. Plot of above pycnocline cyanophyte abundance at station CB7.3E for the period of 1985 through 2009.

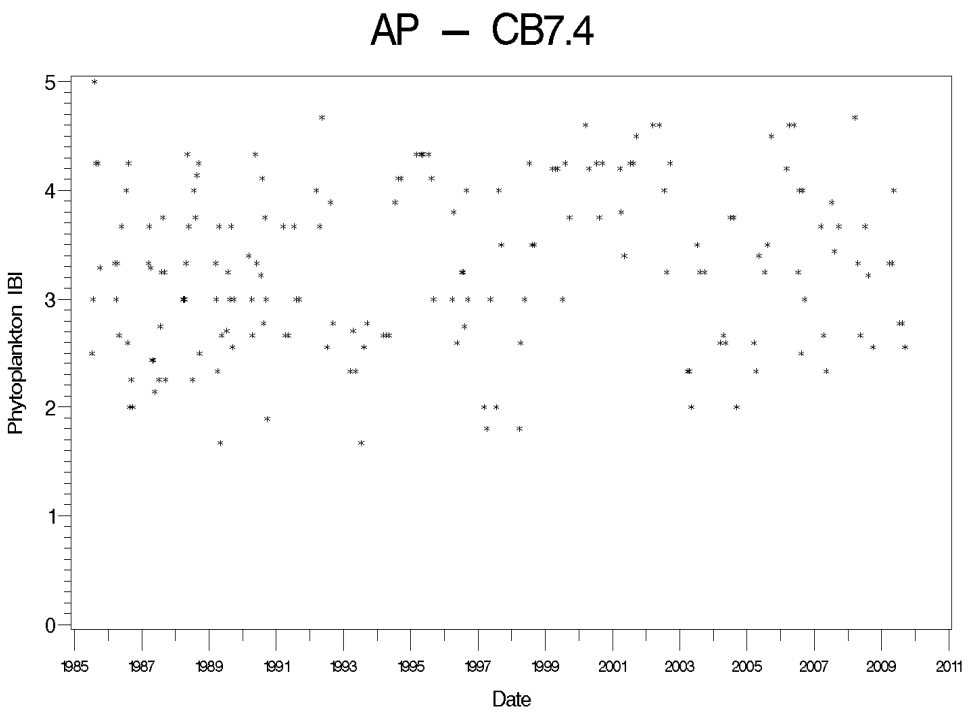


Figure 144. Plot of above pycnocline phytoplankton IBI scores against time at station CB7.4 for the period of 1985 through 2009.

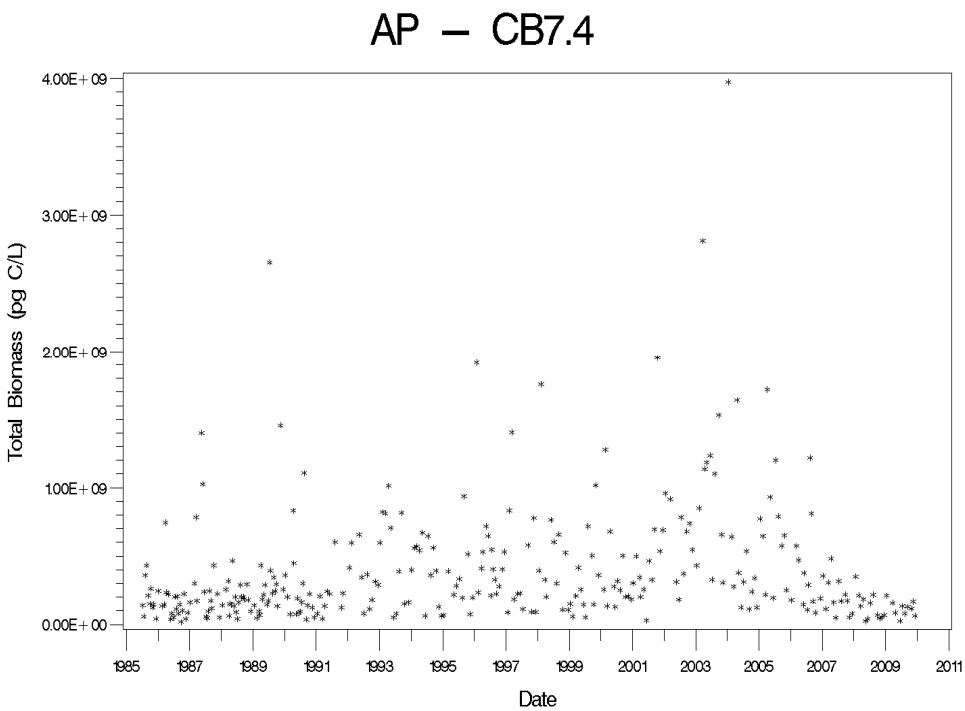


Figure 145. Plot of above pycnocline total phytoplankton biomass against time at station CB7.4 for the period of 1985 through 2009.

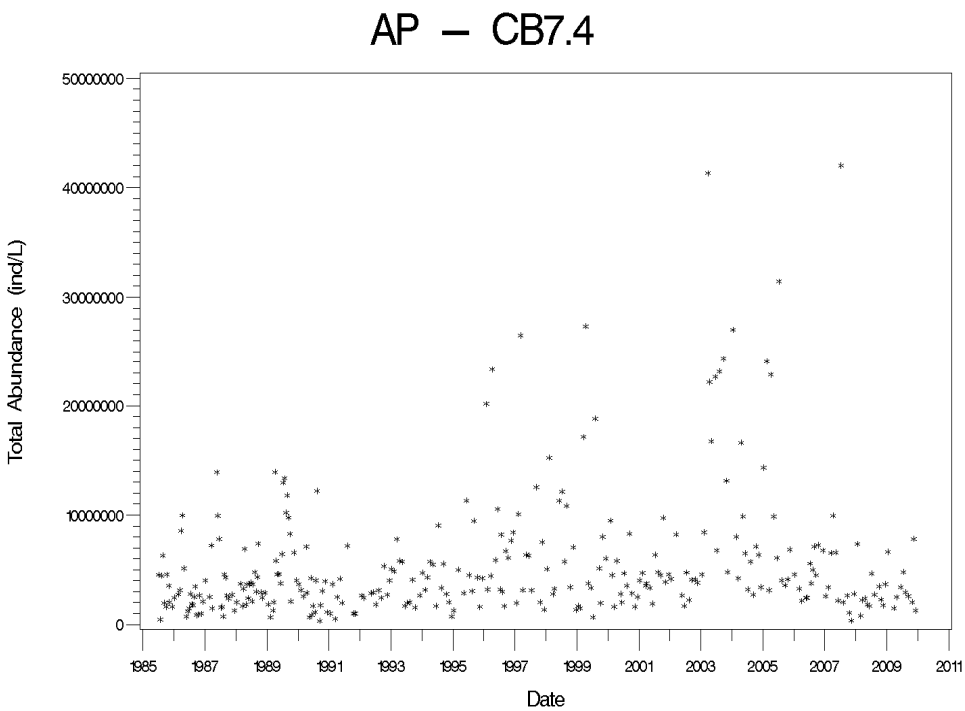


Figure 146. Plot of above pycnocline ratio of total phytoplankton biomass to total phytoplankton abundance against time at station CB7.4 for the period of 1985 through 2009.

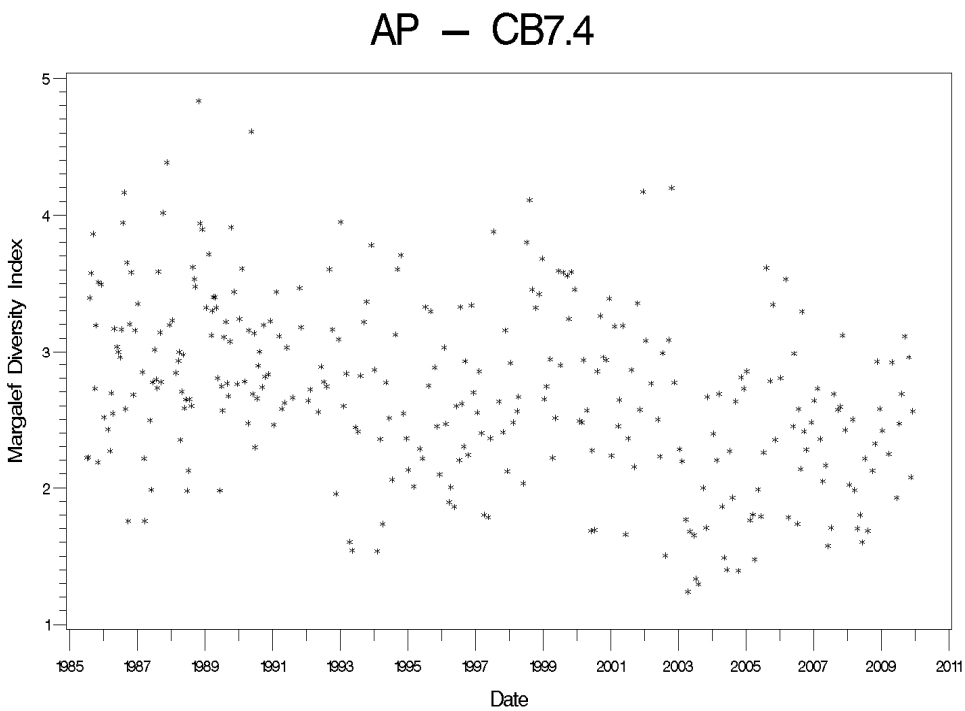


Figure 147. Plot of above pycnocline Margalef diversity index against time at station CB7.4 for the period of 1985 through 2009.

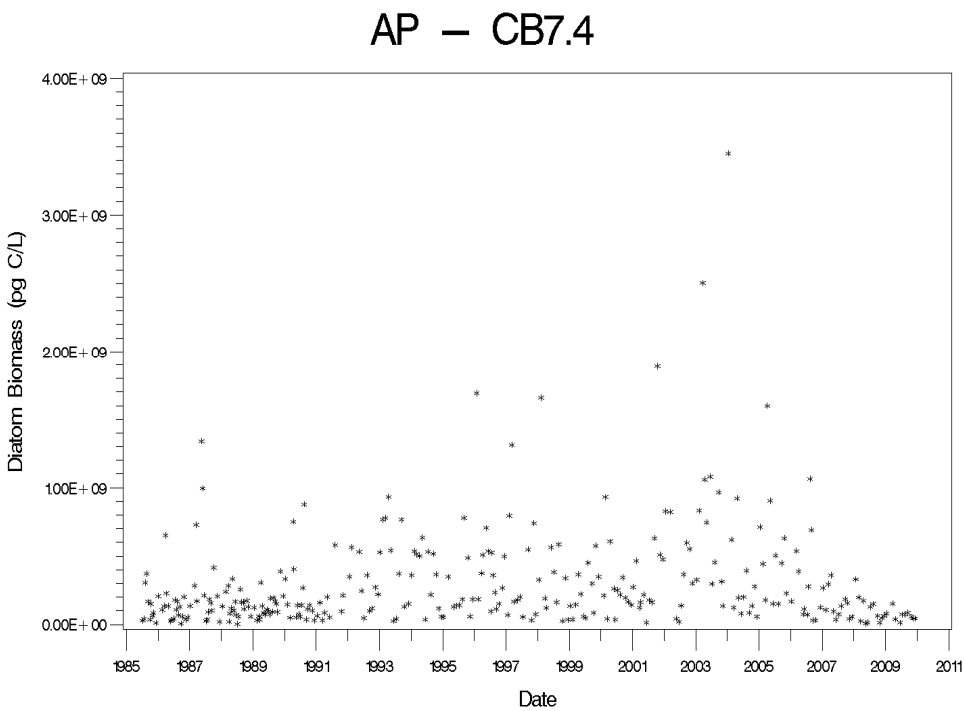


Figure 148. Plot of above pycnocline diatom biomass against time at station CB7.4 for the period of 1985 through 2009.

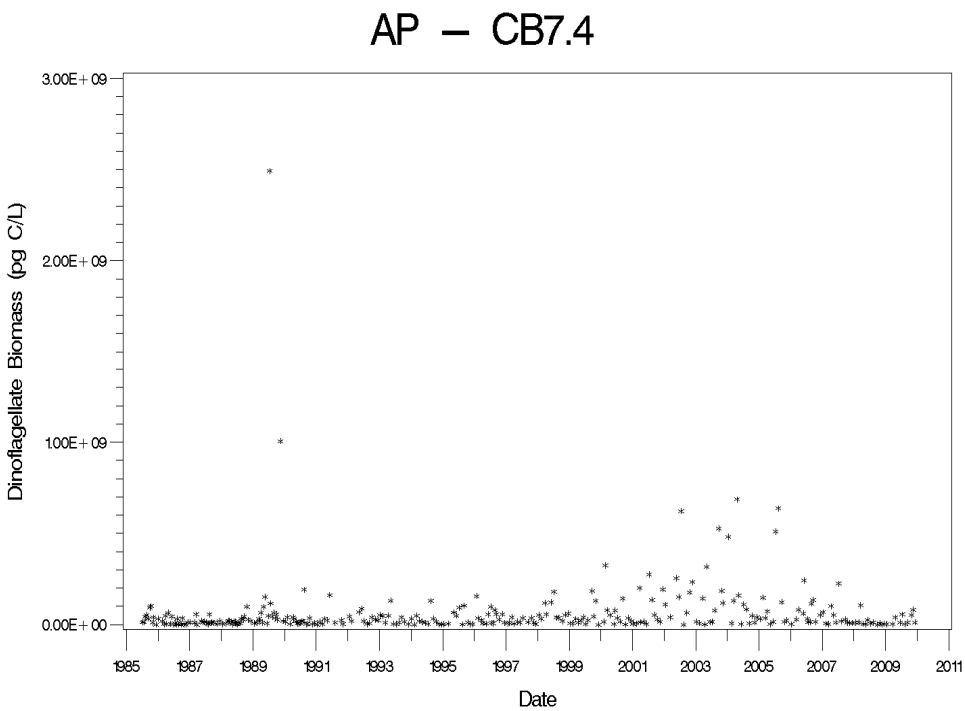


Figure 149. Plot of above pycnocline dinoflagellate biomass against time at station CB7.4 for the period of 1985 through 2009.

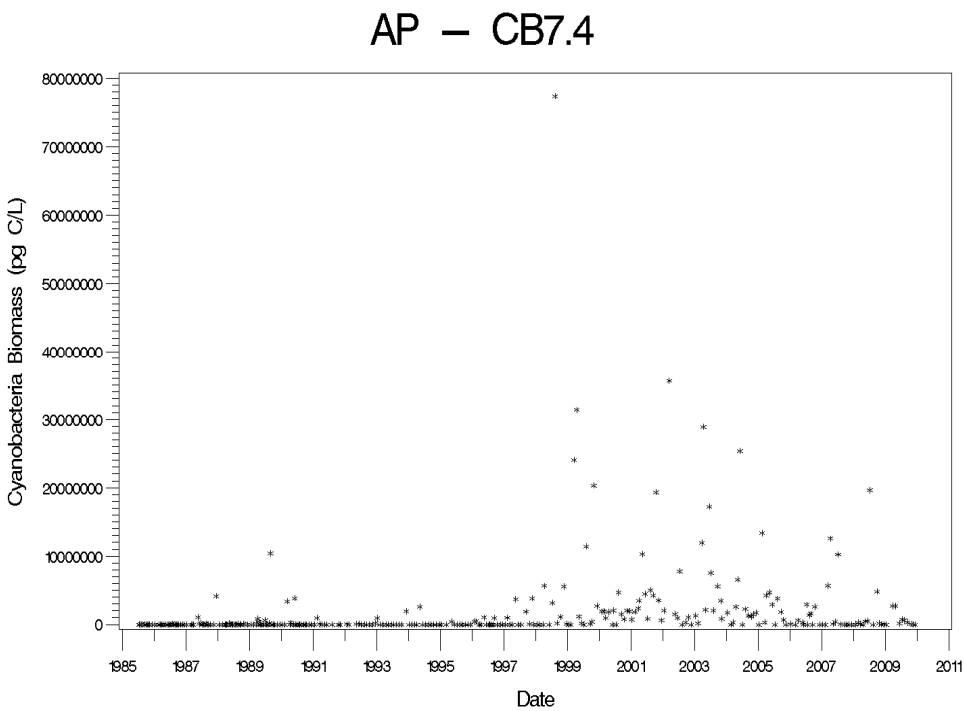


Figure 150. Plot of above pycnocline cyanobacteria biomass against time at station CB7.4 for the period of 1985 through 2009.

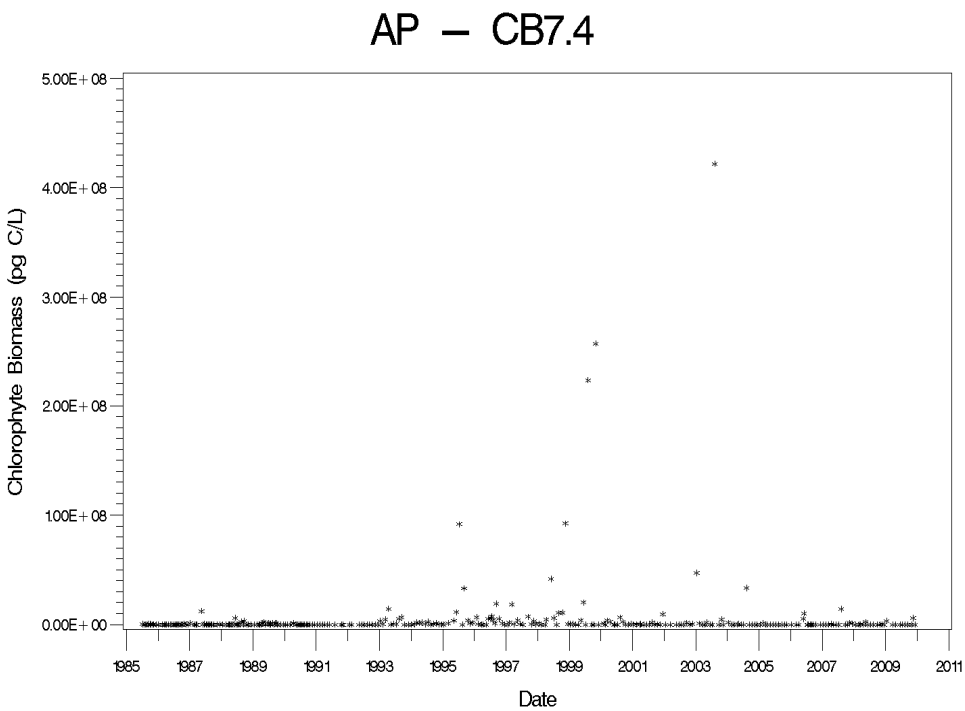


Figure 151. Plot of above pycnocline chlorophyte biomass against time at station CB7.4 for the period of 1985 through 2009.

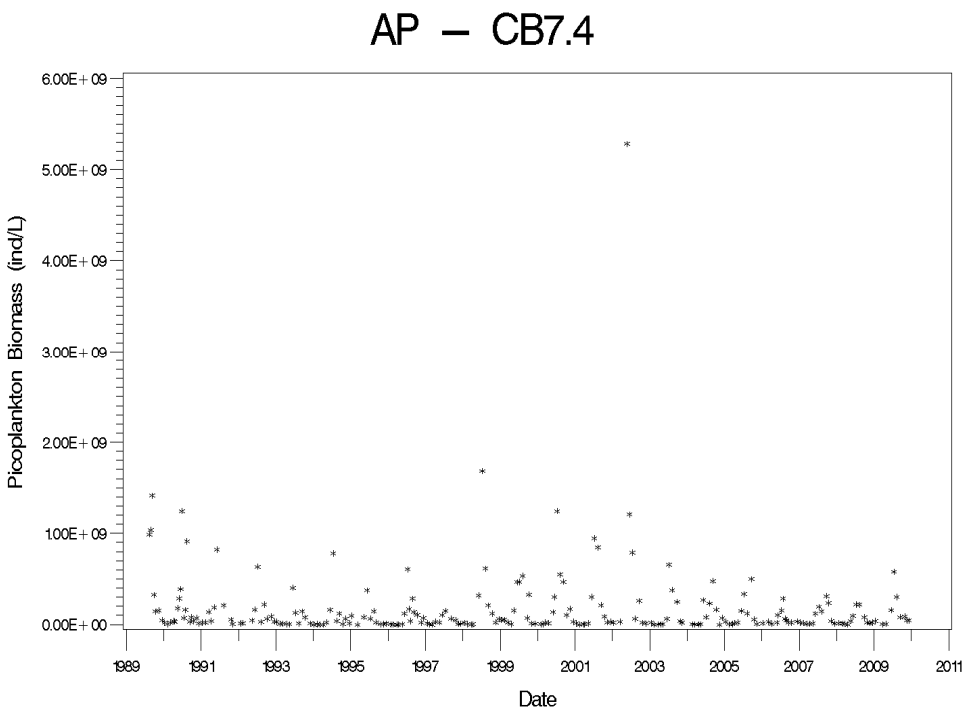


Figure 152. Plot of above pycnocline picoplankton biomass against time at station CB7.4 for the period of 1985 through 2009.

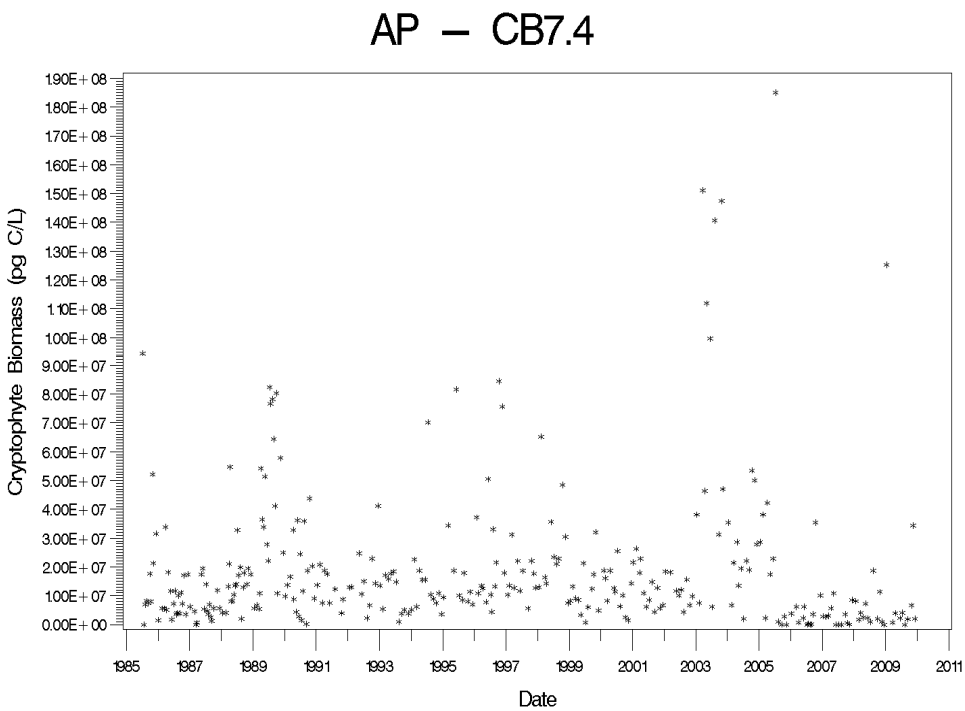


Figure 153. Plot of above pycnocline cryptophyte biomass at station CB7.4 for the period of 1985 through 2009.

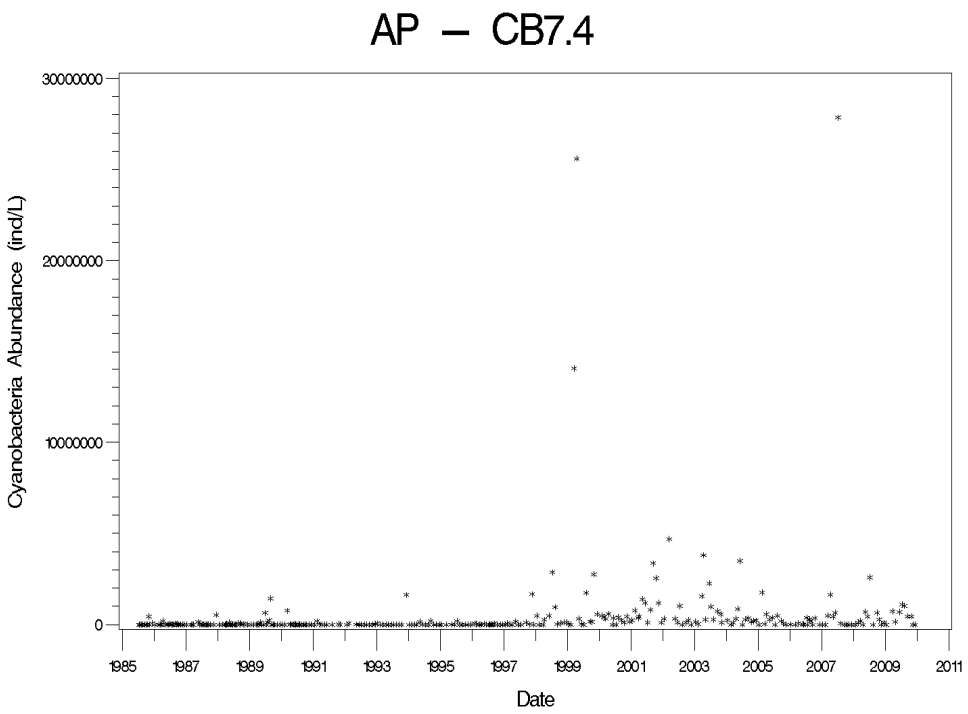


Figure 154. Plot of above pycnocline cyanophyte abundance at station CB7.4 for the period of 1985 through 2009.

Appendix E. Scatterplots of primary productivity

List of Figures

Figure 1. Plot of primary productivity against time at station TF5.5 for the period of 1989 through 2009. 1

Figure 2. Plot of primary productivity against time at station RET5.2 for the period of 1989 through 2009. 2

Figure 3. Plot of primary productivity against time at station LE5.5 for the period of 1989 through 2009. 3

Figure 4. Plot of primary productivity against time at station SBE5 for the period of 1989 through 2009. 4

Figure 5. Plot of primary productivity against time at station TF4.2 for the period of 1989 through 2009. 5

Figure 6. Plot of primary productivity against time at station RET4.3 for the period of 1989 through 2009. 6

Figure 7. Plot of primary productivity against time at station WE4.2 for the period of 1989 through 2009. 7

Figure 8. Plot of primary productivity against time at station TF3.3 for the period of 1989 through 2009. 8

Figure 9. Plot of primary productivity against time at station LE3.6 for the period of 1989 through 2009. 9

Figure 10. Plot of primary productivity against time at station CB6.1 for the period of 1989 through 2009. 10

Figure 11. Plot of primary productivity against time at station CB6.4 for the period of 1989 through 2009. 11

Figure 12. Plot of primary productivity against time at station CB7.3E for the period of 1989 through 2009. 12

Figure 13. Plot of primary productivity against time at station CB7.4 for the period of 1989 through 2009. 13

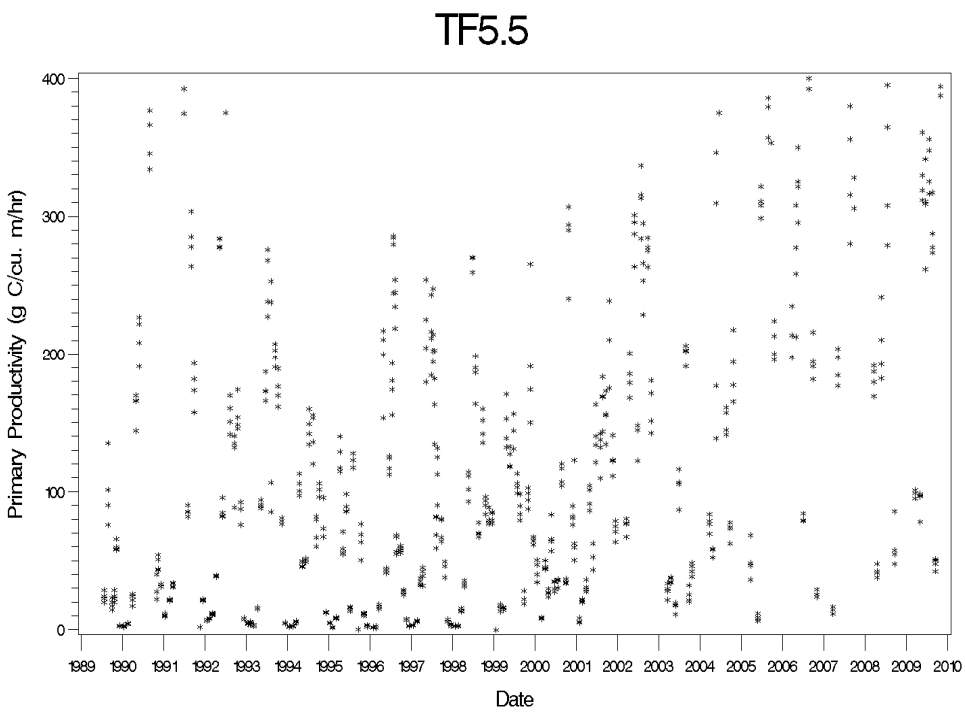


Figure 1. Plot of primary productivity against time at station TF5.5 for the period of 1989 through 2009.

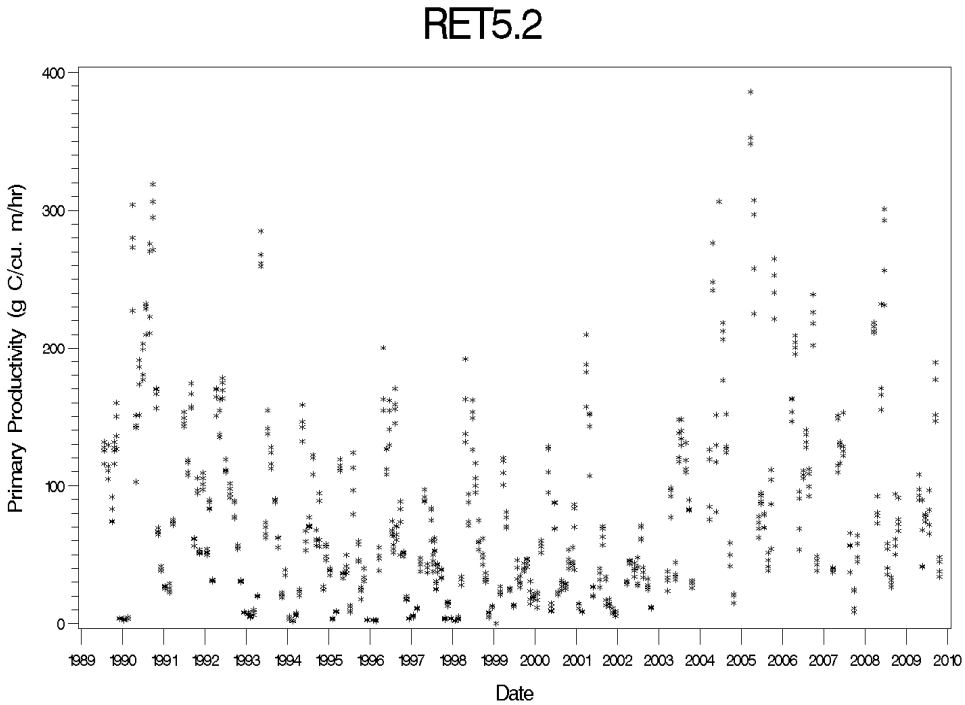


Figure 2. Plot of primary productivity against time at station RET5.2 for the period of 1989 through 2009.

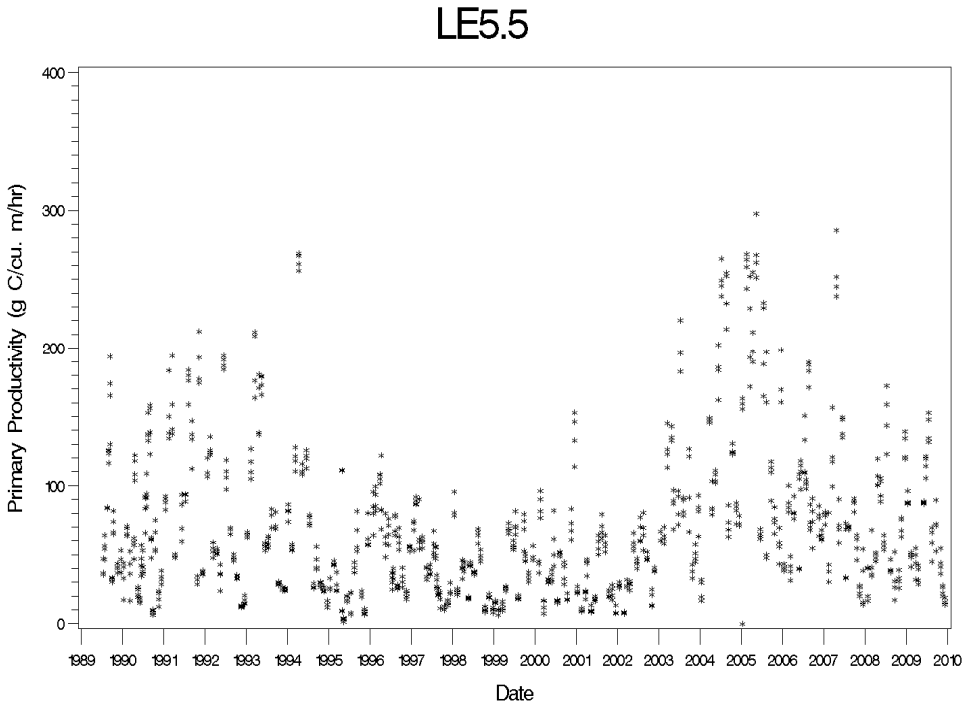


Figure 3. Plot of primary productivity against time at station LE5.5 for the period of 1989 through 2009.

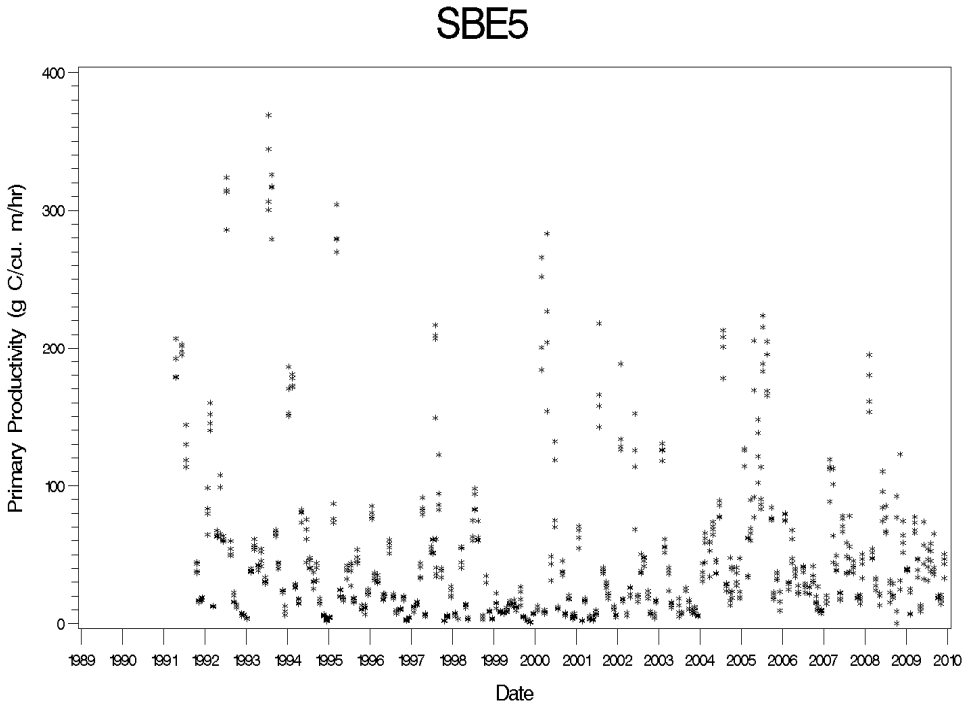


Figure 4. Plot of primary productivity against time at station SBE5 for the period of 1989 through 2009.

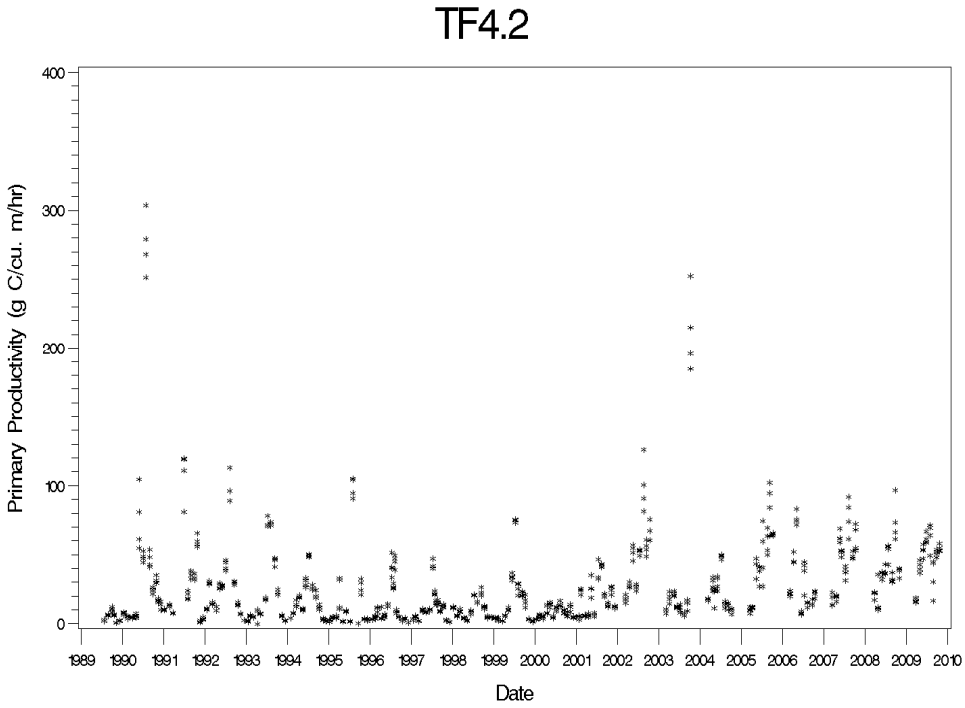


Figure 5. Plot of primary productivity against time at station TF4.2 for the period of 1989 through 2009.

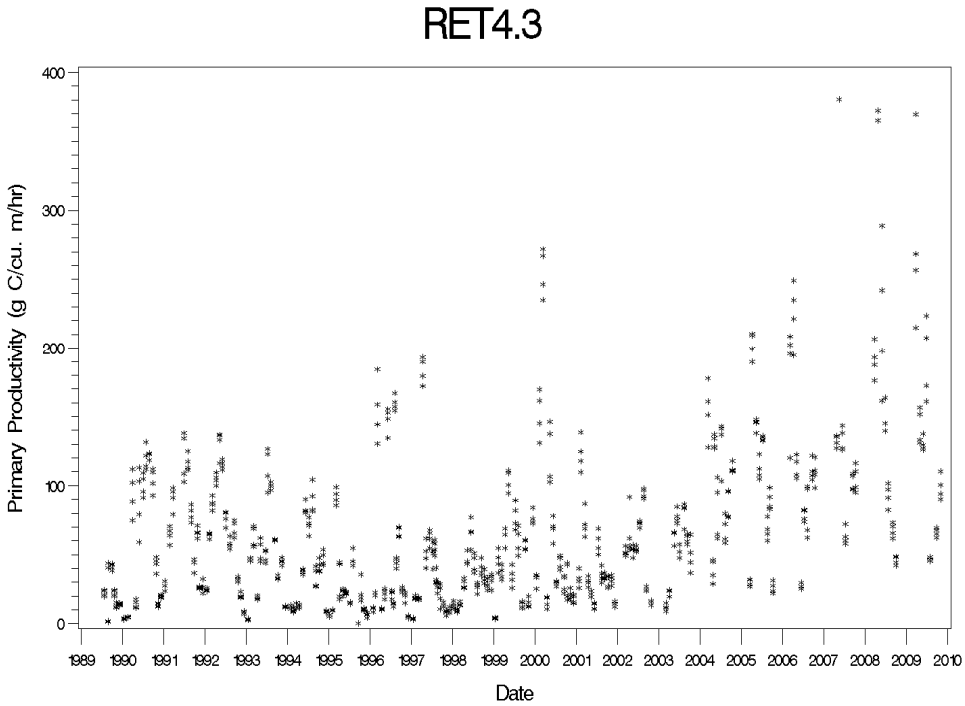


Figure 6. Plot of primary productivity against time at station RET4.3 for the period of 1989 through 2009.

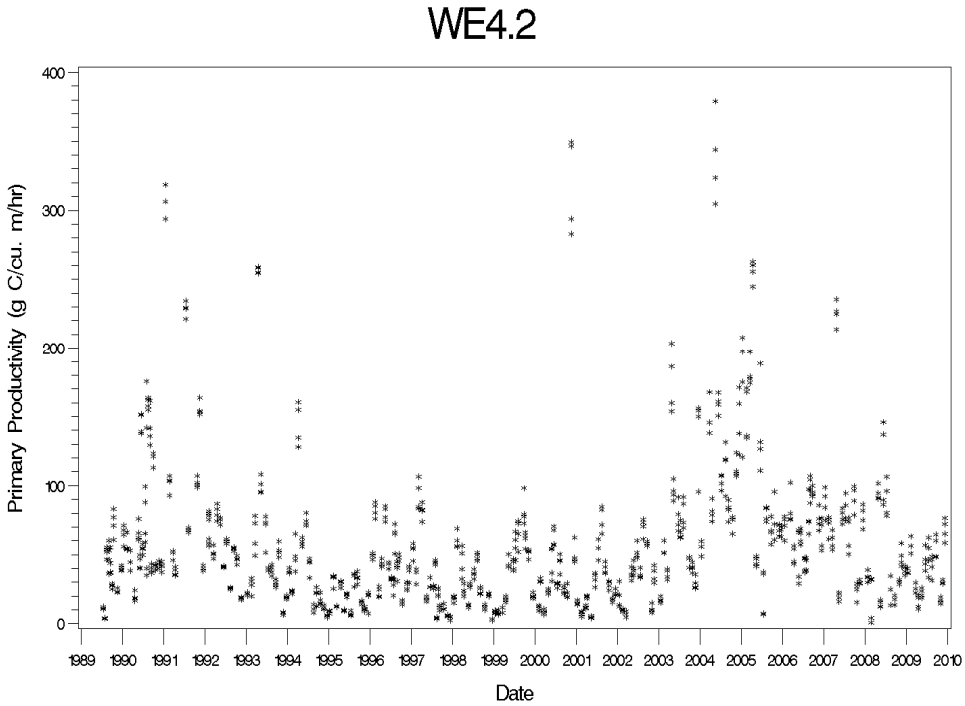


Figure 7. Plot of primary productivity against time at station WE4.2 for the period of 1989 through 2009.

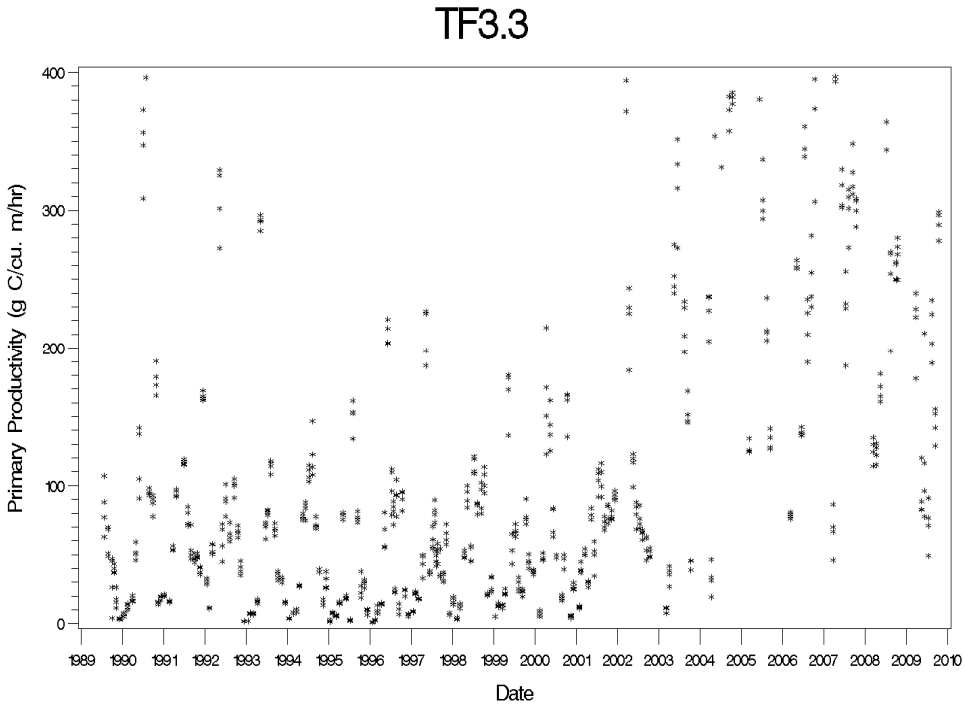


Figure 8. Plot of primary productivity against time at station TF3.3 for the period of 1989 through 2009.

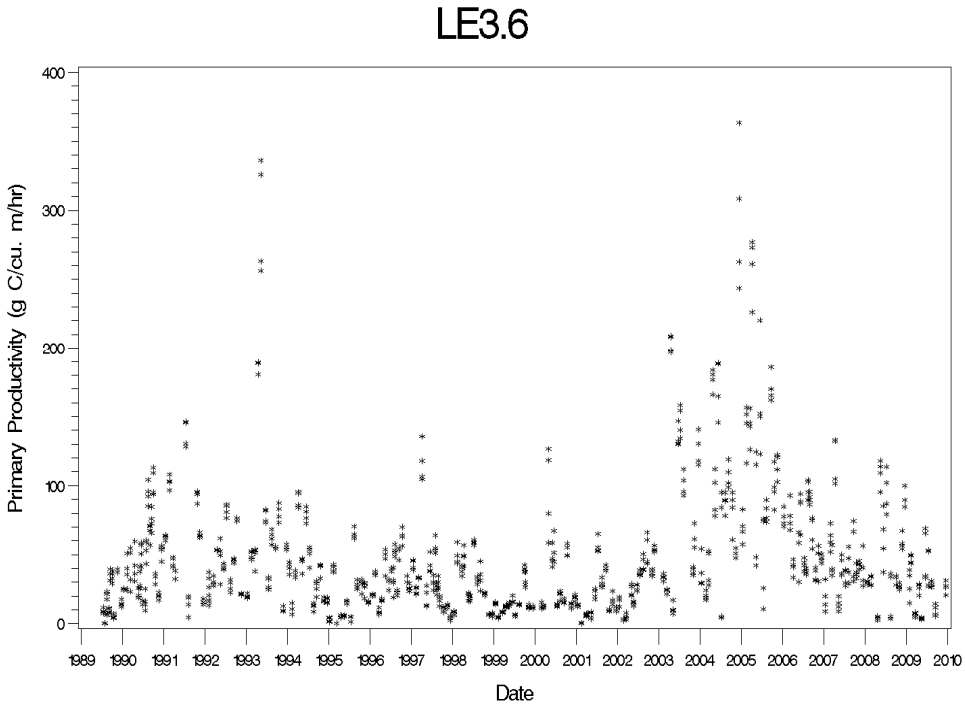


Figure 9. Plot of primary productivity against time at station LE3.6 for the period of 1989 through 2009.

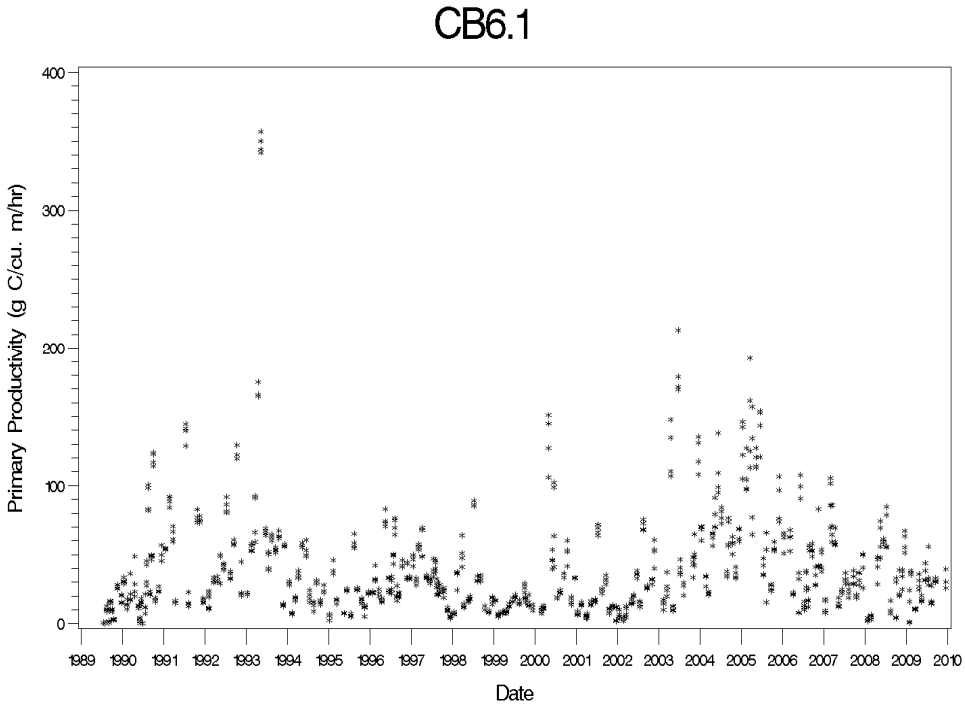


Figure 10. Plot of primary productivity against time at station CB6.1 for the period of 1989 through 2009.

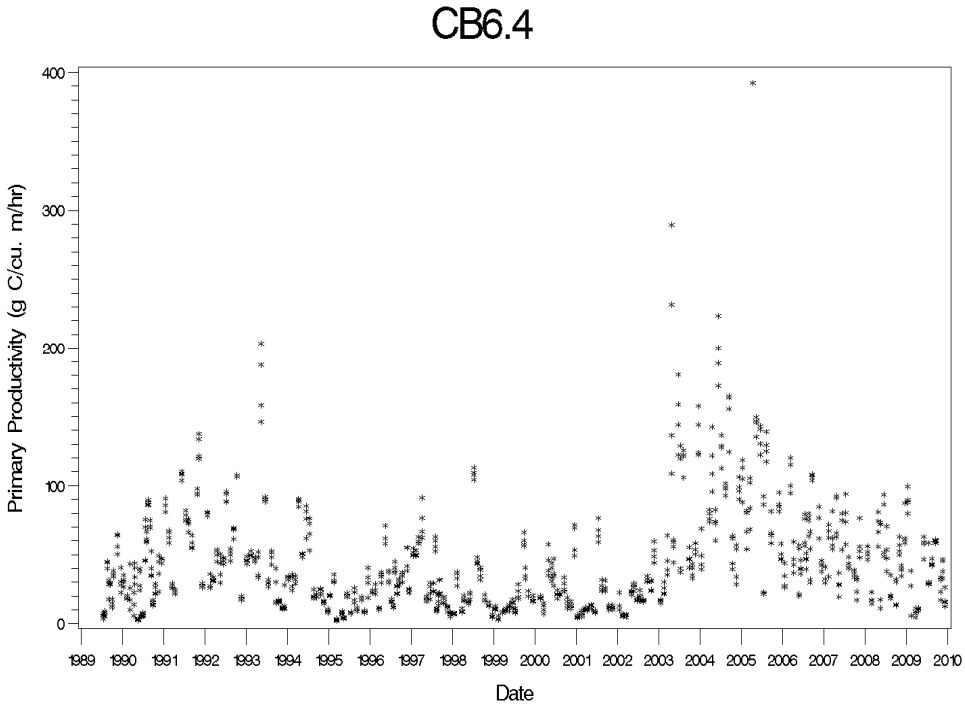


Figure 11. Plot of primary productivity against time at station CB6.4 for the period of 1989 through 2009.

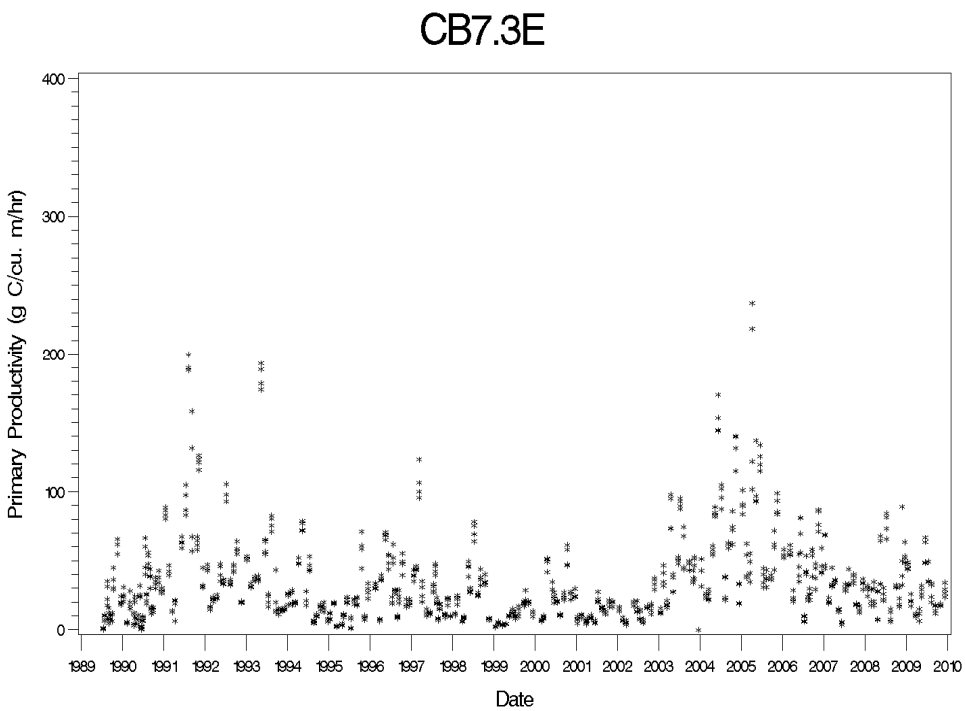


Figure 12. Plot of primary productivity against time at station CB7.3E for the period of 1989 through 2009.

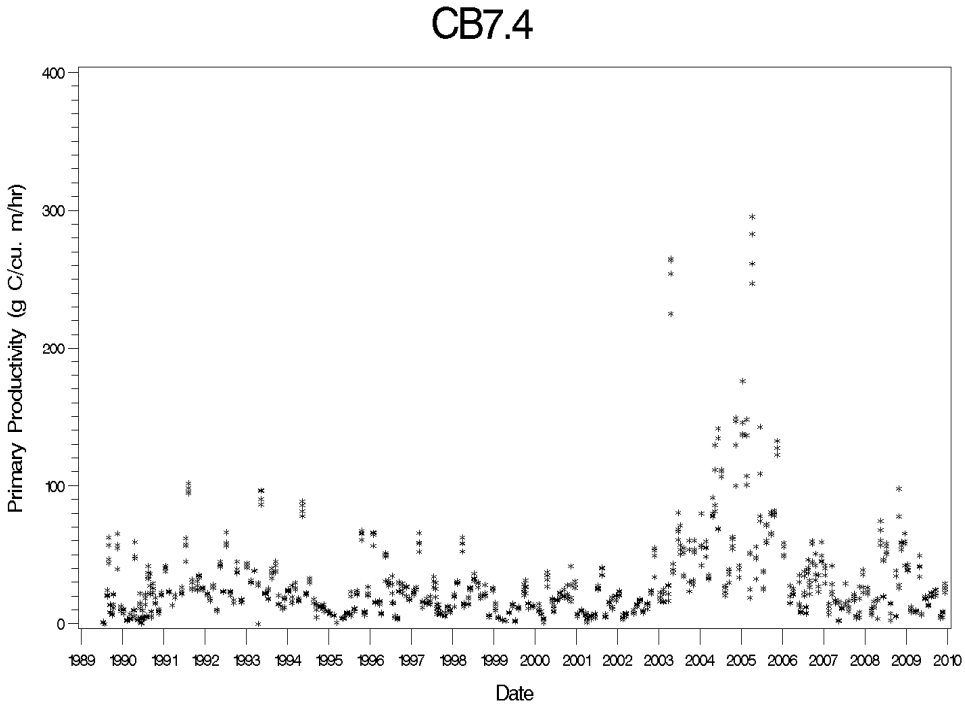


Figure 13. Plot of primary productivity against time at station CB7.4 for the period of 1989 through 2009.

Appendix E. Scatterplots of primary productivity

List of Figures

Figure 1. Plot of primary productivity against time at station TF5.5 for the period of 1989 through 2009. 1

Figure 2. Plot of primary productivity against time at station RET5.2 for the period of 1989 through 2009. 2

Figure 3. Plot of primary productivity against time at station LE5.5 for the period of 1989 through 2009. 3

Figure 4. Plot of primary productivity against time at station SBE5 for the period of 1989 through 2009. 4

Figure 5. Plot of primary productivity against time at station TF4.2 for the period of 1989 through 2009. 5

Figure 6. Plot of primary productivity against time at station RET4.3 for the period of 1989 through 2009. 6

Figure 7. Plot of primary productivity against time at station WE4.2 for the period of 1989 through 2009. 7

Figure 8. Plot of primary productivity against time at station TF3.3 for the period of 1989 through 2009. 8

Figure 9. Plot of primary productivity against time at station LE3.6 for the period of 1989 through 2009. 9

Figure 10. Plot of primary productivity against time at station CB6.1 for the period of 1989 through 2009. 10

Figure 11. Plot of primary productivity against time at station CB6.4 for the period of 1989 through 2009. 11

Figure 12. Plot of primary productivity against time at station CB7.3E for the period of 1989 through 2009. 12

Figure 13. Plot of primary productivity against time at station CB7.4 for the period of 1989 through 2009. 13

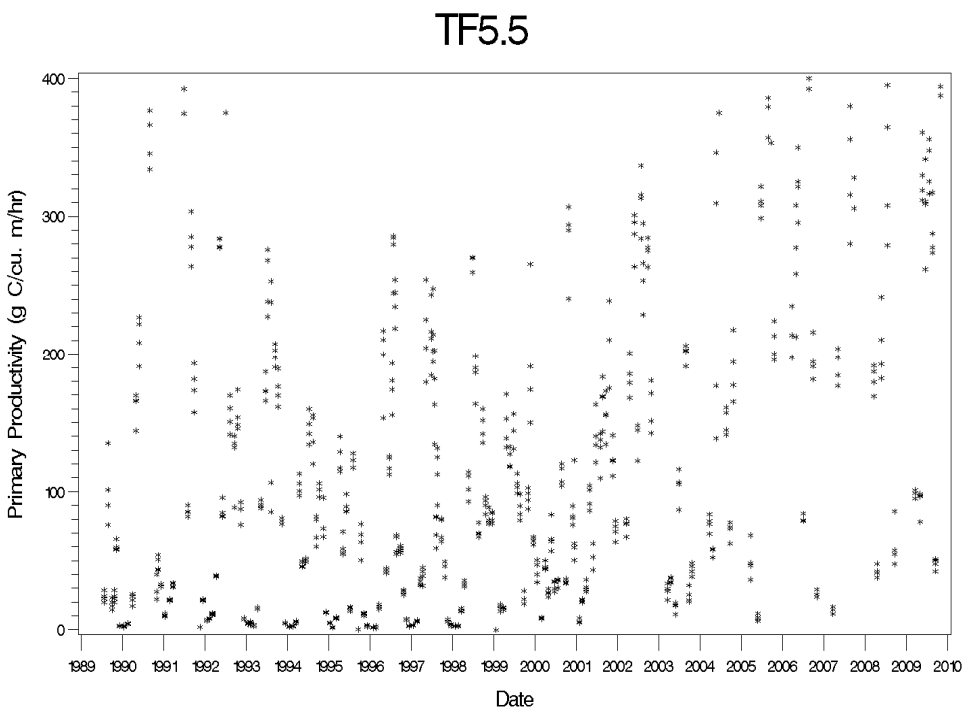


Figure 1. Plot of primary productivity against time at station TF5.5 for the period of 1989 through 2009.

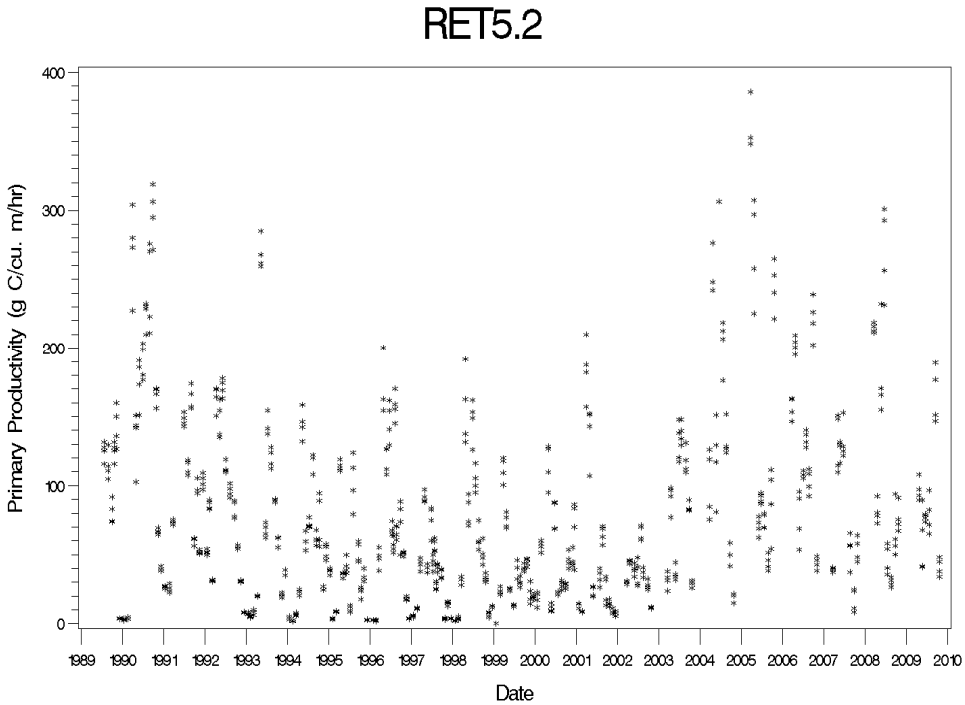


Figure 2. Plot of primary productivity against time at station RET5.2 for the period of 1989 through 2009.

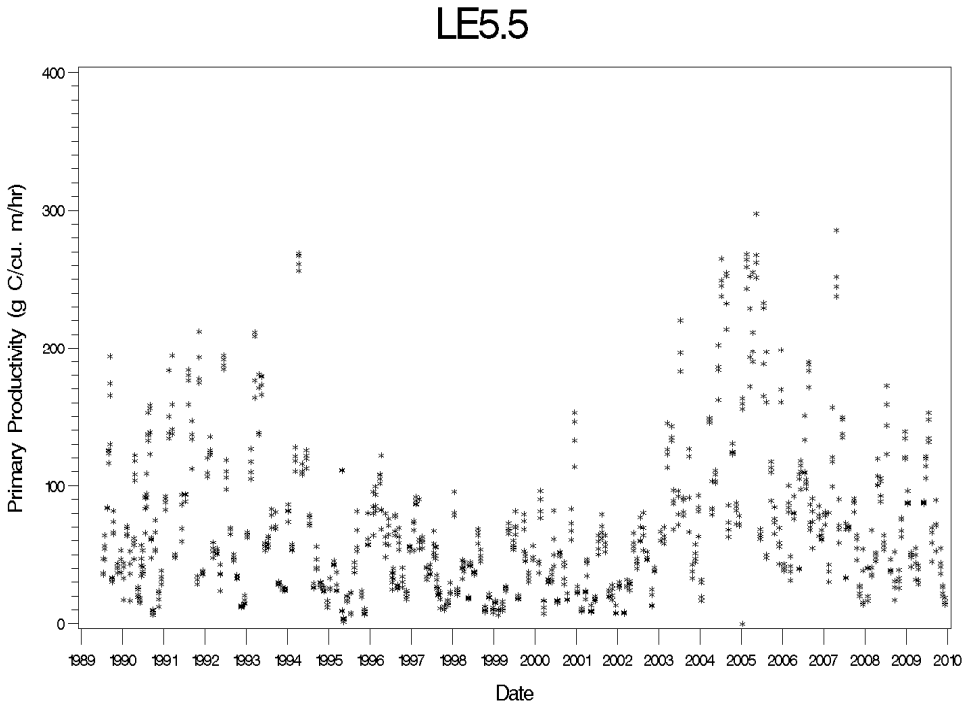


Figure 3. Plot of primary productivity against time at station LE5.5 for the period of 1989 through 2009.

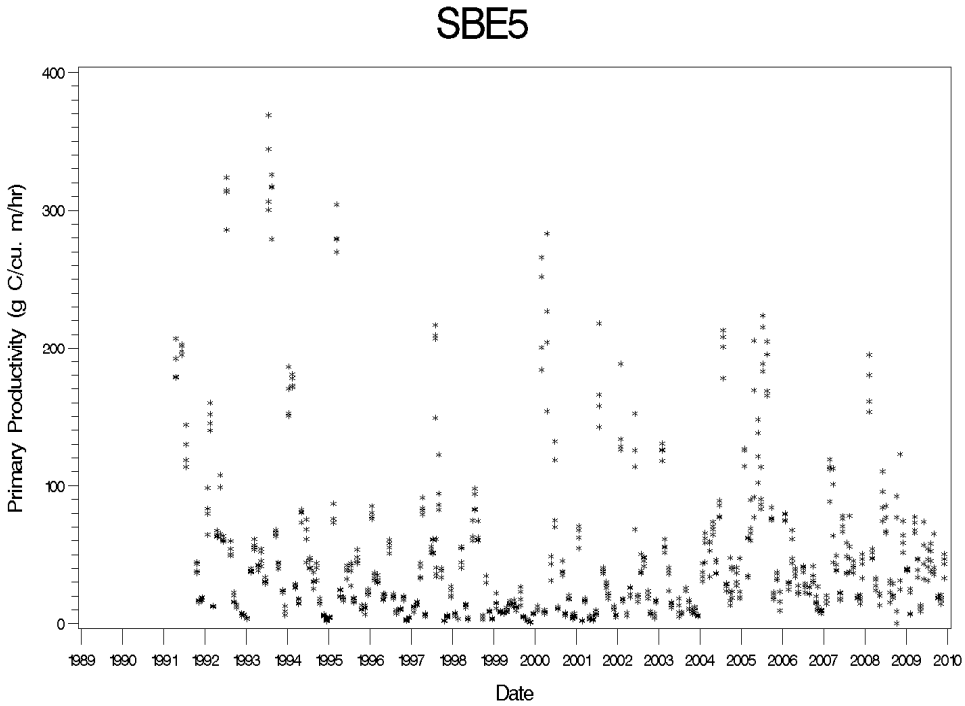


Figure 4. Plot of primary productivity against time at station SBE5 for the period of 1989 through 2009.

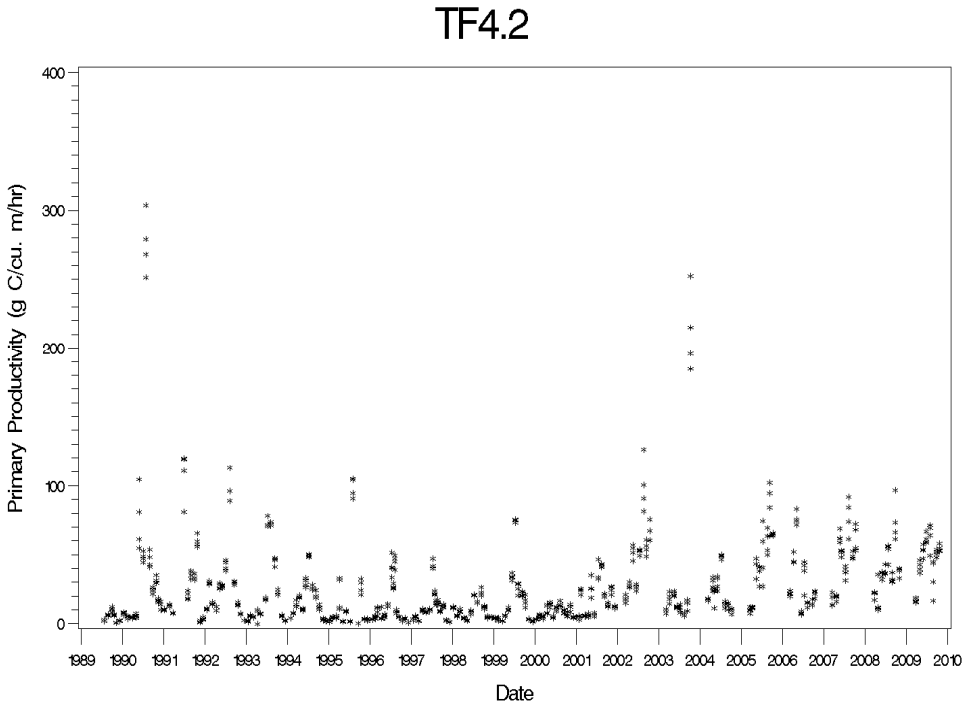


Figure 5. Plot of primary productivity against time at station TF4.2 for the period of 1989 through 2009.

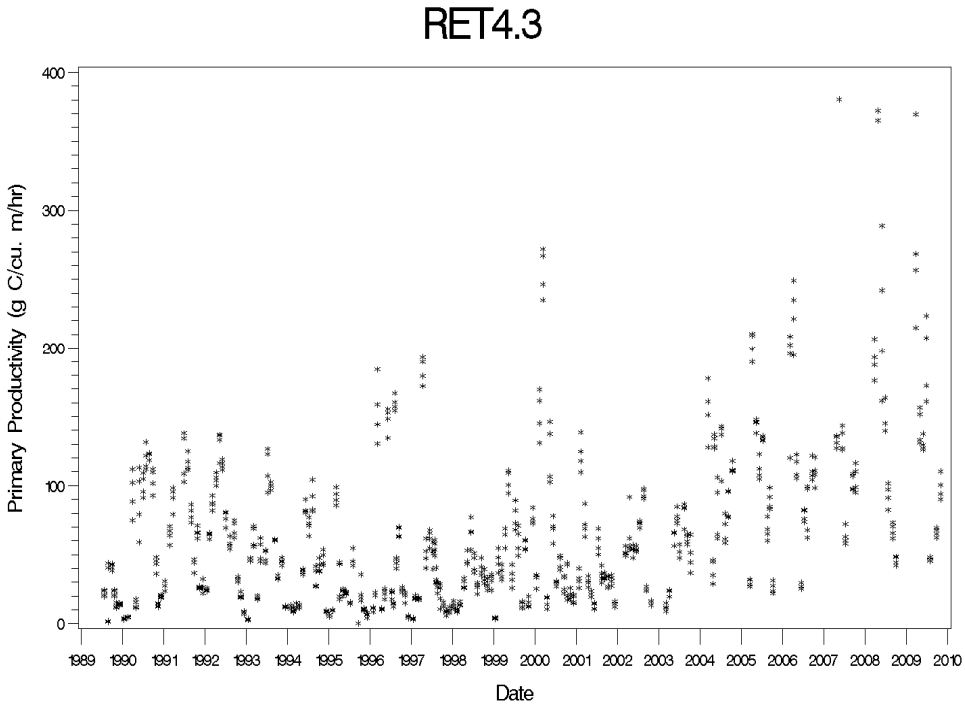


Figure 6. Plot of primary productivity against time at station RET4.3 for the period of 1989 through 2009.

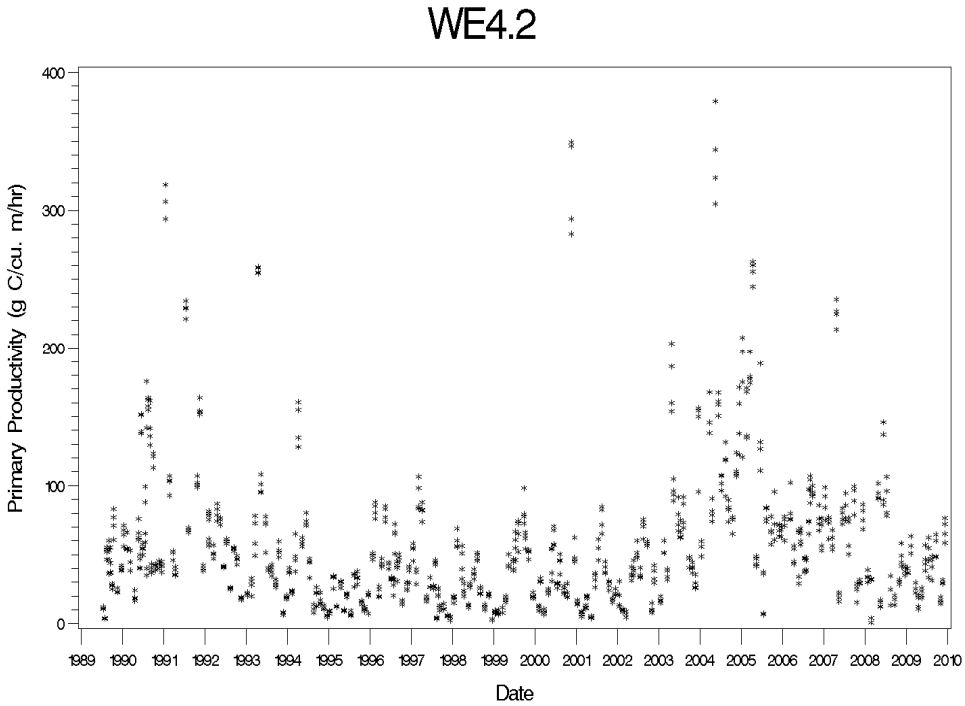


Figure 7. Plot of primary productivity against time at station WE4.2 for the period of 1989 through 2009.

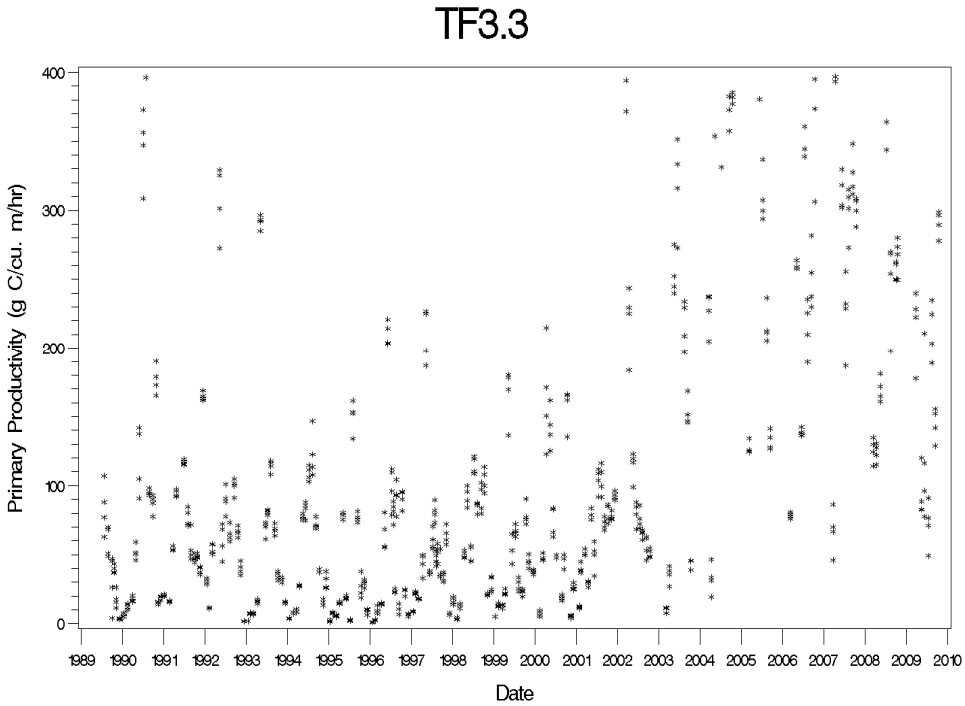


Figure 8. Plot of primary productivity against time at station TF3.3 for the period of 1989 through 2009.

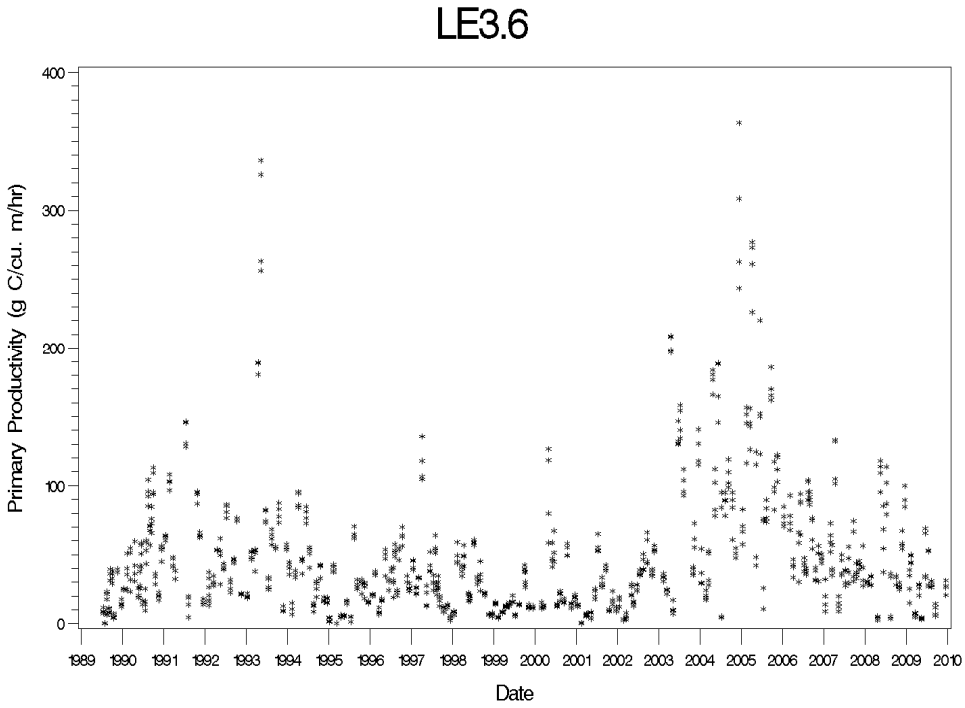


Figure 9. Plot of primary productivity against time at station LE3.6 for the period of 1989 through 2009.

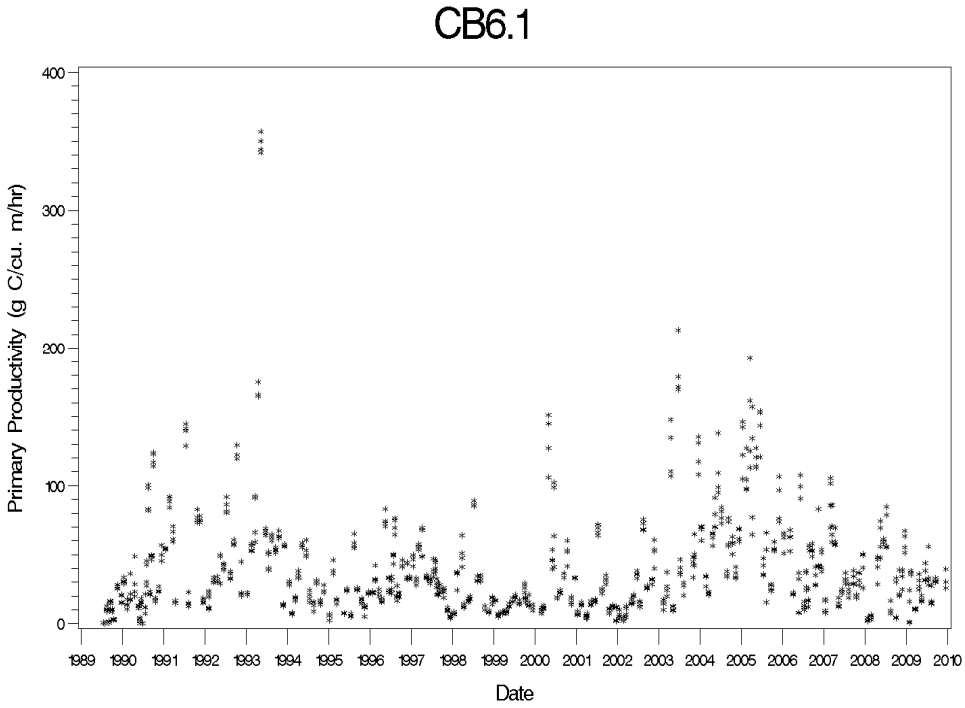


Figure 10. Plot of primary productivity against time at station CB6.1 for the period of 1989 through 2009.

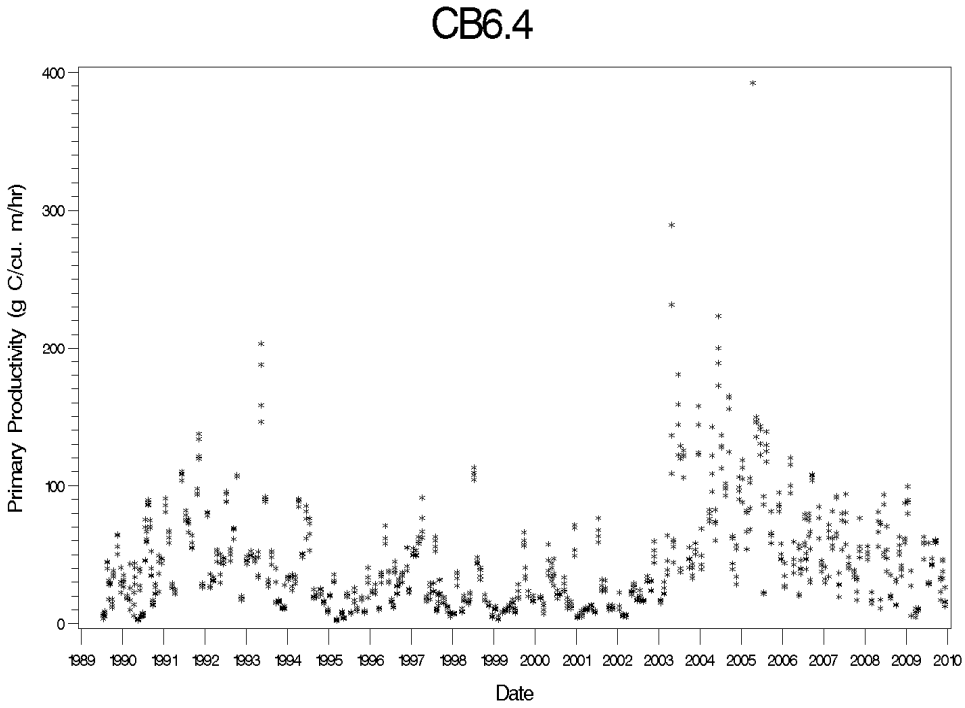


Figure 11. Plot of primary productivity against time at station CB6.4 for the period of 1989 through 2009.

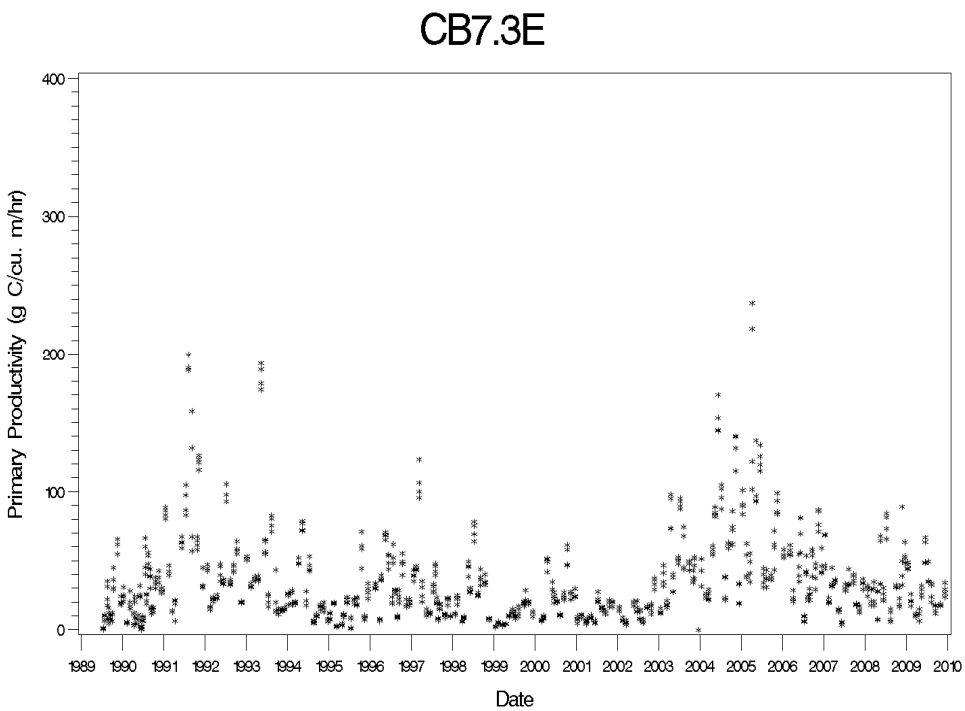


Figure 12. Plot of primary productivity against time at station CB7.3E for the period of 1989 through 2009.

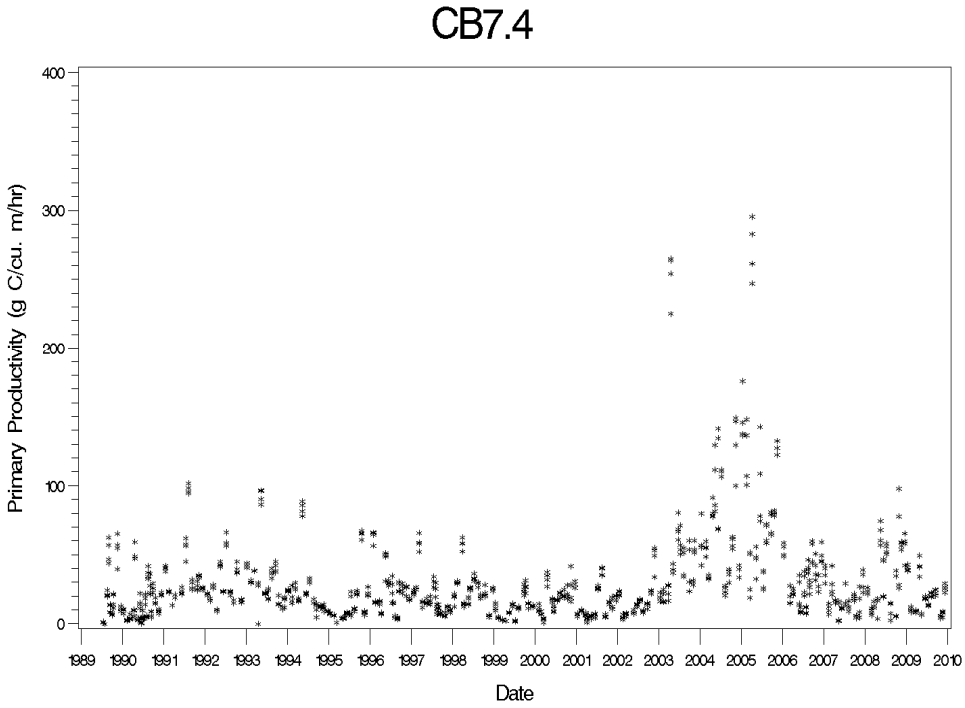


Figure 13. Plot of primary productivity against time at station CB7.4 for the period of 1989 through 2009.

Appendix F - Long-term Trends in Benthic Bioindicators

Appendix F - Section A. Longterm trends in the B-IBI and associated bioindicators for the James River stations for the period of 1985 through 2009.

James River						
Station	Parameter	P value	Slope	Baseline	% Change	Direction
TF5.5	Benthic Index of Biotic Integrity	0.1082	0.0	2.2	38.66	No Trend
TF5.5	Total Abundance per square meter	0.1738	206.49	1335.60	386.50	No Trend
TF5.5	Total Biomass per square meter	0.4366	0.03	0.34	196.43	No Trend
TF5.5	Shannon-Weiner Diversity Index	0.8969	0.00	1.18	7.03	No Trend
TF5.5	Pollution Sensitive Species Abundance	0.0038	1.33	0.00		Improving
TF5.5	Pollution Indicative Species Abundance	0.0277	-2.23	90.08	-62.02	Improving
TF5.5	Pollution Sensitive Species Biomass	0.0031	3.05	0.00		Improving
TF5.5	Pollution Indicative Species Biomass	0.0096	-3.45	75.00	-114.97	Improving
RET5.2	Benthic Index of Biotic Integrity	0.0085	0.0	2.1	59.58	Improving
RET5.2	Total Abundance per square meter	0.2064	26.42	610.56	108.19	No Trend
RET5.2	Total Biomass per square meter	0.7211	-0.01	7.34	-2.30	No Trend
RET5.2	Shannon-Weiner Diversity Index	0.0197	0.05	1.66	67.92	Improving
RET5.2	Pollution Sensitive Species Abundance	0.0008	1.67	10.42	400.28	Improving
RET5.2	Pollution Indicative Species Abundance	0.4173	-0.61	17.50	-87.42	No Trend
RET5.2	Pollution Sensitive Species Biomass	0.0115	2.24	28.04	199.94	Improving
RET5.2	Pollution Indicative Species Biomass	0.1273	-0.71	11.20	-158.64	No Trend
LE5.1	Benthic Index of Biotic Integrity	0.2502	0.0	2.9	26.69	No Trend
LE5.1	Total Abundance per square meter	0.8054	11.33	524.70	47.50	No Trend
LE5.1	Total Biomass per square meter	0.3243	-0.04	5.71	-15.34	No Trend
LE5.1	Shannon-Weiner Diversity Index	0.8054	0.01	2.06	6.58	No Trend
LE5.1	Pollution Sensitive Species Abundance	0.5654	-0.29	32.16	-19.83	No Trend
LE5.1	Pollution Indicative Species Abundance	0.1337	0.28	7.13	85.41	No Trend
LE5.1	Pollution Sensitive Species Biomass	0.8054	-0.28	74.24	-8.41	No Trend
LE5.1	Pollution Indicative Species Biomass	0.1567	0.12	4.82	54.50	No Trend
LE5.2	Benthic Index of Biotic Integrity	0.5172	0.0	3.3	-15.30	No Trend
LE5.2	Total Abundance per square meter	0.0858	45.22	1221.12	92.58	Improving
LE5.2	Total Biomass per square meter	0.3634	-0.16	4.58	-84.64	No Trend
LE5.2	Shannon-Weiner Diversity Index	0.3313	-0.03	2.55	-25.91	No Trend
LE5.2	Pollution Sensitive Species Abundance	0.0520	2.01	34.48	145.54	Improving
LE5.2	Pollution Indicative Species Abundance	0.9484	-0.07	17.25	-10.60	No Trend
LE5.2	Pollution Sensitive Species Biomass	0.8459	-0.13	40.78	-7.93	No Trend
LE5.2	Pollution Indicative Species Biomass	0.1201	0.56	8.76	159.07	No Trend
LE5.4	Benthic Index of Biotic Integrity	0.7435	0.0	3.7	0.00	No Trend
LE5.4	Total Abundance per square meter	0.5172	19.95	2528.10	19.73	No Trend
LE5.4	Total Biomass per square meter	0.0015	-1.54	22.86	-167.99	Degrading
LE5.4	Shannon-Weiner Diversity Index	0.0922	-0.02	3.69	-15.60	Degrading
LE5.4	Pollution Sensitive Species Abundance	0.1201	-0.77	48.80	-39.42	No Trend
LE5.4	Pollution Indicative Species Abundance	0.0892	-0.08	2.24	-87.21	Improving
LE5.4	Pollution Sensitive Species Biomass	0.0197	-1.99	59.75	-83.21	Degrading
LE5.4	Pollution Indicative Species Biomass	0.9479	0.00	0.94	0.00	No Trend

Appendix F - Section B. Longterm trends in the B-IBI and associated bioindicators for the Elizabeth River stations for the period of 1985 through 2009.

Elizabeth River						
Station	Parameter	P value	Slope	Baseline	% Change	Direction
SBE2	Benthic Index of Biotic Integrity	0.2176	0.0	1.9	21.58	No Trend
SBE2	Total Abundance per square meter	0.0136	150.26	1659.96	190.09	Improving
SBE2	Total Biomass per square meter	0.1283	0.04	0.92	100.96	No Trend
SBE2	Shannon-Weiner Diversity Index	0.7738	0.01	1.67	12.39	No Trend
SBE2	Pollution Sensitive Species Abundance	0.0008	4.26	4.62	1936.79	Improving
SBE2	Pollution Indicative Species Abundance	0.0536	-2.66	75.68	-73.70	Improving
SBE2	Pollution Sensitive Species Biomass	0.1183	1.59	8.41	397.70	No Trend
SBE2	Pollution Indicative Species Biomass	0.4851	-0.78	69.21	-23.75	No Trend
SBE5	Benthic Index of Biotic Integrity	0.0239	0.0	1.3	71.77	Improving
SBE5	Total Abundance per square meter	0.4353	76.32	3806.46	42.11	No Trend
SBE5	Total Biomass per square meter	0.1175	0.05	0.58	167.21	No Trend
SBE5	Shannon-Weiner Diversity Index	0.3885	0.02	0.99	48.14	No Trend
SBE5	Pollution Sensitive Species Abundance	0.0001	2.85	0.31	19139.99	Improving
SBE5	Pollution Indicative Species Abundance	0.0016	-4.68	85.43	-115.06	Improving
SBE5	Pollution Sensitive Species Biomass	0.0214	2.54	2.15	2479.42	Improving
SBE5	Pollution Indicative Species Biomass	0.1754	-2.18	77.83	-58.80	No Trend

Appendix F - Section C. Longterm trends in the B-IBI and associated bioindicators for the York River stations for the period of 1985 through 2009.

York River						
Station	Parameter	P value	Slope	Baseline	% Change	Direction
TF4.2	Benthic Index of Biotic Integrity	0.7431	0.0	2.6	-1.99	No Trend
TF4.2	Total Abundance per square meter	0.3275	34.34	410.22	209.30	No Trend
TF4.2	Total Biomass per square meter	1.0000	0.00	0.15	0.00	No Trend
TF4.2	Shannon-Weiner Diversity Index	0.0946	0.03	0.96	72.92	Improving
TF4.2	Pollution Sensitive Species Abundance	0.1654	0.53	12.50	106.10	No Trend
TF4.2	Pollution Indicative Species Abundance	0.2706	-1.54	65.97	-58.17	No Trend
TF4.2	Pollution Sensitive Species Biomass	0.7132	-0.26	19.44	-33.33	No Trend
TF4.2	Pollution Indicative Species Biomass	0.7132	-0.35	59.72	-14.73	No Trend
RET4.3	Benthic Index of Biotic Integrity	0.6538	0.0	3.6	-4.56	No Trend
RET4.3	Total Abundance per square meter	0.0376	197.61	1030.32	479.50	Improving
RET4.3	Total Biomass per square meter	0.8383	-0.04	4.43	-21.55	No Trend
RET4.3	Shannon-Weiner Diversity Index	0.4386	-0.02	2.50	-19.91	No Trend
RET4.3	Pollution Sensitive Species Abundance	0.5961	-0.51	40.89	-30.96	No Trend
RET4.3	Pollution Indicative Species Abundance	0.8385	0.03	14.84	5.51	No Trend
RET4.3	Pollution Sensitive Species Biomass	0.5409	0.63	83.08	18.87	No Trend
RET4.3	Pollution Indicative Species Biomass	0.7137	-0.05	4.11	-27.42	No Trend
LE4.1	Benthic Index of Biotic Integrity	0.4868	0.0	3.0	-12.47	No Trend
LE4.1	Total Abundance per square meter	0.9675	0.00	1535.94	0.00	No Trend
LE4.1	Total Biomass per square meter	0.2063	-0.57	27.51	-51.66	No Trend
LE4.1	Shannon-Weiner Diversity Index	0.1118	-0.02	2.47	-20.54	No Trend
LE4.1	Pollution Sensitive Species Abundance	0.8385	0.06	37.56	4.02	No Trend
LE4.1	Pollution Indicative Species Abundance	0.2209	0.76	23.71	80.30	No Trend
LE4.1	Pollution Sensitive Species Biomass	0.0946	-2.45	82.49	-74.15	Degrading
LE4.1	Pollution Indicative Species Biomass	0.1917	0.36	8.28	108.41	No Trend
LE4.3	Benthic Index of Biotic Integrity	0.1020	0.1	2.9	47.62	No Trend
LE4.3	Total Abundance per square meter	0.8801	9.09	3138.66	7.24	No Trend
LE4.3	Total Biomass per square meter	0.9699	0.03	6.32	10.39	No Trend
LE4.3	Shannon-Weiner Diversity Index	0.1633	0.03	2.47	33.73	No Trend
LE4.3	Pollution Sensitive Species Abundance	0.7345	0.16	56.44	7.31	No Trend
LE4.3	Pollution Indicative Species Abundance	0.3861	-0.24	16.74	-35.15	No Trend
LE4.3	Pollution Sensitive Species Biomass	0.6785	-0.24	72.97	-8.13	No Trend
LE4.3	Pollution Indicative Species Biomass	0.7345	-0.04	4.88	-19.60	No Trend
LE4.3B	Benthic Index of Biotic Integrity	0.0558	0.1	2.6	62.08	Improving
LE4.3B	Total Abundance per square meter	0.7313	9.54	2766.60	7.59	No Trend
LE4.3B	Total Biomass per square meter	0.9609	-0.01	3.28	-6.40	No Trend
LE4.3B	Shannon-Weiner Diversity Index	0.1854	0.05	2.44	43.76	No Trend
LE4.3B	Pollution Sensitive Species Abundance	0.1549	1.09	18.36	130.30	No Trend
LE4.3B	Pollution Indicative Species Abundance	0.1549	-1.25	41.44	-66.31	No Trend
LE4.3B	Pollution Sensitive Species Biomass	0.5237	0.56	54.16	22.77	No Trend
LE4.3B	Pollution Indicative Species Biomass	0.9609	0.00	14.87	-0.65	No Trend

Appendix F - Section D. Longterm trends in the B-IBI and associated bioindicators for the Rappahannock River stations for the period of 1985 through 2009.

Rappahannock River						
Station	Parameter	P value	Slope	Baseline	% Change	Direction
TF3.3	Benthic Index of Biotic Integrity	0.9441	0.0	2.6	-0.95	No Trend
TF3.3	Total Abundance per square meter	0.8887	9.54	1001.70	23.81	No Trend
TF3.3	Total Biomass per square meter	0.0501	-2.16	93.92	-57.56	Degrading
TF3.3	Shannon-Weiner Diversity Index	0.3273	-0.02	1.95	-20.25	No Trend
TF3.3	Pollution Sensitive Species Abundance	0.1617	-1.00	32.36	-77.29	No Trend
TF3.3	Pollution Indicative Species Abundance	0.4207	0.82	11.14	184.97	No Trend
TF3.3	Pollution Sensitive Species Biomass	0.0096	-2.04	80.17	-63.75	Degrading
TF3.3	Pollution Indicative Species Biomass	0.3100	0.45	6.59	170.95	No Trend
RET3.1	Benthic Index of Biotic Integrity	0.0325	-0.1	3.6	-47.47	Degrading
RET3.1	Total Abundance per square meter	0.2623	60.95	1001.70	152.12	No Trend
RET3.1	Total Biomass per square meter	0.0063	-0.40	9.02	-111.37	Degrading
RET3.1	Shannon-Weiner Diversity Index	0.3273	-0.02	2.37	-18.04	No Trend
RET3.1	Pollution Sensitive Species Abundance	0.0016	-1.43	33.99	-105.54	Degrading
RET3.1	Pollution Indicative Species Abundance	0.2770	0.39	1.88	523.94	No Trend
RET3.1	Pollution Sensitive Species Biomass	0.0033	-3.91	71.23	-137.13	Degrading
RET3.1	Pollution Indicative Species Biomass	0.1945	0.23	1.57	366.75	No Trend
LE3.2	Benthic Index of Biotic Integrity	0.5057	0.0	1.9	-15.43	No Trend
LE3.2	Total Abundance per square meter	0.3624	11.13	429.30	64.81	No Trend
LE3.2	Total Biomass per square meter	0.7793	0.00	0.27	22.68	No Trend
LE3.2	Shannon-Weiner Diversity Index	0.5989	-0.01	1.21	-30.27	No Trend
LE3.2	Pollution Sensitive Species Abundance	0.4796	-0.28	41.28	-16.70	No Trend
LE3.2	Pollution Indicative Species Abundance	0.6485	0.23	55.38	10.44	No Trend
LE3.2	Pollution Sensitive Species Biomass	0.5717	-0.25	46.51	-13.35	No Trend
LE3.2	Pollution Indicative Species Biomass	0.4615	1.13	47.94	58.76	No Trend
LE3.4	Benthic Index of Biotic Integrity	0.5336	0.0	2.1	23.31	No Trend
LE3.4	Total Abundance per square meter	0.9671	0.00	791.82	0.00	No Trend
LE3.4	Total Biomass per square meter	0.7729	0.00	1.17	-2.88	No Trend
LE3.4	Shannon-Weiner Diversity Index	1.0000	0.00	1.56	0.00	No Trend
LE3.4	Pollution Sensitive Species Abundance	0.8682	0.00	16.74	0.00	No Trend
LE3.4	Pollution Indicative Species Abundance	0.8048	-0.28	68.60	-9.44	No Trend
LE3.4	Pollution Sensitive Species Biomass	0.5067	-0.74	51.66	-32.82	No Trend
LE3.4	Pollution Indicative Species Biomass	0.9016	0.44	38.94	26.25	No Trend

Appendix F - Section E. Longterm trends in the B-IBI and associated bioindicators for the Mainstem stations for the period of 1985 through 2009.

Chesapeake Bay Mainstem						
Station	Parameter	P value	Slope	Baseline	% Change	Direction
CB5.4	Benthic Index of Biotic Integrity	0.8336	0.0	1.8	9.46	No Trend
CB5.4	Total Abundance per square meter	0.5754	9.54	333.90	71.43	No Trend
CB5.4	Total Biomass per square meter	0.5509	-0.01	0.44	-32.61	No Trend
CB5.4	Shannon-Weiner Diversity Index	0.9442	0.00	1.71	1.47	No Trend
CB5.4	Pollution Sensitive Species Abundance	0.9442	0.20	29.84	16.81	No Trend
CB5.4	Pollution Indicative Species Abundance	0.5756	0.40	36.32	27.64	No Trend
CB5.4	Pollution Sensitive Species Biomass	0.8887	-0.05	29.89	-3.97	No Trend
CB5.4	Pollution Indicative Species Biomass	0.7264	-0.21	33.95	-15.78	No Trend
CB6.1	Benthic Index of Biotic Integrity	0.8610	0.0	3.4	-2.96	No Trend
CB6.1	Total Abundance per square meter	0.0501	50.88	1488.24	85.47	Improving
CB6.1	Total Biomass per square meter	0.1073	-0.12	10.82	-28.32	No Trend
CB6.1	Shannon-Weiner Diversity Index	0.4011	0.01	2.64	7.38	No Trend
CB6.1	Pollution Sensitive Species Abundance	0.6243	-0.16	31.37	-12.76	No Trend
CB6.1	Pollution Indicative Species Abundance	0.0078	1.07	16.08	165.79	Degrading
CB6.1	Pollution Sensitive Species Biomass	0.7264	0.18	27.34	16.44	No Trend
CB6.1	Pollution Indicative Species Biomass	0.0501	0.48	1.70	698.05	Degrading
CB6.4	Benthic Index of Biotic Integrity	0.8885	0.0	4.5	-3.27	No Trend
CB6.4	Total Abundance per square meter	0.0358	143.63	1640.88	218.83	Improving
CB6.4	Total Biomass per square meter	0.0999	-0.14	5.35	-67.20	Degrading
CB6.4	Shannon-Weiner Diversity Index	0.0301	0.03	2.94	22.23	Improving
CB6.4	Pollution Sensitive Species Abundance	0.7264	-0.17	49.63	-8.31	No Trend
CB6.4	Pollution Indicative Species Abundance	0.7264	-0.16	16.91	-23.91	No Trend
CB6.4	Pollution Sensitive Species Biomass	0.2342	-0.76	83.36	-22.87	No Trend
CB6.4	Pollution Indicative Species Biomass	0.6243	0.08	1.39	135.89	No Trend
CB7.3E	Benthic Index of Biotic Integrity	0.7759	0.0	4.2	0.00	No Trend
CB7.3E	Total Abundance per square meter	0.6490	-17.49	5495.04	-7.96	No Trend
CB7.3E	Total Biomass per square meter	0.3443	-0.16	12.91	-31.24	No Trend
CB7.3E	Shannon-Weiner Diversity Index	0.7796	0.00	3.72	2.66	No Trend
CB7.3E	Pollution Sensitive Species Abundance	0.9442	-0.01	49.82	-0.53	No Trend
CB7.3E	Pollution Indicative Species Abundance	0.0501	-0.46	13.76	-84.34	Improving
CB7.3E	Pollution Sensitive Species Biomass	0.6243	-0.30	63.30	-11.85	No Trend
CB7.3E	Pollution Indicative Species Biomass	0.2342	-0.06	1.62	-88.23	No Trend
CB8.1	Benthic Index of Biotic Integrity	0.5838	0.0	4.3	-2.85	No Trend
CB8.1	Total Abundance per square meter	0.1840	69.37	3129.12	55.42	No Trend
CB8.1	Total Biomass per square meter	0.8562	-0.05	12.22	-10.21	No Trend
CB8.1	Shannon-Weiner Diversity Index	0.1164	0.02	3.79	12.12	No Trend
CB8.1	Pollution Sensitive Species Abundance	0.2047	-0.34	54.87	-15.62	No Trend
CB8.1	Pollution Indicative Species Abundance	0.0217	-0.76	18.00	-105.23	Improving
CB8.1	Pollution Sensitive Species Biomass	0.0297	-1.20	82.88	-36.21	Degrading
CB8.1	Pollution Indicative Species Biomass	0.2047	-0.04	1.07	-100.66	No Trend

Appendix G. Scatterplots of the B-IBI and its component metrics

List of Figures

Figure 1. Plot of the benthic IBI against time at station TF5.5 for 1985 through 2009. 1

Figure 2. Plot of total benthic community abundance at station TF5.5 for 1985 through 2009. 2

Figure 3. Plot of total benthic community biomass at station TF5.5 for 1985 through 2009..... 3

Figure 4. Plot of pollution sensitive species abundance at station TF5.5 for 1985 through 2009..... 4

Figure 5. Plot of pollution indicative species abundance at station TF5.5 for 1985 through 2009. 5

Figure 6. Plot of pollution sensitive species biomass at station TF5.5 for 1985 through 2009. 6

Figure 7. Plot of pollution indicative species biomass at station TF5.5 for 1985 through 2009. 7

Figure 8. Plot of Shannon-Weiner diversity index at station TF5.5 for 1985 through 2009. 8

Figure 9. Plot of the benthic IBI against time at station RET5.2 for 1985 through 2009. 9

Figure 10. Plot of total benthic community abundance at station RET5.2 for 1985 through 2009. 10

Figure 11. Plot of total benthic community biomass at station RET5.2 for 1985 through 2009. 11

Figure 12. Plot of pollution sensitive species abundance at station RET5.2 for 1985 through 2009. 12

Figure 13. Plot of pollution indicative species abundance at station RET5.2 for 1985 through 2009. 13

Figure 14. Plot of pollution sensitive species biomass at station RET5.2 for 1985 through 2009. 14

Figure 15. Plot of pollution indicative species biomass at station RET5.2 for 1985 through 2009. 15

Figure 16. Plot of Shannon-Weiner diversity index at station RET5.2 for 1985 through 2009. 16

Figure 17. Plot of the benthic IBI against time at station LE5.1 for 1985 through 2009..... 17

Figure 18. Plot of total benthic community abundance at station LE5.1 for 1985 through 2009. 18

Figure 19. Plot of total benthic community biomass at station LE5.1 for 1985 through 2009. 19

Figure 20. Plot of pollution sensitive species abundance at station LE5.1 for 1985 through 2009. 20

Figure 21. Plot of pollution indicative species abundance at station LE5.1 for 1985 through 2009. 21

Figure 22. Plot of pollution sensitive species biomass at station LE5.1 for 1985 through 2009. 22

Figure 23. Plot of pollution indicative species biomass at station LE5.1 for 1985 through 2009. 23

Figure 24. Plot of Shannon-Weiner diversity index at station LE5.1 for 1985 through 2009. 24

Figure 25. Plot of the benthic IBI against time at station LE5.2 for 1985 through 2009..... 25

Figure 26. Plot of total benthic community abundance at station LE5.2 for 1985 through 2009. 26

Figure 27. Plot of total benthic community biomass at station LE5.2 for 1985 through 2009. 27

Figure 28. Plot of pollution sensitive species abundance at station LE5.2 for 1985 through 2009. 28

Figure 29. Plot of pollution indicative species abundance at station LE5.2 for 1985 through 2009. 29

Figure 30. Plot of pollution sensitive species biomass at station LE5.2 for 1985 through 2009. 30

Figure 31. Plot of pollution indicative species biomass at station LE5.2 for 1985 through 2009. 31

Figure 32. Plot of Shannon-Weiner diversity index at station LE5.2 for 1985 through 2009. 32

Figure 33. Plot of the benthic IBI against time at station LE5.4 for 1985 through 2009. 33

Figure 34. Plot of total benthic community abundance at station LE5.4 for 1985 through 2009. 34

Figure 35. Plot of total benthic community biomass at station LE5.4 for 1985 through 2009. 35

Figure 36. Plot of pollution sensitive species abundance at station LE5.4 for 1985 through 2009. 36

Figure 37. Plot of pollution indicative species abundance at station LE5.4 for 1985 through 2009. 37

Figure 38. Plot of pollution sensitive species biomass at station LE5.4 for 1985 through 2009. 38

Figure 39. Plot of pollution indicative species biomass at station LE5.4 for 1985 through 2009. 39

Figure 40. Plot of Shannon-Weiner diversity index at station LE5.4 for 1985 through 2009. 40

Figure 41. Plot of the benthic IBI against time at station SBE2 for 1985 through 2009. 41

Figure 42. Plot of total benthic community abundance at station SBE2 for 1985 through 2009. 42

Figure 43. Plot of total benthic community biomass at station SBE2 for 1985 through 2009. 43

Figure 44. Plot of pollution sensitive species abundance at station SBE2 for 1985 through 2009. 44

Figure 45. Plot of pollution indicative species abundance at station SBE2 for 1985 through 2009. 45

Figure 46. Plot of pollution sensitive species biomass at station SBE2 for 1985 through 2009. 46

Figure 47. Plot of pollution indicative species biomass at station SBE2 for 1985 through 2009. 47

Figure 48. Plot of Shannon-Weiner diversity index at station SBE2 for 1985 through 2009. 48

Figure 49. Plot of the benthic IBI against time at station SBE5 for 1985 through 2009. 49

Figure 50. Plot of total benthic community abundance at station SBE5 for 1985 through 2009. 50

Figure 51. Plot of total benthic community biomass at station SBE5 for 1985 through 2009. 51

Figure 52. Plot of pollution sensitive species abundance at station SBE5 for 1985 through 2009. 52

Figure 53. Plot of pollution indicative species abundance at station SBE5 for 1985 through 2009. 53

Figure 54. Plot of pollution sensitive species biomass at station SBE5 for 1985 through 2009. 54

Figure 55. Plot of pollution indicative species biomass at station SBE5 for 1985 through 2009..... 55

Figure 56. Plot of Shannon-Weiner diversity index at station SBE5 for 1985 through 2009. 56

Figure 57. Plot of the benthic IBI against time at station TF4.2 for 1985 through 2009. 57

Figure 58. Plot of total benthic community abundance at station TF4.2 for 1985 through 2009. 58

Figure 59. Plot of total benthic community biomass at station TF4.2 for 1985 through 2009..... 59

Figure 60. Plot of pollution sensitive species abundance at station TF4.2 for 1985 through 2009. 60

Figure 61. Plot of pollution indicative species abundance at station TF4.2 for 1985 through 2009. 61

Figure 62. Plot of pollution sensitive species biomass at station TF4.2 for 1985 through 2009. 62

Figure 63. Plot of pollution indicative species biomass at station TF4.2 for 1985 through 2009..... 63

Figure 64. Plot of Shannon-Weiner diversity index at station TF4.2 for 1985 through 2009. 64

Figure 65. Plot of the benthic IBI against time at station RET4.3 for 1985 through 2009. 65

Figure 66. Plot of total benthic community abundance at station RET4.3 for 1985 through 2009. 66

Figure 67. Plot of total benthic community biomass at station RET4.3 for 1985 through 2009. 67

Figure 68. Plot of pollution sensitive species abundance at station RET4.3 for 1985 through 2009. 68

Figure 69. Plot of pollution indicative species abundance at station RET4.3 for 1985 through 2009. 69

Figure 70. Plot of pollution sensitive species biomass at station RET4.3 for 1985 through 2009. 70

Figure 71. Plot of pollution indicative species biomass at station RET4.3 for 1985 through 2009. 71

Figure 72. Plot of Shannon-Weiner diversity index at station RET4.3 for 1985 through 2009. 72

Figure 73. Plot of the benthic IBI against time at station LE4.1 for 1985 through 2009..... 73

Figure 74. Plot of total benthic community abundance at station LE4.1 for 1985 through 2009. 74

Figure 75. Plot of total benthic community biomass at station LE4.1 for 1985 through 2009..... 75

Figure 76. Plot of pollution sensitive species abundance at station LE4.1 for 1985 through 2009. 76

Figure 77. Plot of pollution indicative species abundance at station LE4.1 for 1985 through 2009. 77

Figure 78. Plot of pollution sensitive species biomass at station LE4.1 for 1985 through 2009. 78

Figure 79. Plot of pollution indicative species biomass at station LE4.1 for 1985 through 2009. 79

Figure 80. Plot of Shannon-Weiner diversity index at station LE4.1 for 1985 through 2009. 80

Figure 81. Plot of the benthic IBI against time at station LE4.3 for 1985 through 2009. 81

Figure 82. Plot of total benthic community abundance at station LE4.3 for 1985 through 2009. 82

Figure 83. Plot of total benthic community biomass at station LE4.3 for 1985 through 2009. 83

Figure 84. Plot of pollution sensitive species abundance at station LE4.3 for 1985 through 2009. 84

Figure 85. Plot of pollution indicative species abundance at station LE4.3 for 1985 through 2009. 85

Figure 86. Plot of pollution sensitive species biomass at station LE4.3 for 1985 through 2009. 86

Figure 87. Plot of pollution indicative species biomass at station LE4.3 for 1985 through 2009. 87

Figure 88. Plot of Shannon-Weiner diversity index at station LE4.3 for 1985 through 2009. 88

Figure 89. Plot of the benthic IBI against time at station LE4.3B for 1985 through 2009. 89

Figure 90. Plot of total benthic community abundance at station LE4.3B for 1985 through 2009. 90

Figure 91. Plot of total benthic community biomass at station LE4.3B for 1985 through 2009. 91

Figure 92. Plot of pollution sensitive species abundance at station LE4.3B for 1985 through 2009. 92

Figure 93. Plot of pollution indicative species abundance at station LE4.3B for 1985 through 2009. 93

Figure 94. Plot of pollution sensitive species biomass at station LE4.3B for 1985 through 2009. 94

Figure 95. Plot of pollution indicative species biomass at station LE4.3B for 1985 through 2009. 95

Figure 96. Plot of Shannon-Weiner diversity index at station LE4.3B for 1985 through 2009. 96

Figure 97. Plot of the benthic IBI against time at station TF3.3 for 1985 through 2009. 97

Figure 98. Plot of total benthic community abundance at station TF3.3 for 1985 through 2009. 98

Figure 99. Plot of total benthic community biomass at station TF3.3 for 1985 through 2009. 99

Figure 100. Plot of pollution sensitive species abundance at station TF3.3 for 1985 through 2009. 100

Figure 101. Plot of pollution indicative species abundance at station TF3.3 for 1985 through 2009. 101

Figure 102. Plot of pollution sensitive species biomass at station TF3.3 for 1985 through 2009. 102

Figure 103. Plot of pollution indicative species biomass at station TF3.3 for 1985 through 2009. 103

Figure 104. Plot of Shannon-Weiner diversity index at station TF3.3 for 1985 through 2009. 104

Figure 105. Plot of the benthic IBI against time at station RET3.1 for 1985 through 2009. 105

Figure 106. Plot of total benthic community abundance at station RET3.1 for 1985 through 2009. 106

Figure 107. Plot of total benthic community biomass at station RET3.1 for 1985 through 2009. 107

Figure 108. Plot of pollution sensitive species abundance at station RET3.1 for 1985 through 2009. 108

Figure 109. Plot of pollution indicative species abundance at station RET3.1 for 1985 through 2009. 109

Figure 110. Plot of pollution sensitive species biomass at station RET3.1 for 1985 through 2009. 110

Figure 111. Plot of pollution indicative species biomass at station RET3.1 for 1985 through 2009. 111

Figure 112. Plot of Shannon-Weiner diversity index at station RET3.1 for 1985 through 2009. 112

Figure 113. Plot of the benthic IBI against time at station LE3.2 for 1985 through 2009. 113

Figure 114. Plot of total benthic community abundance at station LE3.2 for 1985 through 2009. 114

Figure 115. Plot of total benthic community biomass at station LE3.2 for 1985 through 2009. 115

Figure 116. Plot of pollution sensitive species abundance at station LE3.2 for 1985 through 2009. 116

Figure 117. Plot of pollution indicative species abundance at station LE3.2 for 1985 through 2009. 117

Figure 118. Plot of pollution sensitive species biomass at station LE3.2 for 1985 through 2009. 118

Figure 119. Plot of pollution indicative species biomass at station LE3.2 for 1985 through 2009. 119

Figure 120. Plot of Shannon-Weiner diversity index at station LE3.2 for 1985 through 2009. 120

Figure 121. Plot of the benthic IBI against time at station LE3.4 for 1985 through 2009. 121

Figure 122. Plot of total benthic community abundance at station LE3.4 for 1985 through 2009. 122

Figure 123. Plot of total benthic community biomass at station LE3.4 for 1985 through 2009. 123

Figure 124. Plot of pollution sensitive species abundance at station LE3.4 for 1985 through 2009. 124

Figure 125. Plot of pollution indicative species abundance at station LE3.4 for 1985 through 2009. 125

Figure 126. Plot of pollution sensitive species biomass at station LE3.4 for 1985 through 2009. 126

Figure 127. Plot of pollution indicative species biomass at station LE3.4 for 1985 through 2009. 127

Figure 128. Plot of Shannon-Weiner diversity index at station LE3.4 for 1985 through 2009. 128

Figure 129. Plot of the benthic IBI against time at station CB5.4 for 1985 through 2009. 129

Figure 130. Plot of total benthic community abundance at station CB5.4 for 1985 through 2009. 130

Figure 131. Plot of total benthic community biomass at station CB5.4 for 1985 through 2009. 131

Figure 132. Plot of pollution sensitive species abundance at station CB5.4 for 1985 through 2009. 132

Figure 133. Plot of pollution indicative species abundance at station CB5.4 for 1985 through 2009. 133

Figure 134. Plot of pollution sensitive species biomass at station CB5.4 for 1985 through 2009. 134

Figure 135. Plot of pollution indicative species biomass at station CB5.4 for 1985 through 2009. 135

Figure 136. Plot of Shannon-Weiner diversity index at station CB5.4 for 1985 through 2009. 136

Figure 137. Plot of the benthic IBI against time at station CB6.1 for 1985 through 2009. 137

Figure 138. Plot of total benthic community abundance at station CB6.1 for 1985 through 2009. 138

Figure 139. Plot of total benthic community biomass at station CB6.1 for 1985 through 2009. 139

Figure 140. Plot of pollution sensitive species abundance at station CB6.1 for 1985 through 2009. 140

Figure 141. Plot of pollution indicative species abundance at station CB6.1 for 1985 through 2009. 141

Figure 142. Plot of pollution sensitive species biomass at station CB6.1 for 1985 through 2009. 142

Figure 143. Plot of pollution indicative species biomass at station CB6.1 for 1985 through 2009. 143

Figure 144. Plot of Shannon-Weiner diversity index at station CB6.1 for 1985 through 2009. 144

Figure 145. Plot of the benthic IBI against time at station CB6.4 for 1985 through 2009. 145

Figure 146. Plot of total benthic community abundance at station CB6.4 for 1985 through 2009. 146

Figure 147. Plot of total benthic community biomass at station CB6.4 for 1985 through 2009. 147

Figure 148. Plot of pollution sensitive species abundance at station CB6.4 for 1985 through 2009. 148

Figure 149. Plot of pollution indicative species abundance at station CB6.4 for 1985 through 2009. 149

Figure 150. Plot of pollution sensitive species biomass at station CB6.4 for 1985 through 2009. 150

Figure 151. Plot of pollution indicative species biomass at station CB6.4 for 1985 through 2009. 151

Figure 152. Plot of Shannon-Weiner diversity index at station CB6.4 for 1985 through 2009. 152

Figure 153. Plot of the benthic IBI against time at station CB7.3E for 1985 through 2009. 153

Figure 154. Plot of total benthic community abundance at station CB7.3E for 1985 through 2009. 154

Figure 155. Plot of total benthic community biomass at station CB7.3E for 1985 through 2009. 155

Figure 156. Plot of pollution sensitive species abundance at station CB7.3E for 1985 through 2009. 156

Figure 157. Plot of pollution indicative species abundance at station CB7.3E for 1985 through 2009. 157

Figure 158. Plot of pollution sensitive species biomass at station CB7.3E for 1985 through 2009. 158

Figure 159. Plot of pollution indicative species biomass at station CB7.3E for 1985 through 2009. 159

Figure 160. Plot of Shannon-Weiner diversity index at station CB7.3E for 1985 through 2009. 160

Figure 161. Plot of the benthic IBI against time at station CB8.1 for 1985 through 2009. 161

Figure 162. Plot of total benthic community abundance at station CB8.1 for 1985 through 2009. 162

Figure 163. Plot of total benthic community biomass at station CB8.1 for 1985 through 2009. 163

Figure 164. Plot of pollution sensitive species abundance at station CB8.1 for 1985 through 2009. 164

Figure 165. Plot of pollution indicative species abundance at station CB8.1 for 1985 through 2009. 165

Figure 166. Plot of pollution sensitive species biomass at station CB8.1 for 1985 through 2009. 166

Figure 167. Plot of pollution indicative species biomass at station CB8.1 for 1985 through 2009. 167

Figure 168. Plot of Shannon-Weiner diversity index at station CB8.1 for 1985 through 2009. 168

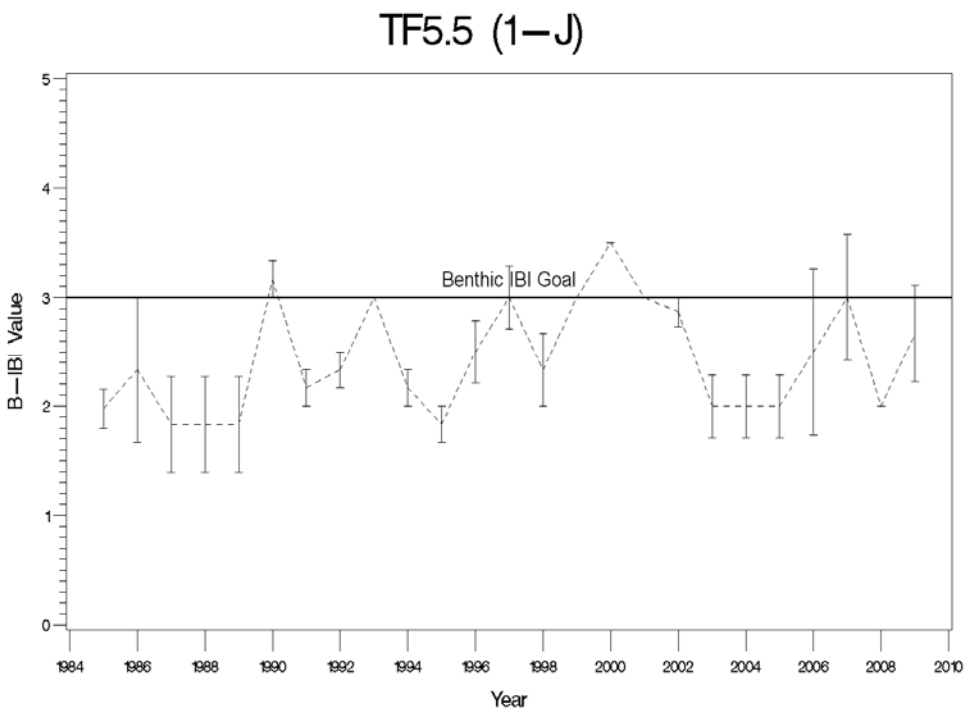


Figure 1. Plot of the benthic IBI against time at station TF5.5 for 1985 through 2009.

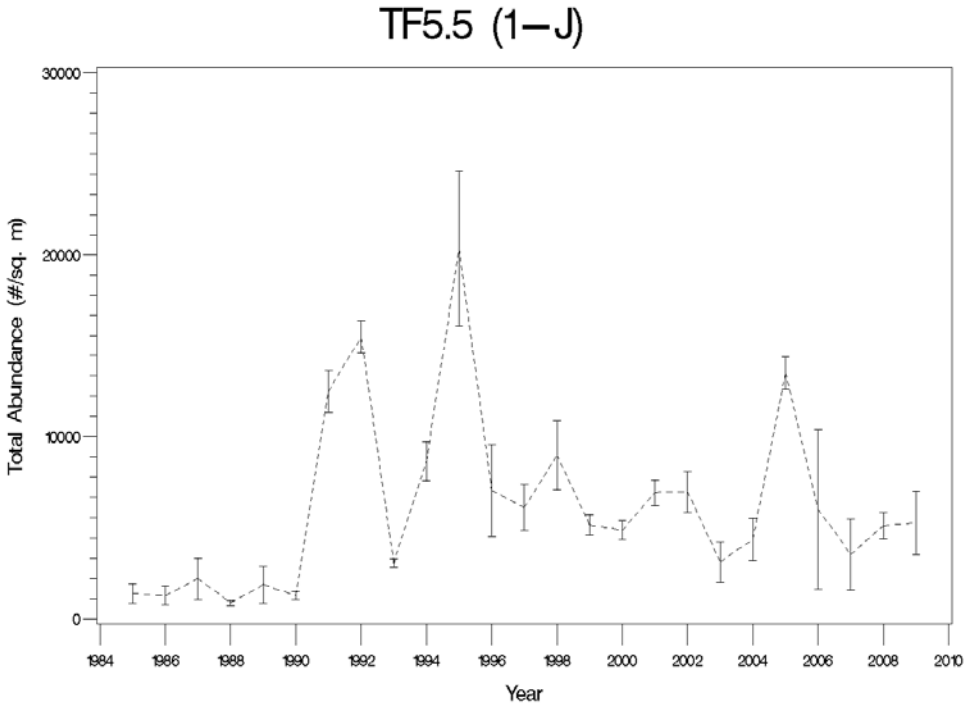


Figure 2. Plot of total benthic community abundance at station TF5.5 for 1985 through 2009.

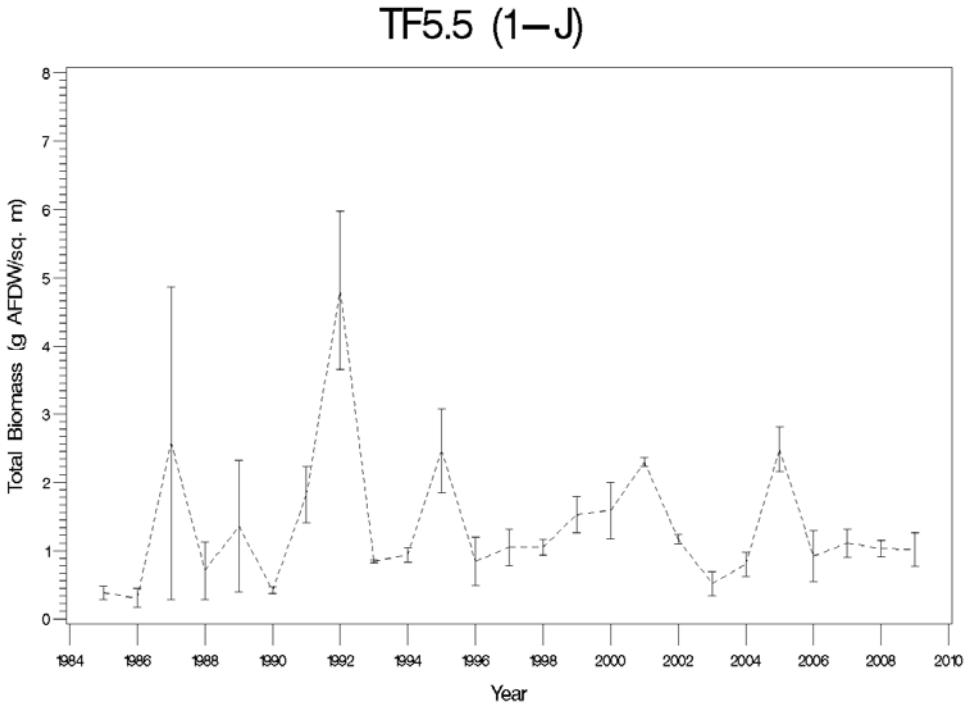


Figure 3. Plot of total benthic community biomass at station TF5.5 for 1985 through 2009.

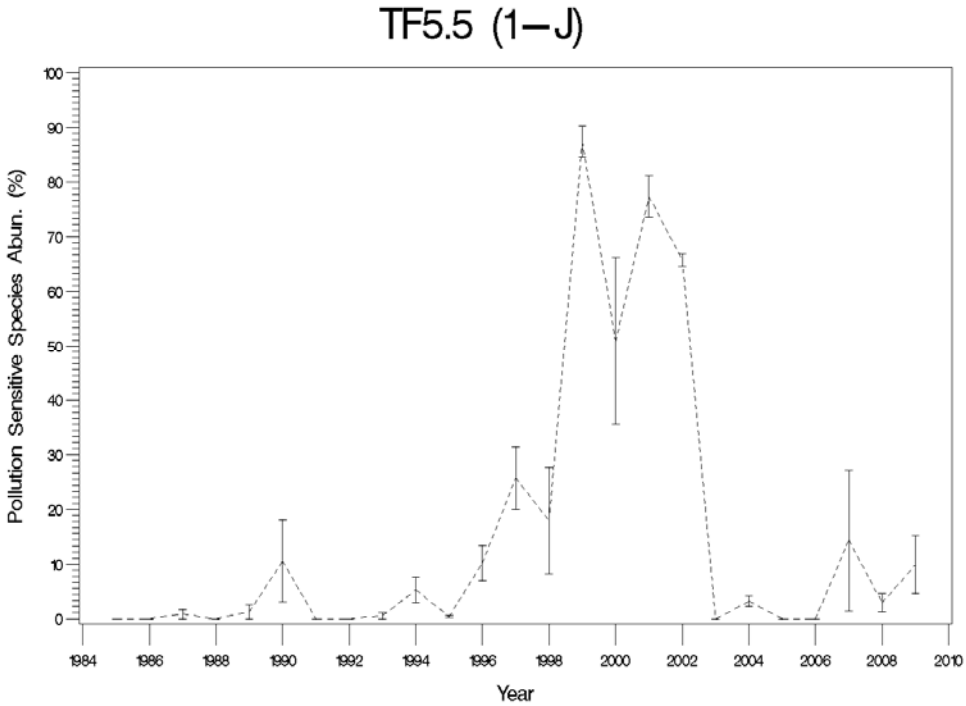


Figure 4. Plot of pollution sensitive species abundance at station TF5.5 for 1985 through 2009.

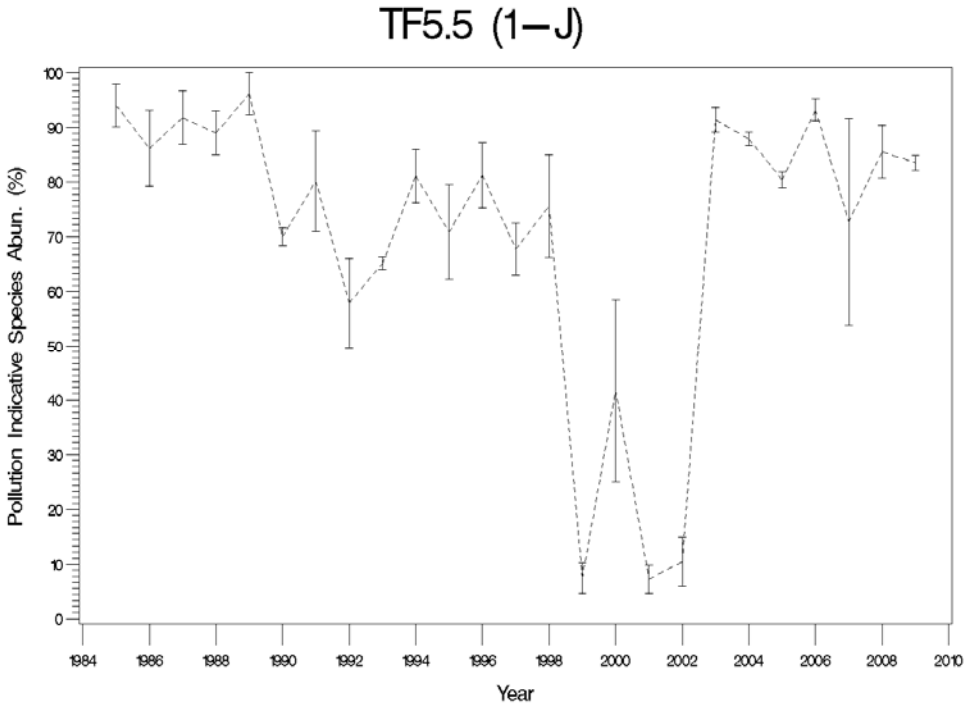


Figure 5. Plot of pollution indicative species abundance at station TF5.5 for 1985 through 2009.

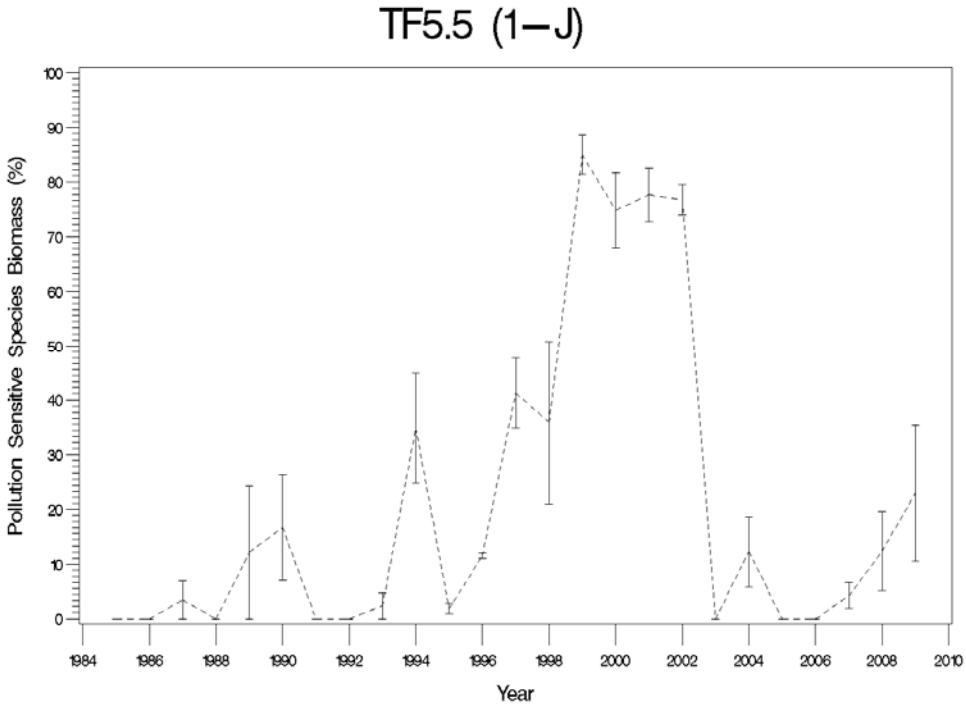


Figure 6. Plot of pollution sensitive species biomass at station TF5.5 for 1985 through 2009.

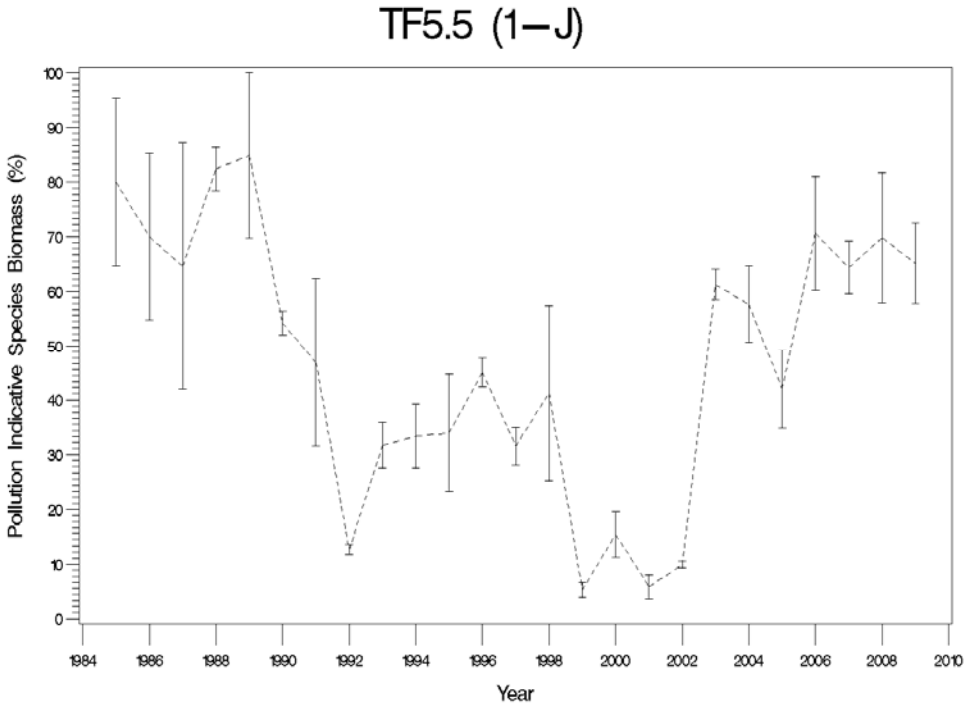


Figure 7. Plot of pollution indicative species biomass at station TF5.5 for 1985 through 2009.

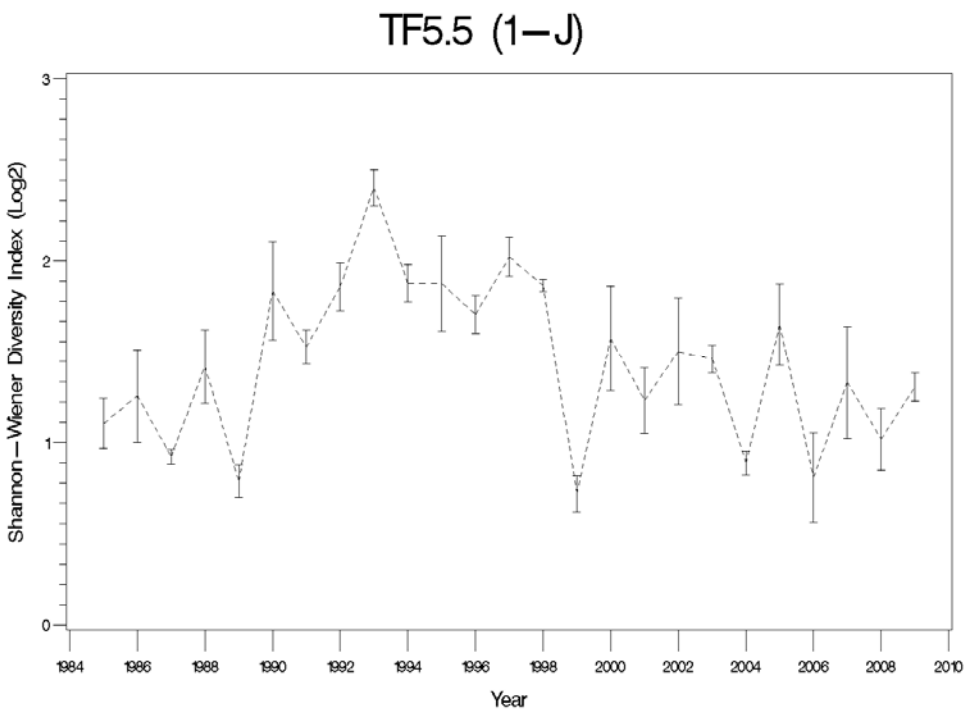


Figure 8. Plot of Shannon-Weiner diversity index at station TF5.5 for 1985 through 2009.

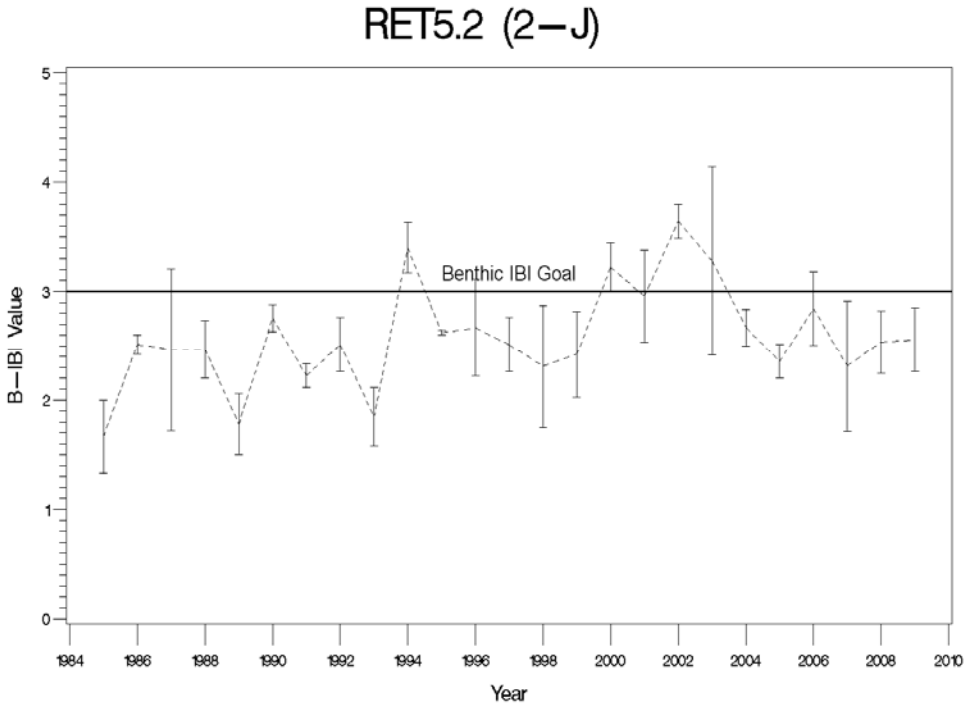


Figure 9. Plot of the benthic IBI against time at station RET5.2 for 1985 through 2009.

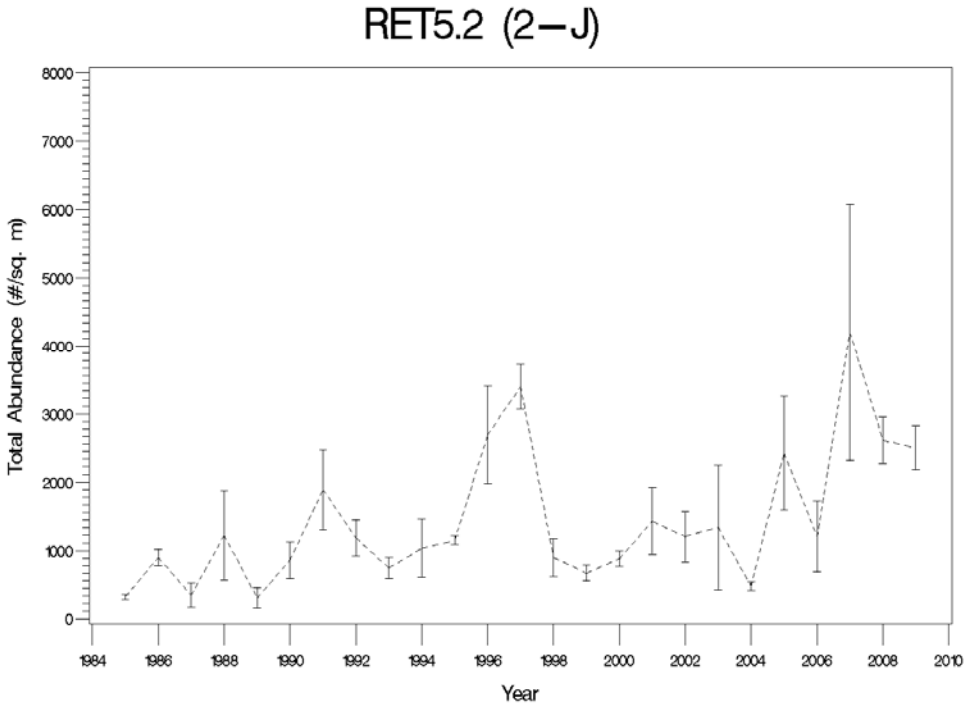


Figure 10. Plot of total benthic community abundance at station RET5.2 for 1985 through 2009.

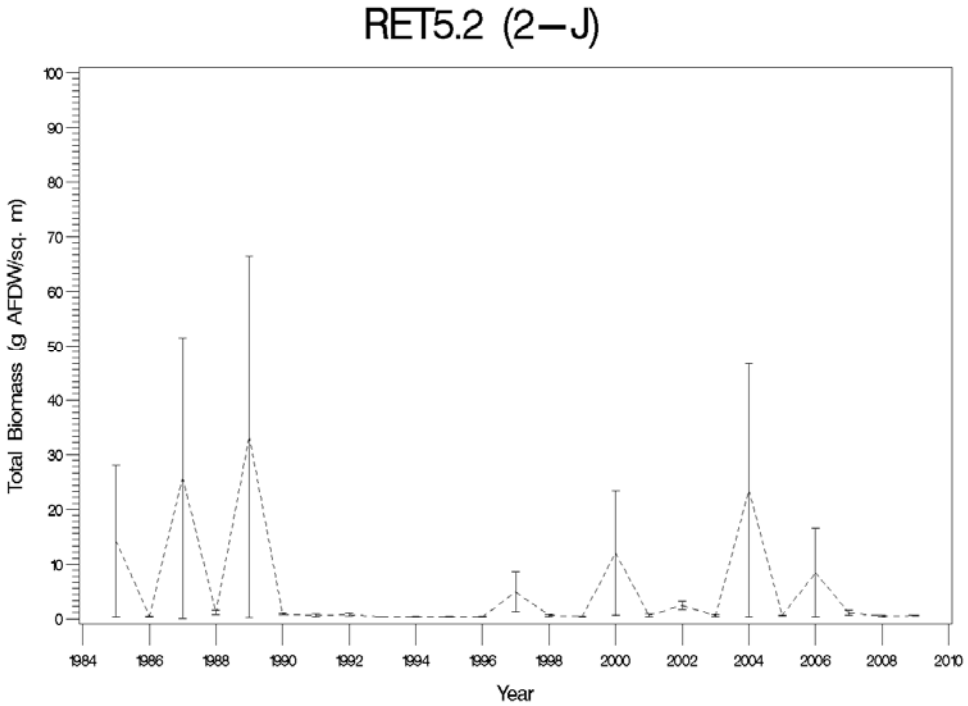


Figure 11. Plot of total benthic community biomass at station RET5.2 for 1985 through 2009.

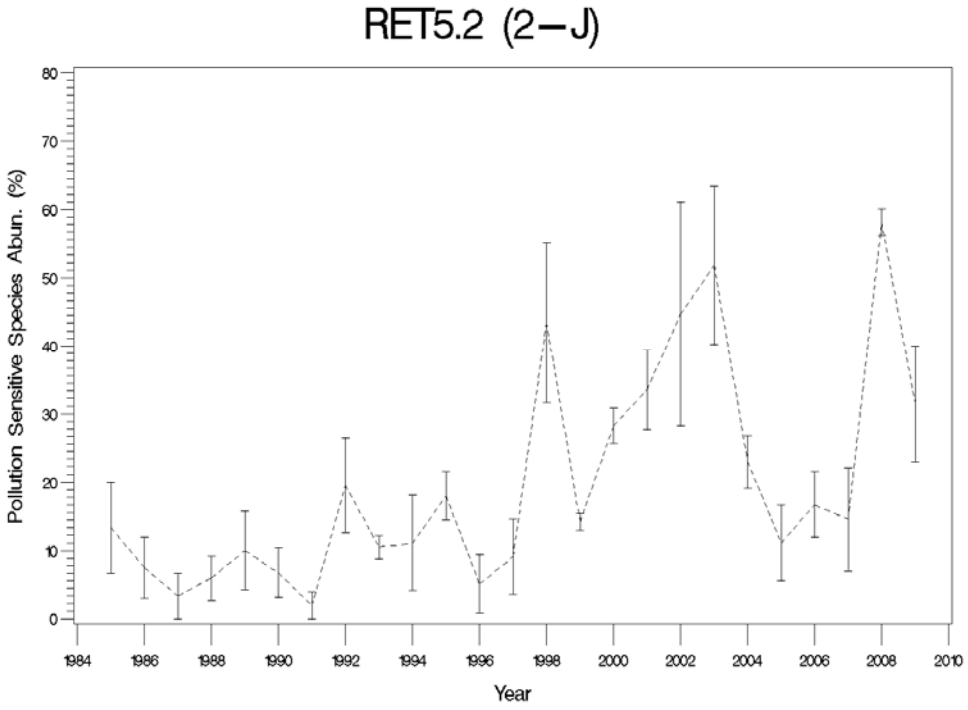


Figure 12. Plot of pollution sensitive species abundance at station RET5.2 for 1985 through 2009.

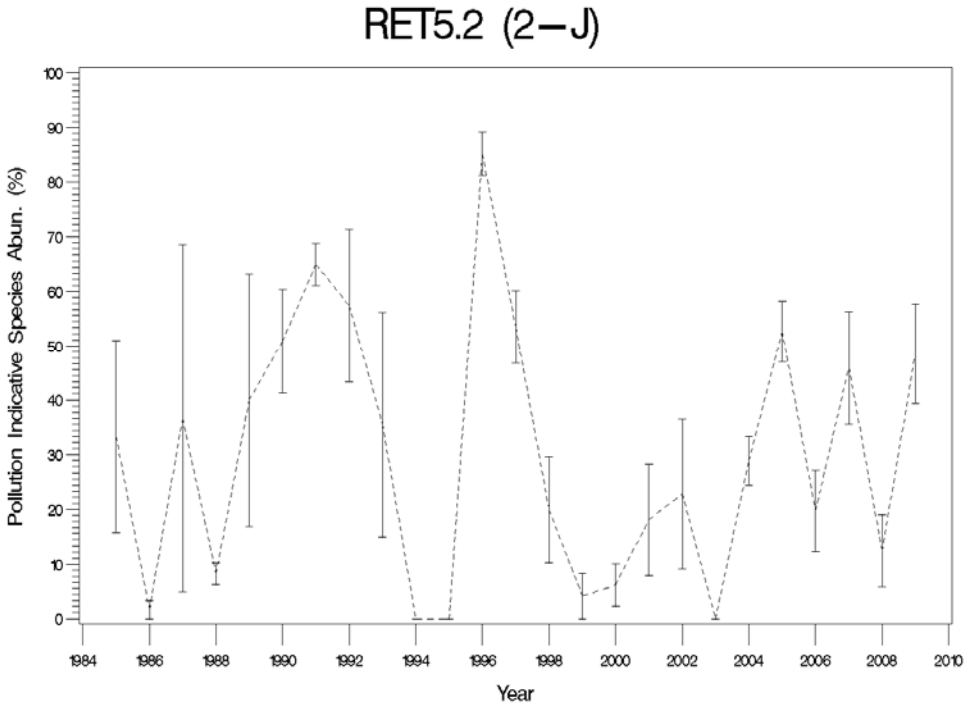


Figure 13. Plot of pollution indicative species abundance at station RET5.2 for 1985 through 2009.

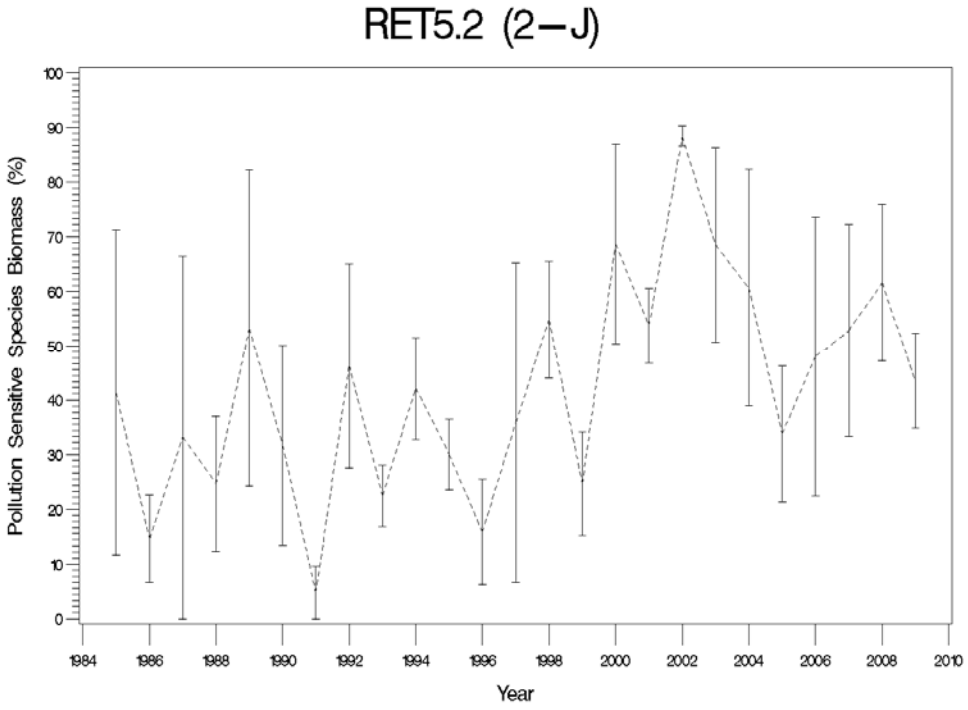


Figure 14. Plot of pollution sensitive species biomass at station RET5.2 for 1985 through 2009.

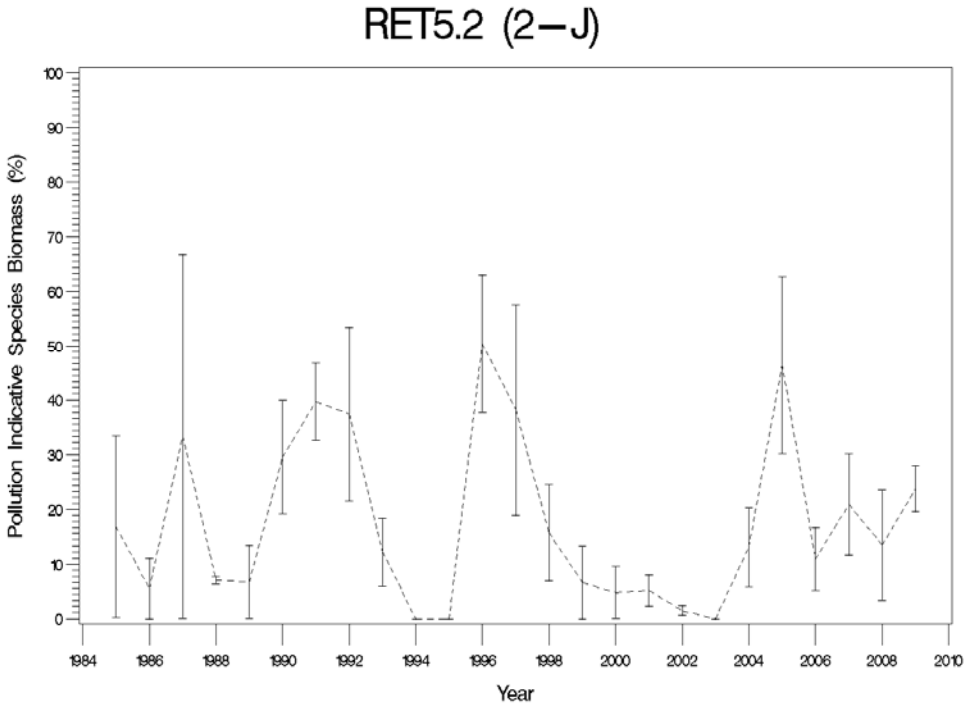


Figure 15. Plot of pollution indicative species biomass at station RET5.2 for 1985 through 2009.

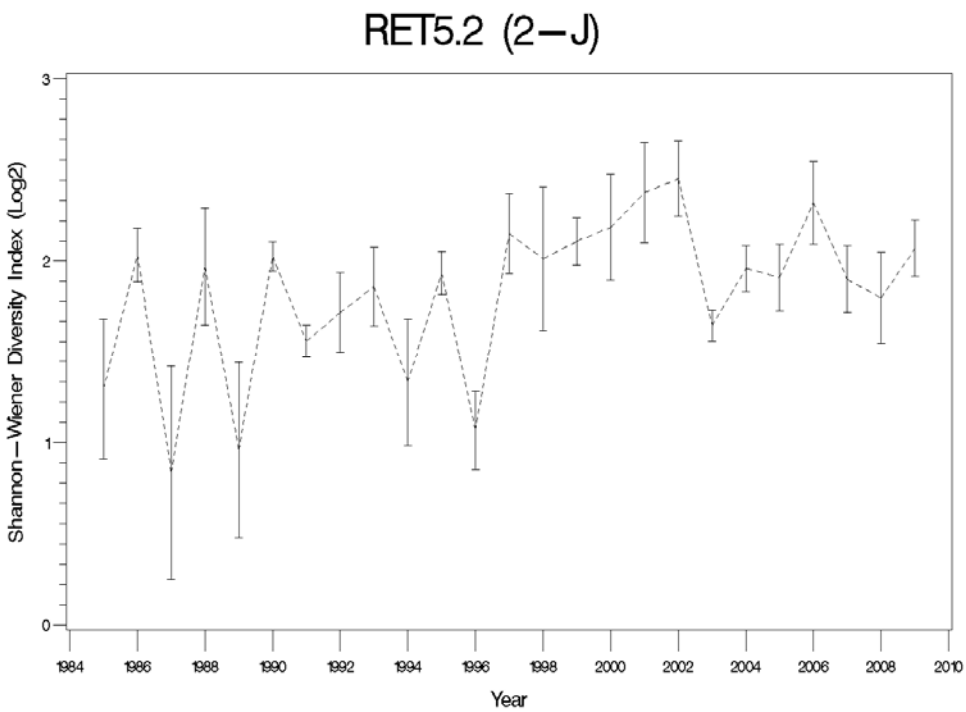


Figure 16. Plot of Shannon-Weiner diversity index at station RET5.2 for 1985 through 2009.

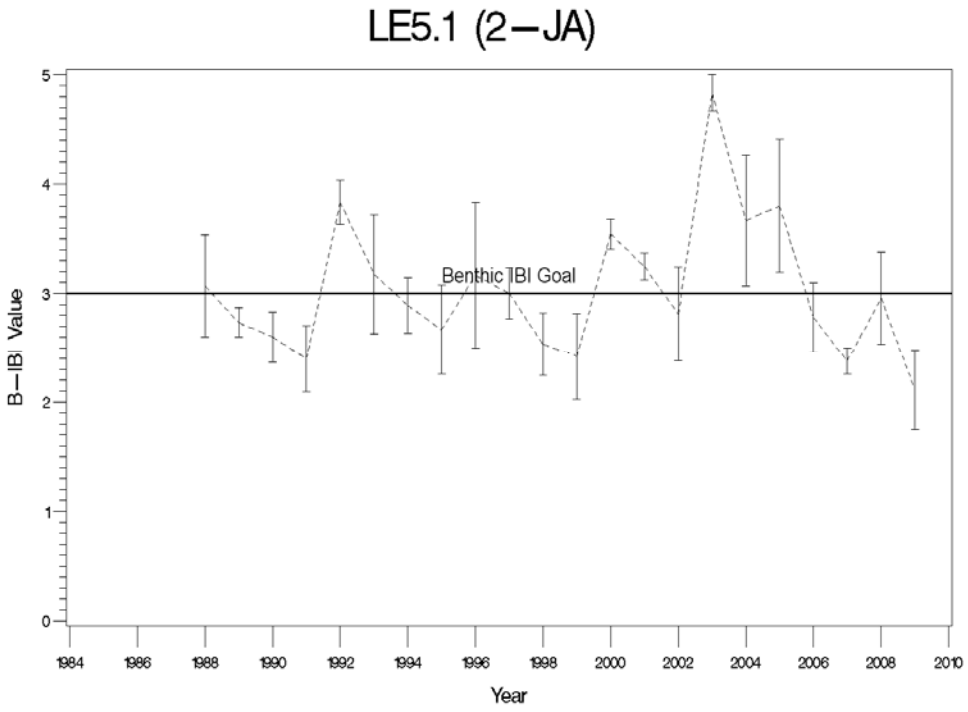


Figure 17. Plot of the benthic IBI against time at station LE5.1 for 1985 through 2009.

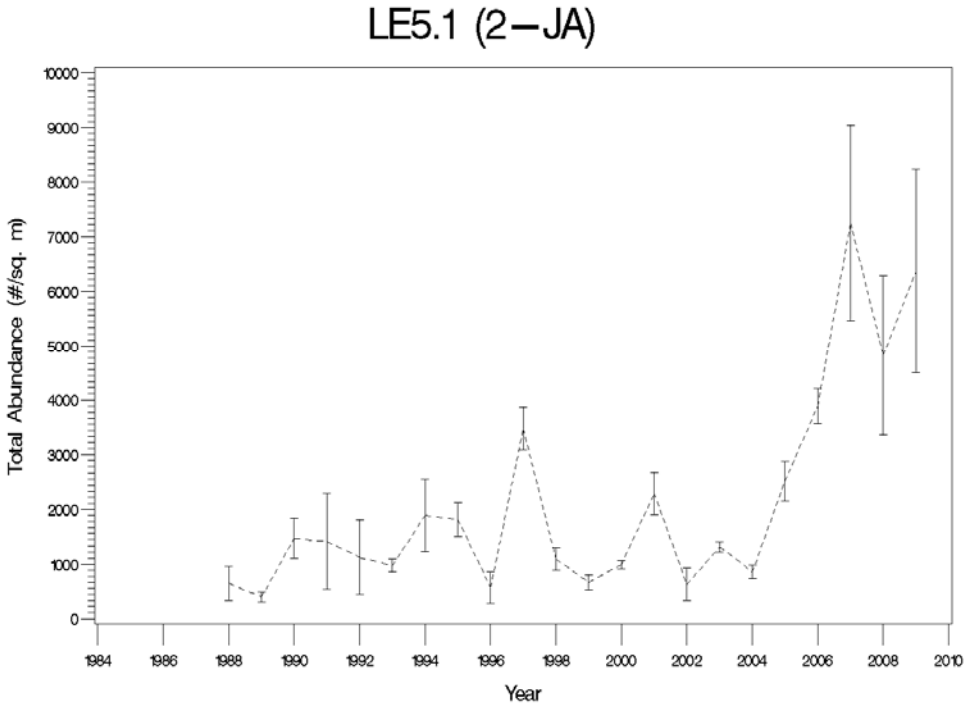


Figure 18. Plot of total benthic community abundance at station LE5.1 for 1985 through 2009.

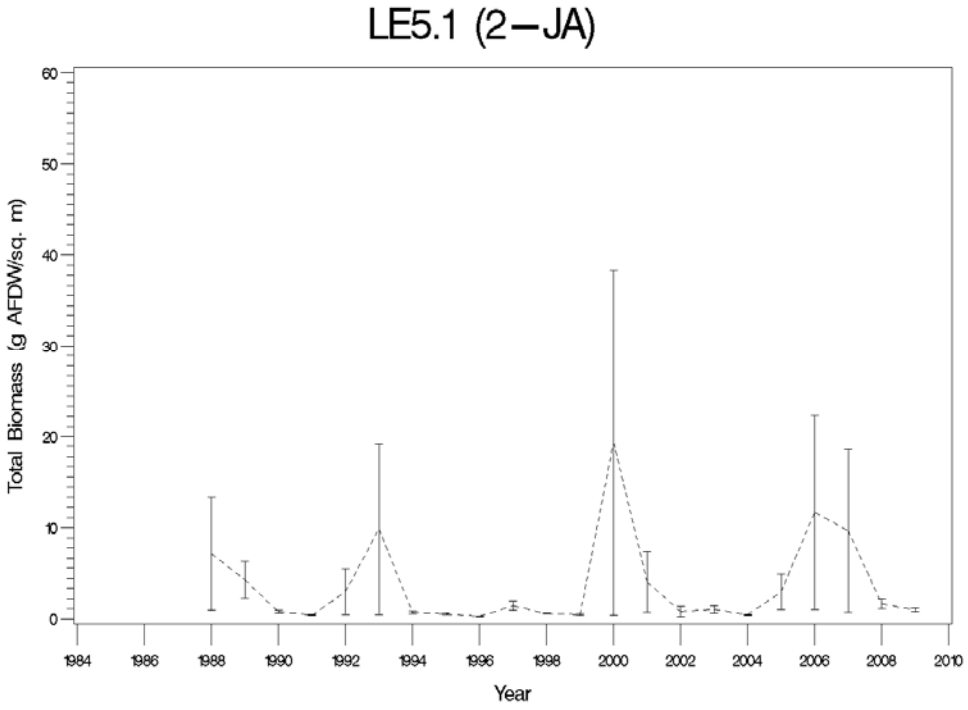


Figure 19. Plot of total benthic community biomass at station LE5.1 for 1985 through 2009.

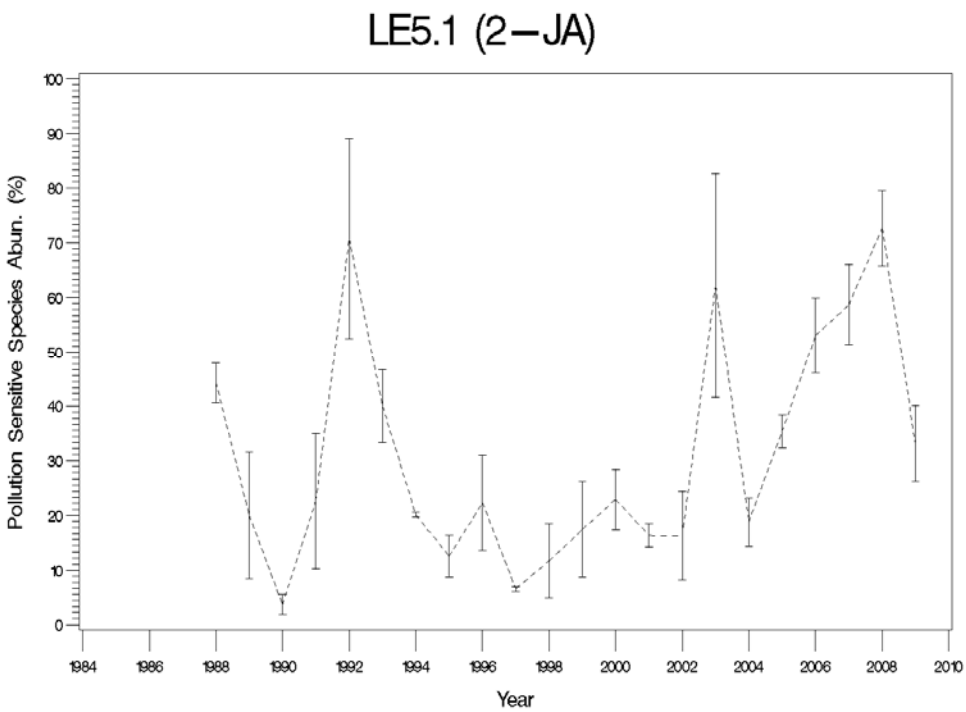


Figure 20. Plot of pollution sensitive species abundance at station LE5.1 for 1985 through 2009.

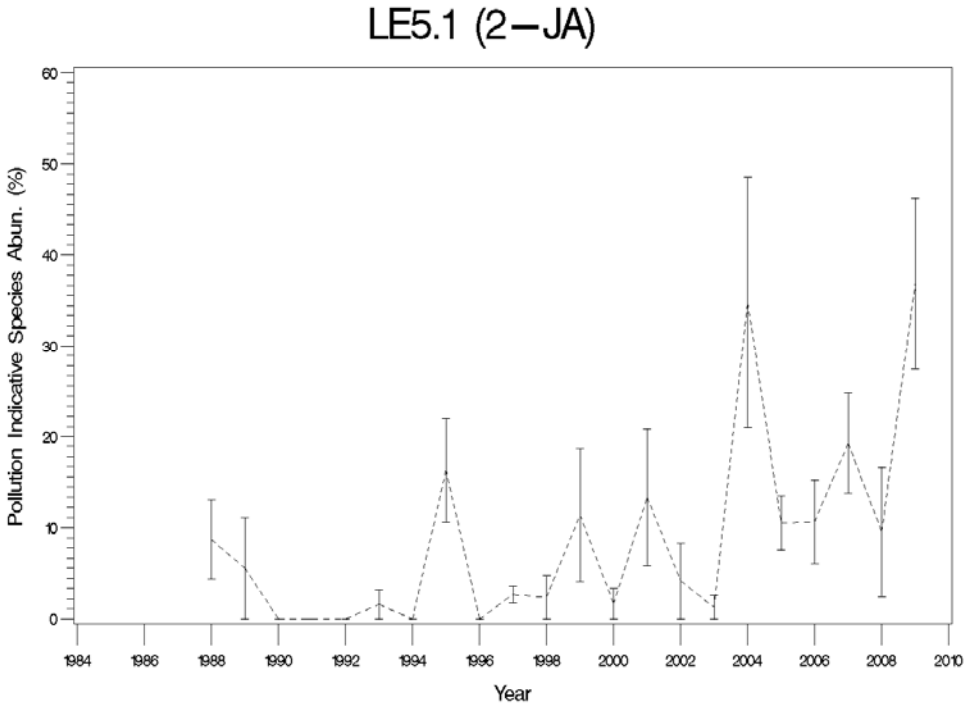


Figure 21. Plot of pollution indicative species abundance at station LE5.1 for 1985 through 2009.

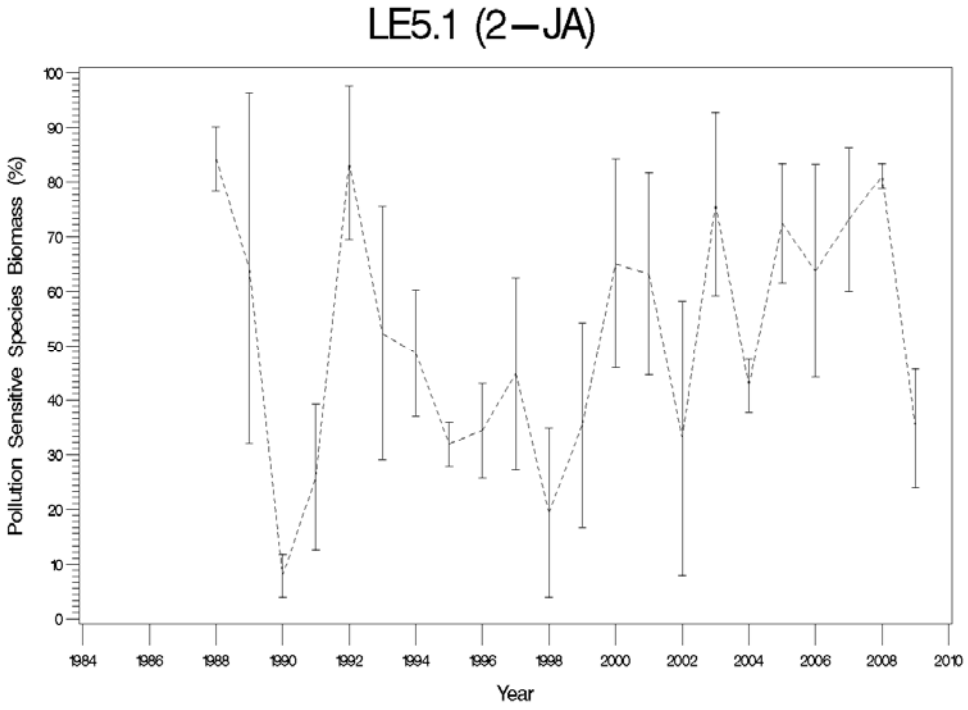


Figure 22. Plot of pollution sensitive species biomass at station LE5.1 for 1985 through 2009.

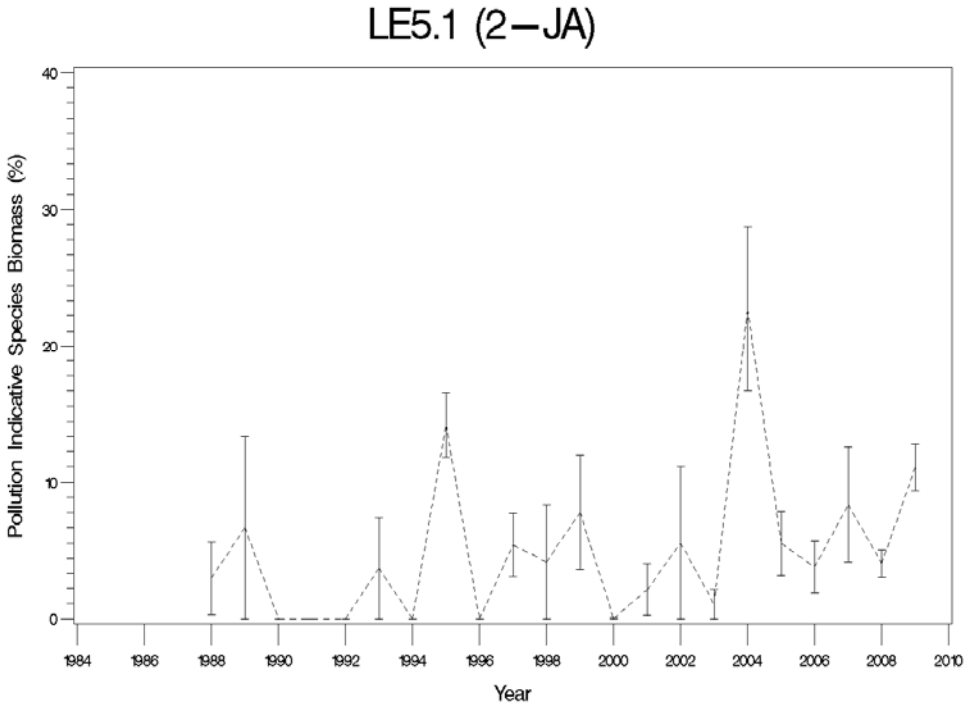


Figure 23. Plot of pollution indicative species biomass at station LE5.1 for 1985 through 2009.

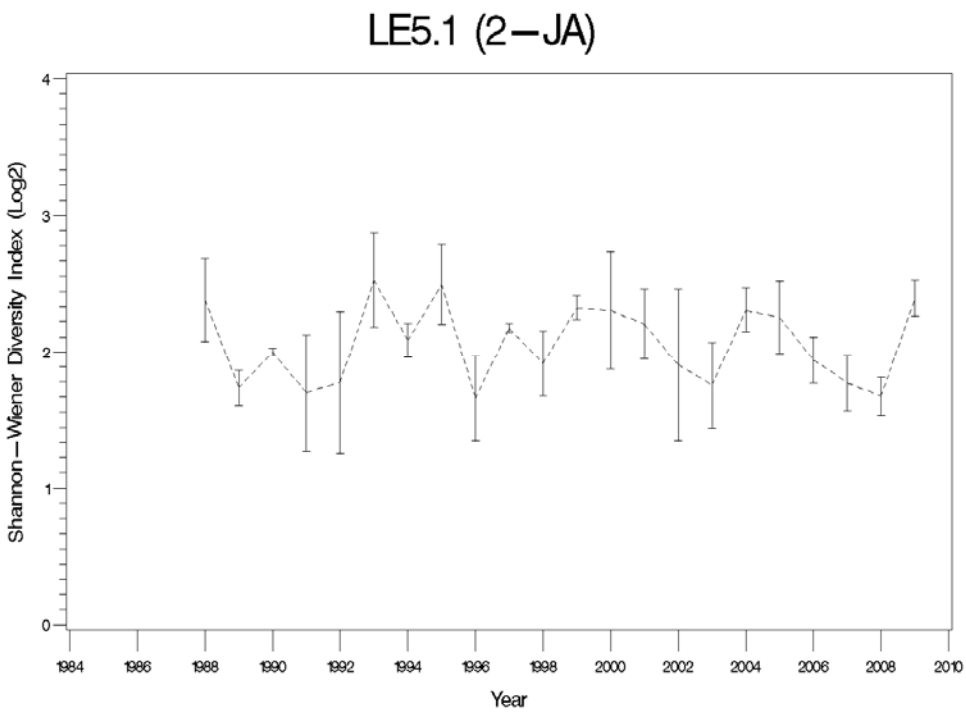


Figure 24. Plot of Shannon-Weiner diversity index at station LE5.1 for 1985 through 2009.

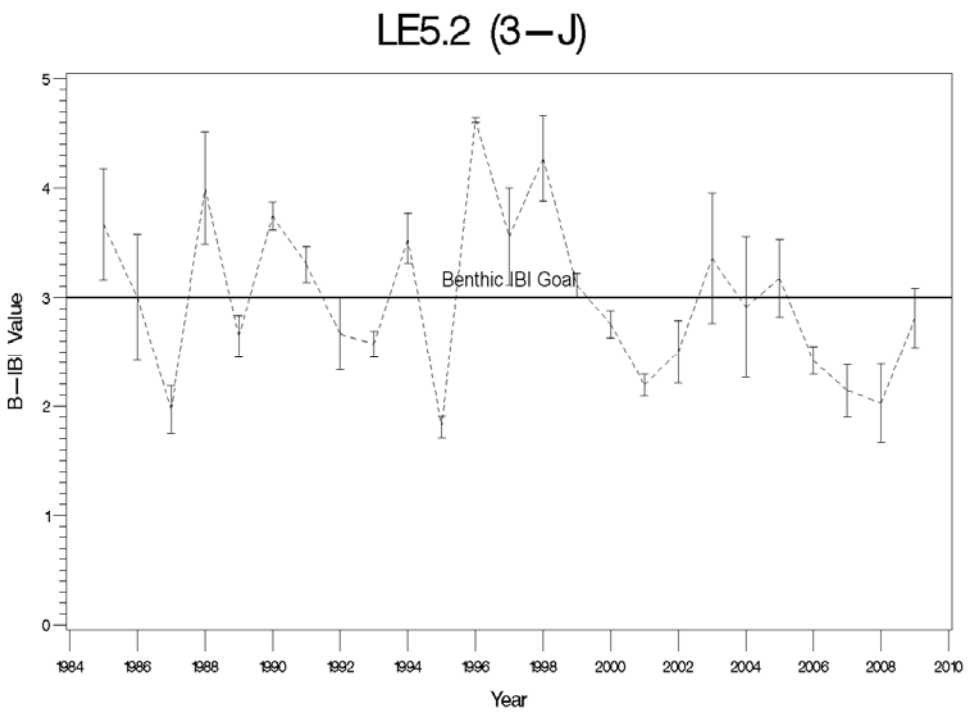


Figure 25. Plot of the benthic IBI against time at station LE5.2 for 1985 through 2009.

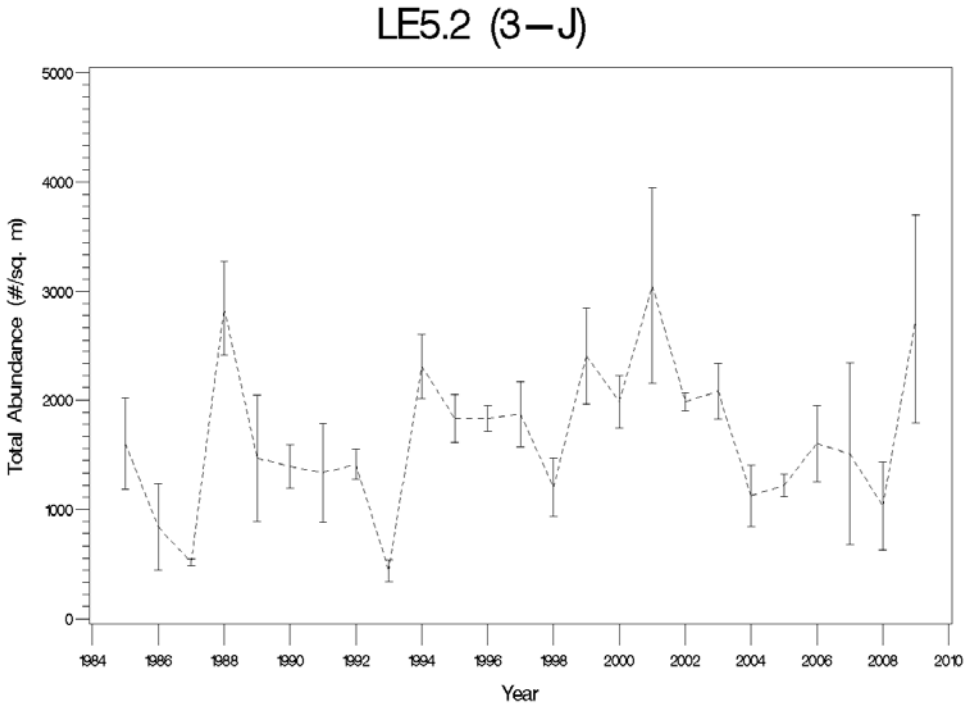


Figure 26. Plot of total benthic community abundance at station LE5.2 for 1985 through 2009.

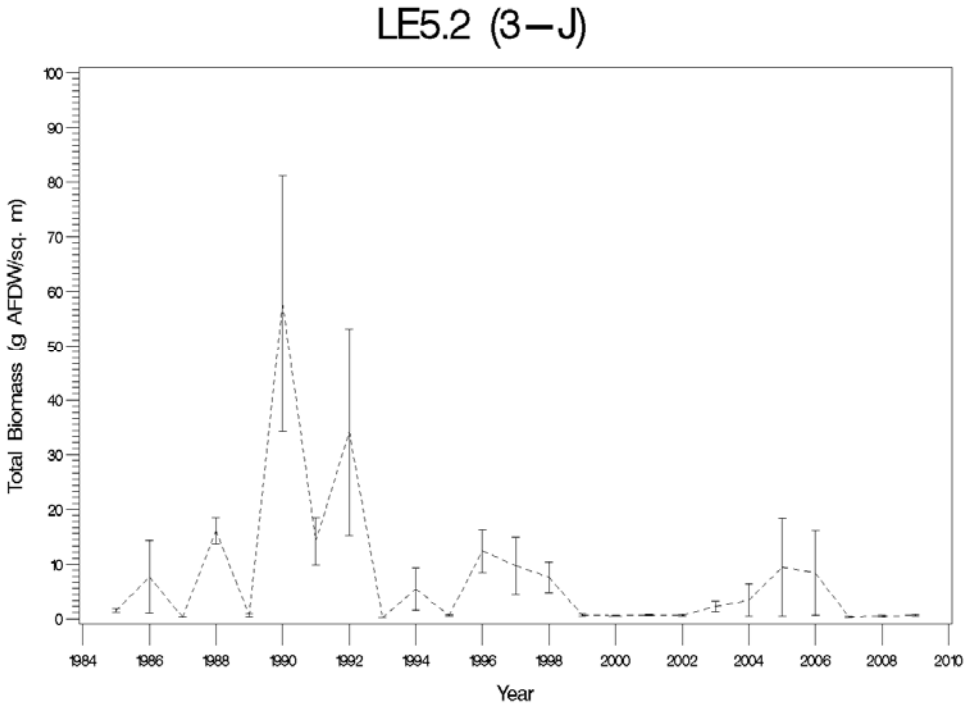


Figure 27. Plot of total benthic community biomass at station LE5.2 for 1985 through 2009.

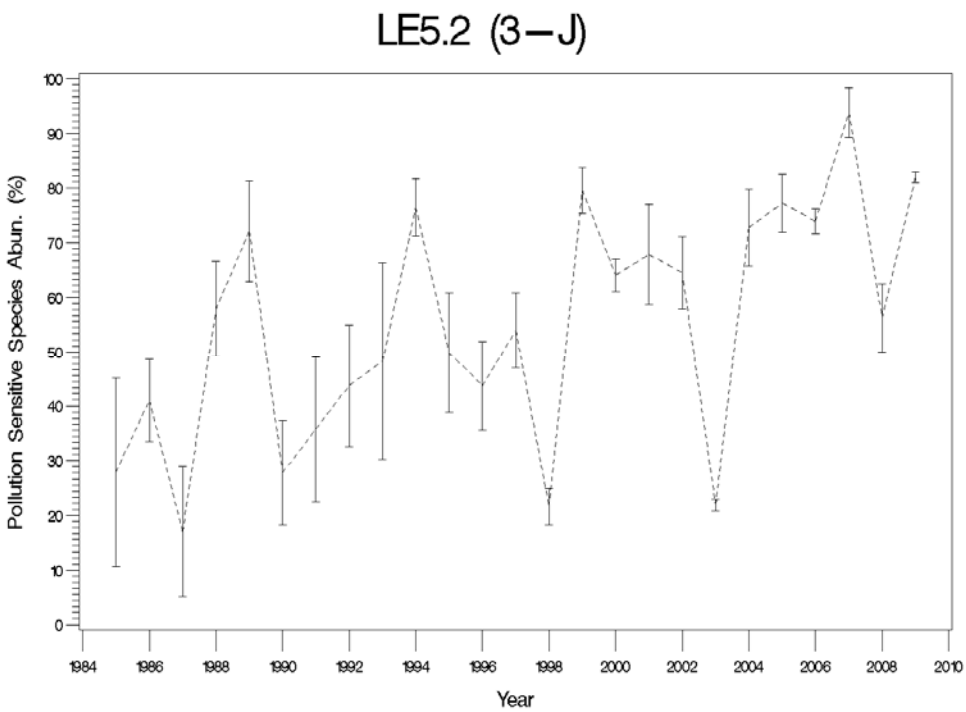


Figure 28. Plot of pollution sensitive species abundance at station LE5.2 for 1985 through 2009.

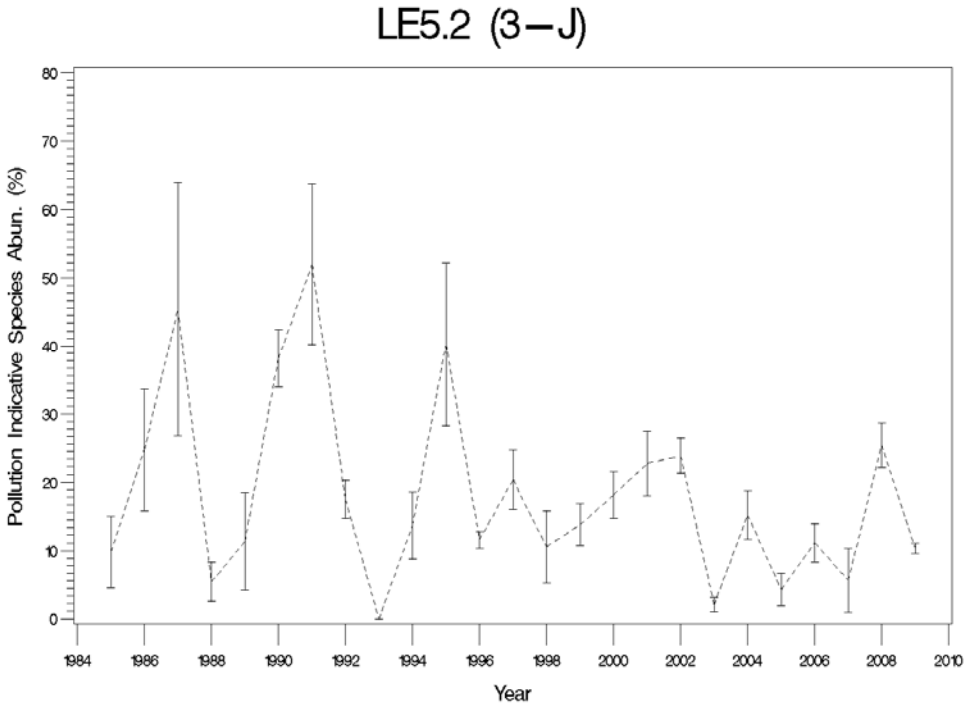


Figure 29. Plot of pollution indicative species abundance at station LE5.2 for 1985 through 2009.

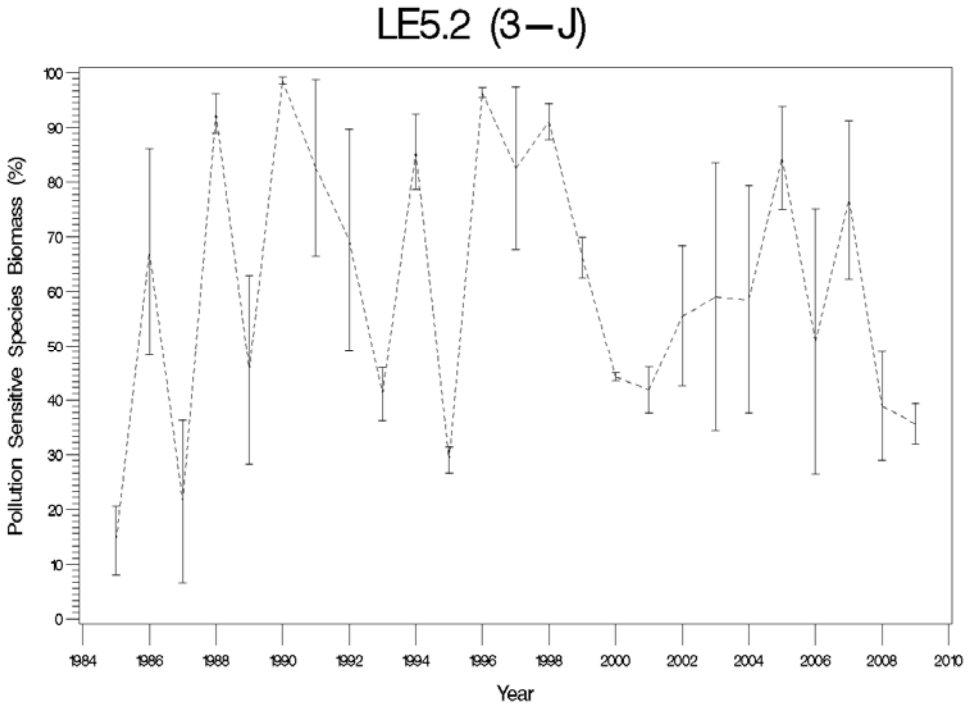


Figure 30. Plot of pollution sensitive species biomass at station LE5.2 for 1985 through 2009.

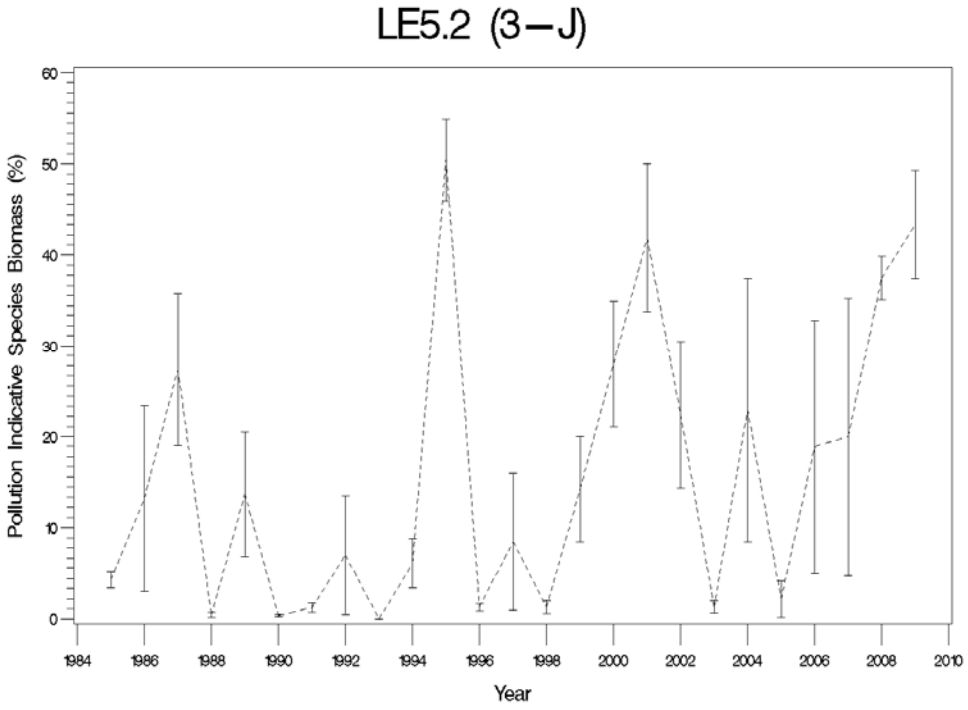


Figure 31. Plot of pollution indicative species biomass at station LE5.2 for 1985 through 2009.

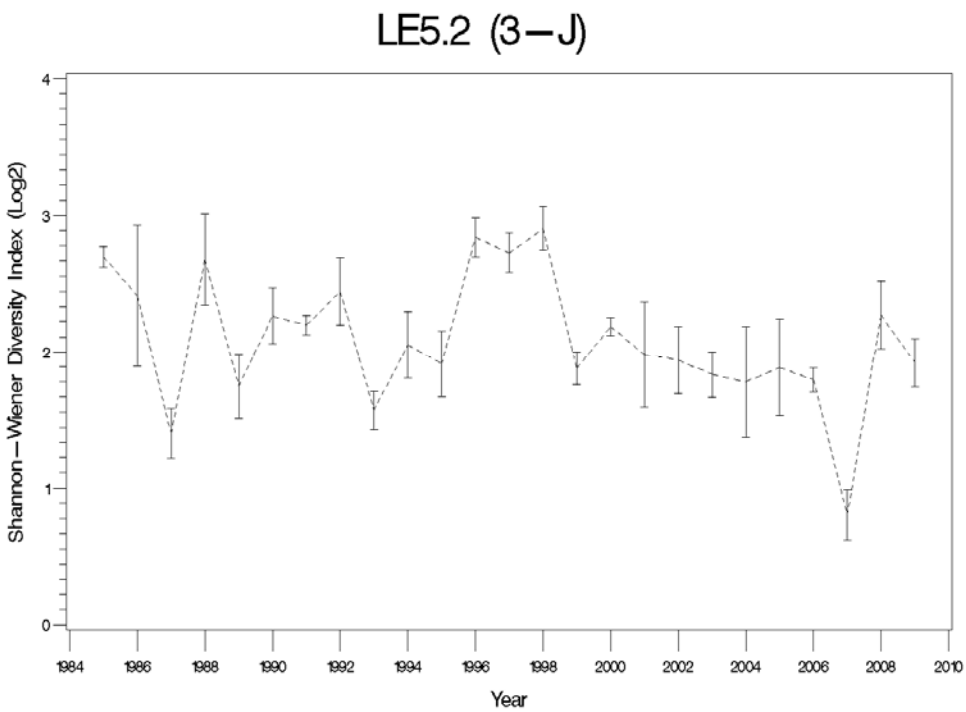


Figure 32. Plot of Shannon-Weiner diversity index at station LE5.2 for 1985 through 2009.

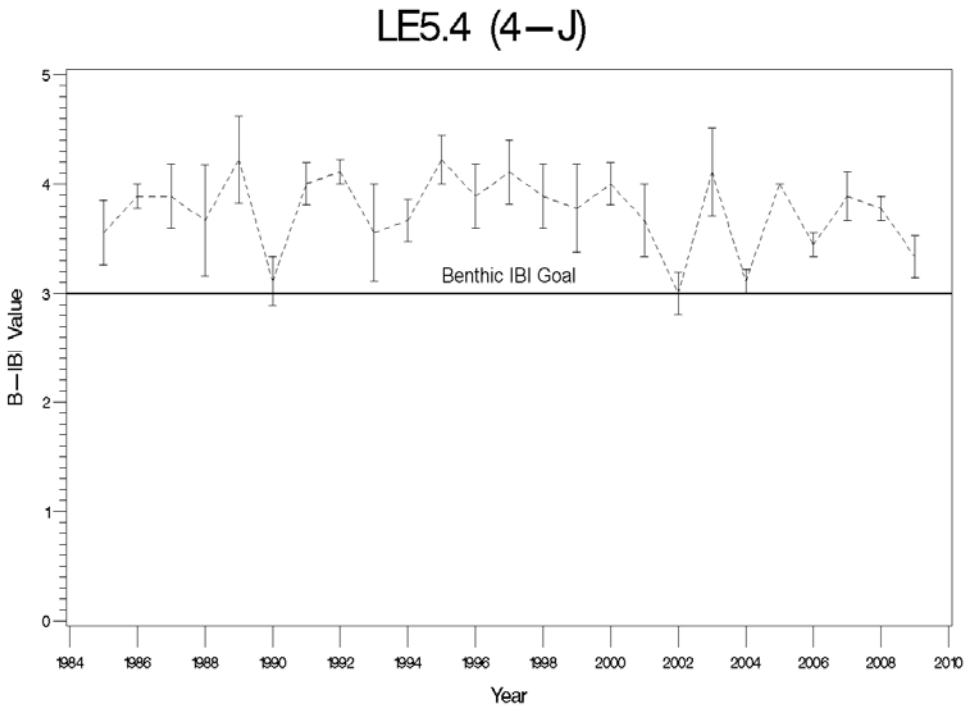


Figure 33. Plot of the benthic IBI against time at station LE5.4 for 1985 through 2009.

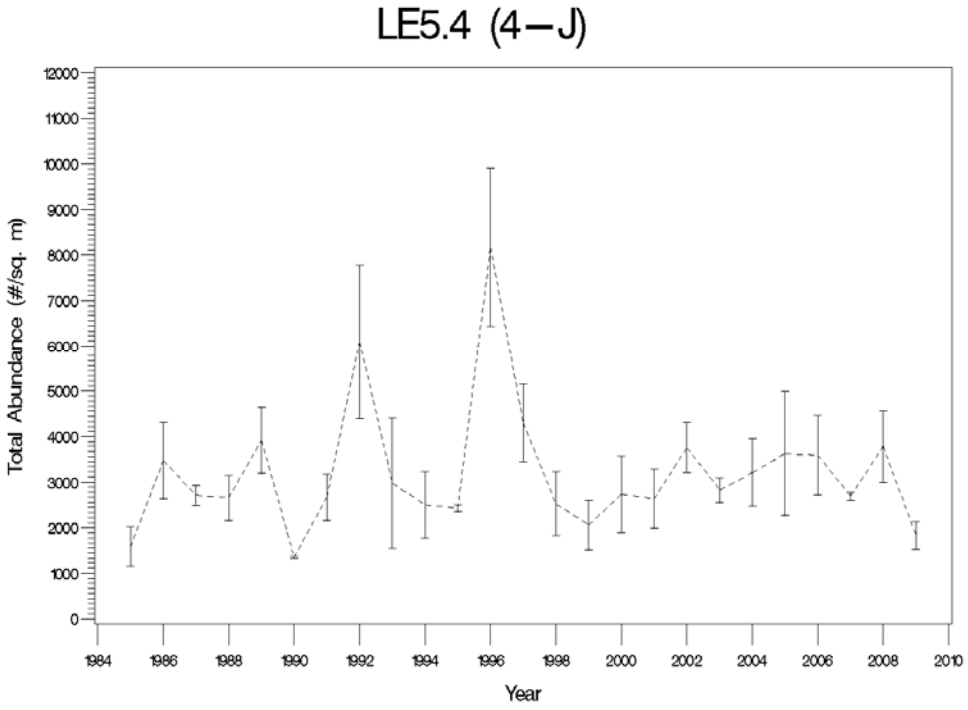


Figure 34. Plot of total benthic community abundance at station LE5.4 for 1985 through 2009.

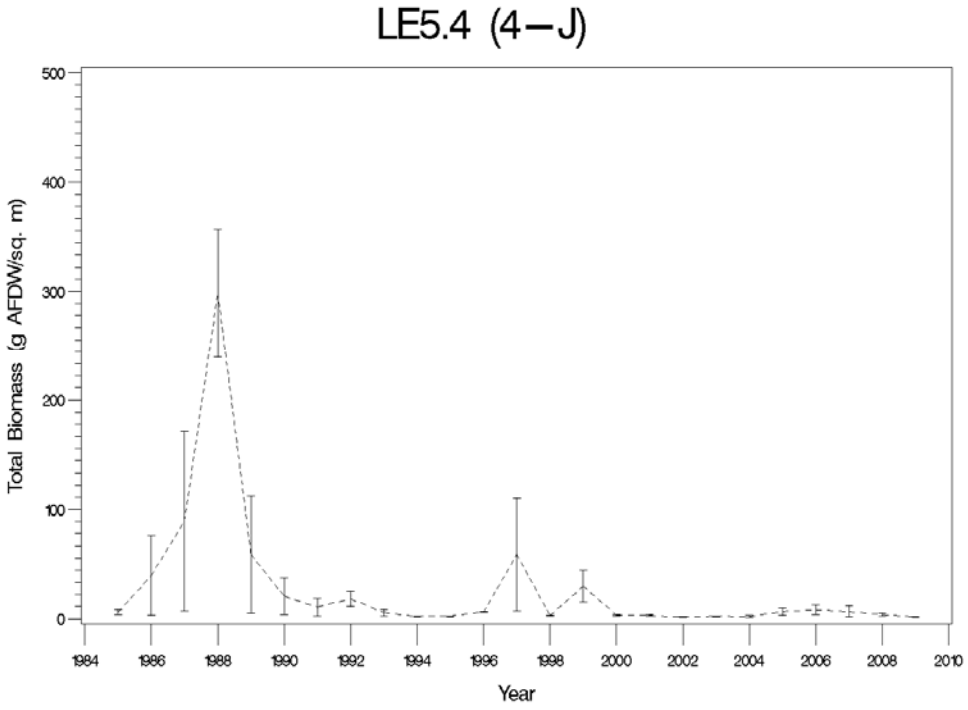


Figure 35. Plot of total benthic community biomass at station LE5.4 for 1985 through 2009.

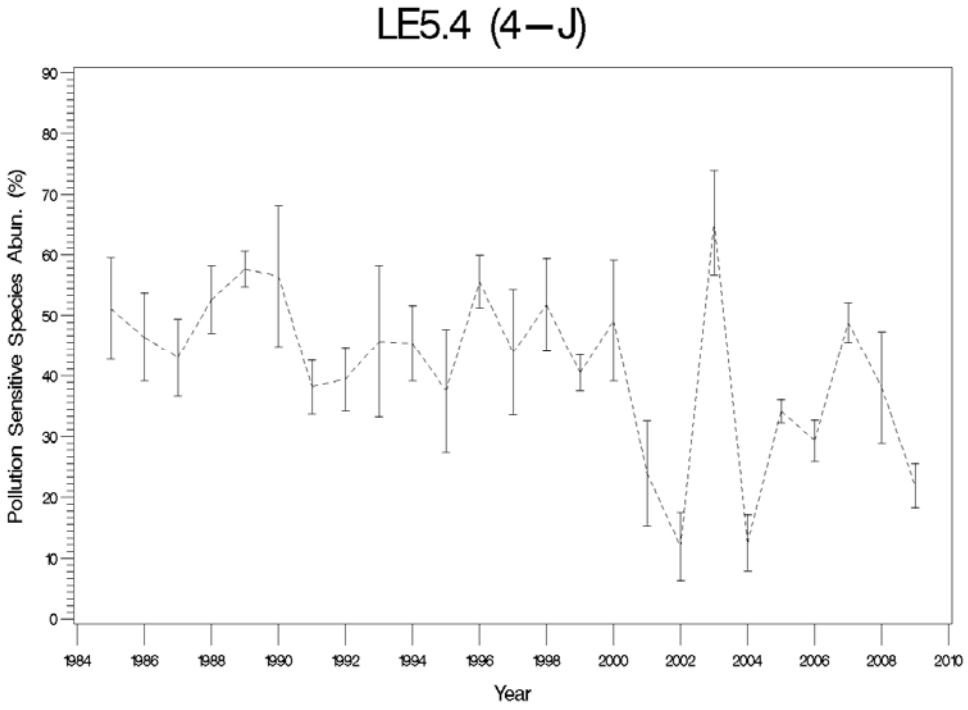


Figure 36. Plot of pollution sensitive species abundance at station LE5.4 for 1985 through 2009.

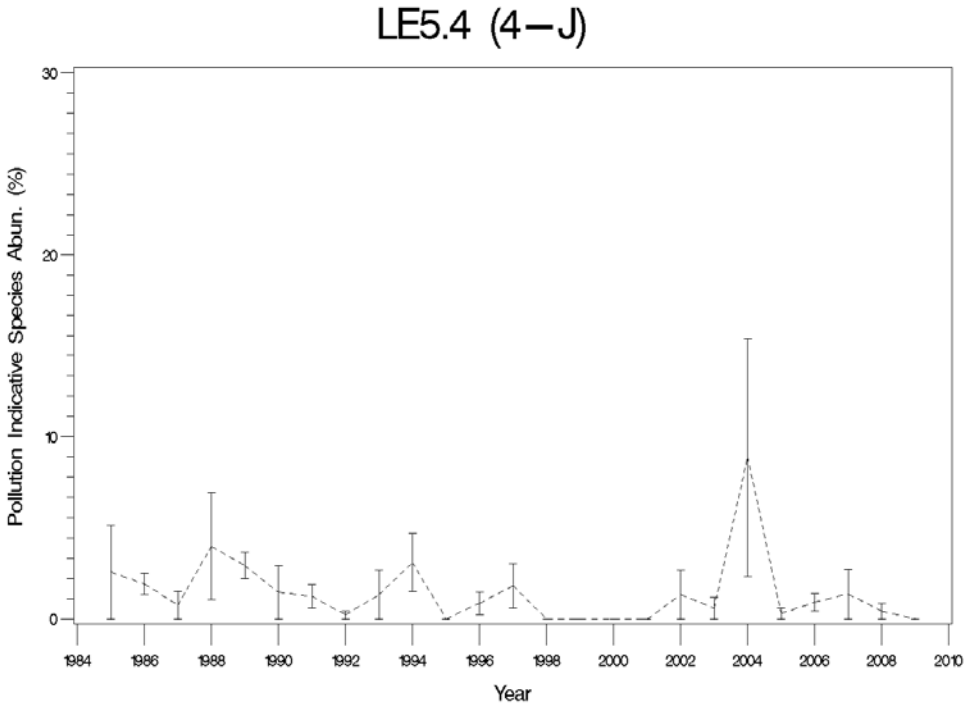


Figure 37. Plot of pollution indicative species abundance at station LE5.4 for 1985 through 2009.

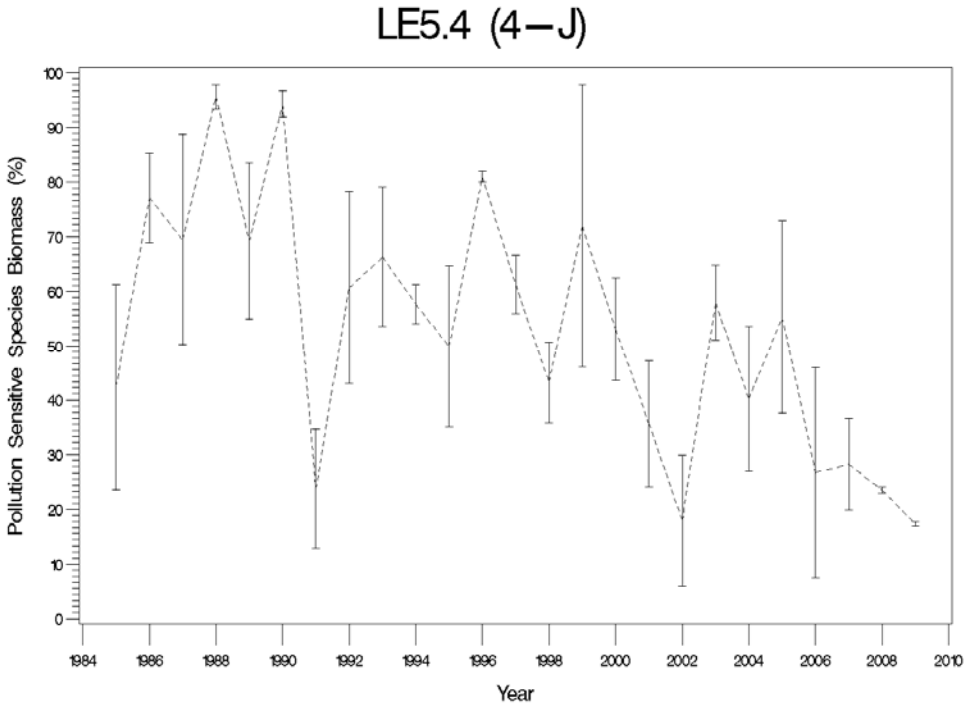


Figure 38. Plot of pollution sensitive species biomass at station LE5.4 for 1985 through 2009.

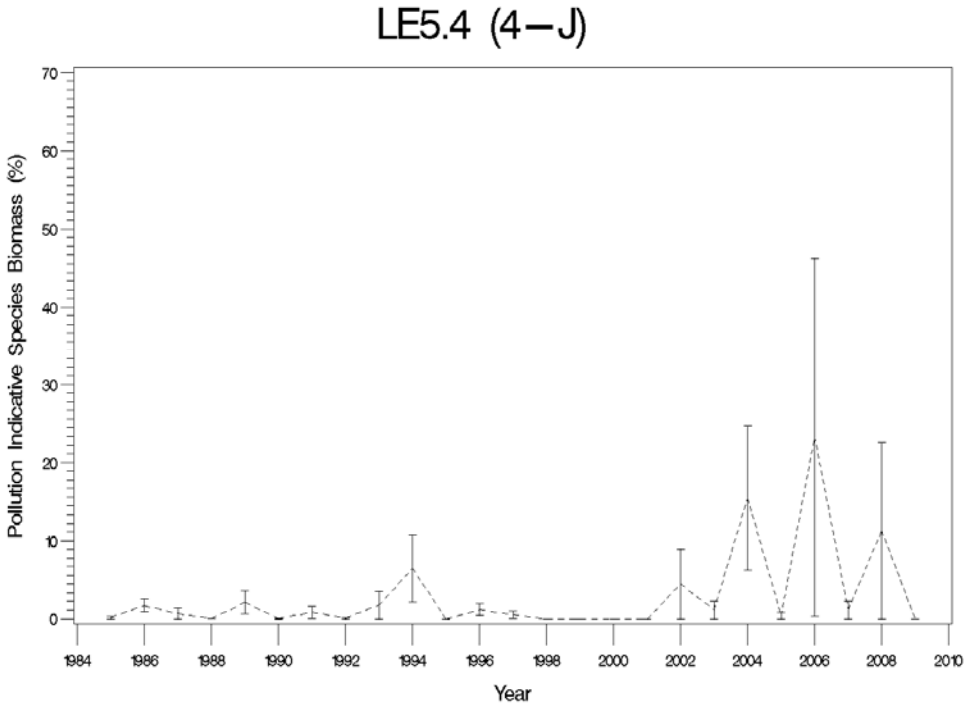


Figure 39. Plot of pollution indicative species biomass at station LE5.4 for 1985 through 2009.

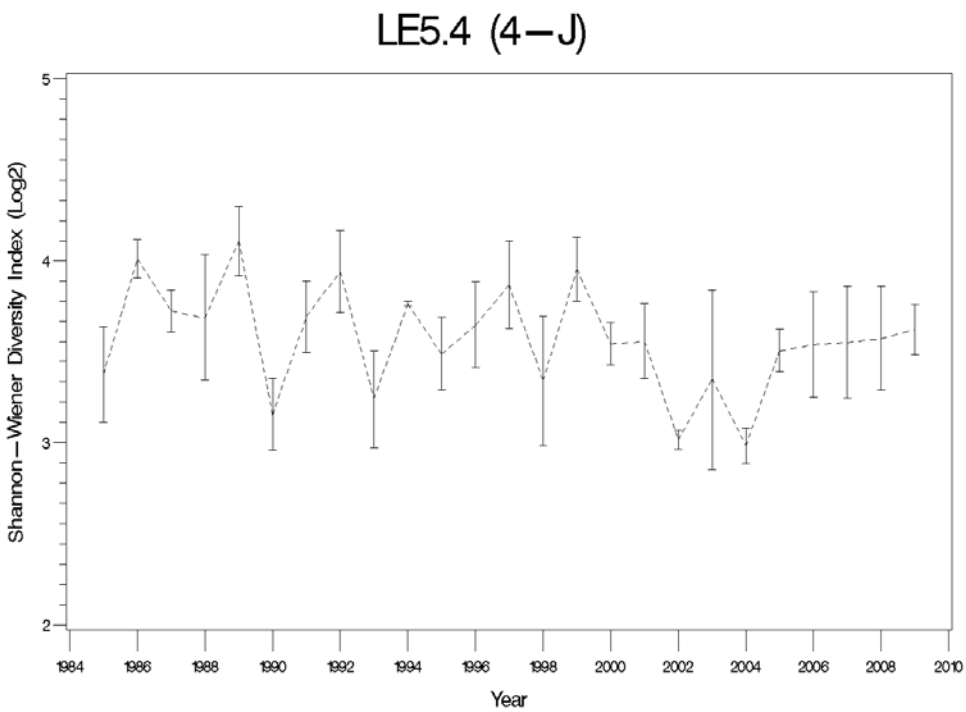


Figure 40. Plot of Shannon-Weiner diversity index at station LE5.4 for 1985 through 2009.

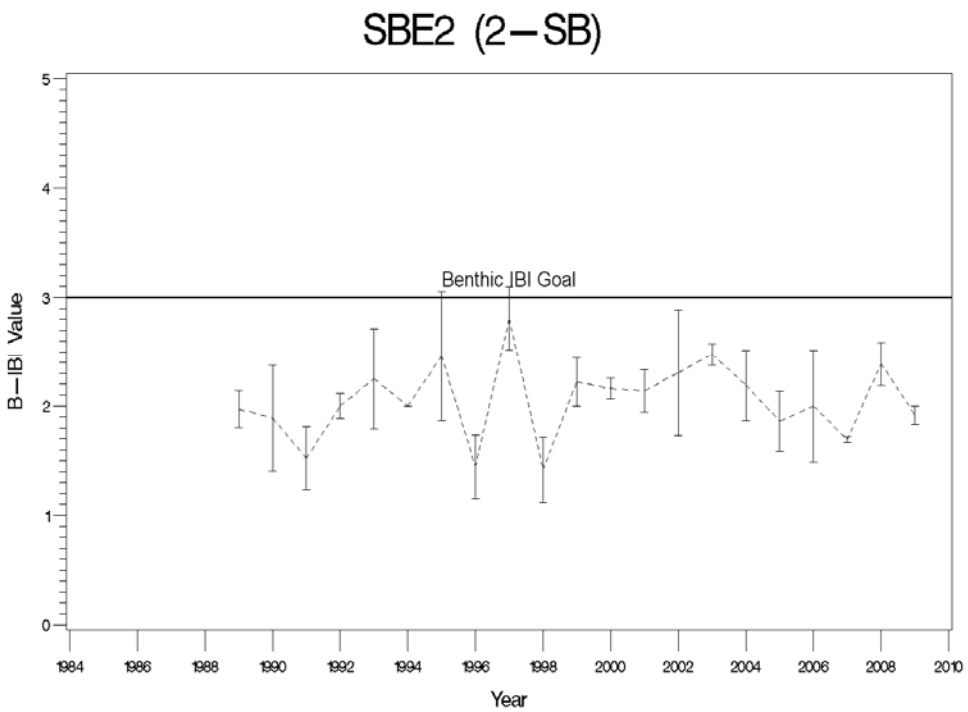


Figure 41. Plot of the benthic IBI against time at station SBE2 for 1985 through 2009.

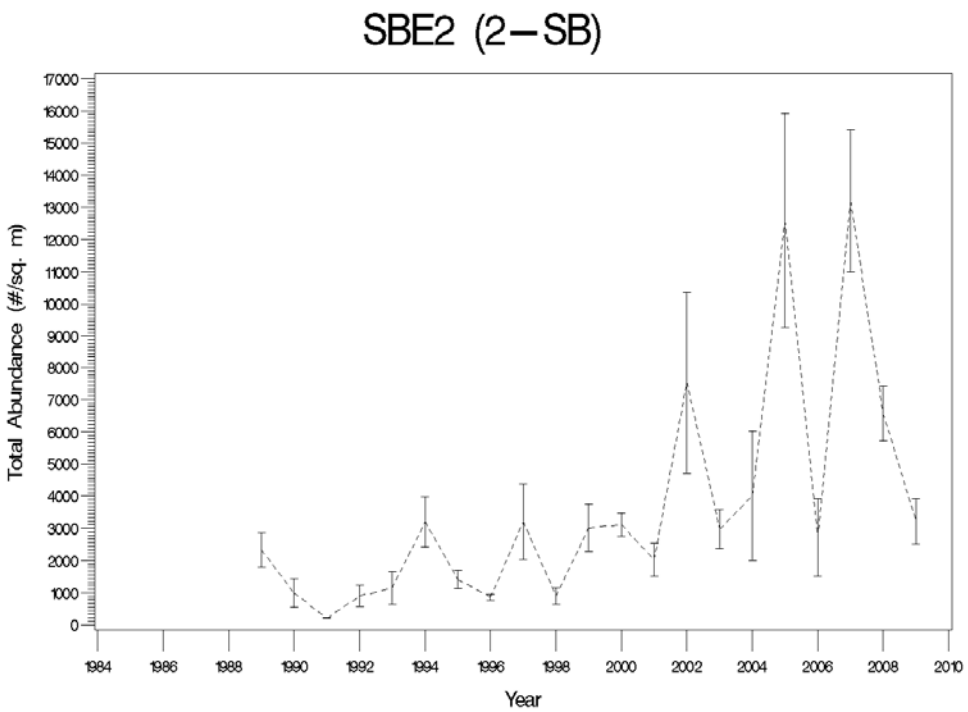


Figure 42. Plot of total benthic community abundance at station SBE2 for 1985 through 2009.

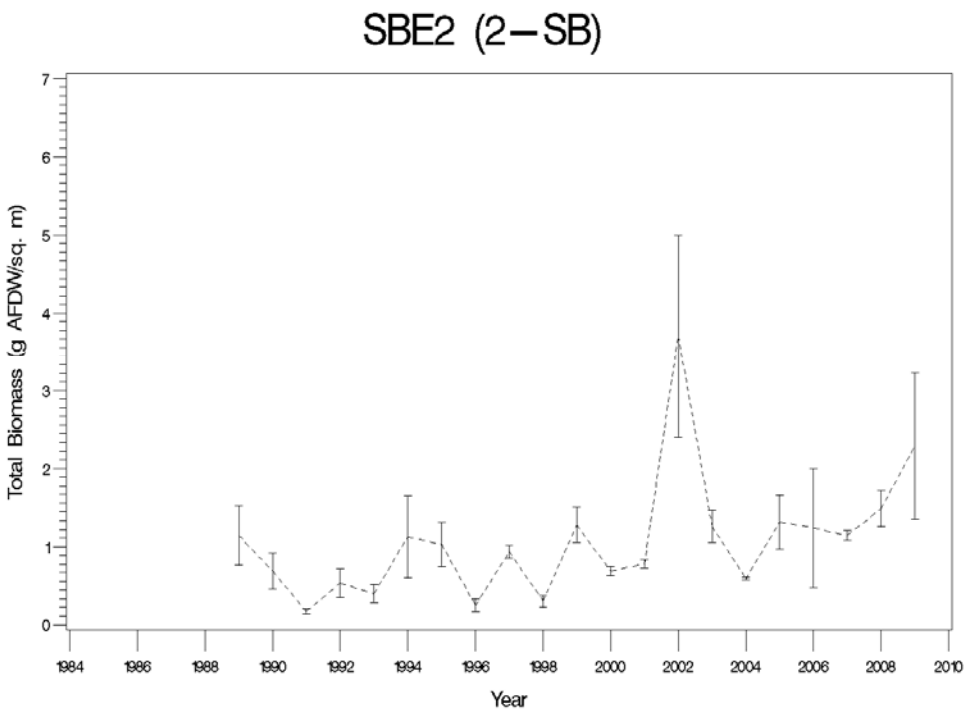


Figure 43. Plot of total benthic community biomass at station SBE2 for 1985 through 2009.

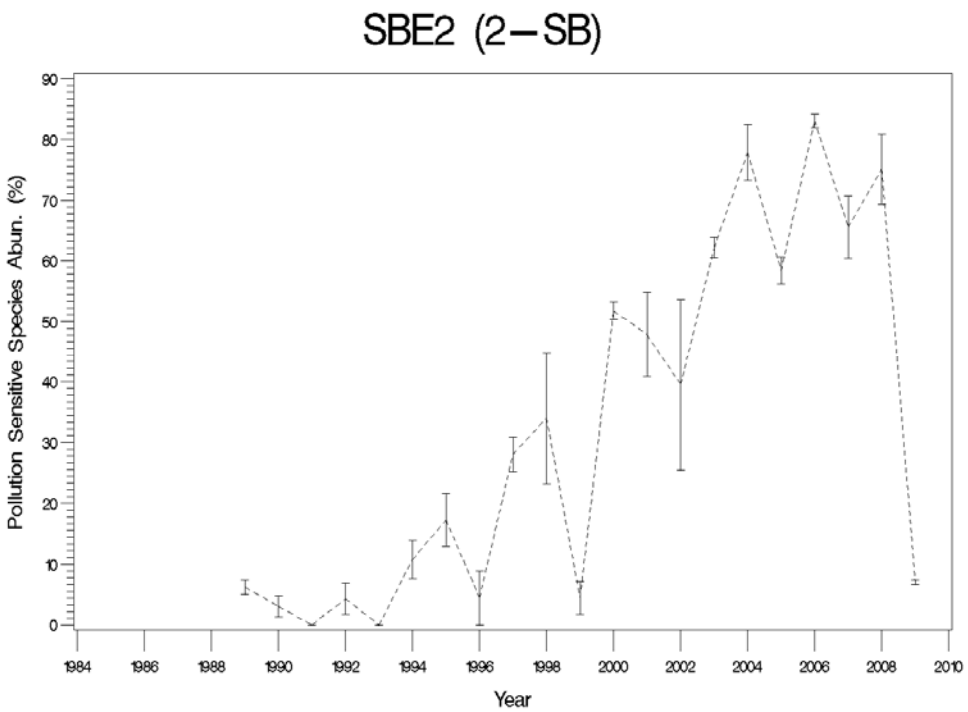


Figure 44. Plot of pollution sensitive species abundance at station SBE2 for 1985 through 2009.

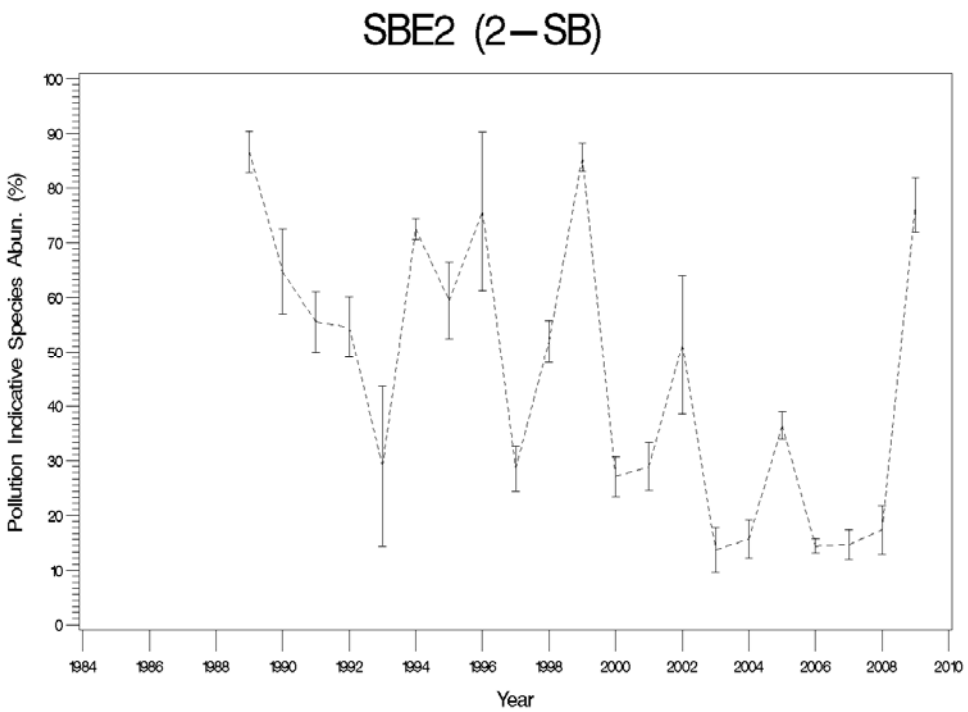


Figure 45. Plot of pollution indicative species abundance at station SBE2 for 1985 through 2009.

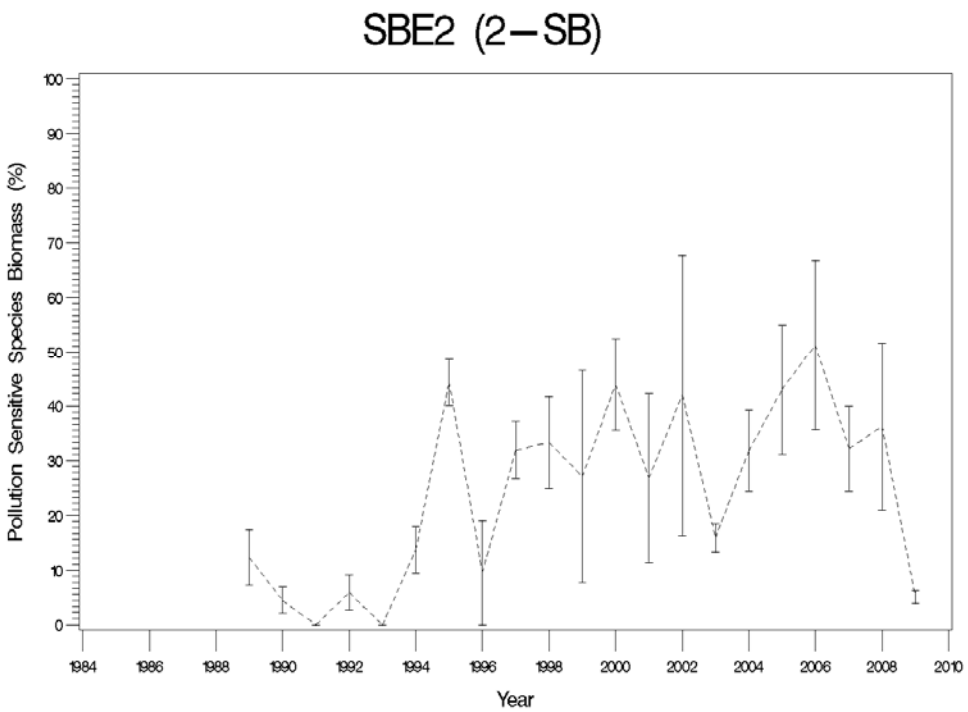


Figure 46. Plot of pollution sensitive species biomass at station SBE2 for 1985 through 2009.

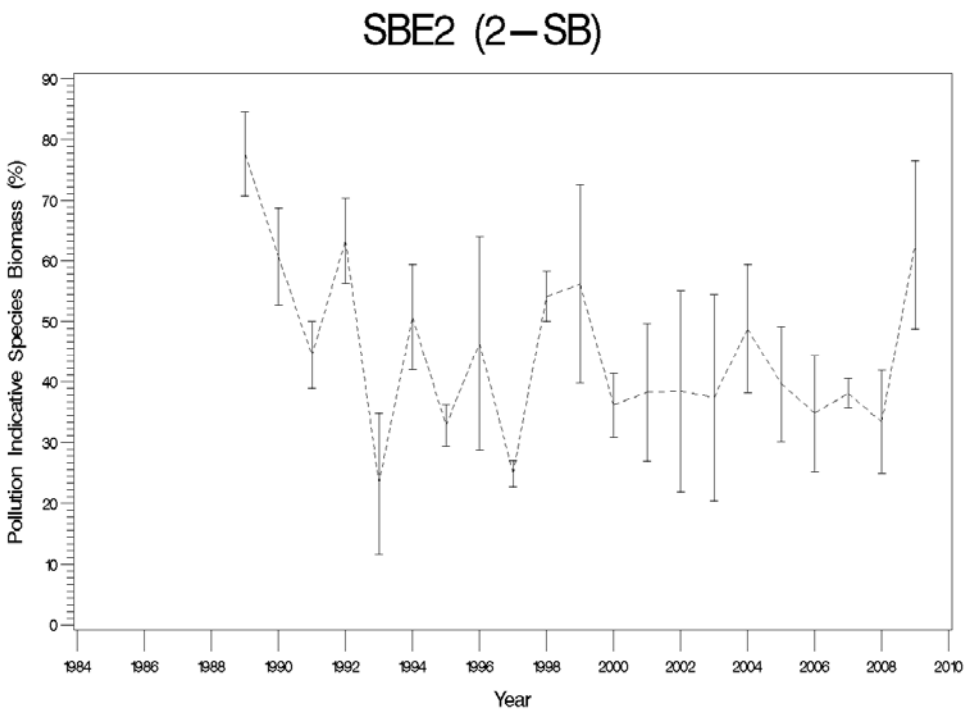


Figure 47. Plot of pollution indicative species biomass at station SBE2 for 1985 through 2009.

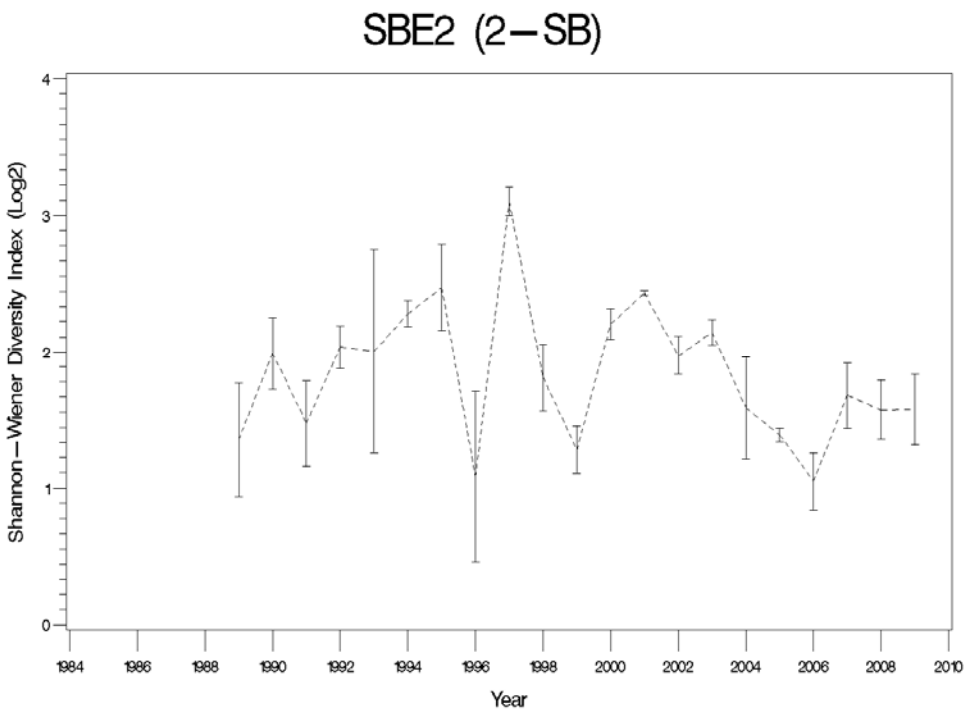


Figure 48. Plot of Shannon-Weiner diversity index at station SBE2 for 1985 through 2009.

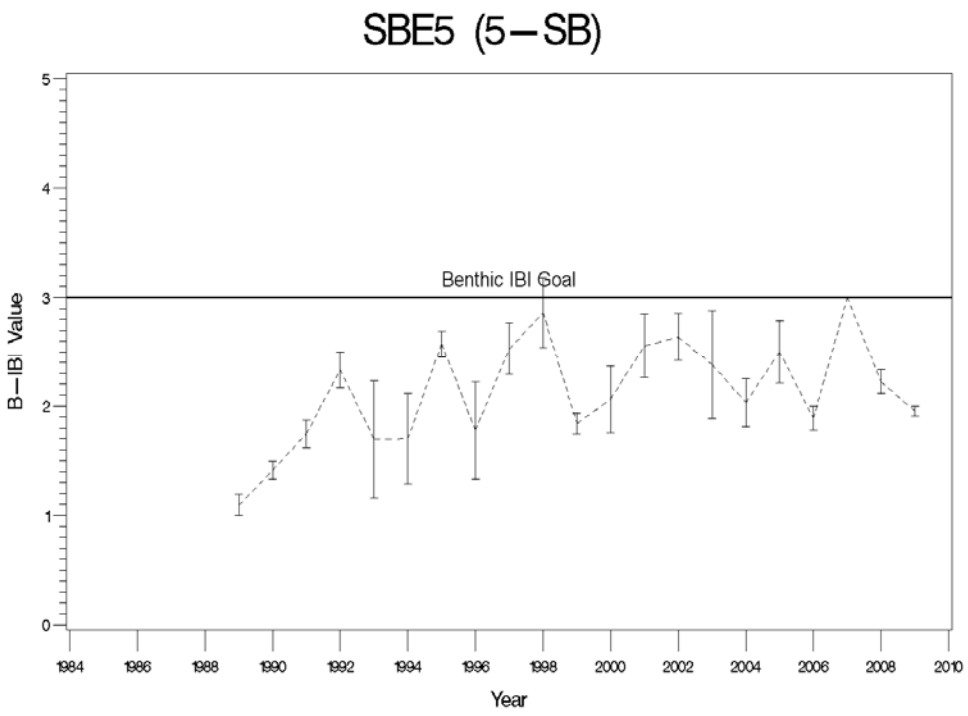


Figure 49. Plot of the benthic IBI against time at station SBE5 for 1985 through 2009.

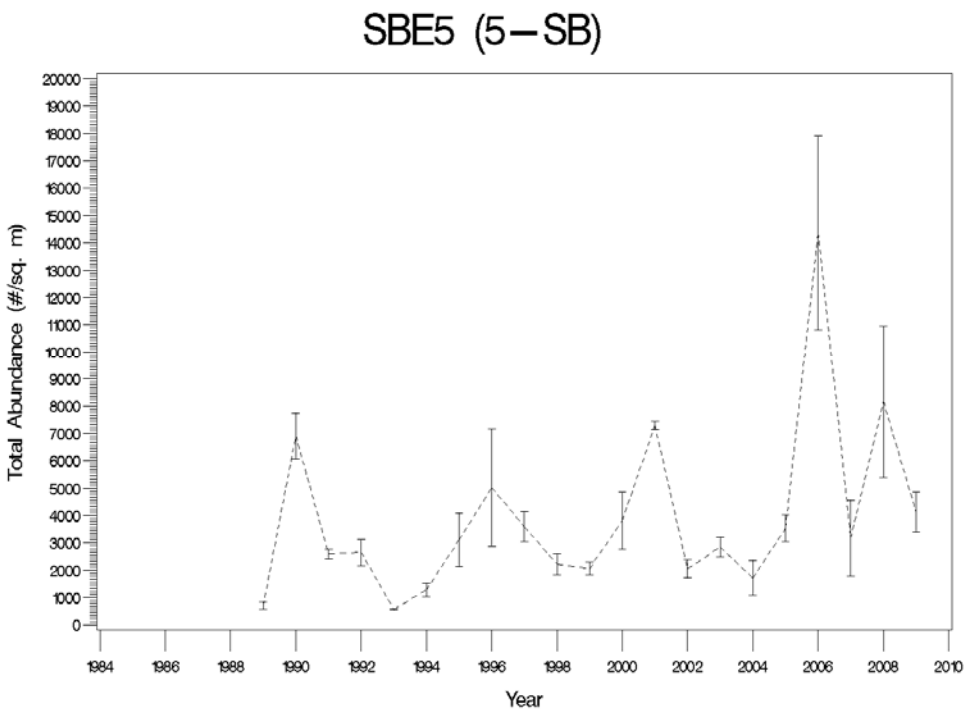


Figure 50. Plot of total benthic community abundance at station SBE5 for 1985 through 2009.

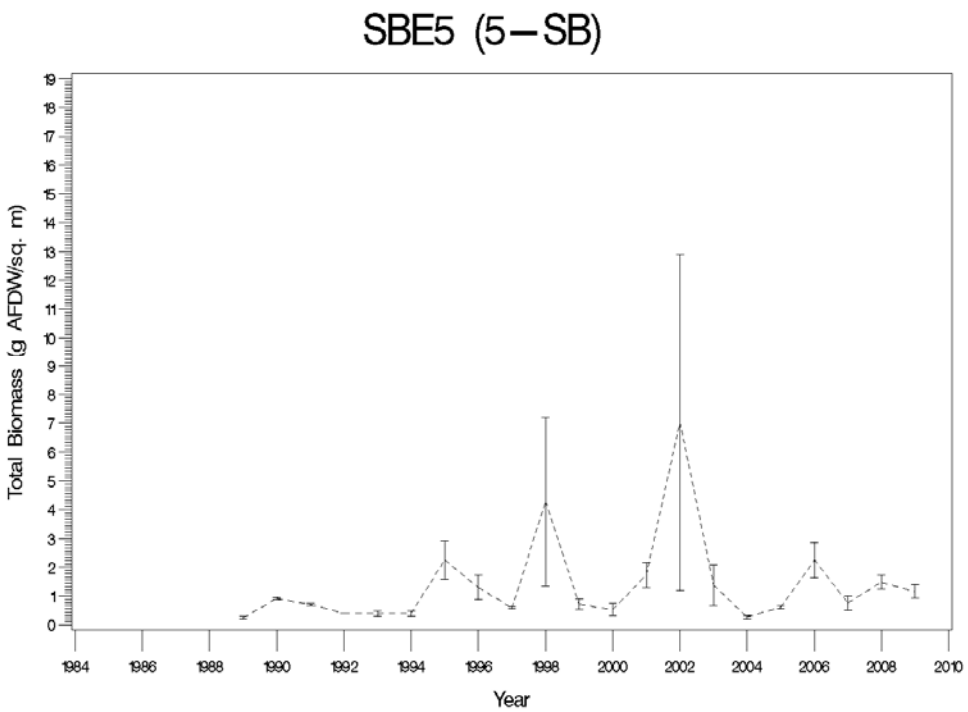


Figure 51. Plot of total benthic community biomass at station SBE5 for 1985 through 2009.

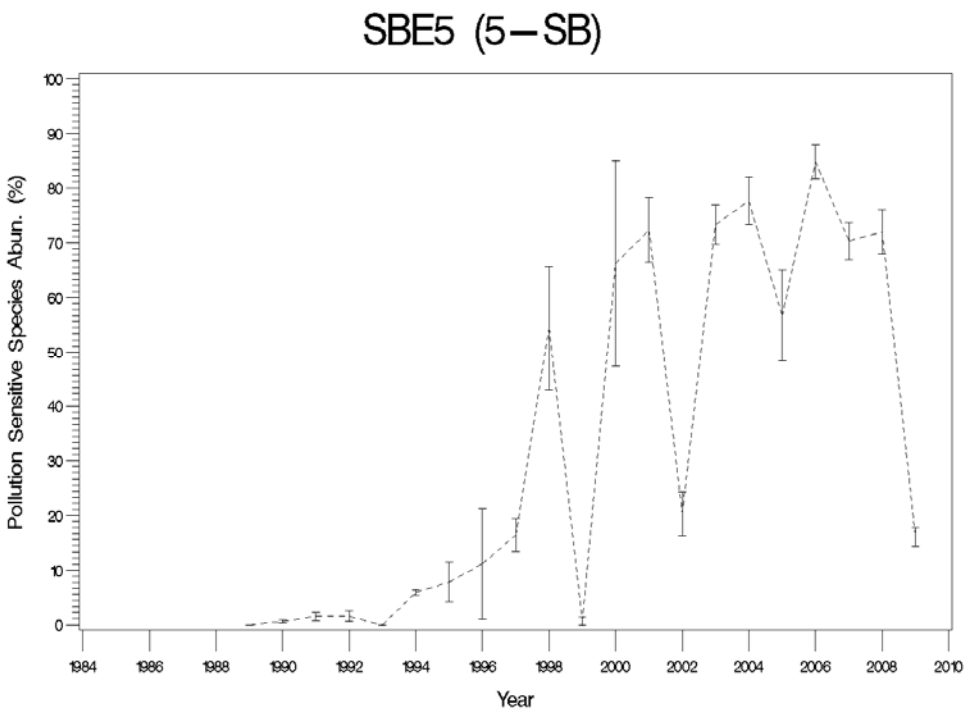


Figure 52. Plot of pollution sensitive species abundance at station SBE5 for 1985 through 2009.

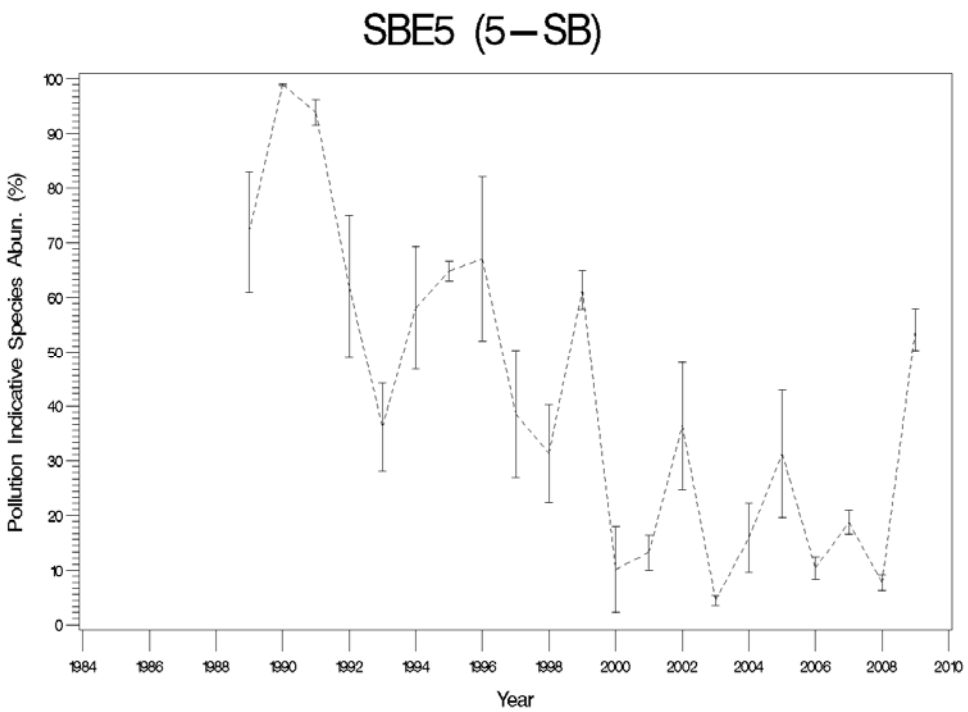


Figure 53. Plot of pollution indicative species abundance at station SBE5 for 1985 through 2009.

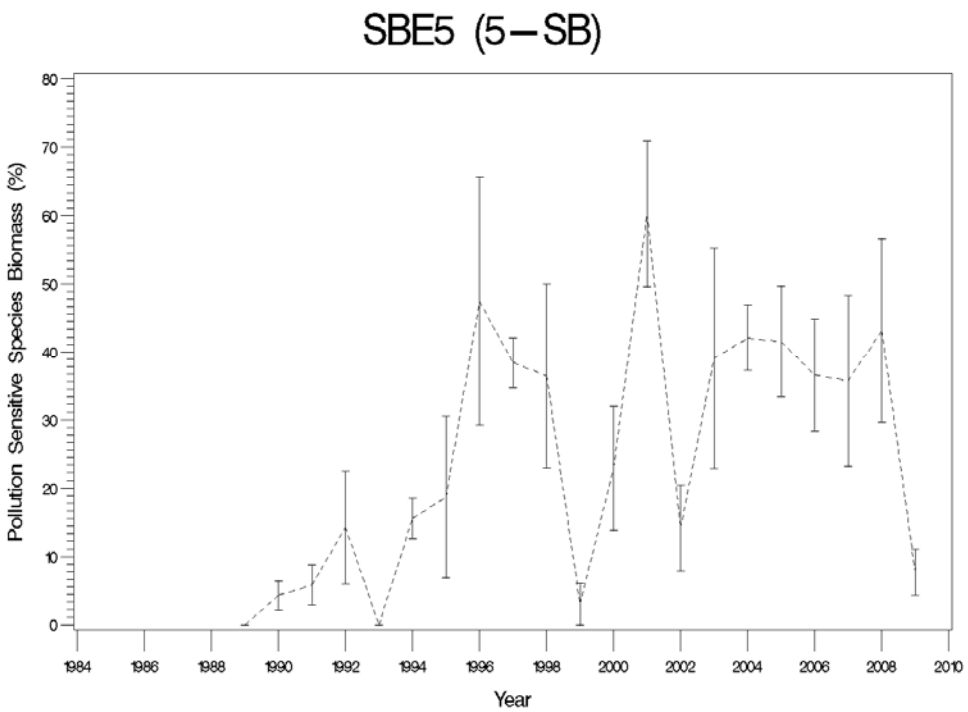


Figure 54. Plot of pollution sensitive species biomass at station SBE5 for 1985 through 2009.

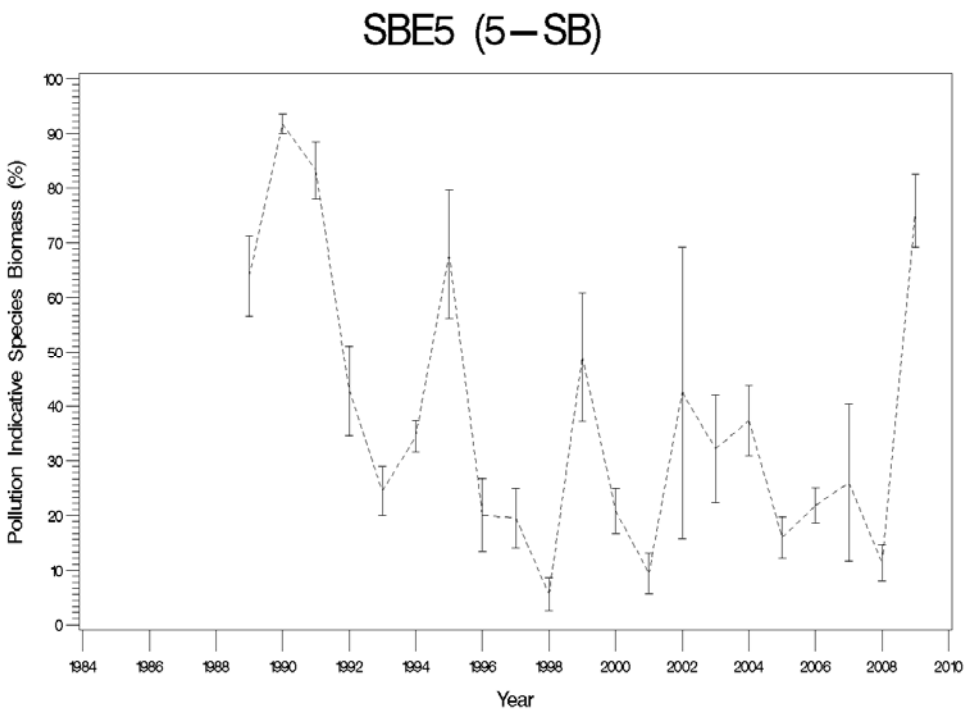


Figure 55. Plot of pollution indicative species biomass at station SBE5 for 1985 through 2009.

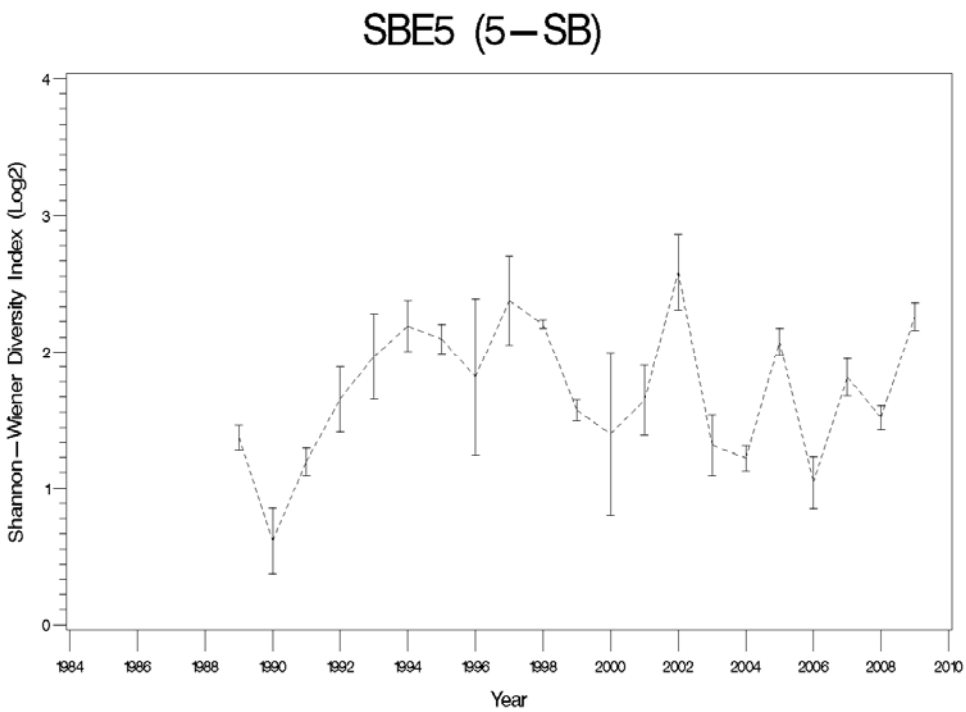


Figure 56. Plot of Shannon-Weiner diversity index at station SBE5 for 1985 through 2009.

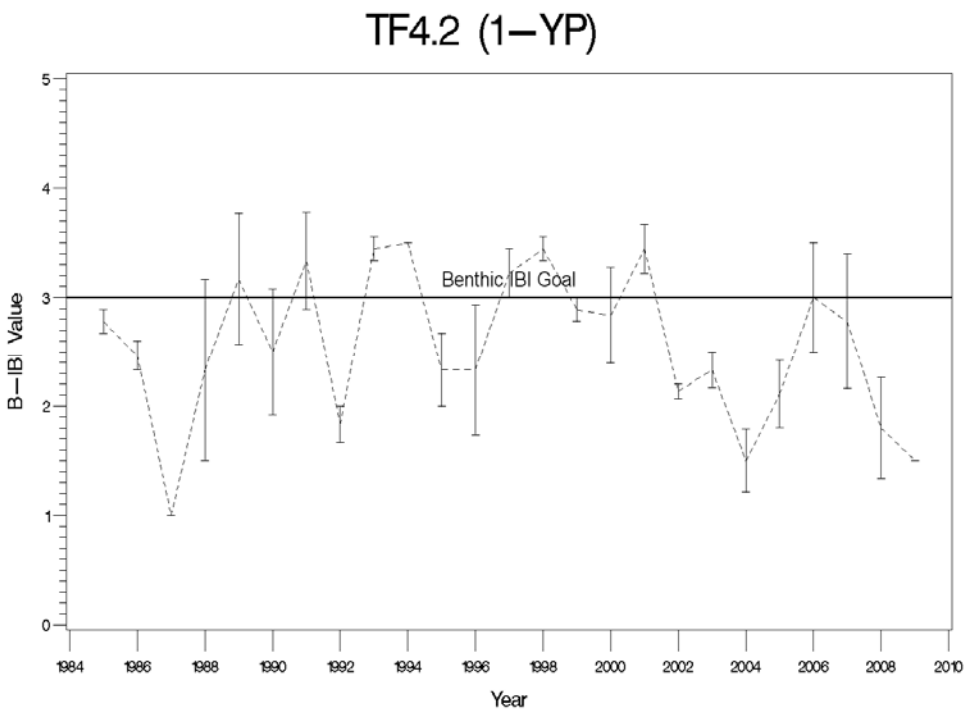


Figure 57. Plot of the benthic IBI against time at station TF4.2 for 1985 through 2009.

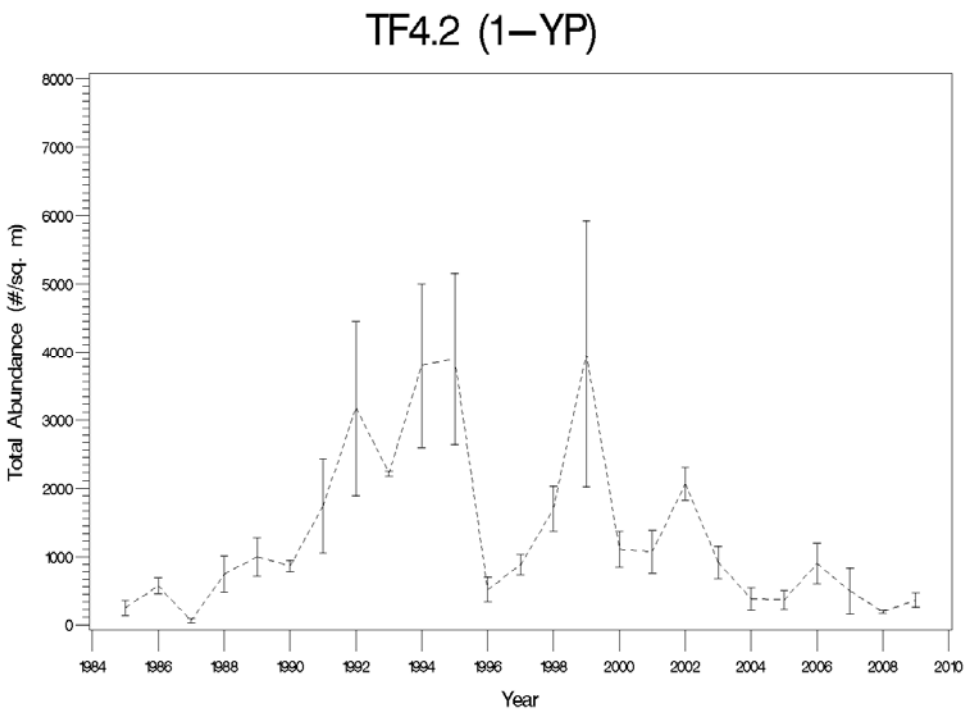


Figure 58. Plot of total benthic community abundance at station TF4.2 for 1985 through 2009.

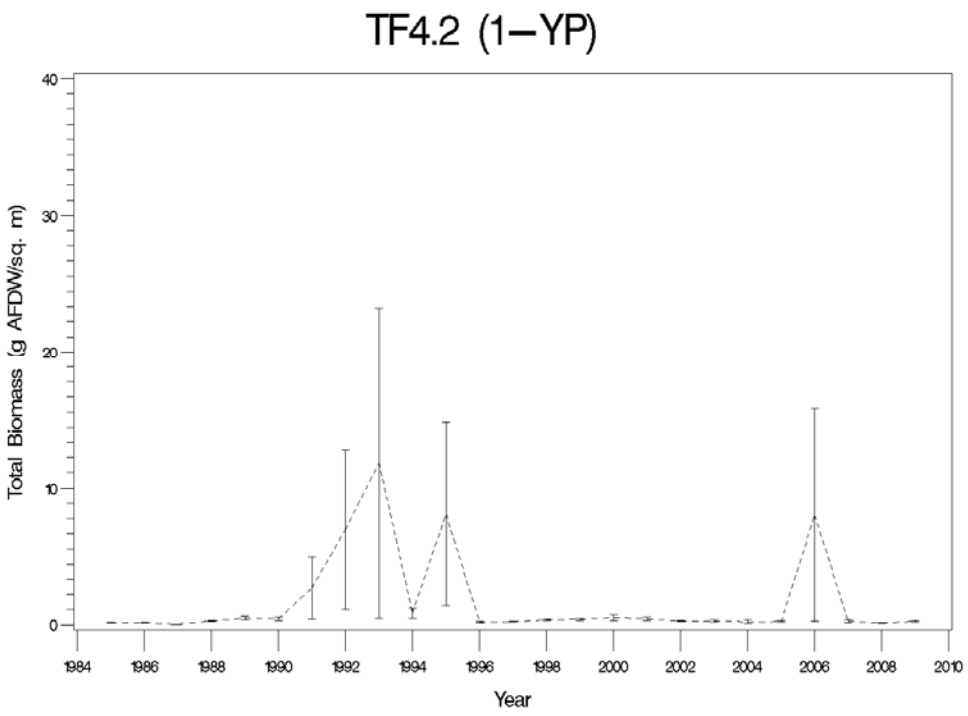


Figure 59. Plot of total benthic community biomass at station TF4.2 for 1985 through 2009.

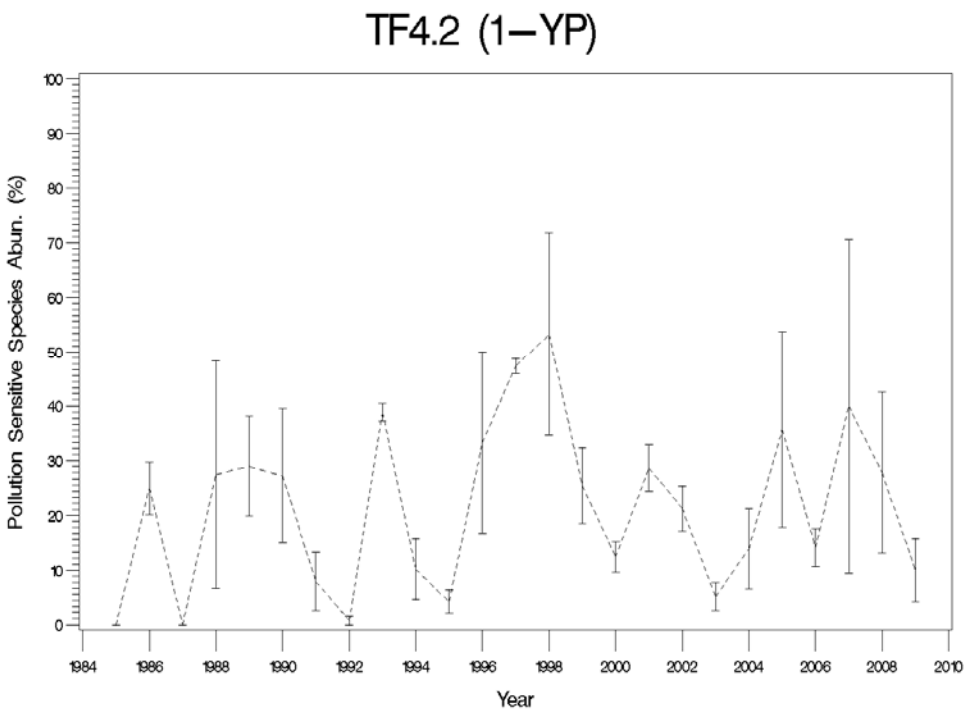


Figure 60. Plot of pollution sensitive species abundance at station TF4.2 for 1985 through 2009.

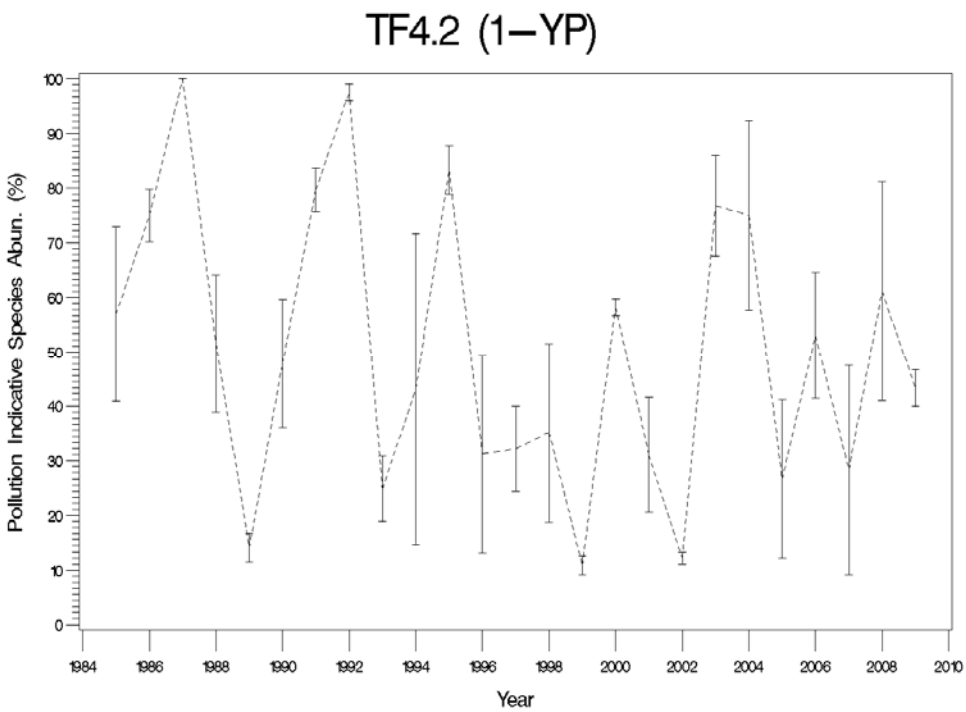


Figure 61. Plot of pollution indicative species abundance at station TF4.2 for 1985 through 2009.

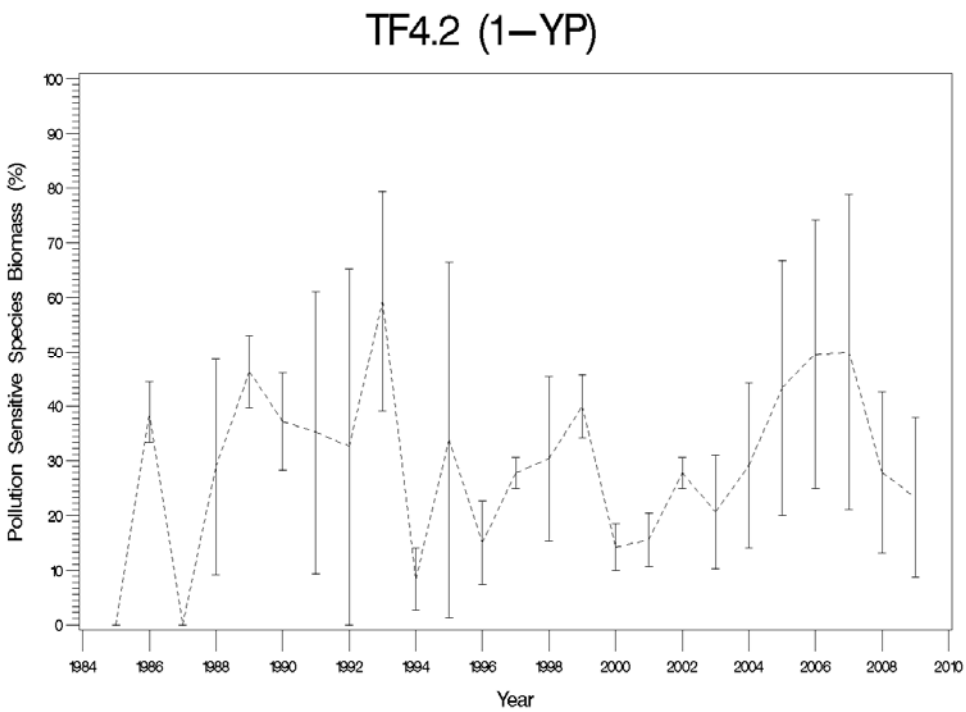


Figure 62. Plot of pollution sensitive species biomass at station TF4.2 for 1985 through 2009.

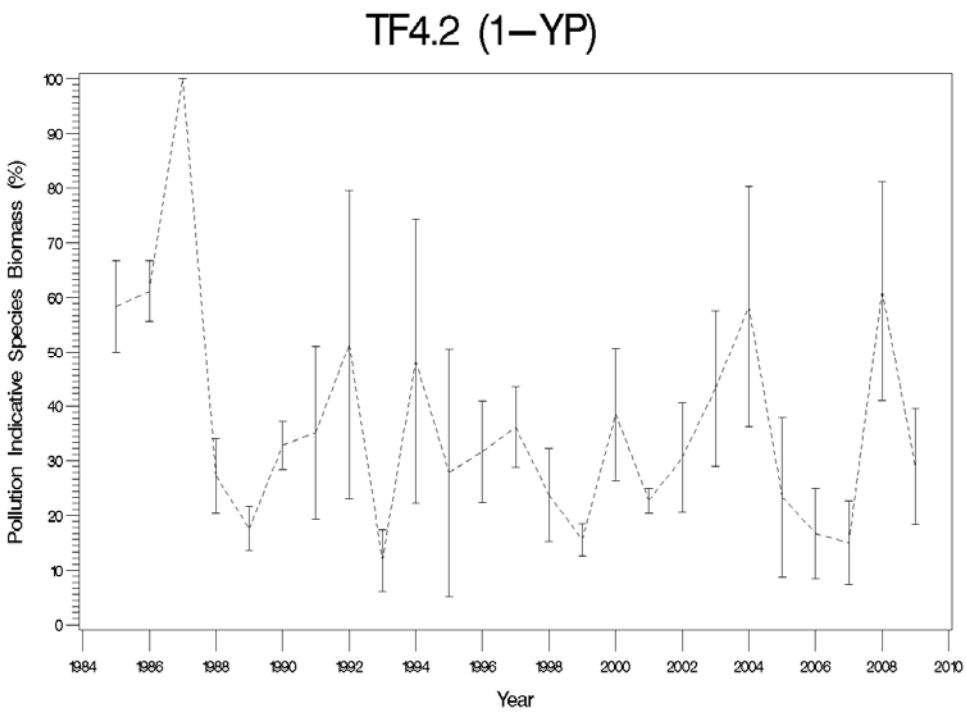


Figure 63. Plot of pollution indicative species biomass at station TF4.2 for 1985 through 2009.

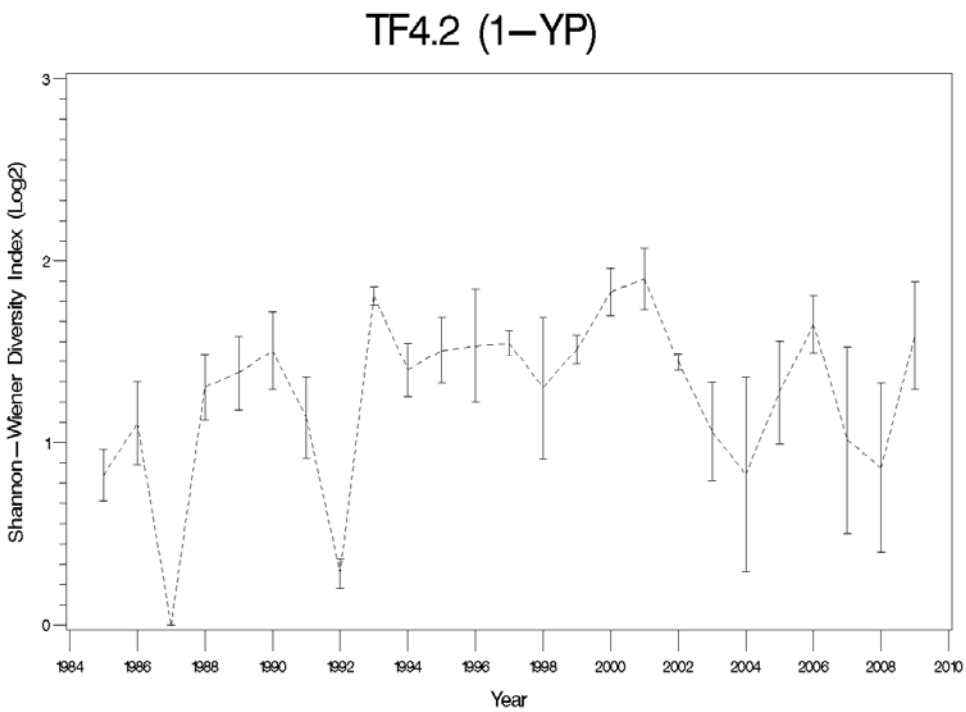


Figure 64. Plot of Shannon-Weiner diversity index at station TF4.2 for 1985 through 2009.

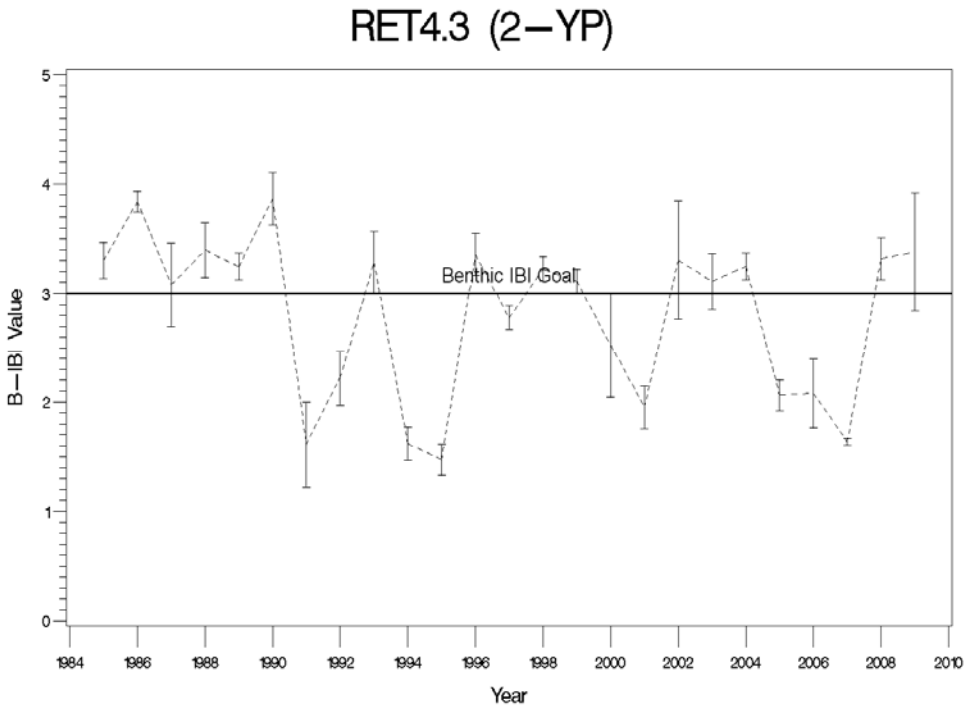


Figure 65. Plot of the benthic IBI against time at station RET4.3 for 1985 through 2009.

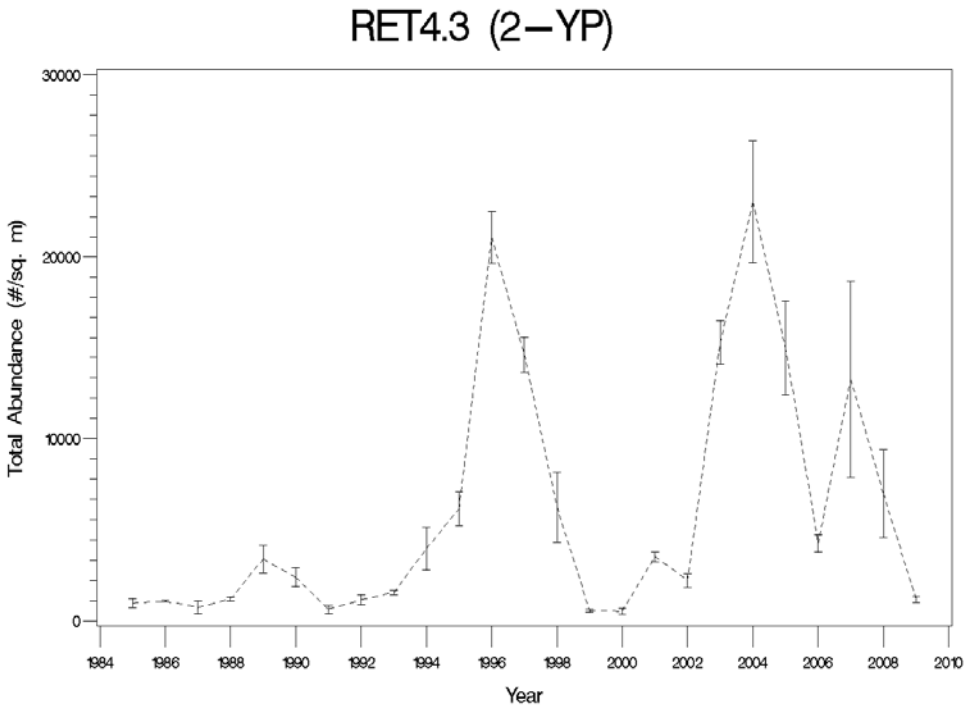


Figure 66. Plot of total benthic community abundance at station RET4.3 for 1985 through 2009.

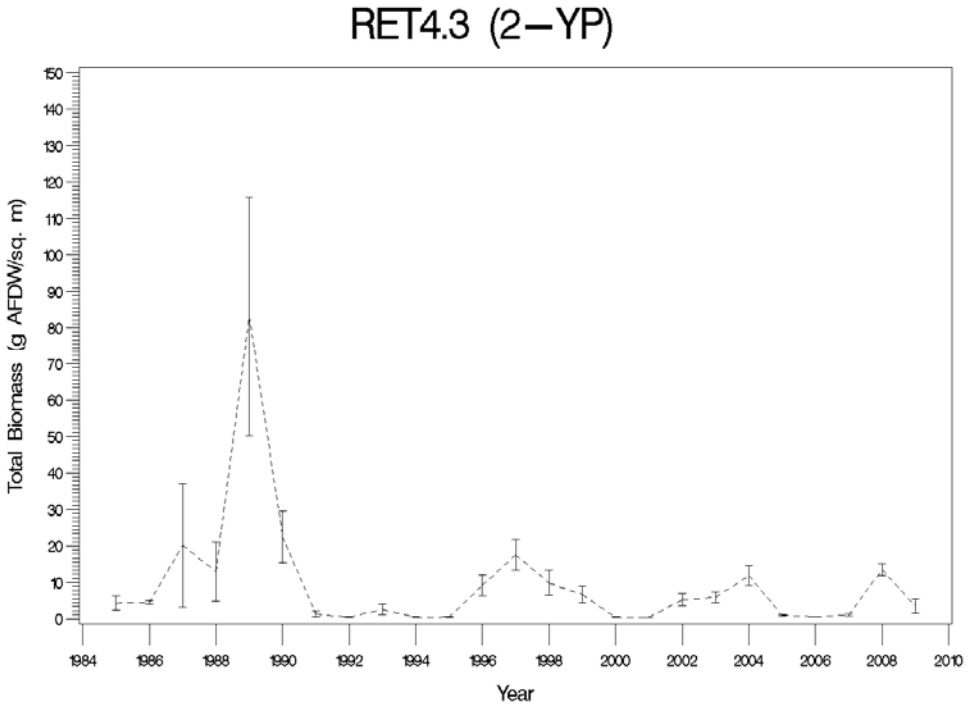


Figure 67. Plot of total benthic community biomass at station RET4.3 for 1985 through 2009.

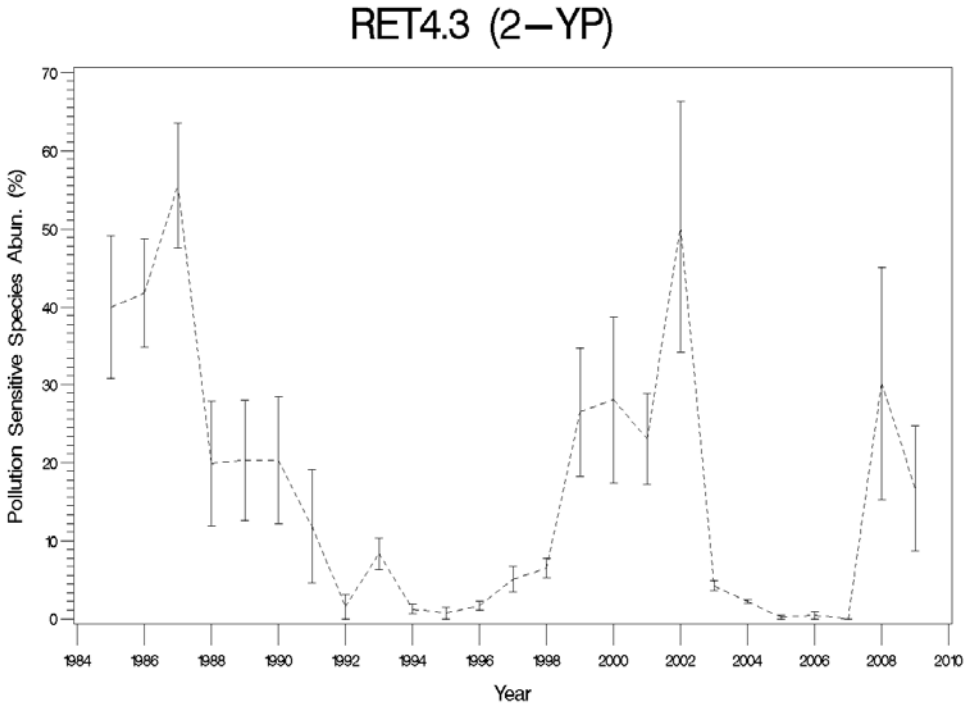


Figure 68. Plot of pollution sensitive species abundance at station RET4.3 for 1985 through 2009.

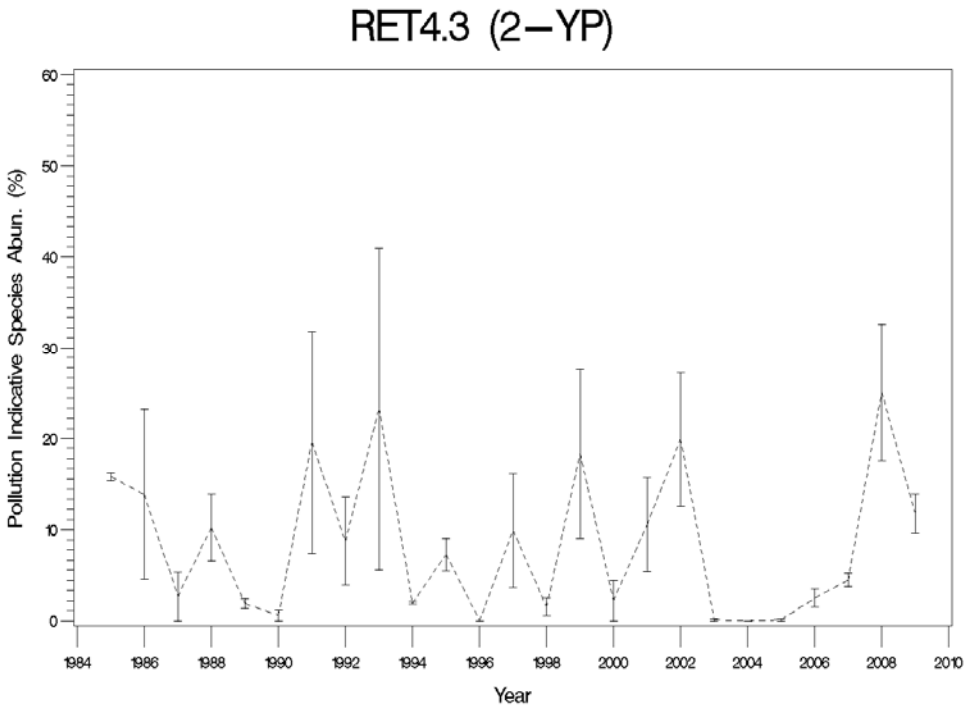


Figure 69. Plot of pollution indicative species abundance at station RET4.3 for 1985 through 2009.

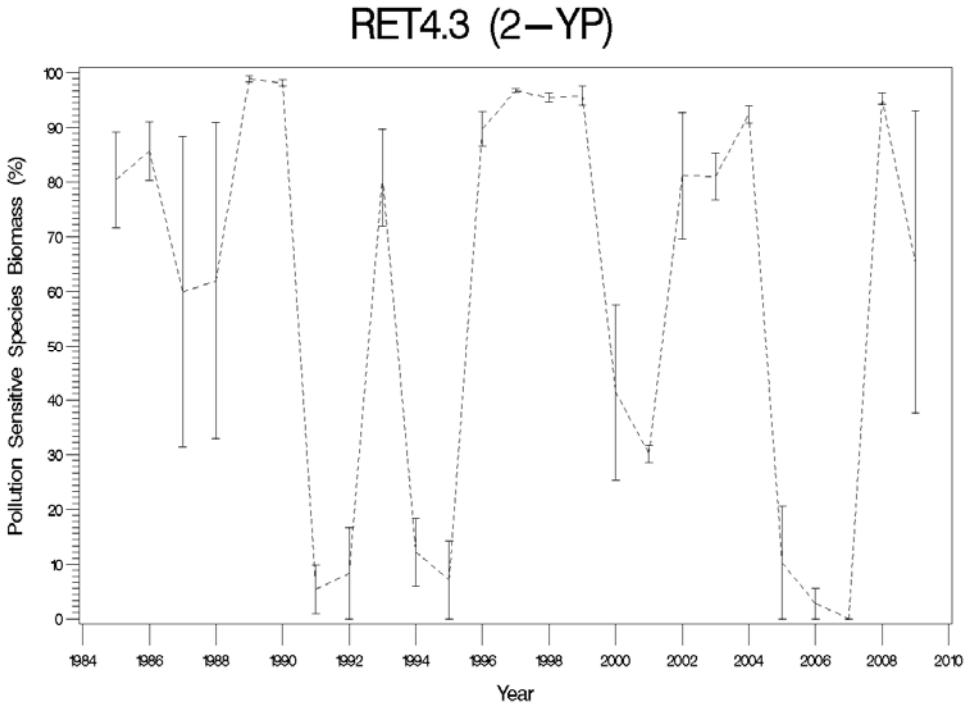


Figure 70. Plot of pollution sensitive species biomass at station RET4.3 for 1985 through 2009.

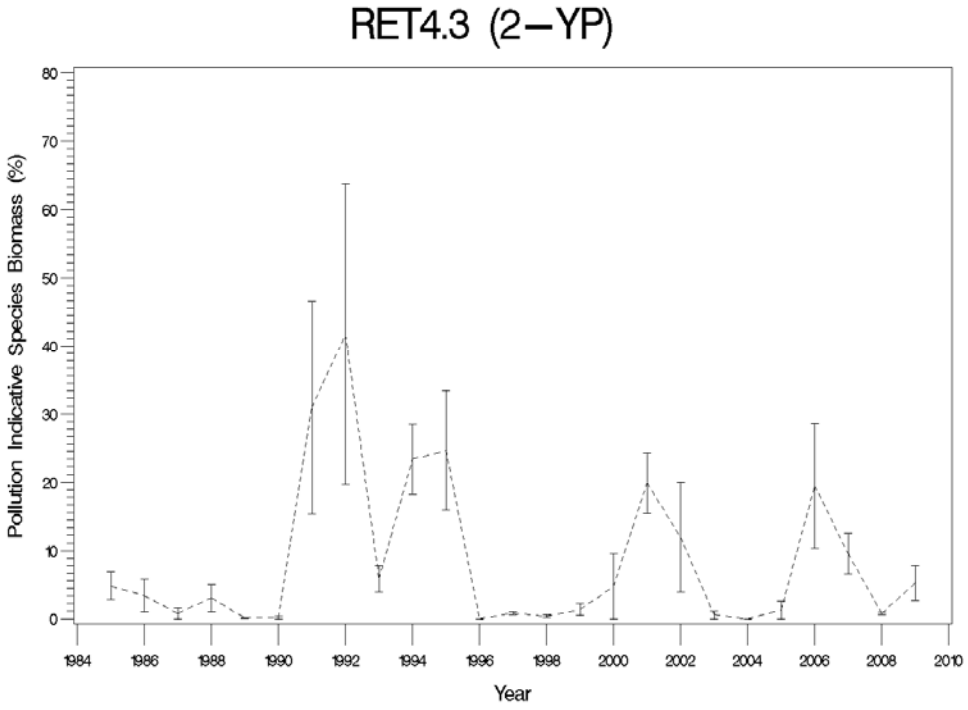


Figure 71. Plot of pollution indicative species biomass at station RET4.3 for 1985 through 2009.

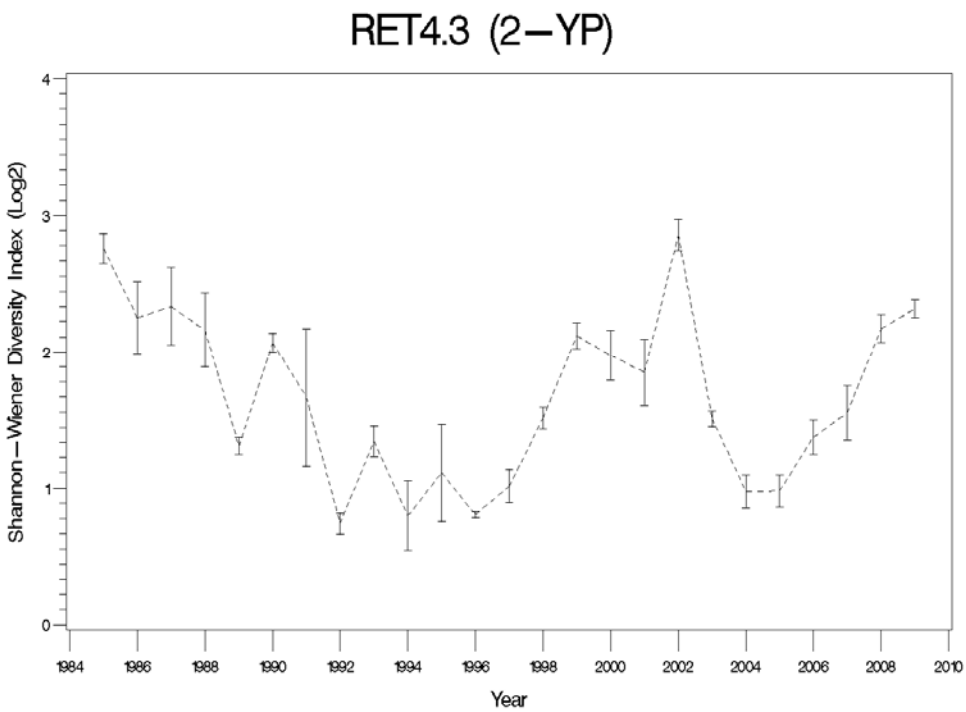


Figure 72. Plot of Shannon-Weiner diversity index at station RET4.3 for 1985 through 2009.

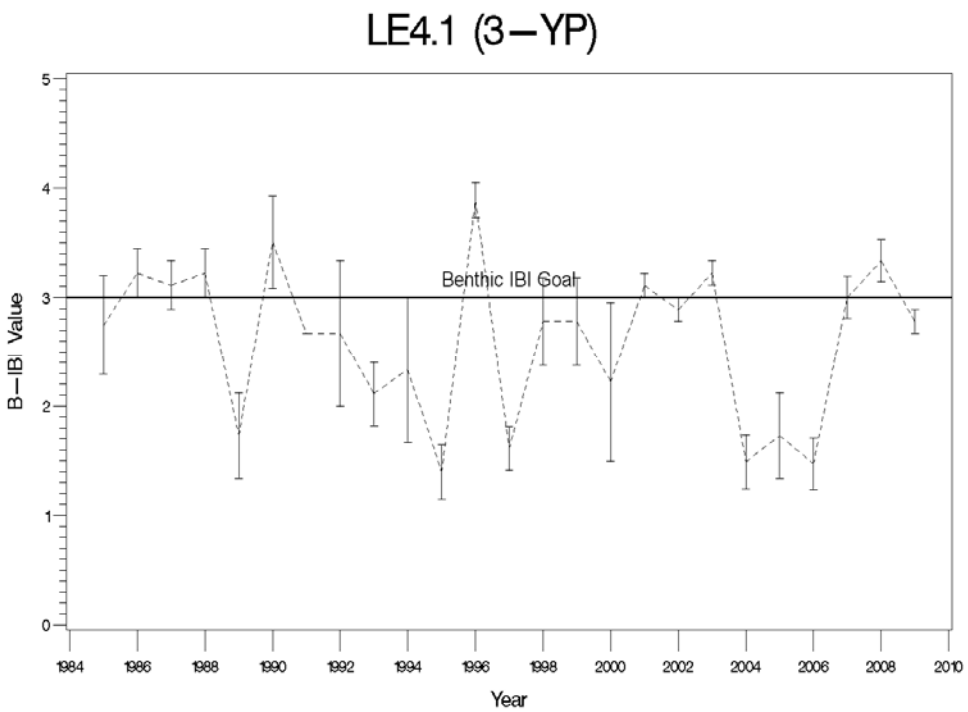


Figure 73. Plot of the benthic IBI against time at station LE4.1 for 1985 through 2009.

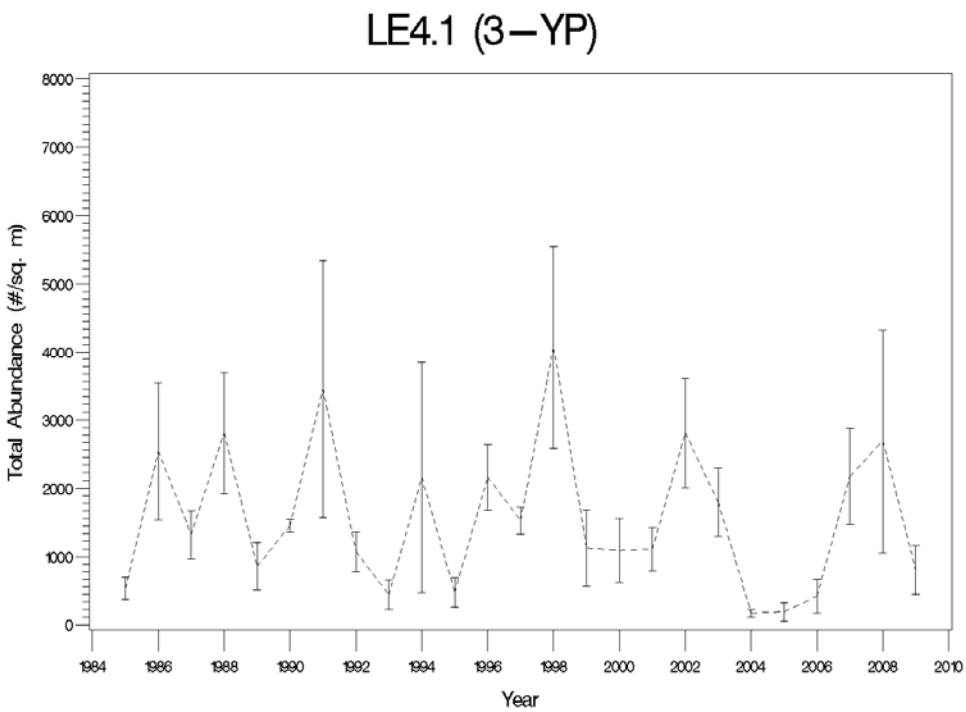


Figure 74. Plot of total benthic community abundance at station LE4.1 for 1985 through 2009.

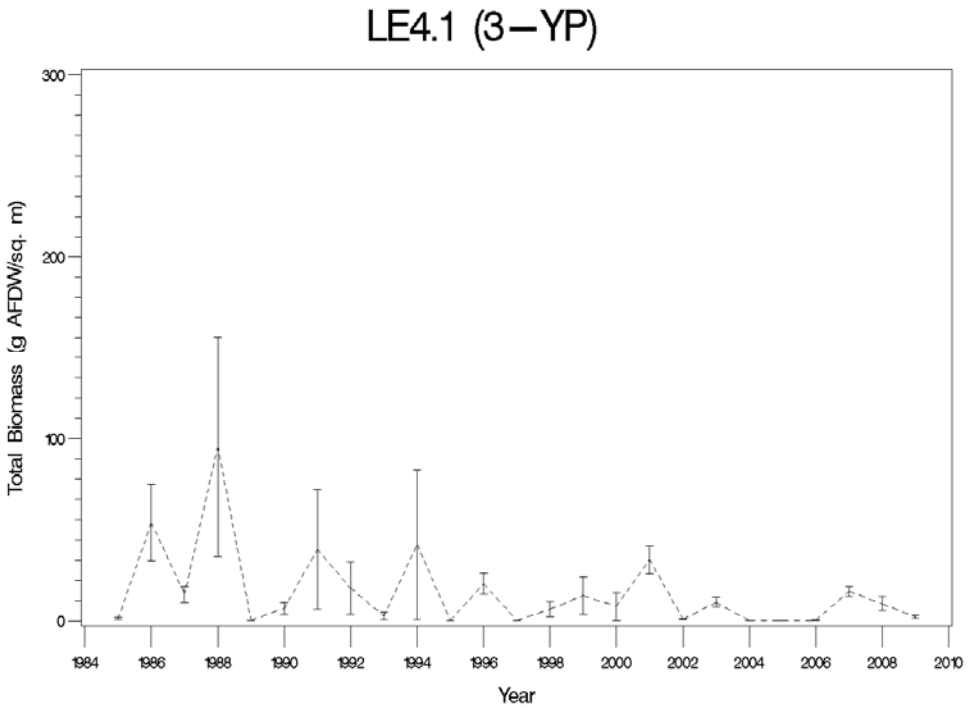


Figure 75. Plot of total benthic community biomass at station LE4.1 for 1985 through 2009.

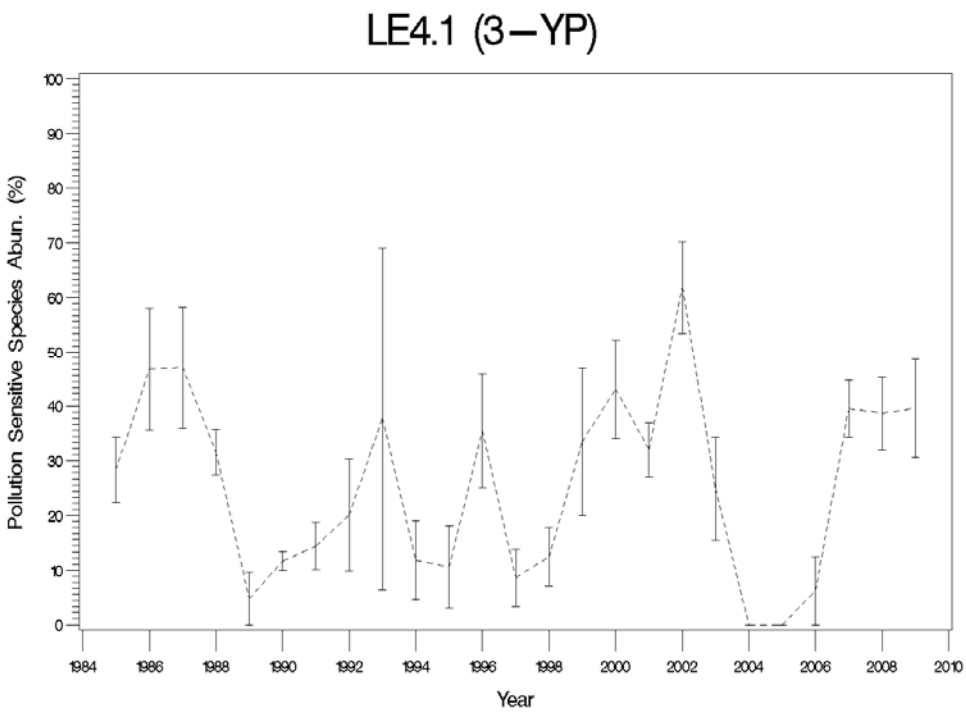


Figure 76. Plot of pollution sensitive species abundance at station LE4.1 for 1985 through 2009.

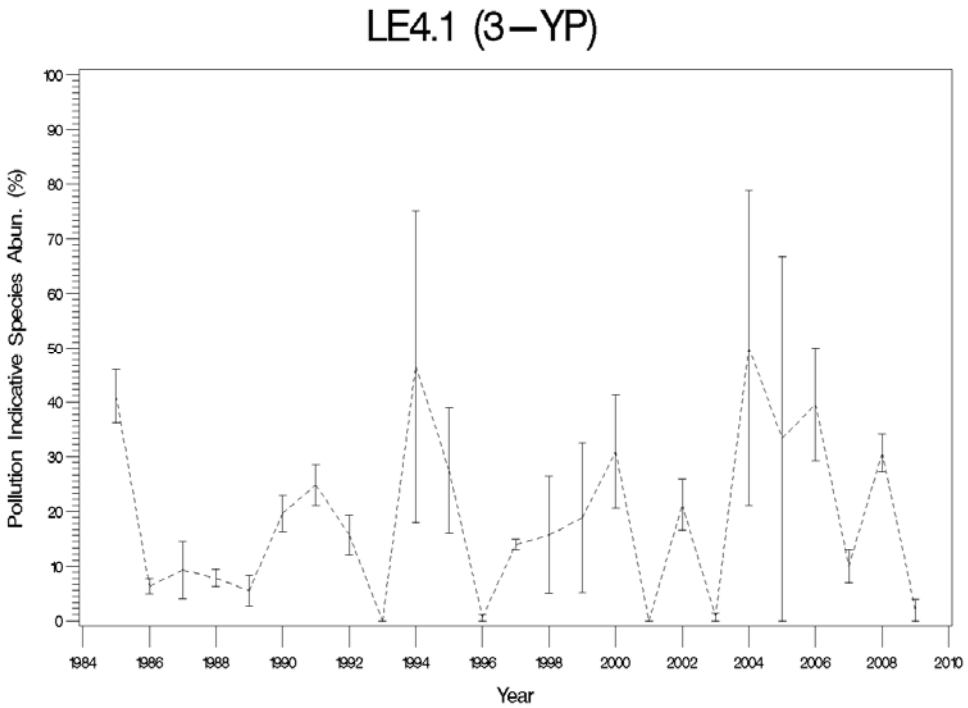


Figure 77. Plot of pollution indicative species abundance at station LE4.1 for 1985 through 2009.

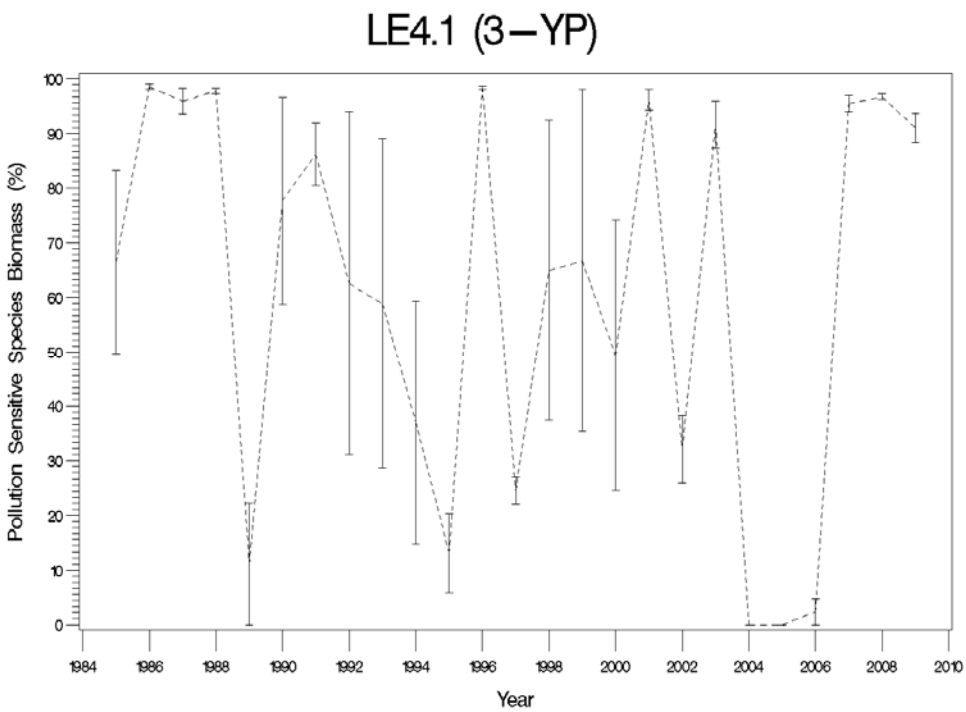


Figure 78. Plot of pollution sensitive species biomass at station LE4.1 for 1985 through 2009.

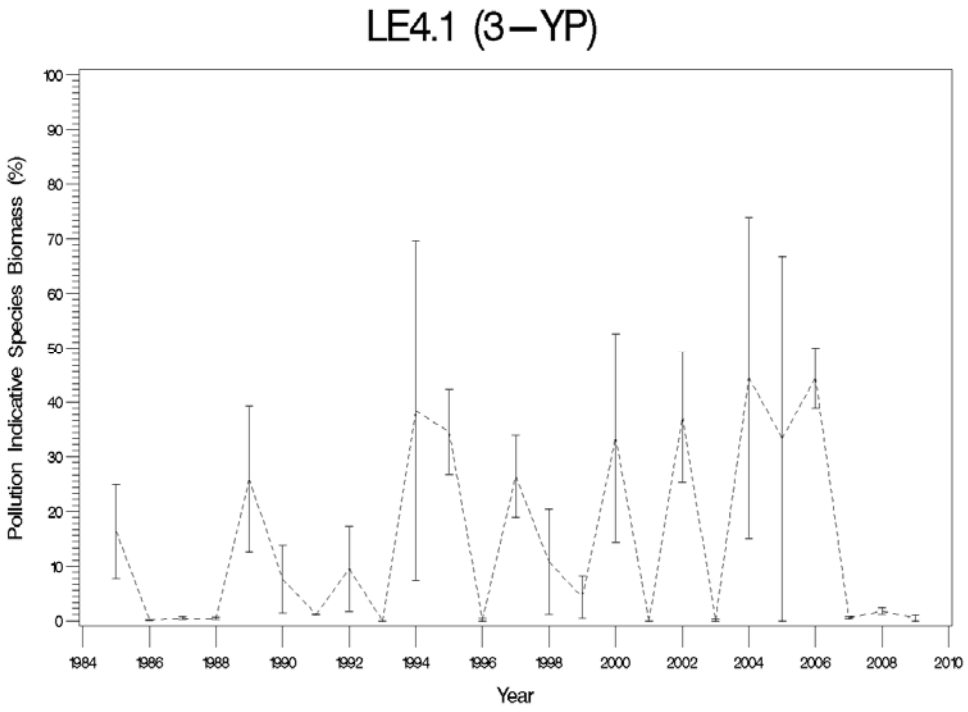


Figure 79. Plot of pollution indicative species biomass at station LE4.1 for 1985 through 2009.

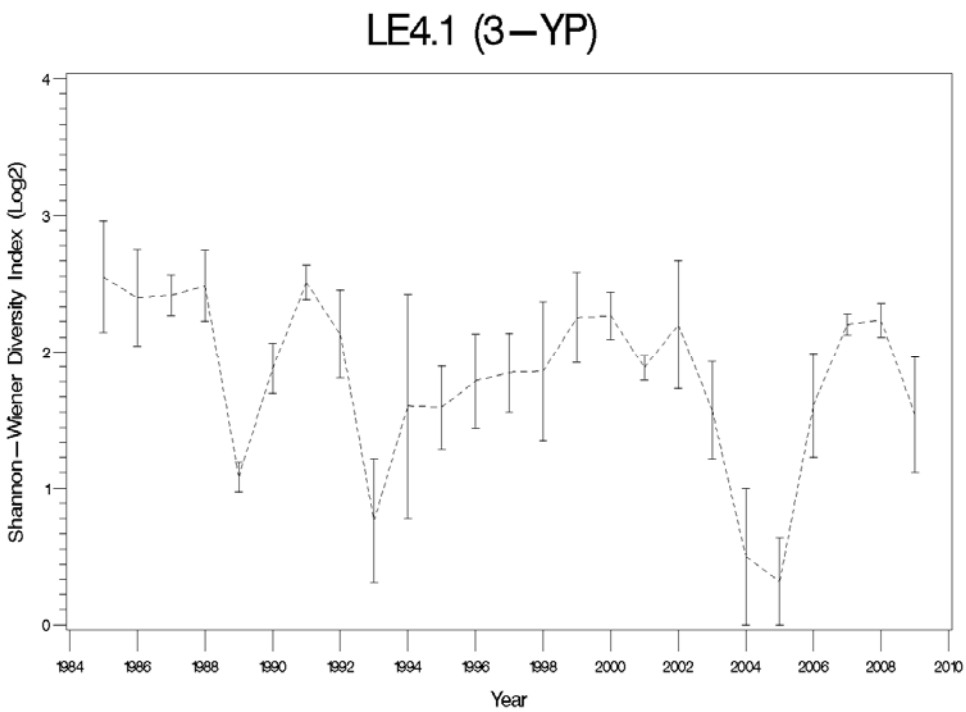


Figure 80. Plot of Shannon-Weiner diversity index at station LE4.1 for 1985 through 2009.

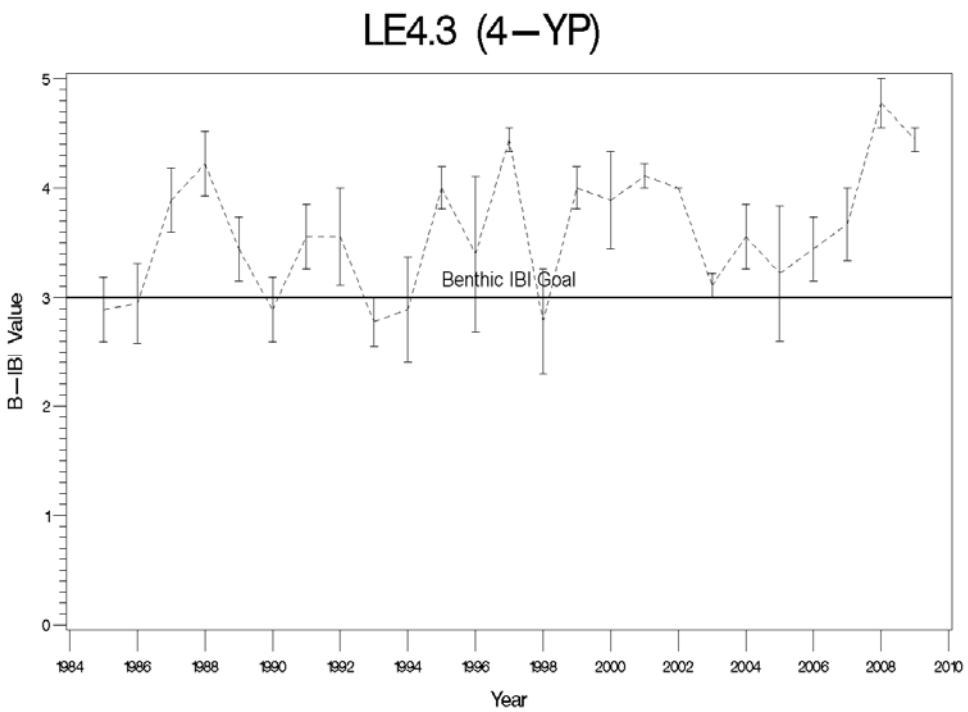


Figure 81. Plot of the benthic IBI against time at station LE4.3 for 1985 through 2009.

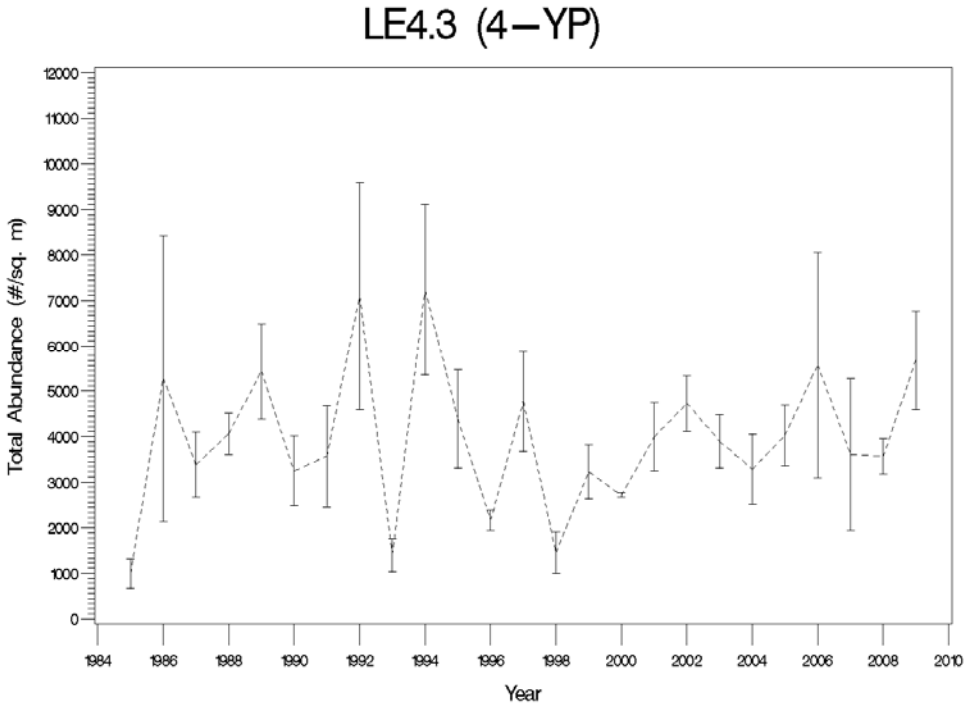


Figure 82. Plot of total benthic community abundance at station LE4.3 for 1985 through 2009.

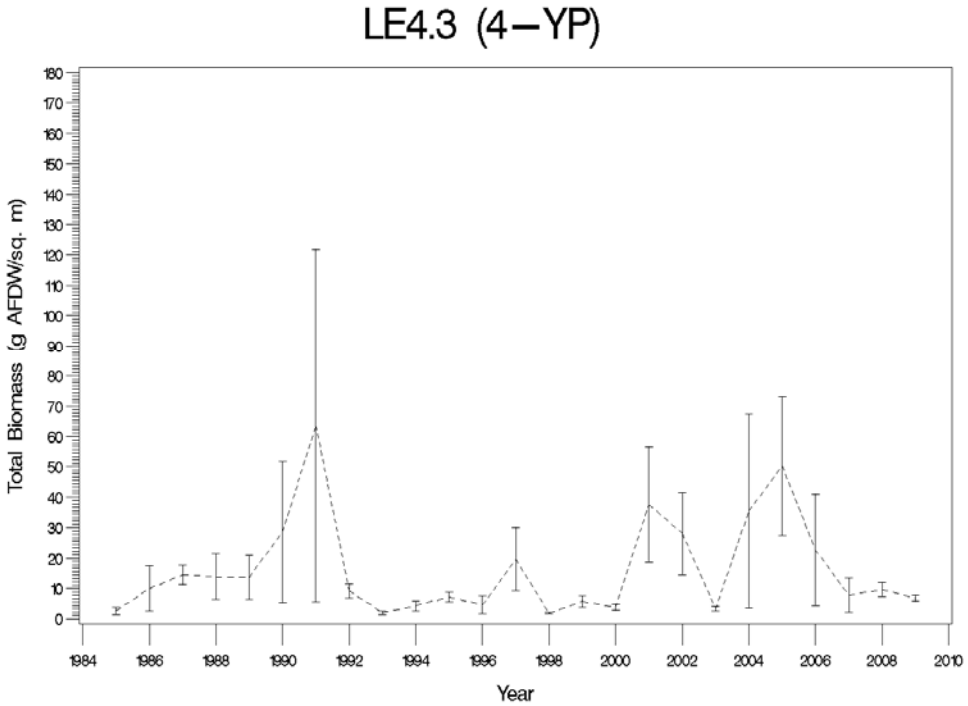


Figure 83. Plot of total benthic community biomass at station LE4.3 for 1985 through 2009.

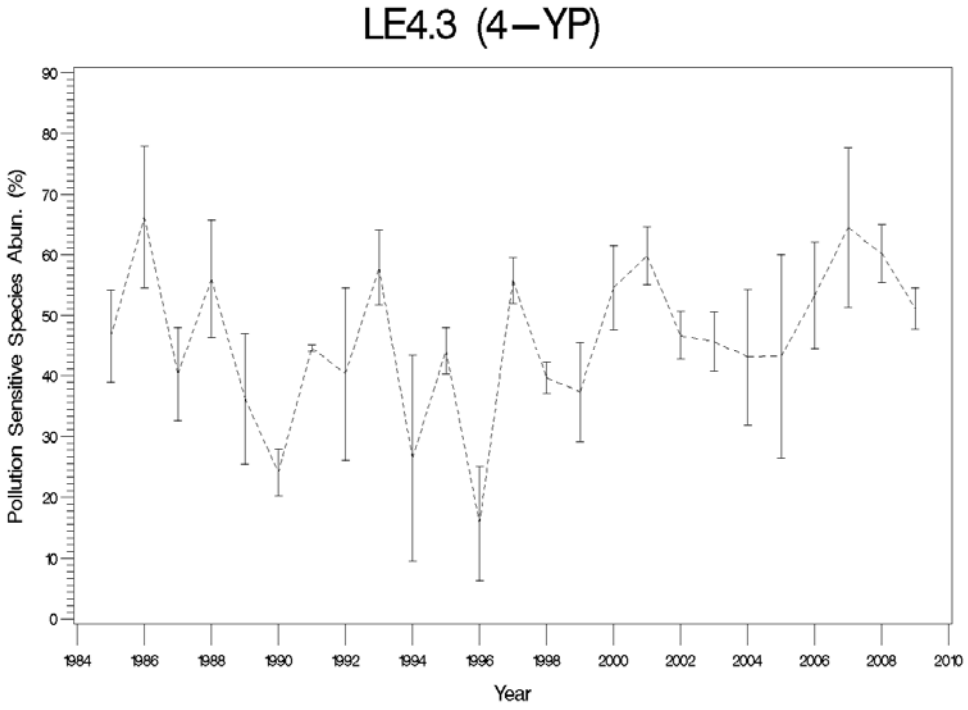


Figure 84. Plot of pollution sensitive species abundance at station LE4.3 for 1985 through 2009.

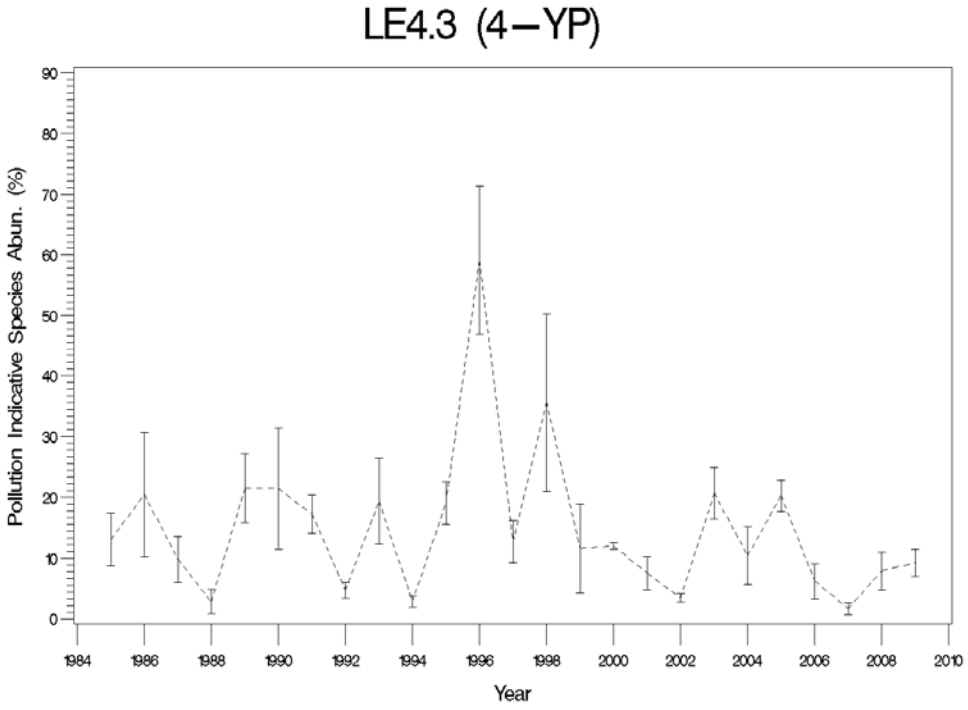


Figure 85. Plot of pollution indicative species abundance at station LE4.3 for 1985 through 2009.

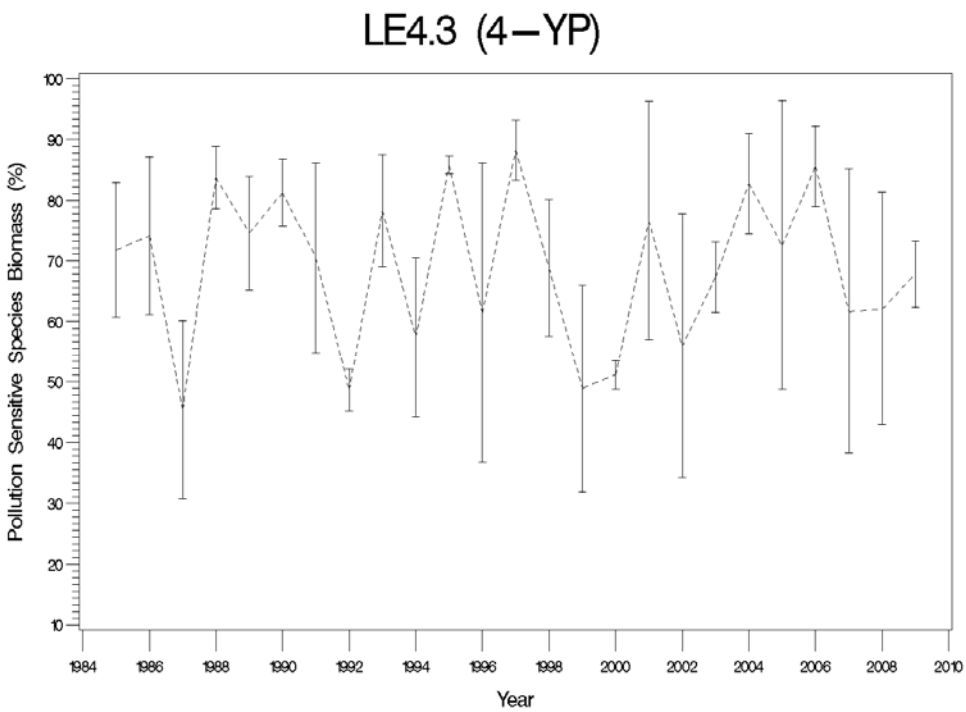


Figure 86. Plot of pollution sensitive species biomass at station LE4.3 for 1985 through 2009.

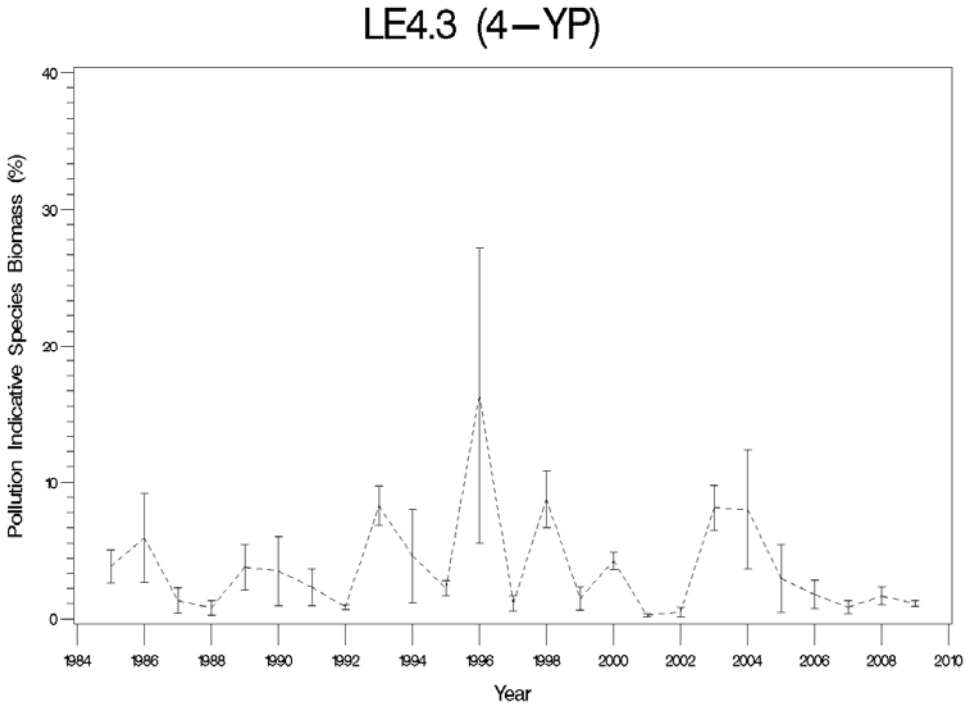


Figure 87. Plot of pollution indicative species biomass at station LE4.3 for 1985 through 2009.

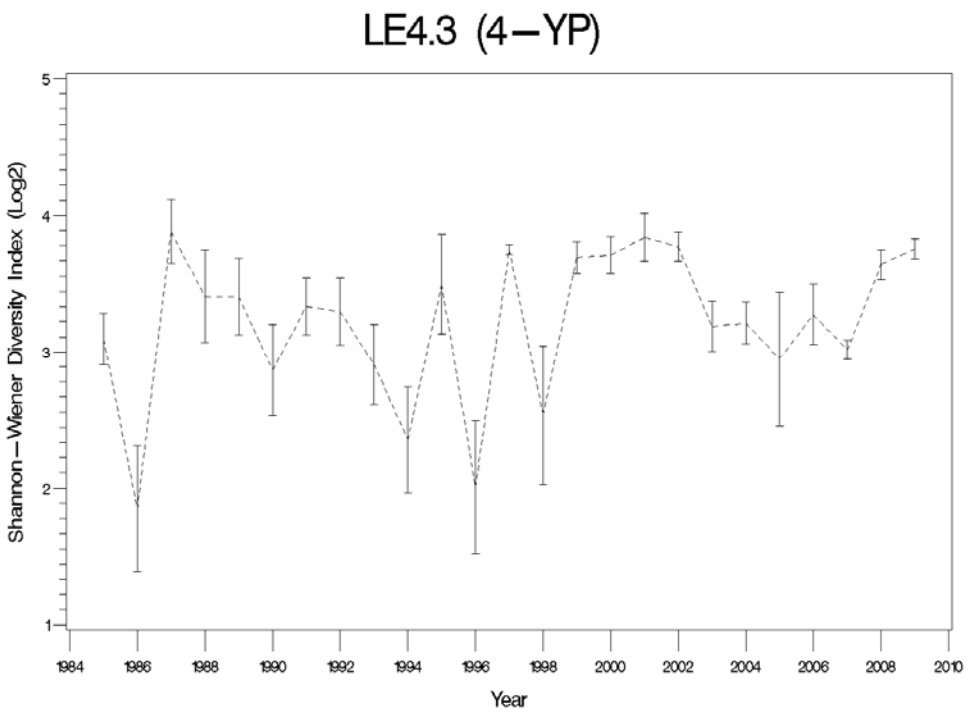


Figure 88. Plot of Shannon-Weiner diversity index at station LE4.3 for 1985 through 2009.

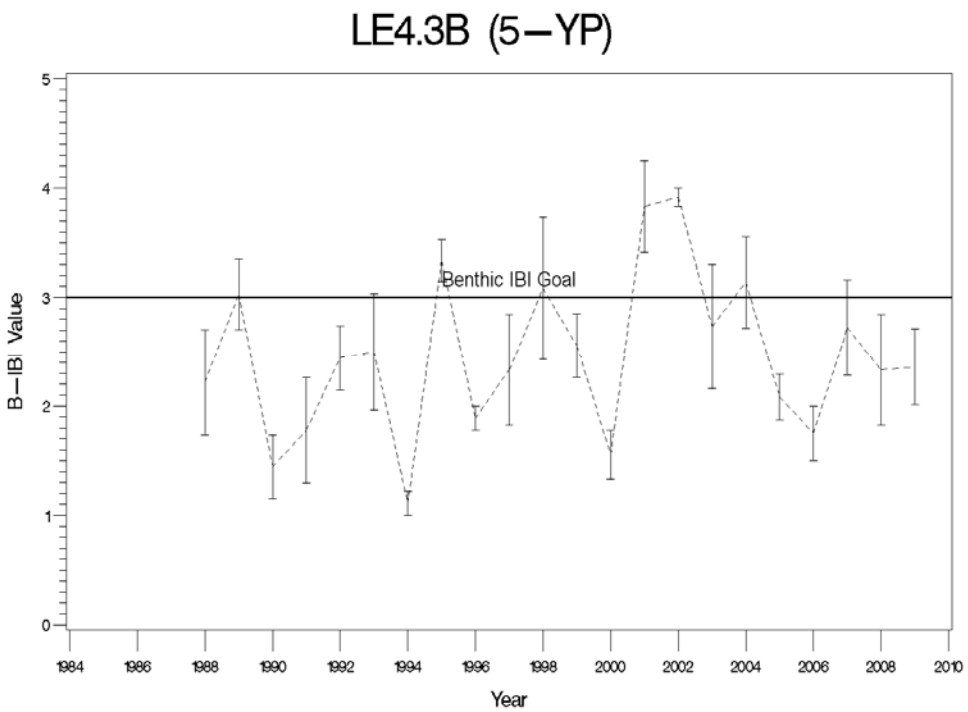


Figure 89. Plot of the benthic IBI against time at station LE4.3B for 1985 through 2009.

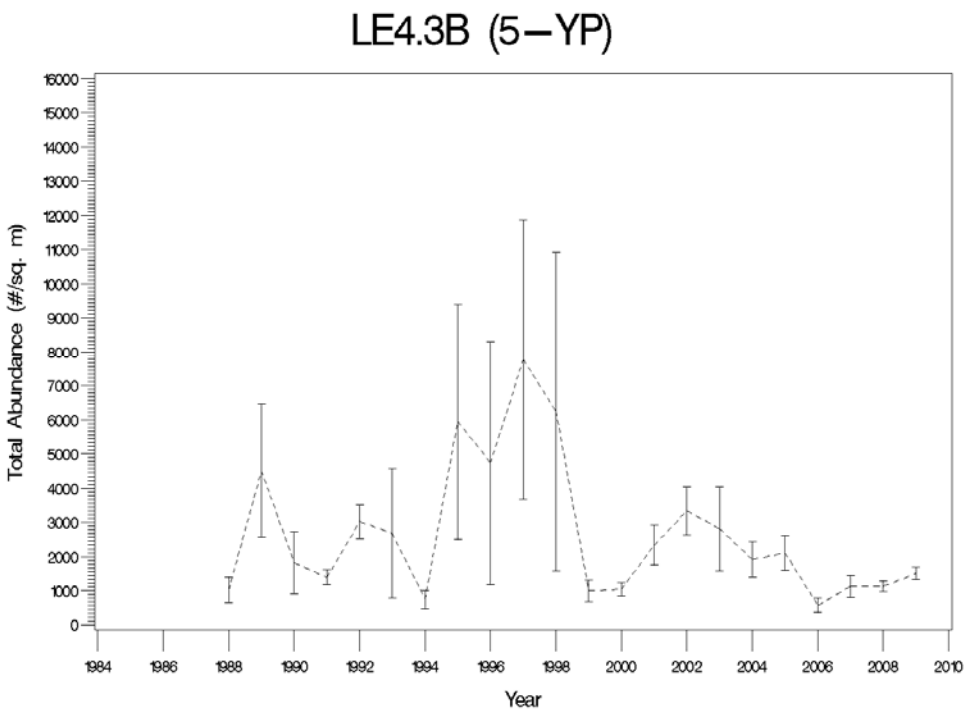


Figure 90. Plot of total benthic community abundance at station LE4.3B for 1985 through 2009.

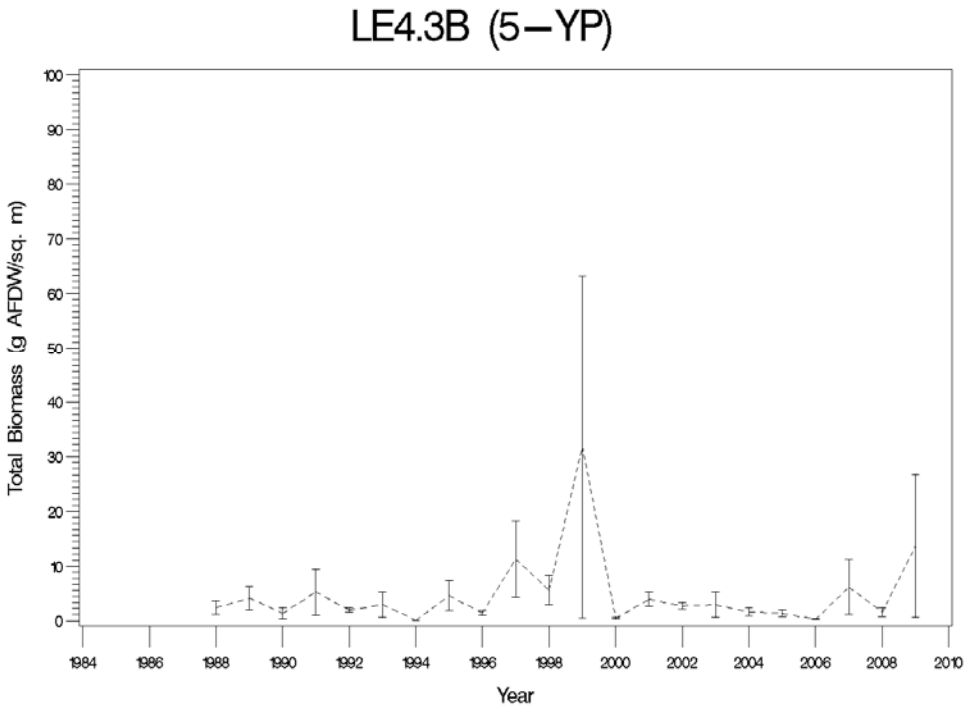


Figure 91. Plot of total benthic community biomass at station LE4.3B for 1985 through 2009.

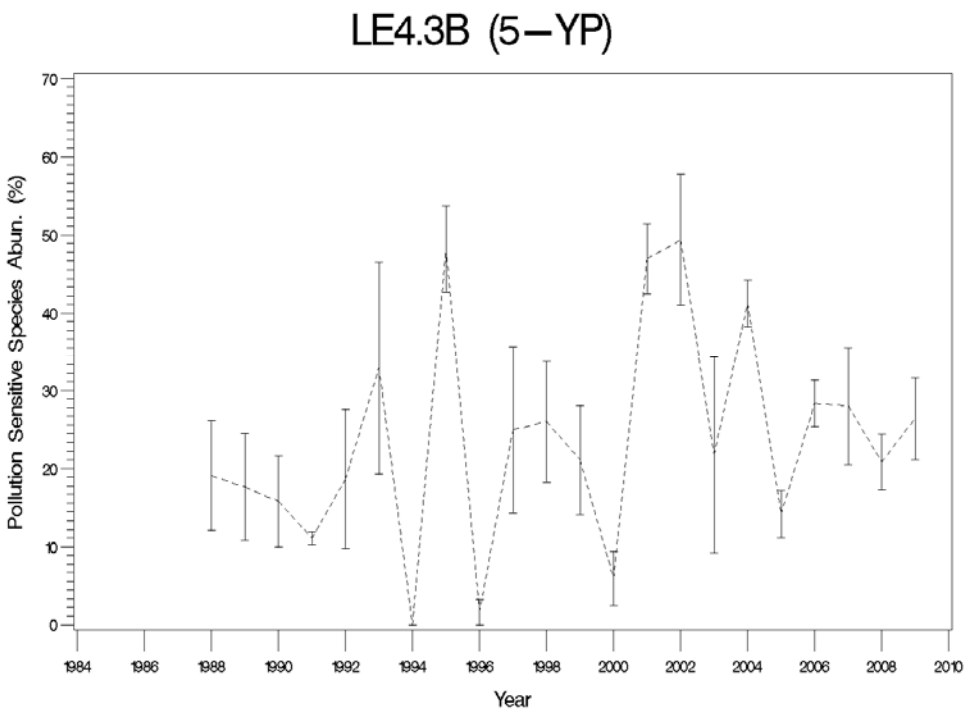


Figure 92. Plot of pollution sensitive species abundance at station LE4.3B for 1985 through 2009.

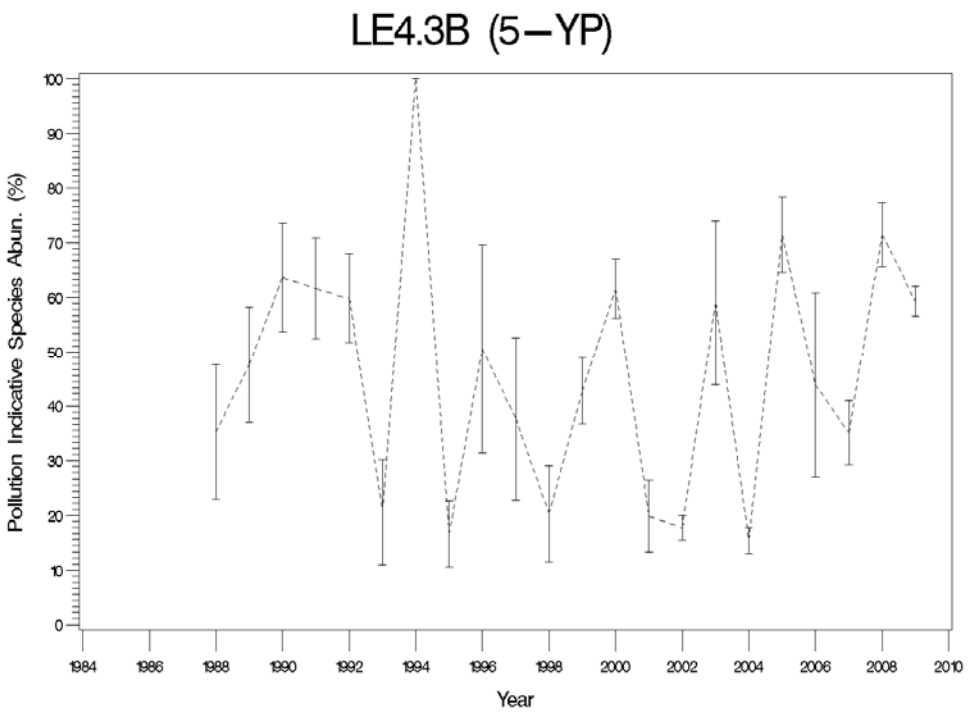


Figure 93. Plot of pollution indicative species abundance at station LE4.3B for 1985 through 2009.

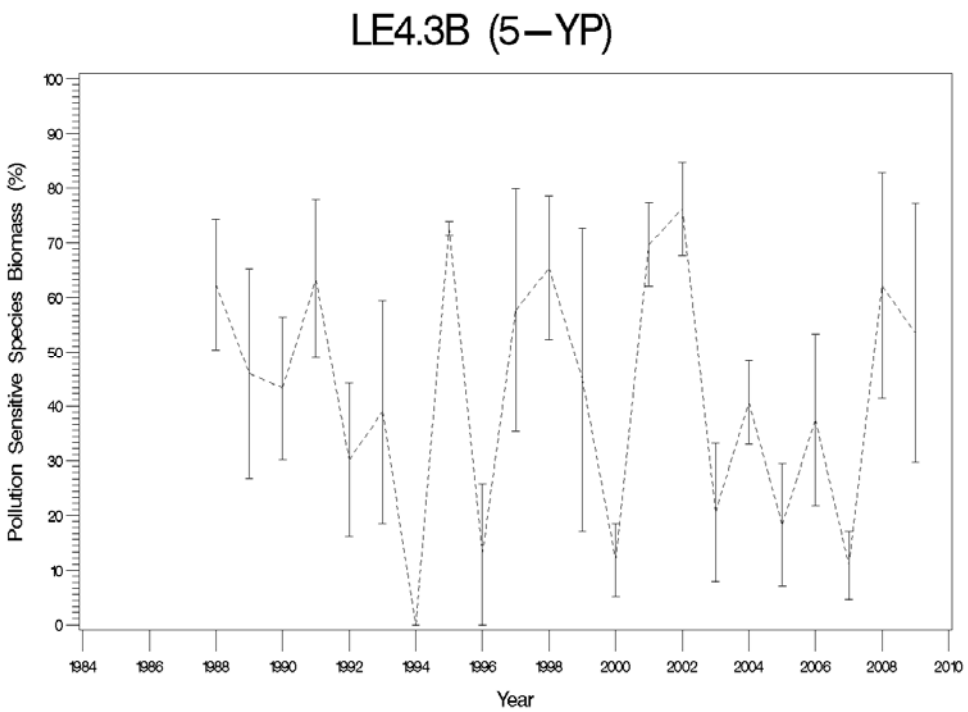


Figure 94. Plot of pollution sensitive species biomass at station LE4.3B for 1985 through 2009.

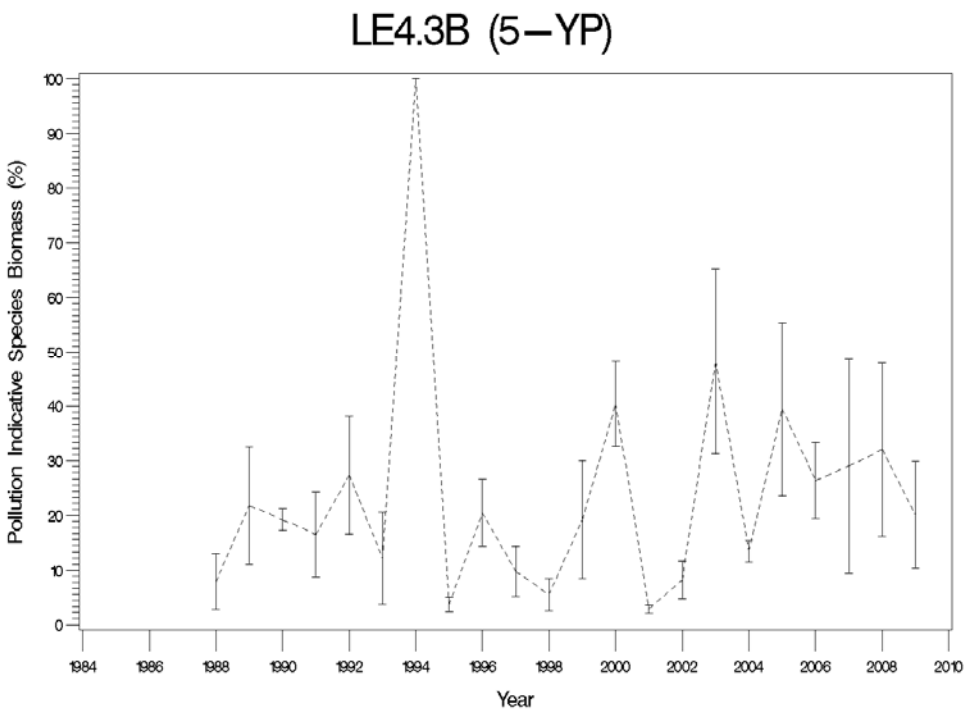


Figure 95. Plot of pollution indicative species biomass at station LE4.3B for 1985 through 2009.

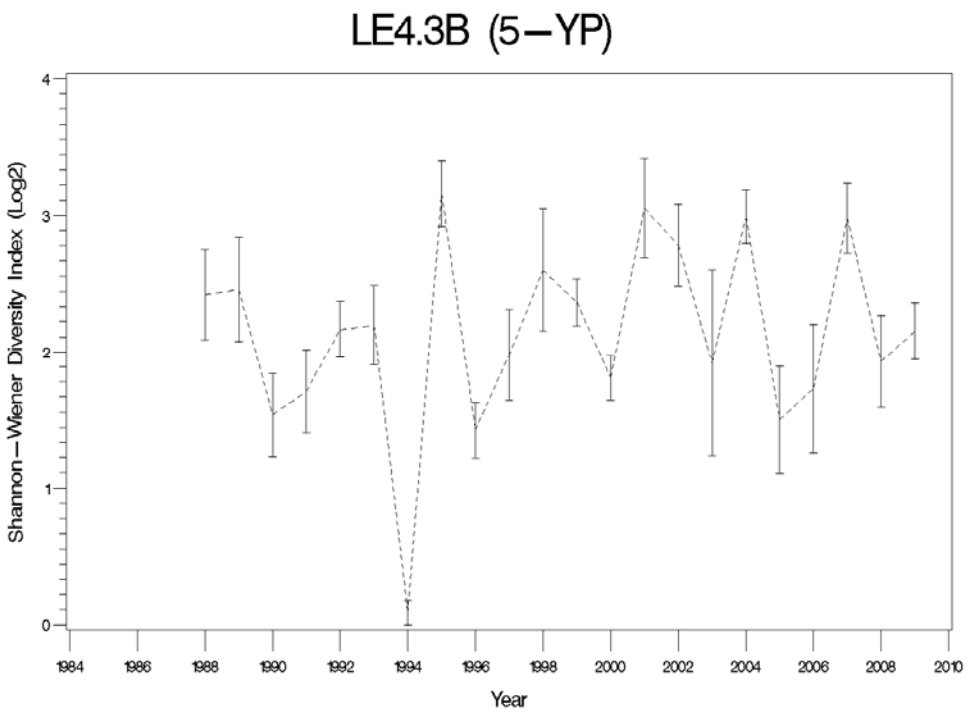


Figure 96. Plot of Shannon-Weiner diversity index at station LE4.3B for 1985 through 2009.

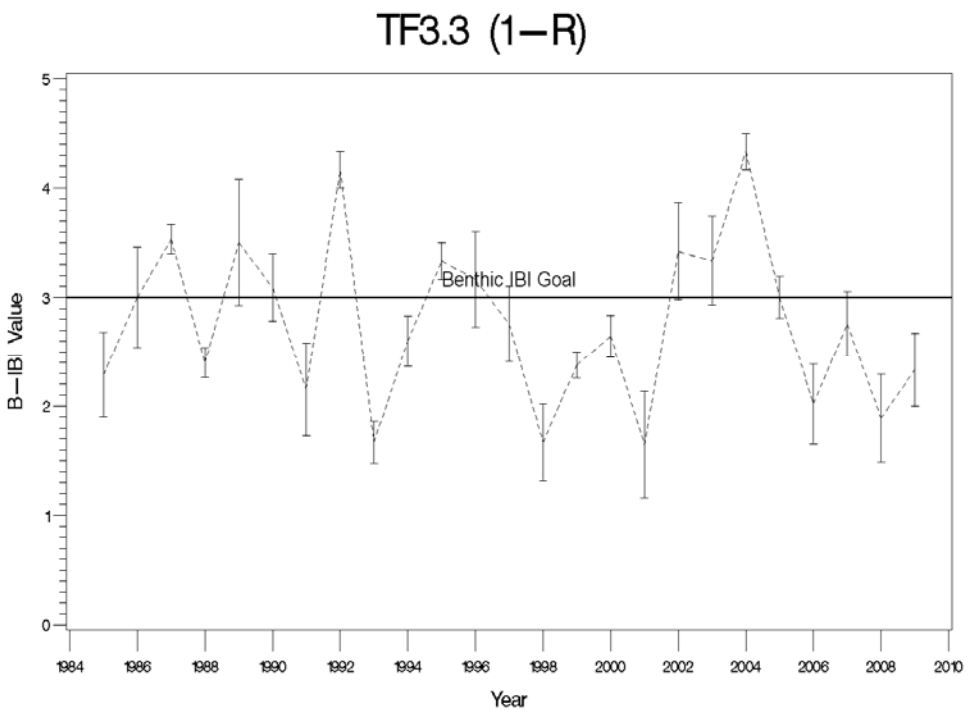


Figure 97. Plot of the benthic IBI against time at station TF3.3 for 1985 through 2009.

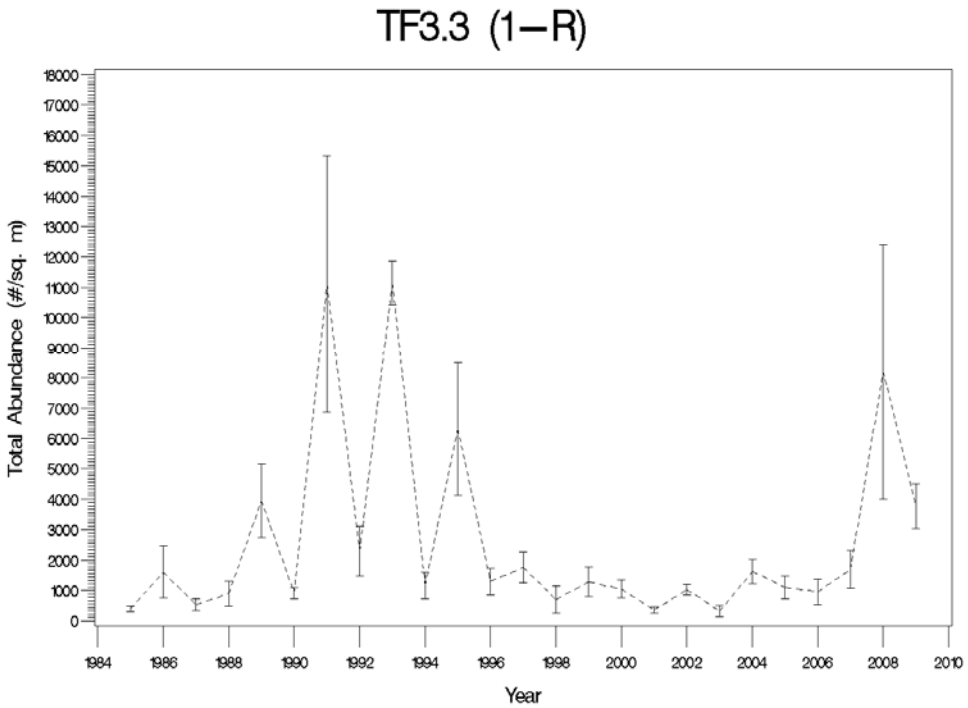


Figure 98. Plot of total benthic community abundance at station TF3.3 for 1985 through 2009.

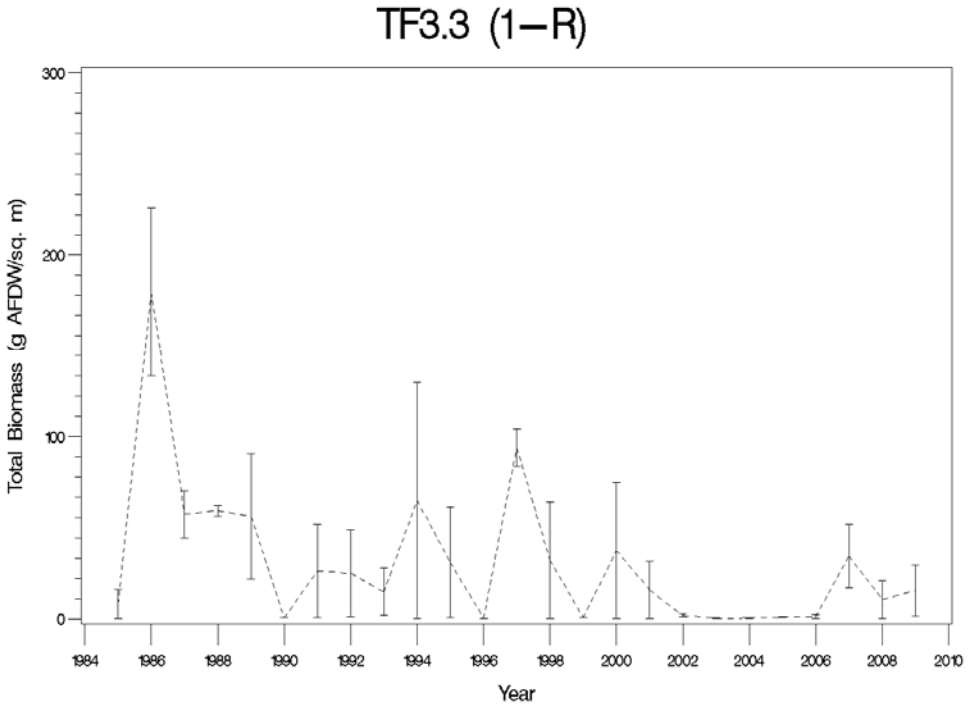


Figure 99. Plot of total benthic community biomass at station TF3.3 for 1985 through 2009.

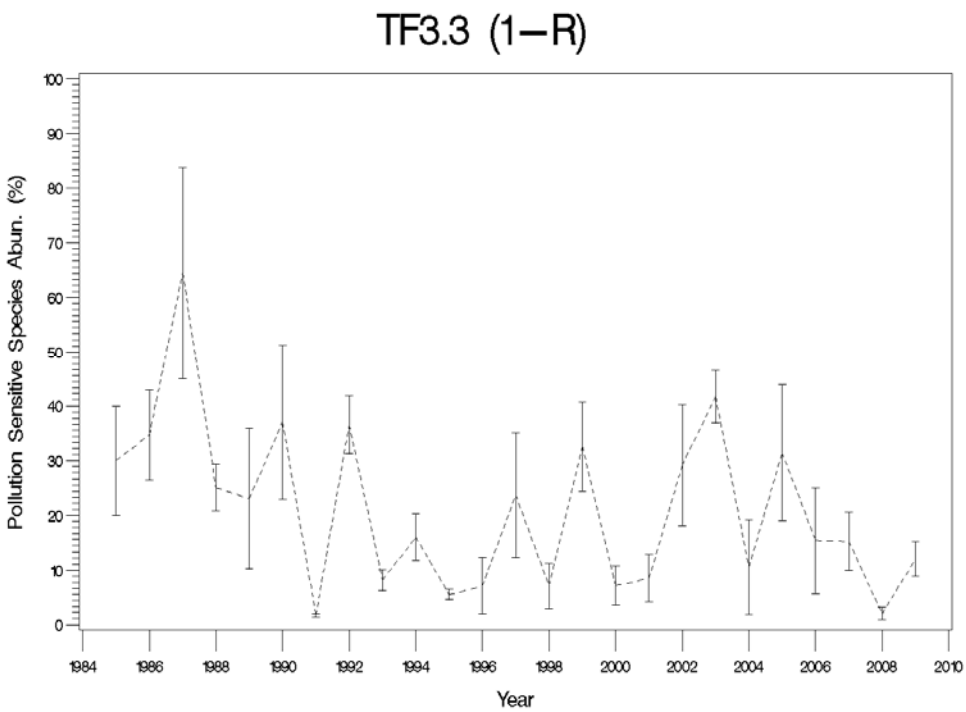


Figure 100. Plot of pollution sensitive species abundance at station TF3.3 for 1985 through 2009.

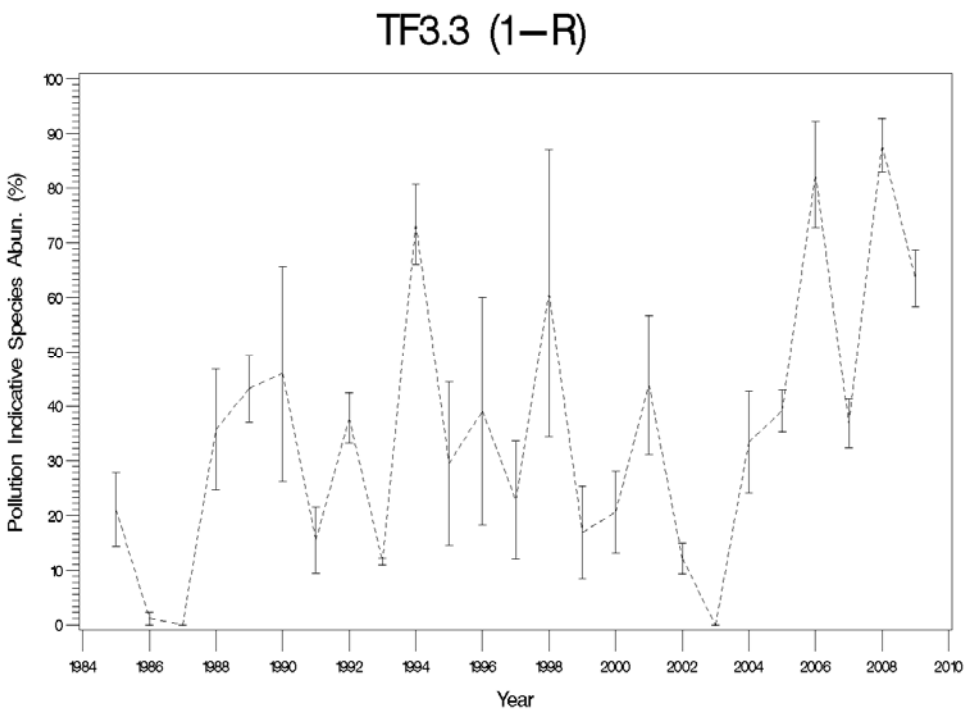


Figure 101. Plot of pollution indicative species abundance at station TF3.3 for 1985 through 2009.

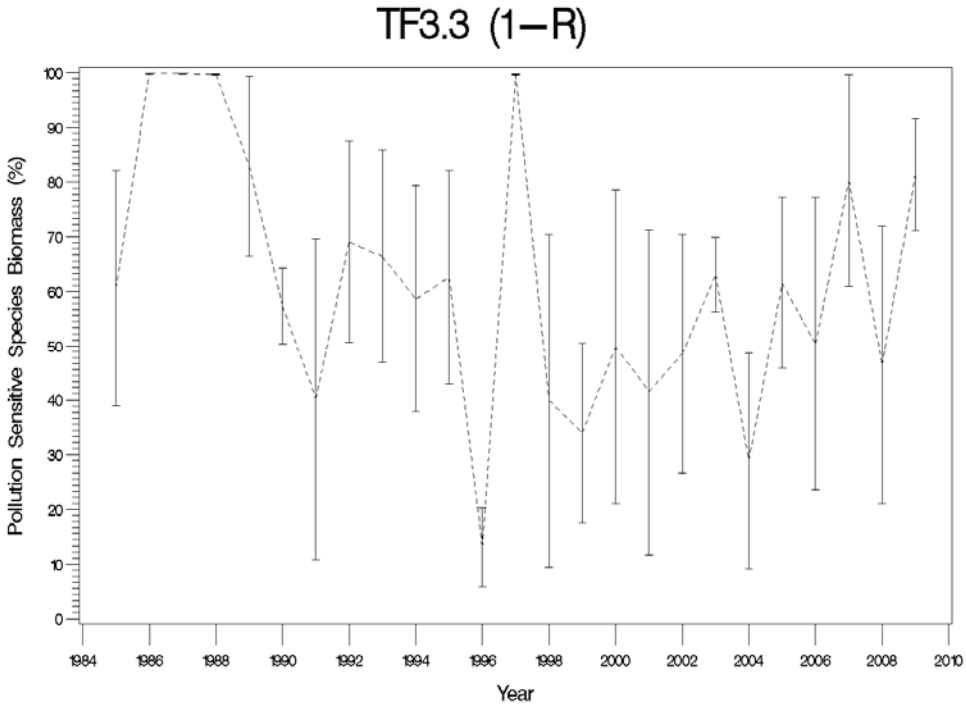


Figure 102. Plot of pollution sensitive species biomass at station TF3.3 for 1985 through 2009.

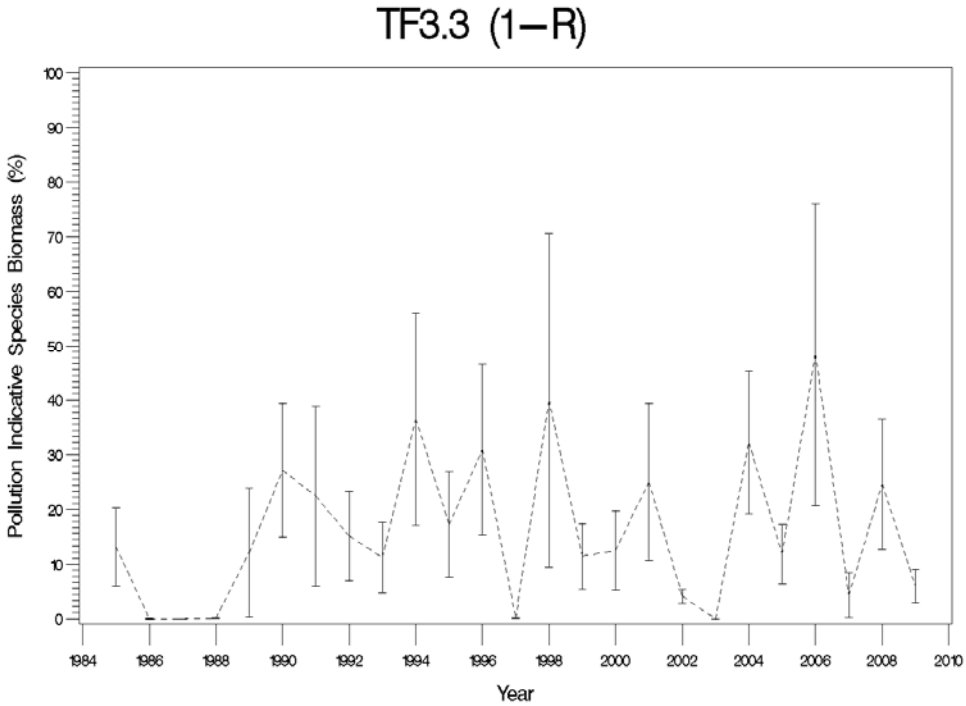


Figure 103. Plot of pollution indicative species biomass at station TF3.3 for 1985 through 2009.

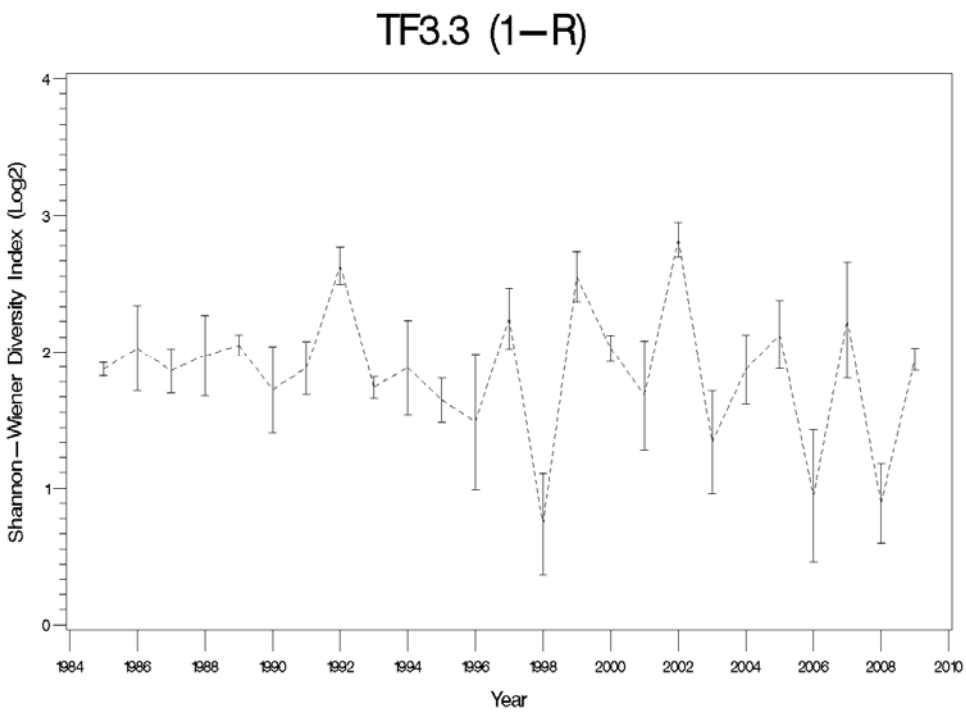


Figure 104. Plot of Shannon-Weiner diversity index at station TF3.3 for 1985 through 2009.

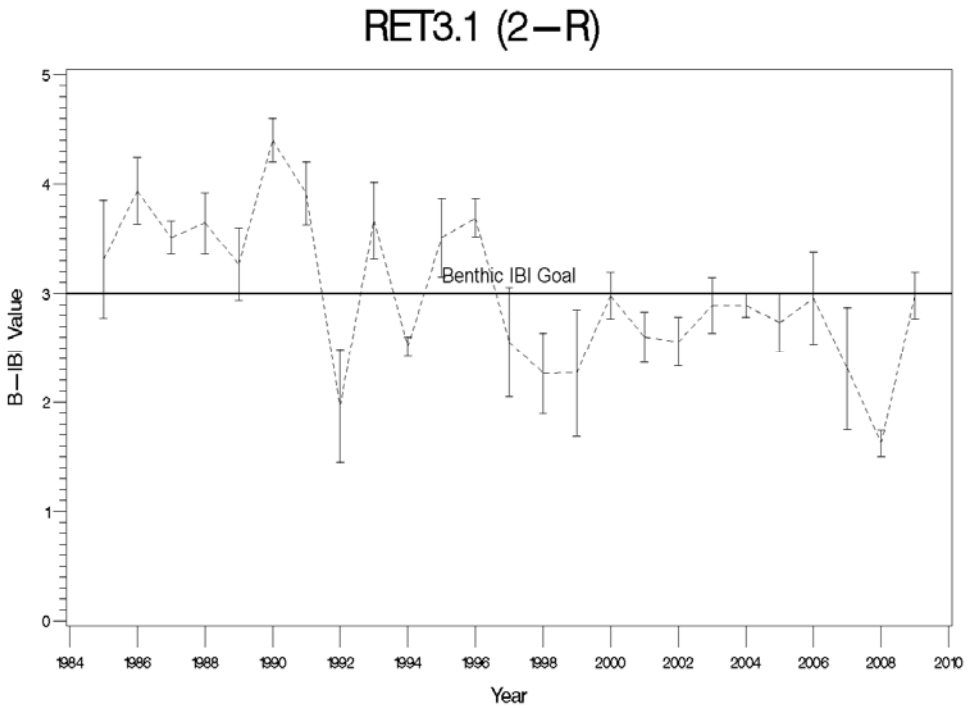


Figure 105. Plot of the benthic IBI against time at station RET3.1 for 1985 through 2009.

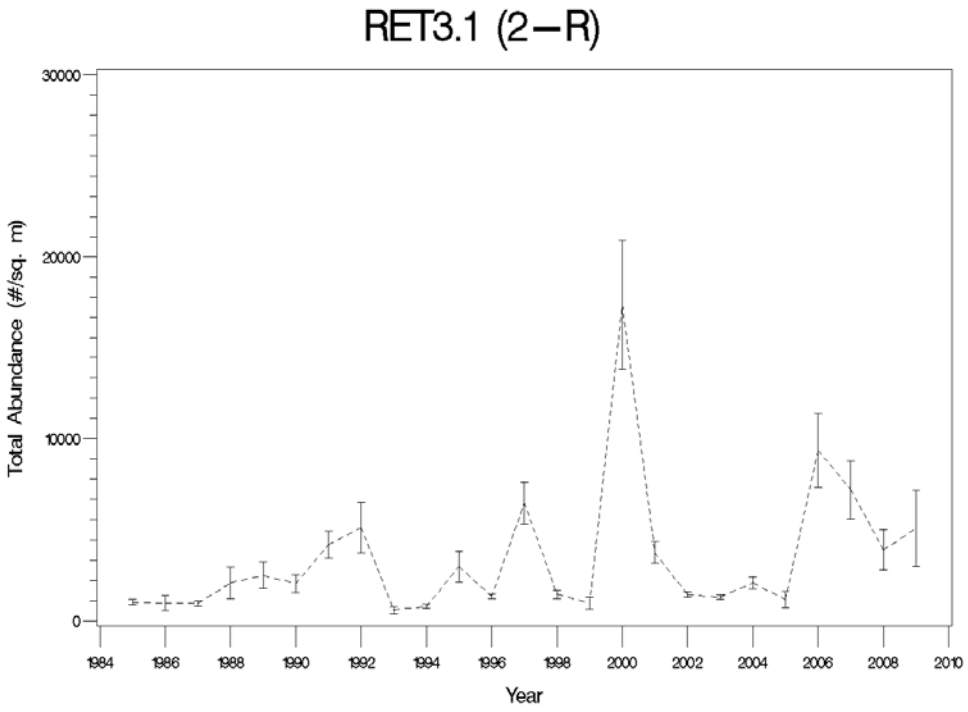


Figure 106. Plot of total benthic community abundance at station RET3.1 for 1985 through 2009.

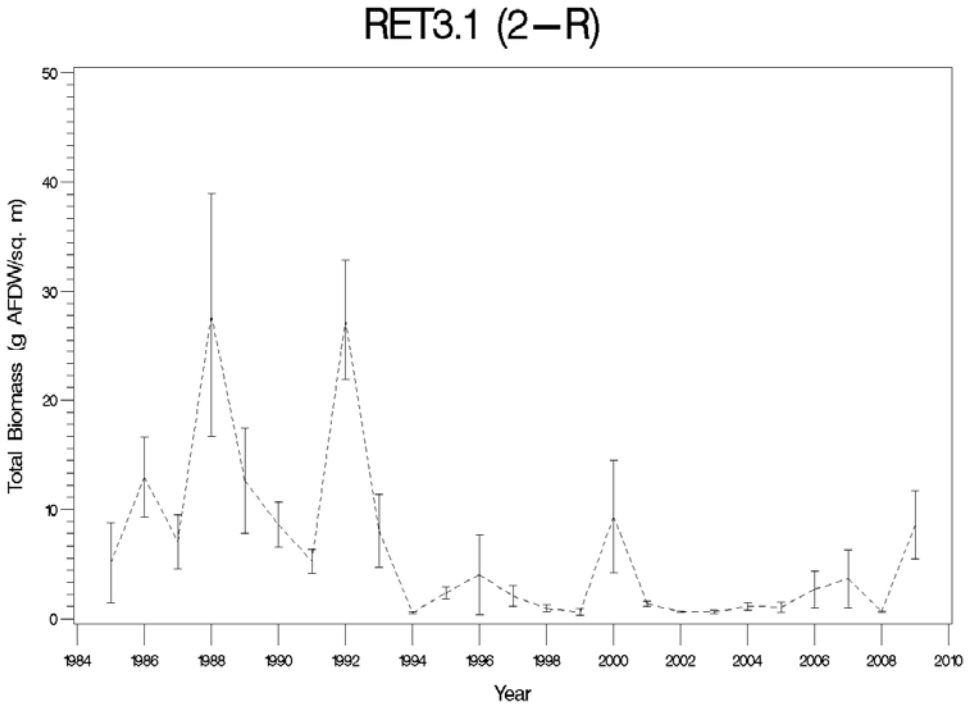


Figure 107. Plot of total benthic community biomass at station RET3.1 for 1985 through 2009.

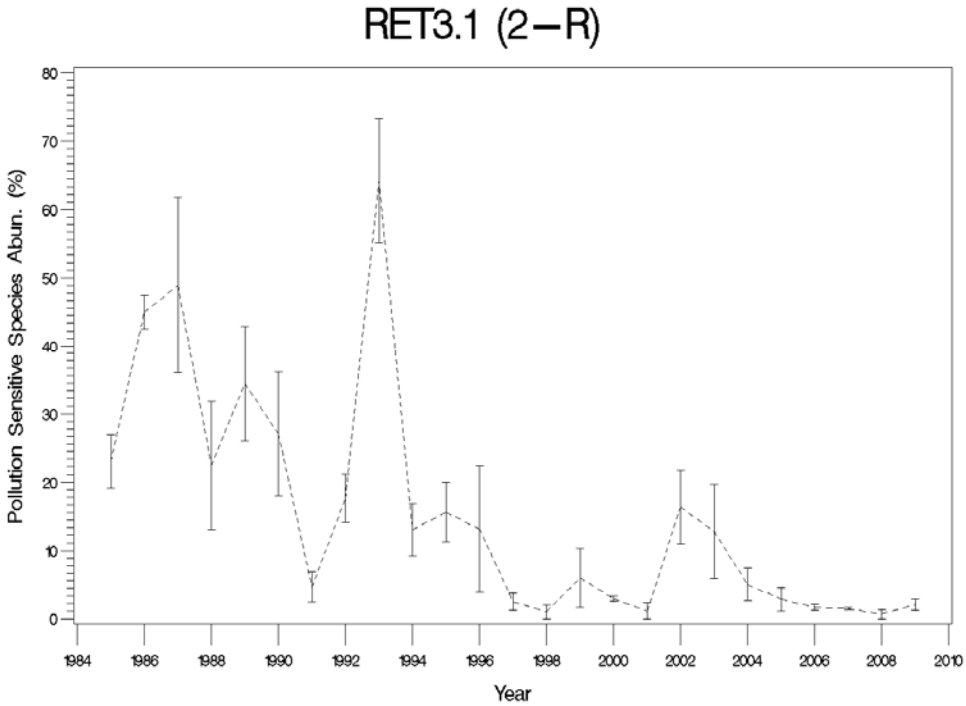


Figure 108. Plot of pollution sensitive species abundance at station RET3.1 for 1985 through 2009.

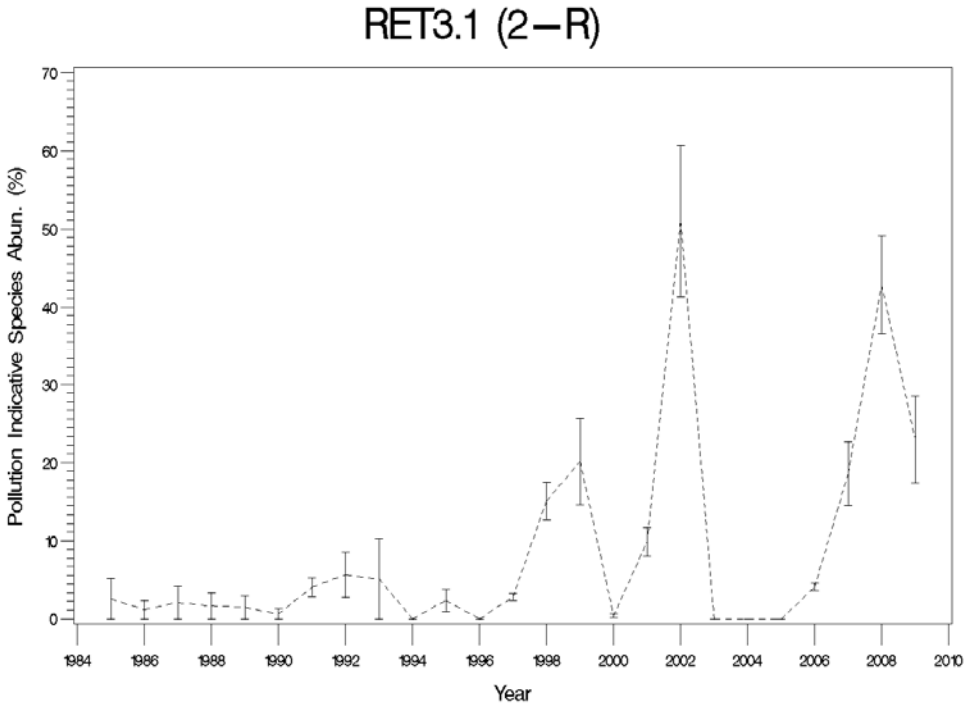


Figure 109. Plot of pollution indicative species abundance at station RET3.1 for 1985 through 2009.

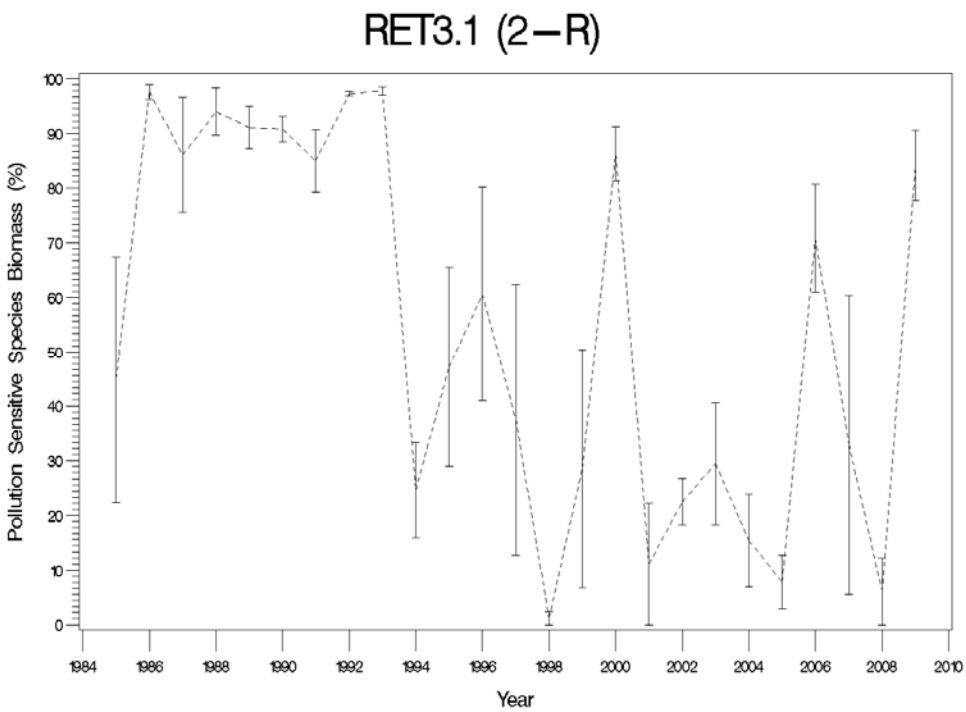


Figure 110. Plot of pollution sensitive species biomass at station RET3.1 for 1985 through 2009.

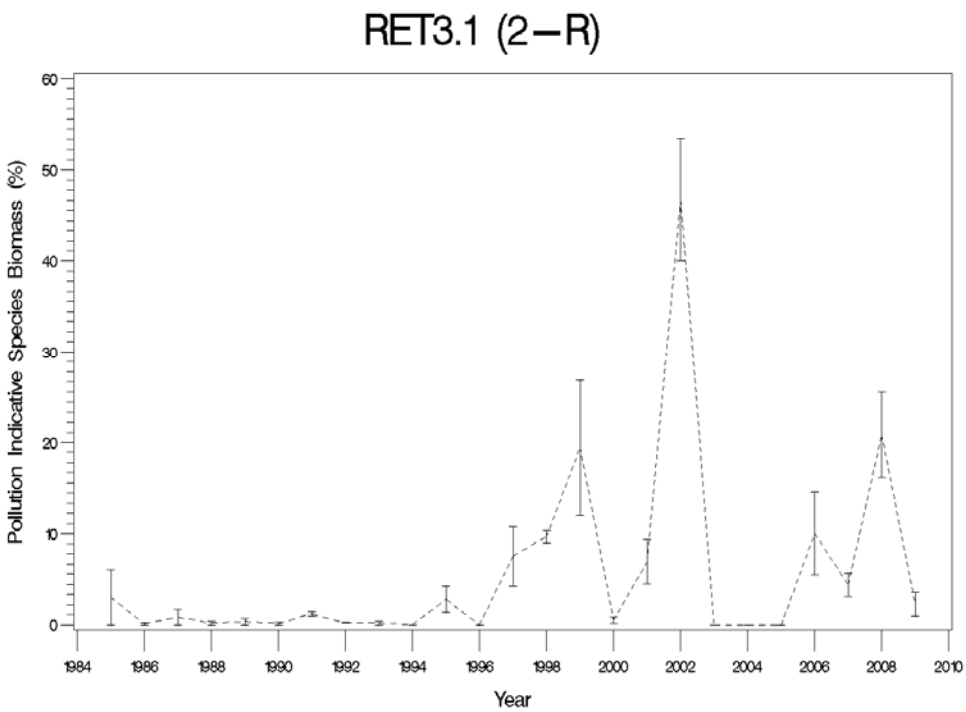


Figure 111. Plot of pollution indicative species biomass at station RET3.1 for 1985 through 2009.

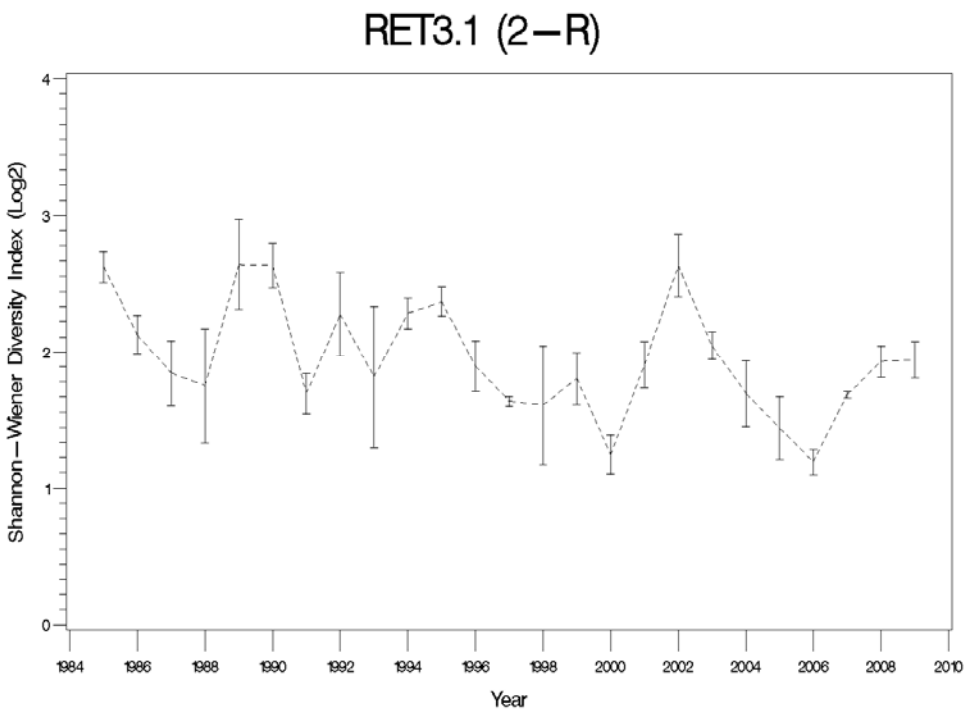


Figure 112. Plot of Shannon-Weiner diversity index at station RET3.1 for 1985 through 2009.

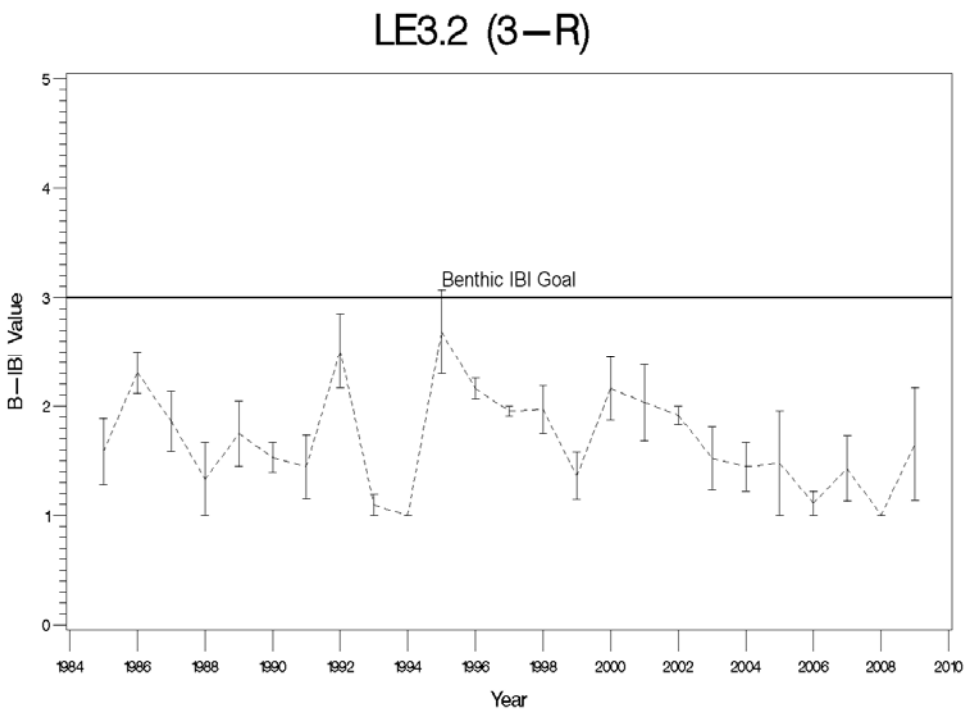


Figure 113. Plot of the benthic IBI against time at station LE3.2 for 1985 through 2009.

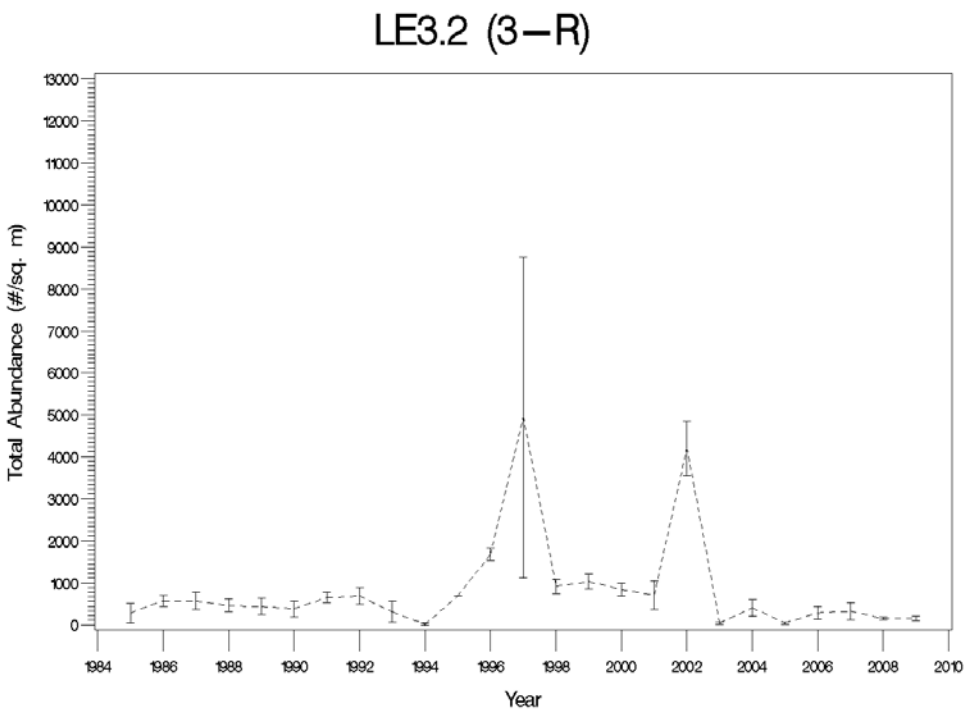


Figure 114. Plot of total benthic community abundance at station LE3.2 for 1985 through 2009.

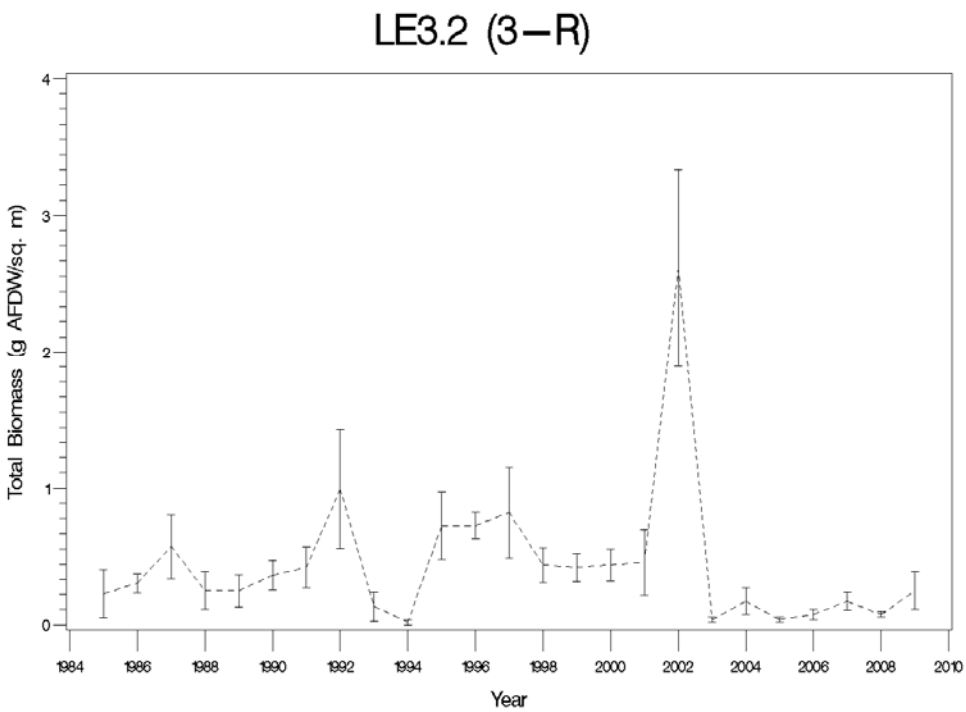


Figure 115. Plot of total benthic community biomass at station LE3.2 for 1985 through 2009.

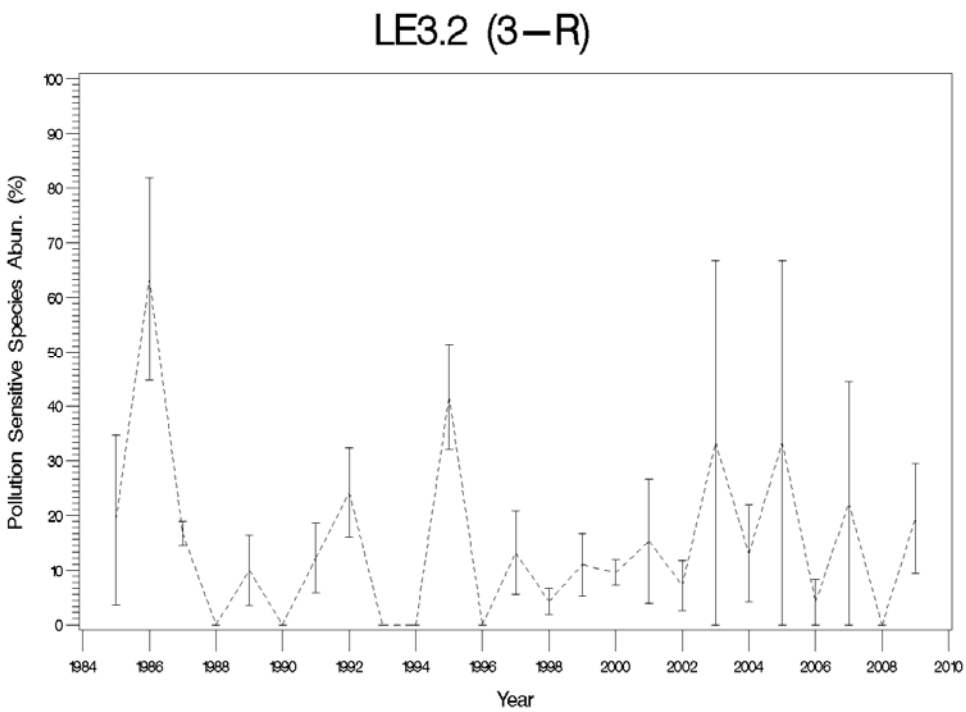


Figure 116. Plot of pollution sensitive species abundance at station LE3.2 for 1985 through 2009.

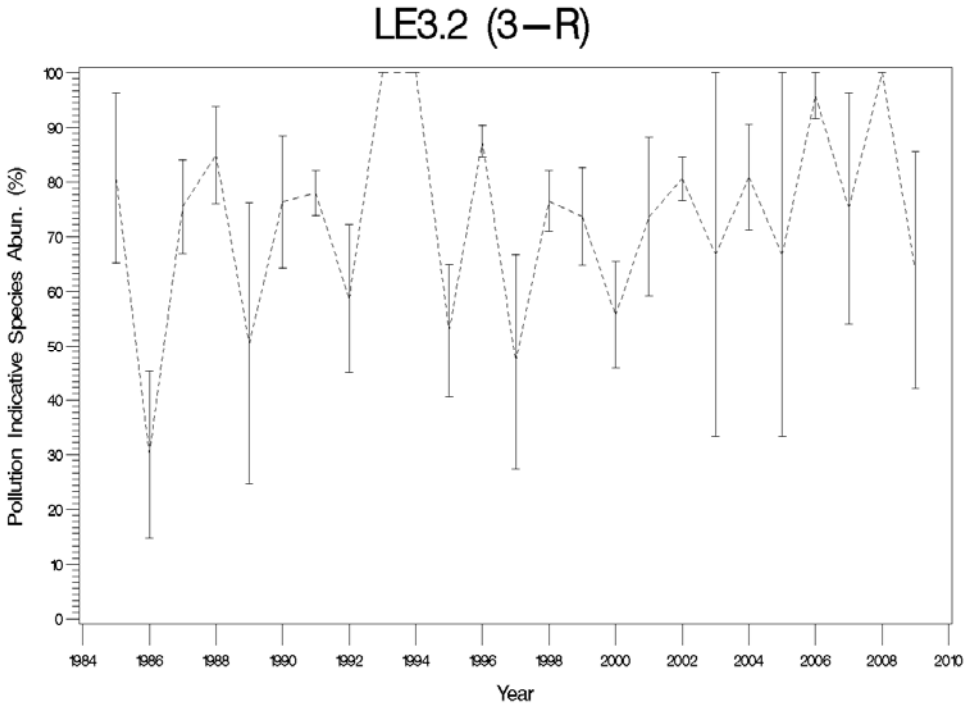


Figure 117. Plot of pollution indicative species abundance at station LE3.2 for 1985 through 2009.

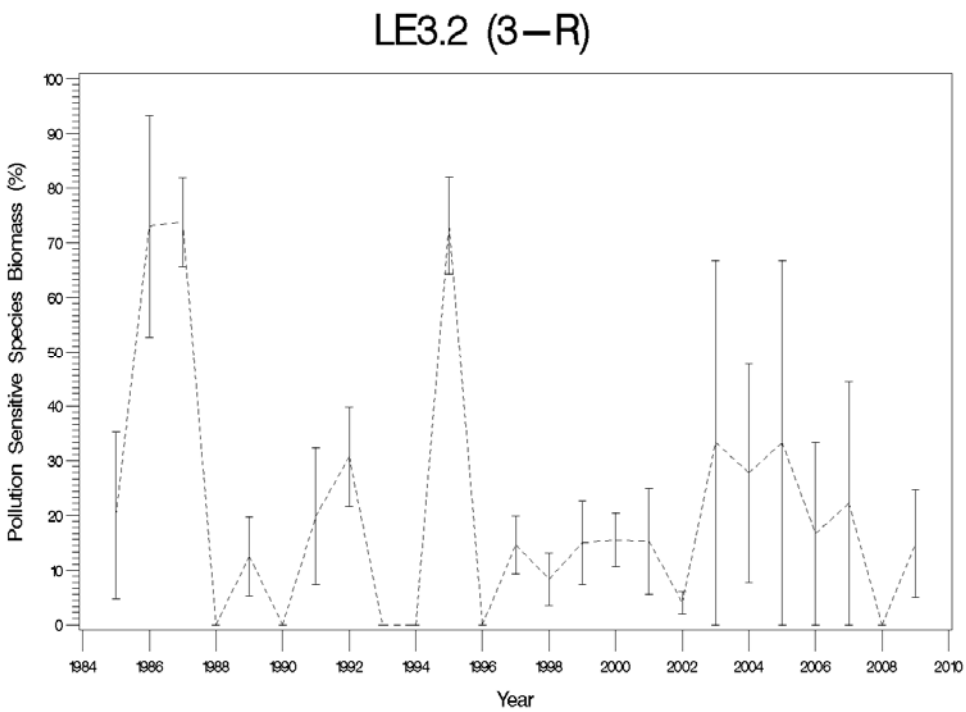


Figure 118. Plot of pollution sensitive species biomass at station LE3.2 for 1985 through 2009.

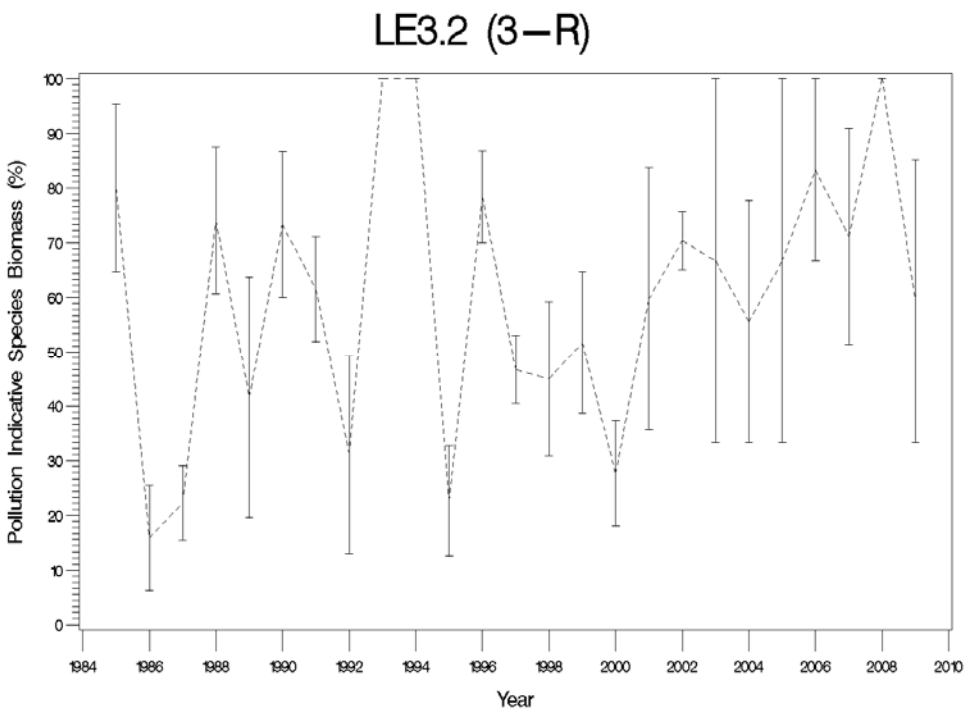


Figure 119. Plot of pollution indicative species biomass at station LE3.2 for 1985 through 2009.

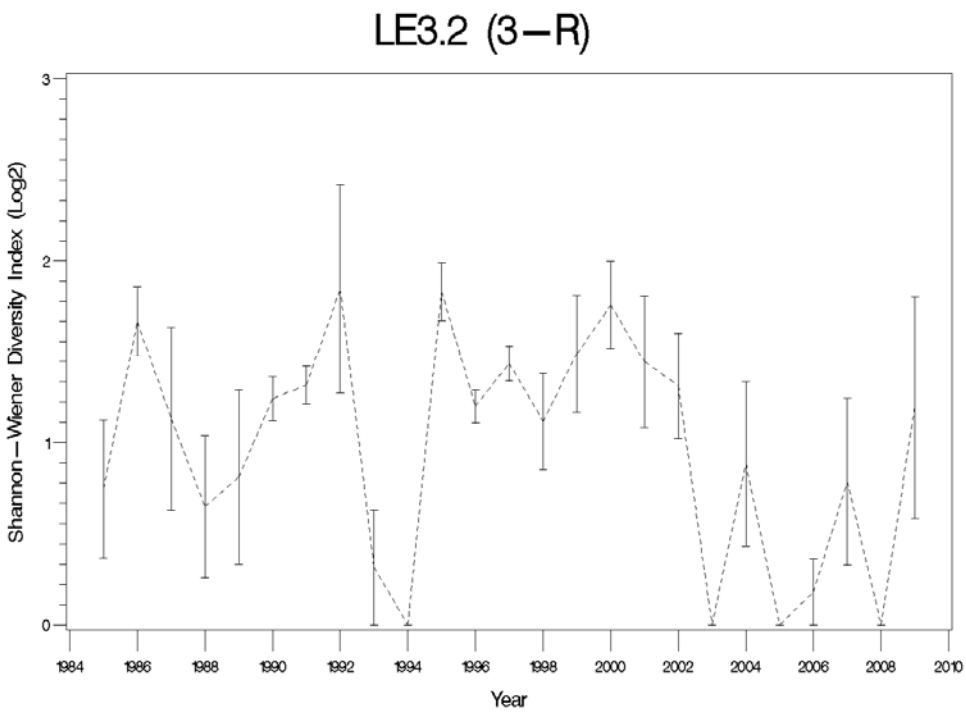


Figure 120. Plot of Shannon-Weiner diversity index at station LE3.2 for 1985 through 2009.

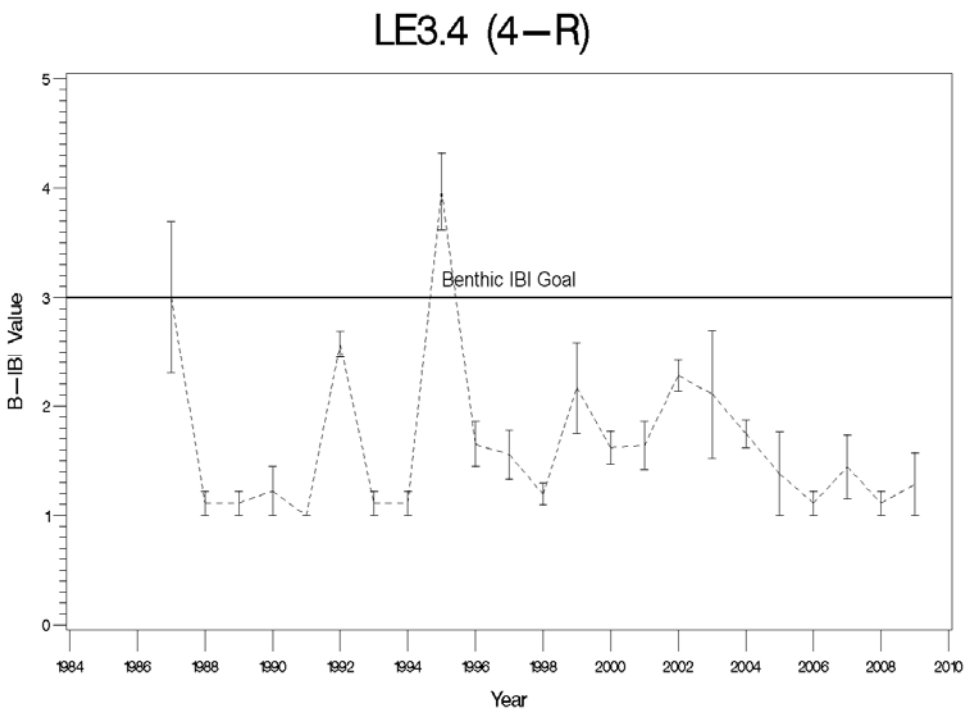


Figure 121. Plot of the benthic IBI against time at station LE3.4 for 1985 through 2009.

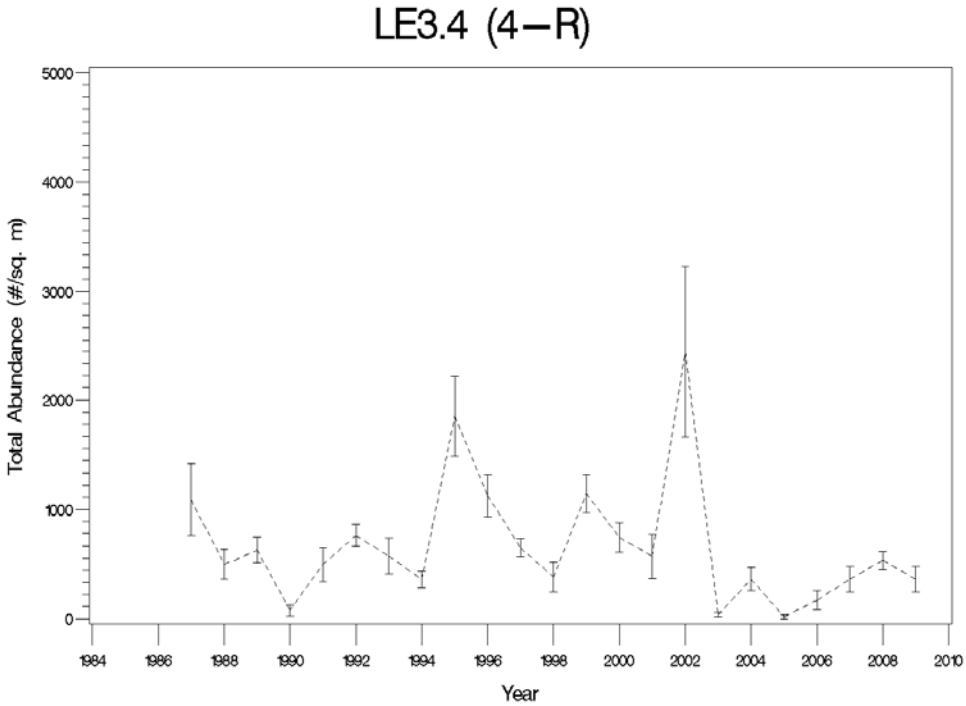


Figure 122. Plot of total benthic community abundance at station LE3.4 for 1985 through 2009.

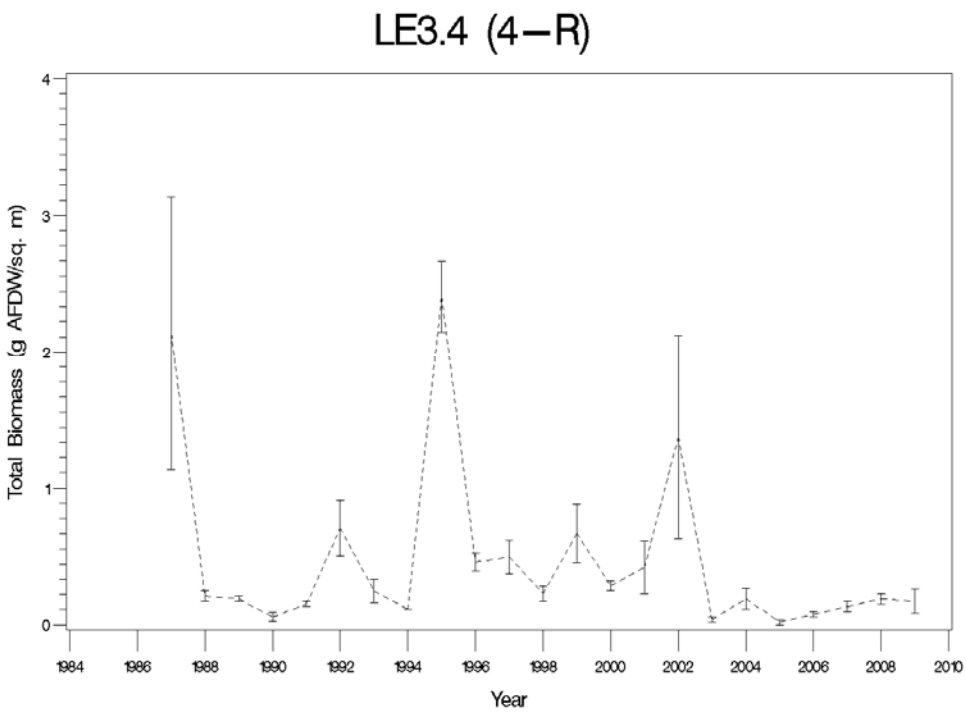


Figure 123. Plot of total benthic community biomass at station LE3.4 for 1985 through 2009.

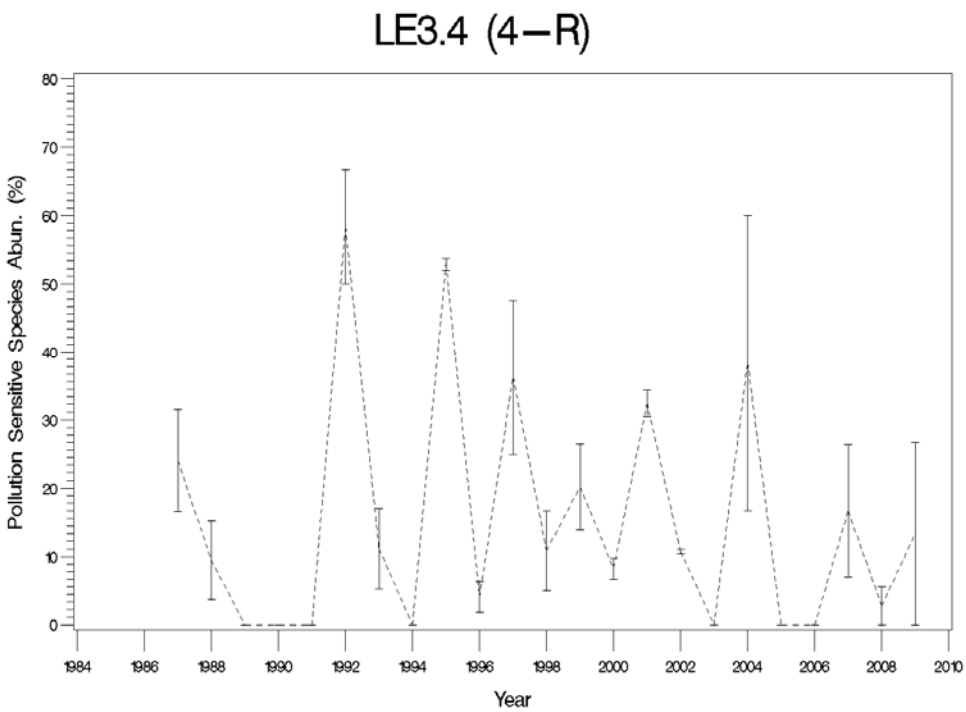


Figure 124. Plot of pollution sensitive species abundance at station LE3.4 for 1985 through 2009.

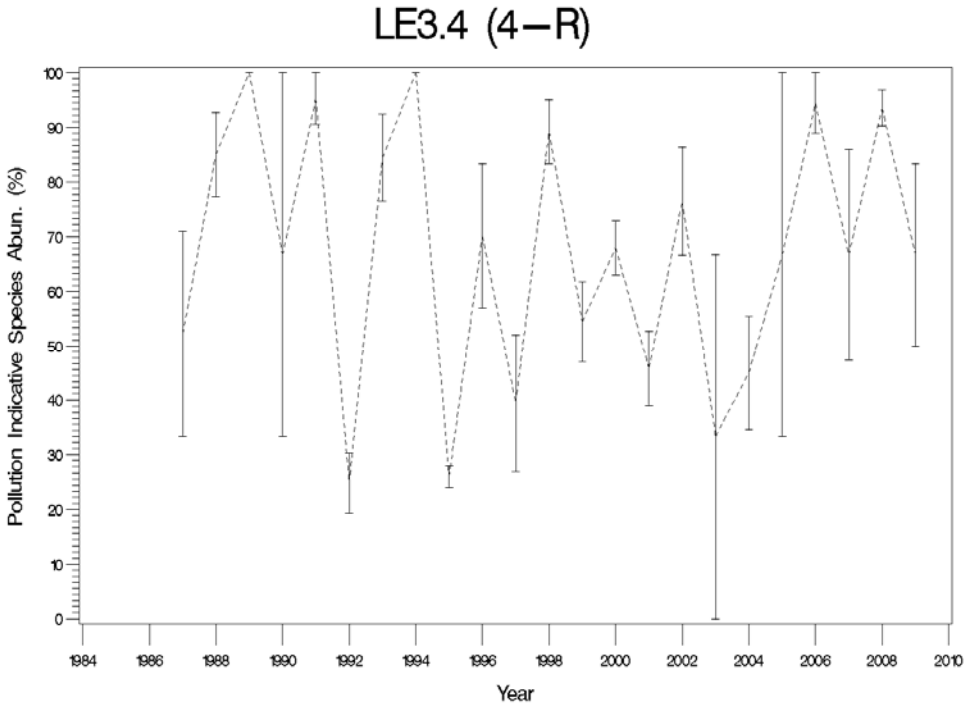


Figure 125. Plot of pollution indicative species abundance at station LE3.4 for 1985 through 2009.

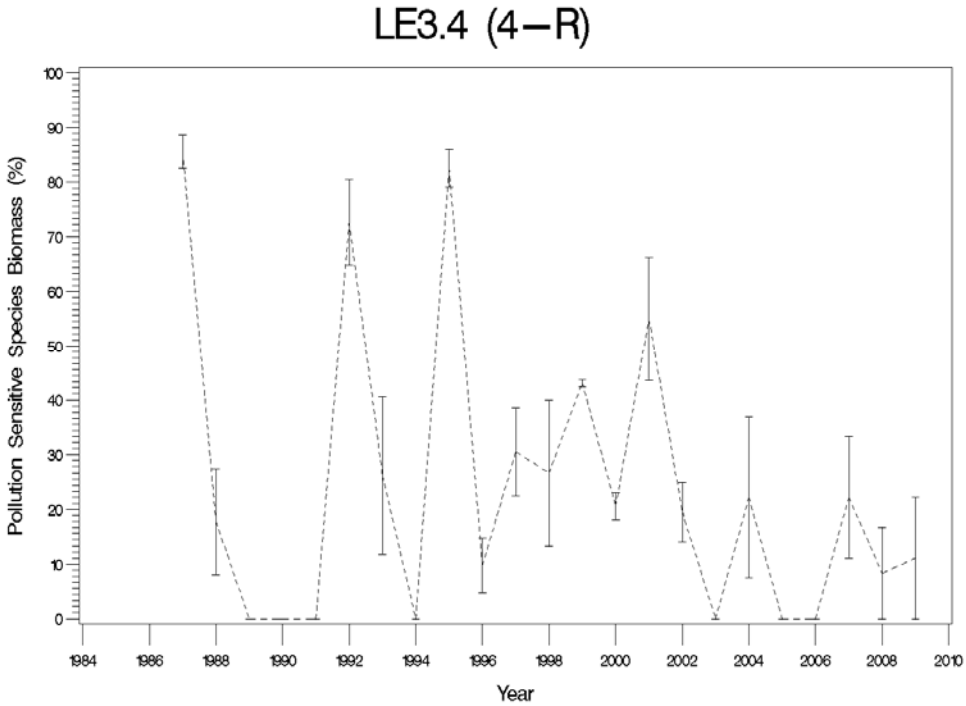


Figure 126. Plot of pollution sensitive species biomass at station LE3.4 for 1985 through 2009.

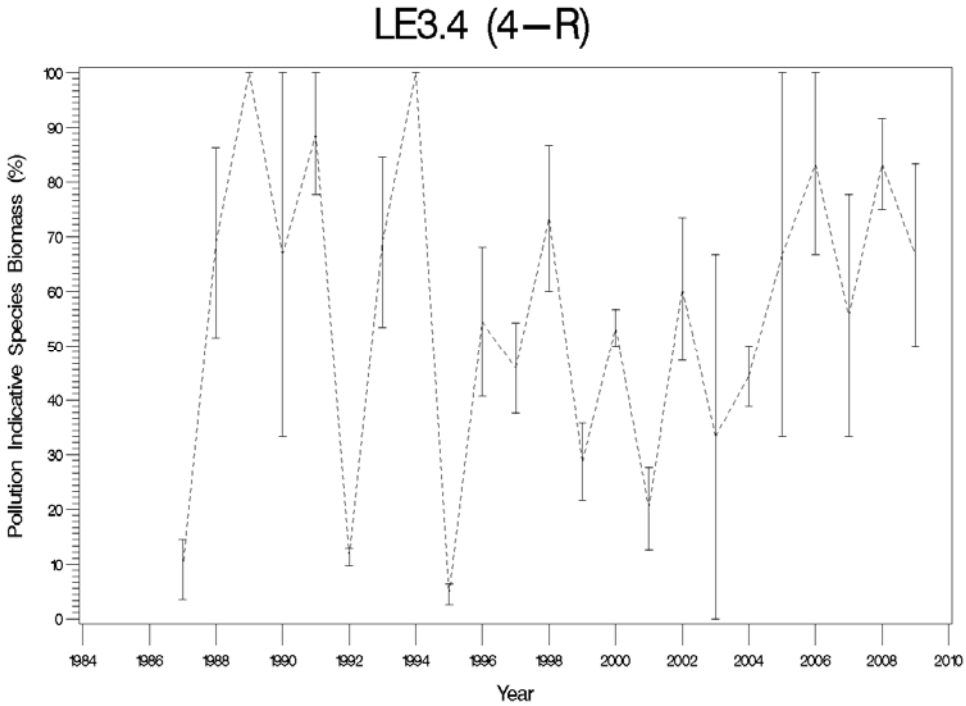


Figure 127. Plot of pollution indicative species biomass at station LE3.4 for 1985 through 2009.

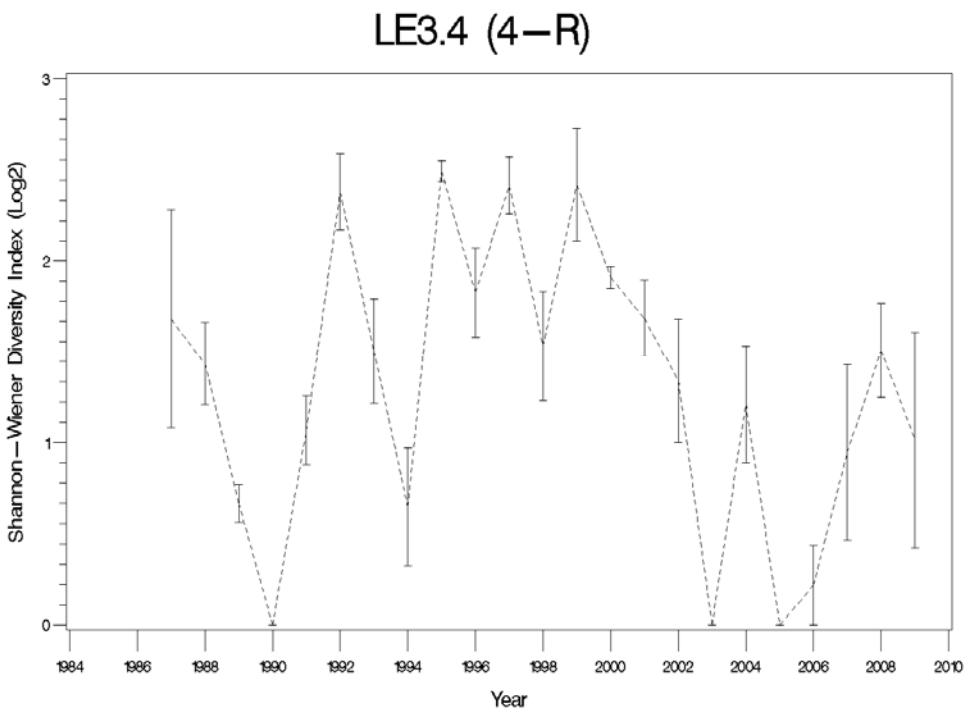


Figure 128. Plot of Shannon-Weiner diversity index at station LE3.4 for 1985 through 2009.

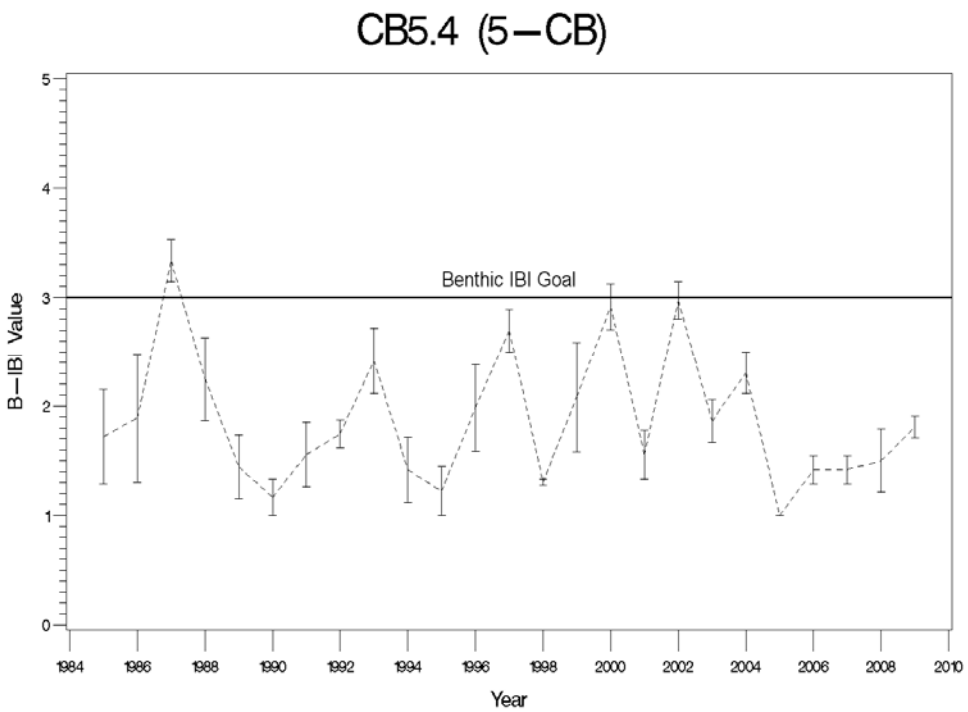


Figure 129. Plot of the benthic IBI against time at station CB5.4 for 1985 through 2009.

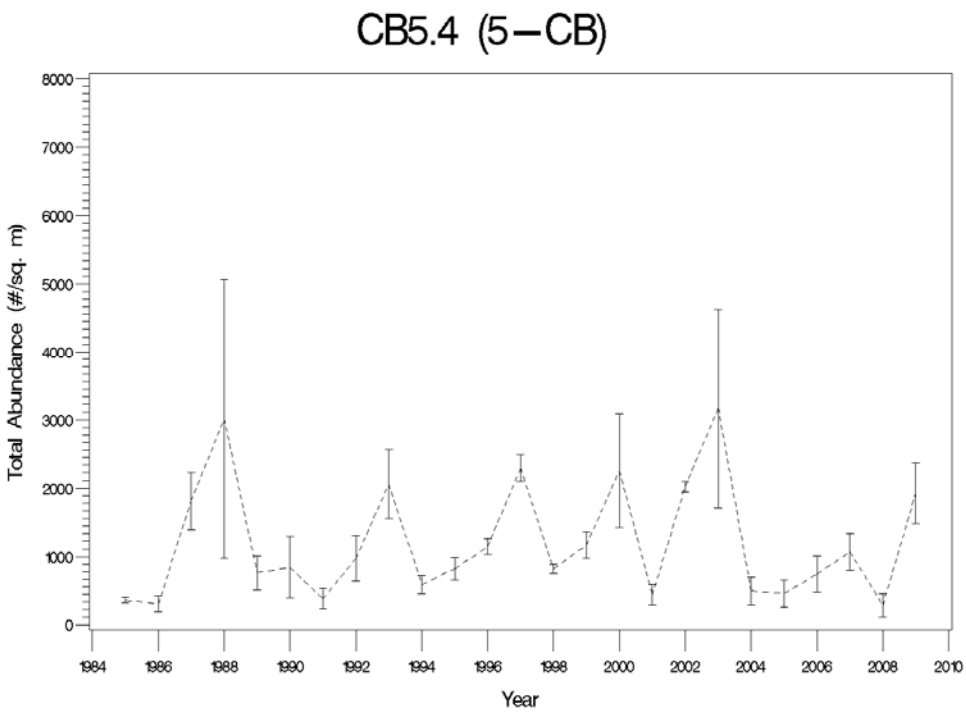


Figure 130. Plot of total benthic community abundance at station CB5.4 for 1985 through 2009.

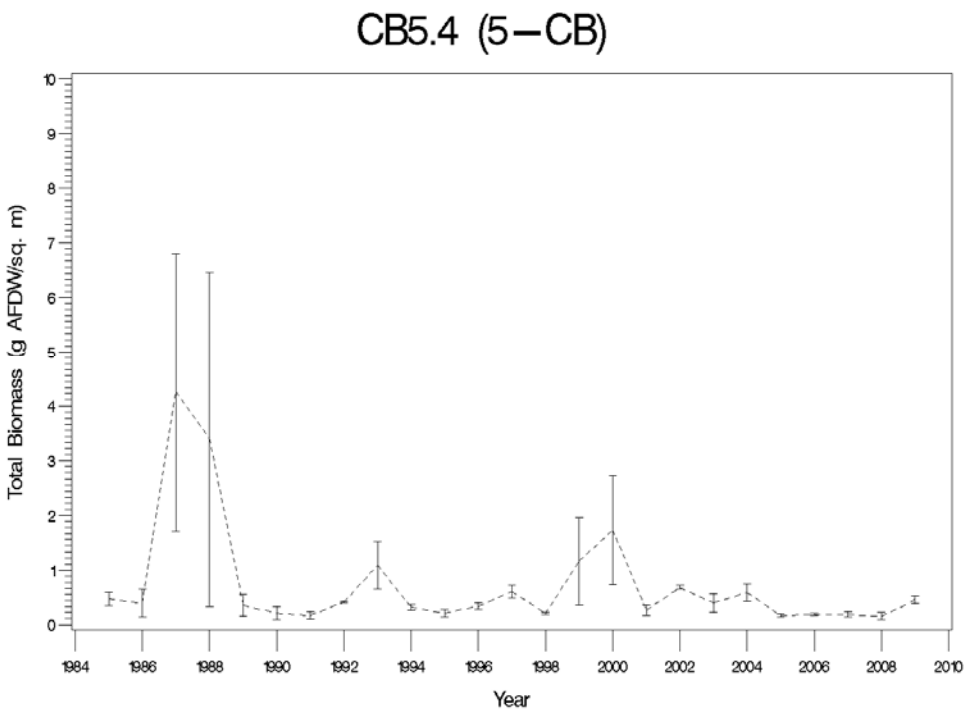


Figure 131. Plot of total benthic community biomass at station CB5.4 for 1985 through 2009.

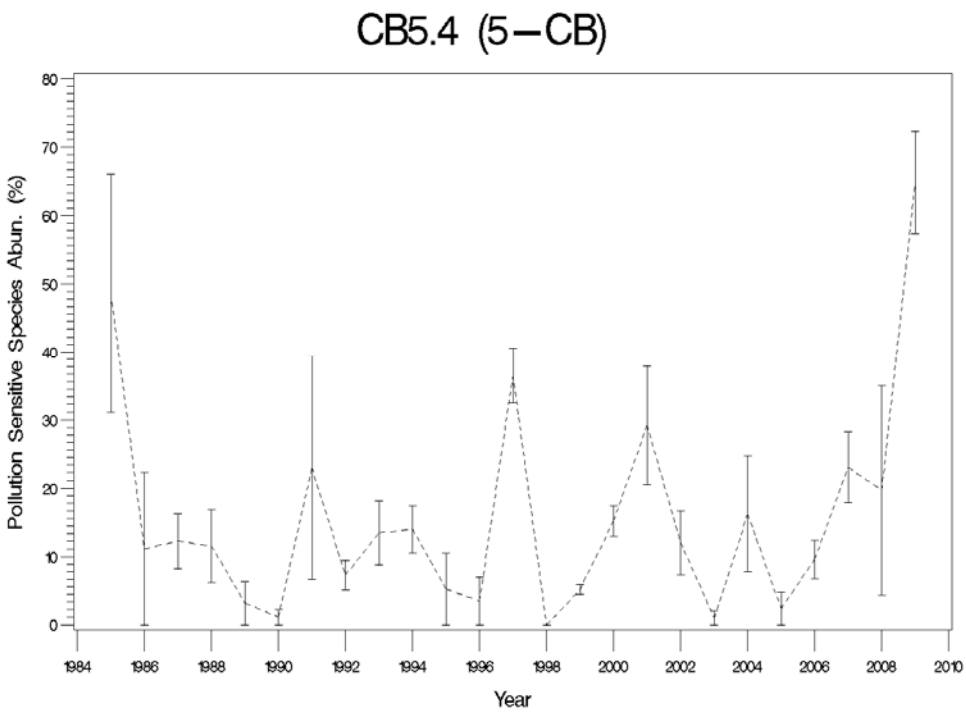


Figure 132. Plot of pollution sensitive species abundance at station CB5.4 for 1985 through 2009.

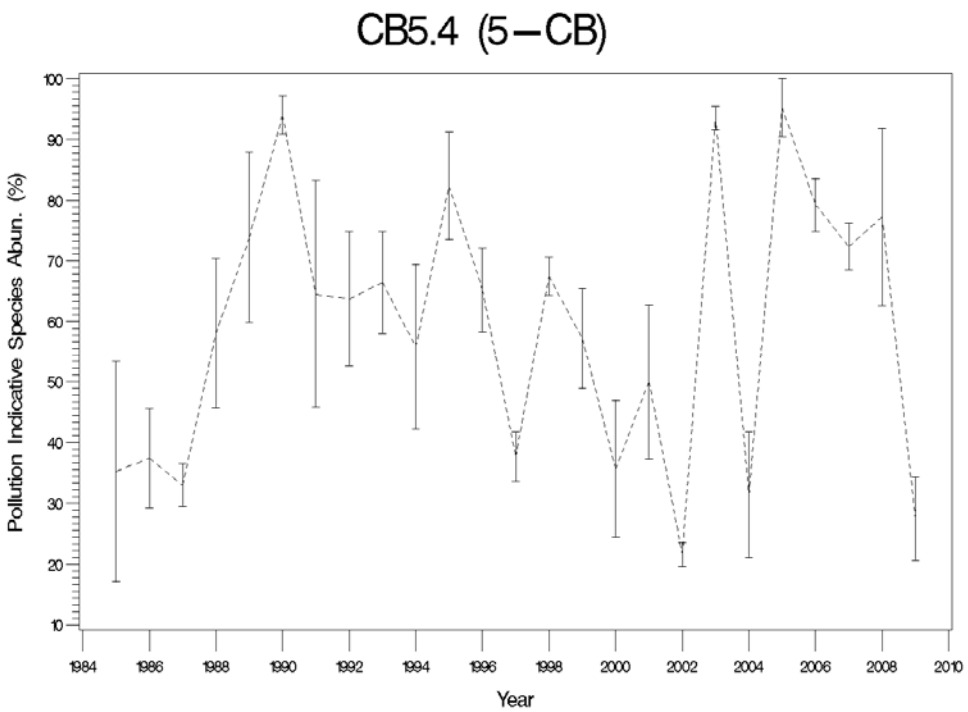


Figure 133. Plot of pollution indicative species abundance at station CB5.4 for 1985 through 2009.

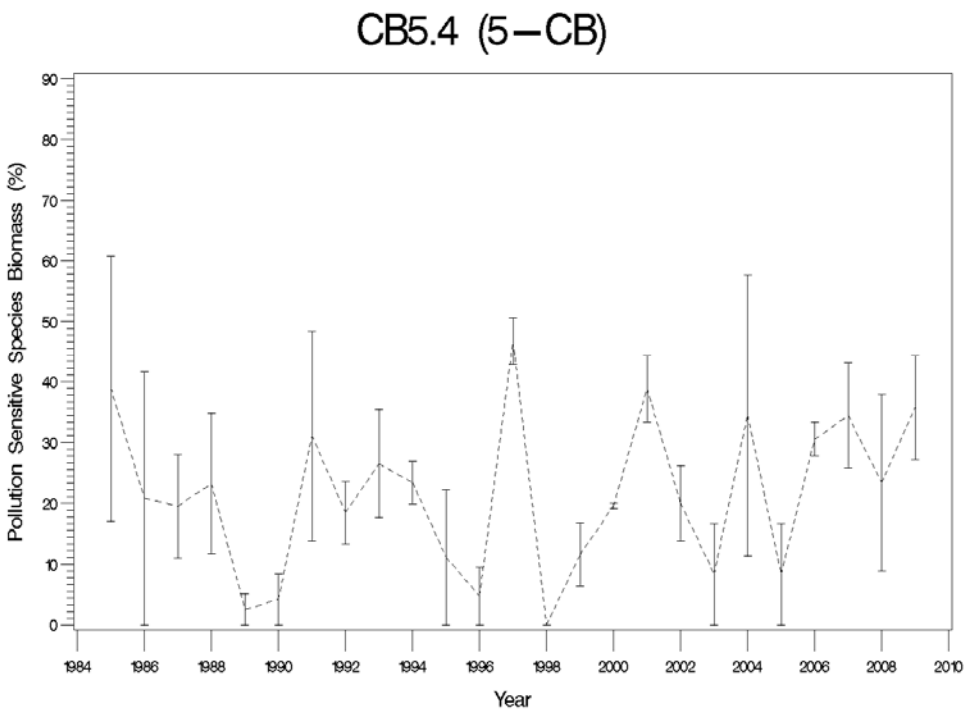


Figure 134. Plot of pollution sensitive species biomass at station CB5.4 for 1985 through 2009.

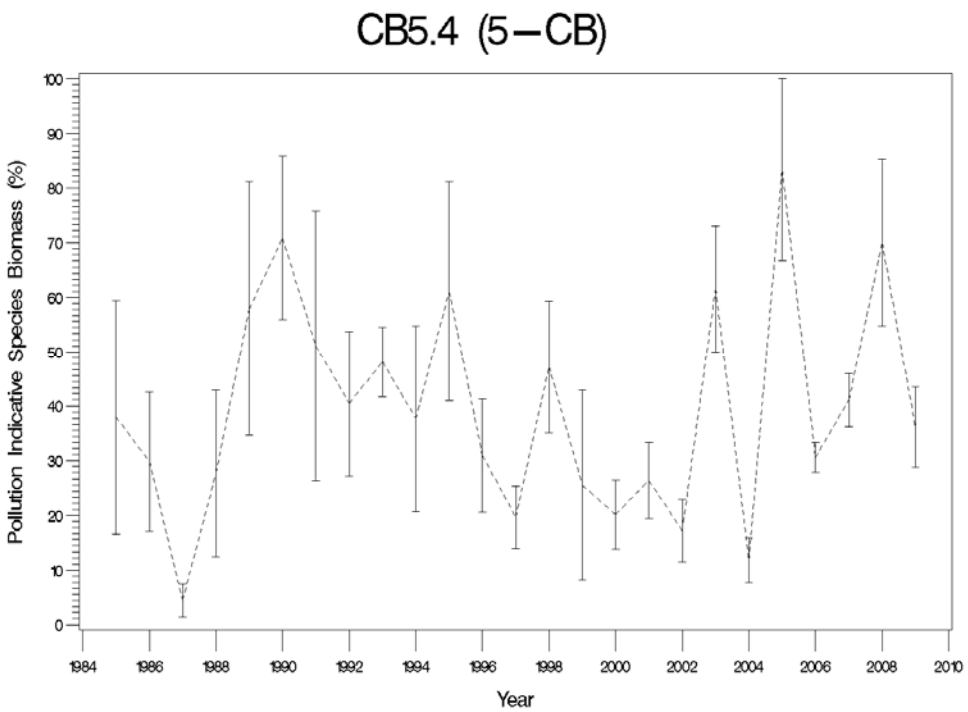


Figure 135. Plot of pollution indicative species biomass at station CB5.4 for 1985 through 2009.

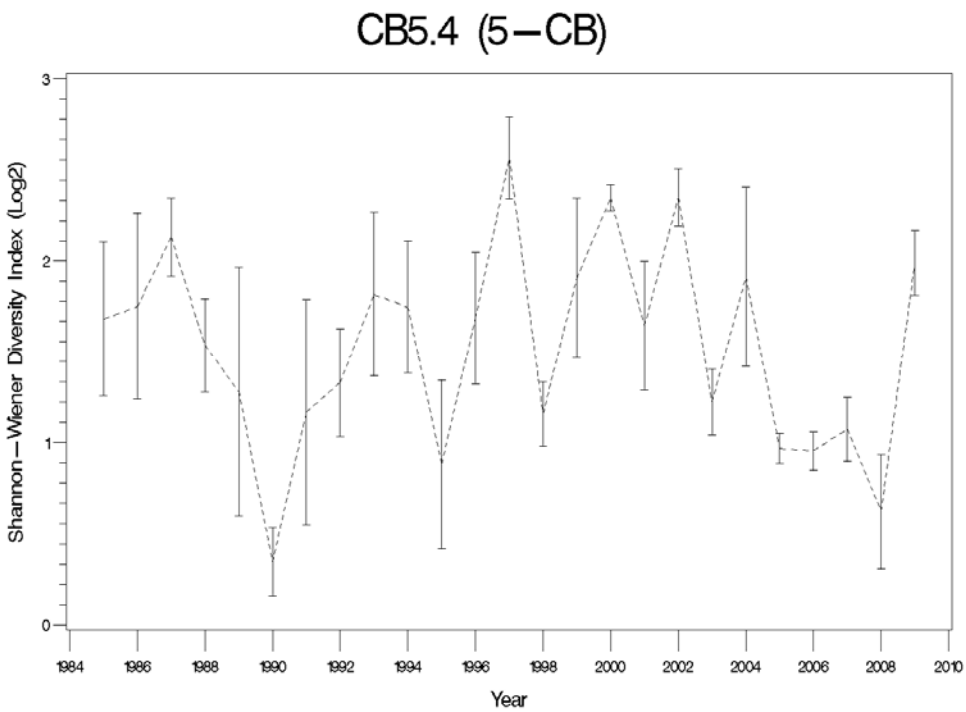


Figure 136. Plot of Shannon-Weiner diversity index at station CB5.4 for 1985 through 2009.

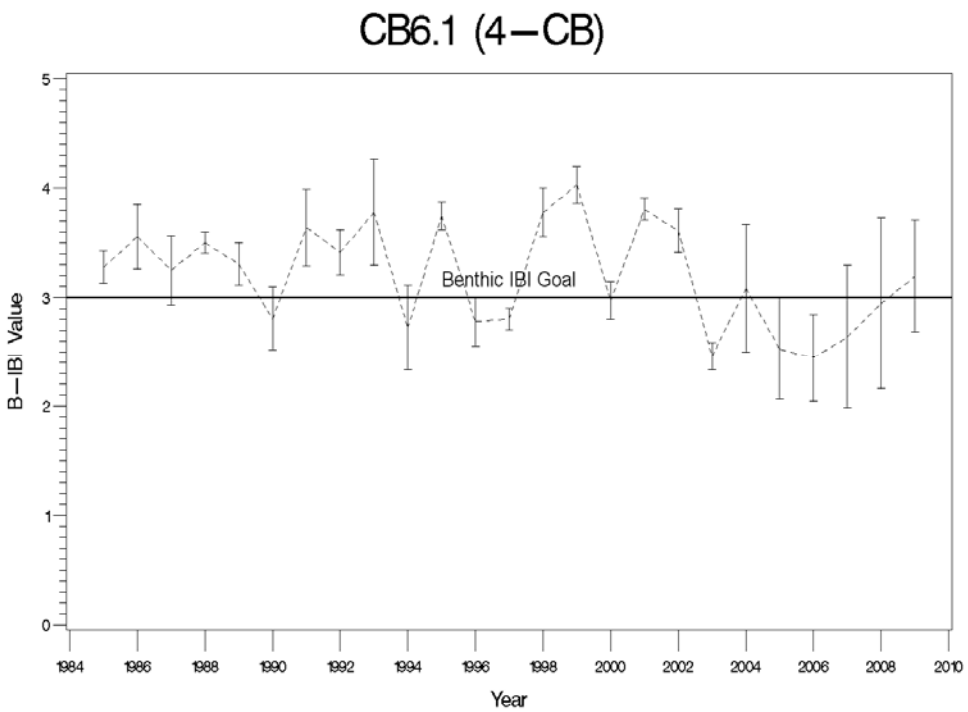


Figure 137. Plot of the benthic IBI against time at station CB6.1 for 1985 through 2009.

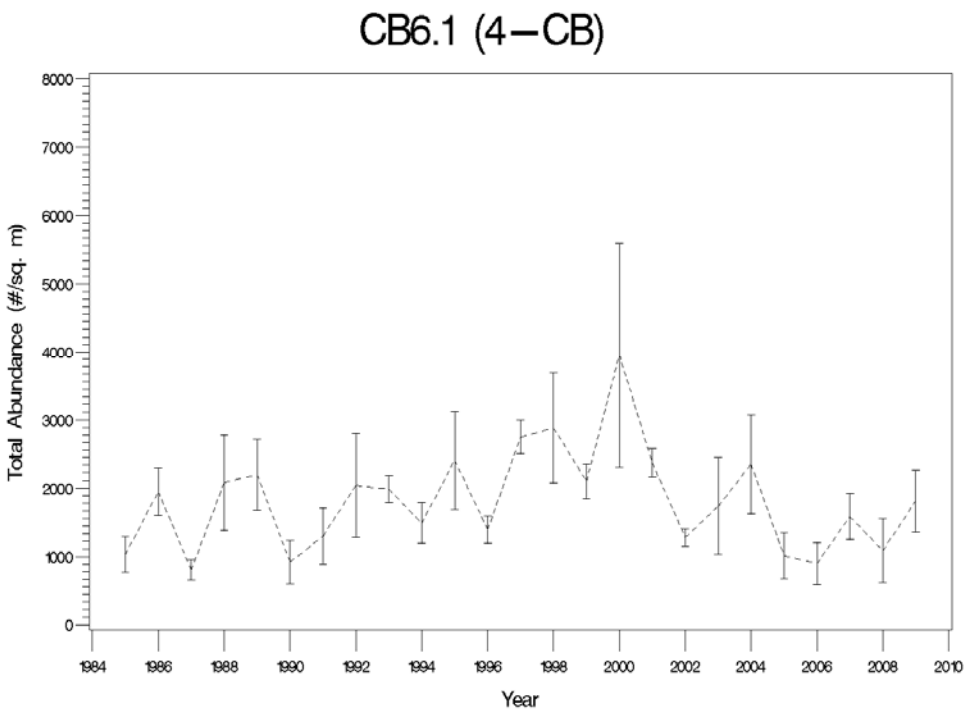


Figure 138. Plot of total benthic community abundance at station CB6.1 for 1985 through 2009.

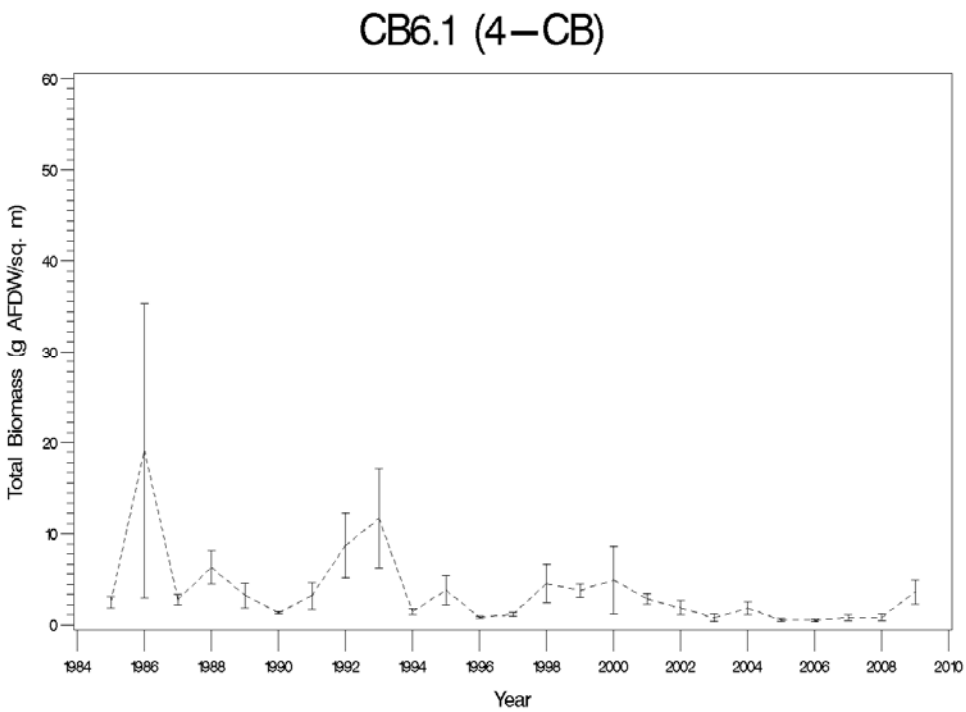


Figure 139. Plot of total benthic community biomass at station CB6.1 for 1985 through 2009.

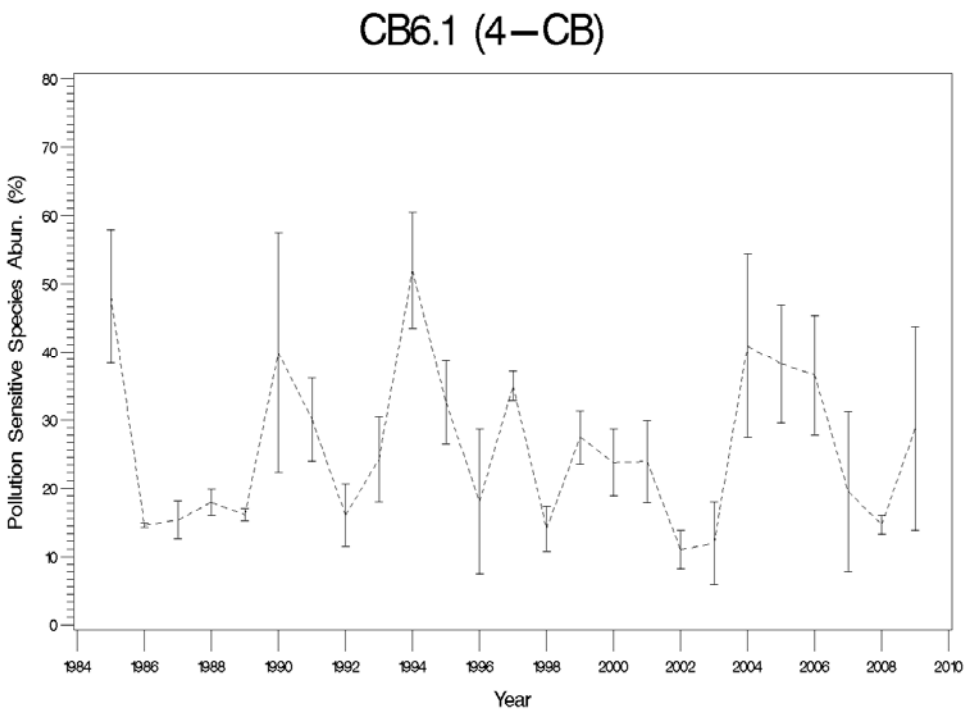


Figure 140. Plot of pollution sensitive species abundance at station CB6.1 for 1985 through 2009.

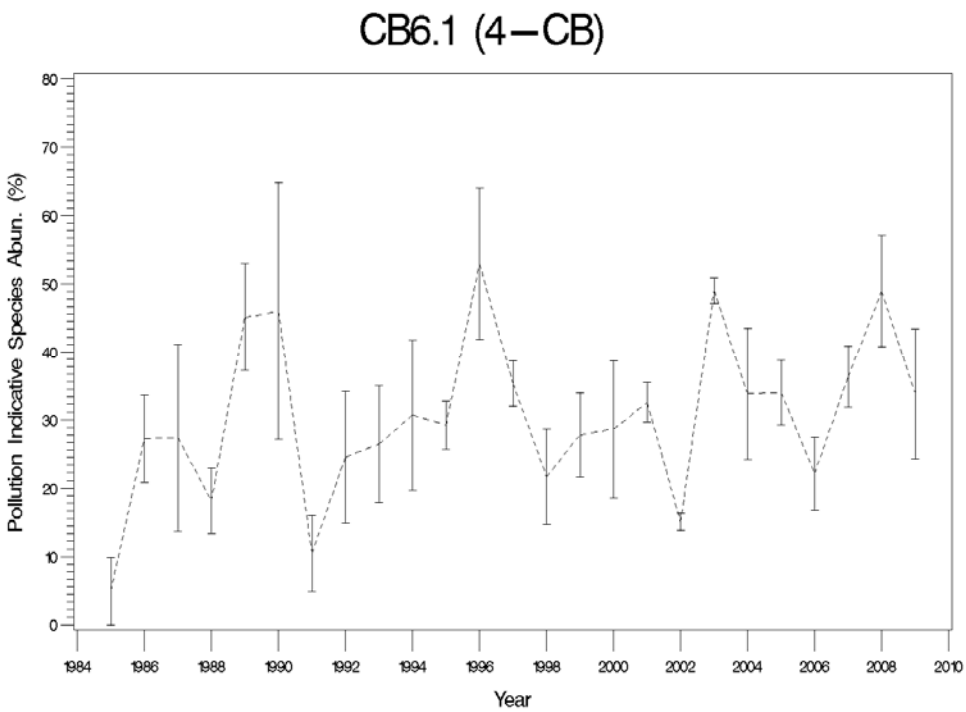


Figure 141. Plot of pollution indicative species abundance at station CB6.1 for 1985 through 2009.

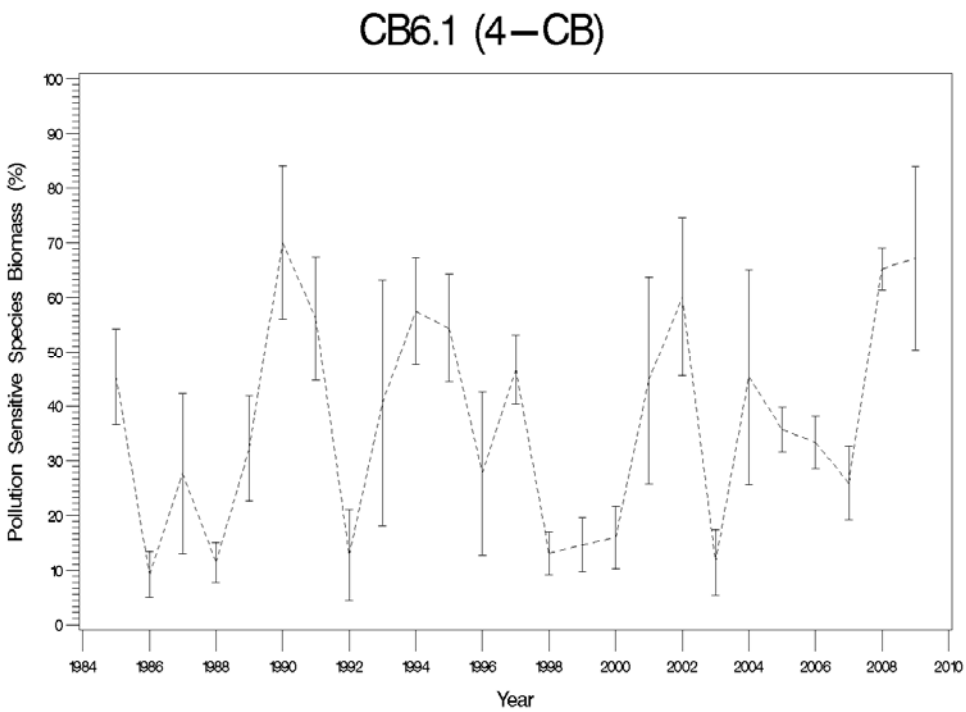


Figure 142. Plot of pollution sensitive species biomass at station CB6.1 for 1985 through 2009.

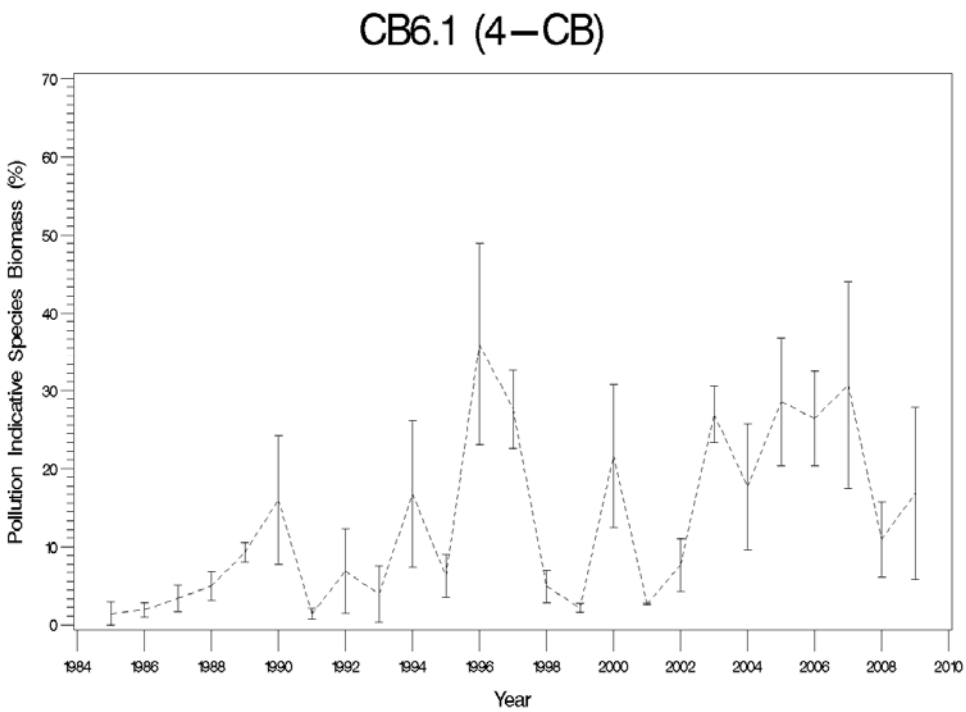


Figure 143. Plot of pollution indicative species biomass at station CB6.1 for 1985 through 2009.

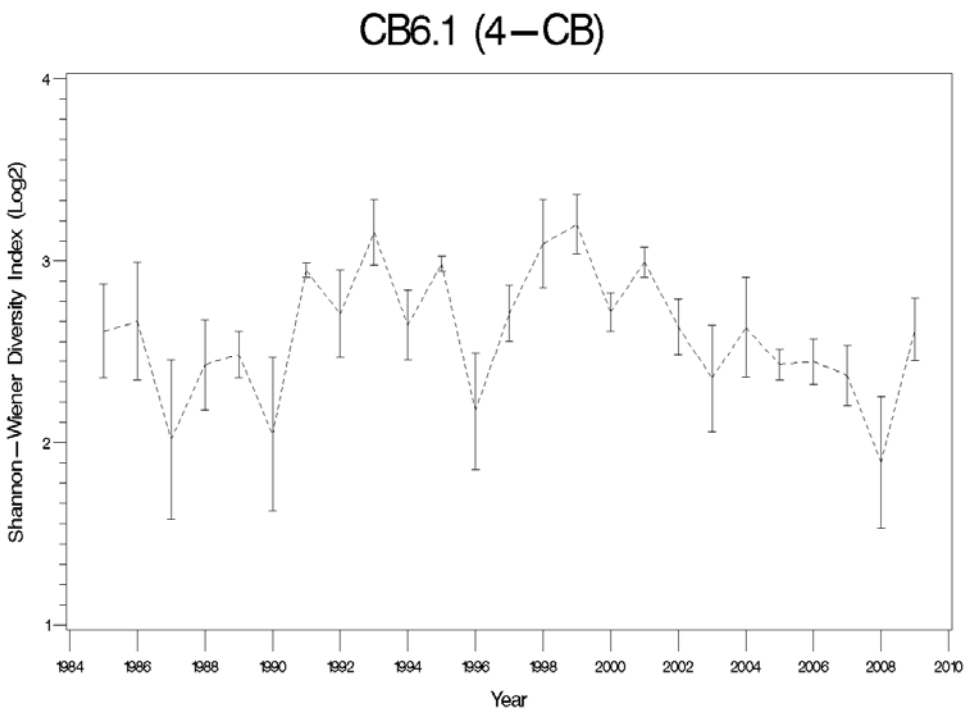


Figure 144. Plot of Shannon-Weiner diversity index at station CB6.1 for 1985 through 2009.

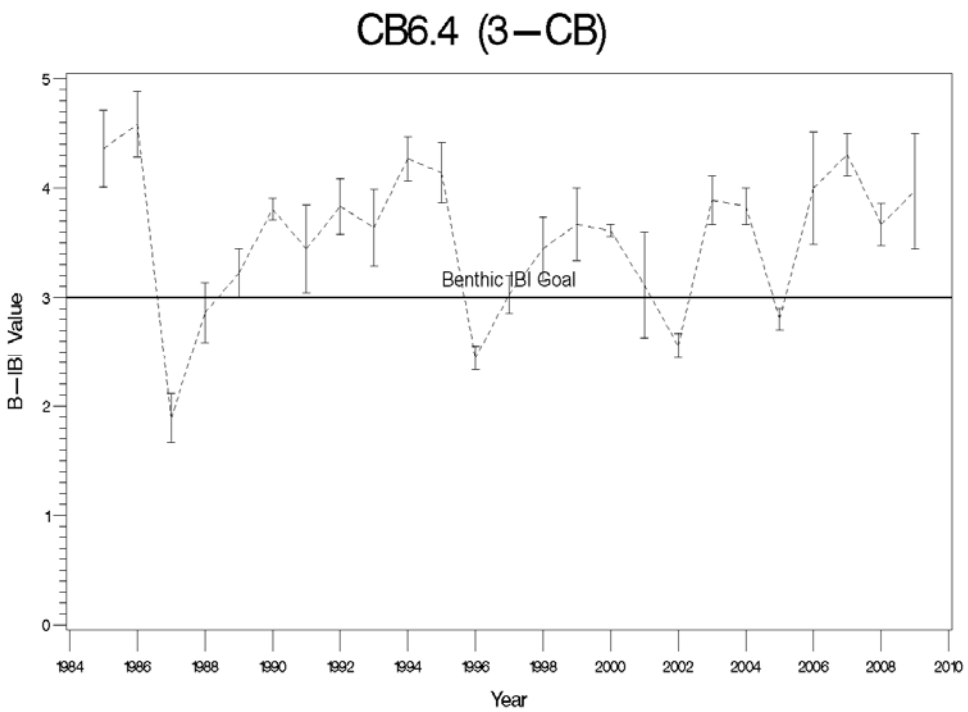


Figure 145. Plot of the benthic IBI against time at station CB6.4 for 1985 through 2009.

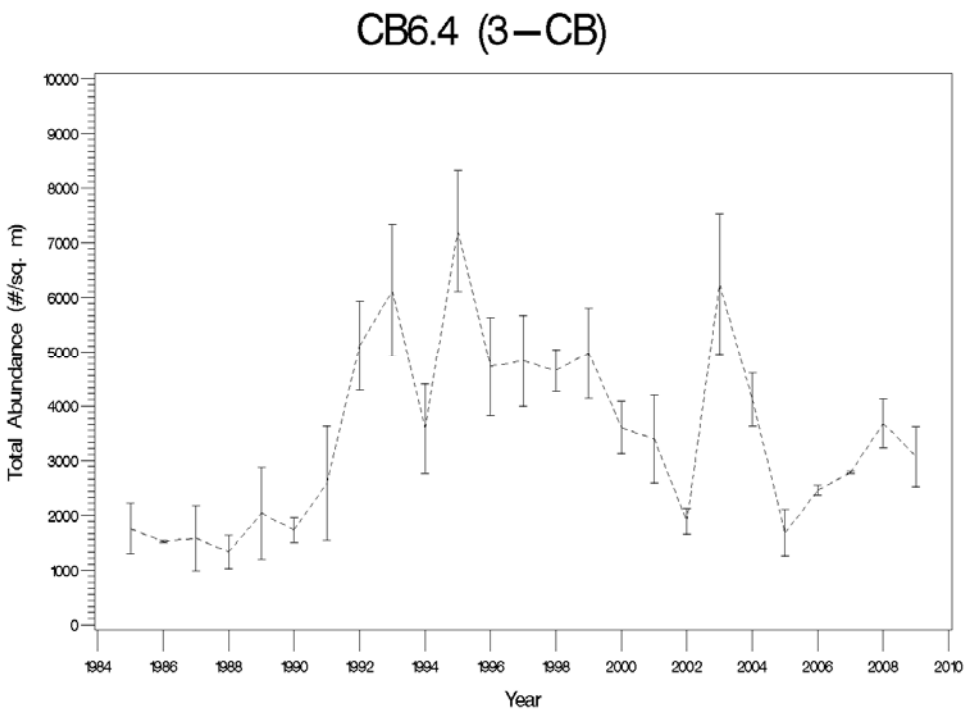


Figure 146. Plot of total benthic community abundance at station CB6.4 for 1985 through 2009.

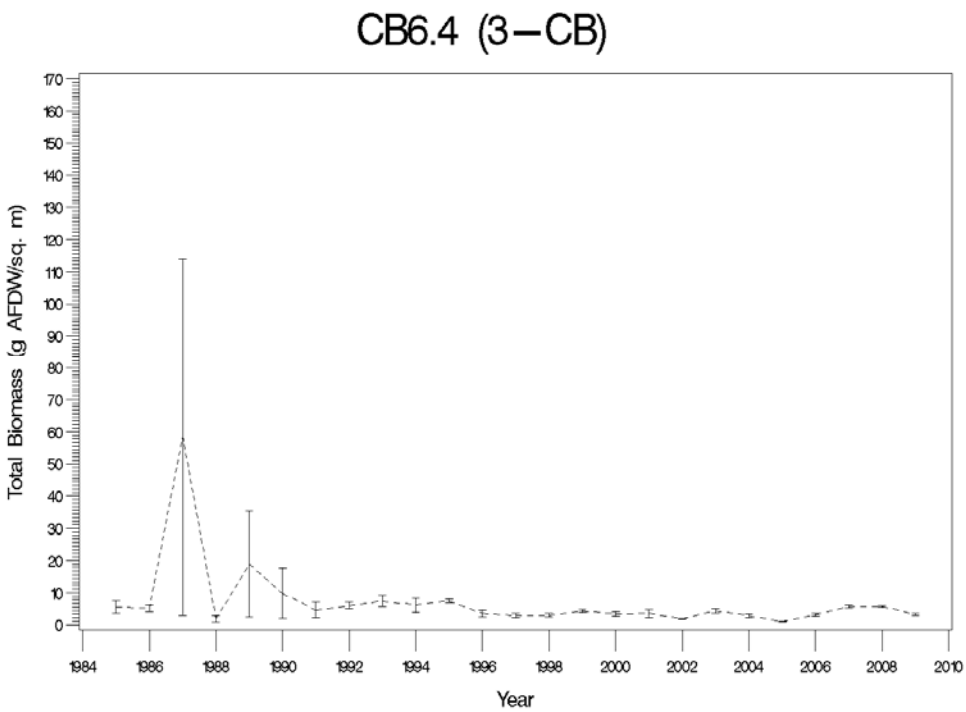


Figure 147. Plot of total benthic community biomass at station CB6.4 for 1985 through 2009.

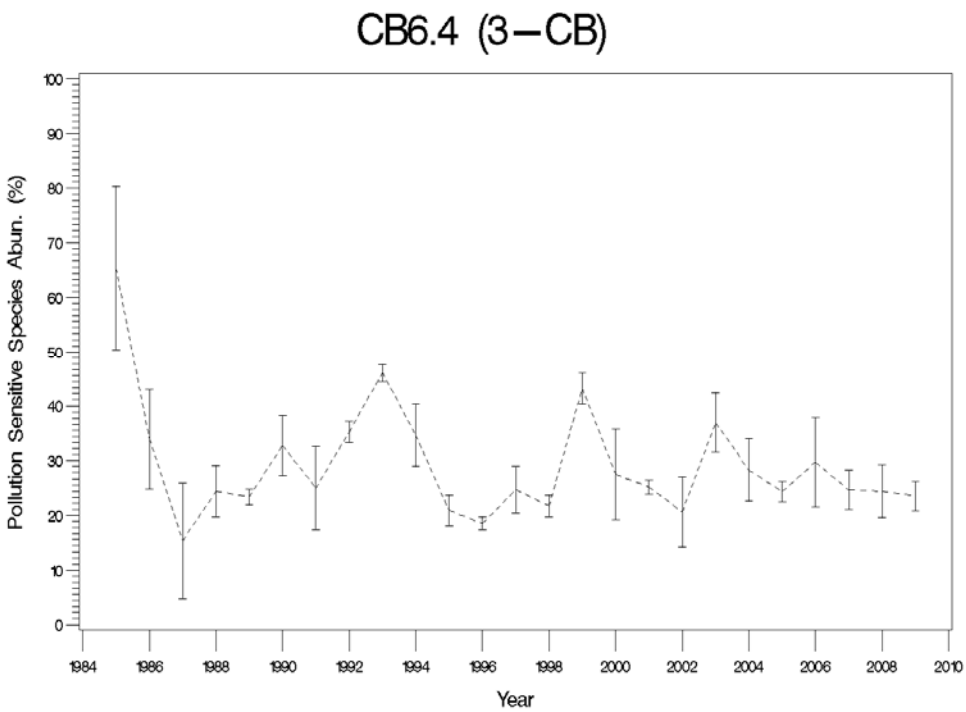


Figure 148. Plot of pollution sensitive species abundance at station CB6.4 for 1985 through 2009.

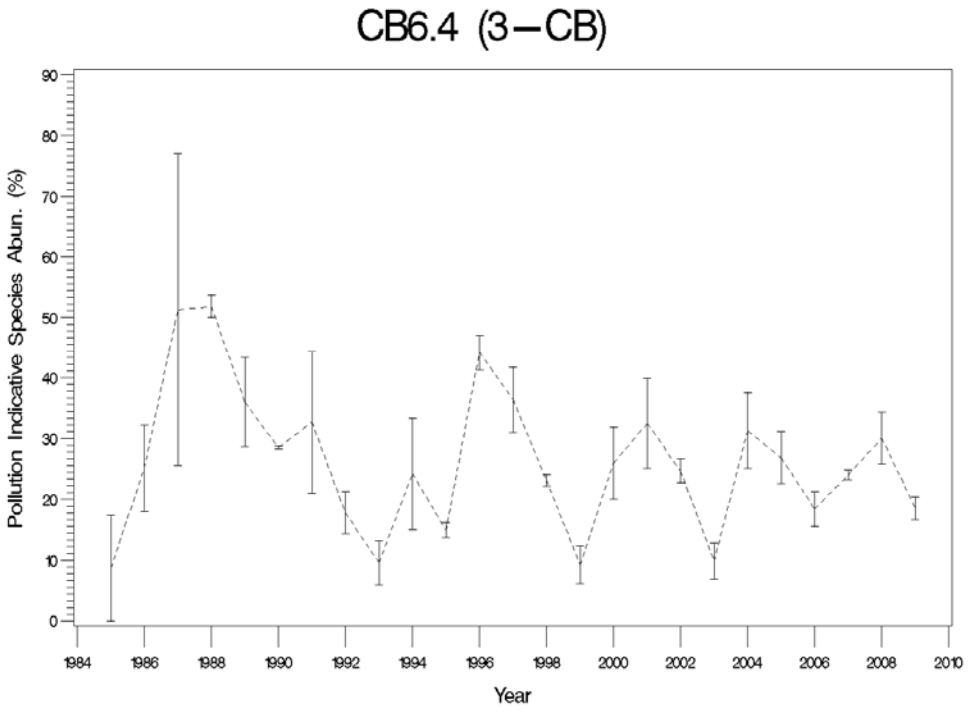


Figure 149. Plot of pollution indicative species abundance at station CB6.4 for 1985 through 2009.

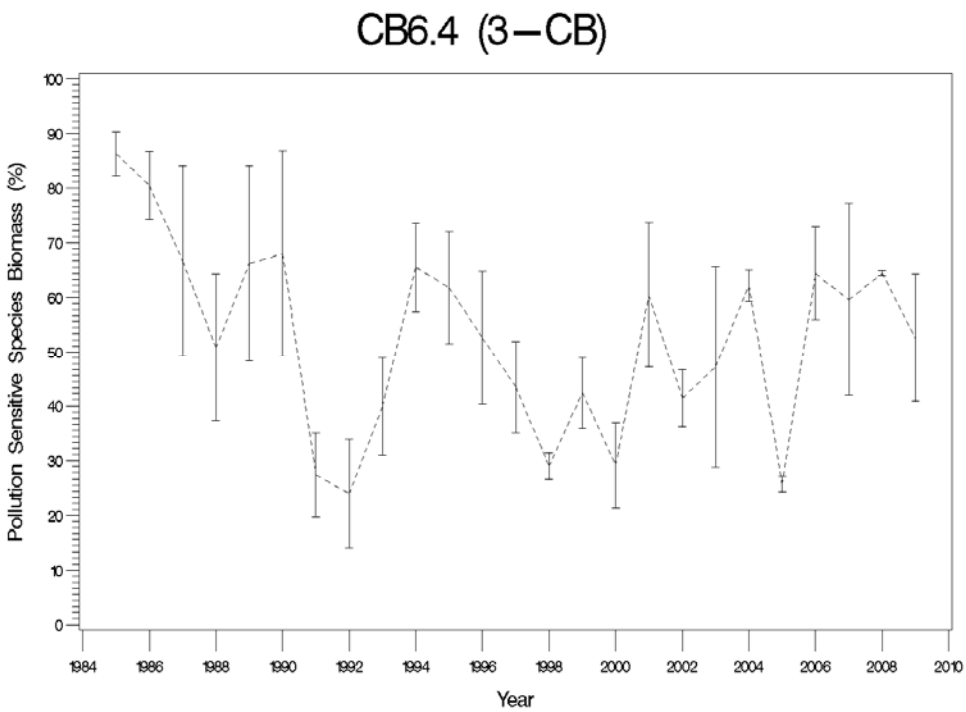


Figure 150. Plot of pollution sensitive species biomass at station CB6.4 for 1985 through 2009.

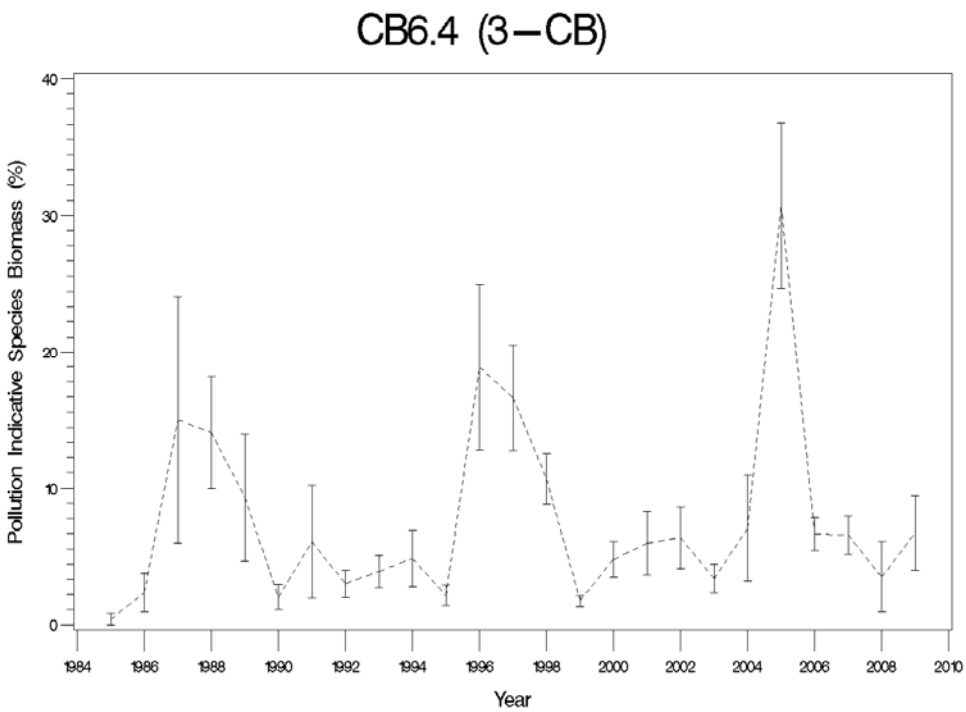


Figure 151. Plot of pollution indicative species biomass at station CB6.4 for 1985 through 2009.

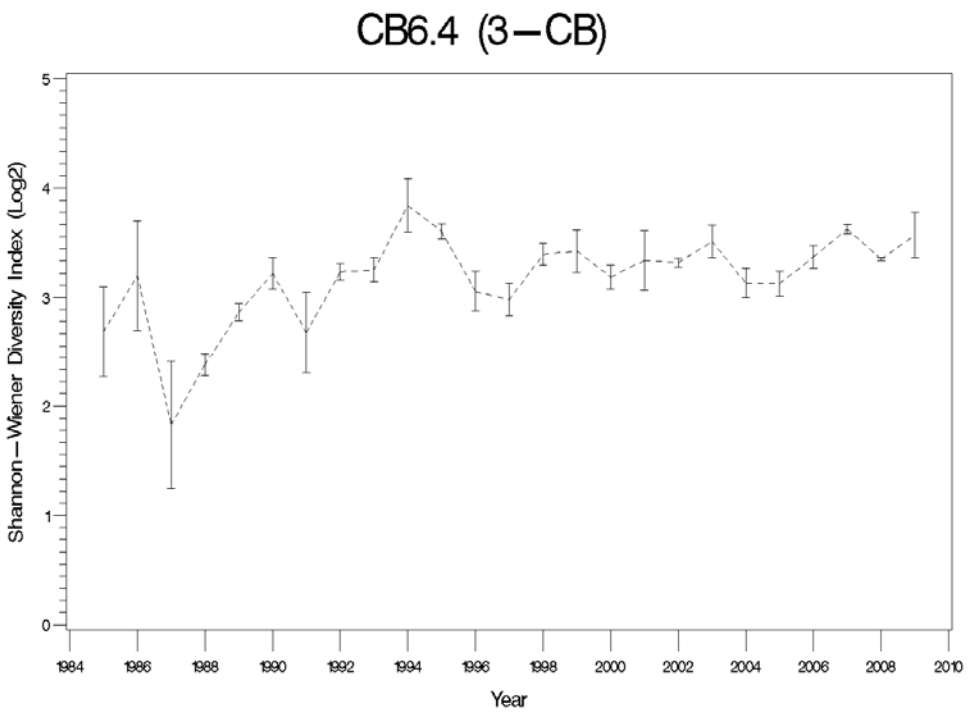


Figure 152. Plot of Shannon-Weiner diversity index at station CB6.4 for 1985 through 2009.

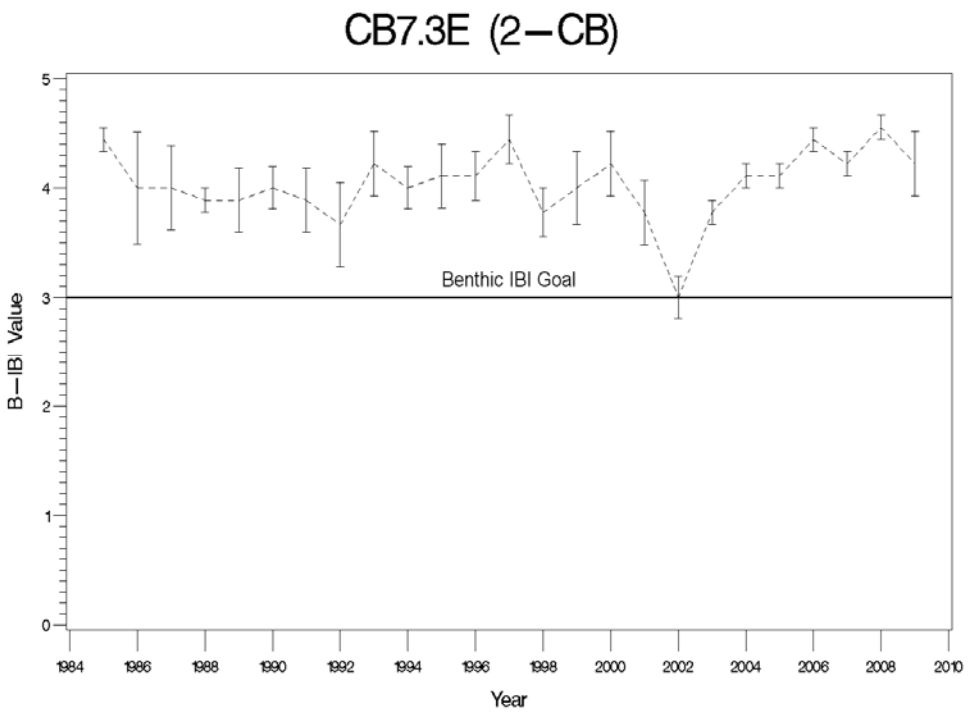


Figure 153. Plot of the benthic IBI against time at station CB7.3E for 1985 through 2009.

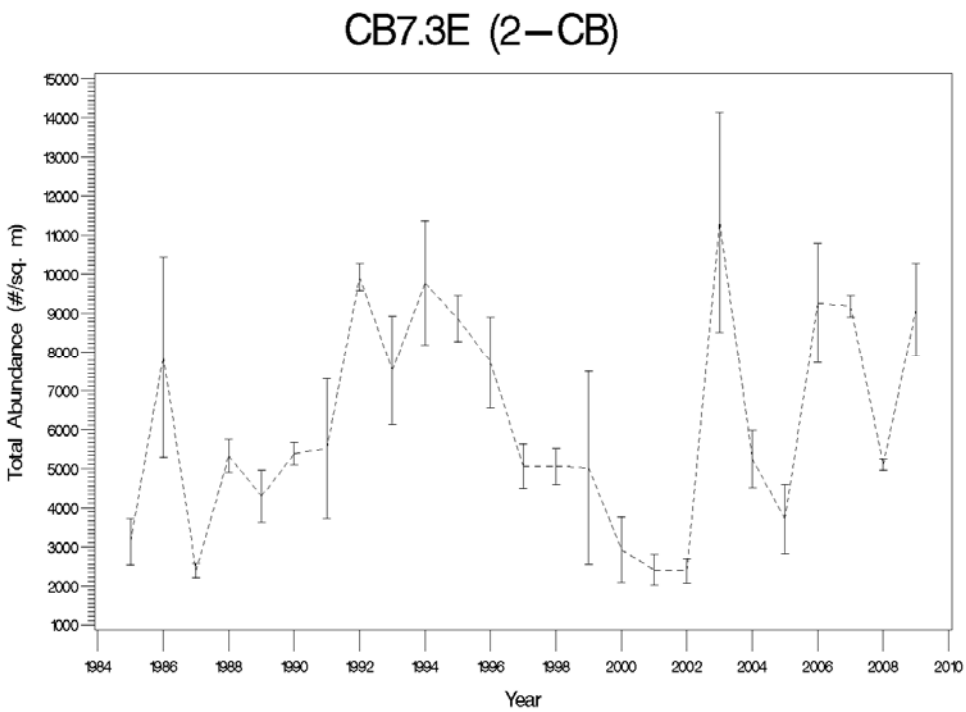


Figure 154. Plot of total benthic community abundance at station CB7.3E for 1985 through 2009.

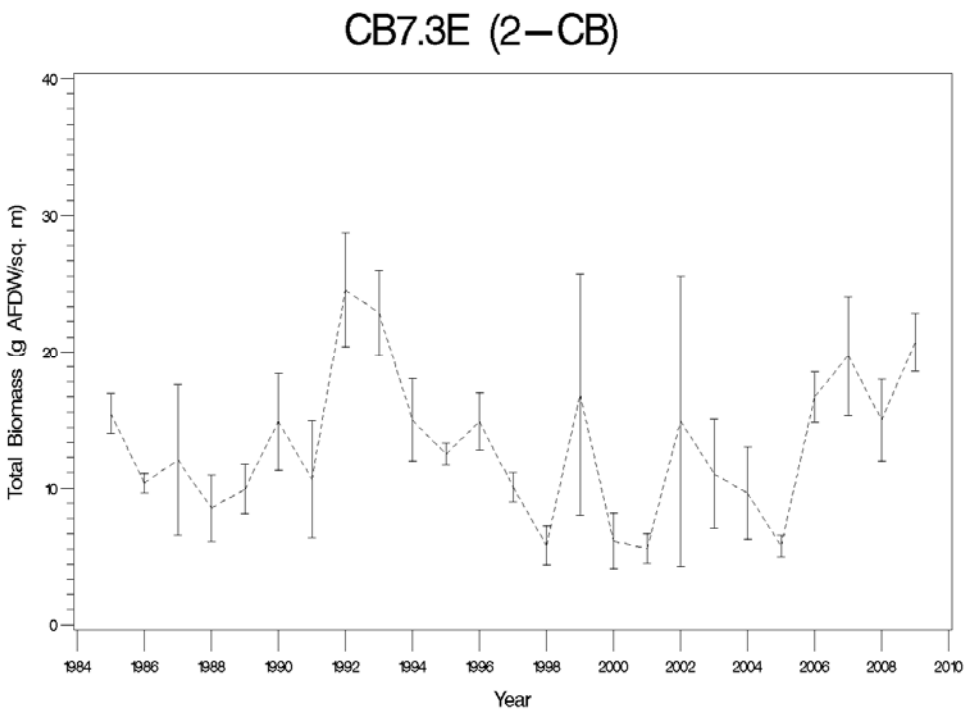


Figure 155. Plot of total benthic community biomass at station CB7.3E for 1985 through 2009.

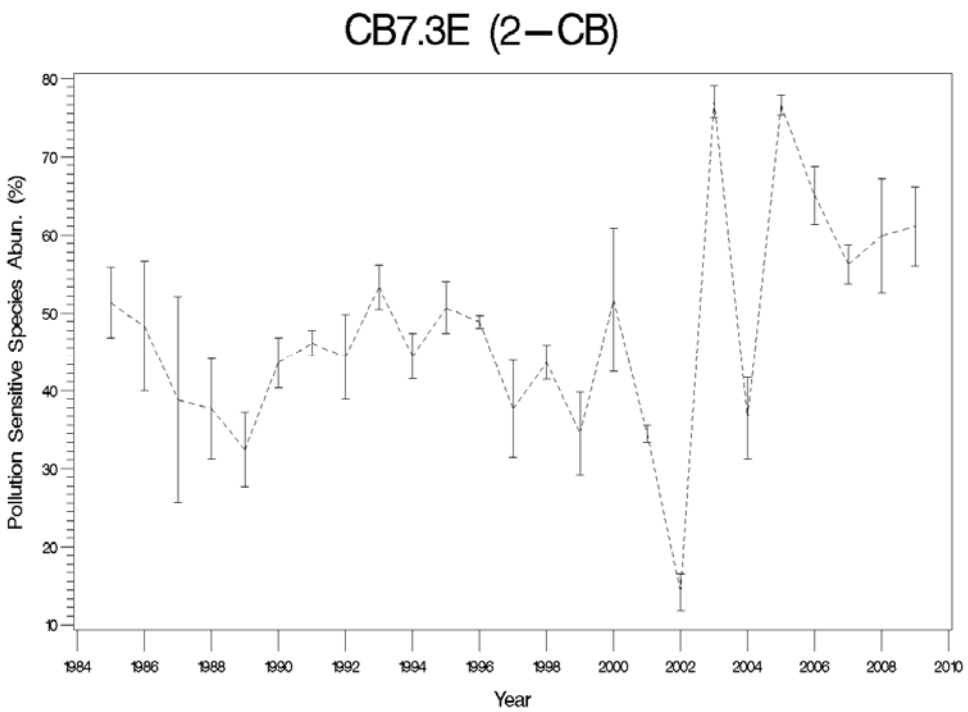


Figure 156. Plot of pollution sensitive species abundance at station CB7.3E for 1985 through 2009.

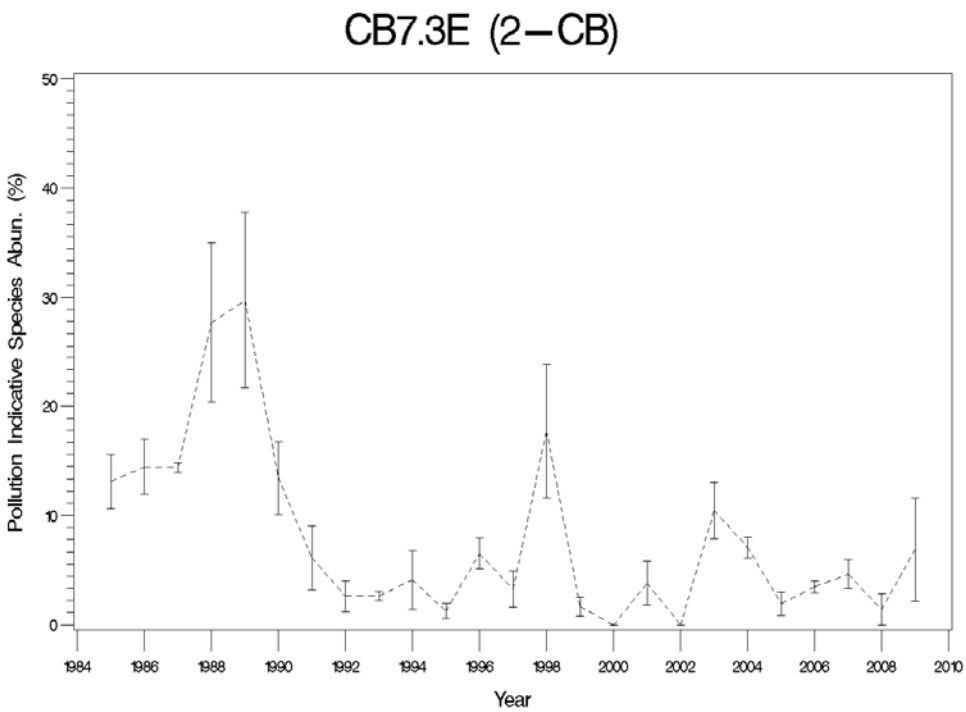


Figure 157. Plot of pollution indicative species abundance at station CB7.3E for 1985 through 2009.

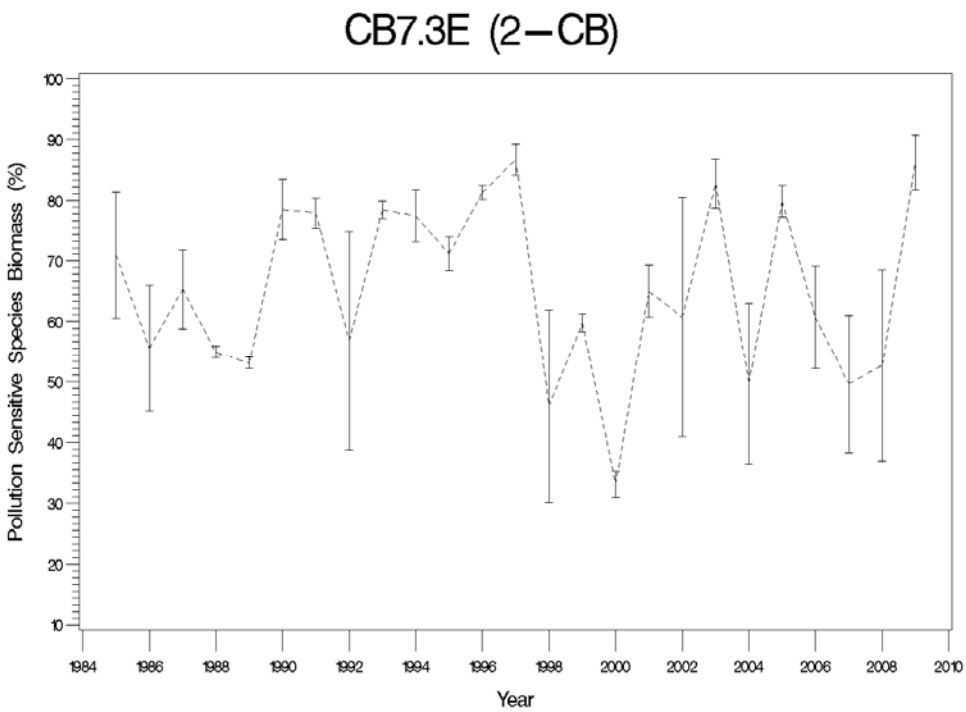


Figure 158. Plot of pollution sensitive species biomass at station CB7.3E for 1985 through 2009.

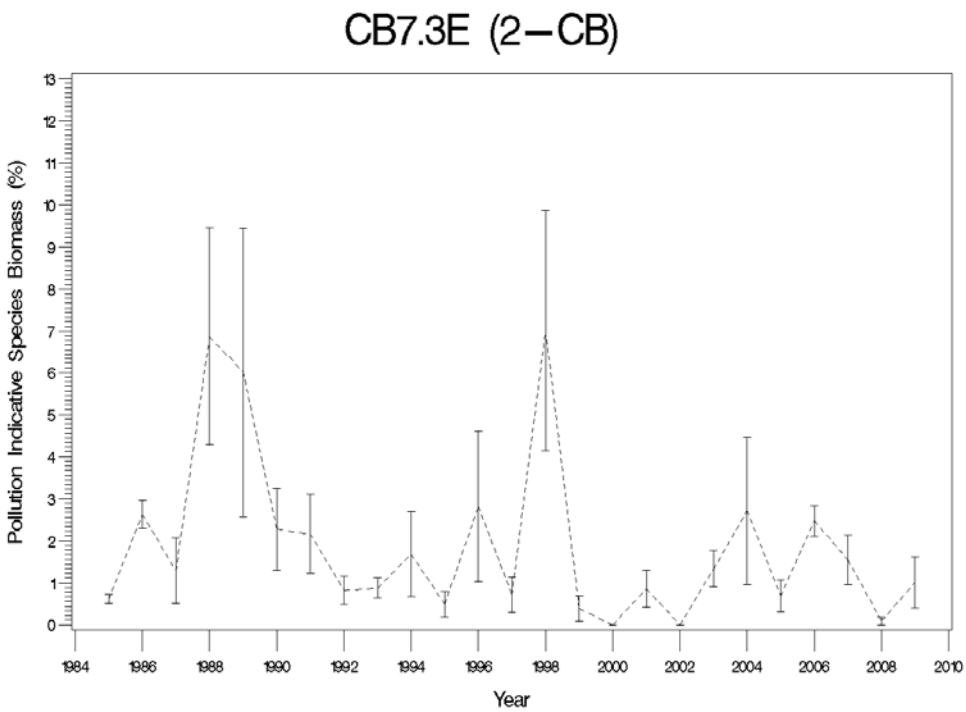


Figure 159. Plot of pollution indicative species biomass at station CB7.3E for 1985 through 2009.

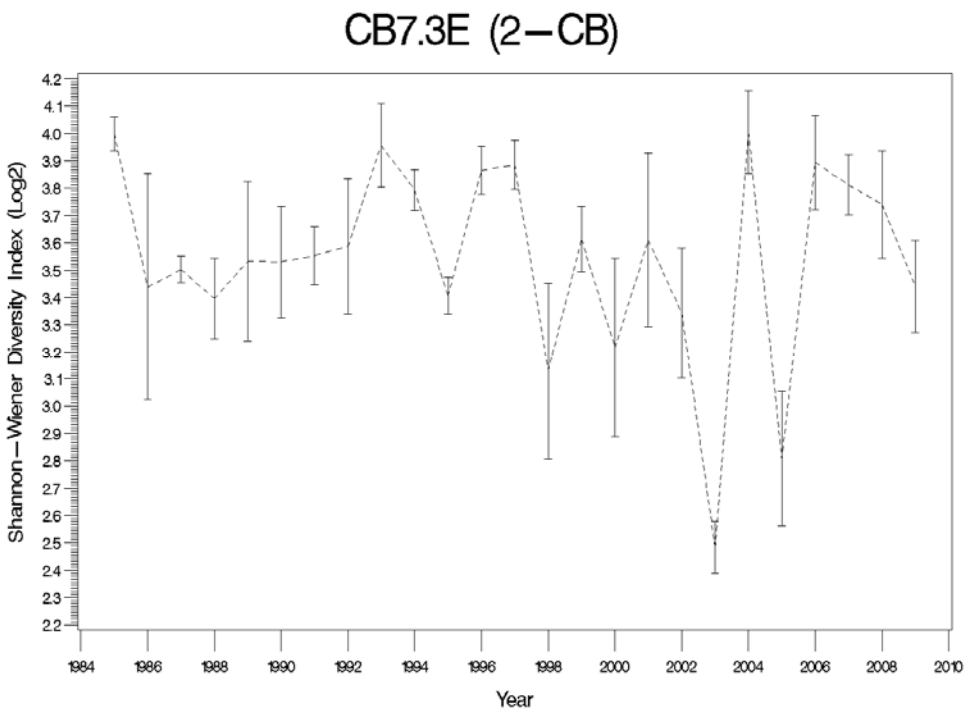


Figure 160. Plot of Shannon-Weiner diversity index at station CB7.3E for 1985 through 2009.

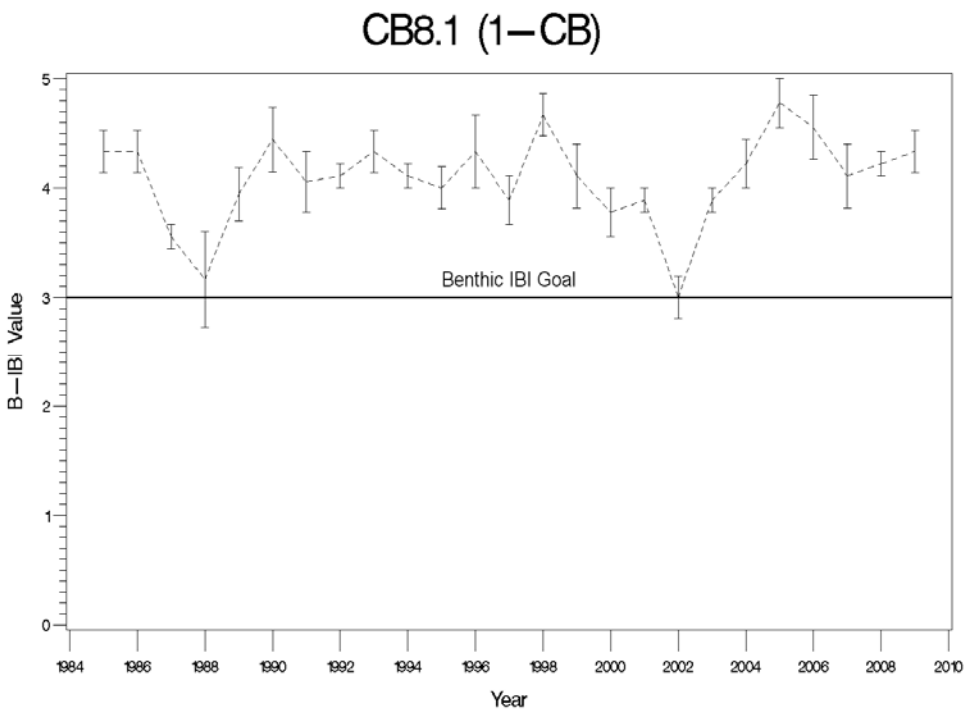


Figure 161. Plot of the benthic IBI against time at station CB8.1 for 1985 through 2009.

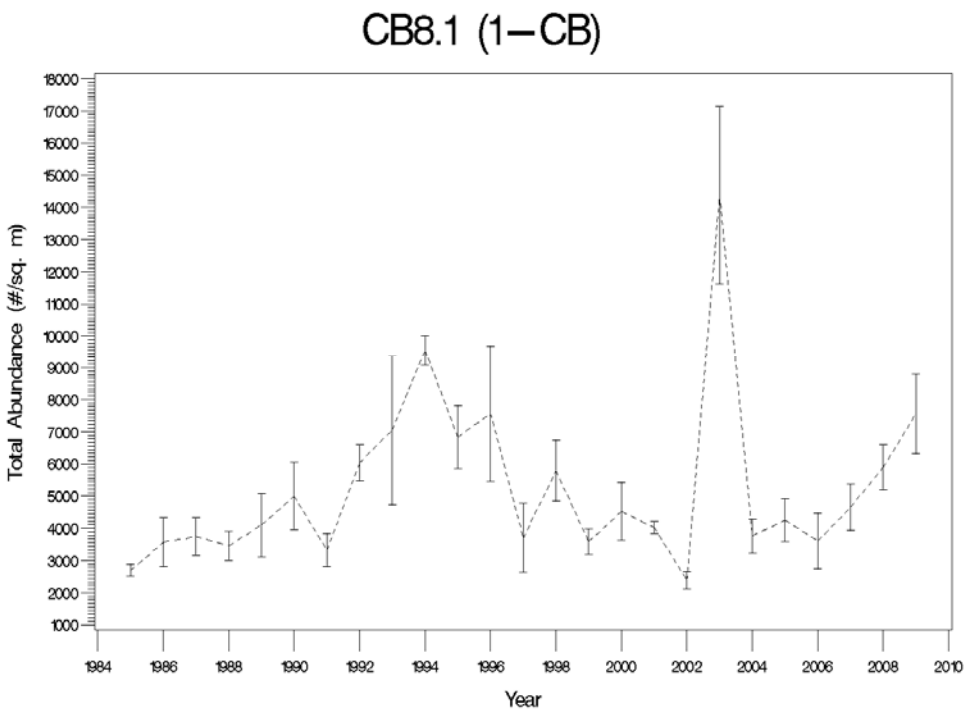


Figure 162. Plot of total benthic community abundance at station CB8.1 for 1985 through 2009.

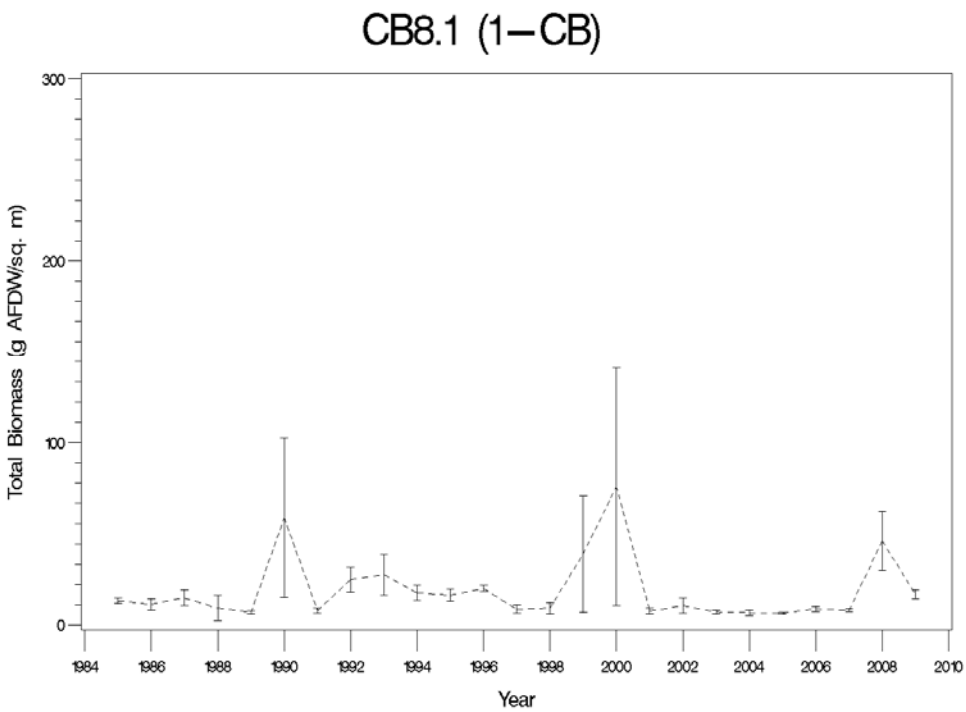


Figure 163. Plot of total benthic community biomass at station CB8.1 for 1985 through 2009.

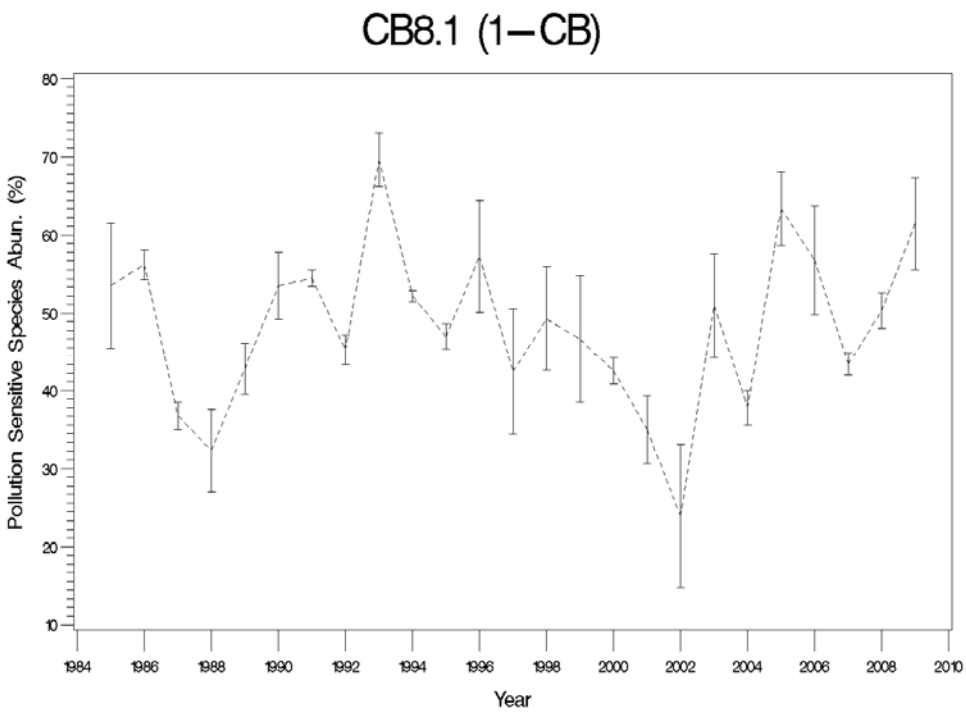


Figure 164. Plot of pollution sensitive species abundance at station CB8.1 for 1985 through 2009.

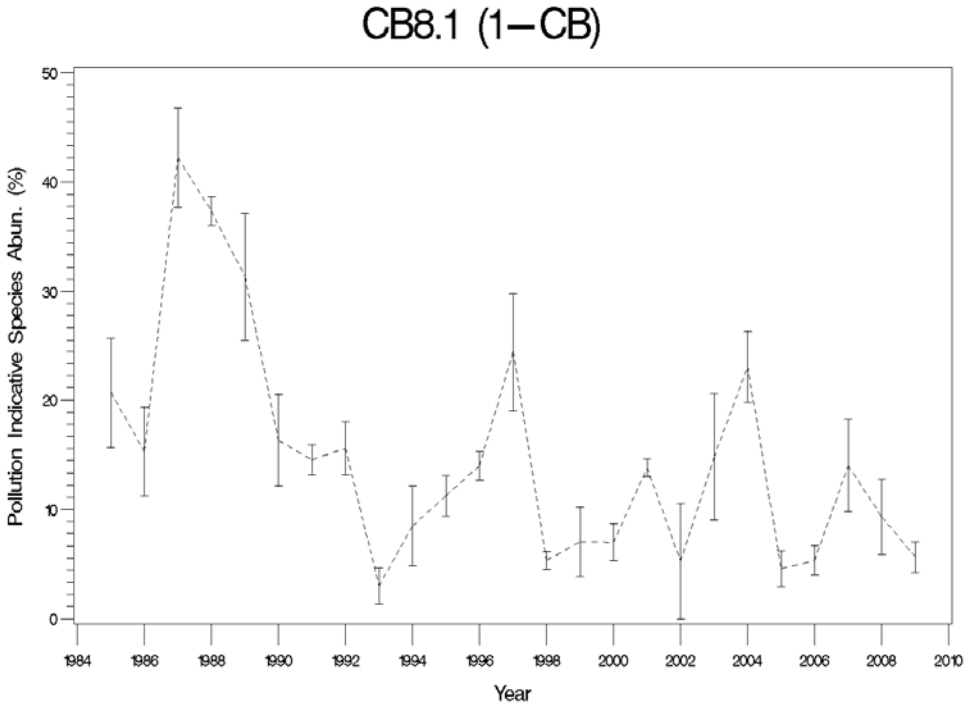


Figure 165. Plot of pollution indicative species abundance at station CB8.1 for 1985 through 2009.

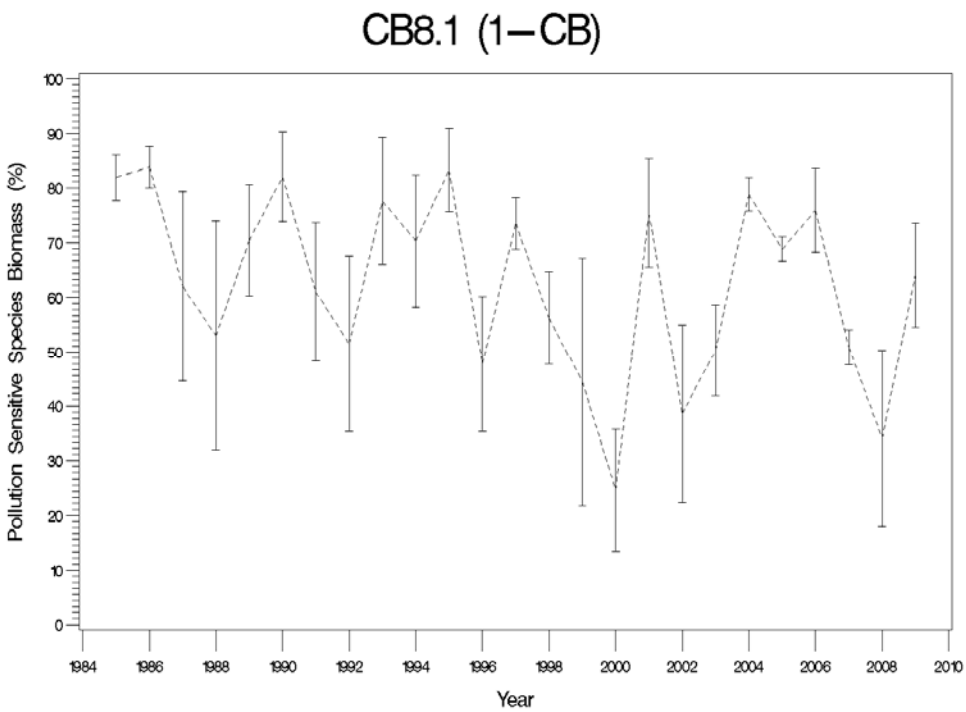


Figure 166. Plot of pollution sensitive species biomass at station CB8.1 for 1985 through 2009.

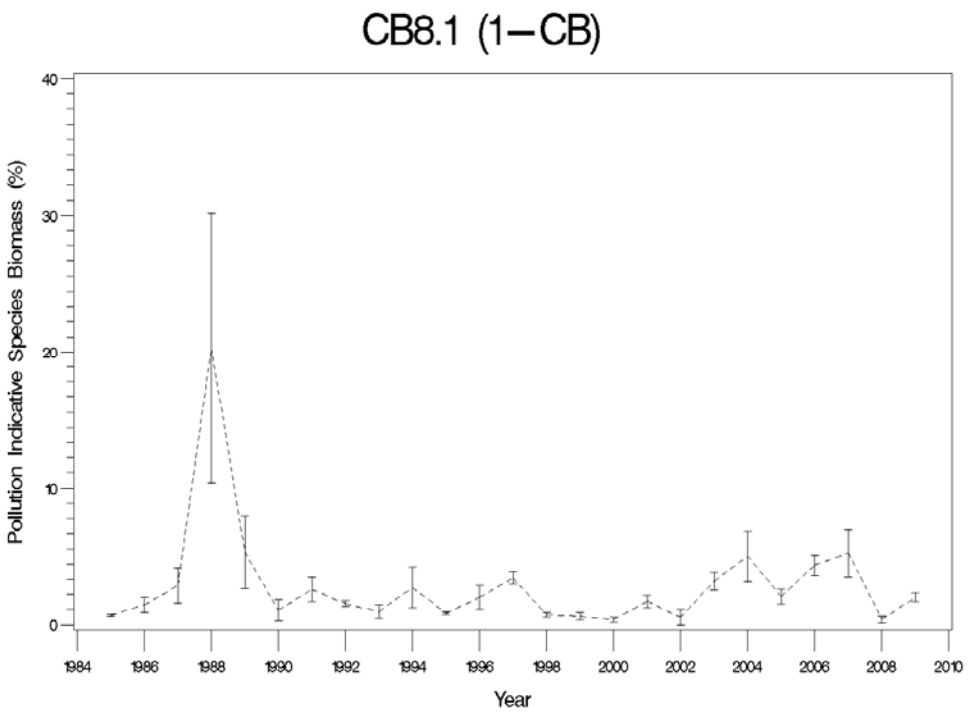


Figure 167. Plot of pollution indicative species biomass at station CB8.1 for 1985 through 2009.

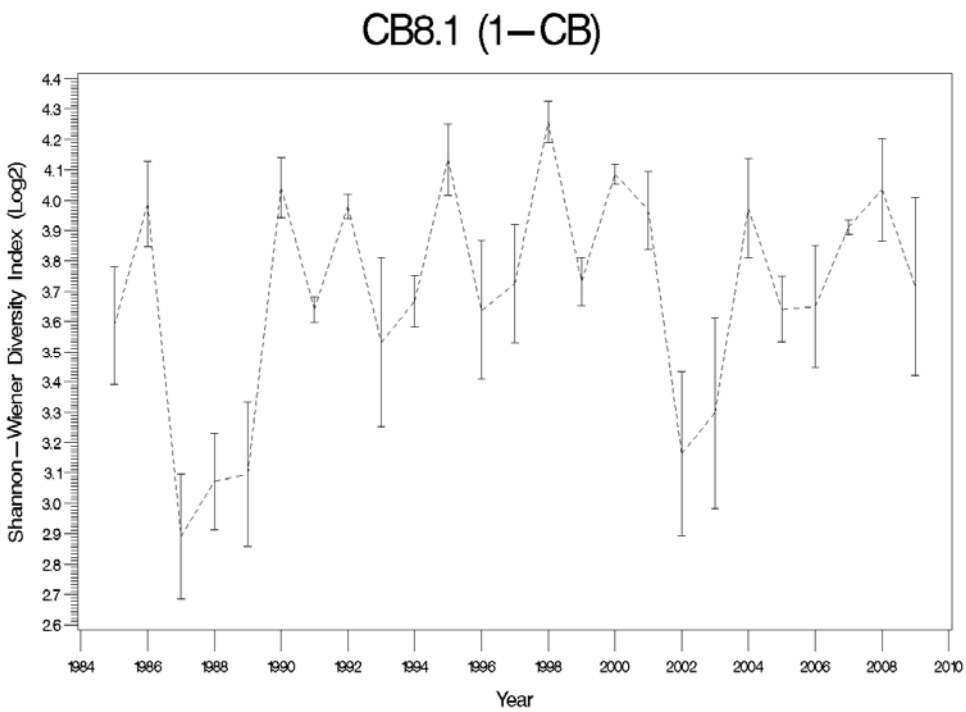
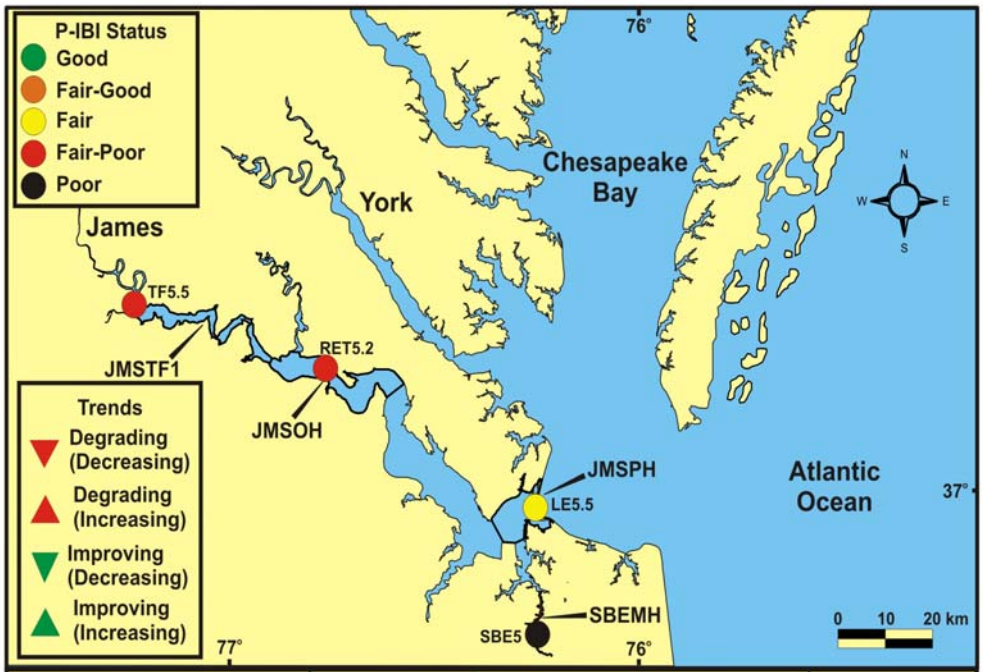


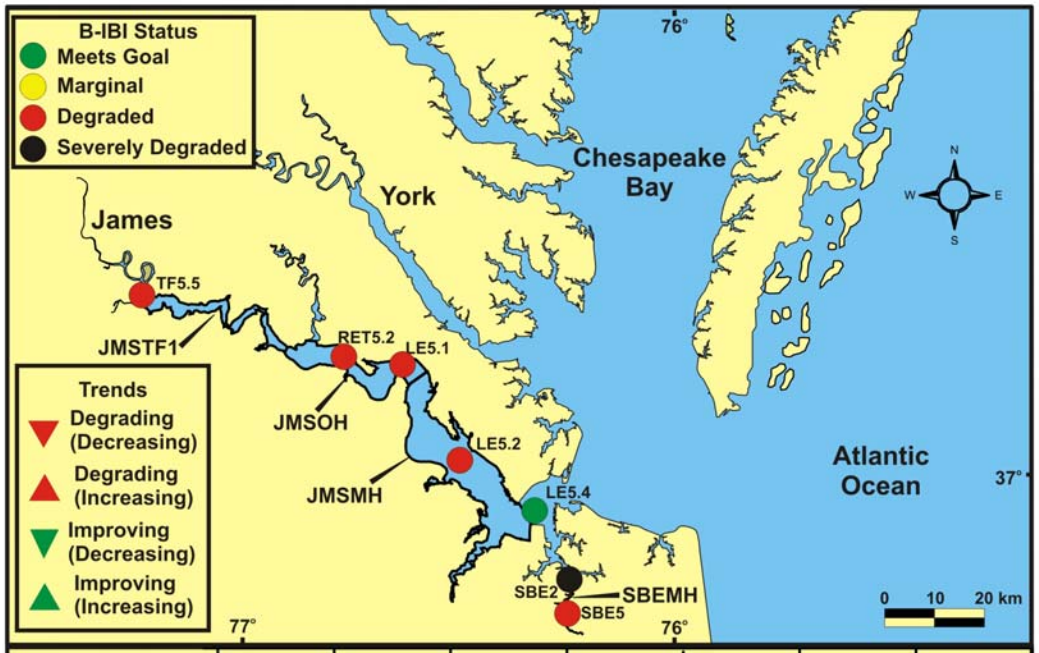
Figure 168. Plot of Shannon-Weiner diversity index at station CB8.1 for 1985 through 2009.

Appendix H - Additional Living Resources Summary Figures.



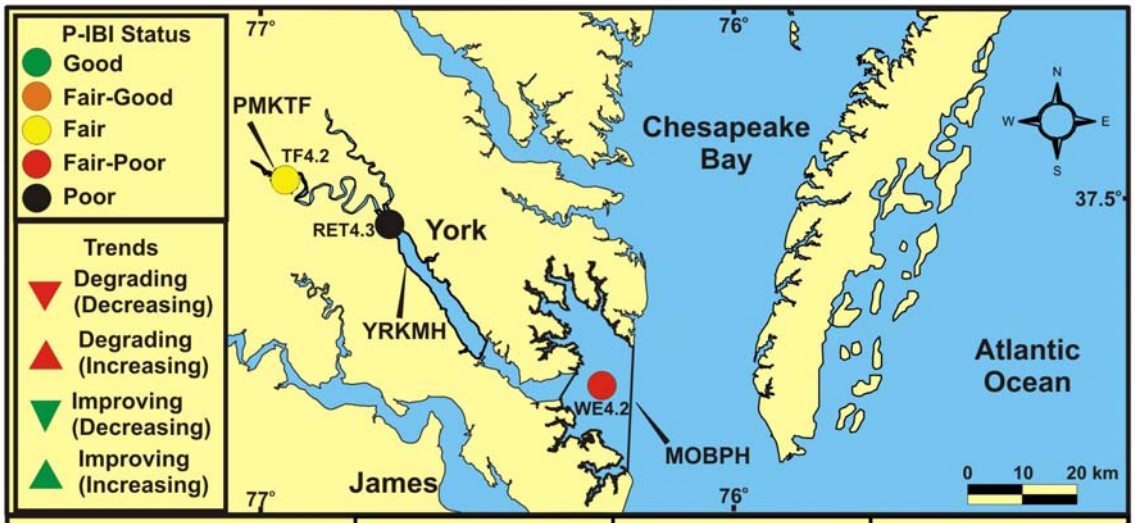
	TF5.5	RET5.2	LE5.5	SBE5
Phytoplankton IBI				
Total Abundance		↓	↓	↓
Total Biomass		↓	↓	↓
Margalef Diversity Index		▼		
Diatom Biomass	▼	▼	▼	▼
Dinoflagellate Biomass				
Cyanophyte Biomass				
Chlorophyte Biomass		▼	▼	▼
Picoplankton Biomass				▲
Cryptophyte Biomass	↓	↓	↓	↓

Figure 1. Map of the James River basin showing summaries of the status and trend analyses for the Phytoplankton Index of Biotic Integrity (P-IBI) and trend analyses of other phytoplankton bioindicators for each segment for the period of 1985 through 2009.



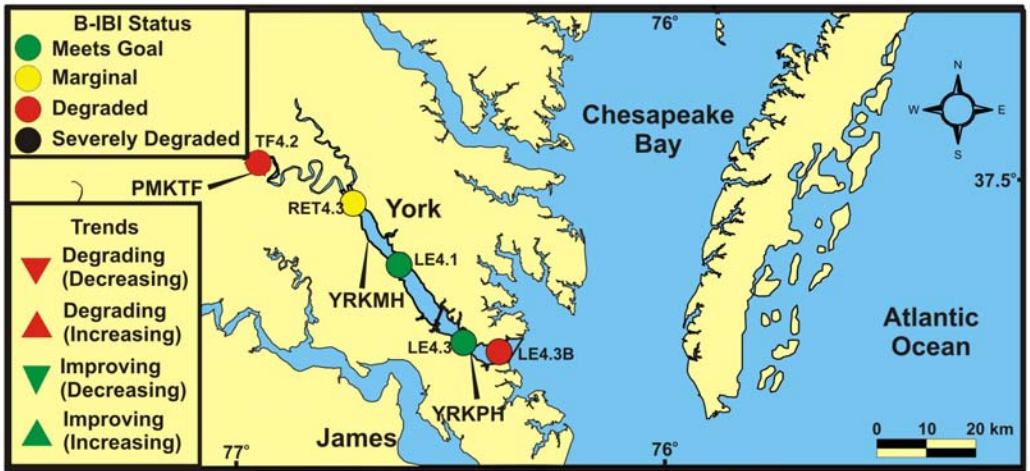
	TF5.5	RET5.2	LE5.1	LE5.2	LE5.4	SBE5	SBE2
Benthic IBI		▲				▲	
Total Abundance				▲			▲
Total Biomass					▼		
Pollution Sensitive Species Abundance (%)	▲	▲		▲		▲	▲
Pollution Indicative Species Abundance (%)	▼				▼	▼	▼
Pollution Sensitive Species Biomass (%)	▲	▲			▼	▲	
Pollution Indicative Species Biomass (%)	▼						
Shannon-Weiner Diversity Index		▲			▼		

Figure 2. Map of the James River basin showing summaries of the status and trend analyses for Benthic Index of Biotic Integrity (B-IBI) and associated benthic bioindicators for each segment for the period of 1985 through 2009.



	TF4.2	RET4.3	WE4.2
Phytoplankton IBI			
Total Abundance			
Total Biomass	↓		↓
Margalef Diversity Index			
Diatom Biomass			▼
Dinoflagellate Biomass			
Cyanophyte Biomass			
Chlorophyte Biomass		▼	▼
Picoplankton Biomass	▲		
Cryptophyte Biomass	↓	↓	↓

Figure 3. Map of the York River basin showing summaries of the status and trend analysis for the Phytoplankton Index of Biotic Integrity (P-IBI) and trend analyses for other phytoplankton indicators for all segments for the period of 1985 through 2009.

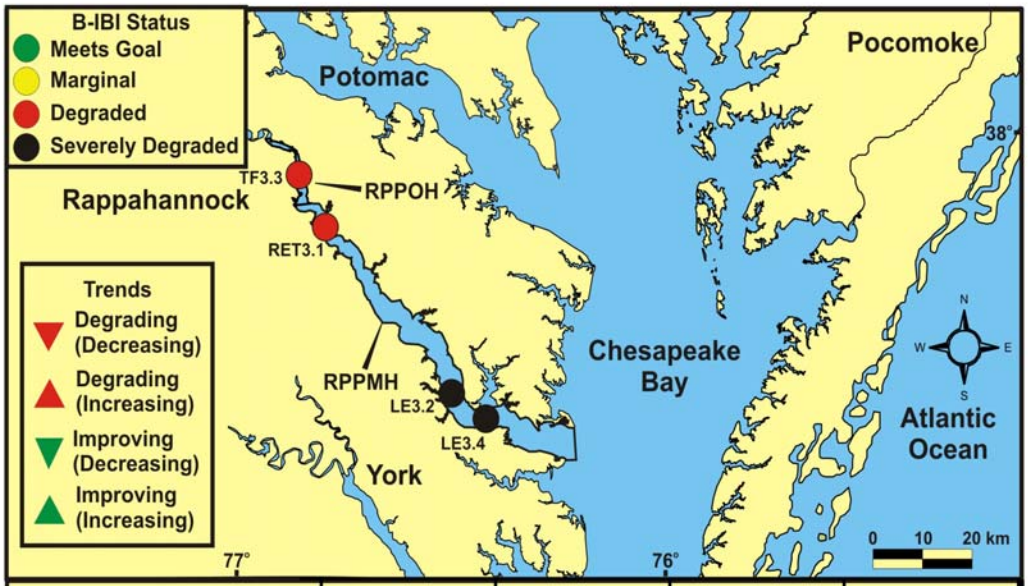


	TF4.2	RET4.3	LE4.1	LE4.3	LE4.3B
Benthic IBI					▲
Total Abundance		▲			
Total Biomass					
Pollution Sensitive Species Abundance (%)					
Pollution Indicative Species Abundance (%)					
Pollution Sensitive Species Biomass (%)			▼		
Pollution Indicative Species Biomass (%)					
Shannon-Weiner Diversity Index	▲				

Figure 4. Map of the York River basin showing summaries of the status and trend analyses for Benthic Index of Biotic Integrity (B-IBI) and associated benthic bioindicators for each segment for the period of 1985 through 2009.

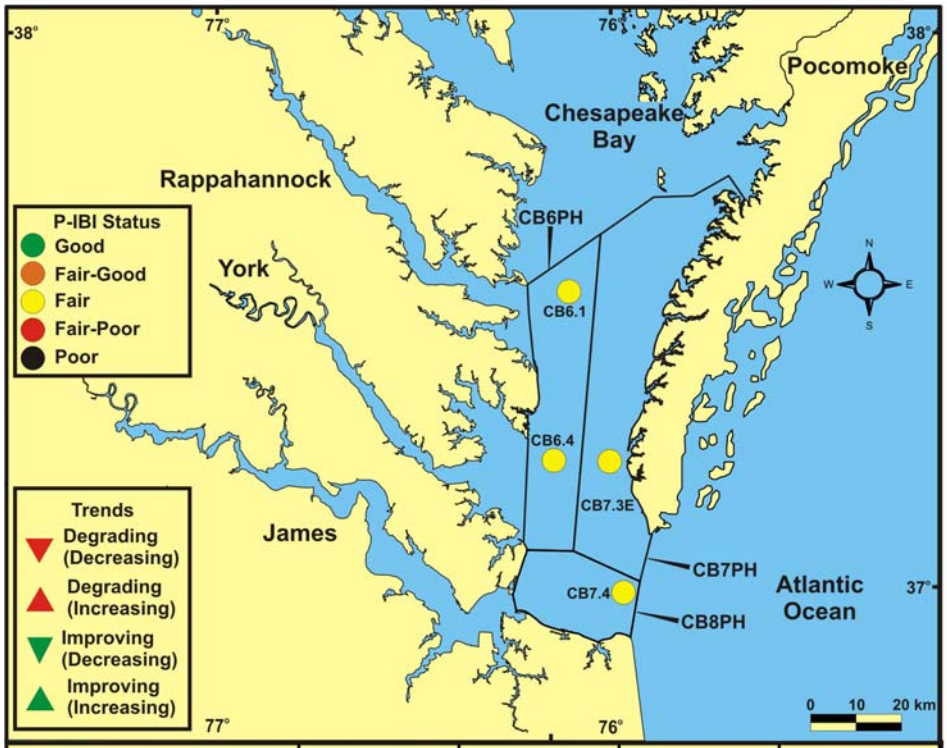
	TF3.3	RET3.1	LE3.6
Phytoplankton IBI			↓
Total Abundance			
Total Biomass			↓
Margalef Diversity Index			
Diatom Biomass			▼
Dinoflagellate Biomass	▲		
Cyanophyte Biomass	▲		▲
Chlorophyte Biomass			▼
Picoplankton Biomass			▼
Cryptophyte Biomass	↓	↓	↓

Figure 5. Map of the Rappahannock River basin showing summaries of the status and trend analyses for the Phytoplankton Index of Biotic Integrity (P-IBI) and trend analyses of other phytoplankton bioindicators for each segment for the period of 1985 through 2009.



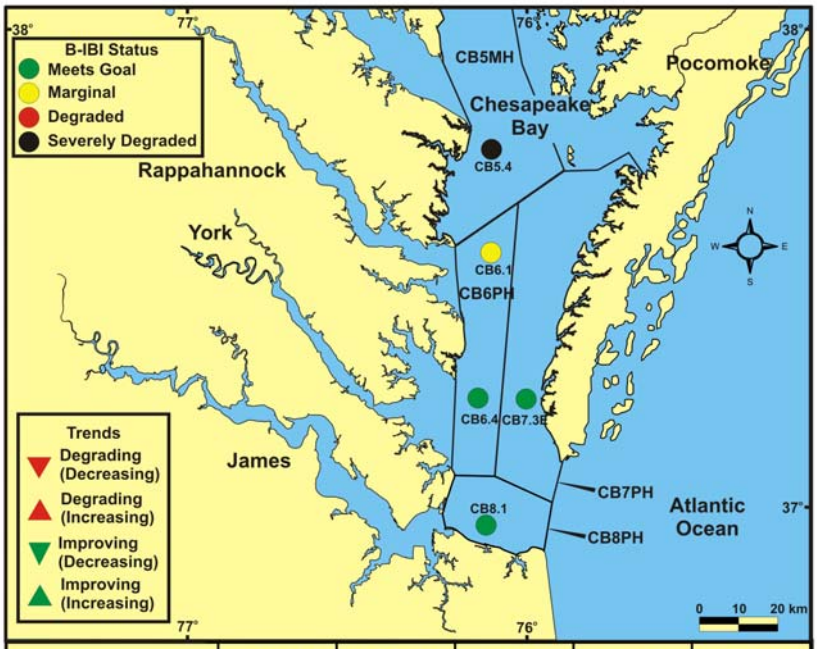
	TF3.3	RET3.1	LE3.2	LE3.4
Benthic IBI		▼		
Total Abundance				
Total Biomass	▼	▼		
Pollution Sensitive Species Abundance (%)		▼		
Pollution Indicative Species Abundance (%)				
Pollution Sensitive Species Biomass (%)	▼	▼		
Pollution Indicative Species Biomass (%)				
Shannon-Weiner Diversity Index				

Figure 6. Map of the Rappahannock River basin showing summaries of the status and trend analyses for Benthic Index of Biotic Integrity (B-IBI) and associated benthic bioindicators for each segment for the period of 1985 through 2009.



	CB6.1	CB6.4	CB7.3E	CB7.4
Phytoplankton IBI				
Total Abundance				
Total Biomass	↓	↓	↓	↓
Margalef Diversity Index				▼
Diatom Biomass	▼	▼	▼	▼
Dinoflagellate Biomass				
Cyanophyte Biomass	▲	▲		
Chlorophyte Biomass	▼	▼	▼	▼
Picoplankton Biomass				
Cryptophyte Biomass	↓	↓	↓	↓

Figure 7. Map of the Virginia Chesapeake Bay Mainstem showing summaries of the status and trend analyses for the Phytoplankton Index of Biotic Integrity (P-IBI) and trend analyses of other phytoplankton bioindicators for each segment for the period of 1985 through 2009.



	CB5.4	CB6.1	CB6.4	CB7.3E	CB8.1
Benthic IBI					
Total Abundance		▲	▲		
Total Biomass			▼		
Pollution Sensitive Species Abundance (%)					
Pollution Indicative Species Abundance (%)		▲		▼	▼
Pollution Sensitive Species Biomass (%)					▼
Pollution Indicative Species Biomass (%)		▲			
Shannon-Weiner Diversity Index			▲		

Figure 8. Map of the Virginia Chesapeake Bay Mainstem showing summaries of the status and trend analyses for Benthic Index of Biotic Integrity (B-IBI) and associated benthic bioindicators for each segment for the period of 1985 through 2009.

Appendix I. Glossary of Important Terms

Anoxic - condition in which the water column is characterized by a complete absence of oxygen. Anoxic conditions typically result from excessive decomposition of organic material by bacteria, high respiration by phytoplankton, stratification of the water column due to salinity or temperature effects or a combination of these factors. Anoxic conditions can result in fish kills or localized extinction of benthic communities.

Anthropogenic - resulting from or generated by human activities.

Benthos - refers to organisms that dwell on or within the bottom. Includes both hard substratum habitats (e.g. oyster reefs) and sedimentary habitats (sand and mud bottoms).

B-IBI - the benthic index of biotic integrity of Weisberg et al. (1997). The B-IBI is a multi-metric index that compares the condition of a benthic community to reference conditions.

Biological Nutrient Removal (BNR) - A temperature dependent process in which the ammonia nitrogen present in wastewater is converted by bacteria first to nitrate nitrogen and then to nitrogen gas. This technique is used to reduce the concentration of nitrogen in sewage treatment plant effluents.

Biomass - a quantitative estimate of the total mass of organisms for a particular population or community within a given area at a given time. Biomass for phytoplankton is measured as the total carbon within a liter of water. Biomass for the benthos is measured as the total ash-free dry weight per square meter of sediment habitat.

Chlorophyll *a* - a green pigment found in plant cells that functions as the receptor for energy in the form of sunlight. This energy is used in the production of cellular materials for growth and reproduction in plants. Chlorophyll *a* concentrations are measured in µg/L and are used as estimate of the total biomass of phytoplankton cells in the water column. In general, high levels of chlorophyll *a* concentrations are believed to be indicative of excessive growth of phytoplankton resulting from excess nutrients such as nitrogen and phosphorus in the water column.

Chlorophytes - algae belonging to the division Chlorophyta often referred to as true "green algae." Chlorophytes occur in unicellular, colonial and filamentous forms and are generally more common in tidal freshwater and oligohaline portions of estuaries.

Cryptomonads -algae belonging to the division Cryptophyta that have accessory pigments in addition to chlorophyll *a* which give these small flagellated cells a red, brown or yellow color.

Cyanophytes - algae belonging to the division Cyanophycea that are procaryotic and that occur in single-celled , filamentous and colonial forms. In general, high concentrations of cyanobacteria are considered to be indicative of poor water quality.

Diatoms - algae belonging to the division Bacillariophyta that have a cell wall that is composed primarily of silica and that consists of two separate halves. Most diatoms are single-celled but some are colonial and filamentous forms. Diatoms are generally considered to be indicative of good water quality and are considered to be appropriate food for many zooplankton.

Dinoflagellates - biflagellated, predominately unicellular protists which are capable of performing photosynthesis. Many dinoflagellates are covered with cellulose plates or with a series of membranes. Some dinoflagellates periodically reproduce in large numbers causing blooms that are often referred to as "red tides." Certain species produce toxins and blooms of these forms have been implicated in fish kills. High concentrations of dinoflagellates are generally considered to be indicative of poor water quality.

Dissolved oxygen (DO) - the concentration of oxygen in solution in the water column, measured in mg/L. Most organisms rely on oxygen for cellular metabolism and as a result low levels of dissolved oxygen adversely affect important living resources such as fish and the benthos. In general, dissolved oxygen levels decrease with increasing pollution.

Dissolved inorganic nitrogen (DIN) - the concentration of inorganic nitrogen compounds including ammonia (NH_4), nitrates (NO_3) and nitrites (NO_2) in the water column measured in mg/L. These dissolved inorganic forms of nitrogen are directly available for uptake by phytoplankton by diffusion without first undergoing the process of decomposition. High concentrations of dissolved inorganic nitrogen can result in excessive growth of phytoplankton which in turn can adversely effect other living resources.

Dissolved inorganic phosphorus (PO4F) - the concentration of inorganic phosphorus compounds consisting primarily of orthophosphates (PO_4), The dissolved inorganic forms of phosphorus are directly available for uptake by phytoplankton by diffusion without first undergoing the process of decomposition. High concentrations of dissolved inorganic phosphorus can result in excessive growth of phytoplankton which in turn can adversely effect other living resources.

Estuary - A semi-enclosed body of water that has a free connection with the open sea and within which seawater is diluted measurably with freshwater derived from land drainage.

Eucaryote - organisms the cells of which have discrete organelles and a nucleus separated from the cytoplasm by a membrane.

Fall-line - location of the maximum upstream extent of tidal influence in an estuary typically characterized by a waterfall.

Fixed Point Stations - stations for long-term trend analysis whose location is unchanged over time.

Flow adjusted concentration (FAC) - concentration value which has been recalculated to remove the variation caused by freshwater flow into a stream. By removing variation caused by flow, the effects of other factors such as nutrient management strategies can be assessed.

Habitat - a local environment that has a community distinct from other such habitat types. For the B-IBI of Chesapeake Bay, seven habitat types were defined as combinations of salinity and sedimentary types - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand and polyhaline mud.

Hypoxic - condition in which the water column is characterized by dissolved oxygen concentrations less than 2 mg/L but greater than 0 mg/L. Hypoxic conditions typically result from excessive decomposition of organic material by bacteria, high respiration by phytoplankton, stratification of the water column due to salinity or temperature effects or a combination of these factors. Hypoxic conditions can result in fish kills or localized extinction of benthic communities.

Light attenuation (KD) - Absorption, scattering, or reflection of light by dissolved or suspended material in the water column expressed as the change in light extinction per meter of depth. Light attenuation reduces the amount of light available to submerged aquatic vegetation.

Loading - the total mass of contaminant or nutrient added to a stream or river generally expressed in lbs/yr.

Macrobenthos - a size category of benthic organisms that are retained on a mesh of 0.5 mm.

Mesohaline - refers to waters with salinity values ranging between 0.5 and 18.0 ppt.

Metric - a parameter or measurement of community structure (e.g., abundance, biomass, species diversity).

Non-point source - a source of pollution that is distributed widely across the landscape surrounding a water body instead of being at a fixed location (e.g. run-off from residential and agricultural land).

Oligohaline - refers to waters with salinity values ranging between 0.5 and 5.0 ppt.

Percent of light at the leaf surface (PLL) - the percentage of light at the surface of the water column that reaches the surface of the leaves of submerged aquatic vegetation generally estimated for depths of 0.5 m and 1.0 m. Without sufficient light at the leaf surface, submerged aquatic plants cannot perform photosynthesis and hence cannot grow or reproduce.

Phytoplankton - that portion of the plankton capable of producing its own food by photosynthesis. Typical members of the phytoplankton include diatoms, dinoflagellates and chlorophytes.

P-IBI - the phytoplankton index of biotic integrity (Buchanan et al., 2005; Lacouture et al., 2006). The P-IBI is a multi-metric index that compares the condition of a phytoplankton community to reference conditions.

Picoplankton - phytoplankton with a diameter between 0.2 and 2.0 µm in diameter. Picoplankton consists primarily of cyanobacteria and high concentrations of picoplankton are generally considered to be indicative of poor water quality conditions.

Pielou's evenness - an estimate of the distribution of proportional abundances of individual species within a community. Evenness (J) is calculated as follows: $J=H'/\ln S$ where H' is the Shannon - Weiner diversity index and S is the number of species.

Plankton - aquatic organisms that drift within and that are incapable of movement against water currents. Some plankton have limited locomotor ability that allows them to change their vertical position in the water column.

Point source - a source of pollution that is concentrated at a specific location such as the outfall of a sewage treatment plant or factory.

Polyhaline - refers to waters with salinity values ranging between 18.0 and 30 ppt.

Primary productivity - the rate of production of living material through the process of photosynthesis that for phytoplankton is typically expressed in grams of carbon per liter of water per hour. High rates of primary productivity are generally considered to be related to excessive concentrations of nutrients such as nitrogen and phosphorus in the water column.

Probability based sampling - all locations within a stratum have an equal chance of being sampled. Allows estimation of the percent of the stratum meeting or failing the benthic restoration goals.

Procaryote - organisms the cells of which do not have discrete organelles or a nucleus (e.g. Cyanobacteria).

Pycnocline - a rapid change in salinity in the water column indicating stratification of water with depth resulting from either changes in salinity or water temperature.

Random Station - a station selected randomly within a stratum. In every succeeding sampling event new random locations are selected.

Recruitment - The successful dispersal settlement and development of larval forms of plants or animal to a reproducing adult.

Reference condition - the structure of benthic communities at reference sites.

Reference sites - sites determined to be minimally impacted by anthropogenic stress. Conditions at theses sites are considered to represent goals for restoration of impacted benthic communities. Reference sites were selected by Weisberg et al. (1997) as those outside highly developed watersheds, distant from any point-source discharge, with no sediment contaminant effect, with no low dissolved oxygen effect and with a low level of organic matter in the sediment.

Restoration Goal - refers to obtaining an average B-IBI value of 3.0 for a benthic community indicating that values for metrics approximate the reference condition.

Riparian Buffer - An area of trees and shrubs a minium of 100 feet wide located up gradient, adjacent, and parallel to the edge of a water feature which serves to: 1) reduce excess amounts of sediment, organic matter, nutrients, and other pollutants in surface runoff, 2) reduce soluble pollutants in shallow ground water flow, 3) create shade along water bodies to lower aquatic temperatures, 4) provide a source of detritus and large woody debris aquatic organisms, 5) provide riparian habitat and corridors for wildlife, and 6) reduce erosion of streambanks and shorelines.

Salinity - the concentration of dissolved salts in the water column measured in mg/L, ppt or psu. The composition and distribution of plant and animal communities is directly affected by salinity in estuarine systems. The effects of salinity on living resources must be taken into consideration when interpreting the potential effects of human activities on living resources.

Secchi depth - the depth of light penetration expressed in meters as measured using a secchi disk. Light penetration depth directly affects the growth and recruitment of submerge aquatic vegetation.

Shannon Weiner diversity index - a measure of the number of species within a community and the relative abundances of each species. The Shannon Weiner index is calculated as follows:

$$H' = -\sum_{i=1}^{s} p_i \log_2 p_i$$

where p_i is the proportion of the *i*th species and *S* is the number of species.

Stratum - a geographic region of unique ecological condition or managerial interest.

Submerged aquatic vegetation (SAV) - rooted vascular plants (e.g. eelgrass, widgeon grass, sago pondweed) that grow in shallow water areas . SAV are important in marine environments because they serve as major food source, provide refuge for juvenile crabs and fish, stabilize sediments preventing shoreline erosion and excessive suspended materials in the water column, and produce oxygen in the water column.

Threshold - a value of a metric that determines the B-IBI scoring. For all metrics except abundance and biomass, two thresholds are used - the lower 5th percentile and the 50th percentile (median) of the distribution of values at reference sites. Samples with metric values less than the lower 5th percentile are scored as a 1. Samples with values between the 5th and 50th metrics are scored as 3 and values greater than the 50th percentile are scored as 5. For abundance and biomass, values below the 5th and above the 95th percentile are scored as 1, values between the 5th and 25th and the 75th and 95th percentiles are scored as 3 and values between the 25th and 75th percentiles are scored as 5.

Tidal freshwater - refers to waters with salinity values ranging between 0 and 0.5 ppt which are located in the upper reaches of the estuary at or just below the maximum upstream extent of tidal influence.

Total nitrogen (TN) - the concentration of both inorganic and organic compounds in the water column which contain nitrogen measured in mg/L. Nitrogen is a required nutrient for protein synthesis. Inorganic forms of nitrogen are directly available for uptake by phytoplankton while organic compounds must first be decomposed by bacteria prior to being available for use for other organisms. High levels of total nitrogen are considered to be detrimental to living resources either as a source of nutrients for excessive phytoplankton growth or as a source of excessive bacterial decomposition that can increase the incidence and extent of anoxic or hypoxic events.

Total phosphorus (TP) - the concentration of both inorganic and organic compounds in the water column which contain phosphorus measured in mg/L. Phosphorus is a required nutrient for cellular metabolism and for the production of cell membranes. Inorganic forms of phosphorus are directly available for uptake by phytoplankton while organic compounds must first be decomposed by bacteria prior to being available for use for other organisms. High levels of total nitrogen are considered to be detrimental to living resources either as a source of nutrients for excessive phytoplankton growth or as a source of excessive bacterial decomposition that can increase the incidence and extent of anoxic or hypoxic events.

Total suspended solids (TSS) - the concentration of suspended particles in the water column, measured in mg/L. The composition of total suspended solids includes both inorganic (fixed) and organic (volatile) compounds. The fixed suspended solids component is comprised of sediment particles while the volatile suspended solids component is comprised of detrital particles and planktonic organisms. The concentration of total suspended solids directly affects water clarity which in turn affects the development and growth of submerged aquatic vegetation.