

Appendix C - Long Term Trends in Phytoplankton Indicators

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 2010. See the Methods section for definitions of Seasons. "N.E." in the Percent Change column indicates "No Estimate" was made for the percent change due to a zero baseline value.

James River/ Elizabeth River

Station	Season	Parameter	Trend Test P Value	Slope	Baseline Median	Absolute Change	% Change	Trend Direction	Homogen. Test P value
TF5.5	Annual	Phytoplankton IBI	0.3313	0.0000	1.6	0	0.00	No Trend	0.1857
TF5.5	Annual	Total Abundance	0.2925	180692	21206834	4878692	23.01	No Trend	0.0373
TF5.5	Annual	Total Biomass	0.0001	0.0265	0.5089	0.7158	141	Increasing	0.7994
TF5.5	Annual	Margalef Diversity Index	0.8626	0.00	2.33	0.02	1.07	No Trend	0.7318
TF5.5	Annual	Diatom Biomass	0.7293	0.0010	0.3439	0.0258	7.51	No Trend	0.4049
TF5.5	Annual	Dinoflagellate Biomass	0.8205	0.0000	0.0007	0.0000	0.00	No Trend	0.4977
TF5.5	Annual	Cyanobacteria Biomass	0.0003	0.0007	0.0162	0.0185	114.15	Degrading	0.2229
TF5.5	Annual	Chlorophyte Biomass	0.0000	0.0104	0.0137	0.2807	2053	Improving	0.8912
TF5.5	Annual	Picoplankton Biomass	0.0003	-0.0011	0.0768	-0.0271	-35.29	Improving	0.0537
TF5.5	Annual	Cryptophyte Biomass	0.1000	-0.0002	0.0103	-0.0064	-61.86	No Trend	0.0167
RET5.2	Annual	Phytoplankton IBI	0.4157	0.0000	2.5	0	0.00	No Trend	0.456
RET5.2	Annual	Total Abundance	0.0156	-260397	7429773	-7030730	-94.63	No Trend	0.0039
RET5.2	Annual	Total Biomass	0.7617	-0.0009	0.1678	-0.0235	-13.99	No Trend	0.0019
RET5.2	Annual	Margalef Diversity Index	0.0006	-0.01	1.62	-0.39	-23.94	Degrading	0.1350
RET5.2	Annual	Diatom Biomass	0.0723	-0.0033	0.1177	-0.0886	-75.29	No Trend	0.0033
RET5.2	Annual	Dinoflagellate Biomass	0.7828	0.0000	0.0005	0.0000	0.00	No Trend	0.5725
RET5.2	Annual	Cyanobacteria Biomass	0.1258	-0.0002	0.0036	-0.0041	-114.07	No Trend	0.4673
RET5.2	Annual	Chlorophyte Biomass	0.0723	0.0004	0.0018	0.0104	589.21	No Trend	0.0050
RET5.2	Annual	Picoplankton Biomass	0.0000	-0.0020	0.1136	-0.0472	-41.54	Improving	0.5258
RET5.2	Annual	Cryptophyte Biomass	0.0783	-0.0003	0.0144	-0.0068	-46.98	No Trend	0.3592
LE5.5	Annual	Phytoplankton IBI	0.7368	0.0000	2.49	0	0.00	No Trend	0.7082
LE5.5	Annual	Total Abundance	0.9903	469	5066591	13125	0.26	No Trend	0.6789
LE5.5	Annual	Total Biomass	0.0360	-0.0029	0.2351	-0.0815	-34.65	No Trend	0.2722
LE5.5	Annual	Margalef Diversity Index	0.0008	-0.01	2.50	-0.35	-13.87	Degrading	0.4741
LE5.5	Annual	Diatom Biomass	0.0875	-0.0016	0.1615	-0.0446	-27.63	No Trend	0.4172
LE5.5	Annual	Dinoflagellate Biomass	0.9420	0.0000	0.0208	-0.0005	-2.20	No Trend	0.7974
LE5.5	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0002	41110	Degrading	0.3011
LE5.5	Annual	Chlorophyte Biomass	0.3548	0.0000	0.0000	0.0000	0.00	No Trend	0.5359
LE5.5	Annual	Picoplankton Biomass	0.1976	-0.0001	0.0689	-0.0031	-4.47	No Trend	0.1701
LE5.5	Annual	Cryptophyte Biomass	0.0000	-0.0004	0.0202	-0.0117	-57.89	Decreasing	0.1659
SBE5	Annual	Phytoplankton IBI	0.5812	0.0000	1.4	0	0.00	No Trend	0.0959
SBE5	Annual	Total Abundance	0.0104	-56720	2554283	-1361273	-53.29	No Trend	0.7110
SBE5	Annual	Total Biomass	0.0003	-0.0031	0.0763	-0.0737	-96.64	Decreasing	0.5477
SBE5	Annual	Margalef Diversity Index	0.1528	-0.01	2.33	-0.13	-5.76	No Trend	0.9716
SBE5	Annual	Diatom Biomass	0.0000	-0.0027	0.0444	-0.0646	-146	Degrading	0.2338
SBE5	Annual	Dinoflagellate Biomass	0.7831	0.0000	0.0087	-0.0003	-3.80	No Trend	0.5515
SBE5	Annual	Cyanobacteria Biomass	0.1126	0.0000	0.0001	0.0001	58.86	No Trend	0.7679
SBE5	Annual	Chlorophyte Biomass	0.0093	0.0000	0.0003	-0.0001	-33.14	Degrading	0.2458
SBE5	Annual	Picoplankton Biomass	0.0154	0.0002	0.0269	0.0037	13.88	No Trend	0.0369
SBE5	Annual	Cryptophyte Biomass	0.0001	-0.0004	0.0137	-0.0084	-61.18	Decreasing	0.8181

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York River

Station	Season	Parameter	Trend Test		Baseline Median	Absolute		Trend Direction	Homogen. Test P value
			P Value	Slope		Change	% Change		
TF4.2	Annual	Phytoplankton IBI	0.8932	0.0000	3	0	0.00	No Trend	0.0146
TF4.2	Annual	Total Abundance	0.1101	32982	3316370	857534	25.86	No Trend	0.9859
TF4.2	Annual	Total Biomass	0.4199	0.0010	0.1001	0.0257	25.63	No Trend	0.7183
TF4.2	Annual	Margalef Diversity Index	0.0311	0.01	1.79	0.24	13.66	No Trend	0.3750
TF4.2	Annual	Diatom Biomass	0.5048	-0.0004	0.0867	-0.0100	-11.54	No Trend	0.9121
TF4.2	Annual	Dinoflagellate Biomass	0.5747	0.0000	0.0002	0.0000	0.00	No Trend	0.9413
TF4.2	Annual	Cyanobacteria Biomass	0.0040	0.0000	0.0004	0.0011	302	Degrading	0.0544
TF4.2	Annual	Chlorophyte Biomass	0.0000	0.0002	0.0009	0.0062	708	Improving	0.4158
TF4.2	Annual	Picoplankton Biomass	0.9559	0.0000	0.0384	-0.0002	-0.45	No Trend	0.9553
TF4.2	Annual	Cryptophyte Biomass	0.1952	-0.0001	0.0085	-0.0019	-22.29	No Trend	0.1901
RET4.3	Annual	Phytoplankton IBI	0.2151	0.0000	1.5	0	0.00	No Trend	0.3585
RET4.3	Annual	Total Abundance	0.6458	27004	7855528	729104	9.28	No Trend	0.2863
RET4.3	Annual	Total Biomass	0.5532	0.0012	0.3290	0.0334	10.16	No Trend	0.4123
RET4.3	Annual	Margalef Diversity Index	0.8240	0.00	1.61	-0.02	-0.94	No Trend	0.7126
RET4.3	Annual	Diatom Biomass	0.9291	0.0002	0.1850	0.0043	2.34	No Trend	0.1322
RET4.3	Annual	Dinoflagellate Biomass	0.4719	0.0001	0.0199	0.0016	8.04	No Trend	0.8234
RET4.3	Annual	Cyanobacteria Biomass	0.1400	0.0000	0.0009	0.0009	101.36	No Trend	0.2903
RET4.3	Annual	Chlorophyte Biomass	0.0073	0.0000	0.0000	0.0013	92658	Improving	0.0973
RET4.3	Annual	Picoplankton Biomass	0.2145	-0.0003	0.0425	-0.0065	-15.23	No Trend	0.0211
RET4.3	Annual	Cryptophyte Biomass	0.0261	-0.0004	0.0193	-0.0102	-52.84	No Trend	0.0026
WE4.2	Annual	Phytoplankton IBI	0.1216	0.0100	2.39	0.3	12.63	No Trend	0.1435
WE4.2	Annual	Total Abundance	0.5660	-15001	6089918	-420018	-6.90	No Trend	0.7044
WE4.2	Annual	Total Biomass	0.0002	-0.0062	0.3590	-0.1749	-48.71	Decreasing	0.7728
WE4.2	Annual	Margalef Diversity Index	0.0000	-0.02	2.61	-0.57	-21.81	Degrading	0.3775
WE4.2	Annual	Diatom Biomass	0.0075	-0.0025	0.1832	-0.0705	-38.47	Degrading	0.7632
WE4.2	Annual	Dinoflagellate Biomass	0.1955	-0.0003	0.0518	-0.0091	-17.62	No Trend	0.0751
WE4.2	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0006	N.E.	Degrading	0.4303
WE4.2	Annual	Chlorophyte Biomass	0.8647	0.0000	0.0001	0.0000	0.00	No Trend	0.3398
WE4.2	Annual	Picoplankton Biomass	0.6289	-0.0001	0.0569	-0.0018	-3.09	No Trend	0.0763
WE4.2	Annual	Cryptophyte Biomass	0.0000	-0.0007	0.0233	-0.0188	-80.90	Decreasing	0.7205
RET3.1	Annual	Picoplankton Biomass	0.0264	-0.0008	0.1197	-0.0187	-15.65	No Trend	0.2979
RET3.1	Annual	Cryptophyte Biomass	0.0273	-0.0003	0.0214	-0.0086	-40.12	No Trend	0.1463

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Rappahannock River

Station	Season	Parameter	Trend Test		Baseline Median	Absolute Change	% Change	Trend Direction	Homogen. Test P value
			P Value	Slope					
TF3.3	Annual	Phytoplankton IBI	0.0120	0.0000	2	0	0.00	No Trend	0.0005
TF3.3	Annual	Total Abundance	0.0000	660454	4890437	17832250	364	Increasing	0.6051
TF3.3	Annual	Total Biomass	0.0000	0.0199	0.0943	0.5380	570	Increasing	0.7046
TF3.3	Annual	Margalef Diversity Index	0.8014	0.00	1.48	-0.02	-1.34	No Trend	0.8100
TF3.3	Annual	Diatom Biomass	0.0000	0.0104	0.0724	0.2801	386	Improving	0.2972
TF3.3	Annual	Dinoflagellate Biomass	0.0677	0.0000	0.0009	0.0001	12.79	No Trend	0.6960
TF3.3	Annual	Cyanobacteria Biomass	0.0000	0.0012	0.0014	0.0322	2371	Degrading	0.4913
TF3.3	Annual	Chlorophyte Biomass	0.0000	0.0031	0.0017	0.0843	4818	Improving	0.8586
TF3.3	Annual	Picoplankton Biomass	0.8746	-0.0001	0.0717	-0.0020	-2.75	No Trend	0.5846
TF3.3	Annual	Cryptophyte Biomass	0.0161	-0.0003	0.0124	-0.0081	-64.87	No Trend	0.0452
RET3.1	Annual	Phytoplankton IBI	0.3477	0.0000	2.25	0	0.00	No Trend	0.1216
RET3.1	Annual	Total Abundance	0.0004	294837	6640040	7960592	119	Increasing	0.8079
RET3.1	Annual	Total Biomass	0.0129	0.0067	0.2011	0.1821	90.57	No Trend	0.7850
RET3.1	Annual	Margalef Diversity Index	0.3802	0.00	1.76	-0.08	-4.70	No Trend	0.5914
RET3.1	Annual	Diatom Biomass	0.3882	0.0016	0.1176	0.0433	36.82	No Trend	0.8335
RET3.1	Annual	Dinoflagellate Biomass	0.3256	0.0000	0.0208	-0.0011	-5.52	No Trend	0.4083
RET3.1	Annual	Cyanobacteria Biomass	0.0000	0.0006	0.0019	0.0161	828	Degrading	0.5207
RET3.1	Annual	Chlorophyte Biomass	0.0000	0.0005	0.0015	0.0148	990	Improving	0.5829
LE3.6	Annual	Phytoplankton IBI	0.0127	0.0200	2.88	0.52	17.98	No Trend	0.786
LE3.6	Annual	Total Abundance	0.9545	-1797	5063581	-50312	-0.99	No Trend	0.6798
LE3.6	Annual	Total Biomass	0.0103	-0.0052	0.3775	-0.1463	-38.75	No Trend	0.5134
LE3.6	Annual	Margalef Diversity Index	0.0002	-0.01	2.23	-0.32	-14.51	Degrading	0.7877
LE3.6	Annual	Diatom Biomass	0.0317	-0.0027	0.2251	-0.0748	-33.23	No Trend	0.3042
LE3.6	Annual	Dinoflagellate Biomass	0.4584	0.0002	0.0232	0.0058	25.21	No Trend	0.0789
LE3.6	Annual	Cyanobacteria Biomass	0.0000	0.0001	0.0000	0.0017	265223	Degrading	0.6908
LE3.6	Annual	Chlorophyte Biomass	0.4058	0.0000	0.0002	0.0000	0.00	No Trend	0.7344
LE3.6	Annual	Picoplankton Biomass	0.0000	-0.0010	0.1065	-0.0228	-21.43	Improving	0.3953
LE3.6	Annual	Cryptophyte Biomass	0.0000	-0.0006	0.0272	-0.0157	-57.58	Decreasing	0.1510

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Virginia Chesapeake Bay Mainstem

Station	Season	Parameter	Trend Test		Baseline Median	Absolute Change	% Change	Trend Direction	Homogen. Test P value
			P Value	Slope					
CB6.1	Annual	Phytoplankton IBI	0.0420	0.0100	3.25	0.34	10.38	No Trend	0.9841
CB6.1	Annual	Total Abundance	0.5727	11190	5316407	313315	5.89	No Trend	0.8933
CB6.1	Annual	Total Biomass	0.0063	-0.0054	0.4221	-0.1510	-35.77	Decreasing	0.0848
CB6.1	Annual	Margalef Diversity Index	0.0006	-0.01	2.33	-0.35	-15.08	Degrading	0.4267
CB6.1	Annual	Diatom Biomass	0.0307	-0.0019	0.2288	-0.0545	-23.80	No Trend	0.2425
CB6.1	Annual	Dinoflagellate Biomass	0.9848	0.0000	0.0321	-0.0005	-1.58	No Trend	0.0599
CB6.1	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0014	210263	Degrading	0.7312
CB6.1	Annual	Chlorophyte Biomass	0.5388	0.0000	0.0001	0.0000	0.00	No Trend	0.3732
CB6.1	Annual	Picoplankton Biomass	0.0002	-0.0010	0.0820	-0.0244	-29.73	Improving	0.3083
CB6.1	Annual	Cryptophyte Biomass	0.0000	-0.0006	0.0257	-0.0172	-66.96	Decreasing	0.5410
CB6.4	Annual	Phytoplankton IBI	0.2289	0.0100	2.74	0.2	7.39	No Trend	0.8445
CB6.4	Annual	Total Abundance	0.0715	43935	3712028	1230172	33.14	No Trend	0.5035
CB6.4	Annual	Total Biomass	0.0735	-0.0031	0.2219	-0.0858	-38.67	No Trend	0.2126
CB6.4	Annual	Margalef Diversity Index	0.0000	-0.02	2.19	-0.58	-26.29	Degrading	0.0549
CB6.4	Annual	Diatom Biomass	0.0641	-0.0018	0.1616	-0.0502	-31.04	No Trend	0.3663
CB6.4	Annual	Dinoflagellate Biomass	0.5986	0.0001	0.0319	0.0035	11.01	No Trend	0.0717
CB6.4	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0007	N.E.	Degrading	0.9809
CB6.4	Annual	Chlorophyte Biomass	0.9538	0.0000	0.0001	0.0000	0.00	No Trend	0.1162
CB6.4	Annual	Picoplankton Biomass	0.0006	-0.0007	0.0925	-0.0160	-17.30	Improving	0.6489
CB6.4	Annual	Cryptophyte Biomass	0.0000	-0.0004	0.0168	-0.0122	-72.58	Decreasing	0.0611
CB7.3E	Annual	Phytoplankton IBI	0.3496	0.0100	2.67	0.16	6.07	No Trend	0.9741
CB7.3E	Annual	Total Abundance	0.8626	2495	3401397	69863	2.05	No Trend	0.6697
CB7.3E	Annual	Total Biomass	0.0073	-0.0040	0.2977	-0.1128	-37.91	Decreasing	0.5855
CB7.3E	Annual	Margalef Diversity Index	0.0000	-0.02	2.46	-0.58	-23.70	Degrading	0.8872
CB7.3E	Annual	Diatom Biomass	0.0084	-0.0023	0.1937	-0.0648	-33.44	Degrading	0.9198
CB7.3E	Annual	Dinoflagellate Biomass	0.6209	-0.0001	0.0314	-0.0032	-10.20	No Trend	0.0854
CB7.3E	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0005	5235	Degrading	0.9986
CB7.3E	Annual	Chlorophyte Biomass	0.7914	0.0000	0.0000	0.0000	0.00	No Trend	0.7420
CB7.3E	Annual	Picoplankton Biomass	0.2786	-0.0002	0.0831	-0.0053	-6.44	No Trend	0.6023
CB7.3E	Annual	Cryptophyte Biomass	0.0000	-0.0004	0.0180	-0.0113	-62.74	Decreasing	0.5938
CB7.4	Annual	Phytoplankton IBI	0.2962	0.0100	3.15	0.19	6.16	No Trend	0.6026
CB7.4	Annual	Total Abundance	0.0272	42685	2535640	1195186	47.14	No Trend	0.4620
CB7.4	Annual	Total Biomass	0.6096	-0.0007	0.1633	-0.0191	-11.72	No Trend	0.2642
CB7.4	Annual	Margalef Diversity Index	0.0000	-0.03	2.85	-0.94	-33.09	Degrading	0.8699
CB7.4	Annual	Diatom Biomass	0.7075	-0.0004	0.1351	-0.0100	-7.41	No Trend	0.1995
CB7.4	Annual	Dinoflagellate Biomass	0.8104	0.0000	0.0182	0.0010	5.53	No Trend	0.3991
CB7.4	Annual	Cyanobacteria Biomass	0.0000	0.0000	0.0000	0.0002	N.E.	Degrading	0.8351
CB7.4	Annual	Chlorophyte Biomass	0.6697	0.0000	0.0000	0.0000	0.00	No Trend	0.0837
CB7.4	Annual	Picoplankton Biomass	0.8250	0.0000	0.0978	-0.0009	-0.89	No Trend	0.7695
CB7.4	Annual	Cryptophyte Biomass	0.0041	-0.0002	0.0078	-0.0054	-68.89	Decreasing	0.1118