

Appendix E - Long-term Trends in Benthic Bioindicators

Appendix E - Long term trends in the B-IBI and associated bioindicators for the period of 1985 through 2015.

Section I. James River/Elizabeth River

Station	Parameter	Trend test		Baseline	Absolute		Direction
		P value	Slope		Change	% Change	
TF5.5	Benthic Index of Biotic Integrity	0.1896	0.02	2.16	0.57	26.63	No Trend
TF5.5	Total Abundance per square meter	0.2182	166.63	1335.60	5165.59	386.76	No Trend
TF5.5	Total Biomass per square meter	0.6354	0.02	0.34	0.53	155.00	No Trend
TF5.5	Shannon-Weiner Diversity Index	0.8746	0.00	1.18	-0.06	-5.39	No Trend
TF5.5	Pollution Sensitive Species Abundance	0.0057	0.66	0.00	20.50		Improving
TF5.5	Pollution Indicative Species Abundance	0.0719	-1.53	90.08	-47.33	-52.54	Improving
TF5.5	Pollution Sensitive Species Biomass	0.0038	2.40	0.00	74.50		Improving
TF5.5	Pollution Indicative Species Biomass	0.0294	-3.00	75.00	-93.08	-124.11	Improving
RET5.2	Benthic Index of Biotic Integrity	0.0267	0.04	2.09	1.25	59.62	Improving
RET5.2	Total Abundance per square meter	0.1645	27.56	610.56	854.36	139.93	No Trend
RET5.2	Total Biomass per square meter	0.6578	-0.01	7.34	-0.20	-2.69	No Trend
RET5.2	Shannon-Weiner Diversity Index	0.0541	0.03	1.66	1.08	64.78	Improving
RET5.2	Pollution Sensitive Species Abundance	0.0050	1.19	10.42	36.87	353.78	Improving
RET5.2	Pollution Indicative Species Abundance	0.6579	-0.23	17.50	-7.25	-41.44	No Trend
RET5.2	Pollution Sensitive Species Biomass	0.0344	1.85	28.04	57.24	204.11	Improving
RET5.2	Pollution Indicative Species Biomass	0.1840	-0.58	11.20	-17.92	-160.01	No Trend
LE5.1	Benthic Index of Biotic Integrity	0.3641	0.02	2.90	0.62	21.46	No Trend
LE5.1	Total Abundance per square meter	0.9685	-1.36	524.70	-38.16	-7.27	No Trend
LE5.1	Total Biomass per square meter	0.1239	-0.10	5.71	-2.67	-46.74	No Trend
LE5.1	Shannon-Weiner Diversity Index	0.9058	0.00	2.06	0.04	2.04	No Trend
LE5.1	Pollution Sensitive Species Abundance	0.2213	-0.56	32.16	-15.73	-48.92	No Trend
LE5.1	Pollution Indicative Species Abundance	0.1012	0.28	7.13	7.78	109.03	No Trend
LE5.1	Pollution Sensitive Species Biomass	0.4073	-0.88	74.24	-24.74	-33.32	No Trend
LE5.1	Pollution Indicative Species Biomass	0.0602	0.19	4.82	5.45	113.01	Degrading
LE5.2	Benthic Index of Biotic Integrity	0.6354	-0.02	3.33	-0.52	-15.50	No Trend
LE5.2	Total Abundance per square meter	0.0820	38.16	1221.12	1182.96	96.88	Improving
LE5.2	Total Biomass per square meter	0.2963	-0.10	4.58	-3.25	-71.04	No Trend
LE5.2	Shannon-Weiner Diversity Index	0.5073	-0.02	2.55	-0.55	-21.49	No Trend
LE5.2	Pollution Sensitive Species Abundance	0.1218	1.47	34.48	45.50	131.99	No Trend
LE5.2	Pollution Indicative Species Abundance	0.8746	0.03	17.25	0.91	5.25	No Trend
LE5.2	Pollution Sensitive Species Biomass	0.5914	-0.49	40.78	-15.04	-36.89	No Trend
LE5.2	Pollution Indicative Species Biomass	0.1745	0.35	8.76	10.75	122.75	No Trend
LE5.4	Benthic Index of Biotic Integrity	0.7244	0.00	3.72	0.00	0.00	No Trend
LE5.4	Total Abundance per square meter	0.4659	20.81	2528.10	645.25	25.52	No Trend
LE5.4	Total Biomass per square meter	0.0026	-0.90	22.86	-27.92	-122.14	Degrading
LE5.4	Shannon-Weiner Diversity Index	0.1203	-0.02	3.69	-0.66	-17.78	No Trend
LE5.4	Pollution Sensitive Species Abundance	0.1362	-0.72	48.80	-22.31	-45.72	No Trend
LE5.4	Pollution Indicative Species Abundance	0.1410	-0.07	2.24	-2.24	-100.17	No Trend
LE5.4	Pollution Sensitive Species Biomass	0.0393	-1.72	59.75	-53.32	-89.24	Degrading
LE5.4	Pollution Indicative Species Biomass	0.8982	0.00	0.94	0.00	0.00	No Trend
SBE2	Benthic Index of Biotic Integrity	0.1364	0.02	1.93	0.51	26.64	No Trend
SBE2	Total Abundance per square meter	0.0865	93.67	1659.96	2528.97	152.35	Improving
SBE2	Total Biomass per square meter	0.2192	0.03	0.92	0.77	84.38	No Trend
SBE2	Shannon-Weiner Diversity Index	0.5768	0.02	1.67	0.41	24.39	No Trend
SBE2	Pollution Sensitive Species Abundance	0.0014	3.47	4.62	93.67	2025.67	Improving
SBE2	Pollution Indicative Species Abundance	0.0941	-1.54	75.68	-41.50	-54.83	Improving
SBE2	Pollution Sensitive Species Biomass	0.0444	1.88	8.41	50.65	602.29	Improving
SBE2	Pollution Indicative Species Biomass	0.1928	-1.02	69.21	-27.66	-39.97	No Trend
SBE5	Benthic Index of Biotic Integrity	0.1271	0.03	1.25	0.77	61.16	No Trend
SBE5	Total Abundance per square meter	0.4346	76.32	3806.46	2060.64	54.14	No Trend
SBE5	Total Biomass per square meter	0.2044	0.03	0.58	0.82	141.64	No Trend
SBE5	Shannon-Weiner Diversity Index	0.1468	0.04	0.99	1.00	101.00	No Trend
SBE5	Pollution Sensitive Species Abundance	0.0004	1.92	0.31	51.76	16548.25	Improving
SBE5	Pollution Indicative Species Abundance	0.0066	-3.23	85.43	-87.30	-102.19	Improving
SBE5	Pollution Sensitive Species Biomass	0.0739	0.94	2.15	25.33	1176.77	Improving
SBE5	Pollution Indicative Species Biomass	0.4346	-0.97	77.83	-26.21	-33.68	No Trend

Appendix E - Long term trends in the B-IBI and associated bioindicators for the period of 1985 through 2015.

Section II. York River

Station	Parameter	Trend test		Baseline	Absolute		Direction
		P value	Slope		Change	% Change	
TF4.2	Benthic Index of Biotic Integrity	0.9681	0.00	2.62	0.00	0.00	No Trend
TF4.2	Total Abundance per square meter	0.1887	57.24	410.22	1774.44	432.56	No Trend
TF4.2	Total Biomass per square meter	0.8419	0.00	0.15	0.10	62.88	No Trend
TF4.2	Shannon-Weiner Diversity Index	0.0671	0.03	0.96	0.89	92.18	Improving
TF4.2	Pollution Sensitive Species Abundance	0.3194	0.38	12.50	11.77	94.12	No Trend
TF4.2	Pollution Indicative Species Abundance	0.3391	-1.44	65.97	-44.54	-67.52	No Trend
TF4.2	Pollution Sensitive Species Biomass	0.6902	-0.27	19.44	-8.47	-43.58	No Trend
TF4.2	Pollution Indicative Species Biomass	0.8110	-0.26	59.72	-7.92	-13.25	No Trend
RET4.3	Benthic Index of Biotic Integrity	0.8735	0.00	3.57	-0.10	-2.93	No Trend
RET4.3	Total Abundance per square meter	0.0258	250.03	1030.32	7750.85	752.28	Improving
RET4.3	Total Biomass per square meter	0.8111	0.01	4.43	0.21	4.73	No Trend
RET4.3	Shannon-Weiner Diversity Index	0.5243	-0.02	2.50	-0.48	-19.05	No Trend
RET4.3	Pollution Sensitive Species Abundance	0.8113	-0.32	40.89	-9.90	-24.22	No Trend
RET4.3	Pollution Indicative Species Abundance	0.9366	0.02	14.84	0.63	4.25	No Trend
RET4.3	Pollution Sensitive Species Biomass	0.2651	1.04	83.08	32.19	38.74	No Trend
RET4.3	Pollution Indicative Species Biomass	0.5243	-0.09	4.11	-2.70	-65.70	No Trend
LE4.1	Benthic Index of Biotic Integrity	0.4010	-0.02	2.98	-0.50	-16.80	No Trend
LE4.1	Total Abundance per square meter	0.7500	7.56	1535.94	234.29	15.25	No Trend
LE4.1	Total Biomass per square meter	0.2325	-0.50	27.51	-15.37	-55.86	No Trend
LE4.1	Shannon-Weiner Diversity Index	0.0799	-0.02	2.47	-0.65	-26.14	Degrading
LE4.1	Pollution Sensitive Species Abundance	0.9682	-0.11	37.56	-3.46	-9.22	No Trend
LE4.1	Pollution Indicative Species Abundance	0.2822	0.68	23.71	21.23	89.53	No Trend
LE4.1	Pollution Sensitive Species Biomass	0.0731	-2.43	82.49	-75.38	-91.38	Degrading
LE4.1	Pollution Indicative Species Biomass	0.1633	0.32	8.28	9.96	120.25	No Trend
LE4.3	Benthic Index of Biotic Integrity	0.0729	0.05	2.92	1.60	54.83	Improving
LE4.3	Total Abundance per square meter	0.7960	11.45	3138.66	354.89	11.31	No Trend
LE4.3	Total Biomass per square meter	0.7120	-0.08	6.32	-2.38	-37.66	No Trend
LE4.3	Shannon-Weiner Diversity Index	0.0895	0.04	2.47	1.13	45.69	Improving
LE4.3	Pollution Sensitive Species Abundance	0.5548	0.22	56.44	6.76	11.99	No Trend
LE4.3	Pollution Indicative Species Abundance	0.4168	-0.23	16.74	-7.14	-42.63	No Trend
LE4.3	Pollution Sensitive Species Biomass	0.7120	-0.23	72.97	-7.00	-9.60	No Trend
LE4.3	Pollution Indicative Species Biomass	0.9412	0.01	4.88	0.42	8.52	No Trend
LE4.3B	Benthic Index of Biotic Integrity	0.0518	0.07	2.63	2.01	76.54	Improving
LE4.3B	Total Abundance per square meter	0.3433	36.03	2766.60	1008.89	36.47	No Trend
LE4.3B	Total Biomass per square meter	0.8497	-0.02	3.28	-0.63	-19.22	No Trend
LE4.3B	Shannon-Weiner Diversity Index	0.1294	0.07	2.44	1.82	74.73	No Trend
LE4.3B	Pollution Sensitive Species Abundance	0.1294	1.24	18.36	34.67	188.82	No Trend
LE4.3B	Pollution Indicative Species Abundance	0.1294	-1.48	41.44	-41.55	-100.26	No Trend
LE4.3B	Pollution Sensitive Species Biomass	0.5696	0.37	54.16	10.44	19.28	No Trend
LE4.3B	Pollution Indicative Species Biomass	0.7762	-0.23	14.87	-6.57	-44.18	No Trend

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Section III. Rappahannock River

Station	Parameter	Trend test		Baseline	Absolute		Direction
		P value	Slope		Change	% Change	
TF3.3	Benthic Index of Biotic Integrity	0.9179	0.00	2.64	-0.03	-1.15	No Trend
TF3.3	Total Abundance per square meter	0.9453	5.30	1001.70	159.00	15.87	No Trend
TF3.3	Total Biomass per square meter	0.0395	-2.19	93.92	-65.81	-70.07	Degrading
TF3.3	Benthic Index of Biotic Integrity	0.8909	0.00	2.64	-0.06	-2.37	No Trend
TF3.3	Total Abundance per square meter	0.8641	9.54	1001.70	295.74	29.52	No Trend
TF3.3	Total Biomass per square meter	0.0511	-2.16	93.92	-66.90	-71.23	Degrading
TF3.3	Shannon-Weiner Diversity Index	0.2310	-0.02	1.95	-0.63	-32.48	No Trend
TF3.3	Pollution Sensitive Species Abundance	0.1236	-1.00	32.36	-31.02	-95.84	No Trend
TF3.3	Pollution Indicative Species Abundance	0.5377	0.68	11.14	21.18	190.15	No Trend
TF3.3	Pollution Sensitive Species Biomass	0.0056	-2.17	80.17	-67.26	-83.90	Degrading
TF3.3	Pollution Indicative Species Biomass	0.2444	0.50	6.59	15.42	233.97	No Trend
RET3.1	Benthic Index of Biotic Integrity	0.0136	-0.07	3.62	-2.14	-59.14	Degrading
RET3.1	Total Abundance per square meter	0.1232	85.86	1001.70	2661.66	265.71	No Trend
RET3.1	Total Biomass per square meter	0.0055	-0.40	9.02	-12.51	-138.57	Degrading
RET3.1	Shannon-Weiner Diversity Index	0.2888	-0.02	2.37	-0.65	-27.20	No Trend
RET3.1	Pollution Sensitive Species Abundance	0.0015	-1.10	33.99	-34.05	-100.18	Degrading
RET3.1	Pollution Indicative Species Abundance	0.1925	0.49	1.88	15.31	815.47	No Trend
RET3.1	Pollution Sensitive Species Biomass	0.0036	-3.54	71.23	-109.67	-153.98	Degrading
RET3.1	Pollution Indicative Species Biomass	0.0998	0.38	1.57	11.65	742.03	Degrading
LE3.2	Benthic Index of Biotic Integrity	0.5375	-0.01	1.94	-0.33	-16.72	No Trend
LE3.2	Total Abundance per square meter	0.3917	9.54	429.30	295.74	68.89	No Trend
LE3.2	Total Biomass per square meter	0.7063	0.00	0.27	0.11	40.26	No Trend
LE3.2	Shannon-Weiner Diversity Index	0.6555	-0.01	1.21	-0.42	-34.98	No Trend
LE3.2	Pollution Sensitive Species Abundance	0.6532	-0.10	41.28	-3.18	-7.71	No Trend
LE3.2	Pollution Indicative Species Abundance	0.7838	0.10	55.38	3.13	5.65	No Trend
LE3.2	Pollution Sensitive Species Biomass	0.7558	0.00	46.51	0.00	0.00	No Trend
LE3.2	Pollution Indicative Species Biomass	0.5832	0.84	47.94	26.08	54.41	No Trend
LE3.4	Benthic Index of Biotic Integrity	0.3760	0.02	2.06	0.70	34.12	No Trend
LE3.4	Total Abundance per square meter	0.8099	2.08	791.82	60.21	7.60	No Trend
LE3.4	Total Biomass per square meter	0.8729	0.00	1.17	0.08	6.40	No Trend
LE3.4	Shannon-Weiner Diversity Index	0.8415	0.00	1.56	0.03	1.91	No Trend
LE3.4	Pollution Sensitive Species Abundance	0.9038	0.00	16.74	0.00	0.00	No Trend
LE3.4	Pollution Indicative Species Abundance	0.7189	-0.44	68.60	-12.71	-18.53	No Trend
LE3.4	Pollution Sensitive Species Biomass	0.7170	-0.36	51.66	-10.57	-20.46	No Trend
LE3.4	Pollution Indicative Species Biomass	0.8730	-0.42	38.94	-12.26	-31.47	No Trend

Appendix E - Long term trends in the B-IBI and associated bioindicators for the period of 1985 through 2015.

Section IV. Virginia Chesapeake Bay Mainstem

Station	Parameter	Trend test		Baseline	Absolute		Direction
		P value	Slope		Change	% Change	
CB5.4	Benthic Index of Biotic Integrity	0.6559	0.01	1.81	0.32	17.96	No Trend
CB5.4	Total Abundance per square meter	0.4721	15.26	333.90	473.18	141.71	No Trend
CB5.4	Total Biomass per square meter	0.8369	0.00	0.44	-0.05	-12.25	No Trend
CB5.4	Shannon-Weiner Diversity Index	0.6564	0.01	1.71	0.28	16.04	No Trend
CB5.4	Pollution Sensitive Species Abundance	0.8641	0.21	29.84	6.46	21.64	No Trend
CB5.4	Pollution Indicative Species Abundance	0.6564	0.27	36.32	8.26	22.73	No Trend
CB5.4	Pollution Sensitive Species Biomass	0.9182	-0.01	29.89	-0.18	-0.59	No Trend
CB5.4	Pollution Indicative Species Biomass	0.7066	-0.23	33.95	-7.18	-21.14	No Trend
CB6.1	Benthic Index of Biotic Integrity	0.9454	0.00	3.42	0.11	3.15	No Trend
CB6.1	Total Abundance per square meter	0.0182	63.60	1488.24	1971.60	132.48	Improving
CB6.1	Total Biomass per square meter	0.1604	-0.11	10.82	-3.40	-31.44	No Trend
CB6.1	Shannon-Weiner Diversity Index	0.1820	0.02	2.64	0.49	18.63	No Trend
CB6.1	Pollution Sensitive Species Abundance	0.8107	-0.06	31.37	-1.88	-5.99	No Trend
CB6.1	Pollution Indicative Species Abundance	0.0261	0.88	16.08	27.13	168.70	Degrading
CB6.1	Pollution Sensitive Species Biomass	0.8641	0.11	27.34	3.30	12.06	No Trend
CB6.1	Pollution Indicative Species Biomass	0.1078	0.41	1.70	12.64	741.49	No Trend
CB6.4	Benthic Index of Biotic Integrity	0.8104	-0.01	4.47	-0.31	-7.03	No Trend
CB6.4	Total Abundance per square meter	0.0103	158.51	1640.88	4913.83	299.46	Improving
CB6.4	Total Biomass per square meter	0.1504	-0.14	5.35	-4.34	-81.05	No Trend
CB6.4	Shannon-Weiner Diversity Index	0.0261	0.03	2.94	0.80	27.25	Improving
CB6.4	Pollution Sensitive Species Abundance	0.8641	-0.03	49.63	-1.06	-2.14	No Trend
CB6.4	Pollution Indicative Species Abundance	0.6564	-0.17	16.91	-5.20	-30.75	No Trend
CB6.4	Pollution Sensitive Species Biomass	0.2310	-0.73	83.36	-22.59	-27.10	No Trend
CB6.4	Pollution Indicative Species Biomass	0.6077	0.08	1.39	2.41	173.37	No Trend
CB7.3E	Benthic Index of Biotic Integrity	0.9168	0.00	4.22	0.00	0.00	No Trend
CB7.3E	Total Abundance per square meter	0.8911	-9.54	5495.04	-295.74	-5.38	No Trend
CB7.3E	Total Biomass per square meter	0.3041	-0.20	12.91	-6.15	-47.66	No Trend
CB7.3E	Shannon-Weiner Diversity Index	0.9182	0.00	3.72	0.02	0.58	No Trend
CB7.3E	Pollution Sensitive Species Abundance	0.7066	-0.12	49.82	-3.76	-7.55	No Trend
CB7.3E	Pollution Indicative Species Abundance	0.1078	-0.38	13.76	-11.82	-85.88	No Trend
CB7.3E	Pollution Sensitive Species Biomass	0.4724	-0.35	63.30	-11.00	-17.38	No Trend
CB7.3E	Pollution Indicative Species Biomass	0.2055	-0.06	1.62	-1.77	-109.45	No Trend
CB8.1	Benthic Index of Biotic Integrity	0.5693	0.00	4.33	-0.15	-3.46	No Trend
CB8.1	Total Abundance per square meter	0.1155	89.04	3129.12	2760.24	88.21	No Trend
CB8.1	Total Biomass per square meter	0.9290	-0.01	12.22	-0.43	-3.55	No Trend
CB8.1	Shannon-Weiner Diversity Index	0.1456	0.02	3.79	0.50	13.27	No Trend
CB8.1	Pollution Sensitive Species Abundance	0.1814	-0.34	54.87	-10.68	-19.47	No Trend
CB8.1	Pollution Indicative Species Abundance	0.0259	-0.64	18.00	-19.82	-110.11	Improving
CB8.1	Pollution Sensitive Species Biomass	0.0404	-1.10	82.88	-34.10	-41.14	Degrading
CB8.1	Pollution Indicative Species Biomass	0.2016	-0.04	1.07	-1.33	-123.54	No Trend