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Side-by-Side Comparison of Young Grab and Composite Petite Ponar Grab Samples for the Calculation of the Benthic Index of Biological Integrity (B-IBI)

Prepared by

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Introduction

The Virginia Department of Environmental Quality (DEQ) intends to unite elements of its National Coastal Assessment Program (NCA) with its Chesapeake Bay Probabilistic Benthic Monitoring (CBP-PBM) Program beginning in the summer of 2005. The primary motivations for this decision were two-fold. First, the probable reduction of federal grant support for the NCA Program after the summer of 2004 would require considerable restructuring of the of DEQ's estuarine probabilistic monitoring to continue with a comprehensive program in the future. Second, the current CBP-PBM Program has not provided sufficient data for the assessment of minor tidal tributary segments using the recently approved Benthic Index of Biotic Integrity (B-IBI) assessment method. A formal assessment methodology, using the standardized Chesapeake Bay Benthic IBI, was approved by the States of Virginia and Maryland, the Interstate Chesapeake Bay Program, and EPA Region 3 for the 2004 305(b) assessment.

The sharing of objectives and resources among these two monitoring activities will provide a number of advantages to both monitoring programs and to the assessment process.

1. Chesapeake Bay Program
    a. Increase the number of B-IBI samples for the characterization of the minor tidal tributaries (at no extra resource expenditure).
    b. Associate the B-IBI data with other elements of the Sediment Quality Triad (SQT) - toxicity and chemical contaminants.
    c. Associate the B-IBI data with additional water column parameters – nutrients, chlorophyll, bacteria, clean metals, PAR and field parameter profiles – not collected during CBP probabilistic B-IBI sampling.

2. Estuarine ProbMon (NCA) Program (under reduced resources in 2005 and beyond)
    a. Provide a second screening element to the SQT (B-IBI + toxicity tests) prior to investing resources in the (relatively expensive) chemical analyses of sediment metals and organic contaminants, in the event that resources limit the number of chemical analyses that can be performed.
    b. Adding B-IBI data at these sites would relax the necessity of performing toxicity tests on two species to single species tests at each site, thus reducing per site resource requirements.
    c. Provide a possible increase in the annual number of probabilistic sites (current N = 35) in minor tidal tributaries within the CB drainage.

3. 305(b) Assessment (2006 and beyond)
    a. Association of the B-IBI evaluation with the toxicity test and chemical results, as well as the water column data, would provide the basis for a more robust "weight of evidence" assessment, even if a single probabilistic site were to be sampled within a minor tributary segment. (Most minor tributary sub-segments had insufficient numbers of observations for CBP B-IBI assessment in 2004.)

During its execution of the Coastal 2000 / National Coastal Assessment Program, from 2000 – 2004, the Virginia Department of Environmental Quality has utilized a composite of two samples with a Petite Ponar grab to collect sediment samples for benthic infauna, chemical and toxicity analyses. This method of sampling has served as a substitute for the single benthic sample collected with a standard Young (Young-modified Van Veen) grab described in the NCA Field Operations Manual and Quality Assurance Project Plan. The use of this substitute sampling methodology was evaluated and approved by the Director and QA Officer of the Southeast Regional Project of the National Coastal Assessment Program in the spring of 2001.

The two types of gear sample essentially the same surface area (±5%; composite 6" Petite Ponar = 0.046m^2; single 8" Young = 0.044 m^2), although the Petite Ponar generally takes a shallower bite, especially in the harder (sandy) substrates. For the NCA Program, the top 2-3 cm of sediment from at least three replicate grabs is homogenized to a composite sample for toxicity and chemical analyses, and the results would not be expected to differ between the two methods. In the case of benthic infauna, however, the slight difference in surface area and the difference in depth of penetration, as well as the fact that the two samples are not contiguous, may influence the species richness, taxonomic diversity and community structure of the samples and, consequently, the resultant B-IBI scores. The guidance documentation for Chesapeake Bay B-IBI specifies that, "Samples to which the B-IBI is to be applied should be collected from subtidal unvegetated soft substrates (sand or mud) using a Young grab with a sampling area of 0.0440 m^2 to a depth of 10 cm, and within the July 15 through September 30 time period."

Several questions have arisen because of the potential differences in B-IBI scores. The answers to these questions become even more critical considering the fact that DEQ now intends to integrate elements of its NCA Program and its CBP-PBM Program in the minor tidal tributaries within the Chesapeake Bay drainage.

1. Are previous benthic taxonomic data collected using the alternate (Petite Ponar) sampling method appropriate for formal assessments using the standardized Chesapeake Bay Benthic IBI, which has been approved by the States of Virginia and Maryland, the Interstate Chesapeake Bay Program, and EPA Region 3? The same question may be posed relative to the use of the EMAP discriminant index and the MAIA-IBI, which may be applied in other coastal mid-Atlantic waters.

2. If a two-grab composite Petite Ponar sample gives comparable B-IBI results, would a single Petite Ponar grab be sufficient for benthic characterization and B-IBI assessment? (*i.e.*, could the resource requirements for sample collection, processing and subsequent B-IBI calculation be reduced by utilizing a single Petite Ponar grab, without compromising the reliability of the assessments?)

3. Would it (consequently) be necessary for the Virginia DEQ to alter its sampling methodology in the future (2005 and beyond) for the purpose of B-IBI assessments and data comparability with other state and interstate benthic monitoring programs? For the agency to employ the larger Young grabs for benthic sampling, additional resources would be required for the purchase of equipment and for the modification of vessels to install lightweight pillars, booms and hand winches to manipulate the heavier grabs.

This study is designed to answer the questions above, as well as to provide data for additional purposes described in the following objectives.

Objectives

1. Determine whether Benthic IBI scores [CBP, EMAP & MAIA) calculated from single-grab samples collected with the standard 'Young' grab and two-grab composite samples collected with the 'Petite Ponar' grab differ significantly in their results.

2. Provide sufficient probabilistic benthic samples to complete the 'aquatic life use' assessment of three targeted estuarine segments which had insufficient data available for the 2004 305(b) assessment.

3. If no significant difference in B-IBI scores is detected in response to Objective 1, to determine whether a single Petite Ponar grab sample would be acceptable for calculating representative and reliable B-IBI scores.

Study Design and Site Selection

A side-by-side sampling with the two types of grabs targeted three tidal segments that represent three major salinity regimes: (1) tidal freshwater - Mattaponi River, (2) mesohaline – Nansemond River, and (3) polyhaline – Mobjack Bay. Ten random sites were chosen in each of the three tidal segments.

These specific segments were chosen for two primary reasons. First, although salinities and substrate types vary within each segment, the predominant habitats within each represent the extremes and midpoint of the salinity gradient and both mud and sand substrates. Secondly, none of these segments contained a sufficient number of probabilistic benthic IBI samples ($n \geq 10$ required) to perform a satisfactory 305(b) assessment in 2004. Benthic IBI scores calculated from the Young grab results of this study will complement those calculated previously and will guarantee sufficient data for formal B-IBI assessment of these segments to be performed in 2006.

The field sampling period corresponded to the specified sampling window required by the B-IBI methodology (Weisberg et al. 1997), specifically within the July 15 through September 30 time period. This sampling period also coincides with that defined in the National Coastal Assessment QAPP and Field Operations Manual.

Side-by-side benthic infauna samples were collected with each gear type at each site. Deployment and recovery of the grabs, sample evaluation for acceptability, sediment sieving and fixation of benthic invertebrates in the field, sample transportation, etc. used the appropriate CBP/ODU and NCA protocols and SOPs. The benthic infauna from each grab (one Young and two Petite Ponar) were fixed, stored, and identified separately. The taxonomic results from the two Petite Ponar replicates were combined, *a posteriori*, for the calculation of a single set of metrics and a resultant B-IBI score for that grab type at each site.

A single, homogenized sediment surface (upper 2 cm) sample was taken from a single additional grab at each site for particle size (% sand, clay, silt) and TOC (as total volatile solids) analyses. Ancillary data, consisting of near-bottom salinity, temperature and DO, were recorded from each site.

Sample Processing

Samples from each station (i.e. 1 young grab, 2 petite ponar grabs) were processed for the determination of benthic community composition according to procedures given in "Quality Assurance/Quality Control Plan, Benthic Biological Monitoring Program of the Lower Chesapeake Bay (July 1, 2003 to June 30, 2005)".

Data Analysis

Individual benthic metrics and the Chesapeake Bay B-IBI scores were calculated for all samples collected using the Young grab. B-IBI scores will be united with those previously calculated within the normal CBP-PBM Program and will be utilized for annual characterization of the target segments within the established CBP benthic characterization process. These data will also be utilized for the formal assessment of 'aquatic life use' attainment within the identified segments for DEQ's 2006 Integrated 305(b)/303(d) Report.

Individual benthic metrics were calculated and recorded separately for each of the two Petite Ponar grab samples from each site. The individual metrics were subsequently pooled to calculate a single CBP B-IBI for the site using composite Petite Ponar grabs.

Paired CPB B-IBI scores from the Young and the composite Petite Ponar samples at each site were compared using parametric and non-parametric statistical methods.

Statistical Analysis

For the B-IBI and its component metrics, significant differences in gear types were tested using (1) Wilcoxon's (matched pairs) signed rank test to determine if there were significant differences between median values, (2) t-test to determine if there were significant differences in mean values and (3) a Kolmogorov-Smirnoff test to determine if there were significant differences in distributions. The Wilcoxon signed rank test, t-tests and the Kolmogorov-Smirnoff test were conducted using SAS© software's UNIVARIATE and NPAR1WAY procedures, respectively (SAS Institute, 1990). Box and whisker plots of the B-IBI and its component metrics were made to compare their distributional properties between methods.

This study also presented the opportunity to determine if the use of the different gear types could result in different characterizations of stratum-specific benthic community composition and dominance. Three statistcal approaches were used to examine differences in species composition between gears within each stratum. For the first approach, K-dominance curves of abundance and biomass (ABC curves) were calculated. Secondly, a MANOVA was used to determine if there were significant differences in the top ten abundance density and biomass density dominants between gear types. The third approach combined two procedures: (1) 1-way ANOSIM analysis (Clarke and Green, 1988) to determine if there were significant differences in average rank dissimilarities between gear types, and (2) SIMPER analysis (Clarke and Gorley, 2001) to determine which species, if any, contributed the highest percentages of average between gear type dissimilarities i.e. those that best discriminated between gear types. SAS© software's CANDISC procedure (SAS Institute, 1990) was used to conduct the parametric multivariate statistical tests, while the ANOSIM and SIMPER analyses, as well as the K-dominance and ABC curves were conducted using the PRIMER v. 5 software package (Clarke and Gorley, 2001).

Plots of the difference between methods (the bias) against the mean of both methods for the B-IBI and its component metrics were examined to determine if the bias is consistent across the range of measurement. If the bias for a given metric is consistent, the limits of agreement for each method were determined as:

$$d \pm 2s$$

where d is the mean difference between methods and s is the standard deviation of d (Bland and Altman, 1986). If the limits of agreement are within a range that allows for consistent interpretation of the B-IBI between methods, mean differences between methods would serve as a correction factor for the B-IBI and/or the metrics calculated from the alternate technique, if significant differences were detected. All analyses were conducted within strata and any correction factors developed will be salinity regime specific

Results

Univariate tests

Comparing median values only five metric-gear type tests and comparing mean values only one metric-gear type test had a $P < 0.05$ (Table 1). When comparing the Young grab with the combined Ponar grabs only a single metric, Total Abundance in Mobjack Bay had a $P < 0.05$. However, there were 56 tests performed and the Bonferroni adjustment for multiple comparisons would require a $P < 0.0009$; therefore, none of the univariate median or mean tests were significant. In addition, there were no significant differences in the distributions of the B-IBI or its metrics (Table 2). Box and whisker plots of the B-IBI and its component metrics are presented in Figs.1-8.

Species composition tests

Comparing the Young grab and combined Ponar grabs using the ABC method indicated similar K-dominance curves for abundance and biomass at each of the three segments (Figs. 9-11). MANOVAs testing for differences between gears using the top ten density dominants (Table 3) and the top ten biomass dominants (Table 4) were not significant. Finally, ANOSIM and SIMPER analyses of density dominants and biomass dominants indicated no significant differences in the patterns of dominant species (Tables 5-12).

Method agreement tests

Plots of differences between Young grabs and combined Ponar grabs showed strong agreement between the two methods (Figs. 12-13).

Discussion

Comparisons between a single Young grab and two combined Petite Ponar grabs indicated that B-IBI and individual metric values were not significantly different. There were no differences in dominance patterns or in similarity of either density or biomass dominants.

Acknowledgments

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Tables

Table 1. **Wilcoxon signed rank test and the Student's *t* test of median and mean values of the benthic IBI and its component metrics comparing the Young grab and the alternative gears for each stratum. Comparisons are as follows: YG vs. CP=Young grab versus combined ponar; YG vs. PR-1=Young grab versus Ponar grab replicate 1; YG vs PR-2=Young grab versus Ponar grab replicate 2. Presented are the test statistics and *P* values for the Wilcoxon signed rank test and the Student's *t* test.**

Stratum	Comparison	Parameter	Wilcoxon Signed Rank |S|	P > |S|	Student's|t|	P > |t|
Mattaponi	YG vs. CP	Benthic IBI	-7.5	0.1563	-1.7928	0.1066
Mattaponi	YG vs. PR-1	Benthic IBI	-7.0	0.3828	-1.1623	0.2750
Mattaponi	YG vs. PR-2	Benthic IBI	-8.0	0.1250	-1.8773	0.0932
Nansemond	YG vs. CP	Benthic IBI	-2.0	0.6250	-0.6493	0.5323
Nansemond	YG vs. PR-1	Benthic IBI	0.5	0.9375	0.1765	0.8638
Nansemond	YG vs. PR-2	Benthic IBI	-2.5	0.7188	-0.8076	0.4402
Mobjack Bay	YG vs. CP	Benthic IBI	0.5	0.9922	0.1606	0.8760
Mobjack Bay	YG vs. PR-1	Benthic IBI	-1.0	0.7500	-0.6419	0.5369
Mobjack Bay	YG vs. PR-2	Benthic IBI	-2.5	0.8008	-0.3943	0.7025
Mattaponi	YG vs. CP	Total Abundance (#/m^2)	-18.5	0.0645	-1.8565	0.0963
Mattaponi	YG vs. PR-1	Total Abundance (#/m^2)*	-20.5	0.0371	-2.2090	0.0545
Mattaponi	YG vs. PR-2	Total Abundance (#/m^2)	-13.5	0.1934	-1.5140	0.1643
Nansemond	YG vs. CP	Total Abundance (#/m^2)	2.5	0.8457	-0.2056	0.8417
Nansemond	YG vs. PR-1	Total Abundance (#/m^2)	-6.5	0.5566	-0.8439	0.4206
Nansemond	YG vs. PR-2	Total Abundance (#/m^2)	7.5	0.4922	0.6976	0.5030
Mobjack Bay	YG vs. CP	Total Abundance (#/m^2)*	-19.5	0.0488	-2.0593	0.0696
Mobjack Bay	YG vs. PR-1	Total Abundance (#/m^2)*	-20.5	0.0371	-2.6739	0.0255
Mobjack Bay	YG vs. PR-2	Total Abundance (#/m^2)	-17.5	0.0840	-1.3440	0.2118
Mattaponi	YG vs. CP	Total Biomass (g. C/m^2)	0.5	1.0000	-0.5370	0.6043
Mattaponi	YG vs. PR-1	Total Biomass (g. C/m^2)	-9.5	0.3750	-0.5095	0.6227
Mattaponi	YG vs. PR-2	Total Biomass (g. C/m^2)	-3.5	0.7695	-0.5528	0.5938
Nansemond	YG vs. CP	Total Biomass (g. C/m^2)	2.5	0.8457	0.1431	0.8894
Nansemond	YG vs. PR-1	Total Biomass (g. C/m^2)	6.5	0.5566	0.6806	0.5133
Nansemond	YG vs. PR-2	Total Biomass (g. C/m^2)	0.5	1.0000	-0.6651	0.5227
Mobjack Bay	YG vs. CP	Total Biomass (g. C/m^2)	-11.5	0.2754	-1.3321	0.2156
Mobjack Bay	YG vs. PR-1	Total Biomass (g. C/m^2)	-17.5	0.0840	-2.0769	0.0676
Mobjack Bay	YG vs. PR-2	Total Biomass (g. C/m^2)	-5.5	0.6250	-0.7102	0.4956
Mattaponi	YG vs. CP	Shannon Weiner Index	-0.5	1.0000	-0.0233	0.9820
Mattaponi	YG vs. PR-1	Shannon Weiner Index	-17.5	0.0840	-1.5326	0.1597
Mattaponi	YG vs. PR-2	Shannon Weiner Index	-12.5	0.2324	-1.4218	0.1888
Nansemond	YG vs. CP	Shannon Weiner Index	-17.5	0.0840	-1.8047	0.1046
Nansemond	YG vs. PR-1	Shannon Weiner Index	-16.5	0.1055	-1.9183	0.0873
Nansemond	YG vs. PR-2	Shannon Weiner Index	-13.5	0.1934	-1.4306	0.1863
Mobjack Bay	YG vs. CP	Shannon Weiner Index	7.5	0.4922	1.2661	0.2373
Mobjack Bay	YG vs. PR-1	Shannon Weiner Index	-2.5	0.8457	-0.4440	0.6676
Mobjack Bay	YG vs. PR-2	Shannon Weiner Index	1.5	0.9219	0.0933	0.9277
Mattaponi	YG vs. CP	Pollution Sensitive Species	-0.5	1.0000	0.8649	0.4095
Mattaponi	YG vs. PR-1	Pollution Sensitive Species	3.5	0.7344	1.1737	0.2706
Mattaponi	YG vs. PR-2	Pollution Sensitive Species	-9.0	0.2500	-0.3435	0.7391
Nansemond	YG vs. CP	Pollution Sensitive Species	1.5	0.9219	0.2022	0.8443
Nansemond	YG vs. PR-1	Pollution Sensitive Species	9.5	0.3750	0.7381	0.4792
Nansemond	YG vs. PR-2	Pollution Sensitive Species	-1.5	0.9219	-0.2522	0.8065
Mobjack Bay	YG vs. CP	Pollution Sensitive Species	-5.5	0.6250	-0.1792	0.8618
Mobjack Bay	YG vs. PR-1	Pollution Sensitive Species	-5.5	0.6250	-0.4771	0.6447
Mobjack Bay	YG vs. PR-2	Pollution Sensitive Species	-6.5	0.5566	-0.1800	0.8612

Table 1. Continued.

Stratum	Comparison	Parameter	Wilcoxon Signed Rank |S|	P > |S|	Student's|t|	P > |t|
Mattaponi	YG vs. CP	Pollution Indicative Species	-1.5	0.9102	0.3384	0.7428
Mattaponi	YG vs. PR-1	Pollution Indicative Species	-3.5	0.7344	-0.5276	0.6106
Mattaponi	YG vs. PR-2	Pollution Indicative Species	4.5	0.6523	0.7857	0.4522
Nansemond	YG vs. CP	Pollution Indicative Species	-3.5	0.7695	-0.1349	0.8957
Nansemond	YG vs. PR-1	Pollution Indicative Species	-9.5	0.3750	-0.4604	0.6562
Nansemond	YG vs. PR-2	Pollution Indicative Species	2.5	0.8457	0.2698	0.7934
Mobjack Bay	YG vs. CP	Pollution Indicative Species	12.5	0.2324	1.3174	0.2203
Mobjack Bay	YG vs. PR-1	Pollution Indicative Species	12.5	0.2324	1.6768	0.1279
Mobjack Bay	YG vs. PR-2	Pollution Indicative Species	11.5	0.2754	1.0358	0.3273
Mattaponi	YG vs. CP	Pollution Sensitive Species Biomass	-0.5	1.0000	-0.2110	0.8376
Mattaponi	YG vs. PR-1	Pollution Sensitive Species Biomass	1.5	0.9102	0.0331	0.9743
Mattaponi	YG vs. PR-2	Pollution Sensitive Species Biomass	-4.0	0.6406	-0.5065	0.6247
Nansemond	YG vs. CP	Pollution Sensitive Species Biomass	9.5	0.3750	0.6295	0.5446
Nansemond	YG vs. PR-1	Pollution Sensitive Species Biomass	12.5	0.2324	1.3354	0.2145
Nansemond	YG vs. PR-2	Pollution Sensitive Species Biomass	-9.5	0.3750	-0.9158	0.3837
Mobjack Bay	YG vs. CP	Pollution Sensitive Species Biomass	-6.5	0.5566	-0.3114	0.7626
Mobjack Bay	YG vs. PR-1	Pollution Sensitive Species Biomass	7.5	0.4922	0.9802	0.3526
Mobjack Bay	YG vs. PR-2	Pollution Sensitive Species Biomass	-7.5	0.4922	-0.4801	0.6426
Mattaponi	YG vs. CP	Pollution Indicative Species Biomass	11.5	0.2031	1.5269	0.1611
Mattaponi	YG vs. PR-1	Pollution Indicative Species Biomass	2.5	0.8203	0.8953	0.3939
Mattaponi	YG vs. PR-2	Pollution Indicative Species Biomass*	18.5	0.0273	2.1759	0.0576
Nansemond	YG vs. CP	Pollution Indicative Species Biomass	-6.5	0.5566	-0.5064	0.6248
Nansemond	YG vs. PR-1	Pollution Indicative Species Biomass	-17.5	0.0840	-0.9356	0.3739
Nansemond	YG vs. PR-2	Pollution Indicative Species Biomass	-3.5	0.7695	-0.1792	0.8618
Mobjack Bay	YG vs. CP	Pollution Indicative Species Biomass	-17.5	0.0840	-1.8849	0.0921
Mobjack Bay	YG vs. PR-1	Pollution Indicative Species Biomass*	-22.5	0.0195	-2.6226	0.0277
Mobjack Bay	YG vs. PR-2	Pollution Indicative Species Biomass	-12.5	0.2324	-1.3042	0.2245

Table 2. Komolgorov-Smirnoff two-sample test comparing of sample distributions of the benthic IBI and its component metrics between the Young grab and the alternative gears for each stratum. Comparisons are as follows: Overall=between all gears; YG vs. CP=Young grab versus combined ponar; YG vs. PR-1=Young grab versus Ponar grab replicate 1; YG vs PR-2=Young grab versus Ponar grab replicate 2. Presented are the test statistic and *P* values for the Komolgorov-Smirnoff two-sample test.

Stratum	Comparison	Variable	Two Sample *D* Statistic	Prob. > D value
Mattaponi	YG vs CP	Benthic IBI	0.20	0.99
Mattaponi	YG vs PR-1	Benthic IBI	0.30	0.76
Mattaponi	YG vs PR-2	Benthic IBI	0.20	0.99
Nansemond	YG vs CP	Benthic IBI	0.20	0.99
Nansemond	YG vs PR-1	Benthic IBI	0.20	0.99
Nansemond	YG vs PR-2	Benthic IBI	0.30	0.76
Mobjack Bay	YG vs CP	Benthic IBI	0.10	1.00
Mobjack Bay	YG vs PR-1	Benthic IBI	0.20	0.99
Mobjack Bay	YG vs PR-2	Benthic IBI	0.20	0.99
Mattaponi	YG vs CP	Total Abundance (#/m^2)	0.20	0.99
Mattaponi	YG vs PR-1	Total Abundance (#/m^2)	0.30	0.76
Mattaponi	YG vs PR-2	Total Abundance (#/m^2)	0.20	0.99
Nansemond	YG vs CP	Total Abundance (#/m^2)	0.20	0.99
Nansemond	YG vs PR-1	Total Abundance (#/m^2)	0.20	0.99
Nansemond	YG vs PR-2	Total Abundance (#/m^2)	0.20	0.99
Mobjack Bay	YG vs CP	Total Abundance (#/m^2)	0.40	0.40
Mobjack Bay	YG vs PR-1	Total Abundance (#/m^2)	0.40	0.40
Mobjack Bay	YG vs PR-2	Total Abundance (#/m^2)	0.40	0.40
Mattaponi	YG vs CP	Total Biomass (g C/m^2)	0.10	1.00
Mattaponi	YG vs PR-1	Total Biomass (g C/m^2)	0.40	0.40
Mattaponi	YG vs PR-2	Total Biomass (g C/m^2)	0.20	0.99
Nansemond	YG vs CP	Total Biomass (g C/m^2)	0.30	0.76
Nansemond	YG vs PR-1	Total Biomass (g C/m^2)	0.40	0.40
Nansemond	YG vs PR-2	Total Biomass (g C/m^2)	0.30	0.76
Mobjack Bay	YG vs CP	Total Biomass (g C/m^2)	0.50	0.16
Mobjack Bay	YG vs PR-1	Total Biomass (g C/m^2)	0.60	0.05
Mobjack Bay	YG vs PR-2	Total Biomass (g C/m^2)	0.30	0.76
Mattaponi	YG vs CP	Shannon Weiner Index	0.40	0.40
Mattaponi	YG vs PR-1	Shannon Weiner Index	0.50	0.16
Mattaponi	YG vs PR-2	Shannon Weiner Index	0.30	0.76
Nansemond	YG vs CP	Shannon Weiner Index	0.30	0.76
Nansemond	YG vs PR-1	Shannon Weiner Index	0.50	0.16
Nansemond	YG vs PR-2	Shannon Weiner Index	0.30	0.76
Mobjack Bay	YG vs CP	Shannon Weiner Index	0.30	0.76
Mobjack Bay	YG vs PR-1	Shannon Weiner Index	0.20	0.99
Mobjack Bay	YG vs PR-2	Shannon Weiner Index	0.30	0.76
Mattaponi	YG vs CP	Pollution Sensitive Species Abundance	0.30	0.76
Mattaponi	YG vs PR-1	Pollution Sensitive Species Abundance	0.30	0.76
Mattaponi	YG vs PR-2	Pollution Sensitive Species Abundance	0.40	0.40
Nansemond	YG vs CP	Pollution Sensitive Species Abundance	0.30	0.76
Nansemond	YG vs PR-1	Pollution Sensitive Species Abundance	0.30	0.76
Nansemond	YG vs PR-2	Pollution Sensitive Species Abundance	0.40	0.40
Mobjack Bay	YG vs CP	Pollution Sensitive Species Abundance	0.20	0.99
Mobjack Bay	YG vs PR-1	Pollution Sensitive Species Abundance	0.20	0.99
Mobjack Bay	YG vs PR-2	Pollution Sensitive Species Abundance	0.20	0.99

Table 2. Continued.

Stratum	Comparison	Variable	Two Sample *D* Statistic	Prob. > D value
Mattaponi	YG vs CP	Pollution Indicative Species Abundance	0.20	0.99
Mattaponi	YG vs PR-1	Pollution Indicative Species Abundance	0.30	0.76
Mattaponi	YG vs PR-2	Pollution Indicative Species Abundance	0.20	0.99
Nansemond	YG vs CP	Pollution Indicative Species Abundance	0.30	0.76
Nansemond	YG vs PR-1	Pollution Indicative Species Abundance	0.40	0.40
Nansemond	YG vs PR-2	Pollution Indicative Species Abundance	0.40	0.40
Mobjack Bay	YG vs CP	Pollution Indicative Species Abundance	0.30	0.76
Mobjack Bay	YG vs PR-1	Pollution Indicative Species Abundance	0.30	0.76
Mobjack Bay	YG vs PR-2	Pollution Indicative Species Abundance	0.30	0.76
Mattaponi	YG vs CP	Pollution Sensitive Species Biomass	0.20	0.99
Mattaponi	YG vs PR-1	Pollution Sensitive Species Biomass	0.30	0.76
Mattaponi	YG vs PR-2	Pollution Sensitive Species Biomass	0.40	0.40
Nansemond	YG vs CP	Pollution Sensitive Species Biomass	0.20	0.99
Nansemond	YG vs PR-1	Pollution Sensitive Species Biomass	0.30	0.76
Nansemond	YG vs PR-2	Pollution Sensitive Species Biomass	0.30	0.76
Mobjack Bay	YG vs CP	Pollution Sensitive Species Biomass	0.20	0.99
Mobjack Bay	YG vs PR-1	Pollution Sensitive Species Biomass	0.20	0.99
Mobjack Bay	YG vs PR-2	Pollution Sensitive Species Biomass	0.20	0.99
Mattaponi	YG vs CP	Pollution Indicative Species Biomass	0.40	0.40
Mattaponi	YG vs PR-1	Pollution Indicative Species Biomass	0.30	0.76
Mattaponi	YG vs PR-2	Pollution Indicative Species Biomass	0.40	0.40
Nansemond	YG vs CP	Pollution Indicative Species Biomass	0.30	0.76
Nansemond	YG vs PR-1	Pollution Indicative Species Biomass	0.50	0.16
Nansemond	YG vs PR-2	Pollution Indicative Species Biomass	0.30	0.76
Mobjack Bay	YG vs CP	Pollution Indicative Species Biomass	0.50	0.16
Mobjack Bay	YG vs PR-1	Pollution Indicative Species Biomass	0.50	0.16
Mobjack Bay	YG vs PR-2	Pollution Indicative Species Biomass	0.30	0.76

Table 3. Multivariate comparisons (MANOVAs) of the top ten species density dominants between the Young grab and alternative gears for each stratum. Comparisons are as follows: YG vs. CP=Young grab versus combined ponar; YG vs. PR-1=Young grab versus Ponar grab replicate 1; YG vs PR-2=Young grab versus Ponar grab replicate 2. DF = degrees of freedom. Numerator degrees of freedom may exceed 10 when there were rank ties for the 10th species.

Mattaponi River					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.7191	0.2841	11	8	0.9714
YG vs PR-1	0.5368	0.6276	11	8	0.7675
YG vs PR-2	0.3657	1.2614	11	8	0.3796
Nansemond River					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.8483	0.1610	10	9	0.9957
YG vs PR-1	0.5998	0.6005	10	9	0.7810
YG vs PR-2	0.6664	0.4506	10	9	0.8849
Mobjack Bay					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.6092	0.3743	12	7	0.9353
YG vs PR-1	0.4253	0.7881	12	7	0.6582
YG vs PR-2	0.6043	0.3820	12	7	0.9313

Table 4. Multivariate comparisons (MANOVAs) of the top ten species biomass dominants between the Young grab and alternative gears for each stratum. Comparisons are as follows: YG vs. CP=Young grab versus combined ponar; YG vs. PR-1=Young grab versus Ponar grab replicate 1; YG vs PR-2=Young grab versus Ponar grab replicate 2. DF = degrees of freedom. Numerator degrees of freedom may exceed 10 when there were rank ties for the 10th species.

Mattaponi River					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.1088	0.9638	17	2	0.6243
YG vs PR-1	0.1392	0.7277	17	2	0.7202
YG vs PR-2	0.0791	1.3696	17	2	0.5036
Nansemond River					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.3839	0.9360	12	7	0.5619
YG vs PR-1	0.4184	0.8108	12	7	0.6428
YG vs PR-2	0.3950	0.8933	12	7	0.5886
Mobjack Bay					
Comparison	Wilk's Λ	F Value	Numerator DF	Denominator DF	Prob. of > F value
YG vs CP	0.3108	1.6130	11	8	0.2541
YG vs PR-1	0.2114	2.7137	11	8	0.0835
YG vs PR-2	0.4018	1.0829	11	8	0.4670

Table 5. **Summary of ANOSIM and SIMPER analysis results on log-transformed species densities for comparisons between the Young grab and alternate gears for each stratum. Provided are the Global R values and its associated probabilities along with within-group average similarities (Avg. *S*) for the Young grab and alternate gears and the between-group dissimilarities (Avg. δ) for each comparison (SIMPER Results).**

Mattaponi River	ANOSIM Results		SIMPER Results		
Comparison	Global R	Prob > R	Young Grab Avg. *S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	-0.111	0.978	47.53	42.15	51.8
YG vs PR-1	-0.068	0.902		32.23	57.02
YG vs PR-2	0.001	0.429		37.83	56.65
Nansemond River	**ANOSIM Results**		**SIMPER Results**		
Comparison	Global R	Prob > R	Young Grab Avg. *S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	-0.088	0.979	55.31	52.41	43.79
YG vs PR-1	-0.066	0.916		50.3	45.49
YG vs PR-2	-0.069	0.929		50.28	45.11
Mobjack Bay	**ANOSIM Results**		**SIMPER Results**		
Comparison	Global R	Prob > R	Young Grab Avg.*S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	-0.062	0.794	40.52	39.61	57.87
YG vs PR-1	-0.031	0.631		34.02	61.28
YG vs PR-2	-0.028	0.600		37.17	59.85

Table 6. **Summary of ANOSIM and SIMPER analysis results on log-transformed species biomass for comparisons between the Young grab and alternate gears for each stratum. Provided are the Global R values and its associated probabilities along with within-group average similarities (Avg. *S*) for the Young grab and alternate gears and the between-group dissimilarities (Avg. δ) for each comparison (SIMPER Results).**

Mattaponi River	ANOSIM results		SIMPER Results		
Comparison	Global R	Prob > R	Young Grab Avg. *S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	-0.078	0.885	19.86	20.08	76.87
YG vs PR-1	-0.106	0.97		17.97	79.08
YG vs PR-2	-0.106	0.978		19.55	80.21
Nansemond River	**ANOSIM results**		**SIMPER Results**		
Comparison	Global R	Prob > R	Young Grab Avg. *S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	-0.086	0.933	31.83	33.96	64.83
YG vs PR-1	-0.068	0.857		31.17	67.45
YG vs PR-2	-0.04	0.683		33.54	66.48
Mobjack Bay	**ANOSIM results**		**SIMPER Results**		
Comparison	Global R	Prob > R	Young Grab Avg. *S*	Alternate Avg. *S*	Between Group Avg. δ
YG vs CP	0.064	0.187	26.56	29.68	72.79
YG vs PR-1	0.124	0.055		28.49	75.18
YG vs PR-2	0.082	0.109		25.83	75.3

Table 7. **Contributions of individual species to the average dissimilarity in abundance for the Mattaponi River. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.**

Young Grab vs Combined Ponar

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Cyathura polita	79.38	74.74	4.86	1.14	9.37	9.37
Hexagenia spp.	95.26	96.96	4.75	1.08	9.17	18.55
Gammarus daiberi	63.50	34.34	4.31	1.28	8.33	26.88
Stictochironomus spp.	179.17	38.38	3.84	0.96	7.41	34.28
Limnodrilus spp.	526.18	438.34	3.67	0.84	7.09	41.37
Marenzelleria viridis	38.56	10.10	3.48	0.94	6.72	48.09
Corbicula fluminea	523.91	248.46	3.40	1.21	6.57	54.66
Xenochironomus spp.	18.14	16.16	2.53	0.64	4.88	59.55
Pristinella osborni	15.88	8.08	2.14	0.57	4.13	63.68
Rangia cuneata	6.80	6.06	2.13	0.76	4.12	67.80
Dero spp.	18.14	16.16	2.12	0.65	4.10	71.89
Chiridotea almyra	4.54	6.06	1.82	0.57	3.52	75.41
Ablabesmyia parajanta	9.07	4.04	1.73	0.68	3.35	78.76
Chaoborus punctipennis	6.80	4.04	1.60	0.57	3.09	81.86
Cryptochironomus fulvus	13.61	4.04	1.56	0.59	3.02	84.87
Gomphidae spp.	2.27	4.04	1.54	0.57	2.98	87.85
Clinotanypus pinguis	2.27	4.04	1.49	0.57	2.88	90.73

Young Grab vs Ponar Replicate 1

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Limnodrilus spp.	526.18	391.88	6.16	0.93	10.81	10.81
Corbicula fluminea	523.91	218.16	5.81	1.12	10.19	21.00
Cyathura polita	79.38	92.92	5.79	1.03	10.16	31.15
Hexagenia spp.	95.26	105.04	5.48	1.08	9.61	40.77
Gammarus daiberi	63.50	28.28	5.10	1.28	8.94	49.71
Stictochironomus spp.	179.17	48.48	4.58	0.94	8.04	57.74
Marenzelleria viridis	38.56	16.16	4.13	0.91	7.25	65.00
Dero spp.	18.14	20.20	2.29	0.53	4.01	69.01
Xenochironomus spp.	18.14	4.04	2.15	0.53	3.77	72.78
Cryptochironomus fulvus	13.61	8.08	1.93	0.59	3.38	76.16
Chiridotea almyra	4.54	4.04	1.90	0.58	3.32	79.49
Rangia cuneata	6.80	4.04	1.67	0.57	2.93	82.41
Ablabesmyia parajanta	9.07	4.04	1.65	0.57	2.89	85.31
Chaoborus punctipennis	6.80	0.00	1.26	0.48	2.21	87.52
Pristinella osborni	15.88	0.00	1.26	0.32	2.21	89.73
Rhithropanopeus harrisii	2.27	4.04	1.09	0.46	1.92	91.65

Table 7. Continued.

Young Grab vs Ponar Replicate 2						
Species	**Young Grab Avg. Abund**	**Combined Ponar Avg. Abund**	**Avg. δ_i**	**Avg. δ_i / SD(δ_i)**	**% Contribution**	**Cumulative % Contribution**
Gammarus daiberi	**63.50**	**40.40**	**5.68**	**1.67**	**10.03**	**10.03**
Cyathura polita	**79.38**	**56.56**	**5.05**	**1.06**	**8.91**	**18.94**
***Hexagenia* spp.**	**95.26**	**88.88**	**5.03**	**1.07**	**8.88**	**27.82**
Corbicula fluminea	**523.91**	**278.76**	**4.68**	**1.06**	**8.27**	**36.09**
***Limnodrilus* spp.**	**526.18**	**484.80**	**3.86**	**0.86**	**6.82**	**42.91**
***Stictochironomus* spp.**	**179.17**	**28.28**	**3.86**	**0.90**	**6.81**	**49.72**
Marenzelleria viridis	**38.56**	**4.04**	**3.33**	**0.82**	**5.89**	**55.61**
***Xenochironomus* spp.**	**18.14**	**28.28**	**2.88**	**0.63**	**5.08**	**60.68**
Pristinella osborni	**15.88**	**16.16**	**2.52**	**0.57**	**4.45**	**65.13**
***Dero* spp.**	**18.14**	**12.12**	**2.20**	**0.68**	**3.88**	**69.02**
Chiridotea almyra	**4.54**	**8.08**	**2.18**	**0.54**	**3.84**	**72.85**
Rangia cuneata	**6.80**	**8.08**	**2.07**	**0.66**	**3.66**	**76.51**
***Gomphidae* spp.**	**2.27**	**8.08**	**1.94**	**0.58**	**3.43**	**79.94**
Chaoborus punctipennis	**6.80**	**8.08**	**1.81**	**0.57**	**3.20**	**83.15**
Clinotanypus pinguis	**2.27**	**8.08**	**1.80**	**0.57**	**3.18**	**86.33**
Ablabesmyia parajanta	**9.07**	**4.04**	**1.54**	**0.57**	**2.73**	**89.06**
Ilyodrilus templetoni	**2.27**	**12.12**	**1.35**	**0.44**	**2.38**	**91.44**

Table 8. **Contributions of individual species to the average dissimilarity in abundance for the Nansemond River. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.**

Young Grab vs Combined Ponar						
Species	**Young Grab Avg. Abund**	**Combined Ponar Avg. Abund**	**Avg. δ_i**	**Avg. δ_i / SD(δ_i)**	**% Contribution**	**Cumulative % Contribution**
Tubificoides heterochaetus	**4034.77**	**3718.82**	**3.83**	**1.25**	**8.75**	**8.75**
Glycinde solitaria	**133.81**	**137.36**	**2.94**	**1.08**	**6.72**	**15.47**
***Tubificoides* spp. Group I**	**455.87**	**567.62**	**2.68**	**1.28**	**6.12**	**21.58**
Cyathura polita	**40.82**	**56.56**	**2.41**	**1.19**	**5.50**	**27.08**
Leptocheirus plumulosus	**86.18**	**38.38**	**2.30**	**1.04**	**5.26**	**32.34**
Leucon americanus	**40.82**	**38.38**	**2.28**	**1.07**	**5.21**	**37.55**
Neanthes succinea	**22.68**	**40.40**	**2.20**	**1.10**	**5.03**	**42.57**
Macoma balthica	**31.75**	**32.32**	**2.19**	**1.23**	**4.99**	**47.57**
Macoma mitchelli	**24.95**	**40.40**	**2.18**	**1.18**	**4.97**	**52.54**
***Nemertea* spp.**	**24.95**	**42.42**	**2.06**	**1.16**	**4.70**	**57.24**
Streblospio benedicti	**1188.43**	**1119.08**	**1.98**	**1.15**	**4.52**	**61.75**
Acteocina canaliculata	**18.14**	**12.12**	**1.49**	**0.81**	**3.40**	**65.15**
Paraprionospio pinnata	**27.22**	**10.10**	**1.48**	**0.69**	**3.38**	**68.54**
Mulinia lateralis	**20.41**	**16.16**	**1.46**	**0.67**	**3.32**	**71.86**
Rictaxis punctostriatus	**9.07**	**6.06**	**1.18**	**0.68**	**2.69**	**74.55**
Parahesione luteola	**4.54**	**8.08**	**1.17**	**0.69**	**2.67**	**77.22**
Mysidopsis bigelowi	**0.00**	**12.12**	**1.07**	**0.63**	**2.44**	**79.67**
***Leitoscoloplos* spp.**	**15.88**	**4.04**	**1.04**	**0.58**	**2.38**	**82.05**
Mediomastus ambiseta	**2599.13**	**2527.02**	**0.95**	**0.94**	**2.17**	**84.22**
Marenzelleria viridis	**4.54**	**4.04**	**0.91**	**0.59**	**2.09**	**86.31**
Heteromastus filiformis	**9.07**	**2.02**	**0.86**	**0.59**	**1.96**	**88.27**
Callinectes sapidus	**6.80**	**0.00**	**0.64**	**0.50**	**1.47**	**89.75**
Melita nitida	**6.80**	**4.04**	**0.64**	**0.47**	**1.46**	**91.20**

Table 8. Continued.

Young Grab vs Ponar Replicate 1						
Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Tubificoides heterochaetus	4034.77	2896.68	4.11	1.24	9.04	9.04
Tubificoides spp. Group I	455.87	270.68	3.23	1.32	7.10	16.14
Glycinde solitaria	133.81	84.84	3.13	1.15	6.88	23.01
Cyathura polita	40.82	56.56	2.67	1.10	5.87	28.89
Neanthes succinea	22.68	48.48	2.48	1.07	5.44	34.33
Streblospio benedicti	1188.43	929.20	2.45	1.05	5.39	39.72
Leucon americanus	40.82	28.28	2.45	1.04	5.38	45.10
Macoma balthica	31.75	36.36	2.40	1.25	5.28	50.38
Leptocheirus plumulosus	86.18	40.40	2.37	0.92	5.20	55.58
Nemertea spp.	24.95	32.32	2.31	1.11	5.08	60.67
Macoma mitchelli	24.95	12.12	2.20	1.01	4.84	65.51
Acteocina canaliculata	18.14	8.08	1.40	0.69	3.07	68.58
Paraprionospio pinnata	27.22	0.00	1.40	0.61	3.07	71.65
Rictaxis punctostriatus	9.07	12.12	1.37	0.67	3.01	74.66
Mulinia lateralis	20.41	16.16	1.31	0.58	2.89	77.55
Parahesione luteola	4.54	8.08	1.13	0.59	2.49	80.04
Marenzelleria viridis	4.54	8.08	1.07	0.59	2.35	82.39
Mediomastus ambiseta	2599.13	2440.16	0.98	1.10	2.16	84.55
Heteromastus filiformis	9.07	4.04	0.95	0.59	2.10	86.65
Leitoscoloplos spp.	15.88	0.00	0.91	0.48	2.00	88.64
Melita nitida	6.80	8.08	0.72	0.47	1.59	90.23

Young Grab vs Ponar Replicate 2						
Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Tubificoides heterochaetus	4034.77	4540.96	4.47	1.19	9.92	9.92
Tubificoides spp. Group I	455.87	864.56	3.27	1.28	7.25	17.17
Glycinde solitaria	133.81	189.88	3.26	1.05	7.22	24.38
Cyathura polita	40.82	56.56	2.59	1.13	5.75	30.14
Macoma mitchelli	24.95	68.68	2.52	1.11	5.58	35.72
Streblospio benedicti	1188.43	1308.96	2.47	1.11	5.47	41.19
Leucon americanus	40.82	48.48	2.47	1.03	5.47	46.66
Leptocheirus plumulosus	86.18	36.36	2.44	0.96	5.41	52.07
Neanthes succinea	22.68	32.32	2.32	1.08	5.14	57.20
Macoma balthica	31.75	28.28	2.30	1.21	5.10	62.31
Nemertea	24.95	52.52	2.29	1.09	5.07	67.38
Paraprionospio pinnata	27.22	20.20	1.64	0.69	3.64	71.02
Mulinia lateralis	20.41	16.16	1.64	0.66	3.63	74.65
Mediomastus ambiseta	2599.13	2613.88	1.27	0.79	2.83	77.48
Acteocina canaliculata	18.14	16.16	1.18	0.59	2.61	80.08
Leitoscoloplos spp.	15.88	8.08	1.17	0.58	2.59	82.67
Parahesione luteola	4.54	8.08	1.04	0.60	2.30	84.98
Mysidopsis bigelowi	0.00	8.08	0.78	0.49	1.73	86.71
Heteromastus filiformis	9.07	0.00	0.73	0.49	1.62	88.33
Rictaxis punctostriatus	9.07	0.00	0.71	0.48	1.58	89.91
Marenzelleria viridis	4.54	0.00	0.71	0.49	1.57	91.48

Table 9. **Contributions of individual species to the average dissimilarity in abundance for Mobjack Bay. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.**

Young Grab vs Combined Ponar

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Phoronis spp.	535.25	123.22	2.66	1.31	4.60	4.60
Paraprionospio pinnata	283.50	244.42	2.45	1.24	4.23	8.83
Acteocina canaliculata	290.30	197.96	2.30	1.14	3.97	12.80
Ampelisca spp.	195.05	129.28	2.17	1.15	3.76	16.55
Streblospio benedicti	68.04	54.54	2.17	1.33	3.75	20.30
Neanthes succinea	40.82	28.28	1.82	1.14	3.15	23.46
Haminoea solitaria	52.16	36.36	1.78	0.93	3.08	26.54
Loimia medusa	45.36	34.34	1.77	1.14	3.07	29.60
Mediomastus ambiseta	827.82	700.94	1.68	1.01	2.91	32.51
Spiophanes bombyx	52.16	8.08	1.68	1.07	2.91	35.42
Mulinia lateralis	24.95	6.06	1.68	1.25	2.90	38.32
Leucon americanus	108.86	50.50	1.67	0.78	2.88	41.20
Rictaxis punctostriatus	31.75	34.34	1.58	0.96	2.73	43.93
Glycinde solitaria	283.50	214.12	1.48	0.85	2.56	46.49
Leitoscoloplos spp.	20.41	30.30	1.47	1.07	2.53	49.03
Spiochaetopterus costarum	36.29	28.28	1.41	0.91	2.43	51.46
Nemertea spp.	18.14	12.12	1.40	1.08	2.42	53.88
Heteromastus filiformis	36.29	4.04	1.32	0.88	2.28	56.16
Sigambra tentaculata	11.34	28.28	1.32	0.77	2.28	58.44
Scolelepis texana	20.41	10.10	1.32	0.90	2.28	60.72
Brania welfleetensis	15.88	12.12	1.32	0.86	2.27	62.99
Leptosynapta tenuis	27.22	8.08	1.23	0.78	2.13	65.12
Edwardsia elegans	79.38	22.22	1.17	0.70	2.03	67.15
Ampelisca verrilli	18.14	4.04	1.12	0.85	1.93	69.09
Eteone heteropoda	6.80	6.06	1.12	0.83	1.93	71.02
Tellina agilis	6.80	8.08	1.06	0.85	1.84	72.86
Ameroculodes species complex	9.07	10.10	1.03	0.79	1.77	74.63
Turbellaria spp.	2.27	10.10	1.02	0.84	1.76	76.38
Pectinaria gouldii	18.14	10.10	0.95	0.69	1.64	78.03
Podarkeopsis levifuscina	2.27	12.12	0.93	0.70	1.60	79.63
Acanthohaustorius millsi	38.56	26.26	0.92	0.46	1.59	81.22
Parahesione luteola	4.54	4.04	0.74	0.58	1.28	82.50
Rhepoxynius epistomus	4.54	6.06	0.73	0.59	1.27	83.77
Glycera dibranchiata	9.07	0.00	0.73	0.65	1.25	85.02
Pseudeurythoe paucibranchiata	2.27	6.06	0.70	0.58	1.20	86.23
Listriella barnardi	6.80	4.04	0.65	0.59	1.12	87.34
Asabellides oculata	4.54	2.02	0.64	0.58	1.10	88.44
Caulleriella killariensis	2.27	4.04	0.63	0.58	1.09	89.53
Oxyurostylis smithi	2.27	4.04	0.63	0.58	1.09	90.62

Table 9. Continued.

Young Grab vs Ponar Replicate 1						
Species	**Young Grab Avg. Abund**	**Combined Ponar Avg. Abund**	**Avg. δ_i**	**Avg. δ_i / SD(δ_i)**	**% Contribution**	**Cumulative % Contribution**
***Phoronis* spp.**	**535.25**	**149.48**	**3.07**	**1.19**	**5.01**	**5.01**
Paraprionospio pinnata	**283.50**	**242.40**	**2.88**	**1.16**	**4.69**	**9.70**
Acteocina canaliculata	**290.30**	**214.12**	**2.67**	**1.16**	**4.35**	**14.06**
***Ampelisca* spp.**	**195.05**	**113.12**	**2.51**	**1.11**	**4.10**	**18.15**
Streblospio benedicti	**68.04**	**44.44**	**2.28**	**0.99**	**3.71**	**21.87**
Neanthes succinea	**40.82**	**16.16**	**2.18**	**1.14**	**3.56**	**25.43**
Haminoea solitaria	**52.16**	**48.48**	**2.14**	**0.89**	**3.49**	**28.92**
Mulinia lateralis	**24.95**	**4.04**	**2.13**	**1.33**	**3.48**	**32.40**
Loimia medusa	**45.36**	**40.40**	**2.06**	**1.13**	**3.37**	**35.76**
Glycinde solitaria	**283.50**	**157.56**	**2.04**	**0.94**	**3.33**	**39.09**
Mediomastus ambiseta	**827.82**	**569.64**	**2.01**	**0.93**	**3.29**	**42.37**
***Leitoscoloplos* spp.**	**20.41**	**32.32**	**1.95**	**1.13**	**3.18**	**45.56**
Spiophanes bombyx	**52.16**	**8.08**	**1.90**	**0.99**	**3.11**	**48.67**
Nemertea spp.	**18.14**	**12.12**	**1.76**	**1.10**	**2.87**	**51.54**
Rictaxis punctostriatus	**31.75**	**40.40**	**1.71**	**0.90**	**2.79**	**54.33**
Leucon americanus	**108.86**	**24.24**	**1.65**	**0.68**	**2.69**	**57.02**
Sigambra tentaculata	**11.34**	**32.32**	**1.54**	**0.75**	**2.51**	**59.53**
Heteromastus filiformis	**36.29**	**4.04**	**1.46**	**0.82**	**2.39**	**61.92**
Tellina agilis	**6.80**	**16.16**	**1.35**	**0.86**	**2.20**	**64.12**
Eteone heteropoda	**6.80**	**8.08**	**1.31**	**0.78**	**2.14**	**66.26**
Ampelisca verrilli	**18.14**	**8.08**	**1.31**	**0.85**	**2.13**	**68.39**
Scolelepis texana	**20.41**	**12.12**	**1.19**	**0.67**	**1.95**	**70.34**
Brania welfleetensis	**15.88**	**4.04**	**1.19**	**0.70**	**1.94**	**72.28**
Leptosynapta tenuis	**27.22**	**4.04**	**1.10**	**0.58**	**1.79**	**74.07**
Edwardsia elegans	**79.38**	**20.20**	**1.08**	**0.58**	**1.77**	**75.83**
Spiochaetopterus costarum	**36.29**	**28.28**	**1.04**	**0.59**	**1.69**	**77.53**
Acanthohaustorius millsi	**38.56**	**8.08**	**1.02**	**0.47**	**1.66**	**79.19**
Ameroculodes species complex	**9.07**	**4.04**	**0.99**	**0.71**	**1.61**	**80.80**
Pseudeurythoe paucibranchiata	**2.27**	**12.12**	**0.91**	**0.59**	**1.48**	**82.29**
Glycera dibranchiata	**9.07**	**0.00**	**0.82**	**0.64**	**1.34**	**83.62**
Pectinaria gouldii	**18.14**	**4.04**	**0.82**	**0.58**	**1.33**	**84.95**
Asabellides oculata	**4.54**	**4.04**	**0.81**	**0.57**	**1.32**	**86.28**
Listriella barnardi	**6.80**	**4.04**	**0.72**	**0.59**	**1.17**	**87.45**
Mysidopsis bigelowi	**2.27**	**16.16**	**0.71**	**0.44**	**1.16**	**88.61**
Parahesione luteola	**4.54**	**0.00**	**0.63**	**0.47**	**1.02**	**89.63**
Microphiopholis atra	**0.00**	**12.12**	**0.59**	**0.49**	**0.96**	**90.59**

Table 9. Continued.

Young Grab vs Ponar Replicate 2						
Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Phoronis spp.	535.25	96.96	2.86	1.33	4.78	4.78
Paraprionospio pinnata	283.50	246.44	2.66	1.27	4.44	9.21
Acteocina canaliculata	290.30	181.80	2.57	1.20	4.29	13.51
Ampelisca spp.	195.05	145.44	2.39	1.16	3.99	17.50
Streblospio benedicti	68.04	64.64	2.22	1.03	3.72	21.21
Mediomastus ambiseta	827.82	832.24	2.06	1.04	3.44	24.65
Neanthes succinea	40.82	40.40	2.05	1.19	3.43	28.08
Mulinia lateralis	24.95	8.08	1.93	1.29	3.22	31.30
Loimia medusa	45.36	28.28	1.87	1.10	3.12	34.43
Haminoea solitaria	52.16	24.24	1.81	0.88	3.02	37.45
Spiophanes bombyx	52.16	8.08	1.79	1.00	3.00	40.44
Leitoscoloplos spp.	20.41	28.28	1.71	1.10	2.86	43.30
Leucon americanus	108.86	76.76	1.70	0.69	2.84	46.14
Nemertea spp.	18.14	12.12	1.65	1.12	2.76	48.90
Rictaxis punctostriatus	31.75	28.28	1.61	0.89	2.70	51.60
Spiochaetopterus costarum	36.29	28.28	1.61	0.91	2.69	54.29
Glycinde solitaria	283.50	270.68	1.60	0.81	2.67	56.96
Brania welfleetensis	15.88	20.20	1.53	0.85	2.55	59.51
Heteromastus filiformis	36.29	4.04	1.41	0.84	2.36	61.87
Sigambra tentaculata	11.34	24.24	1.37	0.77	2.29	64.15
Edwardsia elegans	79.38	24.24	1.29	0.70	2.16	66.31
Leptosynapta tenuis	27.22	12.12	1.29	0.68	2.15	68.46
Scolelepis texana	20.41	8.08	1.17	0.69	1.95	70.41
Pectinaria gouldii	18.14	16.16	1.14	0.68	1.90	72.31
Ampelisca verrilli	18.14	0.00	1.11	0.79	1.85	74.16
Eteone heteropoda	6.80	4.04	1.10	0.72	1.84	76.00
Turbellaria spp.	2.27	16.16	1.07	0.71	1.78	77.78
Ameroculodes species complex	9.07	16.16	1.05	0.72	1.75	79.53
Acanthohaustorius millsi	38.56	44.44	1.00	0.46	1.67	81.20
Podarkeopsis levifuscina	2.27	16.16	0.89	0.57	1.48	82.68
Parahesione luteola	4.54	8.08	0.86	0.58	1.43	84.11
Rhepoxynius epistomus	4.54	12.12	0.85	0.58	1.43	85.54
Glycera dibranchiata	9.07	0.00	0.78	0.65	1.30	86.83
Tellina agilis	6.80	0.00	0.74	0.64	1.24	88.07
Listriella barnardi	6.80	4.04	0.69	0.59	1.15	89.22
Macoma tenta	0.00	8.08	0.64	0.49	1.07	90.29

Table 10. **Contributions of individual species to the average dissimilarity in biomass for the Mattaponi River. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.**

Young Grab vs Combined Ponar

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Corbicula fluminea	8.08	12.01	31.31	0.90	40.72	40.72
Rangia cuneata	0.71	0.29	13.31	0.56	17.31	58.03
Hexagenia spp.	0.11	0.07	10.15	0.59	13.20	71.23
Limnodrilus spp.	0.05	0.07	4.22	0.77	5.49	76.72
Cyathura polita	0.02	0.02	2.41	0.65	3.14	79.86
Marenzelleria viridis	0.01	0.02	2.41	0.65	3.13	82.99
Gammarus daiberi	0.01	0.02	1.71	0.69	2.22	85.21
Chiridotea almyra	0.00	0.00	1.47	0.45	1.91	87.12
Stictochironomus spp.	0.01	0.01	1.35	0.46	1.75	88.87
Xenochironomus spp.	0.01	0.00	1.19	0.39	1.54	90.41

Young Grab vs Ponar Replicate 1

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Corbicula fluminea	8.93	12.01	33.54	0.94	42.41	42.41
Hexagenia spp.	0.15	0.07	11.66	0.64	14.75	57.16
Rangia cuneata	0.07	0.29	7.72	0.45	9.77	66.93
Limnodrilus spp.	0.05	0.07	5.16	0.97	6.52	73.45
Marenzelleria viridis	0.02	0.02	3.62	0.60	4.58	78.03
Cyathura polita	0.02	0.02	3.37	0.70	4.26	82.29
Gammarus daiberi	0.02	0.02	3.27	0.78	4.14	86.42
Chiridotea almyra	0.00	0.00	1.60	0.49	2.02	88.45
Stictochironomus spp.	0.01	0.01	1.57	0.47	1.99	90.43

Young Grab vs Ponar Replicate 2

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Corbicula fluminea	7.24	12.01	32.47	0.94	40.48	40.48
Rangia cuneata	1.35	0.29	13.40	0.56	16.71	57.19
Hexagenia spp.	0.06	0.07	9.30	0.56	11.59	68.78
Limnodrilus spp.	0.05	0.07	4.87	0.78	6.07	74.85
Cyathura polita	0.02	0.02	2.55	0.63	3.18	78.03
Gammarus daiberi	0.01	0.02	2.29	0.83	2.85	80.88
Marenzelleria viridis	0.00	0.02	2.03	0.56	2.53	83.41
Chiridotea almyra	0.00	0.00	1.58	0.42	1.97	85.38
Pristinella osborni	0.01	0.00	1.50	0.42	1.87	87.25
Gomphidae spp.	0.01	0.00	1.41	0.41	1.75	89.00
Stictochironomus spp.	0.01	0.01	1.26	0.47	1.57	90.57

Table 11. Contributions of individual species to the average dissimilarity in biomass for the Nansemond River. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.

Young Grab vs Combined Ponar

Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Macoma balthica	0.17	0.23	12.36	1.04	19.07	19.07
Cyathura polita	0.10	0.12	8.34	0.99	12.86	31.93
Neanthes succinea	0.09	0.06	6.58	0.83	10.15	42.08
Mediomastus ambiseta	0.11	0.14	5.97	1.19	9.21	51.29
Leitoscoloplos spp.	0.09	0.01	4.80	0.56	7.41	58.70
Glycinde solitaria	0.03	0.03	2.95	1.20	4.55	63.25
Tubificoides heterochaetus	0.04	0.05	2.89	1.20	4.46	67.70
Mulinia lateralis	0.02	0.02	2.48	0.51	3.83	71.54
Nemertea spp.	0.02	0.04	2.46	1.11	3.79	75.32
Macoma mitchelli	0.03	0.02	2.06	0.74	3.18	78.50
Paraprionospio pinnata	0.03	0.01	1.97	0.60	3.03	81.54
Marenzelleria viridis	0.01	0.01	1.71	0.55	2.63	84.17
Leptocheirus plumulosus	0.02	0.01	1.42	0.78	2.20	86.36
Streblospio benedicti	0.04	0.04	1.29	1.30	1.99	88.36
Tubificoides spp. Group I	0.02	0.03	1.26	1.19	1.94	90.3

Young Grab vs Ponar Replicate 1

Species	Young Grab Avg. Abund	Ponar Rep 1 Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Macoma balthica	0.17	0.34	13.87	1.06	20.56	20.56
Cyathura polita	0.10	0.17	9.65	1.03	14.31	34.87
Neanthes succinea	0.09	0.06	7.05	0.77	10.45	45.32
Mediomastus ambiseta	0.11	0.13	5.55	1.13	8.23	53.55
Leitoscoloplos spp.	0.09	0.00	4.32	0.48	6.40	59.95
Marenzelleria viridis	0.01	0.03	2.68	0.47	3.97	63.92
Glycinde solitaria	0.03	0.03	2.66	1.30	3.95	67.87
Mulinia lateralis	0.02	0.03	2.66	0.44	3.94	71.81
Tubificoides heterochaetus	0.04	0.04	2.49	1.06	3.69	75.49
Macoma mitchelli	0.03	0.01	1.98	0.65	2.94	78.43
Nemertea spp.	0.02	0.03	1.98	1.29	2.93	81.36
Leptocheirus plumulosus	0.02	0.01	1.46	0.75	2.17	83.53
Tubificoides spp. Group I	0.02	0.02	1.46	1.43	2.16	85.69
Paraprionospio pinnata	0.03	0.00	1.45	0.49	2.15	87.85
Streblospio benedicti	0.04	0.04	1.44	1.40	2.13	89.98
Leucon americanus	0.01	0.01	1.24	0.92	1.84	91.81

Table 11. Continued.

Young Grab vs Ponar Replicate 2						
Species	Young Grab Avg. Abund	Ponar Rep 2 Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Macoma balthica	0.17	0.12	10.51	0.98	15.81	15.81
Cyathura polita	0.10	0.07	7.35	0.96	11.06	26.87
Mediomastus ambiseta	0.11	0.15	6.85	1.30	10.30	37.17
Neanthes succinea	0.09	0.05	6.50	0.89	9.77	46.94
Leitoscoloplos spp.	0.09	0.02	5.26	0.58	7.92	54.86
Tubificoides heterochaetus	0.04	0.06	3.67	1.23	5.53	60.38
Glycinde solitaria	0.03	0.04	3.40	1.05	5.11	65.49
Nemertea spp.	0.02	0.05	3.30	0.94	4.96	70.45
Macoma mitchelli	0.03	0.03	2.75	0.89	4.14	74.59
Paraprionospio pinnata	0.03	0.02	2.45	0.57	3.69	78.27
Mulinia lateralis	0.02	0.02	2.29	0.60	3.45	81.73
Tubificoides spp. Group I	0.02	0.03	1.91	1.25	2.87	84.60
Leptocheirus plumulosus	0.02	0.01	1.59	0.83	2.39	86.99
Streblospio benedicti	0.04	0.04	1.49	1.53	2.24	89.23
Leucon americanus	0.01	0.01	1.05	0.94	1.57	90.8

Table 12. **Contributions of individual species to the average dissimilarity in biomass for Mobjack Bay. Provided are the average abundance for each gear type, the average dissimilarity contribution for each species (Avg. δ_i), the average dissimilarity divided by its standard deviation (Avg. δ_i / SD(δ_i)), and percent and cumulative percent contribution of each species to the average dissimilarity between gear types.**

Young Grab vs Combined Ponar						
Species	Young Grab Avg. Abund	Combined Ponar Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Paraprionospio pinnata	0.19	0.14	11.80	0.97	16.21	16.21
Phoronis spp.	0.15	0.02	6.15	0.99	8.45	24.66
Mulinia lateralis	0.11	0.02	6.07	0.63	8.34	33.01
Leitoscoloplos spp.	0.07	0.07	4.63	1.22	6.36	39.37
Acteocina canaliculata	0.09	0.03	3.31	0.59	4.54	43.91
Spiophanes bombyx	0.06	0.01	3.30	0.62	4.53	48.44
Macoma tenta	0.00	0.04	2.19	0.34	3.01	51.45
Neanthes succinea	0.02	0.03	2.13	0.78	2.93	54.37
Glycinde solitaria	0.04	0.05	2.09	1.30	2.87	57.24
Haminoea solitaria	0.02	0.02	2.07	0.65	2.84	60.08
Loimia medusa	0.02	0.02	1.68	1.09	2.31	62.39
Spiochaetopterus costarum	0.01	0.03	1.59	0.66	2.18	64.57
Heteromastus filiformis	0.02	0.00	1.51	0.73	2.08	66.65
Ampelisca spp.	0.02	0.03	1.46	1.45	2.01	68.66
Mediomastus ambiseta	0.03	0.04	1.38	1.78	1.90	70.55
Nassarius vibex	0.00	0.02	1.33	0.32	1.83	72.38
Streblospio benedicti	0.01	0.02	1.32	1.17	1.81	74.19
Nemertea spp.	0.02	0.01	1.11	1.16	1.52	75.71
Leptosynapta tenuis	0.01	0.01	1.09	0.58	1.49	77.20
Glycera dibranchiata	0.02	0.00	1.03	0.62	1.42	78.62
Scolelepis texana	0.01	0.01	0.96	0.82	1.32	79.94
Sigambra tentaculata	0.01	0.01	0.92	0.78	1.27	81.20
Rictaxis punctostriatus	0.01	0.01	0.86	0.91	1.18	82.39
Brania welfleetensis	0.01	0.01	0.81	0.69	1.12	83.50
Leucon americanus	0.00	0.01	0.75	0.73	1.03	84.54
Eteone heteropoda	0.01	0.01	0.71	0.79	0.98	85.52
Acanthohaustorius millsi	0.01	0.00	0.69	0.46	0.95	86.47
Glycera americana	0.00	0.01	0.66	0.32	0.91	87.38
Tellina agilis	0.01	0.01	0.64	0.80	0.88	88.25
Edwardsia elegans	0.01	0.01	0.58	0.69	0.79	89.05
Ampelisca verrilli	0.01	0.00	0.56	0.81	0.77	89.82
Ameroculodes species complex	0.01	0.00	0.55	0.76	0.76	90.58

Table 12. Continued.

Young Grab vs Ponar Replicate 1						
Species	Young Grab Avg. Abund	Ponar Rep 1 Avg. Abund	Avg. δ_i	Avg. δ_i / SD(δ_i)	% Contribution	Cumulative % Contribution
Paraprionospio pinnata	0.19	0.14	12.89	0.92	17.14	17.14
Phoronis spp.	0.15	0.02	6.54	0.98	8.70	25.84
Mulinia lateralis	0.11	0.00	6.11	0.58	8.12	33.97
Leitoscoloplos spp.	0.07	0.06	5.13	1.19	6.83	40.79
Acteocina canaliculata	0.09	0.03	3.61	0.62	4.80	45.60
Spiophanes bombyx	0.06	0.01	3.60	0.63	4.79	50.39
Haminoea solitaria	0.02	0.03	3.02	0.57	4.01	54.40
Glycinde solitaria	0.04	0.04	2.40	1.25	3.19	57.59
Loimia medusa	0.02	0.02	2.04	1.07	2.71	60.30
Heteromastus filiformis	0.02	0.00	1.63	0.70	2.17	62.47
Neanthes succinea	0.02	0.01	1.61	1.05	2.14	64.61
Ampelisca spp.	0.02	0.03	1.60	1.47	2.12	66.74
Streblospio benedicti	0.01	0.02	1.52	1.01	2.02	68.75
Mediomastus ambiseta	0.03	0.04	1.48	2.08	1.97	70.72
Spiochaetopterus costarum	0.01	0.02	1.47	0.51	1.96	72.68
Nemertea spp.	0.02	0.01	1.40	1.08	1.86	74.54
Leptosynapta tenuis	0.01	0.00	1.11	0.50	1.47	76.01
Glycera dibranchiata	0.02	0.00	1.10	0.62	1.47	77.48
Tellina agilis	0.01	0.01	1.09	0.78	1.45	78.93
Rictaxis punctostriatus	0.01	0.01	1.08	0.90	1.44	80.38
Sigambra tentaculata	0.01	0.01	1.04	0.73	1.39	81.77
Eteone heteropoda	0.01	0.01	1.03	0.81	1.37	83.13
Scolelepis texana	0.01	0.01	0.99	0.65	1.32	84.45
Leucon americanus	0.00	0.01	0.95	0.69	1.26	85.71
Acanthohaustorius millsi	0.01	0.00	0.74	0.46	0.99	86.70
Pseudeurythoe paucibranchiata	0.00	0.01	0.74	0.57	0.99	87.69
Ampelisca verrilli	0.01	0.00	0.73	0.77	0.97	88.66
Asabellides oculata	0.00	0.00	0.68	0.53	0.90	89.56
Ameroculodes species complex	0.01	0.00	0.66	0.68	0.87	90.44

Table 12. Continued.

Young Grab vs Ponar Replicate 2						
Species	**Young Grab Avg. Abund**	**Ponar Rep 2 Avg. Abund**	**Avg. δ_i**	**Avg. δ_i / SD(δ_i)**	**% Contribution**	**Cumulative % Contribution**
Paraprionospio pinnata	**0.19**	**0.15**	**11.21**	**0.95**	**14.89**	**14.89**
Mulinia lateralis	**0.11**	**0.04**	**6.55**	**0.66**	**8.70**	**23.58**
***Phoronis* spp.**	**0.15**	**0.02**	**6.02**	**1.01**	**7.99**	**31.58**
***Leitoscoloplos* spp.**	**0.07**	**0.07**	**4.85**	**1.24**	**6.44**	**38.02**
Acteocina canaliculata	**0.09**	**0.02**	**3.26**	**0.59**	**4.34**	**42.36**
Spiophanes bombyx	**0.06**	**0.01**	**3.22**	**0.62**	**4.28**	**46.63**
Macoma tenta	**0.00**	**0.08**	**3.18**	**0.35**	**4.22**	**50.86**
Neanthes succinea	**0.02**	**0.04**	**2.60**	**0.62**	**3.45**	**54.31**
Glycinde solitaria	**0.04**	**0.05**	**2.10**	**1.31**	**2.79**	**57.10**
Nassarius vibex	**0.00**	**0.04**	**2.04**	**0.32**	**2.70**	**59.80**
Spiochaetopterus costarum	**0.01**	**0.03**	**1.69**	**0.80**	**2.25**	**62.05**
Mediomastus ambiseta	**0.03**	**0.04**	**1.52**	**1.96**	**2.02**	**64.07**
Loimia medusa	**0.02**	**0.02**	**1.50**	**1.14**	**1.99**	**66.06**
Heteromastus filiformis	**0.02**	**0.00**	**1.49**	**0.72**	**1.98**	**68.04**
Haminoea solitaria	**0.02**	**0.01**	**1.43**	**0.73**	**1.90**	**69.94**
Streblospio benedicti	**0.01**	**0.02**	**1.43**	**1.00**	**1.90**	**71.84**
***Ampelisca* spp.**	**0.02**	**0.03**	**1.41**	**1.40**	**1.87**	**73.72**
Glycera americana	**0.00**	**0.02**	**1.27**	**0.32**	**1.69**	**75.41**
Nemertea spp.	**0.02**	**0.01**	**1.25**	**1.07**	**1.66**	**77.06**
Leptosynapta tenuis	**0.01**	**0.01**	**1.23**	**0.60**	**1.63**	**78.69**
Brania welfleetensis	**0.01**	**0.01**	**1.12**	**0.71**	**1.49**	**80.19**
Scolelepis texana	**0.01**	**0.01**	**1.02**	**0.63**	**1.35**	**81.54**
Glycera dibranchiata	**0.02**	**0.00**	**1.00**	**0.62**	**1.33**	**82.87**
Rictaxis punctostriatus	**0.01**	**0.01**	**0.89**	**0.93**	**1.19**	**84.05**
Sigambra tentaculata	**0.01**	**0.01**	**0.87**	**0.78**	**1.16**	**85.21**
Eteone heteropoda	**0.01**	**0.00**	**0.77**	**0.69**	**1.03**	**86.24**
Turbellaria spp.	**0.00**	**0.01**	**0.77**	**0.64**	**1.02**	**87.26**
Leucon americanus	**0.00**	**0.01**	**0.76**	**0.69**	**1.01**	**88.27**
Edwardsia elegans	**0.01**	**0.01**	**0.72**	**0.62**	**0.96**	**89.23**
Acanthohaustorius millsi	**0.01**	**0.00**	**0.66**	**0.46**	**0.88**	**90.1**

Figures

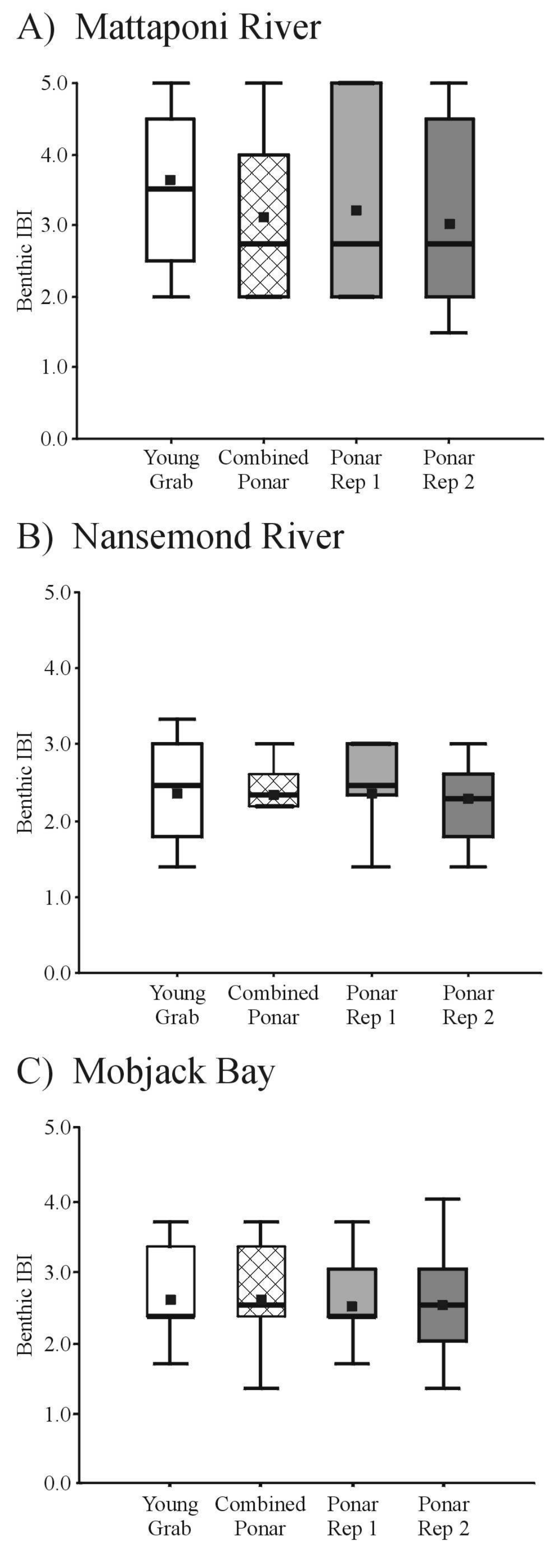


Figure 1. Boxplot of the Benthic Index of Biotic Integrity for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■).

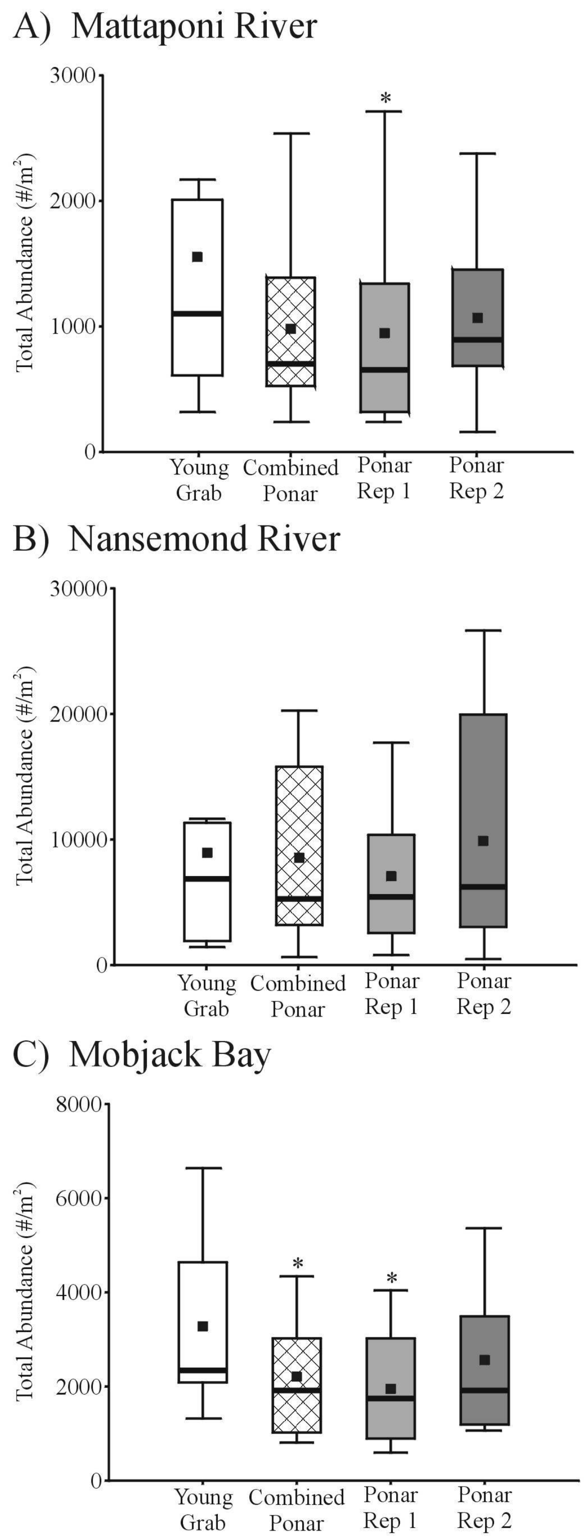


Figure 2. Boxplot of total abundance per m^2 for each gear type within each sampling stratum. Shown are the 5^{th} and 95^{th} percentiles (bars), the 25^{th} and 75^{th} percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

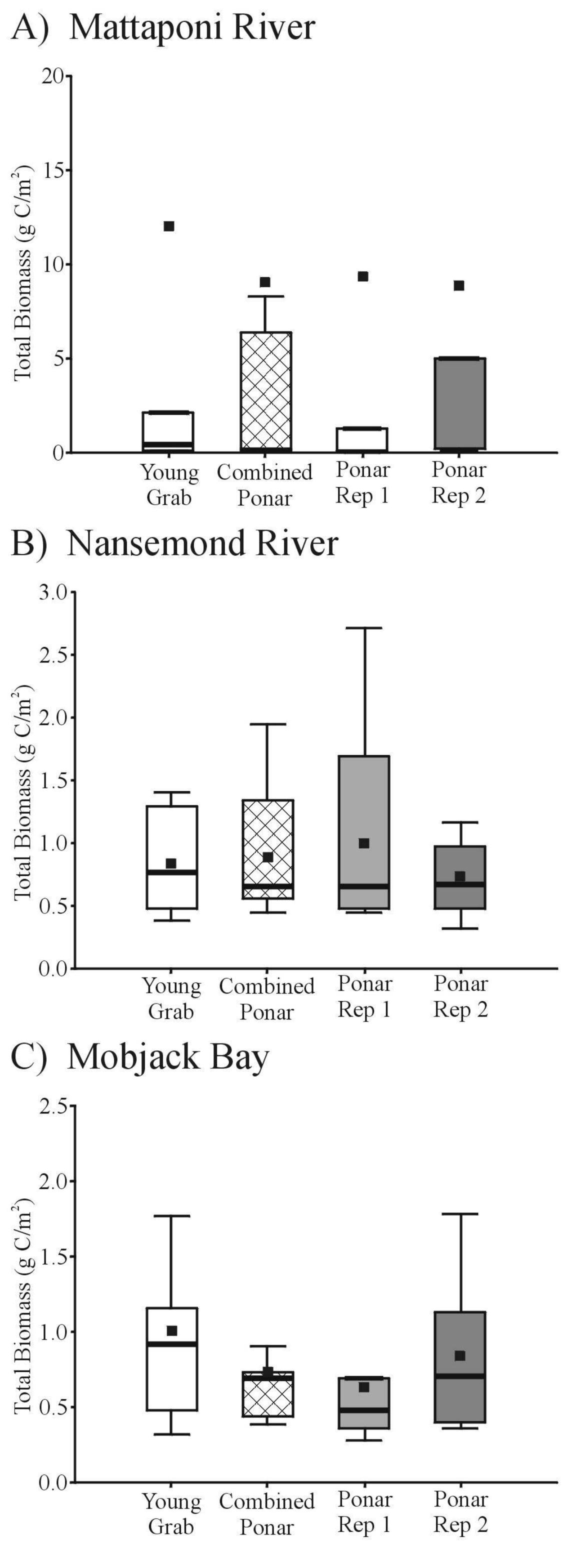


Figure 3. Boxplot of total biomass per m^2 for each gear type within each sampling stratum. Shown are the 5^{th} and 95^{th} percentiles (bars), the 25^{th} and 75^{th} percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

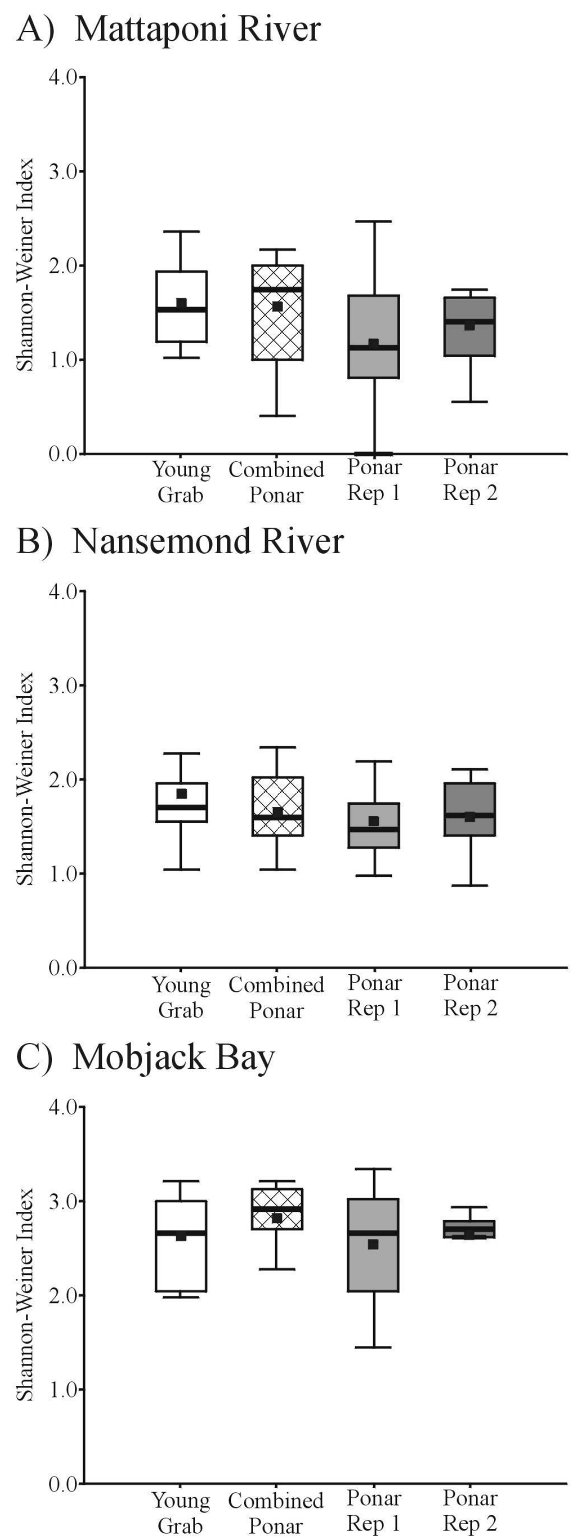


Figure 4. Boxplot of Shannon-Wiener Index for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

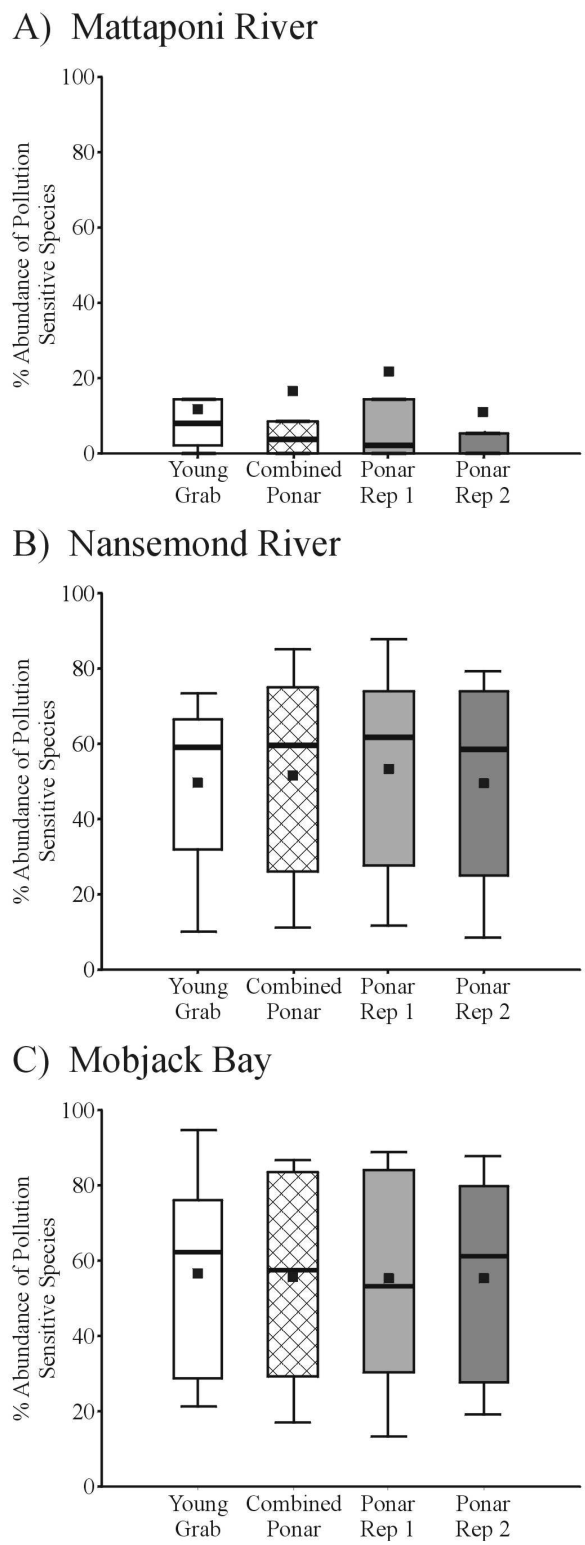


Figure 5. Boxplot of % abundance of pollution sensitive species for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

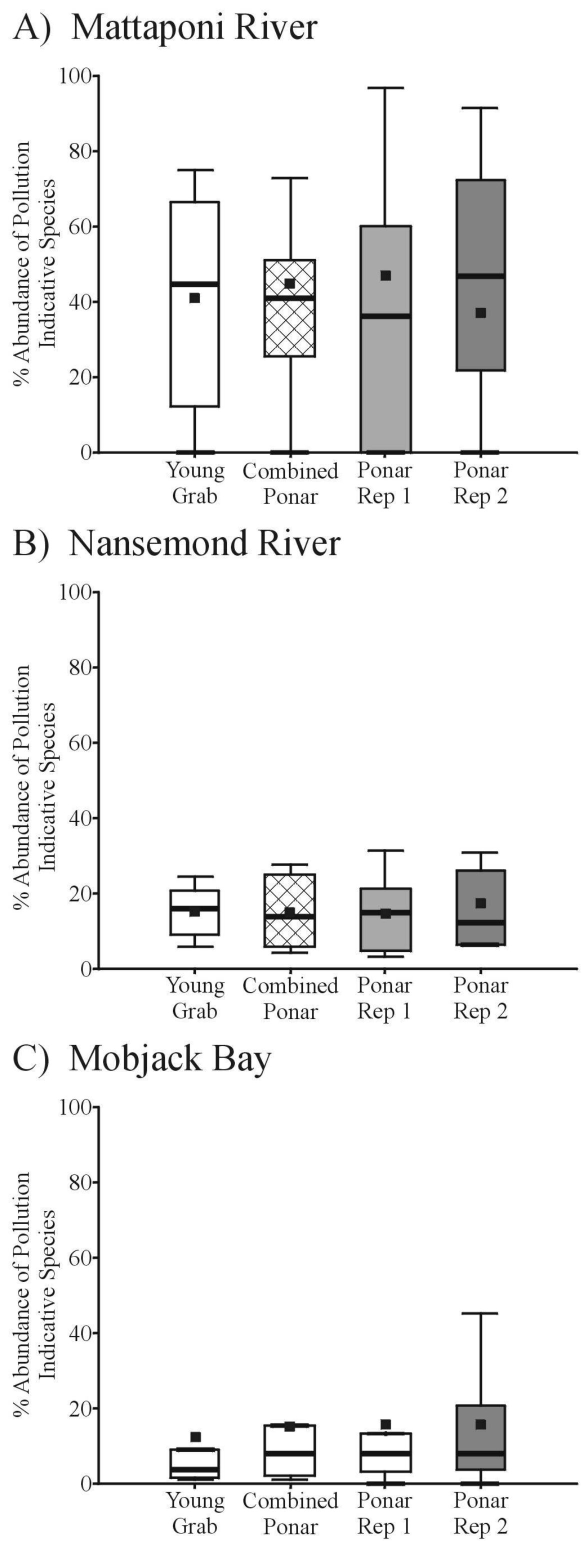


Figure 6. Boxplot of % abundance of pollution indicative species for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

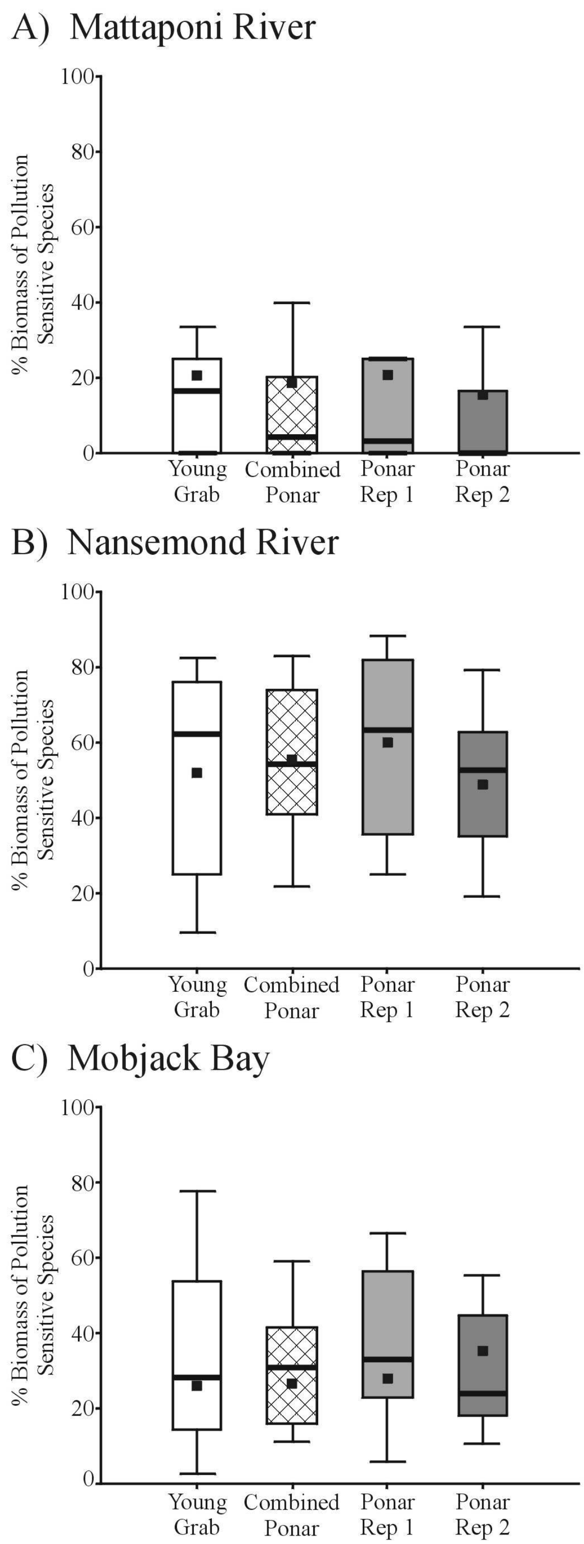


Figure 7. Boxplot of % biomass of pollution sensitive species for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

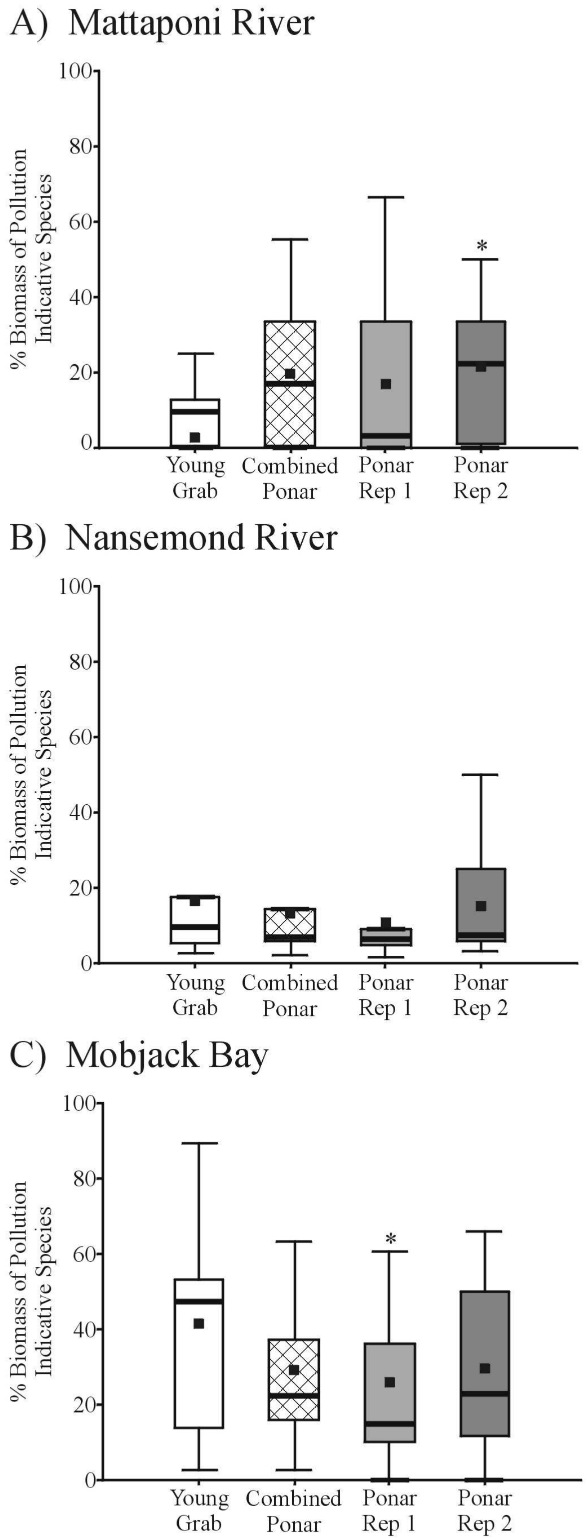


Figure 8. Boxplot of % biomass of pollution indicative species for each gear type within each sampling stratum. Shown are the 5th and 95th percentiles (bars), the 25th and 75th percentiles (box margins), the median (thick line) and mean (■). *= significant difference from Young grab.

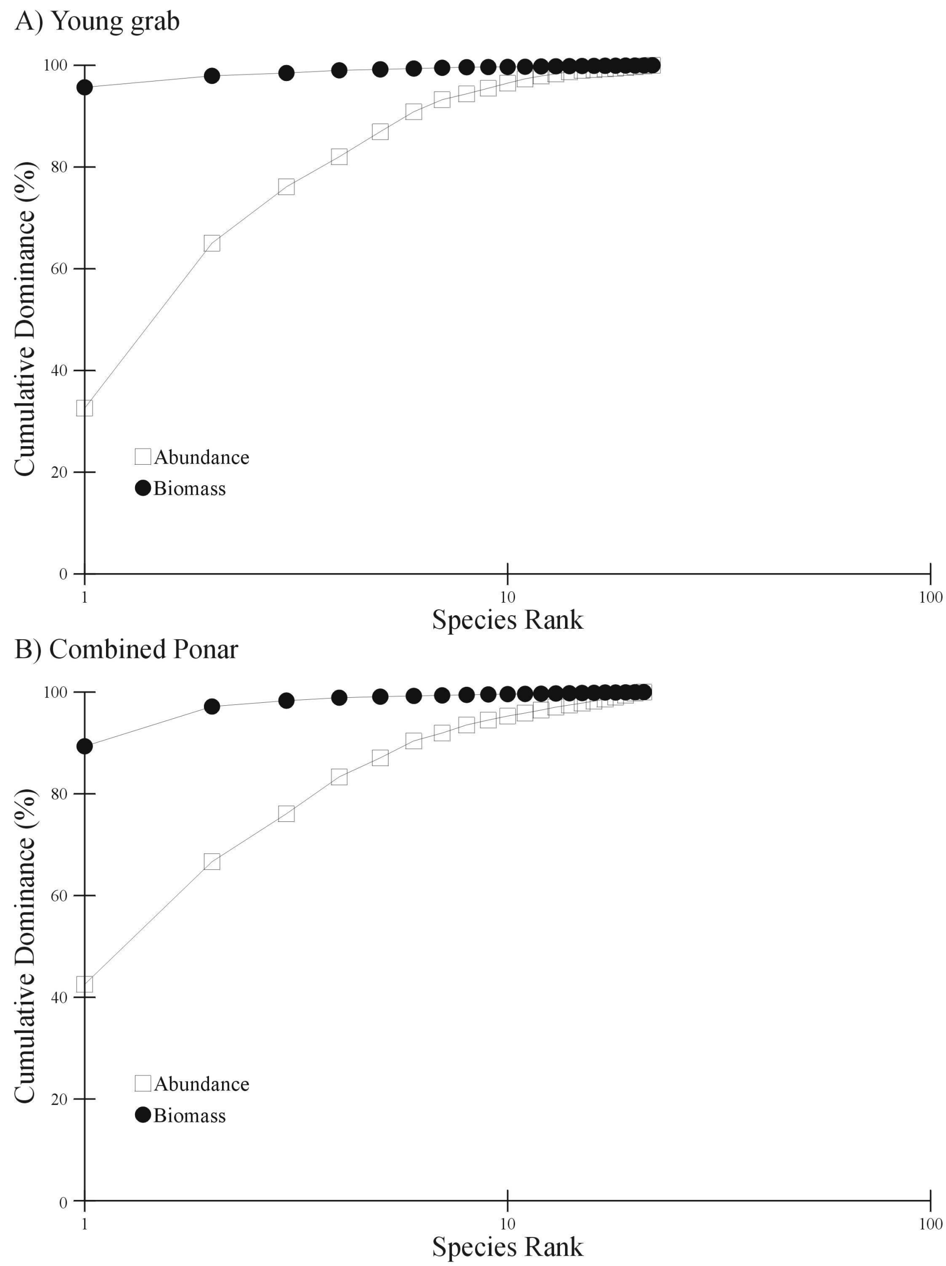
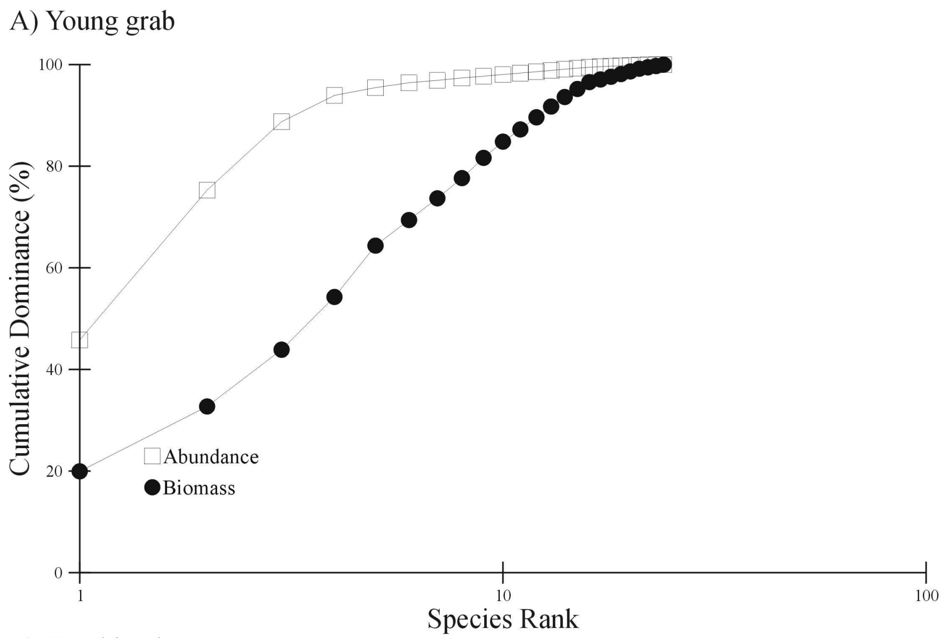


Figure 9. ABC curves comparing grab types for the Mattaponi River. A) the Young grab and B) combined Ponar grab.



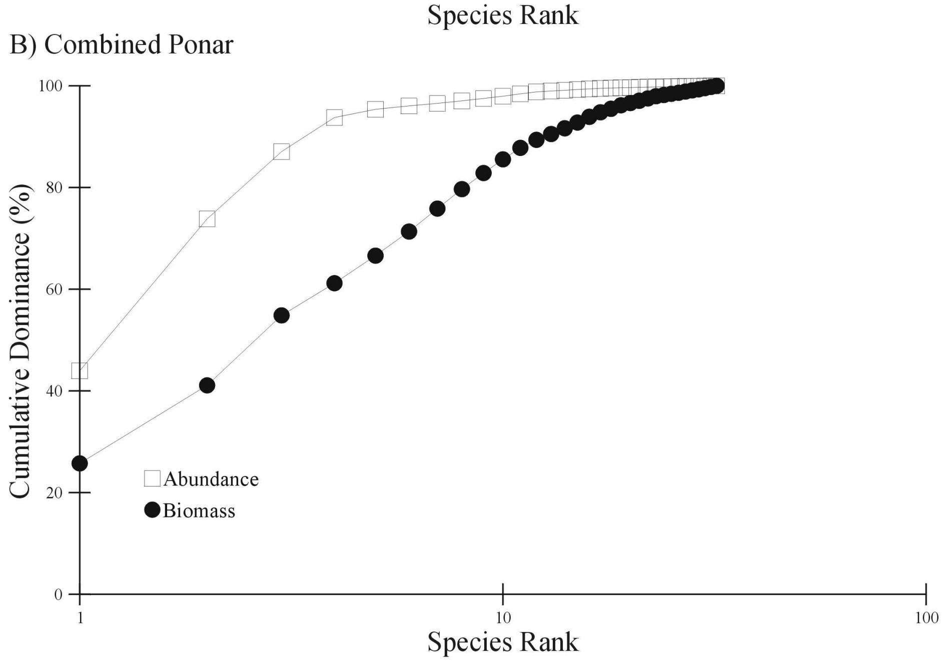
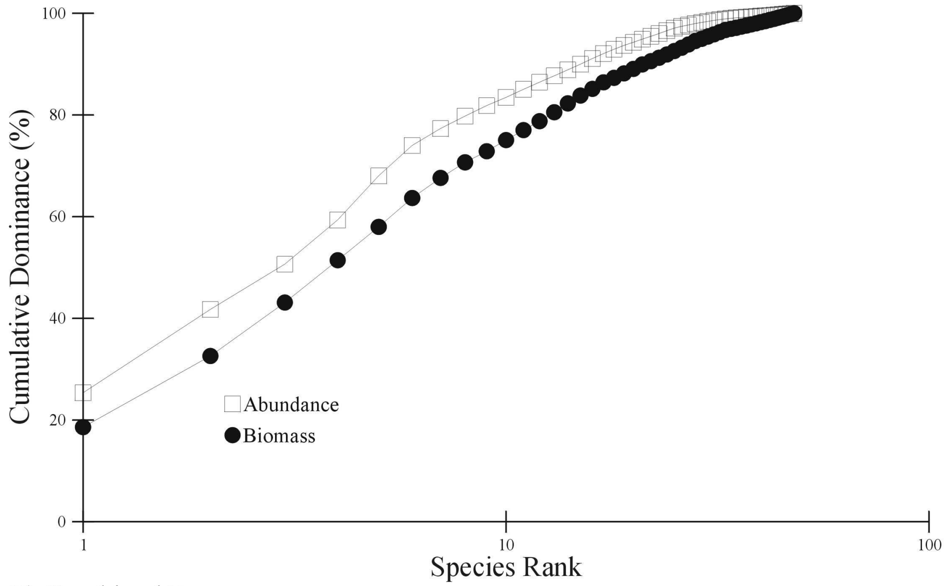


Figure 10. ABC curves comparing grab types for the Nansemond River. A) the Young grab and B) combined Ponar grab.

A) Young grab



B) Combined Ponar

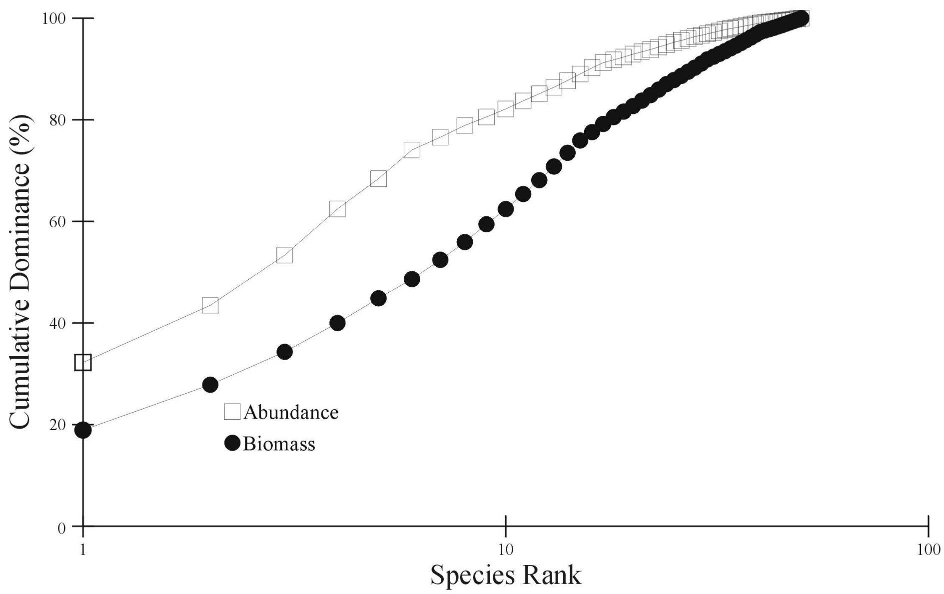


Figure 11. ABC curves comparing grab types for Mobjack Bay. A) the Young grab and B) the combined Ponar grab.

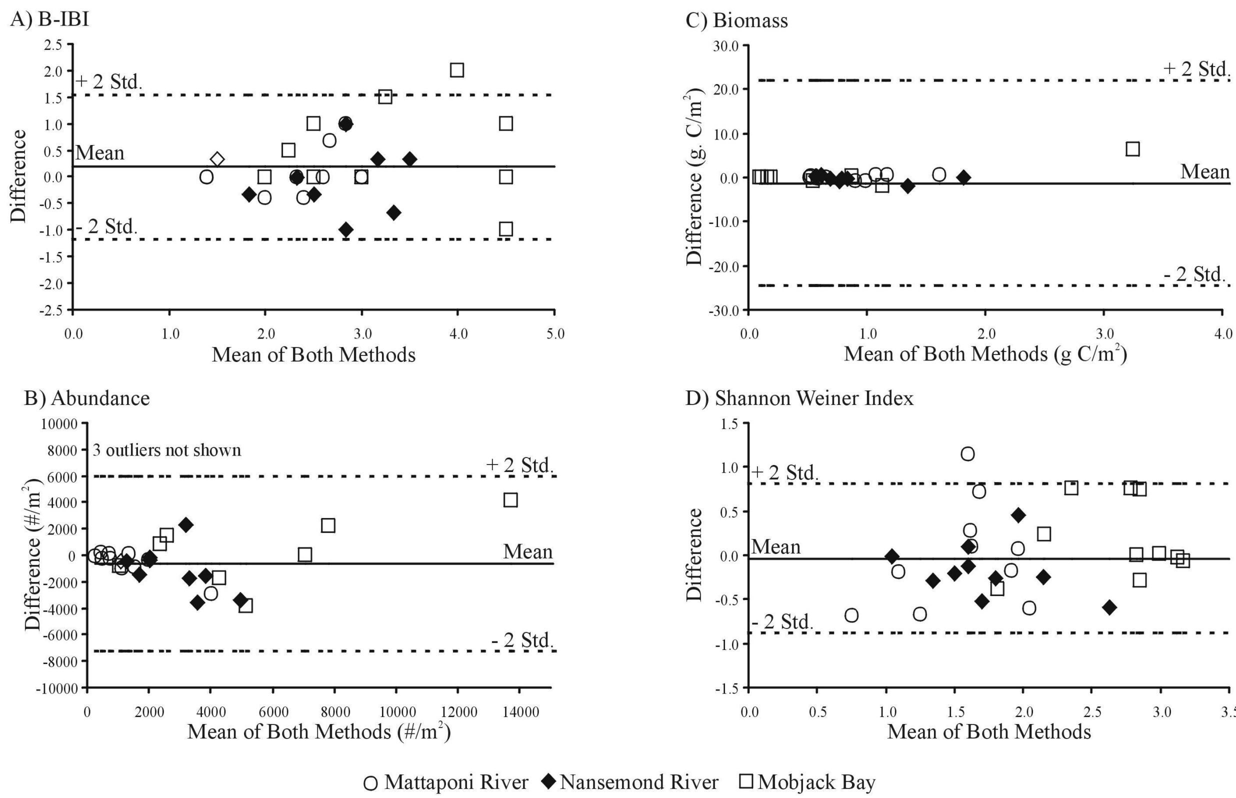


Figure 12. Plots of the difference between methods over the mean of both methods across all strata for: A) the B-IBI; B) total abundance per m^2; C) total biomass per m^2 and; D) the Shannon Weiner Index. Solid line represents the mean difference between methods while dashed lines are ± two standard deviations (Std.) from the mean.

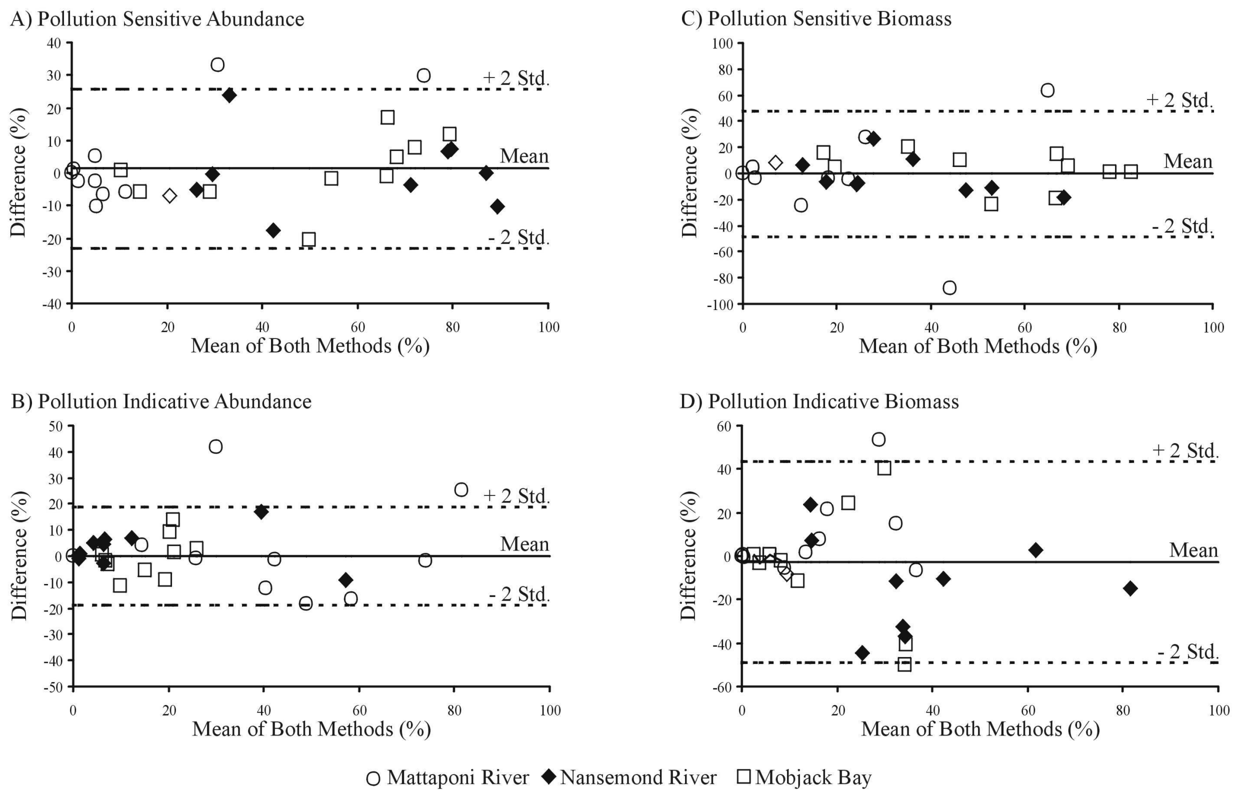


Figure 13. Plots of the difference between methods over the mean of both methods across all strata for: A) pollution sensitive species abundance; B) pollution indicative species abundance; C) pollution sensitive species biomass and; D) pollution indicative species biomass. Solid line represents the mean difference between methods while dashed lines are ± two standard deviations (Std.) from the mean.