OLD DOMINION UNIVERSITY

Department of Biological Sciences
Old Dominion University, Norfolk, Virginia 23529

BIOLOGICAL CONDITION OF MONEY PONT BENTHIC COMMUNITIES, SOUTHERN BRANCH OF THE ELIZABETH RIVER (2010, 2013, 2016)

Prepared by

Principal Investigator:

Dr. Daniel M. Dauer

Submitted to:

Josef Rieger
Director of Watershed Restoration
The Elizabeth River Project
475 Water Street, Suite 103
Portsmouth, Virginia 23704

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EXECUTIVE SUMMARY

This report summarizes the ecological condition of the subtidal macrobenthic communities off Money Point in the Southern Branch of the Elizabeth River based upon quantitative sampling in summer 2016. The designated Money Point study area was part of a sediment contaminant remediation effort. The primary objectives were to: (1) characterize the biological health of the benthos of Money Point comparing pre-remediation condition (2010) to post-remediation condition in 2013 and again in 2016, and (2) assess the effectiveness of the sediment contamination remediation efforts with respect to the ecological condition of the Money Point benthos.

Prior to sediment contaminant remediation, Dauer (2011) characterized the benthic community condition off Money Point as consistent with previous characterizations of the Elizabeth River watershed: (1) benthic community species diversity and biomass were below reference condition levels; (2) abundance often above reference condition levels and considered excessive; and (3) community composition was unbalanced with levels of pollution indicative species above, and levels of pollution sensitive species below, reference conditions.

Compared to previous characterizations of the benthos of the Elizabeth River, the Money Point benthos as sampled in 2010 had (1) the lowest average B-IBI value, 2.0, a level characterized as severely degraded; (2) relatively high abundance levels, exceeding 6,000 individuals per m^2; (3) the lowest Shannon Diversity Index value; and (4) the lowest biomass level. The low level of biomass was probably indicative of poor ecological value of the benthos as a food source for higher trophic levels, i.e. fish, crabs, birds, etc.

In 2013 after sediment contaminant remediation (Dauer 2014), the benthic community showed (1) a significant increase in the value of the B-IBI from 1.8 to 2.1; (2) a highly significant reduction in abundance levels from 6,012 to 2,640 individuals per m^2; (3) a highly significant increase in the Shannon Diversity Index value from 1.62 to 2.33; and (4) a highly significant increase in the level of biomass from 0.35 to 0.85 AFDW g C per m^2 (142% increase). The increase in the species diversity (H') was due to both an increase in species richness (the species per sample increased significantly from 9.48 to 11.96) and lower dominance by two pollution indicative polychaete species (*Mediomastus ambiseta* and *Streblospio benedicti*) from a combined level of 4,956 individuals per m^2 in 2010 to 1,244 individuals per m^2 in 2013. Those levels of these two species represented, respectively, 82.4% of the individuals in 2010 and only 47.1% of the individuals in 2013.

Benthic data collected in 2016 (this report) showed that at Money Point the B-IBI, abundance, biomass and species richness all decreased and were significantly lower than levels at Blows Creek. The declines in the BIBI, abundance, biomass and species richness at Money Point were most likely due to factors such as poor larval recruitment, low post-larval survivorship, increased mortality associated with predation, etc. This conclusion is based on the observed

patterns of benthic community condition at two long-term benthic monitoring stations – one located downstream of Money Point (SBE2) and the other upstream of Money Point (SBE5). These two fixed point stations of the Chesapeake Bay Benthic Monitoring Program have been sampled yearly since 1989. The long-term patterns of the BIBI and its metrics at the fixed stations (SBE2 and SBE5) indicate that over time at larger spatial scales (e.g. for the entire Southern Branch) patterns of recruitment and survivorship may have overwhelmed the signal of the initial remediation improvement of benthic community condition at Money Point shown in the 2013 data.

In contrast there were positive aspects of changes in benthic community composition at Money Point after remediation in the 2013 data that continued in the 2016 data. Specifically (1) the continued decline of the two pollution indicative polychaete species, *Mediomastus ambiseta* and *Streblospio benedicti*, at Money Point; (2) the larger body size of species at Money Point; (3) continued lowered level of pollution indicative abundance; and the (4) slightly higher level of pollution sensitive abundance. All these metrics collectively indicate that the very positive improvement in benthic community composition quantified after remediation in the 2013 sampling has continued in 2016.

Continued periodic sampling at Money Point and Blows Creek will provide further assessment of the apparent beneficial effects of the remediation on the benthic community condition.

INTRODUCTION

The Money Point region in the Southern Branch of the Elizabeth River was previously characterized by high levels of PAHs in the sediments. As part of a sediment contaminant remediation project the subtidal macrobenthic communities of a designated portion off Money Point in the Southern Branch of the Elizabeth River (Figs. 1-3) was quantitatively characterized based upon samples collected in the summer of 2010 (Dauer 2011). In addition, a reference stratum across the channel near Blows Creek (Fig. 4) was also sampled in the summer of 2010 prior to any remediation efforts (Webb 2014).

This study represents a post-remediation assessment of the biological condition of the benthos of Money Point by comparing macrobenthic community condition from samples from Money Point and the Blows Creek strata collected in 2010, 2013 and 2016. This comparison emphasizes the values of the Benthic Index of Biotic Integrity (B-IBI) developed for the Chesapeake Bay (Ranasinghe et al. 1994; Weisberg et al. 1997; Alden et al. 2002) and probability-based sampling to calculate confidence intervals around estimates of condition of the benthic communities and allowed estimates of the areal extent of degradation of the benthic communities. In addition, the important metrics of abundance, biomass, species diversity and species richness were also compared between strata (Money Point and Blows Creek) and among years (2010, 2013, 2016).

The macrobenthic communities of the Elizabeth River have been studied since the 1969 sampling of Boesch (1973) with three stations in the Mainstem of the river. Other important studies were limited to the Southern Branch of the river including seasonal sampling at 10 sites in 1977-1978 (Hawthorne and Dauer 1983), seasonal sampling at the same 10 sites a decade later in 1987-1988 by Hunley (1993), the establishment of two long-term monitoring stations in 1989 as part of the Virginia Chesapeake Bay Benthic Monitoring Program (Dauer et al. 1999) and summarizations of the two Southern Branch long-term monitoring stations (Dauer 1993; Dauer et al. 1993). The condition of the benthic community of the Elizabeth River watershed was characterized by spatially extensive sampling of the river in 1999 with 175 locations sampled among seven strata (Dauer 2000; Dauer and Llansó 2003). Beginning in 2000 the Elizabeth River watershed was sampled as a single stratum with the benthic community condition characterized at 25 random locations (Dauer 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009).

RATIONALE

Characterizing Benthic Community Condition

Coastal seas, bays, lagoons and estuaries have become increasingly degraded due to anthropogenic stresses (Nixon 1995). Relationships between land use, levels of nutrients and contaminants, and the condition of the biotic communities of receiving waters are well studied in freshwater ecosystems (Allan et al. 1997) with fewer studies addressing these relationships in estuarine ecosystems (Comeleo et al. 1996; Valiela et al. 1997; Dauer et. al. 2000).
Land use patterns in a watershed influence the delivery of nutrients, sediments and contaminants into receiving waters through surface flow, groundwater flow, and atmospheric deposition (Correll 1983; Correll et al. 1987; Hinga et al. 1991; Correll et al. 1992; Lajtha et al. 1995; Jordan et al. 1997c). Increased nutrient loads are associated with high levels of agricultural and urban land use in both freshwater and coastal watersheds compared to forested watersheds (Klein 1979; Ostry 1982; Duda 1982; Novotny et al. 1985; Ustach et al. 1986; Valiela and Costa 1988; Benzie et al. 1991; Fisher and Oppenheimer 1991; Turner and Rabalais 1991; Correll et al. 1992; Hall et al. 1994; Jaworski et al. 1992; Lowrance 1992; Weiskel and Howes 1992; Balls 1994; Hopkinson and Vallino 1995; Nelson et al. 1995; Hall et al. 1996; Hill 1996; Allan et al. 1997; Correll 1997; Correl et al. 1997; Valiela et al. 1997; Verchot et al. 1997a, 1997b; Gold et al. 1998). At smaller spatial scales, riparian forests and wetlands may ameliorate the effects of agricultural and urban land use (Johnston et al 1990; Correll et al. 1992; Osborne and Kovacic 1993).

Aquatic biotic communities associated with watersheds with high agricultural and urban land use are generally characterized by lower species diversity, less trophic complexity, altered food webs, altered community composition and reduced habitat diversity (Fisher and Likens 1973; Boynton et al. 1982; Conners and Naiman 1984; Malone et al. 1986, 1988, 1996; Mangum 1989; Howarth et al. 1991; Fisher et al. 1992; Grubaugh and Wallace 1995; Lamberti and Berg 1995; Roth et al 1996; Correll 1997). High nutrient loads in coastal ecosystems result in increased algal blooms (Boynton et al. 1982; Malone et al. 1986, 1988; Fisher et al. 1992),

increased low dissolved oxygen events (Taft et al. 1980; Officer et al. 1984; Malone et al. 1996), alterations in the food web (Malone 1992) and declines in valued fisheries species (Kemp et al. 1983; USEPA 1983). Sediment and contaminant loads are also increased in watersheds dominated by agricultural and urban development mainly due to storm-water runoff (Wilber and Hunter 1979; Hoffman et al. 1983; Medeiros et al. 1983; Schmidt and Spencer 1986; Beasley and Granillo 1988; Howarth et al. 1991; Vernberg et al. 1992; Lenat and Crawford 1994; Corbett et al. 1997).

Benthic invertebrates are used extensively as indicators of estuarine environmental status and trends because numerous studies have demonstrated that benthos respond predictably to many kinds of natural and anthropogenic stress (Pearson and Rosenberg 1978; Tapp et al. 1993; Wilson and Jeffrey 1994; Dauer et al. 2000). Many characteristics of benthic assemblages make them useful indicators (Bilyard 1987; Dauer 1993), the most important of which are related to their exposure to stress and the diversity of their responses to stress. Exposure to hypoxia is typically greatest in near-bottom waters and anthropogenic contaminants often accumulate in sediments where benthos live. Benthic organisms generally have limited mobility and cannot avoid these adverse conditions. This immobility is advantageous in environmental assessments because, unlike most pelagic fauna, benthic assemblages reflect local environmental conditions (Gray 1979). The structure of benthic assemblages responds to many kinds of stress because these assemblages typically include organisms with a wide range of physiological tolerances, life history strategies, feeding modes, and trophic interactions (Pearson and Rosenberg 1978; Rhoads et al. 1978; Boesch and Rosenberg 1981; Dauer 1993). Benthic community condition in the Chesapeake Bay watershed has been related in a quantitative manner to water quality, sediment quality, nutrient loads, and land use patterns (Dauer et al. 2000).

Estuarine Contaminant Perspective

Historically our nations' estuarine and coastal waters have been repositories of potentially toxic contaminants through municipal sewage, agricultural runoff, industrial effluents, and various other routes. The accumulation of these contaminants varies between different components of coastal ecosystems and their ecological effects are depended upon the different chemical/biological states of each contaminant.

<u>The ultimate fate of all organisms, particles and compounds is to reside at some time in the benthos.</u>

Most contaminant entities become attached to very small suspended particles in the water (e.g. clay sized particles). As these particles sink to the bottom they carry the toxicants with them. The natural interaction of currents, waves and tides results in the accumulation in fine-grained sedimentary deposits. Typically, the concentrations of toxicants are much higher in sediments than in the overlying water. High winds, shallow water depth, strong currents, or changes in ambient chemistry, result in the release, resuspension or dispersion of accumulated

contaminants are released. Sediments are both sinks and sources of contaminants and; therefore, can pose serious threats to the health of resident marine life.

The Chesapeake Bay Index of Biotic Integrity

The Benthic Index of Biotic Integrity (B-IBI) was developed for macrobenthic communities of the Chesapeake Bay (Weisberg et al. 1997). The index defines expected conditions based upon the distribution of metrics from reference samples. Reference samples were collected from locations relatively free of anthropogenic stress. In calculating the index, categorical values are assigned for various descriptive metrics by comparison with thresholds of the distribution of metrics from reference samples. The result is a multi-metric index of biotic condition, frequently referred to as an index of biotic integrity (IBI). The analytical approach is similar to the one Karr et al. (1986) used to develop comparable indices for freshwater fish communities. Selection of benthic community metrics and metric scoring thresholds were habitat-dependent but by using categorical scoring comparisons between habitat types are possible.

A six-step procedure was used to develop the index: acquire and standardize data sets from a number of monitoring programs; temporally and spatially stratify data sets to identify seasons and habitat types; identify reference sites; select benthic community metrics; select metric thresholds for scoring; and validate the index with an independent data set (Weisberg et al. 1997). The B-IBI developed for Chesapeake Bay is based upon subtidal, unvegetated, infaunal macrobenthic communities. Hard-bottom communities, e.g., oyster beds, were not sampled as part of the monitoring program because the sampling gears could not obtain adequate samples to characterize the associated infaunal communities. Infaunal communities associated with submerged aquatic vegetation (SAV) were not avoided, but were rarely sampled due to the limited spatial extent of SAV in Chesapeake Bay. Only macrobenthic data sets based on processing with a sieve of 0.5-mm mesh aperture and identified to the lowest possible taxonomic level were used. A data set of over 2,000 samples collected from 1984 through 1994 was used to develop, calibrate and validate the index (see Table 1 in Weisberg et al. 1997). Because of inherent sampling limitations in some of the data sets, only data from the period of July 15 through September 30 were used to develop the index.

A multivariate cluster analysis of the biological data was performed to define habitat types. Salinity and sediment type were the two important factors defining habitat types and seven habitats were identified - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand, and polyhaline mud habitats (see Table 5 in Weisberg et al. 1997).

Metrics to include in the index were selected from a candidate list proposed by benthic experts of the Chesapeake Bay. Selected metrics had to (1) differ significantly between reference and all other sites in the data set and (2) differ in an ecologically meaningful manner. Reference sites were selected as those sites which met all three of the following criteria: no sediment contaminant exceeded Long et al.'s (1995) effects range-median (ER-M) concentration, total organic content of the sediment was less than 2%, and bottom dissolved oxygen concentration

was consistently high. A total of 11 metrics representing measures of species diversity, community abundance and biomass, species composition, depth distribution within the sediment, and trophic composition were used to create the index (see Table 2 in Weisberg et al. 1997).

The habitat-specific metrics are scored and combined into a single value of the B-IBI. Thresholds for the selected metrics were based on the distribution of values for the metric at the reference sites. The IBI approach involves scoring each metric as 5, 3, or 1, depending on whether its value at a site approximates, deviates slightly, or deviates greatly from conditions at reference sites (Karr et al. 1986). Threshold values are established as approximately the 5th and 50th (median) percentile values for reference sites in each habitat. For each metric, values below the 5th percentile are scored as 1; values between the 5th and 50th percentiles are scored as 3, and values above the 50th percentile are scored as 5. Metric scores are combined into an index by computing the mean score across all metrics for which thresholds were developed. Assemblages with an average score less than three are considered stressed, as they have metric values that on average are less than values at the poorest reference sites. Two of the metrics, abundance and biomass, respond bimodally; that is, the response can be greater than at reference sites with moderate degrees of stress and less than at reference sites with higher degrees of stress (Pearson and Rosenberg 1978; Dauer and Conner 1980; Ferraro et al. 1991). For these metrics, the scoring is modified so that both exceptionally high (those exceeding the 95th percentile at reference sites) and low (<5th percentile) responses are scored as a 1. Values between the 5th and 25th percentiles or between the 75th and 95th percentiles are scored as 3, and values between the 25th and 75th percentiles of the values at reference sites are scored as 5. The index was validated by examining its response at a new set of reference sites and a new set of sites with known environmental stress. Data used for validation were collected between 1992 and 1994 and were independent of data used to calibrate the index. The B-IBI classified 93% of the validation sites correctly (Weisberg et al. 1997).

Values for the B-IBI range from 1.0 to 5.0. Benthic community condition was classified into four levels based on the B-IBI. Values ≥ 2 were classified as **severely degraded**; values from 2.1 to 2.6 were classified as **degraded**; values greater than 2.6 but less than 3.0 were classified as **marginal**; and values of 3.0 or more were classified as **meeting the goal**. Values in the marginal category do not meet the Restoration Goals, but they differ from the goals within the range of measurement error typically recorded between replicate samples. These categories are used in annual characterizations of the condition of the benthos in the Chesapeake Bay (Dauer et al. 2006a,b,c).

METHODS

A glossary of selected terms used in this report is found in Appendix C.

Probability-based Sampling

A wide variety of sampling designs have been used in marine and estuarine environmental monitoring programs (e.g., see case studies reviewed recently in Kramer, 1994; Kennish, 1998; Livingston, 2001). Allocation of samples in space and time varies depending on the environmental problems and issues addressed (Kingsford and Battershill, 1998) and the type of variables measured (e.g., water chemistry, phytoplankton, zooplankton, benthos, nekton). In the Chesapeake Bay, the benthic monitoring program consists of both fixed-point stations and probability-based samples. The fixed-point stations are used primarily for the determination of long-term trends (e.g., Dauer and Alden, 1995; Dauer, 1997; Dauer et al. 2006a,b,c) and the probability-based samples for the determination of the areal extent of degraded benthic community condition (Llansó et al. 2003; Dauer and Llansó 2003). The probability-based sampling design consists of equal replication of random samples among strata and is, therefore, a stratified simple random design (Kingsford, 1998). Sampling design and methodologies for probability-based sampling are based upon procedures developed by EPA's Environmental Monitoring and Assessment Program (EMAP, Weisberg et al. 1993) and allow unbiased comparisons of conditions between strata (Dauer and Llansó 2003).

Within each stratum (Money Point and Blows Creek) 25 random locations were sampled using a 0.04 m^2 Young grab. The 2010 sampling locations are in Table 1 of Dauer (2011), for the 2013 sampling in Table 1 of Appendix B of Dauer (2014). The 2016 sampling locations are shown in Figures 5 and 6 and the coordinates are in Table 1 of Appendix B. The minimum acceptable depth of penetration of the grab was 7 cm. At each station one grab sample was taken for macrobenthic community analysis and an additional grab sample for sediment particle size analysis and the determination of total volatile solids. A 50 g subsample of the surface sediment was taken for sediment analyses. Salinity, temperature and dissolved oxygen were measured at the bottom and water depth was recorded.

Fixed point stations

To better understand the spatial and temporal patterns in benthic community condition measures at the two probability-based strata (Money Point and Blows Creek), data from two fixed stations of the Chesapeake Bay Benthic Monitoring Program (Dauer et al. 2017) were included. Station SBE2 is downstream of the Money Point beyond the Jordon Bridge and SBE5 is located upstream between the Gilmerton Bridge and the High Rise Bridge (Figure 2). Both stations have been sampled every summer since 1989.

For the fixed point stations three replicate box core samples were collected for benthic community analysis. Each replicate had a surface area of 0.0184 m^2, a minimum depth of penetration to 25 cm within the sediment, was sieved on a 0.5 mm screen, relaxed in dilute

isopropyl alcohol and preserved with a buffered formalin-rose bengal solution. At each station on each collection date a 50g subsample of the surface sediment was taken for sediment analysis.

Probability-Based Estimation of Degradation

Areal estimates of degradation of benthic community condition within a stratum can be made because all locations in each stratum are randomly selected. The estimate of the proportion of a stratum failing the Benthic Restoration Goals developed for Chesapeake Bay (Ranasinghe et al. 1994; updated in Weisberg et al. 1997) is the proportion of the 25 samples with B-IBI values of less than 3.0. The process produces a binomial distribution: the percentage of the stratum attaining goals versus the percentage not attaining the goals. With a binomial distribution the 95% confidence interval for these percentages can be calculated as:

$$95\% \text{ Confidence Interval} = p \pm 1.96 (SQRT(pq/N))$$

where p = percentage attaining goal, q = percentage not attaining goal and N = number of samples. This interval reflects the precision of measuring the level of degradation and indicates that with a 95% certainty the true level of degradation is within this interval. Differences between levels of degradation using a binomial distribution can be tested using the procedure of Schenker and Gentleman (2001).

50 random points were selected using the GIS system of Versar, Inc. Decimal degree reference coordinates were used with a precision of 0.000001 degrees (approximately 1 meter) which is a smaller distance than the accuracy of positioning; therefore, no area of a stratum is excluded from sampling and every point within a stratum has a chance of being sampled. In the field the first 25 acceptable sites are sampled. Sites may be rejected because of inaccessibility by boat, inadequate water depth or inability of the grab to obtain an adequate sample (e.g., on hard bottoms).

Laboratory Analysis

Each replicate was sieved on a 0.5 mm screen, relaxed in dilute isopropyl alcohol and preserved with a buffered formalin-rose bengal solution. In the laboratory each replicate was sorted and all the individuals identified to the lowest possible taxon and enumerated. Biomass was estimated for each taxon as ash-free dry weight (AFDW) by drying to constant weight at 60 ^{o}C and ashing at 550 ^{o}C for four hours. Biomass was expressed as the difference between the dry and ashed weight.

Particle-size analysis was conducted using the techniques of Folk (1974). Each sediment sample is first separated into a sand fraction (> 63 µm) and a silt-clay fraction (< 63 µm). The sand fraction was dry sieved and the silt-clay fraction quantified by pipette analysis. For random stations, only the percent sand and percent silt-clay fraction were estimated. Total volatile solids of the sediment was estimated by the loss upon ignition method as described

above and presented as percentage of the weight of the sediment.

Benthic Index of Biotic Integrity

B-IBI and Benthic Community Status Designations

The B-IBI is a multiple-metric index developed to identify the degree to which a benthic community meets the Chesapeake Bay Program's Benthic Community Restoration Goals (Ranasinghe et al. 1994; Weisberg et al. 1997; Alden et al. 2002). The B-IBI provides a means for comparing relative condition of benthic invertebrate communities across habitat types. It also provides a validated mechanism for integrating several benthic community attributes indicative of community health into a single number that measures overall benthic community condition.

The B-IBI is scaled from 1 to 5, and sites with values of 3 or more are considered to meet the Restoration Goals. The index is calculated by scoring each of several attributes as either 5, 3, or 1 depending on whether the value of the attribute at a site approximates, deviates slightly from, or deviates strongly from the values found at reference sites in similar habitats, and then averaging these scores across attributes. The criteria for assigning these scores are numeric and dependent on habitat type. Application of the index is limited to a summer index period from July 15th through September 30th.

Benthic community condition was classified into four levels based on the B-IBI. Values **≥** 2 were classified as **severely degraded**; values from 2.1 to 2.6 were classified as **degraded**; values greater than 2.6 but less than 3.0 were classified as **marginal**; and values of 3.0 or more were classified as **meeting the goal**. Values in the marginal category do not meet the Restoration Goals, but they differ from the goals within the range of measurement error typically recorded between replicate samples. These categories are used in annual characterizations of the condition of the benthos in the Chesapeake Bay (e.g. Dauer et al. 2002a, b; Llansó et al 2004).

Further Information concerning the B-IBI

The analytical approach used to develop the B-IBI was similar to the one Karr et al. (1986) used to develop comparable indices for freshwater fish communities. Selection of benthic community metrics and metric scoring thresholds were habitat-dependent but by using categorical scoring comparisons between habitat types were possible. A six-step procedure was used to develop the index: (1) acquiring and standardizing data sets from a number of monitoring programs, (2) temporally and spatially stratifying data sets to identify seasons and habitat types, (3) identifying reference conditions, (4) selecting benthic community metrics, (5) selecting metric thresholds for scoring, and (6) validating the index with an independent data set (Weisberg et al. 1997). The B-IBI developed for Chesapeake Bay is based upon subtidal, unvegetated, infaunal macrobenthic communities. Hard-bottom communities, e.g., oyster beds, were not sampled because the sampling gears could not obtain adequate samples to characterize the associated infaunal communities. Infaunal communities associated with

submerged aquatic vegetation (SAV) were not avoided, but were rarely sampled due to the limited spatial extent of SAV in Chesapeake Bay.

Only macrobenthic data sets based on processing with a sieve of 0.5 mm mesh aperture and identified to the lowest possible taxonomic level were used. A data set of over 2,000 samples collected from 1984 through 1994 was used to develop, calibrate and validate the index (see Table 1 in Weisberg et al. 1997). Because of inherent temporal sampling limitations in some of the data sets, only data from the period of July 15 through September 30 were used to develop the index. A multivariate cluster analysis of the biological data was performed to define habitat types. Salinity and sediment type were the two important factors defining habitat types and seven habitats were identified - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand and polyhaline mud habitats (see Table 5 in Weisberg et al. 1997).

Reference conditions were determined by selecting samples which met all three of the following criteria: no sediment contaminant exceeded Long et al.'s (1995) effects range-median (ER-M) concentration, total organic content of the sediment was less than 2%, and bottom dissolved oxygen concentration was consistently high.

A total of 11 metrics representing measures of species diversity, community abundance and biomass, species composition, depth distribution within the sediment, and trophic composition were used to create the index. The habitat-specific metrics were scored and combined into a single value of the B-IBI. Thresholds for the selected metrics were based on the distribution of values for the metric at the reference sites. Data used for validation were collected between 1992 and 1994 and were independent of data used to develop the index. The B-IBI classified 93% of the validation sites correctly (Weisberg et al. 1997).

Llansó et al. 2016 using new data collected after Weisberg et al. 1997, in order to assess whether the B-IBI and the thresholds for its metric should be re-calibrated. They concluded that modifications to the original thresholds of Weisberg et al. (1997) and Alden et al. (2002) based upon new data did not result in better overall classification efficiencies. The single change in the B-IBI metrics was changing the classification of the polychaete *Mediomastus ambiseta* from pollution sensitive to unclassified. This species has been referred to as opportunistic and pollution indicative based both on ecological surveys (Grassle and Grassle, 1974; Boesch, 1977; Billheimer et al., 1997) and experimental results (Shaffner, 1990). Given the evidence from the literature and their extensive data analyses, Llansó et al. 2016, concluded that *M. ambiseta* could not be classified as either pollution sensitive or pollution indicative for the purposes of the B-IBI calculation. This change did result in lower B-IBI values for both Money Point and Blows Creek as reported in Dauer (2011, 2014).

Statistical Analyses

Two-way ANOVAs were performed on the BIBI, abundance, biomass, species diversity, species richness, body size (weight per individual), percentage of pollution indicative species

abundance and percentage of pollution tolerant species abundance with stratum (Money Point versus Blows Creek) and year (2010, 2013, 2016) as the main effects. A significant interaction term between the main effects would indicate that significant changes occurred between the strata and the years. This results in a BACI (Before- After Control-Impact) design where a significant space-time interaction term is indicative of a possible remediation effect (Green 1979; Stewart-Oaten et al. 1992). All tests with a significant interaction term were further tested separately by the main effects. A One Way ANOVA and the post hoc Scheffe was used to test for the main effect of years and a t-test for the main effect of stratum within each year.

RESULTS AND SUMMARY

Benthic Community Condition using Probability-Based Sampling

Environmental Parameters

Physical-chemical parameters are summarized in Tables 2-5 of Appendix B. Salinity was in the polyhaline range (18-32) for all samples except for the Blows Creek samples collected on 9/23/2016 when salinities in the low mesohaline to oligohaline range were recorded. Rainfall was higher than average that year. Between the September 9 and September 23 samples at Blows Creek, 5.8 inches of rain fell with the average total rainfall for September is 4.8 inches (measured at Norfolk International Airport and data from the Weather Underground website).

Sediments were a mixture of sands and muds. For both the mean percentage of silt-clay and total volatile solids the pattern at Money Point was high values of both in 2010, a decrease in both in 2013 and then an increase again in 2016 (Figures 7 and 8). The high total volatile solids (mean of 6.9%) at Money Point in 2010 reflects the levels of PAHs in the sediment at that time. In 2013 after remediation total volatile solids greatly decreased and the sediments were less muddy (greater amount of sand probably due to the cap of clean sand). However, in 2016 the sediments at Money Point were muddier, having the highest mean percent silt-clay but with total volatile solids lower than in 2010 and only marginally different from Blows Creek in 2016 ($p = 0.094$). Clearly the remediation affected the sediments at Money Point and resulted in sandier sediment; however, in 2016 sedimentation of fine particles changed the sediments at Money Point back to finer sediments than Blows Creek (Figure 7).

Benthic Community Condition

The benthic community parameters (the B-IBI value, abundance, biomass, Shannon diversity index and species richness) were compared between the strata (Money Point, Blows Creek) and times (summer samples from 2010, 2013, 2016). The two-way ANOVAs with stratum and year as the main effects resulted in significant stratum-year interaction terms for the BIBI (0.008), biomass (0.0007), Shannon diversity (<0.0001), and species richness (0.005) but not for abundance (0.319). The BIBI and the metrics with significant interactions terms indicate significant changes occurred between the strata and years that could be indicative of a significant remediation effect. Therefore, separate statistical tests were necessary between the

strata and among the years as indicated in Table 1 - t-tests for the stratum comparisons and one-way ANOVAs for the year comparisons.

BIBI

The value of the BIBI was significantly lower at Money Point in 2010 compared to Blows Creek, increased in 2013 and then decreased in 2016 and was again significantly lower than Blows Creek (Figures 9). However, the BIBI values at Money Point did not change significantly over the years (Figure 10). BIBI values showed a convex, non-linear trend at SBE2 and a declining trend at SBE5 over the previous 10-year period (Figures 25, 26). BIBI values at both SBE2 and SBE5 showed more variability and often higher values in the years between the sampling at Money Point (2010, 2013, 2016). Compared to SBE2 and SBE5, Money Point BIBI values were higher in all three years except for the 2010 BIBI value at SBE2. BIBI values at both SBE2 and SBE5 were higher that the sampling years of 2010, 2013 and 2016 with the single exception of SBE5 in 2015.

Abundance

The abundance at both Money Point and Blows Creek were high in 2010, declined at both strata in 2013 with the Money Point value significantly lower than at Blows Creek, and again declined at both strata in 2016 with the Money Point value again significantly lower than at Blows Creek (Figure 11). At Money Point the abundance values were significantly different in each year and declined in each sampling year (Figure 12). Abundance values at both SBE2 and SBE5 showed declining patterns over the past decade (Figures 12, 27, 28) with a single exception at SBE5 in 2011 (Figure 28).

Biomass

Biomass at Money Point was significantly lower than that at Blows Creek in 2010, significantly increased in 2013, but decreased in 2016 and was again significantly lower than levels at Blows Creek (Figure 13). There was a pattern of declining biomass at Blows Creek over the years but the differences were not significant (Figure 14). In general, there was a pattern of decreasing biomass at both SBE2 and SBE5 over the past decade (Figures 29, 30) and during the collections years (2010, 2013, 2016) biomass values at both SBE2 and SBE5 were similar to, or lower than, both the Money Point and Blows Creek strata except for the Money Point values in 2010 (Figures 29, 30). The 2010, 2013 and 2016 biomass values at SBE5 were the lowest recorded at that station for the past decade.

Species Diversity (H')

Species diversity (H') in 2010 was not significantly different between the strata (Figure 15), increased significantly at Money Point in 2013 and was also significantly higher at Money Point than at Blows Creek (Figure 15), and H' increased to the highest levels at both strata in 2016 (Figure 15, 16). The pattern for species diversity values at SBE2 showed an increasing trend similar to the increasing pattern at the two strata (Figure 31). In contrast, the species diversity values at SBE5 showed no pattern (Figure 32). In 2016, species diversity values at the two strata were higher than either fixed station (Figures 31, 32).

Species Richness

Species richness (number of species per sample) showed a very different pattern than species diversity (H') (Figures 17, 18). Species richness was significantly lower at Money Point in 2010 (Figure 17), significantly increased at Money Point in 2013 to a level not different from Blows Creek, and declined in 2016 with a value significantly lower than Blows Creek (Figure 18). Species richness at both fixed stations did not show a strong pattern and values at these two stations cannot be directly compared because different gear types were used – a Young grab (0.04 m^2) at MP and BC and a box-corer (0.0184 m^2) at SBE2 and SBE5 (Figures 33, 34).

Pollution Sensitive Species, Pollution Indicative Species, and Body Size

Benthic communities unaffected by anthropogenic or natural stress are expected to have (1) higher species diversity, (2) higher community biomass and (3) are dominated in composition by longer-lived, larger-bodied and often deeper-dwelling (within the sediment) species (Rhoads and Boyer, 1982; Warwick, 1986, Dauer 1993). Such species are often referred to as equilibrium, K-selected (McCall 1977, Gray 1979, Dauer 1993) or pollution sensitive species (Weisberg et al. 1997). In contrast, stressed benthic communities are characterized by (1) lower species diversity, (2) often lower community biomass and (3) are dominated in composition by short-lived, small-bodied and often surface-dwelling species (Boesch, 1977; Pearson and Rosenberg, 1978, Dauer 1993). Such species are often referred to as eurytopic opportunistic, r-selected or pollution tolerant species (Boesch, 1977; Pearson and Rosenberg, 1978, Dauer 1993).

Prior to the sediment remediation the average body size of benthic species was only marginally different between the strata in 2010 and after remediation the average body size increased significantly at Money Point in 2013 (Figure 20) and was significantly greater that at Blows Creek (Figure 19). Finally, in 2016 the average body size at Money Point remained high and was marginally greater than at Blows Creek in 2016 (Figure 19).

The percentage of pollution sensitive abundance was lowest at Money Point in 2010 but not significantly different from that at Blows Creek in 2010 (Figure 21). After remediation the pollution sensitive abundance increased steadily at both Money Point and Blows Creek in 2013 and again in 2016 (Figures 21 and 22). By 2016 the pollution sensitive species abundance was significantly higher at Money Point compared to the pre-remediation value in 2010 (Figure 22) although lower than the value at Blows Creek in 2016 (Figure 21).

The percentage of pollution indicative abundance was highest at Money Point in 2010 and was significantly higher than at Blows Creek (Figure 23). The value of pollution indicative taxa abundance significantly declined after remediation in 2013 and remained unchanged in 2016 (Figure 24).

In 2016 at Money Point the (1) continued large body size (Figure 20), (2) continued lowered level of pollution indicative abundance (Figure 24) and (3) slightly higher level of pollution sensitive abundance (Figure 22) all indicate that the very positive improvement in benthic community composition quantified after remediation in the 2013 sampling continued in 2016. Although the percentage of pollution sensitive abundance in 2016 was significantly lower at Money Point (Figure 21) and the percentage of pollution indicative abundance was significantly higher (Figure 23), the average body size was higher at Money Point – all positive indicators of persistent remediation improvements.

Benthic Community Condition Summary

The patterns above for the BIBI, abundance, biomass, species diversity and species richness are summarized in Table 2.

The patterns above for the body size, pollution indicative species abundance and pollution sensitive abundance are summarized in Table 3.

Benthic Community Dominant Species

The dominant taxa of the random sites are summarized in Tables 4 and 5. Consistent with previous studies the Money Point stratum was dominated by annelid species including the polychaete species *Mediomastus ambiseta*, *Hermundura* sp. A, *Paraprionospio pinnata*, *Streblospio benedicti*, *Leitoscoloplos* spp., and *Glycinde solitaire.*

The only major change was that the two pollution indicative polychaete species (*Mediomastus ambiseta* and *Streblospio benedicti*) at Money Point decreased from a combined level of 4,956 individuals per m^2 in 2010 to 1,244 individuals per m^2 in 2013 and then to 457 individuals per

m^2 in 2016; representing, 82.4% of the individuals in 2010, 47.1% of the individuals in 2013, and 33.5% of the individuals in 2016.

Mediomastus ambiseta has often been characterized as a stress tolerant or opportunistic species characteristic of disturbed habitats (Grassle and Grassle 1974; Schaffner 1990; Dauer et al. 1993; Dauer 1993). *Streblospio benedicti* has also been characterized as a stress tolerant or euryhaline opportunist characteristic of disturbed habitats (Boesch 1977; Holland et al. 1987; Dauer et al. 1993; Dauer 1993) with tolerance to both hypoxic bottom water conditions (Ritter and Montagna 1999; Llansó, 1991, 1992) and sediment PAHs (Chandler et al. 1997).

The decline in abundance of these two pollution indicative species indicates that there are no lasting and returning sediment contaminant effects at Money Point. More importantly abundance values at both SBE2 and SBE5 showed declining patterns over the past decade (Figures 12, 19, 20) indicating larger scale watershed factors were influencing abundance patterns at the level of the entire Southern Branch, for example, poor larval recruitment, low post-larval survivorship, increased mortality associated with predation, etc.

The most consistent and common species was the polychaete *Hermundura* sp. A (reported as *Parandalia tricuspis* in Dauer 2011) recorded as the third most common species in 2010 (514 individuals per m^2), second most common species in 2013 (381 individuals per m^2), and again second most common species in 2016 (351 individuals per m^2). *Hermundura* sp. A is most similar to a species described in the Gulf of Mexico (*H. americana* (Hartman 1947)) and was first reported in Chesapeake Bay in 2009 from a single sample in the Southern Branch of the Elizabeth River. This species is now collected throughout the tidal James River but nowhere else in Chesapeake Bay. Nothing is known of its biology.

Benthic Community Level of Degraded Area

The 2010 level of degraded benthic bottom of Money Point was 96% ± 4.0% - the highest level of degradation recorded by any previous studies in the Elizabeth River watershed. Previous quantitative areal estimates of benthic degradation in the watershed have varied from 52 ± 19.6% in 2001 to 84 ± 12.7% in 2005. In the summer of 2013 the level of degraded benthic bottom off Money Point declined to 76% ± 16.3%. However, in the summer of 2016 level of degraded benthic bottom off Money Point increased again to 92% ± 10.6%.

Recommendation

The benthic community condition at Money Point clearly improved after sediment remediation as shown in the results from the 2013 field sampling (Dauer 2014). The present results indicate that (1) natural sedimentation increased the silt-clay content and percent total volatile solids content; (2) although the BIBI remains unchanged over time at Money Point, species diversity remains relatively high and is tracking the levels at Blows Creek; (3) the continued decrease in

abundance of the two dominant pollution indicative polychaete species clearly indicates that there are not any persistent sediment contaminant effects; (4) the larger body size of species at Money Point, continued lowered level of pollution indicative abundance, and slightly higher level of pollution sensitive abundance indicate that the very positive improvement in benthic community composition quantified after remediation in the 2013 sampling continued in 2016. Continued periodic sampling at Money Point and Blows Creek will provide further assessment of the apparent beneficial effects of the remediation on the benthic community condition.

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Figures 1- 26

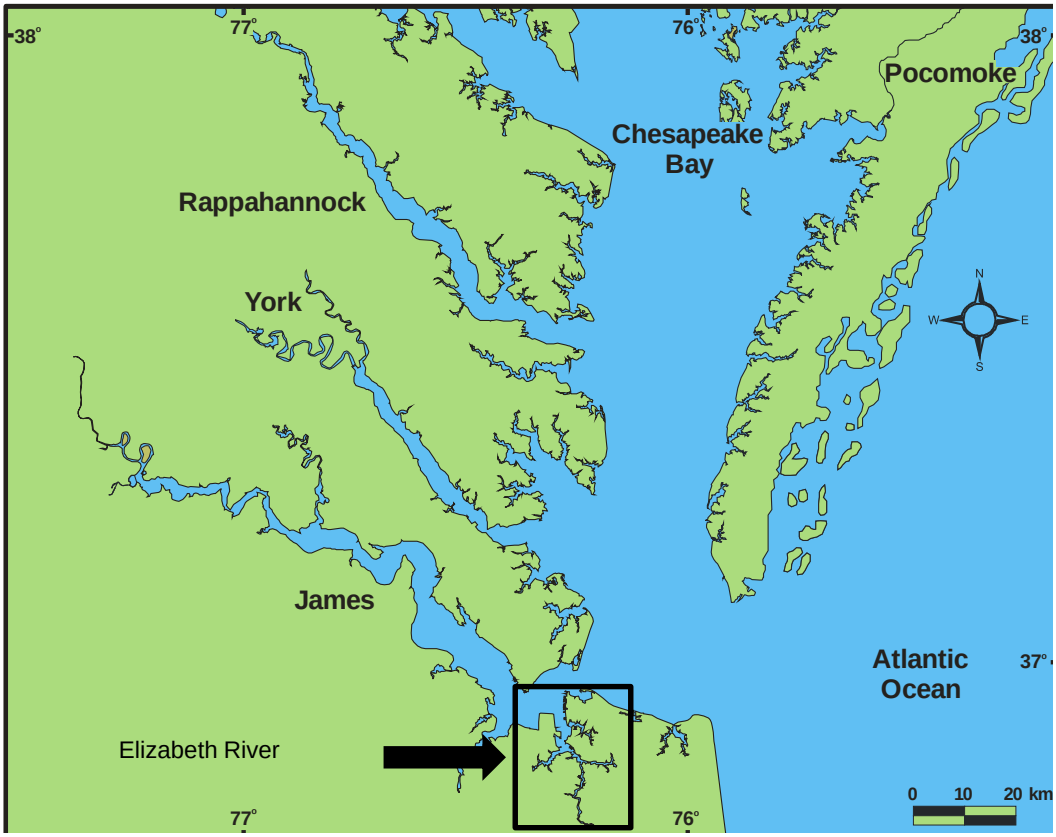

Figure 1. Lower Chesapeake Bay indicating the Elizabeth River watershed.

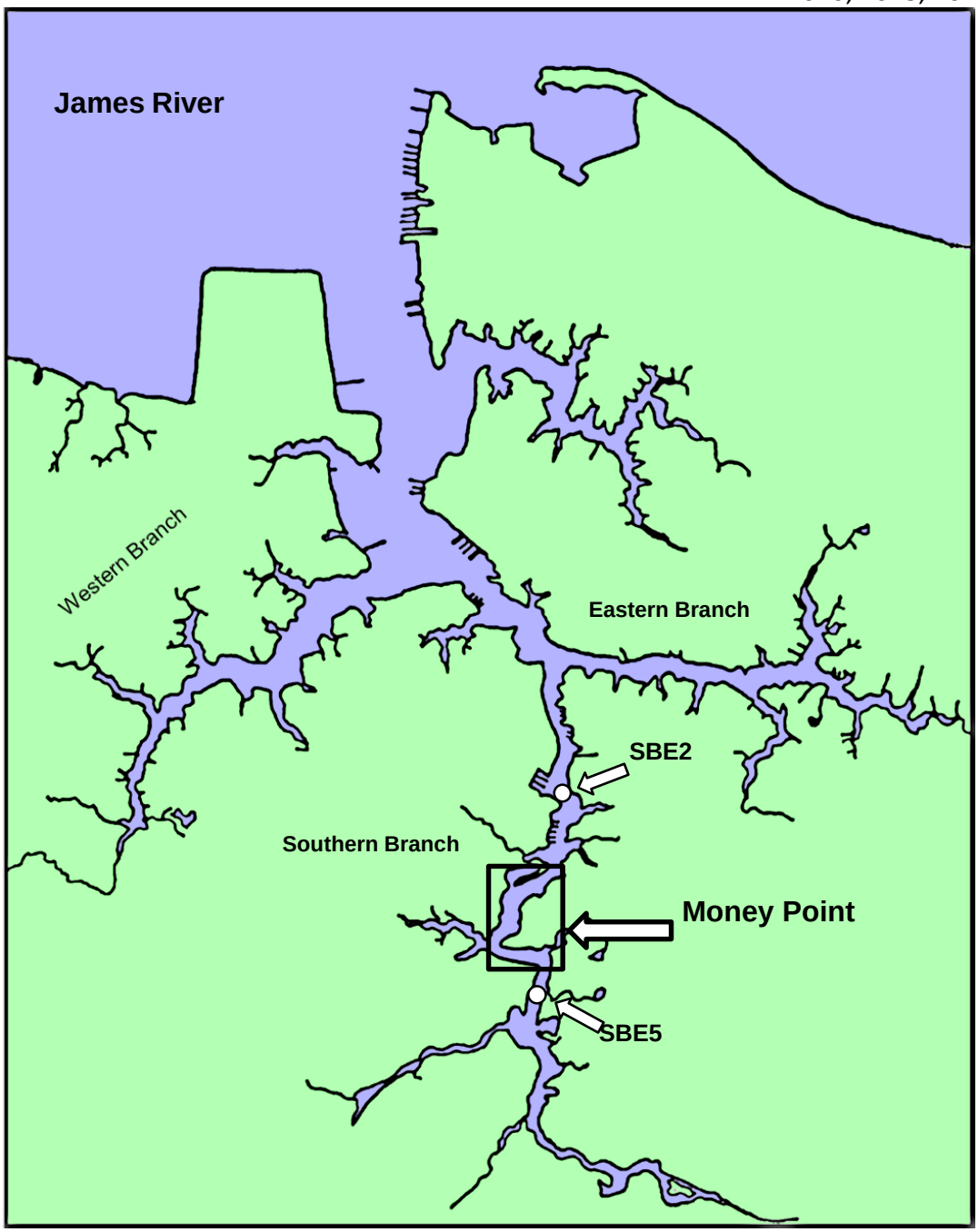

Figure 2. Elizabeth River Watershed indicating the Money Point region of the Southern Branch. SBE2 and SBE5 fixed stations of the Chesapeake Bay Benthic Monitoring Program sampled from 1989 to present.

Figure 3. Money Point region of the Southern Branch of the Elizabeth River showing in red the benthic sampling stratum.

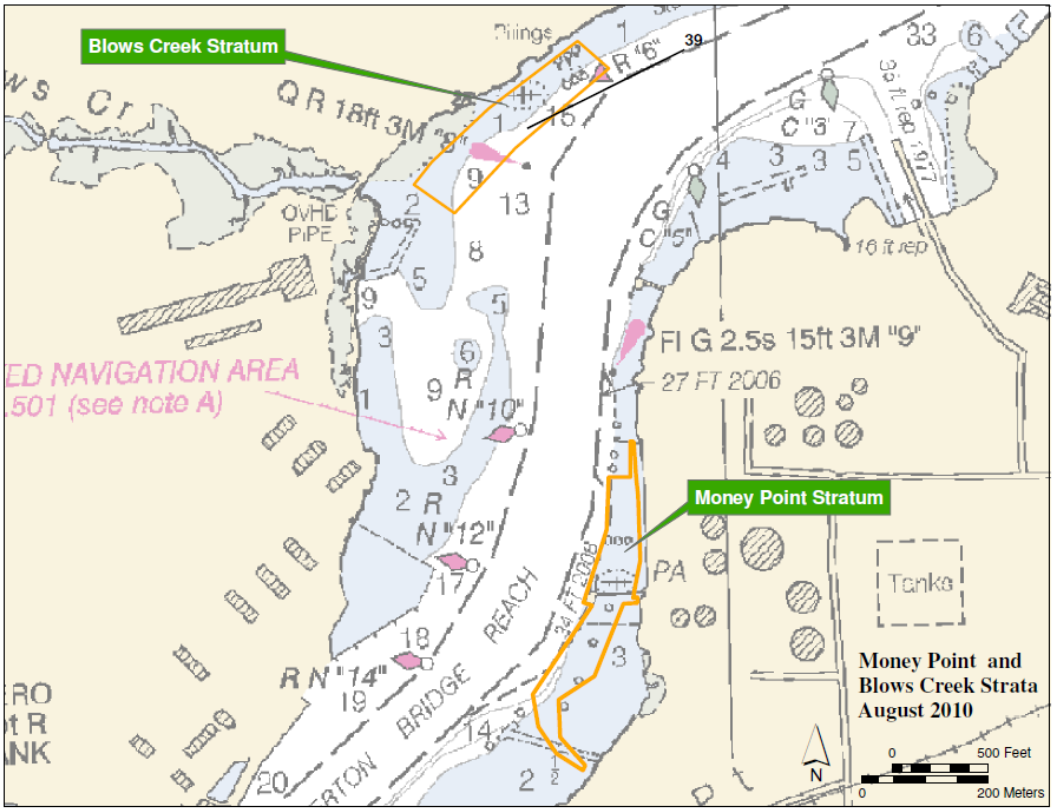

Figure 4. Location of the Money Point and Blows Creek strata in the Southern Branch of the Elizabeth River.

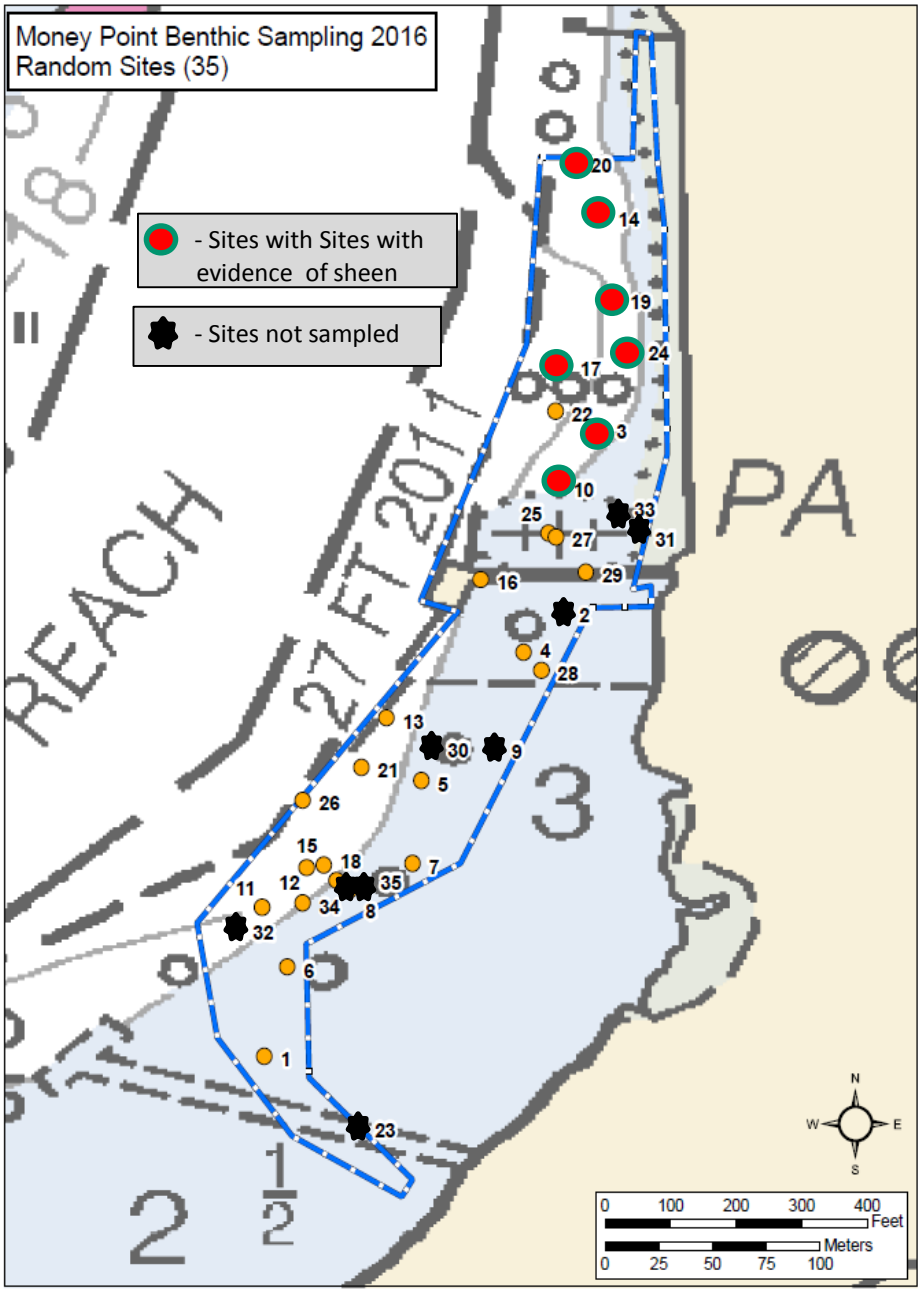

Figure 5. Money Point stratum random locations. Sites sampled with marked by gold circle. Sampled sites that showed evidence of sheen in the field marked with a red circle.

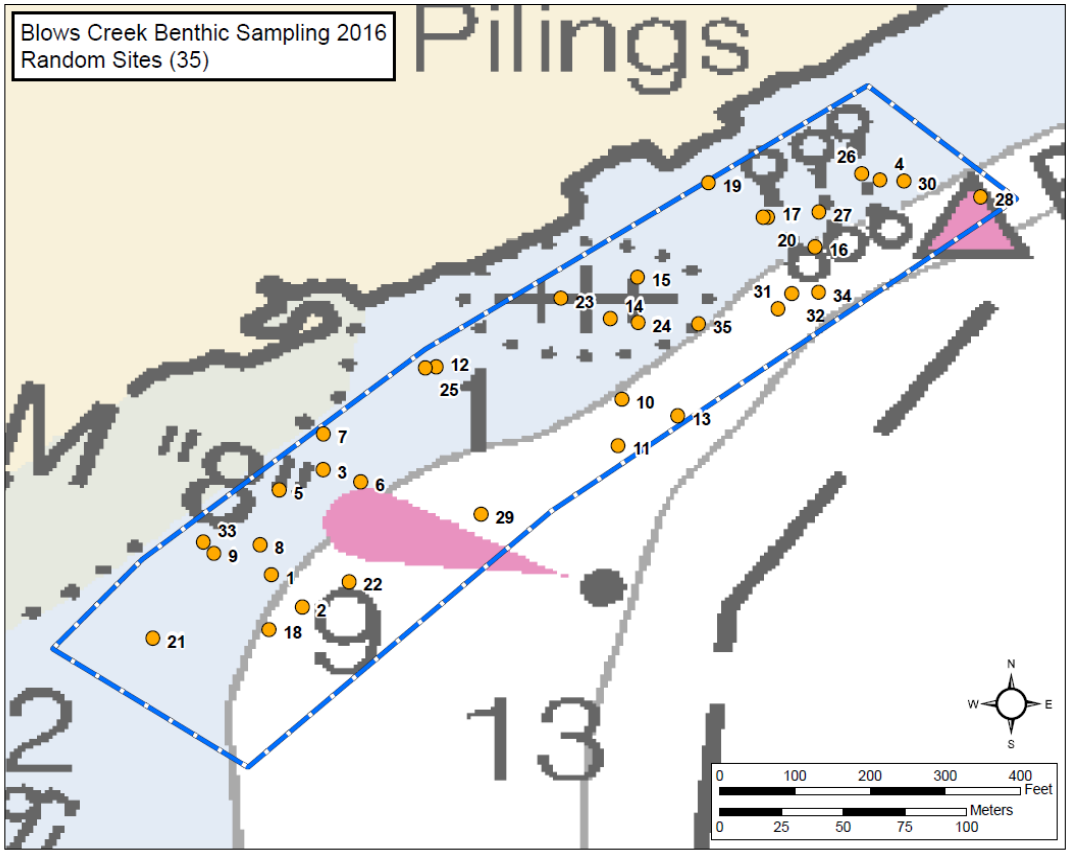

Figure 6. Blows Creek stratum random locations. Sites 1-25 were sampled.

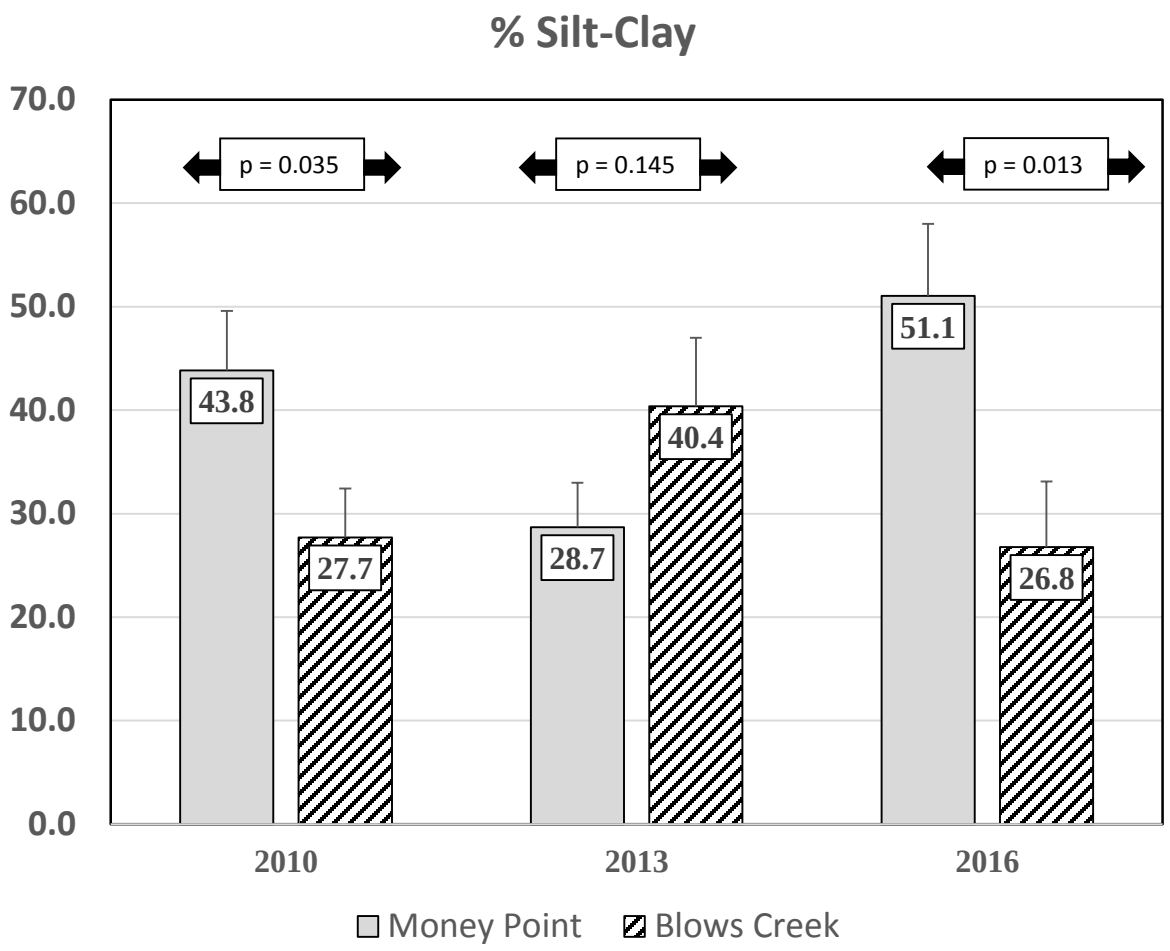

Figure 7. Comparison of sediment percentage silt-clay content between collection years (2010, 2013, 2016) at Money Point and Blows Creek. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar.

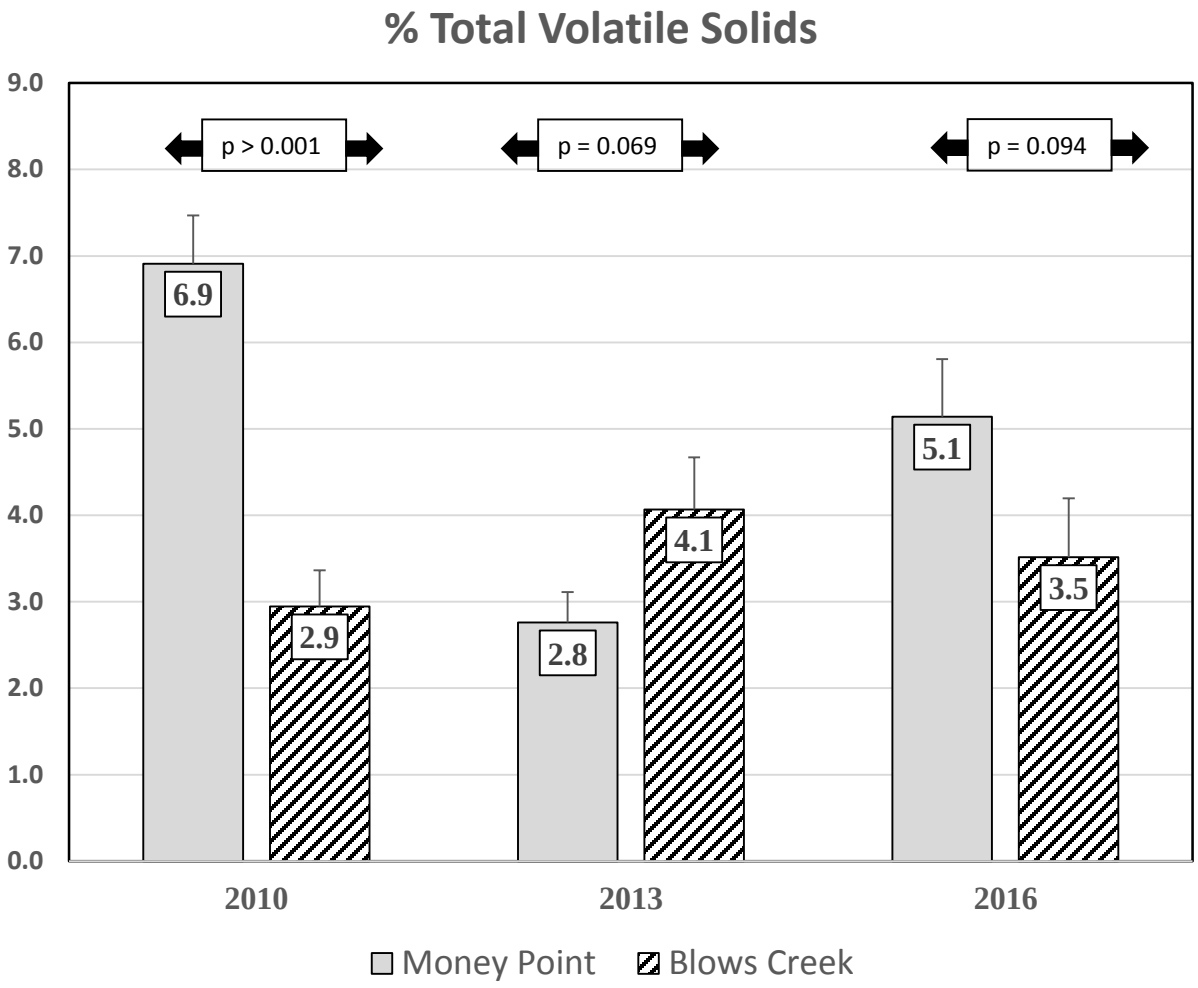

Figure 8. Comparison of total volatile solids between collection years (2010, 2013, 2016) at Money Point and Blows Creek. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar.

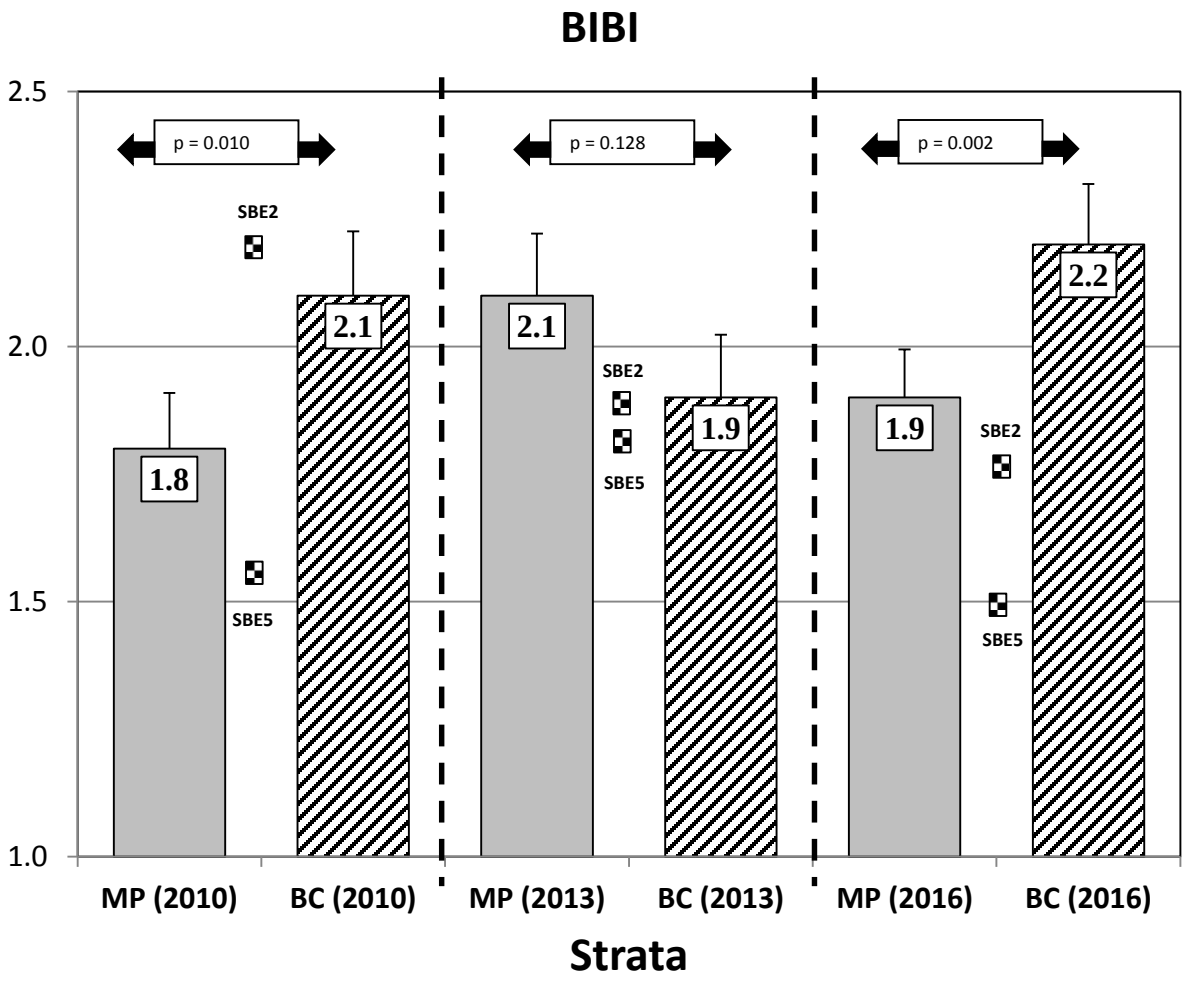

Figure 9. Mean BIBI values (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar. Checkered squares are mean values at SBE2 (downstream) and SBE5 (upstream) in the respective sampling years for spatial perspective.

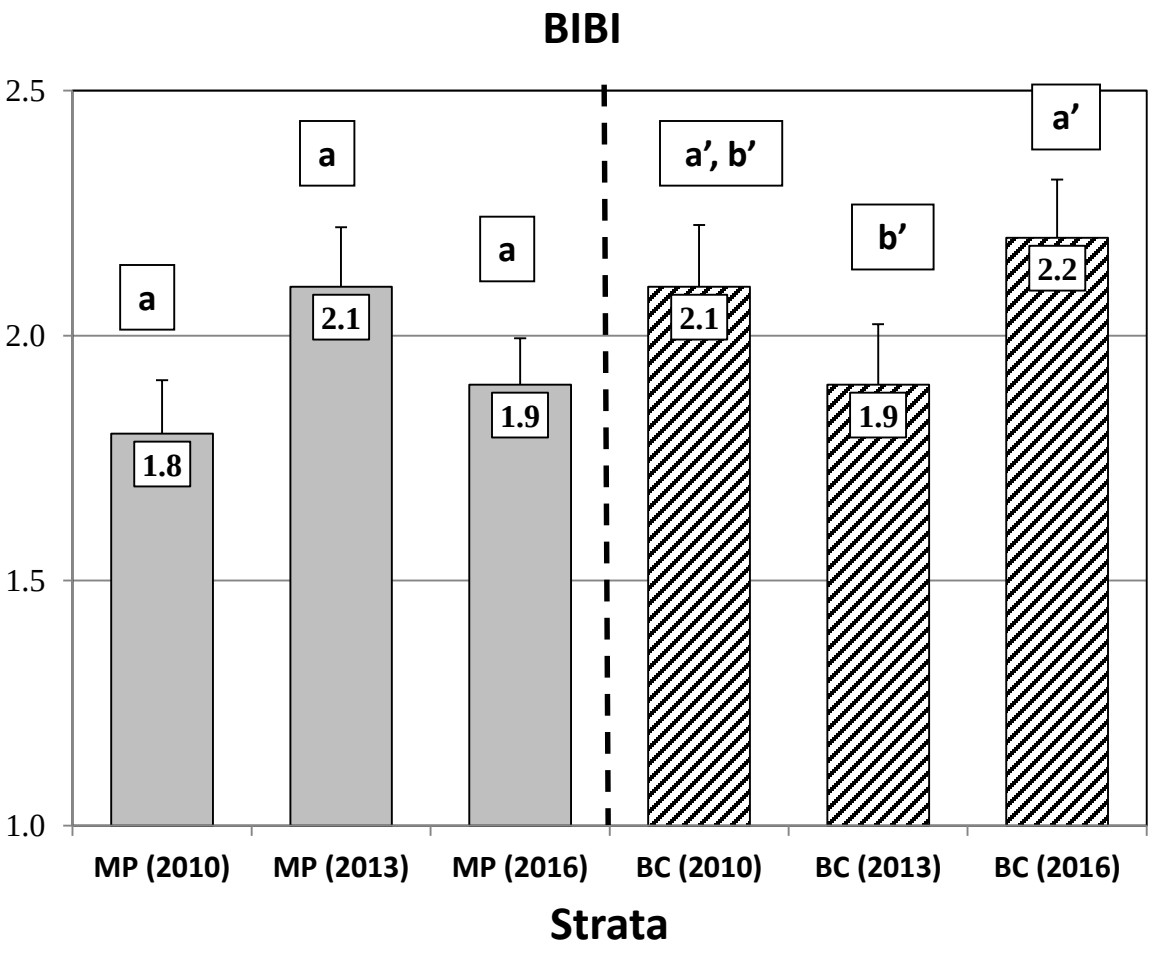

Figure 10. Mean BIBI (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) strata sampled prior to the sediment contaminant remediation (2010) and after the remediation (2013 and 2016). Mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

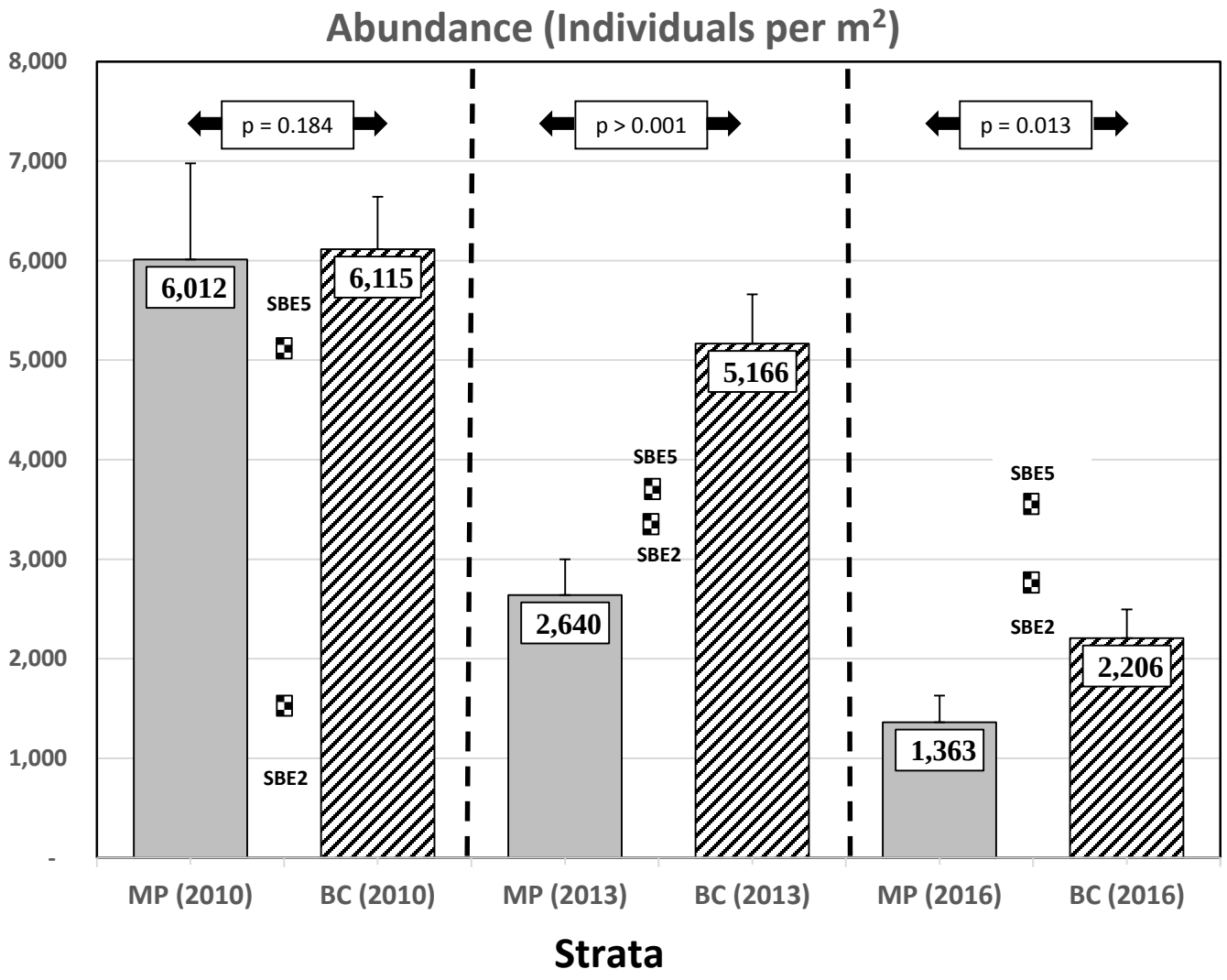

Figure 11. Abundance (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar. Checkered squares are mean values at SBE2 (downstream) and SBE5 (upstream) in the respective sampling years for spatial perspective.

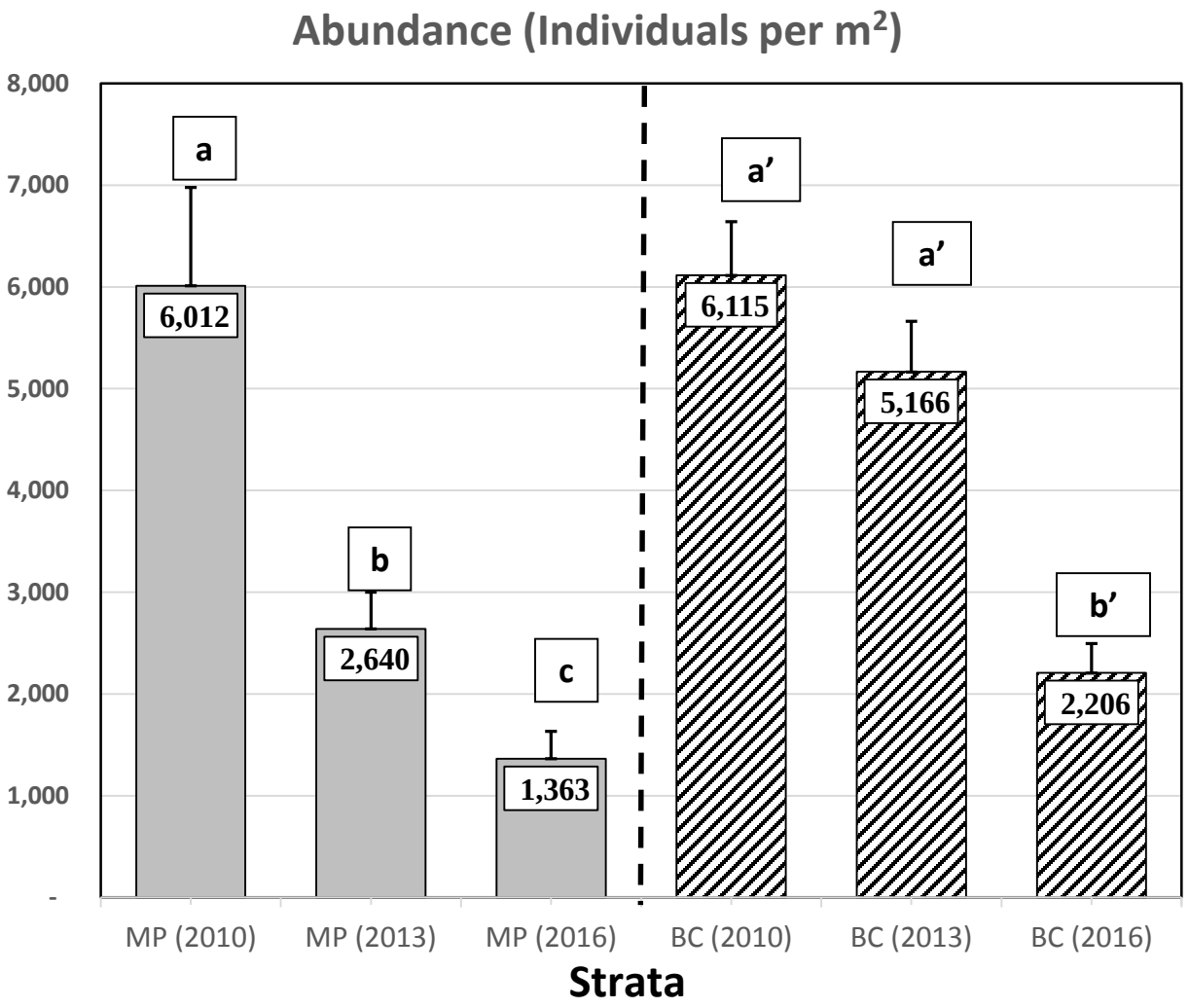

Figure 12. Abundance (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

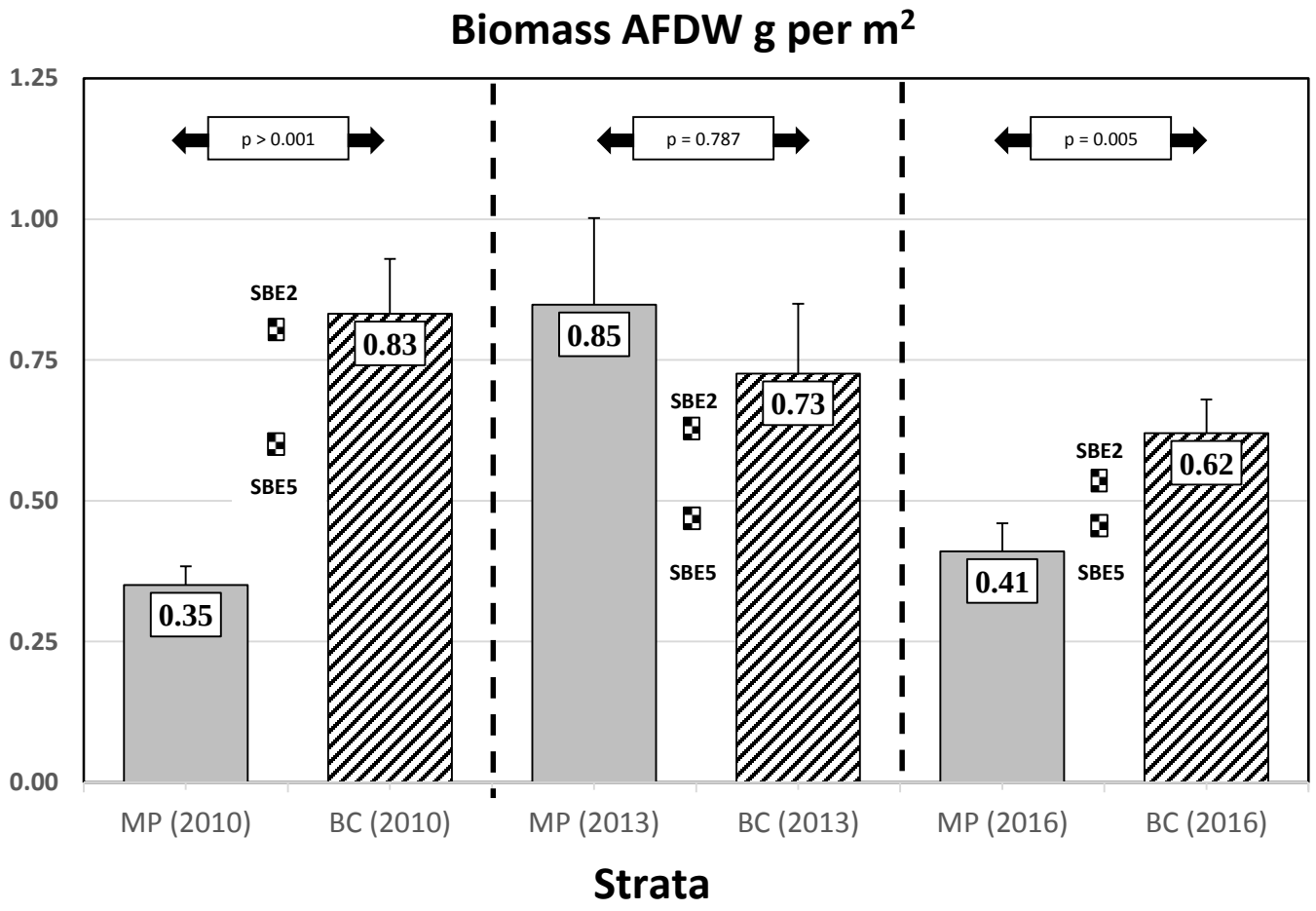

Figure 13. Biomass (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar. Checkered squares are mean values at SBE2 (downstream) and SBE5 (upstream) in the respective sampling years for spatial perspective.

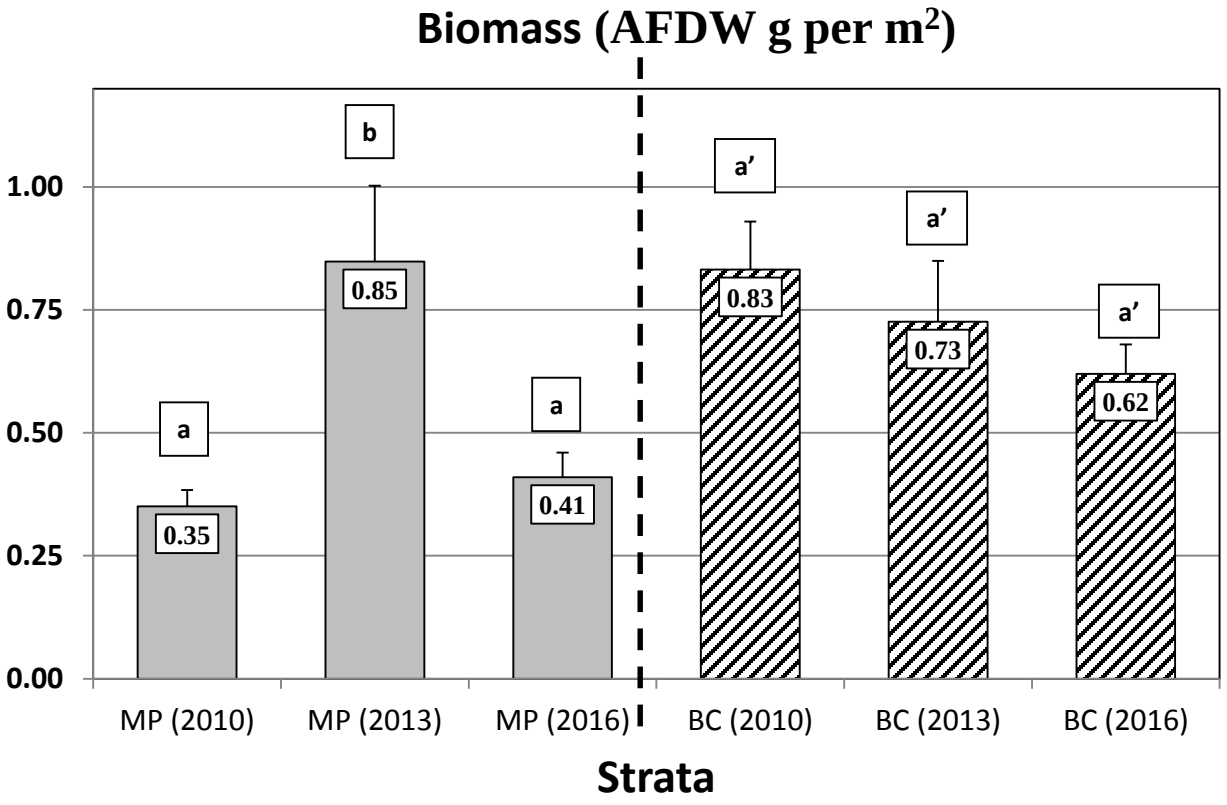

Figure 14. Biomass (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

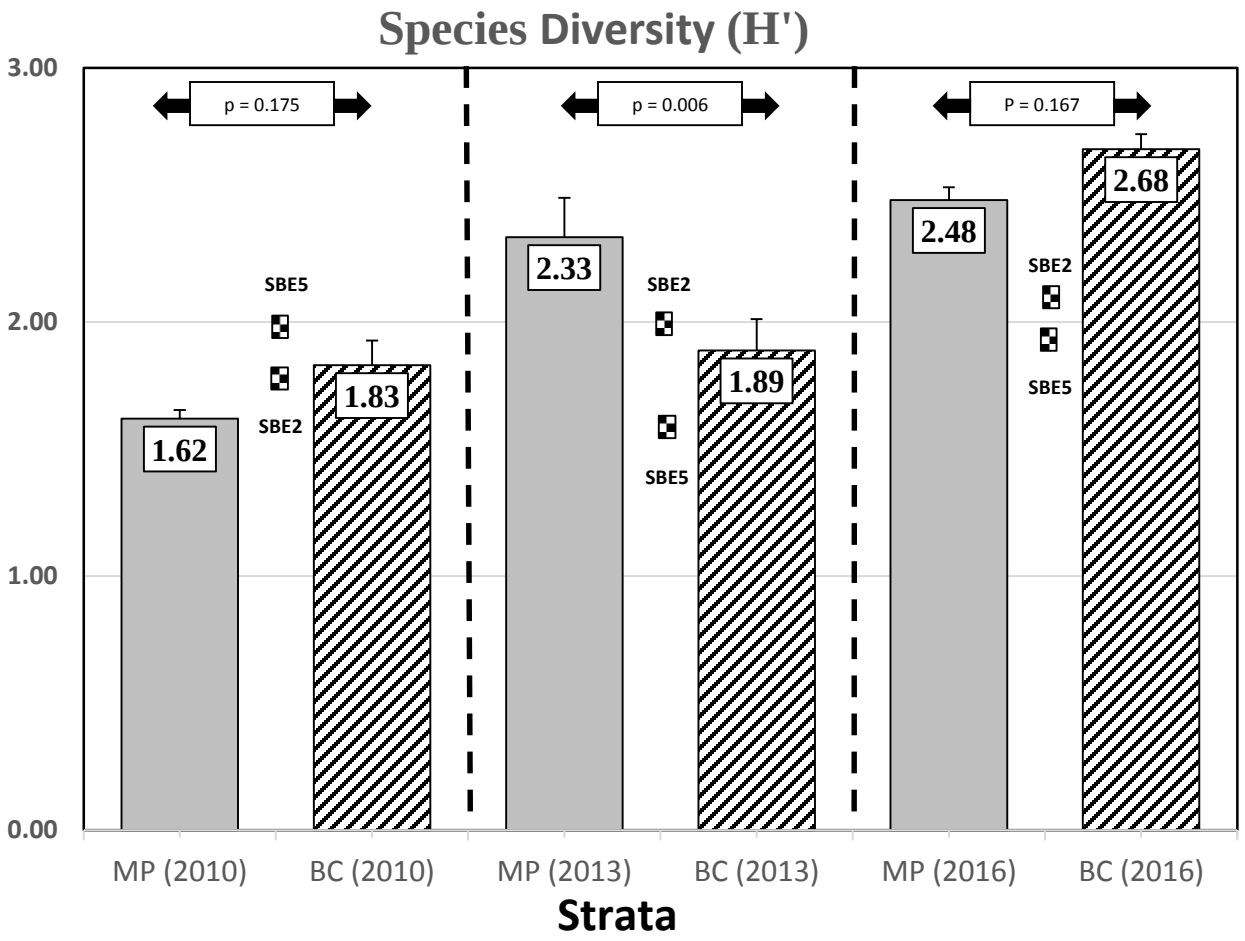

Figure 15. Species diversity (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar. Checkered squares are mean values at SBE2 (downstream) and SBE5 (upstream) in the respective sampling years for spatial perspective.

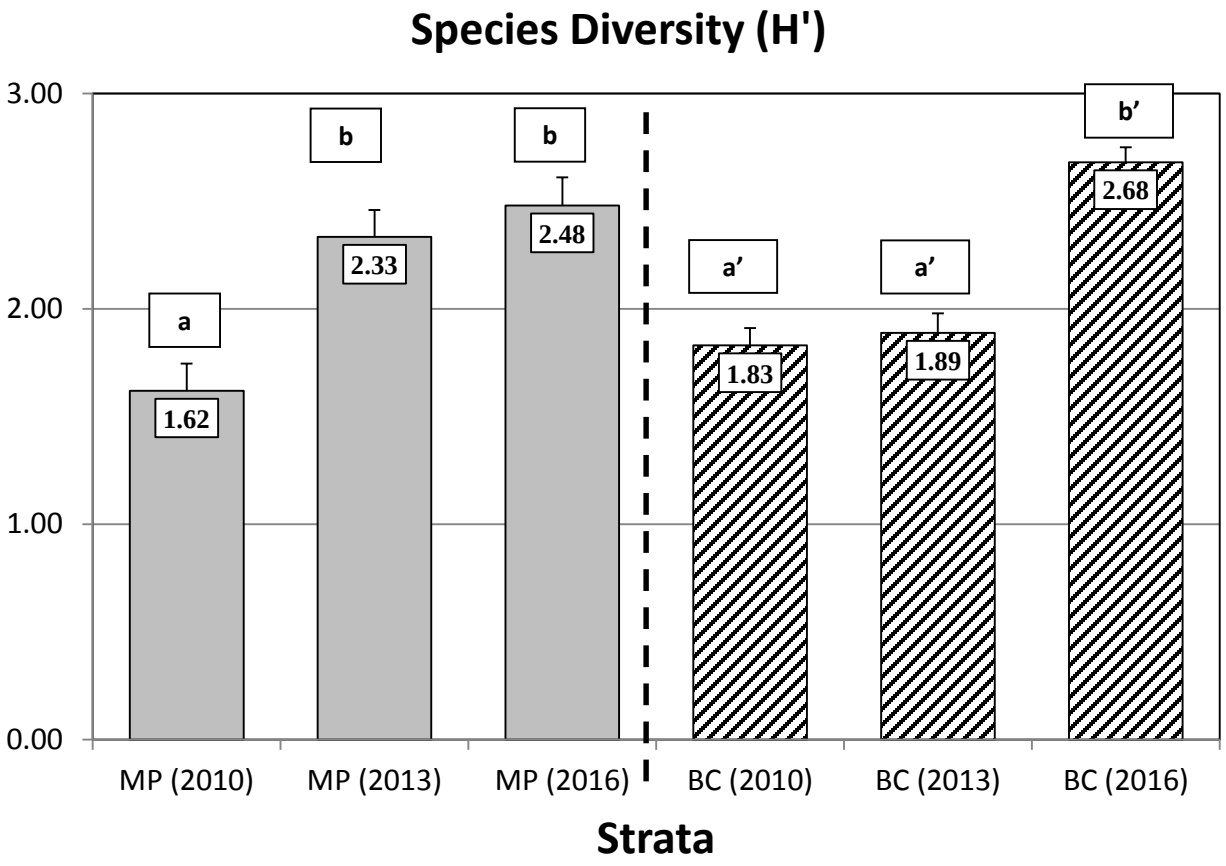

Figure 16. Species diversity (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

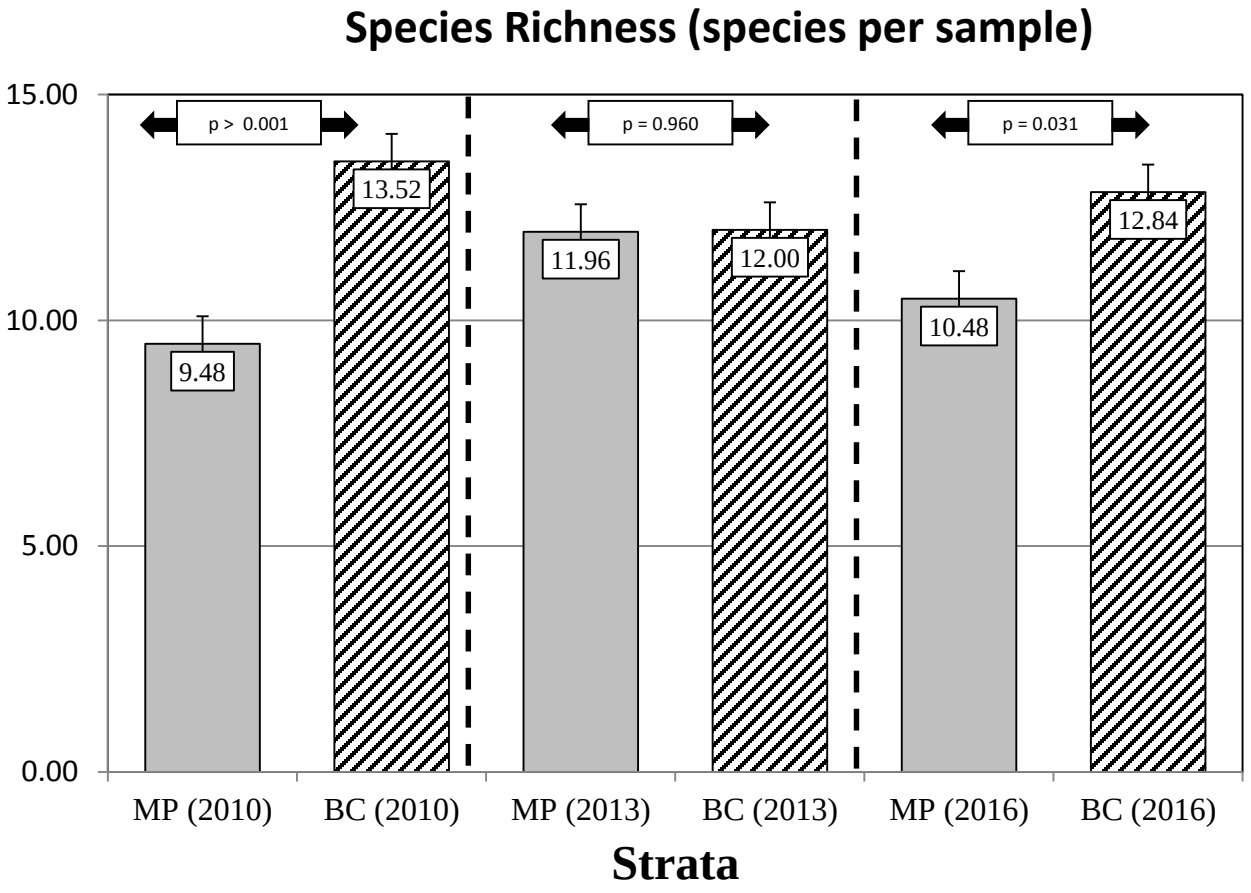

Figure 17. Species richness (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar. Comparisons with values at MP (Money Point) and BC (Blows Creek) in the respective sampling years cannot be made because sampling gears of different sizes were used - Young grab at MP and BS and box-corer at SBE2 and SBE5.

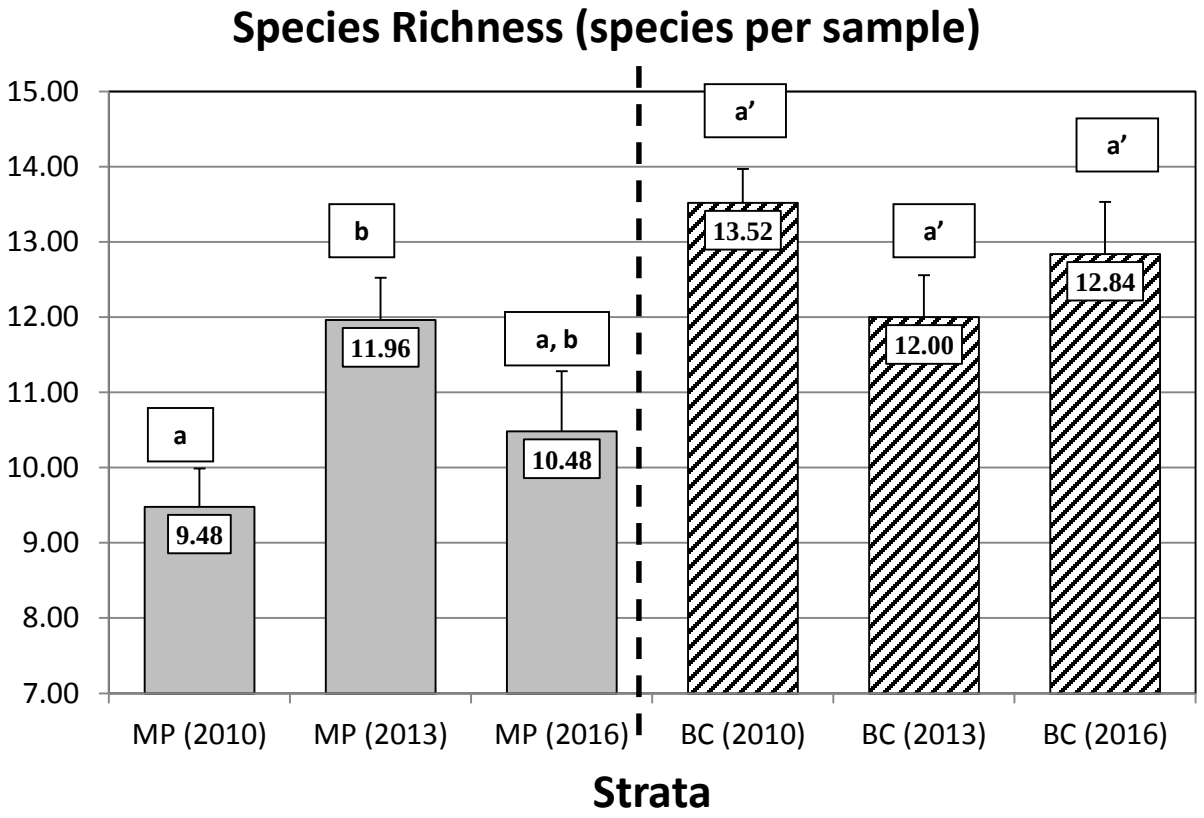

Figure 18. Species richness (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different ($p = 0.05$). Ordinate truncated to better show pattern.

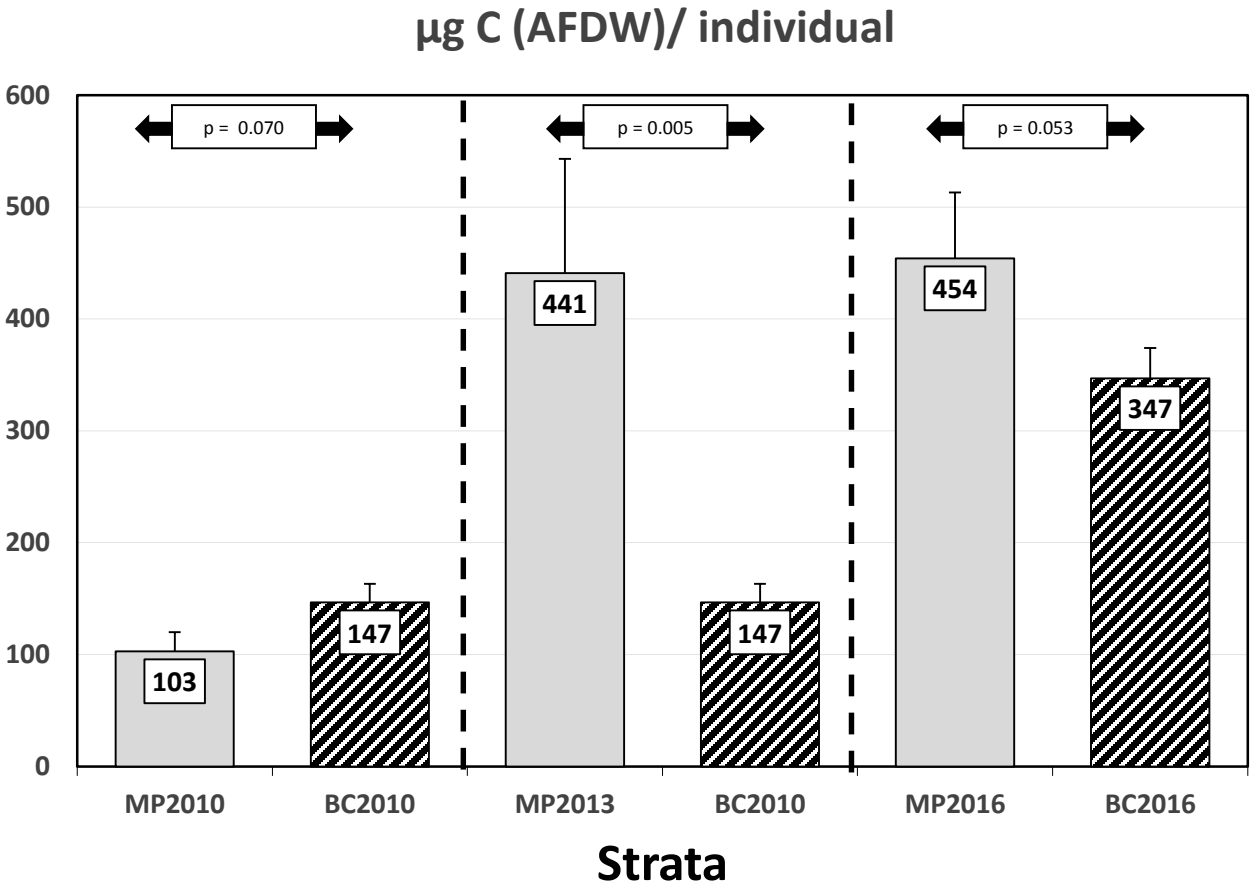

Figure 19. Weight per individual (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar.

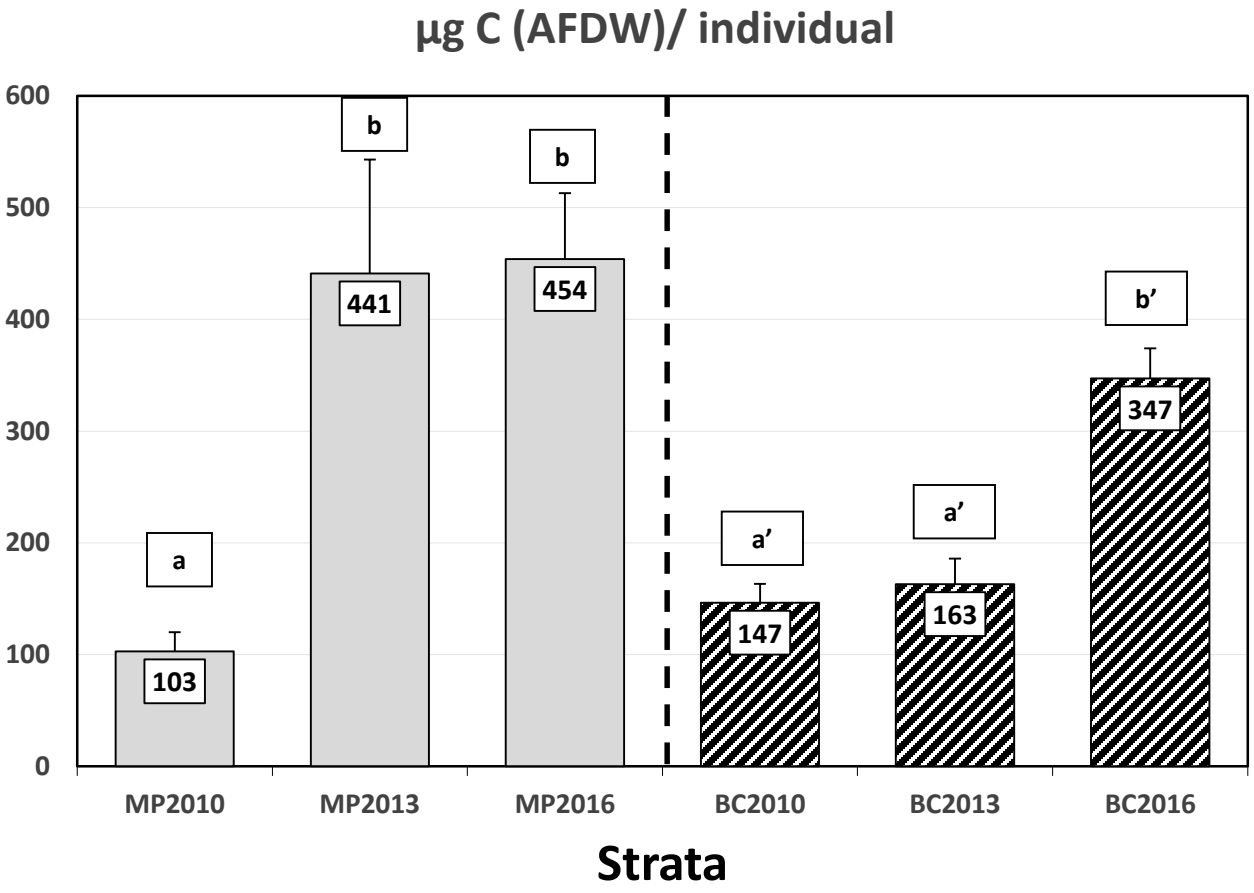

Figure 20. Weight per individual (one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

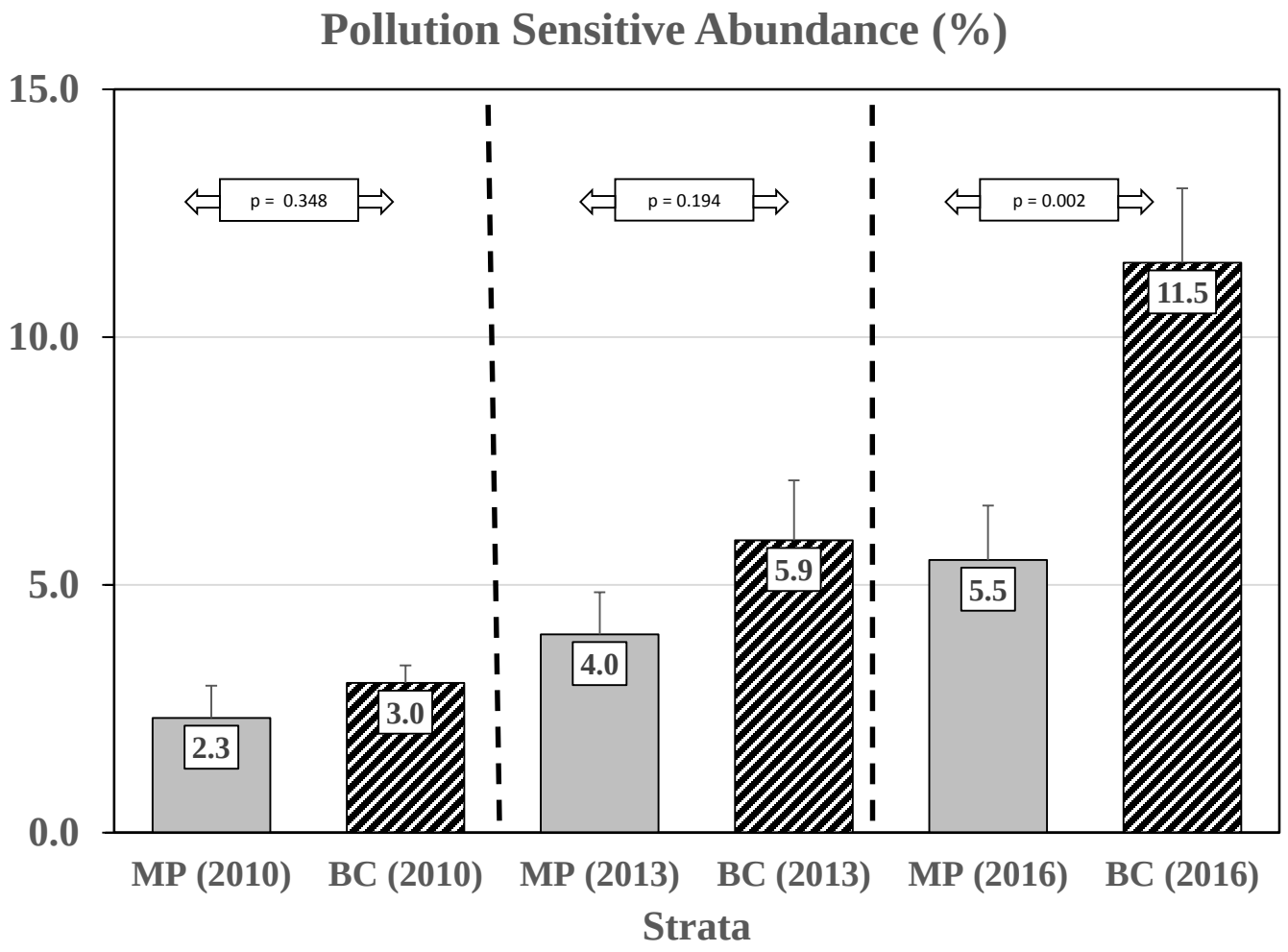

Figure 21. Percent Pollution Sensitive Abundance (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar.

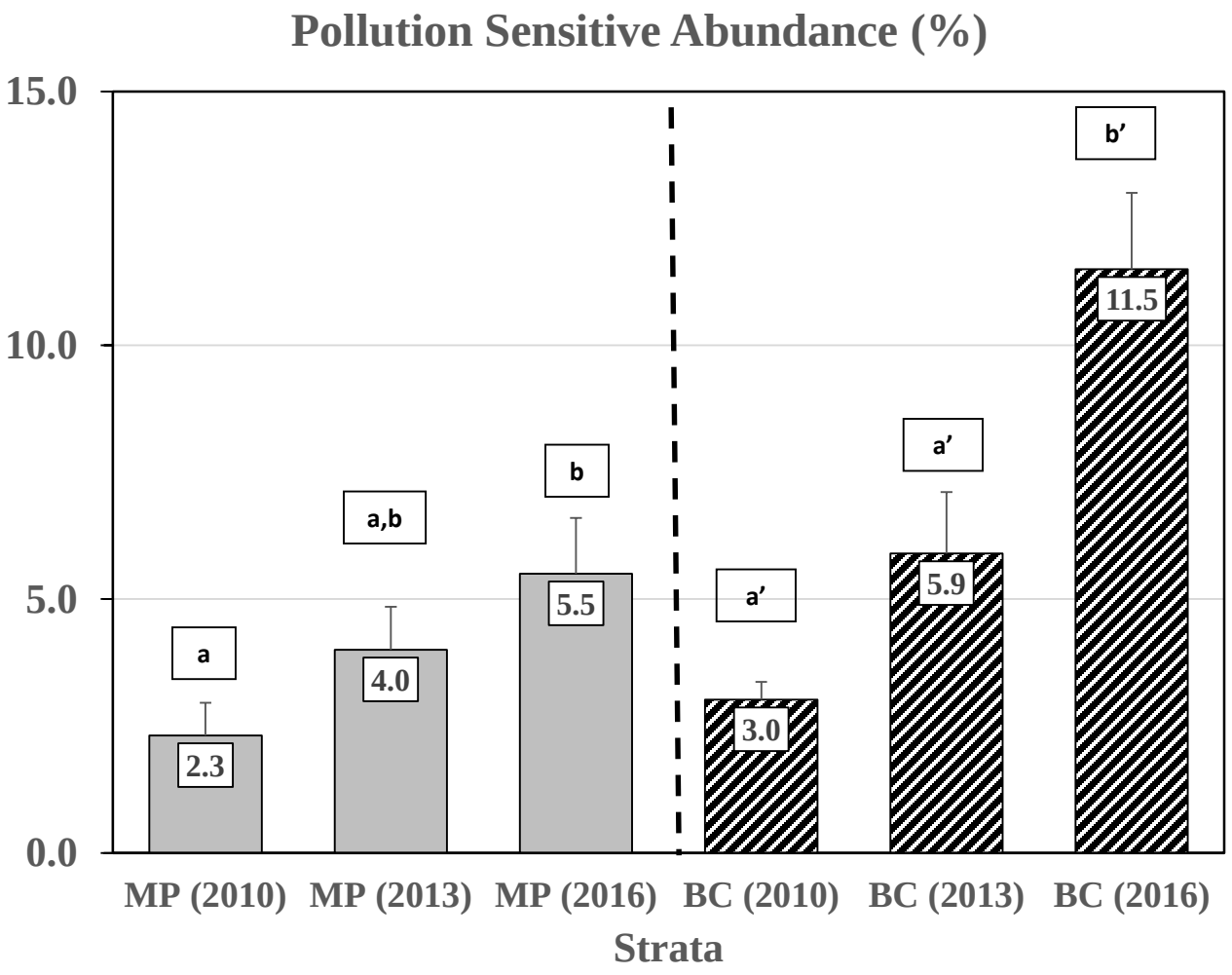

Figure 22. Percentage Pollution Sensitive Abundance(one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

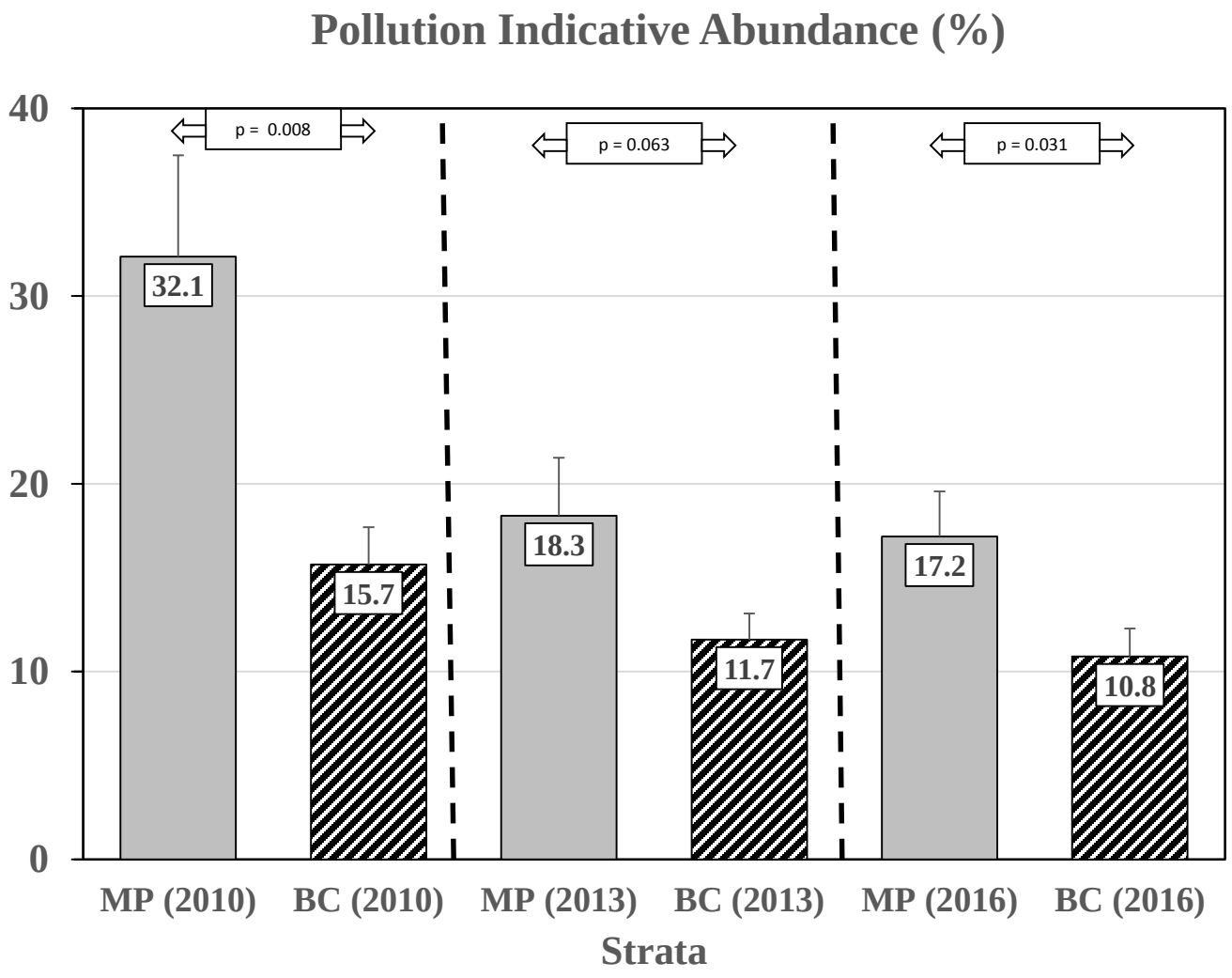

Figure 23. Percent Pollution Indicative Abundance (one standard error shown) comparing each sampling year. Money Point (MP) and Blows Creek (BC) strata. Compared by t-test with p value shown for each year. Mean values indicated at top of each bar.

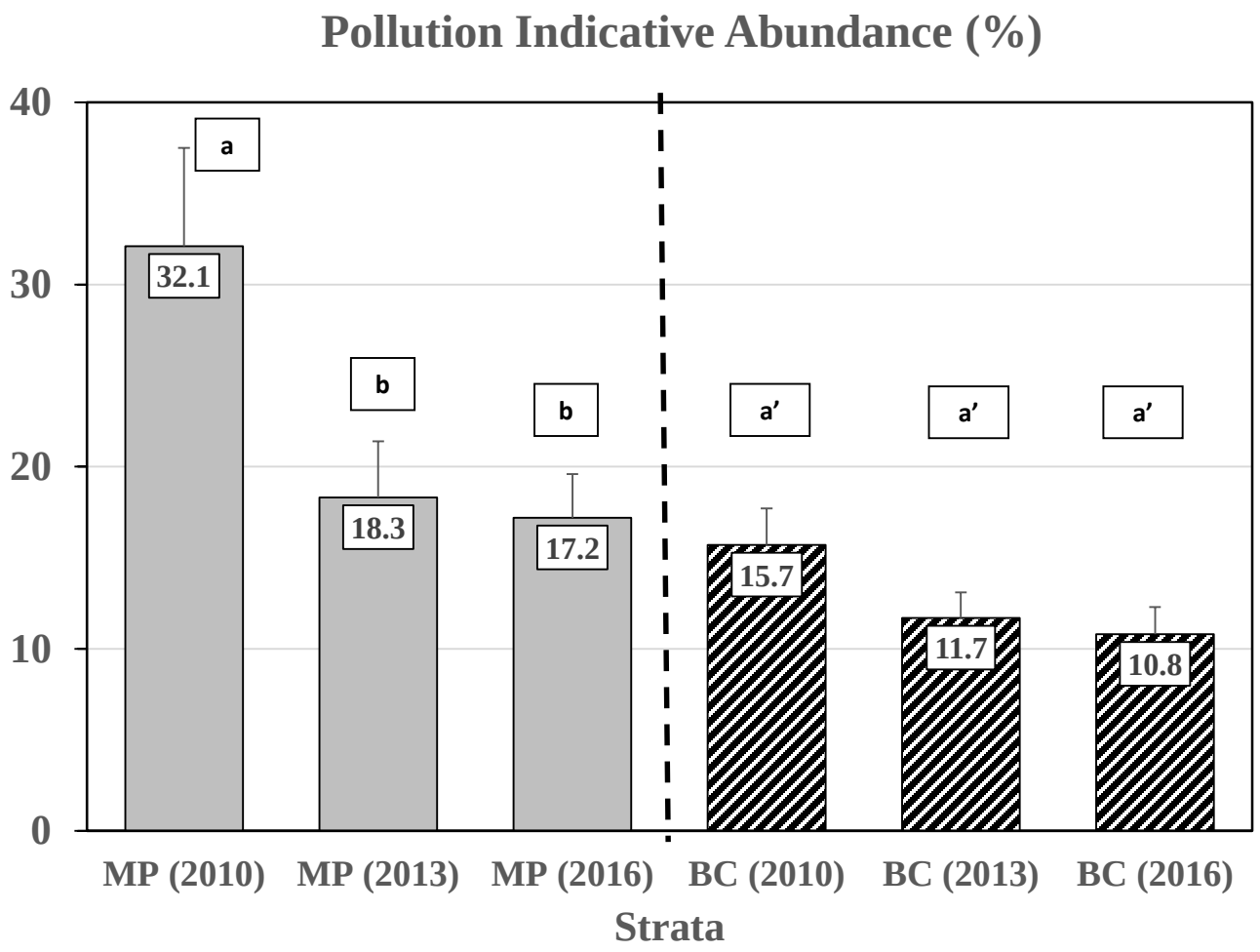

Figure 24. Percentage Pollution Indicative Abundance(one standard error shown) by stratum. Money Point (MP) and Blows Creek (BC) mean values indicated at top of each bar. One-way ANOVA by each stratum. Within each stratum years with same letter are not significantly different (p = 0.05).

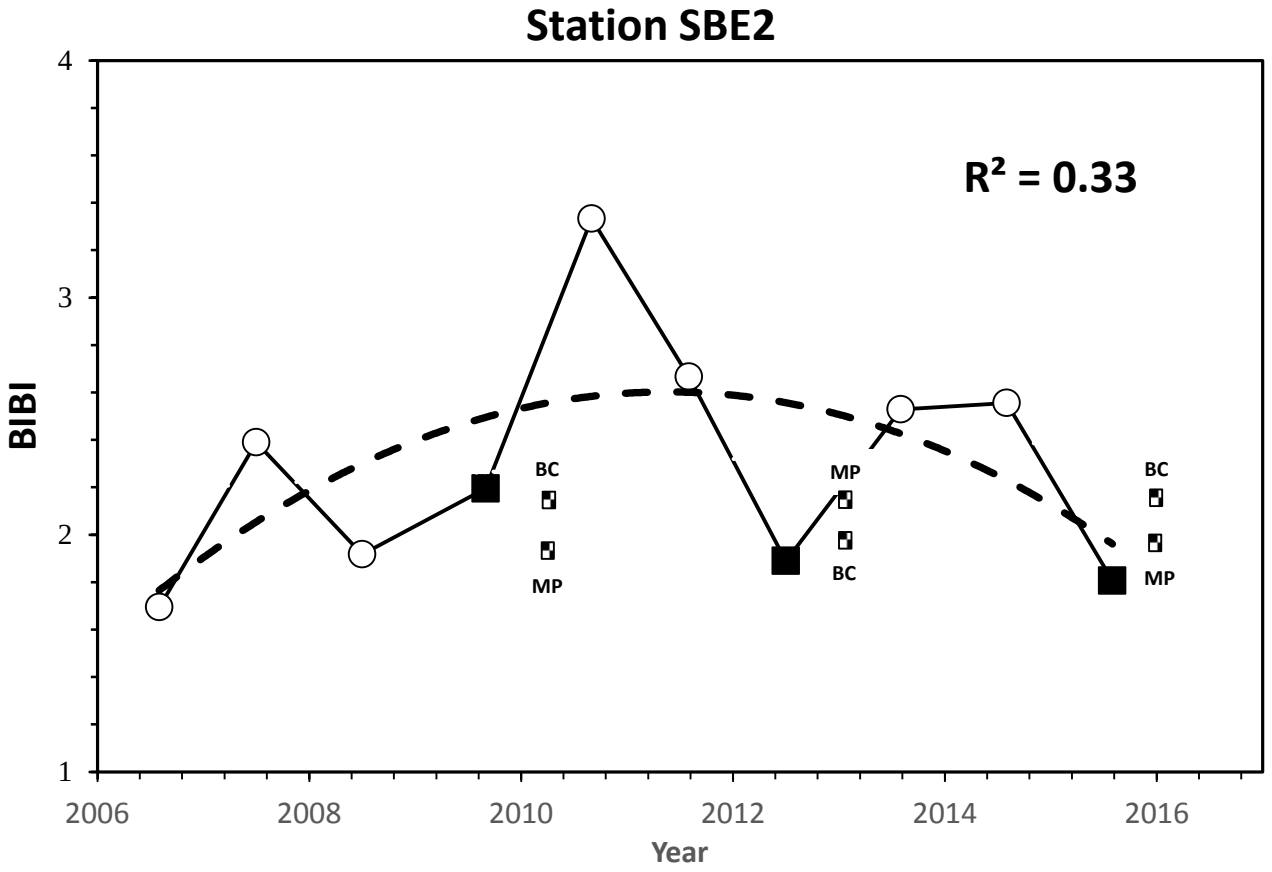

Figure 25. BIBI pattern at CBP station SBE2 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

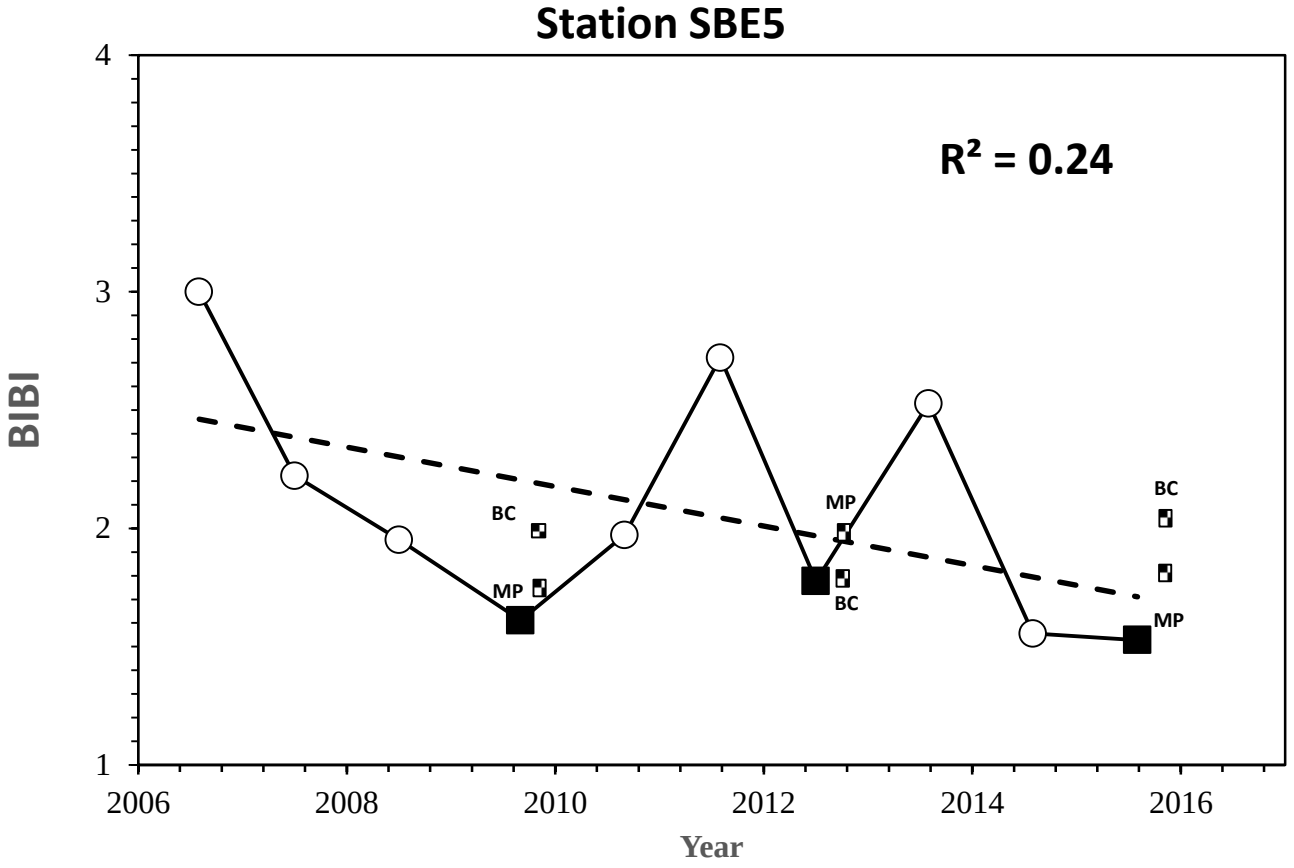

Figure 26. BIBI pattern at CBP station SBE5 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

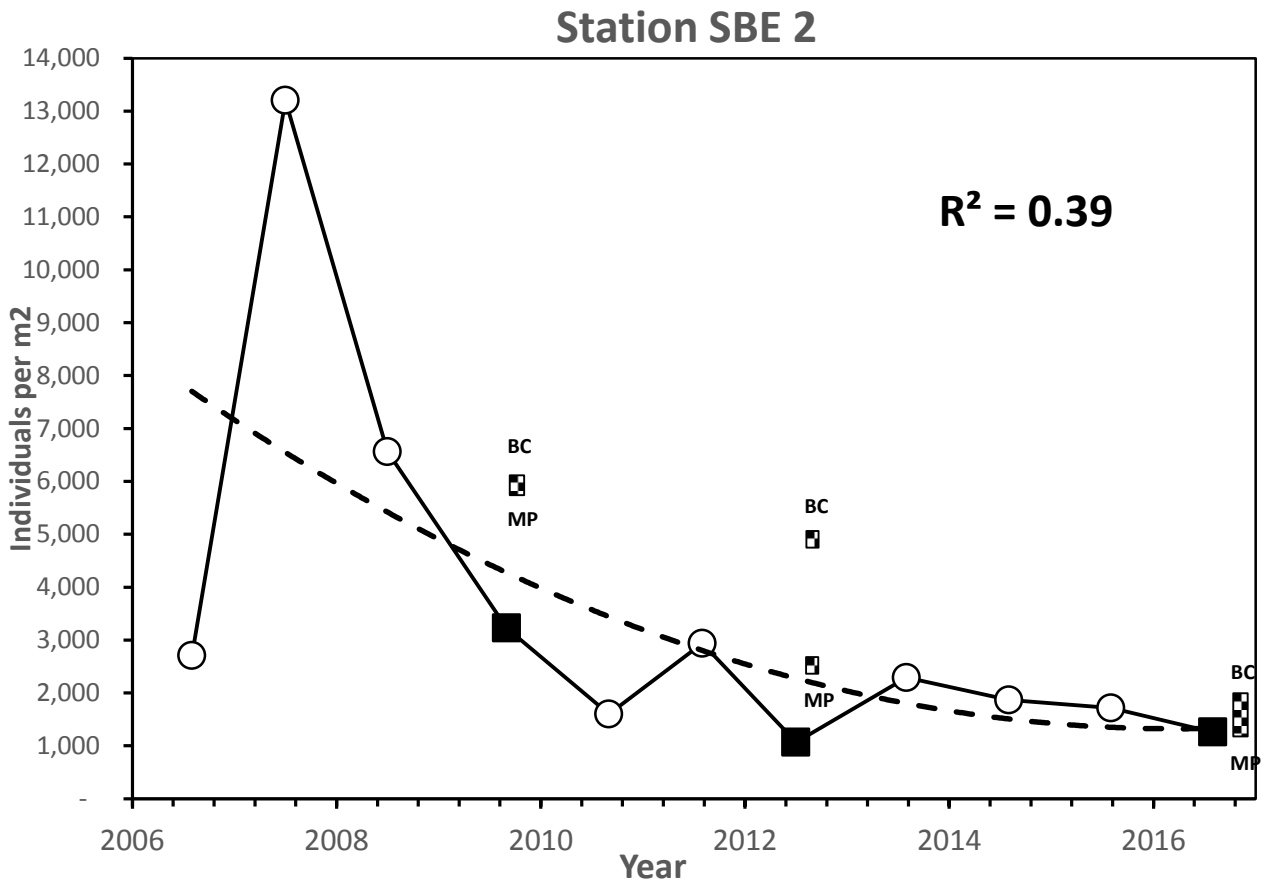

Figure 27. Density pattern at CBP station SBE2 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

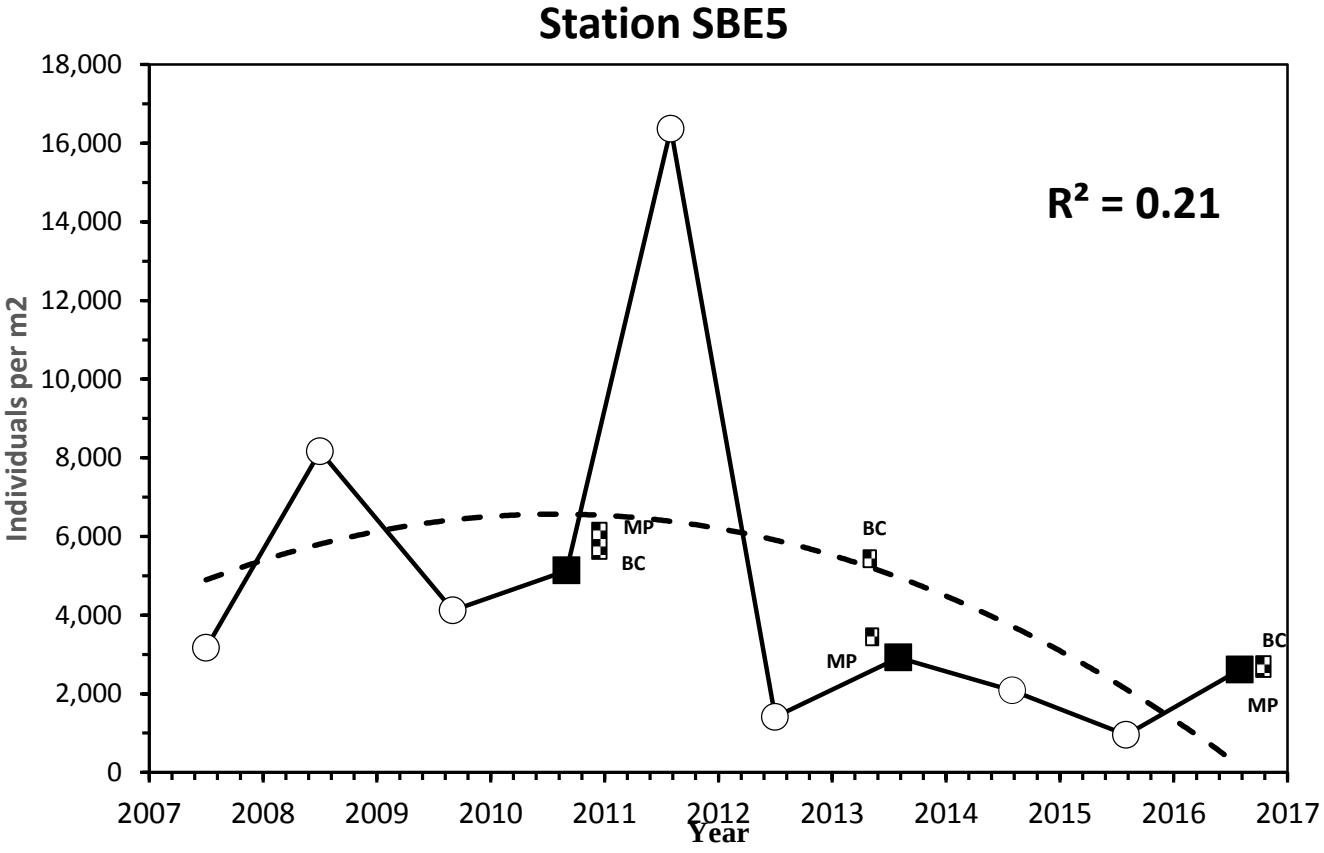

Figure 28. Density pattern at CBP station SBE5 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

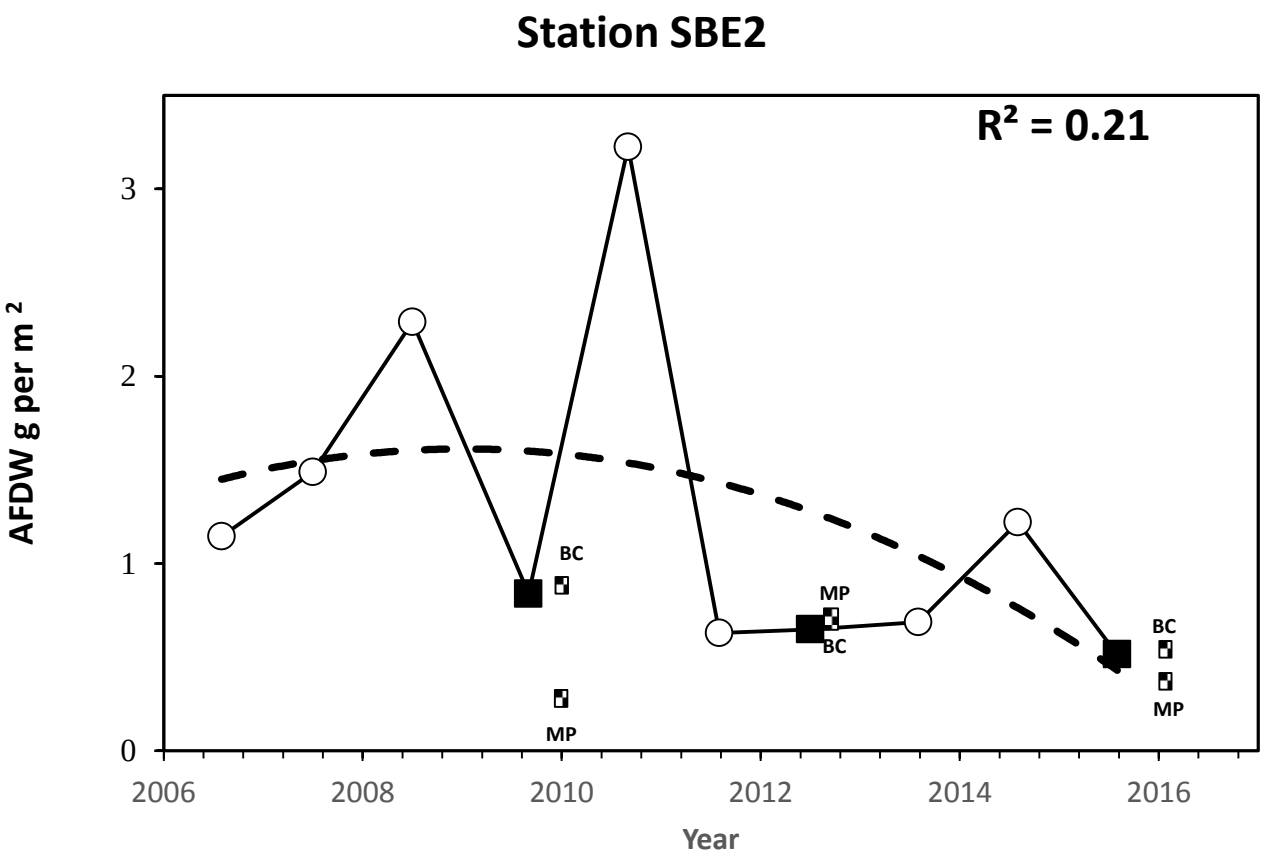

Figure 29. Biomass pattern at CBP station SBE2 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

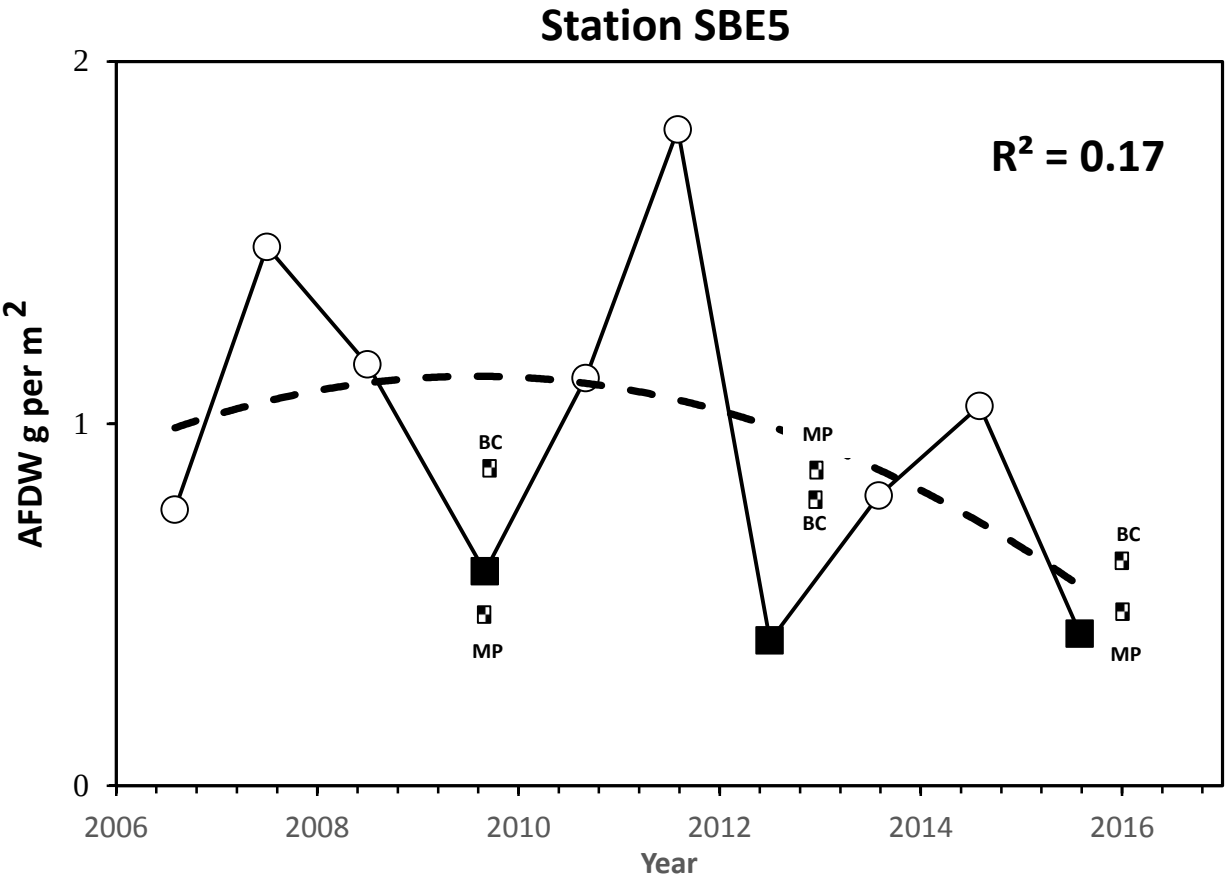

Figure 30. Biomass pattern at CBP station SBE5 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

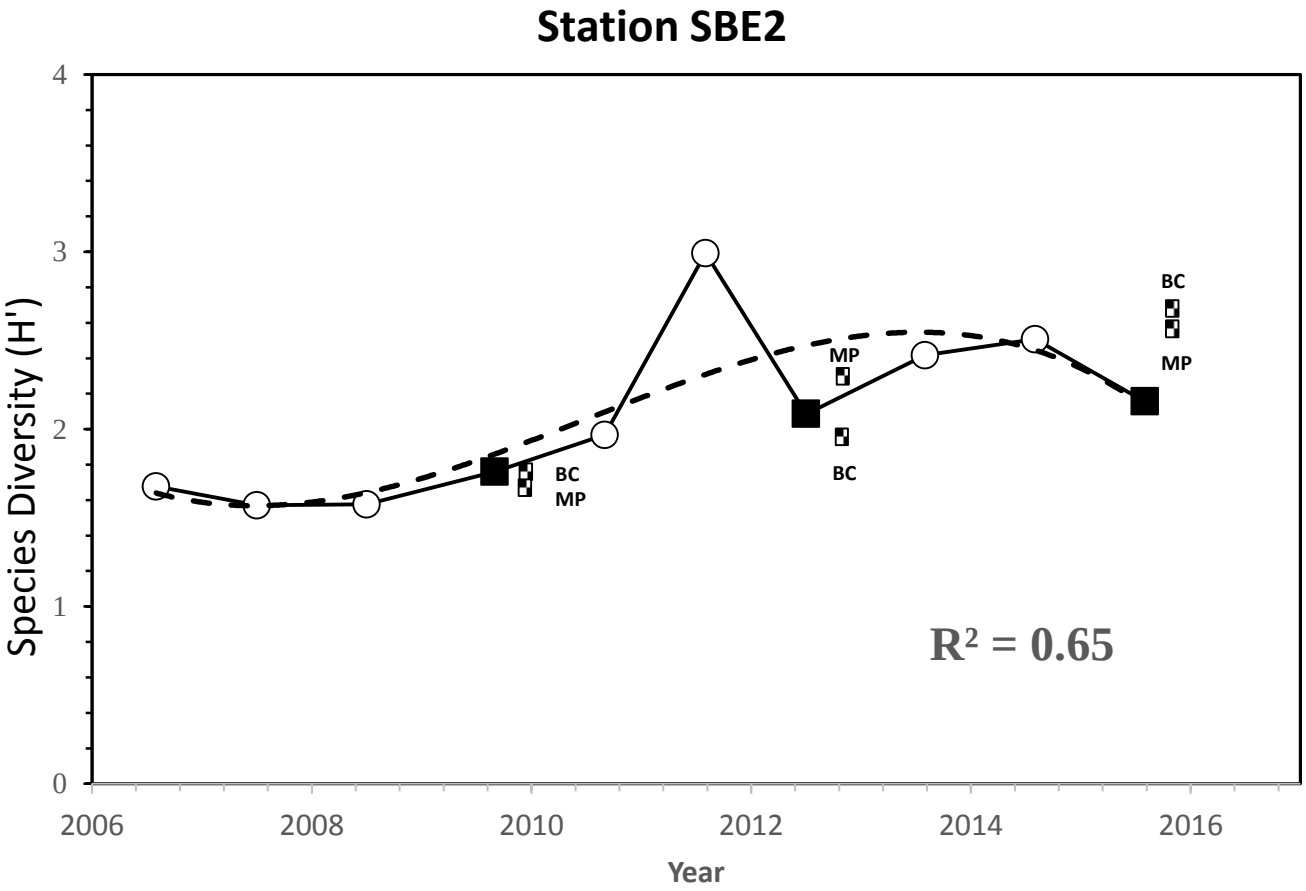

Figure 31. Species Diversity pattern at CBP station SBE2 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

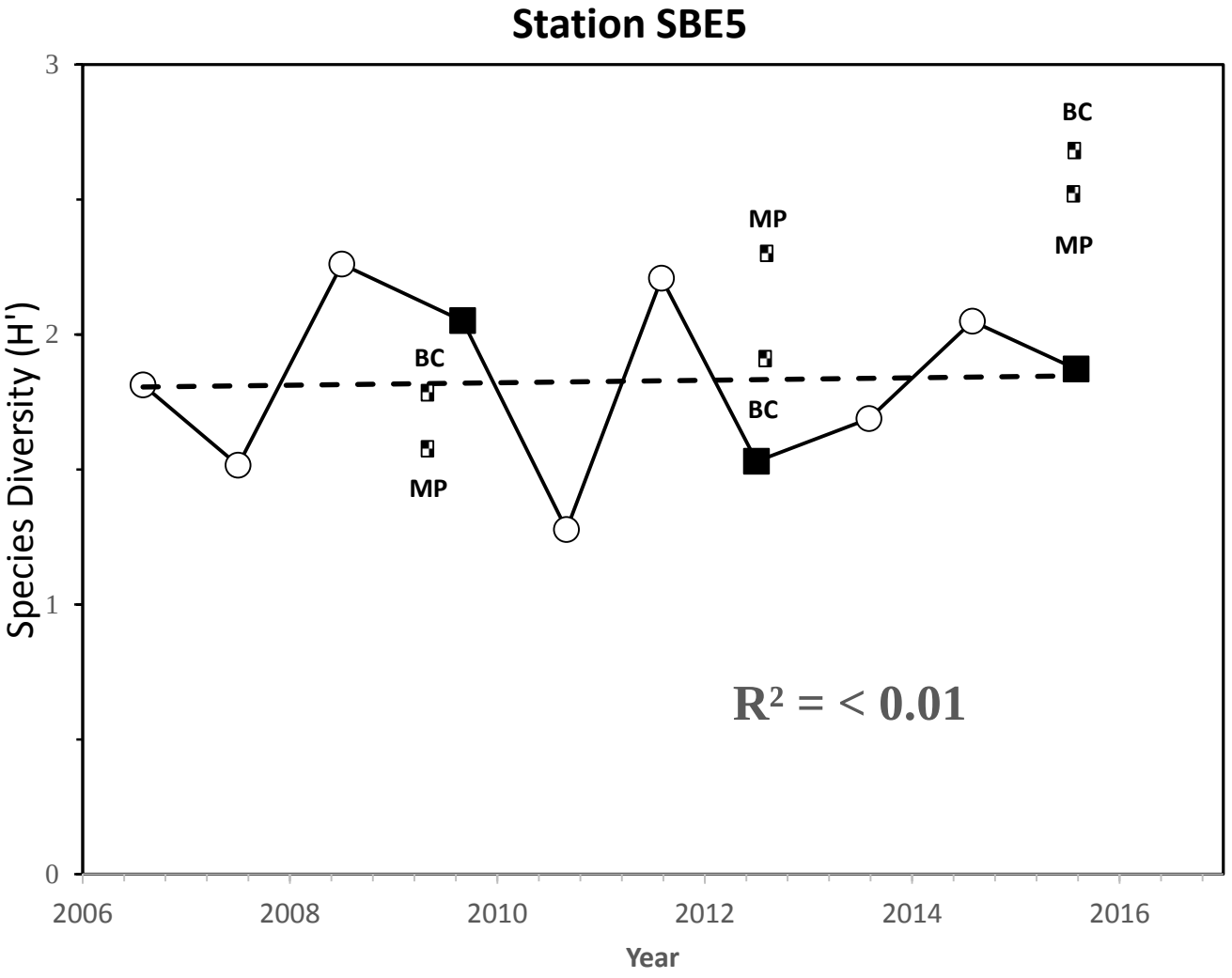

Figure 32. Species Diversity pattern at CBP station SBE5 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. Checkered squares are mean values at MP (Money Point) and BC (Blows Creek) in the respective sampling years for spatial perspective.

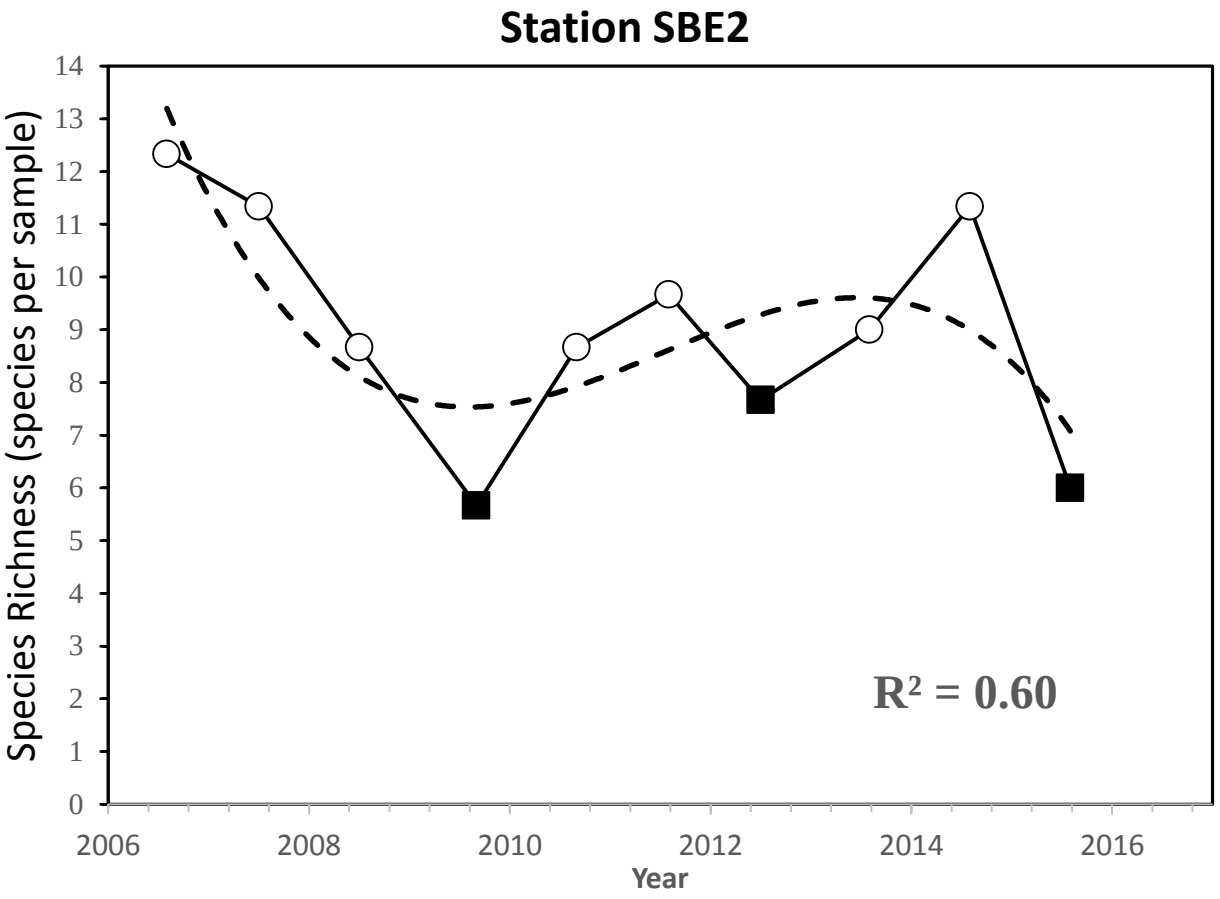

Figure 33. Species Richness pattern at CBP station SBE2 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. . Comparisons with values at MP (Money Point) and BC (Blows Creek) in the respective sampling years cannot be made because sampling gears of different sizes were used - Young grab at MP and BS and box-corer at SBE2 and SBE5.

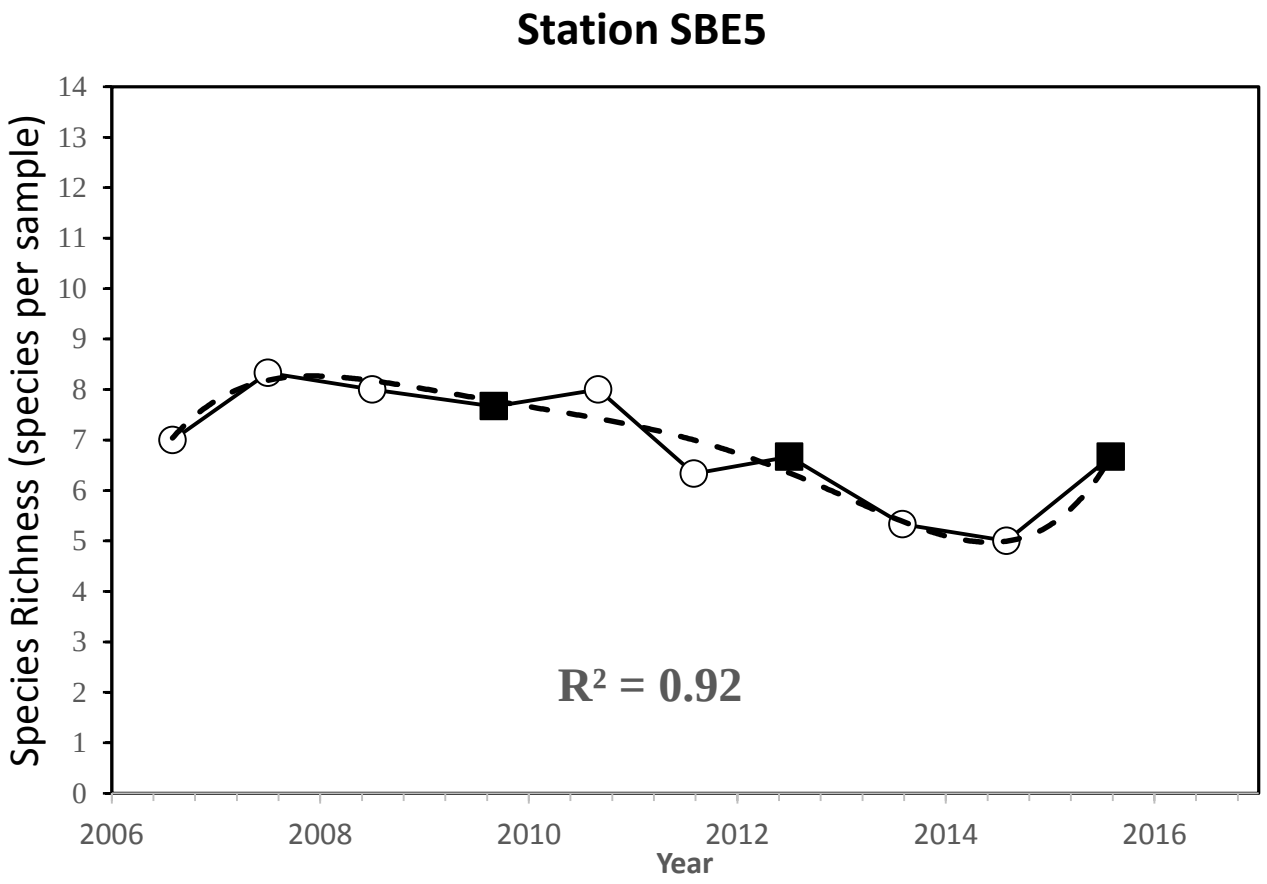

Figure 34. Species Richness pattern at CBP station SBE5 from 2007 to 2016. Money Point sampling years (2010, 2013, 2016) shown with black squares. . Comparisons with values at MP (Money Point) and BC (Blows Creek) in the respective sampling years cannot be made because sampling gears of different sizes were used - Young grab at MP and BS and box-corer at SBE2 and SBE5.

Tables 1-4

Table 1. Stratum comparisons and rationales

Comparisons	Rationale
MP (2010) X BC (2010)	Was the MP ecological condition different from the reference condition (BC) before remediation?
MP (2013) X BC (2013)	Was the MP ecological condition different from the reference condition (BC) after remediation?
MP (2016) X BC (2016)	Was the MP ecological condition different from the reference condition (BC) after two additional years since remediation?
MP (2010 X 2013 X 2016)	Did the remediation stratum (MP) change over time?
BC (2010 X 2013 X 2016)	Did the reference stratum (BC) change over time?

Table 2. A. Results of t-tests showing the p-value for stratum comparisons for the BIBI, Species Diversity (H'), Species Richness (mean species per sample), Biomass and Abundance. Shaded cells indicate a significant difference between strata at $p \leq 0.05$. B. Test for differences between years at each stratum using a one-way ANOVA and Scheffe post-hoc test. For the BIBI and each metric, years with the same letter were not significantly different at $p \leq 0.05$.

A. Money Point comparison to Blow Creek using a t-test. Probability of a difference shown. For significant difference arrow indicates whether the Money Point stratum index or metric was significantly higher (↑) or lower (↓) than value at the Blows Creek stratum.

Comparisons	BIBI	Abundance	Biomass	Species Diversity (H')	Species Richness
MP (2010) X BC (2010)	0.010 ↓	0.184	>0.001 ↓	0.175	>0.001 ↓
MP (2013) X BC (2013)	0.128	>0.001 ↓	0.787	0.006 ↑	0.960
MP (2016) X BC (2016)	0.002 ↓	0.013 ↓	0.005 ↓	0.167	0.031 ↓

B. Stratum comparisons among the years (2010, 2013, 2016) with one-way ANOVA and Scheffe post hoc test. Years with the same letter were not significantly different at $p \leq 0.05$.

	2010	2113	2016	2010	2113	2016	2010	2113	2016	2010	2113	2016	2010	2113	2016
MP (2010 X 2013 X 2016)	a	a	a	a	b	c	a	b	a	a	b	b	a	b	a, b
	2010	2113	2016	2010	2113	2016	2010	2113	2016	2010	2113	2016	2010	2113	2016
BC (2010 X 2013 X 2016)	a, b	b	a	a	a	b	a	a	a	a	a	b	a	a	a

Table 3. A. Results of t-tests showing the p-value for stratum comparisons for Body Size (weight per individual), Pollution Sensitive Abundance, and Pollution Indicative Abundance. Shaded cells indicate a significant difference between strata at $p \leq 0.05$. B. Test for differences between years at each stratum using a one-way ANOVA and Scheffe post-hoc test. Years with the same letter were not significantly different at $p \leq 0.05$.

A. Money Point comparison to Blow Creek using a t-test. Probability of a difference shown. For significant difference arrow indicates whether the Money Point value was significantly higher (↑) or lower (↓) than value at the Blows Creek stratum.

Comparisons	Body Size	Pollution Sensitive	Pollution Indicative
MP (2010) X BC (2010)	0.070	0.348	0.008 ↑
MP (2013) X BC (2013)	0.005 ↑	0.194	0.063
MP (2016) X BC (2016)	0.053 ↑	0.002 ↓	0.031 ↑

B. Stratum comparisons among the years (2010, 2013, 2016) with one-way ANOVA and Scheffe post hoc test. Years with the same letter were not significantly different at $p \leq 0.05$.

	2010	2113	2016	2010	2113	2016	2010	2113	2016
MP (2010 X 2013 X 2016)	a	b	b	a	a,b	b	a	b	b
	2010	2113	2016	2010	2113	2016	2010	2113	2016
BC (2010 X 2013 X 2016)	a	a	b	a	a	b	a	a	a

Table 4. Top twenty A. Abundance density dominants and B. Biomass density dominants across all stations at Money Point in the Elizabeth River for summer 2016. An "*" in the species name column indicates the species was considered epifaunal. AFDW biomass is expressed in g C.

A. Abundance density dominants		
Taxon Group	Taxon	Ind per m2
Polychaeta	*Mediomastus ambiseta*	432
Polychaeta	*Hermundura* sp. A	351
Polychaeta	*Paraprionospio pinnata*	81
Polychaeta	*Podarke obscura*	73
Polychaeta	*Leitoscoloplos* spp.	56
Polychaeta	*Demonax microphthalmus*	47
Polychaeta	*Tharyx* sp. A Doner	45
Polychaeta	Grandidierella sp.	41
Polychaeta	*Streblospio benedicti*	25
Oligochaeta	*Tubificoides* spp. Group I	24
Polychaeta	*Glycinde solitaria*	21
Polychaeta	*Podarkeopsis levifuscina*	18
Cumacea	*Leucon americanus*	18
Amphipoda	*Ampelisca* spp.	16
Polychaeta	*Spiochaetopterus costarum*	14
Amphipoda	*Ampelisca abdita*	14
Hemichordata	*Saccoglossus kowalevskii*	14
Nemertea	Nemertea spp.	13
Polychaeta	*Parahesione luteola*	8
Polychaeta	*Hobsonia florida*	5
B. Biomass dominants		
Taxon Group	Taxon	AFDW per m2
Polychaeta	*Leitoscoloplos* spp.	0.061
Polychaeta	*Hermundura* sp. A	0.057
Hemichordata	*Saccoglossus kowalevskii*	0.034
Gastropoda	*Nassarius vibex*	0.034
Polychaeta	*Paraprionospio pinnata*	0.023
Polychaeta	*Mediomastus ambiseta*	0.022
Polychaeta	*Podarke obscura*	0.019
Polychaeta	*Tharyx* sp. A Doner	0.015
Polychaeta	*Demonax microphthalmus*	0.014
Polychaeta	*Glycinde solitaria*	0.012
Cumacea	*Leucon americanus*	0.011
Nemertea	Nemertea spp.	0.010
Polychaeta	*Podarkeopsis levifuscina*	0.010
Polychaeta	*Clymenella torquata*	0.010
Amphipoda	*Ampelisca* spp.	0.008
Polychaeta	*Spiochaetopterus costarum*	0.008
Polychaeta	*Neanthes succinea*	0.008
Amphipoda	*Grandidierella* sp.	0.007
Polychaeta	*Streblospio benedicti*	0.005
Isopoda	*Edotea triloba*	0.004

Table 5. Top twenty A. Abundance density dominants and B. Biomass density dominants across all stations at Blows Creek in the Elizabeth River in summer 2016. An "*" in the species name column indicates the species was considered epifaunal. AFDW biomass is expressed in g C.

A. Abundance density dominants		
Taxon Group	Taxon	Ind per m2
Polychaeta	*Hermundura* sp. A	794
Polychaeta	*Mediomastus ambiseta*	379
Amphipoda	*Ampelisca* spp.	239
Tanaidacea	*Hargeria rapax*	186
Polychaeta	*Leitoscoloplos* spp.	97
Isopoda	*Cyathura polita*	94
Polychaeta	*Streblospio benedicti*	69
Phoronida	*Phoronis* spp.	48
Amphipoda	*Grandidierella* sp.	44
Polychaeta	*Spiochaetopterus costarum*	29
Polychaeta	*Podarke obscura*	27
Polychaeta	*Glycinde solitaria*	24
Polychaeta	*Paraprionospio pinnata*	22
Bivalvia	*Gemma gemma*	18
Gastropoda	*Acteocina canaliculata*	16
Polychaeta	*Tharyx* sp. A Doner	16
Amphipoda	*Leptocheirus plumulosus*	13
Cumacea	*Leucon americanus*	10
Nemertea	Nemertea spp.	9
Polychaeta	*Neanthes succinea*	8
B. Biomass dominants		
Taxon Group	Taxon	AFDW per m2
Polychaeta	*Hermundura* sp. A	0.149
Polychaeta	*Leitoscoloplos* spp.	0.120
Polychaeta	Phoronis spp.	0.032
Polychaeta	*Spiochaetopterus costarum*	0.031
Isopoda	*Cyathura polita*	0.024
Holothuroidea	*Leptosynapta tenuis*	0.024
Polychaeta	*Glycera americana*	0.022
Polychaeta	*Mediomastus ambiseta*	0.022
Amphipoda	*Ampelisca* spp.	0.020
Tanaidacea	*Hargeria rapax*	0.013
Polychaeta	*Podarke obscura*	0.013
Polychaeta	*Paraprionospio pinnata*	0.012
Nemertea	Nemertea spp.	0.012
Polychaeta	*Glycinde solitaria*	0.011
Amphipoda	Grandidierella sp.	0.011
Polychaeta	*Tharyx* sp. A Doner	0.011
Bivalvia	*Gemma gemma*	0.009
Polychaeta	*Streblospio benedicti*	0.009
Gastropoda	*Acteocina canaliculata*	0.008
Polychaeta	Maldanidae spp.	0.007

Appendix A. Taxa collected at Money Point Project Monitoring Stations Random 2016

Appendix A. Taxa collected by Money Point Project Monitoring Stations.

Taxonomic Group	Taxon
Platyhelminthes : Turbellaria	Stylochus ellipticus Girard*
Nemertea	Nemertea spp.
Annelida : Polychaeta	Clymenella torquata Leidy
	Demonax microphthalmus (Verrill)
	Eteone heteropoda Hartman
	Eteone lactea Claparede
	Glycera americana Leidy
	Glycera spp.
	Glycinde solitaria Webster
	Hermundura sp. A
	Hobsonia florida Hartman
	Hydroides dianthus Verrill*
	Leitoscoloplos spp.
	Loimia medusa Savigny
	Maldanidae spp.
	Mediomastus ambiseta Hartman
	Neanthes succinea Frey and Leuckart
	Nephtys picta Ehlers
	Parahesione luteola Webster
	Paraprionospio pinnata Ehlers
	Pectinaria gouldii Verrill
	Phyllodoce arenae Webster
	Podarke obscura Verrill
	Podarkeopsis levifuscina Hartmann-Schroder
	Sigambra tentaculata Treadwell
	Spiochaetopterus costarum Webster
	Spiophanes bombyx Claparede
	Streblospio benedicti Webster
	Tharyx sp. A Doner
Annelida : Oligochaeta	Tubificoides spp. Group I
Mollusca : Gastropoda	Acteocina canaliculata Say
	Cerithiidae spp. *
	Gastropoda spp. *
	Haminoea solitaria Say

Taxonomic Group	Taxon
	Nassarius vibex Say
	Nudibranchia spp. *
	Rictaxis punctostriatus Adams
	Turbonilla interrupta Totten*
Mollusca : Bivalvia	Aligena elevata Stimpson
	Barnea truncata Say
	Bivalvia spp.
	Gemma gemma Totten
	Lyonsia hyalina Conrad
	Parvilucina multilineata Tuomey and Holmes
	Tagelus plebeius Lightfoot
	Tellina agilis Stimpson
	Tellinidae spp.
Arthropoda : Isopoda	Cyathura polita Stimpson
	Edotea triloba Say*
	Ptilanthura tenuis Harger
Arthropoda : Amphipoda	Ameroculodes species complex
	Ampelisca abdita Mills
	Ampelisca spp.
	Corophiidae *
	Grandidierella sp.
	Leptocheirus plumulosus Shoemaker
	Listriella barnardi Wigley
	Melita nitida Smith*
Arthropoda : Cumacea	Cyclaspis varians Calman
	Leucon americanus Zimmer
Arthropoda : Mysidacea	Americamysis bigelowi (Tattersall)*
Arthropoda : Tanaidacea	Hargeria rapax (Harger)
Phoronida	Phoronis spp.
Echinodermata : Holothuroidea	Leptosynapta tenuis Ayres
Chordata : Hemichordata	Saccoglossus kowalevskii Agassiz
Chordata : Urochordata	Molgula lutulenta Van Name*
Chordata : Cephalochordata	Branchiostoma virginae Hubbs

Appendix B. Data by Site
Coordinates, Physical, Sedimentary and Species Abundances and Biomass collected at Money Point Project Monitoring Stations - 2016

Table 1. Station Coordinates for MPP Project Monitoring Stations. (Random Cruise 2016).

Station	Latitude in Decimal Degrees	Longitude in Decimal Degrees
23BC01	36.791094	-76.304594
23BC02	36.79098	-76.30448
23BC03	36.791468	-76.304405
23BC04	36.792496	-76.302376
23BC05	36.791396	-76.304565
23BC06	36.791424	-76.304269
23BC07	36.791595	-76.304403
23BC08	36.791201	-76.304634
23BC09	36.79117	-76.304803
23BC10	36.791717	-76.303317
23BC11	36.791552	-76.30333
23BC12	36.791833	-76.303993
23BC13	36.791659	-76.303113
23BC14	36.792004	-76.303359
23BC15	36.79215	-76.303259
23BC16	36.792259	-76.302614
23BC17	36.792365	-76.302785
23BC18	36.790899	-76.304602
23BC19	36.792486	-76.303001
23BC20	36.792364	-76.302803
23BC21	36.790868	-76.305024
23BC22	36.791069	-76.304311
23BC23	36.792076	-76.303539
23BC24	36.79199	-76.303257
23BC25	36.791829	-76.304032

Station	Latitude in Decimal Degrees	Longitude in Decimal Degrees
23MP01	36.782957	-76.303208
23MP03	36.785485	-76.301806
23MP04	36.784584	-76.302124
23MP05	36.784067	-76.302552
23MP07	36.783734	-76.302588
23MP08	36.783625	-76.302854
23MP10	36.785252	-76.301985
23MP11	36.783557	-76.303218
23MP12	36.783715	-76.303031
23MP13	36.78432	-76.302697
23MP14	36.786342	-76.301798
23MP15	36.783728	-76.302959
23MP16	36.784876	-76.302304
23MP17	36.78574	-76.301956
23MP18	36.783664	-76.302906
23MP19	36.786007	-76.301748
23MP20	36.78656	-76.301911
23MP21	36.78412	-76.302801
23MP22	36.785555	-76.301991
23MP24	36.785802	-76.301672
23MP25	36.785064	-76.302019
23MP26	36.783988	-76.303048
23MP27	36.785048	-76.301989
23MP28	36.78451	-76.302051
23MP29	36.784906	-76.301864

Table 2. Physical Data for MPP Project Monitoring Stations (Random Cruise 2016)

CBP Station Name	Sampling Date	Depth (m)	Salinity (ppt)	Dissolved Oxygen (ppm)	Temperature (deg. C)
23BC01	9/7/2016	4.1	20.1	4.13	26.2
23BC02	9/7/2016	4	19.5	4.33	26.3
23BC03	9/23/2016	2	3.6	4.7	23.9
23BC04	9/7/2016	2.1	18.9	4.25	26.2
23BC05	9/7/2016	2.3	18.9	4.67	26.8
23BC06	9/23/2016	2.3	3.7	4.56	23.8
23BC07	9/23/2016	1.7	3.4	4.67	24.4
23BC08	9/23/2016	3	6.4	4.8	24
23BC09	9/7/2016	1.9	19.4	4.56	26.8
23BC10	9/7/2016	3	19.4	4.26	26.2
23BC11	9/7/2016	4	19.4	4.13	26.2
23BC12	9/7/2016	1.8	19	4.23	26.2
23BC13	9/7/2016	6.1	19	4.35	26.3
23BC14	9/23/2016	1.9	3.3	4.71	24.2
23BC15	9/7/2016	1.7	18.8	4.35	26.2
23BC16	9/7/2016	2.8	18.6	4.64	26.6
23BC17	9/7/2016	1.5	18.7	4.98	26.9
23BC18	9/7/2016	4.2	20.1	4.2	26.2
23BC19	9/7/2016	1.4	18.7	4.64	26.7
23BC20	9/7/2016	1.5	18.7	4.9	26.8
23BC21	9/7/2016	1.9	19.5	4.54	26.3
23BC22	9/7/2016	4	19.3	4.34	26.3
23BC23	9/7/2016	1.5	18.8	4.32	26.5
23BC24	9/7/2016	1.7	18.7	4.91	26.8
23BC25	9/7/2016	1.7	19	4.16	26.3

CBP Station Name	Sampling Date	Depth (m)	Salinity (ppt)	Dissolved Oxygen (ppm)	Temperature (deg. C)
23MP01	9/15/2016	2.4	19.8	4.58	26.3
23MP03	9/15/2016	3.5	20.4	3.5	26.1
23MP04	9/15/2016	4.2	20.2	4.24	26.2
23MP05	9/15/2016	4.5	20.3	4.02	26.1
23MP07	9/15/2016	3.4	20.2	3.95	26.1
23MP08	9/15/2016	4.2	20.2	4.19	26.1
23MP10	9/15/2016	4	20.6	3.25	26.1
23MP11	9/15/2016	4.3	20.7	3.8	26
23MP12	9/15/2016	5.3	21.5	3.37	25.8
23MP13	9/15/2016	9.7	21.3	3.28	25.9
23MP14	9/15/2016	4.7	20.5	4.29	26
23MP15	9/15/2016	9.5	22	3.23	25.8
23MP16	9/15/2016	6.6	20.7	3.07	26
23MP17	9/15/2016	9.3	22.2	3.14	25.8
23MP18	9/15/2016	3.2	20.3	4.08	26.1
23MP19	9/15/2016	7.4	21.4	3.52	25.9
23MP20	9/15/2016	8.2	22.1	3.13	25.8
23MP21	9/15/2016	8.6	21.1	3.51	25.9
23MP22	9/15/2016	10.2	21.7	2.6	25.8
23MP24	9/15/2016	3.9	20.4	3.89	26
23MP25	9/15/2016	4.5	20.4	3.37	26.1
23MP26	9/15/2016	11.2	22.6	3.09	25.7
23MP27	9/15/2016	4.4	20.4	3.47	26.1
23MP28	9/15/2016	4.3	20.2	4.11	26.2
23MP29	9/15/2016	3	20.3	3.8	26.2

Table 3. Sedimentary Data for MPP Project Monitoring Stations (Cruise #5 2016).

Station	Sand (% Weight)	Silt-Clay (% Weight)	Volatile Solids (%)
23BC01	14.31	85.69	9.53
23BC02	26.16	73.84	8.29
23BC03	94.14	5.86	1.33
23BC04	94.87	5.13	1.14
23BC05	89.86	10.14	1.79
23BC06	79.12	20.88	3.17
23BC07	94.11	5.89	1.12
23BC08	61.23	38.77	5.49
23BC09	91.62	8.38	1.58
23BC10	49.57	50.43	5.34
23BC11	16.96	83.04	8.32
23BC12	96.54	3.46	0.76
23BC13	46.71	53.29	6.71
23BC14	96.89	3.11	0.93
23BC15	81.64	18.36	3.52
23BC16	82.17	17.83	2.43
23BC17	97.52	2.48	0.79
23BC18	15.53	84.47	10.54
23BC19	98.04	1.96	1.01
23BC20	98.01	1.99	0.74
23BC21	95.02	4.98	1.19
23BC22	17.71	82.29	9.85
23BC23	97.6	2.4	0.79
23BC24	97.77	2.23	0.74
23BC25	97.58	2.42	0.79

Station	Sand (% Weight)	Silt-Clay (% Weight)	Volatile Solids (%)
23MP01	81.6	18.4	2.16
23MP03	94.12	5.88	0.45
23MP04	81.33	18.67	2.35
23MP05	39.8	60.2	7.25
23MP07	48.83	51.17	6
23MP08	61.11	38.89	4.29
23MP10	84.12	15.88	1.37
23MP11	7.62	92.38	5.81
23MP12	63.19	36.81	3.48
23MP13	2.3	97.7	8.12
23MP14	93.3	6.7	1.11
23MP15	4.33	95.67	7.56
23MP16	35.06	64.94	8.15
23MP17	5.7	94.3	10.41
23MP18	60.46	39.54	3.91
23MP19	31.45	68.55	7.21
23MP20	21.21	78.79	8.93
23MP21	2.77	97.23	9.52
23MP22	5.1	94.9	8.56
23MP24	73.33	26.67	1.21
23MP25	94.78	5.22	0.82
23MP26	2.5	97.5	10.77
23MP27	82.07	17.93	3.82
23MP28	54.09	45.91	4.32
23MP29	93.51	6.49	0.95

Table 4. Total Community Parameters for MPP Project Monitoring Stations (Cruise #5 2016).

CBP Station Name	Total Species	Ind/sq.m	Biomass
23BC01	11	1,157	0.4082
23BC02	10	590	0.2722
23BC03	11	3,039	0.4309
23BC04	16	1,588	0.6577
23BC05	21	3,765	1.202
23BC06	13	4,150	0.499
23BC07	12	3,583	0.5897
23BC08	10	816	0.3402
23BC09	12	2,087	0.7258
23BC10	9	748	0.3402
23BC11	11	658	0.2722
23BC12	15	3,016	1.2928
23BC13	11	590	0.4082
23BC14	8	1,383	0.4309
23BC15	16	2,654	1.066
23BC16	15	1,633	0.4536
23BC17	20	2,880	0.7258
23BC18	13	658	0.3175
23BC19	14	3,266	0.9299
23BC20	20	2,676	0.6577
23BC21	15	2,586	0.8392
23BC22	7	386	0.2268
23BC23	10	2,109	0.7484
23BC24	19	3,153	1.1567
23BC25	18	6,418	0.8845

CBP Station Name	Total Species	Ind/sq.m	Biomass
23MP01	13	4,218	0.4082
23MP03	13	1,293	0.4536
23MP04	8	726	0.3629
23MP05	8	340	0.2041
23MP07	10	2,064	0.3856
23MP08	5	1,043	0.3175
23MP10	7	612	0.1814
23MP11	8	658	0.2495
23MP12	8	431	0.1814
23MP13	9	408	0.3175
23MP14	15	1,520	0.3629
23MP15	17	1,429	0.7711
23MP16	17	6,282	0.6124
23MP17	11	567	0.6804
23MP18	5	1,134	0.2495
23MP19	8	363	0.3402
23MP20	24	2,109	1.5422
23MP21	6	227	0.2041
23MP22	7	1,134	0.2041
23MP24	15	1,792	0.499
23MP25	14	1,520	0.5443
23MP26	9	522	0.4309
23MP27	12	1,225	0.3629
23MP28	7	476	0.2041
23MP29	17	2,404	0.5216

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC01

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Hermundura sp. A	26	0.006
	Leitoscoloplos spp.	5	0.003
	Mediomastus ambiseta	6	0.001
	Parahesione luteola	1	0.001
	Paraprionospio pinnata	3	0.001
	Podarke obscura	4	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	1	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
Arthropoda : Cumacea	Leucon americanus	2	0.001
STATION		**51**	**0.018**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC02

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	4	0.002
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	7	0.001
	Paraprionospio pinnata	1	0.001
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	1	0.001
	Spiochaetopterus costarum	1	0.001
Mollusca : Gastropoda	Acteocina canaliculata	4	0.001
Arthropoda : Amphipoda	Ampelisca spp.	1	0.001
Arthropoda : Cumacea	Leucon americanus	5	0.001
STATION		**26**	**0.012**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC03

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Hermundura sp. A	44	0.007
	Leitoscoloplos spp.	4	0.003
	Mediomastus ambiseta	19	0.001
	Podarkeopsis levifuscina	1	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	27	0.001
Arthropoda : Tanaidacea	Hargeria rapax	34	0.001
Phoronida	Phoronis spp.	1	0.001
STATION		**134**	**0.019**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC04

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Platyhelminthes : Turbellaria	Stylochus ellipticus	1	0.001
Annelida : Polychaeta	Eteone lactea	3	0.001
	Glycinde solitaria	1	0.001
	Hermundura sp. A	13	0.002
	Leitoscoloplos spp.	9	0.009
	Mediomastus ambiseta	1	0.001
	Neanthes succinea	1	0.002
	Phyllodoce arenae	1	0.001
	Podarke obscura	4	0.001
	Podarkeopsis levifuscina	1	0.001
Arthropoda : Amphipoda	Ameroculodes species complex	1	0.001
	Ampelisca spp.	22	0.001
	Grandidierella sp.	4	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	2	0.001
Arthropoda : Tanaidacea	Hargeria rapax	3	0.001
Phoronida	Phoronis spp.	3	0.004
STATION		**70**	**0.029**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC05

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	59	0.009
	Leitoscoloplos spp.	10	0.009
	Loimia medusa	1	0.001
	Maldanidae spp.	1	0.008
	Mediomastus ambiseta	28	0.001
	Phyllodoce arenae	2	0.001
	Podarke obscura	3	0.001
	Spiochaetopterus costarum	4	0.004
	Tharyx sp. A Doner	1	0.001
Mollusca : Gastropoda	Haminoea solitaria	3	0.001
	Rictaxis punctostriatus	2	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	21	0.001
	Grandidierella sp.	4	0.001
	Leptocheirus plumulosus	1	0.001
	Listriella barnardi	1	0.001
Arthropoda : Cumacea	Cyclaspis varians	3	0.001
Arthropoda : Tanaidacea	Hargeria rapax	17	0.001
Phoronida	Phoronis spp.	1	0.002
Echinodermata : Holothuroidea	Leptosynapta tenuis	2	0.006
STATION		**166**	**0.053**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC06

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	2	0.001
	Hermundura sp. A	47	0.008
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	25	0.001
	Paraprionospio pinnata	1	0.001
	Podarke obscura	2	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
	Rictaxis punctostriatus	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	31	0.001
	Grandidierella sp.	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	66	0.002
Phoronida	Phoronis spp.	4	0.001
STATION		**183**	**0.022**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC07

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone lactea	1	0.001
	Hermundura sp. A	74	0.015
	Leitoscoloplos spp.	4	0.001
	Mediomastus ambiseta	14	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	1	0.001
Mollusca : Gastropoda	Rictaxis punctostriatus	1	0.001
Arthropoda : Isopoda	Cyathura polita	5	0.001
Arthropoda : Amphipoda	Ameroculodes species complex	2	0.001
	Ampelisca spp.	10	0.001
Arthropoda : Tanaidacea	Hargeria rapax	43	0.001
Phoronida	Phoronis spp.	2	0.001
STATION		**158**	**0.026**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC08

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	13	0.003
	Hobsonia florida	1	0.001
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	9	0.001
	Paraprionospio pinnata	2	0.001
	Spiochaetopterus costarum	3	0.003
	Tharyx sp. A Doner	1	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
	Haminoea solitaria	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	4	0.001
STATION		**36**	**0.015**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC09

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone lactea	1	0.001
	Hermundura sp. A	41	0.011
	Leitoscoloplos spp.	10	0.011
	Loimia medusa	1	0.001
	Mediomastus ambiseta	2	0.001
	Neanthes succinea	1	0.001
	Podarke obscura	1	0.001
	Tharyx sp. A Doner	1	0.001
Arthropoda : Isopoda	Cyathura polita	5	0.001
Arthropoda : Amphipoda	Ampelisca spp.	15	0.001
Arthropoda : Tanaidacea	Hargeria rapax	13	0.001
Phoronida	Phoronis spp.	1	0.001
STATION		**92**	**0.032**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC10

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	12	0.004
	Leitoscoloplos spp.	5	0.002
	Mediomastus ambiseta	2	0.001
	Paraprionospio pinnata	1	0.001
	Podarke obscura	2	0.001
	Spiochaetopterus costarum	2	0.003
Mollusca : Bivalvia	Tagelus plebeius	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	7	0.001
STATION		**33**	**0.015**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC11

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Hermundura sp. A	6	0.002
	Leitoscoloplos spp.	2	0.001
	Mediomastus ambiseta	7	0.001
	Paraprionospio pinnata	2	0.001
	Podarke obscura	4	0.001
	Tharyx sp. A Doner	1	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	3	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Phoronida	Phoronis spp.	1	0.001
STATION		**29**	**0.012**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC12

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	63	0.015
	Leitoscoloplos spp.	8	0.014
	Mediomastus ambiseta	8	0.001
	Neanthes succinea	1	0.001
	Phyllodoce arenae	1	0.001
	Spiochaetopterus costarum	2	0.004
	Spiophanes bombyx	1	0.001
	Streblospio benedicti	3	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Isopoda	Cyathura polita	26	0.006
Arthropoda : Amphipoda	Ampelisca spp.	11	0.001
	Grandidierella sp.	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	4	0.001
Phoronida	Phoronis spp.	2	0.002
Echinodermata : Holothuroidea	Leptosynapta tenuis	1	0.007
STATION		**133**	**0.057**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC13

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	2	0.002
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	4	0.002
	Leitoscoloplos spp.	2	0.002
	Paraprionospio pinnata	4	0.002
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	1	0.001
	Spiochaetopterus costarum	5	0.003
	Tharyx sp. A Doner	2	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
Phoronida	Phoronis spp.	3	0.002
STATION		**26**	**0.018**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC14

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Hermundura sp. A	35	0.006
	Leitoscoloplos spp.	1	0.001
	Mediomastus ambiseta	3	0.001
	Spiochaetopterus costarum	3	0.004
Arthropoda : Amphipoda	Ampelisca spp.	4	0.001
	Grandidierella sp.	7	0.001
Phoronida	Phoronis spp.	7	0.004
STATION		**61**	**0.019**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC15

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Platyhelminthes : Turbellaria	Stylochus ellipticus	1	0.001
Annelida : Polychaeta	Glycinde solitaria	2	0.001
	Hermundura sp. A	48	0.007
	Leitoscoloplos spp.	13	0.020
	Mediomastus ambiseta	16	0.001
	Podarke obscura	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	3	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Isopoda	Cyathura polita	14	0.003
Arthropoda : Amphipoda	Ameroculodes species complex	1	0.001
	Ampelisca spp.	9	0.001
	Grandidierella sp.	2	0.001
Arthropoda : Tanaidacea	Hargeria rapax	3	0.001
Echinodermata : Holothuroidea	Leptosynapta tenuis	1	0.005
Chordata : Urochordata	Molgula lutulenta	1	0.001
STATION		**117**	**0.047**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC16

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.003
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	21	0.003
	Loimia medusa	1	0.001
	Mediomastus ambiseta	17	0.001
	Podarke obscura	3	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	3	0.001
Mollusca : Gastropoda	Acteocina canaliculata	7	0.001
	Rictaxis punctostriatus	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	10	0.001
	Grandidierella sp.	1	0.001
Arthropoda : Cumacea	Leucon americanus	2	0.001
Phoronida	Phoronis spp.	2	0.002
Chordata : Urochordata	Molgula lutulenta	1	0.001
STATION		**72**	**0.020**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC17

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	41	0.004
	Leitoscoloplos spp.	3	0.004
	Loimia medusa	1	0.002
	Mediomastus ambiseta	29	0.001
	Neanthes succinea	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	24	0.001
Mollusca : Gastropoda	Haminoea solitaria	1	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Isopoda	Cyathura polita	7	0.002
	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	6	0.001
	Leptocheirus plumulosus	1	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	2	0.001
Phoronida	Phoronis spp.	3	0.002
Echinodermata : Holothuroidea	Leptosynapta tenuis	1	0.003
Chordata : Hemichordata	Saccoglossus kowalevskii	1	0.001
Chordata : Cephalochordata	Branchiostoma virginae	1	0.002
STATION		**127**	**0.032**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC18

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Glycinde solitaria	2	0.001
	Hermundura sp. A	3	0.001
	Leitoscoloplos spp.	3	0.002
	Mediomastus ambiseta	6	0.001
	Paraprionospio pinnata	5	0.001
	Phyllodoce arenae	1	0.001
	Podarke obscura	1	0.001
	Tharyx sp. A Doner	2	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**29**	**0.014**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC19

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	58	0.009
	Hobsonia florida	1	0.001
	Leitoscoloplos spp.	8	0.019
	Loimia medusa	1	0.001
	Mediomastus ambiseta	32	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	21	0.001
Mollusca : Bivalvia	Gemma gemma	2	0.001
Arthropoda : Isopoda	Cyathura polita	7	0.001
Arthropoda : Amphipoda	Ampelisca spp.	3	0.001
	Leptocheirus plumulosus	5	0.001
Arthropoda : Tanaidacea	Hargeria rapax	1	0.001
Phoronida	Phoronis spp.	3	0.002
STATION		**144**	**0.041**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC20

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	6	0.002
	Hermundura sp. A	49	0.007
	Leitoscoloplos spp.	1	0.003
	Mediomastus ambiseta	24	0.001
	Parahesione luteola	1	0.001
	Paraprionospio pinnata	1	0.001
	Streblospio benedicti	8	0.001
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
	Gastropoda spp.	1	0.001
Mollusca : Bivalvia	Bivalvia spp.	1	0.001
	Gemma gemma	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	8	0.001
	Grandidierella sp.	2	0.001
	Leptocheirus plumulosus	7	0.001
Arthropoda : Tanaidacea	Hargeria rapax	2	0.001
Phoronida	Phoronis spp.	1	0.001
Echinodermata : Holothuroidea	Leptosynapta tenuis	1	0.001
Chordata : Urochordata	Molgula lutulenta	1	0.001
Chordata : Cephalochordata	Branchiostoma virginae	1	0.001
STATION		**118**	**0.029**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC21

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	3	0.004
Annelida : Polychaeta	Eteone lactea	1	0.002
	Hermundura sp. A	48	0.008
	Leitoscoloplos spp.	6	0.008
	Mediomastus ambiseta	14	0.001
	Phyllodoce arenae	2	0.001
	Spiochaetopterus costarum	3	0.003
	Streblospio benedicti	1	0.001
Mollusca : Gastropoda	Gastropoda spp.	1	0.001
Mollusca : Bivalvia	Gemma gemma	1	0.001
Arthropoda : Isopoda	Cyathura polita	5	0.002
	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	13	0.001
Arthropoda : Tanaidacea	Hargeria rapax	11	0.001
Phoronida	Phoronis spp.	4	0.002
STATION		**114**	**0.037**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC22

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	8	0.003
	Paraprionospio pinnata	3	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	2	0.002
Mollusca : Gastropoda	Haminoea solitaria	1	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
STATION		**17**	**0.010**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC23

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	37	0.014
	Leitoscoloplos spp.	5	0.009
	Mediomastus ambiseta	10	0.001
	Streblospio benedicti	1	0.001
Arthropoda : Isopoda	Cyathura polita	11	0.002
Arthropoda : Amphipoda	Ampelisca spp.	18	0.001
	Grandidierella sp.	4	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	2	0.001
Phoronida	Phoronis spp.	4	0.002
Chordata : Cephalochordata	Branchiostoma virginae	1	0.001
STATION		**93**	**0.033**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC24

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycera americana	1	0.024
	Glycinde solitaria	1	0.001
	Hermundura sp. A	35	0.007
	Mediomastus ambiseta	40	0.001
	Neanthes succinea	4	0.001
	Parahesione luteola	1	0.001
	Phyllodoce arenae	1	0.001
	Podarke obscura	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	5	0.001
	Tharyx sp. A Doner	3	0.001
Mollusca : Bivalvia	Gemma gemma	5	0.001
	Tellina agilis	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	11	0.001
	Corophiidae	1	0.001
	Grandidierella sp.	17	0.002
Arthropoda : Tanaidacea	Hargeria rapax	4	0.001
Phoronida	Phoronis spp.	6	0.003
STATION		**139**	**0.051**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=. Station=23BC25

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Glycinde solitaria	9	0.001
	Hermundura sp. A	86	0.009
	Leitoscoloplos spp.	5	0.005
	Mediomastus ambiseta	99	0.002
	Neanthes succinea	1	0.001
	Paraprionospio pinnata	1	0.002
	Podarke obscura	2	0.001
	Streblospio benedicti	9	0.001
Mollusca : Bivalvia	Gemma gemma	6	0.001
	Parvilucina multilineata	1	0.001
Arthropoda : Isopoda	Cyathura polita	19	0.004
Arthropoda : Amphipoda	Ampelisca spp.	27	0.001
	Grandidierella sp.	6	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	4	0.001
Phoronida	Phoronis spp.	5	0.002
Echinodermata : Holothuroidea	Leptosynapta tenuis	1	0.004
STATION		**283**	**0.039**
STRATCODE		**2451**	**0.700**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP01

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Glycinde solitaria	2	0.001
	Hermundura sp. A	64	0.005
	Leitoscoloplos spp.	8	0.001
	Mediomastus ambiseta	85	0.002
	Paraprionospio pinnata	5	0.001
	Streblospio benedicti	1	0.001
	Tharyx sp. A Doner	1	0.001
Mollusca : Gastropoda	Haminoea solitaria	2	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Ampelisca abdita	14	0.001
	Grandidierella sp.	1	0.001
STATION		**186**	**0.018**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP03

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Demonax microphthalmus	10	0.008
	Hermundura sp. A	11	0.001
	Hobsonia florida	1	0.001
	Leitoscoloplos spp.	1	0.001
	Loimia medusa	3	0.001
	Neanthes succinea	1	0.001
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	3	0.001
	Tharyx sp. A Doner	4	0.001
Mollusca : Bivalvia	Tellinidae spp.	3	0.001
Arthropoda : Isopoda	Ptilanthura tenuis	1	0.001
Arthropoda : Amphipoda	Grandidierella sp.	17	0.001
STATION		**57**	**0.020**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP04

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Glycinde solitaria	3	0.001
	Hermundura sp. A	12	0.002
	Leitoscoloplos spp.	5	0.007
	Mediomastus ambiseta	3	0.001
	Paraprionospio pinnata	6	0.002
Arthropoda : Amphipoda	Ampelisca spp.	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**32**	**0.016**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP05

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	3	0.001
	Leitoscoloplos spp.	2	0.002
	Podarke obscura	4	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	1	0.001
Arthropoda : Cumacea	Leucon americanus	2	0.001
STATION		**15**	**0.009**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP07

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	5	0.001
	Hobsonia florida	5	0.001
	Leitoscoloplos spp.	2	0.007
	Mediomastus ambiseta	65	0.002
	Parahesione luteola	1	0.001
	Paraprionospio pinnata	1	0.001
	Podarke obscura	1	0.001
	Streblospio benedicti	7	0.001
	Tharyx sp. A Doner	2	0.001
Arthropoda : Cumacea	Leucon americanus	2	0.001
STATION		**91**	**0.017**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP08

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	5	0.002
	Leitoscoloplos spp.	4	0.007
	Mediomastus ambiseta	22	0.001
	Paraprionospio pinnata	14	0.003
STATION		**46**	**0.014**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP10

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Hermundura sp. A	18	0.001
	Leitoscoloplos spp.	2	0.002
	Paraprionospio pinnata	2	0.001
	Pectinaria gouldii	1	0.001
	Phyllodoce arenae	1	0.001
	Podarke obscura	1	0.001
	Tharyx sp. A Doner	2	0.001
STATION		**27**	**0.008**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP11

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Glycinde solitaria	3	0.001
	Hermundura sp. A	15	0.002
	Leitoscoloplos spp.	2	0.003
	Paraprionospio pinnata	3	0.001
	Podarke obscura	3	0.001
	Tharyx sp. A Doner	1	0.001
Mollusca : Bivalvia	Barnea truncata	1	0.001
Arthropoda : Amphipoda	Ampelisca abdita	1	0.001
STATION		**29**	**0.011**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP12

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	6	0.001
	Mediomastus ambiseta	1	0.001
	Nephtys picta	1	0.001
	Parahesione luteola	2	0.001
	Paraprionospio pinnata	3	0.001
	Podarkeopsis levifuscina	1	0.001
	Tharyx sp. A Doner	4	0.001
STATION		**19**	**0.008**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP13

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Leitoscoloplos spp.	1	0.003
	Mediomastus ambiseta	5	0.001
	Paraprionospio pinnata	5	0.001
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	1	0.001
	Sigambra tentaculata	1	0.001
	Streblospio benedicti	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	2	0.004
STATION		**18**	**0.014**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP14

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	10	0.001
	Hermundura sp. A	19	0.002
	Leitoscoloplos spp.	4	0.001
	Mediomastus ambiseta	6	0.001
	Paraprionospio pinnata	4	0.001
	Podarkeopsis levifuscina	1	0.001
	Spiochaetopterus costarum	3	0.001
	Tharyx sp. A Doner	8	0.001
Mollusca : Bivalvia	Aligena elevata	1	0.001
	Lyonsia hyalina	1	0.001
Arthropoda : Isopoda	Ptilanthura tenuis	2	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
	Grandidierella sp.	2	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	1	0.001
STATION		**67**	**0.016**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP15

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	5	0.003
Annelida : Polychaeta	Clymenella torquata	1	0.011
	Eteone lactea	2	0.001
	Glycinde solitaria	2	0.001
	Hermundura sp. A	15	0.002
	Leitoscoloplos spp.	3	0.003
	Loimia medusa	1	0.001
	Paraprionospio pinnata	8	0.002
	Podarke obscura	9	0.001
	Podarkeopsis levifuscina	4	0.001
	Spiochaetopterus costarum	2	0.001
	Tharyx sp. A Doner	3	0.001
Mollusca : Bivalvia	Aligena elevata	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	1	0.001
	Melita nitida	2	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	3	0.002
STATION		**63**	**0.034**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP16

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Glycinde solitaria	2	0.001
	Hermundura sp. A	19	0.005
	Leitoscoloplos spp.	4	0.003
	Mediomastus ambiseta	193	0.004
	Paraprionospio pinnata	3	0.001
	Podarke obscura	15	0.002
	Podarkeopsis levifuscina	3	0.001
	Streblospio benedicti	14	0.001
	Tharyx sp. A Doner	4	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	9	0.001
Mollusca : Bivalvia	Barnea truncata	1	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
	Grandidierella sp.	2	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
STATION		**277**	**0.027**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP17

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	2	0.001
	Leitoscoloplos spp.	3	0.004
	Maldanidae spp.	1	0.004
	Paraprionospio pinnata	4	0.001
	Podarke obscura	5	0.001
	Podarkeopsis levifuscina	1	0.001
	Sigambra tentaculata	1	0.001
	Spiochaetopterus costarum	2	0.001
	Tharyx sp. A Doner	1	0.001
Arthropoda : Amphipoda	Listriella barnardi	4	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	1	0.014
STATION		**25**	**0.030**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP18

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	43	0.007
	Leitoscoloplos spp.	3	0.001
	Mediomastus ambiseta	2	0.001
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	1	0.001
STATION		**50**	**0.011**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP19

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Hermundura sp. A	3	0.001
	Leitoscoloplos spp.	2	0.008
	Mediomastus ambiseta	2	0.001
	Paraprionospio pinnata	3	0.001
	Podarke obscura	2	0.001
	Podarkeopsis levifuscina	1	0.001
	Spiochaetopterus costarum	2	0.001
	Tharyx sp. A Doner	1	0.001
STATION		**16**	**0.015**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP20

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Platyhelminthes : Turbellaria	Stylochus ellipticus	2	0.001
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Demonax microphthalmus	3	0.001
	Glycera spp.	1	0.001
	Glycinde solitaria	1	0.001
	Hermundura sp. A	7	0.002
	Hydroides dianthus	4	0.001
	Leitoscoloplos spp.	4	0.003
	Mediomastus ambiseta	27	0.001
	Neanthes succinea	1	0.001
	Paraprionospio pinnata	8	0.002
	Podarke obscura	5	0.001
	Podarkeopsis levifuscina	2	0.001
	Spiochaetopterus costarum	2	0.001
	Tharyx sp. A Doner	8	0.001
Mollusca : Gastropoda	Acteocina canaliculata	2	0.001
	Cerithiidae spp.	1	0.001
	Nassarius vibex	1	0.038
	Turbonilla interrupta	1	0.001
Arthropoda : Isopoda	Ptilanthura tenuis	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	4	0.001
	Grandidierella sp.	2	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	4	0.004
STATION		**93**	**0.068**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP21

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	3	0.003
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	2	0.001
	Paraprionospio pinnata	1	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	1	0.001
Mollusca : Gastropoda	Acteocina canaliculata	2	0.001
STATION		**10**	**0.009**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP22

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Leitoscoloplos spp.	2	0.003
	Mediomastus ambiseta	28	0.001
	Streblospio benedicti	2	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	15	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	1	0.001
STATION		**50**	**0.009**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP24

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	11	0.002
	Hermundura sp. A	45	0.007
	Leitoscoloplos spp.	1	0.001
	Mediomastus ambiseta	2	0.001
	Pectinaria gouldii	1	0.001
	Podarke obscura	2	0.001
	Spiochaetopterus costarum	1	0.001
	Tharyx sp. A Doner	4	0.001
Mollusca : Gastropoda	Nudibranchia spp.	1	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
	Grandidierella sp.	5	0.001
Arthropoda : Cumacea	Cyclaspis varians	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	1	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	1	0.001
STATION		**79**	**0.022**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP25

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	2	0.001
Annelida : Polychaeta	Glycera americana	1	0.002
	Hermundura sp. A	20	0.004
	Leitoscoloplos spp.	2	0.001
	Mediomastus ambiseta	8	0.001
	Neanthes succinea	1	0.006
	Parahesione luteola	5	0.001
	Paraprionospio pinnata	5	0.001
	Podarke obscura	10	0.002
	Tharyx sp. A Doner	2	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Grandidierella sp.	6	0.001
	Melita nitida	3	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**67**	**0.024**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP26

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Hermundura sp. A	1	0.001
	Mediomastus ambiseta	5	0.001
	Paraprionospio pinnata	7	0.001
	Podarke obscura	2	0.001
	Streblospio benedicti	3	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	1	0.001
Arthropoda : Amphipoda	Listriella barnardi	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Chordata : Hemichordata	Saccoglossus kowalevskii	2	0.011
STATION		**23**	**0.019**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP27

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.001
Annelida : Polychaeta	Demonax microphthalmus	4	0.001
	Glycinde solitaria	2	0.001
	Hermundura sp. A	16	0.004
	Mediomastus ambiseta	2	0.001
	Paraprionospio pinnata	3	0.001
	Podarke obscura	13	0.002
	Podarkeopsis levifuscina	2	0.001
	Tharyx sp. A Doner	4	0.001
Arthropoda : Isopoda	Edotea triloba	2	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
STATION		**54**	**0.016**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP28

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Hermundura sp. A	1	0.001
	Leitoscoloplos spp.	2	0.003
	Mediomastus ambiseta	12	0.001
	Paraprionospio pinnata	3	0.001
	Podarke obscura	1	0.001
	Spiochaetopterus costarum	1	0.001
STATION		**21**	**0.009**

Table 5. Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2016) (Continued).

Stratum=Virginia Mainstem Station=23MP29

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Demonax microphthalmus	13	0.001
	Eteone heteropoda	1	0.001
	Glycinde solitaria	3	0.001
	Hermundura sp. A	54	0.007
	Leitoscoloplos spp.	4	0.001
	Loimia medusa	1	0.001
	Mediomastus ambiseta	6	0.001
	Neanthes succinea	1	0.001
	Parahesione luteola	1	0.001
	Paraprionospio pinnata	1	0.001
	Phyllodoce arenae	1	0.001
	Podarke obscura	4	0.001
	Spiochaetopterus costarum	1	0.001
Arthropoda : Amphipoda	Ampelisca spp.	3	0.001
	Grandidierella sp.	10	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	1	0.001
STATION		**106**	**0.023**
STRATCODE		**1521**	**0.467**
		3972	**1.167**

Appendix C. Glossary of terms

Glossary of selected terms

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

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

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

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

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

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

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

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

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

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

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

Stratum - a geographic region of unique ecological condition or managerial interest. In this study the primary strata were the Mainstem of the river, the Lafayette River, the Eastern Branch, Western Branch and Southern Branch. In future years the entire Elizabeth River watershed will be sampled as a single stratum.

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

Appendix D. Data by Site – BIBI, Abundance, Biomass, Shannon Index, Species Richness, Total Volatile Organics, Salinity, Water Depth

Table D1. Money Point sample sites sampled in 2010. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
17MP01	9/21/2010	2.00	6,464	0.18	1.40	7	7.69	21.9	2.00
17MP02	9/21/2010	1.67	2,313	0.18	1.36	6	9.44	22.0	3.80
17MP03	9/21/2010	1.00	953	0.16	1.34	7	6.09	21.8	6.20
17MP04	9/21/2010	2.00	7,212	0.82	2.15	12	1.22	21.8	0.50
17MP05	9/21/2010	1.33	15,989	0.57	1.07	14	7.92	22.0	3.40
17MP06	9/21/2010	2.67	1,497	0.34	2.80	13	9.42	21.7	4.30
17MP07	9/21/2010	2.33	1,043	0.39	2.78	10	6.47	22.0	4.40
17MP08	9/21/2010	2.33	3,924	0.23	1.45	7	4.86	21.9	2.10
17MP09	9/21/2010	1.67	6,396	0.41	1.17	8	5.14	21.8	0.70
17MP10	9/21/2010	1.67	12,429	0.36	0.88	10	7.19	21.9	1.90
17MP11	9/21/2010	2.33	3,810	0.34	1.91	13	7.72	21.8	2.90
17MP12	9/21/2010	2.00	5,511	0.25	1.82	9	6.72	21.8	0.50
17MP13	9/21/2010	2.33	3,515	0.20	1.18	9	10.79	21.7	4.10
17MP14	9/21/2010	1.33	14,946	0.52	1.09	11	9.20	21.8	5.80
17MP15	9/21/2010	1.67	9,253	0.36	1.44	11	7.88	21.8	3.50
17MP16	9/21/2010	1.67	10,115	0.48	1.65	10	2.18	21.9	1.00
17MP17	9/21/2010	1.67	11,907	0.68	1.82	13	2.61	21.8	0.70
17MP18	9/21/2010	1.67	2,200	0.34	2.08	9	10.15	22.0	8.00
17MP19	9/21/2010	1.00	431	0.11	1.47	5	4.06	21.8	7.50
17MP20	9/21/2010	1.67	2,654	0.32	2.21	12	11.65	22.0	10.70
17MP21	9/21/2010	2.00	1,950	0.32	2.69	11	9.92	22.0	4.00
17MP22	9/21/2010	2.00	2,291	0.36	2.23	10	5.85	21.8	6.80
17MP23	9/21/2010	2.00	14,356	0.20	0.55	6	6.64	21.9	3.20
17MP24	9/21/2010	1.33	1,905	0.18	1.11	6	3.27	21.8	1.20
17MP25	9/21/2010	1.33	6,600	0.36	0.75	8	8.69	21.8	3.50

Table D2. Blows Creek sample sites sampled in 2010. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
17BC01	9/14/2010	1.33	3,493	0.29	1.88	12	5.57	21.9	3.20
17BC02	9/14/2010	1.67	3,198	0.50	2.50	14	7.10	22.0	2.50
17BC03	9/14/2010	2.33	10,410	2.09	1.69	19	1.91	22.0	0.90
17BC04	9/14/2010	2.33	9,412	1.07	1.51	17	3.41	22.1	1.70
17BC05	9/14/2010	2.00	8,301	0.86	1.58	15	1.11	21.9	1.40
17BC06	9/14/2010	2.00	2,994	0.64	2.21	13	3.18	22.1	3.50
17BC07	9/14/2010	2.33	3,447	0.36	1.98	11	3.98	22.1	3.60
17BC08	9/14/2010	3.00	4,264	1.11	2.50	15	2.87	22.0	3.20
17BC09	9/14/2010	2.00	8,845	1.50	1.58	12	0.64	22.0	1.00
17BC10	9/14/2010	3.00	3,039	1.20	2.08	12	2.67	22.2	3.50
17BC11	9/14/2010	1.67	4,173	0.36	1.50	11	4.94	22.1	3.80
17BC12	9/14/2010	2.00	9,208	0.68	1.45	12	1.87	22.0	1.30
17BC13	9/14/2010	2.00	1,928	0.32	2.58	12	4.22	22.3	7.70
17BC14	9/14/2010	2.33	7,620	0.75	1.82	14	3.79	22.2	1.90
17BC15	9/14/2010	2.00	6,872	0.41	1.14	13	4.01	22.3	4.00
17BC16	9/14/2010	2.67	7,507	1.16	1.71	17	0.53	22.2	1.40
17BC17	9/14/2010	1.00	10,569	0.50	1.12	12	8.49	22.3	3.40
17BC18	9/14/2010	2.00	6,078	0.52	1.66	13	2.56	22.2	1.10
17BC19	9/14/2010	2.67	4,445	1.45	2.55	17	1.53	22.2	1.30
17BC20	9/14/2010	2.33	8,618	1.79	1.58	13	1.77	22.1	0.20
17BC21	9/14/2010	2.00	2,812	0.32	1.71	10	0.56	22.3	1.30
17BC23	9/23/2010	2.00	6,713	0.75	1.77	13	1.34	21.8	0.50
17BC24	9/23/2010	2.00	5,421	0.54	1.93	13	0.64	21.8	0.20
17BC25	9/23/2010	2.00	5,058	0.61	2.31	16	4.32	21.7	1.70
17BC26	9/23/2010	2.33	7,258	0.82	1.29	12	0.64	21.8	0.70

Table D3. Money Point sample sites sampled in 2013. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
20MP01	9/20/2013	2.33	1,452	2.15	2.83	15	0.55	20.4	1.00
20MP02	9/13/2013	1.33	1,134	0.39	1.87	11	2.61	20.4	4.50
20MP04	9/13/2013	2.00	7,053	0.52	0.70	8	2.00	20.2	2.80
20MP05	9/13/2013	1.67	1,247	0.27	3.06	11	1.76	19.7	1.50
20MP06	9/13/2013	3.00	1,678	3.74	1.47	10	1.21	20.2	3.20
20MP07	9/13/2013	1.67	1,179	0.29	2.57	13	3.22	20.1	3.80
20MP08	9/13/2013	1.67	2,699	0.39	2.24	8	6.07	20.1	4.90
20MP09	9/13/2013	2.67	2,767	0.88	2.34	13	0.68	19.8	2.30
20MP10	9/13/2013	2.33	4,831	0.27	1.46	11	2.17	20.1	4.00
20MP11	9/13/2013	2.00	1,882	0.54	3.22	17	2.44	20.4	9.90
20MP14	9/13/2013	2.33	1,882	0.32	2.72	12	3.48	20.5	6.50
20MP15	9/13/2013	2.33	3,856	1.27	2.05	10	4.87	20.2	4.60
20MP16	9/20/2013	2.00	3,311	0.70	2.47	15	0.27	20.5	1.70
20MP17	9/20/2013	1.67	1,474	0.88	2.42	11	1.29	20.5	2.00
20MP18	9/13/2013	3.00	2,449	1.25	3.08	16	0.79	20.5	6.10
20MP19	9/20/2013	2.00	2,744	1.00	2.62	16	1.68	20.5	1.10
20MP21	9/13/2013	2.00	7,144	0.73	1.16	9	2.39	20.1	4.30
20MP23	9/13/2013	1.67	5,489	1.25	2.36	18	4.61	20.5	10.00
20MP24	9/13/2013	1.67	3,606	0.61	1.98	11	4.89	19.8	5.00
20MP25	9/13/2013	1.67	1,021	0.27	2.45	9	1.15	20.1	4.40
20MP26	9/13/2013	2.67	748	0.25	2.86	11	3.79	20.1	3.00
20MP27	9/13/2013	2.00	1,860	0.54	2.22	10	5.35	20.5	13.40
20MP28	9/20/2013	2.00	1,610	0.57	2.84	13	1.66	20.5	2.80
20MP29	9/13/2013	3.00	1,724	0.45	2.42	9	6.06	20.1	4.90
20MP30	9/20/2013	3.00	1,157	1.66	2.95	12	3.97	20.6	8.50

Table D4. Blows Creek sample sites sampled in 2013. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
20BC01	9/6/2013	2.00	5,330	0.52	1.82	12	0.53	22.1	1.50
20BC02	9/6/2013	2.00	5,398	0.88	2.03	15	1.26	21.1	1.10
20BC03	9/6/2013	2.00	5,693	0.75	1.80	13	0.72	20.8	1.20
20BC04	9/6/2013	1.67	3,243	0.52	2.05	9	7.38	21.1	3.60
20BC05	9/6/2013	2.00	5,216	0.43	1.59	11	0.59	21.1	1.70
20BC06	9/6/2013	2.00	7,666	0.75	1.78	14	2.85	21.0	4.40
20BC07	9/6/2013	2.00	3,561	0.75	2.23	11	5.40	21.1	4.80
20BC08	9/6/2013	2.33	6,282	3.52	1.77	14	6.05	21.2	4.00
20BC09	9/6/2013	1.67	7,757	0.52	1.68	13	6.02	21.1	6.30
20BC10	9/6/2013	2.67	1,860	0.54	3.10	16	6.15	21.0	1.90
20BC11	9/6/2013	1.33	3,447	0.29	1.60	8	8.62	21.1	3.40
20BC12	9/6/2013	2.33	3,016	0.73	2.19	10	0.63	21.0	1.40
20BC13	9/6/2013	1.33	3,720	0.39	1.80	11	7.40	21.1	6.00
20BC14	9/6/2013	2.00	1,882	0.61	2.36	8	0.69	20.9	0.50
20BC15	9/6/2013	2.33	4,082	0.34	2.39	11	2.58	21.2	4.00
20BC16	9/6/2013	1.33	771	0.25	2.59	10	4.11	21.0	2.80
20BC17	9/6/2013	2.00	6,985	0.88	1.44	11	0.75	21.1	0.40
20BC18	9/6/2013	1.33	7,190	0.50	1.22	9	6.58	20.8	2.80
20BC19	9/6/2013	1.67	7,258	0.70	1.68	12	7.82	21.0	3.00
20BC20	9/6/2013	2.00	10,569	1.22	1.32	16	1.53	21.0	0.50
20BC21	9/6/2013	2.33	4,060	0.50	1.87	15	1.58	21.1	1.50
20BC22	9/6/2013	1.67	9,798	0.75	1.18	19	0.65	21.0	1.50
20BC23	9/6/2013	1.67	7,394	0.57	1.59	10	7.35	20.9	2.70
20BC24	9/6/2013	3.33	2,880	0.73	2.45	13	5.77	21.1	0.50
20BC25	9/6/2013	1.33	4,082	0.50	1.68	9	8.67	21.1	3.20

Table D5. Money Point sample sites sampled in 2016. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
23MP01	9/15/2016	2.33	4,218	0.41	2.05	13	2.16	19.8	2.40
23MP03	9/15/2016	2.00	1,293	0.45	2.97	13	0.45	20.4	3.50
23MP04	9/15/2016	1.67	726	0.36	2.51	8	2.35	20.2	4.20
23MP05	9/15/2016	2.00	340	0.20	2.79	8	7.25	20.3	4.50
23MP07	9/15/2016	1.67	2,064	0.39	1.67	10	6.00	20.2	3.40
23MP08	9/15/2016	1.67	1,043	0.32	1.81	5	4.29	20.2	4.20
23MP10	9/15/2016	1.33	612	0.18	1.75	7	1.37	20.6	4.00
23MP11	9/15/2016	1.67	658	0.25	2.28	8	5.81	20.7	4.30
23MP12	9/15/2016	1.33	431	0.18	2.66	8	3.48	21.5	5.30
23MP13	9/15/2016	1.33	408	0.32	2.77	9	8.12	21.3	9.70
23MP14	9/15/2016	2.33	1,520	0.36	3.31	15	1.11	20.5	4.70
23MP15	9/15/2016	3.67	1,383	0.75	3.46	16	7.56	22.0	9.50
23MP16	9/15/2016	2.00	6,260	0.59	1.87	16	8.15	20.7	6.60
23MP17	9/15/2016	2.33	567	0.68	3.19	11	10.41	22.2	9.30
23MP18	9/15/2016	1.67	1,134	0.25	0.84	5	3.91	20.3	3.20
23MP19	9/15/2016	1.67	363	0.34	2.91	8	7.21	21.4	7.40
23MP20	9/15/2016	3.33	1,928	1.45	3.53	20	8.93	22.1	8.20
23MP21	9/15/2016	2.00	227	0.20	2.45	6	9.52	21.1	8.60
23MP22	9/15/2016	1.33	1,134	0.20	1.70	7	8.56	21.7	10.20
23MP24	9/15/2016	1.67	1,746	0.45	2.23	13	1.21	20.4	3.90
23MP25	9/15/2016	2.00	1,429	0.50	2.99	12	0.82	20.4	4.50
23MP26	9/15/2016	1.67	522	0.43	2.78	9	10.77	22.6	11.20
23MP27	9/15/2016	1.67	1,179	0.34	2.90	11	3.82	20.4	4.40
23MP28	9/15/2016	1.00	476	0.20	2.02	7	4.32	20.2	4.30
23MP29	9/15/2016	1.67	2,404	0.52	2.64	17	0.95	20.3	3.00

Table D6. Blows Creek sample sites sampled in 2016. BIBI, selected metrics, and physiographic/sedimentary measurements.

Station	Date	BIBI	Abundance	Biomass	Shannon	Species Richness	Volatile Organics	Salinity	Depth
23BC01	9/7/2016	2.33	1,157	0.41	2.46	11	9.53	20.1	4.10
23BC02	9/7/2016	1.67	590	0.27	2.88	10	8.29	19.5	4.00
23BC03	9/23/2016	2.00	3,039	0.43	2.36	11	1.33	3.6	2.00
23BC04	9/7/2016	2.00	1,520	0.61	3.01	14	1.14	18.9	2.10
23BC05	9/7/2016	2.67	3,742	1.18	3.05	20	1.79	18.9	2.30
23BC06	9/23/2016	2.00	4,150	0.50	2.37	13	3.17	3.7	2.30
23BC07	9/23/2016	2.33	3,583	0.59	2.22	12	1.12	3.4	1.70
23BC08	9/23/2016	1.67	816	0.34	2.63	10	5.49	6.4	3.00
23BC09	9/7/2016	1.67	2,087	0.73	2.47	12	1.58	19.4	1.90
23BC10	9/7/2016	2.67	748	0.34	2.61	9	5.34	19.4	3.00
23BC11	9/7/2016	2.00	658	0.27	3.07	11	8.32	19.4	4.00
23BC12	9/7/2016	2.33	3,016	1.29	2.53	15	0.76	19.0	1.80
23BC13	9/7/2016	2.00	590	0.41	3.22	11	6.71	19.0	6.10
23BC14	9/23/2016	1.33	1,383	0.43	2.06	8	0.93	3.3	1.90
23BC15	9/7/2016	2.67	2,608	1.02	2.71	14	3.52	18.8	1.70
23BC16	9/7/2016	2.67	1,610	0.43	2.94	14	2.43	18.6	2.80
23BC17	9/7/2016	2.33	2,812	0.68	2.80	18	0.79	18.7	1.50
23BC18	9/7/2016	2.00	658	0.32	3.39	13	10.54	20.1	4.20
23BC19	9/7/2016	2.33	3,266	0.93	2.60	14	1.01	18.7	1.40
23BC20	9/7/2016	2.00	2,631	0.64	2.79	18	0.74	18.7	1.50
23BC21	9/7/2016	2.00	2,540	0.82	2.75	13	1.19	19.5	1.90
23BC22	9/7/2016	2.00	363	0.20	2.08	6	9.85	19.3	4.00
23BC23	9/7/2016	1.67	2,064	0.73	2.48	9	0.79	18.8	1.50
23BC24	9/7/2016	3.67	3,130	1.13	3.05	18	0.74	18.7	1.70
23BC25	9/7/2016	2.00	6,396	0.86	2.68	17	0.79	19.0	1.70