Description of Foraminiferal Assemblages within the Hood Canal Basin of Puget Sound, WA.

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A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Science

University of Washington

2018

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Program Authorized to Offer Degree:

Earth and Space Sciences

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Abstract

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This study investigatded the assemblages of benthic foraminifera present within Hood Canal, part of Puget Sound, Washington State. The investigation used foraminiferal assemblage measures and linear regressions to detect meaningful relationships between foraminifera and environmental conditions. Hood Canal experiences many local environmental stressors such as seasonal eutrophication and hypoxia cycles, impacts from historical saw mills, acquicultural fascilites and a large naval base, as well as legacy polycyclic aromatic hydrocarbon input from creosote treated pilings throughout its many smaller embayments. Shallow areas in proximity to historical mill sites and the Bangor Trident Naval base generally have lower foraminiferal health measures such as assemblage density, diversity, and species richness. Areas within the southern portion of Hood Canal which experience seasonal hypoxia did not display a detectable negative effect on foraminiferal populations. Generally, assemblages throughout Hood Canal indicate a complex and stressful benthic environment for foraminifera.

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ACKNOWLEDGEMENTS

I would like to thank my advisor Dr. Elizabeth Nesbitt for her wisdom, support and mentorship through my undergraduate and graduate years. Without her, I would never have believed myself capable of pursuing a graduate degree. I dearly appreciate her confidence in my abilities. I must also acknowledge the mentorship of Dr. Ruth Martin and her assistance in statistics, methods, and identification of foraminiferal taxa.

Thank you to my family, without whom I could not have completed this research. My sister Arielle Danner has provided many of the graphics used in this thesis as well as many graphics not included that aided me in my ability to sift through the large amount of data collected throughout this process. I would also like to thank my sister, parents, and parents-in-law for providing much need babysitting during my hours of research. Nichole Haas, my best friend and platonic life partner provided indispensable mathematic and statistical assistance in addition to asking thoughtful questions about my research that prompted a closer look at things I had not noticed.

Thank you to my long suffering and unwaveringly supportive husband who has provided monumental moral support and has heard quite enough about foraminifera in Hood Canal. Finally, I would like to acknowledge my son Benjamin helping me see the larger context for my research.

DEDICATION

I dedicate this research to my beloved grandmother Norma Jean Danner. Her life and memory are a continuing source of inspiration to me. Our time spent in the forests and mountains of central Oregon picking up rocks along the way sent me on my path toward natural science. I hope that she is proud of what I have been able to achieve.

Chapter 1. INTRODUCTION

This study is an initial investigation of benthic foraminiferal assemblages as environmental indicators within Hood Canal in Puget Sound,Washington State, and is part of the Burke Museum's Puget Sound Foram Research Project (PSFRP). The objectives of this research were to use samples from Hood Canal to describe changes in foraminiferal assemblages and determine significant relationships between species assemblages, individual taxa, and physical characteristics of their environment. In the course of the research it became clear that foraminifera within Hood Canal do not form a larger homogenous assemblage and that there is a high level of heterogeneity across the main channel and within smaller embayments.

Ecological monitoring using foraminiferal assemblages has been a successful tool in studies across the world (e.g., Bandy, et al., 1964; Alve, 1991; Thomas, et al., 2000; Scott, et al., 2005; Ferraro, et al., 2006; Coccioni, et al., 2009; Martínez-Colón, et al., 2009; Eichler, et al., 2012; Martin, et al., 2013; Jorissen, et al., 2018). Because of the utility of foraminifera in ecological monitoring, a large group of foraminiferal researchers convened to detail a protocol to standardize research across the world. These guidelines are called FoBiMo for Foraminiferal Bio-Monitoring (Schonfeld, et al., 2012). Foraminiferal research in Puget Sound did not formally begin until 2007 when researchers with the University of Washington and Burke Museum, Dr. Elizabeth Nesbitt and Dr. Ruth Martin, began the Puget Sound Foraminifera Research Project using samples collected by the Washington State Department of Ecology. Studies have described foraminiferal communities in anthropogenically impacted embayments in the main basin of Puget Sound, but this study is the first within Hood Canal (Martin, et al., 2015; Martin and Nesbitt, 2015; Nesbitt, et al. 2015, Martin and Nesbitt, 2017).

1.1 SETTING

Hood Canal is a 109 km long, narrow fjord located within Kitsap, Mason and Jefferson Counties, Washington State (Fig. 1). It receives cold (8-10°C) water from the Pacific Ocean via the Strait of Juan de Fuca with the daily tidal currents (Cokelet, et al., 1992; Babson, et al., 2006; Gregg & Pratt, 2010). The main channel has a complex bathymetry with a maximum depth of 183 m, with two sills in the middle of its northern reaches, several smaller embayments, a deep-water midsection that extends from Dabob Bay and shallows to a sharp eastern turn at its southern reach; it continues to shallow to the terminus to a tidal marsh in Lynch Cove, at Belfair (Fig. 1).

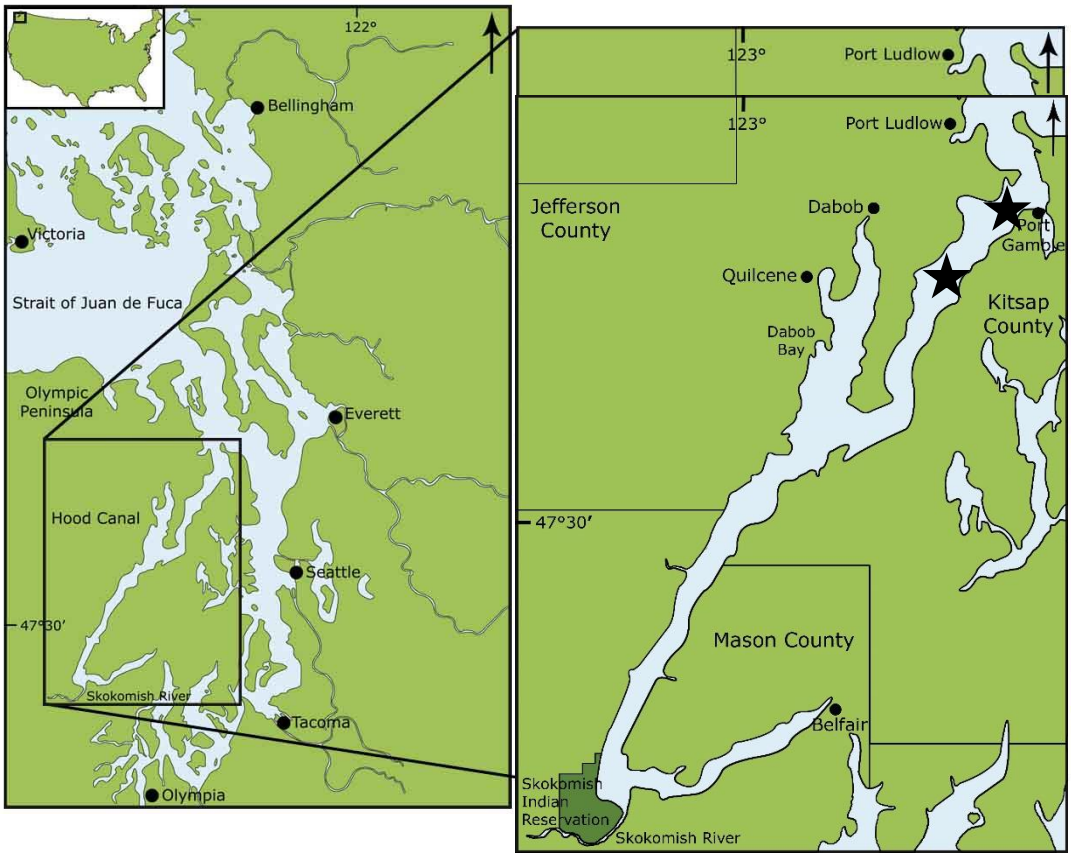


Figure 1. Map of Puget Sound, Washington, with inset of Hood Canal. The stars indicate the location of the twin sills in the northern portion of the canal.

The sills rise to approximately 55m in depth, deepening to approximately 175m and partially restricting (Port Ludlow, Port Gamble, and Dabob Bay are smaller embayments at the north end of the Canal.

Five major rivers and several smaller rivers flow from the west into Hood Canal, the largest of which is the Skokomish River. These rivers are fed by rain and snow-melt from the Olympic Mountains and peak freshwater input to Hood Canal is from late spring to midsummer (Gregg & Pratt, 2010). The Skokomish River carries the most sediment to the Canal and has built a delta at the Great Bend (Fig. 1) (Warner, et al., 2001, Czuba, et al., 2011).

Because the influx of fresh and marine waters into the canal is small in scale, residency times for parcels of water have been estimated to be as long as four months for deep waters (Feely, et al., 2010). This long water residency time, combined with observed weak water column mixing (Gregg & Pratt, 2010), results in strong stratification of the water column and low dissolved oxygen levels in all layers except the uppermost (Feely, et al., 2010). Lowest dissolved oxygen levels are located at the Great Bend portion of the South Canal and can be as low as 1.5mg/l (Newton, et al., 1995).

Because of the large geographical extent and the variation in human population, urban development and known physical conditions in Hood Canal, three larger regions and eight sub-regions will be referred to throughout the paper. These regions are shown in Figure 2. Port Ludlow, which is the northernmost embayment included in this study, is shallow and, while historically a logging community, it is now known as a planned community for active retirees. The North Main channel has two sills and on the west side the Bangor Trident Naval Base is located. Port Gamble is a northern embayment and historical logging community. The sawmill at

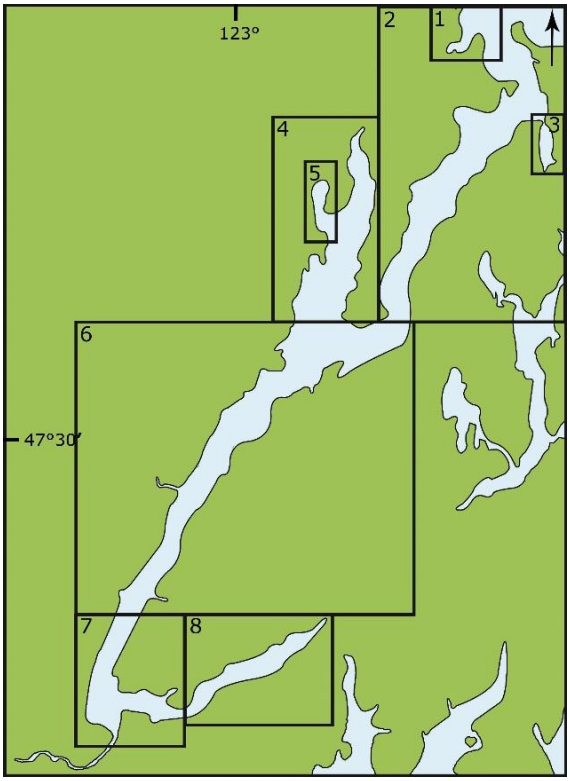


Figure 2. Map of Hood Canal designated sub-regions. 1. Port Ludlow, 2. North Main, 3. Port Gamble, 4. Dabob Bay, 5. Quilcene Bay, 6. The Midsection, 7. The Great Bend and 8. Lynch Cove.

Port Gamble was taken out of commission in October of 1995 making it the longest continuously operating sawmill in the United States (Lane, 1995).

Dabob Bay is the southernmost and largest Hood Canal embayment, and the only embayments south of the sills. Quilcene Bay is a smaller portion of Dabob Bay that receives freshwater input from the Quilcene River and has many economically important shellfisheries. The Midsection of the canal is where Hood Canal is deepest and has steep topography to the west and fresh water input from the Duckabush, Dosewallips, and Hamma Hamma rivers. The Great Bend is the portion of the canal where there is a sharp eastern turn (nearly 180°) and the

Skokomish River estuary is located. Lynch Cove is the shallow terminus with extensive mud flats, longest water residency time, and seasonal hypoxic events (Fig. 2).

1.1 FORAMINIFERA

Foraminifera are marine protists that cover their single cell with a shell, or test, constructed either by secreting $CaCO_3$ (calcareous forms) or by cementing available sediment together using organic glue (agglutinated forms). The tests of most agglutinated foraminiferal species do not include $CaCO_3$. Tests can be single or multi-chambered structures, with a wide diversity of shapes and chamber arrangement. Calcareous tests are susceptible to dissolution in ocean water below pH 7.6 (Prazeres, et al., 2015) and this can be used as a proxy for ocean acidification. Tests showing dissolution effects have pitted and ridged surfaces, or have become thin, and in extreme cases, have one or more outer chambers completely dissolved. This study used benthic taxa; no planktonic foraminifera inhabit Puget Sound beyond the Straits of Juan de Fuca. Benthic foraminifers have short life spans ranging between a few months to a year and have taxon-specific habitat ranges (Gupta, 1999; Murray, 2006). Taxa found within estuarine environments, such as Puget Sound, must be adaptable to survive in its highly variable and stressful environment. This results in lowered numbers of species per sample than in the open coastal or deeper water marine environments.

Foraminifera are well documented throughout the fossil record and utilized as stratigraphic marker species, paleoenvironmental proxies, and oceanographic temperature indicators. In modern sediments, foraminiferal taxa have been used as indicator species numerous physical conditions and to detect water/sediment contamination. Studies utilizing foraminifera as

ecological indicators have been conducted globally and are highly useful in describing ecological changes to anthropogenically impacted waterways (e.g. Alve, 1995; Nigam, et al., 2006; Osterman and Smith, 2012; Langlet et al., 2014, Wu, et al., 2015).

Because of the difficulty in studying live sample communities, assemblages of dead tests are used as a proxy population. The collected assemblages can be separated into "live" individuals whose tests have protoplasm marked by an organic stain, or "dead" individuals that remain unstained. This study used a combined assemblage of benthic foraminiferal taxon and individual taxa as proxies for changing environmental conditions from sample years 1985 to 2017.

1.2 PROJECT SAMPLES

Foraminifera from 112 sediment samples were used for this study. Sediment samples were obtained from three sources (Table 1). The primary collection was provided by the Washington State Department of Ecology Puget Sound Environmental Monitoring Project (PSEMP). Ten annual samples (Long Term stations) and different numbers of Spatial stations from targeted portions of Puget Sound are collected by PSEMP on a 5-6 year rotating schedule. For Hood Canal, one Long Term station, 13R, is located on the sill immediately south of Port Gamble, and was samples were available for most years between 1998 and 2017. Thirty two Spatial samples were available for 1999 and 2004 (Fig. 3). PSEMP sediment samples were collected from the upper 2cm of the sea floor using a Van Veen grab sampler and held at 4°C (Dutch, et al., 2009). Field measurements of depth, temperature, salinity of bottom water and sediment grain size, texture, color, and odor were recorded for each sample.

Sub-samples for the invertebrate macrobiota were set aside, the remaining sediment was homogenized and sub-sampled for chemical and foraminiferal analyses. Macrobiota assemblages

were studied by biologists at the Department of Ecology. Chemical analyses were conducted by the Manchester Environmental Laboratory in Port Orchard, WA, which provides analyses of samples every five years including measurement of 140 heavy metal and semi-volatile organic chemical contaminants and descriptions of field measurements of the sample. Contaminant data used in this study are concentrations of arsenic, cadmium, copper, mercury, lead, zinc, total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAH), and polychlorinated biphenyls (PCB) Aroclor 1242 and 1016.

A second collection was provided by the United States Geological Survey (USGS) which sampled the vicinity of the Great Bend utilizing Kasten corer and Van Veen sampler. Cores were split into 2cm slices for analysis. All cores were found to contain both calcareous and agglutinated foraminifera within the first 6 to 10cm, after which foraminifera were absent. Water chemistry was not provided for these samples. Samples collected prior to 1999 were donated to the Burke Museum by Robert Harman, from Shoreline Community College (SCC). Donated samples were previously processed by SCC students and included documents detailing foraminiferal and other invertebrate counts and maps that show physical parameters of various regions. Data used from these samples for this study include verified foraminifera counts and sediment grain size.

Once custody was transferred to the Burke Museum, FoBiMo protocols were followed (Schonfeld, et al., 2012). Samples were refrigerated until washed in water using a 65um sieve, and air dried. In cases where foraminiferal density was low, samples were floated in the heavy liquid Trichloroethylene. Floating samples is efficient in terms of time spent picking but has been observed to bias the sample assemblage by selecting for fossil and calcareous species (Schonfeld, et al., 2012). Large sediment samples were partitioned using a dry sample splitter

and portions were completely picked for foraminifera with a target of 300 individuals/sample for statistical validation. The remaining sediment was weighed to obtain specimen density data. Sample data is stored on a PSFRP database and all sample assemblages is archived in the Paleontology Division of the Burke Museum, University of Washington.

1.3 Statistical Methods Overview

Taxonomic composition, relative abundances, and dominant and rare taxa in the sample assemblage were analyzed for each sample and compared geographically and temporally. Diversity analyses were conducted for each sample. These statistics were performed over the entire dataset. Linear regressions, hierarchical cluster analysis, principal component analysis, and canonical correspondence analysis were performed on a smaller of PSEMP samples with complete information on physical and chemical parameters. This dataset is included in Appendix D. Linear regressions, Hierarchical Clustering Analysis and Canonical Correspondence Analysis were calculated using RStudio version 3.2.0 and the Vegan Community Ecology Package.

1.4 Assemblage Data

Initial calculations preformed on the dataset includes total individuals/ sample, density (number of individuals/ gram of sediment/ sample), percent of calcareous taxa showing dissolution effects, percent of assemblage represented by agglutinated taxa, species richness (number species per sample), total concentrations of heavy metals, PAHs, and selected PCBs, average temperature, salinity, percent of fine grains (< 2mm) within the sediment sample and TOC.

Table 1: Samples used this study with locations, Burke Museum catalogue numbers, depth, temperature and salinity of each where available.

Year	Sample #	UWBM #	Lat. degrees	Lat. minutes	Long. degrees	Long. minutes	Depth (m)	Temp. (°C)	Salinity (PSU)
1985	85.001.SCC	B8722	47	49.635	122	34.3695			
1985	85.002.SCC	B8723	47	49.125	122	34.366			
1985	85.003.SCC	B8724	47	49.3018	122	34.2999	7.5		
1985	85.004.SCC	B8725	47	49.5695	122	34.537	16.5		
1985	85.005.SCC	B8726	47	49.5404	122	34.169			
1985	85.006.SCC	B8727	47	50.3229	122	34.1801			
1985	85.007.SCC	B8728	47	50.3892	122	34.5242			
1985	85.008.SCC	B8729	47	51.7092	122	34.476			
1985	85.009.SCC	B8730	47	51.331	122	34.3784			
1985	85.010.SCC	B8731	47	51.2737	122	32.1541			
1985	85.011.SCC	B8732	47	52.764	122	34.3004	9		
1985	85.012.SCC	B8733	47	52.2353	122	34.4259			
1985	85.013.SCC	B8734	47	52.3648	122	34.5801			
1985	85.021.SCC	B8742	47	48.3105	122	51.3818	2		
1985	85.022.SCC	B8743	47	48.1577	122	51.3233	9		
1985	85.023.SCC	B8744	47	47.4617	122	51.3075			
1985	85.024.SCC	B8745	47	47.227	122	51.3498			
1985	85.025.SCC	B8746	47	47.3098	122	51.3558	9		
1985	85.026.SCC	B8747	47	46.4879	122	51.2996	9		
1985	85.027.SCC	B8748	47	46.5021	122	51.5037			
1985	85.028.SCC	B8749	47	46.3145	122	51.3072	9		
1985	85.029.SCC	B8750	47	47.2031	122	51.1531			
1992	92.001.SCC	B8751	47	22.4363	123	7.585			
1992	92.002.SCC	B8752	47	23.1915	123	7.4747			
1992	92.004.SCC	B8754	47	21.4305	123	9.4022			
1992	92.005.SCC	B8755	47	21.1282	123	8.5197			
1992	92.006.SCC	B8756	47	21.208	123	8.3432			
1992	92.007.SCC	B8757	47	20.5234	123	8.1948			
1992	92.008.SCC	B8758	47	21.2594	123	7.1637			
1992	92.009.SCC	B8759	47	21.5582	123	7.4141			
1992	92.010.SCC	B8760	47	21.309	123	6.1552			
1992	92.011.SCC	B8761	47	21.462	123	5.5874			
1992	92.012.SCC	B8762	47	22.1097	123	5.4264			
1992	92.013.SCC	B8763	47	22.1387	123	5.32515			
1992	92.014.SCC	B8764	47	21.505	123	3.1885			
1992	92.015.SCC	B8765	47	21.3427	123	3.3543			
1992	92.016.SCC	B8766	47	21.1773	123	3.5731			
1992	92.017.SCC	B8767	47	21.803	123	4.1537			
1996	96.015.SCC	B8735	47	56.0047	122	39.3882	5.5		
1996	96.017.SCC	B8736	47	55.3328	122	40.2076	17.5		
1996	96.018.SCC	B8737	47	55.2597	122	40.435	11		
1996	96.019.SCC	B8738	47	54.5664	122	40.4486	9		
1996	96.020.SCC	B8739	47	55.7058	122	40.5412	18.5		
1996	96.022.SCC	B8741	47	55.6042	122	41.3965	5		
1998	98.013.PSEMP	B8691	47	50.2544	122	37.7367	21.8	10	29
1999	99.013.PSEMP	B8691	47	50.2544	122	37.7367	22	11	30
1999	99.206.PSEMP	B8692	47	55.3063	122	40.6082	17	11	30
1999	99.207.PSEMP	B8693	47	55.4679	122	40.77	14.5	12	30
1999	99.208.PSEMP	B8694	47	54.9999	122	40.8296	5.5	14	30
1999	99.210.PSEMP	B8695	47	50.67	122	39.6699	39.7	11	30
1999	99.211.PSEMP	B8696	47	56.6334	122	38.5536	111.5	11.5	31
1999	99.212.PSEMP	B8697	47	50.6345	122	34.3765	14	12	30

Year	Sample #	UWBM #	Lat. degrees	Lat. minutes	Long. degrees	Long. minutes	Depth (m)	Temp. (°C)	Salinity (PSU)
1999	99.213.PSEMP	B8698	47	49.3379	122	34.5359	4.5	13.5	30
1999	99.214.PSEMP	B8699	47	50.1775	122	34.7111	12.2	12	30
1999	99.215.PSEMP	B8679	47	47.9473	122	51.4184	14.8	11	25
1999	99.216.PSEMP	B8680	47	47.8279	122	51.5182	16.2	12	27
1999	99.217.PSEMP	B8684	47	47.4054	122	51.3196	27.2	11	30
1999	99.218.PSEMP	B8686	47	49.2345	122	49.1035	61	11	29
1999	99.220.PSEMP	B8687	47	44.0791	122	50.6446	175	12	27
1999	99.221.PSEMP	B8673	47	25.238	123	6.6198	120	12	25
1999	99.224.PSEMP	B8670	47	22.6786	123	7.7477	87	11	25
1999	99.225.PSEMP	B8671	47	23.4444	122	56.385	21.5	11.5	24
1999	99.226.PSEMP	B8674	47	23.7925	122	57.3611	19.2	11.5	25
2001	01.013.PSEMP	B8691	47	50.2553	122	37.7379	22	9	32
2002	02.013.PSEMP	B8691	47	50.2553	122	37.7379	23		
2003	03.013.PSEMP	B8691	47	50.2553	122	37.7379	22.1		
2004	04.013.PSEMP	B8691	47	50.2553	122	37.7379	22.2		
2004	04.024.PSEMP	B8700	47	47.015	122	43.233	47	10.1	31
2004	04.032.PSEMP	B8688	47	48.119	122	48.161	111	9.4	30
2004	04.048.PSEMP	B8689	47	44.104	122	49.589	174	10.3	30
2004	04.064.PSEMP	B8676	47	23.579	123	7.325	95	9.8	30
2004	04.075.PSEMP	B8701	47	54.088	122	36.249	95	9.8	30
2004	04.088.PSEMP	B8702	47	50.023	122	39.056	54	10.1	31
2004	04.096.PSEMP	B8677	47	36.222	122	57.479	164	10	30
2004	04.118.PSEMP	B8172	47	23.082	122	58.177	32	9.9	28
2004	04.120.PSEMP	B8682	47	23.551	123	6.291	132	9.9	29
2004	04.128.PSEMP	B8675	47	21.239	123	3.011	38	11.2	29
2004	04.144.PSEMP	B8690	47	47.077	122	51.553		9.2	28
2004	04.216.PSEMP	B8703	47	51.173	122	39.538	18.9	10.5	30
2004	04.224.PSEMP	B8678	47	35.305	122	57.107	25	9.8	30
2004	04.248.PSEMP	B8681	47	36.322	122	57.278	134	10.4	29
2004	04.296.PSEMP	B8680	47	23.369	123	7.439	93	10.3	30
2005	05.013.PSEMP	B8691	47	50.2553	122	37.7379	22.1	9	30
2006	06.013.PSEMP	B8691	47	50.2553	122	37.7379	23		
2007	07.013.PSEMP	B8691	47	50.255	122	37.737	23	9	30
2008	08.013.PSEMP	B8691	47	50.2554	122	37.7371	20.8	8.3	30
2009	09.013.PSEMP	B8691	47	50.2553	122	37.7377	21.9	8.4	31
2010	10.013.PSEMP	B8691	47	50.255	122	37.737	21.4	9.1	30
2011	11.013.PSEMP	B8691	47	50.255	122	37.737			30
2012	12.013.PSEMP	B8691	47	50.255	122	37.737		8.8	30
2013	13.013.PSEMP	B8691	47	50.255	122	37.737	22.4		
2013	13.GS01.USGS	B8704	47	36.3187	122	56.3605			
2013	13GS02.USGS	B8705	47	33.5283	123	0.134			
2013	13.GS03.USGS	B8706	47	27.1814	123	5.1157			
2013	13.GS04.USGS	B8719	47	23.2585	123	57.608			
2013	13.GS05.USGS	B8720	47	22.5332	123	59.2796			
2013	13.GS06.USGS	B8709	47	21.1811	123	1.1534			
2013	13.GS07.USGS	B8710	47	21.2481	123	3.4586			
2013	13.GS09.USGS	B8711	47	21.408	123	6.158			
2013	13.GS10.USGS	B8712	47	21.5303	123	6.153			
2013	13.GS11.USGS	B8713	47	22.2068	123	6.1734			
2013	13.GS12.USGS	B8714	47	22.1438	123	6.1796			
2013	13.GS14.USGS	B8715	47	21.5584	123	8.117			
2013	13.GS16.USGS	B8716	47	21.4249	123	3.5882			
2013	13.KC01.USGS	B8707	47	36.933	122	56.316	176		
2013	13.KC03.USGS	B8708	47	36.731	122	56.886	159		
2013	13.KC04.USGS	B8721	47	23.4333	122	57.1304	28.3		
2013	13.KC05.USGS	B8717	47	22.0919	123	6.2677	66.1		
2013	13.KC07.USGS	B8718	47	21.9513	123	7.9641	81.2		
2015	15.013.PSEMP	B8691	47	50.255	122	37.737	23	10.3	31
2016	16.013.PSEMP	B8691	47	50.255	122	37.737	28	11.2	30
2017	17.317.PSEMP	B8691	47	50.255	122	37.737			

1.5 Diversity Statistics

A suite of diversity indices, Species Richness, Simpsons Diversity Index, Shannon's Diversity Index, and Pielou's Evenness Index were run to minimize any bias and ensure a more robust foraminiferal diversity measure than one index can provide. Diversity indices describe how many taxa occur in a given sample and how evenly individuals are distributed across those taxa. Samples with higher diversity indicate a habitat with more hospitable conditions to a wide range of species, while those with a low diversity indicate an environment where only one or two species can thrive. All diversity indices assume random sampling methods, which this dataset satisfies.

1.5.1 *Species Richness*

Species richness calculates the number of taxa that occur in the sample. The power of this calculation in assessing community health is limited because it assumes that all taxa within the larger community are equally represented in the sample subset of individuals. Because of the "patchiness" of foraminiferal communities and the possibility of rare taxa being unrepresented in a small sample, this number can vary highly between samples in the same community (Beck & Schwanghart, 2010). To limit the effects of patchiness a minimum of 300 individual foraminifera were collected for each sample where possible.

1.5.2 *Simpsons Diversity Index*

The Simpson index (D) is widely used in ecology research and measures the probability that two randomly selected individuals from the same sample will be of the same taxon. There

have been many papers criticizing the use of this statistic because it produces counterintuitive results at high and low diversity data sets. Despite this, the Simpson's index does capture real trends across samples. Simpson's Index has been used in many studies in foraminiferal ecology, and it allows comparisons between this and other such studies.

Simpson's Index values have an inverse relationship to population diversity, such that an index value of 0 is interpreted to represent infinite diversity and a value of 1 represents no diversity.

D index values are calculated as such:

$$D = \frac{\sum n(n-1)}{N(N-1)} \quad (1.5.1a)$$

Where n is the number of organisms in a particular taxa and N is the total number of organisms in the sample.

Because of the inverse relationship between Simpson's D and diversity, and for the sake of clarity, a modified calculation of Simpsons Index was used. This modified calculation still ranges from 0 to 1 but now has a direct relationship to diversity. That calculation is as follows:

$$D' = 1 - D = 1 - \frac{\sum n(n-1)}{N(N-1)} \quad (1.5.2b)$$

1.5.3 *Shannon's Diversity Index*

Shannon's diversity index (H') is also widely used and generally thought to be more accurate than Simpson's index (Washington, 1984). This statistic was first used in communication theory to measure entropy. Shannon's H' is a measure of uncertainty which proposes to answer the question of how one can predict the next letter in a communication. This uncertainty calculation has been adopted by the biological sciences to measure the diversity of

taxa within a sample population. Its use rests on the assumption that high numbers of species in a sample is equivalent to the high the uncertainty of the next letter in a communication. At small sample size, this index underrepresents the diversity of the population but this bias decreases with increased sample size; 300 specimens are considered sufficient to disregard bias effects (Hughes, 1978; Chao & Shen, 2003; Beck & Schwanghart, 2010).

Shannon's H' diversity is calculated using Shannon's original formula:

$$H' = -\sum_{i=1}^{k} p_i \log p_i \quad (1.5.2a)$$

Where k is the number of categories and p_i is the portion of observations in a category i.

Because the proportion of observations is found by the ratio of the number of observations to the sample size, Shannon's H' can also be written:

$$H' = \frac{n \log n - \sum_{i=1}^{k} f_i \log f_i}{n} \quad (1.5.2b)$$

Where n is the sample size and f_i is the number of observations in the category i.

1.5.4 *Peilou's Evenness Index*

Peilou's Evenness index (Evenness) measures how equal the proportion of species is within a sample. This index is constrained between 0 and 1. It should be noted that this index is calculated using Shannon's H' and thus the H' negative bias may affect this index.

Evenness is calculated using Peilou's Evenness index:

$$E = \frac{H\prime}{\ln R} \quad (1.5.3)$$

Where H' is Shannon's Diversity index, and R is the number of taxa present in the sample.

1.6 Linear Regressions

Linear regressions were performed to detect relationships between physical-environmental factors and assemblage statistics, individual taxa, and regions. This statistic was the initial step in evaluating the presence of direct correlations between two variables in the dataset. These tests were performed in RStudio version 3.2.0 using the two-tailed Student-t test under the null assumption that there is no relationship between the variables (or that $\mu=0$). The t-value indicates the probability of the null hypothesis being true, the p-value indicates the significance of the student-t test by indicating how far away the mean of the sample variables are from 0, and the associated R^2 value indicates how well the variances are explained by the model.

1.7 Cluster Analysis

Hierarchical Clustering is used to create a dendrogram that orders data such that the closer the data points appear on the dendrogram, the more similar the data points are. Cluster analysis has been used in this study as an indication of relationships between assemblages, physical characteristics, and samples. Hierarchical Clustering is a "bottom-up" method, meaning that each point is considered a singleton, and then monotonically merged. Hierarchical Cluster analysis was performed on foraminiferal taxa counts, foraminiferal assemblage data, and physical characteristics of the samples. It was used to compare similarity/dissimilarity of samples within and across the geographic regions of Hood Canal.

Chapter 2. RESULTS

Statistical analysis shows a high level of temporal and spatial heterogeneity of foraminiferal assemblages across Hood Canal, with few large-scale trends. There are detectable relationships between foraminiferal species and assemblage measures with physical characteristics of the samples, but they are not consistent between years or regions. The heterogeneity between and within sub-regions suggests that foraminiferal assemblages are patchy and variable.

2.1 Assemblage and Environmental Statistics

Averages of raw data and assemblage statistical values were taken for all samples in this study (Table 2) to allow for comparison with studies from other areas within Puget Sound. Hood Canal samples had an average of 10 species/sample; higher than many regions of Puget Sound that have been studied (Martin, et al., 2013; Martin, et al., 2015; Nesbitt, et al., 2015). Thirty-five species were found from Hood Canal in this study (Table 3). The average percent agglutinated individuals present in Hood Canal assemblages is 37%. An average of 29.4% calcareous individuals/sample, from all samples, showed evidence of test dissolution. Foraminiferal density averaged 822 foraminifera/g of sediment and ranged from 0 to 6,360 (with an outlier of 18,170) foraminifera/g of sediment over the length of the Canal, with the highest densities in the South Regions (Fig. 3). Lowest species richness, diversity and evenness of species were found in the Dabob Region. Agglutinated taxa had the highest contribution to assemblages in the South Region and dissolution rates are lowest in the North Region.

Regional assemblage statistics such as density of individuals/g sediment and species richness were compared between 1999 and 2004 samples with an additional comparison in the South Region between 2004 and 2013 samples. There is a high level of heterogeneity in species contribution within assemblages, for example samples in the North Main sub-region which are spatially close from the 1999 and 2004 sample years (Fig. 3). However, the assemblage measures such as density, species richness, and agglutinated contribution to the assemblage are relatively stable, with a few notable exceptions in the Great Bend, Dabob Bay, and Quilcene sub-regions. As can be seen from figure 4, samples that are temporally and/or spatially proximal have large differences foraminiferal assemblages (both common and rare species) between them.

Foraminiferal species found in Hood Canal can be classified into three categories: ubiquitous species, non-ubiquitous species showing no spatial pattern, and non-ubiquitous species with a spatial pattern. Ubiquitous species are found throughout the Puget Sound, and are

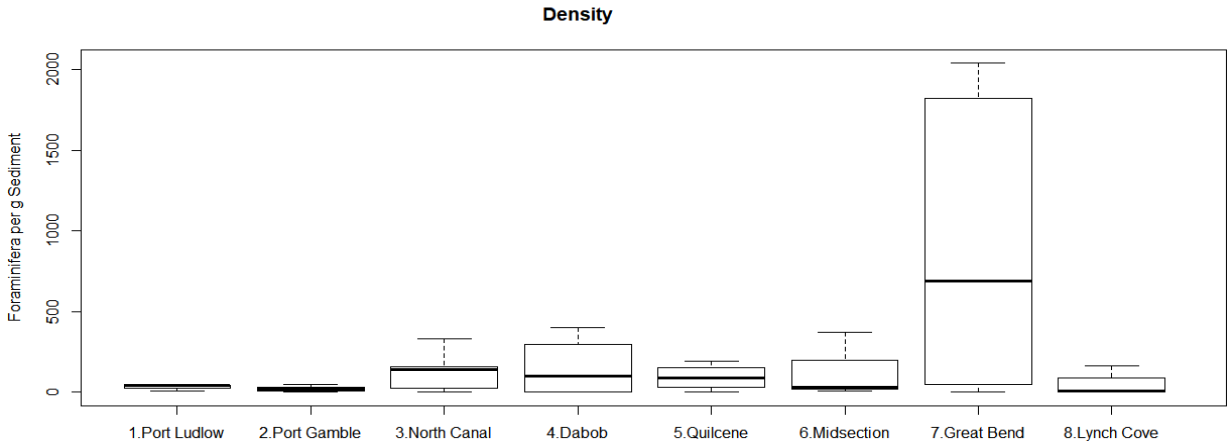


Figure 3. Boxplot of densities for each of the sub-regions; an outlier of high density (18,170 foraminifera/g sediment) from the North Main sub-region in 1999 was omitted from this plot.

Table 2: Average assemblage and physical measurements for all regions and sub-regions of Hood Canal

Port Ludlow		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1996	Average		9	0.66	1.91	0.88	14.79	59.13						
	Minimum		5	0.77	1.67	0.71	2.10	39.14						
	Maximum		11	0.59	2.42	1.05	32.14	79.12						
1999	Average	30.91	9	0.67	2.20	1.01	29.72	26.32	36.03	1.08	30.0	12.3	60.496	0.614
	Minimum	8.33	8	0.84	1.42	0.59	10.59	10.00	11.50	0.36	30.0	11.0	26.352	0.117
	Maximum	42.32	11	0.40	2.82	1.36	45.24	44.21	84.00	2.30	30.0	14.0	127.59	0.938

Port Gamble		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1985	Average		8	0.63	1.94	0.93	18.61	0.00	40.05					
	Minimum		4	0.77	0.73	0.37	0.84	0	0					
	Maximum		12	0.19	2.55	1.11	61.15	0	92					
1999	Average	23	6	0.63	1.76	1.01	61.43	0.00	28.53	1.77	30.0	12.5	57.742	0.595
	Minimum	0	4	0.68	1.55	0.78	0.39	0.00	7.90	0.37	30.0	12.0	20.560	0.453
	Maximum	49	9	0.58	2.02	1.13	97.62	0.00	67.00	4.40	30.0	13.5	121.91	0.740

North Main		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1999	Average	2124	14	0.8	2.54	0.96	13.41	40.87	13.13	0.37	30.3	11.2	50.796	0.073
	Minimum	140	11	0.70	2.43	0.93	6.11	35.68	4.7	0.26	30.0	11.0	43.127	0.036
	Maximum	6060	17	0.80	2.69	1.01	21.13	45.28	19.6	0.48	31.0	11.5	58.464	0.110
2004	Average	211	14.6	0.627	2.571	0.961	57.84	30.01	21.77	0.44	30.33	10.13	61.1	0.141
	Minimum	25	12	0.54	2.16	0.87	15.01	16.67	13.7	0.13	30.0	9.8	57.564	0.081
	Maximum	95	18	0.82	2.96	1.06	85.95	49	29.5	0.72	31.0	10.5	66.510	0.238

Dabob Bay		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1999	Average	100	4	0.39	1.20	0.62	2.50	36.84	80.30	2.05	28.0	11.5	114.27	0.039
	Minimum	0	0	0.00	0.00	0.00	0.00	0.00	69.60	1.40	27.0	11.0	78.868	0.022
	Maximum	200	7	0.78	2.39	1.23	5.00	73.68	91.00	2.70	29.0	12.0	149.67	0.056
Dabob Bay	Average	200	11	0.72	2.37	0.99	99.05	60.00	78.6	2.4	30.0	9.9	139.07	0.031
	Minimum	0	11	0.72	2.37	0.99	99.05	60.00	78.6	0.0	0.0	0.0	0.000	0.000
	Maximum	400	5	0.45	1.31	0.82	5.00	42.11	80.0	2.4	30.0	10.3	144.08	0.047

Quilcene		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1985	Average	NA	11	0.72	2.37	0.99	99.05	60.00	78.60	NA	NA	NA	NA	NA
	Minimum	NA	5	0.23	0.87	0.36	7.41	24.55	1.46	NA	NA	NA	NA	NA
	Maximum	NA	11	0.72	2.37	0.99	99.05	60.00	78.60	NA	NA	NA	NA	NA
1999	Average	195	18	0.87	3.31	1.15	71.58	71.08	71.0	3.4	30.0	12.0	159.66	0.023
	Minimum	65	17	0.84	3.03	1.07	46	30	30	1	25	11	113.80	0.018
	Maximum	195	18	0.87	3.31	1.15	72	71	71	3	30	12	159.66	0.023

Midsection		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
2004	Average	136	10	0.55	1.92	0.80	73.21	43.91	56.13	1.63	29.3	10.2	112.84	0.034
	Minimum	7	6	0.84	0.38	0.21	22.39	31.73	8.40	0.22	29.0	9.9	30.928	0.019
	Maximum	370	14	0.09	2.98	1.13	98.65	50.00	88.00	2.46	30.0	10.4	156.27	0.042
2013	Average	631	16	0.79	2.77	1.01	43	30						
	Minimum	61	14	0.83	2.53	0.91	24	21						
	Maximum	1835	18	0.74	2.94	1.11	60	42						

Great Bend		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
1992	Average		12	0.73	2.40	1.00	50.93	45.07	33.58					
	Min	0	6	0.88	1.54	0.77	7.09	0.00	1.44	0	0	0	0	0
	Max	0	19	0.53	3.45	1.26	95.21	98.39	75.1	0	0	0	0	0
1999	Average	385	7	0.53	1.61	0.96	27.64	86.07	78.50	2.40	25.0	11.8	202.18	0.031
	Min	50	4	0.70	1.38	0.60	15.28	72.13	72.00	2.40	25.0	11.5	196.21	0.028
	Max	720	10	0.37	1.85	1.33	40.00	100.00	85.00	2.40	25.0	12.0	208.14	0.035
2004	Average	1132	10	0.65	2.18	0.95	92.83	12.50	69.00	2.12	29.8	10.2	175.77	0.026
	Min	3	10	0.83	0.97	0.42	78.57	0.00	58.00	1.68	29.0	9.8	124.95	0.010
	Max	2040	10	0.27	2.85	1.24	100.00	50.00	83	2	30	11	203	0
2013	Average	829	13	0.74	2.46	1.00	30.84	37.48						
	Min	4	4	0.89	1.52	0.79	0.00	16.16						
	Max	3330	18	0.59	3.481	1.228	76.11	59.26						

Lynch Cove		Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals	Total PAH
Lynch Cove	Average	83	4	0.91	1.32	0.64	21.21	13.16	70.50	2.90	24.5	11.3	211.62	0.010
	Minimum	0	0	0.00	0.00	0.00	0.00	0.00	60.00	2.00	24.0	11.0	207.78	0.000
	Maximum	165	8	0.82	2.64	1.27	42.42	26.32	81.00	3.80	25.0	11.5	215.46	0.020
2013	Average	4839	11	0.79	2.64	1.11	36.38	50.68						
	Minimum	4	8	0.87	1.91	0.80	0.11	18.14						
	Maximum	18170	17	0.64	3.35	1.37	78.23	77.78						

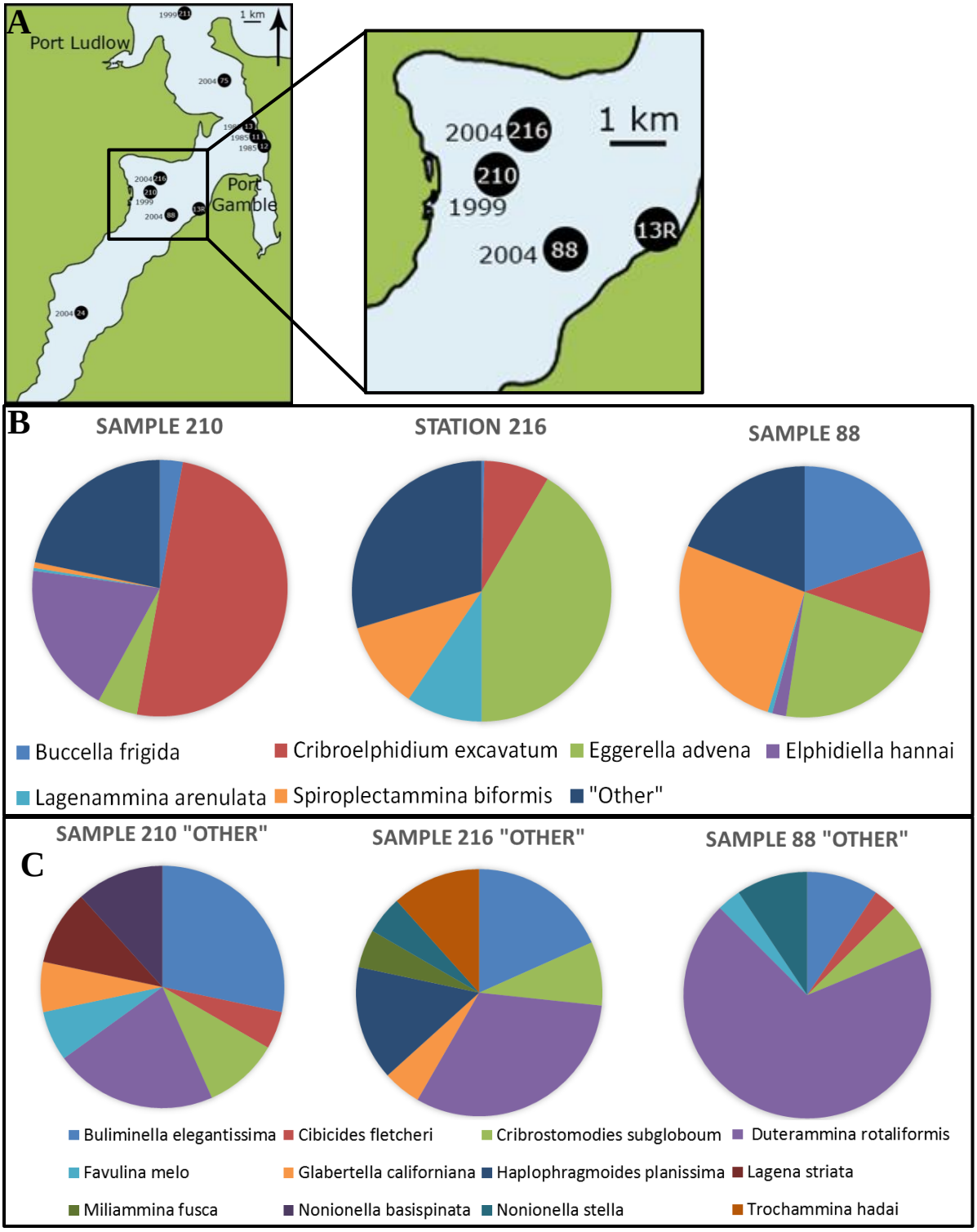


Figure 3. A) Map of samples from the North Main sub-region of Hood Canal highlighting 3 samples, 99.210.PSEMP, 04.216.PSEMP and 04.088.PSEMP which were collected within a close spatial region during 1999 and 2004. B) Dominant assemblages, C) "Other" assemblage.

almost always the most common taxa in each assemblage. These are the species best adapted to Puget Sound environmental conditions. The majority of the species found in Hood Canal were non-ubiquitous with no discernable spatial pattern (refer to Table 3); however the majority of individuals were ubiquitous species.

The most notable pattern in physical data was that fine grained sediment made up a larger proportion of sediment from Dabob Bay and south of Hood Canal. Heavy metals and Total Organic Carbon increased in concentration from the North Main sub-region to Lynch Cove. Also of note were significantly higher levels of PAH in Port Ludlow and Port Gamble (Fig. 5). Dissolution rates of calcareous tests within each assemblage showed no significant spatial pattern across regions or sub-regions.

Table 3: Species of Foraminifera from Hood Canal

Ubiquitous species
Buccella frigida (Cushman, 1922)
Cribroelphidium excavatum (Terquem, 1875)
Eggerella advena (Cushman, 1922)
Elphidiella hannai (Cushman & Grant, 1927)

Non-ubiquitous species with spatial pattern
Ammobaculites sp.
*Bolivinella pacifica (*Cushman & McCulloch, 1942)
Cassidulina limbata Cushman & Hughes, 1925
Cibicidoides lobatulus (Walker & Jacob, 1878*)*
Discorbis sp.
Eponides repandus (Fichtel & Moll, 1798)
Favulina melo (d'Orbigny, 1839*)*
Fursenkoina seminuda (Natland, 1938)
Globobulimina pacifica Cushman, 1927
Nonionella basispinata (Cushman & Moyer, 1930)
Nonionella stella Cushman & Moyer, 1930
Trochammina hadai Uchio, 1962
Uvigerina peragrina Cushman, 1923

Non-ubiquitous species without spatial pattern
Buliminella elegantissima (d'Orbigny, 1839)
Cibicides fletcheri Galloway & Wissler, 1927
Cribrostomoides subglobosa (Cushman, 1910)
Deuterammina rotaliformis (Heron-Allen & Earland, 1911)
Elphidium frigidum Cushman, 1933
Glabratella californiana Lankford, 1973
Haplophragmoides planissima Cushman, 1927
Labrospira columbiensis (Cushman, 1925*)*
Lagena striata (d'Orbigny, 1839)
Lagenammina arenulata (Skinner, 1961)
Miliammina fusca (Brady, 1870)
Psammosphaera fusca Schulze, 1875
Quinqueloculina vulgaris d'Orbigny, 1826
Reophax advena Cushman, 1919
Rotaliammina squamiformis (Cushman & McCulloch, 1939)
Spiroplectammina biformis (Parker & Jones, 1865)
Trochammina inflata (Montagu, 1808)
Trochammina pacifica Cushman, 1923

Table 4: Difference in Average Values for Assemblage and Physical Measures

Geographical Field	Years	Density (foraminifera/g sediment)	Species Richness (species/sample)	Shannon Index	Evenness Index	Percent Agglutinates	Percent Dissolution Effects	Percent Fines	PercentTOC	Salinity (g/kg)	Temperature (°C)	Heavy Metal Concentrations (mg/kg)	PAH Concentrations (mg/kg)
Hood Canal	1999-2004	-106	0	-0.13	-0.11	28.09	-11.38	11.1	0.0	1.4	-1.7	15.030	-0.182
North Region	1999-2004	-1913	0	0.03	0.00	44.43	-10.87	8.6	0.1	0.0	-1.0	10.301	0.068
North Main	1999-2004	-1913	1	0.03	0.00	44.43	-10.87	8.6	0.1	0.0	-1.0	10.301	0.068
Port Ludlow	1996-1999	NA	0	0.29	0.13	14.93	-32.81	NA	NA	NA	NA	NA	NA
Port Gamble	1985-1999	NA	-2	-0.17	0.08	42.82	0.00	-11.5	NA	NA	NA	NA	NA
Dabob Region	1999-2004	57	-10	-1.96	-0.65	-34.44	-31.04	16.0	0.4	1.7	-1.8	12.427	-0.003
Dabob Bay	1999-2004	100	8	1.17	0.37	96.55	23.16	-1.7	0.4	2.0	-1.7	24.801	-0.008
Quilcene	1985-1999	NA	7	0.94	0.16	-27.48	11.08	-7.6	NA	NA	NA	NA	NA
South Region	1999-2004	384	4	0.65	0.13	60.75	-26.90	-10.0	-0.7	4.6	-1.3	-53.115	0.007
South Region	2004-2013	1047	4	0.47	0.10	-49.65	15.71	NA	NA	NA	NA	NA	NA
Midsection	2004-2013	496	6	0.85	0.21	-29.96	-13.60	NA	NA	NA	NA	NA	NA
The Great Bend	1992-1999	NA	-5	-0.79	-0.04	-23.29	41.00	44.9	NA	NA	NA	NA	NA
The Great Bend	1999-2004	747	3	0.57	-0.02	65.19	-73.57	-9.5	-0.3	4.8	-1.6	-26.406	-0.005
The Great Bend	2004-2013	-303	3	0.27	0.05	-61.98	24.98	NA	NA	NA	NA	NA	NA
Lynch Cove	1999-2013	4756	7	1.32	0.48	15.17	37.52	NA	NA	NA	NA	NA	NA

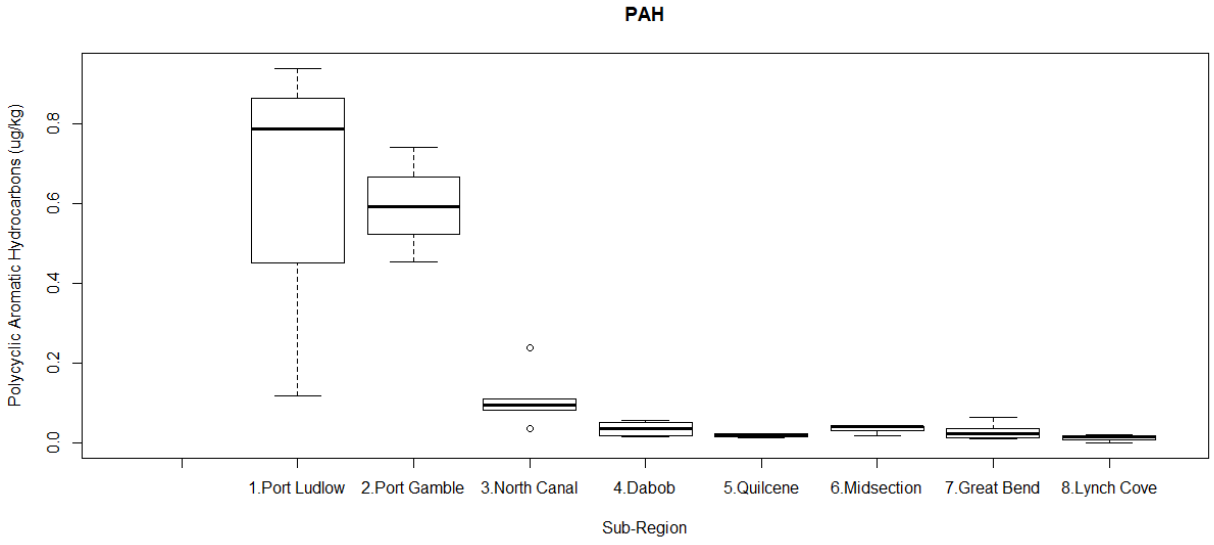


Figure 5. Boxplot of PAH measurements for each of the sub-regions.

2.1 DIVERSITY STATISTICS

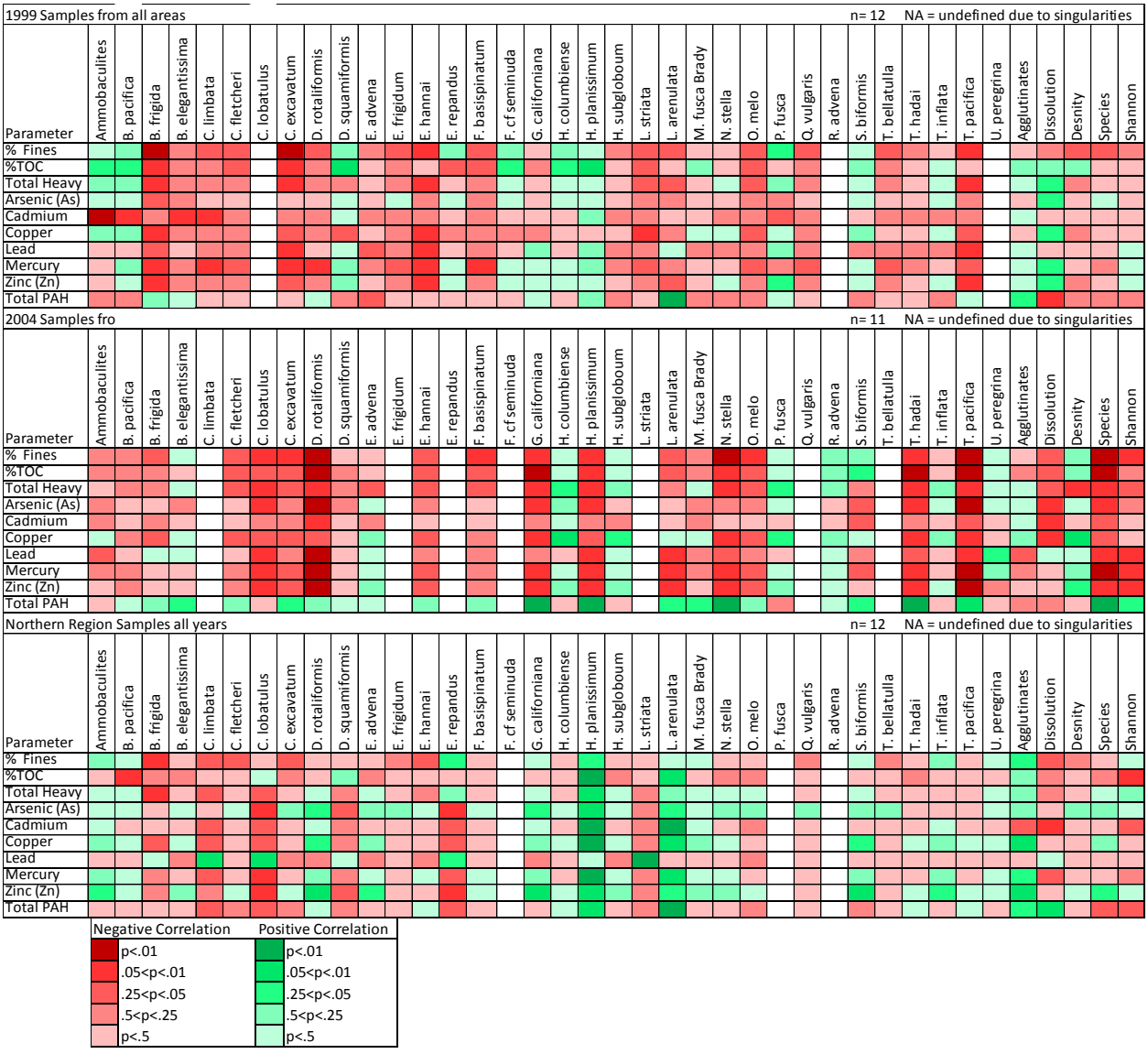
Regional species diversity of Hood Canal assemblages were compared between 1999 and 2004 samples with an additional comparison in the South Region between 2004 and 2013. Generally, species richness and diversity index numbers increased from 1985 to 2013 across Hood Canal with the largest increases in the Dabob and South Regions. The two exceptions are a decrease in the Great Bend between 1992 and 1999 (Table 5) and a complete loss of species in Quilcene in 2004. The average diversity measures are lower in the smaller embayments and terminus of the canal with the exceptions of the Great Bend in 1999 and Quilcene Bay, which has the highest average observed diversity measures of all sub-regions in 1999. The lowest average species richness was in the 1999 Lynch Cove samples. The lowest average Shannon Diversity index value was in 1999 Dabob Bay samples.

Table 5: Regional Diversity Measures

	North Region						Dabob Region			
	Port Ludlow		Port Gamble		Main Channel		Dabob Bay		Quilcene Bay	
	1996	1999	1985	1999	1999	2004	1999	2004	1985	1999
Species Richness	9	9	8	6	14	15	4	11	11	18
Simpsons Index	0.66	0.67	0.63	0.63	0.80	0.63	0.39	0.72	0.72	0.87
Shannon Index	1.91	2.20	1.94	1.76	2.54	2.57	1.20	2.37	2.37	3.31
Evennes Index	0.88	1.01	0.93	1.01	0.96	0.96	0.62	0.99	0.99	1.15
	South Region									
	Midsection		The Great Bend				Lynch Cove			
	2004	2013	1992	1999	2004	2013	1999	2013		
Species Richness	10	16	12	7	10	13	4	11		
Simpsons Index	0.55	0.79	0.73	0.53	0.65	0.74	0.91	0.79		
Shannon Index	1.92	2.77	2.40	1.61	2.18	2.46	1.32	2.64		
Evennes Index	0.80	1.01	1.00	0.96	0.95	1.00	0.64	1.11		

Table 6. Linear regressions between foraminifera and physical measurements in Hood Canal.

Significance levels were set at the standard of p-values less than .05

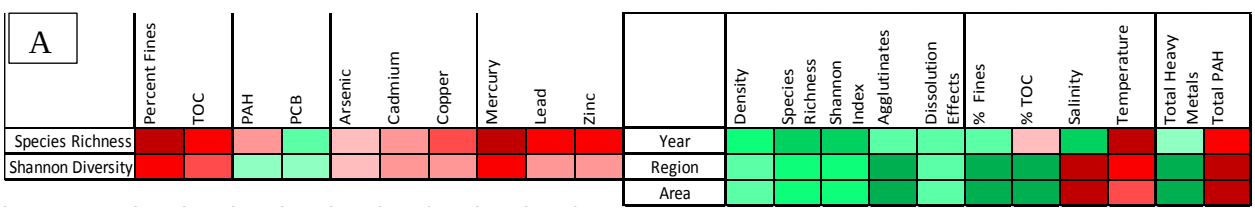



Dabob Region Samples all years
n= 7
NA = undefined due to singularities
Parameter
Ammobaculites
B. pacifica
B. frigida
B. elegantissima
C. limbata
C. fletcheri
C. lobatulus
C. excavatum
D. rotaliformis
D. squamiformis
E. advena
E. frigidum
E. hannai
E. repandus
F. basispinatum
F. cf seminuda
G. californiana
H. columbiense
H. planissimum
H. subgloboum
L. striata
L. arenulata
M. fusca Brady
N. stella
O. melo
P. fusca
Q. vulgaris
R. advena
S. biformis
T. bellatulla
T. hadai
T. inflata
T. pacifica
U. peregrina
Agglutinates
Dissolution
Desnity
Species
Shannon
% Fines
%TOC
Total Heavy
Arsenic (As)
Cadmium
Copper
Lead
Mercury
Zinc (Zn)
Total PAH
Southern Region Samples all years
n= 11
NA = undefined due to singularities
Negative Correlation
Positive Correlation
p<.01
.05<p<.01
.25<p<.05
.5<p<.25
p<.5

2.1 LINEAR REGRESSIONS

Significance for linear regressions was set at a p-value of 0.05 or less. The results of these regressions can be seen in Table 6, and appendices E and F. Significant relationships between individual taxa and physical or chemical characteristics of the sample were recorded within a dataset of all regions and years. However, these findings were not consistent between regressions based on sample years or regions (Appendices E and F). For example, *Buccella frigida* was found to have a negative correlation between percent fine grains, percent TOC, and concentrations of heavy metals when regressions were performed in a dataset of combined years for all regions during 1999. However, none of these relationships were detected in region-specific datasets or in the combined region dataset for 2004. Regressions on the combined year's datasets detected significant relationships between species richness and Shannon diversity with physical parameters (Table 7). The high percent of fine grains in the sediment sample has a negative correlation with both species richness and Shannon diversity. Heavy metal concentrations do not have this negative relationship with the exception of species richness and mercury.

Table 7. A) Significant regressions for species richness and chemical contaminants. B)



Significant regressions by year, region, and sub-region

Other significant relationships were found when sample years, regions, and sub-regions were regressed with assemblage, physical, and chemical measures (Table 7). This verifies the detected differences found by examining assemblage and environmental statistics and assigns quantifiable significance. The southernmost sub-regions have the highest percent of fine grains, TOC and concentrations heavy metals in the sediment, while the North Region has the highest salinity and PAH concentrations within the sediment. Species richness and Shannon Diversity both increased between 1999 and 2004.

2.1 Cluster Analysis

Cluster analysis of samples indicates that physical conditions separate samples into two groups most strongly correlated to percent fines in sediment, TOC and concentration of heavy metals (Fig. 6). Foraminiferal clusters appear to separate northern samples from Dabob and southern samples with the exception of 5 samples. No other explanations for clustering patterns are detected at this time.

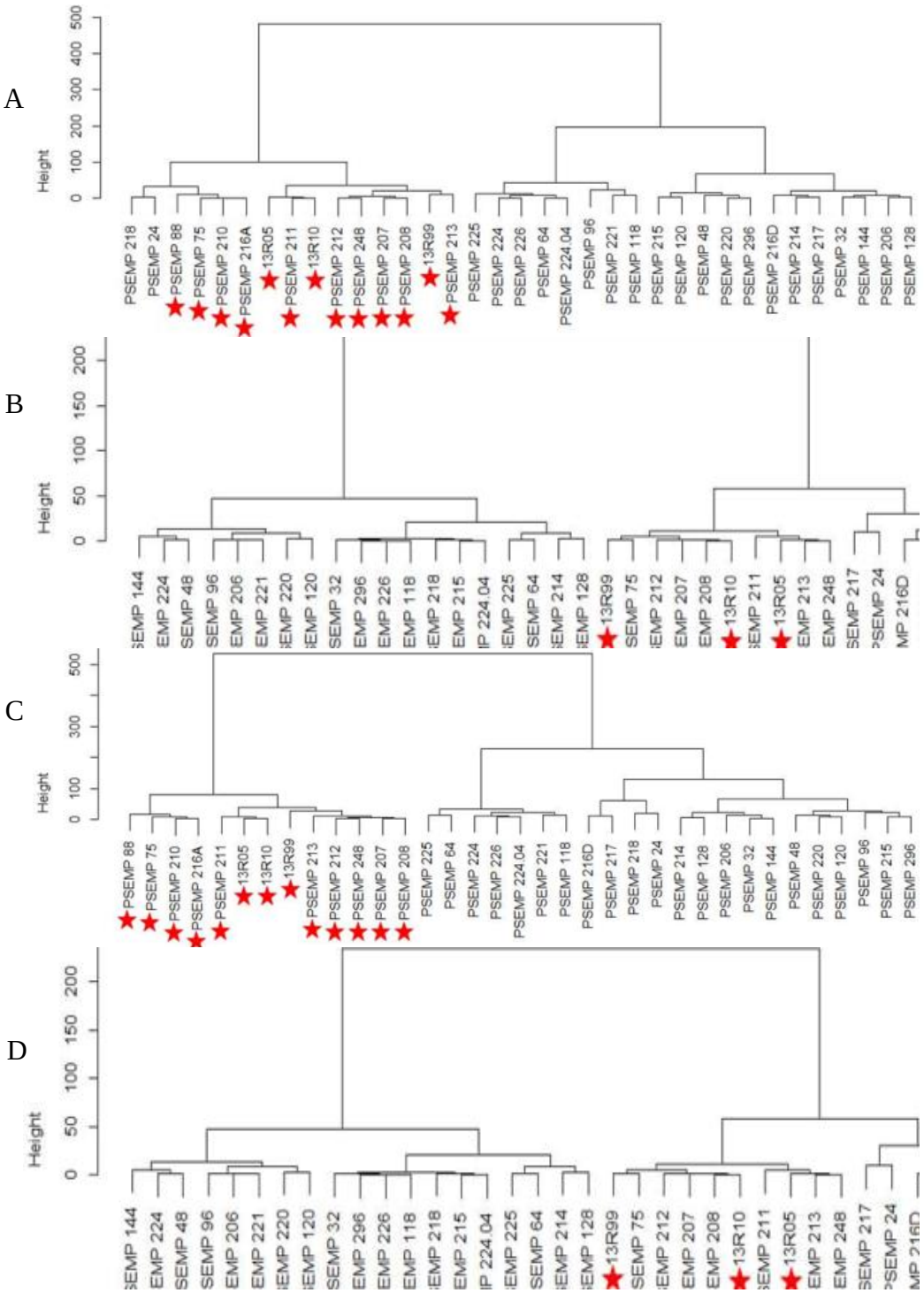


Figure 6. Hierarchical cluster dendrogram. A) Clusters based on all physical and chemical measures. B) Clusters based on percent of fine grained sediment. C) Clusters based on heavy metal concentration. D. Clusters based on percent TOC. Red stars were placed on cluster 1 of all physical and chemical measures dendrogram, and then on those samples throughout B, C and D to show similarity of clusters.

Chapter 3. DISCUSSION

A high level of variability was recorded between all the Hood Canal foraminiferal assemblages, which suggests that the physical conditions within the waterway are variable. It is expected that there would be heterogeneity between samples from different regions or sub-regions but the variability within the sub-regions was unexpected. Spatial differences in sample stations between sample years and the inability to study yearly assemblages for all but one station make this inconsistency difficult to quantify. This difference in sample geography coupled with the patchy nature of foraminiferal distributions may be sufficient to account for the variability recorded in this study.

Differences in the physical conditions between regions are likely to account for a portion of the difference between regional foraminiferal assemblages. Species with large percentage of increased numbers within assemblages was found in Dabob Bay and the South regions and these included *Nonionella stella* (37% increase), *Ammobaculites sp.* (20% increase), *Cribrostomoides subglobosa* (14% increase), and *Psammosphera fusca* (10% increase).

Fine grained sediment, TOC and heavy metal concentration have a strong positive correlation likely due to the preferential absorption of carbon and heavy metals into clay particles. Heavy metals found in sediment pore water all fall under the Federal government Environmental Protection Agency safety thresholds (EPA, 2018). Fine grains are negatively correlated to species richness and Shannon Diversity, and this measure has been used in previous Puget Sound studies to indicate declining foraminiferal populations (Martin, et al., 2015; Nesbitt, et al., 2015; Martin and Nesbitt, 1917). This would suggest that species that contribute higher

percentages to assemblages in samples with high fine grains are opportunistic species able to colonize environmentally unfavorable sites.

Fine grains, TOC, and heavy metals are highest in the South Region. In contrast, density, species richness and Shannon Diversity are not low in comparison to other sub-regions as would be expected from linear regression analysis. The Dabob Bay sub-region has the highest average percent of fine-grained sediments in Hood Canal, higher levels of lead, mercury and zinc and the lowest average species richness and Shannon Diversity. Many commercial shellfisheries are located along the shoreline of Dabob Bay which is the shallowest sub-region. In addition, the Bangor Naval Base is located on the western shores of Dabob Bay (Fig. 7). No environmental information is available from Federal military facilities, thus their impact on the bay's ecosystems is unknown, but they may have also contributed to the low benthic microbiota diversity and density.

Also of note is the presence of two species in Dabob Bay samples, *Bolivinella pacifica* and *Fursenkoina semidnuda* which are rare within Puget Sound, and are usually found in outer coast waters (Patterson, et al., 2000; Gupta, et al., 2009). It is possible that these species are not native to Dabob Bay, but a product of effluent from coastal water for shellfish larvae collected for the commercial shellfisheries. Further studies that separate "live" and "dead" components of sample assemblages will be needed to determine if these species have colonized and survived at Dabob Bay or have their tests transported through some means after the organism has died.

The North Regions embayments of Port Ludlow and Port Gamble have significantly high levels of PAH (Fig. 5). These sub-regions also have low average density and species richness in comparison with other sub-regions. PAH compounds are a contaminant found in creosote, and

the high concentration of PAH compounds in sediment pore water was most likely contributed to by the treated pilings that were used by lumber and railroad operations in these areas. (Abercrombie, 2018). Piling removal projects within Dabob Bay and Port Gamble began in 2014.

These shallow embayments are also impacted by the invasive foraminifera *Trochammina hadai*. The Quilcene Bay and Port Gamble sub-regions had the highest average percent of *Trochammina hadai* within the sample populations at 10.36% and 5.19% respectively, but it was detected in most sub-regions. *Trochammina hadai*, originating in Japan, has been identified as an invasive species along the West Coast (McGann, et al., 2000). It is thought that *T. hadai* was first

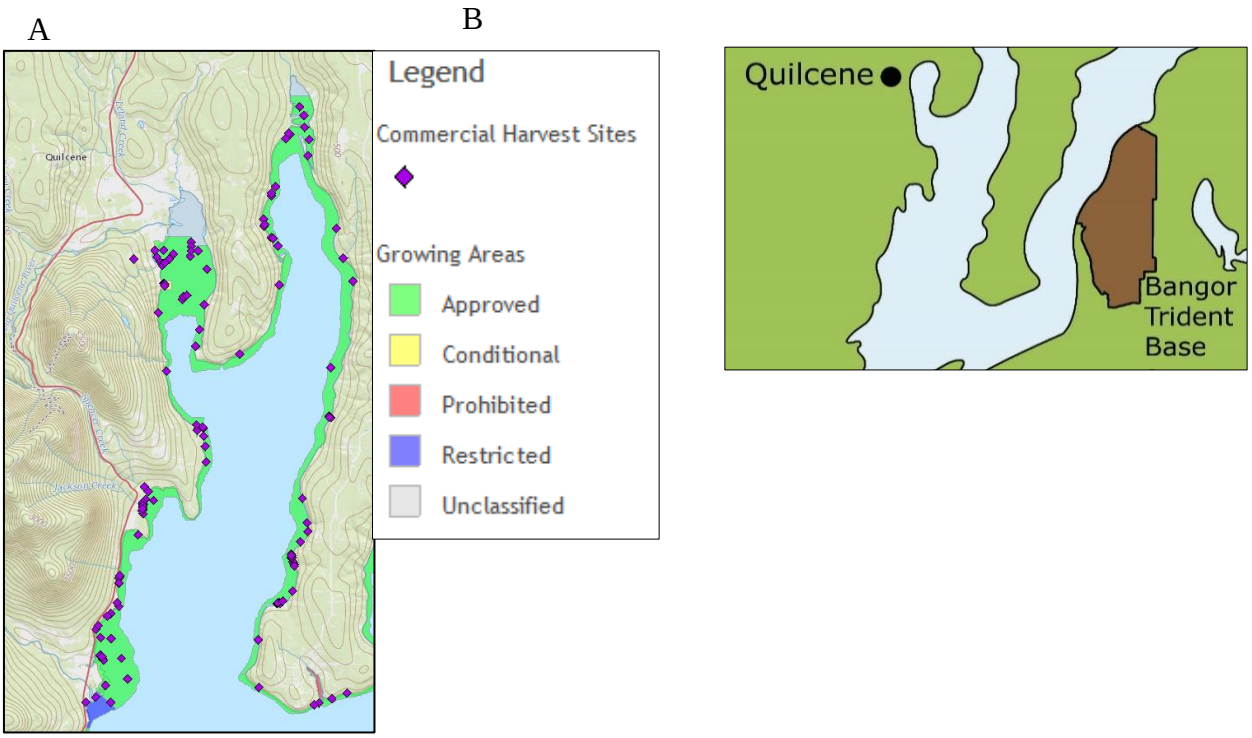


Figure 7. A) Map of commercial shellfisheries within Dabob Bay, provided by the Washington State Department of Health. B) Map of lower North Region and Dabob Regions of Hood Canal showing commercial aquiculture zones and location of the Bangor Naval Base.

transported to Washington State in ballast sediment, anchor mud, or in sediment associated with baitworms, seaweed, or oysters, clams and mussels imported for mariculture, but this species has been present in the Puget Sound benthos since 1971(McGann, et al., 2012). Both Quilcene Bay and Port Gamble have shallow, oxygenated waters and robust shellfish industries that may make them more suitable habitat for this species. Further study is needed to find correlation between the spatial extent of significant *T. hadai* populations and environmental conditions. These populations have grown from introduced individuals transported from Japan in association with Japanese shellfish such as oysters, or via released from marine traffic.

The South Region of Hood Canal is frequently impacted by summer season hypoxia, particularly within Lynch Cove. Linear regressions showed this region as having the highest heavy metal concentrations within Hood Canal, for which there is currently no explanation. Calcareous species such as *Buliminella elegantissima, Nonionella stella, Spiroplectammina biformis* and *Uvigerina peregrina* are found in abundance in this region and these species are known for their ability to tolerate hypoxic conditions (Berhard and Gupta, 1999; Raposo et al., 2018). Other dominant species are agglutinate taxa, e.g. *Eggerella advena* and *Trochammina pacifica* are found in the South Region and are known ato be tolerant of heavy metal and/or sewage pollution (Alve, 1995; McGann et al., 2003).

Hypoxia has been attributed to seasonal nutrient loading leading to eutrophication, long residency times of water parcels, and stratification of water column (Newton, et al., 2007; Feely, et al., 2010). In the case of eutrophication there would be evidence of higher acidification and therefore higher levels of dissolution effects to calcareous tests in these regions. This is because during eutrophication events there is a large scale die off of photosynthetic microorganisms which lead to high levels of respiration from the bacteria that consumes their biomass. This

respiration produces acidic byproducts and lowers the oxygen saturation of the bottom water. In this study, no clear pattern of calcareous tests dissolution was found in the South (Table 6 and Fig. 8). However, there are other mechanisms that can lead to acidification such as exchange of CO_2 gasses with the atmosphere, which could be a stronger control of test dissolution than eutrophication. A more detailed investigation into acidification in Hood Canal is needed to clarify this issue.

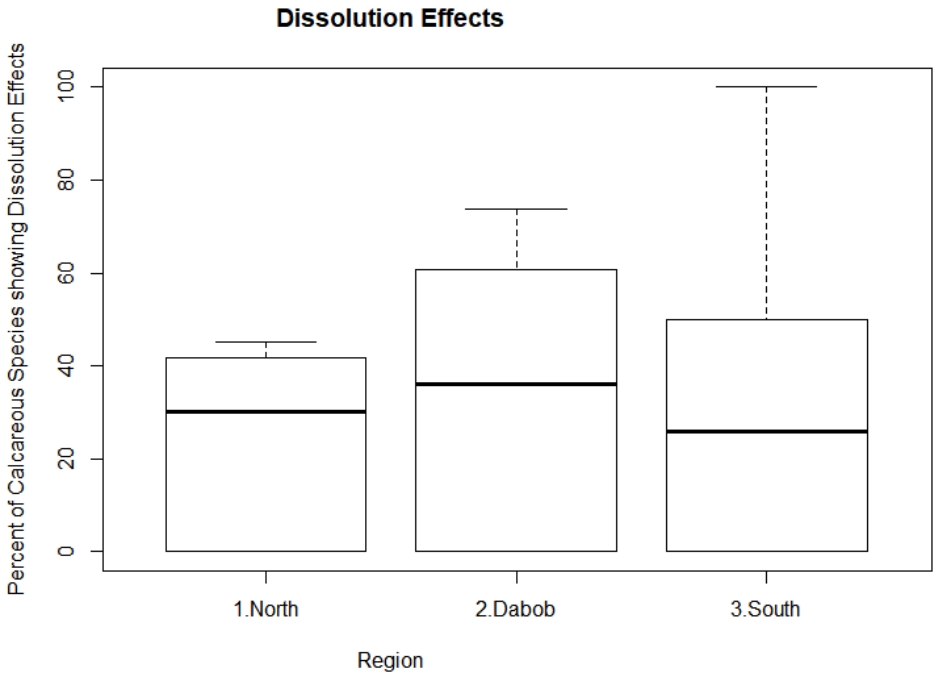


Figure 8. Boxplots of average dissolution effects for 1999 and 2004 samples divided by region. While hypoxic events are observed in the South Region, there is no significant rise in calcareous test dissolution in this region.

Chapter 4. CONCLUSION

Benthic foraminiferal assemblages within Hood Canal indicate that this region of Puget Sound is complex because of numerous and varied environmental stressors. While sampling within sub-regions was infrequent and station sites, with few exceptions, were not the same between sampling years, this study was able to detect some relationships between benthic foraminiferal assemblages and environmental conditions. Higher levels of fine grained sediment were negatively correlated with density, diversity and species richness in foraminiferal populations, and this relationship was strongest in the South Region. Species richness was the most sensitive to higher levels of fine grained sediments.

Further studies using counts of live (stained with Rose Bengal which stains tissues within the test) and dead (unstained) assemblages in the sample will be needed to more fully explore whether the environmental conditions are impacting live foraminiferal communities. The smaller northern embayments of Port Gamble and Port Quilcene had degraded foraminiferal health measures which correlate to high PAH concentrations in sediment pore waters. Dabob Bay had the most degraded foraminiferal health measures with the addition of non-native species.

Because foraminifera are near the base of the food web, the health of this benthic ecosystem is vital to the health and wellbeing of Hood Canal residents and shellfish consumers. The large shellfish industry provides livelihoods for many Hood Canal residents. Because of this, closer monitoring of benthic microfauna should be conducted. The Great Bend and Lynch Cove sub-regions have the longest residency time of water parcels, heavy metal concentrations, and experience seasonal hypoxia yet assemblage health measures such as species richness, diversity, and density of individuals in the samples do not appear to be significantly negatively impacted.

This could be due to the high number of species tolerant to low oxygen conditions such as *Nonionella stella* (Hogslund et al., 2008) and species tolerant to high levels of nutrient input or heavy metal concentration such as *Buliminella elegantissima, Eggerella advena* and *Trochammina pacifica* (Mcgann, et al., 2003; Covelli, et al., 2013; Donnici, et al., 2012).

Ongoing research is needed in Hood Canal within each region and sub-region as defined by this study. Of interest is Dabob Bay, Port Gamble, the Great Bend, and Lynch Cove where health and human interest intersect environmental concerns. Port Gamble and Quilcene are undergoing large scale clean-up and restoration projects to support salmonid and native shellfish populations (Abercrombie, 2018; Harlow, 2018). The Skokomish Tribe has been working with the U.S. Army Corps of Engineers within the Skokomish River delta at the Great Bend to restore wild habitat to native wildlife (USACE, 2015). The study presented here presents the first investigation into the effects of anthropogenic action on benthic foraminifera, but further research is needed to support these State and local efforts.

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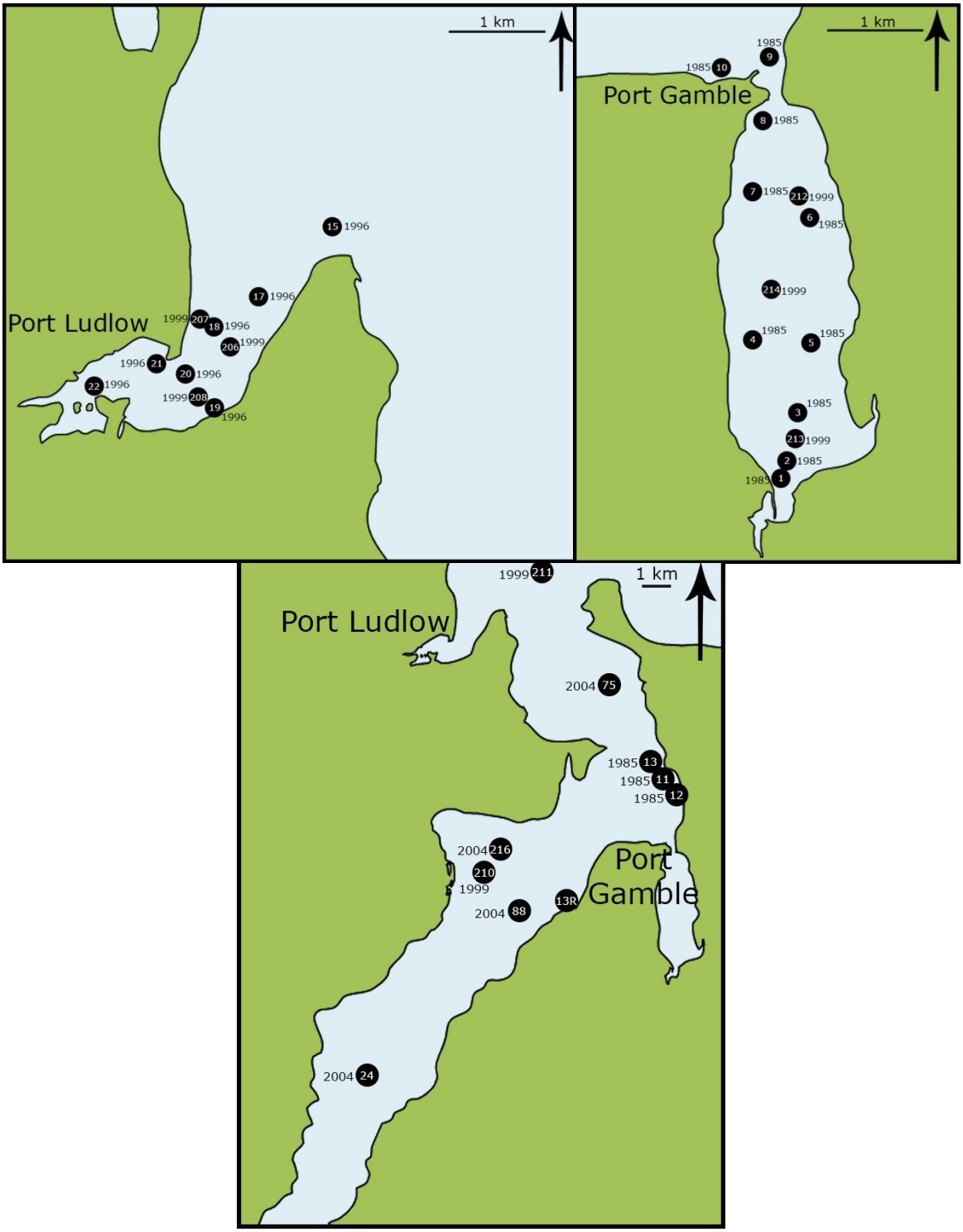
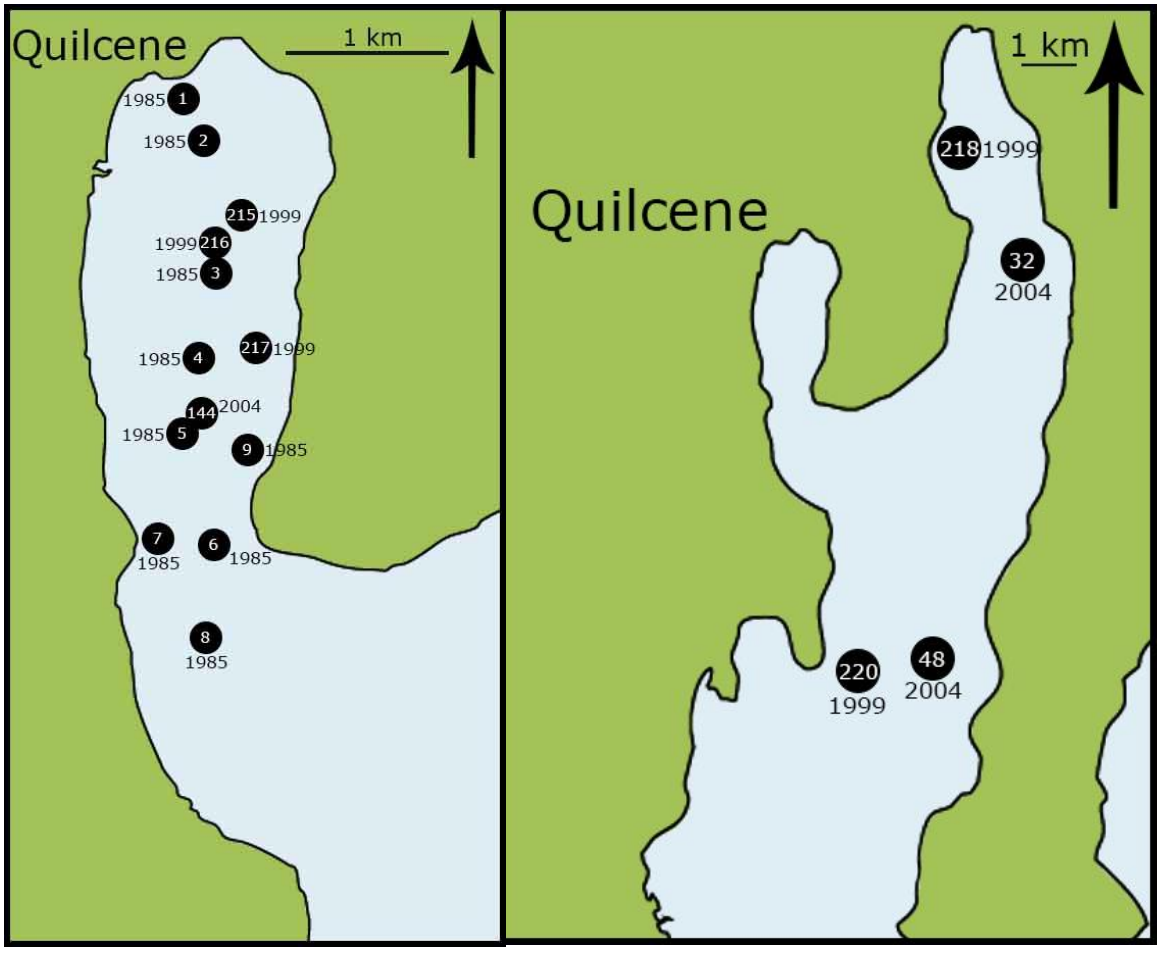
APPENDIX A

Location of sediment samples

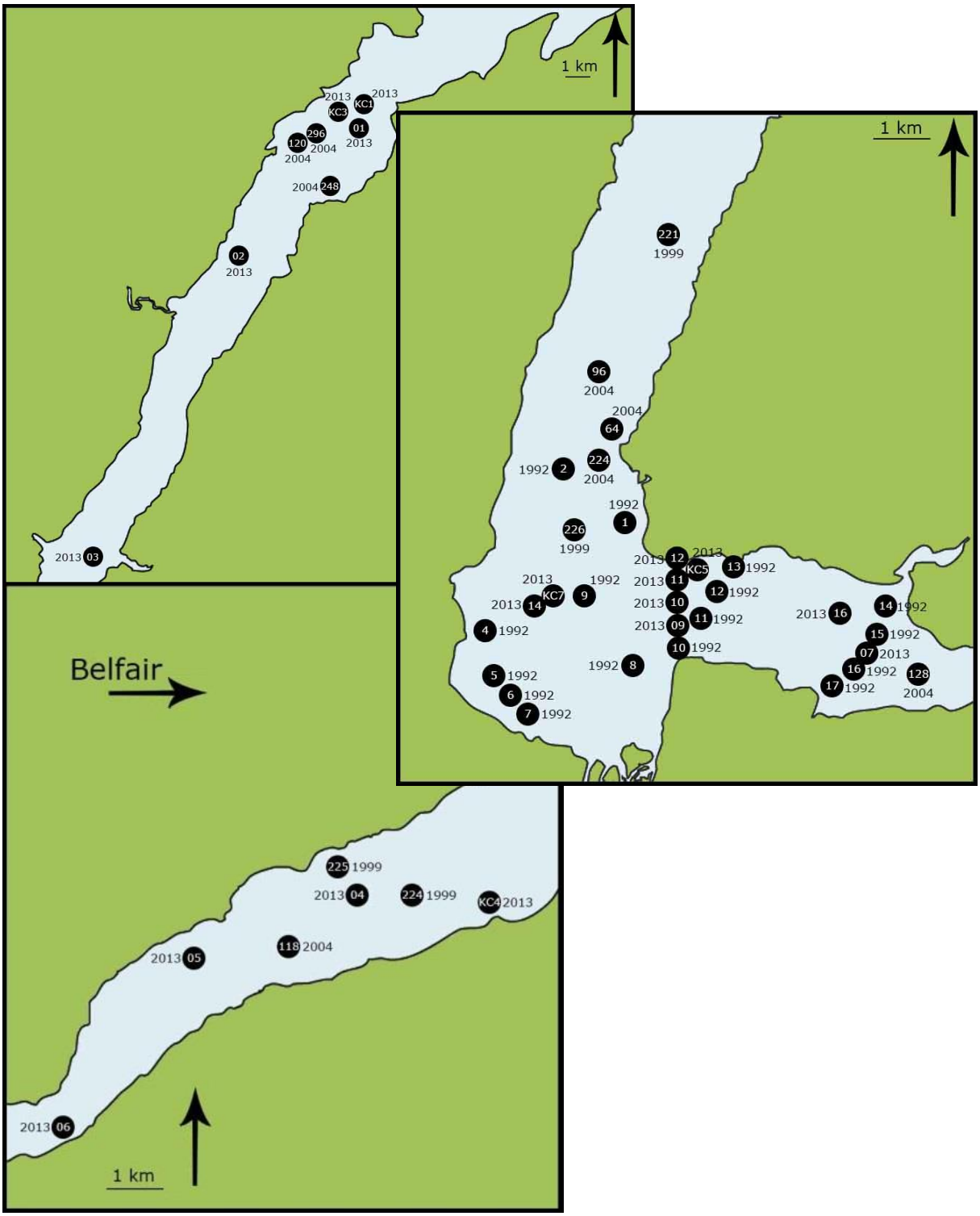
North Region



Dabob Region



South Region



APPENDIX B

Complete foraminferal, physical, and metadata

Publishable Sample Number	Locality Field Number	Burke Locality Number	Project	Year	Date	Region	Location	Latitude Degrees	Latitude Minutes	Longitude Degrees	Longitude Minutes	Depth
85.001.H	HPG1	B8722	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.002.H	HPG2	B8723	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.003.H	HPG3	B8724	Harman	1985	18-May	Admiralty Inlet	Port Gamble					7.5
85.004.H	HPG4	B8725	Harman	1985	18-May	Admiralty Inlet	Port Gamble					16.5
85.005.H	HPG5	B8726	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.006.H	HPG6	B8727	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.007.H	HPG7	B8728	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.008.H	HPG8	B8729	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.009.H	HPG9	B8730	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.010.H	HPG10	B8731	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.011.H	HPG11	B8732	Harman	1985	18-May	Admiralty Inlet	Port Gamble					9
85.012.H	HPG12	B8733	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.013.H	HPG13	B8734	Harman	1985	18-May	Admiralty Inlet	Port Gamble					
85.021.H	HQ1	B8742	Harman	1985	19-May	Dabob Bay	Quilcene					2
85.022.H	HQ2	B8743	Harman	1985	19-May	Dabob Bay	Quilcene					9
85.023.H	HQ3	B8744	Harman	1985	19-May	Dabob Bay	Quilcene					
85.024.H	HQ4	B8745	Harman	1985	19-May	Dabob Bay	Quilcene					
85.025.H	HQ5	B8746	Harman	1985	19-May	Dabob Bay	Quilcene					9
85.026.H	HQ6	B8747	Harman	1985	19-May	Dabob Bay	Quilcene					9
85.027.H	HQ7	B8748	Harman	1985	19-May	Dabob Bay	Quilcene					
85.028.H	HQ8	B8749	Harman	1985	19-May	Dabob Bay	Quilcene					9
85.029.H	HQ9	B8750	Harman	1985	19-May	Dabob Bay	Quilcene					
92.001.H	HGB1	B8751	Harman	1992		South Hood Canal	The Great Bend					
92.002.H	HGB2	B8752	Harman	1992		South Hood Canal	The Great Bend					
92.004.H	HGB4	B8754	Harman	1992		South Hood Canal	The Great Bend					
92.005.H	HGB5	B8755	Harman	1992		South Hood Canal	The Great Bend					
92.006.H	HGB6	B8756	Harman	1992		South Hood Canal	The Great Bend					
92.007.H	HGB7	B8757	Harman	1992		South Hood Canal	The Great Bend					
92.008.H	HGB8	B8758	Harman	1992		South Hood Canal	The Great Bend					
92.009.H	HGB9	B8759	Harman	1992		South Hood Canal	The Great Bend					
92.010.H	HGB10	B8760	Harman	1992		South Hood Canal	The Great Bend					
92.011.H	HGB11	B8761	Harman	1992		South Hood Canal	The Great Bend					
92.012.H	HGB12	B8762	Harman	1992		South Hood Canal	The Great Bend					
92.013.H	HGB13	B8763	Harman	1992		South Hood Canal	The Great Bend					
92.014.H	HGB14	B8764	Harman	1992		South Hood Canal	The Great Bend					
92.015.H	HGB15	B8765	Harman	1992		South Hood Canal	The Great Bend					
92.016.H	HGB16	B8766	Harman	1992		South Hood Canal	The Great Bend					
92.017.H	HGB17	B8767	Harman	1992		South Hood Canal	The Great Bend					
96.015.H	HPL15	B8735	Harman	1996		Admiralty Inlet	Port Ludlow					5.5
96.017.H	HPL17	B8736	Harman	1996		Admiralty Inlet	Port Ludlow					17.5
96.018.H	HPL18	B8737	Harman	1996		Admiralty Inlet	Port Ludlow					11
96.019.H	HPL19	B8738	Harman	1996		Admiralty Inlet	Port Ludlow					9
96.020.H	HPL20	B8739	Harman	1996		Admiralty Inlet	Port Ludlow					18.5
96.022.H	HPL22	B8741	Harman	1996		Admiralty Inlet	Port Ludlow					5
98.013.T	13R98	B8691	Temporal	1998	8-Apr	Admiralty Inlet	Squamish Harbor	47	50.2544	122	37.7367	21.8
99.013.T	13R99	B8691	Temporal	1999	28-Apr	Admiralty Inlet	Squamish Harbor	47	50.2544	122	37.7367	22
99.206.P	PSEMP 206	B8692	PSEMP	1999	25-Jun	Admiralty Inlet	Port Ludlow	47	55.3063	122	40.6082	17
99.207.P	PSEMP 207	B8693	PSEMP	1999	24-Jun	Admiralty Inlet	Port Ludlow	47	55.4679	122	40.77	14.5
99.208.P	PSEMP 208	B8694	PSEMP	1999		Admiralty Inlet	Port Ludlow	47	54.9999	122	40.8296	5.5
99.210.P	PSEMP 210	B8695	PSEMP	1999	23-Jun	Admiralty Inlet	Squamish Harbor	47	50.67	122	39.6699	39.7
99.211.P	PSEMP 211	B8696	PSEMP	1999	23-Jun	Admiralty Inlet	Mouth of Canal	47	56.6334	122	38.5536	111.5
99.212.P	PSEMP 212	B8697	PSEMP	1999	24-Jun	Admiralty Inlet	Port Gamble	47	50.6345	122	34.3765	14
99.213.P	PSEMP 213	B8698	PSEMP	1999	24-Jun	Admiralty Inlet	Port Gamble	47	49.3379	122	34.5359	4.5
99.214.P	PSEMP 214	B8699	PSEMP	1999	24-Jun	Admiralty Inlet	Port Gamble	47	50.1775	122	34.7111	12.2
99.215.P	PSEMP 215	B8679	PSEMP	1999	28-Jun	Dabob Bay	Quilcene	47	47.9473	122	51.4184	14.8

Publishable Sample Number	Ammobaculites sp.	Bolivinella pacifica	Buccella frigida	Buliminella elegantissima	Cassidulina limbata	Cibicides fletcheri	Cibicides lobatulus	Cribroelphidium excavatum	Cribrostomoides subgloboum	Discorbis fusca	Deuterammina rotaliformis	Eggerella advena	Elphidium frigidum	Elphidiella hannai	Eponides repandus	Favulina melo
85.001.H	16	0	8	0	0	0	0	276	0	0	0	0	0	12	0	0
85.002.H	0	0	13	13	4	0	2	47	0	0	0	0	0	11	0	0
85.003.H	0	0	79	0	0	0	0	119	0	0	0	0	0	272	0	0
85.004.H	0	0	56	0	0	0	0	692	0	0	16	48	0	1236	0	0
85.005.H	0	0	144	8	0	0	0	192	0	0	0	0	0	238	0	0
85.006.H	0	0	111	6	0	0	3	1	4	0	0	6	0	83	0	0
85.007.H	0	0	192	8	0	0	0	37	0	0	14	1	0	69	0	0
85.008.H	0	0	88	0	0	0	1	2	0	0	2	0	0	1	0	0
85.009.H	0	0	27	0	0	0	0	2	0	1	5	0	0	15	0	0
85.010.H	0	0	368	38	0	0	0	124	0	0	2	52	0	64	0	0
85.011.H	0	0	76	16	0	0	0	48	0	0	8	16	0	68	0	0
85.012.H	0	0	146	48	0	0	0	148	0	0	34	5	0	15	0	0
85.013.H	0	0	32	28	0	0	26	486	6	4	36	94	0	162	0	0
85.021.H	0	0	0	0	0	0	0	15	0	1	0	0	0	1	0	0
85.022.H	0	0	3	0	0	0	0	1	4	0	2	0	0	0	0	0
85.023.H	0	0	56	26	0	0	1	3	0	0	0	0	0	244	0	0
85.024.H	0	0	4	132	0	0	0	55	2	0	1	54	0	0	0	0
85.025.H	0	0	122	41	0	0	0	0	8	0	22	392	0	2	0	0
85.026.H	0	0	66	596	0	0	0	0	0	12	4	344	0	2	0	0
85.027.H	2	0	116	14	0	0	0	0	0	0	26	26	0	17	0	0
85.028.H	0	0	126	194	0	0	0	0	12	0	4	354	0	4	0	0
85.029.H	1	0	51	0	0	0	2	62	0	0	0	0	0	2	0	0
92.001.H	5	0	38	219	0	0	0	23	0	0	4	272	0	231	0	0
92.002.H	4	0	65	5	0	0	0	6	1	0	7	77	0	13	0	0
92.004.H	1	0	47	8	0	0	0	18	3	0	5	0	0	2	0	0
92.005.H	6	0	182	146	0	0	0	6	0	0	12	234	0	0	0	0
92.006.H	0	0	13	0	0	0	0	6	34	0	0	0	0	0	0	0
92.007.H	54	0	62	0	0	0	0	8	0	0	0	0	0	0	0	0
92.008.H	0	0	24	294	0	0	0	64	0	0	8	24	0	0	0	0
92.009.H	34	0	7	122	0	0	0	6	0	0	9	5	0	4	0	0
92.010.H	9	0	9	1	0	0	0	2	0	0	0	0	0	0	0	0
92.011.H	75	0	17	8	0	0	0	8	2	0	4	1	0	0	0	0
92.012.H	3	0	19	52	0	0	0	81	1	0	1	48	0	4	0	0
92.013.H	5	0	17	56	0	15	0	4	1	0	19	22	0	3	0	0
92.014.H	3	0	28	0	0	0	0	18	0	0	0	0	0	0	0	0
92.015.H	4	0	29	139	0	0	0	3	3	0	0	33	0	0	0	0
92.016.H	2	0	61	223	0	0	0	13	0	0	7	23	0	0	0	0
92.017.H	1	0	13	22	0	0	0	8	0	0	11	1	0	19	0	0
96.015.H	0	0	79	8	0	0	2	44	0	0	2	3	0	192	0	0
96.017.H	0	0	262	2	0	0	0	484	0	0	0	0	0	23	0	0
96.018.H	0	0	12	0	0	0	0	1	0	0	18	0	0	36	0	0
96.019.H	0	0	64	8	0	0	0	124	0	0	0	24	0	184	0	0
96.020.H	0	0	54	1	0	0	0	88	0	0	8	2	0	94	0	0
96.022.H	0	0	122	6	0	0	0	18	0	0	4	3	0	98	0	0
98.013.T	0	0	54	1	0	0	0	235	0	0	14	1	0	78	0	0
99.013.T	0	0	75	45	0	0	0	3	0	0	12	35	0	137	0	0
99.206.P	0	0	3	0	0	0	0	3	0	0	1	1	0	1	0	0
99.207.P	0	0	89	15	0	0	0	65	0	0	23	4	0	19	0	0
99.208.P	0	0	25	1	0	0	0	28	0	0	9	6	0	326	0	0
99.210.P	0	0	8	17	1	3	0	138	6	0	13	14	0	53	0	4
99.211.P	0	0	135	1	27	27	0	169	0	0	1	26	52	146	0	3
99.212.P	0	0	1	0	0	0	0	0	0	0	9	3	0	0	0	0
99.213.P	0	0	113	0	0	0	0	52	0	0	0	0	0	93	0	0
99.214.P	0	0	0	0	0	0	0	9	0	0	5	1	0	17	0	0
99.215.P	63	21	9	2	0	0	0	1	1	0	3	44	0	0	36	0

Publishable Sample Number	Fursenkoina seminuda	Glabertella californiana	Globobulimia pacifica	Haphlophragmoides planissima	Labrospira columbiense	Lagena striata (d'Orbigny)	Lagenammina arenulata	Miliammina fusca Brady	Nonionella basispinata	Nonionella stella	Psammosphera fusca	Quinqueloculina vulgaris	Rotaliammina squamiformis	Reophax advena	Spiroplectammina biformis	Trochammina hadai
85.001.H	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	384
85.002.H	0	0	0	0	0	0	0	0	1	0	0	0	8	0	0	3
85.003.H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
85.004.H	0	0	0	0	0	0	148	32	0	0	0	0	0	0	16	0
85.005.H	0	0	0	48	0	0	32	0	0	0	0	0	0	0	0	0
85.006.H	0	0	1	0	0	0	21	0	0	0	0	0	1	0	4	0
85.007.H	0	0	0	0	0	0	8	3	0	0	0	0	1	0	7	9
85.008.H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
85.009.H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85.010.H	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	12
85.011.H	0	0	0	0	0	0	164	0	0	0	0	0	0	16	2	0
85.012.H	0	0	0	4	0	0	15	0	0	0	0	0	0	0	2	0
85.013.H	0	0	0	0	0	36	6	0	0	0	0	0	0	0	0	0
85.021.H	0	0	0	0	0	0	0	57	0	0	0	0	0	0	0	5
85.022.H	0	0	0	0	4	0	2	17	0	0	0	1	0	0	0	462
85.023.H	0	0	0	0	0	0	0	2	0	16	0	0	0	0	8	2
85.024.H	0	0	0	0	6	0	1	1	0	143	0	0	0	0	0	0
85.025.H	0	0	0	0	48	0	134	0	0	0	0	0	0	14	24	0
85.026.H	0	0	0	0	34	0	0	0	0	744	0	0	0	0	28	0
85.027.H	0	0	0	0	0	0	8	2	0	2	0	0	0	0	0	4
85.028.H	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
85.029.H	0	0	0	0	1	0	0	1	0	0	0	7	0	0	0	149
92.001.H	0	0	0	0	0	0	39	4	0	177	1	0	8	2	43	0
92.002.H	0	0	0	2	4	4	4	3	0	6	0	0	1	1	71	0
92.004.H	0	0	0	3	0	0	1	1	0	0	0	0	0	0	0	0
92.005.H	0	0	0	0	0	0	4	0	0	44	0	0	0	4	0	0
92.006.H	0	0	0	2	0	0	4	15	0	0	0	0	0	0	0	0
92.007.H	0	0	0	0	0	0	2	184	0	0	0	0	0	0	8	0
92.008.H	0	0	0	0	0	0	8	0	0	142	0	0	0	0	0	0
92.009.H	0	0	0	0	5	0	67	0	0	81	4	0	6	0	9	1
92.010.H	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
92.011.H	0	0	0	2	13	0	8	151	0	1	2	0	1	0	2	0
92.012.H	0	0	0	0	7	0	16	0	0	28	1	0	0	0	5	0
92.013.H	0	0	0	0	8	0	39	1	0	1	0	0	3	1	15	2
92.014.H	0	0	0	0	8	0	0	626	0	0	0	0	0	0	0	0
92.015.H	0	6	0	0	1	0	261	2	0	0	2	0	0	0	11	0
92.016.H	0	0	0	0	0	0	44	1	0	19	5	0	0	0	4	0
92.017.H	0	0	0	0	0	0	1	1	0	0	0	0	1	0	4	0
96.015.H	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0
96.017.H	0	0	0	58	2	0	18	0	0	2	0	2	0	16	2	0
96.018.H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
96.019.H	0	0	0	4	8	0	132	4	0	0	0	0	0	0	0	8
96.020.H	0	0	0	1	0	0	2	2	0	0	0	0	0	1	2	0
96.022.H	0	5	0	0	0	0	0	11	0	0	0	0	0	0	0	1
98.013.T	0	0	0	2	0	0	43	0	0	6	0	1	0	0	1	0
99.013.T	0	0	0	0	0	1	0	0	0	2	0	2	11	0	13	0
99.206.P	0	3	0	0	0	0	0	0	0	0	2	0	1	0	0	0
99.207.P	0	2	0	0	0	0	126	0	0	0	0	0	4	0	0	0
99.208.P	0	0	0	0	0	0	2	15	0	0	0	0	5	0	0	1
99.210.P	0	4	0	0	0	6	1	0	7	0	0	0	0	0	2	0
99.211.P	0	2	0	0	0	3	4	0	2	0	0	1	0	0	6	0
99.212.P	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	4
99.213.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.214.P	0	1	0	119	0	0	43	0	0	0	0	0	1	0	0	0
99.215.P	13	1	0	5	9	0	0	19	0	0	1	0	13	0	49	0

Publishable Sample Number	Trochammina inflata	Trochammina pacifica	Uvigerina peregrina	Total # individuals picked	Weight (g)	Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	# Calcareous Individals	# Dissolution Effects	% Dissolution Effects
85.001.H	0	0	0	762	NA	NA	6	0.61	1.61	0.90	10.76	296	NA	NA
85.002.H	0	0	0	102	NA	NA	9	0.73	2.42	1.10	7.84	91	NA	NA
85.003.H	0	0	0	474	NA	NA	4	0.58	1.45	1.05	0.00	470	NA	NA
85.004.H	64	0	0	2308	NA	NA	9	0.62	1.83	0.83	14.04	1984	NA	NA
85.005.H	0	0	0	662	NA	NA	6	0.73	2.11	1.09	12.08	582	NA	NA
85.006.H	0	0	0	241	NA	NA	11	0.66	1.99	0.83	14.94	209	NA	NA
85.007.H	2	0	0	351	NA	NA	12	0.65	2.11	0.85	10.26	306	NA	NA
85.008.H	0	0	0	95	NA	NA	6	0.19	0.73	0.37	2.11	92	NA	NA
85.009.H	0	0	0	50	NA	NA	5	0.61	1.63	1.01	12.00	44	NA	NA
85.010.H	4	0	0	728	NA	NA	9	0.69	2.21	1.00	16.76	594	NA	NA
85.011.H	8	0	0	422	NA	NA	10	0.77	2.55	1.11	50.71	208	NA	NA
85.012.H	4	0	0	421	NA	NA	10	0.73	2.29	1.00	15.20	357	NA	NA
85.013.H	0	0	0	916	NA	NA	11	0.67	2.23	0.93	15.94	776	NA	NA
85.021.H	0	0	0	79	NA	NA	5	0.44	1.21	0.75	73.42	16	NA	NA
85.022.H	18	13	0	527	NA	NA	11	0.23	0.87	0.36	11.39	8	3	37.5
85.023.H	16	0	0	374	NA	NA	10	0.55	1.81	0.76	6.95	346	NA	NA
85.024.H	0	0	0	399	NA	NA	10	0.72	2.10	0.91	16.29	336	82	24.40
85.025.H	2	0	0	809	NA	NA	11	0.71	2.31	0.96	79.60	173	NA	NA
85.026.H	4	0	0	1834	NA	NA	10	0.69	1.98	0.86	23.23	1408	NA	NA
85.027.H	8	0	0	225	NA	NA	11	0.69	2.37	0.99	32.00	149	NA	NA
85.028.H	2	0	0	700	NA	NA	8	0.63	1.71	0.82	53.71	336	NA	NA
85.029.H	0	0	0	276	NA	NA	9	0.62	1.74	0.79	1.09	117	64	54.70
92.001.H	0	3	0	1069	NA	NA	15	0.81	2.73	1.01	35.64	688	205	29.80
92.002.H	3	0	0	277	NA	NA	18	0.80	2.83	0.98	64.26	100	79	79.00
92.004.H	0	1	0	90	NA	NA	11	0.67	2.23	0.93	16.67	78	NA	NA
92.005.H	4	0	0	642	NA	NA	10	0.73	2.17	0.94	41.12	378	NA	NA
92.006.H	17	0	0	91	NA	NA	7	0.77	2.39	1.23	79.12	53	NA	NA
92.007.H	28	0	0	346	NA	NA	7	0.65	1.94	0.99	79.77	70	NA	NA
92.008.H	0	0	0	564	NA	NA	7	0.65	1.91	0.98	7.09	524	NA	NA
92.009.H	11	0	0	371	NA	NA	15	0.80	2.81	1.04	40.43	220	121	55
92.010.H	3	0	0	32	NA	NA	6	0.77	2.26	1.26	62.50	12	NA	NA
92.011.H	5	3	0	303	NA	NA	17	0.68	2.36	0.83	88.78	36	0	0
92.012.H	0	1	0	267	NA	NA	14	0.82	2.81	1.07	31.09	185	103	55.68
92.013.H	4	22	0	238	NA	NA	19	0.88	3.45	1.17	58.82	97	46	47.42
92.014.H	166	112	0	961	NA	NA	7	0.53	1.54	0.79	95.21	46	NA	NA
92.015.H	0	4	0	498	NA	NA	13	0.64	1.98	0.77	64.46	180	12	6.67
92.016.H	0	2	0	404	NA	NA	12	0.65	2.18	0.88	21.78	316	101	31.96
92.017.H	0	3	0	85	NA	NA	12	0.83	2.86	1.15	27.06	62	61	98.39
96.015.H	0	0	0	334	NA	NA	9	0.60	1.70	0.78	2.10	325	128	39.38
96.017.H	0	0	0	871	NA	NA	11	0.59	1.71	0.71	11.02	773	NA	NA
96.018.H	0	0	0	69	NA	NA	5	0.63	1.67	1.04	28.99	49	NA	NA
96.019.H	0	0	0	560	NA	NA	10	0.77	2.42	1.05	30.71	380	NA	NA
96.020.H	0	0	0	255	NA	NA	11	0.70	2.00	0.84	7.06	237	NA	NA
96.022.H	1	0	0	269	NA	NA	10	0.65	1.95	0.85	7.06	249	197	79.12
98.013.T	0	0	0	436	19.4	22	11	0.65	1.99	0.83	13.99	374	40	10.70
99.013.T	0	0	0	336	2.4	140	11	0.75	2.43	1.01	21.13	263	120	45.63
99.206.P	0	0	0	15	1.8	8	8	0.84	2.82	1.36	33.33	10	1	10
99.207.P	0	0	0	347	8.2	42	9	0.76	2.36	1.08	45.24	190	47	24.74
99.208.P	0	7	0	425	10.1	42	11	0.40	1.42	0.59	10.35	380	168	44.21
99.210.P	0	0	0	277	1.6	173	15	0.70	2.51	0.93	13.00	247	86	34.82
99.211.P	0	0	0	605	0.1	6050	16	0.80	2.69	0.95	6.12	567	237	41.80
99.212.P	0	4	0	42	89.5	0	6	0.68	2.02	1.13	88.10	1	0	0
99.213.P	0	1	0	259	13.8	19	4	0.64	1.55	1.12	0.39	258	0	0
99.214.P	0	1	0	197	4	49	9	0.58	1.72	0.78	86.29	27	0	0
99.215.P	2	0	0	292	1.5	195	18	0.87	3.31	1.15	71.58	84	59	70.24

Publishable Sample Number	Picked by	Verified by	% Fines	% sand	% silt	% clay	% TOC	Salinity	Temperature	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper	Lead	Mercury (Hg) (mg/kg)	Zinc (Zn) (mg/kg)
85.001.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.002.H	SCC	AS	73.6	16.6	6.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.003.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.004.H	SCC	AS	41.3	3.1	549.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.005.H	SCC	AS	26.1	3	70.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.006.H	SCC	AS	90.7	2.9	6.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.007.H	SCC	AS	80.7	8.8	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.008.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.009.H	SCC	AS	26.7	50.9	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.010.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.011.H	SCC	AS	89.5	4.7	5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.012.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.013.H	SCC	AS	92	0.48	7.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.021.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.022.H	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.023.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.024.H	AS	AS	78.6	4.6	16.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.025.H	SCC	AS	33.8	2.1	62.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.026.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.027.H	SCC	AS	10.1	5.29	8.94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.028.H	SCC	AS	1.46	0.07	98.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.029.H	AS	AS	12.3	63.43	3.03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.001.H	AS	AS	27.2	16	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.002.H	AS	AS	1.44	NA	98.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.004.H	SCC	AS	49.03	6.1	6.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.005.H	SCC	AS	37.37	26.14	22.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.006.H	SCC	AS	9.3	0.03	90.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.007.H	SCC	AS	42.75	0.3	57.22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.008.H	SCC	AS	2.86	0.09	96.93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.009.H	AS	AS	39.34	0.25	60.37	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.010.H	SCC	AS	66.88	1.33	31.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.011.H	AS	AS	42.05	1.47	56.48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.012.H	AS	AS	11.65	6.2	81.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.013.H	AS	AS	19.9	7.53	6.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.014.H	SCC	AS	75.1	5.83	18.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.015.H	AS	AS	52.65	42.17	5.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.016.H	AS	AS	18.33	1	79.93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.017.H	AS	AS	41.35	23.32	0.46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.015.H	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.017.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.018.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.019.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.020.H	SCC	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.022.H	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
98.013.T	AS	AS	14	85.99	8.63	5.35	NA	29	10	NA	NA	NA	NA	NA	NA	NA
99.013.T	AS	AS	15.1	85.13	11.5	3.14	NA	30	11	NA	NA	NA	NA	NA	NA	NA
99.206.P	AS	AS	84	16.1	64.5	18.5	0.58	30	11	127.5886	5.92	0.5	28.8	14.1	0.0686	78.2
99.207.P	AS	AS	12.6	87.1	10.2	2.6	0.36	30	12	27.547	2.8	0.2	1.5	3.93	0.017	19.1
99.208.P	AS	AS	11.5	87.4	10.4	1.5	2.3	30	14	26.352	4.37	0.31	1.5	2.15	0.022	18
99.210.P	AS	AS	19.6	80.3	15	4.6	0.48	30	11	58.464	3.91	0.13	7.73	4.77	0.024	41.9
99.211.P	AS	AS	4.7	95.1	2.9	1.8	0.26	31	11.5	43.127	4.69	0.12	4	3.6	0.017	30.7
99.212.P	AS	AS	10.7	89.3	7.1	3.6	0.53	30	12	30.761	2.3	0.33	2.8	2.81	0.021	22.5
99.213.P	AS	AS	7.9	91.5	5.7	2.2	0.37	30	13.5	20.56	2	0.31	0.75	2.18	0.02	15.3
99.214.P	AS	AS	67	32.2	49.1	18.1	4.4	30	12	121.9062	7.59	1.04	28.4	15.2	0.0762	69.6
99.215.P	AS	AS	71	28.9	60.9	10.4	3.4	25	11	159.664	7.77	0.36	73.3	5.87	0.064	72.3

Publishable Sample Number	Total PAH	Acenaphthene (ug/Kg)	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[e]pyrene	Benzo[b]fluoranthene	Benzo[ghi]perylene	Benzo[k]fluoranthene	Chrysene	Dibenzo[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-cd]pyrene	Phenanthrene
85.001.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.002.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.003.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.004.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.005.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.006.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.007.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.008.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.009.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.010.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.011.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.012.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.013.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.021.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.022.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.023.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.024.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.025.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.026.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.027.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.028.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
85.029.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.001.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.002.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.004.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.005.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.006.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.007.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.008.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.009.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.010.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.011.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.012.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.013.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.014.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.015.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.016.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
92.017.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.015.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.017.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.018.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.019.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.020.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
96.022.H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
98.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
99.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
99.206.P	0.786748	29	119	75	71	88	66	80	95	109	101	9.5	325	42	78	283
99.207.P	0.937656	38	93	54	49	54	35	55	40	53	68	6.4	253	30	29	193
99.208.P	0.116754	21	58	51	21	32	20	29	37	24	30	2.5	184	20	26	206
99.210.P	0.110192	2.8	14	5.7	9.2	9.3	8.5	12	9.9	9.4	15	2	31	8.5	7.4	47
99.211.P	0.036401	0.49	0.68	1.1	2.1	2.1	2.5	3.5	2.9	2.7	3.5	2	5.4	1.4	1.4	6.5
99.212.P	0.592722	24	143	49	28	38	24	34	45	35	34	3.44	185	21	32	198
99.213.P	0.452579	11	52	26	16	27	17	20	36	22	18	1.5	128	9.7	23	107
99.214.P	0.739585	264	1190	535	330	468	283	228	562	366	442	60	2210	228	362	2030
99.215.P	0.018498	2.5	2	7	16	14	18	28	18	20	25	4	49	5.3	13	25

Publishable Sample Number	Pyrene	Naphthalene	PCB Aroclor 1242	PCB Aroclor 1016	Notes:
85.001.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.002.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.003.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.004.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.005.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.006.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.007.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.008.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.009.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.010.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.011.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.012.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.013.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.021.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.022.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.023.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.024.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.025.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.026.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.027.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.028.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
85.029.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.001.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.002.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.004.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.005.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.006.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.007.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.008.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.009.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.010.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.011.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.012.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.013.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.014.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.015.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.016.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
92.017.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.015.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.017.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.018.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.019.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.020.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
96.022.H	NA	NA	NA	NA	Locations were recorded on a hand drawn map
98.013.T	NA	NA	NA	NA	
99.013.T	NA	NA	NA	NA	
99.206.P	322	348	5.8	5.8	
99.207.P	234	373	4.9	4.9	
99.208.P	184	373	4.8	4.8	
99.210.P	33	35	5.2	5.2	
99.211.P	4.8	3.4	11	5.1	
99.212.P	203	446	4.7	4.7	
99.213.P	134	174	4.9	4.9	
99.214.P	2440	3980	5.5	5.5	
99.215.P	37	25	5.6	5.6	

Publishable Sample Number	Locality Field Number	Burke Locality Number	Project	Year	Date	Region	Location	Latitude Degrees	Latitude Minutes	Longitude Degrees	Longitude Minutes	Depth
99.216.P	PSEMP 216D	B8680	PSEMP	1999	28-Jun	Dabob Bay	Quilcene	47	47.8279	122	51.5182	16.2
99.217.P	PSEMP 217	B8684	PSEMP	1999	28-Jun	Dabob Bay	Quilcene	47	47.4054	122	51.3196	27.2
99.218.P	PSEMP 218	B8686	PSEMP	1999	28-Jun	Dabob Bay	Dabob	47	49.2345	122	49.1035	61
99.220.P	PSEMP 220	B8687	PSEMP	1999	29-Jun	Dabob Bay	Near Jackson Cove	47	44.0791	122	50.6446	175
99.221.P	PSEMP 221	B8673	PSEMP	1999	30-Jun	South Hood Canal	The Great Bend	47	25.238	123	6.6198	120
99.224.P	PSEMP 224	B8670	PSEMP	1999	30-Jun	South Hood Canal	Lynch Cove	47	22.6786	123	7.7477	87
99.225.P	PSEMP 225	B8671	PSEMP	1999	30-Jun	South Hood Canal	Lynch Cove	47	23.4444	122	56.385	21.5
99.226.P	PSEMP 226	B8674	PSEMP	1999	30-Jun	South Hood Canal	The Great Bend	47	23.7925	122	57.3611	19.2
01.013.T	13R01	B8691	Temporal	2001	3-May	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	22
02.013.T	13R02	B8691	Temporal	2002	9-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	23
03.013.T	13R03	B8691	Temporal	2003	10-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	22.1
04.013.T	13R04	B8691	Temporal	2004	13-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	22.2
04.024.P	PSEMP 24	B8700	PSEMP	2004	3-Jun	Admiralty Inlet	Near Navel Base	47	47.015	122	43.233	47
04.032.P	PSEMP 32	B8688	PSEMP	2004	6-Jun	Dabob Bay	Dabob	47	48.119	122	48.161	111
04.048.P	PSEMP 48	B8689	PSEMP	2004	7-Jun	Dabob Bay	Near Jackson Cove	47	44.104	122	49.589	174
04.064.P	PSEMP 64	B8676	PSEMP	2004	10-Jun	South Hood Canal	The Great Bend	47	23.579	123	7.325	95
04.075.P	PSEMP 75	B8701	PSEMP	2004	2-Jun	Admiralty Inlet	Near Hood Head	47	54.088	122	36.249	95
04.088.P	PSEMP 88	B8702	PSEMP	2004	3-Jun	Admiralty Inlet	Squamish Harbor	47	50.023	122	39.056	54
04.096.P	PSEMP 96	B8677	PSEMP	2004	10-Jun	South Hood Canal	The Great Bend	47	36.222	122	57.479	164
04.118.P	PSEMP 118	B8172	PSEMP	2004	9-Jun	South Hood Canal	Lynch Cove	47	23.082	122	58.177	32
04.120.P	PSEMP 120	B8682	PSEMP	2004	8-Jun	South Hood Canal	Midsection	47	23.551	123	6.291	132
04.128.P	PSEMP 128	B8675	PSEMP	2004	9-Jun	South Hood Canal	The Great Bend	47	21.239	123	3.011	38
04.144.P	PSEMP 144	B8690	PSEMP	2004	7-Jun	Dabob Bay	Quilcene	47	47.077	122	51.553	
04.216.P	PSEMP 216A	B8703	PSEMP	2004	2-Jun	Admiralty Inlet	Squamish Harbor	47	51.173	122	39.538	18.9
04.224.P	PSEMP 224	B8678	PSEMP	2004	10-Jun	South Hood Canal	The Great Bend	47	35.305	122	57.107	25
04.248.P	PSEMP 248	B8681	PSEMP	2004	8-Jun	South Hood Canal	Midsection	47	36.322	122	57.278	134
04.296.P	PSEMP 296	B8680	PSEMP	2004	8-Jun	South Hood Canal	Midsection	47	23.369	123	7.439	93
05.013.T	13R05	B8691	Temporal	2005	20-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	22.1
06.013.T	13R06	B8691	Temporal	2006	5-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7379	23
07.013.T	13R07	B8691	Temporal	2007	25-Apr	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	23
08.013.T	13R08	B8691	Temporal	2008	22-Apr	Admiralty Inlet	Squamish Harbor	47	50.2554	122	37.7371	20.8
09.013.T	13R09	B8691	Temporal	2009	23-Apr	Admiralty Inlet	Squamish Harbor	47	50.2553	122	37.7377	21.9
10.013.T	13R10	B8691	Temporal	2010	20-Apr	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	21.4
11.013.T	13R11	B8691	Temporal	2011		Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	
12.013.T	13R12	B8691	Temporal	2012	17-Apr	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	
13.013.T	13R13	B8691	Temporal	2013	16-Apr	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	22.4
13.GS01.C	GS01	B8704	HCCP	2013	11-Sep	South Hood Canal	Midsection					
13GS02.C	GS02	B8705	HCCP	2013	11-Sep	South Hood Canal	Midsection					
13.GS03.C	GS03	B8706	HCCP	2013	11-Sep	South Hood Canal	Midsection					
13.GS04.C	GS04	B8719	HCCP	2013	12-Sep	South Hood Canal	Lynch Cove					
13.GS05.C	GS05	B8720	HCCP	2013	12-Sep	South Hood Canal	Lynch Cove					
13.GS06.C	GS06	B8709	HCCP	2013	12-Sep	South Hood Canal	Lynch Cove					
13.GS07.C	GS07	B8710	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS09.C	GS09	B8711	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS10.C	GS10	B8712	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS11.C	GS11	B8713	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS12.C	GS12	B8714	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS14.C	GS14	B8715	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.GS16.C	GS16	B8716	HCCP	2013	12-Sep	South Hood Canal	The Great Bend					
13.KC01.C	KC01	B8707	HCCP	2013	11-Sep	South Hood Canal	Midsection	47	36.933	122	56.316	176
13.KC03.C	KC03	B8708	HCCP	2013	11-Sep	South Hood Canal	Midsection	47	36.731	122	56.886	159
13.KC04.C	KC04	B8721	HCCP	2013	12-Sep	South Hood Canal	Lynch Cove	47	23.4333	122	57.1304	28.3
13.KC05.C	KC05	B8717	HCCP	2013	12-Sep	South Hood Canal	The Great Bend	47	22.0919	123	6.2677	66.1
13.KC07.C	KC07	B8718	HCCP	2013	12-Sep	South Hood Canal	The Great Bend	47	21.9513	123	7.9641	81.2
15.013.T	13R15	B8691	Temporal	2015	16-Apr	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	23
16.013.T	13R16	B8691	Temporal	2016	9-May	Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	28
17.317.T	13R17	B8691	Temporal	2017		Admiralty Inlet	Squamish Harbor	47	50.255	122	37.737	

Publishable Sample Number	Ammobaculites sp.	Bolivinella pacifica	Buccella frigida	Buliminella elegantissima	Cassidulina limbata	Cibicides fletcheri	Cibicides lobatulus	Cribroelphidium excavatum	Cribrostomoides subglobosum	Discorbis fusca	Deuterammina rotaliformis	Eggerella advena	Elphidium frigidum	Elphidiella hannai	Eponides repandus	Favulina melo
99.216.P	6	1	1	3	0	0	0	87	19	0	0	54	0	46	0	0
99.217.P	3	0	16	9	0	0	0	61	1	0	51	19	1	47	0	0
99.218.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.220.P	0	1	14	9	0	0	0	7	0	0	0	0	0	5	0	0
99.221.P	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0
99.224.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.225.P	0	0	18	0	0	0	0	11	0	0	0	0	0	7	0	0
99.226.P	2	0	1	2	0	0	0	57	0	0	2	3	0	0	0	0
01.013.T	0	0	76	9	0	1	0	14	0	0	15	12	0	15	0	0
02.013.T	0	0	37	1	0	0	0	29	0	0	0	21	0	318	0	0
03.013.T	0	0	35	17	0	0	0	52	0	0	14	38	0	16	0	0
04.013.T	0	0	14	3	0	0	0	41	0	0	9	24	0	111	0	0
04.024.P	3	0	0	1	0	0	0	0	1	0	7	68	0	0	0	0
04.032.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.048.P	0	0	6	2	0	0	0	29	0	0	0	2	0	0	0	0
04.064.P	5	0	0	0	0	0	0	0	21	0	15	61	0	0	0	0
04.075.P	0	0	89	3	0	34	0	159	0	0	11	18	0	1	0	5
04.088.P	0	1	33	3	0	1	0	18	2	0	22	37	0	3	0	1
04.096.P	0	0	5	25	0	0	0	9	21	0	0	54	0	0	0	0
04.118.P	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0
04.120.P	0	0	1	1	0	0	0	0	3	0	0	141	0	0	0	0
04.128.P	0	0	1	2	0	0	0	0	2	0	3	11	0	0	0	0
04.144.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.216.P	1	0	1	11	0	0	0	24	5	0	19	122	0	0	0	0
04.224.P	1	0	2	0	0	0	0	0	1	0	13	282	0	0	0	0
04.248.P	3	0	0	0	0	0	1	0	8	0	37	13	0	0	0	0
04.296.P	0	0	65	0	0	8	0	7	6	0	4	12	0	0	0	0
05.013.T	0	0	32	74	0	2	0	139	0	0	26	48	0	116	0	1
06.013.T	0	0	28	143	0	0	0	195	0	0	15	55	0	52	0	0
07.013.T	0	0	46	8	0	0	0	12	0	0	12	64	0	75	0	0
08.013.T	0	0	3	7	0	0	0	52	0	0	0	15	0	124	0	0
09.013.T	0	0	26	4	0	0	0	158	0	0	3	12	6	82	0	0
10.013.T	0	0	46	95	0	0	0	479	0	0	17	23	0	49	0	1
11.013.T	0	0	37	8	0	1	0	377	0	0	5	23	0	118	0	1
12.013.T	0	0	3	57	0	8	0	213	1	0	6	27	0	75	0	0
13.013.T	0	0	19	4	0	2	0	21	0	0	6	15	0	37	0	0
13.GS01.C	0	0	92	93	0	2	0	9	38	3	7	14	0	5	0	0
13GS02.C	0	0	72	75	0	2	0	13	32	0	15	2	0	6	0	0
13.GS03.C	0	1	18	64	0	3	0	71	21	0	14	142	4	5	0	0
13.GS04.C	0	0	1	3	0	0	0	3	1	0	0	1	0	0	0	0
13.GS05.C	6	0	5	5	0	0	0	9	1	0	1	9	0	2	0	0
13.GS06.C	0	0	6	242	0	0	0	132	2	0	1	4	0	0	0	0
13.GS07.C	1	0	8	45	0	0	0	78	6	0	3	67	0	0	0	0
13.GS09.C	123	0	17	27	0	0	0	19	6	0	4	0	4	7	0	0
13.GS10.C	13	0	3	39	0	0	0	51	14	0	3	3	2	8	0	0
13.GS11.C	8	0	8	91	0	0	0	54	17	0	3	5	0	3	0	0
13.GS12.C	2	0	5	6	0	0	0	84	1	0	0	24	0	2	0	0
13.GS14.C	1	0	13	48	0	0	0	76	0	0	2	0	0	0	0	0
13.GS16.C	6	0	145	47	0	0	0	4	0	0	1	1	0	0	0	0
13.KC01.C	0	0	97	2	0	3	0	16	0	0	1	156	0	13	0	0
13.KC03.C	0	0	51	22	0	3	0	5	0	0	1	61	0	4	0	0
13.KC04.C	0	0	516	515	0	0	0	376	0	0	0	0	14	47	0	0
13.KC05.C	0	0	45	124	0	2	0	96	0	0	1	6	0	2	0	0
13.KC07.C	0	0	0	141	0	0	0	53	0	0	0	0	0	0	0	0
15.013.T	0	0	145	18	0	2	0	264	0	0	18	26	0	158	0	0
16.013.T	0	0	78	96	0	0	0	286	0	0	25	46	0	223	0	0
17.317.T	3	0	137	123	0	0	0	22	0	0	28	124	0	315	0	0

Publishable Sample Number	Fursenkoina seminuda	Glabertella californiana	Globobulimia pacifica	Haphlophragmoides planissima	Labrospira columbiense	Lagena striata (d'Orbigny)	Lagenammina arenulata	Miliammina fusca Brady	Nonionella basispinata	Nonionella stella	Psammosphera fusca	Quinqueloculina vulgaris	Rotaliammina squamiformis	Reophax advena	Spiroplectammina biformis	Trochammina hadai
99.216.P	0	2	0	74	0	0	9	6	0	7	1	0	0	0	32	0
99.217.P	0	1	0	15	0	0	4	0	0	7	0	0	4	0	0	13
99.218.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.220.P	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0
99.221.P	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0
99.224.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.225.P	0	1	0	8	0	0	13	0	0	1	0	0	7	0	0	0
99.226.P	0	1	0	0	0	0	0	0	0	0	1	0	1	0	2	0
01.013.T	0	0	0	0	4	0	11	1	0	2	0	0	8	0	0	0
02.013.T	0	0	1	0	0	0	64	0	0	1	0	0	1	0	15	0
03.013.T	0	1	0	3	0	0	1	0	0	1	0	0	15	0	16	0
04.013.T	0	1	0	0	1	0	28	0	0	1	0	1	8	0	2	0
04.024.P	0	5	0	0	0	0	1	2	0	0	0	0	21	0	72	1
04.032.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.048.P	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.064.P	0	0	0	0	32	0	15	4	0	0	2	0	0	0	34	0
04.075.P	0	3	0	0	0	0	3	0	1	5	0	0	2	0	8	2
04.088.P	0	0	0	0	0	0	1	0	0	3	0	0	0	0	44	0
04.096.P	0	0	0	0	0	0	0	2	0	0	0	0	4	1	55	0
04.118.P	0	0	0	0	3	0	8	0	0	1	0	0	3	0	0	0
04.120.P	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
04.128.P	0	0	0	0	1	0	21	1	0	0	0	0	1	0	0	0
04.144.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.216.P	0	3	0	9	2	0	28	3	0	3	0	0	1	0	32	7
04.224.P	0	0	0	1	0	0	8	0	0	0	0	0	3	0	19	0
04.248.P	0	1	0	5	0	0	14	1	0	0	0	0	3	0	19	1
04.296.P	0	0	0	0	0	0	0	0	0	1	0	0	0	0	6	0
05.013.T	0	0	0	0	0	2	49	0	0	17	0	8	5	0	34	0
06.013.T	0	0	0	0	16	0	3	0	0	2	0	0	6	0	15	0
07.013.T	0	0	0	0	1	0	37	0	0	1	0	0	7	0	5	0
08.013.T	0	0	0	0	0	0	4	0	0	3	0	1	7	0	1	0
09.013.T	0	0	0	0	2	0	2	0	0	0	0	0	0	0	14	0
10.013.T	0	0	0	0	7	0	8	0	0	13	0	0	4	0	17	0
11.013.T	0	0	0	0	7	0	36	2	0	3	0	1	15	0	2	0
12.013.T	0	0	0	0	9	1	14	0	0	0	0	0	18	0	15	0
13.013.T	0	0	0	0	0	0	65	0	0	1	0	0	0	0	2	0
13.GS01.C	0	0	7	0	1	1	2	0	0	11	0	8	1	0	4	0
13GS02.C	0	0	7	0	19	0	0	0	0	4	0	0	1	7	0	0
13.GS03.C	0	0	0	0	7	0	0	0	0	4	0	2	6	1	3	0
13.GS04.C	0	0	0	0	2	0	2	0	0	0	0	0	4	0	2	0
13.GS05.C	0	0	0	4	1	0	17	1	0	1	0	5	21	0	4	0
13.GS06.C	0	0	0	0	2	0	8	0	0	53	0	19	2	0	0	0
13.GS07.C	0	0	0	0	2	0	4	1	0	2	0	0	3	2	8	0
13.GS09.C	0	0	0	3	4	0	7	49	0	7	0	0	4	4	5	0
13.GS10.C	0	0	0	0	0	0	41	36	0	13	9	0	3	0	6	0
13.GS11.C	0	0	1	0	2	1	6	44	0	22	2	0	3	0	5	0
13.GS12.C	0	0	0	3	3	0	11	0	0	46	0	0	0	0	0	0
13.GS14.C	0	0	0	0	0	0	0	0	0	193	0	0	0	0	0	0
13.GS16.C	0	0	0	0	1	0	84	1	0	2	0	0	8	0	2	0
13.KC01.C	0	0	1	1	19	3	1	0	0	11	0	0	6	0	9	0
13.KC03.C	0	0	3	0	34	1	0	0	0	24	0	4	6	0	8	0
13.KC04.C	0	0	0	0	2	0	0	0	0	264	0	83	0	0	0	0
13.KC05.C	0	0	0	0	0	1	0	0	0	83	0	16	0	1	0	0
13.KC07.C	0	0	0	0	0	0	0	0	0	127	0	2	0	0	0	0
15.013.T	0	0	0	0	0	0	15	1	0	0	0	2	11	0	6	0
16.013.T	0	0	0	0	4	0	33	0	0	0	0	0	0	0	21	0
17.317.T	0	2	0	4	1	0	67	0	5	0	1	5	23	0	41	0

Publishable Sample Number	Trochammina inflata	Trochammina pacifica	Uvigerina peregrina	Total # individuals picked	Weight (g)	Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	# Calcareous Individals	# Dissolution Effects	% Dissolution Effects
99.216.P	3	2	0	353	5.4	65	17	0.84	3.03	1.07	58.36	166	74	44.58
99.217.P	5	4	0	261	2.3	113	17	0.86	3.23	1.14	40.61	143	43	30.07
99.218.P	0	0	0	0	0		0	0.00	0.00	0.00	0	0	0	0
99.220.P	0	0	0	40	0.2	200	7	0.78	2.39	1.23	5.00	38	28	73.68
99.221.P	0	0	0	10	0.2	50	4	0.70	1.85	1.33	40.00	6	6	100
99.224.P	0	0	0	0	0.6	0	0	0.00	0.00	0.00	0	0	0	0
99.225.P	0	0	0	66	0.4	165	8	0.82	2.64	1.27	42.42	38	10	26.32
99.226.P	0	0	0	72	0.1	720	10	0.37	1.38	0.60	15.28	61	44	72.13
01.013.T	1	1	0	170	27.5	6	14	0.76	2.77	1.05	31.18	117	61	52.14
02.013.T	0	1	0	489	30.1	16	11	0.55	1.75	0.73	20.86	387	52	13.44
03.013.T	0	1	0	210	8.9	24	13	0.85	3.00	1.17	41.90	122	42	34.43
04.013.T	0	0	0	244	45.9	5	13	0.74	2.48	0.97	29.51	171	44	25.73
04.024.P	3	0	0	185	7.5	25	12	0.70	2.16	0.87	96.22	7	1	14.29
04.032.P	0	0	0	0	0		0	0.00	0.00	0.00	0	0	0	0
04.048.P	0	0	0	40	0.1	400	5	0.45	1.31	0.82	5.00	38	16	42.11
04.064.P	15	0	0	204	0.1	2040	10	0.83	2.85	1.24	100.00	21	0	0
04.075.P	0	9	0	353	2.5	141	16	0.72	2.46	0.89	14.45	300	147	49.0
04.088.P	0	0	2	171	6.7	26	14	0.82	2.79	1.06	61.99	67	15	22.4
04.096.P	0	6	0	182	0.1	1820	10	0.78	2.55	1.11	78.57	60	0	0
04.118.P	0	1	0	21	2.8	8	7	0.77	2.42	1.24	90.48	2	0	0
04.120.P	0	0	0	148	0.4	370	6	0.09	0.38	0.21	98.65	5	1	20
04.128.P	0	2	0	45	16.4	3	10	0.71	2.36	1.02	93.33	5	0	0
04.144.P	0	0	0	0	0		0	0.00	0.00	0.00	#DIV/0!	0	0	0
04.216.P	1	27	0	299	0.9	332	18	0.79	2.96	1.02	83.61	47	15	31.91
04.224.P	0	2	0	332	0.5	664	10	0.27	0.97	0.42	99.40	3	1	33.33333
04.248.P	3	34	0	143	20.5	7	14	0.84	2.98	1.13	97.90	10	1	10
04.296.P	0	2	23	134	4.5	30	10	0.72	2.42	1.05	22.39	110	33	30.00
05.013.T	0	0	0	553	21.4	26	14	0.85	3.05	1.16	29.29	383	64	16.71
06.013.T	1	0	3	534	30.1	18	13	0.77	2.57	1.00	20.79	423	82	19.39
07.013.T	0	0	0	268	62.3	4	11	0.81	2.70	1.12	47.01	142	60	42.25
08.013.T	0	0	0	217	25.1	9	10	0.61	1.89	0.82	12.44	189	110	58.20
09.013.T	0	0	0	309	4.1	75	10	0.66	2.04	0.89	10.68	276	27	9.78
10.013.T	0	0	0	759	35.8	21	12	0.58	1.98	0.80	10.01	683	0	0
11.013.T	0	0	0	636	0.1	6360	15	0.61	2.01	0.74	14.15	545	0	0
12.013.T	3	3	0	453	0.1	4530	15	0.73	2.54	0.94	21.19	358	0	0
13.013.T	0	2	0	174	90.1	2	11	0.78	2.59	1.08	51.72	84	44	52.38
13.GS01.C	0	1	0	299	1	299	18	0.79	2.81	0.97	23.75	258	49	18.99
13GS02.C	2	0	0	257	4.2	61	14	0.81	2.84	1.08	30.35	211	57	27.01
13.GS03.C	4	0	0	370	1.8	206	17	0.78	2.75	0.97	53.51	191	73	38.22
13.GS04.C	0	0	0	19	5.4	4	9	0.86	3.01	1.37	63.16	8	5	62.50
13.GS05.C	32	0	0	124	25.9	5	17	0.87	3.35	1.18	78.23	23	21	91.30
13.GS06.C	0	0	0	471	0.4	1178	11	0.64	1.91	0.80	4.03	435	82	18.85
13.GS07.C	2	1	0	233	16.8	14	16	0.76	2.57	0.93	42.92	139	37	26.62
13.GS09.C	48	1	0	339	7.9	43	18	0.81	3.08	1.06	76.11	87	48	55.17
13.GS10.C	17	7	0	268	6.4	42	17	0.89	3.48	1.23	56.72	130	38	29.23
13.GS11.C	22	0	0	297	5.4	55	18	0.83	3.12	1.08	39.39	197	93	47.21
13.GS12.C	1	0	0	188	0.7	269	12	0.72	2.34	0.94	23.94	144	63	43.75
13.GS14.C	0	0	0	333	0.1	3330	6	0.59	1.60	0.89	0.90	330	164	49.70
13.GS16.C	4	1	0	307	75.9	4	14	0.68	2.08	0.79	35.50	198	32	16.16
13.KC01.C	0	28	0	367	0.2	1835	16	0.74	2.53	0.91	60.22	146	34	23.29
13.KC03.C	0	0	0	227	0.3	757	14	0.83	2.94	1.11	48.46	113	38	33.63
13.KC04.C	0	0	0	1817	0.1	18170	8	0.77	2.31	1.11	0.11	1732	642	37.07
13.KC05.C	0	0	0	377	0.8	471	11	0.76	2.31	0.96	2.12	353	91	25.78
13.KC07.C	0	0	0	323	0.1	3230	4	0.63	1.52	1.10	0.00	321	101	31.46
15.013.T	0	0	0	666	14.9	45	12	0.74	2.31	0.93	11.56	587	62	10.56
16.013.T	4	0	0	816	26.2	31	10	0.77	2.51	1.09	16.30	683	117	17.13
17.317.T	0	33	2	936	51.5	18	18	0.82	2.96	1.02	34.72	606	159	26.24

Publishable Sample Number	Picked by	Verified by	% Fines	% sand	% silt	% clay	% TOC	Salinity	Temperature	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper	Lead	Mercury (Hg) (mg/kg)	Zinc (Zn) (mg/kg)
99.216.P	AS	AS	30.4	69.1	25.4	5.4	1.3	27	12	113.804	6.3	0.18	44.4	3.59	0.034	59.3
99.217.P	AS	AS	39.6	60.5	32.7	6.6	1.4	30	11	118.858	7.16	0.13	46.4	4.33	0.038	60.8
99.218.P	AS	AS	69.6	30.4	59.8	9.6	1.4	29	11	78.868	4.75	0.35	21.3	5.43	0.038	47
99.220.P	AS	AS	91	9	46.8	44.1	2.7	27	12	149.673	5.96	0.12	41.5	19.2	0.093	82.8
99.221.P	AS	AS	85	13.6	49.4	36	2.4	25	12	196.208	6.55	0.28	90.2	10.8	0.078	88.3
99.224.P	AS	AS	81	13.2	55.8	24.7	2	25	11	207.784	8.11	0.19	110	7.13	0.054	82.3
99.225.P	AS	AS	60	8.6	41.5	17.6	3.8	24	11.5	215.459	14.6	1.49	99.7	11.4	0.069	88.2
99.226.P	AS	AS	72	13.1	50.7	21	NA	25	11.5	208.144	17.4	1.78	92.5	12	0.064	84.4
01.013.T	AS	AS	12	88	9.3	2.7	0.39	32	9	NA	NA	NA	NA	NA	NA	NA
02.013.T	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
03.013.T	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
04.013.T	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
04.024.P	AS	AS	49.1	50.8	41.1	8.1	0.9	31	10.1	82.87	4.2	0.26	14.6	7.27	0.04	56.5
04.032.P	AS	AS	73	26.9	50.5	22.3	2.43	30	9.4	134.059	6.3	0.29	37.6	12.1	0.069	77.7
04.048.P	AS	AS	80	16.6	44.9	34.9	2.41	30	10.3	144.084	5.32	0.29	33.2	14.5	0.074	90.7
04.064.P	AS	AS	58	42.1	39.5	18.4	2.2	30	9.8	202.417	6.84	0.28	97.1	7.64	0.057	90.5
04.075.P	AS	AS	13.7	86.2	9.4	4.3	0.47	30	9.8	57.564	4.36	0.2	9.23	4.75	0.024	39
04.088.P	AS	AS	29.5	71	21.8	7.5	0.72	31	10.1	66.51	4.27	0.22	12	5.99	0.03	44
04.096.P	AS	AS	83	16.9	42.5	40.2	2.44	30	10	172.304	4.78	0.26	72	11.1	0.064	84.1
04.118.P	AS	AS	72	27.8	55.8	15.5	2.94	28	9.9	188.667	10.1	1.05	86.9	7.26	0.057	83.3
04.120.P	AS	AS	88	10.9	54.7	32.6	2.46	29	9.9	156.267	5.98	0.3	41.2	15.6	0.087	93.1
04.128.P	AS	AS	64	34.4	47.8	16	1.68	29	11.2	124.95	7.2	0.37	75.3	4.74	0.04	37.3
04.144.P	AS	AS	76	26.7	66	10.3	2.5	28	9.2	131.553	5.99	0.49	49.8	6.22	0.053	69
04.216.P	AS	AS	22.1	78.4	15.5	6.1	0.13	30	10.5	59.214	3.33	0.22	10	4.65	0.014	41
04.224.P	AS	AS	71	29.8	45.5	24.8	2.15	30	9.8	203.408	7.08	0.26	98.9	7.81	0.058	89.3
04.248.P	AS	AS	8.4	91.4	6.6	1.8	0.22	29	10.4	30.9275	1.59	0.1	7.17	1.66	0.0075	20.4
04.296.P	AS	AS	72	27.6	38.1	34.2	2.22	30	10.3	151.328	6.29	0.26	39.3	14.6	0.078	90.8
05.013.T	AS	AS	9.3	91	6.9	2.4	2.2	30	9	40.444	2.97	0.1	5.97	3.39	0.014	28
06.013.T	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
07.013.T	AS	AS	7.9	92.1	5.9	2	NA	30	9	NA	NA	NA	NA	NA	NA	NA
08.013.T	AS	AS	11.5	88.3	9.4	2.1	0.29	30	8.3	NA	NA	NA	NA	NA	NA	NA
09.013.T	AS	AS	93.4	6.5	91.6	1.8	0.38	31	8.4	NA	NA	NA	NA	NA	NA	NA
10.013.T	AS	AS	11.8	89.3	8.7	3.1	0.28	30	9.1	42.441	3.43	0.057	6.62	3.42	0.014	28.9
11.013.T	AS	AS	9.4	90.6	7	2.4	0.24	30	NA	NA	NA	NA	NA	NA	NA	NA
12.013.T	AS	AS	25.9	74	19.5	6.4	NA	30	8.8	NA	NA	NA	NA	NA	NA	NA
13.013.T	AS	AS	10	88.7	7.5	2.5	0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS01.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13GS02.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS03.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS04.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS05.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS06.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS07.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS09.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS10.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS11.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS12.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS14.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS16.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC01.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC03.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC04.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC05.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC07.C	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15.013.T	AS	AS	NA	NA	NA	NA	NA	31	10.3	39.62	3.2	0.5	4.3	3.6	0.017	28
16.013.T	AS	AS	NA	NA	NA	NA	NA	30	11.2	NA	NA	NA	NA	NA	NA	NA
17.317.T	AS	AS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Publishable Sample Number	Total PAH	Acenaphthene (ug/kg)	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[e]pyrene	Benzo[b]fluoranthene	Benzo[ghi]perylene	Benzo[k]fluoranthene	Chrysene	Dibenzo[a,h]anthracene	Fluoranthene	Fluorene	Indeno[1,2,3-cd]pyrene	Phenanthrene
99.216.P	0.020711	1.2	1	3	6.5	6.4	8.3	12	9.8	10	9.9	1.1	22	2.4	5.8	11
99.217.P	0.023392	1.3	1.2	3.4	10	7.4	9.4	16	11	10	15	1.5	25	2.8	6.6	14
99.218.P	0.022432	0.7	1.4	2.9	6.6	8.3	9.3	15	14	11	12	1.9	21	2.6	11	13
99.220.P	0.055767	4.3	7.4	11	33	43	42	66	62	45	53	7.6	94	16	48	83
99.221.P	0.02808	1.3	3	5.3	13	20	21	33	33	25	21	3.7	37	5.6	28	30
99.224.P	0.019761	1.7	3.3	5.3	11	19	24	43	36	27	19	3.8	39	4.4	32	20
99.225.P	0	1.7	3.8	6	13	21	29	40	43	30	22	3.3	36	4.9	35	22
99.226.P	0.034572	1.9	3.6	6	12	22	27	41	41	37	21	4.5	45	5.1	36	23
01.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
02.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
03.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
04.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
04.024.P	0.083299	2.5	12	7.6	12	13	14	27	16	30	20	3.4	43	8.6	11	68
04.032.P	0.014504	0.75	2.3	3.2	7	9.5	12	10	16	14	11	3.3	20	4.2	12	19
04.048.P	0.046978	3.6	9.4	11	24	31	33	35	35	36	42	8.9	72	13	28	74
04.064.P	0.010497	0.49	1.6	2.3	4.6	6	7.4	6.4	9.6	8.6	7.2	1.9	14	2.4	7.3	13
04.075.P	0.103566	2.4	18	6.3	8.2	8	8.8	9.9	7.5	11	16	2.7	26	5.5	5.7	35
04.088.P	0.080816	3.6	17	7	7.4	7.3	8.3	8.6	9.7	10	12	2.3	36	9	6.5	44
04.096.P	0.063462	5.9	45	13	25	31	30	27	26	29	37	7.4	83	13	17	97
04.118.P	0.013737	1	2.5	3.5	7.6	9.7	15	16	21	16	12	3.5	25	2.5	16	14
04.120.P	0.04224	2.5	7.8	8.8	21	29	31	30	40	38	34	8.6	62	7.5	30	60
04.128.P	0.013058	0.71	1.3	2.1	4	5.5	5.8	8.1	9.3	7.6	8.5	1.9	14	2	7.2	9.1
04.144.P	0.012929	1.1	1.8	2.8	5.8	5.6	6.1	7	9.3	8.4	20	1	36	3.3	14	22
04.216.P	0.238133	1.6	5.4	3.4	4.2	4.2	4.8	4.9	6.3	7.8	9.6	1.8	19	5.8	4.2	29
04.224.P	0.018117	0.75	2.5	3.1	7.4	12	13	14	19	15	12	3.2	20	3.3	13	16
04.248.P	0.018756	0.09	0.26	0.52	1.1	1.1	1.3	1.5	1.5	1.1	0.73	1	2.8	0.49	1	2.2
04.296.P	0.042018	2.6	6.4	7.8	18	29	28	34	37	28	30	7.7	53	9.5	27	56
05.013.T	0.009435	0.92	7	2.9	2.3	3.5	NA	3.4	3.4	3.3	4	2	13	2	2.2	17
06.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
07.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
08.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
09.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10.013.T	0.053251	2.52	3.67	1.76	2.17	2.22	NA	3.92	3.07	2.52	2.64	1.01	9.48	2.4	2.71	11.7
11.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS01.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13GS02.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS03.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS04.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS05.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS06.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS07.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS09.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS10.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS11.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS12.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS14.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.GS16.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC01.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC03.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC04.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC05.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.KC07.C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16.013.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17.317.T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Publishable Sample Number	Pyrene	Naphthalene	PCB Aroclor 1242	PCB Aroclor 1016	Notes:
99.216.P	16	5.8	5.1	5.1	
99.217.P	20	6.2	5.3	5.3	
99.218.P	18	5.5	5.3	5.3	
99.220.P	91	33	7.4	7.4	
99.221.P	40	11	5.5	5.5	
99.224.P	40	11	5.6	5.6	
99.225.P	45	13	6	6	
99.226.P	46	14	6.4	6.4	
01.013.T	NA	NA	NA	NA	
02.013.T	NA	NA	NA	NA	
03.013.T	NA	NA	NA	NA	
04.013.T	NA	NA	NA	NA	
04.024.P	41	39	5.7	5.7	
04.032.P	20	8.8	6.1	6.1	
04.048.P	59	41	3.4	5.6	
04.064.P	14	6.6	3	3	
04.075.P	26	42	5.6	5.6	
04.088.P	33	64	5.7	5.7	
04.096.P	86	188	14	14	
04.118.P	22	11	6.4	6.4	
04.120.P	58	42	5.6	5.6	
04.128.P	14	6.6	5.6	5.6	
04.144.P	8.2	6.3	5.5	5.9	
04.216.P	18	22	5.7	5.7	
04.224.P	25	12	6.1	6.1	
04.248.P	2.6	0.97	5.4	5.4	
04.296.P	52	32	5.6	5.6	
05.013.T	13	22	13	13	
06.013.T	NA	NA	NA	NA	
07.013.T	NA	NA	NA	NA	
08.013.T	NA	NA	NA	NA	
09.013.T	NA	NA	NA	NA	
10.013.T	9.32	12.1	NA	NA	Nice series of B. frigida to B. sp
11.013.T	NA	NA	NA	NA	
12.013.T	NA	NA	NA	NA	
13.013.T	NA	NA	NA	NA	
13.GS01.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13GS02.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS03.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS04.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS05.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS06.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS07.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS09.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS10.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS11.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS12.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS14.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.GS16.C	NA	NA	NA	NA	Locations were provided on a Google Earth Map by WA Department of Ecology
13.KC01.C	NA	NA	NA	NA	at HC5 location; discard due to stop slump. Kasten Core.
13.KC03.C	NA	NA	NA	NA	drifted to shallower site; 2m core; fine muds, evidence of worms to 120cm; UW to xray. Kasten Core.
13.KC04.C	NA	NA	NA	NA	2.1m core, very fine grained, grey-green mud, few shell fx, sulfidic @ bottom. 0 after top 8 cm of core. Kasten Core.
13.KC05.C	NA	NA	NA	NA	Very short core, 67 cm. More silt than last. Kasten Core.
13.KC07.C	NA	NA	NA	NA	
15.013.T	NA	NA	NA	NA	
16.013.T	NA	NA	NA	NA	
17.317.T	NA	NA	NA	NA	

APPENDIX C

Species by Locality

Locality Number	*Ammobaculites sp. Cushman, 1910*	*Bolivinella pacifica Cushman & McCulloch, 1942*	*Buccella frigida (Cushman, 1922)*	*Buliminella elegantissima*	*(d'Orbigny, 1839)*	*Cibicides fletcheri Galloway & Wissler, 1927*	*Cibicidoides lobatulus (Walker & Jacob, 1878)*	*Cribroelphidium excavatum (Terquem, 1875)*	*Cribrostomoides subglobosa (Cushman, 1910)*	*Discorbis sp. Lamarck, 1804*	*Deuterammina rotaliformis (Heron-Allen & Earland, 1911)*	*Eggerella advena (Cushman, 1922)*	*Elphidium frigidum Cushman, 1933*	*Elphidiella hannai (Cushman & Grant, 1927)*	*Eponides repandus (Fichtel & Moll, 1798)*	*Favulina melo (d'Orbigny, 1839)*	*Fursenkoina seminuda (Natland, 1938)*
85.001.SCC	X		X					X						X			
85.002.SCC			X	X	X		X	X						X			
85.003.SCC			X					X						X			
85.004.SCC			X					X			X	X		X			
85.005.SCC			X	X				X						X			
85.006.SCC			X	X			X	X	X			X		X			
85.007.SCC			X	X				X			X	X		X			
85.008.SCC			X				X	X			X			X			
85.009.SCC			X					X		X	X			X			
85.010.SCC			X	X				X			X	X		X			
85.011.SCC			X	X				X			X	X		X			
85.012.SCC			X	X				X			X	X		X			
85.013.SCC			X	X			X	X	X	X	X	X		X			
85.021.SCC								X		X				X			
85.022.SCC			X					X	X		X						
85.023.SCC			X	X			X	X						X			
85.024.SCC			X	X				X	X		X	X					
85.025.SCC			X	X					X		X	X		X			
85.026.SCC			X	X						X	X	X		X			
85.027.SCC	X		X	X							X	X		X			
85.028.SCC			X	X					X		X	X		X			
85.029.SCC	X		X				X	X						X			
92.001.SCC	X		X	X				X			X	X		X			
92.002.SCC	X		X	X				X	X		X	X		X			
92.004.SCC	X		X	X				X	X		X			X			
92.005.SCC	X		X	X				X			X	X					
92.006.SCC			X					X	X								
92.007.SCC	X		X					X									
92.008.SCC			X	X				X			X	X					
92.009.SCC	X		X	X				X			X	X		X			
92.010.SCC	X		X	X				X									
92.011.SCC	X		X	X				X	X		X	X					
92.012.SCC	X		X	X				X	X		X	X		X			
92.013.SCC	X		X	X		X		X	X		X	X		X			
92.014.SCC	X		X					X									
92.015.SCC	X		X	X				X	X			X					
92.016.SCC	X		X	X				X			X	X					
92.017.SCC	X		X	X				X			X	X		X			

Locality Number	*Glabratella californiana Lankford, 1973*	*Globobulimina pacifica Cushman, 1927*	*Haplophragmoides planissima Cushman, 1927*	*Labrospira columbiensis (Cushman, 1925)*	*Lagena striata (d'Orbigny, 1839)*	*Lagenammina arenulata (Skinner, 1961)*	*Miliammina fusca (Brady, 1870)*	*Nonionella basispinata (Cushman & Moyer, 1930)*	*Nonionella stella Cushman & Moyer, 1930*	*Psammosphaera fusca Schulze, 1875*	*Quinqueloculina vulgaris d'Orbigny, 1826*	*Reophax advena Cushman, 1919*	*Rotaliammina squamiformis (Cushman & McCulloch, 1939)*	*Spiroplectammina biformis (Parker & Jones, 1865)*	*Trochammina hadai Uchio, 1962*	*Trochammina inflata (Montagu, 1808)*	*Trochammina pacifica Cushman, 1923*	*Uvigerina peregrina Cushman, 1923*
85.001.SCC							X								X			
85.002.SCC								X					X		X			
85.003.SCC															X			
85.004.SCC						X	X							X		X		
85.005.SCC			X			X												
85.006.SCC		X				X							X	X				
85.007.SCC						X	X						X	X	X	X		
85.008.SCC															X			
85.009.SCC																		
85.010.SCC						X									X	X		
85.011.SCC						X						X		X		X		
85.012.SCC			X			X								X		X		
85.013.SCC					X	X												
85.021.SCC							X								X			
85.022.SCC				X		X	X				X				X	X	X	
85.023.SCC							X		X					X	X	X		
85.024.SCC				X		X	X		X									
85.025.SCC				X		X						X		X		X		
85.026.SCC				X					X					X		X		
85.027.SCC						X	X		X						X	X		
85.028.SCC						X										X		
85.029.SCC				X			X				X				X			
92.001.SCC						X	X		X	X		X	X	X			X	
92.002.SCC			X	X	X	X	X		X			X	X	X		X		
92.004.SCC			X			X	X										X	
92.005.SCC						X			X			X				X		
92.006.SCC			X			X	X									X		
92.007.SCC						X	X							X		X		
92.008.SCC						X			X									
92.009.SCC				X		X			X	X			X	X	X	X		
92.010.SCC							X									X		
92.011.SCC			X	X		X	X		X	X			X	X		X	X	
92.012.SCC				X		X			X	X				X			X	
92.013.SCC				X		X	X		X			X	X	X	X	X	X	
92.014.SCC				X			X									X	X	
92.015.SCC	X			X		X	X			X				X			X	
92.016.SCC						X	X		X	X				X			X	
92.017.SCC						X	X						X	X			X	

Locality Number	*Ammobaculites sp. Cushman, 1910*	*Bolivinella pacifica Cushman & McCulloch, 1942*	*Buccella frigida (Cushman, 1922)*	*Buliminella elegantissima*	*(d'Orbigny, 1839)*	*Cibicides fletcheri Galloway & Wissler, 1927*	*Cibicidoides lobatulus (Walker & Jacob, 1878)*	*Cribroelphidium excavatum (Terquem, 1875)*	*Cribrostomoides subglobosa (Cushman, 1910)*	*Discorbis sp. Lamarck, 1804*	*Deuterammina rotaliformis (Heron-Allen & Earland, 1911)*	*Eggerella advena (Cushman, 1922)*	*Elphidium frigidum Cushman, 1933*	*Elphidiella hannai (Cushman & Grant, 1927)*	*Eponides repandus (Fichtel & Moll, 1798)*	*Favulina melo (d'Orbigny, 1839)*	*Fursenkoina seminuda (Natland, 1938)*
96.015.SCC			X	X			X	X			X	X		X			
96.017.SCC			X	X				X						X			
96.018.SCC			X					X			X			X			
96.019.SCC			X	X				X				X		X			
96.020.SCC			X	X				X			X	X		X			
96.022.SCC			X	X				X			X	X		X			
98.013.PSEMP			X	X				X			X	X		X			
99.013.PSEMP			X	X				X			X	X		X			
99.206.PSEMP			X					X			X	X		X			
99.207.PSEMP			X	X				X			X	X		X			
99.208.PSEMP			X	X				X			X	X		X			
99.210.PSEMP			X	X	X	X		X	X		X	X		X		X	
99.211.PSEMP			X	X	X	X		X			X	X	X	X		X	
99.212.PSEMP			X								X	X					
99.213.PSEMP			X					X						X			
99.214.PSEMP								X			X	X		X			
99.215.PSEMP	X	X	X	X				X	X		X	X			X		X
99.216.PSEMP	X	X	X	X				X	X			X		X			
99.217.PSEMP	X		X	X				X	X		X	X	X	X			
99.218.PSEMP																	
99.220.PSEMP		X	X	X				X						X			
99.221.PSEMP			X					X									
99.224.PSEMP																	
99.225.PSEMP			X					X						X			
99.226.PSEMP	X		X	X				X			X	X					
01.013.PSEMP			X	X		X		X			X	X		X			
02.013.PSEMP			X	X				X				X		X			
03.013.PSEMP			X	X				X			X	X		X			
04.013.PSEMP			X	X				X			X	X		X			
04.024.PSEMP	X			X					X		X	X					
04.032.PSEMP																	
04.048.PSEMP			X	X				X				X					
04.064.PSEMP	X								X		X	X					
04.075.PSEMP			X	X		X		X			X	X		X		X	
04.088.PSEMP		X	X	X		X		X	X		X	X		X		X	
04.096.PSEMP			X	X				X	X			X					
04.118.PSEMP			X									X					

Locality Number	*Glabratella californiana Lankford, 1973*	*Globobulimina pacifica Cushman, 1927*	*Haplophragmoides planissima Cushman, 1927*	*Labrospira columbiensis (Cushman, 1925)*	*Lagena striata (d'Orbigny, 1839)*	*Lagenammina arenulata (Skinner, 1961)*	*Miliammina fusca (Brady, 1870)*	*Nonionella basispinata (Cushman & Moyer, 1930)*	*Nonionella stella Cushman & Moyer, 1930*	*Psammosphaera fusca Schulze, 1875*	*Quinqueloculina vulgaris d'Orbigny, 1826*	*Reophax advena Cushman, 1919*	*Rotaliammina squamiformis (Cushman & McCulloch, 1939)*	*Spiroplectammina biformis (Parker & Jones, 1865)*	*Trochammina hadai Uchio, 1962*	*Trochammina inflata (Montagu, 1808)*	*Trochammina pacifica Cushman, 1923*	*Uvigerina peregrina Cushman, 1923*
96.015.SCC						X					X							
96.017.SCC			X	X		X			X		X	X		X				
96.018.SCC														X				
96.019.SCC			X	X		X	X								X			
96.020.SCC			X			X	X					X		X				
96.022.SCC	X						X								X	X		
98.013.PSEMP			X			X			X		X			X				
99.013.PSEMP					X				XX		X		X	X				
99.206.PSEMP	X									X			X					
99.207.PSEMP	X					X							X					
99.208.PSEMP						X	X						X		X		X	
99.210.PSEMP	X				X	X		X						X				
99.211.PSEMP	X				X	X		X			X			X				
99.212.PSEMP						X									X		X	
99.213.PSEMP																	X	
99.214.PSEMP	X		X			X							X				X	
99.215.PSEMP	X		X	X			X			X			X	X		X		
99.216.PSEMP	X		X			X	X		X	X				X		X	X	
99.217.PSEMP	X		X			X			X				X		X	X	X	
99.218.PSEMP																		
99.220.PSEMP	X												X					
99.221.PSEMP	X												X					
99.224.PSEMP																		
99.225.PSEMP	X		X			X			X				X					
99.226.PSEMP	X									X			X	X				
01.013.PSEMP				X		X	X		X				X			X	X	
02.013.PSEMP		X				X			X				X	X			X	
03.013.PSEMP	X		X			X			X				X	X			X	
04.013.PSEMP	X			X		X			X		X		X	X				
04.024.PSEMP	X					X	X						X	X	X	X		
04.032.PSEMP																		
04.048.PSEMP	X																	
04.064.PSEMP				X		X	X			X				X		X		
04.075.PSEMP	X					X		X	X				X	X	X		X	
04.088.PSEMP						X			X					X				X
04.096.PSEMP							X					X	X	X			X	
04.118.PSEMP				X		X			X				X				X	

Locality Number	*Ammobaculites sp. Cushman, 1910*	*Bolivinella pacifica Cushman & McCulloch, 1942*	*Buccella frigida (Cushman, 1922)*	*Buliminella elegantissima (d'Orbigny, 1839)*	*Cibicides fletcheri Galloway & Wissler, 1927*	*Cibicidoides lobatulus (Walker & Jacob, 1878)*	*Cribroelphidium excavatum (Terquem, 1875)*	*Cribrostomoides subglobosa (Cushman, 1910)*	*Discorbis sp. Lamarck, 1804*	*Deuterammina rotaliformis (Heron-Allen & Earland, 1911)*	*Eggerella advena (Cushman, 1922)*	*Elphidium frigidum Cushman, 1933*	*Elphidiella hannai (Cushman & Grant, 1927)*	*Eponides repandus (Fichtel & Moll, 1798)*	*Favulina melo (d'Orbigny, 1839)*	*Fursenkoina seminuda (Natland, 1938)*
04.120.PSEMP			X	X				X			X					
04.128.PSEMP			X	X				X		X	X					
04.144.PSEMP																
04.216.PSEMP	X		X	X			X	X		X	X					
04.224.PSEMP	X		X					X		X	X					
04.248.PSEMP	X					X		X		X	X					
04.296.PSEMP			X		X		X	X		X	X					
05.013.PSEMP			X	X	X		X			X	X		X		X	
06.013.PSEMP			X	X			X			X	X		X			
07.013.PSEMP			X	X			X			X	X		X			
08.013.PSEMP			X	X			X				X		X			
09.013.PSEMP			X	X			X			X	X	X	X			
10.013.PSEMP			X	X			X			X	X		X		X	
11.013.PSEMP			X	X	X		X			X	X		X		X	
12.013.PSEMP			X	X	X		X	X		X	X		X			
13.013.PSEMP			X	X	X		X			X	X		X			
13.GS01.USGS			X	X	X		X	X	X	X	X		X			
13GS02.USGS			X	X	X		X	X		X	X		X			
13.GS03.USGS		X	X	X	X		X	X		X	X	X	X			
13.GS04.USGS			X	X			X	X			X					
13.GS05.USGS	X		X	X			X	X		X	X		X			
13.GS06.USGS			X	X			X	X		X	X					
13.GS07.USGS	X		X	X			X	X		X	X					
13.GS09.USGS	X		X	X			X	X		X		X	X			
13.GS10.USGS	X		X	X			X	X		X	X	X	X			
13.GS11.USGS	X		X	X			X	X		X	X		X			
13.GS12.USGS	X		X	X			X	X			X		X			
13.GS14.USGS	X		X	X			X			X						
13.GS16.USGS	X		X	X			X			X	X					
13.KC01.USGS			X	X	X		X			X	X		X			
13.KC03.USGS			X	X	X		X			X	X		X			
13.KC04.USGS			X	X			X					X	X			
13.KC05.USGS			X	X	X		X			X	X		X			
13.KC07.USGS				X			X									
15.013.PSEMP			X	X	X		X			X	X		X			
16.013.PSEMP			X	X			X			X	X		X			
17.317.PSEMP	X		X	X			X			X	X		X			

Locality Number	*Glabratella californiana Lankford, 1973*	*Globobulimina pacifica Cushman, 1927*	*Haplophragmoides planissima Cushman, 1927*	*Labrospira columbiensis (Cushman, 1925)*	*Lagena striata (d'Orbigny, 1839)*	*Lagenammina arenulata (Skinner, 1961)*	*Miliammina fusca (Brady, 1870)*	*Nonionella basispinata (Cushman & Moyer, 1930)*	*Nonionella stella Cushman & Moyer, 1930*	*Psammosphaera fusca Schulze, 1875*	*Quinqueloculina vulgaris d'Orbigny, 1826*	*Reophax advena Cushman, 1919*	*Rotaliammina squamiformis (Cushman & McCulloch, 1939)*	*Spiroplectammina biformis (Parker & Jones, 1865)*	*Trochammina hadai Uchio, 1962*	*Trochammina inflata (Montagu, 1808)*	*Trochammina pacifica Cushman, 1923*	*Uvigerina peregrina Cushman, 1923*
04.120.PSEMP													X	X				
04.128.PSEMP				X		X	X						X				X	
04.144.PSEMP																		
04.216.PSEMP	X		X	X		X	X		X				X	X	X	X	X	
04.224.PSEMP			X			X							X	X			X	
04.248.PSEMP	X		X			X	X						X	X	X	X	X	
04.296.PSEMP									X					X			X	X
05.013.PSEMP					X	X			X		X		X	X				
06.013.PSEMP				X		X			X				X	X		X		X
07.013.PSEMP				X		X			X				X	X				
08.013.PSEMP						X			X		X		X	X				
09.013.PSEMP				X		X								X				
10.013.PSEMP				X		X			X				X	X				
11.013.PSEMP				X		X	X		X		X		X	X				
12.013.PSEMP				X	X	X							X	X		X	X	
13.013.PSEMP						X			X					X			X	
13.GS01.USGS		X		X	X	X			X		X		X	X			X	
13GS02.USGS		X		X					X			X	X			X		
13.GS03.USGS				X					X		X	X	X	X		X		
13.GS04.USGS				X		X							X	X				
13.GS05.USGS			X	X		X	X		X		X		X	X		X		
13.GS06.USGS				X		X			X		X		X					
13.GS07.USGS				X		X	X		X			X	X	X		X	X	
13.GS09.USGS			X	X		X	X		X			X	X	X		X	X	
13.GS10.USGS						X	X		X	X			X	X		X	X	
13.GS11.USGS		X		X	X	X	X		X	X			X	X		X		
13.GS12.USGS			X	X		X			X							X		
13.GS14.USGS									X									
13.GS16.USGS				X		X	X		X				X	X		X	X	
13.KC01.USGS		X	X	X	X	X			X				X	X			X	
13.KC03.USGS		X		X	X				X		X		X	X				
13.KC04.USGS				X					X		X							
13.KC05.USGS					X				X		X	X						
13.KC07.USGS									X		X							
15.013.PSEMP						X	X				X		X	X				
16.013.PSEMP				X		X								X		X		
17.317.PSEMP	X		X	X		X		X		X	X		X	X			X	X

APPENDIX D

Statistical Data Set

Publishable Sample Number	Density	Species Richness	Simpsons Index	Shannon Index	Equitability	% Agglutinates	% Dissolution Effects	% Fines	% TOC	Salinity	Temperature	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper (Cu) (mg/kg)	Lead (Pb) (mg/kg)	Mercury (Hg)(mg/kg)	Zinc (Zn) (mg/kg)	Total PAH
99.206.P	8	8	0.16	2.82	1.36	33.33	10	84	0.58	30	11	128	5.92	0.5	28.8	14.1	0.07	78.2	0.79
99.207.P	42	9	0.24	2.36	1.08	45.24	24.74	12.6	0.36	30	12	27.5	2.8	0.2	1.5	3.93	0.02	19.1	0.94
99.208.P	42	11	0.60	1.42	0.59	10.59	44.21	11.5	2.3	30	14	26.4	4.37	0.31	1.5	2.15	0.02	18	0.12
99.210.P	173	15	0.30	2.51	0.93	13.00	35.68	19.6	0.48	30	11	58.5	3.91	0.13	7.73	4.77	0.02	41.9	0.11
99.211.P	6060	17	0.20	2.69	0.95	6.11	41.65	4.7	0.26	31	11.5	43.1	4.69	0.12	4	3.6	0.02	30.7	0.04
99.212.P	0	6	0.32	2.02	1.13	97.62	0	10.7	0.53	30	12	30.8	2.3	0.33	2.8	2.81	0.02	22.5	0.59
99.213.P	19	4	0.36	1.55	1.12	0.39	0	7.9	0.37	30	13.5	20.6	2	0.31	0.75	2.18	0.02	15.3	0.45
99.214.P	49	9	0.42	1.72	0.78	86.29	0	67	4.4	30	12	122	7.59	1.04	28.4	15.2	0.08	69.6	0.74
99.215.P	195	18	0.13	3.31	1.15	71.58	71.08	71	3.4	25	11	160	7.77	0.36	73.3	5.87	0.06	72.3	0.02
99.216.P	65	17	0.16	3.03	1.07	58.36	50.34	30.4	1.3	27	12	114	6.3	0.18	44.4	3.59	0.03	59.3	0.02
99.217.P	113	17	0.14	3.23	1.14	45.59	30.28	39.6	1.4	30	11	119	7.16	0.13	46.4	4.33	0.04	60.8	0.02
99.218.P		0	0	0	0	0	0	69.6	1.4	29	11	78.9	4.75	0.35	21.3	5.43	0.04	47	0.02
99.220.P	200	7	0.23	2.39	1.23	5.00	73.68	91	2.7	27	12	150	5.96	0.12	41.5	19.2	0.09	82.8	0.06
99.221.P	50	4	0.30	1.85	1.33	40.00	100	85	2.4	25	12	196	6.55	0.28	90.2	10.8	0.08	88.3	0.03
99.224.P	0	0	0	0	0	0	0	81	2	25	11	208	8.11	0.19	110	7.13	0.05	82.3	0.02
99.225.P	165	8	0.18	2.64	1.27	42.42	26.32	60	3.8	24	11.5	215	14.6	1.49	99.7	11.4	0.07	88.2	0
99.226.P	720	10	0.63	1.38	0.60	15.28	72.13	72		25	11.5	208	17.4	1.78	92.5	12	0.06	84.4	0.03
04.024.P	25	12	0.30	2.16	0.87	96.76	16.67	49.1	0.9	31	10.1	82.9	4.2	0.26	14.6	7.27	0.04	56.5	0.08
04.032.P		0	0	0	0	0	0	73	2.43	30	9.4	134	6.3	0.29	37.6	12.1	0.07	77.7	0.01
04.048.P	400	5	0.55	1.31	0.82	5.00	42.11	80	2.41	30	10.3	144	5.32	0.29	33.2	14.5	0.07	90.7	0.05
04.064.P	2040	10	0.17	2.85	1.24	100.0	0	58	2.2	30	9.8	202	6.84	0.28	97.1	7.64	0.06	90.5	0.01
04.075.P	141	16	0.28	2.46	0.89	15.01	49.0	13.7	0.47	30	9.8	57.6	4.36	0.2	9.23	4.75	0.02	39	0.1
04.088.P	26	14	0.18	2.79	1.06	61.99	23.1	29.5	0.72	31	10.1	66.5	4.27	0.22	12	5.99	0.03	44	0.08
04.096.P	1820	10	0.22	2.55	1.11	78.57	0	83	2.44	30	10	172	4.78	0.26	72	11.1	0.06	84.1	0.06
04.118.P	8	7	0.23	2.42	1.24	90.48	0	72	2.94	28	9.9	189	10.1	1.05	86.9	7.26	0.06	83.3	0.01
04.120.P	370	6	0.91	0.38	0.21	98.65	50	88	2.46	29	9.9	156	5.98	0.3	41.2	15.6	0.09	93.1	0.04
04.128.P	3	10	0.29	2.36	1.02	93.33	0	64	1.68	29	11.2	125	7.2	0.37	75.3	4.74	0.04	37.3	0.01
04.144.P		0	0	0	0	0	0	76	2.5	28	9.2	132	5.99	0.49	49.8	6.22	0.05	69	0.01
04.216.P	332	18	0.21	2.96	1.02	85.95	35.71	22.1	0.13	30	10.5	59.2	3.33	0.22	10	4.65	0.01	41	0.24
04.224.P	664	10	0.73	0.97	0.42	99.40	50	71	2.15	30	9.8	203	7.08	0.26	98.9	7.81	0.06	89.3	0.02
04.248.P	7	14	0.16	2.98	1.13	98.60	50	8.4	0.22	29	10.4	30.9	1.59	0.1	7.17	1.66	0.01	20.4	0.02
04.296.P	30	10	0.28	2.42	1.05	22.39	31.73	72	2.22	30	10.3	151	6.29	0.26	39.3	14.6	0.08	90.8	0.04

Publishable Sample Number	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	Discorbis sp.	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus	F. basispinatum	F. cf seminuda	G. californiana Lankford
99.206.P	0	0	3	0	0	0	0	3	0	1	1	1	0	1	0	0	0	3
99.207.P	0	0	89	15	0	0	0	65	0	23	4	4	0	19	0	0	0	2
99.208.P	0	0	25	1	0	0	0	28	0	9	5	6	0	326	0	0	0	0
99.210.P	0	0	8	17	1	3	0	138	0	13	0	14	0	53	0	7	0	4
99.211.P	0	0	135	1	27	27	0	169	0	1	0	26	52	146	0	2	0	2
99.212.P	0	0	1	0	0	0	0	0	0	9	0	3	0	0	0	0	0	0
99.213.P	0	0	113	0	0	0	0	52	0	0	0	0	0	93	0	0	0	0
99.214.P	0	0	0	0	0	0	0	9	0	5	1	1	0	17	0	0	0	1
99.215.P	63	21	9	2	0	0	0	1	0	3	13	44	0	0	36	0	13	1
99.216.P	6	1	1	3	0	0	0	87	0	0	0	54	0	46	0	0	0	2
99.217.P	3	0	16	9	0	0	0	61	0	51	4	19	1	47	0	0	0	1
99.218.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.220.P	0	1	14	9	0	0	0	7	0	0	2	0	0	5	0	0	0	2
99.221.P	0	0	3	0	0	0	0	2	0	0	4	0	0	0	0	0	0	1
99.224.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.225.P	0	0	18	0	0	0	0	11	0	0	7	0	0	7	0	0	0	1
99.226.P	2	0	1	2	0	0	0	57	0	2	1	3	0	0	0	0	0	1
04.024.P	3	0	0	1	0	0	0	0	0	7	21	68	0	0	0	0	0	5
04.032.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.048.P	0	0	6	2	0	0	0	29	0	0	0	2	0	0	0	0	0	1
04.064.P	5	0	0	0	0	0	0	0	0	15	0	61	0	0	0	0	0	0
04.075.P	0	0	89	3	0	34	0	159	0	11	2	18	0	1	0	1	0	3
04.088.P	0	1	33	3	0	1	0	18	0	22	0	37	0	3	0	0	0	0
04.096.P	0	0	5	25	0	0	0	9	0	0	4	54	0	0	0	0	0	0
04.118.P	0	0	1	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0
04.120.P	0	0	1	1	0	0	0	0	0	0	1	141	0	0	0	0	0	0
04.128.P	0	0	1	2	0	0	0	0	0	3	1	11	0	0	0	0	0	0
04.144.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.216.P	1	0	1	11	0	0	0	24	0	19	1	122	0	0	0	0	0	3
04.224.P	1	0	2	0	0	0	0	0	0	13	3	282	0	0	0	0	0	0
04.248.P	3	0	0	0	0	0	1	0	0	37	3	13	0	0	0	0	0	1
04.296.P	0	0	65	0	0	8	0	7	0	4	0	12	0	0	0	0	0	0

Publishable Sample Number	G. pacifica	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena	T. bellatulla	S. biformis	T. hadai	T. inflata	T. pacifica	U. peregrina
99.206.P	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
99.207.P	0	0	0	0	0	126	0	0	0	0	0	0	0	0	0	0	0	0
99.208.P	0	0	0	0	0	2	15	0	0	0	0	0	0	0	1	0	7	0
99.210.P	0	0	0	6	6	1	0	0	4	0	0	0	0	2	0	0	0	0
99.211.P	0	0	0	0	3	4	0	0	3	0	1	0	1	6	0	0	0	0
99.212.P	0	0	0	0	0	21	0	0	0	0	0	0	0	0	4	0	4	0
99.213.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
99.214.P	0	0	119	0	0	43	0	0	0	0	0	0	0	0	0	0	1	0
99.215.P	0	9	5	1	0	0	19	0	0	1	0	0	0	49	0	2	0	0
99.216.P	0	0	74	19	0	9	6	7	0	1	0	0	0	32	0	3	2	0
99.217.P	0	0	15	1	0	4	0	7	0	0	0	0	0	0	13	5	4	0
99.218.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.220.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.221.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.224.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99.225.P	0	0	8	0	0	13	0	1	0	0	0	0	0	0	0	0	0	0
99.226.P	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0
04.024.P	0	0	0	1	0	1	2	0	0	0	0	0	0	72	1	3	0	0
04.032.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.048.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.064.P	0	32	0	21	0	15	4	0	0	2	0	0	0	34	0	15	0	0
04.075.P	0	0	0	0	0	3	0	5	5	0	0	0	0	8	2	0	9	0
04.088.P	0	0	0	2	0	1	0	3	1	0	0	0	0	44	0	0	0	2
04.096.P	0	0	0	21	0	0	2	0	0	0	0	1	0	55	0	0	6	0
04.118.P	0	3	0	0	0	8	0	1	0	0	0	0	0	0	0	0	1	0
04.120.P	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0
04.128.P	0	1	0	2	0	21	1	0	0	0	0	0	0	0	0	0	2	0
04.144.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04.216.P	0	2	9	5	0	28	3	3	0	0	0	0	0	32	7	1	27	0
04.224.P	0	0	1	1	0	8	0	0	0	0	0	0	0	19	0	0	2	0
04.248.P	0	0	5	8	0	14	1	0	0	0	0	0	0	19	1	3	34	0
04.296.P	0	0	0	6	0	0	0	1	0	0	0	0	0	6	0	0	2	23

APPENDIX E

Linear Regressions Across the Entire Statistical Data Set

Species	Test	% Agglutinates	% Dissolution Effects	% Fines	Salinity	Temperature	%TOC	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper	Lead	Mercury (Hg) (mg/kg)	Zinc (Zn) (mg/kg)	Total PAH
Ammobaculites sp.	p value	0.373	0.1026	0.623	0.0504	0.981	0.18	0.487	0.579	0.879	0.343	0.532	0.618	0.662	0.494
	t test	0.904	1.684	0.496	-2.039	-0.024	1.374	0.703	0.56	-0.154	0.963	-0.632	0.504	0.442	-0.693
	R^2 value	-0.0059	0.0559	-0.0249	0.0924	-0.0333	0.0287	-0.0166	-0.0226	-0.0325	-0.0024	-0.0198	-0.0247	-0.0267	-0.0171
B. pacifica	p value	0.5482	0.0961	0.5355	0.0464	0.93	0.146	0.536	0.63	0.863	0.42	0.697	0.507	0.68	0.57
	t test	0.607	1.718	0.627	-2.078	0.088	1.496	0.626	0.487	-0.173	0.818	-0.393	0.672	0.417	-0.575
	R^2 value	-0.0208	0.0592	-0.02	0.0967	-0.0331	0.0396	-0.02	-0.0252	-0.0323	-0.0108	-0.028	-0.018	-0.0274	-0.0221
B. frigida	p value	0.0314	0.8121	0.0013	0.0934	0.101	0.0229	0.0056	0.1134	0.2641	0.113	0.1263	0.0272	0.0075	0.1961
	t test	-2.258	0.24	-3.562	1.733	1.694	-0.2402	-2.982	-1.631	-1.138	-2.699	-1.573	-2.322	-2.87	1.322
	R^2 value	0.1168	-0.0314	0.2738	0.0607	0.0569	0.1372	0.2029	0.0508	0.0094	0.1686	0.0454	0.1241	0.1892	0.0236
B. elegantissima	p value	0.8913	0.9217	0.519	0.308	0.918	0.3012	0.428	0.2235	0.1812	0.4318	0.88	0.412	0.5465	0.4934
	t test	0.138	0.099	-0.653	1.038	-0.104	-1.053	-0.785	-1.243	-1.369	-0.797	-0.152	-0.832	-0.61	0.693
	R^2 value	-0.0327	-0.033	-0.0189	0.0025	-0.033	0.0036	-0.0125	0.0173	0.0274	-0.0119	-0.0325	-0.01	-0.0207	-0.017
C. limbata	p value	0.271	0.641	0.0906	0.275	0.63	0.1837	0.213	0.642	0.467	0.254	0.343	0.1777	0.228	0.654
	t test	-1.121	0.471	-1.748	1.112	0.487	-1.362	-1.271	-0.47	-0.737	-1.162	-0.963	-1.38	-1.23	-0.453
	R^2 value	0.0082	-0.0257	0.0622	0.0076	-0.0252	0.0277	0.0195	-0.0258	-0.0149	0.0112	-0.0023	0.0284	0.0163	-0.0263
C. fletcheri	p value	0.1288	0.372	0.0366	0.193	0.524	0.0861	0.125	0.449	0.3368	0.1159	0.363	0.1358	0.2008	0.6054
	t test	-1.562	0.907	-2.189	1.332	-0.645	-1.777	-1.577	-0.766	-0.976	-1.619	-0.923	-1.533	-1.308	-0.522
		0.0444	-0.0058	0.1089	0.0244	-0.0192	0.0671	0.0458	-0.0135	-0.0015	0.0497	-0.0048	0.0417	0.0224	-0.024
C. lobatulus	p value	0.184	0.446	0.13	0.939	0.6192	0.186	0.159	0.1574	0.451	0.312	0.1788	0.0852	0.1131	0.6087
	t test	1.36	0.772	-1.557	0.077	-0.502	-1.355	-1.443	-1.45	-0.764	-1.028	-1.377	-1.78	-1.632	-0.517
	R^2 value	0.0267	-0.0132	0.0439	-0.0331	-0.0247	0.0271	0.0337	0.0343	-0.0136	0.0018	0.0281	0.0654	0.051	-0.0242
C. excavatum	p value	0.0339	0.19	0.0003	0.251	0.339	0.0061	0.0154	0.484	0.4094	0.0253	0.05	0.0057	0.021	0.8926
	t test	-2.223	1.341	-4.034	1.172	0.971	-2.956	-2.57	-0.708	-0.837	-2.355	-2.042	-2.977	-2.435	0.136
	R^2 value	0.1128	0.0251	0.3301	0.0119	-0.0018	0.205	0.1531	-0.0163	-0.0098	0.1279	0.0928	0.2024	0.1372	-0.0327
D. rotaliformis	p value	0.11	0.7234	0.0044	0.0581	0.68	0.0238	0.0457	0.1179	0.1006	0.1369	0.0142	0.004	0.034	0.6696
	t test	1.649	0.357	-3.081	1.97	-0.416	-2.386	-2.185	-1.61	-1.694	-1.528	-2.603	-3.122	-2.221	0.431
		0.0525	-0.029	0.215	0.0851	-0.0274	0.1353	0.0975	0.0488	0.0569	0.0413	0.1571	0.22	0.1126	-0.027
D. squamiformis	p value	0.0818	0.326	0.8612	0.49	0.939	0.458	0.823	0.734	0.7875	0.7579	0.7355	0.894	0.891	0.6295
	t test	1.801	0.999	0.176	-0.698	-0.077	0.751	0.226	0.343	0.272	0.311	-0.341	0.135	0.138	-0.487
	R^2 value	0.0675	-3.8E-05	-0.0323	-0.0168	-0.0331	-0.0147	-0.0316	-0.0293	-0.0308	-0.03	-0.0294	-0.0327	-0.0327	-0.0252
E. advena	p value	0.0025	0.31	0.681	0.274	0.0551	0.9051	0.294	0.745	0.2842	0.294	0.995	0.832	0.244	0.3257
	t test	3.3	1.034	0.415	1.114	-1.996	-0.12	1.068	-0.328	-1.09	1.067	-0.006	0.214	1.188	-0.999
		0.2419	0.0022	-0.0274	0.0077	0.0878	-0.034	0.0045	-0.0296	0.0061	0.0045	-0.0333	-0.0318	0.0131	-5.5E-05
E. frigidum	p value	0.286	0.647	0.0975	0.28	0.63	0.196	0.227	0.665	0.3474	0.271	0.348	0.118	0.239	0.651
	t test	-1.087	0.463	-1.71	1.101	0.486	-1.324	-1.233	-0.428	-0.725	-1.121	-0.953	-1.348	-1.201	-0.457
	R^2 value	0.0058	-0.026	0.0585	0.0068	-0.0253	0.0245	0.0165	-0.0268	-0.0155	0.0082	-0.003	0.0257	0.0141	-0.0262
E. hannai	p value	0.0883	0.608	0.0049	0.248	1E-04	0.594	0.0115	0.299	0.4803	0.0397	0.035	0.0321	0.0062	0.9088
	t test	-1.761	0.519	-3.037	1.177	4.497	-0.54	-2.692	-1.057	-0.715	-2.151	-2.208	-2.248	-2.947	0.116
	R^2 value	0.0635	-0.0242	0.2096	0.0123	0.3827	-0.0242	0.1677	0.0038	-0.016	0.1047	0.1111	0.1156	0.1986	-0.0329
E. repandus	p value	0.535	0.121	0.529	0.0512	0.971	0.141	0.523	0.612	0.927	0.397	0.661	0.522	0.682	0.608
	t test	0.628	1.596	0.636	-2.031	0.036	1.515	0.646	0.513	-0.092	0.86	-0.443	0.648	0.413	-0.518
	R^2 value	-0.0199	0.0476	-0.0196	0.0915	-0.0333	0.0414	-0.0191	-0.0243	-0.033	-0.0085	-0.0266	-0.0191	-0.0275	-0.0242
F. basispinatum	p value	0.203	0.646	0.0822	0.354	0.98	0.115	0.16	0.392	0.358	0.159	0.317	0.1362	0.244	0.767
	t test	-1.302	0.464	-1.798	0.941	0.025	-1.625	-1.44	-0.868	-0.934	-1.443	-1.018	-1.531	-1.189	-0.299
	R^2 value	0.0219	-0.026	0.0672	-0.0037	-0.0333	0.0518	0.0335	-0.008	-0.0042	0.0338	0.0012	0.0416	0.0132	-0.0303
F. cf seminuda	p value	0.535	0.121	0.529	0.0512	0.971	0.141	0.5233	0.6122	0.927	0.397	0.661	0.522	0.682	0.608
	t test	0.628	1.596	0.636	-2.031	0.036	1.515	0.646	0.513	-0.092	0.86	-0.443	0.648	0.413	-0.518
	R^2 value	-0.0199	-0.0196	0.0915	-0.0333	-0.0333	0.0414	-0.0191	-0.0243	-0.033	-0.0085	-0.0266	-0.0191	-0.0275	-0.0242
G. californiana	p value	0.8958	0.1512	0.125	0.423	0.955	0.0182	0.0886	0.347	0.4665	0.0314	0.8244	0.1911	0.2986	0.264
	t test	-0.132	1.473	-1.578	0.812	0.057	-2.502	-1.76	-0.956	-0.738	-2.258	-0.222	-1.338	-1.058	1.138
	R^2 value	-0.0327	0.0363	0.0459	-0.0111	-0.0332	0.1492	0.0634	-0.0028	-0.0149	0.1167	-0.0316	0.0248	0.0038	0.0095

Species	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
Ammobaculites sp.		2E-16	0.628	0.788	0.8012	0.6802	0.98	0.5853	0.9057	0.008	0.7024	0.8086	0.681	2.2E-16
		38.097	-0.489	-0.271	-0.0254	-0.416	0.025	-0.552	-0.119	2.844	0.386	-0.244	-0.416	38.627
		0.9791	-0.0252	-0.0308	-0.0311	-0.0274	-0.0333	-0.023	-0.0328	0.1861	0.1861	-0.0313	-0.0274	0.9796
B. pacifica	2E-16		0.752	0.854	0.835	0.738	0.841	0.57	0.688	0.0141	0.828	0.838	0.7	2.0E-16
	38.097		-0.319	-0.185	-0.21	0.338	-0.202	-0.574	-0.406	2.605	0.22	-0.206	-0.389	68.457
	0.9791		-0.0298	-0.0322	-0.0318	-0.0294	-0.0319	-0.0221	-0.0277	0.1573	-0.0317	-0.0319	-0.0281	0.9934
B. frigida	0.628	0.752		0.8085	0.0006	2E-05	0.5847	7E-05	0.864	0.5196	0.3814	0.00055	0.0386	0.76411
	-0.489	-0.319		0.245	3.851	5.015	-0.553	4.605	0.172	-0.652	-0.888	3.869	2.164	-0.303
	-0.0252	-0.0298		-0.0313	0.3085	0.4379	-0.0229	0.3946	-0.0323	-0.0189	-0.0068	0.3107	0.1062	-0.0302
B. elegantissima	0.788	0.854	0.8085		0.7606	0.814	0.5789	0.1226	0.1798	0.9079	0.7971	0.71094	0.89816	.8/2388
	-0.271	-0.185	0.245		-307	-0.237	-0.561	1.589	1.374	0.117	0.259	-0.374	-0.129	-0.225
	-0.0308	-0.0322	-0.0313		-0.0301	-0.0314	-0.0226	0.0469	0.0278	-0.0329	-0.031	-0.0285	-0.0328	-0.0316
C. limbata	0.8012	0.835	0.0006	0.7606		0.0003	0.856	0.001	0.584	0.547	0.919	2E-16	0.0475	0.856
	-0.0254	-0.21	3.851	-307		4.046	-0.183	3.634	-554	-0.609	-0.102	129.4	2.067	-0.183
	-0.0311	-0.0318	0.3085	-0.0301		0.3314	-0.0322	0.2825	-0.0229	-0.0207	-0.033	0.9982	0.09543	-0.0322
C. fletcheri	0.6802	0.738	2E-05	0.814	0.0003		0.766	1E-06	0.889	0.5339	0.751	0.00354	0.383	0.766
	-0.416	0.338	5.015	-0.237	4.046		-0.3	6.089	-0.14	-0.629	-0.321	4.027	0.885	-0.3
	-0.0274	-0.0294	0.4379	-0.0314	-0.0226		-0.0302	0.5378	-0.0327	-0.0199	-0.0298	0.3293	-0.0071	-0.0302
C. lobatulus	0.98	0.841	0.5847	0.5789	0.856	0.766		0.54	0.01	0.915	0.753	0.858	0.71	0.861
	0.025	-0.202	-0.553	-0.561	-0.183	-0.3		-0.62	2.752	0.108	-0.318	-0.18	-0.375	-0.177
	-0.0333	-0.0319	-0.0229	-0.0226	-0.0322	-0.0302		-0.0203	0.1749	-0.0329	-0.0299	-0.0322	-0.0285	-0.0323
C. excavatum	0.5853	0.57	7E-05	0.1226	0.001	1E-06	0.54		0.4616	0.3173	0.5484	0.00144	0.0545	0.55422
	-0.552	-0.574	4.605	1.589	3.634	6.089	-0.62		0.746	-1.017	-0.607	3.511	2.001	-0.598
	-0.023	-0.0221	0.3946	0.0469	0.2825	0.5378	-0.0203		-0.0145	0.0011	-0.0208	0.2676	0.08837	-0.0212
D. rotaliformis	0.9057	0.688	0.864	0.1798	0.584	0.889	0.01	0.4616		0.7307	0.4885	0.62086	0.845	0.69172
	-0.119	-0.406	0.172	1.374	-554	-0.14	2.752	0.746		0.347	0.701	-0.5	0.197	-0.4
	-0.0328	-0.0277	-0.0323	0.0278	-0.0229	-0.0327	-0.0329	-0.0145		-0.0292	-0.0167	-0.0248	-0.032	-0.0278
D. squamiformis	0.008	0.0141	0.5196	0.9079	0.547	0.5339	0.915	0.3173	0.7307		0.4727	0.56633	0.98022	0.0117
	2.844	2.605	-0.652	0.117	-0.609	-0.629	0.108	-1.017	0.347		0.727	-0.58	0.025	2.685
	0.1861	0.1573	-0.0189	-0.0329	-0.0207	-0.0199	-0.0329	0.0011	-0.0292		-0.0154	-0.0219	-0.0333	0.1669
E. advena	0.7024	0.828	0.3814	0.7971	0.919	0.751	0.753	0.5484	0.4885	0.4727		0.92467	0.50852	0.82606
	0.386	0.22	-0.888	0.259	-0.102	-0.321	-0.318	-0.607	0.701	0.727		-0.095	-0.669	0.222
	0.1861	-0.0317	-0.0068	-0.031	-0.033	-0.0298	-0.0299	-0.0208	-0.0167	-0.0154		-0.033	-0.0181	-0.0316
E. frigidum	0.8086	0.838	0.0005	0.7109	2E-16	0.0035	0.858	0.0014	0.6209	0.5663	0.9247		0.0488	0.858
	-0.244	-0.206	3.869	-0.374	129.4	4.027	-0.18	3.511	-0.5	-0.58	-0.095		2.054	-0.18
	-0.0313	-0.0319	0.3107	-0.0285	0.9982	0.3293	-0.0322	0.2676	-0.0248	-0.0219	-0.033		0.09409	-0.0322
E. hannai	0.681	0.7	0.0386	0.8982	0.0475	0.383	0.71	0.0545	0.845	0.9802	0.5085	0.0488		0.71
	-0.416	-0.389	2.164	-0.129	2.067	0.885	-0.375	2.001	0.197	0.025	-0.669	2.054		-0.375
	-0.0274	-0.0281	0.1062	-0.0328	0.0954	-0.0071	-0.0285	0.0884	-0.032	-0.0333	-0.0181	0.09409		-0.0285
E. repandus	2E-16	2E-16	0.7641	0.2388	0.856	0.766	0.861	0.5542	0.6917	0.0117	0.8261	0.858	-0.375	
	38.627	68.457	-0.303	-0.225	-0.183	-0.3	-0.177	-0.598	-0.4	2.685	0.222	-0.18	-0.537	
	0.9796	0.9934	-0.0302	-0.0316	-0.0322	-0.0302	-0.0323	-0.0212	-0.0278	0.1669	-0.0316	-0.0322	-0.0285	
F. basispinatum	0.738	0.782	0.4161	0.0315	0.127	0.113	0.809	0.0002	0.7603	0.4605	0.7309	0.187	0.3579	0.809
	-0.338	-0.279	0.825	2.256	1.572	1.631	-0.244	4.336	0.308	-0.748	-0.347	1.352	0.934	-0.244
	0.7376	-0.0307	-0.0104	0.1166	0.0453	0.0508	-0.0313	0.3648	-0.0301	-0.0144	-0.0292	0.026	-0.0042	-0.0313
F. cf seminuda	2E-16	2E-16	0.7641	0.8239	0.127	0.766	0.861	0.5542	0.6917	0.0117	0.8261	0.858	0.71	2.0E-16
	38.627	68.427	-0.303	-0.225	1.572	-0.3	-0.177	-0.598	-0.4	2.685	0.222	-0.18	-0.375	1.7E+15
	0.9796	0.9934	-0.0302	-0.0316	-0.0322	-0.0302	-0.0323	-0.0212	-0.0278	0.1669	-0.0316	-0.0322	-0.0285	1
G. californiana	0.9199	0.986	0.5598	0.107	0.437	0.113	0.963	0.0058	0.4909	0.0166	0.9882	0.487	0.8525	0.963
	0.101	-0.018	0.59	1.661	0.787	1.633	-0.047	2.968	0.697	2.538	0.015	0.703	-0.188	-0.047
	-0.033	-0.0333	-0.0215	0.0537	-0.0124	0.0511	-0.0333	0.2012	-0.0169	0.1493	-0.0333	-0.0166	-0.0321	-0.0333

Species	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
Ammobaculites sp.	p value	0.738	2E-16	0.9199	0.09533	0.9032	0.8873	0.7414	0.6593	5E-07	0.9352	0.6456	0.06903	0.808	0.8083
	t test	-0.338	38.627	0.101	1.722	0.123	0.143	-0.333	-0.445	6.395	-0.082	-0.464	1.886	-0.245	-0.245
	R^2 value	0.7376	0.9796	-0.033	0.05963	-0.0328	-0.0326	-0.02953	-0.0266	0.5627	-0.0331	-0.026	0.07619	-0.0313	-0.03127
B. pacifica	p value	0.782	2E-16	0.986	0.206	0.9969	0.81	0.785	0.64	1E-06	0.791	0.733	0.145	0.841	0.841
	t test	-0.279	68.427	-0.018	1.294	0.004	-0.243	-0.275	-0.473	6.057	-0.267	-0.344	1.498	-0.202	-0.202
	R^2 value	-0.0307	0.9934	-0.0333	0.02128	-0.0333	-0.0313	-0.03073	-0.0257	0.9934	-0.0309	-0.0293	0.03854	-0.0319	-0.03192
B. frigida	p value	0.41605	0.76411	0.5598	0.47813	0.40159	0.30474	0.25582	0.2052	0.57753	0.6404	0.0056	0.27873	0.00054	0.68219
	t test	0.825	-0.303	0.59	-0.718	-0.851	-1.044	1.158	1.295	-0.563	0.472	2.985	-1.103	3.871	-0.413
	R^2 value	-0.0104	-0.0302	-0.0215	-0.0159	-0.009	0.00291	0.01091	0.02137	-0.0225	-0.0257	0.2033	0.00695	0.3108	-0.02748
B. elegantissima	p value	0.0315	0.82388	0.107	0.56141	0.69689	0.0264	0.0533	0.1068	0.89556	0.4782	0.268	0.38189	0.69764	4.0E-05
	t test	2.256	-0.225	1.661	-0.587	-0.393	2.335	2.012	1.663	-0.132	0.718	1.13	-0.887	-0.392	4.812
	R^2 value	0.1166	-0.0316	0.05369	-0.0216	-0.028	0.1256	0.08953	0.05384	-0.0327	-0.0159	0.00883	-0.0069	-0.0281	0.4169
C. limbata	p value	0.127	0.127	0.437	0.795	0.755	0.631	0.00853	0.786	0.691	0.646	0.0198	0.684	2E-16	0.856
	t test	1.572	1.572	0.787	-0.262	-0.315	-0.486	2.815	-0.274	-0.402	-0.464	2.462	-0.412	147.8	-0.183
	R^2 value	0.04526	-0.0322	-0.0124	-0.031	-0.0299	-0.0253	0.1826	-0.0308	-0.0278	-0.026	0.1403	-0.0275	0.9986	-0.03218
C. fletcheri	p value	0.113	0.766	0.113	0.6707	0.609	0.5576	0.115	0.6077	0.5141	0.162	1E-08	0.5039	0.00035	0.766
	t test	1.631	-0.3	1.633	-0.429	-0.517	-0.593	1.625	-0.519	-0.66	1.433	7.807	-0.676	4.036	-0.3
	R^2 value	0.05084	-0.0302	0.05105	-0.027	-0.0242	-0.0214	0.05025	-0.0241	-0.0185	0.03285	0.6591	-0.0178	0.3303	-0.03024
C. lobatulus	p value	0.809	0.861	0.963	0.802	0.923	0.412	0.812	0.868	0.879	0.658	0.74	0.694	0.861	0.861
	t test	-0.244	-0.177	-0.047	-0.253	-0.098	0.832	-0.24	0.168	-0.153	-0.447	-0.335	-0.397	-0.177	-0.177
	R^2 value	-0.0313	-0.0323	-0.0333	-0.0311	-0.033	-0.0101	-0.03135	-0.0324	-0.0325	-0.0265	-0.0295	-0.0279	-0.0323	-0.03226
C. excavatum	p value	0.00015	0.55422	0.00584	0.4006	0.78102	0.95481	0.000144	0.70899	0.66676	0.0233	3E-09	0.71939	0.00153	0.67204
	t test	4.336	-0.598	2.968	-0.853	0.28	0.057	4.352	0.377	-0.435	2.39	8.295	-0.363	3.487	-0.428
	R^2 value	0.3648	-0.0212	0.2012	-0.0089	-0.0306	-0.0332	0.3665	-0.0285	-0.0269	0.132	0.6863	-0.0288	0.2647	-0.02708
D. rotaliformis	p value	0.76029	0.69172	0.4909	0.64109	0.9589	0.65956	0.88734	0.1007	0.86952	0.0107	0.70417	0.64493	0.57258	0.516718
	t test	0.308	-0.4	0.697	0.471	-0.052	0.445	0.143	1.694	-0.166	2.722	0.383	-0.466	-0.571	-0.656
	R^2 value	-0.0301	-0.0278	-0.0169	-0.0258	-0.0332	-0.0266	-0.03263	0.05684	-0.0324	0.1713	-0.0283	-0.0259	-0.0222	-0.01871
D. squamiformis	p value	0.46048	0.0117	0.0166	0.94452	0.65285	0.56191	0.42957	0.9795	0.0154	0.68236	0.44411	0.90008	0.5621	0.73707
	t test	-0.748	2.685	2.538	0.07	-0.454	-0.587	-0.801	0.026	2.569	-0.413	-0.776	-0.127	-0.586	0.339
	R^2 value	-0.0144	0.1669	0.1493	-0.0332	-0.0263	-0.0216	-0.01171	-0.0333	0.153	-0.0275	-0.013	-0.0328	-0.0216	-0.02939
E. advena	p value	0.73093	0.82606	0.9882	0.54737	0.8696	0.2596	0.75614	0.83819	0.7372	0.7338	0.71535	0.97252	0.9279	0.6947
	t test	-0.347	0.222	0.015	0.609	-0.166	1.149	-0.313	-0.206	0.339	0.343	-0.368	0.035	-0.091	0.396
	R^2 value	-0.0292	-0.0316	-0.0333	-0.0207	-0.0324	0.01023	-0.02996	-0.0319	-0.0294	-0.0293	-0.0287	-0.0333	-0.0331	-0.02795
E. frigidum	p value	0.187	0.858	0.487	0.799	0.768	0.613	0.0158	0.793	0.696	0.702	0.0279	0.689	2E-16	0.858
	t test	1.352	-0.18	0.703	-0.257	-0.298	-0.51	2.558	-0.264	-0.395	-0.387	2.311	-0.404	284.8	-0.18
	R^2 value	0.026	-0.0322	-0.0166	-0.0311	-0.0303	-0.0244	0.1517	-0.0309	-0.028	-0.0282	0.1228	-0.0277	0.9996	-0.03222
E. hannai	p value	0.3579	0.71	0.8525	0.5951	0.9501	0.6252	0.1973	0.7622	0.00795	0.9961	0.4288	0.552	0.0497	0.71
	t test	0.934	-0.375	-0.188	-0.537	0.063	-0.494	1.319	-0.305	2.844	0.005	0.802	-0.601	2.045	-0.375
	R^2 value	-0.0042	-0.0285	-0.0321	-0.0235	-0.0332	-0.025	0.02327	-0.0301	0.1861	-0.0333	-0.0116	-0.021	0.09306	-0.0285
E. repandus	p value	8.1E-01	2E-16	0.963	0.193	0.923	0.739	0.812	0.67	1E-06	0.658	0.74	0.154	0.861	0.861
	t test	-0.24	1.7E+15	-0.047	1.331	-0.098	-0.337	-0.24	-0.431	6.001	-0.447	-0.335	1.462	-0.177	-0.177
	R^2 value	-0.0313	1	-0.0333	0.02429	-0.033	-0.0294	-0.03135	-0.027	0.5304	-0.0265	-0.0295	0.03542	-0.0323	-0.03226
F. basispinatum	p value		0.809	0.00852	0.73	0.678	0.791	2.0E-16	0.629	0.596	0.794	3E-06	0.587	0.185	0.809
	t test		-0.244	2.816	-0.349	-0.42	0.267	22.718	-0.489	-0.536	-0.264	5.756	-0.549	1.356	-0.244
	R^2 value		-0.0313	0.1826	-0.0292	-0.0273	-0.0309	0.9432	-0.0252	-0.0236	-0.0309	0.5089	-0.0231	0.02637	-0.03129
F. cf seminuda	p value	0.809		0.963	0.193	0.923	0.739	0.812	0.67	1.39	0.658	0.74	0.154	0.861	0.861
	t test	-0.244		-0.047	1.331	-0.098	-0.337	-0.24	-0.431	6.001	-0.447	-0.335	1.462	-0.177	-0.177
	R^2 value	-0.0313		-0.0333	0.02429	-0.033	-0.0294	-0.03135	-0.027	0.5304	-0.0265	-0.0295	0.03542	-0.0323	-0.03226
G. californiana	p value	0.00852	0.963		0.431	0.68182	0.81099	0.01683	0.53156	0.87431	0.27521	0.00827	0.54383	0.48706	0.43
	t test	2.816	-0.047		-0.798	0.414	-0.241	2.532	0.633	-0.163	1.111	2.828	0.614	0.704	-0.799
	R^2 value	0.1826	-0.0333		-0.0118	-0.0275	-0.0313	0.1486	-0.0197	-0.0324	0.00753	0.1842	-0.0205	-0.0166	-0.01178

Species	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina
Ammobaculites sp.	p value	0.02214	0.8083	0.8722	0.3531	0.7988	0.7921
	t test	2.413	-0.245	-0.162	0.943	-0.257	0.792
	R^2 value	0.1346	-0.03127	-0.03243	-0.00357	-0.03106	-0.0309
B. pacifica	p value	0.0423	0.841	0.696	0.726	0.641	0.846
	t test	2.121	-0.202	-0.395	0.353	-0.471	-0.196
	R^2 value	0.1014	-0.03192	-0.02799	-0.02905	-0.02576	-0.03201
B. frigida	p value	0.40113	0.00054	0.7722	0.35784	0.6614	0.2028
	t test	-0.852	3.871	-0.292	-0.934	-0.442	1.302
	R^2 value	-0.00894	0.3108	-0.0304	-0.00414	-0.02664	0.02194
B. elegantissima	p value	0.1657	0.69764	0.2373	0.71803	0.4703	0.57585
	t test	1.421	-0.392	1.206	-0.365	0.731	-0.566
	R^2 value	0.03182	-0.02806	0.01444	-0.02878	-0.01524	-0.02243
C. limbata	p value	0.752	2E-16	0.723	0.717	0.665	0.843
	t test	-0.318	147.8	-0.358	-0.366	-0.438	-0.199
	R^2 value	-0.02986	0.9986	-0.02894	-0.02874	-0.02677	-0.03197
C. fletcheri	p value	0.694	0.00035	0.987	0.5524	0.786	0.463
	t test	-0.398	4.036	0.016	-0.601	0.274	0.743
	R^2 value	-0.02791	0.3303	-0.03332	-0.02104	-0.03075	-0.01466
C. lobatulus	p value	0.721	0.861	0.972	0.483	1.1E-06	0.849
	t test	0.36	-0.177	0.036	0.71	6.074	-0.192
	R^2 value	-0.02889	-0.03226	-0.03329	-0.01627	0.5366	-0.03207
C. excavatum	p value	0.50677	0.00153	0.51861	0.65433	0.93726	0.62741
	t test	-0.672	3.487	0.653	-0.452	-0.079	-0.49
	R^2 value	-0.01801	0.2647	-0.01884	-0.02634	-0.03312	-0.02512
D. rotaliformis	p value	0.50855	0.57258	7E-06	0.03622	0.00277	0.83429
	t test	0.669	-0.571	5.42	2.193	3.261	-0.211
	R^2 value	-0.01814	-0.02224	0.4779	0.1094	0.2371	-0.0318
D. squamiformis	p value	0.00037	0.5621	0.77532	0.58813	0.89736	0.5288
	t test	4.012	-0.586	0.288	0.574	-0.13	-0.637
	R^2 value	0.3275	-0.02163	-0.03048	-0.02311	-0.03275	-0.01953
E. advena	p value	0.029	0.9279	0.7024	0.501	0.445	0.74669
	t test	2.294	-0.091	0.386	0.681	0.773	-0.326
	R^2 value	0.1209	-0.03305	-0.02823	-0.0176	-0.01314	-0.02969
E. frigidum	p value	0.758	2.2E-16	0.8	0.747	0.677	0.846
	t test	-0.311	284.8	-0.256	-0.326	-0.42	-0.196
	R^2 value	-0.03001	0.9996	-0.03108	-0.02969	-0.02729	-0.03202
E. hannai	p value	0.3617	0.0497	0.7965	0.7046	0.9289	0.6893
	t test	-0.926	2.045	0.26	-0.383	0.09	-0.404
	R^2 value	-0.0046	0.09306	-0.03101	-0.02831	-0.03305	-0.02775
E. repandus	p value	0.0547	0.861	0.733	0.727	0.676	0.849
	t test	1.999	-0.177	-0.345	0.353	-0.422	-0.192
	R^2 value	0.08816	-0.03226	-0.02925	-0.02907	-0.02723	-0.03207
F. basispinatum	p value	0.554	0.185	0.713	0.629	0.679	0.793
	t test	-0.598	1.356	-0.371	-0.488	-0.418	-0.265
	R^2 value	-0.02117	0.02637	-0.02862	-0.02521	-0.02735	-0.03092
F. cf seminuda	p value	0.0547	0.861	0.733	0.727	0.676	0.849
	t test	1.999	-0.177	-0.345	0.353	-0.422	-0.192
	R^2 value	0.08816	-0.03226	-0.02925	-0.02907	-0.02723	-0.03207
G. californiana	p value	0.554	0.185	0.713	0.629	0.679	0.793
	t test	-0.598	1.356	-0.371	-0.488	-0.418	-0.265
	R^2 value	0.04708	-0.01655	-0.01347	-0.03333	-0.01442	-0.00792

Species	Test	% Agglutinates	% Dissolution Effects	% Fines	Salinity	Temperature	%TOC	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper	Lead	Mercury (Hg) (mg/kg)	Zinc (Zn) (mg/kg)	Total PAH
H. columbiense	p value	0.0864	0.472	0.715	0.972	0.269	0.419	0.129	0.672	0.85	0.0676	0.796	0.652	0.233	0.475
	t test	1.773	-0.728	0.368	0.035	-1.125	0.819	1.563	0.428	-0.19	1.896	-0.261	0.456	1.216	-0.724
	R^2 value	0.0646	-0.0514	-0.0287	0.0333	0.0085	-0.0111	0.0445	-0.027	-0.0321	0.0773	-0.031	0.0262	0.0152	-0.0156
H. planissimum	p value	0.248	0.697	0.92	0.923	0.196	0.0648	0.998	0.602	0.247	0.773	0.497	0.588	0.847	0.0995
	t test	1.179	-0.393	-0.101	-0.098	1.324	1.92	0.002	0.528	1.18	-0.291	0.688	0.548	0.194	1.7
	R^2 value	0.1245	-0.028	-0.033	-0.033	0.0237	0.0822	-0.0333	0.0238	0.0125	-0.0304	-0.0173	-0.0231	-0.032	0.0575
H. subgloboum	p value	0.0431	0.5883	0.892	0.563	0.276	0.863	0.433	0.5153	0.2202	0.35	0.6973	0.839	0.427	0.2547
	t test	2.113	-0.0547	-0.136	0.585	-1.11	-0.174	0.795	-0.658	-1.252	0.948	-0.393	-0.205	0.805	-1.161
	R^2 value	0.1005	-0.0231	-0.0327	-0.0217	0.0074	-0.0334	-0.012	-0.0186	0.2202	-0.0032	-0.0281	-0.0319	-0.0115	0.1112
L. striata	p value	0.1956	0.67	0.0751	0.316	0.803	0.1125	0.154	0.413	0.35	0.1581	0.303	0.128	0.226	0.733
	t test	-1.324	0.43	-1.844	1.02	0.252	-1.637	-1.464	-0.829	-0.95	-1.448	-1.049	-1.565	-1.237	-0.344
	R^2 value	0.0237	.-027	0.0718	0.0013	-0.0312	0.053	0.0355	-0.0102	-0.0032	0.0415	0.0032	0.0447	0.0168	-0.0293
L. arenulata	p value	0.204	0.4541	0.08	0.407	0.26	0.4339	0.11	0.3407	0.951	0.238	0.3244	0.1143	0.05106	2.2E-05
	t test	1.297	-0.758	-1.812	0.841	1.149	-0.793	-1.646	-0.968	0.062	-1.205	-1.002	-1.626	-2.032	4.884
	R^2 value	0.0216	-0.0139	0.0686	-0.0095	-0.0102	-0.0125	0.0522	-0.002	-0.0332	0.0144	0.0001	0.0504	0.0917	0.4244
M. fusca Brady	p value	0.556	0.142	0.54	0.29	0.111	0.231	0.723	0.907	0.5911	0.934	0.1363	0.62	0.496	0.4541
	t test	0.596	1.51	-0.621	-1.077	1.643	1.224	-0.358	-0.118	-0.543	0.083	-1.531	-0.5	-0.689	-0.758
	R^2 value	-0.0212	0.0396	-0.0202	0.0051	0.0519	0.0163	-0.029	-0.0329	-0.0233	-0.0331	0.0416	-0.0248	-0.0172	-0.0139
N. stella	p value	0.864	0.449	0.0865	0.778	0.788	0.2171	0.491	0.966	0.3832	0.557	0.131	0.1358	0.566	0.4054
	t test	0.173	0.767	-1.772	0.285	-0.271	-1.262	-0.697	-0.042	-0.885	-0.594	-1.554	-1.533	-0.581	-0.844
	R^2 value	-0.0323	-0.0135	0.0646	-0.0306	-0.0308	0.0194	-0.0169	-0.0333	-0.007	-0.0213	0.0437	0.0417	-0.0218	-0.0094
O. melo	p value	0.1203	0.401	0.0109	0.167	0.528	0.0284	0.05	0.2836	0.2556	0.0544	0.1735	0.0396	0.0906	0.6494
	t test	-1.599	0.851	-2.713	1.417	-0.638	-2.307	-2.042	-1.092	-1.159	-2.002	-1.394	-2.152	-1.749	-0.459
	R^2 value	0.0478	-0.009	0.1703	0.0315	-0.0195	0.1259	0.0927	0.0062	0.011	0.0884	0.0296	0.1049	0.0623	-0.0261
P. fusca	p value	0.511	0.904	0.325	0.438	0.861	0.976	0.114	0.158	0.365	0.145	0.53	0.327	0.13	0.439
	t test	0.665	0.122	1.001	-0.785	-0.176	-0.03	1.626	1.45	0.919	1.495	0.635	0.996	1.558	0.785
	R^2 value	-0.0183	-0.0328	########	-0.0125	-0.0323	-0.0345	0.0504	0.0343	-0.005	0.0383	-0.0196	-0.0003	0.044	-0.0125
Q. vulgaris	p value	0.286	0.647	0.0995	0.285	0.631	0.198	0.228	0.66	0.482	0.271	0.356	0.191	0.24	0.658
	t test	-1.086	0.462	-1.7	1.089	0.485	-1.317	-1.232	-0.444	-0.711	-1.123	-0.937	-1.338	-1.2	-0.447
	R^2 value	0.0057	-0.026	0.0575	0.006	-0.0253	0.0239	0.0164	-0.0266	-0.0162	0.0083	-0.004	0.0249	0.014	-0.0265
R. advena	p value	0.423	0.29	0.298	0.569	0.394	0.537	0.401	0.681	0.73	0.418	0.506	0.522	0.39	0.736
	t test	0.813	-1.077	1.06	0.576	-0.869	0.625	0.852	-0.416	-0.348	0.822	0.674	0.648	0.872	-0.34
	R^2 value	-0.0111	0.0051	0.004	-0.022	-0.008	-0.0207	-0.0089	-0.0274	-0.0292	-0.0106	-0.0179	-0.0191	-0.0078	-0.0294
S. biformis	p value	0.0042	0.8978	0.7411	0.397	0.0816	0.5869	0.999	0.3426	0.22	0.9315	0.3998	0.4932	0.864	0.2563
	t test	3.102	0.13	-0.334	0.86	-1.802	-0.549	0.001	-0.964	-1.253	0.087	-0.854	-0.694	0.172	-1.157
	R^2 value	0.2177	-0.0328	-0.0295	-0.0085	0.0676	-0.0238	0.0164	-0.0023	0.018	-0.0331	-0.0088	-0.017	-0.0323	0.0108
T. bellatulla	p value	0.286	0.647	0.0995	0.285	0.631	0.198	0.228	0.66	0.482	0.271	0.356	0.191	0.25	0.658
	t test	-1.086	0.462	-1.7	1.089	0.485	-1.317	-1.232	-0.444	-0.711	-1.123	-0.0937	-1.338	-1.2	-0.447
	R^2 value	0.0057	-0.026	0.0575	0.006	-0.0253	0.0239	-0.0333	-0.0266	-0.0162	0.0083	-0.004	0.0249	0.014	-0.0265
T. hadai	p value	0.441	0.979	0.099	0.264	0.963	0.1467	0.234	0.495	0.314	0.3225	0.1125	0.0842	0.2563	0.913
	t test	0.781	0.027	-1.703	1.139	0.047	-1.491	-1.215	-0.691	-1.024	-1.006	-1.635	-1.786	-1.157	0.111
	R^2 value	-0.0128	-0.0333	0.0577	0.0095	-0.0333	0.0392	0.0151	-0.0171	0.0016	0.0004	0.0512	0.066	0.066	-0.0329
T. inflata	p value	0.0481	0.5758	0.703	0.571	0.298	0.953	0.386	0.965	0.4038	0.243	0.397	0.762	0.496	0.3433
	t test	2.061	-0.566	-0.386	0.558	-1.06	-0.059	0.879	-0.044	-0.847	1.191	-0.859	-0.306	0.689	-0.963
	R^2 value	0.0948	-0.0224	-0.0282	-0.0227	0.004	-0.0344	-0.0074	-0.0333	-0.0092	0.0133	-0.0086	-0.0301	-0.0173	-0.0024
T. pacifica	p value	0.0847	0.476	0.015	0.393	0.67	0.0353	0.0316	0.045	0.2521	0.0917	0.0477	0.005	0.0252	0.8387
	t test	1.783	0.721	-2.582	0.866	-0.43	-2.208	-2.255	-2.092	-1.168	-1.742	-2.065	-3.029	-2.356	-0.205
	R^2 value	0.0657	-0.0157	0.1545	-0.0081	-0.027	0.1144	0.1164	0.0982	0.0116	0.0616	0.0953	0.2086	0.128	-0.0319
U. peregrina	p value	0.543	0.937	0.552	0.508	0.514	0.726	0.664	0.998	0.701	0.856	0.166	0.247	0.29	0.657
	t test	-0.616	0.08	0.601	0.67	-0.66	0.354	0.439	0.003	-0.387	-0.183	1.42	1.181	1.078	-0.448
	R^2 value	-0.0204	-0.0331	-0.021	-0.0181	-0.0185	-0.03	-0.0268	-0.0333	-0.0282	-0.0322	0.0317	0.0126	0.0052	-0.0265

Species	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
H. columbiense	0.0953	0.206	0.4781	0.5614	0.795	0.6707	0.802	0.4006	0.6411	0.9445	0.5474	0.799	0.5951	0.193
	1.722	1.294	-0.718	-0.587	-0.262	-0.429	-0.253	-0.853	0.471	0.07	0.609	-0.257	-0.537	1.331
	0.0596	0.0213	-0.0159	-0.0216	-0.031	-0.027	-0.0311	-0.0089	-0.0258	-0.0332	-0.0207	-0.0311	-0.0235	0.02429
H. planissimum	0.9032	0.9969	0.4016	0.6969	0.755	0.609	0.923	0.781	0.9589	0.6529	0.8696	0.768	0.9501	0.923
	0.123	0.004	-0.851	-0.393	-0.315	-0.517	-0.098	0.28	-0.052	-0.454	-0.166	-0.298	0.063	-0.098
	-0.0328	-0.0333	-0.009	-0.028	-0.0299	-0.0242	-0.033	-0.0306	-0.0332	-0.0263	-0.0324	-0.0303	-0.0332	-0.033
H. subgloboum	0.8873	0.81	0.3047	0.0264	0.631	0.5576	0.412	0.9548	0.6596	0.5619	0.2596	0.613	0.6252	0.739
	0.143	-0.243	-1.044	2.335	-0.486	-0.593	0.832	0.057	0.445	-0.587	1.149	-0.51	-0.494	-0.337
	-0.0326	-0.0313	0.0029	0.1256	-0.0253	-0.0214	-0.0101	0.3665	-0.0266	-0.0216	0.0102	-0.0244	-0.025	-0.0294
L. striata	0.7414	0.785	0.2558	0.0533	0.0085	0.115	0.812	0.0001	0.8873	0.4296	0.7561	0.0158	0.1973	0.812
	-0.333	-0.275	1.158	2.012	2.815	1.625	-0.24	4.352	0.143	-0.801	-0.313	2.558	1.319	-0.24
	-0.0295	-0.0307	0.0109	0.0895	0.1826	0.0503	-0.0314	-0.0285	-0.0326	-0.0117	-0.03	0.1517	0.02327	-0.0314
L. arenulata	0.6593	0.64	0.2052	0.1068	0.786	0.6077	0.868	0.709	0.1007	0.9795	0.8382	0.793	0.7622	0.67
	-0.445	-0.473	1.295	1.663	-0.274	-0.519	0.168	0.377	1.694	0.026	-0.206	-0.264	-0.305	-0.431
	-0.0266	-0.0257	0.0214	0.0538	-0.0308	-0.0241	-0.0324	-0.0269	0.0568	-0.0333	-0.0319	-0.0309	-0.0301	-0.027
M. fusca Brady	4.6E-07	1.2E-06	0.5775	0.8956	0.691	0.5141	0.879	0.6668	0.8695	0.0154	0.7372	0.696	0.00795	1.39E-06
	6.395	6.057	-0.563	-0.132	-0.402	-0.66	-0.153	-0.435	-0.166	2.569	0.339	-0.395	2.844	6.001
	0.5627	0.5352	-0.0225	-0.0327	-0.0278	-0.0185	-0.0325	0.132	-0.0324	0.153	-0.0294	-0.028	0.1861	0.5304
N. stella	0.9352	0.791	0.6404	0.4782	0.646	0.162	0.658	0.0233	0.0107	0.6824	0.7338	0.702	0.9961	0.658
	-0.082	-0.267	0.472	0.718	-0.464	1.433	-0.447	2.39	2.722	-0.413	0.343	-0.387	0.005	-0.447
	-0.0331	-0.0309	-0.0257	-0.0159	-0.026	0.0329	-0.0265	0.132	0.1713	-0.0275	-0.0293	-0.0282	-0.0333	-0.0265
O. melo	0.6456	0.733	0.0056	0.268	0.0198	1E-08	0.74	3E-09	0.7042	0.4441	0.7154	0.0279	0.4288	0.74
	-0.464	-0.344	2.985	1.13	2.462	7.807	-0.335	8.295	0.383	-0.776	-0.368	2.311	0.802	-0.335
	-0.026	-0.0293	0.2033	0.0088	0.1403	0.6591	-0.0295	0.6863	-0.0283	-0.013	-0.0287	0.1228	-0.0116	-0.0295
P. fusca	0.069	0.145	0.2787	0.3819	0.684	0.5039	0.694	0.7194	0.6449	0.9001	0.9725	0.689	0.552	0.154
	1.886	1.498	-1.103	-0.887	-0.412	-0.676	-0.397	-0.363	-0.466	-0.127	0.035	-0.404	-0.601	1.462
	0.0762	0.0385	0.007	-0.0069	-0.0275	-0.0178	-0.0279	-0.0288	-0.0259	-0.0328	-0.0333	-0.0277	-0.021	0.03542
Q. vulgaris	0.808	0.841	0.0005	0.6976	2E-16	0.0003	0.861	0.0015	0.5726	0.5621	0.9279	2E-16	0.0497	0.861
	-0.245	-0.202	3.871	-0.392	147.8	4.036	-0.177	3.487	-0.571	-0.586	-0.091	284.8	2.045	-0.177
	-0.0313	-0.0319	0.3108	-0.0281	0.9986	0.3303	-0.0323	0.2647	-0.0222	-0.0216	-0.0331	0.9996	0.09306	-0.0323
R. advena	0.8083	0.841	0.6822	4E-05	0.856	0.766	0.861	0.672	0.5167	0.7371	0.6947	0.858	0.71	0.861
	-0.245	-0.202	-0.413	4.812	-0.183	-0.3	-0.177	-0.428	-0.656	0.339	0.396	-0.18	-0.375	-0.177
	-0.0313	-0.0319	-0.0275	0.4169	-0.0322	-0.0302	-0.0323	-0.0271	-0.0187	-0.0294	-0.028	-0.0322	-0.0285	-0.0323
S. biformis	0.0221	0.0423	0.4011	0.1657	0.752	0.694	0.721	0.5068	0.5086	0.0004	0.029	0.758	0.3617	0.0547
	2.413	2.121	-0.852	1.421	-0.318	-0.398	0.36	-0.672	0.669	4.012	2.294	-0.311	-0.926	1.999
	0.1346	0.1014	-0.0089	0.0318	-0.0299	-0.0279	-0.0289	-0.018	-0.0181	0.3275	0.1209	-0.03	-0.0046	0.08816
T. bellatulla	0.8083	0.841	0.0005	0.6976	2E-16	0.0003	0.861	0.0015	0.5726	0.5621	0.9279	2.2E-16	0.0497	0.861
	-0.245	-0.202	3.871	-0.392	147.8	4.036	-0.177	3.487	-0.571	-0.586	-0.091	284.8	2.045	-0.177
	-0.0313	-0.0319	0.3108	-0.0281	0.9986	0.3303	-0.0323	0.2647	-0.0222	-0.0216	-0.0331	0.9996	0.09306	-0.0323
T. hadai	0.8722	0.696	0.7722	0.2373	0.723	0.987	0.972	0.5186	7E-06	0.7753	0.7024	0.8	0.7965	0.733
	-0.162	-0.395	-0.292	1.206	-0.358	0.016	0.036	0.653	5.42	0.288	0.386	-0.256	0.26	-0.345
	-0.0324	-0.028	-0.0304	0.0144	-0.0289	-0.0333	-0.0333	-0.0188	0.4779	-0.0305	-0.0282	-0.0311	-0.031	-0.0293
T. inflata	0.3531	0.726	0.3578	0.718	0.717	0.5524	0.483	0.6543	0.0362	0.5881	0.501	0.747	0.7046	0.727
	0.943	0.353	-0.934	-0.365	-0.366	-0.601	0.71	-0.452	2.193	0.574	0.681	-0.326	-0.383	0.353
	-0.0036	-0.0291	-0.0041	-0.0288	-0.0287	-0.021	-0.0163	-0.0263	0.1094	-0.0231	-0.0176	-0.0297	-0.0283	-0.0291
T. pacifica	0.7988	0.641	0.6614	0.4703	0.665	0.786	1.1E-06	0.9373	0.0028	0.8974	0.445	0.677	0.9289	0.676
	-0.257	-0.471	-0.442	0.731	-0.438	0.274	6.074	-0.079	3.261	-0.13	0.773	-0.42	0.09	-0.422
	-0.0311	-0.0258	-0.0266	-0.0152	-0.0268	-0.0308	0.5366	-0.0331	0.2371	-0.0328	-0.0131	-0.0273	-0.0331	-0.0272
U. peregrina	0.7921	0.846	0.2028	0.5759	0.843	0.463	0.849	0.6274	0.8343	0.5288	0.7467	0.846	0.6893	0.849
	0.792	-0.196	1.302	-0.566	-0.199	0.743	-0.192	-0.49	-0.211	-0.637	-0.326	-0.196	-0.404	-0.192
	-0.0309	-0.032	0.0219	-0.0224	-0.032	-0.0147	-0.0321	-0.0251	-0.0318	-0.0195	-0.0297	-0.032	-0.0278	-0.0321

Species	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
H. columbiense	p value	0.73	0.193	0.431		0.725	0.00319	0.734	0.889	0.101	0.622	0.635	0.00012	0.802	0.802
	t test	-0.349	1.331	-0.798		-0.355	3.26	-0.044	0.14	1.692	-0.499	-0.479	4.432	-0.253	-0.253
	R^2 value	-0.0292	0.02429	-0.0118		-0.029	0.2304	0.02928	-03266	0.05667	-0.0248	-0.0255	0.3755	-0.0311	-0.03114
H. planissimum	p value	0.678	0.923	0.68182	0.725		0.338	0.6823	0.224	0.762	0.0894	0.568	0.721	0.7634	0.7634
	t test	-0.42	-0.098	0.414	-0.355		0.974	-0.413	1.242	0.306	1.755	-0.577	0.361	-0.304	-0.304
	R^2 value	-0.0273	-0.033	-0.0275	-0.029		-0.0017	-0.02748	0.0172	-0.0301	0.0629	-0.022	-0.0289	-0.0302	-0.03017
H. subgloboum	p value	0.791	0.739	0.81099	0.00319	0.338		0.8289	0.8282	0.3932	0.219	0.74857	0.0256	0.61814	0.00133
	t test	0.267	-0.337	-0.241	3.26	0.974		0.218	-0.219	0.866	1.255	-0.323	2.349	-0.504	3.54
	R^2 value	-0.0309	-0.0294	-0.0313	0.2304	-0.0017		-0.0317	-0.0317	-0.0081	0.01823	-0.0297	0.1271	0.2712	0.2712
L. striata	p value	2E-16	0.812	0.01683	0.734	0.6823	0.8289		0.642	0.602	0.547	3E-05	0.593	0.0156	0.812
	t test	22.718	-0.24	2.532	-0.044	-0.413	0.218		-0.469	-0.528	-0.609	4.889	-0.54	2.563	-0.24
	R^2 value	0.9432	-0.0314	0.1486	0.02928	-0.0275	-0.0317		-0.0258	-0.0238	-0.0207	0.4249	-0.0234	0.1523	-0.03135
L. arenulata	p value	0.629	0.67	0.53156	0.889	0.224	0.8282	0.642		0.6388	0.7961	0.5413	0.6699	0.7974	0.6697
	t test	-0.489	-0.431	0.633	0.14	1.242	-0.219	-0.469		-0.474	-0.261	-0.618	-0.431	-0.259	-0.431
	R^2 value	-0.0252	-0.027	-0.0197	-03266	0.0172	-0.0317	-0.0258		-0.0256	-0.031	-0.0204	-0.027	-0.031	-0.02698
M. fusca Brady	p value	0.596	1.39	0.87431	0.101	0.762	0.3932	0.602	0.6388		0.9233	0.4665	0.105	0.7013	0.937
	t test	-0.536	6.001	-0.163	1.692	0.306	0.866	-0.528	-0.474		0.097	-0.738	1.67	-0.387	0.08
	R^2 value	-0.0236	0.5304	-0.0324	0.05667	-0.0301	-0.0081	-0.02384	-0.0256		-0.033	-0.0149	0.05452	-0.0282	-0.03311
N. stella	p value	0.794	0.658	0.27521	0.622	0.0894	0.219	0.547	0.7961	0.9233		0.2158	0.888	0.658	0.658
	t test	-0.264	-0.447	1.111	-0.499	1.755	1.255	-0.609	-0.261	0.097		1.264	0.143	-0.447	-0.447
	R^2 value	-0.0309	-0.0265	0.00753	-0.0248	0.0629	0.01823	-0.02071	-0.031	-0.033		0.01894	-0.0326	-0.0265	-0.0265
O. melo	p value	3E-06	0.74	0.00827	0.635	0.568	0.74857	3.2E-05	0.5413	0.4665	0.2158		0.4557	0.0275	0.74
	t test	5.756	-0.335	2.828	-0.479	-0.577	-0.323	4.889	-0.618	-0.738	1.264		-0.756	2.318	-0.335
	R^2 value	0.5089	-0.0295	0.1842	-0.0255	-0.022	-0.0297	0.4249	-0.0204	-0.0149	0.01894		-0.014	0.1236	-0.02948
P. fusca	p value	0.587	0.154	0.54383	0.00012	0.721	0.0256	0.593	0.6699	0.105	0.888	0.4557		0.6944	0.6944
	t test	-0.549	1.462	0.614	4.432	0.361	2.349	-0.54	-0.431	1.67	0.143	-0.756		-0.397	-0.397
	R^2 value	-0.0231	0.03542	-0.0205	0.3755	-0.0289	0.1271	-0.02337	-0.027	0.05452	-0.0326	-0.014		-0.0279	-0.02794
Q. vulgaris	p value	0.185	0.861	0.48706	0.802	0.7634	0.61814	0.0156	0.7974	0.7013	0.658	0.0275	0.6944		0.861
	t test	1.356	-0.177	0.704	-0.253	-0.304	-0.504	2.563	-0.259	-0.387	-0.447	2.318	-0.397		-0.177
	R^2 value	0.02637	-0.0323	-0.0166	-0.0311	-0.0302	0.2712	0.1523	-0.031	-0.0282	-0.0265	0.1236	-0.0279		-0.03226
R. advena	p value	0.809	0.861	0.43	0.802	0.7634	0.00133	0.812	0.6697	0.937	0.658	0.74	0.6944	0.861	
	t test	-0.244	-0.177	-0.799	-0.253	-0.304	3.54	-0.24	-0.431	0.08	-0.447	-0.335	-0.397	-0.177	
	R^2 value	-0.0313	-0.0323	-0.0118	-0.0311	-0.0302	0.2712	-0.03135	-0.027	-0.0331	-0.0265	-0.0295	-0.0279	-0.0323	
S. biformis	p value	0.554	0.0547	0.12208	0.107	0.94	0.00242	0.557	0.5542	0.0318	0.4546	0.7432	0.272	0.767	0.0318
	t test	-0.598	1.999	1.591	1.661	0.076	3.313	-0.593	-0.598	2.251	0.758	-0.331	1.118	-0.299	2.251
	R^2 value	-0.0212	0.08816	0.04708	0.05367	-0.0331	0.2435	-0.02134	-0.0212	0.116	-0.0139	-0.0296	0.00802	-0.0303	0.1306
T. bellatulla	p value	0.185	0.861	0.48706	0.802	0.7634	0.61814	0.812	0.7974	0.7013	0.658	0.0275	0.6944	2E-16	0.861
	t test	1.356	-0.177	0.704	-0.253	-0.304	-0.504	-0.24	-0.259	-0.387	-0.447	2.318	-0.397	1.6E+16	-0.177
	R^2 value	0.02637	-0.0323	-0.0166	-0.0311	-0.0302	-0.0247	0.1523	-0.031	-0.0282	-0.0265	0.1236	-0.0279	1	-0.03226
T. hadai	p value	0.713	0.733	0.44916	0.743	0.893	0.7731	0.642	0.8574	0.8884	0.00026	0.9222	0.4425	0.733	0.7326
	t test	-0.371	-0.345	0.767	-0.33	0.136	-0.344	-0.47	0.181	-0.142	4.142	-0.098	-0.778	-0.345	-0.345
	R^2 value	-0.0286	-0.0293	-0.0135	-0.0296	-0.0327	-0.0293	-0.02579	-0.0322	-0.0326	0.3427	-0.033	-0.0129	-0.0293	-0.02925
T. inflata	p value	629	0.727	1	2.0E-11	0.809	0.00037	0.635	0.9517	0.275	0.326	0.5074	0.00057	0.727	0.7268
	t test	-0.488	0.353	0	10.367	0.243	4.008	-0.48	0.061	1.111	0.999	-0.671	3.854	-0.353	-0.353
	R^2 value	-0.0252	-0.0291	-0.0333	0.7745	-0.0313	0.327	-0.02545	-0.0332	0.00751	-9.4E-05	-0.0181	0.3089	-0.0291	-0.02907
T. pacifica	p value	0.679	0.676	0.46039	0.718	0.992	0.2719	0.596	0.6391	0.6768	0.3314	0.946	0.392	0.676	0.7124
	t test	-0.418	-0.422	0.748	-0.365	-0.01	1.119	-0.575	0.474	0.421	0.987	0.068	-0.868	-0.422	0.372
	R^2 value	-0.0274	-0.0272	-0.0144	-0.0288	-0.0333	0.00809	-0.02206	-0.0257	-0.0273	-0.0008	-0.0332	-0.008	-0.0272	
U. peregrina	p value	0.793	0.849	0.391	0.786	0.7438	0.6363	0.796	0.6458	0.6769	0.8758	0.7723	0.6696	0.849	0.849
	t test	-0.265	-0.192	-0.87	-0.274	-0.33	0.478	-0.261	-0.464	-0.421	0.158	-0.292	-0.431	-0.192	-0.192
	R^2 value	-0.0309	-0.0321	-0.0079	-0.0308	-0.0296	-0.0255	-0.03099	-0.026	-0.0273	-0.0325	-0.0304	-0.027	-0.0321	

Species	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina
H. columbiense	p value	0.107	0.802	0.743	2.0E-11	0.718	0.786
	t test	1.661	-0.253	-0.33	10.367	-0.365	-0.274
	R^2 value	0.05367	-0.03114	-0.02959	0.7745	-0.02877	-0.03075
H. planissimum	p value	0.94	0.7634	0.893	0.809	0.992	0.7438
	t test	0.076	-0.304	0.136	0.243	-0.01	-0.33
	R^2 value	-0.03314	-0.03017	-0.0327	-0.0313	-0.03333	-0.0296
H. subgloboum	p value	0.00242	0.61814	0.7731	0.00037	0.2719	0.6363
	t test	3.313	-0.504	-0.344	4.008	1.119	0.478
	R^2 value	0.2435	-0.02467	-0.02927	0.327	0.00809	-0.02553
L. striata	p value	0.557	0.812	0.642	0.635	0.596	0.796
	t test	-0.593	-0.24	-0.47	-0.48	-0.575	-0.261
	R^2 value	-0.02134	0.1523	-0.02579	-0.02545	-0.02206	-0.03099
L. arenulata	p value	0.5542	0.7974	0.8574	0.9517	0.6391	0.6458
	t test	-0.598	-0.259	0.181	0.061	0.474	-0.464
	R^2 value	-0.02115	-0.03103	-0.0322	-0.0332	-0.02566	-0.02596
M. fusca Brady	p value	0.0318	0.7013	0.8884	0.275	0.6768	0.6769
	t test	2.251	-0.387	-0.142	1.111	0.421	-0.421
	R^2 value	0.116	-0.02819	-0.03264	0.00751	-0.02727	-0.02727
N. stella	p value	0.4546	0.658	0.00026	0.326	0.3314	0.8758
	t test	0.758	-0.447	4.142	0.999	0.987	0.158
	R^2 value	-0.01393	-0.0265	0.3427	-9.37E-05	-0.00081	-0.03248
O. melo	p value	0.7432	0.0275	0.9222	0.5074	0.946	0.7723
	t test	-0.331	2.318	-0.098	-0.671	0.068	-0.292
	R^2 value	-0.02958	0.1236	-0.033	-0.01805	-0.03317	-0.03041
P. fusca	p value	0.272	0.6944	0.4425	0.00057	0.392	0.6696
	t test	1.118	-0.397	-0.778	3.854	-0.868	-0.431
	R^2 value	0.00802	-0.02794	-0.01288	0.3089	-0.00799	-0.02698
Q. vulgaris	p value	0.767	2E-16	0.733	0.727	0.676	0.849
	t test	-0.299	1.6E+16	-0.345	-0.353	-0.422	-0.192
	R^2 value	-0.03025	1	-0.02925	-0.02907	-0.02723	-0.03207
R. advena	p value	0.0318	0.861	0.7326	0.7268	0.7124	0.849
	t test	2.251	-0.177	-0.345	-0.353	0.372	-0.192
	R^2 value	0.1306	-0.03226	-0.02925	-0.02907	-0.02858	-0.03207
S. biformis	p value		0.767	0.962	0.0421	0.33761	0.87579
	t test		-0.299	-0.049	2.123	0.974	-0.158
	R^2 value		-0.03025	-0.03325	0.1016	-0.00163	-0.03248
T. bellatulla	p value	0.767		0.733	0.727	0.676	0.849
	t test	-0.299		-0.345	-0.353	-0.422	-0.192
	R^2 value	-0.03025		-0.02925	-0.02907	-0.02723	-0.03207
T. hadai	p value	0.962	0.733		0.245	0.0418	0.7106
	t test	-0.049	-0.345		1.185	2.127	-0.375
	R^2 value	-0.03325	-0.02925		0.01289	0.102	-0.02852
T. inflata	p value	0.0421	0.727	0.245		0.665	0.7043
	t test	2.123	-0.353	1.185		0.437	-0.383
	R^2 value	0.1016	-0.02907	0.01289		-0.0268	-0.0283
T. pacifica	p value	0.33761	0.676	0.0418	0.665		0.848
	t test	0.974	-0.422	2.127	0.437		-0.193
	R^2 value	-0.00163	-0.02723	0.102	-0.0268		-0.03205
U. peregrina	p value	0.87579	0.849	0.7106	0.7043	0.848	
	t test	-0.158	-0.192	-0.375	-0.383	-0.193	
	R^2 value	-0.03248	-0.03207	-0.02852	-0.0283	-0.03205	

Assemblage Statistics	Test	% Agglutinates	% Dissolution Effects	% Fines	Salinity	Temperature	%TOC	Total Heavy Metals (mg/kg)	Arsenic (As) (mg/kg)	Cadmium (Cd) (mg/kg)	Copper	Lead	Mercury (Hg) (mg/kg)	Zinc (Zn) (mg/kg)	Total PAH
Density	p value	0.555	0.968	0.4185	0.255	0.655	0.4839	0.865	0.931	0.5928	0.911	0.67	0.526	0.87	0.3448
	t test	-0.598	0.04	-0.822	1.164	-0.452	-0.71	-0.172	-0.087	-0.541	-0.113	-0.431	-0.642	-0.165	-0.962
	R^2 value	-0.0235	-0.037	-0.0117	0.0125	-0.0292	-0.0187	-0.0359	-0.0367	-0.0259	-0.0366	-0.03	-0.0214	-0.036	-0.0027
Species Richness	p value	0.0525	0.0335	0.0026	0.272	0.819	0.0777	0.107	0.588	0.0375	0.186	0.0526	0.0168	0.0988	0.738
	t test	2.019	2.228	-3.286	1.199	0.231	-1.829	-1.662	-0.547	-0.9	-1.354	-2.018	-2.533	-1.704	-0.338
	R^2 value	0.0903	0.1134	0.2401	0.008	-0.0315	-0.0315	0.0725	0.0538	-0.0231	-0.0062	0.0262	0.0901	0.1487	0.0578
Simpsons Index	p value	0.1806	0.0366	0.766	0.514	0.373	0.4685	0.6606	0.4804	0.2886	0.984	0.1558	0.2668	0.4981	0.797
	t test	1.371	2.188	0.3	0.66	0.904	0.735	0.443	0.715	1.08	0.02	1.456	1.132	0.686	0.259
	R^2 value	0.0276	0.1089	-0.0302	-0.0186	-0.0059	-0.0156	-0.0266	-0.016	0.0054	-0.0333	0.0349	0.009	-0.0174	-0.031
Shannon Index	p value	0.0306	0.204	0.0309	0.622	0.493	0.186	0.334	0.652	0.649	0.481	0.269	0.141	0.267	0.529
	t test	2.269	1.297	-2.265	0.498	0.694	-1.353	-0.982	-0.455	-0.46	-0.713	-1.126	-1.512	-1.131	0.637
	R^2 value	0.1181	0.0216	0.1176	-0.0249	-0.017	0.027	-0.0011	-0.0263	-0.0261	-0.0161	0.0086	0.0398	0.0089	-0.0196
Equitability Index	p value	0.062	0.232	0.16	0.955	0.134	0.412	0.632	0.727	0.964	0.757	0.794	0.579	0.52	0.185
	t test	1.939	1.221	-1.441	0.057	1.54	-0.833	-0.484	-0.353	0.042	-0.313	-0.263	-0.561	-0.651	1.358
	R^2 value	0.0818	0.0156	0.0336	-0.0332	0.0424	-0.0103	-0.0253	-0.0291	-0.0333	-0.03	-0.031	-0.0226	-0.0189	0.0265

APPENDIX F

Linear Regressions by Year and Area

1999 Samples from all areas		n=12	NA = undefined due to singularities												
Parameter	Test	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
% Fines	p value	0.502	0.453	0.008	0.306	0.157	0.137	NA	0.006	0.220	0.471	0.363	0.166	0.014	0.478
	t test	0.688	0.771	-3.086	-1.060	-1.491	-1.571	NA	-3.160	-1.280	0.740	-0.937	-1.455	-2.784	0.728
	R^2 value	-0.034	-0.026	0.348	0.008	0.071	0.084	NA	0.360	0.038	-0.029	-0.008	0.065	0.297	-0.030
%TOC	p value	0.220	0.196	0.065	0.279	0.252	0.223	NA	0.031	0.447	0.032	0.863	0.266	0.633	0.206
	t test	1.283	1.357	-2.004	-1.204	-1.195	-1.275	NA	-2.397	-0.782	2.383	-0.176	-1.159	-0.488	1.328
	R^2 value	0.041	0.053	0.168	0.029	0.028	0.040	NA	0.240	-0.027	0.238	-0.069	0.022	-0.054	0.048
Total Heavy	p value	0.467	0.482	0.021	0.305	0.311	0.284	NA	0.097	0.357	0.257	0.836	0.326	0.028	0.501
	t test	0.747	0.720	-2.568	-1.062	-1.049	-1.111	NA	-1.770	-0.095	1.180	-0.211	-1.015	-2.434	0.689
	R^2 value	-0.028	-0.031	0.259	0.008	0.006	0.014	NA	0.118	-0.006	0.024	-0.064	0.002	0.235	-0.034
Arsenic (As)	p value	0.711	0.783	0.138	0.360	0.623	0.598	NA	0.542	0.567	0.328	0.858	0.642	0.254	0.775
	t test	0.378	0.281	-1.565	-0.943	-0.502	-0.553	NA	-0.625	-0.585	1.012	-0.182	0.474	-1.186	0.291
	R^2 value	-0.057	-0.061	0.083	-0.007	-0.049	-0.045	NA	-0.040	-0.043	0.001	-0.064	-0.051	0.025	-0.061
Cadmium (Cd)	p value	-0.204	-0.263	0.336	-1.349	-0.723	0.451	NA	0.408	0.354	0.644	0.271	0.488	0.385	0.843
	t test	0.008	0.025	-0.994	0.022	0.019	-0.775	NA	-0.852	-0.957	0.472	-1.143	-0.710	-0.894	-0.202
	R^2 value	-0.064	-0.062	0.001	0.049	-0.031	-0.026	NA	-0.017	-0.005	-0.051	0.019	-0.032	-0.013	-0.064
Copper	p value	0.368	0.398	0.051	0.255	0.323	0.292	NA	0.122	0.424	0.184	0.977	0.341	0.059	0.403
	t test	0.929	0.870	-2.125	-1.182	-1.023	-1.098	NA	-1.640	-0.823	1.393	-0.029	-0.984	-2.042	0.861
		-0.009	-0.015	0.180	0.024	0.003	0.012	NA	0.096	-0.021	0.056	-0.067	-0.002	0.165	-0.016
Lead	p value	0.692	0.802	0.110	0.729	0.438	0.415	NA	0.093	0.231	0.944	0.129	0.443	0.064	0.750
	t test	-0.403	-0.255	-1.701	-0.353	-0.797	-0.839	NA	-1.792	-1.247	0.072	-1.605	-0.788	-2.002	-0.325
	R^2 value	-0.055	-0.062	0.106	-0.058	-0.023	-0.019	NA	0.121	0.034	-0.066	0.090	-0.024	0.158	-0.059
Mercury (Hg)	p value	0.530	0.463	0.025	0.360	0.219	0.193	NA	0.015	0.211	0.294	0.398	0.230	0.039	0.504
	t test	0.643	0.754	-2.496	-0.945	-1.284	-1.362	NA	-2.747	-1.307	1.088	-0.870	-1.252	-2.261	0.685
	R^2 value	-0.038	-0.028	0.246	-0.007	0.039	0.051	NA	0.290	0.042	0.011	-0.015	0.034	0.205	-0.034
Zinc (Zn)	p value	0.530	0.530	0.010	0.420	0.332	0.312	NA	0.102	0.365	0.379	0.868	0.344	0.016	0.566
	t test	0.643	0.643	-2.946	-0.829	-1.003	-1.046	NA	-1.744	-0.933	0.906	-0.170	-0.977	-2.724	0.588
		-0.038	-0.038	0.324	-0.019	0.000	0.006	NA	0.113	-0.008	-0.011	-0.065	-0.003	0.286	-0.043
Total PAH	p value	0.438	0.473	0.435	0.681	0.537	0.518	NA	0.582	0.663	0.469	0.195	0.538	0.634	0.511
	t test	-0.797	-0.737	0.803	0.419	-0.632	-0.661	NA	-0.562	0.445	-0.743	-1.356	-0.630	-0.486	-0.674
	R^2 value	-0.023	-0.029	-0.023	-0.054	-0.039	-0.036	NA	-0.045	-0.053	-0.029	0.050	-0.039	-0.050	-0.035

1999 Samples from all areas											n=12 NA = undefined due to singularities				
Parameter	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
% Fines	p value	0.207	0.478	0.961	0.478	0.815	0.431	0.142	0.244	0.775	0.579	0.106	0.187	0.168	NA
	t test	-1.320	0.728	-0.050	0.728	0.238	-0.809	-1.550	-1.213	-0.291	-0.567	-1.722	1.381	-1.447	NA
	R^2 value	0.044	-0.148	-0.066	-0.030	-0.063	-0.022	0.081	0.029	-0.061	-0.044	0.109	0.054	0.064	NA
%TOC	p value	0.216	0.206	0.318	0.206	0.076	0.585	0.164	0.698	0.227	0.801	0.136	0.735	0.268	NA
	t test	-1.296	1.328	-1.035	1.328	1.918	-0.559	-1.469	-0.396	1.263	-0.256	-1.582	-0.345	-1.152	NA
	R^2 value	0.043	0.048	0.005	0.048	0.152	-0.048	0.072	-0.060	0.038	-0.066	0.091	-0.062	0.021	NA
Total Heavy	p value	0.306	0.501	0.887	0.501	0.797	0.866	0.246	0.216	0.826	0.810	0.211	0.298	0.326	NA
	t test	-1.059	0.689	-0.114	0.689	0.262	-0.171	-1.206	-1.292	-0.223	0.245	-1.307	1.078	-1.016	NA
	R^2 value	0.008	-0.034	-0.065	-0.034	-0.062	-0.065	0.028	0.040	-0.063	-0.062	0.042	0.010	0.002	NA
Arsenic (As)	p value	0.436	0.775	0.812	0.775	0.753	0.801	0.410	0.401	0.894	0.802	0.402	0.291	0.641	NA
	t test	-0.800	0.291	-0.242	0.291	0.321	-0.256	-0.847	-0.864	-0.136	-0.863	-0.863	1.095	-0.476	NA
	R^2 value	-0.023	-0.061	-0.063	-0.061	-0.059	-0.062	-0.018	-0.016	-0.065	-0.016	-0.016	0.012	-0.051	NA
Cadmium (Cd)	p value	0.402	0.843	0.578	0.843	0.448	0.426	0.356	0.963	0.624	0.498	0.331	0.399	0.497	NA
	t test	-0.862	-0.202	-0.568	-0.202	0.780	-0.818	-0.952	-0.047	-0.500	-0.695	-1.005	0.869	-0.696	NA
	R^2 value	-0.016	-0.064	-0.044	-0.064	-0.025	-0.021	-0.006	-0.067	-0.049	-0.033	0.001	-0.016	-0.033	NA
Copper	p value	0.266	0.266	0.488	0.902	0.902	0.902	0.216	0.244	0.960	0.744	0.188	0.501	0.340	NA
	t test	-1.155	-1.155	-0.711	0.861	-0.125	-0.125	-1.293	-1.213	0.051	0.333	-1.380	0.689	-0.986	NA
		0.020	0.020	-0.032	-0.016	-0.066	-0.067	0.040	0.029	-0.066	-0.059	0.053	-0.034	-0.002	NA
Lead	p value	0.465	0.750	0.354	0.750	0.403	0.339	0.403	0.706	0.265	0.350	0.363	0.348	0.451	NA
	t test	-0.749	-0.325	0.957	-0.325	0.860	-0.988	-0.860	0.385	-1.159	-0.964	-0.938	0.969	-0.775	NA
	R^2 value	-0.028	-0.059	-0.005	-0.059	-0.017	-0.001	-0.017	-0.056	0.021	-0.004	-0.008	-0.004	-0.026	NA
Mercury (Hg)	p value	0.219	0.504	0.821	0.504	0.439	0.449	0.162	0.338	0.834	0.592	0.130	0.291	0.233	NA
	t test	-1.282	0.685	0.230	0.685	0.795	-0.778	-1.471	-0.989	-0.213	-0.548	-1.602	1.094	-1.243	NA
	R^2 value	0.039	-0.034	-0.063	-0.034	-0.024	-0.025	0.068	-0.001	-0.063	-0.046	0.089	0.012	0.033	NA
Zinc (Zn)	p value	0.432	0.566	0.629	0.566	0.559	0.978	0.354	0.181	0.689	0.758	0.302	0.166	0.343	NA
	t test	-0.808	0.588	0.493	0.588	0.597	-0.028	-0.957	-1.403	-0.408	0.314	-1.070	1.457	-0.980	NA
		-0.022	-0.043	-0.050	-0.043	-0.042	-0.067	-0.005	0.057	-0.055	-0.060	0.009	0.066	-0.003	NA
Total PAH	p value	0.591	0.511	0.604	0.511	0.389	0.410	0.532	0.003	0.354	0.301	0.492	0.555	0.547	NA
	t test	-0.550	-0.674	0.530	-0.674	0.888	-0.847	-0.639	3.615	-0.956	-1.072	-0.704	0.604	-0.617	NA
	R^2 value	-0.046	-0.035	-0.047	-0.035	-0.013	-0.018	-0.038	0.430	-0.005	0.009	-0.033	-0.041	-0.040	NA

1999 Samples from all areas							n= 12	NA = undefined due to singularities				
Parameter	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina	Agglutinates	Dissolution	Desnity	Species Richenss	Shannon
% Fines	p value	0.876	0.168	0.490	0.793	0.052	NA	0.870	0.285	0.238	0.156	0.452
	t test	0.159	-1.447	-0.707	-0.267	-2.114	NA	-0.167	1.109	-1.233	-1.492	-0.733
	R^2 value	-0.065	0.064	-0.032	-0.062	0.178	NA	-0.065	0.014	0.033	0.071	-0.026
%TOC	p value	0.453	0.268	0.636	0.960	0.881	NA	0.255	0.349	0.309	0.891	0.924
	t test	0.771	-1.152	-0.484	0.052	-0.152	NA	1.186	0.969	-1.059	-0.139	-0.097
	R^2 value	-0.028	0.021	-0.054	-0.071	-0.070	NA	0.026	-0.004	0.009	-0.070	-0.071
Total Heavy	p value	0.606	0.326	0.734	0.746	0.085	NA	0.932	0.112	0.427	0.585	0.862
	t test	0.527	-1.016	-0.346	0.330	-1.843	NA	0.087	1.687	-0.818	-0.559	-0.176
	R^2 value	-0.047	0.002	-0.058	-0.059	0.130	NA	-0.066	0.103	-0.023	-0.045	-0.064
Arsenic (As)	p value	0.820	0.641	0.824	0.859	0.302	NA	0.986	0.209	0.874	0.833	0.960
	t test	0.232	-0.476	-0.226	0.180	-1.068	NA	-0.018	1.312	-0.162	0.215	-0.051
	R^2 value	-0.063	-0.058	-0.063	-0.064	0.009	NA	-0.067	0.043	-0.069	-0.063	-0.066
Cadmium (Cd)	p value	0.623	0.497	0.456	0.354	0.470	NA	0.584	0.884	0.701	0.715	0.692
	t test	-0.502	-0.696	-0.762	-0.956	-0.741	NA	0.560	0.148	-0.393	-0.372	-0.470
	R^2 value	-0.049	-0.033	-0.027	-0.005	-0.029	NA	0.045	-0.065	-0.060	-0.057	-0.055
Copper	p value	0.488	0.340	0.819	0.652	0.154	NA	0.996	0.132	0.432	0.532	0.655
	t test	0.710	-0.986	-0.233	0.461	-1.550	NA	-0.005	1.594	-0.810	-0.640	-0.455
		-0.032	-0.002	-0.063	-0.052	0.072	NA	-0.067	0.088	-0.024	-0.038	-0.052
Lead	p value	0.435	0.451	0.339	0.301	0.072	NA	0.943	0.328	0.532	0.365	0.932
	t test	-0.801	-0.775	-0.987	-1.071	-1.936	NA	0.073	1.010	-0.641	-0.935	0.087
	R^2 value	-0.023	-0.026	-0.002	0.009	0.147	NA	-0.066	0.001	-0.041	-0.008	-0.066
Mercury (Hg)	p value	0.873	0.233	0.471	0.742	0.100	NA	0.685	0.123	0.294	0.417	0.915
	t test	0.163	-1.243	-0.740	-0.335	-1.752	NA	0.414	1.632	-1.090	-0.834	0.109
	R^2 value	-0.065	0.033	-0.029	-0.059	0.115	NA	-0.055	0.094	0.012	-0.019	-0.066
Zinc (Zn)	p value	0.635	0.343	0.746	0.703	0.059	NA	0.837	0.118	0.437	0.707	0.855
	t test	0.484	-0.980	-0.329	0.389	-0.205	NA	0.209	1.656	-0.801	-0.383	0.185
		-0.050	-0.003	-0.059	-0.056	0.166	NA	-0.064	0.098	-0.025	-0.056	-0.064
Total PAH	p value	0.292	0.547	0.744	0.260	0.986	NA	0.113	0.039	0.429	0.495	0.279
	t test	-1.093	-0.617	-0.332	-1.170	0.018	NA	1.684	-2.258	-0.815	-0.699	0.279
	R^2 value	0.012	-0.040	-0.059	0.023	-0.067	NA	0.103	0.204	-0.023	-0.033	-0.061

2004 Samples from all areas		n=11	NA = undefined due to singularities												
Parameter	Test	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
% Fines	p value	0.229	0.292	0.202	0.861	NA	0.113	0.051	0.067	0.000	0.693	0.739	NA	0.109	NA
	t test	-1.263	-1.099	-1.343	0.178	NA	-1.697	-2.154	-2.003	-5.490	-0.403	0.340	NA	-1.720	NA
	R^2 value	0.041	0.015	0.054	-0.074	NA	0.118	0.206	0.177	0.676	-0.064	-0.067	NA	0.123	NA
%TOC	p value	0.316	0.294	0.308	0.835	NA	0.223	0.105	0.124	0.001	0.375	0.926	NA	0.141	NA
	t test	-1.043	-1.094	-1.061	-0.212	NA	-1.280	-1.742	-1.646	-4.432	-0.919	-0.095	NA	-1.568	NA
	R^2 value	0.006	0.014	0.009	-0.073	NA	0.044	0.127	0.109	0.571	-0.011	-0.076	NA	0.094	NA
Total Heavy	p value	0.917	0.276	0.302	0.995	NA	0.240	0.072	0.139	0.020	0.486	0.299	NA	0.136	NA
	t test	-0.107	-1.137	-1.074	0.006	NA	-1.230	-1.959	-1.577	-2.660	-0.716	1.083	NA	-1.589	NA
	R^2 value	-0.076	0.020	0.011	-0.077	NA	0.035	0.169	0.096	0.303	-0.036	0.012	NA	0.098	NA
Arsenic (As)	p value	0.382	0.516	0.631	0.326	NA	0.593	0.031	0.372	0.009	0.486	0.907	NA	0.407	NA
	t test	-0.906	-0.668	-0.492	-1.022	NA	-0.548	-2.412	-0.925	-3.061	-0.717	0.119	NA	-0.858	NA
	R^2 value	-0.013	-0.041	-0.057	0.003	NA	-0.053	0.256	-0.010	0.374	-0.036	-0.076	NA	-0.019	NA
Cadmium (Cd)	p value	0.345	0.641	0.429	0.544	NA	0.526	0.306	0.454	0.071	0.897	0.440	NA	0.526	NA
	t test	-0.981	-0.477	-0.817	-0.623	NA	-0.541	-1.066	-0.771	-1.964	-0.132	-0.797	NA	-0.651	NA
	R^2 value	-0.003	-0.058	-0.024	-0.046	NA	-0.043	0.010	-0.030	0.169	-0.075	-0.027	NA	-0.043	NA
Copper	p value	0.742	0.309	0.187	0.948	NA	0.240	0.241	0.145	0.158	0.500	0.283	NA	0.172	NA
	t test	0.337	-1.060	-1.393	0.067	NA	-1.231	-1.228	-1.551	-1.497	-0.694	1.120	NA	-1.445	NA
		-0.068	0.009	0.063	-0.077	NA	0.036	0.035	0.091	0.082	-0.038	0.018	NA	0.072	NA
Lead	p value	0.207	0.575	0.917	0.861	NA	0.602	0.099	0.486	0.001	0.603	0.864	NA	0.409	NA
	t test	-1.328	-0.576	0.106	0.178	NA	-0.534	-1.776	-0.716	-3.195	-0.533	0.175	NA	-0.853	NA
	R^2 value	0.052	-0.050	-0.076	-0.074	NA	-0.054	0.133	-0.036	0.397	-0.054	-0.074	NA	-0.020	NA
Mercury (Hg)	p value	0.282	0.397	0.708	0.826	NA	0.401	0.058	0.236	0.001	0.535	0.782	NA	0.233	NA
	t test	-1.121	-0.875	-0.383	-0.224	NA	-0.869	-2.076	-1.241	-4.380	-0.637	0.283	NA	-1.250	NA
	R^2 value	0.018	-0.017	-0.065	-0.073	NA	-0.018	0.191	0.037	0.057	-0.044	-0.070	NA	0.039	NA
Zinc (Zn)	p value	0.699	0.356	0.585	0.984	NA	0.358	0.048	0.248	0.009	0.607	0.386	NA	0.201	NA
	t test	-0.395	-0.958	-0.560	-0.021	NA	-0.953	-2.188	-1.210	-3.093	-0.527	0.897	NA	-1.346	NA
		-0.064	-0.006	-0.052	-0.077	NA	-0.007	0.213	0.032	0.380	-0.054	-0.014	NA	0.055	NA
Total PAH	p value	0.826	0.651	0.466	0.100	NA	0.425	0.565	0.167	0.358	0.644	0.515	NA	0.477	NA
	t test	-0.225	0.463	0.751	1.770	NA	0.824	-0.591	1.465	0.954	0.473	0.669	NA	0.732	NA
	R^2 value	-0.073	-0.059	-0.032	0.132	NA	-0.024	-0.049	0.076	-0.006	-0.059	-0.041	NA	-0.034	NA

2004 Samples from all areas										n=11 NA = undefined due to singularities					
Parameter	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
% Fines	p value	0.087	NA	0.042	0.998	0.024	0.861	NA	0.101	0.411	0.008	0.051	0.980	NA	0.332
	t test	-1.854	NA	-2.252	0.002	-2.557	0.179	NA	-1.765	-0.849	-3.158	-2.153	0.026	NA	1.008
	R^2 value	0.148	NA	0.042	-0.077	-0.283	-0.074	NA	0.013	-0.020	0.391	0.206	-0.077	NA	0.001
%TOC	p value	0.184	NA	0.009	0.613	0.013	0.774	NA	0.108	0.337	0.020	0.121	0.625	NA	0.460
	t test	-1.403	NA	-3.073	0.518	-2.883	0.293	NA	-1.725	-0.997	-0.267	-1.661	0.500	NA	0.762
	R^2 value	0.065	NA	0.376	-0.055	0.343	-0.070	NA	0.124	0.000	0.304	0.112	-0.057	NA	-0.031
Total Heavy	p value	0.208	NA	0.021	0.157	0.053	0.306	NA	0.485	0.996	0.040	0.136	0.169	NA	0.421
	t test	-1.326	NA	-2.623	1.501	-2.125	1.066	NA	-0.719	0.006	-2.280	-1.588	1.455	NA	0.831
	R^2 value	0.051	NA	0.296	0.082	0.201	0.010	NA	-0.036	-0.077	0.231	0.098	0.074	NA	-0.023
Arsenic (As)	p value	0.546	NA	0.058	0.421	0.037	0.625	NA	0.737	0.406	0.337	0.464	0.529	NA	0.694
	t test	-0.620	NA	-2.076	0.832	-2.331	-0.501	NA	-0.343	-0.859	-0.997	-0.754	0.646	NA	-0.403
	R^2 value	-0.046	NA	0.191	-0.023	0.240	-0.057	NA	-0.067	-0.019	0.000	-0.032	-0.043	NA	-0.064
Cadmium (Cd)	p value	0.577	NA	0.341	0.929	0.331	0.384	NA	0.906	0.410	0.667	0.517	0.846	NA	0.776
	t test	-0.571	NA	-0.989	0.091	-1.010	-0.902	NA	-0.121	-0.852	-0.440	-0.666	-0.199	NA	-0.291
	R^2 value	-0.051	NA	-0.002	-0.076	0.001	-0.014	NA	-0.076	-0.020	-0.061	-0.041	-0.074	NA	-0.070
Copper	p value	0.269	NA	0.021	0.087	0.153	0.214	NA	0.705	0.632	0.061	0.188	0.108	NA	0.428
	t test	-1.156	NA	-2.626	1.851	-1.519	1.307	NA	0.387	0.490	-2.053	-1.389	1.726	NA	0.818
		0.023	NA	0.296	0.148	0.085	0.048	NA	-0.065	-0.057	0.187	0.062	0.124	NA	-0.024
Lead	p value	0.391	NA	0.261	0.777	0.093	0.909	NA	0.020	0.314	0.208	0.332	0.861	NA	0.526
	t test	-0.888	NA	-1.176	-0.289	-1.812	0.117	NA	-2.660	-1.049	-1.324	-0.101	-0.178	NA	0.651
	R^2 value	-0.015	NA	0.027	-0.070	0.140	-0.076	NA	0.303	0.007	0.051	0.001	-0.074	NA	-0.043
Mercury (Hg)	p value	0.267	NA	0.058	0.838	0.013	0.848	NA	0.025	0.288	0.049	0.119	0.777	NA	0.565
	t test	-1.159	NA	-2.078	0.208	-2.890	0.195	NA	-2.535	-1.108	-2.171	-1.352	0.289	NA	0.591
	R^2 value	0.024	NA	0.192	-0.073	0.344	-0.074	NA	0.279	0.016	0.210	0.056	-0.070	NA	-0.049
Zinc (Zn)	p value	0.257	NA	0.100	0.369	0.058	0.497	NA	0.078	0.704	0.085	0.186	0.350	NA	0.501
	t test	-1.185	NA	-1.773	0.931	-2.078	0.699	NA	-1.916	-0.039	-1.862	-1.398	0.970	NA	0.693
		0.028	NA	0.133	-0.010	0.192	-0.038	NA	0.160	-0.065	0.150	0.064	-0.004	NA	-0.039
Total PAH	p value	0.402	NA	0.012	0.542	0.005	0.913	NA	0.169	0.191	0.009	0.354	0.474	NA	0.869
	t test	0.866	NA	2.992	-0.626	3.363	-0.111	NA	1.456	1.379	3.064	0.961	-0.737	NA	0.168
	R^2 value	-0.018	NA	0.350	-0.045	0.424	-0.076	NA	0.074	0.061	0.375	-0.006	0.474	NA	-0.075

2004 Samples from all areas												
Parameter	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina	Agglutinates	Dissolution	Desnity	Species Richenss	Shannon
% Fines	p value	0.311	NA	0.024	0.627	0.003	0.647	0.616	0.175	0.209	0.001	0.015
	t test	-1.055	NA	-2.553	-0.498	-3.642	0.468	-0.513	-1.434	1.335	-4.388	-2.790
	R^2 value	0.008	NA	0.283	-0.057	0.467	-0.059	-0.056	0.070	0.061	0.566	0.326
%TOC	p value	0.134	NA	0.008	0.921	0.004	0.675	0.490	0.103	0.209	0.0002	0.304
	t test	1.597	NA	-3.103	-0.101	-3.491	0.429	-0.711	-1.751	1.335	-0.501	-2.428
	R^2 value	0.100	NA	0.381	-0.076	0.444	-0.062	-0.037	0.129	0.061	0.633	0.259
Total Heavy	p value	0.462	NA	0.043	0.449	0.012	0.738	0.728	0.197	0.049	0.040	0.221
	t test	-0.759	NA	-2.243	0.780	-2.941	0.342	0.355	-1.360	2.203	-2.280	-1.286
	R^2 value	-0.031	NA	0.224	-0.029	0.353	-0.067	-0.067	0.057	0.243	0.231	0.045
Arsenic (As)	p value	0.104	NA	0.083	0.983	0.005	0.766	0.973	0.077	0.747	0.020	0.290
	t test	-1.749	NA	-1.881	0.021	-3.364	0.304	0.035	-1.917	0.330	-2.159	-1.103
	R^2 value	0.128	NA	0.154	-0.077	0.424	-0.069	-0.077	0.161	-0.080	0.207	0.015
Cadmium (Cd)	p value	0.212	NA	0.420	0.629	0.199	0.744	0.882	0.069	0.655	0.148	0.679
	t test	-1.311	NA	-0.832	-0.495	-1.354	-0.333	0.152	-1.980	-0.459	-1.538	-0.423
	R^2 value	0.049	NA	-0.022	-0.057	0.056	-0.068	0.750	0.173	-0.070	0.089	-0.062
Copper	p value	0.572	NA	0.082	0.287	0.084	0.783	0.264	0.091	0.052	0.192	0.628
	t test	-0.580	NA	-1.884	1.110	-1.873	-2.810	1.168	-1.824	2.181	-1.375	-0.497
		-0.050	NA	0.154	0.016	0.152	-0.070	0.025	0.142	0.239	0.060	-0.057
Lead	p value	0.422	NA	0.159	0.549	0.033	0.145	0.246	0.864	0.522	0.044	0.069
	t test	-0.828	NA	-1.493	-0.615	-2.390	1.549	-1.214	0.175	0.660	-2.226	-1.980
	R^2 value	-0.023	NA	0.081	0.046	0.252	0.091	0.033	-0.074	-0.049	0.220	0.173
Mercury (Hg)	p value	0.247	NA	0.020	0.800	0.002	0.268	0.381	0.547	0.323	0.003	0.022
	t test	-1.213	NA	-2.641	-0.259	-3.766	1.158	-0.906	-0.618	1.035	-3.598	-2.608
	R^2 value	0.033	NA	0.299	-0.071	0.485	0.024	0.013	-0.046	0.006	0.461	0.293
Zinc (Zn)	p value	0.535	NA	0.081	0.690	0.008	0.386	0.630	0.574	0.101	0.021	0.081
	t test	-0.638	NA	-1.889	0.409	-3.098	0.897	-0.493	-0.577	1.792	-2.630	-1.891
		-0.044	NA	0.155	-0.063	0.381	-0.014	0.057	-0.050	0.156	0.297	0.155
Total PAH	p value	0.162	NA	0.000	0.601	0.078	0.881	0.383	0.275	0.670	0.009	0.158
	t test	1.483	NA	8.028	-0.535	1.911	-0.153	0.208	1.141	-0.438	3.045	1.497
	R^2 value	0.079	NA	0.819	-0.054	0.159	-0.075	-0.073	0.021	-0.072	0.371	0.081

Northern Region Samples all years		n= 12	NA = undefined due to singularities												
Parameter	Test	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
% Fines	p value	0.462	0.945	0.050	0.628	0.207	0.235	0.570	0.169	0.825	0.548	0.968	0.371	0.234	0.101
	t test	0.765	0.070	-2.223	-0.500	-1.348	-1.265	-0.587	-1.484	-0.227	-0.622	-0.041	-0.936	-1.267	1.805
	R^2 value	-0.039	-0.099	0.264	-0.073	0.069	0.052	-0.063	0.098	-0.094	-0.059	-0.100	-0.011	0.052	0.170
%TOC	p value	0.795	0.085	0.287	0.382	0.609	0.504	0.535	0.316	0.543	0.279	0.357	0.575	0.543	0.588
	t test	-0.267	-0.195	-1.125	-0.915	-0.528	-0.693	0.642	-1.056	-0.630	1.145	-0.966	-0.579	-0.630	-0.560
	R^2 value	-0.092	-0.096	0.024	-0.015	-0.070	-0.050	-0.056	0.010	-0.058	0.028	-0.006	-0.064	-0.058	-0.067
Total Heavy	p value	0.547	0.863	0.090	0.972	0.218	0.590	0.271	0.556	0.796	0.330	0.813	0.638	0.378	0.262
	t test	0.623	0.177	-1.877	-0.036	-1.315	-0.557	-1.164	-0.610	0.266	-1.008	0.243	-0.485	-0.923	1.189
	R^2 value	-0.059	-0.097	0.187	-0.100	0.062	-0.067	0.031	-0.061	-0.092	0.002	-0.094	-0.075	-0.014	0.036
Arsenic (As)	p value	0.638	0.620	0.923	0.576	0.560	0.516	0.019	0.276	0.209	0.116	0.481	0.486	0.531	0.087
	t test	0.485	0.512	-0.099	0.578	-0.602	0.674	-2.783	1.152	1.342	-1.719	0.732	0.723	0.649	-1.897
	R^2 value	-0.075	-0.072	-0.099	-0.064	-0.061	-0.052	0.380	0.029	0.068	0.151	-0.044	-0.045	-0.056	0.191
Cadmium (Cd)	p value	0.949	0.956	0.473	0.679	0.235	0.536	0.165	0.657	0.745	0.376	0.894	0.685	0.966	0.215
	t test	0.066	-0.057	-0.746	-0.427	-1.264	-0.641	-1.499	-0.457	0.335	-0.926	-0.137	-0.417	-0.044	-1.323
	R^2 value	-0.100	-0.100	-0.042	-0.080	0.051	-0.057	0.102	-0.078	-0.088	-0.013	-0.098	-0.081	-0.100	0.064
Copper	p value	0.353	0.594	0.244	0.731	0.221	0.765	0.139	0.887	0.204	0.376	0.397	0.686	0.597	0.188
	t test	0.974	0.550	-1.239	0.354	-1.307	-0.307	-1.606	-0.146	1.358	-0.093	0.884	-0.417	-0.546	-1.413
		-0.005	-0.068	0.046	-0.086	0.060	-0.090	0.125	-0.098	0.071	-0.013	-0.020	-0.081	-0.068	0.083
Lead	p value	0.702	0.750	0.775	0.481	0.047	0.775	0.018	0.338	0.266	0.550	0.433	0.678	0.446	0.157
	t test	-0.394	-0.328	0.294	-0.733	2.269	-0.294	2.825	-1.005	-1.178	0.618	-0.816	-0.427	-0.794	1.529
	R^2 value	-0.083	-0.088	-0.091	-0.044	0.274	-0.091	0.388	0.001	0.034	-0.059	-0.031	-0.080	-0.035	0.108
Mercury (Hg)	p value	0.492	0.718	0.463	0.966	0.213	0.740	0.074	0.997	0.444	0.286	0.864	0.811	0.892	0.114
	t test	0.714	0.372	-0.763	-0.044	-1.331	-0.341	-1.993	-0.004	0.798	-1.127	0.176	-0.246	0.023	-1.733
	R^2 value	-0.047	-0.085	-0.040	-0.100	0.066	-0.087	0.213	-0.100	-0.034	0.024	-0.097	-0.093	-0.100	0.154
Zinc (Zn)	p value	0.189	0.563	0.456	0.359	0.339	0.967	0.039	0.621	0.076	0.152	0.178	0.976	0.925	0.069
	t test	1.410	0.599	-0.776	0.961	-1.004	0.042	-2.378	0.511	1.983	-1.551	1.447	-0.031	-0.096	-2.038
		0.082	-0.062	-0.037	-0.007	0.001	-0.100	0.297	-0.072	0.211	0.113	0.091	-0.100	-0.099	0.223
Total PAH	p value	0.684	0.636	0.535	0.658	0.174	0.309	0.189	0.499	0.902	0.379	0.671	0.517	0.952	0.241
	t test	-0.419	-0.488	-0.643	-0.456	-1.463	-1.073	-1.409	-0.701	0.126	-0.920	-0.437	-0.672	0.062	-1.247
	R^2 value	-0.081	-0.074	-0.056	-0.078	0.094	0.014	0.082	-0.049	-0.098	-0.014	-0.079	-0.053	-0.100	0.048

Northern Region Samples all years											n=12 NA = undefined due to singularities				
Parameter	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
% Fines	p value	0.525	NA	0.957	0.831	0.113	0.789	0.528	0.521	0.774	0.603	0.729	NA	0.371	NA
	t test	-0.649	NA	0.056	-0.219	1.737	-0.274	-0.065	0.665	0.295	-0.537	-0.356	NA	-0.936	NA
	R^2 value	-0.054	NA	-0.100	586.00	0.155	-0.092	-0.055	-0.053	-0.091	-0.069	-0.086	NA	-0.011	NA
%TOC	p value	0.551	NA	0.604	0.505	0.000	0.406	0.619	0.013	0.545	0.447	0.334	NA	0.575	NA
	t test	-0.617	NA	-0.536	-0.692	5.733	-0.868	-0.513	3.029	-0.627	-0.792	-1.012	NA	-0.558	NA
	R^2 value	-0.060	NA	-0.069	-0.050	0.743	-0.023	-0.072	0.426	-0.058	-0.035	0.003	NA	-0.064	NA
Total Heavy	p value	0.849	NA	0.593	0.978	0.064	0.941	0.342	0.408	0.736	0.990	0.761	NA	0.638	NA
	t test	-0.195	NA	0.551	-0.028	2.077	0.076	-0.998	0.864	0.346	0.013	0.312	NA	-0.485	NA
	R^2 value	-0.096	NA	-0.068	-0.100	0.232	-0.099	0.000	-0.024	-0.087	-0.100	-0.089	NA	-0.075	NA
Arsenic (As)	p value	0.549	NA	0.144	0.955	0.019	0.614	0.278	0.166	0.751	0.464	0.490	NA	0.486	NA
	t test	0.621	NA	1.587	0.058	2.803	0.520	-1.146	1.493	0.326	0.761	0.717	NA	0.723	NA
	R^2 value	-0.059	NA	0.121	-0.100	0.384	-0.071	0.028	0.101	-0.088	-0.040	-0.046	NA	-0.045	NA
Cadmium (Cd)	p value	0.616	NA	0.950	0.956	0.000	0.732	0.376	0.006	0.999	0.873	0.418	NA	0.685	NA
	t test	-0.517	NA	0.065	-0.057	6.973	-0.352	-0.927	3.459	0.001	-0.164	-0.846	NA	-0.417	NA
	R^2 value	-0.071	NA	-0.100	-0.100	0.812	-0.087	-0.013	0.499	-0.100	-0.097	-0.027	NA	-0.081	NA
Copper	p value	0.957	NA	0.225	0.767	0.002	0.627	0.359	0.043	0.453	0.555	0.841	NA	0.686	NA
	t test	-0.055	NA	1.294	0.305	4.232	502.00	-0.960	2.300	0.781	0.611	-0.206	NA	-0.417	NA
		-0.100	NA	0.058	-0.090	0.606	-0.073	-0.007	0.285	-0.037	-0.060	-0.095	NA	-0.081	NA
Lead	p value	0.592	NA	0.351	0.709	0.985	0.495	0.000	0.760	0.631	0.510	0.351	NA	0.678	NA
	t test	-0.554	NA	-0.979	-0.383	0.019	-0.708	11.317	-0.314	-0.469	-0.683	-0.978	NA	-0.427	NA
	R^2 value	0.067	NA	-0.004	-0.084	-0.100	-0.048	-0.920	-0.089	-0.074	-0.051	-0.004	NA	-0.080	NA
Mercury (Hg)	p value	0.974	NA	0.370	0.705	0.002	0.983	0.280	0.073	0.882	0.951	0.793	NA	0.811	NA
	t test	0.028	NA	0.939	-0.390	4.241	0.022	-1.142	2.004	0.152	0.063	-0.270	NA	-0.246	NA
	R^2 value	-0.100	NA	-0.011	-0.084	0.607	-0.100	0.027	0.215	-0.097	-0.100	-0.092	NA	-0.093	NA
Zinc (Zn)	p value	0.604	NA	0.042	0.660	0.050	0.305	0.447	0.193	0.283	0.419	0.839	NA	0.976	NA
	t test	0.535	NA	2.338	0.453	2.229	1.081	-0.792	1.397	1.135	0.884	0.208	NA	-0.031	NA
		-0.069	NA	0.289	-0.078	0.265	0.015	-0.035	0.080	0.026	-0.027	-0.095	NA	-0.100	NA
Total PAH	p value	0.552	NA	0.557	0.893	0.016	0.695	0.397	0.009	0.881	0.624	0.228	NA	0.517	NA
	t test	-0.616	NA	-0.607	0.138	2.890	-0.403	-0.885	3.202	-0.154	-0.506	-1.284	NA	-0.672	NA
	R^2 value	-0.060	NA	-0.061	-0.098	0.101	-0.082	-0.020	0.460	-0.097	-0.073	0.056	NA	-0.053	NA

Northern Region Samples all years												
Parameter	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina	Agglutinates	Dissolution	Desnity	Species Richenss	Shannon
% Fines	p value	0.578	0.371	0.507	0.462	0.535	0.945	0.231	0.147	0.352	0.544	0.658
	t test	0.575	-0.936	-0.687	0.765	-0.643	0.070	1.277	-1.574	-0.977	-0.629	0.456
	R^2 value	-0.065	-0.011	-0.050	-0.039	-0.056	-0.099	0.054	0.118	-0.004	-0.058	-0.078
%TOC	p value	0.619	0.575	0.440	0.795	0.633	0.849	0.461	0.397	0.548	0.488	0.053
	t test	-0.513	-0.579	-0.804	-0.267	-0.493	-0.195	0.767	-0.885	-0.622	-0.720	-2.193
	R^2 value	-0.072	-0.064	-0.033	-0.092	-0.074	-0.096	-0.039	-0.020	-0.059	-0.046	0.257
Total Heavy	p value	0.550	0.638	0.606	0.547	0.698	0.863	0.266	0.361	0.634	0.893	0.375
	t test	0.618	-0.049	-0.532	0.623	-0.399	0.177	1.179	-0.958	-0.492	0.138	0.929
	R^2 value	-0.060	-0.075	-0.070	-0.059	-0.083	-0.097	0.034	-0.008	-0.074	-0.098	-0.013
Arsenic (As)	p value	0.408	0.486	0.875	0.638	0.886	0.620	0.308	0.834	0.465	0.234	0.733
	t test	0.863	0.723	-0.162	0.485	-0.147	0.512	1.073	-0.215	0.760	1.266	0.352
	R^2 value	-0.024	-0.045	-0.097	-0.075	-0.095	-0.072	0.014	-0.095	-0.040	0.052	-0.087
Cadmium (Cd)	p value	0.978	0.685	0.994	0.949	0.883	0.956	0.121	0.075	0.678	0.520	0.249
	t test	-0.029	-0.417	-0.008	0.066	-0.151	-0.057	1.694	-1.989	-0.428	-0.667	-1.224
	R^2 value	-0.100	-0.081	-0.100	-0.100	-0.098	-0.100	0.145	0.212	-0.080	-0.053	0.043
Copper	p value	0.239	0.686	0.971	0.353	0.905	0.594	0.069	0.546	0.706	0.480	0.913
	t test	1.252	-0.417	0.038	0.974	0.123	0.550	2.034	-0.606	-0.399	0.734	-0.112
		0.049	-0.081	-0.100	-0.005	-0.098	-0.068	0.222	-0.059	-0.084	-0.044	-0.099
Lead	p value	0.522	0.678	0.508	0.702	0.644	0.750	0.968	0.810	0.660	0.568	0.719
	t test	-0.664	-0.427	-0.687	-0.394	-0.476	-0.328	-0.042	0.247	-0.453	-0.590	-0.370
	R^2 value	-0.054	-0.080	-0.050	-0.083	-0.076	-0.088	-0.100	-0.093	-0.078	-0.063	-0.085
Mercury (Hg)	p value	0.434	0.811	0.700	0.492	0.593	0.718	0.128	0.212	0.803	0.984	0.463
	t test	0.816	-0.246	-0.396	0.714	-0.552	0.372	1.662	-1.335	-0.256	-0.020	-0.764
	R^2 value	-0.031	-0.093	-0.083	-0.047	-0.067	-0.085	0.138	0.066	-0.093	-0.100	-0.039
Zinc (Zn)	p value	0.097	0.976	0.801	0.189	0.864	0.563	0.086	0.835	0.986	0.209	0.722
	t test	1.829	-0.031	0.259	1.410	0.176	0.599	1.905	-0.214	0.018	1.343	0.366
		0.176	-0.100	-0.093	0.082	-0.097	-0.062	0.193	-0.095	-0.100	0.068	-0.085
Total PAH	p value	0.474	0.517	0.509	0.684	0.891	0.636	0.152	0.013	0.507	0.124	0.129
	t test	-0.744	-0.672	0.684	-0.419	0.141	-0.488	1.549	-3.027	-0.688	-1.677	-1.656
	R^2 value	-0.042	-0.053	-0.051	-0.081	-0.098	-0.074	0.113	0.426	-0.050	0.142	0.137

Dabob Region Samples all years n=7 NA = undefined due to singularities															
Parameter	Test	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
% Fines	p value	0.946	0.805	0.865	0.817	NA	NA	NA	0.013	0.244	0.920	0.094	0.241	0.005	0.794
	t test	0.072	0.260	0.178	-0.244	NA	NA	NA	-3.753	-1.320	0.105	-2.061	-1.331	-4.824	0.278
	R^2 value	-0.199	-0.138	-0.192	-0.186	NA	NA	NA	0.656	0.110	-0.197	0.351	0.114	0.788	-0.182
%TOC	p value	0.125	0.086	0.604	0.882	NA	NA	NA	0.124	0.408	0.134	0.932	0.359	0.102	0.087
	t test	1.844	2.132	0.554	-0.156	NA	NA	NA	-1.846	-0.902	1.787	-0.090	-1.010	-2.000	2.121
	R^2 value	0.286	0.371	-0.131	-0.194	NA	NA	NA	0.287	-0.032	0.268	.-1981	0.003	0.333	0.368
Total Heavy	p value	0.271	0.234	0.297	0.597	NA	NA	NA	0.645	0.788	0.228	0.806	0.740	0.545	0.248
	t test	1.237	1.351	1.163	0.565	NA	NA	NA	-0.490	-0.284	1.375	0.259	-0.350	-0.649	1.308
	R^2 value	0.081	0.121	0.056	-0.128	NA	NA	NA	-0.174	-0.181	0.129	-0.184	-0.171	-0.107	0.106
Arsenic (As)	p value	0.080	0.100	0.272	0.487	NA	NA	NA	0.709	0.317	0.034	0.137	0.371	0.460	0.104
	t test	2.188	2.015	1.234	0.751	NA	NA	NA	0.395	1.110	2.888	1.768	0.982	0.800	1.985
	R^2 value	0.387	0.338	0.080	-0.078	NA	NA	NA	-0.164	0.037	0.550	0.262	-0.006	-0.064	0.329
Cadmium (Cd)	p value	0.304	0.293	0.165	0.010	NA	NA	NA	0.173	0.277	0.565	0.924	0.248	0.098	0.255
	t test	1.145	1.175	-1.625	-4.039	NA	NA	NA	-1.590	-1.220	0.616	-0.101	-1.307	-2.031	1.285
	R^2 value	0.049	0.060	0.215	0.719	NA	NA	NA	0.203	0.075	-0.115	-0.198	0.105	0.343	0.098
Copper	p value	0.010	0.012	0.345	0.667	NA	NA	NA	0.923	0.735	0.005	0.091	0.819	0.792	0.015
	t test	4.080	3.827	1.043	0.467	NA	NA	NA	0.102	0.358	4.676	2.093	0.241	0.278	3.611
		0.723	0.695	0.014	-0.153	NA	NA	NA	-0.198	-0.170	0.777	0.360	-0.186	-0.182	0.667
Lead	p value	0.493	0.605	0.628	0.631	NA	NA	NA	0.297	0.398	0.577	0.113	0.423	0.196	0.588
	t test	-0.739	-0.551	0.516	0.511	NA	NA	NA	-1.165	-0.923	-0.596	-1.918	-0.873	-1.490	-0.579
	R^2 value	-0.082	-0.131	-0.139	-0.141	NA	NA	NA	0.056	-0.025	-0.121	0.309	-0.041	0.169	-0.126
Mercury (Hg)	p value	0.928	0.802	0.513	0.702	NA	NA	NA	0.176	0.372	0.850	0.291	0.368	0.119	0.820
	t test	0.095	0.265	0.704	0.405	NA	NA	NA	-1.575	-0.981	0.199	-1.181	-0.990	-1.876	0.240
	R^2 value	-0.198	-0.183	0.092	-0.162	NA	NA	NA	0.198	-0.006	-0.191	0.062	-0.003	0.296	-0.186
Zinc (Zn)	p value	0.963	0.885	0.564	0.789	NA	NA	NA	0.578	0.561	0.934	0.521	0.559	0.338	0.891
	t test	0.049	0.152	0.618	0.282	NA	NA	NA	-0.594	-0.622	0.088	-0.690	-0.626	-1.059	0.144
		-0.199	-0.195	-0.115	-0.181	NA	NA	NA	-0.121	-0.114	-0.198	-0.096	-0.113	0.020	-0.195
Total PAH	p value	0.477	0.560	0.294	0.255	NA	NA	NA	0.824	0.713	0.623	0.321	0.743	0.609	0.529
	t test	-0.768	-0.624	1.173	1.286	NA	NA	NA	-0.235	-0.390	-0.523	-1.101	-0.347	-0.545	-0.677
	R^2 value	-0.073	-0.113	0.059	0.098	NA	NA	NA	-0.187	-0.165	-0.138	0.034	-0.172	-0.133	-0.099

Dabob Region Samples all years										n=7 NA = undefined due to singularities					
Parameter	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
% Fines	p value	NA	0.794	0.670	0.794	0.026	0.063	NA	0.005	0.834	0.002	NA	0.317	NA	NA
	t test	NA	0.275	-0.452	0.275	-3.119	-2.380	NA	-4.684	-0.221	-5.954	NA	-1.112	NA	NA
	R^2 value	NA	-0.182	-0.153	-0.182	0.593	0.437	NA	0.777	-0.188	0.852	NA	0.038	NA	NA
%TOC	p value	NA	0.087	0.927	0.087	0.235	0.300	NA	0.126	0.209	0.093	NA	0.713	NA	NA
	t test	NA	2.121	0.097	2.121	-1.348	-1.156	NA	-1.834	1.443	-2.075	NA	0.389	NA	NA
	R^2 value	NA	0.368	-0.198	0.368	0.120	0.053	NA	0.283	0.153	0.355	NA	-0.165	NA	NA
Total Heavy	p value	NA	0.248	0.403	0.248	0.605	0.633	NA	0.516	0.334	0.509	NA	0.655	NA	NA
	t test	NA	1.308	0.914	1.308	-0.552	-0.508	NA	-0.698	1.069	-0.711	NA	0.475	NA	NA
	R^2 value	NA	0.106	-0.028	0.106	-0.131	-0.141	NA	-0.094	0.023	-0.090	NA	-0.148	NA	NA
Arsenic (As)	p value	NA	0.104	0.604	0.104	0.726	0.847	NA	0.656	0.095	0.460	NA	0.211	NA	NA
	t test	NA	1.985	0.554	1.985	0.371	0.203	NA	0.473	2.052	0.801	NA	1.434	NA	NA
	R^2 value	NA	0.329	-0.131	0.329	-0.168	-0.190	NA	-0.149	0.349	-0.064	NA	0.150	NA	NA
Cadmium (Cd)	p value	NA	0.255	0.089	0.255	0.422	0.526	NA	0.255	0.362	0.144	NA	0.725	NA	NA
	t test	NA	1.285	-2.110	1.285	-0.874	-0.681	NA	-1.286	1.002	-1.734	NA	0.372	NA	NA
	R^2 value	NA	0.098	0.365	0.098	-0.041	-0.098	NA	0.098	0.001	0.251	NA	-0.168	NA	NA
Copper	p value	NA	0.015	0.448	0.015	0.774	0.825	NA	0.836	0.011	0.793	NA	0.081	NA	NA
	t test	NA	3.611	0.823	3.611	0.303	0.233	NA	0.218	3.925	0.277	NA	2.183	NA	NA
		NA	0.667	-0.057	0.667	-0.178	-0.187	NA	-0.189	0.706	-0.182	NA	0.386	NA	NA
Lead	p value	NA	0.588	0.702	0.588	0.230	0.302	NA	0.186	0.395	0.150	NA	0.234	NA	NA
	t test	NA	-0.579	0.406	-0.579	-1.367	-1.150	NA	-1.534	-0.929	-1.701	NA	-1.354	NA	NA
	R^2 value	NA	-0.125	-0.162	-0.125	0.126	0.051	NA	0.184	-0.023	0.240	NA	0.122	NA	NA
Mercury (Hg)	p value	NA	0.820	0.966	0.820	0.179	0.245	NA	0.116	0.922	0.087	NA	0.525	NA	NA
	t test	NA	0.240	0.414	0.240	-1.562	-1.316	NA	-1.901	-0.103	-2.121	NA	-0.682	NA	NA
	R^2 value	NA	-0.186	-0.160	-0.186	0.194	0.109	NA	0.304	-0.198	0.368	NA	-0.098	NA	NA
Zinc (Zn)	p value	NA	0.891	0.614	0.891	0.140	0.471	NA	0.345	0.941	0.310	NA	0.679	NA	NA
	t test	NA	0.144	0.538	0.144	-0.898	-0.779	NA	-1.042	-0.078	-1.131	NA	-0.439	NA	NA
		NA	-0.195	-0.134	-0.195	-0.033	-0.070	NA	0.014	-0.199	0.044	NA	-0.155	NA	NA
Total PAH	p value	NA	0.529	0.242	0.529	0.534	0.581	NA	0.529	0.424	0.520	NA	0.373	NA	NA
	t test	NA	-0.677	1.325	-0.677	-0.667	-0.590	NA	-0.675	-0.870	-0.691	NA	-0.979	NA	NA
	R^2 value	NA	-0.099	0.112	-0.099	-0.102	-0.122	NA	-0.100	-0.042	-0.095	NA	-0.007	NA	NA

Dabob Region Samples all years												
Parameter	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina	Agglutinates	Dissolution	Desnity	Species Richenss	Shannon
% Fines	p value	0.509	NA	0.241	0.019	0.022	NA	0.134	0.797	0.381	0.141	0.323
	t test	-0.711	NA	-1.331	-3.424	-3.280	NA	-1.788	0.272	0.960	-1.747	-1.097
	R^2 value	-0.090	NA	0.114	0.641	0.619	NA	0.268	-0.183	-0.013	0.255	0.033
%TOC	p value	0.443	NA	0.359	0.379	0.138	NA	0.886	0.235	0.288	0.976	0.805
	t test	0.832	NA	-1.010	-0.964	-1.765	NA	0.150	1.351	1.189	0.031	0.260
	R^2 value	-0.054	NA	0.003	-0.012	0.261	NA	-0.195	0.121	0.064	-0.200	-0.184
Total Heavy	p value	0.486	NA	0.740	0.848	0.570	NA	0.630	0.086	0.129	0.534	0.351
	t test	0.752	NA	-0.350	-0.202	-0.608	NA	0.512	2.136	1.814	0.667	1.021
	R^2 value	-0.078	NA	-0.171	-0.190	-0.118	NA	-0.140	0.373	0.276	-0.102	0.007
Arsenic (As)	p value	0.135	NA	0.371	0.111	0.371	NA	0.032	0.305	0.998	0.039	0.063
	t test	1.783	NA	0.982	1.931	0.982	NA	2.957	1.143	-0.003	2.772	2.377
	R^2 value	0.266	NA	-0.006	0.313	-0.006	NA	0.564	0.049	-0.200	0.527	0.437
Cadmium (Cd)	p value	0.539	NA	0.248	0.307	0.136	NA	0.879	0.467	0.951	0.450	0.262
	t test	0.660	NA	-1.307	-1.138	-1.778	NA	-0.160	-0.786	-0.065	-0.820	-1.265
	R^2 value	-0.104	NA	0.105	0.047	0.265	NA	-0.194	-0.068	-0.199	-0.058	0.091
Copper	p value	0.029	NA	0.819	0.306	0.785	NA	0.023	0.102	0.677	0.041	0.051
	t test	3.023	NA	0.241	1.141	0.288	NA	3.235	2.000	0.442	2.727	2.551
		0.576	NA	-0.186	0.048	-0.181	NA	0.612	0.333	-0.155	0.518	0.479
Lead	p value	0.280	NA	0.423	0.093	0.201	NA	0.112	0.593	0.271	0.247	0.563
	t test	-1.211	NA	-0.873	-2.070	-1.473	NA	-1.923	0.571	1.238	-1.311	-0.619
	R^2 value	0.072	NA	-0.041	0.354	0.163	NA	0.310	-0.127	0.082	0.107	-0.115
Mercury (Hg)	p value	0.683	NA	0.368	0.137	0.136	NA	0.352	0.346	0.214	0.478	0.825
	t test	-0.433	NA	-0.990	-1.767	-1.773	NA	-1.026	1.039	1.422	-0.377	-0.234
	R^2 value	-0.157	NA	-0.003	0.261	0.263	NA	0.009	0.013	0.146	-0.074	-0.187
Zinc (Zn)	p value	0.785	NA	0.559	0.301	3.618	NA	0.576	0.357	0.060	0.751	0.974
	t test	-0.287	NA	-0.626	-1.006	-1.003	NA	-0.597	1.014	2.426	-0.336	0.034
		-0.181	NA	-0.113	0.002	0.001	NA	-0.120	0.005	0.449	-0.174	-0.200
Total PAH	p value	0.375	NA	0.743	0.392	0.578	NA	0.342	0.258	0.079	0.692	0.867
	t test	-0.973	NA	-0.347	-0.936	-0.594	NA	-1.050	1.276	2.206	-0.420	0.176
	R^2 value	-0.009	NA	-0.172	-0.021	-0.121	NA	0.017	0.095	0.392	-0.159	-0.193

Southern Region Samples all years		n=11 NA = undefined due to singularities													
Parameter	Test	Ammobaculites sp.	B. pacifica	B. frigida	B. elegantissima	C. limbata	C. fletcheri	C. lobatulus	C. excavatum	D. rotaliformis	D. squamiformis	E. advena	E. frigidum	E. hannai	E. repandus
% Fines	p value	0.064	NA	0.828	0.457	NA	0.843	0.0002	0.764	0.0001	0.695	0.603	NA	0.741	NA
	t test	-2.112	NA	0.223	0.777	NA	0.204	-5.843	0.310	-6.357	-0.404	0.539	NA	-0.340	NA
	R^2 value	0.257	NA	-0.105	-0.041	NA	-0.106	0.768	-0.099	0.798	-0.091	-0.076	NA	-0.097	NA
%TOC	p value	0.239	NA	0.536	0.775	NA	0.945	0.008	0.053	0.009	0.232	0.911	NA	0.039	NA
	t test	-1.272	NA	0.646	0.295	NA	0.071	-3.469	2.268	-3.415	1.294	0.115	NA	2.467	NA
	R^2 value	0.064	NA	-0.069	-0.113	NA	-0.124	0.551	0.315	0.542	0.070	-0.123	NA	0.361	NA
Total Heavy	p value	0.641	NA	0.944	0.981	NA	0.740	0.001	0.394	0.016	0.817	0.656	NA	0.410	NA
	t test	-0.482	NA	-0.072	0.024	NA	-0.342	-4.754	0.895	-2.957	0.239	0.460	NA	0.865	NA
	R^2 value	-0.083	NA	-0.111	-0.111	NA	-0.097	0.684	-0.020	0.436	-0.104	-0.086	NA	-0.026	NA
Arsenic (As)	p value	0.826	NA	0.984	0.584	NA	0.731	0.144	0.005	0.126	0.126	0.545	NA	0.112	NA
	t test	-0.227	NA	0.020	-0.568	NA	-0.355	-1.600	6.693	-1.687	-1.687	-0.628	NA	1.762	NA
	R^2 value	-0.105	NA	-0.111	-0.073	NA	-0.096	0.135	0.558	0.156	0.156	-0.066	NA	0.174	NA
Cadmium (Cd)	p value	0.988	NA	0.995	0.776	NA	0.672	0.481	0.002	0.340	0.346	0.428	NA	0.063	NA
	t test	-0.016	NA	0.006	-0.293	NA	-0.438	-0.736	4.465	-1.007	0.995	-0.829	NA	2.117	NA
	R^2 value	-0.111	NA	-0.111	-0.101	NA	-0.088	-0.048	0.655	0.001	-0.001	-0.032	NA	0.258	NA
Copper	p value	0.861	NA	0.392	0.933	NA	0.270	0.018	0.575	0.091	0.753	0.837	NA	0.450	NA
	t test	-0.180	NA	-0.900	-0.086	NA	-1.175	-2.893	0.581	-1.893	0.324	0.212	NA	0.791	NA
		-0.107	NA	-0.019	-0.110	NA	0.037	0.424	-0.071	0.205	-0.098	-0.106	NA	-0.039	NA
Lead	p value	0.195	NA	0.146	0.693	NA	0.215	0.040	0.356	0.018	0.995	0.827	NA	0.657	NA
	t test	-1.401	NA	1.593	0.407	NA	1.334	-2.398	0.973	-2.891	0.006	0.225	NA	0.460	NA
	R^2 value	0.088	NA	0.133	-0.091	NA	0.072	0.322	-0.005	0.424	-0.111	-0.105	NA	-0.086	NA
Mercury (Hg)	p value	0.165	NA	0.300	0.850	NA	0.404	0.003	0.657	0.003	0.970	0.666	NA	0.676	NA
	t test	-1.510	NA	1.099	0.195	NA	0.876	-3.983	0.460	-3.990	0.038	0.447	NA	0.432	NA
	R^2 value	0.114	NA	0.020	-0.106	NA	-0.024	0.598	-0.086	0.599	-0.111	-0.087	NA	-0.089	NA
Zinc (Zn)	p value	0.058	NA	0.466	0.841	NA	0.585	0.005	0.609	0.032	0.997	0.412	NA	0.659	NA
	t test	-0.576	NA	0.761	0.206	NA	0.566	-0.364	0.531	-2.539	-0.004	0.861	NA	0.456	NA
		-0.072	NA	-0.044	-0.106	NA	-0.073	0.551	-0.077	0.353	0.111	-0.027	NA	-0.086	NA
Total PAH	p value	0.579	NA	0.466	0.841	NA	0.585	0.005	0.609	0.032	0.997	0.412	NA	0.659	NA
	t test	-0.576	NA	0.761	0.206	NA	0.566	-3.641	0.531	-2.539	-0.004	0.861	NA	0.456	NA
	R^2 value	-0.072	NA	-0.044	-0.106	NA	-0.073	0.551	-0.077	0.353	-0.111	-0.027	NA	-0.086	NA

Southern Region Samples all years												n=11 NA = undefined due to singularities			
Parameter	Test	F. basispinatum	F. cf seminuda	G. californiana	H. columbiense	H. planissimum	H. subgloboum	L. striata (d'Orbigny)	L. arenulata	M. fusca Brady	N. stella	O. melo	P. fusca	Q. vulgaris	R. advena
% Fines	p value	NA	NA	0.222	0.671	0.054	0.665	NA	0.037	0.462	0.922	NA	0.766	NA	0.490
	t test	NA	NA	-1.313	-0.439	-2.218	-0.447	NA	-2.451	-0.768	-0.100	NA	-0.306	NA	0.720
	R^2 value	NA	NA	0.068	-0.088	0.282	-0.087	NA	0.334	-0.043	-0.110	NA	-0.100	NA	-0.051
%TOC	p value	NA	NA	0.971	0.975	0.667	0.725	NA	0.509	0.657	0.130	NA	0.962	NA	0.755
	t test	NA	NA	-0.038	0.032	0.447	-0.364	NA	-0.690	-0.462	1.686	NA	0.049	NA	0.322
	R^2 value	NA	NA	-0.125	-0.125	-0.098	-0.107	NA	-0.062	-0.096	0.170	NA	-0.125	NA	-0.111
Total Heavy	p value	NA	NA	0.758	0.577	0.549	0.694	NA	0.284	0.836	0.721	NA	0.382	NA	0.966
	t test	NA	NA	-0.318	0.579	-0.622	-0.407	NA	-1.139	-0.214	0.396	NA	0.918	NA	0.043
	R^2 value	NA	NA	-0.099	-0.071	-0.065	-0.091	NA	0.029	-0.106	-0.095	NA	-0.016	NA	-0.111
Arsenic (As)	p value	NA	NA	0.234	0.820	0.550	0.185	NA	0.770	0.362	0.387	NA	0.435	NA	0.494
	t test	NA	NA	1.270	-0.235	0.562	-1.434	NA	-0.302	-0.961	0.908	NA	0.818	NA	-0.712
	R^2 value	NA	NA	0.059	-0.104	-0.073	0.096	NA	-0.100	-0.008	-0.018	NA	-0.034	NA	-0.052
Cadmium (Cd)	p value	NA	NA	0.068	0.691	0.266	0.296	NA	0.094	0.423	0.334	NA	0.507	NA	0.672
	t test	NA	NA	2.077	-0.410	1.187	-1.111	NA	-0.075	-0.840	1.021	NA	0.691	NA	-0.438
	R^2 value	NA	NA	0.249	-0.091	0.039	0.023	NA	-0.110	-0.030	0.004	NA	-0.066	NA	-0.088
Copper	p value	NA	NA	0.860	0.498	0.697	0.632	NA	0.920	0.909	0.811	NA	0.375	NA	0.932
	t test	NA	NA	-0.181	0.705	-0.403	-5.600	NA	-0.104	0.117	-0.246	NA	0.934	NA	-0.088
		NA	NA	-0.107	-0.053	-0.091	-0.082	NA	-0.110	-0.109	-0.104	NA	-0.013	NA	-0.110
Lead	p value	NA	NA	0.766	0.638	0.497	0.791	NA	0.021	0.341	0.203	NA	0.895	NA	0.709
	t test	NA	NA	-0.306	-0.487	-0.707	-0.273	NA	-2.791	-1.005	1.372	NA	-0.135	NA	0.386
	R^2 value	NA	NA	-0.100	-0.083	-0.053	-0.102	NA	0.404	0.001	0.081	NA	-0.109	NA	-0.093
Mercury (Hg)	p value	NA	NA	0.586	0.883	0.333	0.696	NA	0.041	0.425	0.345	NA	0.983	NA	0.847
	t test	NA	NA	-0.656	-0.152	-1.024	-0.404	NA	-2.387	-0.836	0.997	NA	-0.022	NA	0.199
	R^2 value	NA	NA	-0.073	-0.108	0.005	-0.091	NA	0.320	-0.031	-0.001	NA	-0.111	NA	-0.106
Zinc (Zn)	p value	NA	NA	0.512	0.628	0.405	0.959	NA	0.046	0.782	0.458	NA	0.525	NA	0.782
	t test	NA	NA	-0.683	0.502	-0.874	0.052	NA	-2.320	-0.285	0.775	NA	0.661	NA	0.285
		NA	NA	-0.056	-0.081	-0.024	-0.111	NA	0.305	-0.101	-0.042	NA	-0.060	NA	-0.101
Total PAH	p value	NA	NA	0.512	0.628	0.405	0.959	NA	0.046	0.782	0.458	NA	0.525	NA	0.782
	t test	NA	NA	-0.683	0.502	-0.874	0.052	NA	-2.320	-0.285	0.775	NA	0.661	NA	0.285
	R^2 value	NA	NA	-0.056	-0.081	-0.024	-0.111	NA	0.305	-0.101	-0.042	NA	-0.060	NA	-0.101

Southern Region Samples all years												
Parameter	Test	S. biformis	T. bellatulla	T. hadai	T. inflata	T. pacifica	U. peregrina	Agglutinates	Dissolution	Desnity	Species Richenss	Shannon
% Fines	p value	0.730	NA	0.000	0.336	0.001	0.843	0.867	0.916	0.701	0.029	0.062
	t test	-0.356	NA	-5.843	-1.016	-5.070	0.204	0.176	0.109	0.397	-0.259	-2.126
	R^2 value	-0.096	NA	0.768	0.003	0.712	-0.106	-0.193	-0.110	-0.092	0.363	0.261
%TOC	p value	0.720	NA	0.008	0.703	0.007	0.945	0.348	0.895	0.659	0.265	0.744
	t test	-0.371	NA	-3.469	-0.394	-3.563	0.071	-0.996	-0.136	0.458	-1.197	-0.339
	R^2 value	-0.106	NA	0.551	-0.104	0.565	-0.124	-0.001	-0.122	-0.096	0.046	-0.109
Total Heavy	p value	0.808	NA	0.0010	0.934	0.0005	0.740	0.177	0.996	0.364	0.081	0.237
	t test	-0.250	NA	-4.754	0.086	-5.302	-0.342	-1.465	0.006	0.956	-1.967	-1.267
	R^2 value	-0.103	NA	0.684	-0.110	0.731	-0.097	0.103	-0.111	-0.009	0.223	0.057
Arsenic (As)	p value	0.206	NA	0.144	0.616	0.090	0.731	0.083	0.635	0.925	0.650	0.620
	t test	-1.362	NA	-1.600	-0.619	-1.898	-0.355	-1.951	0.491	-0.097	-0.469	-0.514
	R^2 value	0.079	NA	0.135	-0.079	0.207	-0.096	0.219	-0.082	-0.110	-0.085	-0.079
Cadmium (Cd)	p value	0.336	NA	0.481	0.596	0.386	0.672	0.197	0.489	0.948	0.810	0.914
	t test	-1.016	NA	-0.736	-0.550	-0.912	-0.438	-1.393	0.721	-0.067	0.247	0.112
	R^2 value	0.003	NA	-0.048	-0.075	-0.017	-0.088	0.086	-0.050	-0.111	-0.104	-0.110
Copper	p value	0.825	NA	0.018	0.794	0.013	0.270	0.291	0.679	0.459	0.105	0.360
	t test	-0.227	NA	-2.893	0.269	-0.108	-1.175	-1.121	-0.427	-0.774	-1.805	-0.964
		-0.105	NA	0.424	-0.102	0.464	0.037	0.025	-0.089	-0.042	0.184	-0.007
Lead	p value	0.655	NA	0.040	0.417	0.042	0.215	0.302	0.456	0.811	0.408	0.408
	t test	-0.462	NA	-0.398	-0.851	-2.396	1.334	-1.095	0.779	0.247	-0.868	-0.868
	R^2 value	-0.085	NA	0.322	-0.028	0.316	0.072	0.020	-0.049	-0.104	-0.025	-0.025
Mercury (Hg)	p value	0.582	NA	0.003	0.554	0.003	0.404	0.324	0.504	0.755	0.138	0.271
	t test	-0.571	NA	-3.983	-0.615	-4.072	0.876	-0.104	0.696	0.321	-1.626	-1.193
	R^2 value	-0.072	NA	0.598	-0.066	0.609	-0.024	0.009	-0.054	-0.099	0.141	0.036
Zinc (Zn)	p value	0.947	NA	0.005	0.937	0.005	0.585	0.293	0.740	0.306	0.146	0.241
	t test	0.038	NA	-3.641	0.081	-3.752	0.566	-1.118	0.342	1.084	-1.590	-1.256
		-0.111	NA	0.551	-0.110	0.567	-0.073	0.024	-0.097	0.017	0.133	0.055
Total PAH	p value	0.947	NA	0.005	0.937	0.005	0.585	0.827	0.791	0.404	0.947	0.693
	t test	0.068	NA	-3.641	0.081	-3.752	0.566	-0.225	0.274	0.875	0.068	-0.408
	R^2 value	-0.111	NA	0.551	-0.110	0.567	-0.073	-0.105	-0.102	-0.024	-0.111	-0.091