Assessment of Benthic Species Assemblages and Their Relation to Environmental Conditions in Casco Bay

Thomas J. Trott, Ph.D., Benthic Ecologist, Maine Coastal Mapping Initiative, Maine Coastal Program, Department of Marine Resources

This report summarizes the results of the benthic survey conducted in Casco Bay, Maine during August 2020, as part of the DEP project, Ambient Water Quality Monitoring and Eelgrass Monitoring and Mapping.

Sample Locations and General Methods of Analysis

Sample stations are distributed within the inner waters of Casco Bay and strategically placed according to the overarching goals of the study (Figure 1). Survey data used for analysis are the product of benthic sampling with a standard ponar grab (8.2 L maximum sample volume), three grabs per station.

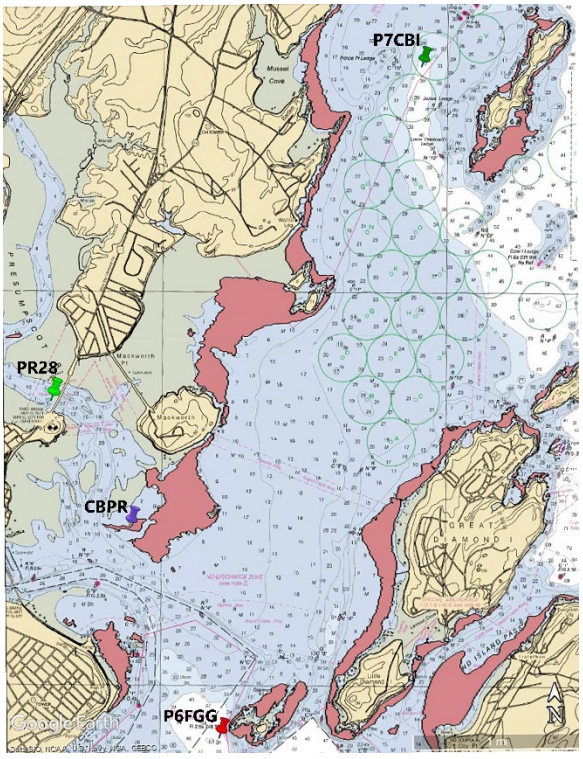

Figure 1. Sampling locations for 2020 benthic surveys in Casco Bay. Shaded areas indicate eelgrass beds.

Statistical analyses using Primer Permanova+ explore similarities among benthic assemblages and possible relationships with environmental measures and sediment characteristics. When present, epifaunal assemblages are combined with infauna ones prior to analysis. Combining is justified since some mobile epifauna can detach or crawl out and join the pool of infauna in a grab sample prior to on-ship sample sorting. Moreover, mixing can also occur prior to laboratory processing because hard substrata are not always held in sample containers separate from ones with presumed infauna. Consequently, since a sample can contain some species which may be both infaunal and epifaunal, not knowing which assemblage they originate from makes post-sampling categorization artificial. The most parsimonious solution to this problem is combine all species regardless of the source they come from.

Species Diversity and Abundance

In general, annelids, molluscs and arthropods are dominant taxa among all stations. The one exception is P7CBI where annelids far outnumber other taxa both in number of species and abundance (Figure 2). This distinction is likely due to the mud

bottom, favorable for polychaetes. CBPR is the only location with similar substrate, but its mud(clay) bottom is prone to anoxia and therefore a less optimal habitat. Indeed, CBPR has the least number of species and lowest overall abundance among stations. However, it ranks second in terms of the proportion of species that are annelids and their percentage of total abundance.

The highest species diversity and abundance occurs at PR28, with P6FGG ranking second. Both locations have muddy shell hash bottoms with shell and gravel, Consequently, epifauna living on these hard substrata contribute greatly to the high species diversity and abundance which distinguish these two locations.

A comparison of all sample locations for dominant taxa shows only one or two species that are most abundant. These epifaunal species greatly outnumber all others. Among molluscs, the mussel *Mytilus* and slipper shell *Crepidula* are the most abundant. The barnacle, *Balanus crenatus*, and harpacticoids are the most abundant arthropods. The most abundant annelids were capitellids and the sabellid *Chone infundibuliformis* nearly equal in abundance. *Capitella capitata,* normally an infaunal species, inhabits the branches of the bushy creeping bryozoan *Amathia gracilis* at both P28 and P6FGG. In mud sediments at CBPR and P7CBI, annelids are dominant, namely the capitellid *Mediomastus ambeseta*, the nephtyid *Nephtys incisa*, and the cossurid *Cossura longocirrata*. These polychaetes occur in roughly equal numbers (22-26 individuals), but with abundances far below the hundreds of dominant epifaunal species at PR28 and P6FGG.

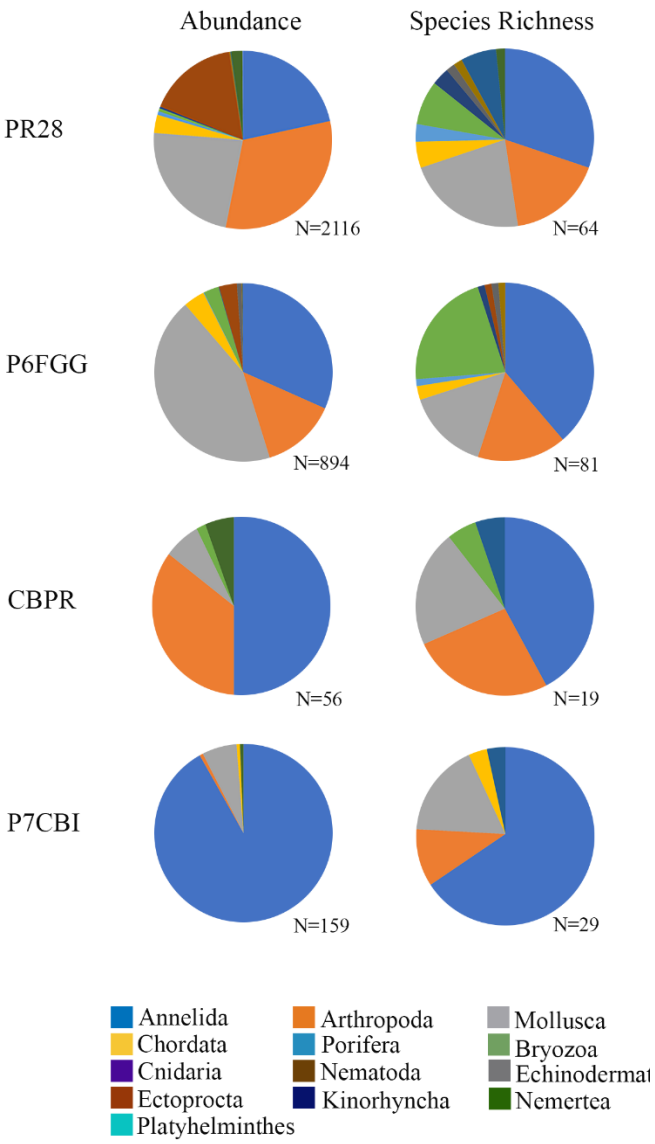

Figure 2. Composition of benthic species assemblages among Casco Bay sample stations. N refers to the number of individuals or number of species for abundance and species richness, respectively.

Rare species make-up the bulk of species

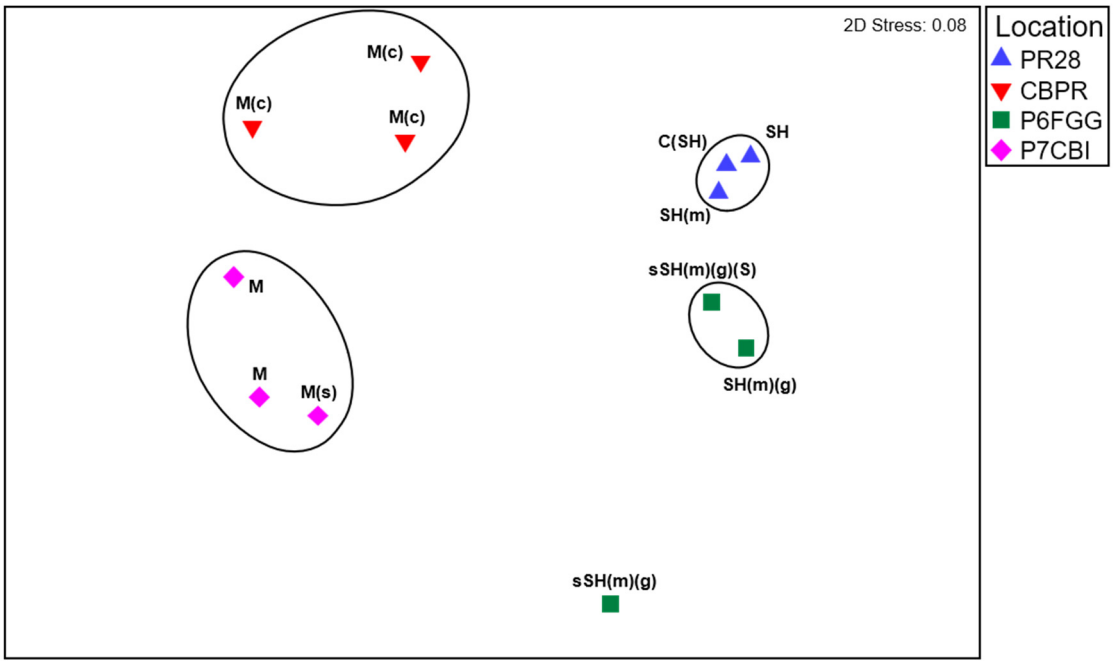

Figure 3. Two-dimensional nonparametric MDS configuration of Casco Bay species assemblages from Bray-Curtis similarities on standardized square root transformed abundances with clusters identified within ellipses as not significantly different (SIMPROF, $P>0.05$). Abbreviations in bold caps indicate Major sediment type. Minor components are within parentheses. M, mud; SH, shellhash; C, cobble; S, shell; c, clay; s, sand; g, gravel.

diversity with rare meaning species present as one or few individuals at most. Noteworthy species are the cumacean *Petalosarsia declivis* at PR28 and the kinorhynch *Leiocanthus mainensis* at PR28 and P6FGG. Interestingly, mites also occur at those two locations.

In summary, benthic assemblages are associated with sediments characteristics and this relationship explains most of the qualitative differences among sample locations. As expected, few species are dominant, and most species are rare.

Similarity Among Sampling Locations

The configuration of species assemblages among sample locations produced by nonparametric multidimensional scaling of Bray-Curtis similarities aligns with the qualitative descriptions (Figure 3). Species assemblages among locations are statistically distinct (SIMPER, $P<0.05$), but not so within stations. Assemblages from hard substrates (PR28 and P6FGG) are closer together, i.e., similar, and separate from those from muddy locations that are nearer to each other (CBPR and P7CBI). The exception to this pattern is P6FGG where there is a large disparity in abundances among samples. Only 30 individuals are represented in one sample in contrast to 520 and 344 individuals in the other two. Average dissimilarities among sample locations and the taxa contributing to 70% to those values (SIMPER) are in Appendix 1 & 2.

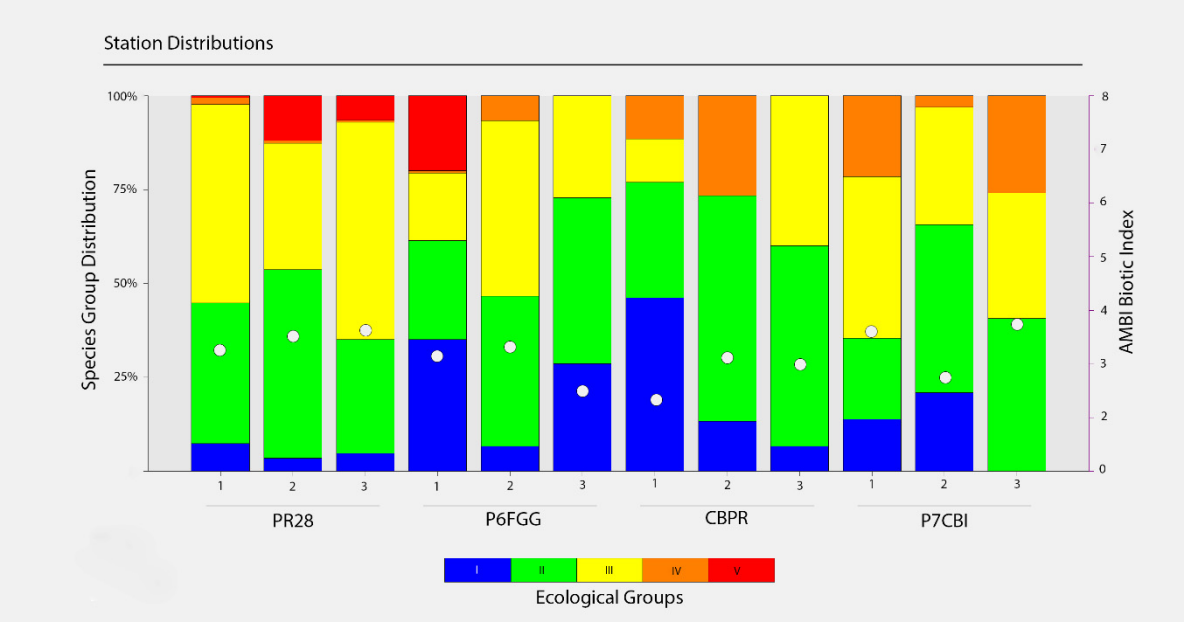

Figure 4. Ranking of species assemblages of individual samples from each sample station according to AMBI. Open circles indicate the AMBI index. Definitions of ecological groups and the source of data are in Table 2.

Analyses investigating the degree that sample location and sediment types contribute to differences among species assemblages yields mixed results. Location is a significant factor (PERMANOVA, P=0.02), however sediment type is not. Pair-wise tests of stations support nMDS results. The pair CBPR and P7CBI is not significantly different, and neither is PR28 and P6FGG. All other combinations of locations differed significantly (P=0.001). These results are preliminary since the qualitative classification of sediments may influence the outcomes of analysis. The relationship between sediments and species assemblages will be examined further when sediment samples have been processed and analyzed.

Ecological Index of Habitat Quality

There are many indices of habitat quality. AMBI is a marine biotic index based on species sensitivity/tolerance, with diversity and richness, making it compliant with the European Water Framework Directive. M-AMBI (Multivariate AMBI) is a multimetric index for assessing the ecological quality status of marine and transitional waters and integrates AMBI by means of factor analysis and principal coordinates ordination. As with most biotic indices, AMBI draws its own share of criticism. It is used here for illustrative purposes and because it is a well-established standard.

All samples show some degree of impact (Table 1, Figure 4), but the overall AMBI index shows it is slight and generally equivocal among stations (Figure 5). Species sensitivity/tolerance is used in AMBI to classify species according to ecological groups which are organized from I to V and range from high to low sensitivity, respectively.

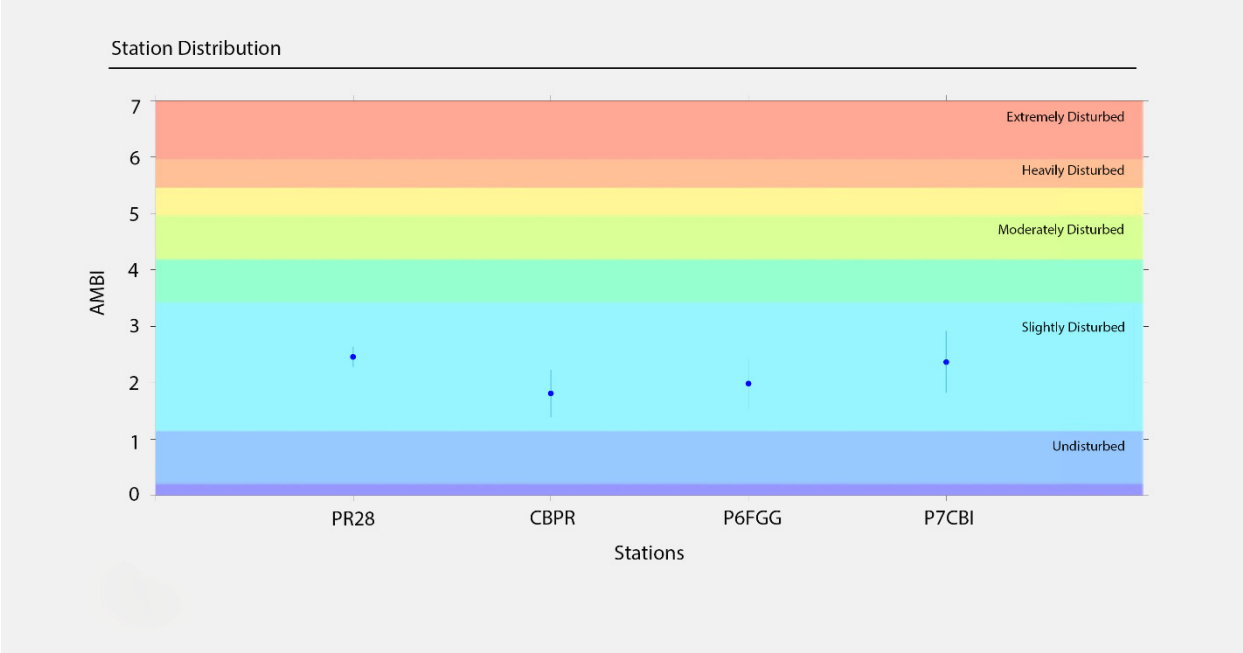

Figure 5. Biotic index from mean AMBI ± SD for each Casco Bay station. Values are in Table 1.

Sensitivity/tolerance varies among the Casco Bay assemblages. Ecological Group V is best represented by samples PR28-2 and P6FGG-1 that contain *Capitella capitata*. This first-order opportunistic species can resist high disturbance, is a deposit feeder, and proliferates in reduced sediments. Noteworthy is where *C. capitata* is found. It inhabits the branches of the bushy creeping bryozoan *Amathia gracilis* and is not infaunal. Ecological Group 4 is also well represented by the capitellid *Mediomastus abesita* and is present in all samples except those from CBPR. The paranoid *Levinsenia gracilis* (Group 3) occurs only at P7CBI and is known to occupy sediments with high organic content. Filter feeders (Group 2) were abundant, particularly the bryozoan *Amathia gracilis* that formed thick mats on hard substrate at PR28 and P6FGG. This species has been associated with poor water quality because of its resistance to enrichment. No metric was used to measure the abundance of *A. gracilis* or any colonial animal where individual colonies are difficult to distinguish. i.e., ectoprocts, hydrozoans, encrusting bryozoans. Notes on the abundance of *A. gracilis* are from observations only.

Species Assemblages and Environmental Conditions

The relationships among samples between species assemblages and environmental metrics measured with a multiparameter Exo1 sonde are statistically significant. When considered individually in sequential tests, the variation among assemblages is predicted, listed here in decreasing order of significance, by salinity (P<0.007), pH (P<0.006), dissolved oxygen (P<0.017), and temperature (P<0.025) according to distance-based linear modelling. Depth and chlorophyll were not significant predictors. When considered as sets that predict variation among assemblages, the smallest includes depth, salinity, and temperature (R^2 =0.58). However, all six parameters

Table 1. Biodiversity and AZTI Marine Biotic Index for Casco Bay species assemblages.

Station	Replicate	Richness	Abundance	AMBI Ecological Groups*					AMBI	Mean AMBI	Biotic Index from Mean AMBI	Standard deviation	Disturbance Classification
				I(%)	II(%)	III(%)	IV(%)	V(%)					
PR28	1	35	620	7.365	37.48	52.864	1.8	0.491	2.259				
PR28	2	37	582	3.493	50.184	33.64	0.735	11.949	2.512	2.459	2	0.18	Slightly disturbed
PR28	3	46	914	4.745	30.324	57.87	0.579	6.481	2.606				
CBPR	1	10	26	46.154	30.769	11.538	11.538	0	1.327				
CBPR	2	8	15	13.333	60	0	26.667	0	2.1	1.809	2	0.42	Slightly disturbed
CBPR	3	8	15	6.667	53.333	40	0	0	2				
P6FGG	1	60	520	35.078	26.357	18.023	0.581	19.961	2.16				
P6FGG	2	13	30	6.667	40	46.667	6.667	0	2.3	1.979	2	0.441	Slightly disturbed
P6FGG	3	45	344	28.66	44.237	27.103	0	0	1.477				
P7CBI	1	17	65	13.846	21.538	43.077	21.538	0	2.585				
P7CBI	2	18	67	20.896	44.776	31.343	2.985	0	1.746	2.37	2	0.548	Slightly disturbed
P7CBI	3	10	27	0	40.741	33.333	25.926	0	2.778				

*Definition of Ecological Groups

Group 1. Species very sensitive to organic enrichment and disturbance, usually present only under unpolluted conditions. They include specialist carnivores, some deposit-feeding tubiculous polychaetes and species that structure communities. Most have long life cycles.
Group 2. Species indifferent to enrichment or disturbance, always present in low densities with non-significant variations over time. These include suspension feeders, less selective carnivores and scavengers.
Group 3. Species tolerant of excess organic matter enrichment, that may occur under normal conditions, but their populations are stimulated by organic enrichment. They are surface deposit feeding species, such as tubiculous spionids.
Groups 4. Second-order opportunistic species. They are mainly small subsurface deposit-feeding polychaetes, such as cirratulids.
Group 5. First order opportunistic species, able to resist high disturbance. These are deposit-feeders, which proliferate in reduced sediments.

form the best set for predicting (R^2 =0.757). The strength and direction of these environmental metrics are visualized in the vectors overlaid on the configuration of samples from distance-based redundancy analysis (Figure 6). Although all six parameters best predict variation among species assemblages, they explain only 36% of the total variation. Measurement of additional water quality metrics like water velocity, turbidity, and nitrogen might improve both fit and the amount explained of the total variation among samples. Adding a geological indicator, i.e., sediments, to the analysis makes little improvement; it slightly decreases fit while % total variation basically remains unchanged (44.2% of fitted, 36.2% of total variation). Such a minor change is expected, since distanced-based linear modelling shows the influence of environmental indicators is greater (P=0.001) than geological ones (P=0.019). As a set, both indicators best predict the variation among samples (R^2=0.82), however, the single best predictor is environmental (R^2=0.757), not geological (R^2=0.222).

The configuration of samples in a combined MDS of Bray-Curtis similarities and

environmental parameters groups species assemblages similar to the one shown in Figure 3, except the separation between samples is somewhat reduced (Figure 7). The primary sediment types are superimposed along with bubble plots of abundance for *A. gracilis*, *C. capitata*, *M. ambesita*, and *L. gracilis*. This plot summarizes the main points established in the previous sections regarding differences among species assemblages, their relation to sediment types, occurrence of species of interest, and the relationship of environmental conditions to variation in similarity among samples.

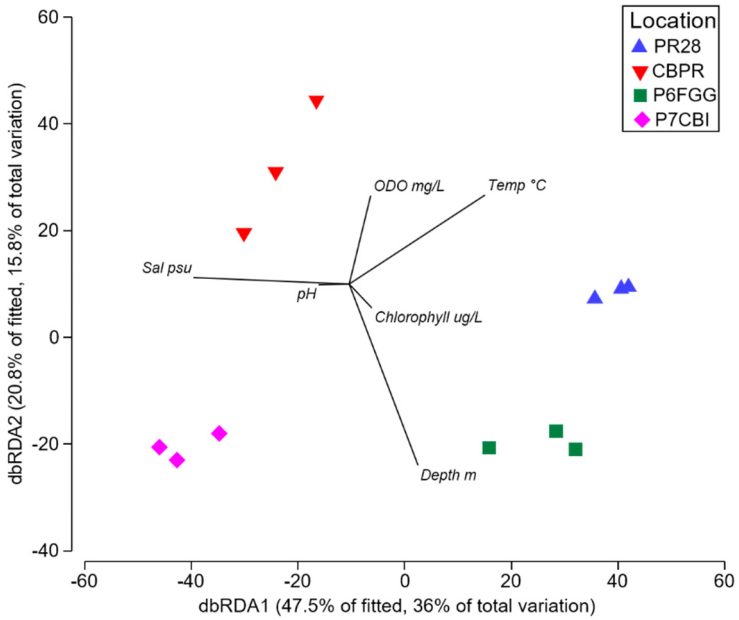

Figure 6. dbRDA of Casco Bay benthic species assemblages with vector overlays for environmental parameters.

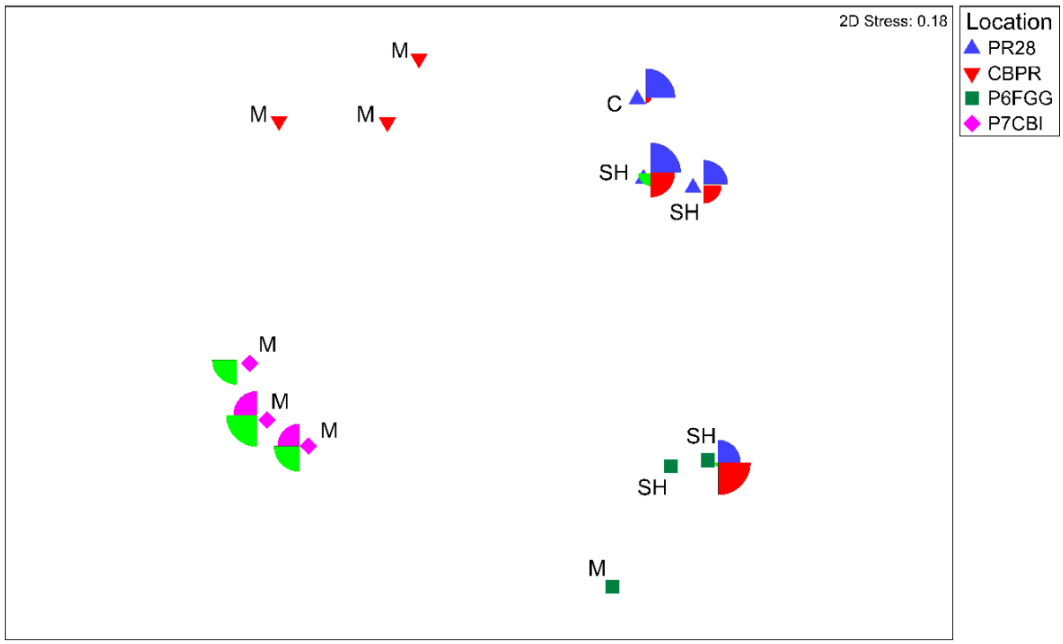

Figure 7. Combined MDS of Bray-Curtis similarities and environmental data (salinity, pH, dissolved oxygen, temperature, and depth) for Casco Bay samples. Primary sediment types are: M, mud; SH, shellhash; C, cobble. Bubble plots and size correspond to *Amathia gracilis* (●), *Capitella capitata* (●), *Mediomastus ambesita* (●), and *Levinsinia gracilis* (●). Scale for bubble size: 1-20 except for colonial *A. gracilis* (not counted).

Environmental Conditions among Stations

Environmental conditions, defined by salinity, pH, dissolved oxygen, temperature, and depth, among Casco Bay stations are significantly different. Moreover, measurements within stations do not differ significantly, except for one sample at PR28 (Figure 8). The configuration of samples in a principal coordinates ordination shows samples grouped by station with clear separation among them, supporting the idea of the distinctness of stations (Figure 9). The environmental metrics explain 87% of the total variation among samples. Vector overlays show the strength and direction of Spearman correlations for each metric. Chlorophyll and dissolved oxygen are least correlated with the configuration of samples.

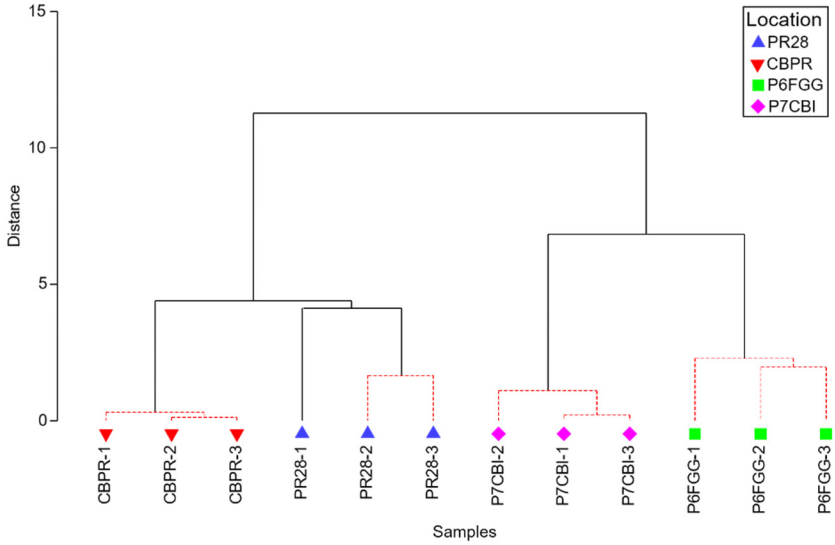

Figure 8. Hierarchal cluster analysis using group average for environmental metrics at each Casco Bay sample location. Red lines connect samples that do not differ significantly (SIMPROF Test, $P>0.05$).

The clustering of stations differs considerably from what is shown for benthic samples (Figure 6), notably the pattern is the complete opposite. However, these two PCO's cannot be directly compared statistically to draw con-

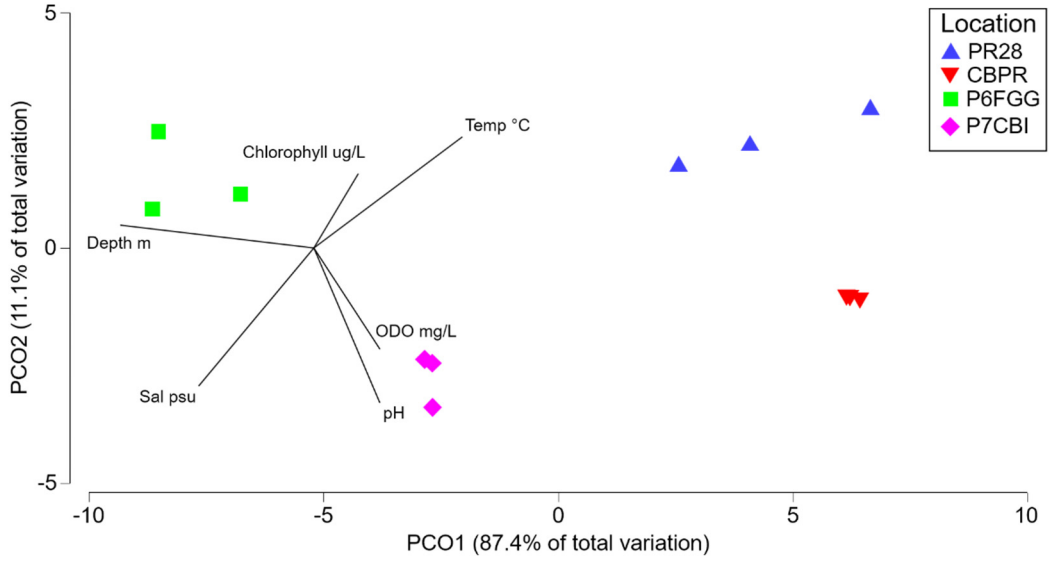

Figure 9. Principal coordinates ordination of environmental parameters at each Casco Bay sample location. Vector overlays show Spearman correlations of each metric, with length and direction indicating degree of correlation and effect, respectively.

clusions. This is because the ordination of samples in Figure 6 is based on Bray-Curtis similarities, while that in Figure 9 based on Euclidean distance.

Caveats to Biological Data Interpretation

There are some limitations inherent in the sampling design that in some degree need to be held in mind when interpreting biological data in this report. In most instances, they have produced a conservative view of species diversity and abundance. That said, the magnitude of the points raised regarding species assemblages may be greater than described.

Specific caveats are:

1. The abundance of epifauna is underestimated, a consequence of using a ponar grab designed to sample infauna. The grab is not the best instrument for quantitatively sampling whole and broken shells, stones, and living oysters and mussels.
2. Caution should be used for making comparisons of abundance among epifaunal samples and locations. The amount of rock, shell, and living molluscs that epifauna lived on differed among samples. Abundance of epifauna was not standardized for volume of material.
3. The abundance of colonial animals like sponges, some ascidians and bryozoans, ectoprocts, and hydrozoans was not meaningfully quantified as it was for noncolonial species which were counted. Typically, biomass or surface area occupied is used rather than counts to quantify colonial species. Such methods are limited by the ability to distinguish co-occurring colonies of the same species occupying the same substrate.

Recommendations for Future Surveys

The caveats to this study point the way for improvements in the survey design for future studies. Saving rocks, shell and cobble was fortuitous, since epifauna became an important contribution to understanding species assemblages and the presence of species of interest. Better ways of sampling this benthic component should be used so that species abundance can be standardized for statistical comparisons. Collection of $0.1m^2$ quadrat samples of surface substrata by SCUBA is recommended. On hard bottoms where a ponar grab has reduced performance, infauna samples should be gathered after epifauna sampling.

Sample size restricted some statistical analyses. The degrees of freedom were too small for testing interactions between factors as in the instances of location x sediment and interactions among environmental parameters. Sample size should be increased to at least four samples per station if such analyses are needed. Increasing the number of samples will also ameliorate the large variation among samples within stations and increase their similarity. The low similarity among grab samples per station is evident as reported in Appendix 1.

Appendix 1. Comparisons of species assemblages within stations using Bray-Curtis similarities among grab samples within locations (SIMPER routine). Cut-off for low contributions to similarities is 70%.

PR28 Average similarity among samples: 62.29

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Balanus crenatus	4.58	9.03	5.28	14.5	14.5
Mytilus edulis/trosullus	3.61	6.73	23.9	10.81	25.31
Nematodes	3.56	5.71	11.63	9.17	34.49
Chone infundibuliformis	3.11	5.34	3.2	8.57	43.06
Monocorophium insidiosum	2.18	3.73	5.18	5.98	49.04
Capitella capitata	2.17	2.82	1.28	4.52	53.56
Crepidula plana	1.7	2.34	22.56	3.76	57.32
Anomia simplex	1.34	2.32	8.65	3.73	61.05
Hiatella arctica	1.2	2.27	5.72	3.65	64.69
Ascidiella aspersa	1.4	2.23	2.92	3.57	68.27
Harpacticoids	1.65	2.1	1	3.38	71.65

P7CBI Average similarity among samples: 46.76

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Mediomastus ambiseta	3.7	9.64	18.41	20.61	20.61
Cossura longocirrata	3.69	7.88	1.47	16.86	37.46
Nephtys incisa	3.31	5.97	3.37	12.76	50.22
Ninoe nigripes	2.23	4.43	2.44	9.47	59.69
Nephtys bucera	1.46	3.51	12.51	7.51	67.2
Levinsenia gracilis	2.09	2.62	0.58	5.6	72.8

P6FGG Average similarity among samples: 30.34

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Tritia trivittata	3.4	6.14	5.12	20.25	20.25
Ophelina acuminata	3.33	3.97	5.84	13.09	33.34
Botrylloides violaceus	1.5	2.78	3.33	9.15	42.49
Anomia simplex	2.63	1.96	0.58	6.45	48.94
Hiatella arctica	2.06	1.77	0.58	5.85	54.79
Mytilus edulis/trosullus	1.77	1.52	0.58	5	59.79
Balanus crenatus	2.05	1.21	0.58	3.98	63.77
Ampharete arctica	1.08	1.15	0.58	3.78	67.55
Ascidiella aspersa	0.95	0.83	0.58	2.74	70.29

CPBR Average similarity among samples: 29.65

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nephtys incisa	4.52	14.87	11.2	50.14	50.14
Balanus crenatus	2.43	4.46	0.58	15.05	65.19
Polydora cornuta	2.62	4.07	0.58	13.73	78.92

Appendix 2. Comparisons of average Bray-Curtis dissimilarities of species assemblages among sample stations (SIMPER routine). Cut-off for species contributions to dissimilarities is 70%.

Compare: PR28 & CPBR. Average dissimilarity = 91.47

Species	Group PR28 Av. Abund	Group CPBR Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Nephtys incisa	0	4.52	6.2	7.89	6.77	6.77
Mytilus edulis/trosullus	3.61	0	4.96	4.24	5.42	12.2
Nematodes	3.56	0	4.85	2.79	5.3	17.49
Chone infundibuliformis	3.11	0	4.25	3.53	4.65	22.14
Polydora cornuta	0.63	2.62	3.3	1.59	3.61	25.75
Monocorophium insidiosum	2.18	0	3.01	3.13	3.29	29.04
Capitella capitata	2.17	0	2.96	1.87	3.23	32.27
Balanus crenatus	4.58	2.43	2.94	1.11	3.22	35.48
Ampelisca vadorum	0	2.17	2.94	0.67	3.21	38.7
Cerebratulus lacteus	0	2.08	2.86	1.28	3.13	41.83
Alitta succinea	0	1.79	2.44	1.33	2.67	44.49
Ninoe nigripes	0	1.72	2.37	0.67	2.59	47.08
Crepidula plana	1.7	0	2.35	1.75	2.56	49.65
Harpacticoids	1.65	0	2.24	1.75	2.45	52.1
Ascidiella aspersa	1.4	0	1.9	2.93	2.08	54.18
Anomia simplex	1.34	0	1.84	3.23	2.01	56.19
Crepidula convexa	1.23	0	1.7	2.41	1.86	58.05
Pagurus acadianus	0	1.22	1.68	0.67	1.83	59.88
Hiatella arctica	1.2	0	1.65	5.02	1.81	61.69
Grandidierella japonica	1.13	0	1.54	4.62	1.69	63.37
Littorina littorea	0.27	0.86	1.31	0.92	1.43	64.81
Microdeutopus gryllotalpa	0.93	0	1.27	5.25	1.39	66.2
Botrylloides violaceus	0.92	0	1.25	6.15	1.37	67.57
Leitoscoloplos robustus	0.16	0.86	1.25	0.78	1.37	68.94
Crangon septemspinosa	0	0.86	1.19	0.67	1.3	70.23

Compare PR28 & P6FGG. Average dissimilarity = 73.40

Species	Group PR28 Av. Abund	Group P6FGG Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Ophelina acuminata	0	3.33	3.98	1.25	5.43	5.43
Tritia trivittata	0.23	3.4	3.61	2.46	4.92	10.35
Chone infundibuliformis	3.11	0	3.45	3.2	4.71	15.06
Balanus crenatus	4.58	2.05	3.13	1.31	4.27	19.32
Nematodes	3.56	1.24	2.67	1.27	3.64	22.96
Capitella capitata	2.17	1.48	2.45	1.83	3.33	26.29
Anomia simplex	1.34	2.63	2.35	2.46	3.2	29.49
Mytilus edulis/trosullus	3.61	1.77	2.22	1.06	3.03	32.51
Monocorophium insidiosum	2.18	0.46	1.97	1.91	2.69	35.2
Crepidula plana	1.7	0	1.9	1.7	2.59	37.79
Hiatella arctica	1.2	2.06	1.8	4.37	2.46	40.25
Thelepus cincinnatus	0	1.52	1.56	0.97	2.13	42.38
Harpacticoids	1.65	0.57	1.54	1.43	2.1	44.47
Ampharete arctica	0	1.08	1.28	1.24	1.75	46.22
Grandidierella japonica	1.13	0	1.25	3.94	1.71	47.93
Pagurus longicarpus	0	0.86	1.12	0.67	1.52	49.45
Crepidula convexa	1.23	0.39	0.99	1.34	1.34	50.8
Parvicardium pinnulatum	0	0.79	0.98	0.91	1.33	52.13
Cribrilina macropunctata	0	0.75	0.94	0.86	1.28	53.41
Polycirrus eximius	0	0.75	0.94	0.86	1.28	54.68
Ascidiella aspersa	1.4	0.95	0.89	1.1	1.21	55.89
Leitoscoloplos robustus	0.16	0.61	0.83	0.79	1.13	57.02
Halichondria (Halichondria) bowerbanki	0.71	0	0.79	2.63	1.08	58.1
Exogone dispar	0	0.61	0.79	0.67	1.08	59.18
Pagurus pubescens	0	0.61	0.79	0.67	1.08	60.26
Praxillella praetermissa	0	0.61	0.79	0.67	1.08	61.33
Siliqua costata	0	0.61	0.79	0.67	1.08	62.41
Pherusa aspera	0.11	0.76	0.75	1.5	1.02	63.43
Microdeutopus gryllotalpa	0.93	0.33	0.7	1.64	0.95	64.38
Mediomastus ambiseta	0.57	0.18	0.7	0.83	0.95	65.33
Lineus pallidus	0.62	0	0.68	0.66	0.93	66.26
Mite	0.11	0.69	0.68	0.98	0.92	67.18
Crepidula fornicata	0.79	0.29	0.67	1.62	0.92	68.1
Botrylloides violaceus	0.92	1.5	0.67	1.43	0.92	69.02
Epigamia alexandri	0.61	0	0.66	0.96	0.91	69.92
Scolelepis (Scolelepis) squamata	0.59	0	0.66	1.3	0.9	70.82

Compare CPBR & P6FGG. Average dissimilarity = 94.60

Species	Group CPBR Av. Abund	Group P6FGG Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Nephtys incisa	4.52	0	6.3	4.9	6.66	6.66
Ophelina acuminata	0	3.33	5.08	1.21	5.37	12.02
Tritia trivittata	0	3.4	4.88	2.43	5.16	17.18
Polydora cornuta	2.62	0.21	3.56	1.3	3.77	20.95
Anomia simplex	0	2.63	3.26	1.26	3.45	24.4
Ampelisca vadorum	2.17	0	2.99	0.66	3.16	27.56
Cerebratulus lacteus	2.08	0	2.91	1.24	3.07	30.63
Balanus crenatus	2.43	2.05	2.87	1.19	3.03	33.66
Hiatella arctica	0	2.06	2.57	1.31	2.71	36.38
Ninoe nigripes	1.72	0.15	2.47	0.7	2.61	38.98
Alitta succinea	1.79	0.59	2.23	1.43	2.36	41.35
Mytilus edulis/trosullus	0	1.77	2.2	1.31	2.33	43.68
Botrylloides violaceus	0	1.5	2.13	2.81	2.25	45.92
Thelepus cincinnatus	0	1.52	1.91	0.97	2.02	47.95
Capitella capitata	0	1.48	1.81	0.67	1.92	49.86
Pagurus acadianus	1.22	0	1.7	0.66	1.8	51.66
Ampharete arctica	0	1.08	1.63	1.22	1.72	53.39
Nematodes	0	1.24	1.55	1.17	1.64	55.03
Leitoscoloplos robustus	0.86	0.61	1.54	0.98	1.63	56.66
Pagurus longicarpus	0	0.86	1.45	0.67	1.54	58.19
Membranipora membranacea	0.86	0.21	1.29	0.78	1.36	59.56
Parvicardium pinnulatum	0	0.79	1.25	0.9	1.33	60.88
Cribrilina macropunctata	0	0.75	1.21	0.85	1.27	62.16
Polycirrus eximius	0	0.75	1.21	0.85	1.27	63.43
Crangon septemspinosa	0.86	0	1.2	0.66	1.27	64.7
Ensis directus	0.86	0	1.2	0.66	1.27	65.98
Littorina littorea	0.86	0	1.2	0.66	1.27	67.25
Praxillella gracilis	0.86	0	1.2	0.66	1.27	68.52
Ascidiella aspersa	0	0.95	1.18	1.32	1.25	69.77
Exogone dispar	0	0.61	1.03	0.67	1.09	70.86

Compare PR28 & P7CBI. Average dissimilarity = 96.64

Species	Group PR28 Av. Abund	Group P7CBI Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Balanus crenatus	4.58	0	5.72	5.72	5.92	5.92
Cossura longocirrata	0	3.69	4.67	2.34	4.83	10.76
Mytilus edulis/trosullus	3.61	0	4.51	4.14	4.67	15.42
Nematodes	3.56	0	4.41	2.73	4.57	19.99
Nephtys incisa	0	3.31	4.22	1.79	4.37	24.36
Mediomastus ambiseta	0.57	3.7	3.88	3.28	4.02	28.38
Chone infundibuliformis	3.11	0	3.87	3.45	4	32.38
Ninoe nigripes	0	2.23	2.84	2.15	2.94	35.32
Monocorophium insidiosum	2.18	0	2.73	3.09	2.83	38.15
Capitella capitata	2.17	0	2.69	1.85	2.78	40.94
Levinsenia gracilis	0	2.09	2.51	1.33	2.6	43.53
Ampharete arctica	0	2.08	2.48	1.32	2.57	46.1
Micronephthys neotena	0	2.01	2.41	1.33	2.49	48.6
Pseudopotamilla reniformis	0	1.79	2.22	1.24	2.3	50.9
Scoloplos armiger	0	1.84	2.2	1.33	2.28	53.17
Crepidula plana	1.7	0	2.13	1.74	2.21	55.38
Harpacticoids	1.65	0	2.04	1.74	2.11	57.49
Nephtys bucera	0	1.46	1.84	3.32	1.91	59.4
Anomia simplex	1.34	0	1.67	3.19	1.73	61.13
Crepidula convexa	1.23	0	1.55	2.39	1.6	62.73
Hiatella arctica	1.2	0	1.5	4.83	1.56	64.28
Thracia myopsis	0.13	1.23	1.42	1.26	1.47	65.75
Grandidierella japonica	1.13	0	1.4	4.43	1.45	67.2
Ascidiella aspersa	1.4	0.41	1.36	1.68	1.41	68.62
Terebellides stroemii	0	1.05	1.36	1.21	1.41	70.03

Compare CPBR & P7CBI. Average dissimilarity = 84.20

Species	Group CPBR Av. Abund	Group P7CBI Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Cossura longocirrata	0	3.69	6.03	2.29	7.16	7.16
Mediomastus ambiseta	0	3.7	5.9	8.96	7.01	14.16
Polydora cornuta	2.62	0	4.19	1.28	4.98	19.15
Ninoe nigripes	1.72	2.23	3.98	2.4	4.73	23.88
Balanus crenatus	2.43	0	3.92	1.32	4.66	28.53
Ampelisca vadorum	2.17	0	3.43	0.66	4.08	32.61
Cerebratulus lacteus	2.08	0	3.35	1.27	3.98	36.59
Levinsenia gracilis	0	2.09	3.19	1.32	3.78	40.37
Ampharete arctica	0	2.08	3.15	1.32	3.75	44.12
Micronephthys neotena	0	2.01	3.06	1.33	3.64	47.75
Nephtys incisa	4.52	3.31	2.86	1.96	3.4	51.15
Alitta succinea	1.79	0	2.85	1.32	3.38	54.54
Pseudopotamilla reniformis	0	1.79	2.85	1.26	3.38	57.92
Scoloplos armiger	0	1.84	2.79	1.33	3.32	61.24
Pagurus acadianus	1.22	0	1.96	0.66	2.33	63.57
Nephtys bucera	0.65	1.46	1.85	1.72	2.19	65.76
Thracia myopsis	0.65	1.23	1.83	1.23	2.17	67.93
Terebellides stroemii	0	1.05	1.77	1.2	2.1	70.03

Compare P6FGG & P7CBI. Average dissimilarity = 95.07

Species	Group P6FGG Av. Abund	Group P7CBI Av. Abund	Av. Diss	Diss/SD	Contrib%	Cum.%
Cossura longocirrata	0	3.69	4.73	2.19	4.98	4.98
Ophelina acuminata	3.33	0	4.57	1.22	4.8	9.78
Mediomastus ambiseta	0.18	3.7	4.44	4.46	4.67	14.46
Tritia trivittata	3.4	0	4.41	2.48	4.64	19.1
Nephtys incisa	0	3.31	4.28	1.7	4.5	23.6
Anomia simplex	2.63	0	3	1.26	3.15	26.75
Ninoe nigripes	0.15	2.23	2.72	1.83	2.86	29.61
Levinsenia gracilis	0	2.09	2.54	1.29	2.67	32.28
Micronephthys neotena	0	2.01	2.44	1.3	2.56	34.84
Balanus crenatus	2.05	0	2.36	1.1	2.48	37.32
Hiatella arctica	2.06	0	2.35	1.31	2.47	39.8
Scoloplos armiger	0	1.84	2.23	1.3	2.34	42.14
Pseudopotamilla reniformis	0.15	1.79	2.19	1.25	2.3	44.44
Ampharete arctica	1.08	2.08	2.11	1.92	2.22	46.66
Mytilus edulis/trosullus	1.77	0	2.02	1.3	2.13	48.78
Botrylloides violaceus	1.5	0	1.92	2.87	2.02	50.81
Nephtys bucera	0	1.46	1.87	2.94	1.97	52.78
Thelepus cincinnatus	1.52	0	1.75	0.97	1.84	54.62
Capitella capitata	1.48	0	1.67	0.67	1.75	56.37
Thracia myopsis	0	1.23	1.48	1.15	1.56	57.93
Nematodes	1.24	0	1.42	1.17	1.5	59.43
Terebellides stroemii	0.21	1.05	1.3	1.21	1.37	60.79
Pagurus longicarpus	0.86	0	1.3	0.66	1.36	62.16
Leitoscoloplos fragilis	0	0.91	1.24	0.66	1.3	63.46
Parvicardium pinnulatum	0.79	0.41	1.1	1.02	1.15	64.61
Owenia fusiformis	0	0.91	1.09	0.66	1.14	65.75
Cribrilina macropunctata	0.75	0	1.08	0.85	1.14	66.89
Polycirrus eximius	0.75	0	1.08	0.85	1.14	68.02
Yoldia sapotilla	0	0.82	1	1.3	1.05	69.07
Ascidiella aspersa	0.95	0.41	0.98	1.17	1.03	70.1