CITY UNIVERSITY OF HONG KONG
香港城市大學

Effects of Human Disturbance on Biological Traits and Structure of Macrobenthic Communities
人爲擾動對大型底棲動物群落的生物特徵及結構的影響

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by

Anne Lise Fleddum

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Declaration

The research described in this PhD thesis was conducted under supervision of Dr. Paul KS Shin at the Department of Biology and Chemistry, City University of Hong Kong. It was an independent work of the author unless otherwise stated and has not been included in any other thesis or dissertation submitted to this or other institution for a degree, diploma or any other qualifications. Attentions is drawn to the fact that anyone without the author prior consent strictly may not copy, reproduce, transform or publish any data from the authors own work in this study.

Anne Lise Fleddum

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Abstract of thesis entitled

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For the Degree of Doctor of Philosophy at the City University of Hong Kong

Rapid changes in marine biodiversity are occurring globally due to human disturbances, such as fishing and pollution; yet, the ecological impacts of functional features and diversity loss in ecosystems are poorly understood. The effects of trawling on benthic habitat and community structures have drawn much attention in recent years. Trawling is probably the most significant factor affecting the structure of soft sediment communities globally and may lead to large-scale shifts in the functional composition of the marine benthos, with likely effects on the functioning of the entire coastal ecosystem. However, the use of functional features, in combination with traditional methods of analysis of community patterns, based on biodiversity data to detect the effects of trawling is scarce. Although Biological Traits Analysis (BTA) is considered to be a powerful method for evaluating the ecological functioning of benthic assemblages, only a few studies have been reported in temperate waters. Further, the focus of these studies has generally been on the

anthropogenic impact. This thesis discusses the impact of trawling on different coastal systems based on the combined use of traditional biodiversity analysis and BTA methods, taking into account the amount of rare species and their total contribution to ecosystem functioning. There have been no previous studies published using this methodology.

In this study, BTA was used together with traditional biodiversity analysis to investigate how the structure and function of macrobenthic communities are affected by:

1) non- or low- (known) trawling frequency in two different water masses (Arctic and Atlantic);
2) high-trawling frequency with annual hypoxia (hypoxic gradient on infauna and epifauna) and from three coastal systems with different controls (infauna):
    (a) a fjord system in Norway where trawled sites were compared to non-trawled sites,
    (b) an upwelling system in the southern part of Africa (coastal South Africa and Namibia) where heavily trawled sites were compared to lightly trawled sites and
    (c) a subtropic system in Hong Kong where heavily trawled sites were compared to a marine protected area (MPA).
3) recovery from trawling inside the MPA in Hong Kong where past and present data were compared.

All these systems showed changes in structure and functioning to some different degree. As reviewed in literature, the role that rare species play in ecosystem functioning is not well understood. Traditional biodiversity data analysis methods tend to underestimate the importance of rare species. However, the present study showed that rare species are very important when considering the total pool of biological traits (BTs) and, therefore, should not be ignored.

In the study of Norwegian water masses, taxonomic composition, abundance of taxa and BTAs were used to investigate differences in structure and functional diversity. Two distinct marine macrobenthic assemblages were considered: the Arctic (cold water) and the southern part of Norway (relatively warm water). Multivariate analysis techniques were used to examine each assemblage's structure and functioning at 60 sampling stations. The data from seven BTs were divided into 36 categories, for 284 common marine benthic taxa. The two areas showed clear differences in taxonomic composition and relative species abundance. However, when BTs information was taken into account (weighted), the differences between the two areas in the ordination plot were not so apparent. When only the presence or absence of species in the BTs data was considered, there was no significant difference between the assemblages. All of the above suggested that the same BTs are represented in both water masses, but to different degrees, depending on the community dominance of species adapted to each system.

It was also noteworthy that in these two Norwegian water masses, several species within the same genus and family had exactly the same combination of BTs. The results thus indicated that different species possessed the same trait combination, even though they came from different water masses. This finding emphasized a balance in functional traits and indicated that different species contributed equally to the BTs for this analysis. However, the effects that species composition and diversity have on ecosystem functioning are difficult to distinguish, and this observation is not mutually exclusive of an idiosyncratic pattern.

In the Norwegian (Oslofjord) study, taxonomic and BTs compositions of communities from sampling stations collected in trawled and non-trawled areas were compared. Surprisingly, there were significantly higher numbers of species, individuals and BTs diversity at the trawled locations compared to the non-trawled locations in the Oslofjord. The Intermediate Disturbance Hypothesis may explain this finding since repeated trawling will act as an occasional community disturbance. The hypothesis predicts that a certain degree of disturbance may enhance diversity, provided that the disturbance is not too severe. In cases of severe disturbance, a reduced diversity would result.

The South Africa study explored the use of BTA to assess differences in the ecological functioning of infaunal communities between areas exposed to heavy and light-trawling intensities in the southern Benguela region of the south-east Atlantic. Multivariate analyses of biomass were employed to investigate differences in infaunal community composition between sites and differences in intensities of trawling. Multivariate analyses showed significant differences among sampling sites, as well as between heavily and lightly-trawled areas (ANOSIM, $p < 0.05$). The analysis of infauna biomass weighted by BTs showed significant differences between heavily and lightly trawled areas for 17% of the traits investigated (non-parametric Mann-Whitney U test, $p < 0.05$). BTs were also shown to differ significantly between areas having larger or smaller proportions of sand (12% traits differed significantly) and mud (7% traits differed significantly). This suggested that in the coastal region of southern Africa, the disturbances caused by trawling contributed more to the observed differences in BTs than sediment composition.

In the Hong Kong study, heavily trawled sites inside Tolo Channel were compared to a Marine Protected Area (MPA) in Hoi Ha Wan, which has been closed to trawling for approximately 12 years. There were significant differences in community structure and biological functioning between the wet and dry seasons. However, the BTs results showed that there were no significant differences between the trawled area and the non-trawled area (MPA). It was noteworthy that seasonal changes appeared to play a more important role in determining both the structure and functioning of the two macrobenthic communities (trawled and non-trawled) than that played by the effects of trawling.

Prior to this study, it was assumed that biodiversity would increase after the MPA was established (i.e., after trawling has ceased) and that larger and long-lived species would dominate. However, when the author's benthic data from the MPA was compared to historical data (i.e., prior the closure of the area to trawling), it was found that the opposite was the case, i.e., the biodiversity and abundance had decreased dramatically inside the protected area since trawling had ceased.

Regarding the MPA in Hoi Ha Wan, there are three important factors to consider: the rate of recovery from the cessation of trawling, the hydrodynamics of the protected area and the presence of artificial reefs deployed in the MPA. Given the difficulty of assessing the individual effects of these factors, it is hard to deduce any clear cause for the decreasing trend in biodiversity after the closure of the area for trawling. It is suggested that further, long-term research is carried out on the structural and functional diversity inside the MPA. This research should include changes around the artificial reefs and comparisons of the community structures over time between trawling sites and the MPA.

The second study in Hong Kong was related to heavily trawled sites with annual hypoxia problems. Organic pollution and eutrophication arising from poor water circulation and dispersion is a known problem in the Tolo Harbour area and has caused major changes in the structures of phytoplankton, fish and benthic communities. The differences in the macrobenthic communities between the wet and dry season are significant in Hong Kong waters. Data taken at the end of the wet season showed that there was a clear increase in both the hypoxic gradient and the total organic carbon (TOC) gradient moving inland from coastal areas (i.e., from Mirs Bay towards the Tolo Channel and the inner harbour). In general, the dissolved oxygen increased after trawling for all four of the layers measured (1 cm below the sediment surface, and 1 cm, 50 cm and 1 m above the sediment surface). The biodiversity of the infauna decreased with increasing levels of TOC in the sediment. The epifauna followed a similar pattern.

In the dry season, the level of dissolved oxygen (DO) was high for all the stations, and the differences after trawling were not as clear in the upper layers (50 cm and 1 m above the sediment surface) as for the wet season. High mortality occurred in the summer due to the low oxygen content in the inner part of the Tolo Harbour. However, in the winter (dry season), the community managed to revert to normal due to the higher oxygen content, and rapid re-colonization occurred. There were significant differences in BTs composition for the infauna between the two seasons. A closer examination of the traits showed significant differences for 14% (five categories) of the 36 categories considered. These five categories were: size < 5 mm: medium mobility; dorsal flat body form; permanent tube habitat and scavenger feeding type. For the epifauna, 58% (21 out of 36) of the categories showed significant differences. It was anticipated that opportunistic and small-body-size species would be abundant under more hypoxic conditions (summer/wet season). However, the significant BT characteristics of the few species which remained under the hypoxic summer conditions (i.e., no mobility, cylindrical body, permanent and sessile attachment) suggested adaptation rather than opportunism to the low DO levels.

In this thesis, the BTs under different environmental stressor conditions (e.g., different levels of trawling and hypoxia) were examined. The differences in BTs which were observed have led to a better understanding of the impact due to changes in some environmental conditions. A similar examination of the differences in BTs may also help with the future assessment of the effects of different environmental changes (stressors) on the soft benthic community. Study of the changes in the relative proportions of BTs considered in this thesis complements traditional methods of biodiversity and community structure analyses. This combined approach may be helpful in identifying impact-driven alterations to ecological functioning and may also offer more information on ecosystem monitoring, management and conservation.

Publications, poster, report and award

International reviewed Journals

1. **Fleddum A**, Cheung SG, Hodgson and P Shin PKS (2010) Impact of structure and function of epifauna under low level of oxygen in Tolo Harbour, Hong Kong. Marine Pollution Bulletin. Submitted in June 2010

2. **Fleddum A**, Atkinson L, Shin PKS and Field JG (2010) Effects of demersal trawling along the west coast of southern Africa: II. Biological traits analysis of benthic assemblages. Marine Ecology Progress Series. Submitted in April 2009, revised version submitted in April 2010

3. Cooper KM, Barrio Froján CRS, Defew E, Curtis M, **Fleddum A**, Brooks L, Paterson DM (2008) Assessment of ecosystem function following marine aggregate dredging. Journal of Experimental Marine Biology and Ecology 366, 82-91

4. Richardson B; Wu R, Shin P, Lam P, **Fleddum A**; Elliott M; Sheppard C (2008) A tribute to John Stuart Gray (1941-2007). Marine Pollution Bulletin 56 (1), 1-4

Poster

1. **Fleddum A**, Cheung SG and Shin PKS (2010). Impact of structure and function of benthic epifauna under hypoxia in Tolo Harbour, Hong Kong. 2nd International Conference on Biological and Environmental Sciences. Mansoura, Egypt 2010

Report

1. Rinde E, Bøe R, Lepland A, Lepland Aa, **Fleddum A**, Staalstrøm A, Mats Walday (2009) Mapping of marine habitats in inner Oslofjord. Development of a complete area coverage habitat map based on depth, substrate type and energy level. Norwegian Institute for Water Research, ISBN No.: ISBN 82-577-2009

Award

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Your perception of truth is exactly what you think it is!

Anne Lise Fleddum

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1.1 General introduction

Rapid changes in marine macrobenthic biodiversity are occurring globally due to human disturbances, such as fishing and pollution. Yet the ecological impacts of diversity loss are poorly understood (Solan et al. 2004). One of the central debates in ecology focuses on ecosystem structure and function. A major issue, within this debate, is the extent to which species are essential for system functioning. It has been shown that one can remove a large number of rare species and many ecosystems still, apparently, function normally. However, studying this topic experimentally is very difficult since it often requires the use of mesocosm set-ups. Mesocosms are containers which hold large volumes of sea water under controlled conditions in order to simulate marine environments. The use of this technique may lead to great advances in the understanding of ecosystem functioning, but it requires advances in equipment and sampling methods, which are expensive and time-consuming. One method used to analyse species' communities is to use patterns of assemblage distribution. However, this method gives no information on ecosystem functioning. An alternative approach is to use biological traits (BTs) related to functional properties. Characters such as reproduction type, larval type, body size, movement, body form, growth rate, feeding type, habitat, etc. are substituted for species names and multivariate analyses are conducted. It is then possible to compare the patterns generated by species analyses with those from traits analyses. Such analyses can reveal important aspects of how structure and functional properties are linked (Chevenet et al. 1994; Doledec et al. 1999; Charvet et al. 2000; Bremner et al. 2003). Macrobenthic invertebrates have been extensively studied for BTs in freshwater systems, with the hope of establishing the relationships between stream habitats and the functional structure of the communities (Chevenet et al.

1994; Dolédec et al. 1999; Charvet et al. 2000; Usseglio-Polatera et al. 2000a, b; Lamouroux et al. 2004). These studies have revealed that biological trait analysis (BTA) can better discriminate environmental differences in comparison to the examination of taxonomic composition, and that community structure based on BTs is less confounded by natural spatial gradients, which can indicate, reliably, human impact. In marine soft-sediment ecosystems, Schratzberger et al. (2007) used trait composition in meiofauna to investigate which environmental variables controlled the communities. In their study, traits were found to be significantly correlated to grain size and water depth. Bremner et al. (2003) compared traditional analysis techniques using relative taxa composition and trophic guilds with BTA, to investigate the functional diversity of macrobenthic fauna in the southern North Sea and eastern English Channel. They concluded that BTA can offer broader information on assessing ecosystem functioning in benthic environments on both large and small scales, and that there is a significant relationship between habitat and traits.

Trawling is probably the most significant factor affecting the structure and function of soft-sediment communities globally (Watling & Norse 1998; Thrush & Dayton 2002; Gray et al. 2006). A number of studies have investigated the impact of trawling on various components of the marine ecosystem (e.g., Drabsch et al. 2001; Hansson et al. 2000; Sparks-McConkey & Watling 2001; Thrush & Dayton 2002; Nilsson & Rosenberg 2003; Rosenberg et al. 2003). McConnaughey et al. (2000) further demonstrated that there are chronic effects, which result in lower diversity in the sedentary macrofauna in the heavily trawled areas of the eastern Bering Sea. In particular, Tillin et al. (2006) found that chronic bottom trawling can lead to large-scale shifts in the functional composition of benthic communities, with likely effects on the functioning of coastal ecosystems. Watling and Norse (1998) compared trawling with forest cutting and stated that trawling reduces community structural diversity, and recovery after a disturbance is often slow because recruitment is patchy and growth to maturity takes a long period of time (Watling 2005). Freese et al. (1999) studied the short-term effects of trawling on hard-bottom communities. Their study noted significant decreases in density, as well as significant increases in damage to sponges and anthozoans after trawling. Kaiser et al. (1998) investigated the immediate impact of trawling on the megafaunal component of a benthic community and the extent of recovery after six months. Immediately after trawling, the composition of the community was significantly altered. However, after six months, no evidence of trawling was detectable. Other studies on the effects of trawling in the North Sea have found changes in the trophic structure and functioning of benthic communities (Frid et al. 2000; Jennings et al. 2001, 2002). Although the effects of trawling in temperate waters have been well documented, only a few similar studies in tropical/subtropical waters have been conducted. No detailed studies have been undertaken to investigate the potential changes in community function through BTA.

Benthic eutrophication is defined as an increase in the rate of supply of organic matter to benthic environments (Nixon 1995). One of the most important effects of eutrophication on aquatic organisms is the reduction in the concentration of dissolved oxygen. Low or nil oxygen content (hypoxia or anoxia, respectively) can cause direct mortality and reduced growth rates in organisms (Weston 1990). There have been many studies into the changes in biodiversity of macrofaunal benthic communities under hypoxic conditions (Nilsson & Rosenberg 1994; Ritter & Montagna 1999; Craig et al. 2000; Meyers et al. 2000; Nilsson & Rosenberg 2000; Rosenberg et al. 2002) and into the behavioural or physiological responses of species to hypoxia (Rosenberg et al. 1991; Holmes et al. 2002; Wu & Or 2005). All of these studies showed decreases in biodiversity, alterations of species composition and reductions in biological responses, when the benthic environment is subjected to short-term or long-term hypoxic events. Although the effects of hypoxia on biodiversity, physiology and behavioural responses have been extensively studied, there has been no research into the combined effects of trawling and hypoxia on the BTs of benthic communities.

The purpose of this research is to study the changes in biodiversity (structure) and BTs (function) of marine benthic ecosystems due to different trawling stressors. The study concentrated mainly on the effects of different trawling intensities on soft benthic communities. In addition, the effect of trawling in areas with annual variations of dissolved oxygen content was also analysed. The intention of this study was to increase the understanding of the effects of trawling on marine benthic ecosystems and to contribute to the assessment of the ecological consequences of trawling in the future. The investigation of changes in the relative proportions of BTs may provide more information on ecosystem monitoring, management and conservation, and they may provide additional insights into the response of marine benthic ecosystems to environmental perturbations. Finally, the results of this research may also complement similar studies in temperate waters.

Questions that will be studied in this research are:

1. How will different kinds of trawling stressors affect structure and function in soft-sediment benthic communities?
2. Which functional traits will be changed and which will dominate?
3. Do proportions of rare species change?
4. How much do rare species contribute to the structure and function of a benthic ecosystem?

1.2 Datasets

The datasets that are included in this research include the following:

1) A large database of macrofaunal data is from offshore oil and gas monitoring of the Norwegian Oil Industry Association in the North Sea and the southern Norwegian Sea, as well as data from Pechora Sea, Barents Sea and Franz Josef Land, provided by Salve Dale, Aquaculture and Environmental Research and Consultancy (Akvaplan-niva AS). The extraction and processing of this dataset (excluding the heavily polluted stations close to the oilfield) were done by Dr. Anders Bjorgeseater (Department of Biology, University of Oslo). The field work, laboratory work, sorting and taxa identification were performed by Akvaplan-niva AS. The compilation of biological traits for the taxa in this database and subsequent statistical analyses forms part of this research work.

2) There are datasets of macrofauna from trawled and non-trawled areas from Oslofjord, Norway. The field work was performed by the Norwegian Institute for Water Research (NIVA), which included Frode Olsgaard, Morten Scaanning, Jane Indrehus and Annelise Fleddum (as a part of the author's employment with NIVA). This field work was a part of the project "Costing the impact of demersal fishing on marine ecosystem processes and biodiversity" (COST-IMPACT), funded by the EU, contract no. Q5RS-2001-00993. The environmental laboratory work was performed by technicians employed by NIVA. Sorting and taxa identification were done by Jane Indrehus and Annelise Fleddum. The compilation of the BTs database for all the taxa also forms part of this research. The work that will be used in this research comprises data from the grab samples, including environmental and BTs data.

3) One dataset of macrofauna from heavily-trawled and lightly-trawled areas is from the Benguela upwelling system and South African waters. The field work was performed by John Field, Lara Atkinson, Sam Mafwilla, Anders Bjorgeseater and Annelise Fleddum. The laboratory work and taxa identification were done by Lara Atkinson. The BTs database was developed by Annelise Fleddum. This project comprises three PhD studies: Sam Mafwilla will use the fish data from the trawling sites, Lara Atkinson will use the epibenthic invertebrate data, part of the fish data and part of the macrobenthic data and Annelise Fleddum will use the macrofaunal data, together with biological trait data, in this thesis.

4) There is one dataset of macrofauna from a gradient of hypoxia in Hong Kong waters.

5) Finally there is a dataset of macrofauna from a trawled area and a Marine Protected Area (MPA) area in Hong Kong waters.

For the datasets derived from Hong Kong waters, all field and laboratory work, as well as taxa identification, BT compilation and statistical analyses were undertaken as part of this research.

1.3 Objectives

In this research, taxonomic and BT compositions of communities are compared with different impacts in coastal waters of:

a) Norway

b) South Africa

c) Hong Kong

Specifically, this study aims to:

1. Investigate how demersal fishing and hypoxia impact the structure and functioning of marine benthic communities;
2. Identify which BTs will be reduced and which will dominate in dissimilar levels of trawling frequency and in trawled areas with annual variations of dissolved oxygen content and
3. Reveal how these factors influence the change of proportions of rare species and the total contribution to the pool of BTs.

Based on the above objectives, the following null hypotheses will be tested:

(1) $H_{01:}$ There are no significant differences in community structure when comparing non-impacted and impacted areas;

(2) $H_{02:}$ There are no significant differences in BTs when comparing non-impacted and impacted areas and

(3) $H_{03:}$ There are no significant differences in rare species composition when comparing non-impacted and impacted areas.

1.4 Organisation of thesis

This thesis comprises nine chapters which are divided into three major data sections. Chapter 1 is an introduction with brief background information, datasets used in this study, objectives and hypotheses and organisation of the thesis. Chapter 2 presents more detailed background and a literature review of impacts of trawling and hypoxia disturbance on the structure and function of macrobenthic communities. Chapter 3 (data section I) describes the structure and function for macrobenthic communities from different water masses with no influence of major impact of trawling or hypoxia. Chapters 4, 5 and 6 (data section II) depict structure and function for macrobenthic communities under the direct impact of trawling, whereas Chapter 7 (data section III) describes structure and function of macrobenthic communities under the impact of hypoxia and heavy fishing pressure. Chapter 8 provides general discussion and conclusions and Chapter 9 contains references cited in this thesis. Statistical explanations are listed in Appendix 1. Species list with taxonomic information and biological traits for all the species are listed in Excel files stored on a compact disc (Appendix 2) named by: Norway, South Africa and Hong Kong, whereas each spreadsheet is named by Chapters.

Chapter 2 Background of Study

2.1 Structure and functioning debate

2.1.1 The importance of biodiversity

What is the role of biodiversity regarding ecosystem functioning, and more specifically, which components of biodiversity are most important, species diversity or functional diversity? From an anthropogenic perspective, this is a question of major importance and a question that has given rise to heated debate concerning the seriousness of human-induced species loss. There is now little doubt that anthropogenic disturbances have extensively altered the global environment, leading to a decrease in biodiversity. For example, humans have transformed 40-50% of the ice-free land surface, for agricultural and urban use; consequently, many species have been eliminated from areas dominated by human influences (Chapin et al. 1997). The increased globalisation of the world has led to elevated species invasions at unprecedented rates, so that many of the ecologically important plant and animal species of several areas have been introduced outside their native ranges (Lodge 1993). In coastal areas, the invasion of species is usually the result of ship traffic and aquaculture imports, which are a major threat to biodiversity and ecosystem functioning (Briggs 2006). Understanding the effect of a decrease in biodiversity is now recognised to be of vital importance, both ecologically and economically (Chapin et al. 1997). Most of the research carried out so far on the functional consequences of changing biodiversity has focused on the relationship between species richness and ecosystem functioning. Principal environmental factors, such as climate and natural disturbance, strongly influence ecosystem functioning. Similarly, organisms also have a direct effect on their environment. They perform a variety of functions within ecosystems, such as primary productivity, storing and recycling of nutrients, as well as the decomposition of waste and the maintenance of chemical cycles. The ecosystem's responses to change in species richness or species composition can differ among ecosystem types and properties, depending on how dominant the species are, their interactions with others and the functional traits of the remaining and lost species (Lawton 1994; Naeem et al. 1995). On a regional scale, the loss of species richness and individual species is suggested to have minor effects on the ecosystem processes because of greater environmental heterogeneity, but more important effects on small to intermediate spatial scales (Loreau et al. 2001). In other words, the loss of biodiversity locally, in a specific habitat, has a larger effect on ecosystem functioning than when the loss of biodiversity occurs on a larger scale with multiple habitats.

2.1.2 Hypothesis of biodiversity and ecosystem functioning

A number of hypotheses have been proposed to explain the relationship between diversity and ecosystem function. The Central Hypothesis (graphically portrayed by Vitousek and Hooper at the Bayreuth Conference in 1993) looks at the relationship between biodiversity and ecosystem functioning; biodiversity is seen as an independent variable and ecosystem functioning as a dependent variable. The question being asked is: if the degree of ecosystem functioning is related to the known level of biodiversity and at a level of zero diversity, what will the slope be like moving away from the known level? Naeem et al. (2002) considered three groups of species:

1. Species which are primarily singular;
2. Species which are primarily redundant and
3. Species whose impacts are idiosyncratic or unpredictable.

Group 1 species are primarily singular, implying that all species contribute to ecosystem functioning. The Rivet Hypothesis (Ehrlich & Ehrlich 1981; Naeem et al. 1995) suggests that all species matter and loss of any species will weaken ecosystem performance (Fig. 2.1, bottom right). The Keystone Species Hypothesis suggests some species are more important than others. These keystone species interact strongly in the functioning of the ecosystem; their effects are much greater than would be expected by their biomass (Fig. 2.1, middle right). Other relationships have also been suggested. The Diversity Stability Hypothesis (Elton 1958) predicts a linear relationship between ecosystem processes and biodiversity (Fig. 2.1, middle left). Here, ecosystem processes are highest when biodiversity is highest. For Group 2 species, the Species Redundancy Hypothesis (Walker 1992) assumes that the addition or loss of species will have no effect on the ecosystem function, except at very low levels of diversity (Fig 2.1, upper right). For Group 3 species, the Idiosyncratic Hypothesis (Lawton 1994) predicts that changes in ecosystem function will occur with removal or addition of species, but the response is unpredictable (Fig. 2.1, bottom left). In this hypothesis, change in ecosystem function depends on different conditions such as species assemblages and environmental factors. The Null Hypothesis (Fig. 2.1, upper left) states that ecosystem function is unaffected by the addition or deletion of species, i.e., biodiversity has no effect on ecosystem processes.

There have been few empirical tests of these contrasting hypotheses. Most of the work in this area has focused on terrestrial ecosystems (Reynolds 1998). Naeem et al. (1996) measured how the biomass of plants in an artificial system changes with the number of species added. Their results showed that there was a positive relationship between number of species and biomass. Similar findings have also been reported in grassland systems in North America and Europe (Tilman et al. 1996; Tilman et al. 1997a; Hector et al. 1999). A general rule of thumb resulting from these studies was that when half the number of species is removed, the productivity decreases by 10–20%. However, these studies have been heavily criticised by Huston et al. (1997) and Grime (1997). The criticism was that the "sampling effect" (caused by choosing species at random) influenced the results because natural ecosystems do not contain random assemblages of species.

Some studies indicated that an ecosystem may contain more species than is necessary for its functioning (Naeem et al. 1995). If this is the case, changes in species composition will not have an effect on ecosystem properties as long as some functionally important species are still present (Morin 1995). Bolam et al. (2001) investigated marine benthic communities and showed that there is no relationship between ecosystem functioning, diversity and biomass, thus supporting the Redundancy Hypothesis. However, Bolam's study was limited and several other studies have shown strong indirect effects in ecosystem functioning with changes in species abundance; this does not support the Redundancy Hypothesis (e.g., Menge 1995; Botsford, et al. 1997; Pinnegar et al. 2000).

Emmerson et al. (2001) was the first to demonstrate the effects of structure and function in marine benthic ecosystems. Their investigation comprised 241 mesocosms; some mesocosms were manipulated and some were composed of naturally assembled communities. Some of these mesocosm experiments did not show any consistent effect of changes in either species richness or functional group richness. The authors suggested that the lack of consistency might be explained by changes in properties between the sites investigated. However, they did find that an increase in species diversity consistently leads to an increase in the stability of ecosystem functioning. To separate sampling effects and niche complementarity (i.e., morphological differentiation to allow competing species to use a resource in different ways), Emmerson et al. (2001) established monoculture treatments. They found that there was a sampling effect at three sites caused by dominant species. They also found evidence for a complementary effect of diversity on ecosystem functioning. This study clearly demonstrated that the influence of biodiversity on ecosystem functioning can be explained by both sampling effects and niche complementarity.

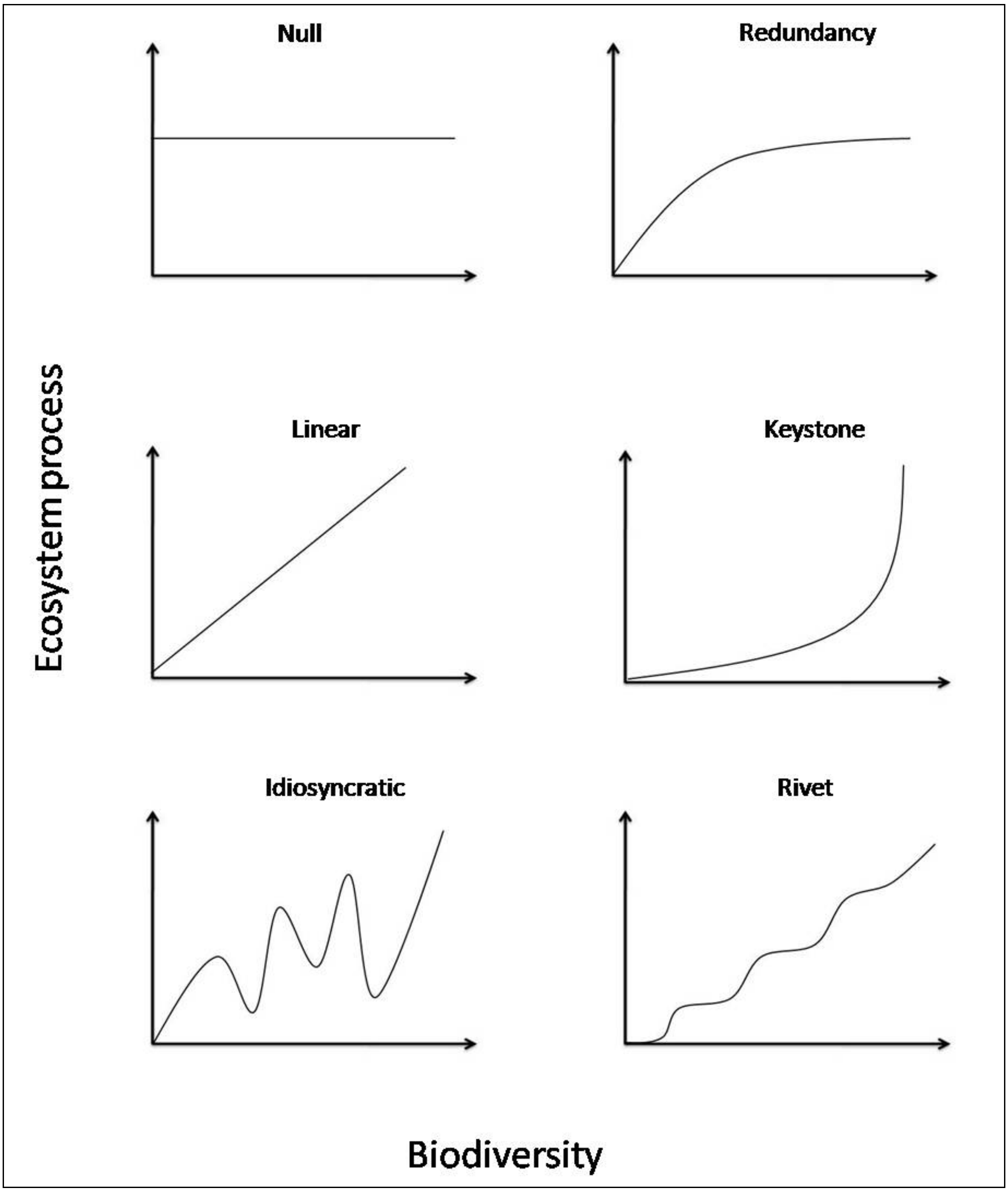

Figure 2.1 Elaborations on the Central Hypothesis, explaining the relationships between biodiversity and ecosystem functioning.

There is evidence that it is not the number of species which is important in ecosystems, but the functional characteristics of the species. Paine (1969) found that one species of sea star preyed so effectively on mussels that it kept these aggressive creatures from monopolizing space on the rocks. When the sea star was removed from the shoreline, the mussels began to multiply, crowding out limpets, barnacles and other marine organisms from the rock surfaces so effectively that the total number of species living on the rocks dropped by half. High diversity might not be necessary to maintain ecosystem processes when environmental conditions are favourable. However, when environmental conditions change, diversity may be beneficial because different species respond differently to environmental fluctuations (Walker 1992). There is a greater probability that some species with important traits will be present when biodiversity is higher. Some investigations (Tilman & Downing 1994) have shown that in more diverse communities, primary productivity recovered more easily and the communities were more resistant to drought after perturbation. When considering the effects of species on ecosystem functioning, it is necessary to consider more than just the abundance of species alone, e.g., the total amount of rare species may also have a great influence. Species that have similar effects on ecosystem processes, but are different in response to changes, provide stability. This is because their loss will be compensated for by an increase in functionally similar species (Walker 1992).

Composition of species and diversity effects on ecosystem functioning are often difficult to distinguish. To understand how biodiversity influences ecosystem functioning, it is necessary to consider the biological traits of the functional groups involved (Bremner 2008). This approach may lead to a better understanding of the relationship between biological diversity and ecosystem functioning; it may also provide an important tool for marine management and conservation.

2.2 Biological Traits (BTs)

A biological trait (BT) is a character of an organism that may be inherited or environmentally determined. The character can be genotypic or phenotypic, e.g., size, body form, movement, feeding, larval type, and so on. These characteristics strongly influence ecosystem properties (Bremner 2008). Using species traits has several potential advantages over traditional indices and multivariate methods based on taxonomic composition (Doledec et al. 2006). Biological Trait Analysis (BTA) has a good potential for describing functional diversity in marine systems (Frid et al. 2000b; Bremner 2008) and provides a great deal of information on the role of each species in ecosystem functioning (Bremner et al. 2006; Bremner 2008). BTA has been widely used [on its own and in combination with Ecological Traits Analysis (ETA)] to investigate macrobenthic invertebrates in freshwater streams (Chevenet et al. 1994; Dolédec et al. 1999; Charvet et al. 2000; Usseglio-Polatera et al. 2000a, b; Lamouroux et al. 2004). BTA is based on the habitat template theory that assumes organisms living in similar habitats have developed similar trait characteristics (Southwood 1977). A consideration of the characteristics of species present in assemblages, e.g., life history, morphology and behaviour, may reveal some aspects of their ecological functioning (Bremner et al. 2006). Snelgrove (1998) also reported that the roles performed by benthic species are important in regulating ecosystem processes and that these roles can be portrayed by the BTs they exhibit. Tillin et al. (2006) used BTA to investigate the impact of trawling and reported that chronic bottom trawling can lead to large-scale shifts in the functional composition of benthic communities. These shifts may have an effect on the functioning of coastal ecosystems. Carson and Hentschel (2006) used life-history traits of polychaetes sampled in Southern California to estimate the dispersal potential. The model indicated that efforts to conserve biodiversity by establishing Marine Protected Areas (MPAs) must consider species' dispersal for successful conservation. Norling et al. (2007) used species-specific traits of benthic macrofauna to investigate how functional biodiversity affects key ecosystem functions related to organic matter. The results of their experiment suggested that species-specific traits may override species richness and functional biodiversity when regulating important ecosystem properties and functions in benthic environments. de Juan et al. (2007) used a set of BTs to investigate the effects of trawling on macrobenthic communities in the Mediterranean Sea. The control area used in the study had been trawl-free for 20 years. In both treatments (trawled and control), the overall benthic community was dominated by burrowing epifaunal deposit feeders and predators and deep-burrowing infaunal deposit feeders. The trawled area had a higher abundance of burrowing epifaunal scavengers and motile burrowing infauna, while the non-trawled area had a higher abundance of surface infauna, epifaunal suspension feeders and predatory fish. Cooper et al. (2008) incorporated BTA to study the recovery after aggregate dredging in Hastings Shingle Bank, UK. They found no significant differences in BTs between low-intensity dredging sites and reference sites but found clear differences between high-intensity dredging sites and reference sites. Their results suggested that assemblages present at low-dredged sites can be as functionally diverse as reference samples, as measured by the range of BTs they accommodate.

A combination of functional traits can allow estimation of the vulnerabilities of organisms and the resilience of populations impacted by trawling (de Juan et al. 2007) and hypoxia. In this study, several functional traits were selected to represent different components of the organisms which could be sensitive to trawling disturbance and hypoxia. The set of chosen traits was based on the biological information available for the species or genus in the country sampled. How important each of these traits is in ecological functioning is difficult to estimate. However, some studies have evaluated the significance of some of the chosen traits. Body sizes appeared to shift from larger to smaller in impacted areas (Kaiser et al. 2000). Feeding type is another trait that has been evaluated to be significant because it reflects the adaptation of the organisms to the habitat (de Juan et al. 2007). Several studies have found significant increases of motile scavengers (Kaiser & Spencer 1994; Collie et al. 1997; Ramsay et al. 1998; Demestre et al. 2000) and deposit feeders (Frid et al. 2000) in trawled areas. The movements and the organisms' positions in the sediments were also considered important with regard to nutrient flux (Widdicombe et al. 2004; Olsgard et al. 2008). Body form can be useful to detect dominance or resilience of higher taxa groups. No records were found in the literature of the significance of larval type affected by trawling or hypoxia but variations in latitude have been shown to influence this trait for several planktonic invertebrates (Thorson 1936; Schluter 1998).

2.3 Rare species and Species Abundance Distribution (SAD)

Modification of the log-normal distribution of individuals among species can be used to isolate objectively groups of species sensitive to pollution effects (Gray & Pearson 1982; Pearson et al. 1983) or anthropogenic disturbances such as trawling and hypoxia. A species abundance distribution (SAD) is a histogram of the number of species in different abundance classes (Fisher et al. 1943; Preston 1948) and it is one of the most basic descriptions of the biodiversity structure in a biological community. The amount of the rarest species (i.e., only one sampled individual) is shown as the first vertical column along the x-axis of the histogram. The next column along the x-axis represents a sampled species abundance of two to three individuals; the next column along represents a species abundance of three to five, and so on, until the abundance of all the species is fully represented along the logarithmic scale. The columns furthest to the right of the x-axis represent the most abundant species. Examination of the distribution of the most abundant species, thus represented, has been used to identify opportunistic organisms and has been suggested as a method to identify indicator species for pollution (Gray & Pearson 1982; Pearson et al. 1983). Although the shape of the curve should theoretically be a log-normal distribution or a bell curve (Preston 1948), practical results have shown otherwise, and the actual form is much debated (Gray & Pearson 1982; McGill 2003b). Most of the species are rare, according to one definition or another (Fisher et al. 1943; Ugland & Gray 1982; Gaston 1994), and this can easily be shown by plotting a SAD histogram (McGill 2003a). The species represented in the first abundant class have often been ignored and been determined to be less important in the analysis of polluted environments. The role of rare species in the environment is still subject to debate (Murray & Lepschi 2004). Most intensive ecological studies have concentrated on the more common species (Chapman 1999) while tending to ignore the rarer species. Although some studies have been carried out on rare species of the following: terrestrial plants (Saetersdal 1994); insects (Hodgson 1993); birds (Karr 1977); mammals (Arita et al. 1990); freshwater molluscs (Allen & Flecker 1993) and fish (Angermeier 1995), there have been very few studies of rare marine invertebrates (Chapman 1999). Rare species may exert a great effect on ecosystem functioning. An examination only of species abundance may not be enough to describe the importance of each species with respect to ecosystem functioning. Biomass and species trait information is very important when considering the significance of rare species in ecosystem functioning. Olsgard et al. (2008) investigated the impact of trawling on macrobenthic communities in fjords and found that the mud shrimp *Calocaris macandreae* and heart urchin *Brissopsis lyrifera* had major impacts on the fluxes of O_2, NO_3 and SiO_2 in the sediment. *C. macandreae* is a medium to large crustacean (4-5 cm), which is known to be territorial, whereas *B. lyrifera* is large in size (> 7 cm). Both are borrowing species with low abundance and higher individual weight, compared to the majority of the invertebrates in soft benthic communities. The two examples above have an important function but appear often (though not always) as rare species; hence their significance tends to be underestimated when using multivariate statistical analysis. Species richness is often driven by rare species; a loss of species richness may not severely change or impair the functionality of a benthic community (Brady et al. 2005). The loss of one or more species does not always affect ecosystem functioning. This may be because the ecosystem contains several species having similar functional roles (Redundancy Hypothesis) or because different species may not contribute equally to ecosystem functioning (Idiosyncratic Hypothesis). Rare species may be important in functional diversity and may also act as a "safety valve" for ecosystem functioning. This may be because rare species are able to take over the role of other species if they become locally extinct. SAD may provide an important insight into how rare species react to different external stressors. SAD in combination with BTA may also contribute to a broader understanding of the contribution of rare species to ecosystem functioning.

2.4 r and K-selected species

r/K selection theory was first developed by MacArthur and Wilson in 1967 from their work on island biogeography and related the growth rate of various organisms to the carrying capacity of the environment. The main concept is that species are driven because of evolutionary pressure to a strategy of either reproducing quickly (r-selection) or reproducing slowly (K-selection). In the former strategy, the species have adapted to as many niches as possible, while in the latter the species have adapted to stronger competition in more crowded niches. Characteristic BTs for r-selected species are: small size; fast reproduction; short generation time and the ability to produce many offspring. Characteristic BTs of K-selected species are: larger size; slower reproduction and longer generation time with fewer offspring. All of these characteristic BTs have been shown to be useful in describing anthropogenic impacted communities (Table 2.1). In strongly impacted ecosystems, such as areas with high levels of fishing or pollution, r-selected species dominate, while in more stable and less disturbed ecosystems, a larger number of K-selected species are found in the assemblage.

Table 2.1 Summary r- and K-selected species in anthropogenic impacted and non-impacted circumstances based on experience from earlier studies.

	Inpacted circumstances r-selected	Non-impacted circumstances K-selected
Species composition	Lower	Higher
Diversity	Lower	Higher
Abundance	Higher	Lower
Biomass	Lower	Higher
Size	Smaller	Larger
Scavengers	Higher	Lower
Deposit feeders	Higher	Lower
Life span	Shorter	Longer

2.5 Intermediate Disturbance Hypothesis (IDH)

Another theory concerning biodiversity is the Intermediate Disturbance Hypothesis (IDH) (Fig. 2.2). This highly-debated hypothesis predicts that the highest biodiversity occurs when the disturbance is of intermediate character (or level). When the level of disturbance is high, only a few specific species, which are adapted to the stresses present, remain. When the level of the disturbance is low, competitive exclusion by the dominant species takes place. The hypothesis was first introduced by Grime in 1973 and later expanded upon by Connell (1978); the latter has been much more cited among ecologists. As was the case for the Central Hypothesis, the development of IDH was initially based on terrestrial research but the latter has been well-adapted and tested in many ecological systems, including marine benthic communities. A very important assumption of the IDH is that there is a trade-off between the ability to withstand disturbance and competitive ability. If the less competitive species are also less able to withstand the disturbance, IDH may not be useful. There are still disagreements of species diversity as a unimodal function of disturbance and the weak experimental evidence for the concept suggests more research is required to assemble a complete understanding of IDH (Lenz et al. 2004). Nevertheless, some marine benthic studies have yielded results which support the IDH in different human-made and naturally-disturbed situations. In a mesocosm experiment, Austen et al. (1998) observed meiofaunal responses to a disturbance from the protobranch bivalve *Nuculoma tenuis*, which were in line with those predicted by the IDH. Contardo Jara et al. (2006) studied the interactive effects of disturbance and nutrient enrichment on epibenthic communities along the coast of Brazil, and their results supported Connell’s predictions of low, high and intermediate disturbance. Lenz et al. (2004) tested the IDH on marine hard-bottom communities in the Western Baltic, and their results supported the IDH in that stability decreased when complexity increased. Similarly, Frouin (2000) examined the impacts of terrestrial run-off on soft benthic lagoon systems in tropical Tahiti and found the highest biodiversity in moderate terrigenous inputs. However, there are soft-bottom benthic studies in which the data do not fit the IDH model, as proposed by Connell. For example, Huxham et al. (2000) performed field experiments in soft-bottom intertidal communities to test the IDH using five different levels of disturbance. The experiment, which lasted for 25 weeks, was considered a small-scale test. The total number of species and the abundance of the dominant species, including the polychaete *Pygospio elegans* and *Streblospio benedicti*, the bivalve *Macoma balthica* and gastropod *Hydrobia ulvae*, were significantly reduced in the high disturbance treatments. There was no evidence of increased species diversity in any of the disturbed treatments.

The IDH has not been experimentally tested using data gathered from different levels of disturbance caused by trawling (Gray 2006). However, if the IDH model is correct, the effect of an intermediate level of trawling disturbance on soft benthic communities should result in an enhanced level of biodiversity.

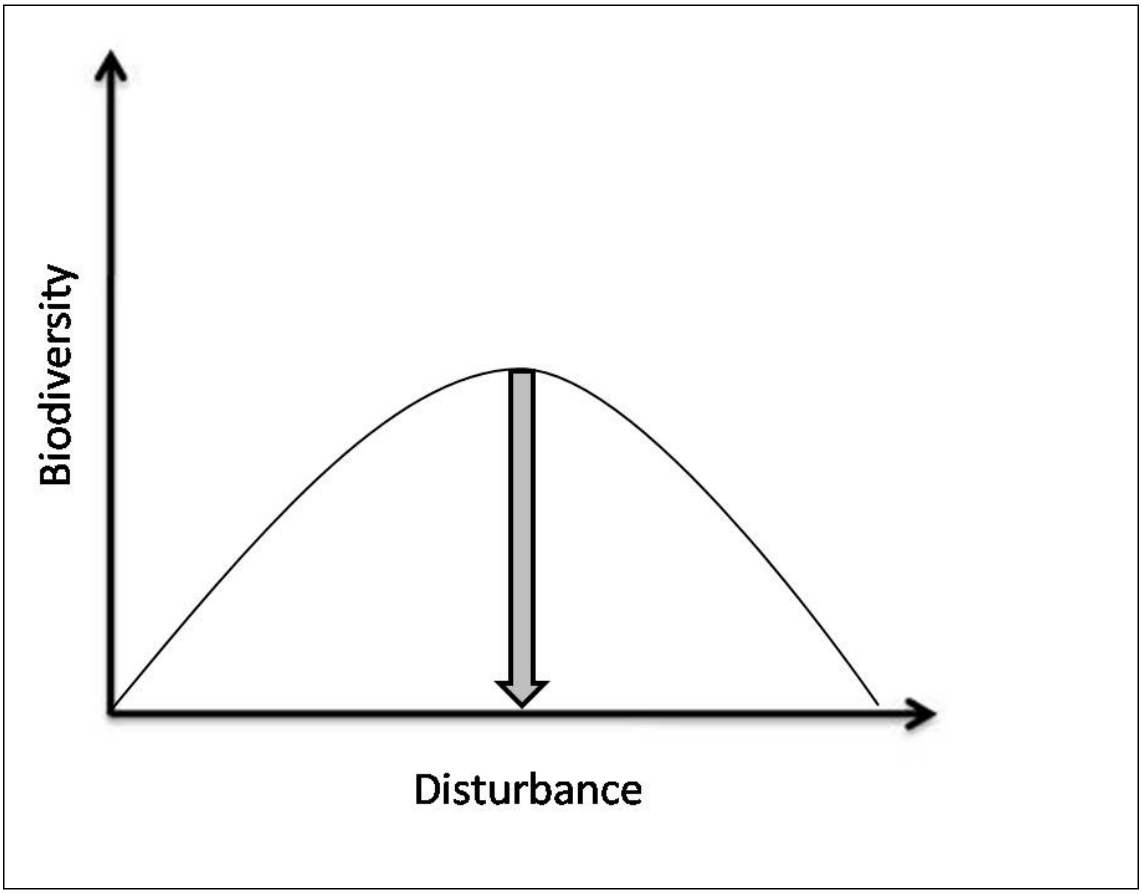

Figure 2.2 A graphical representation of the variation of biodiversity with different levels of disturbance, as predicted by the Intermediate Disturbance Hypothesis (IDH). The hypothesis predicts the highest biodiversity when disturbance level is of an intermediate intensity [i.e. between low and high disturbance levels (Connell 1978)].

2.6 Trawling

2.6.1 Trawling methods

Historically, the effects of fishing on the marine environment have been seen as impacts on the harvested target species and any associated by-catch of prominent fauna, such as cetaceans, birds and turtles (Kaiser et al. 2003). In recent times, the broader and more delicate effects resulting from the pressure of modern fishing on marine ecosystems have begun to receive growing prominence with regard to the management and conservation of marine habitats (Kaiser et al. 2003). Mobile fishing equipment affects the seafloor in a direct, physical way whenever the net bag, chains or doors contact the bottom (Sparks-McConkey et al. 2001). Trawling and dredging are the two most destructive fishing methods (Thrush & Dayton 2002). Dredges can disturb the upper sediment layer to a depth of 6 cm, while trawl nets connected to heavy steel doors can penetrate down to 30 cm (Jennings & Kaiser 1998; Krost 1990). Trawling is a common method for catching fish and prawns. There are several trawling methods used worldwide today. Bottom trawling is one kind of fishing practice with heavy nets connected to large trawl doors. The nets drag along the seafloor leaving deep visual marks on the sea bottom (Enticknap 2002). The design and mode of operation of the trawling gear influences how it interacts with the seafloor and how many species are removed (Thrush & Dayton 2002). **The otter trawl** (Fig. 2.3, top) is an example of a bottom trawl and is commonly used to catch fish and invertebrate species, such as European hake *Merluccius merluccius*; red mullet *Mullus barbatus*; monkfish *Lophius piscatorius* and Norwegian lobster *Homarus gammarus*, all of which live close to the seabed (Sanchez et al. 2000). The trawl net is attached to the vessel by two cables, each of which is connected to a door (otter board) whose function is to hold open the mouth of the net when it is towed through the water (Enticknap 2002). The otter trawl can penetrate the sea bed down to 20 cm (Querios et al. 2006). This method of trawling is commonly used for commercial fishing, e.g. in Norway, South Africa and in the Benguela upwelling system. **The beam trawl** (Fig. 2.3, middle) is held open by a steel beam fitted with chains (Watling & Norse 1998) and is used to catch bottom fish and shrimp. The penetration depth of a beam trawl depends on the bottom type and varies between 1 cm and 8 cm (Fisheries and Aquaculture Department, USA). Otter trawls are generally used over soft-sediment bottom, while beam trawls are more common in coarser sediment (Querios et al. 2006). **The traditional Chinese trawl** (Fig. 2.3, bottom) uses a different design. The trawler tows six nets (three on each side) which are connected to long batons of wood. Heavy chains are used to keep the nets close to the seabed. This method of trawling drags a lot of sediment along with the nets resulting in sediment accumulation in other places. The penetration depth can reach down to 15 cm for the traditional Chinese shrimp trawler and 20 cm for traditional Chinese twin trawler (Paul Hodgson and World Wide Fund (Hong Kong), pers. comm.).

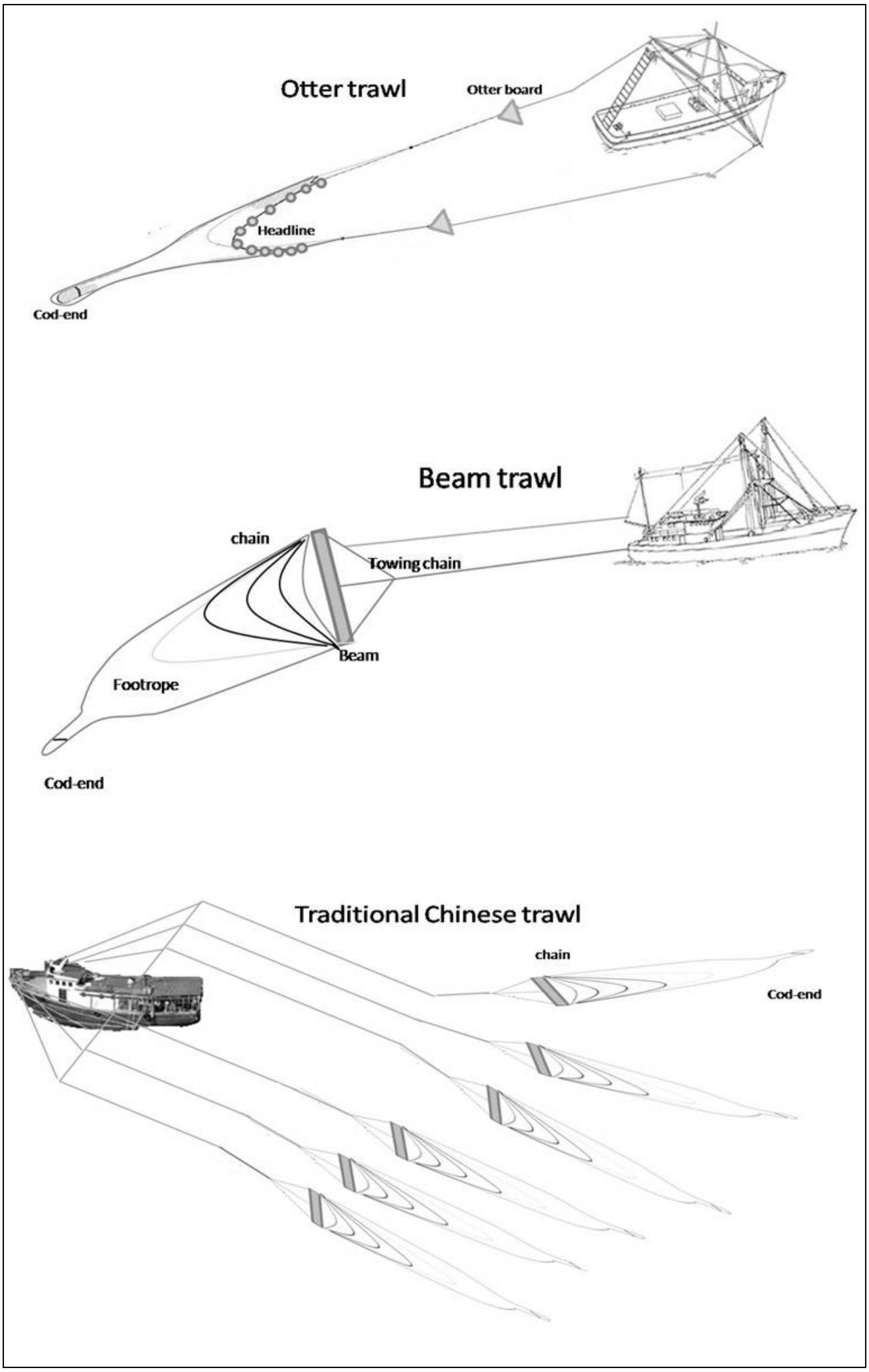

Figure 2.3 Common trawling gear used for commercial fishing.

2.6.2 Trawling effects

Benthic organisms, such as sponges, corals, mussels and tube worms form complex structures and provide important sources of nutrition and refuge for marine species enhancing their chances of survival (Auster et al. 1998; Tupper & Boutilier 1995; Yoklavich et al. 2000). When heavy trawling gear is dragged along the seabed, some of the complex structures are damaged (Auster 1996; Koslow et al. 2001; Stone 2005). Juvenile animals, which are unable to take refuge in the complex structures, may suffer from higher rates of predation (Lindholm et al. 1999) and benthic organisms may be buried in the sediment (Enticknap 2002). Bottom trawling is harmful to seafloor habitats and this effect has been well studied in marine systems (e.g., Kaiser et al. 1998; Watling & Norse 1998; Hansson et al. 2000; McConnaughey et al. 2000; Drabsch et al. 2001; Sparks-McConkey & Watling 2001; Nilsson & Rosenberg 2003; Rosenberg et al. 2003; Watling 2005; Tillin et al. 2006). In general, these studies have concluded that large-scale trawling results in reduced ecosystem functioning, decreased biomass and lowered diversity of benthic organisms, leading to reduced productivity. Repeated habitat disturbance, as caused by large-scale demersal trawl fishing, has been shown to lead to an abundance of small-bodied, opportunistic, short-lived (r-selected) species with a concomitant loss of larger-bodied, longer-lived, slower growing (K-selected) species (Jennings et al. 1999; Ball et al. 2000; Sparks-McConkey & Watling 2001).

Modifications to the composition of benthic assemblages may result in changes to the ecological functioning of the system (Tillin et al. 2006; Bremner et al. 2006a). In order to understand the effects trawling may have on ecosystem functioning, it is necessary to identify the relationship between the biological traits of species and their vulnerability to trawling disturbance (Tillin et al. 2006). The degree of the impact depends on the characteristics of the trawling gear (Jennings and Kaiser 1998; Steele et al. 2002), type of benthic habitat (Koslow et al. 2001; Kenchington et al. 2006; Queiros et al. 2006), trawling frequencies (Enticknap 2002) and the degree of other local disturbances (Sanchez et al. 2000). The degree of disturbance caused by trawling varies from place to place (Thrush et al. 1995; Currie & Parry 1996; Kaiser & Spencer 1996) and also varies with the size of the trawled area (Watling & Norse 1998). Succession processes in soft benthic communities can also be altered in response to disturbances caused by trawling (Sparks-McConkey et al. 2001).

The effects of fishing on the ecosystem can be divided into direct effects and indirect effects (Goñi 1998). Direct effects include:

1. Fishing mortality, especially on the populations of organisms targeted;
2. Fishing mortality on non-target species as by-catch and discards and
3. Physical impacts caused by the fishing gear on benthic communities and the seabed.

Indirect effects include:

1. Changes in biological interactions between species in the ecosystem (e.g., competition and predation);
2. Impact of dumping of discards and organic detritus and
3. Mortality caused by lost fishing gear, i.e., ghost fishing.

Table 2.2 summarizes some important research and reviews on the impact of worldwide trawling and dredging from 1971-2009. All of these studies have shown that trawling and dredging have had ecological impacts which have been varied both in nature and in magnitude.

There are very few studies which show that trawling has had no impact or have increased biodiversity in the soft benthic community. However, Schratzberger and Jennings (2002) recorded significantly higher abundances of meiofauna, where the trawling was of medium intensity, and no change in the overall abundance of meiofauna, even with a chronic level of bottom trawling, occurred. This may be due to the very small size of the organisms, which would allow them to escape from the physical disturbances of the trawl gear (Gilkinson et al. 1998). Seasonal effects may impact the nematode community structure more than trawling (Schratzberger et. al 2002). Liu et al. (2009) studied nematode communities in heavily trawled areas in Hong Kong and did not find any significant seasonal differences in the nematode community structure, suggesting that organic pollution may be more unfavourable to meiofauna than the physical disturbances caused by bottom trawling.

Table 2.2 Selected studies and reviews undertaken on impacts of trawling and dredging on benthic habitats worldwide 1971-2009.

(T = trawl; D = dredge)

Gear impact	Site	Depth	Bottom type	Research	References
Beam T	North Sea	20 m	Sand	Field	de Groot & Apeldoorn 1971
Otter T	Australia	10 m	Sand	Field	Gibbs et al. 1980
Otter T	Georgia, USA	20 m	Gravel, cobble	Field, diving	Van Dolah et al. 1987
Otter T	Main, USA	20 m	Fine mud	Field	Mayer et al. 1991
Otter T	USA	8-30 m	Sand	Field	Van Dolah et al. 1991
Beam T	North Sea	30 m	Sand	Field	Bergman & Hup 1992
Scallop D	Scotland	10 m	Sand	Field	Eleftheriou & Robertson 1992
Beam T	Irish Sea	32 m	Gravel, cobble	Field	Kaiser & Spencer 1994
Otter T	New Zealand	24 m	Sand	Field	Thrush et al. 1995
Beam T	Irish Sea	30 m	Sand	Field	Kaiser & Spencer 1996
Beam T	Irish Sea	30-42 m	Not given	Field, starfish	Kaiser 1996
General	Atlantic Sea	30 m	Sand	Field	Auster et al. 1996
Scallop D	Australia	10-20 m	Sand, silt	Field	Curry & Parry 1996
Beam T	Irish Sea	40 m	Not given	Field, hermit crab	Ramsay et al. 1996
General	Atlantic Sea	40-80 m	Gravel	Field	Collie et al. 1997
Beam T	Irish Sea	26 -34 m	Coarse sand, gravel	Field	Kaiser et al. 1998
Rockhopper	Scotland	30-35 m	Silt, clay	Field	Tuck et al. 1998
Diverse	Diverse	Diverse	Diverse	Review	Watling & Norse 1998
Otter T	California	180 m	Sand	Field	Engel & Kvitek 1998
Otter T	New Zealand	17-35 m	Various	Field	Thrush et al. 1998
Scallop D	Australia	10-20 m	Sand silt	Field	Curry & Parry 1999

Table 2.2, Continued

Gear impact	Site	Depth	Bottom type	Research	References
Not given	Alaska	200 m	Pebble, cobble	Field	Freese et al. 1999
Not given	UK	18-69 m	Sand	Field	Kaiser et al. 1999
Otter T	Newfoundland	120-146 m	Sand	Field	Prena et al. 1999
Not given	Irish Sea	35-75 m	Muddy	Field	Ball et al. 2000
Otter T	Gullmarsfjord	73-96 m	Muddy	Field	Hansson et al. 2000
Not given	North Sea	80 m	Muddy	Field	Frid et al. 2000
Beam T	North Sea	30-50 m	Silt, sand	Field	Bergman & Santbrink 2000
Otter T	Bering Sea	44-52 m	Sand	Field	McConnanghey et al. 2000
Scallop D	Scotland	6-15 m	Sand, mud	Field	Hall Spencer & Moore 2000
Not given	Irish Sea	Not given	Gravel, sand	Field	Kaiser et al. 2000
Otter T	Australia	50 m	Not given	Field	Moran & Stephenson 2000
Not given	Australia	Not given	Sand	Field	Pitcher et al. 2000
Not given	Adriatic Sea	24 m	Sand	Field	Pranovi et al. 2000
Otter T	Catalan coast	30-40 m	Mud	Field	Sanchez et al. 2000
Otter T	Crete	200 m	Mud	Field	Smith et al. 2000
Scallop D	Irish Sea	20-67 m	Sand	Field	Veale et al. 2000
Beam T	North Sea	40-80 m	Muddy sand	Field	Jennings et al. 2001
Otter T	Newfoundland	120-146 m	Sand	Field	Kenchington et al. 2001
Otter T	Maine	60 m	Mud	Field	Sparks-McConcey & Watling 2001
Scallop D	Maine	15 m	Silty sand	Field	Watling et al. 2001
Beam T	North Sea	48-74 m	Sand, mud	Field	Jennings et al. 2002

Table 2.2, Continued

Gear impact	Site	Depth	Bottom type	Research	References
Diverse	Diverse	Diverse	Diverse	Reviews	Thrush & Dayton 2002
Otter T	Norway	Diverse	Sand, mud	Field, mesocoms	Widdicombe et al. 2004
Beam/otter T	North Sea	25-153 m	Sand, mud	Field,traits	Tillin et al. 2006
Diverse	Diverse	Diverse	Diverse	Reviews	Gray et al. 2006a
Diverse	Diverse	Diverse	Diverse	Reviews	Kaiser et al. 2006
Beam T	UK	Diverse	Sand, mud	Field	Querios et al. 2006
General	North Sea	Diverse	Diverse	Modelling study	Allen & Clarke 2007
General	North Sea	Not given	Diverse	Reviews	Callaway et al. 2007
General	Catalan Sea	30-80 m	Not given	Field,traits	de Juan et al. 2007
Dredge	UK	14-40 m	Gravel, sand	Field, recovery	Cooper et al. 2007
Dredge	Bay of Fundy	90 ± m	Not given	Field,traits	Kenchington et al. 2007
Dredge	UK	14-40 m	Gravel, sand	Field,traits	Cooper et al. 2008
Otter T	Norway	101-136 m	Clay	Field, mesocosm	Olsgard et al. 2008
Otter T	Iceland	32-35 m	Sand, mud	Field	Ragnarsson & Lindegarth 2009

2.6.3 Trawling regulations

Ecological damage to the benthic environment by bottom trawling is now a global concern (Watling & Norse 1998; Thrush & Dayton 2002; Gray et al. 2006) and regulations have been developed in several countries for the establishment of trawl-free areas.

The Marine Conservation Biology Institute and Oceana have summarized legislations and trawling restrictions in some vulnerable areas in USA (Oceana & Marine Conservation Biology Institute 2005). For example, **Alaska:** Bottom trawling is prohibited for catching ground fish. There are also seasonal prohibitions on trawling to protect salmon *Oncorhynchus* spp.; and 90% of state waters are closed to all bottom trawling to protect king crab *Paralithodes* spp. habitats and Steller sea lion *Eumetopias jubatus*. **California:** Bottom trawling is prohibited for catching prawns and rock fish. **Connecticut:** Bottom trawling is banned in near shore waters. **Delaware:** Bottom trawling is banned in state waters, except for scientific purposes. **Florida:** Bottom trawling is prohibited for species other than shrimp, scallop and jellyfish. **Hawaii:** All bottom trawling is banned. **Louisiana:** Bottom trawling is prohibited for shrimp and finfish. **Maine:** Bottom trawling is prohibited for lobster *Homarus americanus*. **Maryland:** Bottom trawling is prohibited within one mile (1.6 km) of coastal shore and bays. **Massachusetts:** Bottom trawling is prohibited at night and for lobster *H. americanus*, striped bass *Morone asxatilis*, shad *Alosa sapidissima*, smelt *Osmerus mordax*, tuna *Thunnus* spp, and billfish *Scomberesocidae* spp. **Mississippi:** Recreational trawling is prohibited within the Gulf Islands National Seashore boundaries of Petit Bois, Horn and Ship islands. **New Hampshire:** Complete ban on trawls in state waters. **New Jersey:** No trawling within two miles (3.22 km) off coast is allowed. **North Carolina:** Bottom trawling for marine species is prohibited in estuaries. **Oregon:**

Bottom trawling is prohibited for several species of rockfish and prawns. **Rhode Island:** Established trawl-free areas to protect fish and reduce by-catch. **South Carolina:** Bottom trawling is only conducted for shrimp, but a regulation permits its use for crabs, flounder, finfish and whelks in certain areas and times. **Texas:** Bottom trawling is prohibited for finfish. **Virginia:** Bottom trawling is prohibited in all state waters to protect summer flounder and other spawning and migrating species. **Washington:** Bottom trawling is prohibited for coastal bottom fish and prawns.

Canada has agreed to protect vulnerable coral reefs from bottom trawling off Nova Scotia (Gianni 2004), Northeast Channel, the Gully and Stone Fench (Hall-Spencer et al. 2009).

In 2004, the Council of the European Union banned bottom trawling in Darwin Mounds off the coast of **Scotland** (Freiwald & Roberts 2005). **Norway, Sweden** and **Iceland** have closed several locations of cold-water corals to bottom trawling (Hall-Spencer et al. 2009). In 1984, the Norwegian Government banned all trawling shallower than 60 m in fjords and coastal areas (Act 3 Saltwater Fish Law, June 1983 NO 40). In 1994, the European Union banned the use of dredging equipment for the harvest of the red coral *Corallium rubrum* in the **Mediterranean** (Council of the European Union, 1994).

South Africa is a signatory to the World Summit on Sustainable Development (2002) and is thereby committed to establishing and implementing an Ecosystem Approach to Fisheries (EAF) by 2010.

In 1999, **Australia** agreed to prohibit bottom trawling in the south Tasman Sea and in the Great Australian Bight Marine Park (Gjerde 2006). In 2001, **New Zealand** banned bottom trawling from 19 seamounts, including the Chatham Rise and the east-west coasts of the North Island (Gjerde 2006).

The **Special Administrative Region of Hong Kong** has established four Marine Parks and one Marine Reserve, which are trawl-free areas. However, there are no restrictions or quotas for bottom trawling in other marine waters of the territory [World Wide Fund (Hong Kong), pers. comm.]. Anyone with a boat (and a boat licence) can trawl in Hong Kong waters.

2.6.4 Recovery from trawling

Recovery from trawling is defined as the return of the ecosystem to the same state it was, prior to the disturbance, in regard to environmental factors and species composition. Few studies have been conducted on the recovery of soft benthic habitats after trawling. The difficulty concerning recovery is that trawling has occurred for a long time but benthic data have only been gathered over a relatively short period of time, i.e., little or no data were taken prior to the occurrence of trawling (Thrush & Dayton 2002). A condition that commonly limits trawling impact studies is the lack of adequate controls (Dayton et al. 1995; Thrush et al. 1998; McConnanghey et al. 2000). The changes in ecosystems over time can be caused by natural or human disturbances (Thrush & Dayton 2002). A suitable reference to investigate recovery from trawling is to study areas that have been impacted in the past but have subsequently been closed to trawling as in the case of marine protected areas (Gray et al. 2006). Sites nearby where trawling still takes place can then be studied for comparison. Another ideal way to study the effects due to trawling is to trawl a non-impacted area while conducting a time series sampling of the community. The problem is that it is very difficult to find two areas (i.e., an untrawled and a trawled area) for comparison that are close together and have the the same ecological habitat (Gray et al. 2006). Another frequently used method to establish non-trawled control areas is to study the places where fishermen are reluctant to trawl. Such areas may be near to shipwrecks, have uneven topography or have other obstacles on the seabed which can destroy fishing gear (Olsgard et al. 2008).

Recovery from trawling depends on the following: type of habitat (Collie et al. 2000; Queiros et al. 2006); frequency of disturbance, as compared with natural changes (Walker 1992); species and life history characteristics (Emeis et al. 2001) and size of the area disturbed (Thrust et al. 1998). It is almost impossible for corals to recover from trawling because they grow only a few millimetres each year (Druffel et al. 1995; Gray et al. 2006). de Biasi (2004) studied the impact of experimental otter trawling on soft benthic infaunal communities found off the Italian coast of Tuscany. Significant changes in both the sediment composition and the mollusc community were observed. de Biasi suggested that these changes could be completely reversed within one month following the cessation of trawling. Allen and Clarke (2007) used a model to look at the effects of demersal trawling on ecosystem functioning using North Sea data as a template. The authors suggested that the system will return to its original state within five years, except in extreme cases, where the deposit or filter feeder function is effectively removed; this may result in a permanent change in the function of the benthic ecosystem. Tuck et al. (1998) observed the effects of trawling over an 18-month period and followed the subsequent patterns of recovery over a further period of 18 months. The physical effects of the changes in the benthic community, examined with side-scan and sea bed classification systems (RoxAnn, remote sensing hydro-acoustic sensor) were identifiable immediately after disturbance. Some effects were still noticeable after an 18-month period of recovery. Such a long recovery time suggested that even fishing during a restricted period of the year may be sufficient to maintain communities occupying fine muddy sediment habitats in an altered state. Ragnarsson and Lindegarth (2009) conducted a field experiment to examine the short-term (immediate) and long-term (two- and seven-month) impacts of otter trawling on a macrobenthic infaunal community in Iceland. This community had never been trawled before. Short-term effects on diversity and rare species were detected. However, they could not find any significant impact on the total abundance or on the multivariate analysis of the long-term study. The authors concluded that further power analysis was needed to detect changes in abundance compared to measures of diversity.

2.7 Eutrophication and hypoxia

Eutrophication is a process in which the aquatic ecosystem gradually becomes more productive due to the increase in the rate of supply of organic matter (Nixon 1995). This phenomenon can either occur naturally or unnaturally. An example of a natural occurrence is when lakes and ponds age slowly over a period of several hundred years. An example of an unnatural occurrence of eutrophication is the human input of nutrients, such as nitrogen and phosphorus resulting in stimulation of algal production. Phosphorus and nitrogen contribute significantly to eutrophication. They are the limiting factors for algal production. By increasing the input of nutrients into the aquatic system, the primary production (algae) increases, resulting in more algal biomass for the secondary production (zooplankton). The problem arises when the total production gets out of control and a large amount of plankton dies and sinks down to the bottom; this results in a large increase in the production of bacteria. When bacteria break down, a large amount of oxygen is used up; this results in hypoxia (dissolved oxygen (DO) < 2 mg l^{-1} or < 30%) or, in extreme cases, in anoxia (no oxygen). Eutrophication has been a well-known problem in freshwater systems for many years. Because of urbanization and human pollution, eutrophication has increased globally (Nixon 1990). Eutrophication has increased and become widespread in marine waters, giving rise to concerns about coastal and estuarine systems (Bricker et al. 1999). Eutrophication, which has negative effects on marine communities, is thought to be one of the most important problems affecting the marine environment (Gray et al. 2002). The primary symptoms are decreases in light availability, decreases in water quality and shifts in algal communities, which are often dominated by toxic species that can kill other marine organisms and/or reduce the food quality in shellfish (CENR 2003). The secondary symptoms are hypoxia/anoxia, the release of hydrogen sulphide at the bottom, changes in the marine community structure, damage to coral reefs and fish kill. Hypoxia at the sea bottom has been documented to have large influences on the benthic diversity (e.g., Jorgensen & Richardson 1996; Grall et al. 2002). A large amount of the benthic organisms that live buried in the soft bottom sediment pump oxygenated water down into their burrows, which is important for helping to maintain oxidized conditions (Rosenberg et al. 2001). With the onset of hypoxia, these benthic animals are adversely affected. Some other symptoms of hypoxia are: increased abundance of opportunistic species such as the polychaetes *Capitella capitata* and *Polydora* sp. (Pearson & Rosenberg 1978); shifts in species composition (Nilsson & Rosenberg 1994); decreased biodiversity (Ritter & Montagna 1999); decreased body size of the average species (Weston 1990); changes in trophic structure (Doering et al. 1989) and eventually mass mortality (Dias & Rosenberg 1995).

Some benthic species that are not particularly tolerant towards hypoxia can survive in the area because their life-history traits can facilitate a rapid colonization following improvements in the levels of oxygen (Gray 1979; Rosenberg et al. 2001). However, some invertebrates may be more likely either to remain or to escape low oxygenated water due to their differences in tolerance and their movement responses to hypoxia

(Pihl et al. 1991; Bell et al. 2005). Blue crab *Callinectes sapidus* has shown strong avoidance responses to chronic hypoxia and episodic hypoxic upwelling events in the Neuse River Estuary, North Carolina, USA (Bell et al. 2005). Pearson and Rosenberg (1978) developed a response model to increased levels of disturbance caused by increases in organic matter (Heip 1995; Rosenberg et al. 2001). Their model (Fig. 2.4), which has been documented to fit a stressed benthic system, suggests that the total biomass increases gradually, as organic matter increases. As the disturbance gradient increases, the biomass rises to a maximum, falls and then increases again to a secondary peak. The latter occurs when there are large amounts of organic matter but oxygen concentrations have not yet started to decrease. The change in the maximum number of species with an increasing disturbance gradient is similar to the change in biomass but without a secondary peak. Species abundance increases slowly at first and then rapidly rises to a maximum before falling sharply. The paper describing the above model is one of the most cited in benthic ecology. However, it is regarded as more descriptive than predictive in nature, since there is no quantitative scale for the level of changes in organic matter along the x-axis. The lack of a quantitative scale makes it impossible to predict changes in benthic community structures with increasing organic input (Gray et al. 2002).

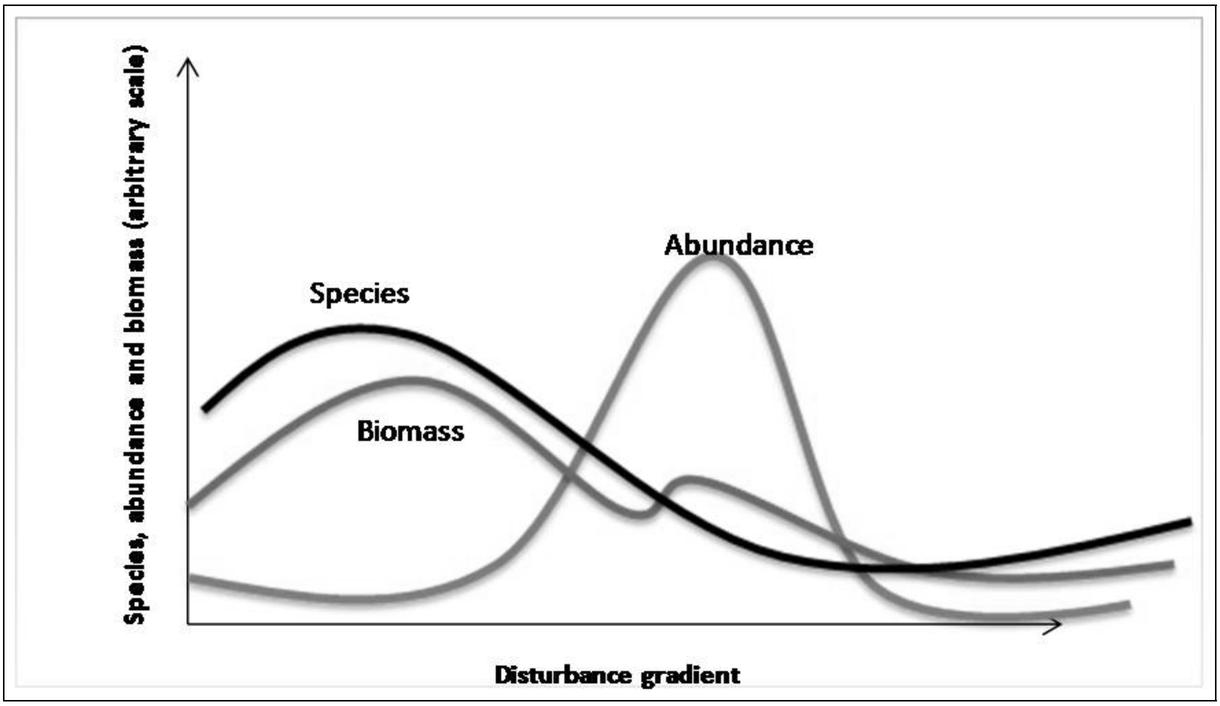

Figure 2.4 Pearson-Rosenberg model (1978) illustrating how species, abundance and biomass change along a gradient of disturbance.

Chapter 3 Structure and function of infaunal communities in arctic and temperate water masses

3.1 Introduction

Benthic communities contain a complex mix of species, each of which performs a role in the habitat, with a variety of life history strategies (Southwood 1977; Levin et al. 2001). The variations in such functional roles within the habitat are large, including: contribution to primary productivity; storage and recycling of nutrients; soil binding; predation; bioturbation and decomposition of waste (Levin et al. 2001). Life history strategies summarize how evolution has shaped organisms in order to successfully survive in a particular habitat (Southwood 1977). An organism in a habitat adapts successfully to the environment on the basis of a combination of traits. Specifically, traits are characteristics of species that are often used to define some biological features of the organism, i.e., biological traits (BTs), or its relation to the habitat, i.e., ecological traits (Olden et al. 2006). Traits can be used as an indicator to explain the functioning of the environment, e.g., bioturbation (Biles et al. 2002). Animals with a certain trait, such as burrowing, can change the structure in the sediment and introduce a higher level of oxygen to the sediment, thereby contributing to ecosystem functioning (Biles et al. 2002; Olsgard et al. 2008). Techniques of analyzing BTs can contribute to broader information on assessing ecosystem functioning of the benthic environments on both large and small scales (Bremner et al. 2003). Trait analysis of macrobenthic invertebrates has been well investigated in French streams (Usseglio-Polatera et al. 2000; Doledec et al. 1999; Charvet et al. 2000; Chevenet et al. 1994). Similar analysis in marine benthic systems has recently been given more attention, the findings of which may broaden the understanding of ecosystem functioning. However, such analyses are still limited, except for studies of invertebrate fauna in the southern North Sea and the

English Channel (Bremner et al. 2003; Tillin et al. 2006; Bremner 2008), the Catalan Sea, NW Mediterranean (de Juan et al. 2007) and Hastings Shingle Bank, eastern English Channel (Cooper et al. 2008).

It is commonly known that species composition can vary through space and time, but trait composition tends to be more stable in similar environments. Species with similar traits occupy a similar habitat type (Southwood 1977). However, it is not clear how different water masses will influence the proportionality of functioning, even if it is well known that different species compositions and distributions are controlled by environmental changes, including temperature and hydrological factors, such as currents. If one assumes that each community has the same basic functioning for communities in a “balanced” state, e.g., a certain amount of: predators; filter feeders; grazers with different sizes; mobility; larval type in the sediment, etc., then, the selected functioning, based on the trait analysis, should be similar in each system, notwithstanding small differences in environmental conditions such as depth, temperature and grain size.

In this study, the taxonomic and BT compositions of communities from sampling stations collected in two different water masses, the South of Norway and the Arctic are compared. There are no known significant disturbance effects, such as heavy trawling or natural/unnatural hypoxic situations in these investigated areas. The dataset from the South of Norway are taken around oil fields where trawling is not allowed, and the “polluted” stations have been eliminated from the dataset. The dataset from the Arctic is from Pechora Sea, Barents Sea and Franz Josef Land and between 70^{o} to 80^{o} N. In 1977, Norway established a ‘Fisheries Protection Zone’ of 200 nautical miles around Svalbard and in a loop south towards the Barents Sea. Based on this knowledge, it is assumed that there are no heavy human impacts in either of these areas. Since the benthic communities come from different water masses, it is hypothesized that, while their species compositions would be different, their functional traits would be similar. A combination of BT and functional structure for macrobenthic communities, using seven traits reflecting size, larval type, mobility, body form, attachment, life habitat and feeding of species, is adopted for the present analysis.

3.2 Materials and methods

3.2.1 Data mining

This study utilized the Norwegian Oil Industry Association (OLF) database and data from Aquaculture and Environmental Research and Consultancy (Akvaplan-niva AS). The extracted dataset contains biological information on soft-bottom benthic communities collected in warm Atlantic waters and cold Arctic waters (Fig. 3.1). In total, 60 sampling stations, with similar depth, were used: 30 stations from the South of Norway (North Sea and southern Norwegian Sea) and 30 stations from the Arctic (Pechora Sea, Barents Sea and Franz Josef Land) (Fig. 3.1). The average depth in the South of Norway was 153 ± 96 m (± SD; n = 30) and in the Arctic 172 ± 97 m (± SD; n = 30).

Referring to the Atlas of the Seas around the British Isles, the mean bottom temperature in winter (February) in the North Sea is 6°C. There are small differences between the surface and bottom temperature at this time of the year. Mean bottom temperature in the summer (August) in the North Sea is 7°C. Mean bottom salinity, in the summer and winter, in the investigated areas in the North Sea is 35.2‰. In the North of the Barents Sea, the bottom temperature ranges from 0-2°C throughout the year and in the Pechora Sea it is approximately 0-1°C, on average (Climatic Atlas of the Arctic Sea 2004). At each sampling station five sediment samples were taken with a 0.1 m^2 van Veen grab. There was a lack of environmental information, such as grain size and total organic carbon (TOC) for several stations in the database, and these data were not included in this biological traits study.

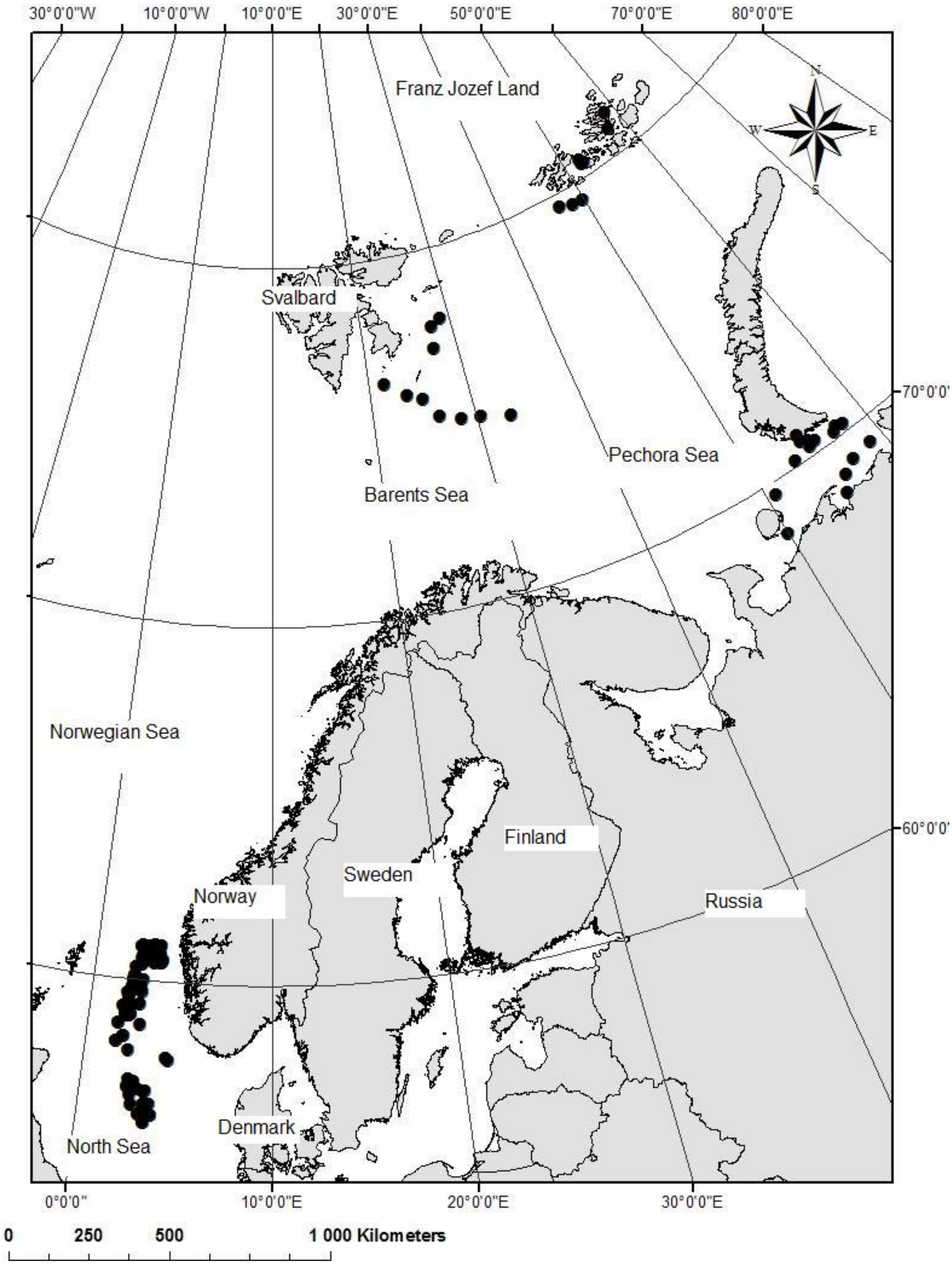

Figure 3.1 Overview of the two study areas and the 60 sampling stations. 30 grab stations are located at the Pechora Sea, Barents Sea and Franz Josef Land, and 30 grab stations are in the southern Norwegian Sea and North Sea. Each dot represents a sampling station, which is the sum of five 0.1 m^2 van Veen grab samples.

Data analyses were conducted on species abundance data pooled over five grabs, i.e., one sampling station comprised five grab samples (0.5 m^2 sampling area). The biological samples were washed through a 1 mm round-mesh sieve and the material fixed in formalin for later identification. Hard-bottom fauna and taxa, not properly sampled by the method used, e.g., Bryozoa, Porifera, Foraminifera and Nematoda were excluded from the analysis. In total, 284 of the most abundant taxa were used for the analysis (approximately 30% of the most abundant taxa from each assemblage were extracted from the database).

3.2.2 Biological traits (BTs)

A total of seven BTs (size, larval type, mobility, body form, attachment, life habitat and feeding) and 36 categories were chosen for the analysis (Table 3.1). The trait information was taken from various literature sources: scientific publications, theses, web databases, general field books, technical papers and expert knowledge. Each category was scored according to the affinity of each taxon for each trait category, ranging from 0-3, were 0 is no affinity and 3 is total affinity, which is referred to as "fuzzy" coding (Chevenet et al. 1994). A taxon may be assigned several scores for the same trait, e.g., one species with two types of feeding strategies was given the affinity of 2 in both categories. For species which no trait information is known, with the exception of size, the function score for the same genus was used since there are similarities between them, such as form, mobility, attachment and larval type. In cases where taxa were only identified to the family level, the affinities for the traits may vary within the taxa. Hence, a lower affinity score was assigned since there are more than two categories represented within a trait (see Table 3.1).

Table 3.1 BT and categories used in the analysis. Each of the categories has affinities ranging from 0-3, where 0 is no affinity and 3 is total affinity.

BT	Code	Categories
Size	NS1	< 5 mm
	NS2	5 mm-1 cm
	NS3	1-3 cm
	NS4	3-6 cm
	NS5	6-10 cm
	NS6	> 10 cm
Larval type	LT1	Planktotroph
	LT2	Lecitotroph
	LT3	Direct development
Mobility	AM1	None
	AM2	Low
	AM3	Medium
	AM4	High
Body form	BF1	Short/cylindrical
	BF2	Dorsally flat
	BF3	Laterally flat
	BF4	Ball shape
	BF5	Long thin
	BF6	Irregular
Attachment	DA1	None
	DA2	Temporary
	DA3	Permanent
Life Habitat	AH1	Sessile
	AH2	Tube (permanent)
	AH3	Tube (semi permanent)
	AH4	Burrower
	AH5	Surface crawler
Feeding	FH1	Suspension/filter
	FH2	Scraper/grazer
	FH3	Surface Deposit Feeder
	FH4	Subsurface Deposit Feeder
	FH5	Dissolved matter/Symbiont
	FH6	Large detrius/sandlicker
	FH7	Scavenger
	FH8	Carnivore/Omnivore
	FH9	Parasite/commensally

3.2.3 Data analysis

A similarity matrix was constructed using square root transformation of the abundance, using the Bray-Curtis similarity coefficient (Bray & Curtis 1957). Non-metric, multidimensional scaling (MDS) was used to visualize the community pattern across the data matrix. The trait matrix was not transformed but weighted with the transformed abundance matrix through matrix multiplication. Each category, with their respective affinities from 0-3, was multiplied with the transformed abundance, and data were summarized for each sampling station (Chevenet et al. 1994). MDS ordination was performed with the weighted trait data matrix. In this case, the affinities would have a larger contribution to identify any community pattern because there was transformation of the abundance but not affinity scores. The aim of the analysis was to investigate how the pattern would change when taking into account trait information. To investigate the pattern of BT without abundance and to see how strong the weighted traits are compared to traits alone, taxa were equally determined to 1. The significance of total abundance and weighted species traits were estimated and compared between the water masses using one-way ANOSIM (Analysis of Similarity, Clarke & Gorley 2006). The contribution of BTs (fuzzy coded matrix) combination and category to the average Bray-Curtis similarity between water masses was examined with SIMPER (Similarity Percentage) analysis (Clarke & Warwick 1994; Carr 1996) using the PRIMER (Plymouth Routines in Multivariate Ecological Research) v6 software (Clarke & Gorley 2006).

A Mann-Whitney U test (using STATISTICA v8) was performed on the weighted BTs with abundance to identify the significance of each category within treatments. The method is based on the rank sum of the median, and the assumption is that the two samples are independent and random. The Mann-Whitney U test can be used in place of a t-test but does not assume normal distribution of the dataset.

3.3 Results

3.3.1 Abundance structure

In both areas, polychaetes were the most dominant taxa in the overall assemblage (58% in the Arctic and 72% in the South of Norway) followed by molluscs (16% in the Arctic and 13% in the South of Norway) (Table 3.2). Arthropods had larger dominance in the Arctic (14%) compared to echinoderms (11%), while in the South of Norway there was an opposite situation (5% molluscs and 7% echinoderms) (Table 3.2).

The MDS ordination of species abundance without weighted BTs showed a clear distinction between the two investigated areas (Fig. 3.2). This result was confirmed by ANOSIM ($p < 0.001$, $R = 0.97$). None of the top 10 most abundant species were represented in both areas (Table 3.3).

Table 3.2 Dominant taxa in each area measured in % of the total abundance within each species, genus and family of the data collected from the database.

Taxa	Arctic (%)	Atlantic (%)
Annelida	58	72
Mollusca	16	13
Arthropoda	14	5
Echinodermata	11	7
Others	1	3
Sum	100	100

Table 3.3 Top ten taxa in Arctic and South of Norway. B = Bivalvia, E = Echinodermata, O = Others and P = Polychaeta.

Arctic	South of Norway
Spiochaetopterus typicus (P)	*Myriochele oculata* (P)
Maldane sarsi (P)	*Amphiura filiformis* (E)
Lumbrineris indetermined (P)	*Nemertina* indetermined (O)
Cirratulidae indetermined (P)	*Paramphinome jeffreysii* (P)
Terebellides stroemii (P)	*Spiophanes kroyeri* (P)
Pholoe synophthalmica (P)	*Spiophanes bombyx* (P)
Scalibregma inflatum (P)	*Goniada maculata* (P)
Heteromastus filiformis (P)	*Scoloplos armiger* (P)
Ennucula tenuis (B)	*Owenia fusiformis* (P)
Levinsenia gracilis (P)	*Abra prismatica* (B)

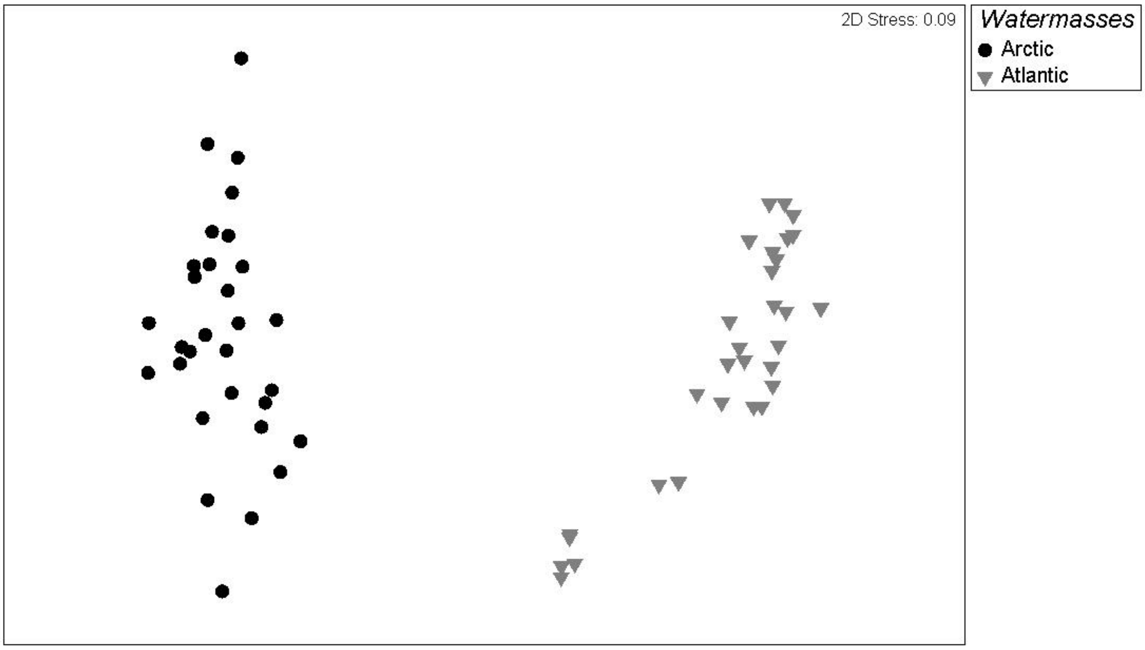

Figure 3.2 MDS of square root transformed species abundance showing significant dissimilarity (ANOSIM, $p < 0.001$, $R = 0.97$). Black spots represent assemblage in Arctic water masses and grey triangles in warmer waters in the South of Norway.

3.3.2 Abundance weighted with BT structure

When the species abundance pattern was weighted with the BTs, the distinction between the sampling stations in the Arctic and the South of Norway was not so clear, as shown in the MDS plot (Fig. 3.3). The ANOSIM results still showed a significant difference ($p < 0.001$, $R = 0.19$). However, the global R value was significantly lower than that ($R = 0.97$) without weighted BT information, indicating smaller differences ($R = 0.19$). Table 3.4 shows significant differences in weighted traits between Arctic and Atlantic water masses when weighted with abundance. The Arctic had a significantly higher level of size categories < 5 mm (NS1, $p = 0.015$, $U = 287$), 6-10 cm (NS5, $p < 0.001$, $U = 116$) and > 10 cm (NS6, $p < 0.001$, $U = 564$). Planktotrophic larval type (LT1, $p = 0.001$, $U = 234$) was more dominant in the South of Norway (Atlantic) and lecitrophic in the Arctic (LT2, $p < 0.001$, $U = 225$). The feeding types were significantly higher in Atlantic for surface deposit feeders (FH3, $p = 0.003$, $U = 250$) and scavengers, while in the Arctic, the number of suspension/filter (FH1, $p < 0.001$, $U = 210$) and large detritus/sandlicker species (FH6, $p = 0.011$, $U = 279$) were significantly higher.

3.3.3 BT structure

The MDS ordination of BTs without weighting with abundance showed significant similarities in trait composition between the two water masses (ANOSIM $p < 0.001$, $R = 0$) (Fig. 3.4).

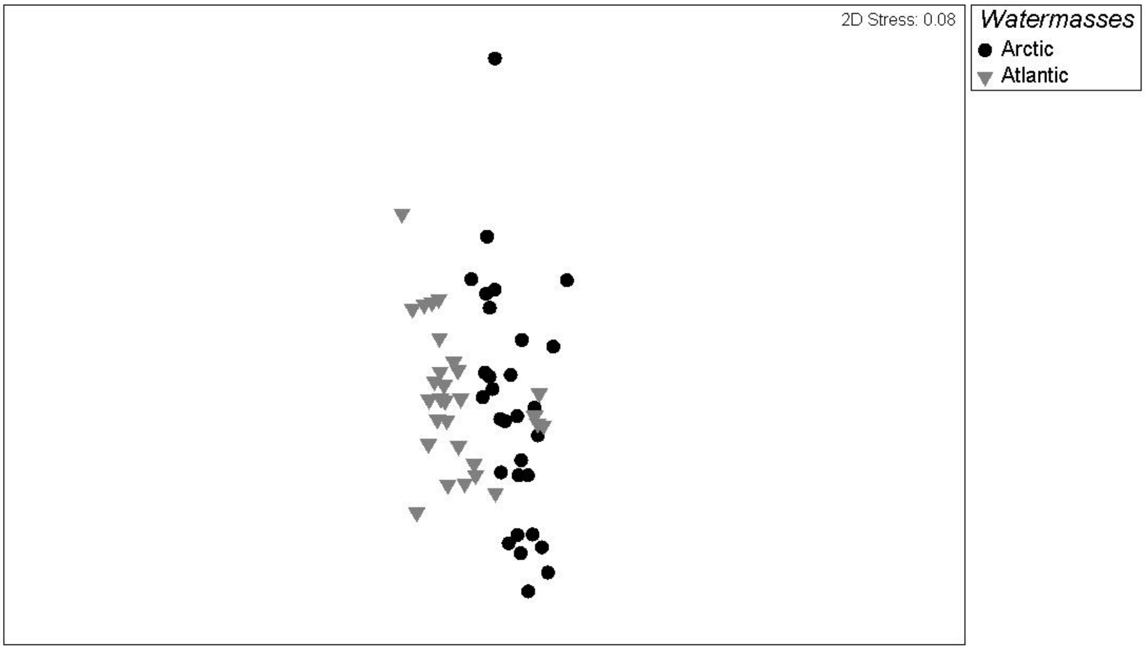

Figure 3.3 MDS of transformed species abundance weighted with BT score affinities showing significant dissimilarity (ANOSIM, $p < 0.001$, $R = 0.19$). Black spots represent assemblages in Arctic water masses and grey triangles in warmer waters in the South of Norway.

Table 3.4 Significantly different BTs in infauna, as tested by non-parametric Mann-Whitney U, between Arctic (Ar) and Atlantic (At) water masses.

BT	Categories	Code	Significant value	Rank Ar/At
Size	<5 mm	NS1	p=0.015, U=287	1078/752
Size	6-10 cm	NS5	p<0.001, U=116	1249/581
Size	>10 cm	NS6	p<0.001, U=564	1269/561
Larval type	Planktotroph	LT1	p=0.001, U=234	699/1131
Larval type	Lecitotroph	LT2	p<0.001, U=225	1140/690
Feeding type	Suspension/filter	FH1	p<0.001, U=210	1155/675
Feeding type	Surface deposit feeder	FH3	p=0.003, U=250	715/1115
Feeding type	Large detritus/ sandlicker	FH6	p=0.011, U=279	1086/744
Feeding type	Scavenger	FH7	p<0.001, U=62	527/1302

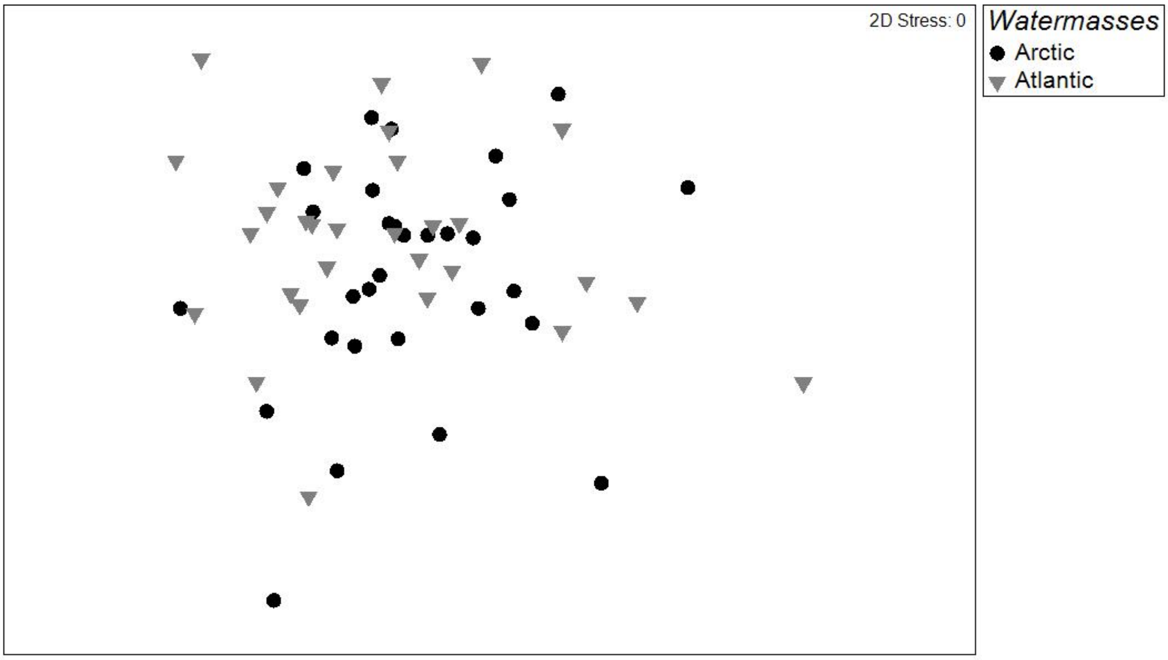

Figure 3.4 MDS without abundance showing significant similarity in BT patterns (ANOSIM, $p < 0.001$, $R = 0$). Black spots represent assemblages in Arctic water masses and grey triangles in warmer waters in the South of Norway.

3.3.4 BT combinations

Of 284 taxa, there were 251 BT combinations that were unique, based on the affinity scores. There were several taxa which shared 100% of the same trait combinations (Table 3.5). The species with 100% trait similarities were closely related taxa, e.g., same genus or families. The most common trait combination was: 1-3 cm (NS3); lecitotroph larval type (LT2); low adult mobility (AM2); dorsal flat body form (BF2); none attachment (DA1); burrower (AH4) and subsurface deposit feeder (FH4), represented by the seven species of the genus *Yoldiella*, a burrowing bivalve. The second most common combination was: 1-3 cm (NS3); planktotroph larval type (LT1); low adult mobility (AM2); cylindrical body form (BF1); long thin body form (BF5); sessile (AH1); tube semi permanent (AH3) and surface deposit feeder (FH3), dominated by five polychaetes (*Galathowenia oculata, Myriochele danielsseni, M. fragilis, M. oculata* and *M. heeri)*. Seven taxa (*Yoldiella lucida, Y. nana, Myriochele fragilis, M. heeri, Spiophanes kroyeri, Chaetozone* indet, *C. setosa*) were common in both areas. The remaining groups with the same trait combinations were represented by 2-3 taxa in each letter groups (Table 3.5).

Table 3.5 Results from Bray Curtis similarity of BT combinations. This table is based only on taxa sharing 100% similarities between groups. Each letter represents one type of combination and is marked with A-V. The letter X is area (30% of the most abundant) with the specific trait combination. See Table 3.1 for the category names.

Taxa	BT combination	Arctic	Atlantic	Group
Sphaerodorum gracilis	NS4, LT2, AM3, BF5, DA1, AH5, FH3		X	A
Sphaerodorum indet.	NS4, LT2, AM3, BF5, DA1, AH5, FH3	X		A
Ophiacantha bidentata	NS6, LT1, AM3, BF6, DA1, AH5, FH1, FH8			B
Ophiocten sericeum	NS6, LT1, AM3, BF6, DA1, AH5, FH1, FH8	X		B
Pholoe baltica	NS3, LT1, AM3, DA1, AH4, FH8, BF1, BF2		X	C
Pholoe inornata	NS3, LT1, AM3, DA1, AH4, FH8, BF1, BF2		X	C
Pholoe pallida	NS3, LT2, AM4, BF2, BF2, DA1, AH4, FH8		X	D
Pholoe synophthalmica	NS3, LT2, AM4, BF2, BF2, DA1, AH4, FH8	X		D
Echinocardium flavescens	NS5, LT1, AM2, BF4, DA1, AH4, FH4		X	E
Echinocyamus pusillus	NS5, LT1, AM2, BF4, DA1, AH4, FH4		X	E
Amphiura filiformis	NS4, LT1, AM2, AM3, BF6, DA1, AH4, AH5, FH3, FH8		X	F
Amphiura sundevalli	NS4, LT1, AM2, AM3, BF6, DA1, AH4, AH5, FH3, FH8		X	F
Yoldia hyperborea	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X		G
Yoldiella frigid	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X		G
Yoldiella indet.	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X		G
Yoldiella enticula	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X		G
Yoldiella lucida	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X	X	G
Yoldiella nana	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X	X	G
Yoldiella solidula	NS3, LT2, AM2, BF2, DA1, AH4, FH4	X		G
Nicomache quadrispinata	NS4, LT2, BF1, BF5, AH4, DA3, AH4, FH4		X	H
Rhodine gracilior	NS4, LT2, BF1, BF5, AH4, DA3, AH4, FH4	X		H

Table 3.5 Continued

Taxa	BT combination	Arctic	Atlantic	Group
Galathowenia oculata	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3	X		I
Myriochele danielsseni	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3		X	I
Myriochele fragilis	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3	X	X	I
Myriochele oculata	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3		X	I
Myriochele heeri	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3	X	X	I
Spio armata	NS3, LT1, AM2, BF1, BF2, BF5, DA1, AH3, AH4, FH3	X		J
Spio decorates	NS3, LT1, AM2, BF1, BF2, BF5, DA1, AH3, AH4, FH3	X		J
Spiophanes kroyeri	NS3, LT1, AM2, BF1, BF2, BF5, DA3, AH2, AH4, FH3	X	X	K
Spiophanes urceolata	NS3, LT1, AM2, BF1, BF2, BF5, DA3, AH2, AH4, FH3		X	K
Onchnesoma squamatum	NS5, LT2, AM2, BF1, DA1, AH4, FH3		X	L
Onchnesoma steenstrupi	NS5, LT2, AM2, BF1, DA1, AH4, FH3	X		L
Diplocirrus glaucus	NS3, LT2, AM3, BF1, BF5, DA1, AH4, FH3, FH6		X	M
Diplocirrus hirsutus	NS3, LT2, AM3, BF1, BF5, DA1, AH4, FH3, FH6	X		M
Chaetozone indet.	NS3, LT2, AM2, BF1, BF5, DA1, AH4, FH3	X	X	N
Chaetozone setosa	NS3, LT2, AM2, BF1, BF5, DA1, AH4, FH3	X	X	N
Spirorbidae indet.	NS1, NS2, LT3, AM1, BF1, DA3, AH2, FH1, FH3, FH8	X		O
Spirorbis indet.	NS1, NS2, LT3, AM1, BF1, DA3, AH2, FH1, FH3, FH8	X		O
Tmetonyx cicada	NS3, LT3, AM3, BF3, DA1, AH5, FH7		X	P
Tmetonyx similis	NS3, LT3, AM3, BF3, DA1, AH5, FH7		X	P
Unciola leucopis	NS3, LT3, AM3, BF3, DA1, AH5, FH7	X		P
Harpinia pectinata	NS2, LT3, AM2, BF3, DA1, AH4, FH4		X	Q
Harpinia plumosa	NS2, LT3, AM2, BF3, DA1, AH4, FH4		X	Q

Table 3.5 Continued

Taxa	BT combination	Arctic	Atlantic	Group
Harpinia serrata	NS2, LT3, AM2, BF3, DA1, AH4, FH4	X		Q
Ampelisca macrocephala	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3		X	R
Ampelisca spinipes	NS3, LT1, AM2, BF1, BF5, AH1, AH3, FH3		X	R
Leucon nasica	NS3, LT3, AM3, BF3, DA1, AH5, FH1	X		S
Leucon nasicoides	NS3, LT3, AM3, BF3, DA1, AH5, FH1	X		S
Astarte crenata	NS3, LT3, AM2, BF2, DA1, AH4, FH1	X		T
Astarte elliptica	NS3, LT3, AM2, BF2, DA1, AH4, FH1	X		T
Aricidea catherinae	NS2, LT3, AM3, BF1, BF2, BF5, DA1, AH4, FH3		X	U
Aricidea roberti	NS2, LT3, AM3, BF1, BF2, BF5, DA1, AH4, FH3		X	U
Cylichna alba	NS2, NS3, LT3, AM2, BF1, DA1, AH5, FH8	X		V
Cylichna occulta	NS2, NS3, LT3, AM2, BF1, DA1, AH5, FH8	X		V

3.4 Discussion

3.4.1 Abundance and BT structure

The analysis conducted in this study supported the contention that groups of marine benthic organisms in the Arctic and warmer waters in the South of Norway can be associated with particular water masses and temperature regimes (Stewart et al. 1985). As expected, the species composition of the two different water masses in this analysis differed significantly (ANOSIM $p < 0.001$, $R = 0.97$) (Fig 3.2). In both areas, polychaetes were the most dominant taxa in the overall assemblage, followed by molluscs. However, there was a difference between the water masses in the third taxa group, in which the Arctic had higher dominance of crustaceans, as compared to echinoderms, and the South of Norway had a lower portion of crustaceans (Table 3.2), with a higher abundance of the brittle star *Amphiura filiformis* (Table 3.3). The polychaete *Spiochaetopterus typicus,* the tube-building *Maldane sarsi* and *Lumbrineris* indet. (indetermined to species level) dominated in the Arctic while the polychaete *Myriochele oculata*, brittle star *Amphiura filiformis,* and Nemertina indet. (indeterminate to genus/species level) were the three most abundant taxa in the South of Norway (Table 3.3).

Studies of latitudinal trends in diversity or differences between polar and temperate regions have largely focused on variations in species richness (Gaston & Williams 1996; Crame 2000; Gaston 2000). However, research on changes in sets of functional groups for large ranges of phyla has remained underexplored or has been limited to specific species or one functional category. In this study, it was hypothesized that the functional traits were similar in warm and cold water masses, notwithstanding differences in species compositions. However, this hypothesis is to be rejected. The differences were significant for three traits (size, larval type and feeding type) and nine categories. When traits of functional groups were weighted with abundance, the difference was still significant between the water masses but not as distinct as abundance without traits (Fig. 3.3). As it appeared from Table 3.4, the size differences in the cold water masses in the Arctic had a higher level of abundance of the smallest size (< 5 mm) and largest size (6-10 cm and > 10 cm) while the highest abundance of 6-10 cm were significantly higher in the Atlantic. Researchers have argued that size increases towards polar areas within and among species (Cushman et al. 1993; Atkinson 1994), whereas species energy theory predicts decreasing size towards polar areas (Turner & Lennon 1989; Cushman et al. 1993). This contradiction could be explained that both hypotheses might be right. The previous studies were based on research on few species within the same phylum, not a large dataset of several phyla, as it was done in this study. It also appeared that there are differences in larval type in the two investigated areas. The Arctic had significantly higher levels of lecitrophic larval types than Atlantic water masses, in which planktonic larval type dominated. Schluter (1998) sampled 27 different larval types in the Barent Sea and suggested that there is a strong influence of Atlantic water masses which transport mero-plantonic larvae, including lecitotrophic larval types, towards the polar region. Thorson (1936) suggested that benthic marine invertebrates at low latitudes tend to produce large numbers of eggs which develop into pelagic planktotrophic and widely-dispersing larvae, whereas at high latitudes, such organisms tend to produce fewer and larger lecithotrophic eggs and larger offspring, often by viviparity or ovoviviparity, which are often brooded. This theory has never been proven and the absolute number of species with pelagic larval type was found to be higher at high latitudes than Thorson`s assumptions (Pearse et al. 1992; Pearse 1994; Arntz 2001). One explanation of this high abundance of lecithotrophy larval type in the Arctic, for this study, could be that pelagic lecithotrophy may be an adaptation to a combination of poor food conditions and slower rates of development in polar areas (Pearse et al. 1992). In addition to size and larval type differences, the feeding types were significantly higher in the Atlantic for surface deposit feeders and scavengers, while in the Arctic, suspension/filter and large detritus/sandlicker species were significantly higher. No information on differences in feeding strategy among the large set of adult benthic invertebrate studies were found in the literature for either different water masses or latitude trends. However, few studies have been conducted on single taxa feeding strategy for latitude comparison (e.g., gastropods: Valentine et al. 2002; bivalves: Roy et al. 2000), in which there are too few data to support a whole range of phyla with multi-feeding strategy. With this lack of supported data from other sources, it is difficult to suggest any clear prediction for this trend, and more research is required on this issue.

To test if all the same traits, with their respective categories, appeared in both water masses, the abundance was scored to equal one (abundance equals 1 for all samples). The BTs which were investigated showed the same patterns between soft macrobenthic assemblages in the Arctic and South of Norway (significantly similar $p < 0.001$, $R = 0$) (Fig. 3.4) despite their distinct different taxa and composition (Table 3.3), demonstrating that the same BTs are present in both macrobenthic communities, but the amount of species showing such traits vary between the two assemblages. This suggested that the same life-history categories are represented in both systems, but to different degrees, depending on the community dominance of species adapted to each system.

3.4.2 BT combinations

A combination of traits that an organism possesses is a product of natural selection by the environmental conditions in which a species or population has evolved (Southwood

1977). This can be interpreted to mean that habitats with similar characteristics have similar traits and are not biogeographically restricted. The habitat template model (Southwood 1988) explains the relationships between environmental parameters and life history strategies. It summarizes how evolution has shaped organisms in order to successfully survive in the environment. An organism in a habitat is successfully stationed to the habitat on the basis of the trait combination. From the 284 taxa identified, there were 23 taxa groups sharing the same trait combinations which consisted of 7-2 species in each combination group of 100% (Table 3.5). All the sharing groups were within the same genus or family. This result suggested that different species possess the same trait combination even from different water masses. Species redundancy hypothesis (Walker 1992), states that not all species matter; if a species is lost then other species can perform similar functions. A potentially redundant species in this investigation is defined as a species that possesses the same trait combinations and a potential candidate to perform similar functioning in the ecosystem. If one hypothetical species dissappear (extirpation) in the investigated area there are other species with the same trait combination that could be a potentially redundant candidate, but that species would be from the same genera or family (Table 3.5). According to the niche differentiation model (Armstrong & McGehee 1980) two species with same BTs preference have to differ in some level, but the species possess multi-trait combinations in nature that will increase the possibilities of a stronger uniqueness when BT information increases. This will, again, increase the chance to be less redundant. Based on the traits investigated in this analysis, it is possible that different macrobenthic species contribute to "balance the environment," independently of which organisms carry out the functions. The idiosyncratic hypothesis (Lawton 1994) foresees that changes do occur when species are removed, but they are unpredictable, depending on surrounding factors. Other studies have indicated that ecosystems may contain more species than necessary for the functioning (Naeem et al. 1995). If this is the case, changes in species composition will not have an effect of ecosystem properties as long as some functionally important species are still present (Morin 1995). Organisms can share one or several traits but can also have a totally different significance in the ecosystem. Species that have similar effects on ecosystem processes, but which respond differently to, e.g., environmental changes, can provide stability, because their loss may be compensated for by an increase in abundance of functionally similar species (Walker 1992). Other studies, e.g., stream communities, have found strong effects of changed biodiversity, even though the species performed the same function (Jonsson & Malmqvist 2000; Cardinale et al. 2002).

The abundance of the species is also an important consideration, with respect to biological traits, rarity and functioning in the ecosystem. *M. oculata* was among the top ten species in the South of Norway and had the same trait combinations of species with a lower abundance. It is difficult to know exactly how the functional role, in which species of a lesser abundance will fulfill in a situation where one dominant species is disappearing, without verifications from mesocosm experiments (Emmerson et al. 2001). In this study, only the most abundant species in each area were used in the analysis. A large portion of the dataset remains to be investigated, and in the remaining 70% of the data, there is a large portion of rare species which contribute species traits to the pool. Rare species may exert a great effect on ecosystem functioning, so abundance alone may not describe the importance of how an ecosystem functions. Biomass information is an important contributor to the significance of rarity. Olsgard et al. (2008) investigated the trawling impact on macrobenthic communities in fjords and found that the burrowing shrimp *Calocaris macandreae* and heart urchin *Brissopsis lyrifera* had major impacts on fluxes of O_2, NO_3 and SiO_2 in the sediment. Both are burrowing species with low abundance. *C. macandreae* is a medium-large crustacean (4-6 cm) which is known to be territorial. The heart urchin, *B. lyrifera* is large in size (> 7 cm) and also low in abundance. The two species are an example of species that have an important function but do not have a strong influence on the results in this study because of too low abundance in the extracted dataset. Species richness is often driven by rare species; a loss of species richness may not severely change or impair the functionality of the community (Brady et al. 2005). A loss of species does not always affect ecosystem properties because the ecosystem contains several species having similar functional roles, or not all species contribute as much as others in ecosystem functioning. Rare species may be important regarding functional diversity; acting as a “safety valve” for the ecosystem, where one species is able to take over if a more dominant species is extirpated.

3.4.3 Continuing research

The risk of global species loss has focused much research on investigating the relationship between biodiversity and ecosystem functioning (Vitousek & Hooper 1993). In order to understand how species loss affects function, one needs knowledge of the processes that affect distribution and abundance of species and address the issue of functional diversity and ecological redundancy in community composition (Walker 1992). Marine soft sediments comprise one of the largest habitats in the world; yet remarkably little is known about the BTs of the species living in these types of marine systems. Very few of the estimated 250,000 benthic marine species have been studied (John Gray pers. comm). Thus, there is little biological information, such as growth rate, fecundity, life duration and reproduction, available for the majority of marine benthic animals. This often means that these types of traits analyses can only be carried out on reduced species lists, which contain the necessary trait information, as conducted in this analysis, or use trait information from lower taxa (e.g., trait information at the genus level or family level, if possible). It can often be difficult for marine benthic ecologists to have a complete picture of the functioning of the ecosystem. The present results showed that the trait patterns were similar in two undisturbed areas, although the environmental factors, such as depth, grain size and total organic compounds, varied. However, Archaimbault et al. (2005) suggested that functional trait analysis could be of value in identifying human impacts (and classify stressor types or disturbance intensities) by simply comparing observed profiles of traits in a stressor situation in the same biogeographical area. This issue will be further investigated in Chapters 4-7 where BT patterns are compared with different levels of trawling impacts and in a situation where hypoxic levels vary throughout the year.

Chapter 4 Impact of structure and function of infaunal communities in trawled and non-trawled areas in the Oslofjord, Norway

4.1 Introduction

The Oslofjord is a fjord in the south-east of Norway, stretching from the Torbjørnskjær and Færder lighthouses to Langesund in the south and to Oslo in the north, with a total length of 100 km (Fig. 4.1). The fjord consists of a number of deep basins, separated by shallow sills (Ruud 1968) and is divided into the inner, middle and outer parts. The inner part is separated from the middle by a sill with a maximum depth of 164 m. The sill restricts the extent of water exchange from the middle to the inner part of the fjord (Ruud 1968; Gade 1968). From the middle part, the Drammens fjord branches towards the northwest, while the outer and deeper part (300 m) continues towards Skagerak. The Oslofjord consists of a wide range of marine fauna and has numerous important habitats (Walday et al. 2005) which are defined under EUNIS (European Nature Information System). Some of these habitats include *Lophelia* reef, spawning ground for fish, kelp forest, soft and hard bottom, oyster and eelgrass community (*Zostera marina*). The Oslofjord was heavily polluted with wastewater from 700,000 people before the installation of wastewater treatment facilities in the 1970s, located 11 km from Oslo centre with a 35 km sewage collection tunnel system around the capital area (Balmer et al. 1977). This treatment plant is essential for cleaning up the Oslofjord and the results have been very effective.

There are, however, other concerns for the health of natural habitats in Oslofjord that require attention, such as heavy fishing activities that have destroyed habitats and reduced marine biodiversity. The Oslofjord has a long history of trawling and fishing activities. The first shrimp trawlers started fishing in Oslofjord at the end of the 1800s and have increased in intensity since then. Cod (*Gadus morhua*), lobster (*Nephrops norvegicus*), shrimp (*Pandalus borealis*) and eel (*Anguilla anguilla*) have been targeted by both commercial and sports activities. Coastal sport fishing is an important activity in Norway, and there is currently no charge for such activities. Concern about reduction in habitats and marine benthic communities, because of high intensity commercial fishing, has been brought up in the Norwegian media on several occasions. In 1984, the Government banned all trawling in waters shallower than 60 m in the Oslofjord and coastal areas (Act 3 Saltwater Fish Law June 1983 NO 40). Most areas in the Oslofjord have been trawled, but there are a few areas which commercial fishermen avoid because the bottom topography damages their nets. These areas usually consist of large stones or ship wrecks where fishing nets can get caught easily. This study focuses on the effect of trawling on the benthic community with respect to infauna in the middle part of the Oslofjord. The first part in this study focused on comparing taxonomic and biological trait (BT) compositions of communities from stations in trawled and non-trawled areas. The second part of this study examines rare species and their contribution to the total BT pool. Olsgard et al. (2008) used a component of the same field data, combined with data from controlled mesocosm experiments, to investigate the effects of bottom trawling on ecosystem functioning. They demonstrated that bottom trawling has the potential to cause long-term impacts on sediment nutrient fluxes.

Conducting Biological Traits Analysis (BTA) with benthic organisms can pose a considerable challenge with respect to finding ecological information on all benthic organisms occurring in the samples. Organisms living in deep habitats are notoriously difficult to sample, and the experimental studies necessary to gain insights about these animals require complex, elaborate, specialist equipment. The benthic ecology in the Oslofjord has been well studied by NIVA (Norwegian Institute for Water Research) and NINA (Norwegian Institute for Nature Research). The University of Oslo is close by and for many years students and scientific staff members have conducted short- and long-term studies on benthic ecology. As a result, there are large amounts of unpublished ecological data stored at the University in the form of reports, masters and doctoral theses, from the early 1960s to present day (mostly in Norwegian). A considerable amount of this information is now stored in a database coded as BT information for the benthic species in the Oslofjord, which has been collated by the author in collaboration with NIVA and the University of Oslo.

Understanding the biology of rare species is an important part of conservation biology (Chapman 1999). The role of rare species in the ecosystem has been long under debate (Murray & Lepschi 2004). One way to investigate rare species in a community is to use logarithmic measurement in different binary classes. The method of Species Abundance Distribution (SAD) has been used by scientists to measure the abundance of rare and opportunistic species or to study the curve pattern of species distributions (Fisher et al. 1943; Preston 1948). The pattern of the curve of species abundance distribution is seldom normally distributed (Gray & Pearson 1982). The reason for non-normally distributed data in nature is often as a result of the amount of rare species being greater than abundant species (Fisher et al. 1943; Ugland & Gray 1982). If this is true, the contribution of rare species to the BT pool could be important to ecosystem functioning. To test this hypothesis, BT, with respective categories for the rare species, is measured as a percentage for the whole trait pool in the present study.

4.2 Materials and methods

4.2.1 Benthic infauna sampling

Infaunal samples were collected from four trawling stations and four control stations in the outer Oslofjord, Norway in June 2002 from *RV* Trygve Braarud. In the investigated area (Fig. 4.1, Table 4.1), a large part of the seabed, deeper than 60 m, is frequently visited by shrimp trawlers. A major challenge was to locate and document non-trawled control areas. Trawling leaves 10-20 cm deep furrows on the seabed, which remains visible to side-scan sonar for several years after the impact (Olsgard et al. 2008). On the recommendation of local fishermen, four field locations, situated within an 8 × 20 km area of the fjord, were surveyed using a ROV (remote operated vehicle) equipped with an autonomous positioning system, a digital video recorder and sonar. At each location, one trawled site and one non-trawled control site were chosen, based on furrow frequencies determined from the sonar images (Olsgard et al. 2008).

At each sampling station, five replicate sediment samples were taken with a 0.1 m^2 van Veen grab. These stations were referred to as AC, AT, BC, BT, CC, CT, DC and DT, where the first letter refers to the four locations (A, B, C, D) and the second letter indicates if the stations were non-trawled controls (C) or trawled areas (T). Control stations were often found near wrecks or rocky grounds, which are avoided by the fishermen to prevent damage to their gear. The biological samples were washed through a 1 mm round-mesh sieve and the material fixed in 4% formalin with Rose Bengal stain. In the laboratory, all infaunal samples were sorted, transferred to 70% ethanol and identified to the species level, or to the lowest taxon possible.

4.2.2 Sediment analysis and TOC determination

Sediment samples for the analyses of sediment grain size and organic content were taken with a Bowers and Connelly multicorer (three replicates combined). Analyses of sediment grain size and TOC (total organic carbon) were performed by technicians at the Norwegian Institute for Water Research (NIVA) and the procedure was as follows: 50-100 g wet sediment was sieved through a 63 μm sieve to separate sand from the silt-clay fraction. The material > 63 μm was sieved on 2 mm, 1 mm, 0.5 mm, 250 μm and 125 μm sieves and the material < 63 μm was analysed by use of a sedigraph (Micrometrics SediGraph 5000D). The data were used to calculate median grain size (Md Φ).

4.2.3 Biological traits (BTs)

A total of 13 BTs and 58 categories were chosen for the analysis (Table 4.2). A database on biological traits was developed for benthic species in the Oslofjord using information from master and doctoral and theses (University of Oslo), scientific publications, web databases, general field books, technical papers and expert knowledge. The database was counter-checked by several researchers at NIVA. Each category was scored according to the affinity of each taxon for each trait category. A scoring range of 0-3 was adopted, with zero being no affinity to a trait category and 3 being high affinity. This coded system, in which individual taxa are scored for their performance, is called "fuzzy" coding (Chevenet et al. 1994). A taxon may get several scores for the same trait, e.g., one species with two types of feeding strategies is given the affinity 2 in both categories. In cases of missing trait information, a value "0" was assigned.

4.2.4 Statistical analysis

To study the degree of similarity of environmental parameters between trawled and control areas, Principal Component Analysis (PCA) on normalised values was performed with prior arcsine transformation of all percent data. PCA is a linear ordination method based on eigenvalue analysis with multi-dimensions axes. It can be defined as a projection of samples onto a new set of axes, such that the maximum variance is projected along the first axis (Principal Component 1), the second highest variation is projected on the second axis (Principal Component 2), the third variation highest variation is projected on the third axis (Principal Component 3), etc. (Jolliffe 2002). To investigate significant similarity in organic carbon and percent clay, one-way ANOSIM (Analysis of Similarity) was performed for the treatments (control *vs.* trawl). Only pooled (no replicate) environmental data were obtained from NIVA.

The five grab replicates of the macrobenthic fauna were summarised as one (pooled) before square-root transformation to reduce the effect of dominant species. Shannon diversity (H') and Pielou evenness (J') of the macrofauna for each location were also calculated to describe the benthic community structure (Schratzberger & Jennings 2002). Non-parametric Mann-Whitney U tests were performed on abundance data to detect any significant species within treatments (trawled vs. control).

A Bray-Curtis (dis)similarity matrix of pooled, square-root transformed abundance data was used to generate a non-metric multidimensional scaling (MDS) plot to identify the community pattern. Two-way nested Analysis of Similarity (ANOSIM) permutations were conducted to test for significant differences within and among sites and treatments (Clarke

1993). This analysis was conducted for both abundance and weighted BTs (see Chapter 3 for explanation). Mann-Whitney U tests were also performed on the weighted BTs with abundance to identify the significance of each category within treatments.

Species abundance distribution (SAD) is a histogram of the number of species in different abundance classes (Fisher et al. 1943; Preston 1948) and it is one of the most basic descriptions of the biodiversity structure in a local community. The number of rare species (i.e., appearing only once in the samples, binary 1 class) provides the first abundance class on the x-axis in the histogram. Species represented by between two and three individuals are placed in the second abundance class (binary 2 class), between three and five individuals in the third class (binary 3 class) and so on until all the species represented are fully incorporated in a logarithmic scale (modified $\log_2$). The SAD method performed in Microsoft Office Excel 2007 was used to investigate trends reflected by rare and abundant species in trawled and non-trawled conditions (Gray 1987; Hubbell 2001; Gray et al. 2006a). To investigate the amount of BT rare species contribute to the total BT pool, BTs from species measured from SAD in binary 1 (species represented only once in trawled or non-trawled areas) were measured as a percentage of the total BT contribution for the whole dataset.

Univariate, multivariate, ANOSIM, SIMPER, PCA and MDS analyses were performed using PRIMER-E v.6 and its add-on package PERMANOVA+ (Clarke & Warwick 2001; Clarke & Gorley 2006; Anderson et al. 2008). Analysis of traits weighted with abundance was undertaken with the software package ADE 4 (Environmental Data Analysis) developed by Thioulouse et al. (1997). Non-parametric Mann-Whitney U tests were conducted using STATISTICA v8.

Table 4.1 Sampling date, depth and positions for the stations in outer Oslofjord, Norway. Four locations (A, B, C, D) with non-trawled controls (C) and trawled areas (T).

Date	Stations	Depth (m)	Position (WGS84*)
20.06.2002	AC	101	59.29.658, 10.35.420
20.06.2002	AT	128	59.29.658, 10.35.420
19.06.2002	BC	106	59.27.214, 10.33.750
19.06.2002	BT	128	59.27.081, 10.34.531
19.06.2002	CC	112	59.21.522, 10.38.260
19.06.2002	CT	136	59.21.216, 10.38.918
19.06.2002	DC	103	59.186.86, 10.32.950
19.06.2002	DT	136	59.19.056, 10.33.963

*World Geodetic System (1984) is a standard coordinate reference system for Earth.

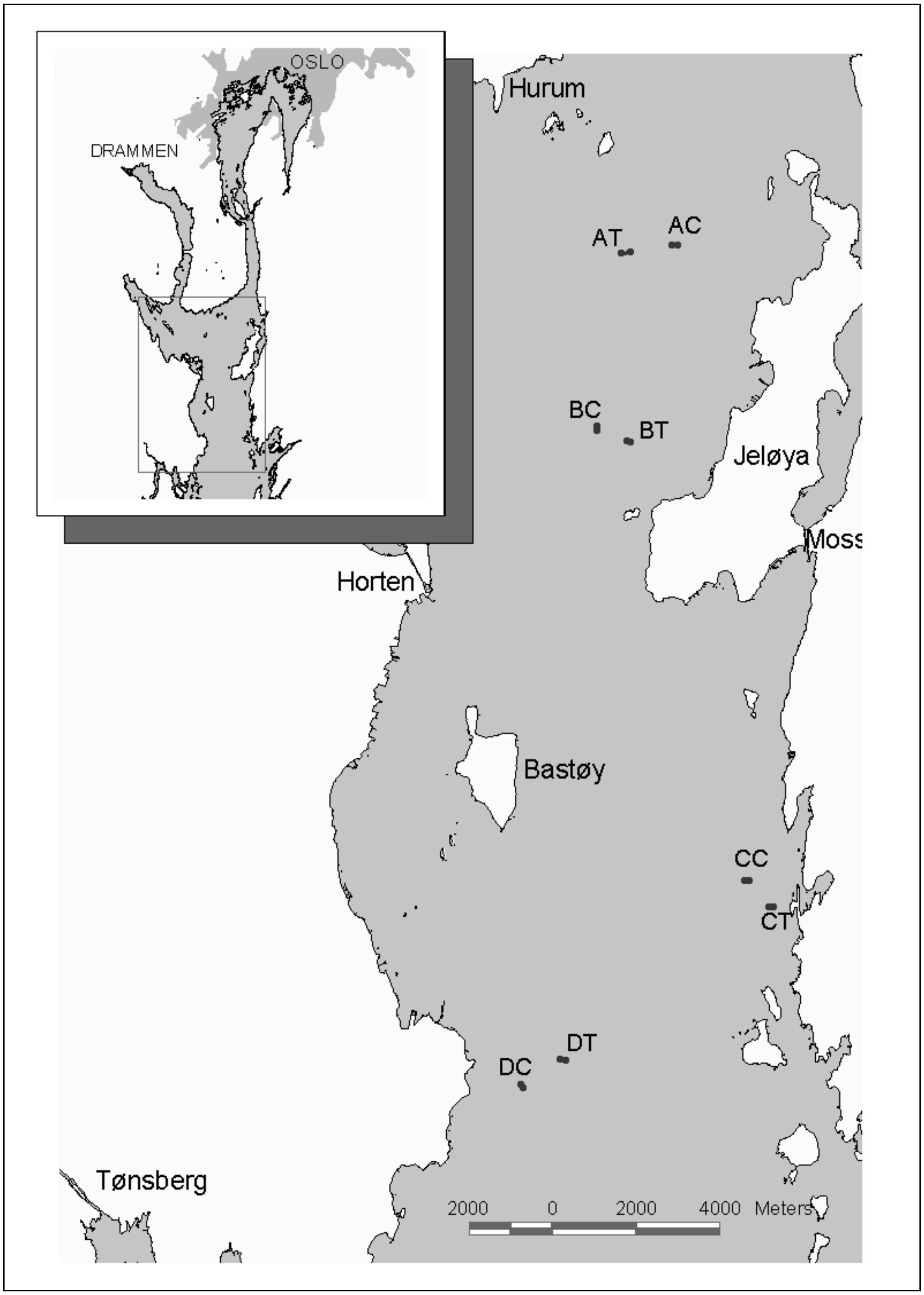

Figure 4.1 Sampling locations of the four different areas (A-D) in the Oslofjord, Norway. The treatment C after area A-D is control (non-trawled), while T is the trawled sites (Olsgard et al. 2008).

Table 4.2 Overview of the 13 biological traits and 58 categories chosen for the analysis. Each category was scored according to the affinity of each taxon for each trait category, ranging from 0-3, where 0 is no affinity and 3 is total affinity.

Code	Traits	Categories
AH1	Adult life habitat	Sessile
AH2	Adult life habitat	Tube (permanent)
AH3	Adult life habitat	Tube (semi-permanent)
AH4	Adult life habitat	Burrower
AH5	Adult life habitat	Surface crawler
AM1	Relative adult mobility	None
AM2	Relative adult mobility	Low
AM3	Relative adult mobility	Medium
AM4	Relative adult mobility	High
BF1	Body form	Short cylindrical
BF2	Body form	Flattened dorsally
BF3	Body form	Flattened laterally
BF4	Body form	Ball shaped
BF5	Body form	Long thin, tread-like
BF6	Body form	Irregular
DA1	Degree of attachment	None
DA2	Degree of attachment	Temporary
DA3	Degree of attachment	Permanent
FD1	Faecal deposition	Sediment surface
FD2	Faecal deposition	Subsurface 0-5cm
FD3	Faecal deposition	Deep subsurface >5cm
FH1	Feeding	Suspension/filter
FH2	Feeding	Scraper/grazer
FH3	Feeding	Surface deposit feeder, SD
FH4	Feeding	Subsurface deposit feeder, DF
FH5	Feeding	Dissolved matter/symbionts
FH6	Feeding	Large detritus/sandlicker
FH7	Feeding	Scavenger
FH8	Feeding	Carnivore/omnivore
FH9	Feeding	Parasite/commensal
LD1	Life duration	< 1 year
LD2	Life duration	1-5 year
LD3	Life duration	>5 year
LT1	Larval type	Planktotroph
LT2	Larval type	Lecitotroph

Table 4.2 Continued

Code	Traits	Categories
NS1	Normal adult size	<5mm
NS2	Normal adult size	5mm-1cm
NS3	Normal adult size	1-3cm
NS4	Normal adult size	3-6cm
NS5	Normal adult size	6-10cm
NS6	Normal adult size	>10cm e
NY1	Reproductive cycles per year	< 1
NY2	Reproductive cycles per year	1
NY3	Reproductive cycles per year	2 or more
RP1	Reproductive period	December-February
RP2	Reproductive period	March-May
RP3	Reproductive period	June-August
RP4	Reproductive period	September-November
RP5	Reproductive period	No particular season
RT1	Reproductive technique	Asexual (budding)
RT2	Reproductive technique	Broadcast spawner
RT3	Reproductive technique	Demersal eggs
RT4	Reproductive technique	Brooder, viviparous
SD1	Sediment dwelling depth	0 cm (surface)
SD2	Sediment dwelling depth	0-1cm
SD3	Sediment dwelling depth	1-5cm
SD4	Sediment dwelling depth	5-15cm
SD5	Sediment dwelling depth	>15 cm

4.3 Results

4.3.1 Environmental analysis

Table 4.3 summarises the results from the environmental analysis for the investigated areas. The sediment composition and the total organic carbon (TOC) were not significantly similar for trawling and control stations: sediment at all stations was mainly composed of clay, with the highest percentage clay content in the trawled areas (AC = 63.78%, AT = 69.42%, BC = 56.37%, BT = 64.15%, CC = 54.54%, C = 66.85%, DC = 55.90% and DT = 63.58%) (one-way ANOSIM for treatment, Global R = 0.552, $p > 0.05$); the average total TOC was lower in the control areas, compared with the trawled areas (AC = 1.63%, BT = 1.77%; BC = 1.19%, BT = 1.81%; CC = 1.23%, CT = 1.93%; DC = 1.19%, DT = 1.55%) (One-Way ANOSIM for treatment, Global R = 0.615, $p > 0.05$).

Figure 4.2 shows the PCA plot of all environmental data, including depth in relation to the control and trawl stations. Most of the variation (70.9%) was explained along the PC1 axis, while PC2 explained 19.7% of the total variation. Three control stations (BC, CC and DC) are clustered on the left of the MDS plot, while AC and the four trawled stations are located on the right. This indicates that the sediment composition at three of the control stations was somewhat different from the trawled stations, with the exception of station AC which had a sediment type more similar to the trawled stations. Trawled stations, to the right of the plot, illustrated higher levels of organic carbon and clay percentage in the sediment.

Table 4.3 Summary of environmental variables for the control (C) and trawled (T) stations: sand/silt/clay (%), Md Φ and TOC (%).

Environmental variables	AC	AT	BC	BT	CC	CT	DC	DT
Depth (m)	101	128	106	128	112	136	103	136
% sand	8.89	12.13	15.86	15.59	23.19	13.18	22.36	11.70
% silt	27.33	18.45	27.77	20.26	22.28	19.97	21.74	24.72
% clay	63.78	69.42	56.37	64.15	54.54	66.85	55.90	63.58
Md Φ	8.95	9.39	8.43	8.56	8.09	9.08	8.02	8.81
% TOC	1.63	1.77	1.19	1.81	1.23	1.93	1.19	1.55

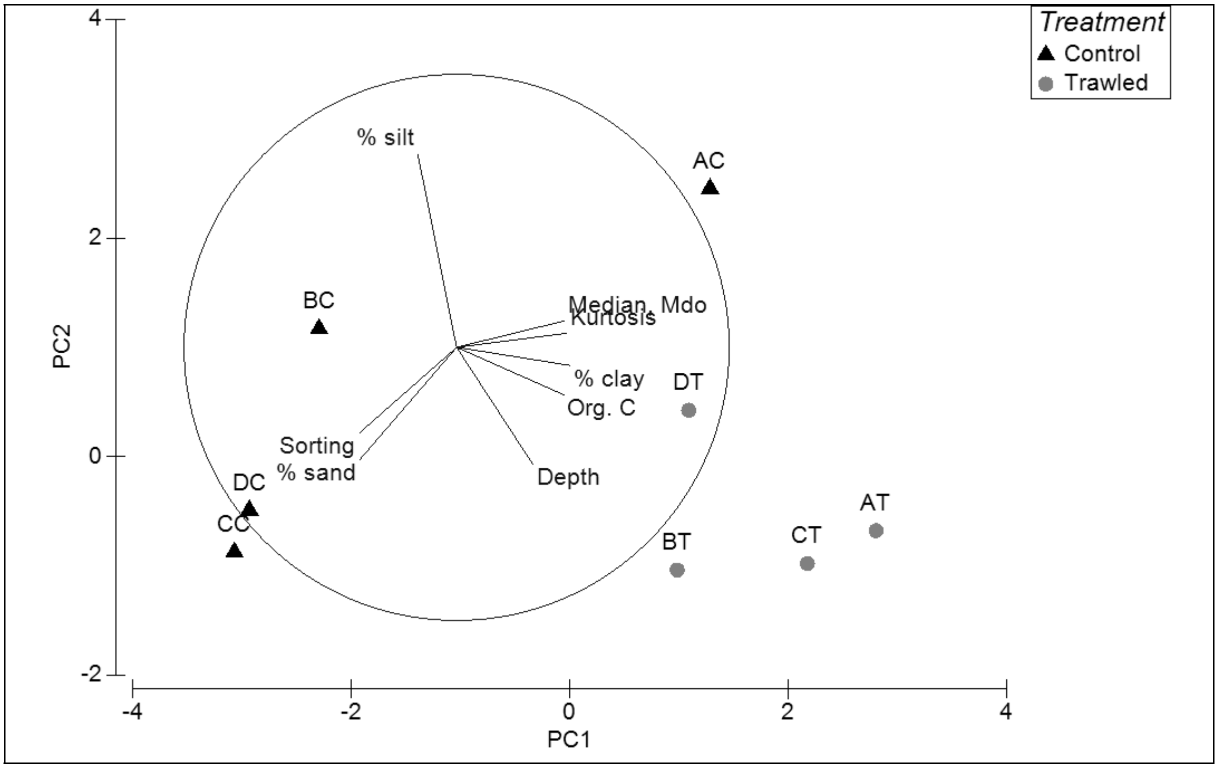

Figure 4.2 PCA bi-plot of environmental data showing the relationship between trawling (black triangle) and control stations (grey circle). The percent sand, clay, silt and TOC were arcsine transformed before data were normalized and are represented by the lines within the circle.

4.3.2 Biodiversity analysis

The total number of species recorded for the whole survey was 179. There was a higher number of species (S/0.5 m^2), number of individuals (N/0.5 m^2), Pielou evenness (J') and Shannon diversity H' (log_e) at the trawled stations compared with the non-trawled stations (Table 4.4). The most dominant taxa for both treatments were polychaetes (control = 87%, trawled = 85%), crustaceans (control = 8%, trawled = 8%), molluscs (control = 3%, trawled = 5%) and others (control = 2%, trawled = 2%).

The top ten species are shown in Table 4.5 for control and trawled stations as total abundance of the pooled dataset. *Heteromastus filiformis* and *Chaetozone setosa* were the most abundance species in both treatments. *Mediomastus fragilis*, *Leucon* indet., *Paradoneis eliasoni* and Nemertinea indet. were most abundantat at the control stations, while *Paradoneis lyra*, *Prionospio cirrifera*, *Abra nitida* and *Prionospio fallax* were dominant at the trawled stations. The results from the Mann-Whitney U test of pooled data showed species that were significantly different between treatments (Table 4.6). Fourteen of seventeen species were greater in trawled areas. The three species occurring in greater abundance in the control areas were *Calocaris macandreae* ($U = 0$, $p = 0.01$), *Eclysippe vanelli* ($U = 2$, $p = 0.04$) and *Glycera* indet. ($U = 0$, $p = 0.01$).

The treatments (control vs. trawled) and stations (A-D) show separation in the MDS plot (Figure 4.3). Two-way nested analysis of ANOSIM (analysis of similarities) revealed that there were significant differences between treatments (Global $R = 0.075$, $p < 0.001$) and areas (Global $R = 0.819$, $p < 0.001$).

Table 4.4 Summary of univariate diversity indices (pooled) for the control (C) and trawled (T) stations. Total species ($S/0.5\ m^2$), total individuals ($N/0.5\ m^2$), Pielou evenness (J') and $\log_e$ Shannon diversity (H').

Diversity Indices	AC	AT	BC	BT	CC	CT	DC	DT
S ($S/0.5\ m^2$)	66	72	84	90	69	94	50	74
N ($N/0.5\ m^2$)	2771	3416	1481	3317	1970	4131	1009	1115
J'	0.45	0.47	0.60	0.68	0.44	0.48	0.62	0.71
H'($\log_e$)	1.91	2.05	2.70	3.09	1.88	2.20	2.46	3.06

Table 4.5 Top ten species for control and trawled stations (pooled data).

Control (C)	Trawled (T)
Heteromastus filiformis	*Heteromastus filiformis*
Chaetozone setosa	*Chaetozone setosa*
Polydora indet.	*Paradoneis* lyra
Mediomastus fragilis	*Polydora* indet.
Ophelina modesta	*Paramphinome jeffreysii*
Eriopisa erongata	*Prionospio cirrifera*
Paramphinome jeffreysii	*Ophelina modesta*
Leucon indet.	*Eriopisa erongata*
Paradoneis eliasoni	*Abra nitida*
Nemertinea indet.	*Prionospio fallax*

Table 4.6 Summary of significant species (alphabetic order) based on Mann-Whitney U rank of pooled abundance for trawled and control areas. Higher rank sum for control areas are marked in bold.

Species	Rank sum Control	Rank sum Trawled	U	p
Calocaris macandreae	**26**	10	0	0.01
Ceratocephale loveni	10	26	0	0.02
Cossura longocirrata	10	26	0	0.01
Eclysippe vanelli	**24**	12	2	0.04
Eriopisa elongata	10	26	0	0.02
Exogone hebes	12	24	2	0.04
Glycera indet.	**26**	10	0	0.01
Ischnosoma bispinosum	12	24	2	0.04
Lilljeborgia indet.	12	24	2	0.04
Melinna cristata	10	26	0	0.01
Melinna palmata	12	24	2	0.04
Nephtys hombergii	12	24	2	0.04
Paramphinome jeffreysii	10	26	0	0.02
Philomedes globosus	12	24	2	0.04
Tanaidacea indet.	11	25	1	0.04
Thyasira equalis	10	26	0	0.02
Thyasira sarsi	12	24	2	0.04

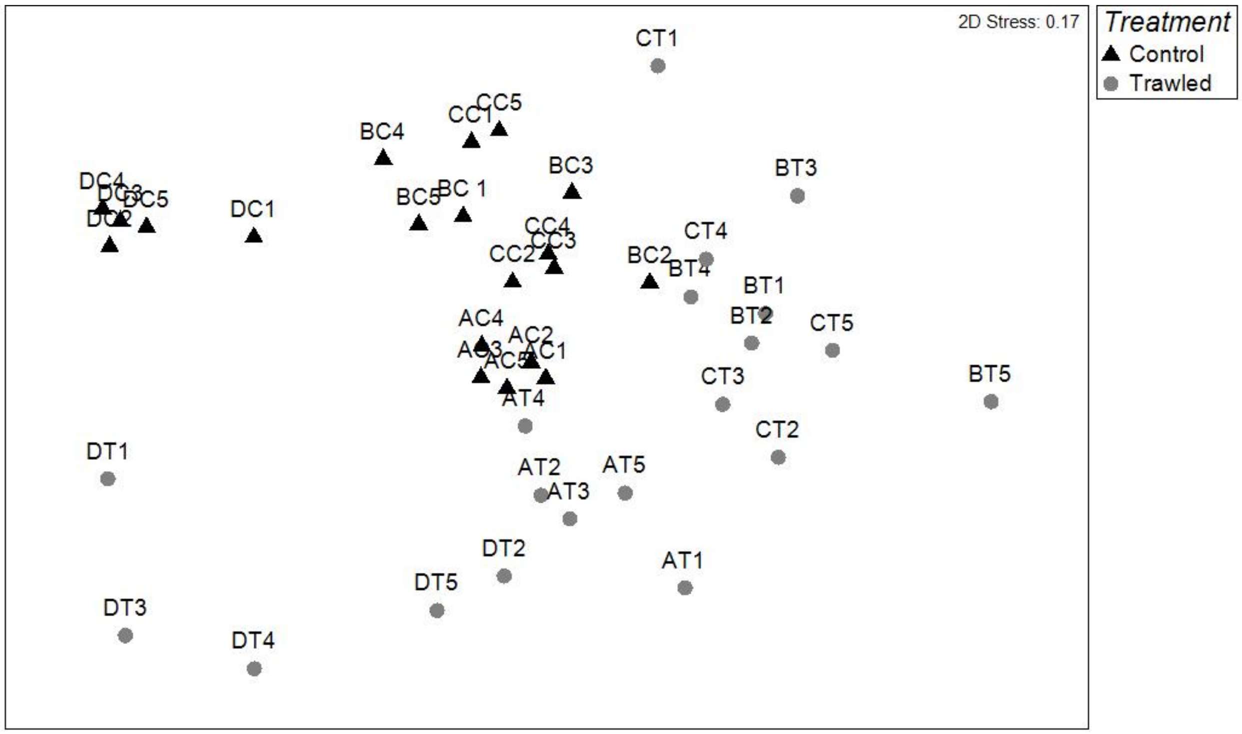

Figure 4.3 MDS of the abundance with five replicates (square-root transformed). Black triangle is the control and grey circle represents the trawled treatment. Capital A-D is the area.

4.3.3 Biological Traits Analysis (BTA)

Square-root transformed abundance weighted with BTs is shown in Figure 4.4. The MDS plot revealed separation between treatments but not clear separation among sites. Two-way nested ANOSIM analysis confirmed this by showing significant differences between the treatments (Global R = 0.362, $p < 0.05$) and non-significant differences among sites (Global R = - 0.042, $p > 0.05$).

Table 4.7 shows the top ten BT categories for control and trawled treatments. For the control treatments, these included: no attachment (DA1), lecitotroph (LT2), tube (semi-permanent) (AH3), 0-1 cm (SD2), long thin (BF5), low mobility (AM2), 1-3 cm (NS3), 5 mm-1 cm (NS2), surface deposit feeder (FH3) and 0 cm (surface) (SD1). For the trawled treatments, these comprised: no attachment (DA1), lecitotroph (LT2), tube (semi-permanent) (AH3), 0-1 cm (SD2), surface deposit feeder (FH3), long thin (BF5), 5 mm-1 cm (NS2), low mobility (AM2), 1-3 cm (NS3) and 0 cm (surface) (SD1).

Mann Whitney U tests were significant for all the categories in favour of trawling with the exception of the large detritus/sandlicker (FH6) feeding type and greater than five-year (LD3) life duration, which had greater significance in favour of the control areas (Table 4.8).

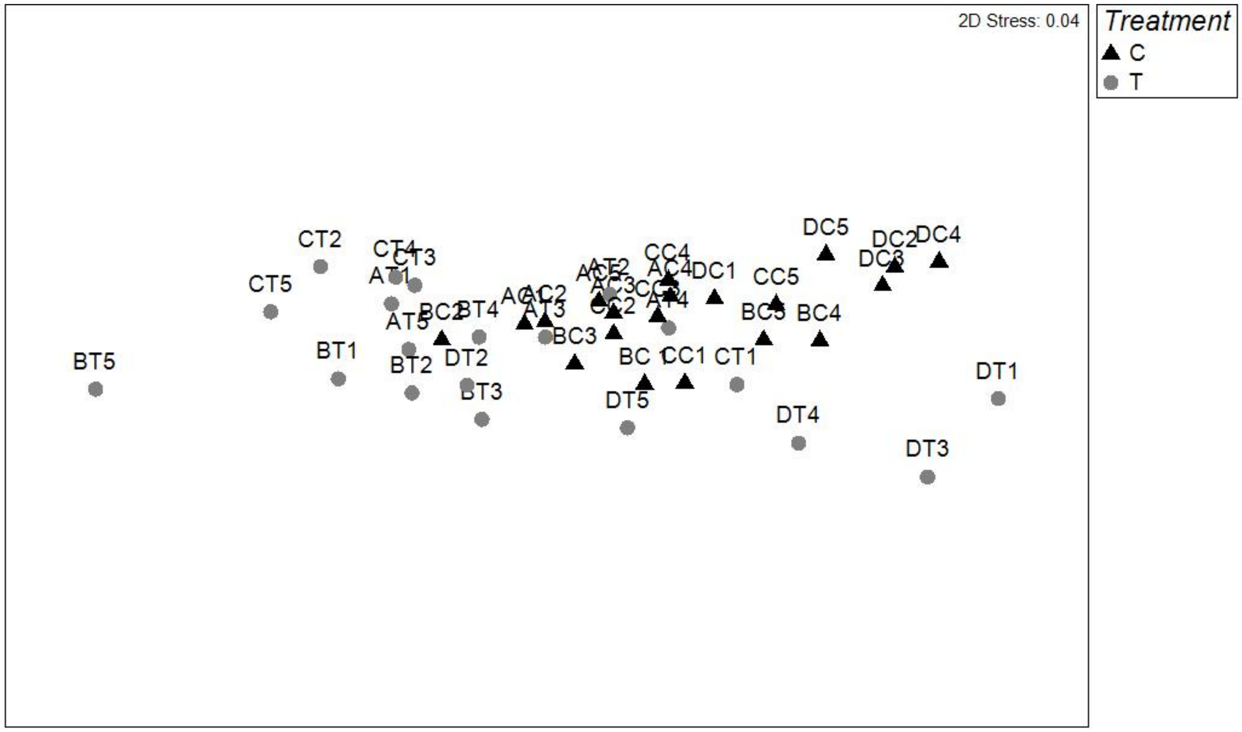

Figure 4.4 MDS of square-root transformation abundance weighted with BTs (five replicates). Black triangle is the control and grey circle represents the trawled treatment. Capital A-D is the area.

Table 4.7 Top ten categories for control and trawled treatments (weighted with square-root transformed abundance).

Control (C)	Trawled (T)
No attachment (DA1)	No attachment (DA1)
Lecitotroph (LT2)	Lecitotroph (LT2)
Tube (semi-permanent) (AH3)	Tube (semi-permanent) (AH3)
0-1 cm (SD2)	0-1 cm (SD2)
Long thin (BF5)	Surface deposit feeder (FH3)
Low mobility (AM2)	Long thin (BF5)
1-3 cm (NS3)	5 mm-1 cm (NS2)
5 mm-1 cm (NS2)	Low mobility (AM2)
Surface deposit feeder (FH3)	1-3 cm (NS3)
0 cm (surface) (SD1)	0 cm (surface) (SD1)

Table 4.8 Results from Mann-Whitney U test by variable treatments (trawled vs. control). Only significant categories are mentioned in the table. Higher rank sum for control is marked in bold.

Code	Category Name	Rank sum Control	Rank sum Trawled	U	p
AH1	Sessile	323	497	113	0.018
AH3	Tube (semi-permanent)	325	495	115	0.021
AH4	Burrower	262	558	52	<0.001
AH5	Surface crawler	334	485	124	0.041
AM1	Non-mobility	312	508	102	0.008
AM2	Low mobility	319	501	109	0.013
AM3	Medium mobility	304	516	94	0.004
BF1	Short cylindrical	303	517	93	0.003
BF2	Flattened dorsally	250	570	40	<0.001
BF3	Flattened laterally	278	542	68	<0.001
BF5	Long thin, tread-like	310	510	100	0.006
DA1	None attachment	317	503	107	0.011
DA3	Permanent attachment	301	518	91	0.003
FD1	Sediment surface	326	494	116	0.023
FH1	Suspension/filter	282	538	72	<0.001
FH3	Surface deposit feeder, SDF	284	536	74	<0.001
FH5	Dissolved matter/symbionts	288	532	78	<0.001
FH6	**Large detritus/sandlicker**	**499**	**320**	**110**	**0.015**
FH7	Scavenger	279	540	69	<0.001
LD3	**>5 year**	**494**	**326**	**116**	**0.023**
LT1	Planktotroph	258	562	48	<0.001
LT2	Lecitotroph	333	487	123	0.037
NS1	<5mm	266	554	56	<0.001
NS2	5mm-1cm	301	519	91	0.003
NS3	1-3cm	305	515	95	0.004
NY2	1 Reproductive cycle a year	297	523	87	0.002
RP1	December-February	337	483	127	0.048
RP3	June-August	317	503	107	0.011
RP4	September-November	326	494	116	0.023
RT2	Broadcast spawner	271	549	61	<0.001
RT4	Brooder, viviparous	329	491	119	0.028
SD1	0 cm (surface)	283	537	73	<0.001
SD2	0-1cm	306	514	96	0.004
SD3	1-5cm	30	513	97	0.005
SD4	5-15cm	321	499	111	0.016

4.3.4 Species Abundance Distribution (SAD) and BT contribution

Species abundance distributions of trawled and control areas are illustrated in Figure 4.5. A greater number of rare species occurred in the trawled areas (36/2 m^2) compared to that of control areas (23/2 m^2). These contributed to 24% (trawled) and 19% (control) of all species recorded in this study. The opportunistic species represented in binary 13 class (number 13 at the x-axis), i.e., *Heteromastus filiformis* (abundance between 4,096-8,191/2 m^2), only occurred in the trawled areas, while the same opportunistic species represented in binary 12 class, *Heteromastus filiformis* (abundance between 2,048-4,095N/2 m^2), only occurred in the control areas. The control areas had higher number of species in binary 2 class (species which had individuals between 2-3/2 m^2) (Fig. 4.5).

Species in binary 1 class (represented only once in the control and trawled areas), measured from species abundance distribution in Figure 4.5, are illustrated in the histograms as total BT contribution (%) in Figure 4.6. Rare species contributed substantially to the total traits pool: adult life habitat (C = 12-22%, T = 13-29%), adult mobility (C = 10-19%, T = 20-25%), body form (C = 5-17%, T = 17-29%), degree of attachment (C = 13-19%, T = 13-33%), faecal deposition (C = 0-18%, T = 13-20%), feeding type (C = 0-71%, T = 9-33%), life duration (C = 0-27%, T = 14-33%), larval type (C = 11-13%, T = 21-26%), normal adult size (C = 10-22%, T = 14-24%), reproductive cycle per year (C = 0-7%, T = 16-33%), reproductive period (C = 10-24%, T = 19-40%), reproductive technique (C = 7-50%, T = 19-40%) and sediment dwelling depth (C = 4-14%, T = 17-22%).

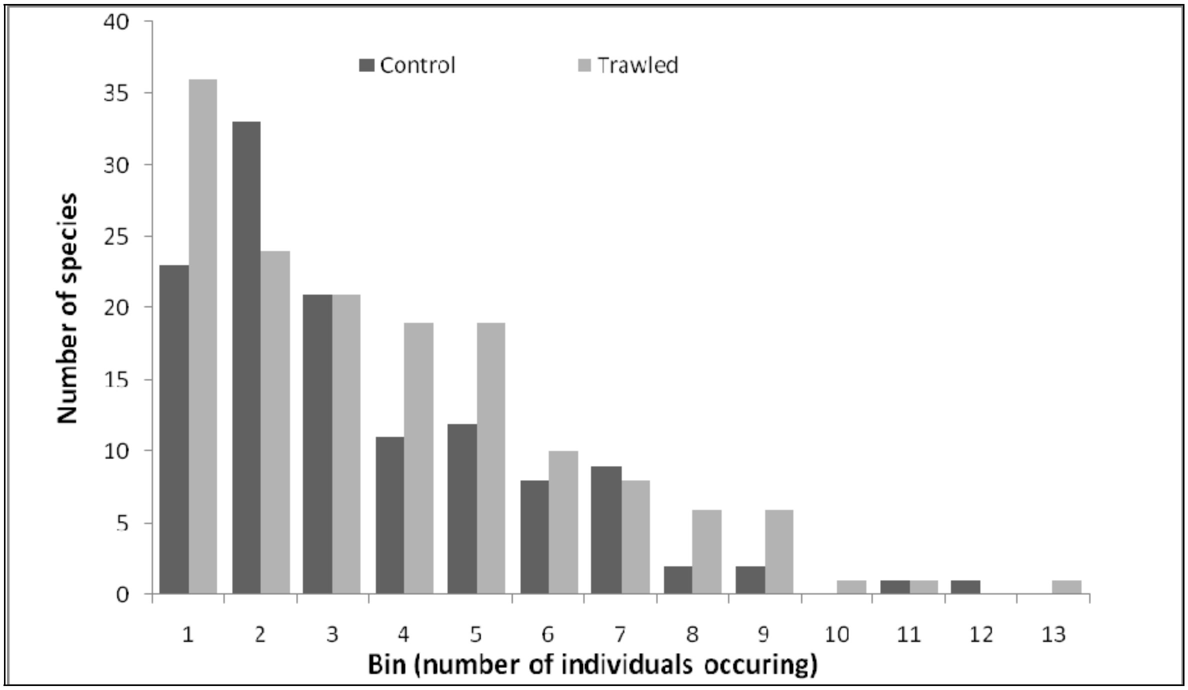

Figure 4.5 Histogram of Species Abundance Distributions (SAD) for the trawled (light grey) and control (dark grey) areas using abundance category of modified $\log_2$ classes. Number 1 (Binary 1 class) at the x-axis represents one species, number 2 (Binary 2 class), 2-3 species, number 3 (Binary 3 class), 4-7, number 4 (Binary 4 class), 8-15, etc in a logarithmic scale.

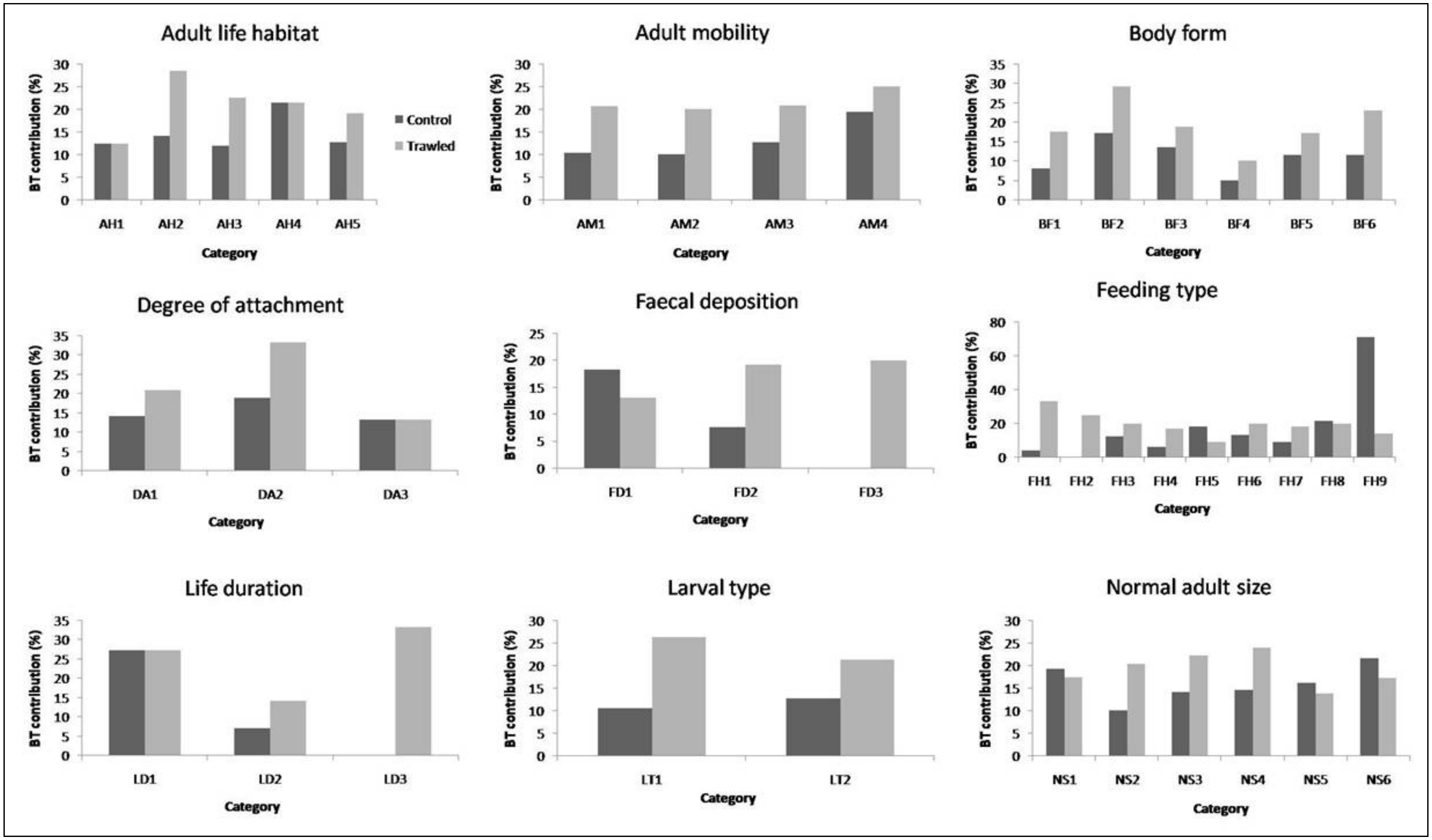

Figure 4.6 BT contributions for rare species from trawling (light grey) and control (dark grey) areas measured as percent of the whole trait pool. The BT is ranked as presence/absence. Dark grey = control areas, light grey = trawled areas.

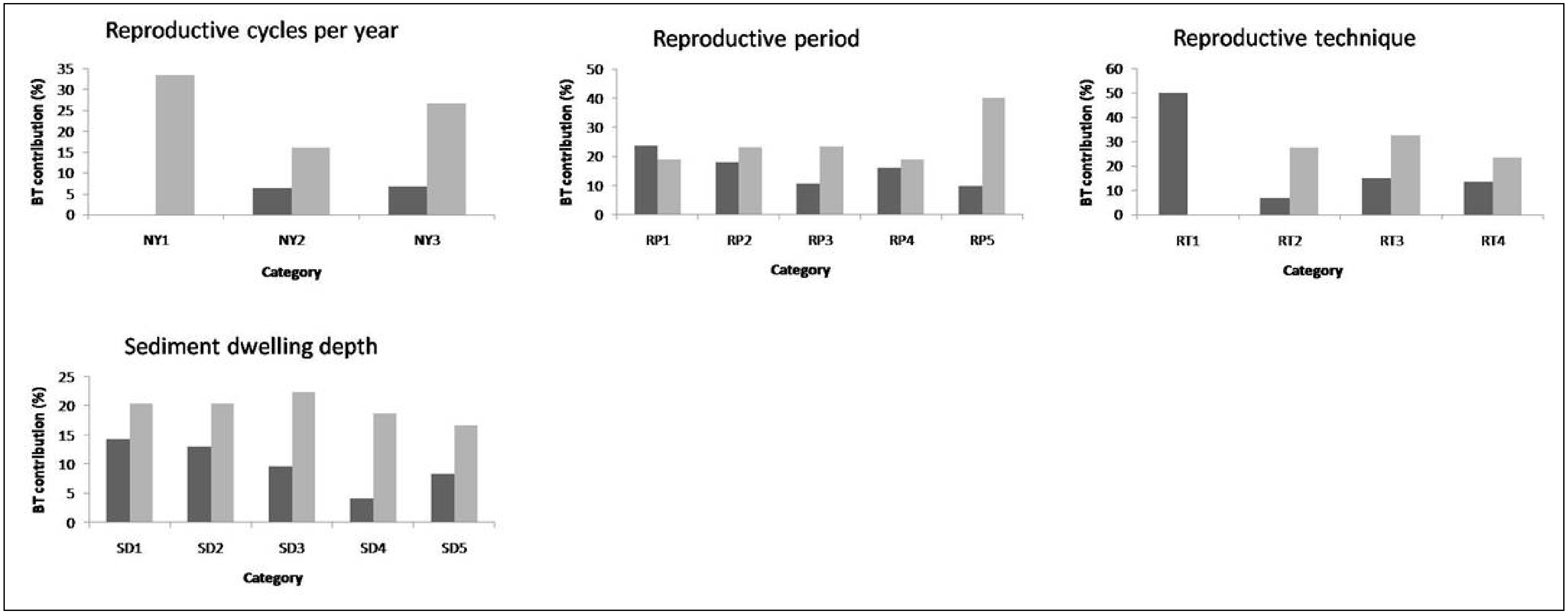

Figure 4.6 (continued)

4.4 Discussion

4.4.1 Environmental analysis and trawling effects

The study "Effects of bottom trawling on ecosystem functioning" (Olsgard et al. 2008) is closed related to this study (the field work was conducted simultaneously). Olsgard et al. (2008) used part of the same field data, combined with data from controlled mesocosm experiments, to show that bottom trawling has the potential to cause long-term impacts on sediment nutrient fluxes. The importance of the decline in bioturbators was demonstrated in the mesocosm experiments. Four species (the heart urchin *Brissopsis lyrifera*, minute nutclam *Nuculana minuta*, mud shrimp *Calocaris macandreae* and brittle starfish *Amphiura chiajei*) were found to have significant roles in bioturbating sediments and nutrient flux. It was suggested that intensive bottom-trawling may affect the nutrient balance, especially in continental shelf and coastal areas. The physiochemical properties of sediment are influenced by its particle size. The silt-clay fraction of sediment is the most important fraction in terms of holding capacity for organic and metal pollutants (Walling & Peart 1980). Results from this study supported the findings that trawling changes environmental factors, such as particle size and organic compounds (Palanques et al. 2001; Brown et al. 2005). The sediment characteristics at both trawled and control areas consisted mainly of clay, with significantly higher values of clay occurring at trawled stations. The organic compounds were significantly lower at control stations.

Bottom trawling is a well-documented, destructive fishing method and has a variety of adverse effects on marine habitats and species composition (Auster et al. 1996; Rosenberg et al. 2003; Jennings et al. 2001), ecosystem functioning (Thrush & Dayton 2002), functional composition (Tillin et al. 2006), as well as on water turbidity (Palanques et al.

2001), surface/subsurface structures and redox conditions (Nilsson et al. 2003). When trawl gear is dragged along the seafloor, sediments are kicked up behind the net, reducing the light available for photosynthetic species and burying benthic organisms (Enticknap 2002). The degree of the impact depends on the characteristics of the gear (Jennings & Kaiser 1998; Steele et al. 2002), type of benthic habitat (Koslow et al. 2001; Kenchington et al. 2006), trawling frequencies (Enticknap 2002) and the degree of other local disturbances (Sanchez et al. 2000). Soft bottoms provide important environments for many species of marine organisms. Destroying this habitat may negatively affect the distribution and abundance of the benthic organisms and fish that depend on it. Bottom trawling affects the structural diversity, abundance and biomass of marine benthic communities (Walting & Norse 1998; Hansson et al. 2000; McConnaughey et al. 2000; Jenning et al. 2001, 2002).

4.4.2 Biodiversity

The total number of species recorded for the survey was 179. Polychaeta dominated in both trawled and control areas. There were significantly higher numbers of species, rare species, individuals and diversity in the trawled areas, compared to that of the non-trawled areas in the Outer Oslofjord. These results were surprising since trawling is reported to reduce biodiversity (e.g., Kaiser et al. 1998; Watling & Norse 1998). This controversial dataset may be one of the few demonstrating that trawling actually favours biodiversity on benthic structure. It is difficult to state any clear reason for this. However, the 'intermediate disturbance hypothesis' (Connell 1978) may explain this finding since repeated trawling may act as an intermittent community disturbance. The hypothesis predicts that diversity is highest when disturbance is neither too infrequent nor too frequent. When the disturbance is high, the number of rare species decreases and more stress-adapted organisms persist.

When the disturbance is low and the ecological factors are more constant, competitive exclusion arises among species with similar habitat, resulting in fewer species. The trawling intensity in this study is estimated to range between 50-100 times trawled per year (Olsgard et al. 2008), which can be considered as high intensity trawled areas. This estimate is based on information from local fishermen and can be over/under-estimated. Whether the trawl gear makes contact with the same spot every time, or just within same area, is uncertain. However, the water masses constantly consist of planktonic larvae ready for settlement. The competition for settlement is believed to be less difficult in areas which are constantly in chaos such as in high intensity trawl grounds in which the organisms have not yet developed sufficiently to claim dominance of the habitat. Removal of a competitively dominant species allows other species to recruit and thereby increase total benthic diversity, until the dominant species become re-established after a certain time period of stable conditions (Connell & Slayter 1977; Sousa 1979, Jenkins et al. 2004; Schiel & Lilley 2007). However, the intermediate disturbance hypothesis has not yet been tested adequately over the broad spatial scales of relevance to fishing disturbance (Thrush & Dayton 2002). This needs to be explored further; however, it is difficult to predict whether the results from this study can be considered as a result of intermediate disturbance, as no such tests have been conducted related to trawling succession.

Over 500 pockmarks, ranging from 16 to 100 m in diameter, with depths from 1 to 12 m below the surrounding seabed, have recently been discovered in the inner Oslofjord, which may protect benthic communities from trawling impacts and allowing for higher invertebrate diversity (Webb et al. 2009a, b and c). Extensive ROV surveys showed that there are very limited areas in the Oslofjord that have not been trawled (Olsgard et al 2007).

A shrimp trawl could easily pass within an area of 16 to 100 m in diameter. The combination of intense trawling activities, and the high number and large size of pockmarks in the Oslofjord, result in it being unlikely that pockmarks function as a refuge from trawl impacts. The pockmarks may reduce the depth of impact of the trawl gear, reducing the overall impact on soft benthic communities and in this way contribute to keeping biodiversity intact. No tests have been conducted to confirm that the trawl areas sampled in this study are within any of the pockmarks. However, the high numbers of pockmarks in the Oslofjord increase the possibility that the trawl stations sampled may be located in or nearby such pockmarks.

The infaunal community found in this study is typical of that expected in the Oslofjord, which is known to be a disturbed fjord environment, and thus dominated by disturbance-tolerant r-selected species (Mirza & Gray 1981; Webb et al. 2009c), such as *Heteromastus filiformis* and *Chaetozone setosa*. Among the top ten species for both treatments, *Polydora* is an opportunist species which often dominates in organically enriched areas and shows high tolerance of low oxygen stress (Gray 1979). *Calocaris macandreae*, *Eclysippe vanelli* and *Glycera* indet. were the only three taxa that were significantly higher in the control than in the trawled areas. *Calocaris macandreae* and *Glycera* species have important bioturbating properties (Widdicombe et al. 2004) that can increase the amount of nutrient flow to the sediments (Olsgard et al 2008). Both these species appear to be reduced in trawled areas. These species are suggested to be important for the maintenance of macrobenthic diversity and may be fulfilling the same role within the benthic ecosystem (Widdicombe et al. 2004). The deep burrowing bivalve *Thyasira sarsi* and *Thyasira equalis* were significantly higher in abundance in the trawled areas. *T. sarsi* are known to reach densities of several thousand m^{-2} in organic rich sediments (Dando & Southward 1986; Dando & Spiro 1993). The bioturbating activities of *T. sarsi* can re-oxidise sediments, reducing pollution, thereby facilitating colonisation by sulphide-intolerant benthic animals (Dando et al. 2004), which could be a good strategy in heavily disturbed trawled areas to reorganize polluted sediments.

4.4.3 Biological traits (BTs)

The biological traits investigation expected to find significantly higher numbers of small-bodied, opportunistic organisms in the trawled areas. To address this, traits weighted with abundance were analysed using Mann-Whitney U tests. The results showed higher trait diversity in trawled areas, which was an unexpected result. This suggested that biological traits are closely related to biodiversity. The two categories which were significantly greater in control areas were feeding type large detritus/sandlicker and life duration greater than five years. Species with a long life duration occurring in greater numbers in control areas is expected as the lack of disturbances allows the benthic fauna to live longer (Teixido et al. 2004). The significant differences for the majority of traits were in favour of trawling, which reflects higher biodiversity, making it difficult to deduce any clear trend as a result of trawling impact.

There was no clear trend in the top ten categories, which did not differ significantly between the trawled and non-trawled areas.

4.4.3 Species Abundance Distribution (SAD) and BTs contribution

Rare species in this study are defined as a species which occurred only once in control or trawling areas (in the sum of the entire grab samples). However, some of the locally rare species may occur in higher abundance elsewhere (Murray & Lepschi 2004), even in the same sampling area. A high degree of consistency has been observed with rare species remaining rare and abundant species remaining abundant (Murray & Lepschi 2004), but with a closer look at different locations, all species are rare somewhere (Gaston 1994). The pattern of the curve of species abundance distribution is seldom normally distributed (Gray & Mirza 1979; Shaw et al. 1983; Gray 1983) and this trend was similarly observed in this study (Fig. 4.4). The reason for this pattern is that, in nature, the number of rare species is generally higher than abundant species (Fisher et al. 1943). In this study, a high number of species represented by only one individual occurred in both trawled and non-trawled areas. Rare species made a greater total contribution of the taxa assemblage in the trawled areas (24%), as compared to the non-trawled areas (19 %, Fig. 4.5).

The rare species from SAD and BTs were measured as a percentage for the whole trait pool. The rare species contributed substantially to the total trait pool, suggesting that the rare species, as a group, may be important in contributing to the functioning of benthic communities. The role of rare species in ecosystem functioning has been debated for a long time (Gaston 1994; Murray & Lepschi 2004), but previous studies have focused on "common" rare species rather than rarity as a total group (Chapman 1999). Although the number of rare species and total contributions were higher in the trawled areas, the present results clearly showed that rarity should not be neglected in studies of ecosystem functioning. It is suggested that further research should be initiated, e.g., a study of rarity as a group, with multi-level trait combinations measuring the response of the species under different pollution scenarios. Mesocosm experiments, in which one or two abundant species in combination with many rare species are manipulated for a set of known biological traits/functioning, may also help clarify the redundancy hypothesis in benthic communities.

Chapter 5 Impact of structure and function of infaunal communities in heavily and lightly trawled areas in Southern Benguela upwelling region

5.1 Introduction

As much as 75% of the world's continental shelf is reportedly subjected to trawl and/or dredge activities (Kaiser et al. 2002). Such large-scale fishing activities have been operational for decades and, in some cases, centuries. The large-scale impact of such fishing levels has not been quantified in many parts of the world, including southern Africa.

South Africa is a signatory to the World Summit on Sustainable Development (2002) and is thereby committed to establishing and implementing an Ecosystem Approach to Fisheries (EAF) in the country by 2010. In establishing an EAF for South African demersal trawl fisheries, it is central to identify and define the effects that trawling has on fish and benthic communities, and the impacts exerted on the seabed over which trawling is conducted. In a research study on the intensity of hake-directed trawling on the benthic habitat in South Africa, Wilkinson and Japp (2005) reported that there have been no specific studies of habitat impact by hake-directed gear in South Africa. The South African commercial trawl fishery originated in the early 1900s and took place in a near continuous band on well-established grounds, extending from the Namibian border on the west coast to the extreme eastern part of the Agulhas Bank off the south-east coast (Payne & Punt 1995; Rademeyer 2003; Wilkinson & Japp 2005). Trawling along the west coast is predominantly conducted in waters of 300 to 800 m depth (offshore fishery) and initially targeted the two Cape hake species *Merluccius capensis* and *M. paradoxus,* with by-catch species, such as kingklip *Genypterus capensis,* monk and sole fish, contributing increasing importance over time.

Similarly, Namibia's demersal hake fishery started in the late 1950's (Boyer & Hampton 2001) and is of equal commercial importance (Macpherson & Gordoa 1992; Van der Westhuizen 2001; Bianchi et al. 2001). The fisheries primarily target the highly sought-after gadoid hake species *Merluccius capensis* and *M. paradoxus* in a near continuous band between 300 and 600 m depth on well-established trawl grounds in the southern Benguela region. The demersal trawl gear used in this region is considered comparatively light-weight by international standards and fishing mostly occurs on sandy substrates (Wilkinson & Japp 2005). Sandy substrates are hypothetically suggested to incur less structural damage, with greater ability to recover, than other sediment types (e.g., mud and gravels, Steele et al. 2002). Furthermore, the trawl gear is intended to skim the surface of the substrate and not plough through the sediment (except for the trawl doors), since the target species generally feed on other fish just above the seabed (Payne & Punt 1995). Collie et al. (2000) reported that the magnitude of change in macrofaunal abundance or biomass, as a result of fishing disturbance, varied greatly according to the types of fishing gear used in different studies, habitats and among different taxa encountered. Dredging is considered to have the greatest initial impact on benthic biota, with trawling inflicting considerably less impact. In comparing the extent of damage inflicted by various demersal fishing gear types, Kaiser et al. (2002) concluded that smaller, lighter otter trawl gear have less direct impact on benthic habitats than dredges, rock-hopper otter and beam trawls, although all trawl doors create furrows in the sediment, and ropes and warps often drag along the seabed, dislodging emergent fauna (Smith et al. 2000). Fauna occurring in stable gravel, mud and biogenic habitats are more likely to be adversely affected by disturbance than those living in more unconsolidated sediments (Collie et al. 2000). Recovery rates in such unstable sediment types are likely to be rapid and generally dominated by opportunistic species. Intense fishing activity is expected to maintain habitats in a permanently altered state (Collie et al. 2000).

In seeking to understand the long-term impacts of fishing, studies are required at the scale of the fishery (Berkes et al. 2001). Comparisons of benthic assemblages, from areas where the commercial trawl activity can be quantified, should be compared to appropriate reference sites, where fishing activities do not take place (e.g., marine protected areas). The scarcity of such representative control sites has been encountered in many parts of the world (Gray et al. 2006) and the situation is no different in southern Africa, where sufficient unfished, representative habitat, similar to trawled habitat, does not exist at any comparable scale. Many previous studies, at the scale of the fishery, have used an experimental design to attribute the changes in benthic assemblages to the impact of trawling disturbance (Collie et al. 1997; Thrush et al. 1998; McConnaughey et al. 2000). However, studies where comprehensive sets of BTs are used to relate the role of benthic fauna species in an assemblage to ecological functioning, to observe trawling or dredging impacts, are few and have only been done in European waters: epifauna in the North Sea (Tillin et al. 2006), infauna and epifauna in the Mediterranean Sea (de Juan 2007) and dredging recovery of macrofauna in the English Channel (Cooper et al. 2008). No published studies have, thus far, made use of BTA to examine impacts of trawling on infauna in the southern Benguela region.

This chapter attempts to provide further understanding of trawling impacts and influence on the ecosystem’s structure and biological function. The aim was to quantify the effects of intensive demersal trawling activity on species composition, diversity, abundance and biomass of benthic infauna and address how BTs change from heavily trawled sediment to lightly trawled areas. Four sites were sampled in the southern Benguela region, each having a paired heavily/lightly trawled area with similar environmental variables. It was expected that areas exposed to lower levels of fishing intensity would yield more species reflecting biological traits aligned with that of k-selected species (e.g., larger-bodied, specialist feeder, long-lived). Areas subjected to heavier fishing activities were expected to yield species with biological traits characteristic of r-selected species (e.g., opportunistic, small-bodied, fast-growing, short life-span).

5.2 Materials and methods

5.2.1 Sampling design

Benthic infauna were collected from aboard the RV *Dr Fridtjof Nansen* in April 2007 and FRS *Ellen Kuzwayo* in February 2008 (Fig. 5.1, Table 5.1). Four sites were sampled [Namibia (Nam), Childs Bank (Child), Cape Columbine (Col) and Cape Point (Point), Fig. 5.1], with areas of heavy trawling (HT) and light trawling (LT) activities being sampled at each site. The first sampling site lies in a region, approximately 130 km south of Luderitz, Namibia. Intense trawling occurs at depths around 400 m where the continental shelf begins to narrow and demersal fish are thought to concentrate, whilst an area adjacent to this reflects considerably fewer trawling activities (MFMR Demersal trawl CPUE data 2005). A second sampling site, located near Childs Bank, west coast of South Africa in 350-400 m has an abandoned wellhead (Fig 5.2) located in the middle of an area that is, otherwise, intensely trawled (Wilkinson & Japp 2005). The guide posts of the abandoned wellhead, projecting 4.6 m from the sediment surface, pose obstructions to fishing gear, thus preventing fishing in the immediate vicinity of the wellhead structure. A third sampling site was near the intensely fished area off Cape Columbine, west coast of South Africa in 400-440 m. Examination of commercial data (Wilkinson & Japp 2005) allowed sampling to take place in a zone reported to be intensely trawled and lightly trawled, having similar environmental attributes (depth, sediment type, oxygen and salinity). The fourth sampling site, Cape Point, is located west off Cape Town, South Africa at 270-349 m. The trawl intensity at each site, located in South Africa Childs Bank, Cape Columbine and Cape Point, was defined by calculating the number of trawl passes within one nautical mile of each site over a five year period (2003-2007, commercial data obtained from DEAT: Marine & Coastal Management). Heavily trawled sites were calculated to have in excess of 270 trawl passes over the five year period, while lightly trawled sites had 30-187 trawl passes over the same time period. Heavily vs. lightly fished areas sampled in Namibia were defined by the difference in the total number of hours spent fishing between each area during 2004 and 2005. An area in which commercial vessels fished between 15 and 27.7 hours was classified as heavily fished, whereas an area in which vessels spent 0.17 to 11 hours fishing was classified as lightly fished over the same period (2004-2005).

A 0.2 m^2 van Veen grab was used to collect five replicate infaunal samples at each site of HT and LT areas. Sediment volume for each grab was measured. The average grab volume of 18 L was comparable between paired HT and LT areas, suggesting an average penetration depth of 9 cm. For each grab sample, 250 ml sediment was sub-sampled for organic and particle size analysis. The remaining sediment was washed over two stacked sieves with mesh sizes of 10 mm and 1 mm and with a 1 mm net covering the seawater hosepipe used to wash samples, preventing larger planktonic organisms from washing into the samples. All infauna less than 1 mm in size, retained by the sieves, were carefully placed into sample bottles and preserved in 96% ethanol. The ethanol in the samples was replaced 24-48 hours after initial preservation, to ensure specimens were adequately preserved. The infauna were sorted and identified to the lowest possible taxonomic level. The abundance, biomass and average size were recorded for each species.

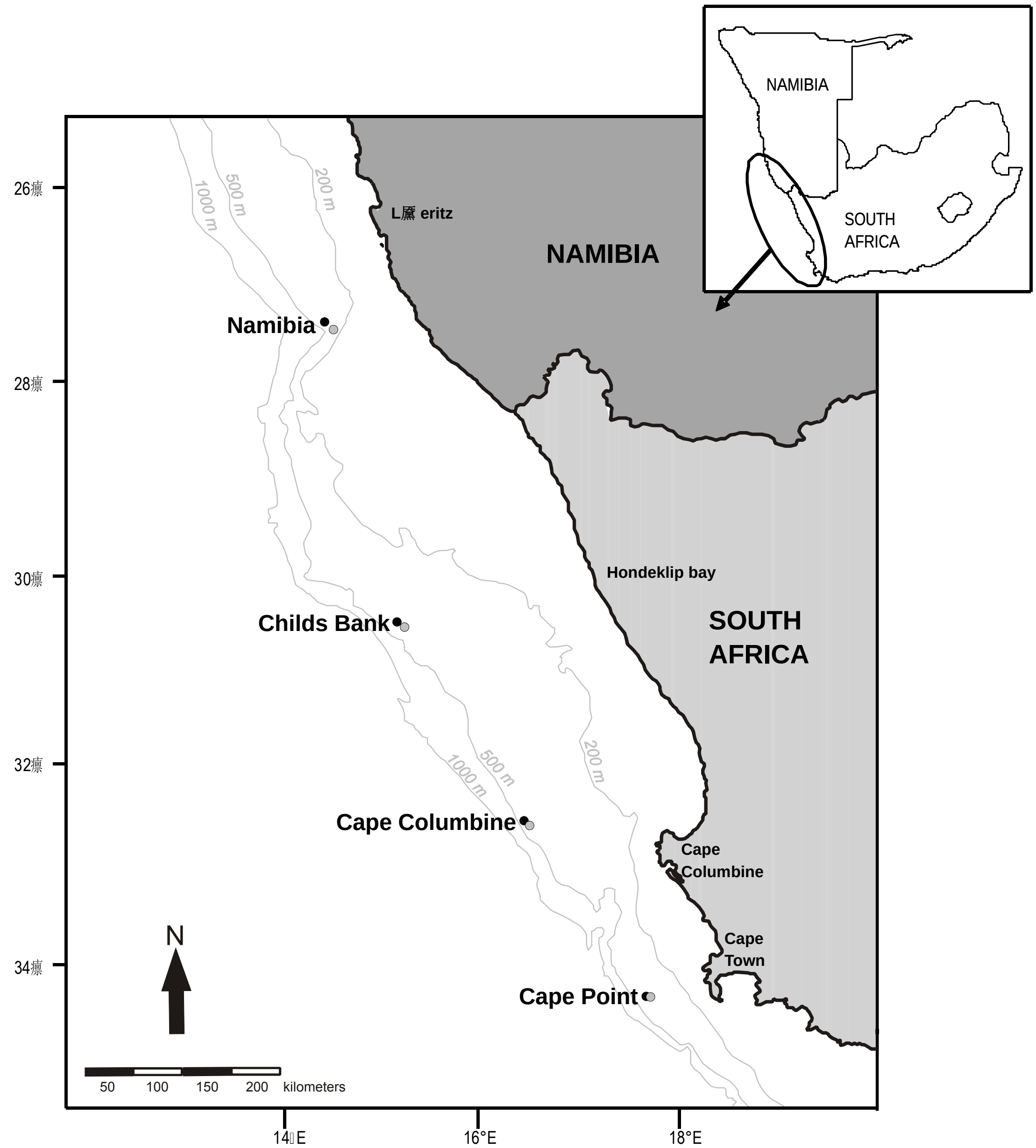

Figure 5.1 Study areas in the southern Benguela region. Black circles represent heavily trawled areas and grey circles represent lightly trawled areas.

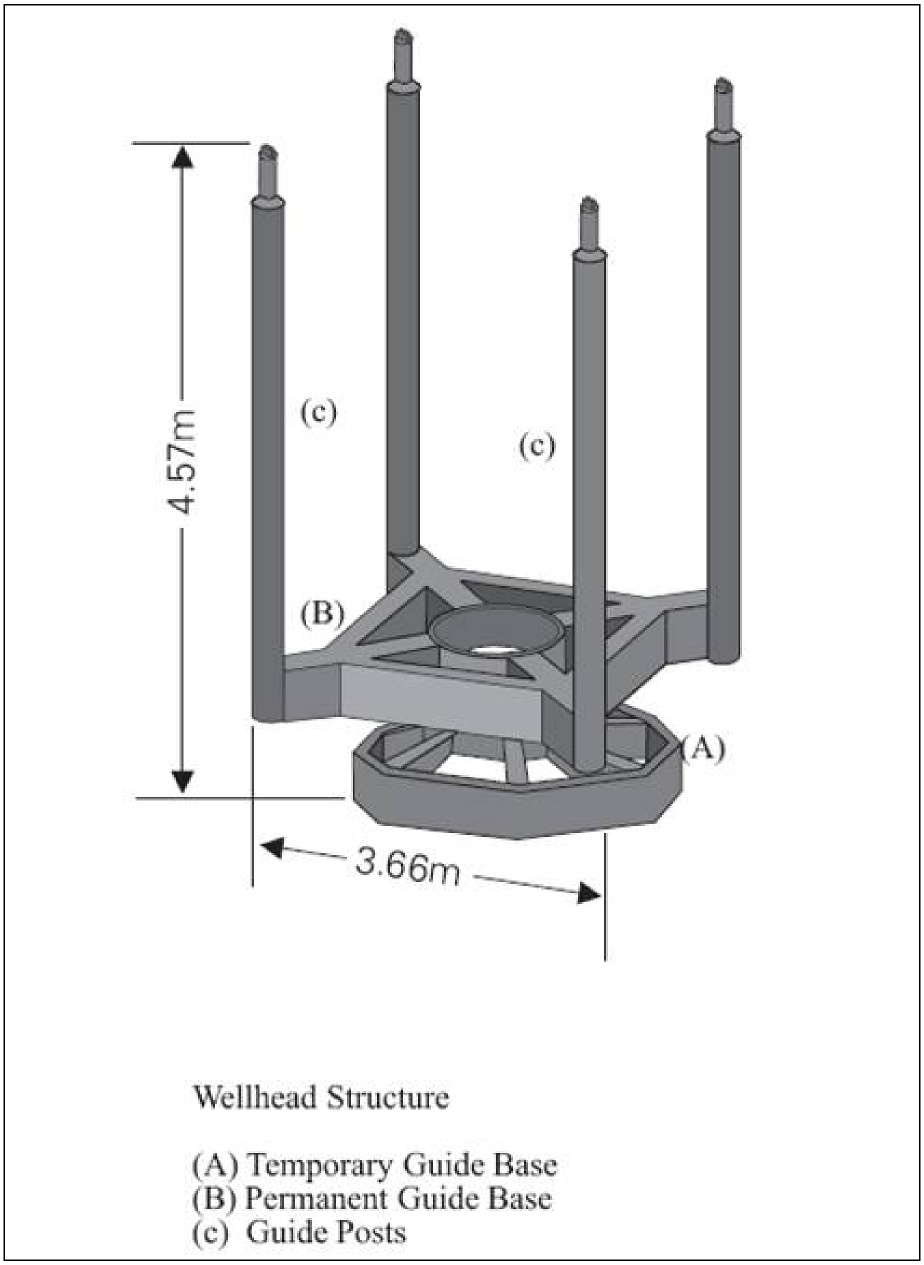

Figure 5.2 Diagrammatic representation of abandoned wellhead structure in lightly trawled area in South Africa (Source: South African Notice to Mariners No 16 of 2007, provided by Lara Atkinson).

Table 5.1 Details of the four sampling sites in the southern Benguela region.

Sites	Heavely trawled (HT) Co-ordinates	Depth (m)	Trawl tracks[a]	Lightly trawled (LT) Co-ordinates	Depth (m)	Trawl-tracks
Namibia	27°46.5'S 14°41.91'E	405 m	[b]	27°48.9'S 14°46.43'E	435 m	[c]
Childs Bank	30°42.88'S 15°25.66'E	400 m	285	30°42.67'S 15°26.01'E	349 m	30
Cape-Columbine	32°37.4'S 16°38.47'E	436 m	271	32°36.9'S 16°41.36'E	412 m	112
Cape Point	34°19.40'S 17°49.03'E	349 m	270	34°19.31'S 17°49.40'E	348 m	187

[a]Trawl tracks: the number of trawl tracks passing within one nautical mile of each sample site over a 5 year period (2003-2007)

[b]Namibia heavily trawled is defined as between 15 and 27.7 hours spent fishing over a one year period (2004-2005)

[c]Namibia lightly trawled is defined as between 0.17 and 11 hours spent fishing over a one year period (2004-2005)

5.2.2 Environmental components

Defrosted sediments from each site replicate were dialyzed for approximately 12 hours using cellophane tubing and fresh water to remove salts. The salt-free sediment was washed out of the tubing and wet-sieved through a 63 µm sieve, separating out sand (> 63 µm) and mud (< 63 µm) fractions. The sand component was visually examined through a dissecting microscope to identify sediment components and then dried at 70°C. Once dry, the sand was sieved through a 2 mm sieve to separate off the gravel component and the remaining sand fraction (< 2 mm and > 63 µm) was sieved for five minutes through a mechanised stack sieve system of six size categories. The gravel and each sand fraction were weighed to three decimal places. The mud component was left to settle for 24 hours, after which the excess water was poured off and a calibrated Andreasen pipette was used to measure off 25 ml of homogenised mud, which was dried at 70°C. A pipetting factor of 43.353 was used to determine the mass of the dried silt/clay proportion. The mass of the gravel, sand (each of five categories) and mud were used to determine the percentages, and the Gravel-Sand-Mud texture category of each replicate sample was determined, using a classification triangle (Folk 1954, Fig. 5.3) with the sand fraction further allocated according to the Wentworth classification scale (Wentworth 1922).

Defrosted sediments from each site replicate were dried at 60°C, homogenised using a pestle and mortar and washed with 50% hydrochloric acid to remove the inorganic carbon component ($C_{total} = C_{org} + C_{inorg}$). Once dried (at 60°C) the sediments were washed with 1M ammonium formate (to remove any acid residue), filtered onto a filter paper and returned to the 60°C oven. Dried sediment, with inorganic carbon removed, was scraped from the filter paper into glass vials for further analysis. The organic carbon content of sediments from each site replicate was measured with a Thermo Flash 1112 elemental CHN analyzer. The percentages of total organic carbon (TOC), gravel, sand and mud were converted to proportions and arcsine transformed.

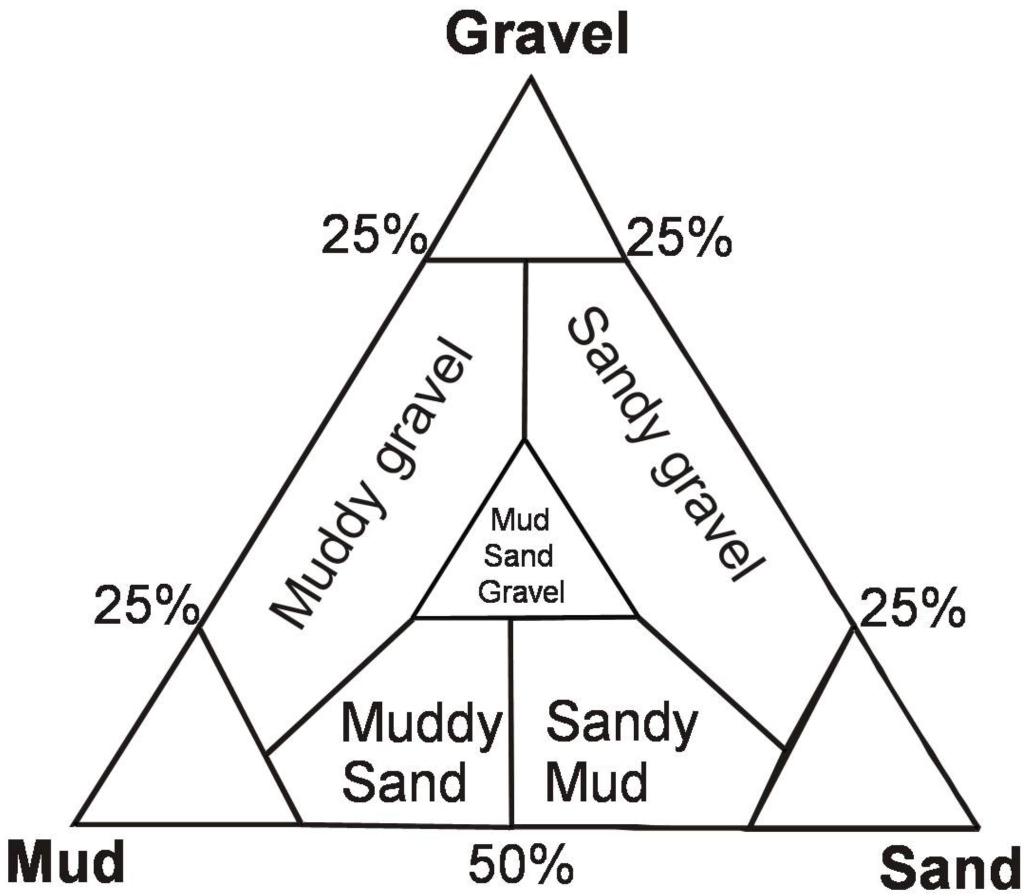

Figure 5.3 Gravel-Sand-Mud classifications according to composition ratios (Folk 1954).

5.2.3 Biological Traits Analysis (BTA)

Eight biological traits with a total of 42 categories were chosen for the analysis (see Chapter 3, Table 3.1 for category names and codes). However, one additional trait (average capture size, NSA) was added to this study, which is not listed in Table 3.1. Average capture size has the same category name as adult body size (NSB). The only difference is that NSA is the average measured size, while NSB is the adult size based on information from literature. The category score and the development of a BTs' matrix are explained in Chapter 3. The database thus comprised eight BTs with 42 categories, instead of 36 as for Chapter 3, 6 and 7.

5.2.4 Statistics and analysis

All univariate and multivariate analyses were performed using PRIMER-E v6 software (Clarke & Warwick 2001; Clarke & Gorley 2006 and its Permanova add-on; Anderson et al. 2008), unless otherwise indicated. A Principal Component Analysis (PCA) was conducted on pooled environmental data to obtain the percentage variation contributed by each environmental variable. Arcsine transformed and normalized replicate data were converted to a Euclidean distance matrix and two-way nested Analysis of Similarity (ANOSIM) permutations conducted to test for significant differences within and among sites and treatments (Clarke 1993).

Univariate indices of total number of macrofauna species (S), total number of individuals (N), Shannon-Weiner diversity (H') and Pielous evenness (J') were calculated to describe the benthic community structure (Schratzberger & Jennings 2002) in lightly and heavily trawled areas. To test for significant differences between univariate indices, a multi-factorial analysis of variance (ANOVA, between sites and treatments) was used. The percentage of occurrence of species at the phylum level was recorded for the dominant phyla (molluscs, polychaetes, echinoderms and crustaceans) with all other species being grouped as "others." One-way analysis of SIMPER (Similarity Percentages) for lightly and heavily trawled areas was conducted to reveal species similarity for each treatment (LT vs. HT) based on species contribution for abundance and biomass. To identify the level of rare and opportunistic species, and to detect the percentage BTs contribution, species abundance distribution (SAD) was conducted, as described in Chapter 4.

A Bray-Curtis (dis)similarity matrix of pooled, square-root transformed biomass data was used to generate a non-metric multidimensional scaling (MDS) plot to visually assess the infaunal community pattern. ANOSIM was conducted on replicate biomass data to test for significant differences among sites (Namibia, Childs Bank, Cape Columbine and Cape Point) and between treatments (HT vs. LT).

The traits matrix was not transformed but weighted by the square-root-transformed biomass matrix through matrix multiplication using software package ADE-4 (Thioulouse et al. 1997). Each category with the affinities from 0-3 was multiplied by the transformed biomass, and data were summarized for each sampling site. In transforming the biomass matrix, but not the affinity scores, the affinities were afforded a greater contribution towards identifying the BTs. The non-parametric Mann-Whitney U test was applied to the replicate traits by biomass matrix to test for significant differences in BTs for each trawling treatment and between different sediment types ($> 72\%$ and $\leq 72\%$ sand) and mud ($> 20\%$ and $\leq 20\%$) using the software STATISTICA v8. The weighted traits data were also used to compare all 40 replicate biological samples using Euclidean distance. These data were displayed graphically using Principal Coordinates Analysis (PCoA), and the values of eight significant BTs, for each replicate, were superimposed on the graphs, using bubble plots proportional to the trait score for each sample. The bubble plots were used to show the contribution of each trait to the multivariate clusters.

5.3 Results

5.3.1 Environmental analysis

The classifications of sediment grain size determined at each site in the lightly and heavily trawled areas are shown in Table 5.2, using the gravel-sand-mud ratios [according to Folk's triangle (Folk 1954, Fig. 5.3)] and the sand component, according to the Wentworth scale (Wentworth 1922). The proportions of sand and mud were strongly correlated (Pearson $p = 0.99$); thus, further statistical analysis was only conducted on one of these variables. In subsequent analysis, percent sand was selected. Gravel contributed very small proportions to the overall sediment composition (< 5%) and was excluded from further statistical analyses. The sediment composition of heavily trawled and lightly trawled areas at Namibia, Childs Bank and Cape Point sites were classified as "sand" or "muddy sand," with sand comprising between 72-90%, according to the Folk's classification triangle (Fig.5.3) and fine "sand" and "very fine sand" according to Wentworth scale. The sediment composition at Cape Columbine's lightly trawled area was classified as "sandy mud," with a larger proportion of finer grained mud particles (79%) than the heavily trawled area (47% mud), which was classified as "muddy sand" (similar to all other areas) or "sand" to "muddy sand" at Wentworth scale. The two-way nested ANOSIM analysis showed significant differences in sediment composition among sites (Global $R = 0.577$, $p = 0.001$)

and between treatments (Global R = 0.358, p = 0.001).

The TOC measured in the sediment collected from the Childs Bank site was considerably higher than that recorded at any of the other three sites (11.19%-14.22% *vs*. 0.63%-5.56%) (Fig. 5.4). The pie diagram showed that the TOC at Child LT and Namibia LT had higher content than HT (56% and 70% vs. 44% and 30%, respectively). An opposite trend occurred for Col LT and Point LT (34% and 35% vs. 66% and 65%). The two-way nested ANOSIM analysis showed significant differences in TOC among sites (Global R = 0.783, p = 0.001) but not between treatments (Global R = - 0. 188, p = 1.0).

The PCA plot of pooled environmental data (sand composition and percentage of TOC) and depths of the HT and LT treatments is shown in Figure 5.5. Most of the variation (48.1%) is explained along the PC1 axis (eigenvalue = 1.93), while PC2 explained 30.8% (eigenvalue = 1.23) of the total variation. It is noted that the lightly trawled areas tend to be on the periphery of the graph, while the heavily trawled areas are more central. There is no clear trend related to heavy or light trawling along either axis. Sand and mud contributed the most towards the variance along the PC1 axis. The LT area at Cape Columbine had a notably greater mud contribution in comparison to the other sites. The two-way nested ANOSIM analysis showed significant differences in the environmental variables among sites (Global R = 0.875, p = 0.01) and between treatments (Global R = 0.504, p = 0.0001).

Table 5.2 Grain size of all the sampling stations and the relationship between Folk's triangle (Gravel-Sand-Mud) and Wentworth scale (Sand). Sand (s), muddy sand (ms), sand mud (sm), fine sand (fs) and very fine sand (vsf).

Site	Folk's triangle	Wentworth scale
Namibia LT	s-ms	fs (125-250 µm)
Namibia HT	ms	fs to vfs (125-250 µm to 63-125 µm)
Childs Bank LT	ms	fs (125-250 µm)
Childs Bank HT	ms	fs (125-250 µm)
Cape Col LT	sm	vfs (63-125µm)
Cape Col HT	ms-sm	vfs (63-125µm)
Cape Point LT	ms	fs (125-250 µm)

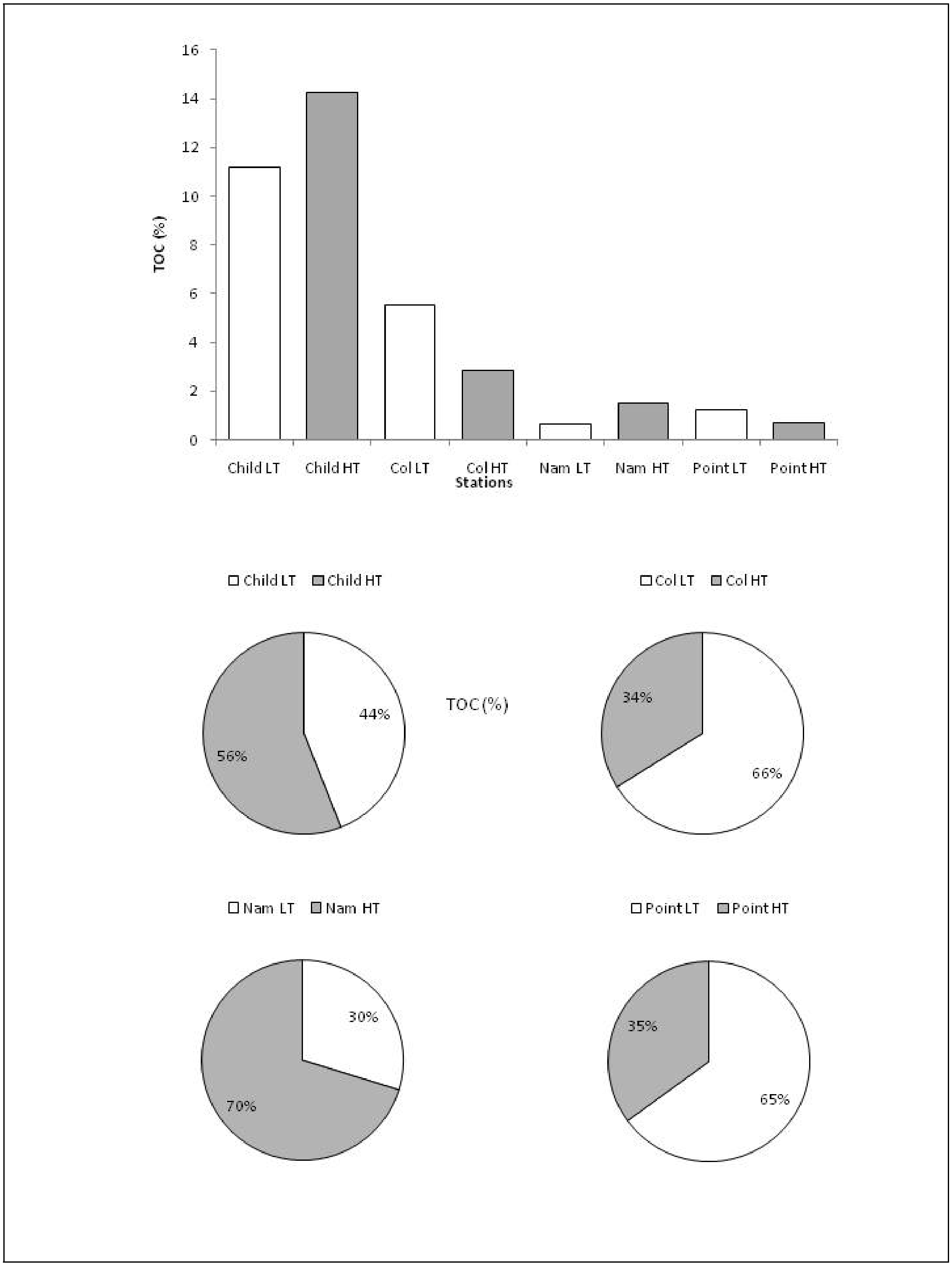

Figure 5.4 Total organic carbon (%) contributions (above) and comparison by site in pie diagram (below) for HT and LT areas. The two-way nested ANOSIM analysis showed significant differences in TOC composition among sites (Global R = 0.783, p = 0.001) but not between treatments (Global R = - 0.188, p = 1.0).

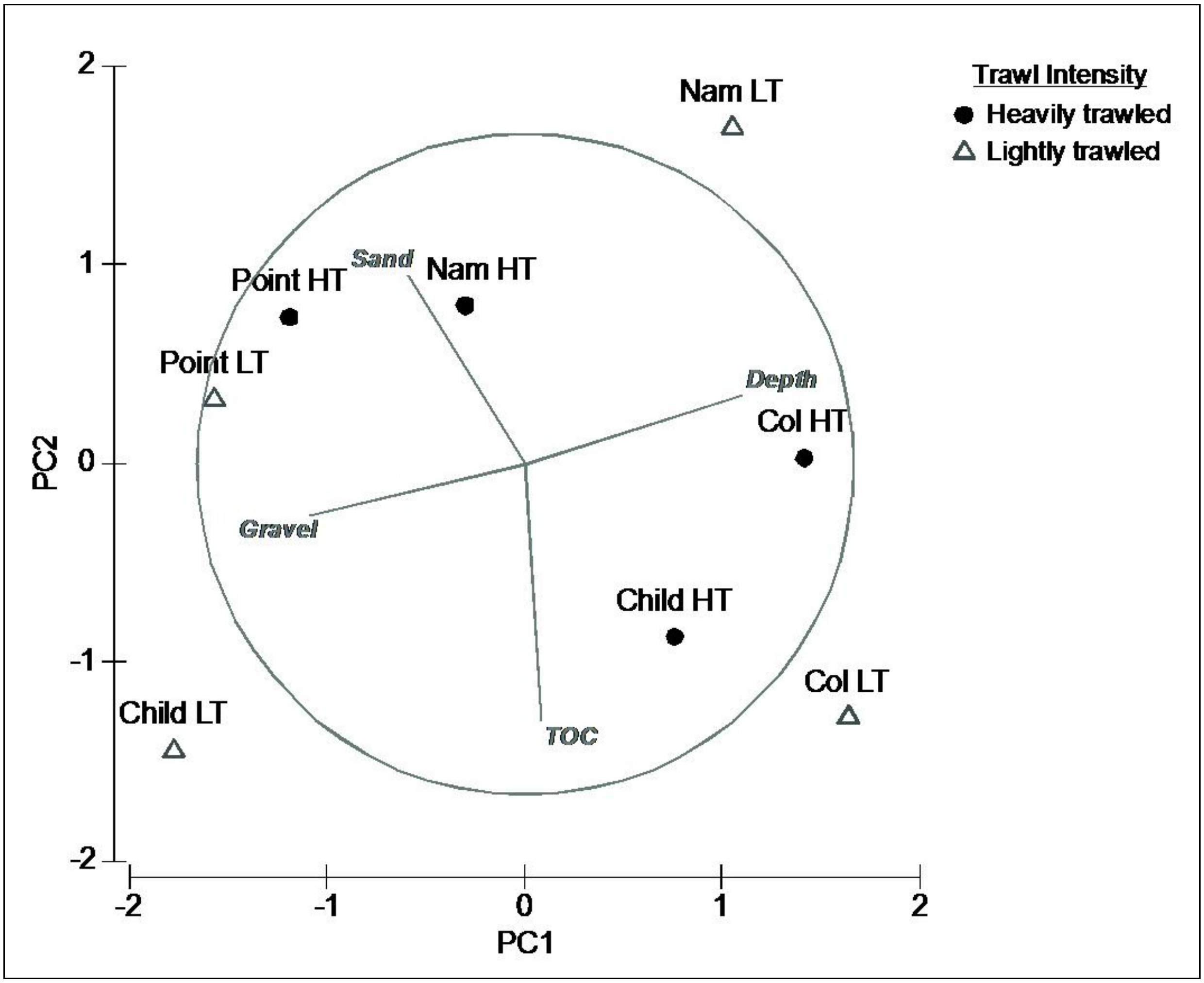

Figure 5.5 Principal Component Analysis plot (correlation-based) of pooled environmental data and depth at lightly trawled (open triangles) and heavily trawled (black circles) sites. NAM: Namibia, Child: Childs Bank; Col: Cape Columbine; POINT: Cape Point (see Fig. 5.1). The eigenvectors are superimposed on the PCA plot. The two-way nested ANOSIM analysis showed significant differences in the environmental variables among sites (Global R = 0.875, p = 0.01) and between treatments (Global R = 0.504, p = 0.0001).

5.3.2 Univariate and multivariate analysis of community structure

A total of 248 species were identified from all sites, with the highest number of species occurring at the lightly trawled area of Cape Point (110/m^2, Table 5.3). The lightly trawled area of Childs Bank yielded the highest number of individual macrofauna (630/m^2, Table 5.3) while the highest total biomass (pooled replicates) was 54.49 g/m^2 at the heavily trawled area of Cape Columbine. The multi-factorial ANOVA of all factors represented in Table 5.3 showed no significant differences between paired heavy vs. light trawling sites, except at Namibia where there was a significantly lower total number of individuals at the lightly trawled area, compared to heavily trawled area ($p = 0.024$, $F_{3,32} = 4.98$).

Table 5.4 summarizes the percentage of dominant taxa occurring at each site and for each treatment. Crustaceans contributed the greatest percent contribution to the macrofauna occurring at Childs Bank (61% LT, 56% HT). Cape Columbine was dominated by polychaetes (61% LT, 34% HT), followed by a high contribution of echinoderms (13% LT, 34% HT). Namibia was dominated by polychaetes (32% LT, 48% HT), followed by molluscs (30% LT, 16% HT).

The top ten species contribution from one-way analysis of SIMPER (Similarity Percentages) showed average dissimilarity in abundance and biomass between 66.89-69.38%, with cumulative values ranging from 18.01-36.20% (Table 5.5). Slight differences between abundance- and biomass-contributing species occurred for several species for LT and HT. For the abundance data (N/m^2), *Ophiura* sp. (HT = 5.03, LT = 1.47), *Diopatra dubia* (HT = 4.04, LT = 2.40), bivalve sp. C (HT = 2.74, LT = 2.72) and bivalve sp. A (HT = 2.82, LT = 2.78), had higher average abundance in HT, while LT had the highest for the six remaining species of the top ten abundant species: *Eriopisella capensis* (HT = 2.88, LT = 3.35), *Notomastus latericeus* (HT = 2.82, LT = 2.95), *Laonice cirrata* (HT = 1.58, LT = 2.76), *Gammaropsis afra* (HT = 1.65, LT = 2.34), *Amphiura* sp. (HT = 2.81, LT = 3.46) and *Apseudes cooperi* (HT = 0.00, LT = 1.82). In terms of average biomass (g/m^2), the top ten species comprised *Brissopsis lyrifera capensis* (HT = 3.68, LT = 2.41), *Chloeia inermis* (HT = 0.46, LT = 1.67), *Amphiura* sp. (HT = 1.15, LT = 0.59), *Brisaster capensis* (HT = 0.43, LT = 0.83), *Macoma crawfordi* (HT = 0.78, LT = 0.01), *Ophiura* sp. (HT = 0.84, LT = 0.34), Nemertea sp. B (HT = 0.69, LT = 0.71), *Nephtys capensis* (HT = 0.41, LT = 0.59), Anemone sp. A (HT = 0.55, LT = 0.00) and Nemertea sp. F (HT = 0.30, LT = 0.32). The biomass (36.20%) had a higher cumulative contribution of the top ten species compared to that for abundance (18.01%).

Table 5.3 Summary of total biomass (g/m^2), total species (S/m^2), total individuals (N/m^2), Pielou's evenness (J') and Shannon-Wiener diversity (H' in $\log_e$) for lightly trawled (LT) and heavily trawled (HT) stations.

Site	Total Biomass (g/m^2)	S (S/m^2)	N (N/m^2)	J'	H'($\log_e$)
Nam LT	17.21	53	301	0.74	2.94
Nam HT	18.57	61	496	0.71	2.94
Child LT	36.43	105	630	0.72	3.38
Child HT	29.49	99	571	0.78	3.58
Col LT	9.15	39	132	0.86	3.15
Col HT	54.49	36	128	0.84	3.02
Point LT	38.86	110	359	0.88	4.15
Point HT	32.22	81	292	0.85	3.74

Table 5.4 Percent of dominant taxa occurring at each site and treatment: Mollusca (M), Polychaeta (P), Echinodermata (E), Crustacea (C) and Others (O).

Site	M	P	E	C	O
Nam LT	30	32	4	31	3
Nam HT	16	48	20	12	4
Child LT	2	24	11	61	3
Child HT	8	25	8	56	4
Col LT	3	61	13	13	11
Col HT	7	34	34	20	5
Point LT	9	34	4	38	15
Point HT	7	37	12	34	10

Table 5.5 Top ten species contribution from one-way analysis of SIMPER (Similarity Percentages) for lightly and heavily trawled areas based on abundance (Average dissimilarity = 66.89%) and biomass (Average dissimilarity = 69.38%). Taxa in bold face occurred at higher abundance/biomass in heavily trawled treatments.

Abundance (N/m^2) Species	Group LT Average Abundance	Group HT Average Abundance	Average Dissimilarity (%)	Contribution (%)	Cumulative (%)
Ophiura sp.	1.47	**5.03**	1.72	2.57	2.57
Diopatra dubia	2.40	**4.04**	1.67	2.49	5.06
Eriopisella capensis	3.35	2.88	1.61	2.41	7.47
Notomastus latericeus	2.95	2.82	1.21	1.81	9.28
Bivalve sp. C	2.72	**2.74**	1.18	1.77	11.05
Bivalve sp. A	2.78	**2.82**	1.02	1.52	12.57
Laonice cirrata	2.76	1.58	0.94	1.41	13.98
Gammaropsis afra	2.34	1.65	0.93	1.39	15.37
Amphiura sp.	3.46	2.81	0.91	1.37	16.74
Apseudes cooperi	1.82	0.00	0.85	1.27	18.01
Biomass (g/m^2) Species	Group LT Average Abundance	Group HT Average Abundance	Average Dissimilarity (%)	Contribution (%)	Cumulative (%)
Brissopsis capensis	2.41	**3.68**	6.61	9.53	9.53
Chloeia inermis	1.67	0.46	4.20	6.05	15.59
Amphiura sp	0.59	**1.15**	2.60	3.74	19.33
Brisaster capensis	0.83	0.43	2.27	3.27	22.60
Macoma crawfordi	0.01	**0.78**	2.17	3.12	25.73
Ophiura sp	0.34	**0.84**	1.85	2.67	28.40
Nemertea sp. B	0.71	0.69	1.58	2.28	30.68
Nephtys capensis	0.59	0.41	1.42	2.05	32.73
Anemone sp. A	0.00	**0.55**	1.33	1.92	34.65
Nemertea sp. F	0.32	0.30	1.07	1.55	36.20

5.3.3 Species Abundance Distribution (SAD)

The Species Abundance Distribution (SAD) showed no trend of normal distribution (Fig. 5.6). Lightly trawled areas were found to have more rare species (i.e., represented only once) in the pooled samples, compared to heavily trawled areas (79 rare species vs. 57 rare species (S/4 m^2), Fig 5.6). The opportunistic species (abundance between 128-255/4 m^2) were represented by three species in heavily trawled areas (*Ophiura* sp., *Diopatra dubia* and *Eriopisella capensis*) compared to only one species in lightly trawled areas (*Eriopisella capensis)*. In the abundance category of 64-127/4 m^2, one species (*Notomastus latericeus*) was represented for both LT and HT.

Species represented only one time in LT and HT areas, measured from species abundance distribution in Figure 5.7, showed a higher percentage contribution to the total BTs' pool for LT and HT, ranging from 0%-50% (measured from presence/absence of BTs). However, the LT had a slightly higher percentage contribution for the majorities of traits: adult life habitat (LT = 26%-34%, HT = 20%-37%); adult mobility (LT = 23%-35%, HT = 19%-31%); body form (LT = 28%-36%, HT = 18%-30%); degree of attachments (LT = 20%-33%, HT = 22%-25%); feeding type (LT = 21%-37%, HT = 8%-28%); larval type (LT = 29%-39%, HT = 18%-30%); capture size (LT = 0%-50%, HT = 0%-50%) and normal adult size (LT = 24%-37%, HT = 14%-28%).

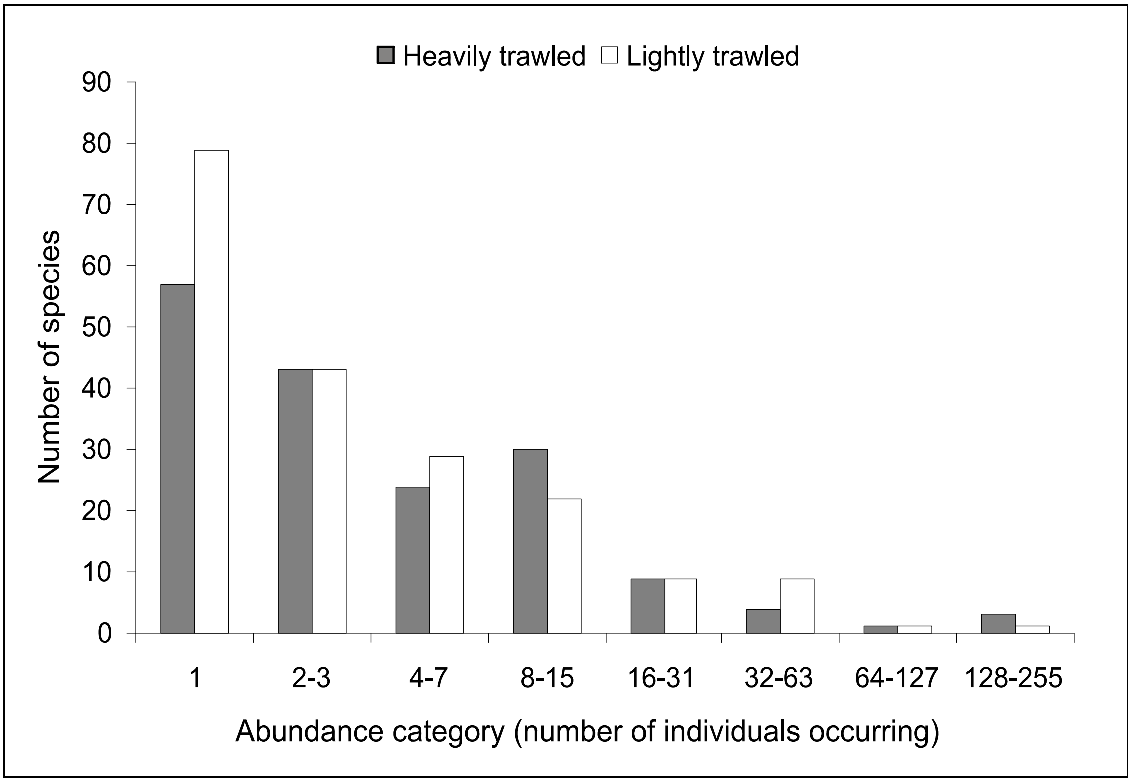

Figure 5.6 Species Abundance Distributions (SAD) for heavily- (grey bars) and lightly- (white bars) trawled areas, using abundance category of modified $\log_2$ classes.

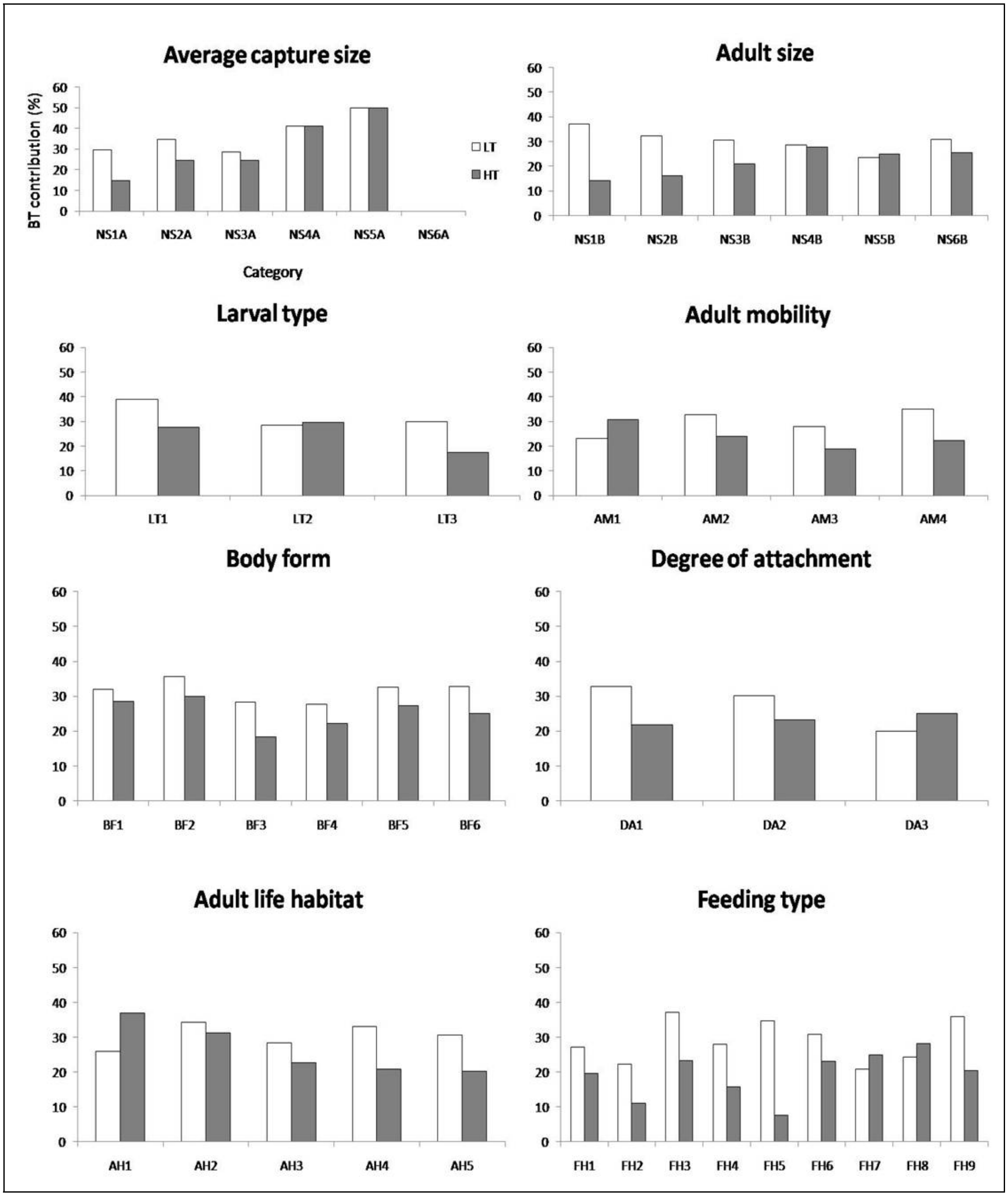

Figure 5.7 BTs' contribution for rare species from LT and HT sites measured as a percent of the whole traits pool. The BT is ranked as presence/absence.

5.3.4 Biomass

The MDS ordination of square-root transformed biomass (pooled replicates, Fig. 5.8) shows separation in community composition among the four sites and, to a lesser extent, between treatments at each site. A two-way nested ANOSIM on all replicates revealed that the four sites and between LT and HT areas differed significantly with respect to species composition in infaunal biomass (Bray-Curtis similarities, sites Global R: 0.83, $p = 0.01$; treatments Global R: 0.51, $p = 0.001$).

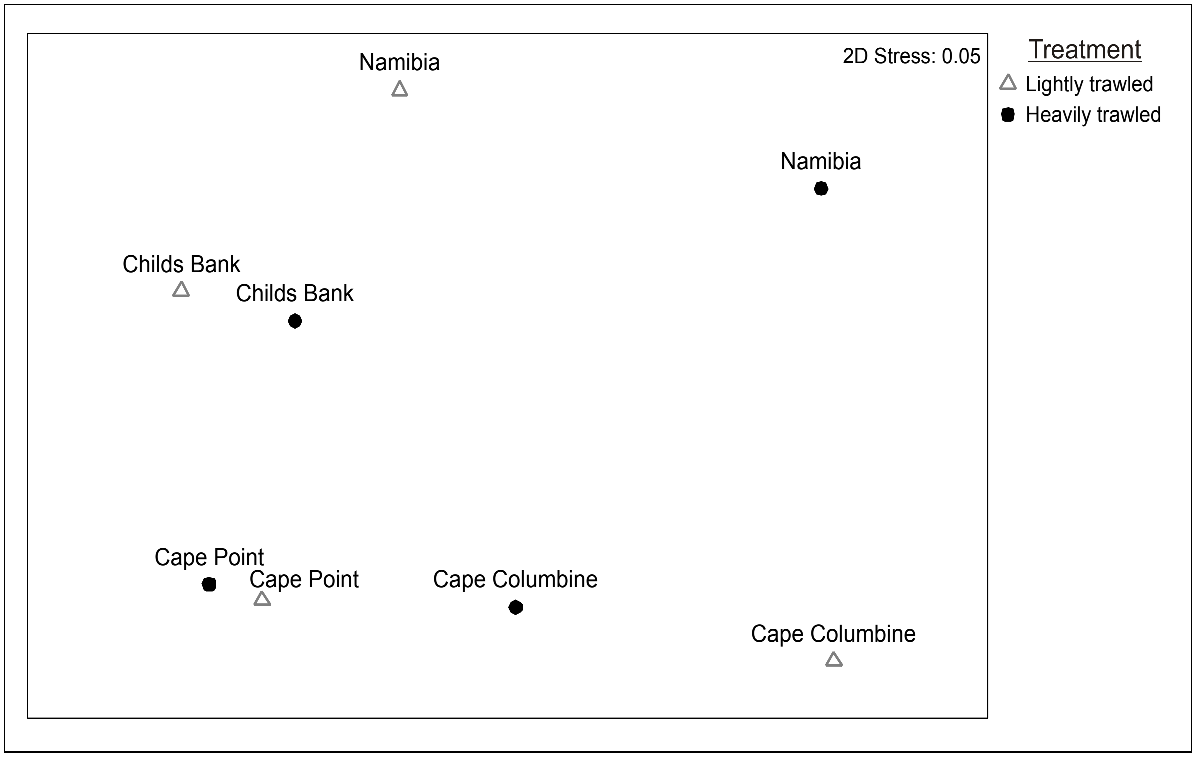

Figure 5.8 MDS of square-root transformed infaunal biomass (two-way nested ANOSIM, Bray-Curtis similarity with all replicates. Sites: Global R = 0.833, p = 0.01; Treatments: Global R = 0.508, p = 0.001). Black circles represent heavily-trawled areas and grey triangles represent lightly-trawled areas.

5.3.5 Biological Traits Analysis (BTA)

The biological structure based on weighted traits with the biomass showed significant differences among sites (Global R = 0.258, p = 0.001) and between treatments (Global R = 0.277, p = 0.004), with clear separation in the MDS plot (Fig. 5.9). Seventeen percent of BTs tested were significantly different between areas of HT and LT intensities (Table 5.6). Twelve and seven percent of BTs were significantly different in areas with small or large proportions of sand or mud contents, respectively (Table 5.7 and Table 5.8). On closer examination of the data (rank sum values calculated for each trait between HT and LT trawled areas from Mann-Whitney U test), it is evident that a higher biomass of smaller (< 5 mm) suspension and surface deposit feeders occurred in HT areas. More surface crawlers with high mobility occurred in LT areas (Table 5.6). All significantly different BTs between mud and sand composition were a result of increased infaunal biomass in sandier environments. Species between 5 mm and 1 cm in size, sessile (non-mobility), having lecithotrophic larval phases and a detritus/sandlicking feeding strategy had greater biomass in areas with more than 72% sand composition (Table 5.7). Surface crawlers and species having no larval life phases (direct development) had significantly greater biomass in areas with more than 20% mud composition (Table 5.8).

Unconstrained Principal Coordinate Analysis (PCoA) (Fig. 5.10) placed samples onto Euclidean axes using the matrix inter-point dissimilarities with scaled bubble plots superimposed to represent each trait, at each site, for the seven significantly different BTs (see Table 5.6). A larger BT biomass of smaller organisms (< 5 mm measured and 1-3 mm from literature) occurred at the HT areas of Namibia and Cape Columbine sites (Fig. 5.10a and Fig. 5.10b), while all LT areas supported a lower biomass of these organisms.

Similarly, suspension and surface deposit feeders occurred in higher biomass in HT areas of Namibia and Cape Columbine (Fig. 5.10f and Fig. 5.10g). Species displaying the BTs of high mobility (AM4), long thin body form (BF5) and surface crawlers (AH5) occurred in higher biomass in LT areas of Namibia and Childs Bank (Fig. 5.10c, d and e).

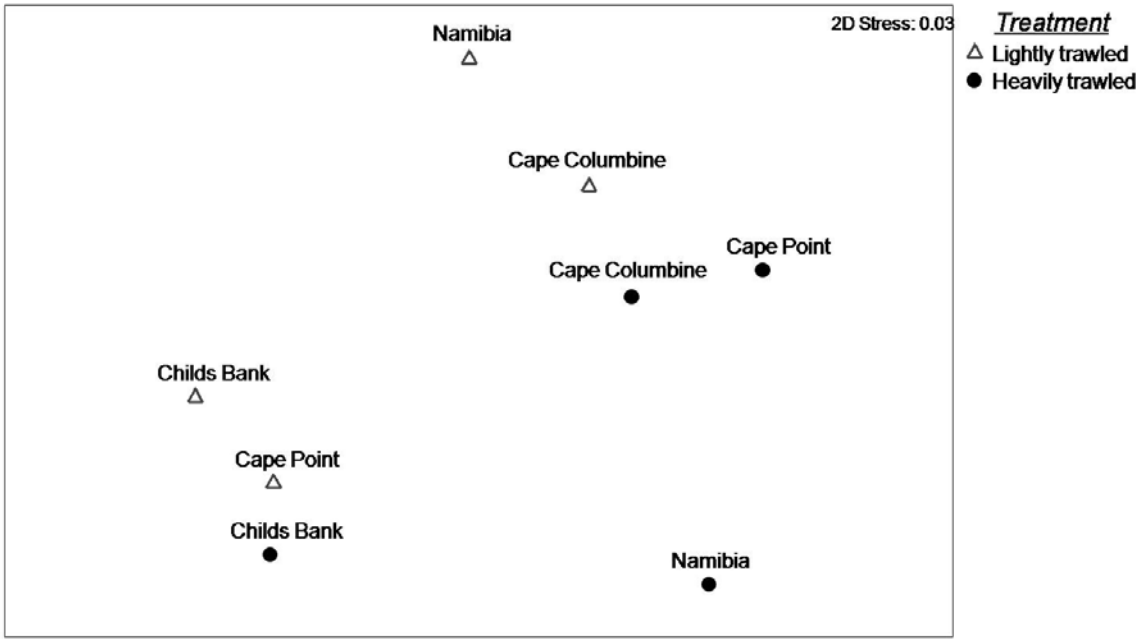

Figure 5.9 MDS of square-root transformed infaunal biomass × biological traits (two-way nested ANOSIM, Bray-Curtis similarity with all replicates. Sites: Global R = 0.258, p = 0.001; Treatments: Global R = 0.277, p = 0.004). Black circles represent heavily-trawled and grey triangles lightly-trawled areas.

Table 5.6 Significantly different biological traits between heavily- and lightly-trawled areas as tested for BTs weighted by biomass (square-root transformed) using Mann-Whitney U tests.

Trait	Category	Code	Significant value	Rank LT/HT
Size (A)	< 5 mm	NS1A	p=0.037, U=123	333/487
Size (B)	1-3 cm	NS3B	p=0.01, U=105	315/505
Mobility	High	AM4	p=0.003, U=91	519/301
Body form	Long thin	BF5	p=0.037, U=123	487/333
Habitat	Surface crawler	AH5	p=0.023, U=116	494/326
Feeding	Suspension	FH1	p=0.006, U=99	309/511
Feeding	Surface DF	FH3	p=0.015, U=110	320/500

Table 5.7 Significantly different biological traits between small (SS) and large proportions of sand (LS), as tested for BTs weighted by biomass (square-root transformed), using Mann-Whittney U test. Sand content was classified as large if > 72% and small if ≤ 72%.

Trait	Category	Code	Significant value	Rank LS/SS
Size (A)	5 mm-1 cm	NS2A	p=0.03, U=111	573/247
Larval type	Lecitotroph	LT2	p=0.04, U=118	566/254
Mobility	None	AM1	p=0.028, U=112	571/248
Habitat	Tube semi permanent	AH3	p=0.04, U=119	565/255
Feeding	Detritus sandlicker	FH6	p=0.03, U=114	414/406

Table 5.8 Significantly different BTs between small (SM) and large proportions of mud (LM), as tested for biological traits weighted by biomass (square-root transformed), using Mann-Whitney U tests. Mud content was classified as large if > 20% and small if ≤ 20%.

Trait	Category	Code	Significant value	Rank LM/SM
Larval type	Direct development	LT3	p=0.04, U=122	488/332
Mobility	None	AM1	p=0.04, U=133	343/476
Habitat	Surface crawler	AH5	p=0.02, U=111	499/321

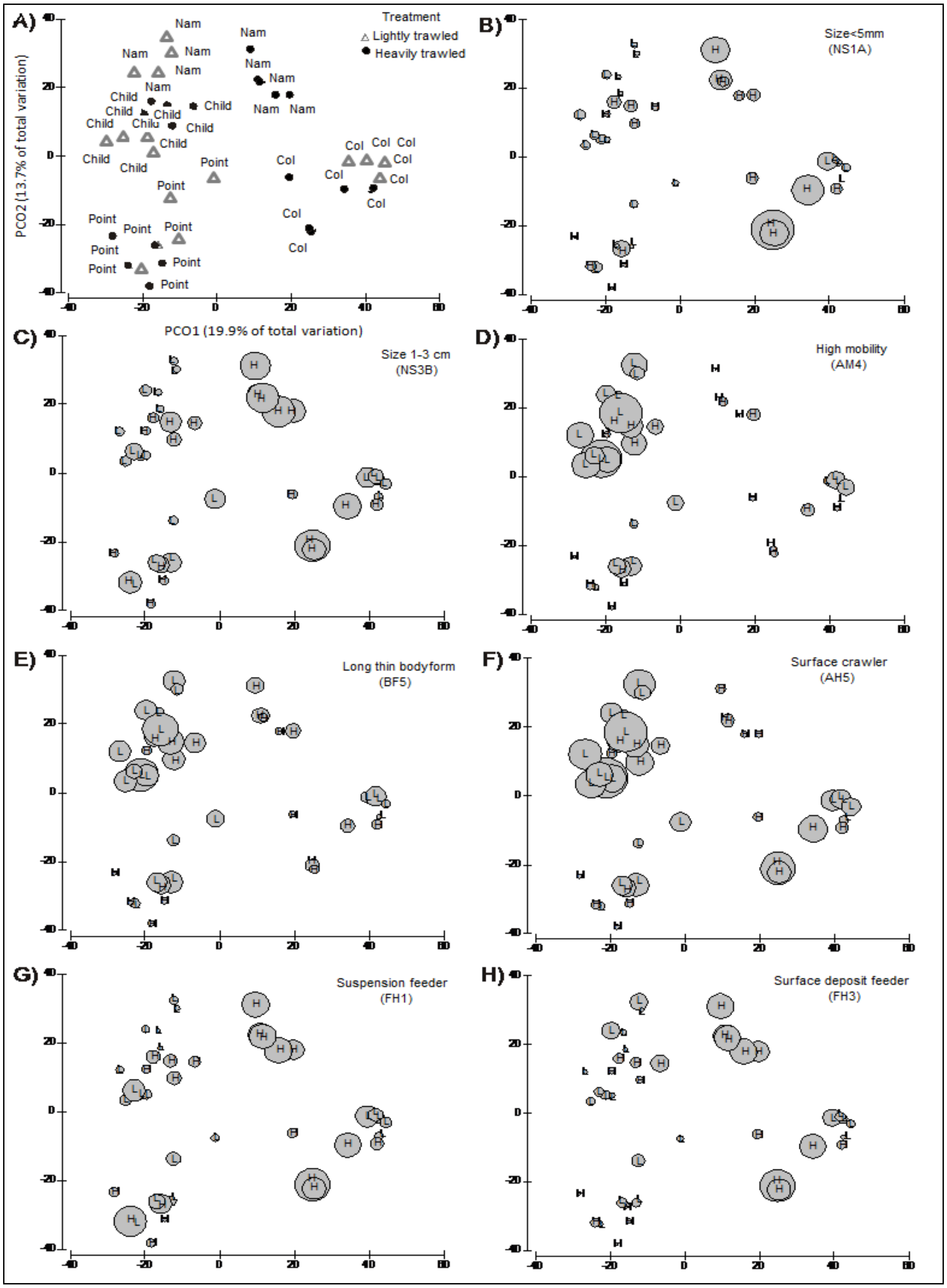

Figure 5.10 PCoA graphs reflecting square-root-transformed infaunal biomass weighted by significant BTs from Table 5.6. Panel a) shows the PCoA of 40 site and area replicates using Euclidean distance on the biomass-weighted BTs matrix. Panels b) to g) show bubble plots superimposed on a) and scaled to represent biomass distribution of each trait of each replicate sample at each site and area. H = heavily trawled, L = lightly trawled.

5.4 Discussion

5.4.1 Environmental characteristics

The environmental characteristics showed significant differences among sites and between treatments (Fig. 5.5). Notwithstanding that the depths ranged from 350-400 m, the differences within the sites, which never extended more than 50 m, would likely not have contributed to any significant differences in benthic community structure. The variability in TOC composition in this study showed only significant differences among sites and was not directly related to trawling. The argument is that differences between the treatments showed no clear trend towards trawling disturbance (Fig. 5.4). For this study, the highest change in environmental factors was sand and mud contribution to sites and treatments.

5.4.2 Community structure

The impacts of trawling are not uniform and are affected by the spatial and temporal distribution of fishing effort, varying with the habitat type and environment in which they occur (Kaiser et al. 2003). The four sites sampled in this study were spatially widely dispersed, spanning seven degrees of latitude (some 800 km). It is expected that benthic communities would display natural variations over such an expansive area, and comparisons among the four sites sampled were expected to yield significant differences, largely as a result of their spatial disparity. The paired heavily- and lightly-trawled areas sampled at each site were located in similar habitat types (sandy seabed), in close proximity to each other, displaying similar environmental components at the time of sampling. Different levels of trawling occurring in these areas are considered to be at least partly responsible for the differences in infaunal communities observed in this study, between heavily- and lightly-fished areas (biomass MDS, Fig. 5.7, ANOSIM $p \leq 0.01$).

The large total biomass (54 g/m^2, Table 5.3) recorded in the HT area of Cape Columbine was an unexpected result. On closer examination of the data, this biomass was largely attributed to several individuals of the burrowing urchin, *Brissopsis lyrifera capensis*. This also contributed to echinoderms featuring as dominant taxa at this site (along with polychaetes, Table 5.4). Trawling has been reported to reduce the abundance of large burrowing species, such as *Brissopsis* sp. (Widdicombe et al. 2004). Several other species occurring in soft sediment macrofaunal communities also function as bioturbators in the ecosystem (e.g., brittle starfish *Amphiura* sp. and the polychaetes *Nepthys* sp.) and are considered to fulfil similar ecological roles (Widdicombe et al. 2004). Ophiuroids are able to regenerate body parts and have been found to be resistant to or even favoured by trawling (Hansson et al. 2000). A large-scale disturbance, such as trawling, is predicted to reduce the abundance of bioturbating species, leading to reduced overall diversity. However, this was not evident in this study, and it is suggested that *Brissopsis* sp. are able to escape fatal damage inflicted from the passing trawl gear because they are able to burrow as deep as 10 cm into the sediment (Buchanan 1967). The trawl gear used in the southern Benguela region is considered to be light in weight, and the nature of the fishery (targeting species just off the seabed) suggests minimal "ploughing" of the sediment (Wilkinson & Japp 2004). The occurrence of *B. lyrifera capensis,* and other similar bioturbating species, at both HT and LT sites in the areas sampled in this study, supports this interpretation.

5.4.2 Rare and opportunistic species

There is little knowledge or understanding of what makes particular marine species rare (Chapman 1999), and most species are probably rare according to one definition or another (Gaston 1994). Species characterized by small populations with low abundance at local and regional scales are generally considered rare (Schoener 1987). The Species Abundance Distribution (Fig. 5.6a) of macrofauna from this study showed that the level of rare species (represented only once in the sampling pool) was higher in lightly trawled areas, suggesting a loss of rare species under heavily trawled conditions. The higher abundance of opportunistic species in heavily trawled areas (Fig. 5.6) suggested that trawl-induced disturbance can enhance sediment conditions, making these areas more favourable for such r-selected species. Similar findings have been reported from other studies (e.g., Hall 1994; Collie et al. 1997; Kaiser 1998; Thrush et al. 1998). However, the percentage of biological traits contribution for all of the rare species to the total traits pool measured from SAD (Fig. 5.6b) showed that the amount of BTs in the rare species was high. This large amount of BTs' contribution may play an important role in ecosystem functioning.

5.4.3 Functional structure

In order to understand the effects trawling may have in contributing towards modification of communities, it is necessary to identify the relationship between the biological functions of species and their vulnerability to trawl disturbance (Tillin et al. 2006). Biological Traits Analysis (BTA) is considered to be a powerful method for evaluating the ecological functioning of benthic assemblages (Bremner et al. 2006a) and was chosen in this study to compare significant BTs in heavily-/lightly-trawled environments. There are significant differences in the traits of the benthic community displayed in heavily- and lightly-trawled areas of the southern Benguela, confirming the sensitivity of functional traits to trawling disturbance. Seventeen percent (seven of 42 categories) of BTs measured showed significant differences between HT and LT areas (Table 5.6, Fig. 5.9). However, significant differences in BTs also occurred with differences in the proportions of sand (12% of BTs) and mud (7% of BTs) (Tables 5.7 and 5.8). Habitat modification and changes in the proportions of mud and sand can occur when the sea bed is frequently trawled (Steele et al. 2002), which in turn can change the habitat suitability for the organisms. Significant differences in BTs between the trawling treatments suggested that surface crawlers and direct larval development occur in LT and muddier environments. Such environments would be expected to be more stable due to reduced physical disturbance, thus retaining finer sediment particles. As predicted, infauna, with smaller body sizes, are significantly more abundant in HT areas. Other studies on benthic trawling impacts have also observed a shift from large, slow growing fauna to smaller and faster growing animals (e.g., Kaiser et al. 2000; Rumohr & Kujawski 2000). Nevertheless, some BTs showed a positive response to trawling disturbance. Surface deposit feeders and suspension feeders were significantly more abundant in HT areas, possibly attracted by the increased disturbance levels, leading to increased suspended matter and damaged or dead organisms on which to feed (Frid et al. 2000). Unexpectedly, the long, thin body form, of species like polychaetes, predicted to proliferate in areas of high disturbance, were more abundant in lightly trawled areas in this study. It is possible that the long, thin body form is vulnerable to physical damage due to trawling. While the results in this study showed these changes in BTs, there are other studies with different results. Tillin et al. (2006) reported significantly more burrowers and scavengers in heavily impacted fishing areas and more filter feeders and attached fauna in less disturbed sites. de Juan et al. (2007) studied changes in biological traits of the soft benthic community in Mediterranean trawling grounds, including an area that had not been fished for 20 years. They reported higher abundance of motile burrowing traits for infauna in the trawled area, while the un-trawled area had higher abundance of surface crawlers, high mobility (which is supported by results in this study), filter-feeding and deposit feeding organisms. Bremner (2008) noted that the variability of BTA results can inhibit clear conclusions, highlighting the importance of further studies on BTs associated with anthropogenic impacts. In order to understand the changes observed in the impacted communities, it is necessary to focus on the response of those BTs which are significantly sensitive to trawling disturbances (de Juan et al. 2007).

Chapter 6 Impact of Intense Fishing Disturbance on Infaunal Communities and Recovery from Trawling in a Marine Protected Area (MPA), Hong Kong

6.1 Introduction

A literature review has been conducted and no registered work on the effects of trawling on seafloor habitat, benthic communities and biological traits (BTs) has been done in Hong Kong where trawling intensity is very high. The trawling gear commonly used in Hong Kong waters by traditional Chinese trawlers comprises several nets which are connected and at the same time are held by two long batons, made of wood, at each side of the boat (Chapter 2). A total of six nets can be used at the same time and are kept down close to the bottom with heavy weights. This method drags a large quantity of sediment with the nets while trawling, resulting in sediment accumulation in another place.

Hong Kong lies within the subtropical region in the northern part of the South China Sea and is influenced by the estuary of the Pearl River from the west and seasonal currents and monsoons from the east. Hong Kong is known to have a long fishing history with heavy trawling in most areas around the coast. Pitcher et al. (2000) identified places in Hong Kong where every square meter of the sea bottom has been trawled, three times a day (Thrush & Dayton 2002). In 2008, Hong Kong fishery industries produced an estimated 158,000 tonnes of fish with an estimated valued at HK$1.780 million, comprising 3,800 fishing vessels and 7,900 fishermen (Agriculture, Fisheries & Conservation Department 2009). The catch rates of Hong Kong's commercial fishery is now only one quarter of what it used to be in 1970s, and the biodiversity of marine species has dramatically decreased in the last 40 years (WWF, Hong Kong 2008). According to the data from the Agriculture, Fisheries and Conservation Department, about 82% of the total catch obtained in Hong Kong is through trawling (Agriculture, Fisheries & Conservation Department 2009). However, there is no restriction and control in place for highly destructive fishing practices, such as bottom trawling in Hong Kong territorial waters (pers. com. WWF Hong Kong), except in marine parks and reserves. Hong Kong coastal waters suffer from (in additional to heavy trawling) heavy pollution, eutrophication and red tide problems (Horikoshi & Thompson 1980; Wear et al. 1984; Wu 1988; Lee & Arega 1999; Mouchel 2004; AECOM Environment 2009). The intensity of red tides, fish kills and eutrophication has increased in all areas of Hong Kong since 1977 (Wu 1988). This could make the coastal waters more vulnerable to loss of species, traits diversity and species extinctions, especially when high trawling intensity is not controlled.

Hoi Ha Wan Marine Park is a bay at the north of Sai Kung Peninsula in Hong Kong. The location has a high biological value, as it shows a high degree of biodiversity (Agriculture, Fisheries & Conservation Department 2006) and type locality of a number of described marine species (Morton 1992). The park is a sheltered bay with pristine water quality, thus providing a good marine environment for housing a great variety of marine organisms and marine habitats (coral reef, hard rock, mangroves, sandy bottom and soft muddy bottom) covering an area of 260 hectares. This area is suited as a control site because it has been a trawl-free area since July 1996 (when the government designated it as a marine park) to heavily trawled sites, such as Tolo Channel (outside the park), allowing for an opportunity to investigate the recovery rate from trawling. High-intensity trawling sites are located just outside the Hoi Ha Wan Marine Park, where traditional Chinese trawling boats fish several times a day for fish and crabs. However, both areas are equally affected by seasonal changes and suffer, to some extent, from hypoxia in the summer when the heavy rain changes the environmental conditions (Wu & Richards 1979; Horikoshi & Thompson 1980; Wu 1982; Wu 1988; Fleddum et al. 2010). In contrast to temperate waters, no detailed studies have been undertaken, thus far, to investigate the potential changes in community function, through biological traits analysis (BTA), regarding recovery from heavy trawling of a soft benthic community and under seasonal effects. The purpose of this field work was to investigate:

1. How intensely trawling affects the structure of infaunal communities in subtropical waters, where seasonal changes in environmental factors significantly vary. It is hypothesized that intensive trawling activity results in decreased species diversity, decreased amount of rare species, an increased abundance of opportunistic species and an overall decrease in biomass. The losses of biodiversity and size reduction are believed significant for the trawling sites, as well as inside the protected areas in the summer, when heavy rain unfavourably changes the environmental conditions. The amount of loss is expected to be equal for both treatments in the rainy season and

2. Differences in biological traits (BTs) between trawled and non-trawled areas and between seasons. It is expected that significant differences between the treatments and between seasons on BTs' composition will be found. BTs, such as filter-feeding, attached and larger animals, have been found to be more abundant in lightly trawled areas, while areas with higher levels of trawling have been found to have higher levels of scavenger feeding types (Tillin et al. 2006; Kaiser & Hiddink 2007). It is hypothesised that there will be a reduction in normal adult size of the general taxa and

that there will be a higher level of organisms with scavenger feeding types in trawled areas. Inside the protected areas, it is expected that a higher amount of larger organism taxa will be found, which have attached form and filter-feeder organisms.

This study also addressed the possibility of recovery inside the marine park, which can be regarded as a Marine Protected Area (MPA) after 12 non-trawling years, by comparing heavily-trawled areas nearby and by comparing infaunal data taken in April 1989. Since benthic organisms generally have a life cycle time between 40 days to 10 years (Watling & Norse 1998), it is expected that the system has been stabilized from trawling and has undergone all successional stages after the 12-year period. The assumption is that the biodiversity, with higher biomass and the rare species ratio, increased during the protected time and larger, longer-lived species, will dominate. However, one can never be certain which species were inhabitants prior to the impacted time if the prior disturbance was heavy and if some species had already disappeared from the area. There are no pre-trawl data available for the area. Re-colonization after trawling can be rapid, but new colonisers are unlikely to be the same species as the original inhabitants, and it can take years for the impacted site to return to a community composition approximating that of pre-disturbed conditions (Rhoads et al. 1978; Watling & Norse 1998).

6.2 Materials and methods

6.2.1 Sampling design

The map and the information of the sampling sites in Hoi Ha Wan Marine Park and Tolo Channel, nearby, are shown in Figure 6.1 and Table 6.1. The border from trawl-free to heavily-trawled areas is marked with a line on the map, with capital letters (A, B, C, D) corresponding to sampling sites and capital letters (C, T) corresponding to trawled or control areas.

During the sampling time for both seasons, two paired Chinese traditional fish trawlers with six connected nets were observed in the morning and in the afternoon, covering the whole area of the outer Tolo Channel during the day. This fishing pattern is regular in this particular area (WWF Hong Kong) except for station AT (where large stones are located at the bottom), where the trawling frequency is lower. The trawling intensity is, on average, five trawls a week for the trawled stations BT, CT and DT and one time a week for station AT (WWF Hong Kong, pers. comm.). Some fishing is allowed inside the marine park when a special permit is issued, but only a single-line fishing method is used. Artificial reefs (ARs) and coral reefs are located in the marine park area. Hence, the location of sampling stations was chosen carefully to minimize reef disturbance.

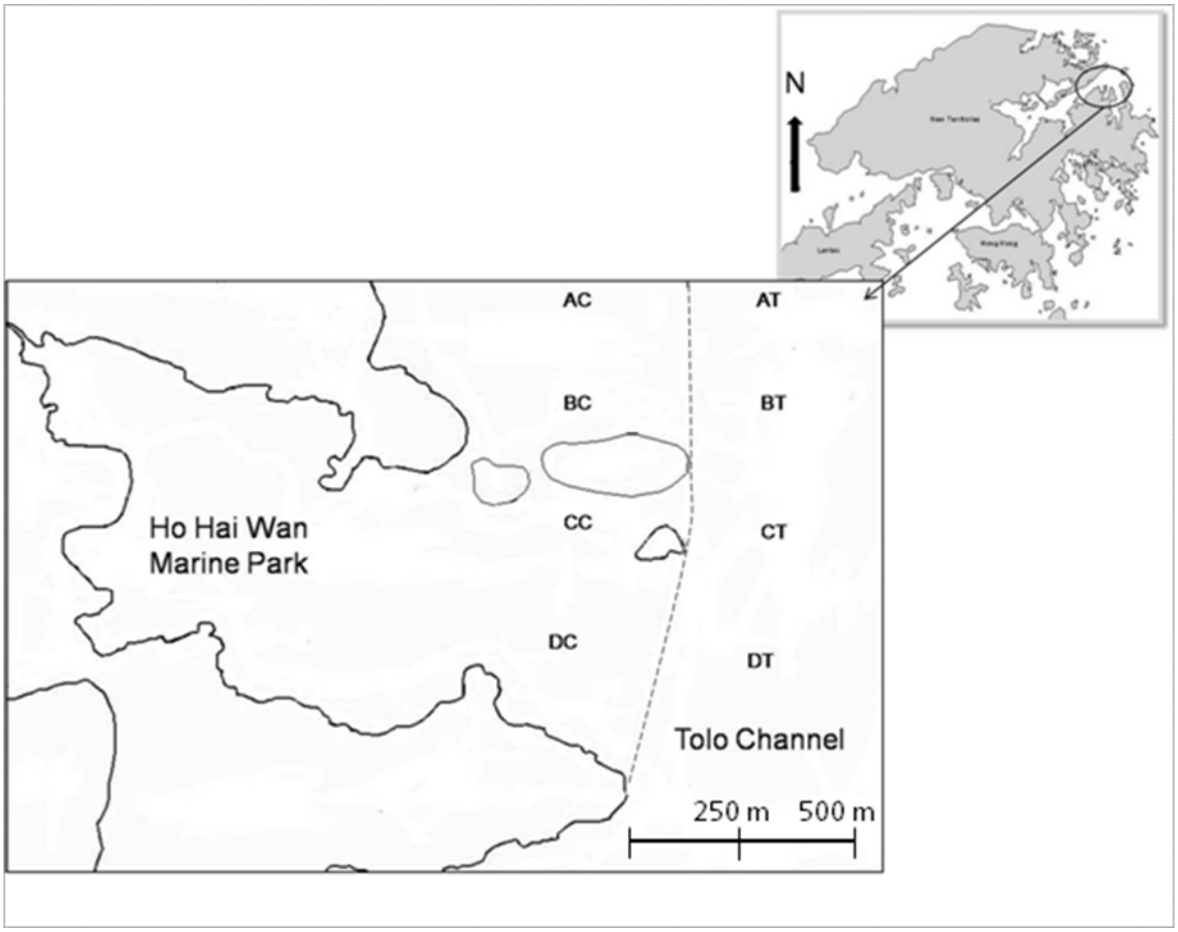

Figure 6.1 Map of all the sampling sites, A-D, and the control, C, inside the Hoi Ha Wan Marine Park and trawled T outside the protected area. The dotted line is the boundary line for the protected area (map modified from Paul Hodgson).

Table 6.1 Position of the heavily-trawled stations (T) and the control area (C) inside the Marine Protected Area.

Location	Station	Latitude	Longitude	Depth (m)
Marine Park	AC	22°28'41.28"N	114°19'31.13"E	16
Marine Park	BC	22°28'40.45"N	114°19'44.18"E	14
Marine Park	CC	22°28'40.54"N	114°20'2.67"E	16
Marine Park	DC	22°28'38.61"N	114°20'17.03"E	16
Tolo Channel	AT	22°29'5.72"N	114°19'30.15"E	22
Tolo Channel	BT	22°29'2.92"N	114°19'45.58"E	23
Tolo Channel	CT	22°28'59.59"N	114°20'6.46"E	20
Tolo Channel	DT	22°28'55.59"N	114°20'29.31"E	18

6.2.2 Field sampling

Five replicates of 0.1 m^2 van Veen grab were used to collect infaunal samples at the trawled (AT, BT, CT and DT) and non-trawled stations (AC, BC, CC and DC), respectively, at the beginning of October 2008 (end of the wet season) and at the beginning of March 2009 (end of the dry season). Three sample replicates were taken from the grab for measurement of Total Organic Carbon (TOC) and for particle size (pooled as one sample on board) and placed in an ice box and kept frozen, in the laboratory, until analysis. At each sampling station, three environmental parameters, including water depth, temperature and dissolved oxygen (DO), at the surface of the sediment, were measured by an optical dissolved oxygen sensor (model D-Opto, Zebra-Tech Ltd., USA). Replicates of sediments were washed over a sieve with a 5 mm mesh opening on board. All residues were preserved in 70% ethanol and stained with Rose Bengal. At each station before sampling, a diver went down to the bottom and took photographs of the sediment surface to make sure that the station had been trawled in the trawled area and not trawled in the control area. The visibility was extremely poor for all sampling locations. Hence, the photographs were only used to check the seabed conditions (trawled in trawled area and non-trawled inside the marine park) and not used for visual analysis in this study.

6.2.3 Laboratory analyses

The animals were identified to lowest possible taxa and counted. The biomass (wet weight) was measured using an electronic balance for each species, after blotting the animals on filter paper for one minute before weighing to the nearest 0.0001 g, since the majority of the animals were small and juvenile. Larger animals were blotted on filter paper for 2-3 minutes (Jennings et al. 2002). Tube-forming polychaetes were removed from tubes before weighing. For damaged specimens, the following procedures, according to Jennings et al. (2002), were applied: (1) 'complete' animals were assembled from fragments in the sample as far as possible and recorded as single individuals and (2) if fragments of an animal constituted less than 30% of the expected mass of a complete animal, they were discarded.

For particle size analysis, the wet-sieving method was performed according to Buchanan (1984). The sediment replicates were mixed before taking out approximately 300 g, wet weight, of sediment for drying over night at 130°C. Dry weight was determined and water was added to the sediment. After one night, 10 ml hydrogen peroxide (H_2O_2) was added to remove the organic matter and stirred with more water. After three nights, the samples were sieved first through 63 µm and then through a series of sieves with mesh size of 2,000 µm, 1,000 µm, 500 µm, 250 µm, 125 µm and 63 µm, respectively. The samples were finally dried in an oven at 130^{o}C for one night before calculating the dry weight retained on each sieve. A geometric grade scale modified by Wentworth (Buchanan 1984) was used to classify the grain size (Table 6.2).

Table 6.2 Wentworth (Φ) scale (Buchanan 1984) and grade classification ($\Phi = -\log_2$) of the particle diameter in millimeters.

Name	Size	Φ scale
Boulder	> 256 mm	> −8
Cobble	256−64 mm	−8 to –6
Pebble	64−4 mm	−6 to−3
Granule	4−2 mm	−4 to−1
Very coarse sand	2−1 mm	−1 to 0
Coarse sand	1,000−500 μm	0 to 1
Medium sand	500−250 μm	1 to 2
Fine sand	250−125 μm	3 to 2
Very fine sand	125−62 μm	4 to 3
Silt	62−4 μm	8 to 4
Clay	< 4 μm	> 8
Colloid	< 1 μm	> 10

For measurement of TOC, the sediment samples were freeze-dried for one week. Approximately 0.50 g of sediment was weighed and 5 ml 0.167 M $K_2Cr_2O_7$ and 10 ml of concentrated H_2SO_4 with Ag_2SO_4 were added to the sediment. After stirring and cooling for 30 minutes, 100 ml of water, 5 ml of ortho-phosphoric acid and 0.5 ml of indicator were added before titration with 0.5M $FeSO_4$. The percentage of TOC was calculated based on the titration volume, mass and standard volume of the dichromate used:

$$\%\ \text{TOC} = (10.2 / m) \times [1 - (y / x)] \times 0.39$$

m = mass of sediment

y = volume of iron (II) solution used for sediment sample

x = the volume of iron (II) solution used for standardization

The number 10.2 in the equation stands for the volume of dichromate used and 0.39 is a constant. Results of the three replicates were calculated as an average percentage of TOC.

6.2.4 Biological traits (BTs)

The same seven biological traits, with 36 categories with the same scoring rules and codes used in Chapter 3, were also used in this analysis: adult maximum body size (<5 mm, 5 mm-1 cm, >1-3 cm, >3-6 cm, >6-10 cm, >10 cm); larval type (planktotroph, lecitotroph, direct development); mobility (none, low, medium, high); body form (short cylindrical, dorsally flat, laterally flat, ball shape, long thin, irregular); attachment (none, temporary, permanent); life habitat (sessile, permanent tube, semi-permanent tube, burrower, surface crawler) and feeding (suspension/filter feeder, scraper/grazer, surface-deposit feeder, subsurface-deposit feeder, dissolved matter/symbiotic, large detritus/sandlicker, carnivore/omnivore, scavenger, parasitic/commensally) (see Chapter 3, Table 3.1). The biological traits analysis in this study was based on changes in functional composition on biomass because many important ecological processes are strongly affected by functional group biomass (Tillin et al. 2006).

6.2.5 Data analysis

The TOC, gravel, sand and mud mass contributions, depth (m), trawling intensity and temperature for each sample were normalized and converted into a Euclidean distance similarity matrix using PRIMER-E v.6 and its add-on package PERMANOVA+ (Clarke & Warwick 2001; Clarke & Gorley 2006; Anderson et al. 2008). Principal Component Analysis (PCA) with bi-plot of environmental data and sites were performed to investigate the variance within the stations and between the treatments for each season. Permutation-based PERMANOVA analysis (permutational MANOVA) was performed to test for significant differences in environmental structure between treatments (Control and Trawled) and between seasons (wet vs. dry) (Anderson et al. 2008).

The five grab replicates of the infauna were pooled as one sample before square-root transformation to reduce the effect of dominant species. The dominant taxa groups were calculated as percentages. The pooled abundance data were used to calculate the Shannon diversity (H') and Pielou evenness (J') of the infauna for each station to describe the benthic community structure (Schratzberger & Jennings 2002). Principal Coordinate Analysis (PCoA) (Anderson et al. 2008) of the pooled biomass was used to illustrate community structure between seasons and treatments. The highest species contribution to similarity through Similarity Percentage (SIMPER) analysis was used to illustrate the position of the PCoA. PERMANOVA was also used to test infaunal abundance and biomass data between treatments and seasons. “Treatments” (fixed factor) was crossed with “seasons” (fixed factor). Where differences or interactions were significant, pair-wise permutation tests were used to further explore these differences. PERMANOVA tests the dissimilarity values generated by the resemblance matrix on which permutations are based, generating a test statistic value of pseudo-F (or pseudo-*t* for pair-wise tests) (Anderson et al. 2008). The contribution of species to the average Bray-Curtis dissimilarity between treatments and seasons were examined with SIMPER analysis (Clarke 1994; Carr 1996) using the PRIMER-E v.6 and its add-on package PERMANOVA+ (Clarke & Warwick 2001; Clarke & Gorley 2006; Anderson et al. 2008).

Microsoft Office Excel 2007 was used to reveal Species Abundance Distribution (SAD) and the percentage of biological contribution in heavily-trawled and controlled areas (see Chapter 4).

The categories in each biological trait were examined using Mann-Whitney U test to determine any significant differences between treatments and between seasons (STATISTICA v8).

6.3 Results

6.3.1 Environmental analysis

The entire study area was considered to be fairly uniform with respect to bottom temperature, depth and dissolved oxygen during the sampling period within each season. Table 6.3 summarizes the environmental factors and Figure 6.2 illustrates the results in the PCA plot from both seasons and treatments of trawling and control. The first two axes from the PCA plot in the wet season (Fig. 6.2a, Table 6.4) contributed to 85% (eigenvalue = 2.64 and 2.46) of the variance and 87.3% (eigenvalue = 3.1 and 2.14) in the dry season (Fig. 6.2b, Table 6.4). The positions of the stations are quite similar for both the seasons, with the trawled stations being positioned to the right and controls at upper left. Station AT, which differed in trawling intensity and environmental factors, showed a different pattern than the other trawling stations. The DO at the bottom was generally higher in the dry season for both treatments (control and trawled) and generally higher for the control stations inside the MPA. The percentage of total organic carbon (TOC) was higher for both treatments in the wet season. Similarity in median diameter [MD (Φ)] was found among the stations and between seasons, with exception of station AT. The temperature ranged from 26.66 to 27.18℃ in the wet summer and 19.01 to 19.86℃ in the dry winter.

A PERMANOVA test showed significant differences in environmental factors between treatments (pseudo-F = 7.9002, df = 1, p = 0.001) and seasons (pseudo-F = 12.61, df = 1, p = 0.001) but not significant for the interaction between treatments and seasons (pseudo-F = 0.110, df = 1, p = 0.927).

Table 6.3 Summary of the environmental characteristics and trawling intensity per week of all the sampling stations in both control/trawled treatments and seasons. DO = Dissolved Oxygen, Temp = Temperature, TOC = Total Organic Carbon, TI = Trawling Intensity, MD = Median Diameter of particle size.

Wet season								
Environmental factor	AT	BT	CT	DT	AC	BC	CC	DC
Depth (m)	22	23	20	18	16	14	16	16
DO (ppm)	6.50	5.92	5.67	5.31	6.29	6.50	6.62	6.56
Temp (℃)	27.18	27.14	27.05	26.66	27.22	27.17	26.99	26.76
TI (week)	1	5	5	5	0	0	0	0
TOC (%)	2.03	2.33	2.54	2.42	2.33	2.36	2.49	2.41
MD (Φ)	5.56	5.72	6.19	6.12	6.09	6.15	6.20	6.19
Dry season								
Environmental factor	AT	BT	CT	DT	AC	BC	CC	DC
Depth (m)	22	23	20	18	16	14	16	16
DO (ppm)	8.39	8.38	8.91	8.84	8.91	8.95	8.85	9.05
Temp (℃)	19.38	19.53	19.04	19.01	19.86	19.84	19.65	19.82
TI (week)	1	5	5	5	0	0	0	0
TOC (%)	1.06	1.94	1.82	1.77	1.68	1.65	1.80	1.80
MD (Φ)	4.65	6.03	6.18	6.14	6.05	6.13	6.21	6.19

Table 6.4 Eigenvalues, percentage variation (contribution to the variance) and cumulative variance for the environmental factors for both seasons. PC 1-5 represents the axis in the PCA plot.

Wet Season			
PC	Eigenvalues	% Variation	% Cumulative
1	2.60	44.1	44.1
2	2.46	40.9	85.0
3	0.62	10.5	95.5
4	0.24	4.0	99.5
5	0.02	0.4	99.9
Dry Season			
PC	Eigenvalues	% Variation	% Cumulative
1	3.10	51.7	51.7
2	2.14	35.6	87.3
3	0.65	10.9	98.2
4	0.07	1.2	99.4
5	0.03	0.6	100.0

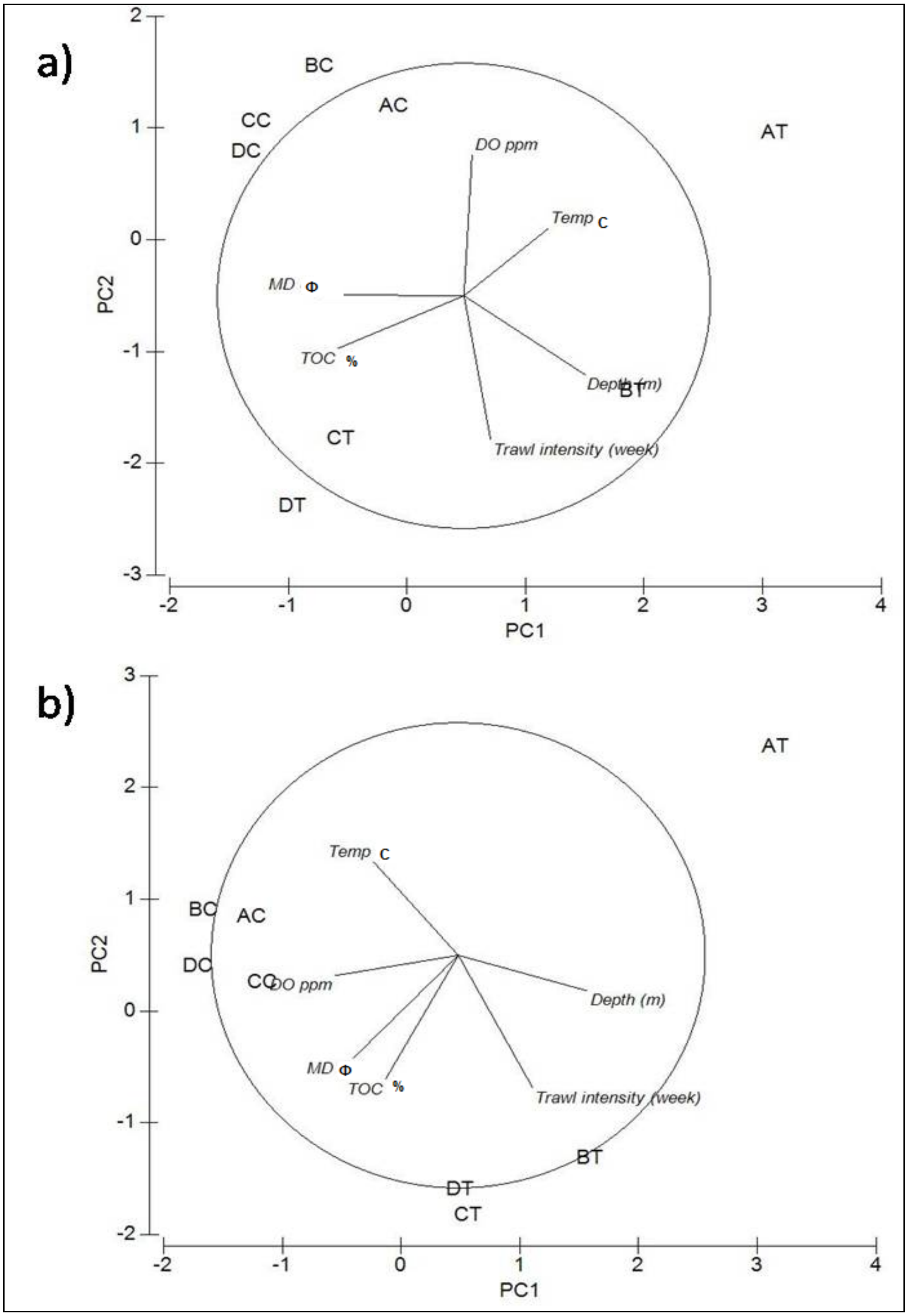

Figure 6.2 Principle Component Analysis (PCA) of normalised environmental factors using Euclidean distance. AT-DT = Trawling stations; AC-DC = control stations. The lines show the direction of the environmental factors relative to the stations. Percentage of TOC was arcsine transformed before data being normalised. The upper figure a) is the result from the wet season and b) from the dry season.

6.3.2 Benthic infauna

A total of 77 species were identified for both seasons and treatments (41 in the wet season and 57 in the dry season, sharing 20 of the same taxa). Polychaetes were the most dominant taxa for all the sampling stations (control area: wet season 94%; dry season 85%; trawled area: wet season 78%; dry season 86% of total species) (Table 6.5). The highest percentage composition of crustaceans was found in the trawled area in the wet season (14%), whereas highest percentage composition of molluscs was recorded in the trawled area in the dry season (7%).

The sampling stations inside the control (protected) area had a low level of species composition and abundance in the wet season (Table 6.6). Several of the grab samples were empty and at station CC, only four individuals of *Sigambra hanaokai* were found. Station BC had the highest: species number (11/0.5 m^2), total biomass (4.79 g/0.5 m^2), number of individuals (17/0.5 m^2), Pielou's eveness (0.95) and $\log_e$ Shannon diversity (2.28) inside the protected area in the wet season. When comparing the trawled area in the wet season, higher species richness, abundance, biomass and diversity index were recorded in the trawled area. Station BT had the highest: species composition (23/0.5 m^2), total biomass (3.87 g/0.5 m^2) and $\log_e$ Shannon diversity (2.84). Amongst these stations, AT had the highest number of individuals (63/0.5 m^2) and CT the highest Pielou's eveness (0.93).

During the next six months, the structure of the macrobenthic communities changed (Table 6.6). The majorities of the identified taxa were dominated by new recruiting juveniles in both sampling areas. At the end of the dry season, all the diversity indices increased for all stations with the exception of BT, which had a smaller species composition but more individuals. All samples, in both control and trawled areas, showed more similarities in the dry season for all the measurements, except for station AT, which had lower trawling intensities and showed the highest species number (31/0.5 m^2) and total biomass (21.53 g/0.5 m^2) with 353/0.5 m^2 in total.

Table 6.5 Dominant taxa measured in percentages for both seasons. Polychaeta (P), Mollusca (M), Crustacea (C), Nemertinea (N), Sipuncula (S), Echinodermata (E) and Echiura (Ec).

Wet season							
Area	P	M	C	N	S	E	Ec
Control	94	0	0	0	3	3	0
Trawled	78	0	14	0	1	1	6
Dry season							
Area	P	M	C	N	S	E	Ec
Control	85	5	1	4	3	1	1
Trawled	86	7	1	1	2	2	1

Table 6.6 Univariate analysis of pooled abundance data (0.5 m^2) is shown for the wet and dry season. The letters that represent in the table are: Species (S/0.5 m^2); total biomass (B) (g/0.5 m^2); number of individuals (N/0.5 m^2); Pielou's eveness (J') and $\log_e$ Shannon diversity (H').

			Wet season		
Sample	S	B	N	J'	H'($\log_e$)
AC	5	0.08	7	0.96	1.55
BC	11	4.79	17	0.95	2.28
CC	1	0.00	4	0	0
DC	4	0.29	6	0.89	1.24
AT	17	0.67	63	0.72	2.05
BT	23	3.87	42	0.90	2.84
CT	8	0.20	15	0.93	1.93
DT	10	0.52	19	0.86	1.98
			Dry season		
Sample	S	B	N	J'	H'($\log_e$)
AC	24	1.73	56	0.91	2.91
BC	21	0.51	87	0.83	2.55
CC	16	1.84	66	0.76	2.11
DC	24	11.74	67	0.89	2.84
AT	31	21.53	353	0.52	1.81
BT	16	4.89	79	0.67	1.87
CT	19	5.32	72	0.72	2.14
DT	17	7.93	97	0.72	2.06

The results from Principal Coordinate Analysis (PCoA) showed that the first axis contributed 25.4% of the total variation and the second axis 13.3% (Fig. 6.3). There is a distance between seasons in the plot in which dry season samples were located at the left side, closer to PCo2, while the wet season samples were located at the right side of the plot. Station CC had only one species, lying closest to PCo1 and also the largest contribution to the variance.

PERMANOVA analysis of the abundance data showed significant differences between treatments (pseudo-F = 2.8987, p = 0.002), seasons (pseudo-F = 6.3538, p = 0.001) and the interaction between treatments and seasons (pseudo-F = 2.4376, d.f. = 1, p = 0.004). Similarly, PERMANOVA results of the biomass data also showed significant differences between treatment (pseudo-F = 2.0238, p = 0.007), seasons (pseudo-F = 4.598, p = 0.001) and interaction between treatments and seasons (pseudo-F = 1.9503, d.f. = 1, p = 0.016). Pair-wise *a posteriori* PERMANOVA analyses between control and trawled areas for abundance and biomass data showed highly significant differences for the biomass and abundance in the wet season but insignificant differences in the dry season (Table 6.7).

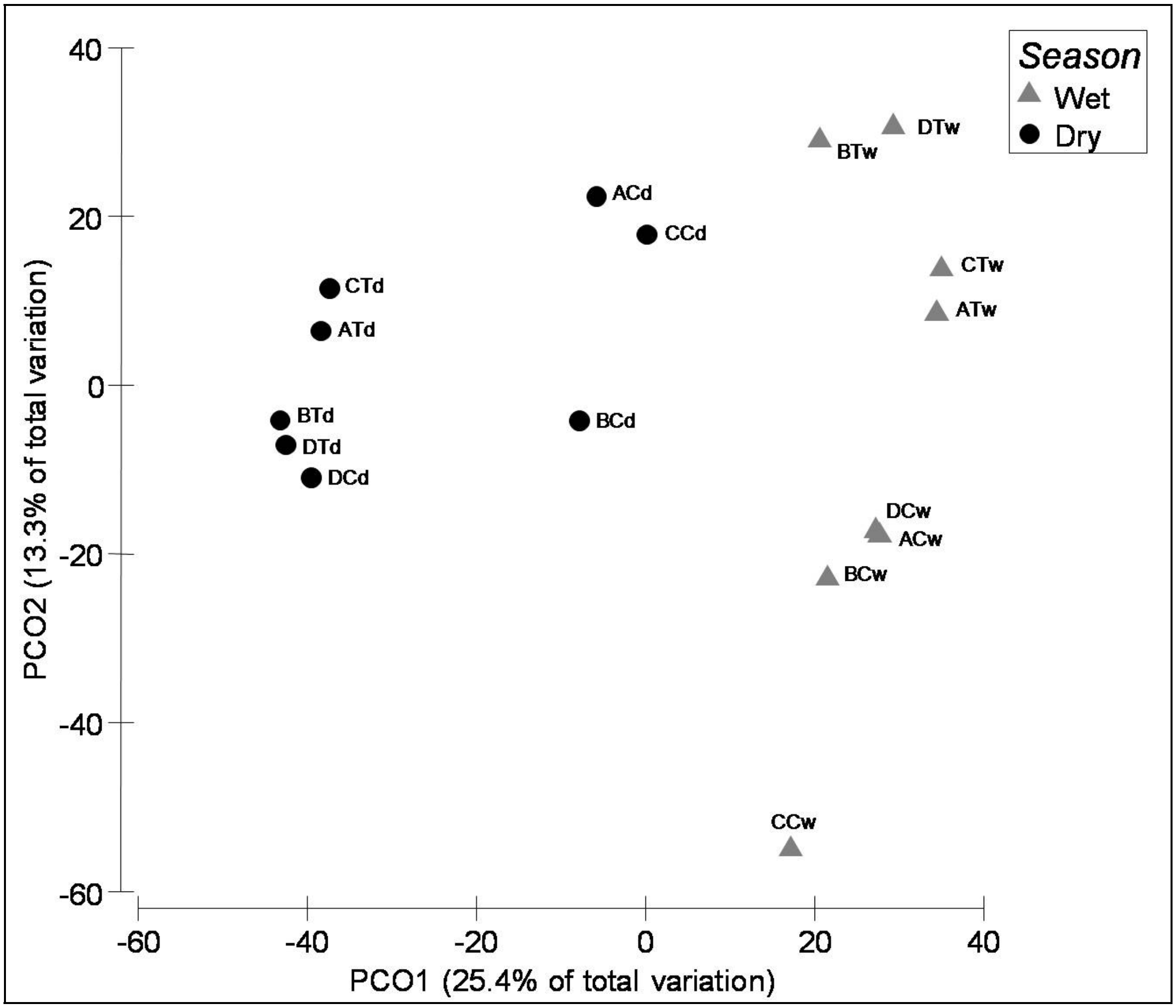

Figure 6.3 Principal Coordinate Analysis (PCoA) of the transformed pooled biomass (g/0.5 m^2) for both treatments (T = trawled, C = control) and seasons (d = dry, w = wet).

Table 6.7 Test statistics for pair-wise PERMANOVA analysis of infaunal abundance and biomass between control and trawled areas for both seasons. Significant values at $p < 0.05$, based on permutations, are shown in bold.

Treatment × Season	t	p (Monte Carlo)
Wet season (abundance)	**1.6944**	**0.028**
Wet season (biomass)	**1.3489**	**0.028**
Dry season (abundance)	1.5149	0.069
Dry season (biomass)	1.5094	0.099

SIMPER analysis revealed that, in general, some of the same species occurred for both treatments and in both seasons with slight differences in cumulative percentages in abundance (Table 6.8). The top five species contributions (%) in the control (protected) area in the wet season were: *Sigambra hanaokai* (55.85%), *Chaetozone setosa* (11.91%), *Cerebratulidae* indet. (8.42%), *Aglaophamus dibranchis* (7.94%) and *Heteromastus filiformis* (7.94%). In the trawled area, the top five species were: *Aglaophamus dibranchis* (22.00%), *Jassa marmorata* (16.45%), *Euryothoe* indet (15.74%), *Chaetozone setosa* (15.41%) and *Cerebratulidae* indet. (6.13%). In the control area, the top five contributing species (%), that were mostly abundant in the dry season were: *Chaetozone setosa* (19.19%), *Sigambra hanaokai* (17.42%), *Prionospio ehlersi* (11.23%), *Prionospio malmgreni* (6.88%) and *Schistomeringos rudolphi* (4.64%). In the trawled area, the top five contributing species (%) were: *Chaetozone setosa* (28.28%), *Aglaophamus dibranchis* (12.67%), *Sigambra hanaokai* (9.61%), *Telinna* indet. sp. A (8.72%) and *Apionsoma trichocephalus* (6.98%).

Table 6.8 The top five species contribution from SIMPER (Similarity Percentages) for the wet and dry season.

Species	Average abundance	Average similarities	Contribution (%)	Cumulative (%)
Control area: wet season				
Sigambra hanaokai	1.29	12.26	55.85	55.85
Chaetozone setosa	0.79	2.62	11.91	67.76
Cerebratulidae indet.	0.60	1.85	8.42	76.18
Aglaophamus dibranchis	0.50	1.74	7.94	84.12
Heteromastus filiformis	0.50	1.74	7.94	92.06
Trawled area: wet season				
Species	Average abundance	Average similarities	Contribution (%)	Cumulative (%)
Aglaophamus dibranchis	1.87	9.54	22.00	22.00
Jassa marmorata	1.70	7.14	16.45	38.46
Euryothoe indet.	2.41	6.83	15.74	54.20
Chaetozone setosa	1.46	6.68	15.41	69.61
Cerebratulidae indet.	1.62	2.66	6.13	75.74
Control area: dry season				
Species	Average abundance	Average similarities	Contribution (%)	Cumulative (%)
Chaetozone setosa	3.55	8.50	19.19	19.19
Sigambra hanaokai	3.00	7.71	17.42	36.60
Prionospio ehlersi	2.32	4.97	11.23	47.83
Prionospio malmgreni	1.80	3.05	6.88	54.71
Schistomeringos rudolphi	1.25	2.05	4.64	59.35
Trawled area: dry season				
Species	Average abundance	Average similarities	Contribution (%)	Cumulative (%)
Chaetozone setosa	8.28	15.62	28.28	28.28
Aglaophamus dibranchis	3.55	7.00	12.67	40.95
Sigambra hanaokai	2.31	5.31	9.61	50.56
Telinna indet.	2.05	4.81	8.72	59.28
Apionsoma trichocephalus	1.82	3.85	6.98	66.26

The dry season was found to have more rare species (e.g., represented only once) in the pooled samples for the whole trawled area and opposite for the whole control (13/2 m^2 vs. 7/2 m^2 for the control and 13/2 m^2 vs. 19/2 m^2 for the trawled area, Fig. 6.4). The strongest opportunistic species (abundance between 256-511/2 m^2) were represented by one species in the trawled area in the dry season (the polychaete *Chaetozone setosa*). The differences in the abundance classes were more similar in the dry season compared to the wet season, reflecting the few species and individuals which occurred inside the control (protected) area in the wet season.

The total rare species contributions (Fig. 6.5) to the biological traits pool were lower for the control area (C) compared to the trawled area (T) in the wet season: normal adult size (T = 44%-58%, C = 0%-17%); larval type (T = 29%-58%, C = 11%-17%); adult mobility (T = 0%-46%, C = 0%-28%); body form (T = 0%-52%, C = 0%-40%); degree of attachments (T = 25%-75%, C = 0%-25%); adult life habitat (T = 43%-63%, C = 0%-43%) and feeding type (T = 43%-83%, C = 0%-29%). In the dry season, the total rare species contribution, within MPA, increased in several categories, which were higher than in the trawled area: normal adult size (T = 0%-50%, C = 17%-100%); larval type (T = 0%-35%, C = 17%-22%); adult mobility (T = 20%-33%, C = 23%-67%); body form (T = 0%-28%, C = 0%-60%); degree of attachments (T = 22%-25%, C = 22%-75%); adult life habitat (T = 15%-38%, C = 21%-60%) and feeding type (T = 7%-60%, C = 21%-57%).

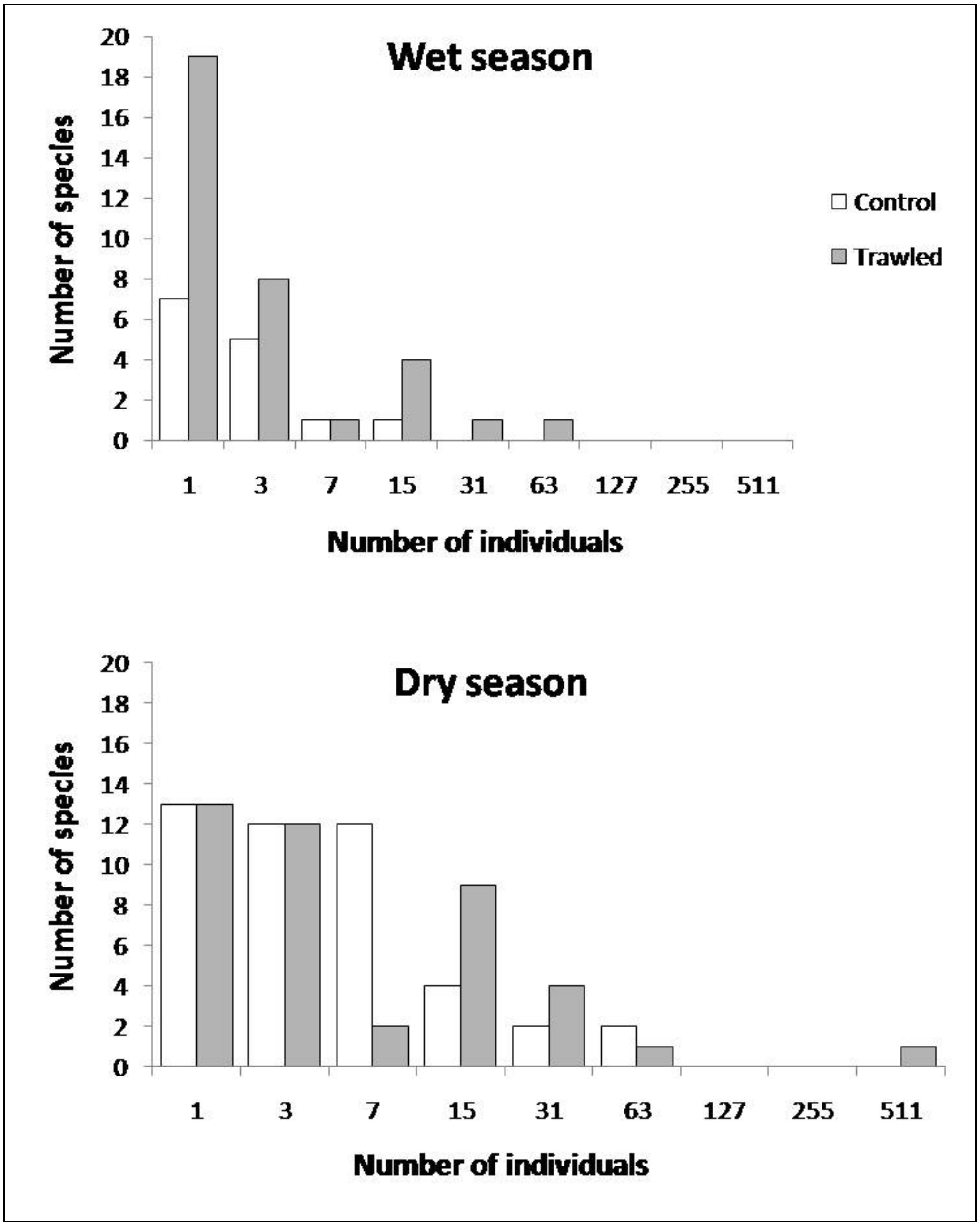

Figure 6.4 Species Abundance Distribution (SAD) for each season and each treatment (trawled and control/MPA). The X-axis is a logarithmic scale (modified $\log_2$ classes). Class 1 represents 1 individual, 3 represents between 2-3 individuals, 7 represents 4-7 individuals, etc.

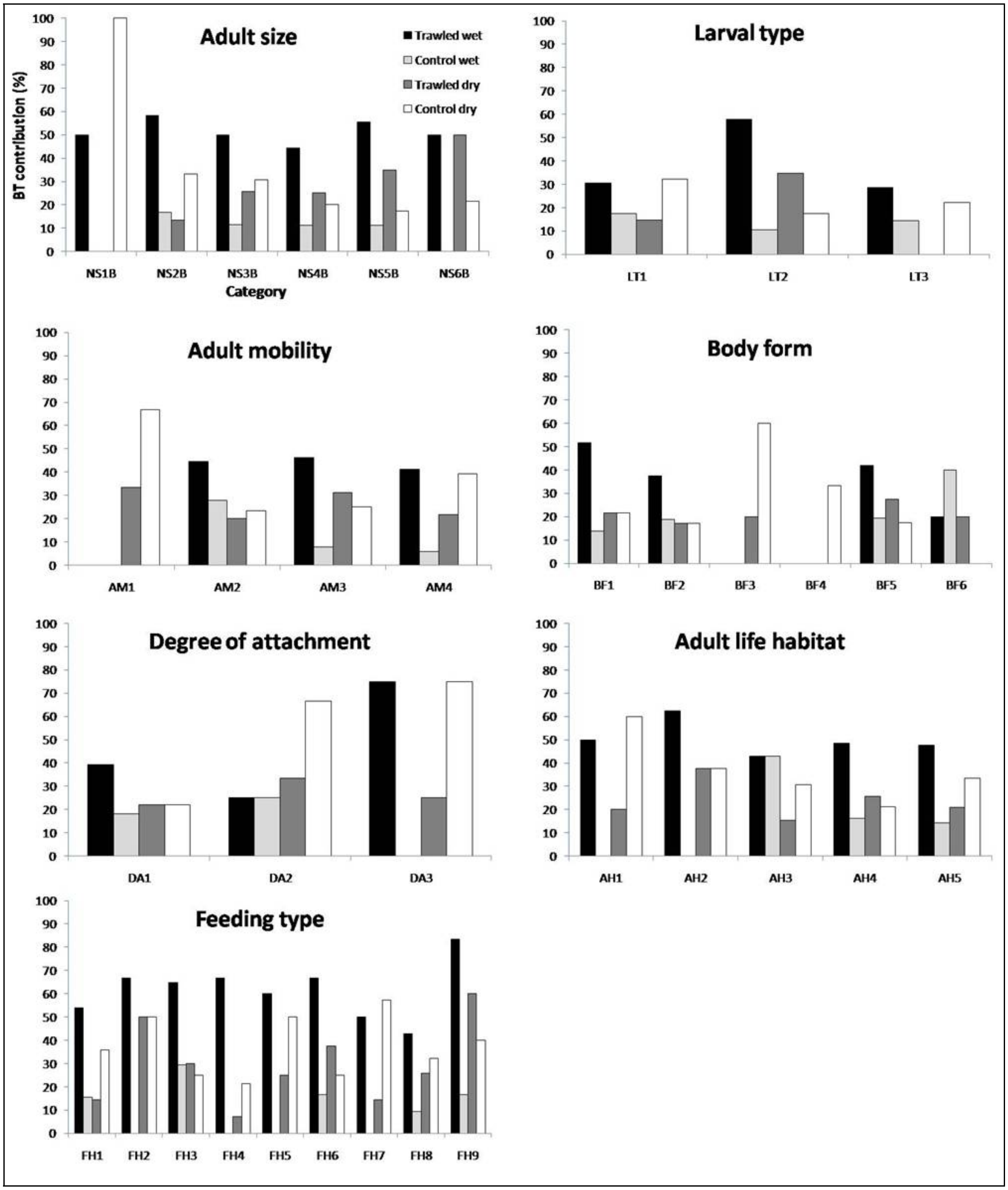

Figure 6.5 Biological traits contribution for rare species from the wet and dry season (trawled area and the control/MPA) measured as percent of the whole traits pole. The BT is ranked as presence/absence. See Chapter 3 for category names.

The most abundant and most important species contributors are illustrated in Figure 6.6. The PCoA plot has the same positions as in Figure 6.3, except for the bubble size of contribution of the most abundant species (results from the SIMPER analysis, Table 6.8). The taxa: *Chaetozone setose, Aglaophamus dibranchis, Sigambra hanaokai, Heteromastus filiformis, Schistomeringos rudolphi* (only in the dry season), *Telinna* indet. A (only in the dry season), *Apionsoma trichocephalus* (only in the dry season), *Prionospio ehlersi* and *Prionospio malmgreni* dominated for both treatments in the dry season, while *Cerebratulidae* indet., *Jassa marmorata* (only in the wet season and trawled area) and *Euryothoe* indet. (only in the wet season and trawled area) dominated in the wet season.

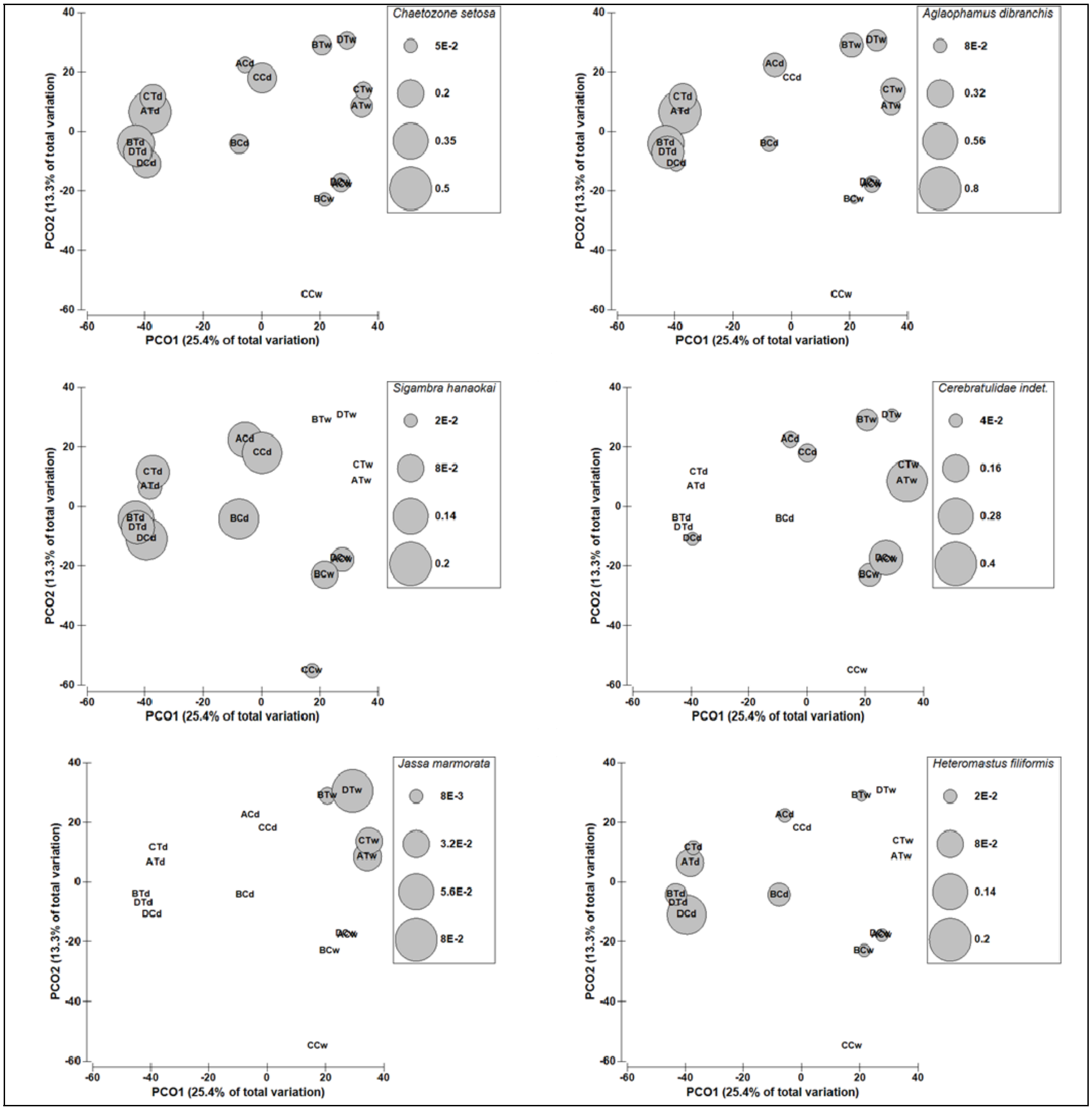

Figure 6.6 Bubble plot of the PCoA (the same station positions as in Fig. 6.3) of species contributors (g/0.5 m^2) from the SIMPER analysis.

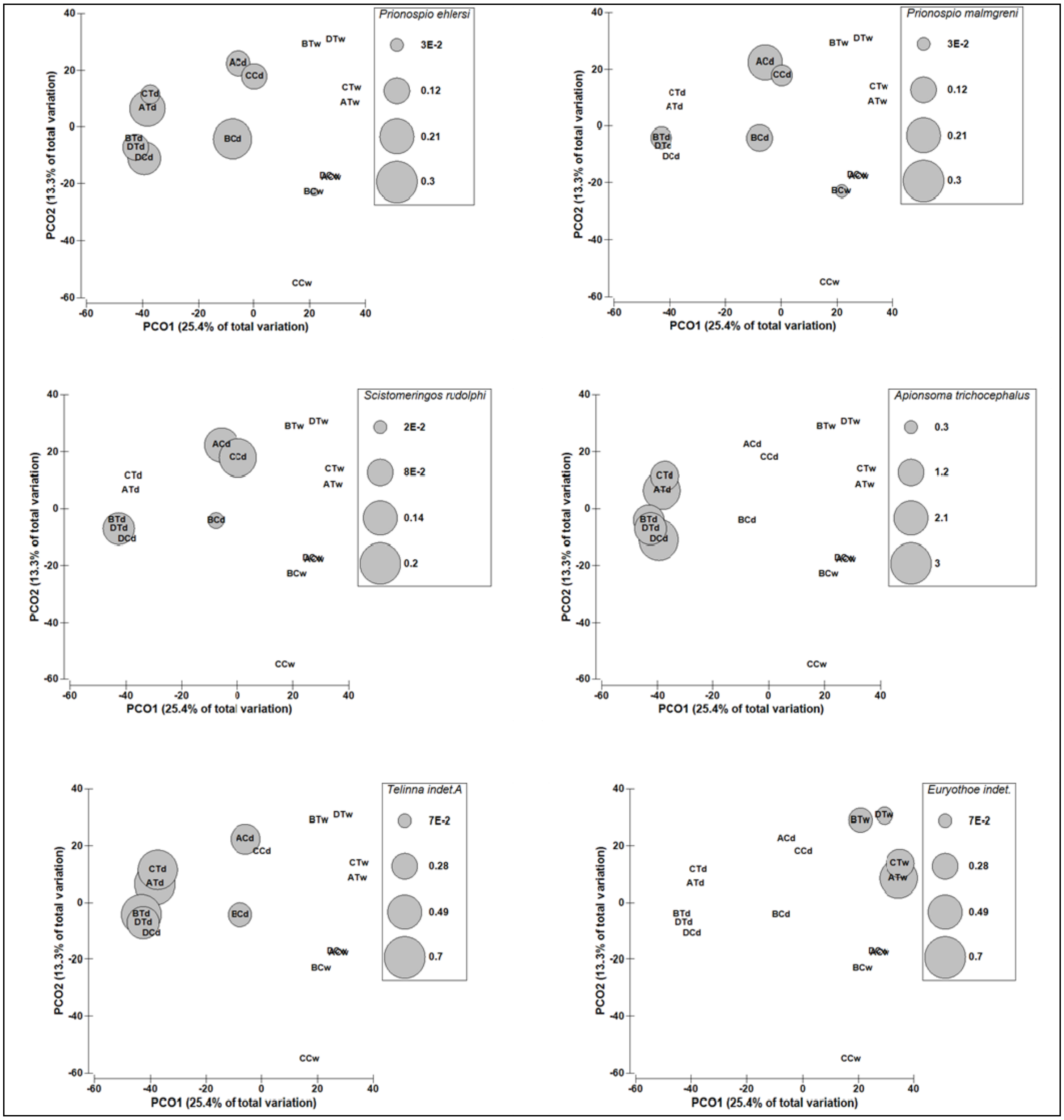

Figure 6.6, Continued

6.3.3 Biological traits (BTs)

The results from PCoA showed that the first axis contributed to 44.5% of the total variation and the second axis 27% (Fig. 6.7). The distance between seasons in the plot decreased after traits were weighted in with the biomass. With only one species, and low traits contribution, station CC was positioned closest to PCo1 and had the largest contribution to data variance. There was no clear grouping between the treatments (trawled and control areas) in the seasons.

PERMANOVA analysis of the traits data showed no significant differences between treatments (pseudo-F = 1.4194, p = 0.179) and between treatments and seasons (pseudo-F = 1.939, d.f. = 1, p = 0.066), but significant difference for seasons (pseudo-F = 5.7934, p = 0.003). This means that the season is more important than trawling on the biological traits structure. Further exploration of the results from SIMPER and significant traits with Mann Whitney U test between seasons is shown in Table 6.9. Nineteen of the 36 BT categories analyzed had up to 90% contribution to dissimilarities between seasons. Fifteen of these were significant, with the highest rank in the dry season: DA1 = none attachment, AH4 = burrower, AM2 = low mobility, FH4 = subsurface deposit feeder, LT2 = lecitotrophic larval type, LT1 = planktotrophic larval type, BF1 = cylindrical body form, BF2 = dorsally flat body form, FH8 = carnivore/omnivore feeding type; NS4 = 3-6 cm in adult size; NS5 = 6-10 cm in adult size; NS3 = 1-3 cm in adult size, FH3 = surface deposit feeder; AM4 = high mobility and AM3 = medium mobility.

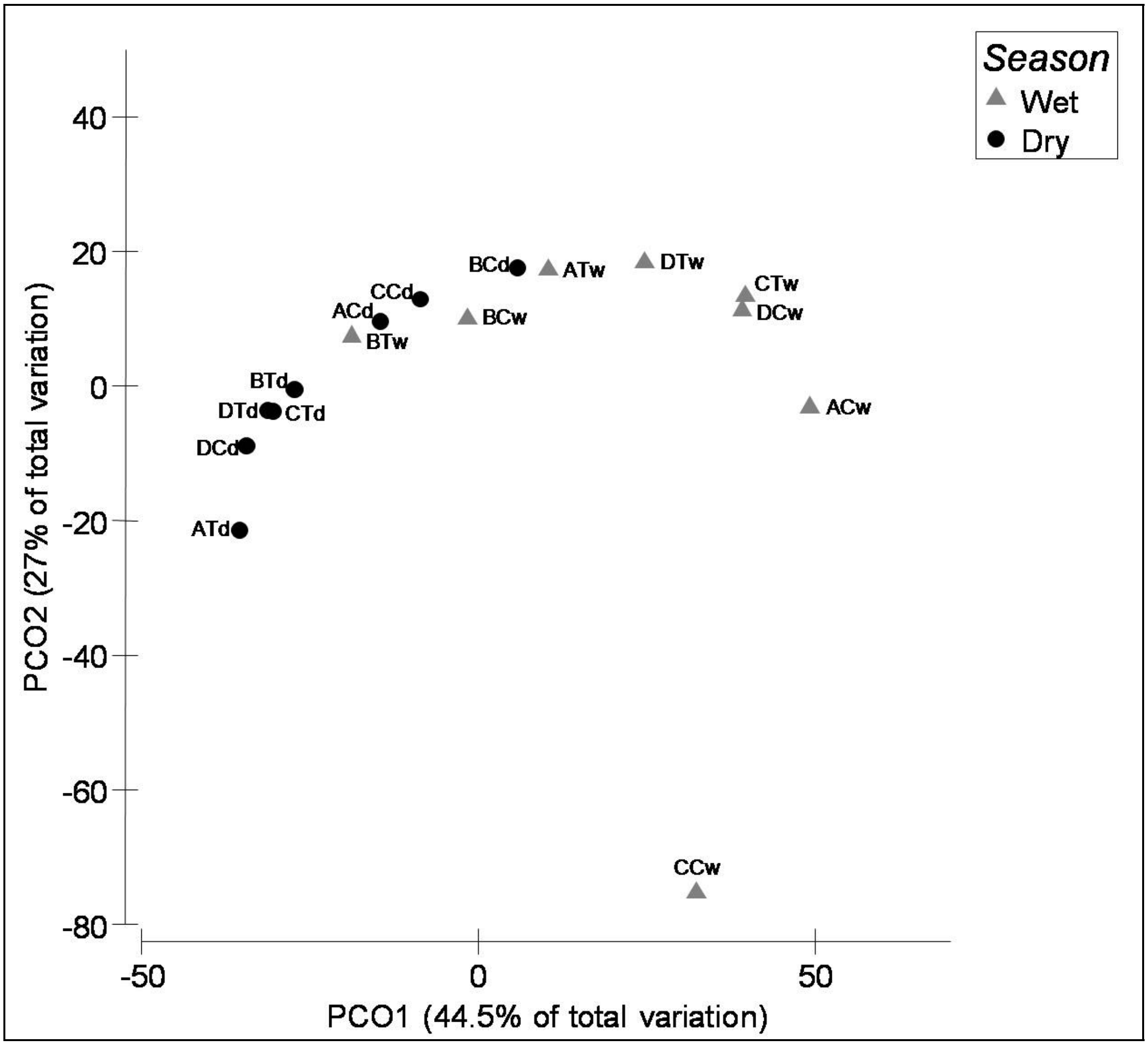

Figure 6.7 PCoA of weighted traits with square-root transformed biomass for treatments (AC-DC = Control areas; AT-DT = trawled areas) and seasons (w = wet; d = dry).

Table 6.9 The BT categories contribution from one-way analysis of SIMPER (Average dissimilarity = 64.58%) and Mann Whitney U test is calculated between seasons. Cut off for low contribution is 90%. Significant level ($p < 0.05$) is shown in bold.

Category	Average abundance wet	Average abundance dry	Contribution (%)	Cumulutative (%)	Rank wet	Rank dry	U	p level
DA1	4.43	18.86	11.16	11.16	40	96	4	**0.003**
AH4	2.85	16.17	9.87	21.03	38	98	2	**0.001**
AM2	2.51	54	6.96	27.98	40	96	4	**0.003**
FH4	0.83	9.84	6.74	34.72	38	98	2	**0.001**
LT2	2.33	10.00	6.17	40.90	42	94	6	**0.006**
LT1	2.10	9.23	5.91	46.81	40	96	4	**0.003**
BF1	2.55	9.78	5.72	52.53	40	96	4	**0.003**
BF2	0.87	7.21	4.75	57.28	36	100	0	**<0.001**
FH8	1.63	6.89	4.30	61.58	41	95	5	**0.004**
NS4	1.97	7.23	4.26	65.84	41	95	5	**0.004**
NS5	0.99	6.57	4.10	69.94	45	91	9	**0.015**
NS3	1.29	5.70	3.64	73.58	36	100	0	**<0.001**
FH3	1.18	5.04	3.20	76.78	41	95	5	**0.004**
BF5	3.19	5.19	2.89	79.68	53	83	17	0.115
AH5	2.32	4.49	2.73	82.40	52	84	16	0.092
AM4	1.69	4.02	2.39	84.79	46	90	10	**0.020**
FH1	1.89	3.21	2.33	87.12	59	77	23	0.343
AM3	0.92	3.09	1.81	88.94	48	88	12	**0.035**
NS6	1.45	2.34	1.72	90.66	57	79	21	0.247

6.4 Discussion

A circumstance that generally limits field studies on trawling impacts is a lack of adequate controls (Dayton et al. 1995; Thrush et al 1998; McConnanghey et al. 2000). In this study, there was an opportunity to investigate recovery from trawling after 12 years, which is rare and this research is novel for soft benthic subtropical systems, for both structural and biological traits analysis. Univariate and multivariate analyses were used to explore the differences in community structure between seasons and through the recovery from cessation of trawling in the north-eastern side of Hoi Ha Wan Marine Park, Hong Kong. Biological traits analysis was used to investigate the significance of the function in trawling sites, recovery from trawling and seasonal changes.

6.4.1 Environmental factors

The entire study area was considered uniform with respect to bottom temperature, depths and dissolved oxygen (DO), during the sampling period, within each season. Notwithstanding, the DO at the bottom was slightly higher in the dry season; the *in-situ* DO measurements in the wet season at the sampling time showed no signs of hypoxia. However, the area is well-known for hypoxic periods during the rainy season. Earlier DO measurements, taken during the summer, in part of the same sampling area, confirmed low oxygen at certain times of the year (Wu & Richards 1979; Horikoshi & Thompson 1980; Wu 1982; Wu 1988; Fleddum et al. 2010). To better detect the effects of changes in macrobenthic community structure for each season, the end of the rainy and the end of the dry season were chosen for this study. This could be the reason for relatively higher DO recorded at the bottom during the end of the rainy season, despite possibly lower DO occurrences during the summer period, prior to field sampling. There were significant differences in environmental factors between treatments and seasons but not for the interaction between treatments and seasons. This means that the seasons are important in environmental changes for the whole sampling area but are not the cause of the differences between trawling and control treatments. Station AT, which differed in trawling intensity and environmental factors, showed a different pattern than the other trawled stations in all aspects. The largest differences between the control and trawled areas are the trawling intensities. Trawling is known to change the environmental factors, such as grain size moving towards finer fractions (Churchill 1989; Pilskaln et al. 1998; Reiss et al. 2009) and TOC towards higher percentage levels (Tuck et al. 1998; Reiss et al. 2009). This study supported this finding, in which differences in MD (Φ) decreased (Table 6.3) in trawled disturbed sediments. However, the trend of increasing TOC in trawled sediments was not clear (Table 6.3).

6.4.2 Biodiversity

The largest differences between the treatments were during the summer, wet season. There were significantly higher abundances, biomasses, biodiversities and amounts of rare species in the trawled area. The control stations inside the marine park had a lower level of species composition and abundance, and several of the grab samples were void of macrofauna. There were few large animals and few other taxa, except for polychaetes, which were dominant at all of the sampling stations. The organisms observed were, in general, small, recruiting individuals with a higher abundance in the dry season for both treatments. An indication of trawling effects is the dominant populations of small regenerating taxa, such as polychaetes, crustaceans and ophiurids (Kaiser 1998; Thrush et al. 1998). Polychaetes are often numerically dominant in the early stages of recolonization, when small spionid worms can become predominant, followed later in the succession stage by tubiculous worms, such as ampharetids, which further competitively exclude other opportunistic species (Dernie et al. 2003). Some of the same species occurred in both treatments and in both seasons with slight differences in abundance. The two most abundant species for the control area were polychaetes *Sigambra hanaokai* (wet: 9/2 m^2, dry: 37/2 m^2) and *Chaetozone setosa* (wet: 5/2 m^2; dry: 54/2 m^2). Species which seemed to be most resistant to trawling were polychaetes *Aglaophamus dibranchis* (wet: 14/2 m^2; dry: 57/2 m^2) and *Chaetozone setosa* (wet: 9/2 m^2; dry: 327/2 m^2). All three species were higher in abundance compared to other species found, and *Chaetozone setosa* is known to be opportunistic in nature (Tuck et al. 1998; Olsgard et al. 2008). *Sigambra hanaokai* and *Aglaophamus dibranchis* are known to occur in higher abundance for all seasons in Hong Kong waters (Shin 1989), suggesting that these species can adapt to survive in periods of hypoxia and under trawling disturbance. *Sigambra* spp. appeared to thrive well in an environment with high organic content and have been suggested as an indicator of organic pollution (Shin 1990; Mackie et al. 1993; Shin et al. 2004). In the dry season, no significant differences were detected between trawling and control areas with respect to community structure (composition). However, the large difference in benthic community in favour to trawling during the rainy season was unexpected. This finding was not in line with the hypothesis that intensive trawling activity results in a shift from K-selected to r-selected species, i.e, decreased species diversity and decreased the amount of rare species. It appeared that the harsh, rainy season may be favourable to trawling disturbances, relative to the environment in the protected, untrawled area. Trawling can modify macrobenthic community structure and a higher abundance of opportunistic species is known to occur (Thrush & Dayton 2002). However, biodiversity is known to be higher in untrawled areas (Thrush & Dayton

2002), which is not the case for this study during the wet season. Tuck et al. (1998) investigated the effects of trawling disturbances on a fine muddy benthic community in a Scottish sea loch that has been closed to fishing for over 25 years. The trawl impact experiment lasted for 18 months, with a recovery experiment extending a further 18 months. During the period of trawl disturbance, the number of species and individuals increased and biodiversity and evenness decreased in the trawled area, relative to the control site. The two most resistant species to disturbances were polychaetes *Chaetozone setosa* and *Caulleriella zetlandica*, whilst the bivalve *Nucula nitidosa* and the polychaetes *Scolopolos armiger* and *Nephtys cirrosa* were found to be most sensitive to trawling.

Olsgard et al. (2008) studied effects of otter trawling in the Oslofjord, Norway on macrobenthic communities. Of the top ten dominant numerical species observed, nine of these had higher abundance in the trawled areas, but a lower abundance of the important larger bioturbating species, which were not recorded among the top ten species (Table 6.10). Ragnarsson and Lindegarth (2009) examined the long- (two and seven months after trawling) and short-term (immediately after trawling) effects of otter trawling on a macrobenthic infaunal community in Iceland. They reported significant differences in biodiversity, but not in abundance. No significant treatment effects could be detected in total abundance or on multivariate structure, only a short-term effect for the bivalve *Thyasira flexuosa* and the amount of rare species. This indicated that recolonization of soft benthic organisms is likely to be rapid in small-scale trawled areas. The area they tested has never been trawled before and the experimental design consisted of four sites which were trawled 10 times and four areas which served as a control.

Table 6.10 The top ten dominant species (N/0.5 m^2) from grab samples in non-trawled and trawled treatments in outer Oslofjord (from Olsgard et al. 2008).

Species	Faunal group	Non-trawled treatments	Trawled treatments
Heteromastus filiformis	Polychaeta	3,396	4,961
Chaetozone setosa	Polychaeta	1,110	1,092
Polydora spp. juv.	Polychaeta	324	450
Paradoneis lyra	Polychaeta	84	590
Paramphinome jeffreysii	Polychaeta	120	422
Ophelina modesta	Polychaeta	212	317
Prionospio cirrifera	Polychaeta	4	390
Eriopisa elongata	Crustacea	135	259
Prionospio fallax	Polychaeta	38	254
Prionospio spp. juv.	Polychaeta	55	221

Higher abundance does not necessarily mean that the community is not disturbed. Watling and Norse (1998) compared trawling activities to forest cutting. Forest cutting is a change in the habitat from one type of community to another. The forest goes through different successional stages until, after several years, it reaches a similar habitat and community to what it was before, if the disturbance ceases. In that process, the biodiversity of opportunistic species increases until the strongest organisms inhabit and displace the weaker ones. This can be compared to trawling, in which the disturbed habitat may change its environmental factors and, in turn, affects the structure of the community. Intermediate disturbance hypothesis (Connell 1979) has often been associated with some level of the successional stages and can be the reason for the highest biodiversity at station AT, where trawling occurred, but at the lowest frequency. The succession that the benthic marine environment goes through will depend on the type of bottom and how it has been changed. The coral community takes decades to be repaired (Druffel et al. 1995), if ever. Communities at the continental shelves and slopes, which have fewer natural disturbances, have a slower recovery time, compared to areas with natural disturbances (Watling & Norse, 1998). For communities in muddy environments, a few years should be enough to restore it back to what it was pre-trawl (de Biasi 2004; Allen & Clarke 2007). In the present study, repeated low DO events, coupled with heavy trawling activities, may have modified the macrobenthic community structure in Tolo Channel. Soft-bottom benthic communities with natural disturbances, such as hypoxia, could benefit from trawling in harsh times (i.e., wet, summer in Hong Kong) to some extent. One can consider that there is a trade-off between trawling and hypoxia. In the winter, when the DO was high and there was no occurrence of hypoxia, there were actually no significant differences in community structure between the treatments. The hypoxia is a natural event in the area and it is known to reduce the biodiversity drastically in the wet season for both epi- and infauna; however, a rapid recovery of community structure to normal conditions has been noted in the winter (Wu 1988; Fleddum et al. 2010). It is thus suggested that trawling could contribute to a higher level of DO in a time when the area suffers from hypoxia, thus increasing the chance of survival for the benthic animals. This might be an explanation of the higher biodiversity in the trawled area, compared to the control, in the wet season. In a study of nematode communities in the North Sea, Schratzberger et al. (2002) reported that seasonality may impact the community structure more significantly than trawling. Another explanation for the present findings could be that trawling may enhance the conditions of the seabed by removing large sessile organisms, such as sponges and soft corals, disturb the sea bottom and make food more available for some fish species (Rijnsdorp & Vingerhoed 2001), which prey on invertebrates, such as polychaetes and crustaceans. However, it is difficult to estimate the exact impact of trawling in any study. Pitcher at al. (2000) removed seven tonnes of epifaunal biomass from the seabed in north-eastern Australia and still did not find any significant differences in the benthic communities in trawled areas, which is an example of what is obvious but is not detectable (Thrush & Dayton 2002).

It is complicated to evaluate the effects in areas with high natural disturbances (Kaiser & Spencer 1996; Thrush & Dayton 2002). Natural disturbances can be factors such as wave forces, heavy tidal, earthquake, typhoon, volcanic activities and seasonal changes, such as hypoxia and heavy rainfall or large temperature differences during summer/winter. The marine fauna are affected by these natural factors and, therefore, it may be difficult to distinguish trawling from the effects of natural disturbances. Hiddink et al. (2006) used a theoretical North Sea model to study large-scale assessment of bottom trawl fishing of benthic fauna in different habitats which experienced different natural disturbances. They found that the impacts of trawling were greatest in areas with low levels of natural disturbance, while the impact of trawling was small in areas with high rates of natural disturbance.

6.4.3 Biological traits (BTs)

The biological traits composition appeared not to be significant between trawled and non-trawled areas. This was not expected, since intense trawling is known to change functional diversity (Tillin et al. 2006) and favour species traits such as small size taxa with short life histories (Jennings et al. 2002), scavenger feeding type (Kaiser & Hiddink 2007) and mobile burrowing animals (de Juan et al. 2007). All of these studies have stated significant differences in biological traits in macrobenthic community between trawled and non-trawled areas. However, these studies have not tested if the annual differences in hypoxia are significant and how the trawling/control areas are related to hypoxia. For the present study, the seasonal changes in function diversity appeared to be more important in eastern Hong Kong waters. Notwithstanding, the biodiversity of the community was significant between the treatments in the wet season, with much higher biomass and diversity, the biological traits composition between the species recorded in the control and trawled areas was similar. The results from the Mann Whitney U test between the seasons showed that 19 of the 36 BT categories analyzed had up to 90% contribution to dissimilarities between seasons. Fifteen of these were significant, with highest rank in the dry season (no attachment, burrower, low mobility, subsurface deposit feeder, lecitotrophic larval type, planktotrophic larval type, cylindrical body form, dorsally flat body form, carnivore/omnivore feeding type, 3-6 cm in adult size, 6-10 cm in adult size, 1-3 cm in adult size, surface deposit feeder, high mobility and medium mobility). These biological traits dominate in the dry season but are deficient in the wet season. The bivalves which represent the majority of the category, with a dorsally flat body form (and also some crustaceans and nemerteans), were totally absent in the wet season for both treatments, suggesting that bivalves are more sensitive to oxygen depletion than other taxa.

There were no differences in the amount of rare species between the trawled and control (MPA) areas in the dry season. Notwithstanding the lack of differences in rare species' contributions in the dry season, the BT contribution differed in few of the categories in favour to MPA. However, in the wet season, the trawled impacted communities had a higher number of rare species (19/2 m^2 vs. 7/2 m^2), which reflected a higher level of BT contribution to the total traits pool. This finding suggested that rare species, and their following traits within MPA, are more sensitive in the wet season, when the environmental conditions (e.g., DO) are unfavourable.

6.4.4 Recovery from trawling in Marine Protected Areas (MPAs)

Recovery is a return of environmental variables and species composition to a state that existed before the disturbance occurred. Recovery from trawling depends on types of habitat (Collie et al. 2000), frequency of disturbance compared with natural changes (Hiddink et al. 2006), species and life history characteristics (Emeis et al. 2001) and the size of the area disturbed (Thrust et al. 1998). There are hardly any data to be obtained from inside this marine protected area (marine park), on the macrobenthic community, taken before the Government closed the area to trawling in 1996. However, Mackie et al. (1993) performed a survey in Hoi Ha Wan and Tolo Channel in April 1989 using duplicate 0.1 m^2

van Veen grab (pooled of two replicates) to investigate the macrofaunal community. This is the only data that can be used to compare with those obtained from the present study, since four of the sampling stations are in the same areas. In general, the abundance, number of species, biodiversity and H′ were higher in 1989, while the evenness J′ was higher in this study, indicating a stronger similarity in abundance among the species and fewer numerically dominant species were found in the present study. Mackie et al. (1993) recorded the dominance of the polychaete *Minuspio* sp. (in Hoi Ha Wan and Tolo Channel), which can serve as an indicator of organic pollution. In this study, there were only two individuals of *Minuspio cirrifera* found inside the protected area in the dry season and none in the trawled area. The polychaetes *Sigambra* sp. and *Aglaophamus* sp. were among the top five abundant species, similar to this study, but the abundance was quite different. Among top five species, the abundance ranged from 260-11/0.2 m^2 in 1989, while for the wet season in 2008, 4-0/0.5 m^2 were recorded and 25-11/0.5 m^2 in the dry season 2009. Only three individuals of *Chaetozone* spp. were observed in the same area in 1989, while in this study the species were among the most dominant. Polychaetes were found to dominate in both studies. The trend in the infaunal communities of subtropical Hong Kong is known to have lower species richness, high abundance, low biodiversity and high evenness in undisturbed localities when compared to temperate regions (Mackie et al. 1993). This trend is not fully understood, but some factors, such as reduced salinity, large annual temperature fluctuations, intense biological interactions, high sediment silt-clay content, sediment instability and negative Eh could be contributing to this state (Shin & Thompson 1982; Shin 1989). However, the significance of the changes in the study area (Hoi Ha Wan) between 1989 and 2008/2009 could be alarming, despite the fact that the community managed to restore significant amounts of newly colonized benthic organisms, to the community, in the dry season.

Some research has been conducted on the recovery of soft benthic communities after trawling. de Biasi (2004) studied the impact of experimental otter trawling on soft benthic infauna communities off the Tuscany coast, Italy. Significant changes in sediment composition and mollusc community were detected. However, it was suggested that recovery from trawling could be back to normal within one month. Allen and Clarke (2007) used a model to look at the effects of demersal trawling on ecosystem functioning, using the North Sea data as a template. The authors suggested that the system will return to its original state within five years. Ragnarsson and Lindegarth (2009) found no significant treatment effects on the total abundance or on multivariate structure in infaunal community after a seven-month recovery from otter trawling. Cooper et al. (2007) investigated recovery from dredging in Hasting Banks, UK after closure of such activities in 1996 (with the exception of one highly disturbed site, which was last dredged in 2003). Data from reference sites and sites with low and high levels of dredging were compared and monitored, annually, over the period of three years (2001-2004). They observed that the track marks from the dredge were still visible after eight years. The structure of the benthic community at the low-dredge intensity site had recovered after seven years. At the high-dredging intensity site, recolonization was relatively rapid after the cessation of dredging in 2003. The ‘colonization community’ may enter a transition phase before eventually reaching equilibrium, and it may take longer than seven years before a recovery can be made. The conclusion from these studies is that Hoi Ha Wan should have had enough time to recover from trawling after 12 years as a trawl-free zone. However this was not the case, according to the data obtained in this study. The low biomass found inside of the marine protected area was surprising. It was expected that a higher biomass and biodiversity would be found in Ho Hai Wan, as compared to the heavily trawled area in Tolo Channel. The protected area covers 260 hectares, and recovery from trawling depends on the size of the area that has been disturbed (Thrust et al. 1998). With natural disturbances, such as an annual hypoxic season, this area could actually need several more years in order to achieve a recovery back to its former state. The protected area is also inside a covered bay. However, the recruitment rate in the area appeared to be good since the biodiversity managed to restore itself during the dry, winter season. The hypoxic situation in the study area is a natural phenomenon, which is likely not the reason for the decreasing trend in biodiversity. Another important consideration is that the MPA itself may have contributed to the changes through time. It is now widespread that MPAs are effective tools for conserving marine systems (Kelleher 1999; Lubchenco et al. 2003; Palumbi, 2003). Studies have observed ranges of responses to MPAs, such as increases in total biodiversity (Edgar & Barrett 1999), increases in biomass/abundance (Russ et al. 2004; Abesamis & Russ 2005), increased frequency of aggressive interactions between adults within the same species (Abesamis & Russ 2005) and a larger mean body size (Edgar & Barrett 1999; Tuya et al. 2000; Abesamis & Russ 2005). However, there could be short- and long-term consequences to MPAs that have been exposed to impact, in varying degrees, or if the boundary is too small. When the MPAs are small, species interactions and movements may make the desired affect difficult to achieve, and top predators may become more abundant within MPAs, which could lead to a depression in their prey species and an increase in the abundance of some species at lower trophic levels (Salomon et al. 2000). Stokesbury et al. (2007) observed mass death of the sea scallop *Placopecten magellanicus* between 2004 and 2005 in the Nantucket Lightship Closed Area, an MPA in the Great South Channel, USA.

After closing the area for scallop dredging in 1994, the population of the scallop increased nine times. The high population density suffered from parasitism and infections resulting in mass death. If one changes a habitat, which had been exposed to different kinds of impacts for a longer period, the ecosystem or the organisms living there could react in a different ways in the beginning of the changes until it stabilized again, after a time of recovery. Edgar and Barrett (1999) studied the effects of four MPAs in Tasmania. The largest reserve, with 7 km of coastline length, proved the most effective at achieving species conservation and biodiversity of fish, invertebrates and algae, which increased significantly when compared to reference sites. No significant differences were found for the three smaller MPAs with 1-2 km coastline length. The authors suggested that the effectiveness of the marine reserves corresponded with the sizes of the reserve.

After the Government closed the area for trawling, several artificial reefs (ARs) have been deployed inside the MPA in Hong Kong, with the intention to increase fish biodiversity. ARs are human-made materials placed at the sea bottom with the intention to mimic natural reefs (Wilding 2006). Notwithstanding, the ARs are in a distance of at least 15 m for all the stations in this study, and may influence the benthic community around. Reefs, in general, are known to attract large predators that feed on benthic organisms on and around the reefs. An important principle of environmental science is that changes in single components of systems are likely to have consequences elsewhere in the same systems (Pinnegar et al. 2000). The latter refers to changes is trophic structure, such as increasing levels of predators, which may prey on soft benthic species near the AR. There is very limited research being undertaken on the long-term consequences of ARs and soft benthic communities nearby. There are three important factors to take into consideration regareding the recovery inside Hoi Ha Wan (recovery from trawling, the protected area itself and presence of artificial reefs), which make it difficult to deduce any clear overall suggestions for the decreasing trend in biodiversity (since the Government closed the area for trawling). It is suggested further long-term research on structural and functional diversity inside the MPA, both on spatial changes around the artificial reefs and temporal changes over time, in comparison with trawling sites outside the MPA, should be undertaken.

Chapter 7 Impact of structure and function of infauna and epifauna in heavily trawled areas and under a low level of oxygen in Tolo Harbour, Hong Kong

7.1 Introduction

Tolo Harbour is located in the north-eastern part of Hong Kong's New Territories and has been well studied for water and sediment quality during the last 20 years, through the Marine Water Quality Monitoring Programme of the Environmental Protection Department (EPD), Hong Kong Special Administrative Region Government. In addition to water and sediment monitoring, several benthic ecological studies have been conducted in the area (e.g., Shin 1982, 1985, 1989; Shin & Thompson 1982; Wu 1982; Shin 1990; Mackie et al. 1990; Shin et al. 2004). Because of the growing human population, the subsequent increase in waste discharge and pollution have become a problem, and there has been strong evidence of increasing eutrophication in Tolo Harbour (Horikoshi & Thompson 1980; Wear et al. 1984), particularly with poorer water quality and decreased oxygen at the bottom (Wu 1988; Lee & Arega 1999). Furthermore, even though the water quality has been improving over the past few years, owing to the diversion of the treated sewage effluents from Tai Po and Shatin New Towns to Victoria Harbour (EPD 2007), the marine environment may take a long time to recover, and the organisms are still under the strong influence of past contamination and increasing organic compounds in the sediment (Shin 2003). Hong Kong has a subtropical climate with western monsoons in the summer, resulting in a hot and wet season from May to September and a cool and dry season from November to March (Hodgkiss 1984). Tolo Harbour, which has a poorly flushed embayment (Watson & Watson 1971; Oakley & Cripps 1972; Preston 1975; Wear 1984; Morton 1989), suffers from hypoxia in the wet season (Wu & Richards 1979; Horikoshi & Thompson 1980;

Wu 1982). It is well known that hypoxic events can cause large reductions in biodiversity (Craig et al. 2000; Service 2004) and have the potential to threaten the natural structure and functioning of benthic communities (Rosenberg et al. 1991). Hypoxia generally refers to dissolved oxygen concentrations below 2.0 mg/l and anoxia is defined as the absence of oxygen in the water column (Pihl et al. 1991; Diaz & Rosenberg 1995). Reductions in dissolved oxygen concentrations are amongst the most important effects of eutrophication on aquatic organisms (Breitburg 2002). Low dissolved oxygen conditions have the potential to threaten the natural structure and functioning of benthic communities through mortality, sublethal stresses, reduced growth rates and indirect restrictions upon habitat availability (Rosenberg et al. 1991; Breitburg 2002). Benthic communities are sensitive to eutrophication and hypoxia (Jorgensen & Richardson 1996) and increased sedimentation of organic matter is harmful to some benthic fauna (Grall et al. 2002). There have been several studies on biodiversity regarding hypoxia (Nilsson & Rosenberg 1994; Meyers et al. 2000; Rosenberg et al. 2002) and species' responses to hypoxia (Rosenberg et al. 1991; Wu & Or 2005) for marine benthic communities. However, from the information reviewed thus far, analysis of functional traits for all of the species in the benthic communities, found in hypoxic gradients, has not been conducted. Traits, in this manner, mean various functions of the organisms, e.g., size, body form, feeding methods, larval type, movements, attachments to the substrate, etc. By investigating the traits under stressed situations, one can better identify the mechanisms behind the effects of the impact and contribute to future assessment of ecological consequences.

The objectives of this study are to:

1. Investigate how hypoxia impacts the structure and functioning of marine benthic communities in subtropical waters;
2. Identify which biological traits will be reduced and which will dominate in heavily hypoxic situations and
3. Elucidate how these impacts influence the change of proportions of rare species.

Macrobenthic community structure is often used to indicate environmental health because benthic animals have relatively long life spans, and they respond to water and sediment quality over time (Alden et al. 1997). The purpose of this field study is to investigate structure and function when macrobenthic infauna and epifauna are exposed to dissimilar level of oxygen in the sediments (rainy season in the summer and dry season in the winter). It is generally assumed that a macrobenthic community subjected to increased organic loading, either spatially or temporally, will exhibit a decrease in the body size of the average species (Weston 1990). Benthic macrofauna sampled in areas of low DO, compared to that sampled in control areas, will be used to quantify the effects of hypoxia on species composition, diversity, abundance and biomass of these biotic components. It is anticipated that a highly hypoxic area will result in a shift from K-selected to r-selected species, decreased species diversity, increased abundance of opportunistic species and an overall decrease in biomass. It is hypothesized that traits, such as low mobility and small size, will be the most dominant traits in areas with low levels of oxygen. The whole sampling area is heavily trawled by Chinese traditional trawling boats (see Chapter 6 for more information); thus, while the focus of this study is on the impact of hypoxia, the effects of trawling will also be discussed.

7.2 Material and methods

7.2.1 Benthic infauna sampling

All the data were collected in Tolo Harbour, Tolo Channel and Mirs Bay, Hong Kong in September 2007 (wet season) and January 2008 (dry season) (Fig. 7.1). The chosen stations are a part of the EPD routine monitoring programme and the data from previous studies are available for comparison. The two control stations, in Mirs Bay, were chosen due to its higher biodiversity and lower impact of hypoxia (AFCD 2002). Three core (8 cm diameter and 20 cm length) replicates were taken from each station, by divers, for measurement of grain size and total organic carbon (TOC). Before sampling with the grab, two divers went down to the bottom and photographed the mud surface and measured the dissolved oxygen with a D-OPTO sensor model that utilizes fluorescence to measure dissolved oxygen connected to an onboard computer (D-Opto, Zebra-Tech Ltd., USA). The D-OPTO was also connected to a box with a lead, for communication with the divers. When the D-OPTO was in the right position, measurements were taken at 1 cm below the sediment, as well as 1 cm, 50 cm and 1 m above the sediment. All the data (temperature, DO in % and DO in ppm) were automatically logged into a text file.

The macrobenthic samplings were conducted with a 0.1 m^2 van Veen grab with five replicates at each of the eight stations, including six stations in Tolo Harbour and Tolo Channel, and two in Mirs Bay as control stations, (40 grabs in total for each season) (Table 7.1). Samples were taken from the heavily hypoxic area in Tolo Harbour, towards the control, in the outer edge of Mirs Bay (Fig. 7.1) using a local diving boat. The study site is relatively shallow, ranging from 7-23 m. All samples were washed gently over a mesh, size 1 mm, and stored, cold, onboard until preserved in 80% alcohol later the same day. The macrofauna were identified to lowest possible taxa. The abundance of each species was counted, and biomass (wet weight) was measured using same procedures as in Chapter 6.

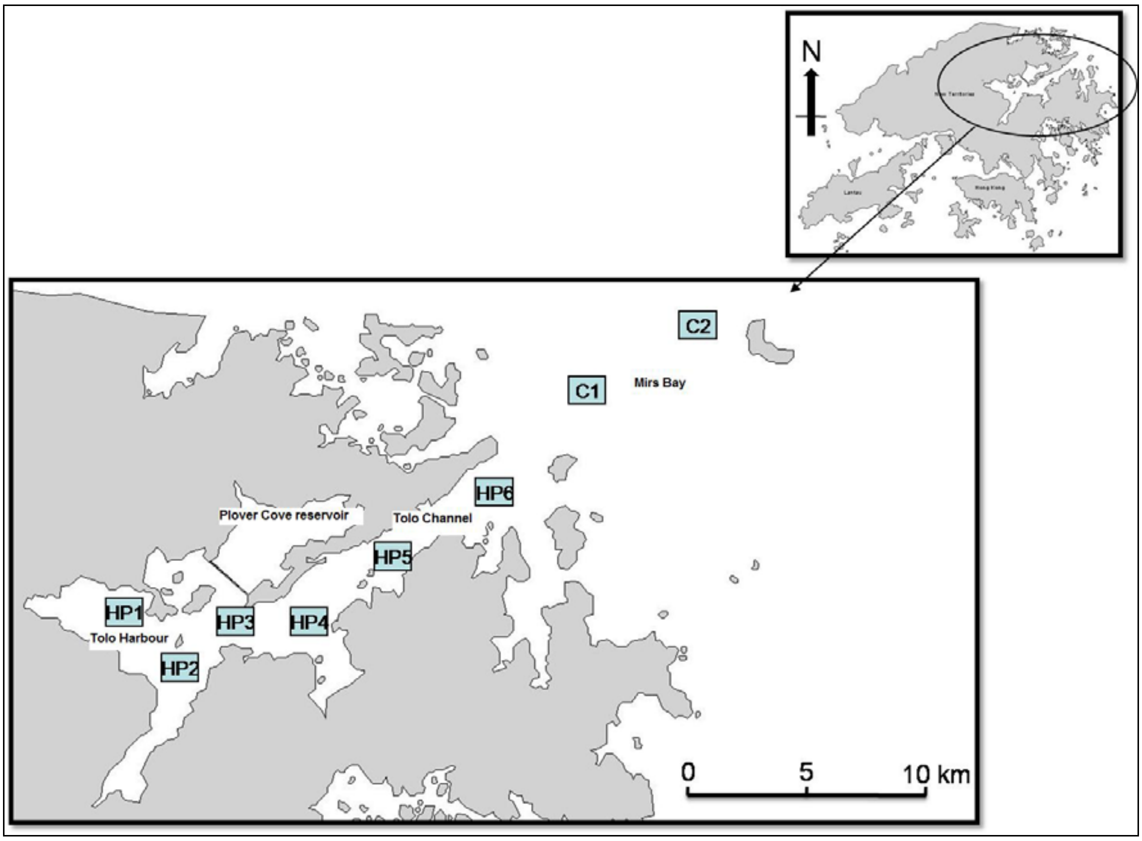

Figure 7.1 Grab and trawling stations in Tolo Harbour (HP1, HP2, HP3), Tolo Channel (HP4, HP5, HP6) and Mirs Bay (control stations, C1, C2) for the wet (September 2007) and dry season (January 2008).

Table 7.1 Position and depth at the grab and trawling stations taken during the wet (September 2007) and the dry season (January 2008). The five stations sampled in this study were the same used by the EPD in their monitoring programme. Stations marked in brackets (107, 112 and 113) are the same stations used in a consultancy study on marine benthic communities in Hong Kong (AFCD 2002).

EPD Quality Stations	EPD Sediment Stations	Stations sampled in this study	Latitude	Longitude	Depth (m)
TM3	TS3	HP1	22° 26.857' N	114° 12.181' E	7
TM4	TS2	HP2	22° 25.964' N	114° 13.176' E	8
TM6	TS4	HP3	22° 26.631' N	114° 14.506' E	12
TM7		HP4	22° 26.907' N	114° 16.057' E	11
TM8	TS5	HP5	22° 28.392' N	114° 18.003' E	22
	(107)	HP6	22° 29.3000' N	114° 19.5015' E	23
	(112)	C1	22° 31.5042' N	114° 21.7002' E	20
	(113)	C2	22° 31.4994' N	114° 23.7996' E	19.5

7.2.2 Epifaunal sampling

The same eight stations were trawled with six replicates for sampling epifauna using a local fishing boat. The trawl boat is a traditional Chinese shrimp trawler employing six nets (each circa 2 m width and 5 m length with a cod end mesh 1 cm) at the same time. The trawling distance was 500 m from the exact grab position in each direction, in a straight line from north to south, in a total trawling distance of 1,000 m over the position where the grab sediment samples were collected. The trawling speed was 3 knots, under the guidance of onboard global positioning system (GPS). A total area of 10^4 m^2 (calculated as trawling distance × width of the net) was trawled for epifauna for each net, at each station. When reaching the exact grab position two buoys with rope were utilized to aid the divers in finding the exact trawling marks at the bottom, for new DO measurements, where the grab samples had been taken previously. The purpose of this was to check if the DO level changed after trawling. The animals for each trawl replicate were photographed to obtain an overview of the biodiversity of the catch. The abundance of each species was counted and biomass (wet weight) was measured, using the same procedures as in Chapter 6.

7.2.3 Sediment analysis and TOC determination

For particle size analysis, the wet sieving method was performed according to Buchanan (1984) (see detailed description in Chapter 6). For measurement of TOC, the sediment samples were freeze-dried for one week. The procedure and equation used to calculate TOC are detailed in Chapter 6.

7.2.4 BTs

The same biological traits table from Chapter 3, with their categories and procedures for data treatment, were adopted.

7.2.5 Species abundance distribution (SAD)

The species abundance distribution (SAD) was used to investigate trends reflected by rare and abundant species in the season conditions at each station and for both epifauna and infauna. Details of the method are described in Chapter 4.

7.2.6 Statistical analysis

All univariate and multivariate analyses were performed using PRIMER-E v6 software (Clarke & Warwick 2001; Clarke & Gorley 2006) and its PERMANOVA add-on (Anderson et al. 2008), unless otherwise indicated. Shannon diversity (H') and Pielou evenness (J') of the macrofauna and epifauna, for each station, were calculated to describe the benthic community structure (Schratzberger & Jennings 2002).

Hierarchical cluster analysis (Clarke & Warwick 2001) was applied to summarize patterns in biological traits and the composition of benthic in- and epifaunal communities using the Bray-Curtis similarity measure on transformed data (Kenchington et al. 2001). The five grab replicates of the macrobenthic fauna were summarized as one (pooled) before square-root transformation, and the six trawling replicates of the epibenthic fauna were measured as an average for each sampling station before data transformation. Log (X+1) transformation was chosen for the epifauna dataset, since stronger transformation was required for the data, which had larger differences between the species abundance/biomass. Two-way crossed ANOSIM (Analysis of Similarities) was used to determine significant differences between stations and seasons.

A non-parametric Mann-Whitney U test was used to detect significant differences between traits (infauna and epifauna) occurring between the dry and wet season, using STATISTICA v8. Excel was used to illustrate the significant rank from the Mann-Whitney U test for infauna and epifauna.

7.3 Results

7.3.1 Dissolved Oxygen (DO)

In the wet season there was a decreasing DO concentration gradient from the control station (C1) towards the inner part of Tolo Harbour, with exceptions at HP2 and HP1, showing higher percentage concentrations (Fig. 7.2). The DO concentration did not remain the same after trawling for 1 cm below and 1 cm, 50 cm and 1 m above the sediment surface for all the stations, except for stations C1 and HP3, where the difference was low (Fig. 7.2). The DO concentration changed from lower to higher after trawling, except for station HP2. The largest difference was at 1 cm below the sediment at stations HP1 and HP2. In general, the low DO concentration (below 30%) showed that the whole study area was hypoxic in the wet season.

In the dry season, the DO concentration from the control station (C1), towards the inner part of Tolo Harbour, was high for all the stations, showing no clear hypoxic gradient (Fig. 7.3). After trawling the DO level decreased for 1 cm below and 1 cm above the sediment but remained the same for 50 cm and 1 m above the sea bottom. In general, the DO concentration (above 60%) showed that the whole study area was not hypoxic in the dry season.

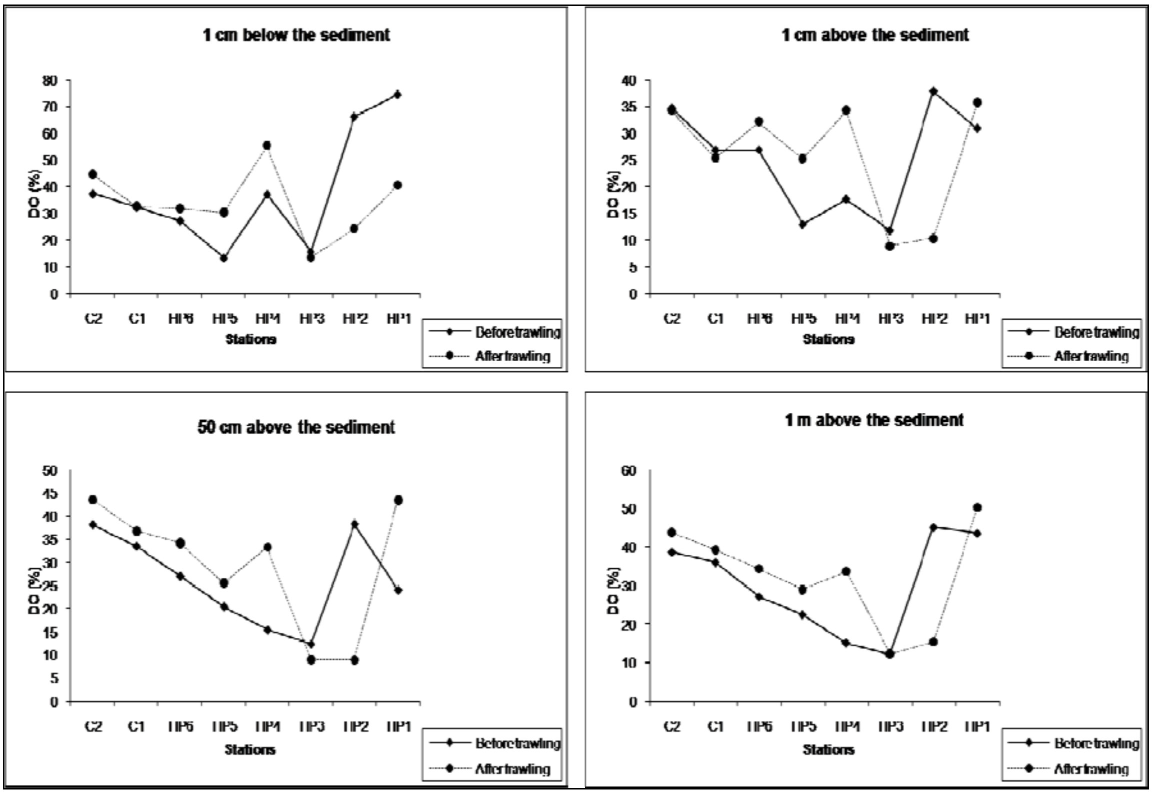

Figure 7.2 Dissolved oxygen 1 cm below the sediment, and 1 cm, 50 cm and 1 m above the sediment, measured in percentage, for all the stations before (solid line) and after trawling (dashed line), in wet season in September 2007.

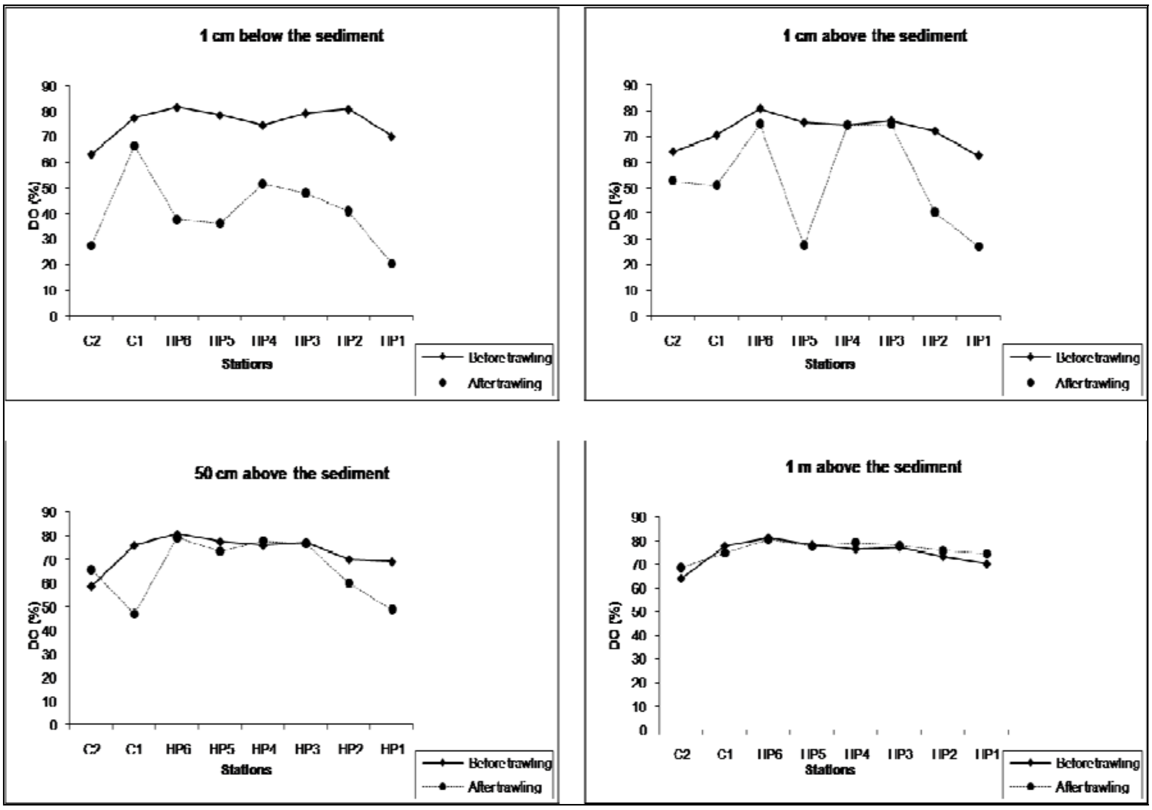

Figure 7.3 Dissolved oxygen 1 cm below the sediment, and 1 cm, 50 cm and 1 m above the sediment, measured in percentage, for all the stations before (solid line) and after trawling (dashed line), in dry season in January 2008.

7.3.2 Benthic infauna

The three most dominant taxa over the sampling stations were polychaetes, molluscs and crustaceans (Table 7.2). In the wet season, polychaetes were the most dominant taxa (67-100%) over the gradient, except for stations HP4 (50%) and HP1 (78%) where molluscs were dominant. The top ten abundant (dominant) species were: *Chaetezone setosa*; *Moerella iridescens*; *Chaetozone* indet.; *Amphioplus laevis*; Nemertina indet.; *Aglaophamus dibranchis*; *Tellina cygnus*; *Heteromastus* indet.; *Pectinaria* indet. juvenile and *Sigambra hanaokai*. No animals were found at station HP2 (i.e., a macrobenthic dead zone).

There was no registered macrobenthic dead zone in the dry season (Table 7.2). Polychaetes dominated (54-100%) for all the stations, except at C1 and HP1, where echinoderms (48%) and molluscs (72%), respectively, had higher abundance. The ten top dominant species for the dry season were: *Moerella iridescens*; *Lovenia subcarinata*; *Aglaophamus dibranchis*; *Theora lata*; *Prionospio malmgreni*; *Sigambra hanaokai*; *Pectinaria* indet.; *Sigambra* indet.; *Prionospio* indet and Nemertina indet.

Table 7.2 Dominance taxa at each grab sampling station measured in percentage (%) for both seasons. Crustacea (C), Echinodermata (E), Mollusca (M), Nemertea (N), Polychaeta (P) and Sipunculida (S).

Taxa	C2	C1	HP6	HP5	HP4	HP3	HP2	HP1
				Wet season				
C	5	5	11	0	25	33	0	0
E	8	12	0	0		0	0	0
M	1	10	8	0	50	0	0	78
N	3	2	14	0	0	0	0	0
P	83	71	67	100	25	67	0	22
Total	100	100	100	100	100	100	100	100
Taxa	C2	C1	HP6	HP5	HP4	HP3	HP2	HP1
				Dry season				
C	11	7	0	0	8	2	0	0
E	19	48	4	0	0	0	0	0
M	1	4	4	0	38	22	32	72
N	7	3	15	0	0	0	0	0
P	61	32	78	100	54	76	68	28
S	1	6	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100

Sediment Md Φ ranged from 5.37-6.14 for all the stations, showing similar silt sediment characteristics in the wet season (Table 7.3). The total organic carbon content was the highest at station HP4 (2.79%), followed by HP1 (2.72%), and decreased outwards Tolo Channel and Mirs Bay. The highest biomass was found at C1 (60.98 g/0.5 m^2) and the lowest at HP2, 3, 4 and 5. The local species richness was relatively low for all stations, but highest at control stations C2 and C1, as well as HP6, ranging from 38-22/0.5 m^2. The inner stations, towards the harbour, decreased to 4-0/0.5 m^2 in total. C2 had the highest total abundance (216/0.5 m^2), followed by HP6 (64/0.5 m^2), HP1 (54/0.5 m^2) and C1 (41/0.5 m^2). Shannon diversity (H') showed the highest value at the control station C1 (2.87), followed by HP6 (2.78) and C2 (2.20) (Table 7.3).

All the stations showed similar silt sediment characteristics (Md Φ 4.46-6.09) in the dry season (Table 7.3). The total organic carbon content was the highest at station HP2 (2.61%) and decreased outwards, towards Tolo Channel and Mirs Bay. The highest biomass was found at C1 (50.57 g/0.5 m^2), followed by C2 (19.4 g/0.5 m^2). The local species richness was relatively low for all stations, but highest at control stations C2 and C1, as well as HP3, ranging from 39-20/0.5 m^2. HP5, HP2 and HP1 had the lowest species compositions. HP1 had the highest total abundance (123/0.5 m^2), followed by HP3 (93/0.5 m^2) and C1 (90/0.5 m^2). Shannon diversity (H') showed the highest values at the control station C1 (3.46), followed by HP3 (2.47) and HP6 (2.39) (Table 7.3).

An increasing gradient in TOC in the study area is illustrated in Figures 7.4 and 7.5. From the trend line in the logarithmic scale, species, abundance and biomass showed a decrease with increasing TOC. However, the TOC logarithmic trend line for the dry season (Fig. 7.5) showed a weaker gradient towards reduction in species, abundance and biomass, compared to the wet season (Fig. 7.4).

Table 7.3 Summary of sediment characteristics: total organic carbon (mean TOC) measured in percentage, total biomass (g/0.5 m^2), total species (S/0.5 m^2), total individuals (N/0.5 m^2), Pielou evenness (J') and $\log_e$ Shannon diversity (H') for all the grab stations

Site	Md (Φ)	Mean TOC (%)	Biomass (g/0.5 m^2)	S (/0.5 m^2)	N (/0.5 m^2)	J'	H'($\log_e$)
			Wet season				
C2	5.97	1.10	4.64	38	216	0.61	2.20
C1	6.14	1.49	60.98	22	41	0.93	2.87
HP6	5.96	1.93	2.24	22	64	0.91	2.87
HP5	5.85	2.38	0.02	2	2	1	0.69
HP4	6.07	2.79	0.02	3	4	0.94	1.04
HP3	5.37	2.35	0.01	2	3	0.91	0.64
HP2	5.84	2.53	0	0	0	0	0
HP1	6.05	2.72	2.99	4	54	0.73	1.02
Site	Md (Φ)	Mean TOC (%)	Biomass (g/0.5 m^2)	S (/0.5 m^2)	N (/0.5 m^2)	J'	H'($\log_e$)
			Dry season				
C2	5.99	1.26	19.4	39	74	0.94	3.46
C1	6.16	1.50	50.57	22	90	0.66	2.06
HP6	5.96	1.63	1.67	13	27	0.93	2.39
HP5	5.57	1.85	0.12	6	11	0.88	1.59
HP4	6.09	2.48	0.56	10	13	0.95	2.20
HP3	5.59	2.15	1.39	20	93	0.82	2.47
HP2	4.46	2.61	0.24	5	25	0.79	1.27
HP1	5.77	2.51	8.44	7	123	0.62	1.21

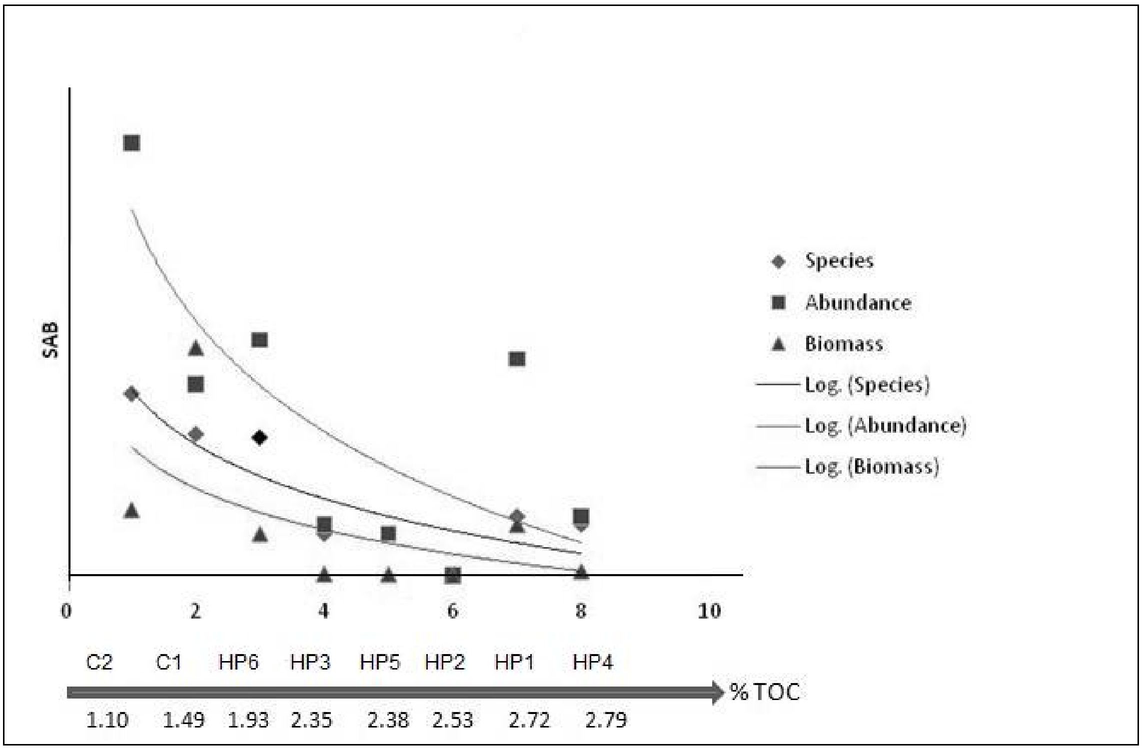

Figure 7.4 Total organic carbon (TOC) measured in percentage as an increasing gradient. SAB: Species (diamond), abundance (square) and biomass (triangle), as points and trend line in logarithmic scale in the wet season.

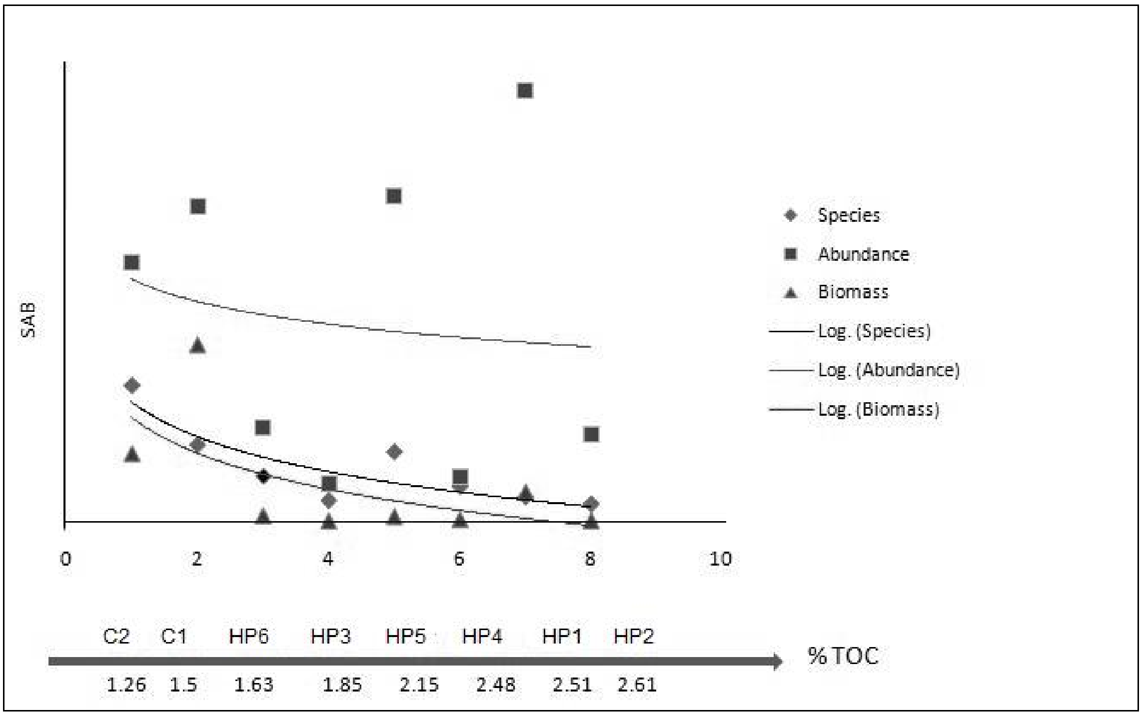

Figure 7.5 Total organic carbon (TOC) measured in % as an increasing gradient. SAB: Species (diamond), abundance (square) and biomass (triangle), as points and trend line in logarithmic scale in the dry season.

Figure 7.6 shows hierarchical cluster analysis of the abundance and biomass for both seasons. HP2 had no similarities with other stations because there were no animals recorded in the wet season. The outer control stations in Mirs Bay C2 and C1, as well as the outermost station in Tolo Channel HP6, showed no significant differences for abundance in the wet season (SIMPROF, $p > 0.05$). A similar pattern for biomass was also found at these outer stations. However, in the wet season, the infauna generally showed less than 40% similarities among the sampling stations. In the dry season, faunal similarities increased for the abundance in the inner part of Tolo Harbour (HP1, HP2 = 60%), showing smaller changes through the hypoxic gradient. Small changes in similarities among stations were also found for benthic biomass (< 40% for C1 and C2) (SIMPROF, $p < 0.05$).

When comparing all the data and all the replicates from both seasons, ANOSIM (two-way crossed) showed that there were significant differences among stations for abundance (Global $R = 0.395$, $p < 0.001$) and biomass (Global $R = 0.401$, $p < 0.001$). Similarly for comparing data obtained in the seasons, there were significant differences for benthic biomass (Global $R = 0.252$, $p < 0.001$) and abundance (Global $R = 0.289$, $p < 0.001$).

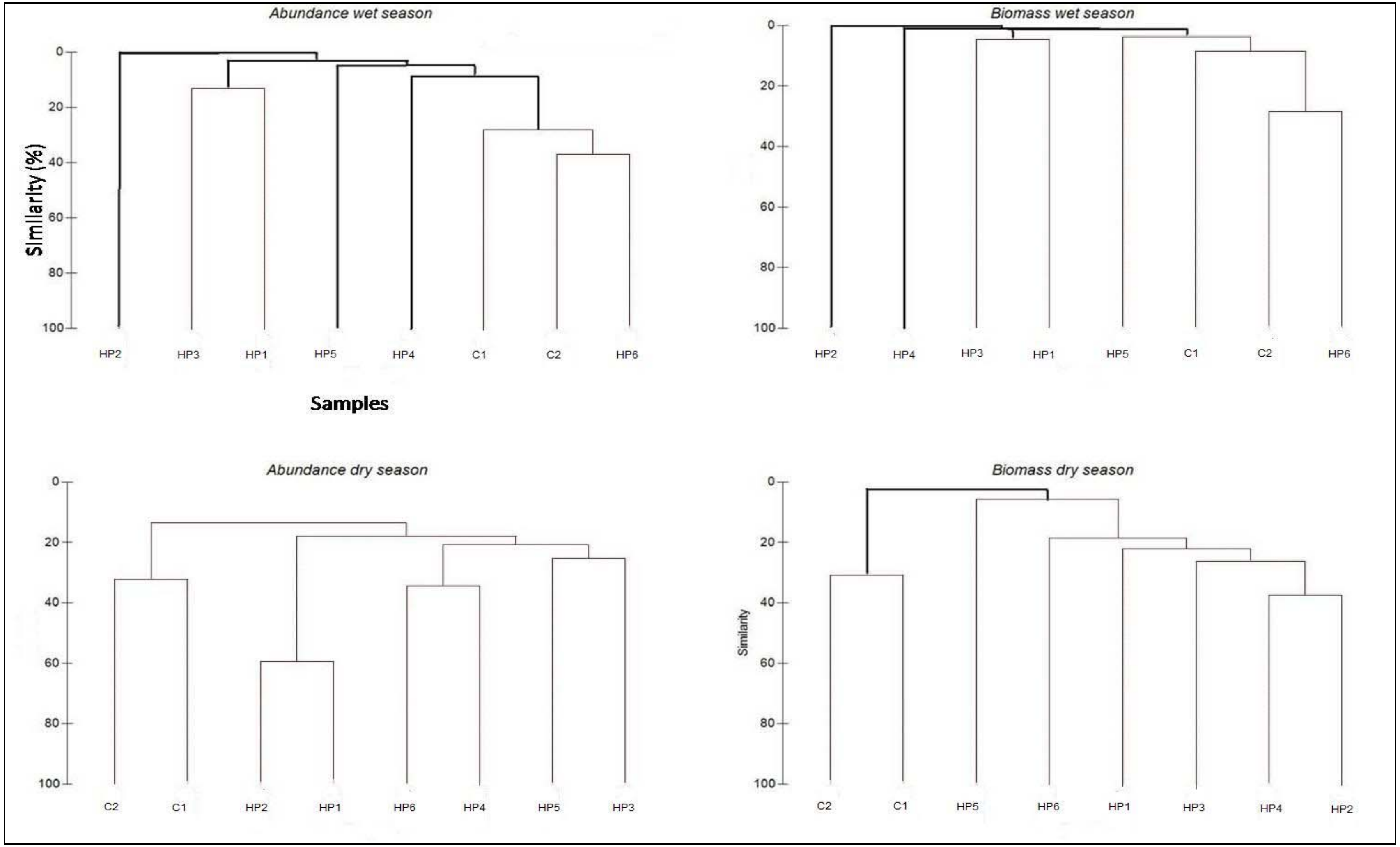

Figure 7.6 Hierarchical cluster analysis of the infauna for both seasons (Bray-Curtis similarities, square-root transformation). Branches connected to each solid line showed significance differences (SIMPROF, $p < 0.05$) in community structure.

7.3.3 Species Abundance Distribution (SAD) for the infauna

The dry season was found to have more rare species (i.e., represented only once) in the pooled samples, compared to the wet season (39/4 m^2 *vs.* 16/4 m^2, Fig. 7.7). The opportunistic species (abundance between 64-127/4 m^2) were represented by one species in both seasons (wet season: the polychaete *Chaetozone setosa*, dry season: the bivalve *Moerella iridescens*). The top five species (total count) in the wet season were: *Chaetozone setosa* (110/4 m^2), *Moerella iridescens* (32/4 m^2), *Chaetozone* indet., (29/4 m^2), *Amphioplus laevis* (17/4 m^2) and Nemertina indet. (16/4 m^2). In the dry season, the top five abundant species included: *Moerella iridescens* (77/4 m^2), *Lovenia subcarinata* (47/4 m^2), *Aglaophamus dibranchis* (33/4 m^2), *Theora lata* (32/4 m^2) and *Prionospio malmgreni* (19/4 m^2).

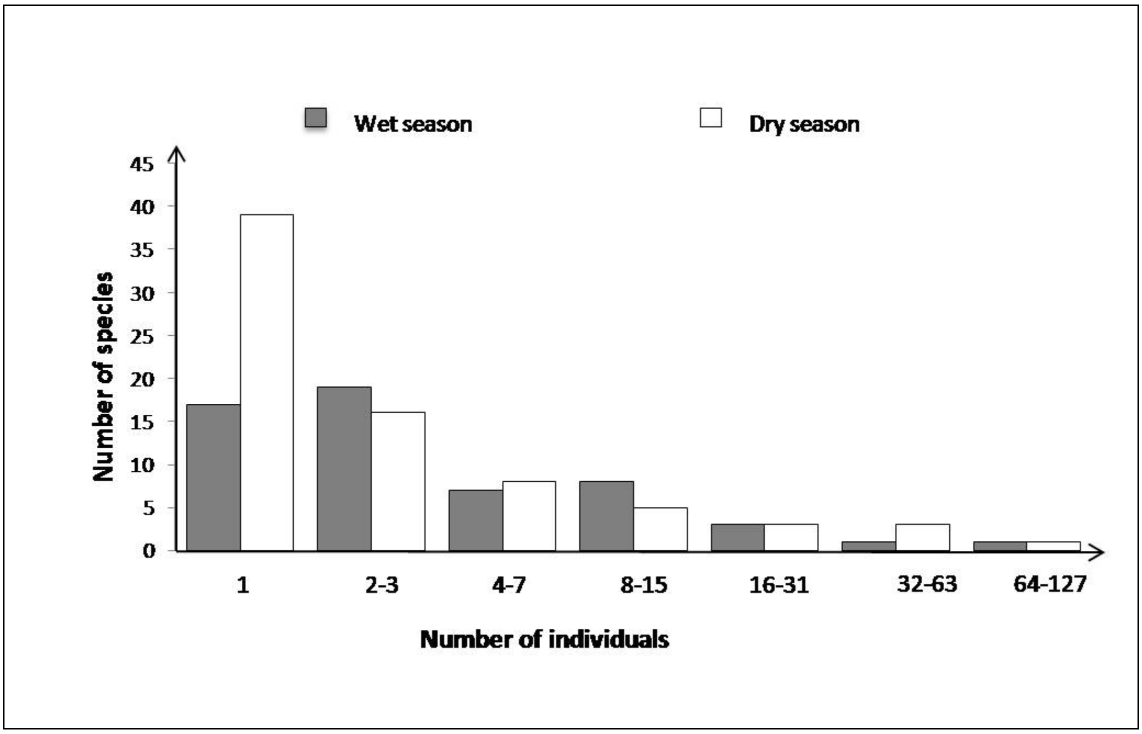

Figure 7.7 Species Abundance Distributions (SAD) for the wet (grey bars) and the dry (white bars) season using abundance category of modified $\log_2$ classes.

7.3.4 BTs for the infauna

Based on results from the non-parametric Mann-Whitney U test, there were significant differences in biological traits composition between the seasons. A closer look at each category within each trait showed significant differences for all of the traits mentioned in Table 7.4 (and the box plot in Fig. 7.8), which contributed 14% (five categories of 36) of all the categories. The rank number in Table 7.4 depicted the contribution to each category for each season. Size < 5 mm, medium mobility, dorsally flat body form, permanent tube habitat and scavenger feeding type had the highest rank sum and were the most important traits of the infauna sampled in the wet season.

Cluster analysis of all the stations, based on similarities in biological traits composition (square-root transformed biomass × categories), for the wet and dry season, is illustrated in Figure 7.9. There were significant similarities in traits diversity among the inner and outer stations (SIMPROF test, C1, HP6 and HP1, $p = 0.027$) and stations in Tolo Channel (HP3, HP5 and HP4, $p = 0.018$) for the wet season. A different trend occurred in the dry season, in which the two control stations in Mirs Bay shared similar traits composition (SIMPROF test, C1 and C2, $p < 0.001$).

Table 7.4 Significantly different biological traits of the infauna as tested by non-parametric Mann-Whitney U between wet/dry seasons for biological traits weighted with biomass (square-root transformed).

Trait	Categories	Code	Significant value	Rank wet/dry
Size	< 5 mm	NS1	p=0.024, U=631	2081/1159
Mobility	Medium	AM3	p=0.005, U=519	2192/1047
Body form	Dorsally flat	BF2	p=0.037, U=564	2148/1092
Habitat	Tube (permanent)	AH2	p=0.034, U=601	1777/1463
Feeding	Scavenger	FH7	p=0.003, U=508	1684/1556

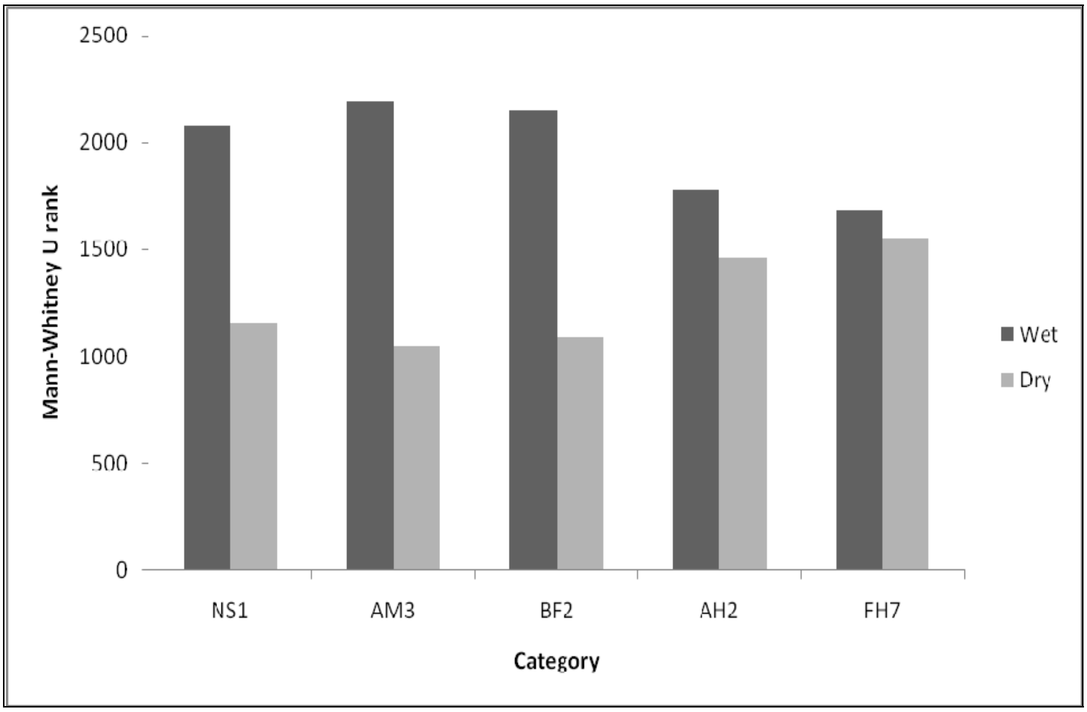

Figure 7.8 Histogram of the significant traits (biomass infauna × biological traits occurring in wet and dry seasons) from Table 7.4, based on Mann-Whitney U rank. See Table 7.4 for category names.

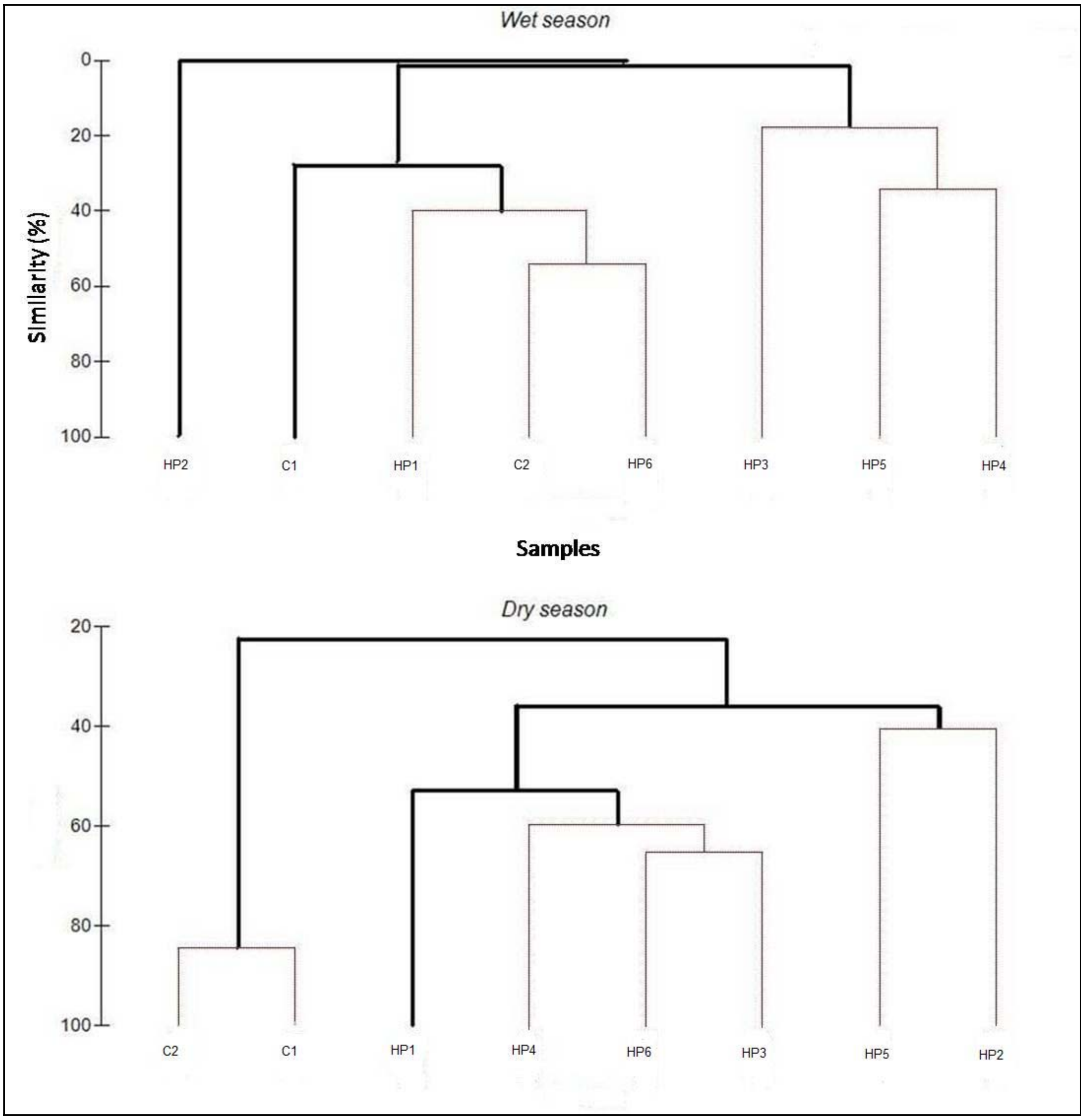

Figure 7.9 Cluster analysis (Bray-Curtis similarity) of all the grab stations based on similarities in biological traits composition (square-root transformed pooled biomass × categories) for the wet and dry seasons. Branches connected to each solid line showed significance differences (SIMPROF, $p < 0.05$) in traits structure.

7.3.5 Benthic epifauna

In the wet season, crustaceans were the most dominant taxa group for C2 (96%), C1 (93%) and HP6 (49%), while echinoderms dominated at HP5 (84%) and molluscs at HP4 (56%) and HP3 (100%) (Table 7.5). No animals were recorded at the two most inner stations, HP2 and HP1. The top ten dominant species in the wet season were: *Dorippe facchino, Schizaster lacunosus, Bucardium fimbriatum, Metapenaeopsis palmensis, Cavernularia* indet.*, Bucardium asiaticum, Lovenia subcarinata, Portunus (*cf. *trilobatus), Placamen calophyllum* and *Harpiosquilla harpax*.

In the dry season, crustaceans were the most dominant taxa group for HP1-HP5 (77-98%), while echinoderms dominated at C2 (95%) and HP6 (66%). Molluscs were most attendant at C1 (76) (Table 7.5). The top ten dominant species in the dry season were: *Ophiura kindbergi, Bucardium asiaticum, Portunus (*cf. *trilobatus), Luidia hardwickii, Portunus hastatoides, Metapenaeopsis barbata, Portunus* (cf. *crenata*), *Dorippe facchino, Metapenaeus affinis* and *Bucardium fimbratum.*

Table 7.5 Dominant taxa at each trawling sampling station, measured in percentage, for the wet and dry season. Crustacea (C), Echinodermata (E), Mollusca (M) and Others (O).

Taxa	C2	C1	HP6	HP5	HP4	HP3	HP2	HP1
				Wet season				
C	96	93	49	1	22	0	0	0
E	0	2	8	84	0	0	0	0
M	2	4	41	9	56	100	0	0
O	2	1	2	6	22	0	0	0
Total	100	100	100	100	100	100	100	100
Taxa	C2	C1	HP6	HP5	HP4	HP3	HP2	HP1
				Dry season				
C	4	13	26	77	85	87	98	98
E	95	11	66	21	14	13	1	1
M	1	76	5	1	1	0	0	0
O	0	0	2	1	0	0	0	0
Total	100	100	100	100	100	100	100	100

In the wet season, the trawling station HP5 had the highest mean biomass (2,308 g/10^4 m^2), followed by C1 (2,060.60 g/10^4 m^2) and C2 (1,812.70 g/10^4 m^2) (Table 7.6). The species composition showed a clear gradient which was highest towards the control stations in Mirs Bay C1 (39/10^4 m^2) and C2 (37/10^4 m^2) and decreased inwards, at HP6 (25/10^4 m^2) and HP5 (14/10^4 m^2), in Tolo Channel. Inside Tolo Harbour, the species composition was decreased to 5/10^4 m^2 (HP4) and 2S/10^4 m^2 (HP3) and the innermost part at HP2 and HP1 were dead zones. C2 had the highest total abundance (430/10^4 m^2) followed by C1 (403/10^4 m^2), HP5 (113/10^4 m^2) and HP6 (110/10^4 m^2). The $\log_e$ Shannon diversity (H') was highest and the same for HP6 (1.52) and HP4 (1.52), followed by the control stations C2 (1.15) and C1 (0.79) (wet season, Table 7.6).

A different pattern occurred in the dry season, with a more even average biomass, species composition, abundance, evenness and diversity through the sampling stations, compared to the wet season (Table 7.6). The gradient of the indices was generally reduced. The highest average biomass was found at the control station C1 (1,761.54 g/ 10^4 m^2) on Mirs Bay. HP6 had the highest species composition (48/10^4 m^2), while HP5 occurred with the largest abundance (527/10^4 m^2). The highest Shannon diversity (H') was found at HP1 (2.06) and HP2 (2.02).

Table 7.6 Summary of mean biomass ($g/10^4\ m^2$), mean species ($S/10^4\ m^2$), mean individuals ($N/10^4\ m^2$), Pielou evenness (J') and $\log_e$ Shannon diversity (H') for all the trawling stations in both seasons. Data on biomass, species and individual are the mean of six replicates while the Pielou and Shannon diversity is the pooled data of six replicates. Standard deviation (± SD) is marked beside the number.

Site	Biomass ($g/10^4\ m^2$)	S ($/10^4\ m^2$)	N ($/10^4\ m^2$)	J'	H'($\log_e$)
			Wet season		
C2	1812.70 ±423	37±3	430±85	0.32	1.15
C1	2060.60±491	39±1	403±110	0.21	0.79
HP6	956.20±1248	25±3	110±74	0.47	1.52
HP5	2308.3±901	14±1	113±47	0.27	0.71
HP4	8.40±8	5±1	1±1	0.94	1.52
HP3	2.10±4	2±0.5	2 ±0.5	1	0.69
HP2	0	0	0	0	0
HP1	0	0	0	0	0
			Dry season		
C2	435.51±186	26±3	505±471	0.22	0.73
C1	1761.54±698	29±3	504±262	0.29	0.97
HP6	560.55±134	48±6	527±432	0.43	1.67
HP5	628.74±229	26±1	407±129	0.54	1.78
HP4	755.94±179	21±1.5	326 ±68	0.39	1.21
HP3	501.81±238	15±1.3	135±40	0.42	1.14
HP2	233.80±167	13±0.8	44 ±19	0.78	2.02
HP1	134.22±101	14±2	25 ±12	0.78	2.06

Figure 7.10 illustrates the cluster results from multivariate analysis (Bray-Curtis similarities, log (X+1) transformation and average data) for both seasons. The general pattern showed that nearby stations were clustered together. The differences increased through the hypoxic gradient in the wet season with low faunal similarities (0-54% abundance, 0-36% biomass). C1 and C2 showed no significant differences for abundance in the wet season (SIMPROF, $p > 0.05$) and the biomass clustered two more nearby station together (HP5 and HP6). The trawling samples from HP1 and HP2 collected in the wet season were empty. In the dry season, the differences also occurred, but with more faunal similarities (22-61% abundance, 29-74% biomass). Two large groups clustered together showing significant differences in epifaunal abundance (SIMPROF, $p < 0.05$). The cluster of the biomass data showed two large groups and four smaller ones, which showed no significant differences (SIMPROF, $p > 0.05$).

When comparing all the data and all the replicates from both seasons, the results from ANOSIM (two-way crossed) showed that there were significant differences in the epifauna among stations (abundance: Global $R = 0.728$, $p < 0.001$, biomass: Global $R = 0,739$, $p < 0.001$) and between seasons (abundance: Global $R = 0.876$, $p < 0.001$, biomass: Global $R = 0.884$, $p < 0.001$).

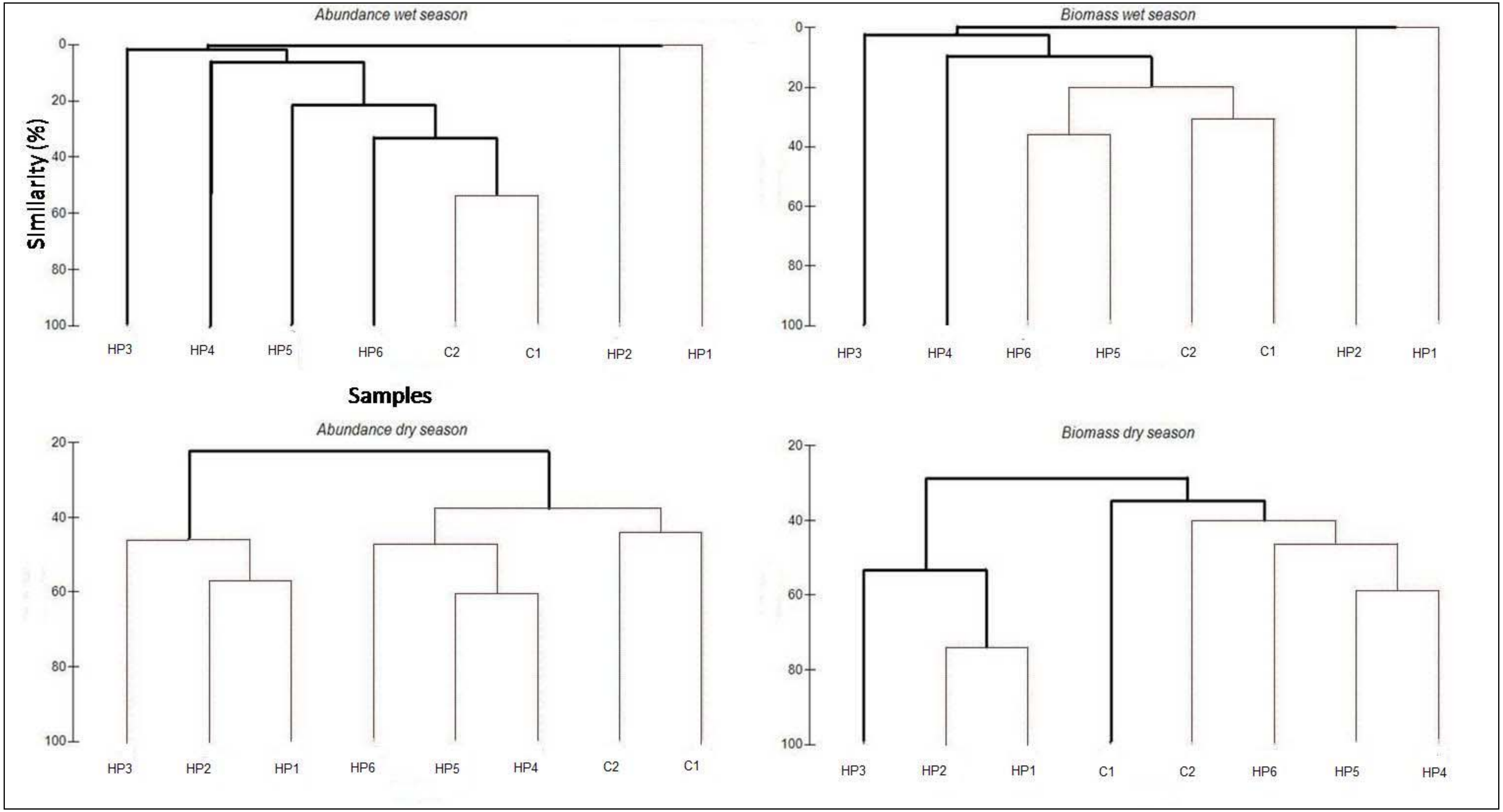

Figure 7.10 Hierarchical cluster analysis of the epifauna measured for both seasons (Bray-Curtis similarities, Log (X+1) transformation). Branches connected to each solid line showed significant differences (SIMPROF, $p < 0.05$) in community structure.

7.3.6 Species Abundance Distribution (SAD) for the epifauna

The dry season was found to have more rare species (represented only once) in the pooled samples, compared to the wet season (22/0.48 km^2 *vs.* 16/0.48 km^2, Fig. 7.11). The opportunistic species (total abundance between 4,096/0.48 km^2–8,191/0.48 km^2) were represented by one species in both seasons (wet season: the crab *Dorippe facchino*, dry season: the echinoderm *Ophiura kinbergi*). The top five species (total abundance) for the wet season were: *Dorippe facchino* (4373/0.48 km^2), *Schizater lacunosus* (574/0.48 km^2*), Bucardium fimbriatum* (219/0.48 km^2), *Metapenaeopsis palmensis* (201/0.48 km^2) and *Cavernularia* indet. (107/0.48 km^2). In the dry season, the top five abundant epifaunal species were: *Ophiura kindbergi* (4,466/0.48 km^2), *Bucardium asiaticum* (2,293/0.48 km^2), *Portunus (cf trilobatus)* (1,808/0.48 km^2), *Luidia hardwickii* (1,715/0.48 km^2) and *Portunus hastatoides* (1,344/0.48 km^2).

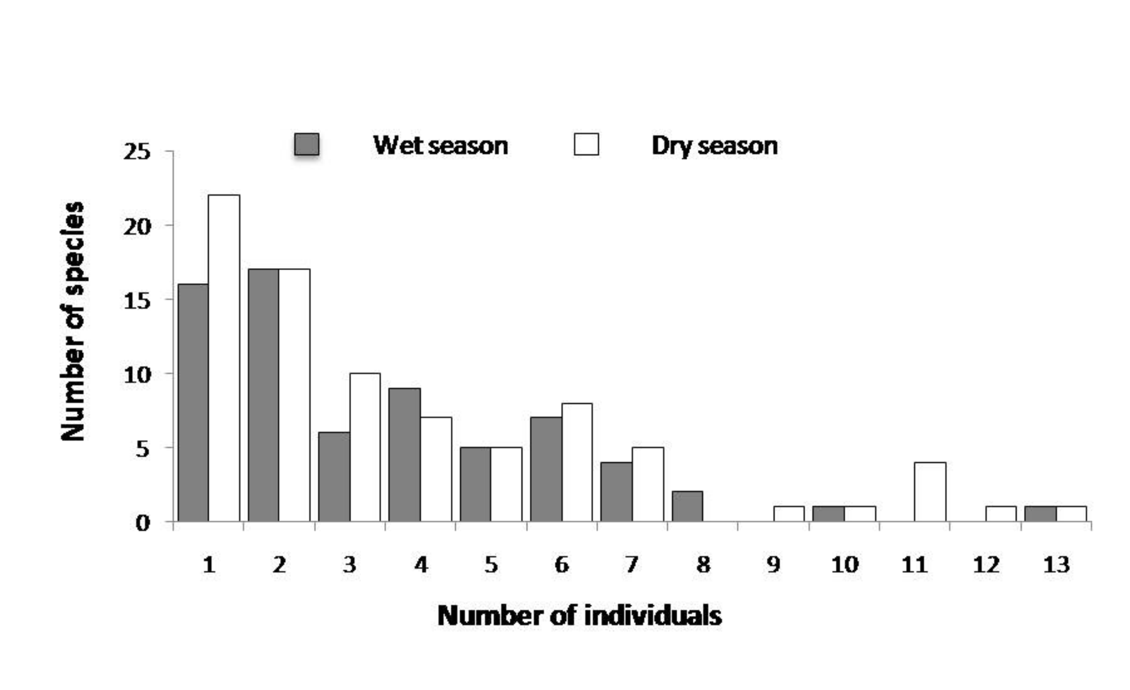

Figure 7.11 SAD for the wet (grey bars) and dry (white bars) season using abundance category of modified $\log_2$ classes.

7.3.7 Biological traits analysis for the epifauna

Non-parametric Mann-Whitney U test showed significant differences in traits composition of the epifauna between the seasons. Fifty-eight percent (21 categories of 36) of all the categories occurring were significant (Table 7.7 and histogram in Fig.7.12). Non-mobility, cylindrical body form, permanent attachment and sessile habitat type were more important categories during the wet season and the remaining 17 categories had higher diversity during the dry season (Table 7.7). The differences in traits diversity was related to the high biomass occurring in the dry season.

Table 7.7 Significantly different biological traits of the epifauna as tested by non-parametric Mann-Whitney U between wet/dry seasons for biological traits weighted with biomass (log (X+1) transformation).

Trait	Categories	Code	Significant values	Rank Wet/dry
Size	3-6 cm	NS4	$p<0.001$, $U=591$	1767/2889
Size	6-10 cm	NS5	$p=0.037$, $U=869$	2045/2611
Size	>10 cm	NS6	$p<0.001$, $U=564$	1740/2916
Larval type	Planktotroph	LT1	$p<0.001$, $U=641$	1817/2839
Larval type	Lecitotroph	LT2	$p=0.023$, $U=847$	2023/2633
Mobility	None	AM1	$p=0.049$, $U=917$	2563/2093
Mobility	Low	AM2	$p=0.020$, $U=840$	2016/2640
Mobility	High	AM4	$p<0.001$, $U=561$	1737/2919
Body form	Cylindrical	BF1	$p=0.036$, $U=904$	2576/2080
Body form	Dorsally flat	BF2	$p<0.001$, $U=680$	1856/2800
Body form	Laterally flat	BF3	$p<0.001$, $U=374$	1550/3106
Body form	Irregular	BF6	$p=0.007$, $U=791$	1967/2689
Attachment	None	DA1	$p<0.001$, $U=665$	1841/2815
Attachment	Permanent	DA3	$p=0.049$, $U=917$	2563/2093
Habitat	Sessile	AH1	$p=0.041$, $U=908$	2572/2084
Habitat	Burrower	AH4	$p=0.038$, $U=872$	2048/2607
Habitat	Surface crawler	AH5	$p<0.001$, $U=586$	1762/2894
Feeding	Surfacedeposit feeder	FH3	$p=0.001$, $U=756$	1932/2724
Feeding	Detritus	FH6	$p<0.001$, $U=456$	1632/3024
Feeding	Scavenge	FH7	$p<0.001$, $U=299$	1475/3181
Feeding	Carnivore/detrivore	FH8	$p<0.001$, $U=679$	1855/2801

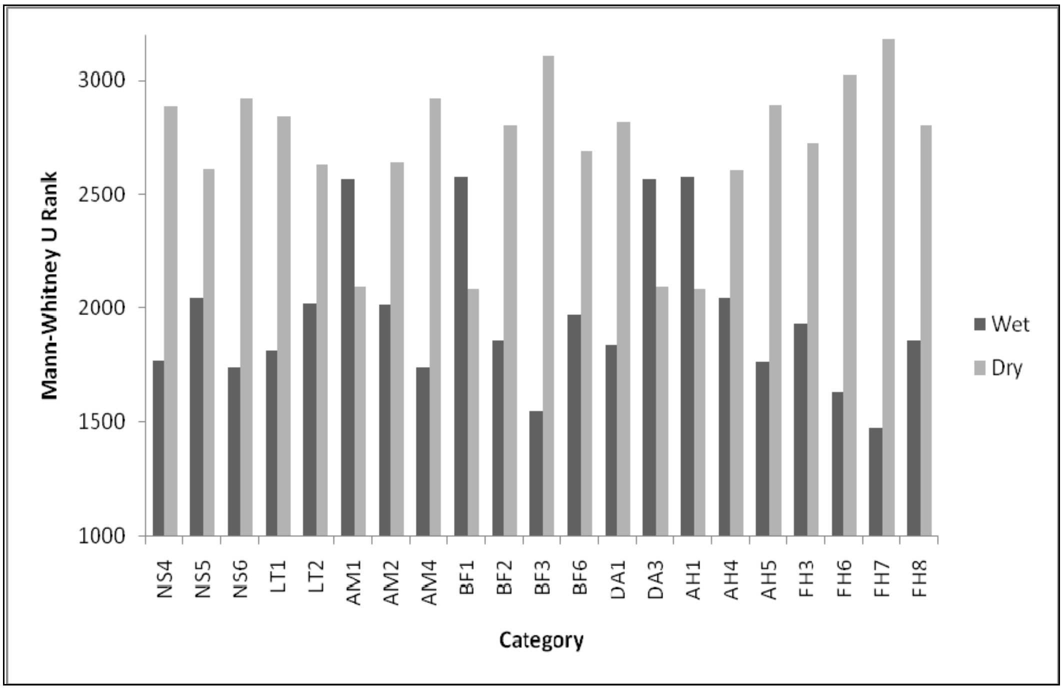

Figure 7.12 Histogram of the significant categories based on non-parametric Mann-Whitney U rank. The log (X+1) biomass of the epifauna was weighted with biological traits occurred in the wet and dry seasons. See Table 7.7 for category names.

Cluster analysis, illustrated in Figure 7.13 for the wet season, showed a clear gradient, with significant similarities in biological traits composition for the epifauna of nearby stations (HP6 and HP5, SIMPROF test $p < 0.001$; C2 and C1, SIMPROF test $p < 0.001$; HP4 and HP3 SIMPROF test $p < 0.001$). HP2 and HP1 occurred as a dead zone in the wet season, without record of any animals. In the dry season, the biological traits diversity was divided into two large branches (HP2 and HP1, SIMPROF test $p < 0.001$; C2, C1, HP6, HP5 and HP4, SIMPROF test $p = 0.005$).

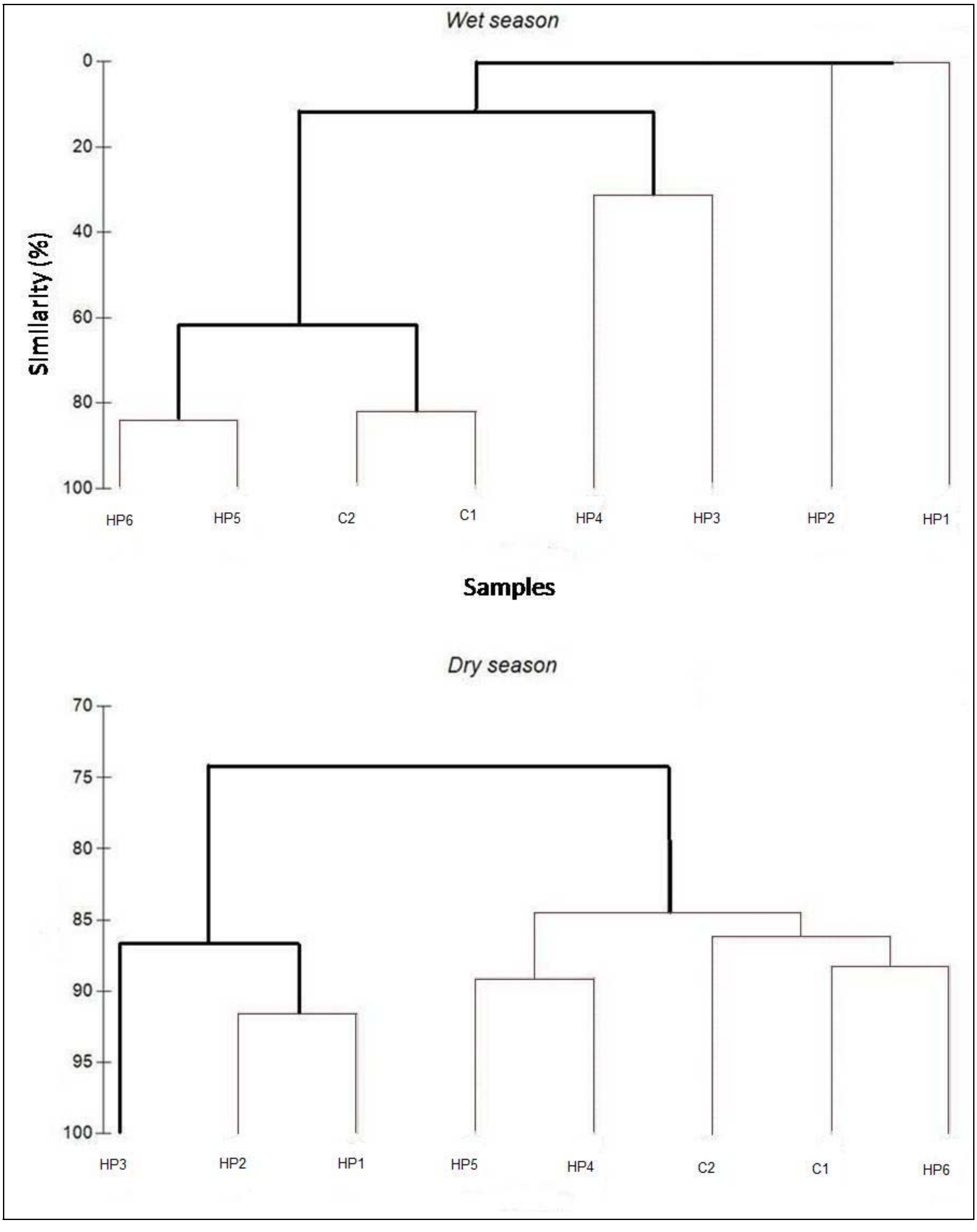

Figure 7.13 Cluster analysis (Bray-Curtis similarity) of all the trawling stations based on similarities in biological traits composition (log (X+1) transformed, pooled biomass × categories) for the wet and dry season. Branches connected to each solid line showed significant differences (SIMPROF, $p < 0.05$) in biological traits structure.

7.4 Discussion

7.4.1 Impact of the structure of infauna and epifauna to seasonal oxygen changes

Organic pollution and eutrophication arising from poor water circulation and dispersion are a problem in Tolo Harbour and have caused major changes in the structure of phytoplankton, fish and benthic communities (Wu & Richards 1979; Horikoshi & Thompson 1980; Wu 1988; Yung et al. 1997; Lee & Arega 1999; Shin 2003; Lui et al. 2007). The differences in the macrobenthic communities between the rainy season and the dry season are significant in Hong Kong waters (Wu 1982, 1988). At the end of the rainy season for this study, there was a clear hypoxic gradient from the control stations in Mirs Bay towards Tolo Channel and the inner Tolo Harbour. The dissolved oxygen increased after trawling at the upper layers of sediment and bottom waters (1 cm below the sediment surface, and 1 cm, 50 cm and 1 m above the sediment surface), except for HP2, which showed the opposite pattern. The pattern of species, abundance and biomass for the infauna decreased with increased total organic gradient (TOC). Tolo Harbour and Tolo Channel have suffered from an increasing trend of organic matter and decreasing trend of infaunal biodiversity since 1975 (Shin 2003). The opportunistic polychaetes *Chaetozone setosa* appeared to have increased in abundance the last 37 years, while the two polychaetes *Aglaophamus* sp. and *Sigambra* sp., have decreased in abundance but are still two of the most dominant organisms in the infaunal community. The bivalve *Moerella iridescens*, ophiurida *Amphioplus laevis*, echinoderm *Lovenia subcarinata* and polychaeta *Prionospio malmgreni* were not recorded in the survey from 1995-1999 and clearly support Shin (2003) that there is a species shift, through time, in the investigated areas.

The epifauna followed a similar pattern, with highest biomass, species composition and abundance through the gradient, with few to no animals inside Tolo Harbour, to an increase towards the control stations outside Tolo Channel. Wu (1982) carried out a detailed study of epibenthic communities in Tolo Harbour and Tolo Channel from 1978-1980 and reported similar findings with higher species diversity, abundance and biomass in outer part of Tolo Channel, reflecting changes in the trophic structure related to organic pollution. In the dry season, for this study, the DO levels were high at all the stations, and the differences after trawling were not as distinguishable in the bottom waters (50 cm and 1 m above the sediment) as for the wet season. A high mortality occurred in the summer, with regard to the low oxygen in the inner part of Tolo Harbour (Wu & Richards 1979; Horikoshi & Thompson 1980; Wu 1982), but the community managed to restore itself to normal during the higher oxygen period in the winter through rapid re-colonization (Wu 1988). Similar results in benthic mortality, with regard to reduced oxygen levels, have been recorded in Gullmar Fjord in Sweden (Josefson & Widbom 1988; Rosenberg et al. 2002).

The infauna and epifauna showed significant differences among the stations and between seasons, with a lower abundance and biomass in the wet season, when high mortality occurred. Some invertebrates may be more likely to remain, or escape, low oxygenated water than the others, owing to differences in tolerance and movement responses to hypoxia (Pihl et al. 1991; Bell et al. 2005). The blue crab (*Callinectes sapidus*) has shown a strong avoidance response to chronic hypoxia and episodic hypoxic upwelling events in the Neuse River Estuary, North Carolina, USA (Bell et al. 2005). The amphipods *Monoporeia affinis* and *Pontoporeia femorata* have been observed to increase their swimming activity when oxygen concentrations decreased (Johansson 1997). Riedel et al. (2008) studied the behavioural responses of benthic macrofauna to low dissolved oxygen in the Northern

Adriatic and documented changes and rapid mortality sequences of the infauna and epifauna over a five-day period. They used an underwater-chamber, equipped with a camera, to induce small-scale experimental anoxia *in situ* at 24 m depth. Both in- and epifauna showed behavioural responses to hypoxia, which can be interpreted as avoidance patterns, to optimize oxygen consumption. McAllen et al. (2009) investigated the annual oxygen changes in Western Trough of the Lough Hyne Marine Reserve in southern Ireland and observed that most of the mobile fish and crustaceans avoided the hypoxic areas, while some crustaceans, such as the prawn *Palaemon serratus* ventured into the hypoxic zone to scavenge on baits. The penaeid shrimp, *Metapenaeus ensis*, appeared to be sensitive to hypoxia, and their ability to detect and avoid hypoxia may enhance their survival in habitats where hypoxia may occur (Wu et al. 2002). In this study, the epifaunal communities, as expected, had a higher abundance and biomass in the dry season when the oxygen level increased inside Tolo Harbour. Communication with commercial fishermen showed that they target crustaceans (mantis shrimps and crabs) in the study area. They change their fishing pattern from fishing inside Tolo Harbour to outside Mirs Bay during the wet season and reverse the trawling direction during the dry season. This reflects the lower biomass in the wet season and higher biomass of the epifauna in the dry season inside Tolo Harbour. The size of the crustaceans found inside was too large to be indicative of newly recruited species, suggesting that mobile organisms may use the outer part of Tolo Harbour as a refuge during the wet season, when there is low dissolved oxygen at the bottom and move inwards again when the oxygen level increases. The groundwater in the Tolo catchment increases during early summer months when the rainfall increases (Paul Hodgson, not published). Such groundwater is not only limited under the land but also continued under the coastal areas. When the pressure of the ground water increases and the reservoir (see

Fig. 7.1, Plover Cove, formed from enclosure of the sea by dams in 1960s) is full, a small amount of fresh water seeps up, from below, into the sediment at the sea bottom (Hodgson, pers. com.). This may be an early signal for the epifauna to start to move out of the areas into more oxygenated water. Mobile species are clearly capable of avoiding the hypoxic zone in summer and can benefit from its productivity in winter and spring (McAllen et al. 2009).

The rapid re-colonization in the winter is mostly due to the infauna which lack mobility skills, as compared to the majority of the epifauna. Lu & Wu (2000) examined the re-colonization and succession of macrobenthic infauna in Hong Kong waters and the time required for recovery from an unstable to a stable community. They documented rapid colonization of the infauna. Results of their study suggested that newly available sediment, that is not stable (such as after high mortality during the wet season), may allow more species to colonize than sediment which is pre-occupied by an established community (such as in the end of the dry season). Recoveries of benthic habitat and fauna have been shown to have the ability to return to the same faunal composition as before, under the pre-disturbed oxygen conditions (Rosenberg et al. 2002). Lui et al. (2007) studied the diversity and abundance of commercially important decapods and stomatopods in Tolo Harbour and Channel. They reported spatio-temporal variations in species community structures and suggested this variation appeared to be related to differences in environmental variables, such as salinity and dissolved oxygen. Rapid recovery was detected after three months. Hodgkiss (1984) studied seasonal patterns of intertidal algal distribution in Hong Kong and reported that 41 of 58 algal species disappeared during the summer and came back again in the winter, when the conditions turned more favourable for them. Wear et al. (1984) also reported a higher biomass of zooplankton in the winter, in Tolo Harbour. The present study, thus, supported the findings in annual changes occurring in Tolo sediments, and as expected, infaunal composition in highly hypoxic areas shifted from K-selected to r-selected species, with decreased species diversity and increased abundance of opportunistic species, with a significantly higher population of small body sized inhabitants in the wet season. Also for the epifauna, it was anticipated that opportunistic and small body size species would be abundant under more hypoxic conditions. However, the significant BT characteristics of the few species which remained in the summer hypoxic conditions (non-mobility, cylindrical body, permanent and sessile attachment) suggested adaptations (rather than opportunism and small body size) to low DO levels.

The occurrence of rare species appeared to increase for both infauna and epifauna in the dry season. This increase in rare species in the dry season may be due to more favourable environmental conditions, as well as to new species being recruited into the areas. Most planktonic organisms die before reaching the adult stage. When environmental factors are more beneficial (e.g., good oxygen supply, less competition from other organisms, good food scources, plenty of space), organisms have a greater chance to reach maturity. Chances for survival decrease when environmental factors are less favourable (e.g., during the wet season in Hong Kong). The above effects were observed during this study, as shown by the increased numbers of rare species observed during the dry season and the decreased numbers during the wet season.

7.4.2 Impact of BTs to seasonal oxygen changes

Biological traits analysis was performed in this study to identify significant differences between the wet and dry season for infauna and epifauna. There were significant differences in biological traits composition between the seasons for the infauna (14%) and epifauna (58%). A size less than 5 mm, medium mobility, dorsally flat body form, permanent tube habitat and scavenger feeding type had the highest rank sum from the Mann-Whitney U test and were the most important traits in the wet season for the infauna. The biological traits diversity for the infauna showed significant similarities among the inner and outer stations and stations inside Tolo Channel. A different trend occurred in the dry season, in which the two control stations in Mirs Bay shared similar traits composition. The clearest traits gradient (increasing abundance × traits from inner part of Tolo Harbour to outer part of Mirs Bay) appeared for the epifauna which followed the same trend as the biodiversity and level of oxygen. This gradient disappeared in the dry season, resulting in fewer stations with similar biological traits diversity. The traits composition at the control stations in Mirs Bay in the wet season could be compared with similarities with the dry season, suggesting that traits pool may always be available in the area and ready to spread inwards when the environmental conditions in the harbour have improved and become more favorable for re-colonization of the marcobenthos.

For the epifauna, non-mobility, cylindrical body form, permanent attachment and sessile habitat type were important categories found in the wet season, suggesting difficulties for these organisms to move away from the source of hypoxia. These organisms may have evolved a biological traits combination which can successfully survive in this harsh, low-oxygen time. This is according to the hypothesis that traits such as low mobility and small size species will be the most dominant traits in areas with low levels of oxygen (Rosenberg et al. 1991; Breitburg 2002). The differences in traits diversity are connected to the high biomass of crustaceans and echinoderms occurring in the dry season (affinity score weighted with transformed biomass), implying that the majority of the species can escape the low oxygen during the wet season. Larger size, mobile organisms with dorsally or laterally flat and irregular body forms, feeding on other live animals, detritus feeding or scavengers were among the important traits in the dry season for the epifauna. Supporting views suggested that biological traits, such as feeding strategy and mobility, could be important variables of the benthic community (Bremner et al. 2003; Tillin et al. 2006) and could be good references to use in multivariate analysis to understand benthic ecology in hypoxia-impacted systems.

Chapter 8 General Discussion and Conclusions

8.1 General discussion

The effects of trawling on benthic habitats and communities have received much attention in recent years. Photographic and video evidence of the destruction of reefs by trawl gear has led researchers to ask if trawling could be similarly destructive to soft-bottom benthic communities. In order to answer this question, scientists from all over the world have conducted many studies over many years (Chapter 2). Trawling does have an impact on soft-bottom benthic communities but the impact is far less destructive to soft-bottom communities than to coral reefs. One of the concerns of trawling disturbance on soft-bottom benthic communities is how this affects the biological traits (BTs) of the dominant species and the proportion of rare species within the community structure. In this study, biological traits analysis (BTA) was used together with traditional biodiversity analysis to investigate how the structure and function of infaunal communities were affected by low trawling and no trawling in two different water masses (Arctic and Atlantic) and high trawling frequency in waters with annual hypoxia (hypoxic gradient on infauna and epifauna). Additionally, the effects of trawling on the infauna of three coastal systems were studied: a fjord system in Norway (heavily trawled sites compared to non-trawled sites), an upwelling system in southern Africa (heavily trawled sites compared to lightly trawled sites) and a subtropical system in Hong Kong (heavily trawled sites compared to a non-trawled, marine protected area (MPA).

This study has demonstrated the importance of BTA for examining ecosystem changes due to trawling. In addition, this study has confirmed the importance of the traditional method of biodiversity analysis in order to examine the effects of trawling on soft benthic communites. The combination of these two analysis techniques may provide a useful tool for biomonitoring and conservation. Results from one part of this study have shown that, in the two different water masses of the Arctic and Atlantic, the biological traits that contributed to the community structure were similar but their significance depended on the abundance of the species. Nevertheless, the species composition and the environmental factors were different in each of these water masses (Chapter 3). BTA, in conjunction with biodiversity analysis, has been shown to provide useful information on ecosystems impacted by different trawling intensities (Chapters 4, 5 and 6) and on trawling-impacted systems exposed to annual reductions in oxygen levels (Chapter 7). All of these systems showed changes in structure and functioning (differences in abundance, biomass, taxa, amount of rare species and significant BTs) due to trawling, albeit to different degrees. However, the fact that some of the investigated systems appeared to be beneficially influenced by trawling was surprising and this has given rise to several questions:

1. Are the changes to soft-bottom benthic communities caused by trawling always negative?
2. Can MPAs provide a solution to protect biodiversity in soft-bottom benthic communities?
3. Can the combination of BTA and traditional biodiversity analysis provide new insights into the “structure and functioning” debate of impacted marine systems?

1. Is trawling good or bad?

It may be possible to answer this question by considering the different effects of various levels of trawling intensity. Three different fishing areas, with different levels of trawling intensity, were chosen for a comparative study: Hong Kong, Norway (the Oslofjord) and South Africa. Hong Kong has extremely intense fishing pressures (approximately 300–350 trawl paths, over the same area, per year); the Oslofjord is ranked second with a strong trawling frequency (approximately 50–100 trawl paths, over the same area, per year); while South Africa is ranked third, with a high to light trawling frequency (approximately 10–70 trawl paths, over the same area, per year). The results showed that Hong Kong had the lowest total species richness and the lowest amount of rare species; while, conversely, South Africa had the highest total species richness and the highest amount of rare species. The amount of species richness and rare species found after trawling in Norway was a mid-value between Hong Kong and South Africa. This supports the conlusions from previous studies that the impact of trawling on biodiversity is dependent on the trawling intensity (Walker 1992; Enticknap 2002) and geographic areas (Thrush et al. 1995; Currie & Parry 1996; Kaiser & Spencer 1996). Although the effects of trawling vary from place to place, one would reasonably expect a greater negative effect to be observed at trawled sites, as compared to their respective control areas (i.e., areas with low or no trawling activity). However, the results of this study showed that this was not always the case.

In Hong Kong, the effects of hypoxia appeared to be more important than the impact of trawling (Chapter 6), such that, in areas exposed to severe hypoxia, the benthic community actually appeared to benefit from trawling (Chapter 7). However, the higher abundance and biodiversity of infauna noted at the trawled sites in the Oslofjord was more difficult to explain (Chapter 4). The Intermediate Disturbance Hypothesis (IDH) (see Chapter 2), which proposes that biodiversity is highest when the disturbance is of an intermediate level, has not been directly tested in this study, but it may play a role when the trawling intensity is varied. There is a greater probability that some species with important traits will be present when biodiversity is higher or when there is a greater number of BTs. This was noted at the trawled sites in the Oslofjord. High diversity might not be necessary to maintain ecosystem functioning when environmental conditions are favourable; however, under changing environmental conditions, it may be more advantageous to have more species because they might respond differently to environmental fluctuations (Walker 1992). Even though the IDH may explain an increase in species richness at intermediate levels of disturbance, this does not provide evidence that trawling is beneficial because the consequences of such complex impacts on biodiversity are not fully understood (Gray et al. 2006). Parts of this study (Chapters 4 and 6) have shown that both the biodiversity and the amount of rare species are higher in trawled areas, compared to their respective control areas. However, this does not suggest that bottom trawling has a net positive effect on the ecosystem in general. This is because the effects of trawling on benthic communities may be influenced both by known factors (habitat, grain size, fishing gear type and fishing intensity) and by factors that are not well studied in relation to trawling (current speeds, annual changes in salinity and oxygen, biological factors, such as predators from nearby reefs, and shipwrecks or other structures at the bottom acting as reefs). The influences of the latter factors on infaunal communities have not been thoroughly investigated; therefore, further research is needed.

2. Marine Protected Areas (MPAs)

The intensity of human pressure on marine systems has led to stronger marine conservation efforts and MPAs have become a highly advocated form of marine conservation (Allison et al. 1998; Kapland 2009). Several areas in Hong Kong are protected from the direct impacts of human pressure (Chapter 6). It is difficult to manage and control changes in marine systems and there are many examples in which commercially-exploited fish species have almost been eliminated as a result of over fishing. The MPAs frequently serve as potential refuges for commercially-exploited fish, but they can also provide a buffer when recruitment of the stock fails. An expected benefit of MPAs is to increase the species biodiversity, biomass and the fecundity (e.g., García-Charton et al. 2008; Stobart et al. 2009). MPAs restrict human impact on marine environments and, therefore, provide an important role in protecting some critical areas, such as nursery grounds, spawning grounds and foci of high species diversity (Allison et al. 1998). Because MPAs restrict human activities (boating, fishing, swimming, etc.), they are most useful where the threats from fishing, pollutants and habitat disturbances are most intense. When a fish population is relieved from fishing pressure, that population may become structured by natural mortality instead of fishing mortality. MPAs could, therefore, increase the density and average size of the fish population (Kapland 2009). Because larger, older individuals are typically much more important to reproduction in a population than young, small individuals (the notion of Big Old Fecund Females (BOFFs), see Berkeley et al. 2004), this change in the fish population structure could drastically increase the reproductive output of the population protected within MPAs and reserves (Allison et al. 1998). Another benefit of MPAs and reserves is that species with high dispersal abilities can respond to protection in MPAs when fishing pressure outside MPAs is high (Micheli et al. 2004).

The fundamental assumption for the use of MPAs is that they protect the population within their boundaries (Kapland 2009). However, in the marine environment this assumption does not always hold true, due to the many processes that are unique to specific environments (e.g., hydrographic circulation patterns, periodic events like hypoxia or the presence of artificial reefs). There are several factors that may affect the ecosystem within MPAs. Some of these factors are as follows: the size and the location of the MPAs (Horwood 2000; Meyer et al. 2007), ocean currents (which have a great influence on the dispersal of both organisms and pollutants) may have a significant influence over local area patterns (MPAs), the dispersal and migration patterns of marine organisms within the MPAs (McClanahan & Mangi 2000; Kaplan 2009) and the scales of fundamental processes in the ocean, which are much larger than those that MPAs are able to encompass.

In this study, the MPA in Hoi Ha Wan (Hong Kong) has shown a significant decrease in soft benthic biodiversity since the cessation of trawling. However, the overall biodiversity in the MPA does not show the same decrease. For example, the coral communities and fish stocks have increased since the Government closed the area to trawling (WWF HK, pers. com.). The intention for establishing this MPA was to increase coral and fish diversity and to protect the habitat of important type species (i.e., the particular species from which the genus is named) (Morton 1992). The seabed inside the MPA is believed to cycle through different successional stages. This change may lead to a less diverse community (see Chapter 6). Because of this, the MPA at Hoi Ha Wan may be less beneficial to the soft-bottom community than the coral and fish communities. This was evident when comparing the infaunal data gathered inside the MPA to data obtained from heavily trawled areas nearby, as well as to historical data obtained from inside the MPA (prior to the cessation of trawling). One explanation for the potentially higher levels of soft benthic invertebrates in trawled areas compared to the MPAs, is that bottom trawling ‘‘farms the sea’’ (Rijnsdorp & Van Beek 1991; Hiddink et al. 2008). The phrase “bottom trawling farms the sea’’ means that trawling removes the larger fauna which compete for food and space with small soft benthic invertebrates, thereby increasing production of the latter (Hiddink et al. 2008). Because of all of the underlying factors mentioned earlier that may affect the ecosystems within the MPAs, it is difficult to state any clear reason why the soft benthic community in Ho Hai Wan cycles through different successional stages.

3. Structure and functioning debate

There has been debate on which component of biodiversity is the most important, species diversity or functional diversity (Naeem 2002; Hooper et al. 2005; Micheli & Halpern 2005). All species may provide unique roles in the ecosystem and some species may have very similar functional roles (Halpern & Floeter 2008). It is not certain which theory is the most accurate and debate is ongoing in the scientific community (see Chapter 2). However, there is a consensus that a minimum number of species is essential for ecosystem functioning, under constant conditions, and that a larger number of species is probably important for maintaining the stability of ecosystem processes under changing environments. If either the Redundancy or the Rivet Theory is correct (Chapter 2), then the presence of more species could mean greater stability in an ecosystem. The Idiosyncratic Hypothesis presents a more realistic relationship, in which each species has an unpredictable effect on the ecosystem (Chapters 2 and 3). However, most of the theoretical and experimental studies conducted thus far have been based on a few species, in a single trophic level, with few functional traits (Halpern & Floeter 2008). The present study conducted an analysis of multiple traits for all taxa, including rare species. Using too few species and too few BTs in an ecosystem analysis may constrain the number of functional groups to a small division of ecosystem functions and may result in an artificial relationship

(Halpern & Floeter 2008). This may produce conflicting outcomes (Mayfield et al. 2005; Micheli & Halpern 2005) and may also create an unrealistic picture of ecosystem functioning.

A practical difficulty, that marine ecologists encounter, comes from the environment with which they have chosen to work, i.e., the sea. Terrestrial environments generally pose fewer practical problems to terrestrial ecologists who have already identified several difficulties in interpreting their experimental findings. The same underlying principles govern the composition of communities in marine systems and, therefore, the structure-function debate should be just as valid in marine and freshwater ecosystems as it is in terrestrial ecosystems (Lecerf & Richardson 2009). The structure-function debate has, for some reason, been less widespread in the field of marine research. Traditionally, marine ecologists have focused on either the effects of individual species, or have ignored individual species and concentrated on gross measures of ecosystem processes, e.g., the calculation of nutrient budgets and the flux of whole ecosystems (Emmerson & Huxham 2003). Marine ecologists often use measures of rates per unit area, per time, to express ecosystem processes (functions). Common parameters for this are PO_4 (phosphate), NH_4 (ammonia), NO_3 (nitrate), NO_2 (nitrite), CO_2 (carbon dioxide) and O_2 (oxygen) and units of secondary production are commonly measured in g/cm^2/yr. In general, the range of research among marine ecologists has been either too specific or too general to make any direct contribution to the structure-function debate. However, it has been suggested that these data sources, which are very abundant, should be revisited with the structure-function debate in mind (Emmerson & Huxham 2003). A synthesis of 15 studies showed that the production of NH_4 from sediments appeared to increase with increasing species richness (Emmerson & Huxham

2003). Even though this synthesis was based on data not originally intended for this use, it still revealed patterns.

Marine ecologists have performed a whole range of high quality ecological studies, including fieldwork, use of mesocosms, experimental investigations and empirical tests but, depite this, they have still contributed only modestly to the structure-function debate. A possible reason for this is that terrestrial ecologists have the advantage of being able to see the functional factors being measured, while marine benthic ecologists have little or no broad visual perspective because they often have to sample beneath the water surface. This could cause difficulties when it comes to estimating important ecological factors. The important factors for ecological functioning, as described by terrestrial ecologists, may or may not also be important in marine benthic systems. Wardle and Zackrison (2005) identified several factors such as: spatial scale, soil nutrient availability, trophic interactions, type of ecosystem functions considered and temporal factors that might affect the importance of diversity on ecosystem function. There is a lack of empirical evidence for such dependence in real ecosystems (Wardle & Zackrisson 2005) and it is suggested that more insight could be gained if it were possible to add more ecological and biological information within the defined communities. The more knowledge researchers have, the better they will be able help to preserve healthy ecosystems which, in turn has broad benefits beyond the immediate environment. An analysis of the biological traits (BTs) characteristics of the organisms in a marine ecosystem may be a useful tool (or technique) to indicate the health of that ecosystem. This technique was used extensively throughout this study. In order to ascertain the relative health of each system, BTs from organisms in impacted areas (e.g., trawled and hypoxic sites) were compared with those from non-impacted areas (e.g., MPAs). Although, biological traits analysis (BTA) does not directly measure the ecosystem processes (Bremner 2008), it may still provide important information on how structure and functioning are affected by disturbances (Dolédec et al. 1999; Charvet et al. 2000; Bremner 2008). By using BTA in this way, marine ecologists may be able to provide important contributions to the structure and functioning debate. This study indicated that rare species may play an important role in ecosystem functioning. An appreciation of this role, which was demonstrated in all the systems studied (Chapter 4-7), may contribute to the structure and functioning debate. In addition, this study showed that many different species exhibit the same combinations of BTs (Chapter 3). The Central Hypothesis (Chapter 2) was not directly tested, and the fact that organisms in this study (Chapter 3) exhibited the same BTs does not exclude the possibility of an idiosyncratic pattern in marine benthic communities.

8.2 Limitations

All marine scientific studies, especially those involving field observations and sampling, are inevitably limited by various factors. Small differences in environmental conditions can have a large effect on species diversity (Committee on Biological Diversity in Marine Systems 1995). Environmental factors (e.g., grain size, dissolved oxygen, temperature, salinity, pollution and artificial reefs) and/or biological factors (e.g., variation in species biodiversity and biological traits diversity) can act as hidden effects and bias the results, leading to misinterpretation of the data.

Another limitation which is important to bear in mind is that the BTs used in this study are only a small sub-set of all the possible traits an organism can perform. This inevitably limits the assortment of BT information that may be the most useful in ecological functioning. The process of selecting which BTs were used for this study was based on information taken from literature. Most of the latter information was based on taxonomic features and ecological observations. It is very difficult to carry out laboratory experiments on benthic species because most of the organisms will not survive sampling from deep waters. This, coupled with the relatively small amount of research carried out on soft-benthic species, has resulted in a general lack of BT information at the species level. To get around the lack of BT data, it was sometimes necessary to use information from the lower taxa levels of genus or family. Therefore, the BT information gathered on benthic species may not be sufficiently robust for a general extrapolation to all systems.

8.3 Suggestions for further work

A mesocosm is an *in-situ* experimental system that simulates the natural environment as closely as possible, whilst allowing the manipulation of specific natural factors (e.g., different levels of oxygen, nitrogen, nutrition or salinity). Manipulated mesocosm experiments, with different disturbance effects and different levels of hypoxia, may provide an understanding of how structure and functioning act in relation to each other.

Another interesting experiment would be to manipulate trawling intensity inside the MPA in Ho Hai Wan. The intention would be to investigate whether an intermediate disturbance, such as trawling, could increase benthic biodiversity. The biodiversity of the infauna inside the MPA in Ho Hai Wan has decreased drastically since the area was closed to trawling in 1997. If the Intermediate Disturbance Hypothesis is correct, then increasing the trawling inside the MPA to an intermediate level should lead to an increase in the biodiversity of the soft benthic organisms.

Systems biology, which is a relatively new area of study, is concerned with the understandlng of all aspects of an organism and its environment through the combination of a variety of scientific fields (Ideker 2004). Unfortunately, the focus has mainly been at the gene or cellular level, while the ecological information of the species has largely been ignored. The research opportunities in systems biology could be greatly enhanced by integrating BTs (e.g., phenotype characteristics, behaviours and interactions with other organisms) with the gene or cellular level studies. A large selection of database information on many marine benthic species at the 'micro-level' (e.g., genes, protein, cellular components and their interactions), is now available for research on the internet (e.g., The National Centre for Biotechnology Information, Census of Marine Life database and Animal Genome Size database). This information is growing rapidly and can be integrated with 'macro-level' data (e.g., biological traits). There are also several databases on the internet which provide BT information on a large number of marine species (e.g., The Marine Life Information Network, Marine Life Taxonomy, Profile & Database Web Resources). As a follow-up to this study, it is suggested that similar 'micro-level' and 'macro-level' information is transformed into numerical presence/absence data for marine benthic species. Each trait could be divided into smaller groups (categories) and the data could be combined into one large numerical matrix (where "1" represents presence and "0" represents absence) with a mix of BT/gene/cell/protein information. This method assumes that each species trait and its associated category have exactly the same definition. This means that the definition can vary among traits but never among species. The intention is to study both regular and irregular patterns of community structure, biological traits structure and cell/gene structure of which could lead to improved understanding of the forces of evolution in ecological functioning. There are some statistical programmes which can be used to analyze numerical absence/presence matrices. Multivariate analysis can also be conducted to reveal any patterns among species micro- or macro-traits. This approach to system biology has never been conducted before and may be a powerful tool to connect marine ecology with cell/gene biology.

8.4 Contributions to our knowledge and overall conclusions

The examination of BTs under different external disturbance conditions (e.g., trawling and hypoxia), may give rise to a better understanding of the effects and impacts of environmental stressors, as well as aiding predictions of the ecological consequences. Investigating changes in the relative proportions of BTs over time, together with traditional statistical methods, may provide a better analytical process for identifying impact-driven alterations to ecological functioning. This combined technique may offer more information on ecosystem monitoring, management and conservation.

Structural responses of benthic communities to trawling have been well studied for the past 15-20 years. However, only a limited number of studies, other than this one, have been conducted in which a combination of structure and function was utilized to investigate the ecological impacts of trawling. To understand the impacts of trawling more clearly, non-trawled, or lightly trawled, and trawled sites from different marine systems were compared to assess if ecological functioning is the same regardless of whether the structure differs. The reason for sampling in different water masses was to ascertain and compare the response of species composition and biological traits in areas with low (or no trawling) activities. This approach is new to marine research. The two areas (Arctic and Atlantic water masses) showed clear differences in taxonomic composition and relative abundance of taxa. When the traits information was taken into account, the differences between the two areas were not as distinct. When the traits information was scored on a presence/absence matrix, there were no significant differences between the assemblages. This suggested that the traits pattern is similar between the Artic and Atlantic areas, although environmental factors such as depth, grain size and total organic carbon content varied. From the 284 taxa identified, there were 23 taxa groups that shared exactly the same combinations of traits. All the shared groups were within the same genus or family. These results suggested that even when sampled from vastly different water masses, different species possess the same traits combinations and are not mutually exclusive of an idiosyncratic pattern.

The present study was the first attempt to use Biological Traits Analysis (BTA) together with traditional structural analysis in three marine systems in different parts of the world: the Oslofjord in Norway, an upwelling system off South Africa and an area in subtropical Hong Kong, with annual variations in levels of dissolved oxygen. In the Oslofjord study, samples were collected from trawled and non-trawled areas to compare the taxonomic and biological trait compositions of the two soft benthic communities. There were significantly higher numbers of species, individuals and diversity in the trawled locations compared to the non-trawled locations. The Intermediate Disturbance Hypothesis may provide an explanation for these findings since the hypothesis predicts that a certain degree of disturbance may enhance diversity.

In the South African study, infaunal biomass weighted by biological traits showed significant differences between heavily and lightly trawled areas for 17% of the traits investigated. Biological traits were also shown to differ significantly between areas having larger or smaller proportions of sand (12% of traits differed significantly) and mud (7% of traits differed significantly). This suggested that trawling disturbances have a greater contribution to the observed differences in biological traits than sediment composition.

In the Hong Kong study, heavily trawled sites inside the Tolo Channel were compared with sites located inside a Marine Protected Area (MPA) at Hoi Ha Wan, which has been closed to trawling since 1996. Structure and functioning of infaunal communities differed significantly between seasons. However, there were no significant differences in BTs between the trawled areas and the non-trawled areas (MPA). Seasonal changes appeared to be more important than the effects of trawling for both structure and functioning. When comparing the data gathered for this study with data taken prior to the closure of the area to trawling, biodiversity and abundance of the infaunal benthos have decreased dramatically inside the MPA. When considering the recovery of the benthic infaunal communities inside Hoi Ha Wan, there are three important factors to take into account: 1) cessation of trawling, 2) changes induced by protection of the area (e.g., when an area is protected from previous impacts, this itself is a change and may affect the biodiversity) and 3) the presence of artificial reefs, which make it difficult to deduce any clear, overall conclusions for the decreasing trend in biodiversity. Further long-term research on structural and functional diversity inside the MPA is recommended.

The present research is the first attempt to study trawling impacts on rare species and their total functional contribution to the BT pool. The amount of rare species is shown to be affected (whether they increase or decrease overall) by trawling activities and the number of rare species has an important contribution to the BTs they perform.

The present research is also the first attempt to study the impact of hypoxia in heavily trawled areas in Tolo Harbour (Hong Kong), with respect to the structure and functioning of benthic communities, in order to address ecological responses. Trawling was shown to increase the dissolved oxygen level in the upper layer of the sediment and in the upper layer of the sea bottom in the summer, when the oxygen level is low. The increase in oxygen levels, as a result of trawling in adverse environments (i.e., with low DO levels), may be of benefit to benthic species because their survival is facilitated under harsh conditions. A large amount of the epifauna in Tolo Harbour was absent in the summer and returned in the winter, suggesting that some species, sensitive to low levels of DO, are able to escape when the environmental conditions become adverse and return when conditions improve.

Chapter 9 References

9.1 References cited

Abesamis RA, Russ GR (2005) Density-dependent spillover from a marine reserve: Long-term evidence. Ecological Applications 15:5, 1798–1812

AECOM Environment (2009) Environmental Impact Assessment of Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link. MTR Corporation Limited. Environmental Impact Assessment Report. Consultancy Agreement No. NOL/ERL–300

Agriculture, Fisheries and Conservation Department (2002) Consultancy Study on Marine Benthic Communities in Hong Kong. Final Report, Centre for Coastal Pollution and Conservation, for Agriculture, Fisheries and Conservation Department, The government of the HKSAR, Hong Kong, PRC, December 2002

Agriculture, Fisheries and Conservation Department (2005) Report 2003–2005. http://www.afcd.gov.hk/misc/download/annualreport2005/index.htm

Agriculture, Fisheries and Conservation Department (2009) Fisheries: Capture Fisheries. http://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_latest/fish_cap_latest.html

Alden RW III, Weisberg SB, Ranasinghe JA, Dauer DM (1997) Optimizing temporal sampling strategies for benthic environmental monitoring programs. Marine Pollution Bulletin 34, 913–922

Allen JD, Flecker AS (1993) Biodiversity conservation in running waters. BioScience 43, 32–43

Allen JI, Clarke KR (2007) Effects of demersal trawling on ecosystem functioning in the North Sea: a modelling study. Marine Ecology Progress Series 336, 63–75

Anderson MJ, Gorley, RN, Clarke KR (2008) PERMANOVA+ for PRIMER: Guide to Software and Statistical Methods. PRIMER-E, Plymouth, UK

Angermeier PL (1995) Ecological attributes of extinction-prone species: loss of freshwater fishes of Virginia. Conservation Biology 9, 143–158

Archaimbault V, Usseglio-Polatera P, VandenBossche JP (2005) Functional differences among benthic macroinvertebrate communities in reference streams of same order in a given biogeographic area. Hydrobiologia 551, 171–182

Arita HT, Robinson JG, Redford KH (1990) Rarity in Neotropical forest mammals and its ecological correlates. Conservation Biology 4, 181–192

Armstrong RA, McGehee R (1980) Competitive exclusion. The American Naturalist 115, 151–170

Arntz WE, Gili JM (2001) A case for tolerance in marine ecology: let us not put out the baby with the bathwater. Scientia Marina 65:2, 283–299

Atkinson D (1994) Temperature and organism size: a biological law for ectotherms. Advanced in Ecology Research 25, 1–58

Atkinson LJ, Field JG, Hutchings L (submitted) Comparing areas of heavy versus light trawling along the west coast of southern Africa: I. Multivariate analysis of benthic communities. Marine Ecology Progress Series (submitted)

Auster PJ, Malatesta RJ, Langton RW, Watling L, Valentine PC, Donaldson CLS, Langton EW, Shepard AN, Babb IG (1996) The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): implications for conservation of fish populations. Reviews in Fisheries Science 4, 185–202

Austen MC, Widdicombe S, Villano-Pitacco N (1998) Effects of biological disturbance on diversity and structure of meiobenthic nematode communities. Marine Ecology Progress Series 174, 233–246

Auster PJ, Michalopoulos C, Valentine PC, Malatesta RJ (1998) Delineating and monitoring habitat management units in a temperate deep-water marine protected area. In: Linking Protected Areas with Working Landscapes, Conserving Biodiversity (Munro NW, Willison JHM, eds), 169-185. Science Management of Protected Areas Association, Wolfville, Nova Scotia.

Ball BJ, Fox G, Munday BW (2000) Long- and short-term consequences of a *Nephrops* trawl fishery on the benthos and environment of the Irish Sea. ICES Journal of Marine

Science 57, 1315–20

Balmer P, Glomnes J, Lindholm O, Saltveit NA (1977) Management of urban runoff and wastewater in the Oslofjord area. Nordic Hydrology 8, 237–248

Bell GW, Eggleston ÆDB (2005) Species-specific avoidance responses by blue crabs and fish to chronic and episodic hypoxia. Marine Biology 146, 761–770

Bergman MJN, Hup M (1992) Direct effects of beam trawling on macrofauna in a sandy sediment in the southern North Sea, ICES Journal of Marine Science 49, 5–11

Bergman MJN, van Santbrink JV (2000) Mortality in megafaunal benthic populations caused by trawl fisheries on the Dutch continental shelf in the North Sea in 1994, ICES Journal of Marine Science 57, 1321–1331

Berkeley SA, Chapman C, Sogard SM (2004) Maternal age as a determinant of larval growth and survival in a marine fish, *Sebastes melanops*. Ecology 85, 1258–1264

Berkes F, Mahon R, McConney P, Pollnac R, Pomeroy R (2001) Managing small-scale fisheries. Alternative Directions and Methods. EDRC Ottawa, 309 pp.

Beukema JJ (1988) An evaluation of the ABC-method (abundance/biomass comparison) as applied to macrozoobenthic communities living on tidal flats in the Dutch Wadden Sea. Marine Biology 99, 425–433

Bianchi G, Hamukuaya H, Alvheim O (2001) On the dynamics of demersal fish assemblages off Namibia in the 1990s. South Africa Journal of Marine Science 23, 419–428

Biles CL, Paterson DM, Ford RB, Solan M, Raffaelli DG (2002) Bioturbation, ecosystem functioning and community structure. Hydrology and Earth System Sciences 6:6, 999–1005

Bolam SG, Fernandes TF, Huxham M (2001) Diversity, biomass, and ecosystem processes in the marine benthos. Ecological Monographs 72:4, 599–615

Botsford LW, Castilla JC, Peterson CH (1997) The management of fisheries and marine ecosystems. Science 277, 509–515

Boyer DC, Hampton I (2001) An overview of the living marine resources of Namibia. South Africa Journal of Marine Science 23, 5–35

Brady P, Doledec S, Fesl C, Gayraud S, Bacchi M, Scøll F (2005) Use of invertebrate traits for the biomonitoring of European large rivers: the effects of sampling effort on genus richness and functional diversity. Freshwater Biology 50, 159–173

Bray JR, Curtis JT (1957) An ordination of upland forest communities of southern Wisconsin. Ecological Monographs 27, 325–349

Breitburg DL (2002) Effects of hypoxia, and the balance between hypoxia and enrichment on coastal fishes and fisheries. Estuaries 25, 767–781

Bremner J, Rogers SI, Frid CLJ (2003) Assessing functional diversity in marine benthic ecosystems: a comparison of approaches. Marine Ecology Progress Series 254, 11–25

Bremner J, Rogers SI, Frid CLJ (2006) Methods for describing ecological functioning of marine benthic assemblages using biological traits analysis (BTA). Ecological indicators 6:7, 609–622

Bremner J, Rogers SI, Frid CLJ (2006b) Matching biological traits to environmental conditions in marine benthic ecosystems. Journal of Marine Systems 60, 302–316

Bremner J (2008) Species traits and ecological functioning in marine conservation and management. Journal of Experimental Marine Biology and Ecology 366, 37–47

Bricker SB, Clement CG, Pirhalla DE, Orlando SP, Farrow DRG (1999) National Estuarine Eutrophication Assessment. Effect of nutrient enrichment in the nation's estuaries, NOAA—NOS Special Projects Office, 71 pp.

Briggs JC (2006) Marine biogeography and ecology: invasions and introductions. Journal of Biogeography 34:2, 193–198

Britton JC, Morton B (1990) Are there obligate marine scavengers? The marine biology of the South China Sea. In: Proceedings of The First International Conference on The Marine

Biology of Hong Kong and The South China Sea, Hong Kong (Morton B, ed). 28 October - 3 November 1990, 357–391, Hong Kong: Hong Kong University

Brown E, Finney B Hills S, Commisse M (2005) Effects of commercial otter trawling on benthic communities in the Southeastern Bering Sea. American Fisheries Society Symposium 41, 439-460

Buchanan JB (1967) Dispersion and demography of some infaunal echinoderm populations. Symposia of the Zoological Society of London 20, 1–11

Buchanan JB (1984) Sediment analysis. In: Methods for the Study of Marine Benthos (Holme NA, McIntyre AD, eds), 41–65. International Biological Programme Handbook No. 16 (2nd ed.,) Blackwell Scientific Publications, Oxford

Callaway R, Engelhard GH, Dann J, Cotter J, Rumohr H (2007) A century of North Sea epibenthos and trawling: Comparison between 1902–1912, 1982–1985 and 2000. Marine Ecology Progress Series 346, 27–43

Cardinale BJ, Palmer MA, Collins L (2002) Species diversity enhances ecosystem functioning through interspecific facilitation. Nature 415, 426–429

Carr MR (1996) Primer User Manual. Plymouth Marine Laboratory, 40 pp.

García-Charton JA, Pérez-Ruzafa A, Sánchez-Jerez P, Bayle- Sempere JT, Reñones O, Moreno D (2004) Multi-scale heterogeneity, habitat structure, and effect of marine reserves on Western Mediterranean rocky reef fish assemblages. Marine Biology 144, 161–182

Carson HS, Hentschel BT (2006) Estimating the dispersal potential of polychaete species in the Southern California Bight: implications for designing marine reserves. Marine Ecology Progress Series 316, 105–113

CENR (2003) An Assessment of Coastal Hypoxia and Eutrophication in U.S. Waters. National Science and Technology Council Committee on Environment and Natural Resources, Washington, DC.

Chapin III FS, Walker BH, Hobbs RJ, Hooper DU, Lawton JH, Sala OE, Tilman D (1997) Biotic control over the functioning of ecosystems. Science 277, 500

Chapman MG (1999) Are there adequate data to assess how well theories of rarity apply to marine invertebrates? Biodiversity and Conservation 8, 1295–1318

Charvet S, Statzner B, Usseglio-Polatera P, Dumont B (2000) Traits of benthic macroinvertebrates in semi-natural French streams: an initial application to biomonitoring in Europe. Freshwater Biology 43, 277–296

Chevenet F, Doledec S, Chessel D (1994) A fuzzy coding approach for the analysis of long-term ecological data. Freshwater Biology 31, 295–309

Clarke KR (1993) Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology 18, 117–143

Clarke KR, Warwick RM (1994) Change in marine communities: an approach to statistical analysis and interpretation. Plymouth Marine Laboratory, Plymouth, Devon, UK. 144 pp.

Clarke KR, Warwick RM (2001) Change in marine communities: an approach to statistical analysis and interpretation, 2nd edition. PRIMER-E: Plymouth, UK

Clarke KR, Gorley RN (2006) PRIMER v6: user manual/ tutorial. PRIMER-E, Plymouth

Climatic atlas of the Arctic Sea (2004) Part I. Database of the Brents, Kara, Latev and White Seas- oceanography and marine biology. World Data Center for Oceanography, Silver Spring International Ocean Atlas and Information Series, Volume 9 NOAA Atlas NESDIS 58

Collie JS, Escanero GA, Valentine PC (1997) Effects of bottom fishing on the benthic megafauna of Georges Bank. Marine Ecology Progress Series 155, 159–72

Collie JS, Hall SJ, Kaiser MJ, Poiner IR (2000) A quantitative analysis of fishing impacts on shelf-sea benthos. Journal of Animal Ecology 69, 785–798

Committee on Biological Diversity in Marine Systems (1995) Understanding Marine Biodiversity: a Research Agenda for the Nation (co-chairs: Butman CA, Carlton JT)

Washington, DC National Academy Press, 114 pp.

Connell JH, Slayter RO (1977) Mechanisms of succession in natural communities and their role in community stability and organization. American Naturalist 111, 1119–1144

Connell JH (1978) Diversity in tropical rain forests and coral reefs. Science 199, 1302–1310

Contardo Jara V, Miyamoto JHS, da Gama BAP, Molis M, Wahl M, Pereira RC (2006) Limited evidence of interactive disturbance and nutrient effects on the diversity of macrobenthic assemblages. Marine Ecology Progress Series 308, 37–48

Cooper K, Boyd S, Eggleton J, Limpenny D, Rees H, Vanstaen K (2007) Recovery of the seabed following marine aggregate dredging on the Hastings Shingle Bank off the southeast coast of England. Estuarine, Coastal and Shelf Science, 1–12

Cooper KM, Barrio Froján CRS, Defew E, Curtis M, Fleddum A, Brooks L, Paterson DM (2008) Assessment of ecosystem function following marine aggregate dredging. Journal of Experimental Marine Biology and Ecology 366, 82–91

Council of the European Union (1994) Laying Down Certain Technical Measures for the Conservation of Fishery Resources in the Mediterranean: Council of the European Union. Council Regulation (EC) No 1626/94, 27 June 1994

Craeymeersch JA (1991) Applicability of the abundance/biomass method to detect pollution effects on intertidal macrobenthic communities. Hydrobiological Bulletin 24:2, 133–140

Craig RS, Austen MC, Boucher G, Heip C, Hutchings PA, King GM, Koike I, Lambshead PJD, Snelgrove P (2000) Global change and biodiversity linkages across the sediment water interface: Biodiversity above and below the surface of soils and sediments. BioScience 50:12, 1108–1120

Crame JA (2000) Evolution of taxonomic diversity gradients in the marine realm: evidence from the composition of recent bivalve faunas. Paleobiology 26, 188–214

Currie DR, Parry GD (1996) Effects of scallop dredging on a soft sediment community: a large-scale experimental study. Marine Ecology Progress Series 134, 131–50

Currie DR, Parry GD (1999) Impacts and efficiency of scallop dredging on different soft substrates. Canadian Journal of Fish and Aquatic Science 56, 539–50

Cushman JH, Lawton JH, Manly BJF (1993) Latitudinal patterns in European ant assemblages: variation in species richness and body size. Oecologia 95, 30–37

Dando PR, Southward AJ (1986) Chemoautotrophy in bivalve molluscs of the genus *Thyasira*. Journal of Marine Biological Association of the UK 66, 915–929

Dando PR, Spiro B (1993) Varying nutritional dependence of the thyasirid bivalves *Thyasira sarsi* and *T. equalis* on chemoautotrophic symbiotic bacteria, demonstrated by isotope ratios of tissue carbon and shell carbonate. Marine Ecology Progress Series 92, 151–158

Dando PR, Southward AJ, Southward EC (2004) Rates of sediment sulphide oxidation by the bivalve mollusc *Thyasira sarsi*. Marine Ecology Progress Series 280, 181–187

Dayton PK, Thrush SF, Agardy T, Hofman RJ (1995) Viewpoint: Environmental effects of marine fishing. Aquatic conservation. Marine and Freshwater Ecosystems 5, 205–232

de Biasi AM (2004) Impact on experimental trawling on the benthic assemblage along the Tuscany coast (north Tyrrheian Sea, Italy). ICES Journal of marine science 61, 1266–1266

de Groot SJ, Apeldoorn JM (1971) Some experiments on the influence of the beam-trawl on the bottom fauna. Report 1971/B: 2. International Council for the Exploration of the Sea, Copenhagen, Denmark.

de Juan S, Thrush SF, Demestre M (2007) Functional changes as indicators of trawling disturbance on a benthic community located in a fishing ground (NW Mediterranean Sea). Marine Ecology Progress Series 334, 117–129

Demestre M, Sanchez P, Kaiser M (2000) The behavioural response of benthic scavengers to otter-trawling disturbance in the Mediterranean. In: Effects of Fishing on Non-Target

Species and HabitatS (Kaiser MJ, de Groot SJ, eds), 121–129. Blackwell Science, Oxford

Dernie KM, Kaiser MJ, Warwick RM (2003) Recovery rates of benthic communities following physical disturbance. Journal of Animal Ecology 72, 1043–1056

Diaz RJ, Rosenberg R (1995) Marine benthic hypoxia: a review of its ecological effects and the behavioural responses of benthic macrofauna. Oceanography and Marine Biology: An Annual Review 33, 245–303

Doering PH, Oviatt CA, Beatty LL, Banzon VF, Rice R, Kelly SP, Sullivan BK, Frithsen JB (1989) Structure and function in a model coastal ecosystem: silicon, the benthos and eutrophication. Marine Ecology Progress Series 52, 287–299

Doledec S, Statzner B, Bournard M (1999) Species traits for future biomonitoring across ecoregions: patterns along a human-impacted river. Freshwater Biology 42, 737–758

Doledec S, Phillips N, Scarsbrook M, Riley RH, Townsend CR (2006) Comparison of structural and functional approaches to determining landuse effects on grassland stream invertebrate communities. Journal of the North American Benthological Society 25:1, 44–60

Drabsch SL, Tanner JE, Connell SD (2001) Limited infaunal response to experimental trawling in previously untrawled areas. Journal of Marine Science 58, 1261–1271

Druffel ERM, Griffin S, Witter A, Nelson E, Southon J (1995) Gerardia: bristlecone pine of the deep-sea? Geochimca Cosmoschimica Acta 59, 5031–36

Edgar GJ, Barrett NS (1999) Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. Journal of Experimental Marine Biology and Ecology, 242:1, 107–144

Ehrlich PR, Ehrlich AH (1981) Extinction. The causes and consequences of the disappearance of species. Random House, New York

Eleftheriou A, Robertson MR (1992) The effects of experimental scallop dredging on the fauna and physical environment of a shallow sandy community. Netherland Journal of Sea Research 30, 289–99

Elton CS (1958) The Ecology of invasions by animals and plants. Methuen. London, England.

Emeis KC, Benoit JR, Deegan L, Gilbert AJ, Lee V, Glade JM, Meybeck M, Olsen SB, von Bodungen B (2001) Unifying concepts for integrated coastal management. In: Science and Integrated Coastal Management (von Bodungen B, Turner RK, eds), 378 pp. Dahlem University Press, Berlin

Emmerson MC, Solan M, Emes C, Paterson DM, Raffaelli D (2001) Consistent patterns and the idiosyncratic effects of biodiversity in marine ecosystems. Nature 411, 73–77

Emmerson MC, Huxham M (2003) How can marine ecology contribute to the biodiversity-ecosystem functioning debate? In: Biodiversity and Ecosystem Functioning (Loreau M, Naeem S, Inchausti P, eds), 139–146. Oxford UP, Oxford

Engel J, Kvitek R (1998) Impacts of otter trawling on a benthic community in Monterey Bay National Marine Sanctuary. Conservation Biology 12, 1204–14

Enticknap B (2002) Trawling the North Pacific. Understanding the effects of bottom trawl. Fisheries on Alaska's living seafloor. Alaska Marine Conservation Council, Fisheries Project Coordinator, 22 pp.

EPD (2007) 20 years of river and marine water quality monitoring reports published. http://www.epd.gov.hk/epd/english/news_events/press/press_070220a.html

Fisher RA, Corbet AS, William CB (1943) The relation between the number of species and the number of individuals in a random sample of animal population. Journal of Animal Ecology 12, 42–58

Folk RL (1968) Petrology of sedimentary rocks. Hemphill's. Austin, Texas, 170 pp.

Freese L, Auster PJ, Heifetz J, Wing BL (1999) Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Ecology Progress Series 182, 119–26

Freiwald A, Roberts JM (2005) Cold-water corals and ecosystems. Springer-Verlag Berlin Heidelberg 1129–1140

Frid CLJ, Harwood KG, Hall SJ, Hall JA (2000) Long-term changes in the benthic communities on North Sea fishing grounds. Journal of Marine Science 57, 1303–1309

Frid CLJ, Rogers SI, Nicholson M, Ellis JR, Freeman S (2000b) Using biological characteristics to develop new indices of ecosystem health. Mini-symposium on defining the role of ICES in supporting biodiversity conservation. 88th Annual Science Conference, Bruges, Belgium

Frouin P (2000) Effects of anthropogenic disturbances of tropical soft-bottom benthic communities. Marine Ecology Progress Series 194, 39–53

Gade HG (1968) Horizontal and vertical exchanges and diffusion in water masses of the Oslo Fjord. Helgoland Wiss Meeresunters 17, 462–475

Gaston KJ (1994) Rarity. Chapman & Hall, London

Gaston KJ, Williams PH (1996) Spatial patterns in taxonomic diversity. In: BIODIVERSITY (Gaston KJ, ed), 202–229. Blackwell Science, Oxford

Gaston KJ (2000) Global patterns in biodiversity. Nature 405, 220–227

Gianni M (2004) High seas bottom trawl fisheries and their impacts on the biodiversity of vulnerable deep-sea ecosystems: Options for international action. IUCN, Gland, Switzerland

Gibbs PJ, Collins AJ, Collett C (1980) Effect of otter prawn trawling on the macrobenthos of a sandy substratum in a New South Wales estuary. Australian Journal of Marine and Freshwater Research 31, 509–516

Gjerde KM (2006) High seas marine protected areas and deep sea fishing. Expert consultation on deep-sea fisheries in the high seas, Bangkok, Thailand from 21–23 November, 40 pp.

Goñi R (1998) Ecosystem effects of marine fisheries: an overview. Ocean and Coastal Management 40, 37–64

Grall J, Chauvaud L. (2002) Marine eutrophication and benthos: the need for new approaches and concepts. Global Change Biology 8, 813–830

Gray JS (1979) Pollution-induced changes in populations. Philosophical Transactions of the Royal Society of London 286, 545–561

Gray JS, Mirza FB (1979) A possible method for the detection of pollution-induced disturbance on marine benthic communities. Marine Pollution Bulletin 10, 142–146

Gray JS, Pearson TH (1982) Objective selection of sensitive species indicative of pollution-induced change in benthic communities. I. Comparative methodology. Marine Ecology Progress Series 9, 111–119

Gray JS (1983) Use and misuse of the log-normal plotting method for detection of effects of pollution - a reply to Shaw et al. (1983). Marine Ecology Progress Series 11, 203–204

Gray JS (1987) Species-abundance patterns. Symposia of the British Ecological Society 2, 53–68

Gray JS, Wu RS, Or YY (2002) Effects of hypoxia and organic enrichment on the coastal marine environment. Marine Ecology Progress Series 238, 249–279

Gray JS, Dayton PK, Thrush SF, Kaiser MH (2006a) On effects of trawling benthos and sampling design. Marine Pollution Bulletin 52, 840–843

Gray JS, Bjorgesaeter A, Ugland KI (2006) On plotting species abundance distributions. Journal of Animal Ecology 75, 752–756

Grime JP (1973) Competitive exclusion in herbaceous vegetation. Nature 242, 344–347

Grime JP (1997) Biodiversity and ecosystem function: the debate deepens. Science 277, 1260–1261

Hall-Spencer JM, Moore PG (2000) Scallop dredging has profound, long-term impacts on maerl habitats. ICES Journal of Marine Science 57, 1407–15

Hall-Spencer JM, Tasker M, Soffker M, Christiansen S, Rogers S, Campbell M, Hoydal K (2009) Design of Marine Protected Areas on high seas and territorial waters of Rockall Bank. Marine Ecology Progress Series 397, 305-308

Hansson M, Lindegarth M, Valentinsson D, Ulmestrand M (2000) Effects of shrimp-trawling on abundance of benthic macrofauna in Gullmarsfjorden, Sweden. Marine Ecology Progress Series 198, 191–201

Hector A, Schmid B, Beierkuhnlein C, Caldeira MC, Diemer M, Dimitrakopoulos PG, Finn JA, Freitas H, Giller PS, Good J, Harris R, Hõgberg P, Huss-Danell K, Joshi J, Jumpponen A, Kõrner C, Leadley PW, Loreau M, Minns A, Mulder CPH, O'Donovan G, Otway SJ, Pereira JS, Prinz A, Read DJ, Scherer-Lorenzen M, Schulze E-D, Siamantziouras ASD, Spehn EM, Terry AC, Troumbis AY, Woodward FI, Yachi S, Lawton JH (2000) Consequences of the reduction of plant diversity for litter decomposition: effects through litter quality and microenvironment. Oikos 90, 357–371

Hector A, Schmid B, Beierkuhnlein C, Caldeira MC, Diemer M, Dimitrakopoulos PG, Finn JA, Freitas H, Giller PS, Good J, Harris R, Hõgberg P, Huss-Danell K, Joshi J, Jumpponen A, Kõrner C, Leadley W, Loreau M, Minns A, Mulder CPH, O'Donovan G, Otway SJ, Pereira JS, Prinz A, Read DJ, Sherer-Lorenzen M, Schulze E-D, Siamantziouras A-SD, Spehn EM, Terry AC, Troubis AY, Woodward FI, Yachi S, Lawton JH (1999) Plant diversity and productivity experiments in European grasslands. Science 286, 1123–1126

Heip C (1995) Eutrophication and zoobenthos dynamics. Ophelia 41, 113–136

Hiddink JG, Jennings S, Kaiser MJ, Queirós AM, Duplisea DE, Piet GJ (2006) Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats. Canadian Journal of Fisheries and Aquatic Science 63:4, 721–736

Hiddink JG, Rijnsdorp AD, Piet GD (2008) Can bottom trawling disturbance increase food production for a commercial fish species? Canadian Journal of Fisheries and Aquatic Science 65, 1393–1401

Hill A, Veale L, Pennington D, Whyte S, Brand A, Hartnoll R (1999) Changes in Irish Sea benthos: possible effects of 40 years of dredging. Estuarine, Coastal and Shelf Science 48, 739–750

Hodgkiss IJ (1984) Seasonal patterns of intertidal algal distribution in Hong Kong. Asian Marine Biology 1, 49–57

Hodgson JG (1993) Commonness and rarity in British butterflies. Journal of Applied Ecology 30, 407–427

Holmes SP, Miller N, Weber A (2002) The respiration and hypoxic tolerance of *Nucula nitidosa* and *N. nucleus*: factors responsible for determining their distribution? Journal of the Marine Biological Association of the United Kingdom 82, 971–981

Horikoshi LB, Thompson GB (1980) Distribution of subtidal molluscs collected by trawling in Tolo Harbour and Tolo Channel, Hong Kong, with special reference to habitat segregation in two venerid bivalves. In: The Malacofauna of Hong Kong and Southern China (Morton B, ed), 149–62. Hong Kong University Press

Horwood JW (2000) No-take zones: a management context. In: Effects of Fishing on Non-Target Species and Habitats: Biological, Conservation and Socioeconomic Issues (Kaiser MJ, de Groot SJ, eds), 302–311. Blackwell Science, Oxford, United Kingdom

Hubbell SP (2001) The unified theory of biodiversity and biogeography. Princeton University Press, Princeton, NJ.

Huston MA (1997) Hidden treatments in ecological experiments: re-evaluating the ecosystem function of biodiversity. Oecologia 110, 449–460

Huxham M, Roberts I, Bremner J (2000) A field test of the intermediate disturbance hypothesis in the soft-bottom intertidal. International Review of Hydrobiology 85:4, 379–394

Ideker T (2004) Systems Biology 101: what you need to know. Nature Biotechnology 22, 473–475

Jenkins SR, Norton TA, Hawkins SJ (2004) Long term effects of *Ascophyllum nodosum* canopy removal on mid shore community structure. Journal of the Marine Biological Association UK 84, 327–329

Jennings S, Kaiser MJ (1998) The effects of fishing on marine ecosystems. Advanced in Marine Biology 34, 203–314

Jennings S, Alvsvag J, Cotter AJR, Ehrich S, Greenstreet SPR, Jarre-Teichmann A, Mergardt N, Rijnsdorp AD, Smedstad O (1999) Fishing effects in northwest Atlantic shelf seas: patterns in fishing effort, diversity and community structure III. International trawling effort in the North Sea: an analysis of spatial and temporal trends. Fisheries Research 40, 125–134

Meyer CG, Holland KN, Papastamatiou YP (2007) Seasonal and diel movements of giant trevally *Caranx ignobilis* at remote Hawaiian atolls: implications for the design of Marine Protected Areas. Marine Ecology Progress Series 333, 13-25

Jennings S, Pinnegar JK, Polunin NVC, Warr KJ (2001) Impact of trawling disturbance on the trophic structure of benthic invertebrate communities. Marine Ecology Progress Series 213, 127–142

Jennings S, Nicholson MD, Dinmore TA, Lancaster JE (2002) Effects of chronic trawling disturbance on the production of infaunal communities. Marine Ecology Progress Series 243, 251–260

Johansson B (1997) Behavioural response to gradually declining oxygen concentration by Baltic Sea macrobenthic crustaceans. Marine Biology 129, 71–78

Jolliffe I (2002) Principal Component Analysis. Springer. 2nd edition

Jonsson M, Malmqvist B (2000) Ecosystem process rate increases with animal species richness: evidence from leaf-eating, aquatic insects. Oikos 89, 519–523

Jorgensen BB, Richardson K (1996) Eutrophication in coastal marine ecosystems. Coastal and Estuarine Studies 52. American Geophysical Union, Washington DC, 267 pp.

Josefson AB, Widbom B (1988) Differential response of benthic macrofauna and meiofauna to hypoxia in the Gullmar Fjord basin. Marine Biology 100, 31–40

Kaplan DM (2009) Fish life histories and marine protected areas: an odd couple? Marine Ecology Progress Series 377, 213-225

Kaiser MJ, Spencer BE (1994) Fish scavenging behaviour in recently trawled areas. Marine Ecology Progress Series 112, 41–49

Kaiser MJ, Spencer BE (1996) The effects of beam-trawl disturbance on infaunal communities in different habitats. Journal of Animal Ecology 65, 348–358

Kaiser MJ (1996) Starfish damage as an indicator of trawling intensity. Marine Ecology Progress Series 134, 303–307

Kaiser MJ, Edwards DB, Armstrong PA, Radford K, Lough NEL, Flatt RP, Jones HD (1998) Changes in megafaunal benthic communities in different habitats after trawling disturbances. ICES Journal of Marine Science 55, 353–361

Kaiser MJ, Spence FE, Hart PJB (1999) Fishing gear restrictions and conservation of benthic habitat complexity. Conservation Biology 14, 1512–25

Kaiser MJ, Ramsay K, Richardson CA, Spence FE, Brand AR (2000) Chronic fishing disturbance has changed shelf sea benthic community structure. Journal of Animal Ecology 69, 494–503

Kaiser MJ, Collie JS, Hall SJ, Jennings S, Poiner IR (2002) Modification of marine habitats by trawling activities: prognosis and solutions. Fish and Fisheries 3:2, 114–136

Kaiser MJ, Collie JS, Hall SJ, Jennings S, Poiner IR (2003) Impacts of fishing gear on marine benthic habitats. In: Responsible Fisheries in The Marine Ecosystem (Sinclair M, Vadimarsson G, eds), 197–217. Wallingford: CABI Publishing

Kaiser MJ, Clarke KR, Hinz H, Austen MCV, Somerfield PJ, Karakassis I (2006) Global analysis of response and recovery of benthic biota to fishing. Marine Ecology Progress Series 311, 1–14

Kaiser MJ, Hiddink JG (2007) Food subsidies from fisheries to continental shelf benthic scavengers. Marine Ecology Progress Series 350, 267–276

Karr JR (1977) Ecological correlates of rarity in a tropical bird community. Auk 94, 240–247

Kelleher G (1999) Guidelines for Marine Protected Areas. IUCN, Gland, Switzerland and Cambridge UK, 107 pp.

Kenchington ELR, Prena J, Gilkinson KD, Gordon DC, MacIsaac K (2001) Effects of experimental otter trawling on the macrofauna of a sandy bottom ecosystem on the Grand Banks of Newfoundland. Canadian Journal of Fish Aquatic Science 58, 1043–57

Kenchington ELR, Gilkinson KD, Kevin G. MacIsaac KG, Bourbonnais-Boyce C, Kenchington TJ, Smith SJS, Gordon DC (2006) Effects of experimental otter trawling on benthic assemblages on Western Bank, northwest Atlantic Ocean. Journal of Sea Research 56, 249–270

Kenchington ELR, Kenchington TJ, Henry L, Fuller S, Gonzalez P (2007) Multi-decadal changes in the megabenthos of the Bay of Fundy: The effects of fishing. Journal of Sea Research 58, 220–240

Koslow JA, Gowlett-Holmes K, Lowry JK, O'Hara T, Poore GCB, Williams A (2001) Seamount benthic macrofauna off southern Tasmania: community structure and impacts of trawling. Marine Ecology Progress Series 213, 111–125

Krost P (1990) The impact of otter-trawl fishery on nutrient release from the sediment and macrofauna of Kieler Bucht (Western Baltic). Berichte aus dem Institut fuer Meereskunde 200, 167

Lamouroux N, Dolédec S, Gayraud S (2004) Biological traits of stream macroinvertebrate communities: effects of microhabitat, reach, and basin filters. Journal of the North American Benthological Society 23, 449-466

Lawton JH (1994) What do species do in ecosystems? Oikos 71, 367–374

Lecerf & Richardson (2009) Biodiversity ecosystem functioning research: Insight gain from streams. River Research and Applications. Wiley Interscience DOI: 10.1002/rra.1286

Lee JHW, Arega F (1999) Eutrophication dynamics of Tolo Harbour, Hong Kong. Marine Pollution Bulletin 39, 187–192

Lenz M, Molis M, Wahl M (2004) Testing the intermediate disturbance hypothesis: response of fouling communities to various levels of emersion intensity. Marine Ecology Progress Series 278, 53–65

Levin LA, Etter RJ, Rex MA, Gooday AJ, Smith CR, Pineda J, Stuart CT, Hessler RR, Pawson D (2001) Environmental influences on regional deep sea species diversity. Annual

Review of Ecology and Systematics 32, 51–93

Lindholm JB, Auster PJ, Kaufman LS (1999) Habitat-mediated survivorship of juvenile (0-year) Atlantic cod *Gadus morhua*. Marine Ecology Progress Series 180, 247–255

Liu XS, Cheung SG, Shin PKS (2009) Meiofauna with special reference to nematodes in trawling ground of subtropical Hong Kong. Marine Pollution Bulletin 58, 607–615

Lodge D (1993) Biological invasions: lessons for ecology. Trends in Ecology and Evolution 8, 133–137

Loreau M (2000) Biodiversity and ecosystem functioning: recent theoretical advances. Oikos 91, 3–17

Loreau M, Naeem S, Inchausti P, Bengtsson J, Grime JP, Hector A, Hooper DU, Huston MA, Raffaelli D, Schmid B, Tilman D, Wardle DA (2001) Biodiversity and ecosystem functioning: Current knowledge and future challenges. Science 294, 804–808

Lu L & Wu RSS (2000) An experimental study on recolonization and succession of marine macrobenthos in defaunated sediment. Marine Biology 136, 291–302

Lubchenco J, Palumbi SR, Gaines SD, Andelman S (2003) Plugging a hole in the ocean: The emerging science of marine reserves. Ecological Applications 13, 3–7

Lui KKY, Ng JSS, Leung KMY (2007) Spatio-temporal variations in the diversity and abundance of commercially important Decapoda and Stomatopoda in subtropical Hong Kong waters. Estuarine, Coastal and Shelf Science 72:4, 635–647

Mackie ASY, Oliver PG, Kingston PF (1993) The macrobenthic infauna of Hoi Ha Wan and Tolo Channel, Hong Kong. In: Proceedings of The First International Conference on The Marine Biology of Hong Kong and The South China Sea, Hong Kong (Morton B, ed), 28 October - 3 November 1990, 657–674. Hong Kong: Hong Kong University Press

Macpherson E, Gordoa A (1992) Trends in the demersal fish community off Namibia from 1983 to 1990. South Africa Journal of Marine Science 12, 635–649

Mayer LM, Schick DF, Findlay RH, Rice DL (1991) Effects of commercial dragging on sediment organic matter. Marine Environmental Research 31, 249–261

McAllen R, Davenport J, Bredendieck K, Dunne D (2009) Seasonal structuring of a benthic community exposed to regular hypoxic events. Journal of Experimental Marine Biology and Ecology 368, 67–74

McClanahan TR, Mangi S (2000) Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery. Ecological Application 10, 1792–1805

McConnaughey RA, Mier KL, Dew CB (2000) An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. Journal of Marine Science 57, 1377–

1388

McGill BJ (2003a) Does Mother Nature really prefer rare species or are log-left-skewed SADs a sampling artefact? Ecology Letters 6, 766–773

McGill BJ (2003b) A test of the unified neutral theory of biodiversity. Nature 442, 881–885

Menge BA (1995) Indirect effects in marine rocky intertidal interaction webs: patterns and importance. Ecology Monographs 65, 21–74

Meyers MB, Di Toro DM, Lowe SA (2000) Coupling suspension feeders to the Chesapeake Bay eutrophication model: water quality ecosystem modelling 1, 123–140

Micheli F, Halpern BS, Bostford LW, Warner RR (2004) Trajectories and correlates of community change in no-take marine reserves. Ecological Application 14, 1709–1723

Mirza FB, Gray JS (1981) The fauna of benthic sediments from the organically enriched Oslofjord, Norway. Journal of Experimental Marine Biology and Ecology 54, 181–207

Moran MJ, Stephenson PC (2000) Effects of otter trawling on macrobenthos and management of demersal scalefish fisheries on the continental shelf of north-western Australia. ICES Journal of Marine Science 57, 510–16

Morin PJ (1995) Functional redundancy, non-additive interactions, and supply-side dynamics in experimental pond communities. Ecology 76, 133–149

Morton B (1989) Pollution of the coastal waters of Hong Kong. Marine Pollution Bulletin 20, 310–318

Morton B (1992) An introduction to Hoi Ha Wan. In: The Marine Flora and Fauna of Hong Kong and Southern China III (Morton B, ed), 781–785. Proceedings of the Fourth International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong, 11–29 April 1989. Hong Kong University Press

Mouchel (2004) Hong Kong- Zhuhai- Macao Bridge: Hong Kong Section and the North Lantau Final 9 Month Ecological Baseline Survey Report. Prepared for the Highways Department, Government of HKSAR

Murray BR, Lepschi BJ (2004) Are locally rare species abundant elsewhere in their geographical range? Australian Ecology 29, 287–293

Naeem S, Thompson LJ, Lawler SP, Lawton JH, Woodfin RM (1994) Declining biodiversity can alter the performance of ecosystems. Nature 368, 734–737

Naeem S, Thompson LJ, Lawler SP, Lawton JH, Woodfin RM (1995) Empirical evidence that declining species diversity may alter the performance of terrestrial ecosystems. Philosophical Transactions of the Royal Society London 347 Series B, 249–262

Naeem S, Hakansson K, Lawler SP, Crawley MJ, Thompson LJ (1996) Biodiversity and plant productivity in a model assemblage of plant species. Oikos 76, 259–264

Naeem S, Loreau M, Inchausti P (2002) Biodiversity and ecosystem functioning: The emergence of a synthetic ecological framework. In: Biodiversity and Ecosystem Functioning: Synthesis and Perspectives (Loreau M, Naeem S, Inchausti P, eds), 3–11. Oxford University Press, Oxford

Naeem S (2002) Disentangling the impacts of diversity on ecosystem functioning in combinatorial experiments. Ecology 83, 2925–2935

Nilsson HC, Rosenberg R (1994) Hypoxic response of two marine benthic communities. Marine Ecology Progress Series 115, 209–217

Nilsson HC, Rosenberg R (2000) Succession in marine benthic habitats and fauna in response to oxygen defiency: analyzed by sediment profile-imaging and by grab samples. Marine Ecology Progress Series 197, 139–149

Nilsson HC, Rosenberg R (2003) Effects on a marine sedimentary habitats of experimental trawling analysed by sediment profile imagery (SPI). Journal of Experimental Marine Biology and Ecology 285:286, 453–463

Nixon SW (1990) Marine eutrophication: a growing international problem. Ambio 19, 101

Nixon SW (1995) Coastal marine eutrophication: a definition, social causes and future concerns. Ophelia 41, 199–219

Norling K, Rosenberg R, Hulth S, Grémare A, Bonsdorff E (2007) Importance of functional biodiversity and species-specific traits of benthic fauna for ecosystem functions in marine sediment. Marine Ecology Progress Series 332, 11–23

Oakley HR, Cripps T (1972) Marine pollution studies at Hong Kong and Singapore. In: Marine Pollution and Sea Life (Ruivo M, ed), 83–91. Fishing News, Surrey UK

Oceana & Marine Conservation Biology Institute (2005) State Regulation of Bottom Trawls. Reports available at http://www.mcbi.org/what/coral_policy.htm

Olden JD, Vieira NK, Finn DS, Simmons MP, Kondratieff BC (2006) Functional trait niches of North American lotic insects: traits-based ecological applications in light of phylogenetic relationships. Journal of the North American Benthological Society 25:4, 730

Olsgard F, Schaanning MT, Widdicombe S, Kendall MA, Austen MC (2008) Effects of bottom trawling on ecosystem functioning. Journal of Experimental Marine Biology and Ecology 366, 123–133

Paine RT (1969) The Pisaster-Tegula interaction: prey patches, predator food preference, and intertidal community structure. Ecology 50, 950–961

Palanques A, Guillen J, Puig P (2001) Impact of bottom trawling on water turbidity and muddy sediment of an unfished continental shelf. Limnology and Oceanography 46:5, 1100–1110

Palumbi SR (2003) Population genetics, demographic connectivity, and the design of marine reserves. Ecological Applications 13, 146–158

Payne A, Punt AE (1995) Biology and Fisheries of South African hakes (*M. capensis* and *M. paradoxus*) In: Hake Fisheries, Ecology and Markets (Alheit J, Pitcher TJ, eds), 15-47. Chapman & Hall, London

Pearse JS, Mcclintock JB, I Bosch (1991) Reproduction of Antarctic benthic marine invertebrates: Tempos, modes, and timing. American Zoologist 31:1, 65–80

Pearse, JS (1994) Cold-water echinoderms break 'Thorson's Rule'. In: Reproduction, Larval Biology and Recruitment of The Deep-Sea Benthos (Young CM, Eckelbarger KJ, eds), 26–43. Columbia University Press, New York

Pearson TH, Rosenberg R (1978) Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanography and Marine Biology Annual Review 16, 229–311

Pearson TH, Gray JS, Johannessen PJ (1983) Objective selection of sensitive species indicative of pollution-induced change in benthic communities. 2. Data analyses. Marine

Ecology Progress Series 12, 237–255

Pihl L, Baden SP, Diaz RJ (1991) Effects of periodic hypoxia on distribution of demersal fish and crustaceans. Marine Biology 108, 349–360

Pinnegar JK, Polunin NVC, Francour P (2000) Trophic cascades in benthic marine ecosystems: lessons for fisheries and protected-area management. Environmental Conservation 27, 179–200

Pitcher CR, Poiner IR, Hill BJ, Burridge CY (2000) Implications of the effects of trawling on sessile megazoobenthos on a tropical shelf in northeastern Australia. ICES Journal of Marine Science 57, 1359–68

Pranovi F, Raicevich S, Franceschini G, Farrace MG, Giovanardi O (2000) Rapido trawling in the northern Adriatic Sea: effects on benthic communities in an experimental area. ICES Journal of Marine Science 57, 517–524

Prena J, Schwinghammer P, Rowell TW, Gordon DC Jr, Gilkinson KD (1999) Experimental otter trawling on a sandy bottom ecosystem of the Grand Banks of Newfoundland: analysis of the trawl bycatch and effects on epifauna. Marine Ecology Progress Series 181, 107–24

Preston FW (1948) The commonness and rarity of species. Ecology 29, 254–283

Preston JR (1975) An account of investigations carried out into marine pollution controls needs in Hong Kong with particular reference to the existing and future urban centres about Victoria and Tolo Harbour. In: Proceeding of Pacific Scientific Association. Special Symposium of Marine Science Hong Kong 1973 (Morton B, ed), 91–99. The Government Printers, Hong Kong

Ragnarsson SA, Lindegarth M (2009) Testing hypotheses about temporary and persistent effects of otter trawling on infauna: changes in diversity rather than abundance. Marine Ecology Progress Series 385, 51–64

Ramsay K, Kaiser MJ, Hughes RN (1996) Changes in hermit crab feeding patterns in response to trawling disturbance. Marine Ecology Progress Series 144, 63–72

Ramsay K, Kaiser M, Hughes R (1998) Responses of benthic scavengers to fishing disturbance by towed gears in different habitats. Journal of Experimental Marine Biology and Ecology 224, 73–89

Reiss H, Simon PR, Greenstreet SPR, Sieben K, Ehrich S, Piet GJ, Quirijns F, Robinson L, Wolff WJ, Kröncke I (2009) Effects of fishing disturbance on benthic communities and secondary production within an intensively fished area. Marine Ecology Progress Series 394, 201–213

Reynolds CS (1998) The state of freshwater ecology. Freshwater Biology 39, 741–753

Rhoads DC, McCall PL, Yingst JY (1978) Disturbance and production on the estuarine seafloor. American Scientist 66, 577–586

Rijnsdorp AD, Van Beek FA (1991) Changes in the growth of plaice *Pleuronectes platessa* L., and sole *Solea solea* in the North Sea. Netherland Journal of Sea Research 27, 441–457

Riedel B, Zuschin M, Haselmair A, Stachowitsch M (2008) Oxygen depletion under glass: Behavioural responses of benthic macrofauna to induced anoxia in the Northern Adriatic. Journal of Experimental Marine Biology and Ecology 367, 17–27

Ritter C, Montagna PA (1999) Seasonal hypoxia and models of benthic response in a Texas Bay. Estuaries 22:1, 7–20

Rumohr H, Kujawski T (2000) The impact of trawl fishery on the epifauna of the southern North Sea. ICES Journal of marine science 57, 1389–1394

Rosenberg R, Hellmann B, Johansson B (1991) Hypoxic tolerance of marine benthic fauna. Marine Ecology Progress Series 79, 127–131

Rosenberg R, Nilsson HC, Diaz RJ (2001) Response of benthic fauna and changing sediment redox profiles over a hypoxic gradient. Estuarine, Coastal and Shelf Science 53, 343– 350

Rosenberg R, Agrenius S, Hellmann B, Nilsson HC, Norling, K (2002) Recovery of marine benthic habitats and fauna in a Swedish fjord following improved oxygen conditions. Marine Ecology Progress Series 234, 43–53

Rosenberg R, Nilssona HC, Gremare A, Amouroux JM (2003) Effects of demersal trawling on marine sedimentary habitats analysed by sediment profile imagery. Journal of Experimental Marine Biology and Ecology 285:286, 465–477

Roy K, Jablonski D, Valentine JW (2000) Dissecting latitudinal diversity gradients: functional groups and clades of marine bivalves. Proceedings in Biological Science 267:1440, 293–9

Ruud JT (1968) Introduction to the studies of pollution in the Oslofjord. Helgolander Wissenschaftliche Meeresuntersuchungen 17, 455–461

Russ GR, Alcala AC, Maypa AP, Calumpong HP, White, AT (2004) Marine reserve benefits local fisheries. Ecological Applications 14:2, 597–606

Saetersdal M (1994) Rarity and species/area relationships of vascular plants in deciduous woods, western Norway – applications to nature reserve selection. Ecography 17, 25–38

Salomon AK, Waller NP, McIlhagga C, Yung R, Walters C (2002) Modeling the trophic effects of marine protected area zoning policies: A case study. Aquatic Ecology 36, 85–95

Sanchez P, Demestre M, Ramon M, Kaiser M J (2000) The impact of otter trawling on mud communities in the northwestern Mediterranean. Journal of Marine Science 57, 1352–1358

Schiel DR, Lilley SA (2007) Gradients of disturbance to an algal canopy and the modification of an intertidal community. Marine Ecology Progress Series 339, 1–11

Schluter M (1998) Die raumliche und- zeitliche Vertelung des Meroplantons (Larven des Evertebraten-Benthos) in der zentralen Barentssee. Diploma Thesis. University of Bremen, 79 pp.

Schratzberger M, Jennings S (2002) Impacts of chronic trawling disturbance on meiofaunal communities. Marine Biology 141, 991–1000

Schratzberger M, Warr K, Rogers SI (2007) Functional diversity of nematode communities in the southwestern North Sea. Marine Environmental Research 63, 368–389

Schwartz MW, CA Brigham JD, Hoeksema KG, Lyons MH, Mills PJ van Mantgem (2000) Linking biodiversity to ecosystem function: implications for conservation ecology. Oecologia 122, 297–305

Service RF (2004) Oceanography. New dead zone off Oregon coast hints at sea change in currents. Science 305, 1099–1099

Shaw KM, Lambshead PJD, Platt HM (1983) Detection of pollution-induced disturbance in marine benthic assemblages with special reference to nematodes. Marine Ecology Progress Series 11, 195–202

Shin PKS (1977) A quantitative and qualitative survey of the benthic fauna of the territorial waters of Hong Kong. M.Phil. thesis, University of Hong Kong

Shin PKS (1982) The marcobenthic infauna of Tolo Harbour and Tolo Channel, Hong Kong. In: Proceedings of The First Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong 1980 (Morton B, Tseng CKT, eds), 721–31. Hong Kong: Hong Kong University Press

Shin PKS, Thompson GB (1982) Spatial distribution of the infaunal benthos of Hong Kong. Marine Ecology Progress Series 10, 37–47

Shin PKS (1985) A trawl survey of the subtidal Mollusca of Tolo Harbour and Mirs Bay, Hong Kong. In: The Malacofauna of Hong Kong and South China II (Morton B, Dudegeon D, eds), 439–447. Proceedings of the Second Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong 1983. Hong Kong: Hong Kong University Press

Shin PKS (1989) Natural disturbance of benthic infauna in the offshore waters of Hong Kong. Asian Marine Biology 6, 193–207

Shin PKS (1990) Benthic invertebrates in Tolo Harbour and Mirs Bay: a review. In:

Proceedings of The Second International Marine Biological Workshop (Morton B, ed), 883–98. The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong, 1986. Hong Kong University Press

Shin PKS (2000) The detection of ecological stress in a sub-tropical marcobenthic community in Hong Kong. Asian Marine Biology 17, 149–160

Shin PKS (2003) Changes in benthic infaunal communities in Tolo Harbour: will the trend continue? In: Perspectives on Marine Environmental Changes in Hong Kong and Southern China, 1977–2001 (Morton B, ed), 579–592. Proceedings of Hong Kong's International Workshops Reunion Conference, 21–26 October 2001. Hong Kong: Hong Kong University Press

Shin PKS, Huang ZG, Wu RSS (2004) An updated baseline of subtropical macrobenthic communities in Hong Kong. Marine Pollution Bulletin 49, 119–141

Smith CJ, Papadopoulou KN, Diliberto S (2000) Impact of otter trawling on an eastern Mediterranean commercial trawl fishing ground. ICES Journal of Marine Science 57, 1340–51

Snelgrove P, Blackburn TH, Hutchings PA, Alongi DM, Grassle JF, Hummel H, King G, Koike I, Lambshead PJD, Ramsing NB, Solis-Weiss V (1997) The importance of marine sediment biodiversity in ecosystem processes. Ambio 26, 578–583

Snelgrove PVR (1998) The biodiversity of macrofaunal organisms in marine sediments. Biodiversity Conservation 7, 1123–1132

Solan M, Cardinale BJ, Downing AL, Engelhardt KAM Ruesink, JL, Srivastava DS (2004) Extinction and ecosystem function in the marine benthos. Science 306, 1177–1180

Sousa WP (1979) Disturbance in marine intertidal boulder fields: the nonequilibrium maintenance of species diversity. Ecology 60, 1225–1239

Southwood TRE (1977) Habitat, the templet for ecological strategies? Journal of Animal Ecology 46, 337–365

Southwood TRE (1988) Tactics, strategies and templets. Oikos 52, 3–18

Sparks-McConkey PJ, Watling L (2001) Effects on the ecological integrity of a soft-bottom habitat from a trawling disturbance. Hydrobiologia 456, 73–85

Steele J, Alverson DL, Auster P, Collie J, DeAlteris JT, Deegan L, Escobar-Briones E, Hall SJ, Kruse GH, Pomeroy C, Scanlon KM, Weeks P (2002) Effects of trawling and dredging on seafloor habitat. National Academy Press, Washington, DC., 126 pp.

Stewart PL, Pocklington P, Cunjaki RA (1985) Distribution, abundance and diversity of benthic macroinvertebrates on the Canadian continental shelf and slope of Southern Davis Strait and Ungava Bay. Arctic 38:4, 281–291

Stobart B, Warwick R, González C, Mallol S, Díaz D, Reñones O, Goñi R (2009) Long-term and spillover effects of a marine protected area on an exploited fish community. Marine Ecology Progress Series 384, 47-60

Stokesbury KDE, Harris BP, Marino II MC, Nogueira JO (2007) Sea scallop mass mortality in marine protected area. Marine Ecology Progress Series 349, 151–158

Stone RP, Masuda MM, Malecha PW (2005) Effects of bottom trawling on soft-sediment epibenthic communities in the Gulf of Alaska. In: Benthic Habitats and The Effects of Fishing (Barnes PW, Thomas JP, eds) American Fisheries Society Symposium, 41:99, 461–475

Teixidó N, Garrabou J, Gutt J, Arntz WE (2004) Recovery in Antarctic benthos after iceberg disturbance: trends in benthic composition, abundance and growth forms. Marine Ecology Progress Series 278, 1–16

Thioulouse J, Chessel D, Doledec S, Olivier, JM (1997) ADE 4: a multivariate analysis and graphical display software. Statistics and Computing 7, 75–83

Thorson G (1936) The larval development, growth and metabolism of Arctic marine bottom invertebrates compared with those of other seas. Meddelingen om Grønland 100, 1–155

Thrush SF, Hewitt JE, Cummings VJ, Dayton PK (1995) The impact of habitat disturbance by scallop dredging on marine benthic communities: What can be predicted from the results of experiments? Marine Ecology Progress Series 129, 141–50

Thrush SF, Hewitt JE, Cummings VJ, Dayton PK, Cryer M (1998) Disturbance of the marine benthic habitat by commercial fishing: impacts at the scale of the fishery. Ecological Applications 8, 866–79

Thrush SF, Dayton PK (2002) Disturbance to marine benthic habitats by trawling and dredging — implications for marine biodiversity. Annual Review of Ecology and Systematics 33, 449−473

Tilman D, Downing J (1994) Biodiversity and stability in grasslands. Nature 367, 363–365

Tilman D, Wedin D, Knops J (1996) Productivity and sustainability influenced by biodiversity in grassland ecosystems. Nature 379, 718–720.

Tilman D, Knops J, Reich P, Ritchie M, Siemann E, Terry AC (1997a) The influence of functional diversity and composition on ecosystem processes. Science 277, 1300–1302.

Tilman D, Lehman CL, Thomson KT (1997b) Plant diversity and ecosystem productivity: Theoretical considerations. Proceedings of the National Academy of Sciences USA 94, 1857–1861

Tillin HM, Hiddink JG, Jennings S, Kaiser MJ (2006) Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea-basin scale. Marine Ecology Progress Series 318, 31–45

Tuck ID, Hall SJ, Robertson MR, Armstrong E, Basford DJ (1998) Effects of physical trawling disturbance in a previously unfished sheltered Scottish sea loch. Marine Ecology Progress Series 162, 227–42

Tupper M, Boutilier RG (1995) Effects of habitat on settlement, growth, and postsettlement survival of Atlantic cod (*Gadus morthua*). Canadian Journal of Fisheries and Aquatic Science 52, 1834–1841

Turner JRG, Lennon JJ (1989) Species richness and the energy theory. Nature 340, 351

Tuya FC, Soboil ML, Kido J (2000) An assessment of the effectiveness of Marine Protected Areas in the San Juan Islands, Washington, USA. ICES Journal of Marine Science 57: 4, 1218–1226

Ugland KI, Gray JS (1982) Log normal distributions and the concept of community equilibrium. Oikos 39, 171–178

Usseglio-Polatera P, Bournaud M, Richoux P, Tachet H (2000a) Biomonitoring through biological traits of benthic macroinvertebrates: how to use species traits databases? Hydrobiologia 422:423, 153–162

Usseglio-Polatera P, Bournaud M, Richoux P, Tachet H (2000b) Biological and ecological traits of benthic freshwater macroinvertebrates: relationship and definition of groups with similar traits. Freshwater Biology 43, 175–205

Valentine JW, Roy K, Jablonski D (2002) Carnivore/non-carnivore ratios in northeastern Pacific marine gastropods. Marine Ecology Progress Series 228, 153–163

Van der Westhuizen A (2001) A decade of exploitation and management of the Namibian hake stocks. South Africa Journal of Marine Science 23, 307–315

Van Dolah RF, Wendt PH, Nicholson N (1987) Effects of a research trawl on a hard-bottom assemblage of sponges and corals. Fisheries Research 5, 39–54

Van Dolah RF, Wendt PH, Levisen MV (1991) A study of the effects of shrimp trawling on benthic communities in two South Carolina sounds. Fish Research 12, 139–56

Veale LO, Hill AS, Hawkins SJ, Brand AR (2000) Effects of long-term physical disturbance by commercial scallop fishing on subtidal epifaunal assemblages and habitats. Marine Biology 137, 325–37

Vitousek PM, Hooper DU (1993) Biological diversity and terrestrial ecosystem biogeochemistry. In: Biodiversity and Ecosystem Function (Schulze ED, Mooney HA, eds), 3–14. Springer-Verlag, New York, New York, USA

Walday M, Fleddum A, Lepland A (2005) Kartlegging av marint biologisk mangfold i indre Oslofjord. Forprosjekt. NIVA report Nr 5097–2005

Walling DE, Peart MR (1980) Some quality considerations in the study of human influence on sediment yields. Proceedings of the Helsinki Symposium, June 1980; Actes du Colloque d'Helsinki, juin 1980: IAHS-AISH Publ. no. 130

Walker BH (1992) Biodiversity and ecological redundancy. Conservation Biology 6, 18–23

Watling L, Norse EA (1998) Disturbance of the seabed by mobile fishing gear: a comparison to forest clearcutting. Conservation Biology 12, 1180–1197

Watling L, Findlay RH, Mayer LM, Schick DF (2001) Impact of a scallop drag on the sediment chemistry, microbiota, and faunal assemblages of a shallow subtidal marine benthic community. Journal of Sea Research 46, 309–24

Watling L (2005) The global destruction of bottom habitats by mobile fishing gears. In: Marine Conservation Biology (Norse EA, Crowder LB, eds), 198–210. Island Press, Washington DC

Watson JP, Watson DM (1979) Marine Investigation into Sewage Discharges. The Government Printer, Hong Kong

Wear RG, Thompsom GB, Stirling HP (1984) Hydrography, nutrients, and plankton in

Tolo Harbour, Hong Kong. Asian Marine Biology 1, 59–75

Webb KE, Hammer Ø, Lepland A, Gray JS (2009a) Pockmarks in the inner Oslofjord, Norway. Geo-Marine Letters 29, 111–124

Webb KE, Barnes DKA, Planke S (2009b) Pockmarks: refuges for marine benthic biodiversity. Limnology and Oceanography 54, 1776–1788

Webb KE, Barnes DKA, Gray JS (2009c) Benthic ecology of pockmarks in the inner Oslofjord, Norway. Marine Ecology Progress Series 387, 15–25

Weston DP (1990) Quantitative examination of macrobenthic community changes along an organic enrichment gradient. Marine Ecology Progress Series 61, 233–244

Widdicombe S, Austen MC, Frode Olsgard F, Schaanning MT, Dashfield SL, Needham HR (2004) Importance of bioturbators for biodiversity maintenance: indirect effects of fishing disturbance. Marine Ecology Progress Series 275, 1–10

Wilding TA (2006) The benthic impacts of the Lock Linnhe artificial reef. Hydrobiologica 555, 345–353

Wilkinson S, Japp D (2005) Description and evaluation of hake-directed trawling intensity on benthic habitat in South Africa. Prepared for the South African Deep Sea Trawling Industry Association by Fisheries and Oceanographic Support Service, 69 pp.

Wu RSS, Richards J (1979) Mass mortality of benthos in Tolo Harbour. Fisheries Occasional Paper 21. Hong Kong Agriculture and Fisheries Department

Wu RSS (1982) Periodic defaunation and recovery in a sub-tropical epibenthic community, in relation to organic pollution. Journal of Experimental Marine Biology and Ecology 64, 253–269

Wu RSS (1988) Marine pollution in Hong Kong: A review. Asian Marine Biology 5, 1–23

Wu RSS, Lam PKS, Wan KL (2002) Tolerance to, and avoidance of, hypoxia by the penaeid shrimp (*Metapenaeus ensis*). Environmental Pollution 118, 351–355

Wu RSS, Or YY (2005) Bioenergetics, growth and reproduction of amphipods are affected by moderately low oxygen regimes. Marine Ecology Progress Series 297, 215–223

Yoklavich MM, Greene HG, Cailliet GM, Sullivan DE, Lea RN, Love MS (2000) Habitat associations of deep-water rockfishes in a submarine canyon: an example of a natural refuge. Fishery Bulletin 98, 625–641

Yung CK, Wong MJ, Broom JA, Ogden SCM, Leung Y (1997) Long-term changes in hydrography, nutrients and phytoplankton in Tolo Harbour, Hong Kong. Hydrobiologia 352, 107–115

9.2 References for biological traits and taxa

9.2.1 Articles

Beare DJ, Moore PG (1998) The life history of the offshore Oedicerotids *Westwoodilla caecula* and *Monoculodes packardi* (Crustacea: Amphipoda) from Loch fine, Scotland. Journal of the Marine Biological Association of the United Kingdom 78, 835–852

Blake JA (1993) Life history analysis of five dominant infaunal polychaete species from the continental slope off North Carolina. Journal of the Marine Biological Association of the United Kingdom 73, 123–141

Bondsdorff E, Pearson TH (1999) Variation in the sublittoral macrozoobenthos of the Baltic Sea along environmental gradients: A functional-group approach. Australian Journal of Ecology 24, 312–326

Børge H (1998) The macrofauna and main functional interactions in the sill basin sediments of the pristine Holandsfjord, Northern Norway, with autecological reviews for some key-species. Sarsia 83, 55–68

Cartes JE, Elizalde M, Sorbe JC (2001) Contrasting life-histories, secondary production, and trophic structure of Peracarid assemblage of the bathyal suprabenthos from the Bay of Biscay (NE Atlantic) and the Catalan Sea (NW Mediterranean. Deep-Sea Research Part I, Oceanographic Research Papers 48:10, 24 pp.

Corey AS (1969) The comparative life histories of three Cumacea (Crustacea): *Cumopsis* *goodsiri* (van Beneden), *Iphinoe trispinosa* (Goodsir), and *Pseudocuma longicornis* (Bate). Canadian Journal of Zoology 47, 695–704

Dufour SC, Felbeck H (2003) Sulphide mining by the superextensile foot of symbiotic Thyasirid bivalves. Nature 426, 65–67

Fauchald K, Jumars PA (1979) The diet of worms: A study of polychaete feeding guilds. Oceanography and Marine Biology: An Annual Review 17, 193–284

Fournier JA, Petersen ME (1991) *Cossura longocirrata*: Redescription and distribution, with notes on reproductive biology and comparison of described species of *Cossura* (Polychaeta: Cossuridae). Ophelia, Supplement 5, 63–80

Gerdes A, Hilbig B, Montiel A (2003) Impact of iceberg scouring on macrobenthic communities in the high-Antarctic Weddell Sea. Polar Biology 26, 295–301

Gremare A, Duchene JC, Rosenberg R, David E, Desmalades M (2004) Feeding behaviour and functional response of *Abra ovata* and *A. nitida* compared by image analysis. Marine Ecology Progress Series 267, 195–208

Heffernan P, Conner BO, Keegan BF (1983) Population dynamics and reproductive cycle of *Pholoe minuta* (Polychaeta: Sigalionidae) in Galway Bay. Marine Biology 73, 285–291

Heip C (1995) Eutrophication and zoobenthos dynamics. Ophelia 41, 113–136

Holte B (1998) The macrofauna and main functional interactions in the sill basin sediments of the pristine Holandsfjord, Northern Norway, with autecological reviews for some key-species. Sarsia 83, 55–68

Holte B, Gulliksen B (1997) Common macrofaunal dominant species in the sediments of some north Norwegian and Svalbard glacial fjords. Polar Biology 19, 375–382

Holthe T (1986) Polychaeta Terebellomorpha. Marine Invertebrates of Scandinavia, No 7. Scandinavian University Press

Jespersen Å, Lutzen J (2000) Sex, seminal receptacles, and sperm ultrastructure in the commensal bivalve *Montacuta phascolionis* (Veneroida; Galeommatacea). Acta Zoologica (Stockholm) 81, 69–75

Johansen PO, Brattegard T (1998) Observations on behaviour and distribution of *Natatolana borealis* (Lilljeborg) (Crustacea, Isopoda). Sarsia 83, 347–360

Josefson AB (1981) Persistence and structure of two deep macrobenthic communities in the Skagerrak (West coast of Sweden). Journal of Experimental Marine Biology and Ecology 50, 63–97

Josefson AB (1986) Temporal heterogeneity in deep-water soft-sediment benthos - an attempt to reveal temporal structure. Estuarine Coastal and Shelf Science 23, 147–169

Kaartvedt S (1986) Diel activity patterns in deep-living cumacean and amphipods. Marine Ecology Progress Series 30, 243–249

Lincoln RJ (1979) British marine amphipoda: Gammeridea. British Museum of Natural History, 1–658

Medernach L, Jordana E, Grémare A, Nozais C, Charles F, Amouroux JM (2000) Population dynamics, secondary production and calcification in a Mediterranean population of *Ditrupa arietina* (Annelida: Polychaeta). Marine Ecology Progress Series 229, 199–171

Miskov-Nodland K, Buhl-Mortensen L, Høisæter T (1999) Has the fauna in the deeper parts of the Skagerrak changed? A comparison of the present amphipod fauna with observations from 1933/37. Sarsia 84, 137–155

Mulsow SP, Landrum F, Robbins JA (2002) Biological mixing responses to sub lethal concentrations of DDT in sediments by *Heteromastus filiformis* using a 137Cs marker layer technique. Marine Ecology Progress Series 239, 181–191

Murina GVV, Pancucci-Papadopoulou MA, Zenetos A (1999) The phylum Sipuncula in the eastern Mediterranean: composition, ecology, zoogeography. Journal of the Marine Biological Association of the United Kingdom 79, 821–830

Nickell LA, Atkinson RJA, Hughes DJ, Ansell AD, Smith CJ (1995) Burrow morphology of the echiuran worm *Maxmuelleria lankesteri* (Echiura: Bonelliidae), and a brief review of burrow structure and related ecology of the Echiura. Journal of Natural History 29, 871–885

Noji AI & Noji TT (1991) Tube lawns of spionid polychaetes and their significance for recolonization of disturbed benthic substrates, a review. Meeresforschung 33, 235–246

Pardo EV, Amaral ACZ (2004) Feeding behavior of the cirratulid *Cirriformia filigera* (Delle Chiaje, 1825) (Annelida: Polychaeta). Brazilian Journal of Biology 64:2, 283–288

Payne A, Punt AE (1995) Biology and Fisheries of South African hakes (*M. capensis* and *M. paradoxus*). In: Hake Fisheries, Ecology and Markets, 15-47

Pearson TH (1971) Studies on the ecology of the macrobenthic fauna and Lochs Linnhe and Eil, West coast of Scotland. Vie et Milieu Supplement 22, 53–91

Pocklington P, Hutcheson MS (1983) New record of viviparity for the dominant benthic invertebrate *Exogone hebes* (Polychaeta, Syllidae) from the grand banks of Newfoundland. Marine Ecology Progress Series 11:3, 239–244

Queiros AM, Hiddink JG, Kaiser MJ, Hinz H (2006) Effects of chronic bottom trawling disturbance on benthic biomass, production and size spectra in different habitats. Journal of Experimental Marine Biology and Ecology 335, 91–103

Radashevsky VI, Hsieh HL (2000) *Pseudopolydora* (Polychaeta: Spionidae) species from

Taiwan. Zoological Studies 39:3, 218–235

Rouse GW, Tzetlin AB (1997) Ultra structure of the body wall and gametogenesis in *Cossura* cf. *longocirrata* (Cossuridae, Polychaeta). Invertebrate Reproduction and Development 32:1, 41–54

Rouse GW, Gambi MC (1998) Evolution of reproductive features and larval development in the genus *Amphiglena* (Polychaeta: Sabellidae), Marine Biology 131, 743–753

Shull AH (2001) Transition-matrix model of bioturbation and radionuclide diagenesis. Limnology and Oceanography 46:4, 905–916

Sponer R, Roy MS (2002) Phylogeographic analysis of the brooding brittle star *Amphipholis squamata* (Echinodermata) along the coast of New Zealand reveals high cryptic genetic variation and cryptic dispersal potential. Evolution 56, 10

Swift AJ (1993) The macrobenthic infauna off Sellafield (North Eastern Irish Sea) with special reference to bioturbation. Journal of the Marine Biological Association of the United Kingdom 73, 143–162

Taylor AC, Moore PG (1995) The burrows and physiological adaptations to a burrowing lifestyle of *Natatolana borealis* (Isopoda, Cirolanidae). Marine Biology 124, 805–814

Tsetlin AB, Markelova NP (1986) Asexual breeding in *Maldane sarsi* (Annelida, Polychaeta, Maldanidae). Akademii Nauk SSSR 288 3, 763–765

Watson GJ, Langford FM, Gaudron SM, Bentley MG (2000) Factors influencing spawning and pairing in the scale worm *Harmothoe imbricata* (Annelida: Polychaeta). Biological Bulletin 199, 50–58

Weslawsci JM, Legezynska J (2002) Life cycles of some Arctic amphipods. Polish Polar Research 23:3-4, 253–264

Widdicombe S, Austen MC, Kendall MA, Warwick RM, Jones MB (2000) Bioturbation as a mechanism for setting and maintaining levels of diversity in subtidal macrobenthic communities. Hydrobiologia 440, 369–377

Yoda AM, Masakazu A (2002) Comparative study of benthicand pelagic populations of *Bodotria similis* (Cumacea) from ZU Peninsula, Southern Japan. Journal of Crustacean Biology, 22: 3, 543–552

9.2.2 Books

Christensen AJM, Larsen S, Nystrøm BO (1978) Muslinger. JW Cappelens Forlag AS, 124 pp.

Dai AY, Yang SL (1991) Crabs of the China Seas. China Ocean Press, Beijing, 681 pp.

Day JH (1967a) A Monograph on the Polychaeta of Southern Africa. Part 1. Errantia. Trustees of the British Museum (Natural History), London, 1–458

Day JH (1967b) A Monograph on the Polychaeta of Southern Africa. Part 2. Sedentaria. Trustees of the British Museum (Natural History), London, 459–878

Enckell PH (1980) Kräftdjur. Bokfölaget Signum i Lund, 685 pp.

Fauchald K (1977) The Polychaete Worms. Definitions and Keys to the Orders, Families and Genera. Natural History Museum of Los Angeles County, Science Series 28, 188 pp.

Hartmann Schrøder (1996) Annelida, Borstenwurmer, Polychaeta. Gustav Fischer, 648 pp.

Hayward P, Nelson-Smith T, Shields C (1996) Sea Shore of Britain and Nothern Europe. Harper Collins Publishers, 544 pp.

Hayward PJ, Ryland JS (1995) Handbook of the Marine Fauna of North-West Europe. Oxford University Press, 800 pp.

Kirkegaard JB (1992) Havbørsteorme I. Danmarks Fauna Bd. 83. Dansk Naturhistorisk forening. København

Kirkegaard JB (1996) Havbørsteorme II. Danmarks Fauna Bd. 86. Dansk Naturhistorisk forening. København

Linder A (1976) Snegler og muslinger fra alle hav. JW Cappelens Forlag AS

Miyake S (1982) Japanese Crustacean Decapods and Stomatopods in Colour. Vol. 1 Macrura, Anomura and Stomatopoda. Hoikusha Publishing Co, Ltd., Osaka, Japan, 261 pp.

Miyake S (1983) Japanese Crustacean Decapods and Stomatopods in Colour. Vol. 2 Brachyura(Crabs). Hoikusha Publishing Co., Ltd., Osaka, Japan, 277 pp.

Moen FE, Svendsen E (1999) Dyreliv i havet. Håndbok i Norsk Marine Fauna. Kom Forlag, 544 pp.

Pleijel F (1993) Polychaeta Phyllodocidae. Marine invertebrates of Scandinavia, No 8. Scandinavian University Press, 159 pp.

Qi ZY (2004) Seashells of China. China Ocean Press, Beijing, 418 pp.

Rouse GW, Pleijel F (2001) Polychaetes. Oxford University Press, 354 pp.

Sars GO (1903) An Account of the Crustacea of Norway IV Copepoda Calanoida. Bergen Museum, 171 pp.

Sun RP, Yang DJ (2004) Fauna Sinica. Phylum Annelida. Class Polychaeta II, Order Nereidida. Science Press. Beijing, 520 pp.

Tucker Abbot R (1974) American Seashell. The Marine Mollusca of the Atlantic and Pacific Coast of North America. Van Nostrans Reinhold Company, Second Edition, 663 pp.

Wu BL, Wu QQ, Qiu JW, Lu H (1997) Fauna Sinica, Phylum Annelida, Class Polychaeta, Order Phyllodocimorpha. Science Press, Beijing, 329 pp.

9.2.3 Software

INTKEY: POLIKEY. An information system for polychaete families and higher taxa. Version 2

9.2.4 Web

http://biogeo.nos.noaa.gov/products/canms_cd/data/pdfs/ELR.pdf

http://biologi.uio.no/plfys/haa/zoologi/pigghud.pdf

http://bugs.bio.usyd.edu.au/Polychaetes/title.htm

http://crimp.marine.csiro.au/nimpis/spSummary.asp?txa=6147

http://erato.acnatsci.org/wasp/search.php/9584

http://erms.biol.soton.ac.uk/lists/full/Isopoda.shtml#genus-Ischnomesus http://erms.biol.soton.ac.uk/lists/full/Sipuncula.shtml

http://gmbis.marinebiodiversity.ca/BayOfFundy/taxListInfo.jsp?taxListInfo=Euchone%20incolor

http://gmbis.marinebiodiversity.ca/BayOfFundy/taxListInfo.jsp?taxListInfo=Polycarpa%20fibrosa

http://ip30.eti.uva.nl/bis/crustacea.php?menuentry=inleiding

http://ip30.eti.uva.nl/bis/tunicata.php?selected=beschrijving&menuentry=soorten&record=Eugyra%20arenosa

http://nature.umesci.maine.edu/Cumacea/diastylidae1.html

http://nature.umesci.maine.edu/Cumacea/diastylidae2.html

http://nephi.unice.fr/Medifaune/HTM/di2/f001.htm

http://nighthawk.tricity.wsu.edu/museum/ArcherdShellCollection/ShellClass.html

http://personal.cityu.edu.hk/~bhworm/sedentary/photo.htm

http://pubs.usgs.gov/of/of00-304/htmldocs/chap10/ch10tab.htm http://scilib.ucsd.edu/sio/nsf/fguide/arthropoda39.html

http://search.marsfind.com/ufts.html?ver=100&uid=671290fa86184503bb63d09e9a19876b&status=2146697211&query=http%3A%2F%2Fbiodiversity.uno.edu%2Fdelta%2Fwww%2Fprograms.htm

http://valoraciencia.ucn.cl/bedim/marbiol132dyopedos.pdf

http://www.amphipoda.com/index.html

http://www.awi-bremerhaven.de/Publications/Kru2002d.pdf

http://www.baybenthos.versar.com

http://www.bioresurs.uu.se/myller/hav/ormstjarna.htm

http://www.ceroi.net/kommuner/trondheim/miljotema/trondheimsfjorden/mer_om_trondheimsfjorden/

http://www.coldoceanaquarium.ca/Exhibits/mudstar.html

http://www.com.univ-mrs.fr/DIMAR/Phoro/SYST/MUEL/muel_ADULT.html http://www.crustacea.net

http://www.dmap.co.uk/fossils/barton/gast/bartgast.htm

http://www.earthlife.net/inverts/pogonophora.html

http://www.ecy.wa.gov/pubs/0309090.pdf

http://www.ifm.uib.no/wwwpdf/HFag/KuttiT.pdf

http://www.io-warnemuende.de/projects/dynas/dynas/aktuelles/steckbriefe.pdf

http://www.jaxshells.org/recyclin.htm

http://www.kluweronline.com/article.asp?PIPS=258114&PDF=1

http://www.kmf.gu.se/pdf-files/rapport2002.pdf

http://www.marlin.ac.uk/

http://www.mov.vic.gov.au/crust/mov938t.html

http://www.nhm.ac.uk/palaeontology/echinoids/GENERA/CLYPEAST/LAGANINA/ECY
AM1.HTM

http://www.palaeos.com/Invertebrates/Molluscs/Caudofoveata/index.html

http://www.saintbrendan.com/cdnapril00/marine4.html

http://www.sakrafarleder.nu/Imp_Doc/Miljorapporter/P200202-8.6.3.pdf

http://www.seaslugforum.net/philscab.htm

http://www.springerlink.com/media/egenqgttwjy0dcu2qrrq/Contributions/V/U/9/7/VU973KLTGJUKRL98.pdf

http://www.teaching-biomed.man.ac.uk/bs1999/bs146/biodiversity/mollusca.htm

http://www.tmbl.gu.se/libdb/taxon/neat_pdf/NEAT*Echinodermata.pdf

http://www.tmbl.gu.se/libdb/taxon/neat_pdf/NEAT*Mollusca.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Abra%20longicallus.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Abra%20prismatica.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Amphilepis%20norvegica.pdf http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20B.arca%20pectunculoides.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Cuspidaria%20lamellosa.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Dentalium%20occidentale.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Limatula%20subauriculata.pdf

http://www.tmbl.gu.se/pdf/Artfaktablad/Artf%20Macoma%20calcarea.pdf

http://www.ub.rug.nl/eldoc/dis/science/j.g.hiddink/c1.pdf

http://www.ukmarinesac.org.uk/communities/seapens/sp3_1.htm

http://www2.eou.edu/~jrinehar/invertzo/priapuli.htm

Appendix I

Statistics

Shannon diversity index (Magurran 1998):

The index is used to measure species richness across equivalent sampling design and is defined as:

$$H' = -\sum_i p_i \ log(p_i)$$

H' = Shannon diversity

p_i = Proportion of total amount of abundance or biomass from the ith species

The diversity value (H') ranges between 0 indicating low community complexity and 4 indicating high community complexities.

Pielou's evenness index:

The index indicates species richness that includes data from total amount of species and total amount of individuals. Evenness is an expression how evenly the individuals are distributed among the different species and is defined as:

$$J' = H'/H'_{max} = H'/\log S$$

H'_{max} = the highest number of Shannon diversity

S = total number of species

High evenness occurs when many species have similar abundance, with no single species dominating. The range of J' values from 0 indicating low evenness to 1 indicating high evenness.

Bray-Curtis similarity coefficient (Bray and Curtis 1957)

This is a similarity coefficient used to determine site similarities in the community structure based on species abundances. This measure helps to evaluate the amount of similarity/ dissimilarity between benthic invertebrate communities at different sites. The method incorporates both species richness and evenness components and can provide information on heterogeneity (Rosenstock 1998; Blair 1999).

The similarity $S^{|}_{il}$ between species *i* and *l* at two sites is:

$$S^{|}_{il} = 100\left\{1 - \frac{\sum_{j=1}^{n}\left|y_{ij} - y_{lj}\right|}{\sum_{j=1}^{n}\left(y_{ij} + y_{lj}\right)}\right\}$$

The similarity value $(S^{|})$ ranges between 0 indicating that two species are never at the same sites and 100 indicating that the two species are found over all sites.

Mann-Whitney U test

Mann-Whitney U test is a non-parametric rank test which not assumes normal distribution of two independent random samples. This test is an alternative to parametric t-test and exactly equivalent tests to Wilcoxon rank sum, Kendall's S, and chi-square. Mann-Whitney U gives rank number in additional to significant p value. The test statistic is U. If U exceeds the critical value at some significance level ($p > 0.05$) it means that there is evidence to reject the null hypothesis in favour of the alternative hypothesis. The Mann-Whitney U statistic is defined as:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n2} R_i$$

- where samples of size n_1 and n_2 are pooled and R_i are the ranks

- U can be determined as the number of observations in one sample contrast number of observations in the other sample in the ranking

Analysis of (dis-)Similarities (ANOSIM)

ANOSIM is used to test statistically whether there is a significant difference between sampling stations in an area, based on the ranks of the dissimilarities (Bray-Curtis similarity coefficient).

The equation is:

$$R = \frac{r_b - r_w}{{}^1/_4\{n(n-1)\}}$$

rb = mean rank of between group dissimilarities

rw = mean rank of within group dissimilarities

n = total number of samples

R = 0, there are no difference among groups

R > 0, the groups differ in community composition

Similarity Percentage Analysis (SIMPER) (Clarke 1993)

SIMPER calculates the average Bray-Curtis dissimilarity between all pairs of samples and sites. This is expressed in terms of the percentage contribution from each species/weighted traits.

Non-metric Multidimensional Scaling (MDS)

MDS is a multivariate method to explore similarities or dissimilarities in the data set by ordinate data points after rank order. MDS maximizes the rank order between the distance that is measures and the distance in the ordination space. Stress is a measure of the mismatch between the two kinds of distance and the points are moved to reduce the stress in the ordination plot. Several similarities method can be used. In this thesis, Bray-Curtis similarity coefficient was used for all abundance/biomass and weighted traits data.

Euclidean Distance

Euclidean Distance is the distance between two points in a straight line in a coordinate system. The Euclidean distance can be calculated using the Pythagorean equation. In two dimensions, the Euclidean distance is defined as:

$$\surd\,[(x1\text{-}x2)^2 + (y1\text{-}y2)^2]$$

x1-x2 = distance between sample x for species 1

y1-y2 = distance between sample y for species 2

The points represent samples and the axes represent the abundances of species/weighted traits. Euclidean distance is the calculation methods for Principal Component Analysis (PCA) and Principal Coordinate Analysis (PCoA).

Principal Component Analysis (PCA)

PCA is a linear ordination method based on eigenvalue analysis with multi-dimensional axes. PCA plots were used in this thesis to explore the environmental data in relation to stations.

Principal Coordinate Analysis (PCoA)

Principal Coordinate Analysis is a technique based on egenvalue to analyse a set of multivariate data between the distances (Euclidean distance) of the data points (e.g., similarities between station and species/weighted traits). The method is distance based (rely on a square, symmetric distance matrix or similarity matrix) which the distances between sites in the ordination diagram are maximally correlated with the species/weighted traits distances.

PERMANOVA Analysis (Anderson et al. 2008)

PERMANOVA tests the dissimilarity values generated by the resemblance matrix on which permutations are based, generating a test statistic value of pseudo-F (or pseudo-*t* for pair-wise test).

Appendix II

BT scores and species lists

End of Thesis

Phylum	Class	Order	Family	Species
Mollusca	Bivalvia	Veneroida	Semelidae	*Abra indet*
Mollusca	Bivalvia	Veneroida	Semelidae	*Abra longicallus*
Mollusca	Bivalvia	Veneroida	Semelidae	*Abra prismatica*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Abyssoninoe hibernica*
Arthropoda	Malacostraca	Amphipoda	Caprellidae	*Aeginina longicornis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus malmgreni*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca brevicornis*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca indet*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca macrocephala*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca spinipes*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca tenuicornis*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete falcata*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete finmarchica*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete lindstroemi*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharetidae indet*
Echinodermata	Stelleroidea	Ophiurida	Amphilepididae	*Amphilepis norvegica*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphipholis squamata*
Arthropoda	Malacostraca	Amphipoda	Amphipoda spp.	*Amphipoda indet*
Annelida	Polychaeta	Terebellida	Terebellidae	*Amphitritinae indet*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura chiajei*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura filiformis*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura sundevalli*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Amythasides macroglossus*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Anobothrus gracilis*
Annelida	Polychaeta	Spionida	Spionidae	*Aonides paucibranchiata*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Aphelochaeta indet*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Aphelochaeta marioni*
Annelida	Polychaeta	Spionida	Apistobranchidae	*Apistobranchus indet*
Arthropoda	Malacostraca	Tanaidacea	Apseudidae	*Apseudes spinosus*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea catherinae*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea hartmani*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea indet*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea roberti*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea wassi*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Arrhis phyllonyx*
Mollusca	Bivalvia	Veneroida	Astartidae	*Astarte borealis*
Mollusca	Bivalvia	Veneroida	Astartidae	*Astarte crenata*
Mollusca	Bivalvia	Veneroida	Astartidae	*Astarte elliptica*
Mollusca	Bivalvia	Veneroida	Astartidae	*Astarte montagui*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Augeneria tentaculata*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Autolytus indet*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Axinopsida orbiculata*
Annelida	Polychaeta	Terebellida	Terebellidae	*Axionice maculata*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Brachydiastylis resima*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Byblis gaimardi*
Arthropoda	Malacostraca	Isopoda	Paranthuridae	*Calathura brachiata*
Annelida	Polychaeta	Capitellida	Capitellidae	*Capitella capitata*
Annelida	Polychaeta	Capitellida	Capitellidae	*Capitellidae indet*
Arthropoda	Malacostraca	Amphipoda	Caprellidae	*Caprellidae indet*
Mollusca	Caudofoveata	Caudofoveata	Caudofoveata	*Caudofoveata indet*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Caulleriella killariensis*
Mollusca	Aplacophora	Chaetodermatida	Chaetodermatidae	*Chaetoderma nitidulum*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone indet*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone setosa*
Annelida	Polychaeta	Sabellida	Sabellidae	*Chone collaris*
Annelida	Polychaeta	Sabellida	Sabellidae	*Chone duneri*
Annelida	Polychaeta	Sabellida	Sabellidae	*Chone indet*
Annelida	Polychaeta	Sabellida	Sabellidae	*Chone paucibranchiata*
Mollusca	Bivalvia	Heterodonta	Cardioidea	*Ciliatocardium ciliatum*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulidae indet*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus cirratus*
Annelida	Polychaeta	Capitellida	Maldanidae	*Clymenura borealis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Clymenura indet*
Annelida	Polychaeta	Capitellida	Maldanidae	*Clymenura polaris*
Mollusca	Bivalvia	Mytiloida	Mytilidae	*Crenella decussata*
Echinodermata	Asterozoa	Asteroidea	Paxillosida	*Ctenodiscus crispatus*
Mollusca	Bivalvia	Pholadomyoida	Cuspidariidae	*Cuspidaria arctica*
Mollusca	Bivalvia	Pholadomyoida	Cuspidariidae	*Cuspidaria lamellosa*
Mollusca	Bivalvia	Pholadomyoida	Cuspidariidae	*Cuspidaria obesa*
Mollusca	Gastropoda	Cephalaspidea	Cylichnidae	*Cylichna alba*
Mollusca	Gastropoda	Cephalaspidea	Cylichnidae	*Cylichna cylindracea*
Mollusca	Gastropoda	Cephalaspidea	Cylichnidae	*Cylichna occulta*
Mollusca	Bivalvia	Mytiloida	Mytilidae	*Dacrydium vitreum*
Mollusca	Scaphopoda	Dentaliida	Dentaliidae	*Dentalium entalis*
Mollusca	Scaphopoda	Dentaliida	Dentaliidae	*Dentalium indet*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylis indet*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylis scorpioides*
Annelida	Polychaeta	Flabelligerida	Flabelligeridae	*Diplocirrus glaucus*
Annelida	Polychaeta	Flabelligerida	Flabelligeridae	*Diplocirrus hirsutus*
Annelida	Polychaeta	Spionida	Spionidae	*Dipolydora coeca*
Echinodermata	Echinoidea	Spatangoida	Loveniidae	*Echinocardium flavescens*
Echinodermata	Echinoidea	Clypeasteroida	Fibulariidae	*Echinocyamus pusillus*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Eclysippe vanelli*
Mollusca	Bivalvia	Nuculoida	Nuculidae	*Ennucula tenuis*
Mollusca	Scaphopoda	Gadilida	Entalinidae	*Entalina quinquangularis*
Arthropoda	Malacostraca	Amphipoda	Melitidae	*Eriopisa elongata*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone indet*
Annelida	Polychaeta	Sabellida	Sabellidae	*Euchone indet*
Annelida	Polychaeta	Sabellida	Sabellidae	*Euchone papillosa*
Annelida	Polychaeta	Sabellida	Sabellidae	*Euchone southerni*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymene affinis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymene droebachiensis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymene lindrothi*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymeninae indet*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorella emarginata*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorellopsis deformis*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Eusyllis blomstrandi*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone verugera*
Annelida	Polychaeta	Fauveliopsida	Fauveliopsidae	*Fauveliopsis indet*

Phylum	Class	Order	Family	Species
Annelida	Polychaeta	Oweniida	Oweniidae	*Galathowenia oculata*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera lapidum*
Arthropoda	Malacostraca	Isopoda	Gnathiidae	*Gnathia indet*
Sipuncula	Sipunculidea	Golfingiida	Golfingiidae	*Golfingia indet*
Sipuncula	Sipunculidea	Golfingiida	Golfingiidae	*Golfingia margaritacea*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada maculata*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Haploops tubicola*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe fraserthomsoni*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe imbricata*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe indet*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia antennaria*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia indet*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia mucronata*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia pectinata*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia plumosa*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia propinqua*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia serrata*
Arthropoda	Malacostraca	Cumacea	Lampropidae	*Hemilamprops roseus*
Annelida	Polychaeta	Capitellida	Capitellidae	*Heteromastus filiformis*
Mollusca	Bivalvia	Myoida	Hiatellidae	*Hiatella arctica*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Hippomedon denticulatus*
Annelida	Polychaeta	Eunicida	Onuphidae	*Hyalinoecia tubicola*
Arthropoda	Malacostraca	Amphipoda	Isaeidae	*Isaeidae indet*
Arthropoda	Malacostraca	Isopoda	Isopoda	*Isopoda indet*
Annelida	Polychaeta	Sabellida	Sabellidae	*Jasmineira candela*
Annelida	Polychaeta	Sabellida	Sabellidae	*Jasmineira caudata*
Mollusca	Bivalvia	Veneroida	Kelliellidae	*Kelliella miliaris*
Echinodermata	Holothuroidea	Apodida	Synaptidae	*Labidoplax buskii*
Annelida	Polychaeta	Terebellida	Terebellidae	*Lanice conchilega*
Annelida	Polychaeta	Spionida	Spionidae	*Laonice cirrata*
Annelida	Polychaeta	Spionida	Spionidae	*Laonice sarsi*
Annelida	Polychaeta	Terebellida	Terebellidae	*Laphania boecki*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Leitoscoloplos indet*
Mollusca	Gastropoda	Archaeogastropoda	Lepetidae	*Lepeta caeca*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon indet*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon nasica*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon nasicoides*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Levinsenia gracilis*
Mollusca	Bivalvia	Arcoida	Limopsidae	*Limopsis cristata*
Mollusca	Bivalvia	Veneroida	Lucinidae	*Lucinoma borealis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Lumbriclymene minor*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris gracilis*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris indet*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Lysianassidae indet*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Lysippe labiata*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Macoma calcarea*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Macoma indet*
Annelida	Polychaeta	Capitellida	Maldanidae	*Maldane sarsi*
Annelida	Polychaeta	Capitellida	Maldanidae	*Maldanidae indet*
Mollusca	Gastropoda	Archaeogastropoda	Trochidae	*Margarites olivaceus*
Arthropoda	Malacostraca	Amphipoda	Melitidae	*Melita dentata*
Arthropoda	Malacostraca	Amphipoda	Melitidae	*Melita quadrispinosa*
Mollusca	Gastropoda	Archaeogastropoda	Turbinidae	*Moelleria costulata*
Mollusca	Bivalvia	Veneroida	Lasaeidae	*Montacuta spitzbergensis*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Mugga wahrbergi*
Arthropoda	Malacostraca	Isopoda	Munnidae	*Munna indet*
Mollusca	Bivalvia	Mytiloida	Mytilidae	*Musculus niger*
Mollusca	Bivalvia	Myoida	Myidae	*Mya truncata*
Annelida	Polychaeta	Oweniida	Oweniidae	*Myriochele danielsseni*
Annelida	Polychaeta	Oweniida	Oweniidae	*Myriochele fragilis*
Annelida	Polychaeta	Oweniida	Oweniidae	*Myriochele heeri*
Annelida	Polychaeta	Oweniida	Oweniidae	*Myriochele oculata*
Mollusca	Bivalvia	Veneroida	Montacutidae	*Mysella bidentata*
Nemertina	Nemertinea	Nemertinea	Nemertinea	*Nemertina indet*
Sipuncula	Sipunculidea	Golfingiida	Golfingiidae	*Nephasoma minutum*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys hombergii*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys hystricis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys longosetosa*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys pente*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Nereimyra punctata*
Annelida	Polychaeta	Capitellida	Maldanidae	*Nicomache indet*
Annelida	Polychaeta	Capitellida	Maldanidae	*Nicomache quadrispinata*
Annelida	Polychaeta	Eunicida	Onuphidae	*Nothria conchylega*
Annelida	Polychaeta	Eunicida	Onuphidae	*Nothria hyperborea*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericeus*
Mollusca	Bivalvia	Nuculoida	Nuculidae	*Nucula tumidula*
Mollusca	Bivalvia	Nuculoida	Nuculanidae	*Nuculana pernula*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Oedicerotidae indet*
Sipuncula	Sipunculidea	Golfingiida	Phascolionidae	*Onchnesoma squamatum*
Sipuncula	Sipunculidea	Golfingiida	Phascolionidae	*Onchnesoma steenstrupi*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Onisimus indet*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelia borealis*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina norvegica*
Echinodermata	Stelleroidea	Laemophiurina	Ophiacanthidae	*Ophiacantha bidentata*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiocten sericeum*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus flexuosus*
Echinodermata	Stelleroidea	Ophiurida	Ophiactidae	*Ophiopholis aculeata*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura robusta*
Arthropoda	Ostracoda	Ostracoda sp.	Ostracoda sp.	*Ostracoda indet*
Annelida	Polychaeta	Oweniida	Oweniidae	*Owenia fusiformis*
Arthropoda	Malacostraca	Decapoda	Paguridae	*Paguridae indet*
Arthropoda	Pycnogonida	Pantopoda	Pantopoda	*Pantopoda indet*
Annelida	Polychaeta	Eunicida	Onuphidae	*Paradiopatra fiordica*
Annelida	Polychaeta	Eunicida	Onuphidae	*Paradiopatra quadricuspis*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paradoneis indet*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paradoneis lyra*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Paramphinome jeffreysii*
Annelida	Polychaeta	Eunicida	Dorvilleidae	*Parougia indet*
Mollusca	Bivalvia	Veneroida	Cardiidae	*Parvicardium minimum*

Phylum	Class	Order	Family	Species
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria auricoma*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria hyperborea*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria koreni*
Mollusca	Pelecypoda	Pelecypoda	Pelecypoda	*Pelecypoda indet*
Sipuncula	Sipunculidea	Golfingiida	Phascolionidae	*Phascolion strombus*
Mollusca	Bivalvia	Veneroida	Pharidae	*Phaxas pellucidus*
Mollusca	Gastropoda	Cephalaspidea	Philinidae	*Philine indet*
Annelida	Polychaeta	Terebellida	Terebellidae	*Phisidia aurea*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe baltica*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe inornata*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe pallida*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe synophthalmica*
Phoronida	Phoronida	Phoronida	Phoronida	*Phoronis indet*
Phoronida	Phoronida	Phoronida	Phoronida	*Phoronis muelleri*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce groenlandica*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Phylo norvegicus*
Annelida	Polychaeta	Terebellida	Terebellidae	*Pista indet*
Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus serpens*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus indet*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus medusa*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora indet*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Polynoidae indet*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Pontocrates indet*
Arthropoda	Malacostraca	Amphipoda	Pontoporeiidae	*Pontoporeia femorata*
Annelida	Polychaeta	Capitellida	Maldanidae	*Praxillella praetermissa*
Annelida	Polychaeta	Capitellida	Maldanidae	*Praxillura longissima*
Cephalorhyncha	Priapulida	Priapulida	Priapulidae	*Priapulus caudatus*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrifera*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio dubia*
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	*Protomedeia fasciata*
Arthropoda	Malacostraca	Cumacea	Pseudocumatidae	*Pseudocuma indet*
Annelida	Polychaeta	Spionida	Spionidae	*Pseudopolydora paucibranchiata*
Arthropoda	Malacostraca	Tanaidacea	Sphyrapidae	*Pseudosphyrapus anomalus*
Annelida	Polychaeta	Capitellida	Maldanidae	*Rhodine gracilior*
Annelida	Polychaeta	Sabellida	Sabellidae	*Sabellidae indet*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Samytha sexcirrata*
Annelida	Polychaeta	Opheliida	Scalibregmidae	*Scalibregma inflatum*
Annelida	Polychaeta	Spionida	Spionidae	*Scolelepis korsuni*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Scoloplos armiger*
Sipuncula	Sipuncula	Sipuncula	Sipunculidae	*Sipuncula indet*
Annelida	Polychaeta	Phyllodocida	Sphaerodoridae	*Sphaerodorum gracilis*
Annelida	Polychaeta	Phyllodocida	Sphaerodoridae	*Sphaerodorum indet*
Annelida	Polychaeta	Spionida	Spionidae	*Spio armata*
Annelida	Polychaeta	Spionida	Spionidae	*Spio decoratus*
Annelida	Polychaeta	Spionida	Spionidae	*Spio indet*
Annelida	Polychaeta	Spionida	Chaetopteridae	*Spiochaetopterus typicus*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes bombyx*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes indet*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes kroyeri*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes urceolata*
Annelida	Polychaeta	Sabellida	Spirorbidae	*Spirorbidae indet*
Annelida	Polychaeta	Sabellida	Spirorbidae	*Spirorbis indet*
Arthropoda	Malacostraca	Amphipoda	Stenothoidae	*Stenothoidae indet*
Annelida	Polychaeta	Phyllodocida	Sigalionidae	*Sthenelais limicola*
Echinodermata	Echinoidea	Echinoida	Strongylocentrotidae	*Strongylocentrotus pallidus*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Syllis indet*
Arthropoda	Malacostraca	Amphipoda	Synopiidae	*Syrrhoe crenulata*
Annelida	Polychaeta	Terebellida	Trichobranchidae	*Terebellides stroemii*
Annelida	Polychaeta	Terebellida	Terebellidae	*Thelepus cincinnatus*
Mollusca	Bivalvia	Pholadomyoida	Thraciidae	*Thracia myopsis*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira croulinensis*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira equalis*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira eumyaria*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira ferruginea*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira flexuosa*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira gouldi*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira granulosa*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira indet*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira obsoleta*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira pygmaea*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira succisa*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasiridae indet*
Mollusca	Bivalvia	Veneroida	Veneridae	*Timoclea ovata*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Tmetonyx cicada*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Tmetonyx similis*
Annelida	Polychaeta	Terebellida	Trichobranchidae	*Trichobranchus roseus*
Arthropoda	Malacostraca	Amphipoda	Aoridae	*Unciola leucopis*
Arthropoda	Malacostraca	Amphipoda	Haustoriidae	*Urothoe elegans*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Westwoodilla caecula*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldia hyperborea*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella frigida*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella indet*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella lenticula*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella lucida*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella nana*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella solidula*

Traits	**Maximum adult size**						**Larval type**			**Mobility**			
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**Planktotroph**	**Lecitotroph**	**Direct development**	**None mobility**	**Low mobility**	**Medium mobility**	**High mobility**
Species/code	**NS1**	**NS2**	**NS3**	**NS4**	**NS5**	**NS6**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Abra indet	0	0	2	0	0	2	3	0	0	0	2	2	2
Abra longicallus	0	0	3	0	0	0	3	0	0	0	2	0	0
Abra prismatica	0	0	3	0	0	0	3	0	0	0	2	0	0
Abyssoninoe hibernica	0	0	0	3	0	0	0	2	0	0	0	0	0
Aeginina longicornis	0	0	3	0	0	0	0	0	3	0	0	0	3
Aglaophamus malmgreni	0	0	0	0	0	3	2	2	0	0	0	0	3
Ampelisca brevicornis	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca indet	0	2	2	2	0	0	0	0	3	0	0	3	0
Ampelisca macrocephala	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca spinipes	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca tenuicornis	0	3	0	0	0	0	0	0	3	0	0	3	0
Ampharete falcata	0	0	2	0	0	0	0	3	0	0	2	0	0
Ampharete finmarchica	0	0	0	3	0	0	0	3	0	0	2	0	0
Ampharete lindstroemi	0	0	2	0	0	0	0	3	0	0	2	0	0
Ampharetidae indet	0	0	2	0	0	0	0	3	0	0	2	0	0
Amphilepis norvegica	0	0	0	0	3	0	0	3	0	0	0	0	0
Amphipholis squamata	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphipoda indet	1	1	1	1	1	1	0	0	3	0	1	1	1
Amphitritinae indet	0	2	2	0	0	0	0	3	0	0	2	0	0
Amphiura chiajei	0	1	2	2	0	0	3	0	0	0	2	1	0
Amphiura filiformis	0	2	2	2	0	0	3	0	0	0	2	1	0
Amphiura sundevalli	0	2	2	2	0	0	3	0	0	0	2	1	0
Amythasides macroglossus	0	0	2	0	0	0	0	3	0	0	3	0	0
Anobothrus gracilis	0	0	0	2	0	0	0	0	3	0	0	0	0
Aonides paucibranchiata	0	0	3	0	0	0	2	0	0	0	0	0	0
Aphelochaeta indet	0	2	2	2	2	2	0	3	0	0	1	1	0
Aphelochaeta marioni	0	2	2	2	2	0	0	3	0	0	1	0	0
Apistobranchus indet	0	2	2	0	0	0	0	0	3	0	2	0	0
Apseudes spinosus	0	0	3	0	0	0	0	0	3	0	0	0	0
Aricidea catherinae	0	3	0	0	0	0	0	0	3	0	0	1	0
Aricidea hartmani	0	0	3	0	0	0	0	0	3	0	0	1	0
Aricidea indet	0	2	2	0	0	0	0	0	3	0	0	1	0
Aricidea roberti	0	3	0	0	0	0	0	0	3	0	0	1	0
Aricidea wassi	0	0	2	0	0	0	0	0	3	0	0	1	0
Arrhis phyllonyx	0	0	3	0	0	0	0	0	3	0	0	2	0
Astarte borealis	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte crenata	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte elliptica	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte montagui	0	0	3	0	0	0	0	0	3	0	2	0	0
Augeneria tentaculata	0	0	2	0	0	0	0	3	0	0	0	2	0
Autolytus indet	1	2	2	0	0	0	3	0	0	0	0	0	3
Axinopsida orbiculata	3	1	0	0	0	0	3	0	0	0	3	0	0
Axionice maculata	0	0	0	0	0	3	0	3	0	0	2	0	0
Brachydiastylis resima	0	3	0	0	0	0	0	3	0	0	0	2	0
Byblis gaimardi	0	0	3	0	0	0	0	0	3	0	0	0	3
Calathura brachiata	0	0	0	3	0	0	0	0	3	0	0	3	0
Capitella capitata	0	0	0	0	2	2	0	3	0	0	0	2	0
Capitellidae indet	0	0	1	2	2	2	0	3	0	0	0	2	0
Caprellidae indet	0	2	2	2	2	2	0	3	0	0	2	2	0
Caudofoveata indet	2	2	2	2	2	2	0	2	0	0	2	0	0
Caulleriella killariensis	0	0	2	0	0	0	0	3	0	0	0	0	0
Chaetoderma nitidulum	0	0	0	0	0	0	0	2	0	0	2	0	0
Chaetozone indet	0	0	3	0	0	0	0	3	0	0	2	0	0
Chaetozone setosa	0	0	3	0	0	0	0	3	0	0	2	0	0
Chone collaris	0	0	0	0	0	0	3	0	0	0	3	0	0
Chone duneri	0	0	0	3	0	0	3	0	0	0	3	0	0
Chone indet	1	2	2	2	0	0	3	0	0	0	3	0	0
Chone paucibranchiata	0	0	0	0	3	0	3	0	0	0	3	0	0
Ciliatocardium ciliatum	2	0	0	0	0	0	3	0	0	0	3	0	0
Cirratulidae indet	0	1	1	1	1	1	0	3	0	0	1	1	1
Cirratulus cirratus	0	0	0	0	0	3	0	3	0	0	2	0	0
Clymenura borealis	0	0	0	3	2	0	0	3	0	0	3	0	0
Clymenura indet	0	0	0	2	2	0	0	3	0	0	3	0	0
Clymenura polaris	0	0	0	0	2	0	0	3	0	0	3	0	0
Crenella decussata	0	3	0	0	0	0	3	0	0	0	3	0	0
Ctenodiscus crispatus	0	0	0	3	0	0	0	3	0	0	3	0	0
Cuspidaria arctica	0	1	3	0	0	0	0	2	0	0	0	2	0
Cuspidaria lamellosa	0	1	0	0	0	0	0	2	0	0	0	2	0
Cuspidaria obesa	3	1	3	0	0	0	0	2	0	0	0	2	0
Cylichna alba	0	1	2	0	0	0	0	0	3	0	3	0	0
Cylichna cylindracea	0	2	2	0	0	0	0	0	3	0	3	0	0
Cylichna occulta	0	1	2	0	0	0	0	0	3	0	3	0	0
Dacrydium vitreum	0	3	0	0	0	0	0	0	3	0	3	0	0
Dentalium entalis	0	0	0	3	0	0	0	0	3	0	0	0	0
Dentalium indet	0	2	2	2	2	2	0	0	3	0	0	0	0
Diastylis indet	0	2	2	0	0	0	0	0	3	0	0	0	2
Diastylis scorpioides	0	0	3	0	0	0	0	0	3	0	0	0	2
Diplocirrus glaucus	0	0	3	0	0	0	0	3	0	0	0	2	0
Diplocirrus hirsutus	0	0	3	0	0	0	0	3	0	0	0	2	0
Dipolydora coeca	0	0	0	3	0	0	3	0	0	0	0	0	0
Echinocardium flavescens	0	0	0	0	3	0	3	0	0	0	2	0	0
Echinocyamus pusillus	0	0	0	0	3	0	3	0	0	0	2	0	0
Eclysippe vanelli	0	0	3	0	0	0	0	3	0	0	2	0	0
Ennucula tenuis	3	0	0	0	0	0	0	3	0	0	3	0	0
Entalina quinquangularis	0	0	3	0	0	0	0	3	0	0	0	0	0
Eriopisa elongata	0	3	0	0	0	0	0	0	3	0	0	3	0
Eteone indet	0	0	2	2	2	2	0	3	0	0	0	2	2
Euchone indet	0	0	2	2	2	0	3	0	0	0	1	0	0
Euchone papillosa	0	0	0	2	0	0	3	0	0	0	1	0	0
Euchone southerni	3	0	0	0	0	0	3	0	0	0	1	0	0
Euclymene affinis	0	0	2	2	0	0	0	3	0	0	2	0	0
Euclymene droebachiensis	0	0	0	2	2	0	0	3	0	0	2	0	0
Euclymene lindrothi	0	0	0	2	0	0	0	3	0	0	2	0	0
Euclymeninae indet	0	0	2	2	2	2	0	3	0	0	2	0	0
Eudorella emarginata	0	0	3	0	0	0	0	3	0	3	0	0	0

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Species/code	NS1	NS2	NS3	NS4	NS5	NS6	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Eudorellopsis deformis	3	0	0	0	0	0	0	3	0	3	0	0	0
Eusyllis blomstrandi	0	0	1	3	0	0	0	0	3	0	0	0	3
Exogone verugera	0	3	0	0	0	0	0	3	0	0	0	2	0
Fauveliopsis indet	1	2	1	0	0	0	1	1	1	0	0	2	0
Galathowenia oculata	0	0	2	0	0	0	3	0	0	0	2	0	0
Glycera lapidum	0	0	0	0	0	3	2	0	0	0	0	2	0
Gnathia indet	2	2	0	0	0	0	0	0	3	0	2	0	0
Golfingia indet	0	0	0	0	0	2	0	3	0	0	2	0	0
Golfingia margaritacea	0	0	0	0	0	3	0	3	0	0	2	0	0
Goniada maculata	0	0	0	0	3	0	0	3	0	0	0	0	2
Haploops tubicola	0	0	3	0	0	0	0	0	3	0	0	3	0
Harmothoe fraserthomsoni	0	0	0	0	2	2	3	0	0	0	0	0	3
Harmothoe imbricata	0	0	0	0	3	0	3	0	0	0	0	0	3
Harmothoe indet	0	0	2	2	2	0	3	0	0	0	0	1	3
Harpinia antennaria	2	2	0	0	0	0	0	0	3	0	2	2	0
Harpinia indet	2	2	0	0	0	0	0	0	3	0	2	2	0
Harpinia mucronata	2	2	0	0	0	0	0	0	3	0	2	0	0
Harpinia pectinata	0	3	0	0	0	0	0	0	3	0	2	0	0
Harpinia plumosa	0	3	0	0	0	0	0	0	3	0	2	0	0
Harpinia propinqua	1	2	0	0	0	0	0	0	3	0	2	0	0
Harpinia serrata	0	3	0	0	0	0	0	0	3	0	2	0	0
Hemilamprops roseus	0	3	0	0	0	0	0	0	3	0	0	0	0
Heteromastus filiformis	0	0	0	0	3	2	0	3	0	0	0	2	0
Hiatella arctica	0	0	0	3	0	0	0	0	3	0	3	0	0
Hippomedon denticulatus	0	0	2	0	0	0	0	0	3	0	0	2	0
Hyalinoecia tubicola	0	0	0	0	0	3	0	0	3	0	2	0	0
Isaeidae indet	2	2	1	0	0	0	0	0	3	0	0	0	3
Isopoda indet	1	1	1	1	1	1	0	0	2	0	1	1	1
Jasmineira candela	0	0	2	0	0	0	3	0	0	0	1	0	0
Jasmineira caudata	0	0	2	0	0	0	3	0	0	0	1	0	0
Kelliella miliaris	2	0	0	0	0	0	3	0	0	0	0	0	0
Labidoplax buskii	0	0	0	0	0	0	0	3	0	0	2	0	0
Lanice conchilega	0	0	0	0	0	3	3	0	0	0	0	0	0
Laonice cirrata	0	0	0	0	2	2	0	3	0	0	0	0	0
Laonice sarsi	0	0	0	0	2	0	0	2	0	0	0	0	0
Laphania boecki	0	0	0	0	3	0	3	3	0	0	2	0	0
Leitoscoloplos indet	0	0	0	1	2	2	0	3	0	0	0	2	0
Lepeta caeca	0	3	0	0	0	0	0	0	3	0	3	0	0
Leucon indet	1	1	1	0	0	0	0	3	0	0	0	2	0
Leucon nasica	0	2	2	0	0	0	0	3	0	0	0	2	0
Leucon nasicoides	0	2	2	0	0	0	0	3	0	0	0	2	0
Levinsenia gracilis	0	0	3	0	0	0	0	3	0	0	0	2	0
Limopsis cristata	0	2	0	0	0	0	0	0	3	0	2	0	0
Lucinoma borealis	0	0	0	3	0	0	0	0	3	0	2	0	0
Lumbriclymene minor	0	0	3	0	0	0	0	3	0	1	3	0	0
Lumbrineris gracilis	0	0	0	3	0	0	0	3	0	0	0	0	0
Lumbrineris indet	0	0	2	2	2	2	0	3	0	0	2	2	2
Lysianassidae indet	1	3	0	0	0	0	0	0	3	0	0	3	0
Lysippe labiata	0	0	0	3	0	0	0	3	0	3	0	0	0
Macoma calcarea	0	0	0	3	0	0	0	0	3	0	2	0	0
Macoma indet	0	0	1	2	0	0	0	0	3	0	2	0	0
Maldane sarsi	0	0	0	0	3	2	0	3	0	0	0	0	0
Maldanidae indet	0	0	0	2	2	2	0	3	0	0	0	0	0
Margarites olivaceus	0	1	1	1	0	0	3	0	0	0	3	0	0
Melita dentata	0	0	0	3	0	0	0	0	3	0	0	2	0
Melita quadrispinosa	0	3	0	0	0	0	0	0	3	0	0	3	0
Moelleria costulata	3	0	0	0	0	0	3	0	0	0	3	0	0
Montacuta spitzbergensis	0	3	0	0	0	0	0	0	3	0	2	0	0
Mugga wahrbergi	0	0	0	2	0	0	0	0	3	0	0	0	0
Munna indet	2	2	0	0	0	0	0	1	0	0	0	2	0
Musculus niger	0	0	0	2	2	0	0	0	3	2	0	0	0
Mya truncata	0	0	0	0	3	0	3	0	0	0	3	0	0
Myriochele danielsseni	0	0	2	0	0	0	3	0	0	0	2	0	0
Myriochele fragilis	0	0	2	0	0	0	3	0	0	0	2	0	0
Myriochele heeri	0	0	3	0	0	0	3	0	0	0	2	0	0
Myriochele oculata	0	0	2	0	0	0	3	0	0	0	2	0	0
Mysella bidentata	3	0	0	0	0	0	0	0	3	0	2	0	0
Nemertina indet	0	2	2	2	2	2	0	0	3	0	2	3	2
Nephasoma minutum	0	0	0	2	2	0	0	0	3	0	2	0	0
Nephtys hombergii	0	0	0	0	0	2	3	2	0	0	0	0	2
Nephtys hystricis	0	0	0	3	0	0	2	0	0	0	0	0	2
Nephtys longosetosa	0	0	0	0	0	3	2	0	0	0	0	3	0
Nephtys pente	0	0	3	0	0	0	2	2	0	0	0	0	3
Nereimyra punctata	0	0	3	0	0	0	3	0	0	0	0	0	2
Nicomache indet	0	0	2	2	2	2	0	2	0	0	0	0	0
Nicomache quadrispinata	0	0	0	3	0	0	0	2	0	0	0	0	0
Nothria conchylega	0	0	0	0	0	3	0	0	3	0	2	0	0
Nothria hyperborea	0	0	0	0	2	2	0	0	3	0	2	0	0
Notomastus latericeus	0	0	0	0	0	3	0	3	0	0	0	2	0
Nucula tumidula	0	2	0	0	0	0	0	3	0	0	0	0	0
Nuculana pernula	0	3	0	0	0	0	0	3	0	0	2	0	0
Oedicerotidae indet	0	3	1	0	0	0	0	0	3	0	1	1	1
Onchnesoma squamatum	0	0	0	0	3	0	0	3	0	0	3	0	0
Onchnesoma steenstrupi	0	0	0	0	3	0	0	3	0	0	3	0	0
Onisimus indet	0	2	2	0	0	0	0	0	3	0	1	1	1
Ophelia borealis	0	0	0	3	0	0	0	3	0	0	0	2	0
Ophelina norvegica	0	0	0	3	0	0	0	3	0	0	0	1	0
Ophiacantha bidentata	0	0	0	0	0	3	3	0	0	0	0	3	0
Ophiocten sericeum	0	0	0	0	0	3	3	0	0	0	0	3	0
Ophiodromus flexuosus	0	0	0	0	2	0	2	0	0	0	0	0	2
Ophiopholis aculeata	0	0	0	0	0	3	3	0	0	0	2	1	0
Ophiura robusta	0	0	0	0	3	0	3	0	0	0	2	0	0
Ostracoda indet	3	1	0	0	0	0	0	0	3	0	0	0	3
Owenia fusiformis	0	2	0	0	0	0	3	0	0	0	2	0	0
Paguridae indet	0	2	2	2	2	0	3	0	0	0	0	3	0

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Species/code	NS1	NS2	NS3	NS4	NS5	NS6	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Pantopoda indet	1	1	1	1	0	0	0	0	3	0	0	0	3
Paradiopatra fiordica	0	0	0	3	0	0	0	3	0	0	0	3	0
Paradiopatra quadricuspis	0	0	0	0	3	0	0	3	0	0	0	3	0
Paradoneis indet	0	1	2	0	0	0	0	3	0	0	2	0	0
Paradoneis lyra	0	0	3	0	0	0	0	3	0	0	0	1	0
Paramphinome jeffreysii	0	0	3	0	0	0	3	0	0	0	0	0	3
Parougia indet	0	2	2	0	0	0	3	0	0	0	0	2	0
Parvicardium minimum	0	0	3	0	0	0	3	0	0	0	3	0	0
Pectinaria auricoma	0	0	0	3	0	0	0	3	0	0	2	0	0
Pectinaria hyperborea	0	0	2	2	0	0	0	3	0	0	2	0	0
Pectinaria koreni	0	0	0	3	0	0	0	3	0	0	2	0	0
Pelecypoda indet	1	1	1	1	1	1	3	0	0	1	3	2	0
Phascolion strombus	0	0	0	3	0	0	0	3	0	0	2	0	0
Phaxas pellucidus	0	0	0	3	0	0	0	0	3	0	0	0	0
Philine indet	0	0	2	0	0	0	3	0	0	0	3	0	0
Phisidia aurea	0	0	0	2	2	0	3	0	0	0	2	0	0
Pholoe baltica	0	0	3	0	0	0	3	0	0	0	0	3	0
Pholoe inornata	0	0	3	0	0	0	3	0	0	0	0	3	0
Pholoe pallida	0	0	3	0	0	0	0	3	0	0	0	0	2
Pholoe synophthalmica	0	0	3	0	0	0	0	3	0	0	0	0	2
Phoronis indet	0	0	0	0	2	2	3	0	0	0	0	0	0
Phoronis muelleri	0	0	0	0	0	3	3	0	0	0	0	0	0
Phyllodoce groenlandica	0	0	0	0	0	3	3	0	0	0	0	0	2
Phylo norvegicus	0	0	0	3	0	0	0	3	0	0	0	3	0
Pista indet	0	0	0	2	2	0	0	3	0	0	2	0	0
Poecilochaetus serpens	0	0	0	3	0	0	3	0	0	0	0	0	0
Polycirrus indet	0	0	0	2	2	1	0	3	0	0	2	0	0
Polycirrus medusa	0	0	0	0	3	0	0	2	0	0	2	0	0
Polydora indet	0	0	2	2	2	0	2	2	0	0	2	2	0
Polynoidae indet	0	1	1	1	1	1	1	1	0	0	0	2	3
Pontocrates indet	0	3	0	0	0	0	0	0	3	0	0	3	0
Pontoporeia femorata	0	0	3	0	0	0	0	0	3	0	0	0	2
Praxillella praetermissa	0	0	0	0	0	3	0	3	0	0	3	0	0
Praxillura longissima	0	0	0	0	0	3	0	3	0	0	3	0	0
Priapulus caudatus	0	0	2	2	2	0	0	0	3	0	0	0	0
Prionospio cirrifera	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio dubia	0	0	3	0	0	0	3	0	0	0	2	0	0
Protomedeia fasciata	0	3	0	0	0	0	0	0	3	0	0	0	3
Pseudocuma indet	2	2	2	0	0	0	0	0	3	0	0	0	2
Pseudopolydora paucibranchiata	2	2	0	0	0	0	0	0	3	0	0	0	0
Pseudosphyrapus anomalus	3	0	0	0	0	0	0	0	3	0	0	0	0
Rhodine gracilior	0	0	0	3	0	0	0	2	0	0	0	0	0
Sabellidae indet	0	1	2	2	1	1	0	2	0	2	2	0	0
Samytha sexcirrata	0	0	2	0	0	0	0	0	3	0	2	0	0
Scalibregma inflatum	0	1	2	1	0	0	0	3	0	0	2	1	0
Scolelepis korsuni	0	0	3	0	0	0	0	3	0	0	2	0	0
Scoloplos armiger	0	0	0	0	0	3	0	2	0	0	0	2	0
Sipuncula indet	0	0	0	2	2	2	0	3	0	0	3	0	0
Sphaerodorum gracilis	0	0	0	3	0	0	0	2	0	0	0	2	0
Sphaerodorum indet	0	0	0	3	0	0	0	2	0	0	0	2	0
Spio armata	0	0	3	0	0	0	3	0	0	0	2	0	0
Spio decoratus	0	0	3	0	0	0	3	0	0	0	2	0	0
Spio indet	0	2	2	2	0	0	3	0	0	0	0	1	0
Spiochaetopterus typicus	0	0	0	3	2	2	3	0	0	0	1	0	0
Spiophanes bombyx	0	0	0	3	0	0	3	0	0	0	2	0	0
Spiophanes indet	0	0	2	2	2	2	3	0	0	0	2	0	0
Spiophanes kroyeri	0	0	3	0	0	0	3	0	0	0	2	0	0
Spiophanes urceolata	0	0	3	0	0	0	3	0	0	0	2	0	0
Spirorbidae indet	2	2	1	0	0	0	0	0	3	3	0	0	0
Spirorbis indet	2	2	1	0	0	0	0	0	3	3	0	0	0
Stenothoidae indet	3	1	0	0	0	0	0	0	3	0	0	3	0
Sthenelais limicola	0	0	0	0	3	0	0	0	3	0	0	0	2
Strongylocentrotus pallidus	0	0	0	0	3	0	3	0	0	0	3	0	0
Syllis indet	0	0	2	2	0	0	0	2	2	0	0	2	2
Syrrhoe crenulata	0	2	2	0	0	0	0	0	3	0	0	3	0
Terebellides stroemii	0	0	0	0	3	0	3	3	0	0	2	0	0
Thelepus cincinnatus	0	0	0	0	0	3	0	3	0	0	2	0	0
Thracia myopsis	0	0	3	0	0	0	0	3	0	0	3	0	0
Thyasira croulinensis	0	0	2	0	0	0	0	3	0	0	0	0	0
Thyasira equalis	0	3	0	0	0	0	0	3	0	0	0	2	0
Thyasira eumyaria	3	0	0	0	0	0	0	3	0	0	2	0	0
Thyasira ferruginea	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira flexuosa	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira gouldi	3	0	0	0	0	0	0	0	3	0	0	0	0
Thyasira granulosa	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira indet	2	2	2	0	0	0	0	3	0	0	0	1	0
Thyasira obsoleta	0	0	2	0	0	0	0	3	0	0	0	0	0
Thyasira pygmaea	2	0	0	0	0	0	0	3	0	0	0	0	0
Thyasira succisa	0	2	0	0	0	0	0	3	0	0	0	1	0
Thyasiridae indet	2	2	2	0	0	0	0	2	2	0	0	1	0
Timoclea ovata	0	0	3	0	0	0	0	0	3	0	0	0	0
Tmetonyx cicada	0	0	3	0	0	0	0	0	3	0	0	3	0
Tmetonyx similis	0	0	3	0	0	0	0	0	3	0	0	3	0
Trichobranchus roseus	0	0	0	2	0	0	0	0	3	0	0	0	0
Unciola leucopis	0	0	3	0	0	0	0	0	3	0	0	3	0
Urothoe elegans	0	2	0	0	0	0	0	0	3	0	0	0	0
Westwoodilla caecula	0	3	0	0	0	0	0	0	3	0	0	0	2
Yoldia hyperborea	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella frigida	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella indet	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella lenticula	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella lucida	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella nana	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella solidula	0	0	3	0	0	0	0	3	0	0	3	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Abra indet	0	3	0	0	0	0	3	0	0
Abra longicallus	0	3	0	0	0	0	3	0	0
Abra prismatica	0	3	0	0	0	0	3	0	0
Abyssoninoe hibernica	2	0	0	0	2	0	3	0	0
Aeginina longicornis	1	0	3	0	1	0	3	0	0
Aglaophamus malmgreni	1	0	0	0	2	0	3	0	0
Ampelisca brevicornis	0	0	3	0	0	0	3	0	0
Ampelisca indet	0	0	3	0	0	0	3	0	0
Ampelisca macrocephala	0	0	3	0	0	0	3	0	0
Ampelisca spinipes	0	0	3	0	0	0	3	0	0
Ampelisca tenuicornis	0	0	3	0	0	0	3	0	0
Ampharete falcata	2	1	0	0	0	0	0	0	2
Ampharete finmarchica	2	1	0	0	0	0	0	0	2
Ampharete lindstroemi	2	1	0	0	0	0	0	0	2
Ampharetidae indet	2	0	0	0	0	0	0	0	2
Amphilepis norvegica	0	1	0	1	1	1	3	0	0
Amphipholis squamata	0	3	0	0	0	3	3	0	0
Amphipoda indet	0	0	3	0	0	0	3	0	0
Amphitritinae indet	1	0	0	0	2	0	0	0	2
Amphiura chiajei	0	1	0	0	0	3	3	0	0
Amphiura filiformis	0	1	0	0	0	3	3	0	0
Amphiura sundevalli	0	1	0	0	0	3	3	0	0
Amythasides macroglossus	2	0	0	0	0	0	3	0	0
Anobothrus gracilis	2	0	0	0	2	1	3	0	0
Aonides paucibranchiata	2	0	0	0	1	0	3	0	0
Aphelochaeta indet	2	0	0	0	2	0	0	2	0
Aphelochaeta marioni	1	0	0	0	2	0	0	2	0
Apistobranchus indet	2	0	0	0	1	0	0	1	2
Apseudes spinosus	2	2	0	0	0	0	3	0	0
Aricidea catherinae	1	1	0	0	2	0	3	0	0
Aricidea hartmani	1	1	0	0	2	0	3	0	0
Aricidea indet	1	1	0	0	2	0	3	0	0
Aricidea roberti	1	1	0	0	2	0	3	0	0
Aricidea wassi	1	1	0	0	2	0	3	0	0
Arrhis phyllonyx	0	0	3	0	0	0	3	0	0
Astarte borealis	0	3	0	0	0	0	3	0	0
Astarte crenata	0	3	0	0	0	0	3	0	0
Astarte elliptica	0	3	0	0	0	0	3	0	0
Astarte montagui	0	3	0	0	0	0	3	0	0
Augeneria tentaculata	2	0	0	0	2	0	3	0	0
Autolytus indet	0	0	0	0	3	0	3	0	0
Axinopsida orbiculata	0	3	0	0	0	0	3	0	0
Axionice maculata	1	0	0	0	2	0	0	0	2
Brachydiastylis resima	0	0	0	2	0	1	3	0	0
Byblis gaimardi	0	0	3	0	0	0	3	0	0
Calathura brachiata	2	3	0	0	1	0	3	0	0
Capitella capitata	2	0	0	0	2	0	3	0	0
Capitellidae indet	2	0	0	0	2	0	3	0	0
Caprellidae indet	2	0	1	0	2	1	2	0	0
Caudofoveata indet	2	0	0	0	2	0	3	0	0
Caulleriella killariensis	0	2	0	0	1	0	3	0	0
Chaetoderma nitidulum	2	0	0	0	2	0	3	0	0
Chaetozone indet	2	0	0	0	1	0	3	0	0
Chaetozone setosa	2	0	0	0	1	0	3	0	0
Chone collaris	2	0	0	0	2	0	0	0	3
Chone duneri	2	0	0	0	2	0	0	0	3
Chone indet	2	0	0	0	2	0	0	0	3
Chone paucibranchiata	2	0	0	0	2	0	0	0	3
Ciliatocardium ciliatum	0	3	0	0	0	0	3	0	0
Cirratulidae indet	2	0	0	0	1	0	3	0	0
Cirratulus cirratus	2	0	0	0	1	0	3	0	0
Clymenura borealis	2	0	0	0	2	0	0	0	3
Clymenura indet	2	0	0	0	2	0	0	0	3
Clymenura polaris	2	0	0	0	2	0	0	0	3
Crenella decussata	0	3	0	0	0	0	3	0	0
Ctenodiscus crispatus	0	1	0	1	0	3	3	0	0
Cuspidaria arctica	0	2	0	0	0	1	3	0	0
Cuspidaria lamellosa	0	2	0	0	0	1	3	0	0
Cuspidaria obesa	0	2	0	0	0	1	3	0	0
Cylichna alba	2	0	0	0	0	1	3	0	0
Cylichna cylindracea	2	0	0	0	0	1	3	0	0
Cylichna occulta	2	0	0	0	0	1	3	0	0
Dacrydium vitreum	0	3	0	0	0	0	1	0	0
Dentalium entalis	2	0	0	0	0	0	2	0	0
Dentalium indet	2	0	0	0	0	0	2	0	0
Diastylis indet	0	0	0	0	0	0	2	0	0
Diastylis scorpioides	0	0	0	0	0	0	2	0	0
Diplocirrus glaucus	2	0	0	0	2	1	2	0	0
Diplocirrus hirsutus	2	0	0	0	2	1	2	0	0
Dipolydora coeca	0	1	0	0	1	0	0	0	2
Echinocardium flavescens	0	0	0	3	0	0	3	0	0
Echinocyamus pusillus	0	0	0	3	0	0	3	0	0
Eclysippe vanelli	1	0	0	0	2	0	0	0	3
Ennucula tenuis	0	3	0	0	0	0	3	0	0
Entalina quinquangularis	2	0	0	0	0	0	2	0	0
Eriopisa elongata	0	0	3	0	0	0	3	0	0
Eteone indet	0	1	0	0	2	0	3	0	0
Euchone indet	2	0	0	0	2	0	0	0	3
Euchone papillosa	2	0	0	0	2	0	0	0	3
Euchone southerni	2	0	0	0	2	0	0	0	3
Euclymene affinis	2	0	0	0	2	0	3	0	0
Euclymene droebachiensis	2	0	0	0	2	0	3	0	0
Euclymene lindrothi	2	0	0	0	1	0	3	0	0
Euclymeninae indet	2	0	0	0	1	0	3	0	0
Eudorella emarginata	0	0	0	2	0	1	2	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	**BF1**	**BF2**	**BF3**	**BF4**	**BF5**	**BF6**	**DA1**	**DA2**	**DA3**
Eudorellopsis deformis	0	0	0	2	0	0	3	0	0
Eusyllis blomstrandi	1	0	0	0	2	0	3	0	0
Exogone verugera	1	0	0	0	2	0	3	0	0
Fauveliopsis indet	1	0	0	0	1	0	3	1	0
Galathowenia oculata	2	0	0	0	2	0	0	0	3
Glycera lapidum	2	0	0	0	2	0	3	0	0
Gnathia indet	0	3	0	0	0	0	1	3	0
Golfingia indet	0	0	0	0	2	0	3	0	0
Golfingia margaritacea	0	0	0	0	2	0	3	0	0
Goniada maculata	0	1	0	0	2	1	3	0	0
Haploops tubicola	0	0	3	0	0	0	3	0	0
Harmothoe fraserthomsoni	0	1	0	0	0	0	3	0	0
Harmothoe imbricata	0	1	0	0	0	0	3	0	0
Harmothoe indet	0	1	0	0	0	0	3	0	0
Harpinia antennaria	0	0	3	0	0	0	3	0	0
Harpinia indet	0	0	3	0	0	0	3	0	0
Harpinia mucronata	0	0	3	0	0	0	3	0	0
Harpinia pectinata	0	0	3	0	0	0	3	0	0
Harpinia plumosa	0	0	3	0	0	0	3	0	0
Harpinia propinqua	0	0	3	0	0	0	3	0	0
Harpinia serrata	0	0	3	0	0	0	3	0	0
Hemilamprops roseus	0	0	0	1	1	1	3	0	0
Heteromastus filiformis	2	0	0	0	2	0	2	0	0
Hiatella arctica	0	3	0	0	0	1	1	0	0
Hippomedon denticulatus	0	0	3	0	0	0	3	0	0
Hyalinoecia tubicola	1	0	0	0	3	0	0	0	3
Isaeidae indet	0	0	3	0	0	0	3	0	0
Isopoda indet	0	3	0	0	0	0	3	0	0
Jasmineira candela	2	0	0	0	2	0	0	0	3
Jasmineira caudata	2	0	0	0	2	0	0	0	3
Kelliella miliaris	0	2	0	1	0	0	3	0	0
Labidoplax buskii	3	0	0	0	0	0	3	0	0
Lanice conchilega	2	0	0	0	3	0	0	3	0
Laonice cirrata	2	0	0	0	1	0	0	3	0
Laonice sarsi	2	0	0	0	1	0	0	3	0
Laphania boecki	1	0	0	0	1	0	0	3	0
Leitoscoloplos indet	3	0	0	0	3	0	3	0	0
Lepeta caeca	0	0	0	1	0	3	3	3	0
Leucon indet	0	0	0	2	0	1	3	0	0
Leucon nasica	0	0	0	2	0	1	3	0	0
Leucon nasicoides	0	0	0	2	0	1	3	0	0
Levinsenia gracilis	2	0	0	0	2	0	3	0	0
Limopsis cristata	0	3	0	0	0	1	2	0	0
Lucinoma borealis	0	2	0	0	0	0	3	0	0
Lumbriclymene minor	2	0	0	0	3	0	0	3	0
Lumbrineris gracilis	1	0	0	0	3	0	3	0	0
Lumbrineris indet	2	0	0	0	2	0	3	0	0
Lysianassidae indet	0	0	3	0	0	0	3	0	0
Lysippe labiata	3	0	0	0	1	0	3	0	3
Macoma calcarea	0	2	0	0	0	1	3	0	0
Macoma indet	0	2	0	0	0	1	3	0	0
Maldane sarsi	1	0	0	0	3	0	0	0	2
Maldanidae indet	1	0	0	0	3	0	0	0	2
Margarites olivaceus	0	0	0	3	0	2	1	0	0
Melita dentata	0	0	3	0	0	0	3	0	0
Melita quadrispinosa	0	0	3	0	0	0	3	0	0
Moelleria costulata	0	0	0	3	0	2	1	0	0
Montacuta spitzbergensis	0	2	0	0	0	0	3	0	0
Mugga wahrbergi	2	0	0	0	0	1	0	0	3
Munna indet	0	3	0	0	0	0	3	0	0
Musculus niger	0	3	0	0	0	0	0	3	1
Mya truncata	0	3	0	0	0	0	3	0	0
Myriochele danielsseni	2	0	0	0	2	0	0	0	3
Myriochele fragilis	2	0	0	0	2	0	0	0	3
Myriochele heeri	2	0	0	0	2	0	0	0	3
Myriochele oculata	2	0	0	0	2	0	0	0	3
Mysella bidentata	0	2	0	0	0	0	3	0	0
Nemertina indet	0	2	0	0	2	0	2	0	0
Nephasoma minutum	0	0	0	0	2	0	3	0	0
Nephtys hombergii	0	1	1	0	2	0	3	0	0
Nephtys hystricis	0	1	1	0	2	0	3	0	0
Nephtys longosetosa	0	1	1	0	2	0	3	0	0
Nephtys pente	0	0	0	0	0	0	3	0	0
Nereimyra punctata	0	0	0	0	0	0	3	0	0
Nicomache indet	2	0	0	0	1	0	3	0	0
Nicomache quadrispinata	2	0	0	0	1	0	0	0	3
Nothria conchylega	2	0	0	0	2	0	0	0	2
Nothria hyperborea	2	0	0	0	2	0	0	0	2
Notomastus latericeus	2	0	0	0	2	0	1	0	0
Nucula tumidula	0	3	0	0	0	1	3	0	0
Nuculana pernula	0	2	0	0	0	1	3	0	0
Oedicerotidae indet	0	0	3	0	0	0	3	0	0
Onchnesoma squamatum	2	0	0	0	0	0	2	0	0
Onchnesoma steenstrupi	2	0	0	0	0	0	2	0	0
Onisimus indet	0	0	3	0	0	0	3	0	0
Ophelia borealis	2	0	0	0	0	0	3	0	0
Ophelina norvegica	2	0	0	0	0	0	2	0	0
Ophiacantha bidentata	0	2	0	1	1	3	3	0	0
Ophiocten sericeum	0	2	0	1	1	3	3	0	0
Ophiodromus flexuosus	1	1	0	0	1	0	3	0	0
Ophiopholis aculeata	0	1	0	0	0	3	3	0	0
Ophiura robusta	0	1	0	1	1	1	3	0	0
Ostracoda indet	0	1	0	3	0	0	3	0	0
Owenia fusiformis	3	0	0	0	0	0	0	0	3
Paguridae indet	0	0	0	1	0	3	3	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	**BF1**	**BF2**	**BF3**	**BF4**	**BF5**	**BF6**	**DA1**	**DA2**	**DA3**
Pantopoda indet	0	0	0	0	0	3	3	0	0
Paradiopatra fiordica	2	0	0	0	2	0	3	0	0
Paradiopatra quadricuspis	2	0	0	0	2	0	3	0	0
Paradoneis indet	2	0	0	0	1	0	2	0	0
Paradoneis lyra	2	0	0	0	1	0	2	0	0
Paramphinome jeffreysii	1	1	0	0	1	0	3	0	0
Parougia indet	2	0	0	0	1	0	3	0	0
Parvicardium minimum	0	3	0	0	0	0	3	0	0
Pectinaria auricoma	1	0	0	0	0	2	0	0	3
Pectinaria hyperborea	2	1	0	0	0	2	0	0	3
Pectinaria koreni	2	1	0	0	0	2	0	0	3
Pelecypoda indet	0	3	0	0	0	0	2	0	0
Phascolion strombus	0	0	0	0	2	0	3	0	0
Phaxas pellucidus	0	3	0	0	1	0	3	0	0
Philine indet	0	0	0	0	0	0	3	0	0
Phisidia aurea	1	1	0	0	1	2	0	3	0
Pholoe baltica	1	1	0	0	0	0	3	0	0
Pholoe inornata	0	1	0	0	0	0	3	0	0
Pholoe pallida	1	1	0	0	0	0	3	0	0
Pholoe synophthalmica	1	1	0	0	0	0	3	0	0
Phoronis indet	2	0	0	0	2	0	0	0	3
Phoronis muelleri	2	0	0	0	2	0	0	0	3
Phyllodoce groenlandica	0	1	1	0	2	0	3	0	0
Phylo norvegicus	2	0	0	0	0	0	3	0	0
Pista indet	2	0	0	0	0	2	0	3	0
Poecilochaetus serpens	2	0	0	0	2	0	3	0	0
Polycirrus indet	2	0	0	0	1	1	0	3	0
Polycirrus medusa	2	1	0	0	1	1	0	3	0
Polydora indet	2	2	0	0	2	0	0	2	0
Polynoidae indet	3	1	0	0	3	0	3	0	0
Pontocrates indet	0	0	3	0	0	0	3	0	0
Pontoporeia femorata	0	0	3	0	0	1	3	0	0
Praxillella praetermissa	0	0	0	0	3	0	3	0	0
Praxillura longissima	3	0	0	0	3	0	0	0	3
Priapulus caudatus	3	0	0	0	0	0	3	0	0
Prionospio cirrifera	2	1	0	0	1	0	3	0	0
Prionospio dubia	1	1	0	0	1	0	3	0	0
Protomedeia fasciata	0	0	3	0	0	1	3	0	0
Pseudocuma indet	0	0	0	0	0	0	3	0	0
Pseudopolydora paucibranchiata	2	1	0	0	1	0	0	0	3
Pseudosphyrapus anomalus	2	2	0	0	0	0	2	1	0
Rhodine gracilior	2	0	0	0	1	0	0	0	3
Sabellidae indet	2	0	0	0	1	2	0	0	3
Samytha sexcirrata	2	0	0	0	0	2	0	0	3
Scalibregma inflatum	2	0	0	1	1	1	3	0	0
Scolelepis korsuni	0	1	0	0	2	0	3	0	0
Scoloplos armiger	0	1	0	0	2	0	0	3	0
Sipuncula indet	0	0	0	0	1	0	2	0	0
Sphaerodorum gracilis	1	0	0	0	2	0	3	0	0
Sphaerodorum indet	1	0	0	0	2	0	3	0	0
Spio armata	2	1	0	0	1	0	0	2	0
Spio decoratus	2	1	0	0	1	0	0	2	0
Spio indet	0	1	0	0	2	0	0	3	0
Spiochaetopterus typicus	2	0	0	0	3	0	0	0	3
Spiophanes bombyx	2	1	0	0	1	0	0	0	2
Spiophanes indet	2	1	0	0	1	0	0	0	2
Spiophanes kroyeri	2	1	0	0	1	0	0	0	2
Spiophanes urceolata	2	1	0	0	1	0	0	0	2
Spirorbidae indet	3	0	0	0	0	0	0	0	3
Spirorbis indet	3	0	0	0	0	0	0	0	3
Stenothoidae indet	0	0	3	0	0	1	3	0	0
Sthenelais limicola	2	1	1	0	3	0	3	0	0
Strongylocentrotus pallidus	0	0	0	3	0	0	3	0	0
Syllis indet	2	0	0	0	2	0	3	0	0
Syrrhoe crenulata	0	0	3	0	0	0	3	0	0
Terebellides stroemii	1	1	0	0	1	2	3	0	0
Thelepus cincinnatus	1	0	0	0	1	1	0	0	3
Thracia myopsis	0	3	0	0	0	0	3	0	0
Thyasira croulinensis	0	2	0	0	0	0	3	0	0
Thyasira equalis	0	3	0	0	0	0	3	0	0
Thyasira eumyaria	0	3	0	0	0	0	3	0	0
Thyasira ferruginea	0	2	0	0	0	0	3	0	0
Thyasira flexuosa	0	2	0	0	0	0	3	0	0
Thyasira gouldi	0	2	0	0	0	0	3	0	0
Thyasira granulosa	0	2	0	0	0	0	3	0	0
Thyasira indet	0	2	0	0	0	0	3	0	0
Thyasira obsoleta	0	2	0	0	0	0	3	0	0
Thyasira pygmaea	0	2	0	0	0	0	3	0	0
Thyasira succisa	0	2	0	0	0	0	3	0	0
Thyasiridae indet	0	2	0	0	0	0	3	0	0
Timoclea ovata	0	2	0	1	0	0	3	0	0
Tmetonyx cicada	0	0	3	0	0	0	3	0	0
Tmetonyx similis	0	0	3	0	0	0	3	0	0
Trichobranchus roseus	2	0	0	0	0	1	0	0	3
Unciola leucopis	0	0	3	0	0	0	3	0	0
Urothoe elegans	0	0	3	0	0	0	3	0	0
Westwoodilla caecula	0	0	3	0	0	0	3	0	0
Yoldia hyperborea	0	2	0	0	0	0	3	0	0
Yoldiella frigida	0	2	0	0	0	0	3	0	0
Yoldiella indet	0	2	0	0	0	0	3	0	0
Yoldiella lenticula	0	2	0	0	0	0	3	0	0
Yoldiella lucida	0	2	0	0	0	0	3	0	0
Yoldiella nana	0	2	0	0	0	0	3	0	0
Yoldiella solidula	0	2	0	0	0	0	3	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Abra indet	0	0	0	3	3
Abra longicallus	0	0	0	3	2
Abra prismatica	0	0	0	3	2
Abyssoninoe hibernica	0	0	0	3	0
Aeginina longicornis	0	0	0	1	3
Aglaophamus malmgreni	0	0	0	3	1
Ampelisca brevicornis	0	0	0	1	1
Ampelisca indet	0	0	0	1	1
Ampelisca macrocephala	0	0	0	0	1
Ampelisca spinipes	0	0	0	0	1
Ampelisca tenuicornis	0	0	2	0	1
Ampharete falcata	2	2	0	0	0
Ampharete finmarchica	2	2	0	0	0
Ampharete lindstroemi	2	2	0	0	0
Ampharetidae indet	2	2	0	1	0
Amphilepis norvegica	0	0	0	3	1
Amphipholis squamata	0	0	0	0	2
Amphipoda indet	0	0	1	1	1
Amphitritinae indet	0	2	0	0	0
Amphiura chiajei	0	0	0	2	2
Amphiura filiformis	0	0	0	2	2
Amphiura sundevalli	0	0	0	2	2
Amythasides macroglossus	2	2	0	0	0
Anobothrus gracilis	0	2	0	0	0
Aonides paucibranchiata	0	0	0	2	0
Aphelochaeta indet	0	0	0	2	0
Aphelochaeta marioni	0	0	0	3	0
Apistobranchus indet	0	0	2	2	1
Apseudes spinosus	0	0	0	0	0
Aricidea catherinae	0	0	0	2	0
Aricidea hartmani	0	0	0	2	0
Aricidea indet	0	0	0	2	0
Aricidea roberti	0	0	0	2	0
Aricidea wassi	0	0	0	2	0
Arrhis phyllonyx	0	0	0	0	2
Astarte borealis	0	0	0	3	0
Astarte crenata	0	0	0	3	0
Astarte elliptica	0	0	0	3	0
Astarte montagui	0	0	0	2	0
Augeneria tentaculata	0	0	0	0	3
Autolytus indet	0	0	0	2	1
Axinopsida orbiculata	0	0	0	3	0
Axionice maculata	0	2	0	0	0
Brachydiastylis resima	0	0	0	0	3
Byblis gaimardi	0	0	0	1	0
Calathura brachiata	0	0	3	0	0
Capitella capitata	0	0	0	3	0
Capitellidae indet	0	0	0	3	2
Caprellidae indet	0	2	2	2	0
Caudofoveata indet	0	0	0	2	0
Caulleriella killariensis	0	0	0	2	0
Chaetoderma nitidulum	0	0	0	3	0
Chaetozone indet	0	0	0	3	0
Chaetozone setosa	0	0	0	3	0
Chone collaris	2	2	0	0	0
Chone duneri	2	2	0	0	0
Chone indet	2	2	0	0	0
Chone paucibranchiata	3	2	0	0	0
Ciliatocardium ciliatum	0	0	0	3	0
Cirratulidae indet	0	0	0	1	0
Cirratulus cirratus	0	0	0	2	0
Clymenura borealis	0	2	0	0	0
Clymenura indet	0	2	0	0	0
Clymenura polaris	0	2	0	0	0
Crenella decussata	0	0	0	3	0
Ctenodiscus crispatus	0	0	0	0	3
Cuspidaria arctica	0	0	0	3	2
Cuspidaria lamellosa	0	0	0	3	2
Cuspidaria obesa	0	0	0	3	2
Cylichna alba	0	0	0	0	2
Cylichna cylindracea	0	0	0	0	2
Cylichna occulta	0	0	0	0	2
Dacrydium vitreum	1	0	0	1	0
Dentalium entalis	0	0	0	2	0
Dentalium indet	0	0	0	2	0
Diastylis indet	0	0	0	2	2
Diastylis scorpioides	0	0	0	2	2
Diplocirrus glaucus	0	0	0	2	0
Diplocirrus hirsutus	0	0	0	2	0
Dipolydora coeca	2	1	2	0	0
Echinocardium flavescens	0	0	0	2	0
Echinocyamus pusillus	0	0	0	2	0
Eclysippe vanelli	2	2	0	0	0
Ennucula tenuis	0	0	0	1	0
Entalina quinquangularis	0	0	0	2	0
Eriopisa elongata	0	0	0	0	3
Eteone indet	0	0	0	2	0
Euchone indet	2	2	0	0	0
Euchone papillosa	2	2	0	0	0
Euchone southerni	2	2	0	0	0
Euclymene affinis	0	2	0	2	0
Euclymene droebachiensis	0	2	0	2	0
Euclymene lindrothi	0	2	0	2	0
Euclymeninae indet	0	2	0	2	0
Eudorella emarginata	0	0	0	0	3

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Eudorellopsis deformis	0	0	0	0	3
Eusyllis blomstrandi	0	0	0	0	3
Exogone verugera	0	0	0	3	0
Fauveliopsis indet	0	0	1	2	0
Galathowenia oculata	2	0	2	0	0
Glycera lapidum	0	0	0	2	0
Gnathia indet	0	0	0	2	2
Golfingia indet	0	0	0	0	2
Golfingia margaritacea	0	0	0	0	2
Goniada maculata	0	0	0	2	1
Haploops tubicola	0	0	3	0	0
Harmothoe fraserthomsoni	0	0	0	0	3
Harmothoe imbricata	0	0	0	0	3
Harmothoe indet	0	0	0	2	2
Harpinia antennaria	0	0	0	1	2
Harpinia indet	0	0	0	2	0
Harpinia mucronata	0	0	0	3	0
Harpinia pectinata	0	0	0	3	0
Harpinia plumosa	0	0	0	3	0
Harpinia propinqua	0	0	0	3	0
Harpinia serrata	0	0	0	3	0
Hemilamprops roseus	0	0	0	1	2
Heteromastus filiformis	0	0	2	2	0
Hiatella arctica	0	0	0	3	0
Hippomedon denticulatus	0	0	0	2	2
Hyalinoecia tubicola	2	2	0	0	0
Isaeidae indet	0	0	0	1	0
Isopoda indet	0	0	1	2	2
Jasmineira candela	2	2	0	0	0
Jasmineira caudata	2	2	0	0	0
Kelliella miliaris	0	0	0	1	1
Labidoplax buskii	0	0	0	2	0
Lanice conchilega	0	0	3	3	0
Laonice cirrata	0	0	3	0	0
Laonice sarsi	0	0	3	0	0
Laphania boecki	1	2	0	1	0
Leitoscoloplos indet	0	0	0	3	0
Lepeta caeca	0	0	0	0	0
Leucon indet	0	0	0	1	1
Leucon nasica	0	0	0	2	2
Leucon nasicoides	0	0	0	2	2
Levinsenia gracilis	0	0	0	3	0
Limopsis cristata	0	0	0	1	1
Lucinoma borealis	0	0	0	0	3
Lumbriclymene minor	0	3	0	1	0
Lumbrineris gracilis	0	0	0	3	0
Lumbrineris indet	0	0	1	3	2
Lysianassidae indet	0	0	0	2	1
Lysippe labiata	0	3	0	1	0
Macoma calcarea	0	0	0	2	0
Macoma indet	0	0	0	2	0
Maldane sarsi	2	2	0	2	0
Maldanidae indet	2	2	2	2	0
Margarites olivaceus	0	0	0	0	3
Melita dentata	0	0	0	1	1
Melita quadrispinosa	0	0	0	1	1
Moelleria costulata	0	0	0	0	3
Montacuta spitzbergensis	0	0	0	2	0
Mugga wahrbergi	0	2	0	0	0
Munna indet	0	0	0	0	3
Musculus niger	0	0	2	0	0
Mya truncata	0	0	0	3	0
Myriochele danielsseni	2	0	2	0	0
Myriochele fragilis	2	0	2	0	0
Myriochele heeri	2	0	2	0	0
Myriochele oculata	2	0	2	0	0
Mysella bidentata	0	0	0	2	0
Nemertina indet	0	0	0	2	2
Nephasoma minutum	0	0	0	3	0
Nephtys hombergii	0	0	0	2	2
Nephtys hystricis	0	0	0	3	0
Nephtys longosetosa	0	0	0	3	0
Nephtys pente	0	0	0	0	2
Nereimyra punctata	0	0	0	0	2
Nicomache indet	0	0	0	3	0
Nicomache quadrispinata	0	0	0	3	0
Nothria conchylega	2	2	0	0	0
Nothria hyperborea	2	2	0	0	0
Notomastus latericeus	0	0	3	3	0
Nucula tumidula	0	0	0	3	0
Nuculana pernula	0	0	0	2	0
Oedicerotidae indet	0	0	0	1	1
Onchnesoma squamatum	0	0	0	1	0
Onchnesoma steenstrupi	0	0	0	1	0
Onisimus indet	0	0	0	1	1
Ophelia borealis	0	0	0	2	1
Ophelina norvegica	0	0	0	2	0
Ophiacantha bidentata	0	0	0	0	3
Ophiocten sericeum	0	0	0	0	3
Ophiodromus flexuosus	0	0	1	1	3
Ophiopholis aculeata	0	0	0	2	2
Ophiura robusta	0	0	0	2	0
Ostracoda indet	0	0	0	1	1
Owenia fusiformis	2	0	2	0	1
Paguridae indet	0	0	0	1	2

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Pantopoda indet	0	0	0	0	3
Paradiopatra fiordica	0	0	0	2	2
Paradiopatra quadricuspis	0	0	0	2	2
Paradoneis indet	0	0	2	2	2
Paradoneis lyra	0	0	2	2	2
Paramphinome jeffreysii	0	0	0	0	2
Parougia indet	0	0	0	1	1
Parvicardium minimum	0	0	0	3	0
Pectinaria auricoma	0	3	0	3	0
Pectinaria hyperborea	2	2	0	2	0
Pectinaria koreni	2	2	0	2	0
Pelecypoda indet	0	0	0	3	0
Phascolion strombus	0	0	0	0	3
Phaxas pellucidus	0	0	0	2	0
Philine indet	0	0	0	0	2
Phisidia aurea	2	2	0	1	0
Pholoe baltica	0	0	0	3	0
Pholoe inornata	0	0	0	3	0
Pholoe pallida	0	0	0	3	0
Pholoe synophthalmica	0	0	0	3	0
Phoronis indet	3	3	0	2	0
Phoronis muelleri	3	3	0	3	0
Phyllodoce groenlandica	0	0	0	0	0
Phylo norvegicus	0	0	0	3	0
Pista indet	2	2	0	0	0
Poecilochaetus serpens	0	0	0	3	0
Polycirrus indet	1	1	1	1	1
Polycirrus medusa	0	0	1	0	0
Polydora indet	2	2	3	2	0
Polynoidae indet	0	0	0	2	2
Pontocrates indet	0	0	0	3	0
Pontoporeia femorata	0	0	0	1	1
Praxillella praetermissa	0	0	3	3	0
Praxillura longissima	0	3	0	1	0
Priapulus caudatus	0	0	0	2	0
Prionospio cirrifera	0	0	2	2	0
Prionospio dubia	0	0	3	2	0
Protomedeia fasciata	0	0	0	0	3
Pseudocuma indet	0	0	0	2	2
Pseudopolydora paucibranchiata	0	2	0	2	0
Pseudosphyrapus anomalus	0	0	2	2	0
Rhodine gracilior	0	0	0	3	0
Sabellidae indet	0	2	0	0	0
Samytha sexcirrata	0	2	0	0	0
Scalibregma inflatum	0	0	0	3	0
Scolelepis korsuni	0	0	2	2	1
Scoloplos armiger	0	0	2	2	0
Sipuncula indet	0	0	0	1	0
Sphaerodorum gracilis	0	0	0	0	2
Sphaerodorum indet	0	0	0	0	2
Spio armata	0	0	3	2	0
Spio decoratus	0	0	3	2	0
Spio indet	0	0	2	2	0
Spiochaetopterus typicus	2	0	2	0	0
Spiophanes bombyx	0	2	0	1	0
Spiophanes indet	0	2	0	1	0
Spiophanes kroyeri	0	2	0	1	0
Spiophanes urceolata	0	2	0	1	0
Spirorbidae indet	0	3	0	0	0
Spirorbis indet	0	3	0	0	0
Stenothoidae indet	0	0	0	1	1
Sthenelais limicola	0	0	0	0	0
Strongylocentrotus pallidus	0	0	0	0	3
Syllis indet	0	0	0	2	2
Syrrhoe crenulata	0	0	0	2	0
Terebellides stroemii	2	2	0	1	0
Thelepus cincinnatus	2	2	0	0	0
Thracia myopsis	0	0	0	3	0
Thyasira croulinensis	0	0	0	2	0
Thyasira equalis	0	0	2	3	0
Thyasira eumyaria	0	0	0	2	0
Thyasira ferruginea	0	0	0	3	0
Thyasira flexuosa	0	0	0	3	0
Thyasira gouldi	0	0	0	3	0
Thyasira granulosa	0	0	0	2	0
Thyasira indet	0	0	2	3	0
Thyasira obsoleta	0	0	0	3	0
Thyasira pygmaea	0	0	0	3	0
Thyasira succisa	0	0	0	3	0
Thyasiridae indet	0	0	1	2	0
Timoclea ovata	0	0	0	0	3
Tmetonyx cicada	0	0	0	0	3
Tmetonyx similis	0	0	0	0	3
Trichobranchus roseus	0	3	0	0	0
Unciola leucopis	0	0	0	0	3
Urothoe elegans	0	0	0	0	3
Westwoodilla caecula	0	0	0	3	2
Yoldia hyperborea	0	0	0	3	0
Yoldiella frigida	0	0	0	3	0
Yoldiella indet	0	0	0	3	0
Yoldiella lenticula	0	0	0	3	0
Yoldiella lucida	0	0	0	3	0
Yoldiella nana	0	0	0	3	0
Yoldiella solidula	0	0	0	3	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Species/code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Abra indet	2	0	2	0	0	2	0	0	0
Abra longicallus	2	0	2	2	0	0	0	0	0
Abra prismatica	2	0	2	0	0	0	0	0	0
Abyssoninoe hibernica	0	0	0	0	0	0	0	3	0
Aeginina longicornis	3	0	0	1	0	0	0	0	2
Aglaophamus malmgreni	0	0	0	0	0	0	0	3	0
Ampelisca brevicornis	3	0	0	0	0	0	0	0	0
Ampelisca indet	0	0	2	0	0	0	0	0	0
Ampelisca macrocephala	2	0	0	0	0	0	0	0	0
Ampelisca spinipes	2	0	0	0	0	0	0	0	0
Ampelisca tenuicornis	2	0	0	0	0	0	0	0	0
Ampharete falcata	0	0	3	0	0	0	0	0	0
Ampharete finmarchica	0	0	3	0	0	0	0	0	0
Ampharete lindstroemi	0	0	3	0	0	0	0	0	0
Ampharetidae indet	0	0	3	0	0	0	0	0	0
Amphilepis norvegica	0	0	3	0	0	0	0	0	0
Amphipholis squamata	2	0	2	0	0	0	0	0	0
Amphipoda indet	1	0	1	1	1	1	1	1	1
Amphitritinae indet	0	0	3	0	0	0	0	0	0
Amphiura chiajei	0	0	2	0	0	0	0	0	0
Amphiura filiformis	2	0	2	0	0	0	0	2	0
Amphiura sundevalli	1	0	2	0	0	0	0	2	0
Amythasides macroglossus	0	0	2	0	0	0	0	0	0
Anobothrus gracilis	0	0	2	0	0	0	0	0	0
Aonides paucibranchiata	0	0	2	0	0	0	0	0	0
Aphelochaeta indet	0	0	3	0	0	0	0	0	0
Aphelochaeta marioni	0	0	3	0	0	0	0	0	0
Apistobranchus indet	0	0	2	0	0	0	0	0	0
Apseudes spinosus	0	0	0	0	0	0	0	0	0
Aricidea catherinae	0	0	2	0	0	0	0	0	0
Aricidea hartmani	0	0	2	0	0	0	0	0	0
Aricidea indet	0	0	2	0	0	0	0	0	0
Aricidea roberti	0	0	2	0	0	0	0	0	0
Aricidea wassi	0	0	2	0	0	0	0	0	0
Arrhis phyllonyx	0	0	3	0	0	0	0	0	0
Astarte borealis	3	0	3	0	0	0	0	0	0
Astarte crenata	3	0	0	0	0	0	0	0	0
Astarte elliptica	3	0	0	0	0	0	0	0	0
Astarte montagui	3	0	0	0	0	0	0	0	0
Augeneria tentaculata	0	0	0	0	0	0	2	2	0
Autolytus indet	0	0	0	0	0	0	0	3	0
Axinopsida orbiculata	3	0	0	0	0	0	0	0	0
Axionice maculata	0	0	3	0	0	0	0	0	0
Brachydiastylis resima	3	0	0	0	0	0	0	0	0
Byblis gaimardi	0	0	0	0	0	3	0	0	0
Calathura brachiata	3	0	0	0	2	0	0	0	0
Capitella capitata	0	0	0	3	0	0	0	0	1
Capitellidae indet	0	0	2	2	0	0	0	0	0
Caprellidae indet	0	0	0	3	0	0	0	3	1
Caudofoveata indet	0	1	2	2	1	0	2	2	0
Caulleriella killariensis	0	0	3	0	0	0	0	0	0
Chaetoderma nitidulum	0	0	0	2	0	0	0	2	0
Chaetozone indet	0	0	3	0	0	0	0	0	0
Chaetozone setosa	0	0	3	0	0	0	0	0	0
Chone collaris	2	0	0	0	0	0	0	0	0
Chone duneri	2	0	0	0	0	0	0	0	0
Chone indet	3	0	0	0	0	0	0	0	0
Chone paucibranchiata	3	0	0	0	0	0	0	0	0
Ciliatocardium ciliatum	3	0	0	0	0	0	0	0	0
Cirratulidae indet	0	0	2	0	0	0	0	0	0
Cirratulus cirratus	0	0	3	0	0	0	0	0	0
Clymenura borealis	0	0	0	2	0	0	0	0	0
Clymenura indet	0	0	0	2	0	0	0	0	0
Clymenura polaris	0	0	0	2	0	0	0	0	0
Crenella decussata	3	0	0	0	0	0	0	0	0
Ctenodiscus crispatus	0	0	3	0	0	0	0	0	0
Cuspidaria arctica	0	0	0	0	0	0	0	3	0
Cuspidaria lamellosa	0	0	0	0	0	0	0	3	0
Cuspidaria obesa	0	0	0	0	0	0	0	3	0
Cylichna alba	0	0	0	0	0	0	0	2	0
Cylichna cylindracea	0	0	0	0	0	0	0	2	0
Cylichna occulta	0	0	0	0	0	0	0	2	0
Dacrydium vitreum	3	0	0	0	0	0	0	0	0
Dentalium entalis	0	0	0	2	0	1	0	0	0
Dentalium indet	0	0	0	2	0	1	0	0	0
Diastylis indet	0	0	2	2	0	2	0	0	0
Diastylis scorpioides	0	0	2	0	0	1	0	0	0
Diplocirrus glaucus	0	0	3	0	0	2	0	0	0
Diplocirrus hirsutus	0	0	3	0	0	2	0	0	0
Dipolydora coeca	1	0	3	0	0	0	0	0	0
Echinocardium flavescens	0	0	0	2	0	0	0	0	0
Echinocyamus pusillus	0	0	0	2	0	0	0	0	0
Eclysippe vanelli	0	0	2	0	0	0	0	0	0
Ennucula tenuis	3	0	0	0	0	0	0	0	0
Entalina quinquangularis	0	0	0	3	0	0	0	0	0
Eriopisa elongata	0	0	0	0	0	3	0	0	0
Eteone indet	0	0	0	0	0	0	0	3	0
Euchone indet	3	0	0	0	0	0	0	0	0
Euchone papillosa	3	0	0	0	0	0	0	0	0
Euchone southerni	3	0	0	0	0	0	0	0	0
Euclymene affinis	0	0	0	3	0	0	0	0	0
Euclymene droebachiensis	0	0	0	3	0	0	0	0	0
Euclymene lindrothi	0	0	0	3	0	0	0	0	0
Euclymeninae indet	0	0	0	3	0	0	0	0	0
Eudorella emarginata	0	0	3	0	0	2	0	0	0

Traits	**Feeding**								
Category	**Suspension / filter**	**Scraper / grazer**	**Surface deposit feeder**	**Subsurface deposit feeder**	**Dissolved matter / symbionts**	**Large detrius / sandlicker**	**Scavenger**	**Carnivore / omnivore**	**Parasite / commensal**
Species/code	**FH1**	**FH2**	**FH3**	**FH4**	**FH5**	**FH6**	**FH7**	**FH8**	**FH9**
Eudorellopsis deformis	0	0	2	0	0	2	0	0	0
Eusyllis blomstrandi	0	0	0	0	0	0	0	3	1
Exogone verugera	0	0	2	0	0	0	0	3	0
Fauveliopsis indet	1	0	0	0	1	0	0	0	0
Galathowenia oculata	0	0	2	0	0	0	0	0	0
Glycera lapidum	0	0	0	0	0	2	0	2	0
Gnathia indet	0	0	0	0	0	0	0	0	3
Golfingia indet	2	0	3	0	0	0	0	0	0
Golfingia margaritacea	2	0	3	0	0	0	0	0	0
Goniada maculata	0	0	0	0	0	0	0	3	0
Haploops tubicola	0	0	0	0	0	0	0	0	0
Harmothoe fraserthomsoni	0	0	0	0	0	0	0	3	1
Harmothoe imbricata	0	0	0	0	0	0	0	3	1
Harmothoe indet	0	0	0	0	0	0	0	2	2
Harpinia antennaria	0	0	2	0	0	0	0	0	0
Harpinia indet	0	0	2	2	0	0	0	0	0
Harpinia mucronata	0	0	0	3	0	0	0	0	0
Harpinia pectinata	0	0	0	3	0	0	0	0	0
Harpinia plumosa	0	0	0	3	0	0	0	0	0
Harpinia propinqua	0	0	0	3	0	0	0	0	0
Harpinia serrata	0	0	0	3	0	0	0	0	0
Hemilamprops roseus	0	0	3	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	3	0	0	0	0	0
Hiatella arctica	3	0	0	0	0	0	0	0	0
Hippomedon denticulatus	0	0	0	0	0	0	3	0	0
Hyalinoecia tubicola	0	0	0	0	0	0	0	3	0
Isaeidae indet	1	0	1	1	1	0	0	0	1
Isopoda indet	1	0	1	1	1	1	0	1	1
Jasmineira candela	2	0	0	0	0	0	0	0	0
Jasmineira caudata	2	0	0	0	0	0	0	0	0
Kelliella miliaris	2	0	2	0	0	0	0	0	0
Labidoplax buskii	0	0	3	0	0	0	0	0	0
Lanice conchilega	2	0	2	0	0	2	0	0	0
Laonice cirrata	0	0	3	0	0	0	0	0	0
Laonice sarsi	0	0	2	0	0	0	0	0	0
Laphania boecki	0	0	3	0	0	0	0	0	0
Leitoscoloplos indet	0	0	0	2	0	2	0	0	0
Lepeta caeca	3	0	3	0	0	0	0	0	0
Leucon indet	3	0	0	0	0	0	0	0	0
Leucon nasica	3	0	0	0	0	0	0	0	0
Leucon nasicoides	3	0	0	0	0	0	0	0	0
Levinsenia gracilis	0	0	0	3	0	0	0	0	0
Limopsis cristata	3	0	0	0	0	0	0	0	0
Lucinoma borealis	3	0	0	0	0	0	0	0	0
Lumbriclymene minor	0	0	0	3	0	0	0	0	0
Lumbrineris gracilis	0	0	0	0	0	0	0	3	0
Lumbrineris indet	0	0	2	1	0	1	0	3	1
Lysianassidae indet	0	1	1	1	0	0	0	0	0
Lysippe labiata	3	0	0	0	0	0	0	0	0
Macoma calcarea	0	0	0	3	0	0	0	0	0
Macoma indet	0	0	0	3	0	0	0	0	0
Maldane sarsi	0	0	0	3	0	0	0	0	0
Maldanidae indet	0	0	0	2	0	0	0	0	0
Margarites olivaceus	0	3	0	0	0	0	0	0	0
Melita dentata	0	0	0	0	0	3	0	0	0
Melita quadrispinosa	1	0	1	0	1	0	0	0	0
Moelleria costulata	0	3	0	0	0	0	0	0	0
Montacuta spitzbergensis	2	0	0	0	0	0	0	0	2
Mugga wahrbergi	0	0	2	0	0	0	0	0	0
Munna indet	3	0	0	0	0	0	0	0	0
Musculus niger	3	0	0	0	0	0	0	0	0
Mya truncata	3	0	0	0	0	0	0	0	0
Myriochele danielsseni	0	0	2	0	0	0	0	0	0
Myriochele fragilis	0	0	2	0	0	0	0	0	0
Myriochele heeri	0	0	2	0	0	0	0	0	0
Myriochele oculata	0	0	2	0	0	0	0	0	0
Mysella bidentata	2	0	0	0	2	0	0	0	2
Nemertina indet	0	0	0	0	0	0	0	3	0
Nephasoma minutum	2	0	2	0	0	0	0	0	0
Nephtys hombergii	0	0	1	1	1	2	2	3	0
Nephtys hystricis	0	0	0	0	0	2	0	0	0
Nephtys longosetosa	0	0	0	0	0	0	0	3	0
Nephtys pente	0	0	2	0	0	2	0	2	0
Nereimyra punctata	0	0	2	0	0	2	0	2	0
Nicomache indet	0	0	0	2	0	0	0	0	0
Nicomache quadrispinata	0	0	0	2	0	0	0	0	0
Nothria conchylega	0	0	0	0	0	0	0	3	0
Nothria hyperborea	0	0	0	0	0	0	0	3	0
Notomastus latericeus	0	0	0	3	0	0	0	0	2
Nucula tumidula	0	0	0	3	0	0	0	0	0
Nuculana pernula	0	0	0	3	0	0	0	0	0
Oedicerotidae indet	1	0	0	0	1	1	0	0	0
Onchnesoma squamatum	0	0	3	0	0	0	0	0	0
Onchnesoma steenstrupi	0	0	3	0	0	0	0	0	0
Onisimus indet	1	0	0	0	1	1	0	0	0
Ophelia borealis	0	0	3	0	0	3	0	2	0
Ophelina norvegica	0	0	0	3	0	0	0	0	0
Ophiacantha bidentata	3	0	0	0	0	0	0	3	0
Ophiocten sericeum	3	0	0	0	0	0	0	3	0
Ophiodromus flexuosus	0	0	0	0	0	0	0	0	2
Ophiopholis aculeata	0	0	2	0	0	0	0	0	0
Ophiura robusta	2	0	0	0	0	0	0	2	0
Ostracoda indet	0	0	0	0	0	3	0	0	0
Owenia fusiformis	2	0	2	0	0	0	0	0	0
Paguridae indet	0	0	0	0	0	0	0	3	3

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Species/code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Pantopoda indet	0	0	0	0	0	0	0	3	0
Paradiopatra fiordica	0	0	0	0	0	0	0	3	0
Paradiopatra quadricuspis	0	0	0	0	0	0	0	3	0
Paradoneis indet	0	0	0	2	0	0	0	0	0
Paradoneis lyra	0	0	0	3	0	0	0	0	0
Paramphinome jeffreysii	0	0	0	0	0	0	1	3	0
Parougia indet	0	0	0	0	0	0	0	2	0
Parvicardium minimum	3	0	0	0	0	0	0	0	0
Pectinaria auricoma	0	0	0	2	0	2	0	0	0
Pectinaria hyperborea	2	0	2	0	0	2	0	0	0
Pectinaria koreni	2	0	2	0	0	2	0	0	0
Pelecypoda indet	3	0	0	0	0	0	0	0	0
Phascolion strombus	2	0	2	0	0	0	0	0	3
Phaxas pellucidus	2	0	0	0	0	0	0	0	0
Philine indet	0	0	0	0	0	0	0	3	0
Phisidia aurea	0	0	3	0	0	0	0	0	0
Pholoe baltica	0	0	0	0	0	0	0	3	0
Pholoe inornata	0	0	0	0	0	0	0	3	0
Pholoe pallida	0	0	0	0	0	0	0	3	0
Pholoe synophthalmica	0	0	0	0	0	0	0	3	0
Phoronis indet	3	0	0	0	0	0	0	0	0
Phoronis muelleri	3	0	0	0	0	0	0	0	0
Phyllodoce groenlandica	0	0	0	0	0	0	0	3	0
Phylo norvegicus	0	0	0	3	0	0	0	0	0
Pista indet	0	0	2	0	0	0	0	0	0
Poecilochaetus serpens	0	0	0	0	0	2	0	2	0
Polycirrus indet	0	0	2	2	0	0	0	0	0
Polycirrus medusa	0	0	2	0	0	0	0	0	0
Polydora indet	2	0	2	2	0	0	0	0	0
Polynoidae indet	0	0	0	0	0	0	0	3	0
Pontocrates indet	0	0	0	2	0	0	0	0	0
Pontoporeia femorata	3	0	0	0	0	0	0	0	0
Praxillella praetermissa	0	0	0	3	0	0	0	0	0
Praxillura longissima	0	0	0	3	0	0	0	0	0
Priapulus caudatus	0	0	0	0	0	0	0	3	0
Prionospio cirrifera	0	0	3	0	0	0	0	0	0
Prionospio dubia	0	0	3	0	0	0	0	0	0
Protomedeia fasciata	3	0	0	0	0	0	0	0	0
Pseudocuma indet	0	0	2	0	0	0	0	0	0
Pseudopolydora paucibranchiata	0	0	3	0	0	0	0	0	0
Pseudosphyrapus anomalus	0	0	2	2	0	0	0	2	0
Rhodine gracilior	0	0	0	2	0	0	0	0	0
Sabellidae indet	0	0	2	0	0	0	0	0	0
Samytha sexcirrata	0	0	2	0	0	0	0	0	0
Scalibregma inflatum	1	0	0	3	0	0	0	0	0
Scolelepis korsuni	0	0	0	2	0	0	0	1	0
Scoloplos armiger	0	0	0	3	0	0	0	0	0
Sipuncula indet	1	0	1	1	0	0	0	0	1
Sphaerodorum gracilis	0	0	2	0	0	0	0	0	0
Sphaerodorum indet	0	0	2	0	0	0	0	0	0
Spio armata	0	0	2	0	0	0	0	0	0
Spio decoratus	0	0	2	0	0	0	0	0	0
Spio indet	0	0	3	0	0	0	0	0	0
Spiochaetopterus typicus	3	0	2	0	0	0	0	0	0
Spiophanes bombyx	0	0	3	0	0	0	0	0	0
Spiophanes indet	2	0	3	0	0	0	0	0	0
Spiophanes kroyeri	0	0	3	0	0	0	0	0	0
Spiophanes urceolata	0	0	3	0	0	0	0	0	0
Spirorbidae indet	2	0	1	0	0	0	0	1	0
Spirorbis indet	2	0	1	0	0	0	0	1	0
Stenothoidae indet	3	0	1	0	0	1	0	0	0
Sthenelais limicola	0	0	0	0	0	0	0	3	0
Strongylocentrotus pallidus	0	0	0	0	0	0	0	3	0
Syllis indet	1	0	1	1	0	0	0	1	1
Syrrhoe crenulata	3	0	0	0	0	1	0	0	0
Terebellides stroemii	0	0	3	0	0	0	0	0	0
Thelepus cincinnatus	0	0	3	0	0	0	0	0	0
Thracia myopsis	3	0	0	0	0	0	0	0	0
Thyasira croulinensis	2	0	0	2	0	0	0	0	0
Thyasira equalis	0	0	0	3	2	0	0	0	0
Thyasira eumyaria	0	0	0	3	0	0	0	0	0
Thyasira ferruginea	0	0	0	3	0	0	0	0	0
Thyasira flexuosa	2	0	2	2	2	0	0	0	0
Thyasira gouldi	2	0	2	2	2	0	0	0	0
Thyasira granulosa	2	0	0	0	0	0	0	0	0
Thyasira indet	2	0	0	3	2	0	0	0	0
Thyasira obsoleta	0	0	0	3	2	0	0	0	0
Thyasira pygmaea	0	0	0	2	0	0	0	0	0
Thyasira succisa	0	0	0	3	0	0	0	0	0
Thyasiridae indet	2	0	1	2	1	0	0	0	0
Timoclea ovata	0	0	0	0	0	0	0	0	0
Tmetonyx cicada	0	0	0	0	0	0	3	0	0
Tmetonyx similis	0	0	0	0	0	0	3	0	0
Trichobranchus roseus	0	0	3	0	0	0	0	0	0
Unciola leucopis	0	0	0	0	0	0	3	0	0
Urothoe elegans	0	0	0	0	0	3	0	0	0
Westwoodilla caecula	0	0	0	0	0	3	0	0	0
Yoldia hyperborea	0	0	0	3	0	0	0	0	0
Yoldiella frigida	0	0	0	3	0	0	0	0	0
Yoldiella indet	0	0	0	3	0	0	0	0	0
Yoldiella lenticula	0	0	0	3	0	0	0	0	0
Yoldiella lucida	0	0	0	3	0	0	0	0	0
Yoldiella nana	0	0	0	3	0	0	0	0	0
Yoldiella solidula	0	0	0	3	0	0	0	0	0

Traits	Maximum adult size						Larval type			Mobility			
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**Planktotroph**	**Lecitotroph**	**Direct development**	**None mobility**	**Low mobility**	**Medium mobility**	**High mobility**
Species/code	**NS1**	**NS2**	**NS3**	**NS4**	**NS5**	**NS6**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Abra indet	0	0	2	0	0	2	3	0	0	0	2	2	2
Abra longicallus	0	0	3	0	0	0	3	0	0	0	2	0	0
Abra prismatica	0	0	3	0	0	0	3	0	0	0	2	0	0
Abyssoninoe hibernica	0	0	0	3	0	0	0	2	0	0	0	0	0
Aeginina longicornis	0	0	3	0	0	0	0	0	3	0	0	0	3
Aglaophamus malmgreni	0	0	0	0	0	3	2	2	0	0	0	0	3
Ampelisca brevicornis	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca indet	0	2	2	2	0	0	0	0	3	0	0	3	0
Ampelisca macrocephala	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca spinipes	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampelisca tenuicornis	0	3	0	0	0	0	0	0	3	0	0	3	0
Ampharete falcata	0	0	2	0	0	0	0	3	0	0	2	0	0
Ampharete finmarchica	0	0	0	3	0	0	0	3	0	0	2	0	0
Ampharete lindstroemi	0	0	2	0	0	0	0	3	0	0	2	0	0
Ampharetidae indet	0	0	2	0	0	0	0	3	0	0	2	0	0
Amphilepis norvegica	0	0	0	0	3	0	0	3	0	0	0	0	0
Amphipholis squamata	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphipoda indet	1	1	1	1	1	1	0	0	3	0	1	1	1
Amphitritinae indet	0	2	2	0	0	0	0	3	0	0	2	0	0
Amphiura chiajei	0	1	2	2	0	0	3	0	0	0	2	1	0
Amphiura filiformis	0	2	2	2	0	0	3	0	0	0	2	1	0
Amphiura sundevalli	0	2	2	2	0	0	3	0	0	0	2	1	0
Amythasides macroglossus	0	0	2	0	0	0	0	3	0	0	3	0	0
Anobothrus gracilis	0	0	0	2	0	0	0	0	3	0	0	0	0
Aonides paucibranchiata	0	0	3	0	0	0	2	0	0	0	0	0	0
Aphelochaeta indet	0	2	2	2	2	2	0	3	0	0	1	1	0
Aphelochaeta marioni	0	2	2	2	2	0	0	3	0	0	1	0	0
Apistobranchus indet	0	2	2	0	0	0	0	0	3	0	2	0	0
Apseudes spinosus	0	0	3	0	0	0	0	0	3	0	0	0	0
Aricidea catherinae	0	3	0	0	0	0	0	0	3	0	0	1	0
Aricidea hartmani	0	0	3	0	0	0	0	0	3	0	0	1	0
Aricidea indet	0	2	2	0	0	0	0	0	3	0	0	1	0
Aricidea roberti	0	3	0	0	0	0	0	0	3	0	0	1	0
Aricidea wassi	0	0	2	0	0	0	0	0	3	0	0	1	0
Arrhis phyllonyx	0	0	3	0	0	0	0	0	3	0	0	2	0
Astarte borealis	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte crenata	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte elliptica	0	0	3	0	0	0	0	0	3	0	2	0	0
Astarte montagui	0	0	3	0	0	0	0	0	3	0	2	0	0
Augeneria tentaculata	0	0	2	0	0	0	0	3	0	0	0	2	0
Autolytus indet	1	2	2	0	0	0	3	0	0	0	0	0	3
Axinopsida orbiculata	3	1	0	0	0	0	3	0	0	0	3	0	0
Axionice maculata	0	0	0	0	0	3	0	3	0	0	2	0	0
Brachydiastylis resima	0	3	0	0	0	0	0	3	0	0	0	2	0
Byblis gaimardi	0	0	3	0	0	0	0	0	3	0	0	0	3
Calathura brachiata	0	0	0	3	0	0	0	0	3	0	0	3	0
Capitella capitata	0	0	0	0	2	2	0	3	0	0	0	2	0
Capitellidae indet	0	0	1	2	2	2	0	3	0	0	0	2	0
Caprellidae indet	0	2	2	2	2	2	0	3	0	0	2	2	0
Caudofoveata indet	2	2	2	2	2	2	0	2	0	0	2	0	0
Caulleriella killariensis	0	0	2	0	0	0	0	3	0	0	0	0	0
Chaetoderma nitidulum	0	0	0	0	0	0	0	2	0	0	2	0	0
Chaetozone indet	0	0	3	0	0	0	0	3	0	0	2	0	0
Chaetozone setosa	0	0	3	0	0	0	0	3	0	0	2	0	0
Chone collaris	0	0	0	0	0	0	3	0	0	0	3	0	0
Chone duneri	0	0	0	3	0	0	3	0	0	0	3	0	0
Chone indet	1	2	2	2	0	0	3	0	0	0	3	0	0
Chone paucibranchiata	0	0	0	0	3	0	3	0	0	0	3	0	0
Ciliatocardium ciliatum	2	0	0	0	0	0	3	0	0	0	3	0	0
Cirratulidae indet	0	1	1	1	1	1	0	3	0	0	1	1	1
Cirratulus cirratus	0	0	0	0	0	3	0	3	0	0	2	0	0
Clymenura borealis	0	0	0	3	2	0	0	3	0	0	3	0	0
Clymenura indet	0	0	0	2	2	0	0	3	0	0	3	0	0
Clymenura polaris	0	0	0	0	2	0	0	3	0	0	3	0	0
Crenella decussata	0	3	0	0	0	0	3	0	0	0	3	0	0
Ctenodiscus crispatus	0	0	0	3	0	0	0	3	0	0	3	0	0
Cuspidaria arctica	0	1	3	0	0	0	0	2	0	0	0	2	0
Cuspidaria lamellosa	0	1	0	0	0	0	0	2	0	0	0	2	0
Cuspidaria obesa	3	1	3	0	0	0	0	2	0	0	0	2	0
Cylichna alba	0	1	2	0	0	0	0	0	3	0	3	0	0
Cylichna cylindracea	0	2	2	0	0	0	0	0	3	0	3	0	0
Cylichna occulta	0	1	2	0	0	0	0	0	3	0	3	0	0
Dacrydium vitreum	0	3	0	0	0	0	0	0	3	0	3	0	0
Dentalium entalis	0	0	0	3	0	0	0	0	3	0	0	0	0
Dentalium indet	0	2	2	2	2	2	0	0	3	0	0	0	0
Diastylis indet	0	2	2	0	0	0	0	0	3	0	0	0	2
Diastylis scorpioides	0	0	3	0	0	0	0	0	3	0	0	0	2
Diplocirrus glaucus	0	0	3	0	0	0	0	3	0	0	0	2	0
Diplocirrus hirsutus	0	0	3	0	0	0	0	3	0	0	0	2	0
Dipolydora coeca	0	0	0	3	0	0	3	0	0	0	0	0	0
Echinocardium flavescens	0	0	0	0	3	0	3	0	0	0	2	0	0
Echinocyamus pusillus	0	0	0	0	3	0	3	0	0	0	2	0	0
Eclysippe vanelli	0	0	3	0	0	0	0	3	0	0	2	0	0
Ennucula tenuis	3	0	0	0	0	0	0	3	0	0	3	0	0
Entalina quinquangularis	0	0	3	0	0	0	0	3	0	0	0	0	0
Eriopisa elongata	0	3	0	0	0	0	0	0	3	0	0	3	0
Eteone indet	0	0	2	2	2	2	0	3	0	0	0	2	2
Euchone indet	0	0	2	2	2	0	3	0	0	0	1	0	0
Euchone papillosa	0	0	0	2	0	0	3	0	0	0	1	0	0
Euchone southerni	3	0	0	0	0	0	3	0	0	0	1	0	0
Euclymene affinis	0	0	2	2	0	0	0	3	0	0	2	0	0
Euclymene droebachiensis	0	0	0	2	2	0	0	3	0	0	2	0	0
Euclymene lindrothi	0	0	0	2	0	0	0	3	0	0	2	0	0
Euclymeninae indet	0	0	2	2	2	2	0	3	0	0	2	0	0
Eudorella emarginata	0	0	3	0	0	0	0	3	0	3	0	0	0

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Species/code	NS1	NS2	NS3	NS4	NS5	NS6	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Eudorellopsis deformis	3	0	0	0	0	0	0	3	0	3	0	0	0
Eusyllis blomstrandi	0	0	1	3	0	0	0	0	3	0	0	0	3
Exogone verugera	0	3	0	0	0	0	0	3	0	0	0	2	0
Fauveliopsis indet	1	2	1	0	0	0	1	1	1	0	0	2	0
Galathowenia oculata	0	0	2	0	0	0	3	0	0	0	2	0	0
Glycera lapidum	0	0	0	0	0	3	2	0	0	0	0	2	0
Gnathia indet	2	2	0	0	0	0	0	0	3	0	2	0	0
Golfingia indet	0	0	0	0	0	2	0	3	0	0	2	0	0
Golfingia margaritacea	0	0	0	0	0	3	0	3	0	0	2	0	0
Goniada maculata	0	0	0	0	3	0	0	3	0	0	0	0	2
Haploops tubicola	0	0	3	0	0	0	0	0	3	0	0	3	0
Harmothoe fraserthomsoni	0	0	0	0	2	2	3	0	0	0	0	0	3
Harmothoe imbricata	0	0	0	0	3	0	3	0	0	0	0	0	3
Harmothoe indet	0	0	2	2	2	0	3	0	0	0	0	1	3
Harpinia antennaria	2	2	0	0	0	0	0	0	3	0	2	2	0
Harpinia indet	2	2	0	0	0	0	0	0	3	0	2	2	0
Harpinia mucronata	2	2	0	0	0	0	0	0	3	0	2	0	0
Harpinia pectinata	0	3	0	0	0	0	0	0	3	0	2	0	0
Harpinia plumosa	0	3	0	0	0	0	0	0	3	0	2	0	0
Harpinia propinqua	1	2	0	0	0	0	0	0	3	0	2	0	0
Harpinia serrata	0	3	0	0	0	0	0	0	3	0	2	0	0
Hemilamprops roseus	0	3	0	0	0	0	0	0	3	0	0	0	0
Heteromastus filiformis	0	0	0	0	3	2	0	3	0	0	0	2	0
Hiatella arctica	0	0	0	3	0	0	0	0	3	0	3	0	0
Hippomedon denticulatus	0	0	2	0	0	0	0	0	3	0	0	2	0
Hyalinoecia tubicola	0	0	0	0	0	3	0	0	3	0	2	0	0
Isaeidae indet	2	2	1	0	0	0	0	0	3	0	0	0	3
Isopoda indet	1	1	1	1	1	1	0	0	2	0	1	1	1
Jasmineira candela	0	0	2	0	0	0	3	0	0	0	1	0	0
Jasmineira caudata	0	0	2	0	0	0	3	0	0	0	1	0	0
Kelliella miliaris	2	0	0	0	0	0	3	0	0	0	0	0	0
Labidoplax buskii	0	0	0	0	0	0	0	3	0	0	2	0	0
Lanice conchilega	0	0	0	0	0	3	3	0	0	0	0	0	0
Laonice cirrata	0	0	0	0	2	2	0	3	0	0	0	0	0
Laonice sarsi	0	0	0	0	2	0	0	2	0	0	0	0	0
Laphania boecki	0	0	0	0	3	0	3	3	0	0	2	0	0
Leitoscoloplos indet	0	0	0	1	2	2	0	3	0	0	0	2	0
Lepeta caeca	0	3	0	0	0	0	0	0	3	0	3	0	0
Leucon indet	1	1	1	0	0	0	0	3	0	0	0	2	0
Leucon nasica	0	2	2	0	0	0	0	3	0	0	0	2	0
Leucon nasicoides	0	2	2	0	0	0	0	3	0	0	0	2	0
Levinsenia gracilis	0	0	3	0	0	0	0	3	0	0	0	2	0
Limopsis cristata	0	2	0	0	0	0	0	0	3	0	2	0	0
Lucinoma borealis	0	0	0	3	0	0	0	0	3	0	2	0	0
Lumbriclymene minor	0	0	3	0	0	0	0	3	0	1	3	0	0
Lumbrineris gracilis	0	0	0	3	0	0	0	3	0	0	0	0	0
Lumbrineris indet	0	0	2	2	2	2	0	3	0	0	2	2	2
Lysianassidae indet	1	3	0	0	0	0	0	0	3	0	0	3	0
Lysippe labiata	0	0	0	3	0	0	0	3	0	3	0	0	0
Macoma calcarea	0	0	0	3	0	0	0	0	3	0	2	0	0
Macoma indet	0	0	1	2	0	0	0	0	3	0	2	0	0
Maldane sarsi	0	0	0	0	3	2	0	3	0	0	0	0	0
Maldanidae indet	0	0	0	2	2	2	0	3	0	0	0	0	0
Margarites olivaceus	0	1	1	1	0	0	3	0	0	0	3	0	0
Melita dentata	0	0	0	3	0	0	0	0	3	0	0	2	0
Melita quadrispinosa	0	3	0	0	0	0	0	0	3	0	0	3	0
Moelleria costulata	3	0	0	0	0	0	3	0	0	0	3	0	0
Montacuta spitzbergensis	0	3	0	0	0	0	0	0	3	0	2	0	0
Mugga wahrbergi	0	0	0	2	0	0	0	0	3	0	0	0	0
Munna indet	2	2	0	0	0	0	0	1	0	0	0	2	0
Musculus niger	0	0	0	2	2	0	0	0	3	2	0	0	0
Mya truncata	0	0	0	0	3	0	3	0	0	0	3	0	0
Myriochele danielsseni	0	0	2	0	0	0	3	0	0	0	2	0	0
Myriochele fragilis	0	0	2	0	0	0	3	0	0	0	2	0	0
Myriochele heeri	0	0	3	0	0	0	3	0	0	0	2	0	0
Myriochele oculata	0	0	2	0	0	0	3	0	0	0	2	0	0
Mysella bidentata	3	0	0	0	0	0	0	0	3	0	2	0	0
Nemertina indet	0	2	2	2	2	2	0	0	3	0	2	3	2
Nephasoma minutum	0	0	0	2	2	0	0	0	3	0	2	0	0
Nephtys hombergii	0	0	0	0	0	2	3	2	0	0	0	0	2
Nephtys hystricis	0	0	0	3	0	0	2	0	0	0	0	0	2
Nephtys longosetosa	0	0	0	0	0	3	2	0	0	0	0	3	0
Nephtys pente	0	0	3	0	0	0	2	2	0	0	0	0	3
Nereimyra punctata	0	0	3	0	0	0	3	0	0	0	0	0	2
Nicomache indet	0	0	2	2	2	2	0	2	0	0	0	0	0
Nicomache quadrispinata	0	0	0	3	0	0	0	2	0	0	0	0	0
Nothria conchylega	0	0	0	0	0	3	0	0	3	0	2	0	0
Nothria hyperborea	0	0	0	0	2	2	0	0	3	0	2	0	0
Notomastus latericeus	0	0	0	0	0	3	0	3	0	0	0	2	0
Nucula tumidula	0	2	0	0	0	0	0	3	0	0	0	0	0
Nuculana pernula	0	3	0	0	0	0	0	3	0	0	2	0	0
Oedicerotidae indet	0	3	1	0	0	0	0	0	3	0	1	1	1
Onchnesoma squamatum	0	0	0	0	3	0	0	3	0	0	3	0	0
Onchnesoma steenstrupi	0	0	0	0	3	0	0	3	0	0	3	0	0
Onisimus indet	0	2	2	0	0	0	0	0	3	0	1	1	1
Ophelia borealis	0	0	0	3	0	0	0	3	0	0	0	2	0
Ophelina norvegica	0	0	0	3	0	0	0	3	0	0	0	1	0
Ophiacantha bidentata	0	0	0	0	0	3	3	0	0	0	0	3	0
Ophiocten sericeum	0	0	0	0	0	3	3	0	0	0	0	3	0
Ophiodromus flexuosus	0	0	0	0	2	0	2	0	0	0	0	0	2
Ophiopholis aculeata	0	0	0	0	0	3	3	0	0	0	2	1	0
Ophiura robusta	0	0	0	0	3	0	3	0	0	0	2	0	0
Ostracoda indet	3	1	0	0	0	0	0	0	3	0	0	0	3
Owenia fusiformis	0	2	0	0	0	0	3	0	0	0	2	0	0
Paguridae indet	0	2	2	2	2	0	3	0	0	0	0	3	0

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Species/code	**NS1**	**NS2**	**NS3**	**NS4**	**NS5**	**NS6**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Pantopoda indet	1	1	1	1	0	0	0	0	3	0	0	0	3
Paradiopatra fiordica	0	0	0	3	0	0	0	3	0	0	0	3	0
Paradiopatra quadricuspis	0	0	0	0	3	0	0	3	0	0	0	3	0
Paradoneis indet	0	1	2	0	0	0	0	3	0	0	2	0	0
Paradoneis lyra	0	0	3	0	0	0	0	3	0	0	0	1	0
Paramphinome jeffreysii	0	0	3	0	0	0	3	0	0	0	0	0	3
Parougia indet	0	2	2	0	0	0	3	0	0	0	0	2	0
Parvicardium minimum	0	0	3	0	0	0	3	0	0	0	3	0	0
Pectinaria auricoma	0	0	0	3	0	0	0	3	0	0	2	0	0
Pectinaria hyperborea	0	0	2	2	0	0	0	3	0	0	2	0	0
Pectinaria koreni	0	0	0	3	0	0	0	3	0	0	2	0	0
Pelecypoda indet	1	1	1	1	1	1	3	0	0	1	3	2	0
Phascolion strombus	0	0	0	3	0	0	0	3	0	0	2	0	0
Phaxas pellucidus	0	0	0	3	0	0	0	0	3	0	0	0	0
Philine indet	0	0	2	0	0	0	3	0	0	0	3	0	0
Phisidia aurea	0	0	0	2	2	0	3	0	0	0	2	0	0
Pholoe baltica	0	0	3	0	0	0	3	0	0	0	0	3	0
Pholoe inornata	0	0	3	0	0	0	3	0	0	0	0	3	0
Pholoe pallida	0	0	3	0	0	0	0	3	0	0	0	0	2
Pholoe synophthalmica	0	0	3	0	0	0	0	3	0	0	0	0	2
Phoronis indet	0	0	0	0	2	2	3	0	0	0	0	0	0
Phoronis muelleri	0	0	0	0	0	3	3	0	0	0	0	0	0
Phyllodoce groenlandica	0	0	0	0	0	3	3	0	0	0	0	0	2
Phylo norvegicus	0	0	0	3	0	0	0	3	0	0	0	3	0
Pista indet	0	0	0	2	2	0	0	3	0	0	2	0	0
Poecilochaetus serpens	0	0	0	3	0	0	3	0	0	0	0	0	0
Polycirrus indet	0	0	0	2	2	1	0	3	0	0	2	0	0
Polycirrus medusa	0	0	0	0	3	0	0	2	0	0	2	0	0
Polydora indet	0	0	2	2	2	0	2	2	0	0	2	2	0
Polynoidae indet	0	1	1	1	1	1	1	1	0	0	0	2	3
Pontocrates indet	0	3	0	0	0	0	0	0	3	0	0	3	0
Pontoporeia femorata	0	0	3	0	0	0	0	0	3	0	0	0	2
Praxillella praetermissa	0	0	0	0	0	3	0	3	0	0	3	0	0
Praxillura longissima	0	0	0	0	0	3	0	3	0	0	3	0	0
Priapulus caudatus	0	0	2	2	2	0	0	0	3	0	0	0	0
Prionospio cirrifera	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio dubia	0	0	3	0	0	0	3	0	0	0	2	0	0
Protomedeia fasciata	0	3	0	0	0	0	0	0	3	0	0	0	3
Pseudocuma indet	2	2	2	0	0	0	0	0	3	0	0	0	2
Pseudopolydora paucibranchiata	2	2	0	0	0	0	0	0	3	0	0	0	0
Pseudosphyrapus anomalus	3	0	0	0	0	0	0	0	3	0	0	0	0
Rhodine gracilior	0	0	0	3	0	0	0	2	0	0	0	0	0
Sabellidae indet	0	1	2	2	1	1	0	2	0	2	2	0	0
Samytha sexcirrata	0	0	2	0	0	0	0	0	3	0	2	0	0
Scalibregma inflatum	0	1	2	1	0	0	0	3	0	0	2	1	0
Scolelepis korsuni	0	0	3	0	0	0	0	3	0	0	2	0	0
Scoloplos armiger	0	0	0	0	0	3	0	2	0	0	0	2	0
Sipuncula indet	0	0	0	2	2	2	0	3	0	0	3	0	0
Sphaerodorum gracilis	0	0	0	3	0	0	0	2	0	0	0	2	0
Sphaerodorum indet	0	0	0	3	0	0	0	2	0	0	0	2	0
Spio armata	0	0	3	0	0	0	3	0	0	0	2	0	0
Spio decoratus	0	0	3	0	0	0	3	0	0	0	2	0	0
Spio indet	0	2	2	2	0	0	3	0	0	0	0	1	0
Spiochaetopterus typicus	0	0	0	3	2	2	3	0	0	0	1	0	0
Spiophanes bombyx	0	0	0	3	0	0	3	0	0	0	2	0	0
Spiophanes indet	0	0	2	2	2	2	3	0	0	0	2	0	0
Spiophanes kroyeri	0	0	3	0	0	0	3	0	0	0	2	0	0
Spiophanes urceolata	0	0	3	0	0	0	3	0	0	0	2	0	0
Spirorbidae indet	2	2	1	0	0	0	0	0	3	3	0	0	0
Spirorbis indet	2	2	1	0	0	0	0	0	3	3	0	0	0
Stenothoidae indet	3	1	0	0	0	0	0	0	3	0	0	3	0
Sthenelais limicola	0	0	0	0	3	0	0	0	3	0	0	0	2
Strongylocentrotus pallidus	0	0	0	0	3	0	3	0	0	0	3	0	0
Syllis indet	0	0	2	2	0	0	0	2	2	0	0	2	2
Syrrhoe crenulata	0	2	2	0	0	0	0	0	3	0	0	3	0
Terebellides stroemii	0	0	0	0	3	0	3	3	0	0	2	0	0
Thelepus cincinnatus	0	0	0	0	0	3	0	3	0	0	2	0	0
Thracia myopsis	0	0	3	0	0	0	0	3	0	0	3	0	0
Thyasira croulinensis	0	0	2	0	0	0	0	3	0	0	0	0	0
Thyasira equalis	0	3	0	0	0	0	0	3	0	0	0	2	0
Thyasira eumyaria	3	0	0	0	0	0	0	3	0	0	2	0	0
Thyasira ferruginea	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira flexuosa	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira gouldi	3	0	0	0	0	0	0	0	3	0	0	0	0
Thyasira granulosa	0	3	0	0	0	0	0	3	0	0	0	0	0
Thyasira indet	2	2	2	0	0	0	0	3	0	0	0	1	0
Thyasira obsoleta	0	0	2	0	0	0	0	3	0	0	0	0	0
Thyasira pygmaea	2	0	0	0	0	0	0	3	0	0	0	0	0
Thyasira succisa	0	2	0	0	0	0	0	3	0	0	0	1	0
Thyasiridae indet	2	2	2	0	0	0	0	2	2	0	0	1	0
Timoclea ovata	0	0	3	0	0	0	0	0	3	0	0	0	0
Tmetonyx cicada	0	0	3	0	0	0	0	0	3	0	0	3	0
Tmetonyx similis	0	0	3	0	0	0	0	0	3	0	0	3	0
Trichobranchus roseus	0	0	0	2	0	0	0	0	3	0	0	0	0
Unciola leucopis	0	0	3	0	0	0	0	0	3	0	0	3	0
Urothoe elegans	0	2	0	0	0	0	0	0	3	0	0	0	0
Westwoodilla caecula	0	3	0	0	0	0	0	0	3	0	0	0	2
Yoldia hyperborea	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella frigida	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella indet	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella lenticula	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella lucida	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella nana	0	0	3	0	0	0	0	3	0	0	3	0	0
Yoldiella solidula	0	0	3	0	0	0	0	3	0	0	3	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Abra indet	0	3	0	0	0	0	3	0	0
Abra longicallus	0	3	0	0	0	0	3	0	0
Abra prismatica	0	3	0	0	0	0	3	0	0
Abyssoninoe hibernica	2	0	0	0	2	0	3	0	0
Aeginina longicornis	1	0	3	0	1	0	3	0	0
Aglaophamus malmgreni	1	0	0	0	2	0	3	0	0
Ampelisca brevicornis	0	0	3	0	0	0	3	0	0
Ampelisca indet	0	0	3	0	0	0	3	0	0
Ampelisca macrocephala	0	0	3	0	0	0	3	0	0
Ampelisca spinipes	0	0	3	0	0	0	3	0	0
Ampelisca tenuicornis	0	0	3	0	0	0	3	0	0
Ampharete falcata	2	1	0	0	0	0	0	0	2
Ampharete finmarchica	2	1	0	0	0	0	0	0	2
Ampharete lindstroemi	2	1	0	0	0	0	0	0	2
Ampharetidae indet	2	0	0	0	0	0	0	0	2
Amphilepis norvegica	0	1	0	1	1	1	3	0	0
Amphipholis squamata	0	3	0	0	0	3	3	0	0
Amphipoda indet	0	0	3	0	0	0	3	0	0
Amphitritinae indet	1	0	0	0	2	0	0	0	2
Amphiura chiajei	0	1	0	0	0	3	3	0	0
Amphiura filiformis	0	1	0	0	0	3	3	0	0
Amphiura sundevalli	0	1	0	0	0	3	3	0	0
Amythasides macroglossus	2	0	0	0	0	0	3	0	0
Anobothrus gracilis	2	0	0	0	2	1	3	0	0
Aonides paucibranchiata	2	0	0	0	1	0	3	0	0
Aphelochaeta indet	2	0	0	0	2	0	0	2	0
Aphelochaeta marioni	1	0	0	0	2	0	0	2	0
Apistobranchus indet	2	0	0	0	1	0	0	1	2
Apseudes spinosus	2	2	0	0	0	0	3	0	0
Aricidea catherinae	1	1	0	0	2	0	3	0	0
Aricidea hartmani	1	1	0	0	2	0	3	0	0
Aricidea indet	1	1	0	0	2	0	3	0	0
Aricidea roberti	1	1	0	0	2	0	3	0	0
Aricidea wassi	1	1	0	0	2	0	3	0	0
Arrhis phyllonyx	0	0	3	0	0	0	3	0	0
Astarte borealis	0	3	0	0	0	0	3	0	0
Astarte crenata	0	3	0	0	0	0	3	0	0
Astarte elliptica	0	3	0	0	0	0	3	0	0
Astarte montagui	0	3	0	0	0	0	3	0	0
Augeneria tentaculata	2	0	0	0	2	0	3	0	0
Autolytus indet	0	0	0	0	3	0	3	0	0
Axinopsida orbiculata	0	3	0	0	0	0	3	0	0
Axionice maculata	1	0	0	0	2	0	0	0	2
Brachydiastylis resima	0	0	0	2	0	1	3	0	0
Byblis gaimardi	0	0	3	0	0	0	3	0	0
Calathura brachiata	2	3	0	0	1	0	3	0	0
Capitella capitata	2	0	0	0	2	0	3	0	0
Capitellidae indet	2	0	0	0	2	0	3	0	0
Caprellidae indet	2	0	1	0	2	1	2	0	0
Caudofoveata indet	2	0	0	0	2	0	3	0	0
Caulleriella killariensis	0	2	0	0	1	0	3	0	0
Chaetoderma nitidulum	2	0	0	0	2	0	3	0	0
Chaetozone indet	2	0	0	0	1	0	3	0	0
Chaetozone setosa	2	0	0	0	1	0	3	0	0
Chone collaris	2	0	0	0	2	0	0	0	3
Chone duneri	2	0	0	0	2	0	0	0	3
Chone indet	2	0	0	0	2	0	0	0	3
Chone paucibranchiata	2	0	0	0	2	0	0	0	3
Ciliatocardium ciliatum	0	3	0	0	0	0	3	0	0
Cirratulidae indet	2	0	0	0	1	0	3	0	0
Cirratulus cirratus	2	0	0	0	1	0	3	0	0
Clymenura borealis	2	0	0	0	2	0	0	0	3
Clymenura indet	2	0	0	0	2	0	0	0	3
Clymenura polaris	2	0	0	0	2	0	0	0	3
Crenella decussata	0	3	0	0	0	0	3	0	0
Ctenodiscus crispatus	0	1	0	1	0	3	3	0	0
Cuspidaria arctica	0	2	0	0	0	1	3	0	0
Cuspidaria lamellosa	0	2	0	0	0	1	3	0	0
Cuspidaria obesa	0	2	0	0	0	1	3	0	0
Cylichna alba	2	0	0	0	0	1	3	0	0
Cylichna cylindracea	2	0	0	0	0	1	3	0	0
Cylichna occulta	2	0	0	0	0	1	3	0	0
Dacrydium vitreum	0	3	0	0	0	0	1	0	0
Dentalium entalis	2	0	0	0	0	0	2	0	0
Dentalium indet	2	0	0	0	0	0	2	0	0
Diastylis indet	0	0	0	0	0	0	2	0	0
Diastylis scorpioides	0	0	0	0	0	0	2	0	0
Diplocirrus glaucus	2	0	0	0	2	1	2	0	0
Diplocirrus hirsutus	2	0	0	0	2	1	2	0	0
Dipolydora coeca	0	1	0	0	1	0	0	0	2
Echinocardium flavescens	0	0	0	3	0	0	3	0	0
Echinocyamus pusillus	0	0	0	3	0	0	3	0	0
Eclysippe vanelli	1	0	0	0	2	0	0	0	3
Ennucula tenuis	0	3	0	0	0	0	3	0	0
Entalina quinquangularis	2	0	0	0	0	0	2	0	0
Eriopisa elongata	0	0	3	0	0	0	3	0	0
Eteone indet	0	1	0	0	2	0	3	0	0
Euchone indet	2	0	0	0	2	0	0	0	3
Euchone papillosa	2	0	0	0	2	0	0	0	3
Euchone southerni	2	0	0	0	2	0	0	0	3
Euclymene affinis	2	0	0	0	2	0	3	0	0
Euclymene droebachiensis	2	0	0	0	2	0	3	0	0
Euclymene lindrothi	2	0	0	0	1	0	3	0	0
Euclymeninae indet	2	0	0	0	1	0	3	0	0
Eudorella emarginata	0	0	0	2	0	1	2	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Eudorellopsis deformis	0	0	0	2	0	0	3	0	0
Eusyllis blomstrandi	1	0	0	0	2	0	3	0	0
Exogone verugera	1	0	0	0	2	0	3	0	0
Fauveliopsis indet	1	0	0	0	1	0	3	1	0
Galathowenia oculata	2	0	0	0	2	0	0	0	3
Glycera lapidum	2	0	0	0	2	0	3	0	0
Gnathia indet	0	3	0	0	0	0	1	3	0
Golfingia indet	0	0	0	0	2	0	3	0	0
Golfingia margaritacea	0	0	0	0	2	0	3	0	0
Goniada maculata	0	1	0	0	2	1	3	0	0
Haploops tubicola	0	0	3	0	0	0	3	0	0
Harmothoe fraserthomsoni	0	1	0	0	0	0	3	0	0
Harmothoe imbricata	0	1	0	0	0	0	3	0	0
Harmothoe indet	0	1	0	0	0	0	3	0	0
Harpinia antennaria	0	0	3	0	0	0	3	0	0
Harpinia indet	0	0	3	0	0	0	3	0	0
Harpinia mucronata	0	0	3	0	0	0	3	0	0
Harpinia pectinata	0	0	3	0	0	0	3	0	0
Harpinia plumosa	0	0	3	0	0	0	3	0	0
Harpinia propinqua	0	0	3	0	0	0	3	0	0
Harpinia serrata	0	0	3	0	0	0	3	0	0
Hemilamprops roseus	0	0	0	1	1	1	3	0	0
Heteromastus filiformis	2	0	0	0	2	0	2	0	0
Hiatella arctica	0	3	0	0	0	1	1	0	0
Hippomedon denticulatus	0	0	3	0	0	0	3	0	0
Hyalinoecia tubicola	1	0	0	0	3	0	0	0	3
Isaeidae indet	0	0	3	0	0	0	3	0	0
Isopoda indet	0	3	0	0	0	0	3	0	0
Jasmineira candela	2	0	0	0	2	0	0	0	3
Jasmineira caudata	2	0	0	0	2	0	0	0	3
Kelliella miliaris	0	2	0	1	0	0	3	0	0
Labidoplax buskii	3	0	0	0	0	0	3	0	0
Lanice conchilega	2	0	0	0	3	0	0	3	0
Laonice cirrata	2	0	0	0	1	0	0	3	0
Laonice sarsi	2	0	0	0	1	0	0	3	0
Laphania boecki	1	0	0	0	1	0	0	3	0
Leitoscoloplos indet	3	0	0	0	3	0	3	0	0
Lepeta caeca	0	0	0	1	0	3	3	3	0
Leucon indet	0	0	0	2	0	1	3	0	0
Leucon nasica	0	0	0	2	0	1	3	0	0
Leucon nasicoides	0	0	0	2	0	1	3	0	0
Levinsenia gracilis	2	0	0	0	2	0	3	0	0
Limopsis cristata	0	3	0	0	0	1	2	0	0
Lucinoma borealis	0	2	0	0	0	0	3	0	0
Lumbriclymene minor	2	0	0	0	3	0	0	3	0
Lumbrineris gracilis	1	0	0	0	3	0	3	0	0
Lumbrineris indet	2	0	0	0	2	0	3	0	0
Lysianassidae indet	0	0	3	0	0	0	3	0	0
Lysippe labiata	3	0	0	0	1	0	3	0	3
Macoma calcarea	0	2	0	0	0	1	3	0	0
Macoma indet	0	2	0	0	0	1	3	0	0
Maldane sarsi	1	0	0	0	3	0	0	0	2
Maldanidae indet	1	0	0	0	3	0	0	0	2
Margarites olivaceus	0	0	0	3	0	2	1	0	0
Melita dentata	0	0	3	0	0	0	3	0	0
Melita quadrispinosa	0	0	3	0	0	0	3	0	0
Moelleria costulata	0	0	0	3	0	2	1	0	0
Montacuta spitzbergensis	0	2	0	0	0	0	3	0	0
Mugga wahrbergi	2	0	0	0	0	1	0	0	3
Munna indet	0	3	0	0	0	0	3	0	0
Musculus niger	0	3	0	0	0	0	0	3	1
Mya truncata	0	3	0	0	0	0	3	0	0
Myriochele danielsseni	2	0	0	0	2	0	0	0	3
Myriochele fragilis	2	0	0	0	2	0	0	0	3
Myriochele heeri	2	0	0	0	2	0	0	0	3
Myriochele oculata	2	0	0	0	2	0	0	0	3
Mysella bidentata	0	2	0	0	0	0	3	0	0
Nemertina indet	0	2	0	0	2	0	2	0	0
Nephasoma minutum	0	0	0	0	2	0	3	0	0
Nephtys hombergii	0	1	1	0	2	0	3	0	0
Nephtys hystricis	0	1	1	0	2	0	3	0	0
Nephtys longosetosa	0	1	1	0	2	0	3	0	0
Nephtys pente	0	0	0	0	0	0	3	0	0
Nereimyra punctata	0	0	0	0	0	0	3	0	0
Nicomache indet	2	0	0	0	1	0	3	0	0
Nicomache quadrispinata	2	0	0	0	1	0	0	0	3
Nothria conchylega	2	0	0	0	2	0	0	0	2
Nothria hyperborea	2	0	0	0	2	0	0	0	2
Notomastus latericeus	2	0	0	0	2	0	1	0	0
Nucula tumidula	0	3	0	0	0	1	3	0	0
Nuculana pernula	0	2	0	0	0	1	3	0	0
Oedicerotidae indet	0	0	3	0	0	0	3	0	0
Onchnesoma squamatum	2	0	0	0	0	0	2	0	0
Onchnesoma steenstrupi	2	0	0	0	0	0	2	0	0
Onisimus indet	0	0	3	0	0	0	3	0	0
Ophelia borealis	2	0	0	0	0	0	3	0	0
Ophelina norvegica	2	0	0	0	0	0	2	0	0
Ophiacantha bidentata	0	2	0	1	1	3	3	0	0
Ophiocten sericeum	0	2	0	1	1	3	3	0	0
Ophiodromus flexuosus	1	1	0	0	1	0	3	0	0
Ophiopholis aculeata	0	1	0	0	0	3	3	0	0
Ophiura robusta	0	1	0	1	1	1	3	0	0
Ostracoda indet	0	1	0	3	0	0	3	0	0
Owenia fusiformis	3	0	0	0	0	0	0	0	3
Paguridae indet	0	0	0	1	0	3	3	0	0

Traits	Bodyform						Attachment		
Category	cylindric bodyform	Flattened dorsally bodyform	Flattened laterally bodyform	shaped bodyform	Long thin, treadlike bodyform	Irregular bodyform	None attachment	Temporary attachment	Permanent attachment
Species/code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Pantopoda indet	0	0	0	0	0	3	3	0	0
Paradiopatra fiordica	2	0	0	0	2	0	3	0	0
Paradiopatra quadricuspis	2	0	0	0	2	0	3	0	0
Paradoneis indet	2	0	0	0	1	0	2	0	0
Paradoneis lyra	2	0	0	0	1	0	2	0	0
Paramphinome jeffreysii	1	1	0	0	1	0	3	0	0
Parougia indet	2	0	0	0	1	0	3	0	0
Parvicardium minimum	0	3	0	0	0	0	3	0	0
Pectinaria auricoma	1	0	0	0	0	2	0	0	3
Pectinaria hyperborea	2	1	0	0	0	2	0	0	3
Pectinaria koreni	2	1	0	0	0	2	0	0	3
Pelecypoda indet	0	3	0	0	0	0	2	0	0
Phascolion strombus	0	0	0	0	2	0	3	0	0
Phaxas pellucidus	0	3	0	0	1	0	3	0	0
Philine indet	0	0	0	0	0	0	3	0	0
Phisidia aurea	1	1	0	0	1	2	0	3	0
Pholoe baltica	1	1	0	0	0	0	3	0	0
Pholoe inornata	0	1	0	0	0	0	3	0	0
Pholoe pallida	1	1	0	0	0	0	3	0	0
Pholoe synophthalmica	1	1	0	0	0	0	3	0	0
Phoronis indet	2	0	0	0	2	0	0	0	3
Phoronis muelleri	2	0	0	0	2	0	0	0	3
Phyllodoce groenlandica	0	1	1	0	2	0	3	0	0
Phylo norvegicus	2	0	0	0	0	0	3	0	0
Pista indet	2	0	0	0	0	2	0	3	0
Poecilochaetus serpens	2	0	0	0	2	0	3	0	0
Polycirrus indet	2	0	0	0	1	1	0	3	0
Polycirrus medusa	2	1	0	0	1	1	0	3	0
Polydora indet	2	2	0	0	2	0	0	2	0
Polynoidae indet	3	1	0	0	3	0	3	0	0
Pontocrates indet	0	0	3	0	0	0	3	0	0
Pontoporeia femorata	0	0	3	0	0	1	3	0	0
Praxillella praetermissa	0	0	0	0	3	0	3	0	0
Praxillura longissima	3	0	0	0	3	0	0	0	3
Priapulus caudatus	3	0	0	0	0	0	3	0	0
Prionospio cirrifera	2	1	0	0	1	0	3	0	0
Prionospio dubia	1	1	0	0	1	0	3	0	0
Protomedeia fasciata	0	0	3	0	0	1	3	0	0
Pseudocuma indet	0	0	0	0	0	0	3	0	0
Pseudopolydora paucibranchiata	2	1	0	0	1	0	0	0	3
Pseudosphyrapus anomalus	2	2	0	0	0	0	2	1	0
Rhodine gracilior	2	0	0	0	1	0	0	0	3
Sabellidae indet	2	0	0	0	1	2	0	0	3
Samytha sexcirrata	2	0	0	0	0	2	0	0	3
Scalibregma inflatum	2	0	0	1	1	1	3	0	0
Scolelepis korsuni	0	1	0	0	2	0	3	0	0
Scoloplos armiger	0	1	0	0	2	0	0	3	0
Sipuncula indet	0	0	0	0	1	0	2	0	0
Sphaerodorum gracilis	1	0	0	0	2	0	3	0	0
Sphaerodorum indet	1	0	0	0	2	0	3	0	0
Spio armata	2	1	0	0	1	0	0	2	0
Spio decoratus	2	1	0	0	1	0	0	2	0
Spio indet	0	1	0	0	2	0	0	3	0
Spiochaetopterus typicus	2	0	0	0	3	0	0	0	3
Spiophanes bombyx	2	1	0	0	1	0	0	0	2
Spiophanes indet	2	1	0	0	1	0	0	0	2
Spiophanes kroyeri	2	1	0	0	1	0	0	0	2
Spiophanes urceolata	2	1	0	0	1	0	0	0	2
Spirorbidae indet	3	0	0	0	0	0	0	0	3
Spirorbis indet	3	0	0	0	0	0	0	0	3
Stenothoidae indet	0	0	3	0	0	1	3	0	0
Sthenelais limicola	2	1	1	0	3	0	3	0	0
Strongylocentrotus pallidus	0	0	0	3	0	0	3	0	0
Syllis indet	2	0	0	0	2	0	3	0	0
Syrrhoe crenulata	0	0	3	0	0	0	3	0	0
Terebellides stroemii	1	1	0	0	1	2	3	0	0
Thelepus cincinnatus	1	0	0	0	1	1	0	0	3
Thracia myopsis	0	3	0	0	0	0	3	0	0
Thyasira croulinensis	0	2	0	0	0	0	3	0	0
Thyasira equalis	0	3	0	0	0	0	3	0	0
Thyasira eumyaria	0	3	0	0	0	0	3	0	0
Thyasira ferruginea	0	2	0	0	0	0	3	0	0
Thyasira flexuosa	0	2	0	0	0	0	3	0	0
Thyasira gouldi	0	2	0	0	0	0	3	0	0
Thyasira granulosa	0	2	0	0	0	0	3	0	0
Thyasira indet	0	2	0	0	0	0	3	0	0
Thyasira obsoleta	0	2	0	0	0	0	3	0	0
Thyasira pygmaea	0	2	0	0	0	0	3	0	0
Thyasira succisa	0	2	0	0	0	0	3	0	0
Thyasiridae indet	0	2	0	0	0	0	3	0	0
Timoclea ovata	0	2	0	1	0	0	3	0	0
Tmetonyx cicada	0	0	3	0	0	0	3	0	0
Tmetonyx similis	0	0	3	0	0	0	3	0	0
Trichobranchus roseus	2	0	0	0	0	1	0	0	3
Unciola leucopis	0	0	3	0	0	0	3	0	0
Urothoe elegans	0	0	3	0	0	0	3	0	0
Westwoodilla caecula	0	0	3	0	0	0	3	0	0
Yoldia hyperborea	0	2	0	0	0	0	3	0	0
Yoldiella frigida	0	2	0	0	0	0	3	0	0
Yoldiella indet	0	2	0	0	0	0	3	0	0
Yoldiella lenticula	0	2	0	0	0	0	3	0	0
Yoldiella lucida	0	2	0	0	0	0	3	0	0
Yoldiella nana	0	2	0	0	0	0	3	0	0
Yoldiella solidula	0	2	0	0	0	0	3	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Abra indet	0	0	0	3	3
Abra longicallus	0	0	0	3	2
Abra prismatica	0	0	0	3	2
Abyssoninoe hibernica	0	0	0	3	0
Aeginina longicornis	0	0	0	1	3
Aglaophamus malmgreni	0	0	0	3	1
Ampelisca brevicornis	0	0	0	1	1
Ampelisca indet	0	0	0	1	1
Ampelisca macrocephala	0	0	0	0	1
Ampelisca spinipes	0	0	0	0	1
Ampelisca tenuicornis	0	0	2	0	1
Ampharete falcata	2	2	0	0	0
Ampharete finmarchica	2	2	0	0	0
Ampharete lindstroemi	2	2	0	0	0
Ampharetidae indet	2	2	0	1	0
Amphilepis norvegica	0	0	0	3	1
Amphipholis squamata	0	0	0	0	2
Amphipoda indet	0	0	1	1	1
Amphitritinae indet	0	2	0	0	0
Amphiura chiajei	0	0	0	2	2
Amphiura filiformis	0	0	0	2	2
Amphiura sundevalli	0	0	0	2	2
Amythasides macroglossus	2	2	0	0	0
Anobothrus gracilis	0	2	0	0	0
Aonides paucibranchiata	0	0	0	2	0
Aphelochaeta indet	0	0	0	2	0
Aphelochaeta marioni	0	0	0	3	0
Apistobranchus indet	0	0	2	2	1
Apseudes spinosus	0	0	0	0	0
Aricidea catherinae	0	0	0	2	0
Aricidea hartmani	0	0	0	2	0
Aricidea indet	0	0	0	2	0
Aricidea roberti	0	0	0	2	0
Aricidea wassi	0	0	0	2	0
Arrhis phyllonyx	0	0	0	0	2
Astarte borealis	0	0	0	3	0
Astarte crenata	0	0	0	3	0
Astarte elliptica	0	0	0	3	0
Astarte montagui	0	0	0	2	0
Augeneria tentaculata	0	0	0	0	3
Autolytus indet	0	0	0	2	1
Axinopsida orbiculata	0	0	0	3	0
Axionice maculata	0	2	0	0	0
Brachydiastylis resima	0	0	0	0	3
Byblis gaimardi	0	0	0	1	0
Calathura brachiata	0	0	3	0	0
Capitella capitata	0	0	0	3	0
Capitellidae indet	0	0	0	3	2
Caprellidae indet	0	2	2	2	0
Caudofoveata indet	0	0	0	2	0
Caulleriella killariensis	0	0	0	2	0
Chaetoderma nitidulum	0	0	0	3	0
Chaetozone indet	0	0	0	3	0
Chaetozone setosa	0	0	0	3	0
Chone collaris	2	2	0	0	0
Chone duneri	2	2	0	0	0
Chone indet	2	2	0	0	0
Chone paucibranchiata	3	2	0	0	0
Ciliatocardium ciliatum	0	0	0	3	0
Cirratulidae indet	0	0	0	1	0
Cirratulus cirratus	0	0	0	2	0
Clymenura borealis	0	2	0	0	0
Clymenura indet	0	2	0	0	0
Clymenura polaris	0	2	0	0	0
Crenella decussata	0	0	0	3	0
Ctenodiscus crispatus	0	0	0	0	3
Cuspidaria arctica	0	0	0	3	2
Cuspidaria lamellosa	0	0	0	3	2
Cuspidaria obesa	0	0	0	3	2
Cylichna alba	0	0	0	0	2
Cylichna cylindracea	0	0	0	0	2
Cylichna occulta	0	0	0	0	2
Dacrydium vitreum	1	0	0	1	0
Dentalium entalis	0	0	0	2	0
Dentalium indet	0	0	0	2	0
Diastylis indet	0	0	0	2	2
Diastylis scorpioides	0	0	0	2	2
Diplocirrus glaucus	0	0	0	2	0
Diplocirrus hirsutus	0	0	0	2	0
Dipolydora coeca	2	1	2	0	0
Echinocardium flavescens	0	0	0	2	0
Echinocyamus pusillus	0	0	0	2	0
Eclysippe vanelli	2	2	0	0	0
Ennucula tenuis	0	0	0	1	0
Entalina quinquangularis	0	0	0	2	0
Eriopisa elongata	0	0	0	0	3
Eteone indet	0	0	0	2	0
Euchone indet	2	2	0	0	0
Euchone papillosa	2	2	0	0	0
Euchone southerni	2	2	0	0	0
Euclymene affinis	0	2	0	2	0
Euclymene droebachiensis	0	2	0	2	0
Euclymene lindrothi	0	2	0	2	0
Euclymeninae indet	0	2	0	2	0
Eudorella emarginata	0	0	0	0	3

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Eudorellopsis deformis	0	0	0	0	3
Eusyllis blomstrandi	0	0	0	0	3
Exogone verugera	0	0	0	3	0
Fauveliopsis indet	0	0	1	2	0
Galathowenia oculata	2	0	2	0	0
Glycera lapidum	0	0	0	2	0
Gnathia indet	0	0	0	2	2
Golfingia indet	0	0	0	0	2
Golfingia margaritacea	0	0	0	0	2
Goniada maculata	0	0	0	2	1
Haploops tubicola	0	0	3	0	0
Harmothoe fraserthomsoni	0	0	0	0	3
Harmothoe imbricata	0	0	0	0	3
Harmothoe indet	0	0	0	2	2
Harpinia antennaria	0	0	0	1	2
Harpinia indet	0	0	0	2	0
Harpinia mucronata	0	0	0	3	0
Harpinia pectinata	0	0	0	3	0
Harpinia plumosa	0	0	0	3	0
Harpinia propinqua	0	0	0	3	0
Harpinia serrata	0	0	0	3	0
Hemilamprops roseus	0	0	0	1	2
Heteromastus filiformis	0	0	2	2	0
Hiatella arctica	0	0	0	3	0
Hippomedon denticulatus	0	0	0	2	2
Hyalinoecia tubicola	2	2	0	0	0
Isaeidae indet	0	0	0	1	0
Isopoda indet	0	0	1	2	2
Jasmineira candela	2	2	0	0	0
Jasmineira caudata	2	2	0	0	0
Kelliella miliaris	0	0	0	1	1
Labidoplax buskii	0	0	0	2	0
Lanice conchilega	0	0	3	3	0
Laonice cirrata	0	0	3	0	0
Laonice sarsi	0	0	3	0	0
Laphania boecki	1	2	0	1	0
Leitoscoloplos indet	0	0	0	3	0
Lepeta caeca	0	0	0	0	0
Leucon indet	0	0	0	1	1
Leucon nasica	0	0	0	2	2
Leucon nasicoides	0	0	0	2	2
Levinsenia gracilis	0	0	0	3	0
Limopsis cristata	0	0	0	1	1
Lucinoma borealis	0	0	0	0	3
Lumbriclymene minor	0	3	0	1	0
Lumbrineris gracilis	0	0	0	3	0
Lumbrineris indet	0	0	1	3	2
Lysianassidae indet	0	0	0	2	1
Lysippe labiata	0	3	0	1	0
Macoma calcarea	0	0	0	2	0
Macoma indet	0	0	0	2	0
Maldane sarsi	2	2	0	2	0
Maldanidae indet	2	2	2	2	0
Margarites olivaceus	0	0	0	0	3
Melita dentata	0	0	0	1	1
Melita quadrispinosa	0	0	0	1	1
Moelleria costulata	0	0	0	0	3
Montacuta spitzbergensis	0	0	0	2	0
Mugga wahrbergi	0	2	0	0	0
Munna indet	0	0	0	0	3
Musculus niger	0	0	2	0	0
Mya truncata	0	0	0	3	0
Myriochele danielsseni	2	0	2	0	0
Myriochele fragilis	2	0	2	0	0
Myriochele heeri	2	0	2	0	0
Myriochele oculata	2	0	2	0	0
Mysella bidentata	0	0	0	2	0
Nemertina indet	0	0	0	2	2
Nephasoma minutum	0	0	0	3	0
Nephtys hombergii	0	0	0	2	2
Nephtys hystricis	0	0	0	3	0
Nephtys longosetosa	0	0	0	3	0
Nephtys pente	0	0	0	0	2
Nereimyra punctata	0	0	0	0	2
Nicomache indet	0	0	0	3	0
Nicomache quadrispinata	0	0	0	3	0
Nothria conchylega	2	2	0	0	0
Nothria hyperborea	2	2	0	0	0
Notomastus latericeus	0	0	3	3	0
Nucula tumidula	0	0	0	3	0
Nuculana pernula	0	0	0	2	0
Oedicerotidae indet	0	0	0	1	1
Onchnesoma squamatum	0	0	0	1	0
Onchnesoma steenstrupi	0	0	0	1	0
Onisimus indet	0	0	0	1	1
Ophelia borealis	0	0	0	2	1
Ophelina norvegica	0	0	0	2	0
Ophiacantha bidentata	0	0	0	0	3
Ophiocten sericeum	0	0	0	0	3
Ophiodromus flexuosus	0	0	1	1	3
Ophiopholis aculeata	0	0	0	2	2
Ophiura robusta	0	0	0	2	0
Ostracoda indet	0	0	0	1	1
Owenia fusiformis	2	0	2	0	1
Paguridae indet	0	0	0	1	2

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Species/code	AH1	AH2	AH3	AH4	AH5
Pantopoda indet	0	0	0	0	3
Paradiopatra fiordica	0	0	0	2	2
Paradiopatra quadricuspis	0	0	0	2	2
Paradoneis indet	0	0	2	2	2
Paradoneis lyra	0	0	2	2	2
Paramphinome jeffreysii	0	0	0	0	2
Parougia indet	0	0	0	1	1
Parvicardium minimum	0	0	0	3	0
Pectinaria auricoma	0	3	0	3	0
Pectinaria hyperborea	2	2	0	2	0
Pectinaria koreni	2	2	0	2	0
Pelecypoda indet	0	0	0	3	0
Phascolion strombus	0	0	0	0	3
Phaxas pellucidus	0	0	0	2	0
Philine indet	0	0	0	0	2
Phisidia aurea	2	2	0	1	0
Pholoe baltica	0	0	0	3	0
Pholoe inornata	0	0	0	3	0
Pholoe pallida	0	0	0	3	0
Pholoe synophthalmica	0	0	0	3	0
Phoronis indet	3	3	0	2	0
Phoronis muelleri	3	3	0	3	0
Phyllodoce groenlandica	0	0	0	0	0
Phylo norvegicus	0	0	0	3	0
Pista indet	2	2	0	0	0
Poecilochaetus serpens	0	0	0	3	0
Polycirrus indet	1	1	1	1	1
Polycirrus medusa	0	0	1	0	0
Polydora indet	2	2	3	2	0
Polynoidae indet	0	0	0	2	2
Pontocrates indet	0	0	0	3	0
Pontoporeia femorata	0	0	0	1	1
Praxillella praetermissa	0	0	3	3	0
Praxillura longissima	0	3	0	1	0
Priapulus caudatus	0	0	0	2	0
Prionospio cirrifera	0	0	2	2	0
Prionospio dubia	0	0	3	2	0
Protomedeia fasciata	0	0	0	0	3
Pseudocuma indet	0	0	0	2	2
Pseudopolydora paucibranchiata	0	2	0	2	0
Pseudosphyrapus anomalus	0	0	2	2	0
Rhodine gracilior	0	0	0	3	0
Sabellidae indet	0	2	0	0	0
Samytha sexcirrata	0	2	0	0	0
Scalibregma inflatum	0	0	0	3	0
Scolelepis korsuni	0	0	2	2	1
Scoloplos armiger	0	0	2	2	0
Sipuncula indet	0	0	0	1	0
Sphaerodorum gracilis	0	0	0	0	2
Sphaerodorum indet	0	0	0	0	2
Spio armata	0	0	3	2	0
Spio decoratus	0	0	3	2	0
Spio indet	0	0	2	2	0
Spiochaetopterus typicus	2	0	2	0	0
Spiophanes bombyx	0	2	0	1	0
Spiophanes indet	0	2	0	1	0
Spiophanes kroyeri	0	2	0	1	0
Spiophanes urceolata	0	2	0	1	0
Spirorbidae indet	0	3	0	0	0
Spirorbis indet	0	3	0	0	0
Stenothoidae indet	0	0	0	1	1
Sthenelais limicola	0	0	0	0	0
Strongylocentrotus pallidus	0	0	0	0	3
Syllis indet	0	0	0	2	2
Syrrhoe crenulata	0	0	0	2	0
Terebellides stroemii	2	2	0	1	0
Thelepus cincinnatus	2	2	0	0	0
Thracia myopsis	0	0	0	3	0
Thyasira croulinensis	0	0	0	2	0
Thyasira equalis	0	0	2	3	0
Thyasira eumyaria	0	0	0	2	0
Thyasira ferruginea	0	0	0	3	0
Thyasira flexuosa	0	0	0	3	0
Thyasira gouldi	0	0	0	3	0
Thyasira granulosa	0	0	0	2	0
Thyasira indet	0	0	2	3	0
Thyasira obsoleta	0	0	0	3	0
Thyasira pygmaea	0	0	0	3	0
Thyasira succisa	0	0	0	3	0
Thyasiridae indet	0	0	1	2	0
Timoclea ovata	0	0	0	0	3
Tmetonyx cicada	0	0	0	0	3
Tmetonyx similis	0	0	0	0	3
Trichobranchus roseus	0	3	0	0	0
Unciola leucopis	0	0	0	0	3
Urothoe elegans	0	0	0	0	3
Westwoodilla caecula	0	0	0	3	2
Yoldia hyperborea	0	0	0	3	0
Yoldiella frigida	0	0	0	3	0
Yoldiella indet	0	0	0	3	0
Yoldiella lenticula	0	0	0	3	0
Yoldiella lucida	0	0	0	3	0
Yoldiella nana	0	0	0	3	0
Yoldiella solidula	0	0	0	3	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Species/code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Abra indet	2	0	2	0	0	2	0	0	0
Abra longicallus	2	0	2	2	0	0	0	0	0
Abra prismatica	2	0	2	0	0	0	0	0	0
Abyssoninoe hibernica	0	0	0	0	0	0	0	3	0
Aeginina longicornis	3	0	0	1	0	0	0	0	2
Aglaophamus malmgreni	0	0	0	0	0	0	0	3	0
Ampelisca brevicornis	3	0	0	0	0	0	0	0	0
Ampelisca indet	0	0	2	0	0	0	0	0	0
Ampelisca macrocephala	2	0	0	0	0	0	0	0	0
Ampelisca spinipes	2	0	0	0	0	0	0	0	0
Ampelisca tenuicornis	2	0	0	0	0	0	0	0	0
Ampharete falcata	0	0	3	0	0	0	0	0	0
Ampharete finmarchica	0	0	3	0	0	0	0	0	0
Ampharete lindstroemi	0	0	3	0	0	0	0	0	0
Ampharetidae indet	0	0	3	0	0	0	0	0	0
Amphilepis norvegica	0	0	3	0	0	0	0	0	0
Amphipholis squamata	2	0	2	0	0	0	0	0	0
Amphipoda indet	1	0	1	1	1	1	1	1	1
Amphitritinae indet	0	0	3	0	0	0	0	0	0
Amphiura chiajei	0	0	2	0	0	0	0	0	0
Amphiura filiformis	2	0	2	0	0	0	0	2	0
Amphiura sundevalli	1	0	2	0	0	0	0	2	0
Amythasides macroglossus	0	0	2	0	0	0	0	0	0
Anobothrus gracilis	0	0	2	0	0	0	0	0	0
Aonides paucibranchiata	0	0	2	0	0	0	0	0	0
Aphelochaeta indet	0	0	3	0	0	0	0	0	0
Aphelochaeta marioni	0	0	3	0	0	0	0	0	0
Apistobranchus indet	0	0	2	0	0	0	0	0	0
Apseudes spinosus	0	0	0	0	0	0	0	0	0
Aricidea catherinae	0	0	2	0	0	0	0	0	0
Aricidea hartmani	0	0	2	0	0	0	0	0	0
Aricidea indet	0	0	2	0	0	0	0	0	0
Aricidea roberti	0	0	2	0	0	0	0	0	0
Aricidea wassi	0	0	2	0	0	0	0	0	0
Arrhis phyllonyx	0	0	3	0	0	0	0	0	0
Astarte borealis	3	0	3	0	0	0	0	0	0
Astarte crenata	3	0	0	0	0	0	0	0	0
Astarte elliptica	3	0	0	0	0	0	0	0	0
Astarte montagui	3	0	0	0	0	0	0	0	0
Augeneria tentaculata	0	0	0	0	0	0	2	2	0
Autolytus indet	0	0	0	0	0	0	0	3	0
Axinopsida orbiculata	3	0	0	0	0	0	0	0	0
Axionice maculata	0	0	3	0	0	0	0	0	0
Brachydiastylis resima	3	0	0	0	0	0	0	0	0
Byblis gaimardi	0	0	0	0	0	3	0	0	0
Calathura brachiata	3	0	0	0	2	0	0	0	0
Capitella capitata	0	0	0	3	0	0	0	0	1
Capitellidae indet	0	0	2	2	0	0	0	0	0
Caprellidae indet	0	0	0	3	0	0	0	3	1
Caudofoveata indet	0	1	2	2	1	0	2	2	0
Caulleriella killariensis	0	0	3	0	0	0	0	0	0
Chaetoderma nitidulum	0	0	0	2	0	0	0	2	0
Chaetozone indet	0	0	3	0	0	0	0	0	0
Chaetozone setosa	0	0	3	0	0	0	0	0	0
Chone collaris	2	0	0	0	0	0	0	0	0
Chone duneri	2	0	0	0	0	0	0	0	0
Chone indet	3	0	0	0	0	0	0	0	0
Chone paucibranchiata	3	0	0	0	0	0	0	0	0
Ciliatocardium ciliatum	3	0	0	0	0	0	0	0	0
Cirratulidae indet	0	0	2	0	0	0	0	0	0
Cirratulus cirratus	0	0	3	0	0	0	0	0	0
Clymenura borealis	0	0	0	2	0	0	0	0	0
Clymenura indet	0	0	0	2	0	0	0	0	0
Clymenura polaris	0	0	0	2	0	0	0	0	0
Crenella decussata	3	0	0	0	0	0	0	0	0
Ctenodiscus crispatus	0	0	3	0	0	0	0	0	0
Cuspidaria arctica	0	0	0	0	0	0	0	3	0
Cuspidaria lamellosa	0	0	0	0	0	0	0	3	0
Cuspidaria obesa	0	0	0	0	0	0	0	3	0
Cylichna alba	0	0	0	0	0	0	0	2	0
Cylichna cylindracea	0	0	0	0	0	0	0	2	0
Cylichna occulta	0	0	0	0	0	0	0	2	0
Dacrydium vitreum	3	0	0	0	0	0	0	0	0
Dentalium entalis	0	0	0	2	0	1	0	0	0
Dentalium indet	0	0	0	2	0	1	0	0	0
Diastylis indet	0	0	2	2	0	2	0	0	0
Diastylis scorpioides	0	0	2	0	0	1	0	0	0
Diplocirrus glaucus	0	0	3	0	0	2	0	0	0
Diplocirrus hirsutus	0	0	3	0	0	2	0	0	0
Dipolydora coeca	1	0	3	0	0	0	0	0	0
Echinocardium flavescens	0	0	0	2	0	0	0	0	0
Echinocyamus pusillus	0	0	0	2	0	0	0	0	0
Eclysippe vanelli	0	0	2	0	0	0	0	0	0
Ennucula tenuis	3	0	0	0	0	0	0	0	0
Entalina quinquangularis	0	0	0	3	0	0	0	0	0
Eriopisa elongata	0	0	0	0	0	3	0	0	0
Eteone indet	0	0	0	0	0	0	0	3	0
Euchone indet	3	0	0	0	0	0	0	0	0
Euchone papillosa	3	0	0	0	0	0	0	0	0
Euchone southerni	3	0	0	0	0	0	0	0	0
Euclymene affinis	0	0	0	3	0	0	0	0	0
Euclymene droebachiensis	0	0	0	3	0	0	0	0	0
Euclymene lindrothi	0	0	0	3	0	0	0	0	0
Euclymeninae indet	0	0	0	3	0	0	0	0	0
Eudorella emarginata	0	0	3	0	0	2	0	0	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Species/code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Eudorellopsis deformis	0	0	2	0	0	2	0	0	0
Eusyllis blomstrandi	0	0	0	0	0	0	0	3	1
Exogone verugera	0	0	2	0	0	0	0	3	0
Fauveliopsis indet	1	0	0	0	1	0	0	0	0
Galathowenia oculata	0	0	2	0	0	0	0	0	0
Glycera lapidum	0	0	0	0	0	2	0	2	0
Gnathia indet	0	0	0	0	0	0	0	0	3
Golfingia indet	2	0	3	0	0	0	0	0	0
Golfingia margaritacea	2	0	3	0	0	0	0	0	0
Goniada maculata	0	0	0	0	0	0	0	3	0
Haploops tubicola	0	0	0	0	0	0	0	0	0
Harmothoe fraserthomsoni	0	0	0	0	0	0	0	3	1
Harmothoe imbricata	0	0	0	0	0	0	0	3	1
Harmothoe indet	0	0	0	0	0	0	0	2	2
Harpinia antennaria	0	0	2	0	0	0	0	0	0
Harpinia indet	0	0	2	2	0	0	0	0	0
Harpinia mucronata	0	0	0	3	0	0	0	0	0
Harpinia pectinata	0	0	0	3	0	0	0	0	0
Harpinia plumosa	0	0	0	3	0	0	0	0	0
Harpinia propinqua	0	0	0	3	0	0	0	0	0
Harpinia serrata	0	0	0	3	0	0	0	0	0
Hemilamprops roseus	0	0	3	0	0	0	0	0	0
Heteromastus filiformis	0	0	0	3	0	0	0	0	0
Hiatella arctica	3	0	0	0	0	0	0	0	0
Hippomedon denticulatus	0	0	0	0	0	0	3	0	0
Hyalinoecia tubicola	0	0	0	0	0	0	0	3	0
Isaeidae indet	1	0	1	1	1	0	0	0	1
Isopoda indet	1	0	1	1	1	1	0	1	1
Jasmineira candela	2	0	0	0	0	0	0	0	0
Jasmineira caudata	2	0	0	0	0	0	0	0	0
Kelliella miliaris	2	0	2	0	0	0	0	0	0
Labidoplax buskii	0	0	3	0	0	0	0	0	0
Lanice conchilega	2	0	2	0	0	2	0	0	0
Laonice cirrata	0	0	3	0	0	0	0	0	0
Laonice sarsi	0	0	2	0	0	0	0	0	0
Laphania boecki	0	0	3	0	0	0	0	0	0
Leitoscoloplos indet	0	0	0	2	0	2	0	0	0
Lepeta caeca	3	0	3	0	0	0	0	0	0
Leucon indet	3	0	0	0	0	0	0	0	0
Leucon nasica	3	0	0	0	0	0	0	0	0
Leucon nasicoides	3	0	0	0	0	0	0	0	0
Levinsenia gracilis	0	0	0	3	0	0	0	0	0
Limopsis cristata	3	0	0	0	0	0	0	0	0
Lucinoma borealis	3	0	0	0	0	0	0	0	0
Lumbriclymene minor	0	0	0	3	0	0	0	0	0
Lumbrineris gracilis	0	0	0	0	0	0	0	3	0
Lumbrineris indet	0	0	2	1	0	1	0	3	1
Lysianassidae indet	0	1	1	1	0	0	0	0	0
Lysippe labiata	3	0	0	0	0	0	0	0	0
Macoma calcarea	0	0	0	3	0	0	0	0	0
Macoma indet	0	0	0	3	0	0	0	0	0
Maldane sarsi	0	0	0	3	0	0	0	0	0
Maldanidae indet	0	0	0	2	0	0	0	0	0
Margarites olivaceus	0	3	0	0	0	0	0	0	0
Melita dentata	0	0	0	0	0	3	0	0	0
Melita quadrispinosa	1	0	1	0	1	0	0	0	0
Moelleria costulata	0	3	0	0	0	0	0	0	0
Montacuta spitzbergensis	2	0	0	0	0	0	0	0	2
Mugga wahrbergi	0	0	2	0	0	0	0	0	0
Munna indet	3	0	0	0	0	0	0	0	0
Musculus niger	3	0	0	0	0	0	0	0	0
Mya truncata	3	0	0	0	0	0	0	0	0
Myriochele danielsseni	0	0	2	0	0	0	0	0	0
Myriochele fragilis	0	0	2	0	0	0	0	0	0
Myriochele heeri	0	0	2	0	0	0	0	0	0
Myriochele oculata	0	0	2	0	0	0	0	0	0
Mysella bidentata	2	0	0	0	2	0	0	0	2
Nemertina indet	0	0	0	0	0	0	0	3	0
Nephasoma minutum	2	0	2	0	0	0	0	0	0
Nephtys hombergii	0	0	1	1	1	2	2	3	0
Nephtys hystricis	0	0	0	0	0	2	0	0	0
Nephtys longosetosa	0	0	0	0	0	0	0	3	0
Nephtys pente	0	0	2	0	0	2	0	2	0
Nereimyra punctata	0	0	2	0	0	2	0	2	0
Nicomache indet	0	0	0	2	0	0	0	0	0
Nicomache quadrispinata	0	0	0	2	0	0	0	0	0
Nothria conchylega	0	0	0	0	0	0	0	3	0
Nothria hyperborea	0	0	0	0	0	0	0	3	0
Notomastus latericeus	0	0	0	3	0	0	0	0	2
Nucula tumidula	0	0	0	3	0	0	0	0	0
Nuculana pernula	0	0	0	3	0	0	0	0	0
Oedicerotidae indet	1	0	0	0	1	1	0	0	0
Onchnesoma squamatum	0	0	3	0	0	0	0	0	0
Onchnesoma steenstrupi	0	0	3	0	0	0	0	0	0
Onisimus indet	1	0	0	0	1	1	0	0	0
Ophelia borealis	0	0	3	0	0	3	0	2	0
Ophelina norvegica	0	0	0	3	0	0	0	0	0
Ophiacantha bidentata	3	0	0	0	0	0	0	3	0
Ophiocten sericeum	3	0	0	0	0	0	0	3	0
Ophiodromus flexuosus	0	0	0	0	0	0	0	0	2
Ophiopholis aculeata	0	0	2	0	0	0	0	0	0
Ophiura robusta	2	0	0	0	0	0	0	2	0
Ostracoda indet	0	0	0	0	0	3	0	0	0
Owenia fusiformis	2	0	2	0	0	0	0	0	0
Paguridae indet	0	0	0	0	0	0	0	3	3

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Species/code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Pantopoda indet	0	0	0	0	0	0	0	3	0
Paradiopatra fiordica	0	0	0	0	0	0	0	3	0
Paradiopatra quadricuspis	0	0	0	0	0	0	0	3	0
Paradoneis indet	0	0	0	2	0	0	0	0	0
Paradoneis lyra	0	0	0	3	0	0	0	0	0
Paramphinome jeffreysii	0	0	0	0	0	0	1	3	0
Parougia indet	0	0	0	0	0	0	0	2	0
Parvicardium minimum	3	0	0	0	0	0	0	0	0
Pectinaria auricoma	0	0	0	2	0	2	0	0	0
Pectinaria hyperborea	2	0	2	0	0	2	0	0	0
Pectinaria koreni	2	0	2	0	0	2	0	0	0
Pelecypoda indet	3	0	0	0	0	0	0	0	0
Phascolion strombus	2	0	2	0	0	0	0	0	3
Phaxas pellucidus	2	0	0	0	0	0	0	0	0
Philine indet	0	0	0	0	0	0	0	3	0
Phisidia aurea	0	0	3	0	0	0	0	0	0
Pholoe baltica	0	0	0	0	0	0	0	3	0
Pholoe inornata	0	0	0	0	0	0	0	3	0
Pholoe pallida	0	0	0	0	0	0	0	3	0
Pholoe synophthalmica	0	0	0	0	0	0	0	3	0
Phoronis indet	3	0	0	0	0	0	0	0	0
Phoronis muelleri	3	0	0	0	0	0	0	0	0
Phyllodoce groenlandica	0	0	0	0	0	0	0	3	0
Phylo norvegicus	0	0	0	3	0	0	0	0	0
Pista indet	0	0	2	0	0	0	0	0	0
Poecilochaetus serpens	0	0	0	0	0	2	0	2	0
Polycirrus indet	0	0	2	2	0	0	0	0	0
Polycirrus medusa	0	0	2	0	0	0	0	0	0
Polydora indet	2	0	2	2	0	0	0	0	0
Polynoidae indet	0	0	0	0	0	0	0	3	0
Pontocrates indet	0	0	0	2	0	0	0	0	0
Pontoporeia femorata	3	0	0	0	0	0	0	0	0
Praxillella praetermissa	0	0	0	3	0	0	0	0	0
Praxillura longissima	0	0	0	3	0	0	0	0	0
Priapulus caudatus	0	0	0	0	0	0	0	3	0
Prionospio cirrifera	0	0	3	0	0	0	0	0	0
Prionospio dubia	0	0	3	0	0	0	0	0	0
Protomedeia fasciata	3	0	0	0	0	0	0	0	0
Pseudocuma indet	0	0	2	0	0	0	0	0	0
Pseudopolydora paucibranchiata	0	0	3	0	0	0	0	0	0
Pseudosphyrapus anomalus	0	0	2	2	0	0	0	2	0
Rhodine gracilior	0	0	0	2	0	0	0	0	0
Sabellidae indet	0	0	2	0	0	0	0	0	0
Samytha sexcirrata	0	0	2	0	0	0	0	0	0
Scalibregma inflatum	1	0	0	3	0	0	0	0	0
Scolelepis korsuni	0	0	0	2	0	0	0	1	0
Scoloplos armiger	0	0	0	3	0	0	0	0	0
Sipuncula indet	1	0	1	1	0	0	0	0	1
Sphaerodorum gracilis	0	0	2	0	0	0	0	0	0
Sphaerodorum indet	0	0	2	0	0	0	0	0	0
Spio armata	0	0	2	0	0	0	0	0	0
Spio decoratus	0	0	2	0	0	0	0	0	0
Spio indet	0	0	3	0	0	0	0	0	0
Spiochaetopterus typicus	3	0	2	0	0	0	0	0	0
Spiophanes bombyx	0	0	3	0	0	0	0	0	0
Spiophanes indet	2	0	3	0	0	0	0	0	0
Spiophanes kroyeri	0	0	3	0	0	0	0	0	0
Spiophanes urceolata	0	0	3	0	0	0	0	0	0
Spirorbidae indet	2	0	1	0	0	0	0	1	0
Spirorbis indet	2	0	1	0	0	0	0	1	0
Stenothoidae indet	3	0	1	0	0	1	0	0	0
Sthenelais limicola	0	0	0	0	0	0	0	3	0
Strongylocentrotus pallidus	0	0	0	0	0	0	0	3	0
Syllis indet	1	0	1	1	0	0	0	1	1
Syrrhoe crenulata	3	0	0	0	0	1	0	0	0
Terebellides stroemii	0	0	3	0	0	0	0	0	0
Thelepus cincinnatus	0	0	3	0	0	0	0	0	0
Thracia myopsis	3	0	0	0	0	0	0	0	0
Thyasira croulinensis	2	0	0	2	0	0	0	0	0
Thyasira equalis	0	0	0	3	2	0	0	0	0
Thyasira eumyaria	0	0	0	3	0	0	0	0	0
Thyasira ferruginea	0	0	0	3	0	0	0	0	0
Thyasira flexuosa	2	0	2	2	2	0	0	0	0
Thyasira gouldi	2	0	2	2	2	0	0	0	0
Thyasira granulosa	2	0	0	0	0	0	0	0	0
Thyasira indet	2	0	0	3	2	0	0	0	0
Thyasira obsoleta	0	0	0	3	2	0	0	0	0
Thyasira pygmaea	0	0	0	2	0	0	0	0	0
Thyasira succisa	0	0	0	3	0	0	0	0	0
Thyasiridae indet	2	0	1	2	1	0	0	0	0
Timoclea ovata	0	0	0	0	0	0	0	0	0
Tmetonyx cicada	0	0	0	0	0	0	3	0	0
Tmetonyx similis	0	0	0	0	0	0	3	0	0
Trichobranchus roseus	0	0	3	0	0	0	0	0	0
Unciola leucopis	0	0	0	0	0	0	3	0	0
Urothoe elegans	0	0	0	0	0	3	0	0	0
Westwoodilla caecula	0	0	0	0	0	3	0	0	0
Yoldia hyperborea	0	0	0	3	0	0	0	0	0
Yoldiella frigida	0	0	0	3	0	0	0	0	0
Yoldiella indet	0	0	0	3	0	0	0	0	0
Yoldiella lenticula	0	0	0	3	0	0	0	0	0
Yoldiella lucida	0	0	0	3	0	0	0	0	0
Yoldiella nana	0	0	0	3	0	0	0	0	0
Yoldiella solidula	0	0	0	3	0	0	0	0	0

Phylum	Class	Order	Family	Species
Mollusca	Bivalvia	Veneroida	Semelidae	*Abra nitida*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete indet*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharetidae indet*
Echinodermata	Stelleroidea	Ophiurida	Amphilepididae	*Amphilepis norvegica*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphipholis squamata*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura chiajei*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura filiformis*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Aora indet*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Aphroditidae indet*
Arthropoda	Malacostraca	Tanaidacea	Apseudidae	*Apseudes spinosus*
Annelida	Polychaeta	Capitellida	Maldanidae	*Asychis biceps*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Bathymedon longimanus*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Brada villosa*
Echinodermata	Echinoidea	Spatangoida	Brissidae	*Brissopsis lyrifera*
Arthropoda	Malacostraca	Decapoda	Calocarididae	*Calocaris macandreae*
Mollusca	Caudofoveata	Caudofoveata	Caudofoveata	*Caudofoveata indet*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Caulleriella killariensis*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Caulleriella indet*
Annelida	Polychaeta	Phyllodocida	Nereididae	*Ceratocephale loveni*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Chaetoparia nilssoni*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone setosa*
Annelida	Polychaeta	Cossurida	Cossuridae	*Cossura longocirrata*
Mollusca	Bivalvia	Pholadomyoida	Cuspidariidae	*Cuspidaria abbreviata*
Mollusca	Gastropoda	Cephalaspidea	Cylichnidae	*Cylichna alba*
Arthropoda	Malacostraca	Isopoda	Desmosomatidae	*Desmosoma armatum*
Arthropoda	Malacostraca	Isopoda	Desmosomatidae	*Desmosoma indet*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylis cornuta*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylis indet*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylis tumida*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastyloides serrata*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Diastylopsis resima*
Annelida	Polychaeta	Flabelligerida	Flabelligeridae	*Diplocirrus glaucus*
Annelida	Polychaeta	Eunicida	Oenonidae	*Drilonereis filum*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Eclysippe vanelli*
Arthropoda	Malacostraca	Amphipoda	Melitidae	*Eriopisa elongata*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone foliosa*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone picta*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone longa*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorella emarginata*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorella hirsuta*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorella indet*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Eudorella truncatula*
Arthropoda	Malacostraca	Isopoda	Desmosomatidae	*Eugerda tenuimana*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Eunoe nodosa*
Arthropoda	Malacostraca	Isopoda	Munnopsidae	*Eurycope cornuta*
Arthropoda	Malacostraca	Isopoda	Munnopsidae	*Eurycope phalangium*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone dispar*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone hebes*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone indet*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone verugera*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera alba*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera capitata*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera lapidum*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera rouxii*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera indet*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Glycinde nordmanni*
Arthropoda	Malacostraca	Isopoda	Gnathiidae	*Gnathia maxillaris*
Sipuncula	Sipunculidea	Golfingiida	Golfingiidae	*Golfingia indet*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada maculata*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe indet*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia pectinata*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Harpinia indet*
Arthropoda	Malacostraca	Cumacea	Lampropidae	*Hemilamprops rosea*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Hesionidae indet*
Annelida	Polychaeta	Capitellida	Capitellidae	*Heteromastus filiformis*
Annelida	Polychaeta	Eunicida	Onuphidae	*Hyalinoecia tubicola*
Arthropoda	Malacostraca	Isopoda	Munnopsidae	*Ilyarachna longicornis*
Arthropoda	Malacostraca	Cumacea	Bodotriidae	*Iphinoe trispinosa*
Arthropoda	Malacostraca	Isopoda	Desmosomatidae	*Ischnosoma bispinosum*
Annelida	Polychaeta	Phyllodocida	Sigalionidae	*Leanira tetragona*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Leptophoxus falcatus*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Leptostylis longimana*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon acutirostris*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon nasica*
Arthropoda	Malacostraca	Cumacea	Leuconidae	*Leucon indet*
Arthropoda	Malacostraca	Amphipoda	Lilljeborgidae	*Lilljeborgia macronyx*
Arthropoda	Malacostraca	Amphipoda	Lilljeborgidae	*Lilljeborgia indet*
Annelida	Polychaeta	Opheliida	Scalibregmidae	*Lipobranchus jeffreysii*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris fragilis*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris gracilis*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris scopa*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris indet*
Arthropoda	Malacostraca	Isopoda	Macrostylidae	*Macrostylis spinifera*
Annelida	Polychaeta	Capitellida	Maldanidae	*Maldane sarsi*
Annelida	Polychaeta	Capitellida	Maldanidae	*Maldanidae indet*
Annelida	Polychaeta	Capitellida	Capitellidae	*Mediomastus fragilis*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Melinna cristata*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Melinna palmata*
Annelida	Polychaeta	Capitellida	Maldanidae	*Microclymene acirrata*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Monoculodes indet*
Arthropoda	Malacostraca	Isopoda	Munnopsidae	*Munnopsis typica*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Mystides southerni*
Nemertina	Nemertinea	Nemertinea	Nemertinea	*Nemertinea indet*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys assimilis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys hombergii*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys longosetosa*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys indet*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericeus*
Mollusca	Bivalvia	Nuculoida	Nuculidae	*Nucula sulcata*

Phylum	Class	Order	Family	Species
Mollusca	Bivalvia	Nuculoida	Nuculidae	*Nucula tumidula*
Mollusca	Bivalvia	Nuculoida	Nuculanidae	*Nuculoma tenuis*
Sipuncula	Sipunculidea	Golfingiida	Phascolionidae	*Onchnesoma steenstrupi*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina acuminata*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina cylindricaudata*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina modesta*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina norvegica*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina indet*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus flexuosus*
Annelida	Polychaeta	Eunicida	Dorvilleidae	*Ophryotrocha longidentata*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbinia norvegica*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbinia sertulata*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paradoneis eliasoni*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paradoneis lyra*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Paramphinome jeffreysii*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paraonis fulgens*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paraonis gracilis*
Mollusca	Bivalvia	Veneroida	Cardiidae	*Parvicardium minimum*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria auricoma*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Perioculodes longimanus*
Sipuncula	Sipunculidea	Golfingiida	Phascolionidae	*Phascolion strombi*
Sipuncula	Phascolosomatidea	Phascolosomatiformes	Phascolosomatidae	*Phascolosoma indet*
Annelida	Polychaeta	Flabelligerida	Flabelligeridae	*Pherusa plumosa*
Arthropoda	Ostracoda	Myodocopida	Cypridinidae	*Philomedes globosus*
Arthropoda	Ostracoda	Myodocopida	Cypridinidae	*Philomedes lilljeborgi*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe minuta*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe pallida*
Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe indet*
Arthropoda	Malacostraca	Amphipoda	Photidae	*Photidae indet*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Phoxocephalidae indet*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Phoxocephalus holbolli*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce longipes*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce rosea*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodocidae indet*
Platyhelminthes	Platyhelminthes	Platyhelminthes	Platyhelminthes	*Platyhelminthes indet*
Arthropoda	Malacostraca	Amphipoda	Podoceridae	*Podoceridae indet*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus latidens*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus norvegicus*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus plumosus*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus indet*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora caulleryi*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora ciliata*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora flava*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora indet*
Cephalorhyncha	Priapulida	Priapulida	Priapulidae	*Priapulus caudatus*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio banyulensis*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrifera*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio fallax*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio indet*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio steenstrupi*
Mollusca	Pelecypoda	Ostreoida	Pectinariidae	*Pseudamussium septemradiatum*
Annelida	Polychaeta	Spionida	Spionidae	*Pseudopolydora paucibranchiata*
Annelida	Polychaeta	Capitellida	Maldanidae	*Rhodine loveni*
Annelida	Polychaeta	Opheliida	Scalibregmidae	*Scalibregma inflatum*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Scoloplos armiger*
Annelida	Polychaeta	Phyllodocida	Sigalionidae	*Sigalionodae indet*
Sipuncula	Sipuncula	Sipuncula	Sipunculidae	*Sipunculida indet*
Annelida	Polychaeta	Phyllodocida	Sphaerodoridae	*Sphaerodoridae indet*
Arthropoda	Malacostraca	Tanaidacea	Sphyrapidae	*Sphyrapus anomalus*
Annelida	Polychaeta	Spionida	Spionidae	*Spionidae indet*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes kroeyeri*
Annelida	Polychaeta	Phyllodocida	Sigalionidae	*Sthenelais jeffreysii*
Annelida	Polychaeta	Terebellida	Terebellidae	*Streblosoma bairdi*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Syllidae indet*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Synchelidium brevicarpum*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Synchelidium haplocheles*
Annelida	Polychaeta	Phyllodocida	Pilargidae	*Synelmis klatti*
Arthropoda	Malacostraca	Tanaidacea	Tanaidacea	*Tanaidacea indet*
Annelida	Polychaeta	Terebellida	Terebellidae	*Terebellidae indet*
Annelida	Polychaeta	Terebellida	Trichobranchidae	*Terebellides stroemi*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx marioni*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx mcintoshi*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx indet*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira croulinensis*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira equalis*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira ferruginea*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira flexuosa*
Mollusca	Bivalvia	Veneroida	Thyasiridae	*Thyasira sarsi*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Westwoodilla caecula*
Mollusca	Bivalvia	Nuculoida	Yoldiidae	*Yoldiella lucida*

Traits	Adult life habitat					Releative adult mobility			
Code	AH1	AH2	AH3	AH4	AH5	AM1	AM2	AM3	AM4
Species/category	**Sessile**	**Tube (permanent)**	**Tube (semi-permanent)**	**Burrower**	**Surface crawler**	**None**	**Low**	**Medium**	**High**
Abra nitida	0	0	2	1	0	0	3	0	0
Ampharete indet	3	0	0	0	0	3	0	0	0
Ampharetidae indet	3	0	0	0	0	2	2	0	0
Amphilepis norvegica	0	0	2	1	0	0	0	0	0
Amphipholis squamata	0	0	0	0	0	0	3	0	0
Amphiura chiajei	0	0	2	0	0	0	2	1	0
Amphiura filiformis	0	0	2	2	0	0	2	1	0
Aora indet	0	0	1	1	1	0	0	3	0
Aphroditidae indet	0	0	2	1	0	0	1	2	0
Apseudes spinosus	0	0	2	0	1	0	0	3	0
Asychis biceps	3	0	0	0	0	3	0	0	0
Bathymedon longimanus	0	0	1	1	1	0	0	3	0
Brada villosa	0	0	3	0	0	0	3	0	0
Brissopsis lyrifera	0	0	3	0	0	0	0	2	0
Calocaris macandreae	0	0	3	0	0	0	3	0	0
Caudofoveata indet	0	0	3	0	0	0	3	0	0
Caulleriella killariensis	0	0	2	1	0	0	2	1	0
Caulleriella indet	0	0	3	0	0	0	2	1	0
Ceratocephale loveni	0	0	3	0	0	0	0	2	1
Chaetoparia nilssoni	0	3	0	0	0	0	1	2	0
Chaetozone setosa	0	0	3	0	0	0	3	0	0
Cossura longocirrata	0	0	3	0	0	0	3	0	0
Cuspidaria abbreviata	0	0	2	1	0	0	3	0	0
Cylichna alba	0	0	1	2	0	0	3	0	0
Desmosoma armatum	0	0	1	1	1	0	0	3	0
Desmosoma indet	0	0	1	1	1	0	0	3	0
Diastylis cornuta	0	0	2	0	1	0	0	2	3
Diastylis indet	0	0	2	0	1	0	0	3	0
Diastylis tumida	0	0	2	0	1	0	0	3	0
Diastyloides serrata	0	0	2	0	1	0	0	3	0
Diastylopsis resima	0	0	2	0	1	0	0	3	0
Diplocirrus glaucus	0	0	3	0	0	0	3	0	0
Drilonereis filum	0	0	3	0	0	0	0	2	1
Eclysippe vanelli	3	0	0	0	0	1	2	0	0
Eriopisa elongata	0	0	1	1	1	0	0	3	0
Eteone foliosa	0	0	2	1	0	0	0	0	3
Eteone picta	0	0	2	1	0	0	0	0	3
Eteone longa	0	0	2	1	0	0	0	0	3
Eudorella emarginata	0	0	2	0	1	0	0	3	0
Eudorella hirsuta	0	0	2	0	1	0	0	3	0
Eudorella indet	0	0	2	0	1	0	0	3	0
Eudorella truncatula	0	0	2	0	1	0	0	3	0
Eugerda tenuimana	0	0	1	1	1	0	0	3	0
Eunoe nodosa	0	0	0	3	0	0	0	1	2
Eurycope cornuta	0	0	1	1	1	0	0	3	0
Eurycope phalangium	0	0	1	1	1	0	0	3	0
Exogone dispar	0	0	2	2	0	0	1	2	0
Exogone hebes	0	0	2	2	0	0	1	2	0
Exogone indet	0	0	2	2	0	0	1	2	0
Exogone verugera	0	0	2	2	0	0	1	2	0
Glycera alba	0	0	2	0	0	0	0	1	2
Glycera capitata	0	0	3	0	0	0	0	1	2
Glycera lapidum	0	0	3	0	0	0	0	1	2
Glycera rouxii	0	0	2	0	0	0	0	1	2
Glycera indet	0	0	2	0	0	0	0	1	2
Glycinde nordmanni	0	0	2	1	0	0	0	0	3
Gnathia maxillaris	0	0	1	1	1	0	0	3	0
Golfingia indet	3	0	0	0	0	3	2	0	0
Goniada maculata	0	0	2	1	0	0	0	0	3
Harmothoe indet	0	0	2	2	0	0	0	2	2
Harpinia pectinata	0	0	1	1	1	0	2	3	0
Harpinia indet	0	0	1	1	1	0	2	3	0
Hemilamprops rosea	0	0	2	0	1	0	0	3	0
Hesionidae indet	0	0	2	1	0	0	0	2	2
Heteromastus filiformis	0	1	2	0	0	1	2	0	0
Hyalinoecia tubicola	2	0	0	2	0	0	3	0	0
Ilyarachna longicornis	0	0	1	1	1	0	0	3	0
Iphinoe trispinosa	0	0	2	0	1	0	0	3	0
Ischnosoma bispinosum	0	0	1	1	1	0	0	3	0
Leanira tetragona	0	0	3	0	0	0	0	1	2
Leptophoxus falcatus	0	0	1	1	1	0	0	3	0
Leptostylis longimana	0	0	2	0	1	0	0	3	0
Leucon acutirostris	0	0	2	0	1	0	0	3	0
Leucon nasica	0	0	2	0	1	0	0	3	0
Leucon indet	0	0	2	0	1	0	0	3	0
Lilljeborgia macronyx	0	0	1	1	1	0	0	3	0
Lilljeborgia indet	0	0	1	1	1	0	0	3	0
Lipobranchus jeffreysii	0	0	3	0	0	0	3	0	0
Lumbrineris fragilis	0	0	3	0	0	0	0	2	1
Lumbrineris gracilis	0	0	3	0	0	0	0	2	1
Lumbrineris scopa	0	0	3	0	0	0	0	2	1
Lumbrineris indet	0	0	3	0	0	0	0	2	1
Macrostylis spinifera	0	0	1	1	1	0	0	3	0
Maldane sarsi	3	0	0	0	0	3	0	0	0
Maldanidae indet	3	0	0	0	0	3	0	0	0
Mediomastus fragilis	0	1	2	0	0	1	2	0	0
Melinna cristata	3	0	0	0	0	3	0	0	0
Melinna palmata	3	0	0	0	0	3	0	0	0
Microclymene acirrata	3	0	0	0	0	3	0	0	0
Monoculodes indet	0	0	1	1	1	0	0	3	0
Munnopsis typica	0	0	1	1	1	0	0	3	0
Mystides southerni	0	0	2	1	0	0	0	0	3
Nemertinea indet	0	0	2	2	0	0	2	2	2

Traits	Adult life habitat					Releative adult mobility			
Code	AH1	AH2	AH3	AH4	AH5	AM1	AM2	AM3	AM4
Species/category	**Sessile**	**Tube (permanent)**	**Tube (semi-permanent)**	**Burrower**	**Surface crawler**	**None**	**Low**	**Medium**	**High**
Nephtys assimilis	0	0	2	2	0	0	0	1	2
Nephtys hombergii	0	0	2	2	0	0	0	1	2
Nephtys longosetosa	0	0	3	0	0	0	0	1	2
Nephtys indet	0	0	2	2	0	0	0	1	2
Notomastus latericeus	0	1	2	0	0	1	2	0	0
Nucula sulcata	0	0	2	1	0	0	3	0	0
Nucula tumidula	0	0	2	1	0	0	3	0	0
Nuculoma tenuis	0	0	2	1	0	0	3	0	0
Onchnesoma steenstrupi	3	0	1	0	0	0	0	0	0
Ophelina acuminata	0	0	3	0	0	0	1	2	0
Ophelina cylindricaudata	0	0	3	0	0	0	1	2	0
Ophelina modesta	0	0	3	0	0	0	2	1	0
Ophelina norvegica	0	0	3	0	0	0	1	2	0
Ophelina indet	0	0	3	0	0	0	1	2	0
Ophiodromus flexuosus	0	0	1	2	0	0	0	2	2
Ophryotrocha longidentata	0	0	1	2	0	0	2	1	0
Orbinia norvegica	0	0	3	0	0	0	0	3	0
Orbinia sertulata	0	0	3	0	0	0	0	3	0
Paradoneis eliasoni	0	0	3	0	0	0	2	1	0
Paradoneis lyra	0	0	3	0	0	0	2	1	0
Paramphinome jeffreysii	0	0	1	2	0	0	0	1	2
Paraonis fulgens	0	0	3	0	0	0	2	1	0
Paraonis gracilis	0	0	3	0	0	0	2	1	0
Parvicardium minimum	0	0	2	1	0	0	3	0	0
Pectinaria auricoma	3	0	0	0	0	1	2	2	0
Perioculodes longimanus	0	0	1	1	1	0	0	3	0
Phascolion strombi	0	3	0	0	0	0	2	0	0
Phascolosoma indet	0	0	3	0	0	0	0	0	0
Pherusa plumosa	0	0	3	0	0	0	3	0	0
Philomedes globosus	0	0	0	2	1	0	0	3	0
Philomedes lilljeborgi	0	0	0	2	1	0	0	3	0
Pholoe minuta	0	0	2	1	0	0	0	3	0
Pholoe pallida	0	0	2	1	0	0	0	3	0
Pholoe indet	0	0	2	1	0	0	0	3	0
Photidae indet	0	0	1	1	1	0	0	3	0
Phoxocephalidae indet	0	0	1	1	1	0	0	3	0
Phoxocephalus holbolli	0	0	1	1	1	0	0	3	0
Phyllodoce longipes	0	0	2	1	0	0	0	0	3
Phyllodoce rosea	0	0	2	1	0	0	0	0	3
Phyllodocidae indet	0	0	2	1	0	0	0	0	3
Platyhelminthes indet	0	0	0	2	0	0	2	2	0
Podoceridae indet	0	0	1	1	1	0	0	3	0
Polycirrus latidens	0	1	2	0	0	1	2	0	0
Polycirrus norvegicus	0	1	2	0	0	1	2	0	0
Polycirrus plumosus	0	1	2	0	0	1	2	0	0
Polycirrus indet	0	1	2	0	0	1	2	0	0
Polydora caulleryi	3	0	0	0	0	2	1	0	0
Polydora ciliata	2	0	2	0	0	2	1	0	0
Polydora flava	3	0	0	0	0	2	1	0	0
Polydora indet	3	0	0	0	0	2	1	0	0
Priapulus caudatus	0	0	2	0	0	0	0	0	0
Prionospio banyulensis	0	0	3	0	0	0	2	1	0
Prionospio cirrifera	0	0	3	0	0	0	2	1	0
Prionospio fallax	0	0	3	0	0	0	2	1	0
Prionospio indet	0	0	3	0	0	0	2	1	0
Prionospio steenstrupi	0	0	3	0	0	0	2	1	0
Pseudamussium septemradiatum	0	0	1	2	0	0	1	1	3
Pseudopolydora paucibranchiata	3	0	0	0	0	2	1	0	0
Rhodine loveni	3	0	0	0	0	3	0	0	0
Scalibregma inflatum	0	0	3	0	0	0	2	1	0
Scoloplos armiger	0	1	2	0	0	0	0	2	1
Sigalionodae indet	0	0	2	1	0	0	0	3	0
Sipunculida indet	0	0	2	0	0	0	2	0	0
Sphaerodoridae indet	0	1	0	3	0	0	1	2	0
Sphyrapus anomalus	0	0	2	0	1	0	0	3	0
Spionidae indet	2	2	2	0	0	2	2	1	0
Spiophanes kroeyeri	3	0	0	0	0	2	1	0	0
Sthenelais jeffreysii	0	0	2	1	0	0	0	3	0
Streblosoma bairdi	3	0	0	0	0	3	0	0	0
Syllidae indet	0	0	2	2	0	0	1	2	0
Synchelidium brevicarpum	0	0	1	1	1	0	0	3	0
Synchelidium haplocheles	0	0	1	1	1	0	0	3	0
Synelmis klatti	0	0	0	3	0	0	0	1	2
Tanaidacea indet	0	1	1	0	1	0	0	3	0
Terebellidae indet	2	1	2	0	0	2	2	0	0
Terebellides stroemi	3	0	0	0	0	3	0	0	0
Tharyx marioni	0	0	3	0	0	0	3	0	0
Tharyx mcintoshi	0	0	3	0	0	0	3	0	0
Tharyx indet	0	0	3	0	0	0	3	0	0
Thyasira croulinensis	0	0	3	0	0	0	3	0	0
Thyasira equalis	0	0	2	1	0	0	3	0	0
Thyasira ferruginea	0	0	2	1	0	0	3	0	0
Thyasira flexuosa	0	0	2	1	0	0	3	0	0
Thyasira sarsi	0	0	2	1	0	0	3	0	0
Westwoodilla caecula	0	0	1	1	1	0	0	3	2
Yoldiella lucida	0	0	2	1	0	0	3	0	0

Traits	Body form						Degree of attachment		
Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Species/category	**Short cylindric**	**Flattened dorsally**	**Flattened laterally**	**Ball shaped**	**Long thin, treadlike**	**Irregular**	**None**	**Temporary**	**Permanent**
Abra nitida	0	0	3	0	0	0	3	0	0
Ampharete indet	2	1	0	0	0	0	0	0	3
Ampharetidae indet	2	1	0	0	0	0	0	2	2
Amphilepis norvegica	0	1	0	1	1	1	3	0	0
Amphipholis squamata	0	2	0	1	1	2	3	0	0
Amphiura chiajei	0	1	0	0	0	3	3	0	0
Amphiura filiformis	0	1	0	0	0	3	3	0	0
Aora indet	0	0	2	0	0	1	3	0	0
Aphroditidae indet	2	2	0	1	0	0	3	0	0
Apseudes spinosus	2	2	0	0	1	1	3	0	0
Asychis biceps	0	0	0	0	3	0	0	0	3
Bathymedon longimanus	0	0	2	0	0	1	3	0	0
Brada villosa	2	0	0	1	0	0	3	0	0
Brissopsis lyrifera	0	1	0	2	0	0	3	0	0
Calocaris macandreae	0	1	0	0	0	1	3	0	0
Caudofoveata indet	1	0	0	0	2	0	3	0	0
Caulleriella killariensis	1	0	0	0	2	0	3	0	0
Caulleriella indet	2	0	0	0	2	0	3	0	0
Ceratocephale loveni	2	1	0	0	2	0	3	0	0
Chaetoparia nilssoni	0	1	0	0	2	0	0	3	0
Chaetozone setosa	2	0	0	0	1	0	3	0	0
Cossura longocirrata	2	0	0	0	2	0	3	0	0
Cuspidaria abbreviata	0	0	2	1	0	1	3	0	0
Cylichna alba	2	0	0	1	0	0	3	0	0
Desmosoma armatum	0	2	0	0	0	1	3	0	0
Desmosoma indet	0	2	0	0	0	1	3	0	0
Diastylis cornuta	0	0	0	0	1	1	3	0	0
Diastylis indet	0	0	0	0	1	1	3	0	0
Diastylis tumida	0	0	0	0	1	1	3	0	0
Diastyloides serrata	0	0	0	0	1	1	3	0	0
Diastylopsis resima	0	0	0	0	1	1	3	0	0
Diplocirrus glaucus	3	0	0	0	0	0	3	0	0
Drilonereis filum	0	0	0	0	3	0	3	0	0
Eclysippe vanelli	2	0	0	0	1	0	0	1	2
Eriopisa elongata	0	0	2	0	1	1	3	0	0
Eteone foliosa	0	1	0	0	2	0	3	0	0
Eteone picta	0	1	0	0	2	0	3	0	0
Eteone longa	0	1	0	0	2	0	3	0	0
Eudorella emarginata	0	0	0	0	1	1	3	0	0
Eudorella hirsuta	0	0	0	0	1	1	3	0	0
Eudorella indet	0	0	0	0	1	1	3	0	0
Eudorella truncatula	0	0	0	0	1	1	3	0	0
Eugerda tenuimana	0	2	0	0	0	1	3	0	0
Eunoe nodosa	2	2	0	0	0	0	3	0	0
Eurycope cornuta	0	2	0	0	0	1	3	0	0
Eurycope phalangium	0	2	0	0	0	1	3	0	0
Exogone dispar	1	0	0	0	2	0	3	0	0
Exogone hebes	1	0	0	0	2	0	3	0	0
Exogone indet	1	0	0	0	2	0	3	0	0
Exogone verugera	1	0	0	0	2	0	3	0	0
Glycera alba	1	0	0	0	2	0	3	0	0
Glycera capitata	1	0	0	0	2	0	3	0	0
Glycera lapidum	1	0	0	0	2	0	3	0	0
Glycera rouxii	1	0	0	0	2	0	3	0	0
Glycera indet	1	0	0	0	2	0	3	0	0
Glycinde nordmanni	0	0	0	0	3	0	3	0	0
Gnathia maxillaris	0	2	0	0	0	1	3	0	0
Golfingia indet	3	0	0	0	0	0	0	0	0
Goniada maculata	0	0	0	0	3	0	3	0	0
Harmothoe indet	2	2	0	0	0	0	3	0	0
Harpinia pectinata	0	0	2	0	0	1	3	0	0
Harpinia indet	0	0	2	0	0	1	3	0	0
Hemilamprops rosea	0	0	0	0	1	1	3	0	0
Hesionidae indet	1	1	0	0	2	0	2	1	0
Heteromastus filiformis	0	0	0	0	3	0	3	0	0
Hyalinoecia tubicola	0	0	0	0	3	0	1	2	0
Ilyarachna longicornis	0	2	0	0	1	1	3	0	0
Iphinoe trispinosa	0	0	0	0	1	1	3	0	0
Ischnosoma bispinosum	0	2	0	0	1	1	3	0	0
Leanira tetragona	0	0	0	0	3	0	3	0	0
Leptophoxus falcatus	0	0	2	0	0	1	3	0	0
Leptostylis longimana	0	0	0	0	1	1	3	0	0
Leucon acutirostris	0	0	0	0	1	1	3	0	0
Leucon nasica	0	0	0	0	1	1	3	0	0
Leucon indet	0	0	0	0	1	1	3	0	0
Lilljeborgia macronyx	0	0	2	0	0	1	3	0	0
Lilljeborgia indet	0	0	2	0	0	1	3	0	0
Lipobranchus jeffreysii	2	0	0	2	2	0	3	0	0
Lumbrineris fragilis	0	0	0	0	3	0	3	0	0
Lumbrineris gracilis	0	0	0	0	3	0	3	0	0
Lumbrineris scopa	0	0	0	0	3	0	3	0	0
Lumbrineris indet	0	0	0	0	3	0	3	0	0
Macrostylis spinifera	0	2	0	0	0	1	3	0	0
Maldane sarsi	0	0	0	0	3	0	0	0	3
Maldanidae indet	0	0	0	0	3	0	0	0	3
Mediomastus fragilis	0	0	0	0	3	0	3	0	0
Melinna cristata	2	1	0	0	0	0	0	0	3
Melinna palmata	2	1	0	0	0	0	0	0	3
Microclymene acirrata	0	0	0	0	3	0	0	0	3
Monoculodes indet	0	0	2	0	0	1	3	0	0
Munnopsis typica	0	2	0	0	0	1	3	0	0
Mystides southerni	2	1	0	0	0	0	3	0	0
Nemertinea indet	0	2	0	0	2	0	2	0	0

Traits	Body form						Degree of attachment		
Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Species/category	**Short cylindric**	**Flattened dorsally**	**Flattened laterally**	**Ball shaped**	**Long thin, treadlike**	**Irregular**	**None**	**Temporary**	**Permanent**
Nephtys assimilis	0	1	0	0	2	0	3	0	0
Nephtys hombergii	0	1	0	0	2	0	3	0	0
Nephtys longosetosa	0	1	0	0	2	0	3	0	0
Nephtys indet	0	1	0	0	2	0	3	0	0
Notomastus latericeus	0	0	0	0	3	0	2	1	0
Nucula sulcata	0	0	2	1	0	0	3	0	0
Nucula tumidula	0	0	2	1	0	0	3	0	0
Nuculoma tenuis	0	0	2	1	0	0	3	0	0
Onchnesoma steenstrupi	3	0	0	0	3	0	0	0	0
Ophelina acuminata	2	0	1	0	0	0	3	0	0
Ophelina cylindricaudata	2	0	1	0	0	0	3	0	0
Ophelina modesta	2	0	1	0	0	0	3	0	0
Ophelina norvegica	2	0	1	0	0	0	3	0	0
Ophelina indet	2	0	1	0	0	0	3	0	0
Ophiodromus flexuosus	2	2	0	0	0	0	3	0	0
Ophryotrocha longidentata	3	0	0	0	0	0	3	0	0
Orbinia norvegica	1	0	0	0	2	0	3	0	0
Orbinia sertulata	1	0	0	0	2	0	3	0	0
Paradoneis eliasoni	0	0	0	0	3	0	3	0	0
Paradoneis lyra	0	0	0	0	3	0	3	0	0
Paramphinome jeffreysii	3	2	0	0	0	0	3	0	0
Paraonis fulgens	0	0	0	0	3	0	3	0	0
Paraonis gracilis	0	0	0	0	3	0	3	0	0
Parvicardium minimum	0	0	2	1	0	0	3	0	0
Pectinaria auricoma	3	0	0	0	0	0	0	3	0
Perioculodes longimanus	0	0	2	0	0	1	3	0	0
Phascolion strombi	0	0	0	0	2	0	0	0	0
Phascolosoma indet	1	0	0	0	1	0	0	2	0
Pherusa plumosa	3	0	0	0	0	0	2	1	0
Philomedes globosus	0	0	1	2	0	0	3	0	0
Philomedes lilljeborgi	0	0	1	2	0	0	3	0	0
Pholoe minuta	2	2	0	0	0	0	3	0	0
Pholoe pallida	2	2	0	0	0	0	3	0	0
Pholoe indet	2	2	0	0	0	0	3	0	0
Photidae indet	0	0	2	0	0	1	3	0	0
Phoxocephalidae indet	0	0	2	0	0	1	3	0	0
Phoxocephalus holbolli	0	0	2	0	0	1	3	0	0
Phyllodoce longipes	0	1	0	0	2	0	3	0	0
Phyllodoce rosea	0	1	0	0	2	0	3	0	0
Phyllodocidae indet	0	1	0	0	2	0	3	0	0
Platyhelminthes indet	0	3	0	0	0	0	3	0	0
Podoceridae indet	0	0	2	0	0	1	3	0	0
Polycirrus latidens	3	0	0	0	0	0	0	3	0
Polycirrus norvegicus	3	0	0	0	0	0	0	3	0
Polycirrus plumosus	3	0	0	0	0	0	0	3	0
Polycirrus indet	3	0	0	0	0	0	0	3	0
Polydora caulleryi	1	1	0	0	2	0	0	3	0
Polydora ciliata	1	1	0	0	2	0	0	2	2
Polydora flava	1	1	0	0	2	0	0	3	0
Polydora indet	1	1	0	0	2	0	0	3	0
Priapulus caudatus	3	0	0	0	0	0	0	0	0
Prionospio banyulensis	0	0	0	0	3	0	3	0	0
Prionospio cirrifera	0	0	0	0	3	0	3	0	0
Prionospio fallax	0	0	0	0	3	0	3	0	0
Prionospio indet	0	0	0	0	3	0	3	0	0
Prionospio steenstrupi	0	0	0	0	3	0	3	0	0
Pseudamussium septemradiatum	0	0	3	0	0	0	3	0	0
Pseudopolydora paucibranchiata	1	1	0	0	2	0	0	3	0
Rhodine loveni	0	0	0	0	3	0	0	0	3
Scalibregma inflatum	2	1	0	0	1	0	3	0	0
Scoloplos armiger	1	1	0	0	2	0	3	0	0
Sigalionodae indet	0	0	0	0	3	0	3	0	0
Sipunculida indet	2	0	0	0	2	2	0	0	0
Sphaerodoridae indet	2	0	0	0	2	0	3	0	0
Sphyrapus anomalus	1	3	0	0	1	1	3	0	0
Spionidae indet	1	1	0	0	2	0	2	2	1
Spiophanes kroeyeri	1	1	0	0	2	0	0	3	0
Sthenelais jeffreysii	0	0	0	0	3	0	3	0	0
Streblosoma bairdi	2	0	0	0	1	0	0	0	3
Syllidae indet	1	0	0	0	2	0	3	0	0
Synchelidium brevicarpum	0	0	2	0	0	1	3	0	0
Synchelidium haplocheles	0	0	2	0	0	1	3	0	0
Synelmis klatti	1	0	0	0	2	0	3	0	0
Tanaidacea indet	2	2	0	0	1	1	3	0	0
Terebellidae indet	2	0	0	0	1	0	0	2	2
Terebellides stroemi	3	0	0	0	0	0	0	0	3
Tharyx marioni	1	1	0	0	2	0	3	0	0
Tharyx mcintoshi	1	2	0	0	2	0	3	0	0
Tharyx indet	2	0	0	0	2	0	3	0	0
Thyasira croulinensis	0	0	1	3	0	0	3	0	0
Thyasira equalis	0	0	2	1	0	0	3	0	0
Thyasira ferruginea	0	0	2	1	0	0	3	0	0
Thyasira flexuosa	0	0	2	1	0	0	3	0	0
Thyasira sarsi	0	0	2	1	0	0	3	0	0
Westwoodilla caecula	0	0	2	0	0	1	3	0	0
Yoldiella lucida	0	0	2	1	0	0	3	0	0

Traits	Feeding											
Code	FD1	FD2	FD3	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Species/category	Sediment surface	Subsurface 0-5cm	Deep subsurface >5cm	Suspension / filter	Scraper / grazer	Surface deposit feeder, SDF	Subsurface deposit feeder, DF	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenge	Carnivore / omnivore	Parasite / commensal
Abra nitida	3	0	0	2	0	2	0	0	0	0	0	0
Ampharete indet	0	0	0	0	0	3	0	0	0	0	0	0
Ampharetidae indet	0	0	0	0	0	3	0	0	0	0	0	0
Amphilepis norvegica	0	0	0	0	0	3	0	0	0	0	0	0
Amphipholis squamata	0	0	0	0	0	0	0	0	0	0	0	0
Amphiura chiajei	0	0	0	2	0	2	0	0	0	0	0	0
Amphiura filiformis	0	0	0	2	0	2	0	0	0	0	2	0
Aora indet	0	0	0	0	0	3	0	0	0	0	0	0
Aphroditidae indet	2	1	0	0	0	0	0	0	0	1	2	0
Apseudes spinosus	0	0	0	0	0	3	0	0	0	0	0	0
Asychis biceps	0	0	0	0	0	0	3	0	0	0	0	0
Bathymedon longimanus	0	0	0	0	0	3	0	0	0	0	0	0
Brada villosa	0	0	0	0	0	2	0	2	2	0	0	0
Brissopsis lyrifera	0	0	3	0	0	0	2	0	0	0	2	0
Calocaris macandreae	0	0	0	0	0	0	2	0	0	0	2	0
Caudofoveata indet	0	0	0	0	1	2	2	1	0	2	2	0
Caulleriella killariensis	0	0	0	0	0	3	0	0	0	0	0	0
Caulleriella indet	3	0	0	0	0	2	1	0	0	0	0	0
Ceratocephale loveni	3	0	0	0	0	0	0	0	0	1	2	0
Chaetoparia nilssoni	0	0	0	0	0	0	0	0	0	0	3	0
Chaetozone setosa	0	3	0	0	0	3	0	0	0	0	0	0
Cossura longocirrata	0	0	0	0	0	1	2	0	0	0	0	0
Cuspidaria abbreviata	0	0	0	3	0	0	0	0	0	0	2	0
Cylichna alba	0	0	0	0	0	0	0	0	0	0	3	0
Desmosoma armatum	0	0	0	0	0	3	0	0	0	0	0	0
Desmosoma indet	0	0	0	0	0	3	0	0	0	0	0	0
Diastylis cornuta	0	0	0	0	0	3	0	0	0	0	0	0
Diastylis indet	0	0	0	0	0	3	0	0	0	0	0	0
Diastylis tumida	0	0	0	0	0	3	0	0	0	0	0	0
Diastyloides serrata	0	0	0	0	0	3	0	0	0	0	0	0
Diastylopsis resima	0	0	0	0	0	3	0	0	0	0	0	0
Diplocirrus glaucus	0	0	0	0	0	2	0	0	2	0	0	0
Drilonereis filum	0	0	0	0	0	0	0	0	0	0	2	2
Eclysippe vanelli	0	0	0	0	0	3	0	0	0	0	0	0
Eriopisa elongata	0	0	0	0	0	3	0	0	0	0	0	0
Eteone foliosa	0	0	0	0	0	0	0	0	0	0	3	0
Eteone picta	0	0	0	0	0	0	0	0	0	0	3	0
Eteone longa	0	0	0	0	0	0	0	0	0	0	3	0
Eudorella emarginata	0	0	0	0	0	3	0	0	0	0	0	0
Eudorella hirsuta	0	0	0	0	0	3	0	0	0	0	0	0
Eudorella indet	0	0	0	0	0	3	0	0	0	0	0	0
Eudorella truncatula	0	0	0	0	0	3	0	0	0	0	0	0
Eugerda tenuimana	0	0	0	0	0	3	0	0	0	0	0	0
Eunoe nodosa	2	1	0	0	0	0	0	0	0	0	3	0
Eurycope cornuta	0	0	0	0	0	3	0	0	0	0	0	0
Eurycope phalangium	0	0	0	0	0	3	0	0	0	0	0	0
Exogone dispar	0	0	0	0	0	2	0	0	0	0	2	0
Exogone hebes	0	0	0	0	0	2	0	0	0	0	2	0
Exogone indet	2	2	0	0	0	2	0	0	0	0	2	0
Exogone verugera	0	0	0	0	0	2	0	0	0	0	2	0
Glycera alba	3	0	0	0	0	0	0	0	0	0	3	0
Glycera capitata	3	0	0	0	0	0	0	0	2	0	1	0
Glycera lapidum	3	0	0	0	0	0	0	0	1	0	2	0
Glycera rouxii	3	0	0	0	0	0	0	0	0	0	3	0
Glycera indet	3	0	0	0	0	0	0	1	2	0	2	0
Glycinde nordmanni	3	0	0	0	0	0	0	0	0	0	3	0
Gnathia maxillaris	0	0	0	0	0	3	0	0	0	0	0	2
Golfingia indet	0	2	0	2	0	2	0	0	0	0	0	0
Goniada maculata	3	0	0	0	0	0	0	0	0	0	3	0
Harmothoe indet	3	0	0	0	0	0	0	0	0	0	2	1
Harpinia pectinata	0	0	0	0	0	2	2	0	0	0	0	0
Harpinia indet	0	0	0	0	0	2	2	0	0	0	0	0
Hemilamprops rosea	0	0	0	0	0	3	0	0	0	0	0	0
Hesionidae indet	3	0	0	0	0	1	0	0	1	1	2	0
Heteromastus filiformis	2	1	0	0	0	0	3	0	0	0	0	0
Hyalinoecia tubicola	3	0	0	0	0	0	0	0	0	0	3	0
Ilyarachna longicornis	0	0	0	0	2	2	0	0	2	0	0	0
Iphinoe trispinosa	0	0	0	0	0	0	0	0	3	0	0	0
Ischnosoma bispinosum	0	0	0	0	0	3	0	0	0	0	0	0
Leanira tetragona	0	0	0	0	0	0	0	0	0	0	3	0
Leptophoxus falcatus	0	0	0	0	0	2	2	0	0	0	0	0
Leptostylis longimana	0	0	0	0	0	3	0	0	0	0	0	0
Leucon acutirostris	0	0	0	0	0	3	0	0	0	0	0	0
Leucon nasica	0	0	0	0	0	3	0	0	0	0	0	0
Leucon indet	0	0	0	0	0	3	0	0	0	0	0	0
Lilljeborgia macronyx	0	0	0	0	0	3	0	0	0	0	0	0
Lilljeborgia indet	0	0	0	0	0	3	0	0	0	0	0	0
Lipobranchus jeffreysii	0	0	0	0	0	0	3	0	0	0	0	0
Lumbrineris fragilis	0	0	0	0	0	0	0	0	0	0	3	0
Lumbrineris gracilis	0	0	0	0	0	0	0	0	0	0	3	0
Lumbrineris scopa	0	0	0	0	0	0	0	0	0	0	3	0
Lumbrineris indet	0	0	0	0	0	1	1	0	1	0	2	0
Macrostylis spinifera	0	0	0	0	0	3	0	0	0	0	0	0
Maldane sarsi	3	0	0	0	0	0	3	0	0	0	0	0
Maldanidae indet	3	0	0	0	0	0	3	0	0	0	0	0
Mediomastus fragilis	3	0	0	0	0	0	3	0	0	0	0	0
Melinna cristata	0	0	0	0	0	3	0	0	0	0	0	0
Melinna palmata	0	0	0	0	0	3	0	0	0	0	0	0
Microclymene acirrata	0	0	0	0	0	0	3	0	0	0	0	0
Monoculodes indet	2	0	0	0	0	3	0	0	0	0	0	0
Munnopsis typica	0	0	0	0	0	3	0	0	0	0	0	0
Mystides southerni	0	0	0	0	0	0	0	0	0	0	3	0
Nemertinea indet	2	2	0	0	0	0	0	0	0	0	3	0

Traits	Feeding											
Code	FD1	FD2	FD3	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Species/category	Sediment surface	Subsurface 0-5cm	Deep subsurface >5cm	Suspension / filter	Scraper / grazer	Surface deposit feeder, SDF	Subsurface deposit feeder, DF	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenge	Carnivore / omnivore	Parasite / commensal
Nephtys assimilis	2	2	1	0	0	1	1	0	0	2	2	0
Nephtys hombergii	2	2	2	0	0	1	1	0	0	1	2	0
Nephtys longosetosa	2	1	0	0	0	0	0	0	0	1	2	0
Nephtys indet	2	2	1	0	0	1	1	0	0	2	2	0
Notomastus latericeus	2	1	0	0	0	0	3	0	0	0	0	0
Nucula sulcata	0	0	0	0	0	0	3	0	0	0	0	0
Nucula tumidula	0	0	0	0	0	0	3	0	0	0	0	0
Nuculoma tenuis	0	0	0	0	0	0	3	0	0	0	0	0
Onchnesoma steenstrupi	0	0	0	0	0	3	0	0	0	0	0	0
Ophelina acuminata	0	3	0	0	0	0	3	0	0	0	0	0
Ophelina cylindricaudata	0	3	0	0	0	0	3	0	0	0	0	0
Ophelina modesta	0	3	0	0	0	0	3	0	0	0	0	0
Ophelina norvegica	0	3	0	0	0	0	3	0	0	0	0	0
Ophelina indet	0	3	0	0	0	0	3	0	0	0	0	0
Ophiodromus flexuosus	3	0	0	0	0	0	0	0	0	1	2	0
Ophryotrocha longidentata	3	0	0	0	1	0	2	0	2	0	1	0
Orbinia norvegica	0	3	0	0	0	0	3	0	0	0	0	0
Orbinia sertulata	0	3	0	0	0	0	3	0	0	0	0	0
Paradoneis eliasoni	0	3	0	0	0	3	0	0	0	0	0	0
Paradoneis lyra	0	3	0	0	0	3	0	0	0	0	0	0
Paramphinome jeffreysii	2	1	0	0	0	0	0	0	0	1	2	0
Paraonis fulgens	0	0	0	0	0	3	0	0	0	0	0	0
Paraonis gracilis	0	0	0	0	0	3	0	0	0	0	0	0
Parvicardium minimum	0	0	0	3	0	0	0	0	0	0	0	0
Pectinaria auricoma	3	0	0	0	0	0	2	0	1	0	0	0
Perioculodes longimanus	0	0	0	0	0	3	0	0	0	0	0	0
Phascolion strombi	0	0	0	2	2	2	0	0	0	0	0	2
Phascolosoma indet	0	0	0	0	0	0	0	0	0	0	0	0
Pherusa plumosa	3	0	0	1	0	2	0	0	2	0	0	0
Philomedes globosus	0	0	0	0	0	3	0	0	0	0	0	0
Philomedes lilljeborgi	0	0	0	0	0	3	0	0	0	0	0	0
Pholoe minuta	0	0	0	0	0	0	0	0	0	0	3	0
Pholoe pallida	0	0	0	0	0	0	0	0	0	0	3	0
Pholoe indet	0	0	0	0	0	0	0	0	0	0	3	0
Photidae indet	0	0	0	0	0	2	1	0	0	0	0	0
Phoxocephalidae indet	0	0	0	0	0	2	2	0	0	0	0	0
Phoxocephalus holbolli	0	0	0	0	0	2	2	0	0	0	0	0
Phyllodoce longipes	0	0	0	0	0	0	0	0	0	0	3	0
Phyllodoce rosea	0	0	0	0	0	0	0	0	0	0	3	0
Phyllodocidae indet	0	0	0	0	0	0	0	0	0	0	3	0
Platyhelminthes indet	0	0	0	0	0	0	0	0	0	0	2	2
Podoceridae indet	0	0	0	2	0	1	0	0	0	0	0	0
Polycirrus latidens	0	0	0	0	0	3	0	0	0	0	0	0
Polycirrus norvegicus	0	0	0	0	0	2	0	1	0	0	0	0
Polycirrus plumosus	0	0	0	0	0	3	0	0	0	0	0	0
Polycirrus indet	0	0	0	0	0	2	2	0	0	0	0	0
Polydora caulleryi	0	0	0	1	0	2	0	0	0	0	0	0
Polydora ciliata	0	0	0	2	0	2	0	0	0	0	0	0
Polydora flava	0	0	0	2	0	2	0	0	0	0	0	0
Polydora indet	1	2	0	2	0	2	0	0	0	0	0	0
Priapulus caudatus	0	0	0	0	0	0	0	0	0	0	3	0
Prionospio banyulensis	0	0	0	0	0	3	0	0	0	0	0	0
Prionospio cirrifera	0	0	0	1	0	3	0	0	0	0	0	0
Prionospio fallax	0	0	0	1	0	3	0	0	0	0	0	0
Prionospio indet	0	0	0	1	0	3	0	0	0	0	0	0
Prionospio steenstrupi	0	0	0	1	0	3	0	0	0	0	0	0
Pseudamussium septemradiatum	0	0	0	3	0	0	0	0	0	0	0	0
Pseudopolydora paucibranchiata	0	0	0	1	0	3	0	0	0	0	0	0
Rhodine loveni	0	0	0	0	0	0	2	0	1	0	0	0
Scalibregma inflatum	2	2	2	1	0	0	2	0	0	0	0	0
Scoloplos armiger	0	0	0	0	0	0	3	0	0	0	0	0
Sigalionodae indet	0	0	0	0	0	0	0	0	0	0	3	0
Sipunculida indet	0	2	0	2	0	2	0	0	1	0	0	0
Sphaerodoridae indet	3	0	0	0	0	2	0	0	0	0	1	1
Sphyrapus anomalus	0	0	0	0	0	3	0	0	0	0	0	0
Spionidae indet	0	0	0	1	0	2	0	0	0	0	0	0
Spiophanes kroeyeri	0	0	0	1	0	3	0	0	0	0	0	0
Sthenelais jeffreysii	0	0	0	0	0	0	0	0	0	0	3	0
Streblosoma bairdi	0	0	0	0	0	3	0	0	0	0	0	0
Syllidae indet	2	2	0	0	0	2	0	2	0	0	2	2
Synchelidium brevicarpum	0	0	0	0	0	3	0	0	0	0	0	0
Synchelidium haplocheles	0	0	0	0	0	3	0	0	0	0	0	0
Synelmis klatti	3	0	0	0	0	0	0	0	0	1	2	0
Tanaidacea indet	0	0	0	0	0	2	2	0	0	0	0	0
Terebellidae indet	0	0	0	1	0	3	1	1	1	0	0	0
Terebellides stroemi	0	0	0	0	0	3	0	0	0	0	0	0
Tharyx marioni	0	0	0	0	0	3	0	0	0	0	0	0
Tharyx mcintoshi	0	0	0	0	0	3	0	0	0	0	0	0
Tharyx indet	0	0	0	0	0	3	0	0	0	0	0	0
Thyasira croulinensis	0	0	0	0	0	0	3	2	0	0	0	0
Thyasira equalis	0	0	0	0	0	0	3	2	0	0	0	0
Thyasira ferruginea	0	0	0	0	0	0	3	2	0	0	0	0
Thyasira flexuosa	0	0	0	0	0	0	3	2	0	0	0	0
Thyasira sarsi	0	0	0	0	0	0	3	2	0	0	0	0
Westwoodilla caecula	2	0	0	0	0	3	0	0	0	0	0	0
Yoldiella lucida	0	0	0	0	0	0	3	0	0	0	0	0

Traits	Life duration			Larvaltype		Normal adult size					
Code	LD1	LD2	LD3	LT1	LT2	NS1	NS2	NS3	NS4	NS5	NS6
Species/category	< 1 year	1-5 year	>5 year	Planktotroph (feeding larvae)	Lecitotroph (non-feeding larvae)	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm
Abra nitida	0	0	0	3	0	0	0	3	0	0	0
Ampharete indet	0	0	0	0	3	0	2	2	0	0	0
Ampharetidae indet	0	0	0	0	3	1	2	2	2	0	0
Amphilepis norvegica	0	0	0	0	3	0	0	0	0	3	0
Amphipholis squamata	0	0	0	0	0	0	3	0	0	0	0
Amphiura chiajei	0	0	3	3	0	0	1	2	2	0	0
Amphiura filiformis	0	0	3	3	0	0	2	2	2	0	0
Aora indet	0	0	0	0	3	1	2	0	0	0	0
Aphroditidae indet	0	3	0	0	3	2	1	0	0	0	0
Apseudes spinosus	0	0	0	0	3	0	0	3	0	0	0
Asychis biceps	0	0	0	0	0	0	1	2	2	2	1
Bathymedon longimanus	0	0	0	0	3	0	3	0	0	0	0
Brada villosa	0	0	0	0	0	0	1	2	0	0	0
Brissopsis lyrifera	0	3	0	3	0	0	0	0	0	3	0
Calocaris macandreae	0	0	3	0	3	0	0	0	3	0	0
Caudofoveata indet	0	0	0	0	3	1	2	2	1	0	0
Caulleriella killariensis	0	0	0	0	3	1	1	2	0	0	0
Caulleriella indet	0	0	0	0	3	1	2	2	1	0	0
Ceratocephale loveni	0	3	0	0	3	0	1	2	0	0	0
Chaetoparia nilssoni	0	0	0	0	0	0	1	2	1	0	0
Chaetozone setosa	2	2	0	0	3	0	1	2	0	0	0
Cossura longocirrata	0	0	0	0	3	1	2	2	0	0	0
Cuspidaria abbreviata	0	0	0	0	3	0	3	0	0	0	0
Cylichna alba	0	0	0	3	0	0	1	2	0	0	0
Desmosoma armatum	0	0	0	0	3	3	0	0	0	0	0
Desmosoma indet	0	0	0	0	3	3	0	0	0	0	0
Diastylis cornuta	0	0	0	0	3	0	0	3	0	0	0
Diastylis indet	0	0	0	0	3	2	2	2	0	0	0
Diastylis tumida	0	0	0	0	3	0	3	0	0	0	0
Diastyloides serrata	0	0	0	0	3	0	3	0	0	0	0
Diastylopsis resima	0	0	0	0	3	3	0	0	0	0	0
Diplocirrus glaucus	0	0	0	0	3	0	1	2	1	0	0
Drilonereis filum	0	0	0	0	3	0	1	2	2	2	2
Eclysippe vanelli	0	0	0	0	3	0	1	2	1	0	0
Eriopisa elongata	0	0	0	0	3	0	3	0	0	0	0
Eteone foliosa	0	0	0	0	3	0	0	1	2	1	1
Eteone picta	0	0	0	0	3	0	0	2	2	0	0
Eteone longa	0	0	0	3	0	0	0	1	2	1	1
Eudorella emarginata	0	0	0	0	3	0	0	3	0	0	0
Eudorella hirsuta	0	0	0	0	3	3	0	0	0	0	0
Eudorella indet	0	0	0	0	3	2	2	1	0	0	0
Eudorella truncatula	0	0	0	0	3	2	1	0	0	0	0
Eugerda tenuimana	0	0	0	0	3	3	0	0	0	0	0
Eunoe nodosa	3	0	0	3	0	0	1	2	1	1	0
Eurycope cornuta	0	0	0	0	3	3	0	0	0	0	0
Eurycope phalangium	0	0	0	0	3	3	0	0	0	0	0
Exogone dispar	0	0	0	0	3	0	3	0	0	0	0
Exogone hebes	0	0	0	0	3	0	3	0	0	0	0
Exogone indet	0	0	0	0	3	0	3	0	0	0	0
Exogone verugera	0	0	0	0	3	0	3	0	0	0	0
Glycera alba	0	3	0	3	0	0	1	2	2	1	0
Glycera capitata	0	3	0	0	0	0	1	2	2	2	1
Glycera lapidum	0	3	0	0	0	0	1	2	2	1	0
Glycera rouxii	0	3	0	3	0	0	1	2	2	2	1
Glycera indet	0	3	0	3	0	1	2	2	2	0	0
Glycinde nordmanni	0	0	0	0	3	0	1	2	1	0	0
Gnathia maxillaris	0	0	0	0	3	3	0	0	0	0	0
Golfingia indet	0	0	0	0	3	0	0	0	0	0	2
Goniada maculata	0	0	0	0	3	0	1	2	2	1	0
Harmothoe indet	3	0	0	3	0	1	2	2	1	1	0
Harpinia pectinata	0	0	0	0	3	0	3	0	0	0	0
Harpinia indet	0	0	0	0	3	2	2	0	0	0	0
Hemilamprops rosea	0	0	0	0	3	0	3	0	0	0	0
Hesionidae indet	0	0	0	3	0	1	2	2	0	0	0
Heteromastus filiformis	0	0	0	0	3	0	1	2	2	1	1
Hyalinoecia tubicola	0	0	0	0	0	0	1	1	2	2	1
Ilyarachna longicornis	0	0	0	0	3	0	2	2	0	0	0
Iphinoe trispinosa	0	0	0	0	0	0	3	0	0	0	0
Ischnosoma bispinosum	0	0	0	0	3	3	0	0	0	0	0
Leanira tetragona	0	3	0	0	3	0	0	1	2	2	1
Leptophoxus falcatus	0	0	0	0	3	3	0	0	0	0	0
Leptostylis longimana	0	0	0	0	3	0	3	0	0	0	0
Leucon acutirostris	0	0	0	0	3	1	2	0	0	0	0
Leucon nasica	0	0	0	0	3	0	3	0	0	0	0
Leucon indet	0	0	0	0	3	1	2	0	0	0	0
Lilljeborgia macronyx	0	0	0	0	3	3	0	0	0	0	0
Lilljeborgia indet	0	0	0	0	3	2	2	2	0	0	0
Lipobranchus jeffreysii	0	0	0	0	3	0	1	2	2	0	0
Lumbrineris fragilis	0	3	0	0	3	0	1	2	2	2	2
Lumbrineris gracilis	2	2	0	0	3	0	1	2	1	0	0
Lumbrineris scopa	2	2	0	0	3	0	1	2	1	0	0
Lumbrineris indet	2	2	0	0	3	0	1	2	2	1	0
Macrostylis spinifera	0	0	0	0	3	3	0	0	0	0	0
Maldane sarsi	0	0	0	0	3	0	1	2	2	0	0
Maldanidae indet	0	0	0	0	3	0	1	2	2	2	1
Mediomastus fragilis	0	0	0	0	3	0	1	2	1	0	0
Melinna cristata	0	0	0	0	3	0	1	2	2	1	0
Melinna palmata	0	0	0	0	3	0	1	2	2	0	0
Microclymene acirrata	0	0	0	0	0	0	1	2	0	0	0
Monoculodes indet	0	0	0	0	3	1	2	0	0	0	0
Munnopsis typica	0	0	0	0	3	0	0	3	0	0	0
Mystides southerni	0	0	0	0	3	2	1	0	0	1	0
Nemertinea indet	0	0	0	0	0	0	2	2	2	2	2

Traits	Life duration			Larvaltype		Normal adult size					
Code	LD1	LD2	LD3	LT1	LT2	NS1	NS2	NS3	NS4	NS5	NS6
Species/category	< 1 year	1-5 year	>5 year	Planktotroph (feeding larvae)	Lecitotroph (non-feeding larvae)	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm
Nephtys assimilis	0	3	0	2	1	0	1	2	2	2	1
Nephtys hombergii	0	3	0	2	1	0	1	2	2	2	1
Nephtys longosetosa	0	3	0	3	0	0	1	2	2	2	1
Nephtys indet	0	3	0	2	1	2	2	2	0	0	0
Notomastus latericeus	0	0	0	0	3	0	1	2	2	2	1
Nucula sulcata	0	0	0	0	3	0	0	3	0	0	0
Nucula tumidula	0	0	0	0	3	0	3	0	0	0	0
Nuculoma tenuis	0	0	0	0	3	0	3	0	0	0	0
Onchnesoma steenstrupi	0	0	0	0	3	0	0	0	0	0	0
Ophelina acuminata	0	0	0	0	0	0	1	2	1	0	0
Ophelina cylindricaudata	0	0	0	0	3	0	1	2	0	0	0
Ophelina modesta	0	0	0	0	3	0	3	0	0	0	0
Ophelina norvegica	0	0	0	0	3	0	1	2	1	0	0
Ophelina indet	0	0	0	0	3	1	2	2	0	0	0
Ophiodromus flexuosus	0	0	0	3	0	0	1	2	2	1	0
Ophryotrocha longidentata	2	1	0	3	0	1	2	0	0	0	0
Orbinia norvegica	0	0	0	0	3	0	1	2	2	1	0
Orbinia sertulata	0	0	0	0	3	0	1	1	2	2	1
Paradoneis eliasoni	0	0	0	0	0	0	2	1	0	0	0
Paradoneis lyra	0	0	0	0	3	0	2	1	0	0	0
Paramphinome jeffreysii	3	0	0	3	0	0	1	2	0	0	0
Paraonis fulgens	0	0	0	0	3	0	2	1	0	0	0
Paraonis gracilis	0	0	0	0	3	0	2	1	0	0	0
Parvicardium minimum	0	0	0	3	0	0	2	1	0	0	0
Pectinaria auricoma	0	3	0	0	3	0	1	2	1	0	0
Perioculodes longimanus	0	0	0	0	3	3	0	0	0	0	0
Phascolion strombi	0	0	0	0	3	0	0	0	3	0	0
Phascolosoma indet	0	0	0	0	0	0	0	0	0	2	0
Pherusa plumosa	0	0	0	0	0	0	1	2	2	0	0
Philomedes globosus	0	0	0	0	0	3	0	0	0	0	0
Philomedes lilljeborgi	0	0	0	0	0	3	0	0	0	0	0
Pholoe minuta	0	2	1	3	0	0	2	1	0	0	0
Pholoe pallida	0	0	0	0	3	0	2	1	0	0	0
Pholoe indet	0	2	1	2	1	1	2	1	0	0	0
Photidae indet	0	0	0	0	3	3	0	0	0	0	0
Phoxocephalidae indet	0	0	0	0	3	0	3	0	0	0	0
Phoxocephalus holbolli	0	0	0	0	3	0	3	0	0	0	0
Phyllodoce longipes	0	0	0	3	0	0	1	2	0	0	0
Phyllodoce rosea	0	0	0	0	3	0	1	2	1	0	0
Phyllodocidae indet	0	0	0	3	0	0	1	2	2	2	1
Platyhelminthes indet	0	0	0	0	0	0	2	2	2	0	0
Podoceridae indet	0	0	0	0	3	2	2	0	0	0	0
Polycirrus latidens	0	0	0	0	3	0	1	2	1	0	0
Polycirrus norvegicus	0	0	0	0	0	0	1	2	1	0	0
Polycirrus plumosus	0	0	0	0	3	0	1	2	1	0	0
Polycirrus indet	0	0	0	0	3	0	1	2	1	0	0
Polydora caulleryi	0	0	0	3	0	0	1	2	1	0	0
Polydora ciliata	2	1	0	3	0	0	1	2	1	0	0
Polydora flava	0	0	0	3	0	0	1	2	1	0	0
Polydora indet	2	1	0	2	2	0	1	2	1	0	0
Priapulus caudatus	0	0	0	0	0	0	0	2	2	2	0
Prionospio banyulensis	0	0	0	3	0	1	2	0	0	0	0
Prionospio cirrifera	0	0	0	3	0	1	2	1	0	0	0
Prionospio fallax	0	0	0	3	0	1	2	1	0	0	0
Prionospio indet	0	0	0	3	0	1	2	1	0	0	0
Prionospio steenstrupi	0	0	0	3	0	0	1	2	1	0	0
Pseudamussium septemradiatum	0	0	0	0	0	0	0	0	3	0	0
Pseudopolydora paucibranchiata	0	0	0	0	3	2	2	0	0	0	0
Rhodine loveni	0	0	0	0	3	0	1	2	2	2	0
Scalibregma inflatum	0	0	0	0	3	0	1	2	1	0	0
Scoloplos armiger	0	0	0	1	2	0	1	2	2	1	0
Sigalionodae indet	0	0	0	2	2	0	2	2	2	2	2
Sipunculida indet	0	0	0	0	3	0	0	0	0	2	2
Sphaerodoridae indet	1	2	0	0	3	1	2	2	0	0	0
Sphyrapus anomalus	0	0	0	0	3	3	0	0	0	0	0
Spionidae indet	0	0	0	3	0	1	2	2	0	0	0
Spiophanes kroeyeri	0	0	0	3	0	0	1	2	2	1	0
Sthenelais jeffreysii	0	0	0	0	0	0	0	1	2	2	1
Streblosoma bairdi	0	0	0	0	3	0	1	2	2	2	0
Syllidae indet	0	0	0	0	3	2	2	2	0	0	0
Synchelidium brevicarpum	0	0	0	0	3	3	0	0	0	0	0
Synchelidium haplocheles	0	0	0	0	3	3	0	0	0	0	0
Synelmis klatti	0	0	0	3	0	1	2	0	0	0	0
Tanaidacea indet	0	0	0	0	3	2	2	0	0	0	0
Terebellidae indet	0	3	0	0	3	1	1	2	2	0	0
Terebellides stroemi	0	0	3	0	3	0	1	2	2	2	1
Tharyx marioni	0	3	0	0	3	0	1	2	2	1	0
Tharyx mcintoshi	0	0	0	0	3	0	1	2	2	1	0
Tharyx indet	0	3	0	0	3	1	2	2	2	1	0
Thyasira croulinensis	0	0	0	0	3	2	1	0	0	0	0
Thyasira equalis	0	0	0	0	3	0	3	0	0	0	0
Thyasira ferruginea	0	0	0	0	3	1	2	0	0	0	0
Thyasira flexuosa	0	0	0	0	3	0	3	0	0	0	0
Thyasira sarsi	0	0	0	0	3	0	0	3	0	0	0
Westwoodilla caecula	0	0	0	0	3	0	3	0	0	0	0
Yoldiella lucida	0	0	0	0	3	0	0	3	0	0	0

Traits	Number of reproductive cycles per year			Reproductive period				
Code	**NY1**	**NY2**	**NY3**	**RP1**	**RP2**	**RP3**	**RP4**	**RP5**
Species/category	**< 1**	**1**	**2 or more**	**December-February**	**March-May**	**June-August**	**September-November**	**no particular season**
Abra nitida	0	0	0	0	0	0	3	0
Ampharete indet	0	0	0	2	2	0	0	0
Ampharetidae indet	0	0	0	2	2	0	0	0
Amphilepis norvegica	0	0	0	0	0	0	0	0
Amphipholis squamata	0	0	0	0	0	0	0	0
Amphiura chiajei	3	0	0	0	0	2	2	0
Amphiura filiformis	0	3	0	0	2	2	2	0
Aora indet	0	0	0	0	0	0	0	0
Aphroditidae indet	0	3	0	1	2	0	1	0
Apseudes spinosus	0	0	0	0	0	0	0	0
Asychis biceps	0	0	0	0	0	0	0	0
Bathymedon longimanus	0	0	0	0	0	0	0	0
Brada villosa	0	0	0	0	0	0	0	0
Brissopsis lyrifera	3	0	0	0	0	0	3	0
Calocaris macandreae	3	0	0	0	0	0	0	3
Caudofoveata indet	0	0	0	0	0	0	0	0
Caulleriella killariensis	0	0	0	0	0	2	2	0
Caulleriella indet	0	0	0	2	0	0	2	0
Ceratocephale loveni	0	3	0	0	0	0	0	0
Chaetoparia nilssoni	0	0	0	0	0	2	2	0
Chaetozone setosa	0	2	2	0	2	1	1	0
Cossura longocirrata	0	0	0	0	2	2	2	0
Cuspidaria abbreviata	0	0	0	0	0	0	0	0
Cylichna alba	0	0	0	0	0	0	0	0
Desmosoma armatum	0	0	0	0	0	0	0	0
Desmosoma indet	0	0	0	0	0	0	0	0
Diastylis cornuta	0	0	0	0	0	0	0	0
Diastylis indet	0	2	0	1	2	2	0	0
Diastylis tumida	0	0	0	0	0	0	0	0
Diastyloides serrata	0	0	0	0	0	0	0	0
Diastylopsis resima	0	0	0	0	0	0	0	0
Diplocirrus glaucus	0	0	0	0	2	2	0	0
Drilonereis filum	0	0	0	0	0	0	0	0
Eclysippe vanelli	0	0	0	0	0	0	0	0
Eriopisa elongata	0	0	0	0	0	0	0	0
Eteone foliosa	0	0	0	0	3	0	0	0
Eteone picta	0	0	0	2	2	2	0	0
Eteone longa	0	0	0	0	3	0	0	0
Eudorella emarginata	0	0	0	0	0	0	0	0
Eudorella hirsuta	0	0	0	0	0	0	0	0
Eudorella indet	0	0	0	0	0	0	0	0
Eudorella truncatula	0	0	0	0	0	0	0	0
Eugerda tenuimana	0	0	0	0	0	0	0	0
Eunoe nodosa	0	3	0	0	0	0	0	0
Eurycope cornuta	0	0	0	0	0	0	0	0
Eurycope phalangium	0	0	0	0	0	0	0	0
Exogone dispar	0	0	0	0	0	3	0	0
Exogone hebes	0	0	0	0	0	0	0	0
Exogone indet	0	0	0	0	0	2	2	0
Exogone verugera	0	0	0	0	0	0	3	0
Glycera alba	0	0	0	2	0	0	1	0
Glycera capitata	0	0	0	0	0	2	2	0
Glycera lapidum	0	0	0	0	2	2	0	0
Glycera rouxii	0	3	0	0	0	2	2	0
Glycera indet	0	0	0	2	0	1	1	0
Glycinde nordmanni	0	0	0	0	0	3	0	0
Gnathia maxillaris	0	0	0	0	0	0	0	0
Golfingia indet	0	0	0	0	0	0	0	0
Goniada maculata	0	0	0	0	0	3	0	0
Harmothoe indet	0	3	0	2	2	0	2	0
Harpinia pectinata	0	0	0	0	0	0	0	0
Harpinia indet	0	0	0	0	0	0	0	0
Hemilamprops rosea	0	0	0	0	0	0	0	0
Hesionidae indet	0	0	0	0	0	0	0	3
Heteromastus filiformis	0	0	0	0	0	0	0	3
Hyalinoecia tubicola	0	0	0	0	0	0	0	0
Ilyarachna longicornis	0	0	2	0	0	0	0	3
Iphinoe trispinosa	0	0	3	0	0	0	0	0
Ischnosoma bispinosum	0	0	0	0	0	0	0	0
Leanira tetragona	0	3	0	0	0	0	0	0
Leptophoxus falcatus	0	0	0	0	0	0	0	0
Leptostylis longimana	0	0	0	0	0	0	0	0
Leucon acutirostris	0	0	0	0	0	0	0	0
Leucon nasica	0	3	0	2	2	0	2	0
Leucon indet	0	2	0	2	2	0	2	0
Lilljeborgia macronyx	0	0	0	0	0	0	0	0
Lilljeborgia indet	0	0	0	0	0	0	0	0
Lipobranchus jeffreysii	0	0	0	0	0	0	0	0
Lumbrineris fragilis	0	0	0	0	0	3	0	0
Lumbrineris gracilis	0	0	0	0	0	0	0	0
Lumbrineris scopa	0	0	0	0	0	0	0	0
Lumbrineris indet	0	0	0	0	0	2	2	0
Macrostylis spinifera	0	0	0	0	0	0	0	0
Maldane sarsi	0	0	0	3	0	0	0	0
Maldanidae indet	0	0	0	0	0	0	0	0
Mediomastus fragilis	0	0	0	0	3	0	0	0
Melinna cristata	0	0	0	3	0	0	0	0
Melinna palmata	0	0	0	0	0	0	0	0
Microclymene acirrata	0	0	0	0	0	0	0	0
Monoculodes indet	0	0	2	0	2	0	2	0
Munnopsis typica	0	0	0	0	0	0	0	0
Mystides southerni	0	0	0	0	0	0	0	0
Nemertinea indet	0	0	0	0	0	0	0	0

Traits	Number of reproductive cycles per year			Reproductive period				
Code	NY1	NY2	NY3	RP1	RP2	RP3	RP4	RP5
Species/category	< 1	1	2 or more	December-February	March-May	June-August	September-November	no particular season
Nephtys assimilis	0	0	3	0	2	2	0	0
Nephtys hombergii	0	0	3	0	2	2	0	0
Nephtys longosetosa	0	0	0	0	0	0	0	0
Nephtys indet	0	0	3	0	0	0	0	3
Notomastus latericeus	0	0	0	2	2	0	0	0
Nucula sulcata	0	0	0	0	0	0	0	0
Nucula tumidula	0	0	0	0	0	0	0	0
Nuculoma tenuis	0	0	0	0	0	3	0	0
Onchnesoma steenstrupi	0	0	0	0	0	0	0	0
Ophelina acuminata	0	0	0	0	0	0	0	0
Ophelina cylindricaudata	0	0	0	0	0	0	0	0
Ophelina modesta	0	0	0	0	0	0	0	0
Ophelina norvegica	0	0	0	3	0	0	0	0
Ophelina indet	0	0	0	3	0	0	0	0
Ophiodromus flexuosus	0	0	0	0	0	3	0	0
Ophryotrocha longidentata	0	3	0	0	3	0	0	0
Orbinia norvegica	0	0	0	3	0	0	0	0
Orbinia sertulata	0	0	0	0	0	0	0	0
Paradoneis eliasoni	0	0	0	0	0	0	0	0
Paradoneis lyra	0	0	0	0	2	2	0	0
Paramphinome jeffreysii	0	3	0	3	0	0	0	0
Paraonis fulgens	0	0	0	0	0	3	0	0
Paraonis gracilis	0	0	0	2	2	2	0	0
Parvicardium minimum	0	0	0	0	0	0	0	0
Pectinaria auricoma	0	2	1	0	0	3	0	0
Perioculodes longimanus	0	0	0	0	0	0	0	0
Phascolion strombi	0	0	0	0	0	0	0	0
Phascolosoma indet	0	0	0	0	0	0	0	0
Pherusa plumosa	0	0	0	0	0	3	0	0
Philomedes globosus	0	0	0	0	0	0	0	0
Philomedes lilljeborgi	0	0	0	0	0	0	0	0
Pholoe minuta	0	2	1	0	2	2	2	0
Pholoe pallida	0	0	0	0	0	0	3	0
Pholoe indet	0	2	1	0	2	2	1	0
Photidae indet	0	0	0	0	0	0	0	0
Phoxocephalidae indet	0	0	0	0	0	0	0	0
Phoxocephalus holbolli	0	0	0	0	0	0	0	0
Phyllodoce longipes	0	0	0	0	0	0	0	0
Phyllodoce rosea	0	0	0	0	0	2	2	0
Phyllodocidae indet	0	0	0	0	0	0	0	3
Platyhelminthes indet	0	0	0	0	0	0	0	0
Podoceridae indet	0	2	2	0	0	0	0	3
Polycirrus latidens	0	0	0	0	0	0	0	0
Polycirrus norvegicus	0	0	0	0	0	0	0	0
Polycirrus plumosus	0	0	0	0	0	0	0	0
Polycirrus indet	0	0	0	0	0	0	0	0
Polydora caulleryi	0	0	0	1	2	0	0	0
Polydora ciliata	0	2	1	0	0	0	0	3
Polydora flava	0	0	0	0	0	2	2	0
Polydora indet	0	2	1	0	0	0	0	3
Priapulus caudatus	0	0	0	0	0	0	0	0
Prionospio banyulensis	0	0	0	0	0	3	0	0
Prionospio cirrifera	0	0	0	0	0	3	0	0
Prionospio fallax	0	3	0	0	2	2	0	0
Prionospio indet	0	3	0	0	2	2	0	0
Prionospio steenstrupi	0	3	0	0	2	2	0	0
Pseudamussium septemradiatum	0	0	0	0	0	0	0	0
Pseudopolydora paucibranchiata	0	0	0	0	2	2	2	0
Rhodine loveni	0	0	0	0	0	0	0	0
Scalibregma inflatum	0	0	0	0	0	0	3	0
Scoloplos armiger	0	3	0	0	2	2	0	0
Sigalionodae indet	0	0	0	0	2	2	2	0
Sipunculida indet	0	0	0	0	0	0	0	0
Sphaerodoridae indet	0	0	0	0	0	2	2	0
Sphyrapus anomalus	0	0	0	0	0	0	0	0
Spionidae indet	0	3	0	0	0	0	0	3
Spiophanes kroeyeri	0	3	0	1	2	0	1	0
Sthenelais jeffreysii	0	0	0	0	0	0	0	0
Streblosoma bairdi	0	0	0	0	0	0	0	0
Syllidae indet	0	2	2	0	2	2	2	0
Synchelidium brevicarpum	0	0	0	0	0	0	0	0
Synchelidium haplocheles	0	0	0	0	0	0	0	0
Synelmis klatti	0	3	0	0	0	3	0	0
Tanaidacea indet	0	0	0	0	0	0	0	0
Terebellidae indet	0	3	0	0	2	2	2	0
Terebellides stroemi	0	3	0	0	1	0	2	0
Tharyx marioni	0	3	0	0	2	0	2	0
Tharyx mcintoshi	0	0	0	0	0	2	2	0
Tharyx indet	0	3	0	0	1	2	1	0
Thyasira croulinensis	0	0	0	0	0	0	0	0
Thyasira equalis	0	0	0	0	0	0	0	0
Thyasira ferruginea	0	0	0	0	0	0	0	0
Thyasira flexuosa	0	0	0	0	0	0	0	0
Thyasira sarsi	0	0	0	0	0	0	0	0
Westwoodilla caecula	0	0	2	0	2	2	0	0
Yoldiella lucida	0	0	0	0	0	0	0	0

Traits	Reproductive technique				Sediment dwelling depth				
Code	RT1	RT2	RT3	RT4	SD1	SD2	SD3	SD4	SD5
Species/category	**asexual (budding)**	**broadcast spawner**	**Demersal eggs**	**Brooder, viviparous**	**0 cm (surface)**	**0-1cm**	**1-5cm**	**5-15cm**	**>15 cm**
Abra nitida	0	3	0	0	2	2	2	0	0
Ampharete indet	0	0	0	0	1	2	2	0	0
Ampharetidae indet	0	0	0	0	2	2	2	1	0
Amphilepis norvegica	0	0	0	0	0	0	1	2	0
Amphipholis squamata	0	0	0	3	0	0	0	0	0
Amphiura chiajei	0	0	2	0	1	2	2	1	0
Amphiura filiformis	0	0	2	0	0	2	2	1	0
Aora indet	0	0	0	3	3	0	0	0	0
Aphroditidae indet	0	3	0	0	1	2	2	0	0
Apseudes spinosus	0	0	0	3	2	2	0	0	0
Asychis biceps	0	0	0	0	1	2	2	1	0
Bathymedon longimanus	0	0	0	3	2	2	0	0	0
Brada villosa	0	0	0	0	1	2	2	0	0
Brissopsis lyrifera	0	0	0	0	0	0	0	3	0
Calocaris macandreae	0	0	0	3	1	1	2	2	0
Caudofoveata indet	0	0	3	0	2	2	2	0	0
Caulleriella killariensis	0	0	0	0	1	2	0	0	0
Caulleriella indet	0	0	3	0	1	2	0	0	0
Ceratocephale loveni	0	0	0	0	0	2	2	2	0
Chaetoparia nilssoni	0	0	3	0	1	2	0	0	0
Chaetozone setosa	0	0	3	0	1	2	0	0	0
Cossura longocirrata	0	0	3	0	0	2	2	0	0
Cuspidaria abbreviata	0	3	0	0	1	2	2	0	0
Cylichna alba	0	0	3	0	2	2	0	0	0
Desmosoma armatum	0	0	0	3	2	1	0	0	0
Desmosoma indet	0	0	0	3	2	1	0	0	0
Diastylis cornuta	0	0	0	3	2	2	0	0	0
Diastylis indet	0	0	0	3	2	2	0	0	0
Diastylis tumida	0	0	0	3	2	2	0	0	0
Diastyloides serrata	0	0	0	3	2	2	0	0	0
Diastylopsis resima	0	0	0	3	2	2	0	0	0
Diplocirrus glaucus	0	0	0	0	1	2	2	0	0
Drilonereis filum	0	0	0	0	2	2	1	0	0
Eclysippe vanelli	0	0	0	0	1	2	2	0	0
Eriopisa elongata	0	0	0	3	3	0	0	0	0
Eteone foliosa	0	0	0	0	1	2	0	0	0
Eteone picta	0	0	0	0	1	2	0	0	0
Eteone longa	0	0	3	0	1	2	0	0	0
Eudorella emarginata	0	0	0	3	2	2	0	0	0
Eudorella hirsuta	0	0	0	3	2	2	0	0	0
Eudorella indet	0	0	0	3	2	2	0	0	0
Eudorella truncatula	0	0	0	3	2	2	0	0	0
Eugerda tenuimana	0	0	0	3	2	1	0	0	0
Eunoe nodosa	0	0	0	0	3	0	0	0	0
Eurycope cornuta	0	0	0	3	2	1	0	0	0
Eurycope phalangium	0	0	0	3	2	1	0	0	0
Exogone dispar	0	0	0	3	2	1	0	0	0
Exogone hebes	0	0	0	3	2	1	0	0	0
Exogone indet	0	0	0	3	2	1	0	0	0
Exogone verugera	0	0	0	3	2	1	0	0	0
Glycera alba	0	0	0	0	1	2	2	1	1
Glycera capitata	0	0	0	0	1	2	2	1	1
Glycera lapidum	0	0	0	0	1	2	1	0	0
Glycera rouxii	0	3	0	0	1	2	2	1	1
Glycera indet	0	0	0	0	1	2	1	0	0
Glycinde nordmanni	0	0	3	0	1	2	0	0	0
Gnathia maxillaris	0	0	0	3	2	1	0	0	0
Golfingia indet	0	0	0	0	0	1	2	2	2
Goniada maculata	0	0	0	0	1	2	0	0	0
Harmothoe indet	0	2	0	2	2	1	0	0	0
Harpinia pectinata	0	0	0	3	2	2	0	0	0
Harpinia indet	0	0	0	3	2	2	0	0	0
Hemilamprops rosea	0	0	0	3	2	2	0	0	0
Hesionidae indet	0	0	3	0	2	2	1	0	0
Heteromastus filiformis	0	0	0	0	1	2	2	2	1
Hyalinoecia tubicola	0	0	0	0	3	0	0	0	0
Ilyarachna longicornis	0	0	0	3	2	1	0	0	0
Iphinoe trispinosa	0	0	0	3	2	2	0	0	0
Ischnosoma bispinosum	0	0	0	3	2	1	0	0	0
Leanira tetragona	0	0	0	0	1	2	2	0	0
Leptophoxus falcatus	0	0	0	3	2	2	0	0	0
Leptostylis longimana	0	0	0	3	2	2	0	0	0
Leucon acutirostris	0	0	0	3	2	2	0	0	0
Leucon nasica	0	0	0	3	2	2	0	0	0
Leucon indet	0	0	0	3	2	2	0	0	0
Lilljeborgia macronyx	0	0	0	3	3	0	0	0	0
Lilljeborgia indet	0	0	0	3	3	0	0	0	0
Lipobranchus jeffreysii	0	0	0	0	1	2	2	0	0
Lumbrineris fragilis	0	0	0	0	2	2	2	1	0
Lumbrineris gracilis	0	0	0	0	2	1	0	0	0
Lumbrineris scopa	0	0	3	0	2	2	1	0	0
Lumbrineris indet	0	0	3	0	2	2	1	0	0
Macrostylis spinifera	0	0	0	3	2	1	0	0	0
Maldane sarsi	2	0	2	0	1	2	2	1	0
Maldanidae indet	0	2	1	0	1	2	2	2	1
Mediomastus fragilis	0	0	3	0	1	2	1	0	0
Melinna cristata	0	0	0	0	2	2	2	1	0
Melinna palmata	0	0	0	0	1	2	1	0	0
Microclymene acirrata	0	0	0	0	1	2	1	0	0
Monoculodes indet	0	0	0	3	2	2	0	0	0
Munnopsis typica	0	0	0	3	2	1	0	0	0
Mystides southerni	0	0	0	0	1	2	0	0	0
Nemertinea indet	0	0	0	0	2	2	2	0	0

Traits	Reproductive technique				Sediment dwelling depth				
Code	RT1	RT2	RT3	RT4	SD1	SD2	SD3	SD4	SD5
Species/category	asexual (budding	broadcast spawne	Demersal eggs	Brooder, viviparous	0 cm (surface)	0-1cm	1-5cm	5-15cm	>15 cm
Nephtys assimilis	0	3	0	0	1	2	2	1	0
Nephtys hombergii	0	3	0	0	1	2	2	1	1
Nephtys longosetosa	0	3	0	0	1	2	1	0	0
Nephtys indet	0	3	0	0	1	2	1	0	0
Notomastus latericeus	0	0	0	0	1	2	2	2	1
Nucula sulcata	0	3	0	0	0	1	2	0	0
Nucula tumidula	0	3	0	0	0	1	2	0	0
Nuculoma tenuis	0	3	0	0	0	1	2	0	0
Onchnesoma steenstrupi	0	0	0	0	0	2	2	2	0
Ophelina acuminata	0	0	0	0	0	2	2	1	0
Ophelina cylindricaudata	0	2	2	0	0	2	2	1	0
Ophelina modesta	0	0	0	0	1	2	1	0	0
Ophelina norvegica	0	0	0	0	1	2	2	1	0
Ophelina indet	0	0	0	0	1	2	2	1	0
Ophiodromus flexuosus	0	0	3	0	2	1	0	0	0
Ophryotrocha longidentata	0	3	0	0	2	2	0	0	0
Orbinia norvegica	0	0	0	0	0	2	2	1	0
Orbinia sertulata	0	0	0	0	0	2	2	1	0
Paradoneis eliasoni	0	0	0	0	1	2	1	1	0
Paradoneis lyra	0	0	0	0	1	2	1	1	0
Paramphinome jeffreysii	0	0	0	0	2	1	1	1	0
Paraonis fulgens	0	0	3	0	1	2	1	1	0
Paraonis gracilis	0	0	0	0	1	2	1	1	0
Parvicardium minimum	0	3	0	0	2	2	0	0	0
Pectinaria auricoma	0	3	0	0	1	2	1	0	0
Perioculodes longimanus	0	0	0	3	2	2	0	0	0
Phascolion strombi	0	0	0	0	0	0	0	0	0
Phascolosoma indet	0	0	0	0	0	0	0	0	0
Pherusa plumosa	0	0	0	0	1	2	1	0	0
Philomedes globosus	0	0	0	3	3	0	0	0	0
Philomedes lilljeborgi	0	0	0	3	3	0	0	0	0
Pholoe minuta	0	2	2	0	1	2	0	0	0
Pholoe pallida	0	0	3	0	1	2	0	0	0
Pholoe indet	0	2	2	0	1	2	0	0	0
Photidae indet	0	0	0	3	3	0	0	0	0
Phoxocephalidae indet	0	0	0	3	2	2	0	0	0
Phoxocephalus holbolli	0	0	0	3	2	2	0	0	0
Phyllodoce longipes	0	0	3	0	2	2	0	0	0
Phyllodoce rosea	0	0	3	0	2	2	0	0	0
Phyllodocidae indet	0	0	3	0	2	2	0	0	0
Platyhelminthes indet	2	0	0	0	2	0	0	0	0
Podoceridae indet	0	0	0	3	3	0	0	0	0
Polycirrus latidens	0	0	0	0	1	2	1	0	0
Polycirrus norvegicus	0	0	0	0	1	2	1	0	0
Polycirrus plumosus	0	0	0	0	1	2	1	0	0
Polycirrus indet	0	0	0	0	1	2	1	0	0
Polydora caulleryi	0	0	0	0	1	2	1	0	0
Polydora ciliata	0	1	2	2	1	2	1	0	0
Polydora flava	0	0	3	0	1	2	1	0	0
Polydora indet	0	1	2	2	1	2	1	0	0
Priapulus caudatus	0	0	0	0	0	2	2	2	2
Prionospio banyulensis	0	0	3	0	1	2	2	1	0
Prionospio cirrifera	0	0	0	0	1	2	2	1	0
Prionospio fallax	0	3	0	0	1	2	2	1	0
Prionospio indet	0	3	0	0	1	2	2	1	0
Prionospio steenstrupi	0	3	0	0	1	2	2	1	0
Pseudamussium septemradiatum	0	3	0	0	3	0	0	0	0
Pseudopolydora paucibranchiata	0	0	2	2	1	2	1	0	0
Rhodine loveni	0	0	3	0	1	2	2	1	1
Scalibregma inflatum	0	0	3	0	1	2	2	2	2
Scoloplos armiger	0	2	2	2	2	2	2	1	1
Sigalionodae indet	0	0	2	2	1	2	1	0	0
Sipunculida indet	0	0	0	0	2	2	2	0	0
Sphaerodoridae indet	0	0	3	0	2	1	0	0	0
Sphyrapus anomalus	0	0	0	3	2	2	0	0	0
Spionidae indet	0	3	0	0	1	2	2	1	0
Spiophanes kroeyeri	0	0	0	0	1	2	2	1	0
Sthenelais jeffreysii	0	0	0	0	1	2	1	0	0
Streblosoma bairdi	0	0	0	0	1	2	2	1	0
Syllidae indet	2	0	2	2	2	2	0	0	0
Synchelidium brevicarpum	0	0	0	3	2	2	0	0	0
Synchelidium haplocheles	0	0	0	3	2	2	0	0	0
Synelmis klatti	0	0	0	0	3	0	0	0	0
Tanaidacea indet	0	0	0	3	2	1	0	0	0
Terebellidae indet	0	1	2	0	1	2	2	1	0
Terebellides stroemi	0	0	3	0	1	2	2	1	0
Tharyx marioni	0	0	3	0	1	2	2	0	0
Tharyx mcintoshi	0	0	0	0	1	2	2	0	0
Tharyx indet	0	0	3	0	1	2	2	0	0
Thyasira croulinensis	0	0	0	0	2	2	0	0	0
Thyasira equalis	0	0	0	0	2	2	2	1	0
Thyasira ferruginea	0	0	0	0	2	2	1	0	0
Thyasira flexuosa	0	0	0	0	2	2	2	0	0
Thyasira sarsi	0	0	0	0	2	2	2	0	0
Westwoodilla caecula	0	0	0	3	2	2	0	0	0
Yoldiella lucida	0	3	0	0	2	2	2	1	0

Phylum	Class	Order	Family	Species
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aedicira belgicae*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Alentia australis*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Allmaniella sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Amaeana trilobata*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Amaryllis macrophthalma*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca anisuropa*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca anomala*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca brevicornis*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca chiltoni*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca excavata*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca fusca*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca miops*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca palmata*
Annelida	Polychaeta	Terebellida	Ampheretidae	*Ampherete sp.*
Annelida	Polychaeta	Sabellida	Sabellidae	*Amphiglena mediterranea*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Amphinomidae juv.*
Echinodermata	Stelleroidea	Ophiurida	Amphiuridae	*Amphiura sp.*
Annelida	Polychaeta	Phyllodocida	Pilargidae	*Ancistrosyllis parva*
Cnidaria	Anthozoa	Anthozoa	Anthozoa	*Anemone sp. A*
Cnidaria	Anthozoa	Anthozoa	Anthozoa	*Anemone sp. B*
			Arcturidae	*Antarturus beliaevei*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Aora gibbula*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Aora kergueleni*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Aora sp.*
			Apistobranchidae	*Apistobranch*
Arthropoda	Malacostraca	Tanaidacea	Tanaidae	*Apseudes cooperi*
			Neomeniidae	*Archaeomenia prisca*
			Arenicolidae	*Arenicola sp.*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Aricidea sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Artacama proboscidea*
			Ascidian	*Ascidian sp. A*
			Asellota	*Asellota sp.*
			Astropectinidae	*Astropectin sp. A*
			Dexaminidae	*Atylus swammerdamei*
Annelida	Polychaeta	Capitellida	Maldanidae	*Axiothella jarli*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Bathynectes piperitus*
			Haustoriidae	*Bathyporeia sp.*
Mollusca	Bivalvia	Bivalvia	Bivalvia	*Bivalve sp. A - mussels*
Mollusca	Bivalvia	Bivalvia	Bivalvia	*Bivalve sp. C*
Mollusca	Bivalvia	Bivalvia	Bivalvia	*Bivalve sp. D - scallop*
			Schizasteridae	*Brisaster capensis*
Echinodermata	Echinoidea	Spatangoida	Brissidae	*Brissopsis lyrifera capensis*
			Bryozoa	*Bryozoa sp.*
			Eusiridae	*Calliopiella michaelseni*
			Caprellidae	*Caperellid sp.*
Annelida	Polychaeta	Capitellida	Capitellidae	*Capitella capitata*
Annelida	Polychaeta	Spionida	Chaetopteridae	*Chaetopterus varieopedatus*
Arthropoda	Malacostraca	Amphipoda	Gammaridae	*Cheirocratus inermis*
			Corophiidae	*Chevalia aviculae*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Chloeia inermis*
			Cirolanidae	*Cirolana borealis*
			Cirolanidae	*Cirolana caeca*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus africanus*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus sp.*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirriformia filigera*
Arthropoda	Malacostraca	Amphipoda	Colomastigidae	*Colomastix pusilla*
			Corophiidae	*Corophid sp. A*
			Corophiidae	*Corophium sp.*
Annelida	Polychaeta	Cossurida	Cossuridae	*Cossura coasta*
Arthropoda	Malacostraca	Decapoda	Decapoda	*Crab sp. A*
Arthropoda	Malacostraca	Crustacea	Crustacea	*Crustacea larvae*
Arthropoda	Malacostraca	Cumacea	Diastylidae	*Cumacid sp. A*
			Cuspidariidae	*Cuspidaria sp.*
Annelida	Polychaeta	Eunicida	Eunicidae	*Diopatra cuprea cuprea*
Annelida	Polychaeta	Eunicida	Eunicidae	*Diopatra dubia*
Annelida	Polychaeta	Eunicida	Eunicidae	*Diopatra monroi*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Diplocirrus capensis*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Dodecacerra fuscia*
Echinodermata	Echinoidea	Spatantangoida	Curculionoidae	*Echinocardium cordatum*
Annelida	Polychaeta	Eunicida	Eunicidae	*Epidiopatra hupferiana hupferiana*
Annelida	Polychaeta	Amphinomida	Paramphithoidae	*Epimeria cornigera*
Arthropoda	Malacostraca	Amphipoda	Gammaridae	*Eriopisella capensis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymene quadrilobata*
Annelida	Polychaeta	Capitellida	Maldanidae	*Euclymene sp.*
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice grubei*
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice schemacephala*
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice sp. A*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Eunoe hubrechti cf.*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Exogone normalis*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Flabelligerid sp. A*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Flabelligerid sp. B*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Gammaropsis afra*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Gammaropsis longicarpus*
Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Gammaropsis palmoides*
Mollusca	Gastropoda	Gastropoda	Gastropoda	*Gastropod sp. A - spiral ridged*
Mollusca	Gastropoda	Gastropoda	Gastropoda	*Gastropod sp. B - cowrie like*
Mollusca	Gastropoda	Gastropoda	Gastropoda	*Gastropod sp. C*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera alba*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera convoluta*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera longipinnis*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera papillosa*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Glycinde capensis*
Phylum	**Class**	**Order**	**Family**	**Species**
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Glycinde sp. c.f.*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada emerita*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada maculata*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniadella gracilis*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniadopsis maskallensis*
			Gorgonian	*Gorgonian sp.*

			Dexaminidae	*Guernea rhomba*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Gyptis capensis*
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	*Halicreion ovalitelson*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Haploscoloplos kerguelensis*
			Anomura	*Hermit crab sp.*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Heterophoxus cephalodens*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Heterophoxus opus*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Hippomedon longimanus*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Hippomedon normalis*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Hippomedon onconotus*
			Holothuroidea	*Holothuroid sp. A*
			Holothuroidea	*Holothuroid sp. B*
			Holothuroidea	*Holothuroid sp. C*
			Onuphidae	*Hyalinoecia tubicola*
			Isopilidae	*Isopilus sp. c.f.*
			Anthuridae	*Katanthura laevitelson*
			Terebratulidae	*Lamp shell sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Lanassa capensis*
Annelida	Polychaeta	Spionida	Spionidae	*Laonice cirrata*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Lepidasthenia sp.*
			Chiton	*Leptochiton sykesi*
Arthropoda	Malacostraca	Decapoda	Sergestidae	*Lucifer chacei*
Annelida	Polychaeta	Capitellida	Maldanidae	*Lumbriclymene cylindricauda*
Annelida	Polychaeta	Capitellida	Maldanidae	*Lumbriclymene minor*
Annelida	Polychaeta	Capitellida	Maldanidae	*Lumbriclymene sp.*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris albidentata*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris brevicirra*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris magalhaensis*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sp.*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris tetraura*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Lysianassa minimus*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Macellicephala sp.*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Macoma crawfordi*
Annelida	Polychaeta	Capitellida	Maldanidae	*Macroclymene saldanha*
Annelida	Polychaeta	Spionida	Magelonidae	*Magelona capensis*
Annelida	Polychaeta	Spionida	Spionidae	*Malacoceros indicus*
Annelida	Polychaeta	Capitellida	Maldanidae	*Maldanid sp.*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Malmgrenia marquesensis*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Mandibulophoxus stimpsoni*
Annelida	Polychaeta	Eunicida	Eunicidae	*Marphysa adenensis*
			Anthuridae	*Mesanthura catenula*
			Calappidae	*Mursia cristimanus*
			Phyllocarida	*Nebalia capensis*
Nematoda	Nematoda	Nematoda	Nematoda	*Nematode sp. A*
Nematoda	Nematoda	Nematoda	Nematoda	*Nematode sp. B*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. A*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. B*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. C*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. D*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. E*
Nemertinea	Anopla	Anopla	Nemertea	*Nemertea sp. F*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys capensis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys hombergi*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys macroura*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys malmgreni*
Annelida	Polychaeta	Spionida	Spionidae	*Nerinides gilchristi*
Annelida	Polychaeta	Spionida	Spionidae	*Nerinides sp.*
Annelida	Polychaeta	Capitellida	Maldanidae	*Nicomache lumbricalis*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericeus*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis eremita*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis geophiliformis*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis holobranchiata*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis sp. A*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelia sp.*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina acuminata*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus spinosus*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura sp.A*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura sp.B*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbinia angrapequensis*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbinia bioreti*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbiniidae*
			Ostracod	*Ostracod sp. A*
			Ostracod	*Ostracod sp. B*
Annelida	Polychaeta	Oweniida	Oweniidae	*Owenia sp.*
			Anthuridae	*Panathura serricauda*
			Eusiridae	*Paramoera capensis*
			Stegocephalidae	*Parandania boecki*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paraonides sp.*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Paraphoxus oculatus*
Arthropoda	Malacostraca	Amphipoda	Gammaridae	*Parelasmopus suluensis*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria koreni cirrata*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria sp. juv*
Sipuncula	Phascolosomatidea	Phascolosomatiformes	Phascolosomatidae	*Phascolosoma sp.*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Pherusa sp.*
			Corophiidae	*Photis dolichommata*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce longipes*
Phylum	**Class**	**Order**	**Family**	**Species**
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce tubicola*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodocid sp. A*
Annelida	Polychaeta	Terebellida	Terebellidae	*Phylo capensis*
Annelida	Polychaeta	Terebellida	Terebellidae	*Pista brevibranchia*
Annelida	Polychaeta	Terebellida	Terebellidae	*Pista cristata*
Annelida	Polychaeta	Terebellida	Terebellidae	*Pista sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Pista unibranchia*
			Corophiidae	*Podoceropsis sophiae*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus plumosus*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Polycirrus tenuisetis*
Annelida	Polychaeta	Spionida	Spionidae	*Polydora sp.*
			Polygordiidae	*Polygordiidae sp.*

Annelida	Polychaeta	Opheliida	Scalibregmidae	*Polyphysia crassa*
			Crangonidae	*Pontophilus gracilis*
Annelida	Polychaeta	Capitellida	Maldanidae	*Praxillella capensis*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrifera*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrobranchiata*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio saldanha*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio sexoculata*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio sp.*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio steenstrupi*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Protomystides capensis*
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	*Pseudoharpinia excavata*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Pterygosquilla armata capensis*
Annelida	Polychaeta	Eunicida	Eunicidae	*Ramphobranchium capense*
			Retusidae	*Retusidae sp. A*
Annelida	Polychaeta	Opheliida	Scalibregmidae	*Scalibregma inflatum*
			Scallpellidae	*Scalpellum sp.*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Schroederella pauliani*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Scoloplella capensis*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Scoloplos uniramus*
			Oxystele	*Sea snail*
			Corophiidae	*Siphonoecetes orientalis*
			Corophiidae	*Siphonoecetes sp.*
Sipuncula	Sipuncula	Sipuncula	Sipunculidae	*Sipunculid sp.*
Annelida	Polychaeta	Spionida	Spionidae	*Spio sp. juv*
Annelida	Polychaeta	Spionida	Spionidae	*Spionidae sp. juv*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes bombyx*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes soederstromi*
Annelida	Polychaeta	Phyllodocida	Aphroditidae	*Sthenelais papillosa*
Annelida	Polychaeta	Terebellida	Terebellidae	*Streblosoma abranchiata*
Annelida	Polychaeta	Terebellida	Terebellidae	*Streblosoma persica*
Annelida	Polychaeta	Spionida	Spionidae	*Streblospio sp.*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Syllidia armata*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Syllidia cornuta*
Annelida	Polychaeta	Phyllodocida	Syllidae	*Syllis cornuta*
Arthropoda	Malacostraca	Tanaidacea	Tanaidae	*Tanais philetaerus*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Tellina sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Terebellides sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Terebellides stroemi*
Brachiopoda	Rhynchonellata	Terebratulida	Terebratulidae	*Terebratulina meridionalis*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx annulosus*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx marioni*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx sp.*
Annelida	Polychaeta	Terebellida	Terebellidae	*Trichobranchus glacialis*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Triodos insignis*
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	*Trischizostoma serratum*
Echinodermata	Echinoidea	Spatantangoida	Spatantangoida	*Urchin juv.*
Arthropoda	Malacostraca	Amphipoda	Haustoriidae	*Urothoe coxalis*
Arthropoda	Malacostraca	Amphipoda	Haustoriidae	*Urothoe elegans*
Arthropoda	Malacostraca	Amphipoda	Haustoriidae	*Urothoe grimaldi*
Arthropoda	Malacostraca	Amphipoda	Haustoriidae	*Urothoe pinnata*
Cnidaria	Anthozoa	Pennatulacea	Virgulariidae	*Virgularia schultzei*

Traits	**Average captured size**						**Maximum adult size**					
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**
Taxa/Code	**NS1A**	**NS2A**	**NS3A**	**NS4A**	**NS5A**	**NS6A**	**NS1B**	**NS2B**	**NS3B**	**NS4B**	**NS5B**	**NS6B**
Aedicira belgicae	0	3	0	0	0	0	0	0	3	0	0	0
Alentia australis	0	0	3	0	0	0	0	0	0	0	3	0
Allmaniella sp.	0	3	0	0	0	0	0	0	2	2	0	0
Amaeana trilobata	0	0	3	0	0	0	0	0	3	0	0	0
Amaryllis macrophthalma	0	3	0	0	0	0	0	0	3	0	0	0
Ampelisca anisuropa	3	0	0	0	0	0	0	2	2	0	0	0
Ampelisca anomala	3	0	0	0	0	0	0	3	0	0	0	0
Ampelisca brevicornis	0	3	0	0	0	0	0	0	3	0	0	0
Ampelisca chiltoni	3	0	0	0	0	0	0	2	2	0	0	0
Ampelisca excavata	3	0	0	0	0	0	0	0	3	0	0	0
Ampelisca fusca	3	0	0	0	0	0	0	2	2	0	0	0
Ampelisca miops	3	0	0	0	0	0	0	2	2	0	0	0
Ampelisca palmata	0	3	0	0	0	0	0	2	2	0	0	0
Ampherete sp.	0	3	0	0	0	0	0	0	1	1	1	0
Amphiglena mediterranea	3	0	0	0	0	0	0	0	3	0	0	0
Amphinomidae juv.	3	0	0	0	0	0	1	1	1	1	1	1
Amphiura sp.	3	0	0	0	0	0	0	2	2	2	0	0
Ancistrosyllis parva	0	0	3	0	0	0	0	3	0	0	0	0
Anemone sp. A	0	0	0	3	0	0	1	1	1	1	1	1
Anemone sp. B	0	3	0	0	0	0	1	1	1	1	1	1
Antarturus beliaevei	0	3	0	0	0	0	0	0	2	2	0	0
Aora gibbula	0	3	0	0	0	0	0	0	3	0	0	0
Aora kergueleni	3	0	0	0	0	0	0	3	0	0	0	0
Aora sp.	0	3	0	0	0	0	0	0	3	0	0	0
Apistobranch	3	0	0	0	0	0	0	2	2	0	0	0
Apseudes cooperi	0	3	0	0	0	0	0	0	3	0	0	0
Archaeomenia prisca	0	0	3	0	0	0	0	0	3	0	0	0
Arenicola sp.	0	0	3	0	0	0	0	0	0	0	0	3
Aricidea sp.	0	3	0	0	0	0	0	2	2	0	0	0
Artacama proboscidea	0	0	0	0	3	0	0	0	0	0	3	0
Ascidian sp. A	3	0	0	0	0	0	0	0	0	2	2	0
Asellota sp.	3	0	0	0	0	0	1	1	1	0	0	0
Astropectin sp. A	0	0	0	3	0	0	0	0	0	0	0	3
Atylus swammerdamei	0	3	0	0	0	0	2	2	0	0	0	0
Axiothella jarli	0	0	0	3	0	0	0	0	0	3	0	0
Bathynectes piperitus	0	3	0	0	0	0	0	0	0	0	2	2
Bathyporeia sp.	3	0	0	0	0	0	2	2	0	0	0	0
Bivalve sp. A - mussels	3	0	0	0	0	0	1	1	1	1	1	1
Bivalve sp. C	3	0	0	0	0	0	1	1	1	1	1	1
Bivalve sp. D - scallop	3	0	0	0	0	0	1	1	1	1	1	1
Brisaster capensis	0	0	0	3	0	0	0	0	0	2	2	0
Brissopsis lyrifera capensis	0	0	3	0	0	0	0	0	0	0	3	0
Bryozoa sp.	0	0	3	0	0	0	1	1	1	1	1	1
Calliopiella michaelseni	3	0	0	0	0	0	0	0	3	0	0	0
Caperellid sp.	3	0	0	0	0	0	0	2	2	2	2	2
Capitella capitata	0	3	0	0	0	0	0	0	0	3	0	0
Chaetopterus varieopedatus	0	3	0	0	0	0	0	0	0	0	0	3
Cheirocratus inermis	3	0	0	0	0	0	0	3	0	0	0	0
Chevalia aviculae	3	0	0	0	0	0	0	3	0	0	0	0
Chloeia inermis	0	0	3	0	0	0	0	0	0	3	0	0
Cirolana borealis	0	3	0	0	0	0	0	0	3	0	0	0
Cirolana caeca	3	0	0	0	0	0	0	0	3	0	0	0
Cirratulus africanus	0	0	0	3	0	0	0	0	0	0	0	3
Cirratulus sp.	0	0	3	0	0	0	0	0	0	0	0	3
Cirriformia filigera	0	3	0	0	0	0	0	0	0	0	0	3
Colomastix pusilla	3	0	0	0	0	0	0	0	3	0	0	0
Corophid sp. A	3	0	0	0	0	0	2	2	0	0	0	0
Corophium sp.	3	0	0	0	0	0	2	2	0	0	0	0
Cossura coasta	3	0	0	0	0	0	0	0	3	0	0	0
Crab sp. A	3	0	0	0	0	0	1	1	1	1	1	1
Crustacea larvae	3	0	0	0	0	0	1	1	1	1	1	1
Cumacid sp. A	0	3	0	0	0	0	2	2	1	0	0	0
Cuspidaria sp.	3	0	0	0	0	0	0	2	2	0	0	0
Diopatra cuprea cuprea	0	0	3	0	0	0	0	0	2	2	0	0
Diopatra dubia	0	0	3	0	0	0	0	0	2	2	0	0
Diopatra monroi	0	0	3	0	0	0	0	0	2	2	0	0
Diplocirrus capensis	0	3	0	0	0	0	0	0	3	0	0	0
Dodecacerra fuscia	0	0	3	0	0	0	0	0	3	0	0	0
Echinocardium cordatum	0	0	3	0	0	0	0	0	0	0	3	0
Epidiopatra hupferiana hupferiana	0	0	3	0	0	0	0	0	3	0	0	0
Epimeria cornigera	0	3	0	0	0	0	0	2	2	0	0	0
Eriopisella capensis	0	3	0	0	0	0	0	2	2	0	0	0
Euclymene quadrilobata	0	0	0	3	0	0	0	0	0	0	3	0
Euclymene sp.	0	0	0	3	0	0	0	0	0	1	1	1
Eunice grubei	0	0	3	0	0	0	0	0	0	0	0	3
Eunice schemacephala	0	0	3	0	0	0	0	0	0	0	3	0
Eunice sp. A	0	3	0	0	0	0	0	0	1	1	1	1
Eunoe hubrechti cf.	0	0	3	0	0	0	0	0	3	0	0	0
Exogone normalis	0	3	0	0	0	0	0	3	0	0	0	0
Flabelligerid sp. A	0	3	0	0	0	0	0	0	1	1	0	0
Flabelligerid sp. B	3	0	0	0	0	0	0	0	1	1	0	0
Gammaropsis afra	0	3	0	0	0	0	2	2	1	0	0	0
Gammaropsis longicarpus	0	3	0	0	0	0	2	2	1	0	0	0
Gammaropsis palmoides	3	0	0	0	0	0	2	2	1	0	0	0
Gastropod sp. A - spiral ridged	3	0	0	0	0	0	1	1	1	1	1	1
Gastropod sp. B - cowrie like	0	3	0	0	0	0	1	1	1	1	1	1
Gastropod sp. C	0	3	0	0	0	0	1	1	1	1	1	1
Glycera alba	0	0	3	0	0	0	0	0	0	2	3	0
Glycera convoluta	0	0	3	0	0	0	0	0	0	2	3	2
Glycera longipinnis	0	0	3	0	0	0	0	0	0	2	3	2
Glycera papillosa	0	0	3	0	0	0	0	0	0	2	3	2
Glycinde capensis	0	0	3	0	0	0	0	0	0	2	0	0
Glycinde sp. c.f.	0	0	3	0	0	0	0	0	0	2	3	2
Goniada emerita	0	0	3	0	0	0	0	0	0	3	0	0
Goniada maculata	0	0	3	0	0	0	0	0	0	3	0	0

Traits	**Average captured size**						**Maximum adult size**					
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**
Taxa/Code	**NS1A**	**NS2A**	**NS3A**	**NS4A**	**NS5A**	**NS6A**	**NS1B**	**NS2B**	**NS3B**	**NS4B**	**NS5B**	**NS6B**
Goniadella gracilis	0	0	0	3	0	0	0	0	0	3	0	0
Goniadopsis maskallensis	0	0	0	3	0	0	0	0	0	2	0	0
Gorgonian sp.	0	3	0	0	0	0	1	1	1	1	1	1
Guernea rhomba	3	0	0	0	0	0	0	2	2	0	0	0
Gyptis capensis	0	3	0	0	0	0	0	3	0	0	0	0
Halicreion ovalitelson	0	3	0	0	0	0	0	2	2	0	0	0
Haploscoloplos kerguelensis	0	0	3	0	0	0	0	0	3	0	0	0
Hermit crab sp.	0	0	3	0	0	0	0	0	2	2	2	0
Heterophoxus cephalodens	3	0	0	0	0	0	0	2	2	0	0	0
Heterophoxus opus	3	0	0	0	0	0	0	2	2	0	0	0
Hippomedon longimanus	0	0	3	0	0	0	0	0	2	0	0	0
Hippomedon normalis	0	3	0	0	0	0	0	0	2	0	0	0
Hippomedon onconotus	0	3	0	0	0	0	0	0	2	0	0	0
Holothuroid sp. A	0	0	3	0	0	0	0	0	0	1	1	1
Holothuroid sp. B	0	0	3	0	0	0	0	0	0	1	1	1
Holothuroid sp. C	0	3	0	0	0	0	0	0	0	1	1	1
Hyalinoecia tubicola	0	0	3	0	0	0	0	0	0	0	0	3
Isopilus sp. c.f.	3	0	0	0	0	0	1	1	1	0	0	0
Katanthura laevitelson	0	3	0	0	0	0	0	0	2	2	0	0
Lamp shell sp.	0	0	3	0	0	0	0	1	1	1	1	1
Lanassa capensis	0	0	3	0	0	0	0	0	3	0	0	0
Laonice cirrata	0	0	3	0	0	0	0	0	0	0	2	2
Lepidasthenia sp.	0	0	3	0	0	0	0	0	2	2	0	0
Leptochiton sykesi	0	3	0	0	0	0	0	0	3	0	0	0
Lucifer chacei	0	3	0	0	0	0	0	0	3	0	0	0
Lumbriclymene cylindricauda	0	3	0	0	0	0	0	0	0	0	0	3
Lumbriclymene minor	0	0	3	0	0	0	0	0	3	0	0	0
Lumbriclymene sp.	0	0	3	0	0	0	0	0	2	2	0	0
Lumbrineris albidentata	0	0	3	0	0	0	0	0	0	3	0	0
Lumbrineris brevicirra	0	0	3	0	0	0	0	0	0	3	0	0
Lumbrineris magalhaensis	0	0	3	0	0	0	0	0	0	3	0	0
Lumbrineris sp.	0	3	0	0	0	0	0	0	2	2	2	2
Lumbrineris tetraura	0	0	3	0	0	0	0	0	0	3	0	0
Lysianassa minimus	3	0	0	0	0	0	0	3	0	0	0	0
Macellicephala sp.	0	3	0	0	0	0	0	0	2	2	0	0
Macoma crawfordi	0	3	0	0	0	0	0	0	3	0	0	0
Macroclymene saldanha	0	0	3	0	0	0	0	0	0	3	0	0
Magelona capensis	0	3	0	0	0	0	0	0	0	3	0	0
Malacoceros indicus	0	3	0	0	0	0	0	0	2	2	0	0
Maldanid sp.	0	0	3	0	0	0	0	0	0	2	2	2
Malmgrenia marquesensis	3	0	0	0	0	0	0	0	3	0	0	0
Mandibulophoxus stimpsoni	3	0	0	0	0	0	0	2	2	0	0	0
Marphysa adenensis	0	0	3	0	0	0	0	0	0	2	2	0
Mesanthura catenula	0	3	0	0	0	0	0	0	3	0	0	0
Mursia cristimanus	0	3	0	0	0	0	0	0	0	2	2	0
Nebalia capensis	3	0	0	0	0	0	0	2	2	0	0	0
Nematode sp. A	0	0	3	0	0	0	1	1	1	0	0	0
Nematode sp. B	0	3	0	0	0	0	1	1	1	0	0	0
Nemertea sp. A	0	3	0	0	0	0	0	1	1	1	1	1
Nemertea sp. B	0	0	3	0	0	0	0	1	1	1	1	1
Nemertea sp. C	0	0	0	3	0	0	0	1	1	1	1	1
Nemertea sp. D	0	0	3	0	0	0	0	1	1	1	1	1
Nemertea sp. E	0	0	3	0	0	0	0	1	1	1	1	1
Nemertea sp. F	0	0	0	3	0	0	0	1	1	1	1	1
Nephtys capensis	0	0	0	3	0	0	0	0	0	3	0	0
Nephtys hombergi	0	0	3	0	0	0	0	0	0	0	0	2
Nephtys macroura	0	0	3	0	0	0	0	0	0	0	2	0
Nephtys malmgreni	0	0	0	0	3	0	0	0	0	0	2	2
Nerinides gilchristi	3	0	0	0	0	0	0	0	3	0	0	0
Nerinides sp.	3	0	0	0	0	0	0	2	2	0	0	0
Nicomache lumbricalis	0	0	3	0	0	0	0	0	0	0	0	3
Notomastus latericeus	0	0	3	0	0	0	0	0	0	0	0	3
Onuphis eremita	0	0	3	0	0	0	0	0	0	0	0	3
Onuphis geophiliformis	0	0	3	0	0	0	0	0	3	0	0	0
Onuphis holobranchiata	0	0	3	0	0	0	0	0	0	3	0	0
Onuphis sp. A	0	0	3	0	0	0	0	2	2	1	0	0
Ophelia sp.	0	0	3	0	0	0	0	0	2	2	0	0
Ophelina acuminata	0	0	3	0	0	0	0	0	0	3	0	0
Ophiodromus spinosus	0	3	0	0	0	0	0	0	0	0	2	0
Ophiura sp.A	3	0	0	0	0	0	0	0	2	2	0	0
Ophiura sp.B	0	3	0	0	0	0	0	0	2	2	0	0
Orbinia angrapequensis	0	3	0	0	0	0	0	0	3	0	0	0
Orbinia bioreti	0	0	3	0	0	0	0	0	0	0	0	3
Orbiniidae	3	0	0	0	0	0	0	0	2	2	0	0
Ostracod sp. A	3	0	0	0	0	0	3	1	0	0	0	0
Ostracod sp. B	3	0	0	0	0	0	3	1	0	0	0	0
Owenia sp.	0	0	3	0	0	0	0	0	1	1	1	1
Panathura serricauda	0	0	3	0	0	0	0	0	2	2	0	0
Paramoera capensis	3	0	0	0	0	0	0	2	2	0	0	0
Parandania boecki	0	3	0	0	0	0	0	2	2	0	0	0
Paraonides sp.	0	3	0	0	0	0	0	1	2	0	0	0
Paraphoxus oculatus	3	0	0	0	0	0	3	0	0	0	0	0
Parelasmopus suluensis	3	0	0	0	0	0	0	2	2	0	0	0
Pectinaria koreni cirrata	0	3	0	0	0	0	0	0	0	3	0	0
Pectinaria sp. juv	3	0	0	0	0	0	0	0	1	2	2	0
Phascolosoma sp.	0	0	3	0	0	0	0	0	0	0	3	0
Pherusa sp.	0	0	0	3	0	0	0	2	2	2	0	0
Photis dolichommata	3	0	0	0	0	0	0	3	0	0	0	0
Phyllodoce longipes	0	0	0	3	0	0	0	0	0	2	2	0
Phyllodoce tubicola	0	3	0	0	0	0	0	0	2	2	0	0
Phyllodocid sp. A	0	0	0	3	0	0	0	0	2	2	2	2
Phylo capensis	0	0	3	0	0	0	0	0	0	3	0	0
Pista brevibranchia	0	0	3	0	0	0	0	0	3	0	0	0
Pista cristata	0	0	0	3	0	0	0	0	0	3	0	0
Pista sp.	0	3	0	0	0	0	0	1	1	1	0	0

Traits	**Average captured size**						**Maximum adult size**					
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**
Taxa/Code	**NS1A**	**NS2A**	**NS3A**	**NS4A**	**NS5A**	**NS6A**	**NS1B**	**NS2B**	**NS3B**	**NS4B**	**NS5B**	**NS6B**
Pista unibranchia	0	3	0	0	0	0	0	3	0	0	0	0
Podoceropsis sophiae	0	3	0	0	0	0	0	2	2	0	0	0
Polycirrus plumosus	3	0	0	0	0	0	0	0	0	3	0	0
Polycirrus sp.	0	3	0	0	0	0	0	0	0	2	2	1
Polycirrus tenuisetis	0	0	3	0	0	0	0	0	3	0	0	0
Polydora sp.	3	0	0	0	0	0	0	0	2	2	2	0
Polygordiidae sp.	0	3	0	0	0	0	0	1	1	1	1	0
Polyphysia crassa	0	3	0	0	0	0	0	0	3	0	0	0
Pontophilus gracilis	0	0	3	0	0	0	0	0	0	3	0	0
Praxillella capensis	0	0	3	0	0	0	0	0	2	2	0	0
Prionospio cirrifera	0	3	0	0	0	0	0	0	3	0	0	0
Prionospio cirrobranchiata	0	3	0	0	0	0	0	0	3	0	0	0
Prionospio saldanha	3	0	0	0	0	0	0	0	3	0	0	0
Prionospio sexoculata	3	0	0	0	0	0	0	0	3	0	0	0
Prionospio sp.	0	3	0	0	0	0	1	2	1	3	0	0
Prionospio steenstrupi	0	3	0	0	0	0	0	0	0	3	0	0
Protomystides capensis	0	3	0	0	0	0	0	0	3	0	0	0
Pseudoharpinia excavata	3	0	0	0	0	0	0	2	2	0	0	0
Pterygosquilla armata capensis	0	0	3	0	0	0	0	0	0	0	0	3
Ramphobranchium capense	0	3	0	0	0	0	0	0	0	3	0	0
Retusidae sp. A	3	0	0	0	0	0	2	2	0	0	0	0
Scalibregma inflatum	0	0	3	0	0	0	0	0	0	3	0	0
Scalpellum sp.	0	3	0	0	0	0	0	1	1	1	0	0
Schroederella pauliani	3	0	0	0	0	0	3	0	0	0	0	0
Scoloplella capensis	3	0	0	0	0	0	0	3	0	0	0	0
Scoloplos uniramus	0	0	3	0	0	0	0	0	0	3	0	0
Sea snail	3	0	0	0	0	0	1	1	1	1	1	0
Siphonoecetes orientalis	0	3	0	0	0	0	0	2	2	0	0	0
Siphonoecetes sp.	0	3	0	0	0	0	0	2	2	0	0	0
Sipunculid sp.	0	3	0	0	0	0	0	0	0	2	2	2
Spio sp. juv	3	0	0	0	0	0	0	2	2	2	0	0
Spionidae sp. juv	3	0	0	0	0	0	1	2	2	2	0	0
Spiophanes bombyx	0	3	0	0	0	0	0	0	0	3	0	0
Spiophanes soederstromi	3	0	0	0	0	0	0	0	3	0	0	0
Sthenelais papillosa	0	0	3	0	0	0	0	0	0	3	0	0
Streblosoma abranchiata	3	0	0	0	0	0	0	0	3	0	0	0
Streblosoma persica	0	3	0	0	0	0	0	0	0	3	0	0
Streblospio sp.	0	3	0	0	0	0	1	1	1	1	0	0
Syllidia armata	3	0	0	0	0	0	0	0	0	2	2	0
Syllidia cornuta	0	0	3	0	0	0	0	0	0	2	2	0
Syllis cornuta	0	3	0	0	0	0	0	0	0	3	0	0
Tanais philetaerus	0	0	3	0	0	0	0	0	2	2	0	0
Tellina sp.	3	0	0	0	0	0	0	1	1	1	1	0
Terebellides sp.	3	0	0	0	0	0	0	1	1	1	1	0
Terebellides stroemi	0	3	0	0	0	0	0	0	0	0	3	0
Terebratulina meridionalis	0	3	0	0	0	0	0	0	2	2	0	0
Tharyx annulosus	0	0	3	0	0	0	0	0	2	0	0	0
Tharyx marioni	0	3	0	0	0	0	0	0	0	0	3	0
Tharyx sp.	0	0	3	0	0	0	0	2	2	2	1	0
Trichobranchus glacialis	0	0	3	0	0	0	0	0	0	3	0	0
Triodos insignis	3	0	0	0	0	0	0	2	2	0	0	0
Trischizostoma serratum	3	0	0	0	0	0	0	2	2	0	0	0
Urchin juv.	3	0	0	0	0	0	1	1	1	1	1	0
Urothoe coxalis	3	0	0	0	0	0	0	2	0	0	0	0
Urothoe elegans	3	0	0	0	0	0	0	2	0	0	0	0
Urothoe grimaldi	3	0	0	0	0	0	0	2	0	0	0	0
Urothoe pinnata	3	0	0	0	0	0	0	2	0	0	0	0
Virgularia schultzei	0	0	0	3	0	0	0	0	0	0	0	3

Traits	Larval type			Mobility			
Category	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Aedicira belgicae	0	3	0	0	2	2	0
Alentia australis	0	3	0	0	0	2	2
Allmaniella sp.	0	3	0	0	0	2	2
Amaeana trilobata	0	3	0	0	3	0	0
Amaryllis macrophthalma	0	0	3	0	0	2	2
Ampelisca anisuropa	0	0	3	0	0	3	0
Ampelisca anomala	0	0	3	0	0	3	0
Ampelisca brevicornis	0	0	3	0	0	3	0
Ampelisca chiltoni	0	0	3	0	0	3	0
Ampelisca excavata	0	0	3	0	0	3	0
Ampelisca fusca	0	0	3	0	0	3	0
Ampelisca miops	0	0	3	0	0	3	0
Ampelisca palmata	0	0	3	0	0	3	0
Ampherete sp.	0	3	0	0	2	0	0
Amphiglena mediterranea	0	0	3	3	0	0	0
Amphinomidae juv.	1	1	1	0	0	2	2
Amphiura sp.	3	0	0	0	2	1	0
Ancistrosyllis parva	3	0	0	0	0	0	3
Anemone sp. A	0	2	0	3	0	0	0
Anemone sp. B	0	2	0	3	0	0	0
Antarturus beliaevei	0	0	3	0	0	3	0
Aora gibbula	0	0	3	0	0	3	0
Aora kergueleni	0	0	3	0	0	3	0
Aora sp.	0	0	3	0	0	3	0
Apistobranch	0	0	3	0	2	0	0
Apseudes cooperi	0	0	3	0	3	0	0
Archaeomenia prisca	3	0	0	0	3	0	0
Arenicola sp.	0	0	3	0	1	2	0
Aricidea sp.	0	0	3	0	0	1	0
Artacama proboscidea	0	3	0	0	2	0	0
Ascidian sp. A	0	3	0	3	0	0	0
Asellota sp.	0	0	3	0	1	1	1
Astropectin sp. A	3	0	0	0	3	0	0
Atylus swammerdamei	0	0	3	0	0	2	1
Axiothella jarli	0	3	0	0	3	0	0
Bathynectes piperitus	3	0	0	0	0	0	3
Bathyporeia sp.	0	0	3	0	0	0	0
Bivalve sp. A - mussels	1	1	0	0	1	1	0
Bivalve sp. C	1	1	0	0	1	1	0
Bivalve sp. D - scallop	1	1	0	0	1	1	0
Brisaster capensis	3	0	0	0	0	2	0
Brissopsis lyrifera capensis	3	0	0	0	0	2	0
Bryozoa sp.	1	1	1	3	0	0	0
Calliopiella michaelseni	0	0	3	0	0	0	3
Caperellid sp.	0	3	0	0	2	2	0
Capitella capitata	0	3	0	0	0	2	0
Chaetopterus varieopedatus	3	0	0	0	3	0	0
Cheirocratus inermis	0	0	3	0	0	0	3
Chevalia aviculae	0	0	3	0	0	3	0
Chloeia inermis	3	0	0	0	0	0	3
Cirolana borealis	0	0	3	0	0	3	0
Cirolana caeca	0	0	3	0	0	3	0
Cirratulus africanus	0	3	0	0	2	0	0
Cirratulus sp.	0	3	0	0	2	0	0
Cirriformia filigera	3	0	0	0	3	0	0
Colomastix pusilla	0	0	3	0	0	3	0
Corophid sp. A	0	0	3	3	0	0	0
Corophium sp.	0	0	3	3	0	0	0
Cossura coasta	0	0	3	0	0	3	0
Crab sp. A	1	1	1	0	1	1	1
Crustacea larvae	1	1	1	0	0	2	2
Cumacid sp. A	0	0	3	0	3	0	0
Cuspidaria sp.	0	2	0	0	0	0	0
Diopatra cuprea cuprea	0	0	3	0	0	3	0
Diopatra dubia	0	0	3	0	0	3	0
Diopatra monroi	0	0	3	0	0	3	0
Diplocirrus capensis	0	3	0	0	0	2	0
Dodecacerra fuscia	0	3	0	0	0	3	0
Echinocardium cordatum	3	0	0	0	2	0	0
Epidiopatra hupferiana hupferiana	3	0	0	0	3	0	0
Epimeria cornigera	0	0	3	0	0	3	0
Eriopisella capensis	0	0	3	0	0	3	0
Euclymene quadrilobata	0	3	0	0	3	0	0
Euclymene sp.	0	3	0	0	2	0	0
Eunice grubei	3	0	0	0	3	0	0
Eunice schemacephala	3	0	0	0	3	0	0
Eunice sp. A	3	0	0	0	2	2	0
Eunoe hubrechti cf.	0	3	0	0	0	2	2
Exogone normalis	0	3	0	0	0	2	0
Flabelligerid sp. A	0	3	0	0	1	2	0
Flabelligerid sp. B	0	3	0	0	1	2	0
Gammaropsis afra	0	0	3	0	0	0	3
Gammaropsis longicarpus	0	0	3	0	0	0	3
Gammaropsis palmoides	0	0	3	0	0	0	3
Gastropod sp. A - spiral ridged	1	1	1	0	3	0	0
Gastropod sp. B - cowrie like	1	1	1	0	3	0	0
Gastropod sp. C	1	1	1	0	3	0	0
Glycera alba	3	0	0	0	0	0	2
Glycera convoluta	3	0	0	0	0	1	2
Glycera longipinnis	3	0	0	0	0	1	2
Glycera papillosa	3	0	0	0	0	1	2
Glycinde capensis	0	3	0	0	0	1	3
Glycinde sp. c.f.	3	0	0	0	0	0	2
Goniada emerita	3	0	0	0	0	0	2
Goniada maculata	3	0	0	0	0	0	2

Traits	Larval type			Mobility			
Category	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Goniadella gracilis	3	0	0	0	0	0	2
Goniadopsis maskallensis	0	3	0	0	0	1	3
Gorgonian sp.	0	0	3	3	0	0	0
Guernea rhomba	0	0	3	0	0	3	0
Gyptis capensis	3	0	0	0	0	0	2
Halicreion ovalitelson	0	0	3	0	0	3	0
Haploscoloplos kerguelensis	0	3	0	0	0	3	0
Hermit crab sp.	3	0	0	0	0	0	3
Heterophoxus cephalodens	0	0	3	0	0	3	0
Heterophoxus opus	0	0	3	0	0	3	0
Hippomedon longimanus	0	0	3	0	0	2	0
Hippomedon normalis	0	0	3	0	0	2	0
Hippomedon onconotus	0	0	3	0	0	2	0
Holothuroid sp. A	1	1	1	0	1	0	0
Holothuroid sp. B	1	1	1	0	1	0	0
Holothuroid sp. C	1	1	1	0	1	0	0
Hyalinoecia tubicola	0	0	3	0	2	0	0
Isopilus sp. c.f.	3	0	0	0	0	0	3
Katanthura laevitelson	0	0	3	0	0	3	0
Lamp shell sp.	1	1	1	0	3	0	0
Lanassa capensis	0	3	0	0	2	0	0
Laonice cirrata	0	3	0	0	0	0	0
Lepidasthenia sp.	3	0	0	0	0	3	0
Leptochiton sykesi	0	3	0	0	3	0	0
Lucifer chacei	0	0	3	0	0	3	0
Lumbriclymene cylindricauda	0	3	0	1	3	0	0
Lumbriclymene minor	0	3	0	1	3	0	0
Lumbriclymene sp.	0	3	0	1	3	0	0
Lumbrineris albidentata	0	3	0	0	0	0	0
Lumbrineris brevicirra	0	3	0	0	0	0	0
Lumbrineris magalhaensis	0	3	0	0	0	0	0
Lumbrineris sp.	0	3	0	0	2	2	2
Lumbrineris tetraura	0	3	0	0	0	0	0
Lysianassa minimus	0	0	3	0	0	3	0
Macellicephala sp.	3	0	0	0	0	3	0
Macoma crawfordi	3	0	0	0	3	0	0
Macroclymene saldanha	0	3	0	0	3	0	0
Magelona capensis	3	0	0	0	2	1	0
Malacoceros indicus	3	0	0	0	3	0	0
Maldanid sp.	0	3	0	0	0	0	0
Malmgrenia marquesensis	3	0	0	0	0	0	3
Mandibulophoxus stimpsoni	0	0	3	0	0	3	0
Marphysa adenensis	0	3	0	0	0	3	0
Mesanthura catenula	0	0	3	0	0	0	3
Mursia cristimanus	3	0	0	0	0	0	3
Nebalia capensis	0	0	3	0	0	2	2
Nematode sp. A	0	0	3	0	3	0	0
Nematode sp. B	0	0	3	0	3	0	0
Nemertea sp. A	0	0	3	0	2	3	2
Nemertea sp. B	0	0	3	0	2	3	2
Nemertea sp. C	0	0	3	0	2	3	2
Nemertea sp. D	0	0	3	0	2	3	2
Nemertea sp. E	0	0	3	0	2	3	2
Nemertea sp. F	0	0	3	0	2	3	2
Nephtys capensis	2	0	0	0	0	0	2
Nephtys hombergi	3	2	0	0	0	0	2
Nephtys macroura	2	0	0	0	0	0	2
Nephtys malmgreni	2	2	0	0	0	1	2
Nerinides gilchristi	3	0	0	0	3	0	0
Nerinides sp.	2	2	0	0	3	0	0
Nicomache lumbricalis	0	2	0	0	0	0	0
Notomastus latericeus	0	3	0	0	0	2	0
Onuphis eremita	3	0	0	0	3	0	0
Onuphis geophiliformis	3	0	0	0	3	0	0
Onuphis holobranchiata	3	0	0	0	3	0	0
Onuphis sp. A	3	0	0	2	2	0	0
Ophelia sp.	0	3	0	0	0	2	0
Ophelina acuminata	0	3	0	0	0	2	0
Ophiodromus spinosus	2	0	0	0	0	0	2
Ophiura sp.A	3	0	0	0	2	0	0
Ophiura sp.B	3	0	0	0	2	0	0
Orbinia angrapequensis	0	3	0	0	0	3	0
Orbinia bioreti	0	3	0	0	0	3	0
Orbiniidae	2	2	0	0	2	0	0
Ostracod sp. A	0	0	3	0	0	0	3
Ostracod sp. B	0	0	3	0	0	0	3
Owenia sp.	3	0	0	0	2	0	0
Panathura serricauda	0	0	3	0	0	3	0
Paramoera capensis	0	0	3	0	0	3	0
Parandania boecki	0	0	3	0	0	3	0
Paraonides sp.	0	3	0	0	2	0	0
Paraphoxus oculatus	1	0	0	0	0	1	0
Parelasmopus suluensis	0	0	3	0	0	3	0
Pectinaria koreni cirrata	0	3	0	0	2	0	0
Pectinaria sp. juv	0	3	0	1	2	0	0
Phascolosoma sp.	0	3	0	0	3	0	0
Pherusa sp.	3	0	0	0	2	2	0
Photis dolichommata	0	0	3	0	0	0	3
Phyllodoce longipes	3	0	0	0	0	0	2
Phyllodoce tubicola	3	0	0	0	0	0	2
Phyllodocid sp. A	2	2	0	0	0	0	2
Phylo capensis	0	3	0	0	0	3	0
Pista brevibranchia	0	3	0	0	2	0	0
Pista cristata	0	3	0	0	2	0	0
Pista sp.	0	3	0	0	2	0	0

Traits	Larval type			Mobility			
Category	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Pista unibranchia	0	3	0	0	2	0	0
Podoceropsis sophiae	0	0	3	0	0	3	0
Polycirrus plumosus	0	3	0	0	2	0	0
Polycirrus sp.	0	3	0	0	2	0	0
Polycirrus tenuisetis	0	0	3	0	2	0	0
Polydora sp.	2	2	0	0	2	2	0
Polygordiidae sp.	3	0	0	0	0	3	0
Polyphysia crassa	0	3	0	0	2	1	0
Pontophilus gracilis	3	0	0	0	0	0	3
Praxillella capensis	0	3	0	0	2	0	0
Prionospio cirrifera	3	0	0	0	2	0	0
Prionospio cirrobranchiata	3	0	0	0	2	0	0
Prionospio saldanha	3	0	0	0	2	0	0
Prionospio sexoculata	3	0	0	0	2	0	0
Prionospio sp.	3	0	0	0	2	0	0
Prionospio steenstrupi	3	0	0	0	2	2	0
Protomystides capensis	3	0	0	0	0	0	3
Pseudoharpinia excavata	0	0	3	0	0	3	0
Pterygosquilla armata capensis	3	0	0	0	0	0	3
Ramphobranchium capense	3	0	0	0	3	0	0
Retusidae sp. A	0	3	0	0	3	0	0
Scalibregma inflatum	0	3	0	0	2	1	0
Scalpellum sp.	2	2	0	3	0	0	0
Schroederella pauliani	0	3	0	0	0	3	0
Scoloplella capensis	0	3	0	0	0	3	0
Scoloplos uniramus	0	2	0	0	0	2	0
Sea snail	1	1	1	0	3	0	0
Siphonoecetes orientalis	0	0	3	0	0	3	0
Siphonoecetes sp.	0	0	3	0	0	3	0
Sipunculid sp.	0	3	0	0	3	0	0
Spio sp. juv	3	0	0	0	0	1	0
Spionidae sp. juv	3	0	0	0	3	0	0
Spiophanes bombyx	3	0	0	0	2	0	0
Spiophanes soederstromi	3	0	0	0	2	0	0
Sthenelais papillosa	0	0	3	0	0	0	2
Streblosoma abranchiata	0	3	0	0	2	0	0
Streblosoma persica	0	3	0	0	2	0	0
Streblospio sp.	2	2	0	0	3	0	0
Syllidia armata	3	0	0	0	0	0	3
Syllidia cornuta	3	0	0	0	0	0	3
Syllis cornuta	0	0	3	0	0	2	2
Tanais philetaerus	0	0	3	0	0	3	0
Tellina sp.	3	0	0	0	3	0	0
Terebellides sp.	0	3	0	0	2	0	0
Terebellides stroemi	3	3	0	0	2	0	0
Terebratulina meridionalis	0	3	0				
Tharyx annulosus	0	3	0	0	0	0	0
Tharyx marioni	0	3	0	0	0	0	0
Tharyx sp.	0	3	0	0	3	0	0
Trichobranchus glacialis	0	0	3	0	0	0	0
Triodos insignis	0	0	3	0	0	3	0
Trischizostoma serratum	0	0	3	0	0	3	0
Urchin juv.	0	3	0	0	3	0	0
Urothoe coxalis	0	0	3	0	0	2	2
Urothoe elegans	0	0	3	0	0	2	2
Urothoe grimaldi	0	0	3	0	0	2	2
Urothoe pinnata	0	0	3	0	0	2	2
Virgularia schultzei	0	2	2	3	0	0	0

Traits	Bodyform						Attachment		
Category	Cylindric bobyform	Flattened dorsally bobyform	Flattened laterally bobyform	Ball shaped bobyform	Long thin, treadlike bobyform	Irregular bobyform	None attachment	Temporary attachment	Permanent attachment
Taxa/Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Aedicira belgicae	2	0	0	0	1	0	3	0	0
Alentia australis	0	0	0	0	1	0	3	0	0
Allmaniella sp.	0	0	0	1	0	1	3	0	0
Amaeana trilobata	2	0	0	0	0	2	0	3	0
Amaryllis macrophthalma	0	0	3	0	0	0	3	0	0
Ampelisca anisuropa	0	0	3	0	0	0	3	0	0
Ampelisca anomala	0	0	3	0	0	0	3	0	0
Ampelisca brevicornis	0	0	3	0	0	0	3	0	0
Ampelisca chiltoni	0	0	3	0	0	0	3	0	0
Ampelisca excavata	0	0	3	0	0	0	3	0	0
Ampelisca fusca	0	0	3	0	0	0	3	0	0
Ampelisca miops	0	0	3	0	0	0	3	0	0
Ampelisca palmata	0	0	3	0	0	0	3	0	0
Ampherete sp.	2	0	0	0	0	0	0	0	2
Amphiglena mediterranea	2	0	0	0	1	2	0	0	3
Amphinomidae juv.	1	1	0	0	2	0	3	0	0
Amphiura sp.	0	1	0	0	0	3	3	0	0
Ancistrosyllis parva	3	0	0	0	3	0	3	0	0
Anemone sp. A	0	0	0	0	0	3	0	0	3
Anemone sp. B	0	0	0	0	0	3	0	0	3
Antarturus beliaevei	3	0	0	0	0	0	3	0	0
Aora gibbula	0	0	3	0	0	0	3	0	0
Aora kergueleni	0	0	3	0	0	0	3	0	0
Aora sp.	0	0	3	0	0	0	3	0	0
Apistobranch	2	0	0	0	1	0	0	0	0
Apseudes cooperi	2	1	0	0	0	0	1	1	0
Archaeomenia prisca	2	2	0	0	0	0	3	0	0
Arenicola sp.	1	0	0	0	3	0	3	0	0
Aricidea sp.	1	1	0	0	2	0	0	0	0
Artacama proboscidea	1	0	0	0	2	0	0	0	2
Ascidian sp. A	0	0	0	3	0	0	0	0	3
Asellota sp.	0	3	0	0	0	0	3	0	0
Astropectin sp. A	0	2	0	0	0	3	3	0	0
Atylus swammerdamei	0	0	3	0	0	0	3	0	0
Axiothella jarli	1	0	0	0	3	0	0	0	2
Bathynectes piperitus	0	3	0	0	0	0	3	0	0
Bathyporeia sp.	0	0	3	0	0	0	3	0	0
Bivalve sp. A - mussels	0	3	0	0	0	0	1	1	0
Bivalve sp. C	0	3	0	0	0	0	1	1	0
Bivalve sp. D - scallop	0	3	0	0	0	0	1	1	0
Brisaster capensis	0	1	0	2	0	2	3	0	0
Brissopsis lyrifera capensis	0	1	0	2	0	2	3	0	0
Bryozoa sp.	0	1	1	1	0	1	0	0	3
Calliopiella michaelseni	0	0	3	0	0	0	3	0	0
Caperellid sp.	2	0	1	0	2	1	2	0	0
Capitella capitata	2	0	0	0	2	0	3	0	0
Chaetopterus varieopedatus	0	1	0	0	1	1	1	2	0
Cheirocratus inermis	0	0	3	0	0	0	3	0	0
Chevalia aviculae	0	0	3	0	0	0	3	0	0
Chloeia inermis	0	1	0	0	2	0	3	0	0
Cirolana borealis	0	3	0	0	0	0	3	0	0
Cirolana caeca	0	3	0	0	0	0	3	0	0
Cirratulus africanus	2	0	0	0	1	0	0	3	0
Cirratulus sp.	2	0	0	0	1	0	0	3	0
Cirriformia filigera	3	0	0	0	1	0	0	2	0
Colomastix pusilla	0	0	3	0	0	0	3	0	0
Corophid sp. A	0	3	0	0	0	0	0	3	0
Corophium sp.	0	3	0	0	0	0	0	3	0
Cossura coasta	2	0	0	0	1	0	3	0	0
Crab sp. A	0	2	2	1	0	0	2	2	0
Crustacea larvae	0	3	0	0	0	0	3	0	0
Cumacid sp. A	0	0	0	2	0	0	3	0	0
Cuspidaria sp.	0	2	0	0	0	1	3	0	0
Diopatra cuprea cuprea	0	3	0	0	0	0	3	0	0
Diopatra dubia	0	3	0	0	0	0	3	0	0
Diopatra monroi	0	3	0	0	0	0	3	0	0
Diplocirrus capensis	2	0	0	0	2	1	3	0	0
Dodecacerra fuscia	3	1	0	0	0	0	3	0	0
Echinocardium cordatum	0	0	0	3	0	0	3	0	0
Epidiopatra hupferiana hupferiana	3	0	0	0	2	0	0	3	0
Epimeria cornigera	0	0	3	0	0	0	3	0	0
Eriopisella capensis	0	0	3	0	0	0	3	0	0
Euclymene quadrilobata	3	0	0	0	1	0	0	3	0
Euclymene sp.	2	0	0	0	1	0	0	3	0
Eunice grubei	3	0	0	0	2	0	0	3	0
Eunice schemacephala	3	0	0	0	2	0	0	3	0
Eunice sp. A	3	0	0	0	2	0	2	2	0
Eunoe hubrechti cf.	0	1	0	0	1	0	3	0	0
Exogone normalis	1	0	0	0	2	0	3	0	0
Flabelligerid sp. A	2	0	0	0	2	1	3	0	0
Flabelligerid sp. B	2	0	0	0	2	1	3	0	0
Gammaropsis afra	0	0	3	0	0	0	3	0	0
Gammaropsis longicarpus	0	0	3	0	0	0	3	0	0
Gammaropsis palmoides	0	0	3	0	0	0	3	0	0
Gastropod sp. A - spiral ridged	0	0	0	0	0	3	3	0	0
Gastropod sp. B - cowrie like	0	0	0	0	0	3	3	0	0
Gastropod sp. C	0	0	0	0	0	3	3	0	0
Glycera alba	0	0	0	0	2	1	3	0	0
Glycera convoluta	0	0	0	0	2	1	3	0	0
Glycera longipinnis	0	0	0	0	2	1	3	0	0
Glycera papillosa	0	0	0	0	2	1	3	0	0
Glycinde capensis	1	0	0	0	2	0	3	0	0
Glycinde sp. c.f.	0	0	0	0	2	1	3	0	0
Goniada emerita	1	0	0	0	1	0	3	0	0
Goniada maculata	1	0	0	0	1	0	3	0	0

Traits	Bodyform						Attachment		
Category	Cylindric bobyform	Flattened dorsally bobyform	Flattened laterally bobyform	Ball shaped bobyform	Long thin, treadlike bobyform	Irregular bobyform	None attachment	Temporary attachment	Permanent attachment
Taxa/Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Goniadella gracilis	1	0	0	0	1	0	3	0	0
Goniadopsis maskallensis	1	0	0	0	2	0	3	0	0
Gorgonian sp.	0	0	0	0	0	3	0	0	3
Guernea rhomba	0	0	3	0	0	0	3	0	0
Gyptis capensis	1	0	0	0	1	0	3	0	0
Halicreion ovalitelson	0	0	3	0	0	0	3	0	0
Haploscoloplos kerguelensis	3	0	0	0	2	0	3	0	0
Hermit crab sp.	0	2	0	0	0	2	3	0	0
Heterophoxus cephalodens	0	0	3	0	0	0	3	0	0
Heterophoxus opus	0	0	3	0	0	0	3	0	0
Hippomedon longimanus	0	0	3	0	0	0	3	0	0
Hippomedon normalis	0	0	3	0	0	0	3	0	0
Hippomedon onconotus	0	0	3	0	0	0	3	0	0
Holothuroid sp. A	3	0	0	0	1	0	3	0	0
Holothuroid sp. B	3	0	0	0	1	0	3	0	0
Holothuroid sp. C	3	0	0	0	1	0	3	0	0
Hyalinoecia tubicola	1	0	0	0	3	0	0	3	0
Isopilus sp. c.f.	3	0	0	0	0	0	3	0	0
Katanthura laevitelson	0	3	0	0	0	0	3	0	0
Lamp shell sp.	0	3	0	0	0	1	3	0	0
Lanassa capensis	2	0	0	0	0	2	0	2	0
Laonice cirrata	2	0	0	0	1	0	3	0	0
Lepidasthenia sp.	1	1	0	1	0	0	3	0	0
Leptochiton sykesi	0	3	0	0	0	0	3	0	0
Lucifer chacei	1	0	0	0	1	1	3	0	0
Lumbriclymene cylindricauda	2	0	0	0	3	0	0	3	0
Lumbriclymene minor	2	0	0	0	3	0	0	3	0
Lumbriclymene sp.	2	0	0	0	3	0	0	3	0
Lumbrineris albidentata	1	0	0	0	3	0	3	0	0
Lumbrineris brevicirra	1	0	0	0	3	0	3	0	0
Lumbrineris magalhaensis	1	0	0	0	3	0	3	0	0
Lumbrineris sp.	2	0	0	0	2	0	3	0	0
Lumbrineris tetraura	1	0	0	0	3	0	3	0	0
Lysianassa minimus	0	0	3	0	0	0	3	0	0
Macellicephala sp.	1	1	0	0	1	0	3	0	0
Macoma crawfordi	0	3	0	0	0	0	3	0	0
Macroclymene saldanha	3	0	0	0	1	0	0	3	0
Magelona capensis	0	0	0	0	3	0	3	0	0
Malacoceros indicus	2	2	0	0	1	0	0	2	0
Maldanid sp.	1	0	0	0	3	0	0	0	2
Malmgrenia marquesensis	0	1	0	0	0	0	3	0	0
Mandibulophoxus stimpsoni	0	0	3	0	0	0	3	0	0
Marphysa adenensis	2	0	0	0	2	0	3	0	0
Mesanthura catenula	0	3	0	0	1	0	3	0	0
Mursia cristimanus	0	3	0	0	0	1	3	0	0
Nebalia capensis	0	0	2	0	0	2	3	0	0
Nematode sp. A	2	0	0	0	2	0	3	0	0
Nematode sp. B	2	0	0	0	2	0	3	0	0
Nemertea sp. A	0	2	0	0	2	0	2	0	0
Nemertea sp. B	0	2	0	0	2	0	2	0	0
Nemertea sp. C	0	2	0	0	2	0	2	0	0
Nemertea sp. D	0	2	0	0	2	0	2	0	0
Nemertea sp. E	0	2	0	0	2	0	2	0	0
Nemertea sp. F	0	2	0	0	2	0	2	0	0
Nephtys capensis	0	1	1	0	2	0	3	0	0
Nephtys hombergi	0	1	1	0	2	0	3	0	0
Nephtys macroura	0	1	1	0	2	0	3	0	0
Nephtys malmgreni	0	1	1	0	2	0	3	0	0
Nerinides gilchristi	0	1	0	0	1	0	3	0	0
Nerinides sp.	0	1	0	0	1	0	3	0	0
Nicomache lumbricalis	2	0	0	0	1	0	3	0	0
Notomastus latericeus	2	0	0	0	2	0	2	0	0
Onuphis eremita	2	0	0	0	2	0	0	3	0
Onuphis geophiliformis	2	0	0	0	2	0	0	3	0
Onuphis holobranchiata	2	0	0	0	2	0	0	3	0
Onuphis sp. A	2	0	0	0	2	0	0	2	2
Ophelia sp.	2	0	0	0	0	0	3	0	0
Ophelina acuminata	2	0	0	0	0	0	3	0	0
Ophiodromus spinosus	1	1	0	0	1	0	3	0	0
Ophiura sp.A	0	1	0	1	1	1	3	0	0
Ophiura sp.B	0	1	0	1	1	1	3	0	0
Orbinia angrapequensis	2	0	0	0	2	0	3	0	0
Orbinia bioreti	2	0	0	0	2	0	3	0	0
Orbiniidae	0	1	0	1	1	1	3	0	0
Ostracod sp. A	0	1	0	3	0	0	3	0	0
Ostracod sp. B	0	1	0	3	0	0	3	0	0
Owenia sp.	3	0	0	0	0	0	0	0	2
Panathura serricauda	0	3	0	0	1	0	3	0	0
Paramoera capensis	0	0	3	0	0	0	3	0	0
Parandania boecki	0	0	3	0	0	0	3	0	0
Paraonides sp.	2	0	0	0	1	0	2	0	0
Paraphoxus oculatus	0	0	3	0	0	0	3	0	0
Parelasmopus suluensis	0	0	3	0	0	0	3	0	0
Pectinaria koreni cirrata	2	1	0	0	0	2	0	3	0
Pectinaria sp. juv	2	0	0	0	3	0	3	0	0
Phascolosoma sp.	2	0	0	0	3	0	0	3	0
Pherusa sp.	2	0	0	0	3	0	1	1	0
Photis dolichommata	0	0	3	0	0	0	3	0	0
Phyllodoce longipes	0	1	1	0	2	0	3	0	0
Phyllodoce tubicola	0	1	1	0	2	0	3	0	0
Phyllodocid sp. A	0	1	1	0	1	0	3	0	0
Phylo capensis	2	0	0	0	0	0	3	0	0
Pista brevibranchia	2	0	0	0	0	2	0	3	0
Pista cristata	2	0	0	0	0	2	0	3	0
Pista sp.	2	0	0	0	0	2	0	3	0

Traits	Bodyform						Attachment		
Category	Cylindric bobyform	Flattened dorsally bobyform	Flattened laterally bobyform	Ball shaped bobyform	Long thin, treadlike bobyform	Irregular bobyform	None attachment	Temporary attachment	Permanent attachment
Taxa/Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Pista unibranchia	2	0	0	0	0	2	0	3	0
Podoceropsis sophiae	0	0	3	0	0	0	3	0	0
Polycirrus plumosus	0	1	0	0	1	2	0	2	0
Polycirrus sp.	2	0	0	0	1	1	0	2	0
Polycirrus tenuisetis	3	1	0	0	1	1	0	2	0
Polydora sp.	2	2	0	0	2	0	0	2	0
Polygordiidae sp.	3	0	0	0	0	0	3	0	0
Polyphysia crassa	2	0	0	1	1	1	3	0	0
Pontophilus gracilis	0	0	2	0	0	0	3	0	0
Praxillella capensis	2	0	0	0	2	0	3	0	0
Prionospio cirrifera	2	1	0	0	1	0	3	0	0
Prionospio cirrobranchiata	1	1	0	0	1	0	3	0	0
Prionospio saldanha	1	1	0	0	1	0	3	0	0
Prionospio sexoculata	1	1	0	0	1	0	3	0	0
Prionospio sp.	1	2	0	0	1	0	3	0	0
Prionospio steenstrupi	1	2	0	0	1	0	3	0	0
Protomystides capensis	2	0	0	0	2	0	3	0	0
Pseudoharpinia excavata	0	0	3	0	0	0	3	0	0
Pterygosquilla armata capensis	0	3	0	0	0	0	3	0	0
Ramphobranchium capense	3	0	0	0	2	0	0	3	0
Retusidae sp. A	0	0	0	0	0	3	3	0	0
Scalibregma inflatum	2	0	0	1	1	1	3	0	0
Scalpellum sp.	0	0	0	2	0	2	0	0	3
Schroederella pauliani	2	0	0	0	2	0	3	0	0
Scoloplella capensis	2	0	0	0	2	0	3	0	0
Scoloplos uniramus	0	1	0	0	2	0	3	0	0
Sea snail	0	0	0	0	0	3	3	0	0
Siphonoecetes orientalis	0	0	3	0	0	0	3	0	0
Siphonoecetes sp.	0	0	3	0	0	0	3	0	0
Sipunculid sp.	0	0	0	0	1	0	2	0	0
Spio sp. juv	0	1	0	0	2	0	3	0	0
Spionidae sp. juv	2	1	0	0	1	0	0	0	2
Spiophanes bombyx	2	1	0	0	1	0	0	0	2
Spiophanes soederstromi	2	1	0	0	1	0	0	0	2
Sthenelais papillosa	2	1	1	0	3	0	3	0	0
Streblosoma abranchiata	2	0	0	0	1	1	3	0	0
Streblosoma persica	2	0	0	0	1	1	3	0	0
Streblospio sp.	0	1	0	0	1	0	0	3	0
Syllidia armata	1	1	0	0	1	0	3	0	0
Syllidia cornuta	1	1	0	0	1	0	3	0	0
Syllis cornuta	2	0	0	0	2	0	3	0	0
Tanais philetaerus	1	1	0	0	0	0	3	0	0
Tellina sp.	0	3	0	0	0	0	3	0	0
Terebellides sp.	1	0	0	0	2	0	0	0	2
Terebellides stroemi	1	1	0	0	1	2	0	0	2
Terebratulina meridionalis	0	3	0	0	0	0	0	0	3
Tharyx annulosus	0	2	0	0	1	0	3	0	0
Tharyx marioni	0	2	0	0	1	0	3	0	0
Tharyx sp.	2	0	0	0	2	0	0	2	0
Trichobranchus glacialis	2	0	0	0	0	1	3	0	0
Triodos insignis	0	0	3	0	0	0	3	0	0
Trischizostoma serratum	0	0	3	0	0	0	3	0	0
Urchin juv.	0	0	0	3	0	0	3	0	0
Urothoe coxalis	0	0	3	0	0	0	3	0	0
Urothoe elegans	0	0	3	0	0	0	3	0	0
Urothoe grimaldi	0	0	3	0	0	0	3	0	0
Urothoe pinnata	0	0	3	0	0	0	3	0	0
Virgularia schultzei	2	0	0	0	3	1	0	0	3

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa/Code	AH1	AH2	AH3	AH4	AH5
Aedicira belgicae	0	0	0	3	1
Alentia australis	0	0	0	3	2
Allmaniella sp.	0	0	0	3	2
Amaeana trilobata	0	3	0	0	0
Amaryllis macrophthalma	0	0	0	2	1
Ampelisca anisuropa	0	0	0	1	1
Ampelisca anomala	0	0	0	1	1
Ampelisca brevicornis	0	0	0	1	1
Ampelisca chiltoni	0	0	0	1	1
Ampelisca excavata	0	0	0	1	1
Ampelisca fusca	0	0	0	1	1
Ampelisca miops	0	0	0	1	1
Ampelisca palmata	0	0	0	1	1
Ampherete sp.	2	2	0	1	0
Amphiglena mediterranea	0	3	0	0	0
Amphinomidae juv.	0	0	1	1	2
Amphiura sp.	0	0	0	2	2
Ancistrosyllis parva	0	0	0	2	2
Anemone sp. A	3	0	0	0	0
Anemone sp. B	3	0	0	0	0
Antarturus beliaevei	0	0	0	0	3
Aora gibbula	0	0	0	0	3
Aora kergueleni	0	0	0	0	3
Aora sp.	0	0	0	2	2
Apistobranch	0	0	2	2	1
Apseudes cooperi	0	0	2	2	0
Archaeomenia prisca	0	0	0	3	0
Arenicola sp.	0	0	0	3	0
Aricidea sp.	0	0	0	2	0
Artacama proboscidea	0	2	0	0	0
Ascidian sp. A	3	0	0	0	0
Asellota sp.	0	0	1	1	1
Astropectin sp. A	0	0	0	3	2
Atylus swammerdamei	0	0	0	0	1
Axiothella jarli	1	2	2	2	0
Bathynectes piperitus	0	0	0	0	3
Bathyporeia sp.	0	0	0	2	2
Bivalve sp. A - mussels	0	0	0	1	0
Bivalve sp. C	0	0	0	1	0
Bivalve sp. D - scallop	0	0	0	1	0
Brisaster capensis	0	0	0	3	0
Brissopsis lyrifera capensis	0	0	0	3	0
Bryozoa sp.	3	0	0	0	0
Calliopiella michaelseni	0	0	0	2	2
Caperellid sp.	0	2	2	2	0
Capitella capitata	0	0	0	3	0
Chaetopterus varieopedatus	0	2	0	2	0
Cheirocratus inermis	0	0	0	0	3
Chevalia aviculae	0	0	0	2	2
Chloeia inermis	0	0	0	0	3
Cirolana borealis	0	0	0	0	3
Cirolana caeca	0	0	0	0	3
Cirratulus africanus	0	0	0	2	0
Cirratulus sp.	0	0	0	2	0
Cirriformia filigera	0	2	0	2	0
Colomastix pusilla	0	0	0	2	2
Corophid sp. A	0	0	2	2	0
Corophium sp.	0	0	2	2	0
Cossura coasta	0	0	0	2	0
Crab sp. A	1	0	1	1	3
Crustacea larvae	0	0	0	1	3
Cumacid sp. A	0	0	0	2	2
Cuspidaria sp.	0	0	0	2	0
Diopatra cuprea cuprea	0	0	0	0	3
Diopatra dubia	0	0	0	0	3
Diopatra monroi	0	0	0	0	3
Diplocirrus capensis	0	0	0	2	0
Dodecacerra fuscia	0	0	0	0	3
Echinocardium cordatum	0	0	0	3	2
Epidiopatra hupferiana hupferiana	0	0	3	1	0
Epimeria cornigera	0	0	0	0	3
Eriopisella capensis	0	0	0	0	3
Euclymene quadrilobata	0	0	0	1	0
Euclymene sp.	0	2	0	2	0
Eunice grubei	0	0	3	1	0
Eunice schemacephala	0	0	3	1	0
Eunice sp. A	0	0	3	1	0
Eunoe hubrechti cf.	0	0	0	3	2
Exogone normalis	0	0	0	3	0
Flabelligerid sp. A	0	0	0	2	0
Flabelligerid sp. B	0	0	0	2	0
Gammaropsis afra	0	0	0	1	0
Gammaropsis longicarpus	0	0	0	1	0
Gammaropsis palmoides	0	0	0	1	0
Gastropod sp. A - spiral ridged	0	0	0	2	2
Gastropod sp. B - cowrie like	0	0	0	2	2
Gastropod sp. C	0	0	0	2	2
Glycera alba	0	0	0	2	2
Glycera convoluta	0	0	1	2	2
Glycera longipinnis	0	0	1	2	2
Glycera papillosa	0	0	1	2	2
Glycinde capensis	0	0	0	2	2
Glycinde sp. c.f.	0	0	1	2	2
Goniada emerita	0	0	0	0	2
Goniada maculata	0	0	0	0	2

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa/Code	AH1	AH2	AH3	AH4	AH5
Goniadella gracilis	0	0	0	0	2
Goniadopsis maskallensis	0	0	0	2	2
Gorgonian sp.	3	0	0	0	0
Guernea rhomba	0	0	0	0	3
Gyptis capensis	0	0	0	0	2
Halicreion ovalitelson	0	0	0	0	3
Haploscoloplos kerguelensis	0	0	0	3	0
Hermit crab sp.	0	0	3	2	2
Heterophoxus cephalodens	0	0	0	0	3
Heterophoxus opus	0	0	0	0	3
Hippomedon longimanus	0	0	0	2	2
Hippomedon normalis	0	0	0	2	2
Hippomedon onconotus	0	0	0	2	2
Holothuroid sp. A	0	0	0	1	1
Holothuroid sp. B	0	0	0	1	1
Holothuroid sp. C	0	0	0	1	1
Hyalinoecia tubicola	2	2	0	0	0
Isopilus sp. c.f.	0	0	0	0	3
Katanthura laevitelson	0	0	0	2	2
Lamp shell sp.	0	0	0	2	2
Lanassa capensis	0	2	0	0	0
Laonice cirrata	0	0	0	3	0
Lepidasthenia sp.	0	0	0	2	2
Leptochiton sykesi	0	0	0	0	3
Lucifer chacei	0	0	0	0	3
Lumbriclymene cylindricauda	0	3	0	1	0
Lumbriclymene minor	0	3	0	1	0
Lumbriclymene sp.	0	3	0	1	0
Lumbrineris albidentata	0	0	0	3	0
Lumbrineris brevicirra	0	0	0	3	0
Lumbrineris magalhaensis	0	0	0	3	0
Lumbrineris sp.	0	0	1	3	2
Lumbrineris tetraura	0	0	0	3	0
Lysianassa minimus	0	0	0	2	1
Macellicephala sp.	0	0	0	2	2
Macoma crawfordi	0	0	0	3	0
Macroclymene saldanha	0	0	0	1	0
Magelona capensis	0	0	0	3	0
Malacoceros indicus	0	0	3	0	0
Maldanid sp.	2	2	2	2	0
Malmgrenia marquesensis	0	0	0	0	3
Mandibulophoxus stimpsoni	0	0	0	0	3
Marphysa adenensis	0	0	1	3	2
Mesanthura catenula	0	0	0	0	3
Mursia cristimanus	0	0	0	0	3
Nebalia capensis	0	0	0	0	3
Nematode sp. A	0	0	0	2	0
Nematode sp. B	0	0	0	2	0
Nemertea sp. A	0	0	0	2	2
Nemertea sp. B	0	0	0	2	2
Nemertea sp. C	0	0	0	2	2
Nemertea sp. D	0	0	0	2	2
Nemertea sp. E	0	0	0	2	2
Nemertea sp. F	0	0	0	2	2
Nephtys capensis	0	0	0	3	0
Nephtys hombergi	0	0	0	2	2
Nephtys macroura	0	0	0	2	2
Nephtys malmgreni	0	0	0	2	2
Nerinides gilchristi	0	0	3	0	0
Nerinides sp.	0	0	3	0	0
Nicomache lumbricalis	0	0	0	3	0
Notomastus latericeus	0	0	3	2	2
Onuphis eremita	0	0	3	0	0
Onuphis geophiliformis	0	0	3	0	0
Onuphis holobranchiata	0	0	3	0	0
Onuphis sp. A	2	2	2	1	0
Ophelia sp.	0	0	0	2	1
Ophelina acuminata	0	0	0	2	0
Ophiodromus spinosus	0	0	1	1	3
Ophiura sp.A	0	0	0	2	0
Ophiura sp.B	0	0	0	2	0
Orbinia angrapequensis	0	0	0	3	0
Orbinia bioreti	0	0	0	3	0
Orbiniidae	0	0	0	2	0
Ostracod sp. A	0	0	0	1	1
Ostracod sp. B	0	0	0	1	1
Owenia sp.	2	0	2	0	1
Panathura serricauda	0	0	0	0	3
Paramoera capensis	0	0	0	0	3
Parandania boecki	0	0	0	0	3
Paraonides sp.	0	0	2	2	2
Paraphoxus oculatus	0	0	0	1	0
Parelasmopus suluensis	0	0	0	0	3
Pectinaria koreni cirrata	2	2	0	2	0
Pectinaria sp. juv	0	3	0	3	0
Phascolosoma sp.	0	0	0	3	0
Pherusa sp.	0	0	0	3	0
Photis dolichommata	0	0	0	1	0
Phyllodoce longipes	0	0	0	0	0
Phyllodoce tubicola	0	0	0	0	0
Phyllodocid sp. A	0	0	0	0	0
Phylo capensis	0	0	0	3	0
Pista brevibranchia	2	2	0	0	0
Pista cristata	2	2	0	0	0
Pista sp.	2	2	0	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa/Code	AH1	AH2	AH3	AH4	AH5
Pista unibranchia	2	2	0	0	0
Podoceropsis sophiae	0	0	0	0	3
Polycirrus plumosus	2	0	2	0	1
Polycirrus sp.	1	1	1	1	1
Polycirrus tenuisetis	2	0	2	0	1
Polydora sp.	2	2	3	2	0
Polygordiidae sp.	0	0	0	2	2
Polyphysia crassa	0	0	0	3	0
Pontophilus gracilis	0	0	0	0	3
Praxillella capensis	0	2	0	2	0
Prionospio cirrifera	0	0	2	1	0
Prionospio cirrobranchiata	0	0	3	2	0
Prionospio saldanha	0	0	3	2	0
Prionospio sexoculata	0	0	3	2	0
Prionospio sp.	0	0	3	1	0
Prionospio steenstrupi	0	0	3	2	0
Protomystides capensis	0	0	0	0	3
Pseudoharpinia excavata	0	0	0	0	3
Pterygosquilla armata capensis	0	0	0	0	3
Ramphobranchium capense	0	0	3	1	0
Retusidae sp. A	0	0	0	0	2
Scalibregma inflatum	0	0	0	3	0
Scalpellum sp.	3	0	0	0	0
Schroederella pauliani	0	0	0	3	0
Scoloplella capensis	0	0	0	3	0
Scoloplos uniramus	0	0	2	2	0
Sea snail	0	0	0	0	3
Siphonoecetes orientalis	0	0	0	0	3
Siphonoecetes sp.	0	0	0	0	3
Sipunculid sp.	0	0	0	1	0
Spio sp. juv	0	0	2	2	0
Spionidae sp. juv	0	2	0	1	0
Spiophanes bombyx	0	2	0	1	0
Spiophanes soederstromi	0	2	0	1	0
Sthenelais papillosa	0	0	0	0	0
Streblosoma abranchiata	2	2	0	0	0
Streblosoma persica	2	2	0	0	0
Streblospio sp.	0	0	3	0	0
Syllidia armata	0	0	1	1	3
Syllidia cornuta	0	0	1	1	3
Syllis cornuta	0	0	0	2	2
Tanais philetaerus	0	0	0	2	2
Tellina sp.	0	0	0	2	2
Terebellides sp.	0	2	0	0	0
Terebellides stroemi	2	2	0	1	0
Terebratulina meridionalis	3	0	0	0	0
Tharyx annulosus	0	0	0	2	0
Tharyx marioni	0	0	0	2	0
Tharyx sp.	0	0	1	1	0
Trichobranchus glacialis	0	0	0	0	0
Triodos insignis	0	0	0	0	3
Trischizostoma serratum	0	0	0	0	3
Urchin juv.	0	0	0	2	2
Urothoe coxalis	0	0	2	0	0
Urothoe elegans	0	0	2	0	0
Urothoe grimaldi	0	0	2	0	0
Urothoe pinnata	0	0	2	0	0
Virgularia schultzei	3	0	0	0	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Taxa/Code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Aedicira belgicae	0	0	3	0	0	0	0	0	0
Alentia australis	1	0	0	0	0	0	0	3	0
Allmaniella sp.	1	0	0	0	0	0	0	3	0
Amaeana trilobata	0	0	3	0	0	0	0	0	0
Amaryllis macrophthalma	0	1	1	1	0	0	0	0	0
Ampelisca anisuropa	3	0	0	0	0	0	0	0	0
Ampelisca anomala	3	0	0	0	0	0	0	0	0
Ampelisca brevicornis	3	0	0	0	0	0	0	0	0
Ampelisca chiltoni	3	0	0	0	0	0	0	0	0
Ampelisca excavata	3	0	0	0	0	0	0	0	0
Ampelisca fusca	3	0	0	0	0	0	0	0	0
Ampelisca miops	3	0	0	0	0	0	0	0	0
Ampelisca palmata	3	0	0	0	0	0	0	0	0
Ampherete sp.	0	0	3	0	0	0	0	0	0
Amphiglena mediterranea	2	0	1	0	0	0	0	0	0
Amphinomidae juv.	0	0	0	0	0	0	1	1	1
Amphiura sp.	2	0	2	0	0	0	0	2	0
Ancistrosyllis parva	0	0	0	0	0	0	0	3	0
Anemone sp. A	2	0	0	0	0	0	0	1	1
Anemone sp. B	2	0	0	0	0	0	0	1	1
Antarturus beliaevei	1	0	0	0	0	0	1	1	1
Aora gibbula	0	0	0	0	0	0	0	3	0
Aora kergueleni	0	0	0	0	0	0	0	3	0
Aora sp.	1	0	1	1	0	0	0	1	0
Apistobranch	0	0	2	0	0	0	0	0	0
Apseudes cooperi	2	0	2	0	0	0	0	0	0
Archaeomenia prisca	0	0	0	0	0	0	0	3	0
Arenicola sp.	0	0	0	3	0	0	0	0	0
Aricidea sp.	0	0	2	0	0	0	0	0	0
Artacama proboscidea	0	0	3	0	0	0	0	0	0
Ascidian sp. A	3	0	0	0	0	0	0	0	0
Asellota sp.	1	0	1	0	0	1	0	1	1
Astropectin sp. A	0	0	0	0	0	0	2	3	0
Atylus swammerdamei	1	0	1	1	1	1	1	1	1
Axiothella jarli	0	0	0	2	0	0	0	0	0
Bathynectes piperitus	0	0	0	0	0	0	3	0	0
Bathyporeia sp.	0	0	0	0	0	0	0	0	0
Bivalve sp. A - mussels	2	0	0	0	1	0	0	0	1
Bivalve sp. C	2	0	0	0	1	0	0	0	1
Bivalve sp. D - scallop	2	0	0	0	1	0	0	0	1
Brisaster capensis	0	0	0	3	0	0	0	0	0
Brissopsis lyrifera capensis	0	0	0	3	0	0	0	3	0
Bryozoa sp.	3	0	0	0	0	0	0	0	1
Calliopiella michaelseni	2	0	1	1	1	0	0	0	0
Caperellid sp.	0	0	0	3	0	0	0	3	1
Capitella capitata	0	0	0	3	0	0	0	0	1
Chaetopterus varieopedatus	3	0	0	0	0	0	0	0	0
Cheirocratus inermis	2	0	0	0	0	0	0	2	0
Chevalia aviculae	2	0	0	0	0	0	0	2	0
Chloeia inermis	0	0	0	0	0	0	0	3	0
Cirolana borealis	0	0	0	0	0	0	0	3	0
Cirolana caeca	0	0	0	0	0	0	0	3	0
Cirratulus africanus	0	0	3	0	0	0	0	0	0
Cirratulus sp.	0	0	3	0	0	0	0	0	0
Cirriformia filigera	0	0	3	0	0	1	0	0	0
Colomastix pusilla	2	0	0	0	0	0	0	2	0
Corophid sp. A	0	0	0	0	0	0	0	0	0
Corophium sp.	0	0	0	0	0	0	0	0	0
Cossura coasta	0	0	1	2	0	0	0	0	0
Crab sp. A	1	1	1	1	1	1	1	1	1
Crustacea larvae	0	0	0	0	1	1	1	1	1
Cumacid sp. A	1	1	0	0	1	0	0	1	1
Cuspidaria sp.	2	0	0	0	0	0	0	2	0
Diopatra cuprea cuprea	2	0	0	0	0	1	1	1	0
Diopatra dubia	2	0	0	0	0	1	1	1	0
Diopatra monroi	2	0	0	0	0	1	1	1	0
Diplocirrus capensis	0	0	3	0	0	2	0	0	0
Dodecacerra fuscia	0	0	3	0	0	0	0	0	0
Echinocardium cordatum	0	0	2	2	0	0	0	0	0
Epidiopatra hupferiana hupferiana	0	0	0	0	0	1	0	3	0
Epimeria cornigera	3	0	0	0	0	0	0	0	0
Eriopisella capensis	3	0	0	0	0	0	0	0	0
Euclymene quadrilobata	0	0	0	3	0	0	0	0	0
Euclymene sp.	0	0	0	3	0	0	0	0	0
Eunice grubei	0	0	0	0	0	1	0	3	0
Eunice schemacephala	0	0	0	0	0	1	0	3	0
Eunice sp. A	0	0	0	0	0	1	0	3	1
Eunoe hubrechti cf.	0	0	0	0	0	0	0	3	0
Exogone normalis	0	0	2	0	0	0	0	3	0
Flabelligerid sp. A	0	0	3	0	0	2	0	0	0
Flabelligerid sp. B	0	0	3	0	0	2	0	0	0
Gammaropsis afra	1	0	1	1	1	0	0	0	1
Gammaropsis longicarpus	1	0	1	1	1	0	0	0	1
Gammaropsis palmoides	1	0	1	1	1	0	0	0	1
Gastropod sp. A - spiral ridged	1	1	1	1	1	1	1	1	1
Gastropod sp. B - cowrie like	1	1	1	1	1	1	1	1	1
Gastropod sp. C	1	1	1	1	1	1	1	1	1
Glycera alba	0	0	0	0	0	0	0	3	0
Glycera convoluta	0	0	0	0	1	2	0	3	0
Glycera longipinnis	0	0	0	0	1	2	0	3	0
Glycera papillosa	0	0	0	0	1	2	0	3	0
Glycinde capensis	0	0	0	0	0	0	0	3	0
Glycinde sp. c.f.	0	0	0	0	1	2	0	3	0
Goniada emerita	0	0	0	0	0	0	0	2	0
Goniada maculata	0	0	0	0	0	0	0	2	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Taxa/Code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Goniadella gracilis	0	0	0	0	0	0	0	2	0
Goniadopsis maskallensis	0	0	0	0	0	0	0	3	0
Gorgonian sp.	3	0	0	0	0	0	0	0	0
Guernea rhomba	3	0	0	0	0	0	0	0	0
Gyptis capensis	0	0	0	0	0	0	0	2	0
Halicreion ovalitelson	3	0	0	0	0	0	0	0	0
Haploscoloplos kerguelensis	0	0	0	3	0	0	0	0	0
Hermit crab sp.	0	0	0	0	0	0	3	0	0
Heterophoxus cephalodens	3	0	0	0	0	0	0	0	0
Heterophoxus opus	3	0	0	0	0	0	0	0	0
Hippomedon longimanus	0	0	0	0	0	0	3	0	0
Hippomedon normalis	0	0	0	0	0	0	3	0	0
Hippomedon onconotus	0	0	0	0	0	0	3	0	0
Holothuroid sp. A	2	0	1	0	0	0	0	1	1
Holothuroid sp. B	2	0	1	0	0	0	0	1	1
Holothuroid sp. C	2	0	1	0	0	0	0	1	1
Hyalinoecia tubicola	0	0	0	0	0	0	0	3	0
Isopilus sp. c.f.	0	0	0	0	0	0	0	3	0
Katanthura laevitelson	2	0	0	0	0	0	0	1	0
Lamp shell sp.	3	0	0	0	0	0	0	1	1
Lanassa capensis	0	0	2	0	0	0	0	0	0
Laonice cirrata	0	0	3	0	0	0	0	0	0
Lepidasthenia sp.	0	0	0	0	0	0	0	3	0
Leptochiton sykesi	0	3	0	0	0	0	0	0	0
Lucifer chacei	3	0	0	0	0	0	0	0	0
Lumbriclymene cylindricauda	0	0	0	3	0	0	0	0	0
Lumbriclymene minor	0	0	0	3	0	0	0	0	0
Lumbriclymene sp.	0	0	0	3	0	0	0	0	0
Lumbrineris albidentata	0	0	0	0	0	0	0	3	0
Lumbrineris brevicirra	0	0	0	0	0	0	0	3	0
Lumbrineris magalhaensis	0	0	0	0	0	0	0	3	0
Lumbrineris sp.	0	0	2	1	0	1	0	3	1
Lumbrineris tetraura	0	0	0	0	0	0	0	3	0
Lysianassa minimus	0	1	1	1	0	0	0	0	0
Macellicephala sp.	0	0	0	0	0	0	0	3	0
Macoma crawfordi	2	0	2	0	0	0	0	0	0
Macroclymene saldanha	0	0	0	3	0	0	0	0	0
Magelona capensis	0	0	3	0	0	0	0	0	0
Malacoceros indicus	3	0	0	0	0	0	0	0	0
Maldanid sp.	0	0	0	2	0	0	0	0	0
Malmgrenia marquesensis	0	0	0	0	0	0	0	3	1
Mandibulophoxus stimpsoni	3	0	0	0	0	0	0	0	0
Marphysa adenensis	0	0	2	1	0	1	0	3	1
Mesanthura catenula	0	0	0	0	0	0	0	3	0
Mursia cristimanus	0	0	0	0	0	0	0	3	0
Nebalia capensis	3	0	0	0	0	0	0	0	0
Nematode sp. A	0	0	2	0	0	0	0	0	2
Nematode sp. B	0	0	2	0	0	0	0	0	2
Nemertea sp. A	0	0	0	0	0	0	0	3	0
Nemertea sp. B	0	0	0	0	0	0	0	3	0
Nemertea sp. C	0	0	0	0	0	0	0	3	0
Nemertea sp. D	0	0	0	0	0	0	0	3	0
Nemertea sp. E	0	0	0	0	0	0	0	3	0
Nemertea sp. F	0	0	0	0	0	0	0	3	0
Nephtys capensis	0	0	0	0	0	2	0	0	0
Nephtys hombergi	0	0	1	1	1	2	2	3	0
Nephtys macroura	0	0	0	0	0	2	0	2	0
Nephtys malmgreni	0	0	1	1	1	0	2	3	0
Nerinides gilchristi	0	0	3	0	0	0	0	0	0
Nerinides sp.	0	0	3	0	0	0	0	0	0
Nicomache lumbricalis	0	0	0	2	0	0	0	0	0
Notomastus latericeus	0	0	2	2	0	0	0	0	2
Onuphis eremita	0	0	0	0	0	0	0	3	0
Onuphis geophiliformis	0	0	0	0	0	0	0	3	0
Onuphis holobranchiata	0	0	0	0	0	0	0	3	0
Onuphis sp. A	0	0	0	0	0	0	2	2	0
Ophelia sp.	0	0	3	0	0	3	0	2	0
Ophelina acuminata	0	0	0	3	0	0	0	0	0
Ophiodromus spinosus	0	0	0	0	0	0	0	0	2
Ophiura sp.A	2	0	2	0	2	2	2	2	0
Ophiura sp.B	2	0	2	0	2	2	2	2	0
Orbinia angrapequensis	0	0	0	3	0	0	0	0	0
Orbinia bioreti	0	0	0	3	0	0	0	0	0
Orbiniidae	2	0	2	0	2	2	2	2	0
Ostracod sp. A	0	0	0	0	0	3	0	0	0
Ostracod sp. B	0	0	0	0	0	3	0	0	0
Owenia sp.	2	0	2	0	0	0	0	0	0
Panathura serricauda	0	0	0	0	0	0	0	3	0
Paramoera capensis	3	0	0	0	0	0	0	0	0
Parandania boecki	3	0	0	0	0	0	0	0	0
Paraonides sp.	0	0	0	2	0	0	0	0	0
Paraphoxus oculatus	0	0	0	0	0	1	0	0	0
Parelasmopus suluensis	3	0	0	0	0	0	0	0	0
Pectinaria koreni cirrata	2	0	2	0	0	2	0	0	0
Pectinaria sp. juv	2	0	2	2	0	2	0	0	0
Phascolosoma sp.	2	0	2	2	0	0	0	0	0
Pherusa sp.	1	0	1	1	0	1	0	0	0
Photis dolichommata	1	0	1	1	1	0	0	0	1
Phyllodoce longipes	0	0	0	0	0	0	0	3	0
Phyllodoce tubicola	0	0	0	0	0	0	0	3	0
Phyllodocid sp. A	0	0	0	0	0	0	0	3	0
Phylo capensis	0	0	0	3	0	0	0	0	0
Pista brevibranchia	0	0	2	0	0	0	0	0	0
Pista cristata	0	0	2	0	0	0	0	0	0
Pista sp.	0	0	2	0	0	0	0	0	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenger	Carnivore / omnivore	Parasite / commensal
Taxa/Code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Pista unibranchia	0	0	2	0	0	0	0	0	0
Podoceropsis sophiae	3	0	0	0	0	0	0	0	0
Polycirrus plumosus	0	0	2	0	0	0	0	0	0
Polycirrus sp.	0	0	2	2	0	0	0	0	0
Polycirrus tenuisetis	0	0	3	0	1	0	0	0	0
Polydora sp.	2	0	2	2	0	0	0	0	0
Polygordiidae sp.	0	0	3	0	0	0	0	0	0
Polyphysia crassa	1	0	0	3	0	0	0	0	0
Pontophilus gracilis	0	0	0	0	0	0	0	3	0
Praxillella capensis	0	0	0	3	0	0	0	0	0
Prionospio cirrifera	0	0	3	0	0	0	0	0	0
Prionospio cirrobranchiata	0	0	3	0	0	0	0	0	0
Prionospio saldanha	0	0	3	0	0	0	0	0	0
Prionospio sexoculata	0	0	3	0	0	0	0	0	0
Prionospio sp.	0	0	3	0	0	0	0	0	0
Prionospio steenstrupi	2	0	3	0	0	0	0	0	0
Protomystides capensis	0	0	0	0	0	0	0	3	0
Pseudoharpinia excavata	3	0	0	0	0	0	0	0	0
Pterygosquilla armata capensis	0	0	0	0	0	0	0	3	0
Ramphobranchium capense	0	0	0	0	0	1	0	3	0
Retusidae sp. A	0	0	0	0	0	0	0	3	0
Scalibregma inflatum	1	0	0	3	0	0	0	0	0
Scalpellum sp.	3	0	0	0	0	0	0	3	0
Schroederella pauliani	0	0	0	3	0	0	0	0	0
Scoloplella capensis	0	0	0	3	0	0	0	0	0
Scoloplos uniramus	0	0	0	3	0	0	0	0	0
Sea snail	0	1	1	0	1	1	1	1	1
Siphonoecetes orientalis	3	0	0	0	0	0	0	0	0
Siphonoecetes sp.	3	0	0	0	0	0	0	0	0
Sipunculid sp.	1	0	1	1	0	0	0	0	1
Spio sp. juv	0	0	3	0	0	0	0	0	0
Spionidae sp. juv	1	0	3	0	0	0	0	0	0
Spiophanes bombyx	0	0	3	0	0	0	0	0	0
Spiophanes soederstromi	0	0	3	0	0	0	0	0	0
Sthenelais papillosa	0	0	0	0	0	0	0	3	0
Streblosoma abranchiata	0	0	3	0	0	0	0	0	0
Streblosoma persica	0	0	3	0	0	0	0	0	0
Streblospio sp.	0	0	3	0	0	0	0	0	0
Syllidia armata	0	0	0	0	0	0	0	0	2
Syllidia cornuta	0	0	0	0	0	0	0	0	2
Syllis cornuta	1	0	1	1	0	0	0	1	1
Tanais philetaerus	3	0	0	0	0	0	0	0	0
Tellina sp.	2	0	2	0	0	0	0	0	0
Terebellides sp.	0	0	3	0	0	0	0	0	0
Terebellides stroemi	0	0	3	0	0	0	0	0	0
Terebratulina meridionalis	3	0	0	0	0	0	0	0	0
Tharyx annulosus	0	0	3	0	0	0	0	0	0
Tharyx marioni	0	0	3	0	0	0	0	0	0
Tharyx sp.	0	0	3	0	0	0	0	0	0
Trichobranchus glacialis	0	0	3	0	0	0	0	0	0
Triodos insignis	3	0	0	0	0	0	0	0	0
Trischizostoma serratum	3	0	0	0	0	0	0	0	0
Urchin juv.	0	0	0	0	0	0	0	3	0
Urothoe coxalis	1	0	1	1	0	0	0	0	0
Urothoe elegans	1	0	1	1	0	0	0	0	0
Urothoe grimaldi	1	0	1	1	0	0	0	0	0
Urothoe pinnata	1	0	1	1	0	0	0	0	0
Virgularia schultzei	3	0	0	0	0	0	0	0	0

Phylum	Class	Order	Family	Species
		Polychaeta	Paraonidae	Aedicira belgicae
		Polychaeta	Aphroditidae	Alentia australis
		Polychaeta	Aphroditidae	Allmaniella sp.
		Polychaeta	Terebellidae	Amaeana trilobata
		Amphipoda	Lysianassidae	Amaryllis macrophthalma
		Amphipoda	Ampeliscidae	Ampelisca anisuropa
		Amphipoda	Ampeliscidae	Ampelisca anomala
		Amphipoda	Ampeliscidae	Ampelisca brevicornis
		Amphipoda	Ampeliscidae	Ampelisca chiltoni
		Amphipoda	Ampeliscidae	Ampelisca excavata
		Amphipoda	Ampeliscidae	Ampelisca fusca
		Amphipoda	Ampeliscidae	Ampelisca miops
		Amphipoda	Ampeliscidae	Ampelisca palmata
		Polychaeta	Ampheretidae	Ampherete sp.
		Polychaeta	Sabellidae	Amphiglena mediterranea
		Polychaeta	Amphinomidae	Amphinomidae juv.
		Echinodermata	Amphiuridae	Amphiura sp.
		Polychaeta	Pilargidae	Ancistrosyllis parva
		Actinaria	Anemone	Anemone sp. A
		Actinaria	Anemone	Anemone sp. B
		Isopoda	Arcturidae	Antarturus beliaevei
		Amphipoda	Corophiidae	Aora gibbula
		Amphipoda	Corophiidae	Aora kergueleni
		Amphipoda	Corophiidae	Aora sp.
		Polychaeta	Apistobranchidae	Apistobranch
		Tanaidacea	Tanaidae	Apseudes cooperi
		Mollusca	Neomeniidae	Archaeomenia prisca
		Polychaeta	Arenicolidae	Arenicola sp.
		Polychaeta	Paraonidae	Aricidea sp.
		Polychaeta	Terebellidae	Artacama proboscidea
		Ascidiaciea	Ascidian	Ascidian sp. A
		Isopoda	Asellota	Asellota sp.
		Echinodermata	Astropectinidae	Astropectin sp. A
		Amphipoda	Dexaminidae	Atylus swammerdamei
		Polychaeta	Maldanidae	Axiothella jarli
		Crustacea	Portunidae	Bathynectes piperitus
		Amphipoda	Haustoriidae	Bathyporeia sp.
		Amphipoda	Haustoriidae	Bathyporeia sp.
		Amphipoda	Haustoriidae	Bathyporeia sp.
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Bivalve	Bivalve sp. A - mussels
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Thyasiridae	Bivalve sp. C
		Bivalve	Bivalve	Bivalve sp. D - scallop
		Bivalve	Bivalve	Bivalve sp. D - scallop
		Echinodermata	Schizasteridae	Brisaster capensis
		Echinodermata	Schizasteridae	Brisaster capensis
		Echinodermata	Schizasteridae	Brisaster capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis

Phylum	Class	Order	Family	Species
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Spatangoida	Brissidae	Brissopsis lyrifera capensis
		Bryozoa	Bryozoa	Bryozoa sp.
		Bryozoa	Bryozoa	Bryozoa sp.
		Amphipoda	Eusiridae	Calliopiella michaelseni
		Amphipoda	Eusiridae	Calliopiella michaelseni
		Amphipoda	Eusiridae	Calliopiella michaelseni
		Amphipoda	Eusiridae	Calliopiella michaelseni
		Amphipoda	Eusiridae	Calliopiella michaelseni
		Copepod	Candaciidae	Candacia armata
		Copepod	Candaciidae	Candacia armata
		Amphipoda	Caprellidae	Caperellid sp.
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Capitellidae	Capitella capitata
		Polychaeta	Chaetopterus	Chaetopterus varieopedatus
		Amphipoda	Gammaridae	Cheirocratus inermis
		Amphipoda	Corophiidae	Chevalia aviculae
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Polychaeta	Amphinomidae	Chloeia inermis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana borealis
		Isopoda	Cirolanidae	Cirolana caeca
		Isopoda	Cirolanidae	Cirolana caeca
		Polychaeta	Cirratulidae	Cirratulus africanus
		Polychaeta	Cirratulidae	Cirratulus africanus
		Polychaeta	Cirratulidae	Cirratulus sp.
		Polychaeta	Cirratulidae	Cirratulus sp.
		Polychaeta	Cirratulidae	Cirriformia filigera
		Polychaeta	Cirratulidae	Cirriformia filigera
		Amphipoda	Colomastigidae	Colomastix pusilla
		Amphipoda	Colomastigidae	Colomastix pusilla
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. A
		Copepod	Copepod	Copepod sp. B
		Copepod	Copepod	Copepod sp. B
		Copepod	Copepod	Copepod sp. B
		Copepod	Copepod	Copepod sp. C
		Amphipoda	Corophiidae	Corophid sp. A
		Amphipoda	Corophiidae	Corophid sp. A
		Amphipoda	Corophiidae	Corophium sp.
		Polychaeta	Cossuridae	Cossura coasta
		Polychaeta	Cossuridae	Cossura coasta
		Polychaeta	Cossuridae	Cossura coasta
		Polychaeta	Cossuridae	Cossura coasta
		Polychaeta	Cossuridae	Cossura coasta
		Crustacea	Crab	Crab sp. A
		Crustacea	Crab	Crab sp. A
		Crustacea	Crab	Crab sp. A

Phylum	Class	Order	Family	Species
		Crustacea	Crab	Crab sp. A
		Crustacea	Crab	Crab sp. A
		Crustacea	Crab	Crab sp. A
		Crustacea	Crustacea	Crustacea larvae
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Cumacea	Cumacid	Cumacid sp. A
		Bivalve	Cuspidariidae	Cuspidaria sp.
		Bivalve	Cuspidariidae	Cuspidaria sp.
		Bivalve	Cuspidariidae	Cuspidaria sp.
		Bivalve	Cuspidariidae	Cuspidaria sp.
		Bivalve	Cuspidariidae	Cuspidaria sp.
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra cuprea cuprea
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra dubia
		Polychaeta	Onuphidae	Diopatra dubia
		Polychaeta	Onuphidae	Diopatra dubia
		Polychaeta	Onuphidae	Diopatra dubia
		Polychaeta	Onuphidae	Diopatra dubia
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Eunicidae	Diopatra monroi
		Polychaeta	Flabelligeridae	Diplocirrus capensis
		Polychaeta	Flabelligeridae	Diplocirrus capensis
		Polychaeta	Flabelligeridae	Diplocirrus capensis
		Polychaeta	Cirratulidae	Dodecacerra fuscia
		Echinodermata	Echinoidea	Echinocardium cordatum
		Polychaeta	Eunicidae	Epidiopatra hupferiana hupferiana
		Amphipoda	Paramphithoidae	Epimeria cornigera
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Amphipoda	Gammaridae	Eriopisella capensis
		Polychaeta	Maldanidae	Euclymene quadrilobata
		Polychaeta	Maldanidae	Euclymene quadrilobata
		Polychaeta	Maldanidae	Euclymene quadrilobata
		Polychaeta	Maldanidae	Euclymene sp.
		Polychaeta	Maldanidae	Euclymene sp.
		Polychaeta	Eunicidae	Eunice grubei
		Polychaeta	Eunicidae	Eunice schemacephala
		Polychaeta	Eunicidae	Eunice sp. A
		Polychaeta	Aphroditidae	Eunoe hubrechti cf.
		Polychaeta	Aphroditidae	Eunoe hubrechti cf.
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens

Phylum	Class	Order	Family	Species
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Euphausiacea	Euphausiidae	Euphausia lucens
		Polychaeta	Syllidae	Exogone normalis
		Polychaeta	Flabelligeridae	Flabelligerid sp. A
		Polychaeta	Flabelligeridae	Flabelligerid sp. A
		Polychaeta	Flabelligeridae	Flabelligerid sp. A
		Polychaeta	Flabelligeridae	Flabelligerid sp. B
		Polychaeta	Flabelligeridae	Flabelligerid sp. B
		Polychaeta	Flabelligeridae	Flabelligerid sp. B
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Foraminifera	Foraminifera	Foraminifera
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis afra
		Amphipoda	Corophiidae	Gammaropsis longicarpus
		Amphipoda	Corophiidae	Gammaropsis longicarpus
		Amphipoda	Corophiidae	Gammaropsis longicarpus
		Amphipoda	Corophiidae	Gammaropsis longicarpus
		Amphipoda	Corophiidae	Gammaropsis longicarpus
		Amphipoda	Corophiidae	Gammaropsis palmoides
		Gastropod	Gastropod	Gastropod sp. A - spiral ridged
		Gastropod	Gastropod	Gastropod sp. A - spiral ridged
		Gastropod	Gastropod	Gastropod sp. A - spiral ridged
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. B - cowrie like
		Gastropod	Gastropod	Gastropod sp. C
		Polychaeta	Glyceridae	Glycera alba
		Polychaeta	Glyceridae	Glycera alba
		Polychaeta	Glyceridae	Glycera convoluta
		Polychaeta	Glyceridae	Glycera longipinnis
		Polychaeta	Glyceridae	Glycera longipinnis
		Polychaeta	Glyceridae	Glycera papillosa
		Polychaeta	Glyceridae	Glycera papillosa
		Polychaeta	Glyceridae	Glycera papillosa
		Polychaeta	Goniadidae	Glycinde capensis
		Polychaeta	Goniadidae	Glycinde capensis
		Polychaeta	Goniadidae	Glycinde sp. c.f.
		Polychaeta	Goniadidae	Goniada emerita
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata

Phylum	Class	Order	Family	Species
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniada maculata
		Polychaeta	Goniadidae	Goniadella gracilis
		Polychaeta	Goniadidae	Goniadella gracilis
		Polychaeta	Goniadidae	Goniadella gracilis
		Polychaeta	Goniadidae	Goniadopsis maskallensis
		Gorgonian	Gorgonian	Gorgonian sp.
		Amphipoda	Dexaminidae	Guernea rhomba
		Polychaeta	Hesionidae	Gyptis capensis
		Polychaeta	Hesionidae	Gyptis capensis
		Polychaeta	Hesionidae	Gyptis capensis
		Amphipoda	Oedicerotidae	Halicreion ovalitelson
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Polychaeta	Orbiniidae	Haploscoloplos kerguelensis
		Crustacea	Anomura	Hermit crab sp.
		Amphipoda	Phoxocephalidae	Heterophoxus cephalodens
		Amphipoda	Phoxocephalidae	Heterophoxus cephalodens
		Amphipoda	Phoxocephalidae	Heterophoxus cephalodens
		Amphipoda	Phoxocephalidae	Heterophoxus cephalodens
		Amphipoda	Phoxocephalidae	Heterophoxus cephalodens
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Phoxocephalidae	Heterophoxus opus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon longimanus
		Amphipoda	Lysianassidae	Hippomedon normalis
		Amphipoda	Lysianassidae	Hippomedon normalis
		Amphipoda	Lysianassidae	Hippomedon normalis
		Amphipoda	Lysianassidae	Hippomedon normalis
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Amphipoda	Lysianassidae	Hippomedon onconotus
		Echinodermata	Holothuroidea	Holothuroid sp. A
		Echinodermata	Holothuroidea	Holothuroid sp. A
		Echinodermata	Holothuroidea	Holothuroid sp. A
		Echinodermata	Holothuroidea	Holothuroid sp. B
		Echinodermata	Holothuroidea	Holothuroid sp. B
		Echinodermata	Holothuroidea	Holothuroid sp. C
		Echinodermata	Holothuroidea	Holothuroid sp. C
		Polychaeta	Onuphidae	Hyalinoecia tubicola
		Polychaeta	Onuphidae	Hyalinoecia tubicola
		Polychaeta	Onuphidae	Hyalinoecia tubicola
		Polychaeta	Onuphidae	Hyalinoecia tubicola
		Polychaeta	Isopilidae	Isopilus sp. c.f.
		Isopoda	Anthuridae	Katanthura laevitelson
		Terebratulida	Terebratulidae	Lamp shell sp.
		Polychaeta	Terebellidae	Lanassa capensis
		Polychaeta	Terebellidae	Lanassa capensis
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata

Phylum	Class	Order	Family	Species
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Spionidae	Laonice cirrata
		Polychaeta	Aphroditidae	Lepidasthenia sp.
		Polyplacophora	Chiton	Leptochiton sykesi
		Polyplacophora	Chiton	Leptochiton sykesi
		Polyplacophora	Chiton	Leptochiton sykesi
		Polyplacophora	Chiton	Leptochiton sykesi
		Penaeidea	Luciferinae	Lucifer chacei
		Polychaeta	Maldanidae	Lumbriclymene cylindricauda
		Polychaeta	Maldanidae	Lumbriclymene minor
		Polychaeta	Maldanidae	Lumbriclymene minor
		Polychaeta	Maldanidae	Lumbriclymene sp.
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris albidentata
		Polychaeta	Lumbrineridae	Lumbrineris brevicirra
		Polychaeta	Lumbrineridae	Lumbrineris brevicirra
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris magalhaensis
		Polychaeta	Lumbrineridae	Lumbrineris sp.
		Polychaeta	Lumbrineridae	Lumbrineris sp.
		Polychaeta	Lumbrineridae	Lumbrineris sp.
		Polychaeta	Lumbrineridae	Lumbrineris sp.
		Polychaeta	Lumbrineridae	Lumbrineris tetraura
		Amphipoda	Lysianassidae	Lysianassa minimus
		Amphipoda	Lysianassidae	Lysianassa minimus
		Amphipoda	Lysianassidae	Lysianassa minimus
		Amphipoda	Lysianassidae	Lysianassa minimus
		Polychaeta	Aphroditidae	Macellicephala sp.
		Polychaeta	Aphroditidae	Macellicephala sp.
		Bivalve	Tellinidae	Macoma crawfordi
		Bivalve	Tellinidae	Macoma crawfordi
		Bivalve	Tellinidae	Macoma crawfordi
		Bivalve	Tellinidae	Macoma crawfordi
		Bivalve	Tellinidae	Macoma crawfordi
		Bivalve	Tellinidae	Macoma crawfordi
		Polychaeta	Maldanidae	Macroclymene saldanha
		Polychaeta	Maldanidae	Macroclymene saldanha
		Polychaeta	Maldanidae	Macroclymene saldanha
		Polychaeta	Magelonidae	Magelona capensis
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Spionidae	Malacoceros indicus
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Maldanidae	Maldanid sp.
		Polychaeta	Aphroditidae	Malmgrenia marquesensis
		Polychaeta	Aphroditidae	Malmgrenia marquesensis
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni

Phylum	Class	Order	Family	Species
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Amphipoda	Phoxocephalidae	Mandibulophoxus stimpsoni
		Polychaeta	Eunicidae	Marphysa adenensis
		Polychaeta	Eunicidae	Marphysa adenensis
		Isopoda	Anthuridae	Mesanthura catenula
		Isopoda	Anthuridae	Mesanthura catenula
		Crustacea	Calappidae	Mursia cristimanus
		Crustacea	Calappidae	Mursia cristimanus
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Phyllocarida	Phyllocarida	Nebalia capensis
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. A
		Nematode	Nematode	Nematode sp. B
		Nematode	Nematode	Nematode sp. B
		Nematode	Nematode	Nematode sp. B
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. A
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. B
		Nemertea	Nemertea	Nemertea sp. C
		Nemertea	Nemertea	Nemertea sp. C
		Nemertea	Nemertea	Nemertea sp. D
		Nemertea	Nemertea	Nemertea sp. D
		Nemertea	Nemertea	Nemertea sp. D
		Nemertea	Nemertea	Nemertea sp. E
		Nemertea	Nemertea	Nemertea sp. E
		Nemertea	Nemertea	Nemertea sp. F
		Nemertea	Nemertea	Nemertea sp. F
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys capensis
		Polychaeta	Nephtyidae	Nephtys hombergi
		Polychaeta	Nephtyidae	Nephtys hombergi
		Polychaeta	Nephtyidae	Nephtys hombergi
		Polychaeta	Nephtyidae	Nephtys hombergi
		Polychaeta	Nephtyidae	Nephtys hombergi
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura

Phylum	Class	Order	Family	Species
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys macroura
		Polychaeta	Nephtyidae	Nephtys malmgreni
		Polychaeta	Spionidae	Nerinides gilchristi
		Polychaeta	Spionidae	Nerinides gilchristi
		Polychaeta	Spionidae	Nerinides gilchristi
		Polychaeta	Spionidae	Nerinides sp.
		Polychaeta	Spionidae	Nerinides sp.
		Polychaeta	Maldanidae	Nicomache lumbricalis
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Capitellidae	Notomastus latericeus
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis eremita
		Polychaeta	Onuphidae	Onuphis geophiliformis
		Polychaeta	Onuphidae	Onuphis geophiliformis
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis holobranchiata
		Polychaeta	Onuphidae	Onuphis sp. A
		Polychaeta	Opheliidae	Ophelia sp.
		Polychaeta	Opheliidae	Ophelina acuminata
		Polychaeta	Opheliidae	Ophelina acuminata
		Polychaeta	Opheliidae	Ophelina acuminata
		Polychaeta	Hesionidae	Ophiodromus spinosus
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Echinodermata	Ophiuridae	Ophiura sp.
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia angrapequensis
		Polychaeta	Orbiniidae	Orbinia bioreti
		Polychaeta	Orbiniidae	Orbiniidae
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. A
		Ostracod	Ostracod	Ostracod sp. B

Phylum	Class	Order	Family	Species
		Ostracod	Ostracod	Ostracod sp. B
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Polychaeta	Oweniidae	Owenia sp.
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Isopoda	Anthuridae	Panathura serricauda
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Eusiridae	Paramoera capensis
		Amphipoda	Stegocephalidae	Parandania boecki
		Polychaeta	Paraonidae	Paraonides sp.
		Polychaeta	Paraonidae	Paraonides sp.
		Polychaeta	Paraonidae	Paraonides sp.
		Polychaeta	Paraonidae	Paraonides sp.
		Polychaeta	Paraonidae	Paraonides sp.
		Amphipoda	Phoxocephalidae	Paraphoxus oculatus
		Amphipoda	Phoxocephalidae	Paraphoxus oculatus
		Amphipoda	Phoxocephalidae	Paraphoxus oculatus
		Amphipoda	Gammaridae	Parelasmopus suluensis
		Polychaeta	Pectinariidae	Pectinaria koreni cirrata
		Polychaeta	Pectinariidae	Pectinaria koreni cirrata
		Polychaeta	Pectinariidae	Pectinaria sp. juv
		Polychaeta	Pectinariidae	Pectinaria sp. juv
		Polychaeta	Pectinariidae	Pectinaria sp. juv
		Sipunculid	Phascolosomatidae	Phascolosoma sp.
		Sipunculid	Phascolosomatidae	Phascolosoma sp.
		Sipunculid	Phascolosomatidae	Phascolosoma sp.
		Sipunculid	Phascolosomatidae	Phascolosoma sp.
		Polychaeta	Flabelligeridae	Pherusa sp.
		Polychaeta	Flabelligeridae	Pherusa sp.
		Polychaeta	Flabelligeridae	Pherusa sp.
		Amphipoda	Corophiidae	Photis dolichommata
		Polychaeta	Phyllodocidae	Phyllodoce longipes
		Polychaeta	Phyllodocidae	Phyllodoce tubicola
		Polychaeta	Phyllodocidae	Phyllodocid sp. A
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Orbiniidae	Phylo capensis
		Polychaeta	Terebellidae	Pista brevibranchia
		Polychaeta	Terebellidae	Pista cristata
		Polychaeta	Terebellidae	Pista cristata
		Polychaeta	Terebellidae	Pista sp.
		Polychaeta	Terebellidae	Pista sp.
		Polychaeta	Terebellidae	Pista sp.
		Polychaeta	Terebellidae	Pista sp.
		Polychaeta	Terebellidae	Pista unibranchia
		Amphipoda	Corophiidae	Podoceropsis sophiae
		Amphipoda	Corophiidae	Podoceropsis sophiae
		Polychaeta	Terebellidae	Polycirrus plumosus
		Polychaeta	Terebellidae	Polycirrus sp.
		Polychaeta	Terebellidae	Polycirrus sp.
		Polychaeta	Terebellidae	Polycirrus sp.
		Polychaeta	Terebellidae	Polycirrus tenuisetis
		Polychaeta	Spionidae	Polydora sp.
		Polychaeta	Polygordiidae	Polygordiidae sp.
		Polychaeta	Scalibregmidae	Polyphysia crassa
		Polychaeta	Scalibregmidae	Polyphysia crassa
		Crustacea	Crangonidae	Pontophilus gracilis
		Polychaeta	Maldanidae	Praxillella capensis
		Polychaeta	Spionidae	Prionospio cirrifera
		Polychaeta	Spionidae	Prionospio cirrifera
		Polychaeta	Spionidae	Prionospio cirrobranchiata
		Polychaeta	Spionidae	Prionospio cirrobranchiata
		Polychaeta	Spionidae	Prionospio cirrobranchiata
		Polychaeta	Spionidae	Prionospio saldanha
		Polychaeta	Spionidae	Prionospio sexoculata
		Polychaeta	Spionidae	Prionospio sexoculata
		Polychaeta	Spionidae	Prionospio sp.
		Polychaeta	Spionidae	Prionospio steenstrupi

Phylum	Class	Order	Family	Species
		Polychaeta	Spionidae	Prionospio steenstrupi
		Polychaeta	Spionidae	Prionospio steenstrupi
		Polychaeta	Phyllodocidae	Protomystides capensis
		Polychaeta	Phyllodocidae	Protomystides capensis
		Polychaeta	Phyllodocidae	Protomystides capensis
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Amphipoda	Phoxocephalidae	Pseudoharpinia excavata
		Crustacea	Stomatopoda	Pterygosquilla armata capensis
		Polychaeta	Eunicidae	Ramphobranchium capense
		Opisthobranchia	Retusidae	Retusidae sp. A
		Polychaeta	Scalibregmidae	Scalibregma inflatum
		Polychaeta	Scalibregmidae	Scalibregma inflatum
		Polychaeta	Scalibregmidae	Scalibregma inflatum
		Polychaeta	Scalibregmidae	Scalibregma inflatum
		Cirripedia	Scallpellidae	Scalpellum sp.
		Cirripedia	Scallpellidae	Scalpellum sp.
		Polychaeta	Orbiniidae	Schroederella pauliani
		Polychaeta	Orbiniidae	Scoloplella capensis
		Polychaeta	Orbiniidae	Scoloplos uniramus
		Polychaeta	Orbiniidae	Scoloplos uniramus
		Polychaeta	Orbiniidae	Scoloplos uniramus
		Mollusca	Oxystele	Sea snail
		Mollusca	Oxystele	Sea snail
		Mollusca	Oxystele	Sea snail
		Mollusca	Oxystele	Sea snail
		Mollusca	Oxystele	Sea snail
		Amphipoda	Corophiidae	Siphonoecetes orientalis
		Amphipoda	Corophiidae	Siphonoecetes orientalis
		Amphipoda	Corophiidae	Siphonoecetes orientalis
		Amphipoda	Corophiidae	Siphonoecetes orientalis
		Amphipoda	Corophiidae	Siphonoecetes sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Sipunculid	Sipunculid	Sipunculid sp.
		Polychaeta	Spionidae	Spio sp. juv
		Polychaeta	Spionidae	Spionidae sp. juv
		Polychaeta	Spionidae	Spionidae sp. juv
		Polychaeta	Spionidae	Spiophanes bombyx
		Polychaeta	Spionidae	Spiophanes bombyx
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Spionidae	Spiophanes soederstromi
		Polychaeta	Aphroditidae	Sthenelais papillosa
		Polychaeta	Aphroditidae	Sthenelais papillosa
		Polychaeta	Aphroditidae	Sthenelais papillosa
		Polychaeta	Terebellidae	Streblosoma abranchiata
		Polychaeta	Terebellidae	Streblosoma persica
		Polychaeta	Spionidae	Streblospio sp.
		Polychaeta	Hesionidae	Syllidia armata
		Polychaeta	Hesionidae	Syllidia cornuta
		Polychaeta	Syllidae	Syllis cornuta
		Polychaeta	Syllidae	Syllis cornuta
		Polychaeta	Syllidae	Syllis cornuta
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Tanaidacea	Tanaidae	Tanais philetaerus
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Bivalve	Tellinacea	Tellina sp.
		Polychaeta	Terebellidae	Terebellides sp.

Phylum	Class	Order	Family	Species
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Polychaeta	Terebellidae	Terebellides stroemi
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Terebratulida	Terebratulidae	Terebratulina meridionalis
		Polychaeta	Cirratulidae	Tharyx annulosus
		Polychaeta	Cirratulidae	Tharyx annulosus
		Polychaeta	Cirratulidae	Tharyx marioni
		Polychaeta	Cirratulidae	Tharyx sp.
		Polychaeta	Cirratulidae	Tharyx sp.
		Polychaeta	Cirratulidae	Tharyx sp.
		Polychaeta	Terebellidae	Trichobranchus glacialis
		Polychaeta	Terebellidae	Trichobranchus glacialis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Ampeliscidae	Triodos insignis
		Amphipoda	Lysianassidae	Trischizostoma serratum
		Echinodermata	Echinoidea	Urchin juv.
		Echinodermata	Echinoidea	Urchin juv.
		Echinodermata	Echinoidea	Urchin juv.
		Amphipoda	Haustoriidae	Urothoe coxalis
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe elegans
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe grimaldi
		Amphipoda	Haustoriidae	Urothoe pinnata
		Amphipoda	Haustoriidae	Urothoe pinnata
		Amphipoda	Haustoriidae	Urothoe pinnata
		Amphipoda	Haustoriidae	Urothoe pinnata
		Amphipoda	Haustoriidae	Urothoe pinnata
		Amphipoda	Haustoriidae	Urothoe pinnata
		Cnidaria	Pennatulacea	Virgularia schultzei

Phylum	Class	Order	Family	Species
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus dibranchis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus* indet.
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus lyrochaeta*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete acutifrons*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete indet.*
Echinodermata	Ophiuruidea	Gnathophiurida	Amphiuridae	*Amphioplus laevis*
Arthropoda	Malacostraca	Amphipoda	Amphipoda	Amphipoda indet.
Echinodermata	Ophiuruidea	Gnathophiurida	Amphiuridae	*Amphipodia obtecta*
Sipuncula	Phascolosomatidea	Phascolosomaliformes	Phascolosomatidae	*Apionsoma trichocephalus*
Annelida	Polychaeta	Terebellida	Flabelligeridae	*Brada villosa*
Arthropoda	Malacostraca	Decapoda	Callianassidae	*Callianassa japonica*
Annelida	Polychaeta	Capitellida	Capitellidae	*Capitellidae* indet.
Nemertinea	Anopla	Heteronemertea	Cerebratilidae	*Cerebratulidae* indet.
Annelida	Polychaeta	Spionida	Chaetopteridae	*Chaetopterus indet.*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone setosa*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulidae indet.*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus indet.*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Cirrophorus miyakoensis*
Annelida	Polychaeta	Aciculata	Dorvilleidae	*Dorvilleidae indet.*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone* indet.
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone maculata*
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunicidae indet.*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Euryothoe* indet.
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera alba*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera tridactyla*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada* indet.
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe* indet.
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Hesionidae indet A.*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Hesionidae indet B.*
Annelida	Polychaeta	Capitellida	Capitellidae	*Heteromastus filiformis*
Arthropoda	Malacostraca	Isopoda	Isopoda	Isopoda
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	*Jassa marmorata*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Lagis* indet.
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Leocrates chinensis*
Arthropoda	Malacostraca	Decapoda	Pasiphaeidae	*Leptochela aculeocaudata*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Linopherus ambigua*
Echinodermata	Echinoidea	Spatantangoida	Loveniidae	*Lovenia subcarinata*
Arthropoda	Malacostraca	Decapoda	Sergestidae	*Lucifer indet.*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris* indet.
Annelida	Polychaeta	Spionida	Magelonidea	*Magelona crenulifrons*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Mantis*
Annelida	Polychaeta	Eunicida	Eunicidae	*Marphysa sanguinea*
Annelida	Polychaeta	Capitellida	Capitellidae	*Mediomastus indet*
Annelida	Polychaeta	Spionida	Spionidae	*Minuspio cirrifera*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Neanthes indet.*
Nemertinea	Anopla	Heteronemertea	Heteronemertea	*Nemertinea* indet.
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nepthys polybranchiata*
Echiura	Echiuroidea	Echiurida	Echiuridae	*Ochetostoma indet.*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphidae* indet.
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophidromus angustifrons*
Annelida	Polychaeta	Orbiniida	Orbiniidae	*Orbinidae* indet.
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Palaemon serrifer*
Mollusca	Bivalvia	Veneroida	Veneridae	*Paphia undulata*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paraonis gracilis*
Annelida	Polychaeta	Spionida	Spionidae	*Paraprionospio pinnata*
Sipuncula	Phascolosomatidea	Phascolosomatiformes	Phascolosomatidae	*Phascolosoma* indet.
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce indet.*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Pilargiidae* indet.
Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus tricirratus*
Annelida	Polychaeta	Polychaeta	Polychaeta	Polychaeta indet.
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio ehlersi*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio* indet.
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio malmgreni*
Annelida	Polychaeta	Aciculata	Dorvilleidae	*Scistomeringos rudolphi*
Annelida	Polychaeta	Phyllodocida	Sigalinoidae	*Sigaloidae indet.*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Sigambra hanaokai*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Sigambra* indet.
Annelida	Polychaeta	Canalipalpata	Chaetopteridae	*Spiochaetopterus costarum*
Annelida	Polychaeta	Spionida	Spionidae	*Spionidae* indet.
Annelida	Polychaeta	Phyllodocida	Sigalionidae	*Sthenelais* indet.
Mollusca	Bivalvia	Veneroida	Tellinidae	*Telinna* indet.A
Mollusca	Bivalvia	Veneroida	Tellinidae	*Telinna* indet.B
Mollusca	Bivalvia	Veneroida	Tellinidae	*Telinna* indet.C
Annelida	Polychaeta	Terebellida	Terebellidae	*Terrebellidae* indet.
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx indet.*
Mollusca	Bivalvia	Veneroida	Veneridae	*Timoclea Scabra*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Typhlocarcinops denticarpes*

Traits	Maximum adult size						Larval type			Mobility			
	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	**NS1B**	**NS2B**	**NS3B**	**NS4B**	**NS5B**	**NS6B**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Aglaophamus dibranchis	0	0	0	3	0	0	2	2	0	0	0	0	3
Aglaophamus indet.	0	0	2	2	2	0	2	2	0	0	0	0	3
Aglaophamus lyrochaeta	0	0	0	3	0	0	2	2	0	0	0	0	3
Ampharete acutifrons	0	0	2	0	0	0	0	3	0	0	2	0	0
Ampharete indet.	0	0	2	0	0	0	0	3	0	0	2	0	0
Amphiodia obtecta	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphioplus laevis	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphipoda indet.	1	1	1	1	1	1	0	0	3	0	1	1	1
Apionsoma trichocephalus	0	0	0	2	2	0	0	3	0	0	3	0	0
Brada villosa	0	0	3	0	0	0	2	2	0	0	3	0	0
Callianassa japonica	0	0	0	3	0	0	3	0	0	0	0	0	3
Capitellidae indet.	0	0	1	2	2	2	0	3	0	0	0	2	0
Cerebratulidae indet.	0	1	1	1	1	1	0	0	3	0	2	3	2
Chaetopterus indet.	0	0	1	1	1	1	3	0	0	0	3	0	0
Chaetozone setosa	0	0	3	0	0	0	0	3	0	0	2	0	0
Cirratulidae indet.	0	1	1	1	1	1	0	3	0	0	3	0	0
Cirratulus indet.	0	1	1	1	1	1	0	3	0	0	3	0	0
Cirrophorus miyakoensis	0	0	3	0	0	0	0	3	0	0	0	3	0
Dorvilleidae indet.	0	2	2	2	0	0	3	0	0	0	0	3	0
Eteone indet.	0	0	2	2	2	2	0	3	0	0	0	2	2
Eteone maculata	0	0	2	2	0	2	0	3	0	0	0	2	2
Eunicidae indet.	0	0	1	1	1	1	3	0	0	0	2	2	0
Euryothoe indet.	0	0	1	1	1	1	0	0	3	0	0	0	3
Glycera alba	0	0	0	2	3	0	3	0	0	0	0	0	2
Glycera tridactyla	0	0	0	3	0	0	3	0	0	0	0	3	0
Goniada indet.	0	0	1	1	1	0	0	3	0	0	0	0	2
Harmothoe indet.	0	0	0	2	2	0	3	0	0	0	0	0	3
Hesionidae indet A.	0	2	2	2	0	0	3	0	0	0	0	2	2
Hesionidae indet B.	0	2	2	2	0	0	3	0	0	0	0	2	2
Heteromastus filiformis	0	0	0	0	3	0	0	3	0	0	3	0	0
Isopoda	1	1	1	1	1	1	0	0	2	0	1	1	1
Jassa marmorata	0	2	2	0	0	0	0	0	3	0	0	3	0
Lagis indet.	0	0	1	2	2	0	0	3	0	1	2	0	0
Leocrates chinensis	0	0	0	3	0	0	3	0	0	0	0	3	0
Leptochela aculeocaudata	0	0	3	0	0	0	3	0	0	0	0	0	3
Linopherus ambigua	0	0	3	0	0	0	0	0	3	0	0	0	3
Lovenia subcarinata	0	0	0	0	3	0	3	0	0	0	0	2	0
Lucifer indet.	0	0	3	0	0	0	0	0	3	0	0	3	0
Lumbrineris indet.	0	0	2	2	2	2	0	3	0	0	0	3	0
Magelona crenulifrons	0	0	0	3	0	0	3	0	0	0	3	0	0
Mantis	0	0	0	1	1	1	3	0	0	0	0	0	3
Marphysa sanguinea	0	0	0	3	0	0	3	0	0	0	3	0	0
Mediomastus indet.	0	0	0	3	0	0	0	0	3	0	0	0	0
Minuspio cirrifera	0	0	3	0	0	0	3	0	0	0	2	0	0
Neanthes indet.	0	0	0	0	2	2	0	3	0	0	0	0	2
Nemertina indet.	0	2	2	2	2	2	0	0	3	0	2	3	2
Nepthys polybranchiata	0	0	0	0	2	2	0	3	0	0	0	0	2
Ochetostoma indet.	0	0	0	0	0	3	2	2	0	0	3	0	0
Onuphidae indet.	0	1	1	1	0	0	3	0	0	2	2	0	0
Ophidromus angustifrons	0	0	3	0	0	0	3	0	0	0	0	0	3
Orbinidae indet.	0	0	2	2	0	0	2	2	0	0	2	0	0
Palaemon serrifer	0	0	2	2	0	0	3	0	0	0	0	0	3
Paphia undulata	0	0	3	0	0	0	3	0	0	0	3	0	0
Paraonis gracilis	0	3	0	0	0	0	0	3	0	0	3	0	0
Paraprionospio pinnata	0	0	0	3	0	0	3	0	0	0	2	0	0
Phascolosoma indet.	0	0	1	1	1	0	0	3	0	0	2	0	0
Phyllodoce indet.	0	0	2	2	2	2	2	2	0	0	0	0	2
Pilargiidae indet.	1	2	2	1	0	0	3	0	0	0	1	1	1
Poecilochaetus tricirratus	0	0	0	2	0	0	3	0	0	0	0	0	0
Polychaeta indet.	1	1	1	1	1	1	1	1	1	1	1	1	1
Prionospio ehlersi	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio indet.	0	2	1	3	0	0	3	0	0	0	2	0	0
Prionospio malmgreni	0	0	3	0	0	0	3	0	0	0	2	0	0
Scistomeringos rudolphi	0	0	2	2	0	0	3	0	0	0	0	3	0
Sigaloidae indet.	0	0	0	1	1	1	2	0	0	0	0	0	3
Sigambra hanaokai	0	0	0	2	2	0	3	0	0	0	0	0	3
Sigambra indet.	0	0	1	1	1	0	3	0	0	0	0	0	3
Spiochaetopterus costarum	0	0	0	3	2	2	3	0	0	0	1	0	0
Spionidae indet.	0	2	2	2	0	0	3	0	0	0	3	0	0
Sthenelais indet.	0	0	1	1	1	0	0	0	3	0	0	0	2
Telinna indet.A	0	1	1	1	0	0	0	3	0	0	3	0	0
Telinna indet.B	0	1	1	1	0	0	0	3	0	0	3	0	0
Telinna indet.C	0	1	1	1	0	0	0	3	0	0	3	0	0
Terrebellidae indet.	0	0	1	1	1	0	2	2	0	0	3	0	0
Tharyx indet.	0	2	2	2	1	0	0	3	0	0	3	0	0
Timoclea scabra	0	0	3	0	0	0	0	0	3	0	3	0	0
Typhlocarcinops denticarpes	0	0	2	2	0	0	3	0	0	0	0	0	3

Traits	**Bodyform**						**Attachment**		
Category	**Cylindric bobyform**	**Flattened dorsally bobyform**	**Flattened laterally bobyform**	**Ball shaped bobyform**	**Long thin, treadlike bobyform**	**Irregular bobyform**	**None attachment**	**Temporary attachment**	**Permanent attachment**
Taxa/Code	**BF1**	**BF2**	**BF3**	**BF4**	**BF5**	**BF6**	**DA1**	**DA2**	**DA3**
Aglaophamus dibranchis	3	1	0	0	1	0	3	0	0
Aglaophamus indet.	3	1	0	0	1	0	3	0	0
Aglaophamus lyrochaeta	3	1	0	0	1	0	3	0	0
Ampharete acutifrons	2	1	0	0	0	0	0	0	2
Ampharete indet.	2	0	0	0	0	0	0	0	2
Amphiodia obtecta	0	3	0	0	0	3	3	0	0
Amphioplus laevis	0	3	0	0	0	3	3	0	0
Amphipoda indet.	0	0	3	0	0	0	3	0	0
Apionsoma trichocephalus	3	0	0	0	0	0	3	0	0
Brada villosa	1	0	0	1	1	0	3	0	0
Callianassa japonica	0	2	0	0	0	0	3	0	0
Capitellidae indet.	2	0	0	0	2	0	3	0	0
Cerebratulidae indet.	0	2	0	0	2	0	2	0	0
Chaetopterus indet.	0	1	0	0	1	1	1	2	0
Chaetozone setosa	2	0	0	0	1	0	3	0	0
Cirratulidae indet.	2	0	0	0	1	0	3	0	0
Cirratulus indet.	2	0	0	0	1	0	3	0	0
Cirrophorus miyakoensis	2	0	0	0	3	0	2	0	0
Dorvilleidae indet.	2	0	0	0	0	0	3	0	0
Eteone indet.	0	1	0	0	2	0	3	0	0
Eteone maculata	0	1	0	0	2	0	3	0	0
Eunicidae indet.	3	0	0	0	2	0	2	2	0
Euryothoe indet.	3	0	0	0	3	0	3	0	0
Glycera alba	0	0	0	0	2	1	3	0	0
Glycera tridactyla	0	0	0	0	3	0	3	0	0
Goniada indet.	0	1	0	0	2	1	3	0	0
Harmothoe indet.	0	3	0	0	0	0	3	0	0
Hesionidae indet A.	3	0	0	0	1	0	3	0	0
Hesionidae indet B.	3	0	0	0	1	0	3	0	0
Heteromastus filiformis	3	0	0	0	2	0	2	0	0
Isopoda	0	3	0	0	0	0	3	0	0
Jassa marmorata	0	0	3	0	0	0	3	0	0
Lagis indet.	2	0	0	0	3	0	3	0	0
Leocrates chinensis	3	0	0	0	0	0	3	0	0
Leptochela aculeocaudata	0	0	2	0	0	0	3	0	0
Linopherus ambigua	3	0	0	0	3	0	3	0	0
Lovenia subcarinata	0	1	0	2	0	2	3	0	0
Lucifer indet.	0	2	0	0	0	1	3	0	0
Lumbrineris indet.	3	0	0	0	3	0	3	0	0
Magelona crenulifrons	0	0	0	0	3	0	3	0	0
Mantis	0	3	0	0	0	0	3	0	0
Marphysa sanguinea	3	0	0	0	2	0	0	3	0
Mediomastus indet.	2	0	0	0	2	0	0	0	0
Minuspio cirrifera	2	1	0	0	1	0	3	0	0
Neanthes indet.	1	0	0	0	2	0	0	0	0
Nemertina indet.	0	2	0	0	2	0	2	0	0
Nepthys polybranchiata	1	0	0	0	2	0	0	0	0
Ochetostoma indet.	3	0	0	0	3	0	3	0	0
Onuphidae indet.	2	0	0	0	2	0	0	2	2
Ophidromus angustifrons	3	0	0	0	1	0	3	0	0
Orbinidae indet.	0	1	0	1	1	1	3	0	0
Palaemon serrifer	0	0	2	0	0	0	3	0	0
Paphia undulata	0	3	0	0	0	0	3	0	0
Paraonis gracilis	3	0	0	0	3	0	3	0	0
Paraprionospio pinnata	2	1	0	0	1	0	3	0	0
Phascolosoma indet.	0	0	0	0	2	0	3	0	0
Phyllodoce indet.	0	1	1	0	1	0	3	0	0
Pilargiidae indet.	3	0	0	0	3	0	3	0	0
Poecilochaetus tricirratus	2	0	0	0	2	0	3	0	0
Polychaeta indet.	1	1	1	0	2	0	1	1	1
Prionospio ehlersi	2	1	0	0	1	0	3	0	0
Prionospio indet.	1	2	0	0	1	0	3	0	0
Prionospio malmgreni	2	1	0	0	1	0	3	0	0
Scistomeringos rudolphi	2	0	0	0	0	0	3	0	0
Sigaloidae indet.	0	1	1	0	3	0	3	0	0
Sigambra hanaokai	3	0	0	0	3	0	3	0	0
Sigambra indet.	3	0	0	0	3	0	3	0	0
Spiochaetopterus costarum	2	0	0	0	3	0	0	0	0
Spionidae indet.	2	1	0	0	1	0	0	0	2
Sthenelais indet.	2	1	1	0	3	0	3	0	0
Telinna indet.A	0	3	0	0	0	0	3	0	0
Telinna indet.B	0	3	0	0	0	0	3	0	0
Telinna indet.C	0	3	0	0	0	0	3	0	0
Terrebellidae indet.	1	1	0	0	1	2	0	0	0
Tharyx indet.	2	0	0	0	2	0	0	2	0
Timoclea scabra	0	3	0	0	0	0	3	0	0
Typhlocarcinops denticarpes	0	3	0	0	0	0	3	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa/Code	AH1	AH2	AH3	AH4	AH5
Aglaophamus dibranchis	0	0	0	3	0
Aglaophamus indet.	0	0	0	3	0
Aglaophamus lyrochaeta	0	0	0	3	0
Ampharete acutifrons	2	2	0	0	0
Ampharete indet.	2	2	0	1	0
Amphiodia obtecta	0	0	0	2	2
Amphioplus laevis	0	0	0	0	3
Amphipoda indet.	0	0	1	1	1
Apionsoma trichocephalus	0	0	0	3	1
Brada villosa	0	0	3	1	0
Callianassa japonica	0	0	0	3	0
Capitellidae indet.	0	0	0	3	2
Cerebratulidae indet.	0	0	0	2	2
Chaetopterus indet.	0	2	0	2	0
Chaetozone setosa	0	0	0	3	0
Cirratulidae indet.	0	0	0	3	0
Cirratulus indet.	0	0	0	3	0
Cirrophorus miyakoensis	0	0	2	2	2
Dorvilleidae indet.	0	0	0	0	3
Eteone indet.	0	0	0	2	0
Eteone maculata	0	0	0	2	0
Eunicidae indet.	0	0	3	1	0
Euryothoe indet.	0	0	0	2	2
Glycera alba	0	0	0	2	2
Glycera tridactyla	0	0	0	2	2
Goniada indet.	0	0	0	2	1
Harmothoe indet.	0	0	0	1	3
Hesionidae indet A.	0	0	0	1	3
Hesionidae indet B.	0	0	0	1	3
Heteromastus filiformis	0	0	2	2	0
Isopoda	0	0	1	2	2
Jassa marmorata	0	0	0	0	3
Lagis indet.	0	3	0	3	0
Leocrates chinensis	0	0	0	0	3
Leptochela aculeocaudata	0	0	0	0	3
Linopherus ambigua	0	0	0	2	2
Lovenia subcarinata	0	0	0	3	0
Lucifer indet.	0	0	0	0	3
Lumbrineris indet.	0	0	0	2	2
Magelona crenulifrons	0	0	0	3	0
Mantis	0	0	0	0	3
Marphysa sanguinea	0	0	3	1	0
Mediomastus indet.	0	3	0	2	0
Minuspio cirrifera	0	0	2	1	0
Neanthes indet.	0	2	0	2	2
Nemertina indet.	0	0	0	2	2
Nepthys polybranchiata	0	2	0	2	2
Ochetostoma indet.	0	0	0	3	0
Onuphidae indet.	2	2	2	1	0
Ophidromus angustifrons	0	0	0	1	3
Orbinidae indet.	0	0	0	2	0
Palaemon serrifer	0	0	0	0	3
Paphia undulata	0	0	0	3	0
Paraonis gracilis	0	0	0	3	0
Paraprionospio pinnata	0	0	2	1	0
Phascolosoma indet.	0	0	0	0	3
Phyllodoce indet.	0	0	0	0	0
Pilargiidae indet.	0	0	0	1	1
Poecilochaetus tricirratus	0	0	0	3	0
Polychaeta indet.	1	1	1	1	1
Prionospio ehlersi	0	0	2	2	0
Prionospio indet.	0	0	3	1	0
Prionospio malmgreni	0	0	2	1	0
Scistomeringos rudolphi	0	0	0	0	3
Sigaloidae indet.	0	0	0	2	2
Sigambra hanaokai	0	0	0	0	3
Sigambra indet.	0	0	0	0	3
Spiochaetopterus costarum	2	0	2	0	0
Spionidae indet.	0	2	0	1	0
Sthenelais indet.	0	0	0	0	0
Telinna indet.A	0	0	0	3	0
Telinna indet.B	0	0	0	3	0
Telinna indet.C	0	0	0	3	0
Terrebellidae indet.	2	2	0	1	0
Tharyx indet.	0	0	1	1	0
Timoclea scabra	0	0	0	3	0
Typhlocarcinops denticarpes	0	0	0	0	3

Traits	**Feeding**								
Category	**Suspension / filter**	**Scraper / grazer**	**Surface deposit feeder**	**Subsurface deposit feeder**	**Dissolved matter / symbionts**	**Large detrius / sandlicker**	**Scavenge**	**Carnivore / omnivore**	**Parasite / commensal**
Taxa/Code	**FH1**	**FH2**	**FH3**	**FH4**	**FH5**	**FH6**	**FH7**	**FH8**	**FH9**
Aglaophamus dibranchis	0	0	0	0	0	0	0	3	0
Aglaophamus indet.	0	0	0	0	0	0	0	3	0
Aglaophamus lyrochaeta	0	0	0	0	0	0	0	3	0
Ampharete acutifrons	0	0	3	0	0	0	0	0	0
Ampharete indet.	0	0	3	0	0	0	0	0	0
Amphiodia obtecta	3	0	0	0	0	0	0	0	0
Amphioplus laevis	2	0	2	0	0	0	0	0	0
Amphipoda indet.	1	0	1	1	1	1	1	1	1
Apionsoma trichocephalus	0	0	2	2	0	0	0	0	0
Brada villosa	2	0	2	0	0	0	0	0	0
Callianassa japonica	2	0	0	2	0	0	0	0	0
Capitellidae indet.	0	0	2	2	0	0	0	0	0
Cerebratulidae indet.	0	0	0	0	0	0	0	3	0
Chaetopterus indet.	3	0	0	0	0	0	0	0	0
Chaetozone setosa	0	0	3	0	0	0	0	0	0
Cirratulidae indet.	0	0	3	0	0	0	0	0	0
Cirratulus indet.	0	0	3	0	0	0	0	0	0
Cirrophorus miyakoensis	0	0	0	3	0	0	0	0	0
Dorvilleidae indet.	0	0	0	0	0	0	0	3	0
Eteone indet.	0	0	0	0	0	0	0	3	0
Eteone maculata	0	0	0	0	0	0	0	3	0
Eunicidae indet.	0	0	0	0	0	1	0	3	1
Euryothoe indet.	0	0	0	0	0	0	3	0	0
Glycera alba	0	0	0	0	0	0	0	3	0
Glycera tridactyla	0	0	0	0	0	0	0	3	0
Goniada indet.	0	0	0	0	0	0	0	3	0
Harmothoe indet.	0	0	0	0	0	0	0	3	0
Hesionidae indet A.	0	0	0	0	0	0	0	3	0
Hesionidae indet B.	0	0	0	0	0	0	0	3	0
Heteromastus filiformis	0	0	0	3	0	0	0	0	0
Isopoda	1	0	1	1	1	1	0	1	1
Jassa marmorata	3	0	0	0	0	0	0	0	0
Lagis indet.	2	0	2	2	0	2	0	0	0
Leocrates chinensis	0	0	0	0	0	0	0	3	0
Leptochela aculeocaudata	0	0	0	0	0	0	0	3	0
Linopherus ambigua	0	0	0	0	0	0	3	0	0
Lovenia subcarinata	0	0	0	3	0	0	0	3	0
Lucifer indet.	3	0	0	0	1	0	0	0	0
Lumbrineris indet.	0	0	0	0	0	0	0	3	1
Magelona crenulifrons	0	0	3	0	0	0	0	0	0
Mantis	0	0	0	0	0	0	0	3	0
Marphysa sanguinea	0	0	0	0	0	1	0	3	0
Mediomastus indet.	0	0	0	3	0	0	0	0	0
Minuspio cirrifera	0	0	3	0	0	0	0	0	0
Neanthes indet.	2	2	2	0	2	2	2	3	2
Nemertina indet.	0	0	0	0	0	0	0	3	0
Nepthys polybranchiata	2	2	2	0	2	2	2	3	2
Ochetostoma indet.	2	0	0	2	0	0	0	0	0
Onuphidae indet.	0	0	0	0	0	0	2	2	0
Ophidromus angustifrons	0	0	0	0	0	0	0	3	0
Orbinidae indet.	2	0	2	0	2	2	2	2	0
Palaemon serrifer	0	0	0	0	0	0	0	3	0
Paphia undulata	2	0	0	2	0	0	0	0	0
Paraonis gracilis	0	0	3	0	0	0	0	0	0
Paraprionospio pinnata	0	0	3	0	0	0	0	0	0
Phascolosoma indet.	2	0	2	0	0	0	0	0	3
Phyllodoce indet.	0	0	0	0	0	0	0	3	0
Pilargiidae indet.	1	0	1	0	0	0	1	1	0
Poecilochaetus tricirratus	0	0	0	0	0	2	0	2	0
Polychaeta indet.	1	1	1	1	1	1	1	1	1
Prionospio ehlersi	0	0	3	0	0	0	0	0	0
Prionospio indet.	0	0	3	0	0	0	0	0	0
Prionospio malmgreni	0	0	3	0	0	0	0	0	0
Scistomeringos rudolphi	0	0	0	2	0	2	0	2	0
Sigaloidae indet.	0	0	0	0	0	0	0	3	0
Sigambra hanaokai	0	0	0	0	0	0	0	3	0
Sigambra indet.	0	0	0	0	0	0	0	3	0
Spiochaetopterus costarum	3	0	2	0	0	0	0	0	0
Spionidae indet.	1	0	3	0	0	0	0	0	0
Sthenelais indet.	0	0	0	0	0	0	0	3	0
Telinna indet.A	0	0	0	3	0	0	0	0	0
Telinna indet.B	0	0	0	3	0	0	0	0	0
Telinna indet.C	0	0	0	3	0	0	0	0	0
Terrebellidae indet.	2	0	2	0	0	0	0	0	0
Tharyx indet.	0	0	3	0	0	0	0	0	0
Timoclea scabra	3	0	0	0	0	0	0	0	0
Typhlocarcinops denticarpes	0	0	0	0	0	0	0	3	0

Phylum	Class	Order	Family	Species
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus dibranchis*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus indet.*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus lyrochaeta*
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	*Ampelisca brevicornis*
Annelida	Polychaeta	Terebellida	Ampharetidae	*Ampharete indet.*
Echinodermata	Ophiuruidea	Gnathophiurida	Amphiuridae	*Amphiodia indet.*
Echinodermata	Ophiuruidea	Gnathophiurida	Amphiuridae	*Amphiodia obtecta*
Echinodermata	Ophiuruidea	Gnathophiurida	Amphiuridae	*Amphioplus laevis*
Arthropoda	Malacostraca	Amphipoda	Amphipoda	*Amphipoda indet.*
Mollusca	Bivalvia	Arcoida	Arcidae	*Anadara juv indet.*
Mollusca	Bivalvia	Bivalvia	Bivalvia	*Bivalvia indet.*
Mollusca	Bivalvia	Cardioidea	Cardiidae	*Bucardium asiaticum*
Mollusca	Gastropoda	Bullomorpha	Bullomorpha	*Bullomorpha indet.*
Arthropoda	Malacostraca	Decapoda	Callianassidae	*Callianassa japonica*
Mollusca	Bivalvia	Euheterodonta incertae sedis	Cardiidae	*Cardium fimbriatum*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone indet.*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Chaetozone setosa*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulidae indet.*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus indet.*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Cirrophorus miyakoensis*
Annelida	Polychaeta	Cossurida	Cossuridae	*Cossuraidae indet.*
Annelida	Polychaeta	Cossurida	Cossuridae	*Cossurella dimorpha*
Mollusca	Bivalvia	Myodia	Myidae	*Cryptomya busoensis*
Arthropoda	Malacostraca	Decapoda	Decapoda	*Decapoda indet.*
Annelida	Polychaeta	Aciculata	Dorvilleidae	*Dorvilleidae indet.*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone indet.*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone maculata*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Eucrate costata*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Fabulina indet.*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera alba*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera tridactyla*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glyceridae indet.*
Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycinde gurjanovae*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada japonica*
Annelida	Polychaeta	Phyllodocida	Goniadidae	*Goniada maculata*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Gyptis indet.*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Gyptis pacificus*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe indet.*
Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe minuta*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Hesionidae indet.*
Annelida	Polychaeta	Capitellida	Capitellidae	*Heteromastus indet*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Leocrates chinensis*
Arthropoda	Malacostraca	Decapoda	Pasiphaeidae	*Leptochela aculeocaudata*
Annelida	Polychaeta	Amphinomida	Amphinomidae	*Linopherus ambigua*
Echinodermata	Echinoidea	Spatantangoida	Loveniidae	*Lovenia subcarinata*
Arthropoda	Malacostraca	Decapoda	Sergestidae	*Lucifer indet.*
Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris indet.*
Annelida	Polychaeta	Spionida	Magelonidae	*Magelona crenulifrons*
Annelida	Polychaeta	Capitellida	Capitellidae	*Mediomastus indet.*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Moerella iridescens*
Mollusca	Gastropoda	Stenoglossa	Nassariidae	*Nassarius festivus*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Neanthes indet.*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Nectoneanthes multignatha*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Nectoneanthes oxypoda*
Nemertinea	Anopla	Heteronemertea	Heteronemertea	*Nemertinea indet.*
Arthropoda	Malacostraca	Decapoda	Pinnotheridae	*Neoxenophthalmus obscurus*
Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nepthys indet.*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Nereis indet.*
Annelida	Polychaeta	Phyllodocida	Nereidae	*Nicon sinica*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus indet.*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus latericus*
Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis indet.*
Annelida	Polychaeta	Opheliida	Opheliidae	*Ophelina acuminata*
Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophidromus angustifrons*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura kindbergi*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Otopsis indet.*
Annelida	Polychaeta	Orbiniida	Paraonidae	*Paraonis gracilis*
Annelida	Polychaeta	Spionida	Spionidae	*Paraprionospio pinnata*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinaria indet.*
Mollusca	Gastropoda	Cephalaspidea	Philinidae	*Philine indet.*
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodoce indet.*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Pilargiidae indet.*
Annelida	Polychaeta	Flabelligerida	Flabelligeridae	*Piromis congoensis*
Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus indet.*
Annelida	Polychaeta	Polychaeta	Polychaeta	*Polychaeta indet.*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio cirrifera*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio ehlersi*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio indet.*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio malmgreni*
Annelida	Polychaeta	Spionida	Spionidae	*Prionospio pygmaea*
Echinodermata	Holothuroidea	Apadida	Synapiidae	*Protankyra bidentata*
Mollusca	Gastropoda	Heterostropha	Pyramidellidae	*Pyramidellidae indet.*
Mollusca	Bivalvia	Nuculoida	Nuculanidae	*Saccella cuspidata*
Annelida	Polychaeta	Opheliida	Scalibregmidae	*Scalibregma inflatum*
Annelida	Polychaeta	Aciculata	Dorvilleidae	*Schistomeringos indet.*
Echinodermata	Echinoidea	Spatantangoida	Schizasteridae	*Schizaster lacunosus*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Sigambra hanaokai*
Annelida	Polychaeta	Phyllodocida	Pilargiidae	*Sigambra indet.*
Annelida	Polychaeta	Canalipalpata	Chaetopteridae	*Spiochaetopterus costarum*
Annelida	Polychaeta	Spionida	Spionidae	*Spionidae indet.*
Annelida	Polychaeta	Spionida	Spionidae	*Spiophanes indet.*
Arthropoda	Malacostraca	Decapoda	Squillidae	*Squilla indet.*
Annelida	Polychaeta	Phyllodocida	Sigalinoidae	*Sthenolepis japonica*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Tellina cygnus*
Annelida	Polychaeta	Terebellida	Terebellidae	*Terebellidae indet.*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita sima*
Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx indet.*
Sipuncula	Sipunculidea	Golfingiformes	Themistidae	*Themiste indet.*
Mollusca	Bivalvia	Veneroida	Semelidae	*Theora lata*

Phylum	Class	Order	Family	Species
Mollusca	Bivalvia	Veneroida	Veneridae	*Timoclea scabra*
Arthropoda	Malacostraca	Decapoda	Pinnotheridae	*Tritodynamia horvathi*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Typhlocarcinops denticarpes*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Typhlocarcinops indet.*
Arthropoda	Malacostraca	Decapoda	Pinnotheridae	*Xenophtalmus pinnotheroides*

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	NS1B	NS2B	NS3B	NS4B	NS5B	NS6B	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Aglaophamus dibranchis	0	0	0	3	0	0	2	2	0	0	0	0	3
Aglaophamus indet.	0	0	2	2	2	0	2	2	0	0	0	0	3
Aglaophamus lyrochaeta	0	0	0	3	0	0	2	2	0	0	0	0	3
Ampelisca brevicornis	0	0	3	0	0	0	0	0	3	0	0	3	0
Ampharete indet.	0	0	2	0	0	0	0	3	0	0	2	0	0
Amphiodia indet.	0	2	2	0	0	0	0	0	3	0	0	3	0
Amphiodia obtecta	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphioplus laevis	0	3	0	0	0	0	0	0	3	0	0	3	0
Amphipoda indet.	1	1	1	1	1	1	0	0	3	0	1	1	1
Anadara juv indet.	0	2	3	2	0	0	0	3	0	0	3	0	0
Bivalvia indet.	1	1	1	1	1	1	1	1	0	0	1	1	0
Bucardium asiaticum	0	0	0	3	0	0	0	0	3	0	3	0	0
Bullomorpha indet.	3	0	0	0	0	0	3	0	0	0	3	0	0
Callianassa japonica	0	0	0	3	0	0	3	0	0	0	0	0	3
Cardium fimbriatum	0	0	3	0	0	0	0	0	3	0	3	0	0
Chaetozone indet.	0	0	3	0	0	0	0	3	0	0	2	0	0
Chaetozone setosa	0	0	3	0	0	0	0	3	0	0	2	0	0
Cirratulidae indet.	0	1	1	1	1	1	0	3	0	0	3	0	0
Cirratulus indet.	0	1	1	1	1	1	0	3	0	0	3	0	0
Cirrophorus miyakoensis	0	0	3	0	0	0	0	3	0	0	0	3	0
Cossuraidae indet.	0	2	2	2	0	0	0	0	3	0	0	3	0
Cossurella dimorpha	0	0	3	0	0	0	0	0	3	0	0	3	0
Cryptomya busoensis	0	3	0	0	0	0	0	0	3	0	3	0	0
Decapoda indet.	1	1	1	1	1	1	0	0	3	0	0	2	2
Dorvilleidae indet.	0	2	2	2	0	0	3	0	0	0	0	3	0
Eteone indet.	0	0	2	2	2	2	0	3	0	0	0	2	2
Eteone maculata	0	0	2	2	0	2	0	3	0	0	0	2	2
Eucrate costata	0	0	0	3	0	0	3	0	0	0	0	0	3
Fabulina indet.	1	1	1	1	0	0	0	0	3	0	3	0	0
Glycera alba	0	0	0	2	3	0	3	0	0	0	0	0	2
Glycera tridactyla	0	0	0	3	0	0	3	0	0	0	0	3	0
Glyceridae indet.	0	0	0	2	3	2	3	0	0	0	0	0	2
Glycinde gurjanovae	0	0	0	3	0	0	0	3	0	0	0	0	3
Goniada japonica	0	0	0	0	3	0	0	3	0	0	0	0	2
Goniada maculata	0	3	0	0	0	0	3	0	0	0	0	0	2
Gyptis indet.	0	2	2	0	0	0	3	0	0	0	0	0	3
Gyptis pacificus	0	2	2	0	0	0	3	0	0	0	0	0	3
Harmothoe indet.	0	0	0	2	2	0	3	0	0	0	0	0	3
Harmothoe minuta	0	0	0	2	2	0	3	0	0	0	0	0	3
Hesionidae indet.	0	2	2	2	0	0	3	0	0	0	0	2	2
Heteromastus indet	0	0	0	0	3	0	0	3	0	0	3	0	0
Leocrates chinensis	0	0	0	3	0	0	3	0	0	0	0	3	0
Leptochela aculeocaudata	0	0	3	0	0	0	3	0	0	0	0	0	3
Linopherus ambigua	0	0	3	0	0	0	0	0	3	0	0	0	3
Lovenia subcarinata	0	0	0	0	3	0	3	0	0	0	0	2	0
Lucifer indet.	0	0	3	0	0	0	0	0	3	0	0	3	0
Lumbrineris indet.	0	0	2	2	2	2	0	3	0	0	0	3	0
Magelona crenulifrons	0	0	0	3	0	0	3	0	0	0	3	0	0
Mediomastus indet.	0	0	0	3	0	0	0	0	3	0	0	0	0
Moerella iridescens	0	0	3	0	0	0	0	3	0	0	3	0	0
Nassarius festivus	0	0	3	0	0	0	3	0	0	0	3	0	0
Neanthes indet.	0	0	0	0	2	2	0	3	0	0	0	0	2
Nectoneanthes multignatha	0	0	0	0	2	2	0	3	0	0	0	0	2
Nectoneanthes oxypoda	0	0	0	0	2	2	0	3	0	0	0	0	2
Nemertina indet.	0	2	2	2	2	2	0	0	3	0	2	3	2
Neoxenophthalmus obscurus	0	3	0	0	0	0	3	0	0	0	0	0	3
Nepthys indet.	0	0	0	1	2	2	3	2	0	0	0	0	2
Nereis indet.	0	0	0	0	2	2	0	3	0	0	0	0	2
Nicon sinica	0	0	3	0	0	0	0	3	0	0	0	0	2
Notomastus indet.	0	0	0	0	2	2	0	3	0	0	0	2	0
Notomastus latericus	0	0	0	0	2	2	0	3	0	0	0	2	0
Onuphis indet.	0	2	2	1	0	0	3	0	0	2	2	0	0
Ophelina acuminata	0	0	0	3	0	0	0	3	0	0	0	2	0
Ophidromus angustifrons	0	0	3	0	0	0	3	0	0	0	0	0	3
Ophiura kindbergi	0	2	0	0	0	0	3	0	0	0	2	0	0
Otopsis indet.	0	1	1	1	0	0	1	2	2	1	0	0	3
Paraonis gracilis	0	3	0	0	0	0	0	3	0	0	3	0	0
Paraprionospio pinnata	0	0	0	3	0	0	3	0	0	0	2	0	0
Pectinaria indet.	0	0	1	2	2	0	0	3	0	1	2	0	0
Philine indet.	0	0	2	0	0	0	3	0	0	0	3	0	0
Phyllodoce indet.	0	0	2	2	2	2	2	2	0	0	0	0	2
Pilargiidae indet.	1	2	2	1	0	0	3	0	0	0	1	1	1
Piromis congoensis	0	0	3	0	0	0	0	0	3	0	2	0	0
Poecilochaetus indet.	0	0	0	2	0	0	3	0	0	0	0	0	0
Polychaeta indet.	1	1	1	1	1	1	1	1	1	1	1	1	1
Prionospio cirrifera	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio ehlersi	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio indet.	0	2	1	3	0	0	3	0	0	0	2	0	0
Prionospio malmgreni	0	0	3	0	0	0	3	0	0	0	2	0	0
Prionospio pygmaea	0	0	3	0	0	0	3	0	0	0	2	0	0
Protankyra bidentata	0	0	0	3	0	0	3	0	0	0	3	0	0
Pyramidellidae indet.	1	1	1	0	0	0	0	3	0	0	3	0	0
Saccella cuspidata	0	3	0	0	0	0	0	0	3	0	3	0	0
Scalibregma inflatum	0	1	2	1	0	0	0	3	0	0	2	1	0
Schistomeringos indet.	0	2	2	2	0	0	3	0	0	0	0	3	0
Schizaster lacunosus	0	0	0	0	3	0	3	0	0	0	2	0	0
Sigambra hanaokai	0	0	0	2	2	0	3	0	0	0	0	0	3
Sigambra indet.	0	0	1	1	1	0	3	0	0	0	0	0	3
Spiochaetopterus costarum	0	0	0	3	2	2	3	0	0	0	1	0	0
Spionidae indet.	0	2	2	2	0	0	3	0	0	0	3	0	0
Spiophanes indet.	0	0	2	2	2	2	3	0	0	0	2	0	0
Squilla indet.	0	0	0	1	1	1	3	0	0	0	0	0	3
Sthenolepis japonica	0	0	3	0	0	0	2	2	0	0	0	0	2
Tellina cygnus	0	0	3	0	0	0	0	3	0	0	3	0	0
Terrebellidae indet.	0	0	1	1	1	0	2	2	0	0	3	0	0

Traits	Maximum adult size						Larval type			Mobility			
Category	<5mm	5mm-1cm	1-3cm	3-6cm	6-10cm	>10cm	Planktotroph	Lecitotroph	Direct development	None mobility	Low mobility	Medium mobility	High mobility
Taxa/Code	NS1B	NS2B	NS3B	NS4B	NS5B	NS6B	LT1	LT2	LT3	AM1	AM2	AM3	AM4
Thalamita sima	0	0	3	0	0	0	3	0	0	0	0	0	3
Tharyx indet.	0	2	2	2	1	0	0	3	0	0	3	0	0
Themiste indet.	0	0	0	3	0	0	0	3	0	0	3	0	0
Theora lata	0	0	3	0	0	0	0	0	3	0	3	0	0
Timoclea scabra	0	0	3	0	0	0	0	0	3	0	3	0	0
Tritodynamia horvathi	0	0	3	0	0	0	3	0	0	0	0	0	3
Typhlocarcinops denticarpes	0	0	2	2	0	0	3	0	0	0	0	0	3
Typhlocarcinops indet.	0	0	1	1	1	0	3	0	0	0	0	0	3
Xenophtalmus pinnotheroides	0	3	0	0	0	0	3	0	0	0	0	0	3

Traits	Bodyform						Attachment		
Category	Cylindric bobyform	Flattened dorsally bobyform	Flattened laterally bobyform	Ball shaped bobyform	Long thin, treadlike bobyform	Irregular bobyform	None attachment	Temporary attachment	Permanent attachment
Taxa/Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Aglaophamus dibranchis	3	1	0	0	1	0	3	0	0
Aglaophamus indet.	3	1	0	0	1	0	3	0	0
Aglaophamus lyrochaeta	3	1	0	0	1	0	3	0	0
Ampelisca brevicornis	0	0	3	0	0	0	3	0	0
Ampharete indet.	2	0	0	0	0	0	0	0	2
Amphiodia indet.	0	3	0	0	0	3	3	0	0
Amphiodia obtecta	0	3	0	0	0	3	3	0	0
Amphioplus laevis	0	3	0	0	0	3	3	0	0
Amphipoda indet.	0	0	3	0	0	0	3	0	0
Anadara juv indet.	0	3	0	0	0	0	2	2	0
Bivalvia indet.	0	3	0	0	0	0	1	1	0
Bucardium asiaticum	0	0	0	0	0	3	3	0	0
Bullomorpha indet.	3	0	0	0	0	1	3	0	0
Callianassa japonica	0	2	0	0	0	0	3	0	0
Cardium fimbriatum	0	0	0	0	0	3	3	0	0
Chaetozone indet.	2	0	0	0	1	0	3	0	0
Chaetozone setosa	2	0	0	0	1	0	3	0	0
Cirratulidae indet.	2	0	0	0	1	0	3	0	0
Cirratulus indet.	2	0	0	0	1	0	3	0	0
Cirrophorus miyakoensis	2	0	0	0	3	0	2	0	0
Cossuraidae indet.	2	0	0	0	3	0	3	0	0
Cossurella dimorpha	2	0	0	0	3	0	3	0	0
Cryptomya busoensis	0	0	0	0	0	3	3	0	0
Decapoda indet.	0	1	1	1	0	1	2	0	0
Dorvilleidae indet.	2	0	0	0	0	0	3	0	0
Eteone indet.	0	1	0	0	2	0	3	0	0
Eteone maculata	0	1	0	0	2	0	3	0	0
Eucrate costata	0	3	0	0	0	0	3	0	0
Fabulina indet.	0	0	0	0	0	3	3	0	0
Glycera alba	0	0	0	0	2	1	3	0	0
Glycera tridactyla	0	0	0	0	3	0	3	0	0
Glyceridae indet.	0	0	0	0	2	1	3	0	0
Glycinde gurjanovae	2	0	0	0	2	0	3	0	0
Goniada japonica	0	1	0	0	2	1	3	0	0
Goniada maculata	1	0	0	0	1	0	3	0	0
Gyptis indet.	1	0	0	0	1	0	3	0	0
Gyptis pacificus	1	0	0	0	1	0	3	0	0
Harmothoe indet.	0	3	0	0	0	0	3	0	0
Harmothoe minuta	0	3	0	0	0	0	3	0	0
Hesionidae indet.	3	0	0	0	1	0	3	0	0
Heteromastus indet	3	0	0	0	2	0	2	0	0
Leocrates chinensis	3	0	0	0	0	0	3	0	0
Leptochela aculeocaudata	0	0	2	0	0	0	3	0	0
Linopherus ambigua	3	0	0	0	3	0	3	0	0
Lovenia subcarinata	0	1	0	2	0	2	3	0	0
Lucifer indet.	0	2	0	0	0	1	3	0	0
Lumbrineris indet.	3	0	0	0	3	0	3	0	0
Magelona crenulifrons	0	0	0	0	3	0	3	0	0
Mediomastus indet.	2	0	0	0	2	0	0	0	0
Moerella iridescens	0	3	0	0	0	0	3	0	0
Nassarius festivus	0	0	0	0	0	3	3	0	0
Neanthes indet.	1	0	0	0	2	0	0	0	0
Nectoneanthes multignatha	1	0	0	0	2	0	0	0	0
Nectoneanthes oxypoda	1	0	0	0	2	0	0	0	0
Nemertina indet.	0	2	0	0	2	0	2	0	0
Neoxenophthalmus obscurus	0	1	0	0	0	0	3	0	0
Nepthys indet.	0	1	1	0	2	0	3	0	0
Nereis indet.	1	0	0	0	2	0	0	0	0
Nicon sinica	1	0	0	0	2	0	0	0	0
Notomastus indet.	2	0	0	0	2	0	2	0	0
Notomastus latericus	2	0	0	0	2	0	2	0	0
Onuphis indet.	2	0	0	0	2	0	0	2	2
Ophelina acuminata	2	0	0	0	0	0	3	0	0
Ophidromus angustifrons	3	0	0	0	1	0	3	0	0
Ophiura kindbergi	0	1	0	1	1	1	3	0	0
Otopsis indet.	0	0	0	1	1	1	3	0	0
Paraonis gracilis	3	0	0	0	3	0	3	0	0
Paraprionospio pinnata	2	1	0	0	1	0	3	0	0
Pectinaria indet.	2	0	0	0	3	0	3	0	0
Philine indet.	0	0	0	0	0	0	0	0	0
Phyllodoce indet.	0	1	1	0	1	0	3	0	0
Pilargiidae indet.	3	0	0	0	3	0	3	0	0
Piromis congoensis	2	0	0	0	0	0	3	0	0
Poecilochaetus indet.	2	0	0	0	2	0	3	0	0
Polychaeta indet.	1	1	1	0	2	0	1	1	1
Prionospio cirrifera	2	1	0	0	1	0	3	0	0
Prionospio ehlersi	2	1	0	0	1	0	3	0	0
Prionospio indet.	1	2	0	0	1	0	3	0	0
Prionospio malmgreni	2	1	0	0	1	0	3	0	0
Prionospio pygmaea	2	1	0	0	1	0	3	0	0
Protankyra bidentata	3	0	0	0	0	0	3	0	0
Pyramidellidae indet.	0	0	0	0	0	3	3	0	0
Saccella cuspidata	0	0	0	0	0	3	3	0	0
Scalibregma inflatum	2	0	0	1	1	1	0	0	0
Schistomeringos indet.	2	0	0	0	0	0	3	0	0
Schizaster lacunosus	0	0	0	3	0	0	3	0	0
Sigambra hanaokai	3	0	0	0	3	0	3	0	0
Sigambra indet.	3	0	0	0	3	0	3	0	0
Spiochaetopterus costarum	2	0	0	0	3	0	0	0	0
Spionidae indet.	2	1	0	0	1	0	0	0	2
Spiophanes indet.	2	1	0	0	1	0	0	0	2
Squilla indet.	0	3	0	0	0	0	3	0	0
Sthenolepis japonica	0	1	1	0	1	0	3	0	0
Tellina cygnus	0	3	0	0	0	0	3	0	0
Terrebellidae indet.	1	1	0	0	1	2	0	0	0

Traits	Bodyform						Attachment		
Category	Cylindric bobyform	Flattened dorsally bobyform	Flattened laterally bobyform	Ball shaped bobyform	Long thin, treadlike bobyform	Irregular bobyform	None attachment	Temporary attachment	Permanent attachment
Taxa/Code	BF1	BF2	BF3	BF4	BF5	BF6	DA1	DA2	DA3
Thalamita sima	0	3	0	0	0	0	3	0	0
Tharyx indet.	2	0	0	0	2	0	0	2	0
Themiste indet.	3	0	0	0	0	0	3	0	0
Theora lata	0	0	0	0	0	3	3	0	0
Timoclea scabra	0	3	0	0	0	0	3	0	0
Tritodynamia horvathi	0	1	0	0	0	0	3	0	0
Typhlocarcinops denticarpes	0	3	0	0	0	0	3	0	0
Typhlocarcinops indet.	0	3	0	0	0	0	3	0	0
Xenophtalmus pinnotheroides	0	1	0	0	0	0	3	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa/Code	AH1	AH2	AH3	AH4	AH5
Aglaophamus dibranchis	0	0	0	3	0
Aglaophamus indet.	0	0	0	3	0
Aglaophamus lyrochaeta	0	0	0	3	0
Ampelisca brevicornis	0	0	0	1	1
Ampharete indet.	2	2	0	1	0
Amphiodia indet.	0	0	0	2	2
Amphiodia obtecta	0	0	0	2	2
Amphioplus laevis	0	0	0	0	3
Amphipoda indet.	0	0	1	1	1
Anadara juv indet.	0	0	0	1	1
Bivalvia indet.	0	0	0	1	0
Bucardium asiaticum	0	0	0	0	3
Bullomorpha indet.	0	0	0	0	3
Callianassa japonica	0	0	0	3	0
Cardium fimbriatum	0	0	0	0	3
Chaetozone indet.	0	0	0	3	0
Chaetozone setosa	0	0	0	3	0
Cirratulidae indet.	0	0	0	3	0
Cirratulus indet.	0	0	0	3	0
Cirrophorus miyakoensis	0	0	2	2	2
Cossuraidae indet.	0	0	0	2	0
Cossurella dimorpha	0	0	0	3	0
Cryptomya busoensis	0	0	0	0	3
Decapoda indet.	0	0	0	0	3
Dorvilleidae indet.	0	0	0	0	3
Eteone indet.	0	0	0	2	0
Eteone maculata	0	0	0	2	0
Eucrate costata	0	0	0	0	3
Fabulina indet.	0	0	0	0	3
Glycera alba	0	0	0	2	2
Glycera tridactyla	0	0	0	2	2
Glyceridae indet.	0	0	1	2	2
Glycinde gurjanovae	0	0	0	0	3
Goniada japonica	0	0	0	2	1
Goniada maculata	0	0	0	0	2
Gyptis indet.	0	0	0	0	2
Gyptis pacificus	0	0	0	0	2
Harmothoe indet.	0	0	0	1	3
Harmothoe minuta	0	0	0	1	3
Hesionidae indet.	0	0	0	1	3
Heteromastus indet	0	0	2	2	0
Leocrates chinensis	0	0	0	0	3
Leptochela aculeocaudata	0	0	0	0	3
Linopherus ambigua	0	0	0	2	2
Lovenia subcarinata	0	0	0	3	0
Lucifer indet.	0	0	0	0	3
Lumbrineris indet.	0	0	0	2	2
Magelona crenulifrons	0	0	0	3	0
Mediomastus indet.	0	3	0	2	0
Moerella iridescens	0	0	0	3	0
Nassarius festivus	0	0	0	0	3
Neanthes indet.	0	2	0	2	2
Nectoneanthes multignatha	0	2	0	2	2
Nectoneanthes oxypoda	0	2	0	2	2
Nemertina indet.	0	0	0	2	2
Neoxenophthalmus obscurus	0	0	0	0	3
Nepthys indet.	0	0	0	2	2
Nereis indet.	0	2	0	2	2
Nicon sinica	0	2	0	2	2
Notomastus indet.	0	0	3	2	2
Notomastus latericus	0	0	3	2	2
Onuphis indet.	2	2	2	1	0
Ophelina acuminata	0	0	0	2	0
Ophidromus angustifrons	0	0	0	1	3
Ophiura kindbergi	0	0	0	0	0
Otopsis indet.	0	3	0	3	0
Paraonis gracilis	0	0	0	3	0
Paraprionospio pinnata	0	0	2	1	0
Pectinaria indet.	0	3	0	3	0
Philine indet.	0	0	0	0	0
Phyllodoce indet.	0	0	0	0	0
Pilargiidae indet.	0	0	0	1	1
Piromis congoensis	0	0	0	3	0
Poecilochaetus indet.	0	0	0	3	0
Polychaeta indet.	1	1	1	1	1
Prionospio cirrifera	0	0	2	1	0
Prionospio ehlersi	0	0	2	2	0
Prionospio indet.	0	0	3	1	0
Prionospio malmgreni	0	0	2	1	0
Prionospio pygmaea	0	0	2	2	0
Protankyra bidentata	0	0	0	3	0
Pyramidellidae indet.	0	0	0	0	2
Saccella cuspidata	0	0	0	0	3
Scalibregma inflatum	0	0	0	3	0
Schistomeringos indet.	0	0	0	0	3
Schizaster lacunosus	0	0	0	3	2
Sigambra hanaokai	0	0	0	0	3
Sigambra indet.	0	0	0	0	3
Spiochaetopterus costarum	2	0	2	0	0
Spionidae indet.	0	2	0	1	0
Spiophanes indet.	0	2	0	1	0
Squilla indet.	0	0	0	0	3
Sthenolepis japonica	0	0	0	0	0
Tellina cygnus	0	0	0	3	0
Terrebellidae indet.	2	2	0	1	0

Traits	**Adult habitat**				
Category	**Sessile attachment**	**Tube permanent attachment**	**Tube semi-permanent attachment**	**Burrower**	**Surface crawler / swimmer**
Taxa/Code	**AH1**	**AH2**	**AH3**	**AH4**	**AH5**
Thalamita sima	0	0	0	0	3
Tharyx indet.	0	0	1	1	0
Themiste indet.	0	0	0	3	0
Theora lata	0	0	0	0	3
Timoclea scabra	0	0	0	3	0
Tritodynamia horvathi	0	0	0	0	3
Typhlocarcinops denticarpes	0	0	0	0	3
Typhlocarcinops indet.	0	0	0	0	3
Xenophtalmus pinnotheroides	0	0	0	0	3

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenge	Carnivore / omnivore	Parasite / commensal
Taxa/Code	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Aglaophamus dibranchis	0	0	0	0	0	0	0	3	0
Aglaophamus indet.	0	0	0	0	0	0	0	3	0
Aglaophamus lyrochaeta	0	0	0	0	0	0	0	3	0
Ampelisca brevicornis	3	0	0	0	0	0	0	0	0
Ampharete indet.	0	0	3	0	0	0	0	0	0
Amphiodia indet.	2	0	2	0	0	0	0	0	0
Amphiodia obtecta	3	0	0	0	0	0	0	0	0
Amphioplus laevis	2	0	2	0	0	0	0	0	0
Amphipoda indet.	1	0	1	1	1	1	1	1	1
Anadara juv indet.	2	1	1	1	0	0	1	0	0
Bivalvia indet.	2	0	0	0	1	0	0	0	1
Bucardium asiaticum	0	0	0	0	0	0	2	2	0
Bullomorpha indet.	0	0	0	0	0	0	0	3	0
Callianassa japonica	2	0	0	2	0	0	0	0	0
Cardium fimbriatum	0	0	0	0	0	0	2	2	0
Chaetozone indet.	0	0	3	0	0	0	0	0	0
Chaetozone setosa	0	0	3	0	0	0	0	0	0
Cirratulidae indet.	0	0	3	0	0	0	0	0	0
Cirratulus indet.	0	0	3	0	0	0	0	0	0
Cirrophorus miyakoensis	0	0	0	3	0	0	0	0	0
Cossuraidae indet.	0	0	2	2	0	0	0	0	0
Cossurella dimorpha	0	0	0	3	0	0	0	0	0
Cryptomya busoensis	0	0	0	0	0	0	2	2	0
Decapoda indet.	0	1	0	0	1	1	1	1	1
Dorvilleidae indet.	0	0	0	0	0	0	0	3	0
Eteone indet.	0	0	0	0	0	0	0	3	0
Eteone maculata	0	0	0	0	0	0	0	3	0
Eucrate costata	0	0	0	0	0	0	2	2	0
Fabulina indet.	0	0	0	0	0	0	2	2	0
Glycera alba	0	0	0	0	0	0	0	3	0
Glycera tridactyla	0	0	0	0	0	0	0	3	0
Glyceridae indet.	0	0	0	0	1	2	0	3	0
Glycinde gurjanovae	0	0	0	0	0	0	0	3	0
Goniada japonica	0	0	0	0	0	0	0	3	0
Goniada maculata	0	0	0	0	0	0	0	2	0
Gyptis indet.	0	0	0	0	0	0	0	2	0
Gyptis pacificus	0	0	0	0	0	0	0	2	0
Harmothoe indet.	0	0	0	0	0	0	0	3	0
Harmothoe minuta	0	0	0	0	0	0	0	3	0
Hesionidae indet.	0	0	0	0	0	0	0	3	0
Heteromastus indet	0	0	0	3	0	0	0	0	0
Leocrates chinensis	0	0	0	0	0	0	0	3	0
Leptochela aculeocaudata	0	0	0	0	0	0	0	3	0
Linopherus ambigua	0	0	0	0	0	0	3	0	0
Lovenia subcarinata	0	0	0	3	0	0	0	3	0
Lucifer indet.	3	0	0	0	1	0	0	0	0
Lumbrineris indet.	0	0	0	0	0	0	0	3	1
Magelona crenulifrons	0	0	3	0	0	0	0	0	0
Mediomastus indet.	0	0	0	3	0	0	0	0	0
Moerella iridescens	0	0	0	3	0	0	0	0	0
Nassarius festivus	0	2	0	0	0	0	3	1	0
Neanthes indet.	2	2	2	0	2	2	2	3	2
Nectoneanthes multignatha	2	2	2	0	2	2	2	3	2
Nectoneanthes oxypoda	2	2	2	0	2	2	2	3	2
Nemertina indet.	0	0	0	0	0	0	0	3	0
Neoxenophthalmus obscurus	0	0	0	0	0	0	0	3	0
Nepthys indet.	0	0	1	1	1	2	2	3	0
Nereis indet.	2	2	2	0	2	2	2	3	2
Nicon sinica	2	2	2	0	2	2	2	3	2
Notomastus indet.	0	0	2	2	0	0	0	0	2
Notomastus latericus	0	0	2	2	0	0	0	0	2
Onuphis indet.	0	0	0	0	0	0	2	2	0
Ophelina acuminata	0	0	0	3	0	0	0	0	0
Ophidromus angustifrons	0	0	0	0	0	0	0	3	0
Ophiura kindbergi	0	0	0	0	0	0	0	0	0
Otopsis indet.	0	0	0	0	1	1	1	0	1
Paraonis gracilis	0	0	3	0	0	0	0	0	0
Paraprionospio pinnata	0	0	3	0	0	0	0	0	0
Pectinaria indet.	2	0	2	2	0	2	0	0	0
Philine indet.	0	0	0	0	0	0	0	3	0
Phyllodoce indet.	0	0	0	0	0	0	0	3	0
Pilargiidae indet.	1	0	1	0	0	0	1	1	0
Piromis congoensis	0	0	2	0	2	2	0	0	0
Poecilochaetus indet.	0	0	0	0	0	2	0	2	0
Polychaeta indet.	1	1	1	1	1	1	1	1	1
Prionospio cirrifera	0	0	3	0	0	0	0	0	0
Prionospio ehlersi	0	0	3	0	0	0	0	0	0
Prionospio indet.	0	0	3	0	0	0	0	0	0
Prionospio malmgreni	0	0	3	0	0	0	0	0	0
Prionospio pygmaea	0	0	3	0	0	0	0	0	0
Protankyra bidentata	0	0	0	3	0	0	0	0	0
Pyramidellidae indet.	0	0	0	0	0	0	0	3	0
Saccella cuspidata	0	0	0	0	0	0	2	2	0
Scalibregma inflatum	1	0	0	3	0	0	0	0	0
Schistomeringos indet.	0	0	0	2	0	2	0	2	0
Schizaster lacunosus	0	0	2	2	0	0	0	0	0
Sigambra hanaokai	0	0	0	0	0	0	0	3	0
Sigambra indet.	0	0	0	0	0	0	0	3	0
Spiochaetopterus costarum	3	0	2	0	0	0	0	0	0
Spionidae indet.	1	0	3	0	0	0	0	0	0
Spiophanes indet.	2	0	3	0	0	0	0	0	0
Squilla indet.	0	0	0	0	0	0	0	3	0
Sthenolepis japonica	0	0	0	0	0	0	0	3	0
Tellina cygnus	0	0	0	3	0	0	0	0	0
Terrebellidae indet.	2	0	2	0	0	0	0	0	0

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenge	Carnivore / omnivore	Parasite / commensal
Taxa/Code	**FH1**	**FH2**	**FH3**	**FH4**	**FH5**	**FH6**	**FH7**	**FH8**	**FH9**
Thalamita sima	0	0	0	0	0	0	0	3	0
Tharyx indet.	0	0	3	0	0	0	0	0	0
Themiste indet.	3	0	0	0	0	0	0	0	0
Theora lata	0	0	0	0	0	0	2	2	0
Timoclea scabra	3	0	0	0	0	0	0	0	0
Tritodynamia horvathi	0	0	0	0	0	0	0	3	0
Typhlocarcinops denticarpes	0	0	0	0	0	0	0	3	0
Typhlocarcinops indet.	0	0	0	0	0	0	0	3	0
Xenophtalmus pinnotheroides	0	0	0	0	0	0	0	3	0

Phylum	Class	Order	Family	Species
Mollusca	Bivalvia	Arcoida	Arcidae	*Anadara ferruginea*
Cnidaria	Anthozoa	Anthozoa	Anthozoa	*Anemone indet.*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Arcania heptacantha*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Arcania undecimspinosa*
Mollusca	Gastropoda	Nudibranchia	Arminidae	*Armina punctulata*
Echinodermata	Asterioidea	Paxillocida	Asteriidae	*Asteriidae A indet.*
Echinodermata	Asterioidea	Platyasterida	Luidiidae	*Luidia hardwickii*
Mollusca	Gastropoda	Buccinoidea	Buccinidae	*Babylonia formosa*
Mollusca	Gastropoda	Buccinoidea	Buccinidae	*Babylonia lutosa*
Mollusca	Bivalvia	Cardioidea	Cardiidae	*Bucardium asiaticum*
Mollusca	Bivalvia	Cardioidea	Cardiidae	*Bucardium fimbratum*
Mollusca	Gastropoda	Docoglossa	Nacellidae	*Cellana grata*
Arthropoda	Malacostraca	Decapoda	Gerionidae	*Charybdis acuta*
Arthropoda	Malacostraca	Decapoda	Gerionidae	*Charybdis bimaculata*
Arthropoda	Malacostraca	Decapoda	Gerionidae	*Charybdis feriatus*
Arthropoda	Malacostraca	Decapoda	Gerionidae	*Charybdis indet.*
Arthropoda	Malacostraca	Decapoda	Gerionidae	*Charybdis truncata*
Mollusca	Gastropoda	Neogastropoda	Buccinidae	*Colus indet.*
Echinodermata	Asterioidea	Paxillocida	Asteriidae	*Asteriidae B indet.*
Arthropoda	Malacostraca	Decapoda	Diogenidae	*Diogenis spinifrons*
Arthropoda	Malacostraca	Decapoda	Dorippidae	*Dorippe facchino*
Echinodermata	Echinoidea	Spatantangoida	Curculionoidae	*Echinocardium cordatum*
Echinodermata	Echinoidea	Spatantangoida	Curculionoidae	*Echinocardium cordatum*
Echinodermata	Echinoidea	Echinoida	Echinometridae	*Echinometridae indet.*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Erugosquilla woodmasoni*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Eucrate crenata*
Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice indet.*
Mollusca	Bivalvia	Veneroida	Cardiidae	*Fulvia (australis)*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Harpiosquilla harpax*
Mollusca	Bivalvia	Veneroida	Semelidae	*Leptomya minuta*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Leucosia rhomboidalis*
Mollusca	Cephalopoda	Teuthoidea	Loliginidae	*Loligo indet.*
Echinodermata	Echinoidea	Spatantangoida	Loveniidae	*Lovenia subcarinata*
Arthropoda	Malacostraca	Decapoda	Sergestidae	*Lucifer indet.*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeopsis barbata*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeopsis palmensis*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeus affinis*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeus burkenroadi*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeus ensis*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Metapenaeus moyebi*
Mollusca	Gastropoda	Caenogastropoda	Mitridae	*Mitra aurantia*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Miyakea nepa*
Mollusca	Gastropoda	Neogastropoda	Muricidae	*Murex indet.*
Mollusca	Bivalvia	Pteriomorpha	Mytilidae	*Mytilidae A indet.*
Mollusca	Bivalvia	Pteriomorpha	Mytilidae	*Mytilidae B indet.*
Mollusca	Gastropoda	Stenoglossa	Nassariidae	*Nassarius siquijorensis*
Mollusca	Gastropoda	Neotaenioglossa	Naticidae	*Natica vitellus*
Annelida	Polychaeta	Capitellida	Capitellidae	*Notomastus indet.*
Mollusca	Bivalvia	Nuculoida	Nuculanidae	*Nuculana indet.*
Mollusca	Bivalvia	Nuculoida	Nuculanidae	*Nuculana sematensis*
Mollusca	Cephalopoda	Octopoda	Octopodidae	*Octopus indet.*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura indet.*
Echinodermata	Stelleroidea	Ophiurida	Ophiuridae	*Ophiura kinbergi*
Arthropoda	Malacostraca	Decapoda	Paguridae	*Pagurus indet.*
Mollusca	Bivalvia	Veneroida	Veneridae	*Paphia undulata*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Parapenaeopsis hungerfordi*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Parapenaeopsis tenella*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Parapenaeus canceolatus*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Parapenaeus sextuberculatus*
Annelida	Polychaeta	Terebellida	Pectinariidae	*Pectinidae indet.*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Penaeus (Fenneropenaeus) merguiensis*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Penaeus (Fenneropenaeus) penicillatus*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Penaeus (Penaeus) semisulcatus*
Arthropoda	Malacostraca	Decapoda	Penaeidae	*Penaeus japonicus*
Cnidaria	Anthozoa	Pennatulacea	Veretillidae	*Cavernularia* indet
Mollusca	Bivalvia	Pteriomorpha	Mytilidae	*Perna viridis*
Mollusca	Gastropoda	Cephalaspidea	Philinidae	*Philine kinglipini*
Mollusca	Gastropoda	Cephalaspidea	Philinidae	*Philinopsis indet.*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Philyra carinasta*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Philyra indet.*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Philyra pisum*
Arthropoda	Malacostraca	Decapoda	Leucisiidae	*Philyra platycheira*
Arthropoda	Malacostraca	Decapoda	Pinnotheridae	*Pinnothers sinensis*
Mollusca	Bivalvia	Veneroida	Chionidae	*Placamen calophyllum*
Arthropoda	Malacostraca	Decapoda	Chirostylidae	*Porcellana streptocheles*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunis indet.*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus crenata*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus gracilimanus*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus haani*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus hastatoides*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus indet.*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus pelagicus*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus sanguinolentus*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Portunus (cf trilobatus)*
Mollusca	Bivalvia	Pterioida	Peteriidae	*Pteria indet.*
Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Scalopidia spinosipes*
Mollusca	Gastropoda	Neogastropoda	Cancellaridae	*Scalptia scalariformis*
Mollusca	Gastropoda	Caenogastropoda	Naticidae	*Sinum javanicum*
Arthropoda	Malacostraca	Decapoda	Solenoceridae	*Solenocera sinensis*
Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Squillidae indet.*
Mollusca	Gastropoda	Caenogastropoda	Strombidae	*Strombus vittatus*
Mollusca	Bivalvia	Veneroida	Tapezidae	*Tapezium sublaevigatum*
Mollusca	Bivalvia	Veneroida	Tellinidae	*Tellinidae indet.*
Mollusca	Gastropoda	Caenogastropoda	Terebridae	*Terebra funiculata*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita crenata*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita indet.*
Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita sima*
Arthropoda	Malacostraca	Decapoda	Alpheidae	*Tozeuma lancolatum*
Mollusca	Bivalvia	Pterioida	Pinnidae	*Trisidos kiyonoi*

Phylum	Class	Order	Family	Species
Mollusca	Gastropoda	Caenogastropoda	Turritellidae	*Turitella terebra*
Mollusca	Gastropoda	Caenogastropoda	Turritellidae	*Turritellidae indet.*
Mollusca	Gastropoda	Neogastropoda	Turridae	*Turricula indet.*
Mollusca	Gastropoda	Neogastropoda	Turridae	*Turricula nelliae*
Mollusca	Gastropoda	Trochoidea	Trochoidae	*Umbonium costatum*
Mollusca	Gastropoda	Trochoidea	Trochoidae	*Umbonium vestiarium*
Mollusca	Gastropoda	Notaspidea	Umbraculidae	*Umbraculum pulchrum*
Arthropoda	Malacostraca	Decapoda	Varunidae	*Varuna litterata*
Mollusca	Bivalvia	Veneroida	Veneridae	*Veremolpa micra*
Mollusca	Bivalvia	Cardioidea	Cardiidae	*Vepricardium coronatum*

Traits	Maximum size						Larval type			Mobility			
									Direct	None	Low	Medium	High
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**Planktotroph**	**Lecitotroph**	**development**	**mobility**	**mobility**	**mobility**	**mobility**
Taxa	**NS1**	**NS2**	**NS3**	**NS4**	**NS5**	**NS6**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Anadara ferruginea	0	0	0	0	3	0	0	3	0	0	3	0	0
Anemone indet.	1	1	1	1	1	1	0	2	0	3	0	0	0
Arcania heptacantha	0	0	0	2	2	0	3	0	0	0	0	3	0
Arcania undecimspinosa	0	0	0	2	2	0	3	0	0	0	0	3	0
Armina punctulata	0	0	0	3	0	0	0	2	2	0	3	0	0
Asteriidae A indet.	0	0	1	1	1	1	1	1	0	0	3	0	0
Luidia hardwickii	0	0	1	1	1	1	1	1	0	0	3	0	0
Babylonia formosa	0	0	0	0	2	2	3	0	0	0	3	0	0
Babylonia lutosa	0	0	0	0	2	2	3	0	0	0	3	0	0
Bucardium asiaticum	0	0	0	3	0	0	0	0	3	0	3	0	0
Bucardium fimbratum	0	0	0	3	0	0	0	0	3	0	3	0	0
Cellana grata	0	0	0	3	0	0	3	0	0	0	3	0	0
Charybdis acuta	0	0	0	3	0	0	3	0	0	0	0	0	3
Charybdis bimaculata	0	0	0	0	0	3	3	0	0	0	0	0	3
Charybdis feriatus	0	0	0	0	3	0	3	0	0	0	0	0	3
Charybdis indet.	0	0	2	2	2	0	3	0	0	0	0	0	3
Charybdis truncata	0	0	0	3	0	0	3	0	0	0	0	0	3
Colus indet.	0	0	0	0	0	3	0	3	0	0	3	0	0
Asteriidae B indet.	0	0	0	0	3	0	1	1	0	0	3	0	0
Diogenis spinifrons	0	0	3	0	0	0	3	0	0	0	0	0	3
Dorippe facchino	0	0	0	0	0	3	3	0	0	0	0	0	3
Echinocardium cordatum	0	0	0	0	2	2	3	0	0	0	3	0	0
Echinocardium cordatum	0	0	0	0	2	2	3	0	0	0	3	0	0
Echinometridae indet.	0	0	0	2	2	2	3	0	0	0	3	0	0
Erugosquilla woodmasoni	0	0	0	0	0	3	3	0	0	0	0	0	3
Eucrate crenata	0	0	0	3	0	0	3	0	0	0	0	0	3
Eunice indet.	0	0	1	1	1	1	3	0	0	0	2	2	0
Fulvia (australis)	0	0	0	3	0	0	0	0	3	0	0	0	3
Harpiosquilla harpax	0	0	0	0	0	3	3	0	0	0	0	0	3
Leptomya minuta	0	0	0	3	0	0	0	3	0	0	2	0	0
Leucosia rhomboidalis	0	0	0	3	0	0	3	0	0	0	0	0	3
Loligo indet.	0	0	0	0	0	3	0	0	3	0	0	0	3
Lovenia subcarinata	0	0	0	0	3	0	3	0	0	0	0	2	0
Lucifer indet.	1	1	1	0	0	0	0	0	3	0	0	3	0
Metapenaeopsis barbata	0	0	0	0	0	3	3	0	0	0	0	0	3
Metapenaeopsis palmensis	0	0	0	0	3	0	3	0	0	0	0	0	3
Metapenaeus affinis	0	0	0	0	0	3	3	0	0	0	0	0	3
Metapenaeus burkenroadi	0	0	0	0	0	3	3	0	0	0	0	0	3
Metapenaeus ensis	0	0	0	0	0	3	3	0	0	0	0	0	3
Metapenaeus moyebi	0	0	0	3	0	0	3	0	0	0	0	0	3
Mitra aurantia	0	0	3	0	0	0	3	0	0	0	3	0	0
Miyakea nepa	0	0	0	0	0	3	3	0	0	0	0	0	3
Murex indet.	0	1	1	1	1	1	3	0	0	0	3	0	0
Mytilidae A indet.	0	0	0	3	0	0	3	0	0	0	3	0	0
Mytilidae B indet.	0	1	1	1	1	0	3	0	0	0	3	0	0
Nassarius siquijorensis	0	0	3	0	0	0	3	0	0	0	3	0	0
Natica vitellus	0	0	0	3	0	0	3	0	0	0	3	0	0
Notomastus indet.	0	0	0	0	0	3	0	3	0	0	0	2	0
Nuculana indet.	1	1	1	1	1	0	0	3	0	0	2	0	0
Nuculana sematensis	0	0	3	0	0	0	0	3	0	0	2	0	0
Octopus indet.	0	0	0	0	0	3	0	0	3	0	0	0	3
Ophiura indet.	0	1	1	1	0	0	3	0	0	0	2	0	0
Ophiura kinbergi	0	0	0	3	0	0	3	0	0	0	2	0	0
Pagurus indet.	0	0	2	2	2	0	3	0	0	0	0	0	3
Paphia undulata	0	0	3	0	0	0	3	0	0	0	3	0	0
Parapenaeopsis hungerfordi	0	0	0	0	3	0	3	0	0	0	0	0	3
Parapenaeopsis tenella	0	0	0	0	3	0	3	0	0	0	0	0	3
Parapenaeus canceolatus	0	0	0	0	3	0	3	0	0	0	0	0	3
Parapenaeus sextuberculatus	0	0	0	0	3	0	3	0	0	0	0	0	3
Pectinidae indet.	0	0	0	2	2	2	3	0	0	0	0	2	2
Penaeus (Fenneropenaeus) merguiensis	0	0	0	0	0	3	3	0	0	0	0	0	3
Penaeus (Fenneropenaeus) penicillatus	0	0	0	0	0	3	3	0	0	0	0	0	3
Penaeus (Penaeus) semisulcatus	0	0	0	0	0	3	3	0	0	0	0	0	3
Penaeus japonicus	0	0	0	0	0	3	3	0	0	0	0	0	3
Cavernularia indet	1	1	1	1	1	1	0	2	2	3	0	0	0
Perna viridis	0	0	0	0	0	3	3	0	0	0	3	0	0
Philine kinglipini	0	0	0	3	0	0	3	0	0	0	3	0	0
Philinopsis indet.	0	1	1	1	0	0	1	1	1	0	3	0	0
Philyra carinasta	0	0	3	0	0	0	3	0	0	0	0	0	3
Philyra indet.	0	1	1	1	0	0	3	0	0	0	0	0	3
Philyra pisum	0	0	3	0	0	0	3	0	0	0	0	0	3
Philyra platycheira	0	0	3	0	0	0	3	0	0	0	0	0	3
Pinnothers sinensis	0	0	0	3	0	0	3	0	0	0	0	0	3
Placamen calophyllum	0	0	3	0	0	0	3	0	0	0	3	0	0
Porcellana streptocheles	0	0	3	0	0	0	3	0	0	0	0	0	3
Portunis indet.	0	2	2	2	0	3	0	0	0	0	0	3	0
Portunus crenata	0	0	0	0	3	0	3	0	0	0	0	0	3
Portunus gracilimanus	0	0	0	3	0	0	3	0	0	0	0	0	3
Portunus haani	0	0	0	0	3	0	3	0	0	0	0	0	3
Portunus hastatoides	0	0	0	3	0	0	3	0	0	0	0	0	3
Portunus indet.	0	0	1	1	1	1	3	0	0	0	0	0	3
Portunus pelagicus	0	0	0	0	0	3	3	0	0	0	0	0	3
Portunus sanguinolentus	0	0	0	0	0	3	3	0	0	0	0	0	3
Portunus (cf trilobatus)	0	0	0	0	3	0	3	0	0	0	0	0	3
Pteria indet.	0	0	1	1	1	1	3	0	0	0	3	0	0
Scalopidia spinosipes	0	0	3	0	0	0	3	0	0	0	0	0	3
Scalptia scalariformis	0	0	3	0	0	0	3	0	0	0	3	0	0
Sinum javanicum	0	0	0	0	3	0	3	0	0	0	3	0	0
Solenocera sinensis	0	0	0	0	0	3	3	0	0	0	0	0	3
Squillidae indet.	0	0	0	1	1	1	3	0	0	0	0	0	3
Strombus vittatus	0	1	1	1	1	1	3	0	0	0	3	0	0
Tapezium sublaevigatum	0	0	3	0	0	0	3	0	0	0	3	0	0
Tellinidae indet.	0	0	1	1	1	0	3	0	0	0	3	0	0
Terebra funiculata	0	0	0	3	0	0	3	0	0	0	3	0	0
Thalamita crenata	0	0	0	3	0	0	3	0	0	0	0	0	3

Traits	**Maximum size**						**Larval type**			**Mobility**			
Category	**<5mm**	**5mm-1cm**	**1-3cm**	**3-6cm**	**6-10cm**	**>10cm**	**Planktotroph**	**Lecitotroph**	**Direct development**	**None mobility**	**Low mobility**	**Medium mobility**	**High mobility**
Taxa	**NS1**	**NS2**	**NS3**	**NS4**	**NS5**	**NS6**	**LT1**	**LT2**	**LT3**	**AM1**	**AM2**	**AM3**	**AM4**
Thalamita indet.	0	0	2	2	0	0	3	0	0	0	0	0	3
Thalamita sima	0	0	3	0	0	0	3	0	0	0	0	0	3
Tozeuma lancolatum	0	0	0	0	3	0	3	0	0	0	0	0	3
Trisidos kiyonoi	0	0	0	0	3	0	3	0	0	0	3	0	0
Turitella terebra	0	0	0	0	3	0	3	0	0	0	3	0	0
Turritellidae indet.	0	1	1	1	1	0	3	0	0	0	3	0	0
Turricula indet.	0	0	2	2	0	0	3	0	0	0	3	0	0
Turricula nelliae	0	0	0	3	0	0	3	0	0	0	3	0	0
Umbonium costatum	0	3	0	0	0	0	3	0	0	0	3	0	0
Umbonium vestiarium	0	3	0	0	0	0	3	0	0	0	3	0	0
Umbraculum pulchrum	0	0	3	0	0	0	3	0	0	0	3	0	0
Varuna litterata	0	0	0	3	0	0	3	0	0	0	0	0	3
Veremolpa micra	0	3	0	0	0	0	3	0	0	0	3	0	0
Vepricardium coronatum	0	0	0	3	0	0	3	0	0	0	3	0	0

Traits	**Bodyform**						**Attachment**		
	Cylindric bobyform	**Flattened dorsally bobyform**	**Flattened laterally bobyform**	**Ball shaped bobyform**	**Long thin, treadlike bobyform**	**Irregular bobyform**	**None attachment**	**Temporary attachment**	**Permanent attachment**
Category									
Taxa	**BF1**	**BF2**	**BF3**	**BF4**	**BF5**	**BF6**	**DA1**	**DA2**	**DA3**
Anadara ferruginea	0	3	0	0	0	0	3	0	0
Anemone indet.	0	0	0	0	0	3	0	0	3
Arcania heptacantha	0	2	0	1	0	0	3	0	0
Arcania undecimspinosa	0	2	0	1	0	0	3	0	0
Armina punctulata	0	3	0	0	0	0	3	0	0
Asteriidae A indet.	0	0	0	0	0	3	3	0	0
Luidia hardwickii	0	0	0	0	0	3	3	0	0
Babylonia formosa	0	0	0	0	0	3	3	0	0
Babylonia lutosa	0	0	0	0	0	3	3	0	0
Bucardium asiaticum	0	0	0	0	0	3	3	0	0
Bucardium fimbratum	0	0	0	0	0	3	3	0	0
Cellana grata	0	0	0	1	0	0	0	3	0
Charybdis acuta	0	3	0	0	0	0	3	0	0
Charybdis bimaculata	0	3	0	0	0	0	3	0	0
Charybdis feriatus	0	3	0	0	0	0	3	0	0
Charybdis indet.	0	3	0	0	0	0	3	0	0
Charybdis truncata	0	3	0	0	0	0	3	0	0
Colus indet.	0	0	0	0	0	3	3	0	0
Asteriidae B indet.	0	0	0	0	0	3	3	0	0
Diogenis spinifrons	0	3	0	0	0	0	3	0	0
Dorippe facchino	0	3	0	0	0	0	3	0	0
Echinocardium cordatum	0	0	0	3	0	0	3	0	0
Echinocardium cordatum	0	0	0	3	0	0	3	0	0
Echinometridae indet.	0	0	0	3	0	0	3	0	0
Erugosquilla woodmasoni	0	3	0	0	0	0	3	0	0
Eucrate crenata	0	3	0	0	0	0	3	0	0
Eunice indet.	3	0	0	0	2	0	2	2	0
Fulvia (australis)	0	0	0	3	0	0	0	3	0
Harpiosquilla harpax	0	3	0	0	0	0	3	0	0
Leptomya minuta	0	3	0	0	0	1	3	0	0
Leucosia rhomboidalis	0	3	0	0	0	0	3	0	0
Loligo indet.	0	0	0	0	0	3	3	0	0
Lovenia subcarinata	0	1	0	2	0	2	3	0	0
Lucifer indet.	1	0	0	0	1	1	3	0	0
Metapenaeopsis barbata	0	0	2	0	0	0	3	0	0
Metapenaeopsis palmensis	0	0	2	0	0	0	3	0	0
Metapenaeus affinis	0	0	2	0	0	0	3	0	0
Metapenaeus burkenroadi	0	0	2	0	0	0	3	0	0
Metapenaeus ensis	0	0	2	0	0	0	3	0	0
Metapenaeus moyebi	0	0	2	0	0	0	3	0	0
Mitra aurantia	0	0	0	0	0	3	3	0	0
Miyakea nepa	0	3	0	0	0	0	3	0	0
Murex indet.	0	3	0	0	0	0	3	0	0
Mytilidae A indet.	0	3	0	0	0	0	3	0	0
Mytilidae B indet.	0	3	0	0	0	0	0	0	3
Nassarius siquijorensis	0	0	0	0	0	3	3	0	0
Natica vitellus	0	0	0	0	0	3	3	0	0
Notomastus indet.	2	0	0	0	2	0	2	0	0
Nuculana indet.	0	3	0	0	0	1	3	0	0
Nuculana sematensis	0	3	0	0	0	1	3	0	0
Octopus indet.	0	0	0	0	0	3	3	0	0
Ophiura indet.	0	1	0	1	1	1	3	0	0
Ophiura kinbergi	0	1	0	1	1	1	3	0	0
Pagurus indet.	0	2	0	0	0	2	3	0	0
Paphia undulata	0	3	0	0	0	0	3	0	0
Parapenaeopsis hungerfordi	0	0	3	0	0	0	3	0	0
Parapenaeopsis tenella	0	0	2	0	0	0	3	0	0
Parapenaeus canceolatus	0	0	2	0	0	0	3	0	0
Parapenaeus sextuberculatus	0	0	2	0	0	0	3	0	0
Pectinidae indet.	0	3	0	0	0	0	3	0	0
Penaeus (Fenneropenaeus) merguiensis	0	0	2	0	0	0	3	0	0
Penaeus (Fenneropenaeus) penicillatus	0	0	2	0	0	0	3	0	0
Penaeus (Penaeus) semisulcatus	0	0	2	0	0	0	3	0	0
Penaeus japonicus	0	0	2	0	0	0	3	0	0
Cavernularia indet	2	0	0	0	3	1	0	0	3
Perna viridis	0	3	0	0	0	0	0	3	0
Philine kinglipini	1	0	0	1	0	1	3	0	0
Philinopsis indet.	0	3	0	0	0	0	3	0	0
Philyra carinasta	0	3	0	0	0	0	3	0	0
Philyra indet.	0	3	0	0	0	0	3	0	0
Philyra pisum	0	3	0	0	0	0	3	0	0
Philyra platycheira	0	3	0	0	0	0	3	0	0
Pinnothers sinensis	0	3	0	0	0	0	3	0	0
Placamen calophyllum	0	3	0	0	0	0	3	0	0
Porcellana streptocheles	0	3	0	0	0	0	3	0	0
Portunis indet.	2	0	0	0	2	3	0	0	0
Portunus crenata	0	3	0	0	0	0	3	0	0
Portunus gracilimanus	0	3	0	0	0	0	3	0	0
Portunus haani	0	3	0	0	0	0	3	0	0
Portunus hastatoides	0	3	0	0	0	0	3	0	0
Portunus indet.	0	3	0	0	0	0	3	0	0
Portunus pelagicus	0	3	0	0	0	0	3	0	0
Portunus sanguinolentus	0	3	0	0	0	0	3	0	0
Portunus (cf trilobatus)	0	3	0	0	0	0	3	0	0
Pteria indet.	0	3	0	0	0	1	3	0	0
Scalopidia spinosipes	0	3	0	0	0	0	3	0	0
Scalptia scalariformis	0	0	0	0	0	2	3	0	0
Sinum javanicum	0	0	0	0	0	3	3	0	0
Solenocera sinensis	0	0	2	0	0	0	3	0	0
Squillidae indet.	0	3	0	0	0	0	3	0	0
Strombus vittatus	0	0	0	0	0	2	3	0	0
Tapezium sublaevigatum	0	3	0	0	0	0	3	0	0
Tellinidae indet.	0	3	0	0	0	0	3	0	0
Terebra funiculata	0	0	0	0	0	3	3	0	0
Thalamita crenata	0	3	0	0	0	0	3	0	0

Traits	**Bodyform**						**Attachment**		
Category	**Cylindric bobyform**	**Flattened dorsally bobyform**	**Flattened laterally bobyform**	**Ball shaped bobyform**	**Long thin, treadlike bobyform**	**Irregular bobyform**	**None attachment**	**Temporary attachment**	**Permanent attachment**
Taxa	**BF1**	**BF2**	**BF3**	**BF4**	**BF5**	**BF6**	**DA1**	**DA2**	**DA3**
Thalamita indet.	0	3	0	0	0	0	3	0	0
Thalamita sima	0	3	0	0	0	0	3	0	0
Tozeuma lancolatum	0	0	2	0	0	0	3	0	0
Trisidos kiyonoi	0	3	0	0	0	0	3	0	0
Turitella terebra	0	0	0	0	0	2	3	0	0
Turritellidae indet.	0	0	0	0	0	2	3	0	0
Turricula indet.	0	0	0	0	0	2	3	0	0
Turricula nelliae	0	0	0	0	0	2	3	0	0
Umbonium costatum	0	0	0	0	0	2	3	0	0
Umbonium vestiarium	0	0	0	0	0	2	3	0	0
Umbraculum pulchrum	0	0	0	0	0	2	3	0	0
Varuna litterata	0	3	0	0	0	0	3	0	0
Veremolpa micra	0	3	0	0	0	0	3	0	0
Vepricardium coronatum	0	3	0	0	0	0	3	0	0

Traits	Adult habitat				
Category	Sessile attachment	Tube permanent attachment	Tube semi-permanent attachment	Burrower	Surface crawler / swimmer
Taxa	AH1	AH2	AH3	AH4	AH5
Anadara ferruginea	0	0	0	3	0
Anemone indet.	3	0	0	0	0
Arcania heptacantha	0	0	0	2	2
Arcania undecimspinosa	0	0	0	2	2
Armina punctulata	0	0	0	0	3
Asteriidae A indet.	0	0	0	2	3
Luidia hardwickii	0	0	0	2	3
Babylonia formosa	0	0	0	0	3
Babylonia lutosa	0	0	0	0	3
Bucardium asiaticum	0	0	0	0	3
Bucardium fimbratum	0	0	0	0	3
Cellana grata	3	0	0	0	0
Charybdis acuta	0	0	0	0	3
Charybdis bimaculata	0	0	0	0	3
Charybdis feriatus	0	0	0	0	3
Charybdis indet.	0	0	0	0	3
Charybdis truncata	0	0	0	0	3
Colus indet.	0	0	0	2	3
Asteriidae B indet.	0	0	0	2	3
Diogenis spinifrons	0	0	0	0	3
Dorippe facchino	0	0	0	0	3
Echinocardium cordatum	0	0	0	3	0
Echinocardium cordatum	0	0	0	3	0
Echinometridae indet.	0	0	0	3	0
Erugosquilla woodmasoni	0	0	0	0	3
Eucrate crenata	0	0	0	0	3
Eunice indet.	0	0	3	1	0
Fulvia (australis)	0	0	0	3	0
Harpiosquilla harpax	0	0	0	0	3
Leptomya minuta	0	0	0	3	0
Leucosia rhomboidalis	0	0	0	0	3
Loligo indet.	0	0	0	2	2
Lovenia subcarinata	0	0	0	3	0
Lucifer indet.	0	0	0	0	3
Metapenaeopsis barbata	0	0	0	0	3
Metapenaeopsis palmensis	0	0	0	0	3
Metapenaeus affinis	0	0	0	0	3
Metapenaeus burkenroadi	0	0	0	0	3
Metapenaeus ensis	0	0	0	0	3
Metapenaeus moyebi	0	0	0	0	3
Mitra aurantia	0	0	0	0	3
Miyakea nepa	0	0	0	0	3
Murex indet.	0	0	0	2	2
Mytilidae A indet.	0	0	0	2	2
Mytilidae B indet.	3	0	0	0	0
Nassarius siquijorensis	0	0	0	0	3
Natica vitellus	0	0	0	0	3
Notomastus indet.	0	0	3	2	2
Nuculana indet.	0	0	0	3	0
Nuculana sematensis	0	0	0	3	0
Octopus indet.	0	0	0	2	2
Ophiura indet.	0	0	0	2	0
Ophiura kinbergi	0	0	0	2	0
Pagurus indet.	0	0	3	2	2
Paphia undulata	0	0	0	3	0
Parapenaeopsis hungerfordi	0	0	0	0	3
Parapenaeopsis tenella	0	0	0	0	3
Parapenaeus canceolatus	0	0	0	0	3
Parapenaeus sextuberculatus	0	0	0	0	3
Pectinidae indet.	0	0	0	3	0
Penaeus (Fenneropenaeus) merguiensis	0	0	0	0	3
Penaeus (Fenneropenaeus) penicillatus	0	0	0	0	3
Penaeus (Penaeus) semisulcatus	0	0	0	0	3
Penaeus japonicus	0	0	0	0	3
Cavernularia indet	3	0	0	0	0
Perna viridis	2	0	0	0	2
Philine kinglipini	0	0	0	0	3
Philinopsis indet.	0	0	0	0	3
Philyra carinasta	0	0	0	0	3
Philyra indet.	0	0	0	0	3
Philyra pisum	0	0	0	0	3
Philyra platycheira	0	0	0	0	3
Pinnothers sinensis	0	0	0	0	3
Placamen calophyllum	0	0	0	2	2
Porcellana streptocheles	0	0	0	0	3
Portunis indet.	0	3	2	2	0
Portunus crenata	0	0	0	0	3
Portunus gracilimanus	0	0	0	0	3
Portunus haani	0	0	0	0	3
Portunus hastatoides	0	0	0	0	3
Portunus indet.	0	0	0	0	3
Portunus pelagicus	0	0	0	0	3
Portunus sanguinolentus	0	0	0	0	3
Portunus (cf trilobatus)	0	0	0	0	3
Pteria indet.	0	0	0	0	3
Scalopidia spinosipes	0	0	0	0	3
Scalptia scalariformis	0	0	0	0	3
Sinum javanicum	0	0	0	0	3
Solenocera sinensis	0	0	0	2	2
Squillidae indet.	0	0	0	0	3
Strombus vittatus	0	0	0	2	2
Tapezium sublaevigatum	0	0	0	0	3
Tellinidae indet.	0	0	0	2	2
Terebra funiculata	0	0	0	0	3
Thalamita crenata	0	0	0	0	3

Traits	**Adult habitat**				
Category	**Sessile attachment**	**Tube permanent attachment**	**Tube semi-permanent attachment**	**Burrower**	**Surface crawler / swimmer**
Taxa	**AH1**	**AH2**	**AH3**	**AH4**	**AH5**
Thalamita indet.	0	0	0	0	3
Thalamita sima	0	0	0	0	3
Tozeuma lancolatum	0	0	0	2	2
Trisidos kiyonoi	0	0	0	0	3
Turitella terebra	0	0	0	2	2
Turritellidae indet.	0	0	0	2	2
Turricula indet.	0	0	0	0	3
Turricula nelliae	0	0	0	0	3
Umbonium costatum	0	0	0	3	0
Umbonium vestiarium	0	0	0	3	0
Umbraculum pulchrum	0	0	0	3	0
Varuna litterata	0	0	0	0	3
Veremolpa micra	0	0	0	0	3
Vepricardium coronatum	0	0	0	0	3

Traits	Feeding								
Category	Suspension / filter	Scraper / grazer	Surface deposit feeder	Subsurface deposit feeder	Dissolved matter / symbionts	Large detrius / sandlicker	Scavenge	Carnivore / omnivore	Parasite / commensal
Taxa	FH1	FH2	FH3	FH4	FH5	FH6	FH7	FH8	FH9
Anadara ferruginea	3	0	0	0	0	0	1	0	0
Anemone indet.	2	0	0	0	0	0	0	1	1
Arcania heptacantha	0	0	0	0	0	0	0	3	0
Arcania undecimspinosa	0	0	0	0	0	0	0	3	0
Armina punctulata	0	0	0	0	0	0	0	3	0
Asteriidae A indet.	0	0	0	0	0	0	2	2	0
Luidia hardwickii	0	0	0	0	0	0	2	2	0
Babylonia formosa	0	0	0	0	0	0	3	0	0
Babylonia lutosa	0	0	0	0	0	0	3	0	0
Bucardium asiaticum	0	0	0	0	0	0	2	2	0
Bucardium fimbratum	0	0	0	0	0	0	2	2	0
Cellana grata	0	3	0	0	0	0	0	1	0
Charybdis acuta	0	0	0	0	0	0	2	2	0
Charybdis bimaculata	0	0	0	0	0	0	2	2	0
Charybdis feriatus	0	0	0	0	0	0	2	2	0
Charybdis indet.	0	0	0	0	0	0	2	2	0
Charybdis truncata	0	0	0	0	0	0	2	2	0
Colus indet.	0	0	0	0	0	0	2	2	0
Asteriidae B indet.	0	0	0	0	0	0	2	2	0
Diogenis spinifrons	0	0	0	0	0	0	0	3	0
Dorippe facchino	0	0	0	0	0	0	2	2	0
Echinocardium cordatum	0	0	3	0	0	0	0	0	0
Echinocardium cordatum	0	0	3	0	0	0	0	0	0
Echinometridae indet.	0	0	2	0	0	0	0	2	0
Erugosquilla woodmasoni	0	0	0	0	0	0	0	3	0
Eucrate crenata	0	0	0	0	0	0	2	2	0
Eunice indet.	0	0	0	0	0	1	0	3	1
Fulvia (australis)	0	0	0	0	2	2	3	0	0
Harpiosquilla harpax	0	0	0	0	0	0	0	3	0
Leptomya minuta	0	0	0	3	0	0	0	0	0
Leucosia rhomboidalis	3	0	0	0	0	0	0	0	0
Loligo indet.	0	0	0	0	0	0	0	3	0
Lovenia subcarinata	0	0	0	3	0	0	0	3	0
Lucifer indet.	3	0	0	0	0	0	0	0	0
Metapenaeopsis barbata	0	0	0	0	0	0	0	3	0
Metapenaeopsis palmensis	0	0	0	0	0	0	0	3	0
Metapenaeus affinis	0	0	0	0	0	0	0	3	0
Metapenaeus burkenroadi	0	0	0	0	0	0	0	3	0
Metapenaeus ensis	0	0	0	0	0	0	0	3	0
Metapenaeus moyebi	0	0	0	0	0	0	0	3	0
Mitra aurantia	0	0	0	0	0	0	2	2	0
Miyakea nepa	0	0	0	0	0	0	0	3	0
Murex indet.	0	2	0	0	0	0	0	2	0
Mytilidae A indet.	0	2	0	0	0	0	0	2	0
Mytilidae B indet.	3	0	0	0	0	0	0	0	0
Nassarius siquijorensis	0	0	0	0	0	0	3	1	0
Natica vitellus	0	0	0	0	0	0	0	3	0
Notomastus indet.	0	0	2	2	0	0	0	0	2
Nuculana indet.	0	0	0	3	0	0	0	0	0
Nuculana sematensis	0	0	0	3	0	0	0	0	0
Octopus indet.	0	0	0	0	0	0	0	3	0
Ophiura indet.	2	0	2	0	2	2	2	2	0
Ophiura kinbergi	2	0	2	0	2	2	2	2	0
Pagurus indet.	0	0	0	0	0	0	3	0	0
Paphia undulata	2	0	0	2	0	0	0	0	0
Parapenaeopsis hungerfordi	0	0	0	0	0	0	0	3	0
Parapenaeopsis tenella	0	0	0	0	0	0	0	3	0
Parapenaeus canceolatus	0	0	0	0	0	0	0	3	0
Parapenaeus sextuberculatus	0	0	0	0	0	0	0	3	0
Pectinidae indet.	3	0	0	0	0	0	0	0	0
Penaeus (Fenneropenaeus) merguiensis	0	0	0	0	0	0	0	3	0
Penaeus (Fenneropenaeus) penicillatus	0	0	0	0	0	0	0	3	0
Penaeus (Penaeus) semisulcatus	0	0	0	0	0	0	0	3	0
Penaeus japonicus	0	0	0	0	0	0	0	3	0
Cavernularia indet	1	0	0	0	1	0	0	0	1
Perna viridis	3	0	0	0	0	0	0	0	0
Philine kinglipini	0	0	0	0	0	0	0	3	0
Philinopsis indet.	0	0	0	0	0	0	0	3	0
Philyra carinasta	3	0	0	0	0	0	0	0	0
Philyra indet.	3	0	0	0	0	0	0	0	0
Philyra pisum	3	0	0	0	0	0	0	0	0
Philyra platycheira	3	0	0	0	0	0	0	0	0
Pinnothers sinensis	0	0	0	0	0	0	3	0	0
Placamen calophyllum	3	0	0	0	0	0	0	0	0
Porcellana streptocheles	0	0	0	0	0	0	3	0	0
Portunis indet.	0	0	0	0	0	3	0	0	0
Portunus crenata	0	0	0	0	0	0	3	0	0
Portunus gracilimanus	0	0	0	0	0	0	3	0	0
Portunus haani	0	0	0	0	0	0	3	0	0
Portunus hastatoides	0	0	0	0	0	0	3	0	0
Portunus indet.	0	0	0	0	0	0	3	0	0
Portunus pelagicus	0	0	0	0	0	0	3	0	0
Portunus sanguinolentus	0	0	0	0	0	0	3	0	0
Portunus (cf trilobatus)	0	0	0	0	0	0	3	0	0
Pteria indet.	3	0	0	0	0	0	0	0	0
Scalopidia spinosipes	0	0	0	0	0	0	3	0	0
Scalptia scalariformis	3	0	0	0	0	0	0	0	0
Sinum javanicum	0	0	0	0	0	0	2	2	0
Solenocera sinensis	0	0	0	0	0	0	0	3	0
Squillidae indet.	0	0	0	0	0	0	0	3	0
Strombus vittatus	0	0	0	0	0	0	2	2	0
Tapezium sublaevigatum	3	0	0	0	0	0	0	0	0
Tellinidae indet.	3	0	0	0	0	0	0	0	0
Terebra funiculata	0	0	0	0	0	0	2	2	0
Thalamita crenata	0	0	0	0	0	0	0	3	0

Traits	**Feeding**								
Category	**Suspension / filter**	**Scraper / grazer**	**Surface deposit feeder**	**Subsurface deposit feeder**	**Dissolved matter / symbionts**	**Large detrius / sandlicker**	**Scavenge**	**Carnivore / omnivore**	**Parasite / commensal**
Taxa	**FH1**	**FH2**	**FH3**	**FH4**	**FH5**	**FH6**	**FH7**	**FH8**	**FH9**
Thalamita indet.	0	0	0	0	0	0	0	3	0
Thalamita sima	0	0	0	0	0	0	0	3	0
Tozeuma lancolatum	0	0	0	0	0	0	0	3	0
Trisidos kiyonoi	3	0	0	0	0	0	0	0	0
Turitella terebra	3	0	0	0	0	0	0	0	0
Turritellidae indet.	3	0	0	0	0	0	0	0	0
Turricula indet.	3	0	0	0	0	0	0	0	0
Turricula nelliae	3	0	0	0	0	0	0	0	0
Umbonium costatum	2	0	0	2	0	0	0	0	0
Umbonium vestiarium	2	0	0	2	0	0	0	0	0
Umbraculum pulchrum	2	0	0	2	0	0	0	0	0
Varuna litterata	1	3	0	0	0	0	1	0	0
Veremolpa micra	3	0	0	0	0	0	0	0	0
Vepricardium coronatum	3	0	0	0	0	0	0	0	0