NIWA
Taihoro Nukurangi

Benthos of inshore Blueskin Bay

Monitoring effects of dredged sediment disposal

Prepared for Port Otago Ltd

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Prepared by:
Graham Fenwick and Jeanie Stenton-Dozey

For any information regarding this report please contact:

Graham Fenwick
Principal Scientist & Assistant Regional Manager
Marine Ecosystems and Aquaculture
+64-3-343 8051
graham.fenwick@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
PO Box 8602
Riccarton
Christchurch 8011

Phone +64 3 348 8987

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	Reviewed by:	Dr Tara J. Anderson
	Formatting checked by:	America Holdene
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Summary

A survey of the marine benthos within, close to and more distant from Port Otago Ltd's two main dredged sediment disposal grounds within Blueskin Bay was completed. This survey i) evaluated the benthic ecosystem in and adjacent to the two grounds, ii) assessed any effects of historical dredged sediment deposition at these grounds, and iii) complemented a desk-top assessment of ecological effects of continued deposition to support renewal of consents for future deposition at Heyward Point and Aramoana. The survey also was the first in a monitoring programme implemented as a condition of resource consent R11.153 to support adaptive management of environmental effects of sediment deposition in inner Blueskin Bay from maintenance dredging within Port Otago.

Sampling within each ground was supplemented by sampling at impact, control and far-control stations to distinguish depth and dredged sediment effects on infauna at the Aramoana ground (7-11 m depth) and shallower (12-14 m depth) and deeper parts of the Heyward Point (17-20 m depth) ground.

Replicate cores from Van Veen grab samples were processed to extract, identify and count benthic infauna. Further grab samples were analysed for sediment characteristics. Replicate tows using a small dredge sampled epibenthos, which was identified and counted. All data were standardised prior to analysis using the PRIMER package and other software tools.

Fine sand was the dominant sediment fraction at all stations. Mud content exceeded 2% and organic matter exceeded 0.5% only at the three far-control stations and one deeper Heyward Point station. A surface layer of fine silt was present at the Heyward Point ground station. Subsurface sulphide layers were apparent at this station and its neighbouring impact stations.

Infaunal densities ranged from 1,471 to 21,778 individuals/m^2 and averaged 8,643/m^2 overall. Densities varied within all stations and this variation decreased with increasing proximity to the dredged sediment deposition grounds. Densities decreased with increasing depth and closer to disposal grounds. Crustaceans, notably amphipods, polychaetes and molluscs dominated the infauna, and crustacean densities decreased and polychaete densities increased with depth. Mollusc and amphipod densities were lower closer to dredged sediment disposal grounds.

One hundred and thirty-eight species were identified from these stations, with up to 50 species per sample and 8-37 species, on average, at any one station. Mean numbers of species per station increased with depth and reduced with proximity to dredged sediment deposition. Evenness (equality of abundances of species), did not change with depth, but increased (fewer dominants) closer to dredged sediment deposition, including within grounds. These community-level changes were largely due to fewer crustacean and mollusc species closer to disposal grounds.

Infauna differed significantly between all stations. Two separate multivariate analyses, using measures of similarities of infauna between all pairs of samples, grouped together replicates from most stations at moderate to high (50-75%) similarities. These analyses distinguished four different benthic communities associated with the different stations: Aramoana ground and impact stations; Purakanui stations; mid-depth stations (two Heyward Point and one Aramoana station); deeper Heyward Point stations. A two-dimensional (multidimensional scaling) plot also arrayed stations in order of proximity to disposal ground, confirming the importance of this factor and depth on benthic communities at these two grounds. Further statistical analyses showed that depth and proximity to dredged sediment disposal together explained 56% of variation in the data, and that proximity alone explained 68% of variation in infauna between stations within the three depth ranges sampled.

Epibenthos was sparse at most stations, with only 21 species recorded from all stations. Epibenthos was most abundant at 12-14 m depth and least abundant at 17-20 m depth. There was no evidence of any dredged sediment deposition effects on epibenthos, probably due to small sample sizes.

Results confirmed the efficacy of the infauna sampling design for monitoring effects of dredge sediment deposition at these two inshore grounds. Infauna sample sizes were adequate and the five replicate samples provided a robust basis for statistically valid comparisons between stations. Results demonstrated the importance of controlling for depth, because this factor strongly influences the nature of infaunal communities.

Recommendations for future monitoring comprised: locating sampling stations based on depth (corrected to mean sea level) first, and distance from ground boundaries second; continuing with five replicate infauna samples of 150 mm diameter from each station; relocating far-control stations away from potential terrestrial influences to off Pilot Point or Whareakeake (Murdering Beach); relocating mid-depth and deep impact and control stations for the Heyward Point ground to 30-50 m and 250 m from the boundaries of the proposed enlarged ground; discontinuing monitoring of the epibenthos.

Key variables for future monitoring ecological effects of dredged sediment deposition activities at these grounds are: sediment particle-size composition, mud content, organic content, total infauna density, number of species, richness, evenness, diversity. Densities of six key species also should be monitored to help identify and diagnose any effects. Trigger levels for adaptive management actions to confirm and address any potentially adverse ecological effects should be differences in these variables at or less than a 0.2 probability level (i.e., differences in a variable at the same station between surveys that, statistically, has a one in five (or lower) probability of being due to chance alone).

Results also confirmed findings from previous investigations of inshore infaunal communities in Blueskin Bay, particularly its heterogeneous and dynamic nature. A distinctly different community inshore of a previous investigation also was confirmed. No regionally or nationally significant species, communities or habitats were identified.

Water depth had a very strong effect on infauna. Two other factors, mud and organic content of sediment, also influenced infauna, especially at the far-control stations. Proximity to dredged sediment deposition exerts a marked effect on infauna over distances of up to c. 50 m (possibly as far as 200-300 m) from deposition ground boundaries at some locations. The magnitude and scale of this effect appears greatest at shallow depths.

Comparison of this study's results with those from a previous detailed investigation revealed higher densities and lower diversities in 2015 compared with a 2003 investigation, confirming the dynamic nature of infaunal communities. The 2003 investigation confirmed changes in infaunal community structure (decreased density and richness, increased evenness) closer to dredged sediment deposition, although the effect of depth confounded clearer interpretation of deposition effects. In 2003, these effects extended at least 30-50 m beyond the margins of both grounds.

Even with the observed effects, moderately abundant, moderately diverse and ecologically functional communities occurred within and close to the margins of both grounds. The natural resilience of communities inhabiting such exposed inshore bottoms appears to underlie their rapid recovery and persistence within and adjacent to these deposition grounds. These findings support our recent

assessment that the ecological effects of dredged sediment at these grounds is no more than minor when considered within the context of southern Blueskin Bay.

Changes to dredged sediment deposition operations may alter the nature and extent of ecological effects, even when the volumes of sediment deposited remain the same. In particular, enlarging the Heyward Point ground is expected to lessen effects within the ground, as well as beyond its boundaries, assuming no other changes to operations. Using a larger dredge that releases much larger individual loads seems likely to increase the depth and area of the immediate depositional footprint (larger active plume)(Fenwick & Stenton-Dozey 2015b). Thus, the potential ecological consequences of any operational changes should be considered carefully before they are implemented.

1 Introduction

Port Otago Ltd's (POL) on-going operations rely on continued dredging to maintain navigable depths for shipping within this busy and hydrodynamically active natural harbour. Dredged sediment has been deposited at three inshore grounds just north of the harbour entrance, within Blueskin Bay, for more than 100 years. POL now seeks to renew its current resource consent (RM11.153) to deposit dredged sediment before its expiry on 18 December 2016.

POL recognised that the consent renewal process will require a sound evaluation of each ground's biodiversity/ecological values, and NIWA prepared a desk-top assessment of biodiversity values associated with the two main grounds, and an assessment of ecological effects (AEE) of proposed future dredged sediment deposition at these grounds (Fenwick & Stenton-Dozey 2015b). A monitoring plan (Fenwick & Stenton-Dozey 2015a) also was prepared to support POL's adaptive management approach (includes stakeholder participation) for managing any effects on this ecosystem, and any other potential environmental effects.

This report presents the results from a survey of benthic fauna (benthos) and bottom sediments within, close to and more distant from the two main grounds (Heyward Point and Aramoana). The survey extended the proposed monitoring design to include the benthos at more distant (far-field) control locations. Thus, the results presented here provide new information on the inshore marine benthos at these grounds and its biodiversity values, as well as assessing the ecological effects of previous dredgeate deposition to complement findings from the desk-top AEE.

The monitoring plan specified comparisons of results with those from previous monitoring surveys to detect differences that may arise due to dredged sediment deposition. No such comparisons are made in this report because it presents results of the first full monitoring survey of benthos adjacent to the two grounds. Thus, it provides a rigorous baseline against which future monitoring results for key variables should be compared to identify potentially important changes. Differences on key attributes that are statistically significant at a probability of 0.2 (trigger level) are to be considered potentially significant and meriting evaluation by Port Otago Ltd's stakeholder Working Party (Fenwick & Stenton-Dozey 2015a).

Future disposal at these sites will comprise predominantly maintenance dredged sediment, plus small volumes of dredged sediment from the capital works as the associated deepening of channels, berths and turning basins proceed. Disposal over a larger area at Heyward Point is sought to reduce any adverse effects on nationally significant surf-breaks.

2 Methods

2.1 Physical environment

Blueskin Bay, a large embayment on New Zealand's South Island east coast, is defined by Taiaroa Head to the south and nominally by Cornish Head to the north. It encompasses the entrance to Otago Harbour, which is a busy shipping port, and several other small bays separated from each other by small headlands. Open from the northeast to southeast, storm waves from southerly quarters are refracted around Otago Peninsula, exposing the shores of Blueskin Bay to substantial wave energy. The north-flowing Southland Current and an inshore eddy add to the bay's hydrodynamic energy. These currents deliver large volumes of fine sands into the bay, which are reworked and dispersed by both waves and current action. Tidal flows into and out of Otago Harbour add further hydrodyanamic energy and influences on sediment dynamics, especially north and west of the harbour mouth.

The two main deposition grounds for maintenance dredged sediment are located just north of the harbour mouth. Sited within 500 m of the shore, the Aramoana ground spans c. 7-10 m depth on predominantly well-sorted (>98%) fine sand bottom sediment (Figure 2-1). The Heyward Point ground, located c. 1 km off this rocky headland, traverses c. 12-18 m depth, with bottom sediments varying from similar well-sorted, fine sands to fine sands mixed with up to 2% mud. Within the ground itself, sediments at Heyward Point are dominated by a mound of deposited sediment, which includes considerable silt and gravels. Farther along the shore, the predominantly fine sand sediments include up to 10% mud, notably off the Purakanui estuary mouth.

2.2 Sampling plan

The methods and sampling design used in this monitoring investigation were those prescribed in a separate report (Fenwick & Stenton-Dozey 2015a) based on a review of available information on the local biophysical environment (Fenwick & Stenton-Dozey 2015b). Three sampling stations were established at Aramoana (all 7-10 m depth): one within the disposal ground, an impact station 30-50 m from the ground's north-western corner, and a control station 200-300 m northwest of the ground's northern corner. Stations sampled at Heyward Point involved a similar set of disposal ground, impact and control stations at 18-20 m depth, plus an impact and a control station at this ground's shallower depths (12-15 m).

This sampling design assumes that all direct effects of dredged sediment disposal (i.e., burial during dredge load release) were limited to within the boundaries of each ground and persisted longer than indirect effects. Any effects at and beyond the boundaries (i.e., at impact and control stations) were considered indirect, and much more gradual in development, cumulative in magnitude, and, therefore, relatively independent of individual deposition events.

The sampling plan was expanded to include three distant (>3.3 km) control stations spanning the depth range of both the Heyward Point and Aramoana disposal grounds (i.e., 6-24 m depth). These were included to preclude any effects of the dredged material disposal activities that might conceivably extend as far as a station's designated control stations. The location selected, off Purakanui Bay, was a compromise between proximity to the same local hydrodynamic and sedimentary environment as the disposal grounds, and being sufficiently distant to avoid any effects from the disposal operations and deposited dredgeate.

Station co-ordinates (Appendix A) were set prior to sampling based on 2013 bathymetry (MetOcean 2014). While depth was identified as an important independent variable for this survey, sea (swells >1 m) and tide conditions during the survey made it impractical to adjust stations in the field to ensure that stations within each group were perfectly matched with respect to depth and located appropriately with respect to the

ground boundaries. Depths measured for each replicate sample at each sampling station in the field were corrected to depths below mean sea level[1].

2.3 Sampling methods

All sampling was completed over 9-12 July 2015. Dredged sediment deposition was essentially continuous at the Heyward Point ground for more than six months prior to this investigation. The dredgeate deposited at this ground over this period comprised 153,000 m^3 of sand and 9100 m^3 of silt (POL internal records). No dredged sediment was deposited at the Aramoana ground for more than six months prior to sampling.

Five replicate Van Veen grab samples (sample area c. 0.13 m^2, maximum sampling depth 22 cm) were taken within a radius of 10 m of each other at each station. For each grab sample, a sediment core (diameter 150 mm, depth 12 cm deep) was removed and washed through 0.5 mm mesh and the residue (mostly benthic invertebrates) retained, labelled and fixed in c. 5% formalin-seawater for later processing.

In the lab, individual samples were carefully washed again on 0.5 mm mesh, the contents sorted into main groups, and either identified immediately (larger invertebrates) or preserved in 70% ethanol for subsequent identification to lowest practicable resolution and counting by taxon-specific experts. Once identified, numbers of individuals of each taxon in each sample were recorded on lab data sheets, entered into an Excel file and subsequently checked.

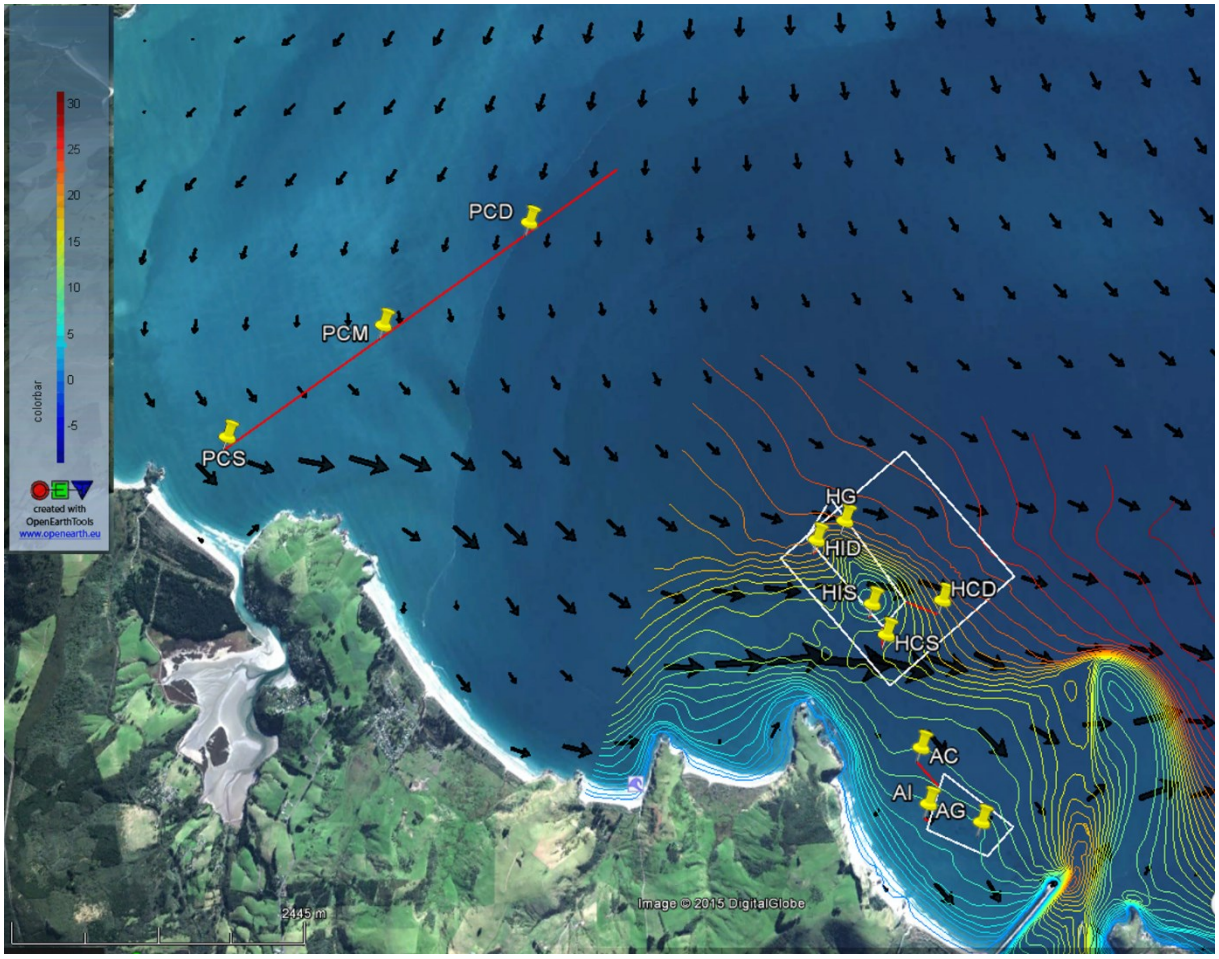


Figure 2-1: Locations of sampling stations in Blueskin Bay relative to the Aramoana (right) and Heyward Point (left) dredged sediment disposal grounds. AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HG, Heyward Point ground; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HID, Heyward

[1] Depths measured at each station were corrected using sampling times and the method outlined at http://www.linz.govt.nz/sites/default/files/docs/hydro/tidal-info/tide-tables/mfth-between-hlw.pdf .

impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep. Colour bar at right indicates depths of contours (m below mean sea level).

Another undisturbed core was then taken from the opposite side of each three of these grab samples using a clear, plastic tube (60 mm diameter, 150 mm depth). Surface and sub-surface sediment structures were noted and a photograph of each core was taken to record of sediment features. The upper 50 mm of sediment from each core was then separated, pooled with other replicates for the same station and thoroughly mixed to provide a composite sample for each station. The composite sample from each station was divided into two subsamples. One subsample was stored frozen, until analysed for organic content following standard protocols for loss on ignition (500 °C for four hours). The other unfrozen sediment sample was refrigerated until analysed to determine sediment particle size composition. For this analysis, samples were oven dried (100 °C), weighed and washed through stacked sieves, with the resulting fractions dried and weighed to determine the percentage contribution of each fraction (Folk-Wentworth terminology).

Larger epifaunal[2] species were also sampled at each station. Five replicate tows, each c. 50 m long, were made using a 400 mm wide Ockelmann detritus (epibenthic) sled fitted with a 2 mm mesh bag. The catch from each tow was separately labelled and stored frozen until processed in the lab. Lab analysis replicated the procedures used for grab faunal samples, with data entered into a separate Excel file.

Data for infauna (grab sample) were standardised to numbers/m^2 prior to analyses of community composition and species distributions. Data for community analyses were square-root transformed to achieve homoscedascity. Basic data manipulations and graphing were completed within Excel. Statistical tests and multivariate routines were performed using the PRIMER 7 package of community analysis (Clarke and Gorley 2015).

[2] Epifauna (or epibenthos) comprises fauna living predominantly on the seabed. It is broadly distinguished from infauna, which lives within the seabed. The distinction is imperfect with some species inhabiting both realms simultaneously or at different times. Different methods are required for sampling infauna and epifauna.

3 Results

3.1 Physical environment

3.1.1 Bathymetry

Both disposal grounds span moderately sloped bottoms, with depths at the Aramoana ground spanning c. 3 m. Sampling stations for this ground ranged between c. 7.4 and 11 m depth below mean sea level (msl; Figure 3-1), with the control station (station AC) c. 2 m deeper than that within the ground (station AG). We note that these are mean depths and that sea conditions (swells >1 m) during sampling introduced considerable error in these measurements.

Stations for the Heyward Point ground spanned a greater depth range. The station within the ground itself (HG) was at 17 m depth, the shallow impact and control stations (HIS, HCS, respectively) were at 12 and 14 m depth, and the deeper impact and control stations (HID, HCD) were at 20 and 17 m depths (Figure 3-1). Control stations off Purakanui were reasonably well matched to impact and control stations at each ground.

Figure 3-1 displays stations arranged to represent their spatial locations (south from Aramoana, north to Heyward Point and to Purakanui) and three depth zones (increasing depth left to right). Within the rows for each ground, stations are arranged with the ground station at left, control station to the right and impact station in between. We use this arrangement consistently in bar graphs to simplify relating benthos differences within and between grounds and comparisons with controls at Purakanui to other stations and their depths.

3.1.2 Sediments

Sand (predominantly fine sand) was the main size fraction in bottom sediments at all stations (Figure 3-2). The main differences between stations were in the mud (silt-clay) and gravel fractions. Most stations had little (<2%) or no gravel, however sediments within the Heyward Point ground included 30% gravel and 2% mud, indicating coarser dredgeate deposited in this ground. The adjacent shallow impact station (HIS) at Heyward Point was the only other station with more than a trace of gravel, suggesting an accumulation from historical dredged sediment deposition.

Sediment mud content was high at four stations relative to most other stations. It was 9-10% at all three Purakanui stations and similar (10%) at the deeper Heyward impact station (HID). These four stations also differed in having higher sediment organic content (0.8-1.1%) than most other stations (0.3-0.6%)(Figure 3-2). The higher mud and organic content of sediments at Purakanui may be due to their proximity to stream and estuary outflows and less complex hydrodynamic conditions than those at the disposal grounds. The higher mud content at station HID relative to others at Heyward Point may be due to disposal activities. Organic content was uniformly low (<0.5%) at the shallower Heyward Point and Aramoana stations, but higher (0.5-1.1%) at the deeper Heyward Point and all Purakanui stations, where mud tended to comprise >8% of bottom sediments (Figure 3-2).

A slight, subsurface redox discontinuity layer and/or a surficial layer of fine silt was evident in sediment only at the Heyward Point ground and adjacent stations (HG, HIS, HID: Table 3-1, Appendix 1). Fine silt layers were apparent at the Heyward Point ground (HG), while evidence of sulphides in the top 1-2 cm of sediments were visible at HIS and HID. Appendix A provides detailed data on sediment profiles from all stations.

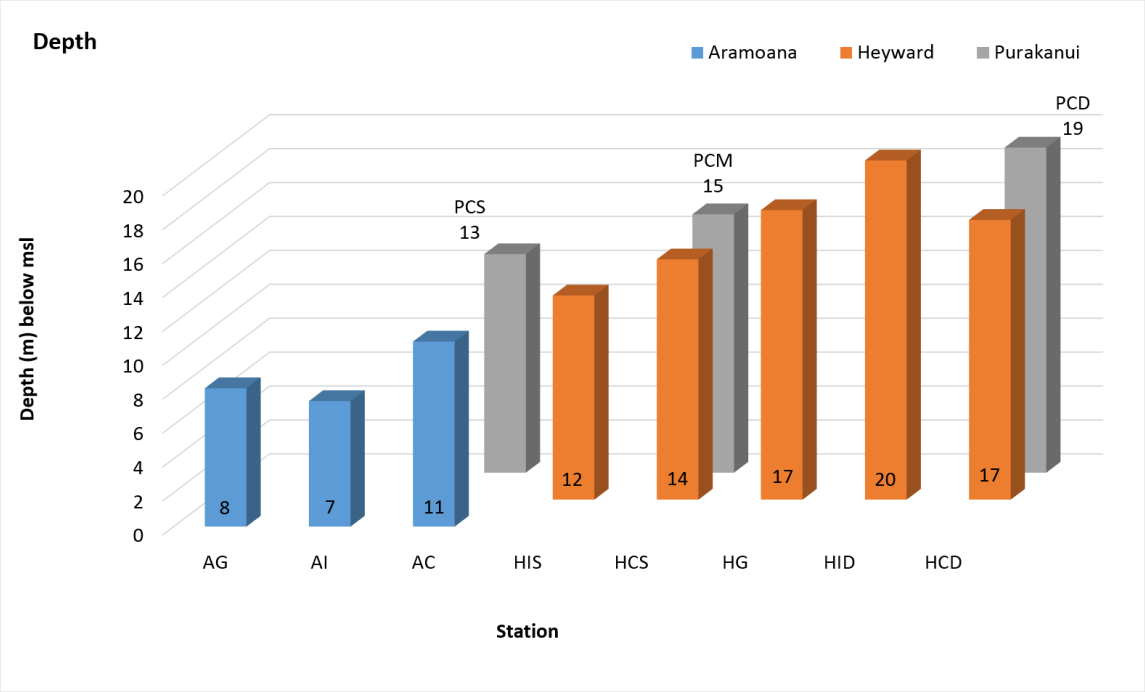


Figure 3-1: Mean depths (m below mean sea level) for samples (n=5) taken at each sampling station in inshore Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

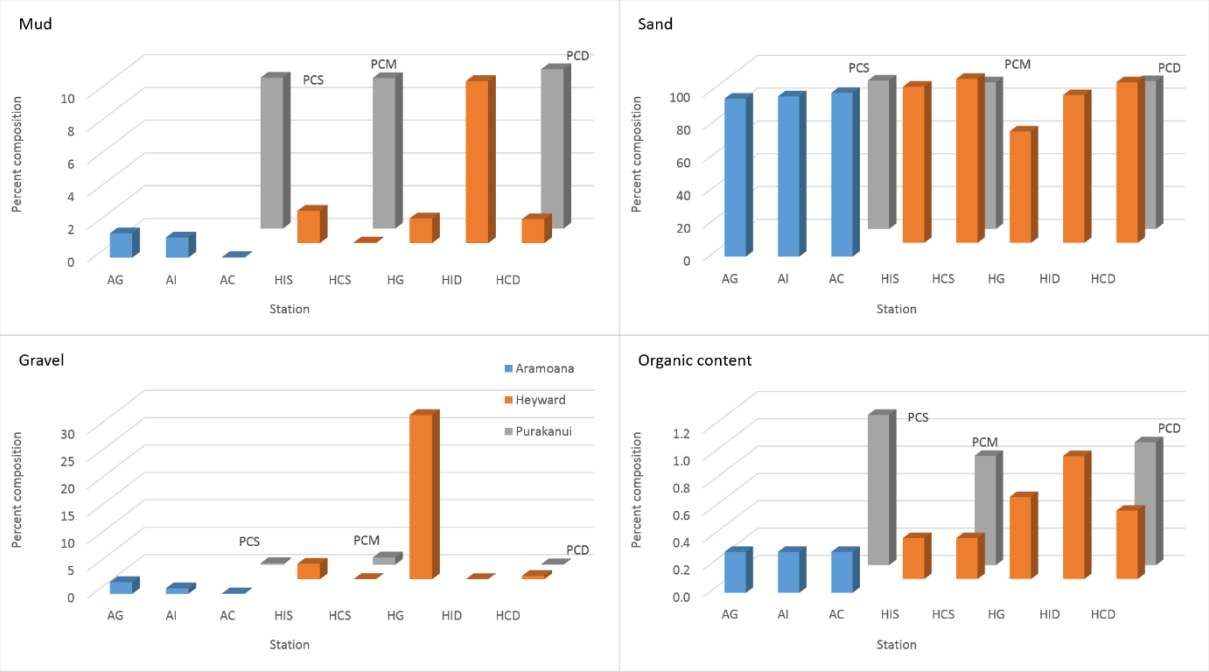
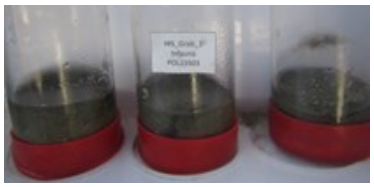
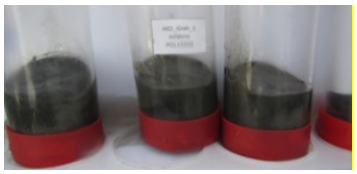
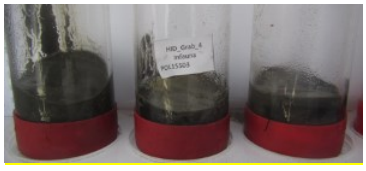
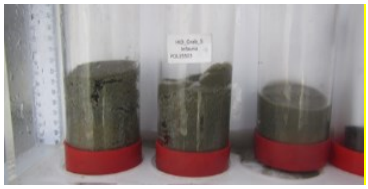


Figure 3-2: Sediment composition (percent by weight) at each monitoring station in inshore Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control deep; PCS, Purakanui control shallow; PCM, Purakanui control mid-depth; PCD, Purakanui control deep. Mud, <63 µ; sand, 63 µ to 2 mm; gravel, >2.0 mm.

Table 3-1: Sediment core profiles from sampling stations with subsurface structures. All cores with obvious redox and/or surficial fine silt layers are shown. Station abbreviations as for Figure 3-1.

Station-replicate	Sediment Cores	Mean redox depth (cm) (n=3)	Mean surface silt layer (cm) (n=3)
HG_2		1.3	1.3
HIS_1		1.0	0.0
HIS_2		2.0	0.0
HIS_4		2.0	0.0
HID_1		1.0	0.0
HID_2		1.0	0.0
HID_4		2.0	0.0
HID_5		2.7	0.0

3.2 Infauna

3.2.1 Infauna abundance

Overall infaunal density across all stations was 8,643 individuals/m^2, but varied between stations (SD=5,798). Densities within individual replicate samples ranged from 1,471/m^2 (station AI) to 21,778/m^2 (station PCS), and mean densities per station ranged from 2,376 individuals/m^2 (station AG) to 18,960/m^2 (PCS)(Figure 3-3). Lowest average densities were just 12.5% of that maximum mean, 2376 individuals/m^2 at the Aramoana disposal ground (station AG). The highest density of any one species was 7,410/m^2 for the small bivalve mollusc, *Nucula dunedinensis* (station AC).

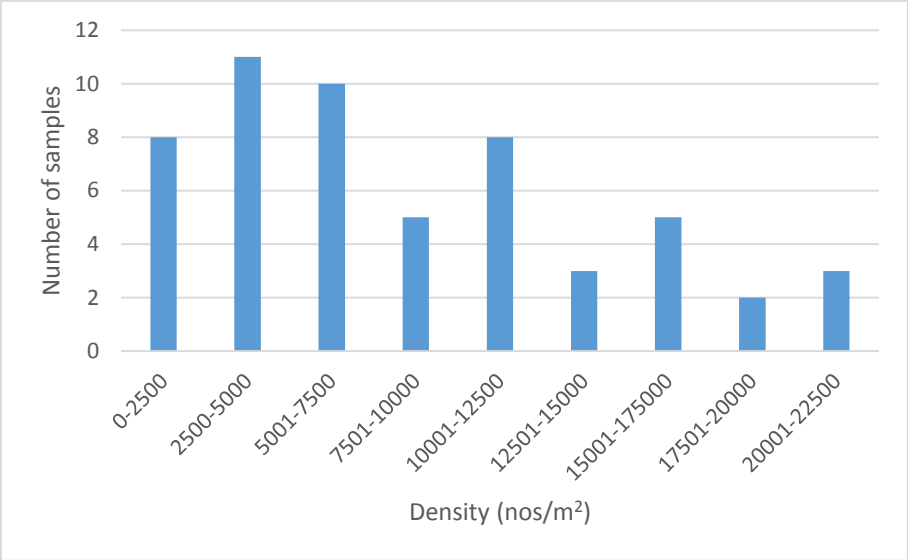


Figure 3-3: Frequencies of replicate samples from inshore Blueskin Bay stations with different densities of benthic infauna.

Infaunal density and species richness increased with distance away from deposition grounds (a measure of disturbance by dredged sediment deposition), but this pattern was partial masked by a decrease in density (Figure 3-4) and an increase in number of species (species richness)(Figure 3-7) with increasing depth. This infaunal density-depth decrease was clearly evident at the far-field control sites, but was also evident at the three local control stations (AC, shallowest; HCS, intermediate; HCD, deepest). However, regardless of this natural depth gradient, mean infaunal densities also increased with distance away from the two grounds (i.e., along the ground-impact-control (G-I-C) series)(Figure 3-4), showing that infauna at deposition grounds and adjacent stations was slightly depauperate relative to local and far-field control sites, regardless of depth. Although, median densities for each station changed similarly (Figure 3-5), the considerable variation between replicate samples within stations (as seen in the 25^{th}-75^{th} percentiles (shown by boxes) and overall ranges) indicates considerable patchiness or heterogeneity of infauna within stations. Importantly, neither density ranges nor the percentile ranges decreased with depth or with distance from deposition grounds (Figure 3-5). Rather, variability, as measured by percentile ranges, was lowest at stations within dredged sediment grounds.

Crustaceans (beach fleas, shrimps and their relatives), polychaete worms and molluscs (snails and bivalves) were the three most abundant groups of invertebrates (>89% of total infauna, except 77% for one AG replicate). Among the crustaceans, amphipods (beach fleas) were especially abundant (46-96% of individual crustaceans) and diverse (46-100%)(Figure 3-6). Thus, changes in the abundances of these groups between stations are examined.

Crustacean and amphipod densities decrease with increasing depth both for the Purakanui controls and along depth gradient from the Aramoana control and the Heyward shallow control to the Heyward deep control stations (AC-HCS-HCD; Figure 3-6). Polychaete densities decreased along the Purakanui depth gradient, but increased with increasing depth along the Aramoana-Heyward shallow-Heyward deep gradient. Mollusc mean densities show similar changes with depth along these control stations, albeit less marked.

Amphipod and total crustacean densities reduced with increasing proximity to deposition grounds for all three depth zones (Figure 3-6). This effect appears greatest within the shallowest zone (i.e., when Aramoana is compared with Purakanui shallow) (Figure 3-6). Mollusc and polychaete densities also appear reduced closer to disturbance, less obviously so for polychaetes.

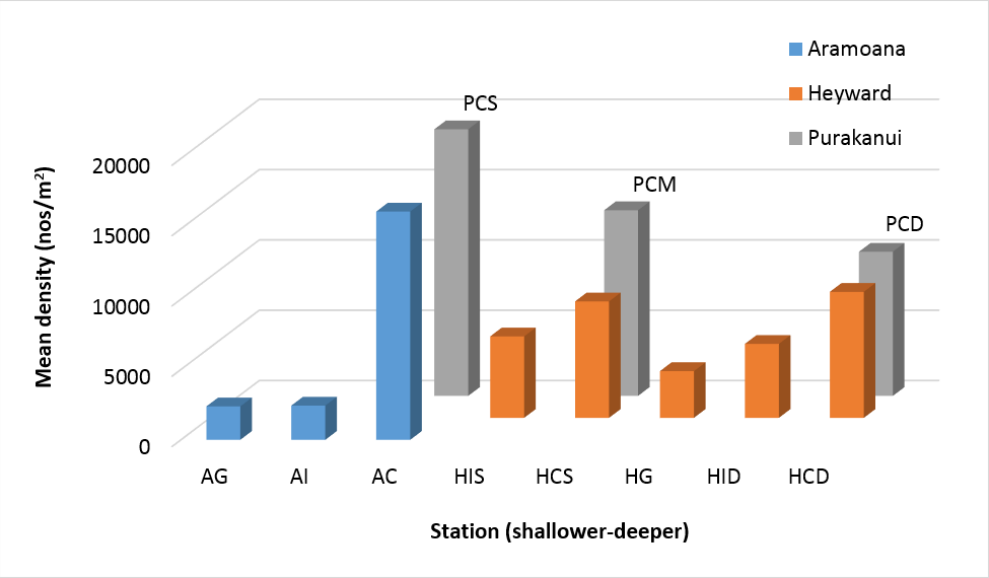


Figure 3-4: Mean densities of total benthic infauna at each sampling station in Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

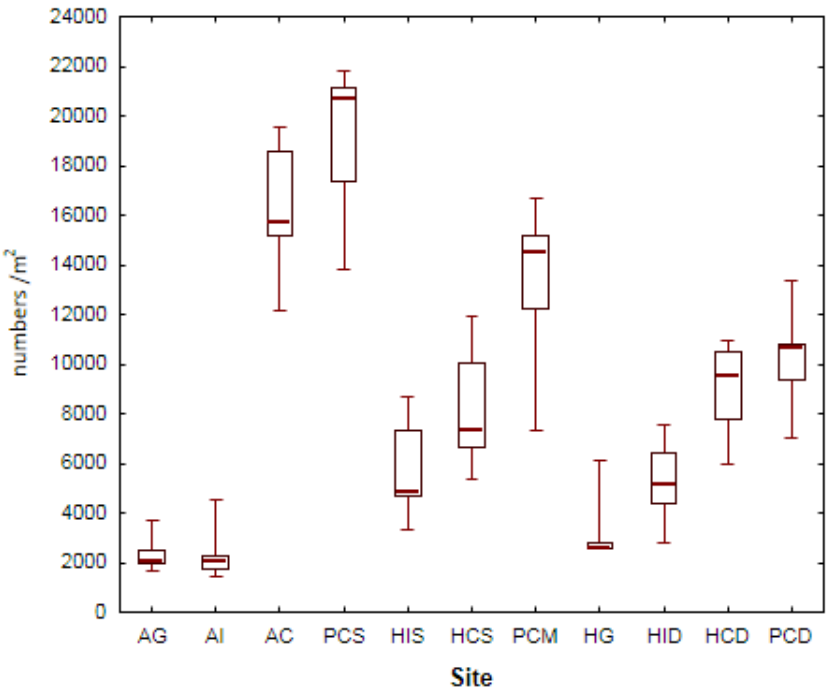


Figure 3-5: Variability of infauna densities (individuals /m^2) at each Blueskin Bay sampling station. Horizontal bar, median; box, 25th-75th percentiles; whiskers, lowest and highest values. Five replicates grab samples (n=5) from AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

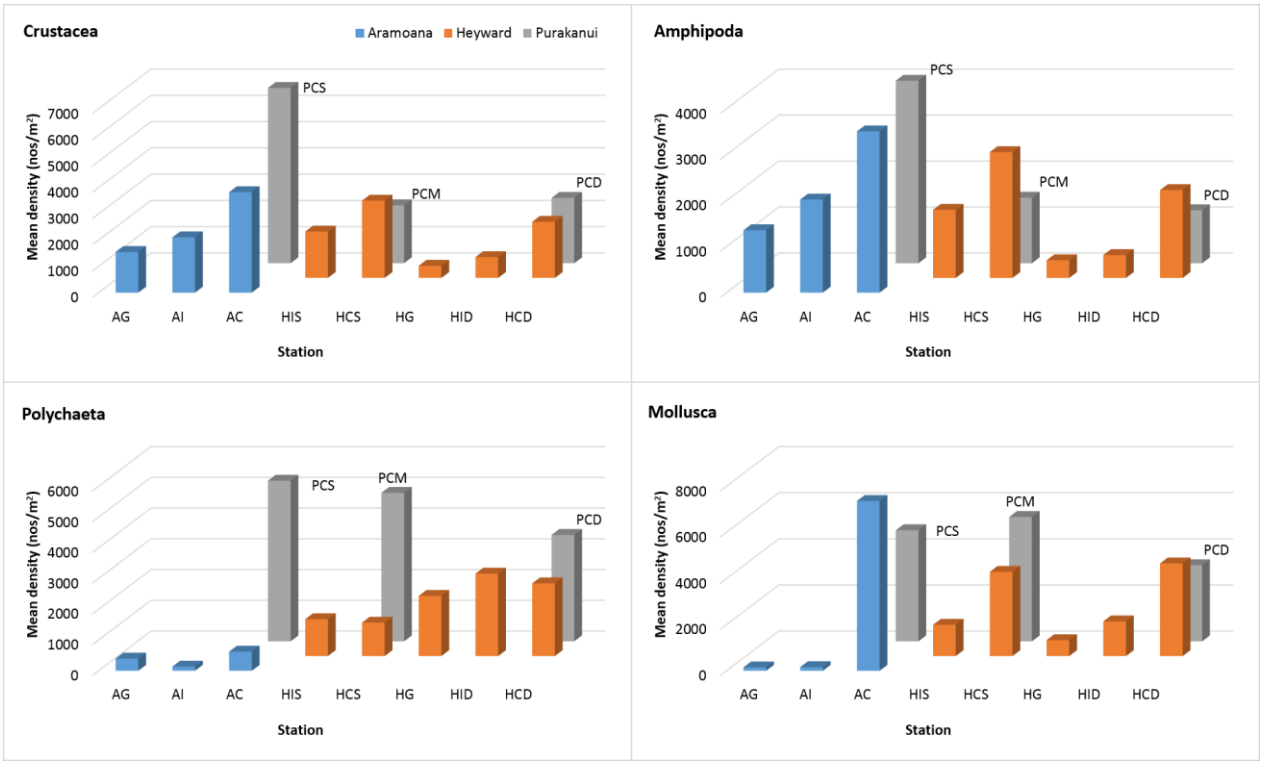


Figure 3-6: Mean densities of each major invertebrate group at each benthic infaunal sampling station in inshore Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

3.2.2 Infauna community structure[3]

A total of 138 species was distinguished from the 55 samples (see Appendix B and Appendix C for list of species at each area). Of these species, there were 53 crustaceans, 34 polychaete worms, 31 molluscs and various minor groups comprising the balance.

Overall community structure (Shannon's diversity index, H') exhibited no pattern across stations, except that the Aramoana stations were markedly lower (Figure 3-8). Also, the Heyward Point ground station seems anomalous: its diversity value (H') is highest of all stations. Numbers of species (S) per replicate ranged from six (station AI) to 50 (station PCD), with these stations having lowest (eight species) and highest (37 species) mean richness, respectively (Figure 3-7). Mean species numbers (S) tended to increase with depth across stations. Comparison of species numbers with disturbance within each depth stratum suggests that proximity to dredge sediment disposal reduces mean numbers of species per station (Figure 3-7).

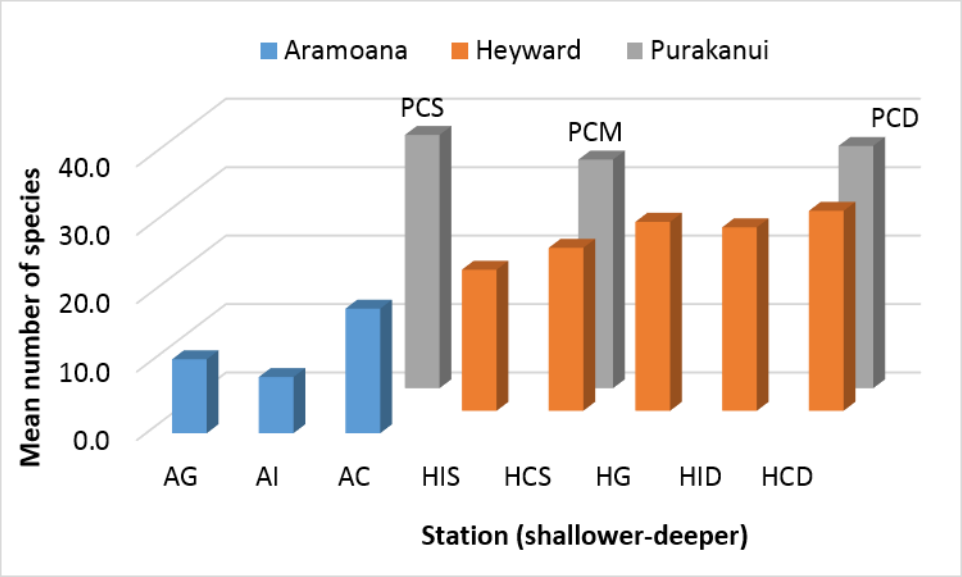


Figure 3-7: Mean total richness (number of species) of infauna at each inshore Blueskin Bay station (n=5). Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left).

Evenness (Pielou's J'), equality of densities between species, differed appreciably between stations. Evenness was lowest (highest variation in individual species' densities) for the Aramoana control station, increased successively for the impact and ground stations and was intermediate for the remote Purakanui control station (Figure 3-8). This index also decreased similarly from the highest score at the Heyward Point ground, through the impact station and control station, to even lower value at the deep Purakanui control station. Reasons for these differences are unclear, but lower numbers of species at inshore stations and larger numbers of infrequent species at the deeper stations are probably key drivers. This unexpectedly high evenness and richness conceivably resulted from benthos being enriched by fauna carried into the area with recently dredged sediments and/or several scavenging species attracted into the area by dead animals. Most of the species present at the Heyward ground were represented by very few (1-4) individuals.

[3] Two components of community structure are widely recognised: richness (numbers of different species) and evenness (the equality of numbers of individuals per species). Richness or diversity here is expressed simply as number of species per sample and using Margalef's d, an index that is less sensitive to sample size. Evenness is measured using Pielou's evenness index. We also use the Shannon (Shannon-Weiner) diversity index as a single measure of both components of community structure and increases with both more species and greater evenness of individuals per species. See Clarke & Warwick (2001) for more specific detail.

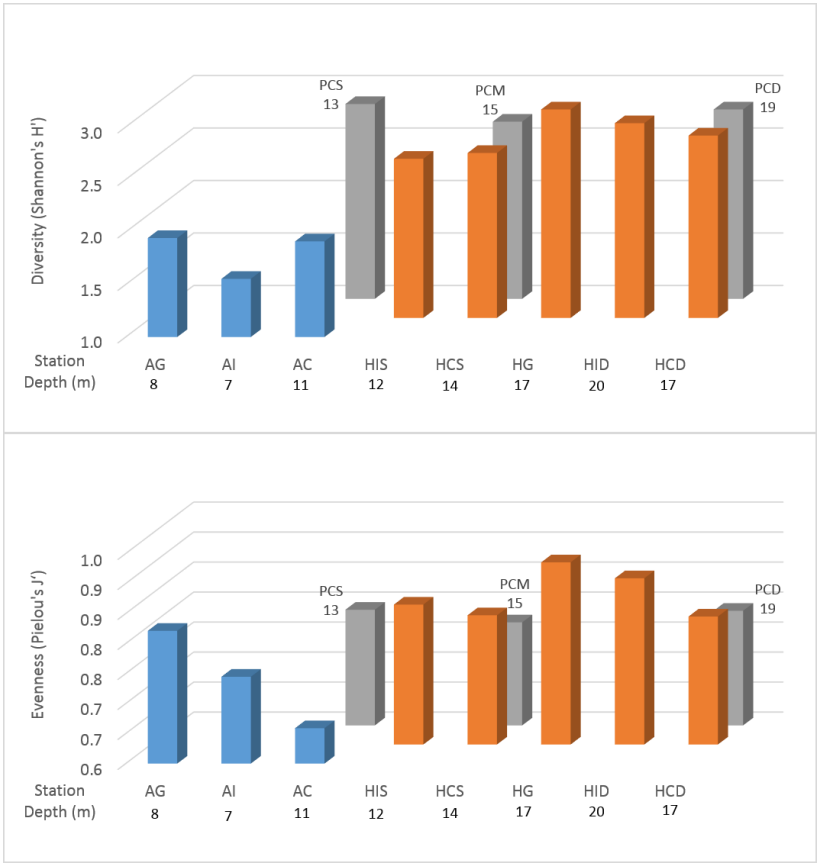


Figure 3-8: Mean diversity measures for benthic infauna at each inshore Blueskin Bay sampling station. Stations arranged by proximity to disposal ground, depth and location. Top, Shannon's diversity index (H'); bottom, Pielou's evenness (J').

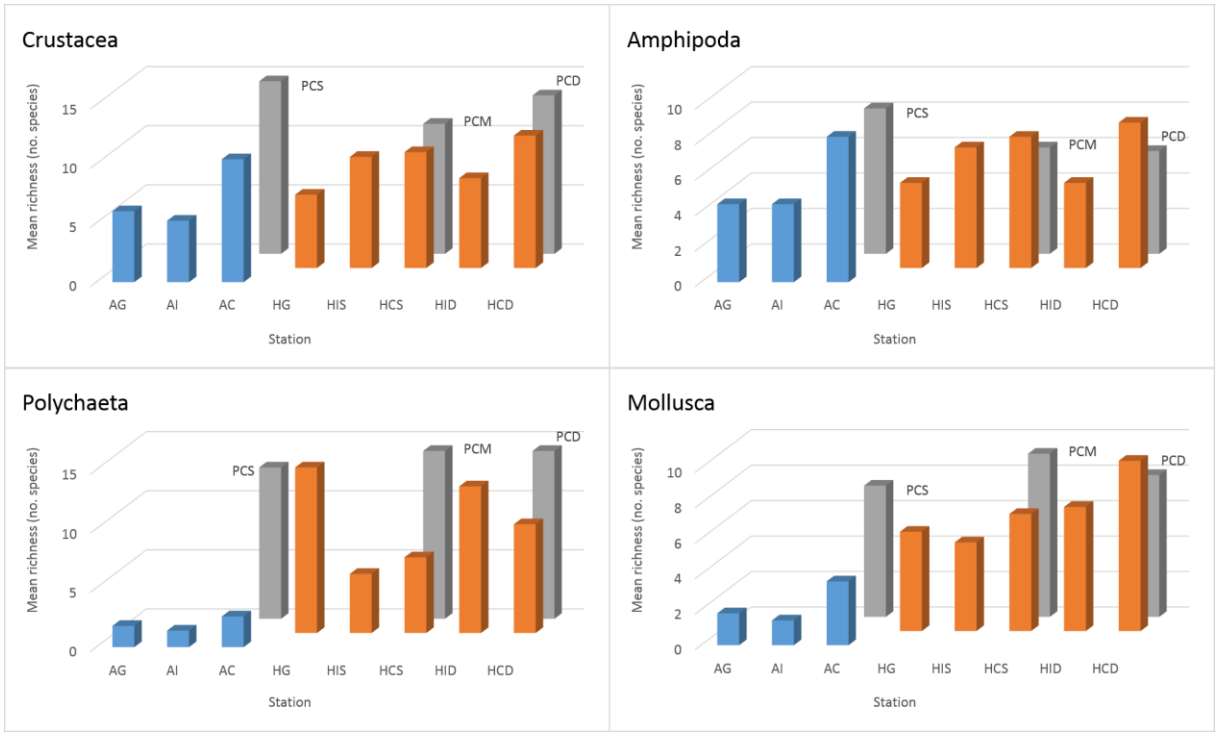


Figure 3-9: Mean richness (number of species) for each major infaunal group at each sampling station in inshore Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

Comparison of mean species numbers (richness) within each major group (Figure 3-9) indicates that amphipod diversity and molluscan diversity were both reduced at deposition ground and impact stations, compared with the respective control stations and with the controls at Purakanui (Figure 3-9).

Polychaete richness changed less consistently (Figure 3-9). Polychaetes were a minor component of the benthos at Aramoana and changes between stations at this ground were minimal. The dramatically greater richness at the shallow Purakanui site is probably attributable to differences in sediment composition between these two areas rather than dredged sediment deposition. Mean richness was highest within the disposal ground at Heyward Point, compared with that at the impact and control stations, and similar to that at the mid-and deep Purakanui stations.

3.2.3 Infauna similarities between stations

Measures of infauna similarities (Bray-Curtis similarity index) between all pairs of replicate samples from all stations were calculated and used to group or cluster samples. Separate statistical processes were used to generate two visual representations of their similarities or closeness. Cluster analysis of all samples produced a dendrogram (or tree structure) with branching levels indicating faunal similarities (Figure 3-10). All five replicate samples were clustered at c. 62-78% similarity for each of six stations, indicating that samples were sufficiently large and of good taxonomic resolution. Of the others, replicates for two stations were inter-mixed (Aramoana ground and impact), and three or more replicates were well grouped for each of the other three stations.

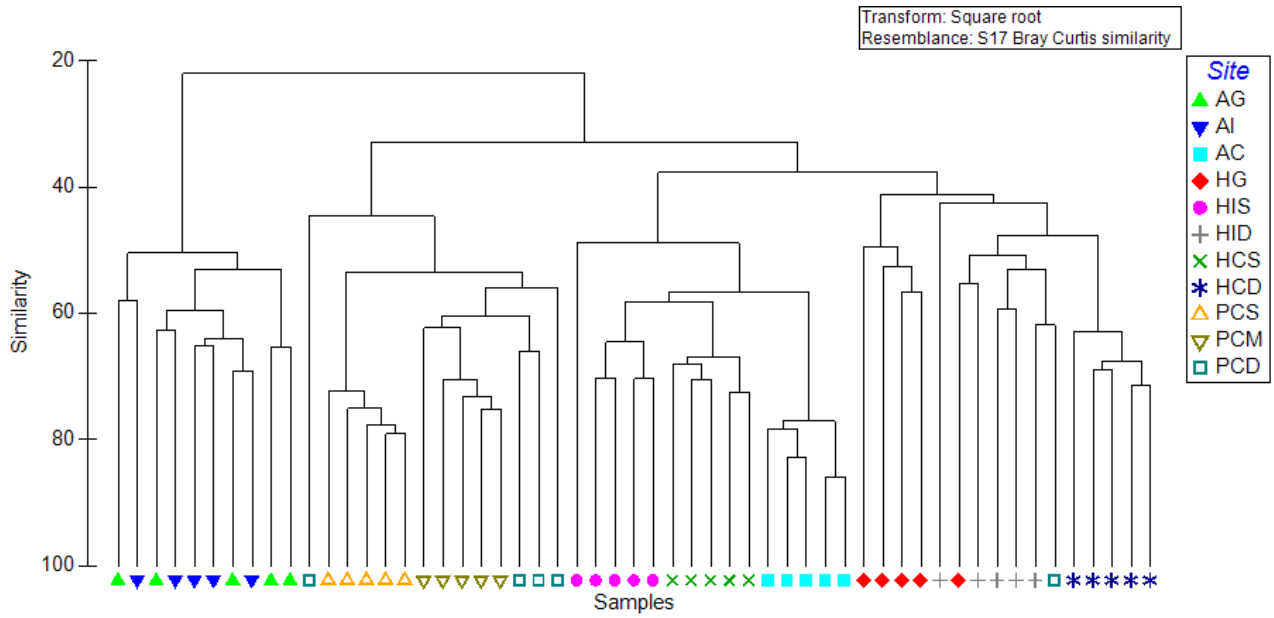


Figure 3-10: Cluster analysis dendrogram showing levels of similarity (%) between infauna at all inshore Blueskin Bay sampling stations. AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HG, Heyward Point ground; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HID, Heyward impact, deep; HCD, Heyward control deep; PCS, Purakanui control shallow; PCM, Purakanui control mid-depth; PCD, Purakanui control deep.

Four clusters of stations are distinguished at c. 40% similarity: the two shallowest stations (Aramoana: AG, AI); all Purakanui stations; the intermediate depth stations at Heyward Point and Aramoana; and all deep Heyward Point stations. The Aramoana ground and impact benthos is distinguished from all other samples and stations, including the Aramoana control, at just 22% similarity.

All samples from the Aramoana ground and impact stations are clustered with each other at c. 50% similarity (Figure 3-10). These stations shared similar assemblages characterised by fewer species and lower densities than more distant sites. Also, the close similarities of ground and impact stations at this ground probably result from the considerable benthos recovery during the six or more months since dredged

sediment was last deposited here. The benthos at the Aramoana control station (AC) was more homogeneous between replicates (almost 80% similarity). It was quite dissimilar to that at the other two Aramoana stations, and more similar (c. 58%, excluding the one outlier station) to that at the two shallower Heyward Point stations, both located at more similar depths (12-13 m, cf. 11 m at station AC)(Figure 3-1).

Replicate samples from all three deep Heyward Point stations are clustered at c. 40% similarity (Figure 3-10). The disposal ground station (HG) replicates were separated from the other two stations (excluding one outlier) at c. 42% similarity. In comparison, the Heyward deep control station replicates were all clustered at c. 65% similarity.

With one exception, all Purakanui station replicate samples are clustered together at c. 45% similarity and separated from all other samples at c. 32% similarity (Figure 3-10). With removal of a second somewhat anomalous replicate from the deepest station (PCD), this similarity between benthos at the three stations increases to c. 55%. However, the presence of two outliers (40% of replicates) at the deep Purakanui station and the relatively lower level (c. 56%) of similarity between the other three replicates (Figure 3-10) indicates that benthos at this deeper station is naturally patchy or heterogeneous.

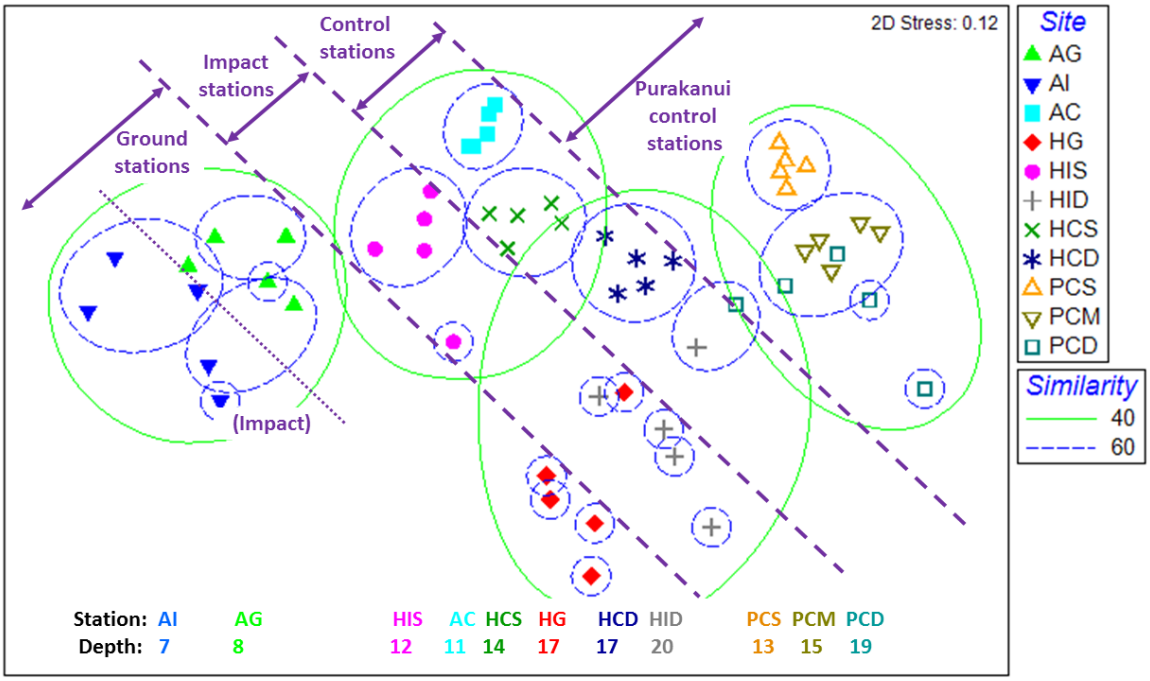


Figure 3-11: Multidimensional scaling plot of relationships between infauna at the inshore Blueskin Bay sampling stations. 40% similarity, solid green ring; 60% similarity, dashed blue rings.; diagonal purple lines separate control (upper right, impact, central (top left-bottom right) and ground (lower left) stations. Data transformed to square roots, Bray-Curtis dissimilarity index. AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HG, Heyward Point ground; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

These same four clusters are clearly separated within the second, two-dimensional representation of similarities between stations and samples (Figure 3-11). Clusters are mostly separated at 40% similarity and the same six stations are essentially separated at 60% similarity. Notably, in this representation of groups, the Purakanui samples and stations (with the two outliers) more tightly grouped (within 40% similarity bubble), and there is some separation of the Aramoana ground samples from those for the Aramoana impact station (Figure 3-11).

Based on species abundance data, the benthic infauna at each station differed significantly from that at any other station (ANOSIM; R = 0.344-1.0; p = 0.008-0.032), including stations AG and AI (R = 0.344; p = 0.032), for which replicates were intermixed in the cluster analysis and dendrogram (Figure 3-10), but better resolved within the MDS plot (Figure 3-11). Comparisons of the infauna within each set of stations based on the measures of community structure (total density, richness (S), Margalef's d, Pielou's evenness, Shannon's diversity) supported this analysis. In particular, infaunas at the shallow stations (Aramoana and PCS) differed from each other on four or all of the five measures (Table 3-2). Infaunas at the two intermediate depth stations at Heyward Point (HIS, HCS) were not significantly different on any measure, but both differed from their Purakanui mid-depth far control (PCM) on 3-4 community measures (Table 3-2). Differences with exposure to dredged sediment deposition were fewer for infauna at the deeper parts of Heyward Point: none of the measures differed significantly between ground and impact stations (HD, HID), and impact and control stations (HID, HCD) differed significantly on only 2-3 of the five measures. Notably, none of the measures differed significantly between the deep Heyward Point control (HCD) and the deep Purakanui station (PCD; Table 3-2).

Table 3-2: Comparisons of infauna in each (depth) set of stations within inner Blueskin Bay. Upper right of matrix, numbers of significantly different community structure measures for each pair of stations; lower left, measures of community structure that differ. N, infauna density; S, number of species or richness; d, Margalef's index; J', Pielou's evenness; H', Shannon's diversity index. Full results of tests in Appendix F.

Aramoana & shallow Purakanui	**AG**	**AI**	**AC**	**PCS**
AG	-----	4	4	4
AI	S, d, J', H'	-----	5	5
AC	S, N, d, J'	S, N, d, J', H'	-----	4
PCS	S, N, d, H'	S, N, d, J', H'	S, d J', H'	-----
Heyward mid-depth & Purakanui mid-depth	**Not sampled**	**HIS**	**HCS**	**PCM**
HIS		-----	0	3
HCS		-	-----	4
PCM		S, N, d	S, N, d, J'	-----
Heyward deep & Purakanui deep	**HG**	**HID**	**HCD**	**PCD**
HG	-----	0	3	2
HID	-	-----	2	2
HCD	N, J', H'	N, J'	-----	0
PCD	N, J'	N, J'	-	-----
Purakanui	**PCS**	**PCM**	**PCD**	
PCS	-----	1	1	
PCM	N	-----	0	
PCD	N	-	-----	

The MDS plot (Figure 3-11) arrayed stations at Aramoana and Heyward Point largely in order of increasing depth from left to right. The Purakanui stations, although in a separate group to the far right also are in order of increasing depth. Stations and samples also are separated into more or less diagonal bands of ground (lower left), impact and control (upper right) stations. The exception is the Aramoana impact (AI) station, the shallowest station and one that may have been impacted to a similar extent to its associated ground station. The three Purakanui stations conform to this pattern: as distant controls, their similarities

locate them at the top right, far from ground and impact stations (Figure 3-11), with the deep station towards the lower right, the mid-depth station intermediate and the shallowest station towards the upper left of the other two Purakanui stations.

The spatial arrangement of replicates from each station in this two-dimensional plot provides compelling evidence that depth is the dominant factor underlying the horizontal (X-axis) dimension. The vertical (Y-axis) dimension appears to correspond to proximity to dredged sediment deposition effects (effect decreases from the origin), with strong separation of control, impact and ground stations for each location. The three deep stations at Heyward Point are best resolved on this dimension, the shallow Heyward stations are unresolved, and Aramoana stations are moderately well separated.

Further statistical analysis (PRIMER's BIOENV procedure) confirmed that depth was very strongly correlated with infaunal community pattern across all stations and explained some 38% of variation (Table 3-3). Together, depth and distance from the nearest disposal ground explained 56% of variation in infauna communities. Additional abiotic factors (e.g., sediment mud content, organic content) did not increase the amount of variation explained.

The sampling design for this monitoring deliberately stratified stations by depth because it was known to strongly influence shallow infauna on exposed coasts. Thus, we repeated this analysis controlling for depth differences between the three sets of stations (shallow, Aramoana stations and PCS; mid-depth, HIS, HCS, PCM; deep, HG, HID, HCD, PCD). Exposure to sediment deposition effects (measured as distance from the nearest ground) explained 68% of variation in infauna between stations within these sets (Table 3-3, lower half). No other factor or combination of factors explained more of the variation (adding distance and/or gravel explained marginally more). This identifies proximity to sediment deposition as a significant influence on benthos within and adjacent to each ground (impact stations, c. 40 m from boundary).

3.2.4 Dominant species

Density plots for the 12 species contributing most to differences (or dissimilarity) between stations (SIMPER analysis; Figure 3-12, Figure 3-13) show several quite different patterns of abundance. Molluscs comprise six of these important species. One bivalve (the small *Nucula dunedinensis*) and two gastropods (*Zethalia zelandica* and *Antisolarium egenum*) were the most abundant species, each with a slightly different distribution pattern. *Nucula* and *Zethalia*, like two abundant amphipods (?*Limnoporeia* sp. S[4] and *Otagia neozelanicus*), extended over the entire depth range investigated here. *Antisolarium*, in comparison, was absent from the two shallowest stations. Others, such as another bivalve (*Glycemeris modesta*) and most other species (Figure 3-12) were absent or present in low densities at one or both of the shallow stations at Aramoana. A few species were abundant at single stations only (e.g., ?*Limnoporeia* sp. M; Tanaidacea, *Tawera spissa*), whereas others were abundant at several stations (e.g., the polychaete worm cirratulid sp. (Figure 3-13)).

Densities of all of these dominant species were affected by dredged sediment deposition, but the effects differed between species and between depths or grounds. Densities of most were reduced within disposal grounds and/or at impact stations (e.g., *Antisolarium egenum*, cirratulid sp., *?Limnoporeia* sp. M), but the effect was not consistent between grounds (Figure 3-12, Figure 3-13). Six species occurred at higher densities at the Heyward deep impact station compared with the Heyward ground station, but their densities at Aramoana were highest at control stations (e.g., *Nucula dunedinensis, Zethalia zelandica, ?Limnoporeia* sp. S, *Glycymeris modesta, Otagia neozelanicus, Nucula* sp. 2).

[4] The question mark indicates that the genus identification is uncertain. "sp. S" indicates that this species is unnamed, and here labelled as "species S" to distinguish it from others that belong to the same genus.

Table 3-3: Combinations of abiotic variables explaining most variation in infaunal community differences between stations. Correlation coefficients (Spearman rank) between station similarity matrices for infauna and for combinations of abiotic factors (normalised, Euclidean distance), using PRIMER's BIOENV routine: coefficients give proportion (0-1) of total infaunal variation explained by each combination of abiotic variables. Shallow stations, AG, AI, AC, PCS; mid-depth stations, HIS, HCS, PCS; deep stations, HG, HID, HCD, PCS.

Number of abiotic variables	Correlation coefficient	Variance explained[5]	Variable/s
Effect of depth differences between shallow, mid and deep stations included (i.e., not controlled)			
2	0.746	0.557	Depth, Distance
3	0.702	0.493	Depth, Distance, Mud
2	0.695	0.483	Depth, Organic content
5	0.692	0.479	Depth, Distance, Organic content, Sand, Mud
3	0.691	0.477	Depth, Distance, Organic content
4	0.691	0.477	Depth, Distance, Mud, Sand
2	0.683	0.466	Depth, Mud
4	0.683	0.466	Depth, Distance, Organic content, Sand
3	0.668	0.446	Depth, Distance, Sand
4	0.664	0.441	Depth, Distance, Organic content, Mud
Effect of depth differences between shallow, mid and deep stations removed (i.e., controlled)			
2	0.831	0.691	Depth, Distance
3	0.831	0.691	Depth, Distance, Gravel
1	0.825	0.681	Distance
2	0.811	0.658	Distance, Gravel
4	0.805	0.648	Depth, Distance, Gravel, Organic content
3	0.802	0.643	Distance, Gravel, Organic content
3	0.786	0.618	Depth, Distance, Organic content
2	0.783	0.613	Distance, Organic content
3	0.776	0.602	Depth, Gravel, Organic content
3	0.754	0.569	Depth, Distance, Sand

[5] Spearman's correlation is an index of the relative strength of a relationship. It ranges from 0 to 1. When squared, it gives the proportion of variance shared or explained (e.g., Healey 1990).

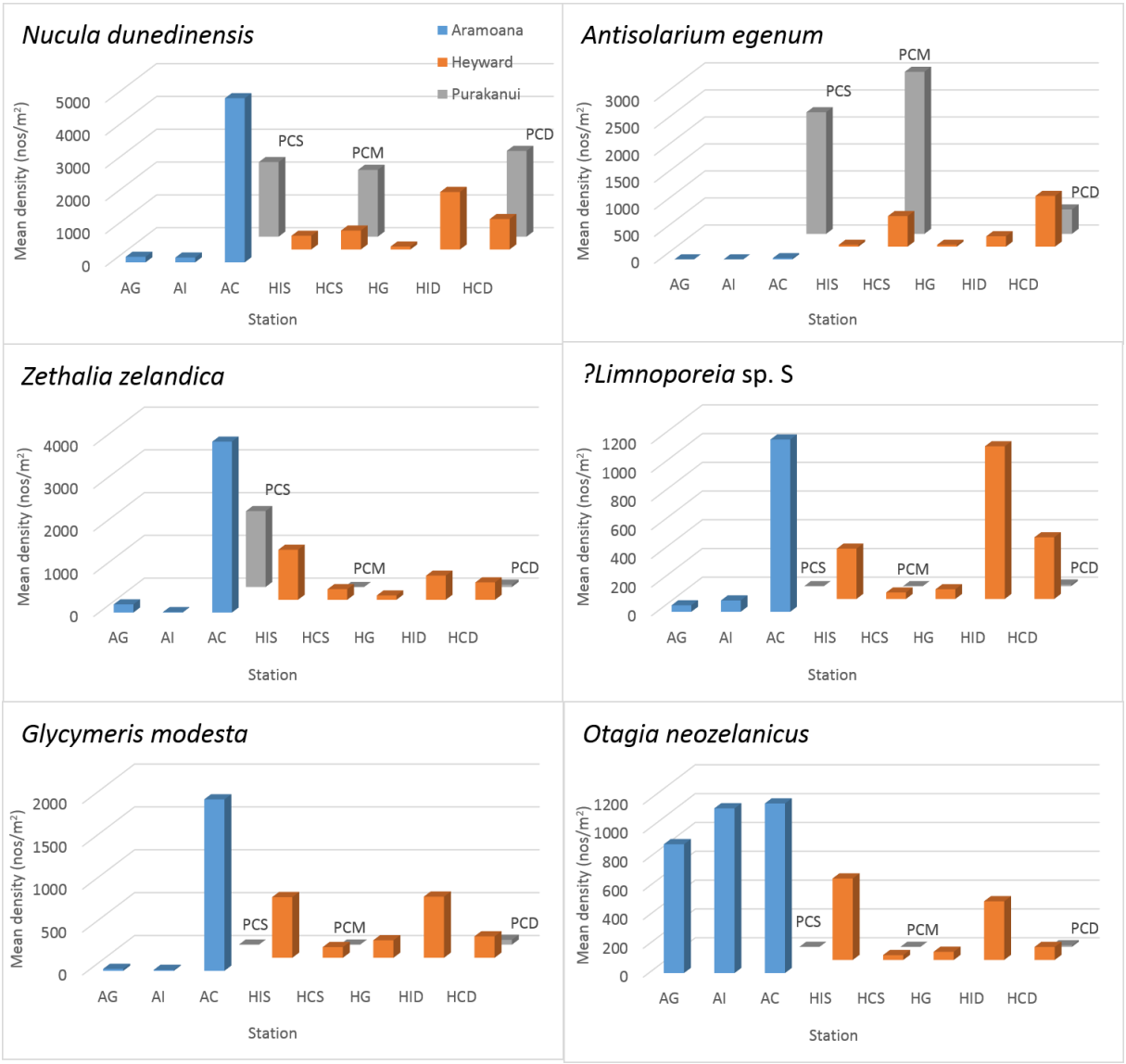


Figure 3-12: Mean densities of infaunal species contributing most to dissimilarities between stations in inshore Blueskin Bay. Species ranked 1-6 in importance (numbers of station pairs to which the species contributed >5% dissimilarity). Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left).

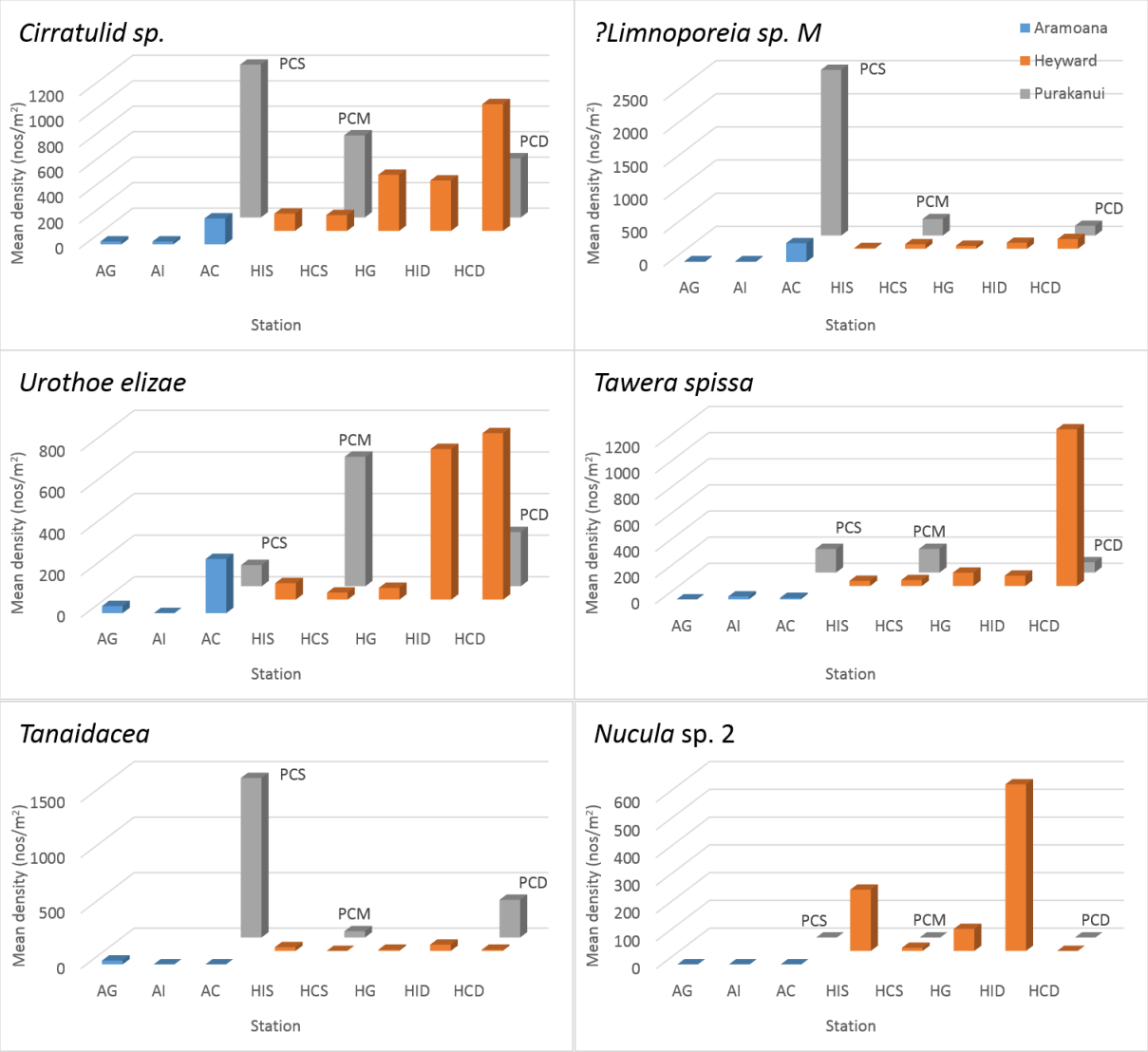


Figure 3-13: Mean densities of infaunal species contributing most to dissimilarities between stations in inshore Blueskin Bay. Species ranked 7-12 in importance (numbers of station pairs to which the species contributed >5% dissimilarity). Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left).

3.3 Epibenthos

3.3.1 Epibenthos abundance

Epibenthos sampling was semi-quantitative, i.e., numbers of individuals taken indicate actual density, but individual species are likely to be under- or over-sampled relative to others. However, because epibenthos sampling is the only practical means of sampling some important benthic species, we use the resulting data as crude estimates of abundances.

Abundances ranged from 0-2018 individuals per 205 m) total catch from five separate, 50 m long tows). No epibenthos specimens were taken in tows from two stations (HG, PCD) and only two specimens were taken at satin HID and one at HCD. These stations were the four deepest (17-20 m depth) stations. Similarly, epibenthos densities at the Purakanui stations also decreased with increased depth (Figure 3-14). Together, these observations indicate a sparse epibenthos on muddy sand bottoms at these depths in this part of Blueskin Bay.

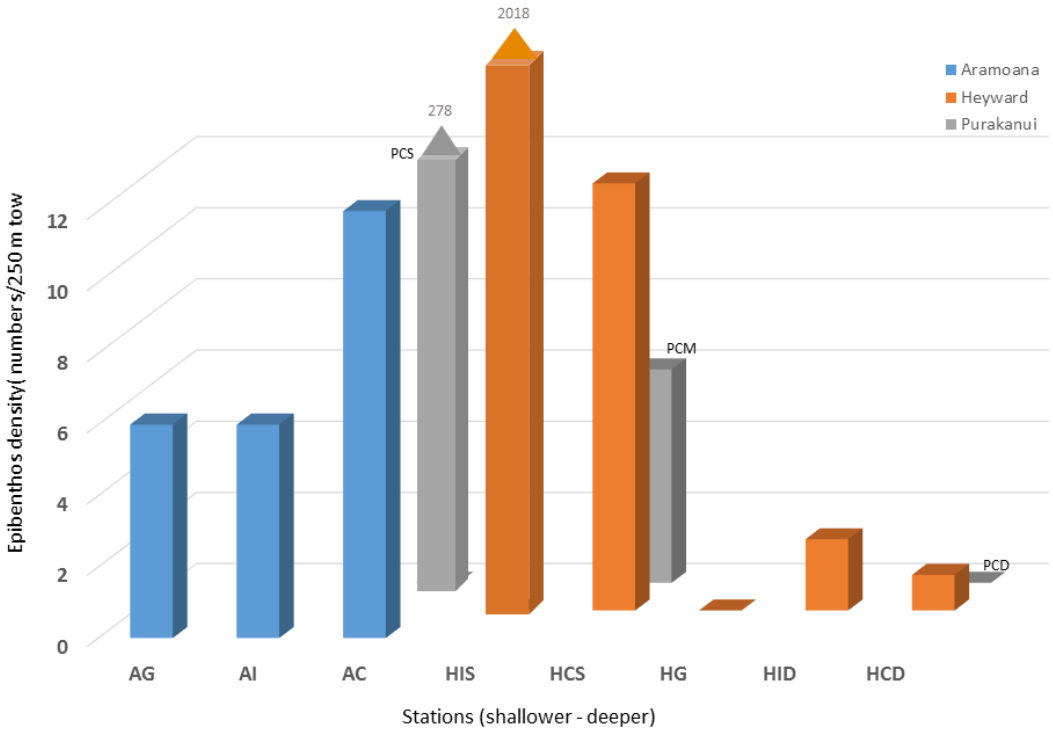


Figure 3-14: Numbers of epibenthic organisms per 250 m tow (pooled results for five 50 m long tows) at each station in Blueskin Bay. Stations arranged by location (front to back), proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HG, Heyward Point ground; HID, Heyward impact, deep; HCD, Heyward control, deep; PCS, Purakanui control, shallow; PCM, Purakanui control, mid-depth; PCD, Purakanui control, deep.

Epibenthos densities were similar at the Aramoana ground and impact stations, and higher at the Aramoana control station (AC)(Figure 3-14), which had much lower densities than the shallow Purakanui station. Density at the shallow Heyward Point control station was similar to that at the Aramoana control stations, but much greater at the shallow Heyward Point impact station. No epibenthic organisms were taken at the deeper Heyward Point ground station. Comparison with other deep (17-20 m depth) stations indicates that this is not necessarily related to dredged sediment deposition effects, because the Purakanui control station also lacked any epibenthos and densities were low at the other deep stations.

Highest densities were at 12-13 m depth at Heyward Point (impact station) and Purakanui (Figure 3-14). These extreme densities were due to the inshore gastropod, *Zethalia zelandica*. Its much greater density at the impact station may be associated with sediment deposition.

3.3.2 Epifauna community structure

Twenty-one species were collected in the epibenthos from all stations, nine of which were also found among the infauna, mostly as minor components. Five species (*Zethalia zelandica, Nucula dunedinensis, Mactra ordinaria, Adamsiella chauvinii, Myadora* sp.) comprised 98% of all epibenthos, with one, Zethalia zelandica, contributing 93.7% of all epifauna collected. Six of the remaining species were represented by single specimens from just one station, while eight species were represented at 2-3 stations by 1-2 indivuduals at each (Table 3-4).

The inshore gastropod *Zethalia zelandica* was taken at four shallow stations at densities of 5, 6, 182 and 2000 /m^2 (Table 3-4, Appendix F). Highest densities of *Zethalia* were at the Heyward Point shallow impact station (2000/m^2) and at the Purakanui shallow control station (Appendix F). The remaining species, the

sand-binding red alga *Adamsiella chauvinii*, was present at seven stations. Most records of this and other algae probably represent drift specimens because substratum suitable for attachment (i.e., rock) is known only from adjacent to the Aramoana ground (Paavo 2007).

No epibenthos was taken in samples from two stations (Table 3-5), and there was one species only at one and two species only at three stations. More species were present at the five intermediate depth (11-15 m deep) stations: three stations yielded five species and there were 10 and 11 species at the remaining two (Table 3-5). With only two species present at four or more stations, just eight represented by three or more specimens at any station, and half of all stations with 0-2 species, further analysis in considered inappropriate.

Table 3-4: Epibenthic species, abundances and occurrence across the three inshore areas in Blueskin Bay. *, indicates present in infaunal samples also.

Phylum	Species	Stations present	Total specimens
Crustacea	*Nectocarcinus integrifrons**	1	1
Crustacea	*Ogyrides* sp. *	1	2
Heterokonta	Filamentous brown alga	1	1
Mollusca	*Diloma* sp.	1	1
Mollusca	*Mactra ordinaria**	1	23
Mollusca	*Myadora* sp.*	1	15
Mollusca	*Nucula dunedinensis**	1	50
Mollusca	*Scalpomactra scapellum**	1	2
Mollusca	*Sepioloidea pacifica*	1	1
Mollusca	*Tanea zelandica**	1	1
Porifera	Filamentous sponge	1	1
Chlorophyta	*Codium* sp.	2	2
Chlorophyta	*Ulva* sp.	2	3
Crustacea	*Pagurus* sp.*	2	2
Rhodophyta	Branching red algae	2	2
Cnidaria	Hydrozoa	3	6
Crustacea	*Periclimenes yaldwyni*	3	3
Crustacea	*Pontophilus australis*	3	6
Rhodophyta	Filamentous red algae	3	6
Mollusca	*Zethalia zelandica**	4	2193
Rhodophyta	*Adamsiella chauvinii*	7	20

Table 3-5: Abundance and diversity of epibenthos at each inshore Blueskin Bay station.

Station	AG	AI	AC	PCS	HIS	HCS	PCM	HG	HID	HCD	PCD
Total individuals from all stations	6	6	9	278	2018	12	6	0	2	1	0
Number of species present	2	2	5	10	11	5	5	0	2	1	0

4 Discussion

4.1 Monitoring design effectiveness

Our monitoring design sought to match disposal ground sampling stations with impact and control stations at the same depth and exposed to similar environmental (notably hydrodynamic) conditions. Far-control stations also were intended to sample infauna at depths matched to ground, impact and control stations. Winter field conditions, notably swell conditions and limited daylight hours, resulted in some mis-matches. Corrected depths for the Aramoana stations ranged from 7-11 m below msl, and the Purakanui far-control was a 13 m depth. Heyward Point shallow stations and the Purakanui mid-depth far-control were more comparable (no mid-depth disposal ground station was sampled), ranging over 12-15 m below msl. Deep stations at Heyward Point and Purakanui were at 17-20 m depth. This variation in sampling station depths compromised assessments for Aramoana most, because faunal responses to depth are greatest in shallower waters (see Figure 3-11), but seems unimportant for the Heyward Point mid-depth and deep stations.

Results of this monitoring emphasise the very strong depth gradient effect on benthic infauna on such hydrodynamically active coasts. For this reason, accurately matching depths below mean sea level (or some other datum) is essential to controlling for depth in order to resolve the effects of dredged sediment deposition on infauna, especially at shallower (c. <15 m depth below msl). Although this introduces practical difficulties, we consider that the benefits of doing this in the field substantially increased the monitoring's effectiveness. Thus, we recommend that all practicable steps be taken to achieve closely matched depths during sampling for future monitoring.

The close similarities of infauna within each of the five replicates from each station and the statistical distinctiveness of infauna between stations indicates that sample sizes were adequate for quantitatively characterising the infauna. The number of replicates (five) also was sufficient, as well as essential for distinguishing treatments within an inherently variable ecosystem. We consider that it is important to continue with five replicates for future monitoring because they provide the statistical power for detecting meaningful differences within the infauna between stations exposed to different sediment deposition effects.

Locations of far-control stations, stations at which the benthos is very unlikely to be affected, but similar in other respects, also is important for the effectiveness of this monitoring plan. The original plan (Fenwick & Stenton-Dozey 2015a) did not specify far-controls. However, results of hydrodynamic modelling available just prior to sampling indicated the potential for controls closer to the disposal grounds to be influenced by dredged sediment deposition and its re-working. Thus, three far-control stations were sampled off Purakanui. Sediments at these stations differed in some important characteristics (greater mud fractions and organic matter, probably from the Purakanui Inlet out-flows) from all Aramoana and those Heyward Point stations located at similar depths. This difference in sediments probably underlies the substantial difference (in relative species abundances and total abundances) of the Purakanui stations' infauna from that at the two grounds. Thus, we recommend retaining far-controls within the monitoring plan, but relocating these to off Pilot Point or Whareakeake (Murdering Beach), closer to but >1 km from the Heyward Point ground.

Epibenthos proved very sparse. Tows of 50 m yielded few specimens and few species. Many of the species collected were infauna found in the surface sediments, such as small bivalves (42% of all epifaunal species), or, in the case of algae, probably drift specimens (29% of all epifaunal taxa). These results indicate that there are no abundant populations of any epifaunal species present in the area, other than the gastropod *Zethalia zelanadica* (we note that some large species, such as stomatopod crustaceans, that occur in the general area were not sampled).

Based on results of this study, we recommend continuing with the present monitoring plan (Fenwick & Stenton-Dozey 2015a), with the changes indicated above. We further note that both shallow and deep impact and control stations at Heyward Point should be relocated to accommodate the proposed enlarged disposal ground. That is, relocate the Heyward Point impact stations to 30-50 m from (a) the disposal ground's western boundary at 12-15 m depth (below msl) and (b) from its northern boundary at 18-20 m depth (below msl); relocate control stations to (a) c. 200 m northeast of the enlarged ground's north-western corner and (b) 200-300 m northwest of the ground's northern corner at 18-20 m depth).

4.1.1 Sampling plan recommendations

Based on the results obtained from this first monitoring survey, we recommend the following improvements to the sampling design and its implementation.

- Sampling stations must be located to ensure that they are both matched on depth (corrected to mean sea level) and at the specified distance from the ground boundary (for control and impact stations). Station depth should be within no more than ±1 m for matched stations because this factor very strongly influences infauna abundance within this environment.
- Sample sizes and replicate numbers used in this study yielded statistically robust results. These should be used in all future monitoring sampling.
- Far-control stations, although not part of the original plan (Fenwick & Stenton-Dozey 2015a) and not ideally located, added considerably to the effectiveness of the monitoring. Thus, we recommend retaining far-controls and relocating these to off Pilot Point or Whareakeake (Murdering Beach), away from potential riverine influences.
- Both shallow and deep impact and control stations at Heyward Point should be relocated to accommodate the proposed enlarged disposal ground:
  - (a) HIS to 30-50 m from the new western boundary at 12-15 m depth (below msl);
  - (b) HID to 30-50 m from the new northern boundary at 18-20 m depth (below msl);
  - (c) HCS to c. 200 m northeast of the enlarged ground's north-western corner at 12-15 m depth (below msl); and
  - (d) HCD to 200-300 m northwest of the new ground's northern corner at 18-20 m depth (below msl).
- Epibenthos proved very sparse. Tows of 50 m yielded few specimens and few species, contributing little to understanding of overall effects of dredged sediment deposition at these grounds. Also, the tows to collect these samples were very time-consuming in the field. For these reasons, we recommend eliminating epibenthos from the monitoring plan.

4.1.2 Effects of dredged sediment deposition: variables and trigger levels

We also note that the sampling work proved hazardous and extremely arduous because of severe winter conditions experienced during July, a time of frequent adverse sea and weather conditions, as well as short day-lengths. For these practical reasons, we recommend changing the timing of future monitoring to either March-April or September-October, when weather and sea conditions tend to be more favourable.

No comparisons with previous surveys are included in this report because of differences in sampling methods and station locations. Results of this survey, however, provide a robust set of quantitative data from a specific sampling plan against which results from future surveys (using the same sampling plan) can be readily compared. Comparisons between impact, control and far-control stations should focus on key

environmental and biological variables. Fenwick & Stenton-Dozey (2015a) identified several and these are listed in Table 4-1.

Table 4-1: Key variables for monitoring potential effects of dredged sediment deposition at inshore grounds, Heyward Point and Aramoana, in Blueskin Bay, Otago.

Environmental variables	Community variables	Species variables
Surface sediment particle-size composition	Benthos densities	*Nucula dunedinensis* density
Clay content	Benthos richness (S)	*Antisolarium egenum* density
Organic content	Species richness (Margalef's d)	*Zethalia zelandia* density
	Species evenness (Pielou's J')	?*Limnoporeia* sp. S density
	Species diversity (Shannon's H')	*Glycymeris modesta* density
		Otagia neozelanicus density

These variables include physical variables that are well-established determinants of benthic infauna composition. Community variables are the primary measures of ecological effects, but densities of key species also are included. It is important to note that changes in one or a few species densities is not necessarily ecologically significant because the relative abundances (or densities) of most species within a community usually vary continuously over diverse time scales. These are included because changes in these may help to understand any changes in community variables or they may indicate community changes that would otherwise be undetected (Fenwick & Stenton-Dozey 2015a).

Trigger levels proposed for monitoring were statistical probability or significance levels, that is, a one in five probability that an observed difference in a single variable for a station between monitoring events was due to chance alone. It was recognised that a difference of this size may have no ecological significance, but that such differences should be evaluated by Port Otago Ltd's Working Party.

4.2 Benthos at the disposal grounds

This investigation confirmed an abundant and diverse infauna inhabiting the predominantly fine sand sediments at all sampling stations, including within the Aramoana and Heyward Point grounds. Mean densities were lowest at Aramoana (2,376 individuals/m^2) and highest at the shallow Purakanui station (18,960 individuals/m^2), but benthos densities within each depth stratum were relatively similar. Overall, 138 infaunal species were distinguished, but mean richness (mean number of species per station (S)) varied from <10 to almost 40. The differences from those reported by Paavo (2007) (220 taxa or species (excluding some 45 hard-bottom or larvae only species), densities ranging from 1,710-13,000 individuals/m^2) are probably that study's larger sample sizes and much larger number of samples taken from a greater depth into the sediment. There is no evidence that this difference is due to any dredged sediment deposition effects.

No regionally or nationally significant species, or ecologically significant populations or natural habitat for any species was identified within this investigation. This result is consistent with findings from an extensive review of available information on marine benthos within Blueskin Bay (Fenwick & Stenton-Dozey 2015b).

One of the earliest investigations of benthos in Blueskin Bay identified an inshore *Zethalia*-Foraminifera community on hard, clean sand "from nearshore to 10-18 m" (Andrews 1973: 818) depth, which was also identified and further described in Rainer's (1981) study of inshore benthos. The present study confirmed the presence of a zone dominated by *Zethalia* (Foraminifera were not considered in this study) over 10-13 m depth, as well as distinguishing another community farther inshore (7-8 m depth). Amphipods, notably *Otagia neozelanicus*, characterised that shallower community, which may extend into shallower waters, but also overlapped the *Zethalia* assemblage to 11 m depth (Figure 3-12)(see also Rainer 1981). Both *Otagia* and *Zethalia* extended beyond these zones into deeper water. Other species also occurred within these two zones, in some cases at equal or greater densities than these two species. For example, stations dominated by *Zethalia* in this study included very high densities of *Nucula dunedinensis*, *Glycymeris modesta* and ?*Limnoporeia* sp. S (Figure 3-12).

The *Antisolarium*-Foraminifera assemblage immediately seaward of the *Zethalia*-Foraminifera zone (Andrews 1973; Rainer 1981) was confirmed, although our results suggest that other species may better characterise at least the shallower portion of the purported 10-27 m depth range. For example, cirratulid sp. and *Tawera spissa* (Figure 3-12, Figure 3-13) were equally if not more consistently abundant species across all deeper stations.

One subsequent, more intensive investigation that focussed on the two disposal grounds found essentially similar distributions of infauna to those observed in the present study: marked differences between shallowest inshore benthos and that at the seaward edge of the deposition ground (c. 20 m depth)(Paavo 2007). More detailed comparison with that study's results is difficult because stations were not readily matched based on depths and locations relative to dredged sediment deposition grounds (i.e., not specified in Paavo 2007). From that intensive study, Paavo (2007: 141) considered that benthic "assemblages in the study area are neither homogeneous nor strongly divided". We interpret this to support the widely accepted understanding that benthic infauna generally comprises combinations of species that vary differentially in response to environmental gradients over scales ranging from centimetres to kilometres.

4.3 Environmental differences between stations

The two grounds span a steep, inshore depth gradient, along which infauna abundance decreases, and richness and diversity increase with depth. This change appears due to a complex of factors associated with depth, notably reduced hydrodynamic disturbance of the seabed and consequential finer sediments with increasing depth. Sediment organic content (potential food for deposit feeders) also tends to increase with finer sediments and there were important differences between both factors at some stations. Proximity to riverine and estuarine influences appears to underlie higher mud and organic content of sediments off Purakanui and possibly at the deep impact station off Heyward Point. These were important influences on infauna density and composition, but beyond this investigation's scope.

In this study, the benthic infauna differed significantly between all Blueskin Bay stations, with depth explaining 62% of variation across all stations. The effect of depth on infauna appears most pronounced at depths less than c. 10-15 m. The infauna of shallower bottoms was more variable than that of deeper bottoms in Blueskin Bay (also reported by Paavo 2007), probably because habitats are more heterogeneous in shallower water due to more variable turbulence, sediment particle size composition and organic content (e.g., Haynes & Quinn 1995).

Infauna composition also changed markedly with sediment mud and organic content. Differences between the two shallower Purakanui stations and their Heyward Point and Aramoana counterparts may be partially due to differences in these two factors. Increased organic content has well-known effects on benthos density and its composition (e.g., Pearson & Rosenberg 1978; Villnas et al. 2011). Finer sediments are well known to include more organic matter and the usual positive relationship of organic content with infaunal densities (e.g., Rhoads 1974) was confirmed for inshore Blueskin Bay (Paavo 2007). This explains some of

the observed differences of infauna at Purakanui with that at Heyward Point and Aramoana, as well as demonstrating the difficulties of establishing well-matched control stations for these grounds.

Proximity to dredged sediment deposition is another gradient superimposed on the effects of depth, sediment particle size composition and organic content, resulting in a complex of environmental influences on inshore benthos in the vicinity of the two disposal grounds. The statistically significant differences of infauna between stations at the same location and very similar depths (e.g., Aramoana ground and impact stations, 7-8 m depth; Heyward shallow impact and control stations, 12-14 m depth; Heyward deep ground, impact and control stations (17-20 m)), particle size compositions and organic contents indicates that proximity to dredged sediment deposition has a statistically significant effect on the infauna at these locations.

4.4 Ecological effects of dredged sediment deposition

Dredged sediment deposition may affect the benthos directly and/or indirectly (e.g., burial, suspended sediment concentrations, organic carbon, hydrodynamics, sediment particle composition, food availability, etc.). These effects probably vary with each load of sediment deposited, as well as cumulatively over time as new material is added and natural hydrodynamic processes rework and redistribute dredgeate at each ground. Identifying ecologically significant effects, therefore, is complicated by volumes of sediment deposited during the past days, weeks and months and locations of these deposits, as well as hydrodynamic conditions during and since deposition events.

The infauna at most stations was quite distinct and statistically different from that at adjacent and most other stations. Comparisons of samples based on calculated similarities showed that replicate samples were most similar to each other for eight of the 11 stations. Replicates for two adjacent stations (Aramoana ground and impact) were not distinguished from each other based on infaunal similarities (cluster analysis and MDS), but they differed on four of five community measures. Two replicates for the remaining station (Purakanui deep) were quite dissimilar from each other and the other three (which were well clustered), and did not differ on any community measure.

Proximity to deposition ground had a marked effect on the infauna, explaining 68% of infauna variation within each of the three sets of stations (i.e., when the depth differences between Aramoana, Heyward Point shallow and Heyward Point deep stations (and their respective Purakanui far-control stations) are excluded). No other factor or combination of factors was important in determining differences in infauna between stations within each set. At Aramoana, these differences in infauna between stations were consistent across most or all (4-5) measures of community structure (density, diversity, richness and evenness), whereas deeper stations (Heyward Point) differed in just 2-3 measures (density, evenness; diversity in one comparison only). This indicates that dredged sediment deposition has a greater effect on shallower benthos than on deeper benthos, within the depth range investigated here.

An earlier (2003) investigation examined infauna in the vicinity of the Aramoana ground in some detail (Paavo 2007). Sampling differed between the two studies (2003: 1 x 0.1 m^2 Day grab; 2015: 5 x 0.18 m^2 cores) and the 2003 sampling followed several years of substantial deposition at this ground (143,350 m^3/y during the preceding five years; see Fenwick & Stenton-Dozey 2015b), whereas deposition averaged just 10% of this (14,162 m^3/y) over 2010-2014, and no deposition during the six months prior to the 2015 investigation. Comparison of results between these two studies revealed several notable points:

- Mean infauna density decreased with increased exposure (or proximity) to dredged sediment deposition at Aramoana and Heyward Point, especially when compared with far-controls (Purakanui and Warrington).
- Mean infauna densities at Aramoana were consistently higher during 2015 (this study) than during Paavo's (2007) investigation in 2003, probably due to reduced volumes of dredgeate

deposited at this ground in the preceding five and a half years, notably the lack of any deposition for six months before sampling.

- In both this study and Paavo (2007[6]), richness or number of species decreased with increased exposure to dredged sediment deposition (and reduced depth), and was lowest adjacent to disposal grounds at Aramoana and Heyward Point (Figure 3-8; Paavo (2007) figures 4-20, 4-22, 2-23).
- There was no apparent pattern to changes in species numbers for the three Purakanui stations. Richness was slightly greater at the shallowest station compared with the mid and deep stations.
- Richness was lower during 2015 than that recorded for each ground and Blueskin Bay in 2003 (Figure 3-8; Paavo (2007) figures 4-20, 4-22). This difference is probably due to the larger sample size (0.1 m^2 cf. 0.018 m^2) for the earlier investigation, given the generally positive relationship between sample size and richness.
- Shannon's diversity index tended to be higher in 2003 compared with 2015 values. This probably results from the greater richness reported for 2003.
- Shannon's index increased with depth in both studies.
- There was no consistent pattern to changes in Shannon's diversity index with exposure to dredged sediment deposition, either within or between the two sampling times.
- Evenness (Pielou's J') increased with increasing proximity to dredged sediment deposition (and decreasing depth for both grounds (Figure 3-8; Paavo (2007) Figure 4-24), but the trend was not consistent.
- Evenness (Pielou's J') differed between 2003 and 2015 for most depths and locations (Aramoana, Heyward Point, Blueskin Bay)(Figure 3-8; Paavo (2007) Figure 4-24).

The two independent clustering methods essentially replicated the same groupings of replicates and stations based on infaunal similarities. This replication confirmed the ecological validity of the groupings.

The strong separation of stations by depth in a two-dimensional map (MDS plot) emphasises the importance of this factor in determining infauna composition across all three areas. The further consistent segregation of all replicates for each station (the Aramoana impact replicates are the single exception) into diagonal bands in order of likely dredged sediment deposition effect (ground stations, impact stations, control stations to far-control (Purakanui) stations) graphically illustrates the important influence of sediment deposition effects on infauna. The specific component of proximity to dredged sediment deposition responsible for this effect (e.g., suspended sediment, burial, food availability, etc.) is unknown, and probably differs between species. These results further underscore the importance of ensuring that sampling for any future monitoring is undertaken at specific, corrected depths in order to resolve dredged sediment deposition effects.

[6] Margalef's index d, another measure of species richness, is less sensitive to sample size (e.g., Clarke & Warwick 2001). It is not reported here because values for 2003 were unavailable.

Table 4-2: Measures of structure for benthic infauna at inshore sampling stations in Blueskin Bay in 2015 and 2003. 2015 stations arranged by location, proximity to disposal ground (left to right) and depth (shallowest left). AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; PCS, Purakanui control shallow; HG, Heyward Point ground; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; PCM, Purakanui control, mid-depth; HID, Heyward impact, deep; HCD, Heyward control, deep; PCD, Purakanui control, deep. Paavo's (2007) 2003 stations: AR3, AR4, vicinity of Aramoana ground; H1-H5, vicinity of Heyward Point ground; BB1, BB4, Blueskin Bay off Warrington. 2003 stations matched to 2015 stations, as far as practical (no information available on location relative to disposal grounds).

2015 stations	AG	AI	AC	PCS	HIS	HCS	PCM	HG	HID	HCD	PCD
2015 station depth (m)	8	7	11	13	12	14	15	17	20	17	19
2003 stations		**AR3**	**AR4**	**BB1**		**H1**		**H2**	**H5**	**H3-H4**	**BB4**
2003 station depth (m)		**8**	**11**	**10**		**14.5**		**16.5**	**19**	**17.5-18.5**	**20.5**
Mean density (individuals/m^2)											
2015	2,376	2,432	16,234	18,961	5,792	8,281	13,202	3,326	5,261	8,960	10,250
2003		1,710	3,630	13,000		4,800		1,890	4,940	5,130	7,220
Species richness (no. spp.)											
2015	10.8	8.2	18.2	37.0	20.6	23.8	33.4	27.6	26.8	29.2	35.4
2003		26.0	21.5	32.5		43.0		46.5	41.0	49.8	54.5
Shannon's diversity, H'											
2015	1.94	1.55	1.91	2.86	2.52	2.57	2.69	2.99	2.85	2.74	2.80
2003		2.78	2.07	1.23		2.99		2.73	2.81	2.97	3.04
Pielou's evenness, J'											
2015	0.821	0.745	0.659	0.793	0.833	0.815	0.772	0.904	0.877	0.813	0.791
2003		0.852	0.679	0.354		0.847		0.675	0.732	0.759	0.761

Similar mapping (MDS scaling) of infauna results from the 2003 sampling at Aramoana (Paavo 2007: Figure 4-31) also separated stations along the x-axis in reasonably consistent depth order (right to left in the plots shown) for samplings at two times. Stations at Heyward Point were similarly, but less consistently, arrayed according to depth. Stations also were separated on the y-axis in plots for both samplings. However, no consistent proximity to dredged sediment deposition ground effect was apparent, partly because distances between Paavo's (2007) station locations and his experimental deposition grounds were unclear.

The spatial scale of this proximity to dredged sediment deposition effect is uncertain. Results presented here show that some effect extended beyond both deposition grounds (i.e., at least to 30-50 m to the impact stations). Infauna at the Purakanui deep far-control station did not differ from that at the Heyward deep control station on any community measure, indicating that dredged sediment deposition effects were limited to less than 200-300 m at this location and depth. The infauna at the shallow and mid-depth Purakanui stations differed appreciably from that at their respective near-control stations at Aramoana and mid-depth Heyward Point. These differences probably resulted from differences in mud and organic content of sediments, but dredged sediment deposition cannot be excluded as a contributing factor in either case. Thus, some effect of dredged sediment deposition extends beyond 50 m (stations AI, HIS), and may extend c. 200-300 m beyond the ground boundaries at Aramoana (station AC) and shallower parts of Heyward Point (station HCS). Relocating the far-control stations away from potential terrestrial inputs and other extraneous factors to better resolve the spatial extent of any effects at these locations is strongly recommended for future surveys.

Despite this inability to more tightly determine the spatial extent of dredged sediment effects, infaunal communities close to (30-300 m outside; i.e., impact and control stations) the ground boundaries were moderately abundant, diverse and heterogeneous; attributes typical of natural benthic communities in such shallow, dynamic environments. These communities may be affected by dredged sediment, but their densities, compositions and structures, along with local sedimentary characteristics, indicate that these are relatively healthy and fully functional ecosystems, even close (50 m) to the dredged sediment deposition grounds.

Shallow (<15-20 m depth) soft sediment habitats on open coasts, such as at both grounds in Blueskin Bay, are highly dynamic and characterised by very mobile sands that are subjected to periodic, natural catastrophic events (i.e., storms). Infauna inhabiting these environments are continually subjected to severe disturbance (e.g., displacement from substratum, burial, etc.) during these events. Typically, the infauna in such habitats, including these disposal grounds and elsewhere in Blueskin Bay, is dominated by smaller and more mobile species that are well-adapted to these repeated physical disturbances (e.g., McLachlan and Dorvlo 2005) and, thus, are resilient to and quickly recover from dredged sediment deposition events (e.g., Paavo, 2007). These findings on the spatial extent and magnitude of effect on infaunal communities support Fenwick & Stenton-Dozey's (2015b) recent assessment that the overall ecological effects of disposal at these grounds to date are no more than minor when considered within the context of southern Blueskin Bay.

It is important to note that the assessment of effects to date is an assessment of ecological effects not only of volumes and sediment types deposited at these grounds, but also of the deposition operations. Changes to dredged sediment deposition operations may alter the nature and extent of ecological effects, even when the volumes of sediment deposited remain the same. In particular, enlarging the Heyward Point ground without increasing annual volumes of sediment deposited is expected to lessen effects within the ground and beyond its boundaries, assuming no other changes

to operations. Using a larger dredge that releases much larger individual loads (even when annual volumes are unchanged) seems likely to increase the depth and area of the immediate depositional footprint (larger active plume)(Fenwick & Stenton-Dozey 2015b). Thus, the potential ecological consequences of any operational changes should be considered carefully before they are implemented. In particular, changes to operations (e.g., larger volumes per deposit, etc.) may alter the effect of dredged sediment deposition at these grounds, even if the annual volumes remain unchanged.

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Appendix A Station co-ordinates and depth, and sediment core features

				Sediment Cores		
Station	Latitude	Longitude	Station depth (m)	Average redox depth (cm) (n=3)	Average surface silt layer (cm) (n=3)	sediment core features
AG_1	-45.76653224	170.7114505	9.6	0.0	0.0	
AG_2	-45.76636876	170.7111891	8.5	0.0	0.0	
AG_3	-45.76643792	170.7111891	8.7	0.0	0.0	
AG_4	-45.76628073	170.7115136	9.5	0.0	0.0	
AG_5	-45.76626816	170.7109908	7.8	0.0	0.0	
AI_1	-45.76482827	170.7050871	7.0	0.0	0.0	
AI_2	-45.764866	170.7048797	7.7	0.0	0.0	
AI_3	-45.76461449	170.7052493	7.4	0.0	0.0	
AI_4	-45.76492888	170.7049519	7.6	0.0	0.0	
AI_5	-45.76482199	170.7050059	8.2	0.0	0.0	
AC_1	-45.76045181	170.7047626	10.7	0.0	0.0	
AC_2	-45.76035749	170.7046544	10.5	0.0	0.0	
AC_3	-45.7604581	170.7047445	11.0	0.0	0.0	
AC_4	-45.76049583	170.7047085	10.7	0.0	0.0	
AC_5	-45.76042666	170.7044832	10.8	0.0	0.0	
HG_1	-45.7417285	170.6972094	18.2	0.0	0.0	shelly
HG_2	-45.74167817	170.6971643	18.0	1.3	1.3	
HG_3	-45.74199898	170.6975338	17.6	0.0	0.0	shelly
HG_4	-45.74182914	170.696957	17.4	0.0	0.0	
HG_5	-45.74193608	170.6973175	17.5	0.0	0.0	shelly
HIS_1	-45.74882359	170.6998773	11.3	1.0	0.0	seam of black
HIS_2	-45.74874183	170.6997331	11.4	2.0	0.0	black surface
HIS_3	-45.74874183	170.6997692	11.2	0.0	0.0	
HIS_4	-45.74874812	170.6997782	11.3	2.0	0.0	streaky
HIS_5	-45.7488173	170.6995348	11.6	0.0	0.0	shelly
HID_1	-45.74338913	170.6937122	20.1	1.0	0.0	black
HID_2	-45.74339542	170.6938744	19.8	1.0	0.0	black
HID_3	-45.74336397	170.6936941	20.0	0.0	0.0	streaky
HID_4	-45.74338284	170.6937572	20.1	2.0	0.0	streaky
HID_5	-45.74329478	170.6937302	20.3	2.7	0.0	streaky
HCS_1	-45.75131421	170.7011572	14.2	0.0	0.0	
HCS_2	-45.75124503	170.7012654	13.9	0.0	0.0	
HCS_3	-45.751201	170.7011662	14.0	0.0	0.0	
HCS_4	-45.75128276	170.7011122	16.8	0.0	0.0	

HCS_5	-45.751201	170.7011122	13.9	0.0	0.0
HCD_1	-45.74872296	170.7079263	17.9	0.0	0.0
HCD_2	-45.74882988	170.7079353	17.2	0.0	0.0
HCD_3	-45.74885504	170.7080074	17.0	0.0	0.0
HCD_4	-45.74864119	170.7080254	17.2	0.0	0.0
HCD_5	-45.74860975	170.7081426	17.2	0.0	0.0
PCD	-45.71609562	170.6612009	20.0	0.0	0.0
PCD	-45.71596975	170.6612821	20.0	0.0	0.0
PCD	-45.7160138	170.661255	19.8	0.0	0.0
PCD	-45.7162026	170.6613361	19.8	0.0	0.0
PCD	-45.71609562	170.6610928	19.4	0.0	0.0
PCM	-45.72457829	170.6432012	16.2	0.0	0.0
PCM	-45.72442728	170.6417771	16.0	0.0	0.0
PCM	-45.72423851	170.6433995	16.1	0.0	0.0
PCM	-45.72427626	170.6427325	15.9	0.0	0.0
PCM	-45.72426997	170.6439584	16.1	0.0	0.0
PCS	-45.73301564	170.6250934	11.8	0.0	0.0
PCS	-45.73309743	170.6249762	11.9	0.0	0.0
PCS	-45.73290869	170.6250663	12.1	0.0	0.0
PCS	-45.73305968	170.6251204	12.3	0.0	0.0
PCS	-45.73293386	170.6250122	12.3	0.0	0.0

Appendix B Infauna taxa and abundance from Aramoana and Purakanui stations.

AG (inside the ground), AI (impact station), AC (control station), Purakanui : PCS (Control Shallow), PCM (Control Mid depth), PCD (Control Deep).
These counts are per sediment core. To determine numbers/m^2, multiply by 56.57.

Phylum	Class	Family	Species	AG_1	AG_2	AG_3	AG_4	AG_5	AI_1	AI_2	AI_3	AI_4	AI_5	AC_1	AC_2	AC_3	AC_4	AC_5	PCS_1	PCS_2	PCS_3	PCS_4	PCS_5	PCM_1	PCM_2	PCM_3	PCM_4	PCM_5	PCD_1	PCD_2	PCD_3	PCD_4	PCD_5
Annelida	Polychaeta	Ampharetidae	Amphicteis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	1	2	6	19	12	3	10	1	3	3	1	1
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	18	25	20	36	11	2	1	5	1	0	12	2	1	0	0
Annelida	Polychaeta	Capitellidae	Notomastus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	2	0	3	0
Annelida	Polychaeta	Cirratulidae	Cirratulid sp.	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	13	23	24	27	23	27	18	21	10	12	7	15	13	8	16
Annelida	Polychaeta	Dorvilleidae	Dorvilleid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Flabelligeridae	Diplocirrus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	3	0	1	0	0	0	0	0	1	4	2	5
Annelida	Polychaeta	Glyceridae	Glyceridae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	4	1	0	0	3	1	0	4	0	1	2	0	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	2	2	4	0	1	2	0	1	0	2
Annelida	Polychaeta	Hesionidae	Hesionida sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Hesionidae	Hesionida sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Lumbrineridae	Lumbrineri sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	10	3	5	1	4	7	0	9	5	17
Annelida	Polychaeta	Magelonidae	Magelona dakini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	5	1	0	2	6	6	5	4
Annelida	Polychaeta	Maldanidae	Asychis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Nephtyidae	Aglaophamus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	18	11	9	17	17	26	19	20	10	29	15	9	11	8	11
Annelida	Polychaeta	Nereididae	Nereididae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Oenonidae	Drilonereid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Annelida	Polychaeta	Onuphidae	Onuphis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Annelida	Polychaeta	Opheliidae	Armandia maculata	0	0	0	0	0	0	1	0	0	0	4	0	3	4	5	10	15	13	14	18	8	4	13	4	11	2	3	1	0	2
Annelida	Polychaeta	Opheliidae	Travisia olens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3	0	1	0	0
Annelida	Polychaeta	Orbiniidae	Scolopos sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Oweniidae	Owenia fusiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	10	1	6	5	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Paraonidae	Aricidea sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocidae	Phyllodoci sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Polynoidae	Lepidastheniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Sabellidae	Euchone sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Annelida	Polychaeta	Sabellidae	Potomilld sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	7	9	9	2	2	7	2	2	7
Annelida	Polychaeta	Sigalionidae	Sigalionid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionidae	Prionospio sp.	9	4	6	3	6	3	0	1	1	2	5	7	8	6	6	1	3	4	2	2	12	7	5	0	1	4	4	3	2	3
Annelida	Polychaeta	Spionidae	Spio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionidae	Spionidae australiensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	3	0	0	0	0
Annelida	Polychaeta	Spionidae	Spionidae bombyx	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	2	2	1	1	0	1	3	2	2	0	5
Annelida	Polychaeta	Syllidae Eusyllinae	Syllidae sp.1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	2	2	1	0	2
Annelida	Polychaeta	Syllidae Exogoninae	Syllidae sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	2	0	2	0
Annelida	Polychaeta	Terebellidae	Terebellid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0	0	0	0	1
Brachiopoda	Rhynchonellata	Notosariidae	Notosaria nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoa			Bryozoan sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Creediidae	Creediidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Tripterygiidae	Tripterygiidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Molgulidae	Molgula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pulla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Styelidae	Cnemidocarpa drygalskii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Asteroidea	Asteriidae	Sclerasterias mollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Chordata	Asteroidea	Asterinidae	Patiriella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Zoantharia	Zoantharian sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	p	p	0	0	0
Crustacea	Amphipoda	Ampeliscidae	Haploops n. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Crustacea	Amphipoda	Aoridae	Meridiolembos sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	6	1	0	0	0	0	0
Crustacea	Amphipoda	Caprellidae	Caprellina longicollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
Crustacea	Amphipoda	Dexaminidae	Syndexamine carinata	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Hyalidae	Hyale sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Gammaropsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Photis phaeocula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	5	0	4	4	0	5	1	0	9	1	0
Crustacea	Amphipoda	Ishyroceridae	Ischyrocerus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	1	2	1	1	0	2	17	1	2	0	0	0
Crustacea	Amphipoda	Liljeborgiidae	Liljeborgia	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	0	0	1	1	0	0	0	1	0	3	0	0	0
Crustacea	Amphipoda	Lysianassidae	Paracentromedon sp	0	2	0	0	1	0	0	2	0	1	0	3	1	0	1	3	1	1	3	6	0	1	0	0	0	0	2	0	0	0	0
Crustacea	Amphipoda	Lysianassidae	Parawaldeckia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	8	4	0	0	0	0	0	1	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Patuki sp	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia paddlefoot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Crustacea	Amphipoda	Phoxocephalidae	Harpinopsis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia slender	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia sp medium	1	0	0	0	0	0	0	1	0	0	1	6	9	5	4	34	53	50	41	58	5	4	7	4	2	1	2	5	5	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia stout P5	0	0	0	3	1	3	3	0	1	0	13	28	18	44	13	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Palabriaphoxus palabria	0	0	0	0	0	0	0	0	0	0	2	1	0	4	2	16	8	7	10	7	6	3	1	3	1	1	5	9	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Protophoxus australis	0	0	0	0	0	0	0	0	0	0	6	6	2	2	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Ringaringa littoralis	1	4	5	3	0	19	6	2	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia hurleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Trichophoxus capillatus	0	1	0	0	0	0	0	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Waitangi rakiura	0	8	2	3	2	5	5	0	3	2	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Platyischnopidae	Otagia neozelanicus	11	19	12	31	6	41	19	14	14	13	20	27	17	23	17	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Crustacea	Amphipoda	Urothoidae	Urothoe elizae	0	0	1	0	2	0	0	0	0	0	2	6	6	5	4	1	2	2	2	2	8	7	17	1	22	4	3	9	7	0	0
Crustacea	Cumacea	Bodotriidae	Cyclaspis sp.	1	1	0	3	1	0	0	0	2	0	1	6	7	4	3	5	2	6	2	7	1	1	0	0	0	1	0	0	0	0	0
Crustacea	Cumacea	Diastylidae	Colurostylis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	2	3	7	3	1	2	3	0	2	0	0	0
Crustacea	Cumacea	Diastylidae	Diastylopsis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5	0
Crustacea	Cumacea	Gynodiastylidae	Gynodiastylis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6	2	7	8	3	4	4	3	1	1	4	2	4	5	0
Crustacea	Decapoda	Alpheidae	Alpheus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Crustacea	Decapoda	Crangonidae	Philocheras sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Crustacea	Decapoda	Ogyrididae	Ogyrides delli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Crustacea	Decapoda	Portunidae	Nectocarcinus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Anthuridae	Anthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Crustacea	Isopoda	Arcturidae	Arcturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Chaetiliidae	Macrochiridothea uncinata	3	0	0	2	0	0	2	0	1	2	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2	0
Crustacea	Isopoda	Cirolanidae	Cirolana sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Demosomatidae	Demosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	4	2	1	5	0
Crustacea	Isopoda	Munnidae	Munna sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	2	0
Crustacea	Isopoda	Paramunnidae	Pleurosignum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Crustacea	Malacostraca	Anthuridae	Anthuridian sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Majidae	Notomithrax sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Paguridae	Pagurus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Porcellanidae	Petrolisthes elongatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Nectocarcinus integrifrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Ovalipes catharus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Crustacea	Maxillopoda	Balanidae	Elminius modestus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Mysidacea	Mysidacea	Mysid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Crustacea	Ostracoda	Cylindroleberididae	Diasterope grisea	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0	1	2	0	0
Crustacea	Ostracoda	Cylindroleberididae	Leurolebris zealandica	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	Cypridinidae	Metavargula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Crustacea	Ostracoda	Cytridinidae	Cypridinodes concentrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	5	9	11	1	7	7	4	8	2	3	7	3	8
Crustacea	Tanaidacea	Tanaidacea	Tanaids	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	21	24	26	22	34	2	1	1	0	1	3	4	12	3	8
Echinodermata	Echinoidea	Echinometridae	Evechinus chloroticus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Cucumariidae	Neocucumella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium armatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium dearmatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopeza cylindrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopsammus maculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	2	4	1	3	4	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Condylocardiidae	Condylocardia crassicosta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Bivalvia	Glycymeridae	Glycymeris modesta	2	0	0	0	0	0	0	1	0	0	33	47	63	22	25	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0
Mollusca	Bivalvia	Hiatellidae	Hiatella arctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Lasaeidae	Arthritica sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	2	0	0	1	1	1	2	1	1
Mollusca	Bivalvia	Lucinidae	Divalucina cumingi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Mollusca	Bivalvia	Mactridae	Cyclomactra ovata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mactridae	Mactra ordinaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	1	1	0	2	0	4	4	1	0	0	0	0
Mollusca	Bivalvia	Mactridae	Scalpomactra scalpellum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Myochamidae	Myodora sp.	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	3	2	6	7	2	7	8	3	3	3	0	5	60	1
Mollusca	Bivalvia	Mytilidae	Modiolus areolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytilidae	Musculus impactus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Bivalvia	Nuculanidae	Nuculana bellula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculidae	Nucula dunedinensis	2	2	2	5	4	5	1	4	3	0	101	119	131	26	77	18	41	40	34	68	45	29	29	42	36	40	53	88	50	0
Mollusca	Bivalvia	Nuculidae	Nucula juv different shape	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Ostreidae	Ostrea chilensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Psammobiidae	Gari sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Mollusca	Bivalvia	Solemyidae	Solemya parkinsonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Dosina mactracea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Dosinia sp. (juv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Tawera spissa	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	4	6	0	5	1	5	5	3	0	3	2	0	0	4	1
Mollusca	Bivalvia		Unidentified bivalve A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Gastropoda	Buccinidae	Austrofusus glans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calliostomatidae	Calliostoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calyptraeidae	Sigapatella novaezelandiae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calyptraeidae	Sigapatella tenuis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Iravadiidae	Nozeba sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Naticidae	Tanea zelandica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0
Mollusca	Gastropoda	Nuceliidae	Cellana radians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Pyramidellidae	Odostomia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	3	0	0	1
Mollusca	Gastropoda	Pyramidellidae	Pyramidellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Gastropoda	Pyramidellidae	Turbonilla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
Mollusca	Gastropoda	Struthiolariidae	Struthiolaria papulosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Trochidae	Antisolarium egenum	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	20	67	36	42	34	63	74	93	19	31	12	14	6	5	3
Mollusca	Gastropoda	Trochidae	Zethalia zelandica	3	1	4	3	6	0	0	0	1	0	81	81	58	62	102	18	36	27	36	40	0	0	0	0	0	4	1	0	0	0
Mollusca	Gastropoda	Turritellidae	Maoricolpus roseus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Turritellidae	Zeacolpus pagoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Turritellidae	Zeacolpus symetricus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Volutidae	Alcithoe sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Eatonilla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Nudibranch?	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Mollusca	Gastropoda		Unidentified gastropod B	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Acanthochitonidae	Notoplax mariae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Parachiton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Rhyssoplax canaliculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Scaphapoda		Scaphapoda sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda			Nematode sp	0	0	0	0	0	0	0	0	0	0	3	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemertea			Nemertean sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified E	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix C Infauna taxa and abundance from the Heyward Point stations.

These counts are per sediment core. To determine numbers/m^2, multiply by 56.57.

a) Heyward Pt disposal ground (HG) and impact sites: HIS (shallow impact station), HID (deep impact station).

Phylum	Class	Family	Species	HG_1	HG_2	HG_3	HG_4	HG_5	HIS_1	HIS_2	HIS_3	HIS_4	HIS_5	HID_1	HID_2	HID_3	HID_4	HID_5
Annelida	Polychaeta	Ampharetidae	Amphicteis sp.	1	0	0	1	1	0	0	0	0	0	1	0	1	0	0
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis	2	0	2	2	3	1	0	0	0	0	23	6	11	2	6
Annelida	Polychaeta	Capitellidae	Notomastus sp.	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Cirratulidae	Cirratulid sp.	4	7	7	23	12	4	0	0	0	0	6	1	5	4	2
Annelida	Polychaeta	Dorvilleidae	Dorvilleid sp.	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Flabelligeridae	Diplocirrus sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Glyceridae	Glyceridae sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.1	0	0	1	1	0	1	0	0	0	0	0	2	1	2	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.2	1	1	1	1	2	0	0	0	0	0	1	0	1	2	0
Annelida	Polychaeta	Hesionidae	Hesionida sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Hesionidae	Hesionida sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Lumbrineridae	Lumbrineri sp.	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0
Annelida	Polychaeta	Magelonidae	Magelona dakini	0	0	0	0	1	0	0	0	0	0	6	1	0	0	0
Annelida	Polychaeta	Maldanidae	Asychis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Nephtyidae	Aglaophamus sp.	2	2	3	5	0	1	4	1	1	0	8	7	4	5	2
Annelida	Polychaeta	Nereididae	Nereididae sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Oenonidae	Drilonereid sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Onuphidae	Onuphis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Opheliidae	Armandia maculata	0	1	1	1	1	3	0	2	1	0	3	0	0	0	0
Annelida	Polychaeta	Opheliidae	Travisia olens	1	2	6	2	1	0	0	0	0	0	11	7	6	6	3
Annelida	Polychaeta	Orbiniidae	Scolopos sp.	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0
Annelida	Polychaeta	Oweniidae	Owenia fusiformis	0	0	0	2	0	0	0	0	1	0	0	1	2	0	0
Annelida	Polychaeta	Paraonidae	Aricidea sp.	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Phyllodocidae	Phyllodoci sp.	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Polynoidae	Lepidastheniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellidae	Euchone sp.	1	2	1	1	1	0	0	0	0	0	3	6	8	11	2
Annelida	Polychaeta	Sabellidae	Potomilld sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Sigalionidae	Sigalionid sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Spionidae	Prionospio sp.	1	2	2	12	1	7	10	16	12	26	10	3	3	7	0
Annelida	Polychaeta	Spionidae	Spio sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Spionidae	Spionidae australiensis	3	2	1	1	3	2	0	1	0	2	2	3	3	3	4
Annelida	Polychaeta	Spionidae	Spionidae bombyx	3	2	1	1	0	1	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Syllidae Eusyllinae	Syllidae sp.1	4	1	2	6	2	2	0	0	0	3	1	0	1	0	0

Annelida	Polychaeta	Syllidae Exogoninae	Syllidae sp.2	0	0	1	0	1	0	0	0	0	0	1	1	3	3	0
Annelida	Polychaeta	Terebellidae	Terebellid sp.	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Brachiopoda	Rhynchonellata	Notosariidae	Notosaria nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoa			Bryozoan sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Creediidae	Creediidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Tripterygiidae	Tripterygiidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Molgulidae	Molgula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pulla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Styelidae	Cnemidocarpa drygalskii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Asteroidea	Asteriidae	Sclerasterias mollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Asteroidea	Asterinidae	Patiriella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Zoantharia	Zoantharian sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 2	0	0	p	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Ampeliscidae	Haploops n. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Aoridae	Meridiolembos sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Caprellidae	Caprellina longicollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Dexaminidae	Syndexamine carinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Hyalidae	Hyale sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Gammaropsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Photis phaeocula	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Ishyroceridae	Ischyrocerus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Liljeborgiidae	Liljeborgia	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Crustacea	Amphipoda	Lysianassidae	Paracentromedon sp	1	0	1	0	1	4	1	1	3	2	0	0	1	0	2
Crustacea	Amphipoda	Lysianassidae	Parawaldeckia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Patuki sp	0	0	1	0	0	1	1	1	1	3	2	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia paddlefoot	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Harpinopsis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia slender	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia sp medium	0	1	0	2	1	0	1	0	0	0	0	0	4	0	2
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia stout P5	0	2	1	3	0	3	14	0	2	12	1	0	3	0	0
Crustacea	Amphipoda	Phoxocephalidae	Palabriaphoxus palabria	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
Crustacea	Amphipoda	Phoxocephalidae	Protophoxus australis	0	3	0	1	1	0	1	1	0	0	0	0	7	1	3
Crustacea	Amphipoda	Phoxocephalidae	Ringaringa littoralis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia hurleyi	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0
Crustacea	Amphipoda	Phoxocephalidae	Trichophoxus capillatus	0	0	0	0	0	2	3	1	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Waitangi rakiura	0	0	0	0	0	3	1	0	3	8	1	0	0	0	0
Crustacea	Amphipoda	Platyischnopidae	Otagia neozelanicus	1	0	3	0	1	9	12	9	5	15	2	1	0	0	0
Crustacea	Amphipoda	Urothoidae	Urothoe elizae	2	1	1	0	1	0	1	1	2	3	0	0	2	1	0
Crustacea	Cumacea	Bodotriidae	Cyclaspis sp.	0	1	0	0	0	0	2	1	1	2	0	0	6	2	0
Crustacea	Cumacea	Diastylidae	Colurostylis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Cumacea	Diastylidae	Diastylopsis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Cumacea	Gynodiastylidae	Gynodiastylis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Decapoda	Alpheidae	Alpheus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Decapoda	Crangonidae	Philocheras sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Decapoda	Ogyrididae	Ogyrides delli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Decapoda	Portunidae	Nectocarcinus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Anthuridae	Anthuridae	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1
Crustacea	Isopoda	Arcturidae	Arcturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Chaetiliidae	Macrochiridothea uncinata	0	0	1	1	1	4	2	3	2	3	0	0	3	0	0
Crustacea	Isopoda	Cirolanidae	Cirolana sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Isopoda	Demosomatidae	Demosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Crustacea	Isopoda	Munnidae	Munna sp	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Isopoda	Paramunnidae	Pleurosignum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Anthuridae	Anthuridian sp	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Majidae	Notomithrax sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Paguridae	Pagurus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Porcellanidae	Petrolisthes elongatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Nectocarcinus integrifrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Ovalipes catharus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Maxillopoda	Balanidae	Elminius modestus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Mysidacea	Mysidacea	Mysid	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Ostracoda	Cylindroleberididae	Diasterope grisea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Crustacea	Ostracoda	Cylindroleberididae	Leurolebris zealandica	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Crustacea	Ostracoda	Cypridinidae	Metavargula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	Cytridinidae	Cypridinodes concentrica	0	0	0	1	0	1	0	0	0	0	0	1	3	0	1
Crustacea	Tanaidacea	Tanaidacea	Tanaids	0	0	1	0	0	0	1	0	0	2	0	0	0	0	0
Echinodermata	Echinoidea	Echinometridae	Evechinus chloroticus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Cucumariidae	Neocucumella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium armatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium dearmatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopeza cylindrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopsammus maculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Condylocardiidae	Condylocardia crassicosta	1	0	0	2	0	0	0	0	0	0	0	0	1	0	0	
Mollusca	Bivalvia	Glycymerididae	Glycymeris modesta	1	0	0	13	4	12	18	10	9	13.5	7	3	0	1	0	
Mollusca	Bivalvia	Hiatellidae	Hiatella arctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Lasaeidae	Arthritica sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
Mollusca	Bivalvia	Lucinidae	Divalucina cumingi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Mactridae	Cyclomactra ovata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Mactridae	Mactra ordinaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Mactridae	Scalpomactra scalpellum	0	0	0	3	0	0	0	0	0	1.5	0	0	0	1	0	
Mollusca	Bivalvia	Myochamidae	Myodora sp.	0	0	0	0	0	0	0	0	0	3	1	4	4	0	1	
Mollusca	Bivalvia	Mytilidae	Modiolus areolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Mytilidae	Musculus impactus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Nuculanidae	Nuculana bellula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Nuculidae	Nucula dunedinensis	1	2	1	4	0	0	14	6	4	13	11	7	14	7	12	
Mollusca	Bivalvia	Nuculidae	Nucula juv different shape	1	1	0	3	2	0	7	2	3	7.5	1	0	0	0	0	
Mollusca	Bivalvia	Ostreidae	Ostrea chilensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Psammobiidae	Gari sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	
Mollusca	Bivalvia	Solemyidae	Solemya parkinsonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Veneridae	Dosina mactracea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Veneridae	Dosinia sp. (juv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Bivalvia	Veneridae	Tawera spissa	4	3	1	1	0	2	0	0	0	1.5	1	2	1	0	0	
Mollusca	Bivalvia		Unidentified bivalve A	0	3	0	2	0	0	2	1	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Buccinidae	Austrofusus glans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Calliostomatidae	Calliostoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Calyptraeidae	Sigapatella novaezelandiae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Calyptraeidae	Sigapatella tenuis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Iravadiidae	Nozeba sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Naticidae	Tanea zelandica	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Nuceliidae	Cellana radians	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
Mollusca	Gastropoda	Pyramidellidae	Odostomia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Pyramidellidae	Pyramidellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Pyramidellidae	Turbonilla sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Struthiolariidae	Struthiolaria papulosa	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Trochidae	Antisolarium egenum	1	0	0	2	0	1	0	2	0	0	2	19	18	7	4	
Mollusca	Gastropoda	Trochidae	Zethalia zelandica	6	0	0	3	0	10	31	26	8	29	3	11	4	3	1	
Mollusca	Gastropoda	Turritellidae	Maoricolpus roseus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mollusca	Gastropoda	Turritellidae	Zeacolpus pagoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Mollusca	Gastropoda	Turritellidae	Zeacolpus symetricus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Volutidae	Alcithoe sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Eatonilla sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Nudibranch?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Unidentified gastropod B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Acanthochitonidae	Notoplax mariae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton juv	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Parachiton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Rhyssoplax canaliculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Scaphapoda		Scaphapoda sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda			Nematode sp	1	0	2	1	0	8	0	0	0	2	0	2	0	0	0
Nemertea			Nemertean sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

b) Control stations: Heyward Point: HCS (Control Shallow), HCD (Control Deep); Purakanui Point: PCS (Control Shallow), PCM (Control Mid depth), PCD (Control Deep).

Phylum	Class	Family	Species	HCS_1	HCS_2	HCS_3	HCS_4	HCS_5	HCD_1	HCD_2	HCD_3	HCD_4	HCD_5	PCS_1	PCS_2	PCS_3	PCS_4	PCS_5	PCM_1	PCM_2	PCM_3	PCM_4	PCM_5	PCD_1	PCD_2	PCD_3	PCD_4	PCD_5
Annelida	Polychaeta	Ampharetidae	Amphicteis sp.	0	0	0	0	0	0	0	0	1	0	5	4	0	1	2	6	19	12	3	10	1	3	3	1	1
Annelida	Polychaeta	Capitellidae	Heteromastus filiformis	0	0	0	1	0	0	0	0	0	0	18	25	20	36	11	2	1	5	1	0	12	2	1	0	0
Annelida	Polychaeta	Capitellidae	Notomastus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	2	0	3	0
Annelida	Polychaeta	Cirratulidae	Cirratulid sp.	0	2	3	1	0	11	16	7	12	16	13	23	24	27	23	27	18	21	10	12	7	15	13	8	16
Annelida	Polychaeta	Dorvilleidae	Dorvilleid sp.	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Flabelligeridae	Diplocirrus sp.	0	0	0	0	0	0	0	0	0	0	1	1	3	3	0	1	0	0	0	0	0	1	4	2	5
Annelida	Polychaeta	Glyceridae	Glyceridae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.1	0	0	0	0	0	0	0	0	0	0	0	2	4	1	0	0	3	1	0	4	0	1	2	0	0
Annelida	Polychaeta	Goniadidae	Goniadida sp.2	0	0	0	0	0	0	1	0	0	0	1	0	1	2	2	2	2	4	0	1	2	0	1	0	2
Annelida	Polychaeta	Hesionidae	Hesionida sp.1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Hesionidae	Hesionida sp.2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Lumbrineridae	Lumbrineri sp.	0	0	0	1	0	0	0	0	1	0	0	0	0	3	0	10	3	5	1	4	7	0	9	5	17
Annelida	Polychaeta	Magelonidae	Magelona dakini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	5	1	0	2	6	6	5	4
Annelida	Polychaeta	Maldanidae	Asychis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Nephtyidae	Aglaophamus sp.	4	2	2	3	2	12	6	12	11	15	18	11	9	17	17	26	19	20	10	29	15	9	11	8	11
Annelida	Polychaeta	Nereididae	Nereididae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Oenonidae	Drilonereid sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Annelida	Polychaeta	Onuphidae	Onuphis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Annelida	Polychaeta	Opheliidae	Armandia maculata	1	0	1	3	3	8	4	6	4	6	10	15	13	14	18	8	4	13	4	11	2	3	1	0	2
Annelida	Polychaeta	Opheliidae	Travisia olens	0	0	0	0	0	0	0	1	1	3	1	0	0	0	0	0	0	0	0	1	3	0	1	0	0
Annelida	Polychaeta	Orbiniidae	Scolopos sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Oweniidae	Owenia fusiformis	2	0	1	5	4	0	0	1	3	1	5	10	1	6	5	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Paraonidae	Aricidea sp.	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocidae	Phyllodoci sp.	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Polynoidae	Lepidastheniella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Sabellidae	Euchone sp.	0	1	0	0	0	1	1	2	0	5	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Annelida	Polychaeta	Sabellidae	Potomilld sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	7	9	9	2	2	7	2	2	7
Annelida	Polychaeta	Sigalionidae	Sigalionid sp.	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionidae	Prionospio sp.	6	13	9	5	9	4	8	3	4	2	1	3	4	2	2	12	7	5	0	1	4	4	3	2	3
Annelida	Polychaeta	Spionidae	Spio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionidae	Spionidae australiensis	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	4	0	0	3	0	0	0	0
Annelida	Polychaeta	Spionidae	Spionidae bombyx	2	3	0	1	1	1	0	2	3	2	1	2	0	4	2	2	1	1	0	1	3	2	2	0	5
Annelida	Polychaeta	Syllidae Eusyllinae	Syllidae sp.1	0	0	2	0	0	0	3	0	2	0	0	0	0	0	0	2	2	1	0	0	2	2	1	0	2
Annelida	Polychaeta	Syllidae Exogoninae	Syllidae sp.2	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	2	0	2	0
Annelida	Polychaeta	Terebellidae	Terebellid sp.	0	0	0	0	0	0	0	0	0	0	3	0	2	1	0	0	0	0	0	0	0	0	0	0	1

Brachiopoda	Rhynchonellata	Notosariidae	Notosaria nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoa			Bryozoan sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Creediidae	Creediidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Tripterygiidae	Tripterygiidaen sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Molgulidae	Molgula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Pyuridae	Pyura pulla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Styelidae	Cnemidocarpa drygalskii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Asteroidea	Asteriidae	Sclerasterias mollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Asteroidea	Asterinidae	Patiriella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Actiniaria	Actiniarian sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Anthozoa	Zoantharia	Zoantharian sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa		hydroid sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	p	p	0	0	0
Crustacea	Amphipoda	Ampeliscidae	Haploops n. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Crustacea	Amphipoda	Aoridae	Meridiolembos sp.	0	1	0	0	0	1	0	0	0	2	0	0	0	0	1	0	2	0	0	6	1	0	0	0	0
Crustacea	Amphipoda	Caprellidae	Caprellina longicollis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
Crustacea	Amphipoda	Dexaminidae	Syndexamine carinata	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Hyalidae	Hyale sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Gammaropsis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0
Crustacea	Amphipoda	Isaeidae	Photis phaeocula	0	0	0	0	0	0	0	0	0	0	0	1	2	0	5	0	4	4	0	5	1	0	9	1	0
Crustacea	Amphipoda	Ishyroceridae	Ischyrocerus sp.	0	0	0	0	0	0	0	0	0	0	1	0	3	1	1	2	1	1	0	2	17	1	2	0	0
Crustacea	Amphipoda	Liljeborgiidae	Liljeborgia	0	0	0	0	0	0	0	3	1	0	1	0	2	0	0	1	1	0	0	0	1	0	3	0	0
Crustacea	Amphipoda	Lysianassidae	Paracentromedon sp	0	2	0	4	3	1	1	2	2	0	3	1	1	3	6	0	1	0	0	0	0	2	0	0	0
Crustacea	Amphipoda	Lysianassidae	Parawaldeckia sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 2	1	0	0	0	0	0	0	0	0	1	0	2	2	8	4	0	0	0	0	0	1	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Oedicerotidae sp 3	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Oedicerotidae	Patuki sp	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia paddlefoot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Crustacea	Amphipoda	Phoxocephalidae	Harpinopsis sp	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia slender	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia sp medium	0	5	1	1	1	0	6	1	4	2	34	53	50	41	58	5	4	7	4	2	1	2	5	5	0
Crustacea	Amphipoda	Phoxocephalidae	Limnoporeia stout P5	11	35	17	17	14	8	14	2	6	8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Palabriaphoxus palabria	0	0	0	0	0	0	0	0	0	0	16	8	7	10	7	6	3	1	3	1	1	5	9	0	0
Crustacea	Amphipoda	Phoxocephalidae	Protophoxus australis	3	4	0	5	2	0	4	1	1	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Ringaringa littoralis	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Torridoharpinia hurleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Amphipoda	Phoxocephalidae	Trichophoxus capillatus	1	1	4	1	0	1	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Crustacea	Amphipoda	Phoxocephalidae	Waitangi rakiura	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Amphipoda	Platyischnopidae	Otagia neozelanicus	13	8	10	5	0	1	5	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Crustacea	Amphipoda	Urothoidae	Urothoe elizae	7	23	9	20	5	7	26	20	10	11	1	2	2	2	2	8	7	17	1	22	4	3	9	7	0
Crustacea	Cumacea	Bodotriidae	Cyclaspis sp.	2	0	0	0	1	0	1	0	1	2	5	2	6	2	7	1	1	0	0	0	1	0	0	0	0
Crustacea	Cumacea	Diastylidae	Colurostylis sp.	0	0	0	1	0	0	0	0	0	0	1	0	0	4	2	3	7	3	1	2	3	0	2	0	0
Crustacea	Cumacea	Diastylidae	Diastylopsis sp	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	5
Crustacea	Cumacea	Gynodiastylidae	Gynodiastylis sp.	0	0	0	0	0	1	1	0	0	1	4	6	2	7	8	3	4	4	3	1	1	4	2	4	5
Crustacea	Decapoda	Alpheidae	Alpheus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Crustacea	Decapoda	Crangonidae	Philocheras sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Crustacea	Decapoda	Ogyrididae	Ogyrides delli	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Decapoda	Portunidae	Nectocarcinus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Anthuridae	Anthuridae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Crustacea	Isopoda	Arcturidae	Arcturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Isopoda	Chaetiliidae	Macrochiridothea uncinata	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2
Crustacea	Isopoda	Cirolanidae	Cirolana sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Isopoda	Demosomatidae	Demosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	4	2	1	5
Crustacea	Isopoda	Munnidae	Munna sp	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	2	0	0	0	2
Crustacea	Isopoda	Paramunnidae	Pleurosignum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Crustacea	Malacostraca	Anthuridae	Anthuridian sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Majidae	Notomithrax sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Paguridae	Pagurus sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Porcellanidae	Petrolisthes elongatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Nectocarcinus integrifrons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Malacostraca	Portunidae	Ovalipes catharus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Crustacea	Maxillopoda	Balanidae	Elminius modestus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Mysidacea	Mysidacea	Mysid	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	Cylindroleberididae	Diasterope grisea	0	0	0	1	0	0	0	1	0	0	4	1	1	0	0	0	0	0	0	0	0	1	2	0	0
Crustacea	Ostracoda	Cylindroleberididae	Leurolebris zealandica	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Ostracoda	Cypridinidae	Metavargula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Crustacea	Ostracoda	Cytridinidae	Cypridinodes concentrica	0	0	0	0	0	0	1	0	1	4	9	9	5	9	11	1	7	7	4	8	2	3	7	3	8
Crustacea	Tanaidacea	Tanaidacea	Tanaids	0	3	1	0	1	0	0	0	0	1	21	24	26	22	34	2	1	1	0	1	3	4	12	3	8
Echinodermata	Echinoidea	Echinometridae	Evechinus chloroticus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Cucumariidae	Neocucumella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium armatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Phyllophoridae	Neothyonidium dearmatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea		Holothuroidian sp 3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopeza cylindrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Echinodermata	Ophiuroidea	Ophiodermatidae	Ophiopsammus maculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 1	0	0	0	0	0	0	0	0	0	1	1	2	0	2	0	2	4	1	3	4	0	0	0	0	0
Echinodermata	Ophiuroidea		Amphiura sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Condylocardiidae	Condylocardia crassicosta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Glycymeridae	Glycymeris modesta	28	11	12	6	6	2	11	6	2	1	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0
Mollusca	Bivalvia	Hiatellidae	Hiatella arctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Lasaeidae	Arthritica sp.	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	2	0	0	1	1	1	2	1	1
Mollusca	Bivalvia	Lucinidae	Divalucina cumingi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Mollusca	Bivalvia	Mactridae	Cyclomactra ovata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mactridae	Mactra ordinaria	0	0	0	0	0	0	1	0	0	0	0	3	2	1	1	0	2	0	4	4	1	0	0	0	0
Mollusca	Bivalvia	Mactridae	Scalpomactra scalpellum	0	0	0	2	0	1	0	1	1	1	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Myochamidae	Myodora sp.	4	9	2	4	0	5	1	7	4	8	0	3	2	6	7	2	7	8	3	3	3	0	5	60	1
Mollusca	Bivalvia	Mytilidae	Modiolus areolatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytilidae	Musculus impactus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Nuculanidae	Nuculana bellula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculidae	Nucula dunedinensis	13	46	30	42	24	10	6	25	21	20	18	41	40	34	68	45	29	29	42	36	40	53	88	50	0
Mollusca	Bivalvia	Nuculidae	Nucula juv different shape	7	11	5	24	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Ostreidae	Ostrea chilensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Psammobiidae	Gari sp.	0	1	0	0	0	2	1	2	1	5	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Mollusca	Bivalvia	Solemyidae	Solemya parkinsonii	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Dosina mactracea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Dosinia sp. (juv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneridae	Tawera spissa	1	3	0	3	0	19	16	12	33	45	4	6	0	5	1	5	5	3	0	3	2	0	0	4	1
Mollusca	Bivalvia		Unidentified bivalve A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Buccinidae	Austrofusus glans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calliostomatidae	Calliostoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calyptraeidae	Sigapatella novaezelandiae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Calyptraeidae	Sigapatella tenuis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Iravadiidae	Nozeba sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Naticidae	Tanea zelandica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0
Mollusca	Gastropoda	Nuceliidae	Cellana radians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Pyramidellidae	Odostomia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	3	0	0	1
Mollusca	Gastropoda	Pyramidellidae	Pyramidellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Gastropoda	Pyramidellidae	Turbonilla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
Mollusca	Gastropoda	Struthiolariidae	Struthiolaria papulosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Trochidae	Antisolarium egenum	4	2	1	8	2	4	39	32	2	6	20	67	36	42	34	63	74	93	19	31	12	14	6	5	3
Mollusca	Gastropoda	Trochidae	Zethalia zelandica	14	18	5	9	4	0	15	16	2	3	18	36	27	36	40	0	0	0	0	0	4	1	0	0	0
Mollusca	Gastropoda	Turritellidae	Maoricolpus roseus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Turritellidae	Zeacolpus pagoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Turritellidae	Zeacolpus symetricus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Mollusca	Gastropoda	Volutidae	Alcithoe sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Eatonilla sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Nudibranch?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda		Unidentified gastropod B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Acanthochitonidae	Notoplax mariae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Chitonidae	chiton juv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Parachiton sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Neoloricata	Rhyssoplax canaliculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Scaphapoda		Scaphapoda sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda			Nematode sp	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemertea			Nemertean sp.	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera			Porifera sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula			Sipunculid sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unidentified		Unidentified E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D SIMPER results for the Heyward Point and Purakanui stations.

		Similarity within sites								Dissimilarity between sites						
		Hdum	HIS	HID	HCS	HCD	PCS	PCM	PCD	HDumXHIS	HDumXHID	HDumXHCS	HDumXHCD	DumXPCS	HDumXPCM	HDumXPCD
Overall mean Similarity/Dissimilarity		50.5	61.8	52.7	67.9	66.1	74.7	68.1	55.8	64.0	57.2	63.4	58.9	72.2	70.3	67.6
Average Number of contributing species		21	13	16	16	19	22	21	22	46	55	44	49	45	53	60
Group	Species															
Amphipoda	*Oedicerotidae sp 2*						1.0							1.2		
Amphipoda	*Otagia neozelanicus*	0.9	6.9		3.0					3.1	0.9	2.2	0.8	0.6	0.7	0.7
Amphipoda	*Palabriaphoxus palabria*						3.1	1.7	0.6		0.6			2.5	1.5	1.2
Amphipoda	*Paracentromedon sp*	0.9	3.0			1.2	1.4			1.1	0.8	1.1	0.6	0.8	0.6	0.6
Amphipoda	*Patuki sp*		2.6							1.2	0.5	0.4	0.5			
Amphipoda	*Photis phaeocula*													0.7	1.1	0.9
Amphipoda	*Protophoxus australis*			0.9	1.9	1.1				0.9	1.2	1.2	0.8	0.6	0.7	0.7
Amphipoda	*Torridoharpinia hurleyi*										0.8					
Amphipoda	*Torridoharpinia paddlefoot*															0.5
Amphipoda	*Trichophoxus capillatus*									1.1		1.2	0.9			
Amphipoda	*Urothoe elizae*	1.8	1.6		5.4	5.4	1.4	2.9	1.7	0.7	0.9	2.8	3.0	0.4	1.9	1.3
Amphipoda	*Waitangi rakiura*		2.0							1.9			0.6			
Annelida	*Aglaophamus sp.*	2.3	1.6	4.2	2.9	5.3	3.8	5.5	4.6	1.1	1.3	0.7	2.2	1.9	2.9	1.9
Annelida	*Amphicteis sp.*						0.9	3.3	1.6	0.8	0.7	0.7	0.6	0.8	2.2	0.7
Annelida	*Aricidea sp.*										0.4			0.4		
Annelida	*Armandia maculata*	1.6			1.4	3.8	3.9	3.2	1.1	0.9	1.0	0.7	1.7	2.3	1.8	0.6
Annelida	*Cirratulid sp.*	6.8		3.2		5.5	4.8	5.0	4.6	3.5	1.7	2.6	1.0	1.3	1.2	0.9
Annelida	*Diplocirrus sp.*								1.3		0.4			0.8		1.2
Annelida	*Dorvilleid sp.*	0.9								1.0	0.9	0.8	0.8	0.4	0.7	0.6
Annelida	*Drilonereid sp.*									0.3	0.3				0.4	
Annelida	*Euchone sp.*	2.8		4.2		1.1				1.5	1.5	1.1	0.6	0.9	1.0	1.0
Annelida	*Goniadida sp.1*			0.7						0.6	0.9	0.4	0.4	0.6	0.8	0.5
Annelida	*Goniadida sp.2*	2.8						0.9		1.5	0.7	1.3	1.0		0.6	0.6
Annelida	*Heteromastus filiformis*	2.3		4.8			4.5	0.9		1.4	2.1	1.3	1.3	2.7	0.7	1.1
Annelida	*Lumbrineri sp.*							2.1	2.2		0.5	0.3	0.3	0.3	1.7	2.3

Annelida	*Magelona dakini*							0.9	2.8	0.3	0.9				1.0	1.9
Bivalvia	*Nucula dunedinensis*	1.7	3.6	6.5	9.3	5.8	6.0	8.0	5.8	2.2	2.7	5.1	3.1	4.1	4.7	5.1
Bivalvia	*Nucula juv different shape*	1.8	2.6		5.4					1.4	1.1	2.6	1.1	0.8	1.0	1.0
Bivalvia	*Scalpomactra scalpellum*					1.1				0.6	0.5	0.5	0.9	0.3	0.5	
Bivalvia	*Tawera spissa*	1.8				7.1	1.0	1.4		1.3	1.1	1.0	4.0	0.8	0.9	0.9
Bivalvia	*Unidentified bivalve A*									1.0	0.8	0.7	0.7	0.5	0.6	0.6
Bryozoa	*Bryozoan sp.*													0.3		
Cnidaria	*hydroid sp 2*															0.4
Crustacea	*Anthuridae*										0.6		0.4			0.4
Crustacea	*Anthuridian sp*									0.4	0.4	0.3	0.3			
Crustacea	*Caprellina longicollis*															0.5
Crustacea	*Colurostylis sp.*							1.9						0.7	1.6	0.5
Crustacea	*Cyclaspis sp.*						1.9			1.1	0.9	0.6	0.7	1.5	0.4	
Crustacea	*Cypridinodes concentrica*			0.7			3.0	2.5	2.6	0.4	0.9		0.8	2.2	1.9	1.9
Crustacea	*Demosomatidae*								2.1							1.7
Crustacea	*Diasterope grisea*										0.4			0.7		0.5
Crustacea	*Diastylopsis sp*															0.7
Crustacea	*Gynodiastylis sp.*						2.1	2.1	2.2				0.6	1.8	1.6	1.8
Crustacea	*Harpinopsis sp*											0.4				
Crustacea	*Ischyrocerus sp.*													0.8	0.9	1.1
Crustacea	*Liljeborgia*										0.5		0.6	0.4	0.4	0.5
Crustacea	*Limnoporeia slender*										0.3					
Crustacea	*Limnoporeia sp medium*	0.8				1.3	7.1	2.5	1.2	0.8	1.0	0.8	1.1	4.9	1.3	1.0
Crustacea	*Limnoporeia stout P5*	0.9	2.7		7.4	3.8				2.1	1.0	4.0	2.0	0.6	0.8	0.8
Crustacea	*Macrochiridothea uncinata*		3.8		2.1					1.4	0.9	0.8	0.6	0.5	0.6	0.6
Crustacea	*Meridiolembos sp.*									0.3	0.3	0.4	0.6		0.8	0.4
Crustacea	*Metavargula*															0.3
Crustacea	*Munna sp*															0.6
Echinodermata	*Amphiura sp 1*							2.0						0.6	1.6	
Gastropoda	*Odostomia sp.*														0.7	0.6
Gastropoda	*Syllidae sp.2*			1.4						0.6	1.0	0.5	0.5	0.4	0.4	0.7
Gastropoda	*Turbonilla sp.*										0.3				0.4	0.4
Gastropoda	*Zethalia zelandica*		9.1	3.3	4.9	1.9	5.6			4.7	1.9	2.6	2.0	3.8	0.8	0.9
Isopoda	*Pleurosignum*															0.3
Mollusca	*Antisolarium egenum*			4.8	2.6	3.9	6.0	8.1	3.3	0.8	3.1	1.5	3.3	4.5	6.2	2.2
Mollusca	*Arthritica sp.*								1.5					0.5	0.6	1.1
Mollusca	*Cellana radians*									0.3						

Mollusca	*chiton juv*										0.3						
Mollusca	*Condylocardia crassicosta*									0.6	0.6	0.5	0.5	0.4	0.4	0.5	
Mollusca	*Eatonilla sp.*										0.3						
Mollusca	*Gari sp.*					2.0					0.6		1.5				
Mollusca	*Glycymeris modesta*	1.0	8.1	0.8	5.5	2.4				3.1	1.6	2.7	1.5	1.0	1.2	1.2	
Mollusca	*Mactra ordinaria*													0.8	1.1		
Mollusca	*Myodora sp.*			1.5	1.9	3.0	1.1	2.4	1.3	0.4	1.5	1.9	2.3	1.3	1.9	2.6	
Nematoda	*Nematode sp*									1.3	0.9	0.7	0.6	0.5	0.6	0.7	
Nemertea	*Nemertean sp.*													0.5			
Polychaeta	*Notomastus sp.*														0.7	0.7	
Polychaeta	*Owenia fusiformis*				1.7		2.0			0.5	0.7	1.5	0.8	1.6		0.4	
Polychaeta	*Phyllodoci sp.*										0.4	0.4	0.3				
Polychaeta	*Potomilld sp.*							2.7	2.4						2.3	1.9	
Polychaeta	*Prionospio sp.*	3.1	7.9	2.4	5.2	3.0	1.4	1.3	2.5	2.9	1.6	1.8	1.0	0.5	1.2	0.7	
Polychaeta	*Scolopos sp.*									0.5	0.3						
Polychaeta	*Spionidae australiensis*	3.3		3.7						1.0	0.5	1.6	0.9	1.1	1.0	1.2	
Polychaeta	*Spionidae bombyx*	1.7			1.2	1.3	0.8		1.3	1.2	1.2	0.8	0.7	0.6	0.6	0.8	
Polychaeta	*Syllidae sp.1*	3.6							1.1	1.6	1.6	1.6	1.2	1.3	0.9	0.7	
Polychaeta	*Syndexamine carinata*													0.3			
Polychaeta	*Terebellid sp.*													0.7			
Polychaeta	*Travisia olens*	3.1		4.9						1.9	1.4	1.7	1.0	1.0	1.2	1.1	
Polyplacophora	*Ringaringa littoralis*											0.7	0.4				
Tanaidacea	*Tanaids*						5.3		2.9	0.7		0.8	0.3	3.8	0.7	2.1	

Appendix E SIMPER results for the Aramoana and Purakanui stations.

		Similarity within stations						Dissimilarity between stations				
		AG	AI	AC	PCS	PCM	PCD	AG x AI	AG x AC	AG x PCS	AG x PCM	AG x PCD
Overall mean Similarity/Dissimilarity (%)		57.7	58.9	78.7	74.7	68.1	55.8	47.0	64.6	84.4	88.2	85.8
Average Number of contributing species		8	5	7	21	21	22	21	20	41	40	49
Group	Species											
Polychaeta	*Aglaophamus sp.*				3.8	5.5	4.6		1.0	3.5	5.0	3.8
Polychaeta	*Amphicteis sp.*				0.9	3.3	1.6			1.3	3.3	1.5
Ophiuroidea	*Amphiura sp 1*					2.0				0.7	1.9	
Gastropoda	*Antisolarium egenum*				6.0	8.1	3.3			5.7	7.9	3.2
Polychaeta	*Armandia maculata*				3.9	3.2	1.1		2.2	3.4	3.1	1.3
Bivalvia	*Arthritica sp.*						1.5			0.5	0.7	1.3
Amphipoda	*Caprellina longicollis*											0.5
Polychaeta	*Cirratulid sp.*				4.8	5.0	4.6	0.7		4.3	4.6	4.1
Cumacea	*Colurostylis sp.*					1.9				0.8	1.9	0.6
Cumacea	*Cyclaspis sp.*	3.1		2.9	1.9			2.5	1.5	1.1	0.8	1.0
Ostracoda	*Cypridinodes concentrica*				3.0	2.5	2.6			2.7	2.5	2.5
Isopoda	*Demosomatidae*						2.1					2.0
Ostracoda	*Diasterope grisea*									0.8		0.5
Cumacea	*Diastylopsis sp*											0.9
Polychaeta	*Diplocirrus sp.*						1.3			1.0		1.7
Polychaeta	*Dorvilleid sp.*									0.6		
Bivalvia	*Glycymeris modesta*							1.2	7.9			0.8
Polychaeta	*Goniadida sp.1*									0.8	1.0	0.7
Polychaeta	*Goniadida sp.2*					0.9				0.9	1.2	0.9
Cumacea	*Gynodiastylis sp.*				2.1	2.1	2.2			2.1	1.9	2.1
Polychaeta	*Heteromastus filiformis*				4.5	0.9				4.0	1.1	1.2
Hydrozoa	*hydroid sp 2*											0.4

Amphipoda	*Ischyrocerus sp.*									0.9	1.0	1.4
Ostracoda	*Leurolebris zealandica*							1.0				
Amphipoda	*Liljeborgia*									0.5		0.6
Amphipoda	*Limnoporeia sp medium*	7.1		3.1		2.5	1.2	1.0	2.7	6.1	2.1	1.5
Amphipoda	*Limnoporeia stout P5*			7.2				2.4	5.7	0.5	0.6	0.7
Polychaeta	*Lumbrineri sp.*					2.1	2.2				2.2	2.9
Isopoda	*Macrochiridothea uncinata*							2.3	1.1	0.6	0.7	0.9
Bivalvia	*Mactra ordinaria*									0.9	1.4	
Polychaeta	*Magelona dakini*					0.9	2.8				1.3	2.5
Amphipoda	*Meridiolembos sp.*										0.8	
Isopoda	*Munna sp*											0.7
Bivalvia	*Myodora sp.*				1.1	2.4	1.3		0.6	1.4	2.1	3.0
Nematoda	*Nematode sp*								1.4			
Nemertea	*Nemertean sp.*									0.5		
Polychaeta	*Notomastus sp.*										0.8	0.8
Bivalvia	*Nucula dunedinensis*	7.8	5.0		6.0	8.0	5.8	2.2	10.3	4.1	5.0	5.8
Gastropoda	*Odostomia sp.*										0.9	0.7
Amphipoda	*Oedicerotidae sp 2*				1.0					1.4		
Amphipoda	*Otagia neozelanicus*	16.3	23.9	7.9				3.5	1.6	3.5	4.3	4.3
Polychaeta	*Owenia fusiformis*				2.0					2.0		
Polyplacophora	*Palabriaphoxus palabria*				3.1	1.7	0.6		1.6	2.9	1.8	1.4
Amphipoda	*Paracentromedon sp*				1.4			1.8	1.0	1.1		0.7
Amphipoda	*Patuki sp*							0.9	0.6			
Amphipoda	*Photis phaeocula*									0.9	1.3	1.1
Polychaeta	*Potomilld sp.*					2.7	2.4				2.7	2.3
Polychaeta	*Prionospio sp.*	11.0	4.0	4.4	1.4	1.3	2.5	3.9		0.8	1.4	0.7
Amphipoda	*Protophoxus australis*			2.8					2.5			
Amphipoda	*Ringaringa littoralis*	4.2	14.3					5.0	1.9	1.3	1.6	1.6
Polychaeta	*Spionidae australiensis*										0.6	
Polychaeta	*Spionidae bombyx*				0.8		1.3	1.3	0.6	0.8	0.8	1.3
Polychaeta	*Syllidae sp.2*											0.9
Polychaeta	*Syllidae sp.1*						1.1	0.7			0.8	1.2
Tanaidacea	*Tanaids*				5.3		2.9	0.8		4.4	0.9	2.4

Bivalvia	*Tawera spissa*				1.0	1.4		1.2		1.4	1.6	1.1
Polychaeta	*Terebellid sp.*									0.8		
Amphipoda	*Torridoharpinia paddlefoot*											0.5
Polychaeta	*Travisia olens*											0.6
Amphipoda	*Trichophoxus capillatus*							1.1	0.7			
Amphipoda	*Urothoe elizae*			3.4	1.4	2.9	1.7	1.5	2.2	0.8	2.8	1.8
Amphipoda	*Waitangi rakiura*	4.6	5.9					2.8	1.7	1.4	1.6	1.7
Gastropoda	*Zethalia zelandica*	7.8			5.6			4.7	9.5	3.4	2.0	1.6

Five measures of community structure are used: Species richness (S, number of species/sample); density (N/m^2, number of individuals/m2), Margalef's richness index (d), evenness (Pielou's J'), diversity index (Shannon's H' (loge)).

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AG
Group 2: AI

Variable	Mean AG	Mean AI	t-value	df	p	Valid N AG	Valid N AI	Std.Dev. AG	Std.Dev. AI	F-ratio Variances	p Variances
S	10.80	8.20	2.50185	8	0.03683	5	5	1.483	1.78	1.45454	0.72539
N/m^2	2376.78	2433.37	-0.08750	8	0.93242	5	5	788.207	1212.40	2.36597	0.42468
d	1.263	0.93	2.71386	8	0.02649	5	5	0.144	0.23	2.54085	0.38845
J'	0.821	0.74	2.58465	8	0.03238	5	5	0.058	0.03	3.67597	0.23529
H'	1.943	1.554	4.30726	8	0.00259	5	5	0.069	0.18	7.53949	0.07585

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AG
Group 2: AC

Variable	Mean AG	Mean AC	t-value	df	p	Valid N AG	Valid N AC	Std.Dev. AG	Std.Dev. AC	F-ratio Variances	p Variances
S	10.80	18.2	-9.716	8	0.00001	5	5	1.483	0.83	3.1428	0.29332
N/m^2	2376.78	16241.3	-10.248	8	0.00000	5	5	788.207	2920.55	13.7293	0.02640
d	1.263	1.78	-6.495	8	0.00018	5	5	0.144	0.10	1.9761	0.52564
J'	0.821	0.66	4.758	8	0.00142	5	5	0.058	0.04	1.4561	0.72462
H'	1.943	1.91	0.473	8	0.64880	5	5	0.069	0.13	3.7330	0.23011

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AG
Group 2: PCS

Variable	Mean AG	Mean PCS	t-value	df	p	Valid N AG	Valid N PCS	Std.Dev. AG	Std.Dev. PCS	F-ratio Variances	p Variances
S	10.80	37.0	-10.935	8	0.00000	5	5	1.483	5.14	12.0454	0.03345
N/m^2	2376.78	18968.9	-10.775	8	0.00000	5	5	788.207	3351.82	18.0835	0.01590
d	1.263	3.66	-10.326	8	0.00000	5	5	0.144	0.49	11.9137	0.03412
J'	0.821	0.79	0.964	8	0.36322	5	5	0.058	0.03	3.8272	0.22192
H'	1.943	2.86	-15.017	8	0.00000	5	5	0.069	0.11	2.8824	0.32970

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AI
Group 2: AC

Variable	Mean AI	Mean AC	t-value	df	p	Valid N AI	Valid N AC	Std.Dev. AI	Std.Dev. AC	F-ratio Variances	p Variances
S	8.200	18.20	-11.322	8	0.00000	5	5	1.789	0.837	4.57142	0.17016
N/m^2	2433.37	16241.3	-9.763	8	0.00001	5	5	1212.40	2920.55	5.80283	0.11694
d	0.933	1.78	-7.492	8	0.00007	5	5	0.230	0.103	5.02118	0.14717
J'	0.745	0.66	3.334	8	0.01031	5	5	0.031	0.049	2.52446	0.39165
H'	1.554	1.91	-3.442	8	0.00879	5	5	0.189	0.133	2.01968	0.51273

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AI
Group 2: PCS

Variable	Mean AI	Mean PCS	t-value	df	p	Valid N AI	Valid N PCS	Std.Dev. AI	Std.Dev. PCS	F-ratio Variances	p Variances
S	8.200	37.00	-11.816	8	0.00000	5	5	1.789	5.148	8.28125	0.06465
N/m^2	2433.37	18968.9	-10.373	8	0.00000	5	5	1212.40	3351.82	7.64313	0.07412
d	0.933	3.66	-11.103	8	0.00000	5	5	0.230	0.498	4.68887	0.16366
J'	0.745	0.79	-2.509	8	0.03642	5	5	0.031	0.030	1.04115	0.96976
H'	1.554	2.86	-13.065	8	0.00000	5	5	0.189	0.117	2.61569	0.37433

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: AC
Group 2: PCS

Variable	Mean AC	Mean PCS	t-value	df	p	Valid N AC	Valid N PCS	Std.Dev. AC	Std.Dev. PCS	F-ratio Variances	p Variances
S	18.20	37.00	-8.060	8	0.00004	5	5	0.837	5.148	37.8571	0.00390
N/m^2	16241.3	18968.9	-1.371	8	0.20732	5	5	2920.55	3351.82	1.31714	0.79598
d	1.78	3.66	-8.267	8	0.00003	5	5	0.103	0.498	23.5437	0.00969
J'	0.66	0.79	-5.235	8	0.00078	5	5	0.049	0.030	2.62835	0.37201
H'	1.91	2.86	-11.905	8	0.00000	5	5	0.133	0.117	1.29510	0.80819

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HIS
Group 2: HCS

Variable	Mean HIS	Mean HCS	t-value	df	p	Valid N HIS	Valid N HCS	Std.Dev. HIS	Std.Dev. HCS	F-ratio Variances	p Variances
S	20.60	23.80	-1.4605	8	0.18225	5	5	2.302	4.324	3.52830	0.24952
N/m^2	5794.81	8284.77	-1.6250	8	0.14280	5	5	2167.33	2653.58	1.49904	0.70444
d	2.275	2.529	-1.2241	8	0.25572	5	5	0.231	0.402	3.04216	0.30665
J'	0.833	0.815	0.6663	8	0.52395	5	5	0.056	0.022	6.21567	0.10459
H'	2.516	2.571	-0.5640	8	0.58815	5	5	0.188	0.112	2.84638	0.33526

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HIS
Group 2: PCM

Variable	Mean HIS	Mean PCM	t-value	df	p	Valid N HIS	Valid N PCM	Std.Dev. HIS	Std.Dev. PCM	F-ratio Variances	p Variances
S	20.60	33.40	-3.6767	8	0.00624	5	5	2.302	7.436	10.4339	0.04321
N/m^2	5794.81	13208.1	-3.9092	8	0.00448	5	5	2167.33	3644.58	2.82779	0.33818
d	2.275	3.41	-3.4359	8	0.00887	5	5	0.231	0.702	9.27495	0.05314
J'	0.833	0.77	2.2754	8	0.05244	5	5	0.056	0.023	5.77805	0.11775
H'	2.516	2.69	-1.4493	8	0.18527	5	5	0.188	0.186	1.02305	0.98290

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HCS
Group 2: PCM

Variable	Mean HCS	Mean PCM	t-value	df	p	Valid N HCS	Valid N PCM	Std.Dev. HCS	Std.Dev. PCM	F-ratio Variances	p Variances
S	23.80	33.40	-2.4954	8	0.03720	5	5	4.324	7.436	2.95721	0.31860
N/m^2	8284.77	13208.1	-2.4419	8	0.04044	5	5	2653.58	3644.58	1.88639	0.55384
d	2.529	3.41	-2.4369	8	0.04075	5	5	0.402	0.702	3.04879	0.30574
J'	0.815	0.77	3.0223	8	0.01650	5	5	0.022	0.023	1.07573	0.94529
H'	2.571	2.69	-1.1992	8	0.26474	5	5	0.112	0.186	2.78223	0.34549

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HG
Group 2: HID

Variable	Mean HG	Mean HID	t-value	df	p	Valid N HG	Valid N HID	Std.Dev. HG	Std.Dev. HID	F-ratio Variances	p Variances
S	27.60	26.80	0.1993	8	0.84694	5	5	4.561	7.727	2.87019	0.33157
N/m^2	3327.49	5262.87	-1.8097	8	0.10794	5	5	1559.25	1813.08	1.35208	0.77714
d	3.294	3.006	0.7293	8	0.48659	5	5	0.41	0.782	3.63834	0.23880
J'	0.904	0.877	1.1521	8	0.28251	5	5	0.045	0.025	3.28364	0.27609
H'	2.985	2.855	1.0748	8	0.31378	5	5	0.125	0.242	3.73593	0.22985

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HG
Group 2: HCD

Variable	Mean HG	Mean HCD	t-value	df	p	Valid N HG	Valid N HCD	Std.Dev. HG	Std.Dev. HCD	F-ratio Variances	p Variances
S	27.60	29.20	-0.5803	8	0.57763	5	5	4.561	4.147	1.20930	0.85832
N/m^2	3327.49	8963.85	-4.8980	8	0.00119	5	5	1559.25	2046.88	1.72326	0.61098
d	3.294	3.104	0.7224	8	0.49060	5	5	0.41	0.421	1.05360	0.96085
J'	0.904	0.813	4.1831	8	0.00306	5	5	0.045	0.017	7.24852	0.08105
H'	2.985	2.737	3.7441	8	0.00567	5	5	0.125	0.080	2.42797	0.41129

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HG
Group 2: PCD

Variable	Mean HG	Mean PCD	t-value	df	p	Valid N HG	Valid N PCD	Std.Dev. HG	Std.Dev. PCD	F-ratio Variances	p Variances
S	27.60	35.40	-1.7218	8	0.12339	5	5	4.561	9.044	3.93269	0.21326
N/m^2	3327.49	10254.1	-5.5443	8	0.00054	5	5	1559.25	2317.91	2.20982	0.46140
d	3.294	3.73	-0.9417	8	0.37388	5	5	0.41	0.943	5.29542	0.13536
J'	0.904	0.79	3.0158	8	0.01666	5	5	0.045	0.070	2.39974	0.41731
H'	2.985	2.80	1.1840	8	0.27038	5	5	0.125	0.320	6.54720	0.09603

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HID
Group 2: HCD

Variable	Mean HID	Mean HCD	t-value	df	p	Valid N HID	Valid N HCD	Std.Dev. HID	Std.Dev. HCD	F-ratio Variances	p Variances
S	26.80	29.20	-0.6119	8	0.55754	5	5	7.727	4.147	3.47093	0.25540
N/m^2	5262.87	8963.85	-3.0264	8	0.01639	5	5	1813.08	2046.88	1.27452	0.81983
d	3.006	3.104	-0.2472	8	0.81097	5	5	0.782	0.421	3.45322	0.25725
J'	0.877	0.813	4.7300	8	0.00148	5	5	0.025	0.017	2.20746	0.46199
H'	2.855	2.737	1.0359	8	0.33052	5	5	0.242	0.080	9.07075	0.05524

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HID
Group 2: PCD

Variable	Mean HID	Mean PCD	t-value	df	p	Valid N HID	Valid N PCD	Std.Dev. HID	Std.Dev. PCD	F-ratio Variances	p Variances
S	26.80	35.40	-1.6166	8	0.14462	5	5	7.727	9.044	1.37018	0.76762
N/m^2	5262.87	10254.1	-3.7925	8	0.00529	5	5	1813.08	2317.91	1.63438	0.64576
d	3.006	3.73	-1.3160	8	0.22460	5	5	0.782	0.943	1.45544	0.72496
J'	0.877	0.79	2.5811	8	0.03255	5	5	0.025	0.070	7.87992	0.07037
H'	2.855	2.80	0.2849	8	0.78293	5	5	0.242	0.320	1.75249	0.60013

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: HCD
Group 2: PCD

Variable	Mean HCD	Mean PCD	t-value	df	p	Valid N HCD	Valid N PCD	Std.Dev. HCD	Std.Dev. PCD	F-ratio Variances	p Variances
S	29.20	35.40	-1.3933	8	0.20100	5	5	4.147	9.044	4.7558	0.16013
N/m^2	8963.85	10254.1	-0.9329	8	0.37812	5	5	2046.88	2317.91	1.2823	0.81538
d	3.104	3.73	-1.3486	8	0.21438	5	5	0.421	0.943	5.0260	0.14695
J'	0.813	0.79	0.6894	8	0.51005	5	5	0.017	0.070	17.3946	0.01709
H'	2.737	2.80	-0.4534	8	0.66230	5	5	0.080	0.320	15.8964	0.02018

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: PCS
Group 2: PCM

Variable	Mean PCS	Mean PCM	t-value	df	p	Valid N PCS	Valid N PCM	Std.Dev. PCS	Std.Dev. PCM	F-ratio Variances	p Variances
S	37.0	33.4	0.89004	8	0.39941	5	5	5.14	7.43	2.08679	0.49370
N/m^2	18968.9	13208.1	2.60154	8	0.03154	5	5	3351.82	3644.58	1.18231	0.87497
d	3.66	3.41	0.64199	8	0.53883	5	5	0.49	0.70	1.98805	0.52207
J'	0.79	0.77	1.24359	8	0.24885	5	5	0.03	0.02	1.67104	0.63108
H'	2.86	2.69	1.71088	8	0.12546	5	5	0.11	0.18	2.52436	0.39167

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: PCS
Group 2: PCD

Variable	Mean PCS	Mean PCD	t-value	df	p	Valid N PCS	Valid N PCD	Std.Dev. PCS	Std.Dev. PCD	F-ratio Variances	p Variances
S	37.0	35.4	0.34378	8	0.73986	5	5	5.14	9.04	3.08679	0.30063
N/m^2	18968.9	10254.1	4.78182	8	0.00138	5	5	3351.82	2317.91	2.09107	0.49252
d	3.66	3.73	-0.14429	8	0.88883	5	5	0.49	0.94	3.58466	0.24394
J'	0.79	0.79	0.05189	8	0.95988	5	5	0.03	0.07	5.46212	0.12885
H'	2.86	2.80	0.34156	8	0.74147	5	5	0.11	0.32	7.45191	0.07736

T-tests; Grouping: Station (Diversity Indices vs 2.sta)
Group 1: PCM
Group 2: PCD

Variable	Mean PCM	Mean PCD	t-value	df	p	Valid N PCM	Valid N PCD	Std.Dev. PCM	Std.Dev. PCD	F-ratio Variances	p Variances
S	33.4	35.4	-0.38194	8	0.71245	5	5	7.43	9.04	1.47920	0.71367
N/m^2	13208.1	10254.1	1.52928	8	0.16472	5	5	3644.58	2317.91	2.47231	0.40209
d	3.41	3.73	-0.60098	8	0.56448	5	5	0.70	0.94	1.80309	0.58200
J'	0.77	0.79	-0.58506	8	0.57462	5	5	0.02	0.07	9.12742	0.05464
H'	2.69	2.80	-0.70250	8	0.50229	5	5	0.18	0.32	2.95199	0.31936

Appendix G Epibenthic species and their abundance per 250 m tow at each station.

Species named in red were also in the infauna. AG, Aramoana ground; AI, Aramoana impact; AC, Aramoana control; HG, Heyward Point ground; HIS, Heyward impact, shallow; HCS, Heyward control, shallow; HID, Heyward impact, deep; HCD, Heyward control deep; PCS, Purakanui control shallow; PCM, Purakanui control mid-depth; PCD, Purakanui control deep.

			Stations										
			AG	AI	AC	HG	HIS	HID	HCS	HCD	PCS	PCM	PCD
Phylum	**Class**	**Species**											
Chlorophyta	Bryopsidophyceae	*Codium* sp.	0	0	0	0	1	0	0	0	1	0	0
Chlorophyta	Ulvophyceae	*Ulva* sp.	0	1	0	0	0	0	2	0	0	0	0
Cnidaria	Hydrozoa	Hydrozoa	0	0	0	0	3	0	2	0	0	1	0
Crustacea	Malacostraca	*Pontophilus australis*	0	0	1	0	3	0	0	0	2	0	0
Crustacea	Malacostraca	*Ogyrides* sp.	0	0	0	0	0	0	0	0	2	0	0
Crustacea	Malacostraca	*Pagurus* sp.	0	0	1	0	0	0	1	0	0	0	0
Crustacea	Malacostraca	*Periclimenes yaldwyni*	0	0	0	0	0	1	0	0	1	1	0
Crustacea	Malacostraca	*Nectocarcinus integrifrons*	0	0	0	0	1	0	0	0	0	0	0
Heterokonta	Phaeophyceae	Filamentous brown alga	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Bivalvia	*Mactra ordinaria*	0	0	0	0	0	0	0	0	23	0	0
Mollusca	Bivalvia	*Scalpomactra scapellum*	0	0	0	0	1	0	0	0	1	0	0
Mollusca	Bivalvia	*Myadora* sp.	0	0	0	0	0	0	0	0	15	0	0
Mollusca	Bivalvia	*Nucula dunedinensis*	0	0	0	0	0	0	0	0	50	0	0
Mollusca	Cephalopoda	*Sepioloidea pacifica*	0	0	0	0	1	0	0	0	0	0	0
Mollusca	Gastropoda	*Tanea zelandica*	0	0	0	0	1	0	0	0	0	0	0
Mollusca	Gastropoda	*Diloma* sp.	1	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	*Zethalia zelandica*	5	0	6	0	2000	0	0	0	182	0	0
Porifera		Filamentous sponge	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Rhodophyceae	*Adamsiella chauvinii*	0	5	1	0	5	1	5	1	0	2	0
Rhodophyta	Rhodophyceae	Branching red algae	0	0	0	0	0	0	0	0	1	1	0
Rhodophyta	Rhodophyceae	Filamentous red algae	0	0	3	0	1	0	2	0	0	0	0