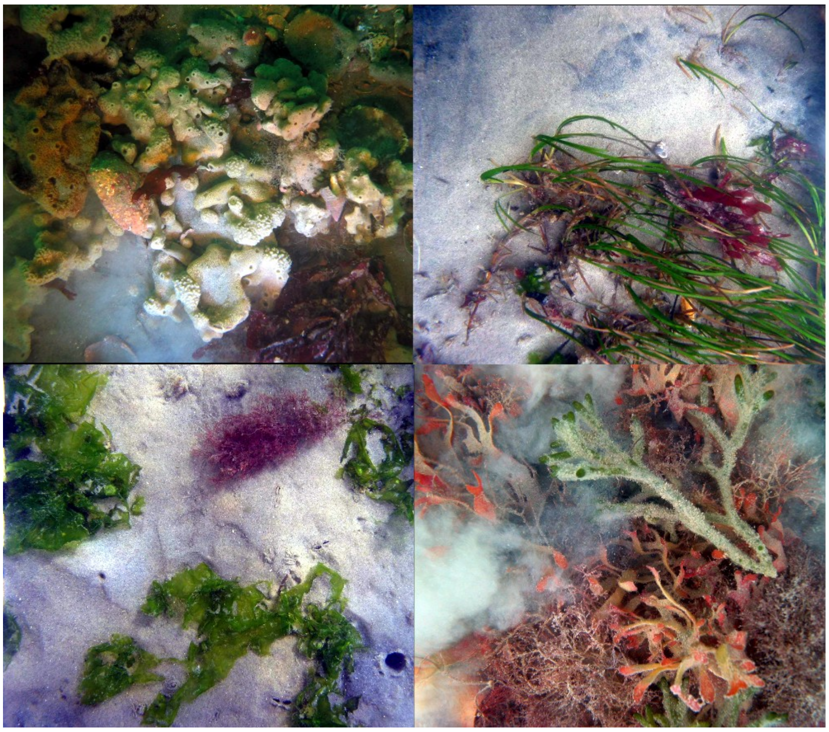
Benthic Habitat Structures and Macrofauna of Lower Otago Harbour



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Lower Otago Harbour

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Executive Summary

Port Otago Limited (POL) is considering a proposal to modify the primary shipping channel in Otago Harbour, Dunedin, New Zealand. These capital dredging works are proposed in addition to the present maintenance dredging programme in order to accommodate larger vessels travelling between the harbour entrance at Taiaroa Heads and Port Chalmers.

POL has commissioned a study to investigate the physical appearance and biological communities present on the seafloor which may be affected by the proposed operations. The report is part of a collection of documents which examine different aspects of the harbour environment and relevant processes. The present study was conducted by Benthic Science Limited in coordination with the University of Otago Department of Marine Science, and the National Institute of Water & Atmospheric Research Ltd. (NIWA). The lower harbour study area included subtidal and low–mid intertidal areas from the constriction formed by the mid-harbour islands and the peninsulas of Port Chalmers and Portobello to the harbour entrance at the Aramoana Spit.

The present study represents the most comprehensive habitat mapping exercise undertaken in the lower harbour to date. The study comprised two principal activities. The first was a photographic survey of benthic (seafloor) features to identify basic physical and biological characteristics. The second exercise collected benthic samples to examine smaller (near microscopic) animals (macrofauna) in an effort to identify distinct biological communities. These data were combined to provide an integrated, spatially-oriented understanding of the harbour within which other studies and anecdotal observations can be used to more effectively inform management decisions.

Photographic Survey

Five photographs of the seafloor (about 300 × 300 mm) were taken at each of 108 sites within the lower harbour. Eight transects of five to eight sites were located across the channel in order to characterise the channel bottom, slopes, and adjacent areas. The remaining sites were placed, according to available information, to include all lower harbour depths in two metre intervals and to include at least one site within every square kilometre.

The Lower Otago Harbour seafloor is a patchwork of different habitat types. The photographs were reviewed and placed into ten categories according to the biological and physical features which dominated each site. These categories were then simplified to six based on the organisms and evidence of dominant forces (such as currents, sediment deposits, etc.) present at each site. These categories are:

- Sandy bottom with some shells present and sparse algal patches
- Sandy bottom free of attached algae and rippled by currents
- Extensive algal mats (bottom often not visible)
- Estuary-like areas with seagrass, ghost-shrimp mounds, and/or lugworm mounds and little algae
- Sandy to muddy areas with extensive mats of animal tubes, sparse algae, and few large shells
- Rocky areas with prominent sessile (attached) animals, such as sponges, hydroids, and tunicates, often mixed in with attached algae.

Algal mats were the most spatially extensive habitat type, forming about 35% of the categorised area. Inlet features (24%) were also common, while tube mats (10%), rippled sand (<6%) and deep sessile areas (about 1%) were less extensive. Additional photographs were taken at 17 sites randomly chosen from the categorised areas in order to assess the predictive value of interpolations between photo sites. Predictions were correct more often than not. The most underestimated category was rippled-sand. Every habitat type was found adjacent to every other habitat type. The habitats were patchy on the scale of 10s to 100s of metres with the possible exception of extensive rippled sandy patches adjacent to Deborah Bay and the estuary-like band on the northern side of the channel from Pulling Point to Aramoana.

Macrofauna Sampling

Lower Harbour areas with soft sediments categorised in the photo survey were divided into grid cells of about 136 × 136 m. Sample sites were randomly located according to the size of each area. A total of 105 benthic grab samples (0.05 m^2 each) were collected throughout the lower harbour. Animals were sieved out of the samples and those retained on a 1 mm mesh were examined. Over 30,000 animals were identified among 156 taxa. Patterns of abundance and diversity of the most numerous mollusc, crustacean, and worm taxa were examined individually and collectively. The distribution of these animals was also examined with respect to habitat classification using both six and ten category schemes. While abundance and diversity values differed throughout the study area no distinct macrofaunal communities were identified. No clear pattern was found relating habitat type to macrofaunal composition despite extensive sampling.

Small Investigations

Two small additional exercises were conducted and reported in this work. Manual sediment cores were collected at low, mid, and high-tide areas on the flats near the Aramoana saltmarsh. Few species were found in low abundance in this very exposed area. It is expected that abundance and diversity will fluctuate considerably according to recent weather conditions. Findings suggested that species assemblages found in studies from the 1960s and 70s are still present.

A brief exercise was conducted specifically focusing on cockles (*Austrovenus stutchburyi).* Cockle abundance estimates using two different methods were compared. Digging large cockles (>1 cm shell width) to a depth of 30 cm produced similar abundance values to photographic methods used in the broader survey.

Conclusions

The lack of distinct macrofaunal communities is probably a realistic reflection of the patchy (metre scale) benthic habitats of the harbour. Samples taken tens of metres apart were often as similar as those taken thousands of metres apart. Furthermore, most sites shared most taxa (35 taxa were present in >25% of samples) very weakly tied to observed benthic structures. With respect to macrofaunal species, the lower harbour appears to consist of one spatially variable, but cohesive community. Dredging operations could be expected to change small portions of the lower harbour channel bottom and margins from one of the existing types to another, but are unlikely to create new habitat types or eliminate any existing type. Once detailed engineering and geological information is available, more reliable biological predictions about proposed operations can be made.

Abstract

Port Otago Limited is proposing to modify the primary shipping channel in the lower portion of Otago Harbour, Dunedin, New Zealand. This report forms one portion of the impact assessment work. The purpose of the enclosed studies was to define spatial patterns of seafloor habitat structure and macrofaunal communities in the lower harbour. A photographic survey of the benthos was conducted to analyse benthic structure and to inform subsequent macrofaunal sampling. The outer harbour benthos is comprised of at least six to ten broad habitat classes dominated by medium sands with a variable overburden of relict shells and extensive sand flats supporting a sheltered inlet seagrass community. Thick algal beds are present in approximately 35% of the study area. Photo surveys indicated that adequate faunal characterisation required soft sediment sampling methodologies for the most extensive and uniform assessment with some core samples from the Aramoana sand flats. Proposed channel modifications intersect areas coincident with each habitat class. Macrofaunal samples were analysed from 105 locations within the harbour. Analyses indicated that macrofaunal distributions did not correspond to benthic structure classes. Furthermore, distinct assemblages of annelids, arthropods, and molluscs were not found. At the current level of taxonomic detail, the macrofaunal data provide evidence that soft sediments of the lower harbour may operate as one spatially variable, but cohesive community. Sub-metre bathymetry in the extensive shallow regions of the lower harbour probably contributes to patchiness of the benthos. The present work represents the most spatially extensive benthic study undertaken in the harbour to date and provides support information for management with the best available data..

Introduction

Port Otago Limited (POL) is the corporate body primarily responsible for commercial shipping operations within Otago Harbour, adjacent to Dunedin, New Zealand. Portions of the principal shipping channel restrict the safe passage of container vessels to specific weather, tide, and load conditions. POL is undertaking several studies of the lower harbour to understand the connectivity of existing harbour communities to inform operational decisions, specifically modifications to the shipping channel. Channel modifications by dredging will be required to safely accommodate the next generation of larger container ships.

The present work contains the principal findings of a series of surveys of benthic habitats in the lower harbour. As it is written for a restricted and informed audience, no attempt has been made to include a comprehensive literature review. Such will be provided separately as an annotated bibliography. This study focused on subtidal habitats with consideration for a few intertidal areas of special interest comprised of the sand flats near the Aramoana Salt Marsh and portions of the central lower harbour sand flat nearest Port Chalmers. Some rocky and sandy intertidal areas may be considered specific habitat types within the study area, mostly along harbour margins.

Anecdotal evidence and prior published works[1,2,3] suggested that the lower harbour benthos is a mosaic of habitats of diverse substratum structures, physico-chemical properties, and water flow conditions supporting distinct macrofaunal communities. Prior studies were restricted to a few sample locations and/or specific taxa. The present work aims to substantially add to our overall understanding of the harbour benthos in a spatially integrative manner. An understanding of community composition and connectivity is an important part of the channel modification planning process. Several benthic environments including muddy sand, seagrass, shell hash mounds, and cobble expanses were known to exist in the lower harbour, but the areal extent and location of such features were largely undocumented prior to the present study. Seabed images were collected to address two issues.

The initial analytical priority was to determine what sampling methods were likely to be effective in subsequent benthic collections. Soft sediments (sand and mud) were expected to dominate the study area. Pragmatic collection and processing considerations indicated that using a small, manually deployed grab (<0.10 m^2) to be the most desirable and widely applicable sampling method. A few habitats were unlikely to be well-sampled by a small grab. The subsurface structure of seagrass beds (*Zostera muelleri*) severely restricts grab penetration. Seagrass often occurs in extensive regions of shallow or intertidal harbour flats. Furthermore, characteristic seagrass fauna, including ghost shrimp (*Callianassa filholi*), lugworms (*Abarenicola affinis*), large bivalves (*e.g. Austrovenus stutchburyi* and *Macomona liliana*), and mantis shrimp (Stomatopoda, commonly *Heterosquilla tricarinata*) often burrow several centimetres beyond grab penetration depths. Dense mats of macroalgae and ephemeral *Ulva* spp. aggregations hinder grab closure and limit faunal collections to species living within the algal mass and the sediment surface (epifauna). If sediment dwelling animal (infaunal) data are most desirable, then carefully placed sediment cores would likely be more informative in such areas. Cobble, relict shell, and boulder communities require different descriptive methodologies. Depending upon sediment particle size and fabric a small naturalist dredge, a heavy grab deployed from a large vessel, or a remote visual survey platform may be more appropriate. Few areas required coring or heavy dredge, so macrofaunal collection efforts focussed on grab samples. Observations were restricted to benthic imagery in areas not amenable to grab sampling.

The secondary objective of the photo survey work was to coarsely classify the seabed according to apparent physical and biological features. Any number of objective measurements can be collected from seabed imagery, but undirected data gathering was judged unlikely to be fruitful and analysis of such data may lead to circular and inappropriate conclusions. As everything cannot be measured, a set of categorical variables was established *a priori*. Inevitably, these variables were consolidated according to expert analysis of the resulting groups among an arbitrary number of levels. The present study attempted to form an overall view using experience-based analysis of images to integrate biotic and abiotic features in an iterative manner. This information was then used to more appropriately allocate finite sampling resources. A second set of seabed photographs was acquired in order to assess the resulting interpolations of habitat structure classification in the first set of images and to extend coverage.

The gross structural map of the benthos produced from the imagery was then used to allocate macrofaunal sampling effort with a benthic grab using a stratified random design. One of the species of interest was the cockle, *Austrovenus stutchburyi.* Because photographic and small grab techniques will necessarily underestimate the abundance of this burrowing species, shallow photographic sites were revisited and excavated to provide a comparison between densities derived from photographic evidence and actual field density. Similarly, areas in the southern flats of the Aramoana salt marsh intertidal area could not be safely sampled by motor vessel, neither photographically nor using a benthic grab. Macrofauna in these areas were assessed using handheld photo quadrats and manually collected cores.

Methods

Photo Survey Locations

Eighty-seven survey sites were chosen for the first benthic imagery survey (Figure 1). Recent (2003) decimetre-resolution bathymetry from regular channel dredging operations was made available by POL, but detailed bathymetric data were not available for the extensive areas beyond the channel. Rough depth values can be estimated from NZ nautical charts interpolated between soundings on a 100 × 100 m grid (data provided by NIWA, Figure 2). Eight transects, designated A-H, were selected to represent the channel's cross-section progressing from the Port's turning basin to the harbour entrance. Within each transect, sites 1 and 5 were selected to represent the flat just beyond the north and south crests of the dredged channel, respectively. Sites 2 and 4 were placed on the channel slopes while site 3 was located at the deepest part of the transect. The southern extent of three transects (B, H, and C) were extended onto the sandflat to provide additional data on cockle beds reported to exist in the area. Thirty-eight discrete sampling points were chosen within the remainder of the harbour based on estimated 2 m isobaths and an arbitrary criterion that no sampling point would be more than 1 km from an adjacent point. Water depths ranged from <0.5 to 19 m.

Thirty-eight additional positions were visited in a second photographic survey. Twenty-one of these positions were added to extend coverage, primarily in channel locations. The remaining 17 positions were located in areas between prior photographic sites where the extent of habitat types were interpolated.

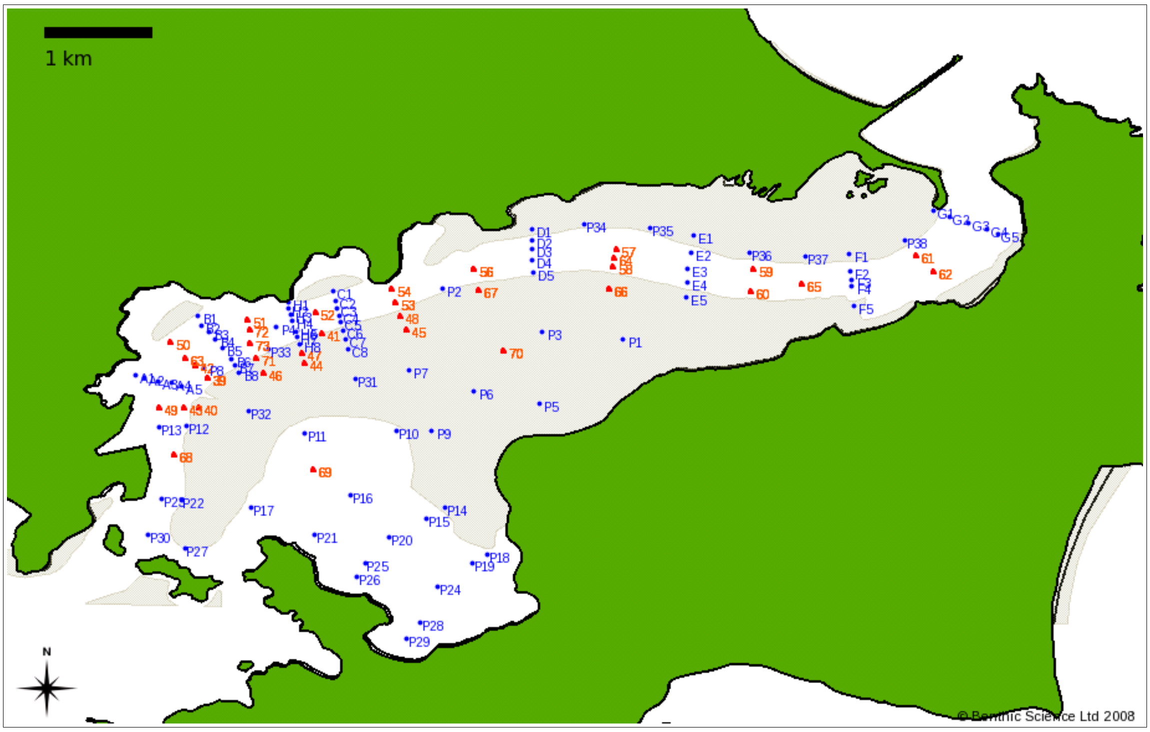

Figure 1. Photographic survey sites in lower Otago Harbour, Dunedin, New Zealand. Blue circles indicate photo sites from the first survey, red triangles identify photo sites from the second survey. Shaded areas represent shallow areas including sandflats exposed at low water. Subsequent figures presented to the same approximate scale.

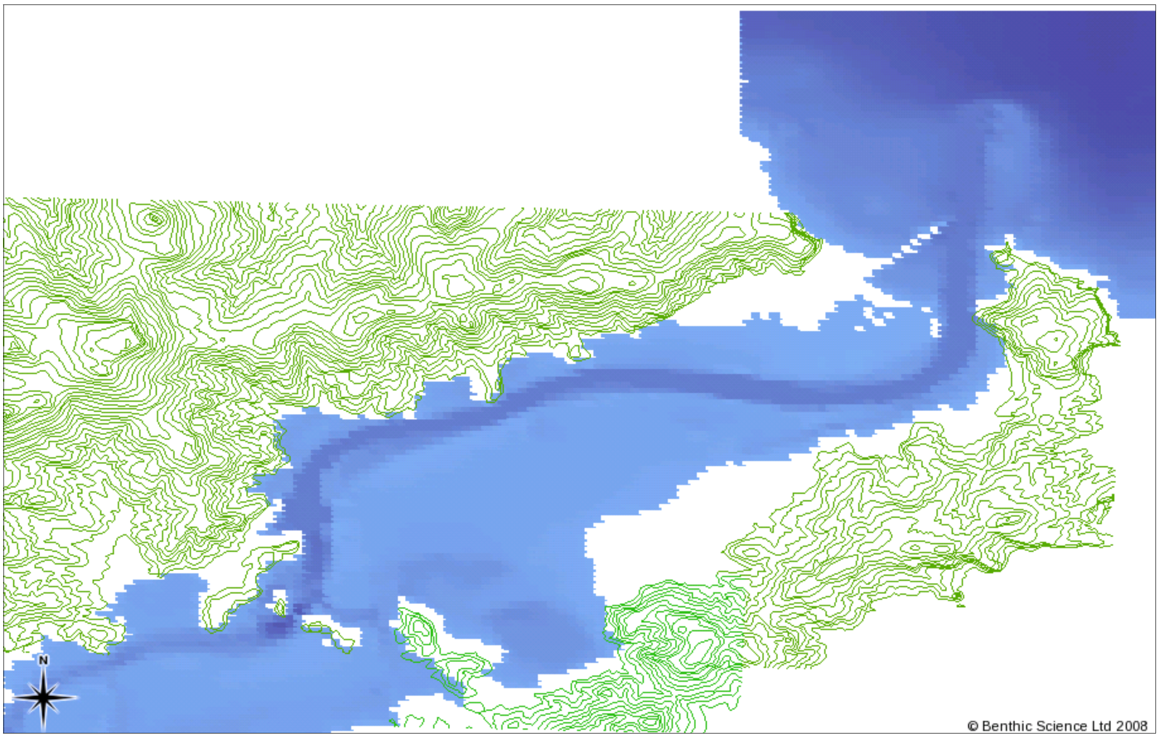

Figure 2. Generalised bathymetric data for the study area (depth in centre of each 100 × 100 m grid cell) presented as a gradient from 0 (white) to 28 m water depths (deepest blue) with respect to chart datum.

Image Acquisition

An underwater camera in a weighted frame was deployed from the University of Otago *R/V Nauplius*, a 6 m motor vessel equipped with a davit and differential GPS/sounder (Garmin 276C). The imaging system utilised a Canon Powershot G2, 4.0 megapixel digital camera which allowed live-video preview on a shipboard computer. A total of 512 images, each covering an unobstructed area of 268 × 240 mm (0.064 m^2), was acquired for the initial photo survey over two days, 6 and 15 March 2008. The second photo survey collected an additional 227 photos on 3 June 2008. A total of 610 images was used in the final analysis.

The same methodology was employed on both surveys. As the vessel approached a site, the camera was manually lowered to just above the seabed as the vessel actively held position with the tether vertical. The camera was then lowered onto the seabed and slack was played out on the tether. After the first photo was taken, the camera was lifted just off the bottom while the vessel was allowed to drift with prevailing conditions. Photos were taken after each approximately 10-20 m of travel. Thus a particular site is represented by a series of 5 photos taken between 60 and 130 m of each other along the current axis. Vessel track points (30 second intervals, Figure 3) roughly indicate the area covered at each station.

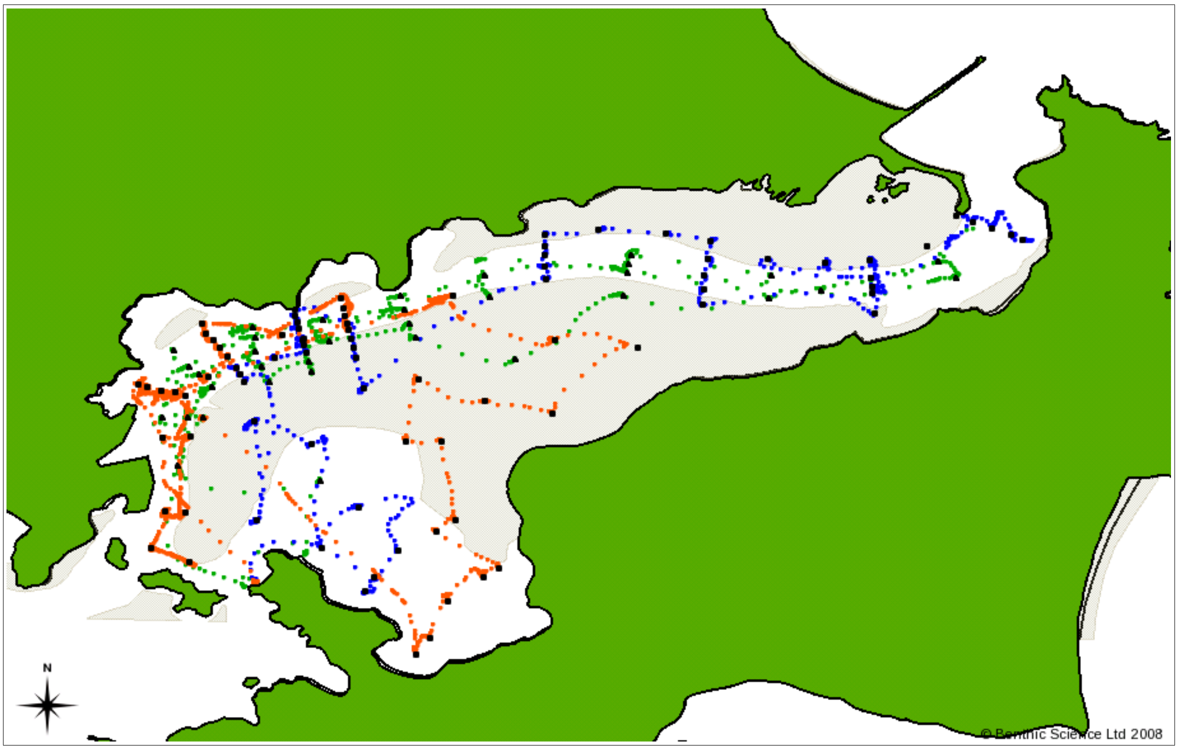

Figure 3. Vessel positions at 30 second intervals on 6 March 2008 (red), 15 March 2008 (blue), and 3 June 2008 (green) in relation to photo survey sites (black circles).

Image Analysis

Although artificial lights were used in the darkest portions of the channel, most images were illuminated by natural light. Marks along the frame skids allowed size reference in the fixed focal plane for each photo in addition to projected laser scales. Images were automatically contrast and colour-corrected in a batch process using Photoshop v6.0 (Adobe, Inc.) using fixed black and white standards on the skids. Another batch process masked the seafloor area of interest from skid obstructions and placed a 10 cm scale and black border on each image. Analyses were therefore conducted using images of the same area and contrast.

Macrofaunal sampling recommendation classifications were based on the dominant physical features of each site. The preferred method of macrofaunal collection was use of a standard Ponar grab (229 × 229 mm) useful for collection of soft sediments with sparse algal and shell overburden. Infaunal communities in dense algal patches, seagrass meadows, or soft sediments with considerable shell overburdens were deemed most suitable to manual core collection by waders or divers. If significant cobbles or large shell hash dominated a site it was classed as an area most suitably described using a small dredge or heavy grab. Some areas contained material fused into a hard-substratum by coralline algae. These reef-like features were dominated by conspicuous sessile epifauna. Infauna in such habitats are notoriously difficult to collect in a quantitative manner. For such areas a dense photographic survey was considered the most appropriate of available methods.

Categorical habitat variables, determined *a priori*, were evaluated for each image (Table 1). The variables were chosen to represent a structural assessment of the physical environment expected to influence fauna through water flow alteration, surface area, and macrofaunal refugia. When visible, substratum type was classified according to primary (>50% of visual field) and secondary (>20%) characteristics[4]. Shell condition was intended to identify whether flow and sedimentation characteristics in shell lag areas permitted encrusting coralline algae growth and retention on the surface over a period of several years or if lags were the product of recent processes like storm events which frequently deposit large numbers of *Zethalia zelandica* shells on nearby shores. Living cockle abundance (a continuous variable) was determined by counting visible siphons. As algae typically formed multi-species aggregations it was not feasible to identify individual taxa from most photos. Instead, the presence of basic algal structures were identified. Blade algal presence was almost entirely due to *Ulva* sp. (*Macrocystis* observations were uncommon) while filamentous and macrothallus alga were represented by several species. The presence of large (>1 cm) burrows, conspicuous sponges and the tunicate *Pyura pachydermatina* were recorded and must be considered to be conservative variables since many were hidden under or within features when viewed from above.

Expert habitat descriptions of each site (a composite of all images collected at that site) were also collated. The first review resulted in 11 distinct apparent habitat types collapsed to 10 after review of classes (Table 1). If a qualitatively different habitat was apparent in two of five photos, then a secondary type was recorded. Images were reviewed for a third time in comparison to the 10 types identified. For the purposes of allocating macrofaunal sampling effort, several of these habitats were then collapsed based on broad biophysical considerations. For example, areas of bioturbated muddy sand covering relict snail (*Maoricolpus* sp.) shells and sparse patches of one algal species was considered to be a single state of a more general condition that included another site with relict snail (*Turbo),* cockle (*Austrovenus),* and *Cominella* shells clearly transported from other areas in the harbour interspersed with sparse drift algae. Therefore a second set of six broader habitat classes were constructed.

Macrofauna were conspicuous in several images including the crabs *Macrophthalmus hirtipes* and *Nectocarcinus antarcticus,* the mantis shrimp *Heterosquilla,* and many unidentified hermit crabs. Small fish, most notably the triplefin (*Tripterygion varium),* were frequently recorded. Several snails were common including *Turbo smaragdus, Micrelenchus tenebrosus, Stiracolpus symmetricus,* and *Maoricolpus roseus.* Less common was the tunicate *Ascidia adspersa*, sponges including *Tethya* sp., and several limpets, chitons, barnacles, and serpulid polychaetes (likely *Galeolaria* sp.) attached to shells. Sea stars including *Ophiomyxa brevirima, Asterina regularis,* and one unidentified species were observed. With the exception of the sea tulip *Pyura pachydermatina*, only qualitative macrofaunal observations were based on the photo survey data. While resolution may be adequate for identifying animals exceeding several centimetres in size, the difficulties of detecting individuals in complex habitats require a per-unit-effort approach deemed inadequate for the small number of images collected in the present study. An example is given in Figure 4a where an asteroid and ophiuroid can be clearly identified in a complex algal habitat, but the sabellid polychaetes are easily overlooked. Even large animals like the portunid crab (Figure 4b) can be overlooked due to repetitious geometry. The subsequent grab samples were analysed to provide quantitative macrofaunal data.

Table 1. Objective and subjective categorical evaluations of benthic images.

Variables evaluated for each image	-Dominant sediment forces - Physical (sand ripples, other indications of high flow rates) or Biological (bioturbation evident or substratum covered by algae). -Substratum Visible? (Y/N) -Primary substratum type (muddy sand, sand, cobble, shell) occupying >50% of the field -Secondary substratum (muddy sand, sand, cobble, shell) occupying >20% of the field -Shell condition (recent or relict) as determined by degree of fracture, wear, and encrusting algae -Living cockle abundance (determined by the number of visible siphons) -Blade algae present. -Filamentous algae present -Macrothallus algae present -Encrusting corraline algae present -Seagrass (*Zostera muelleri)* present -Sponge present -Macrofaunal burrows present (large features evidence of, *e.g., Macrophthalmus hirtipes*, *Macomona liliana, Callianassa filholi*, *Abarenicola affinis*, and Stomatopoda. Numerous small burrows of polychaetes, amphipods, and tanaid shrimp were not considered here) -*Pyura pachydermatina* (Sea tulip) present -Usability, an image was not evaluated if both frame skids were not in firm contact with the seafloor, the image was blurred, too dark, or showed signs of experimental artifact like skid marks, tether destructiong, etc.
superficial benthic structure classes	1 - Relict shell on medium sand with sparse patches of algae (mostly drift) 2 - Relic shell on medium sand with sparse patches of algae present, a silty or floculent layer is present and no sand ripples are present, sediments surface indicates recent bioturbation (includes previous category 4 which differed in degree of bioturbation) 3 - Medium sand with current-formed ripples (only ripples with a wavelength of <240 mm were likely to be detected) 4 - Thick algal mat, usually of several species 5 - Seagrass (*Z. novazelandiae)* on medium sand 6 - *C. filholi* mounds, *A. affinis* fecal casts, stomatopod burrows present, indications of burrowing bivalves (if present) minimal or uncertain. 7 - Cockle beds were indicated if siphons of living animals were observed 8 - Sediment surface dominated by closely packed macrofaunal tubes likely formed by polychaetes, amphipods, and tanaid shrimp. Larger bioturbators can be seen to move 'chunks' of sediment suggesting that the biota are substantially altering sediment fabric. 9 - Typically deeper habitat with cobble-sized stones and mollusc shells fused together by coralline algae, tunicates (including *P. pachydermatina* and other spp.), hydroids, and sponges are evident. Environment shows signs of high water flow (little or no fine sediment, robust sessile invertebrates and algae dominate) 10 - Shell hash, mostly of gastropods including *Maoricolpus* sp., though some sites were dominated by fragmented sub-fossil bivalves.
Reduced set of classes (component categories above)	1 - Sand with shell overburden, sparse algae (consolidating 1, 2, 10) 2 - Rippled medium sand (3) 3 - Algal mats (4) 4 - Estuarine/Inlet features (consolidating 5, 6, 7) 5 - Tube mats (8) 6 - Deep sessile (9)

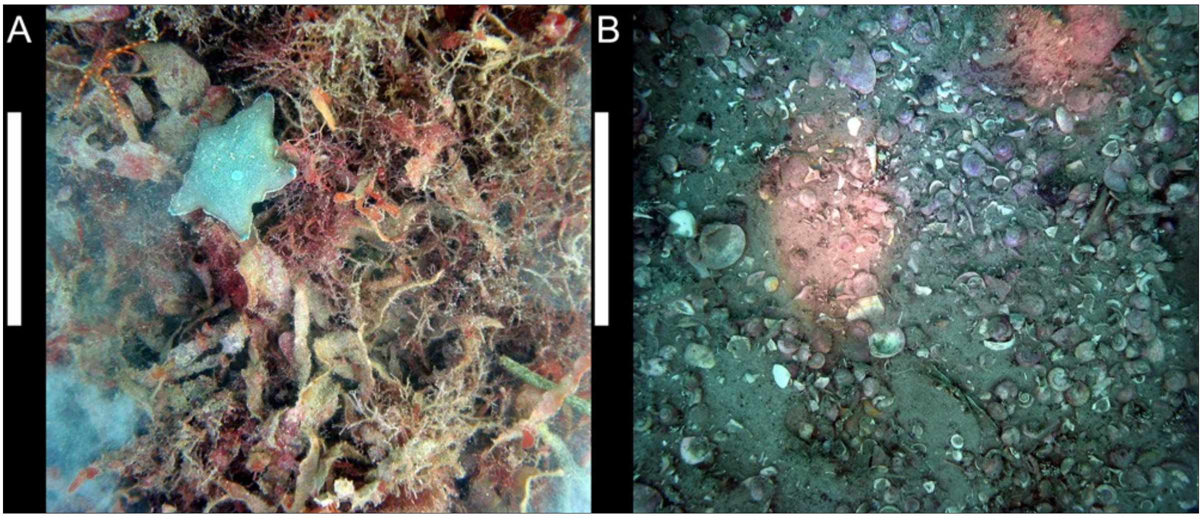

Figure 4. Macrofaunal analyses were not formally analysed in the photo survey due to the complexities of several environments. *Ophiomyxa brevirima* and *Asterina regularis* can be seen in panel A, but small sabellid polychaetes are easily overlooked. Even large animals like the 9 cm portunid crab visible in panel B are easily missed. Scale bars = 10 cm.

Cockle Abundance Validation

Two photographic survey locations (sites C7 and P47) were reoccupied during low tide on 20 July 2008. A 0.25 m^2 quadrat was haphazardly placed at three locations separated by about 15 m within 25 m of the original photo survey point. Sediment was excavated to a depth of 30 cm and collected using a spade. Cockles from each replicate were extracted and enumerated manually. Animals about ≥1 cm maximum shell width were likely to be recorded.

Aramoana Sandflats Sampling

Sediment cores of 125 mm diameter x 150 mm deep (0.01 m^2) were collected on 23 July 2008 from 12 locations on the Southern Flats area of the Aramoana intertidal area (Figure 5). Positions were chosen to occupy approximately the same locations and tidal ranges as sampled in a prior study[6].

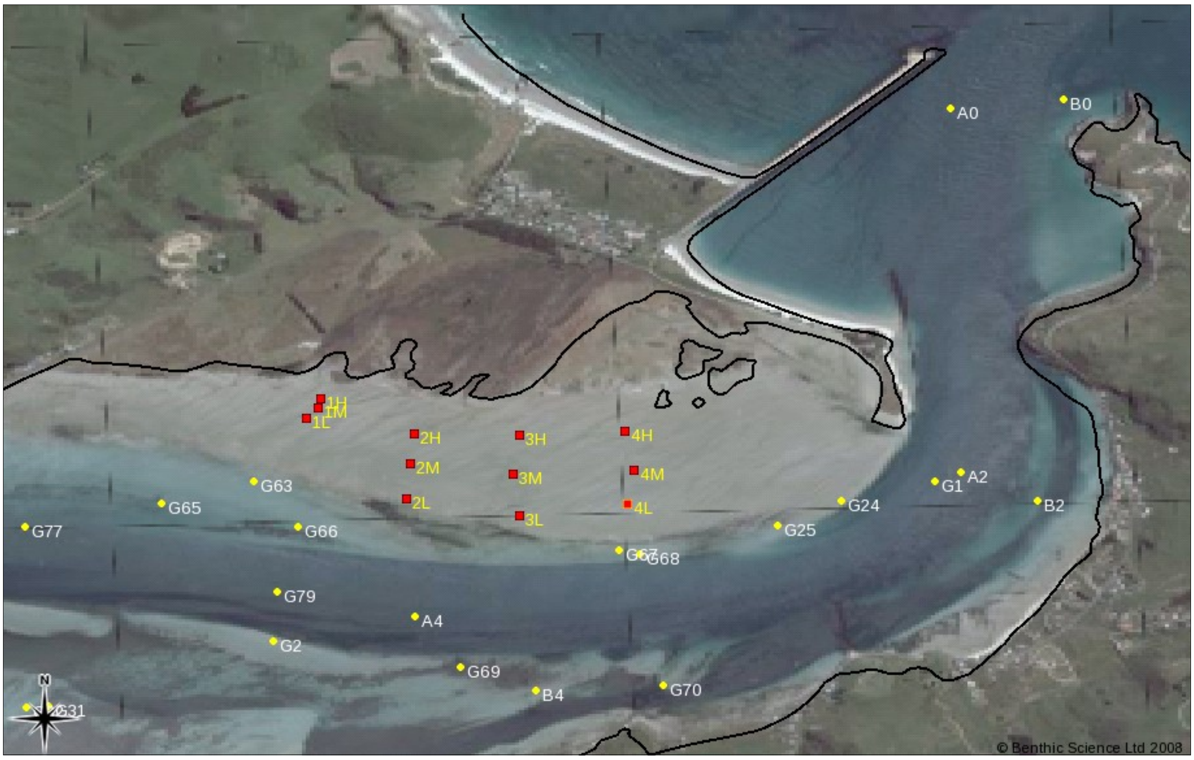

Figure 5. Sediment core sample locations (red squares) in the Southern Flats area of the Aramoana intertidal area. Several macrofaunal grab locations are also visible (yellow diamonds).

Macrofaunal Sample Collection

Macrofaunal sampling effort was allocated using a stratified random approach based upon information from the primary photo survey. The total area of each primary benthic structural class was estimated using a 0.001 degree grid (approximately 136 x 136 m) superposed over GIS layers of the study area. By *a priori* pragmatic reasoning, three samples were to be obtained from the soft-sediment class with the smallest areal extent and a proportional number of samples were to be taken from the other classes. The smallest benthic structure class was type two (clean rippled sand) (of the six habitat types described in Table 1). Three random grid coordinate draws (without replacement) were made from the class 2 pool of grid squares. This process was repeated for other benthic structure classes with a proportional increase in grid squares and sampling sites. Sampling locations form a previous study[2] were also revisited. The 105 resulting macrofaunal sample locations are presented in Figure 6.

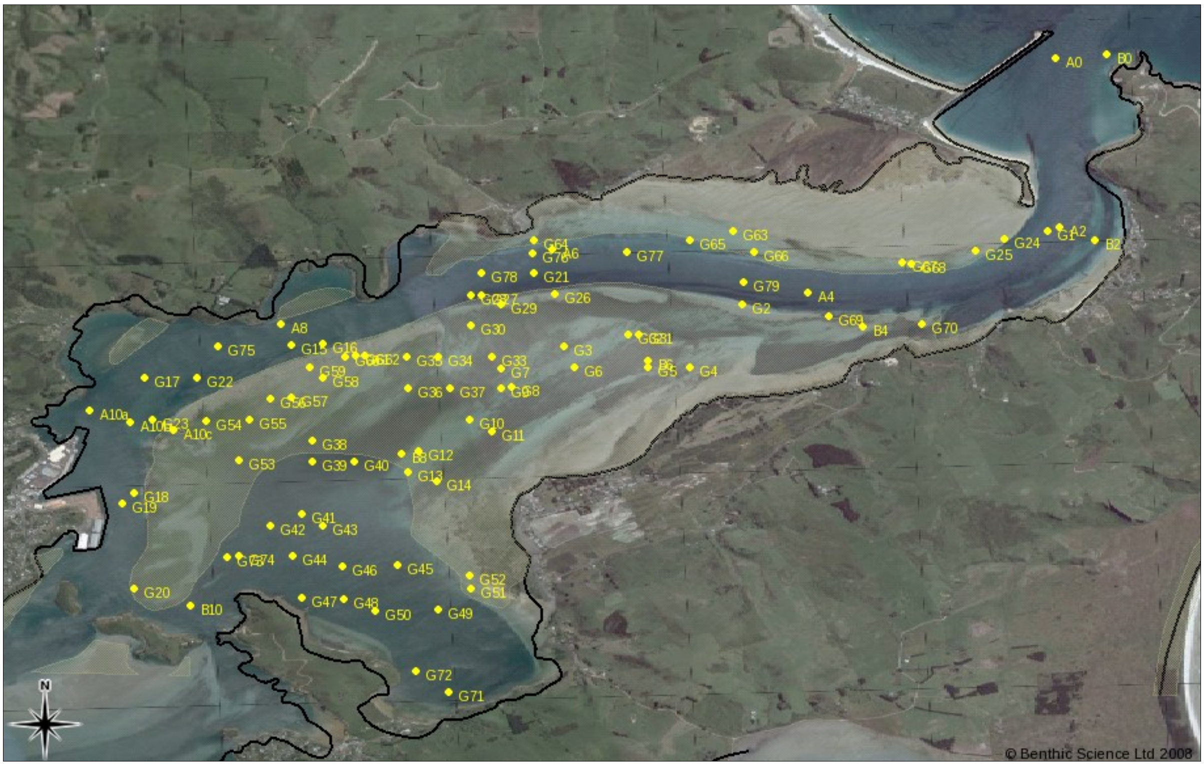

Figure 6. Location of 105 soft-sediment grab samples (yellow diamonds) collected.

Sediments were collected between 5 – 7 June 2008 from the University of Otago *R/V Nauplius* with a standard ponar grab (sampling area of $0.05\ m^2$) weighted with an extra 6 Kg to aid penetration. A sample was rejected and the site resampled if less than 30 mm of sediment (grab centre) was recovered or grab closure was obstructed by debris. A sampling site was abandoned after 5 failed attempts. The contents of each grab were removed to pre-labelled bags. Samples were kept cool until landed within 8 h.

Macrofaunal Processing

Animals were separated from most sediments by a combined elutriation and sieving protocol. This process was intended to provide a standard level of capture efficiency while minimising mechanical stress on the biological material to aid identification and curation. On shore, each sample bag was opened. Buffered formalin was added in sufficient quantity, dependent upon the water content and apparent organic content of the samples, for adequate fixation. The samples were held in a cool, dark location for 3-4 days prior to further processing in the laboratory. After that time samples did not present indications of acidification. Several litres of freshwater were added to each sample bag to dilute the fixative and suspend delicate animals. This supernatent was then poured into a 8.0 x 8.0 mm aperture mesh sieve nested into a pre-wetted 1.0 × 1.0 mm aperture mesh sieve. The process was repeated. If macroalgae was present in the sample it was manually extracted, washed over the sieve, and stored separately. The 1.0 mm sieve residue was gently washed into a small pottle with 70% ethanol with water as a preservative. The remaining content of the sample bags were then washed into a plastic tray. Several litres of freshwater were added and the sediments agitated to suspend non-mineralised organisms before being decanted into the sieves. This process was repeated and animals were again washed into a small pottle. Finally, the entire sample was sieved. If coarse material (*e.g.* shell fragments) was present on the overlying 8.0 mm aperture sieve, they were washed into a separate pottle.

Samples were manually sorted to the lowest readily identifiable taxon by experienced technicians in small aliquots using a stereomicroscope. Taxon counts were entered into a database using the BioTally system (Benthic Science Limited 2007). Samples were curated to the replicate level for subsequent taxonomic analyses and archival purposes. Debris from one of every ten samples was examined by a second, more experienced, technician to ensure that less than 10% of any taxon was overlooked in the original sorting process before the debris from that lot was discarded. Additional data were gathered from samples with macroalgal content. The algal mass was allowed to 'drip dry' in a tray for 1 minute and then weighed to the nearest 10 g. All algal surfaces were examined under a microscope and unattached animals were removed for macrofaunal analysis. Attached epifauna consisting of bryozoans, serpulid polychaetes (*Spirorbis* sp.), hydroids, and sponges were not removed for enumeration but were classed as abundant, common, uncommon, or absent. The values presented in this report represent identifications with varying levels of taxonomic detail as dictated by pragmatic considerations. Biological material (excluding algae) has been stored for further work at a later date if warranted.

Data Analysis

Data from images were stored in a PostgreSQL v8.2 database for possible later analysis with macrofaunal and geochemical data. Geospatial plotting was done using QGIS v10-Io[5] operated within a Mandriva Linux environment. Grid systems of coastline and bathymetric data were converted to WGS84 datum for comparison with data from the present study.

Where animal densities are reported as individuals m^{-2} the values have been extrapolated from the actual sample area under consideration. All faunal data reflect abundances except for colonial animals (bryozoans, hydroids, porifera, etc.) where presence only was recorded.

Statistical analyses were conducted using the Primer 6.1.5 application suite. Abundance data were fourth-root transformed to balance the influence of common and less common taxa. Abundance dendrograms were produced using Bray-Curtis similarity plotting with single linkages. Environmental parameter (image analysis) dendrograms were plotted using Euclidean distances on normalised data to accommodate the different units used. Non-metric multidimensional scaling ordinations (nMDS) were plotted using Primer's MDS routine with two-dimensional reductions after 50 restarts. The relationship between benthic structure classes and macrofaunal abundance and composition was assessed using the ANOSIM routine while SIMPER was used to identify key taxa shaping discrete multivariate groups. For the purposes of this report it is assumed that the reader is familiar with these approaches. Some interpretive comments are provided in the appropriate results sections where specific statistics are presented.

Results

Of the benthic images collected, 610 were used in the final analysis. Due to logistical limitations, the macrofaunal sampling positions were determined using the first collection of images only (398 usable images). One site, G1, was abandoned due to adverse conditions. The initial photo examination assessed the dominant characteristics with respect to subsequent sampling recommendations. Most channel and embayment areas were deemed likely to be adequately sampled with a standard ponar grab which was subsequently used throughout the harbour. A few areas may have been amenable to sampling by a dredge or heavy grab (Day or heavy van Veen grab of ≥ 0.10 m^2), however, shallow depths or restricted manoeuvring space in these areas indicated that deploying such equipment would be problematic at best. Although a diver-operated lift system may have been used, such regions can probably be added to the sites deemed most suitable for analysis using photographic survey techniques. Macrofaunal sampling conducted to date was therefore limited to the dominant soft-sediment subtidal and low intertidal areas via ponar grab throughout the lower harbour. Manual cores were collected only at the Southern Flats area of Aramoana.

Superficial Habitat Classification

Cluster analysis (Figure 7) of objective image parameters (Table 1) produced 8-16 benthic classes depending upon the chosen level of similarity and treatment of outliers. *A priori* assignment of each photo to one of the ten qualitative benthic structure classes was then assessed using ANOSIM. This analysis produced a global R value of 0.37 with a significance of p <0.001 indicating that photo assignments were much more similar within classes than between them. Only images from classes 2 and 8 were regularly misassigned. Collapsing the ten structural classes to six (Table 1) produced a global R value of 0.136 with a significance of p <0.001 indicating a marginally poorer fit with respect to the distribution of observations. Groupings 1x2, 1x5, and 4x5 were occasionally compromised. Examples of superficial habitat types (10 classes) are presented in Figures 8 and 9. Classification data with some notes are listed in Appendix 1.

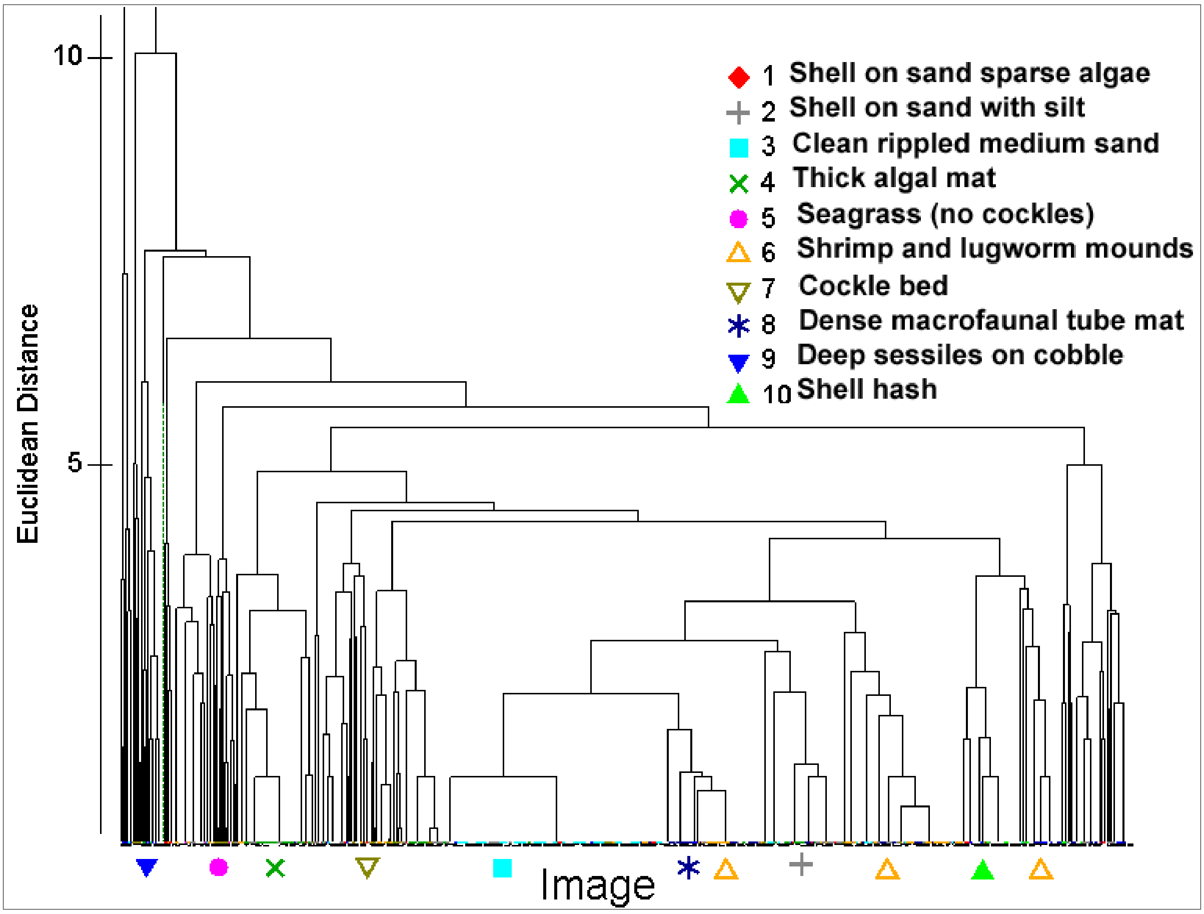

Figure 7. Dendrogram of relationships among individual photos based on Euclidean distance of standardised image analysis parameters (Table 1). Benthic habitat 1 (red diamonds) are present in all clusters.

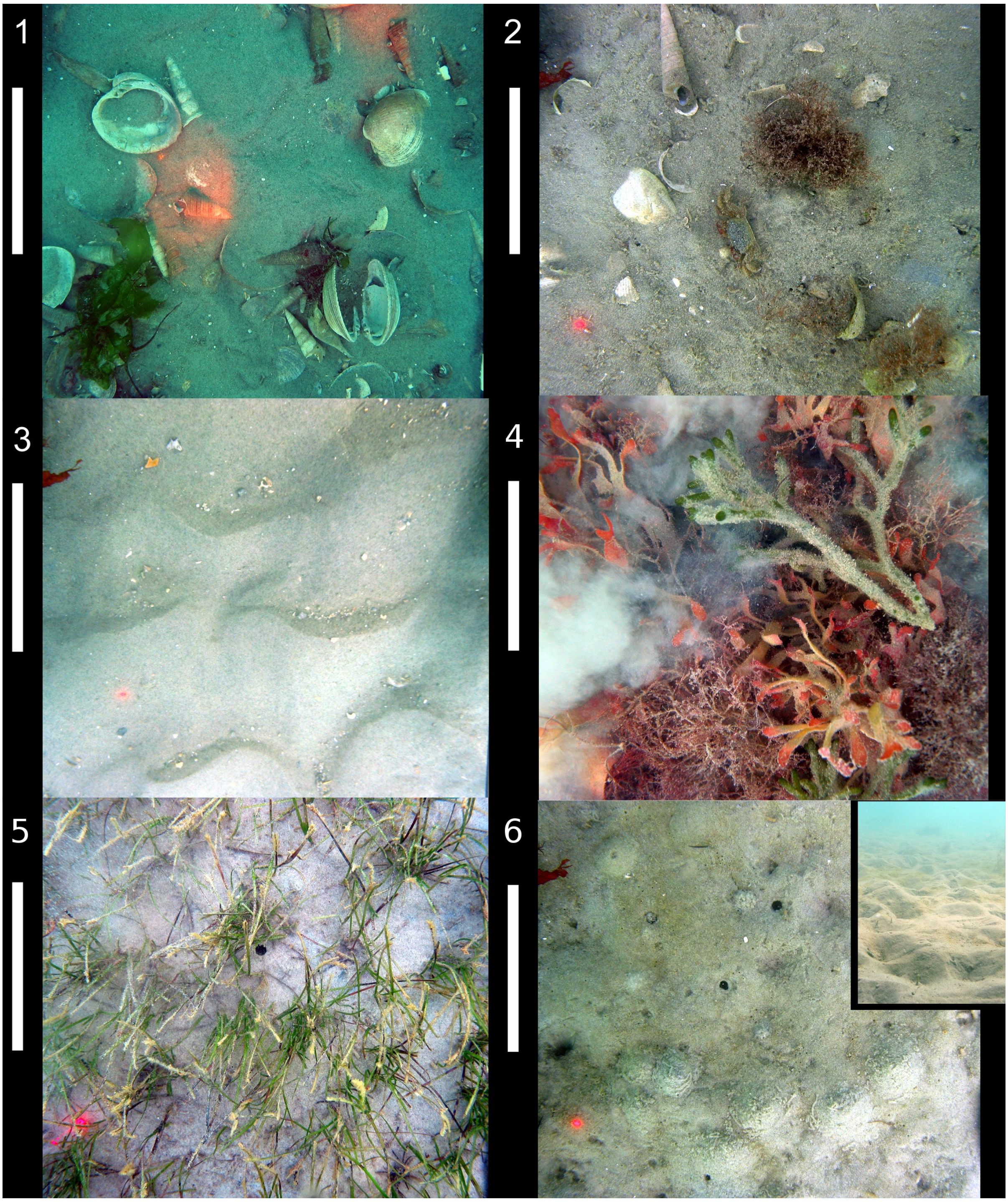

Figure 8. Representative images of habitat types 1-6. See Table 1 for brief descriptions. All scale bars are 10 cm long. The inset image in panel 6 is an oblique view of the habitat showing the vertical relief not apparent in the plan view.

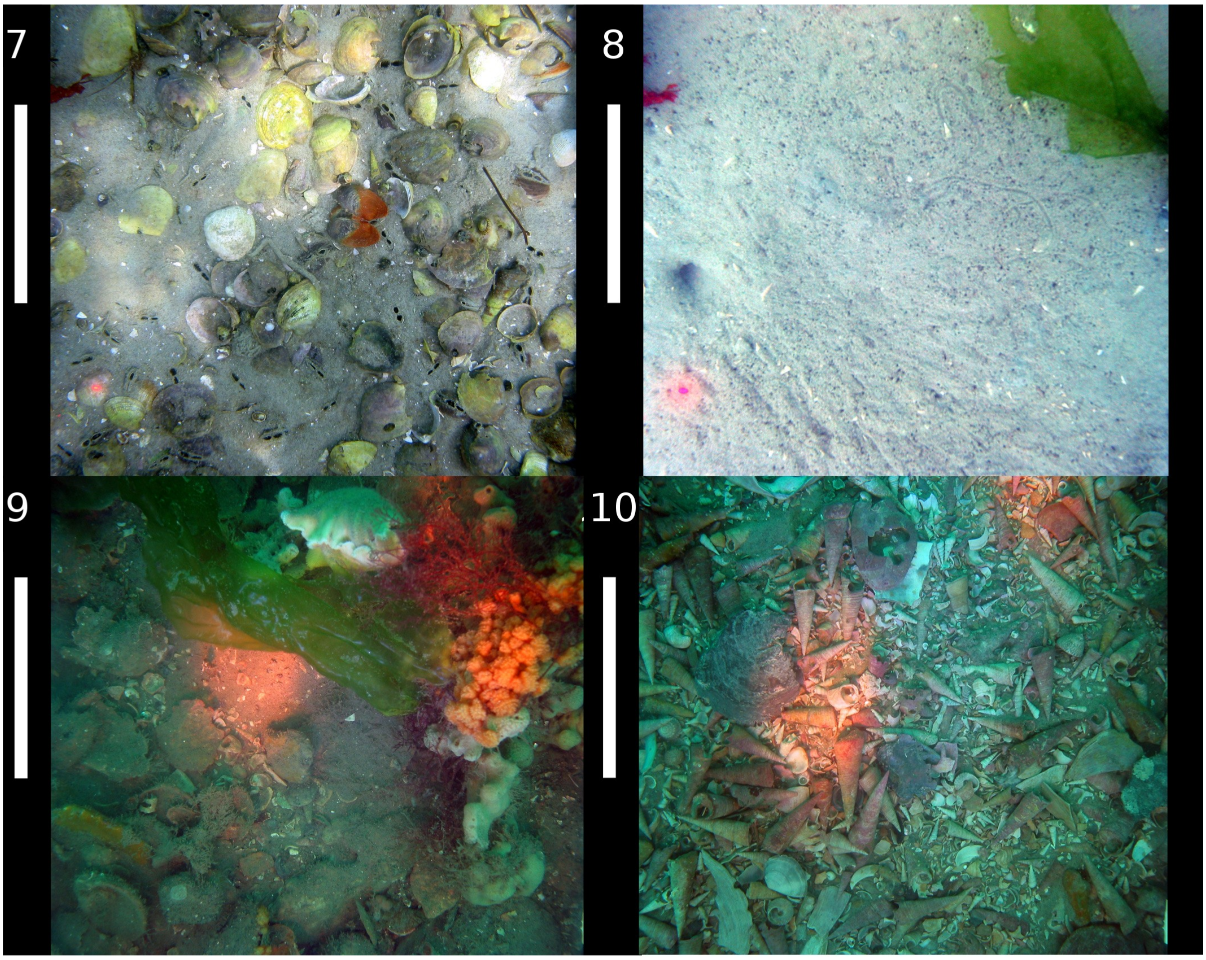

Figure 9. Representative images of habitat types 7-10. See Table 1 for brief descriptions. All scale bars are 10 cm long.

With a few exceptions, large macrofaunal burrows were associated with biologically dominated habitats and water flow features were restricted to channel sites (Figures 10 and 11). The harbour seafloor is predominantly sandy (well sorted medium-sized grains) with seagrass and algal meadows on the sandflats, and occasional shell deposits (each of slightly different character) in the channel from Deborah Bay to the entrance. Muddy sands were only encountered in sheltered areas of Deborah Bay and Portobello Bay (Figure 11). Whether or not a particular site was classified as an algal mat, algae formed a conspicuous and important component of almost all locations in the lower harbour (Figure 12). *Ulva* is an episodically abundant alga in the harbour that was found, often as drifting blades, along the channel. Encrusting coralline 'paint' naturally corresponded to shell and cobble deposits where flow conditions kept hard substrata exposed. Macrothallus algae were mostly restricted to shallow southern portions of the harbour and always contained filamentous epiphytic species. Small individual filamentous algal clumps were a feature of almost every subtidal site except the deepest channel locations. They mostly appeared to be recent growths on bivalve shells and small stones. The tunicate *Pyura pachydermatina* was recorded at few sites restricted to physically dominated channel areas attached to large hard structures or macrothallus algal stipes.

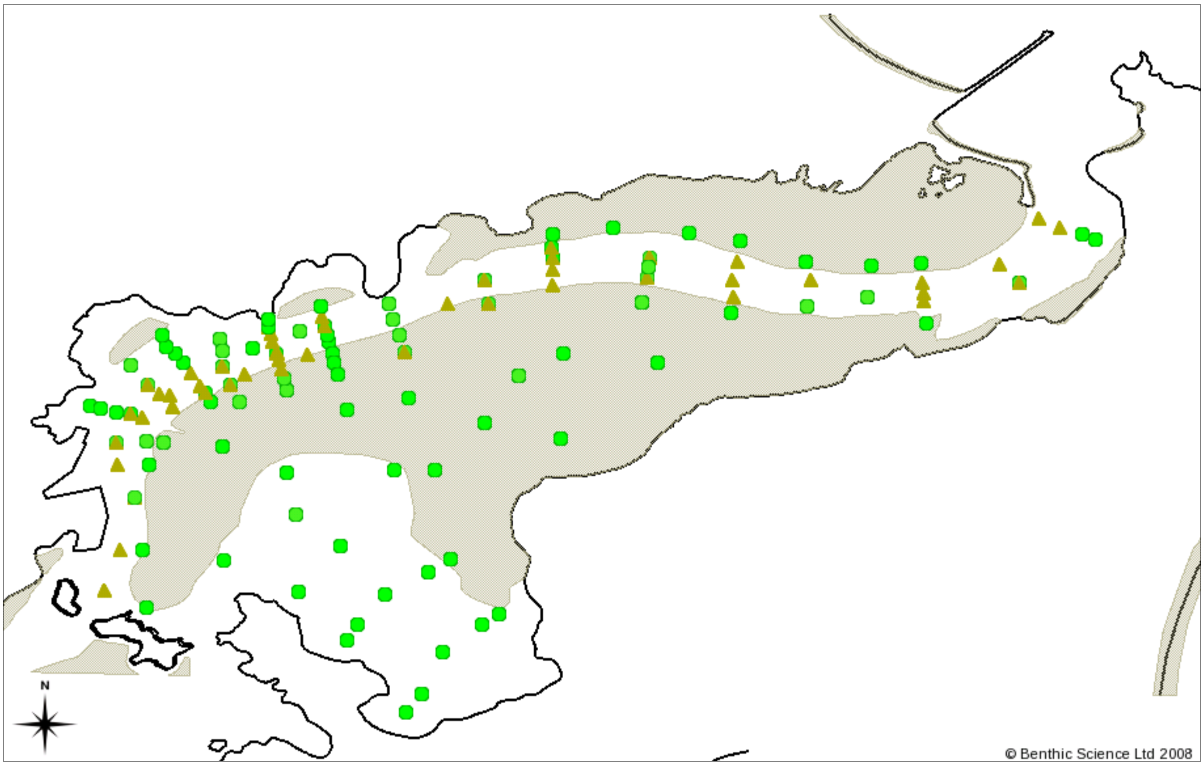

Figure 10. Dominant sediment processes: biological areas (green circles) showed recent bioturbation and no obvious current features whereas physical areas (brown triangles) possessed clear sediment ripples.

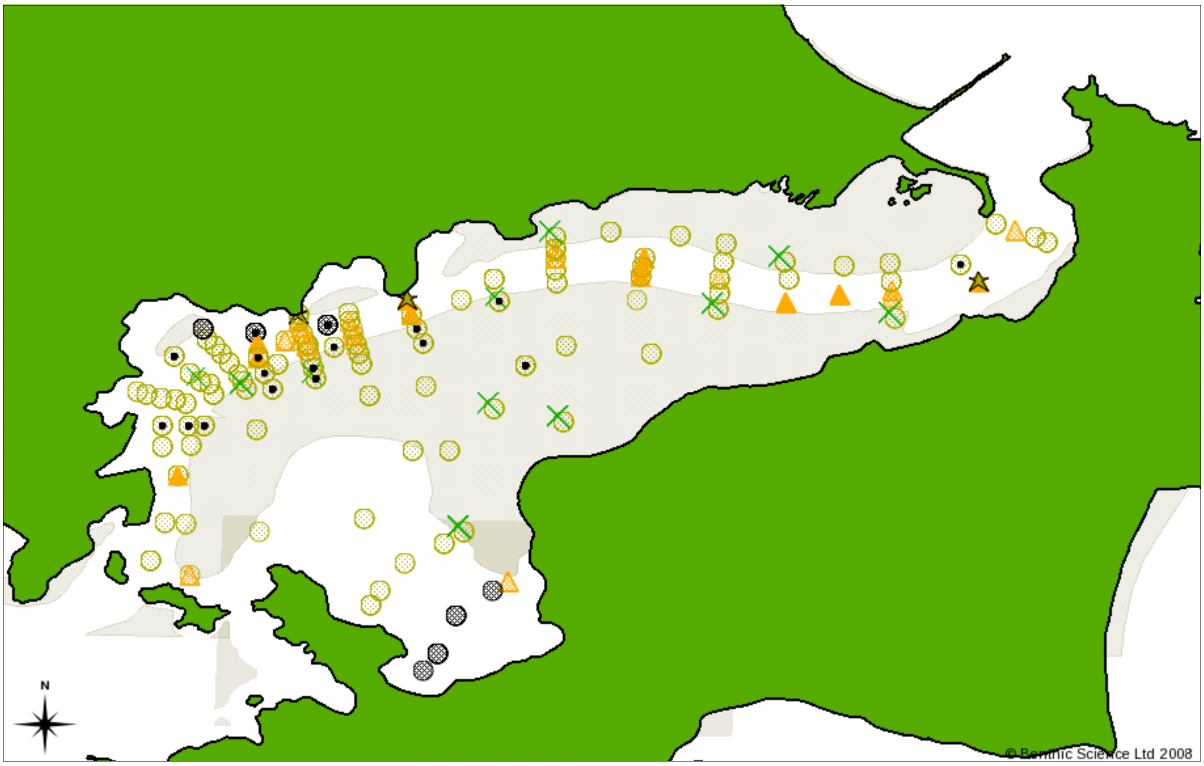

Figure 11. Primary substratum types in the study area including sand (beige circles), cobble-sized formations of fused mollusc shells intermingled with rocks (brown stars), shell deposits of various species (orange triangles), muddy sand (brown squares), and seagrass (green crosses). Macrofaunal burrows are marked with black dots.

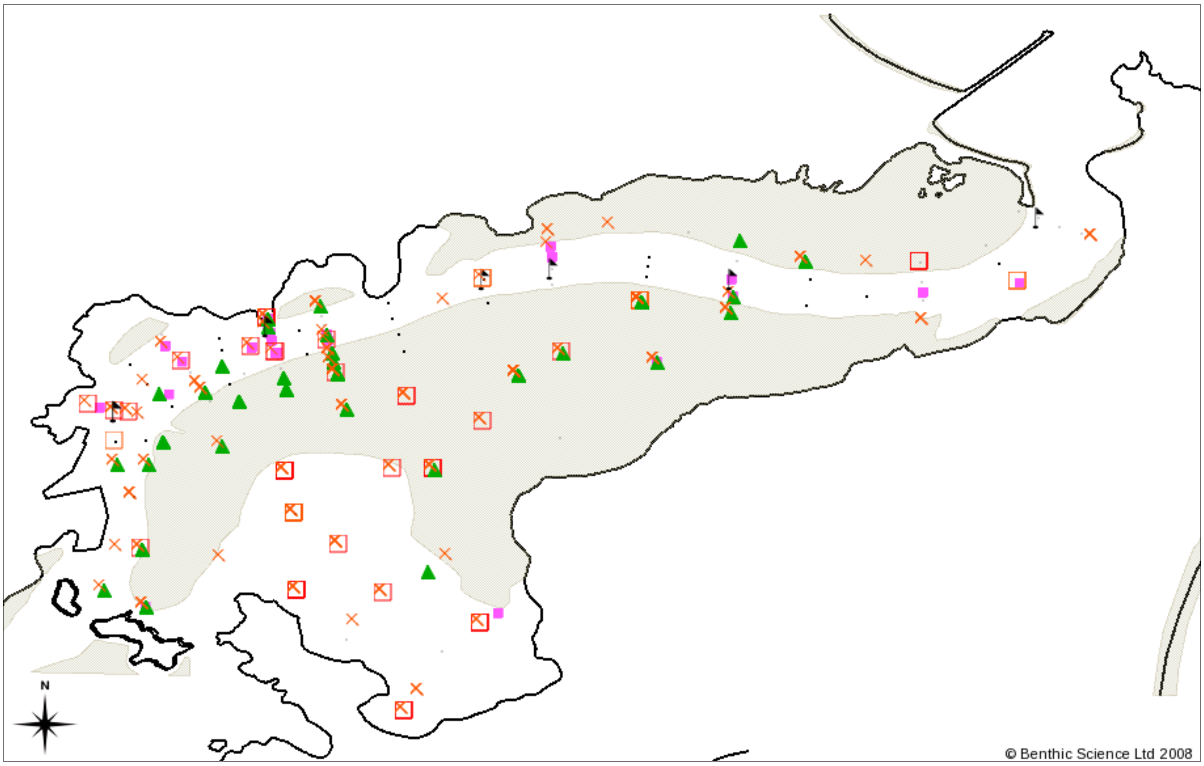

Figure 12. Presence of algal structures in the study area including encrusting coralline algae (pink squares), filamentous browns and reds (red crosses), stout macrothallus algae (red boxes); alga with broad blades (green triangles) were almost entirely represented by *Ulva* sp. The sea tulip *Pyura pachydermatina* (black flags) was also found in the harbour. Samples without any of these structures are marked with small black dots.

Living *Austrovenus stutchburyi* were found at nine sandflat sites in densities ranging from 15 to 625 individuals m^{-2} (Figure 13). The results of the comparison of actual *A. stutchburyi* density with estimates derived from imagery are presented in Table 2. At one site the photo-derived estimate identified a mean of 167 individuals m^{-2} (n=5) while ground-truth values found a mean of 177 individuals m^{-2} (n=3). Imaging methods indicated a mean density of 117 individuals m^{-2} (n=4) at the second site while a density of 240 individuals m^{-2} (n=3) was found by digging. Cockles patches are known to exist in in many other locations throughout the lower harbour.

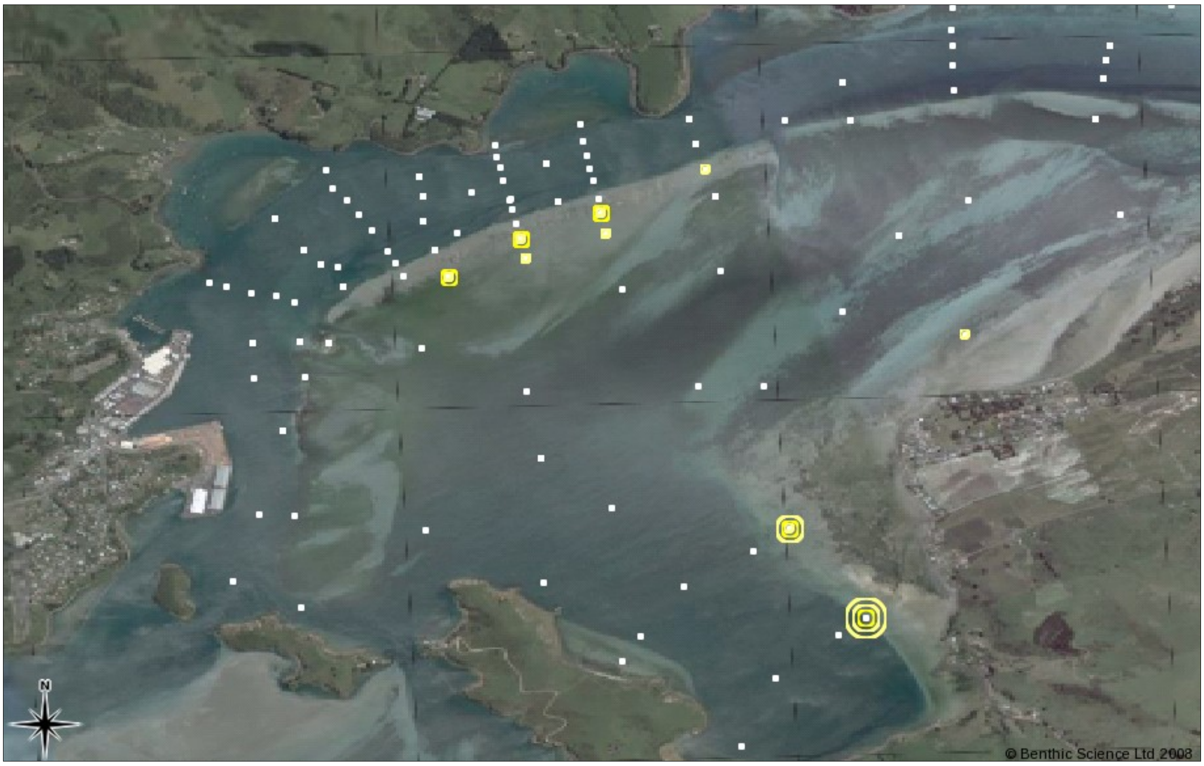

Figure 13. Living cockles (*Austrovenus stutchburyi*) were found during the photo survey at nine sites in densities ranging from 1-40 per frame (15-625 individuals m^{-2}). White dots represent photos with no visible cockles, yellow circles represent values of 1-10, 11-20, 21-30, and 31-40 individuals per frame (0.064 m^2)

Table 2. Extrapolated density of living *Austrovenus stutchburyi* individuals m^{-2} detected in photographic survey (0.064 m^2) compared to ground truth values (actually collected) on site (0.25 m^2).

Site	Replicate 1 Photo density / Actual density (individuals m^{-2})	Replicate 2 Photo density / Actual density (individuals m^{-2})	Replicate 3 Photo density / Actual density (individuals m^{-2})	Replicate 4 Photo density (individuals m^{-2})	Replicate 5 Photo density (individuals m^{-2})	Mean Photo density / mean actual density (individuals m^{-2})
C7	31 / 216	234 / 172	141 / 144	281	156	167 / 177
P47	125 / 268	63 / 240	203 / 212	78		117 / 240

The seagrass (*Zostera muelleri*) and other habitat features typically associated with sheltered environments dominated harbour sandflat margins (Figures 11 and 14). Deep cobble, and clean-swept medium sand habitats were restricted to channels. Medium to fine sands with apparent organic debris and/or floc were an important feature of the harbour showing dense aggregations of bioturbators. Dense algal mats were associated with secondary channels or shallow subtidal areas likely to have moderate water flows. The reduced habitat classification clearly shows the same major features (Figure 15). Macrofaunal-tube dominated areas in Portobello Bay are within or border on deeper waters which likely helped retain the fine material observed in photos (Figures 2, 14, and 15).

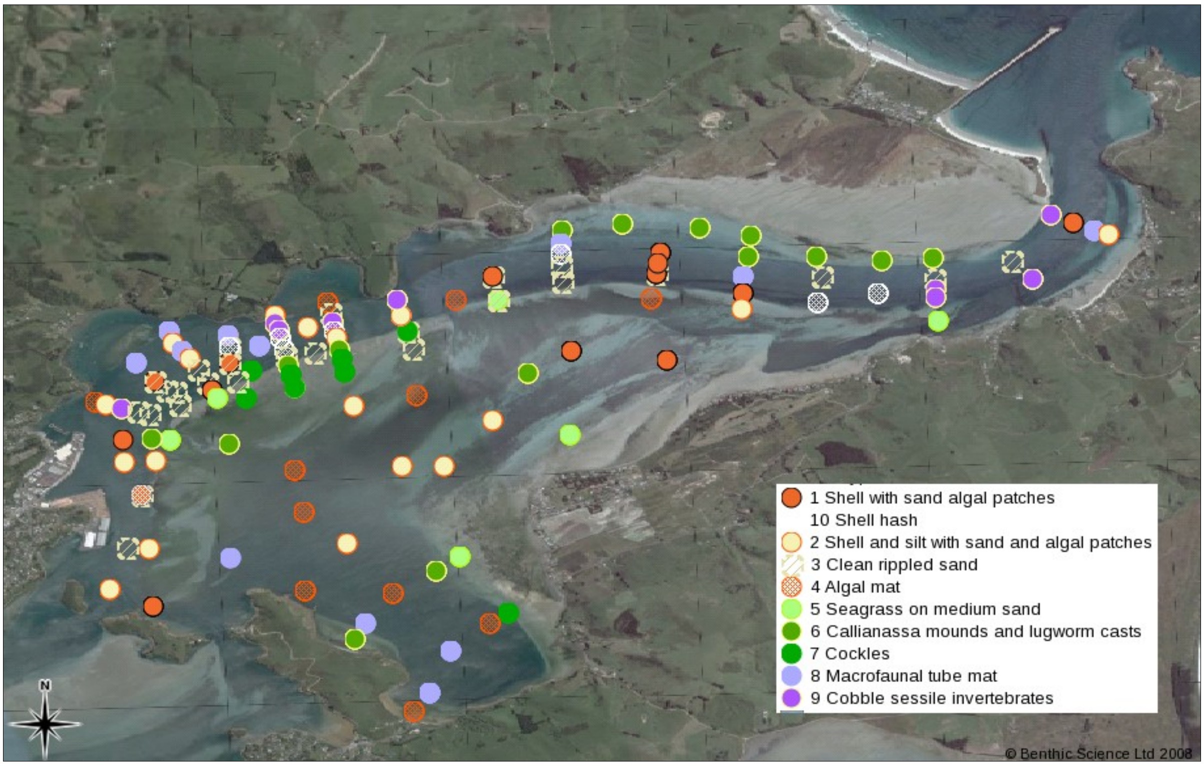

Figure 14 Primary benthic structure classes identified in the study area.

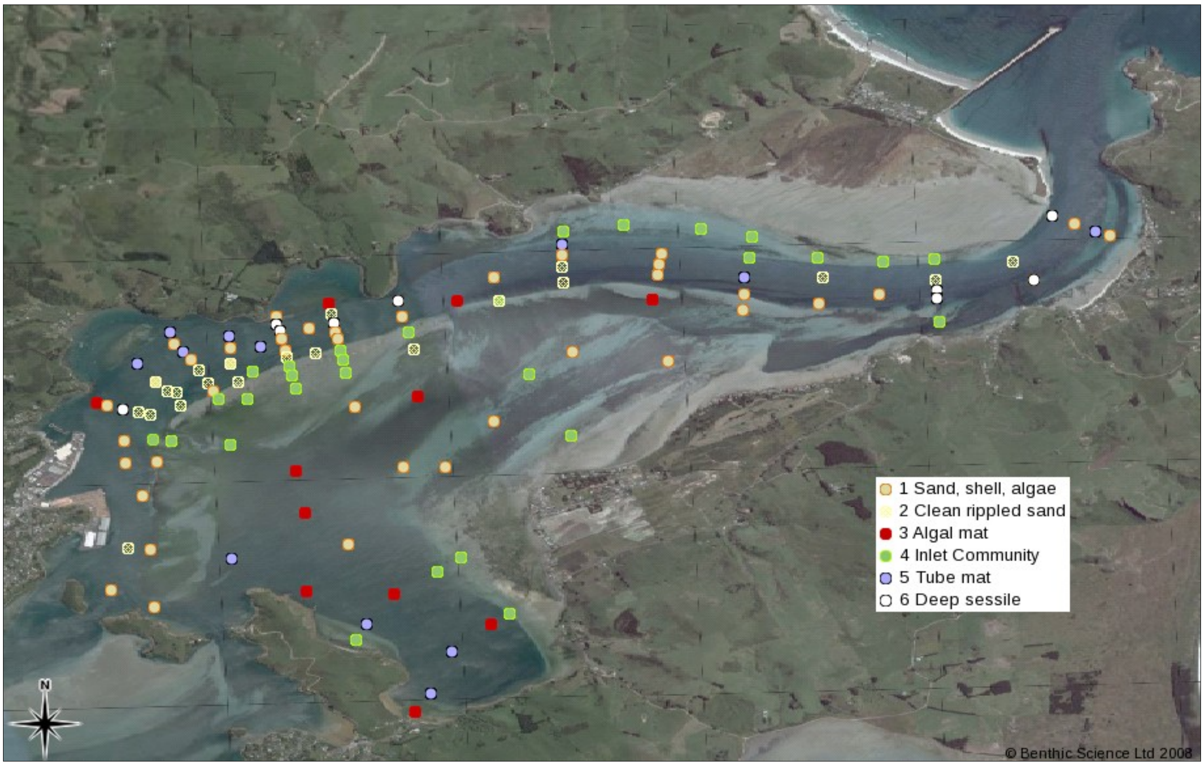

Figure 15 Reduced superficial structure classes identified in the study area (refer to Table 1 for description).

Aramoana Macrofauna

Field observations from the Southern Flats of the Aramoana intertidal area (Figure 4) suggested that shifting, small-scale features through extensive regions of low relief make the plan-view position of any given tide variable to 10s of metres. Sediment cores produced 1,590 specimens among 22 taxa (Table 3). High- and mid-tide samples produced an average of 145 and 153 individuals respectively while low-tide samples produced a mean of 96 individuals. Four to ten taxa were recovered from each core dominated by five taxa representing 97% of all individuals. The small bivalve *Perrierina harrisonae* (1,139 individuals) numerically dominated samples followed by several species among three amphipod families Corophiidae (dominated by *Paracorophium excavatum*), Phoxocephalidae (including *Torridoharpinia hurleyi*), and Haustoridae. There were a few scattered indications of the environmental engineering species *Callianassa filholi* and *Abarenicola affinis*, which were unlikely to be sampled by the present methods (they often burrow >15 cm deep). It is also possible that inclement weather, immediately preceding sampling, removed surface traces of their activity.

Table 3. Macrofaunal specimens (1.0 mm mesh) extracted from manual cores collected in the Southern Flats region of Aramoana. Column numerals indicate shore normal transect and alpha character indicates approximate high (H), mid (M), and low (L) mean tide levels.

TAXON	1H	1M	1L	2H	2M	2L	3H	3M	3L	4H	4M	4L
Perrierina harrisonae	26	36	30	0	304	38	302	133	70	25	44	131
Corophiidae sp.	49	21	21	29	0	0	73	0	0	20	0	0
Phoxocephalidae sp.	13	2	9	6	7	3	28	10	10	7	5	14
Haustoriidae	0	9	1	1	4	8	4	8	8	1	5	5
Syllidae unident.	0	0	2	0	2	5	0	1	7	0	0	0
Mysella unidentata	0	2	3	0	1	2	0	0	0	0	0	1
Capitella sp.	6	0	1	0	0	0	0	0	0	0	0	0
Austrovenus stutchburyi	0	0	0	0	1	3	0	0	1	0	0	0
Aoridae sp.	0	0	0	0	0	1	0	4	0	0	0	0
Macroclymenella stewartensis	0	0	0	0	0	2	0	0	1	0	0	0
Colurostylis lemnurum	0	0	0	0	0	0	0	0	1	0	1	1
Boccardia sp.	0	2	0	1	0	0	0	0	0	0	0	0
Arthritica bifurca	0	0	0	3	0	0	0	0	0	0	0	0
Prionospio sp.	0	0	0	0	0	0	0	2	1	0	0	0
Amphipoda	0	0	0	1	1	0	0	0	0	0	0	0
Nucula hartvigiana	1	0	0	0	0	1	0	0	0	0	0	0
Bivalvia (juv)	0	0	0	0	2	0	0	0	0	0	0	0
Prionospio nr. *aucklandica*	0	0	0	0	1	0	0	1	0	0	0	0
Gastropoda Unidet	0	0	0	0	1	0	0	0	0	0	0	0
Arthropoda_Dan1	1	0	0	0	0	0	0	0	0	0	0	0
Paphies australis	0	0	0	0	0	0	0	0	0	0	0	1
Orbinia sp.	0	0	0	0	0	0	0	0	1	0	0	0

Lower Harbour Macrofauna

A total of 31,434 individuals among 156 taxa (Appendix 2) were recovered from the 105 soft-sediment grab samples (Figure 16) examined. Fourteen taxa (624 individuals) were excluded from further analyses because they were chance captures of organisms the study was not intended to sample or couldn't be reliably quantified. For example, oysters were not included because they colonise large, stable rock surfaces. Any specimens obtained with a soft-sediment grab thus represent an unlikely capture event as the grab scraped a rock or collected a recently transported animal from elsewhere. Exclusions comprised tunicates, oysters, several fish species, sponges, ostracods (seed shrimp), and damaged animals that could not be identified reliably.

Taxon richness and abundance varied directly with each other at most sites (i.e. more taxa were found when more animals were found), but there were exceptions as identified by the Pielou's evenness values (J) overlain with Shannon-Weiner diversity (H') (Figures 17 and 18). Evenness ranged from 0.18 to 1 where a dimensionless value of 1 indicates that there were an equal number of individuals from every taxon found. Very uneven macrofaunal assemblages were found at 12 sites (A10a, 23, 57, 46, 71, 15, 61, 21, 67, 68, 25, and 24). Samples from six of these sites (15, 21, 23, 57, 61, and 80) were from clean sandy areas and were uneven due to very low abundances. Four sites (67, 24, 25, and 68) were unusual in having an abundance (up to 977 individuals) of a single bivalve species, *Perrierina harisonae* while A10a was dominated by the snail cf. *Zeacolpus symmetrica* (1242 individuals). Site 46 produced 127 *Heteromastus filiformis* (capitellid polychaete) and few other animals. Other uneven or low diversity assemblages were similarly dominated by high numbers of a few species. Sites 37 and 71 by the snail *Eatoniella* sp., site 49 by the polychaete *Heteromastus filiformis*, and site 62 by unidentified syllid polychaetes.

Excluding these exceptional sites, the remainder produced samples with a mean of 13 taxa (SD=7), 212 individuals (SD=312). Mean diversity (H') was 1.66 (SD=0.50). Mean Evenness (J) in the lower harbour was 0.74 (SD=0.17). Lower richness, diversity, and abundance values were found near channel sites while higher values dominated the central intertidal sand flats (except the cockle beds nearest the port). Sites 60, 61, and 62 were (by chance) located only 70 m from each other nearly parallel to the intertidal gradient on the central sandflat. These sites presented the expected decrease in diversity with increasing drying time illustrating the importance of small scale vertical relief in harbour communities.

Macrofaunal grab samples were dominated numerically by molluscs (38 taxa among 12,719 individuals), annelids (60 taxa among 9.941 individuals), and arthropods (34 taxa among 6,923 individuals). Each of these groups were identified to different taxonomic levels, making analysis of each group more appropriate than aggregate evaluation. The top ten numerically dominant taxa for each group are presented in Table 4 which collectively account for >92% of all individuals. Thus 126 of the total 156 taxa (comprising <8% of total abundance) were considered uncommon within the context of the harbour.

Figure 16. Sources of 105 macrofaunal grab samples (yellow circles) examined in this report.

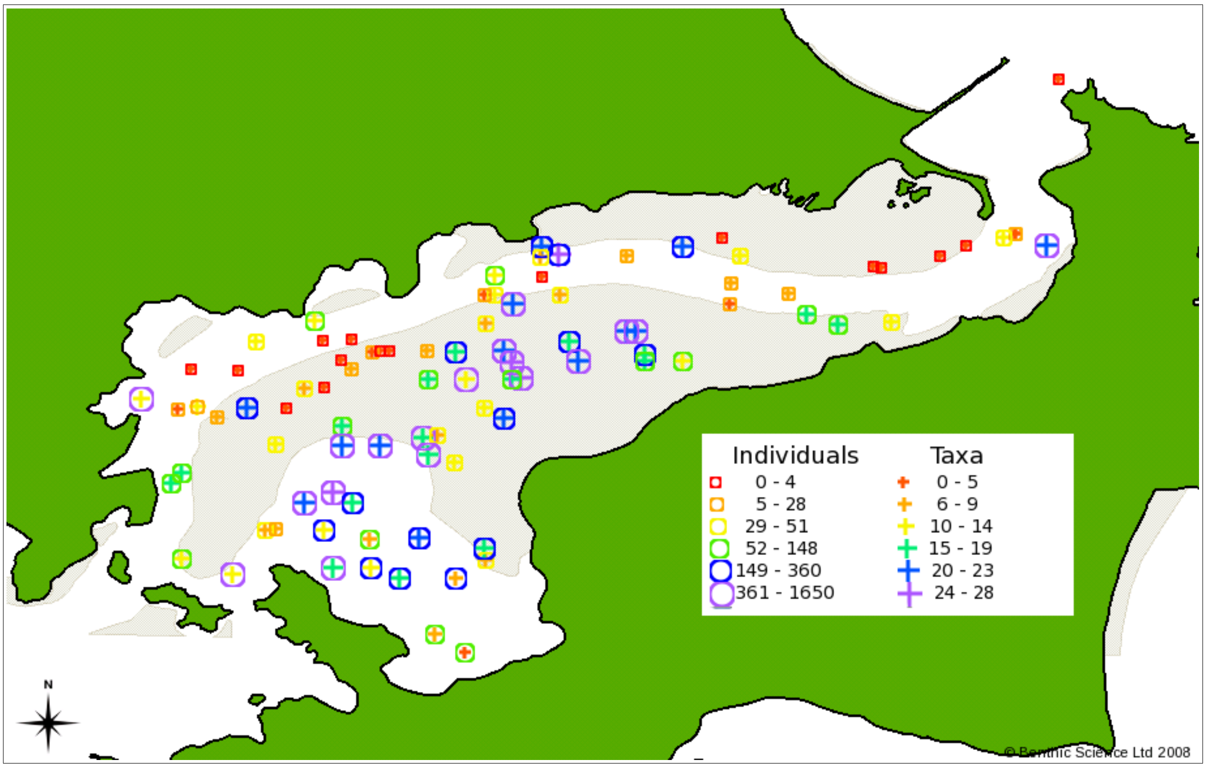

Figure 17. Macrofaunal abundance classes (circles) in the study area compared to taxon richness (plus signs).

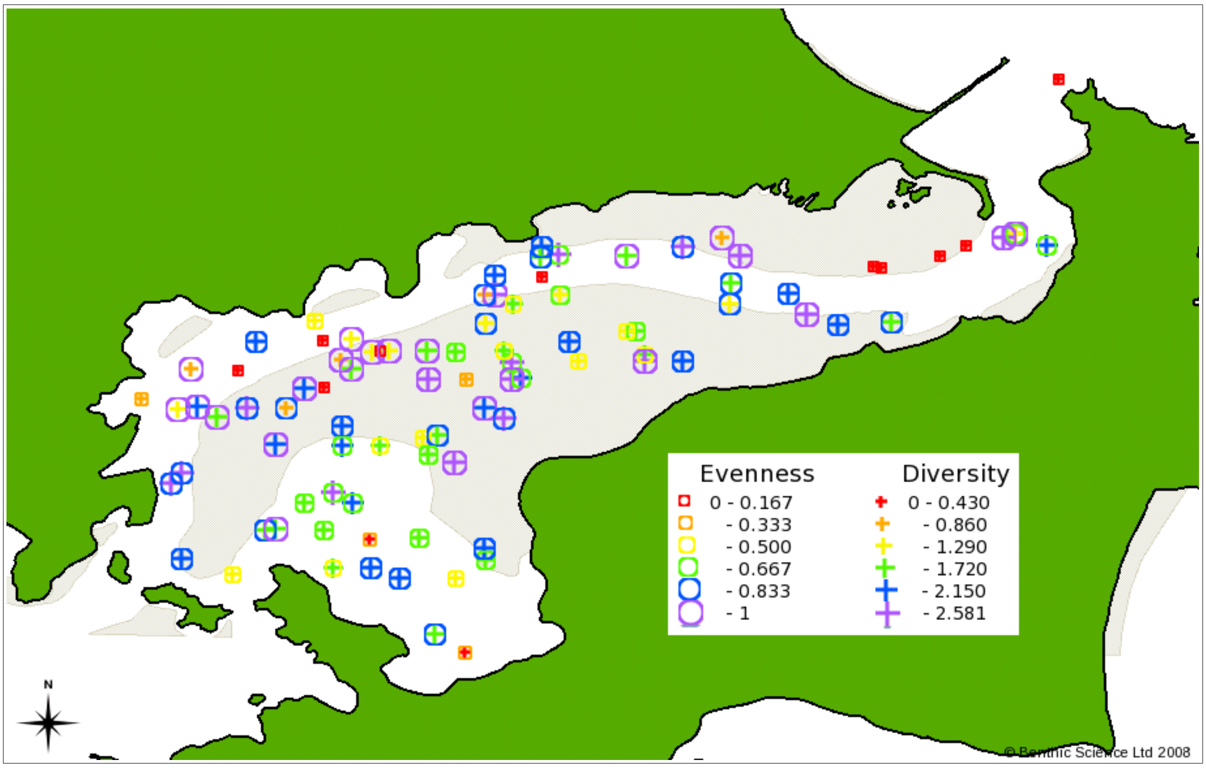

Figure 18. Pielou's evenness classes (J) of macrofaunal samples (circles) compared with Shannon-Wiener Diversity classes (H', plus signs).

Table 4. Top-ten numerically dominant macrofauna within three phyla recovered from grab samples.

Taxon	Total Individuals	X% of Total Macrofauna	Present in X % of samples
ANNELIDA ----------------------------------			
Oligochaeta	2,757	9%	48%
Exogone sp. 1	1317	4%	48%
Heteromastus filiformis	1268	4%	40%
Terebellidae	642	2%	40%
Prionospio sp.	556	2%	49%
Hesionidae	430	2%	37%
Sabellidae	394	1%	35%
Owenia sp.	339	1%	16%
Cirratulidae	256	1%	38%
Boccardia sp.	250	1%	27%
ARTHROPODA -----------------------------			
Lysianassidae	1425	5%	45%
Phoxocephalidae spp. (other)	1350	5%	64%
Tanaidacea	939	3%	42%
Aoridae sp.	797	3%	57%
Amphipoda unident.	517	2%	62%
Torridoharpinia hurleyi	383	1%	30%
Haustoridae	328	1%	24%
Diastylidae sp.	282	1%	29%
Cilicaea canaliculata	220	1%	36%
Halicarcinus varius	220	1%	32%
MOLLUSCA ----------------------------------			
Eatoniella sp.	6,472	22%	48%
Perrierina harrisonae	1,678	6%	23%
Zeacolpus symmetrica	1,318	4%	7%
Nucula nitidula	1,020	3%	37%
Mysella unidentata	507	2%	37%
Nucula hartvigiana	348	1%	17%
Turbonilla	329	1%	51%
Micrelenchus sp.	160	1%	25%
Tawera spissa	145	<1%	17%
Bivalvia D1	101	<1%	14%

Macrofaunal Relationships To Benthic Structure Classes

In order to compare benthic structure data with non-overlapping macrofaunal grab data each grab sample was assigned the same structural class as the nearest photo site along the same interpolated isobath. Exploratory cluster and nMDS analyses were conducted using all macrofaunal data as well as a reduced set including only the 30 common taxa (Table 4). No reliable relationship was found between either structural class scheme and macrofaunal abundance (4^{th} root transformation) nor composition (presence/absence transformation). Furthermore, nMDS analyses produced no distinct sample groups, indicating general composition and abundance characteristics among samples. Because of the varied levels of taxonomic detail between the three major phyla found (Annelida, Mollusca, and Arthropoda) individual analyses are presented below. In each case multivariate analyses of the Bray-Curtis similarity matrix produced from fourth-root transformed macrofaunal abundance data using the reduced (6 type) community class set produced similar results to the larger (10 class) benthic structure scheme. Only results from the six structural class scheme have been presented in the following figures.

Annelida

Cluster and MDS analyses of the annelid abundance data highlighted eight anomalous sites, eight with with zero annelids and one (site 2, see Figure 16) with only two species uncommon in the rest of the harbour (a paraonid and the opheliid *Travisia)*. These sites were removed from subsequent analyses. Cluster and nMDS analyses found (Figures 19 and 20) no reliable relationship between benthic structural class and annelid assemblage composition. All communities were within 40 Bray-Curtis similarity percentage points of each other with no apparent discrete steps. The ANOSIM global statistic R was within the distribution of actual observations using both 6 and 10 class factors. Furthermore, no spatially discrete annelid assemblages (regardless of structure class) were identified beyond the anomalous site 2. The annelid taxon accumulation curve (Figure 20) approached an asymptotic value of about 50 taxa after 40 samples with few additions subsequently. At the reported level of taxonomic detail, CHAO 1 and CHAO 2 diversity estimates suggest that 60 to 70 annelid taxa could be found in the lower harbour. These procedures create probabalistic estimates which consider the percentage of samples producing each taxon in addition to the summation of all observations. The annelid component of the benthos appears to have been well-sampled in the lower harbour. Samples on the least exposed portions of the central sandflats produced the highest total annelid abundance values (Figure 21). Lower values were found on channel and intertidal margins.

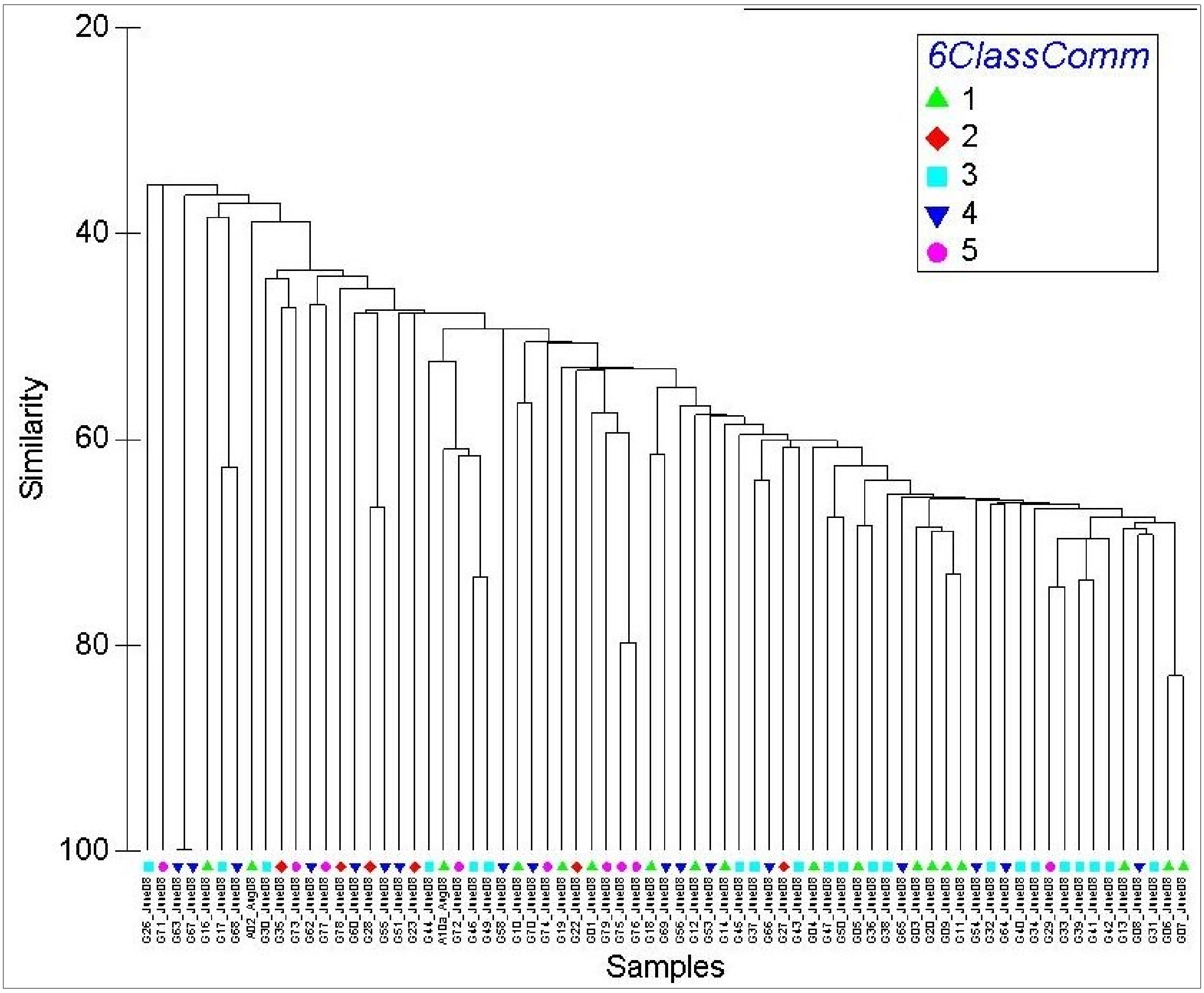

Figure 19. Dendrogram of annelid assemblage similarity (fourth-root transformed abundance data) across all macrofaunal grab samples. Coloured symbols represent closest (along isobath) benthic structure type according to the 6-class scheme (Note: type 6 did not have soft-sediments and was therefore not sampled).

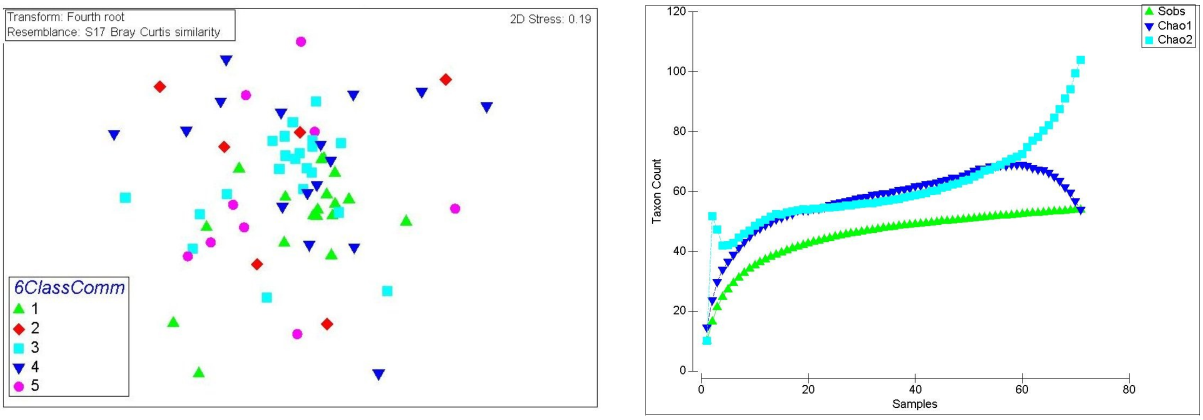

Figure 20. (Left) nMDS ordination of annelid assemblages (fourth-root transformed abundance data) across all macrofaunal grab samples. Coloured symbols represent closest (along isobath) benthic structure type according to the 6-class scheme (Note: type 6 did not have soft-sediments and was therefore not sampled). (Right) Annelid taxon accumulation curves plotted as trend after 999 simulations of sampling order. Green triangles represent actual taxon observations with blue triangles and blue squares represent CHAO 1 and CHAO2 estimates respectively.

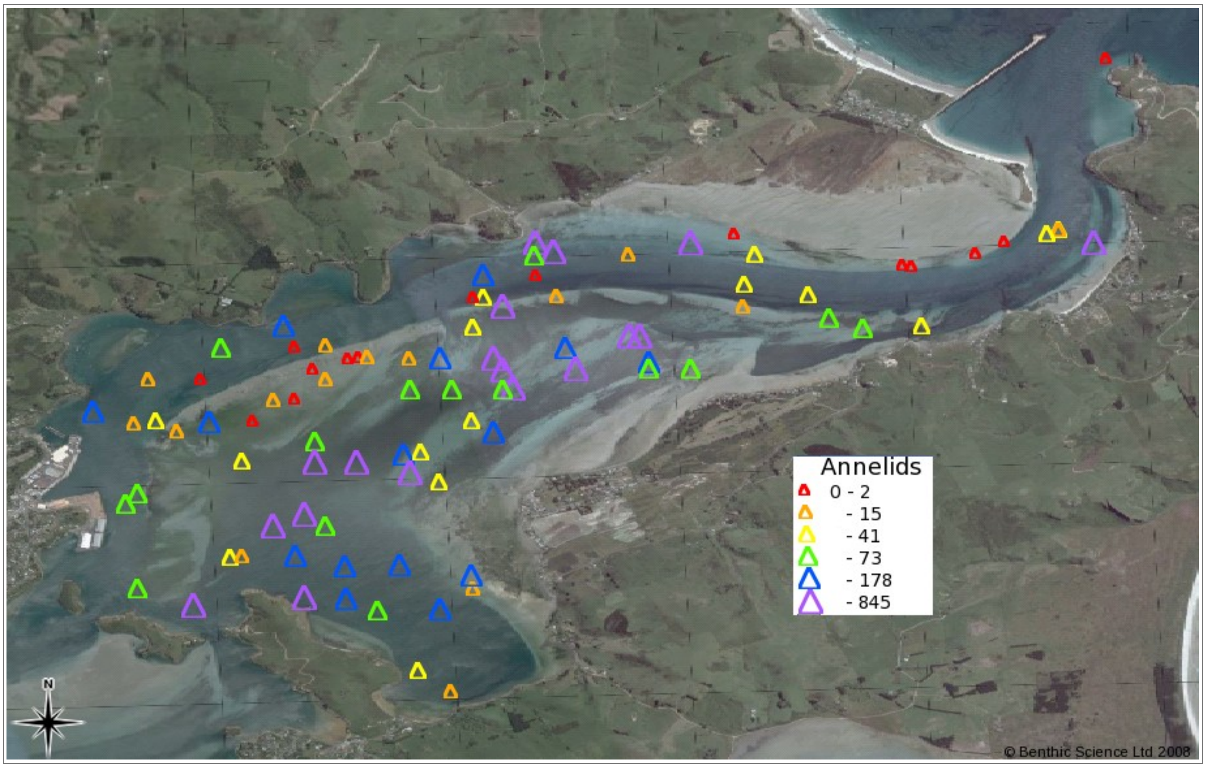

Figure 21. Annelid abundance (individuals per sample) from macrofaunal grab samples among six classes.

Mollusca

Seven sites produced no molluscs (A0, B0, A2, 15, 17, 21, and 23) and therefore had to be excluded from multivariate analyses. All of these sites were in sandy, primarily physically dominated channel areas. Eight additional samples which produced only one mollusc specimen each (sites A10, 16, 28, 46, 57, 74, 77, and 79) were also from sandy channel areas or immediately adjacent. These sites were also removed from multivariate analyses due to their anomalous nature. These sites contained single representatives of *Turbonilla*, *Eatoniella*, or chiton species. As with annelid data, fourth-root transformed mollusc abundance data did not present any reliable relationship with benthic class (neither 6 nor 10 class schemes) nor were any discrete assemblages apparent in cluster (Figure 22) and nMDS analyses (Figure 23). Other weightings of less common species (those represented by a few individuals in only a few samples of this study), including presence/absence transformations, produced similar results. ANOSIM testing of the six class scheme identified significant global results (R=0.289, $p<0.01$) but only between benthic classes 1&2, 4&3, and 2&3. Similarly the ANOSIM test of the ten class scheme found significant relationship between molluscs and benthic class (R=0.26, $p<0.01$), but the distinction was only reliable between algal mat communities from everything else. SIMPER analysis revealed that the consistently abundant *Eationella* and *Turbonilla* in the algal mat samples were responsible for this separation. The mollusc taxon accumulation curve (Figure 23) approached an asymptotic value of about 35 taxa (at the current reported resolution and sampling method) after consideration of 60 samples. Uncommon species caused considerable separation of the CHAO 1 and CHAO 2 diversity estimates suggesting that somewhere between 40 and 60 mollusc taxa are likely to be present in the lower harbour (38 were found). As with annelids, samples from the central sandflat areas usually produced more molluscs (Figure 24) than most channel and margin areas, with the notable exception of large numbers of *Eationella* near the harbour mouth. Only 12 locations (Figure 25) produced cockles when photo and grab samples were combined. Other intertidal beds are known to exist in the harbour (*e.g.* Harwood).

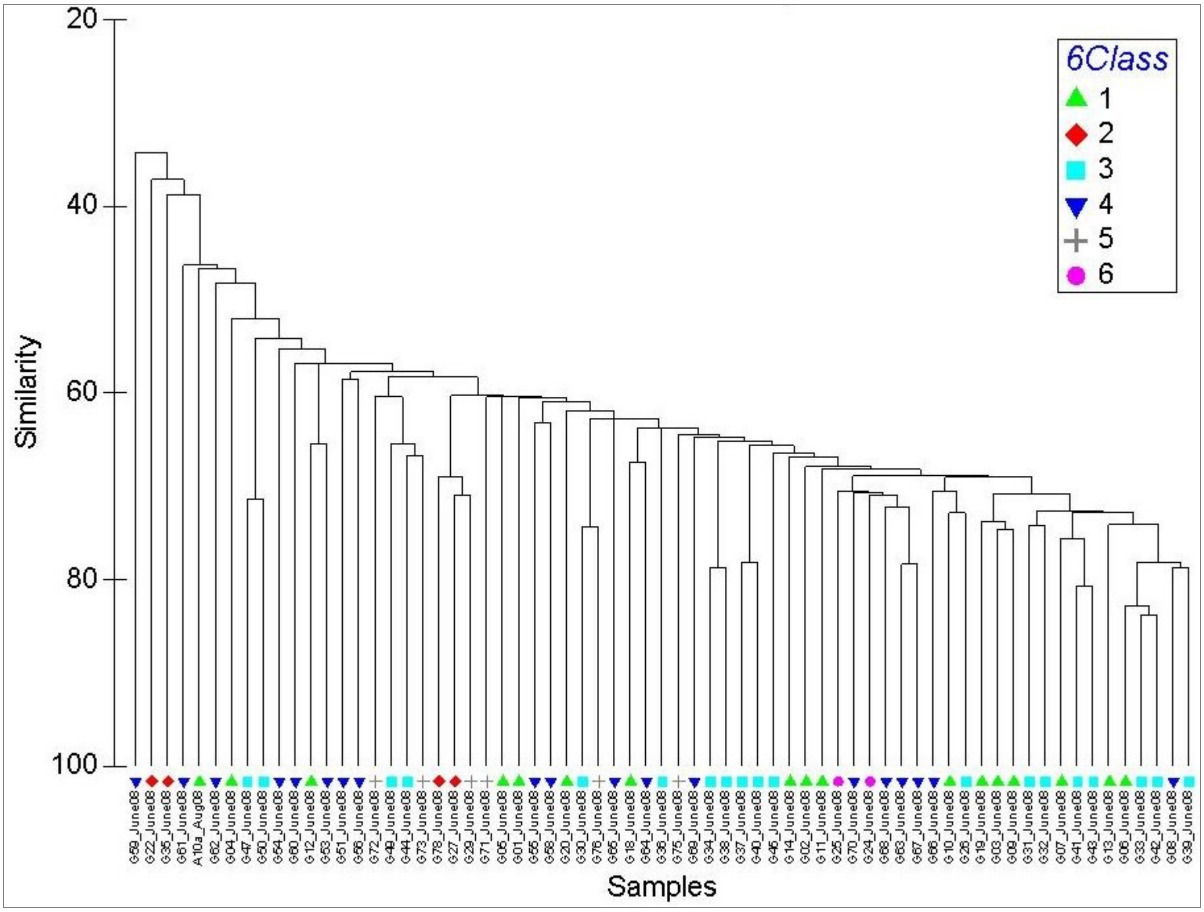

Figure 22. Dendrogram of mollusc assemblage similarity (fourth-root transformed abundance data) across all macrofaunal grab samples. Coloured symbols represent closest (along isobath) benthic structure type according to the 6-class scheme (Note: type 6 did not have soft-sediments and was therefore not sampled).

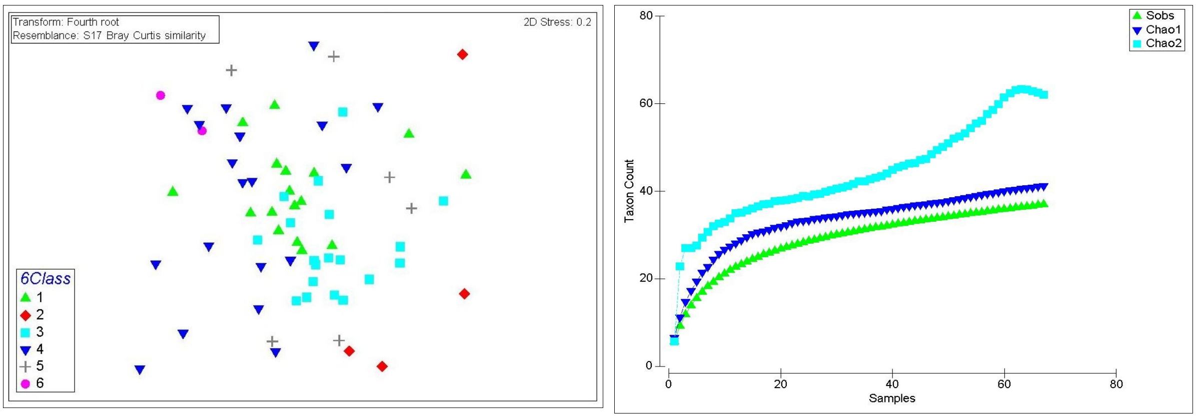

Figure 23. (Left) nMDS ordination of mollusc assemblages (fourth-root transformed abundance data) across all macrofaunal grab samples. Coloured symbols represent closest (along isobath) benthic structure type according to the 6-class scheme (Note: type 6 did not have soft-sediments and was therefore not sampled). (Right) Mollusc taxon accumulation curves plotted as trend after 999 simulations of sampling order. Green triangles represent actual taxon observations with blue triangles and blue squares represent CHAO 1 and CHAO2 estimates respectively.

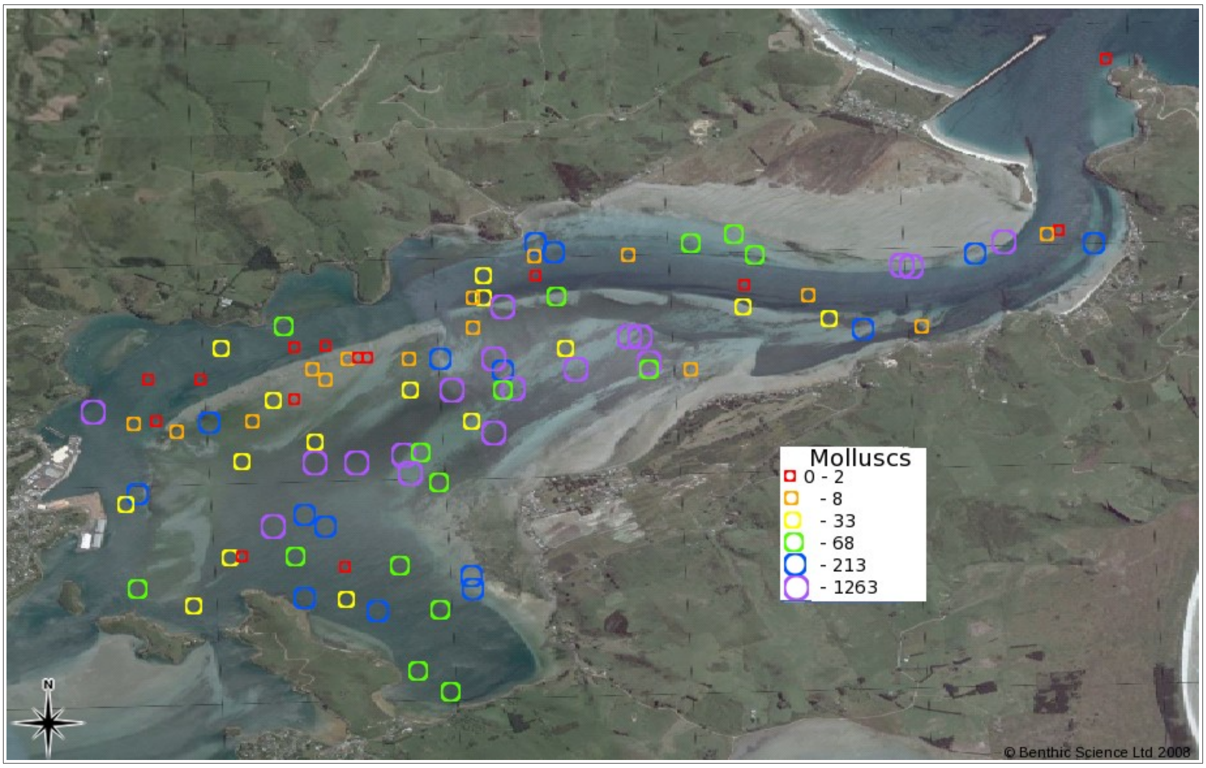

Figure 24. Mollusc abundance (individuals per sample) from macrofaunal grab samples among six classes.

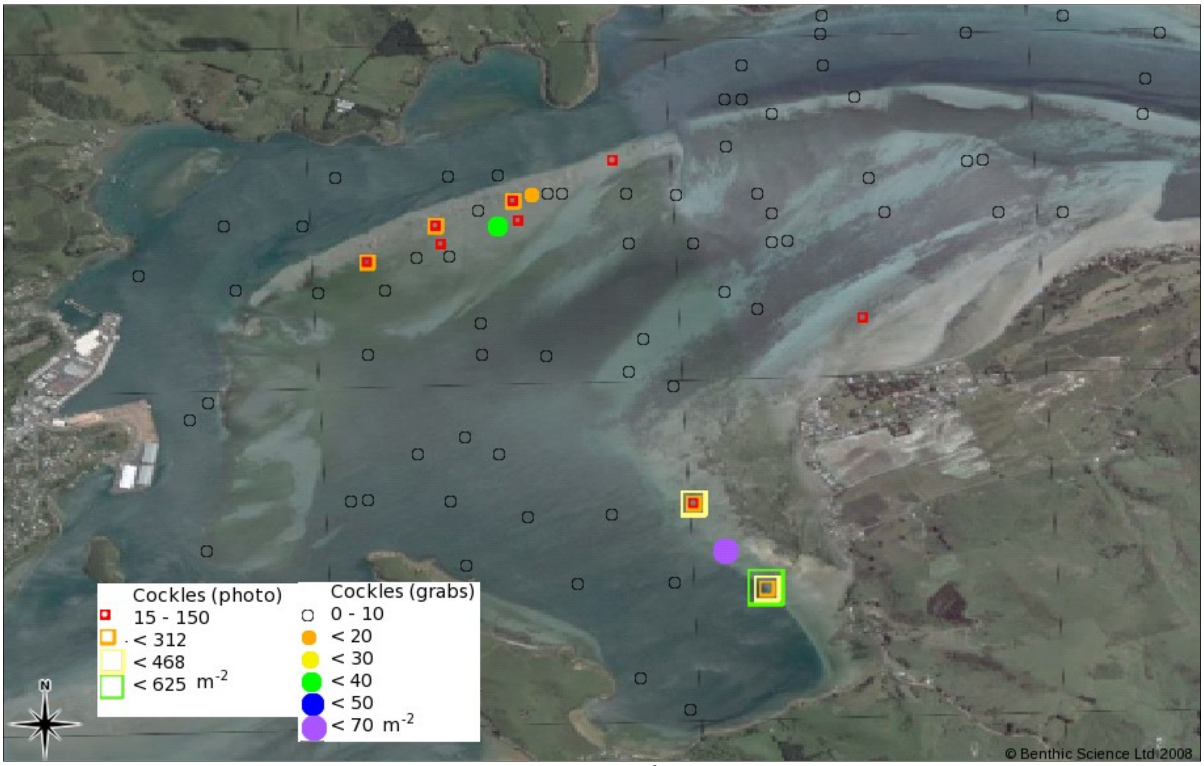

Figure 25. Cockle abundance (extrapolated individuals m^{-2}) from macrofaunal grab samples (circles) among six classes and photo survey sites (squares) among four.

Arthropoda

Arthropoda was the most poorly resolved phylum of the study. Amphipods formed the most abundant arthropod group with tanaidaceans and cumaceans trailing by a considerable margin. Microscopic dissection is often required for positive identification within families. Three amphipod families Phoxocephalidae (inclusive of *Torridoharpinia hurleyi*), Lysianassidae, and Aoridae numerically dominated amphipod abundance. The nearly asymptotic taxon accumulation curve (after 90 samples) suggests that only about 32 taxa could have been found at the current level of taxonomic resolution while CHAO 1 and 2 estimates converged around 44 taxa (Figure 26). Because the most abundant groups were represented by a small number of higher (family) level identifications, presenting cluster, ANOSIM, nMDS, and SIMPER analyses would lack detail and are likely to be inappropriate statistical treatments. Exploratory analyses, however, identified no distinct assemblages with respect to benthic structure classes and completely overlapping ordinations. Arthropod abundance showed a pattern similar to that seen for molluscs and annelids (Figure 27).

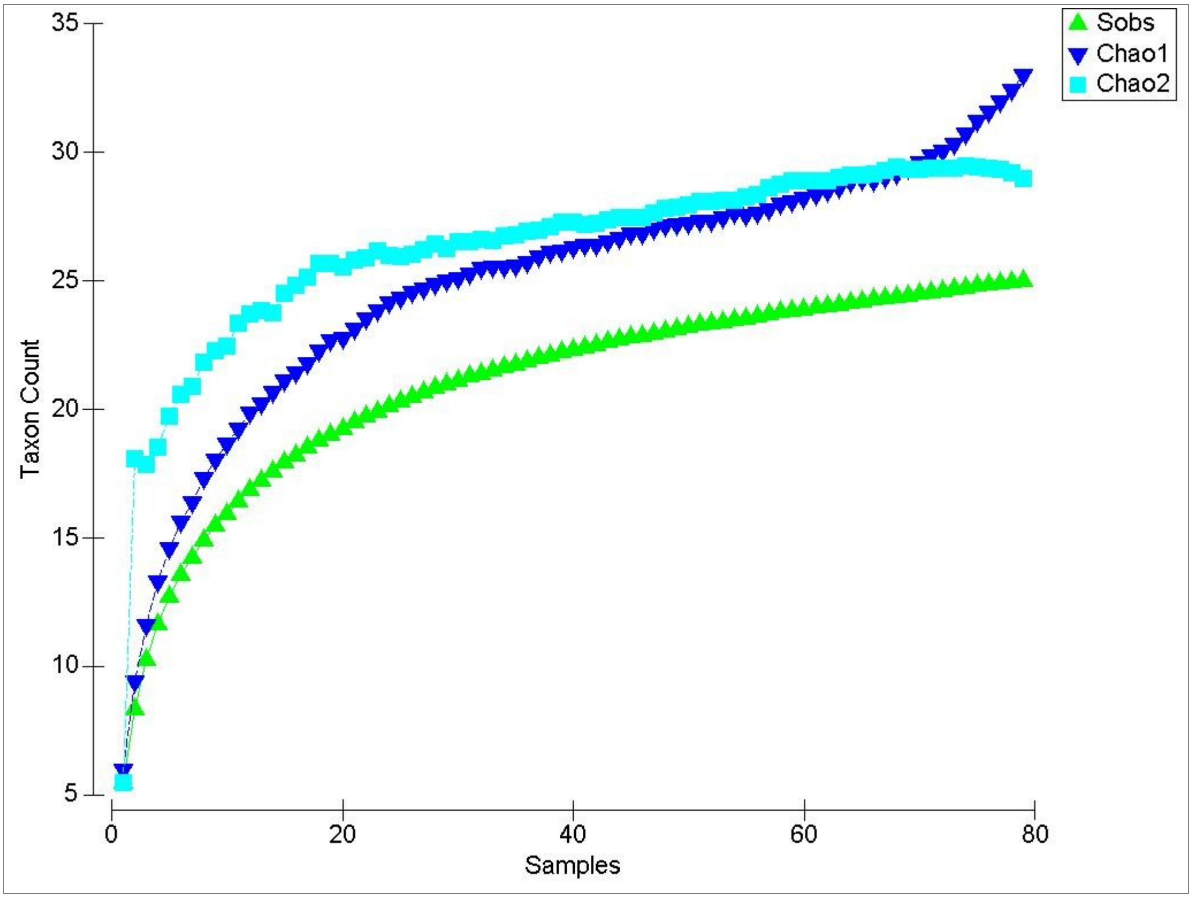

Figure 26. Arthropod taxon accumulation curves plotted as trend after 999 simulations of sampling order. Green triangles represent actual taxon observations with blue triangles and blue squares represent CHAO 1 and CHAO2 estimates respectively.

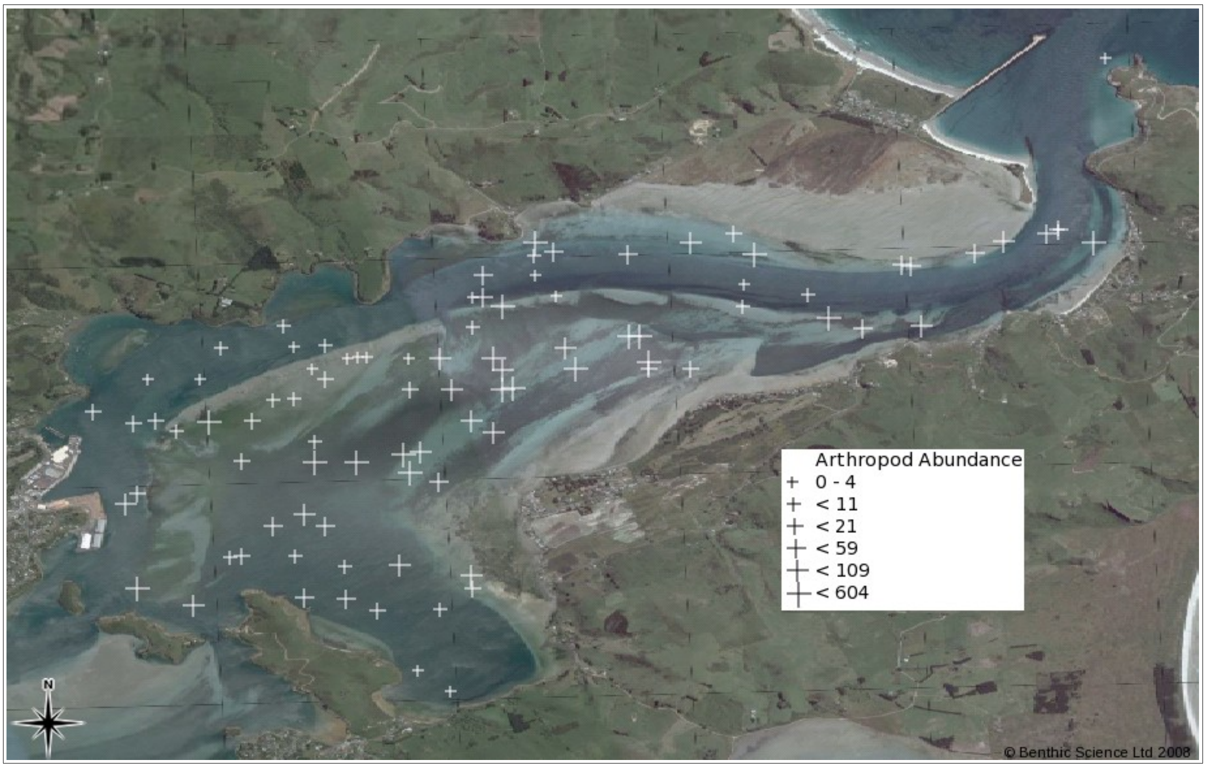

Figure 27. Arthropod abundance (individuals per sample) from macrofaunal grab samples among six classes. Although other arthropods are included in totals, these values reflect mostly amphipod individuals.

Vegetative mass

Seagrasses were photographed at 11 sites in the lower harbour (Figure 28). Though present in some locations, it was not present in quantity at any of the Aramoana core sample sites nor the cockle validation sites. Significant algal masses were found in 15 macrofaunal grab samples. We estimated that over 90% of the mass was contributed by complex assemblages of brown algal species with a smaller amount contributed by several intertwined filamentous rhodophytes. Two green algae, *Ulva* sp. and *Codium* sp., and a flat-bladed rhodophyte comprised the remaining algal mass. *Spirorbis* polychaetes and bryozoans were common or abundant in almost all algal masses (absent in only two) while hydroids and sponges were frequently uncommon or absent. It was interesting to note that shaded areas in the low-resolution satellite imagery (3 visible bands only) could not be reliably identified with algal, seagrass, cockle, or substratum observations. One metre-resolution multi-spectral imagery may, when appropriately processed, provide some discriminatory ability in the extensive shallow areas of the harbour.

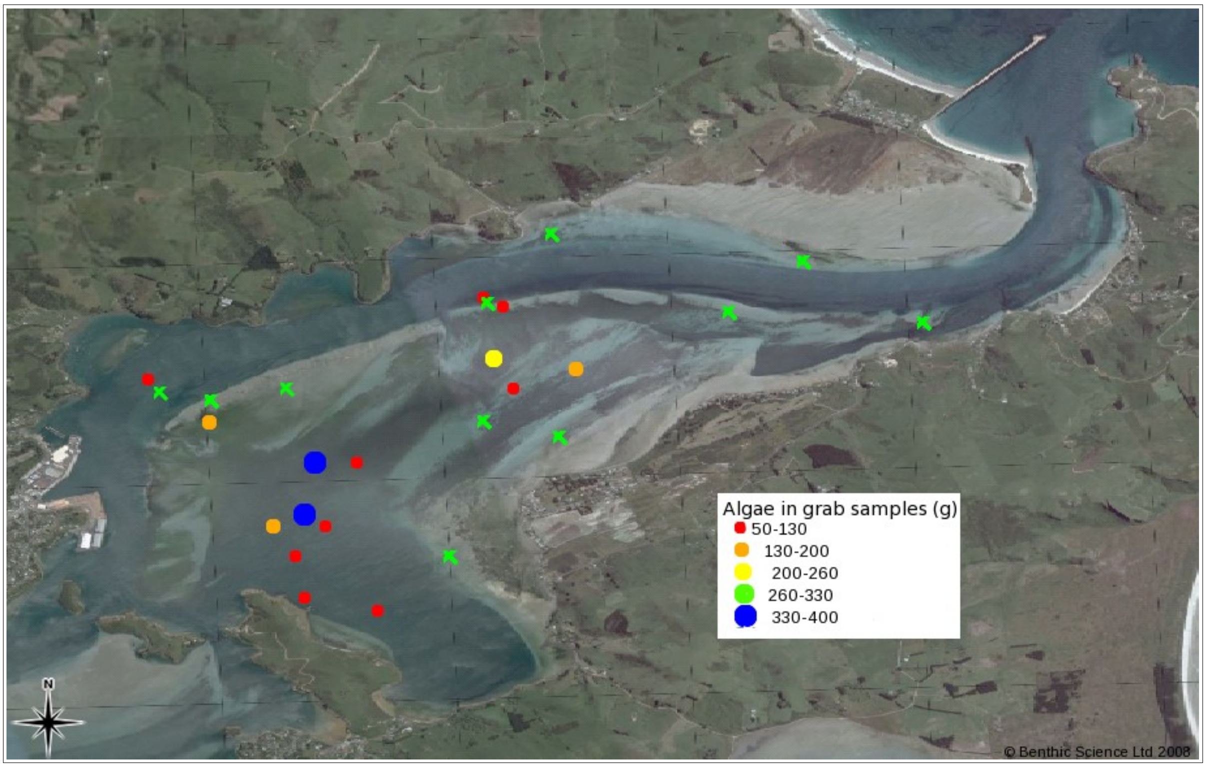

Figure 28. Algal wet mass (g) from macrofaunal grab samples among five classes (circles). Unmarked sites had negligable algal biomass. Photographic seagrass (*Zostera muelleri*) observations were made at sites marked with green crosses.

Discussion

Benthic Structure

The purpose of the present study was to investigate the diversity and extent of superficial benthic habitat structures in lower Otago Harbour and identify potential benthic community boundaries prior to channel modification. The lower harbour is a mosaic of benthic habitats which were unlikely to be successfully sampled and described using a single macrofaunal collection protocol though soft-sediment ponar grabs were successful in most harbour areas including channel and embayment areas. Sand flat margin macrofauna near Aramoana were sampled by a coring technique while the spatially restricted deep cobble communtiy was examined photographically. Given the extensive algal components of the seabed, algal survey methodologies should be considered in any ongoing monitoring.

The six benthic structure classes did not occupy equal proportions of the harbour. With no *a priori* reason for estimating habitat connectivity, area estimates required rule-based (heuristic) interpolations. Benthic features were observed by live video as the research vessel approached each study site, maneuvered, and departed. These field observations were combined with additional information such as bathymetry, presumed water flow patterns, and local experience to interpolate conditions between study sites. The resulting boundaries from the first photo survey (85 sites, Figure 29) were refined and evaluated by the second survey (37 sites, Figure 30). Where interpolated areas of the first classification were revisited and then reclassed (17 sites), the original interpolation was retained more often than not (Table 5) and no new habitat types were found. It was apparent, however, that the extent of clean rippled sand was underestimated. The classified areas total approximately 12 km^2 of the 22 km^2 of the lower harbour. Given the patchy nature of the harbour benthos, sampling extent, and poor bathymetric detail beyond the channel, 10 km^2 were not classified. While patchiness was the norm, continuous areas of estuary-like benthic structures were present on the northern portion of the Lower Harbour channel, while algal-beds dominated the central area. These patterns may be the result of different waterflow and light-level regimes resulting from bathymetry and incident light. Classifications were based on an actual imaged area of 55 m^2 (0.004%), but the actual observed area was greater by at least one order of magnitude if the approach video is considered (which formed part of the extrapolation analysis). Approximately 35% of the classed area consisted of algal mat, 24% medium sand, shell, and sparse algae, 24% inlet features, 10% macrofaunal tube mats, >6% clean rippled sand, and about 1% of deep sessile community benthic classes. These areal extent estimates provide a first-order approximation to inform the present state of the lower harbour benthos and to guide future efforts.

Results from the present study are consistent with previous published accounts of the benthos of Otago Harbour (e.g.[1,2,3]) and numerous unpublished studies (notably dissertations and theses from the University of Otago).

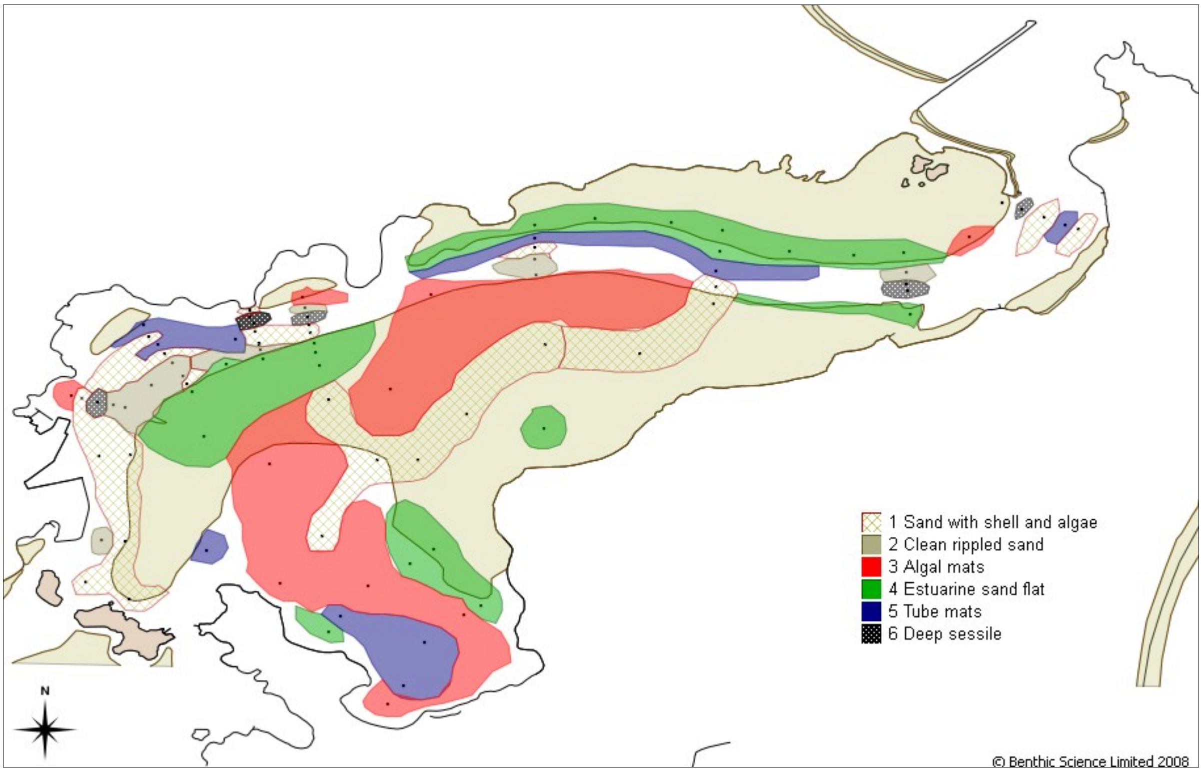

Figure 29. Estimated extent of gross habitat types (see Table 1 for descriptions) in the study area as interpolated from initial photo survey observations (black dots) and evaluation of bathymetry, intersite observations, presumed flow patterns, and personal experience. Uniform beige areas represent shallow sand flats. Areas between classified areas were not classified.

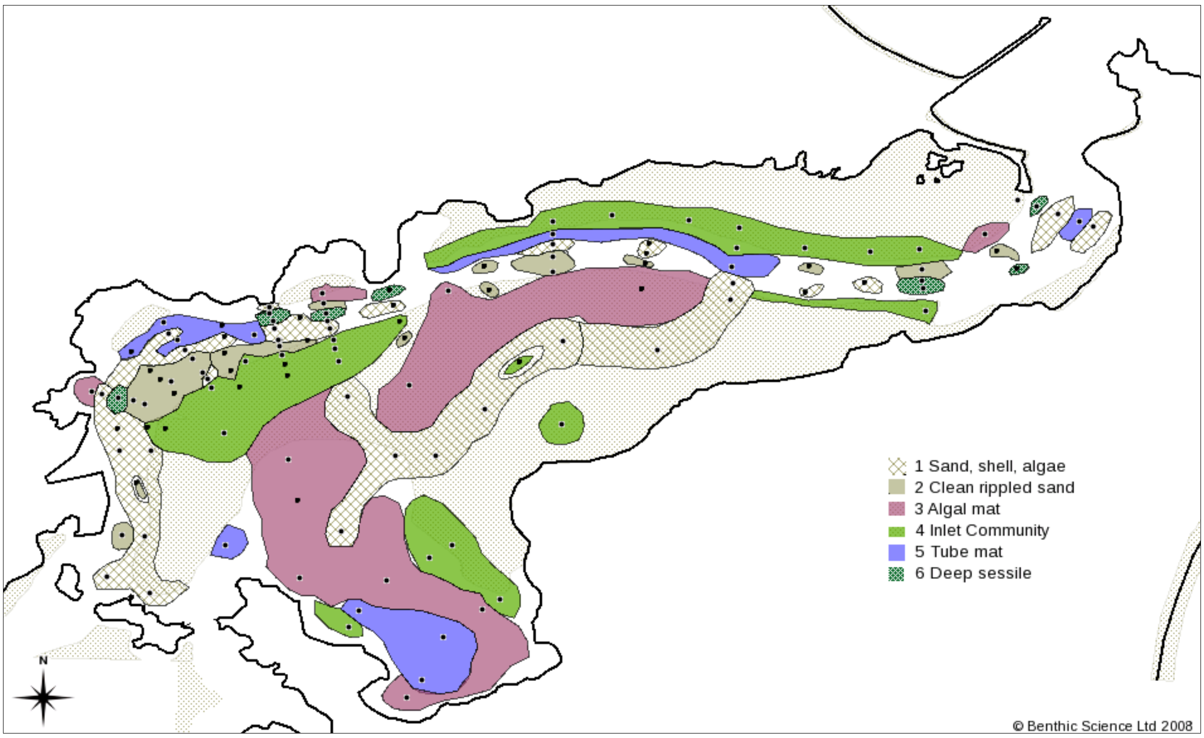

Figure 30. Estimated extent of gross habitat types (see Table 1 for descriptions) in the study area as interpolated using data from both photo surveys (black dots) and evaluation of bathymetry, intersite observations, presumed

flow patterns, and personal experience. Grey areas represent shallow sand flats. Areas between coloured areas were not classified.

Table 5. Comparison of classification of interpolated areas after the first photo survey and the second.

Matches (10)	**Mismatches (7)** initial class → revised class (quantity)
Algal mat (x2)	Algal mat → Rippled sand (x2)
Rippled sand (x2)	Inlet features → Rippled sand
Inlet features (x4)	Tube mat → Rippled sand
Tube mat	Med. sand, shell, algae → Rippled sand
Med. sand, shell, and algae	Med. sand, shell, and algae → Inlet features
	Med. sand, shell, and algae → Tube mat

Cockles

Although photographic cockle assessments were ground-truthed at only two sites, the applicability of the benthic imaging method was supported in both locations for large cockles. Cockle density is expected to be patchy on the scale of metres, but the evidence indicated that cockles were numerous in only a few lower harbour locations. Cockle beds were not found subtidally lower than Pulling Point in the surveys.

Aramoana

Macrofaunal cores collected in the Aramoana sandflats produced surprisingly few animals. Though all animals noted in an early study[6] were not found in present samples, the dominant ones were observed and the general community description remains unchanged. The most common animal, *Perrierina harrisonae*, was not identified in the prior study, but details of mesh size and processing protocols are lacking. The present samples seem to represent the current mid-tidal to littoral zone without sampling sub-littoral sediments (exposed only a few times during each lunar cycle). Future work may consider integrating infaunal observations using a smaller mesh size (0.5 mm aperture) with a large number of surface photos after a period of calm weather to identify small infauna and zones of deeply buried or less common surface-dwelling macrofauna (*e.g. Macrophthalmus hirtipes, Abarenicola affinis, Amphibola crenata, Callianassa filholi,* etc.).

Lower Harbour Macrofauna

Field collections retrieved large quantities of algae, muddy sand, and sandy mud, often filling the grab. The dominant fauna consisted mostly of epifaunal or shallow-burrowing infaunal species. Given the large number of sediment-binding tubes present in harbour samples, surprisingly few polychaetes were found. This may be because abandoned tubes persisted in the lower harbour environment long after the original occupant is gone or the animals were too small to be efficiently captured using a 1.0 mm mesh. In consideration of future sampling effort allocation, experience with these samples suggests that processing most lower harbour sediments (excepting clean rippled sand areas) using a 0.5 mm aperture mesh will take 4-6 times more time than present 1.0 mm mesh samples. Annelids were diverse and abundant. Among polychaetes, only a few of the taxa identified to the family level (*e.g.* Terebellidae*,* Cirratulidae, etc.) consisted of more than one morphospecies (identification was often limited by fragmentation), therefore the lack of distinct communities was probably a realistic reflection of the patchy (metre scale) benthic habitats in the lower harbour.

Analyses did not reveal discrete macrofaunal community distributions within annelida, mollusca, nor arthropoda in the lower harbour. No single channel bottom, slope, or sandflat community was identified. Samples horizontally separated by 10s of metres differed greatly in dominant taxon composition, abundance, and taxon richness while several widely separated samples were very similar. The sites shared most species (35 taxa were present in $\geq$25% of the samples), but in different proportions seemingly unrelated to their horizontal proximity and composition was only weakly tied to benthic structure. Neither of the benthic structure classification systems appeared to be a useful community proxy.

A number of conclusions are consistent with observations made in this study. They can be used to inform management decisions and help establish bounds on benthic assemblage knowledge in the lower harbour. They include:

1) Discrete superficial bottom types exist in the lower harbour study area. In general, sampling density was directly related with spatial heterogeneity. The more photographs obtained in a given area, the more habitat types were found to exist within it. Every structural class was found adjacent (within 0.25 km) to every other class at some point. These observations suggest that the harbour's benthic habitats are patchy on the scale of 10s and 100s of metres. Two possible exceptions include the

clean sandy patches in the channel adjacent to Deborah Bay and the inlet community on the northern side of the channel from Pulling Point to Aramoana.

2) Apparently diverse sessile invertebrate communities (including structure forming animals like sponges and tunicates) were largely restricted to deeper channel areas with extensive cobbles and boulders.
3) Seagrass, cockle, *Callianassa*, and *Abarenicola* dominated areas were restricted to lower intertidal and shallow subtidal margins of the channel. Substratum aspect (relative to sunlight) and composition interactions are possibly responsible for the differences observed on the northern and southern channel margins which reverse at Pulling Point.
4) Clean, rippled-sand areas with few macrofaunal individuals were underestimated by the present methods, but were restricted to artificial channel areas. They were not observed in natural channel areas sampled on the central sand flats. Sediments beyond the manmade channel showed signs of extensive reworking and stabilisation by infauna.
5) Depositional areas (typified by fine sediments and extensive tube mats) formed about 10% of the study area and existed within and without the channel. Comparison of depositional and physically dominated (rippled) areas may be useful in the development cycle of harbour flow models.
6) Despite extensive sampling efforts, no evidence supporting the existence of discrete macrofaunal communities was found. A few environment modifying species (such as cockles, seagrass, *Callianassa*, etc.) formed part of the classification scheme and are therefore intrinsic to the benthic structural landscape. Their presence was clearly delineated by the photographic study despite their well-understood absence in grab samples. Smaller and less obvious macrofaunal species, which were well-sampled by the benthic grab, showed no clear associations with benthic structure classes, nor were they spatially discrete. With respect to these species, the lower harbour appears to consist of one spatially variable, but cohesive community.
7) Algal assemblages, dominated by brown algal assemblages, *Ulva,* and numerous filamentous rhodophytes growing on isolated shell and rubble patches among sandy substrata is the most spatially extensive habitat in the harbour and is largely restricted to the central sandflat area in waters less than 4 m deep. Additional photographic

sampling is likely to find this habitat more fractured than Figure 30 portrays, most likely with inclusions of sheltered inlet areas. Benthic structural classes 1 and 3 form two ends of a gradient that may be best described in any future work by continuous transect, percent algal cover methods.

8) Though we now know considerably more about the macrobenthos of the lower harbour, our understanding of community connectivity and stabilitywould likely be improved by higher-densitydepth soundings beyond the channel and the effects physical factors such as insolation, aspect, flow, and turbidity have on Otago Harbour's ecology. Future studies can build on the information presented here.

The principal findings of this work suggest that though there are discrete structural habitats consisting of different substrata, overburden, and algae; the soft sediment fauna exist in overlapping patches. Unless the lower harbour system as a whole were to be disrupted, any local disturbances (on the scale of 100s of metres) are likely to be recolonised by neighbouring fauna unless a brand new habitat type is created. The central sandflats and less-modified portions of the harbour benthos support abundant fauna that are likely connected by several adult and larval transport pathways. Two habitat types (rippled sand and deep sessile) were found only in the primary channel. It is likely that these two habitat types, with few soft-sediment fauna, exist due to high tidal flows present in the channel. If seabed sheer forces found in these areas were to expand, then a localised drop in infaunal abundance and diversity can be expected with a concurrent expansion of the sessile fauna. Sessile epifaunal patches found in the deep channel (apx. 1% of lower harbour) are likely to be the most sensitive to increased suspended sediment loads. Filter feeding animals like tunicates and sponges provide substantial colonisation area and increase seabed complexity. This habitat type would be unlikely to exist, however, were it not for the flow conditions created by the artificial channel.

Biological material has been retained for possible inspection by specialists should other portions of the assessment work indicate the effort is warranted. Benthic imagery has been submitted to algal experts for additional analyses and comment. Such consultation is likely to provide improved predictive success for impact estimates. Finally, item eight above highlights the fact that we have much to learn about this heavily used resource, the Otago Harbour. It is our opinion that topographic relief is likely to be the single most important factor in the formation and connectivity of harbour communities that result in the observed mosaic. If channel modifications do not substantially alter water flow regimes and are restricted to subtidal areas without changing the aspect or extent of intertidal areas, then the post-dredging community mosaic (barring turbidity effects) is likely to be very similar to the present one. If, however, modifications alter intertidal topography or depostional patterns after sediments have stabilised (post-dredging), then the affected portions of the harbour may change markedly. Detailed bathymetric data beyond the channel may provide insights into the patchy nature of currently observed animal distributions.

Conclusions

Existing plans for channel modification will directly impact representatives of each habitat type found in the study, but each of those types has also been found in areas beyond currently proposed dredging areas. If modifications of the channel slopes and bottom will physically alter the substratum type or intertidal profile of the sandflats, local community types can be expected to change into one of the other benthic habitat classes. The expected longevity of physical alterations make engineering and geological assessments essential to the formation of biological predictions. No fauna endemic to the harbour were identified.

No distinct macrofaunal assemblages (beyond engineering species integral to the structural classes) were identified. Unless water flow regimes are altered substantially in the system as a whole or brand-new habitat types are created, localised channel modifications are unlikely to eliminate any of the identified benthic habitat classes or fauna from the lower harbour. The naturally-existing classes are also present away from the channel and a large proportion of the macrofaunal taxa can be found scattered throughout the lower harbour. Only the deep sessile community is restricted to channel areas likely to be modified. This habitat structure type is likely to be the most vulnerable to dredging operations with a slow recovery rate after direct substrate removal or after periods of increased sedimentation. This habitat probably exists as a consequence of the present channel.

Soft-sediment algae are an important part of the harbour character and biomass. The algal assemblages differ structurally in the channel proceeding from Port Chalmers to the cross-channel. The northern slopes of the channel may also differ from the southern slopes, implying that aspect and sunlight penetration may be a habitat structuring factor.

Acknowledgments

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Appendix 1 - Image Analysis

Image analysis evaluations and brief notes.

·Site = study site (See methods)

·Image number = sequential photograph identifier

·Dominant = Principal forces as inferred from sediment features, B = Biological forces as evidenced by biorturbation or algae, P = physical forces evidenced by sediment ripples.

·Primary strate visible = 1 means Yes, 2 means No

·Primary substrate type = Visible substrate occupying >50% of the visual field as chosen among the following classes: muddy sand / sand / shell / cobble.

·Secondary substratum (muddy sand, sand, cobble, shell) occupying >20% of the visual field as chosen among the following classes: muddy sand / sand / shell / cobble.

·Shell condition (Recent or reLict) as determined by degree of fracture, wear, and encrusting algae

·Living cockle abundance (determined by the number of visible siphons)

·Blade algae present = 1, absent = 0

·Filamentous algae present= 1, absent = 0

·Macrothallus algae present = 1, absent = 0

·Encrusting corraline algae present = 1, absent = 0

·Seagrass (*Zostera muelleri)* present = 1, absent = 0

·Sponge present = 1, absent = 0

·Macrofaunal burrows present (large features evidence of, *e.g., Macrophthalmus hirtipes*, *Macomona liliana, Callianassa filholi*, *Abarenicola affinis*, and Stomatopoda. Numerous small burrows of polychaetes, amphipods, and tanaid shrimp were not considered here)

·*Pyura pachydermatina* (Sea tulip) present = 1, absent = 0

· RecMeth = recommended method of infaunal sampling determined after review of all images from a particular site as chosen from among the following classes: D = heavy grab or dredge, P = Photographic, V = small van Veen or standard Ponar grab, C = manual core.

· CommType = principal habitat type as chosen from among 10 initial designations (see methods section, Table 1 for descriptions).

· SecCommType = habitat type (chosen from same classes as principal habitat types) observed in 2 out of 5 photos at some sites.

· Reduce = habitat type as chosen from among 6 broader categories (see mthods section, Table 1 for descriptions).

· Notes = some brief notes collected during first image review, field notes and macrofaunal observations were recorded elsewhere.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	**Latitude**	**Longitude**	**Site**	**ImgNum**	**DomSub**	**PrimSubVis**	**PrimSubType**	**SecSubType**	**ShellCond**	**LivCokAbu**	**Blade**	**Filament**	**MacroAlg**	**Encrust**	**Seagrass**	**Sponge**	**MacroBurrow**	**Pyura**	**RecMeth**	**CommType**	**SecCommType**	**ReducCommType**
2	-45.8060710	170.6281700	A1	111	B	1	S					1	1						D	4		3
3	-45.8060710	170.6281700	A1	112	B	1	S												D	4		3
4	-45.8063080	170.6291800	A2	116	B	1	S	L	L					1					V	2		1
5	-45.8063080	170.6291800	A2	120	B	1	S	L	L										V	2		1
6	-45.8063080	170.6291800	A2	115	B	1	S	L	L					1					V	2		1
7	-45.8063080	170.6291800	A2	118	B	1	S	L	L					1					V	2		1
8	-45.8066950	170.6306950	A3	218	B	1	S	C				1				1		1	P	9		6
9	-45.8066950	170.6306950	A3	220	B	1	S	C											P	9		6
10	-45.8066950	170.6306950	A3	217	B	1	S	C				1	1			1			P	9		6
11	-45.8066950	170.6306950	A3	216	B	1	S	C				1						1	P	9		6
12	-45.8068730	170.6321510	A4	223	P	1	S												V	3		2
13	-45.8068730	170.6321510	A4	222	B	1	S					1	1						V	3		2
14	-45.8068730	170.6321510	A4	226	P	1	S												V	3		2
15	-45.8068730	170.6321510	A4	225	P	1	S												V	3		2
16	-45.8068730	170.6321510	A4	224	P	1	S					1							V	3		2
17	-45.8072290	170.6332500	A5	228	P	1	S												V	3		2
18	-45.8072290	170.6332500	A5	230	P	1	S												V	3		2
19	-45.8072290	170.6332500	A5	231	P	1	S												V	3		2
20	-45.8072290	170.6332500	A5	227	P	1	S					1							V	3		2
21	-45.8072290	170.6332500	A5	229	P	1	S												V	3		2
22	-45.7993860	170.6350920	B1	261	B	1	M												V	8		5
23	-45.7993860	170.6350920	B1	258	B	1	M												V	8		5
24	-45.7993860	170.6350920	B1	259	B	1	M												V	8		5
25	-45.7993860	170.6350920	B1	262	B	1	M												V	8		5
26	-45.7993860	170.6350920	B1	260	B	1	M												V	8		5
27	-45.8004850	170.6355080	B2	254	B	1	S					1		1					V	2		1
28	-45.8004850	170.6355080	B2	252	B	1	S	L	L					1					V	2		1
29	-45.8004850	170.6355080	B2	257	B	1	S					1		1					V	2		1
30	-45.8004850	170.6355080	B2	255	B	1	S												V	2		1
31	-45.8004850	170.6355080	B2	253	B	1	S							1		1			V	2		1
32	-45.8011690	170.6363700	B3	248	B	1	S												V	8		5
33	-45.8011690	170.6363700	B3	247	B	1	S												V	8		5
34	-45.8011690	170.6363700	B3	250	B	1	S												V	8		5
35	-45.8011690	170.6363700	B3	249	B	1	S												V	8		5
36	-45.8011690	170.6363700	B3	251	B	1	S												V	8		5
37	-45.8020300	170.6370530	B4	246	B	1	S										1		V	2		1
38	-45.8020300	170.6370530	B4	245	B	1	S										1		V	2		1
39	-45.8020300	170.6370530	B4	242	B	1	S	L	R					1					V	2		1
40	-45.8020300	170.6370530	B4	244	B	1	S					1	1						V	2		1
41	-45.8029510	170.6377960	B5	240	P	1	S												V	3		2
42	-45.8029510	170.6377960	B5	241	P	1	S												V	3		2
43	-45.8029510	170.6377960	B5	239	P	1	S												V	3		2
44	-45.8029510	170.6377960	B5	238	P	1	S												V	3		2
45	-45.8029510	170.6377960	B5	237	P	1	S												V	3		2
46	-45.8042100	170.6387500	B6	370	P	1	S					1							V	3		2
47	-45.8042100	170.6387500	B6	369	P	1	S												V	3		2
48	-45.8042100	170.6387500	B6	368	P	1	S												V	3		2
49	-45.8042100	170.6387500	B6	366	P	1	S												V	3		2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
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51	-45.8042100	170.6387500	B6	365	P	1	S					1							V	3		2
52	-45.8042100	170.6387500	B6	367	P	1	S												V	3		2
53	-45.8048900	170.6392100	B7	359	B						1	1							C	1		1
54	-45.8048900	170.6392100	B7	363	P	1	S				1	1							C	1		1
55	-45.8048900	170.6392100	B7	361	P	1	S				1	1							C	1		1
56	-45.8048900	170.6392100	B7	360	P	1	S				1								C	1		1
57	-45.8057100	170.6396600	B8	353	B	1	S								1		1		C	5		4
58	-45.8057100	170.6396600	B8	355	B	1	S								1				C	5		4
59	-45.8057100	170.6396600	B8	356	B	1	S								1				C	5		4
60	-45.7966440	170.6501480	C1	293	B							1							C	4		3
61	-45.7966440	170.6501480	C1	290	B							1							C	4		3
62	-45.7966440	170.6501480	C1	291	B						1	1							C	4		3
63	-45.7966440	170.6501480	C1	292	B							1							C	4		3
64	-45.7966440	170.6501480	C1	289	B							1							C	4		3
65	-45.7976780	170.6503660	C2	288	P	1	S												V	3		2
66	-45.7976780	170.6503660	C2	286	P	1	S												V	3		2
67	-45.7976780	170.6503660	C2	287	P	1	S												V	3		2
68	-45.7985500	170.6505840	C3	282	B	1	*												P	9		6
69	-45.7985500	170.6505840	C3	283	B	1	S	*											P	9		6
70	-45.7985500	170.6505840	C3	284	P	1	S												P	9		6
71	-45.7985500	170.6505840	C3	281	B	1	*												P	9		6
72	-45.7985500	170.6505840	C3	280	B	1	*	L	R										P	9		6
73	-45.7985500	170.6505840	C3	285	P	1	S												P	9		6
74	-45.7985500	170.6505840	C3	279	B	1	L		R										P	9		6
75	-45.7993390	170.6507470	C4	278	B	1	S	L	L					1					P	10		1
76	-45.7993390	170.6507470	C4	275	B	1	L		L					1					P	10		1
77	-45.7993390	170.6507470	C4	276	B	1	L		L		1			1					P	10		1
78	-45.7993390	170.6507470	C4	277	B	1	L		L			1		1					P	10		1
79	-45.8000470	170.6509380	C5	269	B	1	S	L	L				1	1					P	2		1
80	-45.8000470	170.6509380	C5	272	B	1	L		L			1		1					P	2		1
81	-45.8000470	170.6509380	C5	270	B	1	L	S	L					1			1		P	2		1
82	-45.8000470	170.6509380	C5	271	B	1	L	S	L					1					P	2		1
83	-45.8011100	170.6512500	C6	419	B	1	S	L	R		1	1							C	6		4
84	-45.8011100	170.6512500	C6	420	B	1	S												C	6		4
85	-45.8011100	170.6512500	C6	422	B	1	L	S	R		1								C	6		4
86	-45.8011100	170.6512500	C6	421	B	1	S	L	R			1							C	6		4
87	-45.8011100	170.6512500	C6	423	B	1	S	L	R		1	1							C	6		4
88	-45.8019700	170.6514400	C7	424	B	1	S			2	1								V	7		4
89	-45.8019700	170.6514400	C7	427	B	1	S			18									V	7		4
90	-45.8019700	170.6514400	C7	426	B	1	S			9		1							V	7		4
91	-45.8019700	170.6514400	C7	425	B	1	S			15	1	1							V	7		4
92	-45.8019700	170.6514400	C7	428	B	1	S			10							1		V	7		4
93	-45.8031600	170.6517700	C8	434	B	1	S			1	1	1	1						C	7		4
94	-45.8031600	170.6517700	C8	433	B						1								C	7		4
95	-45.8031600	170.6517700	C8	430	B	1	S			6	1	1					1		C	7		4
96	-45.8031600	170.6517700	C8	429	B	1	S				1	1							C	7		4
97	-45.8031600	170.6517700	C8	432	B	1	S			4	1	1					1		C	7		4
98	-45.8031600	170.6517700	C8	431	B	1	S			2	1	1							C	7		4
99	-45.8031600	170.6517700	C8	435	B	1	S				1	1							C	7		4
100	-45.7897900	170.6722310	D1	468	B	1	S								1		1		C	6	5	4
101	-45.7897900	170.6722310	D1	467	B	1	S										1		C	6	5	4
102	-45.7897900	170.6722310	D1	469	B	1	S					1			1				C	6	5	4
103	-45.7897900	170.6722310	D1	470	B	1	S					1					1		C	6	5	4
104	-45.7910430	170.6721840	D2	463	B	1	S	L	L					1					D	8	10	5
105	-45.7910430	170.6721840	D2	460	P	1	L		L					1					D	8	10	5
106	-45.7910430	170.6721840	D2	462	P	1	L	S	L					1					D	8	10	5
107	-45.7910430	170.6721840	D2	461	P	1	S	L	L					1					D	8	10	5
108	-45.7910430	170.6721840	D2	465	P	1	S												D	8	10	5
109	-45.7910430	170.6721840	D2	464	B	1	S	L	L			1							D	8	10	5
110	-45.7920120	170.6722080	D3	456	B	1	L	S	L					1					P	10		1
111	-45.7920120	170.6722080	D3	454	B	1	L	S	L					1					P	10		1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
112	-45.7920120	170.6722080	D3	458	P	1	L		L					1					P	10		1
113	-45.7920120	170.6722080	D3	455	B	1	S	L	L					1					P	10		1
114	-45.7920120	170.6722080	D3	457	P	1	S	L	L					1					P	10		1
115	-45.7931470	170.6722080	D4	451	P	1	S												V	3		2
116	-45.7931470	170.6722080	D4	449	P	1	S											1	V	3		2
117	-45.7931470	170.6722080	D4	450	P	1	S										1		V	3		2
118	-45.7931470	170.6722080	D4	453	P	1	S	L	L										V	3		2
119	-45.7931470	170.6722080	D4	452	P	1	S												V	3		2
120	-45.7946130	170.6723020	D5	448	P	1	S												V	3		2
121	-45.7946130	170.6723020	D5	444	P	1	S												V	3		2
122	-45.7946130	170.6723020	D5	445	P	1	S												V	3		2
123	-45.7946130	170.6723020	D5	446	P	1	S												V	3		2
124	-45.7946130	170.6723020	D5	447	P	1	S												V	3		2
125	-45.7903760	170.6900680	E1	487	B	1	S										1		C	6		4
126	-45.7903760	170.6900680	E1	488	B	1	S				1								C	6		4
127	-45.7903760	170.6900680	E1	483	B	1	S												C	6		4
128	-45.7903760	170.6900680	E1	485	B	1	S												C	6		4
129	-45.7903760	170.6900680	E1	486	B	1	S												C	6		4
130	-45.7923620	170.6898520	E2	490	P	1	S												V	6		4
131	-45.7923620	170.6898520	E2	492	P	1	S										1		V	6		4
132	-45.7923620	170.6898520	E2	493	P	1	S												V	6		4
133	-45.7923620	170.6898520	E2	491	P	1	S												V	6		4
134	-45.7923620	170.6898520	E2	489	P	1	S												V	6		4
135	-45.7941750	170.6893770	E3	495	P	1	S	L	L					1				1	V	8		5
136	-45.7941750	170.6893770	E3	494	P	1	S										1		V	8		5
137	-45.7941750	170.6893770	E3	498	P	1	S												V	8		5
138	-45.7941750	170.6893770	E3	497	P	1	S	L	L					1					V	8		5
139	-45.7941750	170.6893770	E3	496	P	1	L	S	L					1					V	8		5
140	-45.7957300	170.6894200	E4	501	P	1	S												V	1	3	1
141	-45.7957300	170.6894200	E4	499	P	1	S	L	L			1		1					V	1	3	1
142	-45.7957300	170.6894200	E4	502	P	1	S												V	1	3	1
143	-45.7957300	170.6894200	E4	503	P	1	S	L	R		1								V	1	3	1
144	-45.7957300	170.6894200	E4	500	P	1	S	L	L			1		1					V	1	3	1
145	-45.7957300	170.6894200	E4	504	P	1	S												V	1	3	1
146	-45.7972840	170.6892040	E5	506	B	1	S					1			1				C	2	5	1
147	-45.7972840	170.6892040	E5	507	B	1	S					1			1				C	2	5	1
148	-45.7972840	170.6892040	E5	505	B	1	S				1	1							C	2	5	1
149	-45.7972840	170.6892040	E5	509	B	1	S					1			1				C	2	5	1
150	-45.7924910	170.7072960	F1	537	B	1	S												V	6		4
151	-45.7924910	170.7072960	F1	536	B	1	S						1						V	6		4
152	-45.7924910	170.7072960	F1	534	B	1	S						1						V	6		4
153	-45.7924910	170.7072960	F1	533	B	1	S						1						V	6		4
154	-45.7924910	170.7072960	F1	535	B	1	S										1		V	6		4
155	-45.7943910	170.7074690	F2	527	P	1	S												V	3		2
156	-45.7943910	170.7074690	F2	531	P	1	S												V	3		2
157	-45.7943910	170.7074690	F2	532	P	1	S												V	3		2
158	-45.7943910	170.7074690	F2	529	P	1	S												V	3		2
159	-45.7954280	170.7075550	F3	526	P	1	L		L					1					P	9		6
160	-45.7954280	170.7075550	F3	525	P	1	L		L					1					P	9		6
161	-45.7954280	170.7075550	F3	523	P	1	L		L					1					P	9		6
162	-45.7954280	170.7075550	F3	522	P	1	L		L					1					P	9		6
163	-45.7954280	170.7075550	F3	524	P	1	L		L					1					P	9		6
164	-45.7961180	170.7075980	F4	517	P	1	L		L										P	9		6
165	-45.7961180	170.7075980	F4	516	P	1	*												P	9		6
166	-45.7961180	170.7075980	F4	518	P	1	L		L										P	9		6
167	-45.7961180	170.7075980	F4	521	P	1	*												P	9		6
168	-45.7961180	170.7075980	F4	520	P	1	*	L	L										P	9		6
169	-45.7983200	170.7078570	F5	511	B	1	S					1			1				C	5		4
170	-45.7983200	170.7078570	F5	514	B	1	S					1			1				C	5		4
171	-45.7983200	170.7078570	F5	515	B	1	S					1			1				C	5		4
172	-45.7883290	170.7185070	G2	557	P	1	S												V	9	3	6
173	-45.7883290	170.7185070	G2	558	P	1	S												V	9	3	6

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
174	-45.7883290	170.7185070	G2	559	P	1	S											1	V	9	3	6
175	-45.7883290	170.7185070	G2	556	P	1	S												V	9	3	6
176	-45.7883290	170.7185070	G2	555	P	1	S												V	9	3	6
177	-45.7891230	170.7205710	G3	564	P	1	L		L										P	1		1
178	-45.7891230	170.7205710	G3	566	P	1	L		L										P	1		1
179	-45.7891230	170.7205710	G3	565	P	1	L	*	L										P	1		1
180	-45.7898120	170.7226090	G4	571	B	1	S												V	8		5
181	-45.7898120	170.7226090	G4	572	B	1	S												V	8		5
182	-45.7898120	170.7226090	G4	569	B	1	S												V	8		5
183	-45.7898120	170.7226090	G4	568	B	1	S												V	8		5
184	-45.7898120	170.7226090	G4	570	B	1	S												V	8		5
185	-45.7902610	170.7239060	G5	579	B	1	S					1							V	2		1
186	-45.7902610	170.7239060	G5	576	B	1	S					1							V	2		1
187	-45.7902610	170.7239060	G5	575	B	1	S												V	2		1
188	-45.7902610	170.7239060	G5	578	B	1	S					1							V	2		1
189	-45.7902610	170.7239060	G5	574	B	1	S					1							V	2		1
190	-45.7979400	170.6451600	H1	416	B	1	S	C			1		1						P	2		1
191	-45.7979400	170.6451600	H1	414	B	1	S				1	1	1						P	2		1
192	-45.7979400	170.6451600	H1	413	B	1	S				1	1		1					P	2		1
193	-45.7979400	170.6451600	H1	415	B							1	1						P	2		1
194	-45.7979400	170.6451600	H1	418	B	1	S						1	1					P	2		1
195	-45.7979400	170.6451600	H1	417	B	1	C	S				1		1					P	2		1
196	-45.7985800	170.6452000	H2	407	B	1	L	S	L		1	1				1			P	9		6
197	-45.7985800	170.6452000	H2	410	P	1	L	S	L					1					P	9		6
198	-45.7985800	170.6452000	H2	411	P	1	L	S	L					1					P	9		6
199	-45.7985800	170.6452000	H2	408	B							1				1		1	P	9		6
200	-45.7985800	170.6452000	H2	409	P	1	L		L					1					P	9		6
201	-45.7985800	170.6452000	H2	412	B	1	S									1			P	9		6
202	-45.7992600	170.6454700	H3	402	P	1	L		L					1					P	9		6
203	-45.7992600	170.6454700	H3	403	P	1	L	S	L					1					P	9		6
204	-45.7992600	170.6454700	H3	405	P	1	L	S	L					1					P	9		6
205	-45.7992600	170.6454700	H3	404	P	1	L	S	L					1					P	9		6
206	-45.7992600	170.6454700	H3	406	P	1	L		L					1					P	9		6
207	-45.7999800	170.6456100	H4	400	P	1	L		L					1					P	10		1
208	-45.7999800	170.6456100	H4	399	P	1	L		L					1					P	10		1
209	-45.7999800	170.6456100	H4	397	P	1	L	S	L					1					P	10		1
210	-45.7999800	170.6456100	H4	398	P	1	S	L	L					1					P	10		1
211	-45.7999800	170.6456100	H4	401	P	1	S							1					P	10		1
212	-45.8010700	170.6460600	H5	396	P	1	S	L	L					1					C	10	3	1
213	-45.8010700	170.6460600	H5	393	P	1	S												C	10	3	1
214	-45.8010700	170.6460600	H5	391	P	1	S	L	L					1					C	10	3	1
215	-45.8010700	170.6460600	H5	394	P	1	L	S	L					1					C	10	3	1
216	-45.8010700	170.6460600	H5	395	P	1	L		L				1	1					C	10	3	1
217	-45.8010700	170.6460600	H5	392	P	1	S												C	10	3	1
218	-45.8011600	170.6459700	H6	389	P	1	L	S	L					1					C	10	1	1
219	-45.8011600	170.6459700	H6	390	P	1	S	L	L				1	1					C	10	1	1
220	-45.8011600	170.6459700	H6	387	B	1	L	S	L			1		1					C	10	1	1
221	-45.8011600	170.6459700	H6	388	P	1	S												C	10	1	1
222	-45.8011600	170.6459700	H6	386	P	1	S												C	10	1	1
223	-45.8017100	170.6461600	H7	385	P	1	S												V	3		2
224	-45.8017100	170.6461600	H7	382	P	1	S										1		V	3		2
225	-45.8017100	170.6461600	H7	381	P	1	S												V	3		2
226	-45.8017100	170.6461600	H7	384	P	1	S												V	3		2
227	-45.8017100	170.6461600	H7	383	P	1	S												V	3		2
228	-45.8025700	170.6463800	H8	376	P	1	S										1		V	6		4
229	-45.8025700	170.6463800	H8	377	P	1	S												V	6		4
230	-45.8025700	170.6463800	H8	380	P	1	S												V	6		4
231	-45.8025700	170.6463800	H8	378	P	1	S										1		V	6		4
232	-45.8020570	170.6821840	P1	145	B	1	S	L	R			1		1					D	1		1
233	-45.8020570	170.6821840	P1	144	B	1	S	L	R			1		1					D	1		1
234	-45.8020570	170.6821840	P1	142	B	1	S	L	R		1	1							D	1		1
235	-45.8020570	170.6821840	P1	143	B	1	S	L	R			1							D	1		1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
236	-45.8121720	170.6572040	P10	164	B	1	S						1						V	2		1
237	-45.8121720	170.6572040	P10	165	B	1	S					1							V	2		1
238	-45.8121720	170.6572040	P10	167	B	1	S					1							V	2		1
239	-45.8121720	170.6572040	P10	168	B	1	S					1							V	2		1
240	-45.8125240	170.6470010	P11	336	B							1	1						C	4		3
241	-45.8125240	170.6470010	P11	338	B							1	1						C	4		3
242	-45.8125240	170.6470010	P11	337	B							1	1						C	4		3
243	-45.8125240	170.6470010	P11	334	B							1	1						C	4		3
244	-45.8125240	170.6470010	P11	335	B							1	1						C	4		3
245	-45.8116800	170.6338440	P12	98	B	1	S					1							V	2		1
246	-45.8116800	170.6338440	P12	99	B	1	S										1		V	2		1
247	-45.8116800	170.6338440	P12	100	B	1	S										1		V	2		1
248	-45.8116800	170.6338440	P12	101	B	1	S				1	1							V	2		1
249	-45.8117440	170.6308540	P13	107	P	1	S	L	L										V	2		1
250	-45.8117440	170.6308540	P13	104	P	1	S				1	1							V	2		1
251	-45.8117440	170.6308540	P13	105	P	1	S												V	2		1
252	-45.8117440	170.6308540	P13	103	P	1	S					1							V	2		1
253	-45.8207110	170.6625760	P14	174	B	1	S			9					1				C	5		4
254	-45.8207110	170.6625760	P14	176	B	1	S			21					1		1		C	5		4
255	-45.8207110	170.6625760	P14	178	B	1	S			19					1				C	5		4
256	-45.8207110	170.6625760	P14	177	B	1	S			27		1			1				C	5		4
257	-45.8207110	170.6625760	P14	175	B	1	S			24					1				C	5		4
258	-45.8219850	170.6604020	P15	181	B	1	S										1		V	6		4
259	-45.8219850	170.6604020	P15	183	B	1	S										1		V	6		4
260	-45.8219850	170.6604020	P15	179	B	1	S										1		V	6		4
261	-45.8219850	170.6604020	P15	182	B	1	S										1		V	6		4
262	-45.8219850	170.6604020	P15	180	B	1	S				1						1		V	6		4
263	-45.8194360	170.6520060	P16	323	B	1	S					1							V	2	4	1
264	-45.8194360	170.6520060	P16	327	B							1	1						V	2	4	1
265	-45.8194360	170.6520060	P16	321	B	1	S					1							V	2	4	1
266	-45.8194360	170.6520060	P16	324	B							1							V	2	4	1
267	-45.8194360	170.6520060	P16	322	B	1	S					1							V	2	4	1
268	-45.8207860	170.6409870	P17	352	B							1							V	8	4	5
269	-45.8207860	170.6409870	P17	348	B	1	S												V	8	4	5
270	-45.8259580	170.6671480	P18	188	B	1	L	S	R	40				1					P	7		4
271	-45.8259580	170.6671480	P18	186	B	1	L	S	R	28									P	7		4
272	-45.8259580	170.6671480	P18	187	B	1	L	S	R	17				1					P	7		4
273	-45.8259580	170.6671480	P18	185	B	1	L	S	R	37									P	7		4
274	-45.8259580	170.6671480	P18	184	B	1	L	S	R	23									P	7		4
275	-45.8269330	170.6654990	P19	191	B							1	1						V	4	2	3
276	-45.8269330	170.6654990	P19	196	B	1	M					1	1						V	4	2	3
277	-45.8269330	170.6654990	P19	192	B							1	1						V	4	2	3
278	-45.7964280	170.6623060	P2	132	P	1	S												V	4	4	3
279	-45.7964280	170.6623060	P2	130	P	1	S					1							V	4	4	3
280	-45.8240840	170.6563540	P20	316	B	1	S					1							C	4		3
281	-45.8240840	170.6563540	P20	317	B							1							C	4		3
282	-45.8240840	170.6563540	P20	311	B	1	S					1	1						C	4		3
283	-45.8240840	170.6563540	P20	312	B							1							C	4		3
284	-45.8238590	170.6480330	P21	330	B							1	1						C	4		3
285	-45.8238590	170.6480330	P21	328	B							1	1						C	4		3
286	-45.8238590	170.6480330	P21	329	B							1	1						C	4		3
287	-45.8238590	170.6480330	P21	332	B							1	1						C	4		3
288	-45.8238590	170.6480330	P21	333	B							1	1						C	4		3
289	-45.8198880	170.6332720	P22	95	B	1	S				1	1							V	2	4	1
290	-45.8198880	170.6332720	P22	93	B	1	S				1	1							V	2	4	1
291	-45.8198880	170.6332720	P22	94	B						1	1	1						V	2	4	1
292	-45.8198240	170.6311090	P23	88	P	1	S					1							V	3		2
293	-45.8198240	170.6311090	P23	85	P	1	S												V	3		2
294	-45.8198240	170.6311090	P23	86	P	1	S												V	3		2
295	-45.8295560	170.6617510	P24	199	B	1	M												V	8		5
296	-45.8295560	170.6617510	P24	200	B	1	M										1		V	8		5
297	-45.8295560	170.6617510	P24	201	B	1	M												V	8		5

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
298	-45.8295560	170.6617510	P24	198	B	1	M										1		V	8		5
299	-45.8270080	170.6537300	P25	306	B	1	S												V	8		5
300	-45.8270080	170.6537300	P25	309	B	1	S					1							V	8		5
301	-45.8270080	170.6537300	P25	304	B	1	S										1		V	8		5
302	-45.8285070	170.6526810	P26	299	B	1	S										1		V	6		4
303	-45.8285070	170.6526810	P26	298	B	1	S										1		V	6		4
304	-45.8285070	170.6526810	P26	300	B	1	S										1		V	6		4
305	-45.8285070	170.6526810	P26	301	B	1	S												V	6		4
306	-45.8285070	170.6526810	P26	302	B	1	S										1		V	6		4
307	-45.8253590	170.6336530	P27	69	B	1	L	S	R		1	1							P	1		1
308	-45.8253590	170.6336530	P27	68	B	1	S	L	R		1	1							P	1		1
309	-45.8253590	170.6336530	P27	70	B	1	L	S	R		1	1							P	1		1
310	-45.8253590	170.6336530	P27	71	B	1	L	S	R		1	1		1					P	1		1
311	-45.8336040	170.6597270	P28	209	B	1	M												V	8		5
312	-45.8336040	170.6597270	P28	204	B	1	M												V	8		5
313	-45.8336040	170.6597270	P28	207	B	1	M					1							V	8		5
314	-45.8336040	170.6597270	P28	210	B	1	M												V	8		5
315	-45.8336040	170.6597270	P28	205	B	1	M					1							V	8		5
316	-45.8336040	170.6597270	P28	202	B	1	M												V	8		5
317	-45.8336040	170.6597270	P28	206	B	1	M					1							V	8		5
318	-45.8336040	170.6597270	P28	208	B	1	M										1		V	8		5
319	-45.8353280	170.6583030	P29	214	B							1	1						C	4		3
320	-45.8353280	170.6583030	P29	212	B							1	1			1			C	4		3
321	-45.8353280	170.6583030	P29	211	B	1	M					1	1						C	4		3
322	-45.8011770	170.6732120	P3	139	B	1	S					1							V	1		1
323	-45.8011770	170.6732120	P3	138	B						1	1	1						V	1		1
324	-45.8011770	170.6732120	P3	140	B							1							V	1		1
325	-45.8011770	170.6732120	P3	137	B	1	S										1		V	1		1
326	-45.8011770	170.6732120	P3	136	B	1	S												V	1		1
327	-45.8237690	170.6295820	P30	80	P	1	S												V	2	3	1
328	-45.8237690	170.6295820	P30	81	P	1	S												V	2	3	1
329	-45.8237690	170.6295820	P30	79	P	1	S				1	1							V	2	3	1
330	-45.8237690	170.6295820	P30	82	P	1	S												V	2	3	1
331	-45.8237690	170.6295820	P30	77	P	1	S												V	2	3	1
332	-45.8237690	170.6295820	P30	83	P	1	S												V	2	3	1
333	-45.8237690	170.6295820	P30	84	P	1	S												V	2	3	1
334	-45.8064700	170.6526300	P31	441	B	1	S					1							V	2		1
335	-45.8064700	170.6526300	P31	443	B	1	S				1	1							V	2		1
336	-45.8064700	170.6526300	P31	442	B	1	S				1	1							V	2		1
337	-45.8064700	170.6526300	P31	437	B	1	S					1					1		V	2		1
338	-45.8064700	170.6526300	P31	439	B	1	S				1								V	2		1
339	-45.8064700	170.6526300	P31	438	B	1	S												V	2		1
340	-45.8064700	170.6526300	P31	440	B	1	S												V	2		1
341	-45.8099700	170.6407900	P32	343	B	1	S					1							V	6		4
342	-45.8099700	170.6407900	P32	345	B	1	S										1		V	6		4
343	-45.8099700	170.6407900	P32	342	B	1	S				1						1		V	6		4
344	-45.8099700	170.6407900	P32	341	B	1	S												V	6		4
345	-45.8031200	170.6428900	P33	374	P	1	S												V	7	3	4
346	-45.8031200	170.6428900	P33	371	P	1	S	L	R										V	7	3	4
347	-45.8031200	170.6428900	P33	372	P	1	S												V	7	3	4
348	-45.8031200	170.6428900	P33	373	P	1	S												V	7	3	4
349	-45.8031200	170.6428900	P33	375	P	1	S												V	7	3	4
350	-45.7892100	170.6779600	P34	477	B	1	S												C	6		4
351	-45.7892100	170.6779600	P34	475	B	1	S										1		C	6		4
352	-45.7892100	170.6779600	P34	473	B	1	S												C	6		4
353	-45.7892100	170.6779600	P34	472	B	1	S					1					1		C	6		4
354	-45.7892100	170.6779600	P34	476	B	1	S												C	6		4
355	-45.7892100	170.6779600	P34	474	B	1	S												C	6		4
356	-45.7896300	170.6852500	P35	482	B	1	S												C	6		4
357	-45.7896300	170.6852500	P35	479	B	1	S												C	6		4
358	-45.7896300	170.6852500	P35	480	B	1	S												C	6		4
359	-45.7896300	170.6852500	P35	481	B	1	S										1		C	6		4

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
360	-45.7896300	170.6852500	P35	478	B	1	S										1		C	6		4
361	-45.7923500	170.6963600	P36	543	B	1	S										1		C	6		4
362	-45.7923500	170.6963600	P36	546	B	1	S				1	1			1				C	6		4
363	-45.7923500	170.6963600	P36	547	B	1	S				1	1			1				C	6		4
364	-45.7923500	170.6963600	P36	545	B	1	S				1	1			1		1		C	6		4
365	-45.7923500	170.6963600	P36	548	B	1	S					1							C	6		4
366	-45.7927200	170.7025600	P37	540	B	1	S												V	6		4
367	-45.7927200	170.7025600	P37	539	B	1	S					1					1		V	6		4
368	-45.7927200	170.7025600	P37	542	B	1	S												V	6		4
369	-45.7927200	170.7025600	P37	541	B	1	S										1		V	6		4
370	-45.8006730	170.6437230	P4	264	B	1	L		L					1					P	8		5
371	-45.8006730	170.6437230	P4	268	B	1	L		L					1					P	8		5
372	-45.8006730	170.6437230	P4	263	B							1	1						P	8		5
373	-45.8006730	170.6437230	P4	266	B	1	L		L					1					P	8		5
374	-45.8006730	170.6437230	P4	265	B	1	S	L	L			1		1					P	8		5
375	-45.8006730	170.6437230	P4	267	B	1	S	L	L					1					P	8		5
376	-45.8091810	170.6730360	P5	150	B	1	S								1		1		C	5		4
377	-45.8091810	170.6730360	P5	151	B	1	S								1		1		C	5		4
378	-45.8091810	170.6730360	P5	148	B	1	S			1					1		1		C	5		4
379	-45.8091810	170.6730360	P5	149	B	1	S								1		1		C	5		4
380	-45.8077740	170.6657360	P6	157	B	1	S								1				C	2		1
381	-45.8077740	170.6657360	P6	155	B							1	1						C	2		1
382	-45.8077740	170.6657360	P6	153	B	1	S										1		C	2		1
383	-45.8077740	170.6657360	P6	154	B	1	S	L	R			1							C	2		1
384	-45.8077740	170.6657360	P6	156	B	1	S					1			1				C	2		1
385	-45.8053990	170.6585230	P7	159	B							1							C	4		3
386	-45.8053990	170.6585230	P7	163	B	1	S					1	1						C	4		3
387	-45.8053990	170.6585230	P7	162	B	1	S					1	1						C	4		3
388	-45.8053990	170.6585230	P7	161	B							1							C	4		3
389	-45.8053990	170.6585230	P7	160	B							1							C	4		3
390	-45.8051230	170.6357890	P8	234	P	1	S												V	3		2
391	-45.8051230	170.6357890	P8	233	P	1	S							1					V	3		2
392	-45.8051230	170.6357890	P8	236	P	1	S												V	3		2
393	-45.8051230	170.6357890	P8	235	P	1	S												V	3		2
394	-45.8051230	170.6357890	P8	232	P	1	S												V	3		2
395	-45.8121720	170.6610740	P9	172	B	1	S					1	1						C	2		1
396	-45.8121720	170.6610740	P9	171	B	1	S					1	1						C	2		1
397	-45.8121720	170.6610740	P9	170	B	1	S				1	1							C	2		1
398	-45.8121720	170.6610740	P9	169	B	1	S					1							C	2		1
399	-45.8121720	170.6610740	P9	173	B	1	S					1	1						C	2		1
400	-45.8062973	170.6361411	39	122	P	1	S													3		2
401	-45.8062973	170.6361411	39	123	P	1	S													3		2
402	-45.8062973	170.6361411	39	186	P	1	S													3		2
403	-45.8062973	170.6361411	39	187	P	1	S													3		2
404	-45.8062973	170.6361411	39	118	P	1	S													3		2
405	-45.8062973	170.6361411	39	119	P	1	S													3		2
406	-45.8062973	170.6361411	39	120	P	1	S													3		2
407	-45.8062973	170.6361411	39	121	P	1	S													3		2
408	-45.8062973	170.6361411	39	190	P	1	S													3		2
409	-45.8062973	170.6361411	39	188	P	1	S													3		2
410	-45.8062973	170.6361411	39	189	P	1	S													3		2
411	-45.8096305	170.6352290	40	213	B	1	S		R		1									7		4
412	-45.8096305	170.6352290	40	216	B	1	S				1						1			6		4
413	-45.8096305	170.6352290	40	217	B	1	S				1						1			6		4
414	-45.8096305	170.6352290	40	214	B	1	S		R		1						1			5		4
415	-45.8096305	170.6352290	40	215	B	1	S		R		1						1			5		4
416	-45.8012903	170.6488768	41	92	P	1	S													3		2
417	-45.8012903	170.6488768	41	91	P	1	S										1			3		2
418	-45.8012903	170.6488768	41	90	P	1	S													3		2
419	-45.8012903	170.6488768	41	89	P	1	S													3		2
420	-45.8049485	170.6348289	42	195	P	1	S				1				1					3		2
421	-45.8049485	170.6348289	42	192	P	1	S													3		2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
422	-45.8049485	170.6348289	42	191	P	1	S													3		2
423	-45.8049485	170.6348289	42	194	P	1	S													3		2
424	-45.8049485	170.6348289	42	193	P	1	S													3		2
425	-45.8095311	170.6335422	43	126	B	1	S										1			6		4
426	-45.8095311	170.6335422	43	125	B	1	S										1			6		4
427	-45.8095311	170.6335422	43	128	B	1	S										1			6		4
428	-45.8095311	170.6335422	43	124	B	1	S										1			8		5
429	-45.8095311	170.6335422	43	127	B	1	S										1			6		4
430	-45.8046478	170.6470017	44	160	B	1	S			3	1						1			7		4
431	-45.8046478	170.6470017	44	161	B	1	S			2	1				1		1			5		4
432	-45.8046478	170.6470017	44	163	B	1	S			4	1						1			6		4
433	-45.8046478	170.6470017	44	162	B	1	S			5	1						1			7		4
434	-45.8009448	170.6581881	45	156	P	1	S										1			3		2
435	-45.8009448	170.6581881	45	152	P	1	S													3		2
436	-45.8009448	170.6581881	45	151	B	1	S															
437	-45.8009448	170.6581881	45	154	P	1	S													3		2
438	-45.8009448	170.6581881	45	153	P	1	S													3		2
439	-45.8057332	170.6424329	46	176	B	1	S	L	R	7	1						1			7		4
440	-45.8057332	170.6424329	46	173	B	1	S	L	R	3	1						1			7		4
441	-45.8057332	170.6424329	46	172	B	1	S	L	R	2							1			7		4
442	-45.8057332	170.6424329	46	175	B	1	S	L	R	9	1						1			7		4
443	-45.8057332	170.6424329	46	174	B	1	S	L	R	16	1						1			7		4
444	-45.8034780	170.6466644	47	170	B	1	S		R	8	1						1			7		4
445	-45.8034780	170.6466644	47	167	B	1	S		R	15							1			7		4
446	-45.8034780	170.6466644	47	168	B	1	S		R	13							1			7		4
447	-45.8034780	170.6466644	47	165	B	1	S		R	3							1			7		4
448	-45.8034780	170.6466644	47	169	B	1	S		R	4	1						1			7		4
449	-45.7994123	170.6576140	48	157	B	1	S										1			3		2
450	-45.7994123	170.6576140	48	158	B	1	S										1			6		4
451	-45.7994123	170.6576140	48	159	B	1	S			3							1			7		4
452	-45.8096297	170.6307502	49	211	P	1	S													1		1
453	-45.8096297	170.6307502	49	210		1	S													1		1
454	-45.8096297	170.6307502	49	209	P	1	S													1		1
455	-45.8096297	170.6307502	49	208	P	1	S										1			2		1
456	-45.8096297	170.6307502	49	207	B	1	S						1				1			2		1
457	-45.8096297	170.6307502	49	212	P	1	S													1		1
458	-45.8022932	170.6320725	50	203	B	1	S													8		5
459	-45.8022932	170.6320725	50	202	B	1	S										1			8		5
460	-45.8022932	170.6320725	50	206	B	1	S										1			8		5
461	-45.8022932	170.6320725	50	204	B	1	S										1			8		5
462	-45.8022932	170.6320725	50	205	B	1	S										1			8		5
463	-45.7997432	170.6406367	51	182	B	1	M										1			2		1
464	-45.7997432	170.6406367	51	183	B	1	M										1			2		1
465	-45.7997432	170.6406367	51	184	B	1	M										1			2		1
466	-45.7997432	170.6406367	51	178	B	1	M													8		5
467	-45.7997432	170.6406367	51	179	B	1	M										1			8		5
468	-45.7997432	170.6406367	51	180	B	1	M										1			8		5
469	-45.7990324	170.6481970	52	85	B	1	M		L								1			2		1
470	-45.7990324	170.6481970	52	82	B	1	M										1			2		1
471	-45.7990324	170.6481970	52	83	B	1	M										1			2		1
472	-45.7990324	170.6481970	52	84	B	1	M										1			2		1
473	-45.7990324	170.6481970	52	87	B	1	M													2		1
474	-45.7990324	170.6481970	52	86	B	1	M										1			2		1
475	-45.7978693	170.6570496	53	75	B	1	L	S	L											1		1
476	-45.7978693	170.6570496	53	74	B	1	L		L											10		1
477	-45.7978693	170.6570496	53	76	B	1	S	S	R											2		1
478	-45.7978693	170.6570496	53	77	B	1	L		L											2		1
479	-45.7978693	170.6570496	53	79	B	1	S	L	L											2		1
480	-45.7978693	170.6570496	53	81	B	1	L		R											10		1
481	-45.7978693	170.6570496	53	80	B	1	S	L	L											2		1
482	-45.7963831	170.6566619	54	71	B	1	L		L											10		1
483	-45.7963831	170.6566619	54	72	B	1	L		L							1				10		1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
484	-45.7963831	170.6566619	54	73	B	1	L		L							1				10		1
485	-45.7963831	170.6566619	54	70	B	1	L		L							1				10		1
486	-45.7963831	170.6566619	54	68	B	1	L		L							1				9		6
487	-45.7963831	170.6566619	54	69	B	1	C		L											9		6
488	-45.7941473	170.6657348	56	58	P	1	S													3		2
489	-45.7941473	170.6657348	56	47	P	1	S													3		2
490	-45.7941473	170.6657348	56	48	P	1	S	L	L											10		1
491	-45.7941473	170.6657348	56	49	B	1	S		L											10		1
492	-45.7941473	170.6657348	56	57	B	1	S													1		1
493	-45.7941473	170.6657348	56	52	B	1	S						1			1				9		6
494	-45.7941473	170.6657348	56	51	B	1	S		L											10		1
495	-45.7941473	170.6657348	56	50	B	1	S		L							1				10		1
496	-45.7941473	170.6657348	56	56	B	0						1	1			1		1		9		6
497	-45.7941473	170.6657348	56	54	B	1	S		L							1				9		6
498	-45.7941473	170.6657348	56	53	B	1	S		L											10		1
499	-45.7941473	170.6657348	56	59	P	1	S	L	R											1		1
500	-45.7941473	170.6657348	56	61	P	1	S	L	R											3		2
501	-45.7941473	170.6657348	56	60	P	1	S	L	R											1		1
502	-45.7919711	170.6815411	57	32	B	1	L		L											1		1
503	-45.7919711	170.6815411	57	34	P	1	S	L	L											1		1
504	-45.7919711	170.6815411	57	33	P	1	S	L	L											1		1
505	-45.7919711	170.6815411	57	36	P	1	S	L	L											1		1
506	-45.7919711	170.6815411	57	35	P	1	L		L											1		1
507	-45.7939183	170.6811975	58	46	P	1	S													3		2
508	-45.7939183	170.6811975	58	45	P	1	S													3		2
509	-45.7939183	170.6811975	58	44	P	1	S													1		1
510	-45.7939183	170.6811975	58	42	B	1	L	S	L											1		1
511	-45.7939183	170.6811975	58	43	P	1	S													1		1
512	-45.7941473	170.6967746	59	27	P	1	S													3		2
513	-45.7941473	170.6967746	59	28	P	1	S													3		2
514	-45.7941473	170.6967746	59	29	P	1	S													3		2
515	-45.7941473	170.6967746	59	30	P	1	S													3		2
516	-45.7941473	170.6967746	59	31	P	1	S													3		2
517	-45.7966672	170.6964310	60	26	B	1	L		L											10		1
518	-45.7966672	170.6964310	60	23	bb	1	L		L											10		1
519	-45.7966672	170.6964310	60	22	B	1	L		L											10		1
520	-45.7966672	170.6964310	60	25	B	1	L		L											10		1
521	-45.7966672	170.6964310	60	24	B	1	L		L											10		1
522	-45.7926583	170.7147571	61	13	P	1	S													3		2
523	-45.7926583	170.7147571	61	12	P	1	S													3		2
524	-45.7926583	170.7147571	61	11	P	1	S										1			3		2
525	-45.7926583	170.7147571	61	15	P	1	S													3		2
526	-45.7926583	170.7147571	61	14	P	1	S													3		2
527	-45.7943764	170.7167042	62	5	B	1	L		L					1						10		1
528	-45.7943764	170.7167042	62	10	B	1	L		L					1						10		1
529	-45.7943764	170.7167042	62	8	B	1	L		L				1	1						10		1
530	-45.7943764	170.7167042	62	9	B	1	L		L				1	1						10		1
531	-45.7943764	170.7167042	62	6	B	1	L		L					1						10		1
532	-45.7943764	170.7167042	62	7	P	1	C		L					1						9		6
533	-45.8041121	170.6337787	63	196	P	1	S													3		2
534	-45.8041121	170.6337787	63	199	P	1	S													3		2
535	-45.8041121	170.6337787	63	201	B	1	S					1								1		1
536	-45.8041121	170.6337787	63	197	P	1	S													3		2
537	-45.8041121	170.6337787	63	198	P	1	S													3		2
538	-45.7928874	170.6813120	64	38	B	1	S	L	L											1		1
539	-45.7928874	170.6813120	64	39	B	1	L		R											1		1
540	-45.7928874	170.6813120	64	40	B	1	L		R							1				10		1
541	-45.7928874	170.6813120	64	41	B	1	S	L	R											1		1
542	-45.7957509	170.7021579	65	18	B	1	L		L											10		1
543	-45.7957509	170.7021579	65	17	B	1	L		L											10		1
544	-45.7957509	170.7021579	65	16	B	1	L		L											10		1
545	-45.7957509	170.7021579	65	21	B	1	L		L											10		1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
546	-45.7957509	170.7021579	65	20	B	1	L		L											10		1
547	-45.7957509	170.7021579	65	19	B	1	L		L											10		1
548	-45.7963236	170.6807393	66	136	B	0					1	1								4		3
549	-45.7963236	170.6807393	66	135	B	0					1	1								4		3
550	-45.7963236	170.6807393	66	129	B	0					1	1	1							4		3
551	-45.7963236	170.6807393	66	139	B	0					1	1								4		3
552	-45.7963236	170.6807393	66	138	B	0					1									4		3
553	-45.7963236	170.6807393	66	132	B	1	S				1	1								4		3
554	-45.7963236	170.6807393	66	133	B	0					1	1								4		3
555	-45.7963236	170.6807393	66	134	B	0					1	1								4		3
556	-45.7963236	170.6807393	66	137	B	0					1	1								4		3
557	-45.7963236	170.6807393	66	131	B	0					1	1	1							4		3
558	-45.7963236	170.6807393	66	130	B	0					1	1	1							4		3
559	-45.7964381	170.6661930	67	63	P	1	S													3		2
560	-45.7964381	170.6661930	67	66	P	1	S								1					5		4
561	-45.7964381	170.6661930	67	67	B	1	S								1		1			5		4
562	-45.7964381	170.6661930	67	64	P	1	S													3		2
563	-45.7964381	170.6661930	67	65	P	1	S													3		2
564	-45.7964381	170.6661930	67	62	P	1	S													3		2
565	-45.8148787	170.6325188	68	221	P	1	S					1								3		2
566	-45.8148787	170.6325188	68	222	P	1	S					1								1		1
567	-45.8148787	170.6325188	68	219	P	1	S					1								1		1
568	-45.8148787	170.6325188	68	224	P	1	S					1								1		1
569	-45.8148787	170.6325188	68	220	B	1	L		R											10		1
570	-45.8164823	170.6478669	69	225	B	0						1	1							4		3
571	-45.8164823	170.6478669	69	228	B	0						1	1							4		3
572	-45.8164823	170.6478669	69	229	B	0						1	1							4		3
573	-45.8164823	170.6478669	69	226	B	0						1	1							4		3
574	-45.8164823	170.6478669	69	227	B	0						1	1							4		3
575	-45.8033104	170.6690564	70	140	B	1	S				1	1								4		3
576	-45.8033104	170.6690564	70	143	B	0					1	1								4		3
577	-45.8033104	170.6690564	70	144	B	1	S				1						1			6		4
578	-45.8033104	170.6690564	70	141	B	0					1	1								4		3
579	-45.8033104	170.6690564	70	142	B	0					1	1								4		3
580	-45.8033104	170.6690564	70	145	B	1	S				1						1					
581	-45.8033104	170.6690564	70	148	B	1	S					1					1			6		4
582	-45.8033104	170.6690564	70	147	B	1	S				1	1					1			6		4
583	-45.8033104	170.6690564	70	146	B	1	S					1					1			6		4
584	-45.8033104	170.6690564	70	149	B	1	S					1					1			6		4
585	-45.8040982	170.6415703	71	106	P	1	S													3		2
586	-45.8040982	170.6415703	71	104		1	S													3		2
587	-45.8040982	170.6415703	71	103		1	S													3		2
588	-45.8040982	170.6415703	71	102	B	1	S										1			3		2
589	-45.8040982	170.6415703	71	109	P	1	S													3		2
590	-45.8040982	170.6415703	71	108	P	1	S													3		2
591	-45.8009051	170.6408801	71	107	P	1	S													3		2
592	-45.8009051	170.6408801	72	114	B	1	L		L											10		1
593	-45.8009051	170.6408801	72	113	B	1	L		L											10		1
594	-45.8009051	170.6408801	72	112	B	1	L		L											10		1
595	-45.8009051	170.6408801	72	111	B	1	L		L											10		1
596	-45.8023941	170.6408801	72	115	B	1	L		L											10		1
597	-45.8023941	170.6408801	73	117	P	1	L															
598	-45.8023941	170.6408801	73	99	B	1	S															
599	-45.8023941	170.6408801	73	116	B	1	L		L											1		1
600	-45.8023941	170.6408801	73	100	B	1	L	S			1									1		1
601	-45.8023941	170.6408801	73	95	P	1	S													3		2
602	-45.8023941	170.6408801	73	94	P	1	S										1			3		2
603	-45.8023941	170.6408801	73	96	P	1	S				1						1			3		2

Appendix 2 - Macrofaunal Data

Data from macrofaunal samples.

TAXON	A0_Aug08	A10a_Aug08	A10b_Aug08	A10c_Aug08	A2_Aug08	A4_Aug08	A6_Aug08	A8_Aug08	B0_Aug08	B10_Aug08	B2_Aug08	B4_Aug08	B6_Aug08	B8_Aug08	G01_June08	G02_June08	G03_June08	G04_June08	G05_June08	G06_June08	G07_June08	G08_June08	G09_June08	G10_June08	G11_June08	G12_June08	G13_June08	G14_June08	G15_June08	G16_June08	G17_June08	G18_June08	G19_June08	G20_June08	G21_June08	G22_June08	G23_June08	G24_June08	G25_June08	G26_June08	G27_June08	G28_June08	G29_June08	G30_June08	G31_June08	G32_June08	G33_June08	G34_June08	G35_June08	G36_June08	G37_June08	G38_June08	G39_June08
Anthozoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cerianthidae sp.	0	0	0	0	0	8	0	1	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampharetidae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	5	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	0	0
Pectinaridae	0	2	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	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Terebellidae	0	0	0	0	0	0	10	1	0	0	1	1	2	10	0	0	0	1	0	57	72	142	4	0	2	0	10	2	0	0	0	1	0	0	0	0	0	0	0	0	6	0	24	0	5	24	41	1	0	0	8	1	77
Lophophora	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0
Owenia sp.	0	0	0	0	1	9	135	68	0	0	38	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	11	24	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sabellidae sp.	0	0	0	0	0	1	54	0	0	2	12	0	0	0	1	0	7	0	4	1	4	0	4	1	0	15	22	0	0	0	0	0	7	6	0	1	0	0	0	0	5	0	15	0	3	29	1	0	0	9	0	0	0
Serpulidae	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spirorbis sp.	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dorvilleidae	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Eunicida	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	9	1	0	0	0	0	17
Lumbrineridae sp.	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schistomeringos 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exogone sp.	0	0	0	0	0	0	13	3	0	0	38	7	12	98	0	0	10	1	5	50	38	71	1	2	4	3	62	0	0	0	0	19	0	4	0	0	0	0	0	0	12	1	96	0	8	27	63	10	0	11	2	2	239
Hesionidae	3	0	0	0	0	0	0	0	0	9	0	2	1	8	1	0	0	1	0	12	27	21	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	4	1	33	0	3	4	38	6	0	1	1	3	99
Neanthes sp.	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odontosyllis sp.	0	0	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	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Perinereis 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	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platynereis sp.	1	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	1	7	17	14	0	0	0	0	3	0	0	0	0	2	1	0	0	0	0	0	0	0	2	0	5	0	3	10	5	7	0	0	3	1	7
Sigalionidae sp.	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syllidae sp. F	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syllidae spp.	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polynoidae	0	0	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	0	0	7	6	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	7	0	1	1	10	1	0	0	0	1	37
Aglaophamus sp.	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glyceridae	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	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Glyceriformia	0	4	0	0	0	4	7	1	0	0	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	1	0	0	0	0	0	0	2	0	0	0	0	0	0
Glyceriformia I	0	2	0	0	0	0	1	0	0	0	2	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllodocidae	2	0	0	0	0	0	2	0	0	0	0	0	0	1	2	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	0	0	0	0	0	0	0
Sphaerodoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Aonides sp.	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aonides trifides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Armandia maculata	0	11	0	0	0	0	0	0	0	1	7	0	0	1	7	0	3	0	0	6	9	11	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	14	0	3	19	14	0	0	0	6	1	8
Asychis sp.	0	28	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barantolla lepte	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boccardia sp.	0	4	0	0	4	0	8	1	0	0	9	0	2	0	0	0	10	0	1	0	0	1	4	0	4	2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	15	8	0	0	0	0	0	0	0	0
Capitella 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	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	0	0	0	0
Capitellidae sp. G	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	5	0	0	2	0	0	5	0	16	10	0	2	0	0	0	4	0	3	0	2	0	0	0	5	0	0	17	1	0	2	0	0	1	2	0	0	0
Cirratulidae sp.	0	0	0	0	0	1	9	3	0	0	5	0	0	0	1	0	1	1	0	2	6	0	1	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	3	73
Heteromastus filiformis	0	62	0	1	0	0	4	0	0	224	71	1	2	0	0	0	0	11	5	0	0	2	1	0	1	2	0	9	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	0	1	2	0	0	2	1	0	8	0
Levinsenia 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	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Macroclymenella stewartensis	0	0	0	0	0	0	4	0	0	0	6	0	2	0	0	0	6	0	0	0	0	0	0	2	7	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	2	0	14	0	2	0	0	0	0	1	0
Maldanidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	1	4	3	1	4	0	2	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	15	1	0	1	0	0	0	0
Marenzelleria sp. A	0	0	0	0	0	0	1	0	0	0	0	5	17	1	0	0	13	5	4	1	4	4	11	2	25	1	7	8	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	42	25	0	0	0	3	0	2	0
Notomastus sp.	0	0	0	0	0	0	0	0	0	0	2	3	1	1	0	0	0	0	0	15	11	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	1	1
Orbinia sp.	0	2	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0	1
Orbiniidae	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	1	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
Paradoneis lyra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	9	0	0	0	0	0	0	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
Paraonidae	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	0	0
Paraonidae sp. D	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	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylo 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydorid	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0
Prionospio aucklandica	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	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	9	0	0	0	0	0
Prionospio sp.	0	30	2	1	0	2	18	3	0	0	134	11	7	0	5	0	28	0	10	10	7	2	1	0	1	0	0	1	0	0	0	2	7	8	0	4	1	0	0	0	0	0	9	7	10	19	19	1	0	9	7	1	0
Scalibregmatidae 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Scolelepis 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	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TAXON	A0_Aug08	A10a_Aug08	A10b_Aug08	A10c_Aug08	A2_Aug08	A4_Aug08	A6_Aug08	A8_Aug08	B0_Aug08	B10_Aug08	B2_Aug08	B4_Aug08	B6_Aug08	B8_Aug08	G01_June08	G02_June08	G03_June08	G04_June08	G05_June08	G06_June08	G07_June08	G08_June08	G09_June08	G10_June08	G11_June08	G12_June08	G13_June08	G14_June08	G15_June08	G16_June08	G17_June08	G18_June08	G19_June08	G20_June08	G21_June08	G22_June08	G23_June08	G24_June08	G25_June08	G26_June08	G27_June08	G28_June08	G29_June08	G30_June08	G31_June08	G32_June08	G33_June08	G34_June08	G35_June08	G36_June08	G37_June08	G38_June08	G39_June08
Spionidae sp.	0	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	7	2	6	6	4	5	0	4	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	3	8	0	0	2	3	2	0	0	0
Spiophanes cf bombyx	0	0	0	0	0	2	57	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Travisia sp.	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaeta	0	0	0	0	0	0	17	2	0	185	25	18	44	4	1	0	90	18	17	51	106	241	12	0	59	0	87	4	0	0	0	16	3	26	0	0	0	0	0	0	1	0	28	0	85	11	66	73	0	11	23	29	280
Holothurian A	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holothurian B	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0
Holothuroidea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	25
Asteroidea	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	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0
Ophiuroidea	0	0	0	0	0	0	0	1	0	9	0	3	0	9	2	0	0	0	0	3	6	10	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	11	11	1	0	0	0	1	35
Antisolarium egenum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	3	0	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	0	0	0
Cantheridella tesselata	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cominella glandiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eatoniella sp.	0	0	0	2	0	0	1	0	0	3	3	71	188	337	0	0	3	0	9	709	173	357	5	9	35	0	182	3	0	0	0	4	6	0	0	0	0	0	0	34	7	0	490	0	245	662	597	86	2	6	417	18	705
Gastropod 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	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Gastropoda Mike	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	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
Gastropoda_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	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	1	0	1
Maoricolpus roseus	0	0	0	0	0	0	0	0	0	0	0	18	2	2	0	0	1	0	3	0	5	8	5	0	1	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
Micrelenchus sp.	0	0	0	2	0	0	0	0	0	0	0	3	4	0	0	0	0	1	0	6	0	8	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	2	2	0	0	0	1	8
Notacmea helmsi	0	0	0	0	0	0	0	0	0	0	0	3	9	3	0	0	1	0	0	0	1	10	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	2	0	2	3	0	0	0	0	1	0	6
Nudibranch	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	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
Pyramidellidae	0	5	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Trochidae 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turbonilla	0	4	0	0	0	0	4	1	0	1	4	1	0	2	1	2	4	0	4	7	2	1	4	6	9	0	2	1	0	0	0	17	2	6	0	0	0	0	1	2	0	0	0	3	1	0	10	4	0	3	4	7	24
Xymene plebius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Xymene pumilus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zeacolpus symmetrica	0	1242	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zeacumantis lutulentus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zegalerus 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthritica bifurca	0	7	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austrovenus stutchburyi	0	0	0	0	0	0	0	0	0	0	2	0	0	0	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	0	0	0	0	1	0	0	0
Bivalvia_Dan1	0	0	0	0	0	0	1	0	0	0	0	1	2	1	0	0	0	0	0	4	0	24	0	0	6	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	39	0	0	0	0	0	0	9
Bivalvia_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elliptotellina urinatoria	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macomona liliana	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Modiolarca impacta	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mysella unidentata	0	0	0	0	0	0	18	17	0	0	27	5	5	1	0	13	2	1	11	2	0	10	2	1	28	2	1	7	0	0	0	55	1	1	0	0	0	7	52	1	0	0	0	0	3	62	0	0	0	2	0	0	0
Nucula dunedinensis	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Nucula hartvigiana	0	0	0	0	0	0	5	1	0	0	89	1	22	21	0	0	0	0	31	0	0	0	0	0	12	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	13	6	0
Nucula nitidula	0	3	0	0	0	0	0	0	0	3	0	0	0	5	0	0	10	2	0	31	23	83	27	4	208	53	48	18	0	0	0	82	2	29	0	0	0	0	0	9	0	0	0	1	31	59	32	0	0	8	0	0	12
Paphies australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paphies subtriangulata	0	0	0	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perrierina harrisonae	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7	2	0	1	0	0	0	7	3	22	0	0	0	0	0	0	1	0	1	0	0	0	977	137	6	0	0	0	0	3	1	0	0	0	0	0	0	0
Soletellina siliquens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tawera spissa	0	0	0	0	0	4	56	5	0	0	6	0	0	0	4	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	23	3	1	0	1	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0
Solemya parkinsoni	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0
Dentaliidae	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiton	0	1	0	0	0	3	2	1	0	2	0	0	0	2	3	0	0	0	0	8	2	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	6	0	0	0	6	0	0	0	0	0	26
Pycnogonida	4	0	0	0	1	4	2	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1
Callianassidae	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halicarcinus varius	0	0	0	0	0	0	0	0	0	4	0	2	4	4	0	0	0	0	0	20	3	16	0	0	0	0	6	0	0	0	0	1	0	3	0	0	0	0	0	0	6	0	8	0	1	6	15	4	0	0	1	1	37
Halicarcinus whitei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helice crassa	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hemigrapsus 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrophthalmus hirtipes	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	5	2	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	5	0	0	0	0	0	6
Paguridae	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mysidacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0
Colurostylis lemnurum	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TAXON	A0_Aug08	A10a_Aug08	A10b_Aug08	A10c_Aug08	A2_Aug08	A4_Aug08	A6_Aug08	A8_Aug08	B0_Aug08	B10_Aug08	B2_Aug08	B4_Aug08	B6_Aug08	B8_Aug08	G01_June08	G02_June08
Cumacea_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diastylidae sp.	0	0	0	0	0	0	0	0	0	0	5	0	13	0	0	2
Tanaidacea	0	0	0	0	0	0	2	1	0	5	50	11	21	3	0	0
Anthuridae	2	0	0	0	0	1	4	0	0	0	0	0	0	0	3	0
Isopoda22	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cilicaea canaliculata	1	0	0	0	1	1	0	0	0	1	0	1	2	2	10	0
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0
Isopoda 1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda_Dan1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampeliscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipod Rocky	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Amphipoda	1	0	0	0	0	0	0	0	0	1	6	1	1	10	0	3
Aoridae sp.	5	0	0	5	1	0	0	0	0	4	12	1	4	11	8	0
Bathymedon sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Corophidae sp.	8	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Haustoriidae	2	0	3	0	0	0	0	1	1	0	0	0	0	0	0	1
Lysianassidae sp.	1	5	1	1	0	0	0	0	0	50	2	24	23	42	1	0
Phoxocephalidae sp.	0	15	15	2	0	0	8	7	1	35	39	16	45	43	4	0
Torridoharpinia hurleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Caprellida	1	0	0	0	0	0	4	0	0	0	0	0	2	0	0	0
Nebalacea	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Shrimp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	49	1429	35	15	12	45	475	138	2	564	608	211	443	643	67	42
Richness	13	19	8	8	7	16	41	25	2	24	34	25	30	29	24	11

TAXON	G03_June08	G04_June08	G05_June08	G06_June08	G07_June08	G08_June08	G09_June08	G10_June08	G11_June08	G12_June08	G13_June08	G14_June08	G15_June08	G16_June08	G17_June08	G18_June08	G19_June08	G20_June08	G21_June08
Cumacea_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diastylidae sp.	3	11	4	0	0	7	29	5	9	5	53	3	0	0	0	0	0	8	0
Tanaidacea	12	0	3	21	2	26	5	10	5	1	138	8	0	0	0	0	1	7	0
Anthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Isopoda22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cilicaea canaliculata	0	0	0	28	3	23	0	0	0	0	4	0	1	0	0	0	22	0	0
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda_Dan1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampeliscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipod Rocky	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	10	3	1	23	4	68	9	0	6	0	3	0	0	0	1	1	15	15	0
Aoridae sp.	1	0	4	23	43	49	1	16	3	10	29	0	0	1	0	1	1	39	0
Bathymedon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haustoriidae	1	0	0	0	0	0	42	63	1	41	2	0	0	5	0	9	0	0	0
Lysianassidae sp.	1	1	1	76	8	281	2	0	11	0	42	2	0	0	0	0	6	35	0
Phoxocephalidae sp.	20	3	6	62	4	102	27	2	71	6	57	8	0	0	0	5	15	13	1
Torridoharpinia hurleyi	13	0	0	0	1	36	16	9	1	0	15	0	0	0	0	0	2	12	0
Caprellida	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3	7	3	0
Nebalacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrimp	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0
Crustacea G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	264	75	136	1271	619	1674	240	150	569	156	803	85	1	10	5	294	155	233	1
Richness	29	18	24	38	43	40	30	21	36	16	33	20	1	6	4	32	31	28	1

TAXON	G22_June08	G23_June08	G24_June08	G25_June08	G26_June08	G27_June08	G28_June08	G29_June08	G30_June08	G31_June08	G32_June08	G33_June08	G34_June08	G35_June08	G36_June08	G37_June08	G38_June08	G39_June08
Cumacea_Dan2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diastylidae sp.	0	0	0	2	0	0	0	1	0	19	19	0	0	0	3	4	0	0
Tanaidacea	0	0	0	0	0	3	0	2	0	30	134	17	0	0	0	5	0	126
Anthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cilicaea canaliculata	0	0	0	0	0	1	0	9	0	7	4	6	0	0	0	1	2	22
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123
Isopoda 1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda_Dan1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Ampeliscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipod Rocky	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	9	1	2	1	3	20	0	8	1	9	3	13	1	0	11	2	1	42
Aoridae sp.	0	0	0	0	1	11	0	17	1	7	77	68	22	0	3	6	4	87
Bathymedon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophidae sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Haustoriidae	2	0	6	7	0	0	1	0	0	1	4	0	0	0	3	0	0	0
Lysianassidae sp.	1	0	0	0	0	9	0	204	0	2	146	51	45	0	0	22	0	35
Phoxocephalidae sp.	2	0	51	1	0	3	0	75	0	35	199	29	17	1	0	9	4	16
Torridoharpinia hurleyi	0	0	0	43	0	1	0	0	8	18	0	10	0	0	2	17	0	0
Caprellida	0	0	0	0	0	1	0	0	0	2	2	12	0	0	0	0	0	0
Nebalacea	0	0	0	0	0	0	0	5	0	0	4	1	0	0	0	0	0	0
Shrimp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	34	2	1044	244	67	110	8	1094	42	628	1634	1161	297	11	97	554	100	2203
Richness	17	2	6	8	13	24	4	30	10	39	39	34	22	7	23	22	24	39

TAXON	G40_June08	G41_June08	G42_June08	G43_June08	G44_June08	G45_June08	G46_June08	G47_June08	G48_June08	G49_June08	G50_June08	G51_June08	G52_June08	G53_June08	G54_June08	G55_June08	G56_June08	G57_June08	G58_June08	G59_June08	G60_June08	G61_June08	G62_June08	G63_June08	G64_June08	G65_June08	G66_June08	G67_June08	G68_June08	G69_June08	G70_June08	G71_June08	G72_June08	G73_June08	G74_June08	G75_June08	G76_June08	G77_June08	G78_June08	G79_June08	Abundance	% of Total Abundance	# of samples present
Anthozoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Cerianthidae 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	0	0	0	0	0	0	0	0	0	10	0.0	3
Ampharetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	12	0.0	6
Pectinaridae	0	0	1	0	0	0	1	0	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	1	0	0	1	0	12	0.0	9
Terebellidae	36	38	18	15	0	2	0	1	3	0	4	0	1	0	6	0	0	0	0	0	0	0	0	0	1	3	5	0	0	0	1	0	0	0	2	1	1	0	0	1	642	2.1	42
Lophophora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Owenia 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	1	1	0	0	0	0	17	17	0	0	5	339	1.1	17
Sabellidae sp.	0	5	9	3	13	2	0	0	3	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	81	16	0	0	0	11	14	0	0	0	2	2	13	0	3	0	394	1.3	37
Serpulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Spirorbis 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	0	0	0	0	0	0	0	17	0	19	0.1	3
Dorvilleidae	0	0	0	0	0	0	0	0	0	0	0	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	22	0.1	7
Eunicida	0	27	0	0	0	0	0	0	0	0	8	0	7	0	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	88	0.3	14
Lumbrineridae 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	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0.0	4
Schistomeringos sp.	0	0	0	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	0	0	0	0	0	0	1	0.0	1
Exogone sp.	111	118	27	21	0	2	0	1	7	0	0	1	11	1	11	1	4	0	2	0	2	0	0	0	63	9	0	0	0	4	6	0	0	0	3	0	0	0	0	0	1317	4.4	50
Hesionidae	22	40	16	2	0	3	0	1	12	0	3	0	4	0	23	0	1	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0	4	11	0	430	1.4	39
Neanthes 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	0	0	0	0	0	0	0	0	0	3	0.0	1
Odontosyllis sp.	0	0	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	0	0	0	0	0	1	0	8	0.0	6
Perinereis 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	0	0	0	0	0	0	0	0	5	0.0	4
Platynereis sp.	0	18	1	0	0	1	0	0	2	0	0	0	11	0	14	0	5	0	1	0	0	0	0	0	10	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	163	0.5	31
Sigalionidae 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	0	0	0	0	0	0	0	0	0	1	0.0	1
Syllidae sp. F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Syllidae spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0.1	1
Polynoidae	4	11	4	1	4	0	0	3	9	0	4	0	0	0	4	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	132	0.4	24
Aglaophamus 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	2	1	0	0	0	0	1	0	0	0	0	9	0.0	8
Glyceridae	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	4	1	0	0	0	0	4	3	0	0	1	20	0.1	10
Glyceriformia	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	0	0	0	0	0	0	0	0	23	0.1	8
Glyceriformia I	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	13	0.0	10
Goniadidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Phyllodocidae	0	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	0	0	0	0	0	2	11	0	22	0.1	8
Sphaerodoridae	3	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	0	0	0	0	0	0	0	5	0.0	3
Aonides 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	0	0	0	0	0	0	0	0	0	2	0.0	1
Aonides trifides	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0.0	1
Armandia maculata	6	6	17	6	0	1	2	1	4	0	3	0	0	0	8	0	2	0	0	0	0	0	0	0	1	18	3	0	1	0	0	0	0	0	0	1	2	0	4	0	210	0.7	37
Asychis sp.	0	0	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	25	0	0	0	0	0	0	0	57	0.2	5
Barantolla lepte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Boccardia sp.	2	0	0	2	0	117	1	0	0	3	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	1	0	0	2	0	0	0	0	0	0	11	250	0.8	28
Capitella sp.	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0	1
Capitellidae	0	0	0	0	0	2	0	0	0	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	13	0.0	4
Capitellidae sp. G	0	1	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	1	0	0	0	0	0	0	0	0	0	0	85	0.3	21
Cirratulidae sp.	5	23	1	3	8	0	2	9	3	3	9	1	1	0	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	9	0	0	5	0	0	8	4	1	37	3	256	0.9	40
Heteromastus filiformis	1	58	14	0	125	4	127	267	31	143	12	0	19	5	2	0	0	0	0	0	0	0	0	0	2	11	0	0	0	3	0	0	7	21	0	1	1	0	0	0	1268	4.2	42
Levinsenia 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	0	0	0	0	0	0	0	0	0	1	0.0	1
Macroclymenella stewartensis	0	1	0	0	0	4	0	0	0	0	0	0	8	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	64	0.2	16
Maldanidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	51	0.2	17
Marenzelleria sp. A	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	192	0.6	27
Notomastus sp.	1	2	0	1	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	0	0	0	0	0	0	51	0.2	16
Orbinia sp.	2	1	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0.1	15
Orbiniidae	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	0	0	0	0	0	0	0	0	0	0	0	7	0.0	4
Paradoneis lyra	0	48	5	0	0	4	0	8	20	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	120	0.4	11
Paraonidae	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	6	0.0	5
Paraonidae sp. 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	0	0	0	0	0	0	0	0	0	4	0.0	2
Phylo 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	0	1	0	0	0	0	0	0	0	1	0.0	1
Polydorid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Prionospio aucklandica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	0.2	6
Prionospio sp.	5	3	11	0	1	0	1	0	0	0	0	1	0	2	42	0	0	0	1	0	0	0	1	0	10	79	5	0	0	5	0	0	0	0	1	1	4	0	4	2	556	1.9	51
Scalibregmatidae 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	0	0	0	0	0	0	0	0	0	1	0.0	1
Scolelepis 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	0	0	0	0	0	0	0	0	0	1	0.0	1

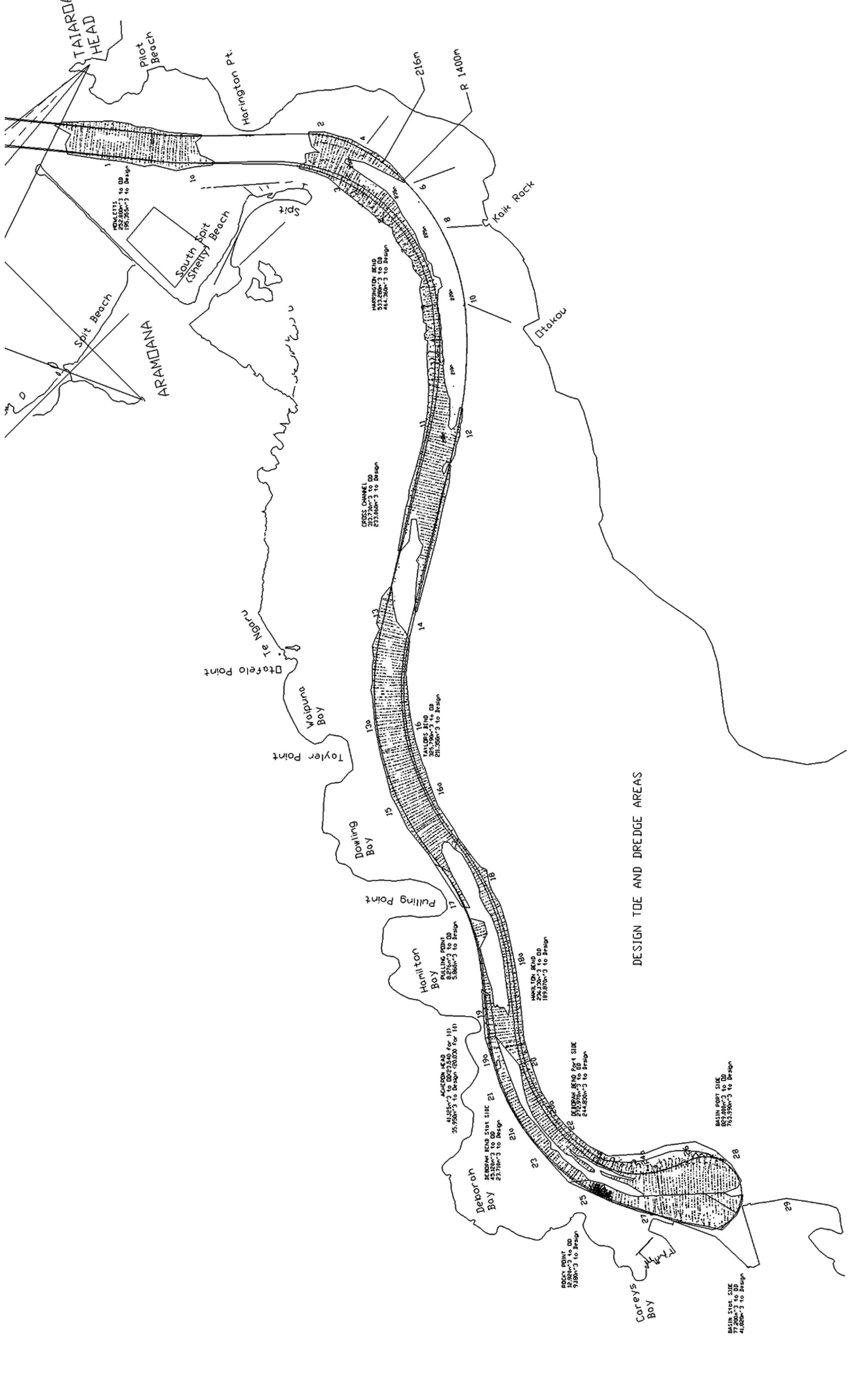
TAXON	G40_June08	G41_June08	G42_June08	G43_June08	G44_June08	G45_June08	G46_June08	G47_June08	G48_June08	G49_June08	G50_June08	G51_June08	G52_June08	G53_June08	G54_June08	G55_June08	G56_June08	G57_June08	G58_June08	G59_June08	G60_June08	G61_June08	G62_June08	G63_June08	G64_June08	G65_June08	G66_June08	G67_June08	G68_June08	G69_June08	G70_June08	G71_June08	G72_June08	G73_June08	G74_June08	G75_June08	G76_June08	G77_June08	G78_June08	G79_June08	Abundance	% of Total Abundance	# of samples present
Spionidae sp.	0	0	0	0	0	1	0	1	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	1	6	2	0	1	0	0	2	0	0	1	0	5	0	0	0	0	88	0.3	31
Spiophanes cf bombyx	0	0	0	0	0	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	0	0	0	0	0	1	72	0.2	10
Travisia 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	0	0	0	0	0	0	0	0	0	17	0.1	5
Oligochaeta	215	348	224	12	1	2	0	28	66	0	17	1	87	6	18	0	3	0	0	0	0	0	0	0	65	27	1	0	0	2	0	1	0	0	0	0	0	0	0	0	2757	9.2	50
Holothurian 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	0	0	0	0	0	0	0	0	0	1	0.0	1
Holothurian 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	0	0	0	0	0	0	0	0	0	2	0.0	1
Holothuroidea	2	2	1	0	1	0	0	3	5	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0.2	9
Asteroidea	0	0	0	1	0	0	0	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	0	0	8	0.0	5
Ophiuroidea	22	14	8	5	3	1	0	11	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	26	2	213	0.7	27
Antisolarium egenum	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	9	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.1	7
Cantheridella tesselata	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	0	0	0	0	0	0	0	0	3	0.0	2
Cominella glandiformis	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	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0	1
Eatoniella sp.	471	140	195	85	15	6	0	2	0	0	63	0	0	0	47	0	4	0	1	0	0	0	0	0	2	4	0	0	0	5	0	55	2	1	0	0	0	4	1	0	6472	21.7	50
Gastropod juv.	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	0	0	0	0	0	0	0	0	0	0	0	5	0.0	5
Gastropoda Mike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Gastropoda_Dan2	1	0	0	0	0	1	0	0	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	0	11	0.0	8
Maoricolpus roseus	4	3	0	1	0	5	0	24	11	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112	0.4	21
Micrelenchus sp.	0	0	4	0	0	0	0	0	0	0	1	18	4	0	69	0	10	0	0	0	2	0	1	0	0	3	1	0	0	1	0	2	0	0	0	0	0	0	0	0	160	0.5	26
Notacmea helmsi	2	3	0	1	0	0	0	0	0	0	0	23	1	0	6	0	5	0	0	0	4	0	0	0	6	5	0	0	0	0	0	0	0	0	0	0	0	0	3	0	115	0.4	27
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	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	2
Pyramidellidae	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0.1	6
Trochidae 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	0	0	0	0	0	0	0	2	0	2	0.0	1
Turbonilla	15	11	6	7	22	21	1	62	0	14	2	1	2	4	0	3	1	1	2	1	0	0	0	1	0	2	3	0	0	0	0	0	0	3	0	0	0	0	0	0	329	1.1	54
Xymene plebius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Xymene pumilus	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	0	0	0	0	0	0	0	0	0	0	0	1	0.0	1
Zeacolpus symmetrica	0	0	0	0	7	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	8	0	0	0	0	0	0	1318	4.4	7
Zeacumantis lutulentus	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	2	0	0	4	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	14	0.0	6
Zegalerus tenuis	0	0	0	0	1	0	0	4	0	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	1	0	7	0.0	4
Arthritica bifurca	0	3	0	0	13	0	0	6	3	6	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	2	4	3	0	0	0	0	0	0	93	0.3	16
Austrovenus stutchburyi	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	1	1	0	4	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0.1	10
Bivalvia_Dan1	10	1	0	6	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	131	0.4	15
Bivalvia_Dan2	0	0	0	0	0	0	0	0	0	0	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	1	0.0	1
Elliptotellina urinatoria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Macomona liliana	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	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	5	0.0	5
Modiolarca impacta	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	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	2
Mysella unidentata	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	11	81	6	37	17	4	4	5	0	1	0	0	2	0	0	0	0	507	1.7	39
Nucula dunedinensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.0	2
Nucula hartvigiana	50	0	0	0	10	0	0	0	0	0	0	0	57	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	348	1.2	18
Nucula nitidula	0	21	25	12	0	2	0	0	0	0	0	45	0	17	0	0	0	0	0	0	0	1	0	1	100	0	4	4	0	1	1	0	1	0	0	0	2	0	0	0	1020	3.4	39
Paphies australis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0
Paphies subtriangulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0.1	3
Perrierina harrisonae	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	43	2	0	16	231	207	1	1	0	0	0	0	3	0	0	0	0	1678	5.6	24
Soletellina siliquens	0	0	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	0	0	0	0	0	0	0	0	1	0.0	1
Tawera spissa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	8	0	0	0	0	0	13	2	0	0	0	145	0.5	18
Solemya parkinsoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Dentaliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Chiton	2	17	9	9	0	0	0	2	4	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	2	1	120	0.4	23
Pycnogonida	1	0	0	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	0	0	0	2	8	0	44	0.1	14
Callianassidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Halicarcinus varius	5	15	9	1	0	0	0	2	3	0	2	0	0	0	25	0	2	0	1	0	0	0	0	0	6	2	0	0	0	1	0	0	0	0	1	0	0	3	0	0	220	0.7	34
Halicarcinus whitei	0	0	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	0	0	0	0	0	0	0	1	0.0	1
Helice crassa	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	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	2
Hemigrapsus 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	0	0	0	0	0	0	0	0	0	1	0.0	1
Macrophthalmus hirtipes	3	10	2	0	7	0	2	6	6	1	12	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	85	0.3	17
Paguridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	4	0.0	3
Mysidacea	1	0	0	0	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	0	0	0	0	0	3	0.0	3
Colurostylis lemnurum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Cumacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	13	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0.1	6

TAXON	G40_June08	G41_June08	G42_June08	G43_June08	G44_June08	G45_June08	G46_June08	G47_June08	G48_June08	G49_June08	G50_June08	G51_June08	G52_June08	G53_June08	G54_June08	G55_June08	G56_June08	G57_June08	G58_June08	G59_June08
Cumacea_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Diastylidae sp.	0	0	0	0	0	5	0	0	0	0	0	1	10	0	0	3	3	8	0	0
Tanaidacea	29	22	14	2	0	22	0	2	44	0	4	1	38	0	0	0	0	0	0	0
Anthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cilicaea canaliculata	13	14	1	0	1	0	0	0	2	0	0	5	0	0	9	0	0	0	2	0
Isopoda	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda_Dan1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampeliscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipod Rocky	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	6	5	4	1	1	4	0	4	2	0	0	4	1	3	9	5	0	1	4	1
Aoridae sp.	9	10	9	4	0	11	2	0	1	0	0	0	0	9	47	0	0	1	0	1
Bathymedon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophidae sp.	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haustoriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lysianassidae sp.	45	22	3	35	0	4	0	2	0	0	0	2	2	0	134	1	0	0	0	0
Phoxocephalidae sp.	11	6	4	15	0	13	2	0	0	3	1	1	34	2	64	0	1	0	0	0
Torridoharpinia hurleyi	1	1	0	0	1	47	3	9	0	5	0	0	0	0	18	0	0	0	0	0
Caprellida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebalacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Shrimp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	1123	1079	645	254	236	304	145	463	243	213	197	122	317	70	612	18	45	11	33	9
Richness	38	40	31	28	20	31	12	27	23	13	23	19	25	14	28	7	15	4	12	6

TAXON	G60_June08	G61_June08	G62_June08	G63_June08	G64_June08	G65_June08	G66_June08	G67_June08	G68_June08	G69_June08	G70_June08	G71_June08	G72_June08	G73_June08	G74_June08	G75_June08	G76_June08	G77_June08	G78_June08	G79_June08	Abundance	% of Total Abundance	# of samples present
Cumacea_Dan2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	2
Diastylidae sp.	0	0	0	0	13	0	16	7	11	0	0	0	0	0	0	0	0	0	0	0	282	0.9	30
Tanaidacea	0	0	0	0	35	13	22	11	0	23	7	0	0	0	1	0	0	0	0	0	939	3.1	44
Anthuridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	0	23	0.1	7
Isopoda22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0	1
Cilicaea canaliculata	2	1	0	0	3	1	0	0	0	3	0	0	0	0	0	2	0	8	1	0	220	0.7	38
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	139	0.5	5
Isopoda 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0	2
Isopoda_Dan1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.0	2
Ampeliscidae	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.0	1
Amphipod Rocky	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0.0	3
Amphipoda	0	0	1	0	23	6	6	10	12	76	4	0	0	0	5	2	1	5	2	0	517	1.7	65
Aoridae sp.	0	0	0	0	10	9	51	1	0	1	22	1	1	1	4	3	2	1	10	0	797	2.7	60
Bathymedon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0	1
Corophidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0.1	6
Haustoriidae	0	0	0	16	10	0	84	0	0	3	19	0	0	0	0	0	0	0	0	0	328	1.1	25
Lysianassidae sp.	0	0	0	0	8	25	0	0	0	0	1	0	0	0	7	0	0	2	1	0	1425	4.8	47
Phoxocephalidae sp.	0	0	0	3	14	17	1	26	29	3	15	0	0	1	1	0	6	0	2	1	1350	4.5	67
Torridoharpinia hurleyi	0	0	0	0	14	18	48	0	0	1	0	0	2	9	0	0	0	0	0	0	383	1.3	32
Caprellida	0	0	0	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	48	0.2	14
Nebalacea	0	0	0	0	19	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0.2	7
Shrimp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.0	6
Crustacea G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.0	1
Abundance	15	3	6	77	632	355	330	308	277	183	105	67	80	55	29	67	59	36	164	28			
Richness	6	3	5	8	36	31	23	9	8	29	19	8	13	10	12	17	14	13	26	10			

Appendix 3 – Channel Modification

One Possible Channel Modification Draft Proposed by POL


TAIAROA HEAD
Pilot Beach
Harington Pt.
216m
R 1400m
Kaik Rock
Otakou
South Spit (Shelly) Beach
Spit
Spit Beach
ARAMOANA
Te Ngaru
Otafelo Point
Waipuna Bay
Taylor Point
Dowling Bay
Pulling Point
Hamilton Bay
Deborah Bay
Careys Bay
DESIGN TOE AND DREDGE AREAS