# Benthic invertebrate samples and data from the Ocean Survey 20/20 voyages to the Chatham Rise and Challenger Plateau, 2007

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## EXECUTIVE SUMMARY

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This report describes data sets derived from benthic invertebrate samples collected during the Ocean Survey 20/20 Chatham-Challenger Hydrographic, Biodiversity and Seabed Habitats Project in 2007. To characterise assemblages across a range of organism sizes and spatial scales, samples were collected from the Chatham Rise and the Challenger Plateau using several gear types: coarse mesh 'seamounts' epibenthic sled and beam trawl (sampling mega-epifauna); multicorer (meiofauna); fine mesh 'Brenke' epibenthic sled (macro-epifauna and hyperbenthic fauna); the still image camera of NIWA's Deep Towed Imaging System (DTIS) (mega- and macro-epifauna, bioturbation, and substrate types), and the video camera of DTIS (mega-epifauna and substrate types). The report: (1) details the samples that were available for analysis, (2) describes the methods used to process and extract data from these samples, and (3) presents summaries of the final data sets.

Large numbers of physical specimens and photographic samples were analysed successfully for taxonomic identities and abundances of fauna, bioturbation, trawl marks, and substrate types. Comprehensive data sets were compiled from each of the gear types, but spatial coverage and the level of taxonomic resolution varied with gear type and the size fraction of the biota sampled, with consequent differences in the utility of each data set for addressing the overarching objectives of the OS 20/20 project. The greatest spatial coverage, in terms of both number of sites and area of seabed sampled, was achieved using the towed underwater video system, DTIS, whereas the greatest numbers of taxa and the finest taxonomic resolution were identified from the seamount sled and beam trawl samples. These two gear types (DTIS and sled/beam trawl) were deployed successfully at more than 90% of the OS 20/20 sampling sites and thus provide consistent quantitative data across the entire study area The least representative data are those for meiofauna and macro-hyperbenthos, where fewer samples, extended sample processing times, and difficult taxonomies resulted in data sets that, in their present form, are of less value for biodiversity studies at the scale of the Chatham-Challenger project.

The samples from these OS 20/20 voyages have generated one of the most comprehensive, spatially extensive, and internally consistent data sets available describing benthic invertebrate distributions in New Zealand waters to date. These data will be of considerable value for future assessments of the ecology of the region.

# INTRODUCTION

## 1.1 Ocean Survey 20/20 Chatham-Challenger project

In November 2004, the Government of New Zealand established Ocean Survey 20/20 (OS 20/20) as a 15 year programme with the aim to:

*"Complete by 2020 an ocean survey that will provide New Zealand with the knowledge of its ocean territory to*:

- *demonstrate our stewardship and exercise our sovereign rights;*
- *conserve, protect, manage and sustainably utilise our ocean resources; and*
- *facilitate safe navigation and enjoyment of the oceans around New Zealand."*

The Chatham-Challenger Hydrographic Biodiversity and Seabed Habitats Project was identified by Cabinet as the priority OS 20/20 project for 2006–07 and the Ministry of Fisheries (MFish), Land Information New Zealand (LINZ), Department of Conservation (DoC), and NIWA collaborated in its development.

The overall goal of the Chatham-Challenger OS 20/20 Project was to map and compare the distribution of seabed habitats and their associated biological diversity across the Chatham Rise and the Challenger Plateau. These areas are in contrasting oceanographic environments and are subject to different levels of anthropogenic disturbance from fisheries. The Chatham Rise lies under waters with high biological productivity which support substantial populations of commercially important fish species, whereas the Challenger Plateau has generally lower productivity and is of less importance for fisheries.

The principal objectives of the project were: to determine the distribution of bottom habitats and biodiversity on the seabed in depths from 200 to 1200 m on the Chatham Rise and the Challenger Plateau; to assess the utility of the Marine Environment Classification (Snelder et al. 2006) as a proxy for habitat types and biodiversity distribution and further develop habitat mapping techniques; and to assess the influence of bottom trawling as a broad-scale driver of sea-bed biodiversity.

Three voyages were undertaken in 2006 and 2007 to complete the field sampling phase of the project. The first voyage conducted multi-beam echo-sounder swath mapping of pre-selected transects across the Chatham Rise and the Challenger Plateau (TAN0610, Mitchell & Nodder 2006). These transects were then targeted for biodiversity and habitat studies on two subsequent voyages (TAN0705 to Chatham Rise and TAN0707 to Challenger Plateau; Nodder 2007a/2007b).

## 1.2 Sampling design

The initial sampling design for the Chatham-Challenger project (Nodder et al. 2007) was based on a multivariate statistical classification of environmental data to determine the optimal number of environmental classes. In this classification, available oceanographic environmental data layers and parameters from the multi-beam transects sampled during voyage TAN0610 were combined. Classifications were run separately for the two locations, identifying eight environmental classes on the Chatham Rise and nine classes on the Challenger Plateau (Figure 1). However, because it was anticipated that time at sea would be insufficient to sample adequately all nine classes on the Challenger Plateau, a secondary classification level was used in which the region was divided into five classes. This is important in relation to the distribution of sampling effort described below. These classes were then used as the strata for the benthic sampling programme, with sampling effort allocated evenly across strata in each location.

To characterise substrate types and biological assemblages across a faunal size range from bacteria to megafauna, samples were collected using several gear types, the principal gears together with their target fauna being: coarse mesh 'seamounts' epibenthic sled and beam trawl (mega-epifauna); multicorer (meiofauna); fine mesh 'Brenke' epibenthic sled (macro-epifauna and hyperbenthic fauna); the still image camera of NIWA's Deep Towed Imaging System (DTIS) (mega- and macro-epifauna, bioturbation, and substrate types), and the video camera of DTIS (mega-epifauna and substrate types). Time constraints dictated that not all sampling gear types could be deployed at all sites. Thus, a hierarchy of site types was defined: *A* sites, at which all gear types were deployed with replicate deployments of each gear; *B* sites at which the DTIS camera platform and the seamounts epibenthic sled were deployed once each; and *C* sites, at which only the DTIS was deployed. In practice, it was possible to deploy both the DTIS and the epibenthic sled at all *C* sites, and thus, for the most part, they are the same as *B* sites for analyses. However, the decision to adopt this approach at sea was not made until the first 10 *C* sites had been sampled and thus these sites are represented only by a DTIS transect (Appendix - Table A1).

A further modification to the sampling programme, made possible by favourable conditions at sea, was the addition of a number of extra sites which were not part of the original sampling design. These were designated as *D* sites and were placed in areas where more detailed coverage was anticipated to be of use to subsequent analyses. On the northeast Chatham Rise, 11 *D* sites were targeted in the orange roughy spawning "box" (Dunn 2007), as two sets of sampling sites arranged as north-south transects: a western transect in an area of high fishing intensity (sites D013–D018, Figure 1), and an eastern transect in an area of relatively low fishing intensity (sites D020–D024, Figure 1). These sites were sampled with DTIS, multicorer, and beam trawl.

For analysis, a minor change was made to the original nomenclature of the sites on the Challenger Plateau. In initial site designations, some site codes were duplicated between areas. For instance, the site code D006 existed on both the Chatham Rise and on the Challenger Plateau. To ensure unique codes for all sites across the entire study, all Challenger Plateau sites were given a double letter prefix; e.g., D006 became DD006.

One hundred sites were sampled on the Chatham Rise and 49 sites were sampled on the Challenger Plateau (Figure 1). These totals include 29 and 9 extra *D* sites in each area respectively (Table 1).

**Table 1: Total number of sites sampled on Chatham Rise and Challenger Plateau during TAN0705 and TAN0707, respectively. Categories indicate the range of sampling gears deployed at each site; see text for details.**

| Site category | Chatham Rise | Challenger Plateau |
|---|---|---|
| A | 11 | 5 |
| B | 37 | 14 |
| C | 23 | 21 |
| D | 29 | 9 |
| Total | 100 | 49 |

## 1.3 Post-voyage analysis of samples

This report describes the methods used for initial processing of Chatham-Challenger OS 20/20 benthic faunal samples under the post-voyage analysis project (MFish code ZBD2007-01) and presents the data sets derived from them. The specific objectives of this research were:

1) To count, measure, and identify to species level (where possible) all macro invertebrates (larger than 2 mm) collected by the seamounts sled and beam trawl.

2) To count, measure, and identify to the finest practicable taxonomic resolution all meiofauna (from 32 µm to 500 µm) from multicorer samples.

3) To count, measure, and identify to species level (where possible) all fauna collected by hyper-benthic sled.

4) To count, measure, and identify to species level (where possible) all macrofauna observed in DTIS still images together with estimates of the number of biogenic features (burrows, mounds etc.) and habitat complexity.

5) To count, measure, and identify to species level (where possible) all macrofauna observed in DTIS video footage.

The following sections detail the numbers and locations of samples that were available for analysis for each gear type, describe the methods used to process and extract data from the samples, and present summaries of the final data sets. Detailed analyses and ecological interpretation of the data sets are outside the scope of this report and will be reported separately.

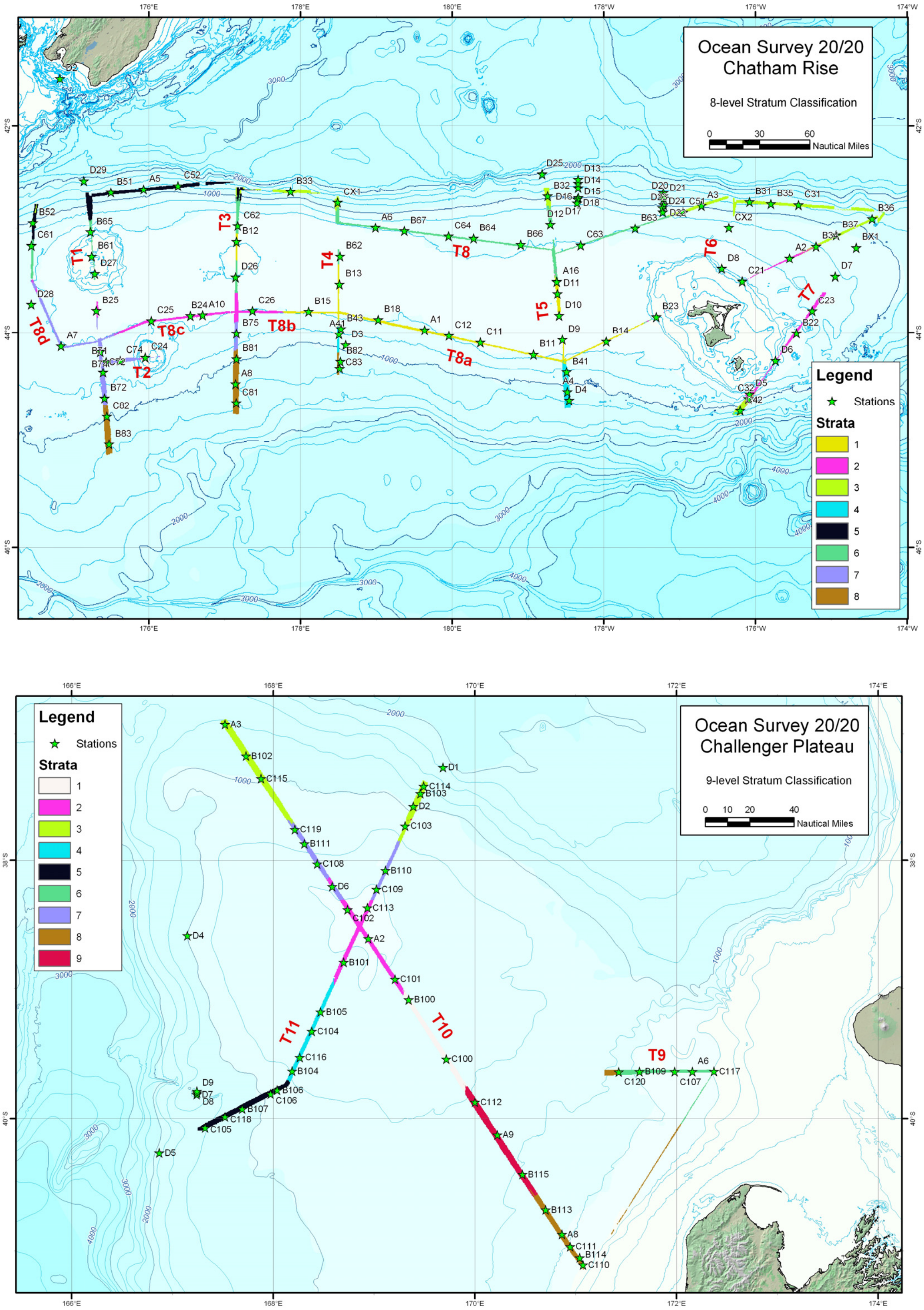


**Figure 1: Sites sampled during Ocean Survey 20/20 voyages to Chatham Rise (TAN0705, top) and Challenger Plateau (TAN0707, bottom). Sites are shown as labelled stars (see Section 1.2 for site numbering protocols) superimposed on the survey strata determined *a priori* from acoustic and environmental data. Red 'T' prefix numbers identify the multibeam sonar transects collected during TAN0610.**

## SAMPLES AND PROCESSING METHODS

### 1.4 Seamounts sled and beam trawl samples (mega-epifauna)

A seamount sled and a beam trawl were deployed to sample organisms larger than ~10 mm (beam trawl) or 25 mm (seamount sled) (*megafauna*) living on the surface of the seabed (*epifauna*) or in surficial sediments where these were soft enough for the lower edge of the gear to dig in.

Depending on substrate suitability, either the seamount sled (SEL) or the beam trawl (TB) was deployed at each site across the two locations. The seamount sled is designed for use on hard, irregular substrata, but sweeps a relatively small seabed area (1 m mouth width), whereas the beam trawl can be used only on smooth substrata but sweeps a larger area (3 m mouth width). More importantly, the SEL has a codend mesh size of 25 mm, but the TB, as used in these surveys, had a 10 mm mesh liner. Both gears were towed for approximately 15 minutes at 2–3 knots. Across all deployments in both geographical regions, the average (±1 SD) seabed area swept by the SEL was 929±137 $m^2$ and for the TB was 2065±479 $m^2$.

During the voyages (TAN0705 and TAN0707), initial plans to use SEL as the standard sampling method for collection of mega-epifauna at all sites were modified. The paucity of fauna and small catch sizes recovered with this gear at some sites led to the TB being used instead of the SEL at 4 sites on the Challenger Plateau and 17 sites on the Chatham Rise (Figure 2 and Figure 3). Because of the differences in swept area and mesh size, this change in gear types during the survey has consequences for analysis of the data. The greater seabed area sampled by the TB and its smaller mesh size (10 mm versus 25 mm as configured for these surveys) mean it is likely to have captured a greater number and diversity of organisms than the SEL. Thus, data from these two sets of samples are not directly comparable. However, the sites at which only the TB was deployed were all *D* class sites, additional to the original sampling plan, and most are either outside the planned survey area (sites DD001, DD003, DD004, DD005) or are part of the additional site transects conducted in the orange roughy spawning box (sites D013–D025 see Sampling design above and Figure 1). Thus, the coverage of sites sampled with the SEL was extensive across both survey regions and only a relatively small proportion of the data would be lost from the core survey if the TB-only sites were to be excluded from analyses (Figure 2, Table 1).

All fauna were sorted to higher level taxonomic groups at sea (class, phylum), preserved appropriately (in ethanol, or formalin, or frozen, depending on taxon), and catalogued in the *Specify* database of the NIWA Invertebrate Collection (NIC). Preserved specimens were then distributed to specialist taxonomists at NIWA and abroad for identification. For most megafaunal groups, identifications were made to species or genus level.

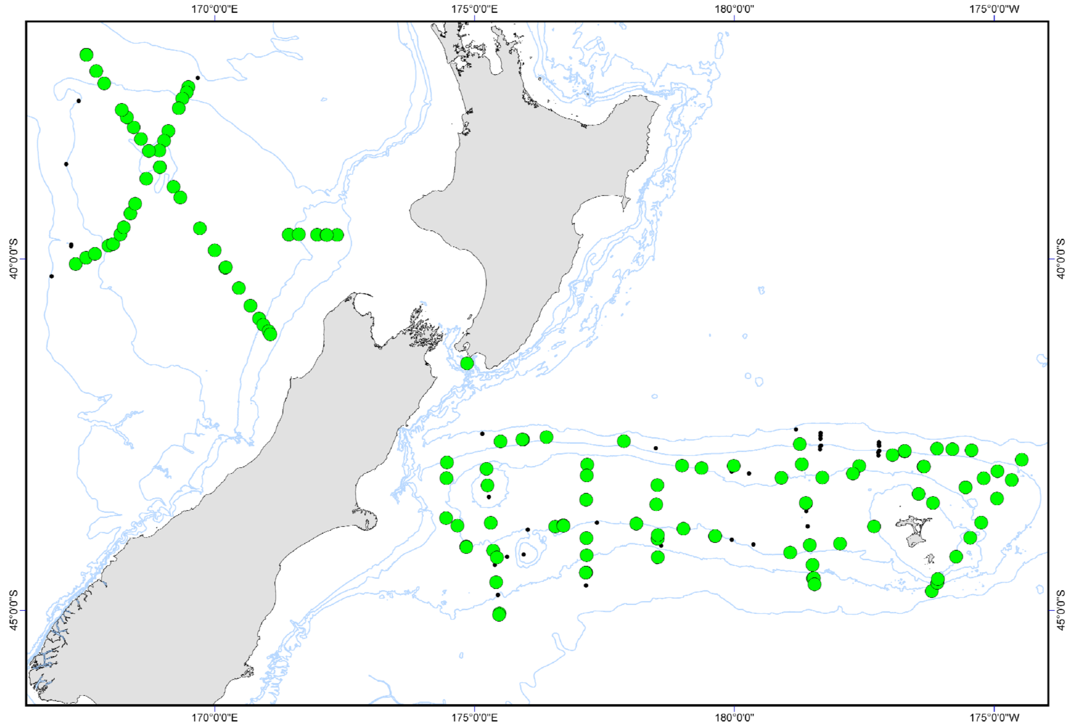


**Figure 2: Seamount sled (SEL): sites sampled during the 2007 Ocean Survey 20/20 voyages (filled circles). Black points show sample sites at which SEL was not deployed.**

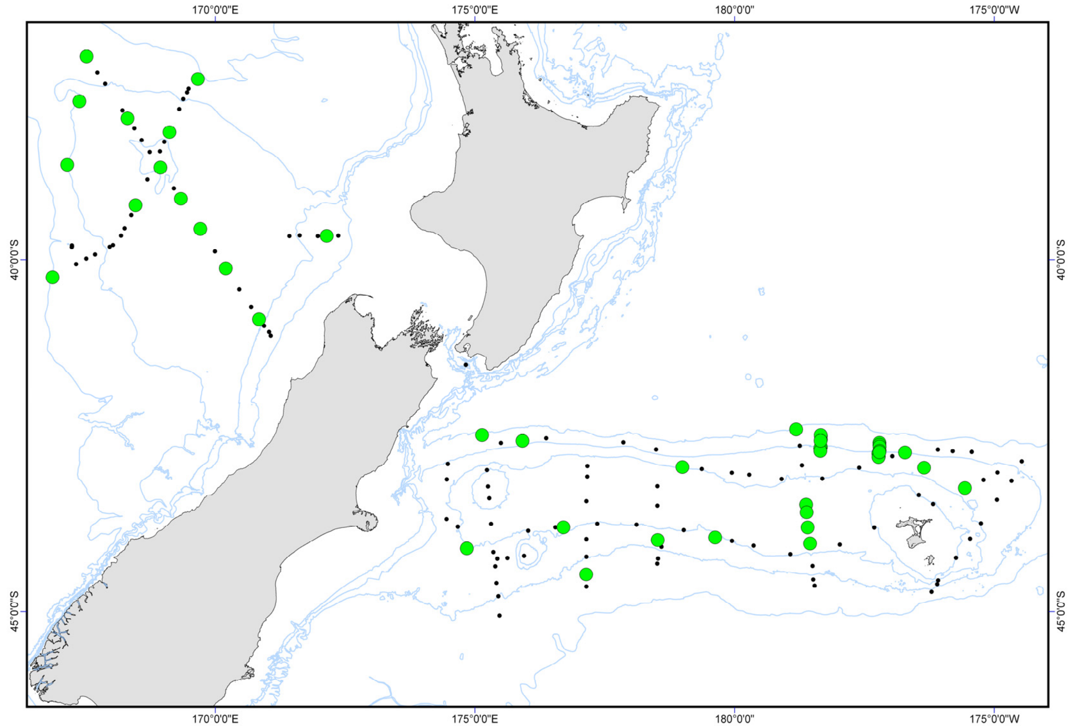


**Figure 3: Beam trawl (TB): sites sampled during the 2007 Ocean Survey 20/20 voyages (filled circles). Black points show sample sites at which TB was not deployed.**

## 1.5 Multicorer samples (meiofauna)

The multicorer recovers undisturbed sediment samples of up to 50 cm sediment depth complete with the overlying seawater. This gear was used to sample sediment characteristics, meiofauna (metazoan organisms under 0.5 mm in size), and surficial bacteria. Sediments and bacteria will be reported elsewhere.

The multicorer was deployed at all *A* sites where soft sediments were present: 10 sites on the Chatham Rise and 5 sites on the Challenger Plateau. Multicorer samples were also obtained from 7 *D* sites on Chatham Rise and 1 *C* site on Challenger Plateau (Figure 4, Table 1).

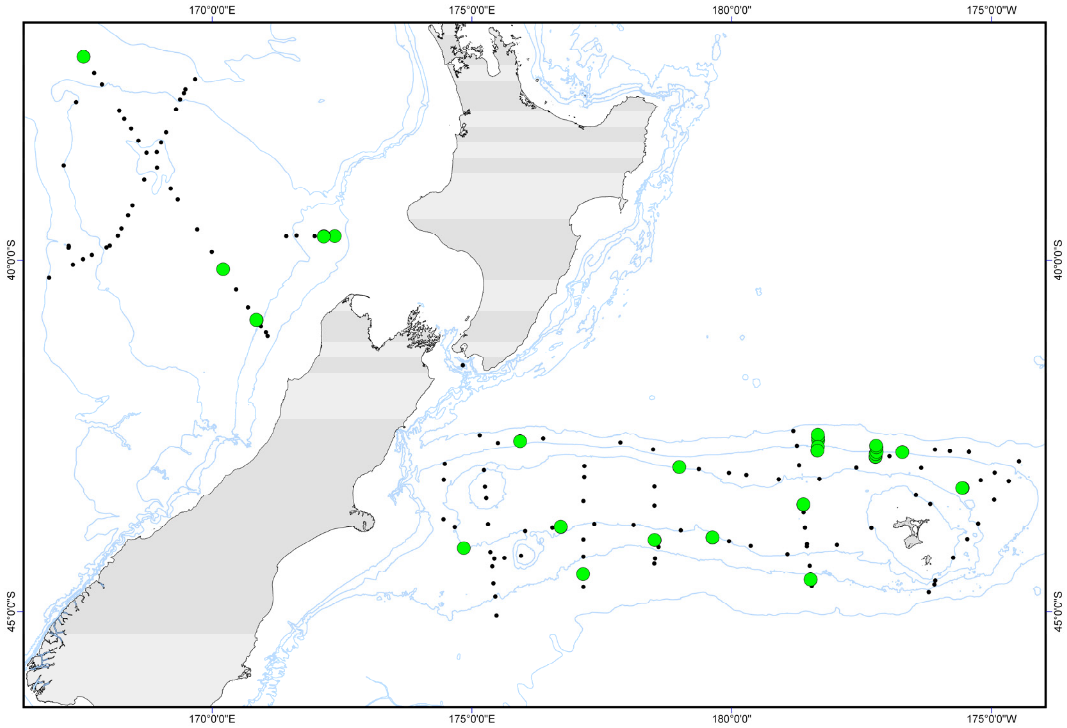


**Figure 4: Multicorer (CM): sites sampled during the 2007 Ocean Survey 20/20 voyages (filled circles). Black points show sample sites at which CM was not deployed.**

For assessment of meiofauna diversity and abundance, the top 5 cm of sediment from a single core at each site was subsampled using a 5.3 cm$^2$ syringe and separated into 0–1 cm and 1–5 cm layers. Samples were preserved at sea in formalin with Rose Bengal dye (to stain body tissues of live organisms). For analysis, samples were sieved to isolate meiofauna in the size range 32 µm to 500 µm and size fractionated on 64, 45, and 32 µm sieves. All specimens were then identified to higher taxonomic groups (phylum, class) and counted.

## 1.6 Hyperbenthic ('Brenke') sled samples (macro-hyperbenthos)

The Brenke sled (SEH) has two fine mesh nets (0.5 mm mesh) with rigid plastic codend containers (Brenke 2005). The nets are positioned one above the other, so that they sample motile macrofauna from the water layers immediately above (lower net) and about 1 m above (upper net) the seabed ('*macro-hyperbenthos*'). The mouth width of the sled is 1 m and a lever mechanism ensures that both nets remain closed unless the sled is in contact with the seabed, thus preventing contamination of the sample by planktonic fauna during ascent and descent through the water column.

The SEH was deployed at all *A* sites where flat substrates were present: 11 sites on the Chatham Rise and 5 on the Challenger Plateau. SEH samples were also obtained from 4 other sites on the Chatham Rise (Figure 5, Table 1).

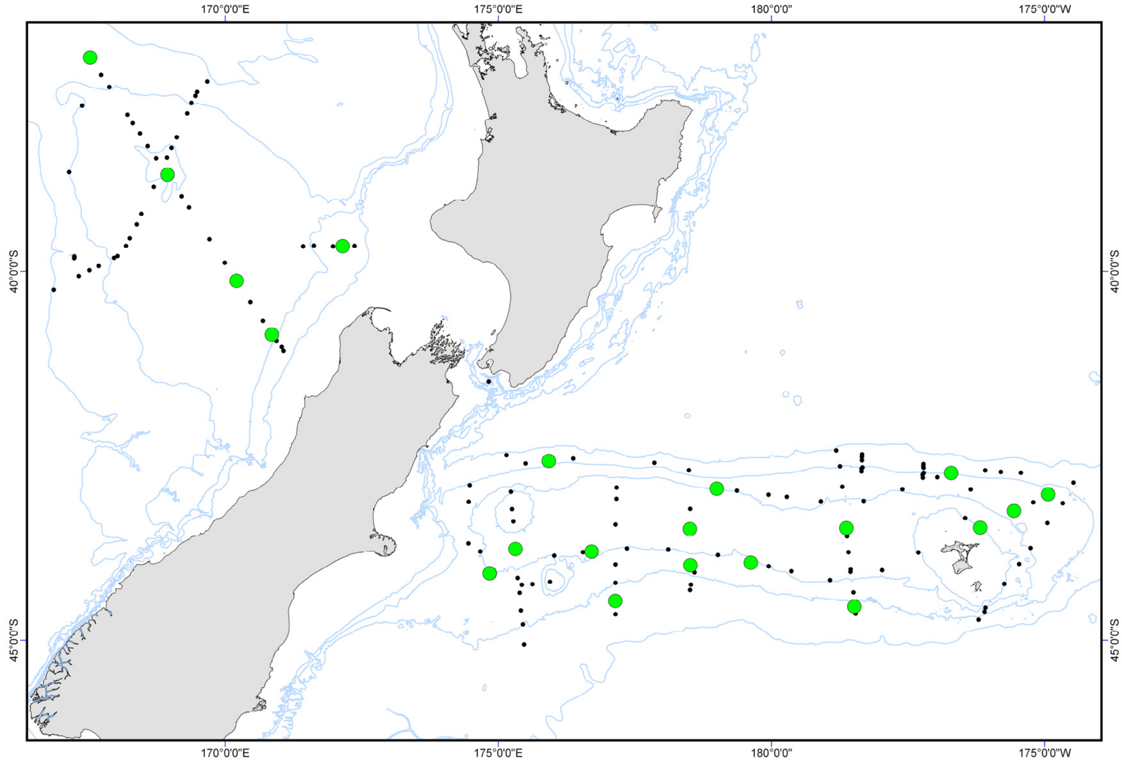


**Figure 5: Brenke sled (SEH): sites sampled during the 2007 Ocean Survey 20/20 voyages (filled circles). Black points show sample sites at which SEH was not deployed.**

Samples from both nets were preserved, but only those from the upper net were analysed. This is because sample processing is very labour-intensive due to the large numbers of small organisms from groups which are often problematic to identify, and because upper net samples are generally smaller and contain less sediment than those from the lower net. Fauna from these samples were identified to higher taxonomic groups (phylum, class, sub-class) and counted. Data were then standardised to abundances per 1000 $m^2$ of seabed.

## 1.7 DTIS still photographs (macro and mega-epifauna, bioturbation, substrate type)

NIWA's Deep Towed Imaging System (DTIS) take continuous high-definition, digital video (Sony HD1080 format) of the seabed, with high resolution digital still photographs (8 megapixel JPEG format) taken automatically at 15 s intervals along each station transect. For the Chatham Rise and Challenger Plateau voyages, the focal axes of both cameras were oriented vertically downwards. A pair of parallel red lasers spaced 20 cm apart projected on to the seabed enable scaling of the images and video. DTIS was towed at a target altitude of 2–3 m above the seabed at speeds of 0.25–0.5 m $s^{-1}$ and for a standard deployment time of 1 hour.

DTIS was deployed at all 149 sampling sites (Figure 6). In total, about 35 000 usable still images were collected across the study locations. At target altitude, the seabed area sampled per image is about 2 $m^2$. At one image every 15 s, this gives the total seabed area sampled by still photographs per transect of about 480 $m^2$.

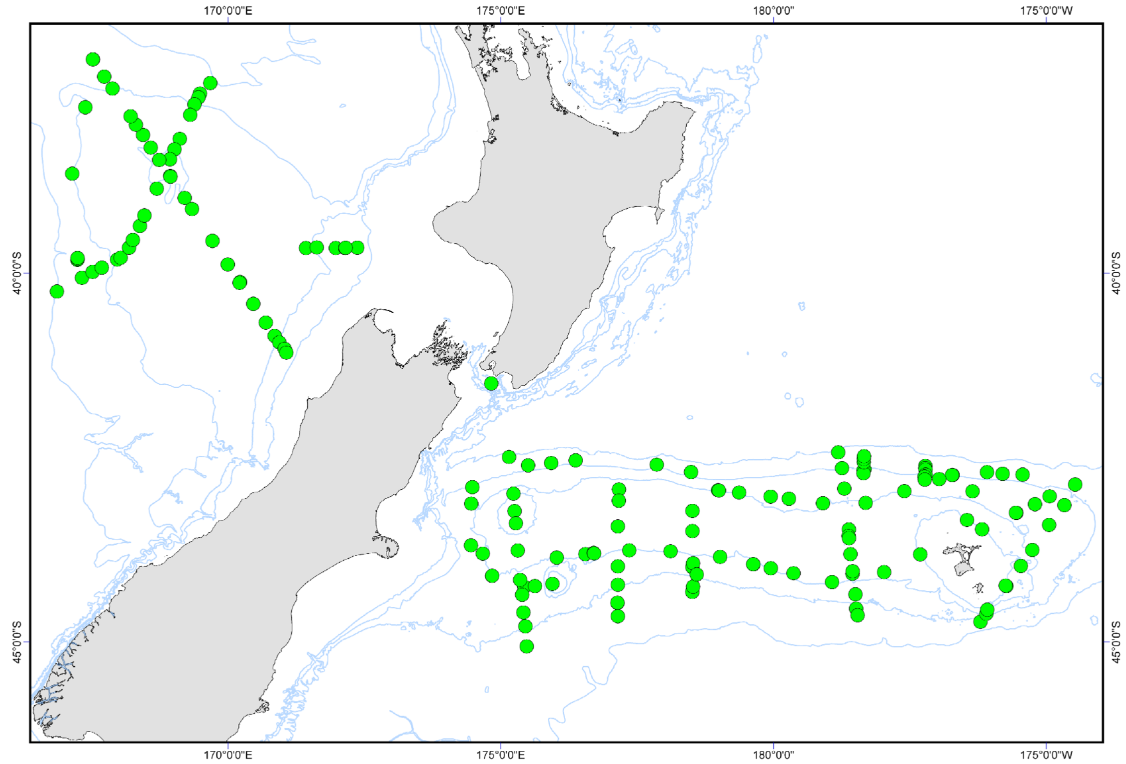


**Figure 6: Deep Towed Imaging System (DTIS): sites sampled during the 2007 Ocean Survey 20/20 voyages (filled circles).**

Analysis of high resolution still images can yield exceptionally detailed data at small spatial scales (less than 1 m). Such analysis is time-consuming, however, and it was necessary to subsample from the full set of DTIS still images, both in terms of the number of images analysed per site, and the number of sites analysed per location.

### 1.7.1 Sample selection for DTIS still image analysis

To assess the number of images that could be analysed, a pilot study was undertaken in which 20–40 images from selected sites were analysed in detail for fauna and substrate. The time taken per image was recorded and taxon accumulation curves were plotted to assess the rate of addition of new taxa with increasing number of images analysed (Figure 7).

The rate of accumulation of taxa within a single transect is affected by the level of habitat heterogeneity. Because the probability of encountering new habitats and new taxa increases with increasing area sampled, particularly along a linear transect, it is also unlikely that DTIS transects will reach a true asymptote. Despite this, the pilot study indicated that analysing about 20 images per transect would capture much of the total megafaunal diversity on homogeneous muddy sediment substrata, but to assess the diversity on more heterogeneous substrata higher levels of sampling would be required (Figure 7). As the original observation logs from DTIS deployments showed that more than 90% of sites were on uniform muddy seabed, the number of images analysed was standardised at 24 images per transect. At this level of sampling, it was possible to analyse 55 transects in total.

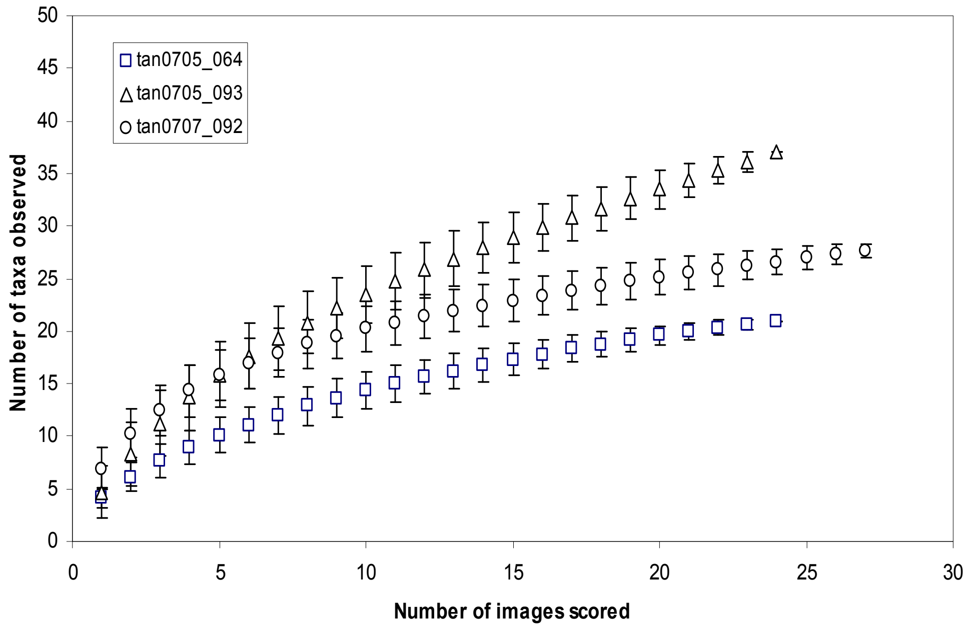


**Figure 7: Taxon accumulation curves for still images scored along 3 example DTIS seabed transects. Transect TAN07050_064 is from site A004 on Chatham Rise, substrate >99% muddy sediments. TAN0707_092 is from site CC100 on Challenger Plateau, substrate 100% muddy sediments. TAN0705_093 is from site A041 on Chatham Rise, substrate 64% sand, 14% muddy sediments, 9% gravel, 8% boulders, 2% shell hash, 1% cobbles. The plotted number of new taxa per image is the mean calculated from 999 random permutations of sample (image) order. Error bars show ±1 SD.**

Within each selected transect, every tenth image was analysed provided that: (1) it was correctly exposed, (2) both scaling lasers were visible, and (3) no part of the image was obscured (e.g., by suspended sediment). In cases where the tenth image in sequence was rejected, the next usable image along the transect was selected.

### 1.7.2 Taxonomic identifications from seabed images

In order to make reliable and consistent identifications from DTIS photographs and video, it was necessary first to generate a reference library of identification images. All DTIS photographs from all transects were first searched for clearly recognisable images of benthic taxa, bioturbation marks, and substrate types present and identifiable at the image resolution (effectively larger than 20 mm). Example images of each taxon were then cropped, colour-corrected, scaled by reference to laser points in the images, and grouped by higher taxa (phylum, class). Specialist taxonomists for each group then assigned identifications for each taxon at the lowest practicable taxonomic resolutions. Because these identifications were across a range of taxonomic levels, including, in some instances, just numbered putative species (e.g., "Corallimorpharia 1"), they are referred to here as operational taxonomic units (OTUs). The result was a reference library of digital images in which all organisms seen in the DTIS transects were represented. This library ensured consistency of identifications between different analysts and between transects.

### 1.7.3 Image analysis protocols

Data extraction from DTIS images was conducted using the image analysis application *ImageJ* (http://rsbweb.nih.gov/ij/). Images were first corrected for colour balance. The seabed area was then calculated by reference to the two parallel laser points (20 cm separation) projected onto the seabed from the DTIS. The proportions of different substrate types visible in the image were measured by either: (1) drawing polygons where distinctions between substrates were clear, or (2) where substrates were mixed, estimation with reference to an overlay of polygon templates of known areas. Substrates were classified by reference to a table of 39 descriptors, ranging from bedrock to muddy sediments (Table A4) and recorded as percentage of the total image area. All benthic megafauna and bioturbation marks (Table A5) were counted using the *Point selection tool* in *ImageJ*. To avoid over estimation of abundances through edge effects (i.e., if individual organisms intersect the frame edge, counting 'half organisms' at different edges effectively includes more individuals than are present in the measured image area), organisms intersecting the edge of the image frame were counted only at the top or left edge of the image.

This resulted in four classes of observation:

(1) Mobile megafauna (larger than 2 cm), as individuals per $m^2$ of seabed
(2) Sessile megafauna (larger than 2 cm), as individuals per $m^2$ of seabed
(3) Bioturbation marks (tracks, mounds, burrows, etc.) as numbers per $m^2$ of seabed
(4) Substrate type, as percent area of the image for substrate classes

The distinction between motile and sessile epifauna was driven by the observation that many sessile organisms are clonal and that counts of colonies may not be ecologically equivalent to counts of unitary organisms. However, because both data sets are in the same units, they may be combined in later analyses.

## 1.8 DTIS video transects (mega-epifauna, bioturbation, substrates)

DTIS video transects were captured at all 149 sampling sites across the Chatham Rise and the Challenger Plateau. Each transect was of 1 h duration and across all deployments the average (±1 SD) swept area of seabed per transect was 2359±644 $m^2$.

Because the continuous video samples from the DTIS camera cover a considerably greater area of seabed than the still images and can be analysed for megafauna more rapidly, they were given higher priority in analyses. There are obviously trade-offs associated with this decision. Working from video enables analysis of the full length of each transect and thus captures data on rarer mega-epibenthic species that are likely to be missed when sampling discontinuous still frames. The principal drawback, however, is that the moving video image is at lower resolution than the still images and, in consequence, smaller benthic fauna (under 5 cm) are under-represented in the data, particularly when they are present in abundances that are too high to allow counting of all individuals in the transect.

### 1.8.1 Video analysis protocols

Post-voyage analyses of video transects were run using the software Ocean Floor Observation Protocol (OFOP; http://ofop.texel.com). This software enables analysts to record spatially referenced data on the occurrence of objects or events seen in video by clicking on pre-defined observation types in a graphical user interface. Raw position data for the DTIS (from the ultra-short baseline acoustic tracking system on *RV Tangaroa*) were first smoothed using an adaptive running median and splined along with all associated metadata (e.g., time, depth, heading) to yield corrected seabed tracks with position coordinates and metadata values at 1 s intervals. The digital video files (in *.avi format) were then synchronised with the corrected position files to enable re-running of the transects in the laboratory, with full video playback control (playback speed, reverse, freeze-frame, etc.) and precise spatial and temporal logging of events. The identities and abundances of mega-epifauna (larger than 5 cm) together with substrate descriptors were logged over the full length of each transect.

The output from OFOP is in the form of a list of spatially referenced point observations for each transect. For fauna, this makes immediate sense, because each individual is represented as a single event and total abundance is simply the sum of all individual observations of that taxon. Substrata, however, are continuous rather than point data. To generate continuous substrate records, all video data were loaded into a PostgreSQL-postGIS database incorporating scripts to separate substrate and fauna observations into different database fields, and then fill down substrate observations at 1 s intervals throughout each transect. The fill-down script was of the form; "if $t_{2\text{-original}}$ is null, make $t_{2\text{-fill}}$= $t_1$, and if $t_{2\text{-original}}$ is not null, make $t_{2\text{-fill}} = t_2$" (where $t_x$ is a value entered in the database relating to time *x*). Because analysts recorded each substratum type as it occurred along the transects, even for highly heterogeneous transects, this yielded a detailed, continuous record of the main substrate types for all transects.

The resulting substrate data were extracted from the database as percentages for each substrate type in each transect. Abundances of fauna and bioturbation features were recorded as counts of individuals or colonies per transect and then standardised to number per 1000 $m^2$ of transect. Thus, although data were recorded in a form that would allow analysis of spatial pattern within transects, for first analyses they were summarised to give an integrated, point-sample measurement of taxon richness and substrate composition per transect.

## RESULTS AND DISCUSSION

### 1.9 Mega-epibenthos

In total, 4200 individual specimens were identified from the SEL and TB samples, representing 867 taxa, most at species level, from 15 phyla (Table A1). The most abundant and widespread phylum caught by both gears was Echinodermata. Crustacea, Mollusca, Annelida, and Cnidaria were also common, but the proportions of these taxa caught varied between gear types. In particular, Annelida were more abundant in SEL samples, with Echinodermata, Crustacea, Mollusca, and Foraminifera being more abundant in TB samples (Figure 8). Given the differences between gear types in the total number of stations (SEL, 130 stations; TB, 45 stations) and sites (SEL, 111 sites; TB, 42 sites) at which each gear was deployed, it is perhaps surprising that overall the TB collected more specimens of these taxa than the SEL. This is likely to be a function of the greater seabed area swept by the TB per deployment, which resulted in broadly similar total swept areas per gear type (SEL 120 000 $m^2$; TB 90 000 $m^2$), combined with its smaller mesh size.

For both Echinodermata and Crustacea, across all samples, more taxa were identified from TB samples than from SEL samples (Figure 9 and 10). The opposite was true for Annelida (all of which are Polychaeta, Table A2) and Porifera, of which substantially more taxa were captured by the SEL than the TB. There are several potential explanations for these differences. For instance, the greater incidence of Porifera in SEL samples is likely to be because this gear was deployed on hard and heterogeneous substrata, where sponges are more common, whereas the TB was used only on level, homogeneous substrates. Similarly, the SEL, being heavier than the TB, tends to dig in to the sediment more and thus might sample infaunal polychaetes more effectively. However, with the data available here – and particularly bearing in mind the lack of matched SEL and TB samples from the same sites – all that we can reliably conclude is that direct comparisons between data from these two gears are problematic.

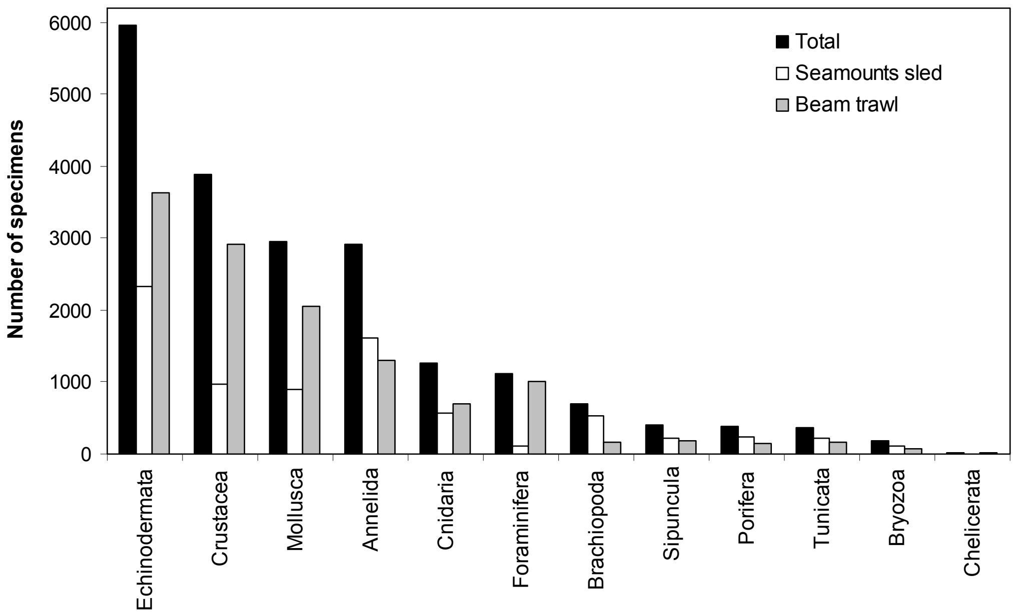


**Figure 8: Epibenthic megafauna collected and identified from the seamounts sled (SEL) and beam trawl (TB): total number of specimens per higher taxonomic group (phylum, superclass) collected by each gear type and in total.**

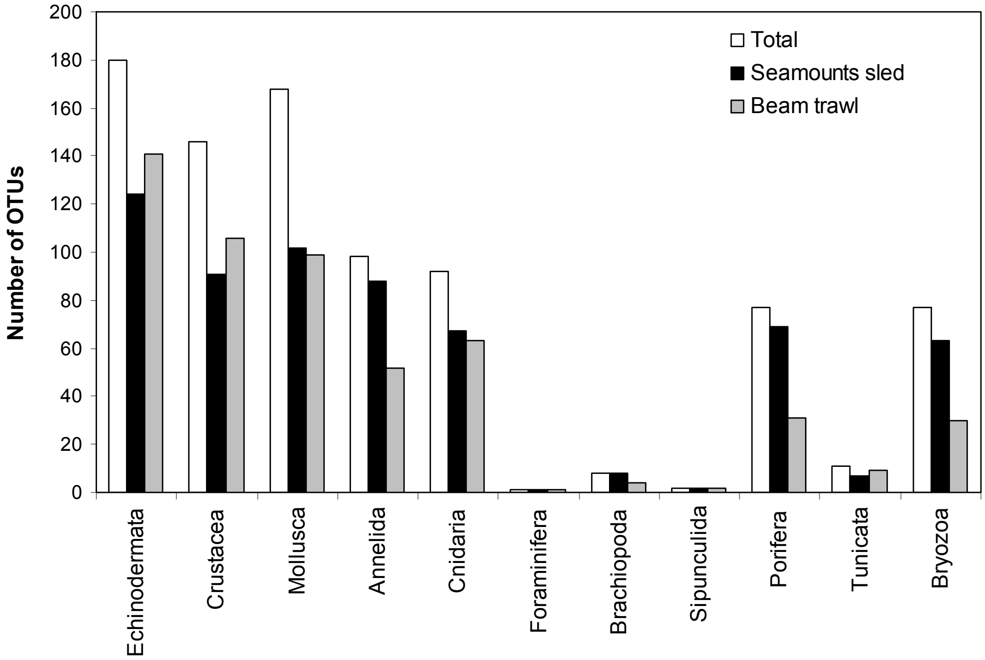


**Figure 9: Epibenthic megafauna collected and identified from the Seamounts sled and beam trawl: number of taxa (operational taxonomic units – OTUs – mostly species level) per higher taxonomic group (phylum, superclass – showing the 11 most abundant taxa only).**

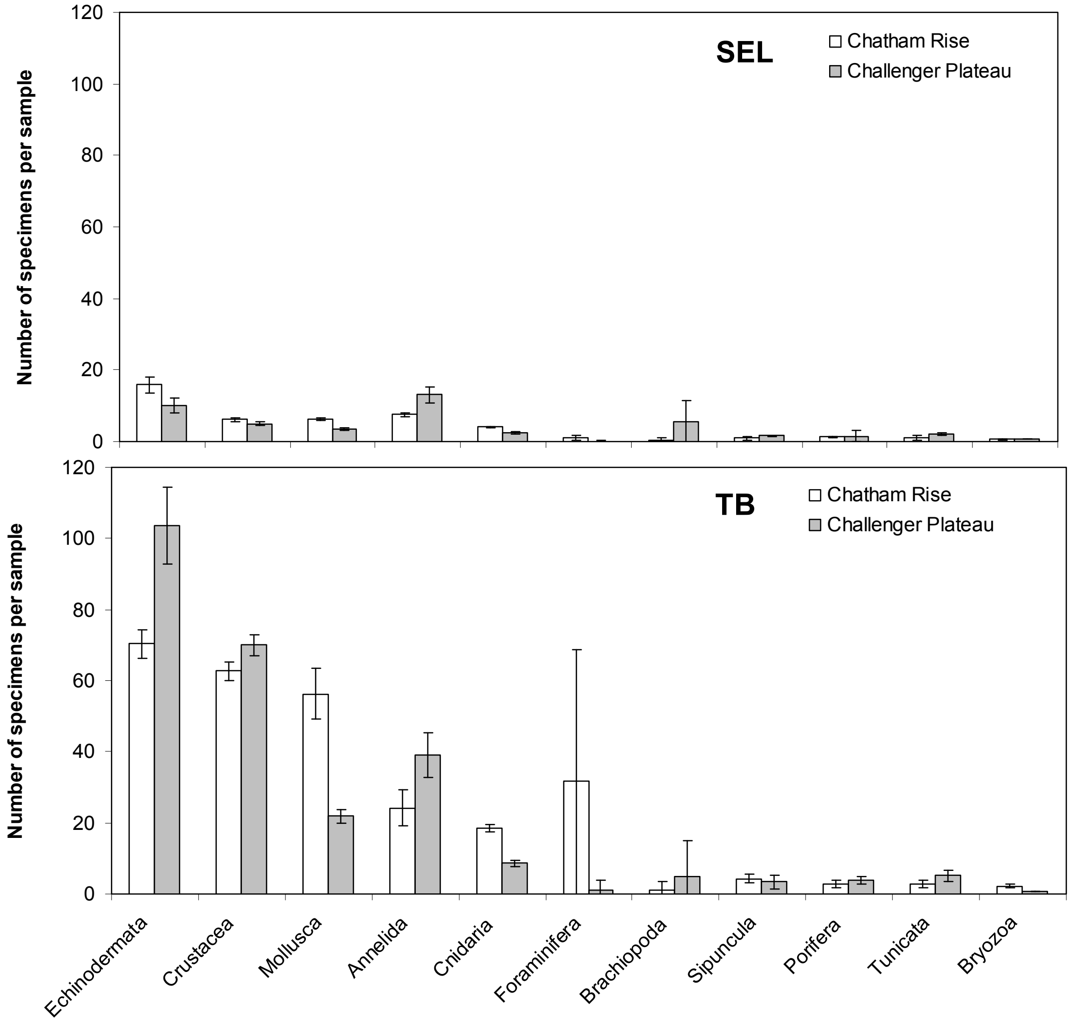


**Figure 10: Number of specimens per sample for the seamounts sled (SEL, upper panel) and beam trawl (TB, lower panel) across Chatham Rise and Challenger Plateau. Values are means of n=109 (Chatham Rise) and n=31 (Challenger Plateau) stations. Error bars ±1 se.**

### 1.9.1 Biomass estimation

In the initial goals of the project, it was planned to derive biomass estimates for epifauna using the wet weights and measurements of identified specimens combined with measurements and abundance counts made from the DTIS video. In practice, however, both aspects of this work proved to be problematic. This is primarily because there are inherent inaccuracies in relating measurements taken from live organisms in the images to those taken from preserved specimens.

First, when they are preserved, soft-bodied taxa, such as holothurians and anemones, contract and, as a consequence, measurements cannot be related directly to length or width measurements taken from live animals in the seabed images. Second, because of varying orientations and degrees of cover by sediment, rocks, or shadows of animals in seabed images, it is often not possible to consistently take the same measurements *in situ* as are taken from the preserved specimens. Third, for infaunal taxa, such as heart-urchins, burrowing anemones, sabellid polychaetes, and bivalve molluscs, there is often no measurement from the image that can be compared directly with the preserved specimen.

To illustrate the first of these points, Figure 11 shows weight-length relationships for preserved specimens of two commonly caught megafauna species: the commensal anthozoan *Epizoanthus* sp. and the holothurian *Molpadia musculus* which have different responses to preservation. *Epizoanthus* sp. cannot contract significantly when preserved because it grows commensally on the shells of pagurid crabs and consequently the length-weight relationship is strong ($R^2$ = 0.89). By contrast, *M. musculus* contracts when preserved and the length-weight relationship is poor ($R^2$ = 0.5). For these reasons, biomass estimates derived from image measurement methods are likely to incorporate unquantifiable errors.

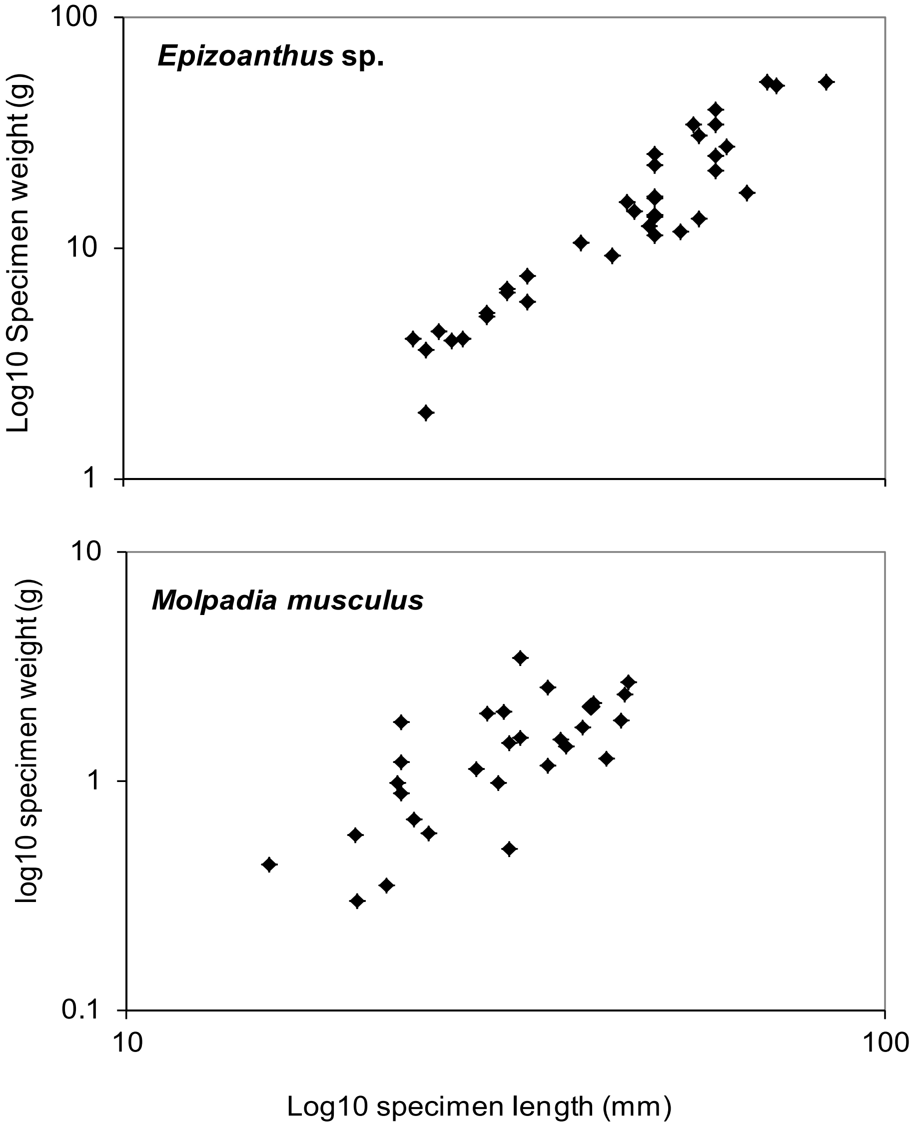


**Figure 11: Example length-weight relationships for preserved megafaunal specimens. Top, the anthozoan *Epizoanthus* sp. cannot contract significantly when preserved because it grows commensally on the shells of pagurid crabs and consequently the length-weight relationship is clear ($R^2$ = 0.89). Bottom, the holothurian *Molpadia musculus* contracts when preserved and the length-weight relationship is poor ($R^2$ = 0.5).**

Some interesting patterns emerged from the biomass data, however, which merit further investigation. For example, the common ophiuroid *Ophiomusium lymani* shows a strong relationship between disc diameter and body weight (Figure 12), but size frequency distributions differ markedly between the two study locations, with unimodal distribution on the Chatham Rise and bimodal distribution and a higher proportion of small individuals on the Challenger Plateau (Figure 13). While the generally smaller body size of this species on the Challenger Plateau could result from lower food availability than on the Chatham Rise, the bimodal distribution on Challenger Plateau also suggests the presence of two distinct cohorts there. If this is the case, it is likely that any overall biomass differences between the two locations could change considerably with time and thus that measured patterns may not represent consistent differences in benthic productivity between locations.

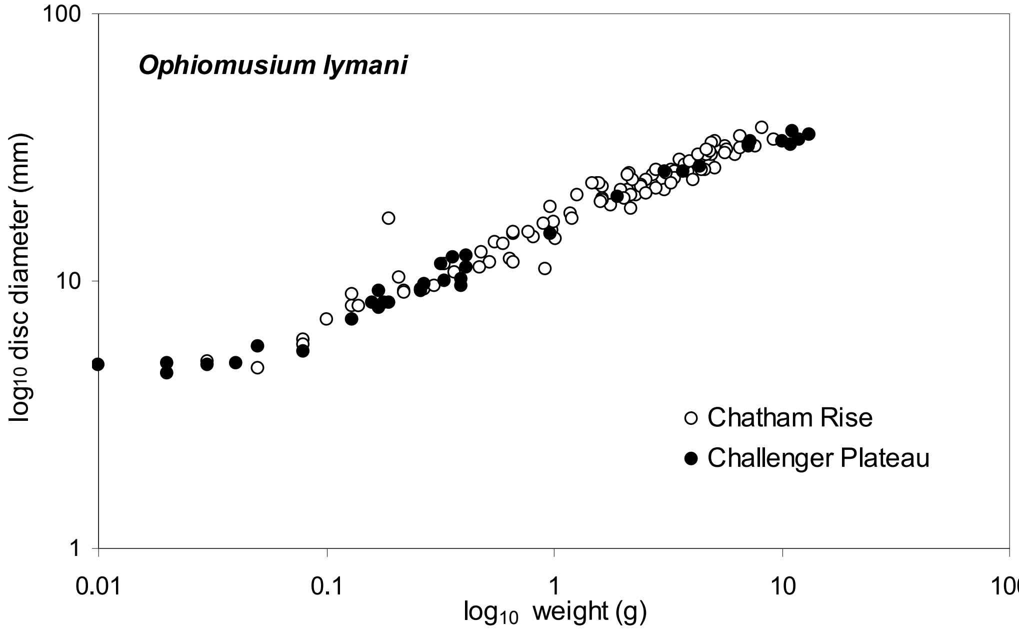


**Figure 12: Size to weight relationship for the ophiuroid *Ophiomusium lymani* on Challenger Plateau and Chatham Rise.**

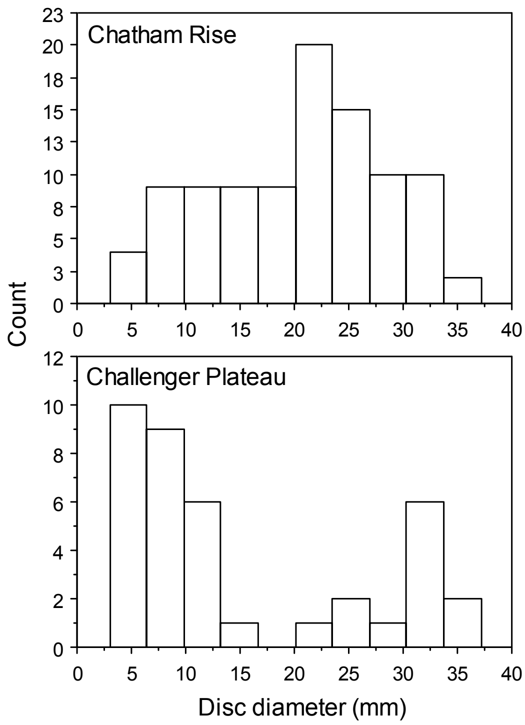


**Figure 13: Size frequency histograms for the ophiuroid *Ophiomusium lymani* on Chatham Rise and Challenger Plateau (note different y-axis scales).**

## 1.10 Meiofauna

Multicore samples were processed from 10 *A sites* and 7 D sites on the Chatham Rise and 5 *A sites* and 1 C site on the Challenger Plateau. More than 11 000 individual organisms representing 18 taxonomic groups (phylum, class, sub-class) were counted and identified. Nematode worms were an order of magnitude more abundant than any other taxon in all samples (Figure 14). Pyriform copepods and nauplii larvae of crustaceans, primarily copepods, were also common, but all other taxa occurred in very low numbers.

The coarse level of taxonomic resolution achieved for meiofauna samples is particularly striking. Although 90% of all specimens were nematode worms, this group was not resolved here beyond the level of phylum. At this level of resolution, therefore, the meiofauna dataset provides limited scope for analyses of spatial patterns of diversity. The abundance data (which are also expressed in the data set as biomass) are, however, potentially important for assessing spatial variations in benthic secondary productivity and will link with data on total sediment oxygen demand collected by the University of Waikato during the OS 2/20 Chatham-Challenger voyages.

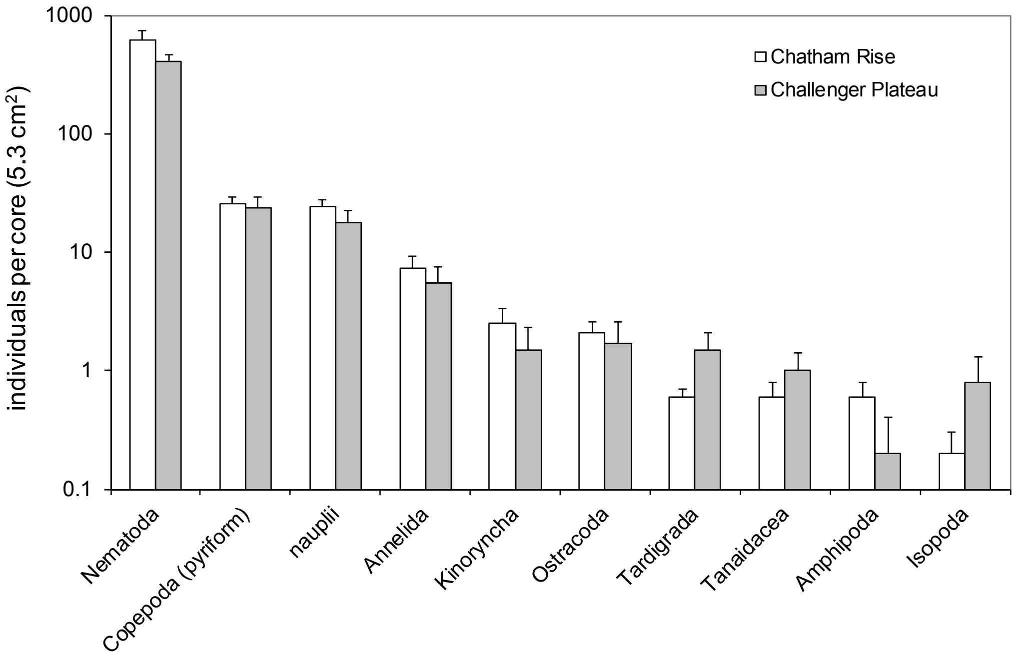


**Figure 14: Meiofauna abundances on Chatham Rise (n = 17 sites) and Challenger Plateau (n = 6 sites). Note log scale for abundance and the predominance of Nematoda at both locations. Means +1se.**

## 1.11 Macro-hyperbenthos

More than 79 500 individual invertebrate specimens were identified from the 20 Brenke sled samples (Figure 15, Table A3). Copepod and peracarid crustaceans were the most abundant taxa but at this stage, and at the relatively coarse taxonomic level of the identifications, the only obvious difference between Chatham Rise and Challenger Plateau samples is the greater overall abundance of Tanaidacea on the Challenger Plateau.

The hyperbenthos of the continental shelf and slope had not been sampled directly in New Zealand before this study and the high abundance of crustaceans recorded here suggests that this component of the seabed fauna may play a significant role in benthic ecosystem processes. There is considerable potential for future research using these samples, including assessment of species-level diversity and elucidation of their trophic relationships, particularly with respect to their role in the processing of organic detrital material at the seabed and their potential significance as prey items for demersal fish species. As with the meiofauna, however, the coarse level of identification achieved to date, combined with the limited spatial coverage of sampling (Table A1, Figure 5) render these data of less use for analyses of biodiversity in the OS 20/20 project than the more extensive data from other gear types

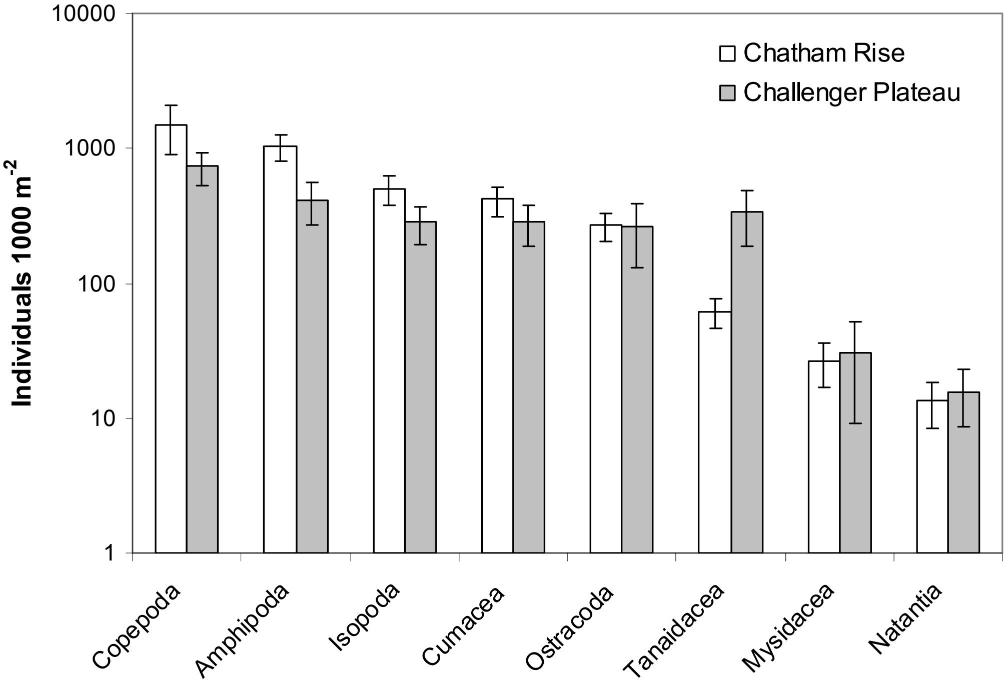


**Figure 15: Abundance of macrofaunal hyperbenthic crustacean taxa in Brenke sled upper net samples from Chatham Rise (n = 16 sites) and Challenger Plateau (n = 5 sites). Means ±1se. Note log scale on y axis.**

## 1.12 Macro and mega-epifauna, bioturbation, and substrates from DTIS still photographs

A total of 1275 still images were analysed from 55 DTIS transects representing 45 sites: 32 on the Chatham Rise and 13 on the Challenger Plateau. Data were extracted from 10 to 25 (mean 22.9, SE 0.35) still images per transect. At least one transect from each *A* site (16 sites) was selected as first priority for analysis and those from a further 29 sites were selected to give broad spatial coverage across both Chatham Rise and Challenger Plateau (Figure 16).

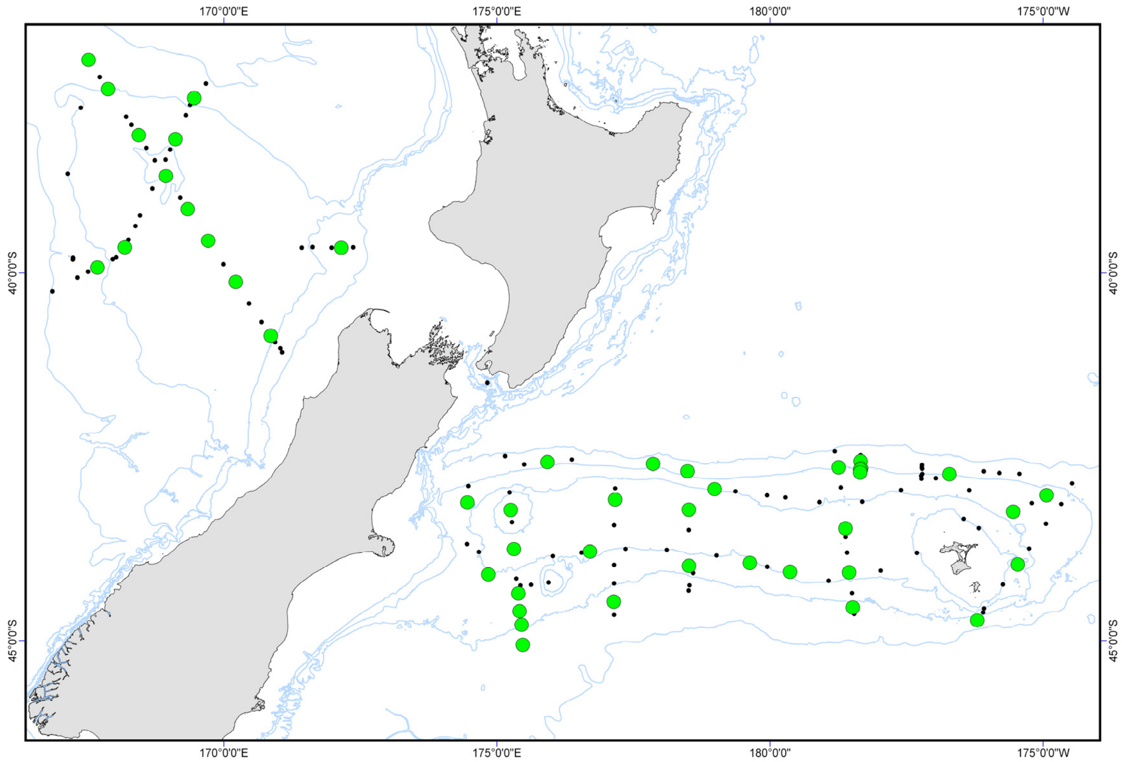


**Figure 16: Deep Towed Imaging System (DTIS) still images: filled circles show sites from which still images were analysed for benthic fauna, substrates, and bioturbation marks. Black dots show all sites sampled during the 2007 Ocean Survey 20/20 voyages.**

A total of 9428 records of individual organisms, representing 93 motile and 84 sessile taxa (Table A6), were identified from the images. More than 5000 records of bioturbation marks were also compiled, together with substrate classifications for all images (see Table A4 and Table A5 for substrate and bioturbation categories). The most taxonomically rich groups were Cnidaria (48 OTUs) and Echinodermata (43) and for all major groups more taxa were recorded on the Chatham Rise than on the Challenger Plateau (Figure 17). Differences in abundances between locations were less pronounced, with only Mollusca and Porifera being in appreciably higher abundance on the Chatham Rise than the Challenger Plateau. The mean abundance of Foraminifera (Xenophyophora) was highest on the Challenger Plateau, but with very high variance resulting from locally abundant populations at some sites (Figure 18).

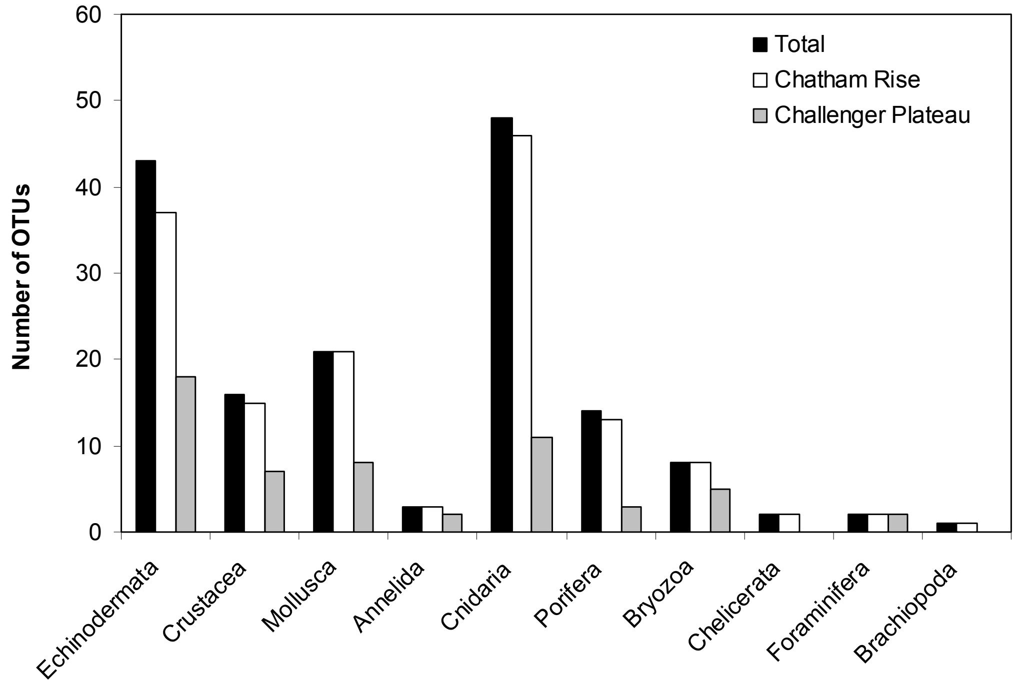


**Figure 17: DTIS still images: numbers of taxa (operational taxonomic units – OTUs) recorded across the whole survey, on Chatham Rise, and on Challenger Plateau.**

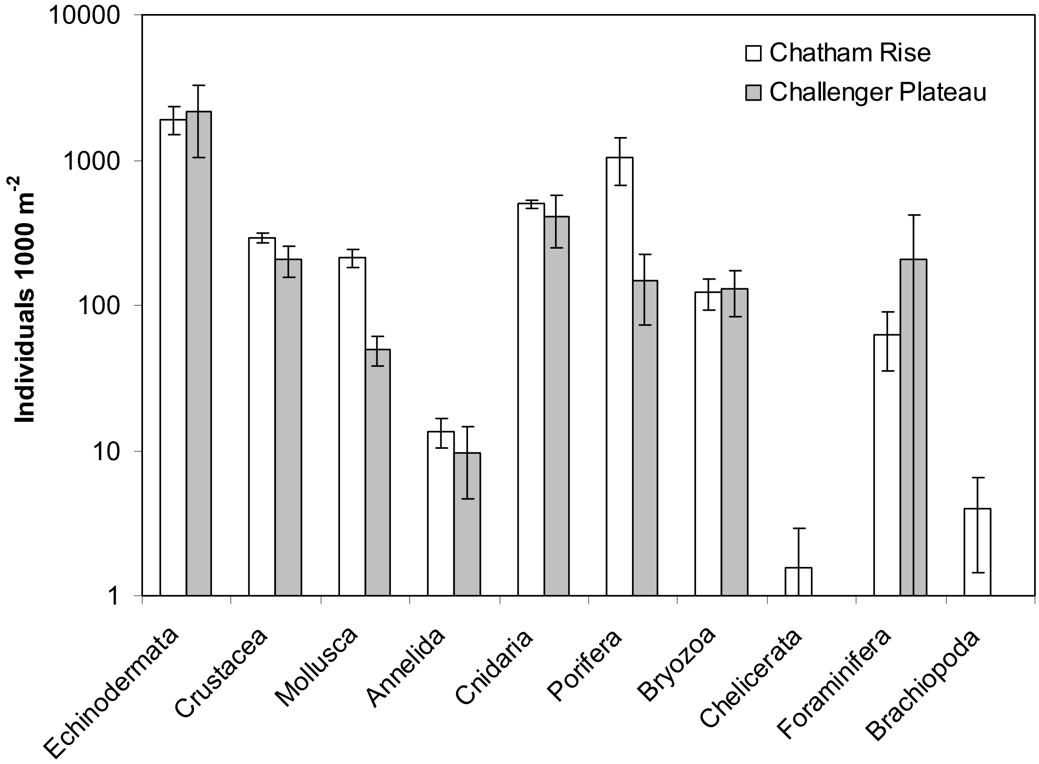


**Figure 18: DTIS still images: number of individuals per 1000 m$^2$ of seabed. Values are means of n=42 (Chatham Rise) and n=13 (Challenger Plateau) transects. Error bars ±1 SE. (Note log scale for abundance).**

### 1.13 Mega-epifauna, bioturbation, and substrates from DTIS video transects

The full length of at least one DTIS video transect was analysed from each of the planned sampling sites across the Chatham Rise and the Challenger Plateau (Figure 19). At all *A* sites across both locations, the two replicate transects were both analysed. Transects from another seven sites, all of which were additions to the sampling plan, were not analysed: six D sites on the Challenger Plateau, five of which were either outside the New Zealand EEZ or not on the original multibeam transects, and one extra B site on the eastern end of the Chatham Rise (Figure 19). This is the most comprehensive coverage of the study area of any of the seabed sampling gears, both in terms of the number of sites and the area of seabed sampled.

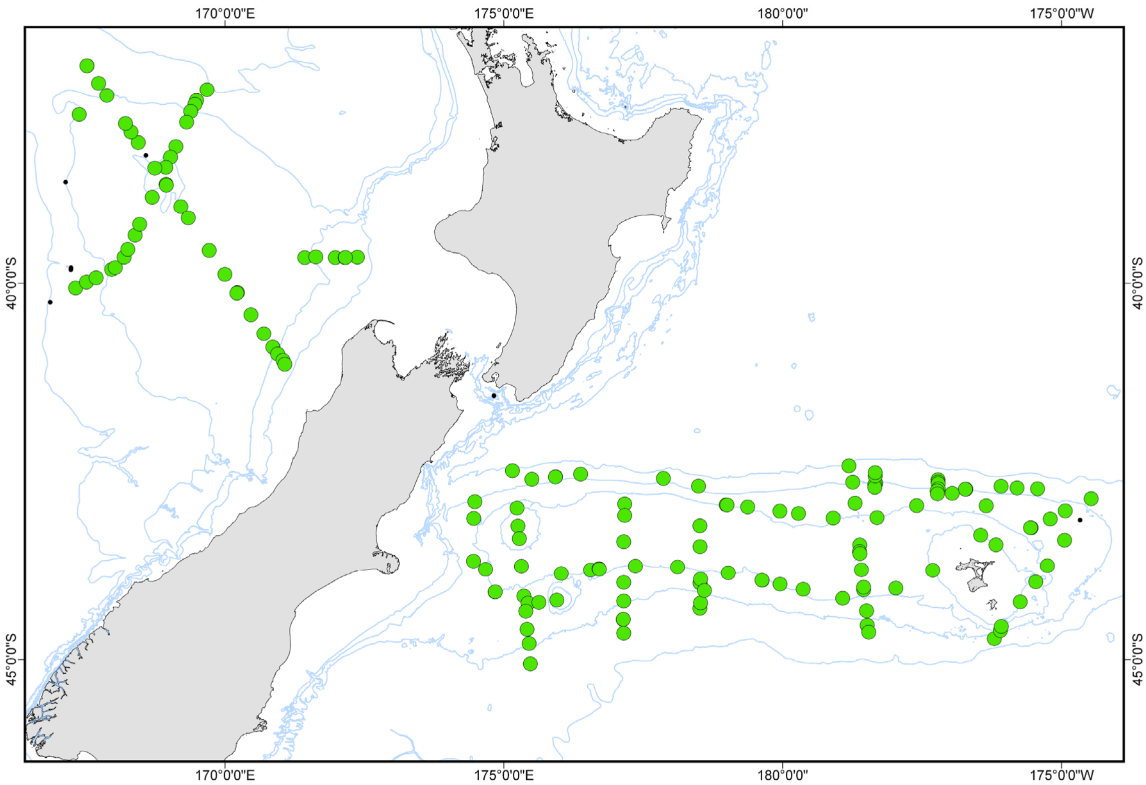


**Figure 19: Deep Towed Imaging System (DTIS) video: filled circles show sites from which video transects were analysed for benthic fauna, substrates, and bioturbation marks. Black dots show sites from which video was not analysed.**

A total of 55 066 records of individual organisms, representing 318 OTUs, were made from the DTIS video data, together with 8225 records of bioturbation features. Substrate type was recorded throughout each transect (see Methods). The most taxonomically rich group in video transects was Echinodermata (75 OTUs), followed by Cnidaria (38) and Arthropoda (34) (Figure 20). For all phyla, more taxa were recorded from the Chatham Rise than from the Challenger Plateau. This is likely to be a consequence of the greater seabed area sampled on the Chatham Rise, and the greater range of habitats encountered there. Echinodermata was also the most abundant phylum across all sites and both locations. At the phylum level, mean abundances of mega-epifauna recorded from video were not significantly different between locations except for Polychaeta and Bryozoa, which were in higher abundance on the Chatham Rise than the Challenger Plateau (ANOVA on $\log_{10}$ transformed data, $P<0.05$) (Figure 21).

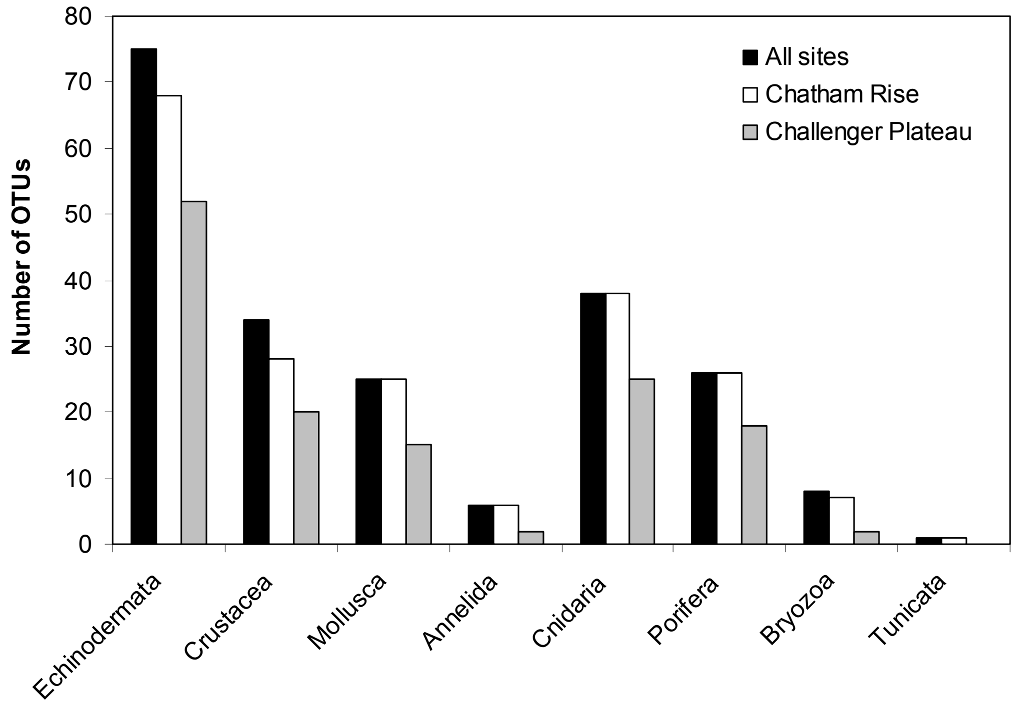


**Figure 20: DTIS video transects: number of taxa (operational taxonomic units – OTUs) recorded across the whole survey (All sites) and in each of the study locations (Chatham Rise and Challenger Plateau).**

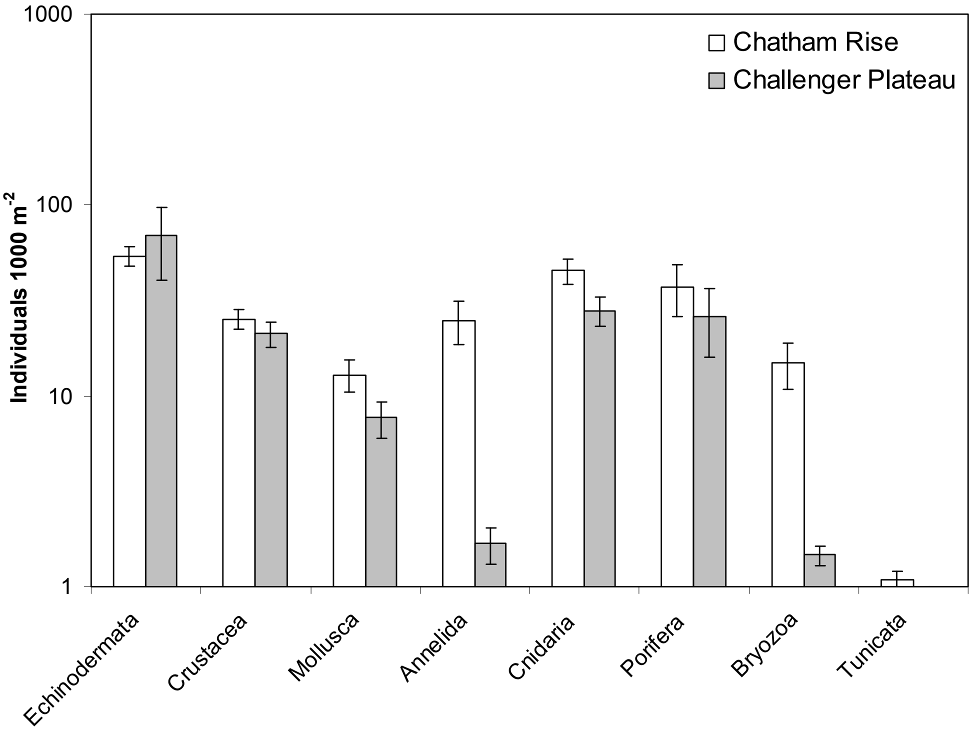


**Figure 21: DTIS video transects: mean number of individuals per 1000 $m^2$ of seabed for the principal phyla recorded. Values are means of n=108 (Chatham Rise) and n=46 (Challenger Plateau) transects. Error bars 1 SE. Note log scale for abundances.**

As noted in the Methods, the principal drawbacks to the video data are that identifications are generally to a coarser taxonomic level than for other megafaunal sampling gears (SEL, TB, DTIS still images) and that smaller organisms (under ca. 50 mm) are not counted. This latter point was important in relation to small-bodied, highly abundant taxa, such as the brittle star *Ophiomusium lymani* and the quill worm *Hyalinoecia* spp., which were impracticable to count from the video (e.g., mean abundances for *O. lymani* were over 10 individuals m$^{-2}$ in some transects). To generate complete data sets for these taxa in video transects, counts were made from still images. Thus, if a taxon was observed to be present in high abundance in sections of a video transect, this was noted in the video analysis file and representative still images were analysed to calculate a mean abundance per square metre. This value was then used to generate an estimate of the total abundance of the taxon along the transect and this was then appended to the original video analysis output. This estimation of abundant, small, taxa was necessary in only 11 transects, and in all cases 8–10 images were sufficient to generate acceptably precise estimates of population density.

For medium- to large-scale habitat mapping, the video transect data have been amalgamated to derive values per transect (abundances summarised as numbers of individuals per unit area (1000 m$^2$) and substrate types summarised as percentages of the overall transect, e.g., 75% muddy sediments, 25% cobbles). However, because each observation is referenced to a position along the transect, the data contain a great deal more spatial information which affords considerable potential for finer scale ecological analyses in future. Thus, the spatial extent of substrate patches and the distribution of organisms in relation to them are inherent in the data (Figure 22 and Figure 23) and could be used, for instance, to examine fine-scale habitat associations, commensal interactions, and spatial aggregation of populations.

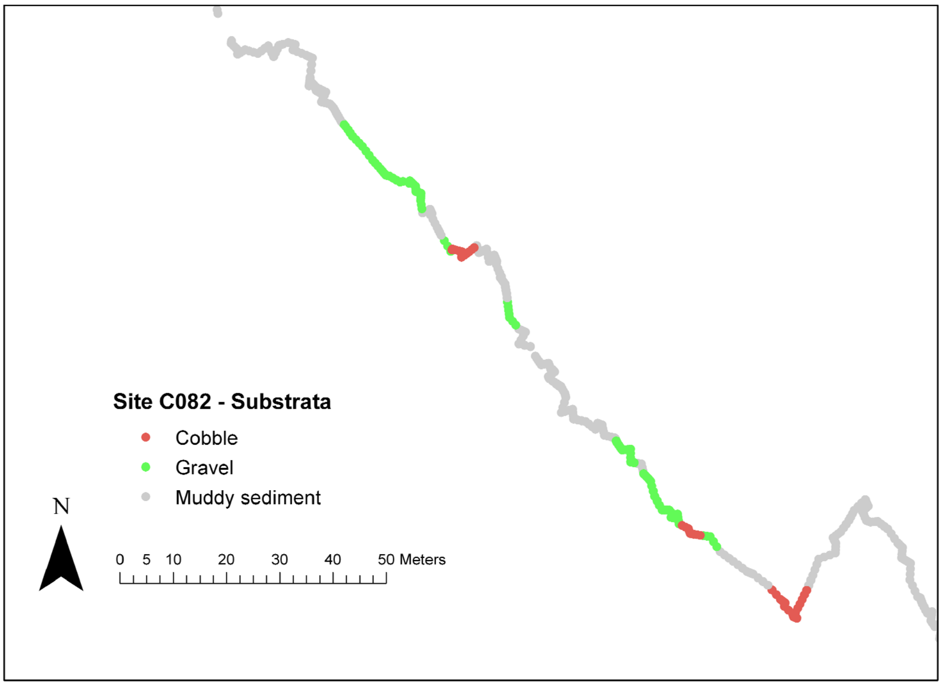


**Figure 22: Within-transect DTIS video detail: example of continuous substrate description throughout transect at Site C082 on Chatham Rise.**

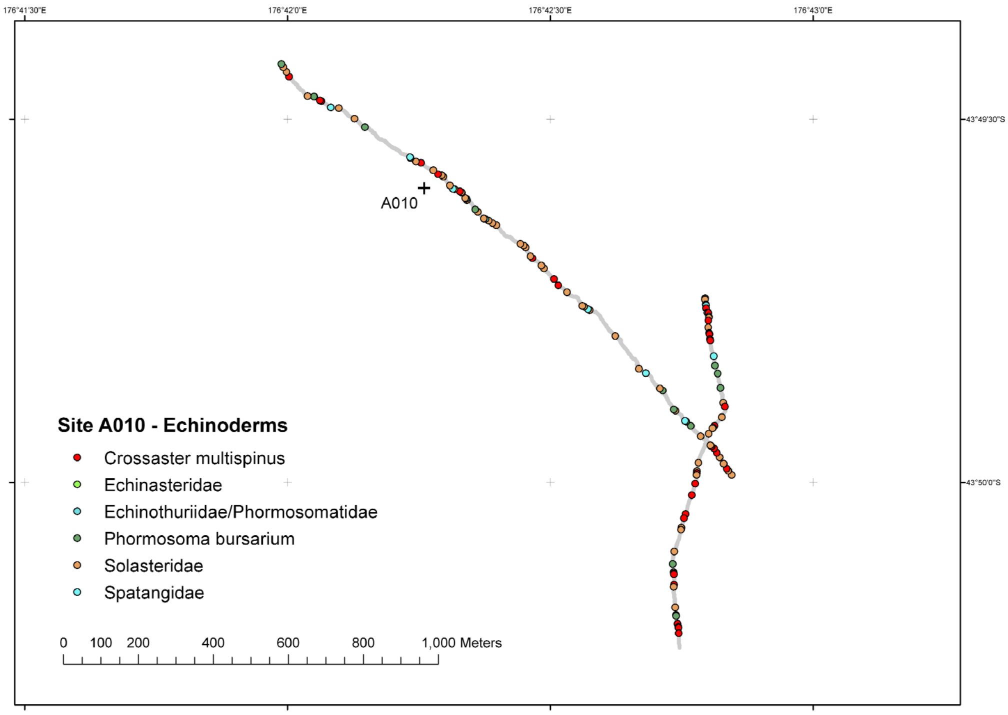


**Figure 23: Within-transect DTIS video data detail: example at site A010 (cross marks the nominal site location) on Chatham Rise showing all echinoderm observations against substrate type (grey = muddy sediment).**

## SUMMARY AND CONCLUSIONS

The Chatham Rise and Challenger Plateau project was the first in the Ocean Survey 20/20 programme and the sampling voyages in 2006 and 2007 were ambitious in terms of the area of seabed covered, the number of gear types deployed, and the range of measurements that were planned from them. A considerable volume of novel, high quality data has been generated from the processing of these samples under the present project and these data will provide the basis for a much-improved understanding of the distribution of benthic biodiversity and habitats across the study area through subsequent analyses. These analyses will centre on validation and testing of the original Marine Environments Classification (MEC) (Snelder et al. 2005, 2006) and its later developments (e.g., Leathwick et al. 2006) but will also include assessment of the utility of multibeam sonar data for predicting seabed habitats and biota at large scales, and the influence of fisheries on benthic habitats.

The sampling strategy and range of gears deployed for the Chatham-Challenger OS 20/20 surveys were decided using the best available information about the survey locations and the types of analyses that were envisaged at the time. Most importantly, the sampling strategy had to balance the conflicting requirements for, on the one hand, broad spatial coverage to adequately characterise variability across the study areas, and on the other, intensive local sampling to provide detail across a broad spectrum of faunal groups and habitats. As with all sampling programmes there were trade-offs involved in these decisions and from this first examination of the samples it is clear that some of the resulting data sets are more useful for addressing the higher-level objectives of the OS 20/20 project than others. These differences are discussed below and result from two principal factors: the number of sites at which each gear type was deployed, and the taxonomic level to which different sample types are routinely identified.

In the present project, most effort was directed to the processing and identification of epibenthic megafauna from the sled and trawl samples. This is the component of the benthos that is most easily sampled over large spatial scales, and for which taxonomies are most complete and New Zealand's taxonomic expertise is strongest. These megafauna samples also represent the largest proportion of sampling effort at sea and the greatest bulk of samples collected. The samples have yielded taxonomically detailed and spatially extensive data sets that are unparalleled in New Zealand waters and will be central to assessments of biodiversity and subsequent analyses of distributional and functional ecology. Of the two data sets derived here from these gears, the seamounts sled samples afford the most complete spatial coverage across the study area and therefore are of most interest for spatial analyses of biodiversity. The seamounts sled is a versatile tool and was selected as the standard gear for these surveys because it allows sampling on any substrate type. However, because it sweeps a smaller area than the beam trawl and because, in this instance, the beam trawl was fitted with a finer mesh net, it catches fewer animals in total and a more restricted range of taxa. This is particularly apparent on the predominantly soft-sediment seabeds that characterise much of the Chatham Rise and the Challenger Plateau (DTIS video data show only 5 sites out of 149 across both locations where bedrock or boulder substrates constituted more than 10% of the transect). Mega- and macro-epifauna are generally scarcer on soft sediments and thus the greater swept area of the beam trawl is more likely to capture representative samples in these environments. For these reasons, it would be more effective to use the beam trawl as the standard gear for sampling mega-epifauna in continental shelf and deep sea habitats and use the seamounts sled only as necessary on the rarer rocky sites.

The DTIS video and still images provide quantitative data across a range of scales, and analysis of the video in particular was very effective for enumeration of mega-epifaunal taxa and their spatial relationships to substrate type throughout the study area. Analysis of the DTIS video and stills samples was dependent on the provision of identifications from the sled and trawl samples and there is a very effective synergy between these two sampling methods; the physical samples from the sled and trawl providing taxonomic validation for the photographic samples. The resulting data sets afford the potential for detailed analyses of distributions across scales ranging from less than 10 $m^2$ within transects to 10–100 $km^2$ between sites and locations.

The two data sets that have the least potential for use in broad-scale ecological analyses in their present form are the meiofauna and the hyperbenthic fauna from the multicorer and Brenke sled, respectively. This is because the level of taxonomic resolution that was achieved is too coarse to enable reliable discrimination between samples and because these gears were deployed only at a relatively small subset of sites. The lack of taxonomic resolution is a consequence of long sample sorting times for the very large numbers of small organisms collected, current lack of taxonomic expertise in New Zealand for many of the faunal groups (e.g., nematodes, isopods), and lack of established taxonomies and identification keys. Both these components of the benthos are highly diverse, are of considerable interest taxonomically and, most importantly, are likely to play significant roles in ecosystem functioning (e.g., Hinz et al. 2008, Ingels et al. 2009). Thus, there are strong arguments for expanding research in these fields as long as the resources required are weighed against the objectives of individual projects and available funding.

The initial decision to deploy five different gear types during sampling was a consequence of wanting to sample a very broad spectrum of faunal sizes. With the resources available both during and after the sample collection phase, this decision has had two important effects on the scope and detail of the data sets described here. First, by committing to deploying many gear types, it was impractical to collect replicate samples other than at a small subset of sites (*A* sites) or to deploy all gear types at all sites. Thus the potential for quantification of within-site variability is limited, and for the multicorer, beam trawl, and Brenke sled, spatial coverage of the samples is restricted. This was known at the time of planning and the strategy adopted was a pragmatic and well informed approach designed to ensure broad coverage while enabling some assessment of variability at a small subset of sites. Second, by collecting samples of many different types, from sediments and bacteria to mobile macro- and megafauna, each of which requires specialist skills and taxonomic knowledge to process, the number of samples that could be analysed and the level of taxonomic detail that could be achieved for some faunal components has, to date, been restricted.

From this preliminary assessment of data sets from the first OS 20/20 voyages, and given that the focus is on epifaunal, rather than infaunal, habitats, the sampling gears that provide the most appropriate data at relevant scales for regional biodiversity research and for which taxonomic expertise currently exists in New Zealand are the DTIS camera system, and either the beam trawl or the epibenthic sled. When used together, these gears provide a practical and effective means for collecting broad-scale quantitative information across large areas of the seabed. This combination of gears was central to the Chatham-Challenger OS 20/20 surveys and has generated an extensive, detailed, and consistent data set, which is of direct relevance to the objectives of the OS 20/20 project and will be of considerable value for future ecological analyses of the region.

Sediment characteristics are also fundamental to ecological or geological studies of the seabed and the multicorer samples from the Chatham-Challenger surveys have generated a wide range of data relating to physical sediment characteristics, bacteria, meiofauna, macro-infauna, and biological oxygen demand. The multicorer is a versatile and practical tool but the value of the resulting data for analyses at spatial scales relevant to the OS 20/20 objectives could be considerably enhanced in future by increasing the spatial coverage of sampling: ideally cores would be taken routinely at all sites. Although the fundamental trade-off between the number of gear types deployed and the number of sites sampled will always remain, as will the limitations of processing time, increasing the spatial coverage of the multicorer sampling would provide a wealth of data for future studies and would resolve one of the main short-comings identified with some of the data described here: the lack of spatial coverage.

## ACKNOWLEDGMENTS

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Constructive reviews by Scott Nodder, Judi Hewitt, and Mary Livingston improved earlier versions of this report.

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## APPENDICES

**Table A1: Challenger Plateau (TAN0707) and Chatham Rise (TAN0705); gear deployments at each sampling site. CB; box corer, CM; multicorer, DTIS; camera, SEH; Brenke sled, SEL; seamount sled, TB; beam trawl.**

| Region | Stratum | Site | longitude | latitude | CB | CM | DTIS | SEH | SEL | TB |
|---|---|---|---|---|---|---|---|---|---|---|
| Challenger | 1 | BB100 | 169.34008 | -39.08889 | | | 1 | | 1 | 1 |
| | | CC100 | 169.71519 | -39.54406 | | | 1 | | 1 | 1 |
| | 2 | AA002 | 168.94528 | -38.62290 | 2 | 2 | 2 | 1 | 2 | 1 |
| | | BB101 | 168.69013 | -38.80054 | | | 1 | | 1 | |
| | | CC101 | 169.20700 | -38.92946 | | | 1 | | 1 | |
| | | CC102 | 168.73717 | -38.38679 | | | 1 | | 1 | |
| | | CC113 | 168.93763 | -38.37821 | | | 1 | | 1 | |
| | 3 | AA003 | 167.52723 | -36.91874 | 2 | 2 | 2 | 1 | 2 | 1 |
| | | BB102 | 167.72800 | -37.17063 | | | 1 | | 1 | |
| | | BB103 | 169.46000 | -37.48575 | | | 1 | | 1 | |
| | | CC103 | 169.30967 | -37.73488 | | | 1 | | 1 | |
| | | CC114 | 169.49296 | -37.41583 | | | 1 | | 1 | |
| | | CC115 | 167.87933 | -37.35233 | | | 1 | | 1 | |
| | | DD001 | 169.67096 | -37.27188 | | | 1 | | | 1 |
| | | DD002 | 169.38154 | -37.58433 | | | 1 | | 1 | |
| | | DD003 | 167.38596 | -37.61967 | | | 1 | | | 1 |
| | | DD004 | 167.14767 | -38.58250 | | | 1 | | | 1 |
| | 4 | BB104 | 168.18763 | -39.63946 | | | 1 | | 1 | |
| | | BB105 | 168.46872 | -39.18319 | | | 1 | | 1 | 1 |
| | | CC104 | 168.38325 | -39.32929 | | | 1 | | 1 | |
| | | CC116 | 168.25350 | -39.53129 | | | 1 | | 1 | |
| | 5 | BB106 | 168.03967 | -39.78179 | | | 1 | | 1 | |
| | | BB107 | 167.69313 | -39.92596 | | | 1 | | 1 | |
| | | CC105 | 167.32363 | -40.07071 | | | 1 | | 1 | |
| | | CC106 | 167.96425 | -39.80763 | | | 1 | | 1 | |
| | | CC118 | 167.52217 | -39.98383 | | | 1 | | 1 | |
| | | DD005 | 166.86713 | -40.25804 | | | 1 | | | 1 |
| | | DD007 | 167.23992 | -39.81367 | | | 1 | | | |
| | | DD008 | 167.24342 | -39.80033 | | | 1 | | | |
| | | DD009 | 167.24292 | -39.78658 | | | 1 | | | |
| | 6 | AA006 | 172.15342 | -39.64543 | | 2 | 2 | 1 | 2 | 1 |
| | | BB109 | 171.62325 | -39.63646 | | | 1 | | 1 | |
| | | CC107 | 171.97413 | -39.64463 | | | 1 | | 1 | |
| | | CC117 | 172.36213 | -39.64273 | 1 | 1 | 1 | | 1 | |
| | | CC120 | 171.42913 | -39.64454 | | | 1 | | 1 | |
| | 7 | BB110 | 169.11589 | -38.08239 | | | 1 | | 1 | 1 |
| | | BB111 | 168.31133 | -37.87439 | | | 1 | | 1 | 1 |
| | | CC108 | 168.44367 | -38.02508 | | | 1 | | 1 | |
| | | CC109 | 169.02450 | -38.23183 | | | 1 | | 1 | |
| | | CC119 | 168.21504 | -37.75725 | | | 1 | | 1 | |
| | | DD006 | 168.58471 | -38.20604 | | | 1 | | 1 | |
| | 8 | AA008 | 170.85563 | -40.87888 | 2 | 2 | 2 | 1 | 2 | 1 |
| | | BB113 | 170.69142 | -40.69229 | | | 1 | | 1 | |
| | | BB114 | 171.03929 | -41.05963 | | | 1 | | 1 | |
| | | CC110 | 171.07163 | -41.10971 | | | 1 | | 1 | |
| | | CC111 | 170.93854 | -40.96983 | | | 1 | | 1 | |
| | 9 | AA009 | 170.21211 | -40.12983 | 2 | 2 | 2 | 1 | 2 | 1 |

| Region | Stratum | Site | longitude | latitude | CB | CM | DTIS | SEH | SEL | TB |
|---|---|---|---|---|---|---|---|---|---|---|
| Challenger | | BB115 | 170.46613 | -40.43146 | | | 1 | | 1 | |
| | | CC112 | 169.99933 | -39.87563 | | | 1 | | 1 | |
| | | | | | | | | | | |
| Chatham | 1 | A001 | 179.63038 | -43.97924 | | 3 | 2 | 1 | 2 | 1 |
| | | A016 | 181.37951 | -43.52803 | | 4 | 2 | 1 | 2 | 1 |
| | | B011 | 181.07596 | -44.21025 | | | 1 | | 1 | |
| | | B012 | 177.16375 | -43.13079 | | | 1 | | 1 | |
| | | B013 | 178.50833 | -43.53569 | | | 1 | 1 | 1 | |
| | | B014 | 182.03142 | -44.08208 | | | 1 | | 1 | |
| | | B015 | 178.11479 | -43.80529 | | | 1 | | 1 | |
| | | B017 | 181.45171 | -44.10304 | | | 1 | | 1 | |
| | | B018 | 179.02263 | -43.87883 | | | 1 | | 1 | |
| | | B043 | 178.52858 | -43.96438 | | | | | 1 | |
| | | C011 | 180.36933 | -44.09625 | | | 1 | | | |
| | | C012 | 179.95283 | -44.02925 | | | 1 | | | |
| | 2 | A002 | 184.44616 | -43.29189 | | 3 | 2 | 1 | 2 | 1 |
| | | A010 | 176.70989 | -43.83266 | 1 | 2 | 2 | 1 | 2 | 1 |
| | | B022 | 184.53883 | -44.00042 | | | 1 | | 1 | |
| | | B023 | 182.69133 | -43.84571 | | | 1 | | 1 | |
| | | B024 | 176.55454 | -43.84492 | | | 1 | | 1 | |
| | | B025 | 175.31467 | -43.79714 | | | 1 | 1 | 1 | |
| | | B0X1 | 185.33738 | -43.19238 | | | 1 | | 1 | |
| | | C021 | 183.82358 | -43.51539 | | | 1 | 1 | 1 | |
| | | C023 | 184.74879 | -43.79008 | | | 1 | | 1 | |
| | | C024 | 175.94983 | -44.23617 | | | 1 | | | |
| | | C025 | 176.02900 | -43.89017 | | | 1 | | | |
| | | C026 | 177.35825 | -43.79333 | | | 1 | | | |
| | 3 | A003 | 183.28313 | -42.78437 | | 3 | 2 | 1 | 3 | 1 |
| | | B031 | 183.90983 | -42.74904 | | | 1 | | 1 | |
| | | B032 | 181.25942 | -42.68983 | | | 1 | | 1 | |
| | | B033 | 177.86788 | -42.64479 | | | 1 | | 1 | |
| | | B034 | 184.79746 | -43.17471 | | | 1 | | 1 | |
| | | B035 | 184.19954 | -42.76417 | | | 1 | | 1 | |
| | | B036 | 185.53308 | -42.91050 | | | 1 | | 1 | |
| | | B037 | 185.06603 | -43.07003 | | | 1 | 1 | 1 | |
| | | C031 | 184.56938 | -42.77692 | | | 1 | | 1 | |
| | | C032 | 183.90496 | -44.62663 | | | 1 | | 1 | |
| | | CX1 | 178.49042 | -42.74542 | | | 1 | | | |
| | | CX2 | 183.64860 | -43.00392 | | | 1 | | 2 | 1 |
| | 4 | A004 | 181.51960 | -44.56104 | | 2 | 2 | 1 | 2 | |
| | | A041 | 178.52010 | -44.01517 | | 3 | 2 | 1 | 2 | 1 |
| | | B041 | 181.50600 | -44.37550 | | | 1 | | 1 | |
| | | B043 | 178.52858 | -43.96438 | | | 1 | | | |
| | | C042 | 183.79813 | -44.73550 | | | 1 | | 1 | |
| | 5 | A005 | 175.92653 | -42.62298 | | 2 | 2 | 1 | 2 | 1 |
| | | B051 | 175.50325 | -42.65221 | | | 1 | | 1 | |
| | | B052 | 174.47563 | -42.94742 | | | 1 | | 1 | |
| | | C051 | 183.04154 | -42.84079 | | | 1 | | 1 | |
| | | C052 | 176.38096 | -42.58733 | | | 1 | | 1 | |
| | 6 | A006 | 179.11933 | -42.99245 | | 2 | 2 | 1 | 2 | 1 |
| | | B061 | 175.25204 | -43.26933 | | | 1 | | 1 | |
| | | B062 | 178.51746 | -43.26588 | | | 1 | | 1 | |
| | | B063 | 182.40267 | -42.99879 | | | 1 | | 1 | |
| | | B064 | 181.28454 | -43.10438 | | | 1 | | 1 | |

| Region | Stratum | Site | longitude | latitude | CB | CM | DTIS | SEH | SEL | TB |
|---|---|---|---|---|---|---|---|---|---|---|
| Chatham | | B065 | 175.23413 | -43.03663 | | | 1 | | 1 | |
| | | B066 | 180.90654 | -43.16425 | | | 1 | | 1 | |
| | | B067 | 179.37163 | -43.02333 | | | 1 | | 1 | |
| | | C061 | 174.46142 | -43.16983 | | | 1 | | 1 | |
| | | C062 | 177.16917 | -42.97781 | 1 | | 1 | | 1 | |
| | | C063 | 181.69354 | -43.15971 | | | 1 | | 1 | |
| | | C064 | 179.95092 | -43.07442 | | | 1 | | | |
| | 7 | A007 | 174.83039 | -44.10292 | 2 | 2 | 2 | 2 | 2 | 1 |
| | | B071 | 175.43263 | -44.27517 | | | 1 | | 1 | |
| | | B072 | 175.41725 | -44.61392 | | | 1 | | 1 | |
| | | B073 | 174.67375 | -43.83417 | | | 1 | | 1 | |
| | | B074 | 175.35996 | -44.18129 | | | 1 | | 1 | |
| | | B075 | 177.15146 | -44.00596 | | | 1 | | 1 | |
| | | C072 | 175.39525 | -44.37900 | | | 1 | | | |
| | | C074 | 175.62958 | -44.26550 | | | 1 | | | |
| | 8 | A008 | 177.14280 | -44.48548 | | 2 | 2 | 1 | 2 | 1 |
| | | B081 | 177.15358 | -44.24654 | | | 1 | | 1 | |
| | | B082 | 178.52804 | -44.27229 | | | 1 | | 1 | |
| | | B083 | 175.47667 | -45.05339 | | | 1 | | 2 | |
| | | C081 | 177.14900 | -44.66208 | | | 1 | | | |
| | | C082 | 175.45425 | -44.79358 | | | 1 | | | |
| | | C083 | 178.51417 | -44.34250 | | | 1 | | | |
| | 9 | D002 | 174.82725 | -41.53683 | | | 1 | | 1 | |
| | | D003 | 178.59625 | -44.11125 | | | 1 | | | |
| | | D004 | 181.54350 | -44.64679 | | | 1 | | 1 | |
| | | D005 | 183.91896 | -44.57396 | | | 1 | | 1 | |
| | | D006 | 184.26558 | -44.26275 | | | 2 | | 1 | |
| | | D007 | 185.05508 | -43.45479 | | | 1 | | 1 | |
| | | D008 | 183.54917 | -43.38954 | | | 1 | | 1 | |
| | | D009 | 181.45442 | -44.06775 | | | 1 | | | 1 |
| | | D010 | 181.41129 | -43.84246 | | | 1 | | | 1 |
| | | D011 | 181.38796 | -43.63008 | | | 1 | | | 1 |
| | | D012 | 181.29917 | -42.97175 | | | 1 | | 1 | |
| | | D013 | 181.66133 | -42.53433 | | 1 | 1 | | | 1 |
| | | D014 | 181.66235 | -42.56604 | | 2 | 1 | | | 1 |
| | | D015 | 181.60201 | -42.67243 | | 2 | 1 | | | 2 |
| | | D016 | 181.66310 | -42.70640 | | 2 | 1 | | | 1 |
| | | D017 | 181.65192 | -42.72621 | | | 1 | | | 1 |
| | | D018 | 181.65135 | -42.76179 | | 2 | 1 | | | 1 |
| | | D019 | 182.78713 | -42.65629 | | | 1 | | | 1 |
| | | D020 | 182.78511 | -42.68694 | | 1 | 1 | | | 1 |
| | | D021 | 182.78854 | -42.71196 | | 2 | 1 | | | 1 |
| | | D022 | 182.79010 | -42.77640 | | 2 | 1 | | | 2 |
| | | D023 | 182.77331 | -42.80679 | | 2 | 1 | | | 1 |
| | | D024 | 182.77275 | -42.84829 | | 3 | 1 | | | 2 |
| | | D025 | 181.18738 | -42.46975 | | | 1 | | | 1 |
| | | D026 | 177.14858 | -43.47392 | | | 1 | | 1 | |
| | | D027 | 175.27833 | -43.43275 | | | 1 | | | |
| | | D028 | 174.45463 | -43.72767 | | | 1 | | 1 | |
| | | D029 | 175.14692 | -42.54171 | | | 1 | | | 1 |

**Table A2: Epibenthic megafaunal taxa identified from seamount sled (SEL) and Beam Trawl (TB) samples collected during voyages TAN0705 and TAN0707 to Chatham Rise and Challenger Plateau.**

| Phylum | Class | Order | Number of taxa (species or higher level) |
|---|---|---|---|
| Foraminifera | Xenophyophorea | | 1 |
| Porifera | Demospongiae | Astrophorida | 8 |
| | | Dendroceratida | 1 |
| | | Dictyoceratida | 3 |
| | | Hadromerida | 11 |
| | | Halichondrida | 6 |
| | | Haplosclerida | 8 |
| | | Poecilosclerida | 21 |
| | | Spirophorida | 6 |
| | Hexactinellida | Amphidiscosida | 5 |
| | | Hexactinosida | 2 |
| | | Lyssacinosida | 6 |
| Cnidaria | Anthozoa | Actiniaria | 15 |
| | | Alcyonacea | 7 |
| | | Antipatharia | 2 |
| | | Corallimorpharia | 2 |
| | | Gorgonacea | 10 |
| | | Pennatulacea | 14 |
| | | Scleractinia | 12 |
| | | Telestacea | 2 |
| | | Zoanthidea | 4 |
| | Hydrozoa | Anthoathecata | 8 |
| | | Hydroida | 1 |
| | | Leptothecata | 11 |
| | Scyphozoa | | 1 |
| Mollusca | Aplacophora | Aplacophora | 1 |
| | Bivalvia | Arcoida | 4 |
| | | Dimyidae | 1 |
| | | Limoida | 1 |
| | | Myoida | 9 |
| | | Mytiloida | 1 |
| | | Nuculoidea | 13 |
| | | Ostreoida | 4 |
| | | Pholadomyoida | 2 |
| | | Pterioida | 2 |
| | | Veneroida | 5 |
| | Cephalopoda | Octopoda | 2 |
| | | Sepiida | 1 |
| | | Sepiolida | 1 |
| | | Spirulida | 1 |
| | | Teuthida | 2 |
| | Gastropoda | Kapala | 1 |
| | | Speoides | 1 |
| | Gastropoda Opisthobranchia | Cephalaspidea | 4 |
| | | Nudibranchia | 1 |

| Phylum | Class | Order | Number of taxa (species or higher level) |
|---|---|---|---|
| Mollusca | Gastropoda Prosobranchia | Archaeogastropoda | 10 |
| | | Cocculiniformia | 1 |
| | | Heterostropha | 1 |
| | | Mesogastropoda | 18 |
| | | Neogastropoda | 31 |
| | | Neotaenioglossa | 6 |
| | | Stenoglossa | 29 |
| | | Vetigastropoda | 2 |
| | Polyplacophora | Neoloricata | 1 |
| | Polyplacophora Neoloricata | Ischnochitonida | 2 |
| | Scaphopoda | Dentaliida | 3 |
| | Solenogastra | | 1 |
| Nemertea | Nemertea | Nemertea | 1 |
| Echiura | | | 1 |
| Priapulida | Priapulida | Priapulida | 1 |
| Sipuncula | Sipunculidea | | 1 |
| Annelida | Polychaeta | Amphinomida | 3 |
| | | Eunicida | 22 |
| | | Phyllodocida | 11 |
| | | Phyllodocida Aphroditiformia | 13 |
| | | Phyllodocida Nereidiformia | 3 |
| | | Sabellida | 13 |
| | | Scolecida | 19 |
| | | Spionida | 5 |
| | | Terebellida Cirratuliformia | 2 |
| | | Terebellida Terebelliformia | 6 |
| Brachiopoda | Articulata | Terebratulida | 6 |
| | Rhynchonellida | | 1 |
| Bryozoa | Gymnolaemata | Cheilostomata | 70 |
| | | Ctenostomata | 1 |
| | Stenolaemata | Cyclostomata | 5 |
| Arthropoda Chelicerata | Pycnogonida | Pycnogonida | 2 |
| Arthropoda Crustacea | Malacostraca | Amphipoda | 20 |
| | | Decapoda | 87 |
| | | Euphausiacea | 1 |
| | | Isopoda | 18 |
| | | Mysidacea | 2 |
| | | Stomatopoda | 1 |
| | | Tanaidacea | 1 |
| | Maxillopoda | Pedunculata | 11 |
| | | Sessilia | 2 |
| | Ostracoda | | 1 |

| Phylum | Class | Order | Number of taxa (species or higher level) |
| --- | --- | --- | --- |
| Echinodermata | Asteroidea | Brisingida | 6 |
| | | Forcipulatida | 5 |
| | | Notomyotida | 9 |
| | | Paxillosida | 18 |
| | | Spinulosida | 4 |
| | | Valvatida | 16 |
| | | Velatida | 9 |
| | Crinoidea | Articulata | 4 |
| | | Bourgueticrinida [aka Millericrinida] | 3 |
| | | Cyrtocrinida | 1 |
| | Echinoidea | Cidaroida | 5 |
| | | Echinoida | 3 |
| | | Echinothurioida | 5 |
| | | Pedinoida | 1 |
| | | Spatangoida | 9 |
| | Holothuroidea | Aspidochirotida | 6 |
| | | Dactylochirotida | 1 |
| | | Dendrochirotida | 9 |
| | | Elasipodida | 6 |
| | | Holothuroidea | 1 |
| | | Molpadiida | 8 |
| | Ophiuroidea | Euryalinida | 3 |
| | | Ophiurida | 48 |
| Chordata | Ascidiacea [Tunicates] | Enterogona Aplousobranchia | 2 |
| | | Pleurogona Stolidobranchia | 7 |
| | Thaliacea [Salps] | | 1 |

**Table A3: Taxa and total number of individuals identified from upper net samples of the Brenke epibenthic sled (SEH). Totals are summed across all 20 sites at which the SEH was deployed.**

| Phylum | Class | Superorder | Order | Taxon | No. individuals |
|---|---|---|---|---|---|
| Cnidaria | Hydrozoa or Scyphozoa | | | Medusa | 26 |
| Mollusca | Bivalvia | | | Bivalvia | 1888 |
| | Gastropoda | | | Gastropoda | 1845 |
| | Scaphopoda | | | Scaphopoda | 676 |
| | Solenogastres | | | Solenogastres | 705 |
| Nematoda | | | | Nematoda | 1567 |
| Nemertea | | | | Nemerteans | 3 |
| Sipuncula | Sipunculida | | | Sipunculida | 8 |
| Annelida | Polychaeta | | | Polychaeta | 5012 |
| | indeterminate worms | | | worms | 1572 |
| Brachiopoda | | | | Brachiopoda | 4850 |
| Chaetognatha | | | | chaetognaths | 44 |
| Arthropoda | Malacostraca | Eucarida | Decapoda | Anomura | 67 |
| | | | | Brachyura | 58 |
| | | | | Natantia | 249 |
| | | | Euphausiacea | Euphausiacea | 20 |
| | | Peracarida | Amphipoda | Amphipoda | 14493 |
| | | | Cumacea | Cumacea | 6294 |
| | | | Isopoda | Isopoda | 7740 |
| | | | Mysida | Mysidacea | 483 |
| | | | Tanaidacea | Tanaidacea | 2214 |
| | | | Leptostraca | Leptostraca | 178 |
| | Maxillopoda | | | Cirripedia | 5 |
| | | | | Copepoda | 21851 |
| | Ostracoda | | | Ostracoda | 4264 |
| | Pycnogonida | | | Pycnogonida | 5 |
| Echinodermata | Asteroidea | | | Asteroidea | 432 |
| | Crinoidea | | | Crinoidea | 90 |
| | Echinoidea | | | Echinoidea | 929 |
| | Holothuroidea | | | Holothuroidea | 441 |
| | Ophiuroidea | | | Ophiuroidea | 1218 |
| Chordata | Ascidiacea | | | Ascidiacea | 5 |
| | Thaliacea | | Salpida | salps | 345 |

**Table A4: Substrate descriptors available during analysis of DTIS still images. Note that this is the full substrate table available in the NICAMS database and only a subset of these descriptors was actually present in the Chatham-Challenger images that were analysed. Substrate types were recorded as percentages of the full image area.**

| Category | Substratum | qualifier | Label | definition |
|---|---|---|---|---|
| Hard substrata | | | Hard substrata | |
| | Bedrock | | Bedrock | |
| | | outcrop | Bedrock outcrop | |
| | | smooth | Bedrock smooth | |
| | | irregular | Bedrock irregular | |
| | | eroded | Bedrock eroded | |
| | | scoured | Bedrock scoured | |
| | Lava | | Larva | |
| | | glassy | Larva glassy | |
| | | pillow | Larva pillow | |
| | | lobate | Larva lobate | |
| | | sheet | Larva sheet | |
| | Breccia | | Breccia | rock composed of angular fragments of rocks or minerals in a matrix of cementing material. |
| | Talus | | Talus | rock that occurs in fragments or particles lying on, above, or adjacent to the place in which it was originally formed or deposited |
| | Boulders | | Boulders | >25.6 cm |
| | Boulders | smooth | Boulders smooth | |
| | Boulders | irregular | Boulders irregular | |
| | Cobbles | | Cobbles | 6.5 - 25 cm |
| | Pebbles | | Pebbles | 0.4 - 6.4 cm |
| Soft sediments | | | Soft sediment | |
| | Gravel | | Gravel | 0.2 - 0.4 cm |
| | | waves | Gravel waves | wavelength > ca 50 cm |
| | | ripples | Gravel ripples | wavelength < ca 30 cm |
| | | flat | Gravel flat | |
| | | overlay | Gravel overlay | gravel overlying hard substrata |
| | Sand | | Sand | 0.063 - 0.2 cm |
| | | waves | Sand waves | wavelength > ca 50 cm |
| | | ripples | Sand ripples | wavelength < ca 30 cm |
| | | flat | Sand flat | |
| | | overlay | Sand overlay | Sand overlying hard substrata |
| | Mud | | Mud | <0.063 cm |
| | | overlay | Mud overlay | Mud overlying hard substrata |
| Biogenic | | | Biogenic substrata | |
| | Coral rubble | | Coral rubble | broken fragments of stony corals |
| | Shell hash | | Shell hash | non seep or vent related taxa |
| | Coral (intact) | | Coral (intact) | structurally intact stands of reef-forming corals: may be live, dead, or mixture |

| Category | Substratum | qualifier | Label | definition |
|---|---|---|---|---|
| Biogenic | Epifauna high | | Epifauna high | mixed complex assemblage of erect epifauna |
| | Epifauna low | | Epifauna low | mixed complex assemblage, epifaunal turf |
| | Pteropod shell | | Pteropod shell | dead pteropod shells |
| | Salps | | Salps | dead salps on the seafloor |
| Anthropogenic | Trawl marks | | Trawl marks | |
| | Fishing gear | | Fishing gear | |
| | Rubbish | | Rubbish | |
| | Sampling marks | | Sampling marks | e.g., sled tracks, grab pits |
| Vents & seeps | Carbonate rock | | Carbonate rock | weathered carbonate rock, few or no live seep fauna associated |
| | Chemoherm | | Chemoherm | 'soft' appearance, high relief, associated with live chemosynthetic fauna and active seepage |
| | Sulphidic sediment | | Sulphidic sediment | dark sediment, often with characteristic 'raindrop' texture |
| | Bacterial mat | | Bacterial mat | white patches, usually on soft sediments |
| | Vesicomyid shell | | Vesicomyid shell | dead vesicomyid clam shells |
| | Bathymodiolin shell | | Bathymodiolin shell | dead Bathymodiolin mussel shells |
| | *Acharax* sp. Shell | | Acharax sp. Shell | dead *Acharax* sp. shells |

**Table A5: Bioturbation mark descriptors available during analysis of DTIS still images. Marks were recorded as numbers per m$^2$.**

| Category | Substratum | qualifier | Label | definition |
|---|---|---|---|---|
| Bioturbation | | | Bioturbation | |
| | Burrow | | Burrow | |
| | Track | | Track | |
| | Mound | | Mound | |
| | Pit | | Pit | |
| | Faecal coil | | Faecal coil | e.g. holothurian casts |
| | Ring of burrows | | Ring of burrows | raised mound surrounded at base by burrow entrances |
| | Spiral | | Spiral | hemichordate worm feeding trace |
| | Resting trace | asteroid | Resting trace asteroid | impression of body outline |
| | Resting trace | ophiuroid | Resting trace ophiuroid | impression of body outline |
| | Paleodictyon | | Paleodictyon | hexagonal dot matrix pattern |

**Table A6: DTIS still images: operational taxonomic units (OTU) for mega-epibenthic fauna identified from seabed still images.**

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Annelida | Echiura | | Echiuran |
| | Polychaeta | Aciculata | Hyalinoecia |
| | | Canalipalpata | Sabellid |
| | | | Errant polychaete |
| | | | Polychaeta |
| | | | Worm indet. |
| Arthropoda | Malacostraca | Decapoda | *Agononida nielbrucei* |
| | | | Atelecyclidae |
| | | | Brachyura |
| | | | *Campylonotus rathbunae* |
| | | | Chirostylidae |
| | | | Galatheidae |
| | | | Galatheoidea |
| | | | *Gastroptychus novaezelandiae* |
| | | | Glyphocrangon |
| | | | Goneplacidae |
| | | | *Haliporoides sibogae* |
| | | | *Ibacus alticrenatus* |
| | | | Inachidae |
| | | | *Leptomithrax longipes* |
| | | | *Lithodes cf. longispinus* |
| | | | *Lithodes murrayi* |
| | | | Lithodidae |
| | | | Majidae |
| | | | *Metanephrops challengeri* |
| | | | *Munida gracilis* |
| | | | *Natant decapod* |
| | | | *Nematocarcinus* sp. |
| | | | *Neolithodes brodiei* |
| | | | *Neommatocarcinus huttoni* |
| | | | Nephropidae |
| | | | Paguridae |
| | | | *Paralomis zealandica* |
| | | | *Platymaia maoria* |
| | | | *Plesionika* sp. |
| | | | *Polycheles* spp. |
| | | | Polychelidae |
| | | | *Pycnoplax victoriensis* |
| | | | Scyllaridae |
| | | | *Teratomaia richardsoni* |
| | | | *Trichopeltarion fantasticum* |
| | | | *Vitjazmaia latidactyla* |
| | | Isopoda | *Acutiserolis* spp. |
| | | | Isopods |
| | | | Serolidae |
| | | | Peracida |
| | Pycnogonida | Pantopoda | *Collossendeis* sp. |
| | | | *Pycnogonid indet* |
| | | | Pycnogonids |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Brachiopoda | | | Brachiopoda |
| Bryozoa (Ectoprocta) | Gymnolaemata | Cheilostomata | Bryozoan |
| | | | Bryozoan - antler form |
| | | | Bryozoan - bushy form |
| | | | Bryozoan - erect cheilostome |
| | | | Bryozoan - feather form |
| | | | Bryzoan - branched form |
| | | | Bryzoan - branched white |
| | | | Bryzoan - encrusting cheilostome |
| | | | Bryzoan - lace form |
| Chordata | Ascidiacea | | Ascidian |
| Cnidaria | Anthozoa | Actiniaria | Anemone (hermit) |
| | | | Anemone (large columnar) |
| | | | Anemone (mauve) |
| | | | Anemone (small red) |
| | | | Anemone indet. |
| | | | Anenome 10 |
| | | | Anenome 11 |
| | | | Anenome 12 |
| | | | Anenome 13 |
| | | | Anenome 14 |
| | | | Anenome 15 |
| | | | Anenome 16 |
| | | | Anenome 17 |
| | | | Anenome 18 |
| | | | Anenome 19 |
| | | | Anenome 4 |
| | | | Anenome 5 |
| | | | Anenome 6 |
| | | | Anenome 7 |
| | | | Anenome 8 |
| | | | Anenome 9 |
| | | | Anenome 1 |
| | | | Anenome 2 |
| | | | Anenome 3 |
| | | | Anenome indet. |
| | | Alcyonacea | Alcyonacea |
| | | | Alcyoniidae |
| | | | Anthomastus 3 |
| | | | *Anthomastus* sp. |
| | | | *Clavularia* sp. |
| | | | Taiaroa tauhou |
| | | | *Telesto* sp. |
| | | Antipatharia | Antipatheria |
| | | | Antipathes |
| | | | Bathypathes |
| | | | Dendrobathypathes |
| | | | Leiopathes |
| | | | Parantipathes |
| | | | Trissopathes |
| | | Ceriantheria | *Ceriantharia* spp |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Cnidaria | Anthozoa | Corallimorpharia | Corallimorpharia |
| | | | Corallimorpharia 1 |
| | | | Corallimorpharia 2 |
| | | | Corallimorpharia 3 |
| | | Gorgonacea | *Callogorgia* sp. |
| | | | Chrysogorgiidae |
| | | | Coralliidae |
| | | | *Corallium* sp. |
| | | | Gorgonacea |
| | | | Isididae |
| | | | *Lepidisis* sp. |
| | | | *Paragorgia* sp. |
| | | | Paragorgiidae |
| | | | *Primnoella* sp. |
| | | | Primnoidae |
| | | | Primnoidea/Callogorgia |
| | | | *Radicipes* sp. |
| | | | *Sibogagorgia* spp. |
| | | | *Thourella* sp. |
| | | Pennatulacea | *Acanthoptilum* sp. |
| | | | *Anthoptilum grandiflorum* |
| | | | *Anthoptilum* sp. |
| | | | *Distichoptilum gracile* |
| | | | *Funiculina quadriangularis* |
| | | | *Gyrophyllum sibogae* |
| | | | *Halipteris* sp. |
| | | | *Kophobelemnon* sp. |
| | | | *Kophobelemnon stelliferum* |
| | | | *Pennatula aculeata* |
| | | | *Pennatula inflata* |
| | | | *Pennatula* sp. |
| | | | Pennatulacea |
| | | | Pennatulacea 1 |
| | | | Pennatulacea 2 |
| | | | Pennatulacea 3 |
| | | | Pennatulacea 4 |
| | | | Pennatulacea 5 |
| | | | *Stylatula* sp. |
| | | Scleractinia | Cup coral |
| | | | *Enallopsammia* spp. |
| | | | Flabellum |
| | | | Flabellum 1 |
| | | | Flabellum 3 |
| | | | *Flabellum knoxi* |
| | | | *Flabellum loure kexeii* |
| | | | *Flabellum rubrum* |
| | | | *Goniocorella dumosa* |
| | | | *Madrepora oculata* |
| | | | *Madrepora* sp. |
| | | | Scleractinia |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Cnidaria | Anthozoa | Scleractinia | *Solenosmillia variabilis* |
| | | | Solitary coral |
| | | Stolonifera | *Rhodelina* sp. |
| | | Zoanthidea | Epizoanthidea |
| | | | Coral indet. |
| | Hydrozoa | Anthoathecatae | Athecate hydroid 1 |
| | | | *Errina* sp. |
| | | | Stylasteridae |
| | | Leptothecatae | Hydroid |
| | | | Hydroid 2 branches |
| | | | Hydroid A |
| | | | Hydroid orange |
| Echinodermata | Asteroidea | Brisingida | *Brisinga chathamica* |
| | | | *Brisinga tasmani* |
| | | | Brisingid 1 |
| | | | Brisingid 2 |
| | | | Brisingid 3 |
| | | | Brisingid 4 |
| | | | Brisingidae |
| | | | Hymenodiscididae |
| | | Forcipulatida | Asteriidae |
| | | | *Cosmasterias dyscrita* |
| | | | *Pseudechinaster rubens* |
| | | | *Zoroaster* sp. |
| | | | Zoroasteridae |
| | | | Zoroasteridae/Asteriidae |
| | | Notomyotida | *Benthopecten* sp. |
| | | | Benthopectinidae |
| | | Paxillosida | Astropectinidae |
| | | | *Dipsacaster magnificus* |
| | | | *Dipsacaster* sp. |
| | | | Paxillosida? |
| | | | *Radiaster* sp. |
| | | | Radiasteridae |
| | | Spinulosida | *Crossaster multispinus* |
| | | | *Crossaster* sp. |
| | | | Echinasteridae |
| | | | *Henricia* sp. |
| | | | *Hymenaster* sp. |
| | | | Pterasteridae |
| | | | *Solaster torulatus* |
| | | | Solasteridae |
| | | Valvatida | *Ceramaster* sp. |
| | | | Goniasteridae |
| | | | *Hippasteria* sp. |
| | | | *Lithosoma novazealandiae* |
| | | | Lithosoma/Pseudarchaster |
| | | | *Mediaster* sp. |
| | | | *Pillsburiaster* sp. |
| | | | Valvatida |
| | | Velatida | Myxaster? |
| | | | Asteroids |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Echinodermata | Crinoidea | Bourgueticrinida | Crinoidea (stalked) |
| | | Comatulida | Crinoidea (motile) |
| | | | Crinoids |
| | Echinoidea | Cidaroida | Cidaridae |
| | | | Cidaroida |
| | | | Goniocidarinae |
| | | | *Goniocidaris parasol* |
| | | | *Goniocidaris* sp. |
| | | | Histocidaridae |
| | | | *Ogmocidaris benhami* |
| | | | Stereocidaridae |
| | | Clypeasteroida | *Peronella hinemoae* |
| | | Echinoida | *Dermechinus horridus* |
| | | | Echinidae |
| | | | Echinoida |
| | | | *Gracilechinus multidentatus* |
| | | Echinothurioida | Echinothuriidae |
| | | | Echinothuriidae/Phormosomatidae |
| | | | *Phormosoma bursarium* |
| | | | Phormosomatidae |
| | | | *Sperosoma* sp. |
| | | Pedinoida | Caenopedina |
| | | | *Caenopedina* spp. |
| | | | Pedinidae |
| | | Spatangoida | *Paramaretia peloria* |
| | | | Spatangidae |
| | | | *Spatangus* sp. |
| | | Temnopleuroida | *Pseudechinus flemingi* |
| | | | Temnopleuridae |
| | | | Echinoids |
| | Holothuroidea | Aspidochirotida | *Bathyplotes moseleyi* |
| | | | *Bathyplotes* sp. |
| | | | *Bathyplotes sulcatus* |
| | | | *Benthodytes incerta* |
| | | | *Pseudostichopus mollis* |
| | | | *Pseudostichopus peripatus* |
| | | | *Pseudostichopus* sp. |
| | | | Stichopodidae |
| | | | *Stichopus mollis* |
| | | | Synallactidae |
| | | Elasipodida | Elasipoda |
| | | | Elasipoda 1 |
| | | | Elasipoda 2 |
| | | | *Enypniastes eximia* |
| | | | *holothurian indet* < 25 mm (Pale) |
| | | | *Laetmogone violacea* |
| | | | *Pannychia* sp. |
| | | | Pelagothuridae |
| | | | Psychropotidae |
| | | | *holothurian indet* < 25 mm (Pale) |
| | | | holothurian indet. |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| Echinodermata | Holothuroidea | | holothurian uni 1 |
| | | | holothurian uni 2 |
| | | | holothurian uni 3 |
| | | | holothurian uni 4 |
| | | | Holothurians |
| | Ophiuroidea | Euryalinida | Euryalinida |
| | | | Gorgonocephalidae |
| | | Ophiurida | Amphiuridae |
| | | | Ophiacanthidae |
| | | | *Ophiomusium lymani* |
| | | | *Ophiomyxa brevirima* |
| | | | Ophiurida (apricot small) |
| | | | Ophiurida (Mauve small) |
| | | | Ophiurida unspecified |
| | | | Ophiuridae |
| | | | Unknown ophiurida 0 |
| | | | Ophiuroids |
| Echiura | | | Echiuran |
| Foraminifera (Protozoa) | Foraminifera | Foraminiferida | Foram (giant) |
| | | | Foraminifera |
| | Granuloreticulosea | Foraminiferida | Bathysiphon |
| Mollusca | Bivalvia | Ostreoida | *Delectopecten fosterianus* |
| | | Pholadomyoida | *Euciroa galatheae* |
| | | | Bivalvia |
| | Cephalopoda | Octopoda | Bathypolypodinae |
| | | | *Benthoctopus* sp. |
| | | | Cirroteuthididae/Luteuthididae |
| | | | *Enteroctopus zealandicus* |
| | | | *Graneledone* sp. |
| | | | Graneledoninae |
| | | | Octopodinae |
| | | | Opisthoteuthididae |
| | | | *Opisthoteuthis* sp. |
| | | | *Pinnoctopus cordiformis* |
| | | | Cephalopoda |
| | Gastropoda | Archaeogastropoda | *Calliostoma alertae* |
| | | | Callostomatidae |
| | | Neogastropoda | Aeneator recens |
| | | | *Amalda* sp. |
| | | | *Austrofusus glans* |
| | | | Buccinidae |
| | | | *Coluzea* sp. |
| | | | *Comitas onokeana vivens* |
| | | | Muricidae |
| | | | Olividae |
| | | | *Pagodula* sp. |
| | | | *Penion* sp. |
| | | | Turbinellidae |
| | | | Turridae |
| | | | Volutidae |
| | | | *Volutomitira banksi* |
| | | | Volutomitridae |

| Phylum | Class | Order | OTU |
|---|---|---|---|
| | | Neotaenioglossa | Cassidae |
| | | | *Fusitriton magellanicus* |
| | | | Naticidae |
| | | | Ranellidae |
| | | Nudibranchia | Opisthobranchia |
| | | | Gastropoda |
| | | | Opisthobranchia |
| | Scaphopoda | | Scaphopoda |
| Porifera | Calcarea | Leucosolenida | Leucosolenia |
| | | | Calcarea |
| | Demospongiae | Astrophorida | Astrophorid |
| | | | *Geodia regina* |
| | | | *Geodinella vestigifera* |
| | | | Pachastrellidae |
| | | | *Tethyopsis n.* sp. |
| | | | *Thenea* sp. |
| | | Hadromerida | Hadromerid |
| | | | *Suberites affinis* |
| | | Halichondrida | Axinella or Pararaphoxya |
| | | | *Axinella* spp. |
| | | | Halichondrid |
| | | Haplosclerida | Haplosclerid |
| | | | Petrosia |
| | | Lithistida | *Awhiowhio sepulchrum* |
| | | | *Costifer wilsoni* |
| | | | Lithistid |
| | | | *Neoaulaxinia persicum* |
| | | Poecilosclerida | Cladhorizidae |
| | | | *Cladhorizidae* sp. nov. |
| | | | *Latrunculia* spp. |
| | | | Poecilosclerid |
| | | Spirophorida | Spirophorida |
| | | | *Tetilla leptoderma* |
| | | | Demonspongiae |
| | | | Encrusting sponges |
| | Demspongiae | | Demospongiae |
| | Hexactinellida | Amphidiscosida | *Hyalonema* sp. |
| | | | *Pheronema* sp. |
| | | Hexactinosida | Farreidae |
| | | | Hexactinosida |
| | | Lyssacinosida | *Euplectella regalis* |
| | | | *Hyalascus* n. sp |
| | | | Hexactinellida |
| | | | Demospongiae |
| | | | Sponge (mauve) |
| | | Amphipoda | Amphipoda |
| | | Euphausiacea | Euphausiacea |
| | | Mysida | Mysida |
| | | | Buccinidae/Ranellidae |
| | | | Galatheidae (white) |