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Benthic Ecological Survey for the Maui Platform Alpha

Annual Production Monitoring - March 2016

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Executive Summary

Shell Todd Oil Services Limited (STOS) is required to undertake annual benthic ecological monitoring around the Maui Platform Alpha (MPA). This annual requirement was previously set out in the approved Discharge Management Plan (DMP) for production activities at MPA and the Increased Recovery Factor (IRF) drilling programme at completed at MPA in 2014. However, due to the implementation of new regulations and the transfer of functions between regulators (Maritime New Zealand (MNZ) to the Environmental Protection Authority (EPA)) the benthic monitoring for MPA is now required to comply with the Marine Consent granted in June 2015, to continue offshore activities associated with the Māui natural gas field for a term of 35 years and the deemed Marine Discharge Consent. The Māui Field DMP was grandfathered into a deemed Marine Discharge Consent (on account of being an existing activity) when the new legislation came into force.

Pre-drill surveys were conducted at MPA in 2012 and 2013, with a mid-drill survey undertaken in 2014, while the first post-drill/annual production monitoring (APM) survey was completed in 2015.

SLR Consulting NZ Limited (SLR) was engaged by Shell Todd Oil Services Limited (STOS) to undertake the annual production monitoring surveys in the vicinity of Māui Platform-Alpha (MPA). In order to achieve the requirements of the ongoing surveys SLR conducted an annual production monitoring benthic survey in March 2016. The aim of this survey was to assess the effects of any discharges associated with MPA on the surrounding marine environment.

This report details the findings of the 2016 benthic survey and compares the results with those collected during the previous surveys, with the intent of assessing any changes to seabed composition (physical and chemical) and benthic community structure which may have arisen due to MPA operations (including the historic IRF drilling program).

METHODOLOGY

The sampling methodology and parameters sampled during this survey were in accordance with the recommendations provided in the Offshore Taranaki Environmental Monitoring Protocol (OTEMP) (Johnston *et al*., 2014), and the 2016 revised EMP synopsis for MPA (SLR, 2016). Sample transects were the same as utilised in the 2015 post-drill/annual production monitoring survey which were selected using dispersal modelling plots created by MetOcean Solutions Ltd (see SLR, 2016). Transects are aligned with the predominant flow direction (North and South) and also the minor flow axis (east and west) to enable comparisons and validation of spatial differences in dispersal patterns. Samples were also collected from three randomly selected stations from both the north and south control stations (within the grid of 25 pre-allocated stations in accordance with OTEMP).

Triplicate sediment samples were collected at each of the sampling stations. This enabled analysis of the infauna/macrofauna community, grain size, organic content, trace metal/metalloid concentrations, total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) to be undertaken. Seafloor video imagery was also obtained at selected representative stations. This footage was viewed on a large, high definition screen by a suitably trained and experienced benthic scientist, with all obvious epifauna identified to the lowest practicable taxonomic level. Biogenic and/or anthropogenic structures such as burrows, mounds, tracks and cuttings piles were also recorded and relative abundance estimates of epifauna or biogenic structures were made where appropriate.

Executive Summary

KEY FINDINGS

The MPA 2016 annual production monitoring survey results showed that the effects of ongoing production activities and the historical drilling activities appear to be largely localised to stations within close proximity to the platform, particularly along the major flow/depositional axes (N - S). Some of the measured physical and biological characteristics showed some recovery compared to previous years, and continue to move towards being similar to conditions encountered during the pre-drill surveys. A summary of the results shows:

- Sediment cores collected around MPA were light-brown/tan coloured soft muds, but samples from stations closest to the platform (250 m) showed a grey colouration with some darker patches and occasional presence of mild sulphide odour;
- Benthic video footage showed a relatively healthy seabed environment surrounding MPA with epifauna organisms, small fish and evidence of infauna communities and no notable areas or signs of obvious physical disturbance;
- Particle grain size distributions remain dominated by silt and clay, similar to previous surveys. While the coarsest sediments were found closest to the platform only weak spatial gradients of increasing fines with distance from the platform were observed, weaker than seen in previous years;
- All but two of the replicate sediment samples collected from MPA in 2016 contained some degree of anthropogenic debris, with the greatest abundances of various cuttings, drilling mudsrust flakes and garnet found at the 250 and 500 m stations;
- Total Organic Matter (TOM) levels continue to remain somewhat higher than those seen in the predrill, although control stations also show a similar level of increase. Stations closest to the platform (250 m), had lower TOM than stations at further distances although there was only a weak spatial gradient of increasing TOM with distance;
- With the exception of nickel, metal/metalloid concentrations at MPA remained below ISQG-Low limits for possible biological effects in 2016. Nickel exceeded guideline levels at two stations and was equal to the guideline at a further two, having increased widely across MPA sampling stations and control sites with most stations now approaching ISQG-Low levels. Elevated Nickel levels have been observed in sediment samples collected across the South Taranaki Bight and likely reflect the deposition of weathered sediments from nearby onshore catchments containing nickel rich minerals. Cadmium, Mercury and Zinc concentrations were highest close to the platform (250-500 m) and showed weak decreasing trends with distance, but were all well below guideline levels;
- Barium concentrations were elevated in 2016 samples compared to 2015, and remain above pre-drill and control station levels out to ~2-4 km from the platform, with a distinct spatial gradient still present. The largest increases were seen close to the platform, particularly on the main flow axes (N – S), and may reflect bioturbation activities and water currents resuspending and moving drilling related sediments;
- PAH's were found at detectable levels at 15 MPA stations and two north control site stations in 2016, with greatest concentrations in sediments sampled close to the platform. While total concentrations in all samples were below guideline levels, Acenaphthlene levels at the N250 station exceeded the ISQG-Low Guideline level in 2016. TPH concentrations were above the ADL at only one station in 2016 (S250), which was below ISQG-Low and represents a decrease in spatial scale compared to 2015;
- The infauna communities at MPA and the control sites were dominated by polychaete worms, and in particular by deposit feeding polychaetes;

Executive Summary

- With the exception of the W250 station the number of infauna taxa identified at MPA had increased across all stations, with some stations (N250, N6000, N4000) being at their highest numbers since monitoring began. Total infauna abundance continued to show notable variability between years, although N250 and S4000 showed distinct increases compared to 2015. Since the completion of drilling at MPA the W250 station has shown a noticeable and ongoing depression in the number of taxa present and overall infauna abundances. This trend continued in 2016 with no obvious sign of recovery towards pre-drill characteristics at this station; and
- Infauna assemblage data showed that communities from the 250 and 500 m stations were significantly different from those at stations further away from MPA, and at the control sites. Multivariate analyses also showed significant differences in the infauna communities between years (surveys) as well as across transects. Control site infauna continued to be significantly different to those seen at MPA, similar to previous surveys.

SUMMARY AND RECOMENDATIONS

The effects of ongoing production activities, along with those of the historical drilling that has occurred at MPA, remained detectable in 2016. The greatest changes to physical and biological characteristics were observed at the 250 and 500 m stations, with only minor changes detectable beyond these stations. It is recommended that annual production monitoring surveys at MPA should continue to be undertaken in 2017 as required by Marine Consent conditions. It is further recommended that surveys should continue to occur in the summer months to keep consistency with previous monitoring.

Table of Contents

Table of Contents

TABLES

FIGURES

Table of Contents

APPENDICES

1 INTRODUCTION

SLR Consulting NZ Limited (SLR) were engaged by Shell Todd Oil Services Limited (STOS) to undertake the second annual production monitoring survey in the vicinity of Māui Platform-Alpha (MPA). The aim of this survey, which was undertaken on 28th – 30th March 2016, was to assess the effects of discharges associated with MPA on the marine environment. No production water is discharged from MPA; however, discharges which could cause environmental effects include:

- Ongoing operational discharges – primarily sewage, macerated biodegradable garbage and deck drainage; and
- Past drilling related discharges – drill cuttings and drilling muds from the Increased Recovery Factor (IRF) Drilling Campaign that commenced in January 2013 and was completed in August 2014.

STOS have conducted benthic ecological surveys at MPA since 2012 as detailed below:

- Pre-drill 1 survey occurred in January 2012;
- Pre-drill 2 survey occurred in January 2013;
- Mid-drill survey occurred in February/March 2014;
- Annual production monitoring (Post-drill 1) occurred in March 2015; and
- Annual production monitoring (Post-drill 2) occurred in March 2016

This report compares the results of the current survey with those collected during the previous surveys, with the intent of assessing any changes to seabed composition (physical and chemical) and any changes to benthic community structure which may have arisen due to MPA operations.

1.1 Regulatory Requirements for the Benthic Monitoring Programme

Previous benthic monitoring programmes at MPA have been undertaken in accordance with the Discharge Management Plan (DMP). The DMP was previously regulated by Maritime New Zealand (MNZ) through Parts 180 and 200 of the Marine Protection Rules under the Maritime Transport Act 1994 (MTA). However, responsibilities for discharges to the marine environment have now been transferred to the Environmental Protection Authority (EPA) in accordance with the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Discharge and Dumping) Regulations, 2015. As a result the Māui Field DMP was grandfathered into a deemed Marine Discharge Consent (on account of being an existing activity) when the new legislation came into force.

STOS have conducted benthic ecological surveys at MPA since 2012, in accordance with the requirements of the DMP in relation to routine operations, as well as the DMP Addendum requirements relating to the IRF Drilling Campaign. Pre-, during- and post-drill benthic surveys at MPA have fulfilled the DMP requirements for annual monitoring at MPA between 2012 and 2014. In 2014, post-drill monitoring switched to Annual Production Monitoring to assess the effects of production related discharges on the marine environment. STOS were granted a Marine Consent in June 2015 to continue offshore activities associated with the Māui natural gas field for a term of 35 years. In line with this, annual production monitoring was one of the consent conditions and will continue into the foreseeable future.

It is generally recommended that ecological surveys are undertaken at the same time of year to remove any seasonal influence from the monitoring results. This has largely been achieved for MPA with all surveys to date occurring in the three months from January to March.

1.2 Aims

The aim of the 2016 annual monitoring programme, as stated in the MPA Environmental Monitoring Plan Synopsis (EMPS) (SLR 2016) is to “assess the effects of the activities authorised by the Marine Consent on the benthic environment”. In order to ensure this aim is satisfied, the monitoring hypotheses (as stated in the EMPS) for the MPA benthic ecological monitoring are as follows:

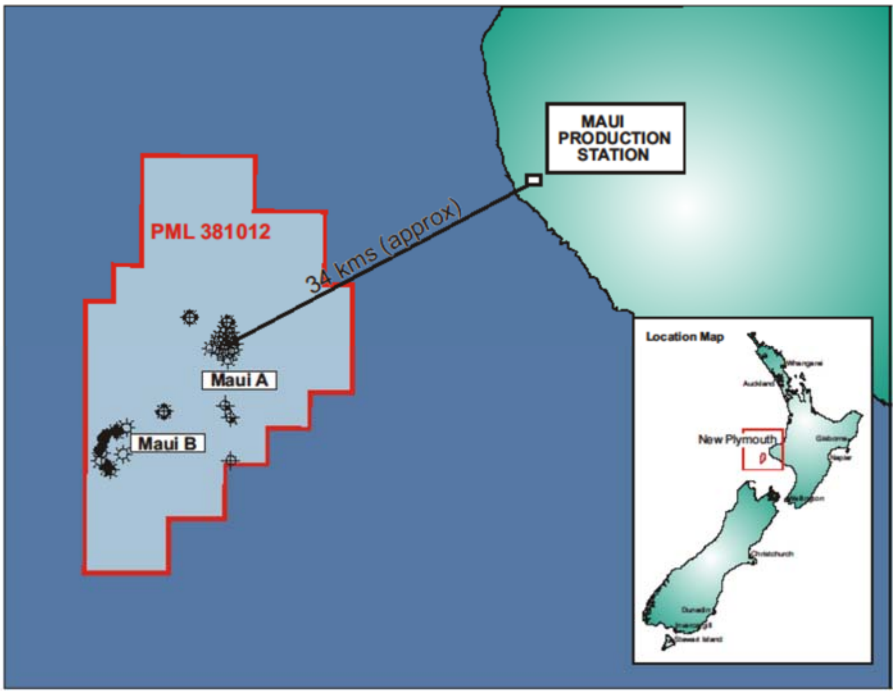
- H_0.1 - There will be no significant effects to the physical sediment characteristics (grain-size and AFDW), beyond 1 km from MPA as a result of the project discharges (i.e. production and drilling discharges);
- H_0.2 - Project discharges will not result in sediment chemistry concentrations to exceed ISQG-Low guideline values (where applicable) or be significantly higher than background or control concentrations;
- H_0.3 – There will be no significant adverse biological effects (i.e. changes to the biological communities compared with background/control communities) beyond 1km from MPA as a result of the project discharges (i.e. production and drilling discharges);
- H_0.4 - Incidental observations of project related debris will not be observed; and
- H_0.5 - Chemical tracers (metals/metalloids, TPH and PAH; as per OTEMP) will not detect the depositional footprint of project discharges as far as the N6000 m station.

1.3 Project Location

MPA lies in 110 m of water approximately 34 km off the Taranaki Peninsula (**Figure 1**). In addition to the MPA operations themselves, this site is within the potential area of influence (~10 km) of a number of other (both recent and historical) oil and gas related activities, (e.g. Ruru-2).

Non-oil and gas related activities also occur in the area surrounding MPA, including commercial fishing and commercial shipping. Fishing in the area is largely mid-water trawling for jack mackerel and barracouta; and a general shipping route passes within the wider area, although a Safety Zone prohibits ships from approaching MPA to within 500 m unless they are servicing the platform.

Figure 1 Location of Māui Platform Alpha



1.4 Summary of previous monitoring

A summary of the key findings from each of the previous benthic ecological surveys at MPA is provided below:

Pre-drill survey – January 2012 (Johnston & Forrest 2012)

Sediments surrounding the MPA platform were dominated by silt, clay and fine sands, but showed a weak spatial gradient of coarsening sediments close to the platform, and increasing presence of anthropogenic debris. Barium showed a distinct spatial pattern of decreasing concentrations with distance from the platform and several metals showed highest concentrations near the platform at the S250 m station (zinc, lead, arsenic). Mercury was the only metal to show elevated levels of concern with the mean concentration at the northern control site equal to the ISQG-Low guideline. Macrofauna abundance and diversity decreased with distance from the platform, with opportunistic polychaete taxa and small bivalves most abundant at 250 and 500 m stations. Statistical testing showed significant differences between control site infauna communities and the communities found at stations close to the MPA platform.

Second pre-drill survey – January 2013 (Johnston *et al*., 2013).

A slight coarsening in grainsize right across the MPA site in was observed in 2013 compared to 2012, but no distinct spatial trends were detected in grainsize or organic matter. Lead was the only metalloid to exceed ISQG-Low guidelines in 2013, while other metals/metalloids, PAH and TPH concentrations were similar to 2012, including decreasing barium levels with distance from the platform. Macrofauna communities at MPA continued to be dominated by small polychaete taxa, but there were no distinct spatial trends with distance or axis, and no clear trends between surveys. Significant differences were detected between infauna communities at MPA and the control sites, and between the north and south control sites themselves.

Mid-drill survey – March 2014 (Johnston *et al*., 2014).

Drilling activities and operational discharges at MPA were found to have had localised effects on physical and biological characteristics in 2014. Stations closest to the platform (250 m) showed elevated level of several metals (barium, cadmium and zinc) and TPH, and decreased organic matter levels. Sediments near the platform also showed darker, mottled grey colourations, and along with the presence of hydrogen sulphide odours indicated decreased oxygen content. Macrofauna communities close to the platform showed decreased numbers of taxa and overall abundances in 2014 compared to previous surveys and weak spatial trends of increasing abundance with distance from the platform were detected (the opposite of 2012). Although the abundances of pollution sensitive taxa were relatively consistent across MPA station the disturbance tolerant polychaete species *Capitella capitata* was present in samples near the platform. Although detectable changes were observed in 2014 the scale of disturbance was considered relatively minor.

Post-drill survey - March 2015 (Johnston & Elvines, 2015):

Localised effects of drilling and operational discharges were obvious through a weak coarsening of sediments closer to the platform, reducing concentrations of barium, cadmium and zinc radiating away from the platform, high polycyclic aromatic hydrocarbon (PAH) levels and macrofauna assemblage differences that were characterised by an increase in the abundance of opportunistic species close to the platform. Despite these observations, the scale of disturbance was generally considered to be minor and in keeping with expectations following a drilling programme.

2 METHODS

The sampling methodology and parameters used in this investigation were in accordance with the specific methodological recommendations provided in OTEMP (Johnston *et al*., 2014) and the MPA EMPS (SLR, 2016). The 2016 survey adopted the same methodology to that of the previous benthic surveys at MPA.

2.1 Sample Locations

Sampling transects surrounding MPA were selected using dispersal modelling plots created by MetOcean Solutions Ltd (see SLR, 2016). Sampling transects were aligned with the predominant flow directions, in this case, the north/south axis. The area downstream of the major flow axis is considered more likely to show influences from drilling and production discharges; however, sample stations were also located along the minor flow axis (east/west) to enable comparisons and validation of spatial differences in dispersal patterns.

Grab samples were taken at each station to assess the physical and chemical nature of the sediment and the benthic communities. Grab samples were collected from the same 19 stations sampled during previous benthic ecological surveys around MPA, with sample sites ranging from 250 to 6,000 m from the Platform (**Figure 2**).

Video sled tows were undertaken along the major axis of current flow: on the north transect videos were taken at the 1,000, 2,000, 4,000 and 6,000 m stations; with tows at the 1,000, 2,000 and 4,000 m stations on the south transect (**Figure 3**). These tows facilitate the collection of qualitative information about the seabed which provides a useful overview of the benthic habitat that grab sampling alone cannot provide. Each video sled tow equates to approximately 250 m or five minutes of 'moving' footage.

In accordance with OTEMP, control station samples were collected from three randomly selected stations within the grid of 25 pre-allocated stations (Johnston *et al*., 2014) in both the 'North Control c' (NCc) and 'South Control b' SCb areas. In line with the OTEMP methodology these stations were randomly selected within the control areas, meaning that the control stations sampled in 2016 were different from those sampled during previous surveys. Sediment and macrofauna at the control stations were sampled using the same methodology as for the stations around MPA. Video sled tows were also undertaken at two stations at each of the northern and southern control stations (NCc5, NCc7, SCb5, SCb10) for comparative purposes (**Figure 4**).

Video sled tow track locations are presented in **Figure 3** and **Figure 4**. Note that these tracks were calculated from data collected by a tracking GPS situated on-board the vessel, with the sleds position then calculated using the predicted layback distance and the direction of the vessels travel. The vessel was manoeuvred throughout the tow to get the sled passing as close as possible to the nominated stations.

Table 1 provides a summary of sampling effort during the second annual production monitoring survey. All sampling station coordinates for benthic grab samples are provided in **Appendix A**, and details for video sled locations are provided in **Appendix B.**

Figure 2 Grab sample locations for 2016 annual production monitoring at MPA

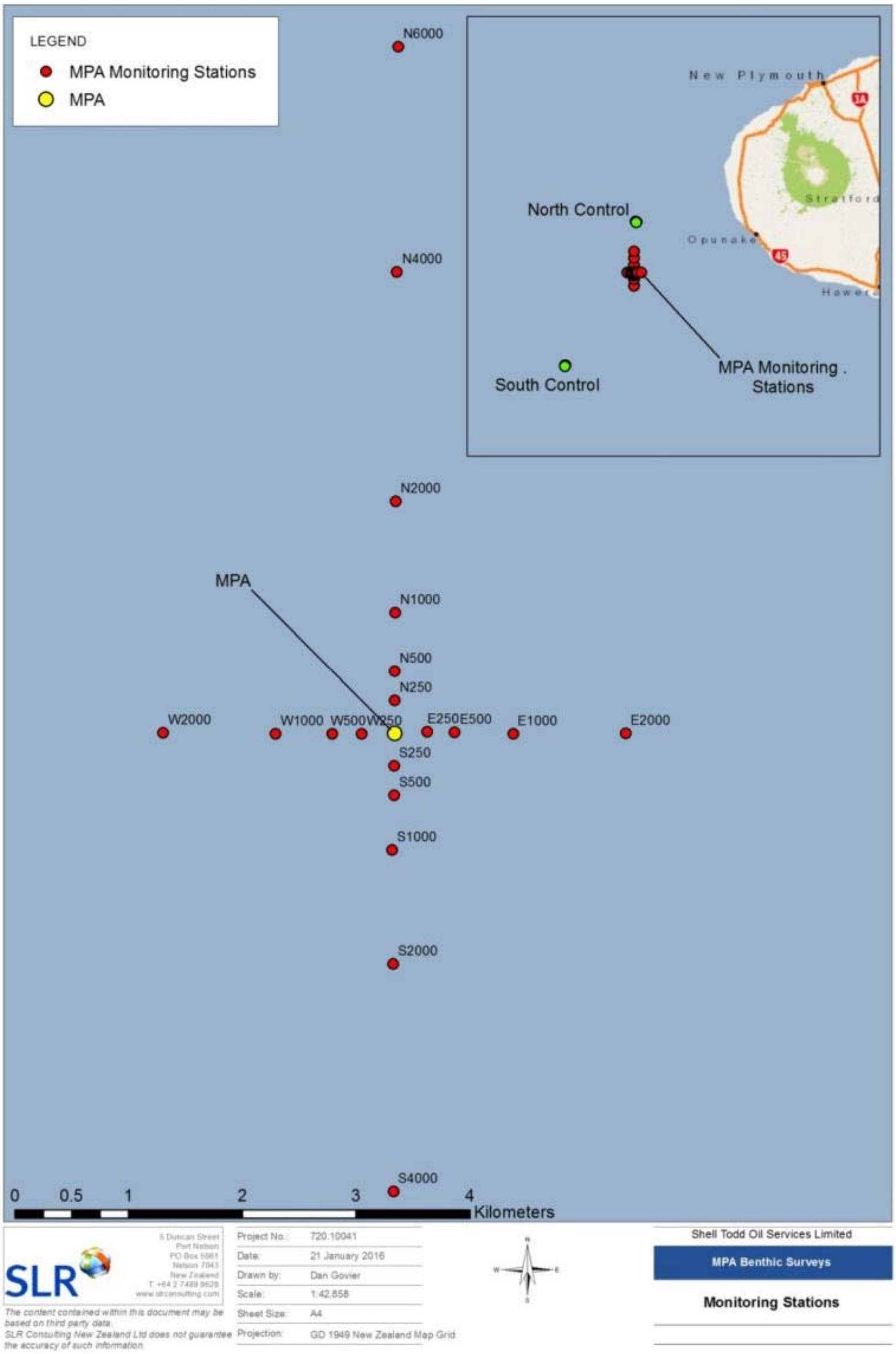


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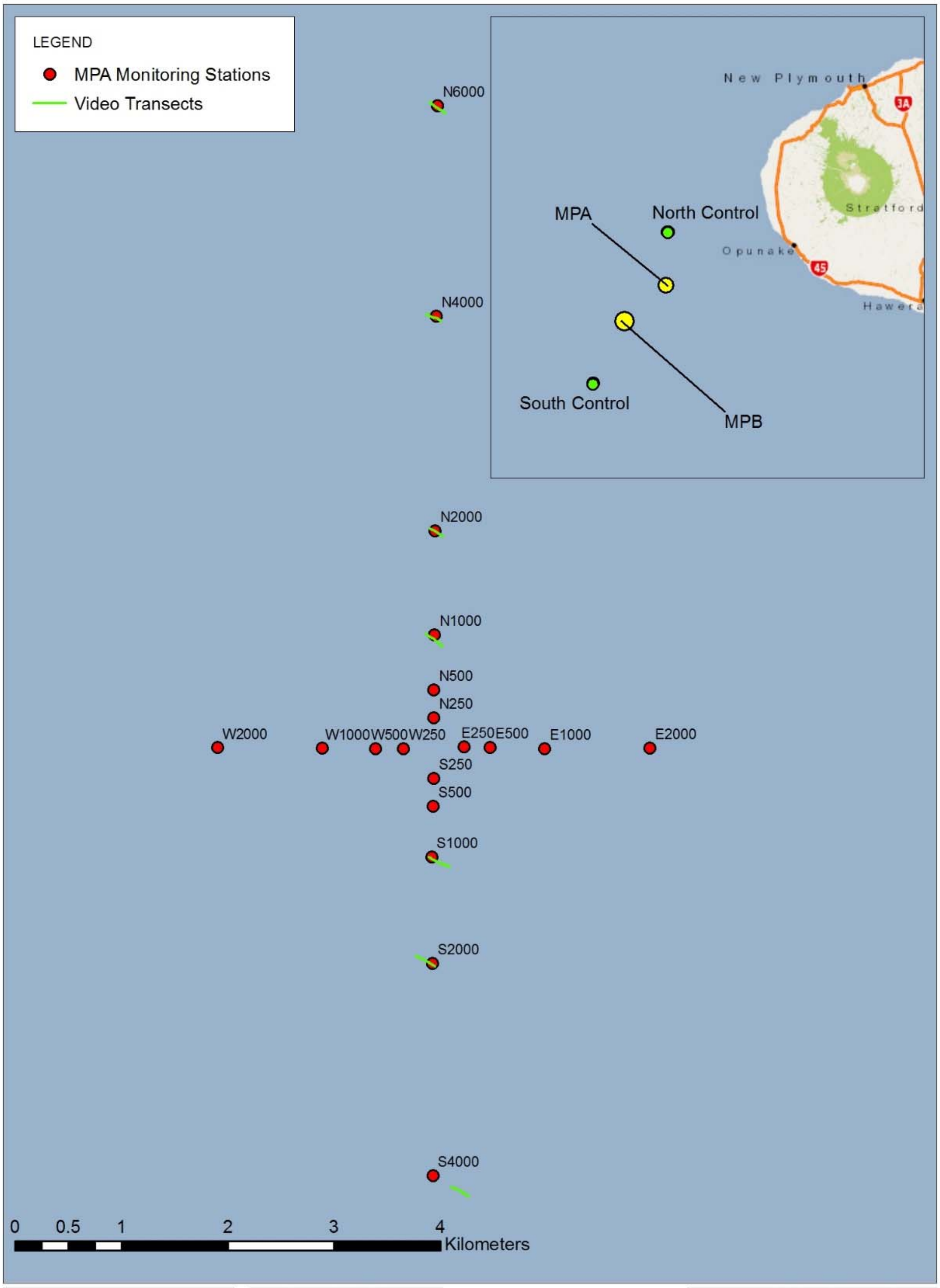
Figure 3 Video sled tows for 2016 annual production monitoring at MPA



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Shell Todd Oil Services Limited

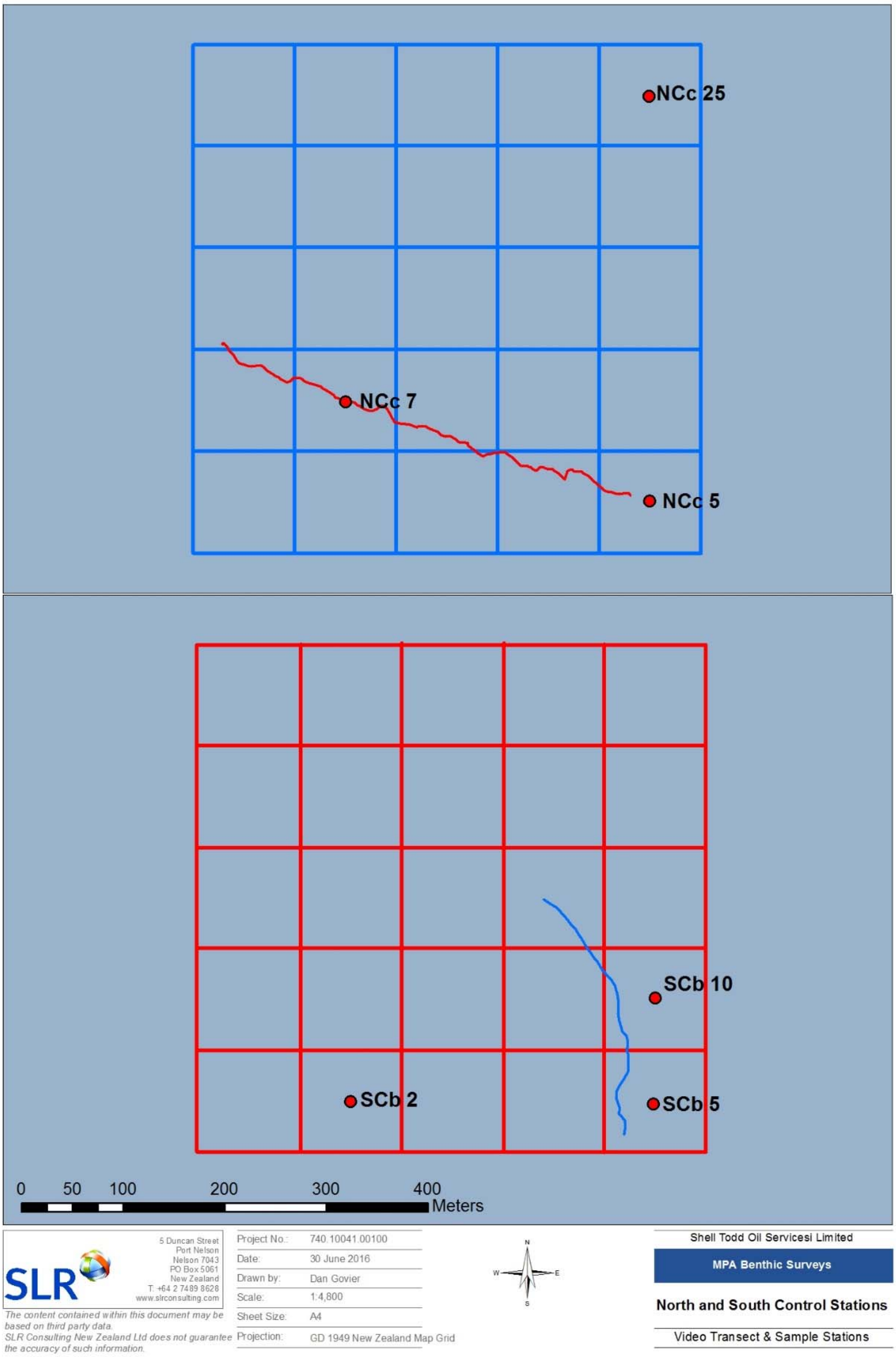
MPA Benthic Surveys

Video Transects

Table 1 Sampling effort summary for 2016 annual production monitoring at MPA

Axis	**Station**	**Number of Grab Sample Replicates**				**Video sled tows**
		Bucket 1	**Bucket 2**			**Approximately 250 m, passing as close as possible to the station coordinates**
		Entire grab sieved for macrofauna	**Sub-sample sediment for grain size and organic matter**	**Composite sub-samples for sediment chemistry**		
				TPH and PAH	Metals and metalloids	
North	N250	3	3	1	1	
	N500	3	3	1	1	
	N1000	3	3	1	1	1
	N2000	3	3	1	1	1
	N4000	3	3	1	1	1
	N6000	3	3	1	1	1
South	S250	3	3	1	1	
	S500	3	3	1	1	
	S1000	3	3	1	1	1
	S2000	3	3	1	1	1
	S4000	3	3	1	1	1
West	W250	3	3	1	1	
	W500	3	3	1	1	
	W1000	3	3	1	1	
	W2000	3	3	1	1	
East	E250	3	3	1	1	
	E500	3	3	1	1	
	E1000	3	3	1	1	
	E2000	3	3	1	1	
	Total	**57**	**57**	**19**	**19**	**7**
North Control 'c'	NCc5	3	3	1	1	1
	NCc7	3	3	1	1	1
	NCc25	3	3	1	1	
	Total	**9**	**9**	**3**	**3**	**2**
South Control 'b'	SCb2	3	3	1	1	
	SCb5	3	3	1	1	1
	SCb10	3	3	1	1	1
	Total	**9**	**9**	**3**	**3**	**2**
	Grand Total	**75**	**75**	**25**	**25**	**11**

Figure 4 Control site video transects and grab stations for 2016 annual production monitoring at MPA



2.2 Field and Sampling Procedures

Field sampling at the MPA and the control stations was undertaken from the *SeaSurveyor* from 28th – 30th March 2016 following the procedures detailed below.

2.3 Benthic Grab Samples

A modified double Van-Veen grab sampler (‘the grab’; **Figure 5**) was used to collect three replicate sediment samples at each of the benthic monitoring stations (**Figure 2**). The grab used for the survey was constructed entirely of stainless steel and featured two independent ‘buckets’ which penetrate the surficial sediments to a depth of 0.16 m. In a successful sample, the grab collected approximately 0.01 m^3 of seabed sediment within each bucket and bought it to the surface.

Upon arrival on the vessel deck, each grab sample was checked for completeness. In order for a benthic sample to be deemed successful, it had to meet the following criteria:

- The surface of the sediment was largely undisturbed upon inspection aboard the vessel;
- Sufficient sediment (≥75% of the grab capacity) was collected to enable the full suite of sediment analyses required;
- The infauna sample bucket was filled to the same volume (approximately 10 l) for all infauna replicates throughout the survey; and
- The grab had not been over-filled with sediments pushing out of the doors or drains, indicating that it may have over-penetrated the sediment.

Figure 5 The double Van-Veen grab sampler used for benthic sampling

Each of the independent buckets from a replicate grab sample were used separately for infauna and sediment physical and chemical analyses, as follows:

- **Bucket one: infauna/macrofauna community analysis.** The entire sample was sieved through 0.5 mm mesh until only approximately 300-500 ml of residual sediment and organisms remained. This remaining material was transferred to a suitably sized plastic container and preserved with a fixative (Anchol^{TM}), ready for later analysis by SLR taxonomists.
- **Bucket two: sediment physical nature and chemical analyses.** Two 64 mm (internal diameter) clear Perspex sub-sampling cores were pushed into the sediments from the centre of the second bucket, to a depth of approximately 150 mm. To ensure that cross-contamination from the stainless steel structures of the grab sampler itself were avoided, as this could influence metal/metalloid concentrations, cores were collected from the middle of the grab bucket. Cores were then photographed and the upper 50 mm from two of the cores was extruded into a polyethylene bag for particle grain size distribution and organic content (ash-free-dry-weight (AFDW)) analyses by an accredited laboratory. The upper 50 mm of the remaining core was also extruded, with half placed into a polyethylene bag for trace metal/metalloids analyses, and half into a decontaminated glass jar for total petroleum hydrocarbons (TPH) and PAH analyses. The trace metal/metalloids samples comprised composite samples for each particular station, meaning that half of the third core for each of the three replicate grabs at a station went into the same container to form a single composite sample.

2.4 Seafloor Video Imagery

Video imagery of the seafloor was obtained using a customised tow-sled fitted with high-intensity LED lighting and a high-definition video camera (**Figure 6**). The system was connected to the vessel via a 10 mm dyneema tow-line and a 300 m umbilical cable that supplied real-time video images to the camera operator on the research vessel. A series of lasers on the video sled provided an indication of scale allowing features of interest in the video recordings to be approximately sized. Six video sled tows were conducted around MPA with two further tows at each of the northern (c) and southern (b) control sites.

The video-sled was launched from the vessel up-current of the pre-determined location and lowered to the seabed, where it auto-located via a series of floats and weights set at specific points on the sled frame, to land upright on its lower skids. At the point where the sled contacted the seabed, a GPS log was started, and this log continued throughout the duration of the tow. Video footage was continuously recorded for approximately 250 m as the sled drifted behind the vessel; this ensured that footage was collected while the sled was passing as close as possible to the required sample location.

Figure 6 The video sled used for collecting seafloor footage in 2016

2.5 Laboratory Analyses

2.5.1 Sediment Physicochemical Analyses

Benthic sediments collected by the grab were analysed by Hill Laboratories (an NZS/ISO/IEC 17025:2005 accredited laboratory) for a variety of physical and chemical parameters (as specified in OTEMP). Results from these analyses enable the detection of any changes to the physical or chemical nature of the sediments that may have occurred as a result of MPA discharges. The aims of this analysis along with the analytical methods are summarised in **Table 2**.

Table 2 Analytical methods used for sediment physicochemical characteristics

Analyte	Aim	Method Number	Description
Particle grain size	Determine physical changes to substrate from drilling/production related discharges. Correlate with macrofauna distribution.	Hill Laboratories KB32136	Sediment was wet-sieved through the following screen sizes, as per the Udden-Wentworth scale (Wentworth, 1922): >2 mm (gravel) >1 mm (very coarse sand) >500 µm (coarse sand) >250 µm (medium sand) >125 µm (fine sand) >63 µm (very fine sand) <63 µm (silt and clay)
Organic content (AFDW)	Determine level of organic matter in sediment. Correlate with macrofauna distribution.	APHA 2540 G 21st ed. 2005	Dried sample ignited in a muffle furnace at 550 ºC for six hours and weighed on a gravimetric scale.
Metals: As, Ba, Cd, Cr, Cu, Pb, Ni, Mn, Fe, Zn, Hg	Determine presence of drilling/production related metal/metalloid contamination in sediment. Correlate with macrofauna distribution.	PSP 2002 mod./APHA metals by ICP-MS	US EPA 200.2 Dried sample underwent nitric/hydrochloric acid digestion. ICP-MS, trace-level (screen-level for Barium, Iron and Manganese).
PAH	As for metals	USEPA 8270C	Sonication extraction, SPE clean up, GC-MS SIM analysis.
TPH	As for metals	USEPA 8015B/MfE	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines.

2.5.2 Macrofauna Analyses

Macrofaunal analyses generally focused on the infauna, or animals living within the sediment matrix larger than 0.5 mm. Epifaunal animals, those living on top of the sediment, were also included in the analyses in order to provide representation of different functional groups present at the sample stations.

Benthic macrofaunal samples collected from the sediment grab samples were sorted and, with the aid of a binocular microscope, identified to the lowest practicable taxonomic level or most recognisable taxa (morphologically similar group). Counts were made to assess the relative abundance of each taxa.

2.5.3 Seafloor Video Analyses

A live feed from the video-sled was captured and recorded on-board the survey vessel; this was watched by SLR staff with significant experience working in the benthic environment of the offshore Taranaki region. Brief notes were made in real-time about obvious structures and organisms observed while watching the live footage. Back onshore the recorded seabed video footage was assessed on a large, high definition screen, by a suitably trained and experienced benthic scientist, who identified all obvious epifauna to the lowest practicable taxonomic level. Biogenic and/or anthropogenic seabed structures such as burrows, mounds, tracks and cuttings piles were also recorded. Relative abundance estimates of epifauna or biogenic structures were made where appropriate. This data was then used to make comparisons between survey stations and control stations and also with previous surveys.

2.6 Data Analyses

Sediment physicochemical parameters were assessed against relevant sediment contaminant guidelines, whilst macrofauna data were subjected to a series of statistical tests. Further detail on these analyses is provided below.

2.6.1 Sediment Quality Analyses

To ensure comparability with previous surveys, sediment trace metal, metalloid, and PAH concentrations were compared against national sediment quality criteria (ANZECC, 2000). These commonly used guidelines are based on statistical models of toxicity data for a wide range of contaminants, and aim to predict levels of contaminants in aquatic sediments above which adverse ecological effects may occur. The criteria are defined as Interim Sediment Quality Guideline–Low (ISQG-Low) and –High (ISQG-High) levels, which represent two distinct probability thresholds for possible and probable biological effects respectively.

2.6.2 Community Characteristic Descriptors

All macrofauna (both epifauna and infauna) taxa were included in the analyses of abundance data. Species identified in the samples as not being exclusively benthic were excluded from further analyses. Prior to beginning any of the analyses, the taxonomic data was standardised between the surveys to account for variances in taxonomic detail. This meant that several taxa were grouped to higher taxonomic levels during the post-drill surveys to allow direct comparisons with the pre-drill survey. As a result some indices results may appear different to those in the pre-drill report.

2.6.2.1 Univariate diversity indices

Diversity indices (number of taxa S, total abundance N, Shannon-Wiener diversity H’, and Pielou evenness J’ (**Table 3**) were calculated from the macrofauna abundance data using the PRIMER software package (PRIMER v6.1.16; PRIMER-E 2000; Clarke, 1993; Clarke & Warwick, 1994; Clarke & Gorley, 2006).

Table 3 Description of macrofauna community characteristic indices

Index	Formula (where applicable)	Description
Number of Taxa (S)	Count of total number of different taxa identified within the *x* sample	Total number of taxa identified within a sample
Total Abundance (N)	Sum of all individual taxa abundances within the *x* sample	Total number/count of all organisms within a sample
Shannon Diversity (H’)	$H' = -SUM\ [(p_i) \times \log_e (p_i)]$ $p_i =$ Number of individuals of taxa i /total number of samples	A single value (log scale) that is used to describe the different types and numbers of organisms present within an assemblage. The index value increases as assemblages have greater numbers of taxa and when the numbers of individual organisms are more evenly distributed across the different taxa. Samples dominated by single taxa will have lower values towards zero.
Pielou Evenness (J’)	$J = H' / \log_e (S)$	A value theoretically between zero and one which indicates how evenly the number of individual organisms are distributed through the different taxa in an assemblage. High values (closer to 1) indicate an even spread amongst the taxa present, whereas a low value indicate an uneven spread or an assemblage highly dominated by only a few, or even a single taxa.

2.6.2.2 Multivariate analyses

The Primer software package was also used to run multivariate analysis on the macrofauna assemblage data. Non-metric multi-dimensional scaling (MDS) and cluster analysis were used to visually display the differences among years, sites, distances and transects. These analyses were based on Bray-Curtis similarity matrices generated from square-root transformed abundance data. Differences in macrofaunal community composition among years, sites, transects and distances were further investigated using permutational multivariate analysis of variance (PERMANOVA) (Anderson, 2001; Anderson *et al*., 2008). Two models were constructed and run:

PERMANOVA - Model 1

The first basic model tested for differences between Site (fixed; 3 levels: MPA, North Control, South Control) and Year (fixed; 5 levels: 2012, 2013, 2014, 2015, 2016) and the associated interaction terms.

PERMANOVA - Model 2

The second model tested for differences between Transect (fixed; 4 levels: North, South, East, West), Distance (fixed; 6 levels: 250 m, 500 m, 1000 m, 2000 m, 4000 m, 6000 m), Year (fixed; 5 levels: 2012, 2013, 2014, 2015, 2016), and the associated interaction terms. Control site data was excluded from this model.

To determine which taxa were contributing most to, or were most responsible for, any significant differences detected from the PERMANOVA analysis, the SIMPER procedure was performed. SIMPER analysis determines the contribution that each species/taxa makes to the average similarity of a group of samples.

3 RESULTS AND DISCUSSION

3.1 Sediment physical and chemical properties

3.1.1 Visual description of sediment cores

The majority of the sediment cores collected from the MPA sampling stations in 2016 displayed relatively cohesive, light-grey/light-tan coloured muds, often graduating into lighter-brown colouration in the uppermost portions of the core samples (**Figure 8**). Similar to 2015 results the upper portions of the sediment cores were often observed to be somewhat less consolidated than deeper sediments, and no distinct aRPD layers were found in the samples. All sediment core photographs are contained in **Appendix C**.

The exceptions to this were the samples collected from the 250 m stations closest to the platform where sediments were notably different in colour (grey to dark-grey), much softer and unconsolidated, had a grainy consistency due to the presence of coarser sized particles and often showed distinct patches of dark-grey/black sediments (**Figure 8**). The darker colouration and patches of darker sediments, along with the presence of a mild to moderate hydrogen sulphide odour in S250 sediments are likely to indicate that sediment oxygen levels at the 250 m stations had decreased compared to sediments from further away from the platform; however, without specific oxygen level, or oxidative state, testing equipment it was not possible to confirm a specific decrease.

3.1.2 Incidental observations

Fifty-seven replicate macroinvertebrate sediment samples were collected during the 2016 survey at MPA and almost every sample (96.5%) contained some degree of anthropogenic debris. This included coal cuttings, drilling muds/gels, flakes of rust and paint, what appears to be welding materials, graphite, garnet, pieces of 'foam', nylon, 'tar', rubber, string, metal, fabric and various forms of plastics. **Figure 7** shows photographs of some of the key anthropogenic debris found in the 2016 MPA samples. A full list of observations is presented in **Appendix D** along with the classifications for abundance estimates used below.

Darker coal-like cuttings occurred in 37 out of the 57 samples (65%); they were abundant (50 – 100 incidences) in seven samples and occurred in every sample out to 1000 m (inclusive) on the north axis, out to 2000 m (inclusive) on the south axis. Coal cuttings were generally common (20 – 50) or abundant at stations closer to the platform and occasional (10 – 20) or low (0 -10) at the outer stations. On the west and east axes, coal cuttings were less commonly encountered and abundances were lower compared with north and south axes, with highest abundances similarly found in replicates collected closest to the platform.

Sandstone cuttings were present in five samples on the north axis and four samples on the south axis in low – common abundances, with all samples containing sandstone coming from the 250 – 500 m stations. Sandstone drill cuttings were found in only one sample on the west axis (W250a) and no samples on the east axis.

Drilling muds/gels were present in 28 samples (49%) and were most common in samples collected close to the platform, particularly on the north and south axes. On both of these axes, drilling muds were very abundant (100 +) in all 250 m samples and abundant in all 500 m samples. On the west axis, drilling muds were very abundant in only one sample: W250a.

Garnet particles occurred in 40 samples (70%) and were very abundant in all 250 m replicates on the north and south axes, as well as in sample W250a. At 500 m and beyond, garnet (when present) occurred in low – common abundances only. High levels of garnet at stations closer to the platform most likely results from historical sandblasting activities.

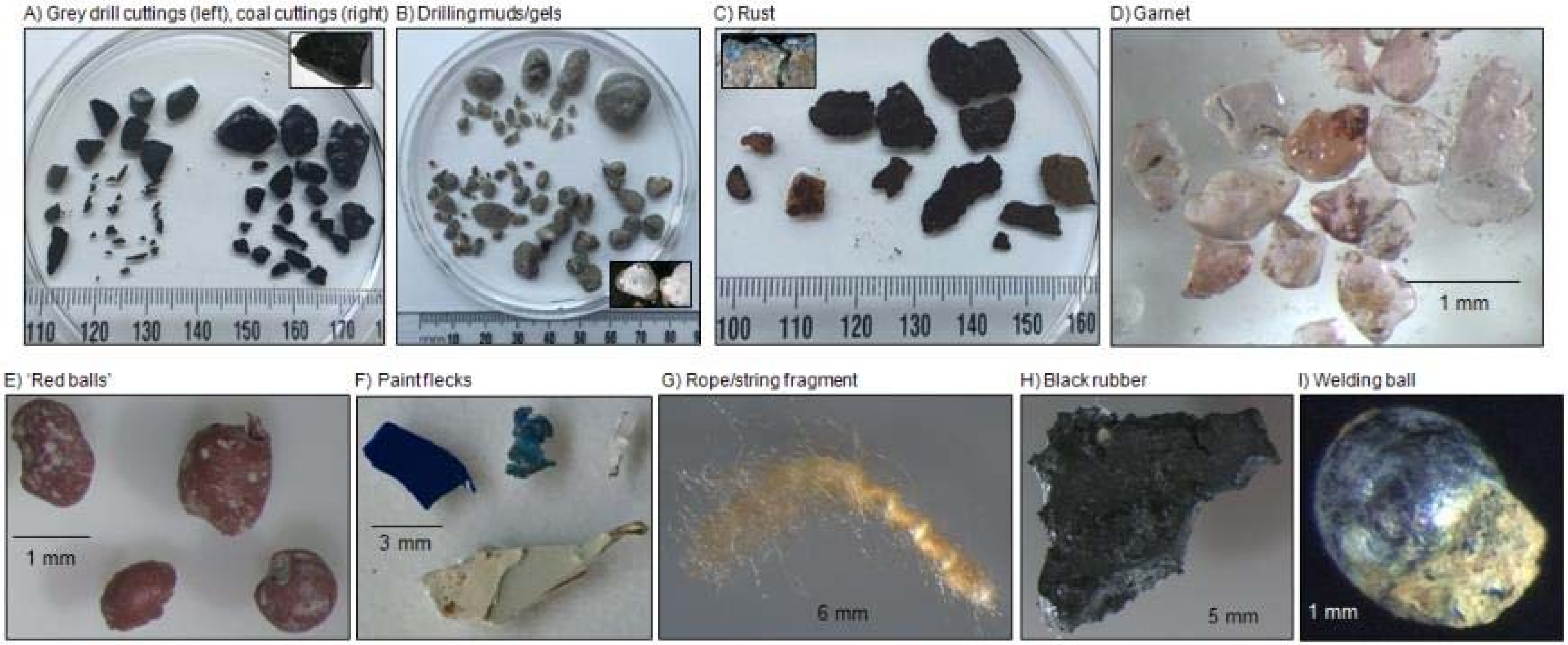
Rust flakes were observed in 46 samples (81%) and was most commonly found at stations closer to the platform (very abundant at N250, abundant at remaining 250 m stations) , although they were present in low abundances at some of the most distant stations. On the north axis, rust was very abundant in all 250 m samples and on all other axes, rust was abundant in the 250 m samples.

Welding balls occurred in 27 samples (47%) in low – common abundances mostly in samples collected close to the platform. Similarly, welding materials (types other than welding balls) were found in low – occasional abundances in 23 samples.

Six samples contained small pieces of black or grey ‘foam’, possibly from insulation material, and small pieces of cloth/fabric occurred in a range of colours, also in six samples. A cable tie was found in N250c and a small piece of flat metal occurred in W500b. Graphite was present in 24 samples (42%) in low – common abundances only and string/rope fragments occurred in seven samples (12%). Small pieces of black rubber occurred in low abundances in nine samples on the east and west axes only and small ‘dark red balls’ of unknown origin (**Figure 7**) were present (low – abundant) in all three replicates at E1000 but did not occur in any other samples. Pieces of plastic and nylon, as well as paint flecks, occurred across a range of samples, generally in low - common abundances.

At each of the north and south control sites, five out of nine grab samples collected contained some degree of anthropogenic debris, although only in low abundances.

Figure 7 **Examples of anthropogenic debris material found at MPA in 2016**



Note: *All measurements are in mm. Inset photos show close-up details.*

Figure 8 Representative sediment core photographs.

3.1.3 Particle grain size

In keeping with general observations of grain size distribution in the offshore Taranaki, the sediments around MPA in 2016 were primarily comprised of silt/clay. The time series data displayed in **Figure 9** (for all of the MPA sites and control sites) allows comparisons to be made between years for the various grain size factions.

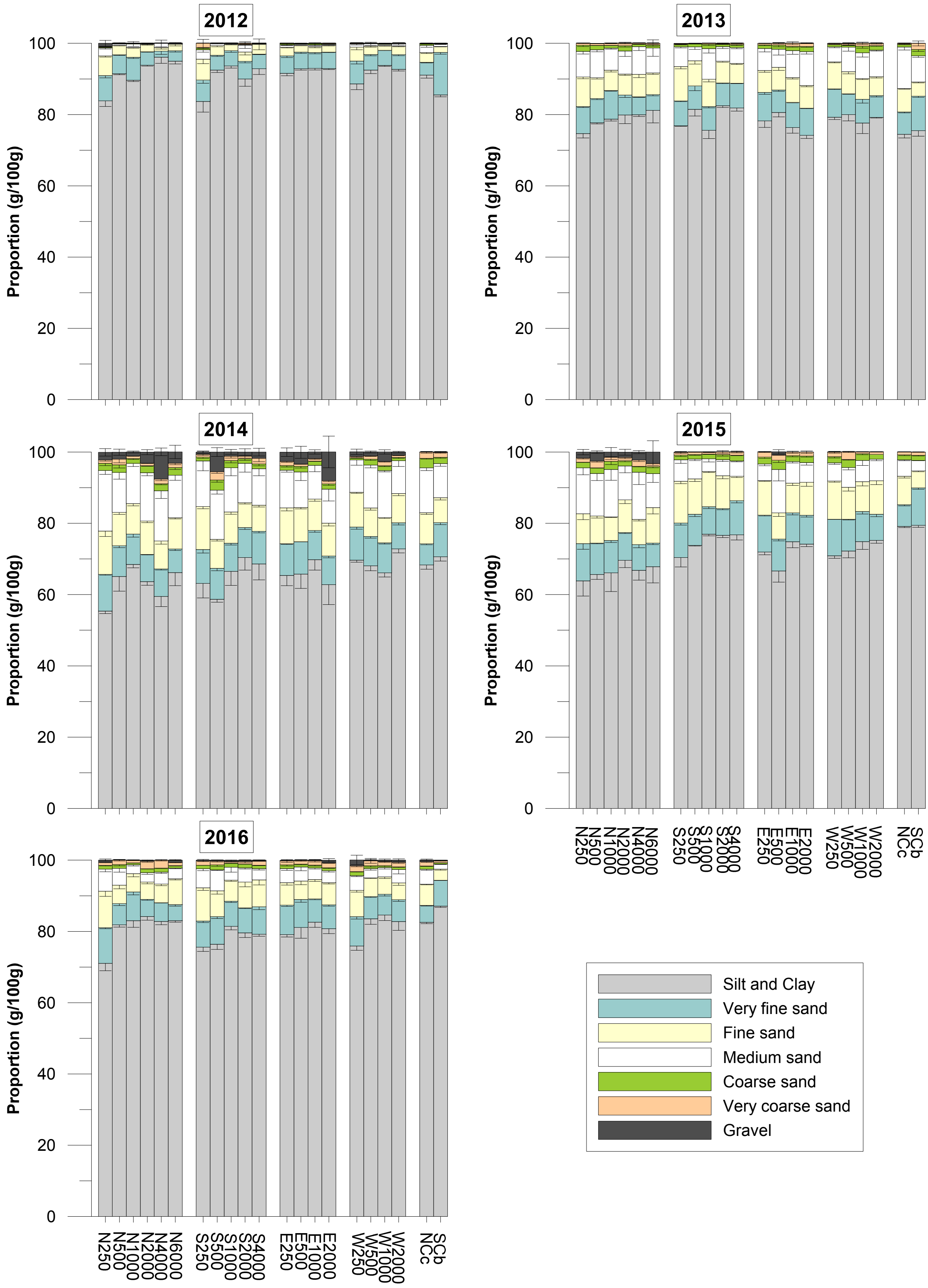
From these data it is apparent that the proportion of silt/clay at MPA sites in 2016 (~70 – 80%) had increased from levels reported in both 2014 (during the drilling programme; ~55 – 70%) and 2015 (during the first post-drill survey; ~65 – 75%). In this respect the proportion of silt/clay in 2016 more closely resembled the 2013 pre-drill results and this observation strongly indicates recovery towards pre-drill levels. Although all sites reported an increase in the proportion of silt/clay, the degree of increase at N250 was not as pronounced as that observed at other sites.

A weak gradient of coarser sediments closer to the platform was reported in 2015 and was attributed to effects of drilling (Johnston & Elvines, 2015). This gradient was less obvious in 2016. In particular, the prevalence of gravel and medium sand in 2016 was noticeably less than that observed in the previous two years. **Figure 9** clearly shows that gravel levels were highest in 2014 when drill cuttings were still being discharged from MPA during the IRF drilling programme. This is a common effect of drilling, whereby cuttings lead to sediments becoming coarser around the platform. The fact that this gradient has decreased (meaning sediments have become more homogenous between sampling sites) provides additional evidence to suggest that sediment structure is returning towards that of pre-drill years.

In 2016, the particle grain size distributions at all but the closest sample stations to the platform (250 m) were broadly comparable in structure to those observed at the control sites; hence, residual effects of drilling are largely spatially constrained to within 500 m of the platform.

A complete set of particle grain size distribution results can be found in **Appendix E**.

Figure 9 **Particle grain size distribution results at MPA and control sites (2012 – 2016)**



Note: *Values are the average of replicate samples taken from each station +/- 1 standard error.*

3.1.4 Organic content

Since drilling commenced, elevations in the organic content (total organic matter, TOM) of MPA sediments have been noted (**Table 4**). Mean TOM content in 2016 (8.2%) remained as high as levels recorded in 2014, which were substantially higher than levels measured during pre-drill surveys (7.2% in both 2012 and 2013). It is important to note however, that similar increases (i.e. noticeable elevations in 2014) were observed at both control sites during this period. Hence, changes to TOM levels appear to be regional in nature and therefore are thought to represent regional processes as opposed to drilling related discharges. In addition to this, the organic content level at MPA in 2016 (8.2%) was clearly within the range of levels reported for control sites (8.9 % for the north control site and 6.9% for the south control site).

Table 4 Total organic matter summary at MPA and control sites (2012 – 2016)

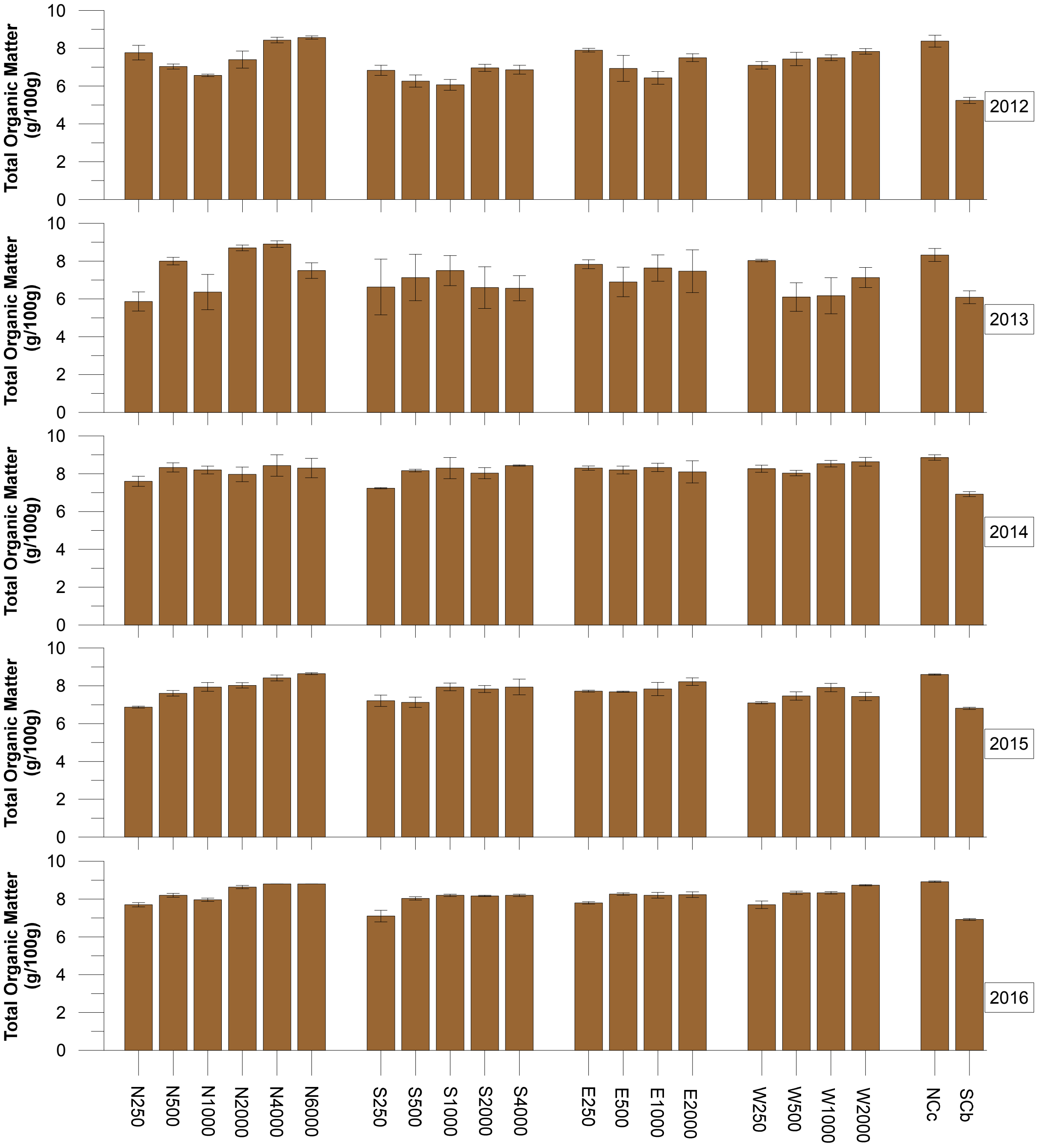
Site	Stage	Mean (%AFDW)	Maximum (%AFDW)	Minimum (%AFDW)
MPA	2012	7.2	8.7	5.5
	2013	7.2	9.2	3.7
	2014	8.2	9.1	7.0
	2015	7.7	8.7	6.7
	2016	8.2	8.8	6.7
Northern Control	2012	8.4	9.2	6.2
	2013	8.3	9.1	5.8
	2014	8.9	9.2	7.8
	2015	8.6	8.7	8.4
	2016	8.9	9.1	8.8
Southern Control	2012	5.2	5.9	4.6
	2013	6.1	7.1	4.4
	2014	6.9	7.5	6.3
	2015	6.8	7.0	6.5
	2016	6.9	7.1	6.6

In 2016, the TOM levels across MPA sample stations were relatively uniform, except for lower TOM levels at stations closest to the platform (**Figure 10**), and results for all MPA stations fell within the range of the two control sites (**Figure 10**). Organic matter concentrations for each sample station showed little variation between the years 2014 to 2016. In contrast, results from 2012 and 2013 showed considerably more variation between stations.

Organic matter concentrations are typically higher in sediment samples with greater percentages of fine silt and clay. This relationship is thought to exist on account of 1) fine particles hindering the diffusion of oxygen into sediments which serves to preserve organic matter; and 2) the adsorption of organic particles onto the charged surface of the clay minerals (Secrieru & Oaie, 2009). Based on the increase in the proportion of silt/clay observed in samples in 2016 (**Section 3.1.3**), an increase in TOM was expected, but was not identified.

Apart from the slight decrease in organic matter concentrations in the immediate vicinity of the platform, there were no transect-related trends in TOM concentrations. Total organic matter results for all sites are presented in **Appendix E.**

Figure 10 Total Organic Matter levels in sediment samples (2012 – 2016)



***Note**: Values are the average of replicate samples +/- 1 standard error.*

3.1.5 Sediment Metals/Metalloids

A number of different trace metals and metalloids (primarily arsenic) are often found in the sediments surrounding an offshore platform. These tend to originate from drilling muds and cuttings deposited at the site, produced water or from other processes and equipment associated with offshore oil and gas activities. As no produced water is discharged at MPA, the most probable sources of metals/metalloids are the platform structures, drilling discharges and deck drainage.

In accordance with OTEMP, eleven metals/metalloids were analysed from sediments during the 2016 benthic survey at MPA. **Figure 11**, **Figure 12**, **Figure 13**, **Figure 14**, and **Figure 15** provide data on a selection of metals for which notable observations are detailed below. A full set of results are provided in **Appendix F.**

Results from the 2016 survey showed that all but one of metals/metalloids tested were below the ISQG-Low trigger value. The exception to this was nickel, where two sediments at two stations had concentrations in exceedance of the ISQG-Low trigger value, while two more stations at MPA, two stations at NCc and one station at SCb had concentrations equal to the trigger value (**Figure 11**). When compared with previous year's data, concentrations had largely increased in 2016 where the ISQG-Low value had been exceeded for the first time. Nickel concentrations at both the north and south control sites in 2016 also approached the ISQG-Low trigger value for possible biological effects. Although no exceedances have been detected at MPA in previous years, it's important to note that nickel concentrations across all MPA sites and control stations have consistently been high. These results are similar to trends observed in a number of other studies in the south Taranaki offshore area (e.g. SLR, 2014), suggesting that the background levels of nickel in the marine sediments are naturally elevated, possibly from the weathering of high nickel minerals onshore. In accordance with this and on account of 1) there being no consistent spatial gradient associated with the platform and 2) control sites also showing elevations; there is little evidence to suggest that the nickel exceedances in 2016 are linked to production or drilling-related discharges.

Of the other metals tested in 2016, concentrations of chromium, copper, lead, manganese, iron and the metalloid arsenic showed no ISQG-Low trigger level exceedances and no distinct spatial trends relative to the platform. Data for these metals/metalloids is presented in **Appendix F**.

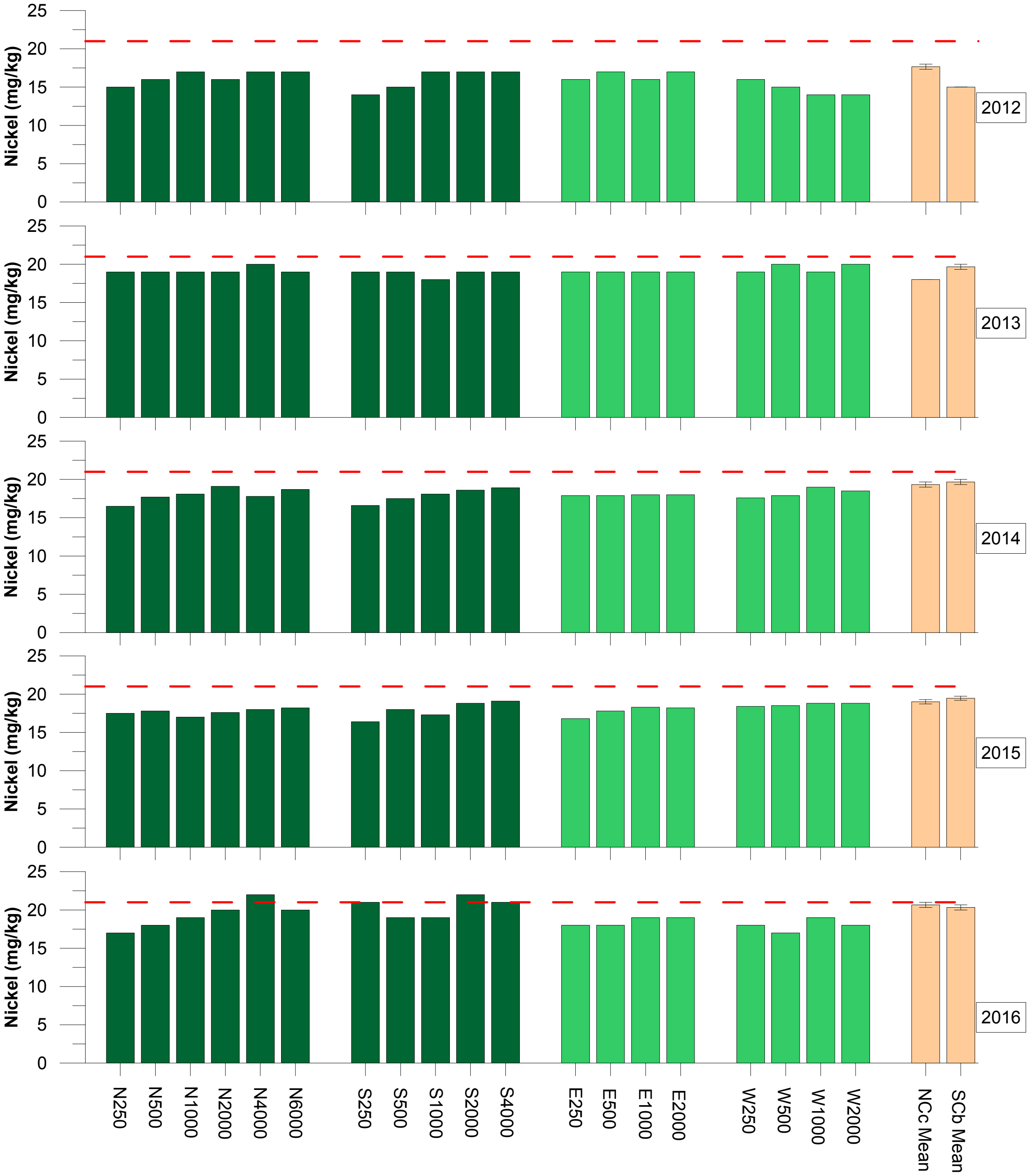
Spatial trends or data anomalies were noted for cadmium, mercury, zinc, and barium; and are discussed individually below.

Cadmium concentrations are shown in **Figure 12** and were generally comparable to concentrations reported for previous years. A notable elevation was detected in 2016 at the S250 sample station (0.127 mg/kg) compared with 2015 (0.072 mg/kg) and likely reflects the patchy nature of the residual drilling discharge around the platform. Despite being elevated, cadmium levels at S250 were still well below the ISQG-Low trigger value for biological effects (1.5 mg/kg). As with the previous two years, the 2016 data show a slight spatial gradient with decreasing cadmium concentrations with distance from the platform, indicating that cadmium is likely to have been part of the production and/or drilling discharges released at the platform. This observation is supported by the fact that MPA concentrations on the major flow axis (north/south) are elevated above those levels of cadmium reported for control stations. Generally metals associated with drilling activities are found in a spatially limited configuration around the well location as illustrated in **Figure 12**.

Mercury levels in the sediment along the north transect had increased slightly in 2016 compared with reported levels for 2015 (**Figure 13)**. Increases were particularly evident at the N250 and N500 sample stations, and contribute to a spatial gradient of mercury levels on the north transect that was now evident. Future testing will be helpful to establish if this trend is ongoing or simply an anomaly as transport processes act in the immediate vicinity of the platform. Mercury levels at all MPA sites and control sites were well below the ISQG-Low trigger values for biological effect.

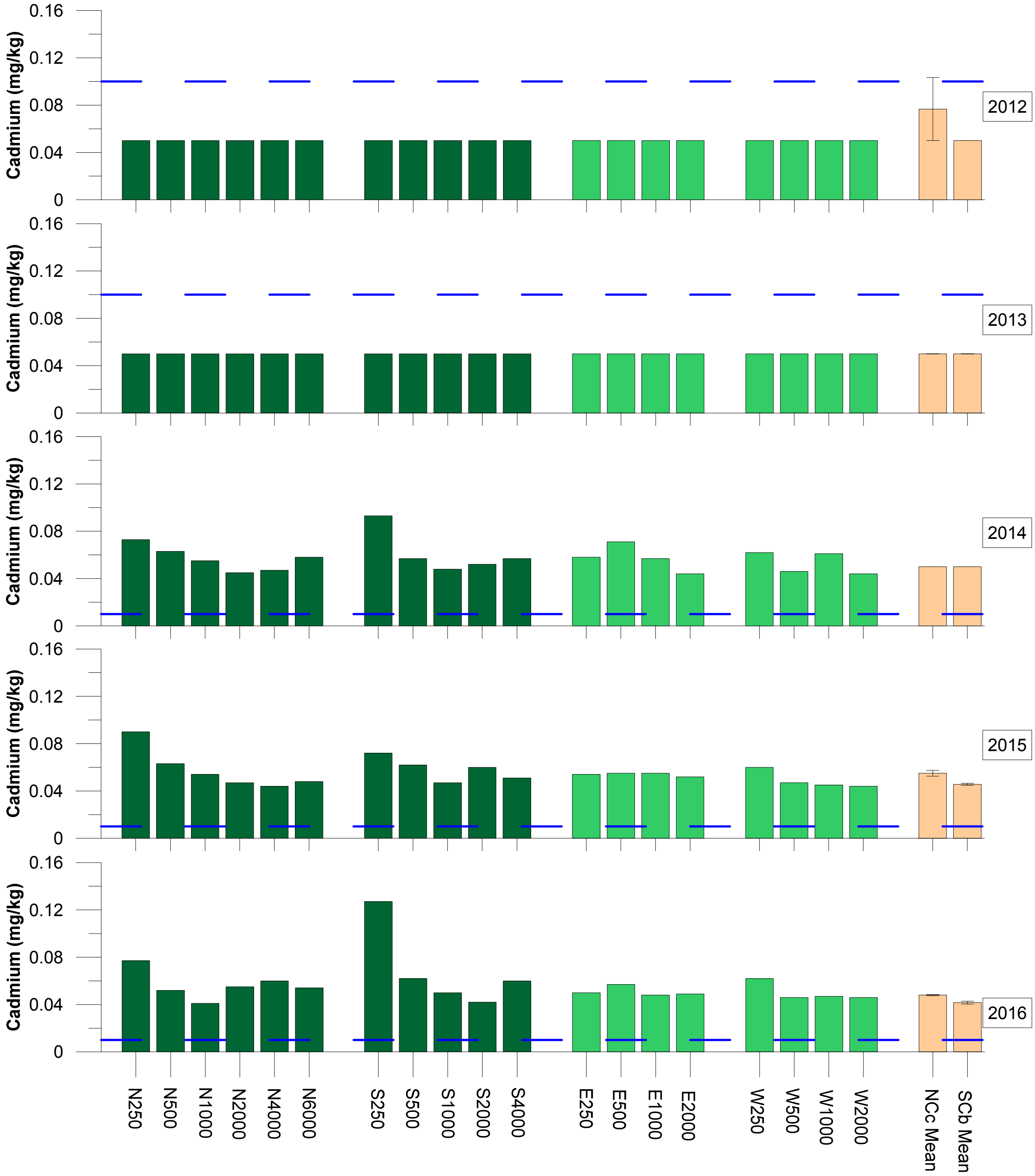
Zinc concentrations in **Figure 14** illustrate that a spatial gradient of decreasing concentrations with distance from the platform has consistently been present since monitoring began in 2012. On account of this trend being noticeable prior to the IRF drilling programme commencing it is reasonable to conclude that elevations in zinc levels in the immediate vicinity of the platforms may be associated with the platform structures. Zinc was historically used in coatings applied to the platform and zinc anodes are used in places on the platform as corrosion inhibitors. Elevations in zinc levels were noted for the N250 and the S250 sample stations in 2016 compared with 2015. These two sites have consistently shown the highest levels of zinc through time. Despite these elevations, the concentrations of zinc in MPA sediments were well below the ISQG-Low trigger levels for biological effects and aside from the N250 and S250 stations, levels were comparable to those of control sites.

Figure 11 Concentrations of nickel in sediments at MPA and control sites (2012 and 2016)



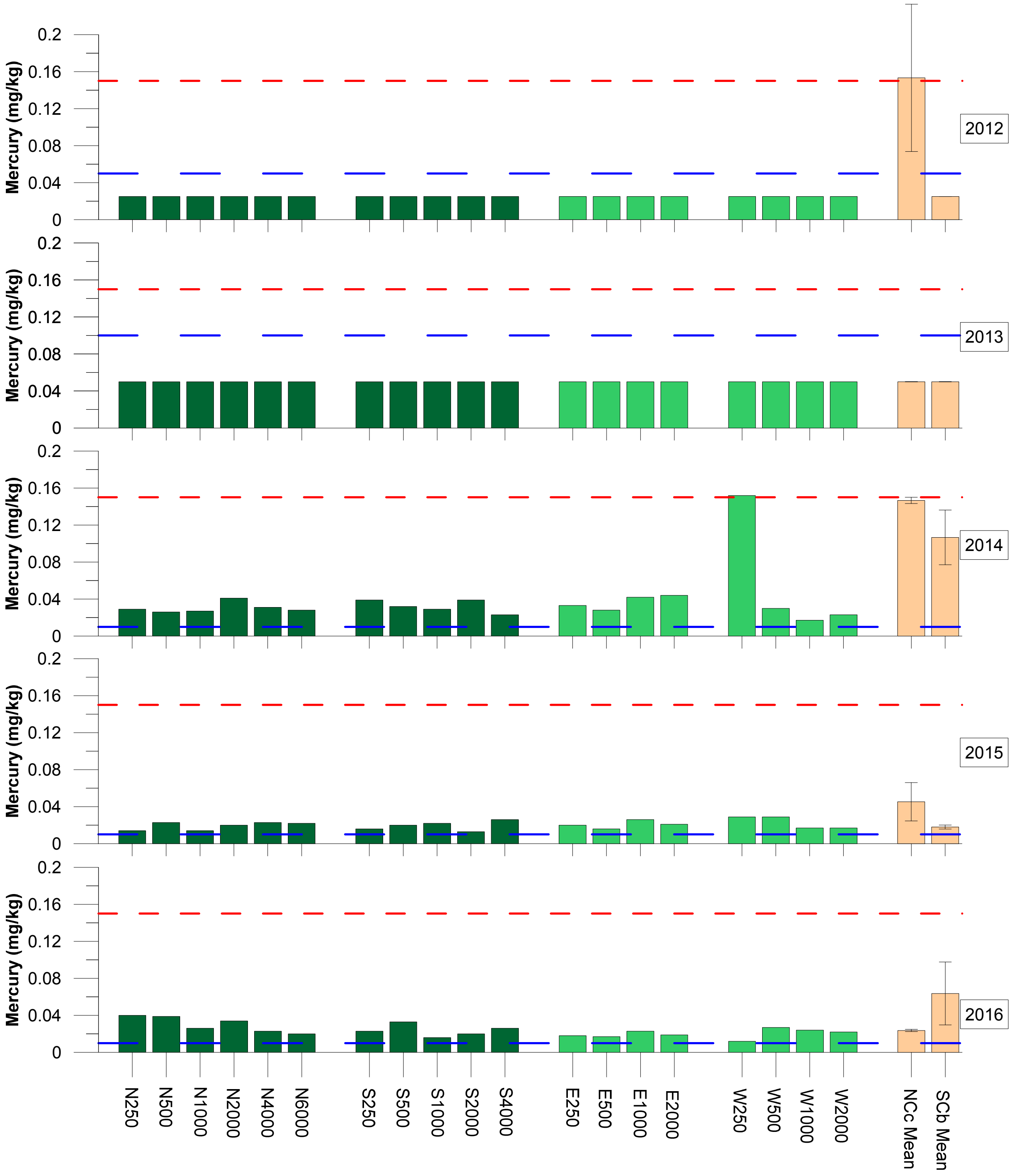
***Note:** MPA stations are single composite samples while control station results are averages of all composite samples collected at that site. Dashed red lines indicate the ISQG-Low level.*

Figure 12 Concentrations of cadmium in sediments at MPA and control sites (2012 – 2016)



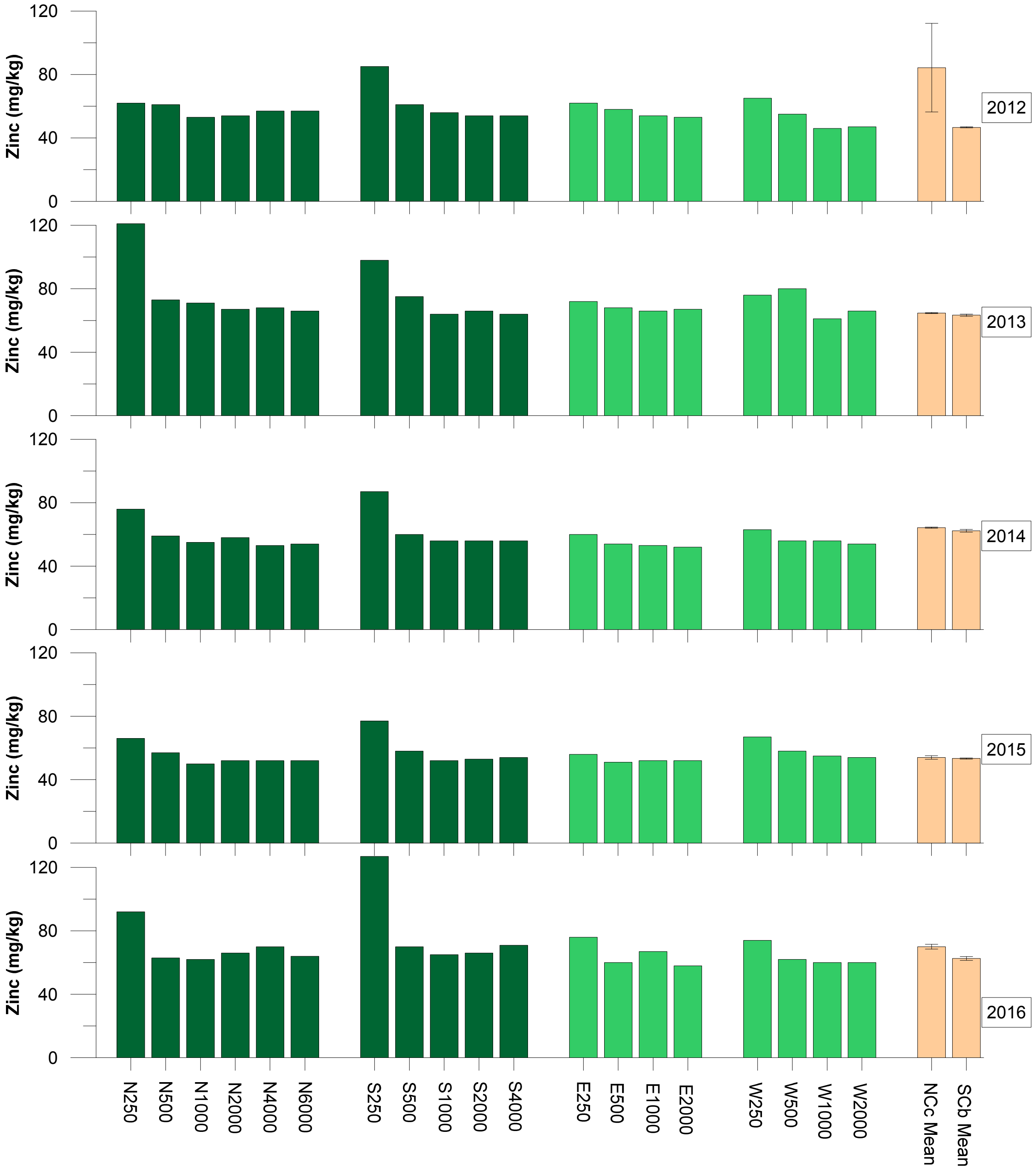
Note: *MPA stations are single composite samples while control station results are averages of all composite samples collected at that site. When concentrations were below the analytical detection limit (ADL), a conservative estimate of half the ADL was used for graphical representation. Dashed blue lines indicate the ADL.*

Figure 13 Concentrations of mercury in sediments at MPA and control sites (2012 and 2016)



Note: *MPA stations are single composite samples while control station results are averages of all composite samples collected at that site. When concentrations were below the analytical detection limit (ADL), a conservative estimate of half the ADL was used for graphical representation. Dashed blue lines indicate the ADL and dashed red lines indicate the ISQG-Low level.*

Figure 14 Concentrations of zinc in sediments at MPA and control sites (2012 and 2016)



Note: *MPA stations are single composite samples while control station results are averages of all composite samples collected at that site.*

3.1.6 Barium trace results

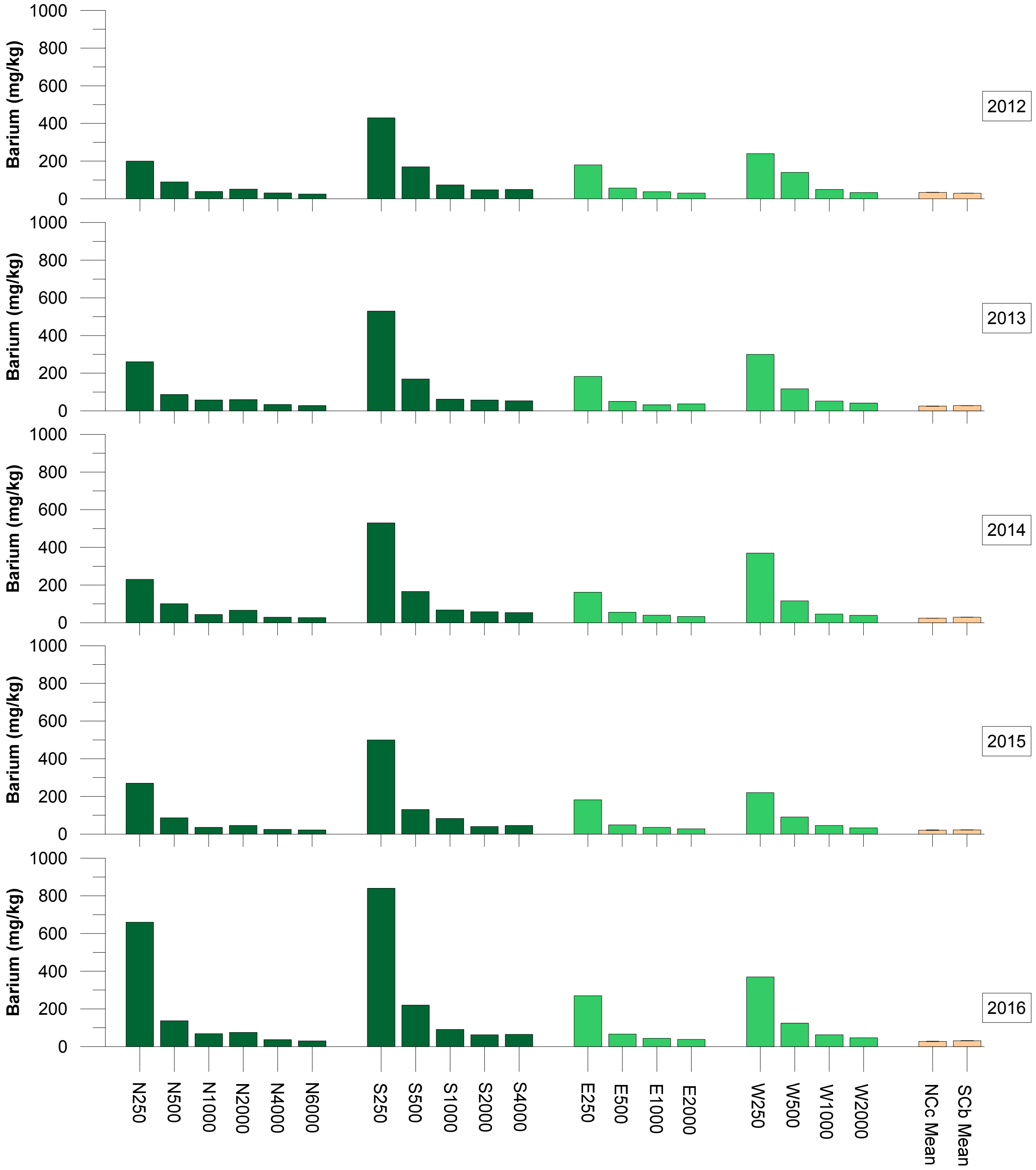
Barium sulphate (barite) was a significant component of the drilling muds used during the IRF drilling programme. Barite, a weighting agent in the drilling muds, is relatively insoluble in seawater so it precipitates quickly from the water column and deposits on the seabed, allowing it to be used to trace the deposition footprint of drilling-related discharges (Ellis *et al*., 2012).

The 2016 concentration trends of sediment barium at MPA sites closely resembled trends seen in previous years; with a strong spatial gradient of decreasing barium concentrations with distance from the platform (**Figure 15**). These trends were apparent on all axes with highest concentrations on the north/south axis at the closest sampling stations to the platform (N250 = 660 mg/kg and S250 = 840 mg/kg) where concentrations were well above background levels measured at control stations (NCc mean = 27.7 mg/kg and SCb mean = 30.7 mg/kg). An interesting observation in 2016 was that barium concentrations at these two sites had increased on reported concentrations from 2015 in the absence of any further drilling-related discharge, possibly as a result of bioturbation activities bring partially buried drilling related materials back to the sediment surface.

The IRF drilling programme commenced at MPA in 2013, therefore the 2012 and 2013 results presented in **Figure 15** have been described as pre-drill surveys. It is important to remember that drilling has occurred at MPA in the past, and the elevations in barium concentrations that were reported close to the platform in 2012 and 2013 samples (**Figure 15)** therefore likely reflect earlier drilling activities (the most recent of which took place in 2010; Johnston & Elvines, 2015). On account of this, the barium concentrations measured at MPA in 2016 reflect the cumulative input through time at this location.

No ANZECC (2000) trigger values have been developed for barium. This is believed to be on account of it being insoluble, inert and having low bioavailability (Neff, 2010; Sneddon, 2011). On this basis no detrimental ecological effects from chemical contamination of barium in seabed sediments are expected at MPA. The levels of barium at MPA are in keeping with other drilling locations in offshore Taranaki waters (e.g. SLR, 2015).

Figure 15 Concentrations of barium in sediments at MPA and control sites (2012 – 2016)



Note: *MPA stations are single composite samples while control station results are averages of all composite samples collected at that site.*

3.1.7 Polycyclic Aromatic Hydrocarbons

PAH concentrations were above analytical detection limits (ADL) at 15 of the 19 MPA sampling stations, and at two of the three northern control site stations. However, the total PAH concentrations at all stations, as well as the high and low molecular weight PAH concentrations were all below the ISQG-Low guideline levels. Similar to 2015 results from the Maui-A site high-molecular weight PAHs were more prevalent than low molecular weight PAHs, with the highest number of PAH species found at the stations close to the MPA platform. Acenaphthene at the N250 station was the only individual PAH that was above its ISQG-Low guideline level, similar to 2015 where it exceeded ISQG-Low at the S500 and W250 stations. Values above the ISQG-low can result in possible biological effects.

A full set of PAH results are presented in **Appendix G**.

The northern control site showed similar low levels of several high molecular weight PAHs as in 2015, but in 2016 a single low Molecular Weight (MW) PAH (Phenanthrene) was also detected. No detectable levels of PAH were found at the southern control site in 2016, compared to Phenanthrene being found at two stations in 2015.

3.1.8 Total Petroleum Hydrocarbons

Presence and concentration of petroleum hydrocarbons in the sediment is tested for via TPH analysis. Dependent on the methodology utilised during the drilling process, drilling muds may contain petroleum hydrocarbons.

In 2016 all but one of the composite sediment samples from the MPA and control sites had TPH concentrations below detectable levels. TPH levels in the sample from the S250 station reached 210 mg/kg, which was an increase from the levels detected at this station in 2015 (119 mg/kg), but was still below the ecological protection trigger value for TPH (275 mg/kg - as set out in Simpson *et al.*, 2015) which indicate the level where negative ecological effects might occur. The N250 station had concentrations above the trigger value in 2015 but TPH levels had decreased below the detection limit in 2016. This continues the trend of decreasing TPH levels at MPA after 2014 results showed concentrations were above the ecological protection trigger values at the north, south and west 250m stations.

A full set of TPH results are presented in **Appendix H**

Given that the one sample with elevated TPH levels was located closest to the MPA platform, along the major flow axis, it is likely that the TPH source comes from historical drilling activities undertaken from the MPA platform.

3.2 Video Sled Imagery

Video footage of the seabed allows scientists to visually assess any notable changes to the seabed resulting from the production and/or historical drilling activities, as well as to observe the epifauna, sediment-type and structures or relief that exist on the seabed around the MPA site (as specified in OTEMP).

Each video tow aimed to cover a horizontal distance of approximately 200 m along the seafloor; however, due to differing drift rates as a result of variable tidal current, changing wind speeds and sea conditions, the actual transect distances, and the time taken to cover the approximate distance, varied between stations. During the 2016 annual production monitoring survey video sled footage was captured at seven stations around MPA (**Figure 3Table 1**). All seven stations were located along the major north-south flow axis (N1000, N2000, N4000, N6000, S1000, S2000, S4000). Footage was also collected at two stations at each of the northern (NCc5, NCc7) and southern (SCb5, SCb10) control sites in March 2016. Where possible (such as at the control sites) tows were positioned so that multiple stations could be passed during a single tow, increasing the efficiency of the operations by reducing the number of times the sled had to be deployed and retrieved. The amount of video footage collected during each tow at each sample station ranged between 5 and 30 minutes, with the longest tows occurring at the control sites when two stations were covered in a single transect.

All video footage collected during the tows has been included on the DVD accompanying this report, with selected still images from the footage displayed in **Figure 16** and **Figure 17**.

Video sled tows were attempted at the N6000, N4000 and S4000 stations on March 29th, but near seabed visibility was almost zero on this day and the tows had to be abandoned before being reattempted the following day when visibility had improved sufficiently.

Similar to the seabed at MPB and at the control sites (NCc and SCb) the seabed observed in the MPA video transects was relatively flat, soft mud sediments with occasional mound or hollow features. These features could reach up to ~30 cm tall or deep, and were likely caused by burrowing activities of larger worms or shrimps (e.g. NCc5 and SCb5 in **Figure 17**), except where mounds and hollows were located beside each other (e.g. image F in **Figure 16**), and are most likely formed through the feeding activities of sharks or rays. Biological activity on and in the sediments was seen by the presence of animal burrows and small worm tubes (images E-H in **Figure 16)**. These tubes were likely formed by worm taxa such as *Onuphis aucklandensis* or *Spiophanes* spp., which are known tube-forming taxa that were found widely in the Maui-a and control station infauna samples. Although there were no notable areas of physical disturbance seen in the MPA video tows, footage at the N1000 station showed some areas of seabed where animal burrows appeared less distinct and their numbers were reduced (image B in **Figure 16**), possibly indicating fine sediments had been deposited or moved around in this area.

Water depth, as measured by a pressure transducer on the video sled, ranged from 108-112 m during the MPA video sled tows (a proportion of this difference is likely due to tidal range over the sampling period), 116 m at the northern control site and 112 m at the southern control site.

Epifauna taxa observed during the video sled tows at MPA included small whelks (image C)(and whelk tracks), small unidentified fish (e.g. image D), a single tusk shell (N1000 tow) and a lone sea pen (N2000 tow). Similar taxa were observed at the control sites (**Figure 17**), with the addition of flatfish (NCc5), a juvenile gurnard (SCb10) and a small yellow sponge (SCb5). Whelk numbers appeared somewhat higher at the northern control sites and lower at the southern, while seapens appeared most common at the southern control. The small skinny fish taxa seen in the video sleds (NCc7 in **Figure 17**) appeared similar between the Māui and control sites, but positive identification was not possible as they moved away from the sled before being close enough to see distinguishing features. Fish numbers were similar or slightly higher than those counted in 2015 videos from MPA.

Figure 16 Representative still images taken from video sled footage collected around the Maui-A platform in March 2016.

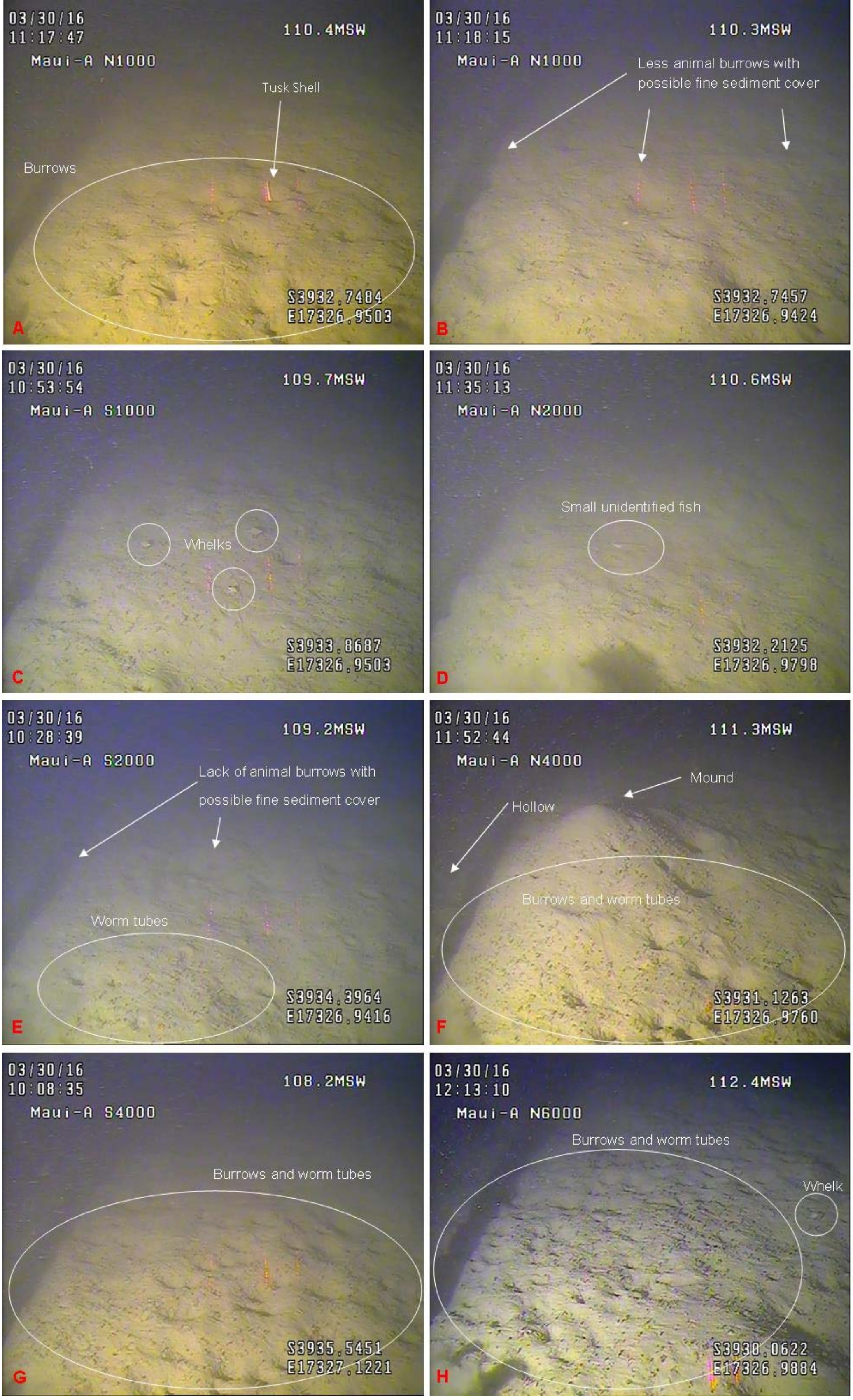
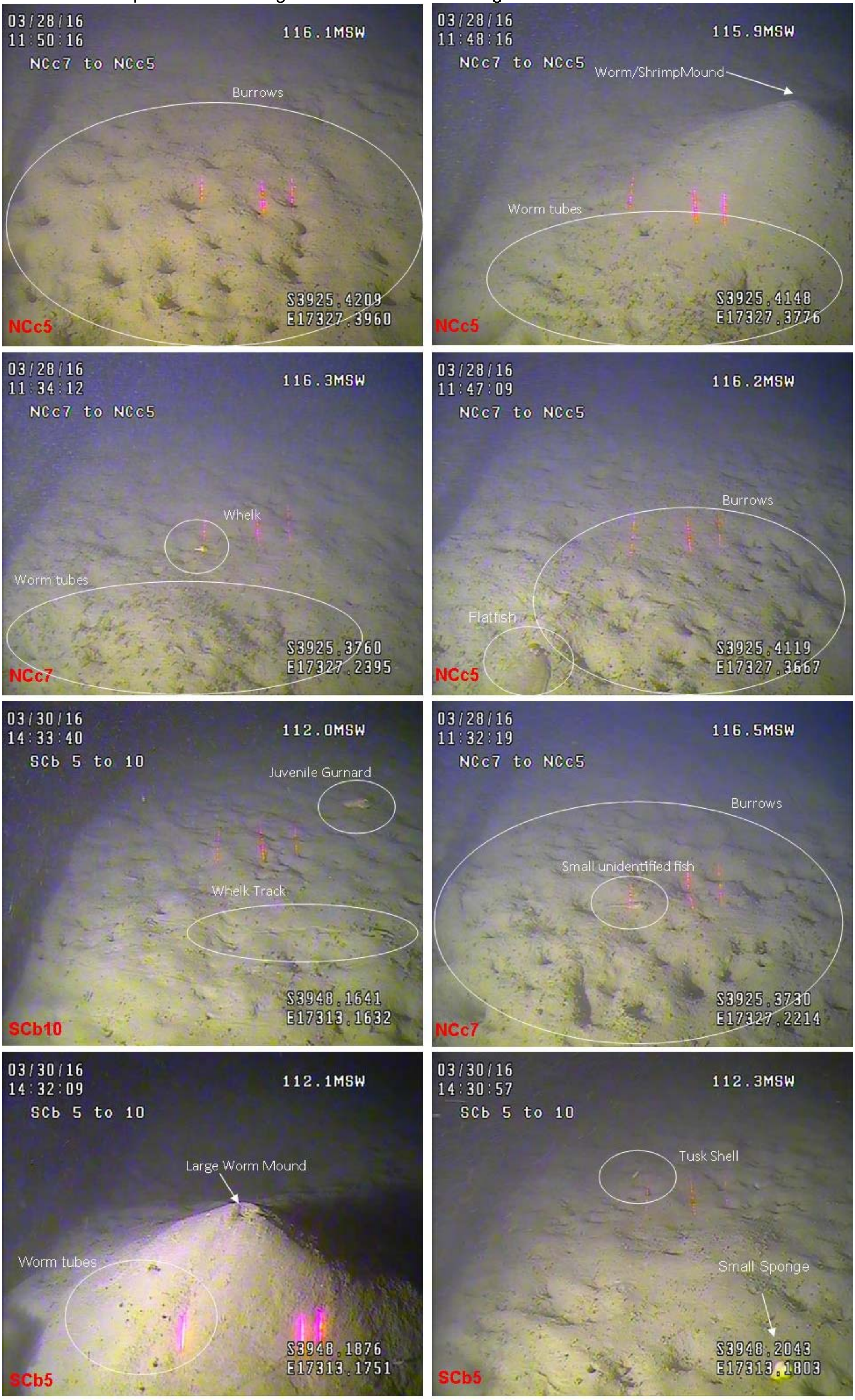


Figure 17 Further representative images from video sled footage.

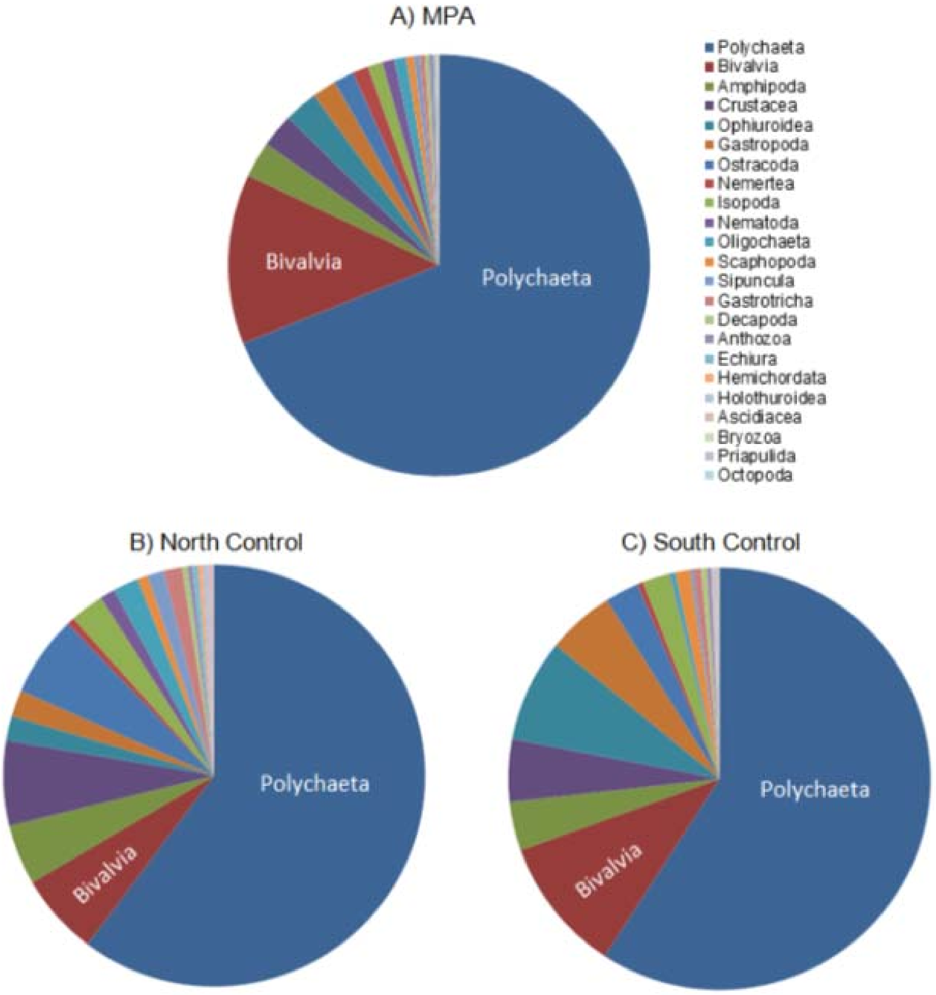


3.3 Macrofauna characteristics

Overall, 148[1] taxa were found at MPA, northern control (NCc) and southern control (SCb) sites in the samples collected during the 2016 survey. A full list of these taxa is provided in **Appendix I**. The benthic macrofauna communities identified within these samples were similar to the communities identified during previous surveys (Johnston & Forrest 2012; Johnston *et al*., 2013; Johnston *et al*., 2014; Johnston & Elvines, 2015) and were typical of offshore benthic communities in the Taranaki Bight region.

At all sites, polychaetes were the most prevalent taxonomic group, contributing approximately 69% of the community at MPA and 60% at each of the control sites. At MPA, bivalves were the second most abundant group (13%), followed by amphipods (2.8%), crustaceans (2.6%), ophiuroids (2.6%), gastropods (1.8%) and ostracods (1.6%). The remaining 6.7% of the community was comprised of a further 16 taxonomic groups. The proportion of the community consisting of each taxonomic group varied by site and is shown in **Figure 18**.

Figure 18 Proportion of taxonomic groups at MPA and the control sites in 2016.



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[1] This number excludes eight pelagic taxa found in the samples: Brachyura (crab) larvae, Chaetognatha (arrow worms), Decapod larvae, Euphausiacea (krill), *Hyperia* sp. (pelagic amphipods), Natantia (shrimp) larvae, Salpidae (planktonic tunicates) and Stomatopoda (mantis shrimp) larvae.

The ten most numerically abundant taxa within the samples collected at MPA and the control sites during the 2016 survey are listed in **Table 5,** with **Table 6** showing the general classification and trophic group of each of the taxa reported in these tables. Representative images of the most abundant taxa at MPA are provided in **Figure 19**.

At MPA, seven out of the ten most abundant taxa found in the 2016 survey samples were polychaetes; the remaining three taxa were the bivalves *Nucinella maoriana* and *Varinucula gallinacea* and ophiuroids (brittle stars) (**Table 5**). Abundances of the top 10 taxa at MPA in 2016 were generally similar to in 2015, with the exception of polychaetes from the family Paraonidae, where the average abundance increased by 14.2 individuals per sample in 2016 compared to the previous year. Paraonidae abundances in 2016 were also higher than they had been in any previous surveys at MPA. The possible ecological significance of this is discussed under *Simper Analysis* in **Section 3.3.2**.

Nine of the ten most abundant taxa at MPA in 2016 were also in the top ten most abundant taxa at one or both control sites in 2016 (**Table 5**), indicating strong similarities between the assemblages at these sites. The nutshell *V. gallinacea* was the only taxa occurring in the top ten at MPA in 2016 but not in the top 10 at either of the control sites.

Table 5 **The ten taxa with the highest abundances at MPA (A) and the south (B) and north (C) control sites in 2016.**

(A) MPA

Top 10 Taxa	**Average abundance per grab**				
MPA 2016	**2016**	**2015**	**2014**	**2013**	**2012**
Paraonidae	**35.9**	21.7	23.6	27.0	17.7
Cirratulidae	**18.3**	20.1	23.8	22.7	9.9
Spiophanes sp.*	**14.2**	14.6	13.6	5.4	9.6
Maldanidae	**12.4**	11.1	17.7	21.4	14.7
Nucinella maoriana	**10.9**	9.6	7.4	10.0	8.4
Lumbrineridae	**6.7**	6.8	6.3	5.6	4.2
Varinucula gallinacea	**6.7**	5.8	5.4	5.0	5.0
Aglaophamus sp.	**6.1**	7.8	8.1	4.6	1.9
Ampharetidae	**5.1**	4.8	4.2	3.5	3.2
Ophiuroidea	**5.1**	3.9	5.2	3.4	1.2

(B) North Control

Top 10 Taxa	**Average abundance per grab**				
North Control 2016	**2016**	**2015**	**2014**	**2013**	**2012**
Paraonidae	**17.1**	11.8	14.3	13.1	6.1
Cirratulidae	**16.2**	18.9	29.3	19.8	8.9
Spiophanes sp.*	**15.1**	7.8	15.8	8.7	1.9
Maldanidae	**9.1**	8.4	15.8	12.0	15.1
Neonesidea sp.	**5.9**	1.8	2.3	0.0	0.0
Cumacea	**5.8**	3.3	10.6	6.3	1.6
Aglaophamus sp.	**5.4**	5.9	5.8	5.1	4.8
Ampharetidae	**5.3**	3.3	7.9	1.8	3.9
Lumbrineridae	**3.3**	2.4	4.1	3.7	1.9
Tanaidacea	**3.3**	1.9	3.1	5.1	0.2

(C) South Control

Top 10 Taxa	Average abundance per grab				
South Control 2016	**2016**	**2015**	**2014**	**2013**	**2012**
Maldanidae	**29.1**	25.1	26.4	30.6	19.7
Ophiuroidea	**13.8**	11.2	10.6	6.9	6.8
Aglaophamus sp.	**13.0**	24.9	23.4	18.9	15.2
Paraonidae	**12.4**	7.7	7.7	9.8	6.3
Cirratulidae	**10.6**	22.2	40.0	20.2	7.8
Spiophanes sp.*	**7.9**	15.7	16.0	5.8	9.2
Gastropoda	**7.6**	8.1	4.6	7.8	1.9
Nucinella maoriana	**6.0**	8.9	8.8	6.6	2.9
Onuphis aucklandensis	**6.0**	7.4	6.3	7.2	4.8
Cumacea	**5.8**	3.3	7.2	3.8	0.9

Note: *Taxa occurring in the top 10 at all three sites in 2016 are coloured consistently for comparison.*

* The majority of *Spiophanes* sp. in the 2016 results were identified as *Spiophanes kroyeri,* however they were grouped to genus level to ensure the data were consistent with, and comparable to, previous years results supplied by another taxonomy provider.

Table 6 General classification and trophic group of each of the taxa reported in Table 5

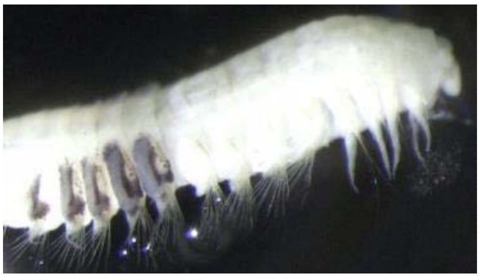
Taxa	General Classification	General Trophic Group
Aglaophamus sp.	Polychaeta: Nephtyidae	Carnivore
Ampharetidae	Polychaeta: Ampharetidae	Deposit feeder
Cirratulidae	Polychaeta: Cirratulidae	Deposit feeder
Cumacea	Cumacea	Filter feeder, deposit feeder
Gastropoda	Gastropoda	Deposit feeder, carnivore, filter feeder
Lumbrineridae	Polychaeta: Lumbineridae	Deposit feeder
Maldanidae	Polychaeta: Maldanidae	Deposit feeder
Neonesidea sp.	Ostracoda: Bairdiidae	Deposit feeder
Nucinella maoriana	Bivalvia: Nucinellidae	Filter feeder
Onuphis aucklandensis	Polychaeta: Onuphidae	Deposit feeder
Ophiuroidea	Ophiuroidea	Filter feeder, deposit feeder
Paraonidae	Polychaeta: Paraonidae	Deposit feeder
Spiophanes sp.	Polychaeta: Spionidae	Deposit feeder
Tanaidacea	Tanaidacea	Deposit feeder, filter feeder
Varinucula gallinacea	Bivalve: Nuculidae	Filter feeder

Figure 19 Representative images of the ten most abundant taxa at MPA in 2016

1) Paraonidae (1 – 10 mm)

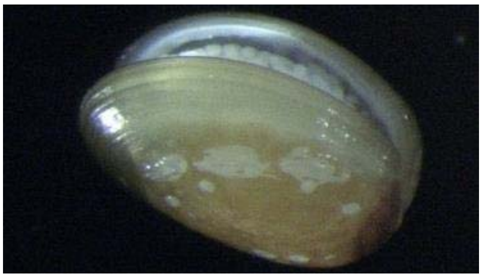
2) Cirratulidae (2 – 10 mm)

3) *Spiophanes kroyeri* (2 – 5+ mm)

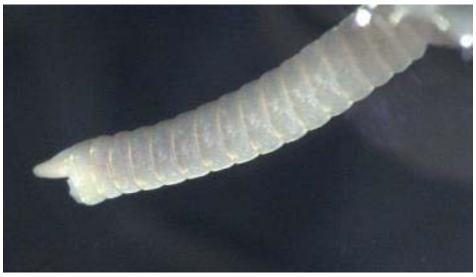


4) Maldanidae (2 – 10+ mm)

5) *Nucinella maoriana* (1 mm)



6) Lumbrineridae (6+ cm)



7) *Varinucula gallinacea* (1 mm)

8) *Aglaophamus* sp. (5 mm)

9) Amphatetidae (1-3 cm)

10) Ophiuroidea (0.5 – 5+ cm)

Note: *Approximate average lengths of each taxa based on observations at MPA are shown in brackets*

3.3.1 Univariate indices of infauna communities

Univariate indices (total number of taxa, total abundance, Shannon-Wiener diversity and Pielou's evenness) describing the benthic macroinvertebrate communities at MPA and the control sites during the pre- and post-drill monitoring surveys, and the annual production monitoring surveys are displayed in **Figure 20** to **Figure 23.** The mean community indices from the 2012 survey were included in the figures; however, previous reports have indicated that there was an increase in taxonomic resolution after 2012 and thus caution must be taken when comparing these results to subsequent years. As such, most interpretation focuses on the 2013 – 2016 results.

In 2016, the average number of taxa across the MPA sampling stations ranged from 32 (W250) to 52 (S4000); the average number at the north and south control sites were 45 and 44 taxa respectively (**Figure 20**). At all stations, with the exception of W250, the number of taxa was higher in 2016 than in 2015; this was also the case at the control sites. While a weak spatial gradient of decreasing taxa numbers was present out to 2,000 m along the northern transect there were no other consistent spatial gradients in 2016 taxa numbers.

Mean abundances in 2016 ranged from 108 to 372 individuals across MPA stations, and were 154 and 175 individuals at the north and south control sites respectively (**Figure 21**). Some points of note include:

- At N250, abundances in 2016 were the highest since monitoring began at any MPA station, with an average of 372 (±47 SE) individuals found. At all other stations on the north axis in 2016, abundances across the remaining north axis stations were less than 200 individuals in 2016, with relatively small variation between stations;

.

- Along the south axis, abundances peaked at the 250 m station in 2016, consistent with the 2015 results. However, abundances were also relatively high at S4000 in 2016, which was a distinct increase compared to 2015;

.

- At W250, abundances were lower than at all other stations on this axis in 2016 and following a notable decrease in abundance in 2014 (1st survey after the completion of drilling), there appears to have been very little recovery in infauna abundance at this station; and

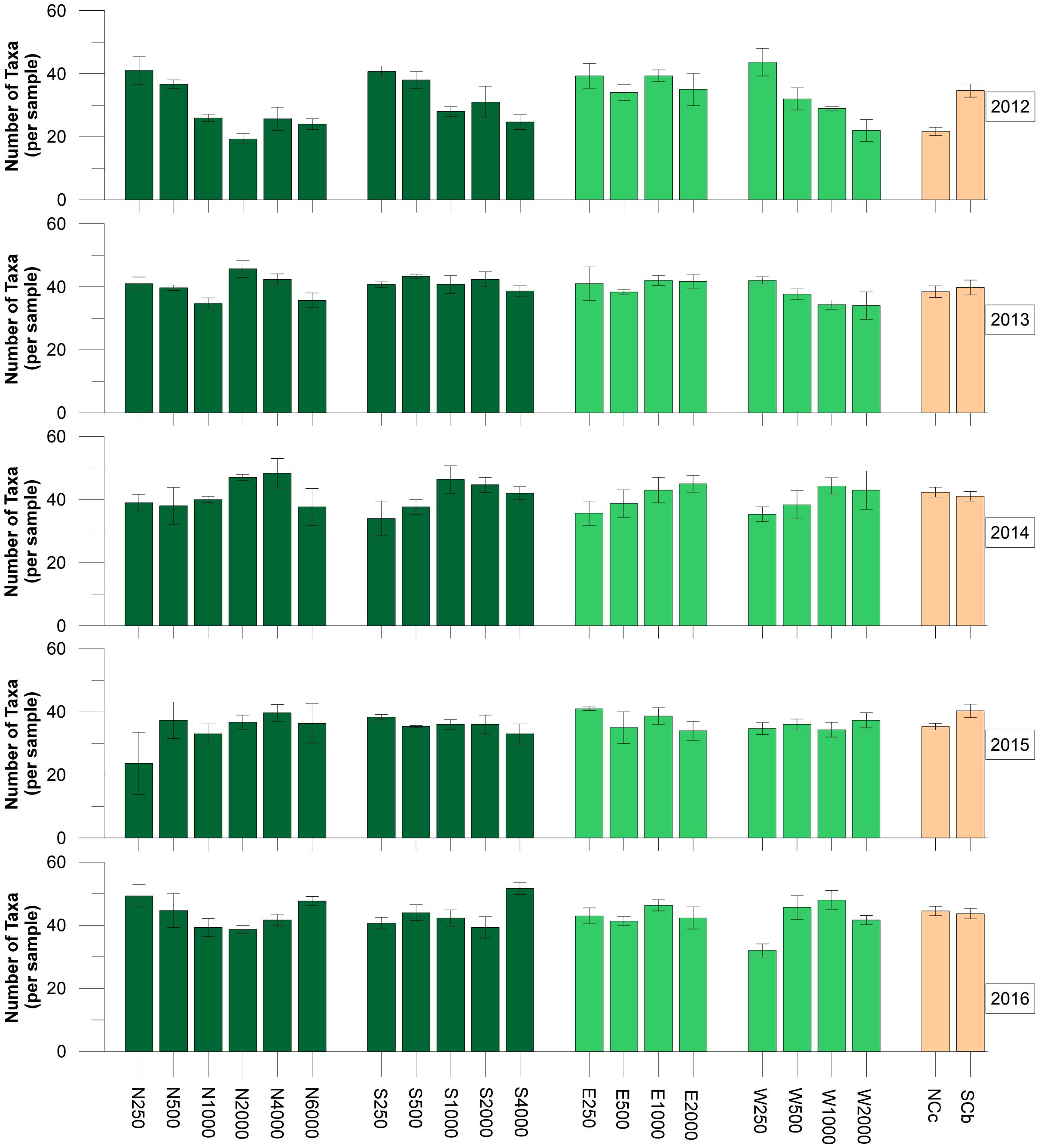
.

- There were no significant differences in total abundance between the north and south control sites in 2016, which was in contrast to 2015, where mean abundances at the north control site were distinctly lower than those at the south control site and the majority of the MPA stations.

Shannon-Wiener diversity index values were similar in 2016 to previous years although were somewhat higher at the majority of stations in 2016 compared to 2015 (**Figure 22**). Diversity was lowest at the 250 m stations on all axes in 2016 and compared with 2015 values had decreased at S250, E250 and W250 in 2016. Diversity index values at both control sites were higher in 2016 than previous years. In 2016, values ranged from 2.8 to 3.4 at MPA, and were 3.3 and 3.2 at the north and south control sites respectively, which is relatively typical for moderately diverse infauna communities.

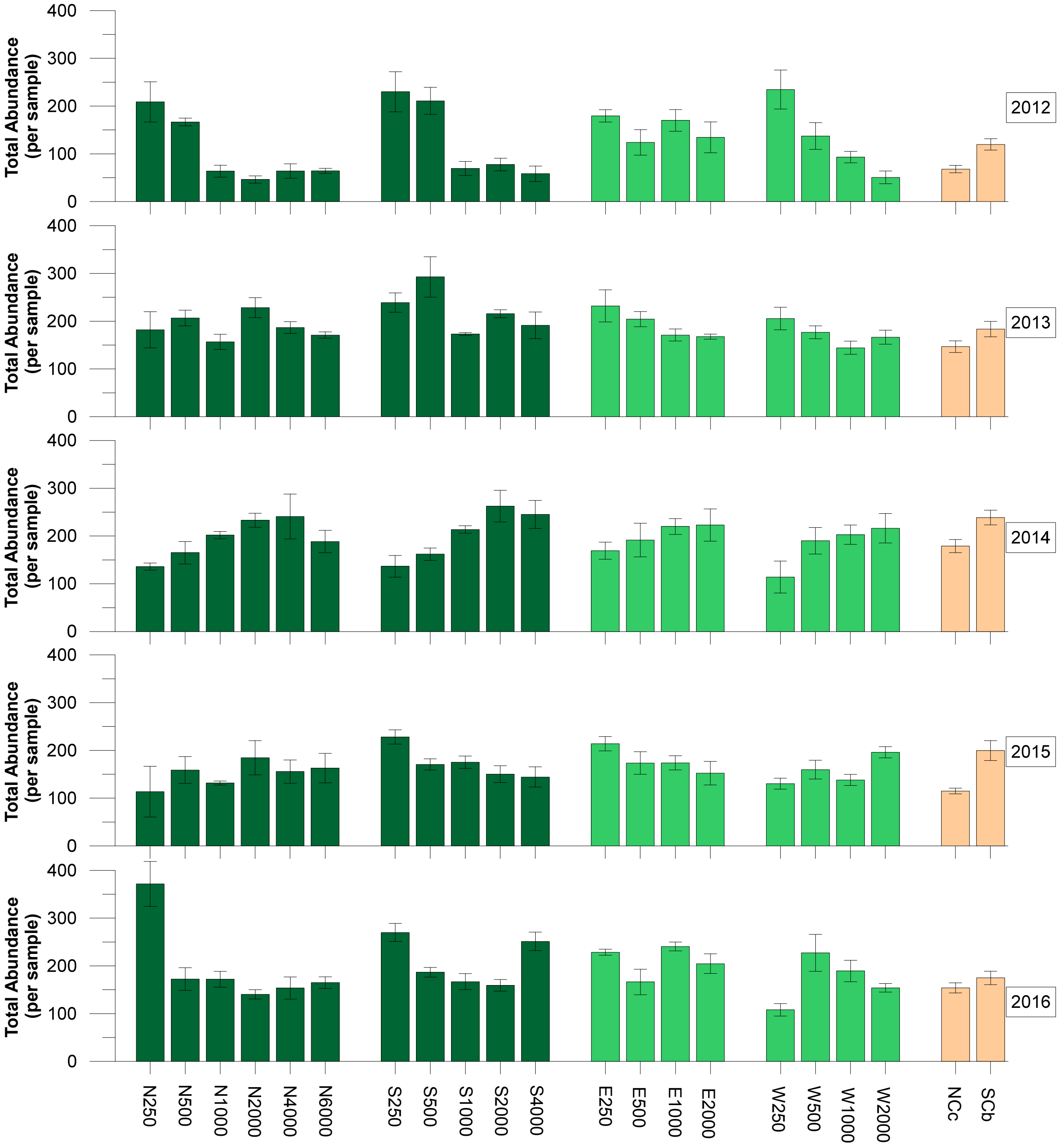
Pielou's evenness values in 2016 were relatively similar to previous years, ranging from averages of 0.73 to 0.88 at the MPA stations (**Figure 23**), and were 0.87 and 0.84 at the north and south control sites respectively. Evenness values were largely uniform across the majority of the stations although 250 m stations on the north and south axes were somewhat lower. Overall, the evenness values were relatively high and indicated that infauna abundances were fairly evenly distributed across the different taxa present in the samples, with no notable dominance by any single taxa (low evenness indicates communities are being numerically dominated by a large number of individuals from a few taxa, rather than lesser numbers of individuals spread more evenly across all the taxa present).

Figure 20 **Mean values for total number of taxa identified at the MPA, north and south control sites during the 2012 - 2016 benthic ecological surveys.**



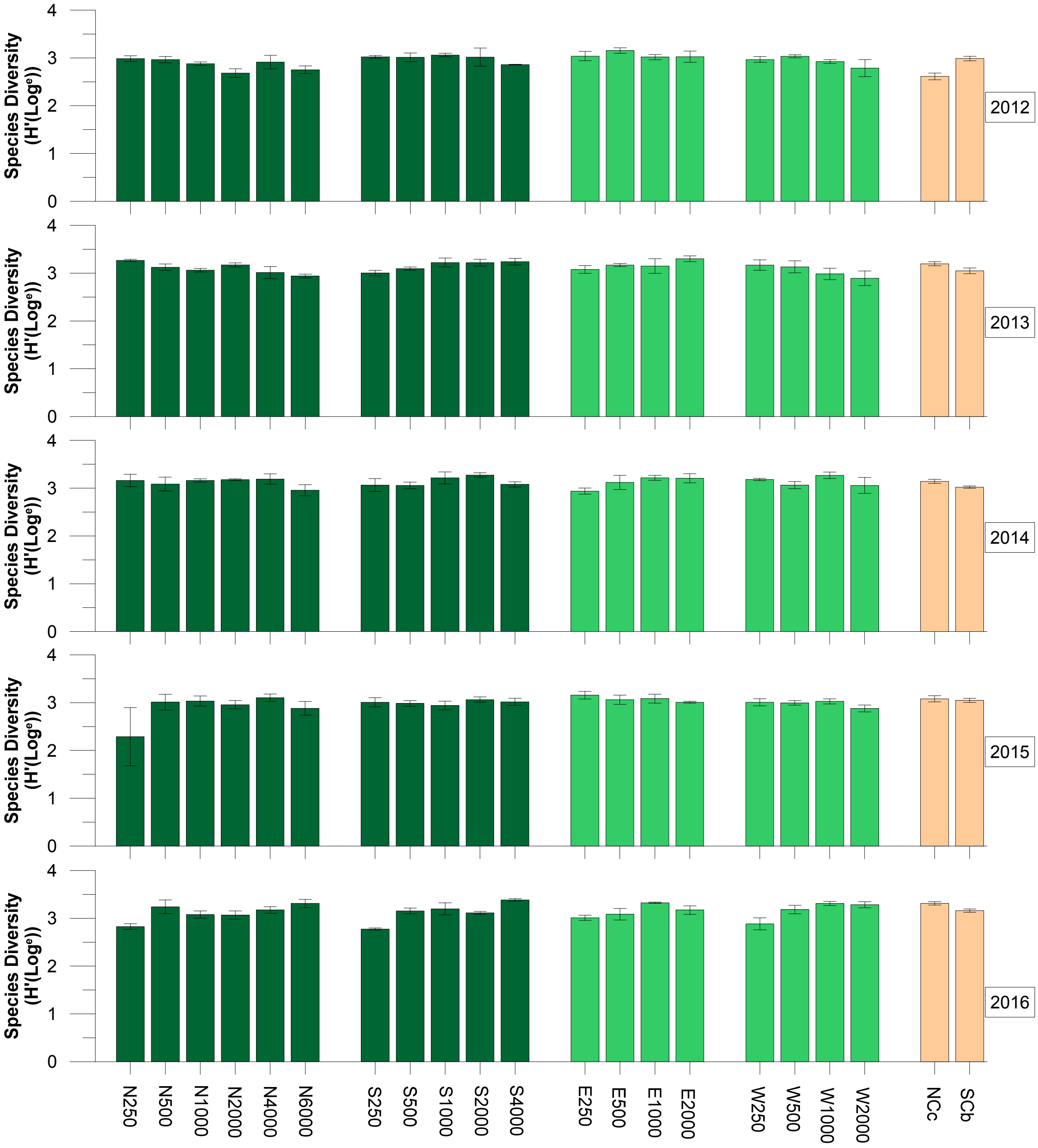
Note: *Values are means +/- 1 standard error. N=3 at MPA stations and N=9 at control stations.*

Figure 21 Mean values for total abundance at the MPA, north and south control sites during the 2012 - 2016 benthic ecological surveys.



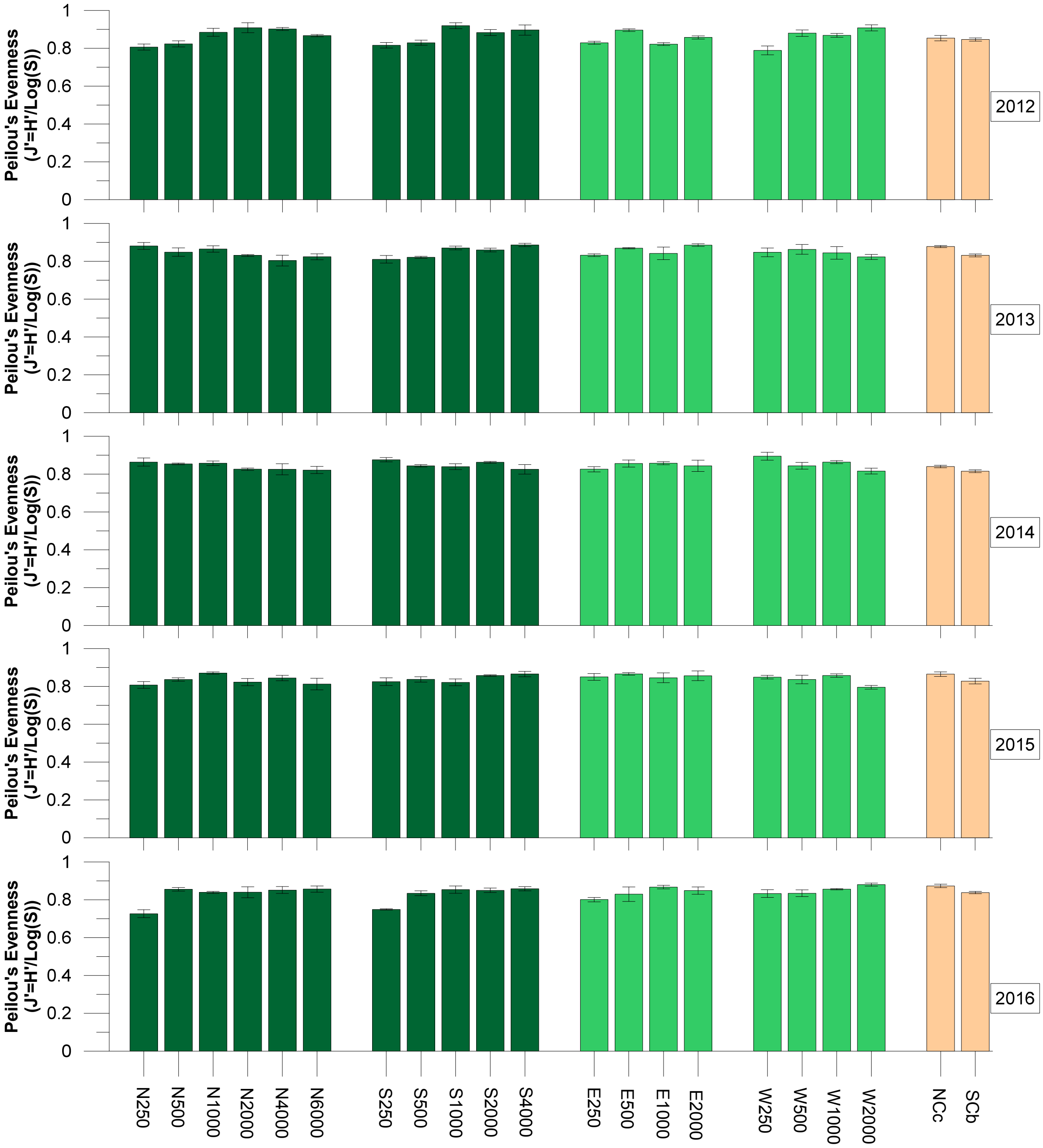
Note: *Values are means +/- 1 standard error. N=3 at MPA stations and N=9 at control stations.*

Figure 22 **Mean values for species diversity at the MPA, north and south control sites during the 2012 - 2016 benthic ecological surveys.**



Note: *Values are means +/- 1 standard error. N=3 at MPA stations and N=9 at control stations.*

Figure 23 **Mean values for Peilou's evenness at the MPA, north and south control sites during the 2012 - 2016 benthic ecological surveys.**



Note: *Values are means +/- 1 standard error. N=3 at MPA stations and N=9 at control stations.*

3.3.2 Community Analyses

MPA and control site infauna assemblage data from 2012 - 2016 was statistically investigated using non-metric multi-dimensional scaling (MDS) (**Figure 24** & **Figure 25**) and cluster analysis (**Figure 26**). Three MDS plots were produced: the first contained data from all years (2012 – 2016; **Figure 24**) whereas the second and the third plots contained data from 2013 – 2016 coded by site/year and distance respectively (**Figure 25 a & b**). The 2012 data was excluded from the second and third plots as the first plot identified that the 2012 data was much more variable than subsequent years' and masked the fine-scale differences occurring among later years. Previous MPA monitoring reports have attributed the differences between 2012 and subsequent years to an increase in taxonomic resolution after 2012, rather than natural variation or discharge effects.

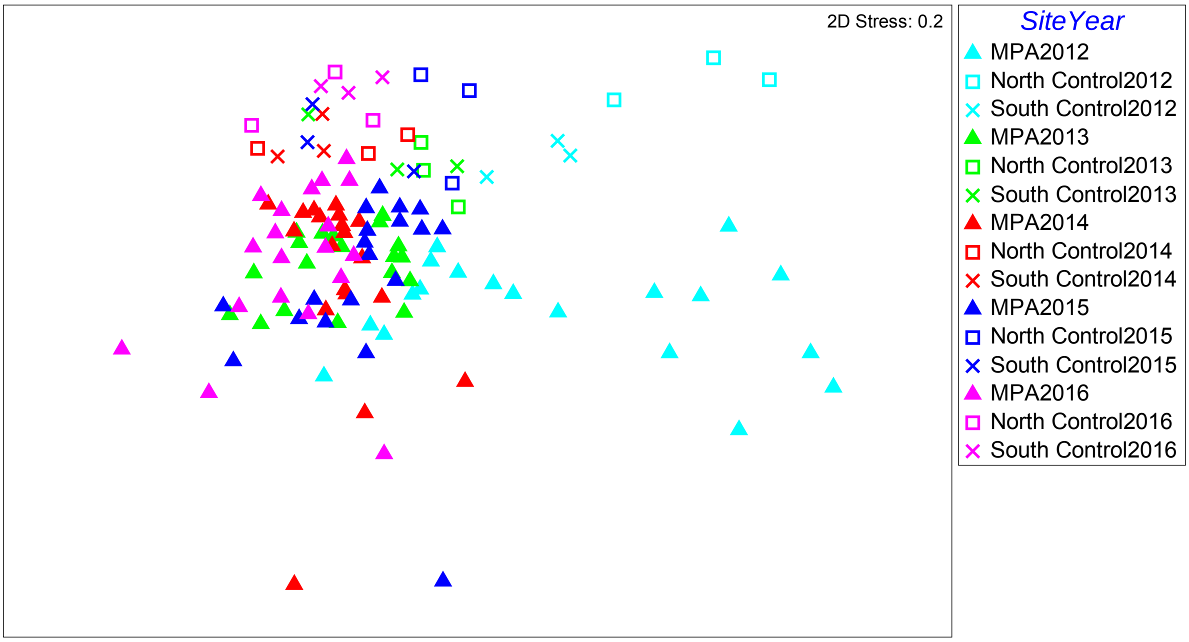
Distance on the MDS plot is relative and has no quantitative meaning; the idea is to visualise the data to get a sense of how near or far the points are from each other. Every MDS plot has an associated stress value which quantitatively reflects the difficulties involved with compressing the data into two dimensions. Where the best possible configuration in two dimensions produces a poor, highly distorted, representation of the data, the stress value will be high. The stress values of 0.2 – 0.21 (**Figure 24** & **Figure 25**) are moderately high and as such, indicate that the overall community differences may not be well represented by the two dimensional plot and that subtle trends may be missed or falsely identified. As such, apparent trends in the MDS plots must be interpreted with caution.

Figure 25a shows that the 2016 MPA infauna communities overlapped with the 2014 and 2015 communities and were fairly heterogeneous (i.e. the 2016 MPA data occupied a relatively large area on the plot indicating higher variability among stations). The 2014 and 2015 communities displayed a similar amount of heterogeneity as the 2016 communities; however, the 2013 community data was more homogenous and grouped more separately (although there was still some overlap with the 2014 MPA community).

Figure 25b shows that there was some clear grouping relating to distance. This was particularly evident with regards to the 250 m samples grouping (generally) together and separate from the other samples albeit with some overlap. The grouping of the 250 m samples was however variable (i.e. they occupied a large amount of space) and this likely reflects inter-annual variation. The plot indicates that overall, the 250 m communities were most similar to the 500 m communities and there was considerable overall similarity among the 1,000 – 6,000 m communities. It appeared that as distance increased, the MPA infauna communities graded towards become increasingly similar to the infauna communities found at the control sites. The MDS plots displayed no overall clear grouping according to 'transect' (i.e. north, east, south, west).

In general, the 2013 - 2016 control site communities grouped together and separately from the MPA communities. Variability was greater in communities from the replicate north control site stations, compared to those from the south control site.

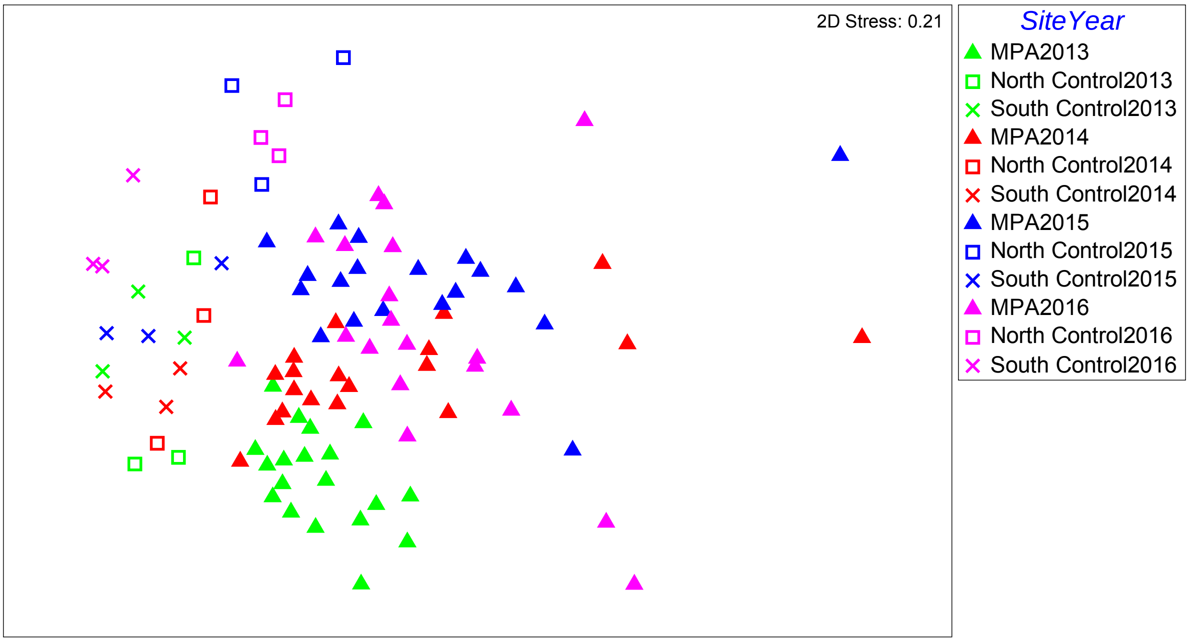
Figure 24 **MDS results of taxa sampled at MPA and the control sites from 2012 - 2016**



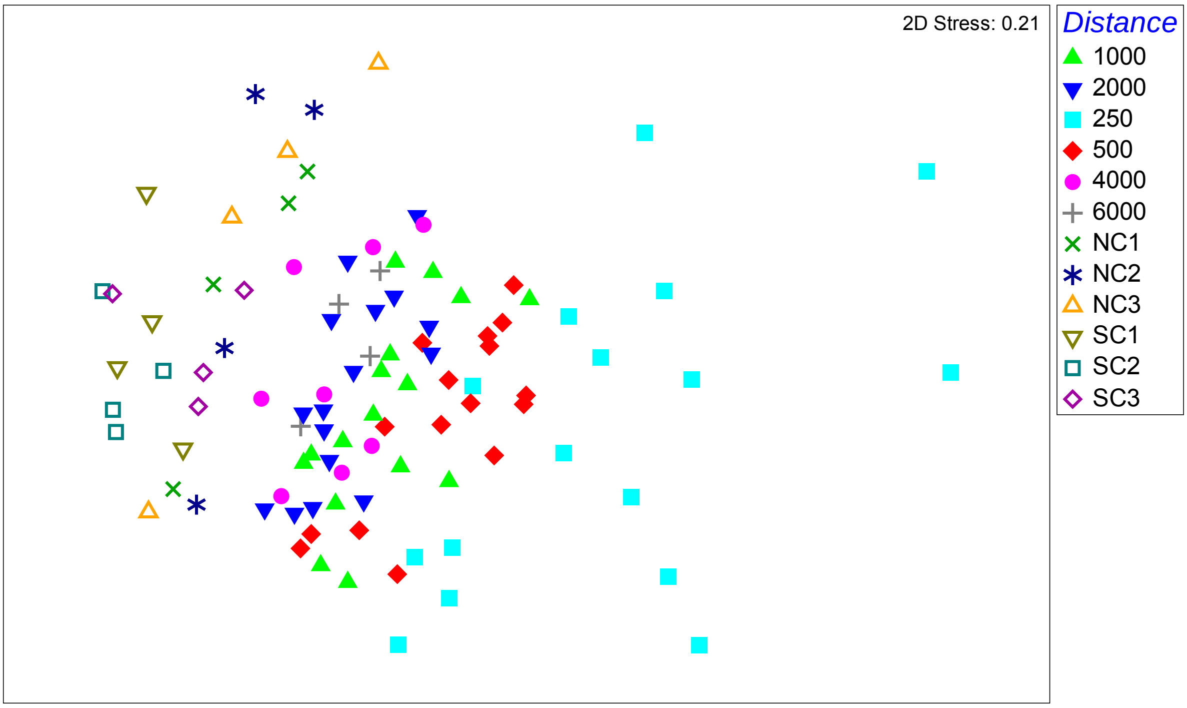
Note: *Distance among centroids (for each distance group at each site within each year). Ordinations are based on square-root transformed infauna data using Bray-Curtis similarities.*

Figure 25 **MDS results of taxa sampled at MPA and the control sites from 2013 – 2016 coded by site/year (A) and distance (B)**

A) Site/Year

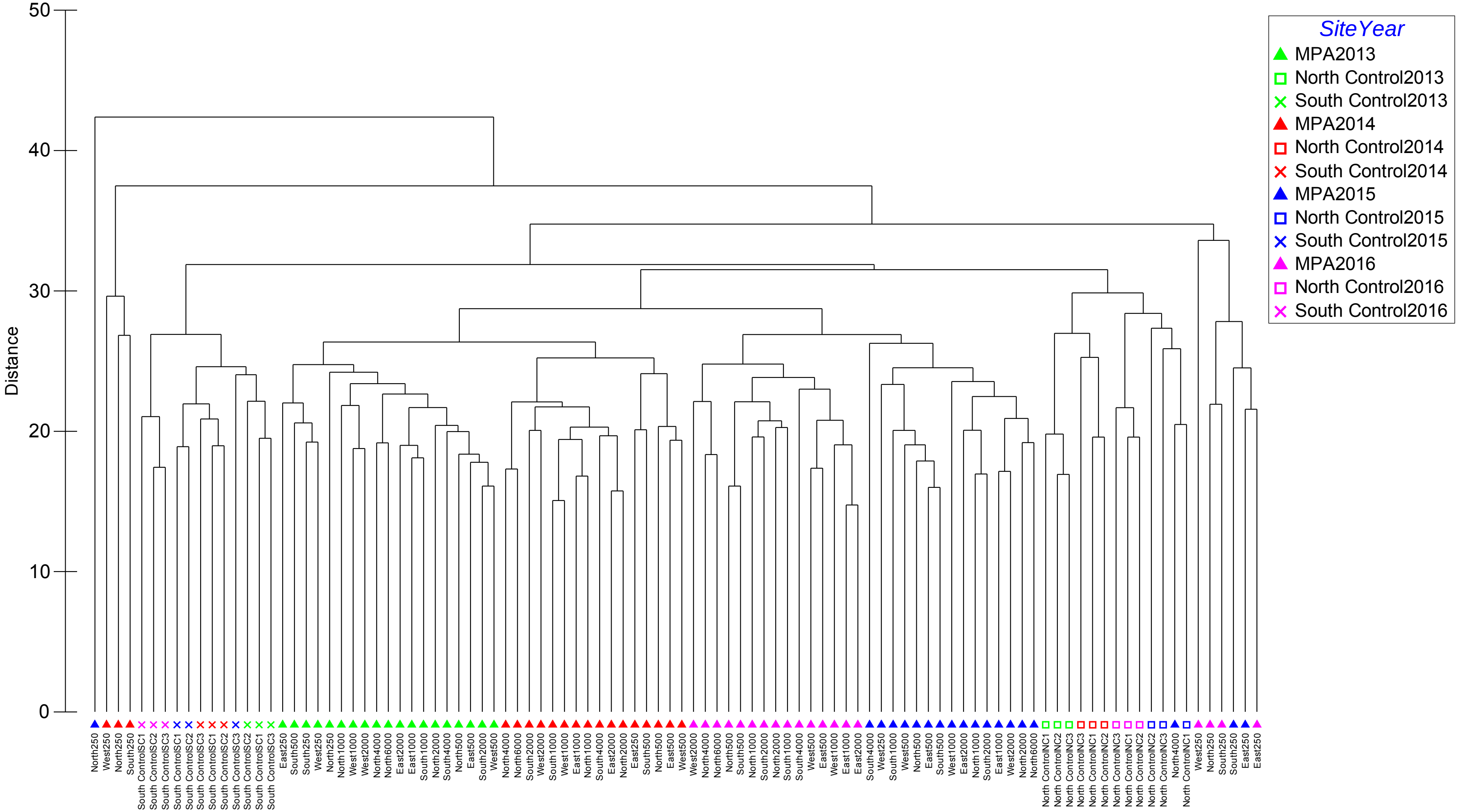


B) Distance



Note: *Distance among centroids (for each distance group at each site within each year). Calculated on the Bray-Curtis similarities of transformed (square root) data*

Figure 26 Cluster analyses performed on the post-drill macroinvertebrate samples from MPA and control sites from 2013 – 2016



Note: *Distance among centroids (for each distance group at each site within each year). Calculated on the Bray-Curtis similarities of transformed (square root) data.*

Two PERMANOVA (permutational multivariate analysis of variance) models were tested.

PERMANOVA 1

The first basic model tested for differences between site and year and found significant ($p<0.05$) differences between community composition across all years and sites, and a significant interaction term (**Table 7**) which indicated that the differences between sites varied across the years.

Pairwise comparisons showed that community composition for each year (2012 – 2016) was significantly different to each other year at (each of) MPA, north control and south control. In 2016, there were significant differences between the communities at MPA, South Control and North Control (this was consistent with previous years).

Table 7 PERMANOVA model testing for differences between site and year.

Source	df	MS	Pseudo-F	P(perm)
Site	2	11780	15.4	**0.0001**
Year	4	6593.9	8.6	**0.0001**
Site x Year	6	2375.5	3.1	**0.0001**

Note: *Significant ($p<0.05$) effects are shown in bold*

PERMANOVA 2

The second model tested for differences between Transect, Distance and Year at MPA; all individual and interaction terms were significant (**Table 8**). The significance of the three-way interaction term indicated that the structure of the communities changed with Distance but the changes varied between Transects and across Years.

With regards to the significant Distance effect, pairwise comparisons for the ‘Distance x Year’ interaction term showed significant differences between 10 out of the possible 15 distance combinations. Full results are provided in **Appendix J** and showed that communities at 250 m stations were significantly different to communities at all other distances/stations. In addition, communities at 500 m stations were significantly different to those at (250 m), 2,000 m and 4,000 m stations, and those at 1,000 m were significantly different to those at (250 m), 4,000 m and 6,000 m. Communities at 2,000 m and 4,000 m were also significantly different to each other.

The pairwise Transect x Year comparisons showed that significant differences occurred between the communities on all axes in 2016 with the exception of the north and south axes (**Appendix J**).

Table 8 PERMANOVA model testing for differences between transect, distance and year.

Source	df	MS	Pseudo-F	P(perm)
Transect	3	1488.9	2.4	**0.0001**
Distance	5	3221.1	5.2	**0.0001**
Year	4	8127.4	13.1	**0.0001**
Transect x Distance	10	1007.4	1.6	**0.0001**
Transect x Year	12	982.46	1.6	**0.0001**
Distance x Year	20	1407	2.3	**0.0001**
Transect x Distance x Year	40	815.07	1.3	**0.0001**

Note: *Significant ($p<0.05$) effects are shown in bold*

Simper Analysis

Taxa contributing most to the distinct differences observed between the assemblages among years and sites were analysed using SIMPER (similarity percentages) analysis. Average percentage dissimilarities among the MPA 2012 - 2016 communities, and the 2016 MPA and control communities are shown in **Table 9**. The 2016 MPA community was most similar to the 2013 MPA community and least similar to the 2012 MPA community although percentage dissimilarities between the 2016 and 2013 – 2015 communities were very similar. In 2016, the MPA community had 42.2% and 44.2% dissimilarity with the north and south control communities respectively.

Table 9 Average percentage dissimilarity among the 2012 - 2016 MPA communities and 2016 MPA and control communities.

Year	2012 MPA	2013 MPA	2014 MPA	2015 MPA	2016 NCc	2016 SCb
2016 MPA	49.05	40.19	40.71	40.33	42.19	44.16

Note: *Green shaded = most similar; Red shaded = least similar (most dissimilar)*

SIMPER comparisons of MPA assemblages in 2016 compared to those in 2012 – 2016, and of the 2016 MPA and control communities are provided in **Appendix K**.

Some observations are listed below and descriptions on the sensitives of taxa are included in italics where they are available/known. Note however that the responses of these taxa to oil/gas related discharges/disturbances may differ to their responses to nutrient/organic enrichment.

- Abundances of the polychaetes Paraonidae, *Spiophanes* sp., and *Armandia maculata*, as well as the bivalves *Nucinella maoriana* and *Varinucula gallinacea* were higher in 2016 than in previous years. While *Paraonidae* have been considered by some to be relatively indifferent to enrichment (Keeley *et al*., 2012), *Spiophanes* sp. have been observed to be tolerant to disturbances where excess organic matter enrichment occurs (Borja *et al*., 2000) and in one study were found to be at their maximum abundance in oil-contaminated sediments (Hiscock *et al*., 2004);
- The abundances of polychaetes from the family Cirratulidae were lower in 2016 than in 2013 – 2016. The presence of *Cirratulidae* can indicate poor environmental conditions (Simboura & Zenetos, 2002; Dean, 2008); however, there is variability among sources with regards to the sensitivity level of this family and this likely reflects differences at the species level;
- Cumaceans were more abundant in 2016 than in 2015, but less abundant than in 2014 and 2013;
- In 2016:
    - The polychaetes *A. maculata*, Lumbrineridae and *Capitellethus zeylanicus* were more abundant at MPA than at the north control site. Although there is little information available on *Capitellethus zeylanicus*, increased abundances of other capitellid taxa have been considered indicators of stressed benthic environments (Dean 2008);
    - The ostracod *Neonesidea* sp. had higher abundances at the north control site than at MPA (this was the taxa contributing most to the differences among these two sites);
    - The bivalves *N. maoriana* and *V. gallinacea* were more abundant MPA than the north control site;
    - The polychaetes Paraonidae, *A. maculata* and Cirratulidae were more abundant at MPA than at the south control site, whereas Maldanidae, *Onuphis aucklandensis* and *Agalophamus* sp. (also all polychaete taxa) were less abundant at MPA compared to at the south control site. *Maldanidae* are known to be sensitive to stressed/poor environmental conditions (Borja *et al*., 2000) and as such their decreased abundances at MPA compared to the control site is not unexpected; and
    - Brittle stars (Ophiuroidea) and gastropods (juveniles) were more abundant at the south control than at MPA.

Comparison of 2016 macrofauna assemblages along the different transects did not reveal any single taxa that disproportionately contributed to differences between the communities on the north, south, east and west axes.

4 KEY FINDINGS AND RECOMMENDATIONS

4.1 Sediment characteristics

The discharge of drilling waste (cuttings and used mud) has been linked to sediment oxygen depletion (anoxia). Although this effect has been observed following the use of WBM (Trannum *et al*, 2010), anoxia is primarily associated with the use of SBM on account of nutrient enrichment from synthetic components (Ellis *et al*., 2012). Despite both WBM and SBM (olefin based) being used during the MPA IRF Drilling Programme, visual analysis of sediment cores collected from MPA sampling stations during the 2016 annual production monitoring survey revealed no evidence of complete anoxia, although some darker patches of sediment and mild sulphide odours were observed in some samples collected closest to the platform.

Sediments from all but two of the replicate grab samples collected from MPA during the 2016 survey were found to contain some degree of anthropogenic debris. The highest abundances of debris, and the greatest variety of materials, were observed in samples collected closest to the platform (250 and 500 m stations). Control station sediment samples were found to contain some anthropogenic debris, but abundances were much lower than MPA samples and the small amounts of debris that were present came from just five of the nine samples collected at each control site.

Physical characteristics of the sediments at MPA remain similar to those found in previous surveys; being dominated by the finest size fractions – silt and clay. Distance related spatial trends in particle grain size were weaker in 2016 compared to previous post-drilling surveys, with residual effects of drilling appearing largely spatially constrained to within 500 m of MPA.

Although mean organic matter levels across MPA sites have remained somewhat higher during and after the IRF drilling programme, similar increases seen at the control stations during this time indicate that the increases may be due to wider regional effects rather than drilling. Similar to previous years the stations closest to the platform showed somewhat lower TOM levels, with a weak spatial gradient of increasing concentrations with distance. This trend is the opposite of the organic enrichment that has often been reported close to oil and gas facilities and/or drilling activities (Ellis *et al.*, 2012) and indicates that production and drilling discharges from MPA have not resulted in seabed enrichment at the site.

The majority of the metal/metalloid concentrations at MPA remained below the ANZECC (2000) ISQG-Low limits for possible biological effects, with the exception of nickel which for the first time exceeded ISQG-Low levels at two stations and was equal to this guideline level at a further two. However nickel concentrations had increased widely across MPA and the control sites, and concentrations at most sampling stations were approaching ISQG-Low levels. Elevated nickel levels approaching ANZECC guideline levels have been observed in sediment samples collected across the South Taranaki Bight since OTEMP monitoring began and likely reflect the deposition of nickel rich minerals in weathered sediments from nearby onshore catchments. Cadmium, Mercury and Zinc concentrations were all well below guideline levels at MPA stations, but stations closest to the platform (250-500 m) showed increased concentrations compared to 2015, particularly along the major flow axes. These metals also showed weak decreasing trends with distance from the platform, similar to previous surveys. The increased concentrations of zinc near the platform likely relates to the platform structure, where zinc anodes are used as corrosion inhibitors and historically zinc containing coatings were applied to the structures.

Barium concentrations at all stations, including controls, had increased in 2016 compared to 2015, with the largest increases noted at the N and S 250 m stations. The notable increase in barium at the N and S 250 m stations in 2016 was somewhat unexpected given there have been no further drilling activities occurring at MPA since the 2015 survey, and perhaps result from bioturbation bringing partially buried drilling-related materials to the seabed surface where they can be moved by near seabed currents. A strong spatial gradient of decreasing barium levels with distance from the platform continues to show the presence of drilling related discharges surrounding MPA.

Detectable concentrations of PAHs were found at 15 of the 19 MPA sampling stations, and two of the three northern control site stations in 2016, with the greatest numbers of PAH compounds being detected in samples collected close to the platform. While total concentrations were well below the ANZECC (2000) ISQG-Low guideline levels, Acenaphthlene concentrations at the N250 station were above the individual ISQG-Low guideline level for this compound. Total Petroleum Hydrocarbons were below analytical detection limits at all but one station in 2016 (S250), with concentrations at this site being below the ISQG-Low guideline. The number of stations with detectable TPH levels and the concentrations detected at these stations continues to decrease.

4.2 Faunal characteristics

Benthic video footage showed a relatively healthy seabed environment surrounding MPA with epifauna organisms, small fish and evidence of infauna communities (mounds, feeding hollows, worm tubes, tracks etc.) observed in all tows. No notable areas or signs of physical disturbance were observed on/in the seabed in 2016, although footage from the N100 station possibly showed some evidence of fine sediment deposition or movement.

In 2016, 148 benthic taxa were identified in the samples collected at MPA and the control sites, with infauna communities' at all three sites being numerically dominated by polychaete worms. The communities identified were similar to those reported during the previous surveys and are typical of offshore benthic communities in the Taranaki Bight. Nine of the top ten most abundant taxa at MPA were also in the ten most abundant taxa at one or both control sites, indicating some relative degree of similarity between the assemblages. At MPA seven of the top ten taxa were polychaete worms, particularly deposit feeders, and the remaining three comprised two bivalve taxa and brittle stars (Ophiuroids).

Univariate macrofauna indices showed that in 2016 the mean number of taxa at all MPA station (with the exception of W250) had increased since 2015, with a number of stations (such as N250, N6000 and S4000) found to have the highest numbers of taxa per sample since monitoring began in 2012. Total abundances of infauna at MPA have been relatively variable between years, with a lack of consistent trends or abundances across years. In 2016, total abundance had increased markedly at the N250 and S4000 stations compared to 2015, and there was a considerable decrease in total abundance between 250 and 500 m stations on the north, south and eastern transects (north in particular). The W250 station has shown a noticeable and ongoing depression in the number of taxa and overall infauna abundances following the completion of drilling at the MPA site, with no obvious sign of recovery towards pre-drill characteristics at this station. Diversity indices and evenness values in 2016 showed MPA to have a moderately diverse infauna community which was not numerically dominated by any particular taxa or group, and indices values were similar to the control sites, and to previous surveys. Diversity index values at MPA were relatively similar to previous years although values had decreased somewhat at the 250 m stations compared to 2015. Evenness was largely similar across MPA sites and comparable with controls, with the exception of the 250 m station from the north, south and to a lesser extent east stations, where evenness was lower.

Multivariate analysis of infauna community structure showed that there were significant differences in the infauna communities between stations close to MPA (250 and 500 m) and both more distant stations and controls. Community structure was also seen to vary significantly across years, and between transects, although the effect of 'transect' appeared to be acting at a smaller scale than 'distance' or 'year'. MPA infauna communities showed significant differences to those observed at the control stations in 2016, similar to what has been observed during earlier surveys.

4.3 Recommendations

The 2016 annual production monitoring survey showed that changes to the physical and biological characteristics of the benthic environment from the previous drilling activities and ongoing production activities at MPA, remain detectable. The majority of effects were observed within around 500 m of MPA, while stations beyond this remained relatively similar to each other. It is recommended that annual production monitoring surveys at MPA should continue to be undertaken in 2017 as required by Marine Consent conditions.

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Appendix A – Sample location and field observations for benthic grab samples collected at Maui-A and Control Site sampling stations in March 2016

Station	Date	Time	Depth	Grab 1		Grab 2		Grab 3		Notes
				Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	
S4000	28.03.16	0742	108M	39° 35' 27.14"S	173° 26' 57.93"E	39° 35' 27.38"S	173° 26' 58.49"E	39° 35' 27.79"S	173° 26' 58.24"E	Cohesive light brown/tan coloured mud sediments, sample 'C' particularly 'sticky'.
S2000	28.03.16	0804	108M	39° 34' 22.50"S	173° 26' 57.98"E	39° 34' 22.34"S	173° 26' 58.19"E	39° 34' 22.06"S	173° 26' 58.27"E	Cohesive light brown/tan coloured mud
S1000	28.03.16	0819	109M	39° 33' 49.54"S	173° 26' 56.88"E	39° 33' 49.97"S	173° 26' 56.74"E	39° 33' 50.08"S	173° 26' 56.90"E	Cohesive light brown/tan coloured mud, but slightly softer than 200 and 400 stations.
S500	28.03.16	0846	109M	39° 33' 33.82"S	173° 26' 57.65"E	39° 33' 34.12"S	173° 26' 57.72"E	39° 33' 34.30"S	173° 26' 57.54"E	Cohesive light brown/tan muds, similar consistency to S500 station. 0835 waiting for permission to enter 500m zone to begin grab sampling
S250	28.03.16	0908	110M	39° 33' 25.90"S	173° 26' 57.39"E	39° 33' 25.57"S	173° 26' 57.66"E	39° 33' 25.54"S	173° 26' 58.03"E	Two missed grabs on sample 'A' initially. Grey to dark-grey to black coloured streaks and patched in light grey mud sediments with mild to moderate hydrogen sulphide odour but no distinct aRPD layer, lots of drill cuttings from fine to medium size and garnet particles visible.
W250	28.03.16	0927	110M	39° 33' 16.43"S	173° 26' 46.05"E	39° 33' 16.78"S	173° 26' 45.97"E	39° 33' 16.43"S	173° 26' 45.20"E	Soft light-grey to light-brown mud sediments, with upper layer of sediment more light brown, deeper light grey. Fine drill cuttings materials in sample 'A' and missed grab sample initially on sample 'B'.
W500	28.03.16	0945	110M	39° 33' 16.91"S	173° 26' 35.21"E	39° 33' 16.61"S	173° 26' 34.79"E	39° 33' 16.39"S	173° 26' 34.92"E	Light-brown/tan coloured mud, somewhat more cohesive than 500m station.
W2000	28.03.16	1030	111M	39° 33' 16.85"S	173° 25' 32.91"E	39° 33' 16.77"S	173° 25' 32.49"E	39° 33' 16.47"S	173° 25' 32.41"E	Light-brown cohesive mud/clay, missed grab on sample 'A' initially.
W1000	28.03.16	1055	111M	39° 33' 16.76"S	173° 26' 13.93"E	39° 33' 16.83"S	173° 26' 13.53"E	39° 33' 17.13"S	173° 26' 13.57"E	Cohesive light brown/tan coloured mud
N500	28.03.16	1118	110M	39° 32' 58.39"S	173° 26' 58.10"E	39° 32' 58.58"S	173° 26' 57.89"E	39° 32' 58.79"S	173° 26' 57.84"E	Missed grab on sample 'A' and 'C' initially. Soft grey mud with upper layer (~20 to 30mm) of lighter brown coloured sediments, some darker streaks in sediment cores from 'A' and 'B'. Sample 'B' was softest of the three and contained fine cuttings, lots of broken shell material in sample 'C'.

N250	28.03.16	1137	110M	39° 33' 07.23"S 173° 26' 57.61"E	39° 33' 06.85"S 173° 26' 58.28"E	39° 33' 07.45"S 173° 26' 58.09"E	Light-grey to light-brown mud sediments with darker grey to black streaks/patches and a 'grainy' texture. No odours present.
E250	28.03.16	1153	109M	39° 33' 15.49"S 173° 27' 09.17"E	39° 33' 15.79"S 173° 27' 08.83"E	39° 33' 16.09"S 173° 27' 09.33"E	Light-brown/light grey soft mud with very grainy texture and fine cuttings present in all samples, darker streaks/patches were visible in core samples.
E500	28.03.16	1208	111M	39° 33' 17.35"S 173° 27' 20.07"E	39° 33' 17.25"S 173° 27' 20.27"E	39° 33' 16.79"S 173° 27' 20.16"E	Light-brown/light grey mud with some slightly greyer streaks visible deeper in the sediment cores.
E2000	28.03.16	1254	110M	39° 33' 16.91"S 173° 28' 22.77"E	39° 33' 16.90"S 173° 28' 23.07"E	39° 33' 16.89"S 173° 28' 23.23"E	Light-brown cohesive mud
E1000	28.03.16	1310	110M	39° 33' 16.38"S 173° 27' 41.41"E	39° 33' 16.28"S 173° 27' 41.81"E	39° 33' 16.60"S 173° 27' 42.00"E	Light-brown cohesive mud
N1000	28.03.16	1329	111M	39° 32' 42.06"S 173° 26' 57.64"E	39° 32' 41.93"S 173° 26' 57.52"E	39° 32' 41.66"S 173° 26' 57.46"E	Light-brown cohesive mud sediments, grading slightly to light grey deeper in cores.
N2000	28.03.16	1346	111M	39° 32' 10.24"S 173° 26' 57.36"E	39° 32' 10.55"S 173° 26' 57.21"E	39° 32' 10.60"S 173° 26' 57.48"E	Light-brown cohesive mud sediments, grading slightly to light grey deeper in cores.
N4000	28.03.16	1415	112M	39° 31' 05.23"S 173° 26' 57.72"E	39° 31' 05.00"S 173° 26' 57.83"E	39° 31' 04.89"S 173° 26' 57.37"E	Grab sample 'A' missed twice initially, light-brown cohesive mud sediments, but sample 'C' had a 'sandier' consistency. Sample 'B' showed some darker grey sediments at the bottom of one core.
N6000	28.03.16	1435	112M	39° 30' 00.52"S 173° 26' 57.45"E	39° 30' 00.21"S 173° 26' 57.52"E	39° 30' 00.08"S 173° 26' 57.94"E	Somewhat softer light brown muddy sediments.
Control Stations							
NCc5	28/3/16	1527	115m	39° 25' 25.16"S 173° 27' 29.39"E	39° 25' 24.91"S 173° 27' 29.67"E	39° 25' 24.71"S 173° 27' 29.67"E	Light-brown/tan coloured mud sediment with a slightly 'sandy' texture to it, particularly in sample 'C'. Missed grab on sample 'A' initially.
NCc7	28/3/16	1546	115m	39° 25' 21.71"S 173° 27' 14.88"E	39° 25' 21.55"S 173° 27' 14.84"E	39° 25' 21.29"S 173° 27' 14.91"E	Softer light-brow/tan coloured mud with some sandy material, sample 'B' somewhat softer than other replicates. Sample 'C' was re-grabbed as first attempt the sampler opened prematurely on deck and part of sample was lost – so was rejected.
NCc25	28/3/16	1606	115m	39° 25' 11.16"S 173° 27' 28.17"E	39° 25' 11.17"S 173° 27' 28.04E	39° 25' 11.42"S 173° 27' 27.90"E	Light-brown/tan coloured sandy mud sediment.
SCb2	29/3/16	1154	111m	39° 48' 13.20"S 173° 12' 57.07"E	39° 48' 12.97"S 173° 12' 56.96"E	39° 48' 12.85"S 173° 12' 57.27"E	Light-grey/light tan colour mud sediment, sample 'A' was notably softer than the other samples while sample 'B' was slightly softer in the surface layers.

SCb5	29/3/16	1138	111m	39° 48' 11.84"S 173° 13' 12.39"E	39° 48' 11.63"S 173° 13' 12.24"E	39° 48' 11.66"S 173° 13' 11.76"E	Light-grey/light tan coloured mud sediments
SCb10	29/3/16	1209	111m	39° 48' 07.64"S 173° 13' 12.99"E	39° 48' 07.61"S 173° 13' 13.16"E	39° 48' 08.20"S 173° 13' 13.04"E	Light-grey/light tan coloured mud, sample ‘A’ was particularly cohesive mud and slow to sieve.

Appendix B - SAMPLE DATE, TIME, DEPTH, LOCATION AND FIELD OBSERVATIONS FOR VIDEO SLED TOWS COMPLETED AT MAUI-A AND CONTROL SITES IN MARCH 2016.

Report Number 740.10041.00100

Station	Date	Start Time	End Time	Depth (m)	Start Position		End Position		Notes
					NZMG-E	NZMG-N	NZMG-E	NZMG-N	
MPA S4000	30/3/16	1503	1510	108.2m	2548969	6179079	2548800	6179165	Soft mud seabed, animal burrows common, worm tubes extending several mm from sediment, small whelks and whelk tracks,
MPA S2000	30/3/16	1527	1534	109.4m	2548651	6181243	2548470	6181342	Soft mud, easily disturbed, fast drift rate as sou-east wind picking up and slowing drift with vessel results in sled sitting in its own disturbed sediment shadow. , animal burrows common and small worm tubes is sediment, small whelks present.
MPA S1000	30/3/16	1547	1555	109.6m	2548788	6182176	2548588	6182272	Muddy seabed, animal burrows and protruding worm tubes common. Small whelks common, particularly through the middle area of the tow, unid. Small fish,
MPA N1000	30/3/16	1613	1621	110.4	2548721	6184250	2548561	6184372	Soft muddy sediment but appeared to have somewhat lower numbers of animal burrows than other stations already surveyed, although still lots of worm tubes present. Mussel?? Small whelks, tusk shell on seabed, small patches along the tow where there definitely appeared to be less animal burrows and possible signs of fine sediment deposition. Some larger animal burrows present or smaller feeding holes, small unid. fish,
MPA N2000	30/3/16	1633	1638	110.9	2548724	6185288	2548603	6185360	Soft mud seabed with animal burrows common (less patchy than at N1000), small whelks and whelk tracks.
MPA N4000	30/3/16	1651	1656	111.3	2548707	6187310	2548569	6187377	Soft mud seabed, very similar to N2000, animal burrows and worm tubes common (less patchy than at N1000), small whelk,
MPA N6000	30/3/16	1712	1717	112.3	2548750	6189273	2548599	6189375	Mud seabed, easily stirred up (soft), worm tubes and animal burrows common, mound/hollow feeding feature observed.

CONTROL STATIONS

Station	Date	Start Time	End Time	Depth (m)	Start Position		End Position		Notes
					NZTM E	NZTM N	NZTM E	NZTM N	
NCc7 to NCc5	28/3/16	1627	1657	116m	2549030	6198010	2549433	6197859	Slow drift SW to NE direction. Soft mud seabed, animal burrows abundant, along worm tubes common, small whelks and whelk tracks, small flatfish, seapens, Mound/hollow feeding features occasional, small unid. fish, area of scattered small sediment chunks on seabed near end of transect likely remnants of grab sampling, hermit crab. .
SCb5 to SCb10	30/3/16	1926	1936	112m	2528739	6155946	2528818	6155717	Soft mud, animal burrows common-abundant, but not as many as NCc, worm tubes extending several mm from sediemnt, small sponge, juv. Gurnard, small unid. fish, small whelks, occasional mound/hollow features.

Appendix C - Sediment core photographs from MPA and Control stations taken in March 2016

Report Number 740.10041.00100


MPA_E1000A.JPG


MPA_E1000B.JPG


MPA_E1000C.JPG


MPA_E2000A.JPG


MPA_E2000B.JPG


MPA_E2000C.JPG


MPA_E250A.JPG


MPA_E250B.JPG


MPA_E250C.JPG


MPA_E500.JPG


MPA_E500B.JPG


MPA_E500C.JPG


MPA_N1000A.JPG


MPA_N1000B.JPG


MPA_N1000C.JPG


MPA_N2000A.JPG


MPA_N2000B.JPG


MPA_N2000C.JPG


MPA_N250A.JPG


MPA_N250B.JPG


MPA_N250C.JPG


MPA_N4000A.JPG


MPA_N4000B.JPG


MPA_N4000C.JPG


MPA_N500A.JPG


MPA_N500B.JPG


MPA_N500C.JPG


MPA_N6000A.JPG


MPA_N6000B.JPG


MPA_N6000C.JPG


MPA_S1000A.JPG


MPA_S1000B.JPG


MPA_S1000C.JPG


MPA_S2000A.JPG


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MPA_S250A.JPG


MPA_S250B.JPG


MPA_S250C.JPG


MPA_S4000A.JPG


MPA_S4000B.JPG


MPA_S4000C.JPG


MPA_S500A.JPG


MPA_S500B.JPG


MPA_S500C.JPG


MPA_W1000A.JPG


MPA_W1000B.JPG


MPA_W1000C.JPG


MPA_W2000A.JPG


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MPA_W250A.JPG


MPA_W250B.JPG


MPA_W250C.JPG


MPA_W500A.JPG


MPA_W500B.JPG


MPA_W500C.JPG


NCc25 A.JPG


NCc25 B.JPG


NCc25 C.JPG


NCc5 A.JPG


NCc5 B.JPG


NCc5 C.JPG


NCc7 A.JPG


NCc7 B.JPG


NCc7 C.JPG


SCb10A.JPG


SCb10B.JPG


SCb10C.JPG


SCb2A.JPG


SCb2B.JPG


SCb2C.JPG


SCb5A.jpg


SCb5B.jpg


SCb5C.JPG

Appendix D - OBSERVATIONS OF DEBRIS IN SEDIMENT SAMPLES. TABLE DISPLAYS ONLY THE REPLICATE SAMPLES THAT WERE FOUND TO CONTAIN INCIDENTAL MATERIALS. VA= VERY ABUNDANT (>50), A=ABUNDANT (50+), C= COMMON (20–50), O=OCCASIONAL (10–20), L=LOW (0–10).

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Red/White/Grey																		L																																																									
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Other																																																																											
Black 'foam'					L															L										L						L																																							
Black nylon									L		L																																																																
Black rubber																																			L						L	L				L	L	L	L	L				L																					
Black tape																														L																																												
Blue/white plastic																			L																							L																																	
Blue 'gum'																			L	L																																																					
Blue nylon						L					L																																																															
Blue plastic		L	L												L	L			L							L									L											L										L									L									
Blue string	L																																																																										
Brown/neutral fabric		L	L																																																																								
Cable tie			L																																																																								
Coal	C	A	A	C	O	O	L	L	O					L	O			L	A	A	A	C	A	C	L	O	L	L	L	L	L			A		L		L	C	L			L			O	O	O	L			L	L																						
Drill cuttings - grey sandstone	C	C	C	O		L														C	C		C								L			C																																									
Drilling mud/gel	VA	VA	VA	A	A	A	L	O	O										VA	VA	VA	A	A	A	C	C	C	L			L	L		VA	L				L				L			L	C	O																											
Flat metal																																						L																																							
Garnet	VA	VA	VA	L	C		L	L	O		L		L						VA	VA	VA	C	O	O	L	L	L	O	L		L	L		VA	C	C	L	L	O	L	L					O	O	O	L	L		L			L	L	L																		
Graphite	L	C		L	O	O	L	L			L		L									L	L	O	L		L	L	L	L	L				L	L			O	L			L				L																												
Green nylon																									L										L			L	L												L																							
Green plastic			L																L	L						L						L			L	L		L		L			L				L																		L									
Green tape/fabric					L																																																																					
Grey 'foam'																											L			L																													L															
Grey plastic																						L																																																				
Gum'																					L																																																						
Orange plastic		L																	L																																																						
Orange string																																				L									L																														
Red balls'																																																				A	O	L																					
Red nylon																																			L																																								
Red string																																																	L																										
Rust	VA	VA	VA	A	C		O	O	O	O			L	L	L		L		A	A	A	A	A	A	L	L		L	L	L	L			A	A	A	A	C	O	O	C	O	L			A	A	A	C	L	L	L	L	L		L	L			L		L									L	L	L		
Silver tape/fabric		L	L																																																																								
String																			L																																																						
Tar																			C		L																		L																																				
Unkown gum-like substance (pink)												L																																																														
Welding ball	O	C	C	L	L	L				L				L	L		L	L	O	C	C	L	L		L	L	L								L	L		L	L							O	O	L	L																							L		L
Welding material	O		L	L	O	O	L		L		L		L	L	L			L	L	L	L	L		L						L					L	L		L								L	L																									L		
White fabric					L																																																																					
White plastic					L														L	L																																																						
White string																																									L	L																																	
Yellow plastic																			L																L																																								

Appendix E - TOTAL ORGANIC MATTER (TOM) CONTENT (PERCENTAGE VIA ASH-FREE DRY WEIGHT) AND PARTICLE GRAINSIZE DISTRIBUTION PERCENTAGES FOR REPLICATE SAMPLES.

Report Number 740.10041.00100

Replicate sample	TOM (%)	Gravel (%)	Very coarse sand (%)	Coarse sand (%)	Medium sand (%)	Fine sand (%)	Very fine sand (%)	Silt & clay (mud) (%)
N250a	7.7	0.5	0.9	1.3	7.5	12.5	9.7	67.6
N250b	7.5	0.3	0.8	0.9	6	10.8	10.5	70.8
N250c	7.9	1.3	0.7	1	5	7.5	9.8	74.7
N500a	8.1	< 0.1	1.7	1.7	4.2	4.7	6.8	80.8
N500b	8.4	< 0.1	1	0.6	6.8	3.7	4.9	83
N500c	8.1	< 0.1	1.1	0.8	3.2	7.1	6.1	81.8
N1000a	7.8	0.3	0.6	0.6	3.1	6.2	9.6	79.6
N1000b	8	< 0.1	0.7	0.4	2	3.4	7.6	86
N1000c	8.1	< 0.1	0.8	0.6	2.4	5.8	7	83.4
N2000a	8.5	0.1	2.3	1.2	1.9	4.1	4.8	85.7
N2000b	8.6	0.3	1.6	1	3.5	4.7	4.4	84.5
N2000c	8.8	0.5	2.3	1.1	2.5	5.8	5.3	82.3
N4000a	8.8	< 0.1	2.5	1.1	3	4.6	5.1	83.7
N4000b	8.8	< 0.1	2.3	1.3	4	6.2	5.3	81
N4000c	8.8	0.1	1.8	1	3	5	5.3	83.7
N6000a	8.8	0.8	0.8	0.6	2.8	7.7	4.5	82.8
N6000b	8.8	0.4	0.8	0.6	3.3	7.3	3.8	83.8
N6000c	8.8	0.8	1.1	0.9	2.9	6.7	5.3	82.4
S250a	7.7	0.7	1.2	0.9	4.6	8	6.8	77.9
S250b	6.7	< 0.1	1.5	1	5.1	9.6	8.2	74.6
S250c	6.9	< 0.1	0.9	1	6.4	10.4	7	74.2
S500a	8.2	0.4	0.7	1.2	5.8	9.1	7.6	75.3
S500b	8	0.2	1.5	2.1	6.2	6.7	8.7	74.6
S500c	7.9	0.3	1	0.9	5.6	6	6.9	79.3
S1000a	8.2	< 0.1	0.7	1	5.9	6.3	6.4	79.5
S1000b	8.3	0.4	0.4	1.3	1.2	6.1	7.6	82.9
S1000c	8.1	0.4	0.3	1.2	3.8	5.3	7.1	81.9
S2000a	8.2	0.6	0.3	1.1	4.3	9.6	6.9	77.2
S2000b	8.1	0.2	1.4	1.1	3.3	5	7.3	81.7
S2000c	8.2	0.4	0.4	1	4.3	7.2	6.8	79.9
S4000a	8.2	0.5	1.1	0.8	2.4	9.9	6.9	78.3
S4000b	8.3	0.2	1.2	1.1	3.8	7.7	6.9	79.1
S4000c	8.1	0.2	1.1	0.9	3.3	5	9.4	80.2
E250a	7.8	< 0.1	0.3	1.6	4	7.4	8.3	78.3
E250b	7.7	0.4	1.5	0.8	4.8	5.1	8.8	78.6
E250c	7.9	0.1	1.5	0.7	3.1	6.4	7.7	80.4
E500a	8.4	< 0.1	1.1	0.8	5.8	6.9	9.3	76.2
E500b	8.2	0.4	1.3	1.2	3.7	5.3	7.6	80.5

Appendix E - TOTAL ORGANIC MATTER (TOM) CONTENT (PERCENTAGE VIA ASH-FREE DRY WEIGHT) AND PARTICLE GRAINSIZE DISTRIBUTION PERCENTAGES FOR REPLICATE SAMPLES.

Replicate sample	TOM (%)	Gravel (%)	Very coarse sand (%)	Coarse sand (%)	Medium sand (%)	Fine sand (%)	Very fine sand (%)	Silt & clay (mud) (%)
E500c	8.2	< 0.1	0.6	0.5	2.3	3.3	6.7	86.6
E1000a	8.3	0.3	0.9	0.5	3	5	6.3	84
E1000b	7.9	0.4	0.9	0.6	2.9	4.8	6.3	84.1
E1000c	8.4	< 0.1	1.8	1.2	3.9	6.5	7	79.7
E2000a	8.2	0.7	1.2	0.5	4	6	6.5	81.2
E2000b	8	< 0.1	1.5	0.8	2.7	5.8	6.2	82.9
E2000c	8.5	1.6	1.3	1.2	3.4	6.9	7.3	78.2
W250a	7.5	4.2	1.6	0.9	3.7	6.7	7.2	75.7
W250b	8.1	0.6	1.2	1.1	4	7.1	8	78.1
W250c	7.5	< 0.1	2.2	1.3	4.7	8.4	9.5	73.9
W500a	8.2	< 0.1	0.6	0.5	2.3	5	6.1	85.5
W500b	8.5	< 0.1	2.7	1.5	3.5	5.3	6.6	80.5
W500c	8.3	0.6	0.8	0.4	2.1	5.4	6	84.6
W1000a	8.4	0.3	0.8	0.3	1.9	4.3	5.5	86.9
W1000b	8.2	1	1.1	0.3	2.7	4.5	5.2	85.3
W1000c	8.4	< 0.1	1.5	1.1	3.2	5.8	6.8	81.6
W2000a	8.7	0.2	1.8	1	6.2	6	6.9	77.9
W2000b	8.7	1.3	1	0.7	2.3	4	6.2	84.5
W2000c	8.8	0.5	1	0.5	2.8	4.1	5.3	85.9
NCc5a	8.8	1.8	0.3	0.5	3.3	5.8	5.7	82.6
NCc5b	8.8	1.1	0.3	0.4	4	6.1	4.6	83.7
NCc5c	8.8	1	1.3	1	4.5	6	4.3	81.9
NCc7a	9	< 0.1	1.6	1.2	4.7	6.9	4.5	81.2
NCc7b	9	< 0.1	1.6	1.5	4.4	5.6	4.7	82.2
NCc7c	9.1	< 0.1	1.3	0.9	3.9	6.4	4.4	83.1
NCc25a	9	< 0.1	1.6	1.2	4.1	5.8	5.4	81.9
NCc25b	8.9	< 0.1	1.4	0.8	5.7	6.1	4.6	81.4
NCc25c	8.9	0.4	1.4	0.9	2.9	4.9	4.4	85.2
SCb2a	7.1	0.3	0.4	0.3	1.1	2.5	7	88.4
SCb2b	7.1	< 0.1	0.7	0.4	1.2	2.4	7	88.3
SCb2c	7	0.4	1.1	0.5	1.3	2.7	7.1	86.8
SCb5a	6.9	< 0.1	0.3	0.2	1.3	4.3	7.4	86.5
SCb5b	6.8	0.3	0.8	0.5	1.5	4	7.7	85.1
SCb5c	6.9	< 0.1	0.3	0.2	1.7	3.9	7.3	86.5
SCb10a	6.9	< 0.1	0.5	0.3	1.6	3	7.4	87.2
SCb10b	7	0.3	0.4	0.6	2.1	3.2	6.9	86.5
SCb10c	6.6	0.2	0.4	0.3	1.2	2.2	7.1	88.7

Appendix F - METAL CONCENTRATIONS (MG/KG OF DRY SEDIMENT) IN SEDIMENTS COLLECTED AT THE MAUI-A AND CONTROL SITES IN MARCH 2016. SAMPLES ARE COMPOSITES FROM ALL THREE REPLICATE GRABS COLLECTED AT EACH STATION.

Report Number 740.10041.00100

Station	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)
MPA-N250	3	660	0.077	24	10	27000	12.4	300	0.04	17	92
MPA-N500	5	137	0.052	24	9	29000	13.8	330	0.039	18	63
MPA-N1000	4	69	0.041	24	9	26000	12.5	300	0.026	19	62
MPA-N2000	4	75	0.055	26	10	28000	12.1	320	0.034	20	66
MPA-N4000	4	37	0.06	26	10	28000	13.2	320	0.023	22	70
MPA-N6000	3	30	0.054	25	11	28000	13.8	310	0.02	20	64
MPA-S250	5	840	0.127	27	11	28000	13.7	300	0.023	21	127
MPA-S500	4	220	0.062	23	10	26000	13.4	290	0.033	19	70
MPA-S1000	3	91	0.05	24	10	26000	13	300	0.016	19	65
MPA-S2000	4	63	0.042	25	10	29000	13.9	320	0.02	22	66
MPA-S4000	4	65	0.06	26	10	28000	14.8	340	0.026	21	71
MPA-E250	4	270	0.05	23	10	26000	14.1	290	0.018	18	76
MPA-E500	4	66	0.057	23	9	25000	12.7	280	0.017	18	60
MPA-E1000	4	44	0.048	24	9	25000	12.8	290	0.023	19	67
MPA-E2000	4	38	0.049	24	10	26000	13.1	300	0.019	19	58
MPA-W250	5	370	0.062	23	10	26000	15	290	0.012	18	74
MPA-W500	5	124	0.046	22	9	25000	12.7	290	0.027	17	62
MPA-W1000	5	63	0.047	23	9	27000	12.9	300	0.024	19	60
MPA-W2000	4	47	0.046	23	9	27000	13	310	0.022	18	60
NCc5	5	29	0.049	26	10	29000	13	340	0.023	21	72
NCc7	5	28	0.048	26	11	27000	13.1	320	0.022	21	71
NCc25	4	26	0.047	25	10	26000	12.6	290	0.026	20	67
SCb2	3	30	0.044	23	8	25000	12.1	310	0.128	20	62
SCb5	3	30	0.041	25	8	25000	12.3	300	0.012	20	61
SCb10	4	32	0.04	25	8	26000	10.1	340	0.051	21	65
ISQG-Low	20		1.5	80	65		50		0.15	21	200
ISQG-High	70		10.0	370	270		220		1.00	52	410

Appendix G - POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONCENTRATIONS (MG/KG OF DRY SEDIMENT) IN COMPOSITE SEDIMENT SAMPLES. SHADED CELLS INDICATE CONCENTRATIONS THAT WERE BELOW ADL. TO ESTIMATE A CONSERVATIVE TOTAL PAH THE SHADED VALUES ARE ASSUMED AS HALF THE VALUE OF THE ADL.

Report Number 740.10041.00100

Station	**Naphthalene**	**Acenaphthylene**	**Acenaphthlene**	**Fluorene**	**Phenanthrene**	**Anthracene**	**Low MW PAH's**	**Fluoranthene**	**Pyrene**	**Benzo[a]anthracene**	**Chrysene**	**Benzo[b]fluoranthene + Benzo[j]fluoranthene**	**Benzo[k]fluoranthene**	**Benzo[a]pyrene (BAP)**	**Indeno(1,2,3-c,d)pyrene**	**Dibenzo[a,h]anthracene**	**Benzo[g,h,i]perylene**	**High MW PAH's**	**Total PAH**
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
N250	0.0070	0.0015	0.0230	0.0160	0.0470	0.0080	0.1025	0.0620	0.0470	0.0300	0.0250	0.0400	0.0170	0.0270	0.0180	0.0040	0.0150	0.2850	0.3875
N500	0.0075	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0050	0.0040	0.0015	0.0015	0.0040	0.0015	0.0030	0.0015	0.0015	0.0015	0.0250	0.0400
N1000	0.0070	0.0015	0.0015	0.0015	0.0015	0.0015	0.0145	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0295
N2000	0.0075	0.0015	0.0015	0.0015	0.0040	0.0015	0.0175	0.0070	0.0050	0.0030	0.0015	0.0050	0.0015	0.0030	0.0015	0.0015	0.0015	0.0305	0.0480
N4000	0.0075	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0300
N6000	0.0080	0.0020	0.0020	0.0020	0.0020	0.0020	0.0180	0.0020	0.0020	0.0020	0.0020	0.0040	0.0020	0.0020	0.0020	0.0020	0.0020	0.0220	0.0400
S250	0.0180	0.0015	0.0015	0.0130	0.0740	0.0080	0.1160	0.0730	0.0530	0.0290	0.0260	0.0410	0.0140	0.0280	0.0200	0.0050	0.0180	0.3070	0.4230
S500	0.0070	0.0015	0.0015	0.0015	0.0050	0.0015	0.0180	0.0100	0.0070	0.0040	0.0040	0.0070	0.0015	0.0050	0.0040	0.0015	0.0030	0.0470	0.0650
S1000	0.0070	0.0015	0.0015	0.0015	0.0015	0.0015	0.0145	0.0040	0.0030	0.0015	0.0015	0.0030	0.0015	0.0015	0.0015	0.0015	0.0015	0.0205	0.0350
S2000	0.0075	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0040	0.0040	0.0015	0.0015	0.0040	0.0015	0.0040	0.0015	0.0015	0.0030	0.0265	0.0415
S4000	0.0075	0.0015	0.0015	0.0015	0.0060	0.0015	0.0195	0.0070	0.0060	0.0015	0.0030	0.0050	0.0015	0.0040	0.0015	0.0015	0.0015	0.0325	0.0520
E250	0.0075	0.0015	0.0060	0.0030	0.0150	0.0015	0.0345	0.0220	0.0170	0.0090	0.0090	0.0150	0.0050	0.0110	0.0060	0.0015	0.0060	0.1015	0.1360
E500	0.0080	0.0020	0.0020	0.0020	0.0040	0.0020	0.0200	0.0070	0.0060	0.0020	0.0040	0.0060	0.0020	0.0050	0.0030	0.0020	0.0030	0.0400	0.0600
E1000	0.0080	0.0020	0.0020	0.0020	0.0020	0.0020	0.0180	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0200	0.0380
E2000	0.0075	0.0015	0.0015	0.0015	0.0040	0.0015	0.0175	0.0070	0.0060	0.0030	0.0030	0.0050	0.0015	0.0050	0.0015	0.0015	0.0015	0.0350	0.0525
W250	0.0070	0.0015	0.0015	0.0015	0.0060	0.0015	0.0190	0.0100	0.0080	0.0040	0.0040	0.0080	0.0030	0.0060	0.0040	0.0015	0.0040	0.0525	0.0715
W500	0.0080	0.0020	0.0060	0.0020	0.0110	0.0020	0.0310	0.0210	0.0170	0.0130	0.0110	0.0200	0.0060	0.0140	0.0080	0.0020	0.0080	0.1200	0.1510
W1000	0.0070	0.0015	0.0015	0.0015	0.0015	0.0015	0.0145	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0295
W2000	0.0080	0.0020	0.0020	0.0020	0.0020	0.0020	0.0180	0.0020	0.0030	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0210	0.0390

Appendix G - POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONCENTRATIONS (MG/KG OF DRY SEDIMENT) IN COMPOSITE SEDIMENT SAMPLES. SHADED CELLS INDICATE CONCENTRATIONS THAT WERE BELOW ADL. TO ESTIMATE A CONSERVATIVE TOTAL PAH THE SHADED VALUES ARE ASSUMED AS HALF THE VALUE OF THE ADL.

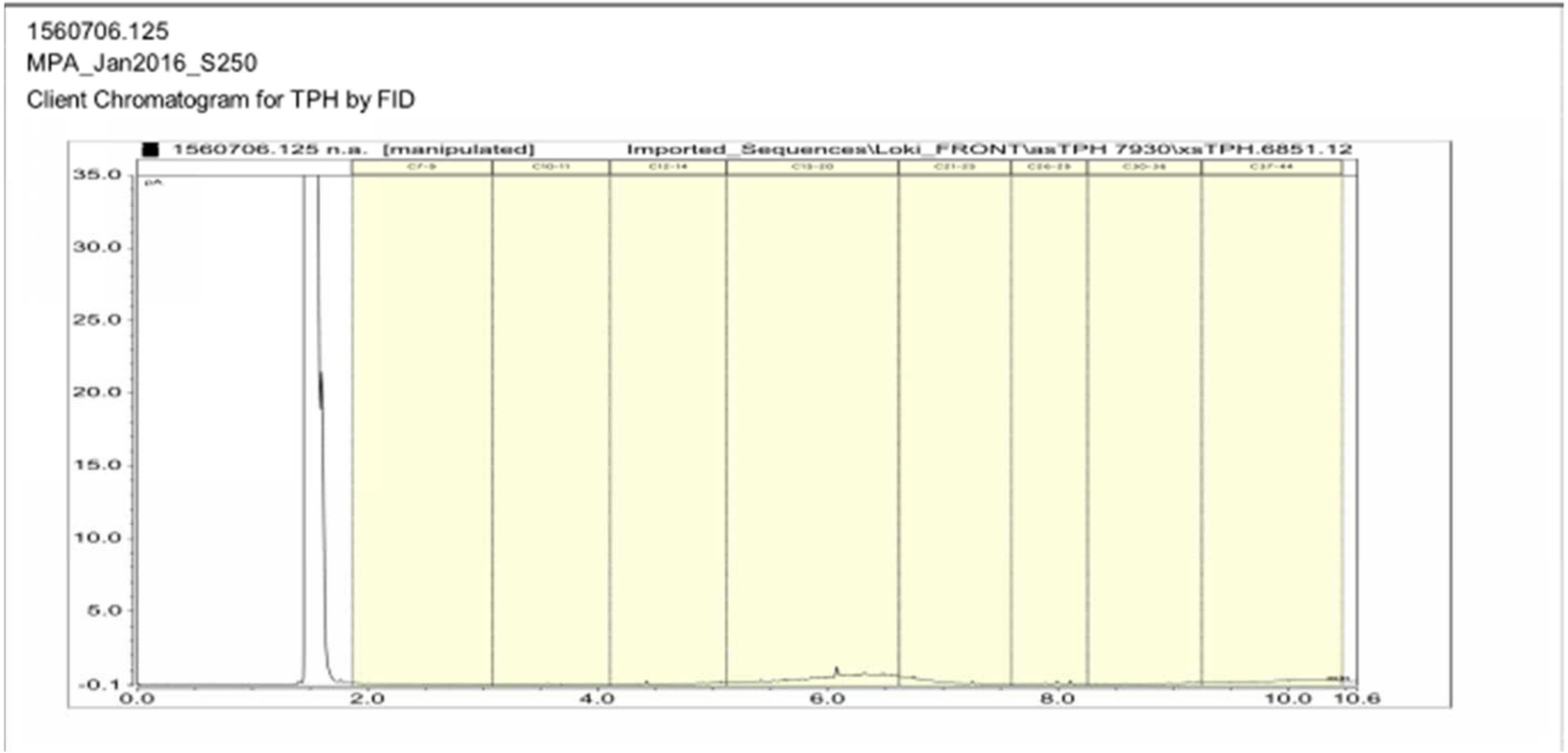
Station	**Naphthalene**	**Acenaphthylene**	**Acenaphthlene**	**Fluorene**	**Phenanthrene**	**Anthracene**	**Low MW PAH's**	**Fluoranthene**	**Pyrene**	**Benzo[a]anthracene**	**Chrysene**	**Benzo[b]fluoranthene + Benzo[j]fluoranthene**	**Benzo[k]fluoranthene**	**Benzo[a]pyrene (BAP)**	**Indeno(1,2,3-c,d)pyrene**	**Dibenzo[a,h]anthracene**	**Benzo[g,h,i]perylene**	**High MW PAH's**	**Total PAH**
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
NCc5	0.0075	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0040	0.0040	0.0015	0.0015	0.0040	0.0015	0.0030	0.0015	0.0015	0.0015	0.0240	0.0390
NCc7	0.0080	0.0020	0.0020	0.0020	0.0040	0.0020	0.0200	0.0060	0.0050	0.0020	0.0020	0.0040	0.0020	0.0030	0.0020	0.0020	0.0020	0.0300	0.0500
NCc25	0.0085	0.0020	0.0020	0.0020	0.0020	0.0020	0.0185	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0200	0.0385
SBb2	0.0075	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0300
SBb5	0.0070	0.0015	0.0015	0.0015	0.0015	0.0015	0.0145	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0295
SCb10	0.0070	0.0015	0.0015	0.0015	0.0015	0.0015	0.0145	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0150	0.0295
ISQG-Low[1]	**0.1600**	**0.0440**	**0.0160**	**0.0190**	**0.2400**	**0.0850**	**0.5520**	**0.600**	**0.6650**	**0.2610**	**0.3840**			**0.4300**		**0.0630**		**1.7000**	**4**
ISQG-High[1]	**2.1000**	**0.6400**	**0.5000**	**0.5400**	**1.500**	**1.1000**	**3.1600**	**5.100**	**2.600**	**1.6000**	**2.800**			**1.6000**		**0.2600**		**9.6000**	**45**
TV[3]																			**10**
SQG-High[3]																			**50**

Appendix H - TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS (MG/KG OF DRY SEDIMENT) IN COMPOSITE SEDIMENT SAMPLES. TPH ECOLOGICAL PROTECTION GUIDELINE VALUES; TRIGGER VALUE = 275 MG/KG, SEDIMENT-QUALITY GUIDELINE-HIGH VALUE = 550 MG/KG (TAKEN FROM SIMPSON ET AL., 2010).

Station	March 2016			
	C7-C9	**C10-C14**	**C15-C36**	**Total hydrocarbons (C7-C36)**
	mg/kg	mg/kg	mg/kg	mg/kg
N250	< 30	< 60	< 110	< 190
N500	< 30	< 60	< 120	< 200
N1000	< 30	< 60	< 110	< 190
N2000	< 30	< 60	< 120	< 200
N4000	< 30	< 60	< 120	< 300
N6000	< 40	< 70	< 130	< 300
S250	< 30	< 60	210	210
S500	< 30	< 60	< 120	< 200
S1000	< 30	< 60	< 110	< 190
S2000	< 30	< 60	< 110	< 190
S4000	< 30	< 60	< 110	< 200
E250	< 30	< 60	< 120	< 300
E500	< 30	< 60	< 120	< 200
E1000	< 30	< 60	< 120	< 300
E2000	< 30	< 60	< 110	< 190
W250	< 30	< 60	< 110	< 190
W500	< 30	< 60	< 120	< 300
W1000	< 30	< 50	< 100	< 170
W2000	< 30	< 60	< 120	< 200
NCc5	< 30	< 60	< 120	< 300
NCc7	< 40	< 70	< 130	< 300
NCc25	< 40	< 70	< 140	< 300
SCb2	< 30	< 60	< 120	< 300
SCb5	< 30	< 60	< 110	< 190
SCb10	< 30	< 60	< 110	< 190

Appendix H - TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS (MG/KG OF DRY SEDIMENT) IN COMPOSITE SEDIMENT SAMPLES. TPH ECOLOGICAL PROTECTION GUIDELINE VALUES; TRIGGER VALUE = 275 MG/KG, SEDIMENT-QUALITY GUIDELINE-HIGH VALUE = 550 MG/KG (TAKEN FROM SIMPSON ET AL., 2010).

TPH Chromatogram from the S250 station sampled in May 2015.



1560706.125
MPA_Jan2016_S250
Client Chromatogram for TPH by FID

Appendix I: Raw count data of macroinvertebrate (infauna and epifauna) abundance per grab sample. Pelagic taxa identified in the benthic samples have been included at the end of the taxa list.

	MPA_N250_a_Mar_2016	MPA_N250_b_Mar_2016	MPA_N250_c_Mar_2016	MPA_N500_a_Mar_2016	MPA_N500_b_Mar_2016	MPA_N500_c_Mar_2016	MPA_N1000_a_Mar_2016	MPA_N1000_b_Mar_2016	MPA_N1000_c_Mar_2016	MPA_N2000_a_Mar_2016	MPA_N2000_b_Mar_2016	MPA_N2000_c_Mar_2016	MPA_N4000_a_Mar_2016	MPA_N4000_b_Mar_2016	MPA_N4000_c_Mar_2016	MPA_N6000_a_Mar_2016	MPA_N6000_b_Mar_2016	MPA_N6000_c_Mar_2016	MPA_S250_a_Mar_2016	MPA_S250_b_Mar_2016	MPA_S250_c_Mar_2016	MPA_S500_a_Mar_2016	MPA_S500_b_Mar_2016	MPA_S500_c_Mar_2016	MPA_S1000_a_Mar_2016	MPA_S1000_b_Mar_2016	MPA_S1000_c_Mar_2016	MPA_S2000_a_Mar_2016	MPA_S2000_b_Mar_2016	MPA_S2000_c_Mar_2016	MPA_S4000_a_Mar_2016	MPA_S4000_b_Mar_2016	MPA_S4000_c_Mar_2016	MPA_W250_a_Mar_2016	MPA_W250_b_Mar_2016	MPA_W250_c_Mar_2016	MPA_W500_a_Mar_2016	MPA_W500_b_Mar_2016	MPA_W500_c_Mar_2016	MPA_W1000_a_Mar_2016	MPA_W1000_b_MPA_2016	MPA_W1000_c_Mar_2016	MPA_W2000_a_Mar_2016	MPA_W2000_b_Mar_2016	MPA_W2000_c_Mar_2016	MPA_E250_a_Mar_2016	MPA_E250_b_Mar_2016	MPA_E250_c_Mar_2016	MPA_E500_a_Mar_2016	MPA_E500_b_Mar_2016	MPA_E500_c_Mar_2016	MPA_E1000_a_Mar_2016	MPA_E1000_b_Mar_2016	MPA_E1000_c_Mar_2016	MPA_E2000_a_Mar_2016	MPA_E2000_b_Mar_2016	MPA_E2000_c_Mar_2016	NCc5_a_Mar_2016	NCc5_b_Mar_2016	NCc5_c_Mar_2016	NCc7_a_Mar_2016	NCc7_b_Mar_2016	NCc7_c_Mar_2016	NCc25_a_Mar_2016	NCc25_b_Mar_2016	NCc25_c_Mar_2016	SCb2_a_Mar_2016	SCb2_b_Mar_2016	SCb2_c_Mar_2016	SCb5_a_Mar_2016	SCb5_b_Mar_2016	SCb5_c_Mar_2016	SCb10_a_Mar_2016	SCb10_b_Mar_2016	SCb10_c_Mar_2016
Aglaophamus sp.	6	2	3	4	0	8	8	5	4	4	6	11	3	4	12	5	5	10	3	4	5	3	3	4	11	7	14	4	9	3	8	4	11	6	3	2	7	10	5	15	6	7	8	8	7	6	4	4	2	5	2	9	6	6	9	6	13	3	6	5	1	4	8	5	6	11	15	11	15	7	17	18	8	13	13
Ampelisca sp.	0	2	0	1	0	0	0	0	1	0	0	2	0	0	0	1	1	2	2	1	1	0	0	2	0	0	2	5	2	1	2	0	4	0	2	1	0	1	0	1	0	1	0	0	1	0	0	0	3	0	1	1	2	2	3	2	0	0	0	2	0	1	1	0	0	0	0	1	0	0	0	1	1	1	2
Ampharetidae	8	11	8	4	2	6	5	5	8	1	5	4	3	3	3	2	4	3	8	4	5	1	5	3	0	0	4	5	2	6	8	11	7	3	4	2	2	10	2	3	2	2	3	10	5	5	6	8	3	10	8	6	10	10	10	7	8	3	6	5	8	4	5	6	4	7	4	5	1	4	2	2	1	2	2
Amphinomidae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphipoda	3	5	1	2	3	2	0	2	4	4	0	1	0	2	3	2	1	3	3	0	1	2	0	0	0	2	2	3	0	1	5	11	8	1	3	1	7	2	5	3	1	4	2	3	7	1	0	5	5	2	3	1	5	6	6	7	2	5	2	2	2	1	5	3	3	5	6	2	1	3	8	2	3	1	4
Anchisquilloides mcneilli	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	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	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Anisodonta alata alata	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	2	3	0	0	0	0	1	0	1	0	0	0	0	0	4	1	3	0	2	0	0	0	0	0	0	2	6	0	0	2	3	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Anomura	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antalis nana	1	0	1	0	0	0	0	0	0	0	0	0	2	1	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	0	0	0	0	0	0	1	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
Anthuridea	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
Aphroditidae	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	0
Arachnanthus sp.	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	1	0	1	0	1	1	2	2	2	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1
Aricidea sp.	3	1	6	2	4	2	0	5	1	1	0	1	0	1	2	1	2	2	3	5	3	5	2	0	2	0	1	0	0	0	0	1	3	0	1	1	9	3	0	2	0	1	0	0	1	1	2	1	0	0	2	1	2	1	2	1	1	0	0	2	0	4	1	0	2	2	3	0	0	1	2	1	1	4	1
Armandia maculata	6	16	11	2	3	3	10	2	3	0	1	0	1	1	1	0	0	1	17	8	6	4	4	1	3	0	0	3	2	1	8	1	6	1	3	2	6	3	2	10	4	3	1	3	0	1	6	7	4	5	1	4	7	8	9	5	2	4	0	1	1	1	0	1	0	1	1	0	0	0	0	0	1	0	0
Asellota	0	0	1	1	0	0	1	2	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	5	1	0	1	4	2	3	0	0	0	2	4	2	2	0	0	2	0	0	0	0	0	0	1	1	3	3	4	1	0	1	4	0	0	3	0	2	2	3	0	1	1	0	8	4	2	2	3	3
Austrofusus glans	2	0	1	0	1	1	0	0	0	0	0	1	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Austrotindaria wrighti	1	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	2	1	0	0	1	2	4	1	3	3	1	7	1	1	1
Axiopsis sp.	0	0	0	0	0	0	0	1	0	0	0	0	2	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	3	1	1	2	0	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0	1	1	0	1	1	0	0	0	1	1	1	1	0
Bivalvia	2	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	4	1	0	0	1	1	3	0	1	1
Bradleya opima	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	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	2	1	0	2	0	0	2	0	0	1	0	0	0	0	0	0	1	1
Bryozoa	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cadulus teliger	2	0	0	2	0	1	0	1	0	1	1	0	0	0	1	0	0	0	2	0	2	3	2	7	1	1	0	0	1	0	6	1	2	0	1	0	2	1	0	1	0	2	0	2	1	0	1	2	1	1	1	0	0	4	0	0	0	1	2	0	3	2	0	1	1	0	3	2	1	3	1	2	2	3	1
Capitellethus zeylanicus	1	2	1	2	4	2	2	6	3	3	5	4	6	5	10	9	6	6	1	2	3	5	2	4	6	2	7	8	4	5	6	5	9	1	1	0	5	3	7	5	1	10	6	8	4	3	3	7	1	5	6	3	7	7	7	6	2	0	0	7	6	4	1	1	6	3	6	1	1	2	1	1	2	0	4
Chloeia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	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
Chlorotocus novaezealandiae	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	37	54	16	16	6	15	14	18	31	15	22	13	10	21	24	19	24	18	16	12	15	13	18	8	25	16	14	13	15	12	18	19	11	10	10	5	32	32	20	19	26	24	12	14	7	30	27	17	15	7	20	17	20	15	36	15	13	9	15	15	12	11	15	13	27	29	6	7	6	19	13	10	4	22	8
Clavellina claviformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Copepoda	0	0	0	0	0	2	1	0	0	0	1	1	0	0	1	1	0	0	2	1	0	0	1	2	0	1	3	0	0	2	0	0	0	0	0	0	1	3	1	0	0	0	0	1	0	0	0	1	0	2	0	1	0	1	1	0	0	1	0	0	0	1	2	1	1	1	0	0	1	0	0	0	1	1	0
Cossura consimilis	3	3	12	2	5	0	3	2	0	0	0	1	0	0	1	2	0	0	8	7	10	10	3	1	0	0	3	2	0	0	0	3	0	2	1	1	3	2	0	0	0	0	1	0	0	3	2	5	0	1	12	1	2	3	1	1	0	0	0	1	0	1	0	1	0	2	1	0	0	0	0	0	0	0	0
Cumacea	1	0	2	4	0	5	2	1	6	4	6	0	4	1	10	3	3	5	1	1	1	2	2	0	1	0	4	4	0	3	3	7	10	0	1	0	2	5	1	4	2	9	7	9	4	3	1	1	1	1	2	5	6	5	3	4	14	5	3	2	8	2	6	5	13	8	5	2	3	19	9	6	2	4	2
Curveulima aupouria	0	0	0	1	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	0	0	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	0	0	0	0
Cuspidaria wellmani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cuspidaria willetti	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	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	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Cymbicopia hispida	2	6	1	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	2	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	3	4	0	0	1	2	0	0	0	1	1
Cypridinoides reticulata	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	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
Cytherella sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	1	1	1	0	0	1	0	0
Decapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	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
Diasterope grisea	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	2	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0
Dorvilleidae	1	0	0	0	0	0	0	0	1	0	1	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	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Dosinia lambata	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duplicaria tristis	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	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
Ebalia laevis	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echiura	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	2	2	0	0	0	1	1	0	1	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	1	0	0	0	1	2	0	0	0	3	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
Edwardsia sp.	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	1	0	0	0	0	2	0	0	0	0	0	0	0	0
Ennucula strangei	2	1	3	4	1	4	0	6	0	0	1	2	1	4	1	0	3	3	1	1	1	4	2	5	3	2	0	3	2	2	2	4	4	2	0	0	2	3	0	3	2	1	0	2	0	2	4	0	4	3	1	7	2	2	4	5	1	1	0	0	1	0	1	1	0	0	3	0	1	0	3	0	0	1	2
Euchone pallida	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	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1	0	1	4	1	0	2	0
Eulimidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Euphilomedes agilis	2	4	1	0	0	4	0	0	0	1	2	0	1	2	0	0	0	1	0	0	0	0	2	1	0	3	1	0	1	0	2	2	2	1	1	2	0	1	3	4	0	1	1	0	1	1	2	3	1	1	0	2	3	1	4	3	3	0	0	0	0	0	1	0	0	0	5	1	1	1	0	2	0	1	2
Flabelligeridae	4	2	4	7	1	6	8	6	4	1	2	1	3	2	1	3	2	2	5	3	4	1	2	9	4	6	6	2	3	5	6	4	5	1	4	0	3	14	3	7	5	4	2	7	5	4	6	12	3	4	4	12	9	12	6	8	6	2	6	3	2	2	2	1	4	2	2	4	1	4	2	3	2	6	3
Gastropoda	2	2	3	0	1	1	0	2	2	1	1	5	0	3	3	1	3	3	0	0	13	2	0	1	3	2	1	1	1	8	8	2	0	0	0	0	7	3	0	1	3	2	5	1	1	7	0	2	3	0	1	12	1	1	3	2	1	8	2	1	3	2	0	6	1	0	7	7	0	4	13	2	5	6	24
Gastrotricha	1	0	0	0	0	1	1	0	0	0	0	0	1	1	0	3	4	1	0	0	0	0	0	3	0	1	2	0	0	0	0	1	1	0	0	1	2	3	3	0	0	2	5	0	0	1	2	0	1	0	0	1	0	1	0	0	0	3	2	1	2	2	2	1	2	4	2	1	2	2	0	0	1	1	0
Glyceridae	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	3	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
Gnathiidea	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	2	0	0	1	3	0	3	0	1	1	0	2	0	0	1	3	0	0	1	0	0
Goniadidae	1	2	3	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	5	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
Haminoea zelandiae	0	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Haustoridae	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	1	1	3	2	0	0	0	0	0	0	1	0	0	0	0	0	2	1	0	0	1	0	0	4	0	0	0	1	0	0	0	1	0	0
Hemichordata	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	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	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0
Hesionidae	0	0	0	2	1	1	2	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	2	0	1	1	2	0	0	0	2	0	0	2	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	1	0	1	2	0	0	0	2	0	0	0	0	1	0	0	0	0	1	0	2	0	1	2
Heteromolpadia marenzelleri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Hyalinoecia 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	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
Ischyroceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	1	0	0	0	2	0

	MPA_N250_a_Mar_2016	MPA_N250_b_Mar_2016	MPA_N250_c_Mar_2016	MPA_N500_a_Mar_2016	MPA_N500_b_Mar_2016	MPA_N500_c_Mar_2016	MPA_N1000_a_Mar_2016	MPA_N1000_b_Mar_2016	MPA_N1000_c_Mar_2016	MPA_N2000_a_Mar_2016	MPA_N2000_b_Mar_2016	MPA_N2000_c_Mar_2016	MPA_N4000_a_Mar_2016	MPA_N4000_b_Mar_2016	MPA_N4000_c_Mar_2016	MPA_N6000_a_Mar_2016	MPA_N6000_b_Mar_2016	MPA_N6000_c_Mar_2016	MPA_S250_a_Mar_2016	MPA_S250_b_Mar_2016	MPA_S250_c_Mar_2016	MPA_S500_a_Mar_2016	MPA_S500_b_Mar_2016	MPA_S500_c_Mar_2016	MPA_S1000_a_Mar_2016	MPA_S1000_b_Mar_2016	MPA_S1000_c_Mar_2016	MPA_S2000_a_Mar_2016	MPA_S2000_b_Mar_2016	MPA_S2000_c_Mar_2016	MPA_S4000_a_Mar_2016	MPA_S4000_b_Mar_2016	MPA_S4000_c_Mar_2016	MPA_W250_a_Mar_2016	MPA_W250_b_Mar_2016	MPA_W250_c_Mar_2016	MPA_W500_a_Mar_2016	MPA_W500_b_Mar_2016	MPA_W500_c_Mar_2016	MPA_W1000_a_Mar_2016	MPA_W1000_b_MPA_2016	MPA_W1000_c_Mar_2016	MPA_W2000_a_Mar_2016	MPA_W2000_b_Mar_2016	MPA_W2000_c_Mar_2016	MPA_E250_a_Mar_2016	MPA_E250_b_Mar_2016	MPA_E250_c_Mar_2016	MPA_E500_a_Mar_2016	MPA_E500_b_Mar_2016	MPA_E500_c_Mar_2016	MPA_E1000_a_Mar_2016	MPA_E1000_b_Mar_2016	MPA_E1000_c_Mar_2016	MPA_E2000_a_Mar_2016	MPA_E2000_b_Mar_2016	MPA_E2000_c_Mar_2016	NCc5_a_Mar_2016	NCc5_b_Mar_2016	NCc5_c_Mar_2016	NCc7_a_Mar_2016	NCc7_b_Mar_2016	NCc7_c_Mar_2016	NCc25_a_Mar_2016	NCc25_b_Mar_2016	NCc25_c_Mar_2016	SCb2_a_Mar_2016	SCb2_b_Mar_2016	SCb2_c_Mar_2016	SCb5_a_Mar_2016	SCb5_b_Mar_2016	SCb5_c_Mar_2016	SCb10_a_Mar_2016	SCb10_b_Mar_2016	SCb10_c_Mar_2016
Leitoscoloplos 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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Limatula maoria	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lumbrineridae	15	22	10	6	0	8	3	4	7	7	1	3	1	2	3	1	7	4	15	10	28	5	14	6	6	5	3	7	3	3	6	7	8	2	8	2	8	5	4	2	7	4	4	2	4	13	11	15	7	4	6	10	8	5	8	5	9	3	2	4	4	1	0	3	8	5	6	1	3	2	5	4	8	5	3
Lysianassidae	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	2	0	0	0	0	0	0	0	1	2	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	1	1	0	1	0	0	0	0	0	1	0	0	0	1	1	2	1	0	3	0	0	2	1	1	1	0
Macroctopus maorum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Maldanidae	12	9	8	9	7	13	11	15	8	13	10	14	13	8	13	12	11	16	3	3	10	8	10	12	27	10	19	15	19	27	27	23	24	3	8	3	12	9	5	16	6	17	9	22	4	6	13	14	6	15	11	13	11	18	8	23	13	10	8	8	5	7	11	9	16	8	29	17	23	26	44	34	27	24	38
Maorithyas marama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0
Marphysa disjuncta	6	12	4	1	1	3	0	1	1	1	2	1	1	3	2	2	2	1	5	2	5	2	0	3	0	2	3	0	1	1	1	1	4	2	7	1	3	4	3	2	2	4	2	3	2	1	3	2	3	2	1	3	2	2	0	1	2	1	2	2	0	1	0	2	1	3	2	2	0	0	2	2	0	0	0
Maxacteon 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	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
Melliteryx parva	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	3	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
Molgula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	1	0	1	1	0	0	0
Myriowenia sp.	1	0	0	1	0	2	0	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1	0	0	1	1	0	1	2	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	2	1	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0
Mysida	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	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	1	0	0	0	0	0	0	0	0
Natatolana sp.	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Naticidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebalia 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	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Neilo australis	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	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	0	0	0
Nematoda	0	0	2	2	0	0	1	1	0	2	3	1	1	5	6	2	4	2	1	1	0	0	0	0	2	1	2	2	1	0	5	3	4	1	2	1	1	9	0	4	1	2	0	2	6	0	3	2	4	1	1	1	2	2	3	4	0	3	0	1	3	0	1	1	3	4	1	0	0	0	0	0	0	0	0
Nemertea	8	4	3	2	3	2	3	3	0	0	1	1	1	1	1	1	1	4	6	7	5	0	1	3	1	1	0	4	4	4	0	1	0	3	1	3	2	3	2	2	3	2	2	2	0	5	4	5	0	2	5	2	4	4	1	2	2	2	2	1	0	2	0	1	0	0	0	0	1	0	1	1	1	2	1
Neolepton antipodum	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neonesidea sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	4	4	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	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	5	2	3	10	7	5	7	6	8	0	0	0	0	0	0	0	0	0
Nucinella maoriana	39	30	20	12	5	17	8	14	3	5	5	8	6	5	14	3	4	11	10	14	21	9	19	8	9	4	6	5	8	10	16	3	15	13	5	5	11	22	9	9	7	12	3	6	4	23	30	18	6	14	9	9	17	9	7	6	4	1	0	1	2	2	3	2	0	1	5	0	7	4	6	14	4	6	8
Oligochaeta	2	3	0	8	5	1	4	2	2	5	6	1	4	0	0	3	0	2	0	0	3	3	4	0	5	6	7	5	1	0	1	3	5	0	0	0	0	0	3	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	5	9	0	6	2	2	0	2	0	0	2	0	0	0	2	0
Onuphis aucklandensis	5	6	0	2	1	4	0	1	2	0	1	1	1	0	1	3	2	1	4	8	10	2	3	3	1	2	3	2	2	1	5	6	2	2	5	0	5	0	2	1	4	1	1	2	1	1	5	3	0	3	3	4	0	1	2	4	5	2	5	1	2	1	2	1	4	0	5	0	2	7	5	9	9	12	5
Ophiuroidea	5	6	8	8	3	6	3	3	5	5	5	0	7	9	4	2	7	2	4	2	4	2	4	2	4	1	4	4	5	2	5	8	8	9	0	2	4	9	3	5	5	7	5	6	7	14	8	5	8	5	5	8	7	6	4	4	6	1	5	3	2	1	3	2	1	8	18	0	13	17	19	19	17	10	11
Orbinia papillosa	0	0	0	0	0	1	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	1	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
Orbiniidae	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	1	0	0	0	0	0	2	2	0	1	1	1	0	2	0	0	0	0	1	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0
Owenia petersenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	1	1	1	2	1	1
Paracaudina chilensis	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Paramunna serrata	1	3	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	5	0	0	0	2	0	1	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	4	1	0	0	0	1	0	0	1	0	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	1	1
Paraonidae	127	142	82	30	32	28	22	38	8	10	18	42	18	18	34	29	20	11	93	84	98	50	37	24	22	17	18	24	15	24	21	24	36	15	25	28	70	40	19	30	14	23	20	20	17	51	37	60	19	21	69	30	23	38	35	21	28	17	15	14	14	12	27	8	20	27	20	0	7	13	16	17	12	13	14
Paraprionospio pinnata	3	2	4	1	0	2	2	2	1	1	1	0	0	0	0	2	4	0	1	4	5	0	5	2	1	0	1	1	0	2	1	1	2	0	0	2	3	1	0	1	2	3	0	1	1	1	3	3	1	0	1	2	3	3	2	2	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Parasterope quadrata	1	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	2	0	0	0	1
Paravireia sp.	0	0	0	0	0	2	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	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Philine angasi	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philine powelli	1	2	1	0	0	0	1	0	0	0	0	0	0	0	1	1	3	0	1	0	0	0	1	0	0	0	0	0	2	0	0	2	1	0	1	0	1	0	0	2	0	1	1	0	1	1	0	0	0	1	0	1	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	2	1	1	1	0
Phoxocephalidae	0	0	0	1	0	1	1	3	0	0	0	1	0	2	4	0	3	2	2	0	1	1	2	0	0	1	1	0	0	3	3	0	3	0	1	0	2	4	2	2	1	3	0	0	1	0	1	0	1	1	2	4	0	1	1	0	0	0	3	1	1	0	3	4	5	0	0	0	0	2	2	0	0	0	3
Phyllochaetopterus socialis	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	1	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0	0	2	0	1	0	2	0	1	0	2	0	1	1	0	0	0	2	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0
Phylo felix	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylo novazealandiae	1	0	0	0	0	0	2	2	1	1	2	1	0	1	0	0	0	0	0	0	1	3	1	1	1	2	0	0	1	0	0	1	2	0	0	0	0	1	2	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pilargidae	3	1	2	4	4	2	2	3	2	0	3	2	0	2	0	0	1	2	8	9	3	1	5	3	1	3	5	2	9	1	0	0	0	1	0	0	12	2	0	0	4	1	0	0	1	3	2	5	2	5	0	2	4	2	3	3	2	2	0	0	1	8	3	1	0	3	0	0	1	0	0	2	0	0	0
Pleuromeris zelandica	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	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
Poecilochaetidae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polynoidae	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0	2	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0	1	0	1	0	2	4
Pontophilus 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Poroleda lanceolata	7	3	1	4	0	1	3	2	1	4	0	1	0	1	1	0	2	1	2	2	2	0	1	2	0	1	2	0	1	0	5	1	5	1	0	0	5	1	0	1	1	0	0	2	1	1	1	0	1	1	2	2	5	7	3	5	1	1	3	0	3	1	2	1	1	0	1	0	2	2	2	2	1	2	3
Pratulum pulchellum	3	1	0	3	1	2	2	2	1	2	0	2	1	2	0	1	1	1	0	0	0	0	3	2	2	0	2	0	0	1	2	2	5	2	1	0	0	2	1	14	1	2	3	1	1	2	1	3	1	0	0	0	1	6	2	0	0	1	6	1	0	0	1	0	2	2	1	0	1	0	1	0	1	0	1
Priapulida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prionospio multicastrata	0	0	0	0	0	0	0	0	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	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
Prionospio sp.	1	5	0	2	2	2	0	2	1	0	1	0	4	0	2	1	0	2	2	2	3	1	0	0	0	0	1	1	1	1	1	1	5	0	1	2	2	5	2	3	1	1	3	1	2	2	3	1	0	2	2	4	5	2	2	0	1	4	1	2	0	0	1	0	1	4	1	0	0	1	0	0	0	0	2
Prionospio yuriel	0	0	0	0	0	0	0	0	0	1	0	0	0	0	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	0	0	1	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
Propontocypris sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyura sp.	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	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Rutiderma 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	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rynkatorpa uncinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	1	0
Sabellidae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	0	0
Saccella 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	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
Scalibregma inflatum	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	1	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	0	2	0	0	0	0	0	0	0	0
Scalpamactra scapellum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0

	MPA_N250_a_Mar_2016	MPA_N250_b_Mar_2016	MPA_N250_c_Mar_2016	MPA_N500_a_Mar_2016	MPA_N500_b_Mar_2016	MPA_N500_c_Mar_2016	MPA_N1000_a_Mar_2016	MPA_N1000_b_Mar_2016	MPA_N1000_c_Mar_2016	MPA_N2000_a_Mar_2016	MPA_N2000_b_Mar_2016	MPA_N2000_c_Mar_2016	MPA_N4000_a_Mar_2016	MPA_N4000_b_Mar_2016	MPA_N4000_c_Mar_2016	MPA_N6000_a_Mar_2016	MPA_N6000_b_Mar_2016	MPA_N6000_c_Mar_2016	MPA_S250_a_Mar_2016	MPA_S250_b_Mar_2016	MPA_S250_c_Mar_2016	MPA_S500_a_Mar_2016	MPA_S500_b_Mar_2016	MPA_S500_c_Mar_2016	MPA_S1000_a_Mar_2016	MPA_S1000_b_Mar_2016	MPA_S1000_c_Mar_2016	MPA_S2000_a_Mar_2016	MPA_S2000_b_Mar_2016	MPA_S2000_c_Mar_2016	MPA_S4000_a_Mar_2016	MPA_S4000_b_Mar_2016	MPA_S4000_c_Mar_2016	MPA_W250_a_Mar_2016	MPA_W250_b_Mar_2016	MPA_W250_c_Mar_2016	MPA_W500_a_Mar_2016	MPA_W500_b_Mar_2016	MPA_W500_c_Mar_2016	MPA_W1000_a_Mar_2016	MPA_W1000_b_MPA_2016	MPA_W1000_c_Mar_2016	MPA_W2000_a_Mar_2016	MPA_W2000_b_Mar_2016	MPA_W2000_c_Mar_2016	MPA_E250_a_Mar_2016	MPA_E250_b_Mar_2016	MPA_E250_c_Mar_2016	MPA_E500_a_Mar_2016	MPA_E500_b_Mar_2016	MPA_E500_c_Mar_2016	MPA_E1000_a_Mar_2016	MPA_E1000_b_Mar_2016	MPA_E1000_c_Mar_2016	MPA_E2000_a_Mar_2016	MPA_E2000_b_Mar_2016	MPA_E2000_c_Mar_2016	NCc5_a_Mar_2016	NCc5_b_Mar_2016	NCc5_c_Mar_2016	NCc7_a_Mar_2016	NCc7_b_Mar_2016	NCc7_c_Mar_2016	NCc25_a_Mar_2016	NCc25_b_Mar_2016	NCc25_c_Mar_2016	SCb2_a_Mar_2016	SCb2_b_Mar_2016	SCb2_c_Mar_2016	SCb5_a_Mar_2016	SCb5_b_Mar_2016	SCb5_c_Mar_2016	SCb10_a_Mar_2016	SCb10_b_Mar_2016	SCb10_c_Mar_2016
Scintillona zelandica	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	2	0	0	0	0	2	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	0	0	0	0	0	0	0	0	0	0	0
Serratina charlottae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigalionidae	0	2	2	1	1	1	1	2	2	2	1	2	3	3	0	0	1	2	1	1	0	4	1	1	0	1	0	1	1	1	1	3	0	0	0	0	0	2	2	1	1	2	0	1	1	1	1	0	1	2	0	0	0	0	0	1	0	1	1	1	0	2	1	0	1	0	2	1	0	0	1	5	1	1	1
Sigapatella lenuis	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigapatella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	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	0	0	0	0	0	0	0	0	0	0	0
Sipuncula	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	0	0	1	2	0	1	0	2	1	4	2	2	0	0	0	0	3	2	2	1	2	4	0	2	1	1	0	0	3	0	0	2	1	1	0	0	5	0	0	9	0	3	1	1	1	0	0	0	1	0	1	0
Sphaerodoropsis 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	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Sphaerosyllis sp.	4	0	3	0	1	1	1	4	0	1	0	0	0	0	0	0	1	0	3	0	1	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	2	0	0	0	0	2	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Spio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiophanes kroyeri	20	30	8	16	12	10	28	15	21	8	7	8	7	6	12	10	19	6	19	11	13	13	11	26	16	14	9	21	9	15	25	23	15	19	8	9	14	9	5	12	11	7	13	9	13	6	13	5	1	16	13	31	20	24	24	13	21	9	16	7	7	9	19	9	25	13	6	7	5	11	9	8	5	11	8
Spiophanes modestus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Spiophanes sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	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	1	0	1	1	0	0	6	6	4	0	0	0	0	0	0	0	0	0
Spiophanes wigleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Stemapsis scutata	0	0	0	1	2	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	4	4	3	1	1	0	0	0	0	2	0	1	1	3	3	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	1
Stomatopoda	0	0	0	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	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	1	0	0	0	0
Syllidae	4	5	3	2	0	2	0	4	0	0	0	0	1	0	0	0	1	0	2	4	4	0	1	1	1	0	0	0	0	1	1	0	1	0	0	1	2	1	0	1	0	1	0	0	0	2	0	1	0	0	0	0	0	2	1	0	0	0	1	0	1	1	1	0	1	0	2	0	0	0	0	0	0	1	0
Tanaidacea	1	0	0	1	1	0	2	1	1	1	0	0	0	1	0	0	2	0	1	0	0	0	2	0	10	0	1	4	1	1	3	6	6	0	0	0	1	2	0	3	2	1	0	0	0	0	0	0	0	1	1	0	4	2	0	2	0	1	1	6	3	7	2	4	3	3	7	2	0	2	1	2	2	1	1
Terebellidae	2	1	3	1	3	3	0	4	1	0	1	2	0	0	0	1	3	0	2	0	0	2	3	2	1	1	2	1	1	3	0	0	2	0	0	0	1	0	1	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	0	0	0	1	0	0	1	0	1	1
Terebellides stroemi	1	0	0	4	0	2	1	1	0	2	2	3	1	2	1	1	2	1	0	0	0	2	3	1	1	1	1	0	2	3	2	1	7	0	2	1	3	2	1	0	0	0	1	0	2	5	0	2	2	1	3	4	1	0	1	0	1	0	0	0	1	0	3	1	1	1	0	1	2	1	0	1	0	1	0
Thracidae	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	1	0	0	0	0	0	0	1	0	0	0	1	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	1	0	0	0	0	0	0	0	0	0
Thyasiridae	1	0	0	0	0	1	1	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	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Trachyleberis lytteltonsis	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	2	0	0	0	0	0	2	0	0	0	1	0	0	0	2	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	1	0	1	0	0	0	0	1	1	0	4	0	0	0	0	1	2	0
Turbonilla sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	0	0
Upogebia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varinucula gallinacea	19	24	28	4	5	0	4	3	6	8	12	2	4	6	11	1	2	2	6	11	4	12	5	2	9	1	3	5	0	9	9	1	23	2	4	1	4	2	18	4	4	15	5	7	6	3	8	1	3	3	1	8	5	12	13	7	5	1	12	1	3	1	4	2	0	2	8	3	3	5	8	9	3	2	0
Virgularia gracillima	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pelagic																																																																													
Brachyura larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetognatha	0	0	0	0	1	0	0	0	0	0	1	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	1	0	1	0	0	0	0	0	0	0	0	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
Decapod larvae	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	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
Euphasidiacea	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	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hyperia sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	2	0	0	0	1	0	1	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	1	0	0	0	0	0	0	0	0	0
Natantia larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Salpidae	0	0	0	0	0	0	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	6	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	2	0	0	0	0	3	1	2
Stomatopoda larvae	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX J: Relevant pairwise comparisons from the second PERMANOVA model. Note: significant results ($p<0.05$) are shown in bold.

PERMANOVA 2: Pairwise Test: *Term 'Distance x Year' for pairs of levels of factor 'Distance'*

2012 Groups	t	P(perm)	Unique perms
1000, 2000	1.2459	0.0739	9921
1000, 250	2.3438	**0.0001**	9918
1000, 500	1.6552	**0.0005**	9910
1000, 4000	1.3143	**0.0396**	9926
1000, 6000	1.0092	0.4396	9911
2000, 250	2.7883	**0.0003**	9933
2000, 500	2.1752	**0.0002**	9925
2000, 4000	1.0452	0.3772	9930
2000, 6000	0.99479	0.4619	9912
250, 500	1.5907	**0.0029**	9928
250, 4000	2.4135	**0.0001**	9932
250, 6000	2.3097	**0.0002**	9916
500, 4000	1.9865	**0.001**	9931
500, 6000	1.8295	**0.0009**	9926
4000, 6000	0.98069	0.5467	829

2013 Groups	t	P(perm)	Unique perms
1000, 2000	1.4277	**0.0057**	9911
1000, 250	1.8591	**0.0002**	9920
1000, 500	1.5838	**0.0012**	9914
1000, 4000	1.3108	**0.0235**	9915
1000, 6000	1.5475	**0.0032**	9925
2000, 250	1.7857	**0.0003**	9919
2000, 500	1.3675	**0.0127**	9918
2000, 4000	1.2113	0.0872	9919
2000, 6000	1.2938	**0.0389**	9903
250, 500	1.5282	**0.001**	9891
250, 4000	1.4388	**0.0027**	9919
250, 6000	1.4179	**0.0054**	9884
500, 4000	1.4513	**0.0035**	9906
500, 6000	1.4448	**0.005**	9908
4000, 6000	1.0471	0.3865	829

2014 Groups	t	P(perm)	Unique perms
1000, 2000	1.4758	**0.0012**	9922
1000, 250	2.6434	**0.0001**	9927
1000, 500	1.6666	**0.0009**	9926
1000, 4000	1.2231	0.0649	9910
1000, 6000	1.3544	**0.0101**	9916
2000, 250	2.8473	**0.0001**	9931
2000, 500	2.0424	**0.0002**	9910
2000, 4000	1.027	0.3999	9902
2000, 6000	1.1533	0.1657	9911
250, 500	1.7147	**0.0005**	9908
250, 4000	2.3581	**0.0001**	9914
250, 6000	1.39	**0.0081**	9921
500, 4000	1.5489	**0.0077**	9913
500, 6000	1.2531	0.0724	9921
4000, 6000	0.89656	0.6962	830

2015 Groups	t	P(perm)	Unique perms
1000, 2000	1.0934	0.2702	9913
1000, 250	1.7738	**0.0001**	9928
1000, 500	1.2059	0.0915	9920
1000, 4000	1.2363	0.079	9890
1000, 6000	1.1856	0.1412	9920
2000, 250	2.1041	**0.0002**	9926
2000, 500	1.5143	**0.0032**	9930

2000, 4000	0.93189	0.6202	9911
2000, 6000	0.9275	0.6325	9923
250, 500	1.5445	**0.0019**	9941
250, 4000	1.8479	**0.001**	9941
250, 6000	1.5765	**0.0309**	9928
500, 4000	1.4243	**0.0062**	9909
500, 6000	1.3266	**0.0241**	9904
4000, 6000	1.0293	0.4527	830

2016 Groups	**t**	**P(perm)**	**Unique perms**
1000, 2000	1.1575	0.1366	9911
1000, 250	2.3499	**0.0001**	9927
1000, 500	1.2555	0.0562	9909
1000, 4000	1.5129	**0.0061**	9914
1000, 6000	1.2972	**0.0456**	9905
2000, 250	2.4759	**0.0002**	9913
2000, 500	1.5898	**0.0011**	9915
2000, 4000	1.3138	**0.0252**	9927
2000, 6000	1.1746	0.1244	9903
250, 500	1.7855	**0.0003**	9921
250, 4000	2.4908	**0.0001**	9921
250, 6000	1.9435	**0.0001**	9919
500, 4000	1.6238	**0.0008**	9916
500, 6000	1.271	0.0714	9925
4000, 6000	0.95084	0.5964	830

PERMANOVA 2: Pairwise Test: *Term 'Transect x Year' for pairs of levels of factor 'Transect'*

2012 Groups	**t**	**P(perm)**	**Unique perms**
East, North	1.4918	**0.0064**	9914
East, South	1.1629	0.1535	9927
East, West	1.1885	0.1275	9902
North, South	1.2105	0.1047	9914
North, West	1.019	0.4208	9914
South, West	1.4279	**0.005**	9908

2013 Groups	**t**	**P(perm)**	**Unique perms**
East, North	1.527	**0.0009**	9899
East, South	1.4481	**0.0029**	9895
East, West	1.4472	**0.006**	9912
North, South	1.4018	**0.0053**	9899
North, West	1.1327	0.1801	9907
South, West	1.2265	0.0716	9917

2014 Groups	**t**	**P(perm)**	**Unique perms**
East, North	1.1005	0.2249	9916
East, South	1.6851	**0.0002**	9919
East, West	1.2845	**0.042**	9905
North, South	1.1085	0.2206	9922
North, West	1.2072	0.0817	9897
South, West	1.2355	0.0733	9920

2015 Groups	**t**	**P(perm)**	**Unique perms**
East, North	1.213	0.1225	9926
East, South	1.0927	0.2539	9907
East, West	1.3245	**0.0122**	9888
North, South	1.3519	**0.0324**	9926
North, West	1.2018	0.1305	9918
South, West	1.451	**0.0025**	9908

2016 Groups	t	P(perm)	Unique perms
East, North	1.5389	**0.0014**	9920
East, South	1.5424	**0.0001**	9913
East, West	1.3552	**0.0189**	9911
North, South	1.1404	0.1633	9916
North, West	1.6521	**0.0004**	9900
South, West	1.657	**0.0004**	9920

APPENDIX K: Results from the SIMPER (similarity percentages) 1-way analysis for community differences among 2016 communities and 2012 - 2015 communities at MPA, and 2016 communities at MPA, North Control (NCc) and South Control (SCb). Only the highest 10 contributing taxa are shown for each comparison

Taxa	**MPA 2012 Av.Abund**	**MPA 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Paraonidae	3.63	5.67	2.26	1.33	4.60	4.60
Cirratulidae	2.92	4.17	1.29	1.28	2.62	7.22
Spiophanes sp.	2.79	3.64	1.19	1.27	2.42	9.64
Capitellethus zeylanicus	0.73	2.00	1.11	1.51	2.26	11.90
Ophiuroidea	0.88	2.15	1.10	1.50	2.24	14.14
Ampharetidae	1.33	2.14	1.09	1.36	2.22	16.36
Nucinella maoriana	2.58	3.15	1.02	1.21	2.09	18.44
Armandia maculata	0.67	1.71	1.01	1.35	2.06	20.50
Aglaophamus sp.	1.20	2.38	1.00	1.38	2.04	22.54
Pilargidae	0.00	1.27	0.98	1.38	2.00	24.54

Taxa	**MPA 2013 Av.Abund**	**MPA 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Paraonidae	5.01	5.67	1.15	1.15	2.87	2.87
Spiophanes sp.	2.11	3.64	1.11	1.50	2.75	5.62
Maldanidae	4.45	3.41	0.98	1.35	2.45	8.07
Phoxocephalidae	2.12	0.77	0.96	1.59	2.38	10.45
Haustoridae	1.59	0.27	0.91	1.57	2.26	12.71
Varinucula gallinacea	1.93	2.34	0.83	1.31	2.07	14.78
Mysidacea	1.22	0.05	0.76	1.42	1.90	16.68
Cirratulidae	4.67	4.17	0.76	1.31	1.90	18.58
Cumacea	2.29	1.56	0.76	1.29	1.88	20.46
Poroleda lanceolata	1.84	1.07	0.74	1.31	1.83	22.29

Taxa	**MPA 2014 Av.Abund**	**MPA 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Paraonidae	4.69	5.67	1.17	1.11	2.87	2.87
Sigalionidae	2.31	0.80	0.99	1.89	2.43	5.29
Spiophanes sp.	3.45	3.64	0.86	1.26	2.10	7.39
Cirratulidae	4.74	4.17	0.84	1.23	2.07	9.46
Armandia maculata	0.66	1.71	0.82	1.36	2.01	11.47
Cumacea	1.83	1.56	0.80	1.30	1.97	13.44
Nucinella maoriana	2.53	3.15	0.79	1.31	1.95	15.39
Maldanidae	4.09	3.41	0.79	1.37	1.94	17.33
Varinucula gallinacea	2.09	2.34	0.79	1.27	1.94	19.27
Phoxocephalidae	1.57	0.77	0.75	1.28	1.85	21.12

Taxa	**MPA 2015 Av.Abund**	**MPA 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Paraonidae	4.53	5.67	1.23	1.00	3.04	3.04
Armandia maculata	0.49	1.71	0.97	1.45	2.41	5.45
Spiophanes sp.	3.61	3.64	0.87	1.07	2.17	7.62
Cumacea	0.91	1.56	0.82	1.29	2.02	9.64
Nucinella maoriana	2.92	3.15	0.81	1.11	2.01	11.65
Varinucula gallinacea	2.21	2.34	0.81	1.19	2.01	13.66
Cirratulidae	4.37	4.17	0.79	1.13	1.96	15.62
Maldanidae	3.17	3.41	0.79	1.08	1.95	17.57
Lumbrineridae	2.41	2.42	0.74	1.12	1.83	19.40
Amphipoda	0.87	1.45	0.73	1.30	1.82	21.22

Taxa	**MPA 2016 Av.Abund**	**NCc 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Neonesidea sp.	0.22	2.37	1.45	2.99	3.45	3.45
Nucinella maoriana	3.15	1.00	1.40	1.99	3.31	6.76

Paraonidae	5.67	4.07	1.21	1.10	2.86	9.63
Varinucula gallinacea	2.34	1.45	0.87	1.35	2.06	11.68
Tanaidacea	0.71	1.75	0.82	1.50	1.94	13.62
Oligochaeta	0.88	1.36	0.81	1.26	1.92	15.54
Armandia maculata	1.71	0.78	0.77	1.38	1.82	17.36
Cumacea	1.56	2.30	0.73	1.29	1.72	19.08
Lumbrineridae	2.42	1.66	0.71	1.25	1.68	20.76
Capitellethus zeylanicus	2.00	1.48	0.69	1.25	1.63	22.39

Taxa	**MPA 2016 Av.Abund**	**SCb 2016 Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**	**Cum.%**
Paraonidae	5.67	3.30	1.63	1.10	3.68	3.68
Maldanidae	3.41	5.35	1.31	1.79	2.96	6.64
Ophiuroidea	2.15	3.48	1.21	2.09	2.74	9.38
Gastropoda	1.23	2.43	1.07	1.37	2.42	11.81
Armandia maculata	1.71	0.22	1.00	1.61	2.25	14.06
Cirratulidae	4.17	3.13	0.89	1.45	2.01	16.07
Onuphis aucklandensis	1.38	2.25	0.84	1.49	1.91	17.97
Aglaophamus sp.	2.38	3.57	0.84	1.56	1.90	19.87
Austrotindaria wrighti	0.19	1.46	0.83	1.84	1.89	21.76
Nucinella maoriana	3.15	2.26	0.81	1.08	1.84	23.60