NIWA
Taihoro Nukurangi

THE NIPPON FOUNDATION-NEKTON
OCEAN CENSUS

Ocean Census Bounty Trough: voyage report of the TAN2402 survey

Prepared for Ocean Census

May 2024

Climate, Freshwater & Ocean Science

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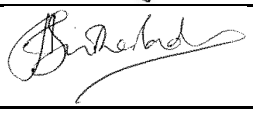
NIWA CLIENT REPORT No: 2024098WN
Report date: May 2024
NIWA Project: OCC24301

Revision	Description	Date
Version 0.1	Draft in preparation/in review	March-April 2024
Version 1.0	Final version sent to client	3 May 2024
Version 1.1	Revisions made after client review	27 May 2024

Quality Assurance Statement		
	Reviewed by:	Mike Williams
	Formatting checked by:	Jess Moffat
	Approved for release by:	Judy Sutherland

Suggested Citation:
Mills, S., Rogers, A., Moore D., Schnabel K., Leduc, D., Bolstad, K., Chin, C., Connell, A., Curtis, T., Downey, R., George, S., Gordon, J., Gress, E., Hall, J., Linley, T., Maurice, A., McIntyre, S., Miller, A., Orpin, A., Parsons-King, R., Stewart, A., Walton, K. (2024) Ocean Census Bounty Trough: voyage report of the TAN2402 survey in February 2024. *NIWA Client Report No.* 2024098WN. 113 pp.

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Executive summary

The Nippon Foundation-Nekton Ocean Census programme aims to accelerate the discovery of ocean life. In this co-planned and co-produced flagship mission with Ocean Census, NIWA and Museum of New Zealand Te Papa Tongarewa as partners we identified the Bounty Trough region of the Aotearoa/New Zealand Exclusive Economic Zone as an area which has been poorly sampled with respect to biodiversity, and hence provided an excellent opportunity to discover new species from a range of canyon, slope, channel and seamount habitats in depths of 600 to 5000 m. The expedition on Research Vessel *Tangaroa* departed Wellington on 8 February 2024 to explore, map and sample these deep-sea habitats for 21 days.

A team of 19 scientists, two videographers and 16 crew members from NIWA, Te Papa, Ocean Census and the Ocean Census Taxonomy Network were involved in the expedition. Bad weather days and gear issues meant that the plan had to be revised during the expedition. These changes to the plan reduced the overall number of sites that could be visited. The team successfully collected 17 hours of video, 6071 seafloor images, nearly 1800 invertebrate, fish and unsorted macrofauna and meiofauna samples, from 107 stations at 19 sampling sites. A total of 6354 specimen images of invertebrates and fish were collected, and tissue samples for genetic analyses were taken from many specimens.

Initial results point at the discovery of at least three new species of fish, a dozen large never-before-seen mollusc species, several new species of sea cucumber, two likely undescribed species of coral, and an unusual new species of anemone-like cnidarian. Detailed morphological examination and genetic sequencing remain to be conducted for these and other groups to confirm the taxonomic identification of the specimens collected. Among the macrofaunal and meiofaunal samples collected, we expect most species to be new to science or belong to known undescribed species. A taxonomic workshop has been arranged to sort these samples immediately after the voyage. The specimens, video footage and still images collected will also add new distribution and depth records for known species in this largely unexplored area of Aotearoa.

1 Introduction

The Bounty Trough is a mid-cretaceous rift basin bounded on the north by the Chatham Rise and on the south by the Campbell Plateau. Through its centre runs the pronounced 800 km long Bounty Channel in depths of 1500–5000 m. The South Island of New Zealand provides the largest source of sediment and a potential food source for fauna living in the Bounty Trough via the system of canyons and channels at the western head of the trough (Carter & Carter, 1987). The Bounty fan extends down to nearly 5000 m towards the Southwest Pacific abyssal plain. The Bounty Trough system has characterised the eastern New Zealand margin since at least the Palaeocene (55-60 Ma) and may represent the longest-lived sediment transport system yet recognised on earth (Carter & Carter 1987).

There is very little previous biological sampling or imagery from the central and eastern half of the proposed research area. However, we expected the slope, channel floor and terminal fan of the trough to mostly be comprised of soft sediments with associated macro- and meio-infauna and epifaunal communities.

Several seamounts are dotted along the channel, and we expected these to have areas of stony coral thickets or reefs, gorgonian and black coral communities on their summits, including species of sponge, anemones and echinoderms.

Canyon areas at the edge of the Otago shelf are known to be inhabited by bryozoan beds (Wood & Probert, 2013), though we expected that they may be in lower densities within the head of Papanui Canyon.

Pockmark fields were identified along the Otago margin (see Hillman et al. 2023), which we expected may contain cold seep communities such as tube worms or seep clams.

1.1 Objectives

The overall scientific goal of this voyage is to accelerate the discovery of species from the New Zealand region by visiting the Bounty Trough area, which is very under-sampled based on records from New Zealand Scientific Collections and hence will yield many undescribed species.

The specific objectives of the voyage were:

1. Investigation of the infaunal diversity in continental shelf and slope habitats at the head of the Bounty system (canyons, pockmarks), the Bounty Channel and adjacent slope, the Bounty Fan, and abyssal plain.
2. Investigation of the epifaunal invertebrate and fish diversity of seamount, canyon and pockmark habitats, and along the Bounty Channel and adjacent slope.
3. Investigation of bait-attracted invertebrate and fish faunal diversity in the Bounty Trough area.

2 Ocean Census

The Nippon Foundation-Nekton Ocean Census programme aims to accelerate species discovery using a combination of approaches. These include digitisation of all data associated with a species; the use of new technologies to accelerate and enable the process of species discovery and description; capacity development and the establishment of a global network of marine taxonomists and Ocean Census Biodiversity Centres to enable access to training and modern scientific facilities (Rogers et al., 2023). Ocean Census is also expedition-based, undertaking missions from the coastal zone to the deepest parts of the ocean. Expeditions either coincide with or are followed by taxonomic workshops involving experienced taxonomists, early career researchers and students. Specimens collected on Ocean Census expeditions are lodged with local institutions forming the basis of reference collections for regional marine biodiversity studies. All Ocean Census expeditions are also co-planned and co-produced with host countries in the case of coastal expeditions or with countries from the region in the case of missions to areas beyond national jurisdiction (ABNJ). This combination of approaches is aimed to offer opportunities to all states and their scientists to participate in Ocean Census Expeditions and to benefit from opportunities to discover and describe species from their regions. These approaches avoid a colonial approach to global species discovery and description.

The Ocean Census NIWA expedition to the Bounty Trough is a Flagship Mission that illustrates the co-planning and co-production strategy described above. In discussions with Ocean Census, scientists from the partner organisation, NIWA, identified the Bounty Trough as a region of the New Zealand Exclusive Economic Zone that has been poorly sampled with respect to biodiversity. Knowledge of the seafloor of this region is also sparse and it is not completely mapped. This provided an excellent opportunity for species discovery in New Zealand waters and together Ocean Census has worked with regional biodiversity experts from NIWA and Museum of New Zealand Te Papa Tongarewa (Te Papa), the national museum aimed at undertaking research on, and preserving the heritage of New Zealand cultures and knowledge of the natural environment, to co-plan and undertake the Bounty Trough mission. The expedition, undertaken on NIWA's RV *Tangaroa* was followed by a taxonomic workshop at NIWA Headquarters and Te Papa in Wellington. A separate report will cover the activities of this workshop. Taxonomists and para-taxonomists drawn from NIWA, Te Papa, and their networks as well as the Ocean Census Taxonomy Network will sort and identify the samples and specimens from the Bounty Trough expedition with the purpose of discovery and description of new species and training and capacity development within the country and wider Ocean Census community. All samples from this mission will be curated in perpetuity by NIWA and Te Papa on behalf of New Zealand and the wider scientific community.

2.1 Voyage Scientific Staff

Twenty-one staff (19 scientists and two videographers) from the Ocean Census Network, NIWA, and Te Papa joined the expedition. The participants, their organisational affiliation and role on the voyage are listed in Table 2-1. Two representatives from Hokonui Rūnanga (Ngāi Tahu) were invited to join the expedition, but unfortunately were unable to join the vessel as a result of outside circumstances.

Table 2-1: TAN2402 Scientific Staff, their affiliation and role on the voyage.

Name	Organisation	Role
Alex David Rogers	Ocean Census, UK	Co-Voyage Leader/Science Director
Daniel Moore	Ocean Census, UK	Expedition Science Manager
Tim Curtis	Video East, UK	Videographer
Rebekah Parsons-King	NIWA	Videographer/Communications Lead
Sadie Mills	NIWA	Voyage Leader/NIWA project manager
Daniel Leduc	NIWA	Watch Leader/DTIS/benthic sampling
Kareen Schnabel	NIWA	Watch Leader/DTIS/benthic sampling
Amelia Connell	NIWA	Biosecurity officer/Benthic curation co-lead
Caroline Chin	NIWA	Chemical officer/Benthic curation co-lead
Alan Orpin	NIWA	Coring lead/Multibeam/Geology
Alicia Maurice	NIWA	Multibeam lead
Steve George	NIWA	Electronics/DTIS
Jacob Hall	NIWA	Electronics/DTIS
Thom Linley	NMNZ/Te Papa Tongarewa	Landers/ Fish taxonomy
Andrew Stewart	NMNZ/Te Papa Tongarewa	Fish Taxonomy
Kerry Walton	NMNZ/Te Papa Tongarewa	Molluscan taxonomy
Erika Gress	Independent	Ocean Census Taxonomist – Black coral
Kathrin Bolstad	Auckland University of Technology, NZ	Ocean Census Taxonomist – Cephalopoda
Allison Miller	University of Otago, NZ	Ocean Census Taxonomist – Holothuroidea
Jessica Gordon	University of Essex, UK	Ocean Census Taxonomist – corals
Rachel Downey	Australia National University, Australia	Ocean Census Taxonomist – Porifera

The scientific staff worked in two 12-hour watches per Table 2-2.

Table 2-2: TAN2402 Scientific Staff Shifts.

Name	0000-1200	1200-2400	0700-1900	Floating
Sadie Mills			●	
Alex Rogers			●	
Daniel Moore			●	
Tim Curtis				●
Rebekah Parsons-King				●
Kareen Schnabel		●		
Amelia Connell		●		
Steve George		●		
Alicia Maurice		●		
Thom Linley		●		
Kerry Walton		●		
Rachel Downey		●		
Allison Miller		●		
Daniel Leduc	●			
Caroline Chin	●			
Jacob Hall	●			
Alan Orpin	●			
Jessica Gordon	●			
Kathrin Bolstad	●			
Erika Gress	●			
Andrew Stewart	●			

2.2 Vessel crew

The Research Vessel *Tangaroa* crew for this expedition are listed in Table 2-3.

Table 2-3: Research Vessel *Tangaroa* personnel.

Name	Organisation	Role
Gus Van Wyk	NIWA Vessels	Master
Ian Popenhagen	NIWA Vessels	1st Mate
Marrisa Judkins	NIWA Vessels	2nd Mate
Andy Lyon	NIWA Vessels	Additional 2nd Mate
Arne Hines	NIWA Vessels	Chief Engineer
Eritaia Kaipati	NIWA Vessels	2nd Engineer
Setaleki Vaivevea	NIWA Vessels	3rd Engineer
Grant Wilkinson	NIWA Vessels	1st Cook
Andre Alexander	NIWA Vessels	2nd Cook
Jo Jackman	NIWA Vessels	Steward
Glen Walker	NIWA Vessels	Bosun
Peter Wall	NIWA Vessels	Leading Hand
Michael O'Connor	NIWA Vessels	Deckhand
Bruce McIntyre	NIWA Vessels	Deckhand
Dean Hardcastle	NIWA Vessels	Deckhand
Barry Fleming	NIWA Vessels	Deckhand

3 Methods

3.1 Survey and project identification

NIWA Project Code: OCC24301

NIWA Project Manager/Voyage Leader: Sadie Mills

Ocean Census Science Director/Co-Voyage Leader: Alex Rogers

Vessel: RV *Tangaroa*

Voyage number: TAN2402

3.2 Survey area

The surveyed area was in the Bounty Trough. It extended from the canyons incising the Otago continental shelf to the Bounty Channel and adjacent slope, the Bounty Fan, and abyssal plain (Fig. 3-1). Sampling did not occur within the 12 nautical mile territorial sea, or outside the Exclusive Economic Zone, nor did any sampling occur within benthic protected areas.

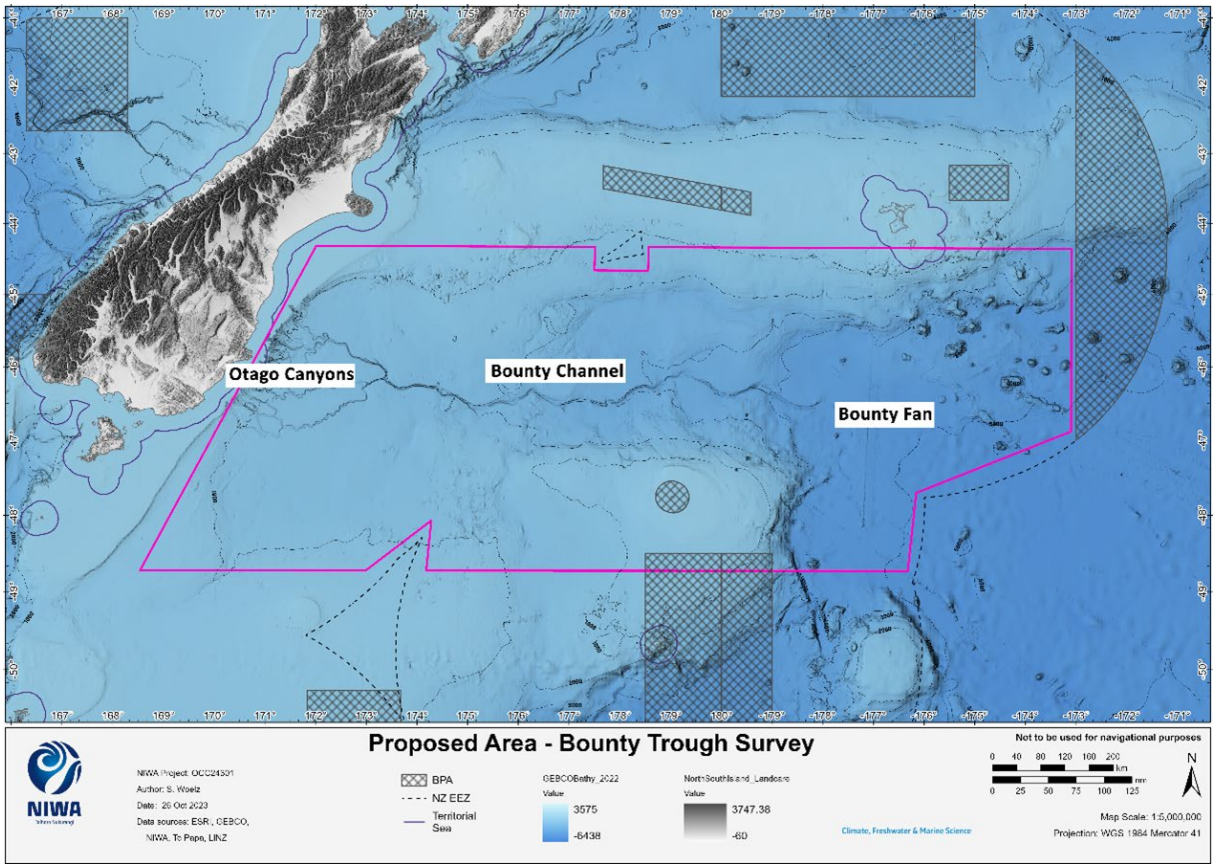
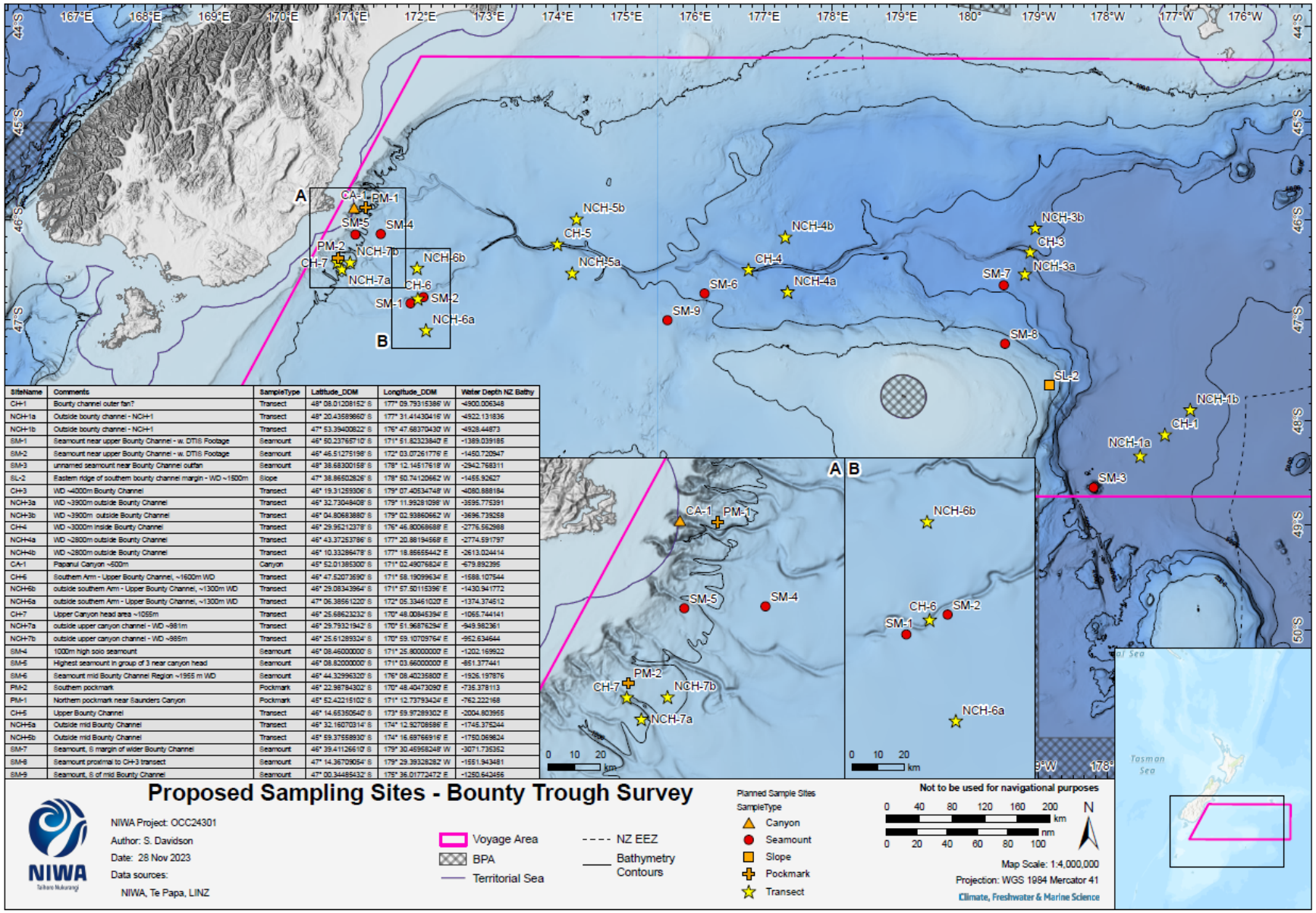


Figure 3-1: Location map showing survey area in the Bounty Trough area.

3.3 Overall survey design

The survey design was split into five main components:

1. a series of transect lines across the Bounty Channel and tributaries from 1000 to 5000 m nominal water depth, with each transect comprising one site within the channel and one site either side of the channel;
2. a slope site on the eastern ridge of Bounty Plateau;
3. selected sites on seamounts with summits at a range of depths;
4. a site at the head of Papanui canyon; and,
5. pockmark features on the continental slope.



SiteName	Comments	SampleType	Latitude_DDM	Longitude_DDM	Water Depth NZ Bathy
CH-1	Bounty channel outer fan?	Transect	48° 08.01208152' S	177° 09.79315386' W	-4900.006348
NCH-1a	Outside bounty channel - NCH-1	Transect	48° 20.43589860' S	177° 31.41430416' W	-4922.131836
NCH-1b	Outside bounty channel - NCH-1	Transect	47° 53.39400822' S	176° 47.68370430' W	-4928.44873
SM-1	Seamount near upper Bounty Channel - w. DTIS Footage	Seamount	46° 50.23765710' S	171° 51.82323840' E	-1389.039185
SM-2	Seamount near upper Bounty Channel - w. DTIS Footage	Seamount	46° 46.51275198' S	172° 03.07261776' E	-1450.720947
SM-3	unnamed seamount near Bounty Channel outfan	Seamount	48° 38.68300158' S	178° 12.14517618' W	-2942.768311
SL-2	Eastern ridge of southern bounty channel margin - WD ~1500m	Slope	47° 38.86602826' S	178° 50.74120662' W	-1455.92627
CH-3	WD ~4000m Bounty Channel	Transect	46° 19.31259306' S	179° 07.40534748' W	-4080.888184
NCH-3a	WD ~3900m outside Bounty Channel	Transect	46° 32.73048408' S	179° 11.99281098' W	-3695.775391
NCH-3b	WD ~3900m outside Bounty Channel	Transect	46° 04.80683880' S	179° 02.93860662' W	-3696.739258
CH-4	WD ~3000m inside Bounty Channel	Transect	46° 29.95212378' S	176° 46.80068688' E	-2776.562988
NCH-4a	WD ~2800m outside Bounty Channel	Transect	46° 43.37253786' S	177° 20.88194568' E	-2774.591797
NCH-4b	WD ~2800m outside Bounty Channel	Transect	46° 10.33286478' S	177° 18.85665442' E	-2613.024414
CA-1	Papanui Canyon ~500m	Canyon	46° 52.01385300' S	171° 02.49076834' E	-679.892395
CH-6	Southern Arm - Upper Bounty Channel, ~1600m WD	Transect	46° 47.52073690' S	171° 58.19099634' E	-1588.107544
NCH-6b	outside southern Arm - Upper Bounty Channel, ~1300m WD	Transect	46° 29.08343964' S	171° 57.50115396' E	-1430.941772
NCH-6a	outside southern Arm - Upper Bounty Channel, ~1300m WD	Transect	47° 06.38561220' S	172° 05.33461020' E	-1374.374512
CH-7	Upper Canyon head area ~1055m	Transect	46° 25.68623232' S	170° 48.00845394' E	-1065.744141
NCH-7a	outside upper canyon channel - WD ~981m	Transect	46° 29.79321942' S	170° 51.96876294' E	-949.982361
NCH-7b	outside upper canyon channel - WD ~985m	Transect	46° 25.61289324' S	170° 59.10709764' E	-952.634644
SM-4	1000m high solo seamount	Seamount	46° 08.46000000' S	171° 25.80000000' E	-1202.169922
SM-5	Highest seamount in group of 3 near canyon head	Seamount	46° 08.82000000' S	171° 03.66000000' E	-851.377441
SM-6	Seamount mid Bounty Channel Region ~1955 m WD	Seamount	46° 44.32996320' S	176° 08.40235800' E	-1926.197876
PM-2	Southern pockmark	Pockmark	46° 22.98784302' S	170° 48.40473090' E	-735.378113
PM-1	Northern pockmark near Saunders Canyon	Pockmark	45° 52.42215102' S	171° 12.73793424' E	-762.222168
CH-5	Upper Bounty Channel	Transect	46° 14.65350540' S	173° 59.97289302' E	-2004.803955
NCH-5a	Outside mid Bounty Channel	Transect	46° 32.16070314' S	174° 12.92708588' E	-1745.375244
NCH-5b	Outside mid Bounty Channel	Transect	45° 59.37558930' S	174° 16.69766916' E	-1750.069824
SM-7	Seamount, S margin of wider Bounty Channel	Seamount	46° 39.41126610' S	175° 30.45958248' W	-3071.735352
SM-8	Seamount proximal to CH-3 transect	Seamount	47° 14.36709054' S	179° 29.39328282' W	-1551.943481
SM-9	Seamount, S of mid Bounty Channel	Seamount	47° 00.34485432' S	175° 36.01772472' E	-1250.642456

Figure 3-2: Planned sampling sites in the Bounty Trough area.

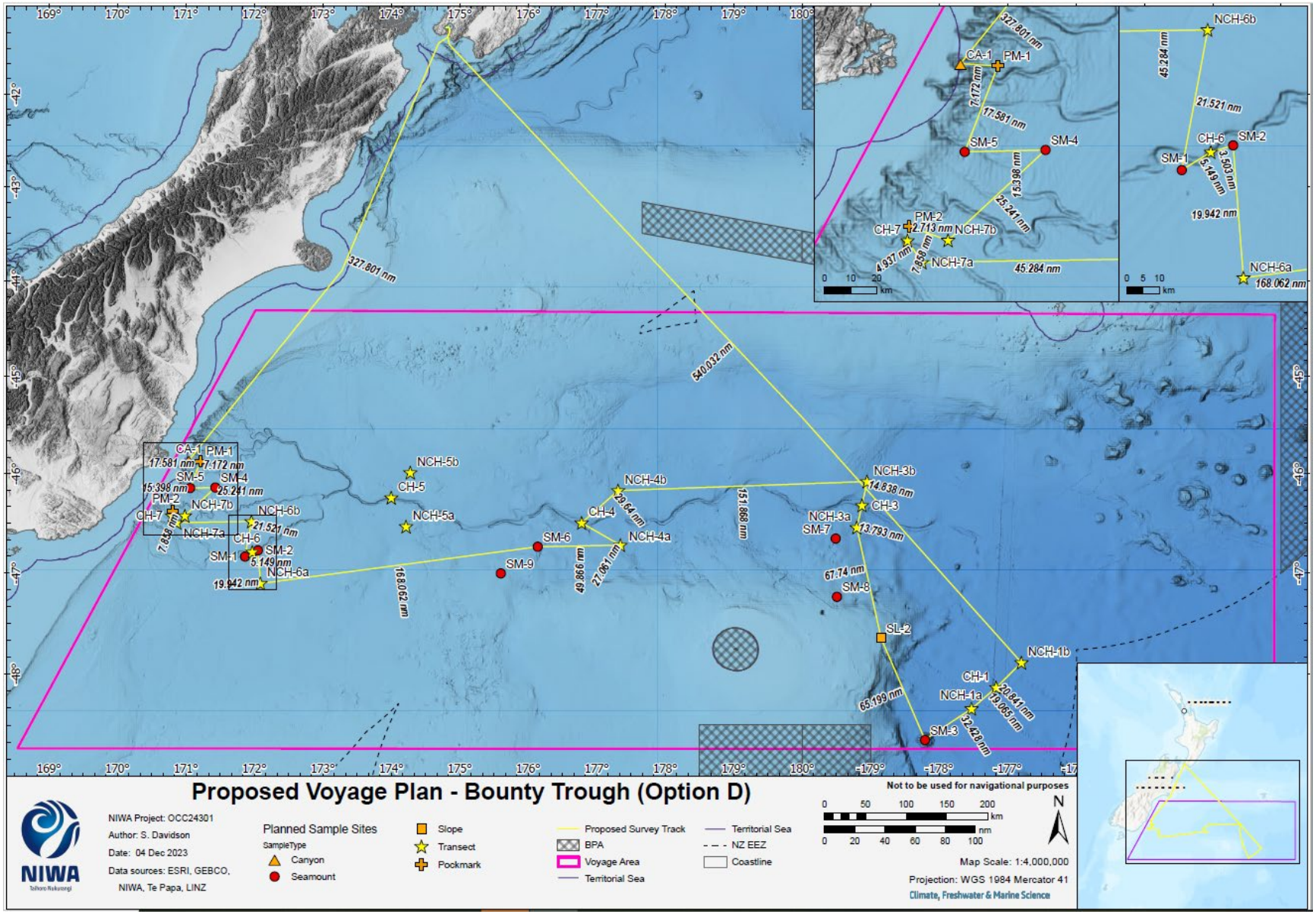


Figure 3-3: Planned transit between sampling sites in the Bounty Trough area.

This survey design allowed us to target a variety of benthic habitats and water depths thus maximising species discovery.

The first stop of the voyage was planned in deep water just outside Cook Strait. This allowed 5 km of wire cable on the coring winch to be streamed out to prepare for abyssal deployments. Once this was completed, we aimed to transit to the shallowest sites of our survey offshore from the Otago coast on the edge of the continental slope at 400-700 m and work deeper along the channel and westwards at channel transect sites, seamounts, and on the Bounty Plateau slope (Figs 3-2 & 3-3). We aimed to finish our survey at the deepest site at ~4900 m.

An alternate transect and several seamount sites were identified should there have been time gained in the sampling programme at any stage to visit additional sites or if the plans needed to change to accommodate shallower sample sites.

Below is a table of the planned sites as shown in Figs 3-2 and 3-3 their position and approximate depths (Table 3-1).

Table 3-1: Planned sampling stations in the Bounty Trough Area. Asterisks (*) indicates optional sites to be sampled if time allows or an alternate sampling plan is required.

Site Name	Comments	Sample Type	Latitude (DDM)	Longitude (DDM)	Water Depth (m, GEBCO)	Water Depth (m, NZBathy)
CH-1	Bounty Channel outer fan	Transect	48° 08.0121' S	177° 09.7932' W	4907	4900
NCH-1a	Outside Bounty Channel - NCH-1	Transect	48° 20.4359' S	177° 31.4143' W	4912	4922
NCH-1b	Outside Bounty Channel - NCH-1	Transect	47° 53.3940' S	176° 47.6837' W	4880	4928
SM-1	Seamount near upper Bounty Channel – prev. DTIS Footage	Seamount	46° 50.2377' S	171° 51.8232' E	1307	1389
SM-2	Seamount near upper Bounty Channel – prev. DTIS Footage	Seamount	46° 46.5128' S	172° 03.0726' E	1128	1451
SM-3	Unnamed seamount near Bounty Channel fan	Seamount	48° 38.6830' S	178° 12.1452' W	2956	2943
SL-2	Eastern ridge of South Bounty Channel margin - WD ~1500m	Slope	47° 38.8650' S	178° 50.7412' W	1448	1456
CH-3	WD ~4000m Bounty Channel	Transect	46° 19.3126' S	179° 07.4053' W	4411	4081
NCH-3a	WD ~3900m outside Bounty Channel	Transect	46° 32.7305' S	179° 11.9928' W	3998	3596
NCH-3b	WD ~3900m outside Bounty Channel	Transect	46° 04.8068' S	179° 02.9386' W	3945	3697
CH-4	WD ~3000m inside Bounty Channel	Transect	46° 29.9521' S	176° 46.8007' E	3008	2777
NCH-4a	WD ~2800m outside Bounty Channel	Transect	46° 43.3725' S	177° 20.8819' E	2826	2775

Site Name	Comments	Sample Type	Latitude (DDM)	Longitude (DDM)	Water Depth (m, GEBCO)	Water Depth (m, NZBathy)
NCH-4b	WD ~2800m outside Bounty Channel	Transect	46° 10.3329' S	177° 18.8566' E	2779	2613
CA-1	Papanui Canyon ~500m	Canyon	45° 52.0139' S	171° 02.4908' E	426	680
CH-6	Upper South Bounty Channel, ~1600m WD	Transect	46° 47.5207' S	171° 58.1910' E	1635	1588
NCH-6b	Outside upper South Bounty Channel, ~1300m WD	Transect	46° 29.0834' S	171° 57.5012' E	1383	1431
NCH-6a	Outside upper South - Bounty Channel, ~1300m WD	Transect	47° 06.3856' S	172° 05.3346' E	1375	1374
CH-7	Upper South Bounty Channel head area near Brodie Canyon ~1055m	Transect	46° 25.6862' S	170° 48.0085' E	1000	1066
NCH-7a	Outside upper South Bounty Channel - WD ~981m	Transect	46° 29.7932' S	170° 51.9688' E	980	950
NCH-7b	Outside upper South Bounty Channel - WD ~985m	Transect	46° 25.6129’ S	170° 59.1071' E	986	953
SM-4	1000m relief solo seamount	Seamount	46° 08.4600' S	171° 25.8000' E	1156	1202
SM-5	Highest relief seamount in group of 3 near canyon head	Seamount	46° 08.8200' S	171° 03.6600' E	705	851
SM-6	Seamount mid Bounty Channel Region ~1955 m WD	Seamount	46° 44.3230' S	176° 08.4024' E	1955	1926
PM-2	Southern pockmark	Pockmark	46° 22.9878' S	170° 48.4047' E	773	735
PM-1	Northern pockmark near Saunders Canyon	Pockmark	45° 52.4222' S	171° 12.7379' E	798	762
CH-5*	Upper Bounty Channel	Transect	46° 14.6535' S	173° 59.9729' E		2005
NCH-5a*	Outside mid Bounty Channel	Transect	46° 32.1607' S	174° 12.9271' E		1745
NCH-5b*	Outside mid Bounty Channel	Transect	45° 59.3756' S	174° 16.6977' E		1750
SM-7*	Seamount, S margin of wider Bounty Channel	Seamount	46° 39.4113' S	179° 30.4596' W		3072
SM-8*	Seamount proximal to CH-3 transect	Seamount	47° 14.3671' S	179° 29.3933' W		1552
SM-9*	Seamount, south of mid Bounty Channel	Seamount	47° 00.3449' S	175° 36.0178' E		1251

3.4 Sampling operations

3.4.1 Shipboard Multibeam Echosounder and Sub-bottom Profiler

The hull-mounted acoustic systems onboard RV *Tangaroa* were important for mapping the seafloor and to produce shallow sub-seafloor data. In concert with any pre-existing benthic information, the multibeam echo-sounder system (MBES) helped to produce high-resolution bathymetric maps at the survey sites for deployment of seafloor camera and benthic sampling equipment. Continuous high-resolution multibeam coverage of the shelf break to the basin floor of the Otago canyon system (referred to historically as the Otago Fan Complex) existed from earlier NIWA multibeam surveys, negating the need for new bathymetric data at slope and western canyon-channel sites.

A hull-mounted Kongsberg EM302 30 kHz multibeam echosounder (MBES) was used on the TAN2402 expedition for two purposes: (1) create high-resolution bathymetric maps at the pre-defined survey sites; and (2), collect opportunistic transit data throughout the Bounty Trough and on the southward and return transits to and from port. Site surveys generally consisted of at least two opposing passes of the MBES swath across the target site, at a reduced survey speed of ~6 knots and around 30% overlap of swath coverage. Water column (*.wcd files) and backscatter data were also logged whenever the MBES was running, but because of resource and time limitations these data were not processed or used operationally during the expedition.

Raw bathymetric data were lightly cleaned and processed in QPS Qimera to generate a cube surface of the bathymetric coverage, typically at 75 m, but ranging from 60-100 m, grid resolution, depending on water depth, coverage, data quality (seastate) and sounding density. A floating point geotiff was exported to ArcGIS Pro, where an appropriate colour ramp, hillshade, contour interval and map graticule interval were applied to create a geo-referenced base map within the Ocean Floor Observation Protocol (OFOP; https://www.emma-technologies.com/en/products/software/ofop/) software for benthic video operations.

The Kongsberg TOPAS PS 18 Parametric Sub-Bottom Profiler (SBP) was used to acoustically image the sub-seafloor strata and structure. The SBP was configured with a chirp pulse from 2.0–6.0 kHz and a pulse length of 15 ms. The SBP provided additional verification of soft sediment locations for multicoring potential. Sub-bottom penetration in excess of 100 m can be achieved under ideal conditions, bottom geometry and soft seafloor substrata, but performance is significantly reduced over compact sand, gravel, rock or hard substrata, and acoustic performance is adversely affected by steep terrain.

During transits, five hull-mounted Simrad EK60 General Purpose Transceiver (GPT) and EK80 Wide-band Transceiver (WBT), split-beam echosounders operating at 5 nominal frequencies (18, 38, 70, 120 and 200 kHz) were turned on to collect opportunistic fisheries acoustic measurements (see Table 3-2). In total, 188 GB of opportunistic data were collected during the trip.

Table 3-2: Fisheries echosounders used during transit for opportunistic data collection (TAN2402).

Echo sounder type	Mode	Frequency range	Pulse length	Power	Recording range
Simrad WBT EK80	FM	12-27kHz	4ms	1000W	1200m
Simrad GPT EK60	CW	38kHz	1ms	2000W	1200m
Simrad WBT EK80	FM	45-90kHz	4ms	750W	900m
Simrad GPT EK60	CW	120kHz	1ms	250W	700m
Simrad GPT EK60	CW	200kHz	1ms	150W	500m

Acoustic acquisition was synchronised using a Kongsberg K-Sync system during transit legs to coordinate the use of the MBES with multiple other echosounders. To maximise the along-track resolution of the MBES during site surveys, all other sounders were deactivated. This was particularly critical in deep water (>4,000 m) because the MBES shot-rate extended to around 10+ seconds if used in conjunction with a single-beam sounder.

3.4.2 Sound velocity profiles

The Sound Velocity Profiles (SVP) were collected using an AML Smart Probe Minos-X to measure the speed of sound in water from the surface to either close to the seafloor or approximately 1500 m maximum, whichever came first. Sound velocity profiles are essential to calibrate the multibeam system and are reacquired whenever changes were detected in the water column structure, such as changes in water temperature, water motions (tides and currents), and the passage of storms and wind direction. In general terms, a new SVP was collected at each new survey site, particularly when separated by significant distance (>150+ km) and/or time since that last SVP. During long transits, when time schedules could not accommodate SVP deployments, modelled SVP profiles were generated from a global database using Sound Speed Manager software (www.hydroffice.org/soundspeed/main).

3.4.3 Seabed video and photographic transect survey

We used NIWA's Deep Towed Imaging System (DTIS) to survey the large animals (>2cm) that live on or just above the seafloor (Fig. 3-4). DTIS is a battery-powered towed camera frame which records continuous high definition (HD) digital video (1080p, @ 60 fps) and simultaneously takes high definition (24 megapixel) still images at 10 second intervals. The video camera is orientated obliquely pointing forwards at about 35° from vertical and the still camera faces directly downwards (0°). Full resolution video and still images are recorded at the seabed and downloaded on return to the surface. Oblique images tend to be useful for identification of seabed biota whilst vertical images are better for quantification of benthic fauna. A lower resolution video image is transmitted to the surface in real time enabling control of camera altitude and initial evaluation of seabed substratum types and biological assemblages. DTIS transects were at a target altitude above the seabed of 1.5 to 2.5 metres and towed for at least 40 minutes at 0.5 to 1 knot. The seabed position and depth of DTIS were planned to be tracked in real time using the Kongsberg ultra-short baseline (USBL) transponder system. Unfortunately, the vessel Hi-PAP system was not functioning correctly on this survey, so the DTIS was used without a beacon for all deployments and its position was estimated by the ship officer of the watch. DTIS control and data collection during operations were based in the Hydro-Dry Lab, with the DTIS vehicle itself deployed on the CTD winch cable from the starboard cut-away.

During all deployments, live, spatially referenced observations on the occurrence of biological assemblages (at relatively coarse taxonomic resolution) and substratum types were recorded by observers using the OFOP system. These initial observations were logged directly to an onboard database. The seabed position of DTIS was plotted in real time (although note that no beacon was used during this survey) using OFOP software with all navigation data, camera commands, and spatially referenced observations of seabed type and the occurrence of biological assemblages recorded to OFOP log files and captured by the ship's Data Acquisition System (DAS).

A Seabird SBE37 Microcat CTD was attached to the DTIS frame during all deployments, to record salinity, temperature and depth. After each transect, all still images and video files were downloaded and transferred to the ship's server for storage.

DTIS transects were run in Dynamic Positioning (DP) mode, to maintain course and speed. This had been successfully done in previous deep-water surveys using the main azimuth thruster, and minimising use of bow or stern thrusters. The use of DP enables much improved DTIS control, as well as excellent quality imagery.

Figure 3-4: NIWA's Deep Towed Imaging System (DTIS). [Photo: Rebekah Parsons-King, NIWA].

3.4.4 Sediment sampling

An Ocean Instruments MC800 multicorer was used for precision seafloor sampling across the sediment-water interface. The multicorer is comprised of a weighted spider of tube-assemblies mounted on a sliding metal frame that is hydraulically damped to ensure a "soft landing" of the tubes into the seafloor and to minimise disturbance of the collected substrata. Tube assemblies include spring-loaded caps and feet to retain the substrate within the tubes, that are cocked prior to deployment. The spider can accommodate up to eight barrels of 9.5-cm diameter and 70 cm length, allowing a single deployment of the multi-corer results to co-collect multiple sediment samples, such as sediment characteristics and infaunal (macrofaunal and meiofaunal) samples. Whilst the multicorer has capacity for eight core tubes, only four tubes were used to give the best balance between seafloor penetration and reliable returns. Additional weights (~40 kg) were added to the spider head of the multicorer to ensure sufficient seabed penetration, which varies depending on the nature of the sediment (e.g., mud or sand). We used the previous DTIS footage to target areas of soft sediment and deployed 4 tubes on at least two deployments of the corer at each suitable sampling site (Fig. 3-5).

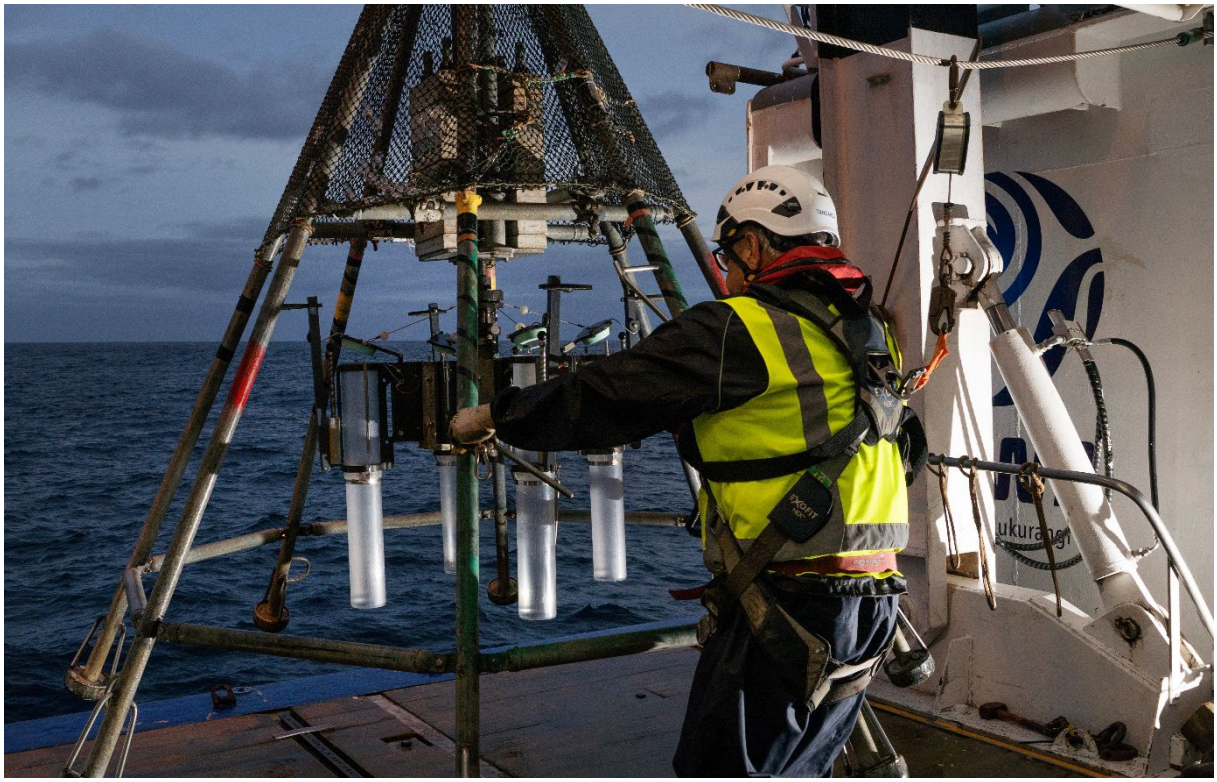


Figure 3-5: Multicorer deployment with 4 tubes rigged for collection of faunal and sediment samples. [Photo: Rebekah Parsons-King, NIWA].

At each site, we aimed to collect three cores of sediment for macrofauna with each core sliced in 5 cm increments (0–5, 5–10, and 10–15 cm) and sieved on 300-micron mesh at sea (Fig. 3-6). The macrofauna samples were then fixed in either 99% ethanol (2 cores per site) or 10% buffered formalin (1 core per site). If fewer than 3 macrofauna cores were obtained from a site, the ethanol-preserved cores were prioritised over formalin-fixed ones.

Figure 3-6: Sediment being sliced in 5 cm sections from an extruded multicore tube for macrofauna.
[Photo: Rebekah Parsons-King, NIWA]

At each site, we aimed to collect three cores of sediment for analyses of meiofauna. Each meiofauna core was processed as follows:

- Two 29 mm internal diameter cut-off syringes were used to collect meiofauna subcores, with each subcore sliced into 0-1 and 1-5 cm sediment depth layers (Fig. 3-7). One subcore was fixed in 10% buffered formalin and the second subcore was fixed in 99% ethanol.
- Three samples for eDNA analyses were collected by scooping surface sediment around the meiofauna subcores. These samples were kept in 50 ml falcon tubes and kept frozen (-80°C).
- The remaining top 5 cm of sediment was transferred into a Twirlem/Whirlpak bag and kept as a sediment archive sample (frozen at -20°C).

Figure 3-7: Sediment being sliced from a subcore for meiofauna. [Photo: Rebekah Parsons-King, NIWA].

We also aimed to collect one core per multicorer deployment for analyses of sediment parameters (e.g., grain size, organic matter content, pigments, etc). These cores were sliced as follows: 0.5 cm layers down to 2 cm sediment depth; 1 cm layers down to 10 cm sediment depth; and 2 cm layers down to the bottom of the core. Each sediment slice was transferred to a whirlpak bag and kept frozen at -20°C.

The Van Veen grab is a small bucket-like grab sampler, which comprises two hinged buckets with extended lever arms, contained with a frame to assist handling and operation stability (Fig. 3-8). The grab was used at sites where the substratum was deemed too sandy or hard for the multicorer. The surface area sampled by the grab is 0.2 m^2, and penetration into the seafloor is usually 10–20 cm, removing a maximum sediment volume of 0.04 m^3. Grab samples were taken when the multicorer failed to penetrate into the coarser sediment surface, or where it was felt that biological samples could be collected without having to use larger towed gear which would have more impact. When sufficiently undisturbed sediment was collected, core for analyses of macrofauna, meiofauna and sediment parameters were collected using the same method as for the multicorer samples.

Figure 3-8: Van Veen Grab used for collection of faunal and sediment samples. [Photo: Rebekah Parsons-King, NIWA].

A boxcorer was brought as back up to the multicorer but was not used on this survey (Fig. 3-9).

3.4.5 Seabed sampling

NIWA's "Seamount" epibenthic sled is 1.5 m long, by 1.0 m wide, and has a vertical opening of 0.5 m. It is fitted with a positioning beacon, meaning we can target fauna of interest seen in DTIS transects to collect live specimens (Fig. 3-9, left). It is towed at 1-1.5 knots and can be used on sloped, somewhat rugged, hard rocky seafloor. The beam trawl consists of a net attached to a 4.2 m wide beam that is towed slowly at 1.5 knots for up to 1 km of soft-smooth seafloor to sample benthic invertebrate fauna and small fish (Fig. 3-9, right). The beam trawl has a ground-rope with small rubber discs and metal skids at each end of the beam that prevent it from digging into the sediment. It cannot be used on hard or rough seabed.

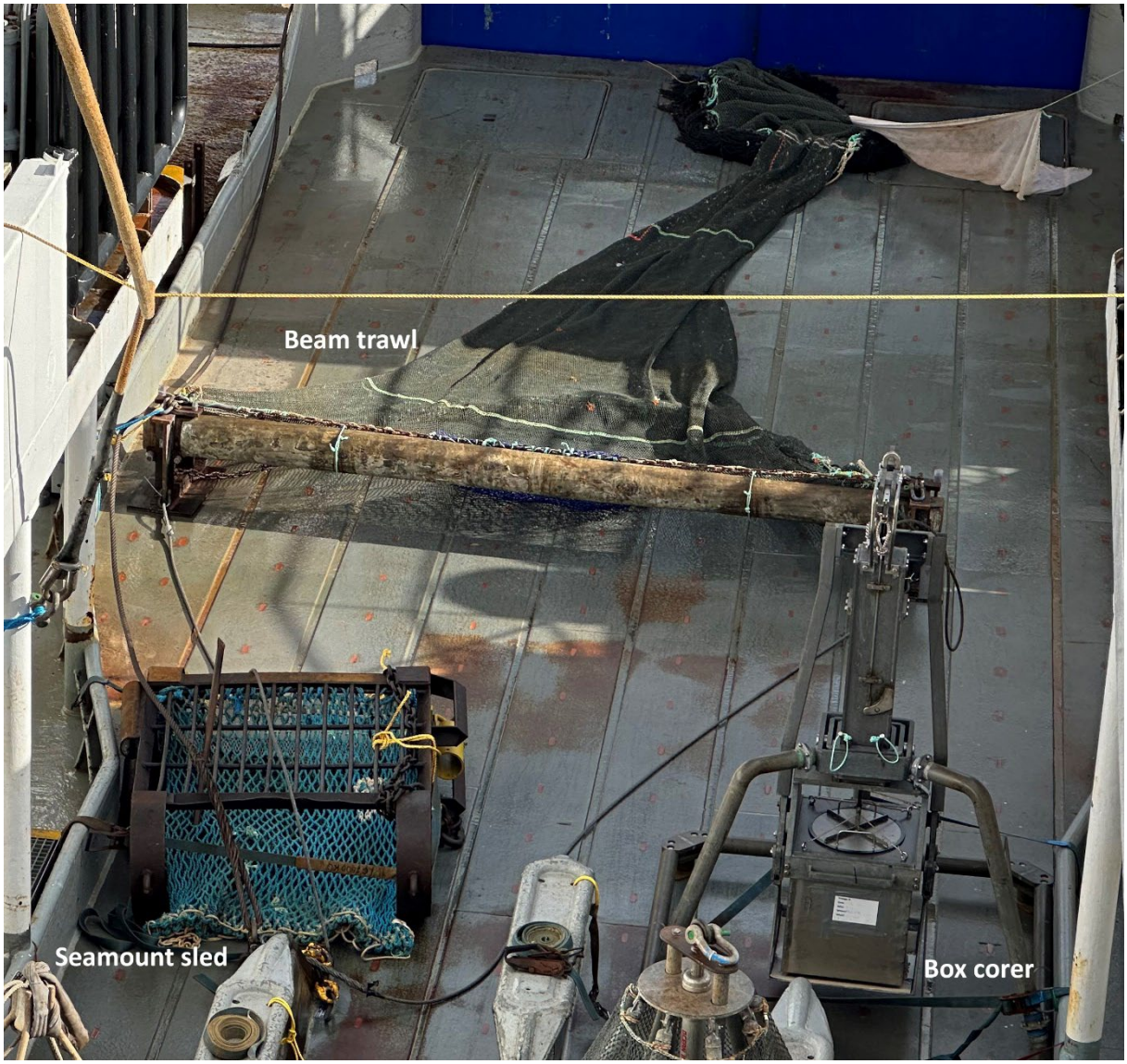


Figure 3-9: Seamount sled, designed to sample larger organisms living on the seabed on rocky, hard seafloor (lower left). Beam trawl designed to sample on soft flat terrain (top of image) [Photo: Sadie Mills]. Box corer is also depicted in the image (bottom right) but was not used during the survey.

When the trawl or sled was retrieved, its catch was either deposited on the trawl deck or the net was opened by the deck-crew depending on the size and fragility of the catch. A photo was taken of the overall sled/trawl contents with the station number, gear type and site name written on a whiteboard.

Fragile specimens were picked out of the net or sample pile and placed into separate trays of iced water. When the catch was clean a rough sort was done on deck into fish bins by major taxon groups (Fig. 3-10). The remaining net contents along with sediment and rocks were placed into fish bins for washing and fine sorting over sieves. Large rocks or boulders were weighed separately, then picked over for encrusting invertebrates. Sample weights were recorded for each fish bin so that a total catch weight could be calculated.

Figure 3-10: TAN2402 voyage participants rough sorting the beam trawl catch on the trawl deck.
[Photo: Rebekah Parsons-King, NIWA].

As much of the sediment as practical from each sample was sieved in a stack comprising a 10 mm, 5 mm and 0.7 mm sieves (Fig. 3-11). The two resulting 0.7–5 mm and 5–10 mm clasts were checked for obvious non-mollusc invertebrates, which were sorted to taxon groups and preserved separately, then all remaining on these sieves were bulk stored in buckets in either 99% ethanol or frozen at -20°C for later sorting according to volume. Grit >10 mm was picked through on board for Mollusca and other invertebrates which were sorted further and preserved separately. Remaining grit was discarded.

Figure 3-11: Kerry Walton sieving sediment from a sled or beam trawl catch. [Photo: Rebekah Parsons-King, NIWA].

Larger biota sorted from the fish bins was washed on the 5 mm sieve table in large trays with gentle hose pressure from the filtered seawater supply to rinse off sediment (Fig. 3-12). Fauna was sorted into broad taxonomic groups, then finer sorted to putative species, if possible, into jars/vials/bags (i.e. sample lots). Note that it was not possible to sort some smaller bodied groups onboard and these were bulk preserved as necessary for further sorting on land. Epifaunal invertebrate specimens were assigned NIWA catalogue numbers and entered into the *niwainvert* Specify database, fish were assigned Te Papa registration numbers. Fresh specimens were appropriately labelled, photographed where time allowed, and preserved.

Figure 3-12: Sorting fauna into taxon groups from trays of filtered seawater at the 5 mm mesh sieving table. [Photo: Rebekah Parsons-King, NIWA]

The hyperbenthic (Brenke) sled collects epifauna from the surface and just above the surface of the seafloor in two nets positioned in a rigid sled frame 0.5 and 1 m from the bottom of the net mouth (Fig. 3-13). When the sled is in contact with the seafloor a drop-down pivoting arm is pushed up horizontal within the base of the sled. This lever action opens the two-spring loaded trapdoors enabling the sample to enter the nets for the duration of seafloor contact. During retrieval, this pivoting arm drops down when the sled is off the seafloor and in the water column. At this point the two spring loaded flaps close shut and seal off the net to minimise pelagic material entering the net. The sled is 3.62 m long x 1.3 m wide (area contacting seafloor 4.71 m^2) and is towed slowly at 1.5 knots for approximately 10 minutes so usually with an average distance of 0.37 km. This sled can be used on flat, even seafloor either on soft sediment or harder gravelly substrata as long as it does not encounter large boulders or rugged terrain.

Floats were attached to the Brenke sled frame to provide stability and were adjusted according to water sampling depth, from 1500 m rated small round floats to 6000 m rated syntactic foam blocks (Figs 3-13, 3-14). The syntactic foam blocks were switched from four to two blocks after one deep deployment as the flotation made the back of the sled lighter than the front and caused some digging in and collection of sediment at the front of the sled frame.

Figure 3-13: Hyperbenthic (Brenke) sled with 1500 m rated floats in towing position.

Figure 3-14: Brenke sled in upright position for retrieval of sample from cod ends, fitted with syntactic foam 6000 m rated floats (left) and 1500 m rated floats (right). [Photo: Sadie Mills & Rebekah Parsons-King, NIWA].

On retrieval to the trawl deck the Brenke sled is stood on end to enable rinsing of nets down to the cod-end with seawater (Fig. 3-14). The top and bottom net cod ends were unscrewed and placed into labelled buckets.

Once at the sieving table the top and bottom net cod ends were elutriated and gently stirred in a specially designed spouted pail (elutriation bucket) with the spout directed over a 500-µm mesh sieve to collect elutriated fauna. The elutriation process was repeated up to three times to gently extract lighter or swimming fauna from sediments. The elutriated samples from the sieve were washed into a labelled jar and preserved in 99% ethanol (there is usually residual water in the samples which would dilute this solution to ~90% and glycerol can be added to the solution to reduce breakage of fragile crustacean limbs). Larger fauna were picked out, labelled and preserved separately per fauna processing following protocols for the sled and beam trawl and the residual sample in the elutriation bucket was split and preserved in ethanol, formalin and either frozen or picked through onboard for micro-molluscs.

3.4.6 Benthic landers with fish/amphipod traps

Benthic landers comprised of metal frames to which funnel/creel/pot-style traps were attached >30 cm above the seafloor was included to complement the existing sampling methods on the expedition, targeting large mobile scavengers at the deeper sites. Two traps were built with funding from a Te Papa Acquisition Proposal and the generous support of equipment and time from NIWA.

The two traps were capable of being deployed to 6 km depth (Fig. 3-15). As with all new equipment, there were teething issues and continual refinement.

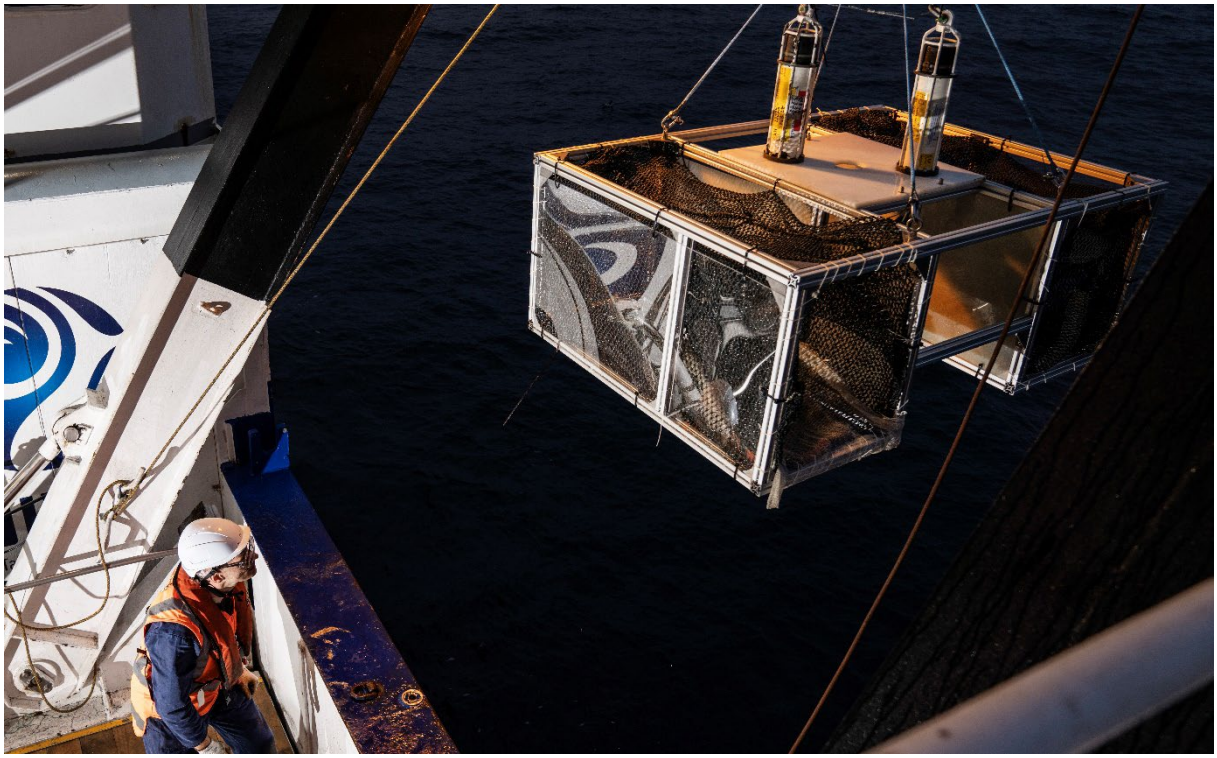


Figure 3-15: Fish trap about to be deployed attached to the benthic lander. [Rebekah Parsons-King, NIWA].

Design and refinement

Two traps were designed and built. They consisted of an aluminium T-slot frame of 1.2 x 1.8 x 0.6 m (L x W x H), forming two chambers 0.6 x 1.2 x 0.6 m for the traps and an open area between them for the release mechanism. The release mechanism consisted of two Sonardyne Deep Ocean Release Transponders (DORTs) mounted in an acrylic plate. Each release would hold one end of a chain, passing through a master-link ring holding the ballast. Only one release would need to fire for the chain to slip through the master link and free the ballast. After unsuccessful deployments, the ballast was rigged higher to ensure the trap entrances sat on the seabed (Fig. 3-16).

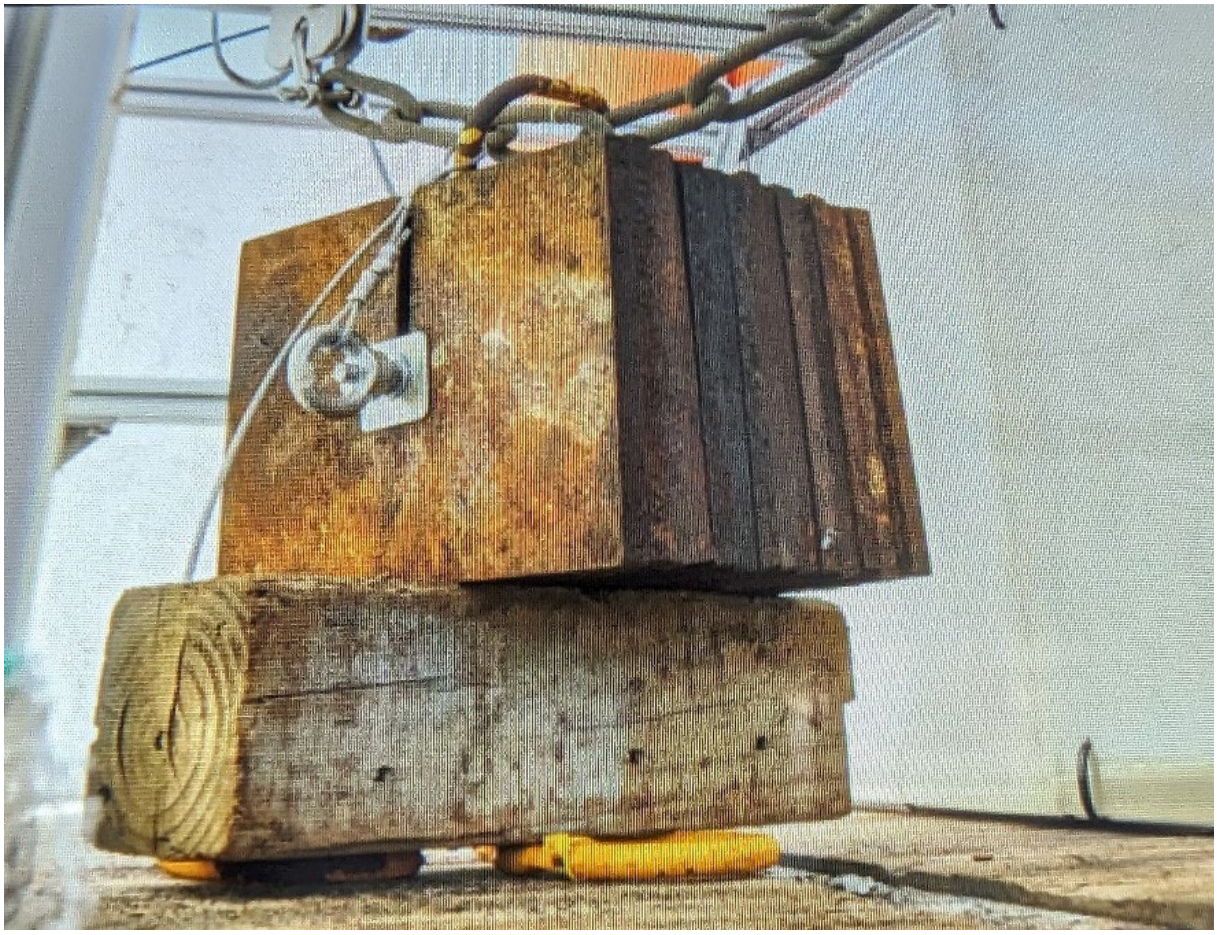


Figure 3-16: Ballast rigged higher to ensure the trap lands with the frame rather than the ballast on the seabed. [Photo: Thom Linley, Te Papa].

Traps were stitched inside each of the two chambers. The initial design used 27 mm mesh with 8 mm mesh in areas where fish were likely to collect on retrieval to minimise damage. Rather than the traditional funnel trap entrance, the traps were optimised for deep-sea fish unwilling to enter confined spaces. The entrance was a letterbox shape, providing a false bottom for the fish to follow before dropping into the chamber. More traditional funnel designs were also tried, and the finer 8 mm mesh was later used for the whole trap (Fig. 3-17). This took considerable time and would not have been possible without the help of Kathrin Bolstad and Daniel Moore. Acrylic panels on the side of each trap chamber orientate the trap to the current, focus the bait odour plume, and prevent the ballast from swinging and getting caught on the frame. Two amphipod/isopod funnel traps were included in each trap. The bait was locally sourced pilchards (*Sardinops sagax* (Jenyns, 1842)).

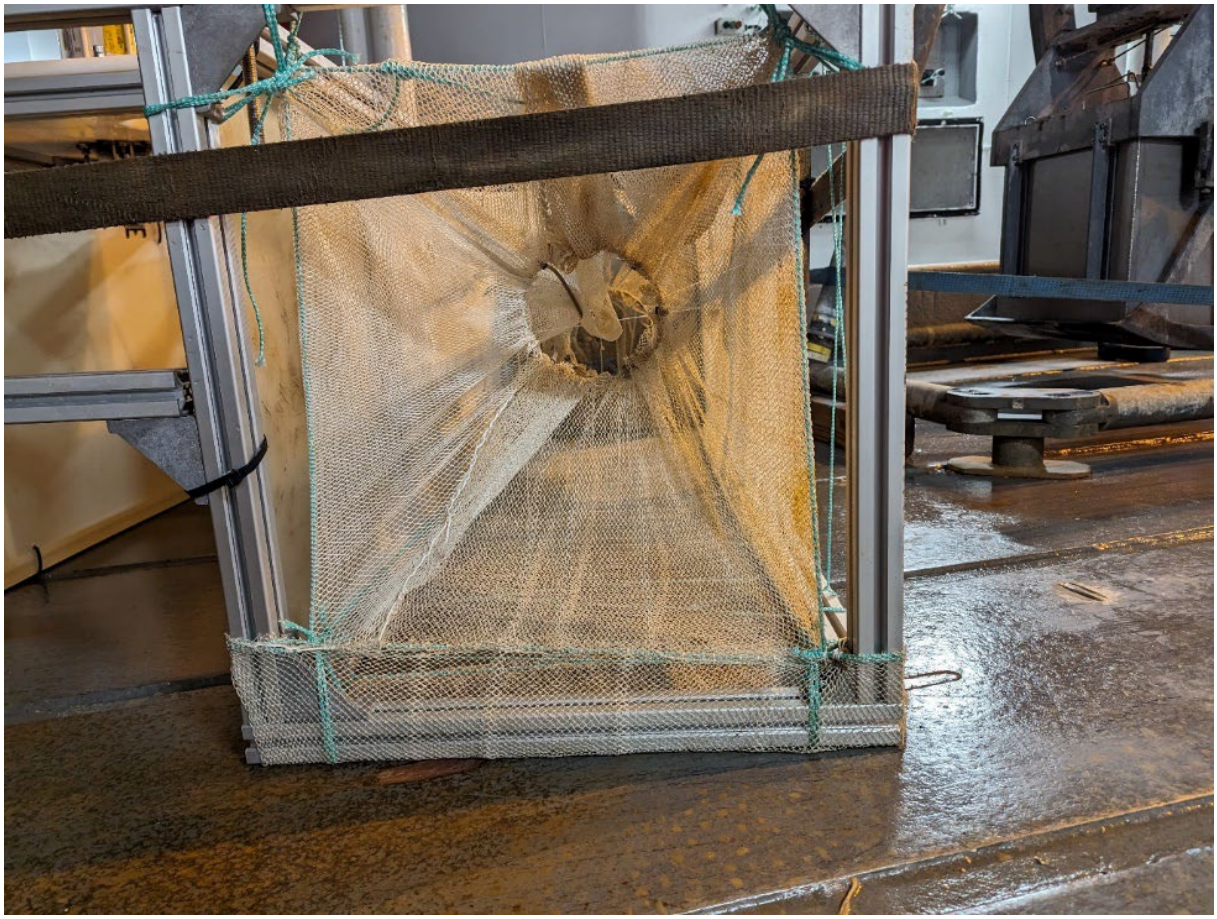


Figure 3-17: Redesigned funnel entrance using the finer mesh. [Photo: Thom Linley, Te Papa]

Floatation was via VITROVEX floatation spheres (FS-6700-17PS) arranged in pairs as float-packs. Four float packs were initially calculated to be needed, but this was later reduced to 3, a total of 7 spheres (3x2 float packs plus a single surface marker). The surface marker buoy consisted of a 'coffin float' with a SABLE Iridium Satellite Beacon with GPS location. The floats were connected to a 12mm Yalex mooring line. From the trap to the first float pack was 50 m; each float pack was separated by 3 m, and there was 10 m between the last float rack and the surface marker buoy to allow grappling.

Each floatation sphere provides 260N of buoyancy (26.5 kg), giving a total lift of 185.5 kg. The estimated 110 kilograms of ballast was insufficient to sink the trap with four float packs. Ballast was adjusted to at least 130 kilograms, but up to 190 kg was used during testing. Initial trap speeds were very slow (10 m/min) and increases in ballast or floatation had little impact on its speed through the water. Drag was identified as the likely cause, and removing the trap from one side increased its speed through the water to 41 m/min.

Deployment and recovery

The traps were deployed from the cut-away on the starboard side following a similar procedure to that used for the safe operating procedure for deployment of the DART (Deep-ocean Assessment and Reporting of Tsunamis) buoy moorings from RV Tangaroa. They are released from the surface to freefall to the site. Recommended soak times varied from 4–8 hrs at the shallower sites to over 24 hrs at deeper stations. Ballast is jettisoned via acoustic command from the surface, rendering the trap positively buoyant to return to the surface.

The ballast weights remained on the seabed. Care has been taken to recycle mild-steel ballast without contaminants or plastic components.

Benthic landers were deployed on the seabed to be recovered a minimum of 2 hours after deployment and up to 12 hours where possible. Specimens retrieved from traps were stored, processed and preserved onboard.

3.4.7 Taxon specific subsampling

Corals

Corals collected on TAN2402 were placed in chilled buckets of seawater before preservation to decrease the potential for DNA to become degraded during subsampling. Corals were subsampled by taking small cuttings for preservation for future genomic work. For at least one of every species that was encountered, a few branches, polyps, or section of coenenchyme were placed in 2 ml cryovials and flash frozen in liquid nitrogen and then stored at -80°C. For all specimens collected, a few branches, polyps, or section of coenenchyme were placed in a 2 ml cryovial in 99% ethanol and stored at -20°C. Whole colonies were preserved in 99% ethanol at room temperature, and whole anemones were preserved in a 10% buffered formalin seawater solution.

Sea cucumbers

Three replicates of any holothurian species collected were placed in cold seawater with 7% MgCl2 solution added to relax specimens where necessary. Once registered these specimens had three subsamples taken from them: 1) 1-2 tentacles and tube feet placed in 2ml cryovials, flash frozen in liquid nitrogen and placed at -80°C; 2) 1-2 tentacles or tube feet placed into a 2ml tube of 99% ethanol; or, 3) 3-5 tentacles minced with sterilised scissors and placed into a preprepared vial of RNA Later. Up to three specimens of extra sea cucumbers, beyond those saved in ethanol as voucher specimens were saved for microplastic analysis frozen in a bag in -20°C. These specimens will be transferred to University of Otago for further analysis.

Sponges

Extra sponge specimens collected were also retained for microplastic analysis frozen at -20°C. These specimens will be transferred to University of Otago for further analysis.

Fish

All fish specimens that were not excessively damaged were identified to lowest possible level and registered on board into the National Fish Collection held at Te Papa. Small and fragile/gelatinous specimens were fixed on-board in 10% formalin to prevent freeze-thaw damage. Where practical, two tissue samples, usually white muscle, were taken from each specimen and stored in vials of 100% ethanol. A total of 113 specimen images (jpg and raw images files) were taken of fish and have been labelled with cruise, station number, catalogue number. All images have photographer name embedded into the metadata information.

3.5 Data Management

All invertebrate specimens were catalogued in the NIWA invertebrate collection Specify database, *niwainvert*, onboard and assigned a unique catalogue number per species jar or unsorted fraction (i.e., meiofauna and macrofauna samples collected from the multicore and Brenke sleds) from each station (Fig. 3-18). The seagoing data were exported from the ships server to Excel spreadsheets and will be imported to the production copy of *niwainvert* on land. Mollusca data were exported and provided to Kerry Walton for accessioning into the Te Papa EMu database.

Figure 3-18: Marine Biology Technician Caroline Chin registering invertebrate samples into the *niwainvert* database. [Photo: Rebekah-Parsons-King]

All fishes were registered with a Te Papa P.— accession number in a spreadsheet onboard and will be imported to Te Papa's EMu database once processed on land.

3.6 Specimen Management

All fish and Mollusca collected on the voyage will be accessioned into the collection of National Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand. Home | Collections Online - Museum of New Zealand Te Papa Tongarewa

All non-molluscan invertebrates will be registered in the collection of the NIWA Invertebrate Collection held in Wellington, New Zealand. https://niwa.co.nz/our-services/online-services/nic

Future specimen loan requests/tissue transfers will be handled by these institutions.

All sediment samples collected from the multicorer for sediment properties will be stored at NIWA and rock samples in the NIWA geological collection for analysis.

eDNA sediment samples will be transferred to the University of Otago, along with several invertebrate samples reserved for microplastic analysis.

3.7 Sampling and import permits

3.7.1 EPA permit

The Environmental Protection Authority (EPA) regulates marine scientific research carried out outside of the 12-nautical miles zone and within the Aotearoa-New Zealand EEZ. All gear types that

impact the seafloor inside the New Zealand Exclusive Economic Zone must be recorded and reported back to the EPA.

This voyage was lodged with the EPA under the following Permitted Activity:

Operation name: Oceans Census - Bounty Trough

Activity code: NIWAPA60

- The Form 1 Pre-activity notice was submitted to the EPA on 31 October 2023 and provides an overview of the marine scientific research, area of activity and gear types to be used (this was well within the 40 working days before undertaking the permitted activity).
- An Iwi Notification email including a PDF of Form 1 was sent to Ngāi Tahu on 14 November 2023 (this was well within 25 working days before undertaking the permitted activity).
- Form 2 – Report of pre-activity notification of relevant iwi was submitted to the EPA on 24 January 2024 before the permitted activity commenced.
- Form 3 – Initial environmental assessment and sensitive environments contingency plan was submitted to EPA on 24 January 2024 before the permitted activity commenced.
- Notice of Commencement (form) - The EPA was notified on 10 February 2024 within 24 hours of commencing our activity (first sampling on the seafloor was a Van Veen Grab at 21:11 h NZDST on Friday 9 February 2024).
- Permitted Activity Logbook - A Permitted Activity Logbook was provided to EPA once per week covering a 7-day period for 3 weeks.
- Notice of Completion (form) - The EPA was notified on 29 February 2024 of the completion of our activities at 17:26 on 27/02/2024 with the completion and retrieval of the beam trawl gear.
- Form 4 – Post-activity report - Within 60 working days of completing our activity a post-activity report must be sent to the EPA. This was submitted on 7 March 2024.

3.7.2 MPI Special Permit

This expedition was added to NIWA's Ministry for Primary Industries (MPI) Special Permit 842(4) under its 2023-24 Schedule of Approved Projects.

This permit authorises all agents, representatives, and employees of NIWA to take fish, aquatic life, or seaweed irrespective of size, state, site, method or time of fishing, subject to specified conditions for the purposes of education and investigative research.

A commencement of research voyage notice was sent via email to Garreth Jay, the Lower South Island Fisheries Compliance Officer in compliance with the Special Permit conditions.

A report will be submitted before September 2024 to MPI on the numbers of fish and invertebrates taken on this voyage; the areas fished; and the method of 'disposal' (in this case preservation and deposition in national collections).

3.7.3 DOC Wildlife Act Authority

NIWA holds a current Department of Conservation (DOC) Wildlife Act Authority (Authorisation number: 114806-CAP) for the low impact collection of protected coral and fish species. This authority also allows the sample to be held in the NIWA Invertebrate Collection and to make them available for further research.

An email was sent to the DOC head office and DOC Dunedin team on 8 February 2024 notifying them of the commencement of this research expedition per authority conditions.

3.7.4 Biosecurity requirements

It is a legal requirement that ALL samples collected outside of the 12 nautical mile zone are imported in accordance with the New Zealand Ministry for Primary Industries (MPI) Biosecurity Import Regulations (Biosecurity Act 1993). NIWA holds the required import permits for the sample types to be collected on this voyage to be held in our transitional facility:

- Permit to import restricted biological products of animal origin: 2023081237
- Permit to import microorganisms and cell cultures: M2308017B
- Permit to import laboratory specimens (rocks, soil, water): 2023081822

The Biosecurity Officer for the voyage, Amelia Connell, submitted a list of sample types, preservation methods and final sample unit numbers to the NIWA Biosecurity Import team 48 hours before our return to port.

The NIWA Biosecurity Team submitted this final list to MPI Biosecurity and we were issued with a Biosecurity Authority/Clearance Certificate (BACC number: B2024/67771) for the import of our samples to NIWA's transitional facility.

An onward Authority to Move Uncleared Biosecurity Risk Goods request was submitted and granted for the frozen fish samples to be moved to Te Papa's transitional facility (CL2743 1/03/2024).

3.8 Communications and outreach

3.8.1 Ocean Census

Media coverage of The Bounty Trough Expedition has been expansive and deliberately targeted at broadcast media in New Zealand and at a global social media and news audience. Our gateway to news outlets worldwide is via our partnership with The Associated Press news agency whose 700 plus broadcasters and 1500 digital publishers receive our content free-of-charge.

The expedition's departure was featured on the main evening newscast in New Zealand by both the public service broadcaster TVNZ and the main commercial network TV News Hub. Both channels came aboard ship and interviewed the co-leaders of the voyage, as well as using a range of video Ocean Census and NIWA supplied to enhance the telling of our story. We also featured prominently on public service Radio New Zealand and in the round up of the week's stories on the main digital publishing site stuff.co.nz. Internationally the departure story was used by 59 broadcasters in more than 40 countries, including CNN, The New York Times, The Guardian, and the BBC.

Our social media campaign has been the most intensive we have mounted to date - 21 different stories were posted on Facebook which has already reached an audience of 103,000 viewers. The departure film picked up 108,000 YouTube views in the first week.

We also used TikTok for the first time and got 35,000 views and now have 282 new followers. Our largest uptake is in Facebook followers which has increased by 31%.

All of this needs to be seen in context against the strategy of holding back from offering a running media commentary on the new and potentially new species finds made by the team on board. We anticipate when the "Big Finds" film is produced and released following the voyage that the number of YouTube viewers will top 1 million for the expedition period. A similar healthy uptake by the world's broadcasters is expected.

4 Results

4.1 Voyage timetable and narrative

The RV *Tangaroa* was scheduled to depart Wellington on 1500 (NZDT) on 7th February 2024, however, an engineering problem delayed departure until 0800 (NZDT) on 8th February. RV *Tangaroa* arrived back in Wellington at 0800 on 29 February 2024. All gear deployments were recorded in New Zealand Standard Time (NZST, 12 hours ahead of UTC), while the ship remained on New Zealand Daylight Time (NZDT, 13 hours ahead of UTC). A summarised voyage narrative is given in Table 4-1. Some bad weather days and additional gear issues meant that the plan had to be revised during the course of the expedition. This was done through discussions between the co-voyage leaders in consultation with shift leaders, Vessel Master and officers to optimise the collection of samples and reduce down time.

Table 4-1: Summary of daily voyage activities. Note that for ease of reference all gear deployment, meeting, departure and arrival times are listed in NZST in the table below (12 hours ahead of UTC). Gear abbreviations are as follows: DTIS = Deep towed imaging system, MUC = Multicorer; GRAB = Van Veen Grab; TRAP = Lander with fish and amphipod traps; SLED = Seamount sled; BEAM = Beam trawl; Brenke = Hyperbenthic sled; SVP = Sound Velocity Profiler; MBES = Multibeam Echosounder; TOPAZ = sub-bottom profile.

Date	Daily activities
Thursday, 8 February 2024	Sail from Wellington 0700, 5000 m cable streamed in deep water off Cook Strait (completed 0130). Transit to Bounty Trough first station.
Friday, 9 February 2024	Arrive on Canyon site CA-1 at 1800, to deploy DTIS at 360 m top of canyon to run a transect down ridge towards canyon floor. 7000 m Beacon produced incorrect depth and coordinate readings, so DTIS brought back onboard and redeployed twice with NIWA beacons, which both produced same fault. Error found in the HiPAP (Portable Acoustic Positioning System). Two GRAB shots taken to retrieve sediment (carbonate rich silty sand) from the canyon floor retrieving fair and good samples.
Saturday, 10 February 2024	Poor weather forecast for midday so decision made to deploy one SLED at 725-680 m on the canyon wall. Transit to Pock mark site PM-1. Deploy TRAP at 0602 with 7 floats, after false start to adjust flotation. SVP deployed at 0649 followed by a short transect line using MBES with fisheries echosounders to look for any apparent flares or bubbles from pockmarks. None seen, so move to DTIS transect over middle of pockmark field at 768 m. Retrieve TRAP on deck at 1322. No fish in trap, but evidence of hag fish slime. Three MUC deployments at first half of DTIS transect where sediment seems softer (disturbed short cores, but some samples retained). Brenke sled transecting the middle of the DTIS transect to avoid/minimise sledding on sensitive foraminifera field seen in DTIS. BEAM transecting the last third of the DTIS transect deployed 2112, but hammerlock caught in guide-on gear on port trawl winch while paying out wire causing loose turns and tangled cable. Did not reach the bottom, fished in midwater. 2213 foul gear was noted.

Date	Daily activities
Sunday, 11 February 2024	Decision made by science leads to drop transect 'b' stations on northern side of the Bounty Trough because of delays at the start of voyage. A smaller hammerlock link has been fitted on the BEAM cable to prevent future jamming in the guide-on gear. The TRAP can only be retrieved in daylight hours since it doesn't have any lights on it, so decision made to cut the SM-4 TRAP from the plan due to short timing and a later evening time arrival at this site. Foul in port winch wire cleared 0252, begin transit to SM-5 at 0340. TOPAZ line run over seamount to check suitability for coring/sled/trawl options in case weather no good for DTIS. SM-5 looks sedimentary in profile so likely flanks are covered in soft sediment. TRAP deployed at 0704 on eastern side of smaller knoll at 900 m. Weather improved enough for DTIS at 0748 so ran a transect over the summit of main hill of seamount SM-5 at 620 m deep and ran down the flank in a SW direction to 848 m. BEAM deployed on the SM-5 flanks at 0923 (towed down slope of DTIS track because of weather) and SLED deployed on the summit. Really nice samples, but a smaller catch from the BEAM (1 fishbin full of assorted specimens). First SLED on the summit came up turned inside out with the sacrificial cable broken and nothing in it, second SLED deployed at 1221 had several boulders and dead coral rubble with encrusting fauna. A nice diverse catch. The TRAP retrieval was slow again. It appears the release wasn't fired on the first attempt at 1401 so some extra time was spent waiting for the lander, before a second release command was sent. The TRAP surfaced and was located at 1554. It contained a few amphipods and 2 x parasitic eels. Two-hour transit to SM-4 at 1530 using MBES and fisheries acoustics echosounders. Nice DTIS transect on the summit and SW flank of the small hill, which was deployed at 1848. A SLED or BEAM planned for deployment at SM-4 tonight.
Monday, 12 February 2024	Three hour transit to PM2 to deploy the TRAP at 0125 and then started a DTIS transect across pockmark features on flat soft sediments, heading southwest. Three MUC collected 5 cores for meiofauna, macrofauna and sediment analyses between 0430-0600. A Brenke was deployed at 0800 and retrieved good samples. Black plastic sheet (1200 mm x 1800 mm x 16 mm) from base of Brenke was torn off and lost in position at 0900 at 46°23.4'S 170°45.7'E, 749 m. Crew able to fit a replacement piece of plywood to the base to make it functional again so we do not have to revert to the spare. No time was lost. TRAP retrieval took ~3 hours today. TRAP surfaced at 1052 and was onboard at 1148, no fish in it. Decision to make modifications to improve performance, including the distribution of the dunnage on the TRAP to make it sit closer to the seafloor. TRAP deployment at the next site (CH-7) will be dropped from the programme in favour of timing and ability to make changes. BEAM deployed at 1322, caught a nice clean selection of invertebrates and fish. After a short transit to the first channel site of the survey (CH-7, upper South Bounty Channel head area near Brodie Canyon) we deployed DTIS at 1505 in a SW direction down the northern wall of the channel and downslope onto the channel floor at 1052 m. Kat Bolstad has attached some glow tape to the bottom of the DTIS frame to attract squid. Lights were turned off, but a video recording was made through the water column ascent and descent to observe any squid activity. Two MUC and a GRAB sample attempted in the bottom of the channel all failed to return a sample despite looking soft enough on DTIS. Good Brenke and BEAM samples returned from along the lower channel section of the DTIS transect.
Tuesday, 13 February 2024	Transit to the first non-channel slope site (NCH-7) for a DTIS and two MUC early morning, which returned good cores of foraminiferal ooze processed for Macrofauna, meiofauna and sediment properties. A BEAM caught a small but nice catch. The Brenke collected a good sample of small invertebrates in both cod ends. Transit to SM-1, a smaller seamount on the edge of the South Bounty Channel. We ran a DTIS camera transect up the south flank across the peak and down north flank. A SLED was deployed this evening to collect a sample. We will also deploy a slightly modified version of the TRAP on this seamount tonight, then will transit over to the nearby Channel site CH-6 to deploy gear there in the early hours of tomorrow morning. This evening a DTIS camera transect in the South Bounty Channel at site CH-6, northeast on the channel levee, then down a steep channel wall, and across the channel itself.

Date	Daily activities
Wednesday, 14 February 2024	A MUC and GRAB were attempted at site CH-6 to collect some mud but these both came back empty confirming our thoughts that the channel floor was probably quite compacted. We did a lot of transits back and forth between our next seamount site (SM-2) and the channel today to deploy and then later retrieve the fish trap which has been rejigged to sit with the fish trap closer to the seafloor to attract fish that might not come up far from the seafloor. Alan Orpin gave us the coordinates for a nearby channel site that had been successfully cored in 2019, so we moved to that location and got a successful MUC full of mud. Brenke sled transect in the channel at 1327 collected good samples including a small fish, but also possibly clipped the channel levee during its retrieval so was full of compacted white clay from the bank revealing a very hard substrate full of burrows with ophiuroids, squat lobsters and a scale worm living in them. A small section of plastic from the front of the sled was torn off and lost during tow (1200 mm x 300 mm x 16 mm) likely during the retrieval when it hit the bank. We also think that the syntactic floats on the sled are too buoyant causing the sled to tip forward onto its nose, so have removed 3 of the floats from the back of the sled to reduce the lift. The crew are fitting another piece of plywood on to the Brenke to replace the lost panel. At 1444 we transited back to pick up the fish trap, which came up quickly and was easy to locate, but unfortunately did not have any fish in it. A beam trawl deployed back in the channel site along the axis from west to east, across the DTIS track came back upside down, but still collected a good catch of sponges and other invertebrates. During the late evening, we completed the DTIS transect up the southern flank and across the summit of seamount SM-2.
Thursday, 15 February 2024	Two SLEDs across the summit of seamount SM-2 and NW across the flank of the seamount completed early morning. Two-hour transit to the non-channel site NCH-6a where we worked the usual regime of DTIS, MUC, Brenke and BEAM deployments. DTIS transect SW on the flat. The transect started recording whilst the camera was descending to the bottom to locate any signs of squid in the water column again, and then recorded 40 mins on the seafloor. The MUC successfully collected 8 tubes of mud, and the Brenke and BEAM caught good but smaller catches. The BEAM came back upside down again, so the crew worked on trying to straighten the shoes on the bottom of the gear in case they were causing it to propellor or spin in the water column. Still a small but diverse catch. Transit for 14 hours to Seamount SM-9. We chose to go to this seamount (SM-6 was originally our plan) as it was closer and meant we would arrive on Friday earlier in the morning allowing us to deploy the TRAP in good time to be able to retrieve it again before night fall. SM-9 also looks like a much larger and more interesting feature based on data from the NZ seamounts database.
Friday, 16 February 2024	Arrived at SM-9 at 0600 and deployed both the SVP and MBES on the seamount, which is ~1250 m at the peak. Deployed the TRAP on the top of the seamount. TRAP has been modified with a finer mesh and a shorter funnel entrance; Thom has added more bait in various forms to create more of an odour plume to attract fish. After a short delay with some DTIS hardware problems, deployed a DTIS transect from an east to west direction across the smaller second northern peak of the seamount. Targeted a SLED up slope across the DTIS track and got a small pile of rocks with encrusting fauna. The TRAP was retrieved at 1700 and unfortunately did not have any fish in it but did collect a nice squat lobster. 6-hour transit to channel site CH-4, collecting MBES and fisheries acoustic data (EM302) and pass over the top of SM-6. Bad weather forecast for Tuesday at this stage, so watching weather.
Saturday, 17 February 2024	At the ~3000 m CH-4 Bounty Channel station deployed TRAP downstream of where we will be sampling for the day to provide a longer soak time from deployment at 0018 to retrieval at 1700 later tonight. Two fish and an ophiuroid were caught in the trap. During the rest of the day we deployed the SVP and ran MBES lines of channel, sent DTIS on an east to west transect from edge of channel, down channel wall, then towards middle of channel itself. We decided against coring in the channel here as it looked too hard and decided to deploy the BEAM first, followed by the Brenke and then attempt a SLED on the channel wall. The BEAM collected a couple of fish and a variety of interesting invertebrates. Brenke sled took nice samples. Opportunistic surface plankton tows were made (NETP) over the cutaway during BRENKE and SLED deployments for juvenile squid. SLED deployed at 1920 came up empty.

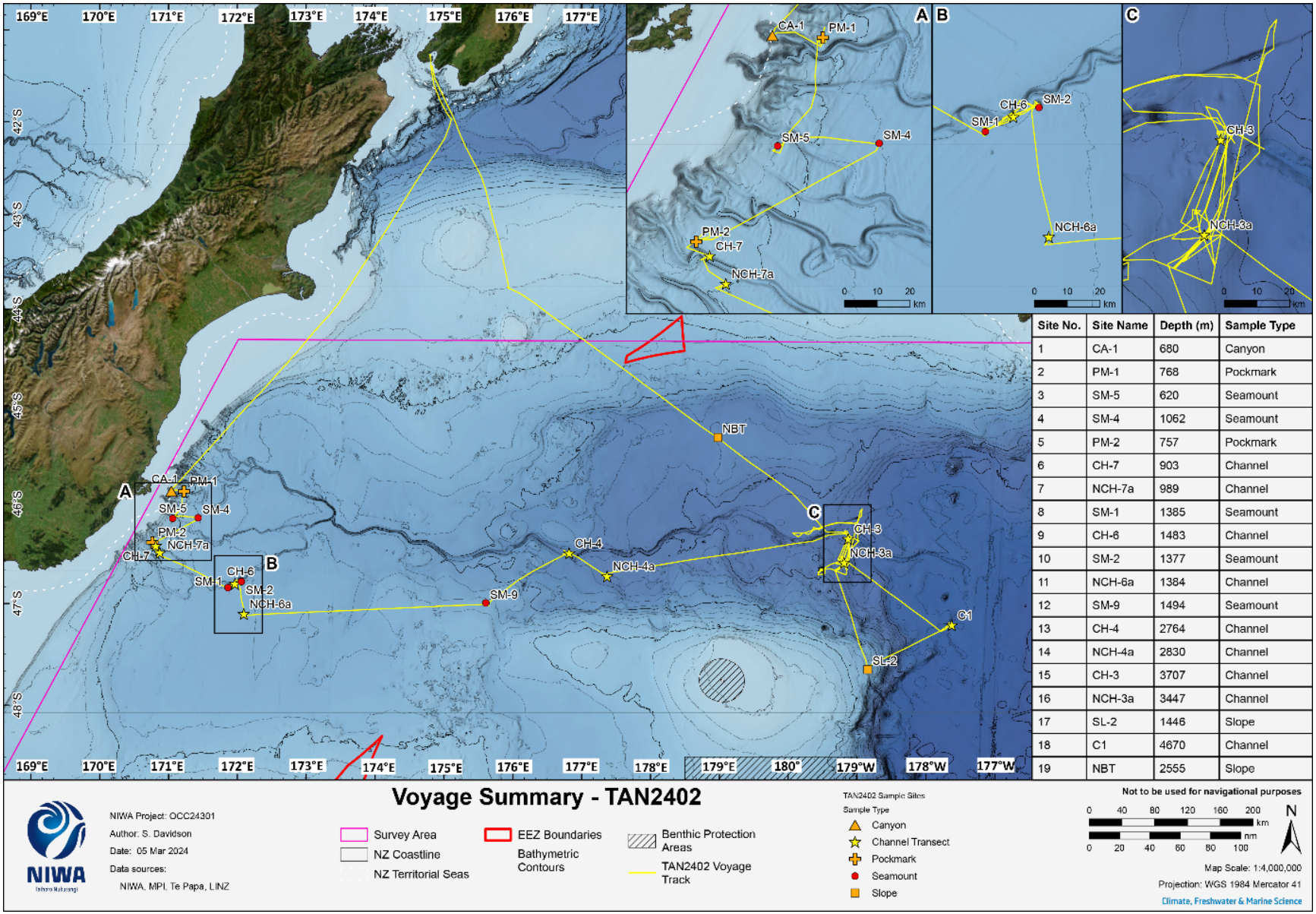
Date	Daily activities
Sunday, 18 February 2024	Transit to non-channel site NCH-4a (~2800 m deep), arriving at 0200 with a DTIS transect in a NW direction across flat, muddy seafloor. Two MUC deployed but only one was successful in getting some sediment, so one each of meiofauna, macrofauna and sediment slicing was collected. Brenke had a nice sample in both nets. The highlight today was the BEAM - a 3-hour deployment at 1500. This had an excellent and diverse catch with fish and an array of invertebrates. The processing of this catch took 6 hours. This afternoon we started the 14-hour steam to Channel site CH-3 (4000 m). Bad weather coming in the next couple of days.
Monday, 19 February 2024	Today we crossed the 180 line and our longitude is 179 W. The swell has increased already and we expect conditions to worsen over the next couple of days. MBES on this 4000 m portion of channel discovered a strong S-bend in the channel, which was not previously mapped. Deployed DTIS here at site CH-3. Deepest deployment of DTIS at 4126 m with a 2 hour-long bottom time video. DTIS started along a spur of the southern levee above a sharp turn of the channel, descended steeply into the channel in a SSE-NNW direction. This site does not look suitable for coring and too rugged for BRENKE or BEAM. At 1728 we deployed a TRAP in the channel downstream from DTIS deployment. Transit using TOPAZ down to the next site NCH-3a where we deployed a second TRAP this evening. The swell has already increased and wind speeds of NW 33-34 Knots were experienced. We expect the wind to change round to the West and then the South-West later tonight and pick up to about 46 knots.
Tuesday, 20 February 2024	Bad weather day, no overside sampling. Swell building all day, currently 6 m and occasional 7 m waves with wind speeds up to 50 knots. All onboard are doing well. MBES at the Non-channel NCH-3a site, discovering rugged terrain, possibly much less "soft" than some of the other non-channel sites we visited. Transit to SM-7 with MBES, but did not find any seamount, so the peak that was seen on the map was not a peak at all! We discussed the various options for running TOPAZ lines for the next 24 hours while we wait out the bad weather. TOPAZ line completed from N-S through CH-3 and NCH-3a and starting down the TOPAZ line that follows the Bounty channel back towards the west, aiming to back at CH-3 again by midday tomorrow to reassess conditions and hopefully pick up TRAPS, which have had a long soak time now.
Wednesday, 21 February 2024	Weather continues to be poor today with large swell (6-7 m, occasional 8 m) and up to 50 knot winds. Wind easing in the evening. Completed short section of TOPAZ line I1 and transited back to NCH3a. Too late to pop TRAPs tonight so will wait till first light tomorrow. DTIS will be attempted at NCH3a at ~2000 if DP can hold ship steady and if swell has eased.
Thursday, 22 February 2024	In the early hours of the morning the weather calmed enough to get two GRAB samples at NCH3a site. First GRAB came up with a few scoops of sediment in it, second GRAB empty. Attempt to retrieve TRAPs at both CH-3 and NCH-3a in the early morning. Unfortunately, neither responded to the release codes that were sent. Short-range boxing in done to try and get a better position on them. After several hours of trying to get a response, we moved on to NCH3a for further sampling. Shift and voyage leads discussed the weather and decided that the poor weather in the south will disrupt our plans to sample at the deepest planned site CH-1 so decided to focus on getting samples from NCH-3a and from the Bounty slope site SL-2 just south of us, then investigate a new deep-water site further to the east. DTIS transect done down a small ridge at the north of the NCH-3a site, down from the peak in a SW direction into a small basin, about 90 m height difference. A dense nodule field was seen, which thinned out quickly, giving way to soft sediments until the end of transect. Attempt TRAP retrieval again, but after 1.5 hours of trying to send release codes the lander was still not responding even though it was communicating with the deck unit. Brenke sled deployed at 1830 on last third of the DTIS transect targeting the soft sediment area. Both port and starboard winches needed to be spliced together to deploy more than 4000 m of wire to get the Brenke down to the seafloor. Weather much improved over the day.

Date	Daily activities
Friday, 23 February 2024	Completed a BEAM at NCH-3a, which got a good catch of deep-sea fishes and invertebrates. Because of the weather looking marginal at the southern seamount SM-3 and CH-1 site we changed plans and decided on transiting to the Bounty slope site SL-2 (1500 m). SVP and MBES transect lines were run over SL-2 on arrival at ~1030 and a DTIS was deployed on a slightly raised area of the multibeam map, indicating some kind of rugged feature. The DTIS camera transect ran in a WSW direction slightly upslope. The DTIS had some hits on the bottom as a result of some larger swell that came through during the deployment and lost comms and we had to retrieve to deck after only a short transect of about 30 minutes. A SLED was deployed after this and collected invertebrates. A fossil shark tooth was also pulled from the catch, identified as *Cosmopolitodus* ?*hastalis* – an ancestral white shark from the Miocene. A second DTIS transect was run E to W slightly uphill to look for flatter ground for a BEAM. Too rugged terrain for a BEAM, so we moved on to transit to a new deeper abyssal site (C1) east of the slope where we hope to find the end of the Bounty channel and deploy more gear tomorrow.
Saturday, 24 February 2024	Today the weather was much calmer and we had very light winds, with a bit of fog rolling in at times. Arrive at deepest site of the survey, abyssal C1 site at 0530. SVP deployed, then 2 hours of MBES to produce the site map. We found a section of channel, a small knoll and some muddy plains to sample in. Deepest DTIS deployment of our voyage at 0850, unfortunately DTIS lost communication with the vessel just as soon as it had reached the seafloor at 4670 m deep. Despite trying to restart the system in the water column it could not be made to work, so brought back on deck. Video camera housing imploded causing damage to the stills camera and blowing fuses in control unit. Tim Curtis flew drone from ships bow collecting footage of the ship while stationary and retrieving DTIS. Using TOPAZ data from our survey of the area this morning identified soft sediments in the area. Collected 3 long cores of mud on the first deployment of MUC from a spot right next to the channel in 4800 m. Second MUC at the same spot collected another 3 full cores. This was followed by a GRAB in the middle of the channel at 4840 m, which came up empty.
Sunday, 25 February 2024	Completed two MUC in soft sediment behind a knoll next to the channel, returning 3 good long cores on the first deployment and 4 cores on the next drop. Weather rougher again during the morning and for our 8 hour transit from C1 back NW to NCH-3a. Weather on arrival in the afternoon at NCH-3a choppy with a short 3 m swell but felt better when pointing into the weather. Deployed BEAM at a parallel transect to where we deployed the DTIS previously. Brilliant selection of fish and invertebrate samples including holothuroids, rattails, a rare abyssal cusk eel in excellent condition, several species of ophiuroids and a shark tooth. Two small specimens of an unusual new type of anemone or zoanthid-like creature also collected. More undescribed sea slugs and two new species of snail. Brenke sled deployment just before midnight collected more small invertebrate samples from sorting back on land.
Monday, 26 February 2024	SLED deployed on 'nodule' site at NCH-3a, collected one nodule, two ophiuroids and sponge. Plankton tow collected amphipods and a new brachioteuthid squid taxon. Approx 7 hours today was spent looking for the two TRAPs at both NCH-3a and CH-3, with attempts to box in and triangulate the adjusted position, scan with TOPAZ, and send release commands with the transponder. It was discovered that they had drifted several kms from their release site. Unfortunately, they did not respond to release commands so were unrecoverable. Transit back to NCH-3a and deployed a SLED once again on the nodule site but from a different transect cutting across the previous DTIS line where we saw a dense patch of nodules. SLED collected rock, clay and some nodules, which have been preserved in several different ways to later examine them for associated meiofauna, and for geology. SLED was deployed at CH-3 last thing on Monday night, coming up in the early hours of Tuesday with some gravel and a few invertebrates and small myctophid fish.
Tuesday, 27 February 2024	Begin transit to Wellington this morning with a stop enroute around midday at Northern Bounty Trough (NBT) location in 2500 m water depth to deploy the Oktopus MUC and BEAM. Good samples in both. End of science work completed. Clean up of sampling equipment and begin packing.
Wednesday, 28 February 2024	Transit to Mernoo Bank to test camera winch at around midday.
Thursday, 29 February 2024	Arrive at Wellington port 0700

4.2 Site maps

As mentioned in the voyage narrative, because of a combination of delays in voyage departure, equipment failures and poor weather conditions at points during the schedule, changes were made in the actual sites visited, compared to those planned. Figure 4-1 indicates the actual sites visited on the survey and the RV *Tangaroa* route.

A list of all sampling station data is provided in Appendix A. Maps are provided for each sampling site visited during the voyage indicating the location (Station numbers) and type of gear that was deployed (Figs 4-3 to 4-21). The key for the sampling gear types is provided in Fig. 4-2.



Site No.	Site Name	Depth (m)	Sample Type
1	CA-1	680	Canyon
2	PM-1	768	Pockmark
3	SM-5	620	Seamount
4	SM-4	1062	Seamount
5	PM-2	757	Pockmark
6	CH-7	903	Channel
7	NCH-7a	989	Channel
8	SM-1	1385	Seamount
9	CH-6	1483	Channel
10	SM-2	1377	Seamount
11	NCH-6a	1384	Channel
12	SM-9	1494	Seamount
13	CH-4	2764	Channel
14	NCH-4a	2830	Channel
15	CH-3	3707	Channel
16	NCH-3a	3447	Channel
17	SL-2	1446	Slope
18	C1	4670	Channel
19	NBT	2555	Slope

Figure 4-1: TAN2402 Actual sampling sites visited and vessel path. A table of sample sites and depths is included.

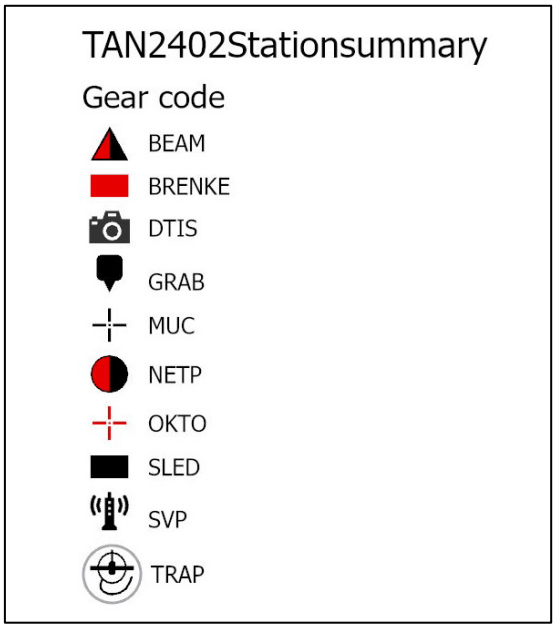


Figure 4-2: Key to the symbols used for gear types in the maps in Figs 4-3 to 4-20. BEAM = Beam trawl; BRENKE = Hyperbenthic sled; DTIS = Deep-towed Imaging System camera; GRAB = Van Veen Grab; MUC = Multicorer; NETP = Surface Plankton net; OKTO = Oktopus multicorer; SLED = Seamount Sled; SVP = Sound Velocity Profiler; TRAP = Lander with fish and amphipod traps. All maps created by Alicia Maurice.

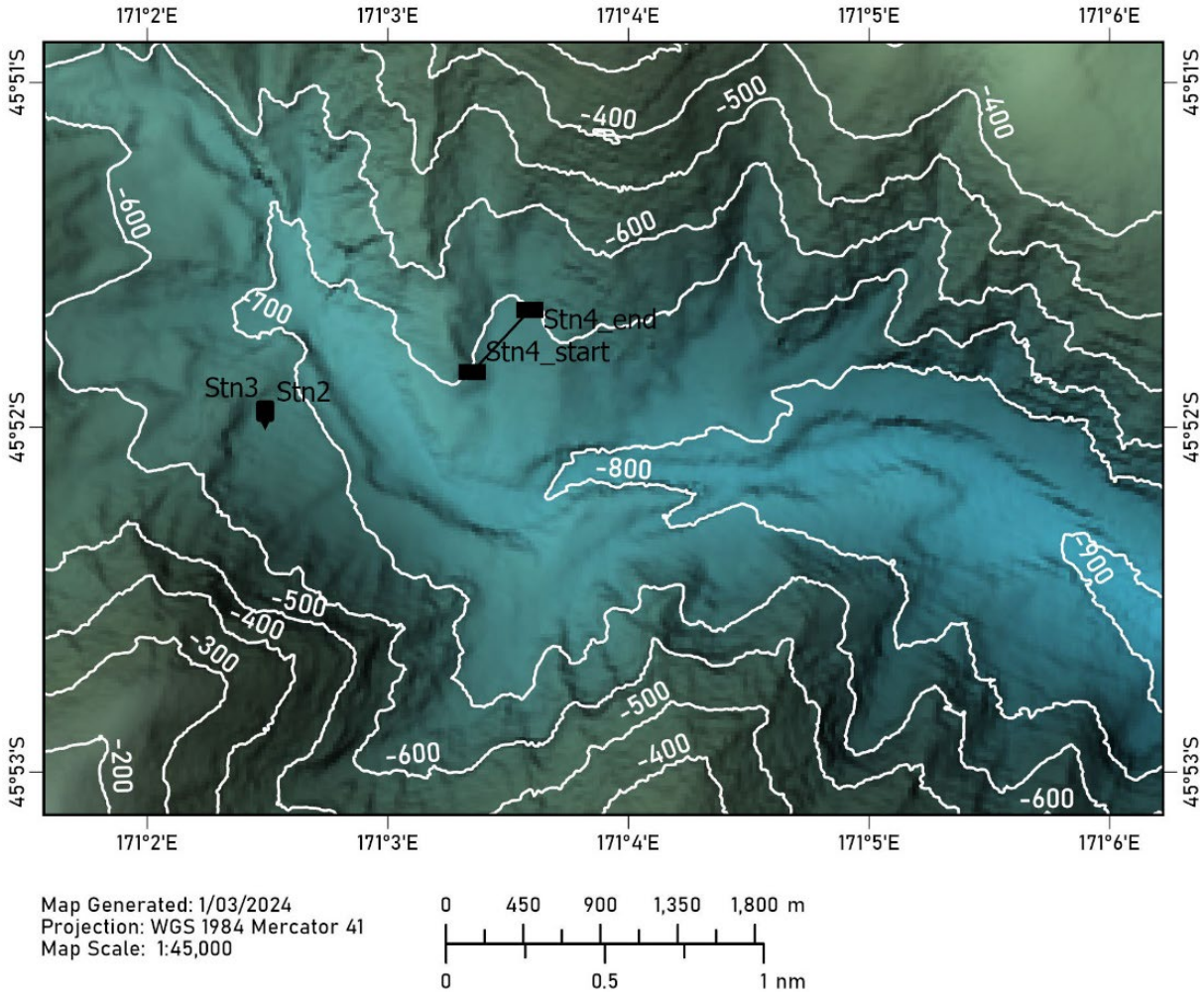


Figure 4-3: Site CA-1, Papanui Canyon. Key to the symbols used is in Fig. 4-2.

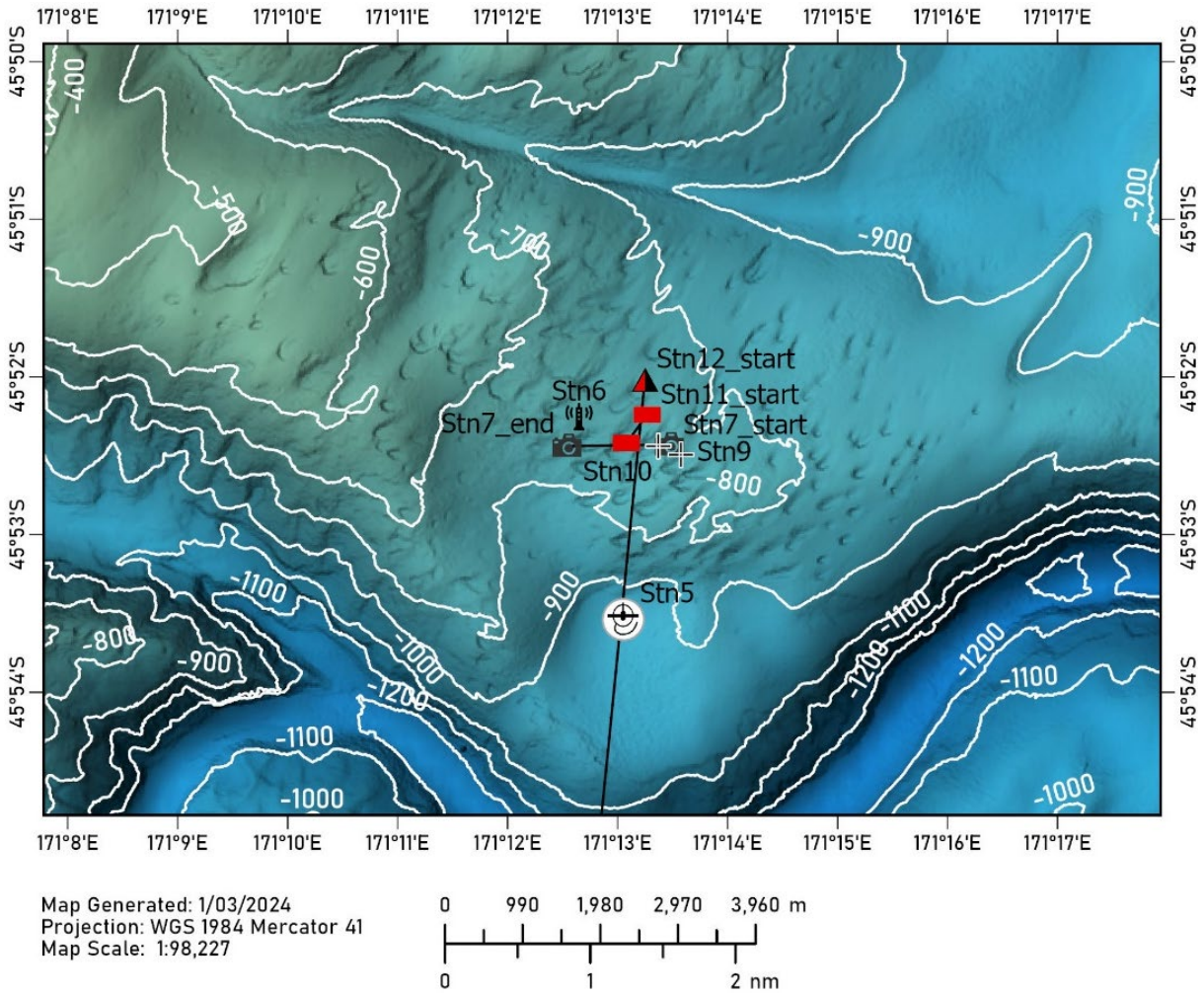


Figure 4-4: Site PM-1, Otago mid-slope pockmarks. Key to the symbols used is in Fig. 4-2.

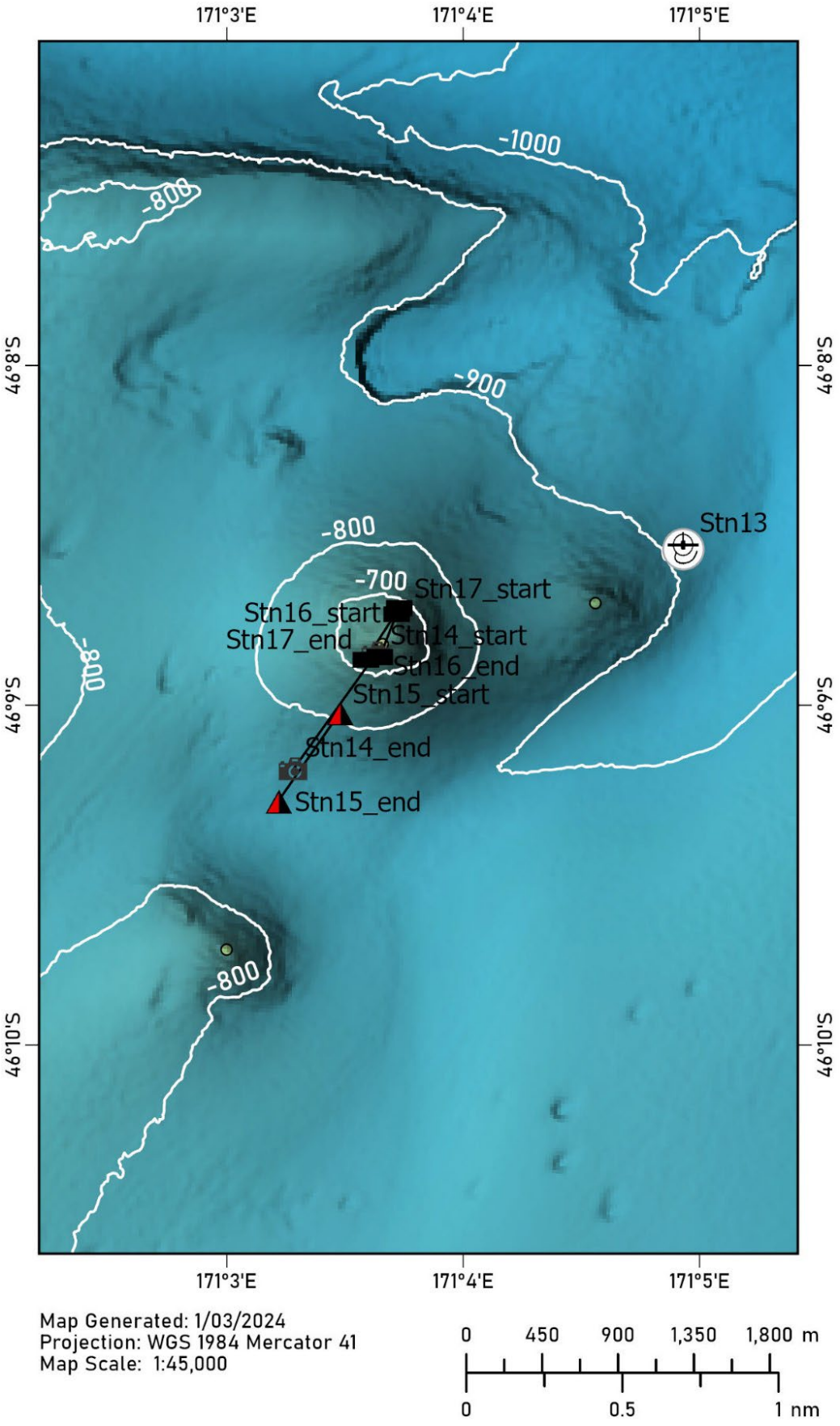


Figure 4-5: Site SM-5, highest relief seamount in group of 3 near Papanui Canyon head. Key to the symbols used is in Fig. 4-2.

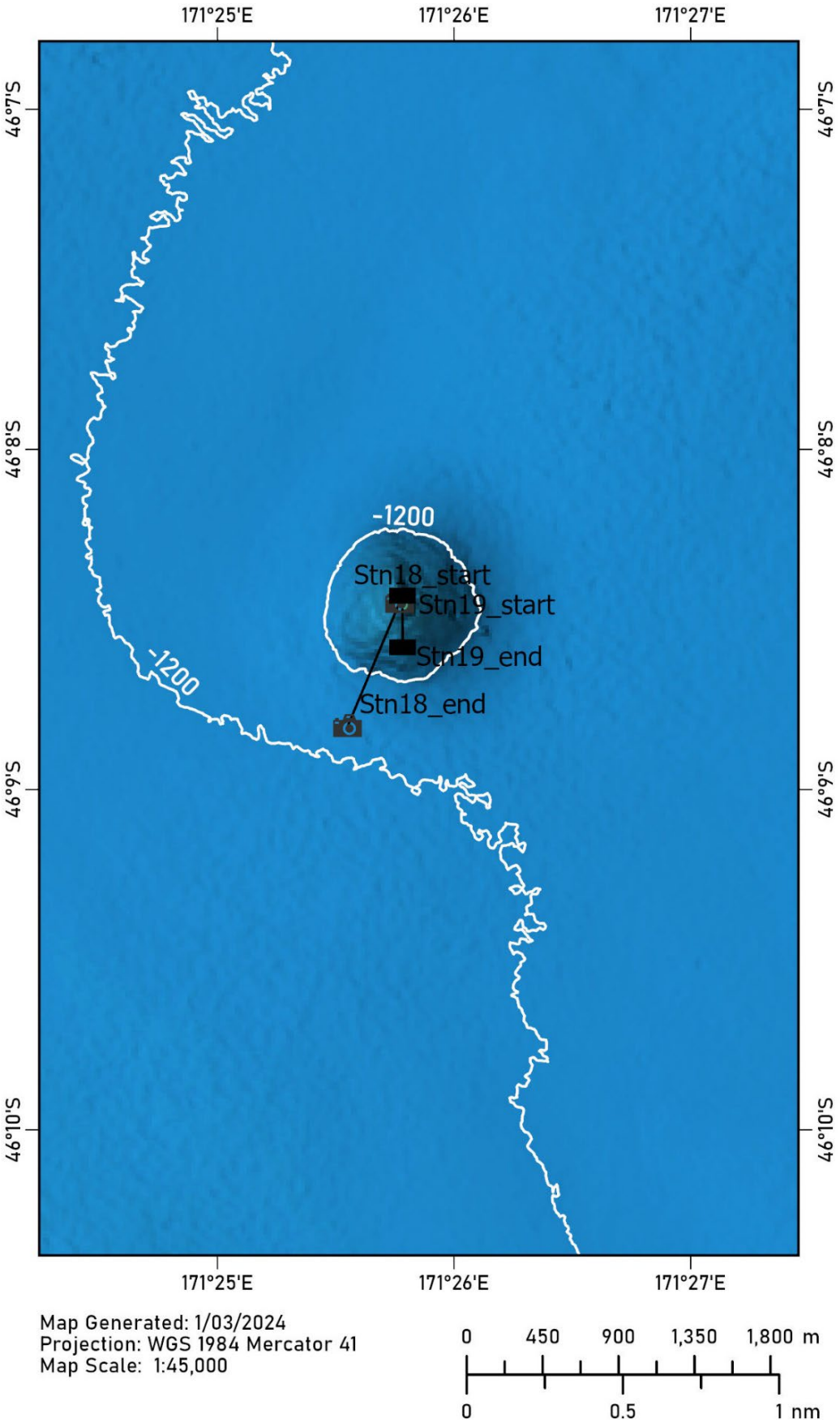


Figure 4-6: Site SM-4, solo seamount with 1000 m of relief, lower Otago slope. Key to the symbols used is in Fig. 4-2.

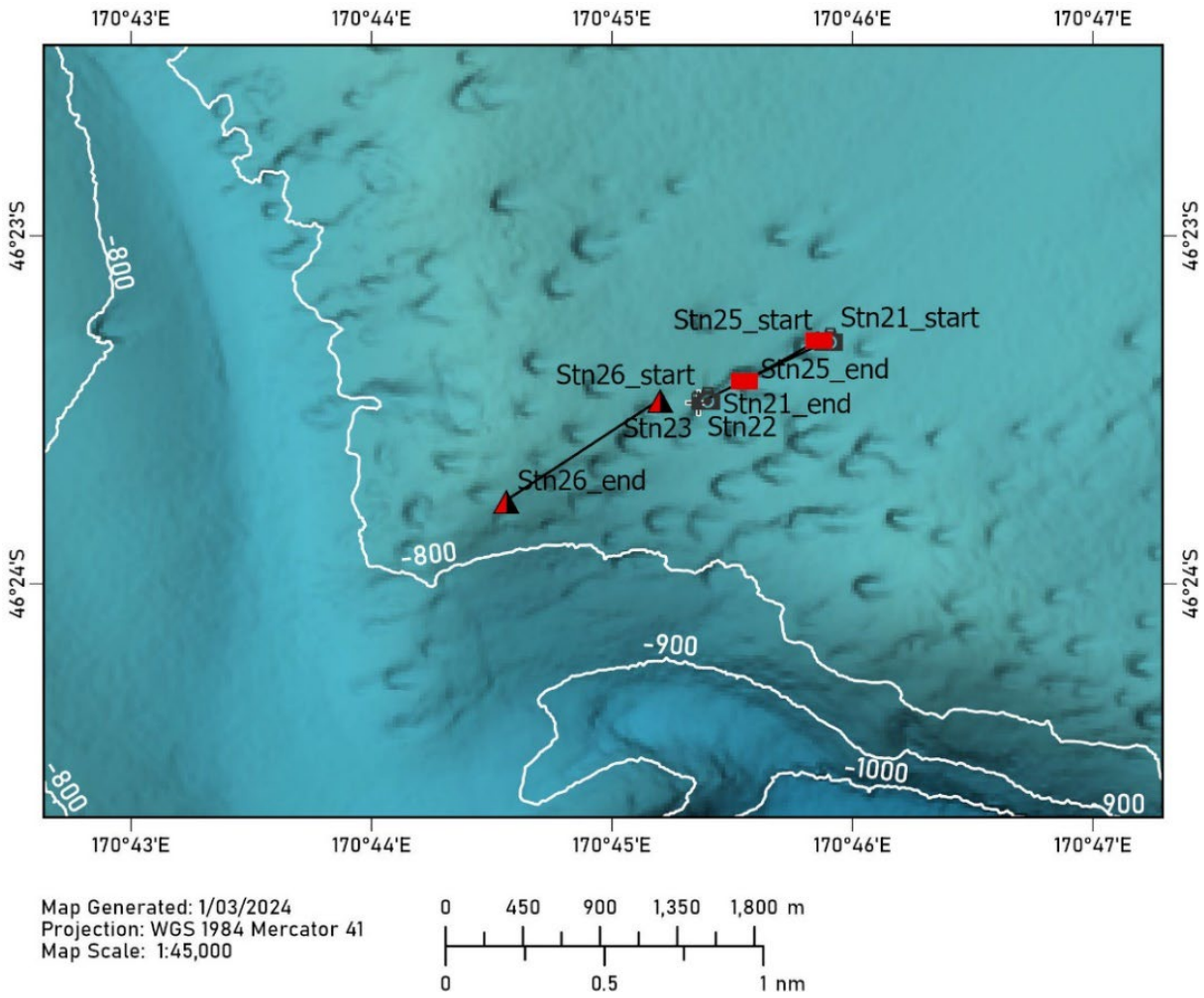


Figure 4-7: Site PM-2, southern pockmark area, lower Otago slope. Key to the symbols used is in Fig. 4-2.

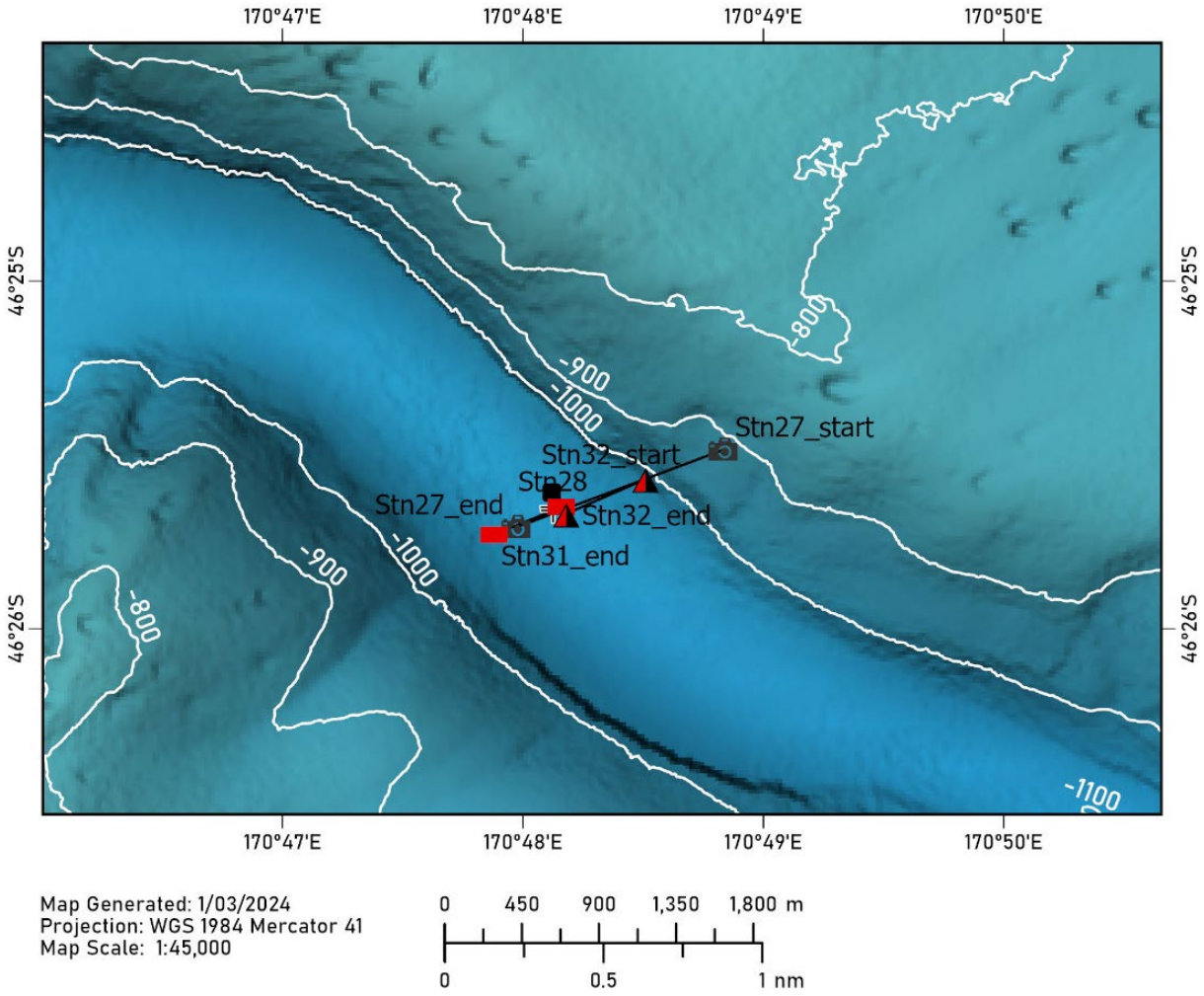


Figure 4-8: Site CH-7, upper South Bounty Channel head area near Brodie Canyon (~1000 m depth). Key to the symbols used is in Fig. 4-2.

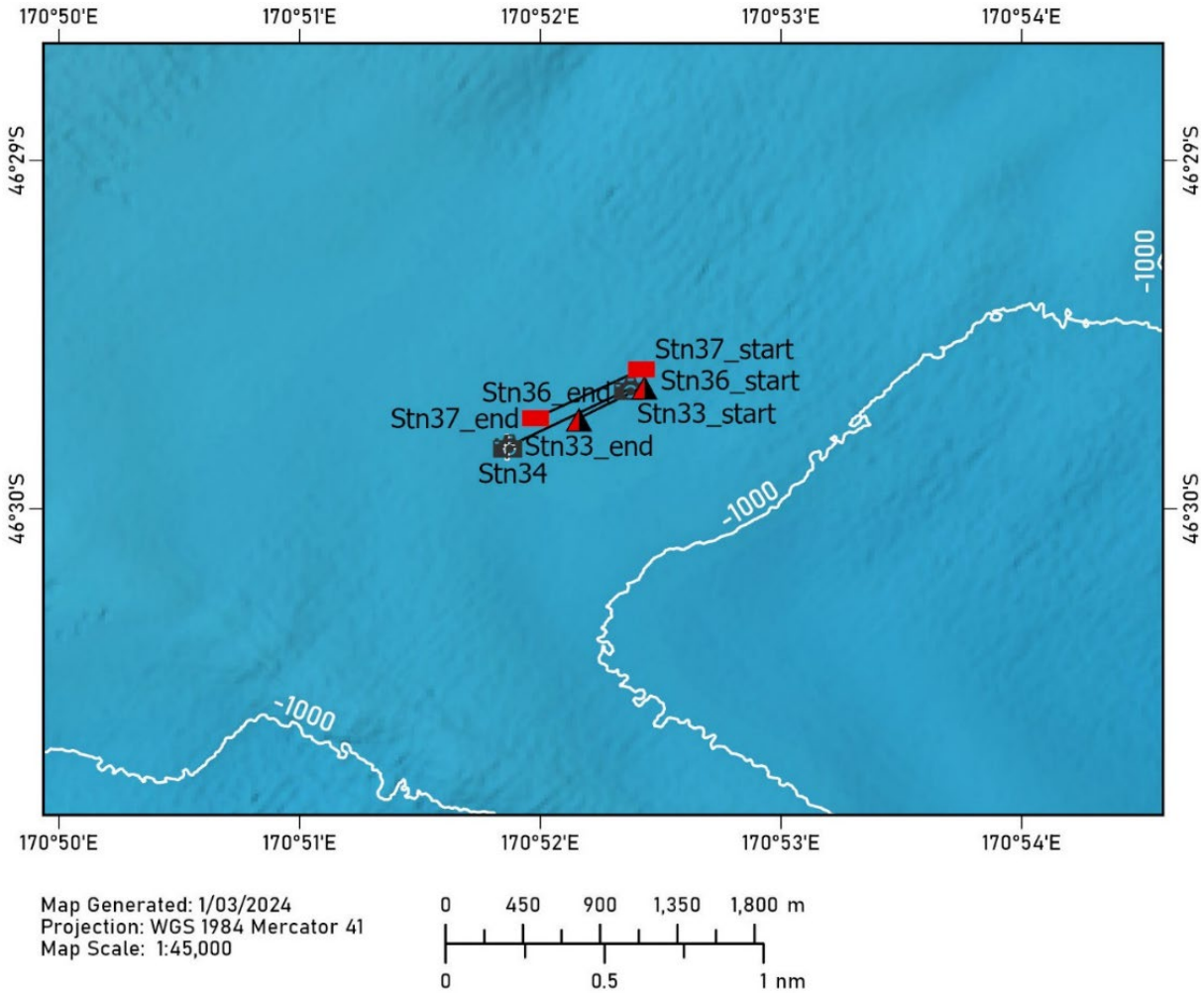


Figure 4-9: Site NCH-7a, outside upper South Bounty Channel area near Brodie Canyon (~1000 m). Key to the symbols used is in Fig. 4-2.

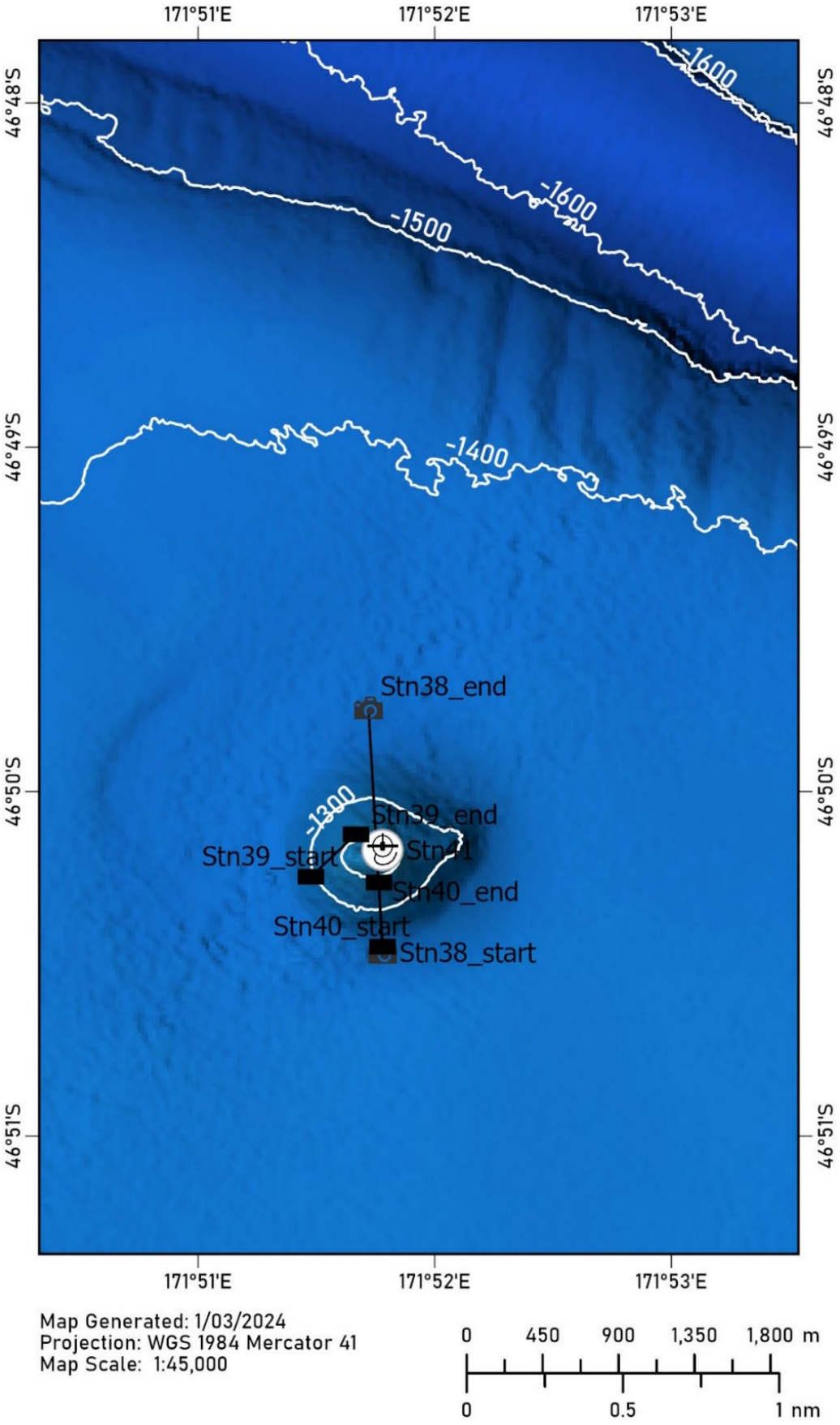


Figure 4-10: Site SM-1, small seamount on the edge of the South Bounty Channel. Key to the symbols used is in Fig. 4-2.

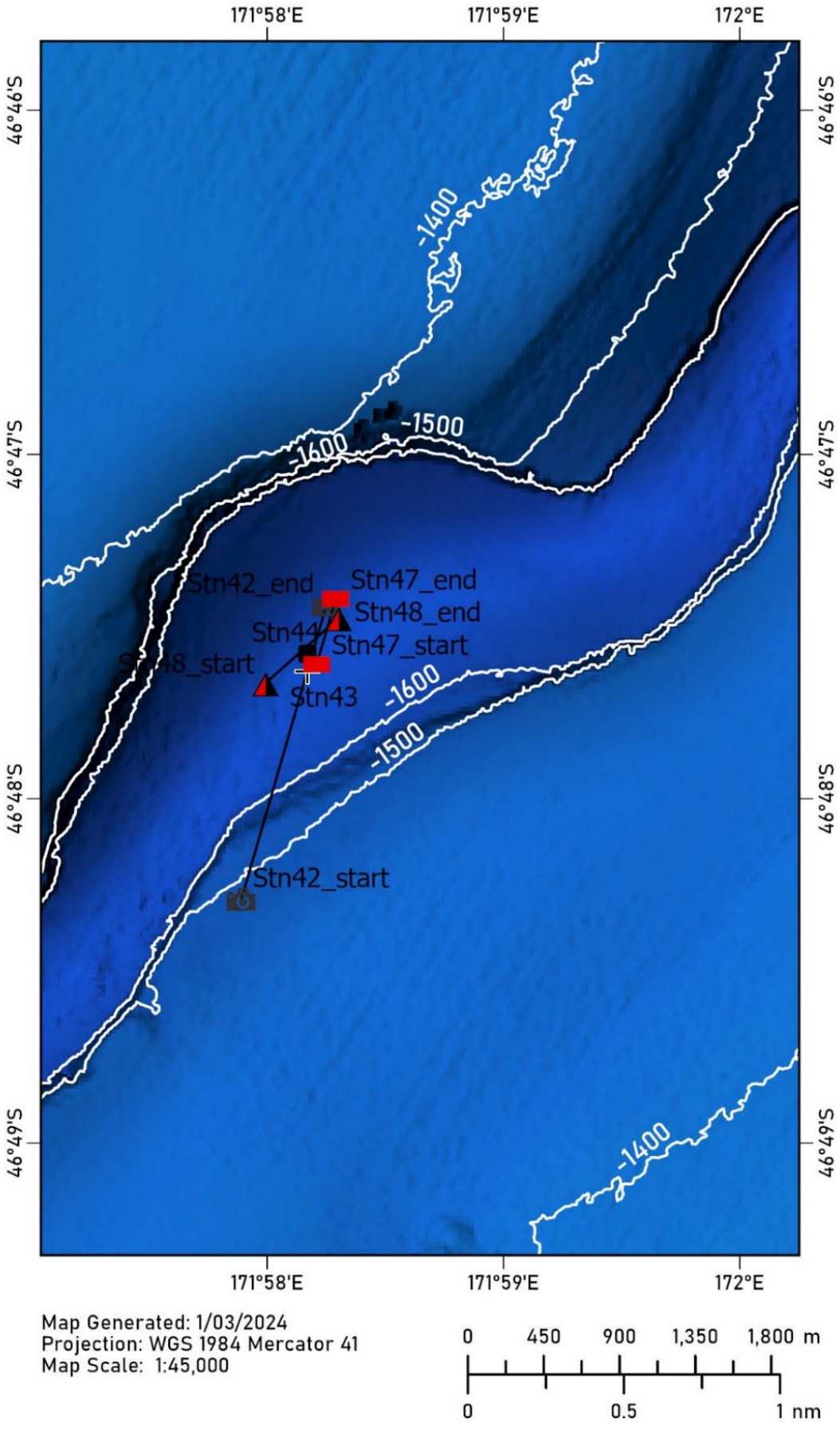


Figure 4-11: Site CH-6, inside South Bounty Channel (~1600 m). Key to the symbols used is in Fig. 4-2.

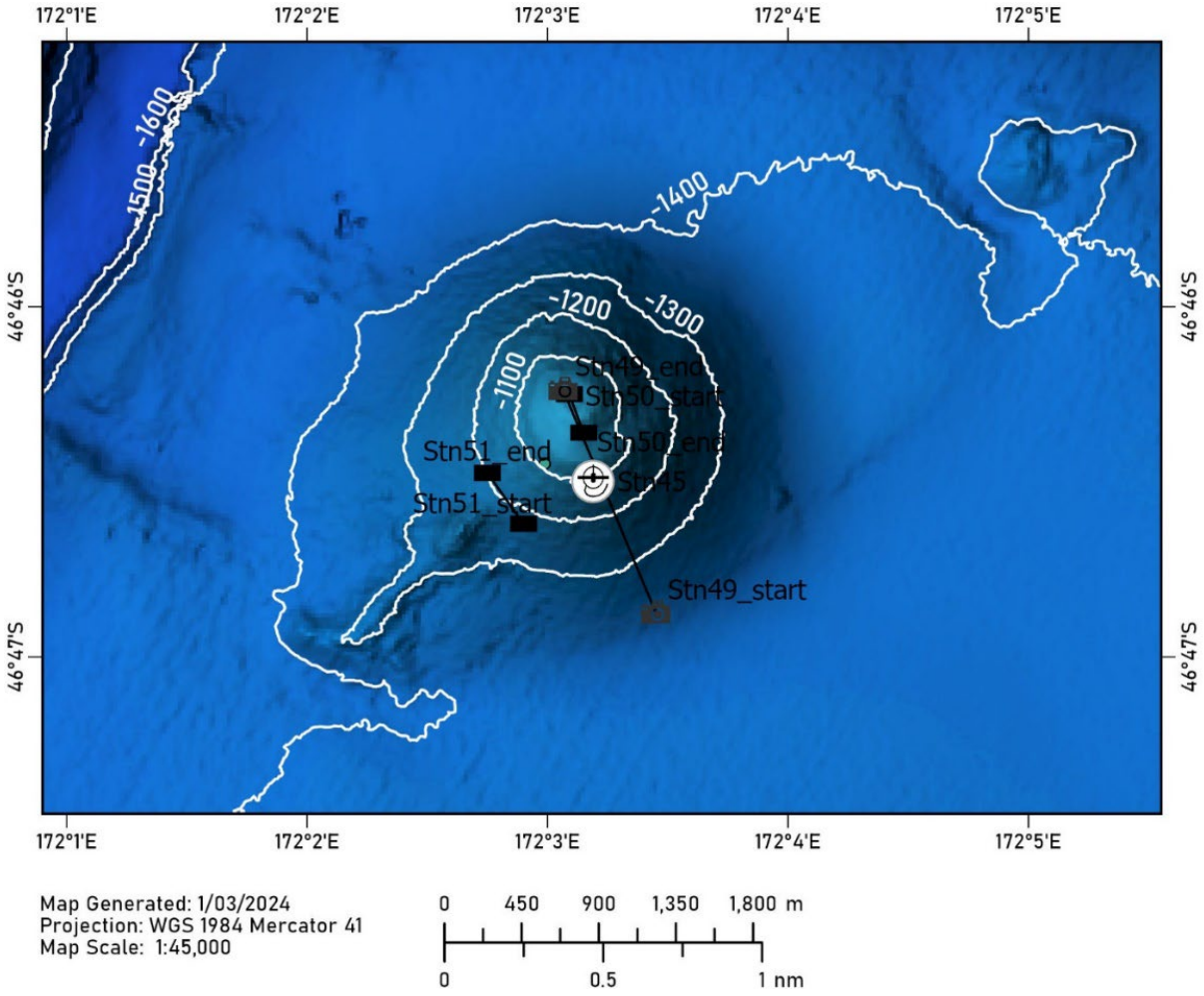


Figure 4-12: Site SM-2, seamount near South Bounty Channel. Key to the symbols used is in Fig. 4-2.

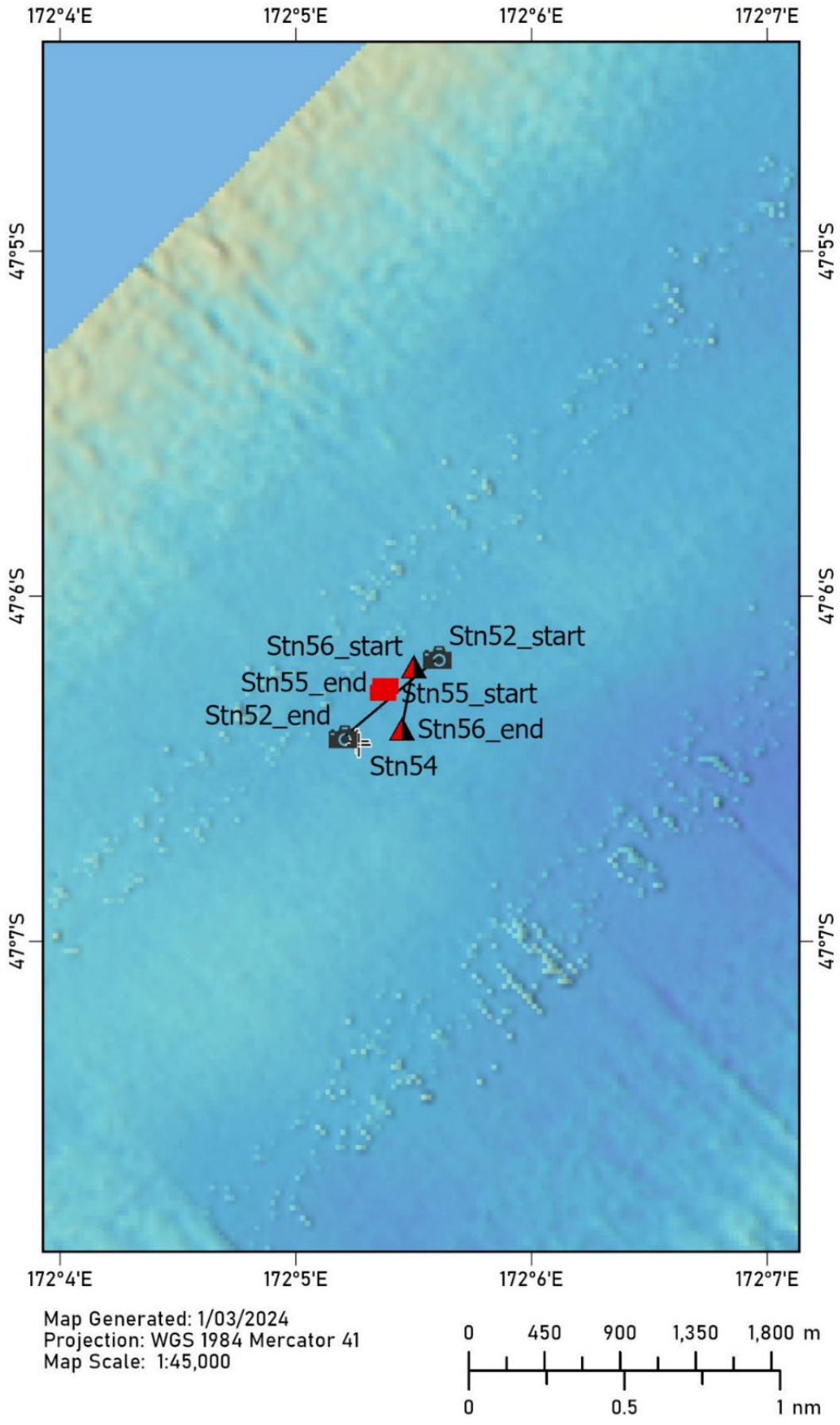


Figure 4-13: Site NCH-6a, outside South Bounty Channel (~1300 m). Key to the symbols used is in Fig. 4-2.

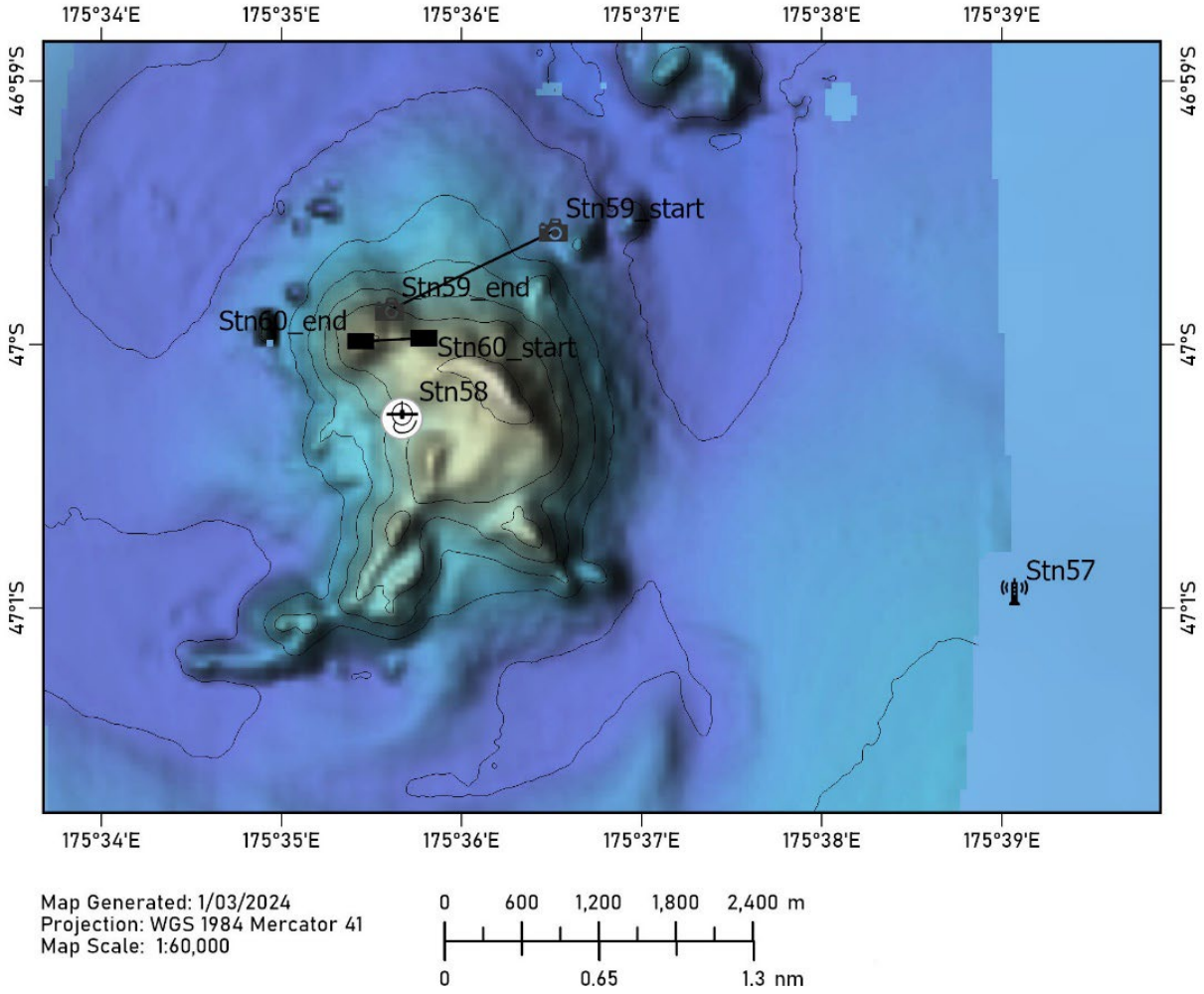


Figure 4-14: Site SM-9, seamount south of mid-Bounty Channel (1150-1550 m depth). Key to the symbols used is in Fig. 4-2.

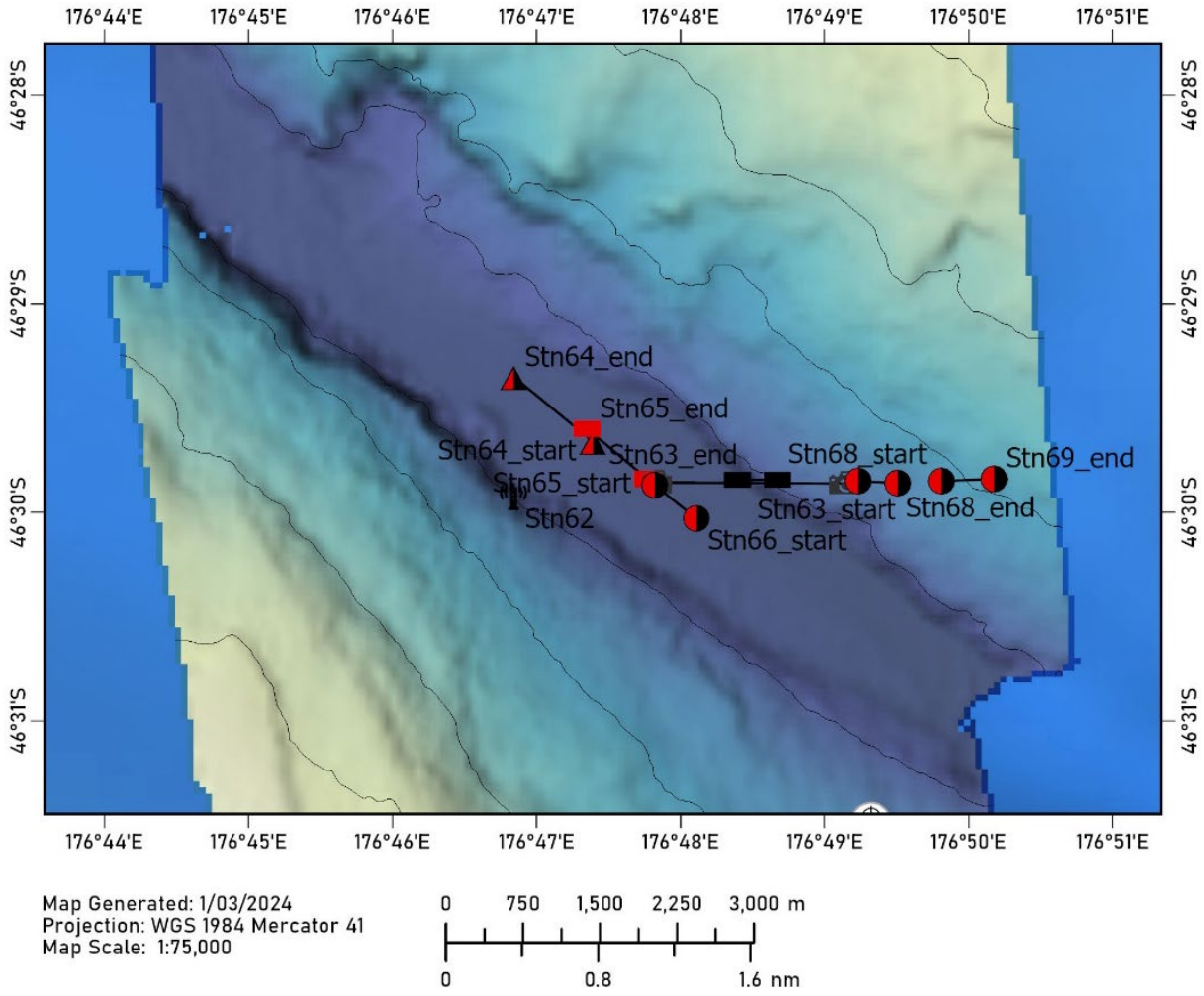


Figure 4-15: Site CH-4, inside mid-Bounty Channel (~2800 m). Key to the symbols used is in Fig. 4-2.

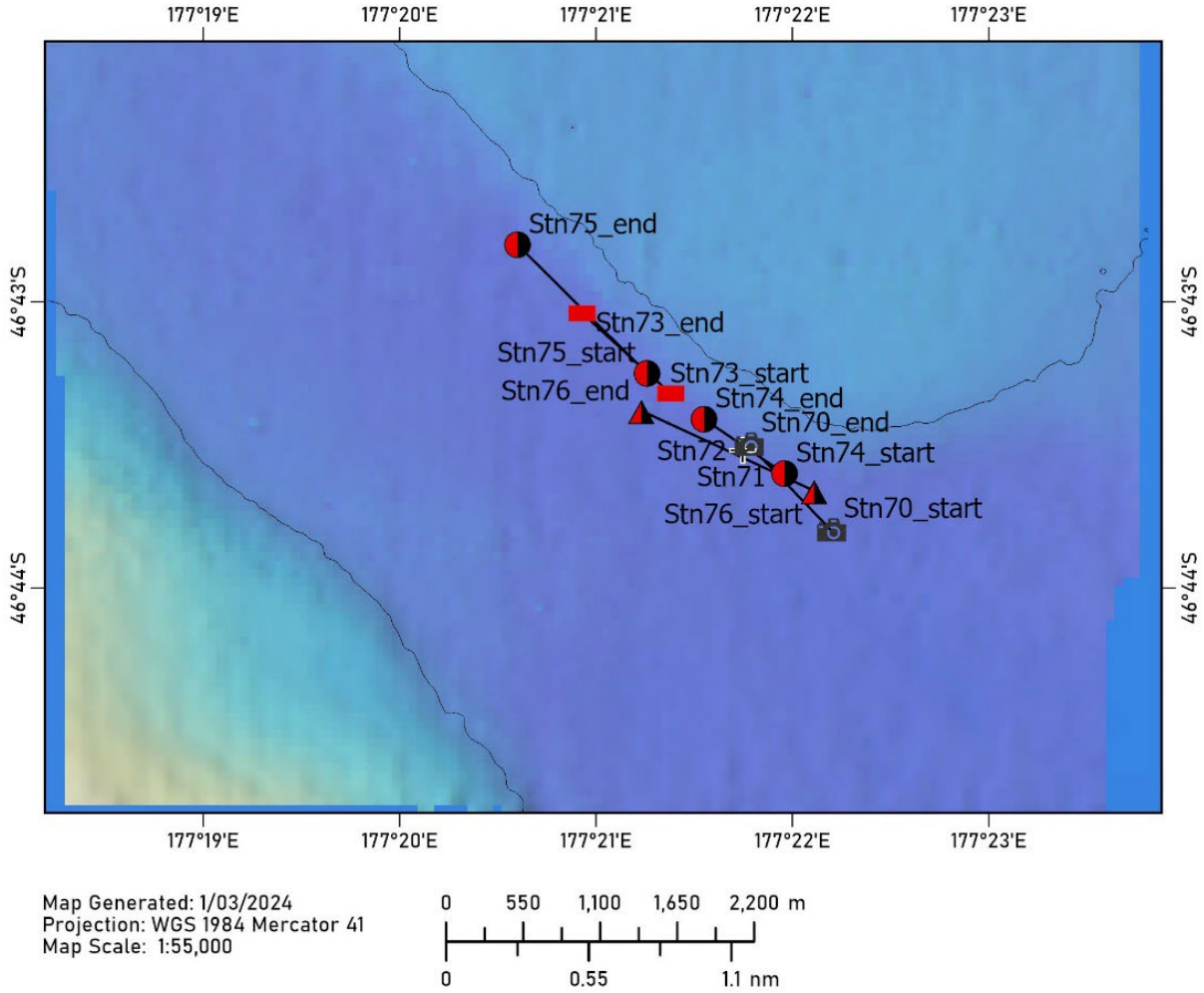


Figure 4-16: Site NCH-4a, outside mid-Bounty Channel (~2800 m). Key to the symbols used is in Fig. 4-2.

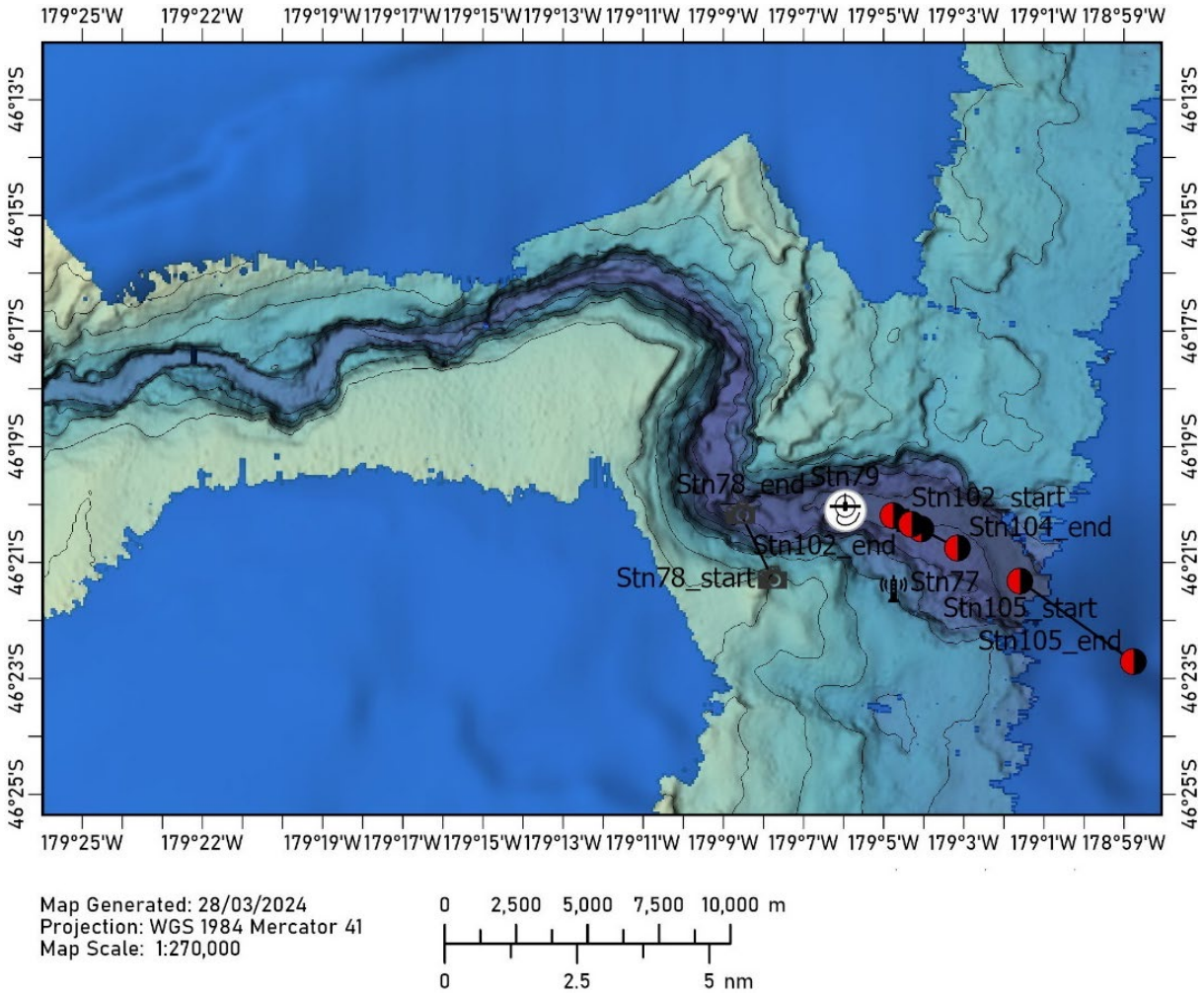


Figure 4-17: Site CH-3 within eastern Bounty Channel (~4000 m). Key to the symbols used is in Fig. 4-2.

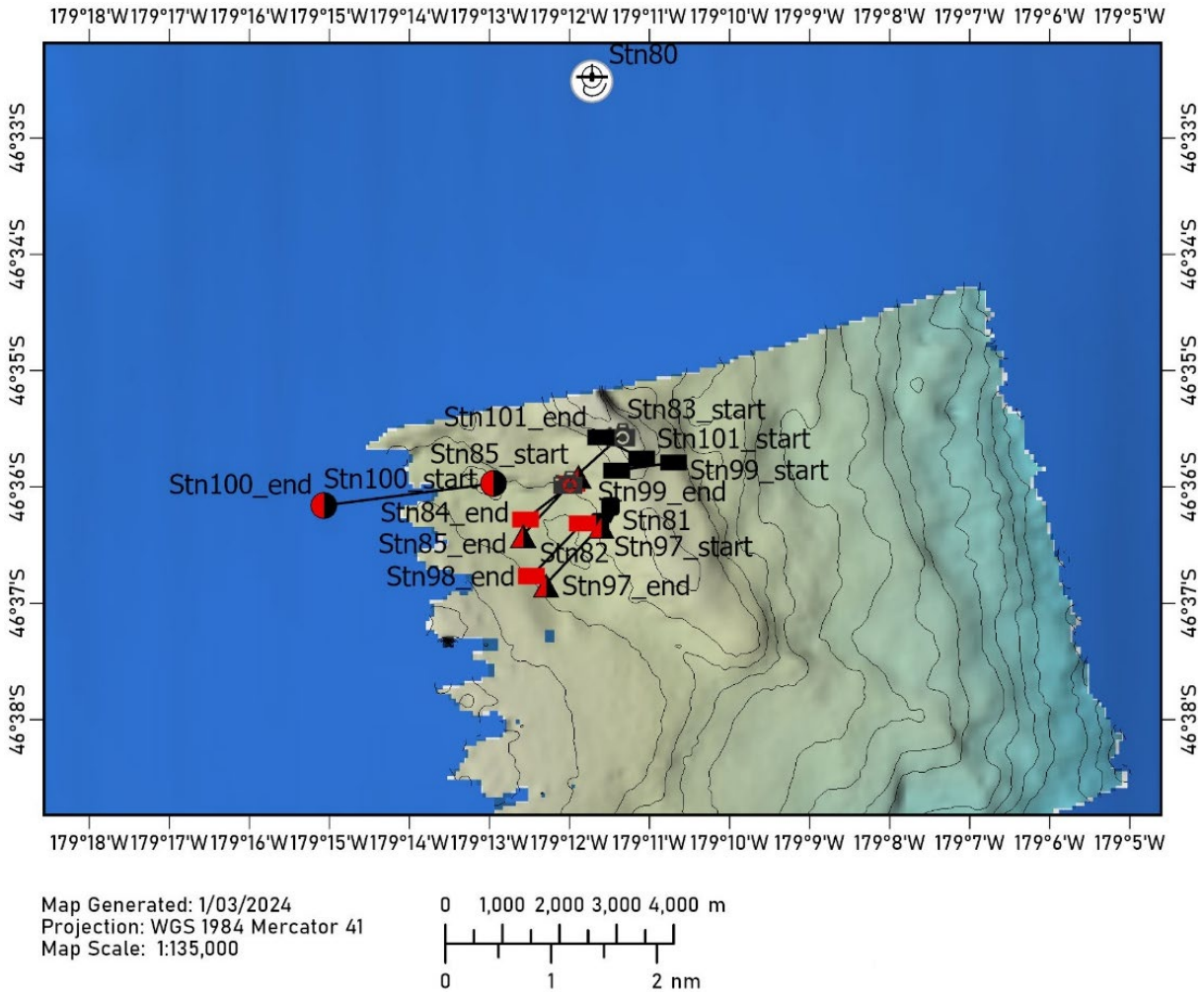


Figure 4-18: Site NCH-3a outside Bounty Channel (~4000 m). Key to the symbols used is in Fig. 4-2.

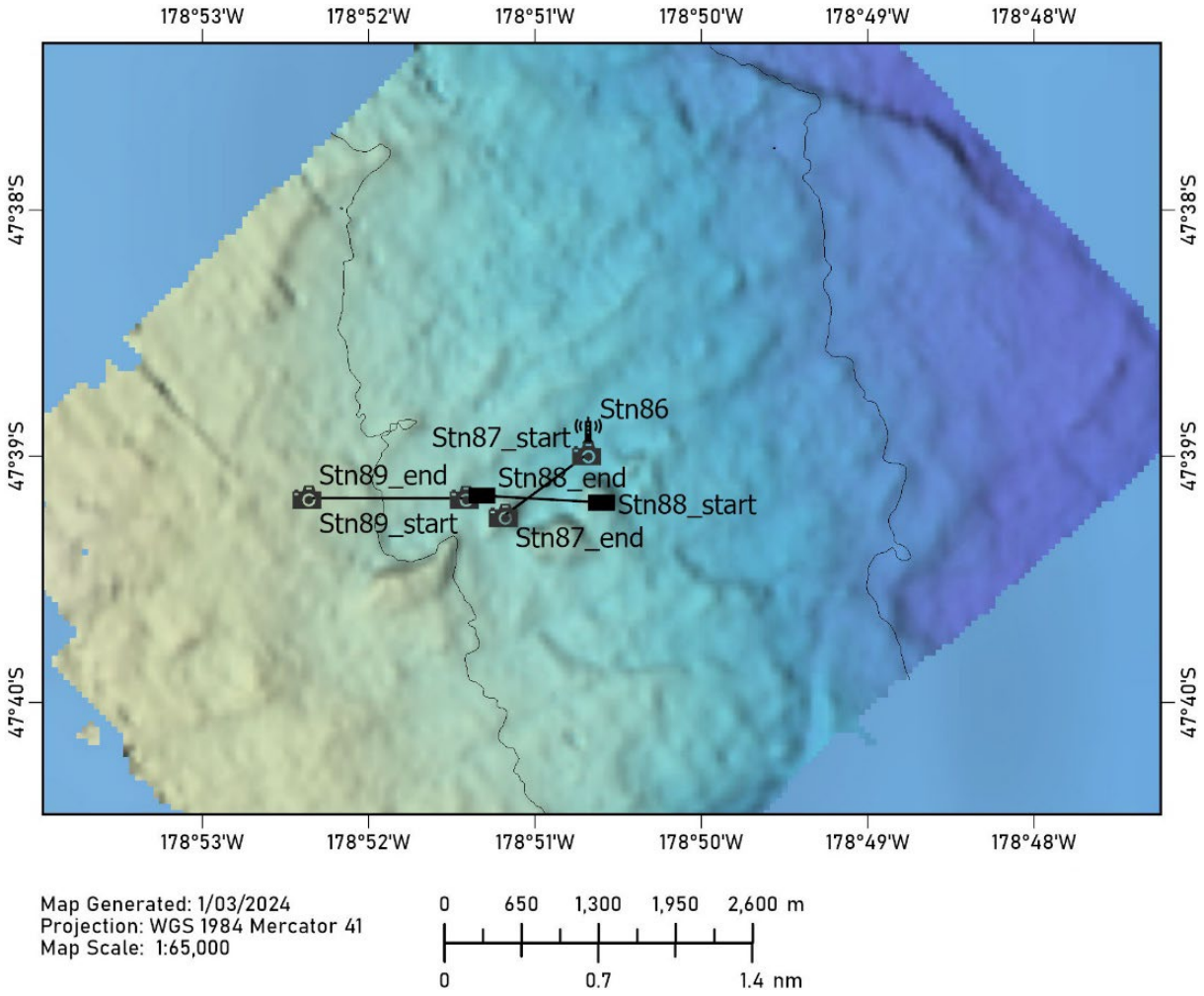


Figure 4-19: Site SL-2, eastern slope of Bounty Plateau (~1500 m). Key to the symbols used is in Fig. 4-2.

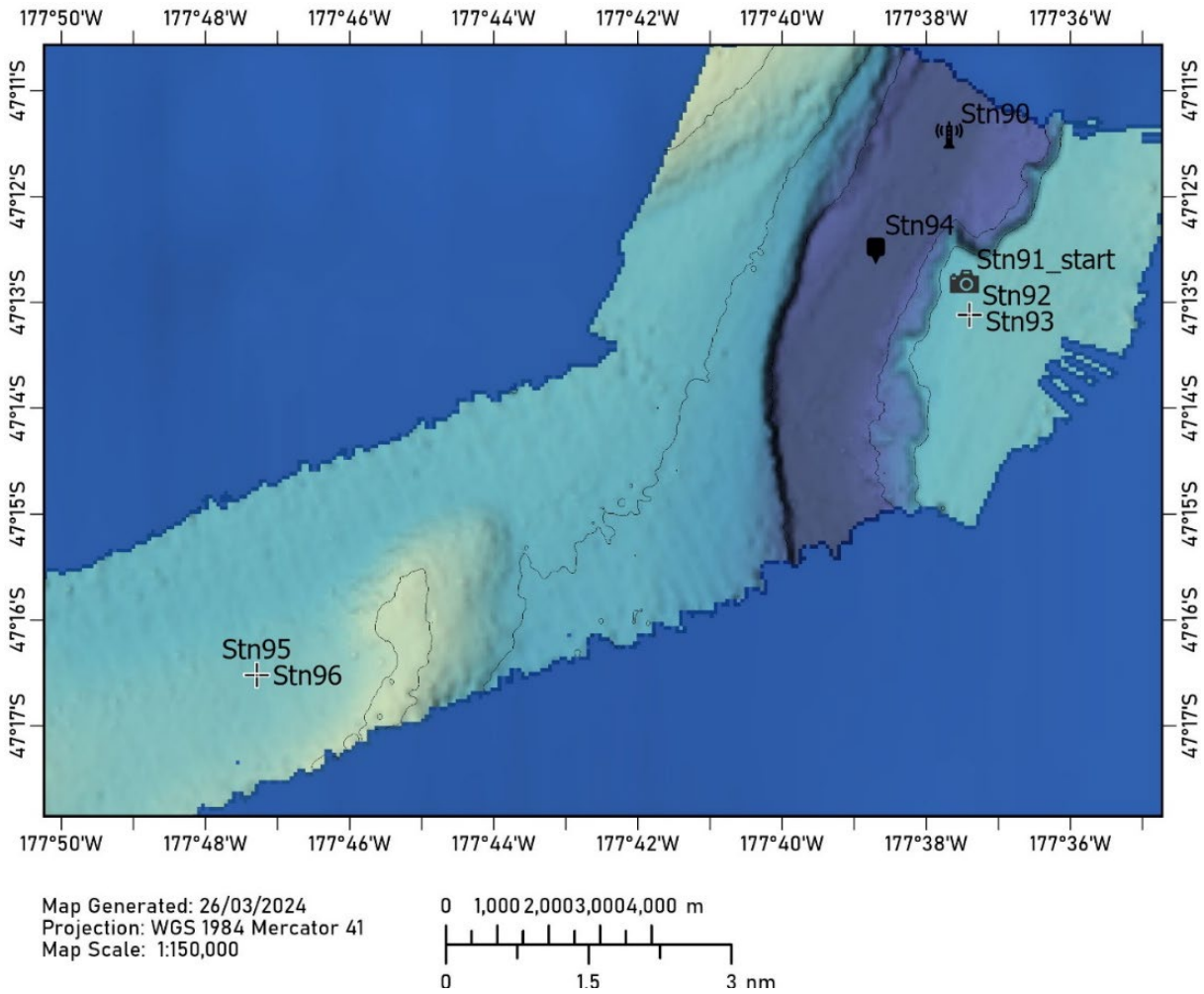


Figure 4-20: Site C1, inside channel of terminal end of Bounty Channel (~4800 m). Key to the symbols used is in Fig. 4-2.

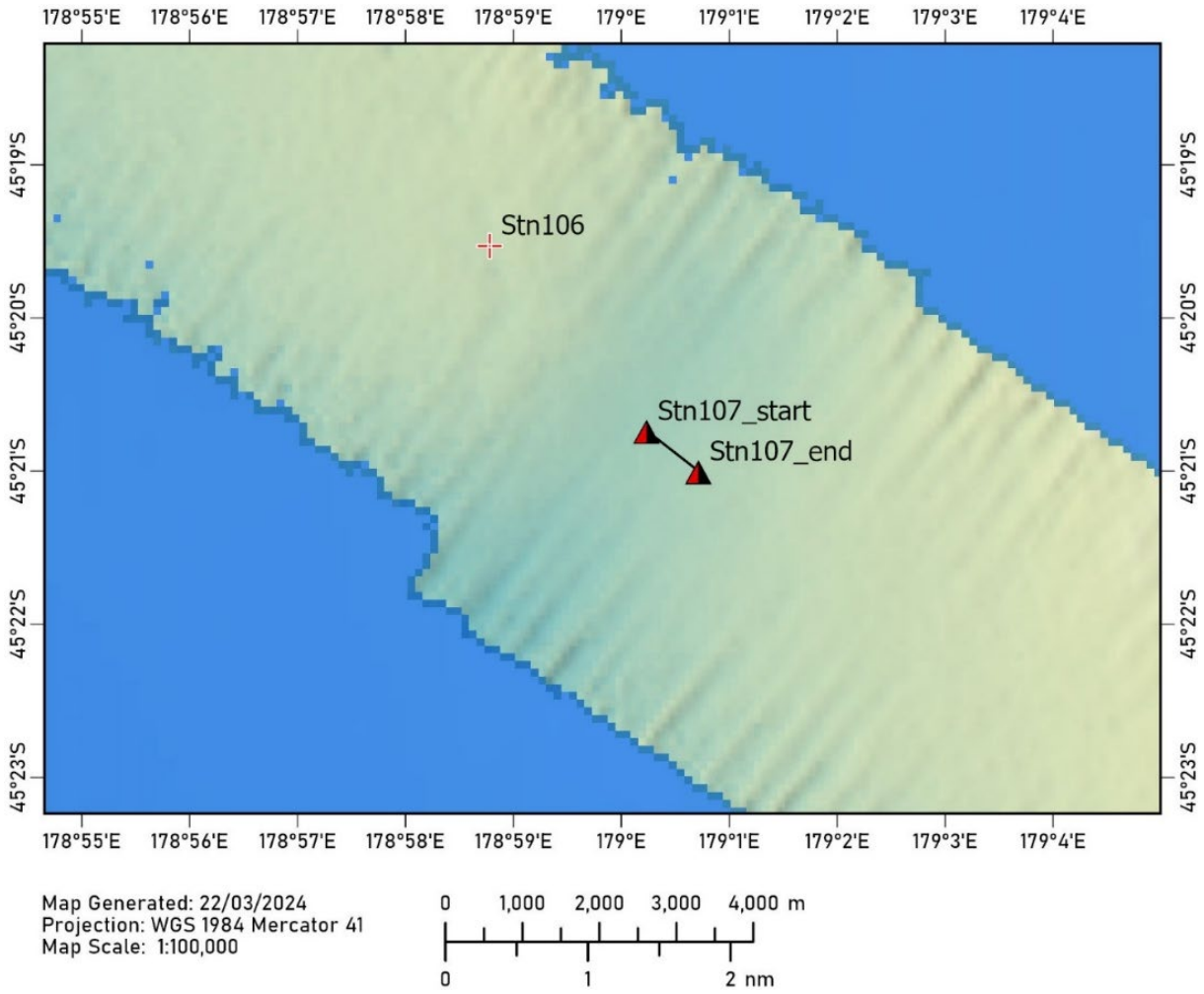


Figure 4-21: Site NBT, northern Bounty Trough (~2000 m). Key to the symbols used is in Fig. 4-2.

4.3 Marine invertebrates

A total of 1090 invertebrate samples were collected and sorted to the lowest possible taxonomic level onboard during the expedition. The final count of numbers of samples and specimens sorted during the workshop will be contained in a separate report. Table 4-2 provides a breakdown of the numbers of samples by the level of identification (taxon name) used onboard. Additional samples collected were:

- 58 unsorted bulk samples of sediment, shell hash or rock washings (sieved on a 0.4 mm mesh sieve) were retained for further sorting, primarily for micromolluscs.
- 381 subsamples were retained for genetics and/or genomics (preserved in ethanol and stored at -20°C, RNA Later and/or flash frozen in liquid nitrogen then stored at -80°C).
- 27 samples were separated for a study into the presence of micro-plastics.
- Four samples were retained for potential isotope studies.

Table 4-2: Number of invertebrate samples collected during the TAN2402 Ocean Census Bounty Trough expedition arranged by lowest onboard identified taxon group.

Phylum	Class	Order	Family	Taxon name	No. of samples
Foraminifera				Foraminifera	4
Porifera				Porifera	64
	Demospongiae			Demospongiae	17
		Poecilosclerida	Cladorhizidae	*Chondrocladia*	2
				Cladorhizidae	2
		Polymastiida		Polymastiida	1
			Polymastiidae	Polymastiidae	1
		Tetractinellida	Tetillidae	Tetillidae	6
	Hexactinellida			Hexactinellida	19
		Sceptrulophora	Aphrocallistidae	*Aphrocallistes*	1
			Farreidae	*Farrea*	1
			Tretodictyidae	Hexactinella	2
Ctenophora				Ctenophora	1
Cnidaria	Anthozoa			Octocorallia	6
		Actiniaria		Actiniaria	26
			Actinostolidae	Actinostolidae	8
		Antipatharia		Antipatharia	6
		Corallimorpharia	Corallimorphidae	*Corallimorphus*	1
		Malacalcyonacea		Malacalcyonacea	1
			Acanthogorgiidae	Acanthogorgiidae	2
			Alcyoniidae	*Anthomastus*	4
			Clavulariidae	Clavulariidae	6
			Isididae	Isididae	4
			Paramuriceidae	Paramuriceidae	1
			Plexauridae	Plexauridae	5
			Taiaroiidae	*Taiaroa tauhou*	1
			Tubiporidae	*Telesto*	3
		Scleractinia		Scleractinia	3
			Caryophylliidae	*Caryophyllia*	3
				Caryophylliidae	2
				Desmophyllum dianthus	2
			Flabellidae	Flabellum	2
			Oculinidae	*Madrepora*	1
		Scleralcyonacea		Pennatuloidea	5
				Scleralcyonacea	11
			Chrysogorgiidae	Chrysogorgiidae	1
				Radicipes	1
			Keratoisididae	Keratoisididae	1
			Mopseidae	*Minuisis*	2

Phylum	Class	Order	Family	Taxon name	No. of samples
				Mopseidae	2
			Primnoidae	*Callogorgia*	3
				Primnoa	2
				Primnoidae	18
				Thouarella	10
				Tokoprymno	2
			Umbellulidae	*Umbellula*	1
		Zoantharia	Zoanthidae	Zoanthidae	1
	Hydrozoa			Hydrozoa	17
		Anthoathecata		Anthoathecata	3
			Stylasteridae	Stylasteridae	22
		Hydroida		Hydroida	5
		Leptothecata		Leptothecata	1
		Siphonophora	Rhodaliidae	Rhodaliidae	1
	Scyphozoa			Scyphozoa	2
Platyhelminthes				Platyhelminthes	1
Mollusca				Mollusca	10
	Bivalvia	Lucinida	Thyasiridae	Thyasiridae	1
		Pectinida	Pectinidae	Pectinidae	1
			Propeamussiidae	Propeamussiidae	1
	Cephalopoda			Cephalopoda	2
		[unassigned] Decapodiformes	Bathyteuthidae	*Bathyteuthis*	1
		Octopoda		*Cirrata*	1
				Octopoda	1
			Cirroteuthidae	Cirroteuthidae	1
			Enteroctopodidae	Enteroctopodidae	1
			Megaleledonidae	*Graneledone taniwha*	1
		Oegopsida	Brachioteuthidae	*Brachioteuthis*	1
			Cranchiidae	Cranchiidae	1
				Galiteuthis	1
		Sepiida	Sepiadariidae	*Sepioloidea jaelae*	1
	Gastropoda			Gastropoda	10
				Opisthobranchia	7
		Cephalaspidea	Scaphandridae	*Scaphander*	5
		Cocculinida	Bathysciadiidae	Bathysciadiidae	1
			Cocculinidae	Cocculinidae	1
		Littorinimorpha	Eulimidae	Eulimidae	1
			Naticidae	Naticidae	1
			Ranellidae	*Fusitriton magellanicus laudandus*	2
			Velutinidae	Velutinidae	2

Phylum	Class	Order	Family	Taxon name	No. of samples
		Neogastropoda	Austrosiphonidae	*Antarctoneptunea benthicola*	1
			Cancellariidae	Cancellariidae	1
			Cominellidae	*Cominella*	1
			Marginellidae	Marginellidae	1
			Prosiphonidae	*Antarctodomus*	2
			Pseudomelatomidae	*Comitas*	1
			Raphitomidae	Raphitomidae	2
			Tudiclidae	*Aeneator valedictus*	1
			Turbinellidae	*Coluzea mariae*	1
			Turridae	Turridae	1
			Volutidae	*Alcithoe flemingi*	1
		Nudibranchia	Doridiidae	Doridiidae	1
		Ptenoglossa GROUP	Epitoniidae	*Cirsotrema*	1
			Nystiellidae	*Iphitus*	1
		Pteropoda		Pteropoda	1
		Seguenziida	Seguenziidae	Seguenziidae	2
		Trochida	Calliostomatidae	*Falsimargarita*	1
			Margaritidae	*Antimargarita*	1
				Antimargarita maoria	1
			Solariellidae	*Zetela kopua*	1
				Zetela tangaroa	1
	Polyplacophora	Chitonida	Mopaliidae	*Placiphorella*	2
Brachiopoda				Brachiopoda	5
Bryozoa				Bryozoa	19
	Gymnolaemata	Ctenostomata	Pachyzoidae	Pachyzoidae	2
Chaetognatha				Chaetognatha	1
Annelida				Annelida	2
		Sipuncula		Sipuncula	13
			Sipunculidae	Sipunculidae	2
	Polychaeta			Echiura	8
				Polychaeta	69
		Amphinomida	Amphinomidae	*Chloeia*	2
		Echiuroidea	Echiuridae	Echiuridae	1
		Eunicida	Onuphidae	*Hyalinoecia longibranchiata*	3
		Phyllodocida	Aphroditidae	*Laetmonice*	1
			Polynoidae	Polynoidae	8
		Spionida	Chaetopteridae	Chaetopteridae	1
Nemertea				Nemertea	4
	Hoplonemertea	Polystilifera	Pelagonemertidae	*Pelagonemertes*	2
Echinodermata	Asteroidea			Asteroidea	37

Phylum	Class	Order	Family	Taxon name	No. of samples
		Brisingida		Brisingida	1
		Notomyotida	Benthopectinidae	*Benthopecten*	1
		Paxillosida	Astropectinidae	Astropectinidae	1
		Valvatida	Goniasteridae	*Ceramaster*	2
				Lithosoma	1
			Solasteridae	*Crossaster*	1
				Crossaster multispinus	1
				Solaster	1
				Solasteridae	2
		Velatida	Pterasteridae	*Hymenaster*	3
				Pterasteridae	2
	Crinoidea			Crinoidea	3
		Comatulida		Comatulida	4
		Hyocrinida		Hyocrinida	1
	Echinoidea			Echinoidea	19
		Cidaroida		Cidaroida	2
				Cidaroidea	1
			Cidaridae	Cidaridae	3
				Goniocidaris	1
		Echinoida		Echinoida	1
		Echinothurioida		Echinothurioida	1
			Echinothuriidae	*Araeosoma*	2
			Phormosomatidae	Phormosomatidae	2
		Pedinoida	Pedinidae	*Caenopedina*	1
		Spatangoida	Loveniidae	Echinocardiinae	1
				Echinocardium	1
			Spatangidae	*Spatangus*	3
	Holothuroidea			Holothuroidea	76
		Synallactida		*Paelopatides*	1
		Dendrochirotida		Dendrochirotida	4
			Psolidae	Psolidae	5
		Elasipodida		Elasipodida	7
			Elpidiidae	Elpidiidae	11
				Scotoplanes	1
			Psychropotidae	*Psychropotes*	1
				Psychropotes longicauda	1
		Persiculida		Persiculida	2
			Molpadiodemidae	*Molpadiodemas*	2
			Pseudostichopodidae	*Pseudostichopus*	2
	Ophiuroidea			Ophiuroidea	71
		Amphilepidida	Amphilepididae	*Amphilepis*	1

Phylum	Class	Order	Family	Taxon name	No. of samples
			Ophiactidae	*Ophiactis*	1
				Ophiactis cuspidata	1
		Ophiacanthida	Ophiacanthidae	*Ophiacantha*	1
				Ophiacanthidae	1
				Ophiolimna	1
			Ophiomyxidae	*Ophiomyxa*	1
		Ophioleucida	Ophiernidae	*Ophiernus*	1
		Ophiurida		Ophiurida	1
			Ophiosphalmidae	*Ophiosphalma*	1
				Ophiosphalma armatum	1
			Ophiuridae	*Ophiura*	2
				Ophiuridae	2
Chordata	Ascidiacea			Ascidiacea	18
		Phlebobranchia	Ascidiidae	Ascidiidae	1
	Thaliacea	Salpida		Salpida	13
Arthropoda				Crustacea	2
	Malacostraca	Amphipoda		Amphipoda	33
				Lysianassoidea	1
			Epimeriidae	*Epimeria*	1
			Hyperiidae	*Themisto*	1
			Phronimidae	*Phronima*	2
		Cumacea	Lampropidae	Lampropidae	1
		Decapoda		Decapoda	12
				Dendrobranchiata	10
				Galatheoidea	9
			Acanthephyridae	*Acanthephyra*	1
			Campylonotidae	*Campylonotus*	1
				Campylonotus rathbunae	2
			Chirostylidae	*Gastroptychus*	1
			Galatheidae	Galatheidae	2
				Phylladiorhynchus nui	2
			Lipkiidae	*Lipkius holthuisi*	2
			Munididae	*Curtonida*	6
				Munididae	1
			Munidopsidae	*Munidopsis*	2
				Munidopsis kaiyoae	2
			Paguridae	*Lophopagurus*	1
				Paguridae	12
			Parapaguridae	*Parapagurus latimanus*	1
			Polychelidae	*Polycheles*	2
				Polychelidae	3

Phylum	Class	Order	Family	Taxon name	No. of samples
			Spongicolidae	Spongicolidae	1
			Trichopeltariidae	*Pteropeltarion novaezelandiae*	2
		Euphausiacea		Euphausiacea	1
		Isopoda		Isopoda	10
			Arcturidae	Arcturidae	8
			Cirolanidae	Cirolanidae	3
			Munnopsidae	Munnopsidae	1
			Serolidae	*Acutiserolis*	1
				Brucerolis	9
				Serolidae	3
		Lophogastrida	Lophogastridae	*Gnathophausia*	1
	Ostracoda			Ostracoda	3
		Myodocopida	Cypridinidae	*Gigantocypris*	3
	Pycnogonida			Pycnogonida	20
		Pantopoda	Colossendeidae	Colossendeidae	2
				Colossendeis	1
			Pycnogonidae	Pycnogonidae	4
	Thecostraca			Cirripedia	7
				Thecostraca	3
		Balanomorpha		Balanomorpha	1
			Balanidae	Balanidae	3
		Scalpellomorpha	Lepadidae	Lepadidae	1
Priapulida				Priapulida	5
Nematoda				Nematoda	1
Invertebrata (unidentified)				unidentified invertebrate	8
Total					1090

A total of 6241 specimen images (a mixture of jpg, raw and png images files) were taken of marine invertebrates and have been labelled with cruise, station number, catalogue number and 3-letter FNZ invertebrate codes (these codes can be looked up in the NIWA | MARLIN database). All images have photographer name, cruise name and NIWA/Ocean Census in their metadata.

4.3.1 Porifera (Rachel Downey, Australian National University)

Sponges (Porifera) are sessile, generally filter-feeding, habitat-forming organisms found in all marine environments, and to date, more than 9,000 species have been described (WoRMS, 2024). There have been substantial recent gains in our knowledge of sponge diversity around Aotearoa New Zealand, which include a doubling of species in the last 15 years, with substantial gains in glass and Tetractinellida (demo) sponges (Kelly & Sim-Smith, 2023). In this region, more than 1,300 species have been proposed from specimens, however, just over half of them are still undescribed.

During this expedition, close to 550 sponges were collected from 26 stations across 15 environments, which included the Bounty Trough channels, slopes, seamounts, pock marks, shelf, and canyons. Close to 60% of sponge specimens were recovered from seamounts, indicating their importance as a

sponge habitat in this region. Channels were also found to be significant sponge habitats, accounting for close to 30% of recovered specimens. The remaining sponges were found on slopes, pockmarks, and canyons, which indicates that these environments were less important as sponge habitats.

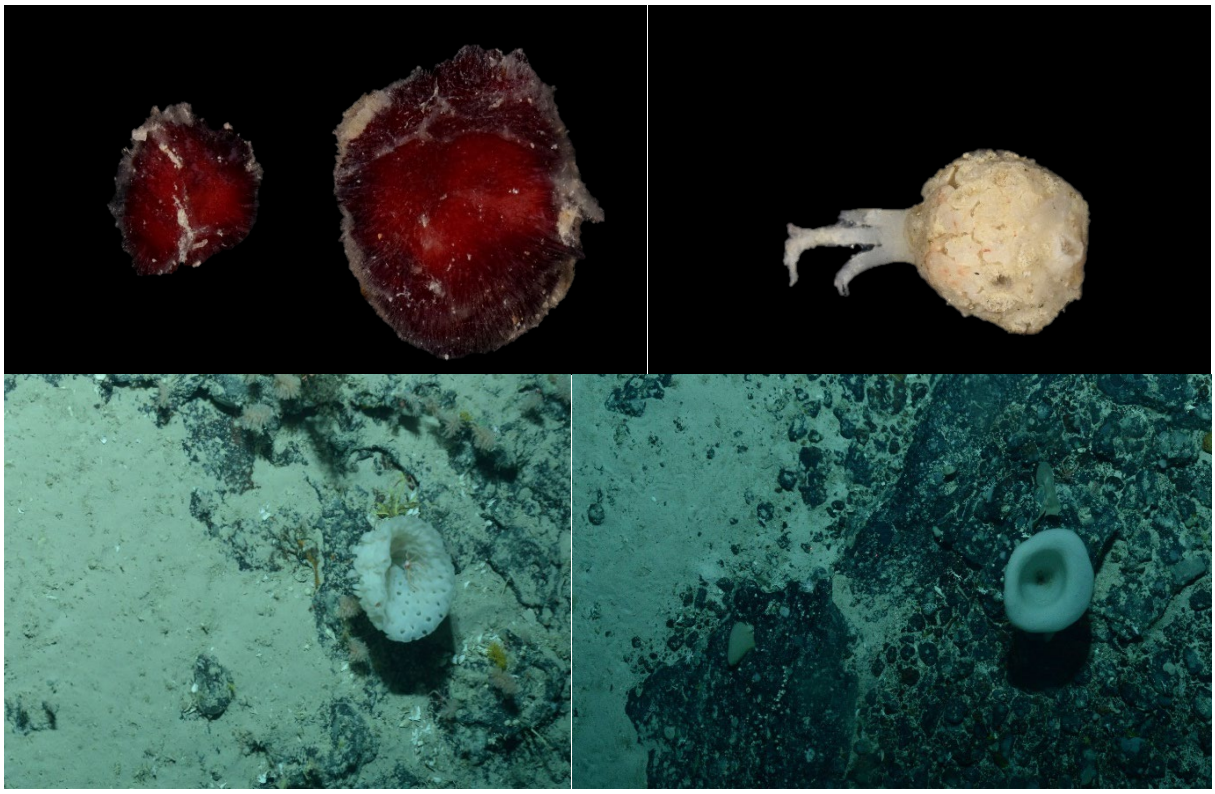


Figure 4-22: Tetractinellid sponge (top left), rooted ball shaped demosponge, (top right), potentially *Atlantisella lorraineae* (bottom left), and Aphrocallistidae (bottom right). The first two images were taken from specimens recovered from sampling, whereas the other images were taken from the DTIS camera system.

Sponges were found in the both the Demospongiae and Hexactinellida classes, however, due to the taxonomic constraints on board the vessel, it is uncertain how many species were found, and if they were new to science, especially when sponges were fragmented during sampling recovery. Notable sponges included several unusually coloured red Tetractinellida sponges, which were found encrusting on rocks from seamounts (Fig. 4-22, top left), as well as another ball-sponge morphotype from seamount environments (Fig. 4-22, top right); and numerous glass sponges from the Rossellidae (potentially *Atlantisella lorraineae*) family (Fig. 4-22, bottom left) and Aphrocallistidae (Fig. 4-22, bottom right) also often found on seamounts.

4.3.2 Corals and kin (Jessica Gordon, University of Essex & Erika Gress, Independent)

A total of 186 cnidarian specimens were collected spanning multiple groups (e.g., Fig. 4-23). Many octocorals from the suborder Calcaxonia were collected including corals from the families Primnoidae, Mopseinae, Keratoisididae and Chrysogorgiidae. Some of the dominant genera of corals collected were primnoids: *Thouarella*, *Tokoprymno*, and *Dasystenella*. Sea pens including *Umbellula* from the superfamily Pennatuloidea were collected infrequently. A few corallimorpharian anemones were collected as well. Small Stylasteridae (lace coral) colonies were collected from many locations spanning at least four genera.

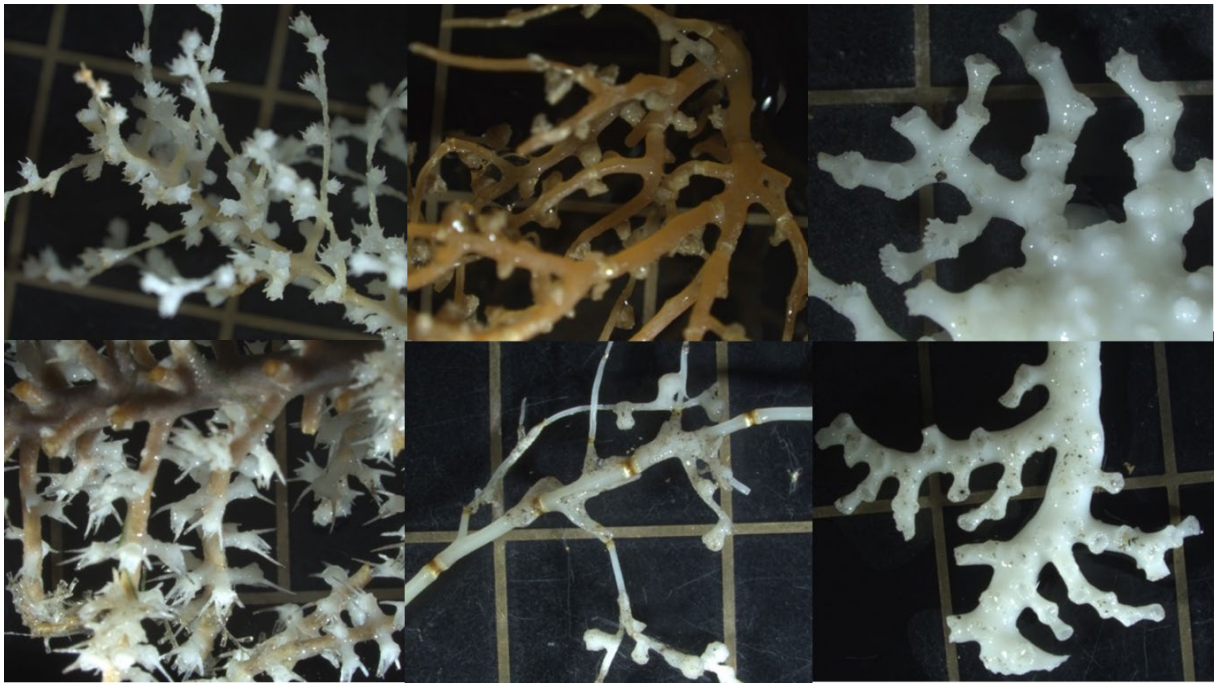


Figure 4-23: A representative selection of corals collected on the TAN2402 expedition. Clockwise from top left: Primnoidae, Mopseinae, Stylasteridae, Stylasteridae, Mopseinae, Primnoidae. [Photo: Jessica Gordon, University of Essex].

Two unusual anemone-like specimens from the eastern end of the Bounty Trough were collected at over 3500 m deep that are as yet unidentified, and very likely represent a new species. Further work is required by taxonomists to determine which group these creatures belong to (Fig. 4-24).

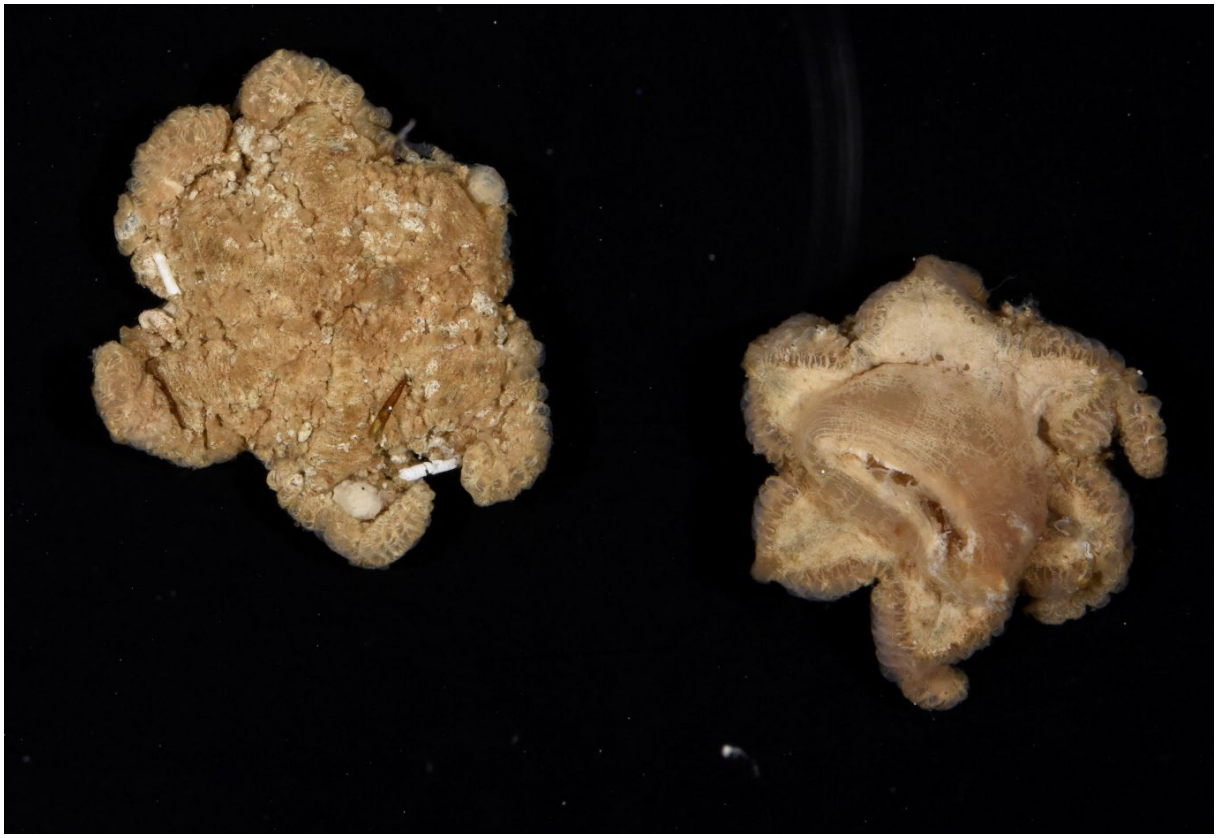


Figure 4-24: Two unusual anemone-like creatures collected at the eastern end of the Bounty Trough at ~3500 m. [Photo: Sadie Mills, NIWA].

4.3.3 Black corals (Hexacorallia: Antipatharia) (Erika Gress)

Corals belonging to the order Antipatharia are commonly referred to as black corals due to the coloration of their skeletons, which range from pale brown to black depending on the thickness of the branches. Despite their gross morphology being more akin to octocorals (soft corals and gorgonians), antipatharians are a sister order to scleractinian corals (hard corals), both belonging to the class Hexacorallia. Antipatharians are known to inhabit all oceans and nearly all depths, ranging from 1 meter to 8,900 meters.

During this expedition, we collected five antipatharian specimens. Subsamples were preserved in 99% ethanol and stored at -20°C, and flash frozen using liquid nitrogen and stored at -80°C for further morphological and genetic analysis. These specimens represent four different genera, with two likely being previously undescribed species. As preliminary analysis, a few branches were cleaned of tissue to conduct an initial inspection of the skeletal spines (one of the main morphological features used for taxonomy) using a light microscope (Zeiss Discovery.V20 compound fitted with an Axiocam 305 camera) aboard the RV *Tangaroa* (see Figure 4-25). However, comprehensive morphometric analysis employing a scanning electron microscope and genetic analysis are deemed necessary to accurately determine and/or describe the species.

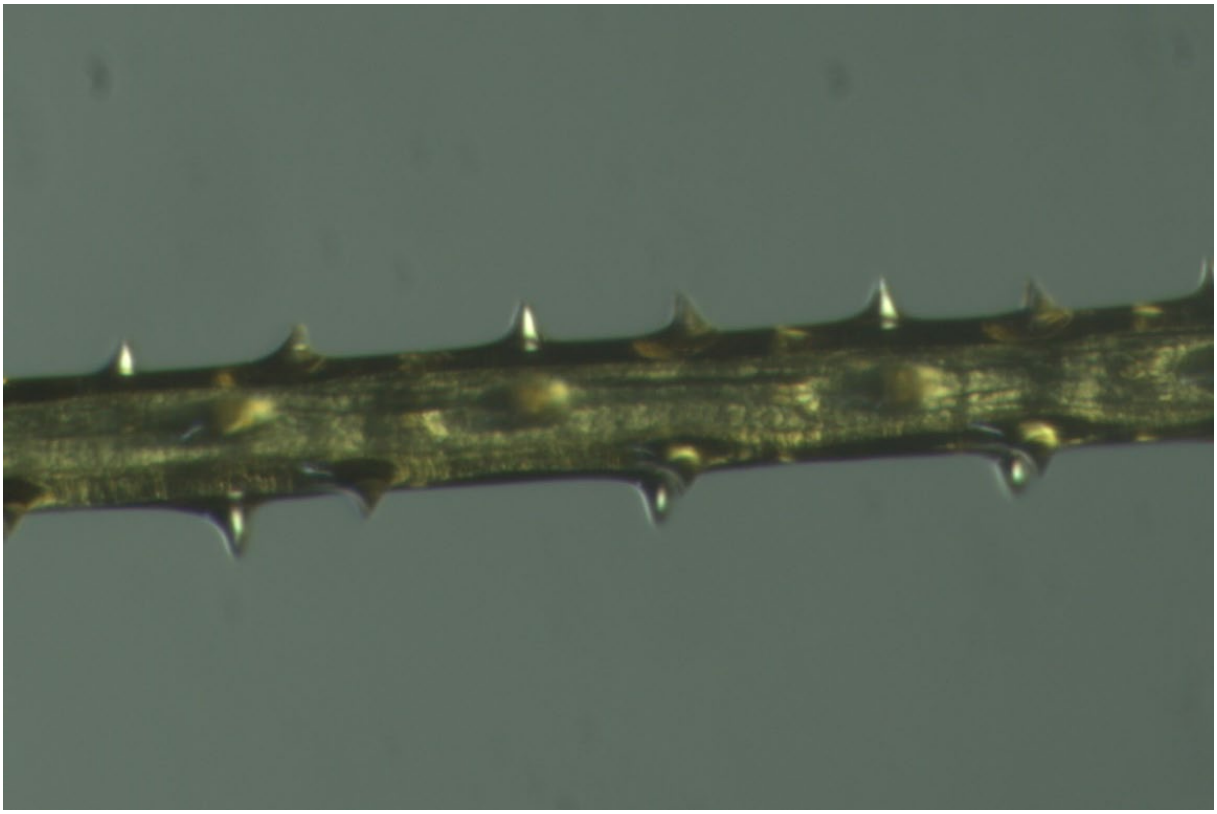


Figure 4-25: Antipatharian coral branch under the light microscope (Zeiss compound Discovery.V20 fitted with an Axiocam 305 camera) after tissue removal, revealing details of the skeletal spines. [Photo: Erika Gress].

4.3.4 Mollusca (Kerry Walton, Te Papa and Kat Bolstad, Auckland University of Technology)

Molluscs are the second most diverse animal group after the arthropods, with approximately 200,000 extant species presently recognized around the globe. The malacofauna of Aotearoa New Zealand is quite well studied and understood, with just shy of 4,500 extant marine species recognized, 80% of which occur nowhere else (Walton et al. 2023). However, the deeper reaches of the Bounty Trough had not previously been surveyed, and a considerable diversity of molluscs was encountered, representing most of the major classes including bivalves, gastropods, cephalopods, and scaphopods.

The expedition resulted in the on-board discovery of about a dozen large never-before-seen deep-sea mollusc species for New Zealand, most of which are likely to be truly new to science. That list will grow as the residues are sorted during the workshop and pending genetic confirmation of several cephalopod species identifications. Additionally, we've more than doubled the known material for many taxa, collected the best-known specimens for about eight previously known species, noted several dozen significant new distribution records for known taxa, and collected the first molecular-grade (in ethanol) material for several dozen species.

While the shallower fauna was fairly well known and had few surprises, everything collected was useful for improving resolution as distribution and temporal records. The DTIS has also captured the first in-situ images and video footage of several species, resulting in significant distribution records for the cephalopods especially, and has substantially contributed to our understanding of the habitat and relative abundances of others. Charismatic footage of a large, hooked-squid, *Taningia danae* (>1m total length) was also recorded at 1640m, including a flash from the animal's large arm-tip photophores (Fig. 4-29).

Figure 4-26: A newly discovered eulimid parasitic gastropod on a *Psychropotes* sp. "gummy squirrel" sea cucumber. [Photo: Thom Linley, Te Papa].

Figure 4-27: A bathysciadiid limpet on a large detrital squid beak. [Photo: Rebekah Parsons-King, NIWA & Kerry Walton, Te Papa].

Figure 4-28: ***Falsimargarita callista*** **B.A. Marshall, 2016. The best-known specimen of this rare, recently described species.** [Photo: Alicia Maurice, NIWA & Kerry Walton, Te Papa].

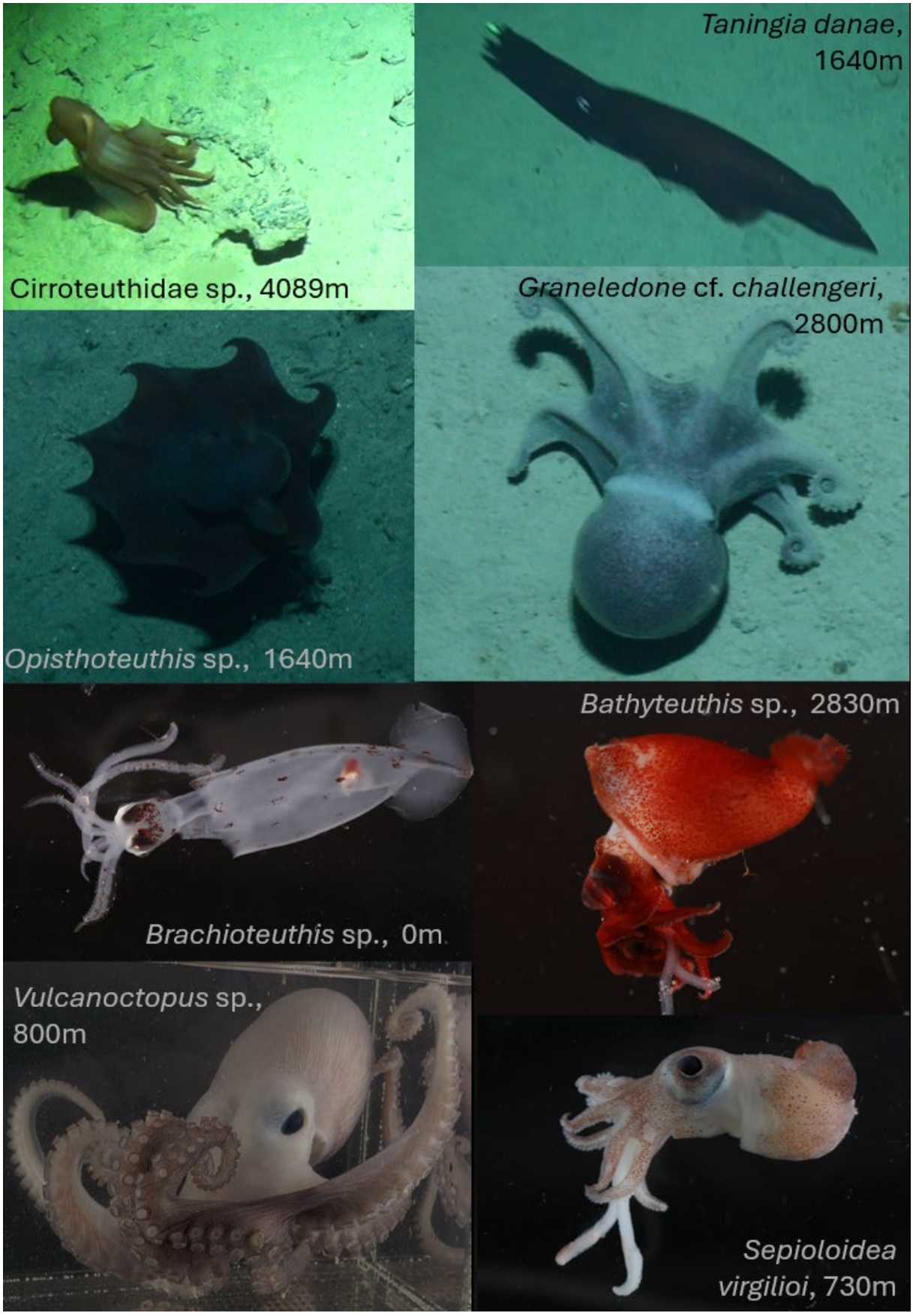


Figure 4-29: A selection of cephalopod specimens collected on the voyage and seen in the Deep Towed Imaging System camera.

4.3.5 Nemertea (Alex Rogers, Ocean Census)

Nemerteans are mainly marine benthic and pelagic predators with a vermiform shape, unsegmented and characterised by an eversible proboscis housed in a dorsal chamber, the rhyncocoel. Although their higher phylogenetic placement was enigmatic for some time they are now recognised as part of the protostome group lophotrochozoa. Approximately 1,300 species have been described to date, the majority from shallow-water benthic habitats, and approximately 100 species are known to be pelagic. Deep-sea nemerteans are very poorly studied as they are difficult to sample and bulk fixation approaches to deep-sea samples generally destroy both the external and internal morphology of the animals. However, they are known from deep-sea benthic ecosystems, including hydrothermal vents and also the deep pelagic realm. Twenty-four species of marine nemerteans have been recorded from New Zealand, 20 of which are endemic according to current information (Gibson, 2002). All of these taxa are from intertidal or shallow-water benthic ecosystems.

During the voyage three nemertean specimens were collected, one benthic species, a small pink animal with almost no external features (Fig. 4-30) and two examples of a pelagic nemertean collected in the suprabenthic layer by the Brenke Sled (Fig. 4-31). These are small semi-transparent animals with a dorso-ventrally flattened but simple body shape, possibly a *Dinonemertes* species. Both taxa are likely to be undescribed species. In both cases the specimens were relaxed in seawater with 7% $MgCl_2$ added, the pink specimen was fixed in 10% formalin whilst one of the pelagic nemerteans was fixed in formalin and the other in ethanol for genetic studies.

Figure 4-30: Benthic nemertean sampled from an epibenthic sled Stn TAN2402/39, base of Seamount 1, 1246 m.

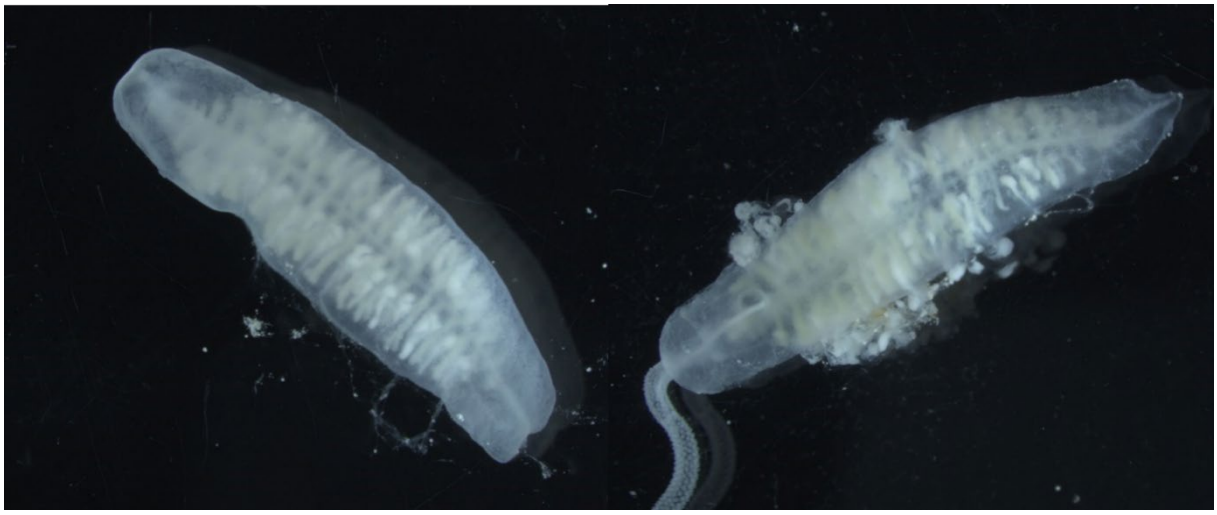


Figure 4-31: Pelagic nemertean species sampled from hyperbenthic Brenke sled Stn TAN2402/73, non-channel site NCH-4a at 2821–2923 m.

4.3.6 Holothuroids (Allison Miller, University of Otago)

Sea cucumbers (Holothuroidea) are arguably the most morphologically diverse echinoderms. Species of sea cucumbers can be infaunal, benthic, semi-pelagic, and fully pelagic. During this cruise we collected species from all but one of these habitat types. We also likely discovered several new species, made new observations, and helped fill large gaps in our understanding of holothuroid relationships.

Although sea cucumbers cannot confidently be identified at first sight (they require further in-depth processing such as making ossicle preparations), it is very likely that we collected several, if not multiple, new species on this voyage. With our first Van Veen grab deployment we likely collected a new species of *Ypsilothuria* (a small urchin-like/spikey dendrochirote). We collected several potentially new species from the groups Synallactida and Persiculida and a beautiful large yellow *Benthodytes* sp (Fig. 4-33). The two most popular species we collected — *Psychropotes* sp. (common name gummy squirrel, Fig. 4-32) and *Scotoplanes* sp. (common name sea pig) — in addition to being very charismatic, may also be new. *Psychropotes* species are identified, in part, by their "tails" (long dorsal appendages), and the specimens we collected appear to have a unique tail shape. Our previous research suggests that there is a *Scotoplanes* complex of which we are better positioned to resolve now that we have specimens from near the type localities (syntypes are recorded from Chile and South Australia).

In addition to all the potentially new species, we also recorded some unique observations. We found a beautiful new mollusc snail (very likely a new eulimid species, Fig. 4-26) attached as a parasite to a *Psychropotes* individual. We also observed, possibly for the first time, the parasitisation of a sea cucumber by an anemone; two sea cucumber species were found with white anemones attached and penetrating their body walls.

Lastly, we collected multiple rare samples that will be used to resolve ordinal-level relationships and expand our understanding of convergent evolution within Holothuroidea. Elasipodida is a deep-sea sea cucumber group that is phylogenetically unresolved. This is largely because specimens were rarely found, or collected in poor condition, in the past. We collected multiple Elasipodida species during this cruise and they will be important in resolving the phylogenetic relationships of many Elasipodida families and genera. Also, because we were able to quickly flash freeze (liquid nitrogen)

and store samples at -80°C, we now have samples that are suitable for whole-genome and transcriptome analyses. We plan to perform genomic analyses to decipher genetic clues as to how sea cucumbers became so diverse in form and behaviour, from burrowers to fully swimming species, and to understand how swimming evolved in the group.

Figure 4-32: Seafloor image of the gummy squirrel sea cucumber *Psychropotes* sp. at 2764–2867 m (Station TAN2402/63). [Photo: DTIS camera, NIWA].

Figure 4-33: Seafloor image of sea cucumber *Benthodytes* sp. at 2764–2867 m (Station TAN2402/63). [Photo: DTIS camera, NIWA].

4.3.7 Ophiuroidea (Sadie Mills, NIWA)

Ophiuroidea, brittle stars, snake stars and basket stars are found in are found in all marine habitats, from intertidal to abyssal depths, from the polar regions to the tropics and this voyage was no exception: Ophiuroids were collected at every site we visited during this expedition, with a total of 1724 specimens collected in 86 lots (examples of specimens collected in Fig. 4-34). While the diversity of Ophiuroidea in New Zealand is well documented (Anderson et al., 2023) there are a large number of known yet undescribed taxa and it is still very likely that examples of these and other undiscovered taxa will be discovered amongst the material collected from this region from the deeper collection sites. Additional samples of described taxa collected are an excellent source of fresh material for phylogenetic and population studies.

Figure 4-34: Morphololological diversity of ophiuroids collected during TAN2402. Not shown to relative scale, clockwise from top left: *Ophiactis*; Ophiurida; *Ophiocreas*; *Ophiacantha*; Ophiuridae; Ophiurida.

4.3.8 Arthropoda (Kareen Schnabel, NIWA)

Arthropods include the sea spiders (Pycnogonida) and the Crustacea (crabs, shrimp, slaters and kin) are known to occupy all marine habitats down to the deepest ocean trenches and with a combined total known species of over 3400 in Aotearoa New Zealand (Schnabel et al., 2023 and Staples & Neill, 2023). Over 200 samples (>1330 specimens) of large arthropods were catalogued over the course of the voyage, with many more, smaller crustaceans expected to be sorted from the Brenke sled and other macrofauna samples during the post-voyage processing (see examples in Fig. 4-35). Considering the larger arthropods, the majority (75 lots) were decapods which appear to be known shrimps, prawns, hermit crabs and squat lobsters, followed by larger amphipods (39 lots), isopods (37 lots) and sea spiders (27 lots). Detailed examinations remain to be conducted to confirm their taxonomic identification. Among the macrofaunal crustaceans, the majority of taxa are expected to be new to science, or belong to known undescribed species, with the deeper sites holding the highest potential for new species discovery. Adding new distribution records for known species in this largely unexplored area provides valuable new data to our understanding of the Aotearoa marine biota.

Figure 4-35: Morphololological diversity of arthropods collected during TAN2402. From top left to bottom right: amphipod (sand hopper), isopod (slater), cumacean (comma shrimp) pycnogonid (sea spider), munidopsid (squat lobster) and polychelid (blind deep-sea lobster).

4.3.9 Meiofauna and macrofauna samples (Daniel Leduc & Kareen Schnabel, NIWA)

Meiofauna samples were obtained from 18 multicorer and Van Veen grab deployments at 11 sites ranging in depths from 680 to 4808 m (Table 4-3). Macrofauna samples were obtained from 17 multicorer and Van Veen grab deployments at 10 sites ranging in depths from 680 to 4808 m (Table 4-4). Sediment parameters samples were obtained from 16 multicorer and Van Veen grab deployments at 11 sites ranging in depths from 680 to 4808 m (Table 4-5).

Table 4-3: Summary of TAN2402 meiofauna samples. MUC = multicorer; GRAB = VanVeen Grab; F = 10% buffered formalin; E = 99% ethanol.

Station	Site	Depth (m)	Gear	Core no.	No. of subcores	Fixative
2	CA1	680	GRAB	1	2	F, E
3	CA1	680	GRAB	2	2	F, E
9	PM-1	790	MUC	2 (12)	2	F, E
10	PM-1	790	MUC	4 (4)	2	F, E
23	PM-2	749	MUC	1 (10)	2	F, E
24	PM-2	749	MUC	2 (7)	2	F, E
34	NCH-7a	987	MUC	1 (4)	2	F, E
34	NCH-7a	987	MUC	4 (10)	2	F, E
35	NCH-7a	987	MUC	4 (14)	1	F
46	CH-6 alt	1530	MUC	4 (9)	2	F, E
53	NCH-6a	1388	MUC	2 (9)	2	F, E
53	NCH-6a	1388	MUC	3 (4)	2	F, E
54	NCH-6a	1388	MUC	4 (6)	2	F, E
71	NCH-4a	2830	MUC	1 (7)	2	F, E
81	NCH-3a	3510	GRAB	1	1	F
92	C1	4800	MUC	4 (4)	2	F, E
93	C1	4808	MUC	3 (12)	2	F, E
95	C1 west mound	4654	MUC	1 (10)	2	F, E
96	C1 west mound	4654	MUC	2 (9)	2	F, E
96	C1 west mound	4654	MUC	3 (40)	2	F, E
106	NBT	2541	MUC	6	2	F, E
106	NBT	2541	MUC	7	2	F, E
106	NBT	2541	MUC	8	2	F, E

Table 4-4: Summary of TAN2402 macrofauna samples. MUC = multicorer; GRAB = VanVeen Grab; F = 10% buffered formalin; E = 99% ethanol.

Station	Site	Stn Depth (m)	Gear	Core #	Core length processed (cm)	No. of samples	Fixative
2	CA1	680	GRAB	1	10	2	F, E
3	CA1	680	GRAB	2	10	2	F, E
9	PM-1	790	MUC	1 (15)	15	3	E
9	PM-1	790	MUC	4 (7)	15	3	E
10	PM-1	790	MUC	1 (10)	10	2	F
23	PM-2	749	MUC	2 (9)	15	3	F
24	PM-2	749	MUC	3 (4)	15	3	E
34	NCH-7a	987	MUC	3 (12)	12	3	E
35	NCH-7a	987	MUC	1 (9)	15	3	F
35	NCH-7a	987	MUC	3 (15)	15	3	E
46	CH-6 alt	1530	MUC	2 (14)	15	3	E
46	CH-6 alt	1530	MUC	3 (4)	15	4	F
53	NCH-6a	1388	MUC	1 (15)	15	3	E
54	NCH-6a	1388	MUC	1 (10)	15	3	E
54	NCH-6a	1388	MUC	2 (7)	15	3	F
71	NCH-4a	2830	MUC	2 (12)	15	3	E
92	C1	4800	MUC	1 (10)	15	3	E
93	C1	4808	MUC	2 (7)	15	3	F
95	C1 west mound	4654	MUC	4 (12)	15	3	E
96	C1 west mound	4654	MUC	1 (4)	15	3	F
106	NBT	2541	MUC	1	10	2	F
106	NBT	2541	MUC	3	2	2	E
106	NBT	2541	MUC	4	2	2	F

Table 4-5: Summary of TAN2402 sediment parameters samples. MUC = multicorer; GRAB = VanVeen Grab. All samples were frozen at -20°C.

Station	Site	Depth (m)	Gear	Core no.	Core length processed (cm)	No. of samples
2	CA1	680	GRAB	1	8	10
3	CA1	680	GRAB	2	9	11
9	PM-1	790	MUC	3(14)	16	14
24	PM-2	749	MUC	4 (15)	10	1
34	NCH-7a	987	MUC	2 (7)	7	8
35	NCH-7a	987	MUC	2 (1)	17	16
46	CH-6 alt	1530	MUC	1 (15)	39	26
53	NCH-6a	1388	MUC	4 (14)	41	28
54	NCH-6a	1388	MUC	3 (12)	38	26
71	NCH-4a	2830	MUC	4 (10)	10	12
81	NCH-3a	3510	GRAB	1	Scrape	1
92	C1	4800	MUC	3 (9)	44	29
93	C1	4808	MUC	1 (15)	47	31
95	C1 west mound	4654	MUC	3 (15)	41	28
96	C1 west mound	4654	MUC	4 (17)	17	16
106	NBT	2541	MUC	2	11	13

The hyperbenthic (Brenke) sled collected Macrofauna samples from 10 sites (Table 4-6). While a range of incidental larger fauna were extracted and preserved according to best practice, the majority of specimens remain in unsorted elutriated samples or residues (both in ethanol and formalin) and will be sorted at the post-voyage workshop.

Table 4-6: Summary of TAN2402 macrofauna samples collected by the hyperbenthic (Brenke) sled.

Station	Site	Start depth (m)	End depth (m)	No. of samples
11	PM-1	775	790	6
25	PM-2	759	750	4
31	CH-7	1066	1065	4
37	NCH-7a	982	981	4
47	Ch-6	1644	1646	8
55	NCH-6a	1389	1389	7
65	CH-4	2874	2872	7
73	NCH-4a	2821	2923	6
84	NCH-3a	3527	3546	2
98	NCH-3a	3550	3523	5

4.4 Fishes

The fishes targeted on this expedition were almost exclusively benthic/demersal to maximise time efficiency and animal groups. The occasional mesopelagic species was taken by the gear in transit, and a single myctophid (*Electrona paucirastra* Bolin, 1962) and larval *Centriscops humerosis* (Richardson, 1846) was taken by the 80 cm ring net sampling plankton to 5 m depth. This survey focused on depths very poorly sampled throughout the New Zealand region. In several cases resulting in considerable range and depth increases of even relatively common and well-known species. The most effective sampling method by numbers was the 4.2 m beam trawl. However, some small and fragile fish such as snailfish (Liparidae) were taken in either the Seamount sled or Brenke sled (Fig. 4-36). The fish trap captured a small number of high-quality specimens which were not captured by the other gear types, including two of the potential new species.

Figure 4-36: A small and fragile snailfish (Liparidae), which may be sponge associated, captured by the Brenke sled. [Photo: Thom Linley, Te Papa].

Benthic fishes were dominated by rattails (Family Macrouridae), basketwork eels (Family Synaphobranchidae), and morid cods (Family Moridae) both on the DTIS and in the beam trawl. Specimens obtained included species which were either rare in the National Fish Collection, such as *Coryphaenoides armatus* (Hector, 1875) (Fig. 4-37 upper), or considered rare in the global collection

community, *Histiobranchus bruuni* Castle, 1964 and *Sciadonus pedicellaris* Garman, 1899 (Fig. 4-37 lower). In the case of the former, the number known in global collections has increased three-fold.

Figure 4-37: Upper, The abyssal grenadier (*Coryphaenoides armatus*); lower, slender abyssal cuskeel (*Sciadonus pedicellaris*). [Photo: Thom Linley, Te Papa].

In addition, three undescribed eelpouts (Family Zoarcidae), two *Pachycara* and one *Lycenchelys*, were caught; the former taken in the fish trap, the latter in the beam trawl (Fig. 4-38).

Figure 4-38: The four eelpouts (Zoarcidae), representing three potential new species, captured during the expedition. [Photo: Thom Linley, Te Papa].

The eight specimens of *Antimora rostrata* (Günther, 1878) caught were unusual in that they were pale, with soft bodies, in contrast to how they usually present – very firm with blue-black skin. A COI analysis will be undertaken to confirm their identification.

Specimens of black oreo (*Allocyttus niger* James, Inada & Nakamura, 1988) and smallhead cod (*Lepidion* ?*microcephalus* Cowper, 1956) were taken at one station, but badly damaged by rocks in the trawl so not retained.

The following table (4-7) is a list of fishes caught and registered.

Table 4-7: List of fishes caught on TAN2402 and registered in the National Fish Collection. [p] = mesopelagic species taken by the gear in transit.

Family	Genus & species	Number
Arhyncobatidae Softnose skates	*Brochiraja spinifera*	1
Synaphobranchidae Basketwork eels	*Histiobranchus australis*	3
	Histiobranchus bruuni	15
	Simenchelys parasitica	2
Notacanthidae Spinyback eels	*Notocanthus sexspinis*	1
Bathylagidae Deepsea smelts	*Bathylagichthys* sp.[p]	1
Sternoptychidae Hatchetfishes	*Argyropelecus hemigymnus*[p]	2

Family	Genus & species	Number
Gonostomatidae Lighthouse fishes	*Cyclothone* sp.[p]	1
Myctophidae Lanternfishes	*Diaphus* sp.[p]	1
	Electrona paucirastra[p]	1
	Symbolophorus boops[p]	2
Macrouridae Rattails	*Coelorinchus* sp. (larvae)[p]	4
	Coelorinchus fasciatus	12
	Coelorinchys innotabilis	1
	Coryphaenoides armatus	7
	Coryphaenoides filicauda	7
	Coryphaenoides subserrulatus	1
	Coryphaenoides ?yaquinae	12
	Coryphaenoides sp.	1
	Haplomacrourus nudirostris	1
	Lucigadus nigromaculatus	2
	Macrourus carinatus	1
	Juvenile Gen & sp. undet	1
Moridae Morid cods	*Antimora rostrata*	8
	Notophycis marginata	2
	Pseudophycis barbata[p]	1
	Lepidion schmidti	1
Melanonidae Pelagic cods	*Melanonus gracilis*[p]	1
Bythitidae Brotulas	*Sciadonus pedicellaris*	1
Diretmidae Discfishes	*Diretmus argenteus*[p]	1
Macrorhramphosidae Snipefishes	*Centriscops humerosis*[p]	1
Psychrolutidae Blobfishes	*Psychrolutes microporos*	1
Liparidae Snailfishes	Gen & sp. undet.	2
Zoarcidae Eelpouts	*Pachycara* n. sp.1	2
	Pachycara n. sp. 2 (cf. *moelleri*)	1
	Lycenchelys n. sp.	1
Centrolophidae Warehous	*Tubbia* sp.[p]	1

DTIS stills and videos were also viewed, and fishes identified to their lowest taxonomic level that could be made with confidence. These included slickheads (*Alepocephalus* sp.? Family Alepocephalidae), three large cuskeels (Family Ophidiidae) and a small enigmatic possible slickhead (Family Alepocephalidae). Unfortunately, no vouchers of these were taken.

4.4.1 Fish traps

The fish traps attached to the benthic landers (Fig. 4-39) captured two speculative new fish species that were not collected by the other gear types. Unfortunately, both vehicles were eventually lost when they failed to surface.

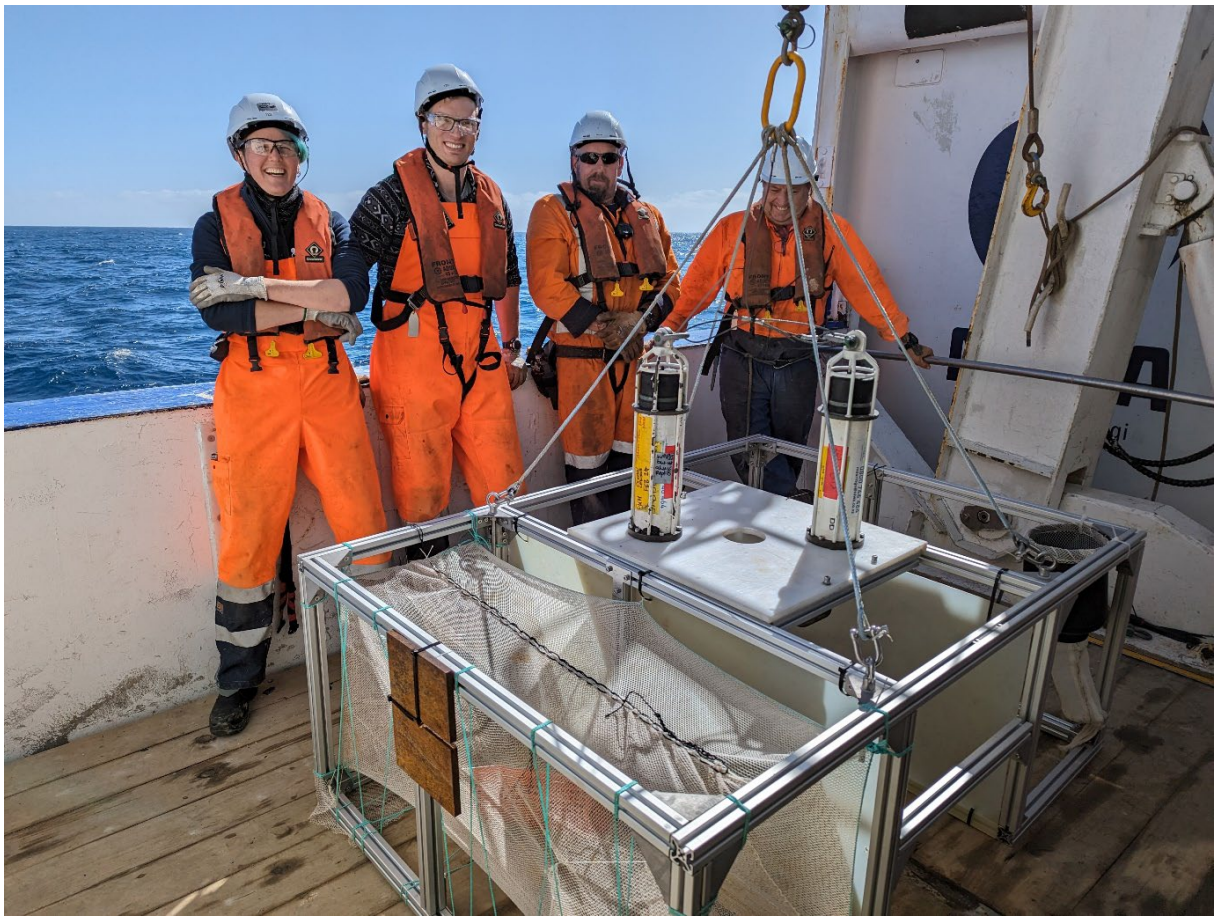


Figure 4-39: Fish trap one rigged for deployment following modification.

Loss and attempted rescue

Before anticipated bad weather, both traps were deployed on 19 February 2024 for recovery on 22 February. Trap 1 was deployed at the channel site CH-3, and Trap 2 was deployed at the off-channel site NCH-3a. Intermittent communication was established with all releases but was marred by inaccurate and false readings. With extensive attempts from all sides of the hypothesised location, only one release command was acknowledged (DORT 4D on Trap 2). Replies are anticipated to be poor at greater depths. However, the DORTs tend to release, even when a confirmation message is not received.

Ranges were taken, but neither trap left the seabed. NIWA MatLab boxing software BoxingDay.exe was used to estimate the trap position.

During the return journey past the site, another recovery was attempted. Following discussion with the crew and NIWA moorings team, the following plan was made.

1. Box in the location starting with the sides we had not called them from.
    A. Attempt to release them from each location.
    B. The new estimated location was compared with the old to look for indication of drift.
2. Pass over the estimated location with the EK80 and Multibeam or TOPAS, looking for the floats. This will give us precise location but also show us how the mooring sits and if a feature is casting a shadow.
3. Attempted to release again from the best location based on what we learned.

The traps were not visible on the TOPAZ or EK80 and spotting them at this water depth was deemed unlikely by the operators. New locations were calculated based on our boxing in and there was evidence of significant lateral movement in both traps.

Limited communication was established with all 4 releases. When a full status message was possible, they reported ‘battery OK’ and ‘not tilted’, but it was still not possible to get a confirmed release command.

Measurements of bottom currents were not possible, but mapping of the channel revealed rugged terrain that, despite its age, was still relatively clear of sediment. The Deep Towed Imaging System (DTIS) showed that the terrain was complex even at the local scale. Sand ripples, scour marks and fish sheltering behind boulders indicated regular strong currents.

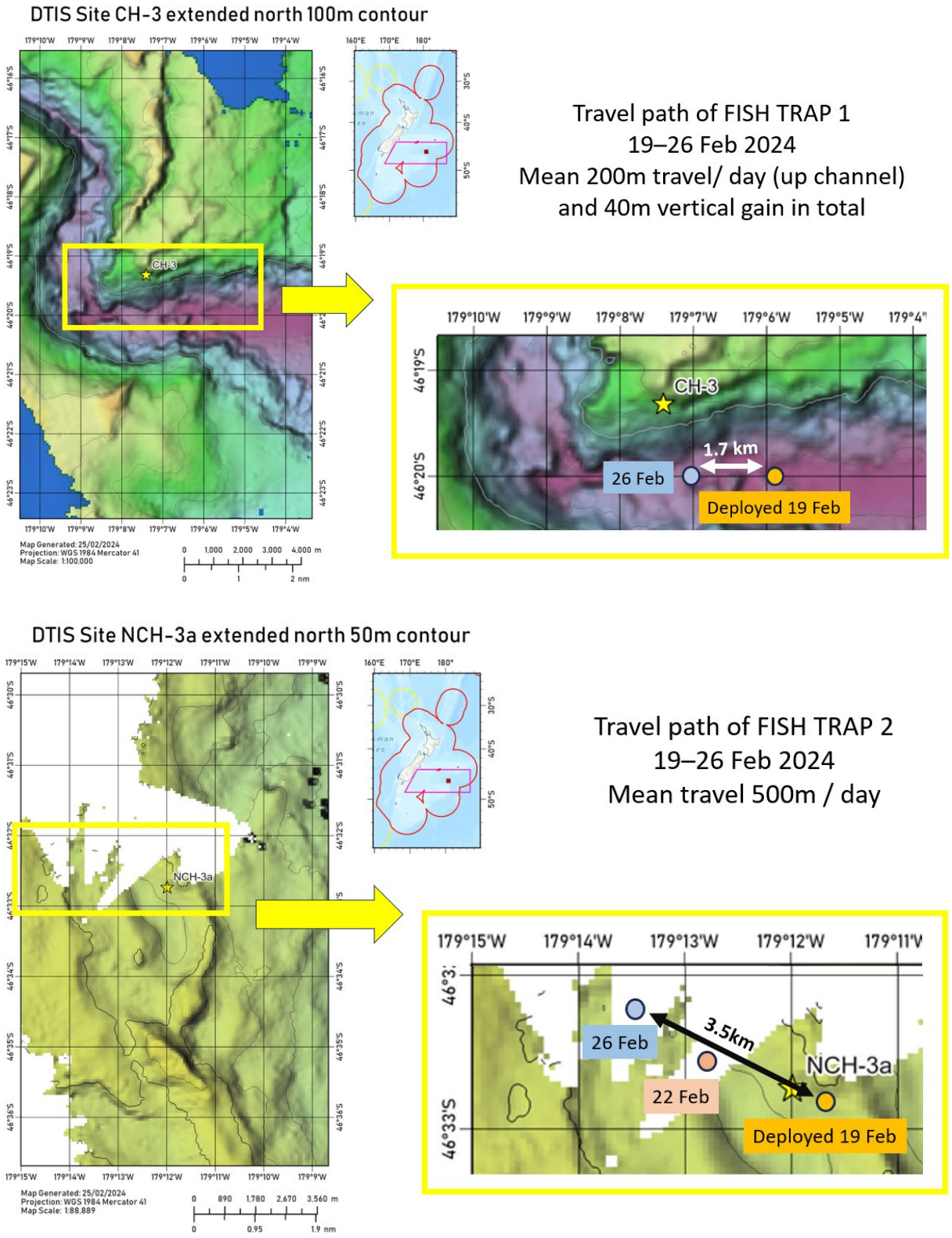


Figure 4-40: Estimated trap locations based on acoustic ranging. Maps prepared by Alan Orpin, figures by Kathrin Bolstad.

We believe the traps moved considerably across rough terrain (Fig. 4-40). This put considerable shock and lateral load on the release system. This eventually broke the acrylic plate the releases attached to or pulled them through. The safety lanyard attached from the DORTs to the lifting ring prevented the ballast and DORTs from falling free, but kept them pointing roughly upward, giving a 'not tilted' response (if this response was accurate during the spurious responses). Falling through in this way would remove tension from the connected chain and prevent it slipping through the master-link.

The final coordinates for each trap are:

- Trap 1, NCH3a: 46° 32.355'S, 179° 13.577'W - 3431 m depth
- Trap 2, CH03: 46° 20.069'S, 179° 6.771'W - 4181 m depth

However, we anticipate continued movement.

The traps contained different metals (aluminium, stainless steel, and zinc galvanised) with the intention that they would corrode relatively quickly and not continue to ghost fishing. Each trap frame weighs 60 kg, and the DORTs weigh 22 kg (in air) each – 44 kg per trap, giving a total of about 100 kg of metal in each trap.

All or part of the trap and mooring line will eventually free itself, at this point, the beacons are likely to make contact.

The beacon serial numbers are as follows:

- Trap 1 – 300034012290980
- Trap 2 – 300234060553540

The beacons are labelled NIWA and contain contact information if found.

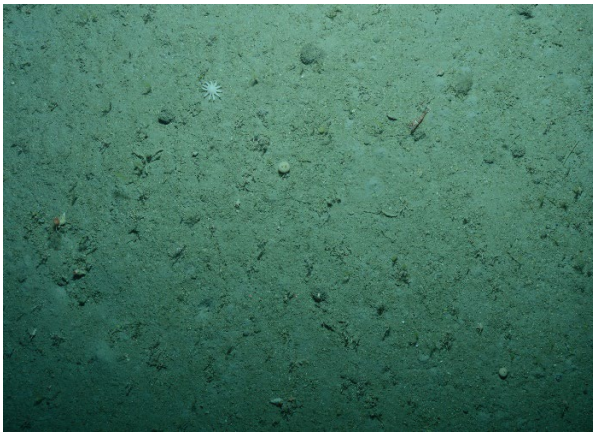
4.5 DTIS imagery

DTIS was deployed 19 times on this survey, once per sampling site, with a total of 17 hours of video footage recorded, and 6071 stills taken.

No video footage or stills were recorded at the first DTIS station (Stn 1, Papanui Canyon, Site CA-1) because of beacon failure, nor the last DTIS station (Stn 91, Bounty Fan, Site C1) as a result of camera housing failure.

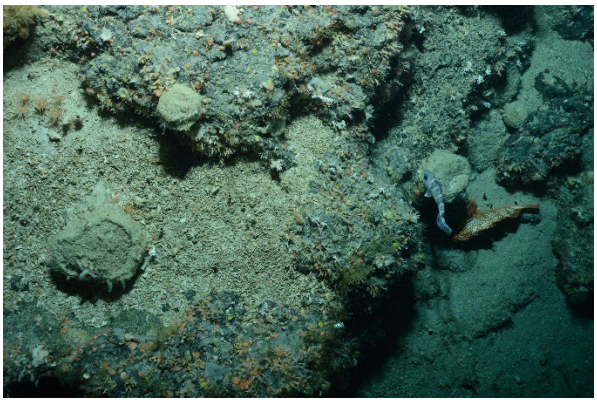
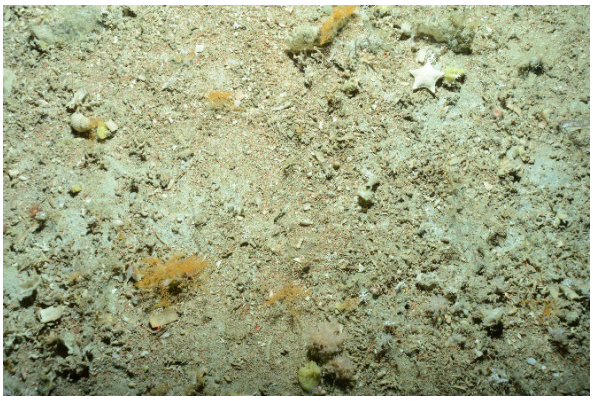
A short description of each DTIS camera transect with example seafloor images is provided below. Recorded depths are in metres.

Area: Bounty Trough – Pockmarks site PM-1	**Station**: 007
Still Images: 395	**Duration**: 1 hr 6 min
Depth start: 761	**Depth end:** 781



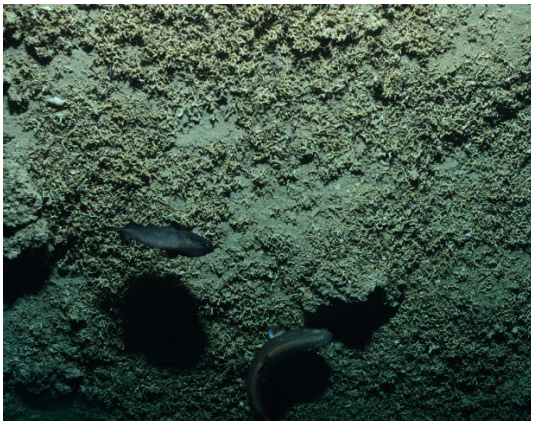
Transect summary: Transect east to west, starting at 761 m and ending at 781 m. Flat seafloor consisting of silty sand, with areas of coral rubble towards the end. Water clear. Variety of invertebrate fauna seen, including two octopus (genus *Graneledone,* probably *taniwha*), starfish, hermit crabs, some sea cucumbers, small corals, cup corals, gastropods, few urchins, sponges. Vertebrate fauna includes small rattails, sharks, chimaera. Xenophyophores were common throughout, sometimes half a dozen or more in a field of view; hermit crabs often associated with xenophyophores.

Area: Bounty Trough – Seamount SM-5	**Station**: 014
Still Images: 248	**Duration**: 40 min
Depth start: 650	**Depth end:** 750

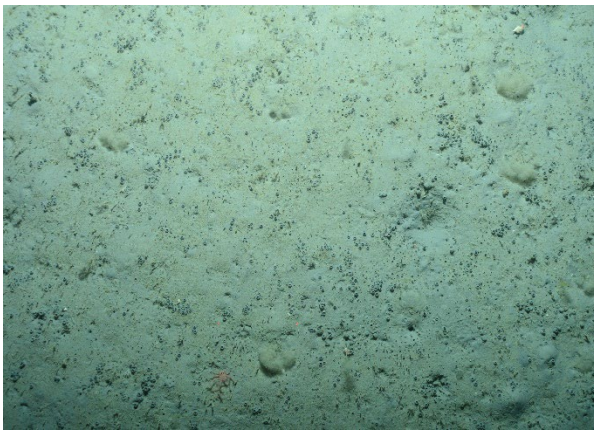
Transect summary: Deployed DTIS at top of SM-5 seamount (ca 650 m depth) down the southwestern flank (final depth ca. 750 m). Substratum is bedrock (probably basalt) covered in dense soft corals, bryozoans, sponges, some fish and asteroids. Substratum gradually changing to dead coral fragments and some sand also covered in soft corals and bryozoans, some sponges, some sea perch, a ling, ghost shark, octopus, cup corals. Substratum becomes gradually sandier near bottom of slope. Sea cucumbers and echinoids on soft substrate. Also, anemones, hermit crabs. The odd coral.

Area: Bounty Trough **–** Seamount SM-4	**Station**: 018
Still Images: 226	**Duration**: 38 min
Depth start: 1063	**Depth end:** 1150



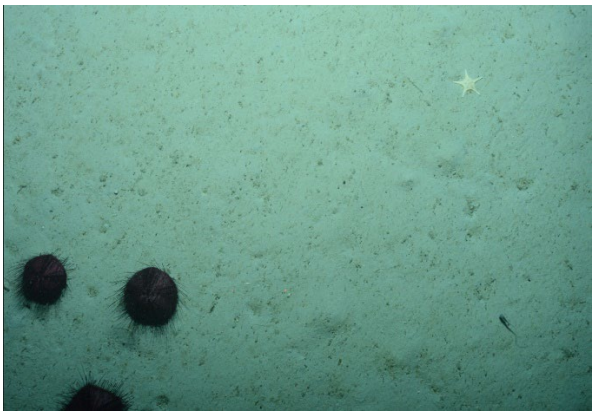

Transect summary: Landed NNE of peak, on hard slope, covered with coral rubble, high numbers of black oreos, deep-sea shark and some orange roughy. Steep outcrops and vertical walls just before peak at 985 m. Many round demosponges and scattered bushy *Primnoa* gorgonian corals. Down SSW slope initially gently sloping bedrock, with coral rubble and possibly barnacle plate rubble overlain, a few bushy gorgonians (cf. *Thouarella*), areas of soft, muddy sediment with abundance of tam'o shanters, at around 1100 m more bedrock ledges. Lost communication 38 minutes in, at about 1150 m and stopped transect before we reached the plain.

Area: Bounty Trough – Pockmarks site PM-2	**Station**: 021
Still Images: 247	**Duration**: 40 min
Depth start: 757	**Depth end:** 768




Transect summary: Transect across soft sediment with pockmarks heading northeast. Soft sediment throughout with multitude of small, rounded cup-shaped structures apparently with small animal inside (only visible in stills) across entire transect. Nature of these structures is unknown. Common soft bryozoans and likely *Bathysiphon* tubes patches scattered along the transect. Also, asteroids, rattails, gastropods, echinoids, some burrows.

Area: Bounty Trough – Upper South Bounty Channel head area site CH-7	**Station**: 027
Still Images: 393	**Duration**: 1 hr 5 min
Depth start: 899	**Depth end:** 1052




Transect summary: Dropped on northern edge of channel and towed downslope along flat, soft sediment for half of transect. Many tam'o'shanters, rattails, eels and a few holothurians. Deep soft sediment indicated by abundance of burrows. No distinct edge and drop into channel but sequence of small ledges, no exposed bedrock. Channel sediments look coarser but still have many burrows, abundance of perhaps two types of demosponges, fewer tam'o'shanters, large numbers of small rattails. Kat Bolstad attached some glowing tape to the bottom of sled, camera on, lights off during both ascent and descent to try and observe large squid response.

Area: Bounty Trough – Outside upper South Bounty Channel head area site NCH-7a	**Station**: 033
Still Images: 212	**Duration**: 53 min
Depth start: 989	**Depth end:** 986


Transect summary: Transect from NE to SW over a flat muddy sediment. Asteroids, burrows, rattails, urchins, eels, octopus. Looks the same throughout transect.

Area: Bounty Trough – Seamount site SM-1	**Station**: 038
Still Images: 433	**Duration**: 1 hr 12 min
Depth start: 1383	**Depth end:** 1393


Transect summary: Transect from S to N up the slope of the seamount, across the top and down the other side. The start on the surrounding soft sediments saw abundance of bioturbation, burrows, brittle stars. The flank of the seamount was mostly rugged bedrock interspersed with patches of soft sediments and large areas covered with barnacle plates, particularly towards the top. Mid-slope we saw many small *Callogorgia* colonies in a north-south direction of the fans. Towards the top, we encountered higher abundances of *Gyrophyllum* rock pens, large bamboo coral colonies, *Thouarella* bottle brush gorgonians and *Anthomastus* soft coral. Occasional glass sponge and a few rat tails. The peak was rugged, covered with barnacle hash. Northern slope was slightly gentler, longer run to the soft sediments, a few black corals were observed along the bottom.

Area: Bounty Trough – Channel site CH-6	**Station**: 042
Still Images: 545	**Duration**: 1 hr 30 min
Depth start: 1483	**Depth end:** 1645

Transect summary: Transect going northeast on channel levee, then down steep channel wall, then across channel itself. Patches of bedrock above channel wall; channel wall was bedrock and very steep. Community inside channel included: sponges (demosponge and carnivorous), very abundant small ophiuroids (not found on channel levee), soft corals, anemones, several octopus, one large squid (at end, signalling). Only few burrows, indicating hard substrata below sediment.

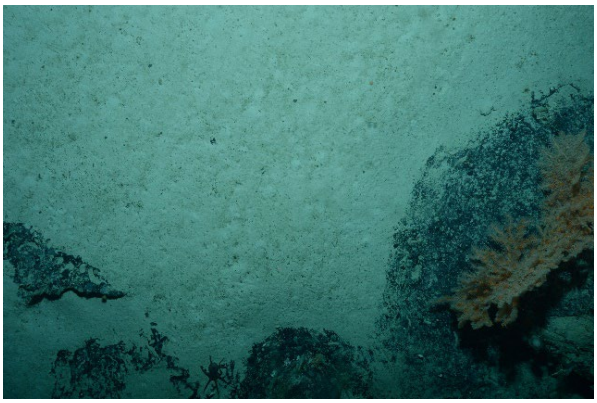
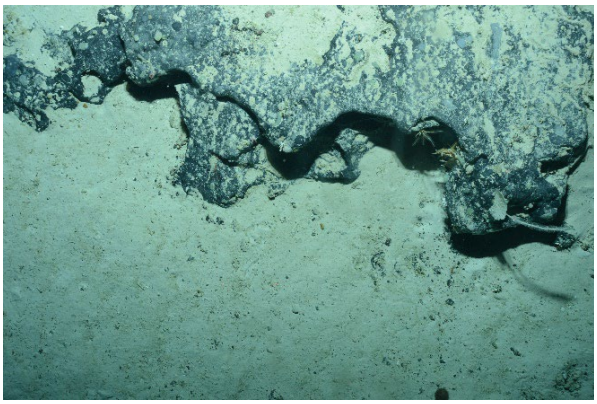
Area: Bounty Trough – Seamount site SM-2	**Station**: 049
Still Images: 423	**Duration**: 1 hr 10 min
Depth start: 1377	**Depth end:** 1016

Transect summary: Transect towed in a south to north direction. Transect started at the base of seamount and towed up the slope of seamount to top, and across the top. The seafloor was predominately hard bedrock with a patchy overlay of muddy sediment. Ophiuroids, echinoids and sponges dominated the early part of the transect. Some yellow *Thouarella,* sponges (glass and demo) and occasional sea fan and *Anthomastus* were seen through most of the transect. One or two bamboo corals were also seen. Patches of barnacle plates and coral rubble were seen about two thirds of the way through the transect. Several King crabs were seen in the latter half, towards the top of the seamount. Rattails, eels and occasional oreos were also seen. Swell was up which made consistent distance above the seafloor challenging.

Area: Bounty Trough – non-channel site NCH-6a	**Station**: 052
Still Images: 233	**Duration**: 1 hr 43 min
Depth start: 1384	**Depth end:** 1383

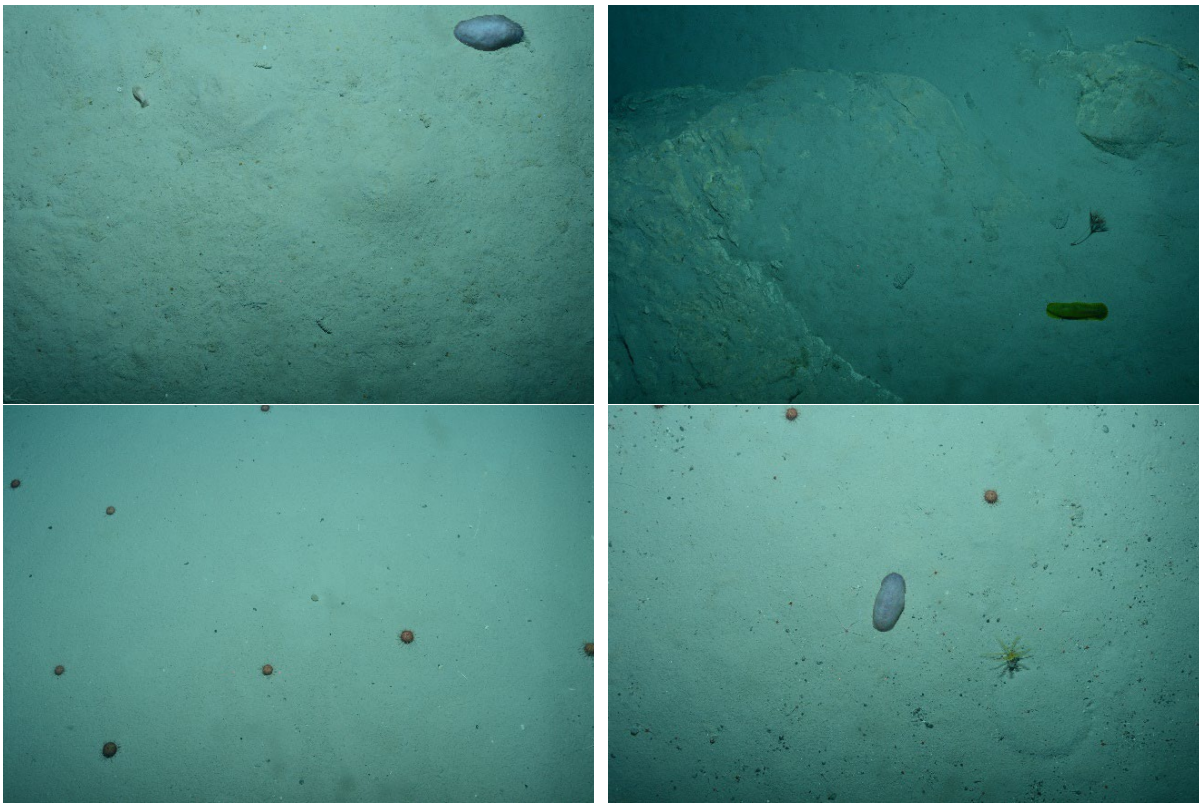

Transect summary: Transect moving southwest on the flat. The transect started recording whilst the camera was descending to the bottom to locate any signs of squid in the water column, and then recorded 40 mins on the seafloor. The seafloor consisted of uniform muddy substrate with an abundance of burrows, tracks and a few mounds. Throughout the transect, common fauna found were stalked sponges, anemones, cerianthids, holothurians, and foraminiferans. Other less common fauna included asteroids, gastropods, *Kophobelemnon* sea pens, ascidians, rattails and fish.

Area: Bounty Trough – seamount site SM-9	**Station**: 059
Still Images: 403	**Duration**: 1 hr 8 min
Depth start: 1497	**Depth end:** 1334

Transect summary: Transect roughly from east to west across northern side of seamount. Sparse fauna throughout. Sediment with ripples in several places. Sponges, anemones, echinoids, glass sponges, demosponges, large bamboo coral at 13:36. Some barnacle plates and xenophyophores in places. The odd crinoid, holothurian, rattail fish.

Area: Bounty Trough – Channel site CH-4	**Station**: 063
Still Images: 537	**Duration**: 1 hr 30 min
Depth start: 2764	**Depth end:** 2867

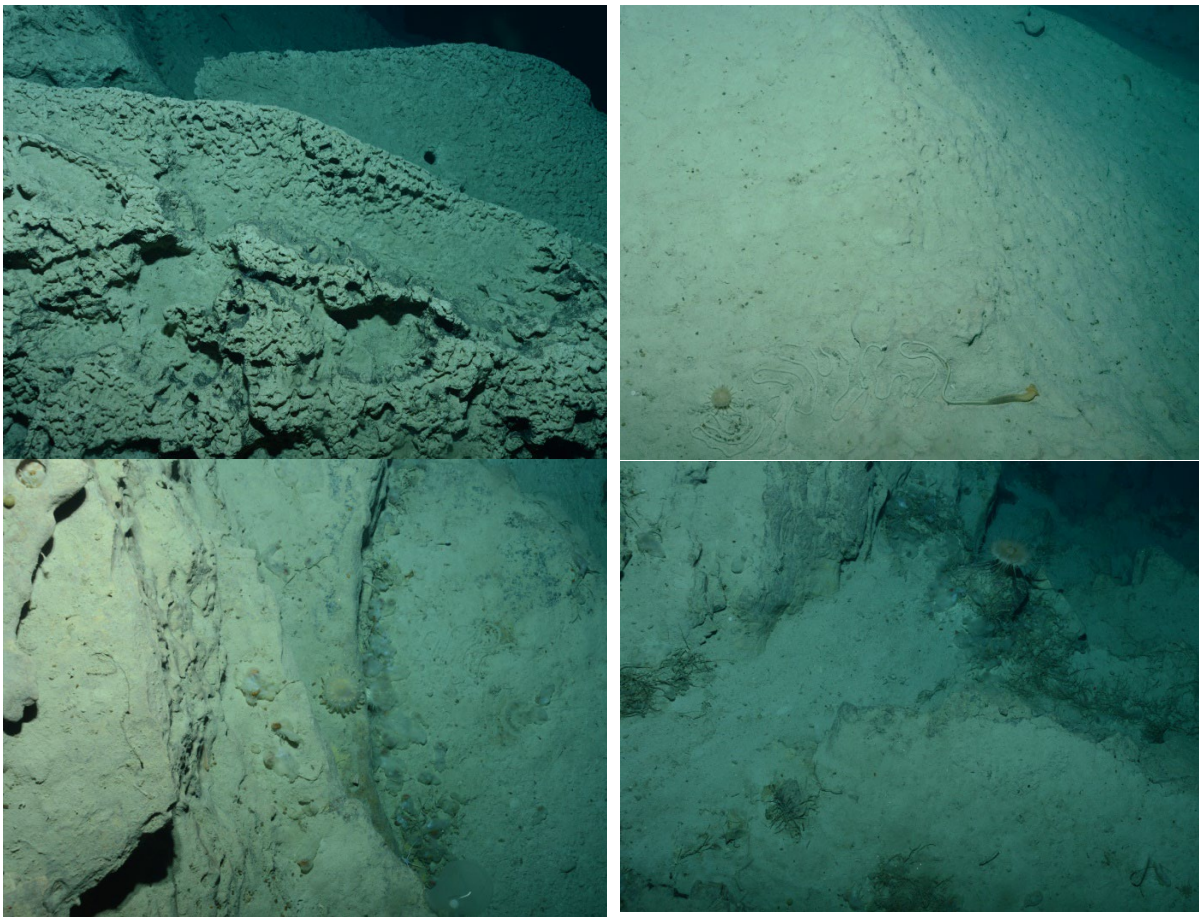


Transect summary: East to west transect from edge of channel, down channel wall, then towards middle of channel itself. Soft sediments with burrows above channel with abundant holothurians, some xenophyophores, ophiuroids, anemones/cerianthids, burrows, faecal coils, hemichordate spirals, urchins, sea pens, asteroids, crinoid. Steep rocky wall going into the channel with coral, lots of echinoids, xenophyophores. Sediment in channel very smooth, probably a thin layer only, with some gravel as we move towards centre of channel. Lots of echinoids, holothurians, ophiuroids, eel, some crinoids, cluster of brisingids on an isolated rock.

Area: Bounty Trough – Non-Channel site NCH-4A	**Station:** 070
Still Images: 245	**Duration**: 40 min
Depth start: 2830	**Depth end:** 2822

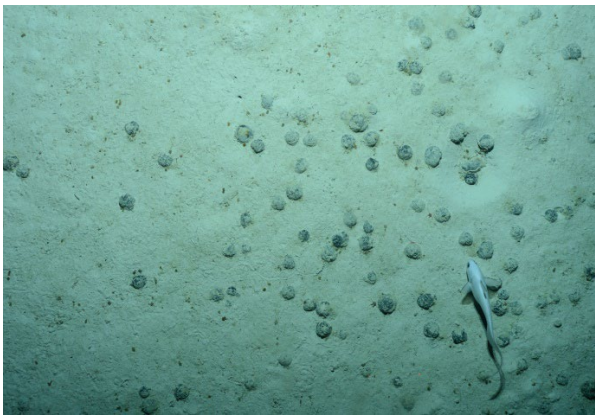
Transect summary: Non-channel transect in northwest direction across flat, muddy seafloor. Sparse megafauna which included echinoids, holothurians, ophiuroids, asteroids. Bioturbation included burrows, faecal coils and tracks.

Area: Bounty Trough – Channel site CH-3	**Station:** 078
Still Images: 751	**Duration**: 2 hr 5 min
Depth start: 3707	**Depth end:** 4124



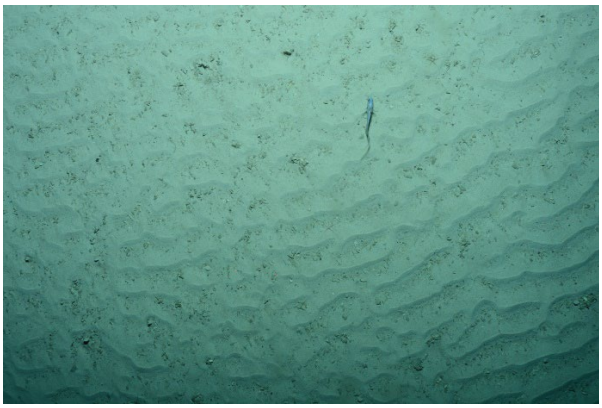
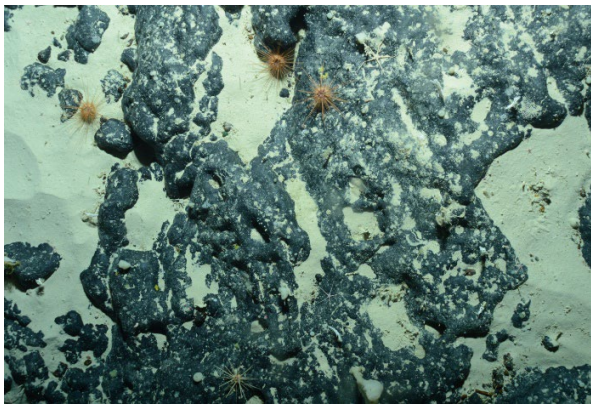
Transect summary: Started along a spur of the southern levee above a sharp turn of the channel, descended into the channel in a SSE-NNW direction. The entire transect was incredibly steep. In most cases only thin layer of sediment covered sharp bedrock, up to 20 m drop offs, terracing, steps with sharp edges. Sparse fauna; occasional hexactinellid glass sponges on exposed rock faces, a few ophiuroids, holothurians, echinoids, anemones, shrimp, a few small gorgonian sea fans, hemichordates and clumps of tube worms (indicating small seepages?).

Area: Bounty Trough – Non-channel site NCH-4a	**Station:** 083
Still Images: 243	**Duration**: 1 hr
Depth start: 3447	**Depth end:** 3483



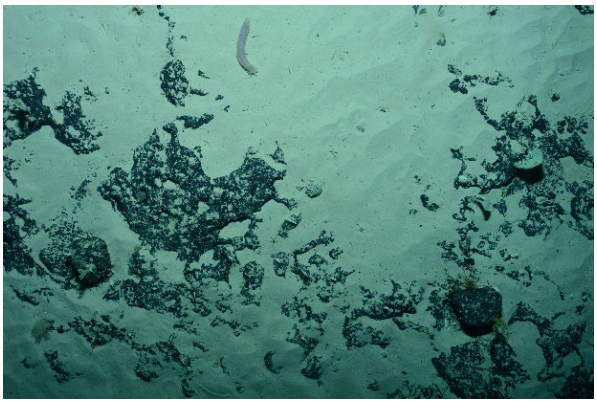
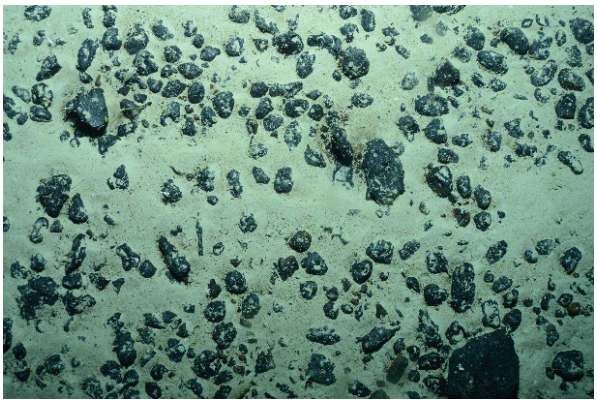

Transect summary: Transect from peak in SW direction into small basin, about 90 m height difference. Dropped near peak, soft sediments and pebbles. Large square boulder with some corals, anemone, hyocrinid and glass sponges. Followed by dense nodule field, with occasional xenophyophore and small fauna, thinned out quickly, gave way to soft sediments to end of transect. Few rat tails, holothurians, ophiuroids and starfish.

Area: Bounty Trough – slope site SL-2	**Station:** 087
Still Images: 173	**Duration**: 38 min
Depth start: 1446	**Depth end:** 1418

Transect summary: Transect in WSW direction slightly upslope. Small outcrops of bedrock and soft sediment, larger patches with ripples and small pebbles. Extended flat areas of pebbles, dense in places. Few animals on rocks, small stylasterids, gorgonians, hexactinellids, and few animals on soft sediments (tam ‘o’ shanters, holothurians, rat tails). Significant swell, frame hit hard a couple of times, track aborted early.

Area: Bounty Trough – slope site SL-2	**Station:** 089
Still Images: 383	**Duration**: 1 hr 3min
Depth start: 1414	**Depth end:** 1387

Transect summary: Transect running E to W slightly uphill. Mostly flattish run, total rise of 27m over the course of the transect. Seafloor consisted of periods of sandy sediment interrupted with sections of exposed bedrock, boulders and cobbles with overlying drape of sand. No burrows, some tracks in the sandy sediment. Sponges on the hard sediment, few animals seen on the soft sediment. Occasional holothurian and ophiuroid. Some rattails and eels seen. Corals. The odd xenophyophore.

4.6 Acoustic data collection

A total area of 8300 km^2 of multibeam acoustic data were collected on this Ocean Census survey. DTIS maps were created for each sampling site some with existing NIWA data and some with new data collected on this survey (see site maps in Section 4.2).

Opportunistic fisheries acoustic data was collected during some of the transits between sampling locations.

On a few occasions, sub-bottom profiler (SBP) lines were acquired to assess seafloor suitability for multicoring, and two opportunistic SBP lines were collected during bad weather days that prevented over the side sampling where they aligned with a data request from a geology Ph.D. student Severine Russo at Total Energies and University of Bordeaux, who is student studying the turbidite channel system and sedimentary bedforms in the Bounty Trough.

5 Acknowledgements

This voyage to the Bounty Trough was funded by The Nippon Foundation – Nekton Ocean Census programme whose purpose is to accelerate the discovery of ocean life. Our thanks to these organisations for the opportunity to explore this special region. Co-funding was provided for this expedition by NIWA through the Ministry of Business Innovation and Employment (MBIE) Strategic Science Investment Fund (SSIF) (Contract No: CO1X1703). Thank you to the Kāi Tahu team (Mike, Riki and Tāne) for their enthusiasm early in the planning for the voyage. Thank you to Sam Davidson and Susi Woelz for creating charts for planning the voyage, assisting us with the setup of GIS projects and providing map visualisations as outreach following the voyage and for the survey area maps reproduced in this report. Thank you to Rob Stewart and Erica Spain for crucial mobilisation preparation, support and training for key staff on this voyage. Thank you to the NIWA and Ocean Census communications team (particularly Ryan Willoughby, Sarah Fraser, Sandy McIntyre and the entire Sputnik team) who supported us from land. Thank you to Mike Williams, Kate Neill, Rachael Peart, (NIWA), Sarah-Jane Walsh, Daniel Moore and Verity Nye (Ocean Census) for their support throughout the pre- and post-planning of the voyage. A huge thank you to the RV *Tangaroa* Vessels company and crew for their enthusiasm and support in making this a successful mission.

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Appendix A Station records

Note that all gear deployment times are in NZST (12 hours ahead of UTC). Gear abbreviations are as follows: DTIS = Deep towed imaging system, MUC = Multicorer; GRAB = Van Veen Grab; TRAP = Lander with fish and amphipod traps; SLED = Seamount sled; BEAM = Beam trawl; Brenke = Hyperbenthic sled; SVP = Sound Velocity Profiler.

Station No.	Site No.	Site name	Gear method	Date (NZST)	Time (NZST)	Latitude (degrees S)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	E or W	Start depth (m)	Finish depth (m)	Distance (nautical miles)	Gear performance
1	1	CA1	DTIS	9-Feb	1921	45	52.14	171	3.35	E	NA	NA	NA	Fail
2	1	CA1	GRAB	9-Feb	2211	45	52.01	171	2.49	E	680	0	NA	Fair
3	1	CA1	GRAB	9-Feb	2338	45	52	171	2.49	E	680	0	NA	Good
4	1	CA1	SLED	10-Feb	0143	45	51.84	171	3.35	E	725	680	0.20	Fair
5	2	PM1	TRAP	10-Feb	0602	45	53.54	171	13.05	E	934	1071	NA	Poor
6	2	PM1	SVP	10-Feb	0649	45	52.34	171	12.65	E	700	0	NA	Good
7	2	PM1	DTIS	10-Feb	0833	45	52.43	171	13.471	E	768	767	0.66	Good
8	2	PM1	MUC	10-Feb	1419	45	52.437	171	13.372	E	798	0	NA	Poor
9	2	PM1	MUC	10-Feb	1515	45	52.495	171	13.577	E	797	0	NA	Fair
10	2	PM1	MUC	10-Feb	1627	45	52.44	171	13.37	E	798	0	NA	Fair
11	2	PM1	BRENKE	10-Feb	1930	45	52.24	171	13.27	E	775	790	0.23	Good
12	2	PM1	BEAM	10-Feb	2112	45	52.01	171	13.25	E	769	1052	NA	Fail
13	3	SM-5	TRAP	11-Feb	0704	46	8.54	171	4.93	E	900	1044	NA	Ok
14	3	SM-5	DTIS	11-Feb	0802	46	8.85	171	3.63	E	620	848	0.42	Good
15	3	SM-5	BEAM	11-Feb	0947	46	9.02	171	3.48	E	740	852	0.31	Good
16	3	SM-5	SLED	11-Feb	1122	46	8.732	171	3.718	E	612	619	0.14	Fail
17	3	SM-5	SLED	11-Feb	1240	46	8.714	171	3.729	E	615	625	0.18	Good
18	4	SM-4	DTIS	11-Feb	1848	46	8.45	171	25.77	E	1062	1150	0.36	Good
19	4	SM-4	SLED	11-Feb	2030	46	8.43	171	25.782	E	1221	1200	0.15	Good
20	5	PM2	TRAP	12-Feb	0125	46	23	170	48.41	E	767	763	NA	Good

Station No.	Site No.	Site name	Gear method	Date (NZST)	Time (NZST)	Latitude (degrees S)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	E or W	Start depth (m)	Finish depth (m)	Distance (nautical miles)	Gear performance
21	5	PM2	DTIS	12-Feb	0248	46	23.3	170	45.9	E	757	768	0.38	Good
22	5	PM2	MUC	12-Feb	0432	46	23.48	170	45.36	E	749	749	NA	Fail
23	5	PM2	MUC	12-Feb	0517	46	23.48	170	45.36	E	749	749	NA	Fair
24	5	PM2	MUC	12-Feb	0602	46	23.48	170	45.36	E	749	749	NA	OK
25	5	PM2	BRENKE	12-Feb	0801	46	23.3	170	45.86	E	758	750	0.24	Ok
26	5	PM2	BEAM	12-Feb	1322	46	23.47	170	45.2	E	734	731	0.19	Good
27	6	CH7	DTIS	12-Feb	1525	46	25.486	170	48.832	E	903	1052	0.64	Good
28	6	CH7	MUC	12-Feb	1724	46	25.651	170	48.124	E	1070	0	NA	Fail
29	6	CH7	MUC	12-Feb	1842	46	25.66	170	48.126	E	1082	0	NA	Fail
30	6	CH7	GRAB	12-Feb	2000	46	25.66	170	48.12	E	1070	0	NA	Fail
31	6	CH7	BRENKE	12-Feb	2137	46	25.65	170	48.16	E	1066	1065	0.21	Good
32	6	CH7	BEAM	12-Feb	2338	46	25.57	170	48.51	E	1035	1060	0.50	Good
33	7	NCH7a	DTIS	13-Feb	0307	46	29.657	170	52.367	E	989	986	0.39	Good
34	7	NCH7a	MUC	13-Feb	0451	46	29.823	170	51.862	E	992	0	NA	Ok
35	7	NCH7a	MUC	13-Feb	0603	46	29.822	170	51.861	E	992	0	NA	Ok
36	7	NCH7a	BEAM	13-Feb	0732	46	29.648	170	52.432	E	968	965	0.33	Good
37	7	NCH7a	BRENKE	13-Feb	0909	46	29.6	170	52.42	E	982	981	0.33	Good
38	8	SM1	DTIS	13-Feb	1548	46	50.47	171	51.78	E	1385	1393	0.71	Good
39	8	SM1	SLED	13-Feb	1849	46	50.247	171	51.477	E	1246	1146	0.18	Good
40	8	SM1	SLED	13-Feb	2039	46	50.45	171	51.78	E	1379	1152	0.19	Good
41	8	SM1	TRAP	13-Feb	2221	46	50.17	171	51.78	E	1141	0	NA	Good
42	9	CH6	DTIS	13-Feb	2353	46	48.295	171	57.89	E	1483	1645	0.89	Good
43	9	CH6	MUC	14-Feb	0255	46	47.63	171	58.17	E	1648	0	NA	Fail
44	9	CH6	GRAB	14-Feb	0435	46	47.63	171	58.17	E	1648	0	NA	Fail

Station No.	Site No.	Site name	Gear method	Date (NZST)	Time (NZST)	Latitude (degrees S)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	E or W	Start depth (m)	Finish depth (m)	Distance (nautical miles)	Gear performance
45	10	SM2	TRAP	14-Feb	0935	46	46.5	172	3.19	E	1091	0	NA	Ok
46	9	CH6_alt	MUC	14-Feb	1044	46	48.52	171	55.54	E	1530	0	NA	Good
47	9	CH6	BRENKE	14-Feb	1327	46	47.61	171	58.21	E	1644	1646	0.19	Good
48	9	CH6	BEAM	14-Feb	1907	46	47.664	171	57.994	E	1642	1646	0.28	Good
49	10	SM2	DTIS	14-Feb	2116	46	46.874	172	3.45	E	1377	1029	0.69	Good
50	10	SM2	SLED	14-Feb	2351	46	46.25	172	3.09	E	1049	1086	0.11	Good
51	10	SM2	SLED	15-Feb	0153	46	46.62	172	2.9	E	1161	1136	0.18	Good
52	11	NCH6a	DTIS	15-Feb	0744	47	6.18	172	5.6	E	1384	1377	0.32	Good
53	11	NCH6a	MUC	15-Feb	0932	47	6.42	172	5.26	E	1388	0	NA	Good
54	11	NCH6a	MUC	15-Feb	1040	47	6.431	172	5.267	E	1389	0	NA	Good
55	11	NCH6a	BRENKE	15-Feb	1221	47	6.26	172	5.38	E	1389	1389	0.02	Ok
56	11	NCH6a	BEAM	15-Feb	1425	47	6.2	172	5.5	E	1388	1388	0.18	Ok
57	12	SM9	SVP	16-Feb	0637	47	0.99	175	39.07	E	1475	0	NA	OK
58	12	SM9	TRAP	16-Feb	1014	47	0.28	175	35.67	E	1278	0	NA	Poor
59	12	SM9	DTIS	16-Feb	1229	46	59.57	175	36.51	E	1494	1334	0.71	OK
60	12	SM9	SLED	16-Feb	1517	46	59.976	175	35.792	E	1244	1201	0.24	Ok
61	13	CH4	TRAP	17-Feb	0018	46	31.49	176	49.32	E	2762	0	0.00	ok
62	13	CH4	SVP	17-Feb	0114	46	29.99	176	46.84	E	2754	0	0.00	Good
63	13	CH4	DTIS	17-Feb	0531	46	29.862	176	49.134	E	2764	2867	0.79	Good
64	13	CH4	BEAM	17-Feb	1012	46	29.66	176	47.39	E	2866	2864	0.46	Good
65	13	CH4	BRENKE	17-Feb	1338	46	29.84	176	47.77	E	2874	2872	0.38	Good
66	13	CH4	NETP	17-Feb	1300	46	30.03	176	48.11	E	2874	2868	0.26	Good
67	13	CH4	SLED	17-Feb	1920	46	29.844	176	48.395	E	2872	2794	0.19	Fail
68	13	CH4	NETP	17-Feb	0000	46	29.85	176	49.23	E	2721	2698	0.29	Ok

Station No.	Site No.	Site name	Gear method	Date (NZST)	Time (NZST)	Latitude (degrees S)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	E or W	Start depth (m)	Finish depth (m)	Distance (nautical miles)	Gear performance
69	13	CH4	NETP	17-Feb	1951	46	29.85	176	49.81	E	2721	2698	0.29	Ok
70	14	NCH4a	DTIS	18-Feb	0213	46	43.8	177	22.2	E	2830	2822	0.40	0
71	14	NCH4a	MUC	18-Feb	0503	46	43.519	177	21.749	E	2829	0	NA	Ok
72	14	NCH4a	MUC	18-Feb	0659	46	43.519	177	21.746	E	2829	0	NA	Fail
73	14	NCH4a	BRENKE	18-Feb	0938	46	43.32	177	21.38	E	2821	2923	0.40	Ok
74	14	NCH4a	NETP	18-Feb	0853	46	43.6	177	21.96	E	0	0	0.32	Good
75	14	NCH4a	NETP	18-Feb	0912	46	43.25	177	21.26	E	0	0	0.63	Good
76	14	NCH4a	BEAM	18-Feb	1316	46	43.66	177	22.11	E	2827	2834	0.67	Good
77	15	CH3	SVP	19-Feb	0552	46	21.69	179	4.752	W	3969	0	NA	Good
78	15	CH3	DTIS	19-Feb	1224	46	21.27	179	7.78	W	3707	4126	1.24	Good
79	15	CH3	TRAP	19-Feb	1728	46	20.1	179	5.96	W	4282	0	NA	Fail
80	16	NCH3a	TRAP	19-Feb	1931	46	32.51	179	11.72	W	3502	0	NA	Fail
81	16	NCH3a	GRAB	21-Feb	2140	46	36.32	179	11.49	W	3519	0	NA	Fail
82	16	NCH3a	GRAB	22-Feb	0043	46	36.455	179	11.62	W	3529	0	NA	Fail
83	16	NCH3a	DTIS	22-Feb	1354	46	35.56	179	11.36	W	3447	3483	0.61	Good
84	16	NCH3a	BRENKE	22-Feb	1948	46	35.97	179	11.97	W	3527	3546	0.51	Fair
85	16	NCH3a	BEAM	23-Feb	0108	46	35.9	179	11.89	W	3522	3542	0.69	Good
86	17	SL2	SVP	23-Feb	1059	47	38.95	178	50.68	W	1465	0	NA	Good
87	17	SL2	DTIS	23-Feb	1605	47	38.994	178	50.69	W	1446	1423	0.42	OK
88	17	SL2	SLED	23-Feb	1854	47	39.188	178	50.6	W	1427	1425	0.48	Good
89	17	SL2	DTIS	23-Feb	2106	47	39.171	178	51.425	W	1486	1387	0.64	Good
90	18	C1	SVP	24-Feb	0542	47	11.546	177	37.682	W	4846	0	NA	Good
91	18	C1	DTIS	24-Feb	0850	47	12.81	177	37.47	W	4670	0	NA	Fail
92	18	C1	MUC	24-Feb	1357	47	13.12	177	37.4	W	4800	0	NA	Ok

Station No.	Site No.	Site name	Gear method	Date (NZST)	Time (NZST)	Latitude (degrees S)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	E or W	Start depth (m)	Finish depth (m)	Distance (nautical miles)	Gear performance
93	18	C1	MUC	24-Feb	1700	47	13.12	177	37.4	W	4808	0	NA	Ok
94	18	C1	GRAB	24-Feb	2037	47	12.645	177	38.7	W	4846	0	NA	Fail
95	18	C1	MUC	25-Feb	0121	47	16.52	177	47.29	W	4660	0	NA	Ok
96	18	C1	MUC	25-Feb	0422	47	16.52	177	47.286	W	4660	0	NA	Ok
97	16	NCH3a	BEAM	25-Feb	1534	46	36.328	179	11.605	W	3527	3531	0.69	Good
98	16	NCH3a	BRENKE	25-Feb	2034	46	36.314	179	11.841	W	3550	3523	0.63	Good
99	16	NCH3a	SLED	26-Feb	0143	46	35.79	179	10.7	W	3505	3488	0.49	Fail
100	16	NCH3a	NETP	26-Feb	0145	46	35.97	179	12.95	W	3524	0	1.47	Ok
101	16	NCH3a	SLED	26-Feb	1718	46	35.756	179	11.099	W	3465	3460	0.39	Good
102	15	CH3	SLED	26-Feb	2231	46	20.21	179	4.693	W	4265	4269	0.27	Ok
103	15	CH3	NETP	26-Feb	2133	46	20.19	179	4.77	W	4306	4280	0.35	Ok
104	15	CH3	NETP	26-Feb	2149	46	20.42	179	4.07	W	4273	4262	0.71	Ok
105	15	CH3	NETP	26-Feb	2319	46	21.32	179	1.6	W	4360	4387	2.40	Ok
106	19	NBT	OKTO	27-Feb	1256	45	19.53	178	58.78	E	2555	0	NA	Good
107	19	NBT	BEAM	27-Feb	1553	45	20.735	179	0.232	E	2568	2563	0.43	Good