RV *Investigator* Voyage Summary

Voyage #:	**IN2019_V01**		
Voyage title:	The availability of Antarctic krill to large predators and their role in biogeochemical recycling in the Southern Ocean (ENRICH voyage)		
Mobilisation:	17th and 18th January 2019		
Depart:	19th January 2019		
Return:	4th March 2019		
Demobilisation:	5th and 6th March 2019		
Voyage Manager:	Lisa Woodward	**Contact details:**	MNF@csiro.au
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Voyage Summary

Scientific objectives

The scientific objectives of the ENRICH voyage (Euphausiids and Nutrient Recycling In Cetacean Hotspots) were to:

1. Characterise the density, distribution and fine-scale 3D structure of Antarctic krill swarms using the latest active acoustic multibeam technology.
2. Compare the krill prey field in the vicinity and absence of a large predator by remotely detecting and tracking the location of Antarctic blue whale aggregations using novel passive acoustic methods.
3. Describe the behaviour of Antarctic blue whales on foraging grounds by investigating the relationships among vocalisations, density, movements and surface behaviour, and compare the local prey field around whales exhibiting different behaviours.
4. Conduct the first field study of the theory of iron fertilisation by whales and krill.

Antarctic krill (*Euphausia superba*) is the primary prey for many squid, fish, bird, and mammal species but the factors that influence the distribution, density, form and behaviour of krill are not well understood. Equally it is not known how the characteristics of krill swarms affect the availability of krill to foraging predators.

To determine how krill swarm characteristics influence predator distribution and behaviour this project used the latest active acoustic multibeam technology to describe the density, distribution, and fine-scale 3D structure of krill swarms both within the vicinity of Antarctic blue whales and in control locations that are demonstrably distant from these specialist and extreme krill predators. Antarctic blue whales facilitate this study because their locations can be tracked in real-time from many hundreds of kilometres using passive acoustic technology explicitly developed to detect these whales' loud, low frequency calls. Within whale aggregations the movement and foraging behaviour of blue whales was described using tracking technologies.

In addition, this project facilitated the first field-based investigation of the controversial theory of iron-fertilisation by whales. Through measurements of the abundance and speciation of whale faecal iron we aimed to establish whether iron concentrations are higher within aggregations of feeding whales than within krill-only aggregations or than in adjacent areas. We will also determine whether whale faeces stimulate local production, alters phytoplankton community structure and growth, and its influence on nutrient cycling, nitrogen-fixation and biogenic climate gas production and the timescale of any effect.

This project could not only profoundly influence our view of the role of whales in the Antarctic ecosystem but will describe the potential dependencies of predators on krill in a form that may be limited in space and time. This information will inform the development of management systems for Antarctica's expanding krill fisheries.

Voyage objectives

This section provides the voyage objectives as written prior to the voyage.

The objective of this voyage is to operate south of 60°S, northward of the ice edge, and between 140°E and 175°W. The specific study area/s within these boundaries will be determined by the locations of vocalising Antarctic blue whales, krill and sea-ice. The survey design is therefore adaptive in that sites will be chosen in real-time on the voyage according to available information. At the commencement of the voyage we will head straight to the closest group of vocalising Antarctic blue whales (ABWs) within our operational area. Vocalising ABWs can be detected using sonobuoys (see below) hundreds of kilometres away. When whales are found we will undertake a series of activities at that site. We will then commence a series of line transects in the same region and remain within the same area for the rest of the voyage. The study is therefore on a mesoscale and we will not aim to survey our entire operational area.

The activities required to achieve our scientific and voyage objectives are:

- Passive Acoustics
- Whale observing, video-tracking and biopsy
- Active Acoustics
- Krill trawls
- Unmanned Aerial Systems (UASs)
- Biogeochemistry

Passive Acoustics (Team Leader – Brian Miller)

To detect, encounter and track vocalising aggregations of Antarctic blue whales (ABWs), sonobuoys will be regularly deployed throughout the entire voyage using established adaptive survey methods. Sonobuoys can provide usable data in calm and rough seas (up to Beaufort sea state 7) and can be deployed from the deck whilst underway without slowing the ship. During transit to the operational area, single sonobuoys will be deployed at 30 NM intervals with acousticians continuously monitoring for ABW calls and making calibrated intensity and bearing measurements to estimate the distance to vocal aggregations. Within 30 NM of ABW aggregations, multiple sonobuoys may be deployed to triangulate the precise location of ABWs. Multiple sonobuoys may also be deployed during (krill) transect surveys that will subsequently occur in the study area. Upon leaving the whale aggregation, single sonobuoys will continue to be deployed at 30 NM intervals to remotely track aggregations of ABWs.

To record omni-directional acoustic data over a slightly broader area and longer time frame than is possible using sonobuoys, upon arriving at a blue whale aggregation area, an acoustic mooring will be deployed. The mooring consists of a High-frequency Acoustic Recording Package (HARP) and an autonomous Simrad Wide-Band Autonomous Transceiver (WBAT) with 70 kHz and 200 kHz transducers. This system will allow us to continuously record blue whales and ambient noise using the HARP, as well as to determine the concurrent prey field, using the different scattering characteristics of organisms at different frequencies, around the mooring using the WBAT. These data, which are more typical of those acquired during long-term passive acoustic monitoring of underwater environments, will be compared with real-time acoustic detections from sonobuoys and krill patch characteristics as determined during shipboard krill surveys (see Active Acoustics below).

Visual Observations, video-tracking and biopsy (Team Leaders – Nat Kelly, Virginia Andrews-Goff)

Observers will conduct visual observations of whales during all daylight hours to confirm the presence of acoustically tracked or non-vocalising whales. Sighting effort and environmental data will be recorded in a database and linked to the vessel track. The whale observers will use observation boxes on Level 05, and a step on the bow of the ship. They will rotate on hourly daytime shifts – up to 30 minutes each time. Observations will only be conducted during good weather.

Upon visual sightings of ABWs, the vessel will stand-off at ~1-2km and conduct a behavioural focal-follow using a photogrammetric video-tracking system. During 1-3 h of observation (to include 6-12 surfacing intervals of ABWs), accurate bearings, locations and behavioural observations will be recorded, including movements, swimming speeds, blow and diving intervals. Simultaneously, observers will estimate the relative number of ABWs and other species present. Continued sonobuoy recordings will provide simultaneous data on vocal behaviour and triangulate underwater movements of vocalising individuals (see above). Whale biopsy samples may also be collected opportunistically from the bow of the ship using a PAXARMS biopsy system (firearms).

Active Acoustics (Team Leaders – Joshua Lawrence, Martin Cox)

The EK60 scientific echosounders, the ME70 scientific multibeam and the SH90 omnidirectional sonar will be used to continuously map water column targets, primarily krill, throughout the voyage detailing swarm density, structure, and vertical distribution. The EK60 will be calibrated. A time-stamped electronic log or transcript of the ship's activities (viz., research modes and sampling events) will be kept throughout the voyage to aid in subsequent analyses of the large volumes of echosounder data.

We will use Echoview software (Echoview, Hobart, Australia) to process and combine EK60 ME70, and SH90 data into a single spatially referenced data set to allow efficient description and interpretation of patterns in krill distribution. Krill will be identified using the frequency response approach adopted by CCAMLR (2010) and krill aggregations delimited using school identification algorithms (Baranage 1992, applied in e.g. Cox et al. 2010, Cox et al. 2011). Acoustic mark identification will be validated by target trawling using an RMT 1+8 (Roe and Shale 1979).

Designed transect surveys will be conducted to directly compare patterns in krill at known distances from ABW aggregations. We will replicate the small-scale night-time survey design of 8 transects, 6 NM long with a 0.75 NM transect spacing carried out previously (O'Driscoll & Double 2015), or a survey design similar to this.

It is highly desirable that a cold-water calibration is conducted for the EK60 echosounder. This will take up to 24 hours of ship time and needs to occur in Antarctic waters on a calm day. The ship will need to be stationary during the calibration. A sound velocity profile (temperature, salinity, pressure) will need to be measured using a Valeport, which will provide depth, salinity and temperature readings from the surface to 10 m below the calibration sphere depth. The profile data needs to be in ASCII format and accessible as soon as possible.

Krill Trawls (Team Leader – So Kawaguchi)

Target trawls for krill will be utilized to support the active acoustic work (above), and to collect live animals for experimentation. All trawls will be conducted using a Rectangular Midwater Trawl with 1+8 nets (RMT 1+8), to be provided by the AAD. Trawls will take approximately 1 h. Live krill will be incubated in a tank (IGR tank provided by AAD) to measure growth rates over time. We will also spawn krill and rear larvae using Kreisel tanks in a temperature-controlled laboratory. It is anticipated that up to 80 trawls will occur during the voyage.

Unmanned aerial systems (UAS) operations (Team Leaders – Joshua Smith, Guy Williams)

UAS operations will be utilised to conduct whale biometrics, collect whale exhalation, monitor whale behavior, estimate biological production, and to collect faecal plumes if present. We will utilise quadcopters to undertake this work. UAS operations will take less than 2 h due to battery life and will be launched from the bow or aft main deck. For UAS operations we would like to take the ship as close as possible to whales (depending on the outcome of permit conditions) to allow visual flying rather than "beyond line of sight".

Pre-flight toolboxes will be held between relevant parties on board to determine that operations can be undertaken in safe conditions. An exclusion zone, as nominated in the UAE systems approval documentation, will be adhered to at all times. Simultaneous drone operations will be also be considered, but only after rigorous deliberations with the on board management team and the pilots to determine the safety of these operations.

Any photos taken by the drone or by those watching the operations must be compliance-checked prior to public release.

Biogeochemistry (Team Leader – Karen Westwood)

Biogeochemistry activities will be undertaken to examine iron availability, microbial production, and biogenic climate gases. For this work we will be undertaking both Conductivity Temperature Depth (CTD) and trace metal rosette (TMR) operations. We intend to undertake these operations no more than once per 24 hours during the voyage, apart from at one Process Station (see below). The maximum depth that we will sample for CTD and TMR operations is 1200m. For CTD operations we require the 24 bottle rosette. To determine the vertical structure of the water column in between CTD sites we also require the launch of two XBTs per day. This will provide a better spatial resolution of our survey area.

We also intend to undertake a Process Station on one occasion – whereby the ship re-visits the same parcel of water for up to 5 days. We intend to sample the water parcel every 24 hours, at the same time of day to avoid diurnal effects on measurements. Process Station CTDs/TMRs will be additional to our sampling requirements at other sites. We may therefore conduct two CTDs/TMRs per 24 hours over this 5 day period (rather than one). To track the same parcel of water during the Process Station we will deploy a small drogue supplied by the National Oceanic and Atmospheric Administration (NOAA, USA) as part of their drifter program (please see http://www.aoml.noaa.gov/phod/dac/gdp_drifter.php). The ship is likely to leave the immediate area of the drogue in between sampling times to conduct other activities. The drogue will therefore need to be re-found every 24 hours over the 5 days. We are able to access the GPS position of the drogue on the hour via internet. The surface buoy of the drogue is only small (30-40 cm), but will be brightly coloured with small light beacons attached for visibility to the ship. Please note that whilst we only require 1 drifter for the Process Station, we intend to deploy up to 10 drifters from the aft of the ship during the voyage in order to assist NOAA with measurements for their database. This does not require the ship to slow down, but a crew member will be required to assist in deployments. No drifters will be recovered.

We also intend to conduct one incubation experiment during the voyage – examining the release of bioavailable iron over time and its effect on phytoplankton and bacteria. Incubations will be run for 2 weeks with regular sampling. The MNF deck incubators are required for this work.

Results

The huge amount of data from this multidisciplinary voyage will take several years to analyse in full so here I described the nature and magnitude of the data collected. The true results of this study will emerge as analyses progress.

Objective 1. Characterise the density, distribution and fine-scale 3D structure of Antarctic krill swarms using the latest active acoustic multibeam technology.

Krill density estimates require a calibrated scientific echosounder. An open-ocean cold-water EK60 calibration was carried out very early in the voyage (26th January 2019, at 141” 39.3’ E, 64” 0.82’ S) to ensure this essential, but very weather dependent, operation was completed successfully. Active acoustic data were then collected continuously throughout the entire voyage, covering over 9,000 km of acoustic transects south of 60°S. The six broad-scale survey transects (approx. north-south) consisted of 1,670 km strict ‘on-effort’ survey tracks (one of which, T5, was surveyed twice). During this effort 975 distinct krill swarms were detected and the acoustic density and 3D structure of each was recorded using the echosounders.

Krill were distributed throughout the survey region, with the highest densities in the western part of the region detected in areas near, but offshore from, the shelf-break (around the 1000m isobath), in contrast to the easternmost transects where the highest densities were found further north, in deeper water.

A total of 41 target trawls were conducted using RMT 1+8 net during the voyage to collect information on krill size, maturity stage composition and growth rates from various swarms. These data will assist in the interpretation of the active acoustic data for krill biomass estimates and also characterise the krill population structure within the study area.

Morphometric data from 4385 krill sampled using the RMT 1+8 net were measured during the voyage. Preliminary analyses indicate the krill population observed in the north east of the study area consisted of mature adult krill with spent females. The krill population in the south-west were mainly juveniles and sub-adults. This distribution (large mature krill in off-shore waters and smaller sub-adult and juvenile krill closer to the content in shallower waters) is a typical segregation pattern known for Antarctic krill during the summer period.

The growth rates of 5472 krill were measured in 20 Integrated Growth Rate (IGR) experiments. Preliminary analyses suggest males and females exhibited different growth rates, with females growing slower than males; spent females showed negative growth. Further analysis will be undertaken by analysing inter-moult periods to derive daily growth rates of Antarctic krill in the survey area.

Objective 2. Compare the krill prey field in the vicinity and absence of a large predator by remotely detecting and tracking the location of Antarctic blue whale aggregations using novel passive acoustic methods.

Large predators, principally whales, were detected and mapped throughout the voyage by the sightings and passive acoustics teams.

Passive acoustic monitoring using sonobuoys was conducted throughout the voyage. In total 295 sonobuoys were deployed, which provided 574 hours of monitoring. Antarctic blue whales were detected most commonly with 33,435 calls detected on 238 sonobuoys. Fin, humpback, sei, right sperm and minke whales were also detected. Over 205 hours of the survey two or three sonobuoys provided data simultaneously. Data from these sonobuoys allowed us to geographically locate calling whales and map their distribution relative to mapped krill swarms.

Visual sightings effort totalled 317 hours over 4471 km. In total there were 569 sightings of 1380 cetaceans. Sightings of humpback whales were most common (201), followed by fin (124), blue (26) and minke whales (23). A further 97 sightings were of unidentified large whales. Nineteen groups of blue whales were approached for photo-identification and suitable imagery for individual identification was collected from 29 whales (re-sighted individuals included).

Objective 3. Describe the behaviour of Antarctic blue whales on foraging grounds by investigating the relationships among vocalisations, density, movements and surface behaviour, and compare the local prey field around whales exhibiting different behaviours.

Video tracking was conducted on 24 occasions for a total of 18 hours, mainly with Antarctic blue whales but some fin whales were tracked to obtain surfacing rate data to help improve the line-transect density estimates. Several of the video tracks were in close proximity to sonobuoy deployments and will allow comparison of the whale's acoustic and surfacing behaviour relative to the local prey field.

During the voyage 134 UAV (drone) flights were conducted from the bow of the ship to undertake photogrammetry, photo-identification, whale 'blow' sampling, surface water sampling, general whale and scenic imagery and surveillance for acoustic mooring retrieval. Of the 134 flights, the media team undertook 113 flights using the DJI Inspire 2 and the AAD science team 21 flights using the DJI Phantom 4. Photogrammetry video data were collected for a total of 8 individual Antarctic blue whales to obtain length measurements for each whale. One blow sample was successfully obtained from an Antarctic blue whale for post-voyage bacterial microbiome analysis of the pulmonary system. The DJI Phantom 4 Pro was also used to collect water samples for trace metal analysis (see table below).

Objective 4. Conduct the first field study of the theory of iron fertilisation by whales and krill.

A total of 110 biogeochemistry deployments were conducted during the voyage. This included the deployment of 28 CTDs (Conductivity, Temperature, Depth) at 22 survey stations and 5 Process Station sites, 35 Trace Metal Rosettes (TMRs) at 21 stations, 37 eXpendable BathyThermographs (XBT), and 10 Drifters. Not all CTD and TMR deployments collected water for experimental work.

The purpose for sampling as well as the number of sampling stations, depths, experiments and total number of samples collected are presented in the table below:

Event/parameter	Stations (includes 5 BPS*)	Depths per station	# Experiments	# Samples
CTD casts (n=28)	28	20	-	-
Dissolved oxygen	26	20	-	-
Dissolved inorganic carbon	22	6	132	132
Salinity	26	44176	-	
Nutrients	26	19-20	-	
Bacterial production	22	2	44	392

Event/parameter	Stations (includes 5 BPS*)	Depths per station	# Experiments	# Samples
Primary production	22	6	132	372
Total microbial community analysis	26	2	-	52
Pico-nano Eukaryotes, Bacteria and viral abundance	22	43892	-	132
Viral lysis and lysogeny	20	2	40	786
DNA/RNA	22	43892	-	318
DMSP lyase	22	43892	44	258
Chl *a* associated with DMSP assays	22	43892	-	129
Total DMSP	22	43892	-	177
Dissolved DMSP	22	43892	-	177
Metagenomic	2	2	-	
HPLC	22	6	-	138
Light-iron incubation experiments	2	1	6	
Chl *a* (Rodriguez Vives)	23	1	-	23
TMR casts	35	12		
Dissolved trace metals	19	12		235
Organic ligands	19	12		212
Trace metal incubation experiment	2		2	
UAV collected trace metal	2	1		22
NOAA Drifters	10	-	-	-
XBTs	37	Surface–1000 m	-	-

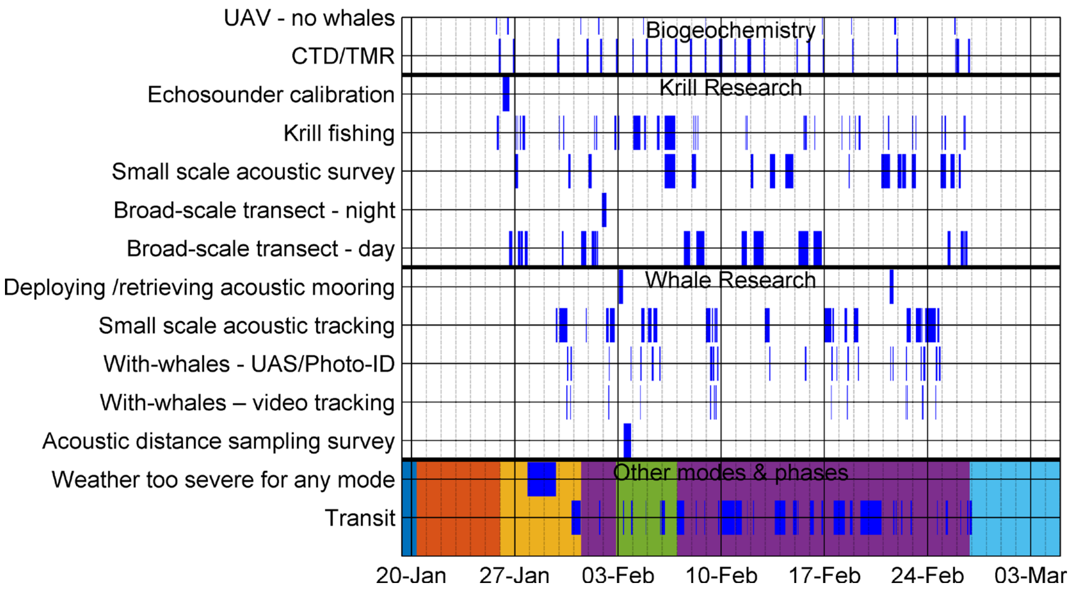
Voyage Narrative

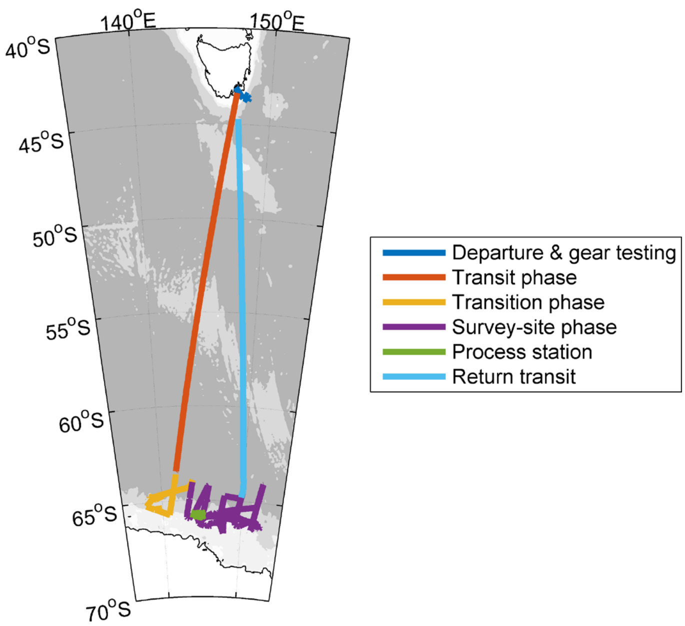
RV *Investigator* departed from Hobart on 19 January 2019. Gear testing in sheltered Tasmanian waters, and transfer of remaining science personnel was conducted on the 19th and 20th of January. The ship headed nearly due south in transit to the Antarctic from 20-24 January undertaking passive acoustic and visual surveys for marine mammals. Antarctic science operations began on January 24th as the ship crossed the 60°S parallel.

Cold water echosounder calibration was conducted on the 25 January. On the 26 and 27 January the ship entered into "Transition phase" and began to conduct an initial site-survey (i.e. broad-scale systematic transects and passive acoustic tracking) to locate Antarctic blue whales. Poor weather was encountered on the 28 and 29 January and all science operations were stopped until the storm had passed. From the 30 January to the 2 February broad-scale systematic surveys resumed. The Biogeochemistry Process Station was conducted over the continental slope from 2-7 February and the Acoustic mooring was deployed on the 3 February. Krill surveys and blue whale studies were conducted during daylight hours around the Process Station. Broad scale systematic transects, small scale active acoustic surveys, and passive acoustic tracking were conducted from the 8 through 26 February with intermittent periods of poor weather during this time used largely for transit between broadscale transects. CTD and/or TMR stations were typically conducted most, but not all nights. The acoustic mooring was recovered on the 21st February.

Return transit commenced on the 27 February, and the ship returned to Hobart on the 5 March.

The phases and modes of operation throughout the voyage are summarised in the figure below.


UAV - no whales
CTD/TMR
Biogeochemistry
Echosounder calibration
Krill fishing
Small scale acoustic survey
Broad-scale transect - night
Broad-scale transect - day
Krill Research
Deploying /retrieving acoustic mooring
Small scale acoustic tracking
With-whales - UAS/Photo-ID
With-whales – video tracking
Acoustic distance sampling survey
Whale Research
Weather too severe for any mode
Transit
Other modes & phases
20-Jan
27-Jan
03-Feb
10-Feb
17-Feb
24-Feb
03-Mar


140°E
150°E
40°S
45°S
50°S
55°S
60°S
65°S
70°S
Departure & gear testing
Transit phase
Transition phase
Survey-site phase
Process station
Return transit

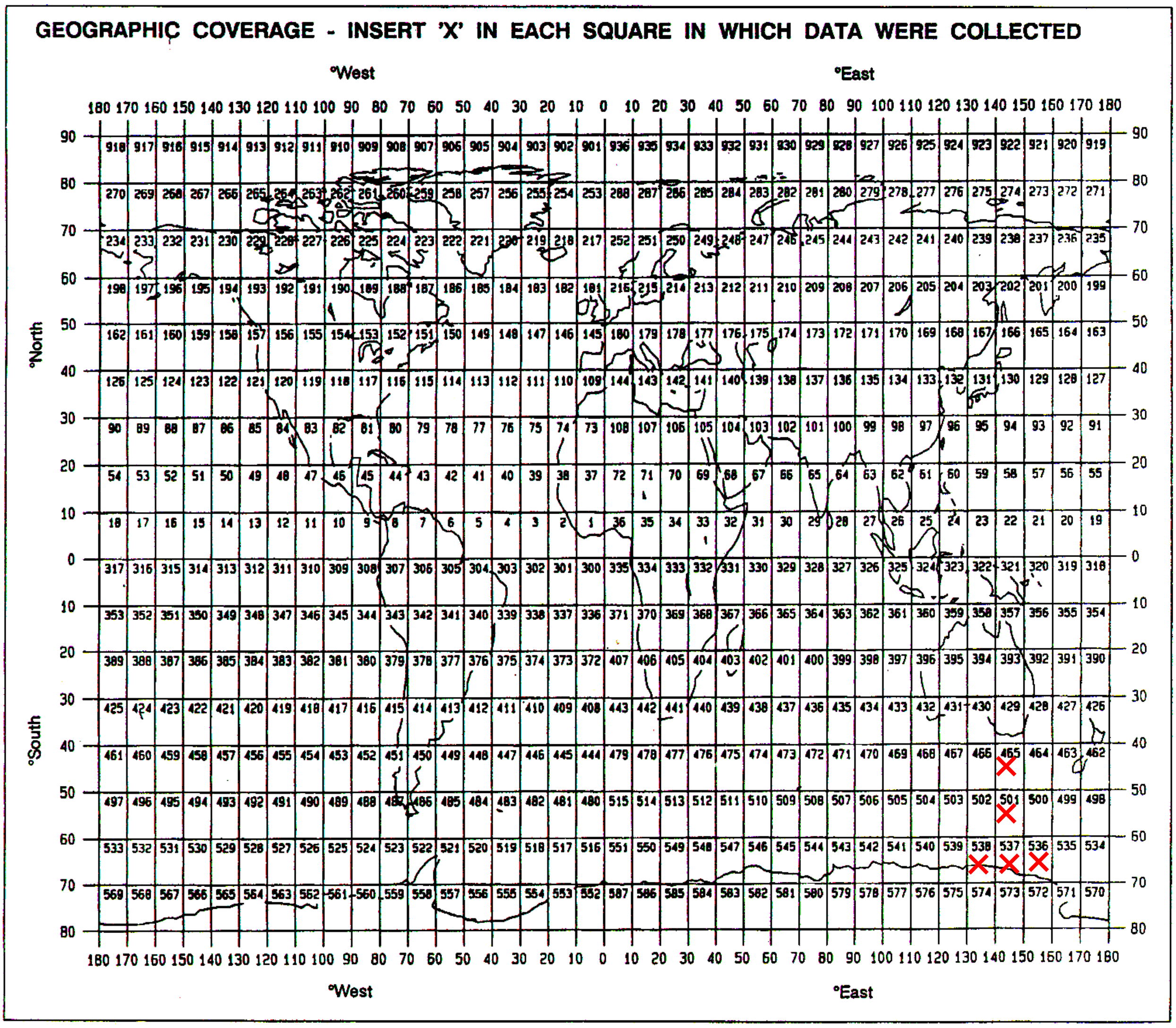
Summary

This was an ambitious and complex multidisciplinary voyage to one of the most remote areas in the world. Despite the many challenges and limitations of conducting science in this location the voyage was a remarkable success. Valuable and informative data were collected against all four of our principal objectives. Many of the datasets generated by this voyage are large and complex and integrating the information across these datasets will take many years but generate novel insights into the Antarctic krill, their environment and the predators that depend upon them. The highest scientific risks on this voyage were associated with gear brought on to the ship by our science teams, principally the acoustic mooring, the krill trawl nets and the TMR. All exhibited some form of failure during the voyage. Approaches such as pre-voyage trials and greater redundancy could reduce such risks for future voyages.

This voyage was successful because of the skills and experience of the ship's crew, MNF staff, the science teams and their ability to work together in any conditions.

Marsden Squares

Move a **red "x"** into squares in which data was collected



Moorings, bottom mounted gear and drifting systems

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
1	22/01/2019 3:24	52	13.272	S	145	20.94	E	H11, D90, H13	XBT
2	22/01/2019 14:55	54	10.77	S	144	48.858	E	H11, D90, H13	XBT
3	23/01/2019 3:07	56	19.728	S	144	11.83	E	H11, D90, H13	XBT
4	23/01/2019 15:10	57	32.388	S	143	49.93	E	H11, D90, H13	XBT
5	24/01/2019 19:50	61	18.6	S	142	37.182	E	H11, D90, H13	XBT
6	25/01/2019 3:01	62	37.45	S	142	9.708	E	H11, D90, H13	XBT
7	26/01/2019 9:29	64	46.5	S	141	17.1	E	D05, D90	Drifter
8	26/01/2019 18:03	64	48.852	S	141	18.198	E	H11, D90, H13	XBT
9	27/01/2019 5:46	65	41.568	S	140	40.008	E	H11, D90, H13	XBT
10	27/01/2019 10:35	65	25.308	S	139	12.06	E	H11, D90, H13	XBT
11	27/01/2019 10:53	65	24.24	S	139	6.33	E	H11, D90, H13	XBT
12	29/01/2019 19:34	64	37	S	138	51.9	E	D05, D90	Drifter
13	30/01/2019 22:05	64	13.89	S	143	31.698	E	H11, D90, H13	XBT
14	31/01/2019 7:26	64	43.812	S	143	28.572	E	H11, D90, H13	XBT
15	31/01/2019 7:26	64	43.812	S	143	28.57	E	H11, D90, H13	XBT
16	31/01/2019 16:31	64	53.8	S	143	20.502	E	D05, D90	Drifter
17	31/01/2019 18:37	64	58.62	S	143	22.05	E	H11, D90, H13	XBT
18	1/02/2019 3:40	65	45.97	S	143	0.74	E	H11, D90, H13	XBT
19	1/02/2019 10:38	65	57.53	S	143	17.52	E	D05, D90	Drifter
20	1/02/2019 18:29	66	8.31	S	144	42.14	E	H11, D90, H13	XBT
21	2/02/2019 4:12	65	37.968	S	145	3.08	E	H11, D90, H13	XBT
22	2/02/2019 12:56	65	49.998	S	144	25.698	E	D05, D90	Drifter
23	2/02/2019 13:30	65	49	S	144	25.05	E	H11, D90, H13	XBT
24	3/02/2019 22:37	65	48.132	S	144	48.87	E	H11, D90, H13	XBT

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
25	3/02/2019 22:37	65	48.132	S	144	48.87	E	H11, D90, H13	XBT
26	3/02/2019 22:43	65	47.442	S	144	49.547	E	H11, D90, H13	XBT
27	5/02/2019 22:50	65	42.91	S	144	24.74	E	H11, D90, H13	XBT
28	7/02/2019 0:44	64	10.698	S	145	47.478	E	H11, D90, H13	XBT
29	9/02/2019 14:39	65	36.1	S	147	22.902	E	D05, D90	Drifter
30	11/02/2019 3:06	64	35.94	S	152	6.37	E	H11, D90, H13	XBT
31	12/02/2019 0:11	65	30.53	S	151	42.64	E	H11, D90, H13	XBT
32	12/02/2019 12:27	66	28.002	S	151	16.8	E	D05, D90	Drifter
33	14/02/2019 17:58	66	4.06	S	147	12.22	E	H11, D90, H13	XBT
34	15/02/2019 13:53	64	45.93	S	147	46.08	E	D05, D90	Drifter
35	15/02/2019 20:29	64	58.43	S	149	43.24	E	H11, D90, H13	XBT
36	16/02/2019 2:58	65	37.35	S	149	24.49	E	H11, D90, H13	XBT
37	16/02/2019 8:58	66	18.59	S	149	25.45	E	H11, D90, H13	XBT
38	17/02/2019 12:03	65	58.77	S	150	29.97	E	H11, D90, H13	XBT
39	17/02/2019 20:03	65	56.62	S	148	7.57	E	H11, D90, H13	XBT
40	17/02/2019 20:44	65	56.63	S	147	55.8	E	H11, D90, H13	XBT
41	17/02/2019 21:08	65	56.6	S	147	48.3	E	D05, D90	Drifter
42	19/02/2019 6:20	66	40.09	S	147	39.88	E	H11, D90, H13	XBT
43	22/02/2019 8:26	65	47.91	S	145	4.89	E	H11, D90, H13	XBT
44	23/02/2019 3:56	65	42.16	S	146	31.8	E	H11, D90, H13	XBT
45	25/02/2019 16:09	65	32.1	S	149	28.6	E	D05, D90	Drifter
46	3/02/2019 0:00	65	50.21	S	144	26.047	E	Passive acoustics, B26, B28	Acoustic mooring
47	21/02/2019 0:00	65	50.21	S	144	26.047	E	Passive acoustics, B26, B28	Acoustic mooring
48	19/01/2019 7:55	43	35.769	S	148	24.92	E	B26	Sonobuoy 1 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
49	20/01/2019 0:12	43	31.512	S	147	28.507	E	B26	Sonobuoy 2 : hydrophone sensor to collected directional passive acoustic data
50	20/01/2019 3:29	44	2.801	S	147	21.423	E	B26	Sonobuoy 3 : hydrophone sensor to collected directional passive acoustic data
51	20/01/2019 3:34	44	3.595	S	147	21.245	E	B26	Sonobuoy 4 : hydrophone sensor to collected directional passive acoustic data
52	20/01/2019 7:05	44	38.488	S	147	13.268	E	B26	Sonobuoy 5 : hydrophone sensor to collected directional passive acoustic data
53	20/01/2019 10:06	45	9.028	S	147	6.227	E	B26	Sonobuoy 6 : hydrophone sensor to collected directional passive acoustic data
54	20/01/2019 10:28	45	12.68	S	147	5.382	E	B26	Sonobuoy 7 : hydrophone sensor to collected directional passive acoustic data
55	20/01/2019 13:38	45	45.079	S	146	57.838	E	B26	Sonobuoy 8 : hydrophone sensor to collected directional passive acoustic data
56	20/01/2019 16:49	46	17.609	S	146	50.17	E	B26	Sonobuoy 9 : hydrophone sensor to collected directional passive acoustic data
57	20/01/2019 20:11	46	49.263	S	146	42.649	E	B26	Sonobuoy 10 : hydrophone sensor to collected directional passive acoustic data
58	20/01/2019 23:27	47	21.206	S	146	34.979	E	B26	Sonobuoy 11 : hydrophone sensor to collected directional passive acoustic data
59	20/01/2019 23:31	47	22.001	S	146	34.788	E	B26	Sonobuoy 12 : hydrophone sensor to collected directional passive acoustic data
60	21/01/2019 2:37	47	54.916	S	146	26.808	E	B26	Sonobuoy 13 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
61	21/01/2019 5:47	48	28.127	S	146	18.661	E	B26	Sonobuoy 14 : hydrophone sensor to collected directional passive acoustic data
62	21/01/2019 5:51	48	28.719	S	146	18.515	E	B26	Sonobuoy 15 : hydrophone sensor to collected directional passive acoustic data
63	21/01/2019 12:07	49	33.35	S	146	2.409	E	B26	Sonobuoy 16 : hydrophone sensor to collected directional passive acoustic data
64	21/01/2019 15:04	50	4.74	S	145	54.453	E	B26	Sonobuoy 17 : hydrophone sensor to collected directional passive acoustic data
65	21/01/2019 18:10	50	37.449	S	145	46.071	E	B26	Sonobuoy 18 : hydrophone sensor to collected directional passive acoustic data
66	21/01/2019 21:17	51	8.608	S	145	37.997	E	B26	Sonobuoy 19 : hydrophone sensor to collected directional passive acoustic data
67	22/01/2019 0:21	51	39.965	S	145	29.781	E	B26	Sonobuoy 20 : hydrophone sensor to collected directional passive acoustic data
68	22/01/2019 3:09	52	10.656	S	145	21.643	E	B26	Sonobuoy 21 : hydrophone sensor to collected directional passive acoustic data
69	22/01/2019 3:37	52	15.625	S	145	20.315	E	B26	Sonobuoy 22 : hydrophone sensor to collected directional passive acoustic data
70	22/01/2019 6:39	52	47.319	S	145	11.792	E	B26	Sonobuoy 23 : hydrophone sensor to collected directional passive acoustic data
71	22/01/2019 10:21	53	23.919	S	145	1.836	E	B26	Sonobuoy 24 : hydrophone sensor to collected directional passive acoustic data
72	22/01/2019 14:52	54	10.626	S	144	48.893	E	B26	Sonobuoy 25 : hydrophone sensor to collected directional passive acoustic data
73	22/01/2019 18:10	54	45.669	S	144	39.034	E	B26	Sonobuoy 26 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
74	22/01/2019 21:07	55	16.833	S	144	30.14	E	B26	Sonobuoy 27 : hydrophone sensor to collected directional passive acoustic data
75	23/01/2019 0:05	55	48.435	S	144	21.011	E	B26	Sonobuoy 28 : hydrophone sensor to collected directional passive acoustic data
76	23/01/2019 3:07	56	19.582	S	144	11.874	E	B26	Sonobuoy 29 : hydrophone sensor to collected directional passive acoustic data
77	23/01/2019 5:55	56	49.243	S	144	3.064	E	B26	Sonobuoy 30 : hydrophone sensor to collected directional passive acoustic data
78	23/01/2019 9:41	57	29.878	S	143	50.805	E	B26	Sonobuoy 31 : hydrophone sensor to collected directional passive acoustic data
79	23/01/2019 18:14	58	1.287	S	143	41.173	E	B26	Sonobuoy 32 : hydrophone sensor to collected directional passive acoustic data
80	23/01/2019 21:09	58	31.468	S	143	31.782	E	B26	Sonobuoy 33 : hydrophone sensor to collected directional passive acoustic data
81	24/01/2019 1:38	59	20.753	S	143	16.148	E	B26	Sonobuoy 34 : hydrophone sensor to collected directional passive acoustic data
82	24/01/2019 5:46	59	50.23	S	143	6.618	E	B26	Sonobuoy 35 : hydrophone sensor to collected directional passive acoustic data
83	24/01/2019 8:16	60	18.171	S	142	57.462	E	B26	Sonobuoy 36 : hydrophone sensor to collected directional passive acoustic data
84	24/01/2019 8:37	60	21.915	S	142	56.215	E	B26	Sonobuoy 37 : hydrophone sensor to collected directional passive acoustic data
85	24/01/2019 9:26	60	30.585	S	142	53.333	E	B26	Sonobuoy 38 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
86	24/01/2019 18:25	61	3.221	S	142	42.395	E	B26	Sonobuoy 39 : hydrophone sensor to collected directional passive acoustic data
87	24/01/2019 20:39	61	27.354	S	142	34.18	E	B26	Sonobuoy 40 : hydrophone sensor to collected directional passive acoustic data
88	24/01/2019 23:40	61	59.526	S	142	23.067	E	B26	Sonobuoy 41 : hydrophone sensor to collected directional passive acoustic data
89	25/01/2019 2:27	62	30.91	S	142	12.028	E	B26	Sonobuoy 42 : hydrophone sensor to collected directional passive acoustic data
90	25/01/2019 5:06	63	1.203	S	142	1.191	E	B26	Sonobuoy 43 : hydrophone sensor to collected directional passive acoustic data
91	25/01/2019 10:48	63	24.826	S	141	52.607	E	B26	Sonobuoy 44 : hydrophone sensor to collected directional passive acoustic data
92	25/01/2019 17:11	64	0.249	S	141	39.513	E	B26	Sonobuoy 45 : hydrophone sensor to collected directional passive acoustic data
93	26/01/2019 4:17	64	5.724	S	141	36.592	E	B26	Sonobuoy 46 : hydrophone sensor to collected directional passive acoustic data
94	26/01/2019 4:21	64	6.436	S	141	36.565	E	B26	Sonobuoy 47 : hydrophone sensor to collected directional passive acoustic data
95	26/01/2019 6:49	64	34.635	S	141	22.962	E	B26	Sonobuoy 48 : hydrophone sensor to collected directional passive acoustic data
96	26/01/2019 9:17	64	48.67	S	141	16.209	E	B26	Sonobuoy 49 : hydrophone sensor to collected directional passive acoustic data
97	26/01/2019 13:42	64	42.746	S	141	11.859	E	B26	Sonobuoy 50 : hydrophone sensor to collected directional passive acoustic data
98	26/01/2019 19:34	65	3.348	S	141	8.757	E	B26	Sonobuoy 51 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
99	27/01/2019 0:22	65	33.579	S	140	53.526	E	B26	Sonobuoy 52 : hydrophone sensor to collected directional passive acoustic data
100	27/01/2019 7:11	65	36.795	S	140	14.096	E	B26	Sonobuoy 53 : hydrophone sensor to collected directional passive acoustic data
101	27/01/2019 22:13	65	21.336	S	139	34.125	E	B26	Sonobuoy 54 : hydrophone sensor to collected directional passive acoustic data
102	28/01/2019 0:26	65	21.484	S	138	51.459	E	B26	Sonobuoy 55 : hydrophone sensor to collected directional passive acoustic data
103	29/01/2019 6:33	64	43.226	S	140	2.836	E	B26	Sonobuoy 56 : hydrophone sensor to collected directional passive acoustic data
104	29/01/2019 9:49	64	43.389	S	139	23.345	E	B26	Sonobuoy 57 : hydrophone sensor to collected directional passive acoustic data
105	29/01/2019 14:14	64	43.006	S	139	1.758	E	B26	Sonobuoy 58 : hydrophone sensor to collected directional passive acoustic data
106	29/01/2019 17:30	64	48.675	S	138	59.805	E	B26	Sonobuoy 59 : hydrophone sensor to collected directional passive acoustic data
107	29/01/2019 19:01	64	40.832	S	138	52.587	E	B26	Sonobuoy 60 : hydrophone sensor to collected directional passive acoustic data
108	29/01/2019 23:14	64	42.904	S	138	52.654	E	B26	Sonobuoy 61 : hydrophone sensor to collected directional passive acoustic data
109	30/01/2019 0:40	64	43.736	S	138	36.746	E	B26	Sonobuoy 62 : hydrophone sensor to collected directional passive acoustic data
110	30/01/2019 1:49	64	43.835	S	138	27.477	E	B26	Sonobuoy 63 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
111	30/01/2019 11:53	64	40.002	S	139	46.15	E	B26	Sonobuoy 64 : hydrophone sensor to collected directional passive acoustic data
112	30/01/2019 14:35	64	33.652	S	140	52.652	E	B26	Sonobuoy 65 : hydrophone sensor to collected directional passive acoustic data
113	30/01/2019 18:25	64	25.83	S	142	14.209	E	B26	Sonobuoy 66 : hydrophone sensor to collected directional passive acoustic data
114	30/01/2019 21:21	64	19.213	S	143	22.914	E	B26	Sonobuoy 67 : hydrophone sensor to collected directional passive acoustic data
115	30/01/2019 23:44	63	56.661	S	143	48.644	E	B26	Sonobuoy 68 : hydrophone sensor to collected directional passive acoustic data
116	31/01/2019 3:37	64	13.646	S	143	41.697	E	B26	Sonobuoy 69 : hydrophone sensor to collected directional passive acoustic data
117	31/01/2019 7:03	64	41.128	S	143	29.752	E	B26	Sonobuoy 70 : hydrophone sensor to collected directional passive acoustic data
118	31/01/2019 9:04	64	53.977	S	143	24.183	E	B26	Sonobuoy 71 : hydrophone sensor to collected directional passive acoustic data
119	31/01/2019 18:10	64	55.527	S	143	23.418	E	B26	Sonobuoy 72 : hydrophone sensor to collected directional passive acoustic data
120	31/01/2019 21:51	65	24.376	S	143	10.539	E	B26	Sonobuoy 73 : hydrophone sensor to collected directional passive acoustic data
121	1/02/2019 4:59	65	53.833	S	143	3.991	E	B26	Sonobuoy 74 : hydrophone sensor to collected directional passive acoustic data
122	1/02/2019 12:17	65	47.474	S	143	39.808	E	B26	Sonobuoy 75 : hydrophone sensor to collected directional passive acoustic data
123	1/02/2019 15:26	65	51.729	S	144	42.753	E	B26	Sonobuoy 76 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
124	1/02/2019 16:41	66	0.564	S	144	46.222	E	B26	Sonobuoy 77 : hydrophone sensor to collected directional passive acoustic data
125	1/02/2019 21:03	65	53.618	S	144	27.222	E	B26	Sonobuoy 78 : hydrophone sensor to collected directional passive acoustic data
126	1/02/2019 23:14	65	58.468	S	144	30.302	E	B26	Sonobuoy 79 : hydrophone sensor to collected directional passive acoustic data
127	2/02/2019 1:18	65	53.177	S	144	53.439	E	B26	Sonobuoy 80 : hydrophone sensor to collected directional passive acoustic data
128	2/02/2019 1:54	65	51.111	S	145	2.073	E	B26	Sonobuoy 81 : hydrophone sensor to collected directional passive acoustic data
129	2/02/2019 2:45	65	47.827	S	145	15.251	E	B26	Sonobuoy 82 : hydrophone sensor to collected directional passive acoustic data
130	2/02/2019 4:02	65	39.17	S	145	4.854	E	B26	Sonobuoy 83 : hydrophone sensor to collected directional passive acoustic data
131	2/02/2019 5:35	65	41.157	S	144	40.782	E	B26	Sonobuoy 84 : hydrophone sensor to collected directional passive acoustic data
132	2/02/2019 7:07	65	47.456	S	144	14.443	E	B26	Sonobuoy 85 : hydrophone sensor to collected directional passive acoustic data
133	2/02/2019 8:43	65	49.823	S	144	38.322	E	B26	Sonobuoy 86 : hydrophone sensor to collected directional passive acoustic data
134	2/02/2019 22:38	65	45.339	S	145	7.15	E	B26	Sonobuoy 87 : hydrophone sensor to collected directional passive acoustic data
135	2/02/2019 22:40	65	45.062	S	145	6.872	E	B26	Sonobuoy 88 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
136	2/02/2019 23:43	65	37.568	S	144	59.491	E	B26	Sonobuoy 89 : hydrophone sensor to collected directional passive acoustic data
137	3/02/2019 0:36	65	39.641	S	145	12.451	E	B26	Sonobuoy 90 : hydrophone sensor to collected directional passive acoustic data
138	3/02/2019 0:56	65	40.473	S	145	8.755	E	B26	Sonobuoy 91 : hydrophone sensor to collected directional passive acoustic data
139	3/02/2019 2:33	65	47.13	S	144	49.842	E	B26	Sonobuoy 92 : hydrophone sensor to collected directional passive acoustic data
140	3/02/2019 3:36	65	54.684	S	144	42.419	E	B26	Sonobuoy 93 : hydrophone sensor to collected directional passive acoustic data
141	3/02/2019 4:29	65	52.824	S	144	54.329	E	B26	Sonobuoy 94 : hydrophone sensor to collected directional passive acoustic data
142	3/02/2019 4:44	65	52.382	S	144	55.577	E	B26	Sonobuoy 95 : hydrophone sensor to collected directional passive acoustic data
143	3/02/2019 6:12	65	45.638	S	144	32.953	E	B26	Sonobuoy 96 : hydrophone sensor to collected directional passive acoustic data
144	3/02/2019 7:18	65	37.552	S	144	25.006	E	B26	Sonobuoy 97 : hydrophone sensor to collected directional passive acoustic data
145	3/02/2019 8:11	65	39.736	S	144	37.997	E	B26	Sonobuoy 98 : hydrophone sensor to collected directional passive acoustic data
146	4/02/2019 1:15	65	47.537	S	144	47.094	E	B26	Sonobuoy 99 : hydrophone sensor to collected directional passive acoustic data
147	4/02/2019 2:30	65	47.831	S	145	0.034	E	B26	Sonobuoy 100 : hydrophone sensor to collected directional passive acoustic data
148	4/02/2019 3:16	65	48.744	S	145	1.593	E	B26	Sonobuoy 101 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
149	4/02/2019 3:58	65	49.414	S	144	53.019	E	B26	Sonobuoy 102 : hydrophone sensor to collected directional passive acoustic data
150	4/02/2019 5:01	65	48.375	S	144	34.126	E	B26	Sonobuoy 103 : hydrophone sensor to collected directional passive acoustic data
151	4/02/2019 7:06	65	45.995	S	144	19.01	E	B26	Sonobuoy 104 : hydrophone sensor to collected directional passive acoustic data
152	4/02/2019 10:27	65	48.154	S	143	58.773	E	B26	Sonobuoy 105 : hydrophone sensor to collected directional passive acoustic data
153	4/02/2019 15:11	65	50.945	S	144	20.661	E	B26	Sonobuoy 106 : hydrophone sensor to collected directional passive acoustic data
154	4/02/2019 15:28	65	50.211	S	144	23.785	E	B26	Sonobuoy 107 : hydrophone sensor to collected directional passive acoustic data
155	4/02/2019 16:25	65	45.473	S	144	13.05	E	B26	Sonobuoy 108 : hydrophone sensor to collected directional passive acoustic data
156	4/02/2019 17:30	65	51.009	S	144	11.919	E	B26	Sonobuoy 109 : hydrophone sensor to collected directional passive acoustic data
157	4/02/2019 22:28	65	52.794	S	144	36.415	E	B26	Sonobuoy 110 : hydrophone sensor to collected directional passive acoustic data
158	5/02/2019 0:03	65	54.675	S	144	59.97	E	B26	Sonobuoy 111 : hydrophone sensor to collected directional passive acoustic data
159	5/02/2019 1:44	65	48.322	S	144	51.789	E	B26	Sonobuoy 112 : hydrophone sensor to collected directional passive acoustic data
160	5/02/2019 3:49	65	49.685	S	145	20.048	E	B26	Sonobuoy 113 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
161	5/02/2019 6:06	65	47.301	S	144	39.374	E	B26	Sonobuoy 114 : hydrophone sensor to collected directional passive acoustic data
162	5/02/2019 7:26	65	47.902	S	144	4.826	E	B26	Sonobuoy 115 : hydrophone sensor to collected directional passive acoustic data
163	5/02/2019 8:44	65	46.874	S	143	49.776	E	B26	Sonobuoy 116 : hydrophone sensor to collected directional passive acoustic data
164	5/02/2019 17:08	65	54.169	S	144	45.498	E	B26	Sonobuoy 117 : hydrophone sensor to collected directional passive acoustic data
165	5/02/2019 20:57	65	36.629	S	144	34.359	E	B26	Sonobuoy 118 : hydrophone sensor to collected directional passive acoustic data
166	5/02/2019 21:35	65	32.763	S	144	31.43	E	B26	Sonobuoy 119 : hydrophone sensor to collected directional passive acoustic data
167	5/02/2019 23:19	65	47.04	S	144	22.02	E	B26	Sonobuoy 120 : hydrophone sensor to collected directional passive acoustic data
168	6/02/2019 0:32	65	54.423	S	144	15.819	E	B26	Sonobuoy 121 : hydrophone sensor to collected directional passive acoustic data
169	6/02/2019 1:13	65	49.467	S	144	12.62	E	B26	Sonobuoy 122 : hydrophone sensor to collected directional passive acoustic data
170	6/02/2019 4:47	65	34.182	S	144	0.71	E	B26	Sonobuoy 123 : hydrophone sensor to collected directional passive acoustic data
171	6/02/2019 7:18	65	47.214	S	143	51.876	E	B26	Sonobuoy 124 : hydrophone sensor to collected directional passive acoustic data
172	6/02/2019 8:43	65	54.655	S	143	45.661	E	B26	Sonobuoy 125 : hydrophone sensor to collected directional passive acoustic data
173	6/02/2019 16:28	65	18.547	S	144	24.887	E	B26	Sonobuoy 126 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
174	6/02/2019 18:52	64	54.955	S	144	52.953	E	B26	Sonobuoy 127 : hydrophone sensor to collected directional passive acoustic data
175	6/02/2019 21:28	64	30.28	S	145	21.884	E	B26	Sonobuoy 128 : hydrophone sensor to collected directional passive acoustic data
176	7/02/2019 0:15	64	7.024	S	145	49.132	E	B26	Sonobuoy 129 : hydrophone sensor to collected directional passive acoustic data
177	7/02/2019 3:49	64	35.561	S	145	36.266	E	B26	Sonobuoy 130 : hydrophone sensor to collected directional passive acoustic data
178	7/02/2019 4:52	64	43.945	S	145	32.378	E	B26	Sonobuoy 131 : hydrophone sensor to collected directional passive acoustic data
179	7/02/2019 4:55	64	44.309	S	145	32.213	E	B26	Sonobuoy 132 : hydrophone sensor to collected directional passive acoustic data
180	7/02/2019 7:14	64	56.357	S	145	46.625	E	B26	Sonobuoy 133 : hydrophone sensor to collected directional passive acoustic data
181	7/02/2019 17:08	65	4.514	S	145	33.73	E	B26	Sonobuoy 134 : hydrophone sensor to collected directional passive acoustic data
182	7/02/2019 20:56	65	0.056	S	145	24.862	E	B26	Sonobuoy 135 : hydrophone sensor to collected directional passive acoustic data
183	8/02/2019 1:53	65	30.525	S	145	9.946	E	B26	Sonobuoy 136 : hydrophone sensor to collected directional passive acoustic data
184	8/02/2019 8:22	65	55.239	S	144	57.578	E	B26	Sonobuoy 137 : hydrophone sensor to collected directional passive acoustic data
185	8/02/2019 9:54	66	5.331	S	144	52.655	E	B26	Sonobuoy 138 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
186	8/02/2019 15:50	65	52.403	S	145	48.267	E	B26	Sonobuoy 139 : hydrophone sensor to collected directional passive acoustic data
187	8/02/2019 18:09	65	50.638	S	146	37.405	E	B26	Sonobuoy 140 : hydrophone sensor to collected directional passive acoustic data
188	8/02/2019 20:33	65	50.878	S	147	4.961	E	B26	Sonobuoy 141 : hydrophone sensor to collected directional passive acoustic data
189	8/02/2019 23:20	65	54.005	S	146	53.425	E	B26	Sonobuoy 142 : hydrophone sensor to collected directional passive acoustic data
190	9/02/2019 2:30	65	58.42	S	146	52.003	E	B26	Sonobuoy 143 : hydrophone sensor to collected directional passive acoustic data
191	9/02/2019 4:25	65	58.255	S	147	4.964	E	B26	Sonobuoy 144 : hydrophone sensor to collected directional passive acoustic data
192	9/02/2019 9:46	65	37.475	S	147	22.149	E	B26	Sonobuoy 145 : hydrophone sensor to collected directional passive acoustic data
193	9/02/2019 18:15	65	30.423	S	148	32.129	E	B26	Sonobuoy 146 : hydrophone sensor to collected directional passive acoustic data
194	9/02/2019 21:53	65	25.089	S	149	42.777	E	B26	Sonobuoy 147 : hydrophone sensor to collected directional passive acoustic data
195	10/02/2019 1:32	65	19.439	S	150	57.314	E	B26	Sonobuoy 148 : hydrophone sensor to collected directional passive acoustic data
196	10/02/2019 21:53	64	1.423	S	152	20.944	E	B26	Sonobuoy 149 : hydrophone sensor to collected directional passive acoustic data
197	11/02/2019 2:23	64	30.648	S	152	8.601	E	B26	Sonobuoy 150 : hydrophone sensor to collected directional passive acoustic data
198	11/02/2019 7:11	64	50.259	S	152	0.466	E	B26	Sonobuoy 151 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
199	11/02/2019 19:42	65	2.702	S	151	55.013	E	B26	Sonobuoy 152 : hydrophone sensor to collected directional passive acoustic data
200	12/02/2019 0:31	65	32.438	S	151	41.771	E	B26	Sonobuoy 153 : hydrophone sensor to collected directional passive acoustic data
201	12/02/2019 2:35	65	45.627	S	151	35.699	E	B26	Sonobuoy 154 : hydrophone sensor to collected directional passive acoustic data
202	12/02/2019 5:30	66	6.216	S	151	26.114	E	B26	Sonobuoy 155 : hydrophone sensor to collected directional passive acoustic data
203	12/02/2019 9:48	66	27.546	S	151	16.049	E	B26	Sonobuoy 156 : hydrophone sensor to collected directional passive acoustic data
204	12/02/2019 15:02	66	15.466	S	151	36.916	E	B26	Sonobuoy 157 : hydrophone sensor to collected directional passive acoustic data
205	12/02/2019 16:01	66	9.762	S	151	42.072	E	B26	Sonobuoy 158 : hydrophone sensor to collected directional passive acoustic data
206	12/02/2019 18:18	66	16.207	S	151	49.826	E	B26	Sonobuoy 159 : hydrophone sensor to collected directional passive acoustic data
207	12/02/2019 19:22	66	15.591	S	152	3.329	E	B26	Sonobuoy 160 : hydrophone sensor to collected directional passive acoustic data
208	13/02/2019 0:37	66	12.064	S	152	8.775	E	B26	Sonobuoy 161 : hydrophone sensor to collected directional passive acoustic data
209	13/02/2019 17:35	65	43.582	S	148	53.703	E	B26	Sonobuoy 162 : hydrophone sensor to collected directional passive acoustic data
210	14/02/2019 6:58	65	40.804	S	147	53.394	E	B26	Sonobuoy 163 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
211	14/02/2019 11:34	66	0.326	S	147	16.746	E	B26	Sonobuoy 164 : hydrophone sensor to collected directional passive acoustic data
212	14/02/2019 18:46	66	2.727	S	147	8.969	E	B26	Sonobuoy 165 : hydrophone sensor to collected directional passive acoustic data
213	14/02/2019 22:54	65	32.59	S	147	23.012	E	B26	Sonobuoy 166 : hydrophone sensor to collected directional passive acoustic data
214	15/02/2019 4:36	65	3.611	S	147	36.026	E	B26	Sonobuoy 167 : hydrophone sensor to collected directional passive acoustic data
215	15/02/2019 10:09	64	45.281	S	147	43.969	E	B26	Sonobuoy 168 : hydrophone sensor to collected directional passive acoustic data
216	15/02/2019 17:23	64	49.05	S	148	53.473	E	B26	Sonobuoy 169 : hydrophone sensor to collected directional passive acoustic data
217	15/02/2019 19:38	64	52.726	S	149	45.914	E	B26	Sonobuoy 170 : hydrophone sensor to collected directional passive acoustic data
218	16/02/2019 0:38	65	22.142	S	149	32.049	E	B26	Sonobuoy 171 : hydrophone sensor to collected directional passive acoustic data
219	16/02/2019 4:35	65	50.546	S	149	17.888	E	B26	Sonobuoy 172 : hydrophone sensor to collected directional passive acoustic data
220	16/02/2019 8:10	66	16.665	S	149	12.645	E	B26	Sonobuoy 173 : hydrophone sensor to collected directional passive acoustic data
221	16/02/2019 10:31	66	17.838	S	149	49.64	E	B26	Sonobuoy 174 : hydrophone sensor to collected directional passive acoustic data
222	16/02/2019 17:38	66	2.608	S	150	58.467	E	B26	Sonobuoy 175 : hydrophone sensor to collected directional passive acoustic data
223	16/02/2019 18:36	66	2.404	S	151	16.277	E	B26	Sonobuoy 176 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
224	16/02/2019 19:17	66	2.197	S	151	28.645	E	B26	Sonobuoy 177 : hydrophone sensor to collected directional passive acoustic data
225	16/02/2019 20:23	66	1.87	S	151	48.432	E	B26	Sonobuoy 178 : hydrophone sensor to collected directional passive acoustic data
226	16/02/2019 22:17	66	13.52	S	152	2.685	E	B26	Sonobuoy 179 : hydrophone sensor to collected directional passive acoustic data
227	16/02/2019 23:07	66	14.326	S	152	18.753	E	B26	Sonobuoy 180 : hydrophone sensor to collected directional passive acoustic data
228	17/02/2019 2:07	66	15.616	S	152	38.291	E	B26	Sonobuoy 181 : hydrophone sensor to collected directional passive acoustic data
229	17/02/2019 3:17	66	20.272	S	152	17.816	E	B26	Sonobuoy 182 : hydrophone sensor to collected directional passive acoustic data
230	17/02/2019 8:43	66	4.53	S	151	43.933	E	B26	Sonobuoy 183 : hydrophone sensor to collected directional passive acoustic data
231	17/02/2019 11:41	65	59.392	S	150	36.662	E	B26	Sonobuoy 184 : hydrophone sensor to collected directional passive acoustic data
232	17/02/2019 14:56	65	56.492	S	149	31.59	E	B26	Sonobuoy 185 : hydrophone sensor to collected directional passive acoustic data
233	17/02/2019 15:03	65	56.493	S	149	29.324	E	B26	Sonobuoy 186 : hydrophone sensor to collected directional passive acoustic data
234	17/02/2019 20:10	65	56.628	S	148	5.898	E	B26	Sonobuoy 187 : hydrophone sensor to collected directional passive acoustic data
235	17/02/2019 23:00	65	51.113	S	147	24.16	E	B26	Sonobuoy 188 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
236	18/02/2019 1:06	66	1.392	S	147	15.697	E	B26	Sonobuoy 189 : hydrophone sensor to collected directional passive acoustic data
237	18/02/2019 8:36	66	14.01	S	147	3.415	E	B26	Sonobuoy 190 : hydrophone sensor to collected directional passive acoustic data
238	18/02/2019 13:09	66	13.396	S	147	9.613	E	B26	Sonobuoy 191 : hydrophone sensor to collected directional passive acoustic data
239	18/02/2019 14:15	66	5.944	S	147	15.514	E	B26	Sonobuoy 192 : hydrophone sensor to collected directional passive acoustic data
240	18/02/2019 16:24	66	3.115	S	147	5.677	E	B26	Sonobuoy 193 : hydrophone sensor to collected directional passive acoustic data
241	18/02/2019 17:44	65	59.665	S	147	22.312	E	B26	Sonobuoy 194 : hydrophone sensor to collected directional passive acoustic data
242	18/02/2019 19:13	65	57.784	S	147	37.75	E	B26	Sonobuoy 195 : hydrophone sensor to collected directional passive acoustic data
243	19/02/2019 2:01	66	12.546	S	147	43.067	E	B26	Sonobuoy 196 : hydrophone sensor to collected directional passive acoustic data
244	19/02/2019 5:08	66	36.48	S	147	43.354	E	B26	Sonobuoy 197 : hydrophone sensor to collected directional passive acoustic data
245	19/02/2019 10:03	66	17.367	S	147	18.328	E	B26	Sonobuoy 198 : hydrophone sensor to collected directional passive acoustic data
246	19/02/2019 12:36	66	10.425	S	146	41.253	E	B26	Sonobuoy 199 : hydrophone sensor to collected directional passive acoustic data
247	19/02/2019 18:04	66	15.16	S	145	58.67	E	B26	Sonobuoy 200 : hydrophone sensor to collected directional passive acoustic data
248	19/02/2019 21:44	66	19.988	S	145	40.246	E	B26	Sonobuoy 201 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
249	20/02/2019 0:18	66	20.824	S	145	16.104	E	B26	Sonobuoy 202 : hydrophone sensor to collected directional passive acoustic data
250	20/02/2019 3:23	66	16.471	S	144	49.211	E	B26	Sonobuoy 203 : hydrophone sensor to collected directional passive acoustic data
251	20/02/2019 5:38	66	10.876	S	144	30.817	E	B26	Sonobuoy 204 : hydrophone sensor to collected directional passive acoustic data
252	20/02/2019 9:22	65	53.082	S	144	22.497	E	B26	Sonobuoy 205 : hydrophone sensor to collected directional passive acoustic data
253	20/02/2019 10:41	65	47.432	S	144	36.172	E	B26	Sonobuoy 206 : hydrophone sensor to collected directional passive acoustic data
254	20/02/2019 11:28	65	52.766	S	144	36.229	E	B26	Sonobuoy 207 : hydrophone sensor to collected directional passive acoustic data
255	20/02/2019 14:26	65	52.52	S	144	31.385	E	B26	Sonobuoy 208 : hydrophone sensor to collected directional passive acoustic data
256	20/02/2019 17:10	65	47.941	S	144	20.228	E	B26	Sonobuoy 209 : hydrophone sensor to collected directional passive acoustic data
257	20/02/2019 18:29	65	52.947	S	144	22.486	E	B26	Sonobuoy 210 : hydrophone sensor to collected directional passive acoustic data
258	20/02/2019 19:36	65	47.575	S	144	36.67	E	B26	Sonobuoy 211 : hydrophone sensor to collected directional passive acoustic data
259	21/02/2019 5:26	65	49.023	S	144	26.317	E	B26	Sonobuoy 212 : hydrophone sensor to collected directional passive acoustic data
260	21/02/2019 12:29	65	52.941	S	144	21.973	E	B26	Sonobuoy 213 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
261	21/02/2019 13:39	65	47.358	S	144	36.587	E	B26	Sonobuoy 214 : hydrophone sensor to collected directional passive acoustic data
262	21/02/2019 14:26	65	52.685	S	144	36.234	E	B26	Sonobuoy 215 : hydrophone sensor to collected directional passive acoustic data
263	21/02/2019 18:31	65	53.045	S	144	21.156	E	B26	Sonobuoy 216 : hydrophone sensor to collected directional passive acoustic data
264	21/02/2019 19:38	65	47.602	S	144	36.698	E	B26	Sonobuoy 217 : hydrophone sensor to collected directional passive acoustic data
265	21/02/2019 20:35	65	52.953	S	144	36.289	E	B26	Sonobuoy 218 : hydrophone sensor to collected directional passive acoustic data
266	21/02/2019 23:35	65	53.144	S	144	50.827	E	B26	Sonobuoy 219 : hydrophone sensor to collected directional passive acoustic data
267	22/02/2019 0:29	65	48.791	S	144	56.052	E	B26	Sonobuoy 220 : hydrophone sensor to collected directional passive acoustic data
268	22/02/2019 4:46	65	53.268	S	144	52.264	E	B26	Sonobuoy 221 : hydrophone sensor to collected directional passive acoustic data
269	22/02/2019 6:45	65	55.378	S	145	13.109	E	B26	Sonobuoy 222 : hydrophone sensor to collected directional passive acoustic data
270	22/02/2019 8:08	65	49.84	S	145	7.933	E	B26	Sonobuoy 223 : hydrophone sensor to collected directional passive acoustic data
271	22/02/2019 10:19	65	48.569	S	144	42.087	E	B26	Sonobuoy 224 : hydrophone sensor to collected directional passive acoustic data
272	22/02/2019 11:19	65	54.031	S	144	54.473	E	B26	Sonobuoy 225 : hydrophone sensor to collected directional passive acoustic data
273	22/02/2019 12:08	65	48.527	S	144	55.96	E	B26	Sonobuoy 226 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
274	22/02/2019 17:13	65	47.386	S	144	36.723	E	B26	Sonobuoy 227 : hydrophone sensor to collected directional passive acoustic data
275	22/02/2019 19:01	65	44.591	S	144	51.113	E	B26	Sonobuoy 228 : hydrophone sensor to collected directional passive acoustic data
276	22/02/2019 20:05	65	48.007	S	145	3.459	E	B26	Sonobuoy 229 : hydrophone sensor to collected directional passive acoustic data
277	22/02/2019 21:07	65	54.606	S	145	9.406	E	B26	Sonobuoy 230 : hydrophone sensor to collected directional passive acoustic data
278	22/02/2019 21:58	65	59.4	S	145	19.713	E	B26	Sonobuoy 231 : hydrophone sensor to collected directional passive acoustic data
279	22/02/2019 23:46	65	49.289	S	145	37.57	E	B26	Sonobuoy 232 : hydrophone sensor to collected directional passive acoustic data
280	23/02/2019 1:19	65	43.733	S	146	0.4	E	B26	Sonobuoy 233 : hydrophone sensor to collected directional passive acoustic data
281	23/02/2019 2:23	65	41.688	S	146	14.694	E	B26	Sonobuoy 234 : hydrophone sensor to collected directional passive acoustic data
282	23/02/2019 4:17	65	44.03	S	146	36.359	E	B26	Sonobuoy 235 : hydrophone sensor to collected directional passive acoustic data
283	23/02/2019 6:22	65	45.98	S	146	41.296	E	B26	Sonobuoy 236 : hydrophone sensor to collected directional passive acoustic data
284	23/02/2019 11:09	65	45.83	S	146	51.706	E	B26	Sonobuoy 237 : hydrophone sensor to collected directional passive acoustic data
285	23/02/2019 12:02	65	45.827	S	147	8.739	E	B26	Sonobuoy 238 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
286	23/02/2019 12:40	65	42.306	S	147	9.733	E	B26	Sonobuoy 239 : hydrophone sensor to collected directional passive acoustic data
287	23/02/2019 13:22	65	39.255	S	147	2.199	E	B26	Sonobuoy 240 : hydrophone sensor to collected directional passive acoustic data
288	23/02/2019 14:37	65	37.172	S	147	12.791	E	B26	Sonobuoy 241 : hydrophone sensor to collected directional passive acoustic data
289	23/02/2019 16:21	65	42.191	S	147	21.21	E	B26	Sonobuoy 242 : hydrophone sensor to collected directional passive acoustic data
290	23/02/2019 20:31	65	37.95	S	147	34.056	E	B26	Sonobuoy 243 : hydrophone sensor to collected directional passive acoustic data
291	23/02/2019 21:25	65	37.863	S	147	50.699	E	B26	Sonobuoy 244 : hydrophone sensor to collected directional passive acoustic data
292	23/02/2019 23:25	65	44.226	S	147	46.013	E	B26	Sonobuoy 245 : hydrophone sensor to collected directional passive acoustic data
293	24/02/2019 0:31	65	50.942	S	147	33.104	E	B26	Sonobuoy 246 : hydrophone sensor to collected directional passive acoustic data
294	24/02/2019 1:52	65	57.035	S	147	25.654	E	B26	Sonobuoy 247 : hydrophone sensor to collected directional passive acoustic data
295	24/02/2019 6:22	66	0.42	S	147	13.004	E	B26	Sonobuoy 248 : hydrophone sensor to collected directional passive acoustic data
296	24/02/2019 6:52	66	3.575	S	147	10.88	E	B26	Sonobuoy 249 : hydrophone sensor to collected directional passive acoustic data
297	24/02/2019 7:59	66	6.812	S	146	50.602	E	B26	Sonobuoy 250 : hydrophone sensor to collected directional passive acoustic data
298	24/02/2019 22:26	65	57.984	S	149	14.293	E	B26	Sonobuoy 251 : hydrophone sensor to

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
									collected directional passive acoustic data
299	25/02/2019 1:35	65	34.565	S	149	25.95	E	B26	Sonobuoy 252 : hydrophone sensor to collected directional passive acoustic data
300	25/02/2019 19:07	65	31.223	S	149	27.602	E	B26	Sonobuoy 253 : hydrophone sensor to collected directional passive acoustic data
301	25/02/2019 23:05	65	0.318	S	149	42.36	E	B26	Sonobuoy 254 : hydrophone sensor to collected directional passive acoustic data
302	26/02/2019 6:43	64	51.285	S	149	46.591	E	B26	Sonobuoy 255 : hydrophone sensor to collected directional passive acoustic data
303	26/02/2019 13:01	64	36.05	S	149	53.661	E	B26	Sonobuoy 256 : hydrophone sensor to collected directional passive acoustic data
304	26/02/2019 16:09	64	14.35	S	149	57.702	E	B26	Sonobuoy 257 : hydrophone sensor to collected directional passive acoustic data
305	26/02/2019 19:00	63	53.825	S	149	56.28	E	B26	Sonobuoy 258 : hydrophone sensor to collected directional passive acoustic data
306	26/02/2019 22:02	63	23.91	S	149	50.042	E	B26	Sonobuoy 259 : hydrophone sensor to collected directional passive acoustic data
307	27/02/2019 1:05	62	52.211	S	149	45.348	E	B26	Sonobuoy 260 : hydrophone sensor to collected directional passive acoustic data
308	27/02/2019 3:56	62	23.479	S	149	41.163	E	B26	Sonobuoy 261 : hydrophone sensor to collected directional passive acoustic data
309	27/02/2019 6:55	61	53.922	S	149	36.923	E	B26	Sonobuoy 262 : hydrophone sensor to collected directional passive acoustic data
310	27/02/2019 16:11	60	21.226	S	149	24.075	E	B26	Sonobuoy 263 : hydrophone sensor to collected directional passive acoustic data

	Date	Lat deg	lat min	N/S	Lon deg	Lon min	E/W	Data type	Description
311	27/02/2019 19:06	59	53.007	S	149	20.291	E	B26	Sonobuoy 264 : hydrophone sensor to collected directional passive acoustic data
312	27/02/2019 22:04	59	24.878	S	149	16.556	E	B26	Sonobuoy 265 : hydrophone sensor to collected directional passive acoustic data
313	28/02/2019 3:56	58	23.412	S	149	8.599	E	B26	Sonobuoy 266 : hydrophone sensor to collected directional passive acoustic data
314	28/02/2019 6:53	57	53.168	S	149	4.762	E	B26	Sonobuoy 267 : hydrophone sensor to collected directional passive acoustic data
315	28/02/2019 9:50	57	24.328	S	149	1.155	E	B26	Sonobuoy 268 : hydrophone sensor to collected directional passive acoustic data

Summary of Measurements and samples taken

Item no.	PI	Number	Units	Data type	Description
1	Double	46	Days	Event log	Data set: Chief Scientist's event log. Custodian: Mike Double. Team: Chief Scientist. Description: Record of changes in survey phases and modes throughout the ENRICH voyage. Data form: Spreadsheet.
2	Double	764	Samples	B01, B07, B08	Data set: Scintillation Counter (primary and bacterial production). Custodian: Karen Westwood. Team: Biogeochemistry. Description: Counts per minute for primary and bacterial production measurements. Data form: Spreadsheet.
3	Double	28	Deployments	H09, H10, H11, H28, H90, D90	Data set: CTD Profiles. Custodian: Kendall Sherrin. Team: Biogeochemistry. Description: Hydrochemistry mesaurements. Data form: Spreadsheet.
4	Double	324	Samples	H10, H21, H22, H24, H25, H76, H27, H28	Data set: CTD water samples. Custodian: Kendall Sherrin. Team: Biogeochemistry. Description: . Data form: .
5	Double	37	Deployments	H11, D90, H13	Data set: XBT Profiles. Custodian: Amy Nau, Matt Boyd. Team: Biogeochemistry. Description: Temperature data XBTs. Data form: Spreadsheet.
6	Double	10	Deployments	D05, D90	Data set: Drifter Profiles. Custodian: Karen Westwood. Team: Biogeochemistry. Description: Drifter positions, temp, hPa. Data form: Spreadsheet.
7	Double	35	Deployments	H30	Data set: TMR deployments. Custodian: Lavenia Ratnarajah. Team: Biogeochemistry. Description: Trace metal rosette deployments. Data form: Spreadsheet.
8	Double	46	Days	Event log	Data set: Biogeochemistry event log. Custodian: Karen Westwood. Team: Biogeochemistry. Description: Record of biogeochemistry deployments. Data form: Spreadsheet.

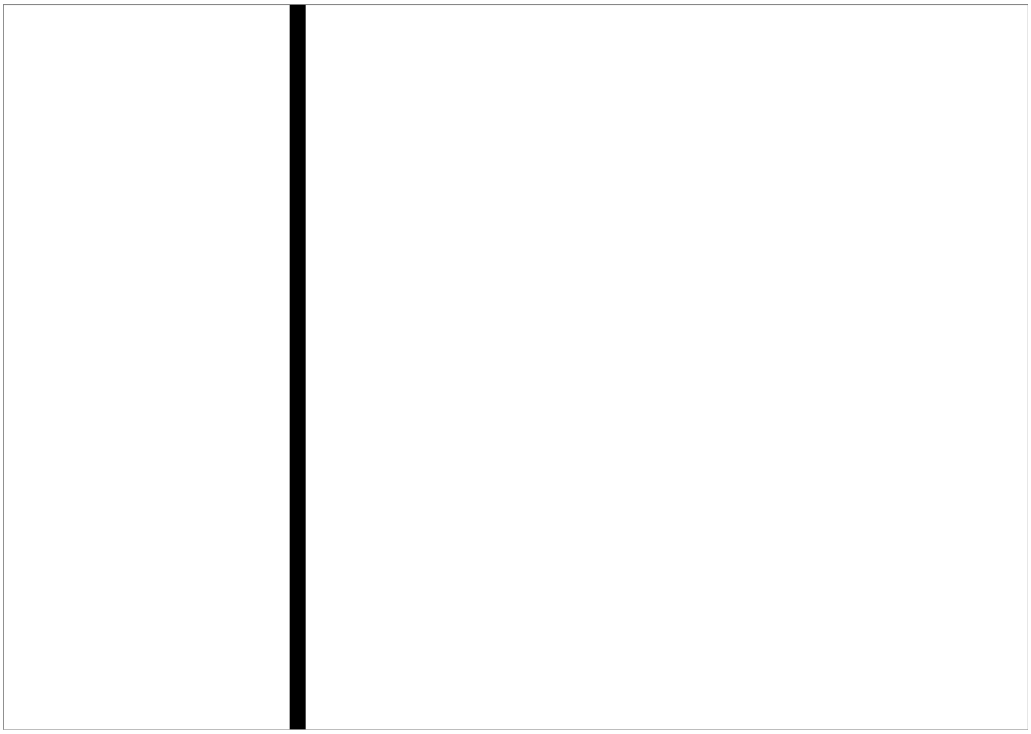
Item no.	PI	Number	Units	Data type	Description
9	Double	318	Samples	B07	Data set: Bacteria and virus RNA/DNA samples. Custodian: James O'Brien. Team: Biogeochemistry. Description: To be extracted and sequenced at UTS/UNSW. Data form: Spreadsheet.
10	Double	132	Samples	B07	Data set: Bacteria Samples. Custodian: James O'Brien. Team: Biogeochemistry. Description: To be analysed using flow cytometery at UTS. Data form: Spreadsheet.
11	Double	741	Samples	B07, H90, H33	Data set: DMSP Samples. Custodian: James O'Brien. Team: Biogeochemistry. Description: To be analysed using gas chromatograph at UTS. Data form: Spreadsheet.
12	Double	23	Samples	B01, B02	Data set: FIRe Underway. Custodian: Clara Rodriguez Vives. Team: Biogeochemistry. Description: Underway fluorometry measurements. Data form: FIRe.
13	Double	138	Samples	B01, B02	Data set: HPLC Samples. Custodian: Karen Westwood. Team: Biogeochemistry. Description: Phytoplankton pigments. Data form: Filtration CTD water.
14	Double	52	Samples	B08, B09	Data set: Lugols Samples. Custodian: Karen Westwood. Team: Biogeochemistry. Description: Phytoplankton identification. Data form: Whole water samples preserved CTD water.
15	Double	786	Samples	B07	Data set: Virus Samples. Custodian: Elanor Bell. Team: Biogeochemistry. Description: To be analysed using flow cytometery at UTS. Data form: Filtration CTD water.
16	Double	235	Samples	P02, B06, H30	Data set: Dissolved Iron. Custodian: Lavenia Ratnarajah. Team: Biogeochemistry. Description: Ligands and dissolved iron concentration from TMR. Data form: Filtered seawater. dFe

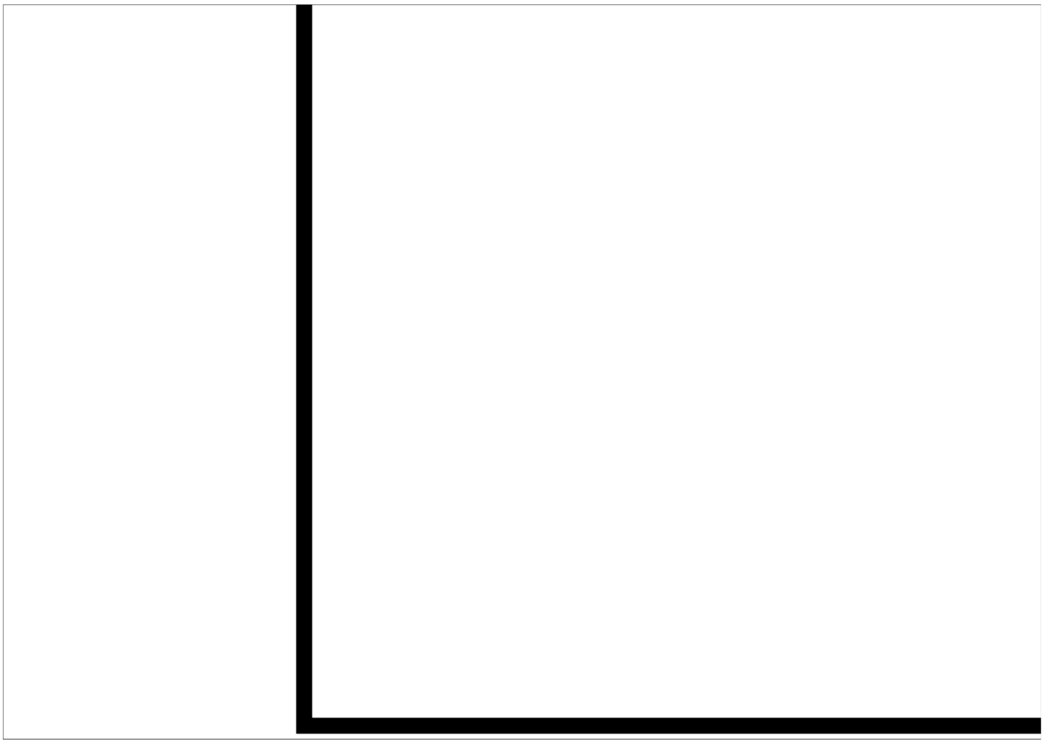
Item no.	PI	Number	Units	Data type	Description
					- acidified (pH 1.8). Ligands - frozen.
17	Double	212	Samples	B71, P02, B02, B06, B07, B08, B09, H30	Data set: Iron incubation. Custodian: Abigail Smith. Team: Biogeochemistry. Description: Dissolved iron, macronutrients, primary produtivity, bacterial productivity, microbial abundance and community, chlorophyll a. Data form: Whole water samples from TMR.
18	Double	22	Samples	P02, B06, H30	Data set: UAV water sampling. Custodian: Josh Smith. Team: UAV. Description: Water samples for trace metal analyses. Data form: .
19	Double	134	Flights	Flight logs	Data set: UAV flight logs. Custodian: Josh Smith. Team: UAV. Description: UAV flight log data. Data form: .
20	Double	1	Samples	B26	Data set: Whale blow samples. Custodian: Josh Smith. Team: UAV. Description: Blow sampling of whales for DNA analysis. Data form: Blow sample.
20	Double	134	Flights	B26	Data set: Video footage. Custodian: Josh Smith. Team: UAV. Description: Video footage of whales for behaviour, videogrammetry and DNA sampling. Data form: .
21	Double	46	Days	Event log	Data set: Sonobuoy deployment log. Custodian: Brian Miller. Team: Passive acoustics. Description: Sonobuoy deployment information. Data form: Hard copy spreadsheet; Pamguard database.
22	Double	295	Deployments	B26	Data set: Sonobuoy data. Custodian: Brian Miller. Team: Passive acoustics. Description: Raw and processed data recorded from sonobuoys. Data form: Digital recordings of audio (24 bit wav files). Pamguard database (sqlite) and Pamguard binary files (see Pamguard Documentation

Item no.	PI	Number	Units	Data type	Description
					for details on binary storage formats)..
23	Double	46	Days	B28, B09, B14	Data set: EK60 raw data. Custodian: DAP/GSM/Josh Lawrence. Team: Active acoustics. Description: Six frequency downward facing scientific echosounder data. Data form: Geotagged, timestamped .raw files.
24	Double	46	Days	B28, B09, B15	Data set: ME70 raw data. Custodian: DAP/GSM/Josh Lawrence. Team: Active acoustics. Description: Scientific multibeam data. Data form: Geotagged, timestamped .raw files.
25	Double	46	Days	B28, B09, B16	Data set: SH90 raw data. Custodian: DAP/GSM/Josh Lawrence. Team: Active acoustics. Description: Omni-directional sonar data. Data form: Geotagged, timestamped .raw files.
26	Double	46	Days	G74	Data set: EM122. Custodian: DAP/GSM. Team: Active acoustics. Description: Bathymetric multibeam data. Data form: .all files (geotagged, timestamped).
27	Double	16	Days	B28, B26	Data set: Active and passive acoustic mooring. Custodian: Anna Sirovic. Team: Passive acoustics. Description: Passive and active acoustic data from bottom-anchored mooring. Data form: .
28	Double	46	Days	D71	Data set: ADCP. Custodian: DAP/GSM. Team: Underway data. Description: ADCP data. Data form: .raw & .png (geotagged, timestamped).
29	Double	46	Days	B26	Data set: Photo-ID data log. Custodian: Paula Olson. Team: Sightings. Description: Record of data associated with whale ID photos. Data form: Hard copy spreadsheet.

Item no.	PI	Number	Units	Data type	Description
30	Double	42	Whales	B26	Data set: Whale identification photos. Custodian: Paula Olson. Team: Sightings. Description: Digital photographs. Data form: SLR digital cameras.
31	Double	317.3	Hours	B26	Data set: Visual observations of whales. Custodian: Russell Leaper. Team: Sightings. Description: Visual effort and sightings. Data form: Logger.
32	Double	18	Hours	B26	Data set: Whale video tracking. Custodian: Russell Leaper. Team: Sightings. Description: Video and still images from whale tracks. Data form: Video SD card and CF card in still camera.
33	Double	41	Deployments	B09, B14, B21	Data set: RMT Trawl log. Custodian: So Kawaguchi. Team: Krill. Description: Record of RMT 1+8 trawls and types of samples collected throughout the Enrich voyage. Data form: Hardcopy spreadsheet.
34	Double	4385	Samples	B09	Data set: RMT Sample demography and IGR data. Custodian: So Kawaguchi. Team: Krill. Description: Krill demography and zooplankton composition, and photos from every trawl, and all krill IGR growth experiments throughout the Enrich Voyage. Data form: Hardcopy spreadsheet.
35	Double	5472	Samples	B09	Data set: RMT Sample demography and IGR data. Custodian: So Kawaguchi. Team: Krill. Description: Krill integrated growth experiments. Data form: Hardcopy spreadsheet.

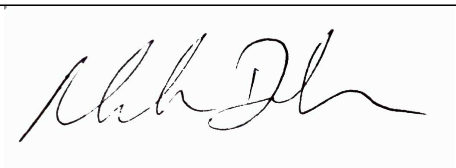
Track Chart





Track line for the 2019 IN2019_001 ENRICH voyage. In each figure the ice coverage is shown for the 15th February 2019.

Signature

Your name	Dr Michael Double
Title	Chief Scientist
Signature	
Date:	6/2/20

List of additional figures and documents

Appendix A CSR/ROSCOP Parameter CodeS

Appendix B Photographs

Appendix C In-depth scientific voyage report

Appendix A - CSR/ROSCOP Parameter CodeS

	METEOROLOGY
M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	Routine standard measurements
M71	Atmospheric chemistry
M90	Other meteorological measurements

	PHYSICAL OCEANOGRAPHY
H71	Surface measurements underway (T,S)
H13	Bathythermograph
H09	Water bottle stations
H10	CTD stations
H11	Subsurface measurements underway (T,S)
H72	Thermistor chain
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H73	Geochemical tracers (eg freons)
D01	Current meters
D71	Current profiler (eg ADCP)
D03	Currents measured from ship drift
D04	GEK
D05	Surface drifters/drifting buoys
D06	Neutrally buoyant floats

	MARINE BIOLOGY/FISHERIES
B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll, fluorescence)
B71	Particulate organic matter (inc POC, PON)
B06	Dissolved organic matter (inc DOC)
B72	Biochemical measurements (eg lipids, amino acids)
B73	Sediment traps
B08	Phytoplankton
B09	Zooplankton
B03	Seston
B10	Neuston
B11	Nekton
B13	Eggs & larvae
B07	Pelagic bacteria/micro-organisms
B16	Benthic bacteria/micro-organisms
B17	Phytobenthos
B18	Zoobenthos
B25	Birds
B26	Mammals & reptiles
B14	Pelagic fish
B19	Demersal fish
B20	Molluscs
B21	Crustaceans
B28	Acoustic reflection on marine organisms

D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

	CHEMICAL OCEANOGRAPHY
H21	Oxygen
H74	Carbon dioxide
H33	Other dissolved gases
H22	Phosphate
H23	Total - P
H24	Nitrate
H25	Nitrite
H75	Total - N
H76	Ammonia
H26	Silicate
H27	Alkalinity
H28	PH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H90	Other chemical oceanographic measurements

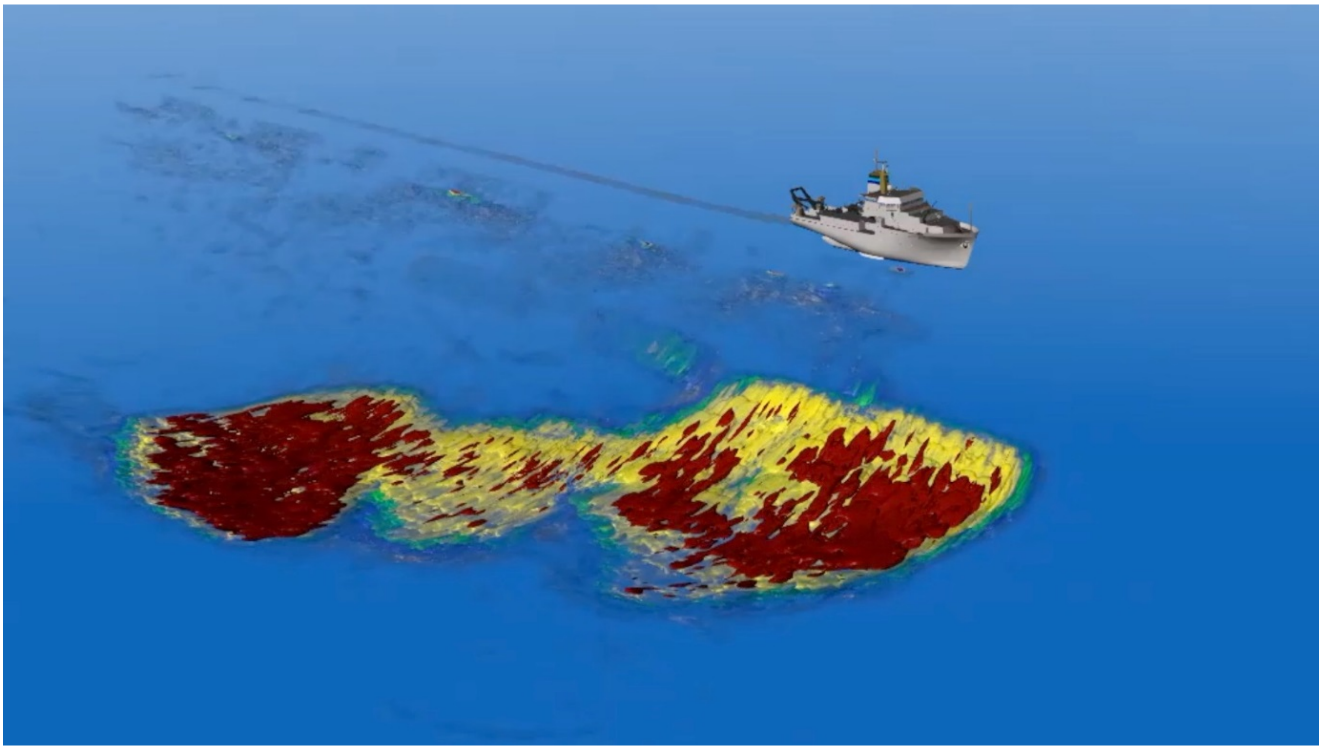
B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries measurements

	MARINE GEOLOGY/GEOPHYSICS
G01	Dredge
G02	Grab
G03	Core - rock
G04	Core - soft bottom
G08	Bottom photography
G71	In-situ seafloor measurement/sampling
G72	Geophysical measurements made at depth
G73	Single-beam echosounding
G74	Multi-beam echosounding
G24	Long/short range side scan sonar
G75	Single channel seismic reflection
G76	Multichannel seismic reflection
G26	Seismic refraction
G27	Gravity measurements
G28	Magnetic measurements
G90	Other geological/geophysical measurements

	MARINE CONTAMINANTS/POLLUTION
P01	Suspended matter
P02	Trace metals
P03	Petroleum residues
P04	Chlorinated hydrocarbons
P05	Other dissolved substances
P12	Bottom deposits
P13	Contaminants in organisms
P90	Other contaminant measurements

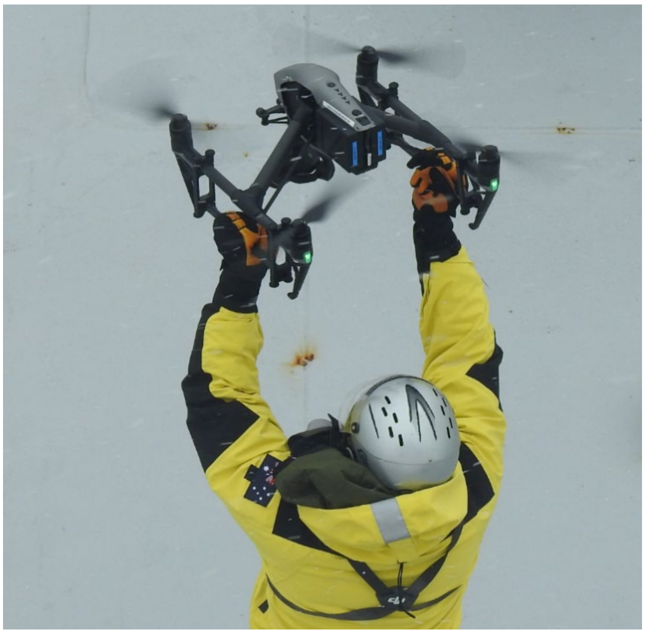
Appendix B - Photographs

Scientist and crew aboard the RV Investigator taken using a DJI Inspire 2 UAV (© Alex Vail and James Cox).



Example of a 3D model of an Antarctic krill swarm, 400 m long x 200 m wide x 100 m deep. Data collected using the ME70 echosounder © Australian Antarctic Division.

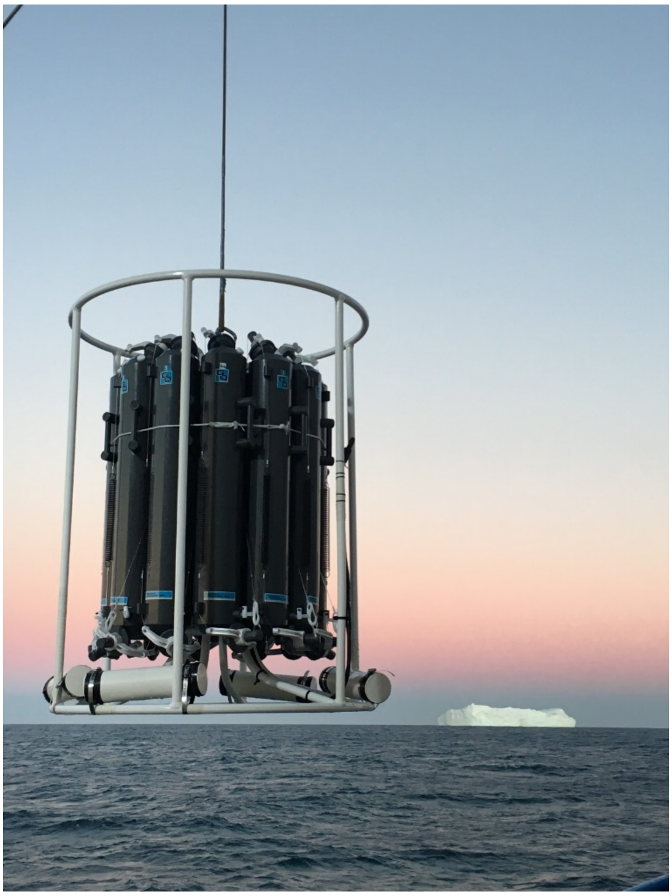
Identification photographs of two individual Antarctic blue whales, illustrating the difference in individual mottling patterns (Paula Olson, AAD).



The DJI Inspire 2 ('media') UAV used to collect scientific data and general whale and scenic imagery. © Peter Shanks, MNF.

The DJI Phantom 4 Pro V1/V2 multi-rotor quadcopter ('science') UAV sampling surface water near an iceberg © Alex Vail

The DJI Phantom 4 Pro V1/V2 multi-rotor quadcopter ('science') UAV *collecting a blow sample from an Antarctic blue whale © Charlotte Boyd, AAD.*



CTD deployment © Lavenia Ratnarajah, University of Liverpool.

Appendix C – In-depth scientific voyage report

To follow.