Larsen-C Benthos
Benthic biodiversity under Antarctic ice-shelves – baseline assessment of the seabed exposed by the 2017 calving of the Larsen-C Ice Shelf

RRS James Clark Ross JR17003a Cruise Report

Benthic biodiversity under Antarctic ice-shelves – baseline assessment of the seabed exposed by the 2017 calving of the Larsen-C Ice Shelf

Katrin Linse & the scientists of Larsen-C Benthos
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Summary

On 12 July 2017, the Larsen-C Ice Shelf calved the largest iceberg originating from the Antarctic Peninsula ever recorded (Fig. 1). As A68 moves north, it will leave an area of 5,800 km² of seabed newly exposed to open-marine conditions. Much of this area has very likely remained ice-covered for centuries and may have been covered since the last inter-glacial period. The calving of A68 offers a unique and short-lived scientific opportunity to establish a fundamental research programme to address questions around the mobility and colonisation capacity of benthic marine species. Such a programme would address fundamental questions relating to the sustainability of polar continental shelves under climate change, the processes by which benthic populations migrate, the extent to which benthic organisms act as a biological carbon sink, and the degree to which the distribution of marine benthos can be used to interpret past responses to climate change in various systems. To enable us to exploit this rare opportunity, it is essential that assessment of the benthic system is achieved in the 2017/18 austral summer before significant colonisation begins.

To date, the research community has not been sufficiently flexible, or able, to exploit opportunities associated with rapidly changing ice shelves in order to answer key scientific questions such as those above. Biodiversity was not studied until respectively 5 and 12 years after the retreats of Larsen-A & B ice shelves, by which time substantial colonisation had already taken place, and so significant questions about the pre-existing ecosystems remain unanswered. Generating a baseline description of biodiversity, benthic community composition and trophic structure at the very earliest opportunity after A68’s calving will allow, for the first time important data to be generated, which will assist in developing a mechanistic understanding of the major processes that lead to colonisation, species’ turnover and energy flow. These will be key to producing predictions of the benthic systems response to future impacts on further ice-shelf collapse.

Our governing hypothesis is:

**H: “Until the calving of the Larsen-C iceberg, A68, the benthic fauna on the seabed beneath ice shelf has likely comprised oligotrophic assemblages resembling deep-sea Weddell Sea assemblages. The calving of A68, and the exposure of the seabed it covered to open-marine and sea-ice conditions will initiate a rapid colonisation by new species that will transform the benthic ecosystem significantly within 3-5 years.”**

Testing this hypothesis, including through follow up cruises from the international community will allow us to determine the baseline, sequence, rate and degree of colonisation, understand the mechanisms of transport of these benthic species, and the sequence of their colonisation. This will allow us to improve fundamental understanding about the resilience of polar continental shelf ecosystems, improve interpretations of marine sediment records, and support effective ecosystem management regulation. We will deploy trawls, corers, cameras, salinity and depth sensors, and echo-sounders to measure mid-water zooplankton assemblages and map the seabed terrain to:

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) agreed in October 2016 to protect areas newly revealed by ice shelf retreat or collapse, as Special Areas for Scientific Study for a minimum of 10 years, allowing scientific research to proceed in the absence of other human activities such as fishing. The area exposed by the calving of A68 was designated as a Special Area in October 2017 and is the first to benefit from this agreement, thus providing a unique opportunity for the international science community.
Objectives

- **Objective 1:** Sample and characterize macro- and mega-faunal biodiversity in the benthic community below A68. Faunal collection and appropriate sample fixation for taxonomic identification, molecular genetic and genomic analyses of phylogeography, evolutionary history and metagenomics. Characterisation of assemblages formerly under A68 and their spatial distribution at a range of scales in relation to distance from the former ice front. Faunal community analysis from photo and video imagery with taxonomic identification validated with physical specimen samples.

- **Objective 2:** Assess the initial benthic trophic structure and carbon flow below A68. 1) Sample fixation appropriate for food web analysis (natural isotopes δ¹³C, δ¹⁵N and δ³⁴S) of macro- and megafauna, and food sources such as plankton and organic matter in the sediment. 2) In-vivo ¹³C uptake experiments of infaunal meio- and macrofauna in multicorer-tube microcosms.

- **Objective 3:** Document and describe the pre-collapse system to provide a springboard for future studies and grant opportunities. Archiving of pre-collapse samples will be vital.

Biological and environmental data will be analysed with multivariate statistics and compared to assemblages and ecosystems reported from the SO shelf, slope and deep-sea, especially those from Larsen-A/B and the bathyal and abyssal Weddell Sea.

![Map of proposed stations for work in Larsen-C, B&A during JR17003a.](image)

Funding

Cruise JR17003a was part of NERC Urgency grant NE/R012296/1. Individual invited scientists from BAS, University of Aberdeen and the SCAR AntEco Programme were externally funded for travel and preparation costs and then supported by BAS whilst on board the ship.
Sea-ice maps during Expedition

For JR17003a Dr Andrew Fleming (MAGIC at BAS) had set up an automated ESA-satellite images transfer to PSO and Master for new published images of the eastern Antarctic Peninsula as well as delivered composite images of the research area for planning purposes.

Fig. 2. Composite satellite images for research area acquired 19th to 21st February 2018 from ESA (left) and MODIS from Nasa (right).

Fig. 3. Images of research area showing open water along norther end of Larsen-C.
Fig. 4. Polar View AMSR2 sea-ice concentration images of 22\textsuperscript{nd} Feb to 10\textsuperscript{th} Mar 2018.
Contingency plan

Larsen-C Benthos (JR17003a) is a British Antarctic Survey (BAS) led expedition linked with the NERC-funded urgency grant NE/R012296/1 “Benthic biodiversity under Antarctic ice-shelves – baseline assessment of the seabed exposed by the 2017 calving of the Larsen-C Ice Shelf” and undertaken in conjunction with a UK national grant applicant team and an international team of scientists from the Scientific Committee for Antarctic Research (SCAR) AntEco research programme. The expedition will take place on board the BAS research ship the RRS James Clark Ross in early 2018 under the cruise number JR17003a. The FCO have permitted sampling following the PEA protocol on the Eastern Antarctic Peninsula to enable contingency stations.

As JR17003a is targeting a research area of high risk to be effected by adverse sea-ice conditions that can deny access to the proposed research area, contingency plans will be in place for different scenarios:
1) Reach Larsen-C and work as proposed
2) Reach Larsen-B area only and amend project plans to sample first proposed Larsen-B stations, then further repeat stations in Larsen-B of previous AWI cruises to continue with the succession studies there
3) Reach Larsen-A area only and amend project plans to sample first proposed Larsen-A station, then further re-peat stations in Larsen-A of previous AWI cruises to continue with the succession studies there
4) Not reach Larsen area, so work would focussed on sites north of Larsen selected following a benthic biodiversity knowledge review in biodiversity.aq (Fig. 2).

Fig. 5. Red points represent specimen records of benthic species reported to biodiversity.aq.

After encountering thick, multi-year pack-ice with tilted and re-frozen floats forming high press-ice ridges on 27th February and only 8 nautical mile progress within 24h on 28th
February, the decision was made to abandon the goal to reach Larsen-C as this target had become unachievable within the given timeframe of the expedition. A contingency meeting of the science team was called and the contingency work area was decided as the Prince Gustav Channel (Fig. 3), which southern entrance became free of an ice-shelf connection when Larsen-A disintegrated in the early 1990ies.

The contingency sites were planned for Duse Bay as a sheltered bay influenced by local glaciers (stations 1-3), Prince Gustav Channel (PGC) South (stations 4-6), PGC Mid (stations 7-12), PGC North (station 10) and Entrance of Duse Bay (station 11).

Summary narrative for JR17003a

The following calendar view (Tab. 1) gives a simplified overview of JR17003a splitting the days into one of three groups. Originally JR17003a had been scheduled with 8 days of transit each to reach Larsen-C and 10 days of science on site. Because of schedule changes caused by unforeseeable events on previous cruises, JR17003a was cut back to 6 days of transit each and 7 days of science on site. As JR17003a had to abandon the goal to reach Larsen-C on 28th February, 8 day were available to science in contingency area Prince Gustav Channel; 3 days were impacted by repairs to the 30 t winch which prohibited AGT, C-EBS and MUC deployments. Several planned locations for science stations were impacted by moving pack-ice or cancelled because of pack-ice cover.
Table 1. Calendar view of activities during JR17003a.

<table>
<thead>
<tr>
<th></th>
<th>Mob/de-mob</th>
<th>Transit</th>
<th>Sampling</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Mar-18</td>
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<td>Mar-18</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Mar-18</td>
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<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

The following is a more detailed day-to-day narrative of cruise events (Tab. 2). To avoid confusion with event logs that form the most detailed narrative, times are given in UTC. On cruise JR17003a, local time was always UTC -3.

Table 2. Day-to day narrative of JR17003a

<table>
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<tr>
<th>Time</th>
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<th>Air pressure</th>
<th>Air °C</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/03/2018</td>
<td>20:00</td>
<td>21</td>
<td>997</td>
<td>1.99 On Transit to Stanley FIPASS (ETA morning 12th March). 9 am Science meeting in officer’s bar with update on BOLs, BioBOLs, packing and cleaning. Day spent with packing of boxes and samples, demobilisation of marine equipment etc. 1 pm cruise photo taken on Monkey Island by BBC NHU drone. 6 pm End of Cruise Dinner. The 200 m site was covered by pack ice but the 400 m sites was ice-free and near iceberg A57A (11x5 nm in size). Science with CTD and SUCS was planned for 9:30 start, but delayed as the German Polar Research Vessel came by for a brief ship passing visit. Science resumed 13:00 with CTD and SUCS (event 58), then proceed to 650 m site (7 miles away). This site was not reached as covered by heavy and tidally influence pack ice that stopped JCR's progress for 5 hours and finished the science deployments for JR17003a.</td>
</tr>
<tr>
<td>08/03/2018</td>
<td>20:00</td>
<td>10</td>
<td>993</td>
<td>-11.04 At 6 am the site PGC North was covered in fast moving pack ice. Decision was taken by PSO to proceed to Duse Bay (~22 miles away) to finish the 200 m and 500 m sites with MUC, AGT and C-EBS deployments. Previous SUCS deployments had shown that the seafloor was covered by soft sediments, so MUC deployment were going ahead. The 500 m site was reached after ~7.5 hours of steaming through</td>
</tr>
<tr>
<td>07/03/2018</td>
<td>20:00</td>
<td>11</td>
<td>985</td>
<td>-6.67</td>
</tr>
</tbody>
</table>
pack-ice and newly formed sea-ice. The cold sea temperatures caused JCR’s seawater intake to stop working and made sieving of sampling in the web lab extremely challenging as sea water was bucketed in from the fire hose on deck. Both sites had successful MUC, AGT and C-EBS deployments.

PSO and Master agreed to proceed overnight to a 200 m and 400 m site North of the entrance to Prince Gustav Channel and past the pack ice to be able to enter Antarctic Sound latest Friday 9.3. in the morning for 12.3. ETA Stanley.

Resume PGC South 1250 m at 6 am with AGT. Then proceed by daylight and without pack-ice cover over shallow and narrow area in PGC to site PGC Mid 800 m. Proceed with deployments of CTD, SUCS, AGT, EBS, MUC (successful), CTD, MUC (unsuccessful) and finish PGC Mid. Transit to site PGC North 800 m overnight.

Resumed PGC South 800 m site with two MUCs (both failed, one landing on rock and tumbling over, one hit hard surface), successful AGT. Proceed to 1250 m site at PGC South: 2 successful MUCs, followed by C-EBS and CTD.

After night on DP north of pack ice field commence science 6 am with SUCS (PGC S 200 m, PGC 500 m), then steam southwards to assess ice situation in Roehss Bay, continue science off Cape Obelisk with SUCS at 500 m, CTD and MUC at 656 m, and MUC and EBS at 800m. 19:30 resume science for day and steam to overnight DP position north of pack ice field. Arrival at Prince Gustav Channel South sites; starting 6:30 with 800 m site CTD near to pack ice edge followed by Bongo. SUCS deployment delayed as winch monitor had issues overnight. After warming of monitor science commenced and 800 m SUCS commenced followed by swath survey of 500 m to 200 m areas to find and map SUCS transects. Drone flight to assess lead through pack ice to open water pool followed by JCR steaming through pack ice. 15:30 science meeting in UIC. SUCS commenced at 800 m and 500 m sites. 19:30 end of over the side" science and start of swath survey to map 200 m sites and area/extent of open water area."
Duse Bay, top of eastern Antarctic Peninsula: Conclude from 6 am 500 m site CTD, BONGO, SUCS. Issues with 30t winch changes sciences plans. Proceed to 200 m site for CTD, BONGO, SUCS. MUC, AGT and C-EBS to be done after winch repair. Opportunistic 300 m and 400 m SUCS transects. Opportunistic swath surveys adding to existing coverage. Proceed to Prince Gustav Channel South sites overnight.

Arrived Duse Bay 1000 m site 11:30, start station work CTD, BONGO, SUCS, AGT, EBS, 2x MUC. AGT net froze while hosed down hanging to remove mud. Water on top of MUC cores started freezing on deck. Swath to extend current lines until late evening. Overnight in deep water of bay.

Progress southwards over 24h by 7:30 about 8 miles; followed by discussion with JCR Master Tim Page on achievability to reach Larsen-C in the area previously covered by iceberg A68 and return safely to Stanley in the time given to JR17003a. We agreed that this would not be possible as Larsen-C was still more than 200 miles away and only 16 days left until scheduled ETA in Stanley remained. 8:00 phone call with BAS Cambridge office to notify about the decision to turn the vessel around and proceed to contiguency 4 area around James Ross Island. 15:00 science meeting to discuss site planning for Prince Gustav Channel.

Passage through pack ice is continuing, 20 mile progress by mid morning since entering heavier pack afternoon before. Change of course to new water lead when encountering thicker pack ice with no water leads. In evening encountered thick multi-year pack ice floats (4-5 m thickness), tilted floats refrozen to thick press ice ridges and ice fields with press ice ridges to the horizon.

Passage to Larsen C. First pack ice floats 2am, encountered grounded tabular icebergs around lunchtime and progressed to steam southwards through pack ice fields with water leads. Occasional ramming of ice.

On transit to Larsen-C. 8:00 passing Clarence and Elephant Island; 10:30 Cold weather talk by doctor; 15:00 PI meeting; 19:00 BBC NHU talk.

On Transit to Larsen-C. Opportunistic swath. 10:30 Fire drill - crew and scientists involved; 13:00 Cruise planning meeting - Master, officers, engineers, Bosun & Sci Ops, AME, PSO

2 am CTD for sound velocity profile followed by swath calibrations. Transit to James Ross Island. AGT, EBS & MUC science meetings

Mare Harbour, resume bunkering (from 9:00). JCR
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21/02/2018</td>
<td>20:00</td>
<td>Mare Harbour, bunkering (9:00-18:00). AME gear mobilisation continues. PI and Science party meetings</td>
</tr>
<tr>
<td>20/02/2018</td>
<td>20:00</td>
<td>departs Mare Harbour at 15:00 heading for James Ross Island. Opportunistic swath started.</td>
</tr>
<tr>
<td>20/02/2018</td>
<td>22:00</td>
<td>19 997 7.97 Mobilisation tasks. Crew change GC to TP; JCR departs FIPASS at 19:00 heading for Mare Harbour</td>
</tr>
<tr>
<td>19/02/2018</td>
<td>22:00</td>
<td>19 997 7.97 Mobilisation tasks. 21:30 last science party arrive on JCR</td>
</tr>
<tr>
<td>18/02/2018</td>
<td>22:00</td>
<td>11 985 11.38 Join JCR at FIPASS 14:00. Familiarisation and start of mobilisation tasks. Larsen-C boxes from science containers.</td>
</tr>
<tr>
<td>17/02/2018</td>
<td>22:00</td>
<td>15 Main science party arrive in Falklands 19:00</td>
</tr>
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</table>

Cruise Track

Fig. 7. Cruise track of JR17003a
Personnel

Officers and crew for JR17003a

PAGE, Timothy S  Master
HIPSEY, Christopher W  Chief Officer
BELLIS, Robert J  2nd Officer
O’DONNEL, Colin M  3rd Officer
CHAPMAN, Matthew C  Ex 3rd Officer
NEWSOM, John M  ETO Comms
LLOYD, GJ  Chief Engineer
BEHRMANN, Gert  2nd Engineer
LITTLE, Amanda  3rd Engineer
MURRAY, Euan R  4th Engineer
BIGGS, Thomas E  Deck Engineer
AMNER, Stephen P  ETO
TURNER, Richard J  Purser
TOMKINSON, Alicia  Doctor
PECK, David J  Bosun/Sci' Ops
BOWEN, Albert Martin  Bosun
HERNANDEZ, Francisco J  Bosun's Mate
SMITH, Sheldon T  SG1A
ENGLISH, Samuel  SG1A
WAYLETT, Graham L  SG1A
NEILANDS, Martins  SG1A
PECK, Daelyn R  SG1A
WALE, Gareth M  MG1
HENRY, Glyndor N  MG1
WALTON, Christopher I  Chief Cook
FILEVA, Zhivka A  2nd Cook
GREENWOOD, Nicholas R  Snr Steward
WINTON, Brian G J  Steward
LIDDY, John SC  Steward
RAY, Charlotte J  Steward
**Scientific Party**

LINSE, Katrin PSO, British Antarctic Survey
APELAND, Bjoerg AME SDA, British Antarctic Survey
BEECHAM, Dan BBC Natural History Unit
BRANDT, Angelika Senckenberg Research Institute, Frankfurt
CLARK, Will AME, British Antarctic Survey
DAHLGREN, Thomas University of Gothenburg
DAVIES, Carwyn AME SDA, British Antarctic Survey
DREUTTER, Simon Alfred Wegener Institute, Bremerhaven
GRANT, Susanna M British Antarctic Survey
GLOVER, Adrian Natural History Museum UK
FIELDING, Sophie British Antarctic Survey
FEDERWISCH, Luisa Alfred Wegener Institute, Bremerhaven
MACKENZIE, Melanie Museum Victoria, AUS
MACSWEEN, Kirsten University of Aberdeen
MAKELA, ANNI University of Aberdeen
POLFREY, Scott AME, British Antarctic Survey
QUIRK, Sean AME, British Antarctic Survey
REID, William University of Newcastle
ROBST, Jeremy IT, British Antarctic Survey
SMITH, Aisling ReDS SDA Lab Manager, British Antarctic Survey
VANREUSEL, Ann University of Ghent
VENABLES, Hugh British Antarctic Survey
TRATHAN, Phil British Antarctic Survey
WHITE, Elisabeth BBC Natural History Unit
WHITTLE, Rowan BBC Natural History Unit

Abbreviations: PSO, Principal Scientific Officer; ReDS, Research Development and Support; AME, Antarctic and Marine Engineering; IT, Information Technology; SDA, RRS Sir David Attenborough

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Fig. 8. *Cruise participants. Photograph by BBC NHU drone (Liz White, Dan Beecham).*
Project Reports:

1. Agassiz Trawl (AGT)

Rowan Whittle, Katrin Linse, Angelika Brandt, Thomas Dahlgren, Luisa Federwisch, Adrian Glover, Susie Grant, Mel Mackenzie, Will Reid, Aisling Smith

Our apparatus, an Agassiz trawl (AGT), was used to sample animals approximately 1 cm and larger in length, which comprise the larger macro- and megafauna, but did capture some smaller animals as well. Pack-ice cover and topography permitting, each site comprised up to three trawls (200 m, 500 m, 800 m/1000 m) and an additional deep trawl in the three Prince Gustav Channel (PGC) basins but only in Duse Bay the three trawling depth were achieved. The 200m and 500m stations in PGC were too influenced by boulders to deploy the AGT.
Our Agassiz trawl used a mesh size of 1 cm and had a mouth width of 2 m. At each station the seabed topography was examined prior to trawl deployment using multibeam sonar (swath) and where possible, the shallow underwater camera system (SUCS). The deployment protocol was standardised. While the AGT was lowered, the ship had to compensate for the wire lowering speed of 45 m.min⁻¹ by steaming at 0.3 knots until the AGT reached the seabed and at 0.5 knots until the full trawling wire length was put out. The full trawling cable length we used was 1.5 times the water depth. The net was then trawled at 1 knot for 5-10 minutes. With the ship stationary, the AGT was hauled at 30 m.min⁻¹ in order to avoid damaging the gear. When the AGT had left the seafloor, the hauling speed was increased to 45 m.min⁻¹ and the ship speed to 0.3 knots.

In total, there were 6 AGT deployments. These were at 3 sites: Duse Bay, Prince PGC South and PGC Mid.

**Preliminary results**

During the expedition, only the AGTs of events 4, 38, 43, 46 and 52 were sorted, counted and identified on board, AGT event 56 was fixed in bulk. In total 5043 benthic specimens and 46 kg of wet weight belonging to 13 Phyla and 20 classes were collected and counted from these AGT catches (Table 3, Fig. 10).

Fig. 10. Numbers of individuals and wet weight collected by AGT for higher taxa
Table 3. Phyla and higher taxa present in AGT samples

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Class</th>
<th>Order/Event</th>
<th>Site</th>
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<td>Duse Bay 1000m</td>
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<td>Annelida</td>
<td>Polychaeta</td>
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</tr>
<tr>
<td></td>
<td>Hydrozoa</td>
<td>7</td>
<td>23</td>
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<tr>
<td>Echinodermata</td>
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<td>Crinoidea</td>
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</tr>
<tr>
<td></td>
<td>Echinoidea</td>
<td>13</td>
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<tr>
<td></td>
<td>Holoturoidea</td>
<td>28</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Ophiuroidea</td>
<td>493</td>
<td>153</td>
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<td>Hemichordata</td>
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<td></td>
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<td>Scaphopoda</td>
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<td>Nemertea</td>
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<td>3</td>
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<td>Demospongiae</td>
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<tr>
<td></td>
<td>Hexactinellida</td>
<td>5</td>
<td>3</td>
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<tr>
<td></td>
<td>indet</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Sipuncula</td>
<td></td>
<td>5</td>
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</tr>
</tbody>
</table>
1.1. Crustacea

*Angelika Brandt*

In total 155 Crustacea (Malacostraca) were sampled during the JR 17003a (Larsen-C) expedition east of the Antarctic Peninsula with the AGT representing a minimum of 18 species. Numbers of individuals (63) were highest at the shallowest station 52 and lowest at the deepest station 4 (5 individuals) (Tab. 4, Fig. 11), numbers of species were highest at station 46 and lowest at station 4. Interestingly, though numbers of individuals were highest at station 52 only 6 species were sampled at this station.

Numbers of species represent minimum, these might increase when the material is properly identified using taxonomic literature for comparisons.

Table 4: Numbers of individuals and species samples during the JR 17003a expedition by means of the AGT.

<table>
<thead>
<tr>
<th>stations</th>
<th>4</th>
<th>38</th>
<th>46</th>
<th>52</th>
</tr>
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<tbody>
<tr>
<td>depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max. (m)</td>
<td>1052</td>
<td>868</td>
<td>877</td>
<td>495</td>
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<td>individuals</td>
<td>5</td>
<td>27</td>
<td>60</td>
<td>63</td>
</tr>
<tr>
<td>species</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

Fig. 11: Numbers of individuals and species of AGT stations.

Three species of Decapoda have been sampled, these were *Nematocarcinus lanceopes* Spence Bate, 1888, *Chorismus antarcticus* (Pfeffer, 1887), and *Notocrangon antarcticus* (Pfeffer, 1887). Euphausiacea only occurred with three individuals of *Euphausia superba* Dana, 1850. Peracarida were most speciose and occurred with taxa of the Mysida, Amphipoda and Isopoda. One species of Mysida, possibly of *Boreomysis* Sars, 1869. Within the Amphipoda, Lysiannasoidea occurred with 1 species, Epimeriidae with one species of the subgenus *Epimeria* (*Drakepimera*) d’Uekem d’Acoz and Verheye 2017, Oedicerotidae with one, Stegocephalidae with one and Eusiridae with four species (*Eusirus antarcticus* Thomson, 1880, *Rhachotropis antarctica* K.H. Barnard, 1932, *Eusirus propeperdentatus* Andres, 1979 and *Eusirus giganteus* Lörz & Brandt, 2002). Isopoda
were sampled with one species of the Australarcturellidae (*Doliciscus* cf. *diana*), at least two species of the Antarcturidae, *Antarcturus* cf. *spinacoronatus*, and *Litarcturus* sp., Munnopsidae occurred with three species, *Munneurycope* sp. *Notopais* sp. and *Echinozone* sp..

The figure 12 shows a species of the Amphipoda, Epimeride, *Epimeria* (*Drakepimeria*) sp. and figure 13. mancas of an antarcturid isopod on an octocoral.

![Fig. 12: Epimeria (*Drakepimeria*) sp. a, lateral view; b, head in lateral view; c, dorsal view; d, head in dorsal view. Scale bar 2mm. © Adrian Glover, Thomas Dahlgren.](image-url)
1.2. Holothuria

Melanie Mackenzie

Aims

The pre-cruise hypothesis that biological material collected from below iceberg A68’s former position may mimic species from much deeper Antarctic environments (such as that in the adjacent Weddell Sea) suggested potential for retrieval of holothuroids and other echinoderms during sampling on JR17003A. With this likely outcome I joined the Larsen C Benthos team as a holothuroid (sea cucumber) taxonomist to identify species found during this first rapid-response survey of under-ice communities, and to compare these samples to species found in previous surveys of the Weddell Sea (e.g. JR275) and other Antarctic and deep-sea/abyssal environments. A secondary aim (as part of the contingency for not reaching Larsen C) was to assess areas earmarked for potential fishing, and determine whether we should push for their protection if a presence of VME taxa was discovered. VME taxa as defined by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) are chiefly slow-growing, habitat-forming or other niche groups such as sponges, corals and chemosynthetic communities. While holothuroids themselves are not classified as VME species, they are a visible and often dominant component of many Antarctic and sub-Antarctic benthic habitats, and are often found in association with VME taxa (e.g. JR15005 assessment of South Orkney Islands ecosystem).

Despite having to abandon the initial brief to get to Larsen C (and contingency plans to get to potential fishing grounds and Larsen A and B) due to heavy pack-ice and unfavourable winds,
we were able to reach scientifically important areas in Duse Bay and Prince Gustav channel, off James Ross Island to the north of the Antarctic Peninsula. Parts of James Ross Island have been previously covered by the Larsen A ice-sheet, with the southern entrance of Prince Gustav channel ice-covered until the early 1990s. Previous examination of under-ice shelf communities 5 and 12 years after exposure have shown different patterns of colonisation, with likelihood of some deep-water holothuroid species (e.g. Protelpidia murrayi and Elpidia glacialis) benefiting from the trophic regime shift after the ice-shelf collapse (Gutt et al, 2011).

At this new site my aim remained to collect and identify holothuroid species, record any associations and habitats, assist other scientists with sampling and processing, and to ensure methods of preservation were of a standard high enough for lodgement in appropriate institutions for further taxonomic and molecular studies into the future. Assistance was also provided with selecting and processing holothuroid specimens to be used in Dr Will Reid’s food web analysis project. Dr Reid generally took samples from lateral muscle bands post-photography. Processing of the whole AGT catch allowed little time for identification of holothuroid material on board, so preliminary identification of specimens during the expedition will be followed up by more thorough examination post-cruise when the specimens are sent to Museums Victoria. Any new species will be described in taxonomic papers and voucher specimens will then be lodged in collections at the British Antarctic Survey, Natural History Museum, Museums Victoria, and other institutions as appropriate. The use of deployed camera systems (SUCS) to image-capture habitats and species, along with photography of live and preserved specimens will help to build identification guides for more accurate field and laboratory identification.

Collection Methods

Holothuroid specimens were collected using two main benthic sampling methods – an Agassiz Trawl (AGT) and an epi-benthic sledge (EBS). The majority of EBS samples (and one AGT sample) were bulk fixed and will be examined back at Museums Victoria. Additional holothuroid species such as Bathyploites bongraini and a number of suspension-feeding dendrochirotids seen on SUCS footage, were not always recovered in AGT samples indicating that this is not a true representation of all holothuroid fauna at this site. Specimens captured on underwater camera were seen sitting crawling along the seafloor, buried in the seafloor with tentacles extended into water column, perched on urchin spines, rocks, corals or bryozoans, or attached to hard substrate.

Preliminary Results

Sampling indicates at least 5 of the holothuroid orders are represented in the area with 370 Holothuroids (in 63 lots) sampled on-board during the expedition. Four orders (Apodida, Dendrochirotida, Elasipodida and Molpadida) were represented in the AGT samples. Greatest diversity was seen at the 800m site in Duse Bay (Ev46) with ~ 11 different morpho-species from 3 different orders seen. Greatest abundance (104 specimens) was seen at the deep (1250m) Prince Gustav channel site (Ev43), with this station sample dominated by the elasipod c.f. Rhipidothuria racovitzai representing 82 of the 104 specimens collected. Despite this dominance by one species there were still 3 orders and ~9 morpho-species represented at the station.

Elasipodida species were also sighted in the EBS samples (bulk still to be processed) and an additional species of Synallactida (formerly Aspidochirotida) was sighted on the Shallow Underwater Cameras (along with additional Elasipodida and Dendrochirotida). At this early/superficial stage of assessment, species appear to be similar to Weddell Sea species, and as such I would hypothesise that two additional orders - Holothuriida (e.g. Mesothuria) and Persiculida (e.g. Pseudostichopus) could also be found in future surveys of the area.
Table 5: Holothuroids sampled by AGT during JR 17003a expedition.

<table>
<thead>
<tr>
<th>Station</th>
<th>4</th>
<th>38</th>
<th>43</th>
<th>46</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target depth (m)</td>
<td>1000</td>
<td>800</td>
<td>1250</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>No. of individuals collected</td>
<td>28</td>
<td>51</td>
<td>104</td>
<td>66</td>
<td>5</td>
</tr>
<tr>
<td>No. of Orders</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Orders represented</td>
<td>Elasipodida, Molpadida, Dendrochirotida</td>
<td>Elasipodida, Dendrochirotida</td>
<td>Apodida, Elasipodida, Dendrochirotida</td>
<td>Apodida, Elasipodida, Dendrochirotida</td>
<td>Dendrochirotida</td>
</tr>
<tr>
<td>Morpho-species</td>
<td>~3</td>
<td>~8</td>
<td>~9</td>
<td>~11</td>
<td>~2</td>
</tr>
</tbody>
</table>

*Note: station 56 was also an AGT but was bulk fixed due to time constraints.

Samples by Station
All IDs are superficial/preliminary only. Specimens sub-sampled by Dr Will Reid for food-web analysis are represented by (*).

**Station 4** (1000m): Dendrochirotida: Paracucumidae (*Paracucumis turricata*), Elasipodida: Elpidiidae (*Protelpidia murrayi*), Molpadia: Molpadidae (*Molpadia violacea*)

**Station 38** (800m): Dendrochirotida: Cucumariidae* (~7 morpho-species), Elasipodida: Elpidiidae (*Rhipidothuria racovitzai*)

**Station 43** (1250m): Apodida: Chiridotidae (c.f. *Sigmodota magnibacula*, *Chiridota*), one additional Apodid morpho-species, Dendrochirotida: Cucumariidae (~4 morpho-species), Elasipodida: Elpidiidae (*Protelpidia murrayi*), (*Rhipidothuria racovitzai*).

**Station 46** (800m): Apodida (1 morpho-species), Dendrochirotida: Cucumariidae (*Heterocucumis steineni*, *Staurocucumis liouvillei*, *Staurocucumis turqueti*, *Trachythyone bouvetensis*), Dendrochirotida: Psolidae (*Psolus sp x 2*), and ~3 extra Dendrochirotid morpho-species, Elasipodida: Elpidiidae (*Rhipidothuria racovitzai*).

**Station 52** (800m): Dendrochirotida: Cucumariidae (*Echinopsolus charcoti*) plus an additional Dendrochirotid morpho-species.
Fig. 14: Sample of diversity of holothuroids collected by AGT during JR 17003a expedition
Clockwise from top right: *Rhipidothuria racovitzai*, *Molpadia violacea*, *Protelpidia murrayi*,
*Staurocucumis liouvillei*, *Psolus* sp. Not to scale.

**Processing & Photography**

Specimens could at best only be split into basic morphotype groups during initial processing;
however live colour photos of specimens and associations were taken by Dr Rowan Whittle
(and other photographers) where possible using different camera systems. Few specimens
were relaxed enough post-trawl to extend their tentacles but photos can still give an indication
of live and colour and contracted size. Samples were fixed in 95% ethanol for further
morphological and molecular analysis. Ample amounts of ethanol were used to ensure
complete coverage, as concentration is expected to drop to 75-85% during transit due to the
water content of specimens. Post-fixation (allowing for at least 48 hours in ethanol), some of
the specimens were examined under a stereomicroscope and notes taken on identifying
features such as tube foot and tentacle arrangements, dimensions, colour, skin texture etc.
More accurate identification of material sent to Museum Victoria will involve sampling the
remnant skeletal elements (ossicles) from specimen tentacles and body wall. Samples will be
cleared for observation using commercial bleach and examined under a compound
microscope or SEM.

Of note is that elasipod specimens seen in the EBS cod-end overflow (c.f. *Rhipidothuria
racovitzai*) appeared to be very well preserved compared to those collected in the AGT here
or during previous surveys, and all specimens seemed to benefit from the colder water
temperatures providing they didn’t freeze immediately on deck or sit out for a long time during
processing.
Fig 15: *Rhipidothuria racovitzai* collected by EBS during JR 17003a expedition

Author Note: There have been numerous revisions of higher level Holothuroid taxonomy over the last 10 years, the most recent large-scale revision being the phylogenetic work of Miller et al 2017 which split the order Aspidochirotida into a number of groups. This should be kept in mind for any comparison with data presented in earlier cruise reports (e.g. Weddell Sea 2012 - JR275 and South Orkneys 2016 - JR15005)

**Bibliography**


1.3. Polychaeta, including EBS ones

*Adrian Glover, Thomas Dahlgren*

**Introduction**

The objective for the Polychaeta team on the JR17003a cruise was to collect the highest-quality samples possible for taxonomic, systematic, phylogenetic and phylogeographic study with the overall aim to test the hypothesis of recent emergence of a deep-sea fauna onto the Weddell Sea shelf following the last glacial maxima (LGM). A secondary goal was to place the biodiversity of the Weddell Sea shelf in an Antarctic and global context.

The focus on polychaetes will allow us to compare samples and material with the extensive collections from the BIOPEARL project in the Amundsen and Scotia Seas, which included large scale DNA analysis (Brasier et al., 2016; Brasier et al., 2017) and the largest identified collection of polychaetes ever undertaken in Antarctic waters (Neal et al., 2017). Glover and
Dahlgren also have an extensive collection and analysed samples from abyssal locations in the central Pacific, which will be used for comparative purposes.

With the impossibility of reaching the Larsen C area, the original cruise objective, efforts focused on the Prince Gustav Channel (PGC) in an area that had been previously covered by an ice shelf as recently as 1995 (Cooper et al., 1997). Samples were obtained from a variety of locations in the PGC that included some areas close to or covered by ice shelf in 1995, and some samples from areas further north (e.g Duse Bay) that have probably been uncovered for a much longer period.

An excellent set of samples were taken following the methods below, and preliminary results are highlighted in the following sections.

Methods

Polychaete collection

Our methods in general followed the live-sorting ‘cold-chain’ protocol outlined in detail in Glover et al. (2016). In summary, the approach is geared towards collecting extremely high-quality well-preserved individual specimens that have been photographed while alive. All types of sampling equipment are used, the emphasis is on collecting from as wide a variety of gears as possible to increase the taxonomic sampling of diversity.

The collection of a high-quality sample set is highly complementary to any other quantitative comparative studies (for example collection of replicate samples by epibenthic sledge or multi-core).

We collected samples, typically mud or washed animals, from the Aggasiz Trawl (AGT), Multi-corer (MUC) and Epibenthic Sledge (EBS).

Sub-samples of these gear samples were carefully washed in cold filtered seawater (CFSW) on 300 micron sieves with the sieves held underwater during washing. This reduces damage to the animals. Following Glover et al., (2016) specimens were picked from the sieve residue and cleaned in CFSW and relaxed in Magnesium Chloride solution prior to photography.

Images were taken with Canon EOS600D cameras either with 100mm Macro lens or through a Leica MZ7.5 microscope with SLR camera mount. Lighting was from two Canon 430EX strobe units in both cases.

Fixation of all samples was in 80% non-denatured ethanol in water. The use of 80% rather than the commonly-used 96% ethanol reduces damage to the specimens from becoming brittle.

Environmental DNA (eDNA) trials

We also took water samples from the CTD for environmental DNA (eDNA) trials. 5L of bottom-water was taken from 3 sites and filtered on a 0.7µm GFF filter paper. The filter paper was then frozen at -80°C. An additional control sample was taken using 5L of milliQ water from the ships milliQ system.

Results and Discussion

795 polychaete specimens were picked through the cold-chain protocol (Glover et al., 2016), from 34 different families (Table 1). 223 macro photographs were taken, and 426 microscope camera images, of specimens ranging in size from more than 10cm in length to less than 1mm.
Table 6. Polychaete families and numbers recovered for live sorting from the JR17003a cruise to Prince Gustav Channel area.

<table>
<thead>
<tr>
<th>Family</th>
<th>AGT</th>
<th>EBS</th>
<th>MUC</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrocirridae</td>
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<td>4</td>
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<td></td>
<td>1</td>
</tr>
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<td>Cirratulidae</td>
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<td>40</td>
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<td>Dorvilleidae</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td>413</td>
<td>259</td>
<td>123</td>
<td>795</td>
</tr>
</tbody>
</table>

Preliminary observations are of a high abundance, low diversity system which is consistent with the hypothesis of a habitat that has recently become available since ice-shelf collapse. Further analysis will be required to species level to place the diversity observations in a broader context.

In terms of phylogenetic understanding, this will have to wait until genetic data have been gathered, but at a very general level at least, there is no obvious similarity to an abyssal fauna.

Broadly-speaking the polychaetes fell into two size classes. The larger ‘megafaunal’ animals were recovered mostly from AGT and EBS trawls that included tube-dwelling animals such as large maldanid worms and sabellids, as well as predator/scavengers such as the nephtys
and polynoids (Figure 1).

On the 300 µm sieved sediment fraction, many small macrofauna-sized polychaetes were also found living within the sediments, including burrowing paraonid and cirratulids and opheliids to name some of the taxa. Examples are given in Figure 2.

Fig. 16. Larger 'megafaunal' sized polychaetes recovered from the AGT and EBS surveys in Prince Gustav Channel. Image credit: A Glover and T Dahlgren.
Fig. 17. Smaller ‘macrofaunal’ sized polychaetes recovered from the EBS, MUC and AGT surveys in Prince Gustav Channel. Image credit: A Glover and T Dahlgren.

Further Analysis

Samples are being returned to the Natural History Museum in London. Funding has been obtained from the University of Gothenburg for a PhD student project that will enable analysis of a portion of the material. Emphasis will be placed on building the first DNA-taxonomy based library of information on the Weddell Sea shelf polychaetes and examining the role of climate change and ice shelf collapse on the ecosystems of the area.

Recommendations

Support from the ship and technicians was excellent throughout. The only major problem encountered was the lack of chilled seawater flowing on the back deck. The water being used was from the ship’s firehose system, which is warmed considerably compared to sea surface temperatures. For example, after one hour of continuous running we measured this temperature to be 18°C compared to sea surface temperature of -1.72°C and air temperature of -10°C. We measured this on one other occasion after further running and found it to be ~8°C when running more slowly and with air temperature of -13°C.

The temperature of the seawater system in the lab was fine (same as sea surface) but there was no obvious way to run this out onto the back deck in the sufficient volumes needed. In addition, when the vessel was surrounded by ice the seawater system had to be turned off to avoid freezing of the system and could not be used.

As the organisms we are bringing back in the samples are used to constant temperature of approximately -2°C this is a significant issue for any bulk sieving of sediments and animals on the back deck. The higher temperatures can lead to destruction of the sample if for example DNA-preservation is a priority. When the ship is in sea-ice, chilled seawater is mostly not possible, which prevents any live animal work.
Acknowledgements

We are grateful to the Principal Scientific Officer Dr Katrin Linse for the invitation to collaborate on the project and the support during the cruise.

References

Cooper, A.P.R. (1997) Historical observations of Prince Gustav Ice Shelf. Polar Record

1.4. Porifera

*Luísa Federwisch*

A total of 72 sponge samples have been collected from the AGT catches, plus one additional one which was hanging on the frame of the EBS at station #05. Some examples are shown in Fig. 18. The majority of the collected sponges belonged to the class Demospongiae. The class Hexactinellida (glass sponges) was represented by only few individuals and small pieces. Most of the sponge samples have been weighed (wet weight) and photos taken with a size standard. Of the 73 sponge samples, 41 have been subsampled for different projects as appropriate (Table 7).

Table 7: Overview of numbers of sponge samples per station and number of individuals (Ind.) subsampled for different projects.

<table>
<thead>
<tr>
<th>Event #</th>
<th>Location</th>
<th>Gear</th>
<th>Sponge samples (IDs)</th>
<th>Sub-sampled IDs</th>
<th>Ind. for micro-biomes</th>
<th>Ind. for invertebrates</th>
<th>Ind. for stable isotopes</th>
<th>Ind. for Si/O isotopes</th>
<th>Ind. for ultra-structure</th>
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</thead>
<tbody>
<tr>
<td>04</td>
<td>Duse Bay, 1000 m</td>
<td>AGT</td>
<td>6</td>
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<tr>
<td>05</td>
<td>Duse Bay, 1000 m</td>
<td>EBS</td>
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<td></td>
</tr>
<tr>
<td>38</td>
<td>PGC South, 800 m</td>
<td>AGT</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</table>
Ten individuals belonging to three different demosponge species (three specimens each) and one hexactinellid species (*Rossella cf. nuda*) were subsampled for analysis of their microbiomes (i.e. the microbial communities associated with the sponges). They were all collected at station #46 (Prince Gustav Channel Mid, 850 m). Three replicate samples of about 1 cm³ were cut from each sponge with a sterile scalpel, rinsed in sterile filtered seawater and frozen at -80 °C. Control samples were taken of the mud from the AGT catch (3 replicates; although the amount of mud in the catch was limited), bottom water from the CTD rosette sampler at this station and the water used for cleaning and sorting the animals (pumped from the ship’s hull). The mud samples were frozen at -80 °C, as well, whereas the water (4 L) was filtered and the filter frozen (see Chapter 6.1 on CTD water sampling for details). The microbiome samples will be analysed in collaboration with Ute Hentschel (GEOMAR, Germany) and the results will be added to a project on Antarctic sponge microbiomes, which so far comprises several hexactinellid species from the eastern Weddell Sea.

49 sponges, collected at five stations, were subsampled for molecular analysis of invertebrates living in the sponge tissue. Three replicates of about 1 cm³ were cut from each specimen using a sterile scalpel and transferred into Eppendorf tubes with 96 % ethanol. They were stored at -20 °C and will be analysed by Rachel Downey (Australian National University).

19 sponges from four different stations were subsampled for stable isotope analysis (carbon and nitrogen) as part of the food web studies conducted by Will Reid. For that, one sample of about 1-3 cm³ was cut from each sponge and frozen at -80 °C.

For the study of silicon and oxygen isotopes in sponge spicules, six suitable specimens from four stations were chosen. Five of these sponges were hexactinellids (Hexactinellida, Lyssacinosida, Rossellidae) and one was a highly silicifying Tetillid (Demospongiae, Tetractinellida, Tetillidae). Small pieces were cut from the upper part of the sponges, close to the osculum, and dried for several days. The samples will be analysed in collaboration with Andrea Abelmann at AWI, Germany, together with filtered bottom water samples from the same stations. The results will be added to an already existing data set on silicon and oxygen isotopes in hexactinellid sponges from the eastern Weddell Sea.

In order to study the ultrastructure of sponge tissue (i.a. in comparison to the microbiome), nine sponges from three stations were subsampled. The project focusses on hexactinellid sponges of which three individuals of different species could be sampled, but six demosponges were sampled for comparison at one of the stations. One or two pieces of each sponge were fixed in 10 % Formalin (exchanged after one day) and stored at +4 °C. The samples will be analysed in collaboration with Sally Leys (University of Alberta, Canada).
To ensure proper identification of all sponge species, the majority of sponge samples was fixed in 96% ethanol and stored at -20 °C. A few large individuals were dried in a warm and well-aerated room. The samples will be sent to Dorte Janussen at the Senckenberg Research Institute and Natural History Museum, Germany, for taxonomic analysis.

Fig. 18: Examples of collected sponge specimens: (a) ID0019, St.4, (b) ID0015, St. 5, (c) ID0105, St. 38, (d) ID0282, St. 46, (e) ID0303, St. 46, (f) ID0346, St. 46, (g) ID0350, St. 46, (h) ID0353, St. 46, (i) ID0385, St. 46.

1.5. Foodwebs - William Reid, Sophie Fielding, Adrian Glover, Luisa Federwisch

Stable isotopes of carbon and nitrogen are commonly used to assess trophodynamics in marine ecosystems. They provide information about what has been integrated into an animal’s tissue from their diet. They provide a means for tracing energy flow and assessing trophic structure. There were two aims of the food web work: (1) to elucidate sources of production sustaining the benthic macrofauna; and (2) provide an overview of the trophic structure of the benthic community living in the Prince Gustav Channel and Duse Bay.

The sources of production sustaining the benthic food web were collected using the CDT, Bongo net, MUC and AGT. These sampling techniques allow the collection of pelagic and benthic trophic endmembers. The CDT collected surface waters (5 m depth) for filtering particulate organic matter (POM). Between 3 and 5 litres of water were filtered at each station through a GF/F 25mm ashed filter paper. One CTD bottle was filtered at each station where water was collected onto duplicate filter papers. The Bongo net was also used to sample the water column using 100 and 200 μm nets. These were filtered onto GF/F 25mm ashed filter paper. The samples largely consisted of krill faecal pellets. All GF/F filters were frozen at -
80°C. The stable isotope values of the benthic end-member was assessed using sediment samples collected by the MUC. A single core was sectioned in the following intervals: 0-1 cm, 1-2 cm, 2-3cm, 3-4cm, 4-5 cm, 5-7 cm, 7-10 cm. Duplicate samples were collected at each site where a core was made available with the exception of Duse Bay 1000m station. The sediment was stored in glass vials at -80°C. Finally, an unexpected catch of shallow water seaweed appeared in the AGT during event 46 were also sampled. The seaweed will have broken away and sunk into the basins of Prince Gustav Channel. This may also provide an important food source for the benthic fauna. All seaweed samples were stored in ziplock bags and frozen at -80°C.

Macrofauna were collected using the EBS and the AGT; although the majority of the samples were collected with the AGT. The EBS was used to collect additional samples of macrofaunal that were also sampled by the AGT. Macrofauna were collected during seven sampling events (4, 34, 38, 41, 42, 43, 46) in Prince Gustav Channel and Duse Bay. The work focused between approximately 800 and 1260m. The AGT was initially sorted into the lowest possible taxonomic groups. Macrofauna were selected for sampling based on a visual inspection of catch. The aim was sample a combination of the most abundant and high biomass groups. Individuals were either frozen whole or a piece of tissue were dissected from the individual. Additional samples were provided from the EBS catches were individuals were in good condition for dissecting. The samples were then frozen at -80°C.

The following taxonomic groups were sampled: Actinopteri, Anthozoa, Ascidiacea, Asteroidea, Bryzoa, Crinoidea, Echinoidea, Holothuroidea, Hydrozoa, Malacostraca, Ophiuroidea, Polychaeta, Porifera and Pycnogonida. The samples will require identification but are traceable back to the original sorted groups. A proportion of the samples have been photographed before dissection to aid with identification. Those individuals that have been dissected were placed in ziplock bags and preserved with the rest of the sorted group. The Polychaeta samples have also been sampled for DNA by Dr Adrian Glover (Natural History Museum) and Dr Thomas Dahlgren (University of Gothenburg). The Porifera were shared with Luisa Federwisch (Alfred Wegener Institute, Bremerhaven) who took samples from the same samples for DNA and taxonomic analysis. A summary of the samples collected can be found in Table 8.

On return to the UK, funding will be sought to analyse the food web samples for carbon and nitrogen stable isotope analysis. The plan is to submit a NERC Life Sciences Mass Spectrometry proposal in time for the Autumn 2018 deadline.

Table 8: Number of samples per taxonomic group collected using the EBS (*) and AGT for food web studies.

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<th>38</th>
<th>41*</th>
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2. Camera- Epibenthic Sledge (C-EBS)

*Angelika Brandt, Katrin Linse*

Seven camera-epibenthic sledge deployments were taken during the JR 17003a expedition (Figure 19, Appendix 5).

<table>
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<tr>
<th>Polychaeta</th>
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<th>6</th>
<th>6</th>
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<td>0</td>
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<td>Pycnogonida</td>
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<td>2</td>
<td>10</td>
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</tbody>
</table>

2. Camera- Epibenthic Sledge (C-EBS)

*Angelika Brandt, Katrin Linse*

Seven camera-epibenthic sledge deployments were taken during the JR 17003a expedition (Figure 19, Appendix 5).

Figure 19: Station map of all C-EBS stations (produced by Simon Dreutter).
The C-EBS (Figure 20) is a proven apparatus designed for sampling small epibenthic and suprabenthic macrofauna at any depth and on any substrate. The EBS is equipped with supra- and epi- benthic samplers of 1 m width and 33 cm height with attached plankton nets of 500 µm and a cod end of 300 µm as described by Brandt and Barthel (1995) and Brenke (2005). A mechanical opening-closing device prevents entry of pelagic fauna during heaving. Additionally, the EBS carries a deep-water camera system (DWCS) and a CTD which measures data on temperature, pressure and conductivity.

A single C-EBS was deployed at those stations were substrate allowed and drop stones were not prevalent. As trawled gear never hits the same spot when repeating a station (Brattegard and Fosså, 1991), pseudo-replicate samples were not taken during this expedition. The C-EBS was trawled for 10 min on the seabed on each of the seven events it was deployed (Figure 19, Appendix 5).

On deck, the supra- and epi-nets were washed down into the cod ends using cold seawater. The cod ends were then transferred into iced seawater, gently sieved, and immediately transferred into chilled (-20°C) 96% ethanol. Samples were stored in a -20°C freezer for at least 48 h to reduce degradation of DNA for subsequent genetic studies. During this time,
samples were gently rolled every three to six hours. Ethanol was changed once for all sub-
fractions. Additionally, after every deployment, all sensor and video data were downloaded
from the internal hard drives and memory cards.
Due to sampling at the end of the expedition and short time availability, sorting of samples to
major taxonomic groups could not be performed on board.

References:


Biological Association of the United Kingdom 71, 153-166.

3. Multicorer (MUC)

Katrin Linse, Aisling Smith, Anni Makela, Kirsten MacSween, Ann Vanreusel, Will Reid, Rowan Whitte

Twelve Multicorer deployments were taken during the JR 17003a expedition (Figure 21, Appendix 6).

The BAS Oktopus 12-core multicorer was deployed at sites when the SUCS deployments indicated that the sediment would be suitable for soft sediment sampling. The science team agreed to deploy 2 MUCS per site and the distribution of cores between the different groups followed at sites agreed as shown below in Table 9.
Preliminary results
Eight of the twelve MUC deployments were successful and yielded cores with sediment suitable for analyses (Table 10) while the events 32, 36, 37, and 50 were unsuccessful. In events 32 and 37 the sediment turned out to be hard to core, in event 36 the corer showed evidence of falling to the side after landing on a boulder and in event 50 the cause is unknown. On arrival on deck, the cores were removed from the MUC, placed into their holders, their sediment height measured and distributed to/labelled for the different groups for their individual treatment (Table 10).

Table 10. Distribution of MUC cores for analysis
<table>
<thead>
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<th>Code</th>
<th>Location</th>
<th>Sample Type</th>
<th>Count</th>
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<td>36</td>
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<td>51</td>
<td>Duse Bay 500m</td>
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<td>26</td>
<td>Meiobio (AV)</td>
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<tr>
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<td>Duse Bay 500m</td>
<td>7</td>
<td>34</td>
<td>X</td>
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<td></td>
<td>8</td>
<td>C-uptake exp/SOSC (AM)</td>
<td></td>
</tr>
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<td>10</td>
<td>X</td>
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<td>X</td>
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<td></td>
<td></td>
<td>11</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Duse Bay</td>
<td>1000m</td>
<td>1</td>
<td>Meiobio (AV)</td>
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</tr>
<tr>
<td></td>
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<td>2</td>
<td>20</td>
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<td>33</td>
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<td>5</td>
<td>36 Microplastics (KL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>32 Isotope (WR)</td>
<td></td>
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<td></td>
<td></td>
<td>7</td>
<td>30 Meiobio (AV)</td>
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<td>8</td>
<td>31</td>
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<td>12</td>
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<td></td>
</tr>
<tr>
<td>Duse Bay</td>
<td>1000m</td>
<td>1</td>
<td>Macrobi (AG)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Meiobio (AV)</td>
<td></td>
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<td></td>
<td>3</td>
<td>Macrobi (AG)</td>
<td></td>
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<tr>
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<td></td>
<td>4</td>
<td>Meiobio (AV)</td>
<td></td>
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<td></td>
<td></td>
<td>5</td>
<td>Macrobi (AG)</td>
<td></td>
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<td>9 Macrobi (AG)</td>
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<td>10</td>
<td>34 Pore Water (KL)</td>
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<td>Macrobi (AG)</td>
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<tr>
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<td>Isotope (WR)</td>
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<td></td>
<td></td>
<td>12</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
3.1. C-experiments

Anni Makela, Kirsten MacSween
Project lead: Professor Ursula Witte (u.witte@abdn.ac.uk)

Introduction and project aims
The original research plan was to assess the initial sediment carbon flow below the A68 ice shelf through isotope tracing experiments and sediment community oxygen consumption (SCOC) measurements. It was hypothesised that the seafloor habitat below the A68 has been an extremely oligotrophic environment with very little organic carbon available to benthic consumers, and therefore the sediment community carbon turnover would be very low, similar to oligotrophic deep Weddell Sea sites. The isotope taking experiments would have provided significant baseline assessment of the contributions of respiration and assimilation by bacteria and macrofauna to the overall sediment nutrient cycling, quantifying the sediment community organic matter processing rates. Due to heavy ice conditions, the expedition did not reach the Larsen C area, and a contingency plan was initiated. This plan involved measuring carbon flow in two contrasting 500 m sites at Duse Bay (oligotrophic site) and Prince Gustav Channel (mesotrophic site), off James Ross Island in the eastern Antarctic Peninsula. The regions were previously covered by the Larsen A ice sheet, with the southern entrance of Prince Gustav Channel being ice covered until early 1990s. Unfortunately, due to failed multicorer (MUC) deployment at stations 4 and 49 and rocky bottom in the Duse Bay making MUC sampling impossible, the comparison between two sites was abandoned and only one sediment incubation experiment was performed at station 33 at Cape Obelisk. The aim of the experiment was to measure the total sediment carbon turnover and to quantify the flow of particulate organic carbon through respiration and benthic consumer uptake during the isotope tracing experiment.

Methods
Bottom water for topping up sediment cores after water exchange was collected from the CTD rosette at each site where a sediment incubation experiment 1) was conducted or 2) was expected but not performed due to MUC failure (Table 11). The bottom water oxygen concentration was measured with a Winkler titration immediately after recovery and the results were compared to those obtained from the CTD. After the CTD deployment, 6 sediment cores were collected from a MUC deployment at station/even 33 (815 m), sealed with air-tight lids, topped up with the previously collected bottom water and incubated in a dark and temperature controlled room at 4°C during the experiments. An additional core was collected and sliced for porosity measurements at 0-1, 1-2, 2-3 and 3-5 cm intervals. During the first 48 hours, 100 ml water sample was removed from the cores every 6 hours to measure the oxygen concentration using Winkler titration. After 2 days, 10.3 mg of 13C-15N labelled phytoplankton (Thalassiosira nordenskioeldii) was added to three cores to initiate the isotope tracing experiment. Three cores acted as controls with no algal addition. The isotope tracing experiment took place over 4 days, during which water samples for nutrient analysis and dissolved inorganic carbon measurements were collected every 24 h, as well as overlying water for the oxygen concentration determinations. After 4 days, the sediment in the cores was sliced. Half of each slice for the 0-5 cm layers was frozen in -80°C for phospholipid fatty acid analysis at 1-2 cm intervals, whereas the other half was sieved with a 500 µm mesh sieve to obtain sediment fauna, which were preserved in a 4% seawater-formalin solution for later isotope tracer uptake analysis. Entire 5-10 cm and 10-15 cm sediment slices were collected for the sediment infauna. Dissolved inorganic carbon, nutrient, faunal and sediment samples will be transported back to University of Aberdeen for analysis after the cruise.
Table 11. Water collected from CTD deployments to top-up incubation cores

<table>
<thead>
<tr>
<th>Date</th>
<th>Event number</th>
<th>Depth (m)</th>
<th>Bottom water oxygen concentration (µmol l⁻¹) WINKLER</th>
<th>Bottom water oxygen concentration (µmol l⁻¹) CTD</th>
<th>Use of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.02.1018</td>
<td>1</td>
<td>2443</td>
<td>196 ± 5</td>
<td>176</td>
<td>Winkler test run, water discarded</td>
</tr>
<tr>
<td>02.03.2018</td>
<td>9</td>
<td>496</td>
<td>310 ± 4</td>
<td>305</td>
<td>MUC failure, water discarded</td>
</tr>
<tr>
<td>04.03.2018</td>
<td>31</td>
<td>685</td>
<td>315</td>
<td>298</td>
<td>Water used to top-up cores curing incubation experiment</td>
</tr>
<tr>
<td>06.03.2018</td>
<td>49</td>
<td>989</td>
<td>316 ± 3</td>
<td>301</td>
<td>MUC failure, water discarded</td>
</tr>
</tbody>
</table>

Preliminary observations
All samples collected during the isotope tracing experiments will be analysed later so no carbon flow experiment results are available. Even at 815 m there were several large epifaunal individuals trapped in the sediment cores. Oxygen consumption during the experiments was low.
It should be noted that the bottom water oxygen concentration measured with Winkler titration was generally 15-20 µmol l⁻¹ higher than the measurements obtained from the CTD at each station where water was collected. A CTD oxygen probe calibration is therefore recommended.

3.2. Meiofauna sampling

Ann Vanreusel

Samples were collected with a multicorer (MUC), type OCTOPUS at three deep stations (800, 1000 and 1250m) along a north-south gradient in the Prince Gustave Channel (PGC) and along a bathymetric transect in Duse bay (200, 500 and 1000m) (Table 12). At each station 1 to 4 cores from up to two different MUC deployments were collected (diameter of 10 cm). From each undisturbed core the overlying water was siphoned off over a 32 µm sieve and preserved with the surface sediment samples. The sediment of each core was sliced per 2 cm up to 8 cm. Each slice was cut in two equal parts of which one part was collected in a 250 ml vial and fixed with 4% formaldehyde (prepared with filtered seawater). The other half was put in plastic bags and frozen at -80°C. Samples fixed in 4% formaldehyde will be processed in the lab according to standard procedures for Meiofauna extraction, after estimation of the sediment volume to allow standardization. Also samples first needs to be sieved over a 1mm sieve to remove stones and to separate macrofaunal individuals which was in some stations abundantly present. This 1 mm fraction will be counted and weighted for macrofauna to relate the presence of potential larger bioturbators present in the samples to the Meiofauna community composition and vertical profiles. The frozen samples will be used
for multiple purposes including pigment concentrations, TOC and TN, granulometry, biomarker analysis, molecular identification of bulk Meiofauna (NGS) or individual barcoding of specific specimens.

Overall the samples will be used to test the following specific research hypotheses:
1. Differences in historical and present ice conditions, glacier impact, surface productivity and hydrodynamics along the channel results in major differences in seafloor conditions and its associated fauna in three adjacent deep basins.
2. The Meiofauna of the PGC deep basins are more similar to adjacent shelf fauna than to bathyal fauna from the Weddell sea
3. There is a significant change in Meiofauna communities within Duse bay from the potentially ice impacted shallow parts towards the possibly more sheltered deepest point of the basins which is expected to act as a carbon sink.

Table 12. List of samples processed for Meiofauna

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Area</th>
<th>depth (m)</th>
<th>latitude (S)</th>
<th>longitude (W)</th>
<th># cores</th>
<th>UGent numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/03/2018</td>
<td>6</td>
<td>Duse bay</td>
<td>1000</td>
<td>63.57557</td>
<td>57.29855</td>
<td>2</td>
<td>1A, 1B</td>
</tr>
<tr>
<td>1/03/2018</td>
<td>7</td>
<td>Duse bay</td>
<td>1000</td>
<td>63.56889</td>
<td>57.29919</td>
<td>2</td>
<td>1C, 1D</td>
</tr>
<tr>
<td>4/03/2018</td>
<td>33</td>
<td>PGC off obelisk Cape</td>
<td>800</td>
<td>64.13119</td>
<td>58.50451</td>
<td>1</td>
<td>2A</td>
</tr>
<tr>
<td>5/03/2018</td>
<td>39</td>
<td>PGC South</td>
<td>1250</td>
<td>63.97651</td>
<td>58.42942</td>
<td>2</td>
<td>3A, 3B</td>
</tr>
<tr>
<td>5/03/2018</td>
<td>40</td>
<td>PGC South</td>
<td>1250</td>
<td>63.97658</td>
<td>58.42954</td>
<td>2</td>
<td>3C, 3D</td>
</tr>
<tr>
<td>6/03/2018</td>
<td>48</td>
<td>PGC mid</td>
<td>1000</td>
<td>63.76125</td>
<td>57.96736</td>
<td>2</td>
<td>4A, 4B</td>
</tr>
<tr>
<td>7/03/2018</td>
<td>51</td>
<td>Duse Bay</td>
<td>500</td>
<td>63.61546</td>
<td>57.49913</td>
<td>4</td>
<td>5A, 5B, 5C, 5D</td>
</tr>
<tr>
<td>7/03/2018</td>
<td>55</td>
<td>Duse Bay</td>
<td>200</td>
<td>63.62481</td>
<td>57.48192</td>
<td>3</td>
<td>6A, 6B, 6C</td>
</tr>
</tbody>
</table>
4. Shallow-water camera system (SUCS)

Susie Grant, Rowan Whittle, Luisa Federwisch, Katrin Linse, Mel Mackenzie, Will Reid

The SUCS for JR17003a comprised three units:

1. The UIC unit consisting of (i) the PC with monitor, (ii) the cable metering sheave indicator and (iii) the deck box.

2. The deck unit consisting of (i) the winch, (ii) UW-cable, (iii) the deck monitor and (iii) the metering sheave on the mid-ships gantry.

3. The UW-unit of the tripod consisting of (i) the UW-housing including the camera, booster and power distribution board, (ii) the UW-light, (iii) the USBL pinger, and (iv) GoPro
camera with 1000 m depth-rated housing.

The SUCS includes 1000 m of fibre-optic cable, allowing operation to approximately 900m depth. A GoPro camera can also be fixed adjacent to the main UW-housing in its own 1000m depth-rated housing. The LabView interface together with the fibre-optic upgrade enables high- resolution photo stills (2448 x 2050) and video footage (720 x 480) to be taken simultaneously.

**Using SUCS during JR17003a**

The SUCS can be used to estimate faunal density, biomass and species abundance of the benthos, which is otherwise difficult to achieve because of the selectivity and semi-quantitative nature of capture by the AGT. In addition, it gives an overview of the conditions of the underwater landscape. The SUCS and Agassiz gears, when both deployed at the same site, increase the value of the data obtained. This is because specimens trawled in the latter and identified by detailed morphological inspection or using molecular methods improve the likelihood and confidence of correct identifications of individuals seen in the SUCS images. The SUCS was deployed at 12 stations (ranging in depth from 200 m to 800 m), according to weather and accessibility due to ice conditions. The SUCS was used extensively during the time when heavier gear could not be operated due to problems with the 30t winch, allowing coverage of a wider range of depth stations (Table 13). On one occasion SUCS deployment was delayed because of very cold temperatures (-15°C) affecting the backlight of the winch monitor screen. This was resolved by re-routing the image output to an alternative monitor, and using a portable heater for subsequent deployments.

Normal protocol involved three consecutive photo transects, the direction of which was determined by the bridge according to wind direction (to allow the ship to sit comfortably in dp), each 100 m apart, with each complete transect consisting of 10 photos, themselves each 10 m apart. Duplicates of each photo were taken with different light levels, to allow distinguishing of different features. At two locations the three transects were not fully completed because of icebergs in close vicinity to the ship or problems with gear. Additional photos were sometimes taken during the 10 m relocation if the camera showed a good view, however these photos will not be included in subsequent analysis. Short videos using the SUCS camera were taken at some transect points or during relocations. The mounted GoPro video camera attached to the camera frame was also used to record the entire event (for events 24, 28 and 56 only). While this footage is not easy to analyse quantitatively, because of the distorting effects of the fisheye lens and the wider field of view, it complements that of the main SUCS and can be used to help characterise the seabed.

SUCS images and video were also used to assess the suitability of the substrate at each location for subsequent deployments of the AGT, EBS and MUC. During each SUCS deployment, general notes were made on the substrate type, observed taxa and dominant communities. Preliminary characterisations and example photographs for each station are given below.
Table 13. SUCS deployments at each site and depth

<table>
<thead>
<tr>
<th>Date</th>
<th>Event No.</th>
<th>Site name</th>
<th>Depth¹</th>
<th>Latitude²</th>
<th>Longitude²</th>
<th>Number of transects / photos</th>
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<tr>
<td>02/03/18</td>
<td>11</td>
<td>Duse Bay</td>
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<td>-63.6154</td>
<td>-57.4976</td>
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<td>-63.6243</td>
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</tr>
<tr>
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<td>17</td>
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<td>300 m</td>
<td>-63.619</td>
<td>-57.4848</td>
<td>3 / 30</td>
</tr>
<tr>
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<td>18</td>
<td>Duse Bay</td>
<td>400 m</td>
<td>-63.6154</td>
<td>-57.4869</td>
<td>3 / 30</td>
</tr>
<tr>
<td>03/03/18</td>
<td>22</td>
<td>Prince Gustav Channel - South</td>
<td>800 m</td>
<td>-64.0412</td>
<td>-58.4526</td>
<td>3 / 26</td>
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<tr>
<td>03/03/18</td>
<td>24</td>
<td>Prince Gustav Channel - Cape Obelisk</td>
<td>800 m</td>
<td>-64.111</td>
<td>-58.4995</td>
<td>3 / 30</td>
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<td>-64.1108</td>
<td>-58.4777</td>
<td>3 / 30</td>
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<tr>
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<td>Prince Gustav Channel - South</td>
<td>200 m</td>
<td>-64.0333</td>
<td>-58.4185</td>
<td>3 / 30</td>
</tr>
<tr>
<td>04/03/18</td>
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<td>500 m</td>
<td>-64.0363</td>
<td>-58.4328</td>
<td>3 / 30</td>
</tr>
<tr>
<td>04/03/18</td>
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<td>Prince Gustav Channel - Cape Obelisk</td>
<td>400 m</td>
<td>-64.128</td>
<td>-58.4750</td>
<td>3 / 30</td>
</tr>
<tr>
<td>06/03/18</td>
<td>45</td>
<td>Prince Gustav Channel - mid</td>
<td>850 m</td>
<td>-63.8044</td>
<td>-58.0632</td>
<td>3 / 29</td>
</tr>
<tr>
<td>08/03/18</td>
<td>58</td>
<td>Andersson Island</td>
<td>500 m</td>
<td>-63.6846</td>
<td>-56.5787</td>
<td>3 / 30</td>
</tr>
</tbody>
</table>

¹General station depth – see event log for depths along all transects
² Coordinates for start of the first transect (action recorded as ‘on the bottom’)

47
Event 11 – Duse Bay (500 m)

Substrate: soft sediment/mud.
Characterized by an abundance of small ophiuroids buried in the mud, with larger ophiuroids on the surface.
Other fauna observed: amphipods, decapods, demosponges (large, yellow green), swimming crinoids, ascidians (orange, and blue specimens - Molgula pedunculata?), umbelulla, asteroids, tunicates (long white stalked compound), anemones, large holothurians (Bathyplotes bongrani, Protelpidia murrayi), white shelled gastropod, pycnogonids, worms, icefish (Cryodraco antarcticus) and krill in the water column.

Event 15 – Duse Bay (200 m)

Substrate: mud with some coarser sediments, presence of small dropstones with associated fauna.
Characterized by abundance of deposit feeders. Other fauna observed: worms, small buried ophiuroids, larger ophiuroids on surface, large ascidians, crinoids (pink), gorgonians, bryozoans (grouped and leaf shaped), pencil urchins, several sponge species, pycnogonids, asteroids, anemones, large hydroids, possible small white bivalves, octocorals, possibly compound ascidians, sabellid worms and icefish (*Cryodraco antarcticus*).

**Event 17 – Duse Bay (300 m)**

Substrate: Mud
Characterised by small and large ophiuroids, Other fauna observed: sponges, bryozoans, ascidians, possible corals, bivalves, small crustaceans.
Event 18 – Duse Bay (400 m)

Substrate: Mud
Characterised by small and large ophiuroids
_Umbellula_, crinoids, large pycnogonids, large polychaetes, sponges, ascidians, asteroids, icefish. Worm/other burrows.

Event 22 – Prince Gustav Channel South (800 m)

Substrate: Mud with coarse gravel, compacted, smaller and larger boulders present.
Characterised by a high abundance of benthic fauna, particularly large ophiuroids. Ophiuroids at this locality were epifaunal rather than infaunal.
Other fauna observed: ophiuroids, asteroids including large yellow thin armed starfish (and _Labidiaster_?), gorgonians (_Thouarella_?), several types of sponge (demosponges), ascidians (_Molgula_?), pycnogonids, worms, hydroids, icefish, holothurians, stalked ctenophore, crinoids, bryozoans and ascidians. Large amount of organic matter, fish and krill in the water column.
Event 24 – Prince Gustav Channel Cape Obelisk (800 m)

Substrate: Coarse mud with dropstones, some large with abundant fauna on them, possibly a strong current. Characterised by large ophiuroids. Other fauna observed: large and small ophiuroids, small pycnogonids, some crustaceans, ascidians (long compound, orange, and stalked) octocorals, asteroids, holothurians, icefish, crinoids, anemones, hydroids, antarcturids, Thouarella gorgonians, demosponges, possible pteropod in video clip, shrimps, bryozoans. Lots of organisms in the water column, including fish in and between transects.

Event 25 – Prince Gustav Channel Cape Obelisk (500 m)
Substrate: Coarse mud, small to medium sized dropstones
Characterised by abundant fauna, large ophiuroids, crinoids and gorgonians.
Other fauna observed: Large and small ophiuroids, some infuana in the sediment, gorgonians (Thouarella), crinoids, yellow deomosponges, sponges, pycnogonids, polychaetes, holothurians, hydroids, pencil urchins, shrimps, fish, sabellid worms, flatworm, stalked ascidians, Chemidocarpa (orange ascidian), asteroids, Polychaetes (Flabellid?).

Event 27 – Prince Gustav Channel Cape South (200 m)

Substrate: gravel and stones, some sandy areas, some boulders.
Characterised by many stones and boulders with associated organisms.
Other fauna observed: large epifaunal ophiuroids, crinoids, bryozoans, urchins (Sterechinus), gorgonians including Thouarella (many in some places), Chemidocarpa, hydroids, sponges and demosponges, asteroids, stalked ascidians.
Event 28 – Prince Gustav Channel South (500 m)

Substrate: rocks with soft sediment on top, some gravel in sandy mud. Characterised by high abundance of holothurians, crinoids, scaleworms. Other fauna observed: large ophiuroids, arms of smaller ones in sediment, abundant crinoids, holothurians, asteroids, pycnogonids, a gastropod, worms, gorgonian - *Thouarella*, sponges, scaleworms, sabellid worms, bryozoans, benthic ctenophore, stalked ascidian, pink soft coral, fish, urchins.

Event 30 – Prince Gustav Channel Cape Obelisk (400 m)

Substrate: Soft sediment with small dropstones and boulders. Characterised by organisms on dropstones.
Big epifaunal ophiuroids, infaunal ophiuroids with arms sticking out of sediment, anemones, branching bryozoans, crinoids, yellow asteroids, pycnogonids, hydroids, sponges and demosponges, big polychaetes, Notocrangon, gorgonians (some fan shaped, Thouarella), asteroids, pencil urchin, sea urchins, holothurians (Cucmariidae, Bathyploites), stalked ascidians, solitary ascidians (large - Chemidocarpa?) and abundant fauna in the water column including abundant krill.

Event 45 – Prince Gustav Channel – mid (850 m)

Substrate: gravel and small stones, covered with sediment. Some small dropstones
Characterised by
Other fauna observed: sponges, compound ascidians, other ascidians, demosponges, pycnogonids, ophiuroids – intermediate size and less abundant than at other stations, benthic ctenophore, bryozoans, hydroids, siphonophore, holothurians, asteroid, fish.
Substrate: mud
Characterised by infaunal ophiuroids.
Epifaunal and infaunal ophiuroids, bryozoans, sponges, krill in water column, ctenophores, small pycnogonids, icefish, anemones, sponges, holothurians on hydrozoans and bryozoans, compound ascidians, sea urchins, shrimp, small bryozoans, crinoids during transect move.
5. Bongo

Sophie Fielding, Will Reid, …

Aim: Sample the pelagic foodweb, for isotope analysis and diversity where relevant.

Method: The bongo was fitted with a 100 µm and 200 µm mesh nets. Where possible it was deployed to 200m, in shallower waters it was 150m. The sample was either preserved in formalin or filtered onto an ashed GFF for isotope analysis.

Comments: Through a combination of weather (winds 25-30 knots) and a winch failure there were only 3 bongos undertaken, 2 in Duse Bay and 1 in Prince Gustav Channel. All samples were very small. The first sample from Duse Bay was preserved. The second two samples were filtered onto ashed GFFs and frozen at -80C. A cursory examination of the samples indicated some copepods, a siphonophore (and several bladders) in the third sample, but mostly krill fecal pellets.

Fig. 23 Locations of Bongo events
<table>
<thead>
<tr>
<th>Event No</th>
<th>Site Name</th>
<th>Water depth (ea600-depth)</th>
<th>Net Max Depth</th>
<th>Catch Fate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Duse Bay 500m</td>
<td>500.4</td>
<td>210</td>
<td>Formalin</td>
</tr>
<tr>
<td>10</td>
<td>Duse Bay 500m</td>
<td>500.4</td>
<td>210</td>
<td>Formalin</td>
</tr>
<tr>
<td>10</td>
<td>Duse Bay 500m</td>
<td>493.31</td>
<td>210</td>
<td>Formalin Filtered for isotopes/frozen</td>
</tr>
<tr>
<td>13</td>
<td>Duse Bay 200m</td>
<td>202.62</td>
<td>150</td>
<td>Filtered for isotopes/frozen</td>
</tr>
<tr>
<td>13</td>
<td>Duse Bay 200m</td>
<td>203.23</td>
<td>150</td>
<td>Filtered for isotopes/frozen</td>
</tr>
<tr>
<td>13</td>
<td>Duse Bay 200m</td>
<td>203.83</td>
<td>150</td>
<td>Filtered for isotopes/frozen</td>
</tr>
<tr>
<td>20</td>
<td>Prince Gustav 1</td>
<td>796.62</td>
<td>200</td>
<td>Part filtered for isotopes and frozen</td>
</tr>
<tr>
<td>20</td>
<td>Prince Gustav 1</td>
<td>803.22</td>
<td>200</td>
<td>Part filtered for isotopes and frozen</td>
</tr>
<tr>
<td>20</td>
<td>Prince Gustav 1</td>
<td>805.14</td>
<td>200</td>
<td>Part filtered for isotopes and frozen</td>
</tr>
</tbody>
</table>
6. CTD deployment and data acquisition
Hugh Venables, Luisa Federwisch, Sophie Fielding

Introduction
A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. 9 casts were carried out in total. CTD positions are included in Appendix 4. CTD profiles were numbered by event number.

CTD instrumentation and deployment
An SBE32 carousel water sampler, holding 24 12-litre niskin bottles, an SBE9Plus CTD and an SBE11Plus deck unit were used. The SBE9Plus unit held dual SBE3Plus temperature and SBE4 conductivity sensors and a Paroscientific pressure sensor. An SBE35 Deep Ocean Standards Thermometer makes temperature measurements each time a bottle is fired, and time, bottle position and temperature are stored, allowing comparison of the SBE35 readings.
with the CTD and bottle data. Additional sensors included an altimeter, a fluorometer, an oxygen sensor, a photosynthetically active radiation (PAR) sensor and a transmissometer. The altimeter returns real-time accurate measurements of height off the seabed within approximately 100m of the bottom. This allows more accurate determination of the position of the CTD with respect to the seabed than is possible with the Simrad EA600 system, which sometimes loses the bottom or reverts to default values (approximately multiples of 500m) and, in deep water, often returns depths that are several tens of metres different from the true bottom depth. A fin attached to the CTD frame reduced rotation of the package underwater. The CTD package was deployed from the mid-ships gantry on a cable connected to the CTD through a conducting swivel.

CTD data were collected at 24Hz and logged via the deck unit to a PC running Seasave version 7.22.3 (Sea-Bird Electronics, Inc.), which allows real-time viewing of the data. The procedure was to start data logging, deploy the CTD, then stop the instrument at 10m wireout, where the CTD package was left for at least two minutes to allow the seawater-activated pumps to switch on and the sensors to equilibrate with ambient conditions. On a couple of occasions the pumps were late to turn on, due to seawater freezing onto the CTD at deployment (air temperatures down to -15°C), with the package lowered to 50m for the initial soak on one of these occasions.

After the 10m soak, the CTD was raised to as close to the surface as sea conditions allowed and then lowered to within 10m of the seabed. In calm conditions the CTD was taken to 5m off the seabed to improve the water sampling for benthic biologists. Bottles were fired on the upcast, where the procedure was to stop the CTD winch, hold the package in situ for a few seconds to allow sensors to equilibrate, and then fire a bottle. The CTD was left at this depth for 10 seconds to allow the SBE35 temperature sensor to take readings over 8 data cycles. The sensor averages these readings to produce one value for each bottle fire. If duplicate bottles were fired at any depth the SBE35 does not take readings unless there is a 20 second gap between firings. The unit needs time to recharge between firings but can cope with two in succession.

For temperature below -13°C water in the Niskin bottles was freezing during recovery, leading to either no water coming out of the outflow or the flow stopping after about a quarter of a litre. Sampling was delayed to allow thawing in the annexe but the was a clear risk of fractionation or other issues with the sampled water.

**Data acquisition and preliminary processing**

The CTD data were recorded using SeaSave version 7.22.3, which created four files:

- `JR17003a_[NNN].hex` hex data file
- `JR17003a_[NNN].XMLCON` ascii configuration file containing calibration information
- `JR17003a_[NNN].hdr` ascii header file containing sensor information
- `JR17003a_[NNN].bl` ascii file containing bottle fire information

where NNN is the CTD number (column 1 in Table 2.5.1).

The SBE Data Processing `Data_cnv` was used to convert the hex file to ascii. `Align` was then used to account for the time lag of the oxygen sensor, with data being advanced by 5 seconds. `Cell thermal mass` module was then used to remove the conductivity cell thermal mass effects from the measured conductivity. This re-derives the pressure and conductivity, taking into account the temperature of the pressure sensor and the action of pressure on the conductivity cell. The output of this process is an ascii file, named as `JR17003a_[NNN]_align_ctm.cnv`.

**SBE35 high precision thermometer**

Data from the SBE35 thermometer were uploaded after every cast using the `SeaTerm` program. Once the readings had been written to an ascii file, the file was opened and the
contents checked to make sure the correct number of readings had been stored. The memory of the SBE35 was then cleared using the `samplenum=0` command. To check that the memory was clear, the command `ds` was entered, which displays the number of data points stored in the instrument's memory. This number should be 0. The date and time are also shown by the `ds` command and these should be checked and corrected if needed.

Salinity samples

Salinity samples were taken from deep areas with little salinity gradient and the mixed layer depth. However, attempts to run the samples were initially delayed by fluctuating lab temperatures (linked to very cold conditions outside and ship heating changes) and then thwarted by a faulty salinometer. Although used successfully on JR17003 and with no changes since, the readings were too low (1.8 5xxx rather than 1.9 99xx) and rose rapidly when the pumps were switched off, as happens when very cold water is run through where heat exchange is ongoing in the cells. The lab temperature was however stable at 21.5˚C and the water was at this temperature (bath temperature 24˚C, same temperatures as for JR17003). When left, the reading appeared to stabilise at 1.9 7xxx, still too low. No obvious reasons for this were found and it was repeatable over several tests.

Following problems on JR17003 of salt crystals building up around the tops of the bottles some testing was done and this could be replicated if the bottle cap was put on with seawater in it or the bottle not wiped, whether the bottle was upside down or the right way up. Seawater droplets on the bottle dried in situ rather than running down the bottle so are not the cause of the salt build up around the cap (for upside down bottles). Post-processed bottles with seawater in but no stopper also showed salt build up if placed upside down, making this a bad option (and the cap gets wet). The procedure of wiping the neck and mouth of the bottle and the cap (if it needed rinsing at all), placing a dry stopper in the bottle and leaving upside down worked for about half the bottles, with the others showing salt buildup over time, most likely linked to expansion-related leaking through the stopper. The argument for upside down bottles being so they have to be turned to be run on the salinometer and to distinguish which bottles have samples but leaving them the right way up appears better, so long as processed bottles are not then put upside down to distinguish them.

CTD data processing

Further processing of CTD data was carried out in Matlab using existing programs, predominantly written by Mike Meredith and Karen Heywood, with modifications by numerous others, and further significant changes made on JR177 and JR307. Further significant changes, mostly generalising the code to reduce the number of adjustments needed between cruises were made on JR17003a and described below. The processing routines were split into two subsets: those that could be carried out in the absence of salinity calibration data and those that required the JR17003a_master.xls file containing the salinometer readings. The first subset of programs was run following each CTD cast and allowed a visual check of the data to ensure that the instruments were working correctly. The second subset was run for those CTDs for which salt samples had been collected, following the salinity analysis. The first subset of Matlab routines applied to the CTD data is as follows:

- `CTDvarn` allows users to define directory paths, file naming conventions, the order and presence of variable output in the seabird .cnv files and which variables should be processed at each step during the processing, thereby avoiding the need to edit the following scripts for standard changes between cruises and CTD setups.

- `ctdreadGEN` invokes the `cnv2mat` routine written by Rich Signell to read in the `JR17003a___NNN_align_ctm.cnv` file (cruise_NNN_fileappend.cnv with the constituent parts defined in `CTDvarn`). Data are stored in Matlab arrays and named accordingly. Latitude and longitude are now written into the file during data capture. The output file is of the form
• *editctdGEN* reads in *JR17003a_ctd_NNN.red* and removes the 10m soak prior to the CTD cast, through finding the minimum pressure after the soak and asking for user confirmation after displaying the full pressure plot for the cast. For unusual casts there is then the option to manually enter a scan count for the start of a cast or edit out pressure spikes. Data collected at the end of the upcast when the CTD was out of the water is removed graphically by selecting bad conductivities when the package is out of the water, these going wrong before pumps are switched off and at pressures either side of zero depending on pressure sensor offsets. The selected data points are set to NaN for all scientific sensors. Primary and secondary conductivity are also despiked using the interactive editor at the same time, with the option to edit the temperature profiles and T/S plots (where small conductivity spikes can be more obvious). Selected data points are set to NaN. These points are also set to NaN for PAR, fluorescence, oxygen and transmission. Output is *JR17003a_ctd_NNN.edt*.

batchGEN.m then runs:
• *deriveGEN* (what was the second half of salcalapp) loads *JR17003a_ctdNNN.edt* (no interpolation done as seems a bad idea, so .edt rather than .int) and calculates salinity, potential temperature and $\sigma_\theta$, $\sigma_2$ and $\sigma_4$ as per the UNESCO 1983 algorithms by invoking the routines *sw_salt*, *sw_ptmp* and *sw_pden*. $\theta$ and salinity are calculated for both the primary and secondary sensors, whilst $\sigma$ is calculated using primary temperature and conductivity. Output is *JR17003a_ctd_NNN.var*.

• *splitcastGEN* reads in *JR17003a_ctd_NNN.var* and splits the downcast and upcast into *JR17003a_ctd_NNN.var.dn* and *JR17003a_ctd_NNN.var.up*. As the pressure profile has been checked, this can be safely done using the maximum pressure.

• *fallrateGEN* was added on JR307 (after retrospectively being applied to JR161 and JR177 data and JR299 through mstar processing). It is a matlab version of the seapath loopedit script. It has to be run after the initial soak is removed as it removes any datapoint on the downcast where pressure is less than one previously recorded or if the fall rate is <0.25 ms$^{-1}$. Loopedit flags such points (excluding the initial soak if set to) but these flags were not subsequently used in the processing and often did erroneously include the initial soak. This process results in smoother density profiles with fewer apparent overturns. Input and output is *JR17003a_ctd_NNN.var.dn* – it is not run on the upcast as it will remove bottle stops.

• *gridctdGEN* reads in both *JR17003a_ctd_NNN.var.dn* and *JR17003a_ctd_NNN.var.up*, and averages the data into 2dbar bins. Data are padded with NaNs to 5999dbar, thereby ensuring that arrays for all CTDs are the same size. Outputs are *JR17003a_ctd_NNN.2db.mat* and *JR17003a_ctd_NNN.2db.up.mat*.

• *fill_to_surf* was not run. It allows any missing data at the surface to be filled with values from the next non-NaN line. This should only be carried out where the upper water column is well mixed. Missing values for the time stamp and PAR are left as NaNs. The output file is the same as the input file.

• *ctdplotGEN* reads in *JR17003a_ctd_NNN.2db.mat* and plots profiles of $\theta$ and salinity (both primary and secondary), density, fluorescence, transmission, oxygen and PAR. Plots are output for the entire CTD depth, for only the upper 200m of the cast and the lower 150m. These plots are saved as png files and printed.

The second subset of Matlab programs is as follows: [these have not been generalised but it wouldn’t be hard to do so]
• *makebot17003a* reads in *JR17003a_ctdNNN.ros*, *JR17003a_ctdNNN.BL* and *JR17003a_ctdNNN.int*, and extracts CTD pressure, temperature (1 & 2), conductivity (1 & 2), transmission, fluorescence, oxygen and PAR for each bottle fired. It also calculates the standard deviation for pressure, temperature and conductivity, and writes a warning to the screen if those for temperature and conductivity are greater than 0.001. Salinity and potential temperature are calculated from both primary and secondary temperature and conductivity using *ds_salt* and *ds_ptmp*. Results are saved in *JR17003abotNNN.1st*. 61
• `readsal17003a` extracts salinity calibration data from `JR17003a_master.xls` and reads in `JR17003abotNNN.1st`. Data from duplicate salinity samples are stored in `niskinsalts.mat`, and if the standard deviation of these samples is >0.002, a warning is written to the screen. Output is `JR17003asalNNN.mat`.
• `addsal17003a` reads in `JR17003abotNNN.1st` and `JR17003asalNNN.mat`, and stores all salinity information in `JR17003abotNNN.sal`.
• `setsalflag17003a` loads `JR17003abotNNN.sal` and flags those bottles with high standard deviations for temperature and conductivity. Output would be `JR17003abotNNN.sal` but it wasn’t run, this filtering being taken into the _decide scripts to allow adjustments of thresholds.
• `sb35read17003a` loads `JR17003asbeNNN.asc`, `JR17003abotNNN.1st` and `JR17003a_ctdNNN.cal`, and plots SBE35 temperature minus CTD temperature (1 & 2) for a visual check. The SBE35 data are saved in `JR17003a_botNNN.sb35` and SBE35 temperature minus CTD temperature is saved in `tempcals.all.mat`. This script must be run prior to `salcal17003a`.
• `salcal17003a` loads `JR17003abotNNN.sal`, `JR17003a_ctdNNN.int` and `tempcals.all.mat`, and uses sample salinities and SBE35 temperatures to calculate conductivity offsets for both CTD sensors. All offsets are stored in `salcals.all.mat`. Plots of temperature and conductivity offsets are output to the screen.
• `tempcal_decide` and `salcal_decide` read in `tempcals.all.mat` and `salcals.all.mat`, and plots primary and secondary temperature and conductivity minus SBE35 temperature and conductivity calculated from the salinity samples. This allows determination of any offsets that should be applied to calibrate the CTD sensors. Temperature offsets are needed first for the back-calculation of conductivity from bottle samples. The two offsets for each sensor should be checked to make sure they remove differences between the sensors as well as fit them to the calibration values available.
• Once this second subset of programs has been run the offsets found in calibrations are entered into `salcalapp`, which is then run again. Any required temperature or conductivity offset is applied here, and salinity, θ, and σ are recalculated, all with _cal appended to variable names. Offset data are saved in `JR17003abotNNN.cal`. All programs following `salcalapp` must then be re-run with versions including the _cal variables. There are currently different versions but these could easily be merged with options for filename endings and CTDvarn column. Calibration is done to conductivity before the fallrate script as this allows further changes to either calculation of salinity or how to deal with package effects on the profile to be applied to calibrated data.

**CTDvarn.m:**

```matlab
dir_sb='C:\hjv\JR17003a\ctd\sbproc\';
dir_out='C:\hjv\JR17003a\ctd\procMB\';
dir_plots='C:\hjv\JR17003a\ctd\plots\';
cruise='JR17003a';
sb_fileadd='_align_ctm'; %expecting cruise_nnn.sb_fileadd.cnv
addpath('C:\hjv\mtlab\seawater')%set path
addpath('C:\hjv\Code\matlab_codes')

%want a code for each section of a script, so that script can find the
%matching column (rather than hard-coded column number, allows columns to
%be added or removed

%Variable names set in table below, some script editing needed if these are
%changed (temp1/2, cond1/2, press)
columnuse={'variable_name' 'seabird_output_position' 'want_to_read'
'plus_derive' 'edit_vars' 'ctd_plot'};
```


varnames={
  'scan'   1    1   1   0   0
  'time_elapsed'   2    1   1   0   0
  'press'   3    1   1   0   0
  'temp1'   4    1   1   1   0
  'temp2'   5    1   1   1   0
  'cond1'   6    1   1   1   0
  'cond2'   7    1   1   1   0
  'oxygen_ml_l'   8    1   1   1   0
  'oxygen_umol_l'   0    1   1   1   0
  'oxygen_V'  10    1   1   1   0
  'oxygen_umol_kg'   9    1   1   1   0
  'BeamTrans'  15    1   1   1   2
  'alt'  12    1   1   0   0
  'fluor_ug_l'  13    1   1   1   1
  'pumps'  14    1   1   0   0
  'flag'  19    1   1   0   0
  'par'   16    1   1   1   4
  'par2'   0    1   1   1   0
  'PressTemp'  11    1   1   0   0
  'nitrate'   0    1   1   1   0
  'latscan'  17    1   1   0   0
  'lonscan'  18    1   1   0   0
  'salin1'  -1    0   1   0   0
  'salin2'  -1    0   1   0   0
  'potemp1'  -1    0   1   0   0
  'potemp2'  -1    0   1   0   0
  'sig0'  -1    0   1   0   0
  'sig2'  -1    0   1   0   0
  'sig4'  -1    0   1   0   0
  'depth'  -1    0   1   0   0
  'salin1_cal'  -1    0   0   0   0   1
  'salin2_cal'  -1    0   0   0   0   1
  'potemp1_cal'  -1    0   0   0   0   1
  'potemp2_cal'  -1    0   0   0   0   1
  'sig0_cal'  -1    0   0   0   0   1
  'sig2_cal'  -1    0   0   0   0   1
  'sig4_cal'  -1    0   0   0   0   1
  'temp1_cal'  -1    0   0   0   0   1
  'temp2_cal'  -1    0   0   0   0   1
  'cond1_cal'  -1    0   0   0   0   1
  'cond2_cal'  -1    0   0   0   0   1
};

%make 1/0 vector of whether sensor is present (column2>0) and variable wanted (column 3~0)

sv=size(varnames);
v=p=zeros(sv(1),1);
vpd=zeros(sv(1),1);
for iv=1:sv(1)
  vp(iv)=(varnames{iv,2}*varnames{iv,3})>0;
  vpd(iv)=(varnames{iv,2}*varnames{iv,4})~=0;  %including derived variables
end

iic=find(strcmp(columnuse,'cal_var')); %ensure looking at right column

sv=size(varnames);

vpp=zeros(sv(1),1);
6.1 Water sampling

*Luisa Federwich*

At five stations, bottom water samples (4 L) were collected from the CTD rosette sampler for analysis of silicon (Si) and oxygen (O) isotopes, as well as microbial communities in...
comparison to collected sponges. The water was filtered through 0.2 µm Sterivex polycarbonate filters (Durapore, Millipore) using a single glass filtration unit and a vacuum pump (Fig. 25). The filters were folded into ethanol-sterilized aluminum foil and frozen at -80 °C for later molecular analysis of microbes. For Si/O isotope analysis, 2 L of the filtered water were filled into acid-washed plastic bottles and stored at +4 °C.

Suitable sponges for Si and O isotope analysis could be collected at four of the stations, but for microbiome analysis enough sponge material could only be collected at one station (Table 15; see also Chapter 1.4). The respective water samples will be analysed in collaboration with Andrea Abelmann (AWI, Germany). Filters will be analysed in collaboration with Ute Hentschel (GEOMAR, Germany).

Table 15: Overview of collected water samples and filters for Si/O isotope and microbiome analysis, respectively. Samples will only be analysed for stations where suitable sponges could be collected (PGC = Prince Gustav Channel).

<table>
<thead>
<tr>
<th>Event #</th>
<th>Location</th>
<th>Water</th>
<th>Filter</th>
<th>Sponges collected for analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>09</td>
<td>Duse Bay, 500 m</td>
<td>1</td>
<td>0</td>
<td>Si/O isotopes</td>
</tr>
<tr>
<td>12</td>
<td>Duse Bay, 200 m</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>PGC South, 800 m</td>
<td>1</td>
<td>1</td>
<td>Si/O isotopes</td>
</tr>
<tr>
<td>42</td>
<td>PGC South, 1250 m</td>
<td>1</td>
<td>1</td>
<td>Si/O isotopes</td>
</tr>
<tr>
<td>44</td>
<td>PGC Mid, 850 m</td>
<td>1</td>
<td>1</td>
<td>Si/O isotopes, microbiomes</td>
</tr>
</tbody>
</table>

Fig. 25: Setup of filtration unit for analysis of silicon and oxygen isotopes as well as microbial communities in the bottom water (photo: Luisa Federwisch).
6.2. Vertical profiles of Chlorophyll-a

**Sophie Fielding**

Aim: Profile water column productivity at each benthic station.
Method: Chlorophyll-\(a\) samples were taken at 8 CTD stations at 5, 20, 50, 75, 100 and 200m depth. 500ml water samples were filtered through 25mm Whatmann GFF glass fibre filters (Table 16). Filters were placed in vials and stored in the -80°C freezer for analysis in Cambridge.

**Table 16. Sample log of Whatmann filters.**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event No</th>
<th>Site name</th>
<th>Bottle No</th>
<th>Filter No</th>
<th>Vol filter (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>17</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>15</td>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>14</td>
<td>3</td>
<td>500</td>
</tr>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>11</td>
<td>4</td>
<td>500</td>
</tr>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>9</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>01/03/2018 14:51</td>
<td>3</td>
<td>Duse Bay 1000m</td>
<td>8</td>
<td>6</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>19</td>
<td>7</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>17</td>
<td>8</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>15</td>
<td>9</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>13</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>11</td>
<td>11</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 09:22</td>
<td>9</td>
<td>Duse Bay 500m</td>
<td>10</td>
<td>12</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>14</td>
<td>13</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>12</td>
<td>14</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>10</td>
<td>15</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>8</td>
<td>16</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>6</td>
<td>17</td>
<td>500</td>
</tr>
<tr>
<td>02/03/2018 13:57</td>
<td>12</td>
<td>Duse Bay 200m</td>
<td>4</td>
<td>18</td>
<td>500</td>
</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
<td>20</td>
<td>19</td>
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</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
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</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
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<td>500</td>
</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
<td>13</td>
<td>22</td>
<td>500</td>
</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
<td>11</td>
<td>23</td>
<td>500</td>
</tr>
<tr>
<td>03/03/2018 10:20</td>
<td>19</td>
<td>PGC South 800m</td>
<td>9</td>
<td>24</td>
<td>500</td>
</tr>
<tr>
<td>04/03/2018 17:43</td>
<td>31</td>
<td>PGC Cape Obelisk 800m</td>
<td>19</td>
<td>25</td>
<td>500</td>
</tr>
<tr>
<td>04/03/2018 17:43</td>
<td>31</td>
<td>PGC Cape Obelisk 800m</td>
<td>17</td>
<td>26</td>
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<tr>
<td>04/03/2018 17:43</td>
<td>31</td>
<td>PGC Cape Obelisk 800m</td>
<td>15</td>
<td>27</td>
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</tr>
<tr>
<td>04/03/2018 17:43</td>
<td>31</td>
<td>PGC Cape Obelisk 800m</td>
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<tr>
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<tr>
<td>Date</td>
<td>Time</td>
<td>Distance</td>
<td>Name</td>
<td>Lap 1</td>
<td>Lap 2</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
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</tr>
<tr>
<td>04/03/2018</td>
<td>17:43</td>
<td>800m</td>
<td>PGC Cape Obelisk</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>05/03/2018</td>
<td>23:06</td>
<td>800m</td>
<td>PGC South 1250m</td>
<td>42</td>
<td>23</td>
</tr>
<tr>
<td>05/03/2018</td>
<td>23:06</td>
<td>800m</td>
<td>PGC South 1250m</td>
<td>42</td>
<td>21</td>
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<td>PGC South 1250m</td>
<td>42</td>
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</tr>
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<td>800m</td>
<td>PGC South 1250m</td>
<td>42</td>
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<tr>
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<td>42</td>
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<tr>
<td>05/03/2018</td>
<td>23:06</td>
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<td>PGC South 1250m</td>
<td>42</td>
<td>12</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>13:27</td>
<td>800m</td>
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<td>44</td>
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</tr>
<tr>
<td>06/03/2018</td>
<td>13:27</td>
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<td>44</td>
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<td>06/03/2018</td>
<td>13:27</td>
<td>800m</td>
<td>PGC mid 800m</td>
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<td>06/03/2018</td>
<td>13:27</td>
<td>800m</td>
<td>PGC mid 800m</td>
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<td>06/03/2018</td>
<td>13:27</td>
<td>800m</td>
<td>PGC mid 800m</td>
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<td>11</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>13:27</td>
<td>800m</td>
<td>PGC mid 800m</td>
<td>44</td>
<td>9</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>17</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>15</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>13</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>11</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>9</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>22:57</td>
<td>1000m</td>
<td>PGC mid 1000m</td>
<td>49</td>
<td>7</td>
</tr>
</tbody>
</table>
7. Underway navigational data  
Hugh Venables

Instrumentation and data collection
Navigational data were collected continuously throughout the cruise. Instrumentation was as follows:
Sperry Mk 37 Model D Gyrocompass
Seatex GPS (Seapath 307)
Hull-mounted Simrad EA600 Hydrographic 12kHz Echosounder (transducers located approximately 5m below the water level).

Navigational data were collected every second, whilst the bathymetric data were logged every 10 seconds.

Processing
Navigational data were processed in Unix (ssh pstar@jrlc, pw pstar) and Matlab using modified versions of programs developed by Mike Meredith. Data were initially read into the Unix system, then transferred to Matlab, where the bulk of the processing was carried out. Directory structures are written in to follow the pattern of the data being stored in parallel directories from the code (././stream/daily_file relative to the code) for both unix and matlab scripts.

Unix
get_nav Calls the scripts get_gyro, get_seatex and get_tsshrp, which invoke the listit command to retrieve 24 hours (day of year must be given as three figure number, e.g. 059) of gyrocompass, Seatex and tsshrp (heave, pitch and roll) data. Data are saved in subdirectories ‘gyro’, ‘seatex’, and ‘tsshrp’ as gyro.NNN, seatex.NNN and tsshrp.NNN, where NNN is the jday. The updated version of listit is sourced from /users/dacon/projects/scs/bin
get_ea600 Invokes the listit command to retrieve 24 hours of EA600 data. Data are saved as ea600.NNN.
get_em122 Invokes the listit command to retrieve 24 hours of under-ship swath data. Data are saved as em122.NNN. Although obviously just a small subset of the total swath data, this is generally more accurate and less noisy than EA600 data but with the same ease of use and therefore worth logging.

Matlab
load_daily.m Reads in navigation files output by the Unix processing (above) by calling the following functions:
• load_daily_gyro: reads in text file gyro.NNN and writes data to Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is gyro/gyroNNN.mat.
• load_daily_seatex: reads in text file seatex.NNN and writes data to Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is seatex/seatexNNN.mat.
• load_daily_tsshrp: reads in text file tsshrp.NNN and writes data to Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is tsshrp/tsshrpNNN.mat.
For a quick visual check, the program then plots seatex data, gyrocompass heading, and pitch and roll.

`plot_seatex_all` Plots entire cruise track. Loads `seatexNNN.mat` for all jdays and GEBCO bathymetry data.

`loadea600` Reads in `ea600.NNN` and stores data in Matlab structure array. Saves `ea600_NNN.mat`

`loadem122` Reads in `em122.NNN` and stores data in Matlab structure array. Saves `em122_NNN.mat`

`cleansim500` Loads `ea600_NNN.mat`. It plots ea600 data (with em122 data underneath if present) and asks for minimum and maximum values for initial cleaning (defaults 0 and 15000). Data outside these limits and set to NaNs. Interpolation and spike removal have been removed as data are still not clean and spike removal was incomplete. Data are then cleaned using an interactive editor written on JR299 using the inpolygon function to speed the process relative to two-point rectangular boxes. Gaps are left as gaps. Output is `ea600_NNNclean.mat`.
8. Underway Oceanlogger and meteorological data Hugh Venables

Instrumentation and data collection
Surface ocean and meteorological data were logged continuously throughout the cruise. Ocean data were collected from the ship’s uncontaminated seawater supply, whilst instruments on the forward mast measured the meteorological data. Instruments were as follows:

Oceanlogger
- SeaBird Electronics SBE45 CTD
- Wet Labs WSCHL fluorometer
- Transmissometer
- Two sea surface temperature probes at the inlet

Both surface ocean and meteorological data were collected at 5 second intervals.

Processing
Initial processing was carried out in Unix, which generated files that could be further processed in Matlab.

Unix
get_underway Calls the scripts get_oceanlog, get_anemom, which invoke the listit command to retrieve 24 hours of underway data. Output files are oceanlog.NNN, anemom.NNN, where NNN is the jday. The updated version of listit is sourced from /users/dacon/projects/scs/bin

Matlab
loadunderway Calls functions loadoceanlog and loadanemom to read oceanlog.NNN and anemom.NNN. Data are stored in structure arrays and saved as oceanlogNNN.mat and anemomNNN.mat. The program then calls the function cleanoceanlog, which sets unrealistic values to NaNs, uses dspike to remove large spikes in conductivity, housing (CTD) temperature and remote (hull) temperature. Linear interpolation is used to fill data gaps. Data from periods of flow >1.5 l/min or <0.4 l/min are also set to NaNs, as are data from 5 minutes after a drop in flow to allow variables to return to normal. Surface ocean data are further cleaned using an interactive editor if necessary (conductivity first), which allows manual removal of remaining bad data from flow changes and spikes. Salinity is then calculated using ds_salt and the interactive editor is used to remove spikes and flier points. The output is oceanlogNNNclean.mat.

plot_oceanlog_daily Loads oceanlogNNNclean.mat and seatexNNN.mat, calculates 1 minute averages and plots maps of sea surface temperature, salinity and fluorescence. Bathymetry data from GEBCO are included in the plots. Output files are oceanlog_navNNN.mat and oceanlog_navNNN_1minave.mat.

plot_oceanlog_all Loads oceanlog_navNNN_1minave.mat for all jdays and plots sea surface temperature, salinity and fluorescence for the entire cruise track. Bathymetry data from GEBCO are included in the plots.

underwayAll Loads oceanlogNNNclean.mat, anemomNNN.mat and oceanlog_navNNN.mat, and appends all data to a master file.

Ice and underway water supply
Due to the need to retract the intake hose when in ice, the underway water supply was off for much of the cruise, leading to much absent data. This, together with a faulty salinometer (see CTD section) meant that no underway samples were analysed.
9. Bathymetry

Simon Dreutter

Most of the Antarctic seas were never surveyed by swath bathymetry systems. Therefore, seabed topography data is often unreliable and depth information is insufficient for navigation. During JR17003a, bathymetric mapping was conducted at all times to extend our knowledge on seafloor topography in the research area and to feed this data into global bathymetric databases like the General Bathymetric Chart of the Oceans (GEBCO) and the International Bathymetric Chart of the Southern Ocean (IBCSO). Additionally, the acquired bathymetry combined with archive data from the BAS and the AWI was used for detailed station planning for other research activities during the cruise, as available satellite altimetry data does not give the sufficient resolution and reliability.

The main task of the bathymetry work was to operate the multibeam echosounder (MBES) Kongsberg EM122 on board RRS James Clark Ross (JCR), including calibration and correction of the data for environmental circumstances (sound velocity, systematic errors in bottom detection, etc.), the post processing and cleaning of the data, the data management, as well as on-site map creation.

Technical description

The bathymetric data was collected with the hull-mounted MBES Kongsberg EM122. The EM122 is a full ocean depth swath bathymetry system operating at a nominal frequency of ~12 kHz (ranging from 10.5 to 13 kHz within the four different transmit sectors). On JCR, the EM122 transducer arrays are arranged in a flush Mill’s cross configuration of 8 m (transmit unit) by 8 m (receive unit) to achieve an angular beam accuracy of 1° by 1°. The combined motion, position, and time data comes from a Kongsberg Seapath system and the signal goes directly into the Processing Unit (PU) of the MBES to do real-time motion compensation in Pitch, Roll, and Yaw in the range of +/-10°. With a combination of phase and amplitude detection algorithms the PU computes the water depth from the returning backscatter signal. The system can cover a sector of up to 150° (75° from nadir), resulting in a swath coverage of ~6.5 times the water depth. As outer beams at higher beam angles tend to give lower quality results, the swath angle was usually reduced to 130° - 140° (65° - 70° from nadir), resulting in a reasonable coverage of 5.5 times the water depth. The across track resolution of the system is determined by the maximum number of discrete beams per ping (432 equidistant soundings) and the along track resolution depends on the triggering setup as other hydroacoustic system were used during the cruise.

Data acquisition and processing

Data acquisition was carried out throughout the entire cruise, starting the 22th of February 2018 outside Mare Harbour on the Falkland Islands and ended the 11th of March before reaching Port Stanley.

Where possible, cruise tracks were planned parallel to existing bathymetric data and the surveys were performed to extend already mapped regions. Due to the short time frame for scientific activities and the low manoeuvrability in sea ice, no extensive large scale surveys were conducted during JR17003a. Yet, shorter survey lines in uncharted waters were run frequently in order to find potential sites for the biological sampling program.

For data acquisition, the Kongsberg SIS (Seafloor Information System) software was used. It processes and logs the collected data, applies all corrections and defined filters, and finally displays the resulting depths on a geographical display. The recorded data was stored in 60 min blocks in the Kongsberg *.all format. Subsequent data processing was performed using Caris HIPS and SIPS. The data editing revealed a good data quality of the EM122 with very little rejected beams. Yet, during ice breaking, the quality of the data showed severe deterioration as ice and air bubbles accumulate under the transducers and interfere with the acoustic pulses.

For generating maps, the data were exported to Quantum GIS in the GeoTIFF raster format.
**Sound velocity profiles**

For best survey results with correct depths, output from the various CTD (Conductivity, Temperature, Depth) casts were used to measure the water sound velocity in the different depths. These profiles were applied in SIS. This is essential, as the acoustic signal travels down the water column from the transducer to the seafloor and back to the surface through several different layers of water masses with each a different sound velocity. The sound velocity is influenced by density and compressibility, both depending on pressure, temperature, and salinity. Wrong or outdated sound velocity profiles lead to refraction errors and reduced data quality.

The CTD measures conductivity, temperature, and depth in the water column while it is lowered to the seafloor. From these parameters, the sound velocity is calculated.

The sound velocity profiles obtained by the CTD were immediately processed and applied within Kongsberg SIS for correct beamforming during the survey. 10 CTD stations were used for sound velocity correction during the expedition (see Fig. 26).

For underway data acquisition during transits, modelled sound velocity profiles were extracted from the World Ocean Atlas (WOA09).

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![Fig. 26: Sound Velocity Profiles used during JR17003a (all profiles are virtually extended to 12000 m water depth for Kongsberg SIS to accept them)](image_url)
Calibration
A calibration of the MBES was conducted at the beginning of the cruise to confirm the correctness of the applied installation values in the system. The calibration procedure was conducted at 7 kts ship's speed at a depth of around 2500 to 1500 m. During calibration of the MBES all other acoustic devices were switched off. For calibrating the roll offset, two profiles in opposite direction on even ground had to be surveyed. The pitch offset calibration required two profiles on the same track, but in opposite direction on a slope or clearly defined object. The heading offset calibration needed two profiles parallel to each other but in opposite direction covering an obstacle in between. The values were checked within Caris HIPS. The following calibration angles were determined and set in SIS:

Table 17: Angular offsets within the MBES survey system as determined during the JR17003a patch test

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Patch Test 2014</th>
<th>SIS Setting</th>
<th>Correction</th>
<th>Final Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll</td>
<td>+0.2°</td>
<td>+0.2°</td>
<td>-0.03°</td>
<td>+0.17°</td>
</tr>
<tr>
<td>Pitch</td>
<td>+0.1°</td>
<td>+0.1°</td>
<td>0°</td>
<td>+0.1°</td>
</tr>
<tr>
<td>Yaw</td>
<td>-1.4°</td>
<td>0°</td>
<td>-1°</td>
<td>-1°</td>
</tr>
</tbody>
</table>

Figure 27 gives an overview over the calibration site. Furthermore, a more detailed calibration report was written and copied to the ship’s server.

Preliminary results
As mentioned, the EM122 was operated during the entire cruise. This resulted in two long transit lines across the Drake Passage that will be added to the global bathymetric dataset. Figure 28 shows an overview of the bathymetry data collected during JR17003a.
The data collected in the Prince Gustav Channel is shown in Figure 29. Four dedicated survey stations were conducted for sampling station planning and to fill gaps in the existing dataset. In addition, transit tracks were planned so that JCR was sailing on the edge of charted areas to assure safe navigation in the rough terrain of the area, but still extend the existing bathymetry with the swath echosounder towards the edges of the channel.
Fig. 29. Map of the collected bathymetry in the main research area. The station markers point to locations were dedicated MBES surveys were conducted to add up to the existing dataset or for specific station planning purposes in uncharted areas of the channel.

**Issues and improvements**

Some issues in the bathymetry setup on JCR were identified during the cruise. These shall be listed here along with some recommendations for improvements.

First, the EM122 on JCR has no built in C keel probe for measuring the water sound velocity at the transducer. Instead, the closest value from the current SV profile is taken. Especially in melt water conditions rapid changes in SV in the upper water column can occur which deteriorates the beam forming quality of the MBES.

To overcome this lag, a script was written which takes the underway data from the Ocean Logger and feeds it into SIS. In order to use the script, a serial input in SIS was configured on COM4 and a serial loop from COM3 to COM4 was set up. The script will send the serial message to COM3 and SIS will then pick it up on COM4. The sent message fits to the Micro SV&T (C+T) format in SIS and is sent with a Baudrate of 9600.
The script was placed in ‘C:\Users\Operator\Documents’ and is called ‘JCR_c_kell.py’. It can be run from any location on the SIS PC by opening a command line shell, navigate to the scripts location and run it with ‘python JCR_c_kell.py’. All dependencies were installed on the PC.

It shall be noted that the use of this script only makes sense, if the Ocean Logger is switched on and gives reasonable values. There are some routines in the program that will check eg. the flow rate, but the MBES operator should be aware of the concept. In sea ice conditions, the bridge might turn off the Ocean Logger and the script will be sending the last SV value until the Ocean Logger is running again. If the script is started with the Ocean Logger being switched off, it will send the default values, which can be changed at the beginning of the script.

In those cases, it might be useful to change the source for the c keel value from SENSOR back to PROFILE in the SIS Sound Speed tab. However, as long as the Ocean Logger is running fine, it is definitely worth a try using this script to increase the data quality.

The second issues it the automated conversion from the CTD raw data to Kongsberg .asvp files. When a CTD station is performed, the CTD will usually be lowered to 10 m until the sensor readings align and give decent quality. Then the device will be heaved to 0 m and then the actual cast is performed. In one occasion during JR17003a, the CTD had to be lowered to 50 m in order to warm up and the readings of this precast gave very strange results. However, the conversion script will still consider those readings during bin averaging which results in unfortunate jumps in the SV profiles in the upper water column. One way to avoid this is by restarting logging and overwriting the initial CTD raw file once the warm up phase is done. Other than that, it might be better to do the conversion manually to set the number of readings to be ignored in the beginning of the file.

Another improvement would be a smaller bin average. Currently a 5 m bin average is used for the conversion. This is sometimes necessary, as SIS only allows a maximum of 1000 values in the SVP. Yet, the 5 m bin average might occasionally not resolve the local changes in the upper water column and therefore the EM122 might give decreased quality in the raytracing of the individual beams.

All in all the EM122 performed very well during JR17003a. The SIS PC needed a restart once due to some network problems. Other than that, the system ran without any breakdowns or major bottom detection mistakes. An exception were the periods of active ice breaking and ship turns after station work. But these issues were to be expected as bubbles and ice under the transducer usually cause false sounding results.
10. Marine Mammals and birds

Phil Trathan, Hugh Venables, Susie Grant

Introduction
As a complement to the other scientific work being carried out during JR17003a, visual observations of higher-predators were undertaken from the ship. To be compatible with ship-based active acoustic data collection during daylight, there was an emphasis on recording feeding diving predators. Having said that, all flying birds were also recorded.

Aims
The main aim of this study was to record air-breathing predators to obtain an overview of possible foraging areas, relative abundance and predator aggregations across the main transit and survey station areas. Assemblages of predators will be analysed for spatial cross correlation with acoustically-detected prey aggregations from ship-based transducers. A further objective for these observations was to record pack-ice seal haulout sites as these may be of relevance to future seal-tagging programmes of work.

Methods
Transect observations
Standard seabirds at sea methodology was used to carry out observations of flying birds, penguins and marine mammals (hereafter known collectively as predators unless there is the need to distinguish otherwise). All transect observations were made from outside on one or other of the bridge wings; the choice of either the port or starboard wing was dependent upon weather and glare. Scanning for predators was done with the naked eye in the forward quadrant (Figure 30). Each individual or group of predators was identified, counted and recorded in one of two distance bands (1: 0 – 300 m; 2 > 300 < 2000 m) that ran parallel to the ship track and were measured from the side of the ship (Figure 30). Cetaceans in particular, but occasionally groups of penguins and pinnipeds as well, were recorded when spotted on the other side as well, but were noted as being outside of the observed transect and this area was not actively scanned and priority was given to recording predators within the survey area. The local time (UTC-3; ship time) of each observation was recorded to the nearest minute, when the predator was first observed; electronic records were subsequently reported in UTC. A calibrated measuring stick was used to estimate distance from the side of the ship, based upon observer eye level and the length of the observer’s arm.
All predators were sighted by eye and where necessary, identified using high quality binoculars. Identification was made to species level or where there was doubt, to genus or a lower taxonomic level. Floating material such as animal remains, were also recorded. Whenever it was considered that light was poor, for example at dawn or dusk, observations ceased. Animal activity was recorded as shown in Table 18.

![Distance bands as measured from the side of the ship for all predator observations](image)

Table 18. Behaviour codes used during JR17003a

<table>
<thead>
<tr>
<th>Type of predator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flying birds</td>
<td>Flying</td>
</tr>
<tr>
<td></td>
<td>Sitting on water</td>
</tr>
<tr>
<td>Penguins</td>
<td>Resting / preening on surface</td>
</tr>
<tr>
<td></td>
<td>Actively swimming</td>
</tr>
<tr>
<td></td>
<td>On ice</td>
</tr>
<tr>
<td>Pinnipeds</td>
<td>Resting on surface</td>
</tr>
<tr>
<td></td>
<td>Actively swimming</td>
</tr>
<tr>
<td></td>
<td>On ice</td>
</tr>
<tr>
<td>Cetaceans</td>
<td>Actively feeding</td>
</tr>
<tr>
<td></td>
<td>Actively swimming</td>
</tr>
</tbody>
</table>

Basic weather conditions (cloud cover, sun glare, sea ice, precipitation and visibility) were estimated visually by the observer at the start of each observation period. If these changed
drastically during the observation period, this was noted. The time of each observation period will allow the meteorological observation data recorded by the bridge Officers to be assimilated with the data set. Wind speed and direction, and vessel speed recorded by the ship’s underway system (data feeds from anemometer-wind-speed, anemometer-wind-dir and emlog-vhw-velocity-f/a respectively) can be matched with the data set.

Ship-following animals (notably some species of flying birds) were recorded, although care was taken to avoid double-counting when possible. Ship observations were not undertaken when the ship was stationary, although there were periods when the ship was moving at a slower speed due to reduced visibility.

**Station observations**

Occasional observations were undertaken at all benthic sampling stations. At some stations benthic sampling began before dawn or was completed after dusk, in which case predator observations were not undertaken. For each observation, the species and number of individuals were recorded. Activity was recorded as above (Table 18).
Summary of observations

Species list
The species observed during JR17003a are shown in Table 19.

Table 19. Species observed during JR17003a

<table>
<thead>
<tr>
<th>Flying seabirds</th>
<th>Penguins</th>
<th>Seals</th>
<th>Cetaceans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antarctic Shag</td>
<td>Adélie Penguin</td>
<td>Antarctic Fur Seal</td>
<td>Killer Whale</td>
</tr>
<tr>
<td>Antarctic Tern</td>
<td>Chinstrap penguin</td>
<td>Crabeater Seal</td>
<td>Fin Whale</td>
</tr>
<tr>
<td>Prion sp</td>
<td>Emperor Penguin</td>
<td>Weddell Seal</td>
<td>Humpback Whale</td>
</tr>
<tr>
<td>Brown skua sp</td>
<td>Magallenic Penguin</td>
<td>Leopard Seal</td>
<td>Minke Whale</td>
</tr>
<tr>
<td>South Polar Skua</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominican Gull</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cape Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diving Petrel sp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Giant Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Giant Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giant Petrel sp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft-plumaged Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White-chinned Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-bellied Storm Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey-backed Storm Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilson’s Storm Petrel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Shearwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sooty Shearwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Fulmar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-browed Albatross</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey-headed Albatross</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light-mantled Sooty Albatross</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern Royal Albatross</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wandering Albatross</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observation metadata
A summary of each observation period was recorded with start and end date and time, the name of each transect, or station, brief weather observations and the names of the observers. Each observation period was assigned a unique observation id which was a sequential number starting at 1. Each individual sighting record can be linked to the metadata record through the time field.

Observation data
The data set has been checked to ensure records are complete, species names are consistent and all columns contain valid values. The comments field contains a variety of information about the individual observations.

Records that were noted when official observing was not taking place (during breaks or whilst not on transect or station) can be identified by having “y” in the out_of_transect field. All
records that were on the opposite side of the ship to the observers were noted as being outside of the transect by having “y” in the out_of_transect field.

Table 20. Observation periods on transects

<table>
<thead>
<tr>
<th>Date</th>
<th>Start_time_UTC</th>
<th>End_time_UTC</th>
<th>Duration</th>
<th>Transect</th>
<th>Transect_name</th>
</tr>
</thead>
<tbody>
<tr>
<td>23/02/2018</td>
<td>13:54:00</td>
<td>14:54:00</td>
<td>01:00:00</td>
<td>T001</td>
<td>North-South transect</td>
</tr>
<tr>
<td>23/02/2018</td>
<td>15:35:00</td>
<td>16:55:00</td>
<td>01:20:00</td>
<td>T002</td>
<td>North-South transect</td>
</tr>
<tr>
<td>23/02/2018</td>
<td>16:55:00</td>
<td>17:55:00</td>
<td>01:00:00</td>
<td>T003</td>
<td>North-South transect</td>
</tr>
<tr>
<td>23/02/2018</td>
<td>17:55:00</td>
<td>18:35:00</td>
<td>00:40:00</td>
<td>T004</td>
<td>North-South transect</td>
</tr>
<tr>
<td>23/02/2018</td>
<td>18:35:00</td>
<td>19:55:00</td>
<td>01:20:00</td>
<td>T005</td>
<td>North-South transect</td>
</tr>
<tr>
<td>24/02/2018</td>
<td>09:00:00</td>
<td>09:30:00</td>
<td>00:30:00</td>
<td>T006</td>
<td>North-South transect</td>
</tr>
<tr>
<td>24/02/2018</td>
<td>09:30:00</td>
<td>10:30:00</td>
<td>01:00:00</td>
<td>T007</td>
<td>North-South transect</td>
</tr>
<tr>
<td>24/02/2018</td>
<td>11:00:00</td>
<td>12:20:00</td>
<td>01:20:00</td>
<td>T008</td>
<td>North-South transect</td>
</tr>
<tr>
<td>24/02/2018</td>
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<td>13:20:00</td>
<td>01:00:00</td>
<td>T009</td>
<td>North-South transect</td>
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<tr>
<td>24/02/2018</td>
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<td>21:20:00</td>
<td>06:00:00</td>
<td>T010</td>
<td>North-South transect</td>
</tr>
<tr>
<td>25/02/2018</td>
<td>09:00:00</td>
<td>10:00:00</td>
<td>01:00:00</td>
<td>T011</td>
<td>North-South transect</td>
</tr>
<tr>
<td>25/02/2018</td>
<td>11:00:00</td>
<td>12:00:00</td>
<td>01:00:00</td>
<td>T012</td>
<td>North-South transect</td>
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<tr>
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<td>13:30:00</td>
<td>01:00:00</td>
<td>T013</td>
<td>North-South transect</td>
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<td>25/02/2018</td>
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<td>14:55:00</td>
<td>01:05:00</td>
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<td>North-South transect</td>
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<td>25/02/2018</td>
<td>15:35:00</td>
<td>17:50:00</td>
<td>02:15:00</td>
<td>T015</td>
<td>North-South transect</td>
</tr>
<tr>
<td>25/02/2018</td>
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<td>20:50:00</td>
<td>01:00:00</td>
<td>T016</td>
<td>North-South transect</td>
</tr>
<tr>
<td>26/02/2018</td>
<td>08:50:00</td>
<td>10:30:00</td>
<td>01:40:00</td>
<td>T017</td>
<td>North-South transect</td>
</tr>
<tr>
<td>26/02/2018</td>
<td>11:00:00</td>
<td>12:00:00</td>
<td>01:00:00</td>
<td>T018</td>
<td>North-South transect</td>
</tr>
<tr>
<td>26/02/2018</td>
<td>12:20:00</td>
<td>13:20:00</td>
<td>01:00:00</td>
<td>T019</td>
<td>North-South transect</td>
</tr>
<tr>
<td>26/02/2018</td>
<td>13:20:00</td>
<td>13:40:00</td>
<td>00:20:00</td>
<td>T020</td>
<td>North-South transect</td>
</tr>
<tr>
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<td>15:00:00</td>
<td>01:20:00</td>
<td>T021</td>
<td>North-South transect</td>
</tr>
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<td>20:30:00</td>
<td>03:30:00</td>
<td>T022</td>
<td>North-South transect</td>
</tr>
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<td>10:30:00</td>
<td>01:30:00</td>
<td>T023</td>
<td>North-South transect</td>
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<tr>
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<td>12:30:00</td>
<td>01:30:00</td>
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<td>North-South transect</td>
</tr>
<tr>
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<td>17:00:00</td>
<td>01:30:00</td>
<td>T025</td>
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<tr>
<td>28/02/2018</td>
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<td>19:00:00</td>
<td>10:00:00</td>
<td>T026</td>
<td>North-South transect</td>
</tr>
<tr>
<td>28/02/2018</td>
<td>19:15:00</td>
<td>20:50:00</td>
<td>01:40:00</td>
<td>T027</td>
<td>South-North transect</td>
</tr>
</tbody>
</table>
Table 21. Observation periods on stations

<table>
<thead>
<tr>
<th>Date</th>
<th>Start_time_UTC</th>
<th>End_time_UTC</th>
<th>Duration</th>
<th>Station</th>
<th>Station_name</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/03/2018</td>
<td>11:30:00</td>
<td>12:15:00</td>
<td>00:45:00</td>
<td>S001</td>
<td>South-North transect</td>
</tr>
<tr>
<td>02/03/2018</td>
<td>09:00:00</td>
<td>10:00:00</td>
<td>01:00:00</td>
<td>S002</td>
<td>Duse Bay</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>09:45:00</td>
<td>10:30:00</td>
<td>00:45:00</td>
<td>S003</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>15:30:00</td>
<td>16:00:00</td>
<td>00:30:00</td>
<td>S004</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>04/03/2018</td>
<td>09:15:00</td>
<td>09:45:00</td>
<td>00:30:00</td>
<td>S005</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>04/03/2018</td>
<td>20:15:00</td>
<td>20:45:00</td>
<td>00:30:00</td>
<td>S006</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>05/03/2018</td>
<td>09:15:00</td>
<td>09:45:00</td>
<td>00:30:00</td>
<td>S007</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>09:40:00</td>
<td>10:10:00</td>
<td>00:30:00</td>
<td>S008</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>06/03/2018</td>
<td>16:00:00</td>
<td>16:30:00</td>
<td>00:30:00</td>
<td>S009</td>
<td>Prince Gustav Channel</td>
</tr>
<tr>
<td>07/03/2018</td>
<td>17:00:00</td>
<td>17:30:00</td>
<td>00:30:00</td>
<td>S010</td>
<td>Duse Bay</td>
</tr>
<tr>
<td>07/03/2018</td>
<td>17:30:00</td>
<td>18:00:00</td>
<td>00:30:00</td>
<td>S011</td>
<td>Duse Bay</td>
</tr>
</tbody>
</table>

**Preliminary summary of results**
Just over 25.5 hours of observing were made on transect and 6.5 hours of observations were carried out whilst on station. Whilst on transect long periods of poor visibility precluded observations. From all observations, 4 species of cetacean, 4 species of seal and 4 species of penguin were observed, while 25 species of flying seabird were recorded.
Aims of BBC filming

The BBC Studios Natural History Unit were appointed as Media Partners for the Larsen C expedition with the aim of covering activities for a number of BBC productions, including the following:

- **Earth from Space** (working title) due for broadcast on BBC One in autumn 2018 / Spring 2019. This 4-part series connects the epic and spectacular world we see from above, with real ‘on the ground’ stories. The focus of interest was the break-up of the Larsen C iceberg A68 and the challenge of reaching such a remote and challenging destination.

- **Frozen Planet 2** (working title) is currently being commissioned as a follow up from Blue Planet 2. This series focuses on all the ‘cold’ regions of the planet, their fragility and how they are changing. The aim for this filming was to begin to document the story of life beneath the A68 iceberg (both in terms of wildlife and scientific endeavour) with a view to returning in subsequent years as the sea bed changes.

- **News / outreach** – as media partners for the expedition, the BBC agreed to supply shots of the ship in ice (including drone) as well as interview material that could be broadcast on news platforms during / after the cruise.

Personnel & equipment involved

Elizabeth White is a former research biologist (she was a scientists on JR100 in 2004!) who has worked for the BBC Natural History Unit for 14 years as a Director / Producer for wildlife films.

Dan Beecham was a former cameraman / diver for Save Our Seas Foundation before joining the BBC Natural History Unit as Bursary cameraman on the series Blue Planet 2.

They brought with them an array of filming equipment with which to document the expedition including: RED Dragon camera for synch / documentary filming, DJI Phantom 4 and DJI Inspire 2 drones for filming the aerial perspective, and small cameras like the DJI Osmo and GoPro systems for covering timelapse and small gimbal moves.
Filming achieved
The team were able to cover various aspects of the expedition, in terms of science, interviews with key personnel and logistic operations as detailed below. We also filmed, edited and submitted back to the UK a short interview with PI Katrin Linse. Although the mission to Larsen C was aborted, we hope that this footage will still be useful in both the Earth from Space and Frozen Planet productions.

Interviews & synch work
Interviews were carried out with Katrin Linse at various points in the expedition, documenting the challenges of working in Antarctica, the mission undertaken and the difficult decision to turn back. Further interviews were also carried out with Chief Office Chris Hipsy focusing on the challenges of navigating a ship through ice and the role of the ships crew in facilitating science in Antarctic regions. Actuality filming on the bridge also stretched to ‘handovers’ between the Captain and Chris.

Actuality of science
Documentary filming was carried out of a range of science activities including deployment of the CTD, SUCS camera and Agassiz trawl, processing of samples and watching the SUCs feed.

Photo: cameraman Dan Beecham filming deployment activities on the starboard deck in cold and snowy conditions!

Drone imagery of ship in ice
A key aim of our filming activities was to film the ship transiting through the ice and add a
sense of scale to the landscape. Wind conditions were not suitable every day (the drone can only fly in winds of less than 10 knots) however 24 successful deployments of the drone were made. This allowed us to capture imagery in a range of different light conditions, and sea states from light brash ice to very heavy pack.

A key shot required was a very high ‘zoom’ down to reveal the ship that could be linked with satellite photographs, and so regular lat/long positions were sent back to the office in the hope of finding a suitable weather window and location to do this. As yet, we have not heard whether any of these satellite images successfully captured the ship, however we did achieve some iconic imagery by flying the drone at its maximum height of 500m.

Left: still image of the ship trawling in light sea ice in the Prince Gustav Channel taken by the DJI Inspire 2 drone. Right: low angle drone shot as JCR works through sea ice.

10.3.4 News package
On the morning of 1st March we shot and edited an interview with Katrin Linse and provided a short news package for the BAS to put out as part of their Press Release regarding the abandonment of reaching Larsen C. This was picked up by various news organisations, including the BBC’s Jonathan Amos who wrote a piece for the Science and Environment section, including the video footage.
Mission to giant A-68 berg thwarted by sea-ice

By Jonathan Amos
BBC Science Correspondent

2 March 2018

Acknowledgements
We would like to thank PI Katrin Linse, Master Tim Paige, Chief Officer Chris Hipsy and all the scientists and crew involved in the expedition to Larsen C. Everyone has been so helpful and accommodating and it has been a real pleasure to document your work.

BBC news article featuring a short clip of the ship in sea ice and Katrin Linse interview.
12. Outreach report

Susie Grant, Rowan Whittle, Huw Griffiths*, Layla Batchellier*, Athena Dinar*
*not on board

As part of our cruise preparation, we developed a Comms Plan to set out priorities and actions for communicating our science to a range of audiences whilst on board the JCR, as well as before and after the cruise. This plan was shared with our collaborators, and BAS guidelines for using social media were also provided to everyone in the team. There was significant media interest in the cruise before departure and during the cruise, particularly when the decision was made to turn back from the Larsen C Ice Shelf. The BAS Press Office issued two press releases (12th Feb and 2nd March), which resulted in over 850 individual media items.

We posted regular Twitter updates from @BAS_News, on topics including science activities and new discoveries, weather, life on the ship, wildlife and scenery. Several members of the science team were also active on Twitter using individual accounts, and this combined effort reached a broad network of the scientific community, stakeholders, NGOs, schools and the general public. Tweets using the #LarsenCBenthos hashtag were re-tweeted widely. Activities also included posts on the BAS Facebook page and blog posts on the BAS website. In addition an ‘NHM Live’ link to the Natural History Museum from the JCR occurred on 9th March to a large public audience. Media activities also resulted from the BBC Natural History Unit being on board the ship, including posts on the BBC news website.

The team produced three ‘Ship Blogs’ which appeared on the BAS website, and were widely publicised on Twitter. These provided information on the science project as well as personal points of view, for example on the experience of BAS staff going to sea for the first time, a perspective from an Australian collaborator and from the BAS marine engineering team.

Communications plan to highlight the Larsen-C Benthos project

Science lead from BAS: Dr Katrin Linse
January 2018

Summary

This communications plan is designed to highlight the Larsen-C Benthos project during the 2017/18 season. The project aims to document the biodiversity in the benthic community under the previous site of A68. This will create a baseline for understanding what lives beneath ice shelves in Antarctica and how the marine life responds to dramatic environmental change, such as a major calving event. It will also enable scientists to study how biodiversity changes over time in the region to assess whether there are unique ecosystems, which may become extinct with future climate change as the ice shelves retreat.

Dr Katrin Linse and a research team from nine institutes will depart on the RRS James Clark Ross (21 Feb-13 March). The expedition is supported by a NERC Urgency Grant. The team will spend three weeks documenting the biodiversity in the surface, water column and seafloor using trawls, bongo nets and towed camera systems. In addition, they will survey the seafloor using swath bathymetry to map its topography.

A crew from BBC NHU (Elizabeth White – Director and Dan Beecham – Camera operator) will be aboard filming for two major series – working titles Earth from Space (2019) and a possible sequel to Frozen Planet (2021).

Key messages

- BAS is leading an important expedition to investigate the hidden ecosystem under Antarctic ice shelves, so quickly after a calving event. This is the first look at what lives on the seafloor beneath ice shelves in Antarctica.
- The team hopes to generate a baseline assessment before the newly exposed marine environment changes and new species begin to colonise the area.
• Understanding what lives beneath Antarctic ice shelves and how this changes over time is essential to discover how this marine ecosystem will respond to environmental change in a climate-sensitive region
• The area is protected by CCAMLR for 10 years, prohibiting commercial fishing. This area is the first to benefit from an international agreement in 2016 by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), to designate Special Areas for Scientific Study in newly-exposed marine areas following the collapse or retreat of ice shelves across the Antarctic Peninsula region. The agreement came following a European Union proposal to CCAMLR, led by BAS scientists Dr Susie Grant and Dr Phil Trathan

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Who/Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>Draft a press release announcing the cruise and the research aims</td>
<td>Done</td>
</tr>
<tr>
<td>January</td>
<td>Create Comms plan for promoting the Larsen-C project</td>
<td>Done</td>
</tr>
<tr>
<td>January</td>
<td>Create a digital comms plan to highlight cruise and project</td>
<td>Layla – to action in January and share with other research institutes in Feb</td>
</tr>
<tr>
<td>January</td>
<td>Contact BAS staff going on cruise to discuss digital media plan and assets we could gather</td>
<td>Layla</td>
</tr>
<tr>
<td>12 February</td>
<td>Issue Press Release announcing the cruise departure and the research aims. “This week...” Make short film for digital channel + media</td>
<td>Athena/Layla</td>
</tr>
<tr>
<td>February</td>
<td>Email all comms people at the institutes with researchers involved in the cruise – share the comms plan and Press Release</td>
<td>Athena</td>
</tr>
<tr>
<td>During the cruise:</td>
<td>Blogs: written by the research team for BAS websites. To be promoted on social media. 1) Meet the Scientific Team 2) Journey to Larsen C 3) Scientific content – about the trawls and other science on board</td>
<td>Rowan/Susie to send content to Layla/Huw</td>
</tr>
<tr>
<td></td>
<td>Video: to share on social media: -60 second science -Go pro time-lapse of lab work and of the trawl on the deck -Short clips with researchers explaining what they are doing eg. what they are looking at through the microscope, what they are finding as they are sorting through the trawl, core work etc</td>
<td>Susie to send during the cruise – content for say 3-5 posts a week</td>
</tr>
</tbody>
</table>
**For social media:** images of ‘science in action’ for all partners’ social media channels.
Examples:
- Sorting through the trawl samples in the labs
- Microscope work
- Studying sea ice maps
- Deploying the multi-corer
- Studying core samples
- Deploying the trawl net

**Susie** to send photos with brief explanation to **Layla and Huw**

**For social media:** images telling the story of the cruise for all partners’ social media channels.
Examples:
- Any wildlife spotted from the ship
- Weather on the ship
- Ship instrument dashboard indicating conditions

**Susie** to send photos with brief explanation to **Layla and Huw**

**JCR webcam stills** to show the progress of the ship?

**News footage:** ‘Interviews, drone etc.’ collected by BBC for BAS comms team to give to News outlets

**Susie** as point of contact. **Phil** to manage crew on board

9 March

Live link up with Darwin Centre at Natural History Museum, London at 3pm. **Huw Griffths** will be at NHM on the day

**Rowan** – Testing the line

12 March

Live link up with schools for British Science Week

**Athena/Layla and Susie**
Cut off for feasibility 1st March – potential to arrange for 12th @ 9:30-12:30

Blog answering pre-submitted Science Week questions

**Layla** to send questions to **Susie**

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**Cruise Participants are as follows:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrin Linse</td>
<td>BAS</td>
</tr>
<tr>
<td>Phil Trathan</td>
<td>BAS</td>
</tr>
<tr>
<td>Rowan Whittle</td>
<td>BAS</td>
</tr>
<tr>
<td>Sophie Fielding</td>
<td>BAS</td>
</tr>
<tr>
<td>Will Reid</td>
<td>UoNewcastle</td>
</tr>
<tr>
<td>Adrian Glover</td>
<td>NHM</td>
</tr>
<tr>
<td>Anni Makela</td>
<td>UoAberdeen</td>
</tr>
<tr>
<td>Luisa Federwisch</td>
<td>AWI</td>
</tr>
<tr>
<td>Kirsten MacSween</td>
<td>UoAberdeen</td>
</tr>
<tr>
<td>Angelika Brant</td>
<td>Sekenberg</td>
</tr>
<tr>
<td>Simon Dreutter</td>
<td>AWI</td>
</tr>
<tr>
<td>Name</td>
<td>Institution</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Ann Vanreusel</td>
<td>UoGhent</td>
</tr>
<tr>
<td>Melanie Mackenzie</td>
<td>Museum Victoria</td>
</tr>
<tr>
<td>Thomas Dalhgren</td>
<td>UoGothenburg</td>
</tr>
<tr>
<td>Hugh Veneables</td>
<td>BAS</td>
</tr>
<tr>
<td>Susie Grant</td>
<td>BAS</td>
</tr>
<tr>
<td>James Smith</td>
<td>BAS</td>
</tr>
<tr>
<td>Scott Polfrey</td>
<td>BAS</td>
</tr>
<tr>
<td>Bjoerg Apeland</td>
<td>BAS</td>
</tr>
<tr>
<td>Carwyn Davies</td>
<td>BAS</td>
</tr>
<tr>
<td>Jeremy Robst</td>
<td>BAS</td>
</tr>
<tr>
<td>ETS Will Clark</td>
<td>BAS</td>
</tr>
<tr>
<td>Aisling Smith</td>
<td>BAS</td>
</tr>
<tr>
<td>Sean Quirk</td>
<td>BAS</td>
</tr>
<tr>
<td>Elizabeth White</td>
<td>BBC NHU</td>
</tr>
<tr>
<td>Dan Beecham</td>
<td>BBC NHU</td>
</tr>
</tbody>
</table>

**Twitter**

@BAS_News
#LarsenCBenthos → *include in all tweets*
#LarsenC
#A68
#Antarctica
#marinebiology

**Facebook profiles**

Museums Victoria
Newcastle University
University of Aberdeen
University of Southampton
Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research
Senckenberg
University of Gothenburg

**Collaborators Twitter handles:**

@dr_will_reid
@adrg1
@melkmack
@susie_hailey
@mucofloris
@griffiths_huw
@museumsvictoria
@NHM_London
@UniofNewcastle
@aberdeenuni
@unisouthampton
@AWI_Media
@Senckenberg
@ResearchUGent
@uniofgothenburg

Website: [https://www.bas.ac.uk/project/larsen-c-benthos/](https://www.bas.ac.uk/project/larsen-c-benthos/)
Examples of social media posts, posts will be generated/adapted when blog material is available:

<table>
<thead>
<tr>
<th><strong>Facebook</strong></th>
<th><strong>Twitter</strong></th>
<th><strong>Timing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Taking advantage of the opportunity presented by the huge calving event, the Larsen C Benthos project is looking at what lies on the newly exposed seafloor. Follow us for updates on the upcoming expedition.</td>
<td>Now giant #A68 berg has calved #LarsenCBenthos project goes this month to see what animals live under an ice shelf. Follow us for updates on the upcoming expedition.</td>
<td>Just before cruise departs</td>
</tr>
<tr>
<td>The Larsen C Benthos team are ready to embark on their cruise aboard the RRS James Clark Ross to get the first look at what was living beneath the Larsen C iceberg (A68)</td>
<td>The #LarsenCBenthos team embark on their cruise on the RRS James Clark Ross to get the first look at life beneath the #LarsenC iceberg #A68 #Antarctica</td>
<td>Photo with the crew on the/by the JCR when they are about to depart</td>
</tr>
<tr>
<td>The Larsen C Benthos project is studying the marine life exposed by the calving of A68. This will provide a baseline for investigations into how ecosystems may respond to environmental change.</td>
<td>Studying the marine life exposed by the calving of #A68 will provide a baseline for investigations into how ecosystems may respond to environmental change #LarsenCBenthos #Antarctica</td>
<td></td>
</tr>
<tr>
<td>Chance to hear BAS Scientist Rowan Whittle speak about her recent expedition on the Larsen C during a “Nature Live Talk” on 9th March at the Darwin Centre, Natural History Museum</td>
<td>Hear BAS Scientist Rowan Whittle speak about her recent expedition #LarsenCBenthos during a “Nature Live Talk” on 9th March at the Darwin Centre</td>
<td></td>
</tr>
</tbody>
</table>

Written by [Layla Batchellier & Athena Dinar](mailto:amdi@bas.ac.uk; laytch@bas.ac.uk) in the British Antarctic Survey Press Office. Contact details as follows: Athena Dinar [amdi@bas.ac.uk](mailto:amdi@bas.ac.uk); Layla Batchellier [laytch@bas.ac.uk](mailto:laytch@bas.ac.uk)
Fig. 31. Impact report of Larsen-C outreach by 5th March
AME Mech Report

The majority of deployments on this cruise were seabed deployments, for imaging, coring or benthic sample collection. This required heavy use of the coring warp, with significant downtime occurring from 02/03 to 03/03 due to a mechanical defect of the 30T winch system. Furthermore, serious damage was noted to the first ~300m of cable, although this was identified following the last deployment and thus did not reduce science time.

Agassiz Trawl (AGT) – 6 deployments

The AGT was deployed successfully several times. On two deployments, however, the cod end of the net became entangled with the towing bridle. On both of these deployments, a sample was still collected, however weighting of the cod end may reduce the chances of this occurring in future.

Epibenthic Sledge (EBS) – 7 deployments

The EBS was deployed with the additional Deep Water Camera System (DWCS) affixed. During build, there was significant difficulty in obtaining a satisfactory cable routing – in particular proper mechanical protection to the cables given the potentially destructive nature of trawled deployments. To resolve this, a steel reinforced hose was used as ducting from the camera position to the battery housing to protect the cables.

An additional problem was the lack of proper support for cable ends where attached to the camera and lights. New mountings would be required to fully resolve this issue. It was noted that the cable terminations were in very poor condition, most probably due to improper attention to detail during cleaning. One of the lasers, used for scaling, was found to be defective despite successful bench testing.

Additionally, attachment of the nets was a very time consuming process and not one well suited to poor weather at sea. Whilst being acceptable for pre-deployment build, had a net required changing between deployments it could have proved challenging.

On one deployment on 04/03, vessel speed during deployment was insufficient to avoid several turns of cable accumulating on top of the sledge, having reached the sea bed. One of these turns became caught on a lifting lug atop the sledge, leading to it being towed sideways. A sample was still collected. In discussion with the bridge, deployment speed was increased from the time of the sledge coming to rest on the sea bed to avoid a recurrence of this problem. Working in ice made it especially difficult to manage this at times, however.

Shallow Underwater Camera System (SUCS) – 15 deployments, 2 failures

The SUCS system was a mainstay of the cruise, proving to be dependable and able to be deployed when mechanical failures prevented use of the coring warp. A modification was, however, required before the first station, as the bearings in the winch drive motor exhibited signs of extreme wear. Therefore the decision was taken to run the winch from a ship hydraulic circuit. This did cause some synchronisation issues with the levelwind system, however provided a great improvement in working conditions due to reduced noise.
Issues noted during deployment included icing of the lens – not unexpected with deployment temperatures dropping below -15 degrees at times. Cold weather also affected the performance of the monitor, which required re-warming for an early morning deployment. Overnight storage in the warmed bottle annex, and addition of a heater atop the winch resolved this issue. An unknown software issue on the 06/03 necessitated an early recovery of the system during the third transect, although the issue was subsequently resolved by a full reboot of both PC and deck box. At this stage the deck box had been powered on for several days which may have been a contributory factor.

**Oktopus Multicorer (MUC) – 12 deployments, 3 failures**

The MUC was deployed at several sites, generally functioning acceptably, although the extreme cold at deployment time caused issues with freezing latches and drain holes. The known problem of the damping cylinder seizing occurred more than once, although removing the bottom bolt and defrosting the cylinder with hot water cleared the blockage.

Two failed deployments were deemed to be because of a rocky sea bed – on one occasion the whole frame showed evidence of having been inverted on the sea bed. This was assessed to be because of an uneven landing site. The other failure returned to the surface with chipped and fractured tube ends, again indicative of a rocky site.

**Bongo net – 3 deployments**

The bongo was deployed when atmospherics allowed – wind speed was consistently high. Concerns over the nets freezing and becoming brittle led to the nets being rolled and lashed to the top rings after each deployment. Some downtime was experienced due to a winch defect 06/03, preventing a deployment.

**AME Maintenance Notes**

**EBS Maintenance:**
- New cables for DWCS
- Connections corroded and bent.
- New O-ring for DWCS Housing
- One of the LASER’s are not working
- 3D Print CTD Brackets for better fit
- Maybe develop an easier way to fit and connect the nets. Too many bolts to do.

**SUCS:**
- Winch down due to broken bearing. Bearing must be changed.

**GENRAL:**
Should take photos for future reference, manuals, and Maximo
The Chief Officer, Christopher Hipsey, handed over the JCR Laboratory spaces to the P.S.O. on the 22nd of February 2018. All spaces were in order with small queries and requests being dealt with before final sign off on the following day. It was noted that the seal on the Prep Lab spill kit was missing, the kit was removed, checked and returned with a valid seal in good time.

Risk assessment and COSHH packs were prepared for each Lab and made available to all users. A master copy of all paperwork for planned lab work was stored in the main Lab near the door. Signage for each lab was prepared to display the chemical hazard types present in each room and on the front of each Chemical Hazard Cabinet. Orientation training was provided where needed and the Lab manager was satisfied that all users were competent in the methods being undertaken.

Fume hoods in the Labs was checked over with the Deck Engineer, associated flow rate readings were up to date. The location of the Prep Lab fume hood was less favourable than the Main Lab fume hood due to its very close proximity to the door. Signage for the lab was generally observed to be out of date or faded and it is suggested that it be renewed.

The Laboratory manager met with the Doctor on board and discussed emergency plans for spills and provided a copy of all SDS sheets and discussed possible injuries pertaining to the work planned. The Doctor made the decision to request a pre-cruise briefing on the chemicals list of subsequent cruises. A walk around of the lab was conducted and the Doctor offered to include the emergency shower and eyewash station in the monthly checks in the absence of a lab manager on board.

During the first AGT trawl it was noticed that the temperature of the Fire pump water source was in excess of 10 degrees warmer than the ambient sea surface temperature. The quality of the benthic organisms due to the temperature change was raised as a serious concern by the scientists. The smaller volume hoses that are often used are form the same water sources, so all on deck seawater sources are impacted. The unfiltered seawater tap had to be used on deck, but this source is prone to freezing in the ice and volume is low. It is suggested that some provision for the requirement of cold seawater be considered for biological cruises. On freezing of the unfiltered seawater tap it was necessary to bring snow from the deck area onto the sorting table in the wet lab to try to keep the temperature at an acceptable level.

Use of PPE was consistent throughout the cruise by all in the science team and good practice was observed. Wet weather gear was acceptable for use in the wet lab and on deck. Lab coats were used for preparing hazardous chemicals in the lab. Gloves were worn by all handling equipment/specimens and a hazardous lab consumables UN grade bin was available.

Issues were had by many whilst filling out the BOL forms, many reported glitches in the form, from odd formatting errors to crashing and failing to save work and corrupted files. Parts of the forms were found to be confusing even with the guide. Lab manager would like to initiate a small talk about the requirement of BOLs and BioBols as part of the cruise training and orientation so that people are aware before sampling commences of the level of detail required at the end of the cruise.
15. IT Engineer’s Report

Jeremy Robst

14.1. Data Logging / SCS
The SCS server and data logging systems worked well throughout the cruise, with no additional logging events apart from the start & stop occurring.

<table>
<thead>
<tr>
<th>Time &amp; Date (GMT)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018/02/18 14:58</td>
<td>ACQ restarted, new leg run (Leg: 20180218)</td>
</tr>
<tr>
<td>2018/02/12</td>
<td>ACQ restarted, end of leg</td>
</tr>
</tbody>
</table>

14.2. Other systems
The other systems on board – the JRLB unix fileserver, SABRIS systems and ESX server all worked without any serious issues.

14.3 Event Logging
An old laptop was rebuilt as JR-EVENTLOG-L1 to be used for realtime eventlogging by scientists monitoring equipment. Typically this will be in the UIC, next to the winch driver for deployments of things like the AGT and EBS.
16. Data management Report

Sophie Fielding, Jeremy Robst, Katrin Linse, Phil Trathan, Hugh Venables

Data storage

All data recorded by instrumentation linked to the ship’s network were recorded directly to respective folders within /data/cruise/jcr/20180218/ and additional folders were created within /data/cruise/jcr/20180218/work/scientific_work_areas to allow the scientists to back-up their work. When the data are transferred to the Storage Area Network (SAN) at BAS, the pathname to the files will be identical.

Event logs

In addition to the bridge event log, a number of digital logs were maintained to record deployments and sampling:

- ADCP
- AGT
- BONGO
- CTD
- CTD_chlorophylls
- CTD Bottles (auto-generated)
- EBS
- EK60
- EM122
- MUC
- MUC_corelog
- PSO diary
- SUCS

Event numbers

Event numbers were assigned to equipment deployments by the officers on watch and were assigned sequentially when completing the bridge event log. 58 separate events were recorded Appendix 1).

Site identifiers

There were no specific codes given to work stations/sites but there was a division of the major benthic biology work areas into compass points in relation to the South Orkney Islands. In addition, the target depth was appended so work area names looked like, ‘South – 1000m’. Such IDs have no particular meaning outside the scope of the cruise and were merely used to more easily sort results but they have been captured in the marine metadata portal. There were no site numbers/ids for any of the non-benthic work.

Data sets and their use – PDC data management plan

In line with NERC grant requirements as Data Management plan was set up in cooperation and agreement with the PDC.
Data Management Plan Template

**“To be completed by Data Centre with successful Grant Holders within 3 months of the Start Date of the Award (do NOT submit this form with Proposals)”**

**Project Information**

**Project Name**: Benthic biodiversity under Antarctic ice-shelves – baseline assessment of the seabed exposed by the 2017 calving of the Larsen-C Ice Shelf

**Project Number (NERC PIs only)**

**Grant Reference**: NE/R012286/1

**Principal Investigator**: Dr Katrin Linse

**Organisation**

**Nominated Data Centre**: PDC

**Data Centre Contact**: Katy Buckland

**Project Data Contact**

**Please specify any other team members with responsibility for data**: Trathan, Griffiths, Fielding, Glover, Jamieson, Witte, Reid

**Roles and Responsibilities**

The UK Polar Data Centre (PDC) together with the PI are responsible for ensuring compliance to the NERC data policy. The PDC will offer support to the PI for any queries they have regarding the policy and managing their data.

**PI Linse** will manage the project in liaison with Co-Is and PPs, and ensure overall delivery. Co-I Trathan will be responsible for vertebrate diversity assessments and policy interactions, Co-I Griffiths for the imagery analyses and Co-I Fielding for the bio-acoustic and plankton data. Co-Is Glover and Witte and named researcher Reid will be responsible for MUC and isotope analyses.

PI Linse is responsible for ensuring that the data management plan is followed and that all data and accompanying metadata are submitted to the PDC by the end of the project for long-term curation.
Data Management Plan Template

Data Generation Activities

**Aims & methodology:**

This project will examine the biological communities formerly under the iceberg A68 in the western Weddell Sea. Iceberg A68 calved from the Larsen-C ice shelf in July 2017, and sampling the benthic biological communities in the first austral summer after this major calving will provide a unique baseline for undisturbed under-ice-shelf communities.

To document the faunal baseline under Larsen-C, we will deploy trawls (epibenthic sledges, Agassiz trawl, bongo net), mega-corer, towed camera systems, CTD, and single and multi-beam echosounders at each station. As the seabed under A68 is uncharted, areas around the proposed stations will be surveyed by swath bathymetry to map seafloor topography. With our holistic sampling approach we will collect information on the assemblage structure, biodiversity and abundance of the in-, epi-, and suprabenthic meio-, macro- and megafauna.

As JR17003a is targeting a research area of high risk to be effected by adverse sea-ice conditions that can deny access to the proposed research area, contingency plans will be in place for different scenarios:

1) Reach Larsen-C and work as proposed.
2) Reach Larsen-B area only and amend project plans to sample first proposed Larsen-B stations, then further repeat stations in Larsen-B of previous AWI cruises to continue with the succession studies there.
3) Reach Larsen-A area only and amend project plans to sample first proposed Larsen-A station, then further re-peat stations in Larsen-A of previous AWI cruises to continue with the succession studies there.
4) Not reach Larsen area, so work would focussed on sites north of Larsen selected following a benthic biodiversity knowledge review in biodiversity.aq

**New data:**

- Cruise metadata from SME 17_512;
  - Cruise Summary
  - Cruise Report
  - Event log
- All shipboard raw data
- Set of processed hydroacoustics
- In situ images and video
- Net samples and core samples
- Benthic fauna presence/absence/density and geophysical data obtained from samples and image analysis
- Bird and mammal obs

All digital data will be within 1TB in volume.

After successful collection of samples, a future grant (to be applied for) will cover:

- Molecular barcoding sequences of marine invertebrates
- Isotope data (foodweb and experiments)
- Analysis of images and video
Data Management Plan Template

In-Project Data Management Approach

Throughout the project it is expected that data (where they are in electronic format) will be backed up on secure systems so that hardware failure and/or malicious attack on the data and/or systems will not cause a permanent loss.

Image data generated by the SUCS and DWCS, as well as associated environmental data, will be stored on RAID-enabled disk systems during the cruise, and during subsequent data processing and analysis, with copies held at BAS. Upon cruise completion, all data will be copied to the BAS Unix system. Data will not exceed 1TB.

The data will be delivered to the PDC before the end of the project. The PDC will store these data in its own area on the BAS SAN, which is secure and regularly backed up.

Metadata and Documentation

While measurements are being made, the necessary metadata to enable their use and re-use will be recorded to the best of the scientists' abilities and should document how, where and who generated the data (including analysis and processing steps). Metadata and any associated documentation will be submitted at the same time as the accompanying datasets.

Metadata will be made accessible through the PDCs Discovery Metadata System, the NERC Data Catalogue Service and the Antarctic Master Directory.

Data Quality

It is expected that data being supplied by the PIs will have been suitably quality checked.

All data analysis will be carried out using nationally or internationally recognised methodologies, where possible. The researcher will ensure that the methodology is documented, and monitor and maintain procedural and analytical reproducibility using replicates and standards where possible. Any corrections or processing of data must be documented.

The PDC will perform their own quality assurance checks on the data and metadata to ensure everything is in order.

Please be aware that some journals are now requiring DOIs to be issued to datasets before papers are published. As a result of this, should you wish to publish any papers in any such journal before the intended data delivery date, then the Polar Data Centre will have to receive such data earlier so we can make it available and assign it a DOI.

Exceptions or Additional Services

Version Date: 16-08-2012
Data Management Plan Template

Any exceptional expectations of Data Centres (for example exceptional volume of data or complexity) - funding for which should be included within the project's Directly Incurred costs and explained within the Justification of Resources attachment;

Data Management Plan Information

Authors

Created Date

Last revision date

Version Number

1

Approved by PI/PM

Approved by (Data Centre)

Data Owner / IPR

NERC, OGL v3
## Datasets

### New Datasets

#### Digital Information

*Enter a brief description of the activities that will produce the data.*

<table>
<thead>
<tr>
<th>Dataset Description</th>
<th>Contact</th>
<th>Data Volume</th>
<th>Date Format</th>
<th>Issues</th>
<th>Delivery Date</th>
<th>Embargo Date</th>
<th>Reuse Scenario</th>
<th>Preservation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cruise summary</td>
<td>K. Line</td>
<td>Doc or pdf</td>
<td></td>
<td>Any issues with data, e.g., login, access, permission etc</td>
<td>2 weeks after cruise</td>
<td>no</td>
<td>none</td>
<td>SSDC</td>
</tr>
<tr>
<td>Cruise report</td>
<td>K. Line</td>
<td>Doc or pdf</td>
<td></td>
<td>6 months after cruise</td>
<td>none</td>
<td>none</td>
<td>SSDC</td>
<td></td>
</tr>
<tr>
<td>JCSR Event Log</td>
<td>S. Fielding</td>
<td>Doc or pdf</td>
<td></td>
<td>2 weeks after cruise</td>
<td>none</td>
<td>none</td>
<td>keep indefinitely at the POC – to be uploaded into the marine metadata portal</td>
<td></td>
</tr>
<tr>
<td>Hydroacoustic bathymetric data (suite of data including EMT22 and ADCP – exact instruments will be confirmed on the cruise)</td>
<td>S. Fielding</td>
<td>Raw EMT22 38 Processed EMT22 Core project and associated files of cleaned acquired sounding data, Raw ADCP INI, SNL, INI, V3.0, STA, V3.0, LOG</td>
<td>2 weeks after cruise</td>
<td>Digital data back-up (after 10 years) is required for export to BAS Unix system</td>
<td>none</td>
<td>Further international cruise is expected to this area. It will appreciate the bathymetric information for navigation.</td>
<td>keep indefinitely at the POC. List of data (processed by AWX) to be provided to POC when available.</td>
<td></td>
</tr>
</tbody>
</table>

### ADCP Calibration Files

- N1 - ADCP calibration: overview pass, calibration files of settings used.
- Raw TOPAS files, Processed TOPAS files

| Hydroacoustic biological data (BK05) | S. Fielding | Raw BK05 raw, net, etc | 2 weeks after cruise | 2 years | Keep indefinitely at the POC |

| Physical sample database | K. Line | Microsoft Access | Software on L drive – will use personal computer and back up manually daily | 2 weeks after cruise | none | Tactonic comparisons, potermic analyses | Keep indefinitely held by the POC via online. Local copy held by scientist |

| In-situ images and video | K. Line | Raw Wav Various formats, Calibration documents of sensors deployed on CTD | 2 weeks after cruise | 2 years | Successor analysis of i.e. shelf occlusion | Keep indefinitely at the POC |

| CTD data | H. Verrables | Raw Data Various formats, Calibration documents of sensors deployed on CTD | 2 weeks after cruise | none | Oceanographic analysis of region | Raw data held by the POC, any processed data held by SSDC |

Version Date: 15-04-2012  Page 5 of 6
Data Management Plan Template

Bird and mammal observations | pdf | Local spreadsheet | Keep indefinitely at the PCC

Harscropy Records
Enter a brief description of the activities that will produce the data

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Contact</th>
<th>Data Volume</th>
<th>Data Format</th>
<th>Issues</th>
<th>Delivery Date</th>
<th>Preservation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample book</td>
<td>K. Linse</td>
<td>1 A4 notebook</td>
<td>Handwritten records; Photorganically stored on a backup book in Cambridge.</td>
<td>Back in UK with JCR, then kept with K Linse until samples fully analyzed</td>
<td>Keeps long-term, to be held by K Linse, but catalogued by specimens.</td>
<td></td>
</tr>
<tr>
<td>Paper Logs</td>
<td>S. Fielding</td>
<td>1 A4 Binder</td>
<td>Paper, handwritten records; Stored in a digital database in Cambridge by PDC, e.g., LACGP Logs, Salary Calibration Logs, CTI Logs, Topos Settings Logs</td>
<td>2 weeks after the event to be scanned and digitized</td>
<td>Keeps long-term and catalogued with the archives. Some may keep paper copies if returns otherwise PDC will be customised.</td>
<td></td>
</tr>
</tbody>
</table>

Physical Collections & Samples
Enter a brief description of the activities that will produce the data

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Contact</th>
<th>Data Volume</th>
<th>Data Format</th>
<th>Issues</th>
<th>Delivery Date</th>
<th>Preservation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGT net samples</td>
<td>K. Linse</td>
<td>Specimens in fixating</td>
<td>Specimens in fixating</td>
<td>JCR return summer 2018</td>
<td>Keep long-term, send to collaborators for taxonomic identifications, after publications selected tissues will be collected at sight.</td>
<td></td>
</tr>
<tr>
<td>Lwii net samples</td>
<td>K. Linse</td>
<td>Specimens in fixating</td>
<td>Specimens in fixating</td>
<td>JCR return summer 2019</td>
<td>Keep long-term, send to collaborators for taxonomic identifications, after publications selected tissues will be collected at sight.</td>
<td></td>
</tr>
<tr>
<td>Bongo net samples</td>
<td>S. Fielding</td>
<td>Specimens in fixating</td>
<td>Specimens in fixating</td>
<td>JCR return summer 2017</td>
<td>Keep long-term, send to collaborators for taxonomic identifications, after publications selected tissues will be collected at sight.</td>
<td></td>
</tr>
<tr>
<td>CTD water bottle samples</td>
<td>W. Verstade</td>
<td>Specimens in fixating</td>
<td>Specimens in fixating</td>
<td>JCR return summer 2018</td>
<td>Used for sample destructive O18 analysis.</td>
<td></td>
</tr>
<tr>
<td>MUC core C experiment</td>
<td>U. White, Aberdeen</td>
<td>Specimens in fixating</td>
<td>Specimens in fixating</td>
<td>JCR return summer 2018</td>
<td>Used for sample destructive U14C uptake study.</td>
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<td>Specimens in fixating</td>
<td>JCR return summer 2018</td>
<td>Used for sample destructive natural isotope analysis for C uptake study.</td>
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<td>Selected diatom and pelagic specimens</td>
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<td>JCR return summer 2015</td>
<td>Used for sample destructive natural isotopic analysis for C uptake study.</td>
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<td>J. Smith</td>
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<td>Specimens in fixating</td>
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Third Party/Existing Datasets

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<td>Who is responsible for ensuring the dataset is kept</td>
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Acknowledgements
We would like to acknowledge and thank Andrew Fleming for providing automated email service of updated POLAR VIEW satellite maps directly to Master and PSO for planning purposes, and John Turner and Cat Murphy (Rothera meteorologist) for providing weather forecasts for the local area. We would also like to acknowledge the outstanding support from the crew and technicians aboard RRS James Clark Ross.
## Appendices

### Appendix 1: Bridge Event Log

<table>
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<tr>
<th>Time</th>
<th>Event</th>
<th>Lat</th>
<th>Lon</th>
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<tr>
<td>08/03/2018</td>
<td>18:48</td>
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<td>56.5821</td>
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<tr>
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<td>18:44</td>
<td>58</td>
<td>63.6894</td>
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</tr>
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<td>06/03/2018</td>
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<td>SUCS recovered to deck</td>
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<td>Commence recovery of SUCS</td>
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06/03/2018 14:57 45 63.8054 58.0644 SUCS transect complete. Vessel moving ahead 100m
06/03/2018 14:35 45 63.8044 58.0633 SUCS at the bottom
06/03/2018 14:20 45 63.8044 58.0633 SUCS redeployed
06/03/2018 14:19 45 63.8044 58.0633 SUCS at surface
06/03/2018 14:12 45 63.8044 58.0633 SUCS deployed
06/03/2018 14:11 45 63.8044 58.0633 SUCS off the deck
06/03/2018 13:59 44 63.8044 58.0633 CTD recovered on deck
06/03/2018 13:57 44 63.8044 58.0633 CTD at surface
06/03/2018 13:27 44 63.8045 58.0633 CTD stopped at 854m
06/03/2018 13:00 44 63.8044 58.0633 CTD deployed
06/03/2018 12:58 44 63.8044 58.0633 CTD off the deck
06/03/2018 12:53 63.8045 58.0633 Vsl on DP
06/03/2018 11:06 63.9917 58.4107 Vsl off DP
06/03/2018 10:54 43 63.9916 58.4113 AGT recovered
06/03/2018 10:01 43 63.9892 58.4198 Commenced recovery of AGT
06/03/2018 09:55 43 63.9881 58.4225 Commenced AGT trawl @ 1kt for 5mins (wire out 1900m)
06/03/2018 09:41 43 63.9864 58.4254 AGT on bottom (~1261m)
06/03/2018 09:07 43 63.9834 58.4278 AGT deployed
06/03/2018 09:06 43 63.9833 58.4279 Commenced AGT deployment
06/03/2018 08:36 -63.983 58.4274 Vessel on DP for 1250m AGT deployment
05/03/2018 23:42 42 63.9885 58.4367 CTD recovered on deck
05/03/2018 23:41 42 63.9885 58.4367 CTD at surface
05/03/2018 23:07 42 63.9885 58.4367 CTD at depth 1240m
05/03/2018 22:42 42 63.9885 58.4367 CTD deployed
05/03/2018 22:41 42 63.9885 58.4367 CTD off deck
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05/03/2018  13:19  37  64.0515  58.4751  Multicore at surface
05/03/2018  12:53  37  64.0514  58.4751  Multicore at the bottom 844m
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05/03/2018  12:28  37  64.0515  58.4751  Multicore off the deck
05/03/2018  12:15  64.0514 -58.475 Vsl repositioned for multicore deployment
05/03/2018  11:54  36  64.0511  58.4727  Multicorer recovered on deck
05/03/2018  11:53  36  64.0511  58.4727  Multicorer at surface
05/03/2018  11:29  36  64.0511  58.4727  Multicorer at seabed 822m
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05/03/2018  11:05  36  64.0511  58.4727  Multicorer off the deck
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05/03/2018  09:59  35  64.0493  58.4674  Commenced recovery of EBS
05/03/2018  09:48  35  64.0476  58.4619  Commenced EBS trawl @ 1kt for 10 mins (wire out 1200m)
05/03/2018  09:39  35  64.0466  58.4599  EBS @ bottom
05/03/2018  09:17  35  64.0449  58.4571  EBS deployed
05/03/2018  09:15  35  64.0448 -58.457 Commenced EBS deployment
05/03/2018  08:46 -64.045  58.4573  Vessel on DP @ 800m EBS site
05/03/2018  08:15  64.0737  58.4929  Vessel off DP to proceed to science station
04/03/2018  22:58  64.0724  58.4939  Vessel on DP at overnight stand by position
04/03/2018  22:10 -64.124  58.4996  Vessel off DP and relocating to overnight standy by position
04/03/2018  22:08  34  64.1243  58.4994  EBS recovered
04/03/2018  21:30  34  64.1273  58.4994  Commenced recovery of EBS
04/03/2018  21:20  34  64.1284  58.5051  Commenced EBS trawl @ 1kt for 10 mins (wire out 1200m)
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03/03/2018 22:22 25 64.1161 58.4785  SUCS recovered
03/03/2018 22:13 25 64.1158 58.4784  Completed transect 3. Commenced recovery
03/03/2018 21:51 25 64.1146 58.4782  Move completed. Commenced transect 3
03/03/2018 21:45 25 64.1137 -58.478  Completed transect 2. Moving 100m ahead
03/03/2018 21:26 25 64.1126 58.4779  Move completed. Commenced transect 2
03/03/2018 21:20 25 64.1118 58.4778  Completed transect 1. Moving 100m ahead
03/03/2018 21:00 25 64.1108 58.4778  SUCS @ bottom; commenced transect 1
03/03/2018 20:51 25 64.1108 58.4777  SUCS deployed
03/03/2018 20:49 64.1108 58.4777  Vessel on DP to commence 500m SUCS survey
03/03/2018 20:28 64.1156 58.4984  Vessel off DP and relocating to 500m SUCS site
03/03/2018 20:26 24 64.1156 58.4984  SUCS recovered
03/03/2018 20:12 24 64.1156 58.4984  Completed transect 3. Commenced recovery
03/03/2018 19:53 24 64.1146 58.4987  Move completed. Commenced transect 3
03/03/2018 19:46 24 64.1137 58.4993  Completed transect 2. Moving 100m ahead
03/03/2018 19:29 24 64.1128 58.4995  Move completed. Commenced transect 2
03/03/2018 19:23 24 -64.112 58.4995  Completed transect 1. Moving 100m ahead
03/03/2018 19:05 24 -64.111 58.4995  SUCS @ bottom; commenced transect 1
03/03/2018 18:50 24 -64.111 58.4996  SUCS deployed
03/03/2018 18:30 23 64.1099 58.4995  Vessel on DP at station 5. SWATH survey ended
03/03/2018 17:48 23 64.0802 58.4646  Vessel off DP. SWATH resumed
03/03/2018 17:20 23 64.0798 58.4652  Vessel stopped on DP for drone launch. SWATH suspended
03/03/2018 15:42 23 64.0465 58.4617  Vessel off DP. Commence SWATH survey
03/03/2018 15:39 22 64.0464 58.4617  SUCS recovered to deck
03/03/2018 15:24 22 64.0452 58.4602  Commence recovery of SUCS
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<td>58.4527</td>
<td>CTD recovered</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>10:21</td>
<td>64.0412</td>
<td>58.4527</td>
<td>CTD @ depth (793m); commenced recovery</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>09:57</td>
<td>64.0412</td>
<td>58.4527</td>
<td>CTD deployed</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>09:56</td>
<td>64.0412</td>
<td>58.4527</td>
<td>Commenced CTD deployment</td>
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<tr>
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<td>09:40</td>
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<td>58.4506</td>
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<tr>
<td>02/03/2018</td>
<td>21:25</td>
<td>63.6177</td>
<td>57.4977</td>
<td>Vessel off DP and proceeding to next science station</td>
</tr>
<tr>
<td>02/03/2018</td>
<td>21:22</td>
<td>63.6177</td>
<td>57.4977</td>
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</tr>
<tr>
<td>02/03/2018</td>
<td>21:15</td>
<td>63.6177</td>
<td>57.4974</td>
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<tr>
<td>02/03/2018</td>
<td>20:54</td>
<td>63.6172</td>
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<td>57.4933</td>
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<td>02/03/2018</td>
<td>20:03</td>
<td>63.6154</td>
<td>57.487</td>
<td>SUCS @ bottom; commenced transect 1</td>
</tr>
<tr>
<td>Date</td>
<td>Time</td>
<td>Latitude</td>
<td>Longitude</td>
<td>Action</td>
</tr>
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<td>-----------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>02/03/18</td>
<td>19:53</td>
<td>63.6154</td>
<td>57.487</td>
<td>SUCS deployed</td>
</tr>
<tr>
<td>02/03/18</td>
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<td>63.6205</td>
<td>57.4959</td>
<td>Vessel off DP and relocating to next SUCS site</td>
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<tr>
<td>02/03/18</td>
<td>19:32</td>
<td>63.6205</td>
<td>57.4959</td>
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</tr>
<tr>
<td>02/03/18</td>
<td>19:26</td>
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<td>63.6201</td>
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<tr>
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<td>57.4918</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>18:35</td>
<td>63.6193</td>
<td>57.4869</td>
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<tr>
<td>02/03/18</td>
<td>18:17</td>
<td>-63.619</td>
<td>57.4848</td>
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</tr>
<tr>
<td>02/03/18</td>
<td>18:12</td>
<td>-63.619</td>
<td>57.4849</td>
<td>SUCS deployed</td>
</tr>
<tr>
<td>02/03/18</td>
<td>18:09</td>
<td>-63.619</td>
<td>57.4849</td>
<td>SUCS recovered to deck (test)</td>
</tr>
<tr>
<td>02/03/18</td>
<td>18:07</td>
<td>-63.619</td>
<td>57.4849</td>
<td>SUCS deployed (test)</td>
</tr>
<tr>
<td>02/03/18</td>
<td>17:48</td>
<td>63.6189</td>
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<tr>
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<td>17:25</td>
<td>63.6257</td>
<td>57.4924</td>
<td>Vessel off DP. Commence move to 300m contour</td>
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<td>17:24</td>
<td>63.6257</td>
<td>57.4924</td>
<td>SUCS recovered to deck</td>
</tr>
<tr>
<td>02/03/18</td>
<td>17:19</td>
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<td>57.4923</td>
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</tr>
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<td>16:54</td>
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</tr>
<tr>
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<td>57.4861</td>
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</tr>
<tr>
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<td>16:27</td>
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<td>57.4843</td>
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</tr>
<tr>
<td>02/03/18</td>
<td>16:08</td>
<td>63.6243</td>
<td>57.4821</td>
<td>SUCS on bottom. Commence SUCS transect at 0.2kts</td>
</tr>
<tr>
<td>02/03/18</td>
<td>16:03</td>
<td>63.6243</td>
<td>57.4821</td>
<td>SUCS deployed</td>
</tr>
<tr>
<td>02/03/18</td>
<td>16:00</td>
<td>63.6243</td>
<td>57.4821</td>
<td>SUCS recovered to deck (camera problem)</td>
</tr>
<tr>
<td>02/03/18</td>
<td>15:59</td>
<td>63.6243</td>
<td>57.4821</td>
<td>SUCS deployed</td>
</tr>
</tbody>
</table>
02/03/2018 15:57 63.6243 57.4821 Vessel stopped in position for SUCS
02/03/2018 15:42 63.6251 57.4877 Commence move on DP 300m astern for SUCS
02/03/2018 15:37 13 63.6251 57.4877 Bongo net recovered to deck
02/03/2018 15:29 13 63.6251 57.4877 Bongo net stopped at 150m. Commence recovery
02/03/2018 15:23 13 63.6251 57.4877 Bongo net deployed
02/03/2018 14:12 12 63.6251 57.4877 CTD recovered on deck
02/03/2018 14:10 12 63.6251 57.4877 CTD at surface
02/03/2018 13:56 12 63.6252 57.4877 CTD stopped at 200m
02/03/2018 13:46 12 63.6252 57.4877 CTD deployed
02/03/2018 13:43 12 63.6251 57.4877 CTD off deck
02/03/2018 13:31 63.6251 57.4874 Vsl on DP at 200m station
02/03/2018 13:31 63.6156 57.4988 Vsl off DP repositioning to 200m station due to winch power pack
02/03/2018 12:57 63.6156 57.4989 Vsl in position for multicore deployment
02/03/2018 12:44 63.6168 57.5092 Vessel repositioning for multicore work
02/03/2018 12:43 11 63.6168 57.5092 SUCS recovered on deck
02/03/2018 12:42 11 63.6168 57.5092 SUCS at surface
02/03/2018 12:35 11 63.6168 57.5091 Commence recovery of SUCS
02/03/2018 11:03 11 63.6154 57.4977 SUCS on the bottom
02/03/2018 10:54 11 63.6154 57.4977 SUCS deployed
02/03/2018 10:31 63.6155 57.4986 Vessel moved 50m astern for SUCS deployment
02/03/2018 10:28 10 63.6155 57.4987 Bongo nets recovered
02/03/2018 10:17 10 63.6155 57.4987 Bongo nets @ 210m; commenced recovery
02/03/2018 10:08 10 63.6155 57.4987 Bongo nets deployed
02/03/2018 09:45 9 63.6155 57.4987 CTD recovered
02/03/2018 09:22 9 63.6155 57.4986 CTD @ depth (496m); commenced recovery
<table>
<thead>
<tr>
<th>Date: 02/03/2018</th>
<th>Time: 09:08</th>
<th>Lat: 63.6155</th>
<th>Lon: 57.4986</th>
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<tr>
<td>Date: 02/03/2018</td>
<td>Time: 09:06</td>
<td>Lat: 63.6155</td>
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<tr>
<td>Date: 02/03/2018</td>
<td>Time: 08:15</td>
<td>Lat: 63.5758</td>
<td>Lon: 57.3822</td>
<td>Event: Vessel off DP to relocate from overnight standby position to Station 2</td>
</tr>
<tr>
<td>Date: 01/03/2018</td>
<td>Time: 22:56</td>
<td>Lat: -63.569</td>
<td>Lon: 57.3006</td>
<td>Event: Swath survey commenced</td>
</tr>
<tr>
<td>Date: 01/03/2018</td>
<td>Time: 22:53</td>
<td>Lat: 63.5689</td>
<td>Lon: 57.2992</td>
<td>Event: MultiCorer recovered</td>
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<td>Date: 01/03/2018</td>
<td>Time: 22:31</td>
<td>Lat: 63.5689</td>
<td>Lon: 57.2992</td>
<td>Event: MultiCorer @ bottom (~1039m); commenced recovery</td>
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<td>Date: 01/03/2018</td>
<td>Time: 22:07</td>
<td>Lat: -63.5689</td>
<td>Lon: 57.2992</td>
<td>Event: MultiCorer deployed</td>
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<td>Date: 01/03/2018</td>
<td>Time: 22:05</td>
<td>Lat: 63.5689</td>
<td>Lon: 57.2992</td>
<td>Event: Commenced MultiCorer deployment</td>
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<tr>
<td>Date: 01/03/2018</td>
<td>Time: 21:35</td>
<td>Lat: 63.5684</td>
<td>Lon: 57.3008</td>
<td>Event: Vessel on DP. Standing by for next MultiCorer deployment</td>
</tr>
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<td>Date: 01/03/2018</td>
<td>Time: 21:26</td>
<td>Lat: 63.5756</td>
<td>Lon: 57.2986</td>
<td>Event: Vessel on DP to reposition due to ice</td>
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<td>Date: 01/03/2018</td>
<td>Time: 21:23</td>
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<td>Lon: 57.2986</td>
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<td>Date: 01/03/2018</td>
<td>Time: 21:00</td>
<td>Lat: 63.5756</td>
<td>Lon: 57.2986</td>
<td>Event: MultiCorer @ bottom; commenced recovery</td>
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<tr>
<td>Date: 01/03/2018</td>
<td>Time: 20:30</td>
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<td>Date: 01/03/2018</td>
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<td>Lat: 63.5755</td>
<td>Lon: 57.2931</td>
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</tr>
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<td>Date: 01/03/2018</td>
<td>Time: 19:14</td>
<td>Lat: -63.575</td>
<td>Lon: 57.2895</td>
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<td>Date: 01/03/2018</td>
<td>Time: 19:05</td>
<td>Lat: 63.5744</td>
<td>Lon: -57.284</td>
<td>Event: Commence trawl at 1.0kts for 10 mins (1600m wire out)</td>
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<td>Date: 01/03/2018</td>
<td>Time: 18:53</td>
<td>Lat: 63.5741</td>
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<td>Date: 01/03/2018</td>
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<td>Lat: 63.5735</td>
<td>Lon: 57.2759</td>
<td>Event: EBS deployed. Ship speed 0.3kts</td>
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<td>Date: 01/03/2018</td>
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<td>Lat: 63.5734</td>
<td>Lon: 57.2756</td>
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<td>Date: 01/03/2018</td>
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<td>Lat: 63.5736</td>
<td>Lon: 57.2772</td>
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01/03/2018 17:41 63.5771 57.3088 Commence move on DP joystick to EBS deployment site
01/03/2018 17:40 4 63.5771 -57.309 AGT recovered to deck
01/03/2018 17:08 4 63.5767 57.3059 AGT off bottom
01/03/2018 16:43 4 63.5762 57.3011 Commence recovery of AGT. Ship speed 0.3kts
01/03/2018 16:33 4 63.5755 57.2951 Commence trawl at 1.0kts for 10mins (1600m wire out)
01/03/2018 16:23 4 63.5752 57.2921 AGT on bottom (1060m). Ship speed 0.5kts
01/03/2018 15:55 4 63.5747 57.2869 AGT deployed. Ship speed 0.3kts
01/03/2018 15:53 4 63.5746 57.2866 Commence deploying AGT
01/03/2018 15:24 3 63.5753 57.2936 CTD recovered to deck
01/03/2018 14:51 3 63.5731 57.2965 CTD stopped at 1035m. Commence recovery
01/03/2018 14:28 3 63.5714 57.2988 CTD deployed
01/03/2018 14:26 3 63.5714 57.2987 CTD off the deck
01/03/2018 14:23 3 63.5719 57.2978 Vsl on DP
01/03/2018 00:30 64.3666 56.3528 Drone recovered
01/03/2018 00:25 64.3689 56.3523 Drone deployed
28/02/2018 18:52 64.6612 56.6801 Commenced series of drone deployments
27/02/2018 23:24 64.8037 56.8789 Drone recovered
27/02/2018 23:13 64.7975 56.8796 Drone deployed
27/02/2018 20:00 64.8066 57.0726 Drone recovered
27/02/2018 19:46 64.8086 57.0784 Drone deployed
27/02/2018 19:42 64.8087 57.0802 Drone recovered
27/02/2018 19:29 64.8073 57.0982 Drone deployed
27/02/2018 19:14 64.8078 57.1151 Drone recovered
23/02/2018 12:50 2 -53.792 -57.557 Swath calibration survey complete
23/02/2018 07:05 2 53.4634 57.6301 Vessel commenced SWATH calibration survey
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<tr>
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<th>Event</th>
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<td>06:48</td>
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<td>57.6374</td>
<td>Vessel off DP. Proceeding to SWATH calibration site</td>
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<td>1</td>
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<td>23/02/2018</td>
<td>05:55</td>
<td>1</td>
<td>53.4474</td>
<td>57.6363 CTD stopped at depth 2454m. Commence recovery</td>
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<tr>
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<td>05:09</td>
<td>1</td>
<td>53.4471</td>
<td>57.6363 CTD deployed</td>
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<td>23/02/2018</td>
<td>05:00</td>
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<td>53.4474</td>
<td>57.6357 Vessel on DP at CTD location</td>
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## Appendix 2: AGT event log

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<th>Lon</th>
<th>Event</th>
<th>Site</th>
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<tbody>
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<td>22:03</td>
<td>-63.62557</td>
<td>57.48859</td>
<td>Duse Bay 200m</td>
<td>188</td>
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</tr>
<tr>
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<td>-63.62544</td>
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<td>Duse Bay 200m</td>
<td>198</td>
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<tr>
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<td>-63.62538</td>
<td>57.48693</td>
<td>Duse Bay 200m</td>
<td>201</td>
<td>End trawl</td>
</tr>
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<td>07/03/2018</td>
<td>21:52</td>
<td>-63.62531</td>
<td>57.48627</td>
<td>Duse Bay 200m</td>
<td>205</td>
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<td>07/03/2018</td>
<td>21:52</td>
<td>-63.6253</td>
<td>57.48618</td>
<td>Duse Bay 200m</td>
<td>205</td>
<td>On ground</td>
</tr>
<tr>
<td>07/03/2018</td>
<td>21:45</td>
<td>-63.62493</td>
<td>57.48274</td>
<td>Duse Bay 200m</td>
<td>216</td>
<td>Off deck</td>
</tr>
<tr>
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<td>18:22</td>
<td>-63.61685</td>
<td>57.51085</td>
<td>Duse Bay 500m</td>
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</tr>
<tr>
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<td>-63.6167</td>
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<td>17:48</td>
<td>-63.61586</td>
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<td>07/03/2018</td>
<td>17:33</td>
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<tr>
<td>06/03/2018</td>
<td>18:30</td>
<td>-63.81169</td>
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<td>PGC mid 850m</td>
<td>835</td>
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</tr>
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<td>-63.81058</td>
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<td>PGC mid 850m</td>
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<td>58.06911</td>
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<td>-63.80815</td>
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## Appendix 6: MUC event log

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**Appendix 8: Scientific staff contact list**

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<tr>
<th>Apeland</th>
<th>Bjoerg</th>
<th>BAS</th>
<th><a href="mailto:bjolan@bas.ac.uk">bjolan@bas.ac.uk</a></th>
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<tr>
<td>Beecham</td>
<td>Dan</td>
<td>BBC NHU</td>
<td><a href="mailto:danbeecham@gmail.com">danbeecham@gmail.com</a></td>
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<tr>
<td>Brandt</td>
<td>Angelika</td>
<td>Senkenberg, D</td>
<td><a href="mailto:angelika.brandt@senckenberg.de">angelika.brandt@senckenberg.de</a></td>
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<tr>
<td>Clark</td>
<td>Will</td>
<td>BAS</td>
<td><a href="mailto:wilcla@bas.ac.uk">wilcla@bas.ac.uk</a></td>
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<tr>
<td>Dahlgren</td>
<td>Thomas</td>
<td>UoGothenburg, S</td>
<td><a href="mailto:thda@mac.com">thda@mac.com</a></td>
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<tr>
<td>Davies</td>
<td>Carwyn</td>
<td>BAS</td>
<td><a href="mailto:carvie@bas.ac.uk">carvie@bas.ac.uk</a></td>
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<tr>
<td>Dreutter</td>
<td>Simon</td>
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<td>Federwisch</td>
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<td>Fielding</td>
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<tr>
<td>Linse</td>
<td>Katrin</td>
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<tr>
<td>Mackenzie</td>
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