JR19001 Polar Ocean Ecosystem Time Series – Western Core Box cruise

15/11/2019 – 26/12/2019

1 Introduction

1.1 Rationale

JR19001 was a combined science and logistics leg of the 2019-2020 voyage of the RRS James Clark Ross. The logistics element was the opening of Signy base and resupply of King Edward Point and Bird Island. The science cruise had three key aims:
1) Undertake the acoustic survey "the Western Core Box" (WCB) survey to determine the distribution and biomass of krill and other plankton to the northwest of South Georgia.
2) Refurbish and redeploy the long-term deep-water biological mooring at P3 (part of SCOOBIES) and redeploy the WCB mooring.
3) Undertake station work and a transect across the Polar front to investigate the distribution of mesopelagic fish across pelagic realms.

15/11/2019 – depart Punta

19/11/2019 – Open Signy Base

22/11/2019 – 1 day science around South Orkneys

25/11/2019 – Bird Island resupply

26/11/2019 – KEP resupply

28/11/2019 – Bird Island resupply

02/12/2019 – WCB fishing

03/12/2019 – P3 mooring recovery

04/12/2019 – WCB survey

09/12/2019 – Stromness acoustic calibration

10/12/2019 – WCB mooring redeployment

11/12/2019 – P3 mooring redeployment

20/12/2019 – Mare Harbour, demob

26/12/2019 – arrive Punta

1.2 Western Core Box Summary

Since 1981 BAS have undertaken cruises to determine krill biomass as part of the ongoing assessment of the status of the marine ecosystem in the region of South Georgia. This unique time series, known as the Western Core Box, is part of the Ecosystems Programme contribution to BAS national capability. It comprises an acoustic grid survey of 8 transects each of 80 km in length, together with associated net and oceanographic sampling and the calibration of acoustic instrumentation. In addition to the acoustic survey, which covers a wide area but has a limited temporal coverage, there is a shelf mooring to provide year-round set of observations.

1.3 SCOOBIES mooring

The SCOOBIES (SCotia sea Open-Ocean BIological laboratoriES) programme has a primary purpose to consider the flux of carbon to deep ocean layers as well as monitoring ocean chemistry parameters, particular in relation to ocean acidification. The P3 mooring site has been occupied since 2006 with a buoy at 200m below sea level and a variety of sensors. CTD, water and net sampling are also completed to compliment the year round observations.

1.4 Polar front sampling

Mesopelagic fish, squid and macrozooplankton are an important component of the Southern Ocean ecosystem. Recent studies suggest that most myctophids inhabiting waters south of the Antarctic Polar Front (APF) are probably expatriates from core populations that reproduce at more temperate latitudes. In 2016 a transect was occupied from South Georgia towards the Falkland Islands. This year we attempted to sample along the same transect, this time further into Falkland Waters. The same sampling strategy (Table 1) as previous years was employed, with stations occurring each night and moving along the transect during daylight periods.

Table 1 Daily plan for polar front sampling strategy

Time of day	Activity
15:00	MOCNESS
19:00	RMT25 deep (1000-700, 700-400)
23:00	RMT25 shallow (400-200, 200-surface)
02:00	CTD to 1000m
03:00	Bongo nets

1.5 Cruise narrative

Time	Latitude (degrees)	Longitude (degrees)	Wind speed (kn)	Water depth (m)	Comment
15/11/2019	-53.0185	-70.6096	17.59	70.03	Depart Punta Arenas at 16:00 LT. Clear weather. RMT8, RMT25 and bongo built. MOCNESS semi-built.
16/11/2019	-54.4289	-63.4778	18.39		Continued sailing towards Signy, good weather and making good speed.
17/11/2019	-56.6903	-57.0903	8.48		Labs cleaned, followed by lab induction from Natalie. Passed outside Argentinian waters at ~11:00. Commence turning underway instruments on from 11:50 onwards. Underway water turned on at 13:00 local time.
18/11/2019	-58.9097	-50.4894	15.16	2772.34	Continuing on to Signy. Lots of humpback whales and krill swarms on the echosounder
19/11/2019	-60.701	-45.5814	12.93	32.77	Arrived early afternoon at Signy base. Advance team sent in to clear ice and snow
20/11/2019	-60.7014	-45.5786	16.25	35.45	Day spent off Signy base. No relief due to high winds. Quite frustrating for all.
21/11/2019	-60.7026	-45.5868	8.13	13.77	First lot of cargo ashore at Signy. Base relief progressing.
22/11/2019	-60.7023	-45.5864	4.33	17.91	Base relief continuing. Carson, Bjorg and Chris head to the sea ice camera. All enjoying the base relief.
23/11/2019	-60.7021	-45.583	7.66	30.29	Jeremy (IT) heading ashore to fix communications. Calibrated the 120 kHz WBAT transducer whilst waiting. Departed Signy mid-afternoon to deploy floating sediment trap at end of gully close to the Inaccessible Islands for its first 24 hour deployment before heading to krill swarm area (identified in JR15004).
24/11/2019	-60.3497	-46.6562	15.78	764.92	A day of CTDs on an on/off shelf transect for eDNA samples. A successful krill swarm fishing event, before returning to pick up the floating sediment trap. All recovered, although the sediment trap had drifted to shallower waters and collected sediment in the lower traps. Two were also damaged.

25/11/2019	-57.6817	-43.0619	10.50	3184.99	On way to Bird Island.
26/11/2019	-55.0111	-39.3684	13.72	3591.87	Arrived Bird Island in the afternoon. Cargo tender in water, as well as humber doing trips.
27/11/2019	-54.0164	-38.0537	16.83	44.2	Relief continuing at Bird Island with both humber and cargo tender. Food in.
28/11/2019	-54.2831	-36.4967	2.84		Relief of KEP. Science team head for walks.
29/11/2019	-54.2831	-36.4967	5.95		Relief of KEP continues. Frozen food moved and people let off for a final walk. Martin Collins joined the science team from KEP.
30/11/2019	-54.017	-38.0538	20.37	50.35	Bird Island cargo continuing, the rest of the food and loose items today.
01/12/2019	-54.0166	-38.0515	3.17	49.5	Off Bird Island doing relief. Fuel going in, and people went for a walk to Big Mac
02/12/2019	-53.6374	-38.0124	22.55	143.23	Headed to WCB mooring to run acoustic transects until 12:00 LT to allow ship staff to change onto 24 hour watches. The day consisted of a test CTD (to test the 20 l bottles) followed by 2 CTDs at 1000m WD and 500m WD for eDNA. The stratified RMT at WCB2.2S was also completed, as well as some successful target fishing on krill.
03/12/2019	-52.8057	-40.1611	21.40		Arrived P3 around 11 LT. Located releases prior to releasing buoy. Triangulated to find mooring not far from anchor release site. The mooring came up quickly. The trimson buoys were tangled in the rope and took a little sorting, otherwise the mooring recovery went smoothly. The pH sensor battery had failed during the deployment, and one end plate was missing. The sediment trap had worked well. A full depth CTD followed the mooring recovery. Then bongos and finally an opportunity to trial and deploy the MOCNESS. Two test deployments of the MOCNESS were followed by the real deployment at P3. The MOCNESS came back with samples for the first time in 3 years!
04/12/2019	-53.4721	-39.2569	29.80	3089.72	Completed WCB acoustic transects 1.1 and 1.2 (N-S, S-N) followed by the CTD and RMT stratified at WCB1.2N. Target fishing was successful heading down to the CTD at 1.2S but time ran out before completing the stratified RMT.

05/12/2019	-53.8542	-38.5612	1.71	154.27	Completed WCB transects 2.1 and 2.2 (S-N and N-S). Followed by CTD2.2S and then RMT stratified at WCB1.2S that was omitted the day before. Headed out to WCB2.2N to complete the CTD and stratified RMT there (no swarms seen on way).
06/12/2019	-53.5017	-38.036	18.17	1922.3	Completed WCB acoustic transects 3.1 and 3.2 (N-S and S-N). The CTD at WCB3.2n was completed, followed by the stratified RMT (plenty of fish). A CTD at 750 m water depth was completed for fish eDNA project. Afterwards target fish recommenced, heading for general area around 4.1 and 4.2 south end. Despite finding a decent target, the fishing was unsuccessful, with event 41 going in the water but no nets fired.
07/12/2019	-53.798	-37.9338	11.72		Transects 4.1 and 4.2 completed, before heading to the WCB mooring for recovery. All went well and the mooring was recovered with all sensors. A CTD was followed by the deployment of the floating sediment trap. Humpback whales and large krill swarms surrounded the ship in this area. Finally headed west to fish for krill, complete CTD2.2S and continue fishing for krill (failed).
08/12/2019	-53.6666	-37.6497	18.27	144.5	Ship headed to 4.2N to complete offshore CTD, Bongos and stratified net, before heading onshore to do net at 4.2S. Finally, the ship recovered the floating sediment trap, which had again sampled the seabed with the bottom trap having drifted into shallower water. A CTD was undertaken before the ship headed to Stromness for the echosounder calibration.
09/12/2019	-54.1592	-36.6938	9.76	85.79	Ship arrived in Stromness around 10:00 LT. Anchored, placed the line under the ship, did a CTD and started calibration of the echosounders. All EK60 transducers were calibrated, and the lowered systems were also calibrated (the 120 kHz mooring WBAT and the 38 kHz WBAT lowering system). AME continued to work on the moorings to ready them for redeployment the next day and we decided to stay overnight so that this could be done in calm waters.
10/12/2019	-53.7978	-37.9358	14.68	296.21	The ship headed out to the WCB mooring location at 07:00, arriving early afternoon. A MOCNESS, RMT, bongo and CTD were followed by the mooring deployment. All went smoothly. The night was spent target fishing (successfully) before heading to P3.

11/12/2019	-52.8249	-40.1515	17.55	4501.89	Arrived at P3 around midday and commenced with the deep MOCNESS, followed by stratified RMT. Krill swarms in the location encouraged target fishing, which successfully recovered a few more large krill for Emily.
12/12/2019	-52.8533	-40.1477	4.37	3796.58	The day started with the deep CTD, followed by the P3 mooring deployment. All went smoothly and after triangulating the position of the mooring we headed South towards P2 (start of Polar front work), target fishing (successfully) on the way.
13/12/2019	-55.2743	-41.3389	34.56	3647.45	Arrived P2 around midday in worsening winds. A deep CTD was completed, but then the ship turned into the wind and say hove too, waiting for better weather
14/12/2019	-55.0038	-41.6407	32.81	3433.82	Day spent hove too at P2 waiting for weather to improve to start fishing.
15/12/2019	-55.0254	-42.8024	13.10	3001.85	Weather finally improving. MOCNESS, RMT25s and CTD completed at station 50 nm in from P2 start of transect (to try and find better weather!).
18/12/2019	-53.2643	-52.1061	33.16	1699.73	Wind unexpectedly high, MOCNESS undertaken, but attempts to deploy the RMT25 were thwarted, with the weight bar redistributing its weights and throwing all off balance during a rather rocky deployment (although caused by a jammed wire rather than the roll). Decision made to abort the RMT25 at this location.
19/12/2019	-52.6829	-55.139	19.21	1880.99	After the cancelled RMTs the night of 18/19, todays science went well. The MOCNESS, CTD, followed by two RMT25s and finally science ended with a bongo.
20/12/2019	-51.9014	-58.437	24.22	34.83	Science ended at 04:00 and the ship headed to East Cove. Ship arrived East Cove at 17:00 and was moored and people let ashore after dinner.
21/12/2019	-51.9014	-58.437	23.64		Clara, Petra and Martin left the ship at early hours to catch the flight home (later cancelled until 22nd). The remaining science party demobbed the ship, packing boxes and finally the container in the afternoon.
22/12/2019	-51.9014	-58.437	30.91		After cleaning the labs, most of the science party headed to Stanley to see the local town.

23/12/2019	-51.9014	-58.437	21.40		An afternoon in Stanley (or around) and an evening out at the Malvina hotel for most of the science party.
24/12/2019	-52.5156	-59.7097	22.12	108.62	Departed East Cove at 10 am local time, leaving through Lively Sound and past Bleakers and SeaLion Island, heading towards Chile.

1.6 Cruise personnel

Ship officers and crew		Science party	
Graham Chapman	Master	Sophie Fielding	PSO (BAS)
Simon Wallace	Chief Officer	Bjorg Apeland	AME (BAS)
Gail MacGregor	2nd Officer	Anna Belcher	Scientist (BAS)
Scott Cramman	3rd Officer	Iliana Bista	Scientist (Sanger Institute)
Jamie McCann	3rd Officer	Martin Collins	Scientist (BAS)
Pat O'Hara	ETO Comms	Natalie Ensor	Lab manager (BAS)
Andris Kubulins	Chief Engineer	Chris Kerr	AME (BAS)
Bryn Ferguson	2nd Engineer	Rodrigo Hernandez Moresino	Scientist (POGO fellow)
Stewart Titterington	3rd Engineer	Roberta Johnson	Scientist (Universita Autonoma de Barcelona)
Steven Eadie	4th Engineer	Clara Manno	Scientist (BAS)
Robert Sutton	Deck Engineer	Ricardo Matias	Student (University of Coimbra)
John Newsom	ETO	Carson McAfee	AME (BAS)
John Liddy	Purser	Julie Meilland	Scientist (MARUM Institute)
Henry Sherreff	Doctor	Jeremy Robst	IT (BAS)
Clifford Mullaney	Bosun/Sci'Ops	Emily Rowlands	PhD student (University of Exeter)
John O'Duffy	Bosun	Gabriele Stowasser	Scientist (BAS)
Craig Lennon	Bosun's Mate	Petra Ten Hoopen	Data manager (BAS)
Alan Howard	SG1A	Jose Xavier	Scientist (University of Coimbra)
Sam Bonsu	SG1A		
Paula Munoz Garcia	SG1A		
Carlos E Leon Vargas	SG1A		
Mark McMahon	SG1A		
Stephen Pictor	MG1		
Arnis Macans	MG1		
Victoria Stone	Chief Cook		
Roman Liubarskyi	2nd Cook		
Derek Lee	Senior Steward		
Russell Covey	Steward		
David Williams	Steward		
Oliver Burch	Steward		

1.7 Cruise track

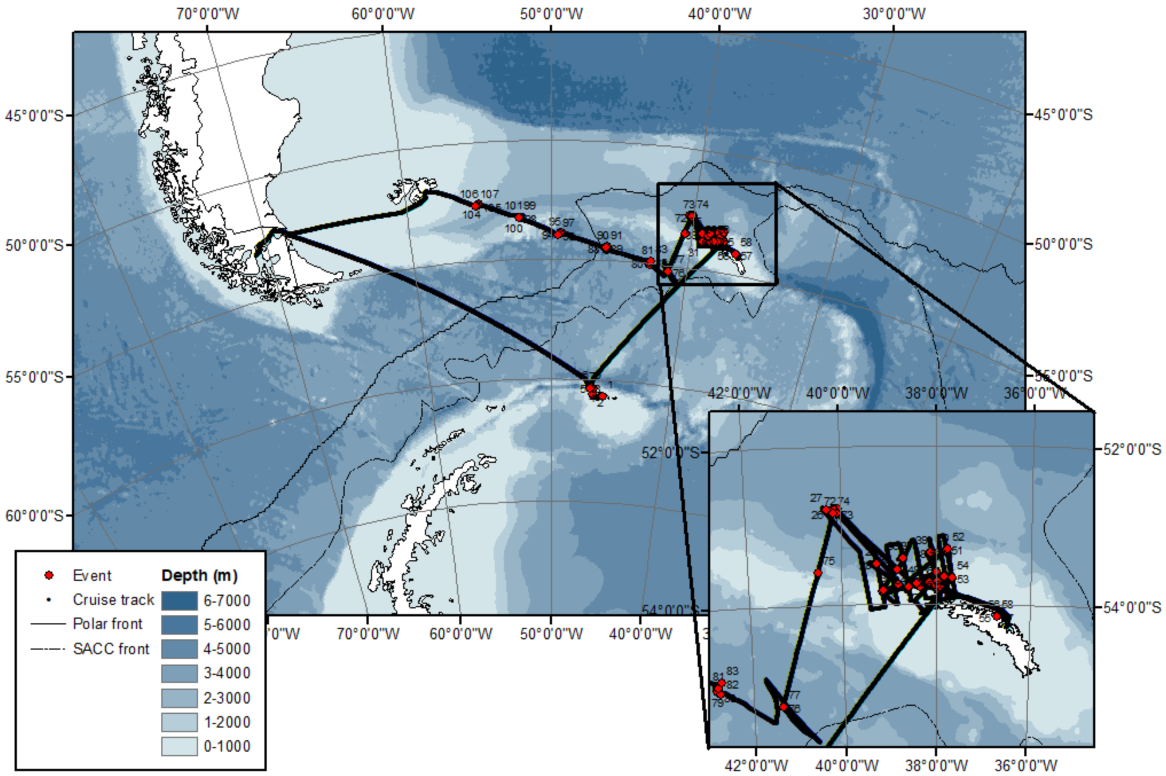


Figure 1 JR19001 cruise track and stations

1.8 Acknowledgements

This cruise is part of a long-term commitment by the BAS Ecosystems programme to investigate the ecology of the Scotia Sea ecosystem and understand the variability and change occurring in the region. The cruise was undertaken by a small team of scientists and support staff who carried out both their own work and all the general cruise tasks. Their enthusiasm and teamwork enabled the objectives to be completed successfully.

We thank the ship's officers and crew for their continued enthusiastic and expert support. We are grateful for their professionalism and helpful attitude that enables work to be completed successfully, particularly in the last year (or two!) of the RRS James Clark Ross' time with BAS.

2. Physical Oceanography

2.1 CTD Operations (*Carson McAffee, Natalie Ensor, Petra Ten Hoopen*)

2.1.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. A total of 32 CTD deployments, 31 of which were successful, were carried out around the South Orkneys, the South Georgia shelf (WCB, P3 and other sites) and on a transect back to the Falkland Islands. The CTD was operated by Carson McAffee, assisted by Natalie Ensor and Petra Ten Hoopen and processed by Sophie Fielding.

2.1.2 CTD Instrumentation and Deployment

An SBE32 carousel water sampler, holding 24 20-litre Niskin bottles, an SBE9Plus CTD and an SBE11Plus deck unit were used. The SBE9Plus unit held dual SBE3Plus temperature and SBE4C conductivity sensors. 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 (Tritech), a fluorometer (CTG Aqua Tracker MkIII), oxygen sensor (SBE43), a photosynthetically active radiation (PAR) sensor (QCP2350) and a transmissometer (C-Star). Serial numbers of all sensors are provided in the AME report (19 Appendix AME electrical report) and calibration certificates are provided in /data/cruise/jcr/20191114/work/scientific_work_areas/CTD_Calibration_Certificates. 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 and, in deep water, often returns depths that are several tens of metres deeper than the true bottom location.

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.

The 20 L bottles leaked at the beginning of the cruise and Carson spent time testing and fixing the lanyards (19 Appendix AME electrical report).

2.1.3 Data Acquisition and Processing

The CTD data were recorded using Seasave, version 7.22.3, and run through the SVP script which created four files:

JR19001_[NNN].hex binary data file

JR19001_[NNN].XMLCON ascii configuration file with calibration information

JR19001_[NNN].hdr ascii header file containing sensor information

JR19001_[NNN].bl ascii file containing bottle fire information

where NNN is the CTD event number (Table 1). Please note all raw data files are held on the BAS central storage system and can be found at /data/cruise/jcr/20191114/ctd.

The following matlab scripts will be used to process the CTD files in Cambridge.

ctdread.m Reads in JR19001CTDnnn_awctm.cnv to matlab. Outputs JR19001ctdnnn.cal

editctd.m Reads in JR19001ctdnnn.cal. Manual edit of CTD file to remove start and end data when CTD out of water and any spikes. Outputs file JR19001ctdnnn.edt

Interpol.m Reads in JR19001ctdnnn.edt. Interpolate any missing data. Output JR19001ctdnnn.int

Salcalapp.m Reads in JR19001ctdnnn.int. Calculates density (sig0, sig2 sig4). Output JR19001ctdnnn.var

Splitcast.m Reads in JR19001ctdnnn.var. Splits up cast and down cast. Output JR19001ctdnnn.var.up and JR19001ctdnnn.var.dn.

Fallrate.m Reads in JR19001ctdnnn.var.dn. Removes data from periods where CTD above a pressure it has already sampled. Output JR19001ctdnnn.var.dn

Gridctd.m Reads in JR19001ctdnnn.var.dn. Grids data into 2dB depth intervals. Output JR19001ctdnnn.2db.mat. Note a 1dB file was also created on request from Richard Lampitt

Fill-to-surf.m Reads in JR19001ctdnnn.2db.mat. Fills in surface values if CTD doesn't reach surface, user input to determine which ones. Output file JR19001ctdnnn.2db.mat

Ctdplot.m Reads in JR19001ctdnnn.2db.mat files and creates overview plots saved in /images folder

Makebot Reads in JR19001ctdnnn.2db.mat. Extracts median and standard deviation of variables at the depth/time of each bottle firing. Output file JR19001botnnn.1st

All processed files will be deposited with the British Oceanographic Data Centre (BODC).

Table 2 JR19001 CTD stations

Cast No	Ship Event No	Date	Start Time UTC	Lat	Lon	Max Depth	Distance to sea floor	Site Name
001	003	24/11/2019	11:57	60°20.582 S	46°39.121 W	1028	8	SOI
002	005	24/11/2019	14:51	60°20.422 S	46°39.578 W	10.44	NA	SOI
003	006	24/11/2019	15:00	60°20.421 S	46°39.575 W	1021.3	8.5	SOI
004	008	24/11/2019	19.14	60°20.980 S	46°39.366 W	771.06	8.2	SOI
005	011	24/11/2019	21:37	60°21.834 S	46°39.207 W	501.8	9.6	SOI
006	012	24/11/2019	22:42	60°22.549 S	46°41.354 W	261.5	5.1	SOI
007	013	02/12/2019	15:42	53°34.924 S	38°00.701 W	20	NA	Test
008	014	02/12/2019	16:09	53°34.926 S	38°00.701 W	1089	10.7	EDNA
009	016	02/12/2019	21:33	53°35.856 S	38°00.266 W	524.7	8.767	EDNA
010	022	03/12/2019	20:07	52°48.240 S	40°09.429 W	3734.6	9.1	P3
011	028	04/12/2019	20:32	53°29.562 S	39°15.015 W	999.35	NA	WCB
012	031	05/12/2019	06:50	53°50.800 S	39°08.582 W	275.75	8.6	WCB
013	032	05/12/2019	20:04	53°47.182 S	38°34.980 W	193.97	9.1	WCB
014	037	06/12/2019	07:36	53°25.896 S	38°41.712 W	998.6	NA	WCB

015	038	06/12/2019	21:22	53°21.696 S	38°04.908 W	997.78	NA	WCB
016	040	07/12/2019	02:43	53°35.518 S	38°00.678 W	807.47	8.2	WCB
017	043	07/12/2019	20:16	53°47.877 S	37°56.028 W	280.6	10.25	WCB
018	045	07/12/2019	23:04	53°42.890 S	37°57.936 W	124.37	9.03	WCB
019	047	08/12/2019	01:51	53°36.492 S	38°00.040 W	254.1	7.6	WCB
020	051	08/12/2019	14:00	53°19.479 S	37°46.598 W	998.77	NA	WCB
021	054	09/12/2019	01:32	53°40.665 S	37°39.202 W	109.4	9.2	WCB
022	055	09/12/2019	13:39	54°09.533 S	36°41.624 W	75.54	9.59	Calibration
023	062	10/12/2019	19:24	53°47.867 S	37°56.147 W	280.48	10.2	WCB mooring
024	071	12/12/2019	10:17	52°48.522 S	40°06.834 W	3737.2	10.35	P3
025	076	13/12/2019	14:04	55°15.510 S	41°21.514 W	2003.6	NA	Polar Front
026	077	13/12/2019	16:08	55°15.513 S	41°21.515 W	3540.7	9.6	Polar Front
027	078	15/12/2019	16:08	55°02.826 S	42°45.363 W	398.2	NA	Polar Front
028	082	16/12/2019	05:29	54°55.175 S	42°41.358 W	1000.8	NA	Polar Front
029	090	17/12/2019	06:04	54°29.177 S	46°00.436 W	1002.5	NA	Polar Front
030	096	18/12/2019	05:31	53°59.665 S	49°26.891 W	1001.5	NA	Polar Front
031	099	19/12/2019	01:41	53°17.658 S	52°11.119 W	1665	9.4	Polar Front
032	103	19/12/2019	21:24	52°41.762 S	55°11.191 W	1000.2	NA	Polar Front

2.1.4 Water samples from Niskin bottles on the CTD frame

Water samples were collected using Niskin bottles on the majority of CTD casts. Twenty L volume Niskin bottles were used for the majority of casts, except at the beginning of the cruise where some 12 L bottles were used. Table 2 describes the samples collected, including the sample volume, sample depth, bottle number and consignee. The chlorophyll maximum was established from the fluorescence profile of the down cast. Collected samples will be used for downstream analysis as described elsewhere in this report.

Table 3 Water samples collected for laboratory analyses

Event number	CTD cast number	Bottle number	Sample depth (m)	Consignee*	Sample volume (L)
003	001	1-2	1028	IB	20
		3-4	800	IB	20
		5-6	600	IB	20
		7,9	400	IB	20
		8,10-12	100	IB, RJ	20

		13-15	75	RJ	20
		16-18	48 - *chlx*	RJ	20
		19-21	25	RJ	20
		22-24	9	RJ	20
005	002	test	test	test	test
006	003	1-2	1023	IB	12
		3-4	800	IB	12
		5-6	600	IB	12
		7,9	400	IB	12
		8,10-12	100	IB, RJ	12
		13-14	75	RJ	12
		21	75	RJ	20
		15-16	52 - *chlx*	RJ	12
		22	52 - *chlx*	RJ	20
		17-18	24	RJ	12
		23	24	RJ	20
		19-20	10	RJ	12
		24	10	RJ	20
008	004	1-2	772	IB	12
		3-4	600	IB	12
		5-6	400	IB	12
		7-8	100	IB	12
		9-20	45 - *chlx*	CM	12
		21-24	45 - *chlx*	CM	20
011	005	1-2	502	IB	12
		3-4	400	IB	12
		5-6	200	IB	12
		7-8	100	IB	12
012	006	1-2	261	IB	12
		3-4	200	IB	12
		5-6	100	IB	12
		13	100	RJ	12
		14	75	RJ	12
		15	45 - *chlx*	RJ	12
		16	25	RJ	12
		17-18	10	RJ	12
013	007	test	test	test	test
014	008	1-2,11	1087	IB	20
		12	1000	IB	20
		3-4	800	IB	20
		5-6	600	IB	20
		7-8	400	IB	20
		9-10	100	IB	20
016	009	1-2	525	IB	20
		3-4	400	IB	20
		5-6	200	IB	20

		7-8	100	IB	20
		11	100	RJ	20
		12	75	RJ	20
		13	50	RJ	20
		14	17 - *chlx*	RJ	20
		15	10	RJ	20
022	010	1-6	3738	IB	20
		7	3000	IB	20
		8-10,13	2000	IB	20
		11-12	1000	IB	20
		14	100	IB	20
		15	100	RJ	20
		16	75	RJ	20
		17	60	RJ	20
		18	50	RJ	20
		19	40	RJ	20
		20	30	RJ	20
		21	20	RJ	20
		22-24	10	RJ	20
028	011	No samples	No samples	No samples	No samples
031	012	1-2	275	IB	20
		3-4	200	IB	20
		5-6	100	IB	20
		13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	25 – *chlx*	RJ	20
		17	10	RJ	20
		7-8	10	IB	20
032	013	1-2	194	IB	20
		3-4	100	IB	20
		5-6	10	IB	20
037	014	13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	22 - *chlx*	RJ	20
		17	10	RJ	20
038	015	1-2	750	GS	20
		3-4	450	GS	20
		5-6	200	GS	20
		7-8	125	GS	20
		9-10	75	GS	20
		11-12	36 - *chlx*	GS	20
		13-14	25	GS	20
		15-16	5	GS	20
040	016	1-2	806	IB	20

		3-4	750	IB	20
		5-6	600	IB	20
		7-8	400	IB	20
		9-10	100	IB	20
043	017	1-4	281	IB	20
		13-14	281	GS	20
		5-6	200	IB	20
		15-16	200	GS	20
		17-18	125	GS	20
		7-8	100	IB	20
		19-20	75	GS	20
		21-22	25	GS	20
		9-10	10	IB	20
		23-24	8	CM	20
045	018	1-2	125	IB	20
		3-4	100	IB	20
		5-6	10	IB	20
047	019	1-2	254	IB	20
		3-4	200	IB	20
		5-6	100	IB	20
		7-8	10	IB	20
051	020	13-14	100	RJ	20
		15-16	75	RJ	20
		17-18	40 - *chlx*	RJ	20
		19-20	25	RJ	20
		21-22	10	RJ	20
054	021	1-2	109	IB	20
		3-4	100	IB	20
		5-6	50	IB	20
		7-8	10	IB	20
055	022	1-2	75	IB	20
		3-4	40	IB	20
		5-6	10	IB	20
062	023	No samples	No samples	No samples	No samples
071	024	1-6	3737	IB	20
		7-8	3000	IB	20
		9-10	2000	IB	20
		11	1000	IB	20
		14	750	GS	20
		15	450	GS	20
		16	200	GS	20
		17	125	GS	20
		12-13	100	IB	20
		18	75	GS	20
		19	50	GS	20
		20	40	GS	20

		21	30 - *chlx*	GS	20
		22	20	GS	20
		23	10	GS	20
		24	5	GS	20
076	025	No samples	No samples	No samples	No samples
077	026	1-6	3550	IB	20
		7-8	3000	IB	20
		9-10	2000	IB	20
		11	1000	IB	20
		12-13	100	IB	20
		14-15	100	RJ	20
		16	75	RJ	20
		17	50	RJ	20
		18	20	RJ	20
		19	10	RJ	20
078	027	13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	28 - *chlx*	RJ	20
		17	10	RJ	20
082	028	No samples	No samples	No samples	No samples
090	029	13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	28 - *chlx*	RJ	20
		17	10	RJ	20
096	030	13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	27 - *chlx*	RJ	20
		17	10	RJ	20
099	031	13	100	RJ	20
		14	75	RJ	20
		15	62 - *chlx*	RJ	20
		16	30	RJ	20
		17	10	RJ	20
103	032	13	100	RJ	20
		14	75	RJ	20
		15	50	RJ	20
		16	30 - *chlx*	RJ	20
		17	10	RJ	20

*Consignee: **CM** - Clara Manno; **GS** - Gabi Stowasser; **IB** - Iliana Bista; **RJ** - Roberta Johnson

chlx = chlorophyll maximum

2.2 Vessel Mounted Acoustic Doppler Current Profiler (ADCP)

The ADCP was run throughout the cruise, interfaced with the other acoustic instruments through the K-sync. It was run in water-track mode throughout. No processing was undertaken. Setup of the ADCP was according to JCR default settings.

2.3 Underway data

Standard underway data were collected throughout the cruise. AME noted issues with the peristaltic pump. In particular that the system was not running appropriately for intermittent periods throughout the cruise (summarised in Table 4).

Table 4 Periods of the cruise where the underway water was in repair/dry

Start	Stop	Days
2019-11-19 16:22	2019-11-27 13:03	8
2019-11-27 13:11	2019-11-28 14:00	1
2019-11-30 10:48	2019-12-03 18:33	3
2019-12-07 17:10	2019-12-08 14:58	1

3. Fisheries acoustic data collection (*Sophie Fielding, Rodrigo Hernandez-Moresino*)

3.1 Introduction

The JCR is equipped with a four frequency Simrad EK60 scientific echosounder operating at 38, 70, 120 and 200 kHz. All transducers are mounted on the hull enabling acoustic data collection through the water column while underway. In addition to the EK60 GPTs running the transducers, there also exist EK80 WBTs that can be connected to the same transducers to operate some (70 and 120 Khz) in FM mode as well as CW.

During cruise JR19001, the EK60 was operated continuously throughout the cruise to collect information on the horizontal and vertical distribution of krill and micronekton and to derive estimates of Antarctic krill biomass for the Western Core Box. At all times, transmission rates and intervals of all actively transmitting acoustic instruments were synchronised using the K-sync to reduce interference. The EM122 was only used periodically and not during periods when the EK60 was being used to derive density data. The EK60 transducers were calibrated at Stromness Harbour on the 09/12/2019.

3.2 EK60

3.2.1 File locations

The EK60 was operated using Simrad ER60 v2.4.3 software, from the PU1 PC. The .raw data files were logged to the Linux server JRLB, using a Samba connection, which is backed up at regular intervals. Raw data were collected to a range of 1100m at all times. Files were stored in /data/cruise/jcr/20191114/ek60 and given the prefix JR19001-.

3.2.2. EK60 (ER60) parameter settings

The EK60 was used to collect acoustic data throughout the cruise. As was standard, the EK60 parameters were checked, but not changed until the calibration on the 09/12/2020 in Stromness Bay, South Georgia (Table 5). The ping rate was set to 2 seconds, and the EK60 was integrated with other instruments to minimise interference in the EK60 data using the K-sync. The Doppler logger was switched off during the acoustic transects of the WCB survey.

Table 5 EK60 parameters before (in brackets) and after calibration

Variable	38 kHz	70 kHz	120 kHz	200 kHz
Sound velocity (m/s)	1464.82 (1469.93)	1464.82 (1469.93)	1464.82 (1469.93)	1464.82 (1469.93)
Mode	Active	Active	Active	Active
Transducer type	ES38	ES70-7C	ES120-7C	ES200-7
Transceiver Serial no.	009072033fa5	0090720770eb	00907203422d	009072033f91
Transducer depth (m)	0	0	0	0
Absorption coef. (dB/km)	9.98 (10.26)	19.10 (20.11)	28.08 (29.72)	41.13 (42.80)
Pulse length (ms)	1.024	1.024	1.024	1.024
Max Power (W)	2000	750	250	300
2-way beam angle (dB)	-20.70	-20.70	-20.40	-19.70
Transducer gain (dB)	25.62 (25.38)	26.56 (26.47)	22.68 (23.13)	22.12 (21.87)
Sa correction (dB)	-0.51 (-0.57)	-0.38 (-0.37)	-0.32 (-0.26)	-0.20 (-0.30)
Angle sensitivity along	21.9	23	23	23
Angle sensitivity athwart	21.9	23	23	23
3 dB Beam along	7.01 (7.01)	6.62 (6.54)	6.43 (6.27)	6.72 (6.56)
3 dB Beam athwart	7.03 (7.05)	6.61 (6.52)	6.37 (6.29)	6.57 (6.54)

Along offset	-0.05 (-0.07)	0.04 (0.04)	0.09 (0.02)	0.02 (-0.13)
Athwart offset	-0.09 (0.00)	-0.07 (-0.05)	0.00 (0.01)	0.01 (-0.14)

3.2.3 EK60 echosounder calibration

An acoustic calibration was carried out in Stromness Harbour, South Georgia on 09/12/2020. The ship was anchored, its movement balanced by minimal DP usage and all over-the-side fresh water deposits were stopped. Transmission of the EK60 was triggered through the k-sync although the EA600 and ADCP were switched off. Each transducer was calibrated in turn, with all transducers transmitting through the entire calibration. Standard ER60 calibration procedures were used as documented for previous cruises. A 38.1 mm tungsten carbide sphere was used for all frequencies. TS gains were similar (within 0.2 dB) to those obtained from the calibration in September off Scotland, except the 120 kHz. The 120 kHz calibration was repeated and the same values found. The updated gains and Sa corrections (first 120 kHz calibration) were applied to the EK60.

A CTD (Event 55) was undertaken prior to calibration (Figure 2). The mean temperature and salinity was calculated for the top 5 to 30 m of the water column, and the values updated in the EK60 software (T = 3.12°C, S = 33.44 PSU). The theoretical target strength (TS) of the tungsten carbide sphere was calculated using the matlab code SGCAL_freeware, ComputeSolidElasticSphereTS.m for each frequency (Table 6).

Table 6 Theoretical target strength values for 38.1mm WC sphere for each frequency

Frequency (kHz)	38	70	120	200
TS (dB)	-42.2	-40.76	-39.66	-39.52

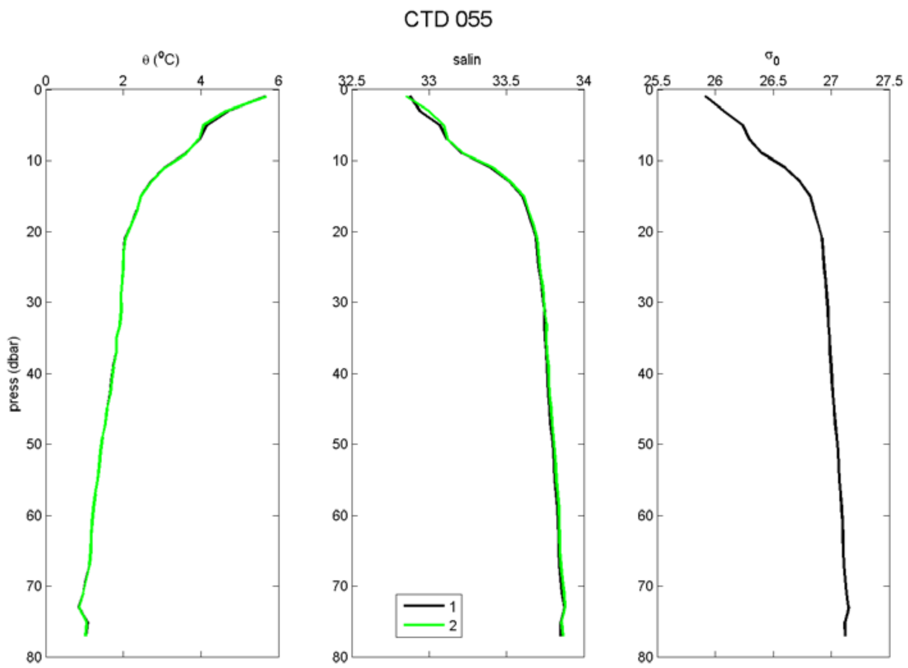


Figure 2 Event 55 Calibration CTD at Stromness

3.3 WBAT deployment and calibrations

3.3.1 Introduction

During this cruise attempts were made to calibrate the WBTs. This was with an initial desire to use them in lowered mode during the polar front transit, as well as to calibrate the system used on the WCB mooring. In eventuality the WBT was only deployed once across the polar front, but several attempts were taken to collect data and calibrate the WBAT.

3.3.2 Methods

The WBAT was secured in the mooring brackets and lowered over the side of the ship both from the mid-ships gantry, and from the aft cranes. When calibrating the WBAT was connected to a laptop using a 10-30 m extension lead, so that the sphere could be seen and located under the transducer. A 21 mm calibration sphere was used to calibrate the 120 kHz transducers, the sphere was lowered on a single line of fishing line from an extendable pole. It was manually steered into all sectors of the transducers. WBAT 253128 and 240826 were calibrated with the 120 kHz transducers. In addition, WBT253128 was calibrated with the 38 kHz transducers (using the 38.1 mm sphere). The first deployment was off Signy for calibration. Further deployments were made in Stromness. Finally, the WBAT with 38 kHz transducer was lowered on the CTD frame as part of event 78 (Table 7).

Table 7 WBAT deployments during JR19001

Event No.	Date/time deployed	Date/time recovered	Latitude (decimal°)	Longitude (decimal°)	Comment
1	23/11/2019 17:12	23/11/2019 19:42	-60.7021	-45.583	Deployment off Signy. To calibrate. 21 mm WC sphere. (120 kHz)
57	09/12/2019 22:16	09/12/2019 22:54	-54.1592	-36.694	Calibration in Stromness (120 kHz)
58	09/12/2019 23:51	10/12/2019 00:26	-54.1593	-36.6939	Calibration in Stromness (38 kHz)
78	15/12/2019 16:06	15/12/2019 17:46	-55.0471	-42.7561	CTD deployment to 400m

4. Planktonic foraminifera and pteropods organic carbon concentration and metabolism (*Julie Meilland*)

4.1 Introduction

Planktonic foraminifera and pteropods are calcifying organisms with a crucial role in the marine biological carbon pump. The inorganic C fluxes they generate to the deep ocean and sediments are intensively studied such as the sensitivity of their shells to ocean acidification. However, their contribution to the biological C pump (living cell/s) is often overlooked while it could be a crucial element of the pump stability and sustainability. Through the collection of planktonic foraminifera and pteropods along this cruise, I intend to better understand their role in the marine organic carbon cycle, and improve our understanding of their cellular lipids and proteins composition. This cruise is also the opportunity to compare foraminifera assemblages and genetic identity with material collected in the same area almost 20 years ago during the "Millenium" cruise (JR79).

4.2 Objectives

- Individual measurement of planktonic foraminifera (focus on the species *Neogloboquadrina pachyderma*) and pteropods protein and lipid concentration;
- Incubations of planktonic foraminifera under different temperature treatment to see if and how they can adjust their metabolism;
- Collection of planktonic foraminifera for genetic analysis (single-cell);
- Preservation of full Bongo net samples for planktonic foraminifera assemblages.

4.3 Methods

Planktonic foraminifera were collected with a Bongo net on a total of 11 stations (Table 8). Depending on the amount of phytoplankton and particles in the water column, we did one or two deployments respectively down to 100m and/or 50 m depth leading to a total number of 16 nets. Exceptionally for Event n°10 the bongo has been deployed to 200 m depth to maximise our chance of collecting a consequent number of individuals (Table 1).

Living specimens of planktonic foraminifera were picked out of the cod ends immediately after the sampling. The healthier individuals were selected for incubations in event 9, 10, 34, 35, 69 and 97 while the others were isolated for protein measurements and genetic analyses to be done back to laboratory.

For the incubations, specimens were isolated in 12 holes culture plate and place at 4 or 6°C under a salinity of 33.8. A total of 48 specimens were kept for each batch of culture, fed and checked daily for their rhizopodial activity and cytoplasm state.

4.4 Preliminary results

All specimens placed in culture displayed a good and intense rhizopodial activity (Figure 3) and very low mortality rate allowing us to run the incubations for 11 days for each batch. No drastic differences were observed between the two temperatures treatment but we noticed behaviour differences between specimens collected around Signy Island and the ones from South Georgia. The Signy population appeared to be particularly active and none of the cultivated organisms built a crust while most of the South Georgia population did.

Table 8 Details of events sampled and targeted analysis for planktonic foraminifera

						Surface informations				Planktonic foraminifera		
Time	Latitude(°S)	Longitude(°W)	Event N°	Water depth (m)	Sample depth (m)	Temperature °C	Salinity	Chlorophyll-*a* (µg/l)	PAR (µmol/S.m2)	Culture	Protein/Lipids	Genetic
20/12/19 06:47	-52.70536	-55.22122	107	1867.77	100	6.7862	33.8917	0.2267	1.2			
19/12/19 03:36	-53.29432	-52.18542	100	1695.02	100	5.8688	34.0287	0.2957	1.2		whole sample frozen	
18/12/19 06:42	-53.99442	-49.44819	97	4016.64	100	4.1932	33.8855	0.3748	5.2			
16/12/19 06:36	-54.91957	-42.68933	83	3489.02	100	2.6678	33.7808	0.4057	6.8			
11/12/19 21:58	-52.80868	-40.11384	69	3786.69	100	3.2938	33.9049	0.5603	63			
10/12/19 18:55	-53.79778	-37.93581	61	297.17	100	3.4015	33.82	0.5884	627.2		No foraminifera	
08/12/19 13:20	-53.32461	-37.77489	50	2835.24	100	2.5561	33.8317	0.1402	824.8			
08/12/19 13:03	-53.32459	-37.7732	49	2832.2	50	2.572	33.832	0.1299	809.8			
06/12/19 02:57	-53.57462	-38.83123	35	4501.6	100	2.7262	33.8753	0.4181	1			
06/12/19 02:42	-53.57464	-38.83122	34	4501.56	50	2.7244	33.8739	0.4196	1			
03/12/19 23:49	-52.80401	-40.15717	24	3796.95	50	2.6822	33.9159	0.7419	1.2			
03/12/19 23:36	-52.80401	-40.15715	23	3797.08	50	2.6839	33.9163	0.7608	1			
02/12/19 22:58	-53.59766	-38.0044	18	514.59	100	2.5825	33.8677	0.199	3.8			
02/12/19 22:38	-53.59763	-38.0044	17	514.83	50	2.6272	33.8672	0.2173	13.8			
24/11/19 20:45	-60.34951	-46.65686	10	764.93	200	-0.8051	33.9068	0.0569	547.2			
24/11/19 20:24	-60.34968	-46.65613	9	765.15	100	-0.8035	33.9069	0.0595	660			

We can attribute these differences to the fact that specimens collected around Signy are probably the ones that “overwintered” and therefore extremely resistant.

From the specimens of planktonic foraminifera (*Neogloboquadrina pachyderma*) collected around South Georgia, we observed a very rare case of asexual reproduction leading to the birth of 92 offspring. Some of them were immediately isolated and some others kept in culture and fed with micro-algae. The offspring presented a very low growth rate but we could see the addition of chambers for most of them, suggesting they were healthy.

Figure 3 Neogloboquadrina pachyderma displaying rhizopodial activity and feeding on an artemia

4.5 Future work

Back in the laboratory, protein and lipids will be measured and DNA will be extracted from the isolated individuals.

SEM images will be undertaken on the offspring and the “mother” to better understand of the reproduction occurred.

5 Distribution of coccolithophore in the Southern Ocean and their contribution to the carbonate pump (*Roberta Johnson, Clara Manno)*

5.1 Introduction

Coccolithophores are a calcifying, unicellular phytoplankton (2-30 µm in size) made up of calcified plates called coccoliths. Coccolithophores influence seawater chemistry and the exchange of carbon dioxide between the atmosphere and the ocean via photosynthesis and the formation and dissolution of their calcium carbonate skeleton. An estimated 83% of the organic carbon flux of the seafloor is associated with calcium carbonate ballast (Klaas and Archer, 2002), establishing coccolithophores as major contributors to the planet's carbon cycle (Falkowski et al., 2008; Lefebvre et al., 2011; Ziveri et al., 2007). Establishing the environmental parameters effecting the distribution of coccolithophores, particularly in the climate sensitive region of the Southern Ocean, will be important for predicting how they will respond to the changing climate.

Water samples were collected from CTDs at 5 different depths for taxonomic analysis and calcium carbonate content. A suite of environmental factors including temperature, salinity, chlorophyll concentration, photosynthetically active radiation, pH, total alkalinity, and dissolved inorganic carbon have been collected which will allow us to determine what, if any, environmental factors are influencing coccolithophore populations, abundance and calcium carbonate content. This will be used to predict how these populations will be affected under climate change, particularly under ocean warming and acidification, and if there is likely to be an effect on their contribution to the carbonate pump in the Southern Ocean.

This work was done in collaboration with the British Antarctic Survey and the Autonomous University of Barcelona.

5.2 Methods

The transect began at the Sub-Antarctic island of Signy and continued north to South Georgia and then north-west to near the Falkland Islands. Samples collected during this cruise made up from a combination of open ocean and coastal water and were collected from both the underway pump system of the JCR (Table 9; 5m depth, flow rate) and from CTD stations (Table 10; 5 depths). Target depths for the CTD stations were 10, 25, 50, 75 and 100m depth. The closest depth to the chlorophyll max would change to the chlorophyll max depth (Figure 4).

5.3 Taxonomic analysis

Approximately 1-2L of water from either the underway pump or the CTD station were filtered (20bar pump) through an acetate cellulose filter (0.45µm). The filters were lightly rinsed with MilliQ water to remove salt build up. The filters were dried in a fumehood for 48 hrs or in an oven at 50°C for 24 hrs. These samples will be analysed via microscopy at the Autonomous University of Barcelona, Spain.

5.4 Coccolith calcium analysis

Sample water was pre-sieved at 63µm and then 3-5L (depending on filtration flow) were filtered (20-50bar pump) through a polycarbonate membrane filter (0.8µm). The filters were lightly rinsed with MilliQ water to remove salt build up. The filters were dried in a fumehood for 48hrs or in an oven at 50°C for 24 hrs. Analysis of these samples were be done at the Autonomous University of Barcelona, Spain.

Table 9 Coccolithophore underway sampling stations

Station	Date	Latitude	Longitude	Depth (m)	Chlorophyll	Water temperature (°C)	Salinity (PSU)	PAR(micromol/s.m2)

1	23/11/2019	-60.7011	-45.582	31.77	0.0659	-0.1	33.8061	557.4
2	25/11/2019	-60.6364	-46.4907	165.66	0.1025	-0.1638	34.0405	1.2
3	25/11/2019	-59.1908	-45.2693	1571.64	0.2608	1.1051	33.8048	482
4	25/11/2019	-57.8991	-43.374	3105.43	0.2351	0.9521	33.821	625.6
5	26/11/2019	-56.9883	-42.082	3859.24	0.2324	1.9428	33.8157	1.2
6	26/11/2019	-55.8971	-40.5647	3148.42	0.1723	1.179	33.784	383.4
7	26/11/2019	-55.369	-39.8386	3275.8	0.0716	2.4786	33.8176	1154.4
8	27/11/2019	-54.5576	-38.7645	214.34	0.172	2.6031	33.8543	1.2
9	27/11/2019	-54.0159	-38.0532	37.58	0.1132	1.8314	33.9178	896
10	29/11/2019	-54.1969	-36.4435	267.06	0.2733	3.2245	32.9728	1.2

Table 10 Coccolithophore CTD sampling stations

Date	Bridge Event	Latitude (°)	Longitude (°)	CTD Cast	Depth (m)	Pressure (dbar)	Temperature (°C)	Conductivity	Salinity (PSU)
24/11/2019	6	-60.34033	-46.65961	3	11.47	11.58	-1.08	2.73	33.92
24/11/2019	12	-60.37583	-46.68924	6	11.8	11.91	-1.14	2.73	33.98
2/12/2019	16	-53.59761	-38.00442	9	11.55	11.65	2.51	3.03	33.88
3/12/2019	22	-52.80402	-40.15712	10	10.1	10.19	2.63	3.05	33.93
5/12/2019	31	-53.84666	-39.14306	12	11.53	11.63	2.17	3.01	33.9
6/12/2019	37	-53.43161	-38.69521	14	11.05	11.15	2.51	3.03	33.89
8/12/2019	51	-53.32465	-37.77668	20	11.08	11.18	2.58	3.04	33.85
13/12/2019	77	-55.25854	-41.35855	26	10.6	10.7	2.58	3.03	33.8
15/12/2019	78	-55.04705	-42.75605	27	10.7	10.8	2.16	2.99	33.78
17/12/2019	90	-54.48742	-46.00377	29	9.96	10.05	4.66	3.23	34.05
19/12/2019	99	-53.29429	-52.18546	31	10.99	11.09	5.83	3.34	34.09
19/12/2019	103	-52.69602	-55.18652	32	10.99	11.09	6.78	3.42	34.03

Figure 4 Filtering water from CTD stations in the prep lab on the James Clarke Ross

5.5 References

Falkowski, P. G., Fenchel, T. and Delong, E. F.: The Microbial Engines That Drive Earth's Biogeochemical Cycles, Science (80-.)., 320(5879), 1034–1039, doi:10.1126/science.1153213, 2008.

Klaas, C. and Archer, D. E.: Association of sinking organic matter with various types of mineral ballast in the deep sea: Implications for the rain ratio, Global Biogeochem. Cycles, 16(4), 63-1-63–14, doi:10.1029/2001GB001765, 2002.

Lefebvre, S., Benner, I., Stillman, J., Parker, A., Drake, M., Rossignol, P., Okimura, K., Komada, T. and Carpenter, E.: Nitrogen source and pCO2 synergistically affect carbon allocation, growth and morphology of the coccolithophore Emiliania huxleyi: potential implications of ocean acidification for the carbon cycle, Glob. Chang. Biol., 18, 493–503, doi:10.1111/j.1365-2486.2011.02575.x, 2011.

Ziveri, P., de Bernardi, B., Baumann, K.-H., Stoll, H. M. and Mortyn, P. G.: Sinking of coccolith carbonate and potential contribution to organic carbon ballasting in the deep ocean, Deep Sea Res. Part II Top. Stud. Oceanogr., 54(5–7), 659–675, doi:10.1016/j.dsr2.2007.01.006, 2007.

6 Western Core Box (*Sophie Fielding*)

6.1 Introduction and event summary

The 24th occupation of the WCB survey commenced on 04/12/2019, starting from the northern end of the WCB1.1 transect. All transects were completed successfully over the next 4 days (Table 11). This year was the first year that no XBTs were deployed within the survey, instead additional CTD stations were placed on leg 4.2. The CTDs and stratified RMT8s were picked off in a more random order than previous cruises as the schedule permitted. Target fishing was completed successfully on day 1, no targets were seen on day 2, target fishing was unsuccessful on day 3 due to a net failure, and were also missed on day 4. However target fishing was undertaken on days surrounding the WCB survey and within the WCB region more successfully and their data was included in the length measurements. CTDs and RMT8 nets completed as part of the WCB survey are listed in Table 12.

There were krill targets throughout the WCB survey area,

Table 11 WCB transect start and end times

Transect	Date	Start time (GMT)	End time (GMT)
1.1	04/12/2019	09:08	13:32
1.2	04/12/2019	14:38	19:03
2.1	05/12/2019	08:54	13:18
2.2	05/12/2019	14:22	18:40
3.1	06/12/2019	10:16	14:33
3.2	06/12/2019	15:37	19:56
4.1	07/12/2019	08:36	12:59
4.2	07/12/2019	13:30	17:51

Table 12 WCB CTD and RMT8 net events

Event No	Date/Time	Station identity	Activity
19	03/12/2019 02:24	Target	RMT8 target net
20	03/12/2019 04:06	CTD2.2S	RMT8 stratified net
28	04/12/2019 20:30	CTD1.2N	CTD (1000m)
29	04/12/2019 22:07	CTD1.2N	RMT8 stratified net
30	05/12/2019 04:27	Target	RMT8 target net
31	05/12/2019 06:49	CTD1.2S	CTD
32	05/12/2019 20:00	CTD2.2S	CTD
33	05/12/2019 22:48	CTD1.2S	RMT8 stratified net
36	06/12/2019 04:54	CTD2.2N	RMT8 stratified net
37	06/12/2019 07:37	CTD2.2N	CTD (1000m)
38	06/12/2019 21:20	CTD3.2N	CTD (1000m)
39	06/12/2019 22:53	CTD3.2N	RMT8 stratified net
41	07/12/2019 06:22	Target	RMT8 target net (duff)
45	07/12/2019 23:04	CTD3.2S	CTD
46	08/12/2019 00:20	Target	RMT8 target net
48	08/12/2019 05:08	Target	RMT8 target net
51	08/12/2019 14:00	CTD4.2N	CTD (1000m)
52	08/12/2019 15:39	CTD4.2N	RMT8 stratified net

53	08/12/2019 19:30	CTD4.2S	RMT8 stratified net
54	09/12/2019 01:32	CTD4.2S	CTD
59	10/12/2019 15:10	WCB mooring	RMT8 stratified net
64	10/12/2019 23:03	Target	RMT8 target net
65	11/12/2019 01:10	Target	RMT8 target net
66	11/12/2019 04:14	Target	RMT8 target net

Antarctic krill were counted, and where there were sufficient at least 100 were measured for length, this included examining the use of automated tools for length frequency analysis.

6.2 Semi-automatic Plankton Image Analysis: a complementary tool for krill stock assessment (*Rodrigo Hernandez Moresino, Sophie Fielding*)

6.2.1 Introduction

Zooplankton is the key mediator between energy synthesized by phytoplankton and higher trophic levels. Because plankton can vary quickly in term of abundance and biomass according to variations of environmental conditions, it constitutes a significant bio-indicator of global changes like increasing atmospheric CO2, global warming or anthropogenic eutrophication.

Antarctic krill (*Euphausia superba*), hereafter krill, is a key species in the Antarctic marine foodweb as a result of its large biomass (Atkinson et al., 2009) and important role in the Antarctic foodweb as prey to fish, squid, penguins, other seabirds, and marine mammals including seals and whales (Croxall et al., 1999). It has a circumpolar habitat that constrains it to the north by the Antarctic Polar Front (APF) and to the south by the continent (Atkinson et al., 2009).

Since 1981, The British Antarctic Survey (BAS) has been estimating krill density to the northwest of South Georgia, considered the northern limit distribution of krill and where is expected to observe biological responses to climate changes. Initially, these surveys were undertaken on an ad hoc basis (Brierley et al., 1999), but in 1997, they were formalized into a set of annually repeated transect lines in an area known as the Western Core Box (WCB; Brierley et al., 1997).

Nowadays, the development of semi-automatic image analysis provides to be useful tools to analyse high amounts of plankton samples in relatively short time periods, with acceptable accuracy and moderate level of taxonomic classification. Computer-assisted analysis of plankton digital images combine current powerful computers with the quality of digitalized devices and the efficiency of machine learning algorithms. In particular, Zoo/PhytoImage software proposes a free solution to the use of plankton pictures from various origins and moreover, provides numerous table of measurements (i.e., abundances, total and partial size spectra, total and partial biomasses, etc.), by recognition of the contour line from each individual in the photograph.

Thus, the main goal of this report was to give a first view of image analysis tool achievements with image samples of krill collected in the oceanographic campaign on board the RRS James Clark Ross in November and December of 2019.

6.2.2 Methodology

Samples of krill were collected with the RMT8 (8 m^2 mouth size and 500 µm mesh) and digital photographed with a Nikon D810 camera mounted on a mechanical arm. For calibration purposes two rulers were located at the top and bottom of the white tray where the krill was photographed, and measures were made using ImageJ, obtaining a pixel size equivalent to ca. 0.056 mm (Figure 5).

Figure 5 Photograph of krill in a white tray

Identification and quantification of krill was conducted by semi-automatic analysis of digital images with ZooImage software v1.2 (http://zooimage-team.software.informer.com/). To predict zooplankton identification, a training set was built by manually sorting objects from samples taken from randomly chosen samplings into user-defined maturity-stage categories: Juveniles (J), Male Adults (MA), Male Subadults (MS), Female Adults (FA), and Female Subadults (FS). The total number of objects included in the training set was 526, around 120 object per category. The exception was the FS in which the number was only 11, because of the absence of more individuals in the stage. In order to have a representative number of objects per category (no less than 25, ZooImage User Manual), the FS category was removed from the analysis. Further methodology descriptions can be found in Hernandez-Moresino et. al. (2017)

6.2.3 Results

The Linear Discriminant Analysis algorithm was selected for machine learning, on account that it was the most accurate in the automatized processing of our samples with ZooImage. The performance of the automatic classification was evaluated by 10-fold cross-validation to identify misclassifications between the categories, and its accuracy was improved up to a maximum of 73.5%. As a result, a confusion matrix was obtained that not only allowed the identification of the wrongly classified objects but also of categories from which these originate. In addition, to obtain more accurate classification, predictions of each category were corrected using coefficients calculated from the confusion matrix (CC = visual inspection/ZooImage classification) (Table 13).

Table 13 Confusion matrix obtained from the training set.

Numbers in the diagonal (in grey) represent the correct classification of objects (true positives), while those outside correspond to misclassified objects (false positives). CC denotes the correction coefficient used to generate more accurate estimations of abundance.

		ZooImage classif.				
	General Accuracy (%) 73.50					**CC**
		1	2	3	4	
User classif.	Femail Adults (1)	70	1	16	12	1.16
	Juveniles (2)	1	95	0	16	1.04
	Males Adults (3)	13	0	77	5	0.98
	Males Subadults (4)	25	24	6	88	1.26
	Total	109	120	99	121	
	Accuracy (%)	64.2	79.2	77.8	72.7	

To test the accuracy of the software, measures of krill length (as other measurements) were obtained with ZooImage software. The total length of an object in ZooImage is the largest axis (referred to as the width of an object), in the case of krill it is from the tip of the rostral spine to the tip of the telson. In krill studies, however, the total length (TL) is measured from the anterior edge of the eye to the tip of the telson. Thus, a correction coefficient (CC) was applied measuring that distance from digital photographs, using the measure tool provided by the software ImageJ (it is an application software included in the ZooImage package), and dividing by the width of the object. A total of 449 individuals were measured. In order to achieve more accurate measurements, two CC were used depending on the width of the object (0.85 and 0.79 when width was < and > than 50 mm, respectively). The result is a relative average difference between in situ and digital measures of -1.17 %, and an absolute average difference of 6.72 %.

The total length for each krill maturity/stage was also measured by manual inspection (Figure 6 and Table 14).

Table 14 Length of krill measured manually by stage

	Length (mm)			Biomass (mg dw)		
Maturity/Stage	Average	Sd. Deviation	n	Average	Sd. Deviation	n
Juv	34.3	2.98	719	1.02	0.27	397
FS	38.14	2.34	22	1.26	0.26	12
FA1	45.31	3.80	104	1.91	0.66	50
FA2	51.14	2.73	58	3.35	0.58	30
FA3	57.33	2.29	6	4.43	0.27	5
MS1	38.34	2.33	107	1.28	0.31	59
MS2	41.50	3.19	40	1.54	0.48	19
MS3	45.67	2.81	30	2.20	0.43	12
MA1	49.56	2.67	94	2.46	0.66	21
MA2	49.94	3.88	32	2.44	0.70	9

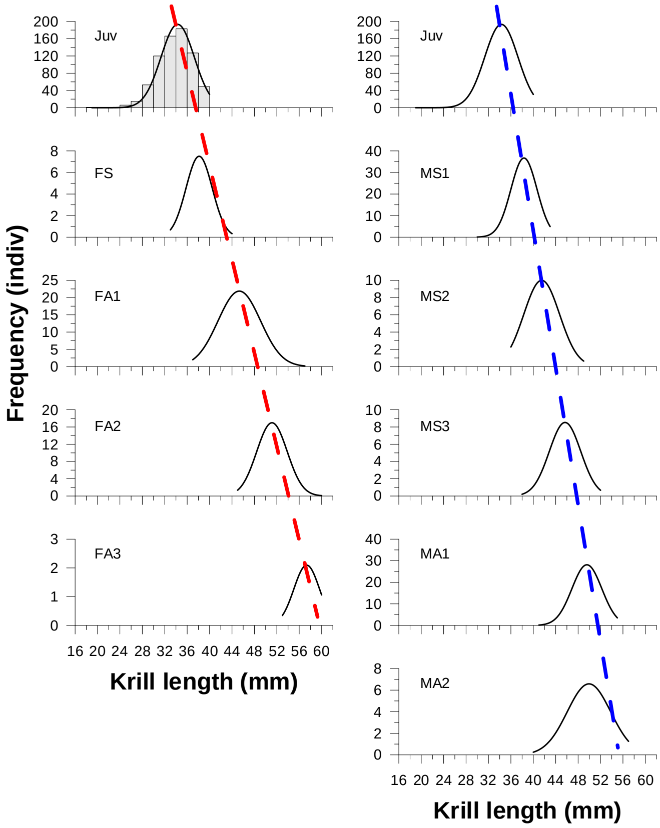


Figure 6 Size frequency plots, separated by female and male (left and right panels, respectively). The dotted diagonal lines indicate average increase trough the stages

The individual biomass of each krill was estimated using the regression equation for Antarctic krill (Hernández-León and Montero, 2006) and area provided by ZooImage (which assumes krill have a prolate spheroid shape and use the major and minor axes from ZooImage). The equation is:

DW = 87.45 * S1.34

(where DW (mg) is the dry weight and S is body area in mm^2).

In this way, biomass frequency plots were also made for each krill stage/maturity (Figure 7 and Table 14).

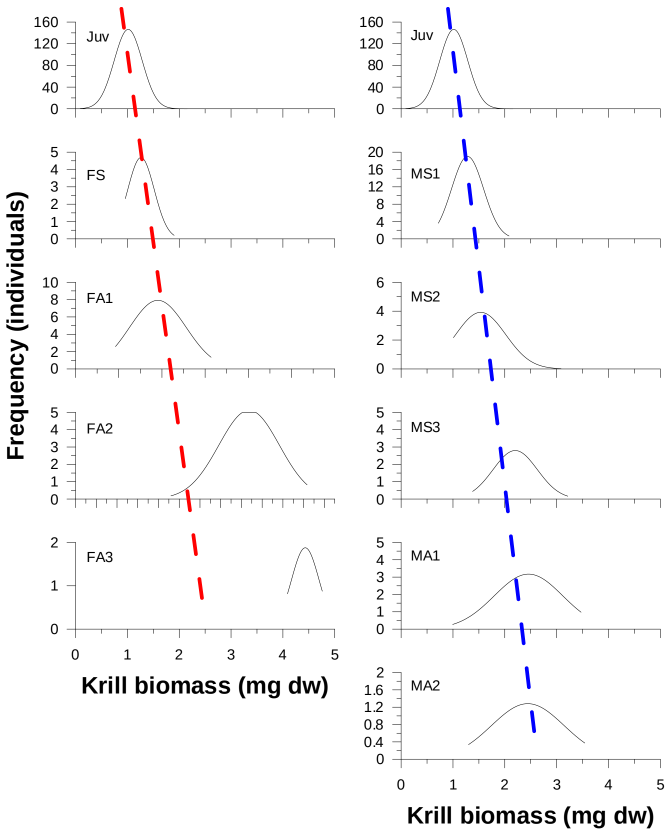


Figure 7 Biomass frequency plots, separated by female and male (left and right panels, respectively). The dotted diagonal lines indicate average increase trough the stages

6.2.4 Highlights

- Semi-automatic image analysis is a helpful set of tools that can be used in future studies on spatial and temporal variability of krill stocks.
- ZooImage software showed moderated accuracy in terms of maturity/stage classification.
- Low morphometric differences among maturity/stage classes prevent a better classification accuracy.
- Biomass estimations in terms of dry weight can be used as a complementary variable of population status.
- ZooImage has not had updates for several years, an alternative software might be taken into consideration.

6.2.5 References

Atkinson, A., Siegel, V., Pakhomov, E.A., Jessopp, M.J., and Loeb, V. 2009. A re-appraisal of the total biomass and annual production of Antarctic krill. Deep Sea Res. I, 56: 727–740.

Brierley, A.S., Watkins, J.L., Goss, C., Wilkinson, M.T., and Everson, I. 1999. Acoustic estimates of krill density at South Georgia, 1981 to 1998. CCAMLR Science, 6: 47–57.

Brierley, A.S., Watkins, J. L., and Murray, A.W.A. 1997. Interannual variability in krill abundance at South Georgia. Marine Ecol. Prog. Ser., 150: 87–98.

Croxall, J.P., Reid, K., and Prince, P.A. 1999. Diet, provisioning and productivity responses of marine predators to differences in availability of Antarctic krill. Mar. Ecol. Pro. Ser., 177: 115–131.

Hernández-León, S., and Montero, I. 2006. Zooplankton biomass estimated from digitalized images in Antarctic waters: a calibration exercise. J. Geophys. Res. Oceans 111, C05S03.

Hernández-Moresino, R.D., Di Mauro, R., Crespi-Abril, A.C., Villanueva-Gomila, G.L., Compaire, J.C., and Barón, P.J. 2017. Contrasting structural patterns of the mesozooplankton community result from the development of a frontal system in San José Gulf, Patagonia. Est. Coast. Shelf Sci., 193, 1-11.

7 Macrozooplankton (*Gabriele Stowasser, Sophie Fielding, Bjørg Apeland, Christopher Kerr, Anna Belcher, Clara Manno, Emily Rowlands, José Xavier, Ricardo Matias, Rodrigo Hernandez-Moresino, Iliana Bista, Petra ten Hoopen*)

7.1 Gear

The RMT8 was used to characterise the macrozooplankton community in the Western Corebox (WCB) in 200m oblique trawls and target trawls. Target trawls were undertaken on krill swarms identified from the EK60. In oblique trawls net 1 was opened near the surface (10-20m) and the net deployed to 200m (where water depth was sufficient) before closing and net 2 opened at 200m depth and closed near the surface (10-20m). The choice of deployment type depended on the task. Target hauls were made to supply the WCB team with *Euphausia superba* (Antarctic krill) for length frequency measurements and Anna Belcher (BAS) with krill for spectral measurements. Krill and other zooplankton were furthermore sampled for micro- and nano-plastic incubation experiments (PhD student Emily Rowlands, University of Exeter) as well as for a study on the trophic ecology of Southern Right Whales in South Georgia waters (PI, Jennifer Jackson, BAS). Oblique trawls within the Western Core Box were only undertaken at the CTD positions. All RMT8 hauls are listed in Table 15.

7.2 RMT8 catch sorting and processing

7.2.1 RMT8 Oblique hauls WCB

For the oblique hauls the total catch of net 2 (200m – surface) was sorted and quantified. Numbers caught and total weight were obtained for each species. For some groups specific identification was not possible and identification will be verified through re-examination in the laboratory. All material collected in net 1 (surface – 200m) was preserved in 4% formalin. All data were recorded in an Excel database.

7.2.2 RMT8 Targeted hauls

The catch of targeted hauls was sorted and quantified. Where live *E. superba* were caught, samples were taken for incubation experiments. In hauls, where sufficient numbers of *E. superba* were caught, length-frequency data was collected (see chapter on krill length frequency, Sophie Fielding, BAS). Krill total length was measured on 100 fresh krill, using the standard BAS measurement from the anterior edge of the eye to the tip of the telson, with measurements rounded down to the nearest mm (Morris et al. 1988). Maturity stage was assessed using the scale of Makarov and Denys with the nomenclature described my Morris et al. (1988).

Table 15 Successful RMT8 hauls carried out in Signy, the Western Core Box (WCB) and South Georgia waters on cruise JR19001

Event No	Time and Date (GMT)	Latitude	Longitude	Net depth (m)	Action	Haul type
7	24/11/2019 18:10	-60.3960	-46.4687	47	N1_Open	Target, Signy
7	24/11/2019 18:15	-60.3954	-46.4763	34	N1_Close	Target, Signy
7	24/11/2019 18:15	-60.3954	-46.4763	34	N2_Open	Target, Signy
7	24/11/2019 18:17	-60.3952	-46.4792	35	N2_Close	Target, Signy
15	02/12/2019 19:47	-53.7583	-38.0243	30	N1_Open	Target
15	02/12/2019 19:49	-53.7597	-38.0245	22	N1_Close	Target
15	02/12/2019 19:50	-53.7604	-38.0245	20	N2_Open	Target
15	02/12/2019 19:52	-53.7618	-38.0243	19	N2_Close	Target
19	03/12/2019 02:29	-53.7858	-38.3434	51	N1_Open	Target
19	03/12/2019 02:30	-53.7864	-38.3436	51	N1_Close	Target
19	03/12/2019 02:32	-53.7875	-38.3442	48	N2_Open	Target
19	03/12/2019 02:34	-53.7889	-38.3446	30	N2_Close	Target

20	03/12/2019 04:10	-53.7725	-38.5798	1	N1_Open	Oblique WCB2.2S
20	03/12/2019 04:42	-53.7957	-38.5896	128	N1_Close	Oblique WCB2.2S
20	03/12/2019 04:43	-53.7964	-38.5900	131	N2_Open	Oblique WCB2.2S
20	03/12/2019 05:18	-53.8240	-38.6045	9	N2_Close	Oblique WCB2.2S
29	04/12/2019 22:11	-53.4915	-39.2567	21	N1_Open	Oblique WCB1.2N
29	04/12/2019 22:50	-53.4816	-39.3074	195	N1_Close	Oblique WCB1.2N
29	04/12/2019 22:50	-53.4813	-39.3083	206	N2_Open	Oblique WCB1.2N
29	04/12/2019 23:28	-53.4774	-39.3589	21	N2_Close	Oblique WCB1.2N
30	05/12/2019 04:36	-53.7599	-38.8162	49	N1_Open	Target
30	05/12/2019 04:37	-53.7602	-38.8177	45	N1_Close	Target
30	05/12/2019 04:40	-53.7610	-38.8218	47	N2_Open	Target
30	05/12/2019 04:41	-53.7613	-38.8231	40	N2_Close	Target
33	05/12/2019 22:52	-53.8575	-39.1437	9	N1_Open	Oblique WCB1.2S
33	05/12/2019 23:35	-53.8316	-39.1371	199	N1_Close	Oblique WCB1.2S
33	05/12/2019 23:35	-53.8313	-39.1370	204	N2_Open	Oblique WCB1.2S
33	06/12/2019 00:12	-53.8074	-39.1218	10	N2_Close	Oblique WCB1.2S
36	06/12/2019 04:58	-53.4286	-38.6753	6	N1_Open	Oblique WCB2.2N
36	06/12/2019 05:29	-53.4327	-38.7160	197	N1_Close	Oblique WCB2.2N
36	06/12/2019 05:30	-53.4328	-38.7173	201	N2_Open	Oblique WCB2.2N
36	06/12/2019 06:02	-53.4358	-38.7600	14	N2_Close	Oblique WCB2.2N
39	06/12/2019 22:54	-53.3645	-38.0583	10	N1_Open	Oblique WCB3.2N
39	06/12/2019 23:34	-53.3603	-38.1082	195	N1_Close	Oblique WCB3.2N
39	06/12/2019 23:35	-53.3602	-38.1096	199	N2_Open	Oblique WCB3.2N
39	07/12/2019 00:13	-53.3581	-38.1603	15	N2_Close	Oblique WCB3.2N
46	08/12/2019 00:22	-53.7548	-37.9073	22	N1_Open	Target
46	08/12/2019 00:24	-53.7537	-37.9088	16	N1_Close	Target
46	08/12/2019 00:27	-53.7519	-37.9108	20	N2_Open	Target
46	08/12/2019 00:29	-53.7507	-37.9122	13	N2_Close	Target
48	08/12/2019 05:15	-53.7246	-38.4011	42	N1_Open	Target
48	08/12/2019 05:17	-53.7234	-38.4030	27	N1_Close	Target
48	08/12/2019 05:17	-53.7229	-38.4037	32	N2_Open	Target
48	08/12/2019 05:17	-53.7228	-38.4039	33	N2_Close	Target
52	08/12/2019 15:42	-53.3369	-37.7739	7	N1_Open	Oblique WCB4.2N
52	08/12/2019 16:16	-53.3131	-37.7682	199	N1_Close	Oblique WCB4.2N
52	08/12/2019 16:16	-53.3128	-37.7681	201	N2_Open	Oblique WCB4.2N
52	08/12/2019 16:51	-53.2901	-37.7530	15	N2_Close	Oblique WCB4.2N
52	08/12/2019 16:51	-53.2901	-37.7530	15	N2_Close	Oblique WCB4.2N
53	08/12/2019 19:34	-53.6863	-37.6553	8	N1_Open	Oblique WCB4.2S
53	08/12/2019 19:55	-53.6707	-37.6507	98	N1_Close	Oblique WCB4.2S
53	08/12/2019 19:55	-53.6700	-37.6505	104	N2_Open	Oblique WCB4.2S
53	08/12/2019 20:20	-53.6519	-37.6463	12	N2_Close	Oblique WCB4.2S
59	10/12/2019 15:15	-53.7936	-37.9318	11	N1_Open	Oblique WCB mooring
59	10/12/2019 15:47	-53.8179	-37.9634	126	N1_Close	Oblique WCB mooring
59	10/12/2019 15:48	-53.8185	-37.9643	136	N2_Open	Oblique WCB mooring
59	10/12/2019 16:19	-53.8371	-37.9914	12	N2_Close	Oblique WCB mooring
64	10/12/2019 23:04	-53.7064	-37.9562	3	N1_Open	Oblique WCB3.2S
64	10/12/2019 23:20	-53.7159	-37.9668	98	N1_Close	Oblique WCB3.2S
64	10/12/2019 23:20	-53.7162	-37.9673	108	N2_Open	Oblique WCB3.2S
64	10/12/2019 23:36	-53.7246	-37.9763	10	N2_Close	Oblique WCB3.2S
65	11/12/2019 01:22	-53.7317	-38.1460	39	N1_Open	Target
65	11/12/2019 01:23	-53.7323	-38.1461	36	N1_Close	Target
65	11/12/2019 01:24	-53.7328	-38.1462	33	N2_Open	Target
65	11/12/2019 01:25	-53.7334	-38.1463	30	N2_Close	Target
66	11/12/2019 04:20	-53.7532	-38.4139	40	N1_Open	Target
66	11/12/2019 04:21	-53.7541	-38.4137	30	N1_Close	Target
66	11/12/2019 04:23	-53.7556	-38.4132	42	N2_Open	Target
66	11/12/2019 04:25	-53.7574	-38.4127	31	N2_Close	Target
67	11/12/2019 15:20	-52.7967	-40.0872	8	N1_Open	Oblique P3
67	11/12/2019 16:00	-52.8131	-40.1224	209	N1_Close	Oblique P3
67	11/12/2019 16:05	-52.8152	-40.1265	213	N2_Open	Oblique P3

67	11/12/2019 16:37	-52.8291	-40.1557	12	N2_Close	Oblique P3
74	12/12/2019 20:31	-52.8399	-40.1424	55	N1_Open	Target
74	12/12/2019 20:32	-52.8392	-40.1421	57	N1_Close	Target
74	12/12/2019 20:33	-52.8385	-40.1418	48	N2_Open	Target
74	12/12/2019 20:34	-52.8379	-40.1415	50	N2_Close	Target
75	13/12/2019 02:35	-53.6004	-40.5037	77	N1_Open	Target
75	13/12/2019 02:45	-53.5966	-40.4941	81	N1_Close	Target
75	13/12/2019 02:50	-53.5947	-40.4896	38	N2_Open	Target
75	13/12/2019 02:53	-53.5936	-40.4869	20	N2_Close	Target

7.3 MOCNESS

To determine the biodiversity/biomass of the mesozooplankton community at the two Mooring sites (P3 and WCB) and stations along the Polar Front transect we used a MOCNESS net equipped with nine 330 µm mesh nets (Table 16). This net was deployed to 1000 m and sampled the water column at 8 depth-discrete intervals of 125 m, with net 1 remaining open throughout deployment. The MOCNESS was deployed during daylight and night-time hours, with each depth strata being sampled for around 10-12 minutes. All catches from nets 2 to 9 were preserved in 4% formaldehyde for future identification in the laboratory. Catches from net 1 were discarded.

Table 16 Successful MOCNESS deployments during JR19001

Event No	Net	Time and Date (GMT)	Latitude	Longitude	Net depth (m)	Action	Station
27	2	04/12/2019 03:22	-52.7964	-40.2928	986	Open	P3
27	3	04/12/2019 03:32	-52.7947	-40.2994	883	Open	P3
27	4	04/12/2019 03:43	-52.7925	-40.3069	763	Open	P3
27	5	04/12/2019 03:55	-52.7900	-40.3153	632	Open	P3
27	6	04/12/2019 04:03	-52.7881	-40.3214	511	Open	P3
27	7	04/12/2019 04:13	-52.7856	-40.3284	387	Open	P3
27	8	04/12/2019 04:22	-52.7833	-40.3349	258	Open	P3
27	9	04/12/2019 04:34	-52.7803	-40.3432	129	Open	P3
27	9	04/12/2019 04:44	-52.7775	-40.3502	15	Close	P3
60	2	10/12/2019 17:39	-53.7797	-37.9188	150	Open	WCB*
60	3	10/12/2019 17:39	-53.7802	-37.9193	147	Open	WCB
60	4	10/12/2019 17:40	-53.7804	-37.9195	145	Open	WCB
60	5	10/12/2019 17:41	-53.7807	-37.9199	145	Open	WCB
60	6	10/12/2019 17:41	-53.7812	-37.9203	145	Open	WCB
60	7	10/12/2019 17:42	-53.7814	-37.9205	143	Open	WCB
60	8	10/12/2019 17:46	-53.7833	-37.9225	125	Open	WCB
60	9	10/12/2019 17:58	-53.7904	-37.9288	64	Open	WCB
60	9	10/12/2019 18:03	-53.7930	-37.9311	77	Close	WCB
68	2	11/12/2019 18:51	-52.8030	-40.1000	1001	Open	P3
68	3	11/12/2019 19:01	-52.8067	-40.1077	880	Open	P3
68	4	11/12/2019 19:22	-52.8136	-40.1231	759	Open	P3
68	5	11/12/2019 19:34	-52.8175	-40.1324	628	Open	P3
68	6	11/12/2019 19:50	-52.8217	-40.1445	501	Open	P3
68	7	11/12/2019 20:01	-52.8253	-40.1524	379	Open	P3
68	8	11/12/2019 20:12	-52.8286	-40.1606	259	Open	P3
68	9	11/12/2019 20:24	-52.8322	-40.1695	127	Open	P3
68	9	11/12/2019 20:35	-52.8358	-40.1779	6	Close	P3
84	2	16/12/2019 19:15	-54.5013	-45.9030	997	Open	PF-1
84	3	16/12/2019 19:23	-54.4965	-45.9016	881	Open	PF-1
84	4	16/12/2019 19:35	-54.4896	-45.8998	761	Open	PF-1
84	5	16/12/2019 19:48	-54.4816	-45.8978	631	Open	PF-1

84	6	16/12/2019 20:03	-54.4729	-45.8940	512	Open	PF-1
84	7	16/12/2019 20:16	-54.4648	-45.8916	391	Open	PF-1
84	8	16/12/2019 20:33	-54.4544	-45.8884	261	Open	PF-1
84	9	16/12/2019 20:49	-54.4453	-45.8861	127	Open	PF-1
84	9	16/12/2019 21:00	-54.4392	-45.8838	8	Close	PF-1
92	2	17/12/2019 19:17	-53.9085	-49.2790	995	Open	PF-2
92	3	17/12/2019 19:32	-53.9133	-49.2844	887	Open	PF-2
92	4	17/12/2019 19:47	-53.9193	-49.2905	754	Open	PF-2
92	5	17/12/2019 20:01	-53.9252	-49.2958	633	Open	PF-2
92	6	17/12/2019 20:14	-53.9313	-49.3010	513	Open	PF-2
92	7	17/12/2019 20:29	-53.9383	-49.3071	382	Open	PF-2
92	8	17/12/2019 20:43	-53.9440	-49.3145	251	Open	PF-2
92	9	17/12/2019 20:57	-53.9489	-49.3204	133	Open	PF-2
92	9	17/12/2019 21:07	-53.9526	-49.3243	14	Close	PF-2
98	2	18/12/2019 19:24	-53.2803	-52.1385	991	Open	PF-3
98	3	18/12/2019 19:36	-53.2763	-52.1282	893	Open	PF-3
98	4	18/12/2019 19:46	-53.2712	-52.1179	751	Open	PF-3
98	5	18/12/2019 19:59	-53.2648	-52.1070	632	Open	PF-3
98	6	18/12/2019 20:15	-53.2575	-52.0939	511	Open	PF-3
98	7	18/12/2019 20:28	-53.2540	-52.0816	395	Open	PF-3
98	8	18/12/2019 20:42	-53.2511	-52.0674	265	Open	PF-3
98	9	18/12/2019 20:51	-53.2484	-52.0578	137	Open	PF-3
98	9	18/12/2019 21:02	-53.2457	-52.0456	18	Close	PF-3
102	2	19/12/2019 19:05	-52.6661	-55.0946	998	Open	PF-4
102	3	19/12/2019 19:17	-52.6695	-55.1041	885	Open	PF-4
102	4	19/12/2019 19:30	-52.6738	-55.1150	753	Open	PF-4
102	5	19/12/2019 19:52	-52.6805	-55.1328	629	Open	PF-4
102	6	19/12/2019 20:05	-52.6846	-55.1431	498	Open	PF-4
102	7	19/12/2019 20:24	-52.6908	-55.1561	384	Open	PF-4
102	8	19/12/2019 20:37	-52.6947	-55.1636	253	Open	PF-4
102	9	19/12/2019 20:47	-52.6954	-55.1706	133	Open	PF-4
102	9	19/12/2019 20:59	-52.6946	-55.1813	8	Close	PF-4
* Due to the shallowness of the area only nets 7 to 9 were opened for collection							

8 Where are they now? Right whales in the South Georgia marine ecosystem (*Jennifer Jackson (PI, BAS), Gabriele Stowasser, Sophie Fielding, Martin Collins*)

8.1 Introduction

Great whales have been subject to centuries of global hunting, first from small boats close to shore, and more recently by offshore factory ships which hunted and processed whales out in the ocean and were responsible for the most intense phase of exploitation of the world's whale stocks. While 20th century whaling rapidly decimated most of the lunge-feeding whales particularly humpback, blue, fin and sei whales, the destruction wrought by a similarly intense fishery for right whales up until the 1850s is not so well known. Right whales were one of the first large whales to be hunted because they are slow moving, calve in sheltered bays and have high fidelity to these calving areas. What catch records exist, suggest this fishery was incredibly intense on their calving grounds and their more accessible offshore aggregations.

In the Southwest Atlantic, right whales were exploited on their coastal calving grounds in Argentina and Brazil; whaling off Brazil began in 1602 and continued until commercial whaling became illegal in 1986. After nearly 400 years of hunting, southern right whales are now calving in these waters again, and for the first time in more than two centuries, they are regularly sighted on their associated high latitude feeding grounds off South Georgia, where they feed on Antarctic krill. Their principal calving ground off Península Valdés is one of the best-studied whale calving grounds in the world, with 40 years of data collection providing estimates of annual abundance and reproductive rates of known individuals through time. Consequently this is the only right whale population for which a direct relationship between high latitude environmental variability and calving ground reproductive success has been uncovered, indicating that climate and food availability off South Georgia influences right whale reproductive rates.

At present almost nothing is known about southern right whale ecology and habitat use on their South Georgia feeding ground, although this area is (i) a significant Southern Ocean krill and biodiversity hotspot, (ii) an area which has experienced significant climate fluctuation, influencing the population dynamics of other well studied krill predators, and (iii) one of the four principal areas where the Antarctic krill fishery operates. No baseline studies of any whale populations foraging in this important ecosystem have been conducted to date, although sightings data and observations from tourist vessels show increasing numbers of whales feeding in this ecosystem. For right whales, such surveys are long overdue and necessary in order to conduct an assessment of whale recovery from four centuries of exploitation (i.e. number and distribution of whales using this feeding ground), and to understand how regional South Georgia climate and habitat influence lower latitude population trends for this population (i.e. linking high latitude sightings, feeding, health status and foraging tracks with life history data available from the calving grounds).

We propose to conduct the first baseline survey of right whales feeding in South Georgia waters spanning 8 weeks of surveys during the austral summer. This survey will commence a crucial program of population monitoring for this species, to understand the population identity, dynamics, abundance and habitat use of right whales feeding in these waters, and link their foraging ecology, health and reproductive status with the low latitude calving grounds off Argentina and Brazil.

8.2 Methods

As part of this project the aim on the Western Core Box Cruise was the sampling of potential prey species for stable isotope analysis. Invertebrate and fish species collected from RMT8, MOCNESS and BONGO hauls are listed in Table 17.

Table 17 Invertebrate and fish species sampled from RMT8, MOCNESS and BONGO catches for stable isotope analysis during JR19001

Species	Event	Net	Numbers sampled	Gear
Bathylagus sp.	27	9	1	MOCNESS
Calanoida sp.	68	9	30	MOCNESS
Calanoides acutus	60		20	BONGO
Chaetognatha	29	2	4	RMT8
Chaetognatha	52	2	5	RMT8
Copepoda sp.	50		10	BONGO
Copepoda sp.	53	2	80	RMT8
Copepoda sp.	59			RMT8
Copepoda sp.	60	1	37	MOCNESS
Electrona antarctica	29	1	1	RMT8
Electrona antarctica	29	2	5	RMT8
Electrona antarctica	30	2	1	RMT8
Electrona antarctica	36	2	1	RMT8
Euphausia frigida	29	2	20	RMT8
Euphausia frigida	33	2	20	RMT8
Euphausia superba	30	2	20	RMT8
Euphausia superba	46	1	20	RMT8
Euphausia triacantha	29	2	20	RMT8
Euphausia triacantha	33	1	20	RMT8
Euphausia vallentini	33	2	3	RMT8
Gymnoscopelus braueri	29	2	6	RMT8
Gymnoscopelus braueri	36	2	1	RMT8
Gymnoscopelus braueri	39	2	9	RMT8
Gymnoscopelus fraseri	29	2	3	RMT8
Gymnoscopelus fraseri	36	2	1	RMT8
Gymnoscopelus nicholsi	39	2	1	RMT8
Gymnsocopelus nicholsi	33	2	3	RMT8
Kreffthychthis anderssoni	67	1	1	RMT8
Protomyctophum bolini	36	2	2	RMT8
Protomyctophum sp.	36	2	3	RMT8
Psychroteuthis glacialis	39	2	1	RMT8
Salpa sp.	29	2	1	RMT8
Salpa sp.	33	2	4	RMT8
Salpa sp.	39	2	20	RMT8
Salpa sp.	52	2	5	RMT8
Slozarczykovia circumantarctica	20	1	5	RMT8
Slozarczykovia circumantarctica	27	1	1	MOCNESS
Slozarczykovia circumantarctica	33	1	1	RMT8
Slozarczykovia circumantarctica	33	2	3	RMT8
Slozarczykovia circumantarctica	36	2	1	RMT8
Slozarczykovia circumantarctica	39	2	1	RMT8
Slozarczykovia circumantarctica	52	2	1	RMT8
Slozarczykovia circumantarctica	75	2	1	RMT8
Themisto gaudichaudii	29	2	10	RMT8
Themisto gaudichaudii	39	2	20	RMT8

Themisto gaudichaudii	52	2	20	RMT8
Thysanoessa spp.	29	2	20	RMT8
Thysanoessa spp.	33	1	20	RMT8

The use of stable isotopes as dietary tracers is based on the principle that isotopic concentrations of consumer diets can be related to those of consumer tissues in a predictable fashion. It has been extensively applied in the investigation of trophic relationships in various marine ecosystems and has been used to determine feeding migrations in numerous species. The stepwise enrichment of both carbon and nitrogen in a predator relative to its prey suggests that the predator will reflect the isotopic composition in the prey and isotope values can be used to identify the trophic position of species in the food web investigated. Additionally $\delta^{13}C$ values can successfully be used to identify carbon pathways and sources of primary productivity. Isotopic measurements of potential prey species will be put into context with isotopic measurements of whale biopsy samples, collected later in the season in the same waters.

In order to establish an isotopic baseline for the depth horizons where zooplankton samples originated from corresponding particulate organic matter (POM) was collected. POM samples were obtained through filtering waters collected by Niskin bottles deployed via a CTD rosette. Water was taken from various depths at each station (Table 18). All water samples collected from Niskin bottles were processed on-board. Depending on the density of particles varying volumes of seawater per depth were filtered onto 47mm GF/F filters and the filters stored frozen at -80°C.

Table 18 POM samples collected for stable isotope analysis on JR19001

Station	Event	sample depths
WCB 3.2N	38	5m, 25m, Chlmax (36m), 75m, 125m, 200m, 450m, 750m, 3042m
WCB Mooring	43	Chlmax (7-8m), 25m, 75m, 125m, 200m, 280m (10m off Bottom)
P3	71	5m, Chlmax (30m), 75m, 125m, 200m, 450m, 750m

9 Krill Spectral measurements (*Anna Belcher*)

9.1 Introduction

Estimates of krill biomass in the Southern Ocean are highly uncertain due to their wide areal distribution (~19 million km^2) and the very patchy and over-dispersed distribution of krill swarms. Traditional krill survey methods utilise nets that suffer problems of net avoidance. Although newer acoustic methods can provide more synoptic scale measurements, converting acoustic returns to krill biomass is not trivial and requires knowledge of a number of parameters that are difficult to measure in situ. Additionally, as transducers are often hull-mounted, most acoustic estimates miss the krill in the surface layer (upper 16m). Satellites offer a way of collecting synoptic data over large spatial scales and, with continued improvements in spatial, temporal and spectral resolution and could provide information on these poorly sampled surface krill populations. As yet, the spectra of live krill collected in situ have not been measured, which is necessary to establish a methodology for detecting krill swarms in satellite imagery. The aim of this sampling regime is to make key initial measurements to assess the feasibility of measuring krill from space.

Objectives:

- Measure reflectance spectra of female, male and adult *Euphausia superba* at oceanographically different sites
- Extract pigments from krill at these sites and measure the absorbance spectra

9.2 Methods

9.2.1 Sampling

Euphausia superba (herein krill), were sampled from target RMT-8 hauls. Krill were immediately removed from the cod ends of the nets into buckets and heathy individuals sampled. It was found that 'fresh, dead' krill were the most suitable for spectroradiometer measurements, in that the krill were alive and actively trying to swim but would sit at the bottom of the bucket rather than actively swimming around. Where possible, female, male and juvenile krill were sampled from the net, with up to 120 krill for each category. Once sampled animals were transferred in buckets of underway seawater to the cold room before analysis.

9.2.2 Acetone extractions

For each net haul sampled, 3 live krill from each category were immediately homogenised in individual glass vials and 5ml of 100% acetone added for extraction of pigments. The vials were left in the dark at -20 °C for 24 hours. After this period, the extract was carefully pipetted out (trying to avoid particulates from the homogenised krill carcass) and into a 1cm cuvette. The absorbance of each sample was analysed on a Cary60 UV-Vis spectrophotometer. A blank reading was taken using 100% acetone, and a baseline reading from 190 to 1600nm with the same cuvette of 100% acetone.

9.2.3 Spectroradiometer measurements ('Bucket spectra')

Once samples had been taken for pigment extraction, the 'fresh, dead' krill were transported into a dark room. One krill category were measured at a time and were kept in a bucket of underway seawater, in a bath of underway water to keep the krill cold. A matt black bucket was filled with underway seawater (UW), krill sequentially added, and the reflectance spectra measured using an ASD FieldSpec Pro Spectroradiometer. This instrument detects radiation in the range 350-2500nm. The bare fibre fore-optic of the FieldSpec Pro was used, giving a field of view of about 25° radius. Measurements were made at nadir, with the fibre optic end just below the surface of the water. 10 spectra were saved for each measurement, i.e. UW water only, 10 krill, 20 krill, etc (with each spectra an average of 26 measurements). A reference reading was taken at the start and end of each experiment using a 20% grey spectralon panel. Additionally, an initial reading of just UW water was taken, as well as a final reading once all krill had been removed. The experiment was conducted under a halogen lamp. These bucket experiments were carried out for each krill category, in both underway seawater and 0.2 µm filtered seawater (FW).

Additionally, a contact probe was connected to the ASD FieldSpec Pro, and 3-5 krill from each category were placed on a matt black tray and the reflectance spectra measured by holding the probe against the krill. A reference reading was taken of a white Spectralon panel, as well as a measurement of the black tray only.

Remote sensing reflectance (Rrs) was calculated using the following equation:

$$Rrs=R/E$$

Where E is the reading from the Spectralon panel, and R is the raw reflectance measurement.

9.3 Results

Time	Latitude (°N)	Longitude (°E)	Event number	Krill sampled	Analysis: Acetone extraction	Analysis: Bucket Spectra FW	Analysis: Bucket Spectra UW	Analysis: Contact probe	Comments
13/12/2019 03:02	-53.5901	-40.4784	75	Juvenille	Yes	Yes	Yes	Yes	
12/12/2019 20:47	-52.83	-40.1391	74	Juvenille	Yes	Yes	Yes	Yes	
11/12/2019 04:40	-53.7699	-38.4103	66	Juvenille, adult	Yes	Yes	Yes	No	
11/12/2019 01:35	-53.7393	-38.1479	65	Female, male	Yes	Yes	Yes	Yes	
08/12/2019 05:23	-53.72	-38.4086	48	Juvenille, adult	Yes	No	Yes	No	
08/12/2019 00:39	-53.7446	-37.9203	46	Juvenille, adult	Yes	Yes	Yes	Yes	
05/12/2019 04:47	-53.7631	-38.8312	30	Juvenille, adult	Yes	Yes	Yes	Yes	
03/12/2019 02:48	-53.7987	-38.3458	19	Adults	No	No	Yes	No	Combined Ev19 and remaining krill from Ev15
02/12/2019 20:00	-53.7674	-38.0254	15	Juvenille, male, female	Yes	Yes	Yes	Yes	
24/11/2019 18:30	-60.3936	-46.5036	7	Juvenille	Yes	Yes	Yes	Yes	

9.4 Future work

Measured spectra will be processed and the reflectance peaks and absorbance features examined to assess if there are significant differences from the spectra of water. Ratios of satellite bands will be investigated to determine if it is possible to define a threshold for the presence of a large krill swarm in a pixel. If possible, this threshold will then be used to interrogate satellite data in the region of the Western Core Box mooring, and compare to data from the acoustic sensors on this mooring.

10 The impact of nanoplastic on Antarctic Krill (*Emily Rowlands, Clara Manno*)

10.1 Introduction

Impacts of plastic on zooplankton function have been acknowledged (Cole et al., 2015), however nanoplastics (NP) which are believed to be the most hazardous of the plastics, have a different impact on zooplankton than larger plastics. Their smaller size enables uptake and translocation into tissues whilst their high surface curvature and large surface area maximises interactions with the surrounding medium. The impact of these smallest plastic particulates is still poorly explored and though nanoplastics have not yet been detected in-situ in the Southern Ocean, like other plastic forms, their presence is believed to be ubiquitous.

Understanding the impact of this anthropogenic stressor on the keystone species supporting the Antarctic marine food web is critical. Antarctic krill (*Euphausia superba*) are pivotal to the Antarctic marine ecosystem and during the cruise, incubation experiments focused primarily on the embryonic development and hatch success rate of *E.superba* eggs. Incubation experiments explored the impact of NP utilising spherical, aminated (PS-NH_2), yellow-green fluorescent nanoparticles (0.050µm), in a temperature controlled laboratory environment (4◦C). Plastic stocks for incubation experiments were prepared within a laminar flow to minimise contamination. The original stock contained no antimicrobials and therefore no additional stock preparation was required.

On board the JCR, krill were collected from either targeted or non-targeted trawls using the RMT net. Krill were moved from the nets into plastic sample buckets from which they were carefully and individually removed using sieves/spoons to determine gender. Identified females were further examined for spermatophores. Gravid female krill appearing healthy were moved to the krill hotel prior to being used in incubation experiments.

10.2 Antarctic krill egg incubation experiments

To explore the impact of plastic associated maternal stress, gravid females were incubated in 2 litre kilner jars in one of three experimental groups including control (0.22 FSW), nanoplastic (2.5µg/ml) and nanoplastic (2.5µg/ml) plus algae in 0.22 FSW, within the JCR cold room (Figure 8). All jars were aerated and contained a plastic mesh inner to allow the krill eggs to sink through and prevent cannibalism.

Females were monitored every four to six hours for egg production. Once a gravid female spawned, a subsample of eggs (at least 60) were preserved in 4% formaldahyde for analysis upon return to Cambridge, after imaging, and females were preserved in the -80◦C. Next, eggs were examined under the light microscope to check suitability for further incubation experiments i.e. successful fertilisation, lack of malformations and normality in terms of shape. All microscope work took place in the cold room to minimise the impact of temperature variance on eggs whilst examination occurred.

In cases where eggs were suitable for further incubation experiments, eggs were placed into 250ml durans in one of three treatments. Control (0.22 FSW), nanoplastic low (0.25µg/ml) or nanoplastic high (2.5µg/ml), each with three replicates. The upper plastic concentration was chosen based on toxicity and sub-lethal effects observed on exposures of zooplankton to polystyrene nanoplastic in Bergami et al., (2017) and Manfra et al., (2017), and in line with the nanoplastic exposures during past cruises (JR16003 – incubation of juvenile *E. superba* / JR17003 – incubation of adult *E. superba*).

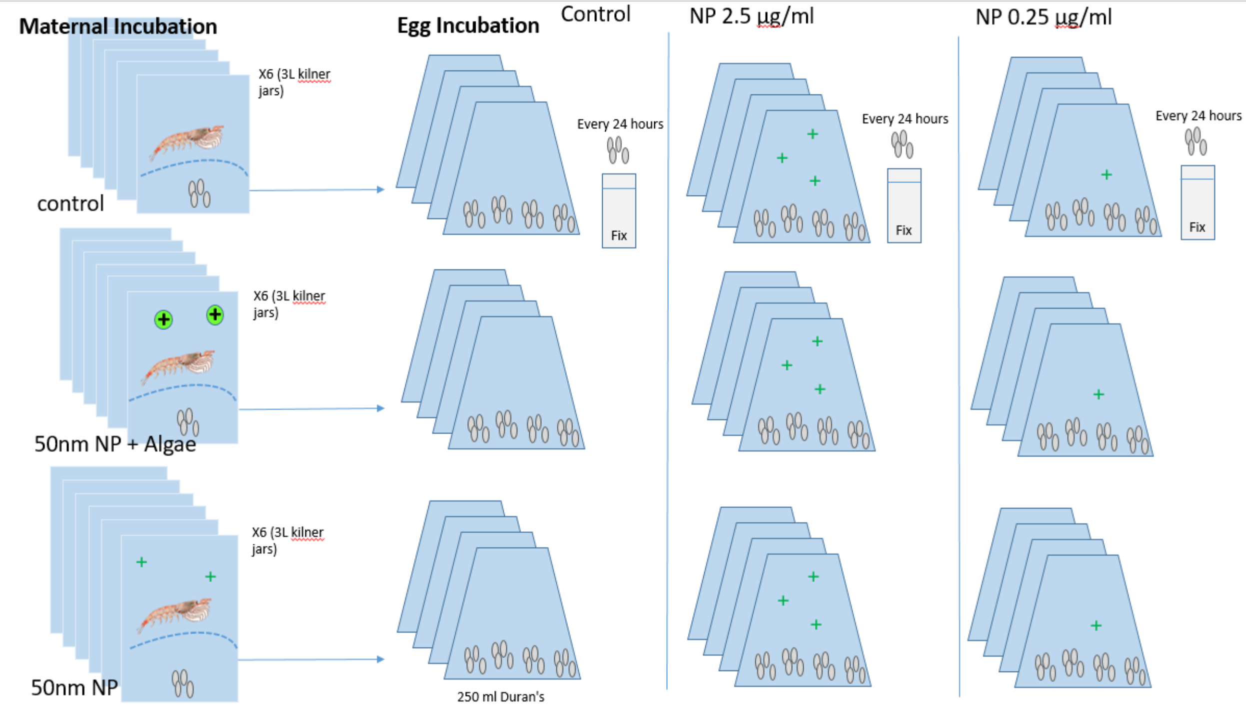


Figure 8 Schematic diagram of maternal stress incubation set-up

10.3 Detecting nanoplastic in-situ in Antarctica – Floating Sediment Trap

Recent developments in detection methods have led to the first NP identification in-situ via isolating the colloidal fraction of seawater in samples from the North Atlantic subtropical gyre (Ter Halle et al., 2017). However presently, we can only hypothesise what these detected NPs may mean for the isolated Antarctic environment due to a lack of sampling of these smallest plastic particulates in the Southern polar region.

Aboard the JCR, the floating sediment trap was utilised to sample water in order to carry out both MP and NP analysis in the UK. The floating sediment trap was successfully deployed in two locations (Table 19).

Table 19 Floating sediment trap deployment locations

Time	Latitude	Longitude	Event	Station	Water depth	Sediment trap depth
07/12/2019 21:59	-53.79799	-37.93388	44	WCB	291.54	50,100,150,200
24/11/2019 00:23	-60.60756	-46.46918	2	Signy	670.08	50,100,150

And recovered after 24 hours (Table 20)

Table 20 Floating sediment trap recovery locations

Time	Latitude	Longitude	Event	Station	Water depth	Sediment trap depth
08/12/2019 23:26	-53.81814	-37.888	44	WCB	193.75	50,100,150,200
25/11/2019 01:38	-60.63637	-46.49069	2	Signy	165.16	50,100,150

Prior to deployment, the lid from each cylindrical bottle was fixed in the open position. The floating sediment trap had been modified to utilise a firing mechanism upon recovery of the device (after 24 hours) to close the trap lids and ensure it was truly the specified depths being sampled.

During event 2, the messenger failed and the bottles remained open. After recovering the bottles from the first tier, the firing mechanism was manually triggered to close the remaining bottles. At the 150m depth, the trap had collected sediment and was damaged due to the trap moving into water too shallow. All other samples from the 150m tier were discarded and only the sediment (4.9kg) was kept.

During event 44, the messenger was lost and the majority of the bottles remained open. At tier two, one bottle was open and the rest were closed. At tier three, all of the bottles remained open. At tier four the trap was damaged and again one bottle had collected sediment (8kg), the sediment was kept and all other samples from this tier were discarded.

Transporting the samples to the cold room was difficult due to the lids not fastening securely and easily loosening, for the next deployment bottles should be modified to have more securely fastening lids.

In terms of processing the water samples, post recovery, two bottles from each depth were filtered using the vacuum pump filtration system (flushed with milli-q before use) and a 45 micron nylon mesh for microplastic analysis. Filters were dried in the fume hood in plastic petri dishes. During filtering, in order to minimise contamination, aluminium foil was utilised to cover both the filtration and decanting beakers when not transferring liquid. A blank filter was exposed to the air each time liquid was poured. After filtration, all water and sediment was preserved at -20◦C for nanoplastic analysis in the UK.

In addition to plastics analysis, a further two bottles from each depth were filtered onto GFF filters for carbonate chemistry analysis in Cambridge. The filter papers were air dried and stored in plastic petri dishes.

10.4 References

Bergami, E., Pugnalini, S., Vannuccini, M.L., Manfra, L., Faleri, C., Savorelli, F., Dawson, K.A., Corsi, I., 2017. Long-term toxicity of surface-charged polystyrene nanoplastics to marine planktonic species Dunaliella tertiolecta and Artemia franciscana. Aquat. Toxicol. 189, 159–169. https://doi.org/10.1016/J.AQUATOX.2017.06.008

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Galloway, T.S., 2015. The impact of polystyrene microplastics on feeding, function and fecundity in the marine copepod Calanus helgolandicus. Environ. Sci. Technol. 49, 1130–1137. https://doi.org/10.1021/es504525u

Manfra, L., Rotini, A., Bergami, E., Grassi, G., Faleri, C., Corsi, I., 2017. Comparative ecotoxicity of polystyrene nanoparticles in natural seawater and reconstituted seawater using the rotifer Brachionus plicatilis. Ecotoxicol. Environ. Saf. 145, 557–563. https://doi.org/10.1016/J.ECOENV.2017.07.068

Ter Halle, A., Jeanneau, L., Martignac, M., Jardé, E., Pedrono, B., Brach, L., Gigault, J., 2017. Nanoplastic in the North Atlantic Subtropical Gyre. Environ. Sci. Technol. 51, 13689–13697. https://doi.org/10.1021/acs.est.7b03667

11 Antarctic fish and squid studies (*José Xavier, Martin Collins, Ricardo Matias, Iliana Bista, Petra ten Hoopen, Bjørg Apeland, Christopher Kerr, Sophie Fielding, Gabriele Stowasser*)

11.1 Introduction

Within the Southern Ocean pelagic community, fish and squid are the dominant mesopelagic fauna in terms of both biomass and diversity, and play a vital role in the transfer of energy through the Antarctic food web. Indeed, they are part of the diet of various predators. Research on pollution (e.g. by microplastics, by trace metals) and adaptation (e.g. by genomics/transcriptomics) research linked to the ecology of fish and squid is needed under a context of climate change. This work will advance our understanding of the role of the APF in fish and squid species ecology. We therefore sampled the mesopelagic fish and squid community, using a range of nets, and underlying environmental conditions along a transect spanning an entire cross-section of the Antarctic Polar Front (APF) to:

1) Examine spatial patterns in fish and squid community structure and abundance between Antarctic and temperate waters, linking patterns to the underlying oceanographic conditions across the APF.

2) Investigate genomics and transcriptomics of squid, under a climate change context.

3) Investigate microplastics and trace metal accumulation in key fish species and squid, and examine their role as vectors of heavy metal contaminants through the Southern Ocean foodweb.

11.2 Gear

An RMT25 net was used to sample the mesopelagic fish and squid (and macrozooplankton) community during the survey. Depth-discrete samples were collected across the APF between 0-1000 m at intervals of 1000-700, 700-400, 400-200 and 200-10 m. All RMT25 hauls were deployed in hours of darkness (nautical sunset to nautical sunrise), with the uppermost depth strata sampled at times of maximum darkness. The RMT25 was operated via a downwire net monitor and was equipped with a flow meter, and temperature and salinity sensors. Each depth strata was sampled for approximately 40 mins. The larval component of the mesopelagic fish and squid community, was sampled using a MOCNESS net that was equipped with nine 300 um mesh nets. This net was deployed to 1000 m and sampled the water column at depth-discrete intervals of ~125 m. The MOCNESS was deployed during daylight hours, with each depth strata being sampled for around 10-12 minutes. A calibrated EK60 echosounder was used to collect echotraces of mesopelagic aggregations during transit to biological stations and during RMT25 fishing operations. Regular CTD stations deployments were undertaken to > 1000 m along the survey transect to quantify the environmental conditions across the APF.

Fish and squid were also caught using RMT8 (for Antarctic krill target fishing, mostly at the Western Core Box) and Neuston (while RMT25 was operating to collect the surface layer) nets (see macrozooplankton section for more deployment details for these nets).

11.3 Sample processing of fish and squid

The total weight of each RMT25 net haul was recorded, following the similar procedure with other nets. All fish, squid and macrozooplankton specimens were first identified to species level, where possible, and then enumerated and measured using Standard Length (SL for fish) and Mantle Length (ML for squid) and weighed individually (when >1 g). Sex was also determined using external features, when possible. All fish were kept for microplastics, trace metal and ecological analyses in individual bags (except *Cyclothone* sp. due to their large number). Each fish specimen was assigned a unique identification number and photographed for subsequent morphometric analyses. For squid, additional collection of samples of skin, flesh, tentacle and buccal mass were collected for genomics and transcriptomics (30 mg of each tissue in ethanol and RNAlater; n= 8 samples per individual). All fish and squid samples were frozen at -80 °C for subsequent analysis at Cambridge HQ. The remainder of the macrozooplankton samples from RMT25 were preserved in 4% formaldehyde for biodiversity studies. Fish and squid in the MOCNESS and Neuston nets samples were identified to the highest taxonomic level possible, enumerated and then frozen at -80 °C.

11.4 Preliminary results

A complete cross-section of the APF was surveyed during the study. A total of 8 RMT25 hauls were obtained at 4 stations, enabling a valuable collection of mesopelagic fish and squid samples to be obtained for our studies (Table 21). Complementary samples were obtained from RMT8, MOCNESS and Neuston nets. Detailed environmental data were collected across the study region, with CTD stations achieved.

Details of the species caught by nets during the survey are given in Table 22. In total, 1067 fish were caught belonging to at least 36 species, with catches with higher numbers of *Cyclothone* sp. and the myctophid *Krefftichthys anderssoni* in the RMT25, *Protomyctophum bolini* and *Gymnoscopelus braueri* in RMT8 and *Cyclothone* sp. and *G. nicholsi* in MOCNESS (Table 2). RMT25 had a higher diversity of species and number of individuals than RMT8, MOCNESS and Neuston nets (Table 22).

In terms of squid, a total of 59 squid specimens were caught, particularly juveniles, caught in RMT25 (n=38), RMT8 (n= 18), MOCNESS (n=2) and Neuston (n=1). The most common squid caught were *Slosarczykovia circumantarctica* (n=28), *Galiteuthis glacialis* (n=10) and *Bathyteuthis abyssicola* (n=7) (Table 22).

Table 21 RMT25 deployment details around the APF during JR19001. For details of the other nets, see appropriate section on macrozooplankton. (SST= Sea Surface Temperature)

Time	Latitude	Longitude	Event	Net_depth(m)	Water_depth(m)	SST (°C)	Net_action	Comment
20/12/19 06:15	-52.70558	-55.21793	106	n/a	1870.22	6.821900	N2_Close	Shallow, PF-4
20/12/19 06:04	-52.70475	-55.21097	106	12	1873.86	6.817000	N2_Close	Shallow, PF-4
20/12/19 05:19	-52.70044	-55.17541	106	203	1887.61	6.816300	N2_Open	Shallow, PF-4
20/12/19 05:19	-52.70027	-55.17467	106	200	1889.22	6.818800	N1_Close	Shallow, PF-4
20/12/19 04:35	-52.68960	-55.14028	106	402	1897.47	6.814200	N1_Open	Shallow, PF-4
20/12/19 04:12	-52.68270	-55.12282	106	n/a	1904.74	6.818100	Deploy	Shallow, PF-4
20/12/19 03:15	-52.66820	-55.08885	104	0.0	1884.62	6.806400	Recover	Deep, PF-4
20/12/19 02:43	-52.65646	-55.06247	104	404.7	1885.05	6.806700	N2_Close	Deep, PF-4
20/12/19 01:58	-52.64026	-55.02190	104	704.1	1898.00	6.789900	N2_Open	Deep, PF-4
20/12/19 01:57	-52.63995	-55.02114	104	703.1	1897.43	6.794700	N1_Close	Deep, PF-4
20/12/19 01:10	-52.62375	-54.98330	104	992.7	1886.21	6.808700	N1_Open	Deep, PF-4
19/12/19 23:54	-52.59718	-54.91166	104	0.0	1875.05	6.794800	Deploy	Deep, PF-4
18/12/19 04:46	-53.99459	-49.44561	95	0.0	4056.58	4.249800	Recover	Shallow, PF-2
18/12/19 04:31	-53.99205	-49.43588	95	15.1	4084.22	4.212300	N2_Close	Shallow, PF-2
18/12/19 03:48	-53.98341	-49.40043	95	200.2	4277.76	4.210900	N2_Open	Shallow, PF-2
18/12/19 03:48	-53.98326	-49.39973	95	199.9	4295.01	4.209600	N1_Close	Shallow, PF-2
18/12/19 03:04	-53.97477	-49.36143	95	401.5	n/a	4.158000	N1_Open	Shallow, PF-2
18/12/19 02:40	-53.96877	-49.34092	95	11.3	4831.10	4.198200	Deploy	Shallow, PF-2
18/12/19 02:12	-53.98673	-49.34887	93	0.0	4808.68	4.124300	Recover	Deep, PF-2
18/12/19 01:31	-53.96752	-49.33313	93	405.5	4876.73	4.153000	N2_Close	Deep, PF-2
18/12/19 00:41	-53.94395	-49.31091	93	696.9	4609.92	4.171900	N2_Open	Deep, PF-2
18/12/19 00:40	-53.94341	-49.31036	93	703.9	0.00	4.171600	N1_Close	Deep, PF-2
17/12/19 23:55	-53.92469	-49.28921	93	982.3	6002.14	4.219800	N1_Open	Deep, PF-2

17/12/19 22:51	-53.89422	-49.26342	93	0.0	6001.88	4.233700	Deploy	Deep, PF-2
17/12/19 05:08	-54.48820	-46.00703	89	0.0	4040.83	4.814400	Recover	Shallow, PF-1
17/12/19 04:51	-54.49442	-46.00258	89	12.4	4073.65	4.855700	N2_Close	Shallow, PF-1
17/12/19 04:06	-54.51650	-45.98621	89	203.4	4502.54	4.791700	N2_Open	Shallow, PF-1
17/12/19 04:05	-54.51696	-45.98600	89	204.5	4253.38	4.789600	N1_Close	Shallow, PF-1
17/12/19 03:20	-54.54156	-45.97449	89	398.8	4366.64	4.966300	N1_Open	Shallow, PF-1
17/12/19 03:00	-54.55215	-45.96968	89	14.3	4393.06	4.960900	Deploy	Shallow, PF-1
17/12/19 02:30	-54.55247	-46.03940	87	0.0	4501.93	4.971500	Recover	Deep, PF-1
17/12/19 01:50	-54.55383	-46.01140	87	399.1	4501.76	4.940200	N2_Close	Deep, PF-1
17/12/19 01:05	-54.55591	-45.98410	87	701.2	4501.97	4.896700	N2_Open	Deep, PF-1
17/12/19 01:04	-54.55595	-45.98351	87	700.7	4501.81	4.899100	N1_Close	Deep, PF-1
17/12/19 00:19	-54.55889	-45.95675	87	997.5	4502.02	4.841900	N1_Open	Deep, PF-1
16/12/19 23:24	-54.56276	-45.92599	87	0.0	4533.14	4.751500	Deploy	Deep, PF-1
16/12/19 04:20	-54.92202	-42.69167	81	n/a	3480.27	2.626700	Recover	Shallow
16/12/19 04:05	-54.92974	-42.70378	81	5.1	0.00	2.562600	N2_Close	Shallow
16/12/19 03:20	-54.95784	-42.73707	81	200.4	4501.80	2.190800	N2_Open	Shallow
16/12/19 03:19	-54.95847	-42.73782	81	203.9	4501.89	2.188700	N1_Close	Shallow
16/12/19 02:36	-54.98480	-42.76662	81	398.5	4502.64	2.252400	N1_Open	Shallow
16/12/19 02:06	-55.00317	-42.78459	81	-0.3	4502.00	2.259100	Deploy	Shallow
16/12/19 01:33	-54.97218	-42.82789	80	-0.3	3320.73	2.245800	Recover	Deep
16/12/19 00:50	-54.99414	-42.80325	80	401.2	3001.85	2.299200	N2_Close	Deep
16/12/19 00:04	-55.01388	-42.78558	80	700.7	3001.70	2.438000	N2_Open	Deep
16/12/19 00:03	-55.01434	-42.78516	80	699.3	3294.65	2.440600	N1_Close	Deep
15/12/19 23:18	-55.03478	-42.76694	80	998.3	3368.71	2.418900	N1_Open	Deep
15/12/19 22:20	-55.05882	-42.73840	80	0.0	3412.74	2.410000	Deploy	Deep

Table 22 Catches of fish and squid during JR19001 from RMT25, RMT8, MOCNESS and Neuston nets. (SL = Standard Length; ML = Mantle Length; JX = José Xavier, RM = Ricardo Matias, RS = Ryan Saunders, GS = Gabriele Stowasser, MC = Martin Collins, IB = Iliana Bista)

Species	Number	Min SL/ML	Max SL/ML	Taken by JX/RM/RS/GS	Taken by MC*	Taken by IB
RMT25						
Argyropelecus spp.	4	15	24	4	0	0
Bathylagus sp.	16	47	162	8	8	0
Benthalbella elongata	2	117	224	2	0	0
Borostomias antarcticus	7	114	217	4	1	2
Cyclothone sp.	334	26	65	334	0	0
Cynomacrurus piriei	4	62	62	1	3	0
Electrona antarctica	1	45	45	1	0	0
Electrona carlsbergi	1	75	75	1	0	0
Fish larvae	7	18	50	6	1	0
Gymnoscopelus braueri	30	35	130	30	0	0
Gymnoscopelus fraseri	30	42	99	30	0	0
Gymnoscopelus microlampus	2	99	130	2	0	0
Gymnoscopelus nicholsi	11	30	75	11	0	0
Gymnoscopelus spp.	1	64	64	1	0	0
Krefftichthys anderssoni	263	31	75	262	0	1
Nannobrachium achirus	33	55	146	31	1	1
Nansenia antarctica	1	84	84	0	0	1
Notolepis sp.	3	45	60	0	3	0
Melanostigma gelatinosum	1	n/a	n/a	1	0	0
Photichthyidae	1	72	72	0	1	0
Poromitra crassiceps	3	80	105	1	1	1
Protomyctophum andriashevi	6	48	52	5	1	0
Protomyctophum bolini	65	21	64	65	0	0
Protomyctophum gemmatum	3	60	64	1	2	0
Protomyctophum parallelum	25*	27	50	22	1	1
Protomyctophum sp.	4	19	27	4	0	0
Protomyctophum tenisoni	6	44	55	6	0	0
Stomias boa boa	1	215	215	0	0	1
Stomias gracilis	3	171	238	3	0	0
Unknown fish	4	26	60	2	2	0
Grand Total of fish	872	15	238	838	25	8
Bathyteuthis abyssicola	7	9	19	7	0	0
Galiteuthis glacialis	6	16	39	6	0	0
Gonatus antarcticus	1	183	183	1	0	0
Semirossia patagonica	1	9	9	0	1	0
Slosarczykovia circumantarctica	13	12	60	13	0	0
Unknown squid	11	10	44	1	10	0
Grand Total of cephalopods	39	9	183	28	11	0
RMT8 net						
Chaenocephalus aceratus	1	35	35	0	1	0

Electrona antarctica	16	28	97	14	0	2
Electrona carlsbergi	1	80	80	1	0	0
Fish larvae	4	n/a	n/a	0	4	0
Gymnoscopelus bolini	1	189	189	1	0	0
Gymnoscopelus braueri	19	40	120	15	2	2
Gymnoscopelus fraseri	8	57	74	8	0	0
Gymnoscopelus nicholsi	4	43	131	4	0	0
Gymnoscopelus spp.	1	81	81	0	0	1
Krefftichthys anderssoni	4	30	66	3	0	1
Notolepis coatsi	1	193	193	0	0	1
Protomyctophum andriashevi	4	48	54	1	1	2
Protomyctophum bolini	23	25	58	21	2	0
Protomyctophum choriodon	1	59	59	1	0	0
Pseudochaenichthys georgianus	1	53	53	0	1	0
Unknown fish	1	n/a	n/a	0	1	0
Grand Total of fish	90	25	193	69	12	9
Galiteuthis glacialis	3	6	29	3	0	0
Psychroteuthis glacialis	1	14	14	1	0	0
Slosarczykovia circumantarctica	15	14	40	15	0	0
Grand Total of cephalopods	19	6	29	19	0	0
MOCNESS nets						
Bathylagus sp.	1	53	53	1	0	0
Borostomias antarcticus	1	116	116	1	0	0
Cyclothone sp.	68	19	47	67	1	0
Electrona carlsbergi	1	74	74	0	0	1
Gymnoscopelus braueri	1	109	109	1	0	0
Gymnoscopelus microlampus	1	120	120	0	1	0
Gymnoscopelus nicholsi	12	29	42	12	0	0
Gymnoscopelus spp.	1	n/a	n/a	1	0	0
Nansenia antarctica	1	29	29	1	0	0
Protomyctophum bolini	1	18	18	1	0	0
Protomyctophum sp.	7	16	21	7	0	0
Stomias gracilis	1	175	175	0	0	1
Unknown fish	6	15	30	6	0	0
Grand Total of fish	102	15	175	99	2	2
Galiteuthis glacialis	1	51	51	1	0	0
Slosarczykovia circumantarctica	1	44	44	1	0	0
Grand Total of cephalopods	2	44	51	2	0	0
Neuston net						
Electrona subaspera	1	117	117	0	1	0
Fish larvae	6	24	37	5	1	0
Notothenia rossii	17	19	35	7	2	8
Grand Total of fish	24	19	117	12	4	8
Unknown squid	1	20	20	1	0	0

Grand Total of cephalopods	1	20	20	1	0	0

* 1 specimen discarded (damaged)

12 Using environmental DNA (eDNA) collected from water samples to detect Antarctic Notothenioid fish populations, and tissue collection for genome sequencing (*Iliana Bista*).

12.1 eDNA of Antarctic Notothenioid fish

12.1.1 Background and objectives

The suborder of Antarctic Notothenioid fish is the dominant fish group in the Southern Ocean and a well-documented marine fish adaptive radiation. Nevertheless, notothenioid fish populations are under intense pressure due to climate change and intensive fishing and the continuous pressure placed on Antarctic fish and other fauna is swiftly leading Antarctic fisheries to a collapse trajectory. Sufficient evaluation of population status and environmental factors in Antarctic waters is difficult due to the remoteness and expense involved, hence more efficient approaches need to be established, to allow adequate detection.

The emergence of environmental DNA (eDNA) methodologies as detection and monitoring tools has enabled species identification and monitoring through non-invasive sampling. Aquatic eDNA uses DNA which is collected from water samples, without collection of the organism itself. The eDNA originates from shed skin cells, feces, and metabolic byproducts of the organisms. Coupled with High-Throughput Sequencing (HTS) of target genes, this approach can identify the presence of species through trace amounts of DNA.

Here, we used an eDNA approach to advance population monitoring of Antarctic fish. Water samples were collected using a CTD instrument from the Signy shelf and the S. Georgia WCB transect. Using HTS of eDNA to detect and survey Antarctic fish populations has the potential to provide a revolutionary solution to population assessment of fish species in the Southern Ocean.

This project was supported by BAS through a Collaborative Antarctic Science Scheme (CASS) grant, and by University of Cambridge.

12.1.2 Methods

Samples were collected from locations around South Georgia and Signy shelf. Sampling locations were selected with an aim to sample at depths within the expected depth presence of Notothenioid fish, where full depth CTDs were possible. Based on this, we sampled along two depth gradient transects, comprising 4 maximum depths, at: 1000, 750, 500 and 250m, with 3 – 4 intermediate depths sampled from benthos to surface. Additionally, water samples were collected from the underway system while on Signy shelf, and from the surface in two locations of the coast of Signy island. Samples were also collected along a 3rd transect along the WCB south CTD stations, at shallower total depths (approximately 100 – 270m total depth). Finally, samples were collected from a single location whilst at Stromness, and the P3 and WCB mooring stations. See Table 23 for full list of CTD sampling locations.

Table 23 List of CTD sampling locations for eDNA work

Date	Event no	Station name	Water depth(m)	CTD depth(m)
13/12/2019	77	P2	3576.62	3550
12/12/2019	71	P3	3786.61	3737
09/12/2019	55	Stromness	85.01	75
09/12/2019	54	WCB_4.2S	119.57	109

08/12/2019	47	S. Georgia4	268.13	254
07/12/2019	45	WCB_3.2S	132.64	125
07/12/2019	43	WCB mooring	0	281
07/12/2019	40	S. Georgia2	775.68	806
05/12/2019	32	WCB_2.2S	205.6	194
05/12/2019	31	WCB_1.2S	286.4	275
03/12/2019	22	P3	3793.95	3738
02/12/2019	16	S. Georgia3	514.56	525
02/12/2019	14	S. Georgia1	1055.04	1087
24/11/2019	12	Signy4	269.82	261
24/11/2019	11	Signy3	508.69	502
24/11/2019	8	Signy2	765.31	772
24/11/2019	6	Signy1	1024.13	1023

Collection was performed using the CTD Niskin bottles. Twelve litres of water were filtered through Sterivex filter units (triplicates) using a peristaltic pump, and then the units were stored at -80°C until processing. Using this type of enclosed filter minimizes possibilities of contamination when filtration is performed in the field. Samples were collected in triplicates from each location and depth and will be processed independently. Blank control samples were also collected alongside each field sample in order to control for potential contamination. All equipment used for filtration and handling of the samples was thoroughly sterilized between different sampling events.

After returning to the UK, DNA extraction will be performed and illumina libraries will be generated using primers designed from a database of notothenioid reference sequences (mtDNA control region and selected autosomal loci) and also using a shotgun sequencing approach. Sequencing will be performed on Illumina HiSeq at the Sanger Institute. Triplicate samples will be analysed separately and data analysis will be performed using a custom pipeline (Bista et al. 2017).

12.1.3 Discussion

The low temperatures in the Southern Ocean should favour the longer persistence of eDNA traces, as it has been demonstrated previously that the persistence of eDNA is related to temperature as well as other environmental variables (productivity levels, high oxygen content, UV exposure). As the ecological niche and depth preference of different species varies, with members of the group occupying different depths, we can estimate plausibility of findings at different sampling depths.

Benchmark work targeting other marine organisms has demonstrated that estimates of haplotype frequencies and genetic diversity can be retrieved from sequenced eDNA. Using a structured sampling design and deep sequencing could allow analysis of population structure. Outcomes of this project combined with existing knowledge of population dynamics can demonstrate the potential to enhance fish population monitoring, and lead to larger scale applications for management and conservation of Antarctic fish fauna that are under environmental and anthropogenic pressures.

The low temperatures in the Southern Ocean should favour the longer persistence of eDNA traces, as it has been demonstrated previously that the persistence of eDNA is related to temperature as well as other environmental variables (productivity levels, high oxygen content, UV exposure). As the ecological niche and depth preference of different species varies, with members of the group occupying different depths, we will use prior knowledge to evaluate plausibility of findings at different depths.

12.2 Tissue sampling for reference genome sequencing (*Iliana Bista, Martin Collins, Sophie Fielding*)

Large genomic projects such as the Vertebrate Genomes project (VGP) and the Darwin Tree of Life (DToL) project at the Sanger Institute are promising to revolutionize the field of biodiversity analysis through the production of high quality reference genome assemblies for eukaryotes across the tree of life. In order to generate good quality long read data from sequencing and associated technologies such as PacBio, Oxford Nanopore, and Bionano optical mappping, high quality fresh frozen tissue samples are required. During the JR19001 cruise, tissues were collected from a diversity of species (from RMT25, RMT8, MOCNES and NEUSTON nets), with an aim to be used for reference genome sequencing.

For fish species, multiple tissues were dissected from freshly collected specimens, and frozen at -80°C straight after collection. Speedy collection and preservation of tissues is important to avoid degradation and allow extraction of High Molecular Weight DNA (HMW DNA) for long read sequencing. Additional tissues were collected in RNA later for transcriptomic analysis, wherever possible. Further to fish, a number of invertebrate specimens were also collected and frozen immediately after documentation. Detailed list of the species that were collected is shown in Table 24.

Table 24 List of species collected for genomic analysis

Number	Species	Family	Order
1	*Parandania boecki*	Stegiocephalidae	Amphipoda
2	*Parandania gigantea*	Stegiocephalidae	Amphipoda
3	*Eurythenes obesus*	Lysianassidae	Amphipoda
4	*Hyperia macrocephala*	Hyperiidae	Amphipoda
5	*Themisto gaudichaudii*	Hyperiidae	Amphipoda
6	*Nansenia antarctica*	Microstomatidae	Argentiniformes
7	*Bathylagus sp.*	Bathylagidae	Argentiniformes
8	*Benthabella elongata*	Scopelarchidae	Aulopiformes
9	*Notolepis coatsi*	Paralepididae	Aulopiformes
10	*Euphausia frigida*	Euphausiidae	Euphausiacea
11	*Euphausia superba*	Euphausiidae	Euphausiacea
12	*Euphausia triacantha*	Euphausiidae	Euphausiacea
13	*Cynomacrurus pireie*	Macrouridae	Gadiformes
14	*Protomyctophum andrieshevi*	Myctophidae	Myctophiformes
15	*Electrona antarctica*	Myctophidae	Myctophiformes
16	*Electrona carlsbergi*	Myctophidae	Myctophiformes
17	*Electrona subaspersa*	Myctophidae	Myctophiformes
18	*Gymnoscopelus bolini*	Myctophidae	Myctophiformes
19	*Gymnoscopelus braueri*	Myctophidae	Myctophiformes
20	*Gymnoscopelus fraseri*	Myctophidae	Myctophiformes
21	*Gymnoscopelus microlampus*	Myctophidae	Myctophiformes
22	*Krefftichthys andersoni*	Myctophidae	Myctophiformes
23	*Lampanyctus mcdonaldi*	Myctophidae	Myctophiformes
24	*Nanobrachium achirus*	Myctophidae	Myctophiformes

25	*Protomyctophum bolini*	Myctophidae	Myctophiformes
26	*Protomyctophum parallelum*	Myctophidae	Myctophiformes
27	*Gigantocypris*	Cypridinidae	Myodocopida
28	*Slosarczykovia sp.*	Brachioteuthidae	Oegopsida
29	*Bathylagus sp.*	Bathylagidae	Osmeriformes
30	*Notothenia rossii*	Nototheniidae	Perciformes
31	*Melanostigma gelatinosum*	Zoarcidae	Perciformes
32	*Poromitra crassiceps*	Melamphidae	Stephanoberyciformes
33	*Borostomias antarcticus*	Stomiidae	Stomiiformes
34	*Stomias boa boa*	Stomiidae	Stomiiformes
35	*Stomias graciilis*	Stomiidae	Stomiiformes
36	*Argyropelecus sp.*	Sternoptychidae	Stomiiformes

12.3 References

Bista, I., Carvalho, G. R., Walsh, K., Seymour, M., Hajibabaei, M., Lallias, D., Christmas, M., & Creer, S. (2017). Annual time-series analysis of aqueous eDNA reveals ecologically relevant dynamics of lake ecosystem biodiversity. *Nature Communications*, *8*, 14087.

13 Education and Outreach (*José Xavier, Ricardo Matias, Emily Rowlands, Anna Belcher, Sophie Fielding*)

Numerous education and outreach activities were carried related to the JR19001, prior, during and planned for after the cruise (Figure 9). We focused our report at 2 levels: World Wide Web (blog, facebook and website) and contact with schools.

13.1 World Wide Web

The bi-lingual blog of José Xavier was created for the International Polar Year (www.cientistapolarjxavier.blogspot.com), and was already used on previous cruises (e.g. JR177 (2008), JR200 (2009), JR15004 (2016) and JR16003 (2017)), with > 165 000 views. The objective of the blog was to provide, on a regular basis in English and Portuguese, interesting information on the science and the living onboard of the James Clark Ross during the JR19001 cruise. Various scientists and crew participated on the blog, either by accepting to be photographed or interviewed, or providing photographs or input in writing.

During the duration of the cruise, more than 2700 hits from more than 10 countries worldwide were recorded. These top 10 countries visiting the blog were: Portugal, UK, USA, Switzerland, Brazil, Russia, Ukraine, New Zealand, Germany and Mexico. The website of the Portuguese Polar Programme PROPOLAR (www.propolar.org/), was also updated, with news from the cruise. Finally, regular updates of the cruise were carried out at the personal facebook pages of José Xavier and Ricardo Matias, with 13 posts which resulted in 2870 likes, 129 comments and 55 shares. Blog, facebook and website are part of Portugal´s polar education and outreach initiatives on promoting polar science. A report to the Scientific Committee on Antarctic Research (SCAR) life science program SCAR-AnTERA and PROPOLAR will be also produced informing about the overall goals of the cruise.

13.2 Contact with schools and other educational institutions

Prior to the cruise, oral presentations about the expeditions took place on more than 10 schools and educational institutions in Portugal (involving > 1 700 students, teachers and educators directly). The flags of these schools and councils were brought onboard by José Xavier and Ricardo Matias, of which photographs were taken during the cruise, on the ship and on land.

During the cruise, José Xavier and Ricardo Matias have recorded footage to produce another education and outreach film (in Portuguese, with English subtitles) to educate the younger generations the basic information about polar research, particularly the marine disciplines to be shown in schools. After the cruise, José Xavier and Ricardo will return to the schools to return their flags and give an overview of the research cruise.

All of these initiatives were carried out in collaboration of the Association of Polar Early Career Scientists (APECS) and Polar Educators International (PEI), the Portuguese Polar Programme PROPOLAR and SCAR AnTERA research program.

During the cruise Emily Rowlands as part of the UK polar network (UKPN), the UK branch of the Association of Early Career Scientists (APECS) coordinated the Antarctica flags day initiative with the help of UKPN vice president Anna belcher. The incentive encourages students to design flags, since Antarctica does not have its own, following a lesson on Antarctica. The flags are then photographed in Antarctica and students receive a certificate of travel confirming the flags final destination and Co-ordinates. Scientists and crew aboard JCR photographed flags at KEP, Bird Island and Signy research station.

13.3 Contact with the crew and other research teams

Jose Xavier gave a talk as an invitee of the Universidad de Magallanes (Punta Arenas, Chile) focusing on the most recent results on Antarctic science related to the needs of the Antarctic Treaty (https://www.youtube.com/watch?v=siz8Wz6hiQM), at the “American corner”.

A research talk by Anna Belcher and informal discussions were carried out during the cruise, as an outreach exercise for sharing ideas and information about what each research team is doing while informing, and acknowledging, the work of the crew of the James Clark Ross.

13.4 Contact with the Media

A TV interview at TV RED (Chilean TV at Punta Arenas), by Iván Yutronic and Alfredo Soto Ortega, to Jose Xavier on the relevance of Antarctic science to Chile and international cooperation in science, policy and education.

An interview by José Xavier to the national radio RDP Antena 1 (Portugal) was done via phone from the James Clark Ross, in relation to the objectives of the cruise, under a context of the COP 2019 in Madrid, where policy makers were gathered to take measures to tackle climate change (https://www.rtp.pt/noticias/mundo/investigador-polar-portugues-diz-que-aquecimento-global-vai-obrigar-o-mundo-a-gastar-trilioes_a1190296).

Figure 9 Antarctic maps and outreach images

14 Mooring deployment and recovery (*Bjørg Apeland, Chris Kerr*)

14.1 P3 mooring

The mooring at P3 was recovered on 03.12.2019 at 17.17 GMT. After performing a trilateration to determine the correct position of the anchor position the P3 mooring was released using first release no 93, then also releasing release no 2060 as the feedback from the first release did not give enough confidence that the release had happened. The second release did not give the correct feedback either, but by that time the buoy had already surfaced and been spotted by the bridge.

The recovery went as planned except for a small problem with the first Trimsin buoy cluster which had tangled around the Kevlar rope. Using boat hooks and extra stopping off points to take off tension we were able to untangle the rope and carry on the recovery of the mooring.

It is believed that the entangling of the rope is down to two different factors. One being the ship speed, and the other being that there was no instrument or weight hanging under the Trimsin buoy cluster. The ship speed should have been higher to stream out the rope better, and usually the AquaMonitor hangs below the Trimsin buoy cluster giving considerable weight to the buoys. However, the AquaMonitor was not deployed on this mooring, but the Trimsin buoys was still in place.

The CO2 sensor battery pack casing suffered severe corrosion and will have to be replaced completely. Not redeployed.

The iridium beacon had a loose top cap, and on further inspection the screws holding the top cap in were found to be sheared off. The Iridium beacon has been replaced with a spare Iridium Beacon.

The Sami pH sensor has been taken off to be recalibrated and factory maintained.

The photo plankton sampler (PPS) has been taken off to be evaluated back in Cambridge.

The Anderaa Seaguards was redeployed on this mooring after being off one season for factory maintenance and calibration. However the SeaGuards was late to return to BAS and only one lithium battery pack arrived at BAS in time. The shallow SeaGuard therefore has a “homemade” alkaline battery pack and not a lithium battery pack. The battery setting on the unit was changed to accommodate for the alkaline batteries.

The mooring was redeployed at 19:39:00 on the 12/12/2019. Fixed position at Lat 52 48.47'S Long 040 06.92'W

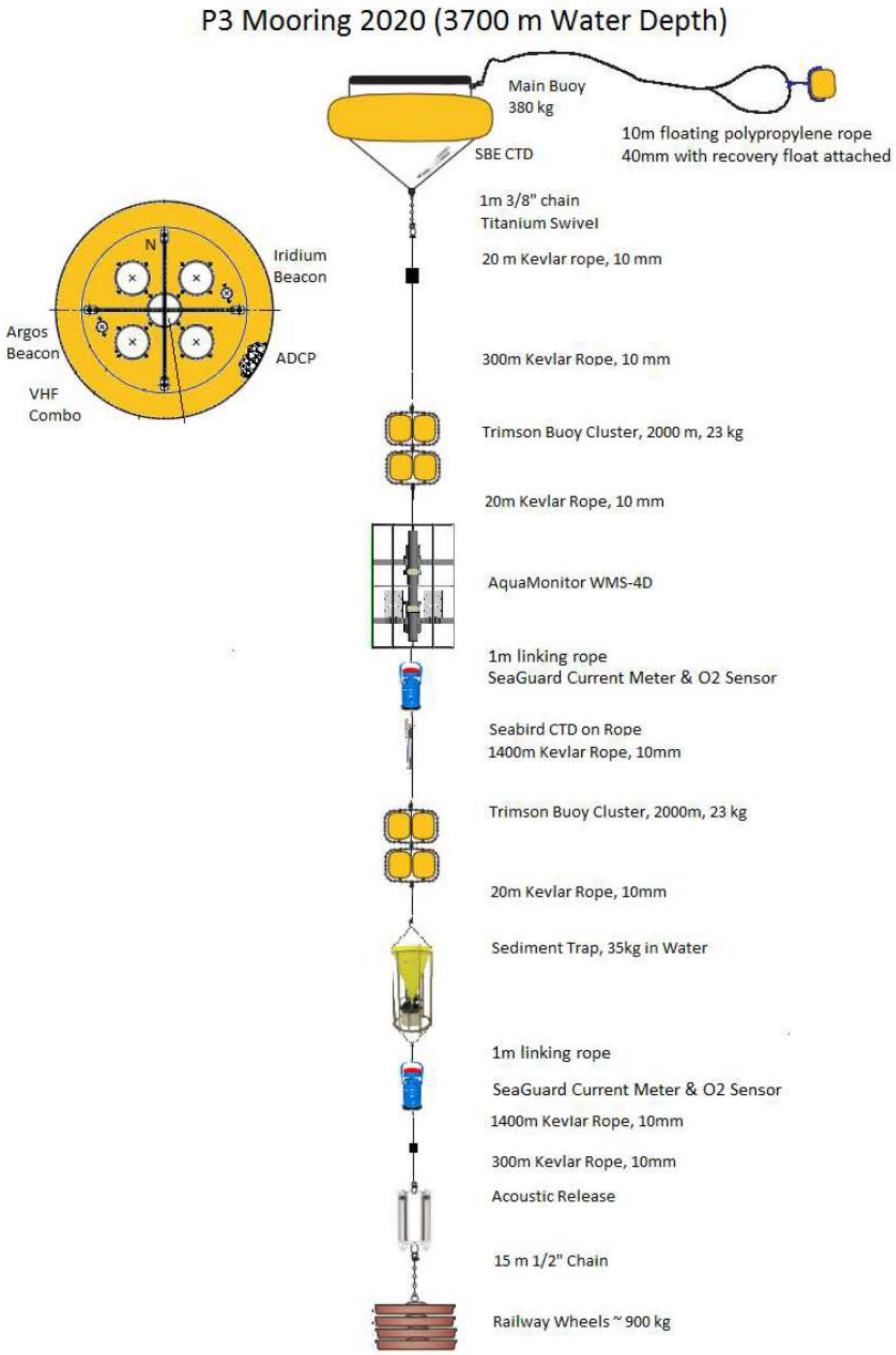


Figure 10 Schematic of P3 mooring deployed on JR19001

14.1.1 Work carried out on redeployed instruments:

Acoustic Releases: 93 + 2060

□ New Batteries

□ Tested

□ New Dropping Bar

□ Clean and lubricate O-rings

□ Check for corrosion on linking bars, nuts and bolts

Inmarsat Iridium Beacon: IMEI: 300434060651120, Serial no: M015U5

□ New Batteries

□ Clean and lubricate O-rings

□ Turn on before deployment

Argos Beacon: SN 280, ID: 60210

□ New Batteries

□ Clean and lubricate O-rings

□ Tested

□ Turn on before deployment

NOVATEC Combo Beacon: D07-018, 160.725 MHz, Channel C.

□ New Batteries

□ Clean and lubricate O-rings

□ Tested

□ Turn on before deployment

ADCP Serial Number: 15548, WHS 300-I-UG164

□ Download Data:

□ L:\scientific_work_areas\Mooring Work\P3\data

□ New Batteries

□ Check and lubricate O-rings

□ Set Up instrument for redeployment

□ Erase Data

□ Start WinSC for set-up of instrument

□ Set up instrument:

□ Number of bins:25(1-128)

□ Bin Size (m) :8 (0.2-16)

- Pings per ensemble: 10
- Interval: 15 min
- Duration: 550 days
- Transducer depth: 200m
- Save deployment settings
- Start Time: xx.xx.xx. 00.00.00 – Start after deployment
- Set up ADCP real time clock to PC clock
- Don’t verify the compass
- Run pre-deployment test to check instrument

CTD on main buoy SN: 37-11807

□ Download Data: L:\scientific_work_areas\Mooring Work\P3\data

□ New Batteries

□ Clean and lubricate O-rings

□ Set up instrument for re-deployment

□ Set real time clock to PC clock (p.28)

□ Check instrument is ok and is set up properly by using “DS” command (p.27)

□ Set up instrument for “autonomous sampling” following instructions on page 24. Started 12.00 13/12/2019

□ Sample num = 0 automatically makes entire memory available for recording.

□ Sample interval = 900 s

CTD 37 SMP 43742: 4548 below lower Trimsyn buoys

□ Download Data: L:\scientific_work_areas\Mooring Work\P3\data

□ New Batteries

□ Clean and lubricate O-rings

□ Set up instrument for re-deployment

□ Set real time clock to PC clock (p.28)

□ Check instrument is ok and is set up properly by using “DS” command (p.27)

□ Set up instrument for “autonomous sampling” following instructions on page 24. Started 12.00 13/12/2019

□ Sample num = 0 automatically makes entire memory available for recording.

□ Sample interval = 900 s

SeaGuard current meter w. O¬2 sensor: 1307 Shallow

- □ SN: 1307
- □ Current meter sensor: 851
- □ Optode: 1561
- □ The seaguard current meter with O2 sensor does not output a setup file
- □ Deployment settings:

The sampling interval was set to 2 hrs, as this resulted in a deployment time of 560 days. All other settings were left at the manufactures settings. It was checked that the current meter was set in burst mode (optimal for long term battery use).

- □ New Batteries, NB! Bodged Alkaline battery pack. Should be changed for the lithium pack next year.
- □ Check and lubricate O-rings
- □ Started recording 13.12.19, 12.00.00

Seaguard Current meter with O2 sensor: 1309, Deep

- □ SN: 1309
- □ Number of records: 4462
- □ Session ended 21.59.10
- □ Current meter sensor: 851
- □ Optode: 1561
- □ The Seaguard current meter with O2 sensor does not output a setup file.
- □ Deployment settings:

The sampling interval was set to 2 hrs, as this resulted in a deployment time of 560 days. All other settings were left at the manufactures settings. It was checked that the current meter was set in burst mode (optimal for long term battery use).

- o Data downloaded, file: L:\cruise_science_work\Mooring P3\SeaGuard 1309
- □ New batteries
- □ Check and lubricate O-rings
- □ Started recording 13.12.19, 12.00.00

Sediment Trap Deep - Parflux No: ?

- □ New Batteries
- □ Do NOT remove both batteries at the same time.
- □ Always disconnect the cable on the sediment trap first, before unplugging the computer end
- □ Set up sediment trap with sample tubes
- □ Download data

- ☐ Clean and lubricate O-rings
- ☐ Check rope and shackles

Work To be Carried out on Mooring and Hardware

- ☐ Checked and/or changed all shackles
- ☐ Checked and/or changed all chain
- ☐ Trimsyn Buoys
- ☐ Chain on Buoy
- ☐ Checked and/or changed all rope
- ☐ Checked titanium swivel
- ☐ Changed ALL stainless steel shackels
- ☐ Done a onceover on all parts of mooring buoy
- ☐ Replaced screws on clamps

14.2 WCB Mooring

The mooring at WCB was recovered on 07.12.2019 at 19.45 GMT. The mooring was released using release no. 2006, and everything went according to plan. The WBAT had again recorded data. The other sensors likewise appeared to have worked.

The mooring was turned around and redeployed on the 10.12.2019, again with no problems. The mooring weight was dropped at 53°47.886'S, 37°56.04'W

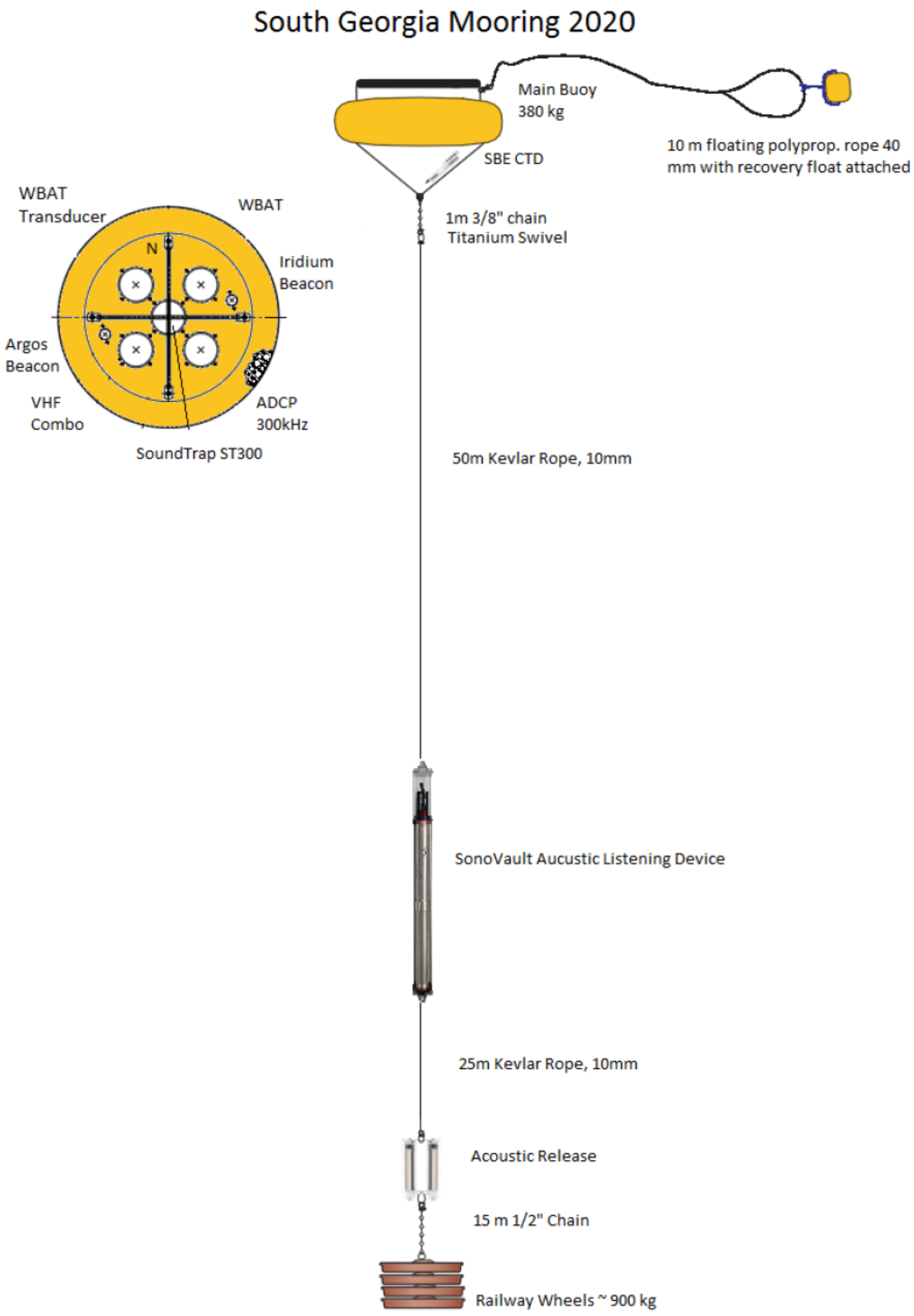


Figure 11 Schematic of WCB mooring deployed on JR19001

Work Carried Out on Instruments:

Acoustic Releases: 2006 + 2062

□ New Batteries

□ Tested

□ New Dropping Bar

□ Clean and lubricate O-rings

□ Linking bars slightly corroded and changed.

Inmarsat Iridium Beacon: IMEI: 300834012098770

□ New Batteries

□ Clean and lubricate O-rings

□ Tested

□ Turn on before deployment

Argos Beacon: SN 251, ID: 35520

□ New Batteries

□ Clean and lubricate O-rings

□ Tested

□ Turn on before deployment

NOVATEC Combo Beacon, Serial number: R09-20, Frequency: 159,48 MHz:

□ New Batteries

□ Clean and lubricate O-rings

□ Tested

□ Turn on before deployment

Due to space issues this was not deployed in a clamp, but jubilee clipped to the buoy. It should go back into a clamp next season.

ADCP WHS300-I-UG161 Serial Number: 17273

□ Download Data:

L:\scientific_work_areas\Mooring Work\WCB\data\ADCP

□ New Batteries

□ Check and lubricate O-rings

□ Set Up instrument for redeployment

o Erase Data

o Start WinSC for set-up of instrument

o Set up instrument:

- Number of bins:25(1-128)
- Bin Size (m) :8 (0.2-16)
- Pings per ensamble: 10
- Interval: 15 min
- Duration: 550 days
- Transducer depth: 200m
- Save deployment settings: L:\scientific_work_areas\Mooring Work\WCB\data\ADCP
- Start Time: xx.xx.xx. 00.00.00 – Start after deployment
- Set up ADCP real time clock to PC clock (Computer was GMT!)
- Don't verify the compass
- Run pre-deployment test to check instrument

SonoVault

The existing SonoVault will be swapped with a new, already configured, SonoVault.

New SonoVault:

- □ Insert batteries
- □ Inspect and lubricate O-rings
- □ Assemble
- □ Turn on just before deployment!

Old SonoVault:

- □ Remove and dispose of batteries
- □ Make sure SD Cards are happy and free of moist
- □ Clean
- □ Check for any sign of corrosion or other maintenance work

SoundTrap Acoustic Listening Device SN 806105112

- □ New Batteries
- □ Check and lubricate O-rings
- □ Configure Deployment
- □ Please refer to manual for set-up.
- □ Insert Dummy Plug
- □ Begin Recording Using the IR Remote Control by pressing START unless it is set to start recording at a later date.

CTD on main buoy 37SM29579 - 2462

□ Download Data:

L:\scientific_work_areas\Mooring Work\WCB\data\

□ New Batteries

□ Clean and lubricate O-rings

□ Set up instrument for re-deployment

□ Set real time clock to PC clock (p.28)

□ Check instrument is ok and is set up properly by using "DS" command (p.27)

□ Set up instrument for "autonomous sampling" following instructions on page 24. Started 12.00 11/12/2019

□ Sample num = 0 automatically makes entire memory available for recording.

□ Sample interval = 900 s

Simrad WBT Serial Number: 240826 and 120kHz transducer serial number: 127

□ Download data file from USB drive: L:\scientific_work_areas\Mooring Work\WCB\WBAT_data

□ New batteries

□ Set up instrument for redeployment

- New Batteries
- Erase USB Stick
- Start Mission Planner
- Send New Mission to WBT to Include

o Start Time / End Time (to not ping in water)

o Ping ensembles including CW/FM pings (15 each)

o Event start interval (1 hour)

o Range 250 m

o Battery Usage =

o Note firmware was not upgraded and WBAT is operating using Storage Controller FW v2.4.0-130, Storage Controller driver v0.6.92, mission controller FW v2.2.5.0, mission controller FPGA v10. These files can only be viewed in EK80 software version 1.11.

Work To be Carried out on Mooring and Hardware

□ Checked and/or changed all shackles

□ Checked and/or changed all chain

□ Trimsyn Buoys

□ Chain on Buoy

□ Checked and/or changed all rope

□ Checked titanium swivel

□ Changed ALL stainless steel shackels

□ Done a onceover on all parts of mooring buoy

□ Replaced screws on clamps

Post Cruise Tasks

- Look for a suitable filler for any damage that has occurred to the rubberised coating on the outside of of the buoy.

15 AME gear (*Bjørg Apeland, Chris Kerr*)

15.1 MOCNESS

15.1.1 Setup

Oil had leaked in transit, and the motor had to be topped up. We also decided to change all the O-rings of which we had no correct spares with us. We used O-rings from the DWNM spares. It is suggested that we go through the Mocness parts and make a proper spares box with O-rings, oil, and fasteners. It was also found that the fasteners on the release are a mix of imperial and metric, this should also be changed so all of them are metric.

Whilst assembling the Mocness bars one of them appears to be imperial though effort was made this summer to separate the imperial bars from the metric bars, so that we only carry metric components.

15.1.2 Test station

A deployment with only one net was carried out just to test the release mechanism. The net was lowered down to about 130m and release motor fired nine times. Upon recovery it was found that the motor had successfully released all nine net bars.

15.1.3 MOCNESS stations

The Mocness have been operating as expected. The release bridles on the dropping bars are showing some significant wear and tear, an example of which is shown in Figure 12 and they should be replaced. It was necessary during the cruise to exchange the release bridles on nets 1 and 8 due to significant wear where the bridle meets the dropping bars. It should be investigated if the release bridles fitted are to design because wear could already be seen on the new bridles after one deployment. Should they be to design, a sleeve should be considered to prevent fretting at the contact area.

Figure 12 MOCNESS release straps

Had one failed 1000m deployment were the release had been cocked the wrong way round. The Mocness was cocked the right way around and worked as expected.

Significant wear was also noted on the dropping bar sliding loop sections, particularly on the bottom bar, shown in Figure 13. This is where the dropping bars had come into contact with serrated section of the side bars. This should be recovered by replacement dropping bars or new sliding sections being welded in place. Care should be taken when setting up the mocness that the serated section of the side bars will not be in contact with the loops on the dropping bars.

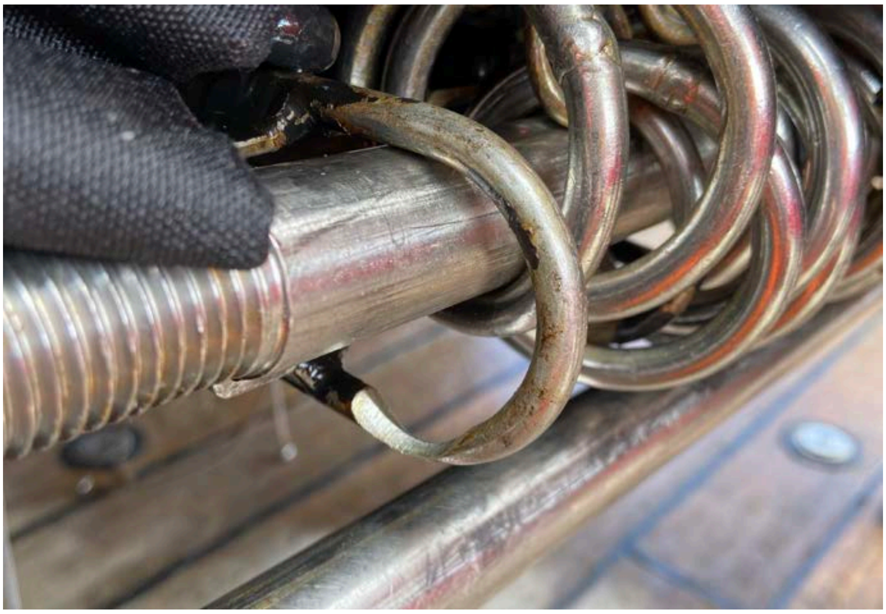


Figure 13 MOCNESS dropping bar

15.1.4 Post-cruise tasks

- Make a dedicated spares box for oil filled Mocness release
    - O-rings
    - Spare Motor
    - Spare shafts
    - Oil for top up and repairs.
- Drill and tap new holes so all nuts and bolts are imperial
- Investigate design and change release bridles on dropping bars
- Change the diaphragm on release motor
- Replace damaged dropping bar sliding section or whole dropping bars

15.2 RMT 8

15.2.1 Setup

Set up as normal, no modifications made, nor was any faults found.

15.2.2 Test station

The test station was done by dipping the RMT8 in down to about 50m, firing all nets and recover to surface. All nets deployed as they should, backed up from depth and tension data in LabVIEW. However, it was noted that the flow meter did not give any reading. The first step was to check the

SubCon connectors to see if they were fully engaged. The connecters seemed fine, so we swapped out the cable. With a new cable the flowmeter performed as expected.

15.2.3. Sites

While target fishing around Signy, the salinity sensor had intermediate faulty readings. After inspection it was found the connector was not fully engaged. But a second deployment is needed to see if the readings are now correct.

It has been said that there are no RMT without faff, but it seems that the 2019/2020 season is the year it would behave.

15.2.4 Post-cruise tasks

- Give release a full servicing
- Make sure there are enough spares for the release
- Can we make a better cross stand?
- Buy full set and spares of wires.

15.3 RMT 25

15.3.1 Setup

Set up as normal. Though it is clear that it might be time for a new weight bar. There is considerate corrosion, and the set screw threads for the end rollers should be bored and re tapped. Preferably so that the end rollers can freely rotate. Currently they are fixed in position.

15.3.2 Test station

Dropped down to about 50m, and all nets released. Worked as expected.

15.3.3 Sites

On one deployment due to weather the weight bar went horizontal and the force of the weights in the horizontal position was enough to overcome the clamping force of the weight clamps allowing the weights on the port side of the net to slide to the starboard side. The deployment was abandoned and the clamps were removed. The threaded holes in the clamps were heavily corroded and full of debris and the fasteners were both too short and has significant thread damaged. The fasteners were exchanged for a more appropriate length and the net was able to be re deployed

15.3.4 Post-cruise tasks

- New bars
- New end rollers
- Can we make a better stand?
- Can we make a stand for storing and lifting?
- Why do we have a swivel?
- Are we using the right type of wire rope? Maybe go for a more flexible rope.
- Buy new set of wires and all metal parts.

- The weight clamps should be drilled and tapped to a larger size that fully removes the current M8 fastener and it recommended that the current depth of the holes be made to thru holes. It might be more appropriate to manufacture new clamps.

15.4 Bongo

15.4.1 Setup

Most of the bongo was already set up, as it was not disassembled after JR18007. The only thing that needed fixing was the whale spectacles and the cod end support frame.

There was trouble finding the correct size nets, and some cod ends seems to have been lost. Some of the nets are also very tricky to get onto the ring and requires more than one person to get on. The nets should be inspected, and a box made with only the correct size nets. The same goes for the cod ends.

15.4.2 Test station

The Bongo was successfully deployed at the test station.

15.4.3 Sites

Operating fine like red wine.

15.5 Neuston Sledge

15.5.1 Setup

Set up as normal, no modifications or issues noted.

15.5.2 Test station

The Neuston sledge was successfully deployed and recovered at the test station during day light.

15.5.3 Sites

The Neuston sledge was deployed 3 times during hours of darkness and no issues or problems were noted.

15.6 Floating Sediment Trap

15.6.1 Setup

The new sediment traps were assembled and checked. Manufacturing differences between the old and newer sediment traps meant that they could easily be assembled the wrong way round. They should be checked to confirm that they are correct.

We also got the mooring buoy out to determine how to release the messenger and what type of beacon to use. It was decided that the messenger should hang off one of the beacons with a big loop and then be lifted off and dropped using a boat hook.

The instruments on the mooring buoy is

Radio Beacon:
- Channel C
- Frequency 160,72500
- Serial Number D07-018
- Model RF700C1

Iridium Beacon
- Serial DO8-21(Housing) / M0169H (Beacon)
- Model Maxi-7

- IMEI: 300434060655100

The Iridium beacon has been tested and is sending it's position around every 10 minutes.

15.6.2 Signy deployment

This was both test station and first deployment. Due to depth in the area only three sediment traps were deployed. The traps were deployed as other moorings with the weight first, and buoy last. Small extension leads were made to hang under the traps to make it easier to handle whilst deploying and recovering. The lanyards for the messengers had then to be extended as well so they hang under the extension line.

Deployment was successful and went according to plan. The Iridium Beacon did its thing and we received position data every 10 minutes for twenty-four hours. After finding and getting the buoy alongside the messenger rope was released. This proved to be very difficult and a bigger eye to get the hook on should be considered. Recovery of the traps went as planned. However, the messenger had not released the lids on the first trap. Most likely due to the lanyard entangling around the wire and hence not reaching the correct speed. Another hypothesis is that the angle of the sediment traps under the buoy is not vertical enough for the messenger to reach terminal velocity.

The bottom trap which would have been hanging at 150m depth came up with sediment in one of the trap tubes. Two of the other tubes had the bottom missing, and the trap construction was bent. This should not be a problem on the two next stations as the depth will be far greater than 150m.

15.6.3 WCB deployment

The floating sediment trap was this time deployed with four traps making up a total of 200m from top buoy to bottom trap. The trap was deployed in the same manner as for Signy using the same iridium beacon and VHF beacon. The deployment went according to plan and the Iridium beacon stayed in touch. To make it easier to release the messenger a bigger loop was made on the top buoy to lift off and release the first messenger. Upon recovery it was discovered that the top messenger had disappeared completely. We cannot quite understand how. This meant that none of the traps had fired. In the future the messenger system should be changed for an electric\mechanical option which is more reliable. It was also found that this trap had hit the bottom and had the bottom tubes crushed or filled with sediment. Again, in it recommended that the system be redesigned to something a bit more substantial. Maybe metal tubes rather than plastic.

15.7 Workshop

Should buy a sound system for the deck/ workshop.

15.8 Consumables

The following consumables are needed:

- Electrical Tape
- Top up nuts and bolts

15.9 Other

A couple of examples of weeping seals were seen. There is little record of when sort seals were replaced and not always correct spares available. Ideally new and correctly stored diaphragms and O-rings, should be fitted upon every opening of a seal. Material compatibly should be ensured by confirming correct oils, and greases are being used as per manufactures instructions.

16 Data Collections Overview (*Petra Ten Hoopen*)

16.1 Data Storage

All data recorded by instrumentation linked to the ship's network were recorded directly to respective folders within the directory /data/cruise/jcr/20191114/. Additional folders were created within the directory /data/cruise/jcr/20191114/work/ to allow the cruise scientists to back-up their work. When all data will be archived as read-only on the Storage Area Network (SAN) at BAS, the pathname to the files will remain the same, i.e. **/data/cruise/jcr/20191114/**. The data are under embargo for the minimum period of three years with the exception of the underway scs data streams.

16.2 Site identifiers

Specific codes were given to work stations consistent with the previous Western Core Box survey transects (W1.1, W1.2, W2.1, W2.2, W3.1, W3.2, W4.1 and W4.2) and mooring sites (WCB and P3). Additional sampling was conducted at the South Orkney Islands (Signy) and along the Polar Front (PF-1, PF-2, PF-3 and PF-4).

16.3 Digital and paper logs

Digital and paper logs were created to provide an overview of equipment deployments and record details of sampling. All deployments were assigned consecutive event numbers by the officers on watch and documented in the digital bridge event log. 107 individual events were recorded. In addition to the bridge event log a number of digital science logs were maintained to view deployment-relevant underway data in the context of sampling details. Copies of these have been downloaded as csv files into the file path /data/cruise/jcr/20191114/work/data_management/Digital_logs. This directory also contains a brief guide named <Digital_Event_Logging> on how to use the digital logging system currently installed on the RRS James Clark Ross. The following 12 digital science logs were maintained: Bongo, CTD, CTD_Bottles, EA600, EK60, Floating sediment trap, Mocness, NEUSTON, PSO diary, RMT8, RMT25 and UWIA_Water_Samples.

Paper sampling logs were maintained for RMT, Mocness and CTD sampling. The latter will be scanned at the end of the survey and available in the Storage Area Network archive directory /data/cruise/jcr/20191114/work/scientific_work_area.

16.4 Data collections

Equipment (*activity*)	**Number of deployments/recoveries**	**Comments**
Acoustic Doppler Current Profiler (ADCP)	NA	vessel-mounted
BONGO	16	
Conductivity-Temperature-Depth (CTD)	32	
EM122 multi-beam echosounder	NA	vessel-mounted
EK60 echosounder	NA	vessel-mounted
EA600 single-beam echosounder	NA	vessel-mounted
Floating sediment trap	2	

MOCNESS	10	
Mooring P3 2019 (*recovery*)	1	
Mooring P3 2020 (*deployment*)	1	
Mooring WCB 2019 (*recovery*)	1	
Mooring WCB 2020 (*deployment*)	1	
NEUSTON	4	
PML met sensor system	NA	vessel-mounted
RMT8	22	
RMT25	11	
Underway data streams	NA	vessel-mounted
Underway water samples	46	

Dataset	**BONGO**	
Instrument	**BONGO net, mesh size 0.1 mm** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0993/)	
Description	Net sampled to the depth 100 m for plankton.	
Metadata	Digital Logs	JR19001_BONGO /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	Physical samples will be stored in the BAS biological store and at Marum, Bremen, Germany. Samples were preserved in -80° Celsius or -20° Celsius.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Julie Meilland, Roberta Johnson	

Dataset	**NEUSTON**
Instrument	**NEUSTON net, mesh size 0.6 mm** (http://vocab.nerc.ac.uk/collection/L05/current/69)
Description	Net sampled on the surface for fish larvae.

Metadata	Digital Logs	JR19001_NEUSTON /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	Physical samples will be stored in the BAS biological store. Samples were preserved in 96% ethanol.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Martin Collins	

Dataset	**MOCNESS**	
Instrument	**Multiple Opening and Closing Net and Environmental Sampling System net, mesh size 0.3 mm** (http://vocab.nerc.ac.uk/collection/L22/current/NETT0185/)	
Description	Net sampled to the depth 1000 m for strata of zooplankton and fish.	
Metadata	Digital Log	JR19001_MOCNESS /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	The primary repository for physical samples will be the BAS biological store. Catches were analysed for wet biomass and number of individuals per taxon. Samples were preserved in 4% formalin, in -80° Celsius or 70% ethanol.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Sophie Fielding, Gabriele Stowasser, Jose Carlos Caetano Xavier, Ricardo Matias	

Dataset	**RMT8**
Instrument	**RMT8 net, mesh size 5mm** (http://vocab.nerc.ac.uk/collection/L22/current/NETT0180/)
Description	Net sampled to the depth 200 m for zooplankton.

Metadata	Digital Log	JR19001_RMT8 /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	The primary repository for physical samples will be the BAS biological store. Catches were analysed for wet biomass and number of individuals per taxon. Samples were preserved in 96% ethanol, -20° Celsius, -80° Celsius or 4% formalin.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Sophie Fielding, Gabriele Stowasser, Anna Belcher, Clara Manno, Emily Rowlands, Martin Collins, Jose Carlos Caetano Xavier, Ricardo Matias	

Dataset	**RMT25**	
Instrument	**RMT25 net, cod-end mesh size 5mm** (http://vocab.nerc.ac.uk/collection/L22/current/NETT0181/)	
Description	Net sampled to the depth 1000 m for fish and zooplankton.	
Metadata	Digital Log	JR19001_RMT25 /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	The primary repository for physical samples will be the BAS biological store. Catches were analysed for wet biomass and number of individuals per taxon. Samples were preserved in 96% ethanol, -80° Celsius or 4% formalin.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Sophie Fielding, Gabriele Stowasser, Martin Collins, Jose Carlos Caetano Xavier, Ricardo Matias	

Dataset	**Floating sediment trap**
Instrument	**Floating sediment trap** (http://vocab.nerc.ac.uk/collection/L05/current/33/)

Description	Four Perspex tubes on a stainless-steel frame. Several frames were placed in succession in 50m distance at depth 50-200 m, deployed cocked and released by a messenger beneath the buoy.	
Metadata	Digital Log	JR19001_floating_sediment_trap /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	The primary repository for physical samples will be the BAS biological store.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Clara Manno, Emily Rowlands	

Dataset	**Underway water samples**	
Instrument	**Non-toxic sea water supply** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0413/)	
Description	Water samples from underway non-toxic sea water supply were taken at distinct times along the ship track.	
Metadata	Digital Log	JR19001_UWIA_water_samples /data/cruise/jcr/20191114/work/data_management/digital_logs
Analogue data	None available at this stage.	
Digital data	None available at this stage.	
Physical samples	Physical samples will be stored in the BAS biological store, the Autonomous University of Barcelona, Spain, and at the Sanger Institute, UK. Samples were preserved in -80° Celsius or dried.	
Long-term preservation	Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.	
Data users	Sophie Fielding, Roberta Johnson, Iliana Bista	

Dataset	**CTD data**
Instruments	**Sensors on the CTD frame** (http://vocab.nerc.ac.uk/collection/L05/current/130/

	http://vocab.nerc.ac.uk/collection/L22/current/TOOL0058/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0416/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0417/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0318/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0036/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0059/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL01254/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0424/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0160/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0749/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0931/)		
Description	Conductivity, Temperature and Depth measurements at Signy, P3, Western Core Box sampling sites and along the Polar Front.		
Metadata	Paper Logs	BAS AME holds paper copies of the CTD sampling logs, scans of the paper logs are in the directory /data/cruise/jcr/20191114/work/scientific_work_area/AME	
	Digital Log	JR19001_CTD /data/cruise/jcr/20191114/work/data_management/digital_logs	
Digital data	Raw	.bl, .hdr, .hex, .000 (LADCP) /data/cruise/jcr/20191114/ctd	
	Processed	asc, .cnv, .ros,	/data/cruise/jcr/20191114/ctd/JR19001_Processed
Long-term preservation	Raw and processed data will be stored on the SAN at BAS and processed data also available from the BODC. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.		
Data users	Any cruise participant, Met Office		

Dataset	**CTD bottle samples**	
Instrument	**Niskin bottle** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0412/)	
Description	Sea water from Niskin bottles was collected at specific stations and depths up to 3780 m. For details see the report chapter Physical Oceanography – Water Samples from CTD.	
Metadata	Paper Logs	BAS AME holds paper copies of the CTD sampling logs, scans of the paper logs are in the directory /data/cruise/jcr/20191114/work/scientific_work_area/AME
	Digital Logs	JR19001_CTD_BOTTLES /data/cruise/jcr/20191114/work/data_management/digital_logs
Digital data	/data/cruise/jcr/20191114/ctd	

Physical samples	Physical samples will be stored in the BAS biological store, the Autonomous University of Barcelona, Spain, and at the Sanger Institute, UK. Samples were preserved in -80° Celsius or dried.
Long-term preservation	Raw data will be stored on the SAN at BAS. Molecular data should be submitted to EMBL-EBI. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Clara Manno, Roberta Johnson, Gabriele Stowasser, Iliana Bista

Dataset	**Underway data**
Instruments	**Underway navigation, meteorology, oceanlogger**, **netmonitor, dopplerlog, gyro** (see AME report for details)
Description	Various underway data streams, such as navigation, surface oceanographic, meteorological, net winch data, logged by the NOAA Scientific Computer System software
Digital data	/data/cruise/jcr/2019114/scs
Long-term preservation	Raw will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Any cruise participant

Dataset	**PML met system data**
Instruments	**Plymouth Marine Laboratory meteorological sensing system** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0085/ http://vocab.nerc.ac.uk/collection/L05/current/101/ http://vocab.nerc.ac.uk/collection/L05/current/385/)
Description	PML meteorological system consisting of Licor 7500 water vapour flux sensor, Metek sonic anemometer, LPMS motion sensor, Systron Donner motion sensor
Digital data	/data/cruise/jcr/2019114/autoflux
Long-term preservation	Raw data will be stored on the SAN at BAS and also transferred to the PML on regular bases.
Data users	Ming-Xi Yang, Plymouth Marine Laboratory

Dataset	**VMADCP data**
Instruments	**Vessel Mounted Ocean Surveyor Acoustic Doppler Current Profiler** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0351/)

Description	A vessel-mounted acoustic 75kHz Ocean Surveyor for measurement of water current velocity using the Doppler effect on sound waves scattered back from particles within the water column.
Digital data	/data/cruise/jcr/20191114/adcp
Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Sophie Fielding

Dataset	**EA600 data**
Instruments	**Kongsberg EA600 single-beam echosounder** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0319/)
Description	Kongsberg EA600 single-beam echosounder for measurement of depth below transducer and used to estimate water depth
Digital data	/data/cruise/jcr/20191114/ea600
Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Any cruise participant

Dataset	**EM122 data**
Instruments	**Kongsberg EM122 multi-beam echosounder** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0492/)
Description	Kongsberg EM122 multi-beam echosounder used briefly to obtain seafloor information
Digital data	/data/cruise/jcr/20191114/em122
Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Sophie Fielding

Dataset	**EK60 data**
Instruments	**Simrad EK60 echosounder** (http://vocab.nerc.ac.uk/collection/L22/current/TOOL0198/)
Description	Simrad EK60 echosounder operated at 4 frequencies (38 kHz, 70 kHz, 120 kHz, 200 kHz) used continuously and specifically to detect swarms of Euphausia superba and for eight Western Core Box acoustic transects.
Digital data	/data/cruise/jcr/20191114/ek60
Calibration	/data/cruise/jcr/20191114/work/scientific_work_areas/EK60_calibration

Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Sophie Fielding, Rodrigo Hernandez Moresino

Dataset	**P3 mooring**
Instruments recovered	SBE 37-SMP CTD on main buoy, SBE 37-SMP CTD below trimson buoy cluster, SAMI pH sensor, Pro-oceansus pCO_2 sensor, PPS phytoplankton collector, sediment trap deep http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018/ http://vocab.nerc.ac.uk/collection/L05/current/355/ http://vocab.nerc.ac.uk/collection/L05/current/351/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL1326/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0786/
Instruments deployed	SBE 37-SMP CTD on main buoy, SBE 37-SMP CTD below trimson buoy cluster, ADCP, Aquamonitor WMS-4D, SeaGuard current meter & O_2 sensor below Aquamonitor, sediment trap deep, SeaGuard current meter & O_2 sensor below sediment trap http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0061/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0381/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0306/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0786/
Description	The P3 mooring was: • deployed on 12.01.2019 during the cruise DY098 • recovered in the event 21 on 03.12.2019 • redeployed in the event 73 on 12.12.2019
Digital data	/data/cruise/jcr/20191114/work/scientific_work_areas/Mooring Work/P3
Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Sophie Fielding, Clara Manno, Emily Rowlands

Dataset	**South Georgia mooring**
Instruments recovered	SBE 37-SMP CTD on main buoy, ADCP, Simrad WBAT, SonoVault http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0061/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL1208/
Instruments deployed	SBE 37-SMP CTD on main buoy, ADCP, Simrad WBT, SonoVault, SoundTrap ST300

	http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL0061/ http://vocab.nerc.ac.uk/collection/L22/current/TOOL1208/
Description	The WCB mooring was: • deployed on 23.01.2019 during the cruise DY098 • recovered in the event 42 on 07.12.2019 • redeployed in the event 63 on 10.12.2019
Digital data	/data/cruise/jcr/20191114/work/scientific_work_areas/Mooring Work/WCB
Long-term preservation	Raw data will be stored on the SAN at BAS. Metadata will be stored in the Marine Metadata Portal developed by the UK Polar Data Centre.
Data users	Sophie Fielding, Rodrigo Hernandez Moresino

17 ICT Engineers report (*Jeremy Robst*)

17.1 Data Logging / SCS

The SCS server and data logging systems worked well throughout the cruise, with few logging events occurring.

Time & Date (GMT)	Event
2019/11/14 16:58	ACQ restarted, newleg run (**Leg: 20191114**).
2019/11/17 14:401	EA600 restarted once in international waters. Up to this point it was outputting around 67m regardless of real depth.
2019/11/18 11:16	Oceanlogger transmissometer calibration updated by AME
2019/11/19 17:36 – 18:55	Oceanlogger not outputting – calibration menu selected, cancelled and outputting again
2019/11/21 08:05 – 11:37	VMware crash, rebooted ESX0 for recovery and restarted data logging to recover JRLB
2019/11/25 00:44 – 12:42	VMware crash again, rebooted ESX0 to recover. Several restarts of SCS logging to try recover JRLB logging. Eventually recovered all around 12:40.
2019/12/20 21:45 – 2019/12/23 11:19	Oceanlogger stuck on calibration menu again and not logging
2019/2/26	ACQ restarted, newleg run

17.2 VMware

The VMware server crashed twice during the cruise, with errors in the logs relating to the maximum heap size for the VMFS file system. This suggested VMware was running out of heap memory as too much VMFS disk space was in use. In an attempt to resolve this all the non-vital Linux infrastructure machines (Spacewalk, Puppet, Git) were moved to JR-ESX1 and removed from ESX0. This appears to have helped as no more VMware crashes have been experienced.

17.3 JRW-DC-S1

On the evening on 24th December 2019, JRW-DC-S1 rebooted apparently by itself in order to apply patches. However the machine appeared to get stuck in a loop and would not progress past Stage 1 of 6. Eventually booting into Safe Mode enabled the machine to break out of the loop, reach Stage 6, fail the updates, revert the changes and boot normally.

17.4 Other systems

The other systems on board generally worked without any issues. With the end of the JCR approaching, these systems are old and have deliberately not been updated, so many of the issues raised have stemmed from this. For example upgrading to VMware 6 and SABRIS II would have resolved the DC & ESX issues.

Appendix 18 Event log

Time	Event	Lat	Lon	Comment
23/11/2019 17:12	1	-60.7021	-45.583	Echo Sounder deployed
23/11/2019 19:42	1	-60.7021	-45.583	Echo sounder recovered.
23/11/2019 23:45	2	-60.608	-46.4668	Vessel on DP
23/11/2019 23:52	2	-60.6077	-46.4686	Start deploying drifter float
24/11/2019 00:23	2	-60.6076	-46.469	Drifter float deployed
24/11/2019 00:30	2	-60.6074	-46.4701	Vessel off DP
24/11/2019 04:30		-60.2962	-46.6445	Vessel on DP
24/11/2019 11:15		-60.3006	-46.6766	Vessel off DP
24/11/2019 11:45		-60.3436	-46.6513	Vessel on DP
24/11/2019 12:00	3	-60.343	-46.652	CTD deployed
24/11/2019 12:03	3	-60.343	-46.652	CTD going to 1020m, EA600 at 1033
24/11/2019 12:24	3	-60.343	-46.652	CTD stopped at 1030m and hauling
24/11/2019 13:25		-60.343	-46.6521	Vessel off DP
24/11/2019 13:54	4	-60.3345	-46.6913	RMT 8 in the water
24/11/2019 13:56	4	-60.334	-46.6942	RMT 8 deployed
24/11/2019 14:17	4	-60.329	-46.7217	RMT 8 recovered
24/11/2019 14:40		-60.3401	-46.6599	Vessel on DP
24/11/2019 14:52	5	-60.3404	-46.6596	CTD deployed
24/11/2019 14:55	5	-60.3404	-46.6596	CTD going to 1030m EA600 showing 1048m
24/11/2019 14:58	5	-60.3404	-46.6596	CTD stopped at 22m- test
24/11/2019 15:06	5	-60.3404	-46.6596	CTD recovered to deck
24/11/2019 15:16	6	-60.3404	-46.6596	CTD deployed
24/11/2019 15:20	6	-60.3404	-46.6597	CTD deploying to approx 1030m
24/11/2019 15:36	6	-60.3404	-46.6596	CTD stopped at 1023m
24/11/2019 16:12	6	-60.3403	-46.6596	CTD recovered
24/11/2019 16:24		-60.3403	-46.6596	Gantry lashed, vessel out of DP for target fishing
24/11/2019 17:45	7	-60.3992	-46.4362	Stern bulwark door open. RMT8 deploying

24/11/2019 17:49	7	-60.3985	-46.4418	Bulwark door closed, net deployed
24/11/2019 18:10	7	-60.396	-46.4687	Start hauling net
24/11/2019 18:23		-60.3944	-46.4901	Stern bulwark open
24/11/2019 18:30	7	-60.3936	-46.5036	Net recovered, stern bulwark closed, proceed to 750mCTD
24/11/2019 19:06		-60.3497	-46.6561	Vessel on DP at 750mCTD
24/11/2019 19:14	8	-60.3497	-46.6561	CTD deployed
24/11/2019 19:18	8	60 20.98 s	046039.37 w	lowering CTD to 755 metres
24/11/2019 20:00	8	-60.3497	-46.6562	CTD RECOVERED AND STOWED ON DECK
24/11/2019 20:06	9	-60.3497	-46.6562	Preparing bongo nets
24/11/2019 20:18	9	-60.3497	-46.6562	Deploy bongo nets
24/11/2019 20:24	9	-60.3497	-46.6561	Bongio nets lowered to 100m and recover
24/11/2019 20:30	9	-60.3497	-46.6561	Bongo nets recovered on deck
24/11/2019 20:36	10	-60.3497	-46.6561	Deploy and lower bongo nets into the water
24/11/2019 20:45	10	-60.3495	-46.6569	Bongo at 200m commenced hauling
24/11/2019 21:02	10	-60.3495	-46.6571	Bongo nets recovered to deck
24/11/2019 21:12		-60.3495	-46.6571	Vessel off DP
24/11/2019 21:30		-60.3641	-46.6535	Vessel on DP
24/11/2019 21:36	11	-60.364	-46.6534	CTD DEPLOYED
24/11/2019 21:48	11	-60.3639	-46.6535	CTD stopped lowering at 500m and recovering
24/11/2019 22:06	11	-60.3639	-46.6534	CTD recovered on deck
24/11/2019 22:12		-60.365	-46.6576	Vessel off DP and proceeding to next CTD location
24/11/2019 22:24		-60.3758	-46.6892	Vessel on DP at new CTD location
24/11/2019 22:42	12	-60.3758	-46.6892	CTD Deployed and in water
24/11/2019 22:48	12	-60.3759	-46.6893	CTD lowering to approx 260 m
24/11/2019 22:54	12	-60.3758	-46.6892	CTD on seabed 260 m
24/11/2019 23:00	12	-60.3758	-46.6892	Recovering CTD
24/11/2019 23:06	12	-60.3758	-46.6893	CTD Recovered on deck
24/11/2019 23:18		-60.3759	-46.6892	Vessel off DP heading towards drifter float position
25/11/2019 01:00	2	-60.6372	-46.4893	Sediment trap float onboard

25/11/2019 01:38	2	-60.6364	-46.4907	Sediment trap onboard
02/12/2019 03:54		-53.6289	-37.94	Start acoustic survey
02/12/2019 06:58		-53.8129	-37.9353	
02/12/2019 13:36		-53.7924	-37.9378	Stop acoustic survey
02/12/2019 15:24		-53.5821	-38.0116	Vessel on DP
02/12/2019 15:28		-53.5821	-38.0118	Gantry unlashed
02/12/2019 15:42	13	-53.5821	-38.0116	CTD Deployed
02/12/2019 15:45	13	-53.5821	-38.0117	CTD stopped at 20m
02/12/2019 15:52	13	-53.5821	-38.0117	CTD recovered to deck
02/12/2019 16:06	14	-53.5821	-38.0117	CTD deployed
02/12/2019 16:13	14	-53.5821	-38.0117	CTD veering to 1040m
02/12/2019 16:36	14	-53.5821	-38.0118	CTD stopped at 1087m
02/12/2019 17:12	14	-53.5821	-38.0117	CTD recovered
02/12/2019 17:30		-53.5821	-38.0118	Vessel out of DP for target fishing
02/12/2019 19:24	15	-53.7423	-38.0236	Stern bulwark opened. RMT8 deployment
02/12/2019 19:30	15	-53.7596	-38.0244	deploy nets
02/12/2019 19:36	15	-53.7509	-38.0242	Close stern bulwark
02/12/2019 19:54	15	-53.7633	-38.0242	bulwark opened
02/12/2019 20:00	15	-53.7674	-38.0254	nets recovered
02/12/2019 20:06	15	-53.6416	-37.9911	bulwark closed
02/12/2019 21:26		-53.5976	-38.0044	vessel on DP @ 500m CTD
02/12/2019 21:35	16	-53.5976	-38.0044	Deploy CTD
02/12/2019 21:39	16	-53.5976	-38.0044	Lowering CTD to 500m
02/12/2019 21:46	16	-53.5976	-38.0044	CTD stopped @ 525 m
02/12/2019 21:54	16	-53.5976	-38.0044	Recovering CTD
02/12/2019 22:12	16	-53.5976	-38.0044	CTD Recovered on deck
02/12/2019 22:36	17	-53.5977	-38.0044	Deploy bongo
02/12/2019 22:38	17	-53.5976	-38.0044	Bongo at 50m
02/12/2019 22:42	17	-53.5977	-38.0044	Bongo recovered

02/12/2019 22:50	18	-53.5977	-38.0044	Bongo deployed
02/12/2019 22:58	18	-53.5977	-38.0044	Bongo at 100m
02/12/2019 23:10	18	-53.5977	-38.0044	Bongo recovered
02/12/2019 23:21		-53.5977	-38.0044	Off DP heading towards XBT14 for target fishing
03/12/2019 00:15		-53.6698	-38.1367	Vessel off Dp
03/12/2019 02:24	19	-53.7825	-38.3422	Nets deployed. RMT8
03/12/2019 02:30	19	-53.46.700	-39.20.400	nets at 77 meters
03/12/2019 02:48	19	-53.7987	-38.3458	nets recovered
03/12/2019 04:03	20	-53.3428	-39.3427	Stern bulwark open
03/12/2019 04:06	20	-53.3428	-39.3427	RMT deployed
03/12/2019 04:12	20	-53.3406	-39.3456	Stern bulwark closed
03/12/2019 04:42	20	-53.7957	-38.5896	RMT at 330m, hauling
03/12/2019 05:20	20	-53.8254	-38.6053	Stern bulwark open
03/12/2019 05:24	20	-53.8286	-38.607	RMT recovered stern bulwark closed
03/12/2019 05:36		-53.8385	-38.6136	All secure on deck, vessel proceeding to P3
03/12/2019 14:10		-53.1589	-39.6103	Vessel on DP at P3
03/12/2019 15:09		-52.8042	-40.1005	Vessel out of DP, proceed 270 x 2nm
03/12/2019 15:36		-52.8038	-40.1545	Vessel on DP
03/12/2019 15:52		-52.804	-40.1555	Vessel move 500m South
03/12/2019 16:23		-52.8085	-40.1555	Vessel move 1000m astern downwind of P3
03/12/2019 16:37	21	-52.8025	-40.1391	Go ahead for P3 mooring release
03/12/2019 16:45		-52.8024	-40.1386	Vessel out of DP for P3 recovery approach
03/12/2019 16:56		-52.8037	-40.1555	Vessel on DP for P3 recovery
03/12/2019 17:09	21	-52.8045	-40.1584	P3 Recovery Float recovered
03/12/2019 17:12		-52.8046	-40.1586	Stern bulwark open
03/12/2019 17:17	21	-52.8045	-40.1586	P3 Main Buoy recovered
03/12/2019 17:36	21	-52.8045	-40.1586	P3 Phytoplankton Sampler recovered
03/12/2019 18:00	21	-52.8057	-40.1611	P3 Trimson Buoy Cluster recovered
03/12/2019 18:17	21	-52.8065	-40.163	P3 Seabird CTD recovered

03/12/2019 18:40	21	-52.8077	-40.1655	P3 Trimson Buoy Cluster
03/12/2019 18:46	21	-52.808	-40.1661	Sediment trap recovered
03/12/2019 19:29	21	-52.8084	-40.1671	Aciustic release recovered
03/12/2019 19:30	21	-52.8084	-40.1671	Bulwark doors closed astern
03/12/2019 20:10	22	-52.804	-40.1572	Deploy CTD
03/12/2019 20:12	22	-52.804	-40.1571	Lowering CTD to 3730 metres
03/12/2019 21:17	22	-52.804	-40.1571	CTD stopped @ 3738 metres
03/12/2019 21:24	22	-52.804	-40.1571	Begin CTD recovery
03/12/2019 23:10	22	-52.804	-40.1572	CTD recovered
03/12/2019 23:35	23	-52.804	-40.1571	Bongos deployed
03/12/2019 23:36	23	-52.804	-40.1572	Bongos at 50m and hauling
03/12/2019 23:40	23	-52.804	-40.1572	Bongos recovered
03/12/2019 23:47	24	-52.804	-40.1572	Bongos deployed
03/12/2019 23:49	24	-52.804	-40.1572	Bongos at 50m and hauling
03/12/2019 23:56	24	-52.804	-40.1571	Bongos recovered
04/12/2019 00:15		-52.804	-40.1572	Vessel off DP
04/12/2019 00:25	25	-52.805	-40.163	Mocness Deployed
04/12/2019 00:37	25	-52.8067	-40.1727	Mocness recovered due to tech issue
04/12/2019 01:00	26	-52.8095	-40.1916	Mocness deployed
04/12/2019 01:28	26	-52.8097	-40.2154	Mocness at 230m and hauling
04/12/2019 01:36	26	-52.8087	-40.2209	Mocness recovered
04/12/2019 02:23	27	-52.8028	-40.2455	Mocness deployed
04/12/2019 03:24	27	-52.7961	-40.294	Mocness stopped at 1546m, hauling
04/12/2019 04:50	27	-52.7756	-40.3543	Mocness recovered
04/12/2019 05:12		-52.7685	-40.3707	Mocness secured on deck, proceed to WCB 1.1 for accoustic survey
04/12/2019 09:10		-53.3496	-39.6018	Begin acoustic survey, pass through 1.1 N
04/12/2019 13:36		-54.0649	-39.3888	Pass through 1.1S
04/12/2019 14:36		-54.0289	-39.087	Begin acoustic survey, pass through 1.2S
04/12/2019 18:57		-53.3154	-39.304	Passing through 1.2N

04/12/2019 20:12		-53.4909	-39.2483	V/L on DP
04/12/2019 20:30	28	-53.4927	-39.2503	Deploy CTD
04/12/2019 20:42	28	-53.4927	-39.2503	CTD on way down to 1000m
04/12/2019 20:55	28	-53.4927	-39.2503	CTD @ 1000m
04/12/2019 21:00	28	-53.4927	-39.2503	Recovering CTD
04/12/2019 21:17	28	-53.4927	-39.2503	CTD recovered on deck
04/12/2019 21:30		-53.4807	-39.3103	vessel off dp
04/12/2019 22:00	29	-53.4958	-39.2453	stern door open
04/12/2019 22:07	29	-53.4927	-39.252	RMT Deployed
04/12/2019 22:10	29	-53.4918	-39.2556	STern door closed
04/12/2019 22:54	29	-53.4804	-39.3119	RMT @ 200 m depth and 407 wire out
04/12/2019 23:40	29	-53.4778	-39.3759	RMT recovered, vessel heading south east for target fishing
05/12/2019 04:27	30	-53.7573	-38.8039	Stern bulwark open. RMT8 deploying
05/12/2019 04:30	30	-53.7582	-38.808	Net deployed- target fishing
05/12/2019 04:32		-53.7575	-38.7823	Stern bulwark closed
05/12/2019 04:42	30	-53.7617	-38.8246	Net at 71m, hauling
05/12/2019 04:52	30	-53.7646	-38.8378	Net recovered, stern bulwark closed
05/12/2019 05:06		-53.7708	-38.8619	All secure on deck, proceed to CTD1.2S position for RMT deployment
05/12/2019 06:14		-53.8303	-39.1369	Proceed to CTD 1.2S, RMT cancelled, 1.0nm run in to CTD 1.2S
05/12/2019 06:33		-53.8467	-39.1431	Vessel on DP at CTD 1.2S
05/12/2019 06:42		-53.8467	-39.1431	Gantry unlashed
05/12/2019 06:49	31	-53.8467	-39.143	CTD deployed
05/12/2019 06:57	31	-53.8467	-39.1431	CTD veering to 275m
05/12/2019 07:00	31	-53.8467	-39.1431	CTD stopped at 275m
05/12/2019 07:18	31	-53.8466	-39.1431	CTD recpvered on deck
05/12/2019 07:30		-53.8485	-39.1452	Vessel off DP
05/12/2019 09:00		-53.9854	-38.8207	Pass through intersect 2.1S
05/12/2019 13:24		-53.2718	-39.0412	Pass through intersect 2.1N
05/12/2019 14:20		-53.2511	-38.7528	Pass through intersect 2.2N

05/12/2019 18:40		-53.9607	-38.5258	Acoustic survey- Pass through intersect 2.2S, proceed to CTD 2.2S
05/12/2019 19:54		-53.7855	-38.5834	Vessel on DP
05/12/2019 20:00	32	-53.7865	-38.5829	Deploy CTD
05/12/2019 20:08	32	-53.7855	-38.5834	CTD veering to 195m
05/12/2019 20:13	32	-53.7856	-38.5833	CTD stopped @ 194m
05/12/2019 20:15	32	-53.7855	-38.5834	Recovering CTD
05/12/2019 20:24	32	-53.7854	-38.5834	CTD on deck
05/12/2019 20:30		-53.7854	-38.5834	vessel off dp
05/12/2019 22:46	33	-53.8615	-39.1435	Open stern bulwark
05/12/2019 22:48	33	-53.8602	-39.1436	Deploy RMT nets
05/12/2019 22:52	33	-53.8575	-39.1437	Close stern bulwark
05/12/2019 23:35	33	-53.8316	-39.1371	RMT stopped at 200m depth and 405m wire
06/12/2019 00:24	33	-53.7992	-39.1155	RMT recovered, vessel heading for CTD2.2N
06/12/2019 02:20		-53.5769	-38.8299	Vessel on DP
06/12/2019 02:40	34	-53.5746	-38.8312	Bongos deployed
06/12/2019 02:42	34	-53.5746	-38.8312	Bongos at 50m and hauling
06/12/2019 02:48	34	-53.5747	-38.8312	Bongos recovered
06/12/2019 02:52	35	-53.5746	-38.8312	Bongos deployed
06/12/2019 02:57	35	-53.5746	-38.8312	Bongos at 100m and hauling
06/12/2019 03:06	35	-53.5747	-38.8312	Bongo recovered
06/12/2019 03:23		-53.5746	-38.8312	Gantry lashed
06/12/2019 03:24		-53.5746	-38.8312	Vessel out of DP, proceed to CTD2.2N for RMT stratified
06/12/2019 04:52		-53.4277	-38.6672	Stern bulwark open
06/12/2019 04:54	36	-53.428	-38.6699	RMT deployed for stratified fishing
06/12/2019 04:57		-53.4284	-38.6739	Stern bulwark closed
06/12/2019 05:30	36	-53.4328	-38.7173	RMT stopped at 318m, hauling
06/12/2019 06:06		-53.4362	-38.7657	Stern bulwark open
06/12/2019 06:12	36	-53.4368	-38.7738	RMT net recovered, stern buklwark closed
06/12/2019 06:24		-53.4374	-38.7874	All secure on deck, proceed to CTD 2.2N for CTD

06/12/2019 07:18		-53.431	-38.6935	Vessel on DP
06/12/2019 07:37	37	-53.4316	-38.6952	CTD Deployed
06/12/2019 07:40	37	-53.4316	-38.6952	Veering CTD to 1000m
06/12/2019 08:00	37	-53.4316	-38.6952	Hauling CTD
06/12/2019 08:26	37	-53.4316	-38.6952	CTD on deck
06/12/2019 08:36		-53.4316	-38.6952	Vessel off DP proceeding to 3.1 N
06/12/2019 10:18		-53.2253	-38.4479	Begin acoustic track @ WCB 3.1N - 3.1 S
06/12/2019 19:54		-53.1929	-38.1379	Pass WCB 3.2N and proceed to 3.2N CTD position
06/12/2019 21:12		-53.3614	-38.0816	Vessel on DP
06/12/2019 21:20	38	-53.3615	-38.0817	CTD Deployed
06/12/2019 21:29	38	-53.3616	-38.0822	CTD veering to 1000m
06/12/2019 21:44	38	-53.3616	-38.0822	CTD @ 1000m
06/12/2019 21:47	38	-53.3616	-38.0823	Hauling CTD
06/12/2019 22:15	38	-53.3616	-38.0822	CTD recovered on deck
06/12/2019 22:23	38	-53.3616	-38.0822	Midships gantry lashed
06/12/2019 22:23		-53.3616	-38.0822	vessel off dp
06/12/2019 22:52	39	-53.3648	-38.0565	stern bulwark open
06/12/2019 22:53	39	-53.3646	-38.0574	rmt net deployed
06/12/2019 23:37	39	-53.3601	-38.1123	RMT stopped at 200m depth and 415m of wire
07/12/2019 00:25	39	-53.3575	-38.1771	RMT recovered
07/12/2019 02:28		-53.5925	-38.0112	On DP
07/12/2019 02:42	40	-53.592	-38.0113	CTD deployed
07/12/2019 02:48	40	-53.592	-38.0113	CTD veering to 750m
07/12/2019 03:03	40	-53.592	-38.0113	CTD stopped at 803m
07/12/2019 03:28	40	-53.592	-38.0113	CTD recovered to deck
07/12/2019 03:36		-53.5919	-38.0113	Vessel out of DP for target fishing, gantry lashed
07/12/2019 05:22		-53.6636	-37.8085	Stern bulwark open
07/12/2019 05:32		-53.6637	-37.829	Stern bulwark closed, net not deployed
07/12/2019 06:06		-53.6625	-37.8062	Stern bulwark open

07/12/2019 06:12	41	-53.6631	-37.8153	Stern bulwark closed, RMT deployed
07/12/2019 06:22	41	-53.6645	-37.8306	RMT at 90m, hauling
07/12/2019 06:28		-53.6651	-37.84	Stern bulwark open
07/12/2019 06:28		-53.6651	-37.84	Stern bulwark open
07/12/2019 06:33	41	-53.6656	-37.8475	Stern bulwark closed, RMT recovered, continue target fishing
07/12/2019 07:06		-53.6393	-37.781	Proceed to 4.1S for accoustic survey
07/12/2019 08:35		-53.871	-37.7261	Pass through 4.1 S intersect heading North
07/12/2019 13:30		-53.1483	-37.832	Pass through W4.2N and start 4.2 transect
07/12/2019 17:51		-53.8534	-37.5938	End of 4.2 transect, pass through 4.2S
07/12/2019 19:00		-53.7979	-37.9325	vessel on dp
07/12/2019 19:30	42	-53.7978	-37.9321	Line attached to SGMooring buoy
07/12/2019 19:38	42	-53.7979	-37.9329	stern door open
07/12/2019 19:38		-53.7979	-37.933	begin recovery of mooring buoy
07/12/2019 19:45	42	-53.798	-37.9335	Mooring buoy on deck
07/12/2019 19:55	42	-53.798	-37.9338	SVALD on deck
07/12/2019 20:00	42	-53.798	-37.9338	acoustic release on deck
07/12/2019 20:01	42	-53.798	-37.9338	stern door closed
07/12/2019 20:14	43	-53.798	-37.9338	deploy ctd
07/12/2019 20:24	43	-53.7979	-37.9338	Lowering CTD
07/12/2019 20:30	43	-53.7979	-37.9338	CTD stopped at 281m
07/12/2019 20:35	43	-53.7979	-37.9338	Hauling CTD
07/12/2019 20:58	43	-53.798	-37.9338	CTD on deck
07/12/2019 21:25	44	-53.798	-37.9338	deploy sediment trap
07/12/2019 21:30	44	-53.798	-37.9338	deploy sediment trap 2
07/12/2019 21:41	44	-53.798	-37.9338	deploy sediment trap 3
07/12/2019 21:46	44	-53.798	-37.9338	Deploy sediment trap 4
07/12/2019 21:59	44	-53.798	-37.9339	Released buoy all released
07/12/2019 22:10		-53.7981	-37.9365	vessel off dp
07/12/2019 22:54		-53.7154	-37.9656	vessel on dp

07/12/2019 23:04	45	-53.7149	-37.9656	CTD deployed
07/12/2019 23:08	45	-53.7148	-37.9656	CTD going to 120m
07/12/2019 23:11	45	-53.7148	-37.9656	CTD at 125m and hauling
07/12/2019 23:20	45	-53.7149	-37.9656	CTD recovered
07/12/2019 23:42		-53.7289	-37.9431	Vessel off DP
08/12/2019 00:20	46	-53.7558	-37.9057	RMT deployed
08/12/2019 00:24	46	-53.7537	-37.9088	RMT stopped at 37m
08/12/2019 00:36	46	-53.7465	-37.9179	RMT recovered
08/12/2019 01:40		-53.6105	-37.9987	Vessel on DP
08/12/2019 01:54	47	-53.6082	-38.0007	CTD deployed and going to 250m
08/12/2019 02:00	47	-53.6082	-38.0007	CTD stopped at 254m and hauling
08/12/2019 02:23	47	-53.6082	-38.0008	CTD recovered
08/12/2019 02:30		-53.6081	-38.0017	Vessel off DP heading for ctd 2.2s, for target fishing
08/12/2019 05:06		-53.7296	-38.3927	Stern bulwark open
08/12/2019 05:08	48	-53.7285	-38.3945	RMT deployed for target fishing
08/12/2019 05:10		-53.7275	-38.3964	Stern bulwark closed
08/12/2019 05:15	48	-53.7246	-38.4011	RMT stopped at 64m
08/12/2019 05:19	48	-53.7223	-38.4048	RMT hauling
08/12/2019 05:22		-53.7206	-38.4076	Stern bulwark open
08/12/2019 05:27	48	-53.7177	-38.4122	Stern bulwark closed, RMT recovered
08/12/2019 12:50		-53.3267	-37.7733	Vessel on DP
08/12/2019 13:00	49	-53.3248	-37.7731	Bongos deployed
08/12/2019 13:03	49	-53.3246	-37.7732	Bongos at 50m and hauling
08/12/2019 13:10	49	-53.3246	-37.7742	Bongos recovered
08/12/2019 13:15	50	-53.3246	-37.7743	Bongos deployed
08/12/2019 13:20	50	-53.3246	-37.7749	Bongos at 100m and hauling
08/12/2019 13:30	50	-53.3247	-37.7766	Bongos recovered
08/12/2019 14:00	51	-53.3247	-37.7767	CTD deployed
08/12/2019 14:23	51	-53.3247	-37.7767	CTD at 1000m and hauling

08/12/2019 14:52	51	-53.3246	-37.7767	CTD recovered
08/12/2019 15:00		-53.3246	-37.7766	Vessel out of DP for stratified fishing at 4.2N CTD
08/12/2019 15:36		-53.3413	-37.7747	Stern bulwark open
08/12/2019 15:39	52	-53.3392	-37.7744	Stern bulwark closed, RMT deployed for stratified fishing
08/12/2019 16:00		-53.3242	-37.7719	Stern bulwark open
08/12/2019 16:16	52	-53.3131	-37.7682	RMT at 462m, hauling
08/12/2019 17:02	52	-53.2828	-37.7472	RMT recovered to deck, stern bulwark closed
08/12/2019 17:04		-53.2815	-37.7461	All secure on deck, proceed to 4.2S CTD for stratified fishing
08/12/2019 19:24	53	-53.6435	-37.6435	stern door open
08/12/2019 19:30	53	-53.6901	-37.6563	RMT deployed
08/12/2019 19:32	53	-53.6882	-37.6558	stern door closed
08/12/2019 19:45	53	-53.6434	-37.6435	passing through 4.2s
08/12/2019 20:00	53	-53.652	-37.6463	200m wire out
08/12/2019 20:22	53	-53.6507	-37.6458	stern door down
08/12/2019 20:26	53	-53.6478	-37.6448	rmt on deck
08/12/2019 20:35		-53.6434	-37.6434	vessel on dp
08/12/2019 20:48		-53.6435	-37.6435	off dp
08/12/2019 22:35		-53.8111	-37.8939	vessel on dp
08/12/2019 22:40	44	-53.8117	-37.8932	stern door open
08/12/2019 22:46	44	-53.8124	-37.8918	Bouy on aft deck
08/12/2019 23:26	44	-53.8181	-37.888	Sediment trap recovered
08/12/2019 23:54		-53.8181	-37.888	Vessel off DP
09/12/2019 01:24		-53.6779	-37.6532	Vessel on DP
09/12/2019 01:32	54	-53.6778	-37.6534	CTD deployed
09/12/2019 01:40	54	-53.6778	-37.6534	CTD going to 110m, EA600 showing 117m
09/12/2019 01:41	54	-53.6778	-37.6534	CTD stopped at 109m and hauling
09/12/2019 01:54	54	-53.6778	-37.6534	CTD recovered
09/12/2019 05:40		-53.7867	-38.3099	Finish with target fishing, proceed to Stromness
09/12/2019 12:24		-54.1588	-36.6932	Vessel anchored in Stromness Harbour - Jetty brg265 x 0.60'

09/12/2019 13:00		-54.1587	-36.6931	Vessel on full retention for calibration.
09/12/2019 13:39	55	-54.1589	-36.6938	CTD deployed
09/12/2019 13:49	55	-54.1589	-36.6937	Veering CTD to approx. 75m, EA600 water depth 83m
09/12/2019 13:52	55	-54.1589	-36.6937	CTD stopped at 75m
09/12/2019 14:04	55	-54.1589	-36.6937	CTD recovered and gantry stowed.
09/12/2019 15:18	56	-54.1592	-36.6941	Sphere deployed
09/12/2019 22:16	57	-54.1592	-36.694	Transponder lowered over ships side using midships gantry
09/12/2019 22:54	57	-54.1593	-36.6941	Transponder sounder recovered
09/12/2019 23:51	58	-54.1593	-36.6939	Transponder deployed
10/12/2019 00:26	58	-54.1592	-36.6939	Transponder recovered
10/12/2019 14:48		-53.7856	-37.9176	Vessel on DP
10/12/2019 15:03		-53.7867	-37.922	Off DP
10/12/2019 15:08		-53.7886	-37.9239	Stern bulwark open
10/12/2019 15:10	59	-53.7901	-37.9265	RMT deployed for stratified fishing at WCB mooring site
10/12/2019 15:47	59	-53.8179	-37.9634	RMT stopped at 370m
10/12/2019 15:50	59	-53.8196	-37.966	RMT, hauling
10/12/2019 16:21		-53.8384	-37.9931	Stern bulwark open
10/12/2019 16:28	59	-53.8421	-37.9985	RMT recovered to deck, stern bulwark closed
10/12/2019 16:30		-53.8432	-38	All secure to proceed for mocness deployment
10/12/2019 17:19		-53.7682	-37.9082	Stern bulwark open
10/12/2019 17:24	60	-53.7712	-37.9107	Mocness deployed, stern bulwark closed
10/12/2019 17:41	60	-53.7808	-37.9199	Mocness at 296m, hauling
10/12/2019 18:12		-53.7975	-37.9357	Stern bulwark open
10/12/2019 18:17	60	-53.8	-37.9388	Mocness recovered to deck, stern bulwark closed
10/12/2019 18:18		-53.8005	-37.9393	Vessel on DP, manouvering to WCB mooring position
10/12/2019 18:27		-53.7979	-37.9359	Vessel on DP at WCB mooring site for Bongo net deployment
10/12/2019 18:42		-53.7978	-37.9358	Gantry unlashed
10/12/2019 18:50	61	-53.7978	-37.9358	Bongo net deployed, veering to 100m
10/12/2019 18:55	61	-53.7978	-37.9358	Bongo @ 100m

10/12/2019 19:05	61	-53.7978	-37.9358	Bongo nets back on deck
10/12/2019 19:25	62	-53.7978	-37.9358	CTD deployed
10/12/2019 19:30	62	-53.7978	-37.9358	CTD veering to 290 m
10/12/2019 19:36	62	-53.7978	-37.9358	CTD all stopped @ 280 m
10/12/2019 19:42	62	-53.7978	-37.9358	CTD back on deck
10/12/2019 19:47	62	-53.7978	-37.9358	CTD stowed
10/12/2019 20:59	63	-53.794	-37.9275	stern bulwark opened
10/12/2019 21:02	63	-53.794	-37.9275	begin deploying South Georgia 100m mooring buoy
10/12/2019 21:34	63	-53.7981	-37.934	Comp;lete deployment of SGMB 100m buoy
10/12/2019 21:37	63	-53.7987	-37.9348	stern door closed
10/12/2019 22:02		-53.7995	-37.9362	vessel off dp
10/12/2019 23:03	64	-53.7057	-37.9554	RMT deployed
10/12/2019 23:22	64	-53.7167	-37.9678	RMT at 177m cable and 100m depth
10/12/2019 23:44	64	-53.7288	-37.981	RMT recovered
11/12/2019 01:10	65	-53.7242	-38.1439	RMT deployed
11/12/2019 01:20	65	-53.7305	-38.1457	RMT at 60m cable out
11/12/2019 01:35	65	-53.7393	-38.1479	RMT recovered
11/12/2019 04:08		-53.7682	-38.4443	Stern bulwark open
11/12/2019 04:14	66	-53.7484	-38.4154	RMT deployed for target fishing, stern bulwark closed
11/12/2019 04:25	66	-53.7574	-38.4127	RMT at 70m, hauling
11/12/2019 04:30		-53.7617	-38.4117	Stern bulwark open
11/12/2019 04:40	66	-53.7699	-38.4103	RMT recovered, stern bulwark closed
11/12/2019 04:54		-53.7819	-38.4084	Finished with target fishing, all secure on deck, proceed to P3
11/12/2019 15:14		-52.7946	-40.0815	Stern bulwark open
11/12/2019 15:16	67	-52.7953	-40.0835	RMT deployed for stratified fishing at P3
11/12/2019 16:00	67	-52.8131	-40.1223	RMT at 420m, hauling
11/12/2019 16:40		-52.8305	-40.1585	Stern bulwark open
11/12/2019 16:46	67	-52.8332	-40.1642	RMT recovered, stern bulwark closed
11/12/2019 16:50		-52.834	-40.1696	Proceeding 2.5nm upwind from P3 for mocness deployment

11/12/2019 17:40		-52.7828	-40.0502	Stern bulwark open
11/12/2019 17:44	68	-52.7843	-40.053	Mocness deployed, stern bulwark closed
11/12/2019 18:51	68	-52.803	-40.1	Mocness stopped at 1850m, hauling
11/12/2019 20:38	68	-52.8367	-40.1799	stern door open
11/12/2019 20:42	68	-52.8376	-40.1824	mocness net on deck
11/12/2019 20:45	68	-52.8374	-40.1818	stern door shut
11/12/2019 21:23		-52.8082	-40.1138	vessel on dp for bongo nets
11/12/2019 21:36	69	-52.8087	-40.1138	gantry unlashed for bongos
11/12/2019 21:53	69	-52.8087	-40.1138	Bongo nets deployed
11/12/2019 22:04	69	-52.8087	-40.1138	bongo nets on deck
11/12/2019 22:18	69	-52.8087	-40.1138	Midships gantry lashed
11/12/2019 22:18		-52.8087	-40.1138	advised to stay in position till RMT 25 nets are ready to go
12/12/2019 01:10		-52.8104	-40.1139	Off DP
12/12/2019 01:18	70	-52.8174	-40.1148	RMT deployed
12/12/2019 01:24	70	-52.8213	-40.1155	RMT at 50 depth and 118m cable
12/12/2019 02:00	70	-52.8488	-40.1205	RMT recovered
12/12/2019 03:12		-52.8088	-40.1136	Vessel on DP at P3. accoustic survey cancelled
12/12/2019 09:59	71	-52.8087	-40.1139	Gantry unlashed for CTD
12/12/2019 10:13	71	-52.8087	-40.1139	Deploy CTD
12/12/2019 10:22	71	-52.8087	-40.1139	CTD Veering to 3780 m
12/12/2019 11:01	71	-52.8087	-40.1139	Vessel has been on full retention for CTD as requested by scientists
12/12/2019 11:34	71	-52.8087	-40.1139	CTD stopped at 3741m and hauling
12/12/2019 13:20	71	-52.8087	-40.1139	CTD recovered
12/12/2019 14:00		-52.8087	-40.1139	Off DP
12/12/2019 14:30		-52.8476	-40.085	On DP
12/12/2019 14:46	72	-52.8476	-40.0849	Deploy Argo float
12/12/2019 15:01	73	-52.8465	-40.0858	Begin P3 Mooring deployment- recovery float deployed
12/12/2019 15:03	73	-52.8462	-40.086	P3- Main buoy deployed
12/12/2019 15:34	73	-52.8422	-40.089	P3-Trimson Buoy cluster deployed

12/12/2019 15:44	73	-52.841	-40.0899	P3-Aquamonitor WMS-4D deployed
12/12/2019 15:45	73	-52.8408	-40.0901	P3- Seaguard Current Meter & O2 Sensor deployed
12/12/2019 15:48	73	-52.8402	-40.0905	P3-Seabird CTD deployed
12/12/2019 16:30	73	-52.8277	-40.0998	P3- Trimson buoy cluster deployed
12/12/2019 16:36	73	-52.8269	-40.1004	P3- Sediment trap deployed
12/12/2019 16:37	73	-52.8268	-40.1005	P3-Seaguard Current Meter and O2 sensor deployed
12/12/2019 17:47	73	-52.8084	-40.1143	P3- Accoustic release deployed
12/12/2019 18:00	73	-52.8052	-40.1169	P3- weight released, stern bulwark closed
12/12/2019 18:45		-52.8008	-40.1205	P3 Range 1 - 3851m
12/12/2019 19:03		-52.8096	-40.0972	P3 Range 2 - 3935m
12/12/2019 19:21		-52.8145	-40.1283	P3 Range 3 - 3910m
12/12/2019 19:39		-52.8145	-40.1284	P3 mooring fixed position Lat 52 48.47'S Long 040 06.92'W. Vessel off DP proceeding towards P2 site and target fishing on route
12/12/2019 20:13	74	-52.8528	-40.147	Stern door open. RMT8 deploying
12/12/2019 20:17	74	-52.8498	-40.1458	Nets deployed
12/12/2019 20:40	74	-52.8342	-40.1402	Stern door open
12/12/2019 20:47	74	-52.8299	-40.1391	nets on board
12/12/2019 20:55	74	-52.8369	-40.146	stern door closed
13/12/2019 02:10	75	-53.6106	-40.5276	RMT deployed
13/12/2019 02:47	75	-53.5958	-40.4923	RMT at 174m and hauling
13/12/2019 02:55		-53.5928	-40.485	Stern bulwark oprn
13/12/2019 03:02	75	-53.5901	-40.4784	RMT recovered to deck, stern bulwark closed
13/12/2019 03:12		-53.586	-40.468	All secure on deck, complete target fishing, proceed to P2
13/12/2019 13:50		-55.2581	-41.3597	On DP
13/12/2019 14:06	76	-55.2586	-41.3587	CTD deployed
13/12/2019 14:09	76	-55.2586	-41.3586	CTD going to 2000m
13/12/2019 14:40	76	-55.2585	-41.3586	CTD at 2007m and hauling
13/12/2019 15:20	76	-55.2585	-41.3586	CTD recovered to deck
13/12/2019 16:09	77	-55.2585	-41.3586	CTD deployed
13/12/2019 16:14	77	-55.2585	-41.3586	CTD veering to approx 3565m

13/12/2019 17:15	77	-55.2586	-41.3586	CTD stopped at 3550m
13/12/2019 18:42	77	-55.2585	-41.3586	CTD recovered to deck
13/12/2019 18:48		-55.2586	-41.3587	Gantry lashed
13/12/2019 19:25		-55.2585	-41.3585	vessel off dp
13/12/2019 19:30		-55.2594	-41.3572	All secure, hove to, waiting on weather
15/12/2019 14:38		-55.0471	-42.7557	Vessel on DP
15/12/2019 16:06	78	-55.0471	-42.7561	CTD deployed
15/12/2019 16:14	78	-55.0471	-42.7561	CTD veering to 400m
15/12/2019 16:22	78	-55.0471	-42.7561	CTD stopped at 400m
15/12/2019 17:46	78	-55.0471	-42.7561	CTD recovered to deck
15/12/2019 17:54		-55.0471	-42.7561	Gantry lashed
15/12/2019 18:33		-55.0471	-42.7561	Vessel out of DP
15/12/2019 18:38	79	-55.0468	-42.7571	Stern bulwark open
15/12/2019 18:42	79	-55.0458	-42.7606	Mocness deployed
15/12/2019 19:46	79	-55.0285	-42.7962	Mocness at 1760 and hauling
15/12/2019 21:11	79	-55.0098	-42.8393	stern door opened
15/12/2019 21:14	79			mocness recovered
15/12/2019 21:18	79	-55.0081	-42.8418	stern door closed
15/12/2019 22:19	80	-55.0593	-42.7375	Stern door open for RMT 25
15/12/2019 22:20	80	-55.0588	-42.7384	NETS IN WATER
15/12/2019 22:34	80	-55.0537	-42.747	stern door closed
15/12/2019 22:35	80	-55.0533	-42.7476	veering to 1000m depth
15/12/2019 23:27	80	-55.0308	-42.7702	RMT at 1575 cable out and hauling
16/12/2019 01:33	80	-54.9722	-42.8279	net recovered
16/12/2019 02:06	81	-55.0032	-42.7846	RMT deployed
16/12/2019 02:44	81	-54.9803	-42.7614	RMT stopped at 755m cable out and hauling
16/12/2019 04:05		-54.9297	-42.7038	Stern bulwark open
16/12/2019 04:20	81	-54.922	-42.6917	RMT recovered, stern bulwark closed
16/12/2019 04:24		-54.92	-42.6893	Vessel on DP, preparing deck

16/12/2019 05:30	82	-54.9196	-42.6893	CTD deployed
16/12/2019 05:33	82	-54.9196	-42.6893	CTD veering to 1000m
16/12/2019 05:51	82	-54.9196	-42.6893	CTD stopped at 1007m
16/12/2019 06:12	82	-54.9196	-42.6893	CTD recovered to deck
16/12/2019 06:33	83	-54.9196	-42.6893	Bongo deployed
16/12/2019 06:36	83	-54.9196	-42.6893	Bongo stopped at 100m
16/12/2019 06:44	83	-54.9196	-42.6892	Bongo recovered to deck
16/12/2019 07:00		-54.9196	-42.6892	Vessel off DP proceeding to PF4 123 NM
16/12/2019 17:58		-54.5445	-45.9176	Stern bulwark open
16/12/2019 18:05	84	-54.5403	-45.915	Mocness deployed, stern bulwark closed
16/12/2019 19:16	84	-54.5008	-45.9027	Mocness wire out 2001m
16/12/2019 21:00	84	-54.4359	-45.8835	stern open
16/12/2019 21:06	84	-54.4352	-45.8836	mocness on board
16/12/2019 21:09	84	-54.433	-45.8837	stern door closed
16/12/2019 21:20	85	-54.423	-45.8806	deploy neuston
16/12/2019 21:35	85	-54.4123	-45.8783	nueston back on board
16/12/2019 21:40		-54.409	-45.8781	Proceed to new PF4 LOCATION FOR rmt 25
16/12/2019 22:54	86	-54.5645	-45.9116	RMT 25 deployed
16/12/2019 23:13	86	-54.5634	-45.9197	RMT recovered
16/12/2019 23:24	87	-54.5628	-45.926	RMT deployed
17/12/2019 00:20	87	-54.5588	-45.9574	RMT cable at 1497m 1000m depth
17/12/2019 00:38	88	-54.5574	-45.9686	Neuston sledge deployed
17/12/2019 01:10	88	-54.5556	-45.9873	Neuston sledge recovered
17/12/2019 02:30	87	-54.5525	-46.0394	RMT recovered
17/12/2019 02:55		-54.5548	-45.9685	Stern bulwark open
17/12/2019 03:00	89	-54.5523	-45.9696	RMT deployed, stern bulwark closed
17/12/2019 03:40	89	-54.5305	-45.9788	RMT stopped at 728m
17/12/2019 04:57		-54.4916	-46.0049	Stern bulwark open
17/12/2019 05:08	89	-54.4882	-46.007	RMT recovered, stern bulwark closed

17/12/2019 05:12		-54.4871	-46.0076	Vessel on DP, preparing on deck
17/12/2019 06:04	90	-54.4863	-46.0073	CTD deployed
17/12/2019 06:08	90	-54.4863	-46.0073	CTD veering to 1000m
17/12/2019 06:27	90	-54.4867	-46.0063	CTD stopped at 1020m
17/12/2019 06:56	90	-54.4874	-46.0038	CTD recovered to deck
17/12/2019 07:24	91	-54.4874	-46.0038	German float deployed over stern
17/12/2019 07:28		-54.4874	-46.0038	Vessel off DP
17/12/2019 18:03		-53.8819	-49.2496	Stern bulwark open
17/12/2019 18:08	92	-53.8839	-49.2517	Mocness deployed, stern bulwark closed
17/12/2019 19:18	92	-53.9087	-49.2793	Mocness wire @ 1839m and hauling
17/12/2019 21:11	92	-53.9535	-49.3255	Stern door open
17/12/2019 21:14	92	-53.9535	-49.3255	mocness on board
17/12/2019 21:17	92			stern door closed
17/12/2019 22:49	93	-53.8934	-49.2627	Stern door opened for RMT 25
17/12/2019 22:51	93	-53.8942	-49.2634	RMT 25 nets in water
18/12/2019 00:03	93	-53.9275	-49.2925	RMT stopped at 1769 cable out and hauling
18/12/2019 01:18	94	-53.9612	-49.3282	neuston sledge deployed
18/12/2019 01:48	94	-53.9762	-49.3406	Neuston sledge recovered
18/12/2019 02:12	93	-53.9867	-49.3489	RMT recovered
18/12/2019 02:36	95	-53.9678	-49.3378	RMT deployed
18/12/2019 03:18	95	-53.9778	-49.3738	RMT stopped at 742m
18/12/2019 04:36		-53.9932	-49.4394	Stern bulwark open
18/12/2019 04:46	95	-53.9946	-49.4456	RMT recovered, stern bulwark closed
18/12/2019 04:48		-53.9949	-49.4467	Vessel on DP, preparing on deck
18/12/2019 05:18		-53.9944	-49.4482	Gantry unlashed
18/12/2019 05:30	96	-53.9944	-49.4482	CTD deployed
18/12/2019 05:34	96	-53.9944	-49.4482	CTD veering to 1000m
18/12/2019 05:54	96	-53.9944	-49.4482	CTD stopped at 1008m
18/12/2019 06:18	96	-53.9944	-49.4482	CTD recovered to deck

18/12/2019 06:36	97	-53.9944	-49.4482	Bongo deployed
18/12/2019 06:42	97	-53.9944	-49.4482	Bongo stopped at 100m
18/12/2019 07:03	97	-53.9944	-49.4482	Bongo on deck
18/12/2019 07:04	97	-53.9944	-49.4482	Gantry lashed
18/12/2019 07:08		-53.9945	-49.4487	vessel off dp
18/12/2019 18:04		-53.3106	-52.2066	Stern bulwark open
18/12/2019 18:08	98	-53.309	-52.204	Mocness deployed, stern bulwark closed
18/12/2019 19:25	98	-53.2801	-52.1377	Mocness wire @ 1915m and hauling
18/12/2019 21:02	98	-53.2457	-52.0456	Stern door open
18/12/2019 21:08	98	-53.2436	-52.0384	Mocness on deck
18/12/2019 21:09	98	-53.2436	-52.0384	Stern door shut
18/12/2019 21:37		-53.238	-52.0142	W.O.W as advised by U.I.C.
19/12/2019 01:24		-53.2951	-52.1861	Vessel on DP
19/12/2019 01:42	99	-53.2943	-52.1853	CTD deployed
19/12/2019 01:48	99	-53.2943	-52.1853	CTD going to 1680m, EA600 reading 1693m
19/12/2019 02:16	99	-53.2943	-52.1855	CTD stopped at 1671m and hauling
19/12/2019 03:00	99	-53.2943	-52.1855	CTD recovered to deck
19/12/2019 03:31	100	-53.2943	-52.1854	Bongo deployed
19/12/2019 03:36	100	-53.2943	-52.1854	Bongo at 100m, hauling
19/12/2019 03:44	100	-53.2943	-52.1854	Bongo recovered to deck
19/12/2019 03:57		-53.2943	-52.1855	Gantry lashed
19/12/2019 04:24		-53.2943	-52.1855	Vessel out of DP
19/12/2019 04:45		-53.2811	-52.1945	Stern bulwark open
19/12/2019 04:50	101	-53.2781	-52.1974	RMT deployed
19/12/2019 05:00	101	-53.2728	-52.2002	RMT recovered- net problem, stern bulwark closed
19/12/2019 06:48		-53.2033	-52.2221	All secure on deck, proceed to next station
19/12/2019 17:00		-52.6368	-54.9915	Vessel head to weather, preparing for net deployment
19/12/2019 17:44		-52.6484	-55.0328	Stern bulwark open
19/12/2019 17:48	102	-52.6491	-55.0358	Mocness deployed, stern bulwark closed

19/12/2019 19:06	102	-52.6664	-55.0954	Mocness net wire @ 2240 m
19/12/2019 20:59	102	-52.6946	-55.1813	Stern bulwark opened
19/12/2019 21:03	102	-52.6949	-55.1842	mocness on board
19/12/2019 21:09	102	-52.6961	-55.1865	stern door shut
19/12/2019 21:10		-52.6961	-55.1865	vessel on dp
19/12/2019 21:16	103			Unlash CTD Gantry
19/12/2019 21:24	103	-52.696	-55.1865	Deploy CTD
19/12/2019 21:35	103	-52.6961	-55.1865	Veering CTD to 1000m
19/12/2019 21:51	103	-52.696	-55.1866	Stopped @ 1008m and hauling
19/12/2019 22:16	103	-52.696	-55.1865	CTD recovered on deck
19/12/2019 22:20	103	-52.696	-55.1865	Gantry and CTD stowed
19/12/2019 22:34		-52.696	-55.1865	Vessel off DP
19/12/2019 22:34	103	-52.696	-55.1865	deck lashed
19/12/2019 23:54	104	-52.5972	-54.9117	RMT deployed
20/12/2019 01:25	104	-52.6291	-54.9959	RMT at 2308m cable out and hauling
20/12/2019 02:00	105	-52.641	-55.0235	Neuston deployed
20/12/2019 02:30	105	-52.6522	-55.0512	Neuston recovered
20/12/2019 03:14		-52.6679	-55.0882	Stern bulwark open
20/12/2019 03:24	104	-52.6708	-55.0938	RMT recovered, stern bulwark closed
20/12/2019 04:00		-52.6795	-55.1141	Stern bulwark open
20/12/2019 04:12	106	-52.6827	-55.1228	RMT deployed, stern bulwark closed
20/12/2019 04:40	106	-52.6911	-55.1438	RMT stopped at 685m
20/12/2019 04:48	106	-52.6935	-55.1502	RMT stopped at 701m, hauling
20/12/2019 06:06		-52.7049	-55.2121	Stern bulwark open
20/12/2019 06:15	106	-52.7056	-55.2179	RMT recovered, stern bulwark closed
20/12/2019 06:18		-52.706	-55.2205	Vessel on DP
20/12/2019 06:36		-52.7053	-55.2212	Gantry unlashed
20/12/2019 06:42	107	-52.7054	-55.2212	Bongo deployed
20/12/2019 06:47	107	-52.7054	-55.2212	Bongo stopped at 100m

20/12/2019 07:10	107	-52.7054	-55.2212	Bongo on deck
20/12/2019 07:15		-52.706	-55.2228	Vessel off DP. Completed JR19001 science stations and heading for Mare Harbour
20/12/2019 18:30		-51.9413	-58.4111	Uncontaminated seawater off. Vessel approaching Choiseul Sound.

19 Appendix AME electrical report (*Carson McAffee*)

AME Scientific Ship Systems Cruise Report

Ship Science Engineer	**Carson McAfee**	carmca@bas.ac.uk
BAS Instrument Contact	**Leigh Wirtz**	lert@bas.ac.uk
Head of Antarctic and Marine Eng	**Mike Rose**	mcr@bas.ac.uk

Compiled on: 24 Dec 2019

For Cruise: JR19001

Contents

1 Cruise Summary

Cruise	Departure	Arrival	AME Engineer(s)
JR19001	14/11/19 (Punta Arenas)	26/12/19 (Punta Arenas)	Carson McAfee (carmca@bas.ac.uk)

This cruise can be broken up in to two parts. The first part of the cruise was used to visit Signy, KEP and Bird Island for the purposes of dropping off people and cargo. The second part was dedicated to Science on the "Western Core Box" research area.

Part one:

We started by going to Signy, and assisting with reopening the base. This took a number of days due to the quantity of cargo. AME and the science members assisted with the loading and unloading of cargo on the ship and the base. At the request of the Station Leader AME also visited the VHF repeater station. The repeater station was not operational, and the problem was traced to a faulty cable. This was temporarily fixed, and a spare cable was sent to the island for later use.

Next we went to Bird Island. This also took a number of days due to cargo and refuelling operations. Everyone helped. AME were also requested to visit the Penguin Weigh Bridge to document the wiring layout and connectors. This will assist in future spares being made.

Finally we spent a few days at KEP to offload cargo, and people. This did not require much assistance from the science party.

Part two:

This is where science officially started. The "Western Core Box" cruise is a regular cruise on the JCR. It collects data from the North-Western region of South Georgia. This primarily involved net fishing, echo sounder recordings, and periodic CTD's. The net operations are discussed in the AME Mechanical report. From an electrical viewpoint there were no major issues. Some minor issues with the CTD at the start of the cruise, but easily fixed. No other issues reported with the other science kit used.

One concern is that the CTD winch had a number of issues. Firstly there was an issue with the cable spooling mechanism, which resulted in a continuous overlapping cable (messy) on the drum, and will only lead to cable damage. Some science time was also lost due to trying to rectify this. The second issue is more problematic. Intermittently the CTD cable drum would jerk for periods of operation, rather than turn smoothly. This caused massive swings in cable back tension. The Deck Engineer/Winch Operator were forced to slow the drum speed down to dampen the severity. This caused a loss in science time, but more importantly an impact on the CTD data quality, as casts require constant speeds on the downcast. The deck engineer reports that winch repairs and cable spooling were requested at the last dry dock visit, but were ignored. This resulted in these issues, and will continue to be a problem on the next science cruise.

2 Instrumentation

2.1 Systems used on cruise

Instrument	#SN if Used	Make and Model	Comments
Lab Instruments			
AutoSal	NA		
Scintillation counter	SGTC20150612	PERKINELMER TRI-CARB 2910TR	Not used on cruise
XBT	NO		
Acoustic			
ADCP	Yes		
EM122	Yes		
TOPAS	No		
EK60/80	Yes		
K-Sync	Yes		
SSU	No		
USBL	No		
10kHz IOS Pinger	No		
Benthos 12kHz Pinger	No		
Benthos 14kHz Pinger	No		
Mors 10kHz Transponder	No		
EA600	Yes		Bridge Equipment but logged
Oceanlogger			
Barometer1	V145002	VAISALA PTB210B1A2B	Inside the UIC
Barometer2	V145003	VAISALA PTB210B1A2B	Inside the UIC
Air humidity & temp1	61019333	Rotronic Hygroclip 2	On Foremast
Air humidity & temp2	61019251	Rotronic Hygroclip 2	On Foremast
TIR1 sensor (pyranometer)	172882	Kipp & Zonen Sp Lite2	On Foremast
TIR2 sensor (pyranometer)	172883	Kipp & Zonen Sp Lite2	On Foremast
PAR1 sensor	160959	Kipp & Zonen PQS-1	On Foremast
PAR2 sensor	160960	Kipp & Zonen PQS-1	On Foremast
Thermosalinograph	4524698-0018	SBE45	PrepLab
Transmissometer	1399DR	CST	PrepLab
Fluorometer	1498	WSCHL-1498	PrepLab
Flow meter	05/811950	LitreMeter F112-P-HC-AP-OR-PP	PrepLab
Seawater temp 1	0601	SBE38	Sea Inlet
Seawater temp 2	0599	SBE38	Sea Inlet

(Continued on next page)

Instrument	#SN if Used	Make and Model	Comments
CTD			
Deck unit 1	0458	SBE11plus	
Underwater Comms/ Depth	0480	SBE9plus	
Temp1	5766	SBE3plus	
Temp2	2366	SBE3plus	
Cond1	2255	SBE 4C	
Cond2	2289	SBE 4C	
Pump1	1813	SBE5T	
Pump2	4709	SBE5T	
Standards Thermometer	0047	SBE35	
Transmissometer	CST-1505DR	C-Star	
Oxygen sensor	2291	SBE43	Plumbed on T2&C2 line.
PAR sensor	70688	QCP2350	
Fluorometer	088216	CTG Aqua Tracker MkIII	
Altimeter	10127.27001	Tritech S10127 232	
CTD swivel linkage	196115	Focal Technologies Group	
LADCP Master Down	14443	TeleDyne WHM300	
LADCP Slave Up	14897	TeleDyne WHM300	
Pylon	0636	SBE32	
Other ship's systems (non-AME)			
Anemometer	Yes		Bridge Equipment, logged
Ships Gyro	Yes		Bridge Equipment, logged
System(s) brought by science team (non-AME)			
EXTRA NOTEWORTHY Sensors	No		

2.2 Notes for Lab Instruments used

2.2.1 AutoSal

The autosals were packed away for this cruise. One unit was stored at the back of the radioactive lab. It's a bit awkward to get out of the back corner so get two people. The second autosal is stored in the science hold, on the left as you walk towards the pump room. The usual storage space (on the right as you enter the hold) has been diminished since installing the new freezer.

2.3 Notes for Acoustic Systems used

The Acoustic systems on the ship were started and maintained during the cruise by Sophie Fielding (PSO). They were all configured to operate through the K-Sync unit. No major problems were reported, except for minor issues with the EA600.

The EA600 seemed to struggle to maintain a bottom track profile. This is unusual for this system, as it normally operates faultlessly. I suspect that the problems may have been caused by incorrect system settings being applied, and incorrect K-Sync operation. However this cannot be confirmed.

2.4 Notes about the CTD

Basic Stats			
Number Of Casts	32	Number of Successful Casts	31
Max Depth	3738	Min Depth	75
Cable Removed (m)	0	Number of Re-terminations (elect.)	1

2.4.1 CTD Deployment Procedure

Prior to deployment all bottles are cocked and the deionised water is vented from the T/C sensors. The lenses for Transmissometer, Fluorometer and PAR and wiped clean with milliQ and Kimtech, and then dried with Kimtech. Pre-deployment technical tests are carried out on the LADCP's and are logged. The LADCP is then activated and starts logging.

Once the Deck crew and winch operator are ready the CTD is lifted into the water and lowered to 10m, where power is started and logging begins. It is held here until the operator sees the difference between T1/T2 and C1/C2 stabilize. This can take some time, especially if the air temperature and sea temperature are far apart. In some circumstances such as turbulent surface waters or areas with large thermoclines, it can be necessary to lower the CTD to 20m or further to a depth where the temperature is more stable. Once stable, the CTD is lifted to as near to the surface as the winch operator deems safe then is lowered to the required depth or near bottom without stopping (attempting to maintain a constant velocity of 60m/min). The bottom depth is an approximation from the best echo sounder available, commonly the EM122. If bottom depth is required then the altimeter will start working from within 100m of the sea bed and is used to stop approximately 10m from the sea bed. From here some adjustment can be made to get closer, but is done at the operator's discretion. Once the down cast is complete bottles are fired at requested depths, in order of deepest first. After each bottle is fired at least 15 seconds are given to ensure that the independent standards thermometer has time to take a reading (The minimum is 8 seconds as defined in the manual).

Once on the surface the CTD is returned to the vessel, the C/T sensors are filled with deionised water to avoid damage. All data is backed up as soon as possible.

2.4.2 CTD Cast Summary Stats

Cast No	Ship Event No	Date	Start Time UTC	Lat	Lon	Max Depth	Distance to sea floor	Site Name
001	003	24/11/2019	11:57	60°20.582 S	46°39.121 W	1028	8	
002	005	24/11/2019	14:51	60°20.422 S	46°39.578 W	10.44	NA	
003	006	24/11/2019	15:00	60°20.421 S	46°39.575 W	1021.3	8.5	
004	008	24/11/2019	19.14	60°20.980 S	46°39.366 W	771.06	8.2	
005	011	24/11/2019	21:37	60°21.834 S	46°39.207 W	501.8	9.6	
006	012	24/11/2019	22:42	60°22.549 S	46°41.354 W	261.5	5.1	
007	013	02/12/2019	15:42	53°34.924 S	38°00.701 W	20	NA	
008	014	02/12/2019	16:09	53°34.926 S	38°00.701 W	1089	10.7	
009	016	02/12/2019	21:33	53°35.856 S	38°00.266 W	524.7	8.767	
010	022	03/12/2019	20:07	52°48.240 S	40°09.429 W	3734.6	9.1	
011	028	04/12/2019	20:32	53°29.562 S	39°15.015 W	999.35	NA	
012	031	05/12/2019	06:50	53°50.800 S	39°08.582 W	275.75	8.6	
013	032	05/12/2019	20:04	53°47.182 S	38°34.980 W	193.97	9.1	
014	037	06/12/2019	07:36	53°25.896 S	38°41.712 W	998.6	NA	
015	038	06/12/2019	21:22	53°21.696 S	38°04.908 W	997.78	NA	
016	040	07/12/2019	02:43	53°35.518 S	38°00.678 W	807.47	8.2	
017	043	07/12/2019	20:16	53°47.877 S	37°56.028 W	280.6	10.25	
018	045	07/12/2019	23:04	53°42.890 S	37°57.936 W	124.37	9.03	
019	047	08/12/2019	01:51	53°36.492 S	38°00.040 W	254.1	7.6	
020	051	08/12/2019	14:00	53°19.479 S	37°46.598 W	998.77	NA	
021	054	09/12/2019	01:32	53°40.665 S	37°39.202 W	109.4	9.2	
022	055	09/12/2019	13:39	54°09.533 S	36°41.624 W	75.54	9.59	
023	062	10/12/2019	19:24	53°47.867 S	37°56.147 W	280.48	10.2	
024	071	12/12/2019	10:17	52°48.522 S	40°06.834 W	3737.2	10.35	
025	076	13/12/2019	14:04	55°15.510 S	41°21.514 W	2003.6	NA	
026	077	13/12/2019	16:08	55°15.513 S	41°21.515 W	3540.7	9.6	
027	078	15/12/2019	16:08	55°02.826 S	42°45.363 W	398.2	NA	
028	082	16/12/2019	05:29	54°55.175 S	42°41.358 W	1000.8	NA	
029	090	17/12/2019	06:04	54°29.177 S	46°00.436 W	1002.5	NA	
030	096	18/12/2019	05:31	53°59.665 S	49°26.891 W	1001.5	NA	
031	099	19/12/2019	01:41	53°17.658 S	52°11.119 W	1665	9.4	
032	103	19/12/2019	21:24	52°41.762 S	55°11.191 W	1000.2	NA	

2.4.3 Information about CTD physical configuration

Name	Purpose	Distance from Base of Frame to Sensor (m)
Altimeter	Distance to sea bed (max 100m)	0.05
LADCP Master	Downward Facing LADCP	0.09
Temp1/Temp2	Temperature at 24Hz	0.3
Fluorimeter	Measures Florescence	0.185
9+	Communications and Pressure measurement	0.39
C1/C2	Conductivity Cells	0.345
Dissolved Oxygen	Oxygen in the Water	0.405
Bottles Bottom End Cap	Water collection (24)	0.56
Bottles Top End Cap	Water collection (24)	1.66
Transmissometer	Measure of light transmitted through water	0.275
SBE35 Top	Accurate Temperature sensor	1.38 (1.355)
SBE35 Bottom	Accurate Temperature sensor	0.72
Par	Radiation Sensor	1.605

2.4.4 Operational Log Summary

This is a shortened list of the CTD operational logs. The rest can be found on the JCR AME WIKI. The logs are listed from newest to oldest.

- **2019-12-20 14:57** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~30 MΩ, 500V=~16 MΩ, 1000V=~21 MΩ.
- **2019-12-19 21:24** Cast 032, Event 103: Had to run the predeployment script for the LADCP slave 3 times as BM3 kept failing.
- **2019-12-19 01:41** Cast 031, Event 099: Had to run the predeployment script for the LADCP slave 3 times as BM3 kept failing.
- **2019-12-15 17:44** Cast 027, Event 078: Wombat test cast. No LADCP.
- **2019-12-13 15:17** Cast 025, Event 076: Test cast for borehole camera. No 10m stop. No LADCP. No Bottles.
- **2019-12-12 13:13** Cast 024, Event 071: Stopped on downcast at ~3250m. Min Back tension alarm going off continuously. Did rest of the cast at 30 m/min. There were many stops during the upcast to sort out drum spooling. Also during upcast we had to lower the CTD down from 3033m to 3036m to sort a spooling issue. Might have compromised water samples in niskins, but I doubt it.
- **2019-12-11 14:54** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~100 MΩ, 500V=~62 MΩ, 1000V=~38 MΩ. Much better than yesterday. Cable should be fine for the rest of the cruise.
- **2019-12-10 20:30** Did an electrical retermination on CTD cable. No need for mechanical testing.

- **2019-12-10 20:00** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~230 kΩ, 500V=~230 kΩ, 1000V=~230 kΩ. Not brilliant,Getting a bit low. Thia was after a cast. Strange that t went up!
- **2019-12-10 19:42** Cast 023, Event 062: Mooring profile.
- **2019-12-10 19:00** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~87 kΩ, 500V=~87 kΩ, 1000V=~187 kΩ. Not brilliant,Getting Very low. This was before a cast.
- **2019-12-09 16:00** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~137 kΩ, 500V=~137 kΩ, 1000V=~137 kΩ. Not brilliant,Getting a bit low.
- **2019-12-08 02:11** Cast 019, Event 047: Small offset in ΔC is still there. Seems stable though. Appears to dissapear during stable conductivity regions. I suspect that it might have something to do with gradient change in conductivity. However ΔC value does not seem to shift on upcast, so probably not. But it does appear to be stable so it is not a problem.
- **2019-12-07 20:55** Cast 017, Event 043: Noted a small offset in ΔC. Lineout was accidentally reset after leaving bottom. Also note that EA600 was not on when starting the cast. Depth of 246 is wrong. Actual depth is ~292 m.
- **2019-12-07 03:24** Cast 016, Event 040: Noted a small offset in ΔC.
- **2019-12-06 22:13** Cast 015, Event 038: Noted a small offset in ΔC.
- **2019-12-03 23:10** Cast 010, Event 022: At approximately 3500m during the downcast the winch had a problem and slowed veer speed to 45m/min.

- **2019-12-02 15:51** ALL REMAINING CASTS IN THIS CRUISE USED 20L niskins. No 12L fitted.
- **2019-12-02 15:51** Cast 007, Event 013: Test cast for 20L niskins. I replaced all remaining 20L niskin lanyards with the updated configuration. Bottles 1-24=20L. All bottles fired correctly.
- **2019-11-24 23:06** Cast 006, Event 012: Attempting normal CTD cast with Bottles 1-20=12L, 21-24=20L. Not all bottles fired as unrequired.
- **2019-11-24 22:05** Cast 005, Event 011: Attempting normal CTD cast with Bottles 1-20=12L, 21-24=20L. Not all bottles fired as unrequired.
- **2019-11-24 19:55** No time to modify remaining 20L niskin lanyards before next cast.
- **2019-11-24 19:55** Cast 004, Event 008: Attempting normal CTD cast with Bottles 1-20=12L, 21-24=20L. I modified the top lanyard element for testing. All niskins, including 20L's are now firing and sealing correctly. I have updated the new lanyard configuration in: "http://wiki.jcr.nerc-bas.ac.uk/AME:_How_to_make_lanyards".
- **2019-11-24 16:08** Cast 003, Event 006: Attempting normal CTD cast with Bottles 1-20=12L, 21-24=20L. I know the 20L niskins will fail, but no time to rectify before cast. Also note that I accidentally started the slave LADCP with the wrong Baud rate, and the data will most likely be no good.
- **2019-11-24 14:51** Cast 002, Event 005: Quick test dip to test newly fitted niskins. (Bottles 1-20=12L, 21-24=20L). All 12L niskins seem fine with no leaks. The 20L niskins failed to close again. Long lanyard element still too short. No time to modify for next cast, will have to modify on cast 004.
- **2019-11-24 14:00** Replaced bottles 1-20 with 12L niskins. Left bottles 21-24 with the 20L niskins for testing lanyard modifications.
- **2019-11-24 13:00** Cast 001, Event 003: All 20L bottles failed to seal. Long element of the lanyards appears to be too short, preventing top and botton end caps from closing. The lanyard elements had knots in them, however even after removing them the lanyards still appear to be too short. As unbelievable as it sounds, I think the lanyards must have shrunk.
- **2019-11-16 16:00** Mega Tested the CTD Cable (Deck unit and Instrument disconnected). 250V=~55 MΩ, 500V=~32 MΩ, 1000V=~20 MΩ. Not brilliant, but acceptable values for use.
- **2019-11-15** Rebuilt CTD, Basic Communications established.
- **2019-11-14** Start of Cruise JR19001

2.4.5 CTD Points of Discussion

2.4.5.1 20L Niskin Leaks

The new SDA 20L CTD niskins were used on this cruise because they were available, and some of the science required large volumes of water. On JR18006 the 20L niskins were setup and configured correctly. However after the first cast on this cruise I found a problem with the lanyards fitted to the niskins. This is shown in Figure 1. The long length element of the lanyards was too short. This prevented the top and bottom caps from closing. This lanyard element should be long enough for both top and bottom caps to seal and still link the caps.

To be honest I cannot explain how this could happen. I found that each element had a knot tied in it to make it shorter, however even after removing the knot they were still not long enough. My only explanation is that the lanyards must have shrunk. This goes against all past experience, where I find that the lanyards normally stretch over time. This may be due to the different material of the lanyards (strimmer cord).

To fix this I modified the lanyard element that pulls the top niskin cap towards the SBE32, by making a bigger loop on the end that connects the top cap with the long element. I have updated the lanyard instructions here: http://wiki.jcr.nerc-bas.ac.uk/AME:_How_to_make_lanyards

Figure 1: CTD 20L niskin lanyard problem.

While implementing the lanyard modification I fitted 12L niskins to bottles positions 1-20, and kept bottles 21-24 as 20L niskins for testing. I have documented this in the operational log summary.

2.4.5.2 Sea End Cable Termination

At the start of the cruise I did a full mechanical and electrical termination on the sea end cable. This was removed during last port visit due to a new CTD cable being installed on the spare CTD drum. The table below shows the resistance values measured on the cable end during the cruise. The initial value after the first termination was acceptable, however half way through the cruise the line resistance had dropped significantly. On the 10th December the line resistance had dropped to approximately 187 kΩ at 250V, which is closest to the operational voltage of the CTD. There was no issue during the cast, with no data lost on the file, or errors reported by the deck box. But this is the lowest value I have seen work during a cast, so I decided I would reterminate the electrical pigtail before a full failure occurs during a cast. It is interesting to note that after the cast the line resistance actually increased.

Date	250V	500V	1000V	Note
2019-11-16 16:00	~55 MΩ	~32 MΩ	~20 MΩ	
2019-12-09 16:00	~137 kΩ	~137 kΩ	~137 kΩ.	
2019-12-10 19:00	~87 kΩ	~87 kΩ	~187 kΩ	Before a cast
2019-12-10 20:00	~230 kΩ	~230 kΩ	~230 kΩ	After a cast. Strange that it went up!
2019-12-11 14:54	~100 MΩ	~62 MΩ,	~38 MΩ	
2019-12-20 14:00	~30 MΩ	~16 MΩ	~21 MΩ	

2.4.5.3 New Drum Slipring

I have terminated the ship end of the new CTD cable to the slipring. This should now be ready to use if the spare CTD cable is needed.

2.4.5.4 CTD cable drum

The CTD winch had a number of issues. Firstly there was an issue with the cable spooling mechanism, which resulted in a continuous overlapping cable (messy) on the drum, and will only lead to cable damage. Some science time was also lost due to trying to rectify this. The second issue is more problematic. Intermittently the CTD cable drum would jerk for periods of operation, rather than turn smoothly. This caused massive swings in cable back tension. The Deck Engineer/Winch Operator were forced to slow the drum speed down to dampen the severity. This caused a loss in science time, but more importantly an impact on the CTD data quality, as casts require constant speeds on the downcast. The deck engineer reports that winch repairs and cable spooling were requested at the last dry dock visit, but were ignored. This resulted in these issues, and will continue to be a problem on the next science cruise.

2.4.5.5 Optic Sensor Calibration

It is good practice to test the optic sensors at the beginning and end of the cruise to evaluate drift. More specifically for the Transmissometer and PAR sensors who require testing to define their calibration constants.

This is done by turning on the CTD and allowing everything to stabilise for 10 minutes. During this time it is important to clean the Transmissometer and PAR lenses. Wet kimtech with milliQ and wipe lenses clean, then dry with kimtech. After 10 minutes, completely cover the PAR sensor (so that no light can reach its lense), and then completely block the transmissiometer beam. Leave like this for 5 minutes. Then remove the covers and leave for a further 5 minutes.

After this you can shut off the CTD, and review the archived data in “seasave”. Pull up a plot of voltage 0 (transmissometer voltage measurements) and voltage 6 (PAR voltage measurements). For the transmissometer zoom in to the plot to find the stable peak and trough voltages. The stable peak voltage is measured when there is no beam attenuation, and is defined as “A1”. The stable trough voltage is measured when there is full beam attenuation (blocked), and is defined as “Y1”. Similarly for PAR, plot the measured voltage and look for the trough stable voltage. This is defined as the “Voltage in Dark Value”.

These measured values and the values provided in their calibration documents, are used to calculate the calibration constants needed in “Seasave” XMLCON. These are shown in the following tables.

PAR Parameter	Start of Cruise	End of Cruise
Date	16/11/2019	20/12/2019
Voltage in Dark	0.00976801	0.00976801
Calibration Constant	1.926782E+10	1.926782E+10
Offset	-5.30805E-2	-5.30805E-2

Transmissometer Parameter	Start of Cruise	End of Cruise
Date	16/11/2019	20/12/2019
Tw%	100%	100%
A1	4.81685V	4.492064V
Y1	0.003663V	0.003663V
M	21.28062	22.82051
B	-0.07795091	-0.08359153

During this cruise the Transmissometer open beam voltage drifted significantly. It may be necessary to change the transmissometer for the next cruise, as the scientists are wanting to use it for turbidity measurements.

2.5 Documentation Folder

David Goodger created a common shared documentation folder on the JCR shared network driver located here: “P:\AME”. Unfortunately I have found that the majority of the project folder files are corrupted/damaged.

I have created my own documentation folder located here: “P:\AME\Carson_Experimental_Folder”. I have merged the old AME ship computer drives in to this folder, and managed to populate the project folders with a lot more documentation. The project folders themselves have not been sorted and organised fully, but they do contain a lot more to work with now. Please try the folder structure out, and pass feedback to Carson. We need to start planning a folder structure for the new ship.

2.6 UWIA

Unfortunately this system did not run well on the cruise. After joining I found that the peristaltic pump was not operational. Additionally the sea water feed pipes had been disassembled and stored in the Deck Engineers cupboard next to the prep lab fridge. The peristaltic pump was repaired twice. The first fix lasted quite well, but the second fix only lasted a few hours. As seen below in the operational logs, the motor had a significant effect on the operational dates of the system. I have arranged for a new pump to be brought to the ship, along with new Drierite. I will train Rob (Deck Engineer) in how to run the system. He will in turn train Seth for the next cruise.

2.6.1 UWIA – Operational periods

The following table summarises all the periods where the system was operating in a normal state: Membrane attached, with sea water on inlet water sample, with dry pipes. Over 18 days the system operated for 13. Outside these dates the system was either being repaired, dried out, or being setup.

Start	Stop	Days
2019-11-19 16:22	2019-11-27 13:03	8
2019-11-27 13:11	2019-11-28 14:00	1
2019-11-30 10:48	2019-12-03 18:33	3
2019-12-07 17:10	2019-12-08 14:58	1

2.6.2 UWIA Operational Logs

The logs are extracted from the AME wiki log: http://wiki.jcr.nerc-bas.ac.uk/AME_Only:UWIA_LOG. They are listed from newest to oldest.

- **2019-12-15 13:27** Shutting system down. No point in running it.
- **2019-12-10 19:00** Pump left in place. No water being pumped through membrane. Running drierite through membrane. Any H2O values measured is the residual water in the pipes/membrane.
- **2019-12-10 19:00** Pump has failed for the last time.
- **2019-12-10 17:47** Restarted the pump manually.
- **2019-12-10 17:45** Pump not running again.
- **2019-12-10 12:54** Started the pump running again.
- **2019-12-08 14:58** Pump not running. Broken again. Removed for repair. No water being pumped through membrane. Dunning drierite through membrane.
- **2019-12-07 17:10** Membrane reattached to drierite source. System running in normal state.
- **2019-12-07 17:10** New pump tube fitted. New water filter fitted.
- **2019-12-07 17:10** Peristatic pump repaired and installed.
- **2019-12-03 18:34** The pump is not turning. It was running last night, but has stopped between now and then. Bugger!! Removed for repair.
- **2019-12-03 18:33** Switching to drierite source with membrane bypassed so that I can dry the pipes out.
- **2019-12-03 18:32** The membrane has moisture on the inside wall of its air outlet pipe.
- **2019-12-03 18:31** Gas flow rate is ~70. This has been the stable operating point for the cruise. Normally in the range of 67->69. Higher is better.

- **2019-12-03 18:31** H2O is ~22400 ppm. This has been the stable operating point for the cruise.
- **2019-11-30 10:48** Sea Water started. System running in normal state.
- **2019-11-30 10:47** Over the course of the past two days the system was running on MilliQ due to KEP visit. During this time the MilliQ ran out.
- **2019-11-28 14:03** Switching to MilliQ source.
- **2019-11-28 14:00** Sea Water stopped. Arrived at KEP.
- **2019-11-27 13:11** Sea Water started again. System running in normal state.
- **2019-11-27 13:09** Changed the inline sea water filter. Changed the peristaltic pump tube.
- **2019-11-27 13:09** The sea water feed was coming direct to the Peristaltic pump. There was no water pressure relief in the system, and peristaltic pump was having to regulate the water flow directly. The system appears to have been working fine, but decided I should add it back.
- **2019-11-27 13:03** Sea water shut off for plumbing modification.
- **2019-11-21 10:50** Filled the "Standards Drift" bottle with MilliQ. Just noticed that it was bone dry and has been for a while.
- **2019-11-19 16:22** Switched to Sea Water as water sample. RUNNING IN NORMAL STATE.
- **2019-11-19 16:19** Reattached drierite air source to membrane. System running with drierite air, and milliQ in the water sample.
- **2019-11-19 16:17** Fitted a new membrane. Labelled as: "Used but serviceable 07/09/16".
- **2019-11-19 16:17** Pump appears to be working.
- **2019-11-18 18:46** Switched to testing the new drierite air source. Bypassed the membrane. Should have a very low H2O value.
- **2019-11-18 18:44** New water filter fitted with new peristaltic pump tube. Still using the old membrane. System still sampling Ambeint air source while Milliq flushes system.
- **2019-11-18 18:44** Peristaltic pump repaired. Running milliq through the pipes. Trying to clean it out of old/stagnant water. Also removing air bubbles.
- **2019-11-18 12:54** System still running on the ambient air source. Testing room ambient levels.
- **2019-11-18 12:54** Changed the Drierite to fresher batch. Also changed the filters in canister. THIS IS THE LAST OF THE DRIERITE ONBOARD.
- **2019-11-18 12:43** Switching to an Ambient Air test. Direct intake at air input with a filter.
- **2019-11-18 12:11** System has been running all night and has a stable H2O value of ~8300 ppm. This is too high.
- **2019-11-17 18:52** Resetting the system clock to correct UTC time.
- **2019-11-17 16:15** Started the instrument. System currently running on a Drierite source. Membrane bypassed. Drierite will probably need changing, but will test first. H2O value should drop to around 400->1000. **Peristaltic pump is currently broken. Attempting to repair it.**
- **2019-11-17 15:50** Started setting up the system for cruise JR19001. Cruise started on the 14th November.

2.6.3 UWIA – Water Sampling Logs

During the cruise I look periodic water samples of the underway sea water feed. The same feed that fed the UWIA. I continued to take these water samples even when the system was not operational. I tried to take samples at locations near the islands we visited as well as locations on the western core box.

The sampling procedure was the same for all samples taken. I would put gloves on and take a new sample bottle down to the prep lab. I would then rinse, full and empty the bottle around 5 times with the UWIA sea water feed. I would then full the bottle as far as possible to the rim, with as little air bobbles as possible, and then I would tighten the cap on the bottle. The date, time and sample number were recorded on each sample bottle, and then recorded digitally on the science log (which logs location of the ship at time of sample).

Time	LAT	LON	Sea Water Temp	Salinity	Sample Number
11/12/2019 13:04	-52.97841	-39.79609	3.5238	33.881	SAMPLE: >046<
11/12/2019 00:06	-53.73567	-38.03992	2.9922	33.8609	SAMPLE: >045<
10/12/2019 17:45	-53.78312	-37.92235	3.2662	33.8339	SAMPLE: >044<
10/12/2019 12:52	-53.91413	-37.3907	4.1705	33.4901	SAMPLE: >043<
09/12/2019 22:44	-54.15926	-36.69392	6.4441	32.5131	SAMPLE: >042<
09/12/2019 14:35	-54.15928	-36.69398	4.0713	33.0283	SAMPLE: >041<
08/12/2019 23:51	-53.81803	-37.88798	3.1115	33.8057	SAMPLE: >040<
08/12/2019 13:30	-53.32465	-37.77661	2.5872	33.8313	SAMPLE: >039<
08/12/2019 03:01	-53.636	-38.10474	2.7668	33.8633	SAMPLE: >038<
07/12/2019 21:19	-53.79795	-37.93381	3.0335	33.8394	SAMPLE: >037<
07/12/2019 02:25	-53.59427	-38.0108	2.7624	33.865	SAMPLE: >036<
06/12/2019 15:45	-53.86748	-37.9145	3.7943	33.6444	SAMPLE: >035<
06/12/2019 05:47	-53.43461	-38.74008	2.6992	33.8726	SAMPLE: >034<
06/12/2019 00:12	-53.80731	-39.12177	2.7049	33.885	SAMPLE: >033<
05/12/2019 15:43	-53.47829	-38.68041	3.0181	33.8811	SAMPLE: >032<
05/12/2019 07:45	-53.87741	-39.08866	2.3218	33.8904	SAMPLE: >031<
05/12/2019 02:19	-53.66249	-38.9856	2.5562	33.8792	SAMPLE: >030<
04/12/2019 13:32	-54.05397	-39.39232	2.4219	33.8882	SAMPLE: >029<
04/12/2019 03:04	-52.79895	-40.28098	2.9314	33.9304	SAMPLE: >028<
03/12/2019 18:31	-52.80724	-40.16449	2.6608	33.9236	SAMPLE: >027<
03/12/2019 13:20	-52.89458	-39.98553	2.9176	33.9286	SAMPLE: >026<
03/12/2019 02:38	-53.79185	-38.34506	2.4235	33.8876	SAMPLE: >025<
02/12/2019 20:26	-53.74945	-38.0227	2.7837	33.8738	SAMPLE: >024<
02/12/2019 14:07	-53.71403	-37.96557	2.7502	33.865	SAMPLE: >023<
02/12/2019 03:05	-53.73008	-38.08488	2.2337	33.8698	SAMPLE: >022<
01/12/2019 21:59	-54.01574	-38.05214	1.9893	33.8583	SAMPLE: >021<
01/12/2019 16:49	-54.01662	-38.05154	1.9124	33.8588	SAMPLE: >020<
01/12/2019 11:01	-54.01676	-38.05231	1.8544	33.8564	SAMPLE: >019<
01/12/2019 01:35	-54.10371	-38.26731	1.7428	33.8944	SAMPLE: >018<
30/11/2019 22:50	-54.01691	-38.05369	1.8686	33.8511	SAMPLE: >017<
30/11/2019 11:45	-54.01679	-38.05426	1.7764	33.8609	SAMPLE: >016<
28/11/2019 10:49	-54.15258	-36.43832	3.3275	33.7403	SAMPLE: >015<
28/11/2019 02:57	-53.92534	-37.56476	2.0217	33.8028	SAMPLE: >014<
27/11/2019 20:46	-54.01651	-38.05373	1.2914	33.9152	SAMPLE: >013<
27/11/2019 10:44	-54.01592	-38.05322	1.1836	33.9141	SAMPLE: >012<
27/11/2019 02:43	-54.46269	-38.64628	2.4579	33.8507	SAMPLE: >011<
26/11/2019 22:53	-54.75895	-39.03455	1.7082	33.7759	SAMPLE: >010<
26/11/2019 19:08	-55.07852	-39.46203	2.2215	33.8296	SAMPLE: >009<
26/11/2019 11:04	-55.77879	-40.40376	0.6498	33.776	SAMPLE: >008<
26/11/2019 03:02	-56.80454	-41.82372	1.4061	33.8294	SAMPLE: >007<
25/11/2019 21:40	-57.46932	-42.75997	0.8348	33.811	SAMPLE: >006<
25/11/2019 10:58	-59.05744	-45.0771	0.1805	33.8427	SAMPLE: >005<
24/11/2019 21:19	-60.35605	-46.65478	-0.8683	33.9085	SAMPLE: >004<
24/11/2019 10:41	-60.30046	-46.67772	-0.9942	33.9111	SAMPLE: >003<
23/11/2019 23:39	-60.61171	-46.45086	-0.5217	34.0271	SAMPLE: >002<
23/11/2019 20:30	-60.70209	-45.58283	-0.5608	33.7872	SAMPLE: >001<

2.6.4 UWIA Peristaltic Pump

The peristaltic pump being used has performed well over the past few years, however the extended running periods have resulted in the motor brushes wearing down, and filling the motor with a fine conductive dust. Additionally the motor shaft has worn through the original brushing to such an extent that there was nothing to support the shaft. The hole was as wide as the housing holding the bushing.

A replacement bushing was made using brass, and this lasted quite well for 12 days until the shaft wore through the bushing, as shown in the following picture:

A second bushing was made, however the motor failed to operate correctly. I suspect that this is due to the severe wear on the motor brushes. I tried to replace the brushes with new ones, however I was not successful. At this point I decided to stop the system.

For reference the motor details are as follows:

Amtek: Technical & Industrial Products,
www.ametektip.com
Pittman: Harleysville, PA, USA, www.pittmannet.com
GM8724G482-R1
D-2753
REV D 9.5 VDC
96:1 Ratio
04-16-08

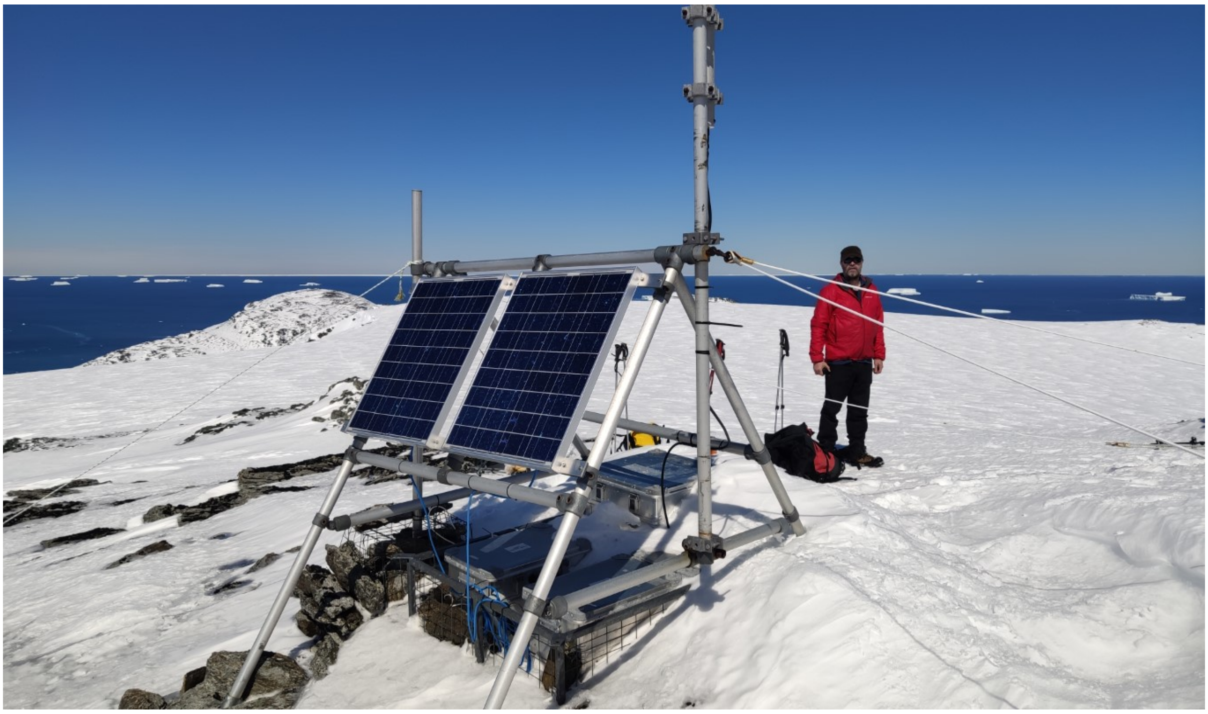
This is an OEM motor, and is therefore tied to the product it is sold in. I found it difficult to final a supplier of the motor, as they are only interested in selling a whole new peristaltic pump.

This is the pump we are using:
https://www.coleparmer.co.uk/i/masterflex-c-l-analog-variable-speed-pump-with-dual-channel-pump-head-for-microbore-tubing-pump-10-to-60-rpm-12-vdc/7712062?PubID=UY&persist=true&ip=no&keyword=&&gclid=CjwKCAiA8qLvBRAbEiwAE_ZzPZTtTL7CuIGxWCcxNXqvt2DKLCLPhb7DLM7637sk81JBkDTPFXoXPxoCrxQQAvD_BwE&gclsrc=aw.ds

2.7 Island Visits

2.7.1 Signy – VHF Repeater

We were fortunate enough to get the opportunity to hike up to the Signy VHF repeater on a mountain behind the base. The station leader reported that there was an issue with the repeater (intermittent and poor quality connections), and requested that the AME team go up and have a look to try find the problem.



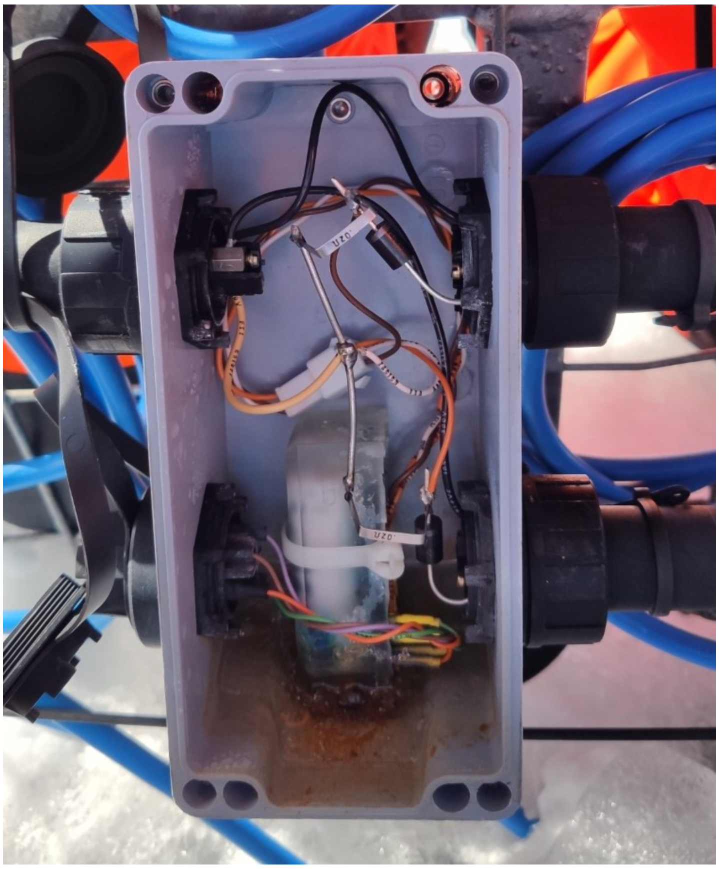
After a short investigation we found what we believe is the main issue. The cable connecting the repeater zarges to the antenna had a poor crimp connection on its N-Type connector (antenna side). The cable just pulled off the connector with very little force, and the connector and cable sheath shows signs of oxidation. I suspect that this poor connection to the antenna is what has been causing the issues. There was also very little slack in the cable, and any snow/ice contracting on the cable could have caused the cable to pull out. It is important to leave some slack in cables near connectors to prevent this from happening in the future.

Unfortunately we did not have the correct crimp tool to reattach the connector properly. What we did was try and solder the outer conductive cable sheath on to the existing connector. The center core and pin were still fine. We cleaned up the connector and the cable sheath conductor with a file, so that the solder would have a better chance of taking. We then used pliers to crimp the crimp ring in to an oval on to the connector. We then heated the connector/crimp ring with two gas soldering irons, and melted solder in to the gap. This felt quite solid, but is definitely not a permanent solution. A quick test proved that the fix was working. We used self-amalgamating tape to seal the connector back up.

Note: After returning to the ship, I made a replacement cable to connect the repeater box to the antenna. I delivered this back to the station leader, and told him how to install it. This replacement cable should be installed as soon as possible.

2.7.1.1 Repeater Battery Box

While investigating the system, I found that one of the battery boxes and panels are not actually connected. Facing the front of the panels, the LHS battery box is not actually feeding in to the power system. There is a little combination box (picture below) that takes a power feed from a wind generator (which is no longer there) and the RHS solar panel. This combination box has a small logger inside that shows signs of water damage, but the cables and diodes are still fine. The output of this combination box then feeds in to the RHS battery box. This input is then fed in to an MPPT solar charger that charges the internal battery, and supplies power out to the repeater box. This battery had a voltage of 14.4V with the repeater attached, and I feel confident that this battery is being charged and maintained.



However when I was testing the LHS battery box I found that the battery has a voltage of 12.17V. Further investigation showed that the Solar panel input (which is present) is not actually wired up to the MPPT charger. So currently the LHS solar panel is not actually doing anything, and the LHS battery is not getting any charge. If anything the battery is slowly being discharged by the MPPT which is attached. Additionally the output of the MPPT/Box does not go anywhere. No cable attached. The LHS panel, battery and MPPT charger are not doing anything, and are not wired up correctly to do anything.

I think that this is a relatively easy thing to fix, and would be worthwhile. The connectors are already present on the zarges, and the internal wiring is quite easy to work though. Everything connects to the MPPT charger, which is quite clearly labelled for Solar Input, Battery, and Load. Once wired up internally, use one of the free panel connectors on the zarges to connect an external cable to the cable feeding the repeater zarges. IE, connect the MPPT outputs from both battery boxes to the Repeater zarges. Maybe use a Y cable for this, or preferably connect inside a battery zarges if there are sufficient panel connectors. I have provided a number of Bulgin connectors to the Station leader so anyone with electrical wiring knowledge should be able to engineer a solution on site.

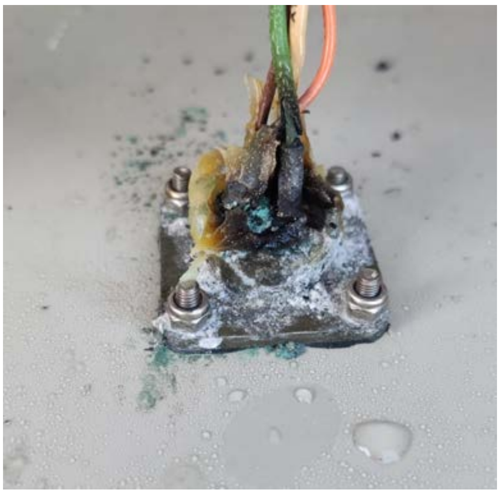
2.7.2 Signy – Sea Ice Camera

After dealing with the Signy VHF Repeater, we hiked back towards the Sea Ice Camera. We followed the instructions for site inspection found here:

"P:\AME\Carson_Experimental_Folder\Scientific_Systems\Signy_Sea_Ice_Camera\Technical_Documents\Customer_Service_of_remote_Camera.pdf"

We power cycled the camera, but there were no LED status indicators. We found that there was no power being supplied to the camera internal din rail terminations from the input power connector. The picture below shows the power input connector. One cable has broken off completely, and the remaining three pins show severe oxidation/damage. By bending the cables around the connector we were able to power up the camera, but it was still intermittent.

I did not have a spare connector, and I didn't feel I could acceptably repair the system at the installation location with the tools I brought. The station leader has approved the recommendation of removing the camera from the island and returning it to Cambridge for repair. The camera box, and power regulator/dump box are stored in the AME Cage in the science hold, and need to be removed at next UK port call.



After returning to the ship, I also found that there were log files on the Camera SD card, but no saved images. This is strange. There may be a bigger issue with the camera configuration.

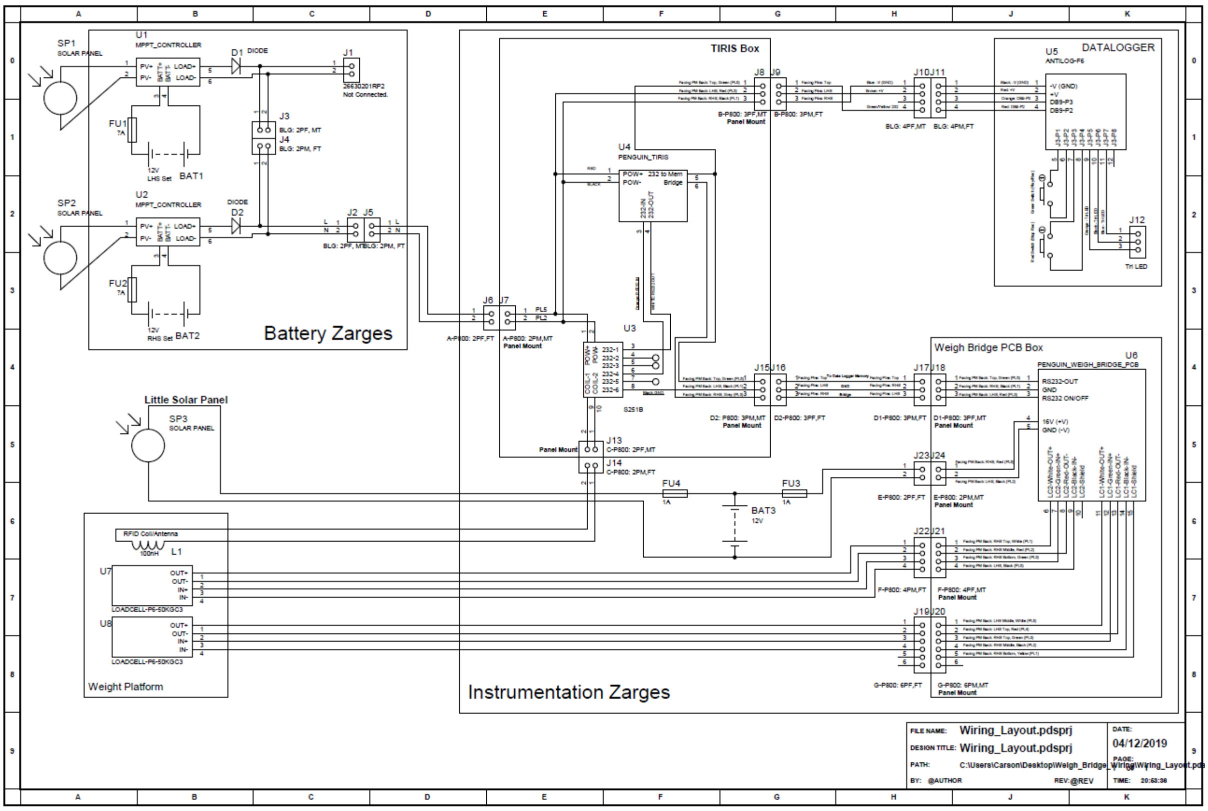
2.7.3 Bird Island – Penguin Weigh Bridge

Seth Thomas requested that we visit the Penguin Weigh Bridge and document the internal and external wiring layout. This had not been documented sufficiently in existing documentation, and was making it difficult to reverse engineer the system, as well as to create spares for the existing system.

The entire system wiring (including connectors and pin assignments) has now been documented here:

“P:\AME\Carson_Experimental_Folder\Cambridge_Projects\Penguin_Weigh_Bridge\Technical_Documents”

The same folder also has a very comprehensive photo collection of the visit. I have also filled the project folder with past documentation from the old AME PC hardrives.



3 AME Department notes

3.1 Priority needs and Notices

Nothing critical. I have mentioned that there are issues with the CTD winch, but I don't think there is much that can be done now.

3.2 Pre-cruise tasks

Task	Status
Download AME_Eng/Platform_Specific/JCR	Y
Check cruise planning meeting notes	N
Number of hours hand over with previous ships AME Engineer	0H

3.3 Daily & weekly tasks

Task	Frequency	Status
Sanity check the Oceanlogger data	Daily	Y
Check the Following Fans: Oceanlogger Acoustic Rack Seapath EM122 (Tween) Topas (Tween)	Monthly	Y
Mega test CTD cable	Weekly	N

3.4 End of cruise checks

Task	Status
XBT left in cage, in a suitable state	Y
The salinity bottles have been cleaned, if used	Y
CTD left in suitable state - Ducts cleaned with Triton and deionised water, blanking plugs installed and system washed with water	Y
CTD Slip Ring have been cleaned	Y
Office is tidy, with manuals and files returned and items stowed for sea	Y
Clean the following fans: Oceanlogger Acoustic Rack Seapath EM122 (Tween) Topas (Tween)	Y
Scintillation Counter test Precedure	Y