Cruise JC106 - RRS James Cook

Cruise Report – 'Britice-Chrono: constraining rates and styles of marine-influenced ice sheet retreat'

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July 16 – August 25, 2014

Deployment of the BGS vibrocorer in the Celtic Sea, July 22nd, 2014

1.1 Acknowledgements

We thank the officers and crew of the RRS James Cook for their excellent support and professionalism throughout cruise JC106. The work was funded by the UK Natural Environment Research Council.

1.2 Scientific Background, Aims and Achievements

Cruise JC106 is the first of two cruises on the UK research vessel the RRS James Cook related to the research project*"BRITICE-CHRONO: constraining rates and style of marine-influenced ice sheet decay"*. BRITICE-CHRONO is a five-year research project that brings together more than 40 researchers comprising glaciologists, marine and terrestrial Quaternary scientists and ice-sheet modellers. It involves researchers from eight UK universities, plus the British Geological Survey, British Antarctic Survey, NERC's radiocarbon facility and Scottish Universities Environmental Research Centre as well as project partners in Ireland, Italy, Sweden and Norway.

The underlying rationale behind BRITICE-CHRONO is concern about the retreat/stability of the marine-influenced West Antarctic and Greenland ice sheets, and consequent sea-level rise. It is imperative that we can predict the future rates of change of these large ice masses but our current ability to do so is limited and a weakness in climate science. Numerical ice sheet models – capable of making predictions have yet to be adequately tested against data on the pattern and timing of a shrinking ice sheet. Although recent work has constrained the pattern of retreat of the ice sheet that once covered Ireland and Britain (Clark et al., 2012, Quaternary Science Reviews), the *timing* of that retreat is inadequately constrained. BRITICE-CHRONO is a systematic and directed campaign to collect and date material to constrain the timing and rates of change of the British-Irish Ice Sheet (BIIS). Retreat of the BIIS will become the best constrained anywhere and be the benchmark against which predictive ice sheet models are improved and tested, thus contributing greatly to glaciology, climate and Quaternary science and the veracity of predictions of sea-level change.

The overall aim of the project is to provide the World's best reconstruction of the demise of a marine-based ice sheet and one that will be critical in developing and testing the next generation of ice sheet models. To achieve this we seek to answer the following research questions:

1 How do marine-based ice sheets deglaciate? By steady, stepped or catastrophic retreat, or partial 'float-off'?

2 What is the main driver(s) of retreat and what is the relative importance of climate change vs. sea level rise?

3 How is ice loss affected as the ice sheet margin crosses the marine-terrestrial transition? Once it back-steps onto land for how long does it stabilise, is it prone to quasi-stable oscillations?

4 What is the glaciological significance of ice rafted detritus (IRD)? This is fundamental for resolving the above because there is current uncertainty as to whether an IRD layer represents ice sheet margin advance or retreat.

5 Which ice sheet model implementations of iceberg calving, grounding line dynamics and ice stream mechanics are best suited for predicting ice sheet retreat?

The BIIS is ideal for such study because two-thirds of the ice sheet was marine-based, and drained by ice streams during its last major phase of expansion about 26,000-23,000 years ago, possibly with some fringing ice shelves, and it is thus a useful analogue for the West Antarctic Ice Sheet (WAIS). It was relatively small (~1/3 volume of WAIS) and therefore presents less demanding computational effort for modelling experiments and fieldwork accessibility compared to other ice sheets such as Greenland and Antarctic is straightforward. Furthermore there is a rapidly growing archive of marine geophysical data around the continental shelf, e.g., the datasets of the Irish National Seabed Survey and INFOMAR.

The focus of BRITICE-CHRONO is on retreat rates from marine-calving to terrestrial-melting margins and this requires that effort is split between these environments. The marine and terrestrial work is fully integrated and follows a common sampling strategy and procedure. Research effort is organised via a series of 8 transects from the continental shelf edge to a short distance (~30 km) onshore (Figure 1). The marine component utilises existing geophysical data archives supplied through our collaboration with the Geological Survey of Ireland and University of Maynooth, and also from British Geological Survey to identify target locations.

Cruise JC106 on the RRS James Cook in 2014 was the first of two BRITICE-CHRONO research cruises. It focused on Celtic and Irish seas, the northern approaches to the Barra Fan, the Malin Sea and the NW and western Irish shelf (transects 3, 4, 5, 6, and 7) (Figure 1). The second cruise will take place in 2015 to the North Sea and northern Britain (transects 1, 2 and 8) (Figure 1).

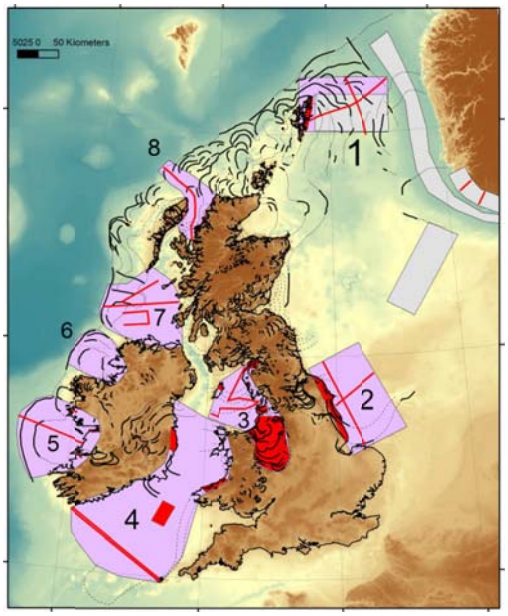


Figure 1. *BRITICE-CHRONO transects. Numbered transects in violet and which all stretch onshore for tens of kilometres (red). Black lines show the known ice sheet retreat pattern. Cruise JC106 focused on transects 3 (eastern Irish Sea), 4 (southern Celtic Sea), 5 (western Irish shelf including Porcupine Bank), 6 (Donegal bay and adjoining shelf) and 7 (Malin Sea and northern approaches to the Barra Fan). Transects 1, 2 and 8 will form the focus of a second cruise in 2015.*

During JC106 we covered 5200 miles and geophysical data from EM120 and EM710 multibeam echo sounder systems and a Kongsberg SBP-120 sub-bottom profiler were collected and used to identify targets for coring. Coring utilised a British Geological Survey 6 m long vibrocorer system and NMFSS 12 m piston corer. Two hundred and twenty three cores were collected during the cruise. Survey transects and associated coring sites were planned by the scientific party based on previous available datasets including survey data collected by INFOMAR, BGS, Ulster University and others. During the survey, each pre-planned transect was re-assessed using geophysical and multibeam investigations in order to verify and confirm previous interpretations, fine tune core locations or add new ones. Data collection during the first leg of this survey campaign began in the Celtic Sea where several survey transects and sediment cores were collected. Survey effort then moved anticlockwise toward the Irish Sea, Isle of Man and Liverpool Bay and subsequently toward the Malin Sea and Donegal Bay. The first leg was completed the 4th of August in Killibegs. Leg 2 focused on the Malin Sea and shelf offshore the Hebridees Sea; Donegal bay and adjoining shelf; and the Porcupine Bank and adjoining shelf offshore of western Ireland. In addition geophysical data and cores were also acquired on transit between these study areas. Maps showing geophysical data tracks and core locations are presented in Figures 2-6 below

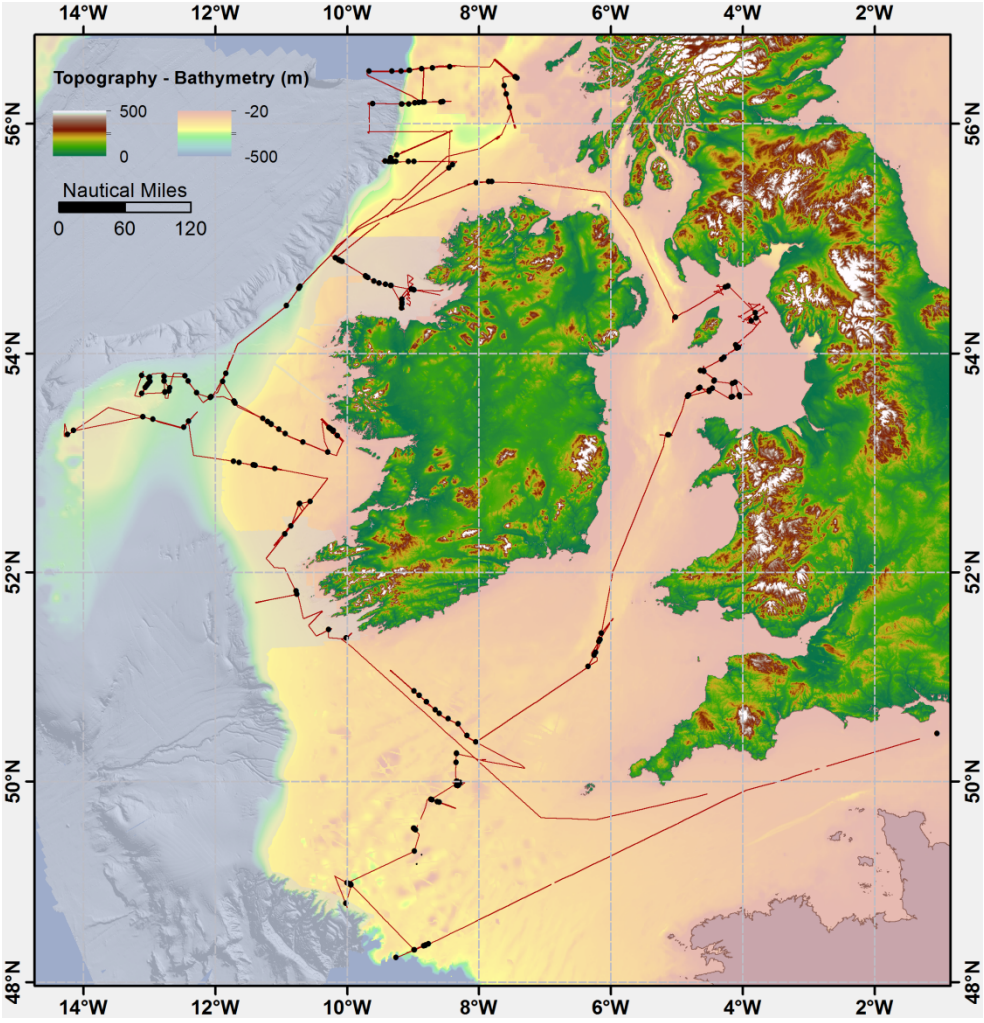


Figure 2. JC106 – Cruise track and core locations

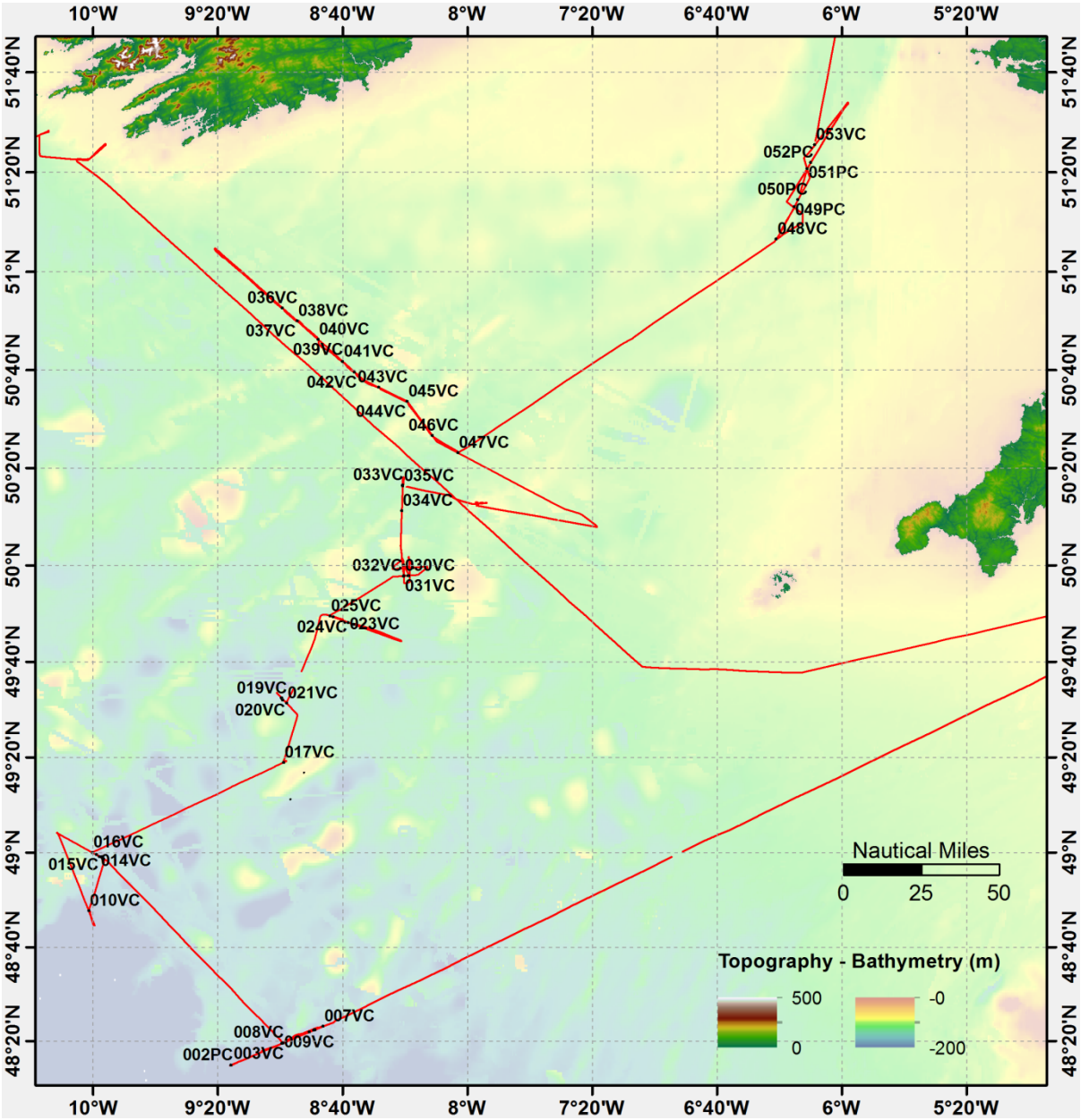


Figure 3. Cruise tracks and core locations in the Celtic Sea during JC106

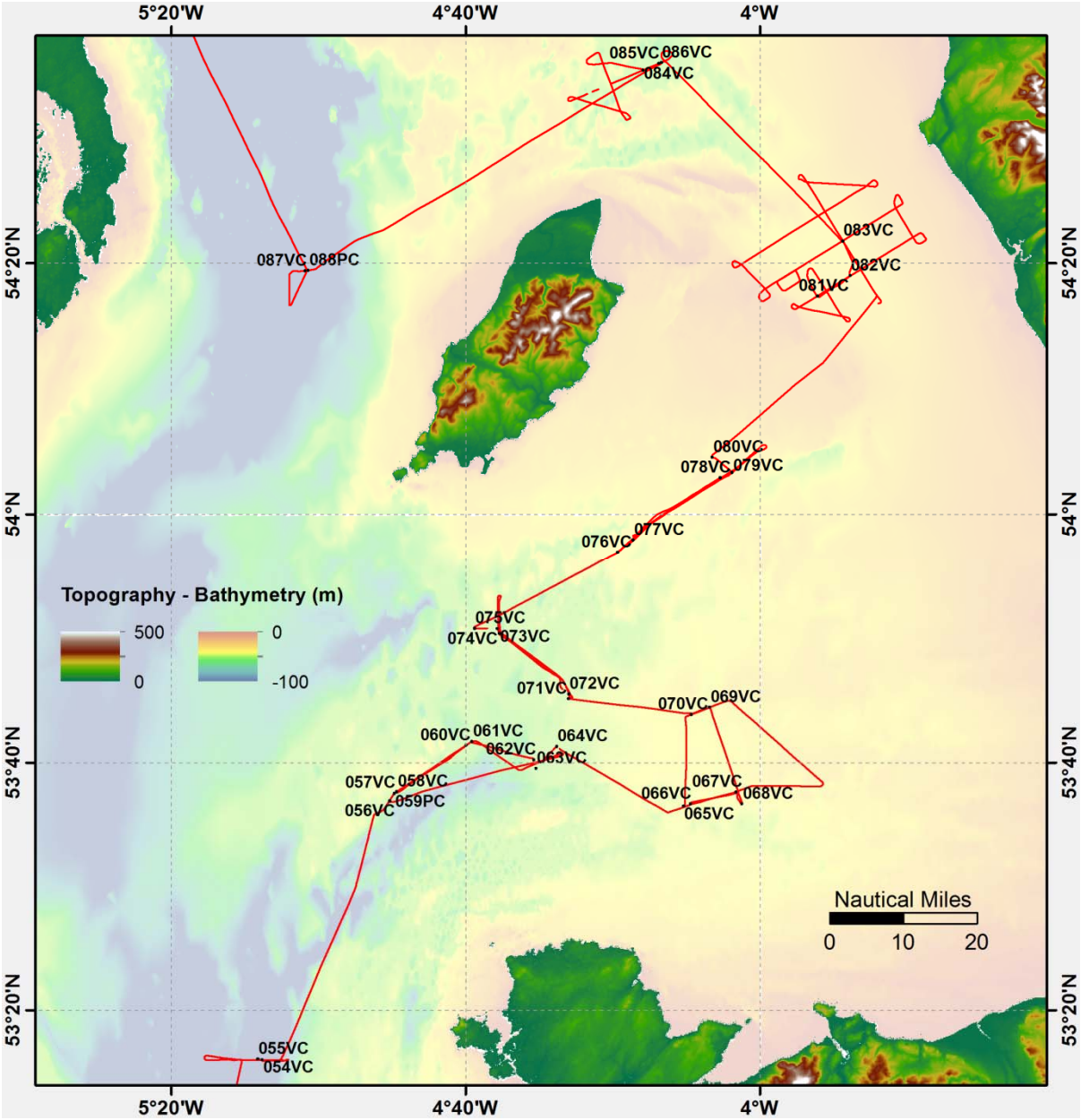


Figure 4. Cruise tracks and core locations in the eastern Irish Sea during JC106

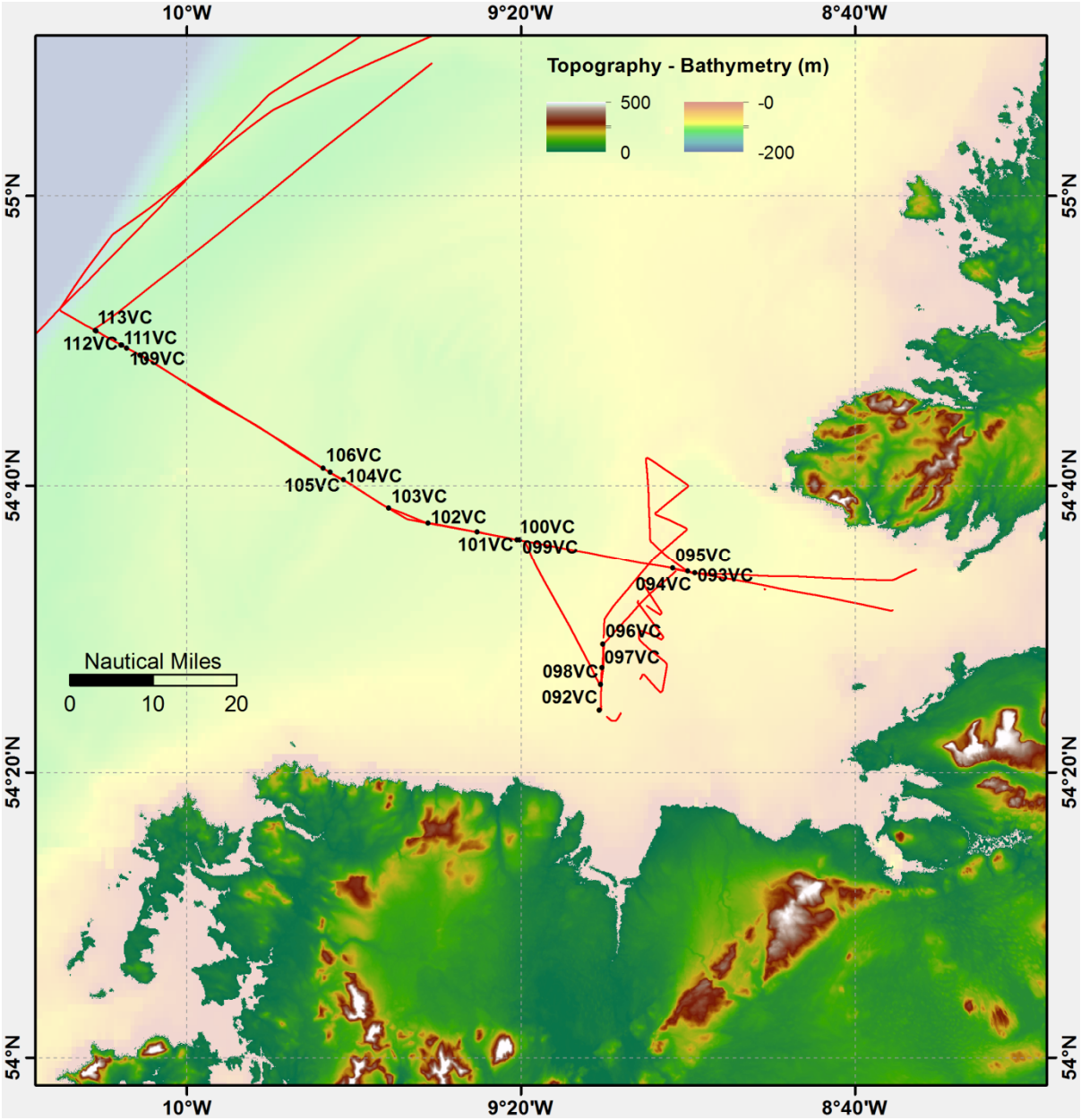


Figure 5. Cruise tracks and core locations in Donegal Bay and the adjoining shelf during JC106

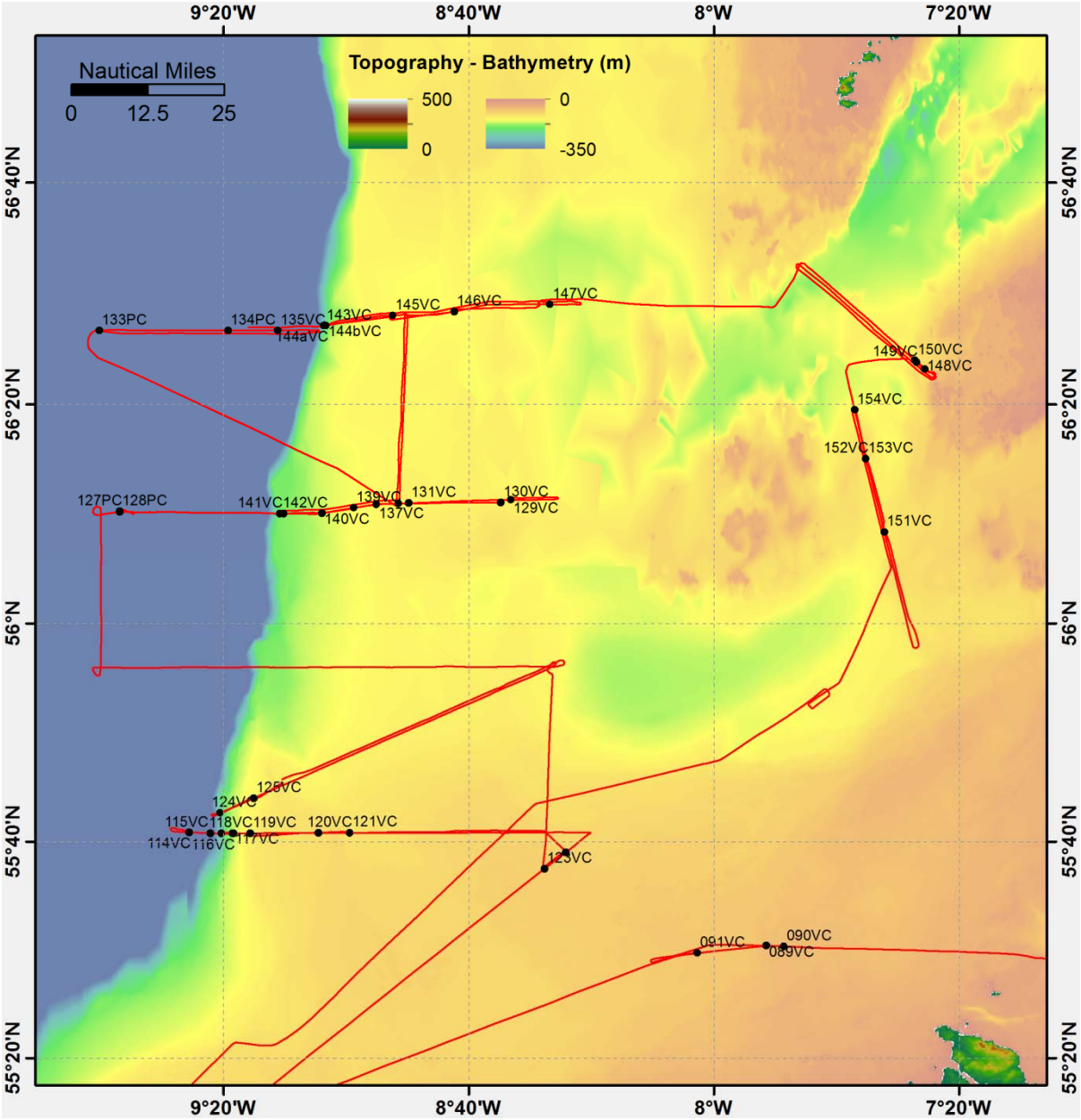


Figure 6. Cruise tracks and core locations in the Malin Sea during JC106

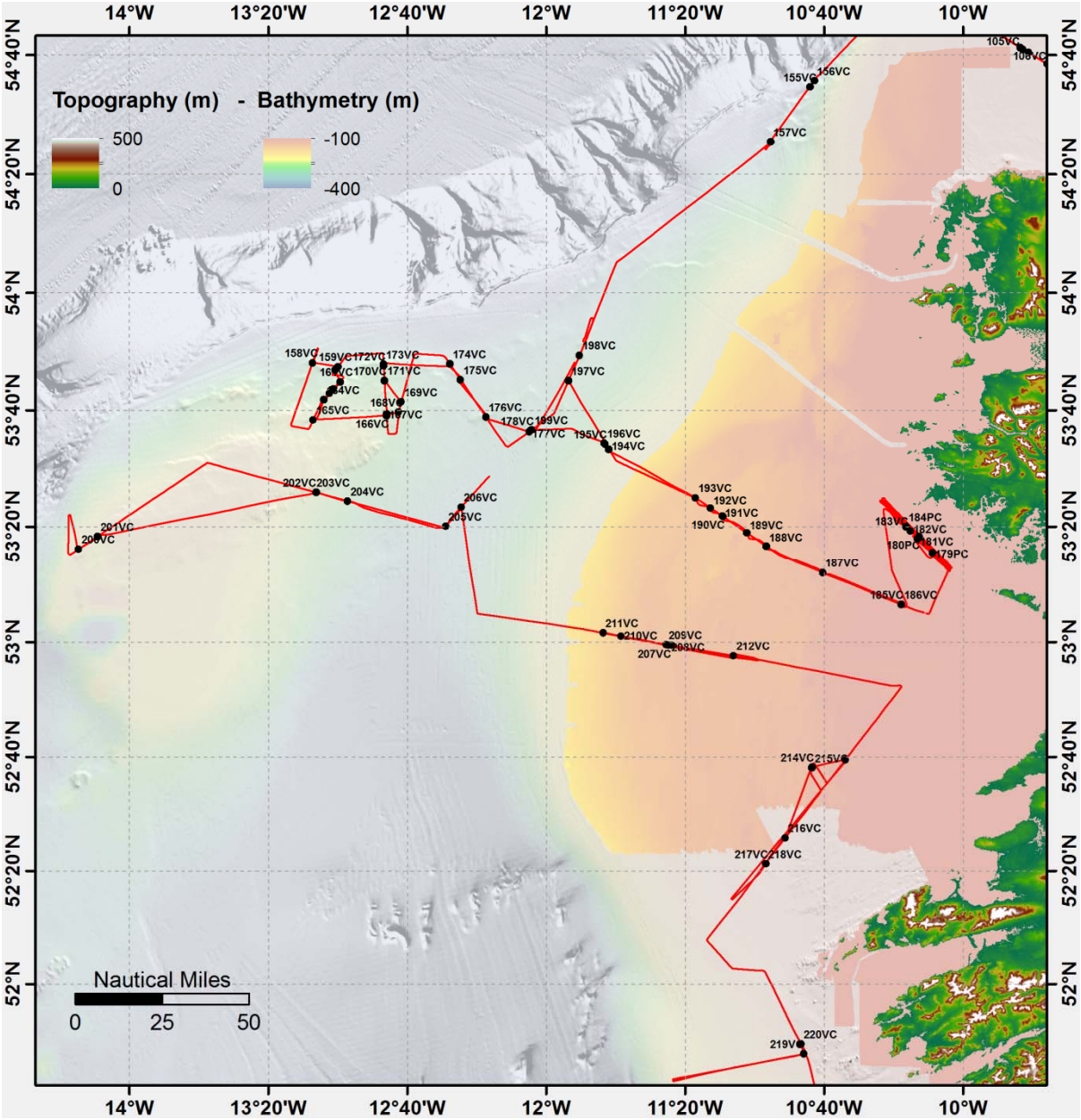


Figure 7. Cruise tracks and core locations on the western Irish shelf and across the Porcupine Bank during JC106

1.3 Cruise Participants

JC106 – Leg 1 – Southampton to Killybegs

1	LEASK	JOHN ALAN	Master
2	NEWTON	PETER WILLIAM	C/O
3	MACLEOD	IAIN	2/O
4	NORRISH	NICHOLAS	3/O
5	LUCAS	ROBERT	C/E
6	KEMP	CHRISTOPHER MARTIN	2/E
7	DAVITT	FRANCIS ROBERT	3/E
8	SLATER	GARY	3/E
9	DAMERELL	PAUL Darren	ETO
10	BULLIMORE	GRAHAM	PCO
11	MacDONALD	JOHN EWAN	CPOS
12	MACLEAN	ANDREW	CPOD
13	DUNCAN	STEVEN	POD
14	HOPLEY	JOHN	SG1a
15	BARTLETT	GRAHAM DAVID	SG1A
16	LAFFERTY	RAOUL JOHN BERNARD	SG1A
17	DAY	STEPHEN PAUL	SG1A
18	SMYTH	JOHN GERARD	ERPO
19	HAUGHTON	JOHN	H/Chef
20	LINK	WALTER JOHN THOMAS	Chef
21	MINGAY	GRAHAM MALCOLM	Stwd
22	MASON	KEVIN JOHN	Stwd
23	MCGRATH	MARIAN CATHERINE	Scientist
24	AROSIO	RICCARDO	Scientist
25	BAXTER	DAVID HUGH	Scientist
26	BENETTI	SARA	Scientist
27	CALLARD	SARAH LOUISE	Scientist
28	CHIVERRELL	RICHARD CHRISTOPHER	Scientist
29	GALES	JENNY ANNE	Scientist
30	GIBSON	KEITH	Scientist
31	GILLES	ALAN	Scientist
32	HANENKAMP	ELKE	Scientist
33	HOTHERSALL	JOSEPH LEO	Scientist
34	O'COFAIGH	COLM	PI
35	PRAEG	DANIEL BRIAN	Scientist
36	PURCELL	CATRIONA SHONA	Scientist
37	ROSEBY	ZOE AMELIA	Scientist
38	SACHETTI	FABIO	Scientist
39	SAHER	MARGOT HELEEN	Scientist
40	SCOURSE	JAMES DAVID	Scientist
41	VAN LANDEGHAM	KATRIEN JOANNA JOZEF	Scientist
42	WEILBACH	KASPER	Scientist
43	WILSON	MICHAEL	Scientist
44	BRIDGER	MARTIN JOHN	SST
45	POOLE	BENJAMIN GEORGE	Tech
46	MURDOCH	IAN CAMPBELL	Tech
47	MOORE	ANDREW STEPHEN	Tech
48	VERNON	TYRONE PAUL	Tech
49	HENSON	ANDREW JOHN	Tech

JC106 Personnel – Leg 2 – Killybegs to Southampton

1	LEASK	JOHN ALAN	Master
2	NEWTON	PETER WILLIAM	C/O
3	MACLEOD	IAIN	2/O
4	NORRISH	NICHOLAS	3/O
5	LUCAS	ROBERT	C/E
6	KEMP	CHRISTOPHER MARTIN	2/E
7	DAVITT	FRANCIS ROBERT	3/E
8	SLATER	GARY	3/E
9	DAMERELL	PAUL Darren	ETO
10	BULLIMORE	GRAHAM	PCO
11	MacDONALD	JOHN EWAN	CPOS
12	MACLEAN	ANDREW	CPOD
13	CONTEH	BRIAN	ERPO
14	DUNCAN	STEVEN	POD
15	HOPLEY	JOHN	SG1a
16	BARTLETT	GRAHAM DAVID	SG1A
17	LAFFERTY	RAOUL JOHN BERNARD	SG1A
18	DAY	STEPHEN PAUL	SG1A
19	HAUGHTON	JOHN	H/Chef
20	LINK	WALTER JOHN THOMAS	Chef
21	MINGAY	GRAHAM MALCOLM	Stwd
22	MASON	KEVIN JOHN	Stwd
23	SMITH	ANDREW LEWIS	Super
24	MCGRATH	MARIAN CATHERINE	Scientist
25	CALLARD	LOUISE SARAH	Scientist
26	CHIVERRELL	RICHARD CHRISTOPHER	Scientist
27	GALES	JENNY ANNE	Scientist
28	HANENKAMP	ELKE	Scientist
29	O'COFAIGH	COLM	PI
30	PURCELL	CATRIONA SHONA	Scientist
31	ROSEBY	ZOE AMELIA	Scientist
32	SAHER	MARGOT HELEEN	Scientist
33	VAN LANDEGHAM	KATRIEN JOANNA JOZEF	Scientist
34	WEILBACH	KASPER	Scientist
35	INGLE	ALEX JOHN WILLIAM	Scientist
36	LIVINGSTONE	STEPHEN JOHN	Scientist
37	MCGOWAN	GARRY GEORGE	Scientist
38	MELLET	CLAIRE LOUISE	Scientist
39	PHEASANT	IAIN JACK	Scientist
40	RICHARDSON	CONNOR DAVID	Scientist
41	SCHIELE	KEVIN CHRISTOPHER	Scientist
42	TSILLIGANNIS	APOSTOLOS	Scientist
43	WALLIS	DAVID GRAY	Scientist
44	BRIDGER	MARTIN JOHN	SST
45	POOLE	BENJAMIN GEORGE	Tech
46	MOORE	ANDREW STEPHEN	Tech
47	MURDOCH	IAN CAMPBELL	Tech

1.4 Cruise Narrative (Science)

Tuesday July 15

Scientific party arrive at ship by 13.00-14.00 hours. Ship familiarisation and safety briefing from Purser at 16.00 hr. Science party meeting at 18.30 hr.

Wednesday July 16

Delay to sailing until BGS core splitter and core catchers for vibrocorer were delivered from Loanhead. Technical problems with the vibrocorer developed in the evening which required additional parts to be delivered from BGS Loanhead.

Thursday July 17

During repair of vibrocorer yet further problems developed with the result that sailing was put back again to 12.00 hr on July 18th.

Friday July 18

BGS testing of vibrocorer took place from 08.00-11.30. Ship sailed at 12.00 hr for first vibrocore test site at 48° 24.1' N, 08° 42.85' W. A vibrocore was collected successfully in 39 m of water at 16.30 hours, recovering 55 cm of sandy gravel. Following recovery of the vibrocore, the EM120, EM710 and sub-bottom profiler were all activated using a 'soft start' procedure and we then proceeded generally west south westwards towards the first survey site at the shelf edge of the Celtic Sea. Clocks were sent back by one hour to GMT at 23.00 hr. A number of problems with the multibeam systems (dropouts and too few pings) were experienced with the multibeam systems but these were resolved. The sub-bottom profiler provide more problematic as did the EPC chart plotter which outputs a paper copy of the sub-bottom profiler but by the end of the day these were running satisfactorily.

Saturday July 19

A boat drill was held at 10.30 hr with a full muster of the ship's crew and the science party. Following the boat drill the science party were briefed on deck regarding the operation of the piston corer. The ship continued to transit west southwest. The EM120 multibeam systems performed relatively well. Teething problems were experienced with the display and paper recording from the EPC plotter but by approx. 18.30 hours these had been largely resolved and both were displaying good data. A persistent problem, however, remains in the transfer of recorded sub-bottom data into seismic processing software with the problem centred around the format of the navigation input. Various solutions were attempted but none fully satisfactory.

Sunday July 20

Overnight Saturday/Sunday we tested the SVP and USBLs and then proceeded to commence a geophysics survey line SW along the outermost shelf for 24 miles. At the end of the survey we deployed the piston corer in 459 m of water on the upper continental slope and recovered

just over 4 m. Upon completion of the piston core we carried out roll and pitch calibrations for the EM170 and then proceeded at 10 kts back east along the existing survey line collecting a total of 6 vibrocores and finishing just after 00.00 hr on the 21st. The first core JC106-003VC was particularly notable in that it recovered an excellent glacigenic sediment sequence.

Monday July 21

Upon completion of the vibrocore transect we commenced a transit of about 55 m along the outer shelf to 48°58.258'N 09°55.573' W where we commenced a 33 m geophysical survey proceeding northwest to 49°03.978'N 10°11.23' W and then southeast to 48°44.795'N 09°59.653' W. Vibrocore locations were selected from the geophysical data along this survey line. At the end of the survey we collected a single vibrocore at 48°47.660'N 10°01.336' W before proceeding north to the start of the geophysical survey line and collecting a further 5 vibrocores 010VC-014VC.

Tuesday July 22

We finished the vibrocore transect collecting 015VC-016VC in the early hours of Tuesday morning before proceed northeast from the outermost shelf and transiting about 50 miles to 49°29.046'N 08°54.700'W and collecting a further vibrocore (017VC) on the way. We then commenced a short (5 miles) survey to the northwest to 49°33.025'N 09°0.465' W collecting geophysical data and 4 vibrocores (018VC-021VC).

Wednesday July 23

Geophysical surveying of a grid just south of 50° 00.00' N and 08° 20.00' W in the central Celtic Sea followed by 6 vibrocores. We then proceeded north and ran a survey line from 50°04.094'N 08°21.305' to 50°17.437'N 08°20.724' W.

Thursday July 24

We collected 3 vibrocores during the early hours of Thursday two of which recovered excellent sequences of glacigenic sediments (033VC and 035VC). Following a short transit we took an SVP and then commenced a EM710 multibeam calibration in the vicinity of Haig Fras (50°12.5'N 07°56.0' W). The rugged seafloor topography of Haig Fras was imaged clearly by the multibeam as we crossed it. The calibration was carried out to rectify a 'heave' problem in the multibeam data which resulted in the seafloor having a 'corrugated' appearance. Upon completion of the calibration we then commenced a 100 mile geophysical survey to the NW towards southern Ireland ('Fastnet Transect') carrying on through the night and into Friday 25th.

Friday July 25

Geophysical surveying along the 'Fastnet Transect was completed by 08.00 and we then turned and commenced a vibrocoring transect back along the survey line collecting 10 vibrocores (036VC-045VC). Recovery was variable in these cores and the sediments

recovered were very sandy. However, cores 44VC-045VC, collected relatively close together, both recovered an excellent sequence of glacigenic sediments.

Saturday July 26.

We finished the 'Fastnet Transect' of vibrocores collecting 046VC-047VC with the latter core recovering glacigenic diamict. We then commenced an 80 mile transit to the northwest to the southern part of the Celtic Deep where we began a coring transect northwards commencing with 048VC at 21.39 hrs.

Sunday July 27

A meeting of the ships Safety Committee which the PSO attended took place 10.30 hrs. Coring from south to north along a transect in the Celtic Deep. Collected 4 piston cores and a final vibrocore. The latter vibrocore 053VC recovered 4.5 m of mud and was the longest vibrocore recovered up to this point on the cruise. The piston cores (JC106-049 to 053PC) had reasonable recovery up to 7.58 m and contained excellent sequences of laminated and massive mud. This completed the work in Britice-Chrono T4 (Celtic Sea), a notable landmark. We then commenced a transit northwards up the Irish Sea to a waypoint west of Anglesey. An SVP deployment was carried out at 23.00 hrs.

Monday July 28th

Following the SVP deployment we completed a short (3.5 nm) geophysical survey west of Anglesey at a latitude of 53°16.00'N and then collected 2 vibrocores (054VC and 055VC) We then transited northwards and commenced a northeastwards and then eastwards survey around Anglesey and in towards Liverpool Bay running with a strong current. The multibeam systems imaged impressive drumlins and streamlined subglacial landforms on the seafloor. The survey was completed by ~11.00 and we then transited back westwards and started a long vibrocore transect eastwards along the survey line collecting two vibrocores (056VC and 057VC) both of which had excellent recovery with 5.5m and 5 m of muddy sediments respectively. Following completion of 058VC (3.8 m; bent barrel reason unclear) we then returned to the site of 059VC at 53°37.559'N 04°50.347'W and collected a piston core (059PC). Unfortunately an imploded barrel resulted in only a limited recovery of 3.64 m. We then continued the vibrocoring transit eastwards recovering 060VC in 66 m of water at 19.30 hr (1.89; bent barrel; reason unclear) and 061VC in 70 m of water at 21.40 hr and 062VC in 85 m of water at 23.45 hr.

Tuesday July 29th

Overnight we completed 4 more vibrocores along this transect, with 063VC being particularly notable in recovering 5.77 m of mud. We then transited 11 miles eastwards towards Liverpool Bay and began a 28 mile long survey initially east, and then northwest and west. Six vibrocores were collected at the southern and northern ends of this transect with a massive, brown diamicton with a muddy matrix (similar to 'Irish Sea Till') recovered in two of these cores. Upon completion of the coring transect we transited 10 miles to the west and

completed an 11 mile swath survey northwestwards and then northwards towards the Isle of man. Upon completion of the survey we transited back along the east side of the existing survey line and commenced a transect of 5 vibrocores from south to north completing 072VC just before midnight.

Wednesday July 30th

We completed the remaining 3 cores by 07.00 hr. Core 074VC was notable in recovering 5.58 m of sediment. A problem developed with the vibrocorer retraction mechanism on this last station. We then commenced a 27 mile survey to the NE during which it was necessary to stop the ship temporarily so that testing could be carried out on the vibrocorer to ascertain the cause of the problem. Repairs were then carried out successfully whilst the ship was in transit and we proceeded to collect 5 vibrocores (076VC-080VC) along this survey line. Upon completion of the survey we transited 9 miles to the NE to commence a 79 mile survey at the start of Thursday 31st.

Thursday July 31st

We recorded an SVP profile shortly before 01.00 hrs and then continued with the survey until 13.17 hrs following which we collected vibrocores 081VC-083VC all of which recovered 4-5 m of sediment in water depths of 42-71 m water depth. We then ran a short survey to the north of the Isle of Man running initially NE-SW and then SE-NW. We imaged excellent examples of drumlins on the EM710 that record former ice flow into the Solway Firth and these were also imaged in the sub-bottom profiler records where the clear examples of laminated acoustic facies could be seen overlain by drumlin-forming till.

Friday August 1st

Upon completion of the survey we proceeded to collect three vibrocores (084VC-086VC); o85VC recovered 5.92 m of mud, the longest vibrocore recovered to this point on the cruise. We then transmitted 27 to the southwest to a basin west of the Isle of Man. We collected a vibrocore and a piston core in a stratified basin fill in 133 m of water recovering 5.20 m (087VC) and 5.905 m (088PC) respectively. This completed the marine work for Britice-Chrono Transect 3. We then sailed northwest up the Irish Sea with good views of Ireland and Scotland. We passed the distinctive rock of Ailsa Craig on the starboard side at 16.30 hrs and proceeded westwards offshore of the north coast of Ireland towards a core site on a moraine at 55°30.534'N, 08°00.373'W.

Saturday August 2

We cored a moraine overnight 55°29' 46.313''N, 08°02' 49.938''W. Three cores were attempted but only 091VC recovered sediment (0.60 m including overconsolidated glacial diamicton). We then continued to transit southwestwards along the outer shelf across a series of low and wide shelf moraines until a waypoint at 54°52.092'N, 10°15.168'W close to the shelf edge offshore Donegal Bay. We commenced completed a short survey up the slope (imaging gullies) and then the outer shelf running across a series of shelf edge moraines

picking sites for a coring transect. However, a deterioration in weather necessitated a transit across the shelf and into innermost Donegal Bay where we hove to overnight. The sub-bottom profiler line eastwards across the shelf on the way into Donegal Bay imaged impressive sequences of acoustically stratified sediment 30-40 m thick.

Figure 8. Removing the vibrocore from the core barrel.

Figure 9. The aft deck with the BGS vibrocore bench and vibrocorer in the background.

Sunday August 3

At 09.00 hrs we transited westwards to determine the sea state on the inner shelf and whether it would be feasible to collect some cores from a large inner shelf moraine. This proved to be impossible and so we collected a series of east-west lines of sub-bottom profiler data before then commencing a series of zig-zig shaped cross lines across the inner shelf moraine. With the exception of one core station offshore of Killala Bay, weather conditions prevented acquisition of any more cores. We therefore completed a survey of the inner shelf moraine and then proceeded to trandit into Donegal Bay for the port-call in Killybegs on the 4th of August.

Monday August 4

Scientific data acquisition stopped at about 04.30 hrs and the ship moved into Killybegs Habour coming alongside about 09.00 hrs for the port-call changeover of scientific and technical personnel.

Tuesday August 5

We sailed from Killybegs at 09.00 hrs and, following an emergency drill and soft start of the geophysical equipment, commenced a long transect of 20 vibrocores extending from the inner shelf to the shelf edge coming onto the first core station (093VC) at 11.30 hrs. We

completed 3 cores on the large inner shelf moraine before turning south and collecting 3 cores on the east-west orientated Killala Bay moraines which record the former advance and retreat of an ice lobe emanating from Killala Bay along the coastline of North Mayo. The Killala Bay moraines are superimposed on the larger, arcuate north-south Donegal Bay shelf moraines. Cores 096VC and 097VC recovered 3.06 m and 4.71 m of sediment respectively both comprising grey, probably glacigenic mud. The mud at the base of 096VC was notably stiff (112 kPa) possibly reflecting ice loading. The following station 098VC had 0 m recovery despite 2 attempts at coring the site. We then proceeded ~10 miles to the northwest to commence coring 8 sites across the mid-shelf. 099VC-101VC all had good recovery collecting 4.75-5.6 m of sediment including well laminated grey mud facies.

Wednesday August 6

We continued coring overnight and into Wednesday recovering a further 5 cores from across the mid shelf (102VC-106VC). Recovery was highly variable ranging from less than 1 m to 5.7 m. We then transited about 10 miles to the outer shelf where we cored 7 stations across a set of shelf edge and outermost shelf moraines. The seafloor in this region was covered by a coarse sand-gravelly lag which was very difficult to penetrate with the vibrocorer. As a result recovery was in general rather poor from this region although 112VC from just inshore of the shelf moraine was notable in that it bottomed out a glacigenic diamicton with a shear strength of 300 kPa which is almost certainly a subglacial till. With the collection of 113VC this completed data collection for T6 and we proceeded NE on an 80 mile transit to the start of a survey line and T7.

Thursday August 7

We reached the waypoint at the start of the survey and collected an SVP. Following this we surveyed 35 miles to the west across the outer shelf and over the shelf edge to about 600 m water depth on the slope. We then commenced a transect of 10 vibrocores up the slope and across the shelf. Recovery in the 3 slope cores (114-116VC) was generally reasonable (2.5-4.5 m) but recovery in the shelf cores (117-123VC) was generally low reaching a maximum of only 1.7 m. It appears to have been hindered by a layer of coarse gravelly sand at the seabed. We completed the last vibrocore station on the shelf in 91 m of water coring through what appears to be a moraine or grounding zone wedge on the sub-bottom profile record (123VC).

Friday August 8

We surveyed southwestwards across the shelf and onto the upper slope to about 300 m water depth. We then turned and proceeded to start a vibrocore transects collecting core 124VC on the upper slope in 240 m of water (recovery 5.72 m) followed by 125VC on the outermost shelf which recovered 1.08 m and bottomed out in stiff grey diamicton. We then proceeded to the next vibrocore station but the corer developed an electrical fault so we continued to survey eastwards across the shelf and then westwards on a line towards 55°56.00’N 09°40.00’W.

Saturday August 9

We completed the survey line to 55°56.00'N 09°40.00'W and then turned and surveyed north to 56°10.00'N 09°40.00'W. Here we turned east and surveyed for a few miles where we collected piston core 127PC in a thick sequence of acoustically stratified sediments in 1440 m of water. This only recovered 0.92 m so we redeployed at the same site and collected 6.86 m (128PC). Upon completion of the piston core site we surveyed east for about 40 miles onto the mid-shelf to 56°11.372'N 08°25.00'W. Upon completion of the survey line we turned west once more and transited back west along the line collecting a series of 9 vibrocores. 129VC recovered 1.3 m bottoming out in stiff grey diamicton. 130VC recovered 0.5 of gravel overlying a stiff grey diamicton.

Sunday August 10

Following completion of 131Vc (1.7 m recovery) significant electrical problems with the vibrocorer temporarily suspended vibrocoring operations. We therefore transited northwest to 56°26.679'N 09°38.944'W where we turned east and ran a survey for about 18 miles up the slope in order to pick sites for piston coring. Piston cores 133PC and 134PC were collected in waters depths of 1537 m and 1036 m respectively and recovered 6.88 m and 6.87 m. Following repair of the vibrocorer we proceeded upslope and collected a 3.36 m long vibrocorer in 783 m on the upper slope. We then surveyed east to 08°50.00'W where we turned south and surveyed to 56°11.018'N 089°51.480'W (the core site where we developed electrical problems with the vibrocorer during the previous night).

Monday August 11

We then recommenced a westwards transect of vibrocores that we had started the previous day with cores 6 cores remaining out of an original 9 to be completed. Although there is a hard seabed of sand and gravel across the shelf in this area we had generally reasonable recovery with several cores collecting ~4m of sediment and bottoming out in shelly stiff diamicton which is probably till, in some cases containing reworked shells (136VC-142VC). Upon completion of the coring transect we surveyed back east and then north to rejoin the survey commenced on the previous day and continued this east to 56°29.00'W08°22.00'W. We then turned and returned west to collect a transect of 5 vibrocores working east from 56°27.099'N 09°03.664'W collecting 143VC before midnight.

Tuesday August 12

We completed the remaining 4 cores on the transect. Two cores recovered over 6 m of sediment (144VC and 147VC). Core 146VC was notable in recovering a thick sequence of laminated muds above a massive stiff diamicton. We then transited east and commenced a series a multibeam and sub-bottom profiler survey running a series of NW-SE lines at the southern entrance to the Sea of Hebrides and north of Stanton Banks. We collected 3 vibrocores at the southeastern end of this survey, coring thick stratified sediments in bedrock basins and recovering over 5 m in two of the cores (148VC and 150VC). At 19.30 hrs we then commenced a 30 mile survey on a SSE heading directly east of Stanton Banks followed

by 4 vibrocores (151VC-154VC). We attempted a final core at 55°53.862'N 07°41.556'W but sea-state precluded the safe deployment of the vibrocorer and we commenced a transit towards the Porcupine Bank. This concluded work in the T7 (Malin Sea/Barra) transect area.

Wednesday August 13

We transited southwest to the outer shelf offshore Donegal Bay and proceeded south towards Porcupine Bank.

Thursday August 14

In the early hours of Thursday morning we slowed to carry out a short survey and then core a couple of outer shelf moraines between 54°36.190'N 010°42.300'W and 54°25.099'N 10°56.00'W (155VC-157VC). We continued to transit south reaching 53°50.00'N 11°50.00'W and the start of a survey of the outer northern sector of Porcupine Bank at about 11.00 hrs.

Friday August 15

We completed the Porcupine Bank survey at about 10.00 hrs and then proceeded to collect a series of vibrocores working (158VC-168VC) broadly west to east across the shelf. In general the seabed was 'hard' and the cores recovered sandy material. However, 158VC and 159VC bottomed out in sandy diamicton with shell fragments. We completed core 168VC just after midnight.

Saturday August 16

We continued coring on the outer Porcupine Bank transect recovering cores (169VC- 178VC) in increasingly rougher seas. Several cores 176-178 recovered glacigenic sediment. Following recovery of 178VC we cut short the rest of the coring transect and headed east across the 'Olex Moraine' and in towards Galway Bay to shelter from the impending bad weather.

Sunday August 17

We ran a series of swath lines SE-NW offshore of the Connemara coast imaging a series of basins infilled by acoustically stratified and draped sediments. We collected two piston cores in stratified basin fills (179PC and 180PC) recovering 5.72 m and 6.46 m respectively followed by vibrocores 181-182VC).

Monday August 18

We completed the coring transect offshore of Connemara with 183VC and 184PC (the recovering 7.9 m). We then transited to 53°06.495'N 10°17.845'W and at ca. 06.00 hrs commenced a transect of 14 vibrocores westwards across the 'Olex Moraine' and onto the Porcupine Bank once more collecting cores 185VC-196VC. Several cores recovered glacigenic sediments including laminated muds.

Tuesday August 19

We finished off the coring transect with cores 197-199VC and at ~07.00 hrs commenced a transect westwards across the Porcupine Bank to 53°22.189'N 14°17.464'W imaging impressive icebergs scours on route. Following completion of the survey line we commenced a transect of 6 vibrocores working eastwards including core 200VC.

Wednesday August 20

We completed the remaining 5 cores in the transect eastwards across the Porcupine Bank. Cores 200-204Vc had generally low recovery 0.3-1.79 m but cores 205VC and 206VC, the furthest east on the transect recovered 4.64 m and 4.45 m respectively and contained glacigenic (glacimarine?) sediments with shells. The remainder of this day was spent running a survey line eastwards across the Olex Moraine onto the inner shelf. Shortly before midnight we commenced a vibrocoring transect along this survey line. A broken cable on the vibrocorer on the first station necessitated some repairs and redeployment although only a bag sample was recovered (207VC).

Thursday August 21

We completed the remaining 5 vibrocores 208VC-212VC recovering up to 2.60 m including some apparently glacigenic sediment. We then ran transited eastwards across the shelf to 53°02.30'N 11°50.00'W, from where, at about 11.30 hrs we commenced a 55 mile survey to the southwest. About mid-way through the survey we broke off and transited on a north-westerly course and participated in a short drill with a helicopter of the Irish Coastguard. We finished the survey shortly before midnight.

Friday August 22

We collected 4 vibrocores (213VC-216VC) recovering from 0.37 m – 1.57 m. A final deployment just inshore of a mid-shelf moraine fragment collected a sample of gravel clasts and a repeat deployment at the same site fared similarly (217VC-218VC). Upon completion of the vibrocores we transited southwest and then turned and transited southeast passing the The Blasket Islands and the Dingle Peninsula. Just west of the Great Skellig we turned west and ran a line for over 20 miles towards the shelf edge. We cut this line short and returned to the start of the line and collected cores at 51°47.708'N 10°45.871'W (219VC; 4,19 m recovery) and 51°49.445'N, 10°46.728'W (220VC; 3.58 m recovery). We then surveyed southeast for 14 miles before turning northeast and running in about 12 miles towards Kenmare River. The seafloor was predominantly hard and sandy with extensive sand sheets imaged by the sub-bottom profiler. No cores were collected in this area on account of the hard substrate and we then turned and proceeded southwest before turning southeast again and running past the Beara Peninsula. At 51°24.00'N 10°28.20'W we turned northeast and ran in towards Bantry Bay over what appears to be a current reworked arcuate moraine.

Saturday August 23

We collected core 221VC in 109 m of water from just inshore of this moraine recovering 1.13 m of sediment. We transited directly east and then northeast running over a prominent moraine ridge southwest of Mizzen Peninsula and collecting vibrocores 222VC and 223VC in about 100 m recovering 3.42 m and 2.87 m of sediment respectively. These were the last cores to be collected on JC106.Upon completion at ~05.30 hrs we commenced transit for Southampton running on a south-easterly heading across the Celtic Sea.

Sunday August 24

We completed the transit across the Celtic Sea and continued east towards the Isle of Wight.

Monday August 25

We picked up the pilot at 08.30 hrs and were alongside on the NOC berth by 10.00 hrs. End of cruise JC106

2. Geophysical Operations

The RRS James Cook is equipped with 2 multibeam systems, the EM120 and the EM710 and the SBP120 sub-bottom profiler. The EM120 is a 12 khz system and it is the primary system for mapping purposes from 10 to 10.000 m. The devise is hull mounted on a fixed installation and does not require regular calibrations. The system is interfaced with both its acquisition system (SIS) and OLEX for routine data acquisition. The EM710 is a 70-100 khz system and it is used for higher resolution mapping in shallower waters (5-1500). This second multibeam is installed on one of the 2 available ship drop keels and does require patch test calibrations every time the drop keel is lowered. The Kongsberg SBP120 Sub-bottom profiler is installed as an extension of the EM120 and it was used throughout the survey in order to image the sediment layers and buried glacially related features. A Sonardyne Ranger USBL system provided underwater positioning during coring operations. Each acoustic devise is interfaced with all the required ancillary sensors. Appanix POS-MV is used as primary positioning and motion sensor while Seapath200 is the secondary system. Both systems are interfaced with a CNAV3050 which provides the required DGPS corrections. The performances of the acoustic equipment were fair. The data collected by both multibeam dataset did suffer from motion artefacts, limited swath coverage, along track artefacts (EM710) and substantial noise caused by keel aeration. The motion artefacts were most likely caused by issues with the way the POS-MV is setup onboard. The issue was eventually resolved when the Seapath200 was selected as primary motion sensor. All the acoustic devises were constantly in use during the survey and only temporarily stopped during coring operation.

Figure 10. Geophysical and hydrographic corner of the main lab. All scientific equipment including multibeam, sub-bottom profiler, navigation systems, Olex, USBL are rack mounted.

3. Coring

Coring operations on JC106 utilised a 6 m long BGS vibrocorer and a 12 m long NMFSS piston corer. Details of each core site are given in Table 1 below.

3.1 BGS Vibrocorer

The British Geological Survey was onboard as project partner during JC106 survey. They provided full vibrocoring support. The BGS vibrocorer weighs approximately 5000kg, in the super-heavyweight class, and can be deployed to a water depth of 2000m. The system consists of a 6 m hollow tube of steel (e.g. barrel), which is driven into the seafloor by a 1 tonne vibrating pot at the top of the barrel. The instrument is held in a vertical upright position by a three legged metal frame that keeps it from tipping over on the seabed. Once deployed, the instrument can remain on the seabed for several hours if needed to penetrate the sediment using vibrations. Various sensors allow monitoring the coring phase and the seabed resistance. The system also has a retracting engine which allows the core barrel to be retracted before recovering, reducing possible damage to the barrel. A team of 6 BGS technicians operated the instrument on a 24 hour operation. In general recovery was good depending on the nature of the substrate.

3.2 NMFSS Piston corer

The RRS James Cook is equipped with an 18 m piston corer as part of the NERC equipment pool. The piston corer is normally launched using a Launch And Recovery System (LARS)

from the starboard side and it is operated by the ship crew. During this survey leg, a 9 or 12 m barrel configuration was used. Images below show the system in its recovery position. A set of additional infrastructure such as dedicated crane and core barrel holders are provided in order to facilitate the overall operation.

3.3 Core analysis on-board ship during JC106

All vibrocores and piston cores recovered during JC106 were cut into 1 m long sections and were then run whole through a multi-sensor core (University of Leicester) to measure magnetic susceptibility, bulk density and p-wave velocity. They were then split and logged with information on sedimentary structures, colour, grain size, sorting, bedding contacts and macrofaunal content recorded. Measurement of sediment shear strength in kPa was recorded using a Torvane. Selected samples of marine carbonate (typically single or broken valves) were collected and stored for future submission for radiocarbon dating.

Figure 11. Recovery of piston corer, Malin Sea.

Table 1: Vibrocores (VC) and Piston Cores (PC) collected during cruise JC106

Core	*Date of collection*	*Grid reference*	*Location*	*Water depth (m)*	*Recovery (m)*	*Comments*

001VC	18/7/2014 JD199	50° 27.984'N 1° 3.257'W	Offshore Isle of Wight	38	0.55 (1 section)	Test core
002PC	20/7/2014 JD201	48° 14.832'N 9° 15.814'W	Celtic Sea – upper continental slope	459	4.03 (5 sections)	
003VC	20/7/2014 JD201	48° 19.442'N 8° 59.437'W	Celtic Sea - outer shelf	211	1.65 (2 sections)	First of six vibrocores on SW-NE transect
004VC	20/7/2014 JD201	48° 21.886'N 8° 50.638'W	Celtic Sea - outer shelf	169	1.10 (1 section)	
005VC	20/7/2014 JD201	48° 22.263'N 8° 49.234'W	Celtic Sea - outer shelf	179	1.42 (2 sections)	
006VC	20/7/2014 JD201	48° 22.363'N 8° 48.855'W	Celtic Sea - outer shelf	182	1.20 (2 sections)	
007VC	20/7/2014 JD201	48° 23.096'N 8° 46.212'W	Celtic Sea - outer shelf	175	3.40 (4 sections)	
008VC	20/7/2014 JD201	48° 19.632'N 8° 59.067'W	Celtic Sea - outer shelf	198	3.46 (4 sections)	
009VC	21/7/2014 JD202	48° 19.539'N 8° 59.047'W	Celtic Sea - outer shelf	197	2.57 (3 sections)	
010VC	21/7/2014 JD202	48° 47.661'N 10° 1.333'W	Celtic Sea - outer shelf	206	2.92 (5 sections)	
011VC	21/7/2014 JD202	48° 58.644'N 9° 56.584'W	Celtic Sea - outer shelf	172	0.43 (1 section)	First of six vibrocores on a N-S transect
012VC	21/7/2014 JD202	48° 58.744'N 9° 56.853'W	Celtic Sea - outer shelf	170	1.59 (2 sections)	
013VC	21/7/2014 JD202	48° 59.122'N 9° 57.089'W	Celtic Sea - outer shelf	168	3.3 (4 sections)	
014VC	22/7/2014 JD203	48° 59.101'N 9° 57.867'W	Celtic Sea - outer shelf	168	2.82 (3 sections)	
015VC	22/7/2014 JD203	48° 59.521'N 9° 58.969'W	Celtic Sea - outer shelf	165	2.17 (3 sections)	
016VC	22/7/2014 JD203	48° 59.967'N 10° 0.215'W	Celtic Sea - outer shelf	160	1.68 (2 sections)	
017VC	22/7/2014 JD203	49° 18.938'N 8° 58.938'W	Outer Celtic Sea	146	1.62 (2 sections)	
018VC	22/7/2014 JD203	49° 32.421'N 8° 59.625'W	Outer Celtic Sea	146	1.86 (2 sections)	First of four vibrocores on a NW-SE transect
019VC	22/7/2014 JD203	49° 32.343'N 8° 59.502'W	Outer Celtic Sea	145	1.62 (2 sections)	
020VC	22/7/2014 JD203	49° 31.941'N 8° 59.141'W	Outer Celtic Sea	143	1.52 (2 sections)	
021VC	22/7/2014 JD203	49° 31.338'N 8° 57.974'W	Outer Celtic Sea	137	1.40 (2 sections)	

022VC	23/7/2014 JD204	49° 47.693'N 8° 36.405'W	Central Celtic Sea	142	1.28 (2 sections)	First of six vibrocores on a SW-NE transect
023VC	23/7/2014 JD204	49° 48.093'N 8° 38.156'W	Central Celtic Sea	122	2.04 (2 sections)	
024VC	23/7/2014 JD204	49° 49.252'N 8° 43.04'W	Central Celtic Sea	125	0.38 (1 section)	
025VC	23/7/2014 JD204	49° 49.473'N 8° 44.011'W	Central Celtic Sea	129	0.41 (1 section)	
026VC	23/7/2014 JD204	49° 59.435'N 8° 17.495'W	Central Celtic Sea	131	1.72 (2 sections)	
027VC	23/7/2014 JD204	49° 59.971'N 8° 20.461'W	Central Celtic Sea	134	1.85 (2 sections)	
028VC	23/7/2014 JD204	49° 57.812'N 8° 18.699'W	Central Celtic Sea	125	1.42 (2 sections)	
029VC	23/7/2014 JD204	49° 57.798'N 8° 19.005'W	Central Celtic Sea	122	1.40 (2 sections)	
030VC	23/7/2014 JD204	49° 57.738'N 8° 20.325'W	Central Celtic Sea	124	1.78 (2 sections)	
031VC	23/7/2014 JD204	49° 57.746'N 8° 20.332'W	Central Celtic Sea	125	1.74 (2 sections)	
032VC	23/7/2014 JD204	49° 57.729'N 8° 20.464'W	Central Celtic Sea	125	1.94 (2 sections)	
033VC	24/7/2014 JD205	50° 16.458'N 8° 20.713'W	Central Celtic Sea	132	1.82 (2 sections)	
034VC	24/7/2014 JD205	50° 11.167'N 8° 21.027'W	Central Celtic Sea	118	1.90 (2 sections)	
035VC	24/7/2014 JD205	50° 16.271'N 8° 20.713'W	Central Celtic Sea	130	2.63 (3 sections)	
036VC	25/7/2014 JD206	50° 52.587'N 8° 59.261'W	Central Celtic Sea	116	0.58 (1 section)	First of ten vibrocores on the "fastnet" transect from near SE Ireland over Labadie and North West Bank
037VC	25/7/2014 JD206	50° 49.996'N 8° 54.576'W	Central Celtic Sea	119	0.00 (0 sections)	
038VC	25/7/2014 JD206	50° 49.989'N 8° 54.563'W	Central Celtic Sea	120	0.30 (1 section)	
039VC	25/7/2014 JD206	50° 46.187'N 8° 47.865'W	Central Celtic Sea	119	0.79 (1 section)	
040VC	25/7/2014 JD206	50° 46.187'N 8° 47.854'W	Central Celtic Sea	119	0.60 (1 section)	
041VC	25/7/2014 JD206	50° 41.727'N 8° 39.997'W	Central Celtic Sea	119	1.29 (2 sections)	
042VC	25/7/2014 JD206	50° 39.584'N 8° 36.155'W	Central Celtic Sea	123	1.39 (2 sections)	
043VC	25/7/2014 JD206	50° 36.454'N 8° 28.356'W	Central Celtic Sea	99	1.00 (1 section)	

044VC	25/7/2014 JD206	50° 33.621'N 8° 19.304'W	Central Celtic Sea	125	2.02 (3 sections)	
045VC	25/7/2014 JD206	50° 33.612'N 8° 19.303'W	Central Celtic Sea	125	2.17 (3 sections)	
046VC	26/7/2014 JD207	50° 26.67'N 8° 11.286'W	Central Celtic Sea	121	0.80 (1 section)	
047VC	26/7/2014 JD207	50° 23.086'N 8° 3.031'W	Central Celtic Sea	134	0.88 (1 section)	
048VC	26/7/2014 JD207	51° 6.588'N 6° 20.989'W	Celtic Deep	110	3.20 (4 sections)	First of 6 vibro- and piston cores on a S-N transect. 048VC at approx. same location as BGS core +51-007 218
049PC	27/7/2014 JD208	51° 13.093'N 6° 15.231'W	Celtic Deep	133	7.17 (8 sections)	
050PC	27/7/2014 JD208	51° 14.502'N 6° 14.057'W	Celtic Deep	128	7.11 (8 sections)	
051PC	27/7/2014 JD208	51° 20.742'N 6° 11.091'W	Celtic Deep	116	6.29 (7 sections)	
052PC	27/7/2014 JD208	51° 21.976'N 6° 9.91'W	Celtic Deep	116	7.58 (8 sections)	
053VC	27/7/2014 JD208	51° 25.481'N 6° 8.673'W	Celtic Deep	108	4.47 (5 sections)	
054VC	28/7/2014 JD209	53° 15.97'N 5° 7.644'W	Southern Irish Sea	146	3.19 (4 sections)	
055VC	28/7/2014 JD209	53° 16.031'N 5° 8.275'W	Southern Irish Sea	160	1.31 (2 sections)	
056VC	28/7/2014 JD209	53° 36.945'N 4° 50.351'W	Liverpool Bay	65	5.50 (6 sections)	
057VC	28/7/2014 JD209	53° 37.555'N 4° 49.703'W	Liverpool Bay	65	5.34 (6 sections)	
058VC	28/7/2014 JD209	53° 37.671'N 4° 49.371'W	Liverpool Bay	64	3.80 (5 sections)	
059PC	28/7/2014 JD209	53° 37.55'N 4° 49.69'W	Liverpool Bay	64	3.64 (4 sections)	Approx. same location as core 057VC
060VC	28/7/2014 JD209	53° 41.396'N 4° 39.964'W	Liverpool Bay	66	1.89 (2 sections)	
061VC	28/7/2014 JD209	53° 41.728'N 4° 39.139'W	Liverpool Bay	70	1.90 (2 sections)	
062VC	28/7/2014 JD209	53° 40.233'N 4° 30.769'W	Liverpool Bay	85	3.16 (4 sections)	
063VC	29/7/2014 JD210	53° 39.523'N 4° 30.463'W	Liverpool Bay	91	5.77 (6 sections)	

064VC	29/7/2014 JD210	53° 41.313'N 4° 27.645'W	Liverpool Bay	73	3.52 (4 sections)	
065VC	29/7/2014 JD210	53° 36.516'N 4° 10.424'W	Liverpool Bay	48	1.25 (2 sections)	
066VC	29/7/2014 JD210	53° 36.671'N 4° 9.453'W	Liverpool Bay	50	0.67 (1 section)	
067VC	29/7/2014 JD210	53° 37.638'N 4° 3.278'W	Liverpool Bay	49	3.85 (4 sections)	
068VC	29/7/2014 JD209	53° 36.668'N 4° 2.477'W	Liverpool Bay	49	3.05 (4 sections)	
069VC	29/7/2014 JD210	53° 44.461'N 4° 6.865'W	Central Irish Sea	47	0.71 (1 section)	
070VC	29/7/2014 JD210	53° 43.885'N 4° 9.369'W	Central Irish Sea	42	0.72 (1 section)	
071VC	29/7/2014 JD210	53° 45.145'N 4° 26.066'W	Central Irish Sea	61	4.84 (5 sections)	
072VC	29/7/2014 JD210	53° 45.539'N 4° 26.009'W	Central Irish Sea	68	2.65 (3 sections)	
073VC	30/7/2014 JD211	53° 50.418'N 4° 35.447'W	Central Irish Sea	67	4.04 (5 sections)	
074VC	30/7/2014 JD211	53° 50.771'N 4° 35.703'W	Central Irish Sea	78	5.58 (6 sections)	
075VC	30/7/2014 JD211	53° 50.79'N 4° 38.797'W	Central Irish Sea	67	3.27 (4 sections)	
076VC	30/7/2014 JD211	53° 56.94'N 4° 19.397'W	Central Irish Sea	48	3.80 (4 sections)	
077VC	30/7/2014 JD211	53° 57.942'N 4° 17.269'W	Central Irish Sea	44	4.80 (5 sections)	
078VC	30/7/2014 JD211	54° 2.916'N 4° 5.453'W	Central Irish Sea	41	0.74 (1 section)	
079VC	30/7/2014 JD211	54° 3.36'N 4° 3.786'W	Central Irish Sea	40	1.05 (2 sections)	
080VC	30/7/2014 JD211	54° 4.56'N 4° 6.503'W	Central Irish Sea	38	2.05 (3 sections)	
081VC	30/7/2014 JD211	54° 17.38'N 3° 52.234'W	Central Irish Sea	41	4.32 (5 sections)	
082VC	30/7/2014 JD211	54° 18.993'N 3° 47.754'W	Central Irish Sea	42	4.56 (5 sections)	
083VC	30/7/2014 JD211	54° 21.762'N 3° 48.792'W	Central Irish Sea	42	5.11 (6 sections)	
084VC	01/08/2014 JD213	54° 35.247'N 4° 15.912'W	Central Irish Sea	63	4.48 (5 sections)	First of three cores from offshore Solway Firth
085VC	01/08/2014 JD213	54° 35.769'N 4° 13.776'W	Central Irish Sea	72	5.97 (6 sections)	
086VC	01/08/2014 JD213	54° 35.851'N 4° 13.448'W	Central Irish Sea	68	2.59 (3 sections)	
087VC	01/08/2014 JD213	54° 19.382'N 5° 1.814'W	Irish Sea, west of Isle	133	5.20 (6 sections)	

			of Man			
088PC	01/08/2014 JD213	54° 19.414'N 5° 1.395'W	Irish Sea, west of Isle of Man	134	5.91 (7 sections)	
089VC	2/8/2014 JD214	55° 30.442'N 7° 51.483'W	South Malin Sea	67	No recovery	First of three cores taken on transit to Donegal Bay
090VC	2/8/2014 JD214	55° 30.376'N 7° 48.591'W	South Malin Sea	65	No recovery	
091VC	2/8/2014 JD214	55° 29.745'N 8° 2.734'W	South Malin Sea	76	0.62 (2 sections)	
092VC	3/8/2014 JD215	54° 24.331'N 9° 10.608'W	Inner Donegal Bay	75	2.7 (3 sections)	First core taken in Donegal Bay
093VC	5/8/2014 JD217	54° 33.898'N 8° 59.177'W	Inner Donegal Bay	81.6	3.55 (4 sections)	First of 3 cores taken across the inner Donegal Bay moraine
094VC	5/8/2014 JD217	54° 34.009'N 9° 0.049'W	Inner Donegal Bay	75.6	0.86 (1 sections)	
095VC	5/8/2014 JD217	54° 34.238'N 9° 1.832'W	Inner Donegal Bay	77.6	2.31 (3 sections)	
096VC	5/8/2014 JD217	54° 28.913'N 9° 10.181'W	Inner Donegal Bay	75	3.06 (4 sections)	First of four cores from southern Donegal Bay
097VC	5/8/2014 JD217	54° 27.287'N 9° 10.322'W	Inner Donegal Bay		4.71 (5 sections)	
098VC	5/8/2014 JD217	54° 26.115'N 9° 10.446'W	Outer Donegal Bay	75	0	First of 8 cores along a SE to NW line outer Donegal Bay
099VC	5/8/2014 JD217	54° 36.218'N 9° 20.139'W	Outer Donegal Bay	99	4.75 (5 sections)	
100VC	5/8/2014 JD217	54° 36.243'N 9° 20.496'W	Outer Donegal Bay	99	4.97 (5 sections)	
101VC	5/8/2014 JD217	54° 36.784'N 9° 25.241'W	Outer Donegal Bay	100	5.65 (6 sections)	
102VC	5/8/2014 JD217	54° 37.407'N 9° 31.134'W	Outer Donegal Bay	90.5	2.52 (3 sections)	
103VC	6/8/2014 JD218	54° 38.438'N 9° 35.833'W	Outer Donegal Bay	100	1.49 (2 sections)	

104VC	6/8/2014 JD218	54° 40.393'N 9° 41.239'W	Outer Donegal Bay	102	0.94 (1 sections)	
105VC	6/8/2014 JD217	54° 40.917'N 9° 42.838'W	Outer Donegal Bay	108	5.82 (6 sections)	
106VC	6/8/2014 JD218	54° 41.202'N 9° 43.656'W	Outer Donegal Bay	105	3.94 (4 sections)	
107VC	6/8/2014 JD217	54° 48.783'N 10° 4.829'W	Donegal Bay	117	1.22 (2 sections)	First of 5 cores from outer Donegal Bay (shelf edge)
108VC	6/8/2014 JD218	54° 49.023'N 10° 5.607'W	Donegal Bay	119	0.45 (1 sections)	
109VC	6/8/2014 JD218	54° 49.521'N 10° 7.189'W	Donegal Bay	120	0	
110VC	6/8/2014 JD218	54° 49.714'N 10° 7.808'W	Donegal Bay	122.7	0.31 (1 sections)	
111VC	6/8/2014 JD218	54° 49.739'N 10° 7.881'W	Donegal Bay	123	0.3 (1 sections)	
112VC	6/8/2014 JD218	54° 50.708'N 10° 10.882'W	Donegal Bay	125	1 (1 sections)	
113VC	6/8/2014 JD218	54° 50.742'N 10° 10.98'W	Donegal Bay		0.23 (1 sections)	
114VC	7/8/2014 JD219	55° 40.886'N 9° 25.613'W	Malin Sea	568.6	4.42 (5 sections)	First of 12 cores from inner shelf to shelf edge in SE Malin sea
115VC	7/8/2014 JD219	55° 40.809'N 9° 22.178'W	Malin Sea	384	3.67 (4 sections)	
116VC	7/8/2014 JD219	55° 40.778'N 9° 20.352'W	Malin Sea	258	2.36 (3 sections)	
117VC	7/8/2014 JD219	55° 40.797'N 9° 18.547'W	Malin Sea	178.2	0	
118VC	7/8/2014 JD219	55° 40.796'N 9° 18.452'W	Malin Sea	178	1.7 (2 sections)	
119VC	7/8/2014 JD219	55° 40.802'N 9° 15.679'W	Malin Sea	131	1.32 (2 sections)	
120VC	7/8/2014 JD219	55° 40.828'N 9° 4.539'W	Malin Sea	110.8	0.95 (11 sections)	
121VC	7/8/2014 JD219	55° 40.85'N 8° 59.452'W	Malin Sea	114	0.6 (1sections)	
122VC	7/8/2014 JD219	55° 39.029'N 8° 24.18'W	Malin Sea	95	0.6 (1 sections)	
123VC	7/8/2014 JD219	55° 37.531'N 8° 27.678'W	Malin Sea	91	1.435 (3 sections)	
124VC	8/8/2014 JD220	55° 42.66'N 9° 20.591'W	Malin Sea	240	5.84 (6 sections)	
125VC	8/8/2014	55° 44.02'N	Malin Sea	129	1.08	

	JD220	9° 15.088'W			(2 sections)	
126VC	9/8/2014 JD221	55°45.270'N 09°10.072'W	Malin Sea		No recovery	
127PC	9/8/2014 JD221	56° 10.282'N 9° 36.988'W	Malin Sea	1478	0.92 (2 sections)	First of 9 cores taken along an east to west transect (not in numerical order
128PC	9/8/2014 JD221	56° 10.288'N 9° 37.005'W	Malin Sea	1475	6.86 (7 sections)	
129VC	9/8/2014 JD221	56° 11.367'N 8° 33.183'W	Malin Sea	130	1.33 (3 sections)	
130VC	9/8/2014 JD221	56° 11.115'N 8° 34.802'W	Malin Sea	126	0.5 (1 sections)	
131VC	9/8/2014 JD221	56° 11.051'N 8° 49.828'W	Malin Sea	135	1.69 (2 sections)	
132VC	9/8/2014 JD221	56° 11.000'N 8° 51.509'W	Malin Sea		No recovery	
133PC	10/8/2014 JD222	56° 26.67'N 9° 40.333'W	Malin Sea	1537	6.88 (2 sections)	First of the most northerly transect of 7 cores from inner shelf to shelf edge
134PC	10/8/2014 JD222	56° 26.683'N 9° 19.274'W	Malin Sea	1036	6.87 (7 sections)	
135VC	10/8/2014 JD222	56° 26.68'N 9° 11.185'W	Malin Sea	783	3.38 (4 sections)	
136VC	11/8/2014 JD223	56° 11.021'N 8° 51.469'W	Malin Sea	124	3.92 (4 sections)	
137VC	11/8/2014 JD223	56° 10.951'N 8° 55.104'W	Malin Sea	141	0.34 (1 sections)	
138VC	11/8/2014 JD223	56° 10.619'N 8° 58.782'W	Malin Sea	148.5	0.275 (1 sections)	
139VC	11/8/2014 JD223	56° 10.625'N 8° 58.78'W	Malin Sea	148.8	3.67 (4 sections)	
140VC	11/8/2014 JD223	56° 10.159'N 9° 3.97'W	Malin Sea	167.12	4.235 (5 sections)	
141VC	11/8/2014 JD223	56° 10.095'N 9° 10.164'W	Malin Sea	190	0.61 (1 sections)	
142VC	11/8/2014 JD223	56° 10.102'N 9° 10.825'W	Malin Sea	201	2.93 (3 sections)	
143VC	11/8/2014 JD223	56° 27.099'N 9° 3.669'W	Malin Sea	272	3.63 (4 sections)	
144aVC	11/8/2014 JD223	56° 27.121'N 9° 3.381'W	Malin Sea	243	0	
144bVC	12/8/2014 JD224	56° 27.125'N 9° 3.374'W	Malin Sea	243	6.08 (6 sections)	
145VC	12/8/2014 JD224	56° 28.017'N 8° 52.465'W	Malin Sea	147	3.98 (4 sections)	
146VC	12/8/2014	56° 28.377'N	Malin Sea	150	4.14	

	JD224	8° 42.418'W			(5 sections)	
147VC	12/8/2014 JD224	56° 29.042'N 8° 26.784'W	Malin Sea	158	6 (6 sections)	
148VC	12/8/2014 JD224	56° 23.201'N 7° 25.646'W	Malin Sea	121	5.02 (5 sections)	First of 7 cores in a north to south transect in central Malin sea
149VC	12/8/2014 JD224	56° 23.837'N 7° 26.928'W	Malin Sea	4.5	4.5 (5 sections)	
150VC	12/8/2014 JD224	56° 23.983'N 7° 27.221'W	Malin Sea	140	5.27 (6 sections)	
151VC	13/8/2014 JD225	56° 8.428'N 7° 32.263'W	Malin Sea	122	4.1 (5 sections)	
152VC	13/8/2014 JD225	56° 15.094'N 7° 35.249'W	Malin Sea	113	0	
153VC	13/8/2014 JD225	56° 15.101'N 7° 35.243'W	Malin Sea		3.35 (4 sections)	
154VC	13/8/2014 JD225	56° 19.515'N 7° 37.083'W	Malin Sea	138	2.7 (2 sections)	
155VC	14/08/2014 JD226	54° 34.638'N 10° 44.178'W	Galway Bay	370	0.54 (1 sections)	First of three cores taken on transit to northern Porcupine Bank
156VC	14/08/2014 JD226	54° 35.673'N 10° 42.905'W	Galway Bay	389	0.05	
157VC	14/08/2014 JD226	54° 25.434'N 10° 55.523'W	Galway Bay	344	4.27 (5 sections)	
158VC	15/08/2014 JD227	53° 48.117'N 13° 7.35'W	Galway Bay	295	2.28 (3 sections)	
159VC	15/08/2014 JD227	53° 47.441'N 12° 59.977'W	Galway Bay	316	0.76 (1 sections)	First of 20 cores taken from north Porcupine Bank
160VC	15/08/2014 JD227	53° 46.858'N 13° 0.785'W	Galway Bay	297.5	1.63 (2 sections)	
161VC	15/08/2014 JD227	53° 44.876'N 12° 59.442'W	Galway Bay	267	0.51 (1 sections)	
162VC	15/08/2014 JD227	53° 43.661'N 13° 1.297'W	Galway Bay	262	0.23 (1 sections)	
163VC	15/08/2014 JD227	53° 42.905'N 13° 2.447'W	Galway Bay	249	1.12 (2 sections)	
164VC	15/08/2014 JD227	53° 41.824'N 13° 4.109'W	Galway Bay	252	0.51 (1 sections)	
165VC	15/08/2014 JD227	53° 38.376'N 13° 7.121'W	Galway Bay	253	2.62 (3 sections)	
166VC	15/08/2014 JD227	53° 39.1'N 12° 45.995'W	Galway Bay	255	1.36 (2 sections)	
167VC	15/08/2014 JD227	53° 39.376'N 12° 46.022'W	Galway Bay	257	0.98 (2 sections)	
168VC	15/08/2014	53° 39.72'N	Galway Bay	246	0.67	

	JD227	12° 42.543'W			(1 sections)	
169VC	16/08/2014 JD228	53° 41.457'N 12° 41.799'W	Galway Bay	277	1.02 (1 sections)	
170VC	16/08/2014 JD228	53° 45.083'N 12° 46.647'W	Galway Bay	267	0.38 (1 sections)	
171VC	16/08/2014 JD228	53° 45.089'N 12° 46.645'W	Galway Bay	267	No recovery	
172VC	16/08/2014 JD228	53° 47.555'N 12° 46.875'W	Galway Bay	271	1.35 (2 sections)	
173VC	16/08/2014 JD228	53° 47.866'N 12° 46.914'W	Galway Bay	271	0.75 (1 sections)	
174VC	16/08/2014 JD228	53° 47.901'N 12° 27.756'W	Galway Bay	345	1.33 (2 sections)	
175VC	16/08/2014 JD228	53° 45.22'N 12° 24.716'W	Galway Bay	325	2.38 (3 sections)	
176VC	16/08/2014 JD228	53° 38.855'N 12° 17.386'W	Galway Bay	292	2.08 (3 sections)	
177VC	16/08/2014 JD228	53° 36.373'N 12° 4.896'W	Galway Bay	277	2.34 (3 sections)	
178VC	16/08/2014 JD228	53° 36.501'N 12° 4.602'W	Galway Bay	298	0.5 (1 sections)	
179PC	17/08/2014 JD229	53° 15.545'N 10° 8.909'W	Galway Bay	111	5.72 (6 sections)	First of 6 cores from offshore south Connemara
180PC	17/08/2014 JD229	53° 18.322'N 10° 12.677'W	Galway Bay	112	6.49 (7 sections)	
181VC	17/08/2014 JD229	53° 17.97'N 10° 13.235'W	Galway Bay	116	2.16 (3 sections)	
182VC	17/08/2014 JD229	53° 19.291'N 10° 15.166'W	Galway Bay	109	0.66 (1 sections)	
183VC	18/08/2014 JD230	53° 19.293'N 10° 15.158'W	Galway Bay	109	0.73 (1 sections)	
184PC	18/08/2014 JD230	53° 20.049'N 10° 16.551'W	Galway Bay	100	7.9 (8 sections)	
185VC	18/08/2014 JD230	53° 6.492'N 10° 17.844'W	Galway Bay	90.5	0.39 (1 sections)	First of a series of cores taken along a SE to NW transect out of Galway bay and over the Olex moraine
186VC	18/08/2014 JD230	53° 6.494'N 10° 17.836'W	Galway Bay	90	2.7 (6 sections)	
187VC	18/08/2014 JD230	53° 12.038'N 10° 40.455'W	Galway Bay	124	0.68 (1 sections)	
188VC	18/08/2014 JD230	53° 16.675'N 10° 56.684'W	Galway Bay	137	0.95 (6 sections)	
189VC	18/08/2014 JD230	53° 18.993'N 11° 2.319'W	Galway Bay	142	1.5 (2 sections)	
190VC	18/08/2014	53° 21.818'N	Galway Bay	149	1.97	

	JD230	11° 9.173'W			(2 sections)	
191VC	18/08/2014 JD230	53° 21.889'N 11° 9.352'W	Galway Bay	150	2.41 (4 sections)	
192VC	18/08/2014 JD230	53° 23.266'N 11° 12.743'W	Galway Bay	142	0.93 (1sections)	
193VC	18/08/2014 JD230	53° 25.008'N 11° 17.092'W	Galway Bay	146	2.58 (3 sections)	
194VC	18/08/2014 JD230	53° 33.31'N 11° 42.048'W	Galway Bay	240	5.24 (7 sections)	Set of 6 cores from east of the Olex moraine
195VC	18/08/2014 JD230	53° 34.237'N 11° 43.13'W	Galway Bay	236	4.18 (5 sections)	
196VC	18/08/2014 JD230	53° 34.414'N 11° 43.295'W	Galway Bay	235	2.38 (3 sections)	
197VC	19/08/2014 JD231	53° 45.064'N 11° 53.655'W	Galway Bay	278	2.44 (3 sections)	
198VC	19/08/2014 JD231	53° 49.389'N 11° 50.428'W	Galway Bay	290	3.85 (4 sections)	
199VC	19/08/2014 JD231	53° 36.677'N 12° 4.23'W	Galway Bay	302	3.29 (4 sections)	
200VC	19/08/2014 JD231	53° 16.168'N 14° 14.617'W	Galway Bay	210	1.79 (2 sections)	First of 13 cores from the Porcupine shelf edge to inner shelf
201VC	20/08/2014 JD232	53° 18.352'N 14° 9.137'W	Galway Bay	196	0.31 (1 sections)	
202VC	20/08/2014 JD232	53° 25.952'N 13° 6.254'W	Galway Bay	223	No recovery	
203VC	20/08/2014 JD232	53° 25.953'N 13° 6.244'W	Galway Bay	222	0.69 (1 sections)	
204VC	20/08/2014 JD232	53° 24.458'N 12° 57.175'W	Galway Bay	267	0.95 (1 sections)	
205VC	20/08/2014 JD232	53° 20.087'N 12° 28.955'W	Galway Bay	344	4.65 (5 sections)	
206VC	20/08/2014 JD232	53° 23.416'N 12° 24.555'W	Galway Bay	341	4.45 (5 sections)	
207VC	20/08/2014 JD232	52° 59.396'N 11° 23.98'W	Galway Bay	145	No recovery	
208VC	21/08/2014 JD233	52° 59.477'N 11° 24.822'W	Galway Bay	145	1.0 (1 section)	
209VC	21/08/2014 JD233	52° 59.533'N 11° 25.58'W	Galway Bay	142	1.77 (2 sections)	
210VC	21/08/2014 JD233	53° 0.976'N 11° 38.502'W	Galway Bay	156	2.69 (3 sections)	
211VC	21/08/2014 JD233	53° 1.556'N 11° 43.657'W	Galway Bay	160	1.94 (2 sections)	
212VC	21/08/2014 JD233	52° 57.625'N 11° 6.147'W	Galway Bay	135	0.77 (1 Section)	
213VC	21/08/2014	52° 39.449'N	Galway Bay	118	1.57	First of 6 cores

	JD233	10° 33.914'W			(2 sections)	along a NE to SW transect in outer Galway Bay
214VC	22/08/2014 JD234	52° 38.215'N 10° 43.526'W	Galway Bay	125	1.19 (2 Sections)	
215VC	22/08/2014 JD234	52° 38.07'N 10° 43.585'W	Galway Bay	127	1.22 (2 Sections)	
216VC	22/08/2014 JD234	52° 25.822'N 10° 51.263'W	Galway Bay	127	0.37 (1 Section)	
217VC	22/08/2014 JD234	52° 21.281'N 10° 56.9'W	Galway Bay	125	No recovery	
218VC	22/08/2014 JD234	52° 21.28'N 10° 56.911'W	Galway Bay	125	No recovery	
219VC	22/08/2014 JD234	51° 47.681'N 10° 45.852'W	Southwest Ireland	134	4.19 (5 Sections)	First of 5 cores from southwest Ireland
220VC	22/08/2014 JD234	51° 49.418'N 10° 46.716'W	Southwest Ireland	131	3.57 (4 Sections)	
221VC	23/08/2014 JD235	51° 27.553'N 10° 17.011'W	Southwest Ireland	109	1.13 (2 Sections)	
222VC	23/08/2014 JD235	51° 22.873'N 10° 0.925'W	Southwest Ireland	91	3.42 (4 Sections)	
223VC	23/08/2014 JD235	51° 22.759'N 10° 1.108'W	Southwest Ireland	92	2.87 (3 Sections)	

Appendix 1

Hydrographic Equipment – JC106 Settings & Notes

Introduction

Hydrographic suite used during JC106:

SBP120 (Sub-bottom profiler) [2500-6500Hz]

EM710 (Shallow-water multi-beam echosounder)

EM120 (Deep-water multi-beam)

EA600 (Single-beam) [12kHz]

SBP120

The SBP was run for most of the cruise. With the exception of the start of the cruise, it was not externally triggered by the K-Sync (synchronization unit).

Raw and SEGY data was logged throughout the cruise.

[For all settings and details refer to 'NMF SBP120 Configuration&Notes – Appendix - JC106']

EM120

Survey Name: JC106_1

Grid Cell Size: 5.60m

No. of cells in processing grid: 256

Projection: MERCATOR_WGS84

Lines Logged:

18/07/2014 – 02/07/2014 (Line 0000 to 0602)

05/08/2014 – 06/08/2014 (Line 0613 to 0638)

Notes: The EM120 was not used after 05/08/2014 in order to maximize the reliability of the SBP120 data when moving from coring/DP stations. It was also found that when the EM120 lost depth when the ship was pitching, it would appear to result in worse SBP performance/recovery. As most of the swath was collected in shallow water <500m the EM120 data was much less important than both the SBP120 and the EM710.

The EM120 was not externally triggered by the K-Sync.

[Screenshots taken of all Installation/Runtime parameters.]

Installation Parameters

Positioning System Ports: COM1

Attitude Sensor Settings: COM2

Heading: COM2

Tx/Rx Opening Angle 1x1 (degrees)

Runtime Parameters

Maximum Coverage and Coverage Mode both generally left as ‘AUTO’ but sometimes Force Dep. was used to help bottom detection and Max. Angle/Coverage was set as below:

Max Angle: Operated between 60-70degrees during different depths and sea states.

Max Coverage: Operated between 400-800m during different depths and sea states.

Sound Speed – Sound Speed at Transducer – Source: SENSOR

EM710

The EM710 was run for virtually the entire cruise. With the exception of the start of the cruise, the system was not externally triggered by the K-Sync.

[Screenshots taken of all Installation/Runtime parameters.]

Survey Name: JC106 *(created 2014-7-18 15:50:49)*

Grid Cell Size: 5.10m

No. of cells in processing grid: 128

Projection: MERCATOR_WGS84

Installation Parameters

Positioning System Ports: COM1

Attitude Sensor Settings: **COM3 (Seapath)**

Heading: **COM3 (Seapath)**

Tx/Rx Opening Angle 2x2 (degrees)

Note: Seapath input used instead of POS-MV due to heave artifact (Refer to 'EM710-EM120 Patch test – CHRONO.docx' for details [F. Sacchetti]).

Runtime Parameters

Maximum Coverage and Coverage Mode both generally left as 'AUTO' but sometimes Min/Max/Force Dep. was used to help bottom detection and Max. Angle/Coverage was set as below.

Max Angle: Operated between 60-70degrees during different depths and sea states.

Max Coverage: Operated between 400-800m during different depths and sea states.

Note: the outer beams of the EM710 were identified early on by the science party as giving poor swath data. This was assumed to be because of the running of the EM710 with the drop keel flush to the hull, rather than fully-deployed.

Calibration – EM710/EM120

Refer to *'EM710-EM120 Patch Test – CHRONO.docx' [F. Sacchetti]* for details on the calibration of the EM710 (flush drop-keel) and application of the identified offsets. The document also includes calibration checks of the EM120 (hull-mounted).

Sound Velocity Profiles

Valeport Midas SVP (S/N: 22355) was used for collecting all sound velocity profiles during the cruise.

The below SVPs were collected, processed and loaded into the multibeam and USBL systems:

20/07/2014 02:14 (FILE9.000) JC106_1

22/07/2014 18:14

23/07/2014 06:06 (FILE14.000) JC106_3

24/07/2014 10:28 (FILE15.000) JC106_4

24/07/2014 19:14

27/07/2014 23:43 (FILE17.000) JC106_5

31/07/2014 01:08 (FILE20.000) JC106_6

02/07/2014 20:17

07/08/2014 00:57 (FILE23.000) JC106_7

11/08/2014 11:46 (FILE26.000) JC106_8

17/08/2014 06:09 (FILE27.000) JC106_9

USBL Beacon

The below Sondardyne USBL beacons were successfully used during the cruise to provide seafloor core positions.

WSM Address: 4701 [Wideband Sub-mini]

SSM HPR B12 [Super-Sub Mini]

SSM HPR B14 [Super-Sub Mini]

EA600

The 12KHz EA600 Single-Beam echo-sounder was run for most of the cruise. It was used as another depth indicator, particularly when the EM120 was not being used and depths beyond the EM710 (>1000m) were encountered.

Draught: 6.8m (set to correct value of 5.5m 22:55 17/08/2014)

K-Sync (Synchronisation Unit)
The EM710/120 and SBP120 were not externally triggered by the K-Sync. The EA600 ping rate was the only system triggered by K-Sync.

Appendix 2

SBP120 Configuration – JC106

Introduction

Screen captures were taken of all SBP parameters during JC106. Some were modified at various points of the cruise, but the images provide a guide to how the system was configured. Some explanation on configuration selection is also included (made from the experiences of operating the equipment during the cruise).

System - Runtime Parameters

Changing any of the runtime parameters will result in a new line (data file) being created. The exception is the ***Acquisition Delay*** that may be adjusted manually without causing the current line to be ended.

'Calculate delay from depth' was not used for most of the cruise due to potential interference from the EM120. Early on this function was used but the SBP appeared to be more reliable when running without the EM120 (and using its depth). Note: for much of the cruise the EM120 was switched off.

Automatic Slope Detection was left on for most of the cruise – the only exception being during the crossings of the Continental Slope when switching it off should provide better returns from reflectors below the surface (at the expense of the surface return).

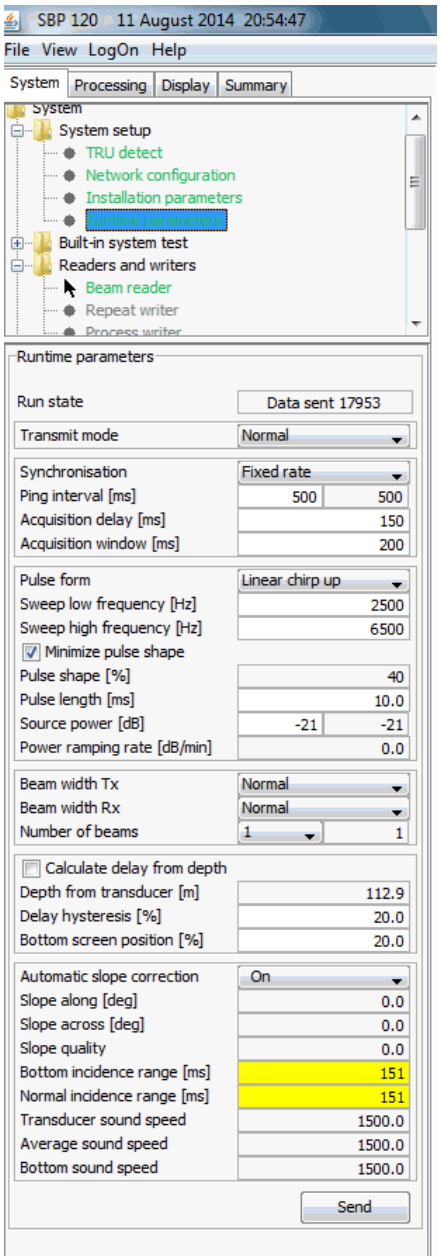
Pulse Length was generally 10ms (water depth 200-300m). Kongsberg suggest using shorter pulse lengths and increased power for particularly shallow survey. In these situations 5ms was used in order to reduce ringing from the surface.

Source Power was generally -30 to -21dB. -30dB is the minimum power of the SBP and in situations where pinging has stopped at this level, it may be resumed again within <30minutes without the need for an MMO soft start. Power levels greater than -30dB will need to be resumed within 10 minutes to avoid a soft start (or ramped down to -30dB if possible prior to the cessation of pinging).

Number of Beams used was always 1 – using an increased number resulted in problems importing the SBP data into Kingdom.

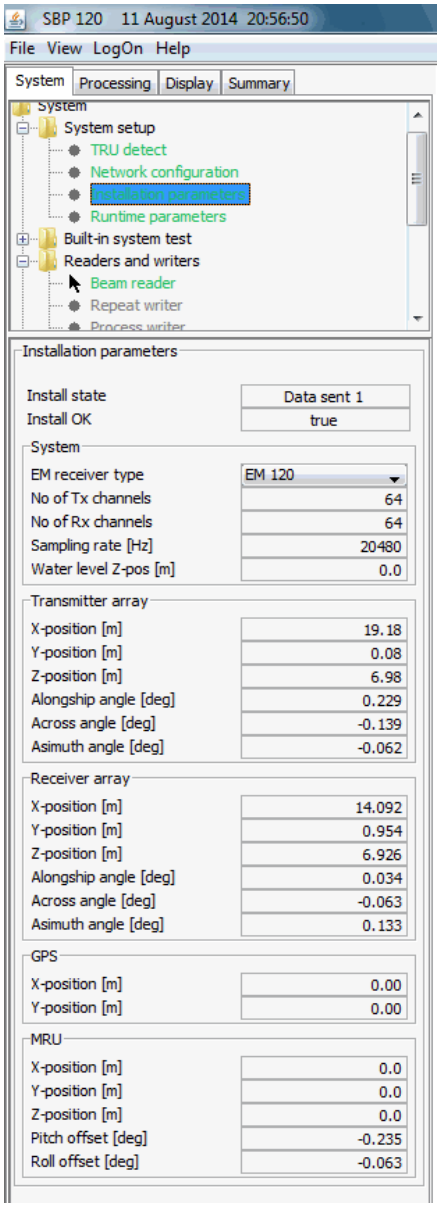
Transmit mode was mainly normal. The only exception was during crossings of the Continental Slope where the 500ms ping rate was unsustainable due to the increased depth. Burst mode may be used on these occasions to keep the same data rate (rather than increasing the ping interval whilst in normal mode, which results in less data samples).

Synchronisation was set to fixed rate from the time it was decided to not use the EM120. This fixed rate of 500ms was then the main default for the ping interval. ***Acquisition delay*** is varied depending on the current depth. ***Acquisition window*** was generally left at 200ms, the only exception again being in regions where steep slopes were requiring many adjustments to the acquisition delay. An approach of using relatively small delay but very large window would cover greater depth changes – using this approach with a Normal transmit mode would result in failure to attain a high ping rate (Burst mode required).

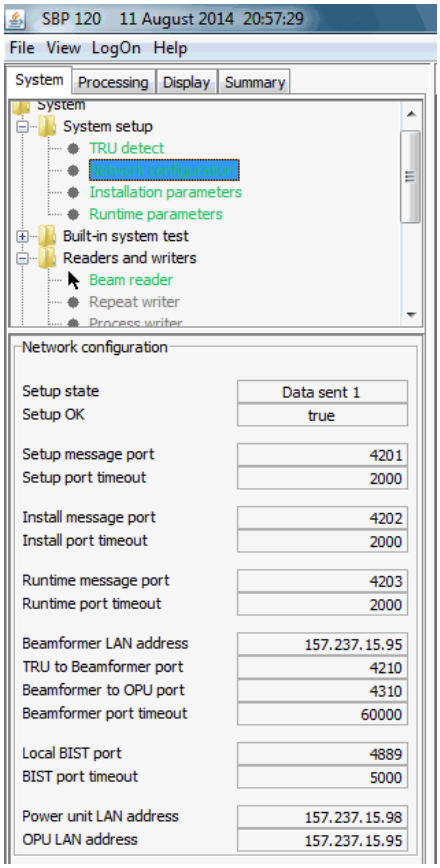


System Installation Parameters

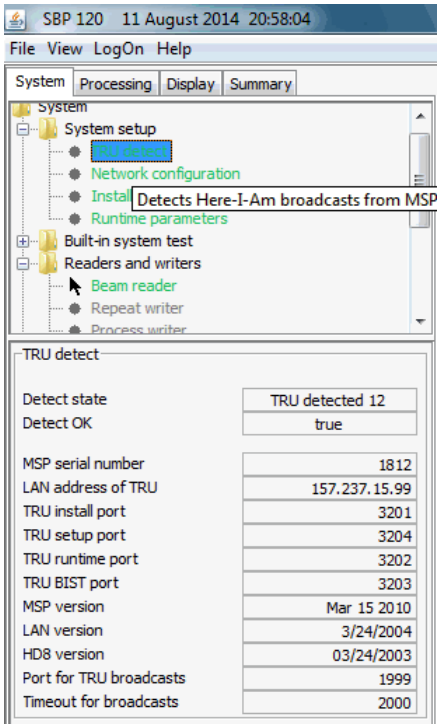
The ***EM receiver type*** is EM120 (SBP shares the EM120 Rx array)


SBP 120 11 August 2014 20:56:50
File View LogOn Help
System Processing Display Summary
System
System setup
TRU detect
Network configuration
Installation parameters
Runtime parameters
Built-in system test
Readers and writers
Beam reader
Repeat writer
Process writer
Installation parameters
Install state
Data sent 1
Install OK
true
System
EM receiver type
EM 120
No of Tx channels
64
No of Rx channels
64
Sampling rate [Hz]
20480
Water level Z-pos [m]
0.0
Transmitter array
X-position [m]
19.18
Y-position [m]
0.08
Z-position [m]
6.98
Alongship angle [deg]
0.229
Across angle [deg]
-0.139
Asimuth angle [deg]
-0.062
Receiver array
X-position [m]
14.092
Y-position [m]
0.954
Z-position [m]
6.926
Alongship angle [deg]
0.034
Across angle [deg]
-0.063
Asimuth angle [deg]
0.133
GPS
X-position [m]
0.00
Y-position [m]
0.00
MRU
X-position [m]
0.0
Y-position [m]
0.0
Z-position [m]
0.0
Pitch offset [deg]
-0.235
Roll offset [deg]
-0.063

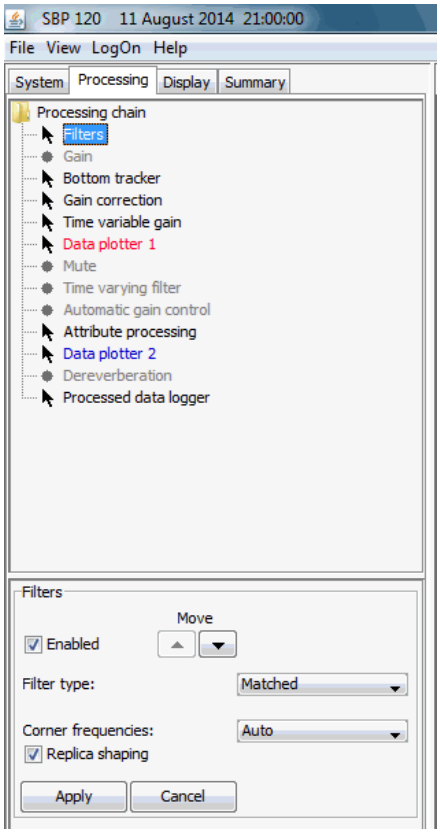
System – Network Configuration



System – TRU Detect

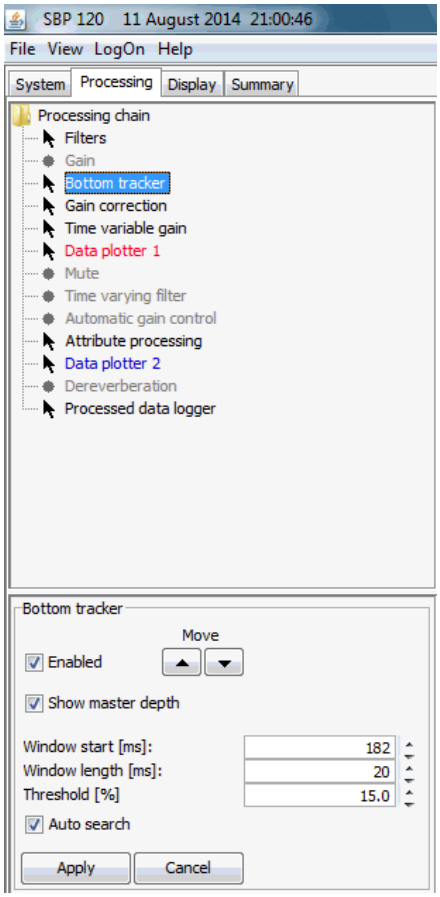


Processing Chain - Filters

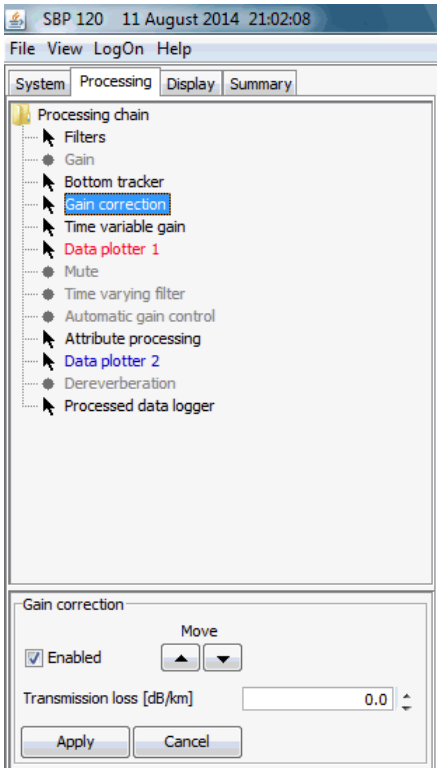


Processing – Bottom Tracker

Bottom Tracker was generally enabled. In some unfavorable pitching conditions it was disabled and the bottom (and TVG) was manually adjusted. This was to prevent lost bottom detections resulting in highly amplified water column data in the segy data.



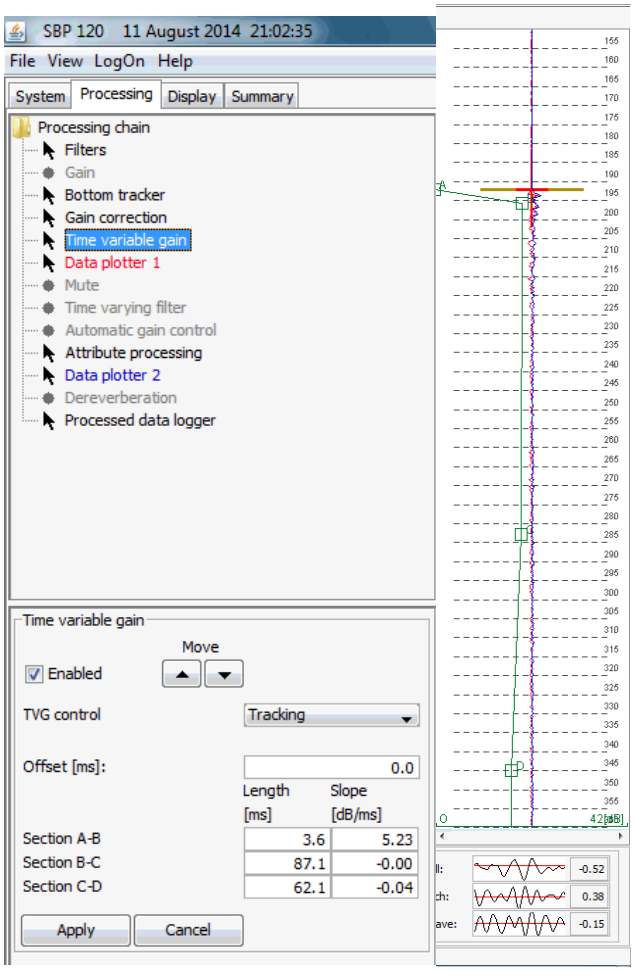
Processing – Gain Correction



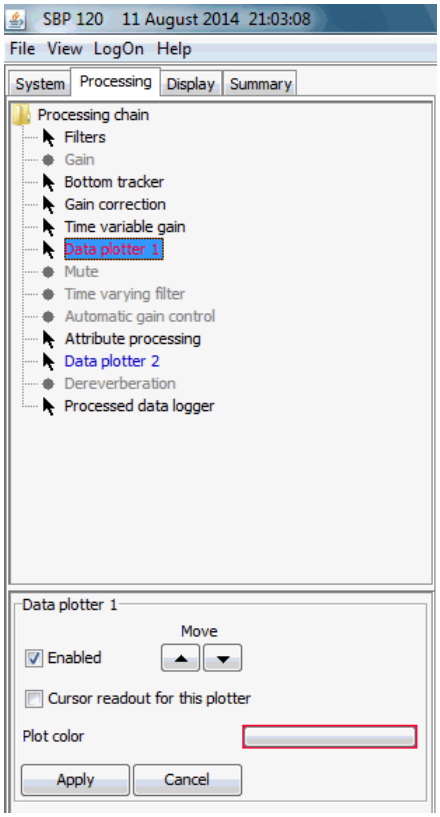
Processing – Time Variable Gain

TVG generally enabled, and set to ***Tracking***. The exception being when Bottom detection has been disabled when the ship is pitching (refer to Bottom detection section).

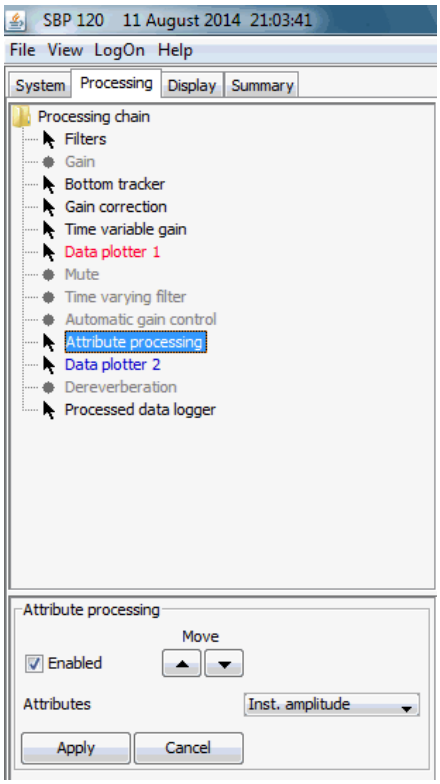
TVG continued to be manually adjusted though out the cruise, although certain settings were eventually used most of the time (right-click in the right-hand TVG window in order to be able to individually adjust the green squares of the TVG sections).


SBP 120 11 August 2014 21:02:35
File View LogOn Help
System Processing Display Summary
Processing chain
Filters
Gain
Bottom tracker
Gain correction
Time variable gain
Data plotter 1
Mute
Time varying filter
Automatic gain control
Attribute processing
Data plotter 2
Dereverberation
Processed data logger
Time variable gain
Move
Enabled
TVG control
Tracking
Offset [ms]:
0.0
Length [ms]
Slope [dB/ms]
Section A-B
3.6
5.23
Section B-C
87.1
-0.00
Section C-D
62.1
-0.04
Apply
Cancel
-0.52
0.38
-0.15

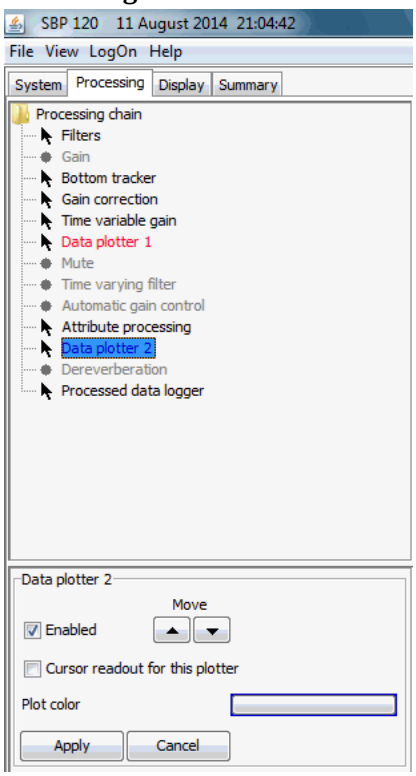
Processing – Data Plotter 1



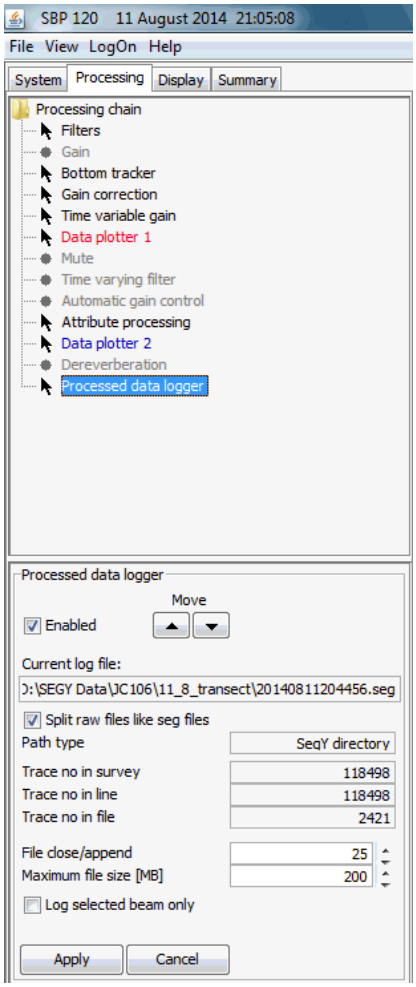
Processing – Attribute Processing



Processing - Data Plotter 2

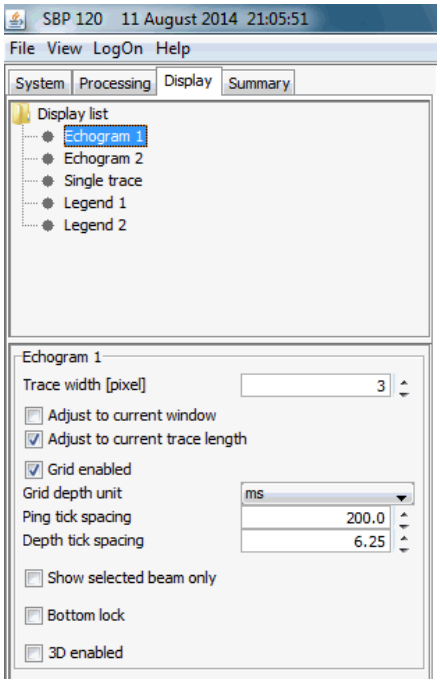


Processing – Processed Data Logger



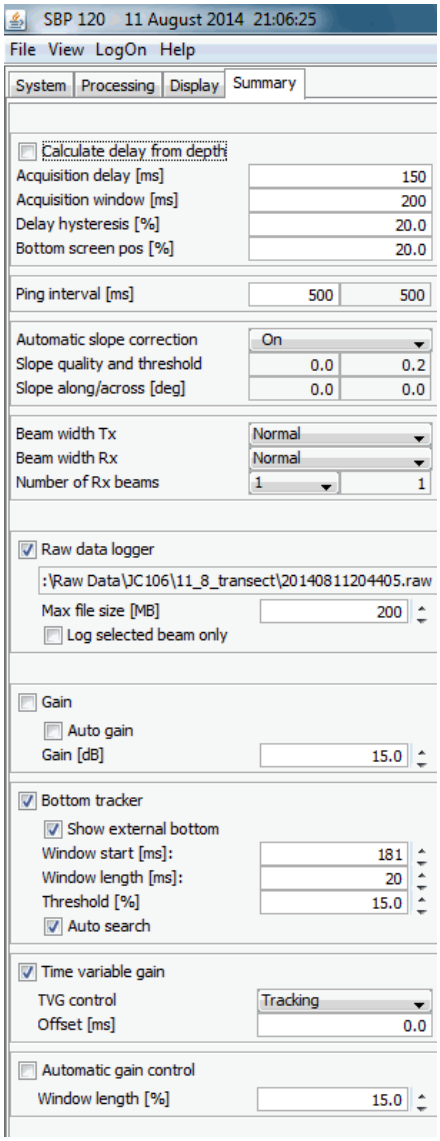
Display - Echogram 1

Using a 3 pixel ***Trace width*** allowed potential target sites to be identified easier (stretching of the x-axis).



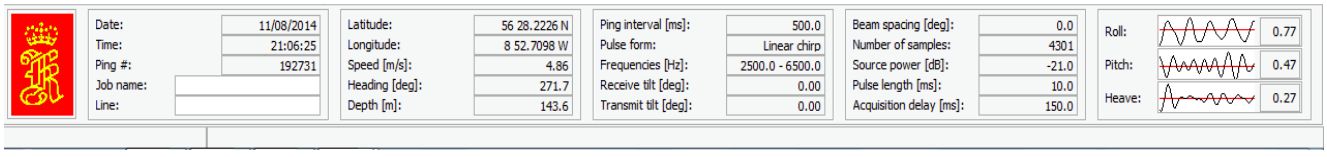
Summary

Max file size set to 200MB at the beginning of the cruise. Changes to most ***Runtime parameters*** (i.e. pulse width, source power) will result in a new file (line) being created, regardless of the current file size.



Note: The above screenshots taken in the conditions below. These were reasonably typical of much of the cruise.

(i.e. approx. 5kts, 150m depth)



Appendix 4.3

Marine Mammal Observer, Post-Cruise Report

James Cook JC106 – Leg 1 & Leg 2

BRITICE-CHRONO: Constraining rates and style of marine-

Celtic Sea, Irish Sea, Malin Sea, and western Irish margin

July 16th - August 25th 2014

Marine Mammal Observer: Marian McGrath

Table of Contents

1.0 Introduction

Under the EU Habitats Directive 92/43/EEC Article 12 – member states are required to establish a system of strict protection for the animal species listed in Annex IV which include all cetaceans. As part of these regulations any company wishing to carry out a seismic survey in UK waters must apply for consent from the Department of Energy and Climate Change. The JNCC are consulted on whether to grant permission for a seismic survey to be undertaken. Licenses are granted under the condition that the JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys are always followed. The guidelines advise on using marine mammal observers to conduct watches for marine mammals during the pre-shooting search and advise the crew and scientists on any mitigation measures that need to be carried out (Jncc.defra.gov.uk, 2014).

The habitats Directive applies within Ireland's 200 nautical mile limit for the protection of species (i. e. the Exclusive Economic Zone (EEZ)) and to the Continental Shelf for habitats. All marine mammal species in Irish waters are protected by the 1976 wildlife act and its subsequent Amendments (2000, 2005, 2010 and 2012). According to this act it is an offence to hunt, injure, or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species (Npws.ie, 2014).

The National parks and Wildlife Service (NPWS) has set aside Special Areas of Conservation (SACs) and Special Protected Areas (SPAs) under this wildlife act to ensure no operations can take place in areas where an abundance of marine mammals are present. Such operations include seismic surveys, multi-beam and side-scan sonar which have been set aside in a code of practice published by the NPWS (Anon. 2007).

Marine Mammal Observers (MMO) are required by law to be aboard any vessel which is carrying out seismic surveys within Irish and UK waters. It has been recognised that the sound generated by seismic sources has the potential to cause both disturbance and injury to marine mammals (Jncc.defra.gov.uk, 2014)

2.0 Date & Location of Survey

July 16th - August 25th 2014
Celtic Sea, Irish Sea, Malin Sea, and western Irish margin

3.0 Survey Vessel

RRS James Cook

4.0 Marine Mammal Observers/Qualifications

- Qualified MMO: Marian McGrath
- Casual Observations: Bridge and deck crew

5.0 Survey Sites

During JC106 we covered 5200 miles and geophysical data from EM120 and EM710 multibeam echo sounder systems and a Kongsberg SBP-120 sub-bottom profiler were collected and used to identify targets for coring. Coring utilised a British Geological Survey 6 m long vibrocorer system and NMFSS 12 m piston corer.
Data collection during the first leg of this survey campaign began in the Celtic Sea where several survey transects and sediment cores were collected. Survey effort then moved anticlockwise toward the Irish Sea, Isle of Man and Liverpool Bay and subsequently toward the Malin Sea and Donegal Bay.
The first leg was completed the 4th of August in Killybegs. Leg 2 focused on the Malin Sea and shelf offshore the Hebridees Sea; Donegal bay and adjoining shelf; and the Porcupine Bank and adjoining shelf offshore of western Ireland. In addition geophysical data and cores were also acquired on transit between these study areas. Maps showing geophysical data tracks and core locations are presented in Figures 1-6 below (JC106 Cruise report).

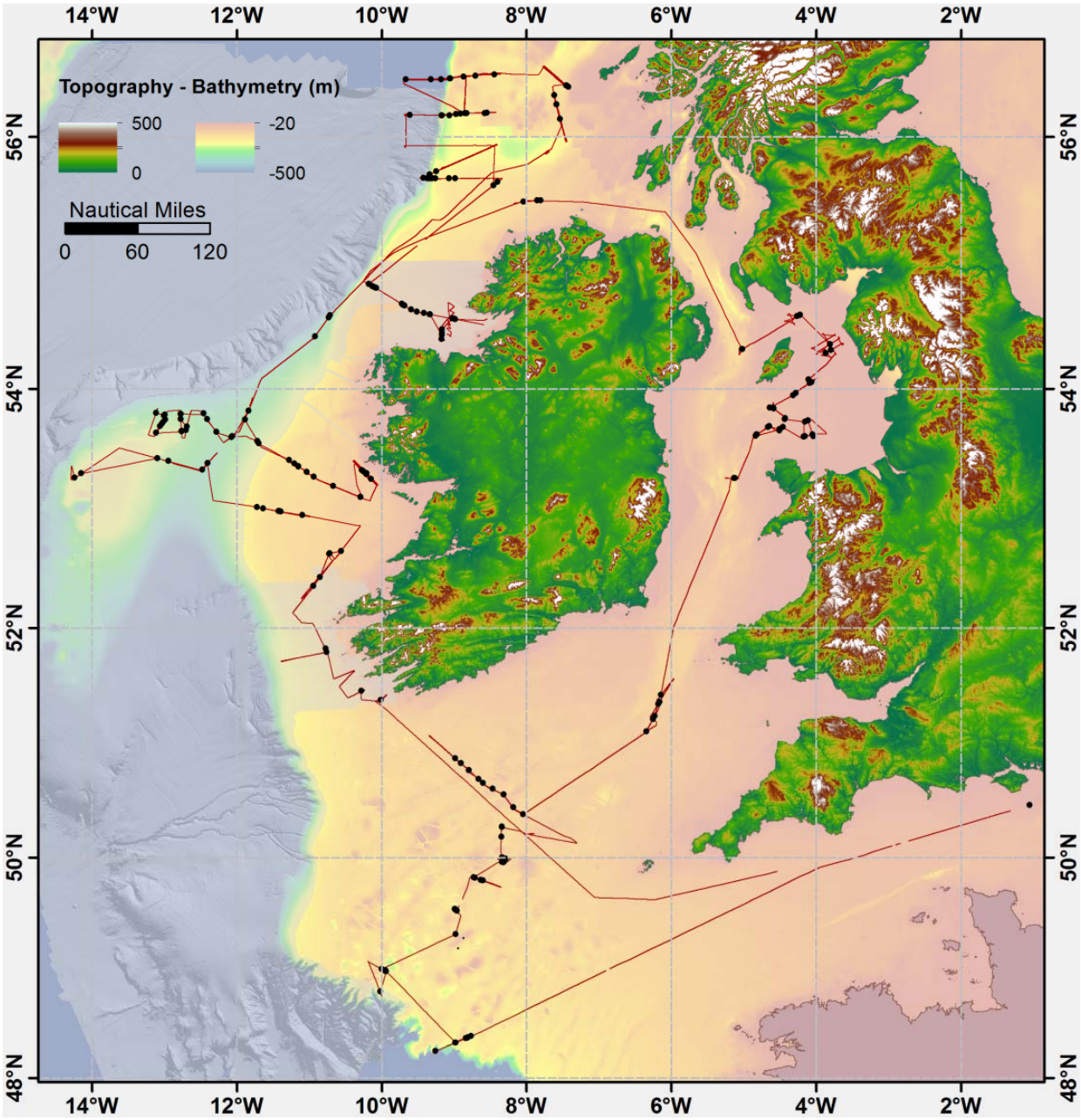


Figure 1. JC106 – Cruise track and core locations

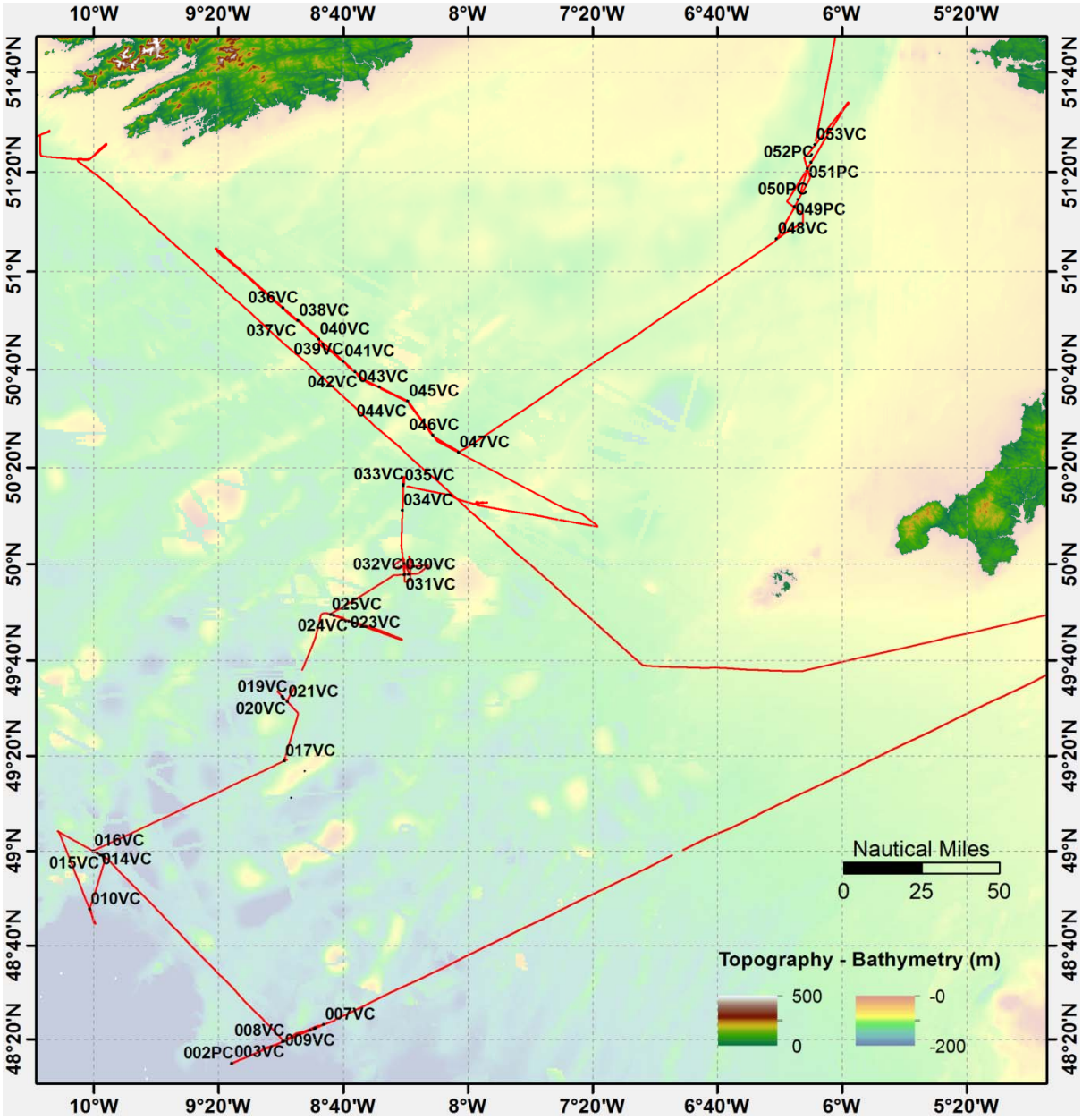


Figure 2. Cruise tracks and core locations in the Celtic Sea during JC106

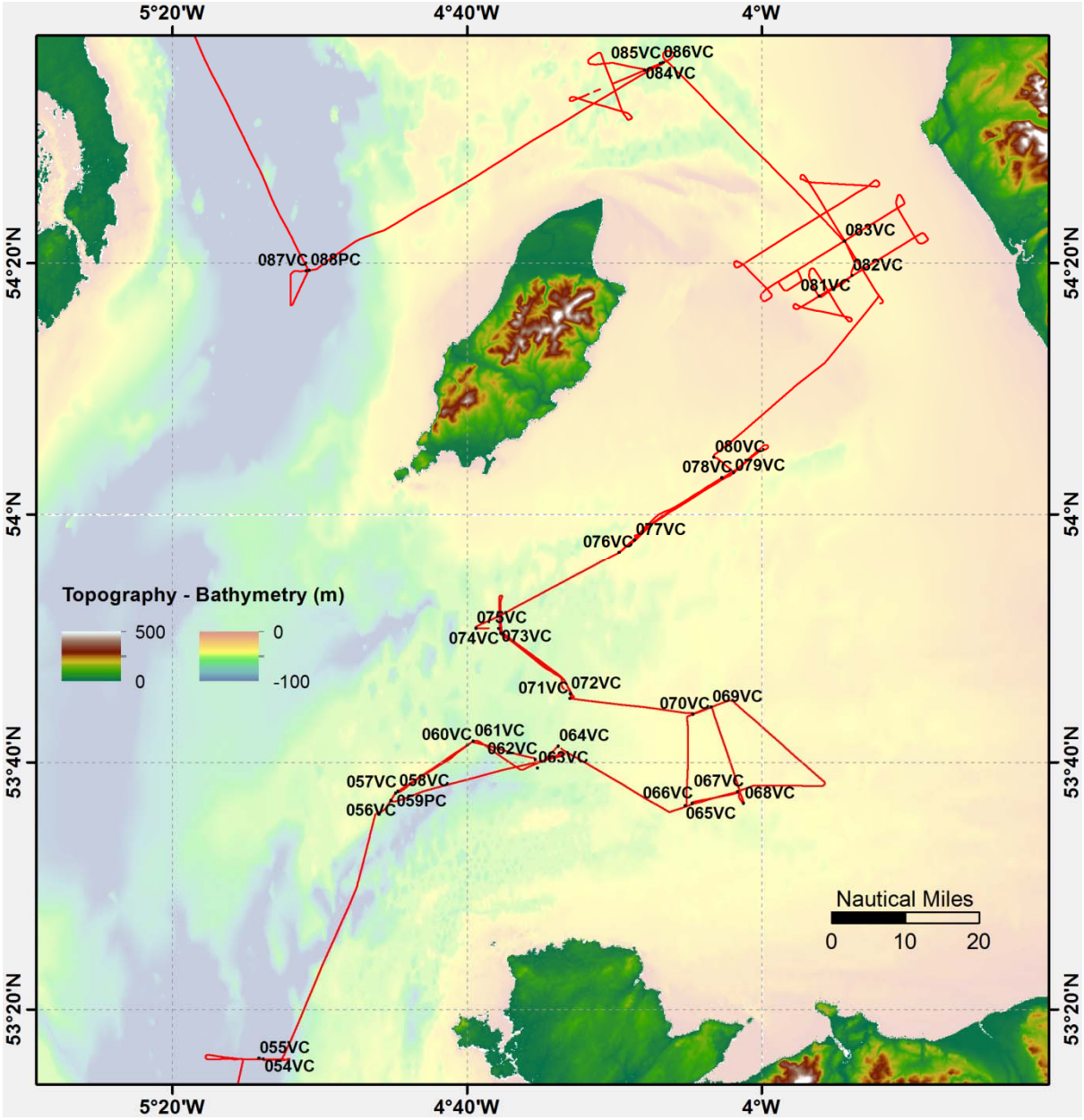


Figure 3. Cruise tracks and core locations in the eastern Irish Sea during JC106

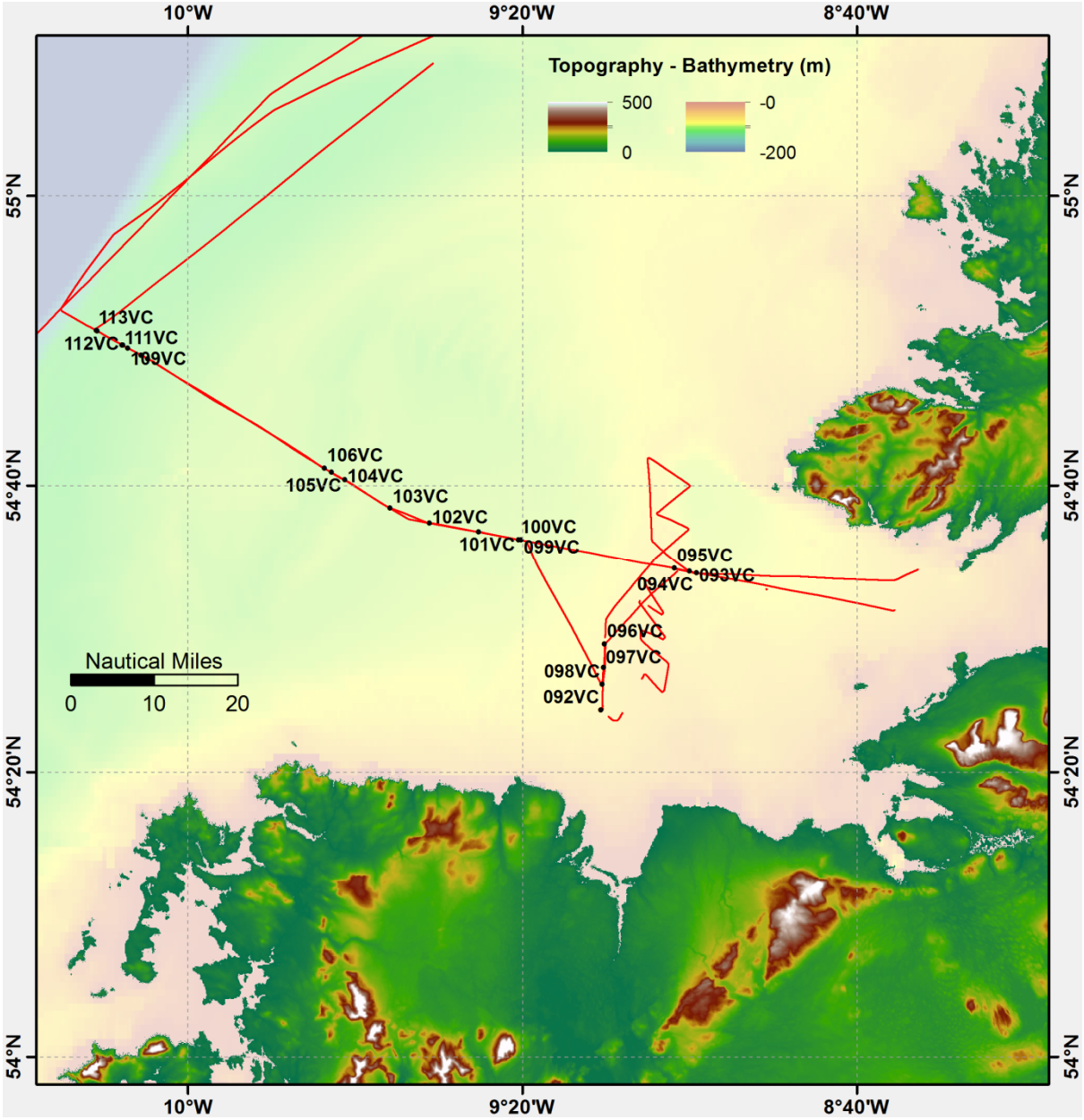


Figure 4. Cruise tracks and core locations in Donegal Bay and the adjoining shelf during JC106

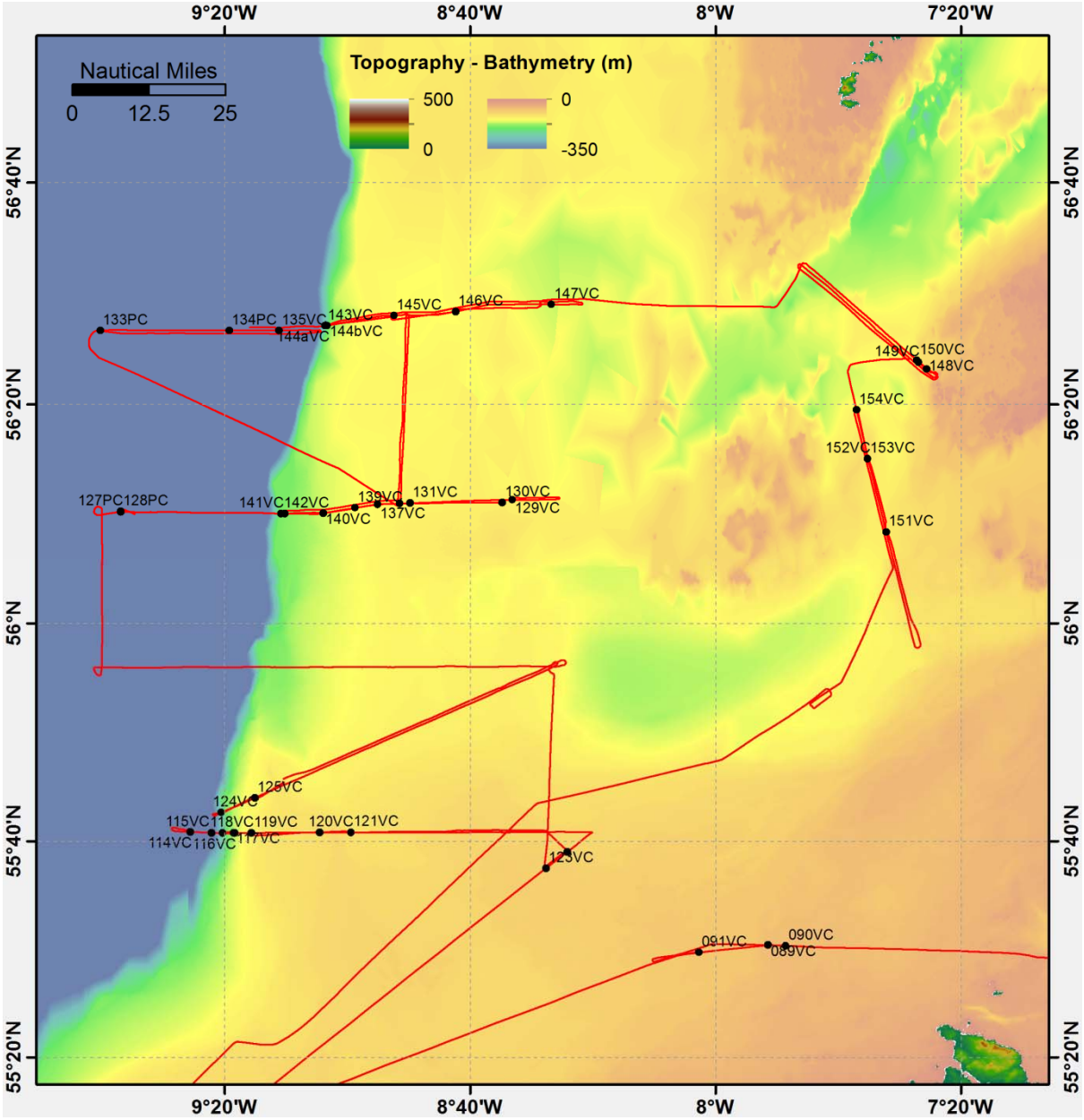


Figure 5. Cruise tracks and core locations in the Malin Sea during JC106

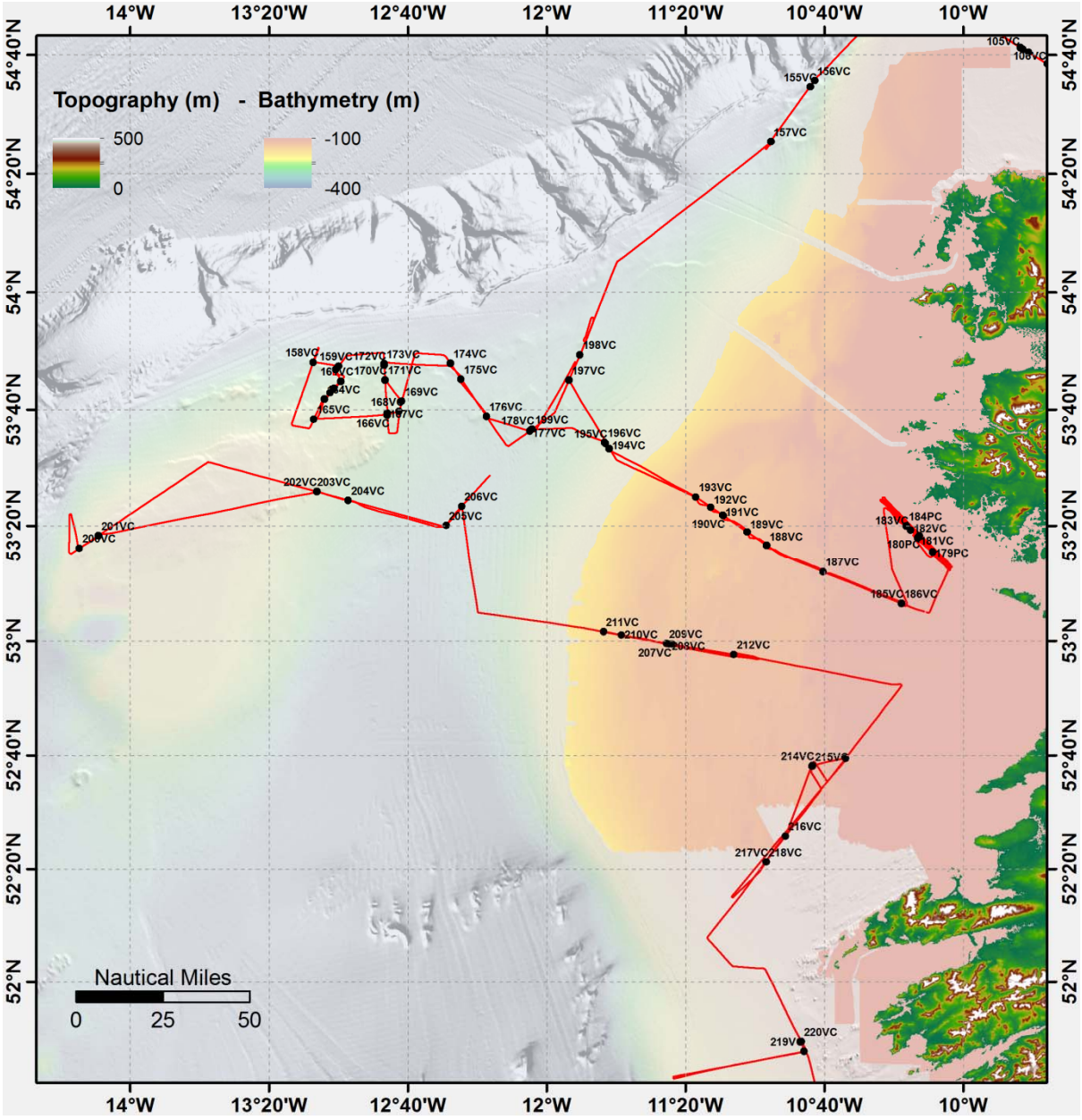


Figure 6. Cruise tracks and core locations on the western Irish shelf and across the Porcupine Bank during JC106

6.0 Acoustic Equipment

The RRS James Cook is equipped with 2 multibeam systems, the EM120 and the EM710 and the SBP120 subbottom profiler.

The EM120 is a 12 khz system and it is the primary system for mapping purposes from 10 to 10,000 m. The devise is hull mounted on a fixed installation and does not require regular calibrations. The system is interfaced with both its acquisition system SIS and OLEX for routine data acquisition

The EM710 is a 70-100 khz system and it is used for higher resolution mapping in shallower waters (5-1500). This second multibeam is installed on one of the 2 available ship drop keels and does require patch test calibrations every time the drop keel is lowered.

The Kongsberg SBP120 Sub-bottom profiler is installed as an extension of the EM120 and it was used throughout the survey in order to image the sediment layers and buried glacially related features.

Images of the geophysical survey lab are provided below:

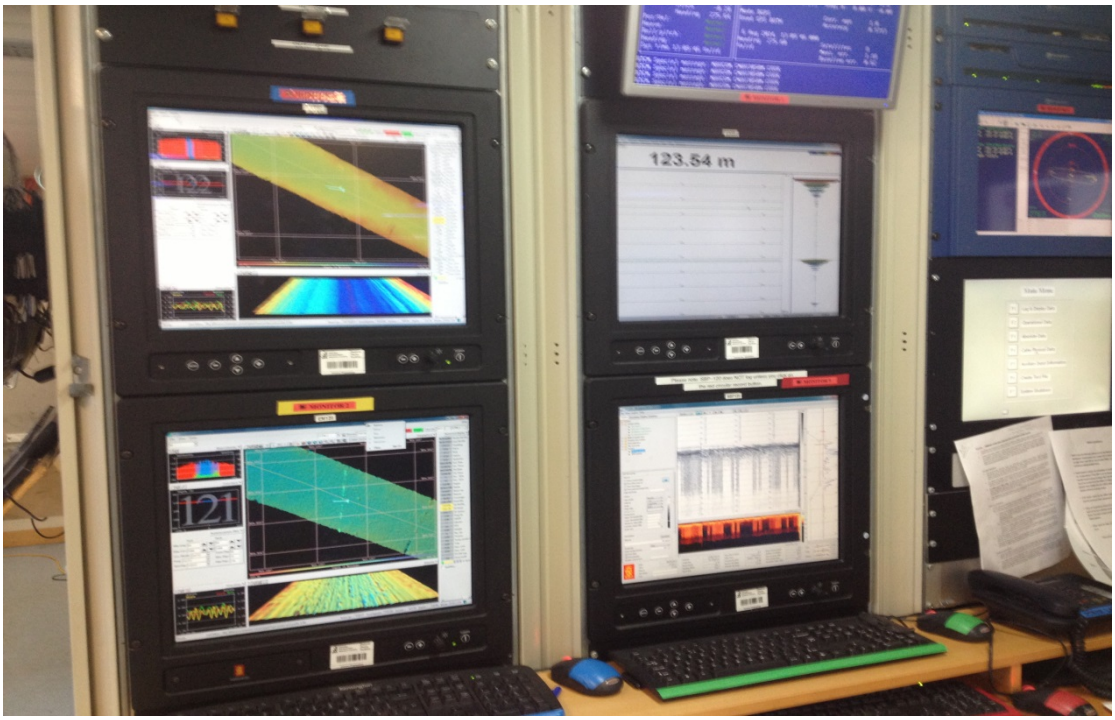


Figure 7. Hydrographic and geophysical computer monitors

Figure 8. TV screen used by Olex to display current position and planned survey tracks

7.0 Marine Mammal Observations

Marine mammal observations were carried out from the bridge and on the bow of the ship during daylight hours. These areas gave the best view point of both sides and in front of the vessel. Prior to commencement of the acoustic survey a 30 minute observation was done either on the bow of the ship or on the bridge depending on the weather. Weather conditions were favourable for the majority of the cruise. Most days were sunny with calm seas with only a few unfavourable weather days. Weather logs are attached in appendix 1 of this report. Observations were undertaken using a reticuled binoculars, a range finder stick and also by the naked eye. Distance to marine mammals was determined using this reticuled binoculars and height above sea level. To determine the range one of the divisions present in the binoculars is placed on the horizon. A formula is then used to determine the distance of the mammal from the ship. The formula is:

Distance (m) = (height of eye above sea level (m) x 1000/ no. of mils down from horizon)

A record was also kept each day of any marine mammals seen outside of pre-shooting searches. This was carried out by the MMO and the crew of the ship as mammals were

spotted. The sighting logs are attached in the appendix 1 of the report. Photographs of marine mammals are in appendix 2.

8.0 Pre-Shoot Searches

As detailed in the NPWS code of Practice, a 30 minute watch was carried out prior to commencement of the multibeam echosounder and the sub bottom profiler for mammals within 1000m range of the equipment. If marine mammals were spotted within this area then the survey would have to be halted for a certain period of time or the vessel would have to move to a different area of the survey. If no marine mammals were seen within the 30 minute watch then a soft start would commence. A soft start was carried out on the Multibeam systems EM120 and EM710 along with the SBP120 sub-bottom profiler each time the acoustic equipment was switched on.

A normal soft start comprises of a ramp up of source power of acoustic emission over at least 20 minutes until full power is reached. However, in this survey the multibeam echosounder and sub bottom profiler were never needed on full power so as a recommended alternative was done to cover the 20 minutes recommended soft start. The soft start consisted of turning power on and off during the 20 minute period. Once the Multibeam and Pinger systems reached their required power, they remained active during the survey. Throughout the duration of this survey no marine mammals were seen during the 30 minute watches prior to the soft starts. Operations never had to be halted during the survey duration. Records of operations are attached in the appendix.

9.0 References:

Jncc.defra.gov.uk, (2014). *Seismic Survey*. [online] Available at: http://jncc.defra.gov.uk/page-1534 [Accessed 7 Sep. 2014].

Npws.ie, (2014). Guidelines - National Parks & Wildlife Service. [online] Available at: http://www.npws.ie/marine/bestpracticeguidelines/ [Accessed 7 Sep. 2014].

JC106 - Cruise report. 2014. RRS James Cook, ‘Britice-Chrono: constraining rates and styles of marine-influenced ice sheet retreat’ Colm O’Cofaigh (PSO) and the Scientific Party of JC106, Department of Geography, Durham University, UK), July 16 – August 25, 2014.

Appendix 1- MARINE MAMMAL RECORDING FORM - COVER PAGE

Regulatory reference number (e.g. DECC no., MMS permit no., OCS lease no., etc.) N/A	**Country** UK & Ireland	**Ship/ platform name** RRS James Cook Bridge Observations
Client Project & Cruise funded by NERC Project PI – Uni of Sheffield Cruise PSO – Durham Uni	**Contractor** N/A	**Survey type** □ site □ 4C √ 2D □ VSP □ 3D □ WAZ □ 4D □ other □ OBC
Start date 16/07/2014	**End date** 25/08/2014	

Number of source vessels 1	**Type of source** (e.g. airguns) Sub Bottom Profiler Two Multibeam echosounders	**Number of airguns** (only if airguns used) None	**Source volume** (cu. in.) 217db – 229db
Source depth (metres) 30 – 210m	**Frequency** (Hz) 2.5kHz – 6.5kHz	**Intensity** (dB re. 1µPa or bar metres) 217db – 229db	**Shot point interval** (seconds) 1 second
Method of soft start □ increase number of guns	□ increase pressure (where permitted)	□ increase frequency (where permitted)	√ Increase energy

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.)	**Magnification of optical equipment** (e.g. binoculars)	**Height of eye** (metres)	**How was distance of animals estimated?** √ by eye □ with laser rangefinder √ with rangefinder stick/ calipers √ with reticle binoculars □ by relating to object at known distance □ other
Binoculars	7x50	29m	

Number of dedicated MMOs	**Training of MMOs**
1	√ JNCC approved MMO induction course for UK waters □ PSO training course for the Gulf of Mexico √ MMO training course for Irish waters □ other □ none

Was PAM used? □ yes √ no	**Number of PAM operators**	
Description of PAM equipment		
Range of PAM hydrophones from airguns (metres)	**Bearing of PAM hydrophones from airguns** (relative to direction of travel)	**Depth of PAM hydrophones** (metres)

MARINE MAMMAL RECORDING FORM - OPERATIONS

Regulatory reference number .....N/A…….. **Ship/ platform name** .....RRS James Cook.....
(e.g. DECC no., MMS permit no., OCS lease no., etc.)

Complete this form every time the airguns are used, including overnight, whether for shooting a line or for testing or for any purpose.
Times should be in UTC, using the 24 hour clock.

Date	**Equipment**	**Reason for firing** l = line t = test x = test followed immediately by line	**Time soft start/ ramp-up began**	**Time of full power**	**Time of start of line**	**Time of end of line**	**Time airguns/ source stopped**	**Time pre-shooting search began**	**Time search ended**	**Was it day or night in period prior to firing?** d = day n = night w = dawn k = dusk	**Was any mitigating action required?** (yes/ no)
18/07/14	SBP	X	18:15	18:35	18:35		31/07/14@13:20	14:00	18:35	d	no
18/07/14	EM120	X	16:00	16:30	16:30		02/08/14@19:45	15:00	16:30	d	no
18/07/14	EM710	X	16:00	16:30	16:30		03/08/14@00:14	15:00	16:30	d	no
31/07/14	SBP	X	14:35	15:00	15:00		03/08/14@00:14	13:20	15:00	d	no
03/08/14	SBP	X	09:30	09:55	10:00		04/08/14@06:44	09:00	10:00	d	no
03/08/14	EM710	X	09:30	09:55	10:00		04/08/14@06:44	09:00	10:00	d	no
05/08/14	SBP	X	10:17	11:00	11:00		07/08/14@09:30	09:45	11:00	d	no
05/08/14	EM120	X	10:17	11:00	11:00		06/08/14@16:52	09:45	11:00	d	no
05/08/14	EM710	X	10:17	11:00	11:00		09/08/14@11:45	09:45	11:00	d	no
07/08/14	SBP	X	10:40	11:15	11:15		09/08/14@11:45	10:00	11:20	d	no
09/08/14	EM710	X	12:45	13:05	13:05		10/08/14@13:30	12:00	13:15	d	no
09/08/14	SBP	X	12:45	13:05	13:05		10/08/14@13:30	12:00	13:15	d	no
10/08/14	SBP	X	14:30	14:50	14:50		10/08/14@17:21	13:00	15:00	d	no
10/08/14	EM710	X	14:30	14:50	14:50		10/08/14@17:21	13:00	15:00	d	no
10/08/14	SBP	X	18:45	19:10	19:10		13/08/14@13:06	18:00	19:15	d	no
10/08/14	EM710	X	18:45	19:10	19:10		25/08/14@00:30	18:00	19:15	d	No

MARINE MAMMAL RECORDING FORM - OPERATIONS

Regulatory reference number .....N/A…….. **Ship/ platform name** .....RRS James Cook.....
(e.g. DECC no., MMS permit no., OCS lease no., etc.)

Complete this form every time the airguns are used, including overnight, whether for shooting a line or for testing or for any purpose.
Times should be in UTC, using the 24 hour clock.

Date	**Equipment**	**Reason for firing** l = line t = test x = test followed immediately by line	**Time soft start/ ramp-up began**	**Time of full power**	**Time of start of line**	**Time of end of line**	**Time airguns/ source stopped**	**Time pre-shooting search began**	**Time search ended**	**Was it day or night in period prior to firing?** d = day n = night w = dawn k = dusk	**Was any mitigating action required?** (yes/ no)
13/08/14	SBP	X	14:50	15:11	15:11		14/08/14@13:03	14:20	15:15	d	no
14/08/14	SBP	X	14:00	14:20	14:20		23/08/14@19:00	13:20	14:20	d	no
23/08/14	SBP	X	19:15	19:50	20:00		25/08/14@00:30	19:00	20:00	d	no

MARINE MAMMAL RECORDING FORM - EFFORT

Regulatory reference number .....N/A…….. **Ship/ platform name** ....RRS James Cook.....
(e.g. DECC no., MMS permit no., OCS lease no., etc.)

Please record the following for all watches, even if no marine mammals are seen.

												Start a new line on form if any one of these changes					
Date	**Visual watch or PAM** v = visual watch p = PAM	**Observer's/ operator's name(s)**	**Time of start of watch** (UTC, 24hr clock)	**Time of end of watch** (UTC, 24hr clock)	**Start position** (latitude and longitude)	**Depth at start** (m)	**End position** (latitude and longitude)	**Depth at end** (m)	**Speed of vessel** (knots)	**Source activity** f = full power s = soft start r = reduced power (not soft start) n = not active	**Wind direction**	**Wind force** (Beaufort scale)	**Sea state** g = glassy (like mirror) s = slight (no or few white caps) c = choppy (many white caps) r = rough (big waves, foam, spray) or Beaufort sea states (0 - 7+)	**Swell** o = low (< 2 m) m = medium (2-4 m) l = large (> 4 m)	**Visibility** (visual watch only) p = poor (< 1 km) m = moderate (1-5 km) g = good (> 5 km)	**Sun glare** (visual watch only) (n= none/ wf= weak front/ sf= strong front/ vf= variable forward/ wb= weak back/ sb= strong back/ vb= variable back	**Precip.** (n= none/ l= light/ m= moderate/ h= heavy/ s= snow)
18/07/14	V	Marian McGrath	14:09	14:33	50.65308, -0.9891083	50	50.59101, -1.007168	50	9	N	022	14	G	O	G	SF	N

18/07/14	V	Marian McGrath	14:33	15:05	50.59101, -1.007168	53	50.50686, -1.034103	55	9	N	024	15	G	O	G	SF	N
18/07/14	V	Marian McGrath	15:05	15:31	50.50686, -1.034103	55	50.46637, -1.054503	56	8.7	N	272	5	G	O	G	SF	N
18/07/14	V	Marian McGrath	15:31	16:22	50.46637, -1.054503	60	50.46619, -1.05415	65	2.5	S	306	5	G	O	G	SF	N
18/07/14	V	Marian McGrath	16:22	18:35	50.46619, -1.05415	65	50.46629, -1.054215	66	0.4	R	245	3	G	O	G	SF	N
19/07/14	V	Marian McGrath	09:03	09:30	49.55, -5.107587	75	49.52047, -5.208112	76	8	R	296	2	G	O	P	N	N
19/07/14	V	Marian McGrath	11:00	11:30	49.42528, -5.503595	80	49.39278, -5.60886	82	8.6	R	144	7	G	O	M	N	N
19/07/14	V	Marian McGrath	12:49	13:30	49.30066, -5.900465	90	49.25251, -6.048335	92	10.5	R	151	11	G	O	G	WF	N
19/07/14	V	Marian McGrath	13:30	14:00	49.25251, -6.048335	100	49.21772, -6.161497	110	9.9	R	166	10	G	O	G	WF	N
19/07/14	V	Marian McGrath	16:47	17:28	49.00204, -6.853874	110	49.00204, -6.853874	111	9.8	R	254	6	G	O	G	WF	N
19/07/14	V	Marian McGrath	18:06	18:57	48.90462, -7.15459	112	48.84412, -7.3423	112	9.3	R	219	4	G	O	G	WF	N
20/07/14	V	Marian McGrath	08:46	10:54	48.24696, -9.263576	116	48.2561, -9.230692	115	0.7	R	309	7	G	O	G	SF	N
20/07/14	V	Marian McGrath	10:54	12:20	48.24696, -9.263576	120	48.33752, -8.814931	120	1.1	R	329	8	G	O	G	SF	N
20/07/14	V	Marian McGrath	15:52	18:46	48.2561, -9.230692	120	48.97962, -10.1346	121	0.5	R	284	10	G	O	G	SF	N
21/07/14	V	Marian McGrath	10:24	11:20	49.0471, -10.1757	125	48.91663, -10.00304	130	5.2	R	209	16	S	O	G	SF	N
21/07/14	V	Marian McGrath	14:00	17:05	48.76125, -10.00304	130	48.91663, -9.96577	132	4.8	R	183	12	S	O	G	SF	N
21/07/14	V	Marian McGrath	17:05	19:12	48.91663, -9096577	130	48.97888, -9.948129	135	9.5	R	183	11	S	O	G	WF	N
22/07/14	V	Marian McGrath	09:00	10:30	49.21.040, -8.58.042	139	49.28.375, 008.54.665	129	10.1	R	158	9	S	O	G	WF	N
22/07/14	V	Marian McGrath	10:00	10:30	49.21.040, -8.59.042	129	49.32.319, 008.59.503	129	10.6	R	068	5	S	O	G	WF	N

22/07/14	V	Marian McGrath	12:35	14:00	49.32.393, -8.59.632	145	49.31.307, 008.57982	144	0.5	R	170	8	S	O	G	SF	N
22/07/14	V	Marian McGrath	13:06	14:00	49.32.389, -8.59.628	144	49.42.800, 008.50.089	144	0.2	R	178	9	S	O	G	SF	N
22/07/14	V	Marian McGrath	16:30	17:30	49.31.311, -8.57.984	136	49.59.181, 008.13.484	136	0.4	R	168	9	S	O	G	WF	N
22/07/14	V	Marian McGrath	18:00	19:00	49.38.506, -8.52.874	133	49.59.770, 00818.584	98	10.5	R	147	7	G	O	G	SB	N
23/07/14	V	Marian McGrath	08:30	09:30	49.57.778, 008.19.581	121	49.59.181, 008.13484	123	5.6	R	086	14	G	O	G	SF	N
23/07/14	V	Marian McGrath	12:30	13:00	49.57.479, 008.18.449	130	49.59.770, 008.18.584	128	4.9	R	176	10	S	M	G	WF	N
23/07/14	V	Marian McGrath	13:00	14:30	49.59.770, 008.18.584	128	49.59.417, 008.17.538	130	5	R	179	11	S	O	G	SB	N
23/07/14	V	Marian McGrath	14:30	15:30	49.59.417, 008.17.538	130	49.59.979, 008.20.498	133	0	R	022	8	G	O	G	WF	N
23/07/14	V	Marian McGrath	15:30	16:40	49.59.980, 008.20.498	133	49.59.412, 008.19.987	131	0.5	R	049	5	G	O	G	WF	N
24/07/14	V	Marian McGrath	09:40	10:40	50.12.753, 007.54.428	82	50.12.798, 007.53.826	80	9.5	R	040	13	S	O	G	WF	N
24/07/14	V	Marian McGrath	10:40	11:30	50.12.798, 007.53.826	80	50.12.624, 007.58.738	108	0.2	R	006	12	S	O	G	WF	N
24/07/14	V	Marian McGrath	12:30	13:30	50.12.419, 007.57.251	75	50.12.048, 007.55.375	98	4.1	R	232	11	S	O	G	WF	N
24/07/14	V	Marian McGrath	13:30	14:30	50.12.048, 007.55.375	98	50.10.439, 007.40.856	107	9.6	R	216	13	G	O	G	SF	N
24/07/14	V	Marian McGrath	16:30	17:30	50.09.868, 007.22.258	114	50.12.167, 007.30.825	109	6.4	R	194	12	G	O	G	SF	N
25/07/14	V	Marian McGrath	09:30	10:30	50.52.616, 008.59.265	115	50.50.029, 008.54.584	120	0	R	176	11	G	O	G	WF	N
25/07/14	V	Marian McGrath	10:30	12:00	50.50.029, 008.54.584	120	50.50.020, 008.54.558	120	0	R	023	8	G	O	G	WF	N
25/07/14	V	Marian McGrath	12:00	13:00	50.50.020, 008.54.528	120	50.48.334, 008.51.386	106	0	R	031	9	G	O	G	WF	N
25/07/14	V	Marian McGrath	13:00	14:00	50.48.334, 008.51.386	106	50.46.218, 008.47.863	119	0	R	038	6	G	O	G	SF	N

25/7/14	V	Marian McGrath	14:00	14:30	50.46.218, 008.47.863	119	50.46.208, 008.47.872	119	0	R	114	1	G	O	G	SF	N
25/7/14	V	Marian McGrath	15:30	16:30	50.45.287, 008.47.591	117	50.41.735, 008.40.075	119	9	R	152	10	G	O	G	WF	N
25/7/14	V	Marian McGrath	16:30	18:00	50.41.735, 008.40.074	124	50.39.708, 008.36.563	119	0	R	171	4	G	O	G	SF	N
26/7/14	V	Marian McGrath	09:30	10:30	50.48.951, 007.01.770	104	50.52.554, 006.53.448	99	10	R	351	2	G	O	G	WF	N
26/7/14	V	Marian McGrath	10:30	11:30	50.52.554, 006.53.448	99	50.57.007, 006.42.880	95	10	R	280	9	G	O	G	WF	N
26/7/14	V	Marian McGrath	13:00	14:00	51.05.453, 006.23.045	107	51.12.950, 006.15.360	128	10	R	279	9	G	O	G	WF	N
26/7/14	V	Marian McGrath	14:00	15:00	51.12.950, 006.15.360	128	51.18.322, 006.10.765	112	6	R	332	10	G	O	G	WF	N
26/7/14	V	Marian McGrath	16:35	17:30	51.25.080 006.06.940	113	51.33.361, 005.58.972	116	6	R	290	9	G	O	G	SB	N
26/7/14	V	Marian McGrath	18:50	19:30	51.30.035, 006.03.105	115	51.30.034, 006.03.150	117	9	R	299	17	G	O	G	WF	N
27/7/14	V	Marian McGrath	10:00	11:30	51.21.979, 006.09.867	113	51.25.485, 006.08.724	106	0	R	336	11	G	O	G	WF	N
27/7/14	V	Marian McGrath	12:45	13:45	51.35.356, 006.05.737	113	51.43.296, 006.03.346	114	9.6	R	277	10	S	O	G	WF	N
27/7/14	V	Marian McGrath	13:45	14:45	51.43.296, 006.03.346	114	51.51.935, 006.00.754	108	9.9	R	275	12	S	O	G	N	N
27/7/14	V	Marian McGrath	16:30	18:30	52.06.902, 005.54.109	95	52.21.781, 005.44.342	82	10.2	R	234	17	C	O	G	SB	N
28/7/14	V	Marian McGrath	09:30	10:30	53.40.575, 004.35.629	74	53.40.715, 004.27.234	68	5	R	326	13	C	M	G	SF	N
28/7/14	V	Marian McGrath	10:30	11:30	53.40.715, 004.27.234	68	53.39.224, 004.36.227	93	4.4	R	323	11	C	M	G	SF	N
28/7/14	V	Marian McGrath	13:10	14:15	53.36.972, 004.50.365	63	53.37.586, 004.49.679	64	0.5	R	004	10	C	M	G	SF	N
28/7/14	V	Marian McGrath	15:50	16:50	53.37.684, 004.49.332	64	53.37.661, 004.49.424	63	0.6	R	009	6	S	O	G	SF	N
28/7/14	V	Marian McGrath	19:00	19:30	53.40.408, 004.42.016	73	53.37.593, 004.49.536	70	3	R	314	7	S	M	G	SB	N

29/7/14	V	Marian McGrath	10:00	11:20	53.36.511, 004.10.477	47	53.36.665, 004.09.400	49	1.1	R	270	13	S	O	M	N	N
29/7/14	V	Marian McGrath	12:20	14:00	53.37.640, 004.03.326	49	53.36.694, 004.02.456	47	0.3	R	329	9.5	S	O	M	N	N
29/7/14	V	Marian McGrath	14:00	15:00	53.36.694, 004.02.456	47	53.38.165, 004.03.293	45	0.3	R	271	9.4	S	O	G	WF	N
29/7/14	V	Marian McGrath	15:00	16:00	53.38.165, 004.03.293	45	53.44.473, 004.06.817	46	8.5	R	262	11	S	O	G	WF	N
29/7/14	V	Marian McGrath	16:00	17:30	53.44.473, 004.06.817	46	53.43.894, 004.09.318	42	0.4	R	272	7	S	O	G	N	N
30/07/14	V	Marian McGrath	09:45	10:45	53.58.358, 004.16.735	45	53.58.400, 004.16.696	46	5	R	251	23	C	M	G	N	N
30/07/14	V	Marian McGrath	10:45	11:45	53.58.400. 004.16.696	46	54.00.936, 004.10.581	45	0.8	R	256	22	C	M	G	WB	N
30/07/14	V	Marian McGrath	13:00	14:00	54.04.869, 004.00.681	43	54.00.113, 004.12.631	45	9	R	248	23	C	M	G	WF	N
30/07/14	V	Marian McGrath	14:00	15:00	54.00.113, 004.12.631	45	53.56.920, 004.19.359	48	9.3	R	218	23	C	M	G	N	N
30/07/14	V	Marian McGrath	17:00	17:40	53.57.930, 004.17.250	44	53.59.250, 004.15.325	43	1.5	R	212	20	C	O	G	SB	N
31/7/14	V	Marian McGrath	09:45	10:45	54.25.374, 003.41.393	26	54.21.970, 003.39.463	29	6.7	R	260	13	C	O	G	WF	N
31/7/14	V	Marian McGrath	10:45	11:30	54.21.970, 003.39.463	29	54.19.745, 003.45.589	29	7.1	R	251	17	S	O	G	SB	N
31/7/14	V	Marian McGrath	13:15	14:35	54.15.792, 03.49.061	39	54.17.618, 003.52.527	40	6.4	R	285	8.8	S	O	G	WF	N
31/7/14	V	Marian McGrath	14:35	16:15	54.17.618, 03.52.527	40	54.18.179, 003.49.630	40	4.8	R	219	15	S	O	G	N	N
31/7/14	V	Marian McGrath	16:15	17:00	54.18.179, 003.49.630	40	54.18.962, 003.47.734	40	9.7	R	211	13	S	O	G	SB	N
1/8/14	V	Marian McGrath	10:15	11:15	54.19.405, 005.01.407	133	54.19.404, 005.01.407	134	0.5	R	182	2.5	G	O	G	WB	N
1/8/14	V	Marian McGrath	12:30	13:30	54.28.750, 005.09.336	130	54.36.149, 005.15.641	145	10.2	R	163	7	G	O	G	WB	N
1/8/14	V	Marian McGrath	13:30	14:30	54.36.149, 005.15.641	145	54.44.953, 005.22.790	136	10.4	R	171	8.3	G	O	G	WB	N

1/8/14	V	Marian McGrath	15:30	16:45	54.54.681, 005.30.828	143	55.07.132, 005.41.833	130	10.3	R	153	11.6	G	O	G	SB	N
1/8/14	V	Marian McGrath	18:00	18:40	55.22.969, 006.02.240	121	55.25.356, 006.09.586	108	10.2	R	158	4.4	G	O	G	SF	N
2/8/14	V	Marian McGrath	10:45	14:50	55.16.968, 009.04.301	103	55.00.710, 010.01.089	103	10.2	R	022	13.9	S	M	G	WB	N
2/8/14	V	Marian McGrath	14:50	16:00	55.00.710, 010.01.089	112	54.52.543, 010.14.839	178	10	R	038	9.4	S	M	G	SF	N
2/8/14	V	Marian McGrath	18:30	18:30	54.43.104, 009.48.802	100	54.43.104, 009.48.802	100	9.8	R	348	21	R	L	M	N	N
3/8/14	V	Marian McGrath	09:00	09:00	54.31.515, 008.36.254	66	54.43.104, 009.48.802	66	7	N	316	32	R	L	P	N	L
5/8/14	V	Marian McGrath	08:55	09:45	54.35.023, 008.35.995	61	54.34.315, 008.50.476	86	10	N	138	10.2	G	O	G	N	N
5/8/14	V	Marian McGrath	09:45	10:50	54.34.315, 008.50.476	86	54.33.872, 008.59.139	81	10.5	N	149	10.5	G	O	G	SB	N
5/8/14	V	Marian McGrath	14:30	16:10	54.30.811, 009.07.165	68	54.28.919, 009.10.225	74	10	R	091	6.2	G	O	G	SF	N
5/8/14	V	Marian McGrath	16:10	18:00	54.28.919, 009.10.225	74	54.26.422, 00910.435	75	0.2	R	062	2.8	G	O	G	WF	N
5/8/14	V	Marian McGrath	18:00	18:30	54.26.422, 009.10.435	75	54.26.111, 009.10.497	72	2.6	R	266	9.2	G	O	G	N	N
6/8/14	V	Marian McGrath	10:20	11:30	54.49.144, 010.05.972	119	54.49.527, 010.07.228	120	0.2	R	280	17	C	O	G	WB	N
6/8/14	V	Marian McGrath	14:00	15:00	54.49.739, 010.07.928	121	54.50.713, 010.10.929	124	0.1	R	271	20	C	M	G	SF	N
6/8/14	V	Marian McGrath	16:40	17:30	54.52.563, 010.06.979	122	54.56.822, 009.57.510	125	9.9	R	246	13	C	O	G	SB	N
6/8/14	V	Marian McGrath	18:45	19:30	55.05.788, 009.38.041	123	55.09.577, 009.29.668	110	9.8	R	264	18.3	C	M	G	SB	N
7/8/14	V	Marian McGrath	10:00	10:40	55.40.781, 009.22.212	384	55.40.753, 009.20.379	258	0.5	R	221	18.8	C	M	G	SB	N
7/8/14	V	Marian McGrath	10:40	11:20	55.40.753, 009.20.379	258	55.40.757, 009.20.384	260	0.5	R	231	21	C	M	G	SF	N
7/8/14	V	Marian McGrath	13:00	14:00	55.40.763, 009.18.472	178	55.40.779, 009.15.701	129	0.3	R	228	24	C	M	G	WF	N

7/8/14	V	Marian McGrath	16:15	17:00	55.40.803, 009.04.569	109	55.40.938, 009.00.446	110	0	R	230	13	C	M	G	WF	N
8/8/14	V	Marian McGrath	10:30	11:30	55.42.881, 009.19.515	235	55.43.992, 009.15.074	139	8.5	R	183	17.3	C	M	G	N	N
8/8/14	V	Marian McGrath	13:00	14:00	55.45.266, 009.10.070	126	55.45.270, 009.10.067	124	0.1	R	231	20	C	M	G	SF	N
8/8/14	V	Marian McGrath	14:00	14:30	55.45.270, 009.10.067	124	55.45.272, 009.10.072	125	0.2	R	216	16.6	C	M	G	SF	N
8/8/14	V	Marian McGrath	16:30	17:30	55.48.182, 008.59.508	133	55.51.727, 008.44.925	132	10.1	R	261	11.8	C	M	G	SB	N
8/8/14	V	Marian McGrath	18:00	18:30	55.53.917, 008.36.159	127	55.54.033, 008.35.689	128	7.5	R	280	6.8	C	M	G	WB	N
9/8/14	V	Marian McGrath	11:30	12:12	56.10.286, 009.37.011	1035	56.10.269, 009.37.002	1027	0	R	239	19	C	M	G	SF	H
9/8/14	V	Marian McGrath	12:12	13:15	56.10.269, 009.37.002	1027	56.10.239, 009.33.116	1249	0	R	220	24	C	M	G	WF	N
9/8/14	V	Marian McGrath	13:15	14:00	56.10.239, 009.33.116	1249	56.10.219, 009.26.675	1227	5.8	R	229	23	C	M	G	WF	N
9/8/14	V	Marian McGrath	15:40	16:20	56.10.094, 009.07163	185	56.10.365, 009.01.716	154	5.8	R	259	13	C	M	G	WF	N
9/8/14	V	Marian McGrath	18:30	19:00	56.11.334, 008.36.357	130	56.11.364, 008.32.120	128	6.3	R	278	5.4	S	M	G	SB	N
10/8/14	V	Marian McGrath	10:15	11:30	56.26.682, 009.04.777	454	56.26.405, 009.23.821	450	6.7	R	250	5.2	G	O	G	SF	N
10/8/14	V	Marian McGrath	13:00	13:30	56.26.653, 009.40.355	1532	56.26.653, 009.40.347	1532	0.4	R	290	10.7	G	O	G	SF	N
10/8/14	V	Marian McGrath	13:30	15:00	56.26.653, 009.40.347	1532	56.26.665, 009.40.337	1532	0	N	280	10	G	O	G	SF	N
10/8/14	V	Marian McGrath	18:30	19:10	56.26.665, 009.19.279	1027	56.26.939, 009.15.493	1027	0	N	288	14	G	O	G	SF	N
11/8/14	V	Marian McGrath	10:00	11:20	56.10.088, 009.10.213	188	56.10.101, 009.10.876	201	0.2	R	281	21.4	C	M	M	SB	N
11/8/14	V	Marian McGrath	12:50	13:50	56.10.886, 008.59.112	143	56.12.209, 008.51.747	145	6.3	R	284	24	C	M	M	N	N
11/8/14	V	Marian McGrath	16:00	16:30	56.25.308, 008.50.660	148	56.28.055, 008.49.278	148	6.5	R	348	21.8	C	M	M	WB	N

12/8/14	V	Marian McGrath	10:00	11:00	56.29.117, 007.37.921	139	56.25.547, 007.30.428	132	5.8	R	292	21.2	C	M	M	N	N
12/8/14	V	Marian McGrath	12:45	13:30	56.26.395, 007.33.173	128	56.28.875, 007.38.193	139	6.2	R	292	16.6	C	M	M	N	N
12/8/14	V	Marian McGrath	14:30	15:30	56.31.142, 007.43.788	192	56.28.736, 007.38.535	142	6.4	R	285	22.8	C	M	M	N	N
12/8/14	V	Marian McGrath	15:30	15:45	56.28.736, 007.38.535	142	56.28.742, 007.38.525	142	8.8	R	305	17.1	C	M	M	N	N
12/8/14	V	Marian McGrath	18:50	19:10	56.23.974, 007.27.280	139	56.23.974, 007.27.284	139	1.2	R	312	22.4	C	M	M	N	N
13/8/14	V	Marian McGrath	10:00	11:00	56.23.896, 007.41.578	136	55.52.302, 007.45.993	140	7.2	R	324	35	R	L	P	WB	N
13/8/14	V	Marian McGrath	11:00	13:00	55.52.302, 007.45.993	146	55.45.344, 008.15.043	106	8.4	R	328	26.8	R	L	P	N	N
13/8/14	V	Marian McGrath	14:20	15:15	55.40.417, 008.34.915	93	55.34.766, 008.45.410	94	8.7	R	314	21.9	R	L	M	SF	N
14/8/14	V	Marian McGrath	10:00	11:00	54.10.743, 011.27.513	376	54.06.594, 011.36.512	363	9.9	R	044	9.8	S	O	G	SF	N
14/8/14	V	Marian McGrath	13:20	14:05	53.52.404, 011.48.326	300	53.55.647, 011.47.249	333	4.3	N	353	13.9	S	O	G	SF	N
14/8/14	V	Marian McGrath	16:00	16:30	53.44.899, 011.53.741	298	53.43.512, 011.54.741	300	5.6	R	058	6.2	S	O	G	SF	N
15/8/14	V	Marian McGrath	09:30	10:00	53.47.557, 013.07.702	299	53.50.016, 013.06.249	341	5.3	R	308	11	S	O	G	WF	N
15/8/14	V	Marian McGrath	15:30	16:00	53.44.890, 012.59.484	265	53.44.891, 012.59.481	265	0.3	R	296	15.7	S	O	G	SB	N
15/8/14	V	Marian McGrath	17:00	17:30	53.43.658, 013.01.379	260	53.42.862, 013.02.528	247	0.7	R	295	14.3	S	O	G	N	N
15/8/14	V	Marian McGrath	17:30	18:30	53.42.862, 013.02.528	249	53.41.772, 013.03.971	249	1.4	R	284	18.7	S	O	G	N	N
16/8/14	V	Marian McGrath	11:15	11:45	53.38.852, 12.17.428	293	53.38.843, 012.17.438	294	0.9	R	266	24	C	L	P	N	N
16/8/14	V	Marian McGrath	13:15	13:45	53.36.371, 012.04.945	290	53.36.366, 012.04.946	291	1.1	R	263	28	R	L	P	N	N
16/8/14	V	Marian McGrath	15:30	15:45	53.36.505, 12.04.647	296	53.36.565, 012.04.648	296	0.6	R	281	29	R	L	P	N	N

17/8/14	V	Marian McGrath	12:30	14:00	53.20.688, 010.17.077	112	53.23.460, 010.22.060	103	5.5	R	329	24.9	C	M	M	SB	N
17/8/14	V	Marian McGrath	14:00	15:00	53.23.460, 010.22.060	103	53.17.610, 010.12.620	114	5.9	R	328	21	C	M	M	SF	N
17/8/14	V	Marian McGrath	15:00	16:30	53.17.610, 010.12.620	135	53.12.258, 010.04.099	95	6	R	317	24	C	M	M	N	N
17/8/14	V	Marian McGrath	16:30	17:15	53.12.258, 010.04.099	95	53.14.929, 010.08.530	107	4	R	341	25	C	M	M	SF	N
18/8/14	V	Marian McGrath	11:00	11:30	53.14.742, 010.50.645	132	53.16.459, 010.56.568	138	3	R	004	19	C	L	M	N	N
18/8/14	V	Marian McGrath	15:15	17:00	53.21.922, 011.09.366	149	53.23.292, 011.12.781	141	1	R	350	17	C	L	M	SB	N
18/8/14	V	Marian McGrath	17:00	17:30	53.23.292, 011.12.781	141	53.23.542, 011.13.833	139	0.9	R	327	17	C	M	G	SB	N
19/8/14	V	Marian McGrath	14:00	14:30	53.27.700, 013.16.911	188	53.28.674, 013.23.136	177	6.4	R	285	7.4	G	O	G	SF	N
19/8/14	V	Marian McGrath	14:30	15:30	53.28.674, 013.23.136	177	53.30.283, 013.33.013	183	6.2	R	010	11.2	G	O	G	SF	N
19/8/14	V	Marian McGrath	15:30	16:3	53.30.283, 013.33.013	183	53.29.223, 013.42.111	194	6.4	R	051	8.2	G	O	G	SF	N
19/8/14	V	Marian McGrath	16:30	17:00	53.29.223, 013.42.111	200	53.28.236, 013.44.581	202	6	R	015	7	G	O	G	SF	N
20/8/14	V	Marian McGrath	10:30	11:30	53.20.642, 012.28.222	345	53.23.414, 012.24.622	343	9.5	R	323	8	G	O	G	SB	N
20/8/14	V	Marian McGrath	11:30	13:00	53.23.414, 012.24.622	343	53.10.745, 012.21.461	333	0.3	R	322	6	G	O	G	SF	N
20/8/14	V	Marian McGrath	13:00	16:00	53.10.745, 012.21.461	333	53.01.490, 011.43.007	167	10.2	R	300	9	G	O	G	SF	N
20/8/14	V	Marian McGrath	16:00	16:50	53.01.490, 011.43.007	167	53.00.693, 011.36.073	152	10.8	R	297	10.8	G	O	G	SF	N
21/8/14	V	Marian McGrath	11:00	13:15	52.53.114, 010.26.521	100	52.43.342, 010.29.062	108	6	R	277	28	C	M	M	N	L
21/8/14	V	Marian McGrath	13:15	14:00	52.43.342, 010.29.062	108	52.39.823, 010.33.440	118	6.5	R	285	28	C	M	M	N	N
21/8/14	V	Marian McGrath	14:00	15:45	52.39.823, 010.33.440	118	52.37.820, 010.43.684	125	6.6	R	300	24	C	M	M	N	N

21/8/14	V	Marian McGrath	15:45	16:20	52.37.820, 010.43.684	125	52.34.570, 010.41.345	126	7.1	R	321	14	S	O	O	N	N
22/8/14	V	Marian McGrath	10:20	11:30	51.57.610, 010.53.329	137	51.47.539, 010.46.380	135	10	R	334	7	G	O	O	SF	N
22/8/14	V	Marian McGrath	14:50	15:35	51.44.741, 011.09.731	185	51.46.116, 010.58.448	163	9.3	R	327	4.2	G	O	G	SF	N
23/8/14	V	Marian McGrath	11:00	12:50	50.48.061, 09.03.810	121	50.38.066, 008.45.976	117	9.4	R	023	2.4	G	O	G	SF	N
23/8/14	V	Marian McGrath	12:50	13:15	50.38.066, 08.45.976	117	50.35.676, 008.41.946	124	10.2	R	335	3	G	O	G	SF	N
23/8/14	V	Marian McGrath	13:15	15:00	50.35.676, 008.41.946	124	50.21.041, 008.16.721	127	10.2	R	311	3	G	O	G	SF	N
23/8/14	V	Marian McGrath	15:00	17:00	50.21.041, 008.16.721	127	049.50.272, 007.23.470	120	10	R	130	3.2	G	O	G	WF	N

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	1	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
21/07/14	11:56	12:20

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	48°52.023'N, 10°03.973'W	195m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
200°	50m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
4	4			√ yes □ no

Behaviour (visual sightings only)
Bow riding, Breaching

Direction of travel (relative to ship)

- √ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- √ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- √ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Airgun (or other source) activity when animals last detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Time animals entered mitigation/ exclusion zone (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
11:56	12:20
Closest distance of animals from airguns (or other source) (metres)	**Time of closest approach** (UTC, 24hr clock)
Bow Riding	11:56

If seen during soft start give:

First distance
Closest distance
Last distance
during soft start (metres)

What action was taken? (according to requirements of guidelines/ regulations in country concerned)

- √ none required
- □ delay start of firing
- □ shut-down of active source
- □ power-down of active source
- □ power-down then shut-down of active source

Length of power-down and/ or shut-down (if relevant) (length of time until subsequent soft start, in minutes)

Estimated loss of production (if relevant) due to mitigating actions (km)

None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	2	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
21/07/14	13:08	13:30

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	48°49.643'N, 10°02.611'W	200m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
250°	40m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
12	11		1	√ yes □ no

Behaviour (visual sightings only)
Travelling, Breaching

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- √ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- √ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	13:08	13:30
		Closest distance of animals from airguns (or other source) (metres) 50m	**Time of closest approach** (UTC, 24hr clock) 13:10

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	3	n/a
Date 26/07/14		**Time at start of encounter** (UTC, 24hr clock) 14:20	**Time at end of encounter** (UTC, 24hr clock) 14:25

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- □ visually detected by observer keeping a continuous watch
- √ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	51°14.860'N, 06°13.755'W	128m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
300°	50m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
3	3		1	□ yes √ no

Behaviour (visual sightings only)
Swimming

Direction of travel (relative to ship)

- □ towards ship
- √ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- √ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	14:20	14:25
		Closest distance of animals from airguns (or other source) (metres) 10m	**Time of closest approach** (UTC, 24hr clock) 14:23

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	4	n/a
Date 26/07/14		**Time at start of encounter** (UTC, 24hr clock) 18:14	**Time at end of encounter** (UTC, 24hr clock) 18:20

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	51°29.6'N, 06°02.5'W	115m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
210°	Next to ship

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
30	20	5	5	□ yes √ no

Behaviour (visual sightings only)
Swimming, bow riding and breaching

Direction of travel (relative to ship)

- □ towards ship
- √ away from ship
- □ parallel to ship in same direction as ship
- √ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- √ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Airgun (or other source) activity when animals last detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Time animals entered mitigation/ exclusion zone (UTC, 24hr clock) 18:14

Time animals left mitigation/ exclusion zone (UTC, 24hr clock) 18:20

Closest distance of animals from airguns (or other source) (metres) Next to ship

Time of closest approach (UTC, 24hr clock) 18:20

If seen during soft start give:

First distance
Closest distance
Last distance

during soft start (metres)

What action was taken? (according to requirements of guidelines/ regulations in country concerned)

- √ none required
- □ delay start of firing
- □ shut-down of active source
- □ power-down of active source
- □ power-down then shut-down of active source

Length of power-down and/ or shut-down (if relevant) (length of time until subsequent soft start, in minutes)

Estimated loss of production (if relevant) due to mitigating actions (km)

None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	5	n/a
Date 27/07/14		**Time at start of encounter** (UTC, 24hr clock) 13:39	**Time at end of encounter** (UTC, 24hr clock) 13:45

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	51°43.296'N, 06°03.346'W	114m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
010°	20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
4	3		1	□ yes √ no

Behaviour (visual sightings only)
Fast swim

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- √ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- √ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	13:39	13:45
		Closest distance of animals from airguns (or other source) (metres) 20m	**Time of closest approach** (UTC, 24hr clock) 13:39

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.) n/a	**Ship/ platform name** RRS James Cook	**Sighting number** (start at 1 for first sighting of survey) 6	**Acoustic detection number** (start at 500 for first detection of survey) n/a
Date 09/08/14		**Time at start of encounter** (UTC, 24hr clock) 18:30	**Time at end of encounter** (UTC, 24hr clock) 18:35

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- □ visually detected by observer keeping a continuous watch
- √ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	56°11.334'N, 08°36.357'W	130m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
025°	20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
2	2		1	□ yes √ no

Behaviour (visual sightings only)
Swimming, breaching

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- √ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- √ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	18:30	18:35
		Closest distance of animals from airguns (or other source) (metres) 5m	**Time of closest approach** (UTC, 24hr clock) 18:30

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	7	n/a
Date 12/08/14		**Time at start of encounter** (UTC, 24hr clock) 18:50	**Time at end of encounter** (UTC, 24hr clock) 18:55

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	56°23.977'N, 07°23.977'W	139m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
265°	5m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
4	4			□ yes √ no

Behaviour (visual sightings only)
Swimming, breaching

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- √ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	18:50	18:55
		Closest distance of animals from airguns (or other source) (metres) 5m	**Time of closest approach** (UTC, 24hr clock) 18:50

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	8	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
15/08/14	08:55	09:30

Were animals detected visually and/ or acoustically?

√ visual
□ acoustic
□ both

How were the animals first detected?

√ visually detected by observer keeping a continuous watch
□ visually spotted incidentally by observer or someone else
□ acoustically detected by PAM
□ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	53°42.9'N, 13°10.8'W	299m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
010°	5m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
80	60	20		√ yes □ no

Behaviour (visual sightings only)
Fast swimming all around and underneath the ship, breaching and bow riding

Direction of travel (relative to ship)

□ towards ship
□ away from ship
□ parallel to ship in same direction as ship
□ parallel to opposite direction to ship
□ crossing perpendicular ahead of ship
√ variable
□ milling
□ stationary
□ other
□ unknown

Direction of travel (compass points)

□ N
□ NE
□ E
□ SE
□ S
□ SW
□ W
□ NW
√ variable
□ stationary
□ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	08:55	09:30
		Closest distance of animals from airguns (or other source) (metres) Right next to ship	**Time of closest approach** (UTC, 24hr clock) 08:55

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.) n/a	**Ship/ platform name** RRS James Cook	**Sighting number** (start at 1 for first sighting of survey) 9	**Acoustic detection number** (start at 500 for first detection of survey) n/a
Date 19/08/14		**Time at start of encounter** (UTC, 24hr clock) 11:45	**Time at end of encounter** (UTC, 24hr clock) 11:47

Were animals detected visually and/ or acoustically?	**How were the animals first detected?**
√ visual □ acoustic □ both	√ visually detected by observer keeping a continuous watch □ visually spotted incidentally by observer or someone else □ acoustically detected by PAM □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	53°23.6'N, 12°52.3'W	188m

Species/ species group	**Description** (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)
Killer Whale	Black and white, pale grey/white saddle patch behind tall dorsal fin. Dorsal fin ½ way along back

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
285°	10m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
2	2	20		□ yes √ no

Behaviour (visual sightings only)
Breaching

Direction of travel (relative to ship)		**Direction of travel** (compass points)	
□ towards ship	□ variable	□ N	√ W
□ away from ship	□ milling	□ NE	□ NW
√ parallel to ship in same direction as ship	□ stationary	□ E	□ variable
□ parallel to opposite direction to ship	□ other	□ SE	□ stationary
□ crossing perpendicular ahead of ship	□ unknown	□ S	□ unknown
		□ SW	

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	11:45	11:47
		Closest distance of animals from airguns (or other source) (metres) 10m	**Time of closest approach** (UTC, 24hr clock) 11:45

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	10	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
21/08/14	11:00	11:45

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	52°53.114'N, 010°26.521'W	100m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
220°	5m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
50	35	10	5	√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- √ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Airgun (or other source) activity when animals last detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Time animals entered mitigation/ exclusion zone (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
11:00	11:45
Closest distance of animals from airguns (or other source) (metres)	**Time of closest approach** (UTC, 24hr clock)
Right next to ship	11:00

If seen during soft start give:

First distance
Closest distance
Last distance

during soft start (metres)

What action was taken? (according to requirements of guidelines/ regulations in country concerned)

- √ none required
- □ delay start of firing
- □ shut-down of active source
- □ power-down of active source
- □ power-down then shut-down of active source

Length of power-down and/ or shut-down (if relevant) (length of time until subsequent soft start, in minutes)

Estimated loss of production (if relevant) due to mitigating actions (km)

None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	11	n/a
Date 21/08/14		**Time at start of encounter** (UTC, 24hr clock) 13:15	**Time at end of encounter** (UTC, 24hr clock) 13:30

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	52°43.342'N, 010°29.062'W	108m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
225°	2m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
2	2	10	5	√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- √ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- √ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	13:15	13:30
		Closest distance of animals from airguns (or other source) (metres) 2m	**Time of closest approach** (UTC, 24hr clock) 13:15

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	12	n/a
Date 21/08/14		**Time at start of encounter** (UTC, 24hr clock) 14:00	**Time at end of encounter** (UTC, 24hr clock) 14:30

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	52°39.823'N, 010°33.440'W	118m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
220°	0-20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
20	15	4	1	√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- √ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	14:00	14:30
		Closest distance of animals from airguns (or other source) (metres) 0-5m	**Time of closest approach** (UTC, 24hr clock) 14:00

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	13	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
22/08/14	10:00	10:20

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	52°02.536'N, 011°00.033'W	137m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
155°	Next to ship

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
40	40			□ yes √ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- √ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	10:00	10:20
		Closest distance of animals from airguns (or other source) (metres) 0-5m	**Time of closest approach** (UTC, 24hr clock) 10:00

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	14	n/a

Date	**Time at start of encounter** (UTC, 24hr clock)	**Time at end of encounter** (UTC, 24hr clock)
22/08/14	14:50	15:15

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	51°44.741'N, 011°09.731'W	185m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
080°	5-20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
20	20			√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- √ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	14:50	15:15
		Closest distance of animals from airguns (or other source) (metres) 0-5m	**Time of closest approach** (UTC, 24hr clock) 14:50

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	15	n/a
Date 23/08/14		**Time at start of encounter** (UTC, 24hr clock) 11:00	**Time at end of encounter** (UTC, 24hr clock) 11:30

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	50°48.061'N, 009°03.810'W	121m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
134°	0-20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
20	15	5		√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- √ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	11:00	11:30
		Closest distance of animals from airguns (or other source) (metres) 5m	**Time of closest approach** (UTC, 24hr clock) 11:00

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	16	n/a
Date 23/08/14		**Time at start of encounter** (UTC, 24hr clock) 13:00	**Time at end of encounter** (UTC, 24hr clock) 13:15

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	50°35.676'N, 008°41.946'W	124m

Species/ species group

Common Dolphin

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black back, white sides, hour glass shaped body pattern, tall curved dorsal fin set halfway along the back. Relatively long narrow beak

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
135°	0-20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
5		5		√ yes □ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- √ parallel to ship in same direction as ship
- □ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- □ S
- □ SW
- □ W
- □ NW
- √ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected	**Airgun (or other source) activity when animals last detected**	**Time animals entered mitigation/ exclusion zone** (UTC, 24hr clock)	**Time animals left mitigation/ exclusion zone** (UTC, 24hr clock)
□ full power □ not firing □ soft start √ reduced power (other than soft start)	□ full power □ not firing □ soft start √ reduced power (other than soft start)	11:00	11:15
		Closest distance of animals from airguns (or other source) (metres) 0-20m	**Time of closest approach** (UTC, 24hr clock) 11:00

If seen during soft start give:	**What action was taken?** (according to requirements of guidelines/ regulations in country concerned)	**Length of power-down and/ or shut-down** (if relevant) (length of time until subsequent soft start, in minutes)	**Estimated loss of production (if relevant) due to mitigating actions** (km)
First distance **Closest distance** **Last distance** during soft start (metres)	√ none required □ delay start of firing □ shut-down of active source □ power-down of active source □ power-down then shut-down of active source		None

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	**Ship/ platform name**	**Sighting number** (start at 1 for first sighting of survey)	**Acoustic detection number** (start at 500 for first detection of survey)
n/a	RRS James Cook	17	n/a
Date 23/08/14		**Time at start of encounter** (UTC, 24hr clock) 15:00	**Time at end of encounter** (UTC, 24hr clock) 15:15

Were animals detected visually and/ or acoustically?

- √ visual
- □ acoustic
- □ both

How were the animals first detected?

- √ visually detected by observer keeping a continuous watch
- □ visually spotted incidentally by observer or someone else
- □ acoustically detected by PAM
- □ both visually and acoustically before operators/ observers informed each other

Observer's/ operator's name	**Position** (latitude and longitude)	**Water depth** (metres)
Marian McGrath	50°21.041'N, 008°16.721'W	130m

Species/ species group

Minke Whale

Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)

Black on top, white below. Pointed head above water as breaking the surface. No blow seen. Pale pectoral fin patches below the surface

Bearing to animal (when first seen or heard) (bearing from true north)	**Range to animal** (when first seen or heard) (metres)
134°	0-20m

Total number	**Number of adults** (visual sightings only)	**Number of juveniles** (visual sightings only)	**Number of calves** (visual sightings only)	**Photograph taken**
1	1			□ yes √ no

Behaviour (visual sightings only)
Swimming, breaching and bow riding

Direction of travel (relative to ship)

- □ towards ship
- □ away from ship
- □ parallel to ship in same direction as ship
- √ parallel to opposite direction to ship
- □ crossing perpendicular ahead of ship
- □ variable
- □ milling
- □ stationary
- □ other
- □ unknown

Direction of travel (compass points)

- □ N
- □ NE
- □ E
- □ SE
- √ S
- □ SW
- □ W
- □ NW
- □ variable
- □ stationary
- □ unknown

Airgun (or other source) activity when animals first detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Airgun (or other source) activity when animals last detected

- □ full power
- □ not firing
- □ soft start
- √ reduced power (other than soft start)

Time animals entered mitigation/ exclusion zone (UTC, 24hr clock) 15:00

Time animals left mitigation/ exclusion zone (UTC, 24hr clock) 15:15

Closest distance of animals from airguns (or other source) (metres) 20m

Time of closest approach (UTC, 24hr clock) 15:00

If seen during soft start give:

First distance
Closest distance
Last distance
during soft start (metres)

What action was taken? (according to requirements of guidelines/ regulations in country concerned)

- √ none required
- □ delay start of firing
- □ shut-down of active source
- □ power-down of active source
- □ power-down then shut-down of active source

Length of power-down and/ or shut-down (if relevant) (length of time until subsequent soft start, in minutes)

Estimated loss of production (if relevant) due to mitigating actions (km)

None

Appendix 2 Common Dolphins

Appendix 4.4

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Britice Chrono JC106
BGS Vibrocorer Daily Operations Log

Sunday: 13/07/14 Joined Ship – 17:00

D Baxter, M Wilson, A Gilles, J Hothersall, J Gales, K Gibson, I Pheasant

Monday 14/07/14: Started unloading trucks with NOC. Crane & forklift. Ships crane out of actions, hire crane brought in shore side, set up approx. 16:00hrs.

Winch unloaded and floated into position and landed. Deck fix brackets bolted into position. (additional bolts required)

Containers lifted onto deck and secured into position with twist locks and additional chains.

Tuesday 15/07/14: Winch screwed to deck. Power pack coupled up umbilical ran off and lifted to sheave. Crew lifted to A-Frame. Ships crane now working. Vibrocorer lifted on deck, use two stern cranes to turn rig into vertical position and install legs.

Wednesday 16/07/14: Powered up umbilical to winch and Vibrocorer. Problem found with retract of pot after rig had been lifted to position lying on side on back deck. Iain Pheasant contacted runners from pot to legs (guides) were seizing on. Only safe way to strip out would be to stand rig on vertical side on deck. Iain Pheasant and Garry McGowan stripped out guides from Loanhead and transported to the ship.

Thursday 17/07/014: Vibrocorer to be lifted from horizontal position on deck to vertical. Started lifting as procedure for launch. Rig tipped to the point of balance where as rig tipped over the jammed pot freed and slid to base of rig.

Whether it was the shock impact or centre of balance shifting deck securing chain on the port side, the eye bolt sheared and the rig skewed to the port side causing the lifting bracket assembly to bend and partially separate.

After assessing the situation the port side AFT Crane was rigged up with lifting strop to top of rig frame and lifted the rig back on deck standing on legs in the vertical position. Rig now in safe position.

Accident report submitted by Master and I Pheasant (BGS).
Visual inspection of sheave carried out by I Pheasant and Scientific Boson. No damage found
Removed pot guides and lifted replacements brought from Loanhead. Sized up and carried out modification of clearances grinding out internal diameters and opening out slotted holes for mounting bolts.
After several attempts the pot retract was working.
Rig was tipped back to horizontal position using both ships main crane and port AFT crane. Rig now in save position on deck. Replacement lifting point required for head of rig.

Arrangements made for Heather Stewart and Dave Wallis to transport lifting point and pins etc from Loanhead to ship.
Damaged bullet clamp bracket and rig lifting bracket dismantled.
All electrical power off and umbilical power cable uncoupled from junction box.
All cables and damaged brackets stripped off ring. Rig frame checked for any damage none found.
New brackets arrived at 20.00.
Checked all compatible, decided on welded modifications to rig lifting bracket.

Friday 18/07/14: Rig lifting bracket stiffners welded onto both sides of bracket.
Fitted bracket to rig. New clamp lifted to bullet and all lifted to rig.
Electrical terminations completed and all operations tested.
Deck anchor points modified both sides by NOC workshop. Base plate 20mm thick bolted to 2 of deck tapped holes with welded pad eye to take rig hook on anchor chains. Carried out test deployment of rig all OK.

Ship sailed from Southampton 12.00.

Wednesday 30/07/14: Nightshift problems retracting core barrel back into rig. Deck winch used to pull rig off sea bed. Rig on deck aprox. 07.00 with bent core barrel. Used powered capstan and pulley system to pull pot up rig. Bent barrel removed.

Problem on rig retract winch, found sea water in hydraulic system. Rig lifted in board using both AFT cranes. Hydraulic bottle changes out.

DAY SHIFT: Coupled pressure hose to winch staffa-motor and flushed out. Left supply and return hoses in bucket. 2-3 broken strands on retract winch rope removed vibrate cable from pot and powered up on "vibrate" to open free-fall valve. Pulled winch rope from drum using powered capstan.

Fitted new winch rope, coupled up hoses on hydraulic power pack and powered up "Retract" function and ran on new rope. Refitted vibrate cable to pot. Filled up oil level on hydraulic bottle.

Rig lifted outboard using cranes. First core site 16:45 all working OK.

- Retract of barrel is quicker than before. Bottle on deck possible replacement of pump and valves. To be investigated when time allows.

Monday 04/08/14: Check Echo sounder fault traced to brake in twisted pair. Test cable and swap to 2nd set, blue and white in use, red and white broken (white broken).

Tuesday 05/08/14: Drain oil filter junction box sort and test repaired twisted pair. Refilll box and compensator. Drill out pressure washer base to realine pump.

Replace main breaker engine room trip. Test system OK.

Winch trip on start up. Dropped one PHS rest TRP and restart HPU. Test OK.

Wednesday 06/08/14: Dynex disconnected (mechanical) from hydraulic lever. Screw tightened to resume operation. To watch out for.

Used penny washers & doubled nutted the bolts which secure pot to barrel as two came loose.

HPU / Winch brake switch not properly tightened. This results in contact not closing reliably Problem resolved by tightening up. To watch in future.

Thursday 07/08/14: Spare E/S (As in use on previous leg) tested inline tube. 5.0m=4.99V, 4.41m=4.40V

Friday 08/08/14: Pp removed from hydraulic power unit, the pump removed, was seized from connection to motor via spline/keyway.
The motor was tested electrically sound and was free to rotate once the Pp was removed.
On inspection of the relief Vv , one O-ring was slightly damaged but still serviceable, couldn't find replacement. Second thinner O ring added to further seal. New Pp was fitted, requires function test. The motor/pump assy, requires moving on holding brackets as lid will not fully seal. Perhaps cause of water ingress?

Dive VC126 dive rig to seabed no amps on rig and no reading on .....bring back to deck and trace to fault in rely case. Test ok. Re-dive. Unsure if dive is OK as we are getting strange readings on PR? And Amps.
Relay case flooded. Cause: trapped O-ring. All contactors to be replaced.

Sunday 10/08/14: High current on switch on at seabed.
Fault was loose HV (Burton) Connector on transformer. Recovered rig to deck. Now craning rig in board.
Transformer, Relay case to deck.
Test complete and replaced connectors.
Result Ok, vibrate OK.
Transformer, Relay Case JB now on rig.
Rig now in normal stern position. Still to top up transformer bottle.
Rig tested ready to go.

Monday 11/08/14: Rig winch cable (subsea) broke due to excess pull out. Retrieved to deck using small deck tugger to pull rig. Past balance point. Cable replaced and operations continued.
Winch (HPU deck side) brake switch. Swapped connection to unused.
Contacts on switch to continue operations.
Action: Replace plastic switch breakers in HPU (ALL!!).

*Tuesday 12/08/14: Fl*ooded relay case rebuilt with spare relay. Wires replaced. Connectors left as original. 2x transformers & 1x 24VPSU not replaced – no spare 24V PSU. Still to test.

Wednesday 13/08/14: Red vibrate “ON” & retract on lights exchanged. See line 5 in headfile.cfg .

Thursday 14/08/14: 2nd relay case reconnected. tested and unassembled - OK.

Friday 15/08/14: 2nd relay now assembled, ready to go and tested. No penetrometer PSU (power supply unit).

Monday 18/08/14: Intermittent unexpected change of function during coring from Vibrate to retract. Relay case remove to investigate.
1/OV connection valve B release transformer loose. Resoldered. System tested with no fault sign. Reassembled on rig.

Wednesday 20/08/14: Retract wire almost parted. Replaced.