MRV Scotia

Survey 0123S

Report

5-19 January 2023

Loading: Aberdeen, 20 December 2022 Sailing: Leith, 5 January 2023 (Scientific crew joined on 4 January 2023) Unloading: Aberdeen, 19 January 2023



In setting the survey programme and specific objectives, etc the Scientist-in-Charge needs to be aware of the restrictions on working hours and the need to build in adequate rest days and rest breaks as set out in Marine Scotland's Working Time Policy (Lab Notice 34/03). In addition, the Scientist-in-Charge must formally review the risk assessments for the survey with staff on-board before work is commenced.

In the interest of efficient data management, it is now mandatory to return the Survey Report, to I Gibb and the Survey Summary Report (old ROSCOP form) to M Geldart, within four weeks of a survey ending. In the case of the Survey Summary Report a nil return is required, if appropriate

Scientific Crew:

Gill Packer (co SIC), Kelly McIntosh, Charlotte Booth, Eric Dalgarno, Nicky Shepherd, Maria Hunter, Samantha Cunningham, Hannah Anderson, Guillaume Hermann (SIC)

Gear:

- Fishing gear: BT 137 with Ground gear E;
- Sediment Sampling: Day grab;
- Litter sampling: Catamaran Neuston trawl; Plankton net;
- Acoustic moorings x 8

Objectives

- 1. To undertake water, sediment and biological sampling for the Clean Seas Environmental Monitoring Programme (CSEMP).
- 2. To collect water samples for nutrient studies as part of the Scottish Coastal Eutrophication Assessment Survey (SCEAS).
- 3. Monitor and record all litter brought aboard in all trawls. Sample water column for micro-plastic litter under project ST04C (20463).
- 4. Extra additional tasks:
 - To check a mooring deployed by the Oceanography group in the Clyde region;
 - To collect 70 kg of sediment samples to be sent to WEPAL (QUASIMEME) for EQA testing material.
- 5. To deploy eight acoustic moorings around Scotland on behalf of the Renewables group (REEA).

Estimated Days Per Project: 12 days 20461; 3 days 20463.

Cruise Overview

The 0123S cruise on MRV *Scotia* started on 5 of January 2023 from Leith and finished on 19 of January 2023 in Aberdeen. The sampling involved the collection of sediment (**67 sites**), flat fish (**dab and plaice from seven different fishing sites**) collected with a total of **11 fishing trawls**, microplastics (**25 catamaran** trawls sifting surface water) and water (**537 nutrients, 268 ammonia, 26 salinity and 26 chlorophyll**). Moreover, eight **acoustic moorings** were deployed around the Scottish seas. A day-by-day detailed cruise narrative is attached in Appendix 2.

Overall, 0123S was a very successful survey, despite the various weather front encountered on the way, leading to multiple weather system with high winds and challenging swells heights. The mooring from Oceanography was not checked however, despite an attempt to locate it during our sampling in the Clyde. The reason being that it was night-time, and strong winds prevented us to move close to the expected mooring position. It has been also impossible to collect the sediment sample for QUASIMEME, as we did not get authorisation to sample within the Aberdeen harbour limits. The required sample will be collected later one this year using a different ship that is currently working for the Harbour authority. Figure 1 below is showing the various sampling region, and the exact track map can be found in Appendix 1.



Figure 1: Map of the sampling regions in 0123S.

Sediments

In total, 67 sediments samples were collected throughout the cruise. No samples were collected for analysis of microplastics due to storage issues in Building C. The following map

details the various sediment grab location. A full list of successful mud grab is attached in Appendix 2.



Figure 2: Maps of successful grabs (green crosses) plotted against the planned sampling location (red circles).

Only three sediment samples were not collected due to various reasons:

- **Rath Ground (Outer Forth region):** a fishing boat was on position, and the bridge was unable to make contact to request the boat to shift.
- **165se (Montrose Bank):** the weather conditions deteriorated whilst on position and sampling was aborted for crew safety reasons.
- **COL5 (Colonsay):** this fixed position returned rocks and gravel; therefore, the sample was not collected.



Picture 1: Day grab used for collecting sediment samples.

Fish

A total of 11 trawls across nine fishing sites were undertaken, leading to a very successful fishing campaign. Samples were collected from Outer Forth, West of Orkney, North Coll, Colonsay, Solway firth, Gallen Head and Outer Moray Firth (see Table 1).

Site	Outer Firth of Forth	West of Orkney	North Coll	Solway Firth	Colonsay	Gallen Head	Outer Moray Firth	Total
No. of fish required	50	50	50	50	50	50	75	375
No. of required fish caught	94	93	51	101	96	65	76 Plaice 112 Dab	688
No. of trawls	1	1	1	1	1	1	1	7
Biological Effects								
External Disease	50	50	50	50	50	50	50	350
Micronucleus	25	24	25	25	25	25	25	174
Bile	24	24	25	18	25	23	22	161
EROD	15	15	10	8	10	15	13	86
Liver histopathology	49	50	50	50	49	50	50	348
Gonad	24	25	10	8	10	23	15	115
Otoliths	50	45	50	50	50	50	50	345
Liver Chemistry								
PCBs / PBDEs	5*	5*	5*	5*	5*	5*	10*	40
Metals	5*	5*	5*	5*	5*	5*	10*	40
Muscle Chemistry								
Metals	5*	5*	5*	5*	5*	5*	10*	40

 Table 1: Fishing samples collected during 0123S.

*Both dab and plaice required at Outer Moray site, all other sites dab only.

* pooled samples

Two other regions were investigated for dabs. In the Clyde region, two fishing trawls were undertaken in Irvine Bay, which returned 11 dabs that were too small for our sampling requirements. According to the fishing master, the ground is too muddy in the Clyde and does not provide a suitable habitat for flat fish. Two new trawls were also attempted in the Central Minch region and returned no dabs. In this region, the ground appeared to be too rocky and shelly for flat fish.

Fishing was attempted on the Montrose Bank site, but operations were stopped due to the strong wind and high swell. The skipper and the fishing master decided to stop the operation as it was deemed unsafe to proceed.

Extra fish sample were collected for the CONNECT project (15 dabs and 10 plaice from the Moray Firth) which were wrapped in aluminium foil and stored whole in the freezer.

Microplastics

The catamaran (Picture 2) was deployed 25 times at various locations along the way.



Picture 2: Catamaran towed behind MRV Scotia.



Figure 3: Maps of successful catamaran tows (orange dots) plotted against the planned sampling location (blue triangle).

All tow locations were plotted on a map and can be seen in Figure 3. All collected samples were processed on-board MRV *Scotia*. A full list of successful catamaran tows is attached in Appendix 3.

The recurrent high winds during this survey made it difficult to deploy and retrieve the catamaran safely, leading to fewer catamaran tows than during previous January surveys.

Marine Litter

All 11 fishing trawls were assessed for the occurrence of marine litter. Only two trawls returned no litter at all, whilst the most common litter item recovered was fishing related equipment such as segments of rope. A whole creel was also collected from Gallen head (North Lewis) Pictures of all collected marine litter items were photographed and collated in a folder.

REEA Mooring Deployment

Eight mooring were successfully deployed around Scotland. The location of the moorings can be seen on Figure 4 below. The complete list of mooring deployment location can be seen in Appendix 4.



Figure 3: Maps of successful acoustic mooring deployment (green star) plotted against the planned deployment location (purple cross).

Acknowledgements

The scientific staff would like to express their thanks to the skipper, fishing mate and crew of the *Scotia* for their hard work, assistance and companionship throughout the cruise. Everybody worked together in a very professional way which made the cruise a pleasure to be part of. Food provided by the galley was outstanding and kept the morale up throughout the whole cruise.

Huge thanks as well to Ian Gibb and Paul McDonald who arranged loading and off-loading in very difficult times.

And finally, congratulation to Eric Dalgarno for whom 0123S would be his last cruise before retiring later on in 2023. His contribution to the various cruises in Marine Scotland Science (and FRS before it) has been immense, especially in Health and Safety advice and he will certainly be missed in future surveys. Eric can be seen enjoying a well-deserved cake made by the galley staff (Thanks Rob!) to celebrate his last cruise (see Picture 3 below).



Picture 3: Eric D. holding his retirement cake.

Submitted by Gill Packer and Guillaume Hermann 25/01/2023

Approved by Bill Turrell 07/03/2023

0123S Track map



Detailed cruise narrative

Wednesday 4 January 2023

Staff travelled to Leith from Aberdeen using rental cars from Enterprise Rent-a-car. Issues were encountered as the two 7-seaters requested were replaced with two x 5-seaters with no luggage space (including a Renault Zoe). After discussing the issue with staff from the Enterprise branch, a third car was sourced from their airport branch allowing staff to reach MRV *Scotia* (docked on South Imperial dock in Leith harbour) around 13:00.

Advice

If rental cars are required in the future from Enterprise, rent three x 5-seaters for nine staff, as no 7-seaters are available from the Aberdeen branches. Make sure before collection/delivery of the car that the final arrangement is suitable by contacting David McAuley (<u>David.McAuley@ehi.com</u> – 01224 894679). Double check for Car model (A Zoe is considered a 5-seater) and number of available seats.

The ship familiarisation was done by the Safety Officer at 15:00. The various workspaces were then set up by the scientific crew, ready for sailing the next day.

Thursday 5 January 2023

Due to the tide and pilot availability, Scotia was only able to leave Leith docks at around 12:00. The non-filtered water supply and the TSG were switched on at 12:45 and water sampling started at 14:00. Fishing on the first site (Outer Forth) commenced at 14:30 for a 1-hour long trawl. 92 dabs were returned in one single trawl. Processing of the fish finished at 22:00. Meanwhile, two cat tows were performed (FoTa1 and FoTa2) and the four Outer Forth sediment samples were collected overnight. One grab (RATH GROUND) could not be collected as a boat was sitting on the sediment site location and communication could not be established with the vessel to require a shift in position.

Friday 6 January 2023

Unfortunately, the next two cat tows (FoTa3 and FoTa4) were not performed because of winds of 40 knots. Scotia then steamed towards the Montrose Bank, aiming to start fishing at 7:00 am. During this 35 nm steam, water sampling was suspended as water would be collected on the way back to the coast. This allowed staff to have the requested rest time. Fishing was trialled but the Fishing Master stopped it as the weather condition were too rough. Wind speed was around 45 knots (SW) with a 4.5 m swell. The ship was not able to get to speed driving into the wind, reducing greatly fishing efficiency. Waves were crashing onto the fishing deck, which made fishing operations more hazardous.

<u>Advice</u>

North Sea swell is very different from what can be encountered in the Atlantic Ocean. A 4 m swell with a short period (7s) makes the ship move a lot, compared to a bigger swell and longer period (8 m with 15 s) where the ship is "riding" the swell. Consider both swell and period before going out offshore in the North Sea.

Water collection resumed at 09:00 when Scotia steamed back west to collect the five East Coast sediment grab samples. Sampling was completed at 15:00 and Scotia started steaming towards the West of Orkney sampling area.

Meanwhile, the first acoustic mooring for the renewable group was assembled (RJ-9, 6732), ready to de deployed near the next fishing site location (Site #9 - West of Orkney). As the conditions were good, time was spent to modify all the eight moorings and double up the rope connecting the Acoustic Release to the chain weight. This is to reduce the height of the mooring off the seabed.

Saturday 7 January 2023

Fishing started on the West of Orkney site at 08:00. As a ship was laying creels on the previous fishing tow, a new line Northwest of the original tow was selected. 93 dabs were returned in one single trawl, with 50 males and 43 females. The first acoustic monitoring mooring (RJ-9, 6732) was then successfully deployed at 10:15. 5 sediment stations (WOK1 to WOK5) were then collected on the West of Orkney. Scotia then steamed toward the NORTH MINCH area.

Advice

It looks like ticklers chain seem to work really well to get the required dab. Are they fitted on *Alba* as well? Should we request this equipment from the Net Store?

Sunday 8 January 2023

The second acoustic mooring was deployed at NUN BANK (Site #11) at 00:30. SCOTIA then proceeded to collect the UPPER MINCH sediment samples. However, due to strong wind gusting at 79 knots, sediment and water sampling was suspended until 14:30. The most northerly sediment (UM1.2) was abandoned as Scotia has to keep travelling south to avoid losing too much time due to the bad weather. UM1 three failed after three attempts. Therefore, secondary sites UM1.6 and UM1.7 shall be collected instead on the way back north (Near the Northeast of Lewis). Meanwhile, all catamaran launched were suspended due to wind averaging around 30 knots. As UM2.1 failed as well, UM2.7 was added to the sampling plan and will be collected on the way back travelling north through the Minch.

Monday 9 January 2023

Fishing resumed in the Central Minch region. two fish trawls were attempted which returned six and one dab respectively. Both trawls resulted in damaged net and ticklers breaking, highlighting the poor ground for dab in this region. Scotia then proceeded to collect the SOH sediment site with a couple of cat tows on route, as the wind speed dropped down to 15 knots. Meanwhile, water nutrients analyses were suspended due to poor baseline data. An email was sent to Seal Techsupport EU Techsupport.EU@seal-analytical.com to request advice on how to resolve the issue. From the response received, it might be related to bubbles issues that the operator will try to solve.

<u>Advice</u>

It might be helpful to give more wire than the current measured depth to make sure that the Day grab sits on the seabed for longer before hauling it back up. At a depth of 130 m, ten extra metres of wire should be enough to secure a successful sampling.

It was considered to reach the Barra (Site #15) for dropping an acoustic mooring, but this would have delayed the fishing planned on 10 January 2023 in North Coll first thing in the morning and was therefore delayed to a further date

Advice

As cat tows position are not opportunistic anymore, and are considered as fixed positions such as the sediment sites, it is helpful to provide the bridge/crew with maps that include all the relevant sampling sites in the regions (SED – red hexagons for primary, and blue triangles for secondary, CAT – green triangles, FISH – limits as purples X, MOORINGS – pink crosses +), such as:



The sampling order can then be decided regarding the forecasted wind speed and direction, swell and weight height.

Question

When pooling samples for liver, five males are often not enough to a pool with enough material for the several analyses required (EROD, Metals, Lipids, PBDEs, PCBs). Therefore, extra livers are added to the pool, often from a bigger female, to make up the sample. So, a pool might be five small males' liver + one big female liver.

- Is this the correct way to do it?
- Can this protocol trump the data?
- Are male and female liver analytically similar? I.e. would male or female have significant "content" concentration? IN which case such pool would be bias?
- Would it be better to have one pool with only small males (i.e., tne) and then one only made up of females' livers (five)? If never done before, this could show us differences when analysing content.

- How are the three pools considered in the data processing? Three replicates of the same site, in which case the more similar they are the better, to reduce the RSD on the measurement?
- Does it actually matter how we pool the livers?

Tuesday 10 January 2023

All the SOH sediment were collected overnight. As SOH1.ten failed (rocks were picked up on two occasions), it was decided to collect a secondary site. Due to time restrictions, SOH1.11 was not available and SOH1.12 was collected instead. The catamaran was deployed successfully (SOH1) before *Scotia* travelled towards North Coll. Another catamaran was considered (SOH2) but it was too windy to deploy. Fishing commenced at 08:30 and returned 51 dabs (12 males, 39 females) after a 59 minute trawl. Meanwhile, engineers repaired the reel of the Hydro cable used for the day grab and the cat: the chain slipped from the device reeling back the wire neatly onto the drum. Scotia then steamed towards Colonsay and deployed the third REEA mooring on the Soa location (Site #17) at 17:35. Sediment sampling resumed in the Colonsay sampling region. COL5 was unsuccessful as only rocks and gravel were collected.

Action

The seabed composition on ArcMap shows that COL5 is on "gravel". It would be better to discuss further sampling on this location as it is not likely to be ever satisfactory. Also, a new fish farm is now located closed to COL2, so the sediment sample was collected 0.75 nm east of the original location. This fixed sediment site location should be updated.

Scotia then headed to the Clyde sampling area, aiming to reach the Irvine Bay fishing site by 07:00 on 11/01/23. Meanwhile, the next two REEA moorings were set up, ready for deployment in the Clyde. While crossing the sound of Jura, the ship's speed had to be increased to 14 knots, and the water sampling was doubled during that time (from 21:00 to 22:00).

Wednesday 11 January 2023

ON route to the Clyde, another two REEA moorings were successfully dropped on location (Site #19 - Kilbrannan Sound and Site #18 – Portencross). *Scotia* steamed near the position of the Hydro mooring south of Arran but was unable to check it as conditions were poor (40 knots wind) and it was night-time (03:00). Fishing resumed on the first new tow position in IRVINE bay and returned 11 dabs, all below the required sampling size (17 cm). A second trawl was attempted a further north, but no dabs were returned in this second tow. *Scotia* steamed north towards Loch Long, deploying the cat on 3 occasions (CLYDE1, CLYDE2 and LOCH LONG6). Scotia turned back south and steamed towards the Solway firth.

Advice 1

Sampling on *Scotia* within Loch Long was not undertaken as the local harbour authority required a pilot to board the boat for us to access this sampling area. It was decided not to proceed time was required to travel to Solway overnight on time.

Advice 2

Three of the fixed cat tow positions were either too close to land or in navigation channels. The fixed cat tow system is not working too well. It would be better to have a box like the fish and have a number of cat tows for each box, allowing some flexibility to deploy the cat when the weather allows.

Advice 3

It is better to use *Scotia* as a wind break when deploying/retrieving the cat. This way, it was possible to deploy and retrieve it safely with winds of about 30 knots. It could be added to the SOP to request Scotia to move the ship perpendicular to the wind direction to allow safe deployment in poor conditions.

Question

does the cat tow has to be in a straight line? How is the total cat distance covered calculated? Finish – Start with Lalong's, or Ship Speed x time?

Thursday 12 January 2023

Four cat tows and one sediment sample were collected in the Solway firth on the way to the fishing tow position. One cat tow was not done because of the shallow water location unsuitable for *Scotia*. One of the tows was also unsuccessful as the cod-end detached itself from the net: the jubilee clip securing those two parts together was lost, but a spare was used to put back the device together. Fishing resumed at 08:00 at slack water at the Solway site and returned 101 dabs in one trawl (eight males, 94 females). The last four sediment sample were collected before *Scotia* made her way back towards the Sea of Hebrides. After a quiet morning, the wind picked up again and gusted at around 50 knots.

Friday 13 January 2023

Scotia reached the fishing site around 07:00 and started fishing at 07:45. 96 (18 males, 78 females) dabs were collected in one trawl. Scotia steamed towards the Outer Hebrides and deployed the cat once (OH6) before deploying the next REEA mooring at the Barra site. Scotia collected then the 5 sediments in the Outer Hebrides site (HEB) with a gentle 4 m swell.

Advice

dab seem to like sandy ground, more than muddy ground. The Clyde is very muddy and is definitely not great for our little dabies.

Action

The site fished was west of Colonsay, and maybe slightly outside the MERMAN box. Request might need to be made to shift that box west of Colonsay, as it is better ground compared to the East of Colonsay.

A new page was set up on the DAVIS SHIP to display the relevant information for our sampling. The page was named "OSPAR" and saved onto the system. The software manual can be found on the shelf in the instrument room and described how to perform this task. The credentials are: **admin – scoti4r00t**

Saturday 14 January 2023

All the five sediment grabs on the Outer Hebrides sites were collected successfully overnight. *Scotia* then steamed towards the Northwest of Lewis and resumed fishing at the Gallen head site at 10:15. The net was hauled back earlier due to the ground becoming poorer. Despite breaking the ticklers chains, 78 dabs were returned in one trawl. On the way to the Upper minch, a REEA mooring was deployed at the Garenin site at 12:45. The catamaran was then deployed three times (OH2, OH1, MINCHE1) before starting to collect

the remaining sediments in the upper Minch region. Due to increasing wind speed from the North (up to 60 knots guts) and a 4 m swell, sediment sampling was paused as the ship was not able to hold position. During a particularly bad turn, the sediment table slide across the hanger deck and hit the catamaran, bending slightly the metal mouth of the net. and Scotia made her way towards Broad Bay (Stornoway) to shelter overnight. Further catamaran sampling was paused until the conditions got better to allow staff to come on deck to check the equipment and replace the front end of the net with the available spare.

Sunday 15 January 2023

Scotia returned to the next sediment sample from the Upper Minch for 06:00, and the four remaining samples were collected by 08:30. *Scotia* made her way towards Cape Wrath. All the catamaran tows planned on route were dropped as the wind remained high (30 knots), with an on-going 4 m swell. The repair of the catamaran front-end was paused until better work conditions on deck were available.

Advice

The cat tow "North Coast 3" is not an ideal position as on top of Cape Wrath which is in the convergence of three water system. Might be good to move it further east along the north coast.

Scotia then made her way towards Aberdeen harbour as the skipper has to leave the boat for an emergency. Water sampling was paused at 21:00 with a full set of samples collected. Water sampling is due to resume after passing Peterhead on our way back to the Moray firth for our final days of sampling.

Action

The laptop recording the NAV files from the DAVIS SHIP system are getting old and would need replaced. The STATIONS software used to record the NAV files would need to be transferred onto those new laptops. Ideally, this should be tested on-board SCOTIA when it is in Aberdeen in-between cruise.

Advice

the connection to the Sediment container on PORT side for the DAVIS ship system relate to where the cables are plugged in the little cable room at the entrance of the container.

- If the ethernet cable coming into the container is plugged to the **RJ45 #2** connection, the TV screen should be connected to the same port number on the wall inside the container.
- Same for the 26-pin RS-232 cable for the laptop: **DB25 #2** connection in the cable room should match the computer connection inside the container.

Monday 16 January 2023

After a boat transfer for the skipper at 08:00, the front mouth of the catamaran was replaced with a new one and the cat was deployed twice on the North-East coast on our way back to the Moray firth. Water sampling resumed at 12:00 with a full set of samples, after the second cat tow at the NEC5 position. *Scotia* followed the north coast inside the Moray firth, but a very unstable weather system with a succession of short blizzard and wind at above 30 knots made any cat deployment unsuitable. Eventually, after reaching the Inner Moray firth, the cat was deployed several times (MF5 to MF9) followed by six sediment samples collection.

Tuesday 17 January 2023

After the last catamaran deployment (MF8) at 03:30, *Scotia* steamed away from the coast towards the Outer Moray fishing, south of the wind farm. Fishing resumed at 08:00 and returned more than 100 dabs in one trawl (18 males, 93 females – not all were counted as there were a lot of juveniles' haddock caught, making it difficult and unnecessary to look for all the dabs on deck). Plaice were also kept for processing to keep historical the time-series going. Extra fish sample were collected for the CONNECT project (17 dabs and 11 plaice) which were wrapped in aluminium foil and stored whole in the freezer. *Scotia* then re-joined the coast and steamed north towards the last MF10 catamaran tow location. Due to strong winds gusting at 40 knots, it was decided not to deploy the cat at MF10 and turn back south towards the remaining Moray firth grabs.

Wednesday 18 January 2023

A sampling window opened from 01:00 until 07:00 during which the wind dropped down to 30 knots, allowing sediment sampling in the Moray Firth. However, the wind was too strong to pick up the remaining catamaran tows in this region, so *Scotia* made her way to Aberdeen and docked at 14:00 at Matthews Cross Quays. Meanwhile, staff had their usual post cruise debrief (minutes in the **CHEM_DAT\...\0123S** folder) whilst eating the cake that Rob prepared to celebrate Eric's last cruise (retirement).

Thursday 19 January 2023 - Unloading day

Metal cages arrived to the ship at 08:00 and our equipment was transported back to the Netstore at around 11:00. Meanwhile, the SIC and co-SIC attended the cruise debrief (09:30 – minutes in the **CHEM_DAT\...\0123S** folder). One remaining cage was transported later on and emptied the following week.

Actual sediment sampling location details (for Chemistry only).

MAR Test ID MAR-2023-	Sample ID	Date	Time	Latitude	Longitude	Sounding (m)	Wind speed (knots)	True wind direction
-1461	Forth E Isle of May	06/01/2023	01:56:05	56 11.891N	002 25.727W	58.1	28	221
-1462	Forth (North of Wheat Stack)	05/01/2023	22:36:37	56 00.014N	002 14.943W	62.4	21	208
-1463	Forth NE Torness	05/01/2023	23:35:00	56 05.938N	002 19.845W	56.6	25	243
-1465	Forth S Isle of May	06/01/2023	00:37:22	56 07.986N	002 31.946W	49.3	32	219
-1466	EC1.1	06/01/2023	14:39:31	56 34.687N	002 22.651W	56.6	23	214
-1467	EC1.2	06/01/2023	13:00:37	56 32.042N	002 24.814W	45.6	22	246
-1468	EC1.3	06/01/2023	13:35:59	56 31.960N	002 31.080W	34.9	21	233
-1469	EC1.4	06/01/2023	14:58:56	56 34.804N	002 21.871W	63.6	23	222
-1470	EC1.5	06/01/2023	14:10:17	56 33.354N	002 26.367W	43.4	22	223
-1472	MF1.1	16/01/2023	20:34:24	57 45.379N	003 30.707W	60.6	25	257
-1473	MF1.2	16/01/2023	21:42:18	57 44.187N	003 45.658W	34.7	17	268
-1474	MF1.3	16/01/2023	20:01:20	57 45.644N	003 25.419W	52.7	22	272
-1475	MF1.4	17/01/2023	00:36:28	57 54.305N	003 41.374W	38.6	15	272
-1476	MF1.5	16/01/2023	19:08:51	57 51.581N	003 28.147W	57.2	23	274
-1477	MF2.1	18/01/2023	05:32:43	57 58.365N	002 43.143W	80.1	20	311
-1478	MF2.2	18/01/2023	01:18:38	57 57.455N	002 57.439W	79.8	24	349
-1479	MF2.3	18/01/2023	06:07:30	57 56.824N	002 38.374W	90.5	24	311
-1480	MF2.4	18/01/2023	02:06:15	57 54.191N	003 07.092W	82.1	23	347
-1481	MF2.5	18/01/2023	02:42:11	57 50.515N	003 06.323W	86.2	20	331
-1482	MF2.6	18/01/2023	07:49:21	57 57.170N	002 11.347W	98.3	18	351
-1483	MF2.7	18/01/2023	02:58:27	57 50.965N	003 05.993W	86.4	20	345
-1484	MF2.8	18/01/2023	00:58:23	57 56.939N	002 57.201W	82.2	31	339

-1485	MF2.9	18/01/2023	04:01:35	57 54.341N	002 53.397W	92.8	22	321
-1486	MF2.10	18/01/2023	04:45:51	57 54.610N	002 45.137W	80.2	25	321
-1487	105SE	17/01/2023	18:52:46	58 02.947N	003 00.037W	52.3	37	326
-1488	95se	16/01/2023	22:29:59	57 39.944N	003 48.893W	40.5	19	264
-1489	UM1.1	14/01/2023	20:18:39	58 13.301N	006 03.931W	127.2	38	22
-1490	UM1.6	14/01/2023	19:44:47	58 14.171N	006 05.991W	122.3	33	15
-1491	UM1.7	15/01/2023	08:19:54	58 08.546N	006 01.214W	111.4	27	330
-1492	UM1.4	08/01/2023	14:49:27	58 02.221N	005 36.295W	116.6	43	201
-1493	UM1.5	15/01/2023	06:15:02	58 11.520N	006 02.995W	126.8	24	320
-1494	85se	08/01/2023	16:16:03	58 00.027N	005 39.996W	98.7	33	196
-1495	UM2.7	15/01/2023	07:42:46	58 08.212N	006 05.254W	122.9	26	344
-1496	UM2.2	08/01/2023	19:52:18	57 40.381N	005 57.010W	154.7	16	190
-1497	UM2.3	15/01/2023	07:04:15	58 09.694N	006 09.942W	135.5	20	316
-1498	UM2.4	08/01/2023	20:54:02	57 37.558N	006 02.391W	148.1	16	232
-1499	UM2.5	08/01/2023	20:24:53	57 38.825N	006 00.457W	162.2	20	233
-1500	SOH1.1	09/01/2023	12:36:55	57 09.846N	006 57.421W	123.7	20	295
-1501	SOH1.2	09/01/2023	20:14:18	56 50.034N	006 38.190W	122.8	22	268
-1502	SOH1.3	09/01/2023	14:54:45	56 58.605N	007 00.235W	129.9	28	297
-1503	SOH1.4	10/01/2023	00:52:37	56 52.601N	007 18.125W	194.9	17	232
-1504	SOH1.5	10/01/2023	02:36:38	56 46.235N	006 55.578W	147.2	19	209
-1505	SOH1.6	09/01/2023	19:39:05	56 52.164N	006 36.484W	113.7	19	258
-1506	SOH1.7	09/01/2023	17:49:02	56 57.844N	006 33.456W	91.6	19	280
-1507	SOH1.8	09/01/2023	14:02:49	57 02.339N	007 00.171W	136.3	24	308
-1508	SOH1.9	09/01/2023	22:00:40	56 51.799N	006 59.460W	135.9	17	252
-1509	SOH1.12	09/01/2023	23:17:37	56 56.939N	006 57.167W	125.3	19	246
-1510	HEB 1.1	13/01/2023	23:26:20	57 26.800N	008 33.704W	158	27	132
-1511	HEB 1.2	14/01/2023	01:44:04	57 38.096N	008 39.469W	160.8	26	167
-1511	HEB 1.2	14/01/2023	01:52:53	57 38.115N	008 39.473W	159.8	27	154
-1512	HEB 1.3	13/01/2023	22:32:45	57 23.836N	008 27.884W	152.5	24	119
-1513	HEB 1.4	14/01/2023	02:43:40	57 38.937N	008 48.978W	163.3	27	187

-1514	HEB 1.5	14/01/2023	00:18:58	57 29.920N	008 26.349W	159.3	35	131
-1515	WOK 1	07/01/2023	18:22:24	59 33.088N	003 50.585W	163.4	19	152
-1516	WOK 2	07/01/2023	16:14:00	59 19.268N	003 48.718W	142.9	14	152
-1517	WOK 3	07/01/2023	16:45:23	59 21.256N	003 47.265W	145.1	16	154
-1518	WOK 4	07/01/2023	15:40:34	59 16.798N	003 49.054W	145.4	12	156
-1519	WOK 5	07/01/2023	18:51:00	59 33.077N	003 52.669W	164.9	23	161
-1520	SOL1	12/01/2023	12:05:47	54 45.026N	003 59.985W	22.5	29	230
-1521	SOL2	12/01/2023	10:38:34	54 45.993N	003 50.027W	18.6	39	227
-1522	SOL3	12/01/2023	11:05:00	54 45.445N	003 51.774W	19.9	32	220
-1523	SOL4	12/01/2023	11:32:00	54 45.014N	003 54.899W	18.5	35	221
-1524	SOL5	12/01/2023	07:15:58	54 43.639N	003 57.638W	21.8	16	187
-1525	COL1	10/01/2023	19:23:35	56 06.601N	006 04.767W	28.7	26	264
-1526	COL2	10/01/2023	19:53:53	56 05.166N	006 07.235W	24.5	24	259
-1527	COL3	10/01/2023	19:00:21	56 07.115N	006 03.004W	39.9	29	253
-1528	COL4	10/01/2023	18:29:41	56 09.127N	006 04.179W	62.7	26	266

Index:	EC	= East Coast
	MF	= Moray Firth
	COL	= Colonsay
	SOL	= Solway Firth

UM = Minch SOH = Sea Of Hebrides

HEB = Outer Hebrides

WOK = West of Orkney

Appendix 4

Catamaran fitted with Neuston trawl details (Coordinates are from each tows Starting position).

MAR Test ID MAR-2023-	Sample ID	Date	Time	Latitude	Longitude	Wind speed (knots)	True wind direction (°)
-1547	0123S_01_START	05/01/2023	18:12:12	55 59.616N	002 21.019W	24	173
-1548	0123S_02_START	05/01/2023	19:54:37	55 54.310N	002 02.025W	11	200
-1549	0123S_03_START	07/01/2023	11:54:43	59 05.897N	003 27.985W	10	173
-1550	0123s_04_START	07/01/2023	13:44:23	59 14.964N	003 25.114W	10	182
-1551	0123S_05_START	09/01/2023	11:17:47	57 14.692N	006 45.498W	14	266
-1552	0123S_06_START	09/01/2023	16:43:05	57 00.760N	006 33.499W	35	297
-1553	0123S_07_START	10/01/2023	03:04:18	56 47.041N	006 51.502W	18	203
-1554	0123S_08_START	11/01/2023	13:13:29	55 46.279N	004 53.052W	18	238
-1555	0123S_09_START	11/01/2023	14:21:29	55 53.657N	004 55.511W	18	208
-1556	0123S_10_START	11/01/2023	15:02:51	55 56.696N	004 53.819W	29	213
-1557	0123S_11_START	11/01/2023	23:22:56	54 47.229N	005 09.923W	12	268
-1558	0123S_12_START	12/01/2023	01:21:19	54 37.441N	005 00.290W	7	318
-1559	0123S_13_START	12/01/2023	04:54:09	54 45.296N	004 09.986W	14	218
-1560	0123S_14_START	12/01/2023	06:23:46	54 45.281N	003 52.134W	18	184
-1561	0123S_15_START	13/01/2023	17:23:33	56 54.305N	007 42.658W	11	242
-1562	0123S_16_START	14/01/2023	14:08:56	58 26.552N	006 41.906W	19	98
-1563	0123S_17_START	14/01/2023	15:51:39	58 32.179N	006 19.251W	18	360
-1564	0123S_18 START	14/01/2023	17:36:55	58 26.043N	005 58.192W	21	28
-1565	0123S_19_START	16/01/2023	08:47:14	57 11.740N	001 57.00W	12	279
-1566	0123S_20_START	16/01/2023	10:32:34	57 23.314N	001 44.289W	22	275
-1567	0123S_21_START	16/01/2023	18:08:52	57 50.101N	003 24.057W	27	277
-1568	0123S_22_START	16/01/2023	22:55:00	57 41.480N	003 47.420W	19	269
-1569	0123S_23_START	17/01/2023	00:55:11	57 55.686N	003 43.409W	20	289
-1570	0123S_24_START	17/01/2023	02:42:12	58 07.911N	003 32.318W	17	273
-1571	0123S_25_START	17/01/2023	13:06:39	58 16.743N	003 14.746W	28	278

Details of deployed acoustic mooring from REEA.

REEA MOORING ID	Sample ID	Date	Time	Latitude	Longitude	Sounding (m)	Wind speed (knots)
SITE#9 - ORKNEY WEST	RT-9 6732	07/01/2023	10:15:47	58 52.734N	003 42.471W	93.3	17
Site#11 - NUN BANK	RT-5 6729	08/01/2023	00:21:22	58 53.413N	004 54.340W	54.1	27
Site#17 - SOA	6485-67420166	10/01/2023	16:21:18	56 10.153N	006 27.864W	68.1	28
SITE#19 - KILBRANAN SOUND	RT-8 6731	11/01/2023	02:41:55	55 22.880N	005 23.562W	45.1	30
SITE#18 - PORTENCROSS	RT-10 6724	11/01/2023	05:42:47	55 37.522N	005 03.856W	86.9	28
SITE#15 - BARRA	RT14D-547271	13/01/2023	19:03:57	57 05.373N	007 42.148W	61.2	4
SITE#13 - GARENIN	RT-1-6728	14/01/2023	12:26:33	58 26.453N	007 13.016W	85.9	15
SITE#10 - TOTEGAN	RT-6 6477	15/01/2023	16:34:18	58 37.331N	003 59.997W	67.5	33