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RV *Corystes*

Survey 0823H

PROGRAMME

02 - 23 May 2023

Transit start: Belfast, 02 May 2023

Loading: Aberdeen, 05 May 2023

Half landing: Aberdeen, 11 May 2023

Unloading: Ullapool, 21 May 2023 (TBC)

Transit end: Belfast, 23 May 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 (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

Out-turn days per scientific project: 7 days RE01V; 10 days ST05B

Gear (PELAGIO part)

Sea-Bird CTDs, rosette, mooring frames for three moorings, one thermistor chain, echosounders, ADCPs and other relevant mooring instrumentation (acoustic releases, lines, surface marker, deck units, hydrophones, etc.), water filtering equipment, chemistry sampling equipment.

Gear (Hydro part)

Sea-Bird CTDs, rosette, mooring frames, anchor chain and 40" buoys, ADCPs and other current meters and oceanographic instrumentation (e.g. SBE37s), water filtering equipment, plankton nets, chemistry sampling equipment, weeHoloCam.

Objectives (PELAGIO part)

1. Test the SBE911 and CTD carousel at a suitable deeper location on the way to the Firth of Forth. Potentially, somewhere around 57° 1.044' N 01° 47.77 W.
2. Deploy UHI mooring (seabed frame with ADCP and echosounder; two pop-up acoustic releases) just outside a 500 m distance of an offshore wind turbine in the Seagreen Offshore Wind Farm (OWF).
3. Deploy NOC mooring (seabed frame with ADCP, ground line, clump weight and thermistor chain to surface buoyancy) and MSS mooring (AL200 trawlproof frame with ADCP) at a distance of ca. 3 km from OWF, east of the UHI mooring.

4. Carry out a CTD survey with water sampling along a 30 km rectangle offshore from the mooring locations, stopping every 2.5 km along the way to perform a CTD deployment and, on selected stations, water sampling from the carousel bottles.
5. Carry out phytoplankton sampling at a subset of the CTD stations, taking samples from the carousel water bottles.
6. Run the underway TSG (taking calibration samples for salinity and chlorophyll at selected stations) if available.
7. Run the underway EK60 echosounder along the CTD survey track.
8. Perform a seabird survey during daylight hours along the CTD survey track.
9. Perform glider CTD calibration casts at selected locations along the CTD survey track.
10. Carry out sampling at the Stonehaven ecosystem monitoring station if time allows on the way back to Aberdeen.

Objectives (Hydro part)

1. Goldeneye station standard sampling (Priority 1).
2. Perform hydrographic sampling along the JONSIS long term monitoring section in the northern North Sea (Priority 1).
3. Recover and re-deploy two ADCPs (NWSD and NWSE: one RDI Longranger and one Nortek Signature 100, respectively, with SBE37 T and C sensors; Seaguard RCM to be added to NWSD mooring) on single string moorings at positions on Fair Isle – Munken (FIM) section (Priority 1).
4. Perform hydrographic sampling along the long term monitoring Faroe-Shetland Channel Fair Isle – Munken (FIM) section in UK EEZ (Priority 1).
5. Carry out a line of CTD stations in Loch Ewe between the mouth of the loch and the metocean buoy position (Priority 1).
6. Deploy a mooring consisting of two Seaguards and two SBE37s, with a surface marker and bottom acoustic release in Loch Ewe (Priority 1).
7. Collect main section of Loch Ewe data buoy from a mooring point set up by Jane Grant (Priority 1).
8. Run the thermosalinograph throughout the survey, if available (Priority 1).
9. Additional sampling: 1) Take zooplankton net samples in the Loch Ewe CTD transect; 2) Deploy the weeHoloCam at all Loch Ewe CTD transect .

Extra work listed below will be performed if time allows, Priority 2 and 3 tasks are not listed in order of importance and the sequence will be determined depending on time/location/weather:

10. If time allows, carry out a grid of CTD stations in Loch Ewe (Priority 2).
11. If weather/time permits conduct CTD sections on the west coast, from the coastline up

to the edge of the continental shelf ("Shelf" sections) (Priority 2).

12. If weather/time permits conduct CTD sections in the Minch (for sheltering from bad Atlantic weather, Priority 3).
13. If weather/time permits conduct CTD stations following the Ellet line transect (Priority 3).

Procedure

PELAgIO part

On sailing from Aberdeen *Corystes* will make passage towards the Seagreen OWF in the Firth of Forth. Along the way, a suitable deeper location will be identified to test the CTD and carousel water sampler on the main CTD (tentatively, somewhere around 57° 1.044' N 01° 47.77' W but the target sampling position will be selected in discussion with the ship). On completion of these tests, *Corystes* will sail to the proximity of the Seagreen OWF to deploy the UHI mooring just outside a 500 m radius of an operational wind turbine, followed by the NOC and MSS moorings further east (this order may change). All mooring operations will take place in daylight hours. Once the mooring operations are completed, *Corystes* will undertake a rectangular seabird, CTD and acoustic survey of an area 30 km long and ca. 3.4 km wide on a pre-determined NE-SW bearing, stopping at regular intervals to carry out CTD deployments for the duration of the PELAgIO part of the survey. At various points, *Corystes* will rendezvous with the two autonomous underwater vehicles (Slocum buoyancy gliders) operating in the area, to carry out cross-calibrations of their instruments. *Corystes* will complete this survey with sufficient time to return to Aberdeen to offload visitors and their equipment and upload personnel arriving for the second leg of the survey. If time allows and no recent sampling has taken place, *Corystes* will sample the Stonehaven ecosystem monitoring station on the way back to Aberdeen.

Hydro part

North Sea:

On sailing from Aberdeen *Corystes* will make passage to the Goldeneye oil field to collect baseline water samples for any potential future Carbon Capture & Storage (CCS) monitoring. The target sampling position will be 58° 0.3' N 0° 21.96' W (which is inside the oil field) or, if not possible, as close as practicable near 58° 0.9' N 0° 19.92' W, which is just outside.

On completion of these tests and sampling, *Corystes* will sail to the eastern most station of the JONSIS section to carry out sampling with the CTD and carousel water sampler. On completion of the JONSIS section *Corystes* will make way to the Faroe Shetland Channel.

Faroe Shetland Channel (FSC; all mooring deployment during daylight hours):

Passage will be made towards NWSD and NWSE mooring locations to turn around the single string mooring currently deployed, carrying out pre-recovery CTD dips (with SBE37 calibrations) in all cases (note that the order of these operations may change for operational reasons). The plan is to retrieve NWSD first and move to NWSE once work is completed. NWSE has priority for redeployment if moorings do not surface for any reason. *Corystes* will head to the Fair Isle – Munken (FIM) section to carry out standard CTD and water sampling along that line until the EEZ boundary.

West coast (all mooring deployments during daylight hours):

Passage will then be made to the mouth of Loch Ewe to carry out a CTD transect into the loch (including water and chemistry sampling, and weeHoloCam deployments) and deploy a mooring string of two Seaguards and two SBE37S with DO, with a surface float to temporarily replace the Loch Ewe metocean buoy. Please note there is an existing pCO₂ mooring (to avoid) at 57° 51.123 N, 5° 39.370 W. *Corystes* will collect the main section of the databuoy, which will be towed to the vicinity of *Corystes* by J Grant. If time allows, *Corystes* will also carry out a spatial grid of CTD stations in Loch Ewe. After the work in Loch Ewe is completed, depending on timings and other considerations (e.g. weather), CTD sampling along the Shelf lines (three, extending across the deep section south west of the WT ridge and four) off the west coast will be carried out. An additional sampling grid in the Minch may be considered if we need to shelter from Atlantic weather. A section of the Ellet line may also be considered if time allows.

Once time is up, *Corystes* will steam to Ullapool to offload the scientists and their gear before heading back to Belfast.

Additional North Sea work:

If Stonehaven has not been sampled recently, this may be added to the Pelagio survey on out or return if time allows

PELAGIO Mooring Positions (Deploy)

| | | | |
|-------------|--------------|-------------|--|
| UHI mooring | 56° 32.74' N | 1° 30.39' W | (steel frame) |
| MSS mooring | 56° 33.95' N | 1° 28.07' W | (AL200) |
| NOC mooring | 56° 32.11' N | 1° 27.95' W | (steel frame with groundline and thermistor chain) |

FSC Mooring Positions (Recover)

| | | | | | |
|------|-----|-----------|-----|-----------|-----------------------|
| NWSE | 60° | 16.364" N | 04° | 23.154" W | (short single string) |
| NWSD | 60° | 27.058" N | 04° | 22.436" W | (short single string) |

FSC Mooring Positions (Deploy)

| | | | | | |
|------|-----|-----------|-----|-----------|-----------------------|
| NWSE | 60° | 16.356" N | 04° | 23.054" W | (short single string) |
| NWSD | 60° | 27.036" N | 04° | 22.428" W | (short single string) |

Loch Ewe Mooring Position (Deploy)

| | | | | | |
|------|-----|-----------|-----|-----------|--|
| LEWE | 57° | 50.982" N | 05° | 39.010" W | (single string with surface float, IxSea acoustic release and two Seaguards and two SBE37DOs) |
|------|-----|-----------|-----|-----------|--|

Scientific Procedures

It is expected that deployments of hydrographic equipment will be carried out with the CTD frame whilst the vessel is on station. A suitable crane/A frame will be used for the deployment of ADCP moorings in trawl-resistant frames (AL-200s), short single-string moorings using an acoustic release to release the frames once they are on/close to the seabed and steel ADCP frames. Recovery of the Loch Ewe data buoy to be conducted using a suitable crane/A frame, following discussion with the ship's crew.

Plankton net samples and weeHoloCam deployments will be carried out using a suitable plankton crane/A frame and wire.

Reduced TA/DIC sampling will occur, focusing on Goldeneye, the FIM stations where TA/DIC is sampled and the Loch Ewe transect.

Chlorophyll samples will be stored frozen in the freezer in the dry lab. Nutrient samples will be stored frozen in a **fish-free** empty freezer in the dry lab. Oxygen samples will be stored in the wet lab.

(NOTE: The position of the CTD sampling station in the Goldeneye oil field will be adjusted for any exclusion zones and oil infrastructure).

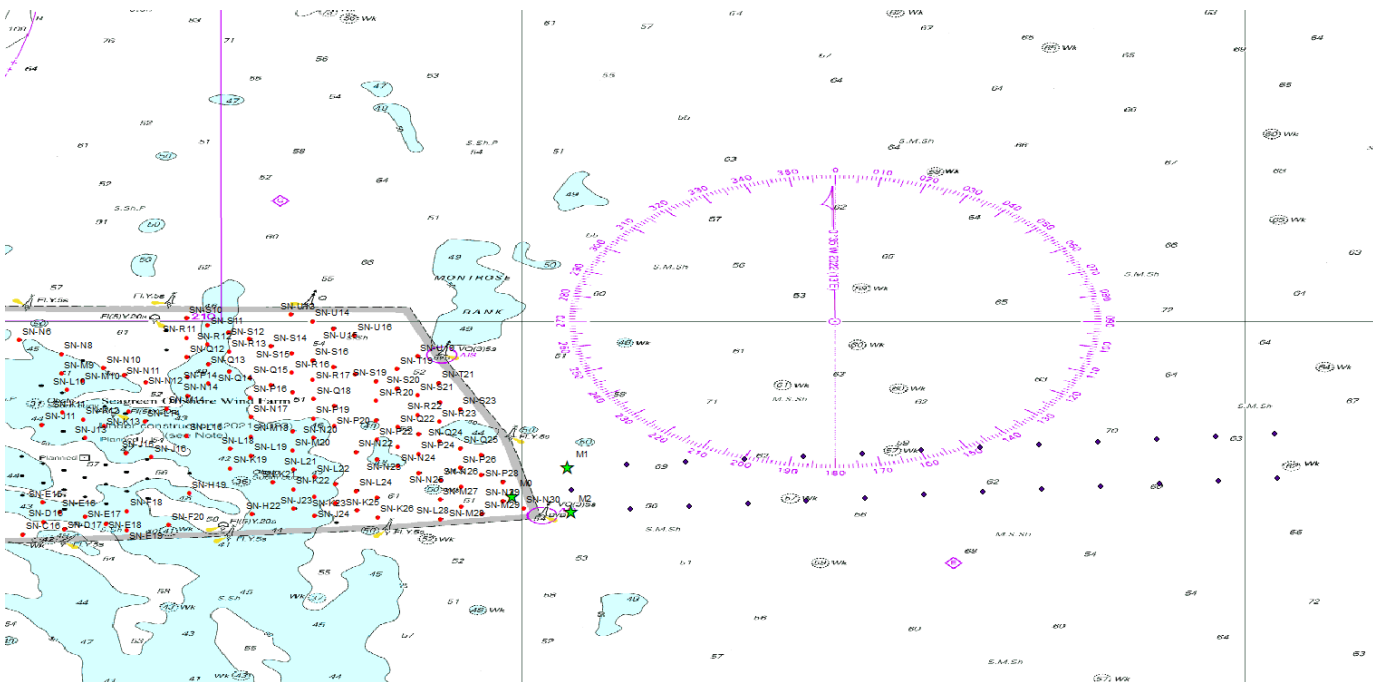
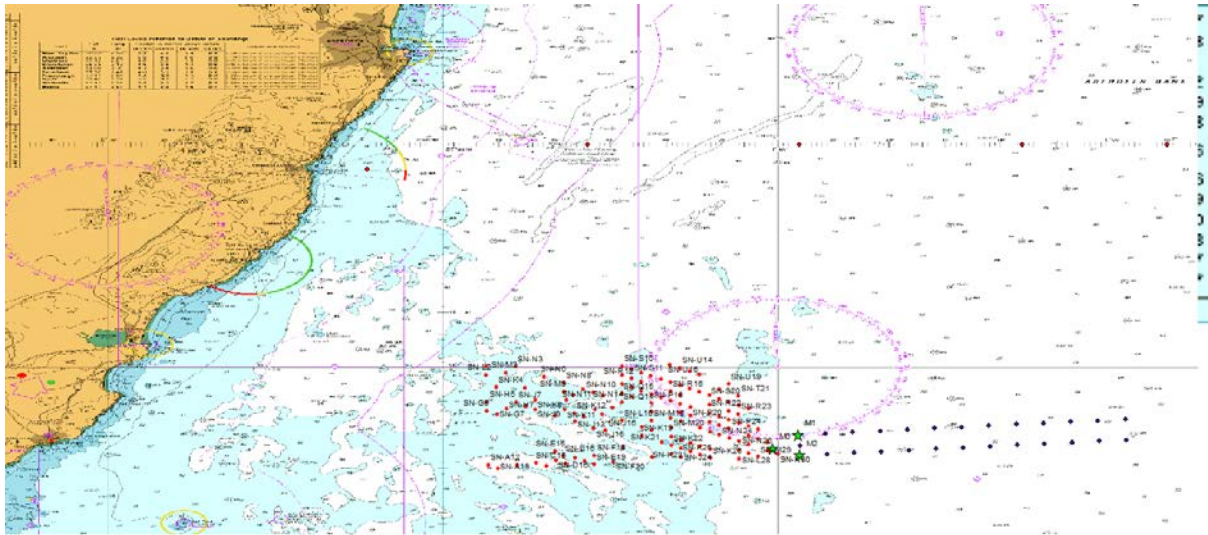
(NOTE: The survey will take *Corystes* into the Foinaven Development Area. This is now standard practice and normal on-site communications will be established with the Foinaven co-ordinating officer).

(NOTE: Hydrographic stations at FIM have been amended to avoid entering Faroese territorial waters).

Normal contacts will be maintained with the laboratory.

Submitted:
A Gallego and H. Smith
Date: 27 April 2023

Approved:
I Gibb
Date: 28 April 2023



Charts showing key activities on 0823H (PELAGIO part) - Seagreen OWF turbines are shown as red dots, mooring locations as green stars, and CTD survey positions as black dots.

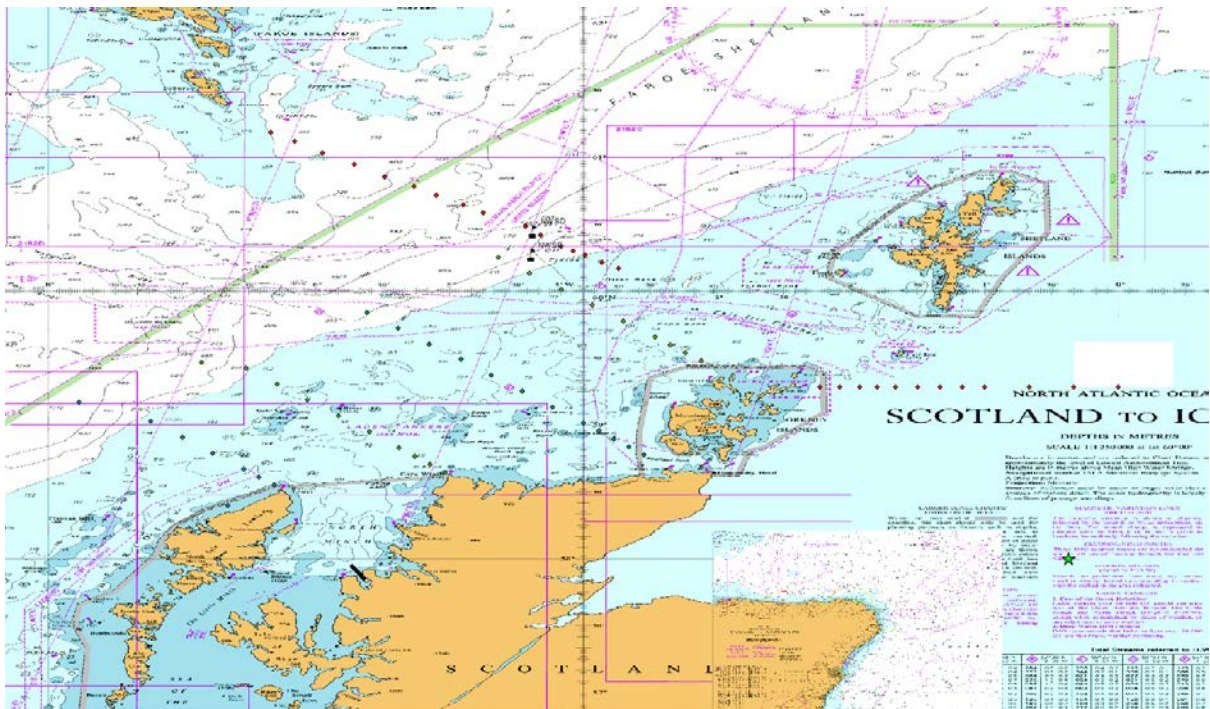


Chart showing key activities on 0823H (Hydro part) - Priority hydrographic lines are shown as red dots, lower priority lines as green dots, moorings for turnaround are black flags. Loch Ewe transect is black dots and Goldeneye station a green star. Note that the Fair Island – Munken (FIM) line will only be sampled within the UK EEZ

Table 1: PELAgIO CTD stations

| | stn | lat deg | lat min | N/S | lon deg | lon min | E/W | |
|-----------|--------------|-----------|--------------|----------|----------|--------------|----------|-----------|
| 1 | T1_00 | 56 | 32.11 | N | 1 | 27.95 | W | M2 |
| 2 | T1_01 | 56 | 32.23 | N | 1 | 25.51 | W | |
| 3 | T1_02 | 56 | 32.35 | N | 1 | 23.07 | W | |
| 4 | T1_03 | 56 | 32.47 | N | 1 | 20.63 | W | |
| 5 | T1_04 | 56 | 32.58 | N | 1 | 18.19 | W | |
| 6 | T1_05 | 56 | 32.7 | N | 1 | 15.75 | W | |
| 7 | T1_06 | 56 | 32.82 | N | 1 | 13.31 | W | |
| 8 | T1_07 | 56 | 32.94 | N | 1 | 10.87 | W | |
| 9 | T1_08 | 56 | 33.05 | N | 1 | 8.43 | W | |
| 10 | T1_09 | 56 | 33.17 | N | 1 | 6 | W | |
| 11 | T1_10 | 56 | 33.29 | N | 1 | 3.56 | W | |
| 12 | T1_11 | 56 | 33.41 | N | 1 | 1.11 | W | |
| 13 | T1_12 | 56 | 33.52 | N | 0 | 58.67 | W | |
| 14 | T3_12 | 56 | 35.37 | N | 0 | 58.78 | W | |
| 15 | T3_11 | 56 | 35.25 | N | 1 | 1.22 | W | |
| 16 | T3_10 | 56 | 35.13 | N | 1 | 3.66 | W | |
| 17 | T3_09 | 56 | 35.01 | N | 1 | 6.1 | W | |
| 18 | T3_08 | 56 | 34.9 | N | 1 | 8.54 | W | |
| 19 | T3_07 | 56 | 34.78 | N | 1 | 10.99 | W | |
| 20 | T3_06 | 56 | 34.66 | N | 1 | 13.43 | W | |
| 21 | T3_05 | 56 | 34.54 | N | 1 | 15.87 | W | |
| 22 | T3_04 | 56 | 34.42 | N | 1 | 18.31 | W | |
| 23 | T3_03 | 56 | 34.31 | N | 1 | 20.75 | W | |
| 24 | T3_02 | 56 | 34.19 | N | 1 | 23.19 | W | |
| 25 | T3_01 | 56 | 34.07 | N | 1 | 25.63 | W | |
| 26 | T3_00 | 56 | 33.95 | N | 1 | 28.07 | W | M1 |
| 27 | T4_01 | 56 | 33.03 | N | 1 | 27.95 | W | (*) |

(*) or we could use M0 position 56° 32.74' N 1° 30.39' W

Table 2: Jonsis

| # | Name | Latitude | Longitude | Depth | Spacing |
|--------|-------|--------------|--------------|--------|----------|
| 01 | JO 1 | 59° 17.00' N | 02° 14.00' W | 75 m | |
| 02 | JO 1A | 59° 17.00' N | 02° 5.00' W | 90 m | 4.59 nm |
| 03 | JO 2 | 59° 17.00' N | 01° 56.00' W | 100 m | 4.59 nm |
| 04 | JO 3 | 59° 17.00' N | 01° 48.00' W | 80 m | 4.08 nm |
| 05 | JO 4 | 59° 17.00' N | 01° 40.00' W | 90 m | 4.08 nm |
| 06 | JO 5 | 59° 17.00' N | 01° 30.00' W | 95 m | 5.10 nm |
| 07 | JO 6 | 59° 17.00' N | 01° 20.00' W | 110 m | 5.10 nm |
| 08 | JO 6A | 59° 17.00' N | 01° 10.00' W | 120 m | 5.10 nm |
| 09 | JO 7 | 59° 17.00' N | 01° 0.00' W | 125 m | 5.10 nm |
| 10 | JO 8 | 59° 17.00' N | 00° 40.00' W | 120 m | 10.20 nm |
| 11 | JO 9 | 59° 17.00' N | 00° 20.00' W | 140 m | 10.20 nm |
| 12 | JO10 | 59° 17.00' N | 00° 0.00' W | 135 m | 10.20 nm |
| Totals | | | | 1180 m | 68.36 nm |

Priority Stations are JO-01, JO-03 and JO-06a, JO-10

Table 3: Fair Isle - Munken (FIM)

| # | Name | Latitude | Longitude | Depth | Spacing |
|-------------|---------------|---------------------|---------------------|--------------|----------------|
| 01 | FIM-01 | 60° 10.00' N | 03° 44.00' W | 150 m | |
| 02 | SEFF1 | 60° 13.00' N | 03° 51.50' W | 170 m | 4.74 nm |
| 03 | FIM-02 | 60° 16.00' N | 03° 59.00' W | 200 m | 4.84 nm |
| 04 | SEFF2 | 60° 18.00' N | 04° 04.50' W | 330 m | 3.36 nm |
| <i>* 05</i> | <i>FIM-03</i> | <i>60° 20.00' N</i> | <i>04° 10.00' W</i> | <i>390 m</i> | <i>3.03 nm</i> |
| 06 | FIM-04 | 60° 25.00' N | 04° 19.00' W | 655 m | 6.88 nm |
| 07 | FIM-05 | 60° 29.00' N | 04° 26.00' W | 995 m | 5.45 nm |
| 08 | FIM-06 | 60° 35.00' N | 04° 45.00' W | 1090 m | 11.15 nm |
| 09 | FIM-6a | 60° 38.00' N | 04° 54.00' W | 1030 m | 5.33 nm |
| 10 | FIM-07 | 60° 43.00' N | 05° 06.00' W | 915 m | 7.70 nm |
| 11 | FIM-08 | 60° 47.00' N | 05° 16.00' W | 830 m | 6.34 nm |
| 12 | FIM-09 | 60° 51.00' N | 05° 29.00' W | 600 m | 7.36 nm |
| 13 | FARF3 | 60° 56.70' N | 05° 42.80' W | 333 m | 8.90 nm |
| 14 | FIM-10 | 61° 02.00' N | 05° 57.00' W | 280 m | 8.68 nm |
| 15 | FARF2 | 61° 07.20' N | 06° 09.40' W | 250 m | 7.95 nm |
| 16 | FIM-11A | 61° 11.30' N | 06° 20.00' W | 242 m | 7.0 nm |
| Totals | | | | 8,558 m | 108.18 nm |

Stations marked in **bold** type are within the UK EEZ

If stations need to be missed they should be dropped in this order

[Priority 4: FARF1, FARF2, FARF3], [Priority 3: SEFF1, SEFF2]

[Priority 2, FIM-04, FIM-06a, FIM-07]

Table 4: Loch Ewe Transect

| stn | lat | | lon | | | Depth | distance |
|------------|------------|--------|------------|--------|---|--------------|-----------------|
| 0 | 57 | 50.982 | 5 | 39.010 | W | 46 | |
| 1 | 57 | 52.104 | 5 | 39.674 | W | 32 | 1 |
| 2 | 57 | 53.061 | 5 | 40.245 | W | 37 | 1 |
| 3 | 57 | 53.977 | 5 | 41.118 | W | 55 | 1 |
| 4 | 57 | 54.893 | 5 | 41.992 | W | 62 | 1 |
| 5 | 57 | 55.810 | 5 | 42.865 | W | 82 | 1 |
| 6 | 57 | 56.726 | 5 | 43.739 | W | 104 | 1 |
| 7 | 57 | 57.642 | 5 | 44.612 | W | 95 | 1 |
| 8 | 57 | 58.559 | 5 | 45.486 | W | 123 | 1 |
| | | | | | | 640 | 8 |

Position of pCO₂ mooring (to avoid):

57° 51.123 N, 5° 39.370 W

Figure 1: Map of some of the extra hydrographic lines (details to be provided at a later stage when necessary).

