

Post Survey Report

Vessel Name: Celtic Voyager

Call Sign: EIQN

Type of Vessel: Research Vessel

Cruise Name: Environmental Survey of Coastal and Shelf Waters – Northabout winter nutrients, benthos and contaminants monitoring.

Cruise Code: CV12002

Start Date: 01/02/2012

End Date: 11/02/2012

Port of Dept: Dublin Port

Port of Return: Galway

Responsible Organisation

Name: Marine Environment & Food Safety Services, Marine Institute

Address: Rinville, Oranmore, Co. Galway

1. Introduction & Rationale

The 2012 survey builds on the Marine Institute Winter Nutrients Survey that ran from 1990 to 2011 (except 2010). The survey evolved during this time period with respect to parameters and sampling strategy. The 2012 survey was designed to collect multidisciplinary information on physics, water chemistry (dissolved nutrients, dissolved oxygen, carbonate parameters (TA, DIC), salinity), sediment chemistry (persistent organic pollutants POPs and trace metals) sediment particle size distribution and benthic macroinvertebrates. This contributes to data collection needs of various statutory drivers (esp WFD Dir 2000/60/EC) as well as providing a research dataset on status and changing conditions (trends and variations) for key environmental variables. Previous winter nutrient surveys for the Irish Sea in the 1990s were extended into the Celtic Sea and coastal waters in recent years. The 2012 survey was the first such survey to sail northabout thus collecting data from areas not sampled previously in this survey. Alternating SouthAbout /NorthAbout annual surveys are envisaged henceforth.

2. Objectives

A) Winter Nutrients Survey: The survey aims to fulfil Ireland's requirements under the Joint Assessment and Monitoring Programme (JAMP) of the 1992 'Oslo Paris Convention for the Protection of the North East Atlantic' (OSPAR). This requires the answering of 3 key questions:

1. What is the spatial distribution of winter nutrients in Irish coastal waters with a particular focus on previously unsampled areas in 2012?
2. Are nutrient concentrations changing over time (trends)?
3. Are nutrient concentrations significantly elevated (>50%) above salinity related and/or regionally specific background levels?
4. Provide data for coastal water bodies to contribute towards assigning a ecological status in accordance with the requirements of the Water Framework Directive
5. Contribute data for assessing changing nutrient profiles in shelf waters which can be influenced by climate change related processes

Establishing status and trends in coastal and inshore waters requires that we know what the 'background levels' are for Atlantic waters and waters entering the Irish Sea. The predominant flow is northwards in the Irish Sea and this survey also sampled across North Channel to identify nutrient concentrations in waters exiting the Irish Sea.

As weather down time frequently disrupts coverage of Winter Surveys in a vessel of the size of the *RV Celtic Voyager* the sampling plan assigns a priority ranking to the stations.

B) Collect sediment samples for assessment of hazardous substances in the marine environment:

- obtain sediment samples to be used for trend analysis (Dublin Bay & Irish Sea and west coast -baseline) for organic and inorganic hazardous substances (OSPAR, WFD).

C) Conduct Water Framework Directive monitoring (Dir 2000/60/EC) and provide supporting information for the implementation of the Natura Directives (Habitats Directive 92/43/EEC).

- Collect samples to provide data to contribute to classification of WFD (client EPA) ecological status of selected water bodies for physico-chemical (nutrients, chlorophyll & DO) and benthic macro-invertebrate ecological quality elements in a select number of waterbodies in the Irish Sea and North Western coastal waters.
- Using benthic invertebrates and associated sediment information (Particle Size Analysis) the survey will be able provide additional habitat distribution data (ground truth data) for a variety of Natura sites along the Eastern and Southeastern Seaboard.

D) *Collect samples for measuring carbonate system parameters (DIC, TA, pCO_{2calc} and pH_{calc} in coastal waters to contribute to baseline dataset for these variables.*

3. Personnel

Scientific complement

Role: Chief Scientist

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Scientific Complement

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Name: Triona McGrath (TMcG)

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Name: Brian Boyle (BB)

Organisation Name: Marine Environment & Food Safety Services, Marine Institute

Address: Marine Institute, Rinville, Oranmore, Galway, Ireland

Email: brian.boyle@marine.ie

Crew: Master and 6 crew . **Master** Philip Baugh

Tech support: Declan Murray

4. Methods & Protocol

4.1. Equipment Listing

4.1.1. CTD Profiler and Rosette Sampler

Make: Seabird SBE 911

Model: SBE 911plus

Sampling Protocols - CTD deployed at designated stations and times. Data collected from temperature, conductivity and pressure sensors. Water samples were collected at most stations from the maximum depth reached and surface (~ 3 metres).

Also deployed on frame was Wetlabs fluorometer, transmissometer, DO Sensor (see sect 5)

4.1.2. Fluorometer

Make: Wetlabs

Model:

Sampling Protocols - OSS fluorometer deployed on CTD frame

4.1.3. Transmissometer

Make:

Model:

Sampling Protocols - Deployed on CTD frame

4.1.4. DO sensor

Make: Seabird

Model: SBE-35

Sampling Protocols - Deployed on CTD frame

4.1.5. On board Seawater Pump

Make:

Model:

Sampling Protocols: The seawater pump was used to collect surface water at all underway stations.

4.1.6. Data were also generated by underway fluorometer, onboard ADCP and MDM 400.

4.1.7. Reineck Box Corer

Make: Reineck

Model:

Sampling Protocols: Sediment samples were taken for contaminant monitoring: Surface sediment was transferred into glass and plastic bottles for organic and inorganic analysis respectively. Sampling material in contact with the side of the grab was avoided

4.1.8 Grab sampler

Make: Day Grab

Model: P&O design

Sampling Protocols: Sediments were sampled for benthic infauna using Day grab and at certain hard sand locations where it was felt the box core would be ineffective for contaminants. For the former sediment samples were

removed from the grab and a small subsample retained (and frozen) for PSA and organic carbon analysis (LOI). The remaining sediment was sieved through a 1mm mesh sieve and fixed in formalin (5%). For the latter surface sediment removed using cleaned spatulas directly from the grab via the top lids and transferred into glass and plastic bottles for organic and inorganic analysis respectively. Sampling material in contact with the side of the grab was avoided

- 4.1.9 Shipek sediment grab sampler
Make: Shipek
Model:
Sampling Protocols: Not used

Equipment brought on board by scientific complement

4.1.10 DO Analysis – Metrohm Titrino
Sampling protocols: See 4.2

4.2. On-board processing

Water Samples - chemistry:

Surface Samples (~3m) from underway stations were collected for nutrients and salinity as below using the onboard pump. From CTD stations the following were sampled using Niskin bottles according to standard protocol and in the following order: Dissolved oxygen (Winkler), TA/DIC (selected stations), nutrients and salinity.

1. Samples for accurate salinity measurement: Unfiltered glass bottle stored at room temperature for subsequent salinity analysis. Samples will be measured subsequently in the Marine Institute using a Guildline Portasal salinometer
2. 2 x 50 ml PP tubes filled with water filtered through a 0.45 μ cellulose acetate (acid-cleaned polycarbonate) filter and frozen immediately after collection for post-cruise nutrient analysis in the Marine Institute using a Skalar San++ autoanalyser.
3. DIC/TA samples collected for Triona McGrath at designated stations. Samples preserved with mercuric chloride (Dickson et al. 2007) Samples will be analysed post survey in NUI Galway for DIC/TA using a Vindta-3C and methods of Dickson et al (2007).
4. DO samples: Collected immediately from Niskin bottles avoiding bubbles and fixed immediately on collection. Samples were analysed on board (Dickson, 1995), generally within 1 day of collection by the modified Winkler method with a Metrohm 848 Titrino Plus, and Metrohm combined Pt electrode for potentiometric endpoint determination.

Sediment Samples – marine chemistry:

Surface sediment was split between glass (solvent washed) and plastic jars (acid washed) and frozen immediately after collection.

Benthic Sediment Samples:

Sediment samples: At all benthic stations (n=56 of 78 attempts) where a suitable sediments could be sampled, a subsample of sediments (100-200g) was taken for Particle Size Analysis (PSA) and Loss on Ignition (LOI). The samples were labelled and stored in plastic zip-loc bags and frozen.

Macroinvertebrate samples: sufficient sediment (>2.5L) was retained at n=56 stations and retained for faunal analysis. These samples comprised single Day grab

samples.. Upon retrieval all sediment (pooled in case of Shipek samples) were washed on a 1mm mesh sieve. All faunal and residue (e.g. sediment and shell matter) were retained and stored in a plastic container and fixed with V:V 4% neutral buffered formalin.

4.3. Equipment Issues

4.3.1 Problem with CTD on deepest cast at the shelf edge when communication was lost with the water sampler. The cast at outermost station of Erris transect was at 1000m and cable length just sufficient to reach bottom at this station. On board tech support Declan Murray quickly identified the problem, attributed to a corroded bulkhead on 9+, and swapped over to back up system. The same sensors were used throughout the survey. Repairs took about 3 hours before the CTD was successfully redeployed at this station.

4.3.2 DO meter (SBE 43) was appropriately calibrated but initial examination of winkler measurements carried out on board suggest that the DO values on the sensor are low and require correction. It is recommended that the DO meter is calibrated closer to the 2013 survey to minimise drift between calibration and survey.

Table 1. Benthic sampling summary table.

Sample code	Longitude	Latitude	Site depth	Sediment type	Fauna	PSA	Sample Depth cm
CV1202-NWIS01	53.4575	-6.1003	10	Start @ 1845: fine sand, samll shell debris	Yes	Yes	5
CV1202-NWIS02	53.4726	-6.0831	11	no sample; 3 attempts; cobbles in all three grabs.	No	No	
CV1202-NWIS03	53.4859	-6.0834	12	Coarse sand and mud	Yes	Yes	Full
CV1202-NWIS04	53.4767	-6.0414	-	fine sand	Yes	Yes	Full
CV1202-NWIS05	53.4720	-6.0242	15	muddy fine sand	Yes	Yes	>5
CV1202-NWIS06	53.4808	-5.9915	33	Time @ 2005: mixed muddy sand and shell	Yes	Yes	6
CV1202-NWIS07	53.4987	-5.9862	40	muddy gravelly sand	Yes	Yes	7
CV1202-NWIS08	53.5082	-6.0239	13	fine sand and mud	Yes	Yes	6
CV1202-NWIS09	52.5031	-6.0845	8	medium sand mixed with mud and shell	Yes	Yes	7
CV1202-NWIS10	53.5318	-6.0602	14	Time @ 2155: sand and shell hash	Yes	Yes	6
CV1202-NWIS11	53.5509	-6.0611	13	muddy sand with shell	Yes	Yes	5
CV1202-NWIS12	53.5672	-6.0679	11	muddy sand with shell	Yes	Yes	5
CV1202-NWIS13	53.5786	-6.0578	15	shelly sand	Yes	Yes	5
CV1202-NWIS14	53.5859	-6.0480	25	mix of cobbles, pebbles, sand and mud	Yes	Yes	7
CV1202-NWIS15	53.5963	-6.0581	27	gravel and mud mix (subsamped 1/2 of sieve contents)	Yes	Yes	Full
CV1202-NWIS16	53.5991	-6.0840	11	fine sand	Yes	Yes	8
CV1202-NWIS17	53.5961	-6.1044	9.5	muddy sand	Yes	Yes	9
CV1202-NWIS18	53.6076	-6.1402	8	Time @ 0006: muddy sand	Yes	Yes	6
CV1202-NWIS19	53.6169	-6.1514	9	muddy sand	Yes	Yes	>5
CV1202-NWIS20	53.6321	-6.1573	11	muddy sand	Yes	Yes	Full
CV1202-NWIS21	53.6425	-6.1696	11	mud	Yes	Yes	Full
CV1202-NWIS22	53.6600	-6.1968	8	sandy mud	Yes	Yes	>5

<i>Sample code</i>	<i>Longitude</i>	<i>Latitude</i>	<i>Site depth</i>	<i>Sediment type</i>	<i>Fauna</i>	<i>PSA</i>	<i>Sample Depth cm</i>
CV1202-NWIS23	53.6772	-6.2005	9	hard sand (3 grab attempts-retained 3rd)	Yes	Yes	5
CV1202-NWIS24	53.6950	-6.2096	8	hard sand	Yes	Yes	<5
CV1202-NWIS25	53.7088	-6.2148	8	hard sand	Yes	Yes	<5
CV1202-BP01	53.7177	-6.2165	8	hard sand	Yes	Yes	>5
CV1202-BP02	53.7242	-6.2191	7.5	hard sand	Yes	Yes	<5
CV1202-BP03	53.7282	-6.2200	7	hard sand	Yes	Yes	5
CV1202-BP04	53.7314	-6.2184	7.5	hard sand	Yes	Yes	6
CV1202-NWAS01	55.0956	-8.4316	49	Rocky ground- no sample	No	No	N/A
CV1202-NWAS02	55.0781	-8.4479	43	Rocky ground- no sample	No	No	N/A
CV1202-NWAS03	55.0936	-8.4737	55	Rocky ground- no sample	No	No	N/A
CV1202-NWAS04	55.0704	-8.4968	55	Rocky ground- no sample	No	No	N/A
CV1202-NWAS05	55.0516	-8.5029	51	fine sand	Yes	Yes	>5
CV1202-NWAS06	55.0297	-8.4944	40	fine sand	Yes	Yes	>5
CV1202-NWAS07	55.0422	-8.5415	40	fine sand	Yes	Yes	>5
CV1202-NWAS08	55.9982	-8.5933	45	Rocky ground- no sample (2 grabs)	No	No	N/A
CV1202-NWAS09	54.9764	-8.6152	45	Rocky ground- no sample (1 grab)	No	No	N/A
CV1202-NWAS10	54.9569	-8.6108	45	Rocky ground- no sample (2 grabs)	No	No	N/A
CV1202-NWAS11	54.9365	-8.5888	38	Rocky ground- no sample (2 grabs)	No	No	N/A
CV1202-NWAS12	54.9338	-8.6196	43	Rocky ground- no sample (1 grab)	No	No	N/A
CV1202-NWAS13	54.9246	-8.5536	29	Rocky ground- no sample (2 grabs)	No	No	N/A
CV1202-NWAS14	54.9200	-8.5460	23	Rocky ground- no sample (1 grab)	No	No	N/A
CV1202-NWAS15	54.8134	-8.6099	43	hard sand	Yes	Yes	>5
CV1202-GB1	54.8930	-8.4399	20	medium/coarse sand	Yes	Yes	>5
CV1202-GB2	54.8858	-8.4269	15	fine sand	Yes	Yes	>5

<i>Sample code</i>	<i>Longitude</i>	<i>Latitude</i>	<i>Site depth</i>	<i>Sediment type</i>	<i>Fauna</i>	<i>PSA</i>	<i>Sample Depth cm</i>
CV1202-GB3	54.8809	-8.4236	15	fine sand	Yes	Yes	>5
CV1202-GB4	54.8732	-8.4194	15	fine sand	Yes	Yes	>5
CV1202-GB5	54.8696	-8.4226	17	fine sand	Yes	Yes	>5
CV1202-GB6	54.8597	-8.4361	20	fine sand	Yes	Yes	>5
CV1202-GB7	54.8709	-8.4363	18	fine sand	Yes	Yes	>5
CV1202-GB8	54.8835	-8.4486	23	fine sand	Yes	Yes	>5
CV1202-GB9	54.8821	-8.4679	23	rock- no sample	No	No	N/A
CV1202-GB10	54.8567	-8.4833	30	fine sand	Yes	Yes	>5
CV1202-SB01	54.3274	-8.7161	32	hard fine sand	Yes	Yes	<5
CV1202-SB02	54.2971	-8.7326	27	hard fine sand	Yes	Yes	<5
CV1202-SB03	54.2964	-8.7037	27	hard fine sand	Yes	Yes	<5
CV1202-SB04	54.3173	-8.6848	29	hard fine sand	Yes	Yes	>5
CV1202-SB05	54.3117	-8.6553	23	coarse sand and gravel (some cobbles)	Yes	Yes	Full
CV1202-SB06	54.3045	-8.6562	18	hard fine sand	Yes	Yes	>5
CV1202-SB07	54.3072	-8.6732	23	hard fine sand	Yes	Yes	>5
CV1202-SB08	54.2982	-8.6834	22	hard fine sand	Yes	Yes	>5
CV1202-SB09	54.2961	-8.6637	18	hard fine sand	No	No	>5
CV1202-SB10	54.2939	-8.6429	16	hard fine sand	Yes	Yes	>5
CV1202-SB11	54.2737	-8.6339	12	hard fine sand	Yes	Yes	>5
CV1202-SB12	54.2814	-8.6581	16	hard fine sand	Yes	Yes	>5
CV1202-SB13	54.2855	-8.6852	21	hard fine sand	Yes	Yes	>5
CV1202-SB14	54.2797	-8.7144	23	hard fine sand	Yes	Yes	>5
CV1202-SB15	54.2856	-8.7336	23	hard fine sand	Yes	Yes	>5

5. Narrative

The weather was uncommonly favourable for this survey with only 24 hours lost due to southerly gales on west coast necessitating sheltering in Broadhaven Bay, Co. Mayo. At some locations sediment sampling (Grabs, box cores) could not be carried out due to weather and related safety concerns.

Winter Nutrients: Good coverage was achieved with 91% of all target water stations sampled (excluding the stations on 53N line..these were not sampled beyond inner 4 stations as the Jan standard section on *RV Celtic Explorer* has sampled this transect) - Figure 1. This including sampling to the shelf edge on Belmullet transect.

Surface samples for dissolved nutrients and accurate salinity were taken at all underway stations sampled and surface and bottom waters were sampled for CTD stations. Additional samples were occasionally sampled in the water column depending on the observed structure of the water column. DO samples were also collected at CTD stations and analysed on board (Winkler). Conductivity, temperature, DO and turbidity profiles were taken at CTD stations

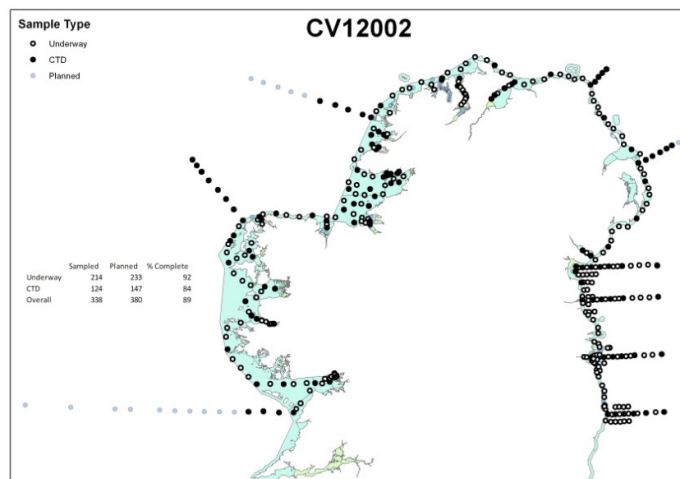


Figure 1: Stations sampled for winter nutrients(black) and stations not sampled (grey priority)

Benthic fauna: Benthic fauna was sampled in two water bodies in the Northwestern Irish Sea (i.e. Northwest Irish Sea and Boyne Plume). Upon advice from the Master, sampling was not carried out in Carlingford Lough. It was advised that the vessel would not be able to stray outside of the channel to the predetermined sampling locations. Samples were also taken from the Northwestern Atlantic Seaboard. However, of 20 attempts within this waterbody only 4 successfully retained sediments. The rest of the habitat encountered comprised of coarse sediment (cobble) or bedrock. Benthic sampling of this waterbody was suspended upon direction of the benthos ecologist due to time constraints the risk of damage to grab due continual deployment onto rock. A full complement of samples was retained in Gweebarra and Sligo Bays. No issues presented in these waterbodies.



Figure 2- Northwest coastal sites

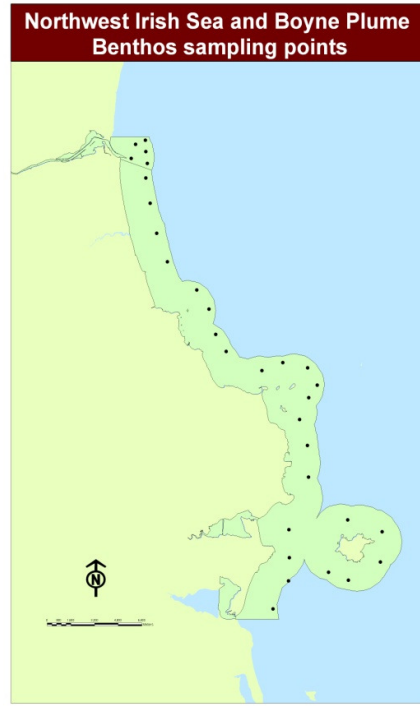


Figure 3 –Northwest Irish Sea sampling stations

Sediment samples were collected for hazardous substances analysis (trace organics and heavy metals) in Dublin Bay (2) and North Irish Sea (1) – trend stations samples were collected as per previous years. A number of additional sediment sampling stations were identified preproject, primarily to take the opportunity to get offshore and coastal sediments with a view to establishing background levels of contaminants. Sediment samples were difficult to obtain as sandy/ rocky beds were often encountered at most offshore and coastal locations. Samples were acquired in Gweebarra Bay (sandy), Off N Bellmullet (sandy – no organics sample obtained) and Outside Aran islands. (well turbated mud sample from prawn grounds)

DIC/TA Samples were collected during following transects: Irish Sea Dublin Bay; Irish Sea Dundalk; North Channel Antrim – Galloway; North Channel Antrim to Mull of Kintyre, North west coast Aranmore.

See appendix for detailed narrative

6. Preliminary Findings

Await sample analysis for results. Data will be available via Marine Institute data request system (www.marine.ie)

7. Conclusions & Recommendations

Effective completion of the cruise objectives.

The survey was very successful with favourable weather considering the time of year. 91% of water stations were completed. It proved difficult to acquire sediment samples for analysis of hazardous substances but all trend stations and 3 additional stations were successfully sampled. Benthic sampling was completed for all the priority areas targeted with the exception of Carlingford Lough although the rocky substrate encountered for most NW Atlantic Seaboard stations attempted were unsuitable for sampling. Additional DIC/TA samples were collected on 5 transects and in Lough Swilly.

The scientific team would like to commend the master (Philip Baugh), and all of the crew (Brandon, Pierce, Stephen, Tommy, Mike and Ollie) and Technical support (Declan) for their excellent support and help over the course of this survey.

Appendix 1: Survey Narrative

Winter Environmental Survey 2012: Northabouts - Irish Sea to Galway 1 – 13 Feb 2012

Crew: Master Philip Baugh, Mate Brandon McGovern, 2nd Mate Stephen, Pierce Tommy, Michael,

Technical support: (P&O): Declan

Scientific Complement: Evin McGovern(CS) Triona McGrath, Brendan McHugh, Tom Szumski, O'Beirn Francis, Brian Boyle

Shifts: BMcH TS: 0600-1200, 1800 – 0000; EMcG, BB 0000-0600, 1200-1800; TMcG Day, FO'B – as required for benthic sampling

1/2/2012

- 0900 - Mobbed at Howth with a view to sailing with tide 1400
- No hot water available on board. Element being replaced. Sailing delayed by 1 hour to complete this work. We cast off from the pier at 1500.
- Problem with sink in chem lab not properly draining. Required for sampling from seawater intake. Declan carried out some work to clear which improved the issue significantly although not completely rectified.
- Initially collected samples close to Howth and then the inner samples from Dublin transect working back in Dublin Bay. CTD confirmed to be working well. All bottle fired on first station. Only bottle 4 did not fire correctly (subsequently fired ok). Bottle 7 missing tap so not used during survey. Station 615 missed. Station 611 too shallow so not taken. Noted two stations given same number 619. One in Dublin Bay and one in N Co. Dublin Coast. Latter labelled as 619 North to avoid confusion
- 1900 Dublin Port indicated that they were unhappy that prior permission had not been sought for sampling in the port area. This has not been an issue in previous surveys as Dublin Port is sampled every year (and sometimes survey starts in Dublin Port). **ACTION** notify RVOPs
- 1900 – 2300 Completed Dublin Bay sampling including 2 sediment stations sampled for chemistry testing (metals and organics). Station 612 and sediment taken at same location

2/2/2012

- Two stations in MAXSEA coordinates and on list for station 603 (one 10 m from station 72). More northerly station taken as correct
- Maxsea software crashed requiring us to heave to for 20 mins while the system was reloaded. Started the southern Wicklow transects and parallel stations. Wicklow transect Completed at noon. Steamed North to work westward on the Dublin transects.
- 14:00 Started Dublin transect with station 322
- Problem with the spooler guide on winch for CTD. Did not interfere with work and dealt with by crew in between CTD deployments.
- 1800 Completed remaining stations of Dublin transect and sailed N to collect coastal samples. Benthic sampling of coastal waters between Malahide and Boyne estuary using Day Grab. 28? Samples acquired (all bar 2 samples).

3/2/2012

- 0400 Benthic sampling complete.
- 0600 Weather good. Proceeded N to collect coastal samples and time entrance to Carlingford Lough. Master advised that many of proposed benthic samples in Carlingford could not be acquired as vessel could not leave channel. FO'B opted not to proceed with Benthic sampling.
- 0600 – 1200 sampled Carlingford Lough for nutrients and completed sampling of Dundalk Bay. Stratification observed for a number of CTD stations in the Boyne – Dundalk bay area with colder

fresher water in top 7 – 10m. This includes stations 34, 36, 13, 623, 9. Some of the other stations too shallow to cast.

- 1200 proceed south to collect remaining stations on Boyne transect. Salinity, nutrient and DO (ctd only) sampled. Swell developing
- 1630 CTD station 41 followed by Irish Sea trend site sediment collection (st 9001). 3 Reineck box core grabs to collect very fine mud for subsequent chemical analysis. Full box core depth showed well bioturbated sediment with no signs of anoxia.
- 1900 completed Boyne transect. Increased swell
- 2040 Commenced Dundalk transect working west from st 448. Nutrients, DO and DIC/TA at CTD stations. Swell increasing.

4/4/2012

- 00:00 Completed Dundalk transect and proceeded N to collect coastal station
- 06:00 Commence Belfast – Galloway transect. Very poor weather – and heavy swell >4m. All CTDs bar last (st 645 completed)
- 1445 Had to move station 651 slightly east on instruction from Larne port to give ½ mile Berth to tanker
- 1730 Commenced the Antrim – Mull of Kintyre transect
- 2030 Completed transect at Mull

5/2/2012

- 06:00 Throttled back to time arrival at entrance L Foyle to coincide with start of 0600 Master's shift to bring vessel in.
- Heavy seas after Malin Head. Sampled Lough Swilly to st711 (past Rathmullan) but on returning to open waters heavy swell still. Not suitable for deploying Day grab (and Wales beat Ireland in the last minute of the 6 nations☺).
- Mulroy Bay deemed unsuitable for ship access by master. Decision made to proceed to Aranmore continuing water sampling/CTD, with a view to reviewing weather conditions for deployment of Day grab for benthic sampling there.

6/2/2012

- 0100 Commence Aranmore transect – completed 0615 CTDs, Nutrients, Carbon, TA, DO and 3 depths sampled at 744 as stratification. No DIC TA at 747. Unable to acquire sediment at station 746 with either the day grab or Reineck box core. A number of attempts only yielded pebbles. Conditions marginal for deployment grab/corer.
- 0900 returned to benthic station B63 North of Aranmore. Few sediments obtained with day grab as we mostly hit rock. Heavy fog reducing visibility
- 1530 Entered Gweebarra Bay WB. St B100/757 had to be moved outside the 10m contour due to very poor visibility. Duplicate numbering - Two stations 762; a CTD and underway. Underway labelled as 762 underway. Benthic grabs successful with fine sandy substrate. Unable to obtain a chemistry sediment sample in NW Atlantic Seaboard WB but took sediment sample using the Day grab close by but within Gweebarra Bay WB (Benthic station B108)
- On further assessment FO'B decided there was little point in trying for remaining grabs in NW Atlantic Seaboard WB south of Gweebarra as expected similar substrate as around Aranmore. One additional benthic sample was collected at nutrient station 759

7/2/2012

- 0000 Sampling nutrients in Donegal Bay. As forecast was for southerly winds to pick up, it was elected to sample open water stations initially with a view to collecting more sheltered coastal

water stations later in the day. Notable stratification in many stations in the bay including stations that were in relatively open water.

- 1000 Sampling Killybegs, McSwynes Bay, Inver Bay and inner Donegal Bay. Duplicate sample stations 789 underway in mid bay and CTD near Sligo coast. Underway labelled 789 UW
- 1700 Commenced benthic sampling of Sligo Harbour. Successful acquisition of samples – substrate fine/hard sand. Weather deteriorating with Gale warnings

8/2/12

- 0000 Sampling Killala Bay. Moved sampling points as inner stations too shallow. Station 806 – sampled CTD and Underway for comparison
- 0600 Sampled Broadhaven Bay. Two sediment samples planned. Inner sediment station moved to outside of Sruwadacon Estuary but ground too hard to get sample. Second sample acquired but sandy. Inner nutrient sample (813) also moved out to enable access.
- Continued gale warnings meant the weather was unsuitable for Erris Transect. Decision made to wait as forecast was for the weather to die down to force 5-6 SW on the morning of 9/2. Unable to find suitable anchorage so ticked engine over in Bay

9/2/12

- 0900 Left Broadhaven Bay and picked up Station 814 before commencing the Erris transect NW to the shelf edge.
- 1300 Unable to attempt sediment grab at station 817 as sea conditions too rough for safe deployment of Day grab. Continued on transect. Beyond 200 m the bottom slope increased markedly. (St 820 260m 3 depths sampled, st 821 506m 4 depths sampled & st 822 1020m 5 depths sampled).
- It was unclear if there was sufficient CTD cable for the deeper casts as thought there may be no more than 500m. At all deeper stations the CTD was deployed with a member of the crew guiding the spooling of the cable and with radio contact for the very deep stations to avoid running out all the cable. In fact at 1000m there was 1.5 layers on winch barrel.
- 1700 Deployed CTD on final transect. Sufficient cable for deployment. Water Mixed to 500m. Beyond a steep decline in temperature and small decrease in salinity. Significant decrease in oxygen concentration though in cast 1 this increased again at lower depths (>800m). Bottles 1,2 tripped on cast at 1000m and bottle 3 at 800m. Further bottles refused to fire. Cast was stopped and set box rebooted at which point contact could not be re-established with the water sampled. CTD upcast was recorded for the remaining 800m. A corroded bulkhead and pins were identified as the problem. Sensors were removed and switched to spare CTD manifold by Declan. Remained on station until repairs corrected and CTD redployed at 2100. This time bottles fired correctly although spigot on bottle 4 aook. The same CTD profile was observed although below 800m O₂ concentrations stabilised rather than increased as observed in cast 1.

10/2/2012

- 00:30 Retrieved Day Grab on steam back towards Erris at 54° 30.59'N 10° 23.88'W. However as expected from echo sounder the ground was coarse sand and too hard to obtain a suitable sediment sample for chemistry analysis.
- 03:00 A further Day grab was attempted at 54° 17.81'N 10° 09.38'W. One successful grab of coarse sand was sampled for trace metal testing as indicative of offshore background conditions (this sediment may well be too coarse for this purpose). Repeated grabs were unable to collect further sediment.
- Continued sampling into Blacksod Bay Bay. Sampled sediment with Box Core – still sandy. Worked around Achill Island and proceeded directly to Killary to ensure daylight access, given the

navigational hazards from aquaculture gear in the harbour. Some stratification of top 4 metres evident in Killary.

- After Killary proceeded back north to sample Clew Bay. Final sampling plan agreed between master and Chief Scientist that would pick up remaining stations and enable access to Galway docks with the second tide of Saturday evening

11/2/2012

- 01:00 Rounded Slyne head. After station 900 proceeded outside Aran Islands to pick up priority 1 stations on 53N transect starting with station 920 and working in.
- 0500 Sediment sampled (sample 9002) with box core at 920. Mud obtained and sufficient subsamples in 3 cores for metal and organic analysis. The sediment was fully aerated for full depth of box core with infauna evident and with no signs of layering or anoxia (the station is within the prawn grounds as confirmed by Mike). The Crew have some difficulties replacing the springs to base on box so this should be raised at post cruise. Completed 53N transect in and worked into Galway Bay slowly to allow time for sufficient water to collect final stations and enter Galway docks. No DO (Winkler samples)
- 1615 Wash down mtg scientific complement. Continued sampling to Lough gates
- ~ 1800 Tied up in Galway Docks and Tom and Triona took a taxi to MI to collect Van. Demobbed all except benthic gear on Sat. Nutrients and sediment samples put in freezers on immediate return to MI

Issues arising to be addressed by scientific complement for 2013

- source Teflon spatulas for 2013 for sediment sampling
- Prenaming of sediment stations confusing. Identify before arrival. System will leave gaps in numbering when stations missed and does not allow additional adjacent samples to be collected concurrently
- Some stations to be moved. Mulroy omitted, Swilly to 711
- Electronic recording next year with GPS, date & time tagging, (backup?)
- DO sensor calibration in time specification but could be calibrated closer to next year survey. Winkler data generated on this survey will be used to assess offset in sensor(SBE43) data which seemed to be giving low readings

Issues arising to be addressed in Post survey meeting

- Galley oven needs to be repaired as it packed in midway through survey
- CTD – spare CTD and technical support were essential
- Springs box core to be replaced
- Internet connection using mobile 3G was poor throughout (especially Vodafone).
- Dublin port – notification of sampling may be required in future years
- Cable on CTD was noted to be ~1000m
- Wet lab info water depth would be useful although it is understood that this may not be practical until a new system is in place and that this is not viable at present.
- Scientists would like to commend the Master, Philip, and the crew who could not have been more obliging and helpful throughout, and of course Ollie for delivering such top quality menus despite the inconvenience of no oven