

Post Survey Report

Vessel Name: Celtic Voyager

Call Sign: EIQN

Type of Vessel: Research Vessel

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

Cruise Code: CV15001

Start Date: 20/01/2015

End Date: 29/01/2015

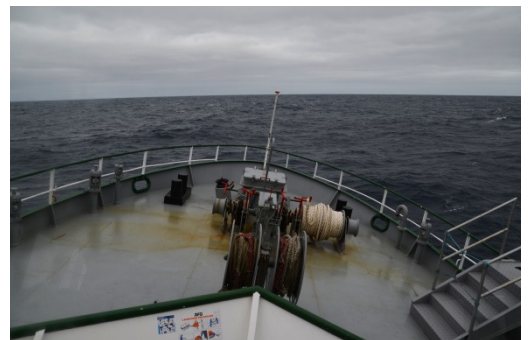
Port of Dept: Dublin Port

Port of Return: Dingle

Responsible Organisation

Name: Marine Environment & Food Safety Services, Marine Institute

Address: Rinville, Oranmore, Co. Galway



1. Introduction & Rationale

The 2015 survey continues the Marine Institute's Winter Nutrients monitoring that commenced in 1990/91. The survey has evolved and expanded during this time period with respect to target areas, parameters and sampling strategy. In 2011 this survey was reestablished as a winter environmental survey with a broader remit to provide supporting information for OSPAR and Water Framework Directive (WFD-Directive 2000/60/EC) assessments and also to maintain the winter time series on key biogeochemical parameters in Irish waters in response to pressures such as land based inputs of nutrients and climate change. Since 2011 the survey circumnavigates the Island of Ireland every two years, alternating southabout (odd years) and northabout (even years), starting in the Irish Sea and ending in Galway. This provides a complete coverage of Ireland's coastal waters over 2 year periods. However, given the timing of the surveys, winter by necessity to ensure minimal biological activity and therefore highest concentrations of dissolved nutrients, the weather is a significant factor in determining the actual as opposed to planned coverage of the target stations. This work is complementary to inshore water quality monitoring activities of the Irish Environmental Protection Agency and Marine Institute and the annual offshore oceanographic survey/climate section (53N/Rockall Trough) on the Celtic Explorer led by the Oceanographic Science Services group at the Marine Institute.

The 2015 survey was designed to collect multidisciplinary information on physical conditions, water chemistry (dissolved nutrients, dissolved oxygen, Total alkalinity (TA), dissolved organic carbon (DIC), dissolved trace metals, and total organic carbon, salinity), sediment chemistry (persistent organic pollutants POPs and trace metals), sediment particle size distribution and benthic macroinvertebrates (at targeted waterbodies around the coast). This contributes to data collection needs of various statutory drivers (WFD and the Marine Strategy Framework Directive (MSFD) Directive 2008/56/EC) as well as providing a research dataset on status and changing conditions (trends and variations) for key environmental variables.

2. Objectives

A) Winter Nutrients Survey: The survey aims to fulfil Ireland's requirements under the Coordinated Environmental Monitoring Programme (CEMP) of the 1992 'Oslo Paris Convention for the Protection of the North East Atlantic' (OSPAR) and to contribute to the Common Procedure for the Identification of the Eutrophication Status of the OSPAR maritime area. This requires the answering of 3 key questions:

1. What is the spatial distribution of winter nutrients in Irish coastal and shelf waters?
2. Are nutrient concentrations changing over time (trends)?
3. Are nutrient concentrations significantly elevated in coastal waters (>50%) above salinity related and/or regionally specific background levels and what are the background concentrations?

Coastal nutrient data are provided to the EPA and to contribute to the assigning of *ecological status* to coastal water bodies in accordance with the requirements of the Water Framework Directive (Directive 2000/60/EC)

Offshore nutrient profiles in shelf waters contribute to determining long term variability which can be influenced by climate change related processes

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) for organic and inorganic hazardous substances (OSPAR CEMP, 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, 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, Southeastern and southwestern 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.

E) Collect samples for measuring levels of dissolved trace metals in coastal and shelf waters.

- Pilot sampling to assess methodology for surface sampling seawater for dissolved trace metals from Celtic Voyager. Data to contribute to WFD assessments and characterization of trace metal concentrations in offshore/shelf areas (MSFD)

3. Personnel

Role: Chief Scientist

Name: Evin McGovern (EMcG) - Chemistry

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

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

Email: evin.mcgovern@marine.ie

Scientific Complement

Name: Francis O'Beirn (FOB) - Benthos

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

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

Email: francis.obeir@marine.ie

Name: Tomasz Szumski (TS) - Chemistry

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

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

Email: tomasz.szumski@marine.ie

Name: James Fahy(JF) -Benthos

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

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

Email: James.Fahy@Marine.ie

Name: Denis Crowley (DC) -Chemistry

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

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

Email: denis.crowley@marine.ie

Name: Brian Boyle (BB) - Chemistry

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

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

Email: brian.boyle@marine.ie

Crew: Master and 5 crew. **Master** Phillip Baugh

Technical support: Lukasz Pawlikowski

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 for nutrients, DO, DIC/TA and DOC/TOC were collected at most stations from the maximum depth reached and surface (~ 3 metres) using niskin bottles (5L) and applying standard MI procedures in line with best practice (Dickson et al. 2007, Grasshof et al 1999). Water samples for metal testing were collected using GO-FLO bottles. GO-FLO bottles were acid cleaned in the laboratory and tested for contamination in advance of the survey

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-43

Sampling Protocols - Deployed on CTD frame

Two SBE-43 DO sensors were deployed on the frame as Winkler titrations were not carried out on this survey, unlike recent surveys. One sensor was outside its calibration date but was unused since calibration.

O2 Sensor 1: Oxygen, SBE 43, Serial number : 1416 Calibrated on : 21-Nov-13

O2 Sensor 2: Oxygen, SBE 43, Serial number : 1716, Calibrated on : 15-Feb-14

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. 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%).

4.1.9 Shipek sediment grab sampler

Make: Shipek

Model:

Sampling Protocols: Not used

4.1.10 SCS system: The system was used to log all sampling events with automated date, time and GPS stamping.

Equipment brought on board by scientific complement

4.1.11 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. Sample salinities measurements were subsequently measured 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. These analyses were carried out by AFBI Northern Ireland on behalf of the Marine Institute using a standard colorimetric methods for determination of nutrients in seawater employing a Seal Analytical instrument using air segmented continuous flow analysis.
3. DIC/TA samples collected at designated stations. Samples preserved with mercuric chloride (Dickson et al. 2007). Samples were analysed post survey in NOC UK for DIC/TA using a Vindta-3C or Apollo system and methods of Dickson et al (2007).
4. Surface seawater dissolved trace metal samples were collected at selected stations using the pre acid-washed and contaminant checked (laboratory) GO-FLO bottles mounted on the CTD rosette. Samples were collected from the GO-FLOs into acid washed 1L plastic bottles. Approximately 50 mls are transferred to a new Fortuna plastic 2 piece syringe (no bung) and filtered through a cellulose acetate syringe filter unit. The first 5mls are filtered to waste and the remainder is collected in acid washed 100ml nalgene bottles

containing 1 ml of concentrated nitric acid. The bottles are closed and stored on board at ~4°C. Samples were analysed within 1 month at the Marine Institute using ICPMS.

Sediment Samples

Sediment Samples – marine chemistry:

Surficial sediments for metal analysis (station ENV 1002 Dublin Bay) were sampled using Rieneck box core. However, in poor weather it was proving difficult to collect sufficient sample, so the day grab was deployed off the stern. The day grab was also used for sampling stations ENV 1003 (Dublin Bay 2) and ENV 1001 (N Irish Sea). Surface sediment was split between glass (solvent washed – for organic analysis) and plastic jars (acid washed –) and frozen immediately after collection. Samples will be analysed (<63µ fraction) in the MI and additional specialist labs for a variety of persistent organic pollutants, trace metals and various cofactors.

Benthic Sediment Samples:

Sediment samples: At all benthic stations where 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: At each station sufficient sediment (>2.5L) was retained for faunal analysis. These samples comprised single Day grab samples. Upon retrieval all sediment 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 SCS system was used to log sample events at the chemistry sampling stations. While there were a small number of system crashes requiring a restart, (e.g. due to windows updates, subsequently disabled) the system worked well. Paper records were not taken during this year's survey.

4.2.2 There were issues with underway flow at various times occasionally requiring repriming of the system.

4.3.3 A number of the sampling bottles were firing and some of the valves and spigots were very stiff. These issues were mostly dealt with during the survey but some additional repair of bottles and firing may be required.

4.3.4 Subsequently it was discovered that Ships GPS had been disconnected from the CTD. However, SCS recorded GPS coordinates were available for incorporation with CTD.

5. Narrative

The proposed survey was scheduled from 20th Jan (Dublin Port) to 31st Jan (Galway Port). Overall the weather conditions for the survey were moderate. However, very poor weather conditions for the last four days meant the leg of the survey from Dingle to Galway could not be completed. The actual sampling plan was dictated by the weather/sea conditions.

The scientific complement joined the vessel on the evening of Mon 20th. The survey departed from Sir John Rogerson's Quay on 17th Jan) at 1000 of the 20th Jan for scheduled 1015 East Link Bridge lift. Sampling was commenced with underway station 54 at 1015 and subsequent sampling in Dublin Bay area in moderate sea conditions. This involved intensive sampling for all parameters, including sediment sampling for contaminant chemistry (ENV1002 ENV 1003), benthic infauna sampling, CTD/ sensor package/ rosette deployments, and sampling for a full suite of seawater chemistry parameters (salinity, dissolved inorganic nutrients, DIC, TA, trace metals (dissolved)). The vessel proceeded east on the Dublin Transect deploying the CTD at selected station. Following the final station (417) the vessel headed north to commence sample the Boyne transect at the outermost station (414) before working west along the transect sampling nutrients/salinity and collecting sediment (contaminants) at station ENV 1001 before continuing south along the coast and into the St. George's Channel and Celtic Seas in line with the planned programme. 24 hour operations were continued throughout.

The following areas were sampled (Figure 1):

- water chemistry – Irish Sea: coastal stations in the Irish Sea (coastal strip between Boyne estuary and Carnsore point, Co. Wexford), Dublin Bay, Dublin transect (incl TA/DIC, DOC, metals), Boyne, Wicklow transect, Arklow transect, and Rosslare transect, Carnsore to St. Davids's Head transect (incl TA/DIC, DOC, metals). South Coastal strip Carnsore Point to Mizen Head, Waterford Harbour, Cork Harbour and Lough Mahon, Roaring Water Bay, and Waterford (incl TA/DIC, DOC), Cork (incl TA/DIC, DOC, metals) and Kinsale Transects (N-S). In the South West sampling was continued in Bantry Bay transect from Inner Bantry Bay to 200m contour (incl TA/DIC, DOC, metals), Kenmare River and Dingle Bay. Sediment chemistry - sampled Dublin Bay and North Irish Sea sediment stations (contaminants)
- for benthic components – target areas Dublin Bay, coastal waters between Dublin and Wexford, South Western Irish Sea coastal water body, Outer Waterford Harbour, Outer Cork Harbour, Outer Kinsale Harbour, Roaringwater Bay and Kenmare

Worsening weather conditions required the vessel to put into Dingle on Tues 27th Jan (~1200). On Thurs 29th following a weather forecast review with CS and Master, and in consultation with vessel operations, it was clear that the sea conditions would not allow completion of the survey within the schedule (due Galway Jan 31st). Consequently the survey was stopped and the vessel demobbed in Dingle on Jan 27th.

Winter Nutrients: 67.8% of CTD and 68% of underway stations were achieved despite not being able to complete the survey, albeit for an ambitious programme with better coverage (90%) for priority 1 stations. Figure 1 shows the coverage achieved.

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. Conductivity, temperature, DO and turbidity profiles were taken at CTD 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

DIC/TA Samples ~ 70 samples (typically surface and bottom) were collected during CTD deployments during following transects/bays: Irish Sea: Dublin Bay transect, Carnsore-St. David's Head transect; South and Sout west: Waterford harbour&transect, Cork harbour & transect; Bantry Bay/SW transect.

Samples were taken and filtered on board for the determination of **dissolved trace metals** (Ag, As, Cd, Cu, Cr, Hg, Ni, Pb and Zn) in surface waters at 25 stations (Dublin, Rosslare, Cork and Bantry Transects – See Figure 2).

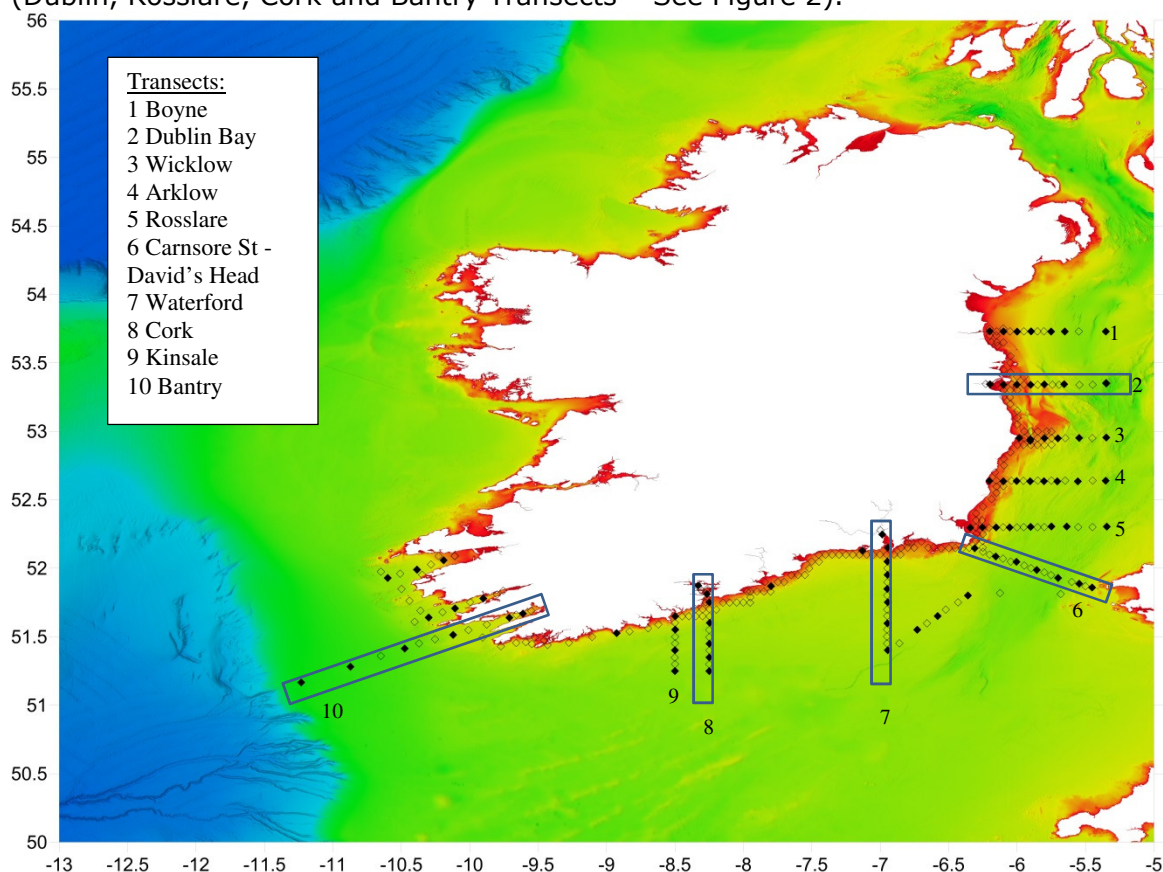


Figure 1: Stations sampled for seawater chemistry during CV15001 survey. (GEBCO Bathymetry shown in colour). Underway stations (open diamonds) sampled for dissolved inorganic nutrients and salinity. CTD deployments (closed diamonds) sampling for dissolved inorganic nutrients, salinity and at CTD stations on transects indicated by grey boxes carbonate parameters (DIC,TA), DOC, trace metals (note metals not sampled on Waterford transect)

Benthic fauna: 113 stations were sampled for benthic invertebrate analysis were . Samples were taken from Dublin Bay, Killiney Bay, South Western Irish Sea, Waterford Harbour, Outer Cork Harbour, Kinsale, Roaringwater Bay and Kenmare River. Sub-Samples were retained for particle size analysis and loss on ignition. In addition, grab samples were sieved on a 1mm sieve and fixed in formalin (4%). Despite not completing the survey (Shannon estuary outstanding for benthic infauna) over 85% of planned benthic stations were sampled.

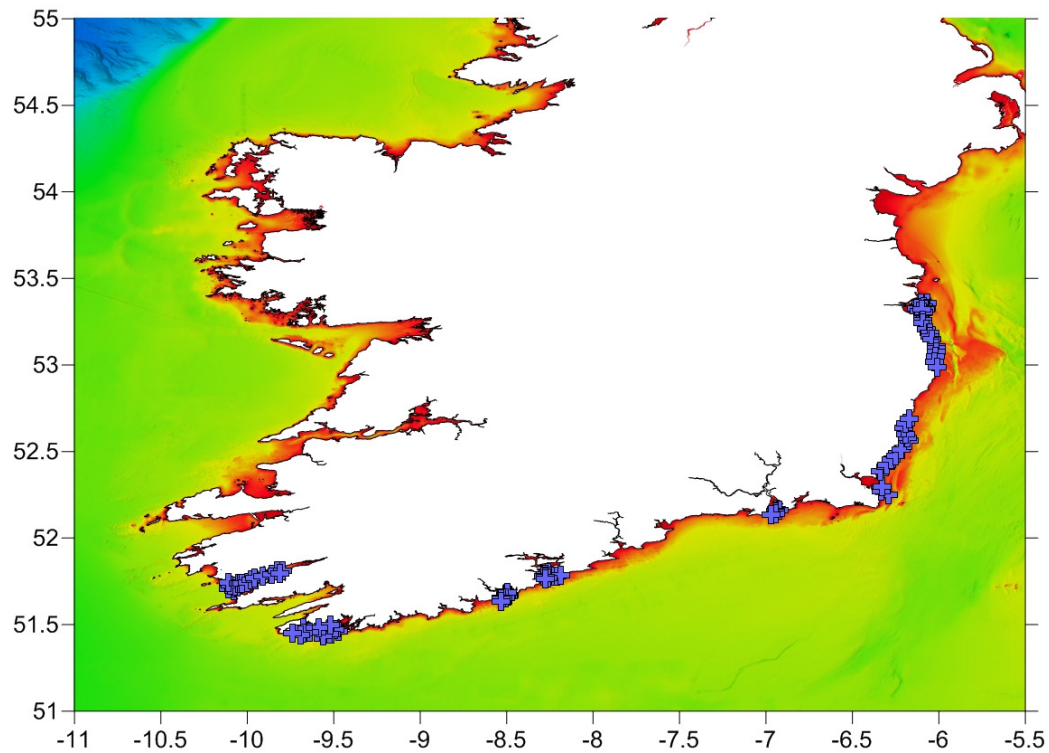
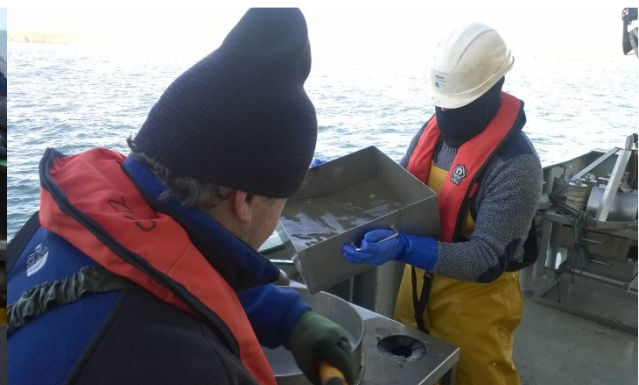


Figure 2: Stations sampled for Benthic Infauna (blue crosses) during CV 15001 survey



Seawater Sampling



Benthic sampling

Table 1. Benthic sampling summary table.

| Waterbody | Sample Code | Site Depth (m) | Sediment type | Latitude (N) | Longitude (W) | Date |
|------------------|--------------------|-----------------------|----------------------------------|---------------------|----------------------|-------------|
| Dublin Bay | MIBE15- 11 | 9.3 | Fine Sand | 53.3153 | 6.1272 | 20/01/2015 |
| Dublin Bay | MIBE15- 12 | 10.8 | Fine Sand | 53.3099 | 6.1112 | 20/01/2015 |
| Dublin Bay | MIBE15- 13 | 13.0 | Fine Sand/Mud | 53.2979 | 6.0950 | 20/01/2015 |
| Dublin Bay | MIBE15- 14 | 20.0 | Mud | 53.3075 | 6.0866 | 20/01/2015 |
| Dublin Bay | MIBE15- 15 | 12.7 | Fine Sand/Mud | 53.3220 | 6.0989 | 20/01/2015 |
| Dublin Bay | MIBE15- 8 | 17.8 | Fine Sand and Shell | 53.3191 | 6.0836 | 20/01/2015 |
| Dublin Bay | MIBE15- 7 | 18.3 | Mixed Sediment and Cobble | 53.3277 | 6.0723 | 20/01/2015 |
| Dublin Bay | MIBE15- 3 | 13.6 | Medium Sand with Shell | 53.3573 | 6.0649 | 20/01/2015 |
| Dublin Bay | MIBE15- 2 | 11.1 | Fine Sand | 53.3517 | 6.0940 | 20/01/2015 |
| Dublin Bay | MIBE15- 4 | 9.9 | Very Fine Sand | 53.3557 | 6.1054 | 20/01/2015 |
| Dublin Bay | MIBE15- 1 | 10.0 | Fine Sand | 53.3476 | 6.1028 | 20/01/2015 |
| Dublin Bay | MIBE15- 5 | 9.8 | Coarse Shell and Cobble | 53.3387 | 6.0994 | 20/01/2015 |
| Dublin Bay | MIBE15- 6 | 12.8 | Medium Sand with Shell | 53.3367 | 6.0855 | 20/01/2015 |
| Dublin Bay | MIBE15- 9 | 9.5 | Fine Sand | 53.3323 | 6.1183 | 20/01/2015 |
| Dublin Bay | MIBE15- 10 | 8.9 | Fine Sand | 53.3253 | 6.1282 | 20/01/2015 |
| Killiney Bay | MIBE15- 16 | 28.0 | Medium Sand - Uniform | 53.2594 | 6.0909 | 21/01/2015 |
| Killiney Bay | MIBE15- 17 | 18.8 | Mixed Sediment - Sandy Mud | 53.2400 | 6.0935 | 21/01/2015 |
| Killiney Bay | MIBE15- 18 | 23.0 | Mixed Sediment - Sandy Mud | 53.2269 | 6.0821 | 21/01/2015 |
| Killiney Bay | MIBE15- 19 | 23.3 | Mud and Shell | 53.2076 | 6.0720 | 21/01/2015 |
| Killiney Bay | MIBE15- 20 | 21.0 | Mud - Coarse Sand and Shell | 53.1900 | 6.0711 | 21/01/2015 |
| Killiney Bay | MIBE15- 21 | 27.4 | Muddy Sand | 53.1820 | 6.0517 | 21/01/2015 |
| Killiney Bay | MIBE15- 22 | 17.0 | Very Coarse Bottom - No Sediment | 53.1644 | 6.0535 | 21/01/2015 |

| <i>Waterbody</i> | <i>Sample Code</i> | <i>Site Depth (m)</i> | <i>Sediment type</i> | <i>Latitude (N)</i> | <i>Longitude (W)</i> | <i>Date</i> |
|-------------------------|---------------------------|------------------------------|---|----------------------------|-----------------------------|--------------------|
| Killiney Bay | MIBE15- _ | 15.0 | Two Attempts (No Samples) Alcyowum and Opiothrix | 53.1471 | 6.0392 | 21/01/2015 |
| Killiney Bay | MIBE15- _ | 13.0 | Two Attempts (No Samples) Rock and Cobble | 53.1084 | 6.0156 | 21/01/2015 |
| Killiney Bay | MIBE15- _ | 14.3 | Two Attempts (No Samples) Coarse Cobble | 53.0965 | 6.0125 | 21/01/2015 |
| Killiney Bay | MIBE15- _ | 18.1 | Two Attempts (No Samples) Cobble | 53.0739 | 6.0141 | 21/01/2015 |
| Killiney Bay | MIBE15- 23 | 12.4 | Cobble and Mud Small Sample | 53.0467 | 6.0220 | 21/01/2015 |
| Killiney Bay | MIBE15- 24 | 13.0 | Very Coarse Muddy Sand and Gravel | 53.0184 | 6.0238 | 21/01/2015 |
| Killiney Bay | MIBE15- 25 | 13.1 | Very Coarse Gravel and Mud | 52.9849 | 6.0070 | 21/01/2015 |
| SWIS | MIBE15- 40 | 13.3 | Muddy Sand | 52.6902 | 6.1689 | 23/01/2015 |
| SWIS | MIBE15- 39 | 11.2 | Fine Sand | 52.6615 | 6.1918 | 23/01/2015 |
| SWIS | MIBE15- 38 | 10.5 | Fine Sand | 52.6358 | 6.2037 | 23/01/2015 |
| SWIS | MIBE15- _ | 13.0 | Cobble No Sample | 52.6029 | 6.1907 | 23/01/2015 |
| SWIS | MIBE15- 37 | 14.5 | Medium Fine Sand | 52.5780 | 6.1836 | 23/01/2015 |
| SWIS | MIBE15- 26 | 16.1 | Medium Sand | 52.2516 | 6.2882 | 23/01/2015 |
| SWIS | MIBE15- 27 | 8.1 | Fine Sand | 52.2679 | 6.3352 | 23/01/2015 |
| SWIS | MIBE15- 28 | 12.0 | Medium Sand and Shell | 52.2952 | 6.3284 | 23/01/2015 |
| SWIS | MIBE15- 29 | 12.6 | Medium Sand and Shell | 52.3563 | 6.3242 | 23/01/2015 |
| SWIS | MIBE15- 30 | 10.7 | Muddy Sand | 52.3847 | 6.3370 | 23/01/2015 |
| SWIS | MIBE15- 31 | 11.0 | Fine Sand | 52.4117 | 6.3053 | 23/01/2015 |
| SWIS | MIBE15- 32 | 10.9 | Fine sand | 52.4204 | 6.3019 | 23/01/2015 |
| SWIS | MIBE15- 33 | 13.1 | Medium Sand and Shell | 52.4549 | 6.2776 | 23/01/2015 |
| SWIS | MIBE15- 34 | 13.5 | Medium Sand and Shell (Missed Waypoint) | 52.4765 | 6.2513 | 23/01/2015 |

| <i>Waterbody</i> | <i>Sample Code</i> | <i>Site Depth (m)</i> | <i>Sediment type</i> | <i>Latitude (N)</i> | <i>Longitude (W)</i> | <i>Date</i> |
|-------------------------|---------------------------|------------------------------|-------------------------------------|----------------------------|-----------------------------|--------------------|
| SWIS | MIBE15- 35 | 12.4 | Medium to Fine Sand | 52.5114 | 6.2178 | 23/01/2015 |
| SWIS | MIBE15- 36 | 17.6 | Gravel (No Fauna Sample) | 52.5608 | 6.1735 | 23/01/2015 |
| Waterford H | MIBE15- 46 | 20.1 | Fine Sand | 52.1343 | 6.9692 | 24/01/2015 |
| Waterford H | MIBE15- 45 | 16.3 | Fine Sand | 52.1449 | 6.9584 | 24/01/2015 |
| Waterford H | MIBE15- _ | 13.8 | Four Attempts (No Sample) | 52.1498 | 6.9453 | 24/01/2015 |
| Waterford H | MIBE15- 44 | 11.1 | Fine Sand | 52.1578 | 6.9424 | 24/01/2015 |
| Waterford H | MIBE15- 42 | 10.1 | Fine Sand | 52.1656 | 6.9570 | 24/01/2015 |
| Waterford H | MIBE15- 43 | 9.6 | Fine Sand | 52.1630 | 6.9245 | 24/01/2015 |
| Waterford H | MIBE15- 41 | 10.6 | Fine Sand | 52.1679 | 6.9412 | 24/01/2015 |
| Outer Cork H | MIBE15- 58 | 20.2 | Fine Sand and Gravel | 51.7641 | 8.2761 | 25/01/2015 |
| Outer Cork H | MIBE15- 49 | 15.4 | Fine Sand | 51.7788 | 8.2873 | 25/01/2015 |
| Outer Cork H | MIBE15- 48 | 14.6 | Fine Sand | 51.7873 | 8.2757 | 25/01/2015 |
| Outer Cork H | MIBE15- 50 | 12.7 | Sandy Mud | 51.7795 | 8.2655 | 25/01/2015 |
| Outer Cork H | MIBE15- 57 | 21.2 | Muddy Fine Sand | 51.7717 | 8.2776 | 25/01/2015 |
| Outer Cork H | MIBE15- 56 | 22.3 | Fine Sand | 51.7696 | 8.2607 | 25/01/2015 |
| Outer Cork H | MIBE15- 52 | 18.7 | Fine Sand | 51.7785 | 8.2444 | 25/01/2015 |
| Outer Cork H | MIBE15- 53 | 19.9 | Fine Sand (Small Sample) | 51.7779 | 8.2249 | 25/01/2015 |
| Outer Cork H | MIBE15- 54 | 18.7 | Fine Sand | 51.7801 | 8.2088 | 25/01/2015 |
| Outer Cork H | MIBE15- 55 | 17.6 | Fine Sand | 51.7865 | 8.1856 | 25/01/2015 |
| Outer Cork H | MIBE15- 51 | 13.3 | Fine Sand | 51.7840 | 8.2580 | 25/01/2015 |
| Outer Cork H | MIBE15- 47 | 19.0 | Muddy Sand and Shell (Small Sample) | 51.7998 | 8.2584 | 25/01/2015 |
| Kinsale H | MIBE15- 59 | 15.2 | Muddy Sand | 51.6635 | 8.4900 | 25/01/2015 |
| Kinsale H | MIBE15- 65 | 30.9 | Fine Sand | 51.6516 | 8.5315 | 25/01/2015 |
| Kinsale H | MIBE15- 67 | 36.3 | Muddy Sand | 51.6368 | 8.5353 | 25/01/2015 |

| <i>Waterbody</i> | <i>Sample Code</i> | <i>Site Depth (m)</i> | <i>Sediment type</i> | <i>Latitude (N)</i> | <i>Longitude (W)</i> | <i>Date</i> |
|-------------------------|---------------------------|------------------------------|---|----------------------------|-----------------------------|--------------------|
| Kinsale H | MIBE15- 66 | 33.4 | Fine Sand | 51.6486 | 8.5324 | 25/01/2015 |
| Kinsale H | MIBE15- _ | 26.2 | Hard Ground (No Sample) | 51.6558 | 8.5231 | 25/01/2015 |
| Kinsale H | MIBE15- _ | 17.1 | Rock (No Sample) | 51.6678 | 8.4850 | 25/01/2015 |
| Kinsale H | MIBE15- _ | 36.4 | Rock (No Sample) | 51.6323 | 8.5274 | 25/01/2015 |
| Kinsale H | MIBE15- 64 | 23.4 | Sandy Mud | 51.6546 | 8.5049 | 25/01/2015 |
| Kinsale H | MIBE15- 60 | 17.6 | Sandy Mud | 51.6620 | 8.5000 | 25/01/2015 |
| Kinsale H | MIBE15- 63 | 22.4 | Muddy Sand | 51.6850 | 8.4967 | 25/01/2015 |
| Kinsale H | MIBE15- 62 | 21.1 | Medium Sand | 51.6793 | 8.5017 | 25/01/2015 |
| Kinsale H | MIBE15- 61 | 18.7 | Muddy Sand | 51.6742 | 8.5086 | 25/01/2015 |
| Roaringwater | MIBE15- 82 | 48.4 | Coarse Sand (1/4 Retained) | 51.4483 | 9.7379 | 25/01/2015 |
| Roaringwater | MIBE15- 81 | 57.3 | Sandy Mud | 51.4370 | 9.6910 | 25/01/2015 |
| Roaringwater | MIBE15- 80 | 51.5 | Muddy Sand | 51.4510 | 9.6768 | 25/01/2015 |
| Roaringwater | MIBE15- 79 | 30.0 | Muddy Sand | 51.4833 | 9.6745 | 25/01/2015 |
| Roaringwater | MIBE15- 78 | 48.1 | Muddy Sand | 51.4550 | 9.6383 | 25/01/2015 |
| Roaringwater | MIBE15- 77 | 45.1 | Muddy sand | 51.4730 | 9.6147 | 25/01/2015 |
| Roaringwater | MIBE15- 74 | 50.2 | Sandy Mud | 51.4555 | 9.5993 | 25/01/2015 |
| Roaringwater | MIBE15- 73 | 48.0 | Medium Sand | 51.4458 | 9.5645 | 25/01/2015 |
| Roaringwater | MIBE15- 72 | 47.0 | Fine Sand (Small Sample) | 51.4346 | 9.5596 | 25/01/2015 |
| Roaringwater | MIBE15- 75 | 41.6 | Muddy Sand | 51.4753 | 9.5593 | 25/01/2015 |
| Roaringwater | MIBE15- 71 | 43.0 | Very Fine Sand | 51.4440 | 9.5238 | 25/01/2015 |
| Roaringwater | MIBE15- 76 | 23.5 | Very Coarse Sand (1/4 Retained, 5 Sand Eels Returned) | 51.4976 | 9.5195 | 25/01/2015 |
| Roaringwater | MIBE15- 70 | 40.5 | Fine Sand | 51.4457 | 9.5148 | 25/01/2015 |
| Roaringwater | MIBE15- 69 | 33.2 | Fine Sand | 51.4685 | 9.4921 | 25/01/2015 |
| Roaringwater | MIBE15- 68 | 22.0 | Very Coarse Sand (1/4 Retained, | 51.4588 | 9.4717 | 25/01/2015 |

| <i>Waterbody</i> | <i>Sample Code</i> | <i>Site Depth (m)</i> | <i>Sediment type</i> | <i>Latitude (N)</i> | <i>Longitude (W)</i> | <i>Date</i> |
|-------------------------|---------------------------|------------------------------|---|----------------------------|-----------------------------|--------------------|
| | | | 4 Sand Eels Returned) | | | |
| Kenmare | MIBE15- 88 | 63.4 | Sandy Mud | 51.7309 | 10.0963 | 26/01/2015 |
| Kenmare | MIBE15- 89 | 47.7 | Fine Medium Sand | 51.7411 | 10.1083 | 26/01/2015 |
| Kenmare | MIBE15- 102 | 31.6 | Mud | 51.8100 | 9.7946 | 26/01/2015 |
| Kenmare | MIBE15- 101 | 30.7 | Mud | 51.8098 | 9.8278 | 26/01/2015 |
| Kenmare | MIBE15- 100 | 33.8 | Mud | 51.8045 | 9.8399 | 26/01/2015 |
| Kenmare | MIBE15- 99 | 34.5 | Mud | 51.8003 | 9.8343 | 26/01/2015 |
| Kenmare | MIBE15- 103 | 29.2 | Mud Mixed sediment and Shell (2 Buckets) | 51.7972 | 9.8136 | 26/01/2015 |
| Kenmare | MIBE15- 98 | 39.1 | Mud | 51.7898 | 9.8598 | 26/01/2015 |
| Kenmare | MIBE15- 97 | 44.0 | Sandy Mud | 51.7768 | 9.9094 | 26/01/2015 |
| Kenmare | MIBE15- 95 | 48.0 | Fine Sand | 51.7591 | 9.9553 | 26/01/2015 |
| Kenmare | MIBE15- 96 | 47.0 | Mud | 51.7709 | 9.9571 | 26/01/2015 |
| Kenmare | MIBE15- 94 | 50.4 | Mud | 51.7571 | 9.9800 | 26/01/2015 |
| Kenmare | MIBE15- 93 | 53.8 | Fine Sand and Mud | 51.7444 | 10.0008 | 26/01/2015 |
| Kenmare | MIBE15- 92 | 57.8 | Mud | 51.4510 | 9.6768 | 26/01/2015 |
| Kenmare | MIBE15- 91 | 57.6 | Mud | 51.7388 | 10.0399 | 26/01/2015 |
| Kenmare | MIBE15- 90 | 59.8 | Mud | 51.7358 | 10.0510 | 26/01/2015 |
| Kenmare | MIBE15- 87 | 63.2 | Mud | 51.7243 | 10.0706 | 26/01/2015 |
| Kenmare | MIBE15- 86 | 63.3 | Fine Sand | 51.7151 | 10.0568 | 26/01/2015 |
| Kenmare | MIBE15- 85 | 68.2 | Muddy Sand | 51.7118 | 10.0786 | 26/01/2015 |
| Kenmare | MIBE15- 84 | 66.7 | Sandy Mud | 51.6947 | 10.0801 | 26/01/2015 |
| Kenmare | MIBE15- 83 | 68.7 | Mud | 51.7070 | 10.1087 | 26/01/2015 |

5. Preliminary Findings

Analysis and processing of data is mostly carried out post cruise. Data will be available via Marine Institute data request system (www.marine.ie).

A comparison of laboratory salinity and CTD salinity is provided in figure 3. Summary results for trace metals in surface seawater determined during the survey are provided in table 2.

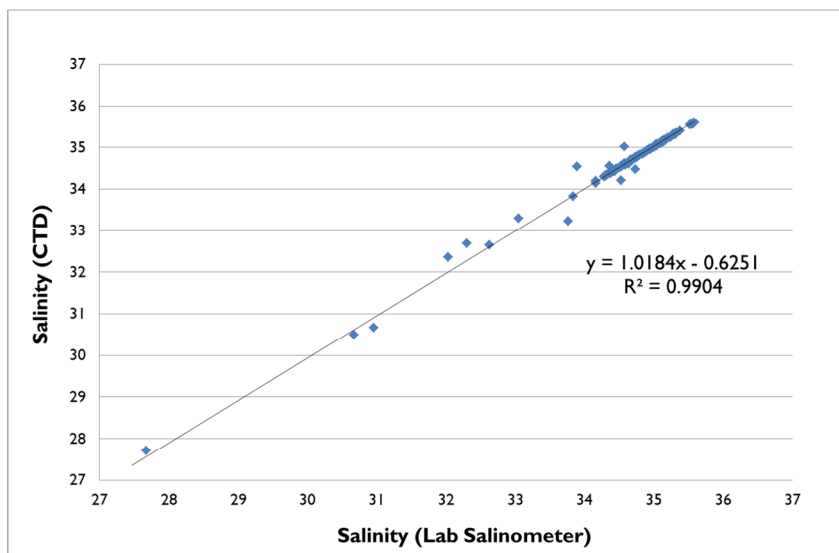
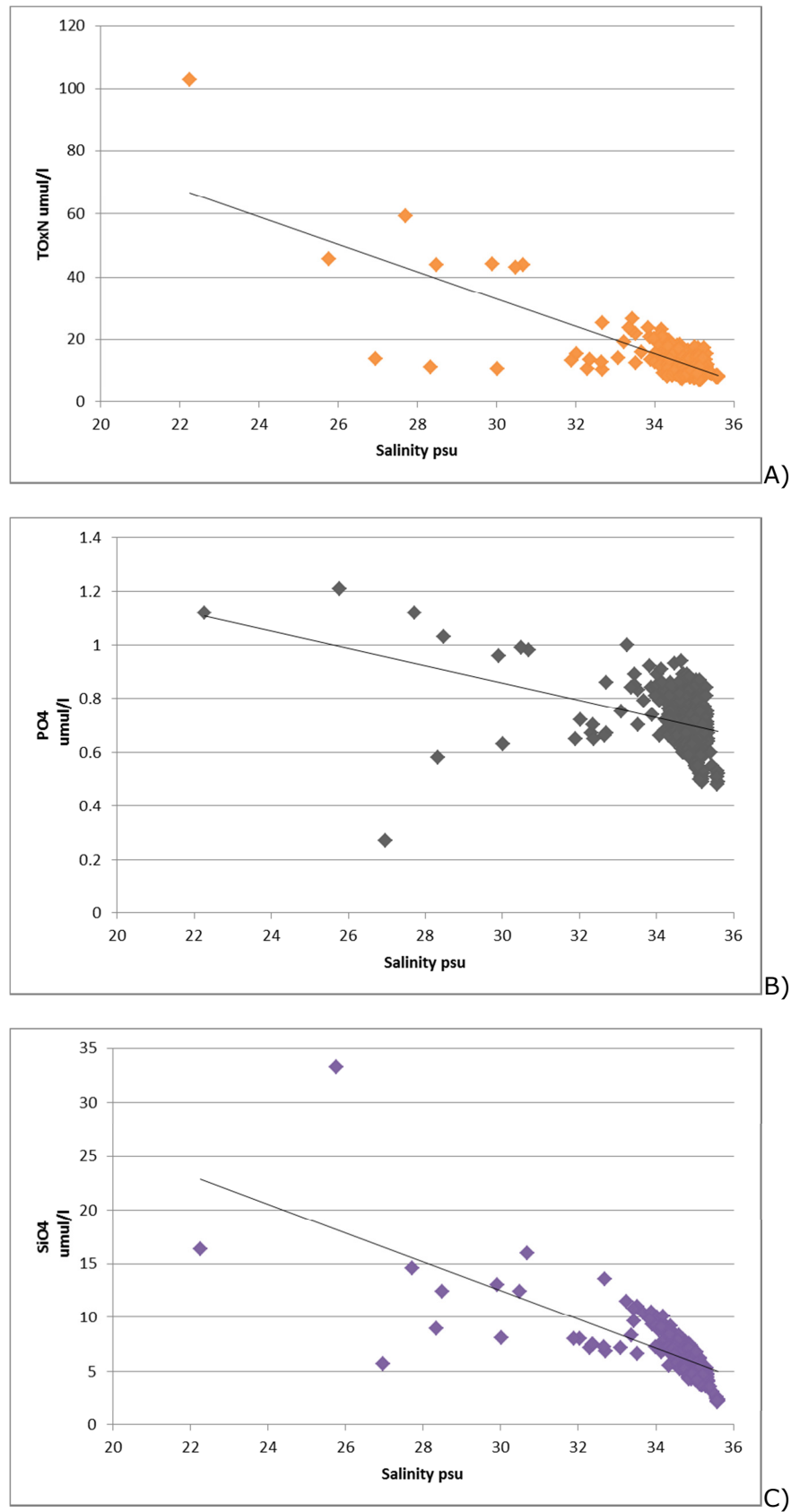


Figure 3: CTD salinity as determined at sampling depth vs laboratory measured salinity (Niskin grab)

Table 2: Measured concentration ranges for dissolved trace metals in seawater sampled during the survey (n=25, see fig 1). Samples were analysed post survey at Marine Institute using an accredited ICP-MS method (Agilent 7700x)

| | <i>Range $\mu\text{g l}^{-1}$</i> |
|----------|--|
| Chromium | 0.11 - 0.17 |
| Nickel | 0.14 - 0.32 |
| Copper | 0.11 - 0.54 |
| Zinc | <1.00 - 1.37 |
| Arsenic | 1.23 - 2.00 |
| Silver | <0.003 |
| Cadmium | <0.05 |
| Lead | <0.1 |

Figure 4: Concentrations of dissolved winter nutrients vs salinity (lab measured) for samples collected during CV15001 survey; A) total oxidised nitrogen, B) ortho-phosphate, C) silicate



6. Conclusions & Recommendations

Effective completion of the cruise objectives.

The survey was reasonably successful given weather conditions. Approximately 68% of water chemistry stations were completed with good coverage of inshore coastal stations in particular, and transects including the Bantry and other south coast transects successfully undertaken. Sediments for OSPAR Hazardous Substance monitoring were acquired at target stations and seawater samples were collected for trace metal testing. Benthic sampling was completed for all the priority areas targeted with the exception of the Shannon estuary. DIC/TA samples were collected on 5 transects/areas.

The scientific team would like to thank the master (Philip Baugh), and all of the crew, on board technical support (Lukasz) and shore based RV operations/P&O team for their excellent support and help over the course of this survey.

7. References

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