

Cruise report PHiXT4 30th July – 2nd August 2009

Cruise Report:

Cruise ID: PHiXT4

Ship: RV Prince Madog

Master: Capt. Steve Duckworth

Location: Liverpool Bay, Eastern Irish Sea.

Cruise dates: 30th July – 2nd August 2009

Scientific personnel:

Emmer Litt (PSO, PML)

Anouska Bailey (UoLiverpool)

Anne Hammerstain (UoBangor)

Ben Powell (UoBangor)

Lucy Abram (UoLiverpool)

Claire Mahaffey (UoLiverpool)

Iris Verhagen (UoBangor)

Gina Siebler (UoBangor)

Pascal Salaun (UoLiverpool)

Clare Bellingham (UoLiverpool)

Nia Thomas (UoCardiff)

Project description:

PHiXT: nutrient PatHways from carbon fluX through the Trophic cascade

This cruise was the fourth of five multidisciplinary cruises during 2009/10 involving scientists from POL, PML and the Universities of Liverpool, Bangor and Cardiff. The majority of work was centred around water samples collected during 25 hour CTD stations at two sites; coastal location (53° 30.6' N, 3° 23'W, 19m) which is just SW of the main mooring site of POL's Irish Sea Observatory, and an offshore site 30 (53° 42'N 3° 55.4' W, 44m). The preference was for work to be conducted whilst at anchor, thus permitting safe concurrent deployment of the CTD

The aims of the cruises are to provide data for a variety of individual projects;

1. "Temporal variability of CO₂ flux estimates in contrasting shelf sea regimes" and the "CARBON-OPS NERC KT Project" - Emmer Litt, CASIX PhD Project.
2. "How does pulsed stratification alter coastal primary and secondary production? A case study in Liverpool Bay". NERC SOFI PhD project – Anouska Bailey
3. Detection and speciation of metals and metalloids in Liverpool Bay. Pascal Salaun
4. Vertical plankton tows at 2m, 5m and 10m sieved in grades of 200, 85 and 45 µm. Natalie Horton, PhD student (UoBangor)

Schedule:

To conduct 25 hour long surveys at,

1. A near-shore station, 53° 30.5' N, 3° 24' W.
2. An off-shore station, 53° 42'N, 3° 55.4' W.

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Each survey consisted of;

- Hourly CTD profiles and discrete water sample collection at a variety of depths.
- Short series of CTD profiles from 2NM west to 2NM east of coastal site with 2NM resolution.
- Vertical plankton tows at 2m, 5m and 10m sieved in grades of 200, 85 and 45 μm at slack tide at both sites.

Narrative (GMT):

30th July 2009:

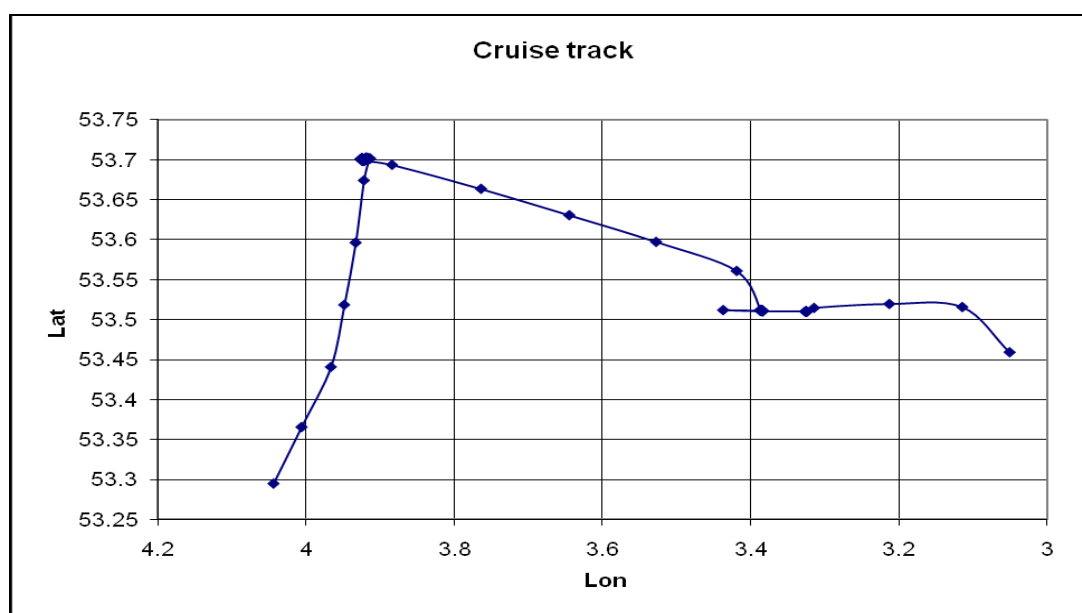
All equipment was loaded onto the ship by 1300. The ship left Menai Bridge at 1400, destination offshore site. At Puffin Island (14:20) the ships ADCP, flow through and pCO₂ systems were turned on. The ship arrived at offshore site at 17:10 (53° 42'N, 3° 55.4' W) in 43m of water. The CTD survey commenced at 17:13, following which 25 further CTD profiles were made on the hour until 31/07/09 17:59.

31st July & 1st August 2009:

Left offshore site at 18:20 and arrived at coastal site and anchored close to site A at 20:30 (53° 30.62' N, 3° 22.99' W) in 23m of water. The CTD survey commenced at 21:00, following which 25 further CTD profiles were made on the hour until 01/08/09 21:59. Following recovery of the ships anchor, CTD profiles and water samples were taken at 2NM west (22:41), at the coastal site (23:07), and 2NM east (23:33).

2nd August 2009:

Anchored at 00:01 on 02/08/09 nearby to Birkenhead, entered lock at 08:00. ADCP, flow through and pCO₂ stopped logging at 06:30. The ship was unloaded at Vittoria Dock by 09:00.



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Samples collected and contact:

Appendix A: Nutrient, zooplankton and phytoplankton samples – Claire Mahaffey (UoLiverpool) Claire.Mahaffey@liverpool.ac.uk & Anouska Bailey (UoLiverpool) Anouska.Bailey@liverpool.ac.uk

Appendix B: Measurements of As(III), Sb(III), Mn²⁺, Zn, Cu and Hg. Pascal Salaun (UoLiverpool) Pascal.Salaun@liverpool.ac.uk

Appendix C: Ships underway measurements – Emmer Litt (PML/UoBangor) emmtta@pml.ac.uk

Appendix D: CTD profiles – Emmer Litt (PML/UoBangor) emmtta@pml.ac.uk

Appendix E: Vertical plankton tows at 2m, 5m and 10m sieved in grades of 200, 85 and 45 µm. Natalie Horton, PhD student (UoBangor) n.horton@bangor.ac.uk

Appendix A:

Size-fractionated chlorophyll *a* – fixed volumes of seawater are filtered through 0.2µm, 2µm, and 10µm polycarbonate filters under low vacuum pressures. The filters are stored frozen at -80°C until analysis in the laboratory where chlorophyll *a* is extracted from the filter by sonicating the filter in 5ml 90% acetone for 10 minutes. Fluorometric analysis of the raw extract as well as the extract post-acidification allows for correction for phaeopigments. Nutrients – sea water samples are stored in 125ml polycarbonate bottles (acid-washed and triple-rinsed with sample water) prior to analysis with Quattro nutrient analyser onboard.

Dissolved organic carbon (DOC) – seawater samples are filtered through combusted GF/F filters in a glass filter assembly. 20ml of filtrate is pipette into an acid-washed, combusted glass vial pre-filled with 50µl 50% (v/v) hydrochloric acid. Samples are stored in laboratory refrigerator for analysis on Shimadzu TOC-V.

Bacterial abundance – 50 ml of seawater from designated Niskin is emptied into a sterile centrifuge tube pre-filled with formaldehyde (final concentration 2%). Samples are stored in cold room before DAPI staining and enumeration under epifluorescence microscope.

Phytoplankton and microzooplankton abundance – 100ml of seawater is measured into amber glass jar pre-filled with acid Lugol's solution (final concentration 2%) and stored in cold-room. Abundances, biovolumes, and community composition are measured under inverted microscope.

Particulate organic nutrients – fixed volumes of seawater are filtered through combusted GF/F (PC/PN), combusted acid-washed GF/F (PP) or 0.8µm polycarbonate (PSi) and the filters frozen prior to analysis in laboratory.

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Net community production - estimated by determining the change in dissolved oxygen concentration in seawater samples in 125 ml glass bottles stored under a 16:8 hour light: dark cycle ('light') or in the dark over a 24-hour incubation period in comparison to a Tzero O₂ concentration. Net community production ($\mu\text{mol O}_2 \text{ l}^{-1} \text{ day}^{-1}$) is calculated by subtracting the mean Tzero oxygen concentration from the mean O₂ concentration in the 'light' bottles.

PHIXT 4 Stn 1: Nutrient and phyto/zooplankton samples; 31 Jul - 1 Aug 09

Time	Chlorophyll a	Dissolved nutrients	DOC	Bacterial abundance	Phytoplankton abundance/ID	Microzooplankton abundance/ID	Particulate C/N	Particulate P	Particulate Si	NCP
22:00	Y	Y	Y							
23:00	Y	Y	Y							
00:00	Y	Y	Y	Y	Y			Y	Y	
01:00	Y	Y	Y							
02:00	Y	Y	Y							
03:00	Y	Y	Y	Y	Y			Y	Y	Y
04:00	Y	Y	Y							
05:00	Y	Y	Y							
06:00	Y	Y	Y	Y	Y			Y	Y	Y
07:00	Y	Y	Y							
08:00	Y	Y	Y							
09:00	Y	Y	Y	Y	Y			Y	Y	Y
10:00	Y	Y	Y							
11:00	Y	Y	Y							
12:00	Y	Y	Y	Y	Y			Y	Y	Y
13:00	Y	Y	Y							
14:00	Y	Y	Y							
15:00	Y	Y	Y	Y	Y			Y	Y	Y
16:00	Y	Y	Y							
17:00	Y	Y	Y							
18:00	Y	Y	Y	Y	Y			Y	Y	Y
19:00	Y	Y	Y							
20:00	Y	Y	Y							
21:00	Y	Y	Y	Y	Y			Y	Y	Y
22:00	Y	Y	Y							
23:00	Y	Y	Y							

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PHiXT 4 Stn 30: Nutrient and phyto/zooplankton samples; 30-31 Jul 09

Time	Chlorophyll a	Dissolved nutrients	DOC	Bacterial abundance	Phytoplankton abundance/ID	Microzooplankton abundance/ID	Particulate C/N	Particulate P	Particulate Si
18:13	Y	Y	Y						
19:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
20:00	Y	Y	Y						
21:00	Y	Y	Y						
22:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
23:00	Y	Y	Y						
00:00	Y	Y	Y						
01:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
02:00	Y	Y	Y						
03:00	Y	Y	Y						
04:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
05:00	Y	Y	Y						
06:00	Y	Y	Y						
07:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
08:00	Y	Y	Y						
09:00	Y	Y	Y						
10:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
11:00	Y	Y	Y						
12:00	Y	Y	Y						
13:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
14:00	Y	Y	Y						
15:00	Y	Y	Y						
16:00	Y	Y	Y	Y	Y	Y	Y	Y	Y
17:00	Y	Y	Y						
18:00	Y	Y	Y						
19:00	Y	Y	Y	Y	Y	Y	Y	Y	Y

NOTE 1: NCP (=Net Community Production) oxygen incubations for 24 hours - light, dark, and Tzero.

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Appendix C: Ship's underway measurements:

The intake for the surface sampling system is located underneath RV Prince Madog, at about 3 m below sea level. The parameters recorded every minute by the WS Oceans system are: Date, Transmittance, Hull Temperature (°C), Barometric Pressure (mbar), Fluorescence, Oxygen concentration, Turbidity, Salinity, Conductivity sensor water temperature (°C). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC. In addition a pCO₂ sensor is incorporated into the surface sampling system. Met package measures and records Barometric pressure (mbar), Solar Radiation (W m⁻²), PAR (µmols / m²s), Air Temperature (°C), Relative Humidity, Relative Wind Speed (m s⁻¹), Relative Wind Direction (°) – zero indicates wind on the bow, Minimum Air Temp (°C), Maximum Air Temp (°C), Wind Gust (m s⁻¹). Underway data, pCO₂ and ships ADCP data were recorded every minute. The ship was fitted with a 300 kHz ADCP set to record 50 x 1m bins, every 30 seconds with 24 pings / ensemble. The systems ran continually beyond Puffin Island between 30/7/09 14:20 and switched off before Mersey tower 02/08/09 06:30.

Appendix D:

The Sea-Bird 911 CTD recorded downwelling PAR light levels, temperature, conductivity, oxygen concentration, transmittance and fluorescence at 24 Hz. The frame was fitted with an altimeter. The CTD temperature data was checked against a Sea-Bird SBE35 precision thermometer. Water samples were taken from a near bed (3mab) bottle for calibration of the CTD salinity data by Anne Forbes-Brook (University of Bangor). A LISST-100X particle sizer with internal logging was attached to the CTD frame. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system.

CTD log:

Cast sequence	Cast ID	time	Latitude (N)	Longitude (W)
001	4off-1	July 30 2009 17:13	53deg 41.952'	03deg 55.258'
002	4off-2	July 30 2009 18:01	53deg 41.931'	03deg 55.287'
003	4off-3	July 30 2009 18:58	53deg 41.963'	03deg 55.532'
004	4off-4	July 30 2009 20:00	53deg 41.993'	03deg 55.346'
005	4off-5	July 30 2009 21:01	53deg 41.947'	03deg 55.340'
006	4off-6	July 30 2009 22:00	53deg 41.977'	03deg 55.225'
007	4off-7	July 30 2009 23:00	53deg 41.958'	03deg 55.288'
008	4off-8	July 31 2009 00:00	53deg 41.948'	03deg 55.323'
009	4off-9	July 31 2009 01:00	53deg 41.922'	03deg 55.214'
010	4off-10	July 31 2009 02:01	53deg 41.966'	03deg 55.258'
011	4off-11	July 31 2009 03:01	53deg 41.881'	03deg 55.240'
012	4off-12	July 31 2009 04:00	53deg 41.992'	03deg 55.271'
013	4off-13	July 31 2009 04:59	53deg 41.993'	03deg 55.318'
014	4off-14	July 31 2009 06:00	53deg 41.978'	03deg 55.380'
015	4off-15	July 31 2009 07:00	53deg 41.936'	03deg 55.341'
016	4off-16	July 31 2009 08:01	53deg 41.963'	03deg 55.202'

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017	4off-17	July 31 2009 09:00	53deg 41.964'	03deg 55.339'
018	4off-18	July 31 2009 10:01	53deg 41.976'	03deg 55.243'
019	4off-19	July 31 2009 11:01	53deg 41.934'	03deg 55.209'
020	4off-20	July 31 2009 12:01	53deg 41.950'	03deg 55.188'
021	4off-21	July 31 2009 13:01	53deg 41.944'	03deg 55.204'
022	4off-22	July 31 2009 14:00	53deg 41.933'	03deg 55.213'
023	4off-23	July 31 2009 15:01	53deg 41.899'	03deg 55.294'
024	4off-24	July 31 2009 16:01	53deg 41.902'	03deg 55.372'
025	4off-25	July 31 2009 17:00	53deg 41.909'	03deg 55.305'
026	4off-26	July 31 2009 17:59	53deg 41.958'	03deg 55.294'
027	4in-1	July 31 2009 21:00	53deg 30.681'	03deg 23.187'
028	4in-2	July 31 2009 22:00	53deg 30.684'	03deg 23.183'
029	4in-3	July 31 2009 23:01	53deg 30.677'	03deg 23.198'
030	4in-4	Aug 01 2009 00:00	53deg 30.684'	03deg 23.187'
031	4in-5	Aug 01 2009 01:00	53deg 30.682'	03deg 23.183'
032	4in-6	Aug 01 2009 02:01	53deg 30.685'	03deg 23.183'
033	4in-7	Aug 01 2009 03:00	53deg 30.679'	03deg 23.193'
034	4in-8	Aug 01 2009 03:59	53deg 30.685'	03deg 23.175'
035	4in-9	Aug 01 2009 04:58	53deg 30.685'	03deg 23.175'
036	4in-10	Aug 01 2009 06:01	53deg 30.685'	03deg 23.175'
037	4in-11	Aug 01 2009 07:00	53deg 30.648'	03deg 23.017'
038	4in-12	Aug 01 2009 08:00	53deg 30.685'	03deg 23.175'
039	4in-13	Aug 01 2009 08:59	53deg 30.685'	03deg 23.175'
040	4in-14	Aug 01 2009 09:59	53deg 30.625'	03deg 23.012'
041	4in-15	Aug 01 2009 11:09	53deg 30.652'	03deg 23.043'
042	4in-16	Aug 01 2009 12:00	53deg 30.658'	03deg 23.043'
043	4in-17	Aug 01 2009 13:00	53deg 30.648'	03deg 23.037'
044	4in-18	Aug 01 2009 14:00	53deg 30.653'	03deg 23.036'
045	4in-19	Aug 01 2009 15:03	53deg 30.643'	03deg 23.035'
046	4in-20	Aug 01 2009 16:00	53deg 30.650'	03deg 23.036'
047	4in-21	Aug 01 2009 17:01	53deg 30.671'	03deg 23.036'
048	4in-22	Aug 01 2009 17:59	53deg 30.681'	03deg 23.036'
049	4in-23	Aug 01 2009 19:00	53deg 30.623'	03deg 22.998'
050	4in-24	Aug 01 2009 20:01	53deg 30.593'	03deg 19.562'
051	4in-25	Aug 01 2009 21:00	53deg 30.686'	03deg 23.122'
052	4in-26	Aug 01 2009 21:59	53deg 30.594'	03deg 26.435'
053	TR1	Aug 01 2009 22:41	53deg 30.671'	03deg 26.236'
054	TR2	Aug 01 2009 23:07	53deg 30.640'	03deg 23.126'
055	TR3	Aug 01 2009 23:33	53deg 30.555'	03deg 19.634'

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Appendix E:

Table 1. Date, time and location of sampling. For each sampling point 2 plankton samples were taken from 2m, 5m and 10m depths. (30/07/09 had 3 samples taken from each depth).

Date	Time	Station
30/07/09	18.00 – 19.00	53°42.0 N 3°55.4 W
31/07/09	01.00 – 02.00	53° 30.6N 3°23.0 W
01/08/09	02.00 – 03.00	53° 30.6 N 3°23.0 W
01/08/09	15.00 – 16.00	53° 30.6 N 3°23.0 W
01/08/09	20.00 – 21.00	53° 30.6 N 3°23.0 W

Acknowledgements:

This work was made possible by the hard work and expertise of the officers and crew of the RV Prince Madog led by Capt. Steve Duckworth. Assistance was also provided by the workshop engineers of Proudman Oceanographic Laboratory. I would like to thank both of these groups and all the science crew for making the cruise such a success in often demanding conditions.