Prince Madog cruise 23/08
POL Coastal Observatory cruise 55
30 July – 1 August 2008

1. Objectives

1. At Site A 53º 32´ N 3º 21.8´ W, (Observatory CTD station 1 and 9)

To recover

a) A sea bed frame containing:
- 600kHz ADCP (waves ADCP) to measure the mean current profile, pressures and directional waves.
- Sea-Bird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and a SeaPoint turbidity sensor.
- SonTek ADV.
- Aanderra oxygen optode.

b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and VEMCO thermistor miniloggers at 7.5 and 15 m below the surface.

To deploy

c) an identical bedframe to that which was recovered.

d) an identical CEFAS smartbuoy to that which was recovered

e) Collect 10 vertical zooplankton net hauls (CEFAS).

2. At Site B 53º 27´ N 3º 38.6´ W (Observatory CTD station 21)

To recover

a) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.

b) A CEFAS SmartBuoy (with cellulose bags) in a single point mooring. Attached to the mooring wire are Sea-Bird MicroCat temperature, conductivity loggers at 5 and 10m below the surface and miniloggers at 7.5 and 15 m below the surface.

3. To conduct a CTD / LISST survey of 34 sites every 5 miles covering the eastern Irish Sea between the North Wales coast and Blackpool and the Lancashire coast and the Great Orme, to determine the effects of the rivers Dee, Mersey and Ribble on Liverpool Bay. To obtain calibration samples for salinity, transmittance, suspended sediment and for chlorophyll at selected stations. To obtain near surface and bed water samples for nutrient and suspended sediment determination.

4. Collect sediment samples at each of the CTD sites.

5. Collect near surface water samples for Elena Stoica (UoL) at stations 1, 21 & the most

offshore station. Some of these samples are to be 'fixed' using provided formaldehyde solutions and frozen at -20ºC and others left in the fridge.

6. Collect and analyse water samples for trace metals (Earth Sciences, UoL).

2.1 Scientific personnel

Phil Knight (Principal Scientist)
Andy Lane
Richard Cooke
Mike Burke
Mike Nelson (BODC)
Dave Sivyer (CEFAS)
Naomi Greenwood (CEFAS)
Anne Hammerstein (School of Ocean Sciences)
Zhiyu Liu (Jo) (School of Ocean Sciences)
Kristopher Gibbon-Walsh (Liverpool University)

2.2 Ship's officers and crew

Steve Duckworth (Master)
David Shaw (Chief Officer)
Les Black (Chief Engineer)
Meikle Mackay (2nd Engineer)
Hefin Grifiths (A.B.)
Mick Callaghan (Bosun)
Kevin Moore (A.B.)
Richard Ederle (Cook)

3. Narrative (times in GMT)

The anchor chain clumps, a sea-bed frame and instrumentation were loaded onto RV Prince Madog on the afternoon of 29 July 2008 between 08:00 and 10:00. The ADV was setup on the frame which had already been fitted out with ADCP and SeaBird at POL. The tower and instruments were fitted to the SmartBuoy toroid by CEFAS personnel. The POL LISST100 was fitted to the CTD frame.

Prince Madog left Menai Bridge at 06:00 on 30 July 2008. The ship's surface monitoring, pCO_2 system and ADCP were switched on at 07:00 at around Puffin Island. We arrived at site A at 09:33 on the 30 July 2008 and carried out the first CTD and sediment grab. The following CTD bottle numbers were used for water samples: (CTD: 3-bottom for salinity and nutrients; 8-surface for nutrients; 4-bottom, 9-surface for SPM; 5-Bottom, 9-Bottom for Cefas; 10-10m depth for trace metals).

At site A the ADCP release was attempted between 11:45-12:00. The acoustics gave distances varying from 180m to 3000+m for the ACDP frame. The release was fired when the acoustics gave 180m, however the frame did not surface. After a few more attempts we decided to leave it while we serviced the SmartBuoy. The replacement SmartBuoy was deployed at 12:28 and the old buoy recovered between 12:38 and 12:55. At 13:10 we tried

again to communicate with the ADCP. We then tried swapping the release codes round (later it was discovered that this was the correct way as each code is opposite for transmit and receive). This seemed to give more realistic distances from the original position. We fired the releases and the ADCP was spotted at 13:23. However, only the pellet lines were visible at the surface. The ADCP was finally recovered between 13:23 and 13:47. The replacement ADCP was then deployed at site A at 14:08. This was followed by zooplankton net hauls and a second CTD at 15:22.

The CTD survey was then started, visiting stations 10, 35, 2-9, 11-21, 21-34. SPM, nutrient and grab samples were attempted (See Tables 3-4 for success rates). The replacement SmartBuoy at site B was redeployed at 08:41 on 31 July 2008 and the old SmartBuoy recovered between 08:55 and 09:08.

The surface monitoring and ADCP were switched off passing Puffin Island at 20:20. The ship's underway pCO_2 was switched off at 20:27 (part way through the cruise the water supply was cut off to the pCO_2 system resulting in a period without data). Prince Madog arrived at Menai Bridge at 22:00 on 31 July 2008. All the major moorings objectives were accomplished. Winds throughout the cruise were from the SE (mainly force 3-4, maximum force 5-6 early in the cruise).

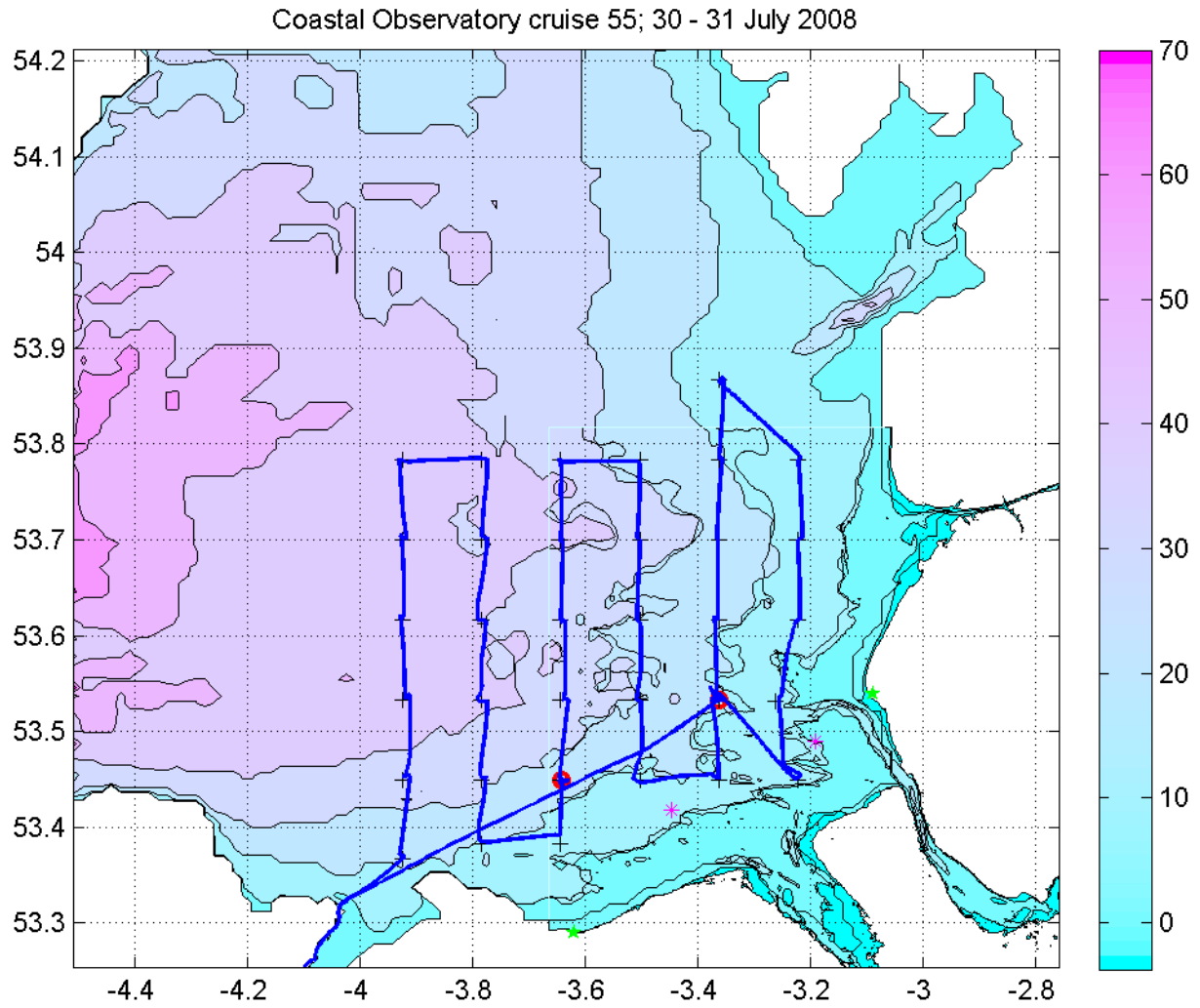

Figure 1. Cruise track.

4. Moorings (times in GMT)

4.1 The set up of the recovered instruments was as follows:

Site A

a) Waves ADCP 600 kHz RDI S/N 3644, 1Gb memory**.**
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 16:39 on 12 May 2008; delayed start 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

Sea-Bird 16plus S/N 5309 on base of frame with pumped conductivity sensor underneath.
Sample interval 600s. SeaPoint turbidity sensor 10471 taped to roll bar; set up for **0 - 125**

FTU range. Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay. Aanderra optode S/N 675. Clock set at 17:01:00 on 12 May 2008; delayed start at 06:00:00 on 13 May 2008. Stop time not available for cruise report.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G250; head B252.
Distance from center of three prong head on ADV transmitter to deck was 1.270m (i.e. above sea bed). Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Time reset to 19:04:00 on 12 May 2008, logging set to start at 06:00:00 on 13 May 2008. Stop time not available for cruise report.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 70355 (Rx 10.0 kHz, Tx 12.0 kHz, release B) and s/n 72382 (Rx 10 kHz, Tx 12.0 kHz, release A).

b) SmartBuoy Mooring.
Sea-Bird MicroCat temperature, conductivity and pressure recorder s/n 5790 at 5m below the surface. Sample interval 600s.
Clock set at 15:33:20 on 12 May 2008. Delayed start 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

Sea-Bird MicroCat temperature and conductivity recorder s/n 5792 at 10m below the surface. Sample interval 600s.
Clock set at 17:48 on 12 May 2008. Delayed start 06:00 on 13 May 2008.
Stop time not available for cruise report.

Mini-logger s/n 6021E at 7.5 m below the surface set to record at 600s intervals. Clock set at 18:07 on the 12 May 2008. Delayed start at 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

Mini-logger s/n 6023E at 15 m below the surface set to record at 600s intervals. Clock set at 18:03 on the 12 May 2008. Delayed start at 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

The CEFAS SmartBuoy is fitted with one surface CTD, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (TOXN and silicate; no filtration therefore no phosphate), fluorometer (SeaPoint), oxygen (Aanderaa Optode) and chlorophyll determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm. The frame was fitted with bags of material supplied by Mike Cox (University of Liverpool) for the determination of bacterial degradation.

The single point mooring was composed of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Site B

a) This frame and the telemetry buoy are scheduled to be recovered on the next cruise.

Waves ADCP 600 kHz RDI 2390, 1GB memory**.**
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).

35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock set at 13:35:20 on 24 June 2008; delayed start 06:00 on 25 June 2008.

Telemetry ADCP 1200 kHz RDI 3052.
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.003 m s^{-1}).
30 x 1 m bins (2.15 – 31.15 m above the bed). 1 Gb memory.
Earth co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 13:46:10 on 24 June 2008; delayed start 15:50:00 on 24 June 2008.
LinkQuest acoustic modem sn008602 set for transmission of ADCP data every hour.
LinkQuest tx at 16:00:00 on 24 June 2008.

Sea-Bird 16plus S/N 4596 (RS485) on base of frame with pumped conductivity sensor underneath. SeaPoint turbidity sensor 10533 taped to roll bar; set up for 0 - 125 FTU range.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay.
Sample interval 600s.
Clock set at 13:22:50 on 24 June 2008; delayed start at 06:00 on 25 June 2008.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 67679 (Rx 11.5 kHz, Tx 12.0 kHz, release B) and s/n 70356 (Rx 10.5 kHz, Tx 12.0 kHz, release D).

b) SmartBuoy mooring.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5793 at 5 m below the surface.
Sample interval 600s.
Clock set at 17:52:36 on 12 May 2008. Delayed start 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

Sea-Bird MicroCat temperature, conductivity recorder s/n 5791 at 10 m below the surface.
Sample interval 600s.
Clock set at 17:42:00 on 12 May 2008. Delayed start 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

VEMCO Mini-logger s/n 6026E at 7.5 m below the surface set to record at 600s intervals.
Clock set at 17:59:00 on 12 May 2008. Delayed start at 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

VEMCO Mini-logger s/n 2425 at 15 m below the surface set to record at 600s intervals.
Clock set at 18:01:00 on 12 May 2008. Delayed start at 06:00:00 on 13 May 2008.
Stop time not available for cruise report.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity sensor and fluorometer). The frame was fitted with bags for the determination of bacterial degradation. The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Table 1. Recovered mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployed Time	Date
ADCP frame (Site A)	53º 32.077´	3º 21.534´	21.4	13:23	30/7/08
First attempted between 11:45-12:00 (see narrative for details)					
SmartBuoy (Site A)	53º 32.075´	3º 21.440´	22.6	12:38	30/7/08
SmartBuoy (Site B)	53º 26.970´	3º 38.284´	27.3	08:55	31/7/08

4.2 The set up of the deployed instruments was as follows:

Site A

a) Frame setup at POL prior to cruise
Waves ADCP 600 kHz RDI (S/N not noted), 1Gb memory**.**
Mode 1: 100 pings every 10 minutes (velocity standard deviation 0.007 m s^{-1}).
35 x 1 m bins (2.65 – 36.65 m above the bed).
Beam co-ordinates - speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock settings not noted.

Sea-Bird 16plus S/N 4848 on base of frame with pumped conductivity sensor underneath.
Sample interval 600s. SeaPoint turbidity sensor (S/N not noted) taped to roll bar; set up for **0 - 125 FTU range**. Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5s, 1 s delay. Aanderra optode S/N 674.
Clock settings not noted.

SonTek ADV (Acoustic Doppler Velocimeter); ADV Logger G479; head A984.
Distance from center of three prong head on ADV transmitter to deck was 1.262m (i.e. above sea bed). Red prong aligned to ADCP beam 3. Sample rate 16Hz; burst interval 3600s; samples in each burst 19200; burst length 1200s. Time reset to 14:00:00 on 29 July 2008, logging set to start at 09:00:00 on 30 July 2008.

The frame was fitted with a fizz link, a spooler with 50m of rope for recovery of the ballast weight and two Benthos releases s/n 71904 (Rx 10.0 kHz, Tx 12.0 kHz, release C) and s/n 70358 (Rx 11.0 kHz, Tx 12.0 kHz, release A).

b) SmartBuoy Mooring. (Loggers set up at POL prior to cruise)
Sea-Bird MicroCat temperature, conductivity and pressure recorder s/n 2991 at 5m below the surface. Sample interval 600s.
Clock settings not noted.

Sea-Bird MicroCat temperature and conductivity recorder s/n 2506 at 10m below the surface.
Sample interval 600s.
Clock settings not noted.

Mini-logger s/n 6020E at 7.5 m below the surface set to record at 600s intervals. Clock settings not noted.

Mini-logger s/n 6028E at 15 m below the surface set to record at 600s intervals.
Clock settings not noted.

The CEFAS SmartBuoy is fitted with one surface CTD, light sensors at 1 and 2 m below the surface, a water sampler which obtains water samples once per day for laboratory nutrient (TOXN and silicate; no filtration therefore no phosphate), fluorometer (SeaPoint), oxygen (Aanderaa Optode) and chlorophyll determination and an in situ NAS2E nutrient analyser. The CTD and light data are transmitted back to CEFAS via Orbcomm. The frame was fitted with bags of material supplied by University of Liverpool for the determination of bacterial degradation.

The single point mooring was composed of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Site B

a) ADCP frame (not deploying on this cruise)

b) SmartBuoy Mooring. (Loggers set up at POL prior to cruise)

Sea-Bird MicroCat temperature, conductivity recorder s/n 2010 at 5 m below the surface. Sample interval 600s. Clock settings not noted.

Sea-Bird MicroCat temperature, conductivity recorder s/n 4966 at 10 m below the surface. Sample interval 600s. Clock settings not noted.

VEMCO Mini-logger s/n 0142E at 7.5 m below the surface set to record at 600s intervals. Clock settings not noted.

NO VEMCO Mini-logger at 15m.

The CEFAS SmartBuoy is fitted with a surface CTD (including turbidity sensor and fluorometer). The frame was fitted with bags for the determination of bacterial degradation. The single point mooring was composed mainly of ½" long link chain, marked by a 1.8 m diameter toroid and anchored by a half tonne clump of scrap chain.

Table 2. Deployed mooring positions and times.

	Latitude (N)	Longitude (W)	Water Depth (m)	Deployed Time	Date
ADCP frame (Site A)	53º 32.096´	3º 21.562´	21.1	14:08	30/7/08
SmartBuoy (Site A)	53º 32.044´	3º 21.796´	23.0	12:28	30/7/08
SmartBuoy (Site B)	53º 26.889´	3º 38.730´	28.0	08:41	31/7/08

5. CTD

The Sea-Bird 911 CTD recorded downwelling PAR light levels, temperature, conductivity, transmittance and fluorescence at 24 Hz. The frame was fitted with an altimeter, which was in perfect working order. The CTD temperature data was checked against a Sea-Bird SBE35

precision thermometer. Water samples were taken from a near bed bottle for calibration of the CTD salinity data by Anne Hammerstein (SOS). Water samples were taken from the near surface (1m) and near bed bottles and filtered to determine suspended sediment load concentration, nutrient concentration and for CEFAS calibration. Copies of the Sea-Bird binary files were taken off for processing and calibration at BODC / POL. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system.

Bottles used: No.3 Salinity and nutrients (bottom), No.4 Suspended sediment (bottom), No.5 Cefas, No.8 Nutrients (Surface), No.9 Suspended sediment (surface), No.10 Trace metals, No.11 Cefas, No.12 Cefas.

Table 3. Nominal CTD positions. (Ss – Suspended sediments, Nu – Nutrients)

Site	Latitude (N)	Longitude (W)	Visited on this cruise	Cefas Chloropyll & Nu & Ss	Trace Metals	POL Nu	POL Ss	Grab No.
1	53º 32′	3º 21.8′	yes	yes+bottom	yes	yes	yes	1
2	53º 37′	3º 13.4′	yes		yes	yes	yes	4
3	53º 42′	3º 13.4′	yes		yes	yes	yes	5
4	53º 47′	3º 13.4′	yes		yes	yes	yes	6
5	53º 52′	3º 21.8′	yes	yes	yes	yes	yes	7
6	53º 47′	3º 21.8′	yes			yes	yes	8
7	53º 42′	3º 21.8′	yes	yes		yes	yes	9
8	53º 37′	3º 21.8′	yes			yes	yes	13
9	53º 32′	3º 21.8′	yes	yes		yes	yes	11
10	53º 27′	3º 13.4′	yes	yes		yes	yes	2
11	53º 27′	3º 21.8′	yes			yes	yes	12
12	53º 27′	3º 30.2′	yes		yes	yes	yes	13
13	53º 32′	3º 30.2′	yes		yes	yes	yes	14
14	53º 37′	3º 30.2′	yes			yes	yes	15
15	53º 42′	3º 30.2′	yes			yes	yes	16
16	53º 47′	3º 30.2′	yes			yes	yes	17
17	53º 47′	3º 47.0′	yes			yes	yes	18
18	53º 42′	3º 38.6′	yes	yes		yes	yes	19
19	53º 37′	3º 38.6′	yes			yes	yes	20
20	53º 32′	3º 38.6′	yes			yes	yes	21
21	53º 27′	3º 38.6′	yes	yes	yes	yes	yes	22
22	53º 23′	3º 38.6′	yes			yes	yes	tried
23	53º 23′	3º 47.0′	yes		yes	yes	yes	23
24	53º 27′	3º 47.0′	yes			yes	yes	24
25	53º 32′	3º 47.0′	yes			yes	yes	25
26	53º 37′	3º 47.0′	yes		yes	yes	yes	26
27	53º 42′	3º 47.0′	yes		yes	yes	yes	27
28	53º 47′	3º 47.0′	yes		yes	yes	yes	28
29	53º 47′	3º 55.4′	yes	yes	yes	yes	yes	29
30	53º 42	3º 55.4′	yes		yes	yes	yes	30
31	53º 37′	3º 55.4′	yes		yes	yes	yes	31
32	53º 32′	3º 55.4′	yes	yes	yes	yes	yes	32
33	53º 27′	3º 55.4′	yes		yes	yes	yes	33
34	53º 22′	3º 55.4′	yes		yes	yes	yes	34
35	53º 32′	3º 15.9′	yes			yes	yes	3

Surface water samples were obtained for Elena Stoica at sites 1 (CTD No.1), 21(CTD No.23) and 29 (CTD No.34). All these samples were taken from CTD bottle No. 8

Table 4. Surface and bottom parameters from CTD, noted in log book.
Note: Nutrient bottles are labelled *CruiseNo_SiteNo_S* or *B*,
e.g. *55_1_S* is nutrient bottle for Site 1 at the surface.

		Nominal positions.				
Site no	CTD no	Latitude (N)	Longitude (W)	Water depth	Temp DegC T / B	Salinity PSU T / B
1	2	53º 32′	3º 21.8′	20.0	16.9 / 16.7	32.2 / 32.2
2	5	53º 37′	3º 13.4′	12.2	17.8 / 17.5	31.4 / 31.7
3	6	53º 42′	3º 13.4′	17.8	17.4 / 17.3	32.0 / 32.0
4	7	53º 47′	3º 13.4′	18.2	17.3 / 17.3	32.1 / 32.1
5	8	53º 52′	3º 21.8′	18.0	17.1 / 17.1	32.4 / 32.4
6	9	53º 47′	3º 21.8′	23.3	16.2 / 16.2	32.9 / 32.9
7	10	53º 42′	3º 21.8′	28.2	16.6 / 15.4	32.9 / 32.9
8	11	53º 37′	3º 21.8′	29.3	16.3 / 16.2	32.6 / 32.7
9	12	53º 32′	3º 21.8′	26.1	16.5 / 15.9	32.7 / 32.8
10	3	53º 27′	3º 13.4′	12.5	17.9 / 17.8	31.6 / 31.6
11	13	53º 27′	3º 21.8′	18.6	16.6 / 16.4	32.5 / 32.6
12	14	53º 27′	3º 30.2′	17.7	16.5 / 16.5	32.5 / 32.5
13	15	53º 32′	3º 30.2′	28.9	16.4 / 15.8	32.8 / 32.9
14	16	53º 37′	3º 30.2′	27.4	16.2 / 15.8	32.8 / 32.9
15	17	53º 42′	3º 30.2′	34.4	16.5 / 15.4	32.9 / 33.1
16	18	53º 47′	3º 30.2′	22.3	16.1 / 15.8	32.8 / 33.0
17	19	53º 47′	3º 47.0′	32.5	16.5 / 15.5	32.9 / 33.1
18	20	53º 42′	3º 38.6′	37.6	16.0 / 15.1	33.0 / 33.3
19	21	53º 37′	3º 38.6′	30.0	15.6 / 15.4	33.2 / 33.2
20	22	53º 32′	3º 38.6′	35.1	15.9 / 15.0	33.2 / 33.5
21	23	53º 27′	3º 38.6′	26.5	16.4 / 15.7	32.7 / 33.2
22	26	53º 23′	3º 38.6′	19.0	16.4 / 16.2	32.8 / 32.9
23	27	53º 23′	3º 47.0′	20.1	16.2 / 16.2	33.0 / 33.1
24	29	53º 27′	3º 47.0′	34.1	15.7 / 15.2	33.4 / 33.5
25	30	53º 32′	3º 47.0′	45.0	15.5 / 14.7	33.6 / 33.7
26	31	53º 37′	3º 47.0′	40.1	15.3 / 14.9	33.4 / 33.5
27	32	53º 42′	3º 47.0′	39.7	15.6 / 14.9	33.3 / 33.5
28	33	53º 47′	3º 47.0′	38.0	15.6 / 15.1	33.3 / 33.4
29	34	53º 47′	3º 55.4′	39.7	15.5 / 14.6	33.4 / 33.7
30	36	53º 42	3º 55.4′	39.5	15.5 / 14.8	33.3 / 33.6
31	37	53º 37′	3º 55.4′	40.1	15.3 / 14.7	33.4 / 33.7
32	38	53º 32′	3º 55.4′	44.1	15.4 / 14.6	33.6 / 33.8
33	39	53º 27′	3º 55.4′	39.3	15.9 / 14.9	33.3 / 33.6
34	40	53º 22′	3º 55.4′	25.1	16.2 / 16.1	33.2 / 33.2
35	4	53º 32′	3º 15.9′	11.4	17.9 / 17.5	31.1 / 31.6

6. Surface sampling

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, Transmissance, Hull Temperature (ºC), Barometric Pressure (mbar), Fluorescence, Turbidity, Salinity, Conductivity sensor water temperature (ºC). Sea surface temperature,

salinity and transmittance were calibrated against the CTD by BODC. In addition a pCO_2 sensor is incorporated into the surface sampling system.

Met package measures and records Barometric pressure (mbar), Solar Radiation (W m^{-2}), PAR (µmols / m^2s), Air Temperature (ºC), Relative Humidity, Relative Wind Speed (m s^{-1}), Relative Wind Direction (º) – zero indicates wind on the bow, Minimum Air Temp (ºC), Maximum Air Temp (ºC), Wind Gust (m s^{-1}).

Underway data, pCO_2 and ships ADCP data were recorded every minute. The ship was fitted with a 300 kHz ADCP set to record 25 x 2m bins, the bin nearest the surface was at 5.1 m depth, every 30 seconds with 29 pings / ensemble. The systems were switched on at 07:00 on 30 July 2008 on passing Puffin Island. The ADCP and underway systems were switched off at 20:20 and the pCO_2 at 20:27 on 31 July 2008 on passing Puffin Island.

Acknowledgements
The assistance of the master, officers, and crew is appreciated in ensuring the success of this cruise.