

**RV Prince Madog 49/10 cruise report
NOC Irish Sea Observatory cruise 73
5 – 8 December**

1. CRUISE OBJECTIVES

1.1 At site A, 53° 32' N, 3° 21.8' W (CTD station 1)

To recover:

- a) A sea bed frame containing a 600 kHz RDI ADCP (measuring mean current profile, pressures and directional waves), SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor, a SeaPoint turbidity sensor with wiper, and a SeaBird SBE 16*plus* with an Aanderra oxygen Optode.

- b) CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m and 15 m below the surface. Plus a new WetLabs ACS unit and Wetlabs fluorometer on a frame at 5m.

To deploy:

- a) A sea bed frame containing a 600 kHz RDI ADCP (measuring mean current profile, pressures and directional waves), SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor, a SeaPoint turbidity sensor with wiper and SeaBird SBE 16*plus* with an Aanderra oxygen Optode.

- b) CEFAS SmartBuoy (including a new weather station system) in a single point mooring. Temperature mini-loggers are attached to the mooring wire at 7.5 m and 15 m below the surface and a SeaBird Microcat temperature and conductivity logger at 10m below the surface. A frame with a WetLabs ACS unit, Wetlabs fluorometer and SeaBird MicoCat is attached at 5m below the surface.

1.2 At 'new' site B, 53° 32.3' N, 3° 38.4' W (CTD station 20)

To recover:

- a) A sea bed frame for a 600 kHz RDI ADCP measuring mean current profile, pressures and directional waves, a SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor and a SeaPoint turbidity sensor (fitted with a wiper).

- b) A CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m, 15 m and 20 m below the surface.

To deploy

- a) A sea bed frame for a 600 kHz RDI ADCP measuring mean current profile, pressures and directional waves, a SeaBird SBE 16*plus* (with pumped conductivity sensor), digiquartz pressure sensor and a SeaPoint turbidity sensor (fitted with a wiper).
- b) A CEFAS SmartBuoy in a single point mooring. Attached to the mooring wire are SeaBird MicroCat temperature, conductivity loggers at 5 m and 10 m below the surface and temperature miniloggers at 7.5 m, 15 m and 20 m below the surface.

1.3 CTD and LISST survey

- To conduct a CTD survey including LISST measurements at 34 sites every five nautical miles covering the eastern Irish Sea to determine the effects of the rivers Dee, Mersey and Ribble on Liverpool Bay. The survey covers the area from the coast of North Wales to a line extending westwards from Blackpool, and from the Lancashire coast to a line extending northwards from Great Ormes Head.
- To obtain calibration samples for salinity, transmittance and suspended sediment at selected stations.
- To obtain near surface and bed water samples for nutrient (nitrate, phosphate, silicate), suspended sediment and chlorophyll-*a* determination. NOC Liverpool has supplied filtering equipment and filters for determining concentrations of suspended sediment and chlorophyll-*a*.
- To test an OSIL YSI CastAway CTD system

1.4 Other activities

- *Sea bed sediment analysis.* To collect sediment samples at each CTD site with a Day grab for Andy Plater (University of Liverpool).
- *Zooplankton net hauls:* To collect 10 vertical zooplankton net hauls for CEFAS at Site A

2. CRUISE PARTICIPANTS

Scientific personnel

John Kenny (Principal, NOC)
Danny McLaughlin
Terry Doyle (NOC)
Ray Edun (NOC)
Anne Forbes-Brook (Bangor University)
Naomi Greenwood (CEFAS)
Chris Read (CEFAS)

Ship's officers and crew

Eric Lloyd (Master)
Nick Davis (Chief Officer)
Gary Barnes
Mick Callaghan
Tom Roberts
Arfon Williams (Chief Engineer)
Alan Thompson (2nd Engineer)
Terry Gordon (Cook)

3. CRUISE NARRATIVE (all times in GMT)

The RV Prince Madog arrived at Queens Channel at 20:30 on 05/12/2010. Due to fog the RV prince Madog was unable to enter the lock at Birkenhead.

The RV Prince Madog arrived at Vittoria Wharf, Birkenhead at 23:30 on 06/12/2010. Loading was completed on 07/12/2010 between 07:30 and 08:30.

The Prince Madog left her berth at 09:17 on 07/12/2010. At 10:23 the ships ADCP and underway Enviro systems were switched on. The Madog went to Site A.

A pre-mooring deployment CTD was conducted at 11:51 and calibration samples taken by CEFAS. The ADCP frame at site A was recovered at 12:17 and a new frame deployed at 12:29.

At 13:07 the new SmartBuoy at site A was released. The 4m wire became tangled around the arm on deployment causing the SmartBuoy to list. The SmartBuoy was retrieved at 13:12 and the wire was untangled. During recovery the weather station antenna was damaged. The SmartBuoy was released at 13:16. The weather station antenna was not repaired prior to deployment.

The old SmartBuoy was recovered between 13:25 and 13:39.

A post-mooring deployment CTD was not conducted due to time constraints.

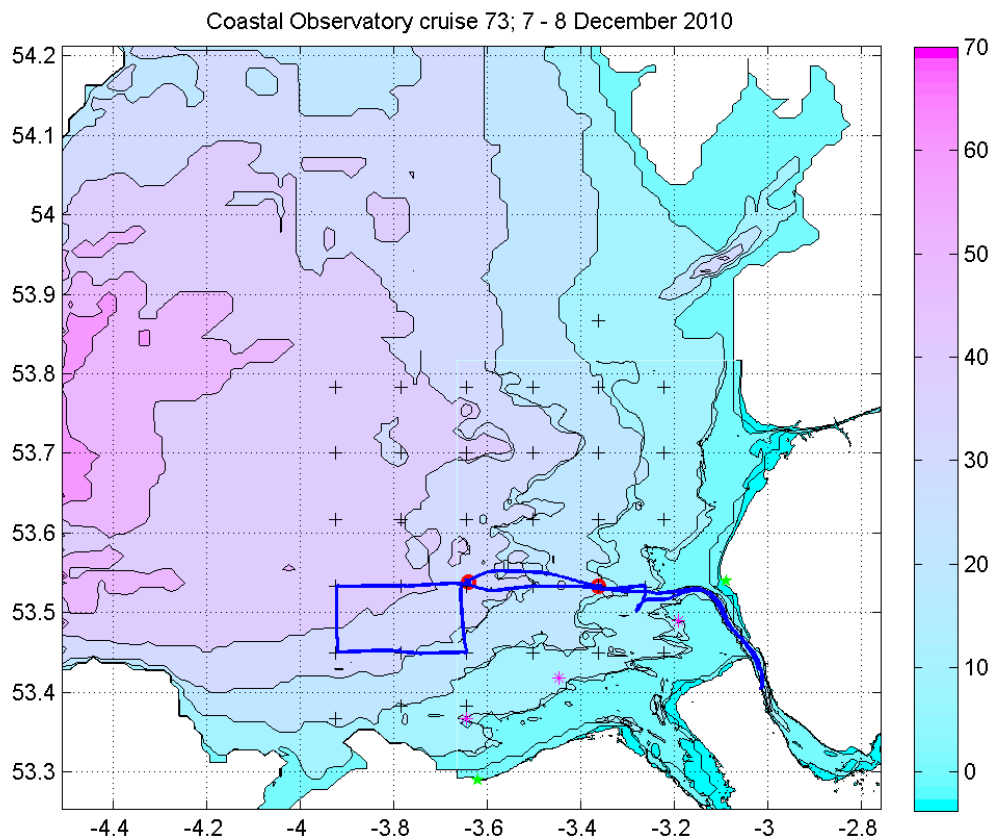
The Madog then headed west to Station 20/Site B to recover the ADCP frame and Smartbuoy.

A pre-deployment CTD cast was not recorded at Site B due to time constraints. The ADCP frame was recovered at 15:00. The new ADCP frame was deployed at 15:17. The SmartBuoy was deployed between 16:04 and 16:05. The old SmartBuoy was recovered between 16:16 and 16:31.

After the moorings work at site B and a post-deployment CTD, the CTD survey was commenced visiting stations 21,24,33,32,25,20,13,9. The CEFAS net hauls commenced at 13:00. The CTD survey commenced visiting station 35. After the last CTD the Prince Madog waited at the entrance of the Mersey before moving down the river for the allocated

time slot for the lock, the following morning. The ships ADCP and Enviro systems were switched off at 08:57 on 08/12/2010. The Prince Madog was tied up at Vittoria docks by 09:55. Unloading was completed between 10:00 and 11:00 on 08/12/2010.

Due to the RV Prince Madog being delayed at the beginning of the cruise not all CTD casts and survey tasks were completed. Both the ADCP frame and SmartBuoy at Site A, and the ADCP frame and SmartBuoy at Site B were serviced.



Coastal Observatory Cruise #73 track

4. MOORINGS

4.1 Recovered Instrumentation

Site A: Bedframe

Waves ADCP 600 kHz RDI S/N 12239: Memory 1GB

Mode 1: 100 pings every 10 minutes 35×1 m bins (2.65–36.65 m above the bed, WN035)

Beam coordinates – speeds, correlation, echo intensity, % good

Sound velocity calculated from temperature, depth and salinity of 32.

Clock set at 08:16:00 on 10/08/2010 : delayed start at 06:00:00 on 11/08/2010

Stopped logging at 08:27:25 on 30/09/2010

Clock drift was 1 minute 33 seconds over the deployment

SeaBird SBE 16plus S/N 4597

Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10471) taped to roll bar setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay.
Clock set at 14:13:00 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010.
Stopped logging at 10:30:00 on 09/12/2010
Clock drift was -17 seconds over the deployment

SeaBird SBE 16plus S/N 4741 (RS232) with Aanderaa Optode (S/N 675)
Sample interval 600 s.
Clock set at 13:48:00 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010
Stopped logging at 12:02:00 on 09/12/2010
Clock drift was +6seconds over deployment

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:
S/N 70358 (Rx=11.0 kHz, Tx=12.0 kHz, RC=A)
S/N 71922 (Rx=11.5 kHz, Tx=12.0 kHz, RC=A)

Site A: SmartBuoy Mooring

SeaBird MicroCat temperature and conductivity recorder S/N 5790
Mounted at 5 m below the surface (on frame with ACS and fluorometer)
Clock set at 15:38:00 on 27/09/10
Delayed start at 06:00:00 on 28/09/2010
Stopped logging at 12:38:10 on 08/12/2010
Clock drift was +20 seconds over the deployment

AC-S S/N 56 at 5m below surface measuring multispectral absorption and attenuation (DH4 data logger S/N 119)– attached WetLabs fluorometer S/N 1514
ACS - Clock set at 16:24:00 on 20/09/10
ACS - Delayed start at 06:00:00 on 28/09/2010
Fluorometer - Clock set at 15:19:00 on 20/09/10
Fluorometer - Delayed start at 06:20:00 on 28/09/2010
ACS - Stopped logging at 12:32:00 on 08/12/2010

SeaBird MicroCat temperature and conductivity recorder S/N 4998
Mounted at 10 m below the surface.
Clock set at 15:43:30 on 27/09/10: delayed start at 06:00:00 on 28/09/2010
Stopped logging at 13:59:40 on 09/12/2010
Clock drift was +8 seconds over the deployment

Mini-logger (StarOddi) S/N 2836
Mounted at 7.5 m below the surface. Set to record at 600s intervals.
Delayed start at 06:00:00 on 28/09/2010
Stopped logging at 14:23:05 on 09/12/2010
Clock drift was +49 seconds over the deployment

Mini-logger (StarOddi) S/N 2838
Mounted at 15 m below the surface. Set to record at 600s intervals.

Delayed start at 06:00:00 on 28/09/2010
Stopped logging at 14:38:00 on 09/12/2010
Clock drift was -6 seconds over the deployment

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1 m below surface, light sensors at 1 m and 2 m below the surface, a fluorometer (SeaPoint), oxygen sensor (Aanderaa Optode), an in-situ NAS2E nutrient analyzer and a water sampler which obtains samples every fourth day for laboratory analysis (ToxN and silicate) and every eighth day (phytoplankton species, composition and abundance). The conductivity, temperature, optical back scatter and light data are transmitted back to CEFAS via Orbcomm satellite.

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: Bedframe

Waves ADCP 600 kHz RDI S/N 5807: Memory 1GB.
Mode 1: 100 pings every 10 minutes.
45 × 1 m bins (2.65–46.65 m above the bed, WN045).
Beam coordinates – speeds, correlation, echo intensity, % good.
Sound velocity calculated from temperature, depth and salinity of 32.
Clock reset at 13:34:00 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010
Stopped logging at 11:01:15 on 08/12/2010
Clock drift was +41 seconds over the deployment

SeaBird SBE 16plus S/N 4737

Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10537) taped to roll bar; setup for 0–125 FTU range and fitted with wiper.
Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay
Clock reset at 14:21:30 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010.
Stopped logging at 11:44:50 on 09/12/2010
Clock drift was +6 seconds over the deployment

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:

S/N 70358 (Rx=11.0 kHz, Tx=12.0 kHz, RC=A)

S/N 71922 (Rx=11.5 kHz, Tx=12.0 kHz, RC=A)

Site B: SmartBuoy

SeaBird MicroCat temperature and conductivity recorder S/N 5433

Mounted at 5 m below the surface

Clock set at 15:26:00 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010.

Stopped logging at 13:54:30 on 09/12/2010

Clock drift was +12 seconds over the deployment

SeaBird MicroCat temperature and conductivity recorder S/N 4966

Mounted at 10 m below the surface
 Clock set at 15:33:50 on 27/09/2010: delayed start at 06:00:00 on 28/09/2010.
 Stopped logging at 12:36:20 on 09/12/2010
 Clock drift was +9 seconds over the deployment

Mini-logger (StarOddi) S/N 2843 mounted at 7.5 m below the surface
 Set to record at 600 s intervals
 Delayed start at 06:00:00 on 28/09/2010
 No response from logger. Faulty.

Mini-logger (StarOddi) S/N 2849 mounted at 15 m below the surface
 Set to record at 600 s intervals
 Delayed start at 06:00:00 on 28/09/2010
 Stopped logging at 14:44:30 on 09/12/2010
 Clock drift was -6 seconds over the deployment

Mini-logger (StarOddi) S/N 2852 mounted at 20 m below the surface
 Set to record at 600 s intervals
 Delayed start at 06:00:00 on 28/09/2010
 Stopped logging at 14:52:30 on 09/12/2010
 Clock drift was -6 seconds over the deployment

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter and a fluorometer at 1 m below surface. 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)	Depth (m)	Date	Time (GMT)
ADCP frame (Site A)	53° 32.049	3° 21.535	27.6	07/12/2010	12:17
SmartBuoy (Site A)	53° 32.023	3° 21.867	26.1	07/12/2010	13:36
ADCP frame (Site B)	53° 32.428	3° 38.574	34.5	07/12/2010	15:17
SmartBuoy (Site B)	53° 32.437	3° 38.283	32.4	07/12/2010	16:27

4.2 Deployed Instrumentation

Site A: Bedframe

Waves ADCP 600 kHz RDI S/N 2390: Memory 1GB

Mode 1: 100 pings every 10 minutes 35 × 1 m bins (2.65–36.65 m above the bed, WN035)

Beam coordinates – speeds, correlation, echo intensity, % good

Sound velocity calculated from temperature, depth and salinity of 32.

Clock set at 09:17:00 on 07/12/2010 : delayed start at 10:00:00 on 07/12/2010

SeaBird SBE 16plus S/N 4736

Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10320) taped to roll bar setup for 0–125 FTU range and fitted with wiper.

Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay.

Clock set at 09:37:45 on 07/12/2010: delayed start at 10:00:00 on 07/12/2010.

SeaBird SBE 16plus S/N 4490 with Aanderaa Optode (S/N 674)

Sample interval 600 s.

Clock set at 09:55:30 on 07/12/2010: delayed start at 10:15:00 on 07/12/2010.

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:

S/N 71919 (Rx=10.5 kHz, Tx=12.0 kHz, RC=C)

S/N 69676 (Rx=11.5 kHz, Tx=12.0 kHz, RC=C)

Site A: SmartBuoy Mooring

SeaBird MicroCat temperature and conductivity recorder S/N 5792

Mounted at 5 m below the surface (on frame with ACS and fluorometer)

Clock set at 09:32:00 on 07/12/2010: delayed start at 10:00:00 on 07/12/2010.

AC-S S/N 60 at 5m below surface measuring multispectral absorption and attenuation (DH4 data logger S/N 140)– attached WetLabs fluorometer S/N 5792

ACS - Clock set at 15:23:00 on 03/12/2010: delayed start at 10:00:00 on 07/12/2010.

Fluorometer - Clock set at 15:32:00 on 12/11/2010: delayed start at 10:00:00 on 07/12/2010.

SeaBird MicroCat temperature and conductivity recorder S/N 5791

Mounted at 10 m below the surface.

Clock set at 09:32:00 on 07/12/2010: delayed start at 10:00:00 on 07/12/2010.

Mini-logger (StarOddi) S/N 2840

Mounted at 7.5 m below the surface. Set to record at 600s intervals.

Delayed start at 11:00:00 on 07/12/2010.

Mini-logger (StarOddi) S/N 2841

Mounted at 15 m below the surface. Set to record at 600s intervals.

Delayed start at 11:00:00 on 07/12/2010.

Weather station

Started at 09:34 on 07/12/2010

First sample 09:40 on 07/12/2010

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter at 1 m below surface, light sensors at 1 m and 2 m below the surface, a fluorometer (SeaPoint), oxygen sensor (Aanderaa Optode), an in-situ NAS2E nutrient analyzer and a water sampler which obtains samples every fourth day for laboratory analysis (ToxN and silicate) and every eighth day (phytoplankton species, composition and abundance). The conductivity, temperature, optical back scatter and light data are transmitted back to CEFAS via Orbcomm satellite.

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: Bedframe

Waves ADCP 600 kHz RDI S/N 5806: Memory 1GB.

Mode 1: 100 pings every 10 minutes.

45 × 1 m bins (2.65–46.65 m above the bed, WN045).

Beam coordinates – speeds, correlation, echo intensity, % good.

Sound velocity calculated from temperature, depth and salinity of 32.

Clock set at 13:50:10 on 07/12/2010: delayed start at 15:00:00 on 07/12/2010.

SeaBird SBE 16plus S/N 4738

Mounted on base of frame with pumped conductivity sensor and SeaPoint turbidity sensor (S/N 10538) taped to roll bar; setup for 0–125 FTU range and fitted with wiper.

Sample interval 600 s; digiquartz integration time 40 s, range 400; pump 0.5 s, 1 s delay

Clock set at 14:04:00 on 07/12/2010: delayed start at 15:00:00 on 07/12/2010.

The frame was fitted with a fizz link, a spooler with 50 m of rope for recovery of the ballast weight and two Benthos releases:

S/N 72863 (Rx=13.5 kHz, Tx=12.0 kHz, RC=A)

S/N 72381 (Rx=11.0 kHz, Tx=12.0 kHz, RC=B)

Site B: SmartBuoy

SeaBird MicroCat temperature and conductivity recorder S/N 2506

Mounted at 5 m below the surface

Clock set at 09:45:30 on 07/12/2010: delayed start at 10:00:00 on 07/12/2010.

SeaBird MicroCat temperature and conductivity recorder S/N 5434

Mounted at 10 m below the surface

Clock set at 09:35:00 on 07/12/2010: delayed start at 10:00:00 on 07/12/2010.

Mini-logger (StarOddi) S/N 2842 mounted at 7.5 m below the surface

Set to record at 600 s intervals

Delayed start at 11:00:00 on 07/12/2010

Mini-logger (StarOddi) S/N 2848 mounted at 15 m below the surface

Set to record at 600 s intervals

Delayed start at 11:00:00 on 07/12/2010

Mini-logger (StarOddi) S/N 2851 mounted at 20 m below the surface
 Set to record at 600 s intervals
 Delayed start at 11:00:00 on 07/12/2010

The CEFAS SmartBuoy is fitted with sensors for conductivity, temperature and optical back scatter and a fluorometer at 1 m below surface. 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)	Depth (m)	Date	Time (GMT)
ADCP frame (Site A)	53° 32.054	3° 21.504	27.3	07/12/2010	12:29
SmartBuoy (Site A)	53° 31.842	3° 21.703	26.9	07/12/2010	13:06
ADCP frame (Site B)	53° 32.428	3° 38.574	34.5	07/12/2010	15:17:00
SmartBuoy (Site B)	53° 32.218	3° 38.282	34.0	07/12/2010	16:05:00

5. CTD

The SeaBird 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 SeaBird SBE35 precision thermometer. A Satlantic SUNA nitrate analyzer was fitted to the CTD. The SUNA nitrate analyzer was not working throughout the duration of the cruise. A LISST-100X particle sizer with internal logging was also attached to the CTD frame.

Water samples were taken by Anne Forbes-Brook (Bangor University) near the sea bed (3m above bottom) for calibration of the CTD salinity. Water samples were taken from the near surface (1 m) and near bed (3 m above bottom) to determine: suspended sediment load (filtered), chlorophyll-a concentration (filtered), nutrients (nitrate, phosphate, silicate), and ammonia oxidation/nitrification rates. Near surface (1m) samples were also taken for alkalinity (Defra) and for CEFAS calibration (chlorophyll, suspended sediment load, nutrients, salinity).

The bottle positions on the rosette were

Near bed:

- Bottle 3 – SPM/chlorophyll
- Bottle 4 – Nutrients
- Bottle 5 – Cefas

Near surface:

Bottle 8 – SPM
Bottle 9 – Nutrients and pH;
Bottle 10, 11 – Cefas

6. SURFACE SAMPLING

The intake of the surface sampling system is located about 3 m below the water line of RV Prince Madog. The parameters recorded every minute by the WS Oceans system are: date, transmittance, hull temperature ($^{\circ}\text{C}$), barometric pressure (mbar), fluorescence, oxygen concentration, turbidity, salinity, conductivity and water temperature ($^{\circ}\text{C}$). A met package measures and records barometric pressure (mbar), solar radiation (W m^{-2}), PAR (photosynthetically active radiation, $\mu\text{mol m}^{-2} \text{s}^{-1}$), air temperature ($^{\circ}\text{C}$), relative humidity, relative wind speed (m s^{-1}), relative wind direction ($^{\circ}$) with zero indicating wind on the bow, minimum air temperature ($^{\circ}\text{C}$), maximum air temperature ($^{\circ}\text{C}$) and wind gust (m s^{-1}).

The ship was fitted with a 300 kHz ADCP set to record current velocity 25×2 m bins (bin nearest the surface at 5.1 m depth), every 30 s with 29 pings per ensemble.

Underway data and ship's ADCP data were recorded between 10:23 on 07/12/2010 and 08:57 on 08/12/2010.

Acknowledgements

The assistance of the master, officers and crew of the RV Prince Madog and all scientists is appreciated in ensuring the success of this cruise.

Table 3. Nominal CTD positions, stations visited and samples taken

Station	Latitude (N)	Longitude (W)	Sediments & chl-a	Nutrients top+bot	Grab #	CEFAS
1(A)&9	53° 32.0'	3° 21.8'	Yes	Yes	9	Yes
13	53° 32.0'	3° 30.2'	Yes	Yes	8	Yes
20(B)*	53° 32.3'	3° 38.4'	Yes	Yes	1,7	Yes
21*	53° 27.0'	3° 38.6'	Yes	Yes	2	Yes
24	53° 27.0'	3° 47.0'	Yes	Yes	3	Yes
25	53° 32.0'	3° 47.0'	Yes	Yes	6	Yes
32	53° 32.0'	3° 55.4'	Yes	Yes	5	Yes
33	53° 27.0'	3° 55.4'	Yes	Yes	4	Yes
35	53° 32.0'	3° 15.9'	Yes	Yes	10	Yes

*Before cruise 66 (26/01/2010), Stn 21 was referred to as Site B and Stn 20 was at 53° 32.0' N 3° 38.6' W