

## RESEARCH VESSEL PROGRAMME

### RV CEFAS ENDEAVOUR Survey: C END 11 - 2023

#### STAFF:

Name	Role	Name	Role
Izzy Lake	SIC	Rosalyn Putland	2IC in training/ Noise Landers/ Water Sampling
Peter Hamstead	2IC in training/Water Sampling	Matt Brown	Deck lead
Axa Molina- Ramirez	Deck support	Tom Hull	Deck support/ data manager
Elise Brabben	Water Sampling; Chemical lead	Camille Visinand	Deck support
Veronique Creach	Flow Cytometer	Tim Green	Shadowing all
Neil Morris	Shadowing all	Freya Mickleburgh	Water Sampling
Uwe Posner	Ferrybox (Jena) Engineer	Steffen Juttner	Ferrybox (Jena) Engineer

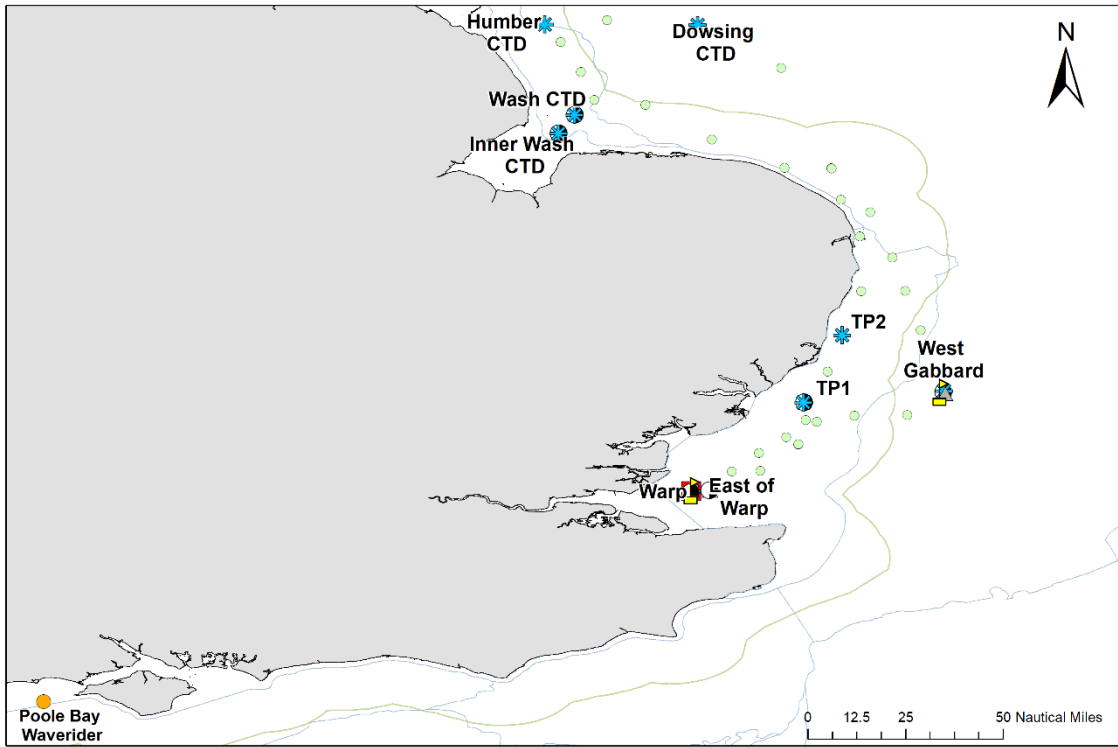
**DURATION:** 31<sup>st</sup> July to 2<sup>nd</sup> August 2023.

30<sup>th</sup> July: boarding in Lowestoft from 13:00, induction at 14:00






31<sup>st</sup> July: Pilot booked and sailing from Lowestoft at 06:15.

02<sup>nd</sup> August: docking in Lowestoft at 23:00

03<sup>rd</sup> August: Disembark at 11:30.



**Cend 11/23 Plan**

-  SmartBuoy
-  Noise Lander
-  Zooplankton
-  UW
-  CTD/Profiler
-  Secchi Disk
-  Waverider

**LOCATION: England**

Station #	Latitude	Longitude	Station
1	51.52869	1.043896	Warp Zooplankton
2	51.53338	1.051922	Warp CTD
3	51.53277	1.045888	Warp Noise Lander Clump Deployment
4	51.5332	1.045326	Warp Noise Lander Deployment
5	51.53314	1.049378	Warp SmartBuoy Deployment
6	51.53503	1.056396	Secchi Disk
7	51.5331	1.1265	East of Warp Zooplankton
8	51.6973	1.356655	UW
9	51.82844	1.660016	UW
10	51.84342	2.005785	UW
11	51.95215	2.111434	West Gabbard SmartBuoy
12	51.95228	2.111698	WG02 Zooplankton
13	51.95187	2.118968	West Gabbard CTD
14	52.19434	1.689969	TP2
15	52.19434	1.689969	Secchi Disk
16	51.90932	1.525894	UW
17	51.91004	1.526797	TP1
18	51.91228	1.527899	Secchi Disk
19	50°38.000N	1°43.16 W	Poole Waverider
20	51.4967	1	CSEMP 466 Grab Station

SB- SmartBuoy; WR-Waverider, UW-underway/continuous flow/FerryBox sampling;  
WG- West Gabbard;

**AIMS:**

3-day survey to exchange 2 SmartBuoys, 1 Noise Lander, 1 Waverider and collect water samples and zooplankton samples on transit in the North Sea and English Channel.

1. Service SmartBuoy at West Gabbard (GIA06D) 1 day
2. Service Noise Lander at Warp (GIA06H) 0.5 days
3. Service SmartBuoy at Warp (GIA03D) 0.5 days
4. Service Waverider at Poole (C6029A) 1 day
5. Continuous flow/underway water sampling as required on various transects
6. CTD Rosette water sampling as required on various transects
7. Secchi disk deployment and Forel Ule sampling as required on various transects
8. Collection of zooplankton sample at West Gabbard
9. Collection of zooplankton sample Warp
10. Collection of zooplankton sample East of Warp
11. \*\* Low priority: Grab station at CSEMP 466 (51.4967, 1.000)

**All timings in UTC (GMT).**

**Narrative:**

**Day 1. 31<sup>st</sup> July 2023**

Pilot boarded at 05:15 and the RV Cefas Endeavour was on its way to the first station by 06:25. At 08:30 scientists proceeded to start 2-hourly underway water sampling from the flowthrough system for the survey. The collected surface seawater samples will be analysed in the lab for salinity, chlorophyll, Suspended Particulate Matter (SPM), Coloured Dissolved Organic Matter (CDOM) and nutrient (phosphate, nitrate, nitrite, silicate and ammonia) concentrations. At 09:30 scientists and crew undertook an abandon ship drill. We were joined by Neil Morris and Tim Green this trip, who were happy to demonstrate how to get into an immersion suit for the rest of the crew.



Figure 1. Tim Green (Left) and Neil Morris (Right) in immersion suits following an abandon ship drill for all crew on the RV Cefas Endeavour.

Following the abandon ship drill was the pre-survey brief with both scientific and ship crew. The entire survey plan is discussed at this point, for example our original aims changed as we were no longer servicing the Dowsing Noise Lander, and instead will be deploying a Waverider at our Poole site due to it going out of position earlier in the month. Due to this, northern CTD stations (Humber and Wash) were sampled on CEND 10/23.

Two flow cytometers were brought on board to measure phytoplankton communities and run set-up and comparison tests. The flowthrough system and electrical connection were tested with the old flow cytometer in the CTD Annex and its performances were tested with discrete samples.

The first successful side gantry deployments of the survey occurred at 12:00 at the West Gabbard SmartBuoy station. Firstly, the zooplankton ring net (0.5 m, 200µm mesh) was deployed to collect zooplankton samples which are preserved for analysis to be undertaken at the lab to assess community assemblage and diversity. This was followed by the pre-recovery CTD Rosette with twelve 10 L niskins at 12:15 to collect bottom and surface seawater samples. These seawater samples are to analyse for dissolved oxygen (3 x samples collected from surface, 3 x bottom); nutrients (1 x surface, 1 x bottom); chlorophyll (3 x surface); suspended particulate matter (SPM) (1 x surface, 1 x bottom); salinity (1 x surface, 1 x bottom); Coloured Dissolved Organic Matter (CDOM) (1 x surface); and Phytoplankton (1 x surface). These samples can stand alone to contribute to eutrophication assessment but can also be used to calibrate sensors on the SmartBuoy and FerryBox, increasing the valid spatial coverage of relevant assessment parameters autonomously measured throughout the survey. However, the CTD lost communication in the surface water due to a cabling issue and therefore it was brought back on deck immediately. The crew switched over to the ESM2 CTD profiler which has a single 10 L niskin on, this is deployed on two separate occasions to collect bottom, and then surface water to measure the same parameters as the CTD Rosette. ESM2 bottom sample was collected at 12:50, and surface at 13:10. Sampling with the ESM2 CTD profiler reduces the sampling ability and quality of results and is not the preferred method of water sampling at SmartBuoy locations, but it still provides a profile of the water column.



Figure 2. RV Cefas Endeavour deck crew ready to deploy the zooplankton net (left). Also pictured is the CTD Rosette (left) which was not used this survey due to a cabling issue. ESM2 CTD profiler (right) was deployed with a 10 L niskin.

Once the side gantry deployments were completed, we changed to stern gantry deployments for the West Gabbard SmartBuoy. The RV Cefas Endeavour was in position arrived at the West Gabbard SmartBuoy site (51.952, 2.111 E) at 14:00. The West Gabbard SmartBuoy was recovered at 14:05 (51.9528, 2.1119 E). The clump was recovered at 14:30 (51.952, 2.112 E). The SmartBuoy and clump were deployed at 15:30 (51.952, 2.111 E). Two post-deployment ESM2 dips were deployed at 15:35 and 15:45 to collect bottom and surface water.

After West Gabbard operations were completed, we steamed through the English Channel assessment areas through the evening and overnight to the Poole Waverider station whilst taking hourly underway samples from the Ferrybox flowthrough system.



Figure 3. West Gabbard SmartBuoy recovery

### **Day 2. 1<sup>st</sup> August 2023**

The SiC usually goes up to the bridge before breakfast to catch up with the Chief Mate to discuss any issues that may have occurred over the night. Additionally, at 08:00 the SiC catches up with the Master and Navigation Officer to discuss the planned route and operations for the day ahead.

Water sampling scientists began analysing the dissolved oxygen concentrations of bottom and surface seawater samples taken at the West Gabbard SmartBuoy station onboard whilst also continuing to take hourly underway stations up until and including at the Poole Waverider site at 11:00. We tried to recover the previous buff and clump, however it was not recoverable due to the current and tide. We would have to return at

slack tide to recover the previous buff/rope and clump. At 11:40 the Poole Waverider was deployed at 50.633, -1.718 W. The RV Cefas Endeavour finish operations by 11:45 and we started our steam towards the East of Warp Zooplankton station.



Figure 4. The Poole Waverider on the back deck ready for deployment

Underway water sampling resumed for the steam through the English Channel towards the Warp sampling sites for arrival tomorrow morning.



### Day 3. 2<sup>nd</sup> August 2023

The RV Cefas Endeavour arrived at the East of Warp Zooplankton site for 04:00 for water sampling scientists to undertake a dip. We proceed further to CSEMP 466 for a day grab. This site was added to our list of aims as a previous survey (CEND 10/23) could not complete it and we were passing by. The location was moved less than half a nautical mile to the Northeast to avoid a cable line. At 05:00 the survey team carried out a toolbox talk followed by 3 Day Grab drops (51.503, 1.011 E) to collect sediment samples for PSA, Metals, Organics, Porosity, Sediment Chlorophyll, Microtoxicology, Microplastics and eDNA analysis back at our Lowestoft and Weymouth laboratories for the Clean Seas Environmental Monitoring Programme.



Figure 5. The Day Grab at the side gantry used to collect sediment samples.

At 07:00 we had arrived at the Warp SmartBuoy station. A zooplankton dip was completed at 07:00 using the 0.5m, 200  $\mu$ m ring net. At 07:15 the water samplers and deck crew deployed the ESM2 profiler with the 10 L niskin bottle to also collect pre-deployment bottom and surface water samples.

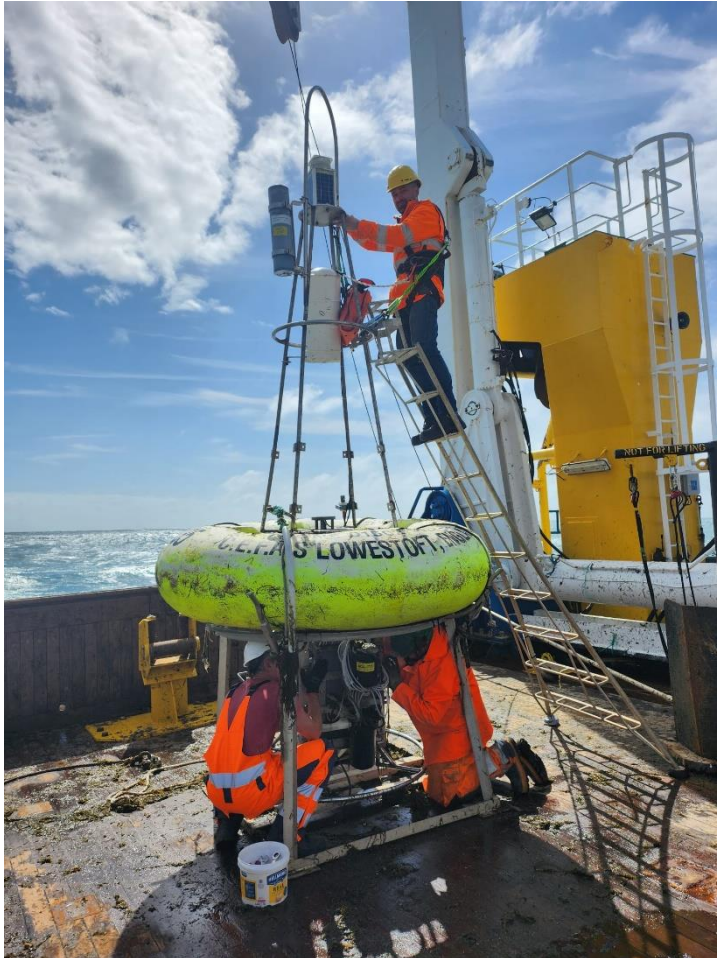


Figure 6. Dismantling a recovered SmartBuoy.

A toolbox talk was carried out in the wet lab for the recovery and deployment of the Warp SmartBuoy and Noise Lander. Once this was finished, the ship got into position by 07:55 and at 08:00 the Noise Lander clump was recovered. The Lander wire dropped back into the sea and therefore we did two grapple attempts to recover. On the second grapple, the wire was recovered, and the Noise Lander was recovered and back on board by 08:55. The SmartBuoy was recovered at 09:35 and clump at 09:40. Once recovery operations were finished, we situated ourselves to deploy the new Warp SmartBuoy and the ship was in position by 10:15.

At 10:25 the Buoy and clump were deployed (51.533, 1.049 E). Afterwards we got into position and deployed the Noise Lander at 11:35 (51.532, 1.046 E), and at 11:56 deployed the clump (51.532, 1.044 E). Post-deployment ESM2 CTD profiler bottom and surface dips were collected at 12:15 and finished by 12:30. The Eye on Water App was used to collect the seawater surface colour in replacement for the Secchi Disk and Forel Ule colour chart. The RV Cefas Endeavour began the steam back to Lowestoft port via positions TP 1 and TP 2, two points within the Thames Plume assessment area in which water samples are taken. Hourly underway water samples were taken on

this route. The Cefas scientists cleaned down the gear on the back deck and packed away the gear during our transit back to Lowestoft. Sampling finished at 19:00 with the final underway water sample being collected and the Pilot boarded at 21:30 to take us into Lowestoft Port.

#### **Day 4. 03<sup>rd</sup> August 2023**

The scientific crew finished packing in the morning in preparation for a smooth demobilisation process. Gear and samples were demobbed and returned to either Pinbush or Lowestoft labs by 11:30.

Scientists disembarked by 11:00 and the SIC, and 2ICs in training met with the Master, Chief Officer, Marine Operations management team and AW management to have a debrief on board at 10:00.

**RESULTS: In relation to the above-mentioned Aims:**

3 day survey to exchange 2 SmartBuoys, 1 Noise Lander, 1 Waverider and collect water samples and zooplankton samples on transit in the North Sea and English Channel.

1. Service SmartBuoy at West Gabbard (GIA06D) 1 day
2. Service Noise Lander at Warp (GIA06H) 0.5 days
3. Service SmartBuoy at Warp (GIA03D) 0.5 days
4. Service Waverider at Poole (C6029A) 1 day
5. Continuous flow/underway water sampling as required on various transects
6. CTD Rosette water sampling as required on various transects – **ESM2 CTD Profiler used as back up.**
7. Secchi disk deployment and Forel Ule sampling as required on various transects – **Not completed, Eye on Water App used at SmartBuoy sites.**
8. Collection of zooplankton sample at West Gabbard
9. Collection of zooplankton sample Warp
10. Collection of zooplankton sample East of Warp
11. \*\* Low priority: Grab station at CSEMP 466 (51.4967, 1.000)

The detailed breakdown of equipment deployed, and samples collected for analysis can be found in Table 1.

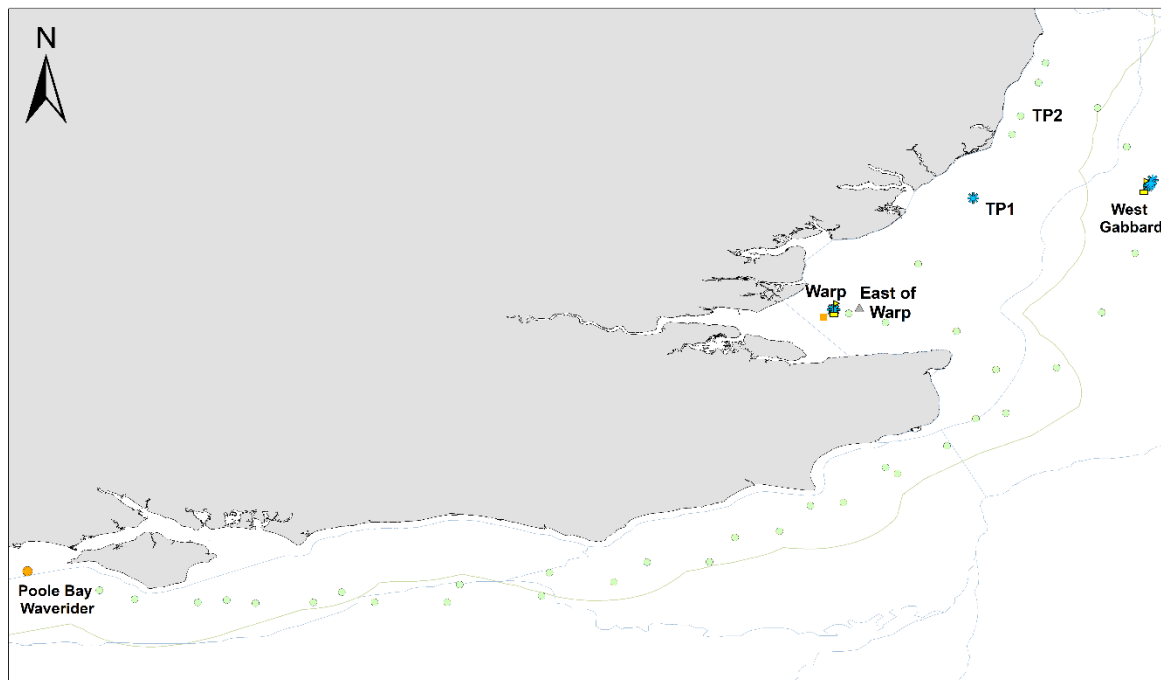
Table 1. Summary of sample collections including deployments and recoveries of gear. (UW = underway water sample, ESM2 = CTD profiler)

STN #	Date	Time	Latitude	Longitude	Gear	Analytic
1	07:59	31/07/2023	52.222	1.950	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
2	08:59	31/07/2023	52.088	2.050	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
3	11:42	31/07/2023	51.950	2.119	ZP	West Gabbard Zooplankton
4	11:59	31/07/2023	51.951	2.119	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
5	12:49	31/07/2023	51.957	2.126	ESM2	West Gabbard Bottom Pre-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM)
6	13:08	31/07/2023	51.973	2.139	ESM2	West Gabbard Surface Pre-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 3 x Chlorophyll, 1 x SPM)
7	14:06	31/07/2023	51.953	2.112	SB_REC	West Gabbard SmartBuoy Recovery
8	14:27	31/07/2023	51.953	2.112	CL_REC	West Gabbard SmartBuoy Clump Recovery
9	15:28	31/07/2023	51.953	2.112	CL_DEP	West Gabbard SmartBuoy Deployment
10	15:44	31/07/2023	51.954	2.126	ESM2	West Gabbard Bottom Post-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM)
11	15:59	31/07/2023	51.962	2.133	ESM2	West Gabbard Surface Post-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 3 x Chlorophyll, 1 x SPM)
12	17:31	31/07/2023	51.724	2.079	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
13	18:32	31/07/2023	51.521	1.965	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
14	19:30	31/07/2023	51.331	1.810	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
15	20:30	31/07/2023	51.176	1.636	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
16	21:31	31/07/2023	51.063	1.434	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
17	22:30	31/07/2023	50.969	1.264	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
18	23:29	31/07/2023	50.870	1.079	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
19	00:29	01/08/2023	50.772	0.860	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
20	01:29	01/08/2023	50.666	0.620	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
21	02:36	01/08/2023	50.597	0.292	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
22	03:25	01/08/2023	50.549	0.044	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
23	04:35	01/08/2023	50.528	-0.280	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
24	05:30	01/08/2023	50.528	-0.528	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM



25	06:28	01/08/2023	50.527	-0.738	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
26	07:28	01/08/2023	50.524	-0.936	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
27	08:29	01/08/2023	50.527	-1.135	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
28	09:59	01/08/2023	50.568	-1.471	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
29	11:07	01/08/2023	50.634	-1.720	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
30	11:38	01/08/2023	50.634	-1.718	WR	Poole Waverider Deployment
31	13:27	01/08/2023	50.538	-1.351	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
32	15:02	01/08/2023	50.535	-1.036	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
33	16:35	01/08/2023	50.562	-0.641	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
34	17:59	01/08/2023	50.588	-0.236	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
35	18:59	01/08/2023	50.629	0.071	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
36	20:00	01/08/2023	50.665	0.406	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
37	21:00	01/08/2023	50.750	0.707	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
38	21:58	01/08/2023	50.858	0.966	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
39	22:59	01/08/2023	50.990	1.224	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
40	00:08	02/08/2023	51.156	1.533	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
41	01:00	02/08/2023	51.325	1.602	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
42	01:58	02/08/2023	51.456	1.467	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
43	03:01	02/08/2023	51.486	1.224	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
44	03:52	02/08/2023	51.518	1.097	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
45	04:08	02/08/2023	51.537	1.134	ZP	East of Warp Zooplankton
46	05:09	02/08/2023	51.504	1.011	DG	CSEMP 466 Day Grab
46	05:20	02/08/2023	51.504	1.011	DG	CSEMP 466 Day Grab
46	05:27	02/08/2023	51.504	1.011	DG	CSEMP 466 Day Grab
47	06:57	02/08/2023	51.527	1.040	ZP	Warp Zooplankton
48	07:08	02/08/2023	51.530	1.043	ESM2	Warp Bottom Pre-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM)
48	07:26	02/08/2023	51.530	1.049	ESM2	Warp Surface Pre-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 3 x Chlorophyll, 1 x SPM)
49	07:59	02/08/2023	51.532	1.046	NLCL_REC	Warp Noise Lander Clump Recovery
50	08:53	02/08/2023	51.532	1.045	NL_REC	Warp Noise Lander Recovery
51	09:33	02/08/2023	51.533	1.049	SB_REC	Warp SmartBuoy Recovery

52	09:41	02/08/2023	51.533	1.049	CL_REC	Warp SmartBuoy Clump Recovery
53	10:24	02/08/2023	51.533	1.049	SB_DEP	Warp SmartBuoy and Clump Deployment
54	11:35	02/08/2023	51.532	1.047	NL_DEP	Warp Noise Lander Deployment
55	11:56	02/08/2023	51.533	1.045	NLCL_DEP	Warp Noise Lander Clump Deployment
56	12:06	02/08/2023	51.529	1.042	ESM2	Warp Bottom Post-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM)
56	12:34	02/08/2023	51.530	1.047	ESM2	Warp Surface Post-ESM2 (3 x Oxygen, 1 x Salinity, 1 x Nutrients, 3 x Chlorophyll, 1 x SPM)
57	14:02	02/08/2023	51.6866	1.3351394	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
58	15:14	02/08/2023	51.9122	1.5236621	ESM2	TP1 (Surface: 3 x Oxygen, 1 x Salinity, 1 x Nutrients, 3 x Chlorophyll, 1 x SPM)
59	16:27	02/08/2023	52.1303	1.6572184	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
60	16:51	02/08/2023	52.1942	1.6862701	UW	TP2 (1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM)
61	17:54	02/08/2023	52.308	1.7479374	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM
62	18:59	02/08/2023	52.3752	1.7715599	UW	1 x Salinity, 1 x Nutrients, 1 x Chlorophyll, 1 x SPM



**CEND 11/23 Stations**











-  SmartBuoy
  Waverider
 Underway water sample
 COMP4 Assessment Areas
-  Noise Lander
 ESM2
 Zooplankton
 12 nm limit
-  Day Grab
 UK Coastline

Figure 7. Locations of deployments and sampling undertaken by the RV Cefas Endeavour on CEND 11/23 in from 31/07/2023 to 02/08/2023.

**Gear:**

See Gear List

Scientist in Charge: Izzy Lake

Date: 03/08/2023

Second Scientist in Charge: Rosalyn Putland and Peter Hamstead

**DISTRIBUTION:**

BODC

MIST

AW

Cefas Staff