

Revifes (64PE485) Borkum reef grounds

Cruise report

01-10 April 2021, RV Pelagia

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Texel, 8 June 2021



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Introduction

This cruise was carried out for the ReViFES project. The rationale behind this cruise and project is to find out what the scale of ecosystem services of reef structures are in the North Sea. The focal area was the Borkum Reef grounds on the border of the Dutch - German continental shelf, situated approximately 20 km offshore (north) from the island of Schiermonnikoog. In 2018 WWF started an experiment in this area by creating a man made European flat Oyster reef on an area of 100 × 100 m. Close to the site of the man-made oyster reef is a small rocky reef and a well developed *Lanice conchilega* reef. Aim of the project is to compare biodiversity and ecosystem functioning of these reef structures to the surrounding area without reef like structures.

Due to the COVID-19 crisis, the number of scientists on board was limited to 5.

Equipment & Sample sharing

The main equipment used during this cruise was the HD video Hopper frame, Box corer, Hamon grab, CTD, "Crab cages", WP-2 plankton net and box corer incubation system. Furthermore two Nortek signature (500 and 1000 types) were tested for future use. In figure 1 the research areas are indicated in the map. In figure 2 the overall cruise track is given. In figure 3 a more detailed cruise track in the research area together with all sample operations is plotted.

List of Participants

Table 1: list of participants and their role.

	Who	Institute	Role
1	Caterina Coral	NIOZ	PhD.
2	Joop Coolen	WUR (NIOZ-Guest)	PI, Cruise leader
3	Anton Tramper	NIOZ	Technician
4	Leandra Kornau	WUR (NIOZ intern)	Student
5	Evaline van Weerlee	NIOZ	Technician
6	Yvo Witte	NIOZ	NMF support

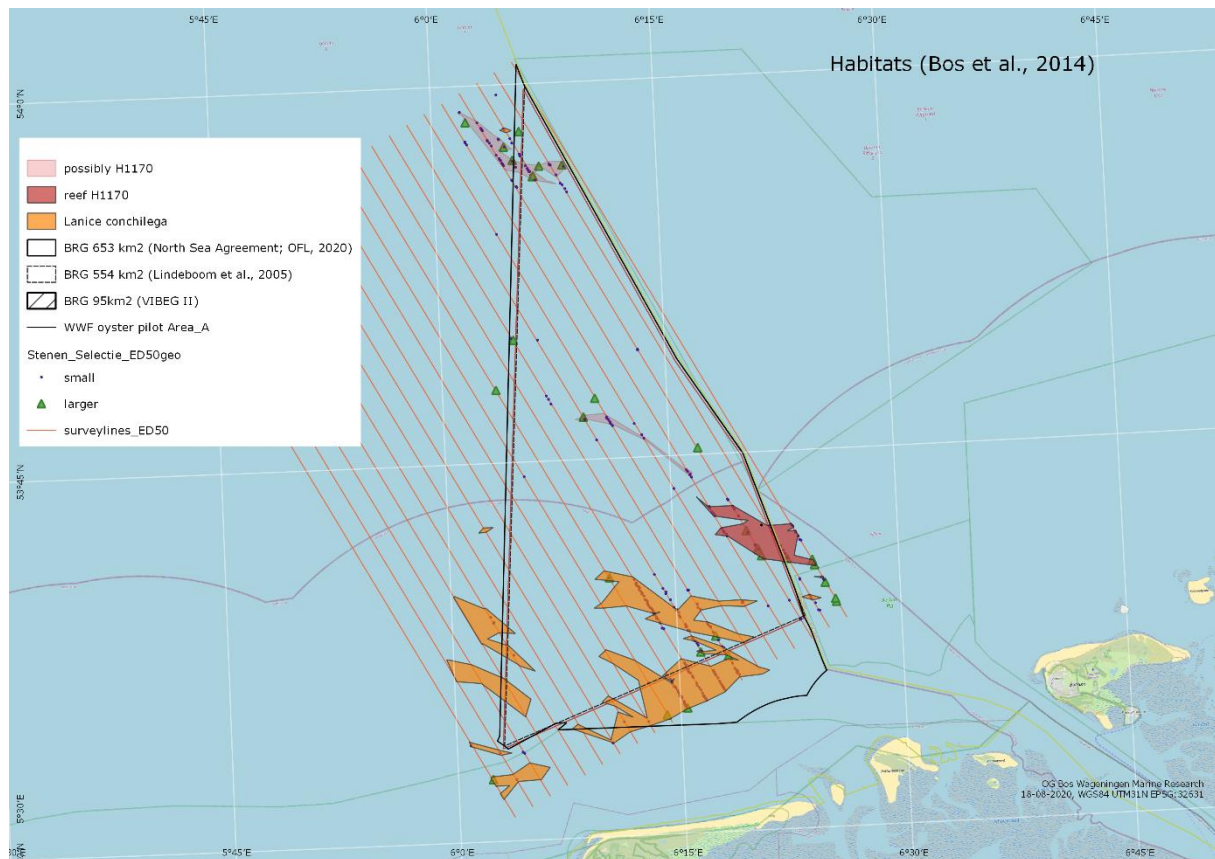


Figure 1. Overview of the Borkum Stones area, situated north of the isle of Schiermonnikoog.

Verbal account of the activities

Station numbers reported are as stored in the Pelagia CASINO system. It was decided to give each consecutive station an increasing station number and samples within a station a cast number. Notation of samples is made easy as for example the cruise number followed by station number and cast number enables reference to all details in the CASINO logbook. During this cruise we had 187 unique sampling operations (casts) which are identified as 64PE485#001_1 to 64PE485#116_1 (Table 10). The Pelagia log time in the CASINO system was in UTC which is 2 hours earlier than the actual (Dutch) time at the start of the cruise.

Day 1 – 1 April 2021.

We set sail shortly after lunch and left the harbor of Texel at 13:50 local time (CET). Weather was winds with 5-6 bft and visibility was good and transit time was used to prepare the crab cages on deck and organize the laboratory setups. We received great help from the crew.

Day 2 - 2 April 2021.

Weather was 5-6 bft with 2 meter waves. In the morning we collected six K2 box corer samples for incubations from the reference area. The incubations were started soon after the collection of bottom water with the CTD was finished. With CTD we measured profiles and collected surface and bottom water. The water was processed for nutrients, SPM, wPOM, pH, DIC and alkalinity analysis. In the afternoon the eight fish cages were placed, including the new whelk pots. All cages and pots were baited with canned mackerell placed in thin meshed nets. Each area received a pair of cage

sets. At the end of the day the Marsdiep lander mounted with the Nortek Signature 1000 was placed in the reference area.

Day 3 - 3 April 2021.

Weather was 5-6 bft with 2 meter waves. In the morning we collected 6 K16 box cores from the reference area and 5 from the oyster area, using a camera mounted on the box corer with live feed on deck to target areas with high *Lanice* densities in the oyster area. From the water above the sediment in the core, water was collected for xPOM stable isotope analysis. Then the cores were photographed and sub sampled for sediment composition and carbon content of the bottom, the sediment surface measured with the benthos-torch and the remainder sieved on a 2 mm mesh size sieve, then organisms collected which were processed for stable isotope analysis.

In the afternoon the cages and Marsdiep lander were recovered. The catches in the cages (mostly crustaceans) were measured and weight and tissue collected for stable isotope analysis. Cage number 7 was not recovered since the marker buoy was missing. This was left in place to be recovered by dredging later in the cruise.

At the end of the day the Marsdiep lander mounted with the Nortek Signature 1000 was placed in the oyster area.

Day 4 - 4 April 2021.

Weather was 4 bft with 1.5 meter waves. In the morning we collected a CTD water sample and six K2 box corers from the oyster-*lanice* area to be incubated, again using the box corer mounted camera to target high *Lanice* densities. In the afternoon video transects were carried out around the *lanice* area and around the rock area.

At the end of the day the Marsdiep lander mounted with the Nortek Signature 1000 was recovered. It was not deployed again since the weather forecast for the following days was poor.

Day 5 - 5 April 2021.

Weather was 6-7 bft with 3 meter waves, increasing to 4 meter in the afternoon. Five zooplankton samples were taken in each area and in the afternoon the incubations from the oyster-*lanice* area were rinsed and conserved. No further sampling activities were undertaken due to poor weather conditions.

Day 6 - 6 April 2021.

Weather was 7-9 bft with 5 m waves. It was unsafe to perform sampling so this day no sampling activities were carried out.

Day 7 - 7 April 2021.

Weather was 7 bft with 3-4 meter waves. Six box corers each with the K16 were collected from the *lanice* area and from the rock area. It was not possible to mount the camera on the box corer due to poor weather so the samples were taken blind. This resulted in a very low number of *Lanice* in the *lanice* area corers and gravelly sediments in about half the cores from the rock area. The battery of the benthos-torch failed after analysing the *lanice* area cores, so not all benthos-torch measurements for the rock area could be taken.

Day 8 – 8 April

Weather was 7 bft with 3 meter waves. We collected a CTD from the rock area and started taking K2 box cores for incubations. This was initially done with the camera mounted on the box corer but the water was extremely turbid (likely due to the storm the previous days) so visibility was zero near the bottom. The camera was taken off and box corers taken 'blind'. This failed several times due to gravel and rocks getting stuck between the core and knife. After 8 attempts we had obtained 4 cores, which were incubated. Then box coring was stopped and we started the recovery of the cage that lost its surface marker buoy.

In the afternoon 7 out of 8 cages were placed again in all areas (1 in Lanice) and the Marsdiep lander was placed in the rocky area.

Day 9 – 9 April

Weather was 4-5 bft with 2.5 meter waves. In the morning we tested the newly built Hamon grab with four samples in the rock area and 6 in the reference area, species were picked from the samples for stable isotope analysis. In the afternoon we recovered all the cages and the lander.

Then the return journey started.

Day 10: The ship arrived back in port at 9:00 local time and the equipment was demobilised from the vessel.



Figure 2. Cruise track to, from and in the area. All sampling took place within an area of approximately 5 km².

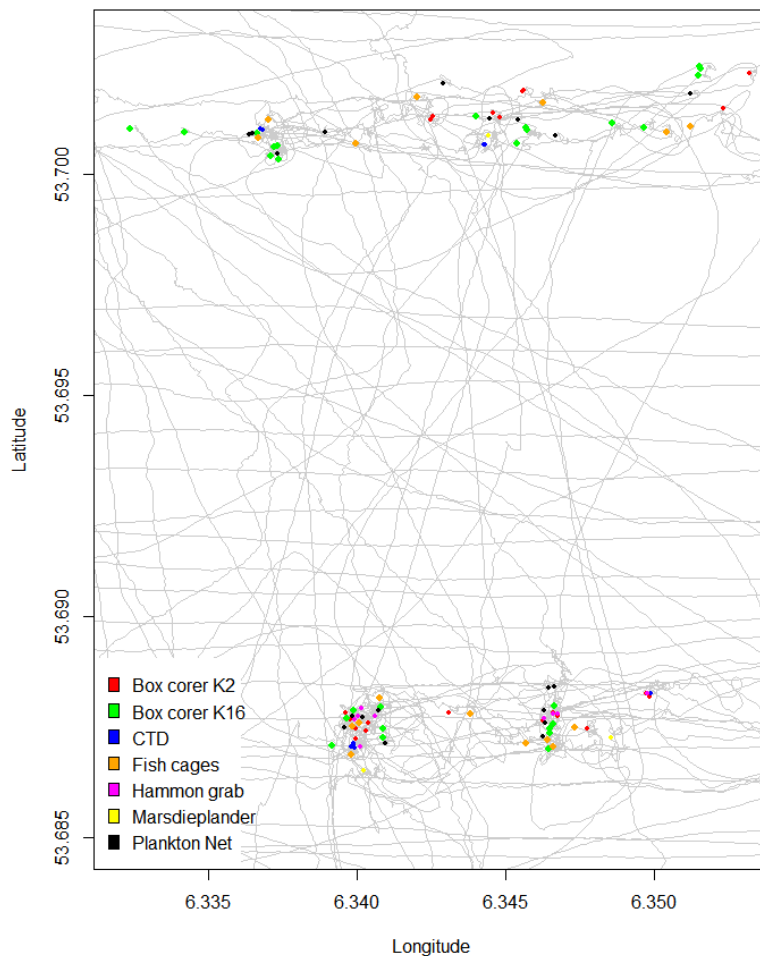


Figure 3. Summary of all sampling operations with the array of gears, indicated by color. The grey lines indicate ship movements in the area. The regular west-east tracks are the tracks during the multibeam scan of the seabed.

Underwater video.

The first days the waves were too high to perform video transects. These were only performed on day 4. Like the september 2020 cruise, before we started we adjusted the times of our laptops as good as we could do and used the “pelnav” software time as leading.

Then the video transects were started using the NIOZ hopper frame. Weather condition was moderate to good. Speed at which the footage was taken was about 0.4-0.8 knots.

The water was quite turbid initially but this improved later in the day. Also the video height above seabed became more stable. While during the first transects the seabed moved in and out of view, later it was visible almost continuously.

On basis of timestamp logged while recording the video observations, positions of high density lanice and stones were obtained from the pel nav software. These were combined with the positions obtained in september 2020. With a R script the areas with highest densities stones and lanice were determined and on basis of the convex hull around these locations a sampling grid was projected. All further boxcore and hamon grab sampling as well as the placement of the cages was based on these.

Some positions had to be replaced, which had to do with nautical safety and the presence of cables. Therefore the actually sampled random positions of the reference area deviated from the plan. Planned positions are given in table 9.

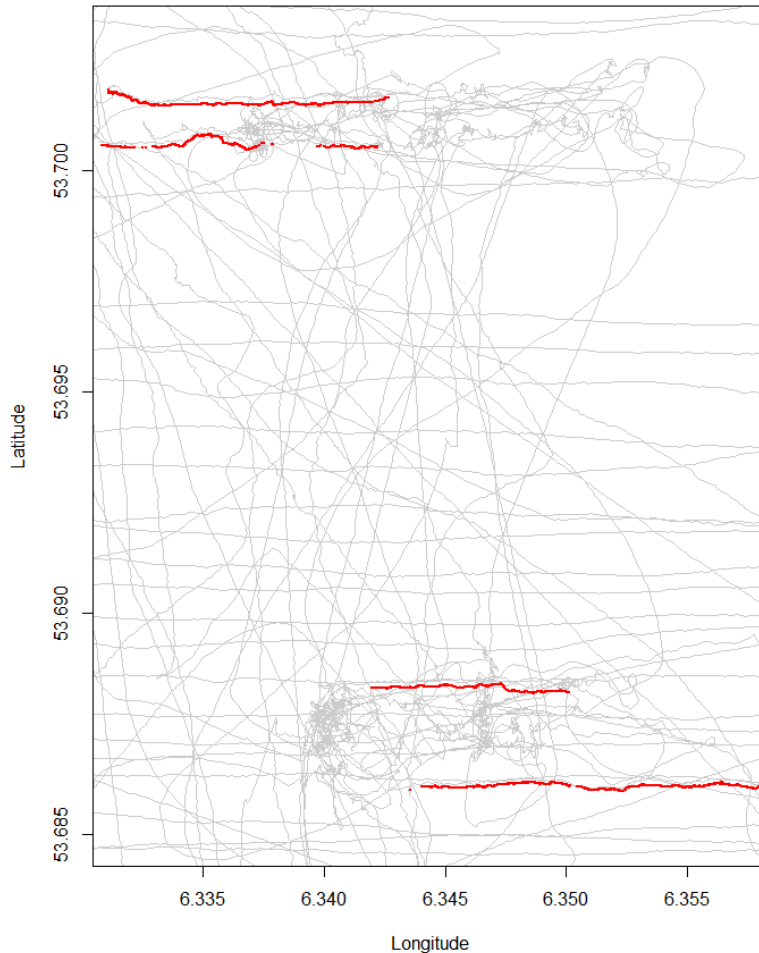


Figure 4. Video tracks with seabed in sight and scored (red dots).

Fish cages

To get an idea of the biodiversity of mobile bottom fauna, fish/crab cages were placed at the seafloor. Three types of cages or fykes were used. Large cages with meshsize of 2×2 cm which were 150 × 150 × 75 cm. Middle sized cages of 60×40×30cm also with 2cm mesh and small fykes with a mesh of .5cm. Additionally a whelk pot was mounted to each large cage, made of plastic jerrycans out of which a hole was carved which was mounted with a wire mesh entrance that should trap whelks after entering the pot. All traps were baited with canned mackerel.

The sets were deployed with the side A frame. Two Benthos glass spheres were used to keep the line upright. At the surface the position was marked by a float equipped with a radar reflector and a flashlight. Each cage was deployed for ±24 hours, with the exception of a single cage that was lost on day 2, and only recovered on day 8.

In each of the research areas 8 cages were deployed in such a way that all cages (N=8) had been used at each of the locations. The catch was quantified and used to sample for stable isotope analyses. Turbidity and Chl_a loggers (JFE Advantech infinity ACLW and ALEC ALW) were placed in one cage per area in each deployment. The logger was mounted on one of the horizontal top bars inside the cage, pointing downwards to measure of the passing water. The logger measured every 60 seconds (ACLW) or 30 seconds (ALW) throughout deployment of the cage.

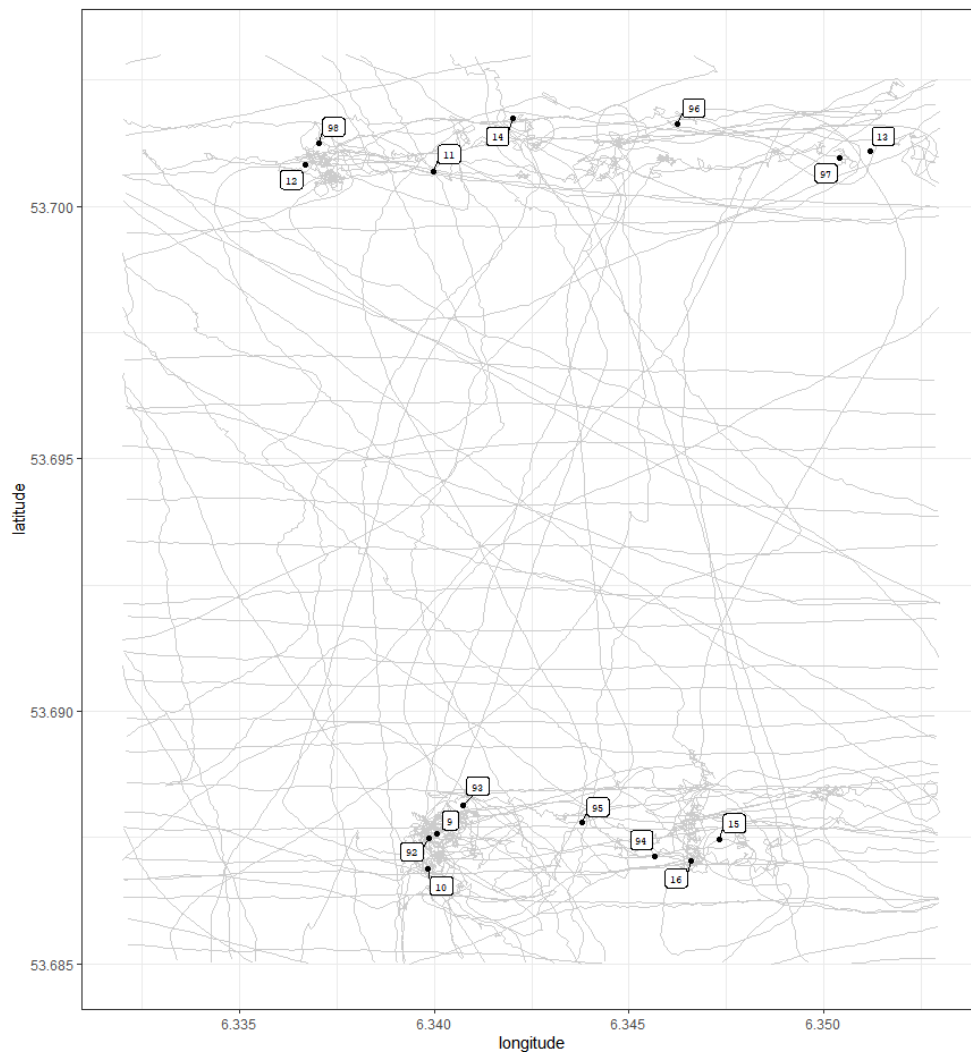


Figure 5. Deployment position of the crab cages as station numbers. Locations were chosen random on basis of the video observations taken in September 2020 and during this cruise.



Figure 6. Large bottom cage with on the left front a medium cage attached, on the left back a small fyke attached and in the right from a wheel pot.

Stable isotopes infauna and sediment composition

Within the focal areas of which the boundaries were determined on basis of the UWvideo, 5 random sampling stations were selected to obtain samples with the K16 box corer. On deck the core was used to take subsamples for sediment grainsize (0-5 cm & 5-10cm) (Table 2) and samples for carbon and chlorophyll analyses (1 cm layers). Sub cores were taken with a 32mm (internal diameter) tube (Table 3). Overlying water from the boxcore was kept apart and filtered over a gff filter to collect suspended material for quantification and qualitative (isotope) analyses. The remainder of the sediment was washed over a 2 and 5 mm screen and larger macrofauna was collected for isotope analyses.

Later in the week the newly built Hamon Grab was tested and the samples (4 in the rock area, 6 in the reference) were sieved on a 5 mm mesh screen and larger macrofauna collected for isotope analyses.

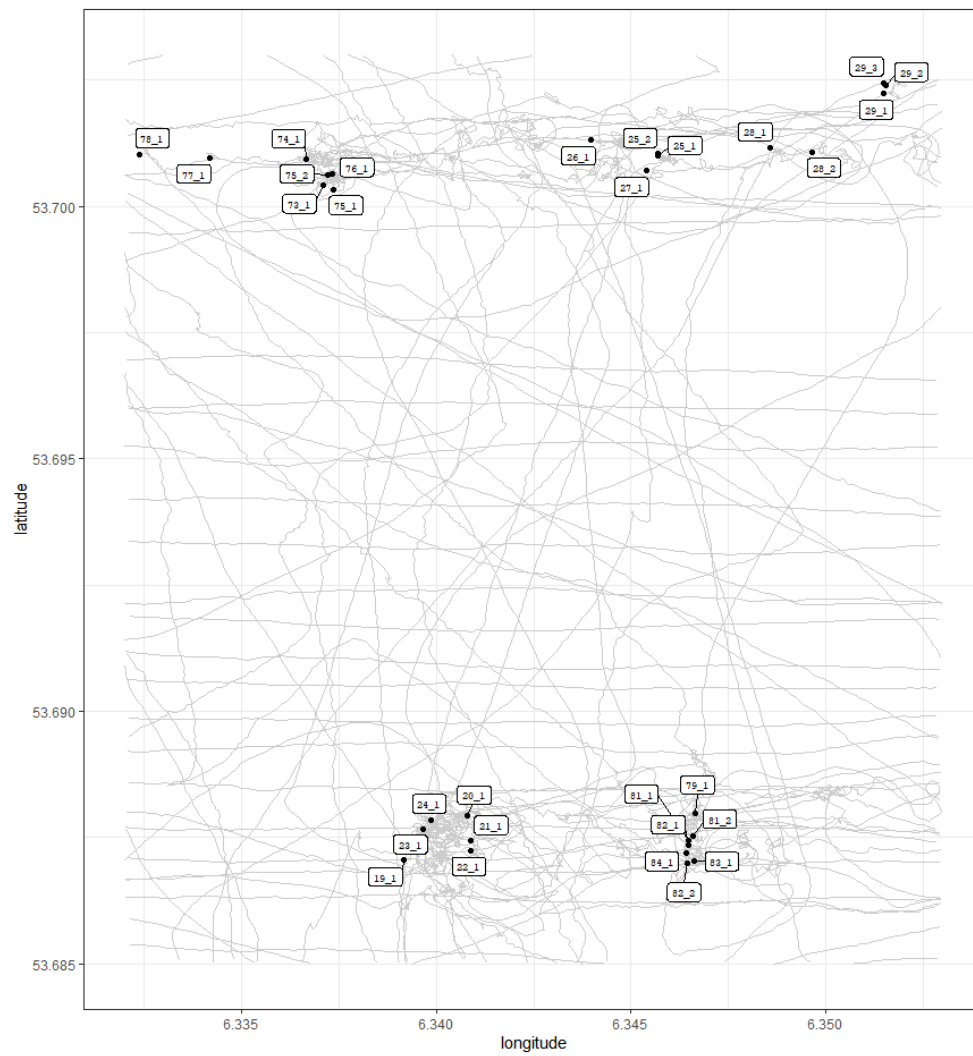


Figure 7. Boxcore K16 locations plotted as station and cast numbers

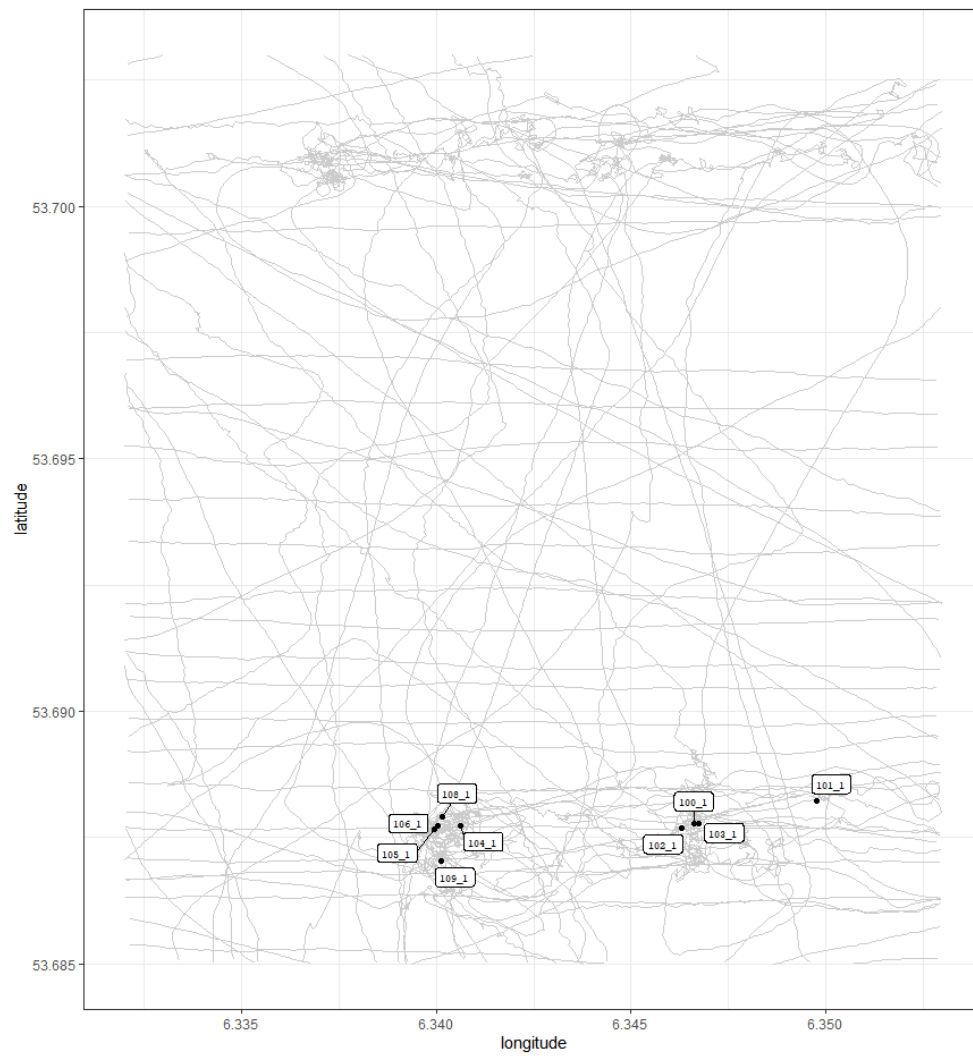


Figure 8 . Locations of the Hamon grabs with station_cast number.

Table 2. overview of samples taken for sediment grainsize analyses.

Date	Vessel Position ID	Core ID	Sample ID: 0 - 5 cm	Sample ID: 5 - 10 cm	Notes
03/04/2021	019	C	SC2000	SC2001	
03/04/2021	020	D	SC2002	SC2003	
03/04/2021	021	G	SC2004	SC2005	
03/04/2021	022	I	SC2006	SC2007	
03/04/2021	023	M	SC2008	SC2009	
03/04/2021	024	N	SC2010	SC2011	
03/04/2021	025 - 2	R	SC2012	SC2013	lost part of SC2012
03/04/2021	026	O	SC2014	SC2015	Removed 1 lanice from 2014 and 2 from 2015
03/04/2021	027	K	SC2016	SC2017	
03/04/2021	028 - 2	AA	SC2018	SC2019	
03/04/2021	029 - 3	CC	SC2020	SC2021	Removed 1 lanice from SC2021
06/04/2021	073	C	SC2022	SC2023	Stuck. I had to use a scoop to take out sample
06/04/2021	074	F			Lost
06/04/2021	075 - 2	H	SC2024	SC2025	
06/04/2021	076	I	SC2026	SC2027	Last cm had a big stone and was removed
06/04/2021	077	L	SC2028	SC2029	
06/04/2021	078	N	SC2030	SC2031	layer 0 - 5 some fell off
06/04/2021	079	P	SC2032	SC2033	
06/04/2021	080	R	SC2034	SC2035	Rock between layers: is now it 0 - 5 one
06/04/2021	081 - 2	T	SC2036	SC2037	
06/04/2021	082 - 2	BB			Not sliced (we had enough)
06/04/2021	083	DD	SC2038	SC2039	
06/04/2021	084	FF	SC2040	SC2041	

Table 3 Overview of samples taken for Carbon and chlorophyll analyses.

Date	Vessel Position ID	Core ID	Sample ID: 0-1 cm	Sample ID: 1-2 cm	Sample ID: 2-3 cm	Sample ID: 3-4 cm	Sample ID: 4-5 cm	Sample ID: 5-10 cm	Sample ID: 10-15 cm	Notes
03/04/2021	019	A	CC2000	CC2001	CC2002	CC2003	CC2004	CC2005	CC2006	
03/04/2021	020	F	CC2007	CC2008	CC2009	CC2010	CC2011	CC2012	CC2013	
03/04/2021	021	H	CC2014	CC2015	CC2016	CC2017	CC2018	CC2019	CC2020	
03/04/2021	022	J	CC2021	CC2022	CC2023	CC2024	CC2025	CC2026	CC2027	
03/04/2021	023	L	CC2028	CC2029	CC2030	CC2031	CC2032	CC2033	CC2034	
03/04/2021	024	P	CC2035	CC2036	CC2037	CC2038	CC2039	CC2041	CC2040	
03/04/2021	025 - 2	S	CC2042	CC2043	CC2044	CC2045	CC2046	CC2047	CC2048	Lanice in core
03/04/2021	026	T	-	-	-	CC2070	CC2071	-	-	
03/04/2021	027	Q	CC2049	CC2050	CC2051	CC2052	CC2053	CC2054	CC2055	
03/04/2021	028 - 2	BB	CC2056	CC2057	CC2058	CC2059	CC2060	CC2061	CC2062	Lanice in core
03/04/2021	029 - 3	DD	CC2063	CC2064	CC2065	CC2066	CC2067	CC2068	CC2069	
06/04/2021	073	A	CC2072	CC2073	CC2074	CC2075	CC2076	CC2077	CC2078	
06/04/2021	074	D	CC2079	CC2080	CC2081	CC2082	CC2083	CC2084	CC2085	Shell in CC2083, Dead ensis in CC2085, which was 10 - 14 cm
06/04/2021	075 - 2	G	CC2086	CC2087	CC2088	CC2089	CC2090	CC2091	-	
06/04/2021	076	J	CC2092	CC2093	CC2094	CC2095	CC2096	CC2097	CC2098	
06/04/2021	077	K	CC2099	CC2100	CC2101	CC2102	CC2103	CC2104	CC2105	CC2105 = 10 - 13 cm
06/04/2021	078	M	-	-	-	-	-	-	-	Not sliced (we had enough)
06/04/2021	079	O	CC2106	CC2107	CC2108	CC2109	CC2110	CC2111	CC2112	
06/04/2021	080	Q	CC2113	CC2114	CC2115	CC2116	CC2117	CC2118	CC2119	
06/04/2021	081 - 2	S	CC2120	CC2121	CC2122	CC2123	CC2124	CC2125	CC2126	Lost 1 cm of CC2125 (lowest cm)
06/04/2021	082 - 2	AA	CC2127	CC2128	CC2129	CC2130	CC2131	CC2132	-	
06/04/2021	083	CC	CC2133	CC2134	CC2135	CC2136	CC2137	CC2138	CC2139	
06/04/2021	084	EE	CC2140	CC2141	CC2142	CC2143	CC2144	CC2145	CC2146	CC2146 = 10 - 12 cm

Incubation samples with box corer K2

It was planned to obtain 6 cores with the K2 box corer from each area, and incubate them. Due to poor weather restricting the work, these cores were only obtained from the reference, oyster-lanice and rocky area. Sampling in the rocky area was problematic, as several samples failed to close the box corer knife due to gravel getting stuck between the core and knife. Finally, four samples were obtained and incubated. The water in these four cores was very turbid, limiting inspection of the sampled sediment before incubation. Only after incubation it was discovered that two out of the four cores contained hardly any sediment.

During incubation we measured respiration (TOU) and nutrient fluxes on the sediment. The 30 cm core was lifted in an incubation tank to keep the *in situ* temperature. The box core was aerated and stirred with the lid closed and stabilized for some time. After stabilization the core was closed and oxygen was measured with firesting optodes until oxygen saturation reached 70-80%. At regular intervals samples were taken for nutrients (T0-T4), DIC and alkalinity (before and after incubation). After incubation had finished, the core height was determined, a surface sample taken for chlorophyll analysis (and stored at -80) and the sample sieved on a 1 mm mesh size sieve. The sediment and fauna left in the sieve were stored in borax buffered formalin 6%.

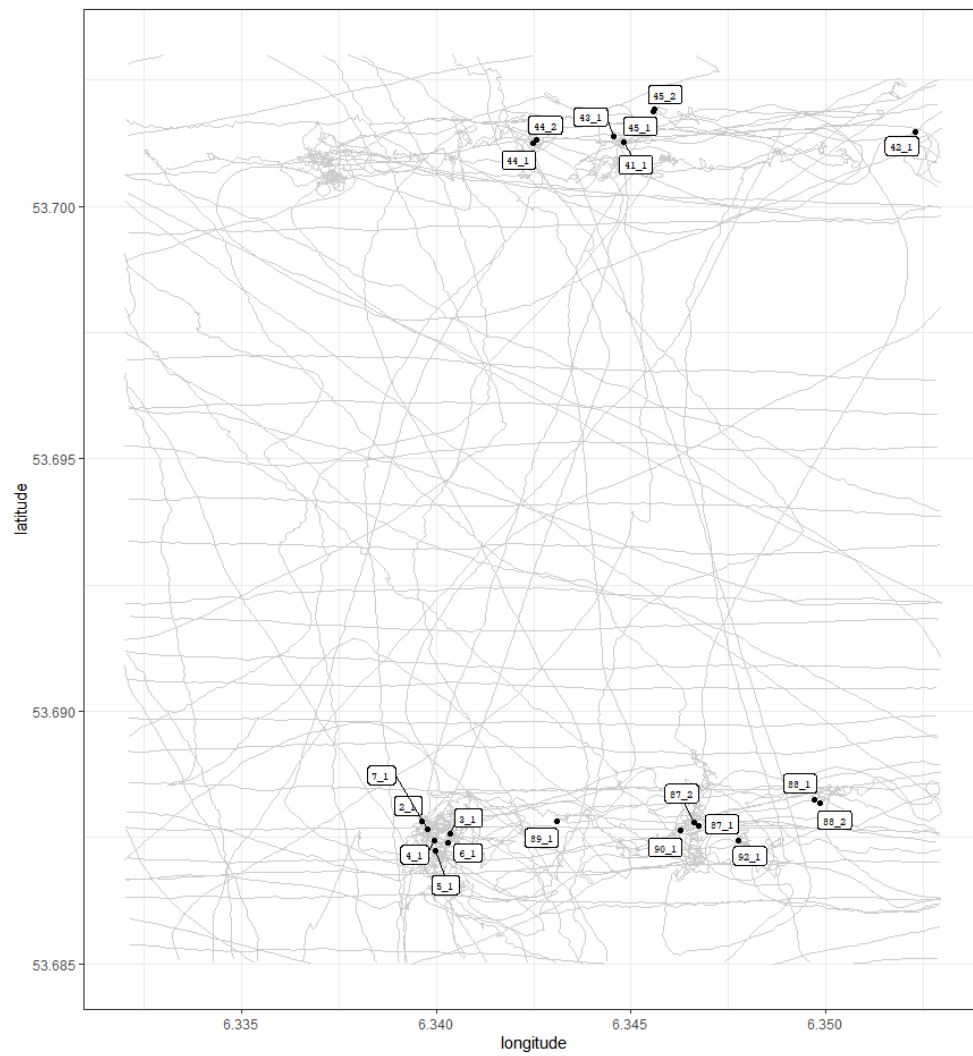


Figure 9 . Locations of the K2 box corers with station_cast number

Table 4. Incubation data

Date	Sample	Casino ID	Firering unit-optode	Start respiration measurement	Stop respiration measurement	Height core (cm)	T0	T1	T2	T3
03/04/2021	Blanc0 1	40	Unit 3-2	14:50	20:15	0	13:50	20:20	8:15	17:25
03/04/2021	Core 1	2	Unit 3-3	14:50	20:15	29	13:55	20:25	8:20	17:30
03/04/2021	Core 2	3	Unit 3-4	14:50	20:15	33	14:05	20:30	8:25	17:35
03/04/2021	Core 3	4	Unit 4-1	15:03	20:15	23	14:10	20:35	8:30	17:40
03/04/2021	Core 4	5	Unit 4-2	15:03	20:15	27	14:15	20:40	8:35	17:45
03/04/2021	Core 5	6	Unit 4-3	15:15	20:15	28	14:20	20:45	8:40	17:50
03/04/2021	Core 6	7	Unit 4-4	15:15	20:15	26	14:25	20:50	8:45	17:55
04/04/2021	Blanco 2	40	Unit 3-2	13:50	19:30	0	13:15	19:45	8:35	13:30
04/04/2021	Core 7	41	Unit 3-3	13:50	19:30	25	13:20	19:50	8:40	13:35
04/04/2021	Core 8	42	Unit 3-4	13:55	19:30	21	13:25	19:55	8:45	13:40
04/04/2021	Core 9	43	Unit 4-1	13:59	19:30	26	13:30	20:00	8:50	13:45
04/04/2021	Core 10	44	Unit 4-2	14:05	19:30	27	13:35	20:05	8:55	13:50
04/04/2021	Core 11	45	Unit 4-3	14:15	19:30	25	13:40	20:10	9:00	13:55
04/04/2021	Core 12	46	Unit 4-4	14:20	19:30	30	13:45	20:15	9:05	14:00
08/04/2021	Blanco 3	85	Unit 3-2	14:30	8:25	0	13:40	19:10	8:30	14:45
08/04/2021	Core 13	87	Unit 3-3	14:30	8:25	22	13:45	19:15	8:35	14:50
08/04/2021	Core 14	89	Unit 3-4	14:30	8:25	0	13:50	19:20	8:40	14:55
08/04/2021	Core 15	90	Unit 4-1	14:30	8:25	0	13:55	19:25	8:45	15:00
08/04/2021	Core 16	91	Unit 4-2	14:30	8:25	30	14:00	19:30	8:50	15:05

*samples taken at T0, T1, T2 and T3 were nutrients, DIC, Alkalinity and pH. The samples were taken to NIOZ-Ye to be analysed

*T2 and T3 are always taken the next day

*Core 13 and 16 the respiration was slow so the respiration measurement was stopped the next day at 8:25. T1 was sampled in the evening 8 of April

*Core 14 and 15 were empty, but we could only see this after the incubation because of the turbid water.

Water sampling

At one station in each area, a CTD cast was performed to provide us with water column profiles of temperature, salinity, turbidity and chlorophyll and water samples from the surface water and near-bottom water. Another reason was to obtain the sound velocity profile for the multi-beaming work.

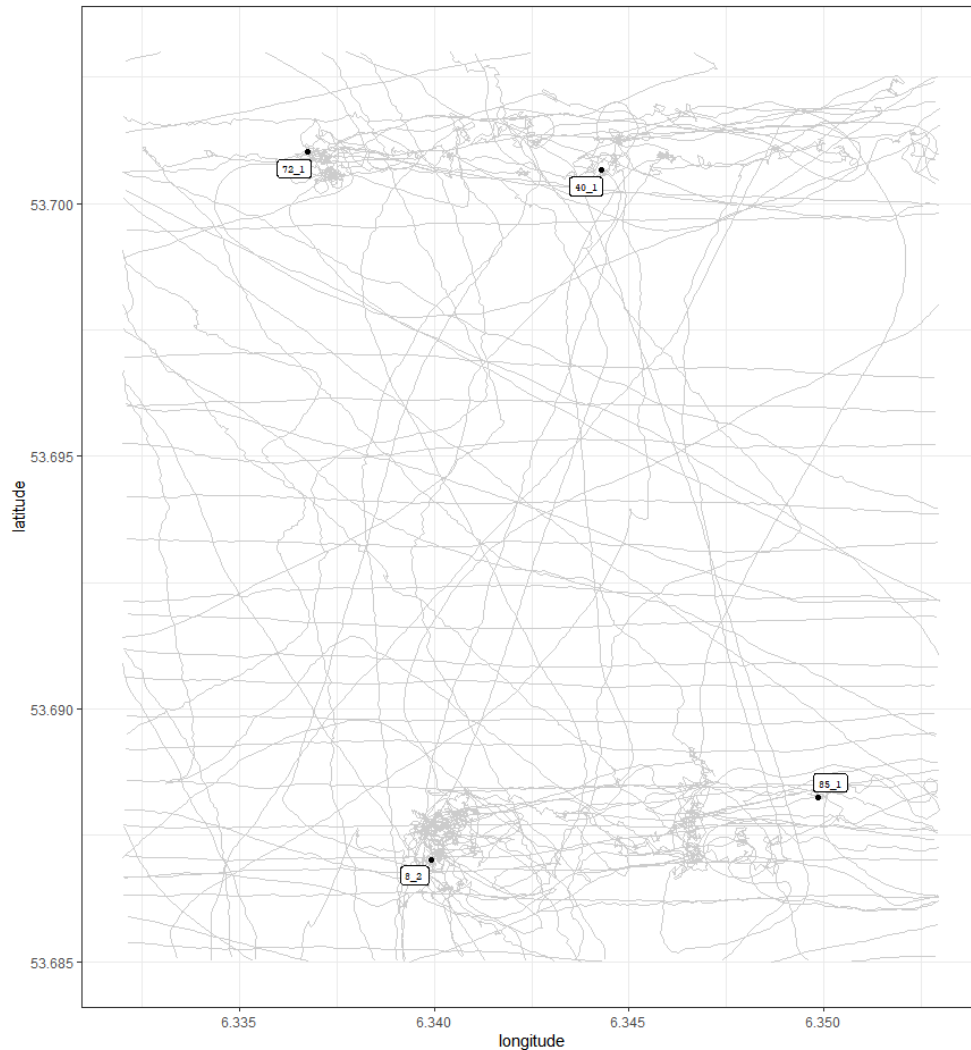


Figure 10. Positions of the CTD deployments with their station_cast numbers.

The following water samples were processed:

1. **SPM:** Approximately 0.5 to 2. l were filtered over a pre-combusted Whatman GF/F glass fiber filter using a vacuum pump as a measure of water turbidity as weight per volume.
2. **Chlorophyll A:** Approximately 0.5 to 2 l were filtered over a Whatman GF/6 filter using a vacuum pump, to measure concentration of ChlA in the water.
3. **wPOM:** for food web analysis. Approximately 0.5 to 2. l were filtered over a pre-combusted Whatman GF/F glass fiber filter using a vacuum.

4. **Nutrient analysis** 2*5 ml were filtered via 0.2 um acrodisk filter, stored in two 5 ml pony vials filled to <80% of which 1 was frozen in -20°C (for N and P analysis) and 1 was stored at 4°C (for Si analysis).
5. **Measure of pH, DIC and alkalinity**
 - a. **pH** was measured in the water from the Niskin using a pH meter and buffer. 50 ml of water were collected in a plastic jar from the Niskin bottle and also conserved with HgCl, to later measure the pH in the lab.
 - b. For **DIC** a gas vial was filled with 10 ml of filtrated water from the Niskin, then conserved with HgCl.
 - c. **Alkalinity** was measured by filling a centrifuge tube with 50 ml of filtrated water from Niskin which is also conserved with HgCl.
6. A **water sample** was taken **from the K16 box core** in 5 locations per reef type and was filtered as described above to obtain wPOM for the stable isotope analysis. This will provide samples from different locations in each reef but above all will allow sampling a mix of water and diatoms/sediment, generally present in the top sediment layer, which will be disturbed by the coring itself.

Table 5. Water samples

Water type	Volum filtered for SPM (L)	SPM Sample ID	Weight SPM filter	Volum filtered for ChlA (L)	ChlA sample ID	Nutrient sample ID (N and P)	Nutrient sample ID (Si)	Notes
CTD water_Bottom	2	SPM2000	131.67	2	ChlA2000	N2000	N2006	
CTD water_Bottom	1.5	SPM2001	125.26	1.5	ChlA2001	N2001	N2007	
CTD water_Bottom	1.5	SPM2002	125.66	1.5	ChlA2002	N2002	N2008	
CTD water_Bottom	1.5	SPM2003	130.26					From bottle 1 again, taken two times by mistake
CTD water_Bottom	1.5	SPM2004	130.14					
CTD water_Bottom	1.5	SPM2005	125					
CTD water_Surface	2	SPM2006	129.36	2	ChlA2003	N2003	N2009	
CTD water_Surface	2	SPM2007	131.68	2	ChlA2004	N2004	N2010	
CTD water_Surface	2	SPM2008	126.3	2	ChlA2005	N2005	N2011	
CTD water_Surface	2	SPM2009	126.32					
CTD water_Surface	2	SPM2010	125.75					
CTD water_Bottom	2	SPM2011	125.89	2	ChlA2006	N2012	N2018	
CTD water_Bottom	2	SPM2012	126.45	2	ChlA2007	N2013	N2019	
CTD water_Bottom	2	SPM2013	127	2	ChlA2008	N2014	N2020	
CTD water_Bottom	2	SPM2014	125.49					
CTD water_Bottom	2	SPM2015	130.93					
CTD water_Surface	2	SPM2016	128.88	2	ChlA2009	N2015	N2021	
CTD water_Surface	2	SPM2017	127.56	2	ChlA2010	N2016	N2022	
CTD water_Surface	2	SPM2018	125.55	2	ChlA2011	N2017	N2023	
CTD water_Surface	2	SPM2019	124.85					
CTD water_Surface	2	SPM2020	125.56					
CTD water_Bottom	0.6	SPM2021	130.47	1.5	ChlA2012	N2024	N2030	

Water type	Volum filtered for SPM (L)	SPM Sample ID	Weight SPM filter	Volum filtered for ChlA (L)	ChlA sample ID	Nutrient sample ID (N and P)	Nutrient sample ID (Si)	Notes
CTD water_Bottom	0.6	SPM2022	129.94	2.5	ChlA2013	N2025	N2031	
CTD water_Bottom	0.6	SPM2023	130	2	ChlA2014	N2026	N2032	
CTD water_Bottom	0.6	SPM2024	131.2					
CTD water_Bottom	0.6	SPM2025	130.69					
CTD water_Surface	1	SPM2026	131.56	1	ChlA2015	N2027	N2033	
CTD water_Surface	1	SPM2027	129.7	1	ChlA2016	N2028	N2034	
CTD water_Surface	1	SPM2028	129.76	1	ChlA2017	N2029	N2035	
CTD water_Surface	1	SPM2029	129.99					
CTD water_Surface	1	SPM2030	132.13					
CTD water_Bottom	0.5	SPM2031	132.79	0.5	ChlA2018	N2036	N2042	
CTD water_Bottom	0.5	SPM2032	129.95	0.5	ChlA2019	N2037	N2043	
CTD water_Bottom	0.5	SPM2033	132.77	0.5	ChlA2020	N2038	N2044	
CTD water_Bottom	0.5	SPM2034	135.03					
CTD water_Bottom	0.5	SPM2035	131.62					
CTD water_Surface	1	SPM2036	126.14	1	ChlA2021	N2039	N2045	
CTD water_Surface	1	SPM2037	125.16	1	ChlA2022	N2040	N2046	
CTD water_Surface	1	SPM2038	130.65	1	ChlA2023	N2041	N2047	
CTD water_Surface	1	SPM2039	129.75					
CTD water_Surface	1	SPM2040	130.89					

*Samples of nutrients, alkalinity, DIC, pH and chlorofyl were taken to the lab at NIOZ-Ye for analyses

*Samples for SPM were taken to NIOZ-tx for analyses

Zooplankton net

At 5 stations in each area, a zooplankton sample was taken using a WP2 net with a mesh size of 200 microns, in order to exclude the phytoplankton fraction. The net was weighed down and lowered approximately 2 meters above the seabed and then pulled back to the surface.

On board large zooplankton was removed from the sample and processed separately, then the remaining plankton was sieved and conserved for stable isotope analysis.

An overview of the zooplankton stable isotope samples is provided in table 6.

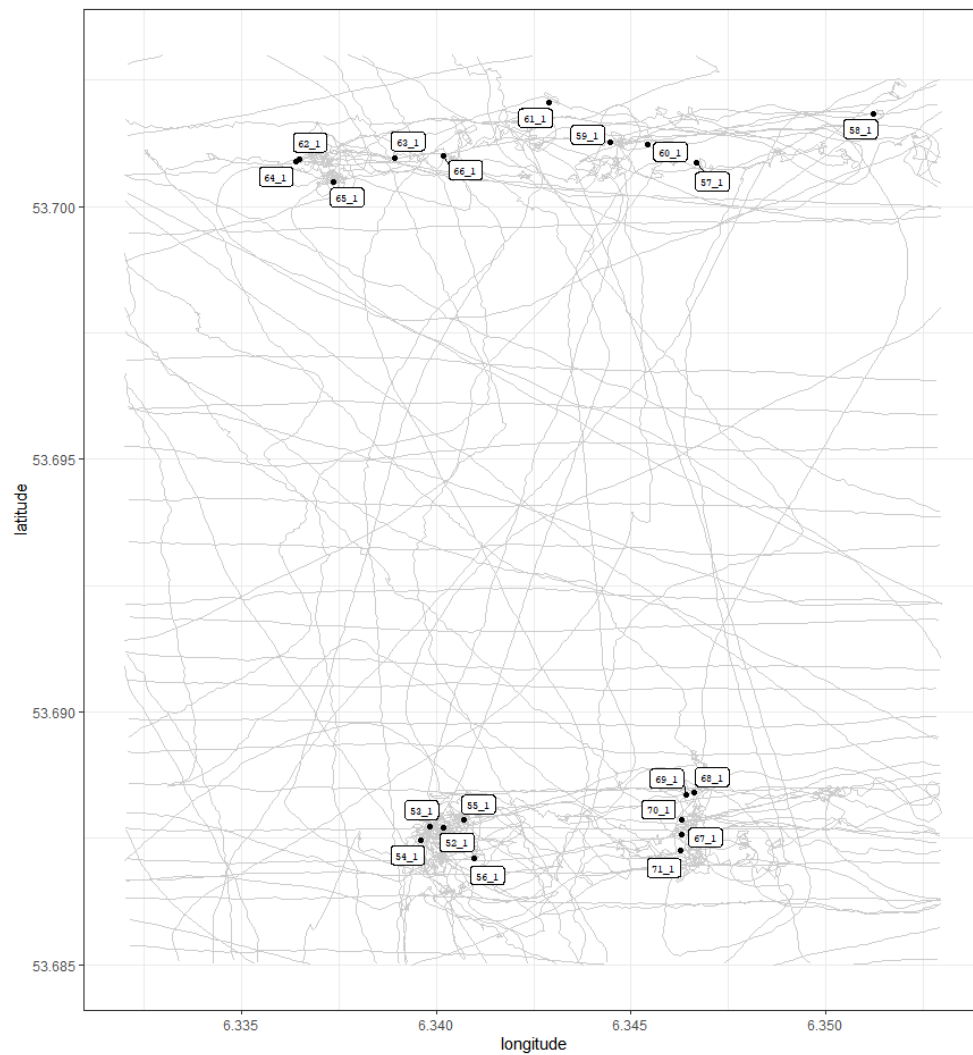


Figure 11. Positions of the plakton samples with their station_cast numbers.

Isotope sampling

From both the fykes, boxcores and hammongrabs, specimen were collected for stable isotope analyses. In the table 6 an overview of the number of kept specimens per area is summarized.

Table 6. overview of the number of collected specimens and species.

Species name	Lanice	Oysters + Lanice	Reference	Rocks	Total
Box Core					
<i>Abra alba</i>		1	9	6	16
<i>Aeolida papillosa</i>		1			1
<i>Anemone</i> sp		7	10	7	24
<i>Asterias rubens</i>		3		1	4
<i>Branchiostoma lanceolatum</i>	5	13		1	19
Briozoan					
Briozoan 2					
<i>Cerianthus lloydii</i>			10		10
Comma worm		3		1	4
<i>Corystes cassivelanus</i>			2		2
<i>Crangon crangon</i>		1	1	1	3
<i>Dosinia exoleta</i>	1				1
<i>Echinocardium cordatum</i>			11		11
<i>Ensis lei</i>	7	12		4	23
Gobiidae				2	2
<i>Lanice conchilega</i>	11	22	5	8	46
<i>Licoarcinus</i> sp	1				1
<i>Liocarcinus</i> sp		5		1	6
<i>Lucinoma borealis</i>		1			1
<i>Lutraria lutraria</i>		1	4	2	7
<i>Nephtys</i> sp	7	4	3	6	20
<i>Nereis</i> sp	4	3	1	5	13
<i>Owenia fusiformis</i>	1	1	19	1	22
<i>Pestarella thyrrena</i>		1	1	5	7
<i>Scoloplos armiger</i>	1			2	3
<i>Spisula elliptica</i>		1			1
SPM/POM_Box Core Water	5	5	5	5	5
<i>Upogebia deltaura</i>				8	8
<i>Venerupis</i> sp.			1		1
Worm 1			2	5	7

Species name	Lanice	Oysters + Lanice	Reference	Rocks	Total
Worm 3		1			1
Laris koreni				1	1
Anemone sp 2				2	2
Licoarcinus navigator				1	1
Hydrozoa					
Bryozoan				3	3
Sagartia troglodites			6	9	15
Processa edulis			1	1	2
Spisula subtruncata				1	1
Box Core Total	43	86	91	89	294
Cage					
Asterias rubens			1	5	6
Balanus sp		2	21	10	33
Cancer pagurus				1	1
Corystes cassivelanus			1	3	4
Crangon crangon	1	4	7	7	19
Crepidula furnicata		6	8	3	17
Gobiidae		1	2		3
Hydralmania falcata			1		1
Liocarcinus holsatus	2	11	5	5	23
Liocarcinus navigator	1	2			3
Lutraria lutraria				1	1
Pagurus bernhardus	1	6	8	7	22
Sagartia sp				5	5
Solea solea				1	1
Limanda limanda		4	1	6	11
Arnoglossus laterna			1	1	2
Lutraria sp				1	1
Lutraria juv ?				1	1
Metridium senile				5	5
Liocarcinus depurator				2	2
Hydroid					
Platichthys flesus		1	1		2
Ciliata mustela		1			1
Solea solea		1			1
Cyanea lamarkii		1			1
Cage Total	5	40	57	64	166
CTD					
SPM/POM_CTD Water_Bottom	5	5	5	5	5

Species name	Lanice	Oysters + Lanice	Reference	Rocks	Total
SPM/POM_CTD Water_Surface	5	5	5	5	5
CTD Total	10	10	10	10	10
Plankton net					
Fish larvae				2	2
Flatfish juv	1	1			2
Flatfish juv 1	1				1
Flatfish juv 2	1				1
Flatfish juv 3	1				1
Jelly zooplankton	5	5	5	5	5
Jellyfish		2			2
Plankton (zoo+phyto) undivided	5	5	5	5	5
Swimming zooplankton	1				1
Plankton net Total	15	13	10	12	20

Multibeam/echosounder signature 500 and 1000



Figure 12. Signature 1000 mounted on Marsdiep lander

Table 7. Deployments Marsdiep lander with signature 1000 time in UTC

Date Deployed	Time deployed	Date recovered	Time recovered	station	Comments
02/04/2021	17:13	3/4/2021	11:43	17,30	Unsuccesfull; loose connection in bat pack
03/04/2021	17:07	4/4/2021	17:17	38,51	Succesfull, data have not been processed
08/04/2021	14:44	09/04/2021	13:18	99,113	Succesfull, data have not been processed

*Some days not deployed because of weather conditions



Figure 13. Signature 500 mounted on measuring pole Pelagia

Table 8. Deployment of measuring pole Pelagia with signature 500 time in UTC

Date Deployed	Time deployed	Date recovered	Time recovered	Comments
02/04/2021	18:09	03/04/2021	05:30	during night with multibeam;succesfull
03/04/2021	19:20	04/04/2021	05:56	during night with multibeam;succesfull
04/04/2021	10:06	04/04/2021	15:40	during video transect,succesfull
09/04/2021	06:18	09/04/2021	15:18	same area as marsdiep lander;succesfulle

*all data still needs to be processed

*Some days not deployed because of weather conditions

In the nights of 2-3 April and 3-4 April the area was mapped with the multibeam. Up to now the data have not been processed.



Figure 14. Map of multibeam track over the lanice area and the souther stoney reef and reference area.

Table 9: all stations as planned, with reference to station and cast number (Casino/Cast, see table 10)

St.name	St.type	Lon_DD.ddd	Lat_DD.ddd	Date	Casino	Cast	Cage #	Logger #
0:1-reference-BRG-April-2021	CTD	6.3398	53.6871	02-Apr	#008	2	NA	NA
0:2-reference-BRG-April-2021	box corer K2	6.3396	53.6879	02-Apr	#002	NA	NA	NA
0:3-reference-BRG-April-2021	box corer K2	6.3403	53.6876	02-Apr	#003	NA	NA	NA
0:4-reference-BRG-April-2021	box corer K2	6.3399	53.6875	02-Apr	#004	NA	NA	NA
0:5-reference-BRG-April-2021	box corer K2	6.3399	53.6873	02-Apr	#005	NA	NA	NA
0:6-reference-BRG-April-2021	box corer K2	6.3403	53.6874	02-Apr	#006	NA	NA	NA
0:7-reference-BRG-April-2021	box corer K2	6.3397	53.6877	02-Apr	#007	NA	NA	NA
0:20-reference-BRG-April-2021	Marsdiep lander	6.3403	53.6871	02-Apr	#017	NA	NA	NA
0:14-reference-BRG-April-2021	Cage	6.3400	53.6878	02-Apr	#009	NA	1	209
0:15-reference-BRG-April-2021	Cage	6.3396	53.6872	02-Apr	#010	NA	2	NA
0:14-lanice-BRG-April-2021	Cage	6.3400	53.7012	02-Apr	#011	NA	3	107
0:15-lanice-BRG-April-2021	Cage	6.3371	53.7011	02-Apr	#012	NA	4	NA
0:14-oysters-BRG-April-2021	Cage	6.3508	53.7012	02-Apr	#013	NA	5	920
0:15-oysters-BRG-April-2021	Cage	6.3421	53.7019	02-Apr	#014	NA	6	NA
0:14-rocks-BRG-April-2021	Cage	6.3477	53.6873	02-Apr	#015	NA	7	724
0:15-rocks-BRG-April-2021	Cage	6.3465	53.6871	02-Apr	#016	NA	8	NA
0:8-reference-BRG-April-2021	box corer K16	6.3396	53.6875	03-Apr	#019	NA	NA	NA
0:9-reference-BRG-April-2021	box corer K16	6.3403	53.6878	03-Apr	#020	NA	NA	NA
0:10-reference-BRG-April-2021	box corer K16	6.3398	53.6874	03-Apr	#021	NA	NA	NA
0:11-reference-BRG-April-2021	box corer K16	6.3399	53.6874	03-Apr	#022	NA	NA	NA
0:12-reference-BRG-April-2021	box corer K16	6.3399	53.6876	03-Apr	#023	NA	NA	NA
0:13-reference-BRG-April-2021	box corer K16	6.3401	53.6879	03-Apr	#024	NA	NA	NA
0:8-oysters-BRG-April-2021	box corer K16	6.3457	53.7011	03-Apr	#025	2	NA	NA
0:9-oysters-BRG-April-2021	box corer K16	6.3438	53.7013	03-Apr	#026	NA	NA	NA
0:10-oysters-BRG-April-2021	box corer K16	6.3453	53.7007	03-Apr	#027	NA	NA	NA
0:11-oysters-BRG-April-2021	box corer K16	6.3484	53.7011	03-Apr	#028	NA	NA	NA
0:12-oysters-BRG-April-2021	box corer K16	6.3515	53.7023	03-Apr	#029	3	NA	NA
0:20-oysters-BRG-April-2021	Marsdiep lander	6.3446	53.7011	03-Apr	#038	NA	NA	NA
0:1-oysters-BRG-April-2021	CTD	6.3444	53.7007	04-Apr	#040	NA	NA	NA
0:2-oysters-BRG-April-2021	box corer K2	6.3448	53.7014	04-Apr	#041	NA	NA	NA

St.name	St.type	Lon_DD.ddd	Lat_DD.ddd	Date	Casino	Cast	Cage #	Logger #
0:3-oysters-BRG-April-2021	box corer K2	6.3523	53.7015	04-Apr	#042	NA	NA	NA
0:4-oysters-BRG-April-2021	box corer K2	6.3445	53.7013	04-Apr	#043	NA	NA	NA
0:5-oysters-BRG-April-2021	box corer K2	6.3424	53.7013	04-Apr	#044	2	NA	NA
0:6-oysters-BRG-April-2021	box corer K2	6.3454	53.7019	04-Apr	#045	2	NA	NA
0:7-oysters-BRG-April-2021	box corer K2	6.3530	53.7022	04-Apr	#046	NA	NA	NA
0:21-reference-BRG-April-2021	Planktonnet	6.3403	53.6879	05-Apr	#052	NA	NA	NA
0:22-reference-BRG-April-2021	Planktonnet	6.3397	53.6878	05-Apr	#053	NA	NA	NA
0:23-reference-BRG-April-2021	Planktonnet	6.3403	53.6874	05-Apr	#054	NA	NA	NA
0:24-reference-BRG-April-2021	Planktonnet	6.3402	53.6879	05-Apr	#055	NA	NA	NA
0:25-reference-BRG-April-2021	Planktonnet	6.3402	53.6872	05-Apr	#056	NA	NA	NA
0:21-oysters-BRG-April-2021	Planktonnet	6.3465	53.7008	05-Apr	#057	NA	NA	NA
0:22-oysters-BRG-April-2021	Planktonnet	6.3509	53.7018	05-Apr	#058	NA	NA	NA
0:23-oysters-BRG-April-2021	Planktonnet	6.3443	53.7014	05-Apr	#059	NA	NA	NA
0:24-oysters-BRG-April-2021	Planktonnet	6.3451	53.7013	05-Apr	#060	NA	NA	NA
0:25-oysters-BRG-April-2021	Planktonnet	6.3429	53.7021	05-Apr	#061	NA	NA	NA
0:21-lanice-BRG-April-2021	Planktonnet	6.3365	53.7010	05-Apr	#062	NA	NA	NA
0:22-lanice-BRG-April-2021	Planktonnet	6.3386	53.7009	05-Apr	#063	NA	NA	NA
0:23-lanice-BRG-April-2021	Planktonnet	6.3365	53.7010	05-Apr	#064	NA	NA	NA
0:24-lanice-BRG-April-2021	Planktonnet	6.3370	53.7005	05-Apr	#065	NA	NA	NA
0:25-lanice-BRG-April-2021	Planktonnet	6.3399	53.7012	05-Apr	#066	NA	NA	NA
0:21-rocks-BRG-April-2021	Planktonnet	6.3458	53.6877	05-Apr	#067	NA	NA	NA
0:22-rocks-BRG-April-2021	Planktonnet	6.3479	53.6873	05-Apr	#068	NA	NA	NA
0:23-rocks-BRG-April-2021	Planktonnet	6.3470	53.6874	05-Apr	#069	NA	NA	NA
0:24-rocks-BRG-April-2021	Planktonnet	6.3464	53.6874	05-Apr	#070	NA	NA	NA
0:25-rocks-BRG-April-2021	Planktonnet	6.3465	53.6872	05-Apr	#071	NA	NA	NA
0:17-lanice-BRG-April-2021	CTD	6.3366	53.7010	07-Apr	#072	NA	NA	NA
0:19-lanice-BRG-April-2021	box corer K16	6.3369	53.7005	07-Apr	#073	NA	NA	NA
0:21-lanice-BRG-April-2021	box corer K16	6.3365	53.7010	07-Apr	#074	NA	NA	NA
0:10-lanice-BRG-April-2021	box corer K16	6.3372	53.7005	07-Apr	#075	2	NA	NA
0:11-lanice-BRG-April-2021	box corer K16	6.3372	53.7005	07-Apr	#076	NA	NA	NA
0:12-lanice-BRG-April-2021	box corer K16	6.3340	53.7010	07-Apr	#077	NA	NA	NA
0:13-lanice-BRG-April-2021	box corer K16	6.3326	53.7010	07-Apr	#078	NA	NA	NA

St.name	St.type	Lon_DD.ddd	Lat_DD.ddd	Date	Casino	Cast	Cage #	Logger #
0:8-rocks-BRG-April-2021	box corer K16	6.3466	53.6878	07-Apr	#079	NA	NA	NA
0:16-rocks-BRG-April-2021	box corer K16	6.3465	53.6871	07-Apr	#084	NA	NA	NA
0:10-rocks-BRG-April-2021	box corer K16	6.3465	53.6872	07-Apr	#080	NA	NA	NA
0:11-rocks-BRG-April-2021	box corer K16	6.3466	53.6876	07-Apr	#081	2	NA	NA
0:12-rocks-BRG-April-2021	box corer K16	6.3463	53.6874	07-Apr	#082	2	NA	NA
0:13-rocks-BRG-April-2021	box corer K16	6.3465	53.6871	07-Apr	#083	NA	NA	NA
0:1-rocks-BRG-April-2021	CTD	6.3497	53.6882	08-Apr	#085	NA	NA	NA
0:2-rocks-BRG-April-2021	box corer K2	6.3466	53.6878	08-Apr	#087	2	NA	NA
0:3-rocks-BRG-April-2021	box corer K2	6.3498	53.6882	08-Apr	#089	NA	NA	NA
0:4-rocks-BRG-April-2021	box corer K2	6.3479	53.6873	08-Apr	#090	NA	NA	NA
0:5-rocks-BRG-April-2021	box corer K2	6.3432	53.6877	08-Apr	#091	NA	NA	NA
0:16-reference-BRG-April-2021	Cage	6.3397	53.6874	08-Apr	#092	NA	8	NA
0:17-reference-BRG-April-2021	Cage	6.3404	53.6877	08-Apr	#093	NA	5	920
0:16-rocks-BRG-April-2021	Cage	6.3465	53.6871	08-Apr	#094	NA	6	NA
0:17-rocks-BRG-April-2021	Cage	6.3432	53.6877	08-Apr	#095	NA	1	209
0:16-oysters-BRG-April-2021	Cage	6.3504	53.7008	08-Apr	#096	NA	4	NA
0:17-oysters-BRG-April-2021	Cage	6.3459	53.7014	08-Apr	#097	NA	3	107
0:17-lanice-BRG-April-2021	Cage	6.3366	53.7010	08-Apr	#098	NA	2	720
0:20-rocks-BRG-April-2021	Marsdiep lander	6.3478	53.6873	08-Apr	#099	NA	NA	NA
0:2-rocks-BRG-April-2021	Hamon grab	6.3466	53.6878	09-Apr	#100	NA	NA	NA
0:3-rocks-BRG-April-2021	Hamon grab	6.3498	53.6882	09-Apr	#101	NA	NA	NA
0:6-rocks-BRG-April-2021	Hamon grab	6.3463	53.6877	09-Apr	#102	NA	NA	NA
0:8-rocks-BRG-April-2021	Hamon grab	6.3466	53.6878	09-Apr	#103	NA	NA	NA
0:4-reference-BRG-April-2021	Hamon grab	6.3399	53.6875	09-Apr	#104	NA	NA	NA
0:12-reference-BRG-April-2021	Hamon grab	6.3399	53.6876	09-Apr	#105	NA	NA	NA
0:14-reference-BRG-April-2021	Hamon grab	6.3400	53.6878	09-Apr	#106	NA	NA	NA
0:13-reference-BRG-April-2021	Hamon grab	6.3401	53.6879	09-Apr	#107	NA	NA	NA
0:24-reference-BRG-April-2021	Hamon grab	6.3402	53.6879	09-Apr	#108	NA	NA	NA
0:19-reference-BRG-April-2021	Hamon grab	6.3402	53.6871	09-Apr	#109	NA	NA	NA

Table 10. Overview of all operations during cruise 64PE476. Time in UTC. Station and Strate numbers refer to table 9.

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
02/04/2021	6:33:33	CTD with samples	Begin	BEGIN	1	1_1	53.687121	6.339867	355.53	0.5	43.44	25.84
02/04/2021	7:13:08	CTD with samples	End	END	1	1_1	53.686978	6.339987	118.85	0.6	42.65	26.62
02/04/2021	7:31:46	Boxcore K02	Bottom	BOT	2	2_1	53.687817	6.339629	287.24	0.1	16.35	26.02
02/04/2021	7:52:33	Boxcore K02	Bottom	BOT	3	3_1	53.68758	6.340358	85.17	0.2	8.88	26.5
02/04/2021	8:06:53	Boxcore K02	Bottom	BOT	4	4_1	53.687451	6.339949	315.35	0.4	353.49	26.21
02/04/2021	8:28:40	Boxcore K02	Bottom	BOT	5	5_1	53.687233	6.339971	16.2	0.4	345.2	27.15
02/04/2021	8:42:59	Boxcore K02	Bottom	BOT	6	6_1	53.687395	6.340305	16.63	0.1	332.93	27.19
02/04/2021	9:03:45	Boxcore K02	Bottom	BOT	7	7_1	53.687662	6.339773	351.85	0.5	334.19	27.2
02/04/2021	9:26:32	CTD with samples	Begin	BEGIN	8	8_1	53.687072	6.339865	212.84	0.3	317.06	28.88
02/04/2021	9:30:04	CTD with samples	Bottom	BOT	8	8_1	53.68708	6.33988	195.18	0.4	319.7	28.26
02/04/2021	9:41:01	CTD with samples	End	END	8	8_1	53.687063	6.339865	46.76	0.1	319.73	28.09
02/04/2021	9:54:41	CTD with samples	Begin	BEGIN	8	8_2	53.687049	6.339807	123.06	0.1	314.83	28.76
02/04/2021	9:58:18	CTD with samples	Bottom	BOT	8	8_2	53.687025	6.339905	109.38	0.1	312.58	28.77
02/04/2021	10:06:21	CTD with samples	End	END	8	8_2	53.687095	6.339825	145.8	0.3	314.08	29.05
02/04/2021	11:57:02	Fish cages	Deploy	BEGIN	9	9_1	53.687584	6.340054	216.77	0.5	289.43	28.54
02/04/2021	12:20:20	Fish cages	Deploy	BEGIN	10	10_1	53.686873	6.339822	138.21	0.7	291.95	29
02/04/2021	12:49:12	Fish cages	Deploy	BEGIN	11	11_1	53.700687	6.339975	291.74	0.5	295.12	26.74
02/04/2021	13:33:59	Fish cages	Deploy	BEGIN	12	12_1	53.700818	6.336686	179.5	1.3	300.68	27.38
02/04/2021	13:57:28	Fish cages	Deploy	BEGIN	13	13_1	53.701088	6.351194	221.32	0.7	296.36	26.63
02/04/2021	14:29:42	Fish cages	Deploy	BEGIN	14	14_1	53.701738	6.342003	222.38	0.8	313.83	26.24
02/04/2021	15:08:47	Fish cages	Deploy	BEGIN	15	15_1	53.687466	6.347311	276.42	0.9	322.56	28.29
02/04/2021	15:27:00	Fish cages	Deploy	BEGIN	16	16_1	53.68705	6.346587	31.88	1	11.38	27.05
02/04/2021	17:13:47	Marsdieplander	Deployment	DEP	17	17_1	53.686514	6.340209	339.54	0.3	31.28	27.07
02/04/2021	18:38:18	Multibeam	Begin	BEGIN	18	18_1	53.706308	6.324146	66.94	2.5	79.26	24.58
02/04/2021	18:38:31	Signature 500	Begin	BEGIN	18	18_2	53.706302	6.324494	91.11	3.5	78.36	24.28
03/04/2021	6:21:41	Boxcore K16	Bottom	BOT	19	19_1	53.687061	6.339152	16.6	0.8	29.92	25.65

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
03/04/2021	6:43:47	Boxcore K16	Bottom	BOT	20	20_1	53.687944	6.340783	350.2	0.6	33.64	26.38
03/04/2021	6:56:21	Boxcore K16	Bottom	BOT	21	21_1	53.687448	6.34087	135.93	0.5	22.74	26.6
03/04/2021	7:07:33	Boxcore K16	Bottom	BOT	22	22_1	53.687246	6.340879	356.48	0.7	18.62	26.03
03/04/2021	7:21:17	Boxcore K16	Bottom	BOT	23	23_1	53.687675	6.33966	84.57	1	22.48	25.63
03/04/2021	7:32:11	Boxcore K16	Bottom	BOT	24	24_1	53.687855	6.339868	43.68	0.3	34.9	25.98
03/04/2021	8:32:32	Boxcore K16	Bottom	BOT	25	25_1	53.700998	6.345699	176.36	1.2	359.11	25.47
03/04/2021	8:48:27	Boxcore K16	Bottom	BOT	25	25_2	53.701056	6.345674	187.02	0.4	353.59	25.44
03/04/2021	9:05:45	Boxcore K16	Bottom	BOT	26	26_1	53.701318	6.34398	0.7	1	354.77	24.49
03/04/2021	9:19:26	Boxcore K16	Bottom	BOT	27	27_1	53.700704	6.345387	341.06	0.9	345.39	24.78
03/04/2021	9:35:07	Boxcore K16	Bottom	BOT	28	28_1	53.701163	6.348561	146.96	1.6	332.87	26.84
03/04/2021	9:43:16	Boxcore K16	Bottom	BOT	28	28_2	53.70106	6.349636	327.28	1.2	327.19	25.01
03/04/2021	9:56:06	Boxcore K16	Bottom	BOT	29	29_1	53.702237	6.351477	274.31	0.1	322	25.68
03/04/2021	10:02:09	Boxcore K16	Bottom	BOT	29	29_2	53.702398	6.351534	129.36	0.5	325.62	25.98
03/04/2021	10:09:21	Boxcore K16	Bottom	BOT	29	29_3	53.702445	6.351493	193.41	0	323.49	25.66
03/04/2021	11:43:51	Marsdieplander	Recovery	END	30	30_1	53.686257	6.339412	294.93	0.7	300.54	27.41
03/04/2021	12:12:32	Fish cages	Recovery	END	31	31_1	53.686824	6.34032	135.58	1	300.75	28.91
03/04/2021	12:52:34	Fish cages	Recovery	END	32	32_1	53.699881	6.342756	270.34	0.1	303.27	28.12
03/04/2021	13:14:47	Fish cages	Recovery	END	33	33_1	53.700672	6.340418	187.98	0.2	305.08	26.85
03/04/2021	13:36:52	Fish cages	Recovery	END	34	34_1	53.700807	6.336509	192.11	0.6	313.65	27.75
03/04/2021	14:32:50	Fish cages	Recovery	END	35	35_1	53.699732	6.351756	223.59	0.9	305.87	26.34
03/04/2021	15:06:26	Fish cages	Recovery	END	36	36_1	53.701385	6.341425	9	0.6	8.91	25.84
03/04/2021	15:46:21	Fish cages	Recovery	END	36	36_1	53.687207	6.346389	29.63	0.1	7.88	27.88
03/04/2021	17:07:09	Marsdieplander	Deployment	DEP	38	38_1	53.700873	6.344432	0.76	0.7	34.68	25.07
03/04/2021	18:40:59	Multibeam	Begin	BEGIN	39	39_1	53.690338	6.3558	270.82	4.3	291.09	26.78
03/04/2021	18:41:14	Signature 500	Begin	BEGIN	39	39_2	53.690325	6.355363	268.42	3.7	291.4	28.13
04/04/2021	5:17:30	Signature 500	Course Change	COCH	39	39_2	53.688301	6.321983	302.46	2.5	334.12	26.03
04/04/2021	6:09:41	CTD	Begin	BEGIN	40	40_1	53.700662	6.344276	193.08	0.9	47.37	26.11
04/04/2021	6:11:18	CTD	Bottom	BOT	40	40_1	53.70067	6.344294	199.64	0.8	45.3	25.02
04/04/2021	6:22:13	CTD	End	END	40	40_1	53.700715	6.344498	358.09	0.7	47.93	25.27

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
04/04/2021	7:14:17	Boxcore K02	Bottom	BOT	41	41_1	53.701275	6.344811	321.14	0.6	53.1	25.02
04/04/2021	7:34:23	Boxcore K02	Bottom	BOT	42	42_1	53.701482	6.352304	36.32	0.5	48.38	24.07
04/04/2021	8:04:16	Boxcore K02	Bottom	BOT	43	43_1	53.701388	6.344562	14.71	0.6	33.15	24.03
04/04/2021	8:28:11	Boxcore K02	Bottom	BOT	44	44_1	53.701239	6.342469	267.57	0.4	23.3	24.89
04/04/2021	8:35:45	Boxcore K02	Bottom	BOT	44	44_2	53.701307	6.342556	309.95	0.5	9.18	25.25
04/04/2021	8:52:07	Boxcore K02	Bottom	BOT	45	45_1	53.701874	6.345557	170.48	0.8	353.6	25.05
04/04/2021	8:58:47	Boxcore K02	Bottom	BOT	45	45_2	53.701914	6.345607	195.57	0	330.37	24.46
04/04/2021	9:14:56	Boxcore K02	Bottom	BOT	46	46_1	53.702288	6.353195	16.48	0.2	327.91	24.1
04/04/2021	9:56:05	HD Videoframe	Begin	BEGIN	47	47_1	53.700524	6.342071	272.49	0.1	287.91	25.39
04/04/2021	11:24:06	HD Videoframe	End	END	47	47_1	53.700584	6.330678	236.53	0.5	268.09	27.45
04/04/2021	11:46:33	HD Videoframe	Begin	BEGIN	48	48_1	53.701675	6.342999	225.03	0.2	267.45	26.57
04/04/2021	13:00:25	HD Videoframe	End	END	48	48_1	53.701769	6.33112	162.26	0.5	254.78	26.98
04/04/2021	13:40:31	HD Videoframe	Begin	BEGIN	49	49_1	53.686099	6.358121	265.77	0.4	256.96	29.17
04/04/2021	14:40:36	HD Videoframe	End	END	49	49_1	53.686048	6.343993	204.16	0.7	262.21	29.05
04/04/2021	15:13:26	HD Videoframe	Begin	BEGIN	50	50_1	53.688219	6.349899	298.88	1.1	263.8	29.4
04/04/2021	15:40:19	HD Videoframe	End	END	50	50_1	53.688306	6.341961	333.71	0.6	261.85	28.36
04/04/2021	17:17:11	Marsdieplander	Recovery	REC	51	51_1	53.700693	6.344105	22.4	0.1	224.94	21.93
05/04/2021	6:32:41	Plankton Net	Begin	BEGIN	52	52_1	53.687716	6.340178	187.56	1.2	359.3	NA
05/04/2021	6:37:47	Plankton Net	Start Heave	HEAV	52	52_1	53.687591	6.340009	17.14	0.4	328.37	27.56
05/04/2021	6:40:49	Plankton Net	End	END	52	52_1	53.687636	6.339847	16.12	0.1	330.77	24.2
05/04/2021	6:54:01	Plankton Net	Begin	BEGIN	53	53_1	53.687731	6.33983	216.62	0.3	339.54	27.41
05/04/2021	6:55:32	Plankton Net	Start Heave	HEAV	53	53_1	53.68757	6.339922	191.65	0.9	343.25	29.45
05/04/2021	7:00:29	Plankton Net	End	END	53	53_1	53.687053	6.339382	355.71	1.1	337.03	27
05/04/2021	7:17:26	Plankton Net	Begin	BEGIN	54	54_1	53.687469	6.339586	97.88	0.7	339.74	30.4
05/04/2021	7:18:27	Plankton Net	Start Heave	HEAV	54	54_1	53.687421	6.339605	74.64	0.3	343.39	30.02
05/04/2021	7:21:47	Plankton Net	End	END	54	54_1	53.687321	6.339515	191.75	0.8	333.29	27.74
05/04/2021	7:29:25	Plankton Net	Begin	BEGIN	55	55_1	53.687865	6.340718	184.61	1.3	351.61	26.39
05/04/2021	7:30:48	Plankton Net	Start Heave	HEAV	55	55_1	53.687943	6.340999	155.79	0.4	341.98	27.75
05/04/2021	7:33:14	Plankton Net	End	END	55	55_1	53.687892	6.340693	156.13	1	325.69	29.64

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
05/04/2021	7:58:24	Plankton Net	Begin	BEGIN	56	56_1	53.687106	6.340956	217.37	0.9	319.38	27.75
05/04/2021	7:59:30	Plankton Net	Start Heave	HEAV	56	56_1	53.686998	6.340605	231.19	0.8	316.3	28.32
05/04/2021	8:01:36	Plankton Net	End	END	56	56_1	53.686702	6.340023	202.33	1	317.83	28.77
05/04/2021	8:20:37	Plankton Net	Begin	BEGIN	57	57_1	53.700872	6.346684	145.25	1.7	327.27	26.99
05/04/2021	8:21:07	Plankton Net	Start Heave	HEAV	57	57_1	53.70073	6.346754	176.6	0.8	326.46	24.01
05/04/2021	8:23:50	Plankton Net	End	END	57	57_1	53.700695	6.346891	308.91	0.4	327.34	25.48
05/04/2021	8:35:00	Plankton Net	Begin	BEGIN	58	58_1	53.701829	6.351206	56.52	0.3	322.44	27.94
05/04/2021	8:35:26	Plankton Net	Start Heave	HEAV	58	58_1	53.701828	6.351179	207.12	0.2	320.29	25.85
05/04/2021	8:37:20	Plankton Net	End	END	58	58_1	53.70175	6.351254	309.27	1.1	324.01	NA
05/04/2021	8:49:12	Plankton Net	Begin	BEGIN	59	59_1	53.70126	6.344474	144.02	1.4	326.29	26.61
05/04/2021	8:50:21	Plankton Net	Start Heave	HEAV	59	59_1	53.701302	6.344413	141.61	1.2	326.93	26.4
05/04/2021	8:52:21	Plankton Net	End	END	59	59_1	53.70132	6.344688	124.47	0.6	327.33	26.39
05/04/2021	8:55:56	Plankton Net	Begin	BEGIN	60	60_1	53.701235	6.345414	304.8	0.7	329.42	26.04
05/04/2021	8:56:53	Plankton Net	Start Heave	HEAV	60	60_1	53.70132	6.345449	272.26	1.1	318.43	26.42
05/04/2021	8:58:55	Plankton Net	End	END	60	60_1	53.701327	6.345187	332.39	0.9	327.05	26.04
05/04/2021	9:05:50	Plankton Net	Begin	BEGIN	61	61_1	53.70206	6.34288	329.08	1	323.29	25.29
05/04/2021	9:06:55	Plankton Net	Start Heave	HEAV	61	61_1	53.702083	6.342889	139.78	0.3	326.12	26.42
05/04/2021	9:09:08	Plankton Net	End	END	61	61_1	53.701941	6.343053	281.26	0.4	320.28	NA
05/04/2021	9:21:19	Plankton Net	Begin	BEGIN	62	62_1	53.700938	6.336485	239.44	1	308.01	26.42
05/04/2021	9:22:11	Plankton Net	Start Heave	HEAV	62	62_1	53.700956	6.33632	107.09	1	311.04	28.32
05/04/2021	9:24:14	Plankton Net	End	END	62	62_1	53.700917	6.336264	132.46	0.5	311.79	26.59
05/04/2021	9:34:12	Plankton Net	Begin	BEGIN	63	63_1	53.700962	6.338928	292.63	1.2	296.39	26.8
05/04/2021	9:35:14	Plankton Net	Start Heave	HEAV	63	63_1	53.701025	6.338725	301.8	0.2	305.27	26.99
05/04/2021	9:37:08	Plankton Net	End	END	63	63_1	53.700911	6.338719	141.44	3.4	298.54	27.67
05/04/2021	9:42:14	Plankton Net	Begin	BEGIN	64	64_1	53.70089	6.336393	288.03	0.7	298.95	26.15
05/04/2021	9:43:50	Plankton Net	Start Heave	HEAV	64	64_1	53.700769	6.335881	284.22	1.7	307.13	25.4
05/04/2021	9:45:30	Plankton Net	End	END	64	64_1	53.700536	6.336005	161.45	0.5	328.57	27.34
05/04/2021	9:50:41	Plankton Net	Begin	BEGIN	65	65_1	53.700475	6.337346	320.06	1.1	322.89	26.23
05/04/2021	9:51:39	Plankton Net	Start Heave	HEAV	65	65_1	53.700506	6.33737	234.72	0.3	322.03	27.12

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
05/04/2021	9:53:20	Plankton Net	End	END	65	65_1	53.700572	6.337194	312.17	0.4	319.85	25.19
05/04/2021	9:58:48	Plankton Net	Begin	BEGIN	66	66_1	53.701167	6.33993	50.32	0.8	323.83	28.13
05/04/2021	9:59:44	Plankton Net	Start Heave	HEAV	66	66_1	53.701075	6.340056	139.94	2.6	322.92	NA
05/04/2021	10:01:28	Plankton Net	End	END	66	66_1	53.701011	6.34019	89.95	0.5	326.31	27.14
05/04/2021	11:13:48	Plankton Net	Begin	BEGIN	67	67_1	53.687574	6.346306	201.45	0.1	310.05	31.35
05/04/2021	11:14:28	Plankton Net	Start Heave	HEAV	67	67_1	53.687526	6.346304	271.93	1.1	302.56	27.22
05/04/2021	11:16:14	Plankton Net	End	END	67	67_1	53.687635	6.346396	141.06	0.5	307.03	28.88
05/04/2021	11:19:55	Plankton Net	Begin	BEGIN	68	68_1	53.688403	6.346624	275.36	1.5	304.65	30.21
05/04/2021	11:20:49	Plankton Net	Start Heave	HEAV	68	68_1	53.688428	6.346665	13.97	1.3	315.31	30.59
05/04/2021	11:22:51	Plankton Net	End	END	68	68_1	53.688543	6.346607	93.42	1	301.52	29.32
05/04/2021	11:27:04	Plankton Net	Begin	BEGIN	69	69_1	53.688367	6.34642	134.64	1.3	311.64	NA
05/04/2021	11:31:25	Plankton Net	Start Heave	HEAV	69	69_1	53.68837	6.346134	298.41	1.1	307.03	28.3
05/04/2021	11:33:20	Plankton Net	End	END	69	69_1	53.6882	6.346247	134.56	2.2	303.81	30.45
05/04/2021	11:40:09	Plankton Net	Begin	BEGIN	70	70_1	53.687873	6.346296	149.28	1.6	307.58	30.54
05/04/2021	11:40:54	Plankton Net	Start Heave	HEAV	70	70_1	53.687845	6.346355	301.2	1.4	302.47	30.02
05/04/2021	11:43:07	Plankton Net	End	END	70	70_1	53.687676	6.34645	304.66	1.7	302.68	28.3
05/04/2021	11:47:34	Plankton Net	Begin	BEGIN	71	71_1	53.68726	6.346254	141.5	1.1	298.25	31.35
05/04/2021	11:48:44	Plankton Net	Start Heave	HEAV	71	71_1	53.687168	6.346495	87.29	0.8	303.99	NA
05/04/2021	11:51:53	Plankton Net	End	END	71	71_1	53.687229	6.346385	150.91	0.4	304.15	28.38
07/04/2021	7:34:25	CTD with samples	Begin	BEGIN	72	72_1	53.700993	6.336847	345.74	0.8	323.87	27.85
07/04/2021	7:35:36	CTD with samples	Bottom	BOT	72	72_1	53.701023	6.336756	286.34	0.6	321.95	27.2
07/04/2021	7:46:13	CTD with samples	End	END	72	72_1	53.700845	6.336729	148.99	1.9	301.15	28.33
07/04/2021	8:33:27	Boxcore K16	Bottom	BOT	73	73_1	53.700411	6.337091	11.14	0.7	327.61	26.59
07/04/2021	8:48:13	Boxcore K16	Bottom	BOT	74	74_1	53.700939	6.336652	152.26	0.9	321.47	29.04
07/04/2021	8:59:19	Boxcore K16	Bottom	BOT	75	75_1	53.700327	6.337366	326.53	1.8	328.8	26.44
07/04/2021	9:10:12	Boxcore K16	Bottom	BOT	75	75_2	53.700629	6.3372	346.67	0.9	324.74	26.99
07/04/2021	9:22:21	Boxcore K16	Bottom	BOT	76	76_1	53.700637	6.337318	315.63	0.4	321.4	27.18
07/04/2021	9:35:01	Boxcore K16	Bottom	BOT	77	77_1	53.700959	6.334186	132.8	1.6	320.93	27.39
07/04/2021	9:45:39	Boxcore K16	Bottom	BOT	78	78_1	53.701023	6.332366	99.51	0.7	322.47	27.52

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
07/04/2021	11:09:21	Boxcore K16	Bottom	BOT	79	79_1	53.687978	6.346647	148	1.1	312.76	28.97
07/04/2021	11:19:26	Boxcore K16	Bottom	BOT	80	80_1	53.687288	6.346654	306.76	0.5	313.23	27.66
07/04/2021	11:28:28	Boxcore K16	Bottom	BOT	81	81_1	53.687445	6.346467	348.05	1.2	323.56	27.95
07/04/2021	11:37:00	Boxcore K16	Bottom	BOT	81	81_2	53.687543	6.346584	121.93	1.2	319	29.85
07/04/2021	11:45:16	Boxcore K16	Bottom	BOT	82	82_1	53.687345	6.346461	333.11	1.2	313.35	26.6
07/04/2021	11:56:41	Boxcore K16	Bottom	BOT	82	82_2	53.686984	6.346452	291.44	1.3	312.26	27.2
07/04/2021	12:07:15	Boxcore K16	Bottom	BOT	83	83_1	53.68705	6.346608	329.58	0.7	316.69	28.48
07/04/2021	12:15:40	Boxcore K16	Bottom	BOT	84	84_1	53.687193	6.346418	324.45	1.2	313.33	28.14
08/04/2021	4:34:40	CTD	Begin	BEGIN	85	85_1	53.688243	6.349856	132.76	0.6	286.13	30.78
08/04/2021	4:45:08	CTD	End	END	85	85_1	53.688289	6.350101	NA	NA	NA	NA
08/04/2021	6:02:26	Boxcore K02	Bottom	BOT	86	86_1	53.694338	6.392	7.64	0.3	283.94	26.15
08/04/2021	6:28:24	Boxcore K02	Bottom	BOT	87	87_1	53.68773	6.346735	304.09	1.4	282.31	28.21
08/04/2021	6:37:18	Boxcore K02	Bottom	BOT	87	87_2	53.687812	6.346605	140.48	0.4	278.15	28.75
08/04/2021	6:53:31	Boxcore K02	Bottom	BOT	88	88_1	53.688256	6.349706	180.9	0.4	278.46	29.65
08/04/2021	7:06:24	Boxcore K02	Bottom	BOT	88	88_2	53.688176	6.349842	24.52	0.1	280.21	28.66
08/04/2021	7:18:59	Boxcore K02	Bottom	BOT	89	89_1	53.687815	6.34308	186.11	0.2	275.04	28.88
08/04/2021	7:32:40	Boxcore K02	Bottom	BOT	90	90_1	53.687636	6.346263	56.03	0.5	270.52	28.7
08/04/2021	9:15:09	Fish cages	Recovery	END	91	91_1	53.687175	6.352785	132.32	1	171.54	28.6
08/04/2021	9:44:32	Boxcore K02	Bottom	BOT	92	92_1	53.68745	6.347741	75.59	0.4	226.61	28.05
08/04/2021	11:53:28	Fish cages	Deploy	BEGIN	92	92_1	53.687499	6.339862	326	0.4	233.73	26.6
08/04/2021	12:12:15	Fish cages	Deploy	BEGIN	93	93_1	53.688145	6.34074	61.17	0.7	223.01	27.46
08/04/2021	12:36:29	Fish cages	Deploy	BEGIN	94	94_1	53.687131	6.345661	171.41	0.8	196.48	26.86
08/04/2021	13:01:47	Fish cages	Deploy	BEGIN	95	95_1	53.687798	6.343795	352.39	0.5	233.59	27.34
08/04/2021	13:30:48	Fish cages	Deploy	BEGIN	96	96_1	53.701627	6.346253	28.09	0.6	244.27	25.5
08/04/2021	13:53:20	Fish cages	Deploy	BEGIN	97	97_1	53.700963	6.350404	182.9	0.3	238.39	26.07
08/04/2021	14:17:14	Fish cages	Deploy	BEGIN	98	98_1	53.701243	6.33704	122.47	0.6	253.33	25.88
08/04/2021	14:44:03	Marsdieplander	Deployment	DEP	99	99_1	53.68724	6.348545	43.17	1	249.24	27.76
09/04/2021	6:24:33	Hammonhapper	Bottom	BOT	100	100_1	53.687773	6.346608	248.28	0.2	248.85	29.47
09/04/2021	6:34:26	Hammonhapper	Bottom	BOT	101	101_1	53.688239	6.349766	237.43	0.5	248.44	29.71

DD/MM/YYYY	HH:MM:SS	Device name	Action name	Action code	Station number	Strate	Latitude (DD.dddd)	Longitude (DD.dddd)	gndcourse	gndspeed	heading	depth_snd
09/04/2021	6:44:42	Hammonhapper	Bottom	BOT	102	102_1	53.687689	6.346297	289.21	0.1	254.01	29.26
09/04/2021	6:51:13	Hammonhapper	Bottom	BOT	103	103_1	53.687786	6.34673	235.55	0.1	253.04	29.81
09/04/2021	7:17:40	Hammonhapper	Bottom	BOT	104	104_1	53.687728	6.340608	355.54	0.2	255.74	28.12
09/04/2021	7:25:42	Hammonhapper	Bottom	BOT	105	105_1	53.687665	6.339938	26.84	0.2	254.32	28.9
09/04/2021	7:33:26	Hammonhapper	Bottom	BOT	106	106_1	53.687742	6.340041	65.07	0.2	253.11	28.58
09/04/2021	7:38:10	Hammonhapper	Bottom	BOT	107	107_1	53.687903	6.340079	357.32	0.3	250.26	29.27
09/04/2021	7:42:40	Hammonhapper	Bottom	BOT	108	108_1	53.687905	6.340143	319.87	0.2	250.78	28.7
09/04/2021	7:55:23	Hammonhapper	Bottom	BOT	109	109_1	53.687033	6.340117	278.48	0.3	254.5	29.02
09/04/2021	11:32:00	Fish cages	Recovery	END	109	109_1	53.687861	6.339832	178.67	0.2	7.65	27.92
09/04/2021	11:48:53	Fish cages	Recovery	END	110	110_1	53.688385	6.340535	98.32	0.1	356.86	28.48
09/04/2021	12:18:01	Fish cages	Recovery	END	111	111_1	53.68795	6.343759	34.34	0.5	4.93	27.58
09/04/2021	12:39:55	Fish cages	Recovery	END	112	112_1	53.687334	6.345771	120.86	0.3	353.04	27.93
09/04/2021	13:18:33	Marsdieplander	Recovery	END	113	113_1	53.69003	6.347759	349.55	4	353.44	28.78
09/04/2021	14:03:29	Fish cages	Recovery	END	114	114_1	53.700997	6.350463	336.77	0.3	359.19	25.27
09/04/2021	14:18:42	Fish cages	Recovery	END	115	115_1	53.701843	6.346446	162.88	0.7	355.64	25.5
09/04/2021	14:39:24	Fish cages	Recovery	END	116	116_1	53.701431	6.337008	109.61	0.5	325.76	25.5