THÜNEN Institute of Baltic Sea Fisheries (TI-OF)

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Cruise Report
FRV „Clupea" Cruise 351
18.01. - 05.02.2021

Study on changes in benthic and demersal fish communities after exclusion of mobile bottom-contacting fishing gear in marine protected areas of the German Baltic Sea

Scientists in charge: Dr. Daniel Oesterwind (TI-OF) & Michael Kriegl (TI-OF)

1. Background

The pilot mission "Protected Areas Baltic Sea: Effects of the exclusion of mobile bottom contacting fishing in marine protected areas" funded by the German Marine Research Alliance (DAM) aims to assess changes in the benthic and demersal fish fauna in two contrasting Natura 2000 sites after exclusion of mobile bottom-contacting fishing gear. This cruise served the purpose of assessing the current status (i.e. before the planned exclusion is implemented) of local fish communities in the marine protected areas Fehmarnbelt and Odra Bank.

2. Cruise Objectives:

- Assessing the fish fauna in the two study sites Fehmarnbelt and Odra Bank using beam trawls
- Collecting specimens for further analysis in the laboratory
- Conducting oceanographic measurements at the study sites (temperature, salinity and oxygen) to interlink fish occurrence with abiotic conditions
- Collecting video material of benthic habitats

Distribution list:

Ship management FFS „Clupea"
BA für Landwirtschaft und Ernährung (BLE) Fischereiforschung
BM für Ernährung und Landwirtschaft (BMEL), Ref. 614
BA für Seeschifffahrt und Hydrographie (BSH), Hamburg
Deutscher Angelfischerverband e.V.
Deutsche Fischfang-Union, Cuxhaven
Deutscher Fischereiverband Hamburg
Doggerbank Seefischerei GmbH, Bremerhaven
Erzeugergemeinschaft der Deutschen Krabbenfischer GmbH
Euro-Baltic Mukran
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
Kutter- und Küstenfisch Sassnitz
LA für Landwirtschaft, Lebensmittels. und Fischerei (LALLF)
LFA für Landwirtschaft und Fischerei MV (LFA)
Landesverband der Kutter- u. Küstenfischer MV e.V.
Leibniz-Institut für Ostseeforschung Warnemünde
Thünen-Institute - Institute of Fisheries Ecology
Thünen-Institute - Institute of Sea Fisheries
Thünen-Institute – Institute of Baltic Sea Fisheries
Thünen-Institute – Press office, Dr. Welling
Thünen-Institute – Presidential office
Thünen-Institute – Scheduling research vessels, Dr. Rohlf
Participants

3. Cruise narrative and preliminary results

3.1 Cruise narrative

The official start date of the cruise was Monday, January 18th 2021. After one day in port to set up fishing gear and sampling equipment, FRV Clupea left Rostock Marienehe on Tuesday, January 19th 2021. The cruise was separated into two legs:

During the first leg, fishing activities were conducted in Kiel Bight. From January 20th until January 26th, a total of 9 hauls using the 2m beam trawl and 9 hauls using the 3m beam trawl were performed within the marine protected area Fehmarnbelt (Natura 2000 site), in an area that is planned to be closed for mobile bottom-contacting fishing gears ("exclusion site") in the future, as well as an adjacent, corresponding reference site outside the Natura 2000 site (Fig. 1B). Within each site, 7 CTD casts were performed (cf. Table 1 for an overview of the number of realized beam trawl hauls and CTD casts per study site). While this fine-scale sampling of fish communities was conducted in the westernmost part of the marine protected area Fehmarnbelt, four further hauls using the 3m beam trawl were conducted in the eastern section of this Natura 2000 site on January 26th. The aim of these hauls was to retrieve specimens of *Lumpenus lampretaeformis* and gain further insights into the spatial and temporal distribution of this understudied species. After the successful completion of the first leg, FRV Clupea set course for the Pomeranian bay.

During the second leg, fishing was conducted around Odra Bank to the east of the island Rügen: From January 28th until February 2nd, a total of 8 hauls using the 3m beam trawl and 12 hauls using the 2m beam trawl were performed within the planned future exclusion site at Odra Bank as well as within the corresponding reference site (cf. Table 1, Fig. 1C). After an initial 4 hauls using the 2m beam trawl within the MPA site, the gear set-up (net construction) was adapted. Therefore, the sampling within the MPA site was repeated and complemented by sampling in the reference site. In total 9 CTD casts were performed at the MPA site, while 5 CTD profiles were recorded at the reference site.

On February 3rd, three further hauls using the 2m beam trawl were conducted just outside the Sassnitz harbour in an area known as "Sassnitzer Rinne". The aim of this sampling was to investigate if, during winter, certain fish species were more abundant in this deeper site than in comparatively shallower sites in the region. Due to bad weather conditions, fishing operations had to be stopped at midday. On February 4th, Clupea steamed towards the final destination of its 351st cruise, the harbour in Dänholm.

The fish caught with the beam trawl were identified to the lowest possible taxonomic level, counted, weighed and frozen for subsequent analysis in the laboratory. In addition to the fish communities sampled using the beam trawls, benthic organisms were collected from the catch at specific locations throughout the Fehmarnbelt as well as the Odra Bank region and frozen for subsequent isotope analysis in the laboratory. In order to get a visual glimpse of the studied benthic habitats, a GoPro was mounted on the 2m beam trawl. This setup enabled the collection of visual material of the benthic habitats (and the fishing procedure) at the future exclusion sites as well as the adjacent reference sites at Fehmarnbelt and Odra Bank.

In total, 24 hauls using the 2m-beam trawl as well as 21 hauls using the 3m-beam trawl were performed. The fish community sampling was complemented by a total of 29 CTD profiles recorded (cf. Tab. 4 for exact locations, date and time of gear deployment). Bad weather prohibited sampling for one day in Fehmarnbelt and another one-and-a-half days in Oderbank. Besides that, conditions remained good throughout the rest of the cruise, allowing fishing and related activities to be performed as planned.

The cruise ended on Friday, February 5th in Dänholm.

Table 1 Overview of the number of realized beam trawl hauls and CTD casts within the Natura 2000 sites Fehmarnbelt and Odra Bank, separated for management regimes ("Exclusion" = study site planned to be closed for mobile bottom-contacting fishing gear, "Reference" = nearby reference area of the same habitat type; * hauls before gear set-up was adapted).

Gear	Fehmarnbelt		Odra Bank	
	Exclusion	Reference	Exclusion	Reference
3m beam trawl	5	4	4	4
2m beam trawl	5	4	4 (+4*)	4
CTD casts	7	7	9	5

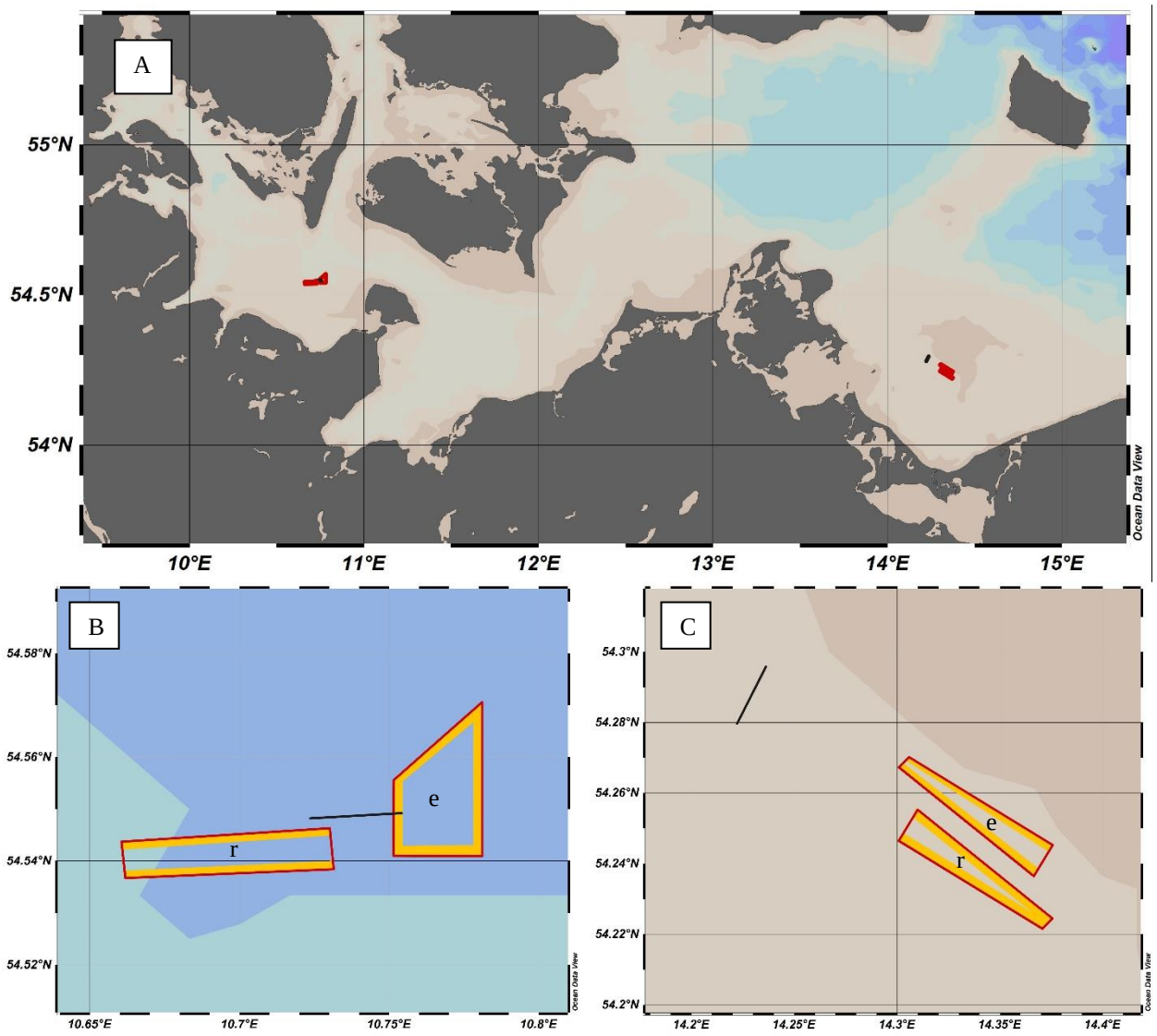

Figure 1 Maps illustrating the fishing stations realized during cruise CLU351. An overview map of the German Baltic Sea (A) as well as a close-up views of the study sites in Fehmarnbelt (B) and Odra Bank (C) are shown, with previously realized TV3-520 bottom trawl hauls indicated by black lines. Studied exclusion sites ("e") and corresponding reference sites ("r") are indicated by red polygons, with the areas sampled with beam trawls highlighted in orange.

3.2 Preliminary Results

During the present study on benthic and demersal fish communities occurring within the marine protected areas of the German Baltic Sea, a total of 1547 individual fish, belonging to 21 species and weighing a total of 30.7 kg were caught with the two different beam trawls.

The fish composition in the Fehmarnbelt region consisted mainly of dab (*Limanda limanda),* plaice *(Pleuronectes platessa)* and transparent goby (*Aphia minuta*), while the fish composition of Odra Bank was mainly made up of sand goby (*Pomatoschistus minutus*) with comparatively few individuals of flounder (*Platichthys flesus)* and plaice *(Pleuronectes platessa).* For the dominant fish species of the two areas, the mean and standard deviation of A) fish abundances per hectare and B) biomass (in kg) per hectare are presented in Figure 2 for Fehmarnbelt and Figure 3 for Odra Bank. For each area, the absolute abundances and biomass per species per management regime sampled during CLU351 are presented in Table 2.

With a total of 20 species, the Fehmarnbelt region exhibited a higher species richness compared to the Odra Bank region, where only 4 species were found.

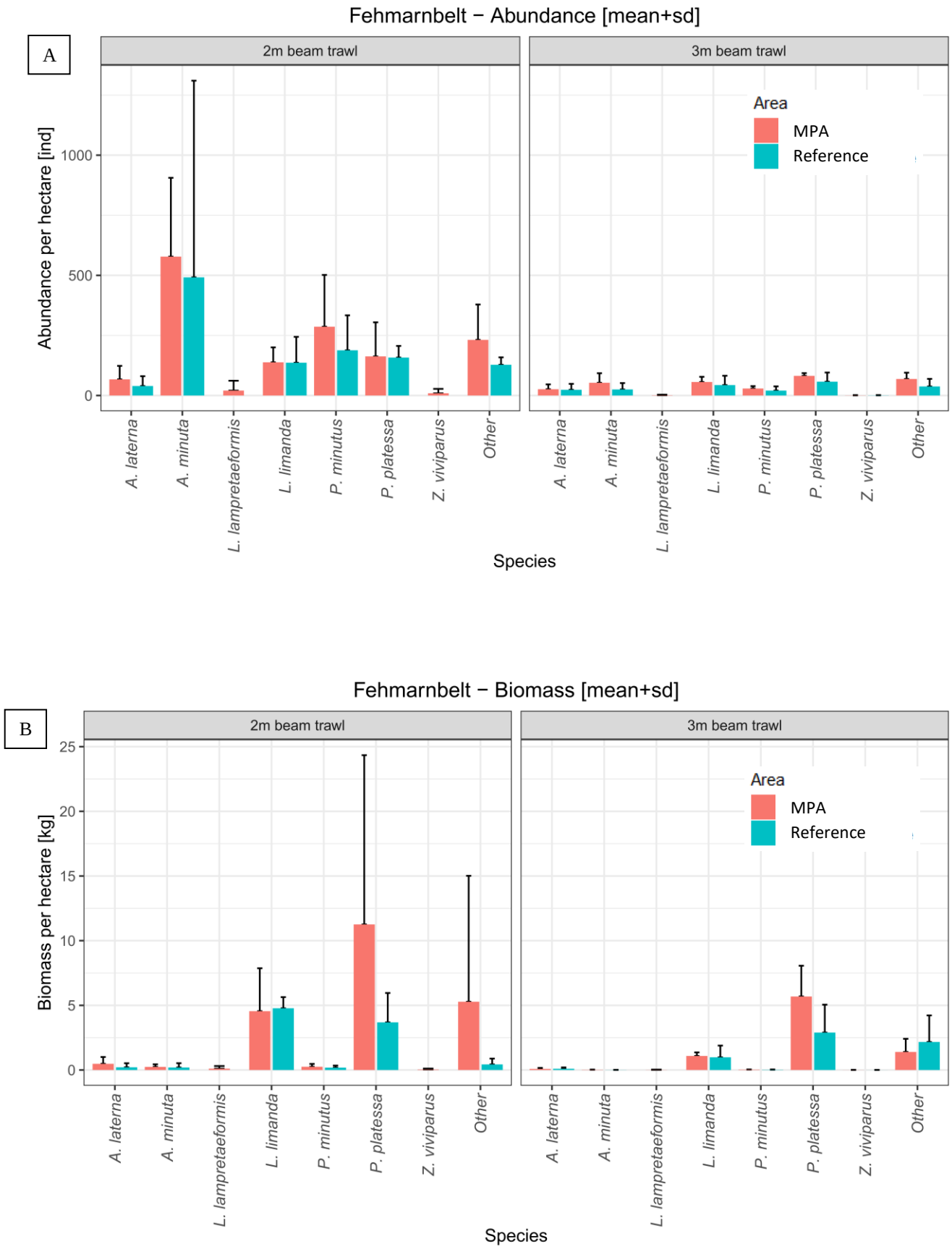

Figure 2. Mean and standard deviation of fish abundances per hectare (A) and biomass per hectare (B) for the dominant fish species of the area Fehmarnbelt, separated for employed fishing gear and management regime (MPA (red) = future exclusion site, Reference (blue) = corresponding reference site)

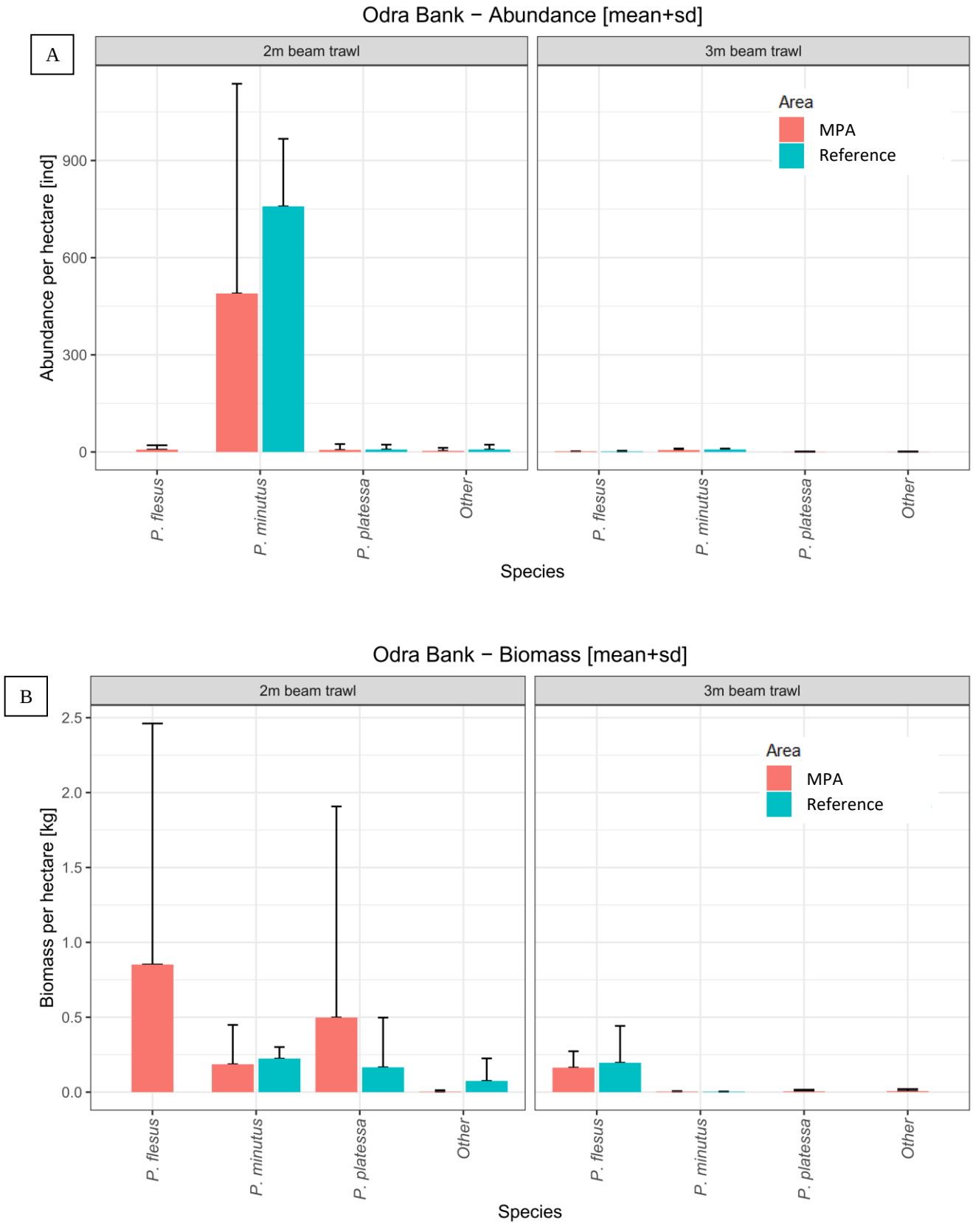

Figure 3. Mean and standard deviation of fish abundances per hectare (A) and biomass per hectare (B) for the dominant fish species of the area Odra Bank, separated for employed fishing gear and management regime (MPA (red) = future exclusion site, Reference (blue) = corresponding reference site)

Table 2 Fish species caught during the cruise CLU351 in the areas Fehmarnbelt and Odra Bank using 2m and 3m beam trawls. Absolute abundances (total number of individuals caught) and absolute biomass (total weight of individuals caught) are indicated per fish species, separated for management regime (Exclusion = study site planned to be closed for mobile bottom-contacting fishing gear, Reference = nearby reference area of the same habitat type).

Species	Fehmarnbelt				Odra Bank				Sum	
	MPA		Reference		MPA		Reference			
	Abundance [ind]	Biomass [g]	Abundance [ind]	Biomass [g]	Abundance [ind]	Biomass [g]	Abundance [ind]	Biomass [g]	Abundance [ind]	Biomass [g]
Zoarces viviparus	2	12	1	4	0	0	0	0	3	16
Pholis gunnellus	1	4	0	0	0	0	0	0	1	4
Gadus morhua	7	175	5	62	0	0	0	0	12	237
Platichthys flesus	1	522	3	1284	6	532	3	353	13	2691
Callionymus maculatus	0	0	2	70	0	0	0	0	2	70
Callionymus sp.	7	151	2	52	0	0	0	0	9	203
Aphia minuta	166	62	105	38	0	0	0	0	271	100
Syngnathus sp.	51	272	28	12	0	0	0	0	79	284
Limanda limanda	117	2501	94	2363	0	0	0	0	211	4864
Ctenolabrus rupestris	1	2	0	0	0	0	0	0	1	2
Arnoglossus laterna	55	206	46	190	0	0	0	0	101	396
Pomatoschistus minutus	87	83	61	60	154	62	119	37	421	242
Pleuronectes platessa	163	11337	123	5749	3	166	1	22	290	17274
Solea solea	9	1254	15	1366	0	0	0	0	24	2620
Lumpenus lampretaeformis	5	32	0	0	0	0	0	0	5	32
Sprattus sprattus	29	120	5	42	0	0	0	0	34	162
Scophthalmus maximus	0	0	1	536	0	0	0	0	1	536
Gobius niger	41	270	18	108	0	0	0	0	59	378
Ammodytes sp.	0	0	0	0	2	14	1	10	3	24
Enchelyopus cimbrius	0	0	1	2	0	0	0	0	1	2
Merlangius merlangus	3	284	3	284	0	0	0	0	6	568
Sum	**745**	**17287**	**513**	**12222**	**165**	**774**	**124**	**422**	**1547**	**30705**

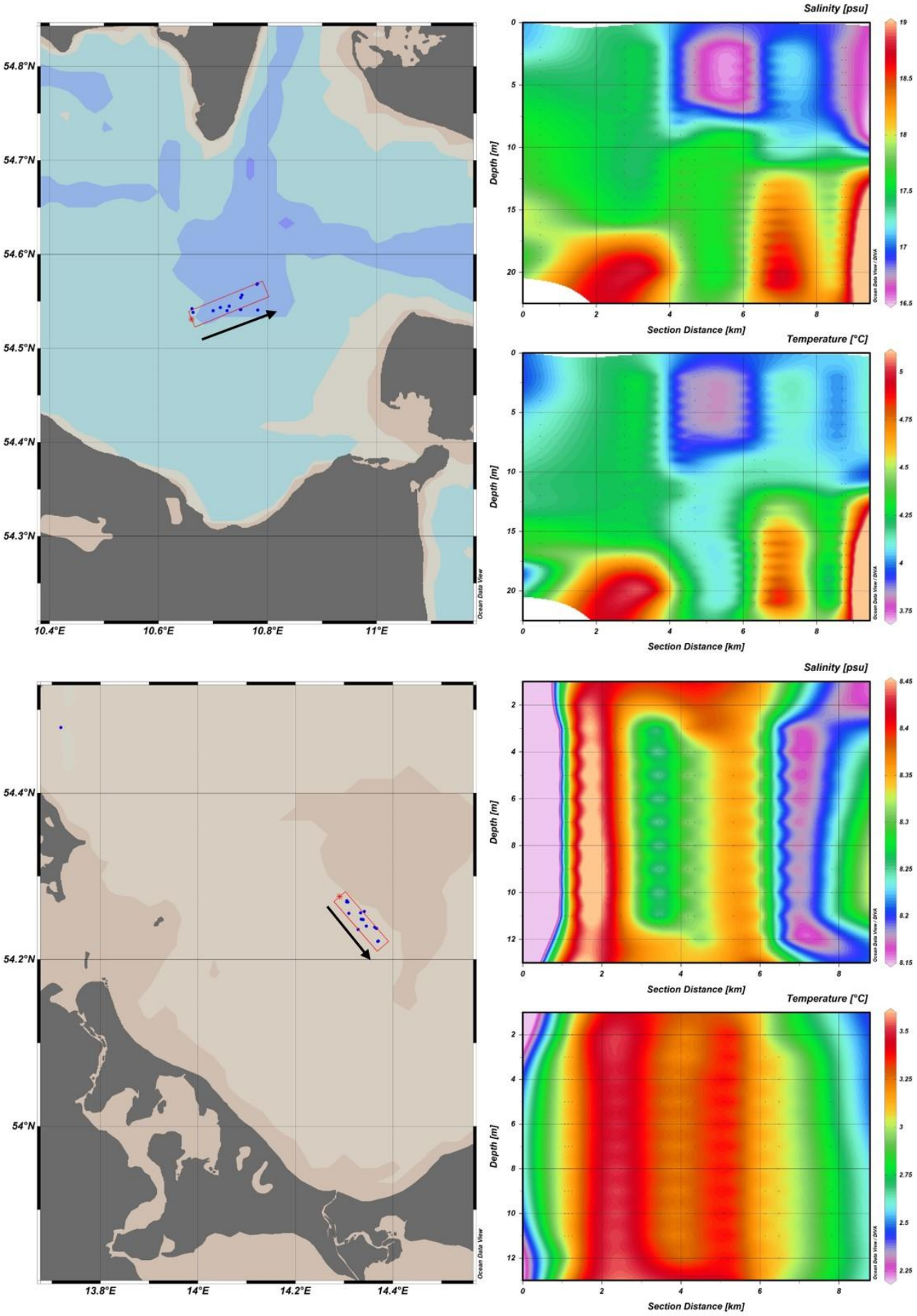

Figure 4 Overview of performed CTD casts during CLU351 with gridded temperature and salinity. Upper line: Fehmarn, lower line: Oder Bank

Fehmarn: CTD data illustrates an expected oceanographic situation, with small differences in water layers. Salinity ranges from 16.55 -18.9 and temperature 3.74 – 5.04°C increasing with depth.

Odra Bank: The water column at Odra Bank was more mixed compared to the Fehmarn area. In addition, salinity (8.16 – 8.44) and temperature (2.29 – 3.56°C) were lower and showed a smaller variance.

4. Cruise participants

Michael Kriegl	scientist	Thünen-OF
Linda Köhler	master student	Thünen-OF (18. - 26.1.)
Dr. Daniel Oesterwind	scientist	Thünen-OF (28.1. - 4.2.)

Dr. Daniel Oesterwind (TI-OF)

Michael Kriegl, M.Sc. (TI-O.F)

Station list

Table 4. Overview of the performed activities during FRV Clupea cruise 351, including station number, date and time (UTC) of deployment, area of deployment, device identifier (TBB = beam trawl, CTD = oceanographic probe) as well as latitude and longitude at the time of first bottom contact for beam trawls as well as at the start of gear deployment for CTD casts.

Station	Date & Time (UTC)	Area	Device Code	Latitude	Longitude
CL351-1-1	20.01.2021 08:56	Fehmarnbelt	CTD	54° 32.509' N	010° 45.078' E
CL351-2-1	20.01.2021 09:10	Fehmarnbelt	TBB 3m	54° 32.506' N	010° 45.126' E
CL351-3-1	20.01.2021 09:35	Fehmarnbelt	TBB 3m	54° 32.422' N	010° 46.502' E
CL351-4-1	20.01.2021 10:12	Fehmarnbelt	TBB 3m	54° 32.506' N	010° 44.962' E
CL351-5-1	20.01.2021 10:33	Fehmarnbelt	CTD	54° 33.388' N	010° 45.173' E
CL351-6-1	20.01.2021 11:40	Fehmarnbelt	TBB 3m	54° 33.387' N	010° 45.319' E
CL351-7-1	20.01.2021 12:03	Fehmarnbelt	CTD	54° 34.148' N	010° 46.872' E
CL351-8-1	20.01.2021 12:11	Fehmarnbelt	TBB 3m	54° 34.078' N	010° 46.959' E
CL351-9-1	20.01.2021 12:45	Fehmarnbelt	TBB 3m	54° 32.702' N	010° 43.849' E
CL351-10-1	22.01.2021 09:05	Fehmarnbelt	CTD	54° 32.629' N	010° 42.829' E
CL351-11-1	22.01.2021 09:18	Fehmarnbelt	TBB 3m	54° 32.660' N	010° 42.226' E
CL351-12-1	22.01.2021 09:46	Fehmarnbelt	CTD	54° 32.302' N	010° 39.783' E
CL351-13-1	22.01.2021 09:53	Fehmarnbelt	TBB 3m	54° 32.281' N	010° 40.155' E
CL351-14-1	22.01.2021 10:19	Fehmarnbelt	CTD	54° 32.441' N	010° 42.087' E
CL351-15-1	22.01.2021 10:26	Fehmarnbelt	TBB 3m	54° 32.370' N	010° 42.536' E
CL351-16-1	25.01.2021 09:08	Fehmarnbelt	CTD	54° 32.501' N	010° 45.059' E
CL351-17-1	25.01.2021 09:20	Fehmarnbelt	TBB 2m	54° 32.506' N	010° 45.047' E
CL351-18-1	25.01.2021 09:29	Fehmarnbelt	TBB 2m	54° 32.716' N	010° 45.167' E
CL351-19-1	25.01.2021 09:46	Fehmarnbelt	CTD	54° 33.254' N	010° 45.068' E
CL351-20-1	25.01.2021 09:58	Fehmarnbelt	TBB 2m	54° 33.298' N	010° 45.237' E
CL351-21-1	25.01.2021 10:18	Fehmarnbelt	CTD	54° 34.101' N	010° 46.861' E
CL351-22-1	25.01.2021 10:27	Fehmarnbelt	TBB 2m	54° 34.000' N	010° 46.934' E
CL351-23-1	25.01.2021 11:35	Fehmarnbelt	CTD	54° 32.437' N	010° 46.962' E
CL351-24-1	25.01.2021 11:44	Fehmarnbelt	TBB 2m	54° 32.405' N	010° 46.954' E
CL351-25-1	25.01.2021 12:09	Fehmarnbelt	CTD	54° 32.692' N	010° 43.800' E
CL351-26-1	25.01.2021 12:23	Fehmarnbelt	TBB 2m	54° 32.675' N	010° 43.797' E
CL351-27-1	25.01.2021 12:50	Fehmarnbelt	CTD	54° 32.537' N	010° 39.703' E
CL351-28-1	25.01.2021 12:57	Fehmarnbelt	TBB 2m	54° 32.475' N	010° 39.949' E
CL351-29-1	26.01.2021 08:57	Fehmarnbelt	CTD	54° 32.293' N	010° 39.800' E
CL351-30-1	26.01.2021 09:04	Fehmarnbelt	TBB 2m	54° 32.269' N	010° 40.031' E
CL351-31-1	26.01.2021 09:25	Fehmarnbelt	CTD	54° 32.404' N	010° 43.505' E
CL351-32-1	26.01.2021 09:34	Fehmarnbelt	TBB 2m	54° 32.442' N	010° 43.649' E
CL351-33-1	26.01.2021 11:31	Fehmarnbelt - East	TBB 3m	54° 36.076' N	011° 12.498' E
CL351-34-1	26.01.2021 11:42	Fehmarnbelt - East	TBB 3m	54° 36.353' N	011° 11.704' E
CL351-35-1	26.01.2021 12:06	Fehmarnbelt - East	TBB 3m	54° 36.645' N	011° 10.666' E
CL351-36-1	26.01.2021 12:27	Fehmarnbelt - East	TBB 3m	54° 36.263' N	011° 11.826' E
CL351-37-1	28.01.2021 10:45	Odra Bank	CTD	54° 16.236' N	014° 18.331' E
CL351-38-1	28.01.2021 10:52	Odra Bank	TBB 3m	54° 16.059' N	014° 18.673' E
CL351-39-1	28.01.2021 11:15	Odra Bank	CTD	54° 15.354' N	014° 20.067' E
CL351-41-1	28.01.2021 11:49	Odra Bank	CTD	54° 14.223' N	014° 22.034' E
CL351-42-1	28.01.2021 11:56	Odra Bank	TBB 3m	54° 14.141' N	014° 21.938' E

CL351-43-1	28.01.2021 12:18	Odra Bank	CTD	54° 14.868' N	014° 20.359' E
CL351-44-1	28.01.2021 12:25	Odra Bank	TBB 3m	54° 14.842' N	014° 20.243' E
CL351-45-1	29.01.2021 09:58	Odra Bank	CTD	54° 15.332' N	014° 18.584' E
CL351-46-1	29.01.2021 10:06	Odra Bank	TBB 3m	54° 15.256' N	014° 18.790' E
CL351-47-1	29.01.2021 10:28	Odra Bank	CTD	54° 14.380' N	014° 20.738' E
CL351-48-1	29.01.2021 10:36	Odra Bank	TBB 3m	54° 14.315' N	014° 20.947' E
CL351-49-1	29.01.2021 11:33	Odra Bank	CTD	54° 13.315' N	014° 22.182' E
CL351-50-1	29.01.2021 11:39	Odra Bank	TBB 3m	54° 13.333' N	014° 22.091' E
CL351-51-1	29.01.2021 12:05	Odra Bank	CTD	54° 14.177' N	014° 19.715' E
CL351-52-1	29.01.2021 12:11	Odra Bank	TBB 3m	54° 14.201' N	014° 19.538' E
CL351-53-1	01.02.2021 10:52	Odra Bank	CTD	54° 16.145' N	014° 18.449' E
CL351-54-1	01.02.2021 10:58	Odra Bank	TBB 2m	54° 16.196' N	014° 18.503' E
CL351-55-1	01.02.2021 11:20	Odra Bank	CTD	54° 15.450' N	014° 20.502' E
CL351-56-1	01.02.2021 11:26	Odra Bank	TBB 2m	54° 15.483' N	014° 20.587' E
CL351-57-1	01.02.2021 11:49	Odra Bank	CTD	54° 14.323' N	014° 21.773' E
CL351-59-1	01.02.2021 12:13	Odra Bank	CTD	54° 14.924' N	014° 20.079' E
CL351-61-1	02.02.2021 09:53	Odra Bank	CTD	54° 16.158' N	014° 18.339' E
CL351-62-1	02.02.2021 09:59	Odra Bank	TBB 2m	54° 16.106' N	014° 18.608' E
CL351-63-1	02.02.2021 10:16	Odra Bank	TBB 2m	54° 15.375' N	014° 20.767' E
CL351-64-1	02.02.2021 10:33	Odra Bank	TBB 2m	54° 14.173' N	014° 21.732' E
CL351-65-1	02.02.2021 10:54	Odra Bank	TBB 2m	54° 15.058' N	014° 19.768' E
CL351-66-1	02.02.2021 11:32	Odra Bank	TBB 2m	54° 15.298' N	014° 18.849' E
CL351-67-1	02.02.2021 11:48	Odra Bank	TBB 2m	54° 14.312' N	014° 20.770' E
CL351-68-1	02.02.2021 12:03	Odra Bank	CTD	54° 13.343' N	014° 22.230' E
CL351-69-1	02.02.2021 12:09	Odra Bank	TBB 2m	54° 13.334' N	014° 22.198' E
CL351-70-1	02.02.2021 12:26	Odra Bank	TBB 2m	54° 14.151' N	014° 19.817' E
CL351-71-1	03.02.2021 07:23	Sassnitzer Rinne	CTD	54° 28.702' N	013° 43.209' E
CL351-72-1	03.02.2021 07:33	Sassnitzer Rinne	TBB 2m	54° 28.806' N	013° 43.070' E
CL351-73-1	03.02.2021 07:42	Sassnitzer Rinne	TBB 2m	54° 29.103' N	013° 43.112' E
CL351-74-1	03.02.2021 07:51	Sassnitzer Rinne	TBB 2m	54° 29.379' N	013° 43.128' E