



Cruise Report
FRV „Clupea“ Cruise 343
06.07. - 22.07.2020

**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 cruise was originally planned to start on Monday, July 6th 2020. However, due to bad weather conditions, FRV Clupea left Rostock Marienehe with a 2-day delay, on Wednesday, July 8th 2020. The cruise was separated into two legs:

During the first leg, the fishing activity was conducted in Kiel Bight. While steaming towards Fehmarn on July 8th 2020, three hauls using the 3m beam trawl, followed by one CTD cast, were performed just off the coast of Warnemünde on request of researchers from the University of Rostock. The aim was to retrieve *Arctica islandica* samples and gain preliminary insights into the community composition of a potential future study site.

From July 9th until July 14th, 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 of the Natura 2000 site (Fig. 1B). Within each site, 4 CTD casts were performed (cf. Table 1 for an overview of the number of realized bottom trawl hauls and CTD casts per study site). This fine-scale sampling was complemented by one TV3-520 bottom trawl haul, preceded by a CTD cast, just along the northern border of the reference site (cf. Fig. 1B). After the successful completion of the first leg, FRV Clupea set course for the Pomeranian bay.

During the second leg, fishing was conducted at the area of Odra Bank to the east of the island Rügen: From July 16th until July 20th, a total of 8 hauls using the 3m beam trawl and 8 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). At each site, 4 CTD casts were performed. Additionally, one TV3-520 bottom trawl haul, preceded by a CTD cast, was conducted in the West of the study sites (cf. Fig. 1C).

At specific locations within the Fehmarnbelt as well as the Odra Bank region, water samples were collected using Niskin bottles mounted on the CTD rosette and prepared for subsequent isotope analysis in the laboratory. In order to collect visual material of the studied benthic habitats, a camera sledge equipped with a GoPro and lighting system was towed at Fehmarnbelt and Odra Bank, both within the future exclusion sites as well as the adjacent reference sites, for a cumulative duration of at least 30 minutes at each site.

In total, 17 hauls using the 2m-beam trawl, 20 hauls using the 3m-beam trawl as well as 2 hauls using the TV3-520 bottom trawl were performed. The data sampling was complemented by a total of 27 CTD profiles recorded (cf. Tab. 4 for exact locations, date and time of gear deployment). After an initial 2-day delay due to bad weather, conditions remained good throughout the rest of the cruise, allowing fishing and related activities to be performed as planned.

The fish caught with the beam trawl were identified to the lowest possible taxonomic level, counted, individually weighed and frozen for subsequent analysis in the laboratory. The fish caught with the TV3-520 bottom trawl were identified to species level, weighed and processed according to BITS standard.

The cruise ended on Wednesday, July 22nd in Rostock Marienehe.

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).

Gear	Fehmarnbelt		Odra Bank	
	Exclusion	Reference	Exclusion	Reference
3m beam trawl	5	4	4	4
2m beam trawl	5	4	4	4
CTD casts	4	4	4	4

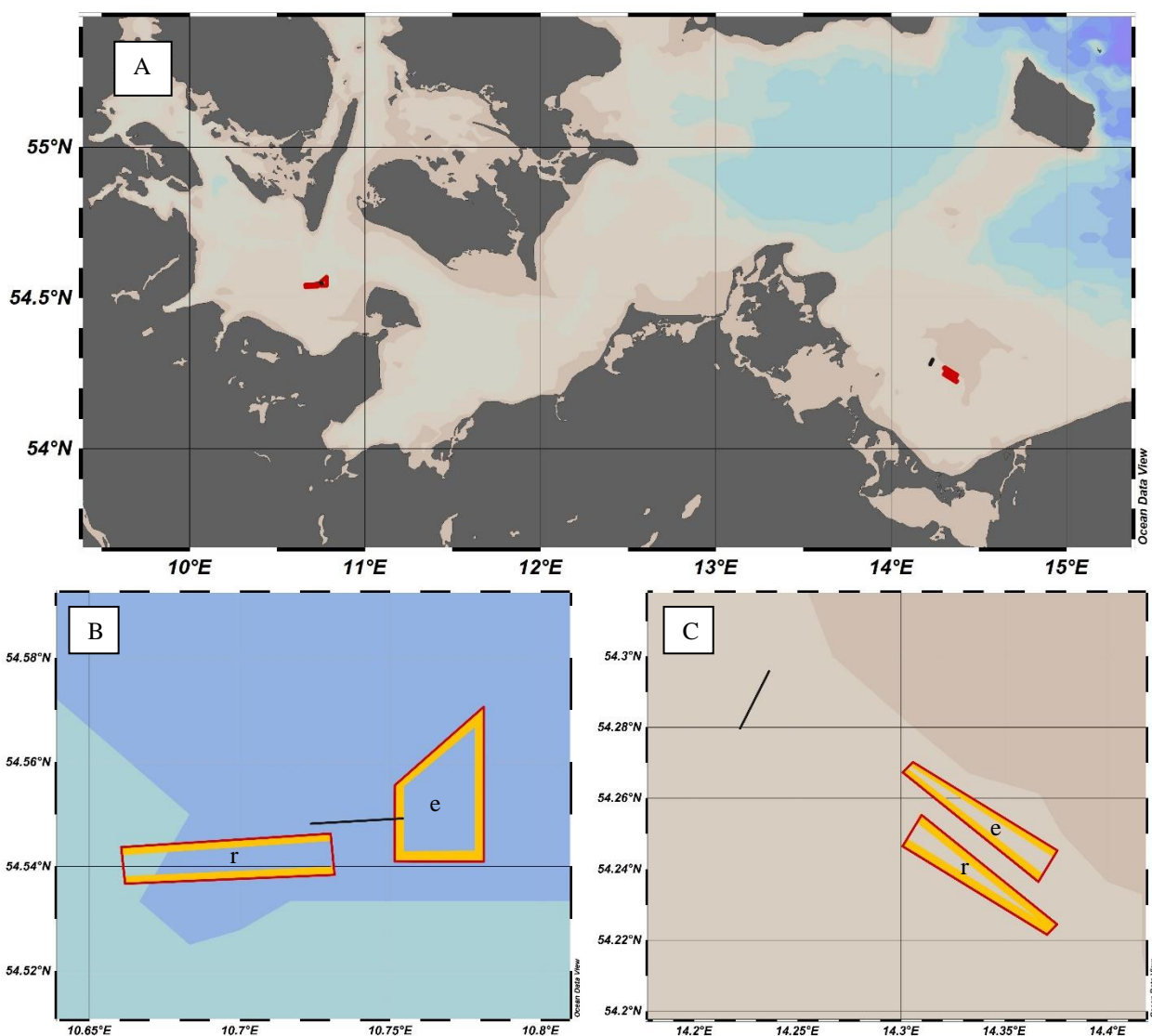


Figure 1 Maps illustrating the fishing stations realized during cruise CLU343. An overview map of the German Baltic Sea (A) as well as a close-up views of the study sites in Fehmarnbelt (B) and Odra Bank (C) are shown, with realized TV3-520 bottom trawl hauls indicated by black lines. Studied exclusion sites (“e”) and corresponding reference sites (“r”) are indicated by red polygons, with the areas sampled with beam trawls highlighted in orange.

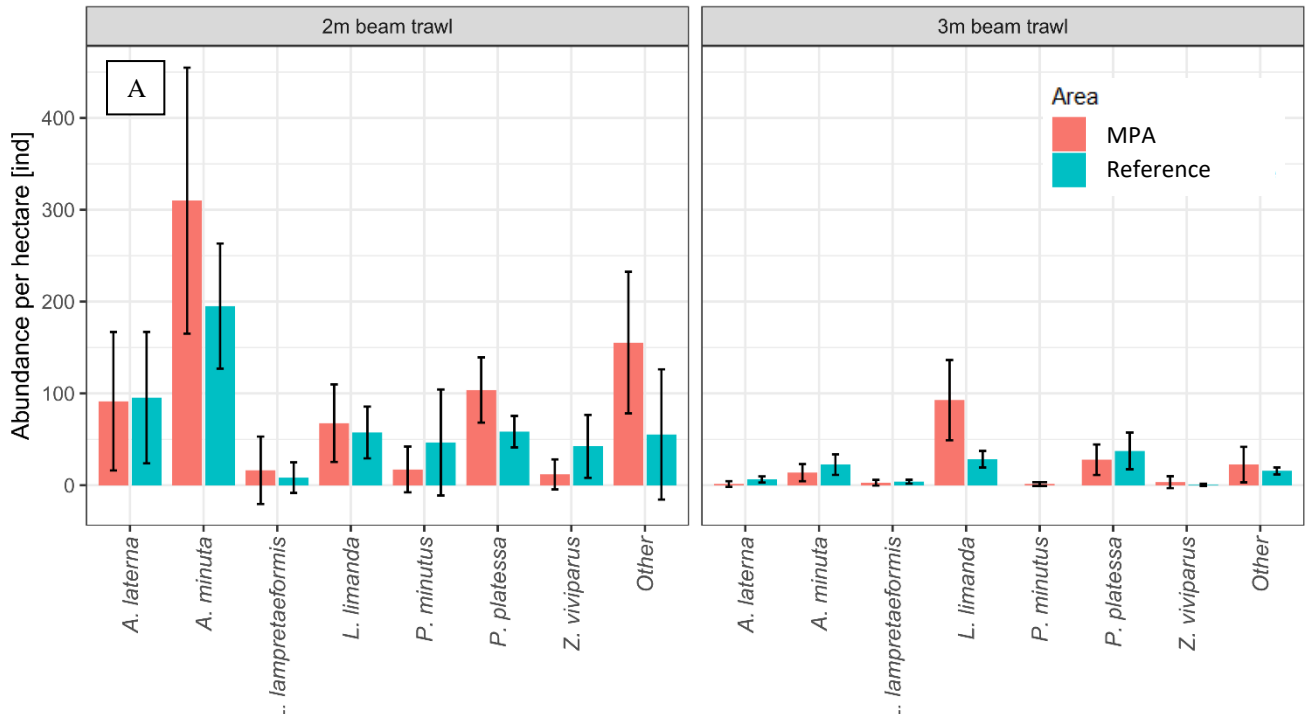
3.2 Preliminary Results

During the present study on benthic and demersal fish communities occurring within the marine protected areas of the German Baltic Sea, a total of 2260 individual fish, belonging to 23 species and weighing a total of 25.7 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*), transparent goby (*Aphia minuta*) and juvenile cod (*Gadus morhua*), while the fish composition of Odra Bank was mainly made up of sand goby (*Pomatoschistus minutus*), 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 are presented in Table 2.

With a total of 16 species, the Fehmarnbelt region exhibits a higher species richness compared to the Odra Bank region, where only 5 species were found.

Fehmarnbelt – Abundance [mean+sd]



Fehmarnbelt – Biomass [mean+sd]

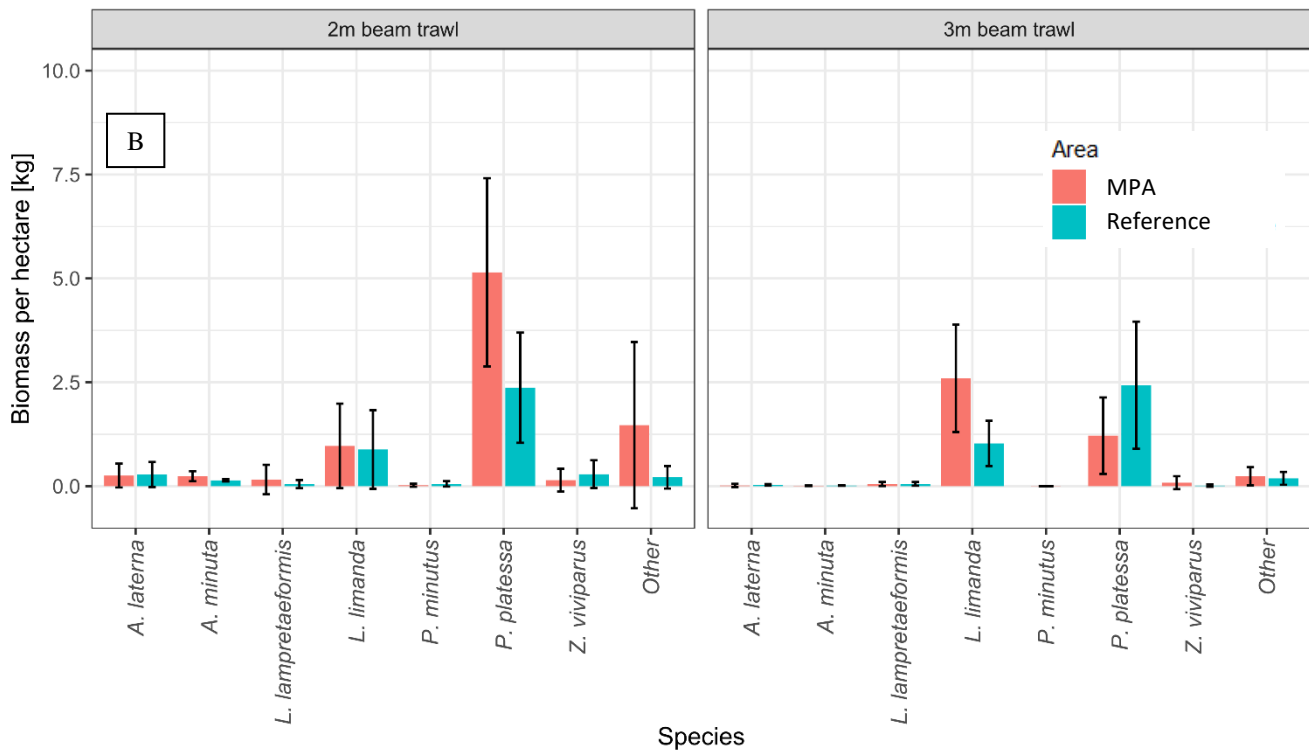


Figure 2. Mean and standard deviation of fish abundances per hectare (A) and biomass per hectare (B) for the dominant fish species of the area Fehmarnbelt, separated for employed fishing gear and management regime (MPA (red) = future exclusion site, Reference (blue) = corresponding reference site)

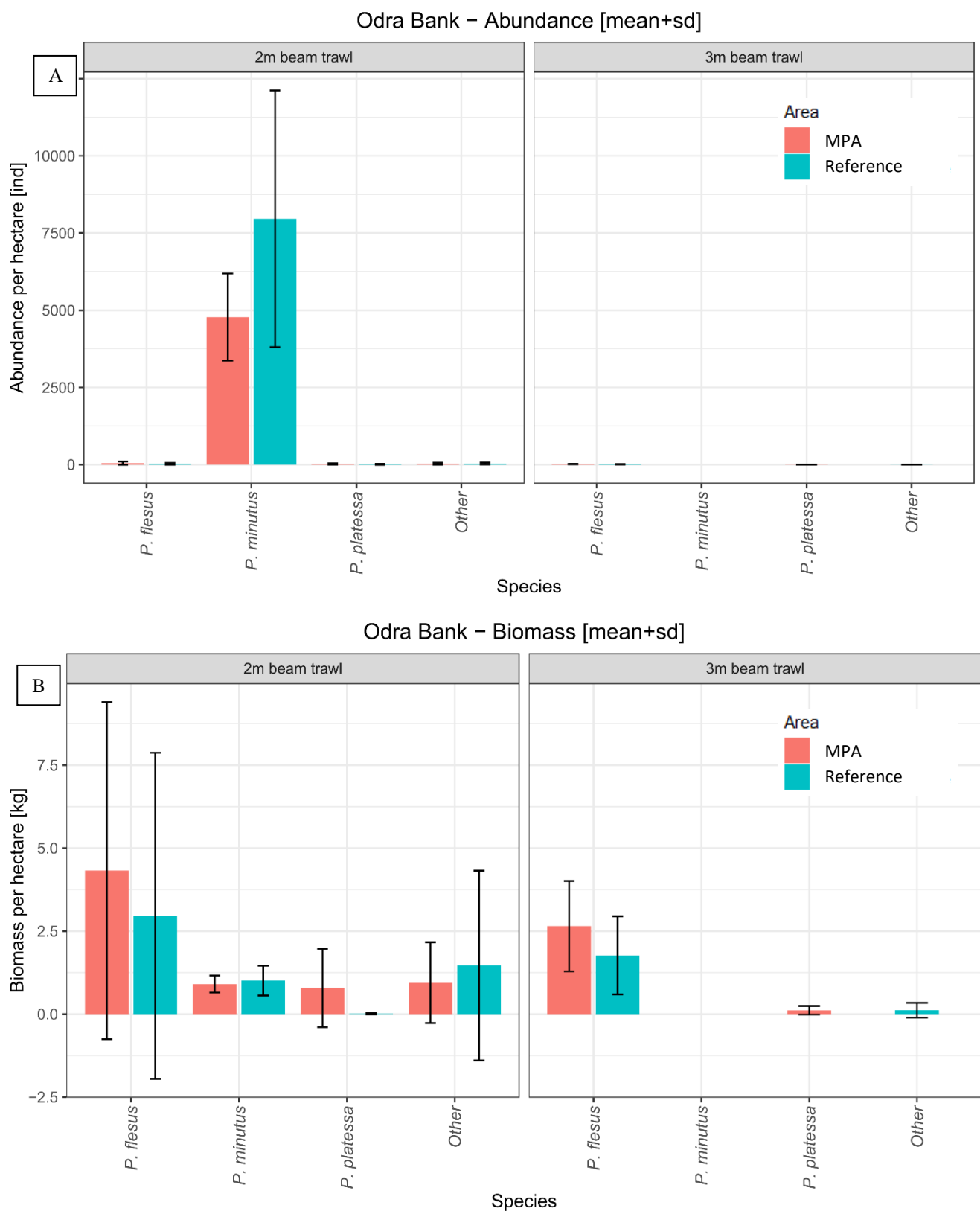


Figure 3. Mean and standard deviation of fish abundances per hectare (A) and biomass per hectare (B) for the dominant fish species of the area Odra Bank, separated for employed fishing gear and management regime (MPA (red) = future exclusion site, Reference (blue) = corresponding reference site)

Table 2 Fish species caught during the cruise CLU343 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]			
<i>Zoarces viviparus</i>	9	198,7		6	61,1		0	0,0		1	7,5		16	267,3
<i>Pholis gunnellus</i>	1	11,4		2	13,5		0	0,0		0	0,0		3	24,9
<i>Gadus morhua</i>	52	90,4		26	45,0		0	0,0		0	0,0		78	135,4
<i>Gasterosteus aculeatus</i>	0	0,0		0	0,0		1	0,2		0	0,0		1	0,2
<i>Platichthys flesus</i>	0	0,0		0	0,0		30	4887,4		20	3222,5		50	8109,9
<i>Callionymus maculatus</i>	4	11,2		0	0,0		0	0,0		0	0,0		4	11,2
<i>Callionymus lyra</i>	2	63,0		2	91,5		0	0,0		0	0,0		4	154,6
<i>Aphia minuta</i>	77	52,4		63	40,4		0	0,0		0	0,0		140	92,7
<i>Syngnathus typhle</i>	0	0,0		0	0,0		0	0,0		2	0,7		2	0,7
<i>Syngnathus rostellatus</i>	1	0,5		0	0,0		0	0,0		0	0,0		1	0,5
<i>Limanda limanda</i>	204	5377,7		55	1830,3		0	0,0		0	0,0		259	7207,9
<i>Arnoglossus laterna</i>	16	69,2		24	85,5		0	0,0		0	0,0		40	154,7
<i>Pomatoschistus minutus</i>	6	7,4		6	5,7		554	17,5		908	23,4		1474	54,0
<i>Pleuronectes platessa</i>	73	3328,7		71	4471,0		6	269,6		1	0,5		151	8069,7
<i>Myoxocephalus scorpius</i>	4	340,3		0	0,0		2	110,7		0	0,0		6	450,9
<i>Solea solea</i>	1	184,1		1	164,8		0	0,0		0	0,0		2	348,9
<i>Lumpenus lampretaeiformis</i>	9	132,8		8	99,8		0	0,0		0	0,0		17	232,7
<i>Sprattus sprattus</i>	0	0,0		1	13,3		0	0,0		0	0,0		1	13,3
<i>Scophthalmus maximus</i>	0	0,0		0	0,0		0	0,0		2	349,4		2	349,4
<i>Agonus cataphractus</i>	5	1,2		0	0,0		0	0,0		0	0,0		5	1,2
<i>Ammodytes tobianus</i>	0	0,0		0	0,0		0	0,0		1	0,1		1	0,1
<i>Enchelyopus cimbrius</i>	0	0,0		2	16,3		0	0,0		0	0,0		2	16,3
<i>Merlangius merlangus</i>	1	11,5		0	0,0		0	0,0		0	0,0		1	11,5
Sum	465	9880,4		267	6938,2		593	5285,3		935	3604,1		2260	25708,1

Oceanographic Data

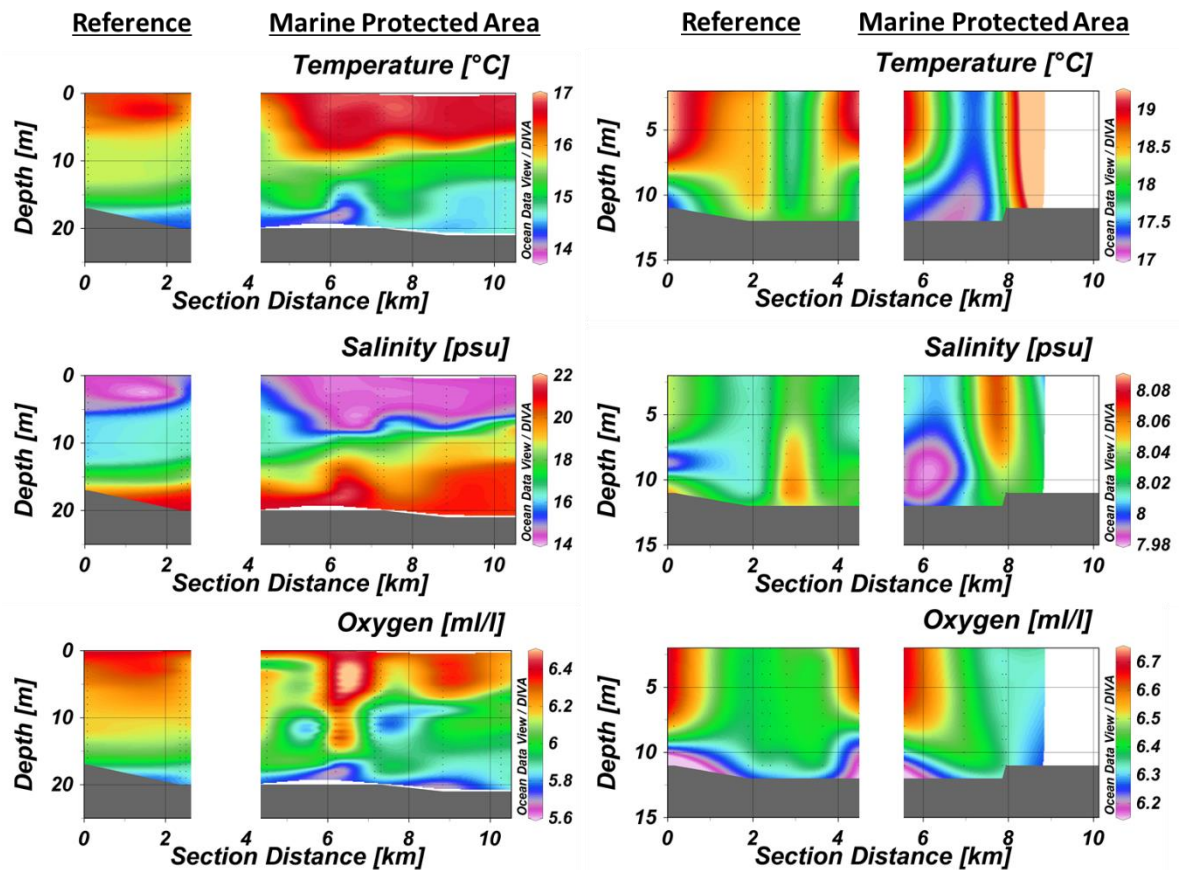


Figure 4 Overview of performed CTD casts during CLU343 with gridded temperature, salinity and oxygen profiles for the different study areas.

Fehmarn: CTD data illustrates an expected oceanographic situation, with small differences in water layers. Salinity ranges from (14.2 - 21.7 psu) increasing with depth, and temperature (14.0 – 16.9°C) as well as oxygen content decreasing with depth.

Odra Bank: The water column at Odra Bank was mixed with higher temperatures (ranging between 17.2 – 19.2°C) and lower salinity values (~8.0 psu) compared to the Fehmarn study site. However, comparatively higher temperatures observed along the Odra Bank indicated a warm water current flowing along this morphological structure as already indicated in spring.

4. Cruise participants

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Ina Hennings
Dr. Martin Paar

scientist Thünen-OF
technician Thünen-OF
scientist University of Rostock (only 9.07.2020)

Dr. Daniel Oesterwind (TI-OF)

Michael Kriegl, M.Sc. (TI-OF)

Station list

Table 4. Overview of the performed activities during FRV Clupea cruise 343, including station number, date and time (UTC) of deployment, area of deployment, device identifier (OTB = otter bottom trawl, TBB = beam trawl, CTD = oceanographic probe) as well as latitude and longitude at the time of first bottom contact for beam trawls and otter bottom trawls as well as at the start of gear deployment for CTD casts and video sledge transects.

Station	Date & Time (UTC)	Area	Device Code	Latitude	Longitude
CLU343-1-1	08.07.2020 07:59	Warnemünde	TBB 3m	54° 11.927' N	011° 57.454' E
CLU343-2-1	08.07.2020 09:01	Warnemünde	TBB 3m	54° 14.643' N	011° 53.094' E
CLU343-3-1	08.07.2020 09:55	Warnemünde	TBB 3m	54° 17.226' N	011° 46.707' E
CLU343-4-1	08.07.2020 10:50	Fehmarnbelt	CTD	54° 16.775' N	011° 45.940' E
CLU343-5-1	09.07.2020 07:56	Fehmarnbelt	CTD	54° 32.459' N	010° 45.051' E
CLU343-6-1	09.07.2020 08:10	Fehmarnbelt	TBB 3m	54° 32.443' N	010° 45.130' E
CLU343-7-1	09.07.2020 08:34	Fehmarnbelt	CTD	54° 32.381' N	010° 46.866' E
CLU343-8-1	09.07.2020 08:43	Fehmarnbelt	TBB 3m	54° 32.497' N	010° 46.916' E
CLU343-9-1	09.07.2020 09:15	Fehmarnbelt	CTD	54° 34.199' N	010° 46.934' E
CLU343-10-1	09.07.2020 09:25	Fehmarnbelt	TBB 3m	54° 34.086' N	010° 46.707' E
CLU343-11-1	09.07.2020 10:50	Fehmarnbelt	CTD	54° 33.288' N	010° 45.196' E
CLU343-12-1	09.07.2020 10:59	Fehmarnbelt	TBB 3m	54° 33.112' N	010° 45.125' E
CLU343-13-1	09.07.2020 11:32	Fehmarnbelt	TBB 3m	54° 32.467' N	010° 45.834' E
CLU343-14-1	09.07.2020 12:18	Fehmarnbelt	Video sledge	54° 33.647' N	010° 45.773' E
CLU343-15-1	09.07.2020 12:59	Fehmarnbelt	CTD	54° 33.503' N	010° 46.101' E
CLU343-16-1	09.07.2020 13:17	Fehmarnbelt	CTD	54° 32.522' N	010° 46.184' E
CLU343-17-1	10.07.2020 07:55	Fehmarnbelt	TBB 2m	54° 32.467' N	010° 45.080' E
CLU343-18-1	10.07.2020 08:16	Fehmarnbelt	TBB 2m	54° 32.573' N	010° 46.737' E
CLU343-19-1	10.07.2020 08:40	Fehmarnbelt	TBB 2m	54° 33.312' N	010° 46.833' E
CLU343-20-1	10.07.2020 09:07	Fehmarnbelt	TBB 2m	54° 34.036' N	010° 46.669' E
CLU343-21-1	10.07.2020 10:33	Fehmarnbelt	TBB 2m	54° 33.125' N	010° 45.202' E
CLU343-22-1	10.07.2020 11:27	Fehmarnbelt	Video sledge	54° 32.439' N	010° 41.889' E
CLU343-23-1	13.07.2020 08:05	Fehmarnbelt	CTD	54° 32.729' N	010° 43.729' E
CLU343-24-1	13.07.2020 08:15	Fehmarnbelt	TBB 3m	54° 32.730' N	010° 43.558' E
CLU343-25-1	13.07.2020 08:38	Fehmarnbelt	CTD	54° 32.611' N	010° 41.878' E
CLU343-26-1	13.07.2020 08:50	Fehmarnbelt	TBB 3m	54° 32.640' N	010° 41.588' E
CLU343-27-1	13.07.2020 09:16	Fehmarnbelt	CTD	54° 32.440' N	010° 39.644' E
CLU343-28-1	13.07.2020 09:24	Fehmarnbelt	TBB 3m	54° 32.294' N	010° 39.948' E
CLU343-29-1	13.07.2020 10:55	Fehmarnbelt	CTD	54° 32.443' N	010° 41.710' E
CLU343-30-1	13.07.2020 11:04	Fehmarnbelt	TBB 3m	54° 32.390' N	010° 41.883' E
CLU343-31-1	13.07.2020 11:43	Fehmarnbelt	TBB 2m	54° 32.657' N	010° 43.667' E
CLU343-32-1	13.07.2020 12:14	Fehmarnbelt	Video sledge	54° 32.658' N	010° 42.207' E
CLU343-33-1	14.07.2020 08:17	Fehmarnbelt	TBB 2m	54° 32.407' N	010° 39.804' E
CLU343-34-1	14.07.2020 08:36	Fehmarnbelt	TBB 2m	54° 32.272' N	010° 40.531' E
CLU343-35-1	14.07.2020 09:04	Fehmarnbelt	TBB 2m	54° 32.434' N	010° 43.025' E
CLU343-36-1	14.07.2020 11:13	Fehmarnbelt	CTD	54° 32.806' N	010° 45.198' E
CLU343-37-1	14.07.2020 11:32	Fehmarnbelt	OTB TV3-520	54° 32.746' N	010° 44.192' E
CLU343-38-1	16.07.2020 10:16	Odra Bank	CTD	54° 16.060' N	014° 18.014' E
CLU343-39-1	16.07.2020 10:26	Odra Bank	TBB 3m	54° 16.004' N	014° 18.233' E
CLU343-40-1	16.07.2020 10:51	Odra Bank	CTD	54° 15.172' N	014° 19.992' E
CLU343-41-1	16.07.2020 10:57	Odra Bank	TBB 3m	54° 15.062' N	014° 20.184' E
CLU343-42-1	16.07.2020 11:25	Odra Bank	CTD	54° 14.695' N	014° 22.211' E
CLU343-43-1	16.07.2020 11:34	Odra Bank	TBB 3m	54° 14.713' N	014° 22.105' E
CLU343-44-1	16.07.2020 11:57	Odra Bank	CTD	54° 15.450' N	014° 20.429' E
CLU343-45-1	16.07.2020 12:04	Odra Bank	TBB 3m	54° 15.462' N	014° 20.258' E

Table 4 (continued).

CLU343-46-1	16.07.2020 12:31	Odra Bank	TBB 3m	54° 15.173' N	014° 18.798' E
CLU343-47-1	16.07.2020 12:53	Odra Bank	CTD	54° 14.199' N	014° 19.878' E
CLU343-48-1	16.07.2020 13:00	Odra Bank	TBB 3m	54° 14.200' N	014° 19.764' E
CLU343-49-1	17.07.2020 09:58	Odra Bank	TBB 2m	54° 16.081' N	014° 18.590' E
CLU343-50-1	17.07.2020 10:48	Odra Bank	TBB 2m	54° 14.916' N	014° 21.704' E
CLU343-51-1	17.07.2020 11:02	Odra Bank	TBB 2m	54° 14.370' N	014° 21.791' E
CLU343-52-1	17.07.2020 11:30	Odra Bank	TBB 2m	54° 15.926' N	014° 18.386' E
CLU343-53-1	17.07.2020 11:58	Odra Bank	TBB 3m	54° 13.870' N	014° 21.552' E
CLU343-54-1	17.07.2020 12:21	Odra Bank	TBB 3m	54° 13.415' N	014° 22.092' E
CLU343-55-1	20.07.2020 08:41	Odra Bank	CTD	54° 15.288' N	014° 18.652' E
CLU343-56-1	20.07.2020 08:55	Odra Bank	TBB 2m	54° 15.251' N	014° 18.676' E
CLU343-57-1	20.07.2020 09:26	Odra Bank	CTD	54° 13.603' N	014° 22.135' E
CLU343-58-1	20.07.2020 09:32	Odra Bank	TBB 2m	54° 13.520' N	014° 22.299' E
CLU343-59-1	20.07.2020 09:48	Odra Bank	CTD	54° 13.300' N	014° 22.194' E
CLU343-60-1	20.07.2020 09:58	Odra Bank	TBB 2m	54° 13.358' N	014° 22.124' E
CLU343-61-1	20.07.2020 11:21	Odra Bank	CTD	54° 14.688' N	014° 18.548' E
CLU343-62-1	20.07.2020 11:28	Odra Bank	TBB 2m	54° 14.679' N	014° 18.421' E
CLU343-63-1	20.07.2020 12:09	Odra Bank	OTB TV3-520	54° 16.688' N	014° 13.253' E
CLU343-64-1	20.07.2020 12:54	Odra Bank	CTD	54° 18.272' N	014° 15.259' E
CLU343-65-1	21.07.2020 08:42	Odra Bank	CTD	54° 14.190' N	014° 20.472' E
CLU343-66-1	21.07.2020 09:06	Odra Bank	CTD	54° 15.238' N	014° 20.417' E
CLU343-67-1	21.07.2020 09:32	Odra Bank	Video sledge	54° 15.415' N	014° 19.514' E
CLU343-68-1	21.07.2020 11:04	Odra Bank	CTD	54° 14.453' N	014° 19.218' E
CLU343-69-1	21.07.2020 11:12	Odra Bank	Video sledge	54° 14.451' N	014° 19.470' E
CLU343-70-1	21.07.2020 11:50	Odra Bank	CTD	54° 14.363' N	014° 20.463' E
CLU343-71-1	21.07.2020 12:02	Odra Bank	CTD	54° 14.342' N	014° 20.787' E