ELISABETH MANN BORGESE-Berichte

MGF-OSTSEE-2024: Assessing the impact of mobile bottom trawl fishing in marine protected areas (Natura 2000) of the western Baltic Sea

Cruise No. EMB342

10.06.2024 – 17.06.2024,

Rostock (Germany) – Rostock (Germany)

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2024

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1 Cruise Summary

1.1 Summary in English

This cruise is part of the research project investigating the impact of mobile, bottom-touching fisheries in marine protected areas (MPAs) of the Baltic Sea ("MGF-Ostsee II"). A consortium of scientists from Leibniz, Helmholtz, Thünen and university institutes study how benthic ecosystems of the Natura 2000 areas in the German Exclusive Economic Zone (EEZ) will develop after the exclusion of mobile bottom-touching fisheries. The cruise serves to record all components of the benthic food web, from prokaryotes to macrozoobenthos, sediment characteristics and biogeochemical processes in MPAs Rönnebank and Oderbank, and complements a series of previous research cruises within this project starting from 2020. Comparative areas inside and outside the protected areas were sampled. The program also includes hydroacoustic mapping to capture the dynamics and density of trawl marks at the seabed. The work was also planned in the Fehmarnbelt area, but due to last-minute restrictions from BSH and the Bundeswehr we were forced to reduce the program from two to one week and could not sample in Fehmarnbelt area due to the ongoing military maneuver (Baltops). This caused a lot of unnecessary work for the entire consortium, though we applied for the ship time a year in advance (specifically for a time slot outside the period of maneuver, after having similar problems in 2023), informed the Bundeswehr about our program in January, and received a confirmation that Bundeswehr has no concerns and there will be no spatial overlaps of the planned EMB342 work and the maneuver activities in March.

1.2 Zusammenfassung

Die Reise erfolgt im Rahmen eines vom Bundesministerium für Bildung und Forschung (BMBF) geförderten interdisziplinären Forschungsprojektes zur Untersuchung der erwarteten Auswirkungen des Ausschlusses mobiler grundberührender Fischerei in Schutzgebieten der Ostsee (DAM Pilotmission „MGF-Ostsee II“, FKZ: 03F0937A). Ein Konsortium von Wissenschaftlern aus mehrere Forschungseinrichtungen und Universitäten untersucht wie sich die Ökosysteme der Natura 2000-Gebiete in der deutschen ausschließlichen Wirtschaftszone (AWZ) der Ostsee nach Ausschluss der mobilen grundberührenden Fischerei (MGF) entwickeln kann. Dafür werden alle Komponenten des benthischen Nahrungsnetzes, von Prokaryoten bis Makrozoobenthos, Sedimenteigenschaften und biogeochemische Prozesse innerhalb und außerhalb der Schutzgebiete Oderbank und Rönnebank erfasst. Das Programm umfasst auch hydroakustische Kartierungen, um Dynamik und Dichte von Schleppnetzspuren zu erfassen. Diese Fahrt ist die Fortsetzung einer Zeitserienbeprobung (seit 2020). Ursprünglich waren die Arbeiten auch im Gebiet Fehmarnbelt geplant. Wir musste aber der Fahrt jedoch auf eine Woche kürzen und dürfte das Gebiet Fehmarnbelt nicht anfahren aufgrund des durchgeführten militärischen Manövers (Baltops) und der deswegen nur begrenzt erteilten Genehmigung nach BbergG von BSH. Diese kurzfristigen Änderungen haben zu sehr viel unnötiger Arbeit für das ganze Konsortium und insbesondere für die Fahrtleitung geführt, obwohl der Fahrt bereits ein Jahr im Voraus (und gezielt nicht für den Zeitraum des Manövers) beantragt wurde, weil es im Jahr 2023 bereits ähnliche Probleme mit einer diesem Projekt assoziierten Fahrt gab. In der Schiffszeitplanung für 2024 wurden diese Erfahrungen leider nicht berücksichtigt.

2 Participants

2.1 Principal Investigators

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Gogina, Mayya Dr.	IOW
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Schulze, Inken Dr.	IOW
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Hartmut, Arndt, Prof. Dr.	Uni Köln
Forster, Stefan, Dr.	Uni Rostock
Powilleit, Martin	Uni Rostock

2.2 Scientific Party

Name	Discipline	Institution
Gogina, Mayya, Dr.	Chief Scientist, Macrozoobenthos	IOW
Piontek, Judith, Dr.	Deputy Chief Scientist, eDNA,	IOW
Schulze, Inken, Dr.	Hydroacoustic	IOW
Pankan, Linsy, Dr.	Geochemistry	GEOMAR
Ostmann, Alexandra, Dr.	Meiofauna	Senckenberg
Hartmut, Arndt, Prof. Dr.	Protists	Uni Köln
Pohl, Frank	Technician, Makrozoobenthos	IOW
Pomrehn, Sebastian	Technician, Makrozoobenthos	IOW
Ems, Ramona	Student, Microbiology	IOW
Janßen, Marjan, Dr.	Microphytobenthos	Uni Rostock
Ackermann, Alicia	Student, Makrozoobenthos	IOW/Uni Rostock
Okolski, Steffen	Technician, Geochemistry	GFZ

2.3 Participating Institutions

IOW	Leibniz Institute for Baltic Sea Research Warnemünde
GFZ	Geoforschungszentrum Potsdam
GEOMAR	GEOMAR - Helmholtz-Zentrum für Ozeanforschung Kiel
Senckenberg	Senckenberg am Meer, Deutsches Zentrum für Marine Biodiversitätsforschung
Uni Köln	Die Universität zu Köln
Uni Rostock	Die Universität Rostock

3 Research Program

3.1 Description of the Work Area

The main working areas of EMB342 cruise were the Rönnebank and Oderbank in the Pommeranian Bay of the Southern Baltic Sea. Investigation areas have been identified previously within or outside (reference, REF) of the marine protected areas (MPAs, see Figure 3.1 and Figure 3.2). For all areas, specific sampling locations have been determined and sampled in previous cruises 2020-2023. Sampling during EMB342 cruise was conducted with a similar methodology as previously. Working areas in Rönnebank are located in silty sediment, with some isolated stones with meter-scale diameters occurring throughout the southern part of the MPA area and particularly more frequent in proximity to the reef. The REF area located to the north is characterized by a rather smooth seafloor surface with trawl marks predominantly running in a north-south direction, also with the presence of individual stones (see Jürgens et al., 2024 - EMB320 cruise report). Oderbank is the large sandbank in the German Baltic Sea, mainly located in the water depths between 10 and 16 m (most sampled stations were located at ~15 m depth), composed of well-sorted fine sand. Water dynamics restrict the development of macrophytes, and the seafloor mainly represents bare fine sand, often with ripple structures, scattered unattached mussel clusters and drifting algae. The area is important as feeding ground for fish species like cod, herring and flat-fish, and wintering seabirds. In the Rönnebank focus area bottom salinity during the cruise ranged from 7.48 to 16.53 (and seemed to indicate an increase towards the end of the cruise, likely due to barotrophic currents). In the Oderbank bottom salinity showed little variability at sampled stations ranging from 7.31 to 7.35. Near-bottom water temperature ranged from 8.8 to 14.6°C in the Rönnebank area and from 15.4 to 16.1°C at the Oderbank. Near-bottom oxygen concentration overall varied from 3.24 to 6.7 ml/l (based on the data from CTD casts).

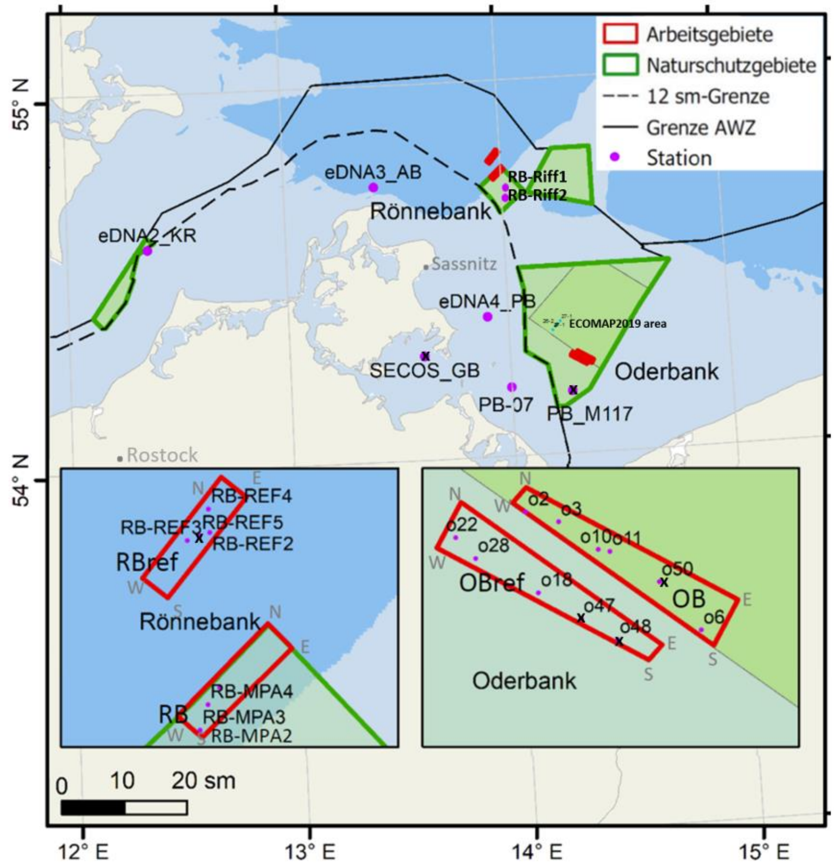

Fig. 3.1 Overview map with sampling areas inside and outside of the MPAs Rönnebank (or Rønne Bank) and Oderbank (or Odra Bank) and sampled locations in the south-western Baltic Sea. Purple points are initially planned sampling stations, "x" symbol on top of them indicate that stations was not sampled during EMB342.

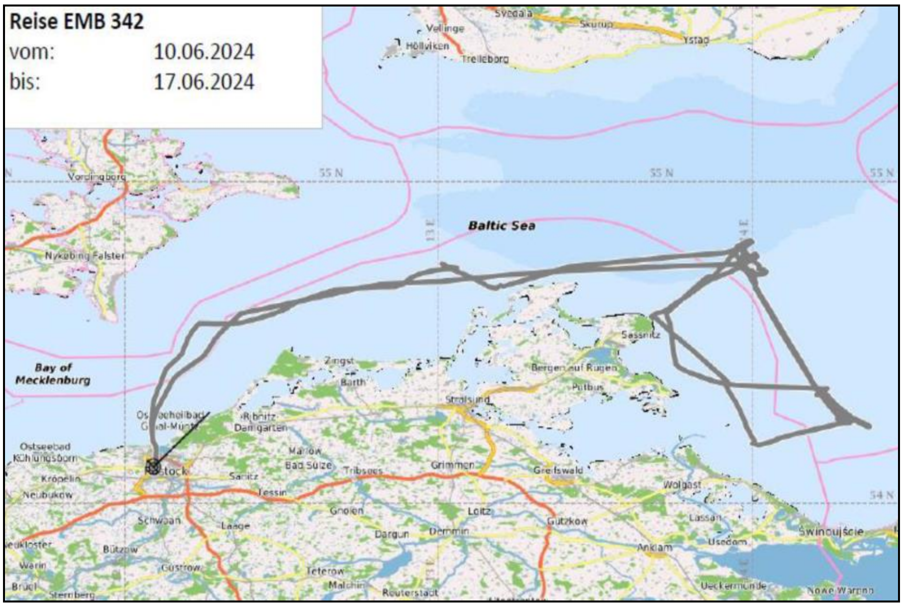

Fig. 3.2 Overview map of the cruise track.

3.2 Aims of the Cruise

The planned cruise is one in a series of cruises under the framework of the DAM pilot project "MGF-Ostsee" funded by BMBF in order to assess the development of sediments and benthic communities in MPAs of the German EEZ after closure of bottom fishing. Our main hypothesis is that soft sediment communities and sediment functions will gradually develop differently after the exclusion of bottom fishing compared to adjacent reference areas outside of the MPAs. We assume immediate direct effects on sediment microbial communities and biogeochemical processes, and a time lag of effects on larger organisms (macrozoobenthos, demersal fish populations) which again may indirectly impact the lower trophic levels of the benthic food chain and associated processes.

Major aim of this cruise was the assessment of spatio-temporal variability and environmental state in the still pre-closure condition in the German EEZ designated marine protected areas ("Rönnebank", "Oderbank" see Fig. 3.1). The focus is on areas within the MPAs which are soft sediment habitats were heavily trawled according to the VMS data during recent years (though now trawling intensity seem to reduce considerably), and where the effects of gradual decrease and the upcoming closure for bottom trawling fishing is expected to be most pronounced.

The cruise complements previous surveys (2020-2023) dedicated to capture the baseline state of the benthic ecosystem components within the marine protected areas (MPAs; Natura-2000 sites) of the German EEZ in the Baltic Sea before the closure for trawling fisheries, which is currently under EU negotiation and expected to be implemented soon. The survey of potential changes and successions in the MPAs is planned to continue after cessation of bottom-trawling. The sampling design is developed to compare similar study areas inside and outside the MPAs and constitutes the basis for a long-term monitoring necessary to document the impacts of bottom fisheries and recovery after its stops. The new findings gained in MGF Ostsee can be used by management and conservation authorities for implementation of the Habitats Directive and the Marine Strategy Framework Directive (MSFD) and further development of the Common Fisheries Policy.

3.3 Agenda of the Cruise

Due to ongoing NATO military manoeuver in the Western Baltic Sea at the time of the cruise, the time schedule and station plan had to be altered, leaving only 8 of 15 planned days at the sea. However, it was possible to conduct 2/3 of the initially planned program (full program in the altered plan), with intensive station work in the MPAs and their reference areas, mainly for hydroacoustic mapping, sediment investigations, and gain of eDNA samples.

List of equipment used for sampling and measurements: R2Sonic 2024 Edgetech 4000 echosounder system, Evo Logistig Ultra Short Baseline Acoustic System (USBL), Multicorer (MUC), van-Veen Greifer, Dredge, SeaViewer UW Video System, CTD, MilliQ, Titrino.

The Declaration of Responsible Marine Research (described in Appendix 1 of the Cruise Proposal Preparation Instructions (Revision 3.0)) as defined by the DFG Senatskommission für Ozeanographie and the KDM are accepted without reservations and were fully implemented.

During the cruise, special care was taken to minimize the environmental impact on marine ecosystems. Efforts were made to reduce pollution and disturbance to sensitive habitats by limiting the use of invasive sampling equipment to the absolute minimum necessary.

Additionally, the research team actively contributed to the development of non-invasive methods (see section 5.6), and fuel consumption was minimized wherever possible. No chemical tracers or any other chemicals were released into the sea during the cruise.

Regarding the operation of weak seismic and/or hydroacoustic sources (such as the onboard Multibeam Echosounder and Sub-Bottom Profiler), we implemented the mitigation measures described in Appendix 3 of the Cruise Proposal Preparation Instructions (Revision 3.0), quoted in the following:

"Start of measurements: Before a source is first triggered, in daylight and adequate visibility, operators should scan the area around the vessel up to a distance of 500 m (mitigation radius) for MMs from a suitable position for a period of 60 minutes. Measurements may only commence if no MMs are observed within the mitigation radius. In darkness, measurements may only commence if the working area is outside known breeding and nursery areas of MMs. If MMs were sighted during daylight hours on the previous day, in darkness the non-presence of MMs in the mitigation radius must be operationally demonstrated using suitable technical aids. If no such technical aids are available, measurements must commence in daylight.

Interruptions: If unscheduled interruptions of less than 5 minutes occur, measurements may continue immediately and without further checks. In the case of interruptions lasting 5-10 minutes, measurements may continue if no MMs have been observed within the mitigation radius. Otherwise, operators must wait until MMs have left this zone before measurements may recommence with a soft start. In the case of interruptions of more than 10 minutes, measurements must begin with a soft start assuming that no MMs have been observed within the mitigation radius. If a seismic source with minimal energy emission (a so-called mitigation pulser) is triggered continuously, measurements are regarded as non-interrupted."

4 Narrative of the Cruise

Monday, 10.06.

Departure took place at 16:00 due to logistical complications with the arrival of colleagues from more distant institutions (due to the shortened trip) and the preparation of equipment and lab spaces. A CTD station for eDNA (eDNA2_KR) was conducted on the way to the investigation area Rönnebank (RB). A modified replacement program allowed for the timely start of work in the Rönnebank investigation area. Arrival at the work area around 01:40. The work began with multibeam mapping to detect changes in trawl marks in the "Rönnebank MPA" focus area compared to the previous year and to fill spatial gaps. There were no weather-related restrictions on the work program that day (and night).

Tuesday, 11.06.

In the morning of 11.06., the station work (at station RB_MPA2) in the Rönnebank MPA area started with a CTD before breakfast to use the time more effectively before the forecasted weather-related restrictions. After breakfast, the first MUC samples (2 x MUC) and 4 x Van Veen grab samples as well as 1 x dredge sample were taken. By 10:40, we were at station RB_REF3 in the "Outside MPA" area. The station work here included 1 x CTD cast, 2 x MUC, 4 x Van Veen grab, 1 x dredge, and a relatively short underwater video transect (about 20 minutes, but with limited visibility due to waves and turbidity). Subsequently, two more stations at the Rönnebank reef were sampled for eDNA, with only one CTD device used at each station. In between, there was a two-hour delay in sampling due to a propulsion problem of the ship. The processing of the samples continued until dinner. Just before dinner, hydroacoustic work with additional multibeam recordings in the "Rönnebank MPA" followed. Night: Completion of the hydroacoustic profiles in the "Rönnebank MPA" area and departure south due to wind, high waves, and swell (during which work in the Rönnebank and Oderbank focus areas would not have been possible).

Wednesday, 12.06.

In the morning, a CTD was taken at station eDNA4_PB, followed by 4 grab samples and a short (3-minute trawl time) use of the Kieler Kinderwagen dredge (1 m width). Due to weather conditions, it was only possible to work at station PB-07 from our station list afterwards. After a CTD cast (with video) and 9 Van Veen grab deployments, including 5 unsuccessful hauls, it was clear that neither MUC nor dredge work was required on this habitat with mixed sediment, stones, and boulders with diameters partly over 10 cm. By the afternoon, wind and waves had decreased in the Oderbank focus area, and further station work was carried out with 1 x CTD, 4 grab samples, and 7 to 9 MUC deployments per station (o10 and o3) in the Oderbank MPA area to obtain enough usable cores for all project groups involved. All changes to the MUC with maximum weight and only 4 instead of 8 tubes per deployment allowed for slightly better penetration of a mussel layer at 15-20 cm depth, but generally no MUC core length over 20 cm could be obtained. At 18:00, multibeam recordings began in the "Oderbank MPA" area.

Thursday, 13.06.

The mapping ended at 06:30. Three stations in the Oderbank REF area (o18, o22, o28) were on the plan for this day to be able to repeat a total of eight stations from previous years during this trip. The morning was spent with 2 CTD and 7 MUC casts, 6 Van Veen grab samples, 1 dredge, and 2 short underwater video deployments; the afternoon with 1 x CTD, 11 x MUC, 3 x Van Veen, 1 x underwater video, and subsequent multibeam recordings (from 17:15).

Friday, 14.06.

The mapping was completed around 3:45 ship time. From 4:00, the transit began towards the Rönnebank MPA area to utilize a day with acceptable weather conditions there. Two stations in the Rönnebank MPA area and 1 station in the Rönnebank REF area (RB_MPA3, RB_MPA4, RB_REF2) were sampled with CTD, MUC, and Van Veen that day. Video recordings and a short dredge deployment in Rönnebank MPA were also made up for. In the afternoon, while processing the samples, an attempt was made to locate the tracks of some MUC and Van Veen samples on the seabed using MBES in the Rönnebank MPA area. Just before 17:00, hydroacoustic work began in the "Rönnebank REF" area.

Saturday, 15.06.

The mapping was completed around 2:40 ship time, then departure towards the Oderbank MPA area to finish the work there. Three stations were again on the plan: o2, o11, and o6. After breakfast, an attempt was made to commission the USBL system, unfortunately without success (ping shows active, but the coordinates of the USBL do not change compared to the introduction in the port of Marienehe and show unrealistic positions). We were well-practiced and managed (despite the sometimes borderline weather) to complete 2 x CTD, 15 x MUC, 9 x Van Veen casts, and some multibeam profiles in multifrequency mode by 14:40 ship time. Then the work in the MGF Oderbank focus area was completed. The originally planned stations SECOS_GB could not be sampled this time due to too shallow an approach in west wind and relatively uncertain bathymetry with RV ELISABETH MANN BORGESE. After sampling at stations eDNA4_PB and PB_07, sampling at station PB_M117 also seemed no longer relevant. Therefore, we planned to sample one more station (RB-REF4) on the Rönnebank on the last day at sea to reach a total of 3 stations inside and outside the protected areas. During the transit there, we took the opportunity to survey an interesting area we had already visited in January 2019 with underwater video and multibeam to acoustically capture strip-like aggregations of Mytilus edulis/trossulus. This time, however, this interesting biological phenomenon was not detectable in the area.

Sunday, 16.06.

A CTD cast was conducted before breakfast and 2 x MUC and 3 x Van Veen grab samples at station RB-REF4 outside the Rönnebank MPA area were taken after breakfast. Then the departure towards Rostock took place, during which the CTD sample at station eDNA3-AB could be made up. Scientific work was completed around 22:00 during the return journey to Rostock, where the ship moored at 08:00 on 17 July, and the cruise EMB342 came to a successful end.

Monday, 17.06.

Arrival in Rostock before 8:00.

5 Preliminary Results

5.1 SEDIMENTOLOGY and GEOPHYSICS (MGF-OSTSEE II WP 1.1)

(Inken Schulze[1])
[1]IOW

The main objective of the hydroacoustic mapping during the survey was to reveal the impact of bottom fisheries on seafloor morphology and composition. The hull-mounted R2Sonic 2024 Multibeam Echo Sounder (MBES) was utilized to collect comprehensive seafloor bathymetry and backscatter data for two survey sites at each of the two areas (Rönne Bank and Oder Bank). The sound velocity profiles (SVP) from several CTD casts at every survey site was used during post-processing, ensuring accurate depth measurements by compensating for the variability in the speed of sound within the water column.

5.1.1 Methods

R2Sonic 2024 multibeam echosounder (MBES)

The seafloor bathymetry and backscatter data were acquired using a hull-mounted multibeam echosounder (MBES) system manufactured by R2Sonic. MBES is a sophisticated sonar system commonly used for mapping the seafloor surface. The system was operated with a swath width of 120 degrees, which refers to the angle covered by the sonar beams. The recording frequency of the MBES was set to a frequency of 400 kHz. The frequency choice is significant as it impacts the resolution and depth penetration of the sonar signal. The following recording parameters were selected (Table 5.1.1):

Table 5.1.1 R2Sonic 2024 settings

	RB_MPA	RB_REF	OB_MPA	OB_REF	OB_ecomap
Frequency [kHz]	400	400	400	400	400
Swath Width [°]	120	120	120	120	120
Ping Rate [Hz]	9.1	6.3	24	24	21.9
Range [m]	70	100	25	25	25
Power [dB]	200	206/203	200/197	194	191
Pulse Width [µs]	35	100	20	20	100/25
Gain	10	10	3	5	10
Absorption [dB/km]	80	80	80	80	80
Spreading	20	20	20	20	20
BSM	ed4	uhd	ed4	ed4	uhd

The vessel’s speed during data acquisition was 4 to 5 knots, adjusted according to water depth and the consequential ping rate. The profile distances were 75 m for Rönne Bank and 25 m for Oder Bank. The hydroacoustic data was post-processed using the QPS Qimera and FMGT software. Sound velocity data from CTD measurements are available for post processing.

5.1.2 Preliminary Results

Rönne Bank (RB)

Bathymetric mapping of the Marine Protected Area (MPA) at Rönne Bank area reveals individual trawl marks curving within the flat sediments north of the slightly elevated the Rönne Bank. Meter-scale isolated stones are distributed throughout the area. The reference area (REF) to the north features a smooth seafloor surface with trawl marks predominantly running north-south and some isolated stones (Fig, 5.1.1, Fig, 5.1.2, Fig, 5.1.3).

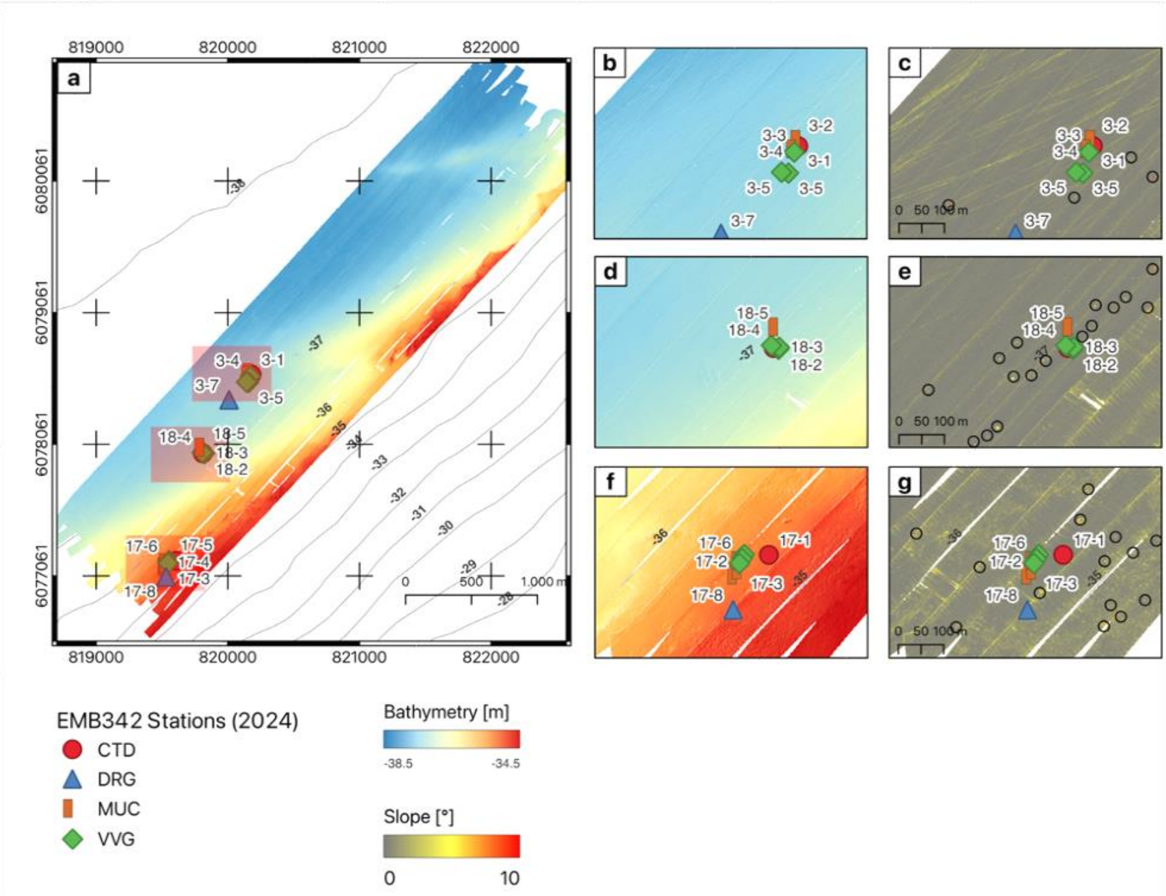

Fig. 5.1.1 (a) Bathymetric map of Rönne Bank MPA area. The impact of trawl tracks on the seafloor surface is clearly visible in the bathymetry with hillshading (b, d, f) and slope data (c, e, g) at the respective stations. Circles mark some of the isolated stones of meter-scale diameter (b, d, f).

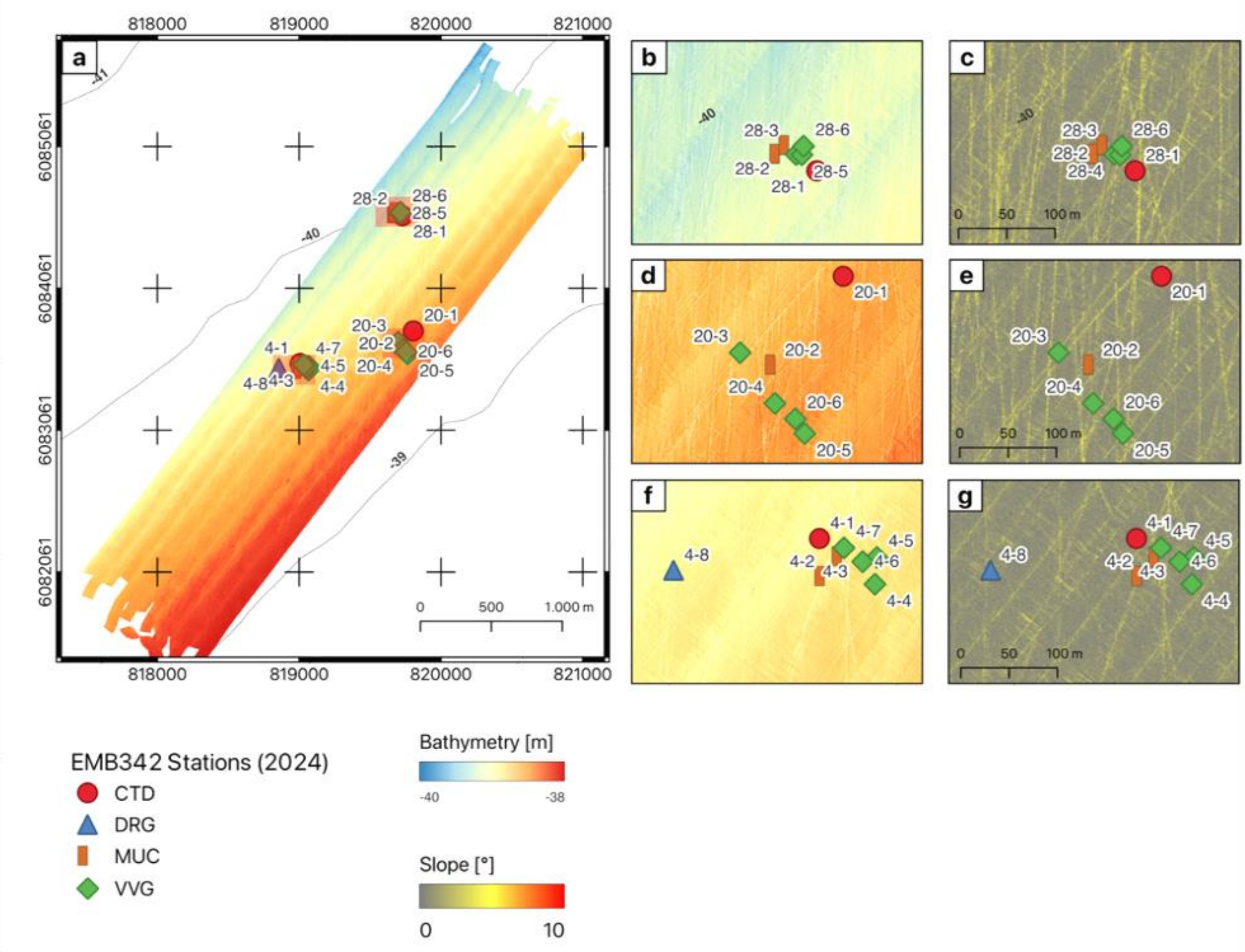

Fig. 5.1.2 (a) Bathymetric map of the REF area at Rönne Bank area. The impact of trawl tracks on the seafloor surface is clearly visible in the bathymetry with hillshading (b, d, f) and slope data (c, e, g) at the respective stations.

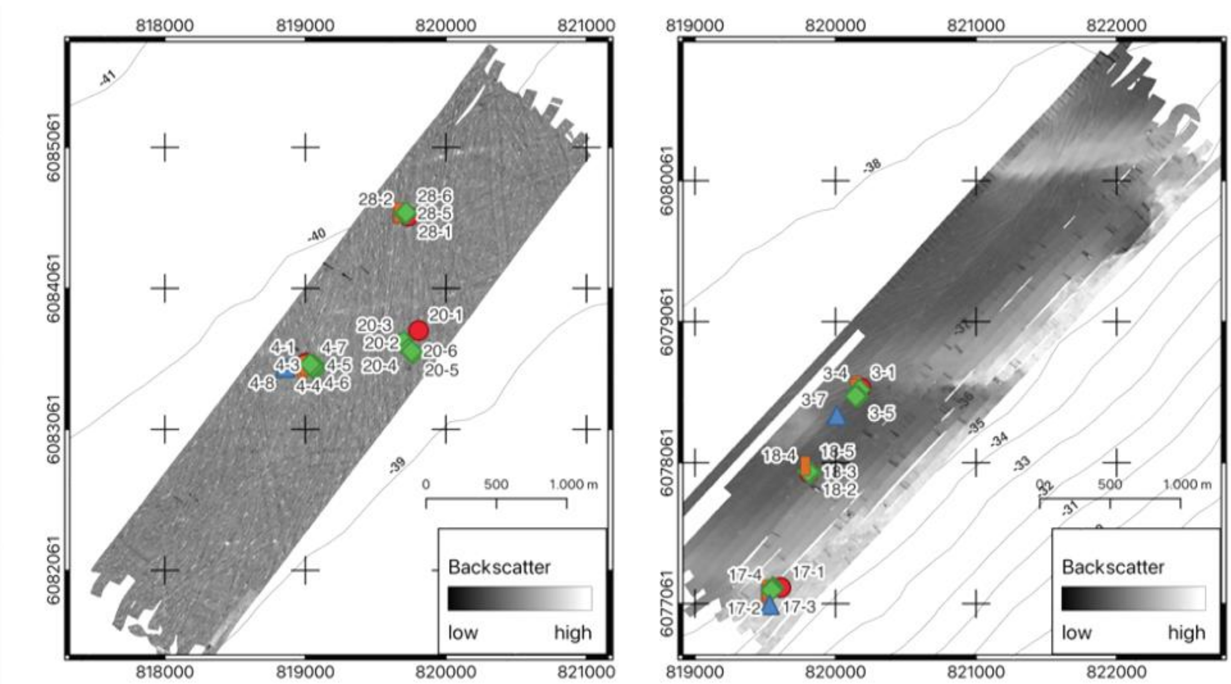

Fig. 5.1.3 Backscatter maps of the REF area (left) and MPA (right) at Rönne Bank area with trawl marks present as described in the data before. Please note: this is a preliminary data processing.

Oder Bank (OB)

The fine-sand Oder Bank exhibits a flat and smooth seafloor surface in both the Marine Protected Area (MPA) and the reference area (REF), with no detectable trawl marks apparent in the bathymetric, slope or backscatter data (Fig. 5.1.4, Fig. 5.1.5).

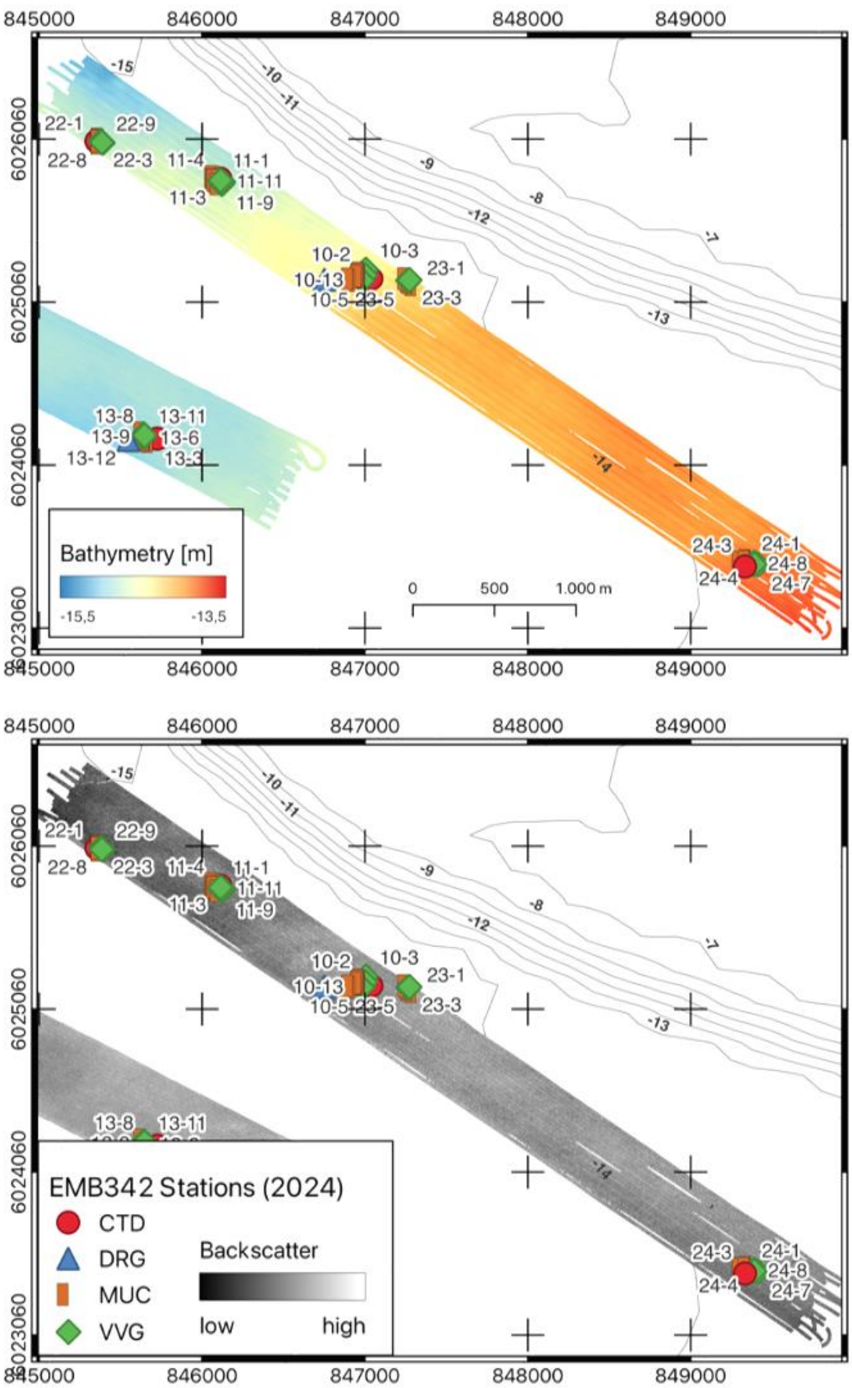

Fig. 5.1.4 Bathymetric (upper) and backscatter (lower) map with hillshade of the MPA at Oder Bank area. No trawl marks are visible in the data.

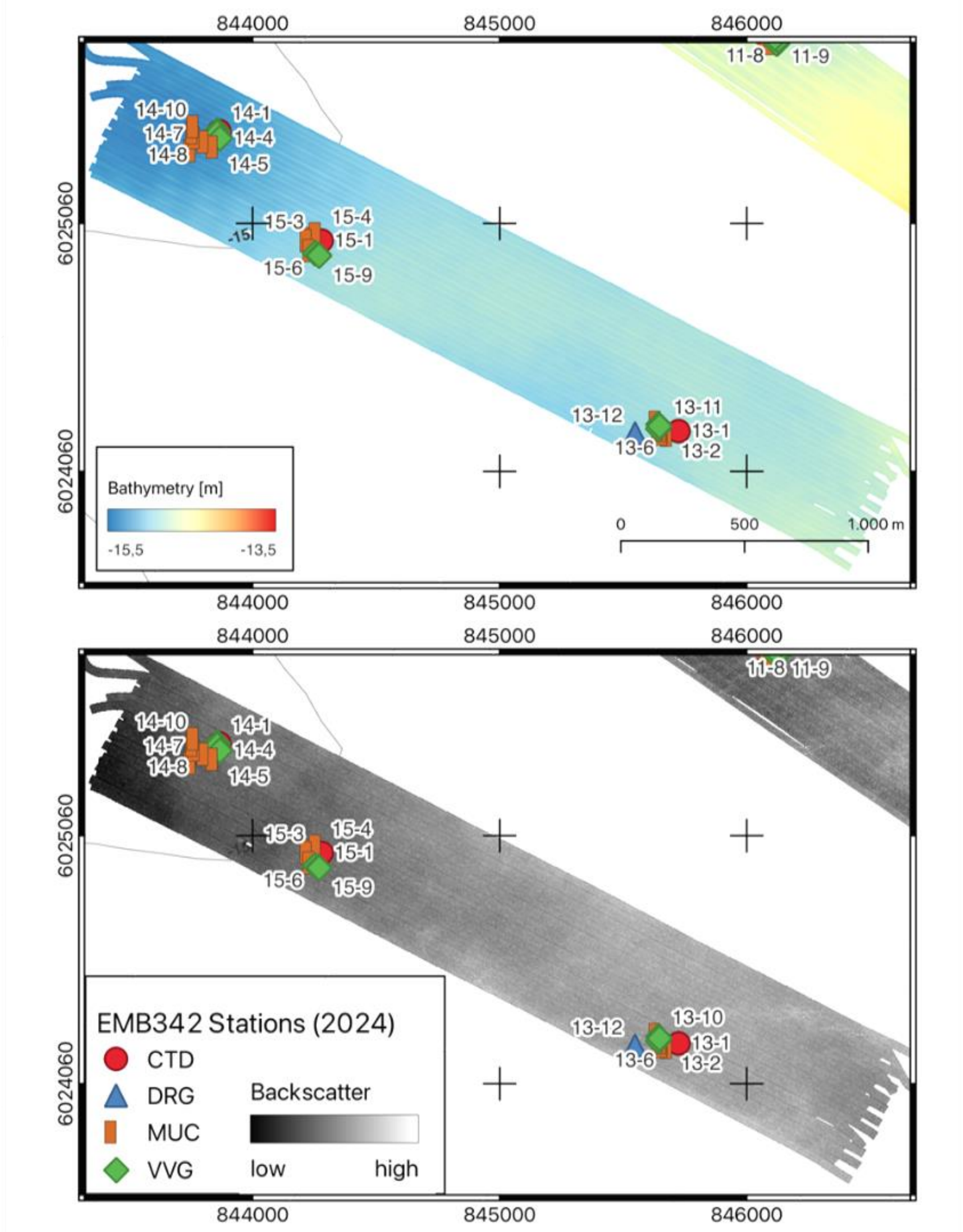

Fig. 5.1.5 Bathymetric (upper) and backscatter (lower) map with hillshade of the REF area at Oder Bank area. No trawl marks are visible in the data.

Oder Bank/ECOMAP (OB_ecomap)

Between the two main survey areas of this cruise, three MBES profiles were recorded at a site previously investigated during cruise EMB205 in 2019, The earlier survey showed elongated of aggregations of *Mytilus edulis/trossulus* as regularly spaced high-intensity stripes in backscatter data, confirmed by a long video transect (Fig. 5.1.6). However, no mussel aggregations were detected during this cruise, neither in the hydroacoustic data nor during the shorter video transect, revealing only a sandy seafloor with small ripples, typical of the Oder Bank area.

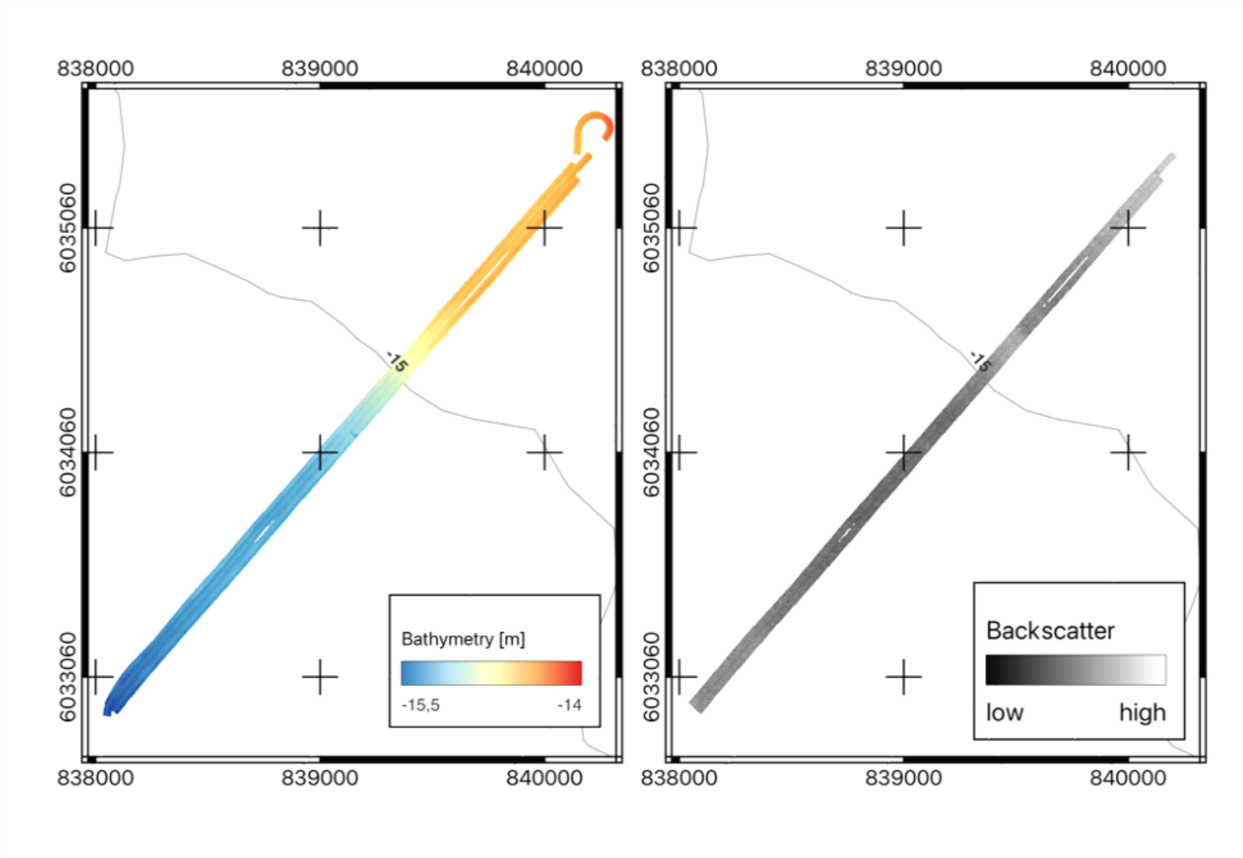

Fig. 5.1.6 Bathymetric map (left) and backscatter map (right) of the ECOMAP area at Oder Bank area. No features are visible at the flat and smooth seafloor surface.

5.2 BIOGEOCHEMICAL PROCESSES in the SURFACE SEDIMENTS

5.2.1 SEDIMENTS and PORE-WATERS GEOCHEMISTRY (MGF-OSTSEE II WP 1.2a)

(Linsy P[1], Andrew Dale[1], Stefan Sommer[1])

[1]GEOMAR

Objectives

Sediment samples were collected from the Oderbank and Rönnebank regions of the Baltic Sea. The primary objective was to understand benthic biogeochemical processes and establish baseline data for the area prior to the exclusion of mobile bottom-dwelling fisheries (MGF). To achieve this, sediment samples (Figure 5.2.1.1) were retrieved from within and outside the marine protected areas (MPA) using a multi-corer.

Methods

An overview of the stations where the sediment geochemical investigations were conducted is provided in Table 5.2.1.1. Sediment samples were collected using a multi-corer. Porewaters were extracted with Rhizon samplers, and bottom water samples were also taken from the overlying water in the MUC cores. Porewater was extracted at 1 cm intervals at the surface and then increasing to 2 cm and 4 cm intervals at greater depths. All extractions were performed in a refrigerated laboratory, maintained at the same temperature (8-11 °C) as the bottom water.

Fig. 5.2.1.1 Parallel MUC cores collected from station 18-5 for benthic geochemical study; show black layered sediment below the surface.

Alkalinity measurements were conducted immediately after porewater extraction. Total alkalinity (TA) was analyzed by titrating the samples (0.5-1 ml) with 0.02N HCl using a color indicator, following the method of Ivanenkov & Lyakhin (1978). The endpoint was determined by the appearance of a stable pink color. Standardization was performed using the International Association for the Physical Sciences of the Oceans (IAPSO) seawater solution.

Samples for H_2S were fixed with zinc acetate and preserved at +4°C. Samples for major cations were acidified with HNO_3 and stored at +4°C for onshore analysis. Sub-samples for nutrients and major anions were frozen at -20°C. Sediment samples for solid-phase analysis were subsampled at 1 cm intervals and preserved at +4°C for porosity, carbon (organic and inorganic), total nitrogen, total sulfur, and elemental analysis in the onshore laboratory. The porosity of the sediment samples was determined from the weight difference of the wet and freeze-dried sediment, assuming a sediment density of 2.5 g cm^{-3} and a seawater density of 1.023 g cm^{-3}.

Table 5.2.1.1 Details of samples collected for sediment geochemistry.

Station	Depth (m)	Date	Latitude [N]	Longitude [E]	TA	H_2S	NUTS + IC	ICP	Solid phase
3-2	35	6/11/2024	54° 45,1427'	013° 58,6104'	**X**	**X**	**X**	**X**	**X**
4-2	37	6/11/2024	54° 47,8130'	013° 57,8449'	**X**	**X**	**X**	**X**	**X**
10-6	11	6/12/2024	54° 15,4212'	014° 19,7239'	**X**	**X**	**X**	**X**	**X**
11-3	12	6/12/2024	54° 15,7650'	014° 18,9524'	**X**	**X**	**X**	**X**	**X**
13-3	12	6/13/2024	54° 14,9232'	014° 18,4736'	**X**	**X**	**X**	**X**	**X**
14-6	12	6/13/2024	54° 15,6342'	014° 16,8343'	**X**	**X**	**X**	**X**	**X**
17-3	33	6/14/2024	54° 44,3808'	013° 57,9236'	**X**	**X**	**X**	**X**	**X**
18-5	35	6/14/2024	54° 44,8517'	013° 58,2339'	**X**	**X**	**X**	**X**	**X**
20-2	37	6/14/2024	54° 47,8806'	013° 58,5278'	**X**	**X**	**X**	**X**	**X**
22-3	12	6/15/2024	54° 15,9177'	014° 18,3154'	**X**	**X**	**X**	**X**	**X**
23-1	11	6/15/2024	54° 15,3735'	014° 20,0224'	**X**	**X**	**X**	**X**	**X**
28-3	37	6/16/2024	54° 48,3811'	013° 58,5570'	**X**	**X**	**X**	**X**	**X**

Preliminary Results

Due to the sandy nature of the sediments at Oderbank, the penetration of the MUC was limited to a maximum depth of 20 cm into the seafloor. In contrast, the muddy sediments of Rönnebank allowed for relatively deeper sediment penetration. The porosity profile of the sediment core is shown in Figure 5.2.1.2. There is significant variability in porosity between Rönnebank and Oderbank. In the Oderbank area, porosity values are relatively constant, around 0.5, which is typical for sandy sediments. In contrast, Rönnebank exhibits relatively high porosity values, characteristic of its clay and organic-rich sediments.

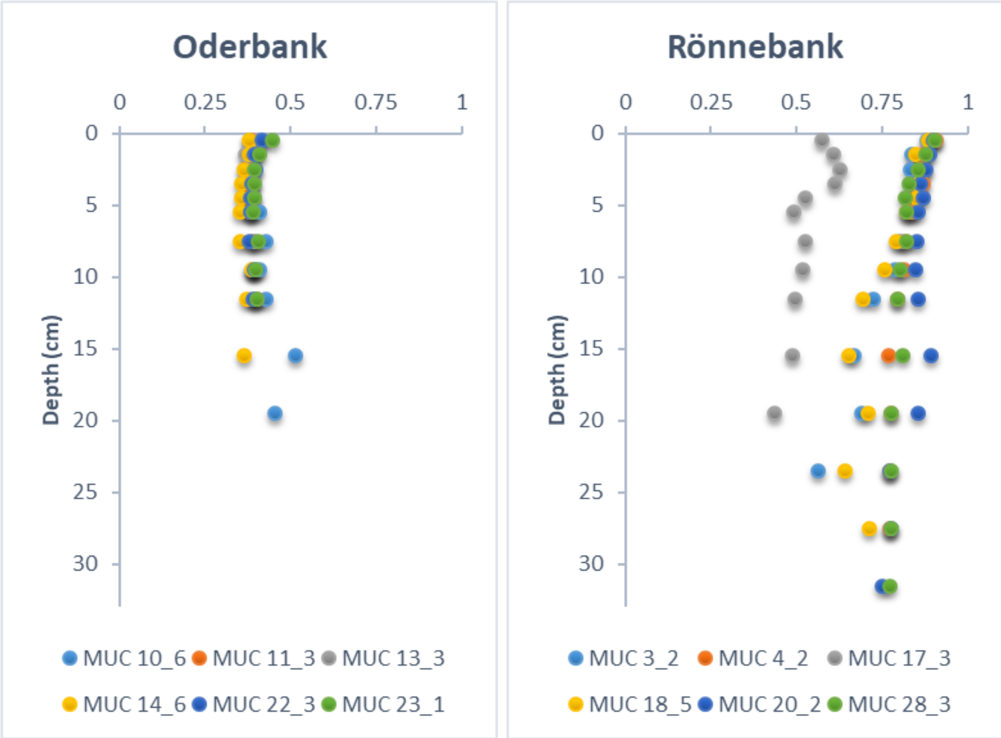

Fig. 5.2.1.2 Porosity profiles on the Oderbank and Rönnebank area

An illustration of the porewater TA data measured during the cruise is shown in Figure Figure 5.2.1.3. TA profiles show significant variability between the Rönnebank and Oderbank areas. TA was much lower at Oderbank and varied little from the overlying seawater value, whereas TA increased to >10 mM at station MUC 20_2 on the Rönnebank. The measured TA data is consistent with previously reports by Van Dam et al., (2022), who observed a significant difference in alkalinity between sandy and muddy sediments in the Baltic Sea. The minor down-core increase in TA at the sandy sites has been attributed to enhanced mixing in sediments with relatively low microbial activity (Van Dam et al., 2022).

At Rönnebank, we observed black-layered sediments with a strong H_2S smell, indicating anaerobic degradation of organic matter. Thus, the higher alkalinity at Rönnebank areas could be attributed to higher accumulation of labile organic matter and differences in the organic matter degradation pathways. Anaerobic degradation of organic matter under oxygen-depleted conditions has been shown to produce enhanced release of alkalinity from the sediment (Gustafsson et al., 2019). Further analyses of porewater and sediments are required to understand the differences in the biogeochemical processes in this area and will be performed at the home laboratory at GEOMAR, Kiel.

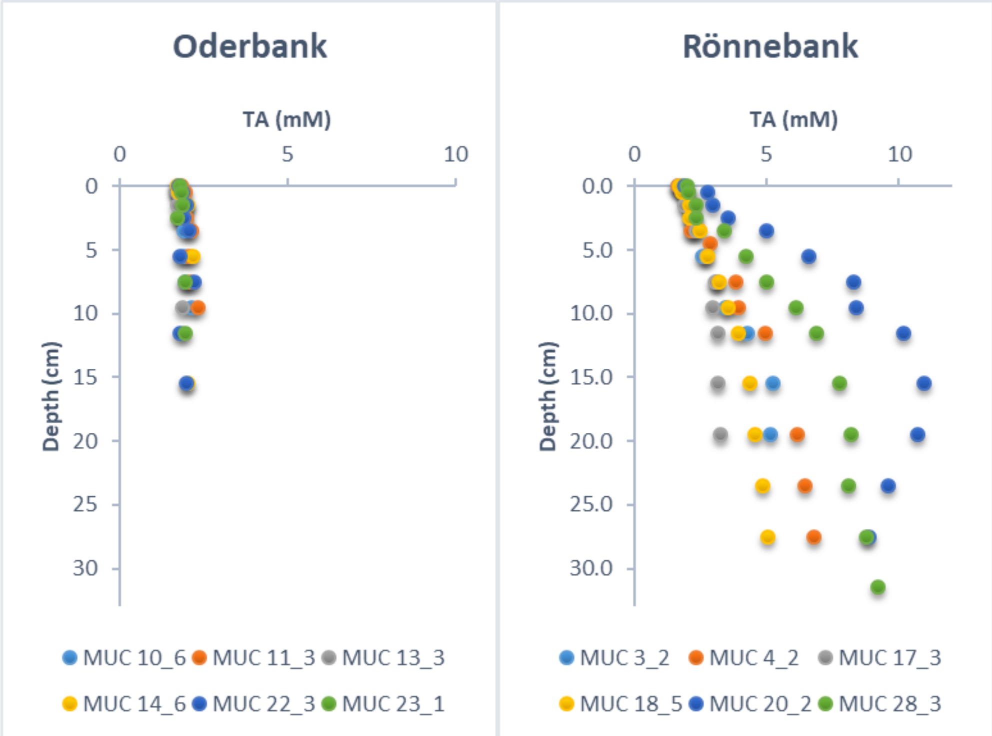

Fig. 5.2.1.3 Porewater profiles of TA on the Oderbank and Rönnebank area.

5.2.2 SULFATE REDUCTION RATES (MGF-OSTSEE II WP 1.2b)

(Steffen Okolski[1], Jens Kallmeyer[1])

[1]GFZ

Method

Sulfate reduction rates (SRR) are quantified using incubations of intact sediment cores with radioactive $^{35}SO_4{}^{2-}$ radiotracer (Jørgensen, 1978). Immediately after retrieval of the multicorer (MUC), one of the cores was subsampled with three 40 cm-long acrylic tubes (30 mm OD, 24 mm ID) for sulfate reduction measurements. All three acrylic tubes were pushed vertically into the sediment to retrieve mechanically undisturbed subcores. These three subsampling tubes were stored in an incubator at approx. in-situ temperature until termination of deck operations. Stations are summarized in Table 5.2.2.1.

After termination of deck operations all samples were incubated. Bottom water except for approximately 5 mL was siphoned off. Each acrylic tube has a row of holes (2 mm diameter) drilled in 1 cm resolution along its side. The holes are sealed with silicone, to avoid seepage of porewater but allow injection of radiotracer. 10 µl of radiotracer (activity ca. 20 kBq/ml) was injected into each hole from the sediment-water interface down to 20 cm below sea floor (cmbsf).

After the injection, the cores were put back into the incubator and incubated for 24 h at in-situ temperature. At such temperatures changes in salinity due to evaporation can be neglected.

Table 5.2.2.1 Stations where samples for sulfate reduction rates were collected

Core Number	Area	Station EMB342	MUC cast
1	RB-MPA2	3	3_2
2	RB-REF3	4	4_2
3	o10 OB-MPA3	10	10_6
4	o3 OB-MPA2	11	11_4
5	o18 OB-REF3	13	13_4
6	o22 OB-REF1	14	14_6
7	o28 OB-REF2	15	15_3
8	RB-MPA3	17	17_3
9	RB-MPA4	18	18_5
10	RB-REF2	20	20_2
11	o2 OB-MPA1	22	22_4
12	o11 OB-MPA	23	23_1
13	o6 OB-MPA	24	24_1
14	RB-REF4	28	28_3

The incubations were terminated by pushing the sediment out of the core tubes, slicing them into depth sections and transferring the sediment into 50 ml centrifuge tubes, filled with 10 ml of 20% (w/v) zinc acetate solution. The following resolution was used on all cores:

0-6 cmbsf: 1 cm sediment per tube

6-10 cmbsf: 2 cm sediment per tube

10-20 cmbsf: 5 cm sediment per tube

The vials were thoroughly shaken to break up all sedimentary structures and frozen overnight to effectively stop all microbial activity. Afterwards the samples were stored at room temperature for the remaining cruise time.

Additional samples from the MUC core were taken for two types of blank measurements:

Time Zero Blanks: Samples were injected with radiotracer like regular samples, but incubation was stopped within 10 minutes after injection.

Tracer Blanks: 10 µl of tracer was directly dropped into a 50 ml centrifuge tube filled with 10 ml of 20% (w/v) zinc acetate solution.

Both types of blank samples are treated like regular samples.

A total of 438 samples were collected.

Expected and preliminary results

Upon return to the home lab at GFZ Potsdam the biologically produced radioactive reduced sulfur species (TRIS, total reduced inorganic sulfur) is currently extracted from the sample using cold chromium distillation (Kallmeyer et al., 2004).

As we do not have the pore water sulfate and porosity profiles yet, it is not possible to draw any conclusion, other than the fact that sulfate reducing activity is ubiquitous in the near surface sediment of the studied areas.

5.3 LOWER TROPHIC LEVELS. NANO- and MICROFAUNA - PROTISTS (MGF-OSTSEE II WP 2.1a)

(Hartmut Arndt[1])
[1]Uni Köln

In Baltic, nanofauna in the size range of 1-20 µm (mainly heterotrophic nanoflagellates and small amoebae) and microfauna in the size range of 20-200 µm (ciliates, heterotrophic dinoflagellates, amoeboid protists etc.) are important parts of the benthic food web. They channel bacterial production to higher trophic levels such as meiofauna and macrozoobenthos which in turn act as nutritional basis for demersal fish. The bacterial abundance and production is assumed to be regulated and controlled by microbial predators. Thereby also a variety of geochemical processes determined by the oxygen consumption of bacteria is potentially regulated by nano- and microfauna organisms. We hypothesize in our sub-project, that disturbance of sediment structures due to trawling significantly changes the microbial food web and its functions. Up to our present knowledge, unicellular eukaryotes comprise the majority of all eukaryotic genotypes in the world's oceans (e.g. de Vargas et al., 2015; Gooday et al. 2020; Schoenle et al., 2021).

In order to compare the benthic nano- and microfauna of the target regions of the Baltic marine protected areas (MPAs), the nano- and microfauna abundance and diversity was estimated combining different methods inside the MPA areas and outside reference areas (REFs). During the present cruise the regions Oderbank and Rønnebank were investigated by different approaches (Schoenle et al., 2016, Jeuck et al, 2017). Abundance and diversity of nano- and microfauna was estimated by a combined analysis of live-counting on board, determination of cultivable protist species in the laboratory at the University of Cologne and - in cooperation with the group of microbiologists (Prof. Jürgens and Dr. Piontek from IOW) – with the evaluation of eDNA metabarcoding analyses.

Methods

Sediment sampling

Sediment samples for WP 2.2 were taken in two marine protected areas (MPA, Natura 2000) in the German Baltic Sea, the Rønnebank and the Oderbank. Samples were taken with a multi-corer (MUC) system from IOW (see list of stations in the general part). The undisturbed sediment cores obtained by the MUC were used for quantitative and qualitative analyses of benthic nano- and microfauna.

At the Rønnebank, at each station one sediment core was sampled for the abundance estimates (life-counting). All cores were sliced into seven sediment layers (0-1cm, 1-2 cm, 3-4 cm, 5-6 cm, 9-10 cm, 14-15 cm, 19-20 cm). At Oderbank, cores were sliced into the sediment layers 0-1cm, 1-2 cm, 2-3 cm, 3-4 cm, 6-7 cm, 9-10 cm and 14-15 cm. Due to a closing mechanism at the top and bottom of the cores, the risk of contamination with organisms and cysts from upper water layers was reduced and samples were processed as quick as possible and stored cooled until further processing.

Abundance estimations of benthic nano- and microfauna

For abundance estimates in the different sediment layers, a volume of 1.5 cm^3 sediment was mixed with 3 ml of sterile filtered (<0.2 µm) Baltic ambient sea water. These suspensions were used to detect living protists under the microscope (ZEISS Axiostar equipped with phase contrast objectives and videocamera). Inspection and counting of 5-50 µl subsamples of sediment suspensions were conducted with 40 x phase-contrast objectives (Arndt et al., 2000; Jeuck & Arndt, 2013). Besides quantitative estimates, live-counting techniques offer the opportunity to determine a certain percentage of organisms up to the morphospecies level and to verify the presence of living specimens of genotypes only known from metagenomic studies. Limitation of this method is the narrow time frame available for observations of sediment suspensions on board, since several nanofauna organisms die after a certain period due to rising temperatures and light. However, the direct counts can serve as a cultivation-independent record of species being active at the time of sampling.

Cultivation of benthic nano- and microfauna

Cultivation of protist species aims to relate the morphological identity of species to their genotype and ecology to derive an idea regarding the functioning of the benthic microbial food web. From several samples, a subsample was mixed with sterile-filtered Baltic ambient sea water and supplied with autoclaved quinoa or wheat grains to enrich co-occurring bacteria as a food source for protists. 50 ml tissue culture flasks were used to establish raw cultures. In addition, the liquid-aliquot method was used to establish monocultures. Subsequent inspections and further isolations will be carried out in the home laboratory in Cologne to analyse species' genotype, taxonomy, phylogeny and ecology for successfully cultivated taxa.

Preliminary results

Onboard, we could obtain preliminary results from live-counting studies. As in earlier studies, highest abundances of heterotrophic protists were always revealed from the upper surface layer of sediment (0-2 cm). Abundances obtained from the Oderbank stations were higher than those determined from Rønnebank. Community structure of nano- and microfauna was similar to the studies obtained in previous expeditions in these regions within MGF Ostsee (EMB267, EMB320). The diversity of protists was similar, though abundances were much lower than studies carried out in the nearby coastal waters of Ruegen Island (Dietrich & Arndt, 2000; Sachs et al., 2023). In contrast to studies carried out at the Oderbank, protists at Rønnebank were not found at sediment depths below 4 cm depth. Dominating groups of nanofauna were euglenids, kinetoplastids (neobodonids) and colourless nano- and microsized dinoflagellates, less important were bicosoecids, colourless cryptomonads, ancyromonads, amastigomonads, thaumatomonads, cercomonads, and other rhizarians. Among microfauna, ciliates dominated the sediment samples with representatives of several bacterivorous spirotrichs and scuticociliates and a few predatory litostomatids and (Fig. 5.3.1). A complex trophic food web with representatives of both, nanofauna and microfauna, which is obviously connected to the abundant meiofauna taxa could be recorded in both regions. Given the very clear vertical stratification observed for all components of the microbial food web, one can derive a fundamental impact of sediment reorganization which might be also triggered by ground fishery. The impact might be very different in the different regions of the Baltic.

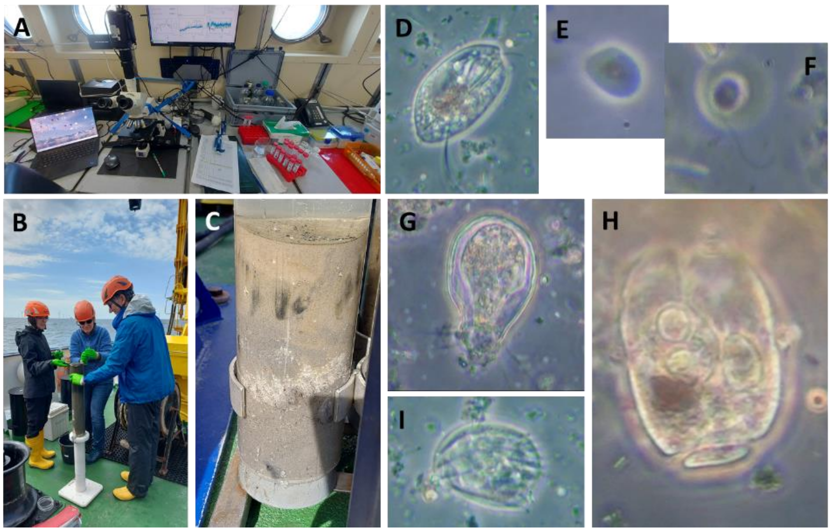

Fig. 5.3.1 Live-counting of protists on board. A – Microscopic investigation by video-microscopy; B - Core slicing for subsequent live-counting, and cultivation of sediment samples; C – typical core from *Oderbank*; D – H different heterotrophic protozoan species observed during live-counting; D – colourless euglenid flagellate; E – goniomonads flagellate; F – Metromonas sp.; G – Testaceafilosea; H – heterotrophic dinoflagellate; I – Aspidisca ciliate.

5.4 LOWER TROPHIC LEVELS. MICROPHYTOBENTHOS (MGF-OSTSEE II WP 2.1b)

(Marjan Janßen[1])

[1]Uni Rostock

The sampling of the cores used for primary production measurement of the microphytobenthos took place at Oderbank and Rönnebank (Figure 5.4.1, Table 5.4.1). The cores were sampled in marine protected areas (MPA) and at reference sites for each location. Overall, 23 cores were sampled during the cruise. A total of 8 cores were sampled at Rönnebank (4 in MPA and 4 in Reference) and a total number of 15 cores were sampled in Oderbank (9 in MPA and 6 in Reference). The cores were stored in a temperature room at approximately 10 °C with the lid kept open for oxygen flow.

The measurements were later conducted in the laboratory of the university of Rostock. The oxygen consumption was detected using a 4-channel fiber optic oxygen transmitter (OXY-4 SMA, PreSens) and planar oxygen sensor spots. The oxygen production was measured in the overlaying water phase of the sediment cores. After the experiments the upper layer (1 cm) of the sediment cores were cut off, homogenized and divided into subsamples for further analysis such as water content, as well as carbon, nitrogen and chlorophyll a content.

The data collected from prior cruises to Oderbank (2021) show no significant differences in terms of brutto primary production between MPA and reference areas. The values for Oderbank are between 14.2 to 18.2 mg C m^{-2} h^{-1} (MPA) and 13.8 to 16.6 mg C m^{-2} h^{-1} (ref). Therefore, similar for Oderbank. Due to the depth of Rönnebank of approximately 38 m, the expected values for brutto primary production and chl a content is likely significantly lower in comparison to Oderbank and possibly no primary production will be measured.

Fig. 5.4.1 Sampling in Oderbank (5 cm Ø) from Multi corer cores 10 cm Ø

Table 5.4.1 Sample list of Fehmarnbelt, Odra Bank and Rönnebank

#	Station-Cast	Location	Area	Sampling date
1	3_2_6	Rönnebank	Inside MPA 2	11.06.24
2	3_2_8	Rönnebank	Inside MPA 2	11.06.24
3	3_3_7	Rönnebank	Inside MPA 2	11.06.24
4	3_3_6	Rönnebank	Inside MPA 2	11.06.24
5	4_2_2	Rönnebank	Reference 3	11.06.24
6	4_2_1	Rönnebank	Reference 3	11.06.24
7	4_3_2	Rönnebank	Reference 3	11.06.24
8	10_6_5	Oderbank	MPA	12.06.24
9	10_10	Oderbank	MPA	12.06.24
10	10_11	Oderbank	MPA	12.06.24
11	11_4	Oderbank	MPA 3	12.06.24
12	11_7	Oderbank	MPA 3	12.06.24
13	13_4_1	Oderbank	Reference	13.06.24
14	13_4_2	Oderbank	Reference	13.06.24
15	13_6	Oderbank	Reference	13.06.24
16	13_7	Oderbank	Reference	13.06.24
17	14_8	Oderbank	Reference	13.06.24
18	14_9	Oderbank	Reference	13.06.24
19	24_1	Oderbank	MPA	15.6.24
20	22_2	Oderbank	MPA	15.6.24
22	22_7	Oderbank	MPA	15.6.24
23	23_3	Oderbank	MPA	15.6.24

5.5 LOWER TROPHIC LEVELS. MEIOFAUNA (MGF-OSTSEE II WP 2.1c)

(Alexandra Ostmann[1], Sahar Khodami[1], Kai H. George[1], Pedro Martínez Arbizu[1])
[1]Senckenberg

Samples were collected at 8 stations at the Oderbank - 5 stations were located in the Marine Protected Area (MPA) and 3 stations in the Reference Area (REF).

Usually, the MUC is equipped with 8 cores, and each core covers a sampling area of 78.54 cm². Due to the structure of the sediment, the MUC was deployed with 4 cores only and with additional weight, to obtain samples of higher quality (Fig. 5.5.1).

From each MUC-cast, 2–3 corers were taken for meiofauna investigations. For morphological investigations 1 corer and for genetic analyses 2 corers were used. The overlaying water of each corer was sieved through 40 µm sieves and, together with the uppermost 5 cm of sediment, preserved in 0.5 L 99 % denatured ethanol. Prior to fixation of the metabarcoding samples, a sub-sample (~ 1g of sediment from the sediment surface) was obtained as an eDNA sample (Fig. 5.5.2). eDNA sub-samples were kept frozen at –20 °C until further processing.

In total, 24 samples for morphological, 47 samples for metabarcoding (not enough sediment from MUC corers available), and 46 samples for eDNA were collected (Table 5.5.1; 1 sample was contaminated).

A B

Fig. 5.5.1 **A** Sample collection using multicorer equipped with 4 corers. **B** Detail of the corers at station EMB342_13_6.

Fig. 5.5.2 Taking eDNA samples of the sediments**.**

Sample processing will be conducted at the laboratories of the DZMB (German Centre for Marine Biodiversity Research, Senckenberg am Meer, Wilhelmshaven). To extract the meiofauna, the samples will be centrifuged with Levasil® and kaolin.

For morphological faunistics, the meiofauna will be sorted manually by means of a Leica M125 stereomicroscope. Benthic copepods (Copepoda Harpacticoida) will be determined at species level.

For metabarcoding and eDNA, DNA will be extracted from the meiofauna. Two gene fragments, COI mtDNA and V1V2 hypervariable region of 18S rRNA, will be amplified and sequenced using MiSeq Illumina platform. Both fragments will be used to assess and compare the diversity of the meiofauna communities in general and of harpacticoid copepods in particular.

Table 5.5.1. List of stations sampled for the meiofauna investigation. MPA = Marine Protected Area, REF = Reference Area. Numbers in bold indicate, that fewer samples were obtained. * due to weather conditions no CTD data was obtained.

Cruise	Region	Location	old Station	Latitude	Longitude	Date	Depth, m	Temperature, °C	Salinity	Oxygen, ml/l	Sample	RepNo	No. corers Morphology	No. corers Metabarcoding	No. tubes eDNA
EMB342	Oderbank	MPA	10	54°15.4251'N	14°19.7295'E	12.06.2024	14.60	15.90	7.31	6.60	EMB342_10_10	1	1	2	2
EMB342	Oderbank	MPA	10	54°15.4216'N	14°19.7283'E	12.06.2024	14.60	15.90	7.31	6.60	EMB342_10_11	2	1	2	2
EMB342	Oderbank	MPA	10	54°15.4082'N	14°19.6694'E	12.06.2024	14.60	15.90	7.31	6.60	EMB342_10_14	3	1	2	2
EMB342	Oderbank	MPA	3	54°15.7699'N	14°18.9467'E	12.06.2024	15.60	15.90	7.33	6.61	EMB342_11_6	1	1	2	2
EMB342	Oderbank	MPA	3	54°15.7660'N	14°18.9539'E	12.06.2024	15.60	15.90	7.33	6.61	EMB342_11_7	2	1	2	2
EMB342	Oderbank	MPA	3	54°15.4251'N	14°18.7295'E	12.06.2024	15.60	15.90	7.33	6.61	EMB342_11_8	3	1	**1**	**1**
EMB342	Oderbank	MPA	2	54°15.9251'N	14°18.3189'E	15.06.2024	15.30	16.08	7.31	6.58	EMB342_22_2	1	1	2	2
EMB342	Oderbank	MPA	2	54°15.9177'N	14°18.3154'E	15.06.2024	15.30	16.08	7.31	6.58	EMB342_22_3	2	1	2	2
EMB342	Oderbank	MPA	2	54°15.9314'N	14°18.3208'E	15.06.2024	15.30	16.08	7.31	6.58	EMB342_22_5	3	1	2	2
EMB342	Oderbank	MPA	11	54°15.3822'N	14°20.0040'E	15.06.2024	14.80	16.08	7.31	6.58	EMB342_23_2*	1	1	2	2
EMB342	Oderbank	MPA	11	54°15.3877'N	14°19.9973'E	15.06.2024	14.80	16.08	7.31	6.58	EMB342_23_3*	2	1	2	2
EMB342	Oderbank	MPA	11	54°15.3956'N	14°19.9842'E	15.06.2024	14.80	16.08	7.31	6.58	EMB342_23_4*	3	1	2	2
EMB342	Oderbank	MPA	6	54°14.3700'N	14°21.7634'E	15.06.2024	14.50	16.08	7.31	6.58	EMB342_24_2*	1	1	2	2
EMB342	Oderbank	MPA	6	54°14.3779'N	14°21.7466'E	15.06.2024	14.50	16.08	7.31	6.58	EMB342_24_3*	2	1	2	2
EMB342	Oderbank	MPA	6	54°14.3770'N	14°21.3826'E	15.06.2024	14.50	16.08	7.31	6.58	EMB342_24_4*	3	1	2	2
EMB342	Oderbank	REF	18	54°14.9267'N	14°18.4564'E	13.06.2024	15.40	15.37	7.34	6.70	EMB342_13_5	1	1	2	2
EMB342	Oderbank	REF	18	54°14.9342'N	14°18.4528'E	13.06.2024	15.40	15.37	7.34	6.70	EMB342_13_6	2	1	2	2
EMB342	Oderbank	REF	18	54°14.9386'N	14°18.4420'E	13.06.2024	15.40	15.37	7.34	6.70	EMB342_13_7	3	1	2	2
EMB342	Oderbank	REF	22	54°15.6216'N	14°16.8671'E	13.06.2024	15.80	15.48	7.35	6.64	EMB342_14_5	1	1	2	2
EMB342	Oderbank	REF	22	54°15.6450'N	14°16.8022'E	13.06.2024	15.80	15.48	7.35	6.64	EMB342_14_8	2	1	2	**1**
EMB342	Oderbank	REF	22	54°15.6690'N	14°16.8017'E	13.06.2024	15.80	15.48	7.35	6.64	EMB342_14_10	3	1	2	2
EMB342	Oderbank	REF	28	54°15.4251'N	14°18.7295'E	13.06.2024	15.60	15.44	7.35	6.68	EMB342_15_2	1	1	2	2
EMB342	Oderbank	REF	28	54°15.4251'N	14°18.7295'E	13.06.2024	15.60	15.44	7.35	6.68	EMB342_15_4	2	1	2	2
EMB342	Oderbank	REF	28	54°15.4251'N	14°18.7295'E	13.06.2024	15.60	15.44	7.35	6.68	EMB342_15_6	3	1	2	2

5.6 PROKARYOTES and eDNA (MGF-OSTSEE II WP 2.2)

(Judith Piontek[1], Ramona Ems[1,2])

[1]IOW

[2]Uni Rostock

The major goals of this work package are (1) to investigate how bottom trawling fisheries affect the composition and functioning of benthic prokaryotes and (2) to develop a non-invasive approach for the assessment of biodiversity in Marine Protected Areas (MPAs) of the Baltic Sea using environmental DNA (eDNA).

(1) Samples were collected for comprehensive taxonomic and functional analyses of benthic prokaryotes, continuing the time series investigation prior to implementation of the fishery exclusion in the study areas. The studies will contribute to a detailed description of prokaryotic processes in the carbon, nitrogen, and sulfur cycles of the sediments. After fishery exclusion continuation of time-series sampling will document changes in the taxonomic and functional diversity of benthic prokaryotes.

(2) Since 2023, samples for eDNA analysis have been taken in the study areas during the annual time series cruises to test the potential of this method compared to traditional, observation-based methods for assessing biodiversity. By detecting genetic markers, the analysis of eDNA offers the possibility to draw conclusions about the spatial distribution of multicellular taxa of all trophic levels (Fig. 5.6.1).

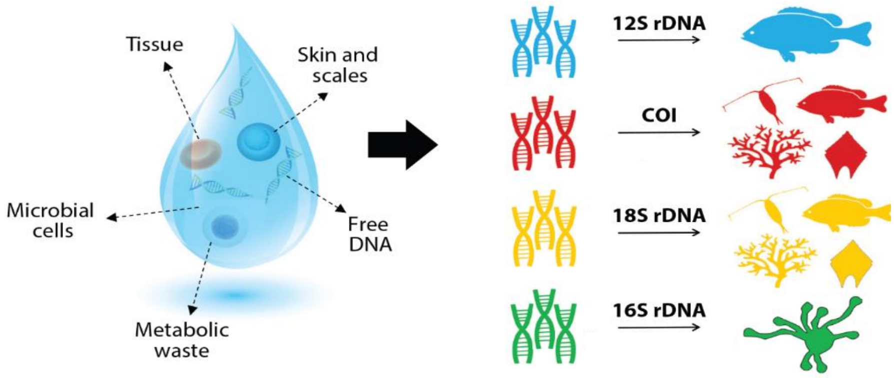

Fig. 5.6.1 Marine eDNA suspended in seawater may contain living cells, metabolic waste, parts of organisms, or dissolved material. Metabarcoding with different primers (for 12S, 16S and 18S rDNA as well as the cytochrome oxidase subunit I [COI]) combined with high-throughput sequencing targets a wide range of organisms from microbes to fish. Figure modiefied from Chavez et al. (2021).

The selection of marker genes and their specificity make it possible to obtain insights into the community composition non-invasively and without direct observation, such as by net catches. While also taxonomy-free approaches are suitable to assess biodiversity and spatial and temporal changes, the taxonomic identification of organisms through DNA sequences requires reference sequences. However, public data bases are still lacking reference sequences for many marine macrofauna species and are prone to errors in taxonomic assignments. Even in case of the North Sea, a heavily sampled marine area that could be considered a “best-case scenario”, the coverage of marker gene sequences in the largest public data bases did not exceed 50% in 2020 (Hestetun et al. 2020). Hence, the use of curated reference libraries supplied with sequences of the local populations of the study area is of great advantage. We started the collection of macrofauna specimens during EMB342 to obtain marker gene sequences of the most abundant species for curated reference libraries for the investigated Baltic Sea MPAs. Vouchers will be sequenced after comprehensive taxonomic identification based on morphology.

Methods

For the investigation of benthic prokaryotes and/or the analysis of eDNA sediment and water samples, respectively, were collected at twenty stations. Stations and sampling efforts are summarized in Table 5.6.1.

Table 5.6.1 Sediment and water sampling during EMB342 (RB: Rønne Bank, ODR: Odra Bank, KDR: Kadettrinne, PB: Pomeranian Bay, AB: Arkona Basin, MPA: Marine Protected Area, REF: reference area adjacent to the MPA, eDNA: environmental DNA, Bac Prod: Bacterial Biomass Production, Seq: Sequencing, Ref_Library: collection of macrozoobenthos specimens to create a sequence library of the most abundant species in Rønne Bank and Odra Bank sediments)

Area	**Station**	**CTD cast**	eDNA	**MUC cast**	Cell numbers	Bac Prod	Amplicon Seq	Ref_Library
KDR	**1**	**1_1**	YES	*NA*	*NA*	*NA*	*NA*	NO
RB_MPA	**3**	**3_1**	YES	**3_2**	YES	YES	YES	NO
RB_REF	**4**	**4_1**	YES	**4_3**	YES	YES	YES	YES
RB_Riff	**5**	**5_1**	YES	*NA*	*NA*	*NA*	*NA*	NO
RB_Riff	**6**	**6_1**	YES	*NA*	*NA*	*NA*	*NA*	NO
PB	**8**	**8_1**	YES	*NA*	*NA*	*NA*	*NA*	NO
PB	**9**	**9_1**	YES	*NA*	*NA*	*NA*	*NA*	YES
OB_MPA	**10**	**10_1**	YES	**10_6**	YES	YES	YES	NO
OB_MPA	**11**	**11_1**	YES	**11_4**	YES	YES	YES	YES
OB_REF	**13**	**13_1**	YES	**13_3**	YES	YES	YES	NO
OB_REF	**14**	**14_1**	YES	**14_6**	YES	YES	YES	NO
OB_REF	**15**	**15_1**	YES	**15_3**	YES	YES	YES	NO
RB_MPA	**17**	**17_1**	YES	**17_3**	YES	YES	YES	YES
RB_MPA	**18**	**18_1**	YES	**18_5**	YES	YES	YES	NO
RB_REF	**20**	**20_1**	YES	**20_2**	YES	YES	YES	YES
OB_MPA	**22**	**22_1**	YES	**22_4**	YES	YES	YES	NO
OB_MPA	**23**	*NA*	*NA*	**23_2**	YES	YES	YES	NO
OB_MPA	**24**	**24_1**	YES	**24_1**	YES	YES	YES	NO
RB_REF	**28**	**28_1**	YES	**28_3**	YES	YES	YES	NO
AB	**29**	**29_1**	YES	*NA*	*NA*	*NA*	*NA*	NO

In order to quantify prokaryotes and to analyse their taxonomic composition and biomass production, sediment cores were collected by MUC hauls. The cores were sliced on deck into seven discrete depth intervals from the surface to 15-20 cmbsf (depth intervals Rønne Bank 0-1, 1-2, 3-4, 5-6, 9-10, 14-15, 19-20 cmbsf, depth intervals Odra Bank 0-1, 1-2, 2-3, 3-4, 6-7, 9-10, 14-15 cmbsf). Sub-samples for cell counting were fixed with formaldehyde, washed with PBS and stored frozen in an ethanol:PBS mixture at -20°C. Samples for taxonomic analysis by amplicon sequencing were shock-frozen in liquid nitrogen and stored at -80°C until further analysis in the lab. From the same cores, bacterial biomass production was analyzed in surface samples on board by the use of radioactively labelled leucine.

Samples for the analysis of eDNA were collected using a rosette sampler equipped with Niskin bottles. A CTD system was used to determine the continuous depth profiles of pressure, temperature and salinity. In addition, sensors for chl-a fluorescence, radiation and turbidity were mounted on the sampler. Bottles were closed 1-2 m above ground without disturbing the sediment. Subsequently, particulate matter of 1-4 litres of bottom water was collected by the use of Sterivex cartridges with 0.22 µm pore size and stored frozen at -80°C. Samples of macrofauna specimens for subsequent sequencing of marker genes were collected from sediment samples and stored either at -20°C or in ethanol at room temperature.

Preliminary Results

Preliminary results show similar levels of heterotrophic bacterial biomass production in surface sediments of the study areas Odra Bank and Rønne Bank. The rates inside the MPA and the respective reference area outside were also similar (Fig. 5.6.2).

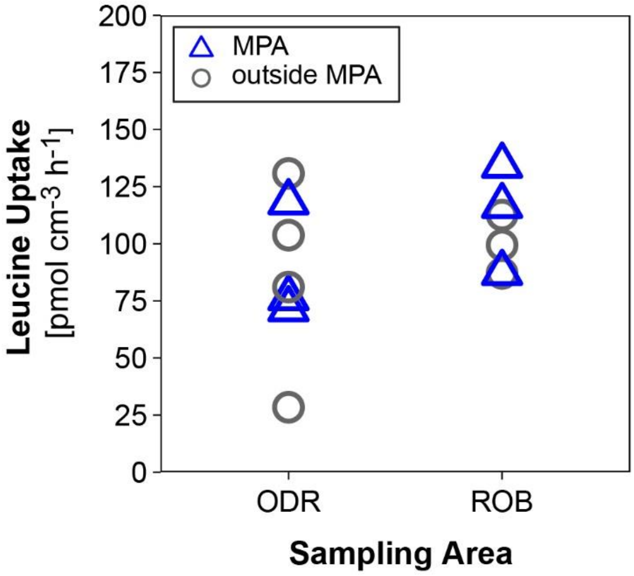

Fig. 5.6.2 Preliminary results on leucine uptake rates in surface sediments of Odra Bank (ODR) and Rønne Bank (ROB). Stations inside and outside the MPA were investigated.

Leucine uptake rates corresponded to heterotrophic bacterial biomass production of 0.16±0.03 µg C cm^{-3} h^{-1} in Odra Bank surface sediments and 0.13±0.05 µg C cm^{-3} h^{-1} in Rønne Bank surface sediments. The rates were similar to those determined in previous years during summer.

Preliminary taxonomic classification revealed that individuals of (at least) 15 macrofauna species were collected for sequencing of marker genes and subsequent implementation of the sequences into curated reference libraries for Odra Bank and Rønne Bank.

5.7 MACROZOOBENTHOS (MGF-OSTSEE II WP 2.3)

(Mayya Gogina[1], Frank Pohl[1], Sebastian Pomrehn[1], Alicia Ackermann[1,2])

[1]IOW

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Objectives

Bottom trawling is expected to alter the structure and density of macrozoobenthos communities, impacting bioturbation and altering biogeochemistry, including solute transport, nutrient cycling, and organic matter remineralization at the sediment-water interface. The benthic macrofauna was investigated during the cruise in order to gain data for a comprehensive evaluation of potential changes after the reduction and exclusion of fishing with mobile bottom-contacting gears in MPAs of the German Part of the Baltic Sea, to study the impacts of reduction in bottom-trawling fishing on benthic ecosystems. Better understanding of those impacts against the background of natural variability in distribution of density of macrofauna species can help more effective management and biodiversity conservation. Gained data can also serve to evaluate the importance of macrozoobenthos in benthic food chain and relationships between biodiversity and ecosystem functioning. During the EMB342 expedition focus areas of the MGF-Ostsee project Odra Bank and Rønne Bank were sampled.

Another special feature was the collection of benthic macrofauna samples from 2 stations outside the MGF study areas for the comparison with data gained by eDNA methodology under development (loactions eDNA4_PB and PB_07, see Fig. 3.1).

Additionally we have revisited the location sampled in Oder Bank during the EMB205 expedition in January 2019 for short underwater video and mulibeam profiling (by WP 1.1 collegues, see section 5.1) investigation in order to search for *Mytilus* spp. agregations of interest (best suited as target object for further development of remote sensing methods for mapping of benthic habitats), however those could not be detected.

Methods

Macrofauna sampling was performed using a van Veen grab (70 kg, sieve lid) with a sampling area of 0.1 m² (sediment penetration depth up to 15-20 cm) to gain the standart estimate of species abundance and biomass per seafloor area, as well as multicorer (MUC) to collect short sediment cores (using 60 cm long acrylic tubes with 10 cm internal diameter and sampling area of 0.00785 m²) for estimate of vertical distribution. Grab samples were sieved on-board using 1.0 mm sieve. For vertical distribution, cores were sliced using intervals 0-2, 2-4, 4-6, 6-8, 8-10, 10-15 and >15 cm sediment depth and sieved separately using 0.5 mm sieve (with the exception of the sediment from the deepest sediment interval >15 cm that was sieved using 1 mm sieve, for logistical reasons and as usually these sediment layers are either not inhabitat or host few larger deep dwelling species). After sieving material was fixed in the 4% seawater-formaldehyde solution buffered with marble chippings.

Samples were collected at the two visited MGF-Ostsee focus areas, including 6 locations in the Rönnebank (RB), and 8 locations in the Oderbank (OB) (Fig. 5.7.1). Locations distributed between the future exclusion area within MPA and in the reference (REF) area outside MPA in each region. Another two locations outside the MGF-Ostsee areas were sampled for macrozoobenthos and eDNA in the Pommeranian Bay. At each location 3 van Veen grabs replicates were collected. Additionally, to resolve vertical distribution and burrowing depth of macrofauna in each region, we sliced a total of 34 cores (17 cores from each RB and OB regions, respectively). Of those, 8 cores were analysed for pore-water biogeochemistry by WP1.2a prior to slicing and sieving. Collected samples will be sorted at Benthos laboratory at The Leibniz Institute for Baltic Sea Research, Warnemünde. To estimate the distribution and both spatial and temporal variability of the benthic macrofaunal species and communities, and to investigate how MGF intensity may impact those parameters, species abundance, dry and wet biomass, biological traits structure and traits-derived functional indices, as well as size classes distribution of key species will be determined in the laboratory (see Table 5.7.1 for the full list of benthic macrofauna samples).

Abiotic parameters describing near-bottom water conditions relevant for distribution of benthic nacrofauna were obtain from CTD (near-bottom water temperature, salinity and oxygen concentrations, see Table 5.7.2), surface sediment sample (upper 2 cm) was taken from one additional grab replicate or MUC core at each location for later sediment granulometry and organic content analysis. Grain size distribution for sands will be derived using dry sieving, for finer sediments it will be done with Mastersizer 3000. Sediment organic content values will be estimated by loss on ignition.

Kieler Kinderwagen dredge has been used to capture qualitatively quick moving, rare or large species at each area the (gear specification: inner opening wide - 92 cm, mesh size - 5 mm, towed with speed of up to 1 knot over the ground for approximately 1 min in mud and for 5 min in sand, see Fig. 5.7.2). One haul each was towed within and outside MPA in RB and OB, and at stations eDNA4_PB and PB_07. Another qualitative sample was collected at the location PB_07 characterized by habitat sediments with rocks and boulders from the multiple unsecsessful (unclosed) grab casts. At selected locations habitat characteristics were also investigated using a hand-held underwater video system with SeaViewer HD camera on short transects (usually around 10 min, towed with 0.5 knot speed).

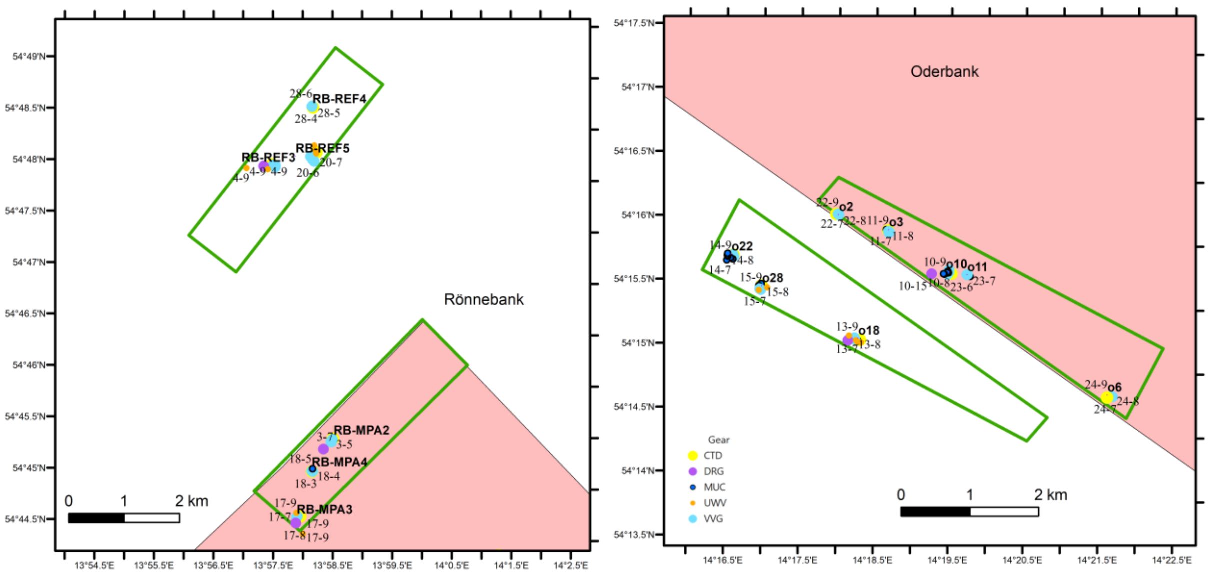

Fig. 5.7.1 Locations sampled for benthic macrofauna in MGF focus areas - 6 stations in the Rönnebank (RB), 8 locations in the Oderbank (OB). Future closure area within MPAs is indicated in red.

To estimate the bioturbation in each MPA and REF area five MUC cores were sampled for depth distribution of chlorophyll-a as particle tracer (assosoated with bioturbation by macrofauna), using the following sediment layers: 0-0.5; 0.5-1.0; 1.0-1.5; 1.5-2; 2-3; 3-4; 4-5; 5-6; 6-7; 7-8; 8-10; 10-12 cm. Also, samples for chlorophyll-a were collected from same MUC cores and each of seven discrete depth intervals analysed for prokaryotes (see section 5.6). These samples will be analyzed in the University of Rostock (responsible person is Stefan Forster)

Preliminary results

In agreement with the newly published map of habitats and biotopes in the German Baltic Sea (Marx et al., 2024) most samples collected from the Rönnebank area were characrteistic for the HELCOM 'HUB' Underwater Biotope AB.H3L1 Baltic aphotic muddy sediment dominated by Baltic tellin (M. balthica). Among dominant species in samples were bivalves *Macoma balthica* and *Mya arenaria*, few polychaetes such as *Scoloplos armiger*, *Capitella capitate*, *Alitta succinea*, lugworm *Arenicola marina* and ragworm *Hediste diversicolor* (Fig. 5.7.2). Bioturbation traces of *A. marina* were commonly observed on underwater videos in the form of mounds of casts and funnels on the sediment surface, similar to previous year observations (Fig. 5.7.3). At the first glance *Macoma balthica* also dominated the abundance of macrofauna at the RB_MPA3 station closest to the edge of the Rönnebank riff (in some way luckily justifiing the choise of stations sampled during the cruise, as according to the Marx et al. (2024) map this location might already fall within the HUB biotope AB.M1E1 Baltic aphotic mixed substrate dominated by Mytilidae, which would be less suitable for the project aims).

Sandy Oderbank stations were typical for HELCOM 'HUB' Underwater Biotope AA.J3L9 'Baltic photic sand dominated by multiple infaunal bivalve species: multiple infaunal bivalve species including *Cerastoderma glaucum, Macoma balthica* and *Mya arenaria'*. Bivalves *Mya arenaria* (deep burrowing suspension feeder), *Macoma balthica* (surface deposit feeder), and *Cerastoderma glaucum* (shallowly burrowing suspension feeder), as well as polychaete *Hediste diversicolor* represented the dominant macrozoobenthic species (Fig. 5.7.4). In contrast to 2023 sampling, even in the dredge samples only relatively low amount of suspension feeding bivalve *Mytilus edulis* (blue mussel) was found.

Fig. 5.7.2 From left to right top row, photos of: Van Veen grab, two grab samples of muddy Rönnebank sediment after washing, dredge gear and gained sample, multicorer and core to be sliced and sieved for vertical distribution. Bottom row from left to right: exemplary organisms that remained after washing on the 1 mm sieve at station RB_MPA2 (lagworm *Arenicola marina*, bivalves *Mya arenaria* and *Macoma balthica*, presumably amphipod *Pontoporeia femorata* and ragworm *Hediste diversicolor).*

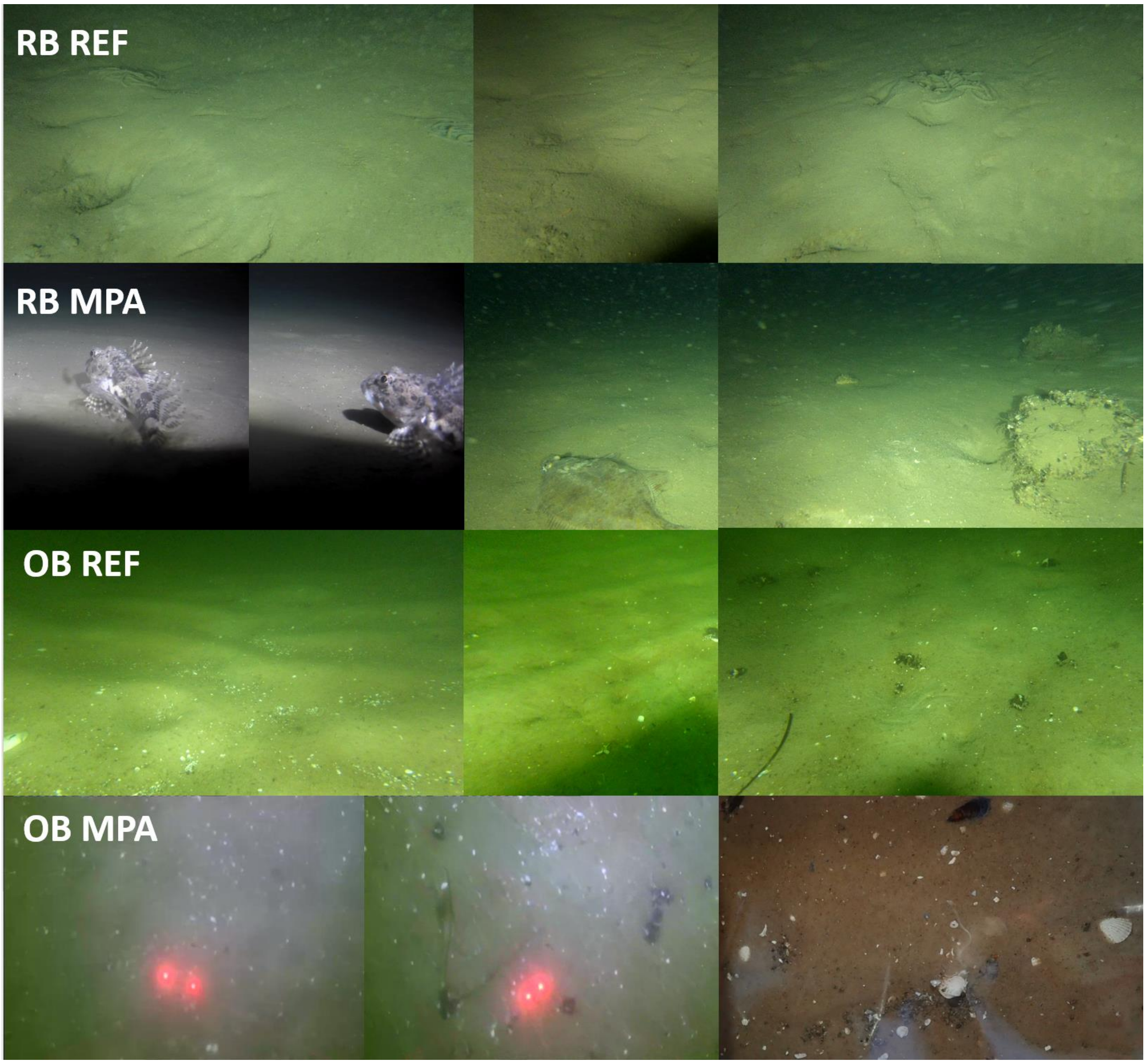

Fig. 5.7.3 Exemplary underwater video stills and photos from the muddy Rönnebank (RB) MPA and REF areas and sandy Oderbank (OB) MPA and REF areas. At stills from RB REF are feeding funnels and faecal casts of lugworm *A. marina* are visible, and at pictures from RB MPA - individuals of shorthorn sculpin scorpion and plaice.

Fig. 5.7.4 Exemplary photos of typical grab samples from the Oderbank REF and MPA areas (with visually less large living individuals of *Mytilus edulis* and *Mya arenaria* observed comparing too previous year sampling; lower row: individuals of *Mya arenaria, Cerastoderma glaucum* and *Peringia ulvae*.

Table 5.7.1 List of samples to be analyzed in "IOW Benthos Labor".

Station	Date	Macrofauna samples		Station	Date	Macrofauna samples
Rönnebank				Oderbank		
EMB342_3 RB-MPA2	11.6	3 grab replicates, dredge		EMB342_10 o10	12.6	3 grab replicates, dredge
EMB342_4 RB-REF3	11.6	3 grab replicates, dredge		EMB342_11 o3	12.6	3 grab replicates
EMB342_17 RB-MPA3	14.6	3 grab replicates, dredge		EMB342_13 o18	13.6	3 grab replicates, dredge
EMB342_18 RB-MPA4	14.6	3 grab replicates		EMB342_14 o22	13.6	3 grab replicates
EMB342_20 RB_REF2	14.6	3 grab replicates		EMB342_15 o28	13.6	3 grab replicates
EMB342_28 RB-REF4	16.6	3 grab replicates		EMB342_22 o2	15.6	3 grab replicates
EMB342_3 RB-MPA2	11.6	sliced PW core		EMB342_23 o11	15.6	3 grab replicates
EMB342_3 RB-MPA2	11.6	sliced core		EMB342_24 o6	15.6	3 grab replicates
EMB342_3 RB-MPA2	11.6	sliced core		EMB342_10 o10	12.6	sliced PW core
EMB342_3 RB-MPA2	11.6	sliced core		EMB342_10 o10	12.6	sliced core
EMB342_4 RB-REF3	11.6	sliced PW core		EMB342_10 o10	12.6	sliced core
EMB342_4 RB-REF3	11.6	sliced core		EMB342_11 o3	12.6	sliced PW core
EMB342_4 RB-REF3	11.6	sliced core		EMB342_11 o3	12.6	sliced core
EMB342_4 RB-REF3	11.6	sliced core		EMB342_11 o3	12.6	sliced core
EMB342_17 RB-MPA3	14.6	sliced PW core		EMB342_13 o18	13.6	sliced core
EMB342_17 RB-MPA3	14.6	sliced core		EMB342_13 o18	13.6	sliced core
EMB342_17 RB-MPA3	14.6	sliced core		EMB342_13 o18	13.6	sliced core
EMB342_18 RB-MPA4	14.6	sliced PW core		EMB342_14 o22	13.6	sliced core
EMB342_18 RB-MPA4	14.6	sliced core		EMB342_14 o22	13.6	sliced core
EMB342_18 RB-MPA4	14.6	sliced core		EMB342_14 o22	13.6	sliced core
EMB342_20 RB_REF2	14.6	sliced PW core		EMB342_15 o28	13.6	sliced core
EMB342_20 RB_REF2	14.6	sliced core		EMB342_15 o28	13.6	sliced core
EMB342_20 RB_REF2	14.6	sliced core		EMB342_15 o28	13.6	sliced core
Bay of Pomerania				EMB342_22 o2	15.6	sliced PW core
eDNA4-PB	12.6	3 grab replicates, dredge		EMB342_22 o2	15.6	sliced core
EMB342_9 PB_07	12.6	3 grab replicates, dredge from unclosed grabs				

Table 5.7.2 Accompanying environmental variables from the closest EMB320 CTD casts.

Station	Depth, m	Salinity	Temperature, °C	Oxygen conc., ml/l	Habitat observed
eDNA2_KR	38.6	9.4	9.6	5.365	NA
RB_MPA2	41.0	9.6	12.3	6.284	mud
RB_REF3	27.7	7.5	10.2	5.955	mud
RB-Riff1	25.9	7.6	8.9	5.441	Riff
RB-Riff2	16.7	7.4	14.8	6.692	Riff
eDNA4_PB	12.6	7.2	16.1	6.378	sand
PB_07	14.7	7.3	15.9	6.603	mixed sediments, boulders
o10	15.6	7.3	15.9	6.614	sand
o3	15.4	7.3	15.4	6.701	sand
o18	15.8	7.4	15.5	6.64	sand
o22	15.6	7.4	15.4	6.683	sand
o28	36.4	8.4	14.6	6.365	sand
RB_MPA3	38.1	9.9	10.4	4.96	mud
RB_MPA4	37.7	13.4	9.7	4.335	mud
RB_REF2	15.3	7.3	16.1	6.579	mud
o2	14.8	7.3	16.1	6.579	sand
o11	14.5	7.3	16.0	6.465	sand
o6	41.0	16.5	8.8	3.243	sand
RB_REF4	34.6	15.1	12.0	4.891	mud
eDNA3_AB	38.6	9.4	9.6	5.365	NA

Species collected for curated reference libraries for the investigated Baltic Sea MPAs, stored frozen under -20°C and in ethanol for later DNA sequencing are listed in Table 5.7.3 (see also section 5.6).

Table 5.7.3 Specimens of macrozoobenthos collected to create a sequence library of the most abundant species in Rønne Bank and Odra Bank sediments

Species	Group	Station EMB342_	Date	Eppi -20°C Nr	Ethanol Nr
Macoma balthica	Bivalvia	20_6 RB_Ref2	14/06	1-3	
Macoma balthica	Bivalvia	17 RB_MPA3	14/06	12-13	
Pontoporeia femorata	Amphipoda	20_6 RB_Ref2	14/06	4-6	2,3
Pontoporeia femorata	Amphipoda	20_6 RB_Ref2	14/06	7	
Diastylis rathkei	Cumacea	20_6 RB_Ref2	14/06	8	
Diastylis rathkei	Cumacea	17 RB_MPA3	14/06	14-16,27	
Terebellides stroemii	Polychaeta	20_6 RB_Ref2	14/06	9-11	1
Halicryptus spinulosus	Priapulida	17 RB_MPA3	14/06	17-19,28	4,5
Mya arenaria	Bivalvia	8_6 eDNA4_PB	12/06	41-42	17
Mya arenaria	Bivalvia	17 RB_MPA3	14/06	20-22	6,7
Peringia ulvae	Gastropoda	17 RB_MPA3	14/06	23-25	
Peringia ulvae	Gastropoda	11 o3	12/06	32-34	10,11
Bylgides sarsi	Polychaeta	17 RB_MPA3	14/06	26	8
Hediste diversicolor	Polychaeta	11 o3	12/06	29-31	9
Mytilus edulis	Bivalvia	8_6 eDNA4_PB	12/06	35-36	12,13
Tubificoides benedii	Oligochaeta	8_6 eDNA4_PB	12/06	37-39	14,15
Amphibalanus improvisus	Cirripedia	8-6_eDNA4_PB	12/06	40	
Einhornia crustulenta	Bryozoa	8_6 eDNA4_PB	12/06	43	18
	Oligochaeta	eDNA4_PB	12/06		16

6 Ship's Meteorological Station

(Mayya Gogina)

According to the data from ship weather station, average air temperature was around 14.3 °C, with lowest values in the night on 12.06., overall very modern amplitudes observed between day and night, and warmest days at the beginning and at the end of the expedition (Figure 6.1). Surface water temperature was on average 1°C higher then air temperature. The general meteorological conditions during the most of the cruise were rather windy, with daily maximum gusts of wind around 7 to 8 on Beaufort wind force scale, and characterized by lower air pressure, that was above 1013hPa only between 12.06. and morning of 14.06., whereas lowest pressure of around 1001hPa was observed in the morning on 11.06.

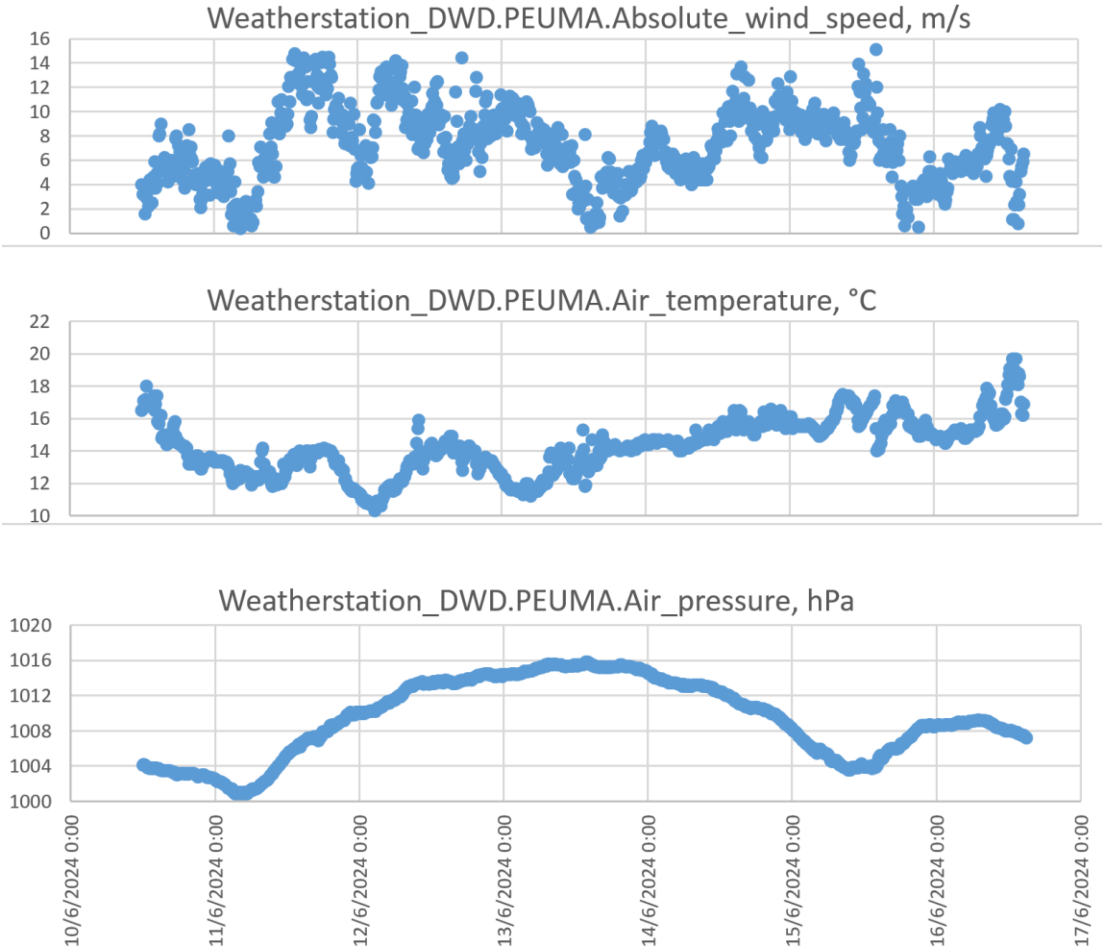

Fig. 6.1 Wind speed, air temperature and pressure measured by RV ELISABETH MANN BORGESE weather station.

7 Stations and Profiles List EMB342

Stations List

Alias_Stations	Device Operation	Date	Latitude	Longitude	Gear
eDNA2_KR	EMB342_1-1	10/06/2024 17:44	54° 35,2429' N	012° 22,0992' E	**CTD**
MB Profile inside MPA	EMB342_2-1	10/06/2024 23:43	54° 44,6433' N	013° 57,2443' E	**MB start**
MB Profile inside MPA	EMB342_2-1	11/06/2024 06:46	54° 44,4045' N	013° 57,4827' E	**MB end**
RB-MPA2	EMB342_3-1	11/06/2024 05:06	54° 45,1347' N	013° 58,6058' E	**CTD**
RB-MPA2	EMB342_3-2	11/06/2024 06:05	54° 45,1427' N	013° 58,6104' E	**MUC**
RB-MPA2	EMB342_3-3	11/06/2024 06:27	54° 45,1315' N	013° 58,5998' E	**MUC**
RB-MPA2	EMB342_3-4	11/06/2024 06:49	54° 45,1279' N	013° 58,5968' E	**VVG**
RB-MPA2	EMB342_3-5	11/06/2024 06:56	54° 45,1035' N	013° 58,5818' E	**VVG**
RB-MPA2	EMB342_3-5	11/06/2024 06:56	54° 45,1051' N	013° 58,5678' E	**VVG**
RB-MPA2	EMB342_3-7	11/06/2024 07:23	54° 45,0377' N	013° 58,4346' E	**DRG**
RB-REF3	EMB342_4-1	11/06/2024 08:31	54° 47,8341' N	013° 57,8427' E	**CTD**
RB-REF3	EMB342_4-2	11/06/2024 08:47	54° 47,8130' N	013° 57,8449' E	**MUC**
RB-REF3	EMB342_4-3	11/06/2024 09:07	54° 47,8233' N	013° 57,8628' E	**MUC**
RB-REF3	EMB342_4-4	11/06/2024 10:33	54° 47,8065' N	013° 57,8931' E	**VVG**
RB-REF3	EMB342_4-5	11/06/2024 10:38	54° 47,8213' N	013° 57,8968' E	**VVG**

RB-REF3	EMB342_4-6	11/06/2024 10:43	54° 47,8195' N	013° 57,8828' E	**VVG**
RB-REF3	EMB342_4-7	11/06/2024 10:49	54° 47,8279' N	013° 57,8657' E	**VVG**
RB-REF3	EMB342_4-8	11/06/2024 11:02	54° 47,8223' N	013° 57,6999' E	**DRG**
RB-REF3	EMB342_4-9	11/06/2024 11:49	54° 47,7889' N	013° 57,7655' E	**UWV start**
RB-REF3	EMB342_4-9	11/06/2024 12:13	54° 47,8120' N	013° 57,4065' E	**UWV end**
RB-Riff1	EMB342_5-1	11/06/2024 12:54	54° 43,9086' N	014° 01,2800' E	**CTD**
RB-Riff2	EMB342_6-1	11/06/2024 14:35	54° 42,3906' N	014° 00,5693' E	**CTD**
MB Profil inside MPA	EMB342_7-1	11/06/2024 15:17	54° 44,4225' N	013° 57,6503' E	**MB start**
MB Profil inside MPA	EMB342_7-1	11/06/2024 20:15	54° 44,1825' N	013° 57,8954' E	**MB end**
eDNA4-PB	EMB342_8-1	12/06/2024 04:56	54° 22,1708' N	013° 55,1638' E	**CTD**
eDNA4-PB	EMB342_8-2	12/06/2024 05:57	54° 22,1662' N	013° 55,1611' E	**VVG**
eDNA4-PB	EMB342_8-3	12/06/2024 06:01	54° 22,1558' N	013° 55,1812' E	**VVG**
eDNA4-PB	EMB342_8-4	12/06/2024 06:04	54° 22,1541' N	013° 55,1685' E	**VVG**
eDNA4-PB	EMB342_8-5	12/06/2024 06:08	54° 22,1526' N	013° 55,1570' E	**VVG**
eDNA4-PB	EMB342_8-6	12/06/2024 06:21	54° 22,0763' N	013° 55,1438' E	**DRG**
PB_07	EMB342_9-1	12/06/2024 08:04	54° 10,9929' N	013° 59,9743' E	**CTD**
PB_07	EMB342_9-2	12/06/2024 08:15	54° 10,9932' N	013° 59,9695' E	**VVG**
PB_07	EMB342_9-3	12/06/2024 08:18	54° 10,9978' N	013° 59,9670' E	**VVG**
PB_07	EMB342_9-4	12/06/2024 08:20	54° 11,0000' N	013° 59,9661' E	**VVG**
PB_07	EMB342_9-5	12/06/2024 08:22	54° 10,9988' N	013° 59,9654' E	**VVG**
PB_07	EMB342_9-6	12/06/2024 08:24	54° 10,9966' N	013° 59,9606' E	**VVG**
PB_07	EMB342_9-7	12/06/2024 08:27	54° 10,9975' N	013° 59,9593' E	**VVG**
PB_07	EMB342_9-8	12/06/2024 08:29	54° 10,9987' N	013° 59,9561' E	**VVG**
PB_07	EMB342_9-9	12/06/2024 08:31	54° 11,0031' N	013° 59,9623' E	**VVG**
PB_07	EMB342_9-10	12/06/2024 08:32	54° 10,9946' N	013° 59,9617' E	**VVG**
o10	EMB342_10-1	12/06/2024 10:42	54° 15,4047' N	014° 19,7749' E	**CTD**
o10	EMB342_10-2	12/06/2024 10:57	54° 15,4238' N	014° 19,7361' E	**VVG**
o10	EMB342_10-3	12/06/2024 11:00	54° 15,4357' N	014° 19,7476' E	**VVG**
o10	EMB342_10-4	12/06/2024 11:03	54° 15,4174' N	014° 19,7422' E	**VVG**
o10	EMB342_10-5	12/06/2024 11:06	54° 15,4007' N	014° 19,7227' E	**VVG**
o10	EMB342_10-6	12/06/2024 11:30	54° 15,4212' N	014° 19,7239' E	**MUC**
o10	EMB342_10-7	12/06/2024 11:45	54° 15,4124' N	014° 19,7193' E	**MUC**
o10	EMB342_10-8	12/06/2024 11:52	54° 15,4134' N	014° 19,7376' E	**MUC**
o10	EMB342_10-9	12/06/2024 11:57	54° 15,4192' N	014° 19,7357' E	**MUC**
o10	EMB342_10-10	12/06/2024 12:05	54° 15,4251' N	014° 19,7295' E	**MUC**
o10	EMB342_10-11	12/06/2024 12:15	54° 15,4216' N	014° 19,7283' E	**MUC**
o10	EMB342_10-12	12/06/2024 12:24	54° 15,4151' N	014° 19,7173' E	**MUC**
o10	EMB342_10-13	12/06/2024 12:38	54° 15,4029' N	014° 19,6807' E	**MUC**
o10	EMB342_10-14	12/06/2024 12:46	54° 15,4082' N	014° 19,6694' E	**MUC**
o10	EMB342_10-15	12/06/2024 13:10	54° 15,4134' N	014° 19,5105' E	**DRG**
o3	EMB342_11-1	12/06/2024 13:32	54° 15,7722' N	014° 18,9666' E	**CTD**
o3	EMB342_11-2	12/06/2024 13:46	54° 15,7777' N	014° 18,9575' E	**MUC**
o3	EMB342_11-3	12/06/2024 13:53	54° 15,7650' N	014° 18,9524' E	**MUC**
o3	EMB342_11-4	12/06/2024 14:01	54° 15,7796' N	014° 18,9418' E	**MUC**
o3	EMB342_11-5	12/06/2024 14:11	54° 15,7690' N	014° 18,9473' E	**MUC**
o3	EMB342_11-6	12/06/2024 14:16	54° 15,7699' N	014° 18,9467' E	**MUC**
o3	EMB342_11-7	12/06/2024 14:29	54° 15,7660' N	014° 18,9539' E	**MUC**

o3	EMB342_11-8	12/06/2024 14:38	54° 15,7544' N	014° 18,9684' E	**MUC**
o3	EMB342_11-9	12/06/2024 14:48	54° 15,7544' N	014° 18,9758' E	**VVG**
o3	EMB342_11-10	12/06/2024 14:51	54° 15,7540' N	014° 18,9723' E	**VVG**
o3	EMB342_11-11	12/06/2024 14:54	54° 15,7608' N	014° 18,9797' E	**VVG**
o3	EMB342_11-12	12/06/2024 14:56	54° 15,7661' N	014° 18,9678' E	**VVG**
MB Profil OB Inside MPA	EMB342_12-1	12/06/2024 16:05	54° 16,1349' N	014° 17,7740' E	**MB start**
MB Profil OB Inside MPA	EMB342_12-1	13/06/2024 04:35	54° 16,1796' N	014° 18,3176' E	**MB end**
o18	EMB342_13-1	13/06/2024 04:54	54° 14,9310' N	014° 18,5009' E	**CTD**
o18	EMB342_13-2	13/06/2024 05:58	54° 14,9268' N	014° 18,4659' E	**MUC**
o18	EMB342_13-3	13/06/2024 06:05	54° 14,9232' N	014° 18,4736' E	**MUC**
o18	EMB342_13-4	13/06/2024 06:14	54° 14,9273' N	014° 18,4568' E	**MUC**
o18	EMB342_13-5	13/06/2024 06:24	54° 14,9267' N	014° 18,4564' E	**MUC**
o18	EMB342_13-6	13/06/2024 06:32	54° 14,9342' N	014° 18,4528' E	**MUC**
o18	EMB342_13-7	13/06/2024 06:40	54° 14,9386' N	014° 18,4420' E	**MUC**
o18	EMB342_13-8	13/06/2024 06:51	54° 14,9531' N	014° 18,4349' E	**MUC**
o18	EMB342_13-9	13/06/2024 06:59	54° 14,9395' N	014° 18,4258' E	**VVG**
o18	EMB342_13-10	13/06/2024 07:02	54° 14,9489' N	014° 18,4277' E	**VVG**
o18	EMB342_13-11	13/06/2024 07:04	54° 14,9449' N	014° 18,4316' E	**VVG**
o18	EMB342_13-12	13/06/2024 07:11	54° 14,9332' N	014° 18,3385' E	**DRG**
o18	EMB342_13-13	13/06/2024 07:36	54° 14,9109' N	014° 18,5112' E	**UWV start**
o18	EMB342_13-13	13/06/2024 07:40	54° 14,9202' N	014° 18,4557' E	**UWV end**
o18	EMB342_13-14	13/06/2024 07:43	54° 14,9292' N	014° 18,4436' E	**UWV start**
o18	EMB342_13-14	13/06/2024 07:54	54° 14,9688' N	014° 18,3569' E	**UWV end**
o22	EMB342_14-1	13/06/2024 08:26	54° 15,6548' N	014° 16,8773' E	**CTD**
o22	EMB342_14-1	13/06/2024 08:26	54° 15,6557' N	014° 16,8793' E	**CTD**
o22	EMB342_14-2	13/06/2024 08:40	54° 15,6573' N	014° 16,8723' E	**VVG**
o22	EMB342_14-3	13/06/2024 08:43	54° 15,6523' N	014° 16,8712' E	**VVG**
o22	EMB342_14-4	13/06/2024 08:45	54° 15,6402' N	014° 16,8795' E	**VVG**
o22	EMB342_14-5	13/06/2024 11:01	54° 15,6216' N	014° 16,8671' E	**MUC**
o22	EMB342_14-6	13/06/2024 11:12	54° 15,6342' N	014° 16,8343' E	**MUC**
o22	EMB342_14-7	13/06/2024 11:20	54° 15,6173' N	014° 16,7839' E	**MUC**
o22	EMB342_14-8	13/06/2024 11:28	54° 15,6450' N	014° 16,8022' E	**MUC**
o22	EMB342_14-9	13/06/2024 11:37	54° 15,6557' N	014° 16,7956' E	**MUC**
o22	EMB342_14-10	13/06/2024 11:44	54° 15,6690' N	014° 16,8017' E	**MUC**
o28	EMB342_15-1	13/06/2024 13:04	54° 15,4018' N	014° 17,2291' E	**CTD**
o28	EMB342_15-2	13/06/2024 13:20	54° 15,4035' N	014° 17,2207' E	**MUC**
o28	EMB342_15-3	13/06/2024 13:29	54° 15,4071' N	014° 17,2066' E	**MUC**
o28	EMB342_15-4	13/06/2024 13:38	54° 15,4169' N	014° 17,2257' E	**MUC**
o28	EMB342_15-5	13/06/2024 13:48	54° 15,4034' N	014° 17,1899' E	**MUC**
o28	EMB342_15-6	13/06/2024 13:57	54° 15,3813' N	014° 17,1976' E	**MUC**
o28	EMB342_15-7	13/06/2024 14:08	54° 15,3755' N	014° 17,2009' E	**VVG**
o28	EMB342_15-8	13/06/2024 14:11	54° 15,3720' N	014° 17,2131' E	**VVG**
o28	EMB342_15-9	13/06/2024 14:13	54° 15,3697' N	014° 17,2153' E	**VVG**
o28	EMB342_15-10	13/06/2024 14:23	54° 15,3682' N	014° 17,1863' E	**UWV start**
o28	EMB342_15-10	13/06/2024 14:34	54° 15,3839' N	014° 17,3003' E	**UWV end**
MB Profil OB REF	EMB342_16-1	13/06/2024 15:15	54° 14,5711' N	014° 19,1737' E	**MB start**
MB Profil OB REF	EMB342_16-1	14/06/2024 01:45	54° 15,9715' N	014° 16,4978' E	**MB end**

RB-MPA3	EMB342_17-1	14/06/2024 05:31	54° 44,3962' N	013° 57,9827' E	**CTD**
RB-MPA3	EMB342_17-2	14/06/2024 05:59	54° 44,3749' N	013° 57,9136' E	**MUC**
RB-MPA3	EMB342_17-3	14/06/2024 06:09	54° 44,3808' N	013° 57,9236' E	**MUC**
RB-MPA3	EMB342_17-4	14/06/2024 06:24	54° 44,3917' N	013° 57,9242' E	**MUC**
RB-MPA3	EMB342_17-5	14/06/2024 06:38	54° 44,3987' N	013° 57,9322' E	**VVG**
RB-MPA3	EMB342_17-6	14/06/2024 06:43	54° 44,3941' N	013° 57,9273' E	**VVG**
RB-MPA3	EMB342_17-7	14/06/2024 06:47	54° 44,3886' N	013° 57,9212' E	**VVG**
RB-MPA3	EMB342_17-8	14/06/2024 06:57	54° 44,3340' N	013° 57,9014' E	**DRG**
RB-MPA3	EMB342_17-9	14/06/2024 07:26	54° 44,4306' N	013° 57,9231' E	**UWV start**
RB-MPA3	EMB342_17-9	14/06/2024 07:56	54° 44,2241' N	013° 58,0095' E	**UWV end**
RB-MPA4	EMB342_18-1	14/06/2024 08:36	54° 44,8268' N	013° 58,2230' E	**CTD**
RB-MPA4	EMB342_18-2	14/06/2024 08:52	54° 44,8251' N	013° 58,2327' E	**VVG**
RB-MPA4	EMB342_18-3	14/06/2024 08:57	54° 44,8272' N	013° 58,2343' E	**VVG**
RB-MPA4	EMB342_18-4	14/06/2024 09:01	54° 44,8302' N	013° 58,2185' E	**VVG**
RB-MPA4	EMB342_18-5	14/06/2024 10:32	54° 44,8517' N	013° 58,2339' E	**MUC**
Profile RB	EMB342_19-1	14/06/2024 11:50	54° 44,6836' N	013° 57,8372' E	**MB start**
Profile RB	EMB342_19-1	14/06/2024 12:07	54° 44,6106' N	013° 57,8245' E	**MB end**
RB-REF2	EMB342_20-1	14/06/2024 12:38	54° 47,9270' N	013° 58,5997' E	**CTD**
RB-REF2	EMB342_20-2	14/06/2024 12:57	54° 47,8806' N	013° 58,5278' E	**MUC**
RB-REF2	EMB342_20-3	14/06/2024 13:16	54° 47,8886' N	013° 58,4951' E	**VVG**
RB-REF2	EMB342_20-4	14/06/2024 13:24	54° 47,8590' N	013° 58,5252' E	**VVG**
RB-REF2	EMB342_20-5	14/06/2024 13:29	54° 47,8410' N	013° 58,5518' E	**VVG**
RB-REF2	EMB342_20-6	14/06/2024 13:33	54° 47,8496' N	013° 58,5437' E	**VVG**
RB-REF2	EMB342_20-7	14/06/2024 14:03	54° 47,9947' N	013° 58,5701' E	**UWV start**
RB-REF2	EMB342_20-7	14/06/2024 14:13	54° 47,9380' N	013° 58,5898' E	**UWV end**
RB-REF2	EMB342_20-7	14/06/2024 14:14	54° 47,9355' N	013° 58,5936' E	**UWV start**
RB-REF2	EMB342_20-7	14/06/2024 14:18	54° 47,9157' N	013° 58,5952' E	**UWV end**
MB Profil RB-REF	EMB342_21-1	14/06/2024 14:50	54° 46,6660' N	013° 56,9410' E	**MB start**
MB Profil RB-REF	EMB342_21-1	15/06/2024 00:37	54° 47,0809' N	013° 56,3504' E	**MB end**
o2	EMB342_22-1	15/06/2024 05:00	54° 15,9260' N	014° 18,2853' E	**CTD**
o2	EMB342_22-2	15/06/2024 06:02	54° 15,9251' N	014° 18,3189' E	**MUC**
o2	EMB342_22-3	15/06/2024 06:31	54° 15,9177' N	014° 18,3154' E	**MUC**
o2	EMB342_22-4	15/06/2024 06:41	54° 15,9258' N	014° 18,3224' E	**MUC**
o2	EMB342_22-5	15/06/2024 06:52	54° 15,9314' N	014° 18,3208' E	**MUC**
o2	EMB342_22-6	15/06/2024 07:01	54° 15,9280' N	014° 18,3164' E	**MUC**
o2	EMB342_22-7	15/06/2024 07:06	54° 15,9255' N	014° 18,3166' E	**MUC**
o2	EMB342_22-8	15/06/2024 07:16	54° 15,9251' N	014° 18,3084' E	**VVG**
o2	EMB342_22-9	15/06/2024 07:18	54° 15,9191' N	014° 18,3201' E	**VVG**
o2	EMB342_22-10	15/06/2024 07:21	54° 15,9207' N	014° 18,3151' E	**VVG**
o11	EMB342_23-1	15/06/2024 08:09	54° 15,3735' N	014° 20,0224' E	**MUC**
o11	EMB342_23-2	15/06/2024 08:18	54° 15,3822' N	014° 20,0040' E	**MUC**
o11	EMB342_23-3	15/06/2024 08:29	54° 15,3877' N	014° 19,9973' E	**MUC**
o11	EMB342_23-4	15/06/2024 08:38	54° 15,3956' N	014° 19,9842' E	**MUC**
o11	EMB342_23-5	15/06/2024 08:46	54° 15,3898' N	014° 19,9805' E	**VVG**
o11	EMB342_23-6	15/06/2024 08:49	54° 15,3884' N	014° 19,9852' E	**VVG**
o11	EMB342_23-7	15/06/2024 08:52	54° 15,3911' N	014° 19,9890' E	**VVG**
o6	EMB342_24-1	15/06/2024 10:37	54° 14,3810' N	014° 21,7877' E	**MUC**

o6	EMB342_24-2	15/06/2024 10:45	54° 14,3700' N	014° 21,7634' E	**MUC**
o6	EMB342_24-3	15/06/2024 10:53	54° 14,3779' N	014° 21,7466' E	**MUC**
o6	EMB342_24-4	15/06/2024 11:01	54° 14,3770' N	014° 21,7826' E	**MUC**
o6	EMB342_24-5	15/06/2024 11:07	54° 14,3785' N	014° 21,7807' E	**MUC**
o6	EMB342_24-6	15/06/2024 11:18	54° 14,3739' N	014° 21,8101' E	**VVG**
o6	EMB342_24-7	15/06/2024 11:22	54° 14,3657' N	014° 21,8290' E	**VVG**
o6	EMB342_24-8	15/06/2024 11:25	54° 14,3683' N	014° 21,8090' E	**VVG**
o6	EMB342_24-9	15/06/2024 12:00	54° 14,3631' N	014° 21,7551' E	**CTD**
MB Profile OB	EMB342_25-1	15/06/2024 12:25	54° 14,2175' N	014° 22,0999' E	**MB start**
MB Profile OB	EMB342_25-1	15/06/2024 12:53	54° 15,3214' N	014° 19,7162' E	**MB end**
Ecomap Video OB	EMB342_26-1	15/06/2024 14:02	54° 20,6089' N	014° 13,2475' E	**UWV start**
Ecomap Video OB	EMB342_26-1	15/06/2024 14:14	54° 20,5233' N	014° 13,1865' E	**UWV end**
Ecomap Video OB	EMB342_26-2	15/06/2024 14:48	54° 20,5523' N	014° 13,1405' E	**UWV start**
Ecomap Video OB	EMB342_26-2	15/06/2024 15:17	54° 20,3292' N	014° 12,7755' E	**UWV end**
MB Profil OB 15.06	EMB342_27-1	15/06/2024 15:29	54° 19,7679' N	014° 11,9572' E	**MB start**
MB Profil OB 15.06	EMB342_27-1	15/06/2024 16:50	54° 21,0763' N	014° 14,1068' E	**MB end**
RB-REF4	EMB342_28-1	16/06/2024 04:49	54° 48,3657' N	013° 58,5824' E	**CTD**
RB-REF4	EMB342_28-2	16/06/2024 05:53	54° 48,3766' N	013° 58,5476' E	**MUC**
RB-REF4	EMB342_28-3	16/06/2024 06:02	54° 48,3811' N	013° 58,5570' E	**MUC**
RB-REF4	EMB342_28-4	16/06/2024 06:17	54° 48,3756' N	013° 58,5636' E	**VVG**
RB-REF4	EMB342_28-5	16/06/2024 06:22	54° 48,3752' N	013° 58,5692' E	**VVG**
RB-REF4	EMB342_28-6	16/06/2024 06:26	54° 48,3799' N	013° 58,5713' E	**VVG**
eDNA3_AB	EMB342_29-1	16/06/2024 10:34	54° 43,8921' N	013° 25,0055' E	**CTD**

EMB342 MBES Rönne Bank Profiles

Area	Profile	File Name	Date [UTC]	Start Time	Latitude	Longitude
RB_MPA	01	20240610_234201	10.06.2024	23:42	54.744070	13.953886
RB_MPA	02	20240611_002036	11.06.2024	00:21	54.770588	14.004664
RB_MPA	03	20240611_002036	11.06.2024	01:02	54.743108	13.955442
RB_MPA	04	20240611_014218	11.06.2024	01:42	54.769625	14.006218
RB_MPA	05	20240611_022032	11.06.2024	02:20	54.742145	13.956997
RB_MPA	06	20240611_025744	11.06.2024	02:57	54.768661	14.007773
RB_MPA	07	20240611_033554	11.06.2024	03:35	54.741182	13.958552
RB_MPA	08	20240611_041229	11.06.2024	04:12	54.767697	14.009327
RB_MPA	09	20240611_151452	11.06.2024	15:15	54.740220	13.960108
RB_MPA	10	20240611_155137	11.06.2024	15:51	54.766733	14.010882
RB_MPA	11	20240611_162927	11.06.2024	16:29	54.739257	13.961663
RB_MPA	12	20240611_170615	11.06.2024	17:06	54.765769	14.012436
RB_MPA	13	20240611_174428	11.06.2024	17:44	54.738294	13.963218
RB_MPA	14	20240611_182139	11.06.2024	18:21	54.764805	14.013990
RB_MPA	15	20240611_190115	11.06.2024	19:01	54.737331	13.964772
RB_MPA	16	20240611_193950	11.06.2024	19:39	54.763842	14.015545
RB_MPA	test01	20240614_115049	14.06.2024	11:50	-	-
RB_MPA	test02	20240614_120018	14.06.2024	12:00	-	-
RB_REF	01	20240614_145026	14.06.2024	14:50	54.780000	13.952000
RB_REF	02	20240614_153208	14.06.2024	15:32	54.809441	13.995117
RB_REF	03	20240614_161148	14.06.2024	16:11	54.780842	13.950176
RB_REF	04	20240614_164907	14.06.2024	16:49	54.810324	13.993352
RB_REF	05	20240614_165317	14.06.2024	16:53	54.781684	13.948351
RB_REF	06	20240614_173253	14.06.2024	17:32	54.811207	13.991587
RB_REF	07	20240614_181630	14.06.2024	18:16	54.782527	13.946526
RB_REF	08	20240614_185821	14.06.2024	18:58	54.812089	13.989822
RB_REF	09	20240614_194323	14.06.2024	19:43	54.783369	13.944702
RB_REF	10	20240614_202157	14.06.2024	20:21	54.812972	13.988057
RB_REF	11	20240614_202414	14.06.2024	20:24	54.784211	13.942877
RB_REF	12	20240614_210757	14.06.2024	21:07	54.813855	13.986291
RB_REF	13	20240614_215242	14.06.2024	21:52	54.785053	13.941052
RB_REF	14	20240614_223333	14.06.2024	22:33	54.814737	13.984526

EMB342 MBES Oder Bank – MPA Profiles

Area	Profile	File Name	Date [UTC]	Start Time	Latitude	Longitude
OB_MPA	01	20240612_160610	12.06.2024	16:06	54.236793	14.365717
OB_MPA	02	20240612_164700	12.06.2024	16:47	54.266965	14.301952
OB_MPA	03	20240612_172749	12.06.2024	17:28	54.237136	14.366186
OB_MPA	04	20240612_180852	12.06.2024	18:08	54.267308	14.302420
OB_MPA	05	20240612_185317	12.06.2024	18:53	54.237479	14.366655
OB_MPA	06	20240612_193417	12.06.2024	19:34	54.267651	14.302889
OB_MPA	07	20240612_201705	12.06.2024	20:17	54.237822	14.367124
OB_MPA	08	20240612_205939	12.06.2024	20:59	54.267995	14.303358
OB_MPA	09	20240612_214032	12.06.2024	21:40	54.238164	14.367594
OB_MPA	10	20240612_214143	12.06.2024	21:41	54.268338	14.303827
OB_MPA	11	20240612_222321	12.06.2024	22:23	54.238507	14.368063
OB_MPA	12	20240612_230537	12.06.2024	23:05	54.268681	14.304296
OB_MPA	13	20240612_234806	12.06.2024	23:48	54.238850	14.368532
OB_MPA	14	20240613_003120	13.06.2024	00:31	54.269024	14.304765
OB_MPA	15	20240613_011501	13.06.2024	01:15	54.239193	14.369001
OB_MPA	16	20240613_015705	13.06.2024	01:57	54.269368	14.305234
OB_MPA	17	20240613_023804	13.06.2024	02:38	54.239536	14.369470
OB_MPA	18	20240613_031903	13.06.2024	03:19	54.269711	14.305703

EMB342 MBES Oder Bank – REF Profiles

Area	Profile	File Name	Date [UTC]	Start Time	Latitude	Longitude
OB REF	03	20240613 151605	13.06.2024	15:16	54.244516	14.316007
OB REF	04	20240613 154241	13.06.2024	15:42	54.259566	14.274590
OB REF	05	20240613 160759	13.06.2024	16:08	54.244893	14.316400
OB REF	06	20240613 163446	13.06.2024	16:34	54.259944	14.274983
OB REF	07	20240613 165956	13.06.2024	16:59	54.245270	14.316794
OB REF	08	20240613 172643	13.06.2024	17:26	54.260322	14.275376
OB REF	09	20240613 175435	13.06.2024	17:54	54.245648	14.317187
OB REF	10	20240613 182241	13.06.2024	18:22	54.260699	14.275769
OB REF	11	20240613 184757	13.06.2024	18:47	54.246025	14.317581
OB REF	12	20240613 191632	13.06.2024	19:16	54.261077	14.276162
OB REF	13	20240613 194323	13.06.2024	19:43	54.246403	14.317974
OB REF	14	20240613 201239	13.06.2024	20:12	54.261455	14.276555
OB REF	15	20240613 203909	13.06.2024	20:39	54.246780	14.318367
OB REF	16	20240613 210652	13.06.2024	21:06	54.261832	14.276948
OB REF	17	20240613 213320	13.06.2024	21:33	54.247157	14.318761
OB REF	18	20240613 220256	13.06.2024	22:03	54.262210	14.277341
OB REF	19	20240613 223009	13.06.2024	22:30	54.247535	14.319154
OB REF	20	20240613 225857	13.06.2024	22:58	54.262588	14.277734
OB REF	21	20240613 232637	13.06.2024	23:26	54.247912	14.319548
OB REF	22	20240613 235542	13.06.2024	23:55	54.262965	14.278127
OB REF	23	20240614 002401	14.06.2024	00:24	54.248290	14.319942
OB REF	24	20240614 002401	14.06.2024	-	54.263343	14.278520
OB REF	25	20240614 002401	14.06.2024	-	54.248667	14.320335
OB REF	26	20240614 002401	14.06.2024	-	54.263721	14.278913
OB REF	27	20240614 002401	14.06.2024	-	54.249044	14.320729
OB REF	28	20240614 002401	14.06.2024	-	54.264098	14.279306
OB REF	29	20240614 002401	14.06.2024	-	54.249422	14.321122
OB REF	30	20240614 002401	14.06.2024	-	54.264476	14.279700
OB REF	31	20240614 002401	14.06.2024	-	54.249799	14.321516
OB ecoman	01	20240615 153149	15.06.2024	15:31	54.332673	14.201547
OB ecoman	02	20240615 155931	15.06.2024	15:59	54.351303	14.234543
OB ecoman	03	20240615 162727	15.06.2024	16:27	54.332289	14.202195

8 Data and Sample Storage and Availability

Data collected during the cruise EMB342 will be used in the MGF-Ostsee project. After the scientific publication or at the latest 3 years after the end of the project, all data will be placed into the PANGAEA database for access of wider scientific public. The metadata for this cruise is made publicly available immediately after the cruise (via BSH DSHIP Landsystem). The raw and processed acoustic data will be archived on the dedicated data servers (responsible Inken Schulze, Peter Feldens). The data collected by all sub-projects will be critically checked and made available to the project partners via an internal database within the deadlines that result from the milestones (persons responsible for different samples and data are the authors of respective Sections 5.1-5.7). For the data collected at the Leibniz Institute for Baltic Sea Research Warnemünde, the metadata information system IOWMETA (http://iowmeta.io-warnemuende.de) is available. In addition, research data of the project from various sub-projects are archived in the PANGAEA database or DNA / RNA sequence data in the public databases Genbank, GFBio, NCBI (responsible Judith Piontek, Klaus Jürgen) and/or IOW database "BenthosDB" (responsible Mayya Gogina, Michael L. Zettler). For more details see MGF-Ostsee data management plan. Availability of hydroacoustic data is restricted due to official regulations during the survey period in 2024, and will be made public after permission from the German Navy.

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11 Abbreviations

MBES:	Multibeam Echosounder
HySo:	Hydrosonde
CTD:	CTD
MUC:	Multi Corer
van Veen grab:	Van Veen Grap
Dredge:	Dredge
VIDEO:	Underwater Video System

12 Appendices

12.1 Selected Pictures of Samples

12.2 Selected Pictures of Shipboard Operations