THÜNEN Institute of Baltic Sea Fisheries (OF)

Alter Hafen Süd 2, 18069 Rostock Fon +49 381 66099-139 Fax +49 381 66099-199 Date 17.06.2022 E-Mail: stefanie.haase@thuenen.de

Cruise Report

Cruise no. 456 of FRV "Walther Herwig III" 03. – 26.05.2022

Baltic acoustic spring survey (BASS)

Scientist in charge: Dr. Stefanie Haase (Thünen-OF)

1. Main purpose of the cruise

Cruise no. 456 of FRV "Walther Herwig III" was conducted as part of the international "Baltic Acoustic Spring Survey (BASS)". The main objective of this hydroacoustic survey is the annual assessment of small pelagic fish stocks, especially sprat, in the Baltic Sea. The BASS is coordinated by the ICES Working Group on Baltic International Fish Surveys (WGBIFS) where timing, survey area and the principal methods of investigation are discussed and decided. The survey has been conducted annually since 2001 and delivers the most important fisheries-independent abundance index for the annual ICES stock assessment of Baltic sprat.

The German investigation area in 2022 covered ICES subdivisions 24, 25, 26, 28, and 29, and thus the major part of the investigation area of the international survey. Other parts were covered by Sweden, Lithuania, Latvia, Estonia, and Poland. The rectangles 48G9 and 48H0 were covered for the first time during the BASS in 2022 and thus expanded the survey area north by two rectangles.

Distribution list:

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

2. Cruise objectives

Main objectives of the cruise were:

- Hydroacoustic measurements in the Baltic Sea for the assessment of small pelagics from the Arkona Sea to Gotland Sea (ICES subdivisions 24 to 26 and SD 28-29).
- Fishing with a pelagic trawl according to hydroacoustic indications and subsequent biological measurement of catches (species, length composition, sex, maturity and age).
- Sampling of herring and sprat (whole fish, otoliths, stomachs and gonads) for further analysis at the Thünen-OF.
- Hydrographic measurements with a CTD probe on predetermined stations and after each fishing station when distant from the planned CTD station (approx. every 10 nmi).
- Acoustic intercalibration of "Walther Herwig III" with the commercial fishing vessel "Kristin" which conducted the survey in 2021.

3. Cruise narrative and preliminary results

3.1 Cruise narrative

"Walther Herwig III" departed from the harbour of Bremerhaven on May 3rd. The vessel arrived in Warnemünde in the evening of the 5th where scientist boarded and equipment was loaded.
Acoustic recordings for the BASS started in the morning of May 6th after reaching the area of investigation in ICES subdivision 24. Acoustic recordings were continued until all 17 transects were surveyed on the 21st of May. The scientific echosounder equipment was calibrated on May 15th. A map summarizing all daily transects is presented in Figure 1.
May 22nd and 23rd were used to conduct an acoustic intercalibration between the research vessel "Walther Herwig III" and the commercial fishing vessel "Kristin" with which the survey was conducted in 2021. Both vessels sailed in formation on hydroacoustic transects while the acoustic instruments on both vessels operated in the same way as during the survey. Vessels took the lead in turns to investigate the influence of both vessels on the detectability of fish schools.

Scientists disembarked in the harbour of Warnemünde on the 24th and the vessel arrived in Bremerhaven on the 26th.

3.2 Hydroacoustic recording

The "Walther Herwig III" is equipped with four Simrad EK60 narrowband echosounders (18, 38, 120 and 200 kHz). The BASS was conducted with the 38 kHz frequency narrow band mode (pulse length = 1024 µs; pingrate = 500 ms) but all frequencies were recorded in continuous wave (CV) mode. Each echosounder was calibrated. Calibration procedure itself was carried out as described in the "Manual for International Baltic Acoustic Surveys (IBAS)" (ICES 2017).

The acoustic and ichthyological sampling stratification was based on ICES statistical rectangles (0.5 degree in latitude and 1 degree in longitude). The daily surveyed distance amounted to approximately 70-90 nautical miles with an objective to cover 60 nautical miles per statistical rectangle. In general, each ICES-rectangle was covered with two parallel transects spaced by a maximum of 15-18 nm whenever possible. Ship's speed was 10 knots during acoustic measurements while fishing operations were conducted at 3 to 4 knots. The standard acoustic investigations and the fishing hauls were carried out at daylight from 4:00 - 20:00 UTC (6:00 - 22:00 local time).

All rectangles assigned to the German investigation area in subdivisions 24 to 26, 28 and 29 were covered by hydroacoustic transects. For some rectangles, due to spatial constraints, the total hydroacoustic track length was however lower than the recommended 60 nautical miles (see Figure 1). The lack of a granted research licence for planned stations in the Swedish EEZ caused significant track changes. Hydroacoustic track lengths less than 60 nautical miles were conducted in 10 of the 26 rectangles assigned to the German investigation area. This resulted in a total hydroacoustic track length of 1391 nautical miles.
For the intercalibration between the fishing vessel "Kristin" and "Walther Herwig III", two transects with a length of approximately 140 nmi each were sailed in formation. The first transect covered water depths of up to 90 m in the Bornholm Basin with continuous fish signals, the second transect was in shallower waters up to 40 m West of Bornholm and was characterized by more patchy fish signals. At the time of writing this report, hydroacoustic data are still being processed and the final analysis will be accomplished by the end of 2022.

3.3 Biological sampling

Trawling was done with the pelagic gear "PSN205" in the midwater as well as near the bottom to sample and identify the echo signals. In accordance with the IBAS manual, codend inlets with 20 mm stretched mesh size in Subdivision 24 and 12 mm in Subdivision 25 to 29 were used. The aim was to conduct at least two fishing hauls per ICES statistical rectangle. The trawling time lasted usually 30 minutes at fishing depth and at a speed of 3 to 4 knots. However, the fishing time was in some cases reduced because of abundant fish echoes observed with the Marport-net-probe.
The trawling depth and the vertical net opening were controlled by the Marport-net-probe. Generally, the vertical net opening was around 12 m when deployed. The trawl depth (headrope below the surface) was chosen depending on the densities of fish on the echogram and ranged from 11.4 m to 155.2 m. Trawl depth could vary within a haul when more than one layer of fish was sampled. The bottom depth at the trawling positions ranged from 26.7 m to 190.6 m.

Samples were taken from each haul in order to determine the length and weight distribution of fish. A comparison of length distribution of herring and sprat between BASS 2021 and BASS 2022 is presented in Figure 2. Sub-samples of herring and sprat were taken to investigate the distribution of sex, maturity and age of the catches. Samples of whole fish and parts of different organs/tissues were also taken for later investigations in the laboratory. Detailed biological analyses were made according to the standard procedure (i.e. sex, maturity, otolith dissection). At the time of writing, the fish otoliths are still being processed to analyse individual fish age and the final analysis will be accomplished by the end of 2022.

In total 48 standard hauls (including three invalid hauls due to small catch sizes in SD 24) were carried out during the BASS:

Subdivision	Hauls (n)
24	10
25	17
26	3
28	8
29	10

Altogether 28,012 fish were measured and 1,579 additional fish (545 sprat and 1,034 herring) were sampled for further age determination.

Species	Common name	Length measurements	Number of hauls where present
Ammodytes marinus	Lesser sandeel	153	2
Clupea harengus	Atlantic herring	11,768	48
Cyclopterus lumpus	Lumpfish	4	3
Gadus morhua	Atlantic cod	195	27
Gasterosteus aculeatus	Three-spined stickleback	1,876	26
Hyperoplus lanceolatus	Great sandeel	224	4
Merlangius merlangus	Whiting	40	4
Myoxocephalus scorpius	Shorthorn sculpin	11	5
Platichthys flesus	European flounder	26	17
Engraulis encrasicolus	European anchovy	14	4
Sprattus sprattus	European sprat	13,701	46

Overall catches (kg 0.5 hr^{-1}) during the BASS per haul, ICES rectangle, ICES subdivision and species are displayed in Table 1. The spatial distribution of the catches per species is presented in Figure 3.

3.4 Hydrography

A Seabird-CTD-probe (SE911) equipped with a water sampler and oxygen sensor was used for hydrographic measurements. Vertical profiles were taken on a fixed station grid along the track. Additional CTD casts were performed after or before each trawl if distance from the planned station was sufficient (ca. 5 nmi). The profiles covered the entire water column to about 2 m above the seafloor. Three water samples from different depths were taken per day to validate the oxygen data by Winkler titration, and to collect reference salinity samples. Altogether 105 CTD casts were performed during the cruise.

Measurements showed a regular stratification of the water column during the survey. Temperature, salinity and oxygen profiles are presented in Figure 4. Seawater temperature ranged from 13.4°C (at the surface) to 3.1°C (recorded at 45.7 m depth). At the deepest CTD cast of the survey (204.1 m) the bottom temperature was 7.2°C. Overall, intermediate water masses (depth ranging from 23.1 to 76.7 m) presented temperatures below 4°C, which is considered as a temperature threshold limit for the distribution of sprat in the water column. Higher temperatures were recorded above and below the midwater stratum. The water column was less stratified in rectangles 48G9 and 48H0 with temperatures between 3.4°C and 7.8°C. Measured salinity ranged from 5.5 at the surface layer up to a maximum of 17.4 at the bottom of the Arkona Basin and the Bornholm Basin. Oxygen concentrations ranged from 0.05 ml l^{-1} at the bottom to 15.4 ml l^{-1} (recorded at 11.4 m water depth). Apart from the rectangles 48G9 and 48H0, were the whole water column was well oxygenated, hypoxic conditions (<1.4 ml l^{-1}) were observed approximately below 63 m depth. No fish echo was usually observed under these conditions.

4. Cruise participants

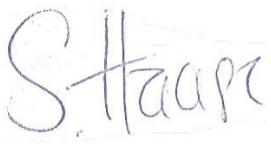
Name	Function	Institution
Dr. Stefanie Haase	Cruise leader	Thünen-OF
Mario Koth	Fishery biology	Thünen-OF
Denise Schneider	Fishery biology	Thünen-OF
Marcel Bächtiger	Fishery biology	Thünen-OF (student assistant)
Alexander Fiek	Fishery biology	Thünen-OF (student assistant)
Maria Golovaneva	Fishery biology	Thünen-OF (student assistant)
Murielle Muesfeldt	Fishery biology	Thünen-OF (student assistant)
Arc'hantael Labrière	Fishery biology	Thünen-OF (student intern)
Gayathra Gedara	Fishery biology	Thünen-OF (student intern)

5. Acknowledgements

We hereby thank all participants and the crew of FRV "Walther Herwig III" and FV "Kristin" for their outstanding cooperation and commitment.

6. Literature

ICES. 2017. Manual for the International Baltic Acoustic Surveys (IBAS). Series of ICES Survey Protocols SISP 8 - IBAS. 47 pp.; http://doi.org/10.17895/ices.pub.3368;



Dr. Stefanie Haase (Thünen-OF)

(Scientist in charge)

7. Figures

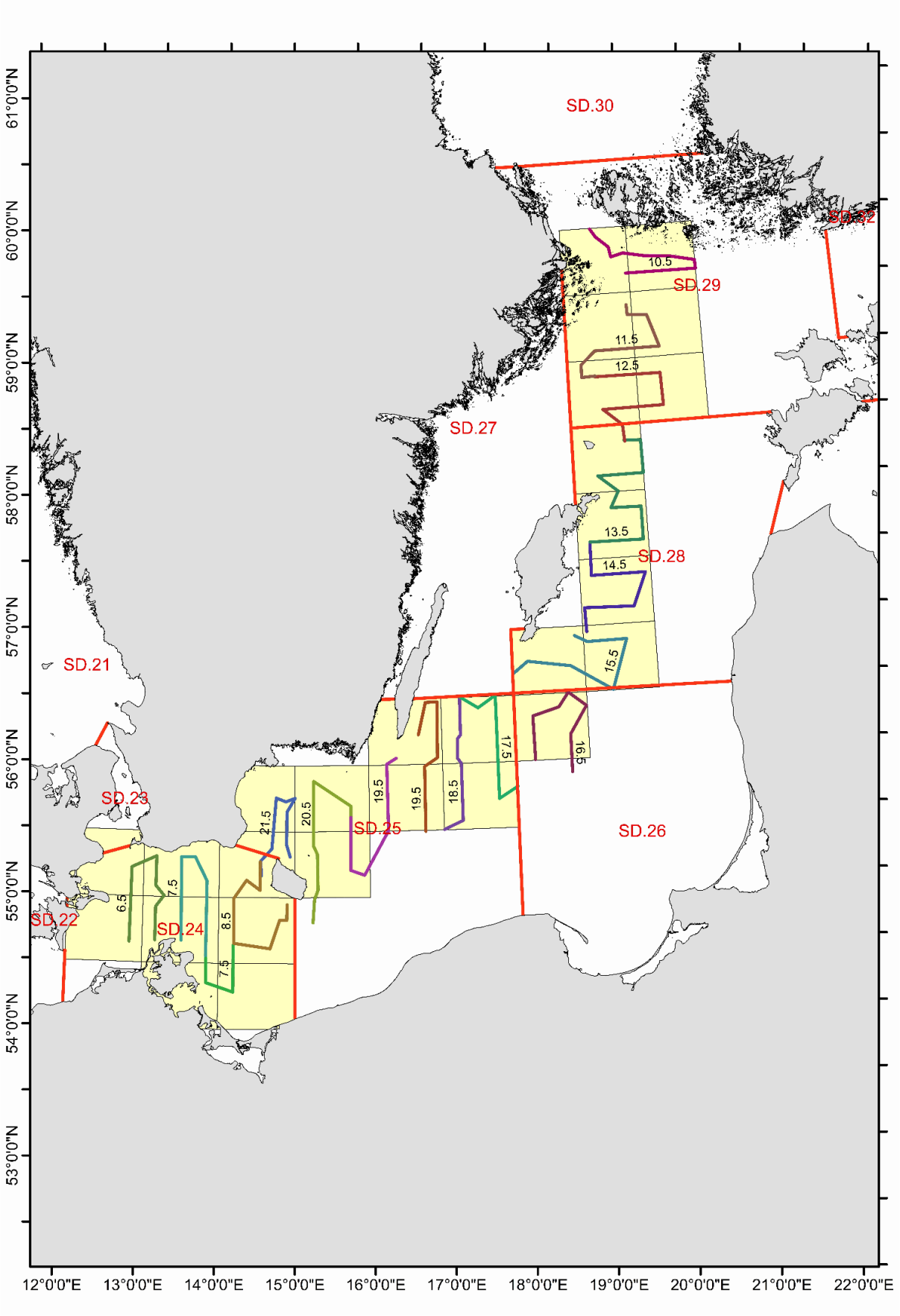


Figure 1: "Walther Herwig III" cruise 456/2022: Daily hydroacoustic tracks recorded during the BASS 2022.

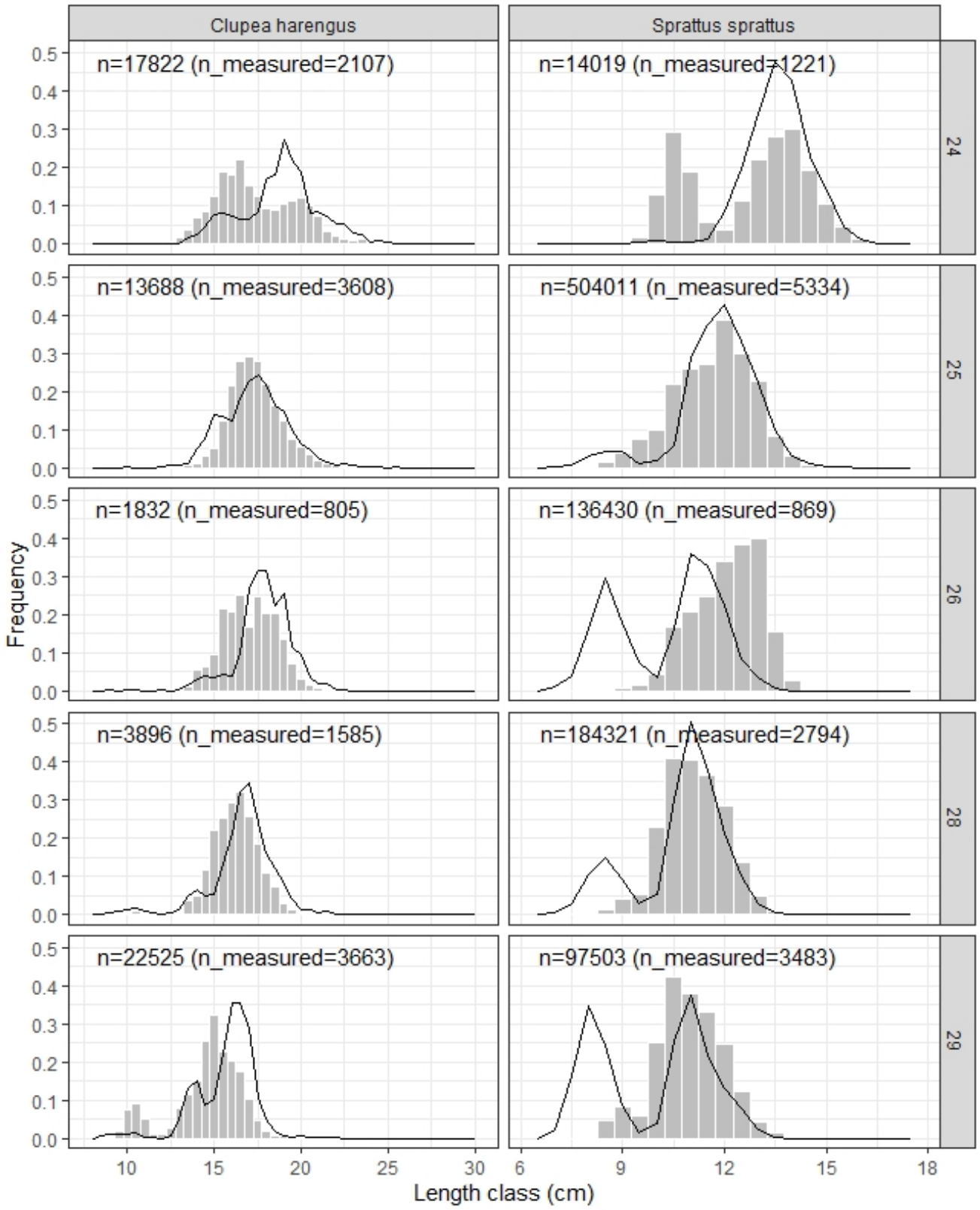


Figure 2: "Walther Herwig III" cruise 456/2022: Herring and sprat length distribution of caught individuals (numbers indicated in the upper left corner) per ICES subdivision during BASS 2021 (black lines) and BASS 2022 (grey bars).

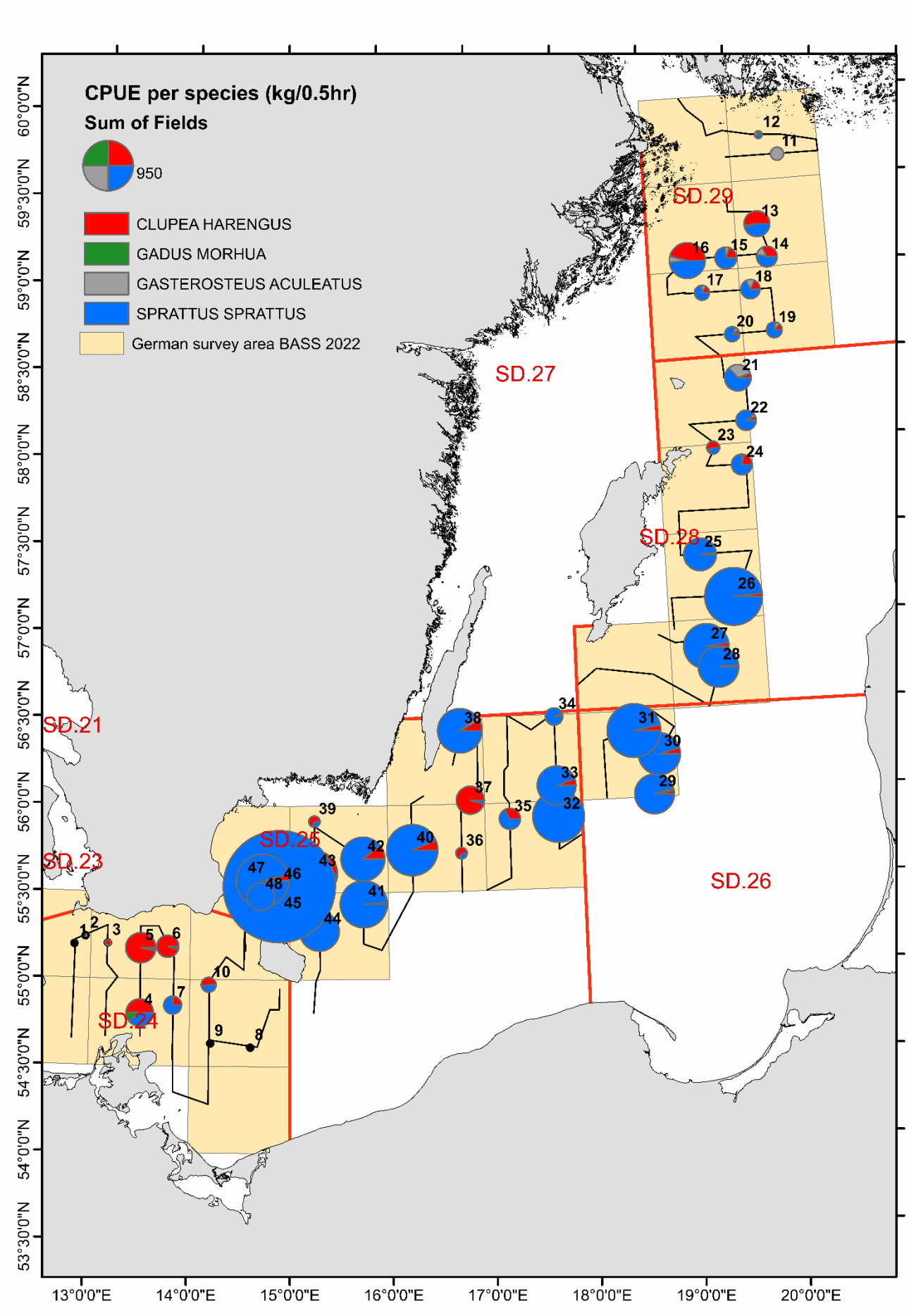


Figure 3: "Walther Herwig III" cruise 456/2022: CPUE (kg/0.5 hr) of catch per species recorded during the BASS 2022. Numbers indicate the haul number.

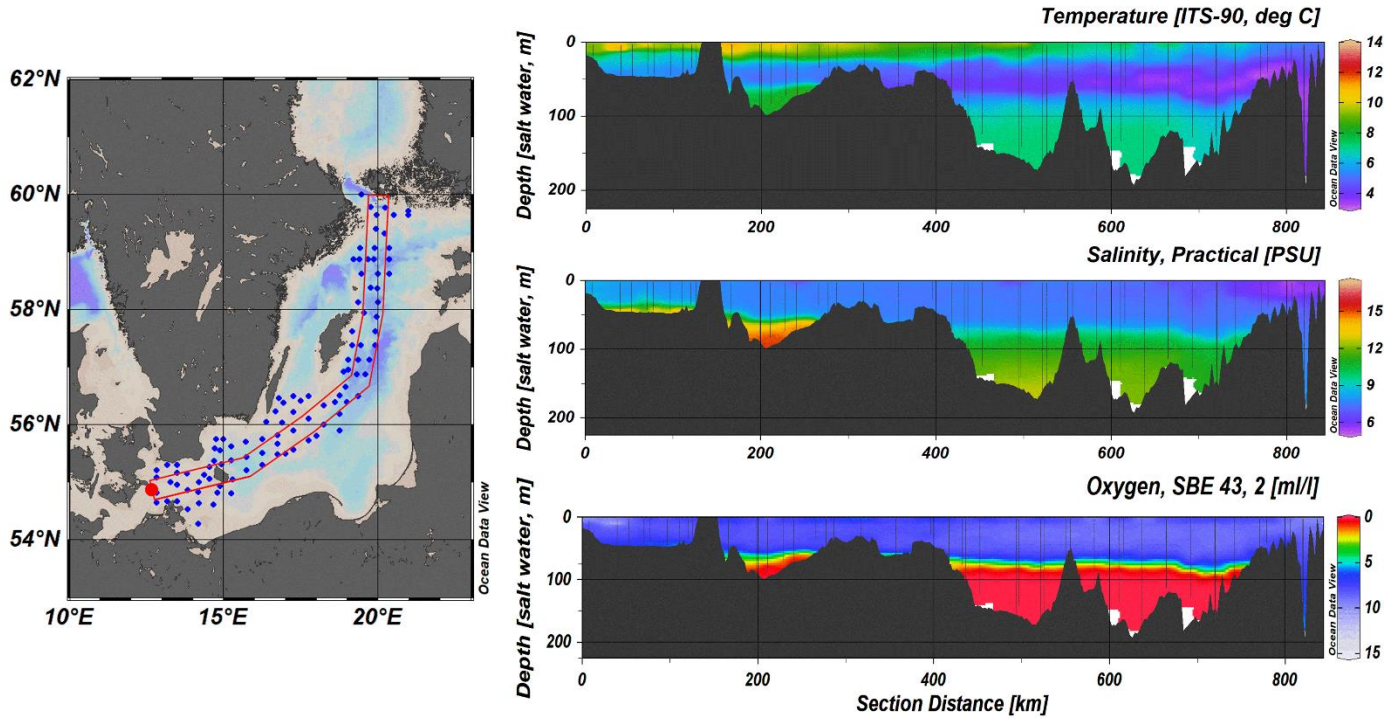


Figure 4: "Walther Herwig III" cruise 456/2022: Temperature (upper right panel), salinity (middle right panel) and oxygen (lower right panel) interpolated from CTD casts along a south/west - north/east transect as shown in the left panel (red line). CTD casts coordinates are displayed as blue dots on the map in the left panel.

8. Tables

Table 1: Vessel "Walther Herwig III" cruise 456/2022: Catch composition (kg 0.5 h-1) per haul, ICES subdivision (SD), ICES rectangle. No catch are indicated by "-" and values lower than 0.01 by "+". Species are indicated by their 3-alpha code (SAN = *Ammodytes marinus*; COD = *Gadus morhua*; FLE = *Platichthys flesus*; ANE = *Engraulis encrasicolus*; GTA = *Gasterosteus aculeatus*; HER = *Clupea harengus*; LUM = *Cyclopterus lumpus;* SCU = *Myxocephalus scorpius;* SPR = *Sprattus sprattus*; WHG = *Merlangius merlangus*; YEZ = *Hyperoplus lanceolatus*).

Haul No.	ICES SD	ICES rectangle	SAN	COD	FLE	ANE	GTA	HER	LUM	SCU	SPR	WHG	YEZ
1	24	39G2	-	-	-	-	+	0.13	-	-	-	-	0.57
2	24	39G2	3.16	-	-	-	+	2.07	-	-	0.01	-	25.28
3	24	39G3	1.83	-	-	-	-	12.53	-	-	0.02	-	4.43
4	24	38G3	-	31.89	-	-	-	138.42	-	-	110.85	10.17	-
5	24	39G3	-	-	-	-	-	328.19	0.44	-	11.53	-	0.02
6	24	39G3	-	1.19	0.14	-	+	171.74	-	-	9.26	1.65	-
7	24	38G3	-	4.44	-	-	-	27.91	0.51	-	87.58	0.98	-
8	24	38G4	-	-	-	-	-	2.41	-	-	-	-	-
9	24	38G4	-	-	-	-	-	0.15	-	-	0.07	-	-
10	24	39G4	-	0.87	-	-	-	44.10	-	-	37.86	0.41	-
11	29	48H0	-	-	-	-	64.48	0.07	-	-	0.03	-	-
12	29	48H0	-	4.97	-	-	4.20	3.23	-	-	10.52	-	-
13	29	47H0	-	-	0.10	-	5.40	129.01	-	0.08	113.06	-	-
14	29	47H0	-	-	0.13	-	22.07	52.49	-	-	84.90	-	-
15	29	47G9	-	-	-	-	12.53	34.47	-	-	128.35	-	-
16	29	47G9	-	-	-	-	26.86	221.57	-	-	231.84	-	-
17	29	46G9	-	-	0.09	-	7.91	13.93	-	-	62.64	-	-
18	29	46H0	-	0.33	-	-	20.08	25.55	-	-	93.79	-	-
19	29	46H0	-	0.56	-	-	9.19	12.24	-	-	71.68	-	-
20	29	46G9	-	-	-	-	7.24	7.82	-	-	70.19	-	-
21	28-2	45G9	-	-	0.48	-	82.05	14.06	-	-	164.66	-	-
22	28-2	45G9	-	0.19	0.17	-	6.87	9.43	-	-	135.55	-	-
23	28-2	44G9	-	-	-	-	3.02	34.55	-	-	24.77	-	-
24	28-2	44G9	-	1.69	0.31	-	2.65	33.74	-	-	121.65	-	-
25	28-2	43G9	-	0.27	0.42	-	2.42	8.54	-	-	386.43	-	-
26	28-2	43G9	-	6.92	0.58	-	0.73	23.30	-	-	1210.77	-	-
27	28-2	42G9	-	4.78	-	-	0.07	20.99	-	-	741.69	-	-
28	28-2	42G9	-	0.92	0.4	-	-	10.73	-	-	599.84	-	-
29	26	41G8	-	10.73	0.84	-	-	17.14	-	-	558.10	-	-
30	26	41G8	-	0.45	0.32	-	-	31.19	-	-	627.73	-	-
31	26	41G8	-	0.27	0.12	-	0.30	36.91	-	0.71	1039.57	-	-
32	25	40G7	-	-	-	-	-	4.08	-	-	996.81	-	-
33	25	41G7	-	-	0.65	-	+	30.62	0.34	-	531.23	-	-
34	25	41G7	-	0.58	-	-	3.06	3.94	-	-	104.10	-	-
35	25	40G7	-	-	-	-	-	56.25	-	-	110.94	-	-
36	25	40G6	-	0.63	-	-	-	33.92	-	0.43	14.16	-	-
37	25	41G6	-	-	-	-	0.02	279.04	-	0.51	13.02	-	-
38	25	41G6	-	-	0.23	-	24.01	59.79	0.20	-	653.20	-	-
39	25	40G6	-	-	-	-	+	32.65	-	0.12	15.10	-	-
40	25	40G6	-	5.33	-	-	-	61.36	-	-	912.92	-	-
41	25	39G5	-	1.05	-	0.13	-	10.00	-	-	820.28	-	-
42	25	40G5	-	1.40	-	-	-	77.86	-	-	641.48	-	-
43	25	40G5	-	29.11	-	0.91	-	129.21	-	-	633.84	-	-
44	25	39G5	-	0.36	0.76	0.10	-	4.75	0.40	-	581.31	-	-
45	25	39G4	-	0.32	-	-	-	7.89	-	-	164.07	-	-
46	25	40G4	-	6.85	-	0.56	-	19.61	-	-	4667.12	-	-
47	25	40G4	-	2.81	0.53	-	-	37.12	-	-	1004.59	-	-
48	25	39G4	-	2.54	-	-	-	1.69	-	-	279.98	-	-
Total			**4.99**	**121.42**	**6.26**	**1.69**	**305.16**	**2318.36**	**1.35**	**1.84**	**18879.07**	**13.20**	**30.29**