Federal Research Institute for Rural Areas, Forestry and Fisheries

Thünen-Institute of Baltic Sea Fisheries

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Cruise Report FRV "Solea II" Cruise 761
03.05. – 28.05.2019

Hydroacoustic survey for the assessment of small pelagics in the Baltic Sea

Scientist in charge: Paco Rodriguez-Tress (TI-OF)

1. Introduction

Cruise no. 761 of the FRV "Solea II" was conducted as part of the annual ICES Baltic International Acoustic Spring Survey (BASS). The main objective of this hydroacoustic survey is the yearly assessment of small pelagic fishes stock, especially sprat, in the Baltic proper. BASS is co-ordinated at the international level by the ICES Baltic International Fish Survey Working Group (WGBIFS) where timing, surveying area and the principal methods of investigations are discussed and decided.

German investigation area in 2019 covered ICES subdivisions 24, 25, 26, 27, 28 and 29. Other areas in the Baltic Sea were covered by Lithuania, Latvia, Estonia and Poland.

Distribution list:
BLE, Hamburg
Schiffsführung FFS „Clupea"
BMEL, Ref. 614
Thünen-Institut - Pressestelle (M. Welling)
Thünen-Institut – Präsidialbüro
Thünen-Institut – Fischereiökologie
Thünen-Institut – Ostseefischerei
Thünen-Institut – Seefischerei
Thünen-Institut – Zentrum für Informationsmanagem.
BSH Hamburg
Max-Rubner-Institut, AG Fischqualität, Hamburg
GEOMAR Helmholz-Zentrum für Ozeanforschung, Kiel
Institut für Fischerei der Landesforschungsanstalt MV
LA für Landwirtschaft, Lebensmittels. u. Fischerei
Deutscher Fischerei-Verband e. V., Hamburg
Leibniz Institut für Ostseeforschung Warnemünde
Fahrtteilnehmer
Mecklenburger Hochseefischerei Sassnitz
Kutter- und Küstenfisch Sassnitz
Landesverband der Kutter- und Küstenfischer
Sassnitzer Seefischer
Thünen-Seeeinsatzplanung, Herr Dr. Rohlf
Euro-Baltic Mukran

2. Cruise objectives

Main objectives of the cruise were:

- Hydroacoustic measurements for the assessment of small pelagics from the Arkona Sea to Gotland Sea (ICES subdivisions 24 to 29).
- Fishing with pelagic trawl according to hydroacoustic requirements and biological measurement of catches (species, length composition, sex, maturity and age).
- Sampling of herring, sprat and cod (whole fish, otoliths, stomachs and gonads) for further laboratory studies at the TI-OF.
- Hydrographic measurements with CTD probe on predetermined station and after each fishing station when away from the station (circa 5 nmi).

3. Cruise narrative and preliminary results

3.1. Narrative

The FRV "Solea II" departed from Cuxhaven harbour the 3rd May in the morning, subsequently crossing the Kiel Channel in direction of Kiel harbour where the scientific team boarded the ship. The ship left Kiel harbour the 4th May in the early morning. Due to good weather conditions the 4th May, the day was used to calibrate the echosounder in the Kiel bight after what the ship steamed to the survey area.

Acoustic recording for the BASS started in the morning of the 5th May after reaching the area of investigation in ICES subdivision 24. Despite minor technical problems with the Ek80 software, the first days of cruise were completed according to the objectives of the survey. The main net broke while fishing close to the ground (station 250/79) in the afternoon of the 11th and the spare net was then used as replacement until the next afternoon. Due to the long-time at sea and good progress of the survey a two days break was done the 18th and 19th May in the harbour of Visby, Gotland. The survey was then resumed the 20th in the morning and went uninterrupted until the 25th when all transects required for the BASS were covered. Due to bad weather at sea during the last days of survey the two additional transects east of Gotland were cancelled in favour of the last remaining priority transect in SD25. The ship then took shelter from the wind close to the coast of Bornholm for the day the 26th. The day of the 27th was used to redo part of the transect conducted the 7th May, were no fish catches had been previously made in rectangle 38G4 and to extend the survey in the rectangle 37G4. This rectangle was historically avoided during this survey as the overall shallow waters limit acoustic recording and fishing operation in this area. A map summarizing the daily transects performed is presented Figure 1.

The cruise ended the 28th May after a total of 21 days of hydroacoustic monitoring when scientists disembarked in the morning in the harbour of Marienehe, Rostock.

3.2. Hydroacoustic sampling

The Solea II is equipped with four Simrad EK80 wideband echosounders (18, 38, 120 and 200 kHz). Although the BASS was done with a 38 kHz frequency narrow band mode (pulse length = 1024 µs; pingrate = 500 ms) fishing operation were recorded in broadband mode whenever possible. As such each transducer was calibrated both in narrow band and

broadband with different combination of pulse duration. Calibration procedure itself was carried out as described in the “Manual for International Baltic Acoustic Surveys (IBAS)” (ICES 2017). EK80 operated at 38, 70,120 and 200 kHz in continuous wave (CW) mode during usual recording along the transect and in frequency modulated (FM) mode with a frequency band ranging from 35 to 260 kHz while fishing.

The acoustic and ichthyologic 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 80-90 nautical miles with an objective of 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 operation were conducted at 3 to 3.5 knots. The standard acoustic investigations and the fishing hauls were carried out at daylight from 4:00 - 19:00 UTC (6:00 and 21:00 local time).

With the exception of rectangle 43G8 (SD 28) where fishing license were not granted all rectangles assigned to German investigation in subdivisions 24 to 29 were covered by hydroacoustic transects. For some rectangles, due to time or spatial constrain the total hydroacoustic track length was however lower than the recommended 60 nautical miles (see Figure 1). Absence of licence delivery for some specific planned station in the Swedish EEZ or military exercise also forced some track changes (rectangle 42G8 and 46G8 respectively).

At the time of writing the hydroacoustic data are still being processed and the final analysis will be accomplished by the end of 2019.

3.3. Biological sampling

Trawling was done with the pelagic gear “PSN388” in the midwater as well as near the bottom to identify the echo signals. The aim was to conduct at least two fishing hauls per ICES statistical rectangle. The trawling time lasted usually 30 minutes at a speed of 3 to 3.5 knots. The fishing time was however decreased in case of abundant echo observed with the Scanmar-net-probe. In accordance to the IBAS manual cod end inlets with stretched 20 mm mesh sizes in Subdivision 24 and 12 mm in Subdivision 25 to 28 were used.

The trawling depth and the net opening were controlled by a Scanmar-net-probe. Generally the net opening was of circa 8 m when deployed. The trawl depth (headrope below the surface) was chosen regarding highest density of fish on the echogram and ranged from 9 m to 81 m. The bottom depth at the trawling positions varied from 20 m to 459 m.

Samples were taken from each hauls in order to determine the length and weight distribution of fish. Comparison of length distribution of herring and sprat between BASS 2018 and BASS 2019 is presented Figure 2. Sub-samples of cod, herring and sprat were done to investigate sex, maturity and age of the catches. Samples of whole fishes 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).

In total 68 standard hauls were (67 valid) carried out for the BASS:

Subdivision	Hauls (n)
24	11
25	24
26	4
27	6
28	14
29	9

Altogether 31,102 fish were measured and 2,197 additional fish (652 sprats, 1,352 herrings and 193 cods) were sampled for further age determination

Species	Length measurements	Number of hauls were present
Ammodytes tobianus	1	1
Clupea harengus	12,321	62
Cyclopterus lumpus	3	3
Gadus morhua	193	30
Gasterosteidae	1	1
Gasterosteus aculeatus	2,340	45
Hyperoplus lanceolatus	79	4
Merlangius merlangus	45	9
Platichthys flesus	31	19
Scomber scombrus	1	1
Sprattus sprattus	16,082	62
Trachurus trachurus	4	4
Zoarces viviparus	1	1

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

3.4. Hydrography

A Seabird-CTD-probe equipped with a carousel water sampler and oxygen sensor was used for hydrographical measurements. Vertical profiles were taken on a fixed station grid along the track. Additional CTD casts were done after or before each trawl if distance from the planned station was high enough (ca. 5 nmi). The profiles covered the entire water column to about 2 m above the sea bottom except on the deepest station were the cable length of the ship was limited to ~320m. Water samples were taken once per day from different depths to check the oxygen data by Winkler titration and to collect reference salinity samples. The hydrological raw data were aggregated to 1 m depth strata. Altogether 237 CTD casts were performed during the cruise.

Measurements showed a regular stratification of the water column during the survey. Temperature, salinity and oxygen profile are represented in Figure 4. Seawater temperature

ranged from 13.9 °C at the surface to 2.9°C (recorded at 39.5 m depth). At the deepest CTD recording of the survey (326.5 m) temperature was measured at 6.4°C. Overall intermediate water masses (depth ranging from 17.5 to 71.5 m) presented temperature below 4°C, which is considered as a temperature threshold limit for the distribution of sprat in the water column, while higher temperature were recorded above and below this stratum. Measured salinity ranged from 5.7 psu at the surface layer up to a maximum of 17.1 psu at the bottom of the Bornholm Basin. Regarding oxygen, concentration ranged from 4.9 to 11.0 $mL.L^{-1}$ in the intermediate water mass and dropped below 1 $mL.L^{-1}$ under this layer. Overall hypoxic conditions (<1.4 $mL.L^{-1}$) were observed below circa 60 m depth all along the survey. No fish echo was usually observed under these conditions.

4. Survey participants

Name	Function	Institution
M. Bachtiger	Fishery biology	TI-OF (student assistant)
A. Fiek	Fishery biology	TI-OF (student assistant
L. Hartkens	Acoustics	TI-SF
M. Koth	Fishery biology	TI-OF
N. Plantener	Fishery biology	TI-OF
P. Rodriguez-Tress	Cruise leader	TI-OF
S. Winning	Fishery biology	TI-OF (student assistant)

5. Acknowledgement

We hereby thank all participants, the crew of FRV “Solea” and Captain S. Meier for their outstanding cooperation and commitment.

6. Litterature

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

7. Figures

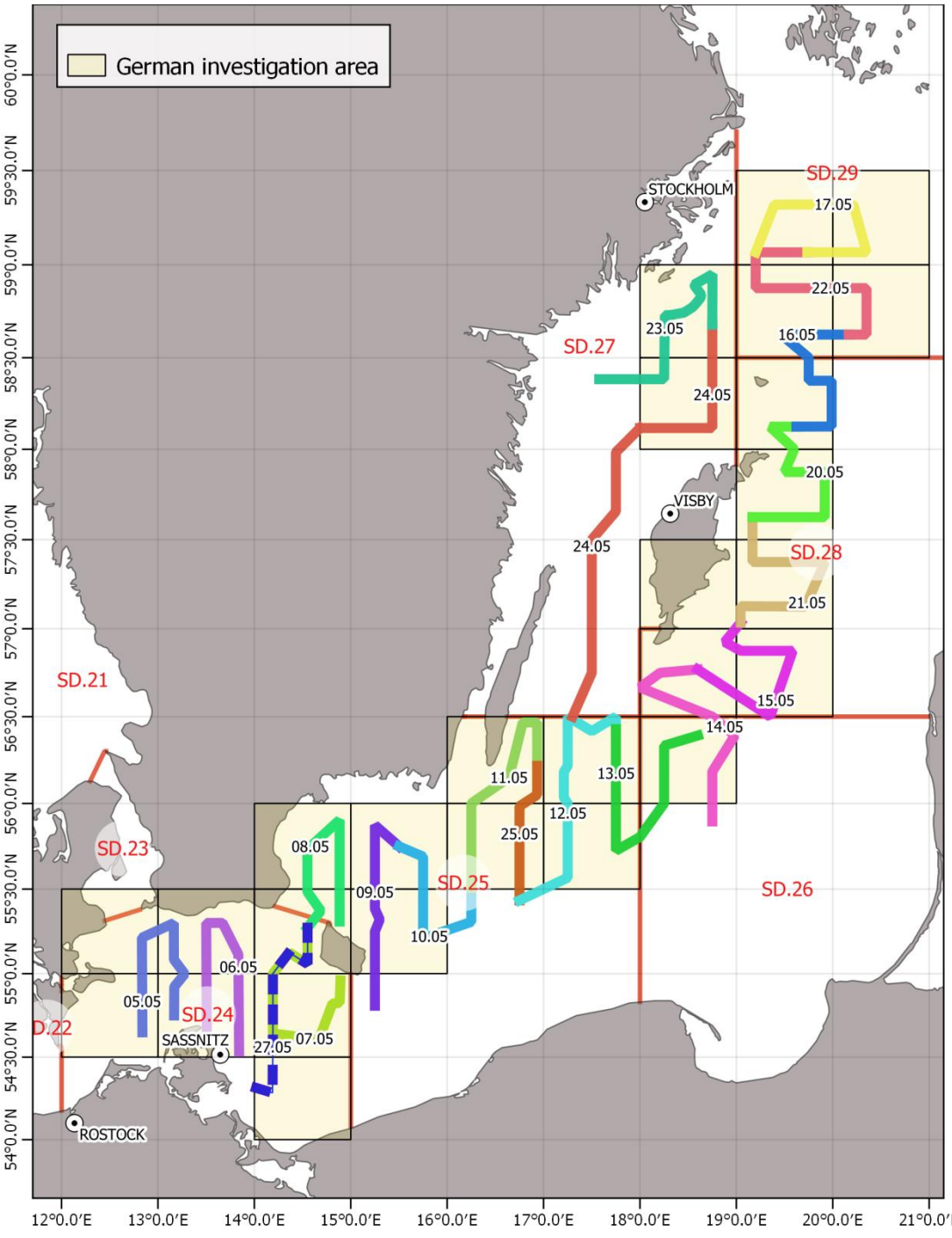

Figure 1: FRV "Solea" cruise 761/2019 BASS: Daily hydroacoustic tracks done during the BASS survey 2018.

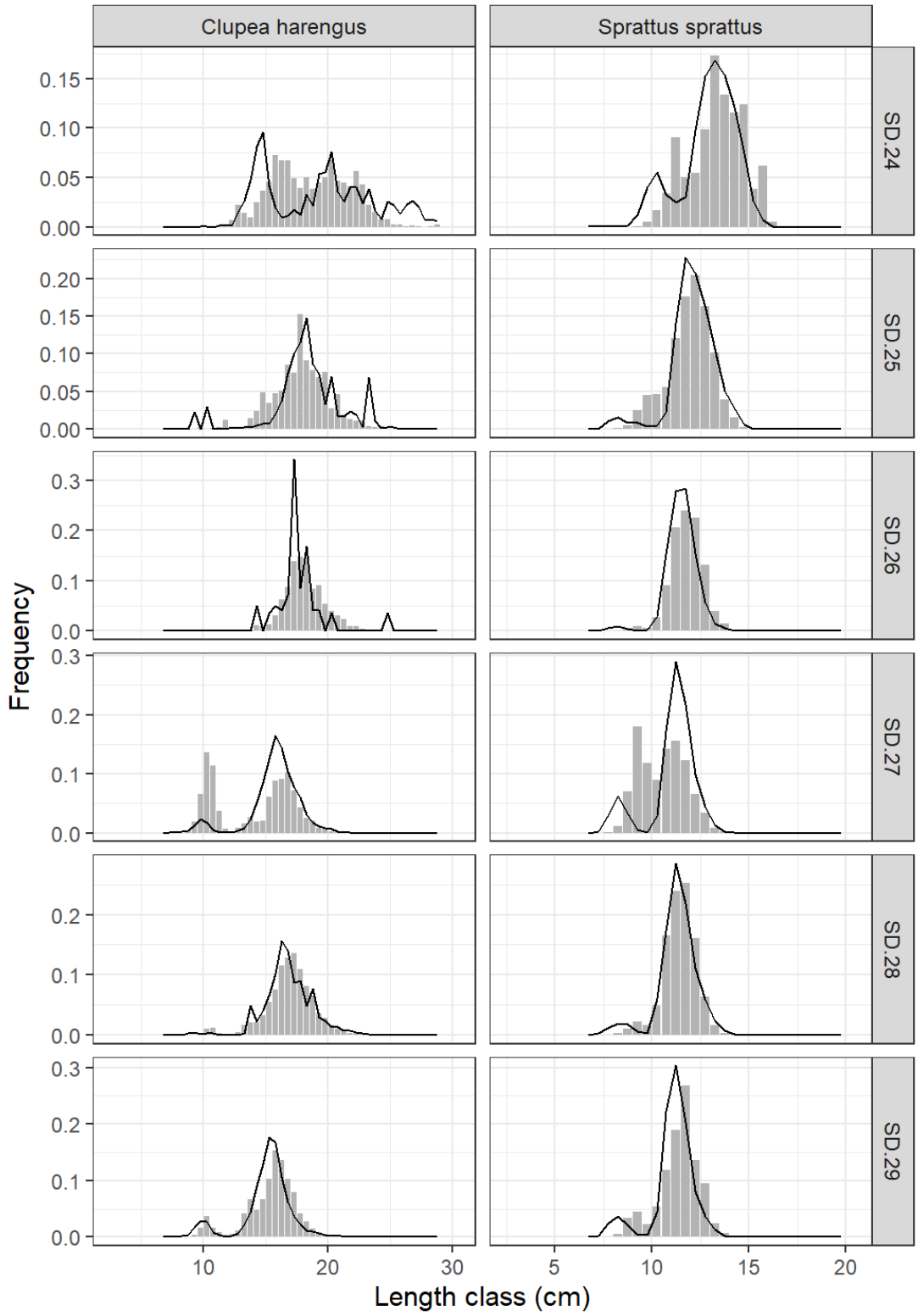

Figure 2: FRV "Solea" cruise 761/2019 BASS: Herring and sprat length distribution measured per ICES subdivision during BASS 2018 (black lines) and BASS 2019 (grey bars).

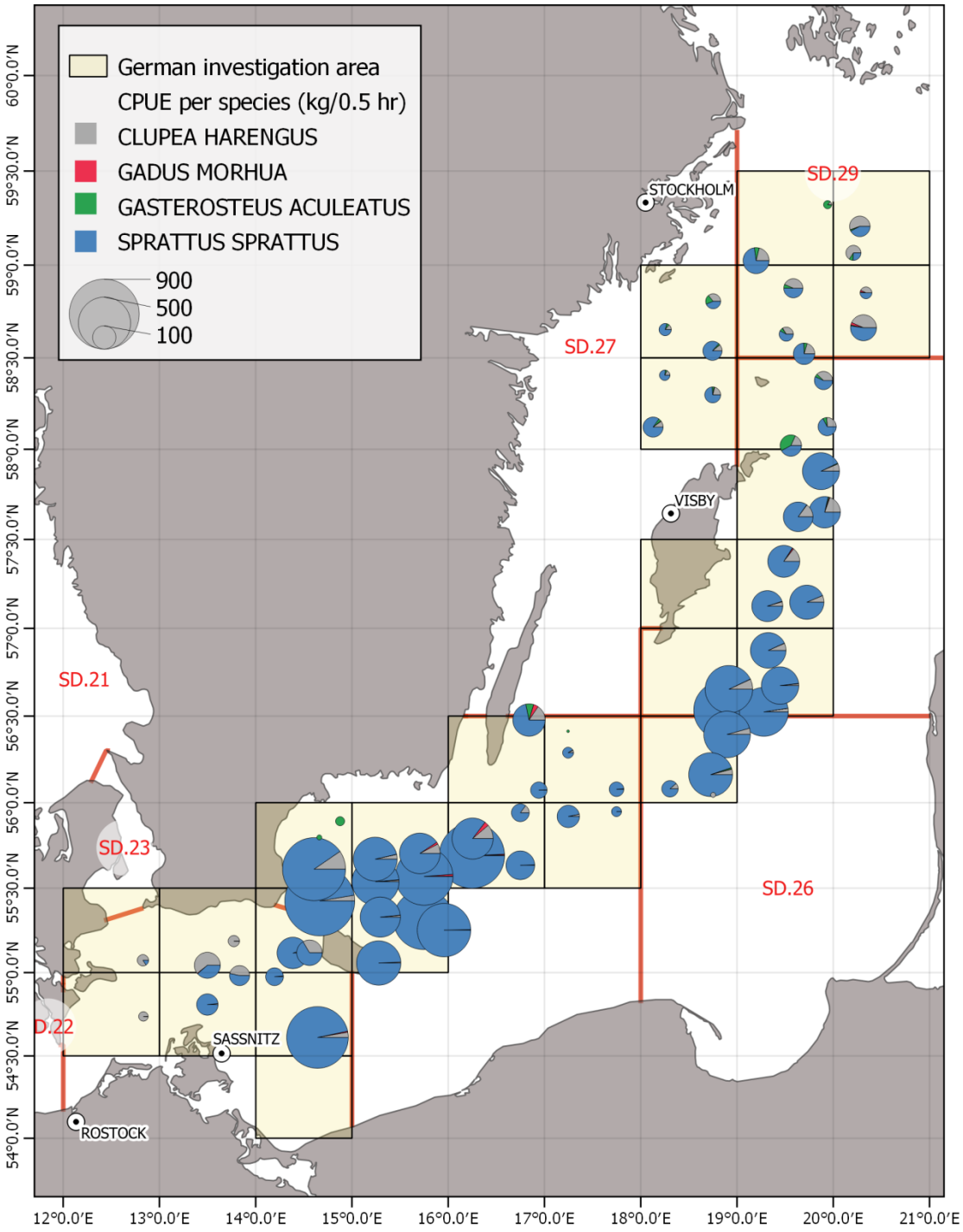

Figure 3: FRV "Solea" cruise 761/2019 BASS: CPUE (kg.0.5 hr^{-1}) of catch per species recorded during the survey.

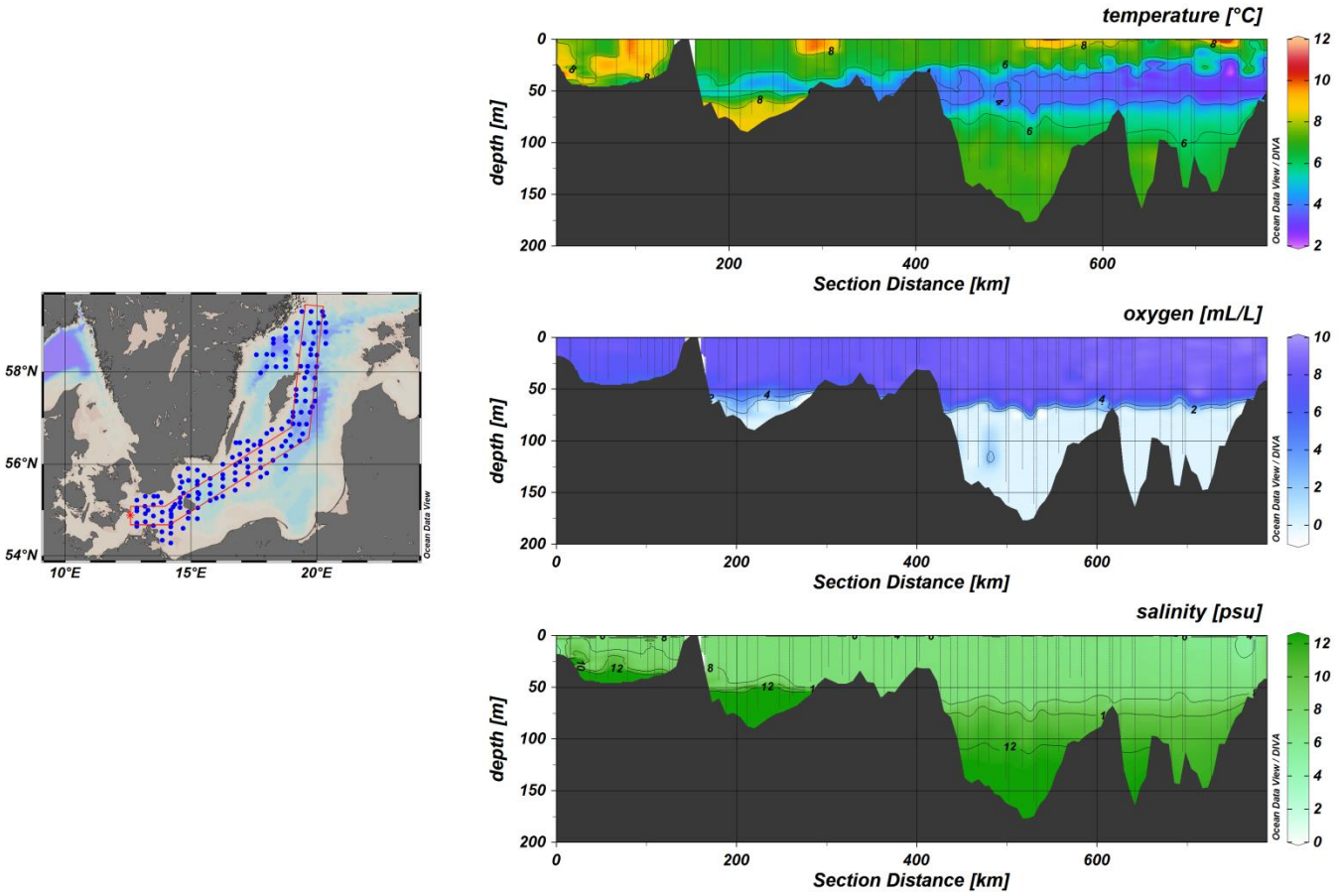

Figure 4: FRV "Solea" cruise 761/2019. Temperature (upper right panel), oxygen (middle right panel) and salinity (lower right panel) interpolated from CTD casts along a south/west - north/east transect as shown in the left panel (red line). CTD casts coordinates are display as blue dots on the map in the left panel.

8. Tables

Table 1: FRV "Solea" cruise 761/2019 BASS: Catch composition (kg 0.5 h-1) per haul, ICES rectangle, ICES subdivision. No catch are indicated by "-" and values lower than 0.01 by "+". Species are indicated by their 3-alpah code (ABZ = *Ammodytes Tobianus*; COD = *Gadus morhua*; ELP = *Zoarces viviparus*; FLE = *Platichthys flesus*; GTA = *Gasterosteus aculeatus*; HER = *Clupea harengus*; HOM = *Trachurus trachurus*; LUM = *Cyclopterus lumpus*; MAC = *Scomber scombrus*; SPR = *Sprattus sprattus*; WHG = *Merlangius merlangus*; YEZ = *Hyperoplus lanceolatus*). Gast stands for gasterosteidae.

Haul N°	*ICES rectangle*	*ICES subdivision*	*ABZ*	*COD*	*ELP*	*FLE*	*Gast.*	*GTA*	*HER*	*HOM*	*LUM*	*MAC*	*SPR*	*WHG*	*YEZ*
1	38G2	24	-	-	-	-	-	-	17.2	-	-	-	0.06	-	-
2	39G2	24	-	-	-	-	-	-	20.52	-	-	-	3.83	-	0.53
3	38G3	24	-	-	-	-	-	-	1.40	-	0.29	0.28	85.94	1.11	-
4	39G3	24	-	1.00	-	-	-	-	77.04	-	-	-	48.94	0.23	-
5	39G3	24	-	-	-	-	-	-	24.61	-	-	-	0.04	-	-
6	38G3	24	-	-	-	-	-	-	35.85	-	0.41	-	40.95	0.49	-
7	38G4	24	-	3.62	-	-	-	-	19.41	-	-	-	682.15	-	-
8	38G4	24	-	-	-	-	-	-	-	-	-	-	-	-	-
9	39G4	25	-	-	-	0.37	-	-	23.68	-	-	-	881.21	-	-
10	40G4	25	-	-	-	-	-	+	70.21	-	-	-	662.64	0.37	-
11	40G4	25	-	-	-	-	-	5.48	-	-	-	-	-	-	-
12	40G4	25	-	-	-	-	-	16.16	-	-	-	-	-	-	1.34
13	39G5	25	-	-	-	-	-	-	2.69	-	-	-	364.12	-	-
14	39G5	25	-	0.66	-	0.54	-	-	4.33	-	-	-	298.70	-	-
15	40G5	25	-	1.04	-	0.65	-	0.19	4.43	-	-	-	408.30	0.29	-
16	40G5	25	-	0.43	-	-	-	0.07	12.25	0.02	-	-	346.54	-	-
17	40G5	25	-	5.08	-	-	-	-	23.57	-	-	-	279.39	1.95	-
18	40G5	25	-	6.26	-	0.28	+	-	1.32	0.04	-	-	603.83	0.38	-
19	39G5	25	-	1.52	-	-	-	-	0.31	-	-	-	664.74	-	-
20	39G5	25	-	0.67	-	1.06	-	+	1.19	0.03	-	-	524.48	-	-
21	40G6	25	-	3.26	-	-	-	-	2.89	0.03	-	-	783.84	0.16	-
22	40G6	25	-	10.82	-	-	-	0.03	35.58	-	-	-	270.45	0.34	-
24	41G6	25	-	9.45	-	0.05	-	15.29	30.43	-	-	-	139.96	-	-
25	40G7	25	-	-	-	-	-	0.01	2.99	-	-	-	91.71	-	-
26	41G7	25	-	-	-	-	-	0.30	1.76	-	-	-	21.40	-	-
27	41G7	25	-	-	-	-	-	1.70	-	-	-	-	-	-	-
28	41G7	25	-	0.34	-	-	-	+	0.07	-	-	-	40.42	-	-
29	40G7	25	-	-	-	-	-	0.05	-	-	-	-	19.07	-	-
30	41G8	26	-	-	-	-	-	0.09	5.72	-	-	-	44.95	-	-
31	41G8	26	-	-	-	-	-	-	5.02	-	-	-	-	-	-
32	41G8	26	-	1.00	-	0.65	-	3.19	14.58	-	-	-	340.60	-	0.03
33	41G8	26	-	-	-	0.38	-	-	17.24	-	-	-	384.60	-	-
34	42G8	28	-	1.66	-	-	-	0.23	30.77	-	-	-	599.99	-	-
35	42G8	28	-	0.30	-	0.32	-	0.30	29.20	-	-	-	391.76	-	-
36	42G9	28	-	0.23	-	0.10	-	0.02	10.25	-	-	-	436.36	-	-
37	42G9	28	-	0.86	-	0.71	-	-	3.98	-	0.24	-	254.56	-	-
38	42G9	28	-	0.60	-	0.25	-	+	15.39	-	-	-	220.26	-	-
39	45G9	28	-	0.06	-	0.11	-	4.36	16.44	-	-	-	42.84	-	-

40	45G9	28	+	-	-	0.30	-	3.48	24.21	-	-	-	36.27	-	-
41	46G9	29	-	-	-	-	-	4.35	17.87	-	-	-	64.77	-	-
42	46G9	29	-	0.29	-	-	-	2.98	13.27	-	-	-	22.70	-	-
43	47H0	29	-	-	-	-	-	3.70	28.84	-	-	-	11.33	-	-
44	47H0	29	-	0.19	-	0.22	-	1.57	43.29	-	-	-	33.01	-	-
45	47G9	29	-	-	-	-	-	11.66	1.88	-	-	-	0.03	-	-
46	45G9	28	-	-	-	-	-	34.51	15.90	-	-	-	36.59	-	-
47	44G9	28	-	-	-	-	-	1.60	16.50	-	-	-	234.44	-	-
48	44G9	28	-	1.59	-	0.25	-	1.91	36.68	-	-	-	147.16	-	-
49	44G9	28	-	-	-	-	-	0.63	24.20	-	-	-	137.80	-	-
50	43G9	28	-	0.77	-	0.24	-	0.07	8.09	-	-	-	168.96	-	-
51	43G9	28	-	-	-	-	-	0.11	13.75	-	-	-	202.98	-	-
52	43G9	28	-	2.08	-	0.31	-	0.86	27.84	-	-	-	162.69	-	-
53	46H0	29	-	4.00	-	-	-	1.29	54.54	-	-	-	65.70	-	-
54	46H0	29	-	1.36	-	0.30	-	0.36	11.90	-	-	-	14.08	-	-
55	46G9	29	-	-	-	-	-	4.49	29.94	-	-	-	34.44	-	-
56	47G9	29	-	-	-	-	-	7.43	26.61	-	-	-	91.32	-	-
57	46G8	27	-	-	-	-	-	8.84	15.71	-	-	-	19.04	-	0.01
58	46G8	27	-	-	0.04	-	-	1.88	4.04	-	-	-	22.60	-	-
59	45G8	27	-	-	-	-	-	1.23	3.76	-	-	-	16.54	-	-
60	46G8	27	-	0.29	-	-	-	1.74	7.49	-	-	-	59.88	-	-
61	45G8	27	-	0.55	-	-	-	1.94	10.18	-	-	-	35.69	-	-
62	45G8	27	-	0.60	-	-	-	3.48	7.63	-	-	-	65.62	-	-
63	41G6	25	-	-	-	-	-	0.05	0.13	-	-	-	50.22	-	-
64	40G6	25	-	-	-	-	-	-	8.74	-	-	-	50.00	-	-
65	40G6	25	-	-	-	-	-	+	0.86	-	-	-	155.74	-	-
66	39G4	24	-	-	-	-	-	-	40.82	-	-	-	81.04	-	-
67	39G4	24	-	-	-	-	-	-	7.66	-	-	-	177.72	-	-
68	38G4	24	-	-	-	-	-	-	0.88	-	-	-	59.49	-	-