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Cruise Report

Cruise no. 391 of FRV "Clupea"
14. – 24.10.2024

Hydroacoustic investigations in the Sound (ICES SD 23)

Scientist in charge: Dr. Paul Kotterba (Thünen-OF)

1. Main purpose of the cruise

The 391st cruise of the fisheries research vessel Clupea was mainly dedicated to recording pelagic schooling fish - particularly herring - in the Sound area (ICES subdivision 23) which is assumed to be a major overwintering area of the spring spawning herring in the Western Baltic Sea. It was carried out at the same time as the 840th cruise of FRV Solea (BIAS/GERAS). One aim of the Clupea cruise was to collect data on the distribution of fish during the day and then compare this with the data collected at night during the contemporaneous Solea cruise.

2. Cruise objectives

Main objectives of the cruise were:

- Hydroacoustic measurements in the Sound (ICES subdivision 23) for the assessment of small pelagic fish (particularly herring)
- Fishing with a pelagic trawl (deeper areas) and herring gill nets (shallower areas) according to hydroacoustic echo signal strengths and subsequent biological measurement of catches (species, length composition, sex, maturity and age)
- Sampling of herring and sprat (whole fish, otoliths, stomachs, and genetic samples) for further analysis at the Thünen-OF
- Hydrographic measurements with a CTD probe on predetermined stations and after each fishing station when distant from a planned CTD station

3. Cruise narrative and preliminary results

3.1 Cruise narrative

The “Clupea” left the port of Rostock on October 12 and reached the port of Copenhagen in the evening of the same day. The scientific crew boarded the ship on the evening of October 13 and the acoustic recordings on the first transect began on the morning of October 14. The “Clupea” worked in the area until October 23, returning to the port of Copenhagen each evening and taking a break on the weekend of October 19 and 20 in accordance with German working time regulations. After completing the work in the Sound, the “Clupea” left Copenhagen in the morning of October 24 for the port of Rostock, where the cruise ended in the evening of the same day.

A total of 127 nautical miles of hydroacoustic transects were surveyed, including the additional transect 13 around the island of Ven (Figure 1) investigated due to the increased occurrence of dense shoals of herring there. We conducted a total of 17 fishing hauls (12 with the pelagic trawl net and 5 with gill nets) targeting detected aggregations of pelagic fish (Figure 1). Further, a total of 51 CTD casts were conducted alongside the hydroacoustic transects and before or after each fishing haul (Figure 2).

3.2 Hydroacoustic recording

The “Clupea” is equipped with two Simrad EK60 narrowband echosounders (38 and 120 kHz). The cruise was conducted with the 38 kHz frequency narrow band mode (pulse length = 1024 µs; ping rate = 500 ms) but both frequencies were recorded in continuous wave (CV) mode. Ship’s speed was 10 knots (range 9.5 – 10.5 knots) during acoustic measurements while fishing operations (pelagic trawl) were conducted at 3 to 4 knots. The standard acoustic investigations and the fishing hauls were carried out at daylight from 06:00 – 16:00 UTC (07:00 – 17:00 local time). A total hydroacoustic track length of 127 nautical miles was covered during the cruise (Figure 1). At the time of writing, acoustic data are still being processed to analyse fish abundance in the Sound. Nevertheless, it can be observed that the distribution of pelagic schooling fish (primarily herring) in the Sound follows very uneven patterns. While fewer echo signals were generally detected in the extensive shallow areas in the southern part of the Sound, massive aggregations of herring were found in the deeper north, especially southeast of the island of Ven (Figure 1). Despite this general pattern, we found a locally limited but strikingly dense accumulation of large herring in the approach to the port of Køge (Denmark).

3.3 Biological sampling

In the deeper areas of the Sound, biological sampling was conducted using a pelagic trawl net (“PSN 388” with 10 mm mesh sizes in the cod end) in the midwater as well as near the bottom to sample and identify the echo signals. In accordance with the IBAS manual, the standard trawling time was defined as 30 minutes but was reduced in most cases to avoid too large catches of fish (particularly when fishing on dense aggregations of fish). In shallower areas, where the pelagic trawling was impossible, herring gill nets were set. The standard configuration of the gill net included a combination of three panels (each approximately 45 metres long and 5-7 meters high)of distinct mesh sizes (25, 27, and 29 mm, respectively) with a standard setting time of 60 minutes which has been case-wise altered depending on the density of echo signals (see Table 1 for detailed deployment times of each haul).

A total of 445.45 kg fish was caught during the cruise with herring (426.90 kg) and sprat (12.59 kg) being the most abundant species in the catches. Details on haul-wise catches are given in tables 1 and 2 while standardised catches (Catches per unit effort are given in Figure 3 and 4)
Samples were taken from each haul in order to determine the length and weight distribution of fish. Subsamples 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. Altogether 3,596 fish were measured and 628 additional fish (i.a. 74 sprat and 553 herring) were sampled for further age determination and genetics.

3.4 Hydrography

A Seabird-CTD-probe (SBE 19 plus V2) was used for hydrographic measurements. Vertical profiles were taken along the hydroacoustic transects. Additional CTD casts were performed after or before each trawl if the distance from the planned station was sufficient. The profiles covered the entire water column to about 2 m above the seafloor. Altogether 51 CTD casts were performed during the cruise.
The measurements showed significant variations in the water parameters, particularly regarding salinity. The salinity readings ranged from 9 to 34 PSU, showing clear stratification in the deeper areas of the sound and a north-south gradient (Figure 2), which highlights the counteracting influences of the respective adjacent sea areas (ICES SDs 21 and 24). The water temperature showed significantly less variation, with measurements ranging between 12 and 15 °C and showing only a slight north-south gradient, while the higher temperatures occurred mainly in the deeper water bodies of the sound (Figure 2). Unfortunately, oxygen levels could not be measured because the corresponding sensor malfunctioned.

4. Cruise participants

Name	Function	Institution
Dr. Paul Kotterba	Cruise leader	Thünen-OF
Verona Henning	Fishery biology	Thünen-OF
Jule Berrit Baum	Fishery biology	Thünen-OF (student assistant)

5. Acknowledgements

We hereby thank Captain Hänse, the crew of FRV “Clupea” and all participants 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. Paul Kotterba (Thünen-OF)
(Scientist in charge)

7. Figures

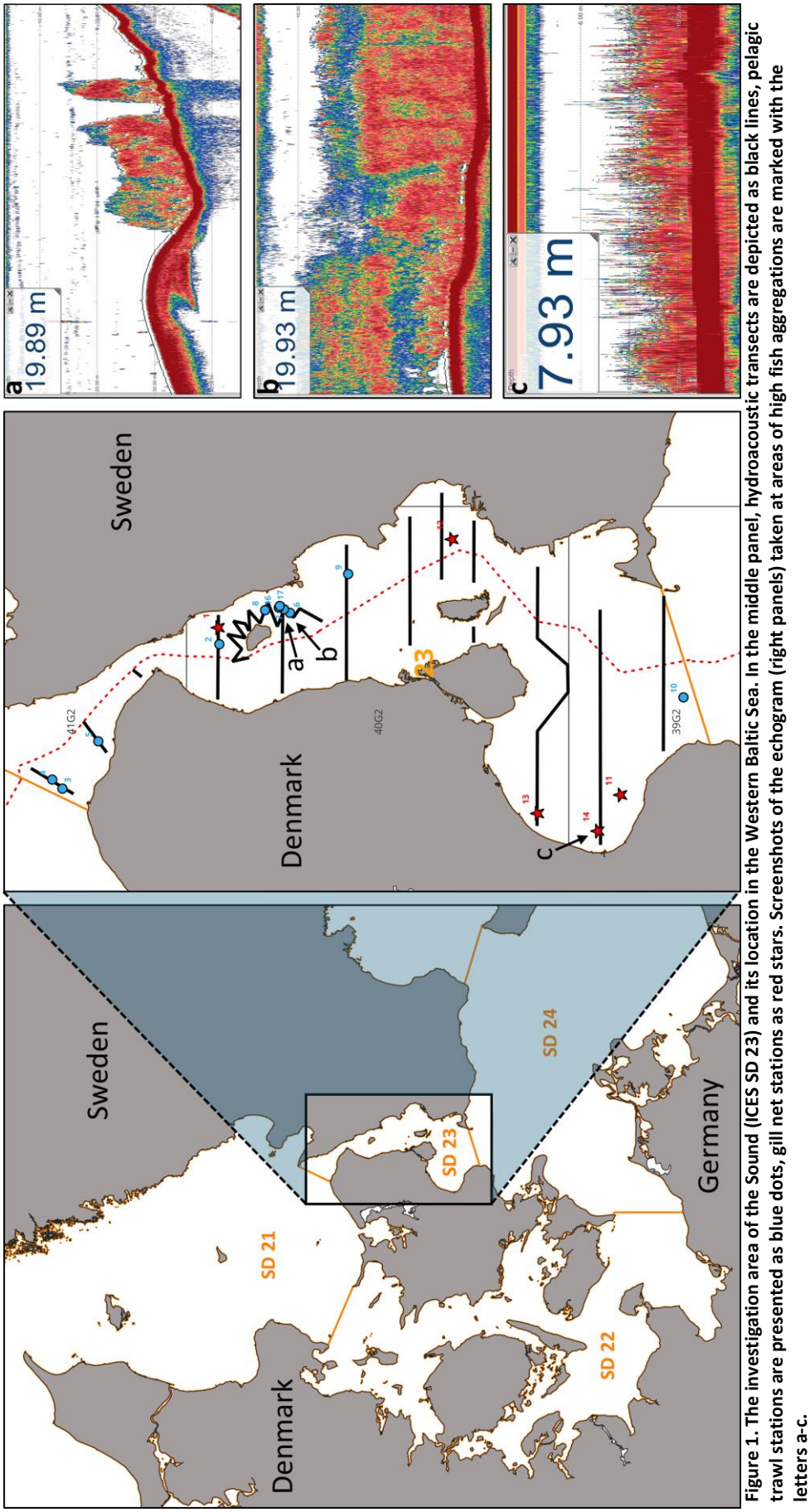

Figure 1. The investigation area of the Sound (ICES SD 23) and its location in the Western Baltic Sea. In the middle panel, hydroacoustic transects are depicted as black lines, pelagic trawl stations are presented as blue dots, gill net stations as red stars. Screenshots of the echogram (right panels) taken at areas of high fish aggregations are marked with the letters a-c.

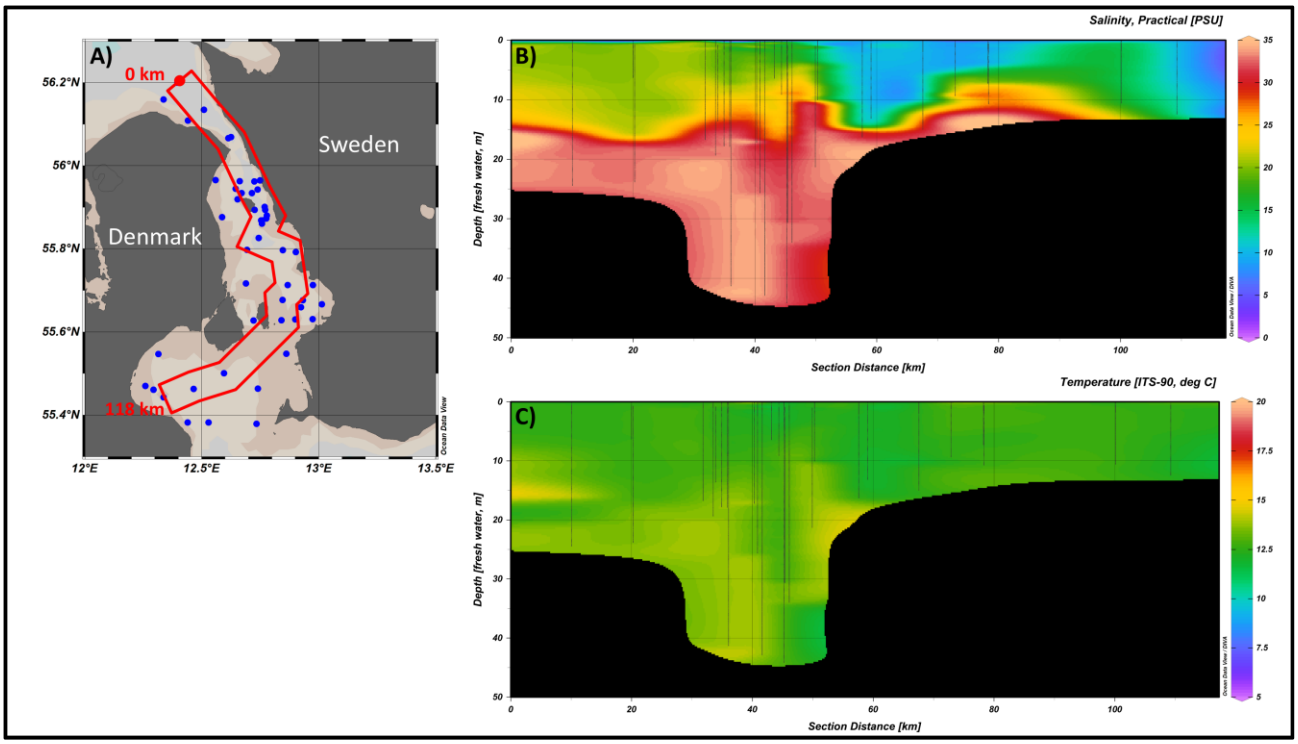

Figure 2. Hydrographic Investigations during the 391st cruise of FRV "Clupea". A) Positions of the 51 CTD casts conducted in the Sound (blue dots) and the stations used (all stations within the red polygon) for the interpolated section plots B (salinity) and C (temperature).

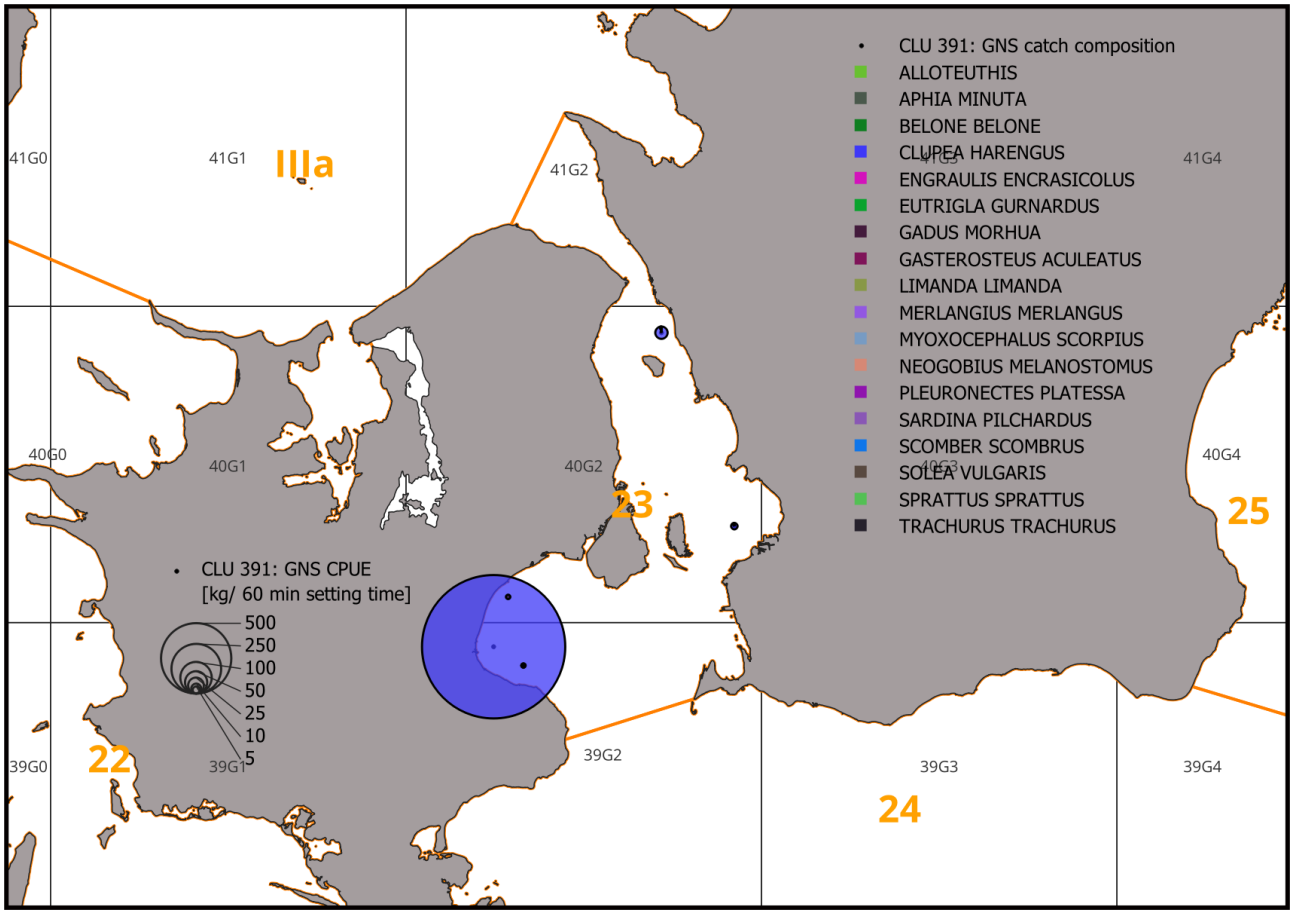

Figure 3. Gill net catches during the 391st cruise of FRV Clupea in October 2024. The total catch of each haul is standardized as catch per unit effort (CPUE, extrapolated to 60 min setting time of the gill net) and represented by the different area sizes of the pie charts. Catch composition is depicted in species specific colors.

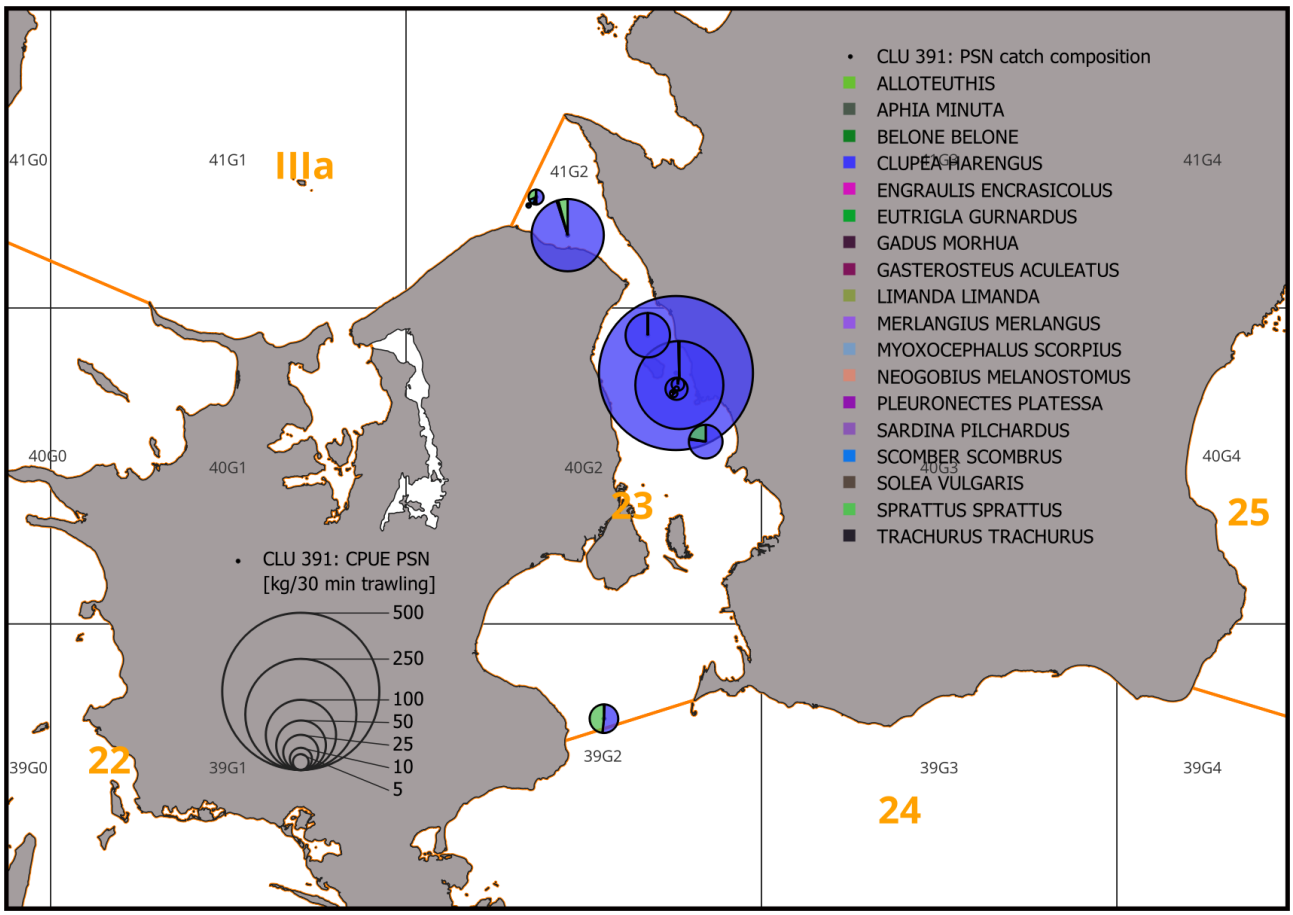

Figure 4. Pelagic trawl catches during the 391st cruise of FRV Clupea in October 2024. The total catch of each haul is standardized as catch per unit effort (CPUE, extrapolated to 30 min trawling time) and represented by the different area sizes of the pie charts. Catch composition is depicted in species specific colors.

8. Tables

Table 1. Total catches (in kg, upper panel; in numbers, lower panel) of distinct species sampled with the gill net (GNS) during the 291. cruise of FRV Clupea (14.10.-24.10.2024).

Date	**14.10.**	**18.10.**	**21.10.**	**22.10.**	**22.10.**	**Sum [kg]**
Net type	**GNS**	**GNS**	**GNS**	**GNS**	**GNS**	
Cruise haul number	**1**	**11**	**12**	**13**	**14**	
Catch duration [min]	**233**	**114**	**126**	**129**	**6**	
Clupea harengus	57.780	0.210	8.150		207.780	**273.920**
Eutrigla gurnardus	0.315					**0.315**
Gadus morhua		0.438		0.196		**0.634**
Limanda limanda	1.047		0.337			**1.384**
Merlangius merlangus	0.099	0.313	0.147			**0.559**
Myoxocephalus scorpius	0.078		0.120			**0.198**
Neogobius melanostomus		0.100				**0.100**
Pleuronectes platessa	0.209		0.179			**0.388**
Scomber scombrus		0.200				**0.200**
Solea vulgaris	0.380					**0.380**
Total catch [kg]	**59.908**	**1.261**	**8.933**	**0.196**	**207.780**	**278.078**
Clupea harengus	424	2	74		1166	**1666**
Eutrigla gurnardus	2					**2**
Gadus morhua		3		1		**4**
Limanda limanda	14		4			**18**
Merlangius merlangus	1	5	1			**7**
Myoxocephalus scorpius	1		1			**2**
Neogobius melanostomus		1				**1**
Pleuronectes platessa	1		1			**2**
Scomber scombrus		1				**1**
Solea vulgaris	7					**7**
Total catch [n]	**450**	**12**	**81**	**1**	**1166**	**1710**

Table 2. Total catches (in kg, upper panel; in numbers, lower panel) of distinct species sampled with the pelagic trawl net (PSN) during the 291. cruise of FRV Clupea (14.10.-24.10.2024).

Date	14.10.	15.10.	15.10.	15.10.	16.10.	16.10.	16.10.	17.10.	18.10.	23.10.	23.10.	23.10.	Sum [kg]
Net type	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	**PSN**	
Cruise haul number	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**16**	**17**	
Catch duration [min]	**19**	**18**	**22**	**10**	**1**	**15**	**1**	**13**	**29**	**2**	**26**	**11**	
Alloteuthis sp.	0.046												**0.046**
Aphia minuta						0.002							**0.002**
Belone belone						0.095			0.122		0.077		**0.294**
Clupea harengus	25.150	0.132	1.647	33.500	0.331	0.249	16.025	7.680	8.178		2.710	57.374	**152.976**
Engraulis encrasicolus		0.002	0.158										**0.160**
Gasterosteus aculeatus	0.060	0.009											**0.069**
Merlangius merlangus			0.029			0.160							**0.189**
Pleuronectus platessa				0.277									**0.277**
Sardina pilchardus			0.064										**0.064**
Scomber scombrus			0.389					0.113				0.206	**0.708**
Sprattus sprattus	0.020	0.006	1.042	1.481		0.068		2.180	7.760		0.030		**12.587**
Trachurus trachurus			0.004										**0.004**
Total catch [kg]	**25.276**	**0.149**	**3.333**	**35.258**	**0.331**	**0.574**	**16.025**	**9.973**	**16.060**	**0.000**	**2.817**	**57.580**	**167.376**
Alloteuthis sp.	28												**28**
Aphia minuta						4							**4**
Belone belone						1			2		1		**4**
Clupea harengus	1140	11	170	3038	2	42	216	666	757		88	520	**6650**
Engraulis encrasicolus		2	17										**19**
Gasterosteus aculeatus	47	7											**54**
Merlangius merlangus			2			7							**9**
Pleuronectus platessa				1									**1**
Sardina pilchardus			11										**11**
Scomber scombrus			8					2				1	**11**
Sprattus sprattus	2	2	214	274		13		388*	1592		5		**2093**
Trachurus trachurus			1						0				**1**
Total catch [n]	**1217**	**22**	**423**	**3313**	**2**	**67**	**216**	**1056***	**2351**	**0**	**94**	**521**	**8885**

* contains estimated numbers to compensate for missing counts