

**Cruise Report**  
**FRV Solea cruise 764**  
**28.06. - 18.07.2019**

**The 2019 ICES Coordinated Acoustic Survey in the Skagerrak and Kattegat, the  
North Sea, West of Scotland and the Malin Shelf area  
(HERAS)**

Cruise Leader: Dr. Matthias Schaber (TI-SF)

## Summary

The survey was part of an international hydroacoustic survey providing information on stock parameters of small pelagics (Acoustic Survey in the Skagerrak and Kattegat, the North Sea, West of Scotland and the Malin Shelf area, HERAS) coordinated by the ICES Working Group of International Pelagic Surveys (WGIPS). Denmark, Ireland, the Netherlands, Norway and Scotland also participated in the survey. In general, this survey provides the most important fisheries independent contribution to the assessment of herring stocks in the North Sea, Western Baltic Sea, Skagerrak/Kattegat as well as areas west of Scotland and the Irish Sea. The total survey area largely covers ICES Divisions IIIa, IVa, IVb and VIa.

The survey design has been standardized across participants and the survey area is partitioned into 23 strata out of which four strata comprising the southern North Sea have been allocated to Germany and were covered during this survey. Main focus was set on herring (*Clupea harengus*) and sprat (*Sprattus sprattus*), whereas distribution patterns and abundance of anchovy (*Engraulis encrasicolus*) as well as pilchard (*Sardina pilchardus*) were another objective of the survey.

Altogether, 1508 nautical miles of hydroacoustic transects were covered, less than planned, due to adverse weather conditions throughout large parts of the survey that accordingly required adaptations to the cruise plan. One transect in S131 had to be omitted, another one significantly shortened to cover the survey area within the remaining survey time available.

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BMEL, Ref. 614

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To allocate biological information to echorecordings and for the collection of biological samples, 41 fishery hauls were conducted. The distribution of backscatter values allocated to clupeid fishes was similar to previous years with generally highest concentrations of schools in the southern strata and along coastal areas, but also notable registrations in the southern part of the central stratum. As in previous years, sprat showed the highest presence in the hauls and also contributed the bulk biomass to total catch weight. Herring often co-occurred with sprat in mixed schools but herring catches were the lowest on record during this survey. While pilchard were caught in two hauls in notable numbers, anchovies were largely only caught in low individual numbers, albeit in more hauls.

Vertical profiles of ambient hydrographic parameters were measured on 97 stations.

## **1. Cruise objectives**

The following objectives were planned for SB764 HERAS:

- Calibration of hydroacoustic equipment
- Hydroacoustic measurements for the estimation of stock parameters (indices of abundance, SSB etc.) for the assessment of small pelagics (herring, sprat, pilchard, anchovy) in the allocated survey area (strata 51, 61, 71 and 131)
- (Targeted) biological sampling including species composition and length-frequency/age distribution of key species in the survey area
- Measurements of hydrographic parameters (e.g. temperature and salinity) in the survey area

### **1.1 Survey design**

The survey design has been standardized across participants. Where applicable, systematic parallel transect lines with randomized starting points and with transects running perpendicular to lines of bathymetry were followed. Survey effort was maintained at a similar level to 2018. Altogether, 23 strata were covered by all participants in the 2019 HERAS survey, out of which four had been allocated to Germany by the HERAS survey coordinator of the ICES Working Group of International Pelagic Surveys WGIPS (Fig. 1) (ICES, 2019).

## **2. Cruise narrative and preliminary results**

### **2.1 Cruise narrative**

After loading and preparation of the scientific equipment, FRV "Solea" left Cuxhaven port in the morning of June 28<sup>th</sup> to calibrate the echosounder near Helgoland Island during slack tide the same afternoon. Survey operations commenced the following day on the northernmost transect of stratum 71 in the eastern German bight with predicted adverse weather conditions for the whole survey area. After finishing the northernmost transect in S71 in deteriorating conditions, transit into S51 was made where weather conditions allowed survey operations to commence. After accomplishing S51 on July 5<sup>th</sup>, weather again required interruption of the survey for one day before continuing on the southernmost transect of S131 on July 7<sup>th</sup>, which also had to be interrupted for a few hours due to bad weather. After accomplishing this transect, FRV "Solea" steamed east into S61 to continue survey operations on July 9<sup>th</sup>, since weather conditions in the central parts of the North Sea did not allow accomplishing S131 during this survey phase. Stratum 61 was fully covered during the following days and accomplished on July 11<sup>th</sup>. Afterwards, the remaining transects of S71 were covered July 12<sup>th</sup>-14<sup>th</sup>. The remaining three long transects in S131 could not be completed due to continuing adverse conditions and lack of remaining survey time due to the weather related losses earlier in the survey. Accordingly, the northernmost transect of S131 had to be omitted, while the southerly neighboring transect could only be covered to roughly 1/3. On July 16<sup>th</sup> survey operations commenced on the remaining transect in S131 and were finalized in the afternoon of July 17<sup>th</sup>. Afterwards, FRV "Solea" steamed to Cuxhaven port where the survey ended on July 18<sup>th</sup> in the morning. Three out of four

strata and the corresponding transects were covered as planned, while 2 transects in S131 had to be omitted or shortened due to the prevailing adverse weather conditions leading to a loss of survey time. Total transect distance measured (excluding intertransects and maneuvering) was 1508 nautical miles (ca. 230 nautical miles short of the planned coverage).

## **2.2 Hydroacoustics**

### **2.2.1 Calibration**

All transducers of the Simrad EK80 scientific echosounder (38, 70, 120 and 200 kHz) were calibrated prior to the beginning of the survey. Calibration took place in suboptimal conditions with acceptable winds but notable swell while the vessel was drifting south of Helgoland Island in water depths of ca. 55 m. All transducers were calibrated in CW-mode as well as in FM-mode (for trial data acquisition) with good/acceptable results based on calculated RMS-values. Resulting transducer parameters were applied for consecutive data-collection and post-processing of survey data.

### **2.2.2 Echo recording**

Hydroacoustic data were recorded continuously along the transects with a Simrad EK80 scientific echosounder with hull-mounted 38, 70, 120 and 200 kHz transducers at a standard ship speed of 10 kn. Transducer and sample settings applied were in accordance with the specifications provided in the HERAS survey manual (ICES, 2015). Survey operations were conducted during daytime between 4 am and 6 pm UTC to allocate for the diurnal activity patterns of clupeids schooling at daytime and dispersing and migrating into shallower water layers during nighttime, rendering the fishes indiscernible from other scattering sources and distributed within the transducer nearfield. In some instances, the sampling of hydroacoustic data was extended to ca. 9 – in one instance 11- pm in areas with low or no clupeid signals to make up lost survey time (see below) or to be able to accomplish a transect without losing time steaming to the next transect the following day. This is considered uncritical since the light intensity during that time was still high without any dispersion of schools occurring until after the end of daily survey operations. Post-processing and analysis of data were conducted with Echoview 10 software (Echoview Software Pty Ltd, 2019).

Clupeids in the survey area are discernible on echograms by their typical pillar shaped schools, either sitting on the seafloor or in pelagic layers (Figure 9). The Nautical Area Scattering Coefficient (NASC) values measured and allocated to clupeids through post-processing of the data were not distributed evenly throughout the survey area. Transect sections and regions with particularly high clupeid densities alternated with sometimes long sections without any detections of clupeid schools. The distribution of clupeid NASC measured mostly resembled patterns observed in the previous years: While NASC values were particularly high on the easternmost transect in S61 around Helgoland and along the western coastal boundary of stratum 51, few clupeids were detected in large parts of strata 71 and 131 (Fig. 2), although NASC values measured on the southernmost transect in S131 were distinctly higher than in 2018. In general, NASC values were highest in the two southern strata 51 and 61 with fishes concentrating in the warm, mixed layers in the shallow southern North Sea (see hydrography) and along the coasts. Echoes from those two strata can mostly be allocated to sprat (see below), although in this area and based on corresponding targeted hauls, horse mackerel (*Trachurus trachurus*) occasionally contributed to the overall NASC measured. NASC values measured in stratum 71 were higher than in the previous year, although also based on only few notable aggregations.

## **2.3 Biological sampling (N. Rohlf)**

Forty-one trawl hauls were conducted during the summer acoustic survey. Trawling was carried out using a PSN 388 pelagic trawl ("Krake"). Trawl duration varied between 10 and 40 minutes, but usually was set to 30 minutes. Hauls were conducted according to echo signals. Additionally, exclusion/validation hauls were shot in areas with echo signals of unclear origin. The positions of all hauls are depicted in Figures 3 and 4. Catches were sorted according to species, and length- and weight-distributions of individual species were measured. Of all clupeids (herring, sprat, pilchard and

anchovy), 10 individuals per 0.5 cm length-class were sampled per trawl. Their individual weight, sex and maturity stage was determined and the otoliths were sampled to enable age estimation.

Altogether, 20 different fish- and four cephalopod species were caught during the survey. A detailed overview on catch compositions (CPUE in kg/30min) of all 41 trawl hauls is given in Tab. 1, CPUE of pelagic/schooling fishes as well as clupeid CPUE (in kg/30 min) per haul is further shown in Figures 3 and 4, respectively. As in the previous years, sprat dominated the catches (present in 33 hauls or 80% of the total hauls) and contributed the bulk of biomass of total catch weight (4.9 t, i. e. 88%). The amount of Herring was very low in the survey area. The total catch weight of herring summed up to only 99 kg (2018: 1.0 tonnes)! This was an all-time low. However, catches alone are not representative for abundance of small pelagics. Detailed conclusions on herring abundance and biomass in the survey area cannot be given until echo integration is accomplished and trawl haul and hydroacoustic data are combined (see below).

A detailed overview on numbers, weights and mean lengths of herring, sprat, pilchard and anchovies sampled is given in Tab. 2a-d, together with their proportion in the total catch. Figures 5 - 8 show length distributions of these species as derived from total catches. Herring lengths ranged from 5 to 22 cm, but the length distribution was dominated by small fish below 10 cm total length. Larger herring were almost entirely absent. Sprat lengths ranged from 4 to 15 cm and their length frequency distribution is highly comparable to the preceding year.

Sardines and anchovies were caught only on occasion and in comparatively small quantities. However, when sardines were caught, the clupeid proportion of the catch consisted almost (97%, haul 25) or entirely of sardines (100%, haul 6 and 34).

Individual and combined abundance estimates for herring and sprat derived from survey data will be available after a final evaluation, combination and analysis of acoustic and trawl data with StoX software (Stox, 2015). This will be accomplished during a post-cruise meeting scheduled for November 2019 at the National Institute of Aquatic Resources DTU Aqua in Hirtshals/Denmark. Results will subsequently presented to ICES WGIPS.

## 2.4 Hydrography

Vertical profiles of temperature and salinity were measured with a SeaBird SBE CTD-probe on a station grid covering the whole survey area. Hydrography measurements were either conducted directly after (or before) a trawl haul or in regular intervals along the cruise track as well as the starting and end point of each transect. Altogether, 91 CTD casts were conducted during this survey.

Surface temperatures in the survey area ranged from ca. 15° in the area south of the Dogger Bank to almost 19° C. Highest surface temperatures were measured along the German and Dutch North Sea coasts (Fig. 9). As in the previous years in summer, the water column was mixed in shallow coastal areas and in the shallow southern part of the North Sea south of ca 54° N. Further northward, a distinct thermocline appeared separating the warm surface water from cold deeper layers where temperatures dropped to below 8° C. As in the previous year, the water appeared rather well mixed on the shallow Dogger Bank with bottom temperatures similar to surface temperatures.

Salinity in the survey area also in July 2019 showed no notable gradient between surface and seafloor layers, except for the northeastern part of the survey area and the inner German Bight near the Elbe river estuary, where surface salinity was lower than salinity near the seafloor. As in previous measurements, salinity was highest in the offshore areas of the southern North Sea and particularly in the southernmost region near the English Channel. Salinity levels altogether ranged from ca. 31 to 35 PSU.

### 3. Survey participants

Dr. Matthias Schaber (cruise leader)	Hydroacoustics	TI-SF
Dr. Norbert Rohlf	Fish lab/Biology	TI-SF
Lea Hartkens	Hydroacoustics/Hydrography	TI-SF
Jörg Appel	Fish lab/Biology	TI-SF
Gitta Hemken	Fish lab/Biology	TI-SF
Svea Winning	Fish lab/Biology	TI-SF

### 4. References

- Echoview Software Pty Ltd (2019). Echoview software, version 10. Echoview Software Pty Ltd, Hobart, Australia.
- ICES (2019). ICES Working Group of International Pelagic Surveys (WGIPS). ICES Scientific Reports 1(11). 499 pp. <http://doi.org/10.17895/ices.pub.5122>
- ICES (2015). Manual for International Pelagic Surveys (IPS). Series of ICES Survey Protocols SISP 9 – IPS. 92 pp.
- StoX (2015). StoX: An open source approach to acoustic and swept area survey calculations. Institute of Marine Research, Bergen, Norway. URL: <http://www.imr.no/stox>.

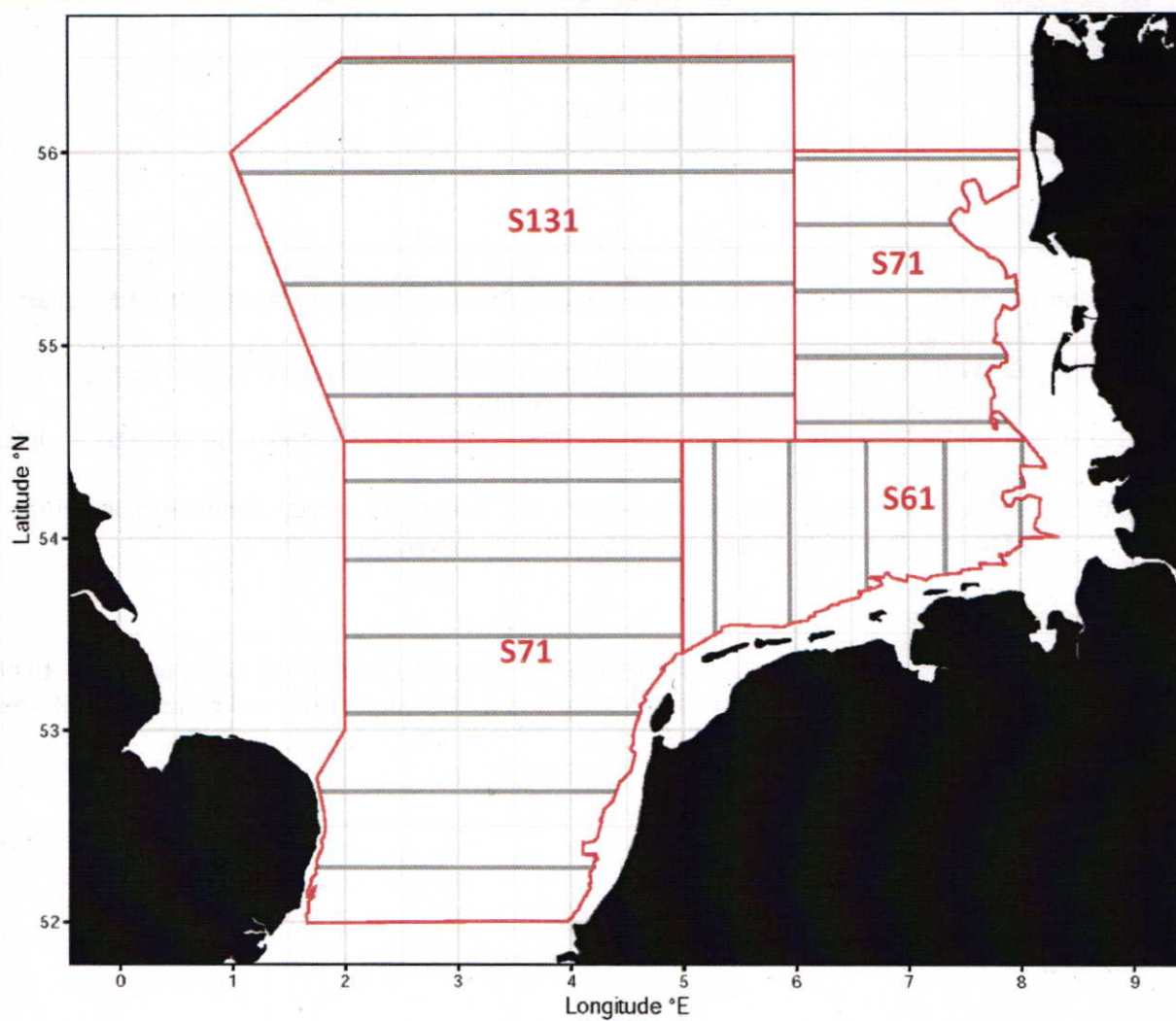
### 5. Acknowledgements

I hereby thank the crew of FRV "Solea" and Captain S. Meier as well as all participants for their outstanding cooperation and commitment that facilitated the successful accomplishment of this survey.

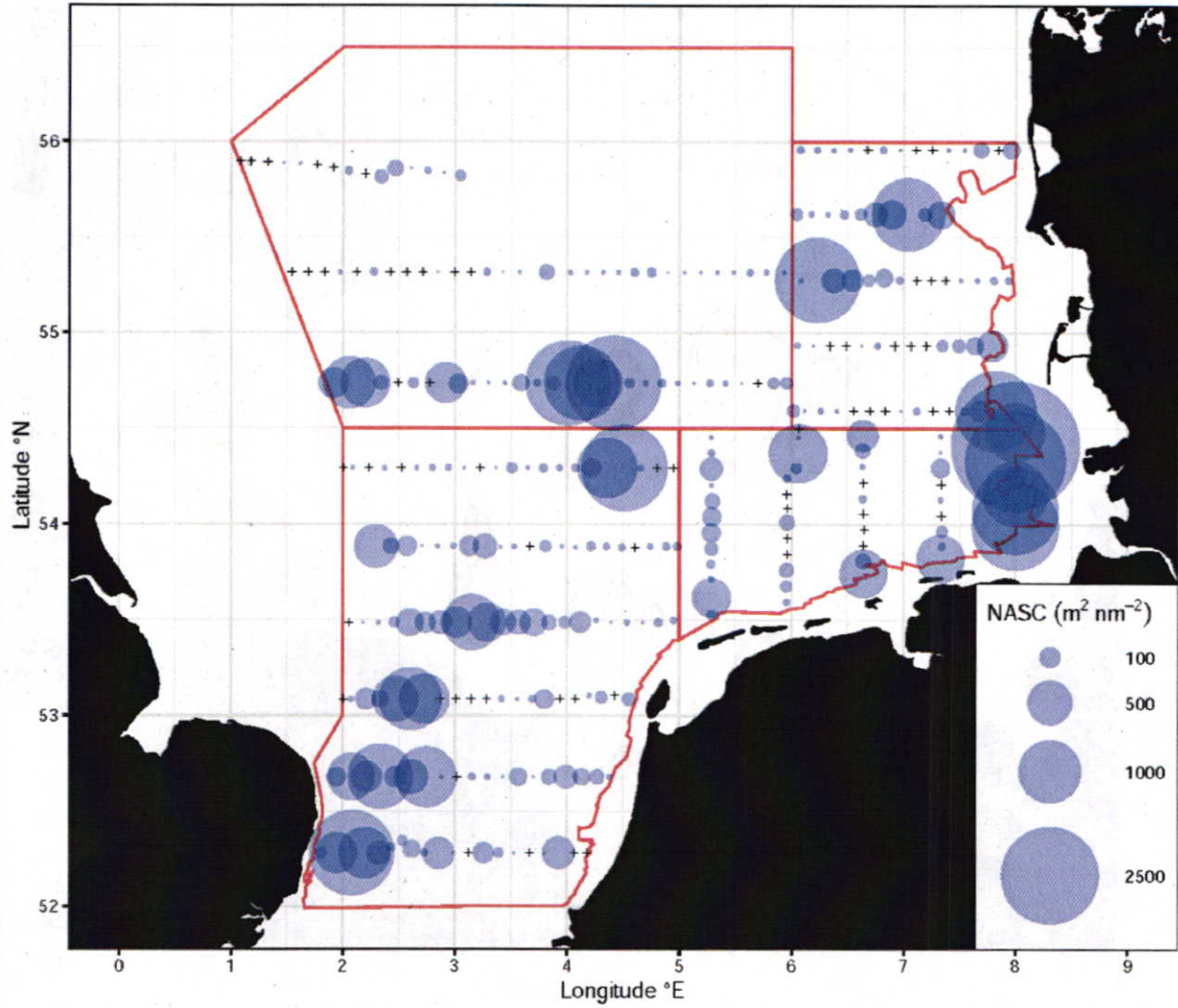


(Dr. M. Schaber, TI-SF / Scientist in charge)

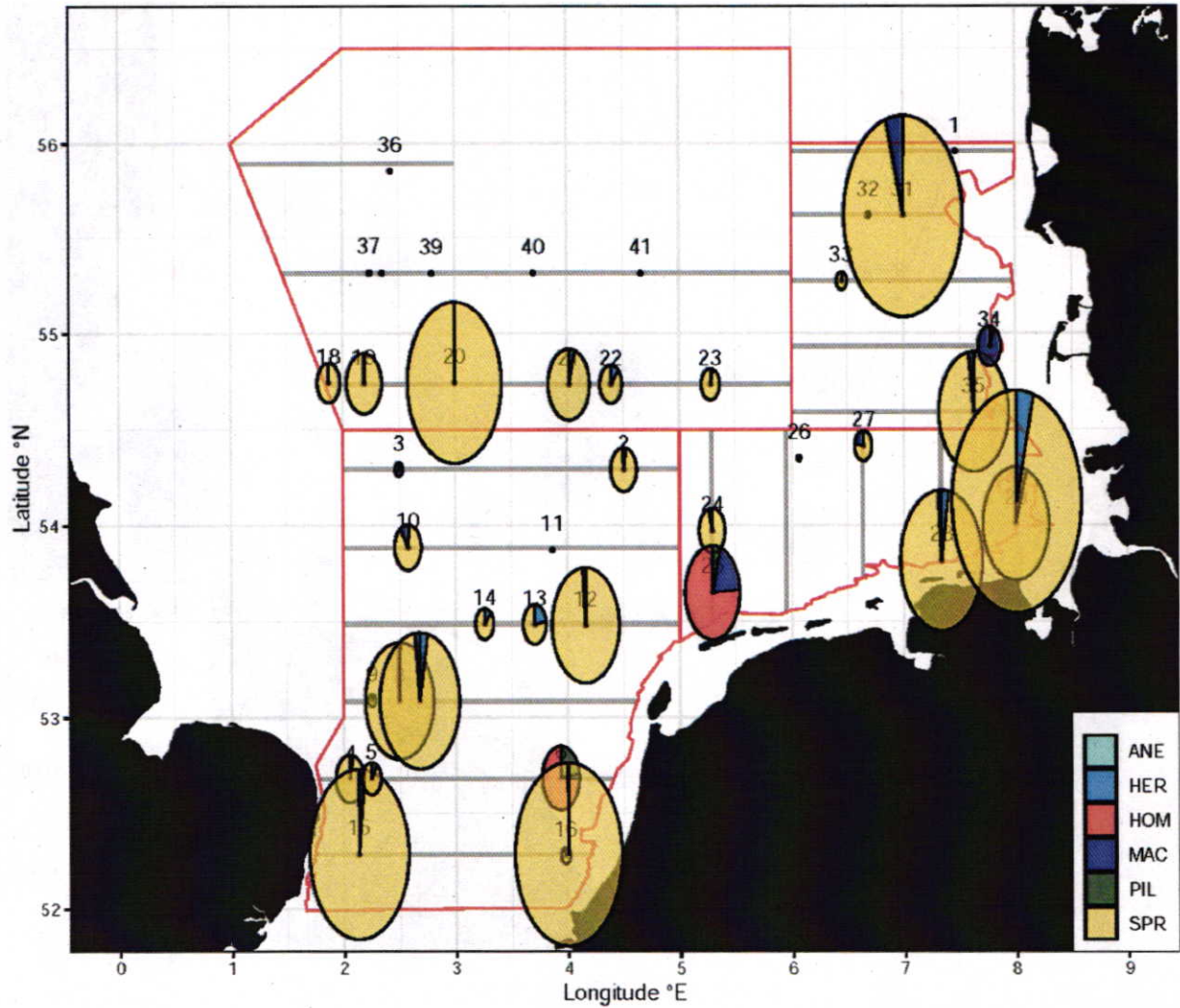
## Figures



**Figure 1:** FRV "Solea" cruise 764/2019. Survey plan. Total survey area and strata covered (S51, S61, S71, S131) outlined in red. Planned transect lines depicted as grey lines.

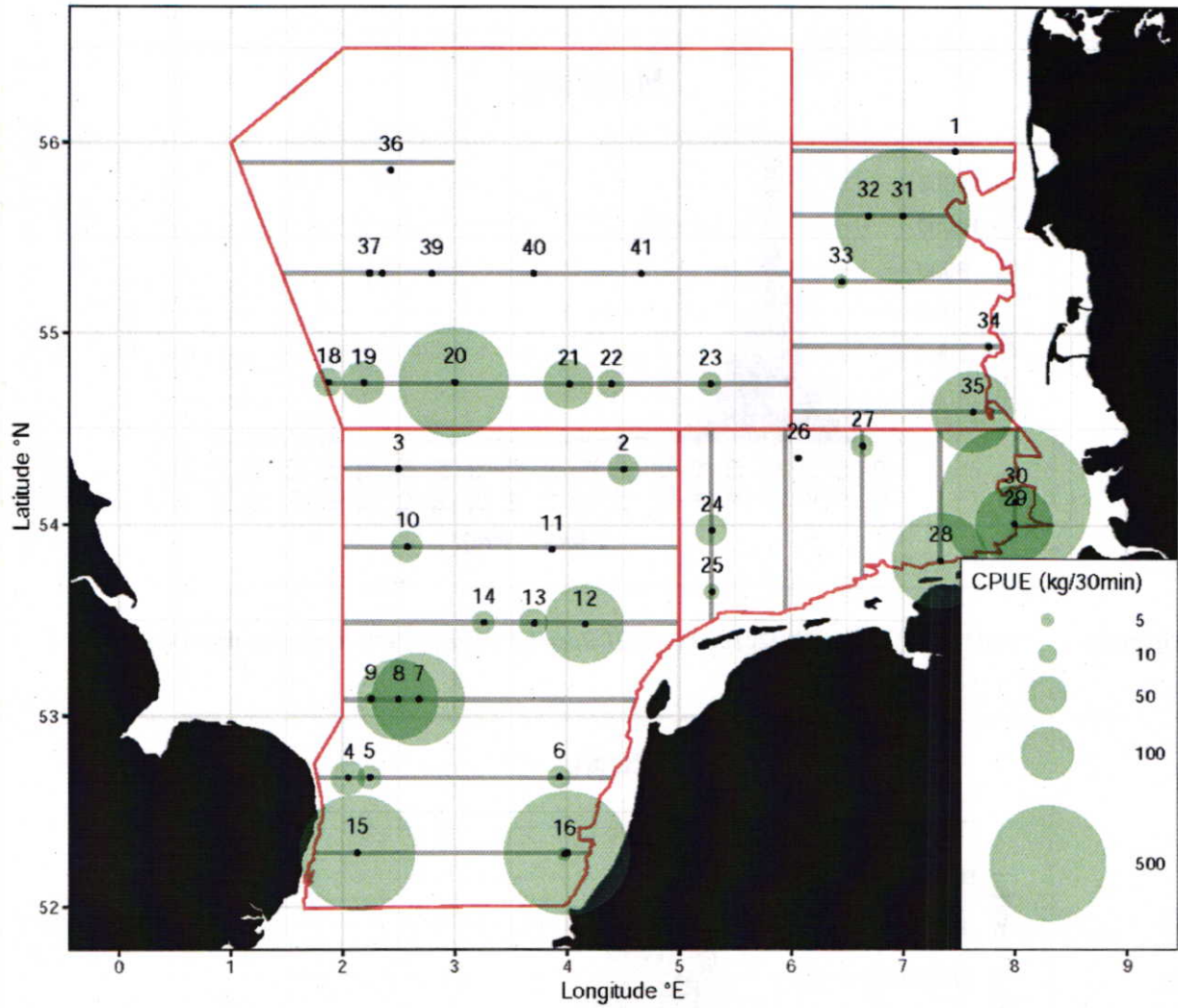


**Figure 2:** FRV "Solea" cruise 764/2019. Mean Clupeid Nautical Area Scattering Coefficient (NASC) measured (blue dots, 5 nmi intervals) along transects realised. Empty intervals indicated by crosses. Total survey area and strata outlined in red.



**Figure 3:** FRV "Solea" cruise 764/2019. Catches (kg/30 min) and catch composition of pelagic/schooling fishes (ANE - anchovy *Engraulis encrasicolus*, HER - herring *Clupea harengus*, HOM - horse mackerel *Trachurus trachurus*, MAC - mackerel *Scomber scombrus*, PIL - pilchard *Sardina pilchardus*, SPR - sprat *Sprattus sprattus*). Numbers indicate haul/station number. Survey area/strata outlined in red. Accomplished transects depicted as grey lines.





**Figure 4:** FRV "Solea" cruise 764/2019. Combined clupeid (herring *Clupea harengus*, sprat *Sprattus sprattus*, pilchard *Sardina pilchardus*, and anchovy *Engraulis encrasicolus*) catches (kg/30 min). Numbers indicate haul/station number. Survey area/strata outlined in red. Accomplished transects depicted as grey lines.

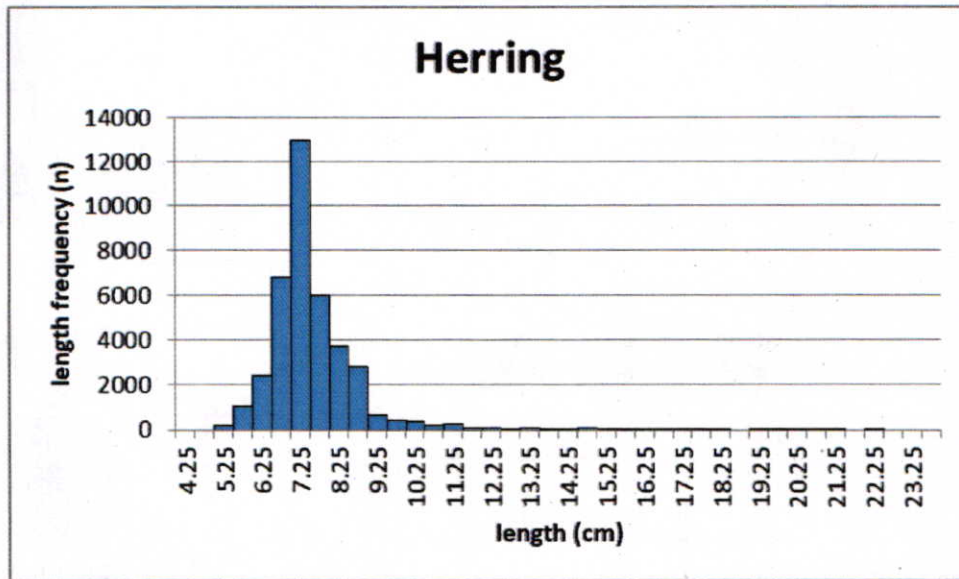


Figure 5: FRV "Solea" cruise 764/2019. Herring (*Clupea harengus*) length-frequency distribution.

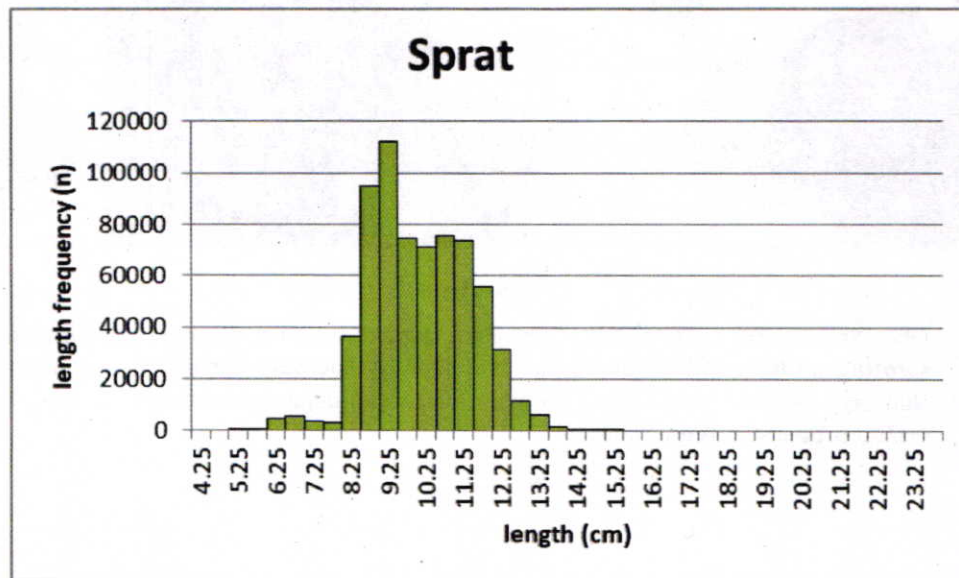


Figure 6: FRV "Solea" cruise 764/2019. Sprat (*Sprattus sprattus*) length-frequency distribution.

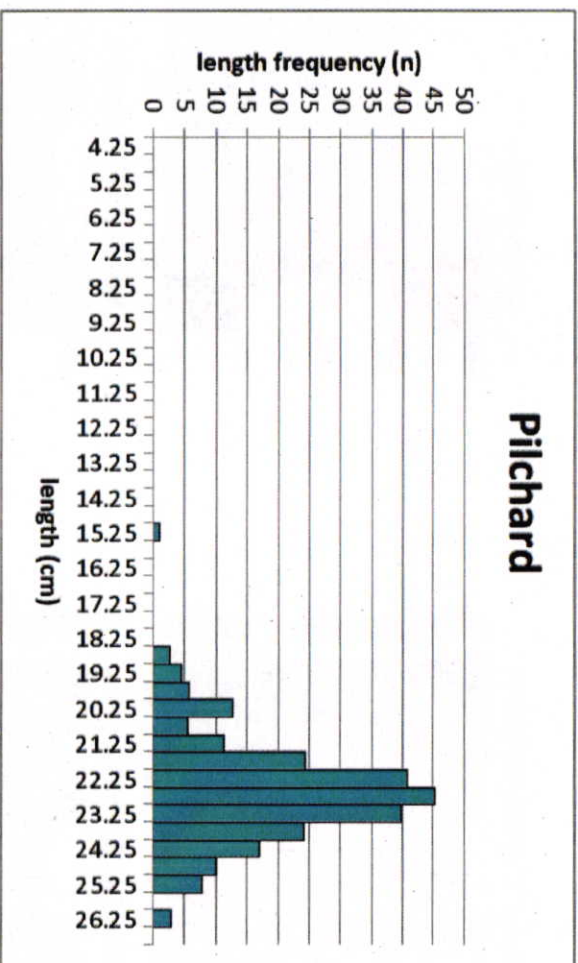


Figure 7:

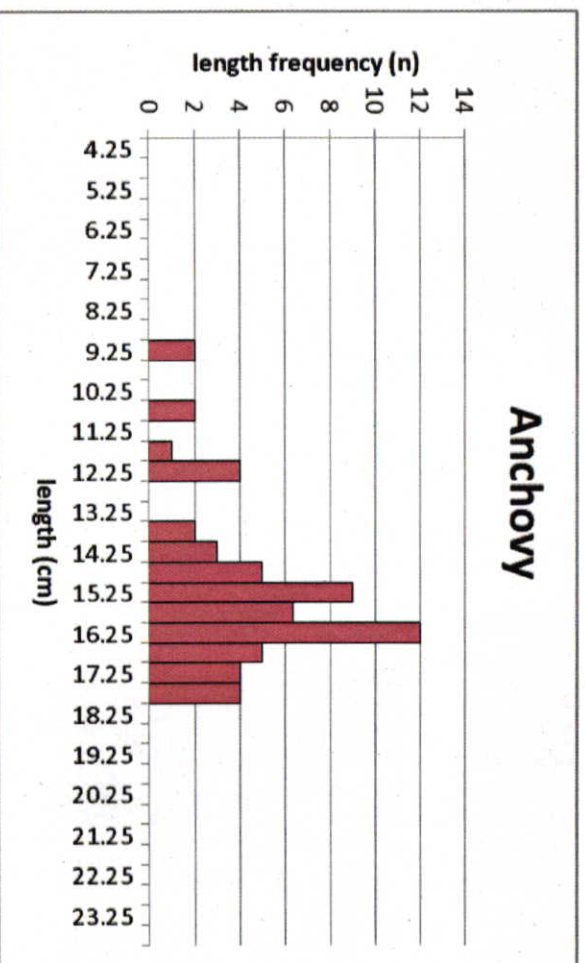
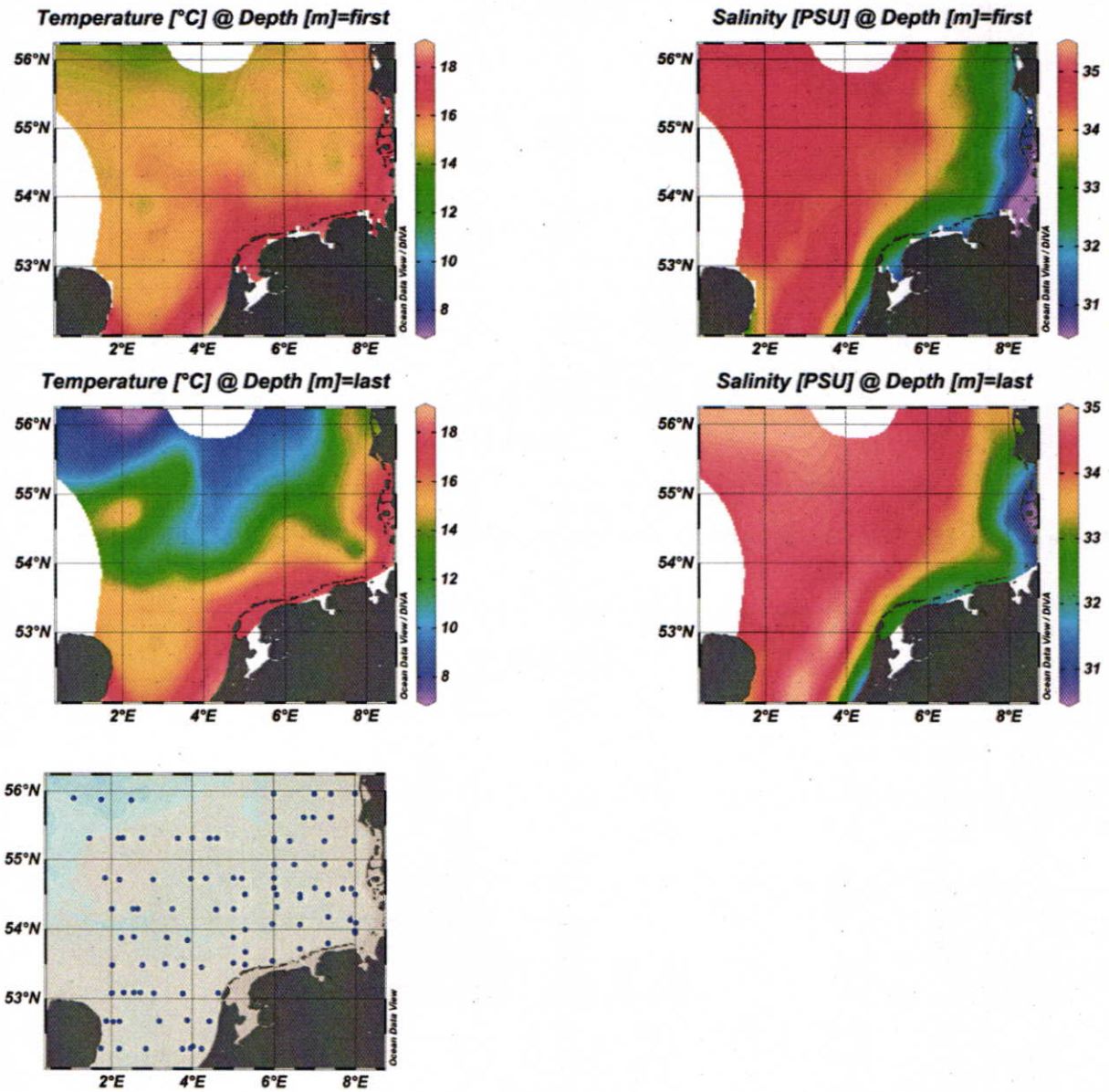
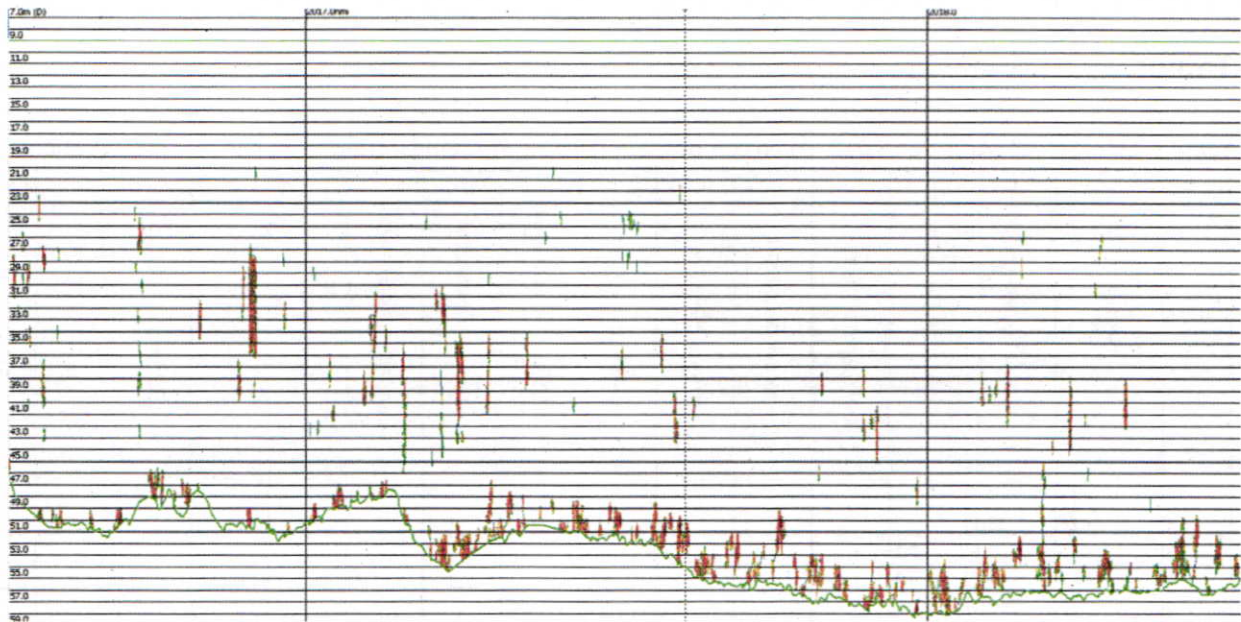
FRV "Solea" cruise 764/2019; Pilchard (*Sardinia pilchardus*) length-frequency distribution.

Figure 8:

FRV "Solea" cruise 764/2019; Anchovy (*Engraulis encrasicolus*) length-frequency distribution.



**Figure 9:** FRV "Solea" cruise 764/2019. Hydrography. CTD stations are depicted as blue dots in the area map (lower panel). Temperature (°C, left panels) and salinity (PSU, right panels) at the surface (top) and near the seafloor (lower).



**Figure 9:** FRV "Solea" cruise 754/2019. Exemplary echogram (38 kHz, post-processed) showing pillar shaped schools typical for clupeids distributed in pelagic layers and on the seafloor.

## Tables

Table 1: FRV "Solea" cruise 764/2019. Catch composition (CPUE in kg) standardized to 30 minutes tow duration.

HAUL	STATION	TOTAL (kg/30 min)	ALLOTEUTHIS SUBULATA	AMMODYTES MARINUS	CALLIONYMUS LYRA	CLUPEA HARENGUS	ECHIICHTHYS VIPERA	ENGRAULIS ENCRASICOLUS	EUTRIGLA GURNARDUS	HYPEROPLUS LANCEOLATUS	ILLEX COINDETI	LAMPETRA FLUVIATILIS	LIMANDA LIMANDA	LOLIGO FORBESI	LOLIGO VULGARIS
1	443	0.3							0.2				0.0		
2	446	33.2				1.0			0.2						
3	449	3.9	0.1						0.3						
4	452	36.8	0.1			1.3	0.5		0.2	0.0					
5	453	203.7	0.0			1.6	0.2	0.0					0.2		
6	455	69.0					0.0								
7	460	319.1	0.2			10.0	0.1	0.2	0.2	0.1					
8	461	234.7	0.1			1.0	0.2								
9	462	2.9	0.0			0.1	0.3								
10	465	35.9				0.5	0.2		0.5						
11	467	0.3	0.0								0.0				
12	470	225.5	0.0			0.4		0.0	0.1						
13	471	26.6	0.0			6.0									
14	472	16.7	0.2			2.1			0.0						
15	477	494.9	0.0			8.8	3.4								
16	479	4.6													
17	481	570.5	0.1			0.2				0.4					
18	483	26.6					0.1								
19	484	62.0													
20	485	443.2	0.1			0.1			0.9				0.1	0.0	
21	486	88.7				3.5			2.8						
22	487	32.1				3.7			0.2						
23	489	17.2				0.7			0.8						
24	492	33.9	0.0			0.0							0.1		
25	493	149.1						0.1					0.0		
26	496	23.9	0.9		0.3	0.0			2.0				18.3	0.1	
27	500	16.0	0.0			0.0			0.2						
28	505	333.9				9.0		1.1							
29	507	220.1	0.6			11.3		0.0		0.0		0.1			
30	508	838.3	0.0			35.7				0.1					
31	511	706.2				0.5			4.7				0.1		
32	512	2.2							1.6						
33	515	7.5							2.1						
34	518	26.6													
35	523	244.6				1.0									
36	527	18.1							5.3						
37	531	0.6				0.1			0.1	0.0			0.1		
38	532	0.3				0.1			0.1						
39	533	0.8		0.5											
40	534	0.2	0.0						0.2						0.0
41	536	1.1							1.1						
total (kg)		5571.7	2.6	0.5	0.3	98.9	5.1	1.4	23.9	0.7	0.0	0.1	18.9	0.0	0.1
proportion (%)			0.0	0.0	0.0	1.8	0.1	0.0	0.4	0.0	0.0	0.0	0.3	0.0	0.0
number of catches			19	1	1	26	9	6	22	6	1	1	8	1	2
presence (%)			46	2	2	63	22	15	54	15	2	2	20	2	5

**Table 1 cont'd:** FRV "Solea" cruise 764/2019. Catch composition (CPUE in kg) standardized to 30 minutes tow duration.

HAUL	STATION	TOTAL (kg/30 min)	MELANOGRAMMUS AEGLEFINUS	MERLANGIUS MERLANGUS	PLEURONECTES PLATYSSA	POMATOSCHISTUS	SALMO SALAR	SARDINA PILCHARDUS	SCOMBER SCOMBRUS	SCOPHTHALMUS RHOMBUS	SPRATTUS SPRATTUS	SYNGNATHUS ROSTELLATUS	TRACHURUS TRACHURUS	NUMBER OF SPECIES
1	443	0.3		0.0										0
2	446	33.2		0.0		0.0			0.5		31.5			0
3	449	3.9		0.1					2.9		0.4			0
4	452	36.8		0.0					0.3		34.3			0
5	453	203.7		185.2							16.4			0
6	455	69.0						15.7	1.9				51.4	0
7	460	319.1		0.2					6.1		302.0			0
8	461	234.7									233.4			0
9	462	2.9		0.0							2.6			0
10	465	35.9		0.0		0.0			3.4		31.2			0
11	467	0.3		0.1							0.1			0
12	470	225.5							3.5		221.5			0
13	471	26.6		0.0							20.6			0
14	472	16.7		0.0		0.0					14.3			0
15	477	494.9							0.7		481.8			0
16	479	4.6		0.0	0.0				0.1		4.4			0
17	481	570.5		0.0					1.0		568.9			0
18	483	26.6		0.0							26.4			0
19	484	62.0									62.0			0
20	485	443.2					0.3				441.6		0.1	0
21	486	88.7		0.0							82.4			0
22	487	32.1		0.2	0.1						27.9			0
23	489	17.2		0.1							15.6			0
24	492	33.9		0.0					0.6		32.2		1.0	0
25	493	149.1						6.7	28.7		0.2		113.4	0
26	496	23.9		0.8	0.4					0.6	0.5			0
27	500	16.0		0.0					3.7		12.1			0
28	505	333.9							3.7		320.1	0.0		0
29	507	220.1		1.5	0.5	0.0			0.6		205.1	0.3		0
30	508	838.3		0.0					0.1		802.3			0
31	511	706.2							32.4		668.4			0
32	512	2.2							0.6					0
33	515	7.5									5.4			0
34	518	26.6						2.0	24.7					0
35	523	244.6		0.0					6.0		237.6			0
36	527	18.1	0.1	12.7										0
37	531	0.6	0.2	0.1										0
38	532	0.3	0.1	0.1										0
39	533	0.8	0.1	0.2							0.0			0
40	534	0.2									0.0			0
41	536	1.1												0
<b>total (kg)</b>		<b>5571.7</b>	0.4	201.5	1.1	0.0	0.3	24.3	121.4	0.6	4903.4	0.3	165.8	
<b>proportion (%)</b>			0.0	3.6	0.0	0.0	0.0	0.4	2.2	0.0	88.0	0.0	3.0	
<b>number of catches</b>			4	27	4	4	1	3	20	1	33	2	4	
<b>presence (%)</b>			10	66	10	10	2	7	49	2	80	5	10	

**Table 2a:** FRV "Solea" cruise 764/2019. Numbers, weights and mean lengths of herring (*Clupea harengus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration).

Haul	Stat	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	herring					herring (% clups)
					catch (kg)	count (n)	range (cm)			
							min	max	mean	
2	446	33.2	32.6	98%	1.0	847	5.25	19.75	6.24	3%
3	449	3.9	0.4	10%	0.0	0	0	0	0	0%
4	452	36.8	35.7	97%	1.3	874	5.25	14.75	6.57	4%
5	453	203.7	18.1	9%	1.6	1234	5.75	15.25	6.19	9%
6	455	69.0	15.7	23%	0.0	0	0	0	0	0%
7	460	319.1	312.2	98%	10.0	3858	6.75	15.75	7.62	3%
8	461	234.7	234.4	100%	1.0	220	6.25	19.25	9.34	0%
9	462	2.9	2.7	91%	0.1	12	8.25	10.25	9.63	3%
10	465	35.9	31.8	88%	0.5	248	5.75	9.25	7.17	2%
11	467	0.3	0.1	44%	0.0	0	0	0	0	0%
12	470	225.5	222.0	98%	0.4	22	8.25	17.25	13.46	0%
13	471	26.6	26.5	100%	6.0	3073	5.75	8.75	6.72	22%
14	472	16.7	16.4	98%	2.1	977	5.25	8.75	6.90	13%
15	477	494.9	490.7	99%	8.8	2255	7.25	11.25	8.58	2%
16	479	4.6	4.4	97%	0.0	0	0	0	0	0%
17	481	570.5	569.1	100%	0.2	9	10.75	19.25	13.19	0%
18	483	26.6	26.4	99%	0.0	0	0	0	0	0%
19	484	62.0	62.0	100%	0.0	0	0	0	0	0%
20	485	443.2	441.7	100%	0.1	3	14.75	19.25	17.42	0%
21	486	88.7	85.9	97%	3.5	944	6.75	15.75	8.18	4%
22	487	32.1	31.6	98%	3.7	655	5.25	20.25	8.07	12%
23	489	17.2	16.2	95%	0.7	25	9.25	21.25	14.95	4%
24	492	33.9	32.2	95%	0.0	1	9.75	9.75	9.75	0%
25	493	149.1	6.9	5%	0.0	0	0	0	0	0%
26	496	23.9	0.5	2%	0.0	2	7.75	8.25	8.00	1%
27	500	16.0	12.1	76%	0.0	1	11.25	11.25	11.25	0%
28	505	333.9	330.2	99%	9.0	966	9.25	22.25	10.87	3%
29	507	220.1	216.4	98%	11.3	3846	6.25	20.75	7.76	5%
30	508	838.3	838.0	100%	35.7	18462	6.25	14.25	7.48	4%
31	511	706.2	668.9	95%	0.5	14	13.75	22.25	16.83	0%
33	515	7.5	5.4	72%	0.0	0	0	0	0	0%
34	518	26.6	2.0	7%	0.0	0	0	0	0	0%
35	523	244.6	238.6	98%	1.0	85	9.75	16.75	11.72	0%
37	531	0.6	0.1	16%	0.1	2	17.25	20.25	18.75	100%
38	532	0.3	0.1	16%	0.1	1	19.75	19.75	19.75	100%
39	533	0.8	0.0	6%	0.0	0	0	0	0	0%
40	534	0.2	0.0	7%	0.0	0	0	0	0	0%



**Table 2b:** FRV "Solea" cruise 764/2019. Numbers, weights and mean lengths of sprat (*Sprattus sprattus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration).

Haul	Stat	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	sprat					sprat (% clups)
					catch (kg)	count (n)	range (cm)			
							min	max	mean	
2	446	33.2	32.6	98%	31.5	5550	7.75	13.25	9.63	97%
3	449	3.9	0.4	10%	0.4	30	11.25	13.75	12.35	100%
4	452	36.8	35.7	97%	34.3	7110	5.75	13.75	8.85	96%
5	453	203.7	18.1	9%	16.4	3535	5.25	13.25	8.38	91%
6	455	69.0	15.7	23%	0.0	0	0	0	0	0%
7	460	319.1	312.2	98%	302.0	49014	7.75	12.75	9.36	97%
8	461	234.7	234.4	100%	233.4	34963	6.25	12.75	9.76	100%
9	462	2.9	2.7	91%	2.6	398	6.25	13.25	9.20	97%
10	465	35.9	31.8	88%	31.2	4562	6.75	11.75	10.01	98%
11	467	0.3	0.1	44%	0.1	9	10.75	13.25	12.42	100%
12	470	225.5	222.0	98%	221.5	22233	9.25	14.25	11.35	100%
13	471	26.6	26.5	100%	20.6	3415	5.75	12.25	9.46	78%
14	472	16.7	16.4	98%	14.3	3945	5.75	11.25	7.98	87%
15	477	494.9	490.7	99%	481.8	99303	6.25	10.75	8.95	98%
16	479	4.6	4.4	97%	4.4	363	10.25	13.25	11.51	100%
17	481	570.5	569.1	100%	568.9	45403	10.25	13.75	11.73	100%
18	483	26.6	26.4	99%	26.4	2500	9.75	13.25	11.22	100%
19	484	62.0	62.0	100%	62.0	6786	10.25	14.25	10.97	100%
20	485	443.2	441.7	100%	441.6	42583	10.25	13.75	11.39	100%
21	486	88.7	85.9	97%	82.4	8553	8.25	14.75	11.35	96%
22	487	32.1	31.6	98%	27.9	3549	6.25	14.75	10.51	88%
23	489	17.2	16.2	95%	15.6	1317	9.25	15.25	12.08	96%
24	492	33.9	32.2	95%	32.2	3566	8.25	13.75	10.92	100%
25	493	149.1	6.9	5%	0.2	16	9.25	13.25	10.94	2%
26	496	23.9	0.5	2%	0.5	77	8.25	13.25	10.20	99%
27	500	16.0	12.1	76%	12.1	1466	9.25	12.75	10.68	100%
28	505	333.9	330.2	99%	320.1	40468	9.25	13.25	10.57	97%
29	507	220.1	216.4	98%	205.1	37649	7.75	13.25	9.27	95%
30	508	838.3	838.0	100%	802.3	144656	8.25	12.25	9.40	96%
31	511	706.2	668.9	95%	668.4	62304	9.75	13.75	11.44	100%
33	515	7.5	5.4	72%	5.4	589	9.75	13.25	10.89	100%
34	518	26.6	2.0	7%	0.0	0	0	0	0	0%
35	523	244.6	238.6	98%	237.6	28202	9.75	13.75	10.85	100%
37	531	0.6	0.1	16%	0.0	0	0	0	0	0%
38	532	0.3	0.1	16%	0.0	0	0	0	0	0%
39	533	0.8	0.0	6%	0.048	5	11.25	12.75	12.08	100%
40	534	0.2	0.0	7%	0.012	1	12.75	12.75	12.75	100%

**Table 2c:** FRV "Solea" cruise 764/2019. Numbers, weights and mean lengths of pilchard (*Sardina pilchardus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration).

Haul	Stat	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	pilchard					pilchard (% clups)
					catch (kg)	count (n)	range (cm)			
							min	max	mean	
6	455	69.0	15.7	23%	15.7	164	18.75	26.25	22.7	100%
25	493	149.1	6.9	5%	6.7	74	15.25	26.25	22.2	97%
34	518	26.6	2.0	7%	2.0	18	21.25	25.25	23.8	100%

**Table 2d:** FRV "Solea" cruise 764/2019. Numbers, weights and mean lengths of anchovy (*Engraulis encrasicolus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration).

Haul	Stat	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	anchovy					anchovy (% clups)
					catch (kg)	count (n)	range (cm)			
							min	max	mean	
5	453	203.7	18.1	9%	0.02	1	15.75	15.75	15.75	0.1%
7	460	319.1	312.2	98%	0.21	14	9.25	15.25	12.89	0.1%
12	470	225.5	222.0	98%	0.04	2	12.25	16.25	14.25	0.0%
25	493	149.1	6.9	5%	0.06	2	16.25	16.75	16.50	0.8%
28	505	333.9	330.2	99%	1.06	39	11.75	17.75	15.94	0.3%
34	507	220.1	216.4	98%	0.03	2	15.75	15.75	15.75	0.0%