

**Cruise report**  
**FRV „Solea“ Cruise 722**  
**29.06. - 19.07.2016**

Scientist in charge: Dr. E. Bethke

**Hydroacoustic survey for the assessment of small pelagics**  
**in the North Sea**  
**(HERAS North Sea summer acoustic survey)**

**1. In a nutshell**

The cruise was part of an international hydroacoustic survey providing information on stock parameters of small pelagics in the North Sea (*HERAS – North Sea, West of Scotland and Malin Shelf summer acoustic survey*), coordinated by the ICES Working Group of International Pelagic Surveys (WGIPS). Denmark, the Netherlands, Norway, Scotland and Ireland 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, with the area covered by FRV "Solea" comprising the southern North Sea from 52° to 56°30' N. Main focus was set on herring (*Clupea harengus*) and sprat (*Sprattus sprattus*), whereas distribution patterns of Anchovy (*Engraulis encrasicolus*) as well as Pilchard (*Sardina pilchardus*) was another objective of the survey.

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**Distribution list:**

TI - Institut für Seefischerei  
Saßnitzer Seefischerei e. G.

**per e-mail:**

Bundesanstalt für Landwirtschaft und  
Ernährung, Hamburg  
Schiffsführung FFS "Solea"  
BMEL, Ref. 614  
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TI – Präsidialbüro (Michael Welling)  
TI – Verwaltung Braunschweig  
TI - Institut für Fischereiökologie  
TI - Institut für Ostseefischerei Rostock  
TI – FIZ-Fischerei  
TI - PR  
MRI - BFEL HH, FB Fischqualität  
Dr. Rohlf, SF - Reiseplanung Forschungsschiffe  
Fahrtteilnehmer

Bundesamt für Seeschifffahrt und Hydrographie,  
Hamburg  
Mecklenburger Hochseefischerei GmbH, Rostock  
Doggerbank Seefischerei GmbH, Bremerhaven  
Deutscher Fischerei - Verband e. V., Hamburg  
Leibniz-Institut für Meereswissenschaften IFM-  
GEOMAR  
H. Cammann-Oehne, BSH  
Deutscher Hochseefischerei-Verband e.V.  
DFFU

To ensure a temporally and spatially consistent coverage of the survey area with newly assigned strata the hitherto used cruise track had been changed. An increased coverage of the area as well as longer hydroacoustic transect mileage (2289 NM) was planned. Due to the very unfavorable weather conditions and a technical problem, the cruise track had to be shortened step by step (1873 NM). This allowed the coverage of the whole planned area, however, with larger distances between transects.

Recording of hydroacoustic data usually took place between 05:00 am and 07:00 pm (UTC), with occasional extensions to 08:00 pm (UTC) according to survey progress and echorecordings.

To allocate biological information to echorecordings and for the collection of biological samples, altogether 30 fishery hauls were conducted.

Generally, sprat showed the highest presence in the catch and also contributed the bulk biomass to total catch weight. In contrast to previous years larger quantities of small sprat were found in the survey area. Herring was somewhat more abundant when compared to the previous year, but still on a low level. Only a very few anchovies were caught during the survey. Pilchards were entirely absent in the trawl hauls. Altogether, 25 different fish species were caught during the survey, plus one cephalopod and one crustacean species. Hydrography profiles were measured with a vertically deployed CTD probe on 62 stations.

## **2. Cruise objectives**

- Calibration of hydroacoustic equipment.
- Hydroacoustic measurements for the assessment of small pelagics.
- Biological sampling incl. assessment of species composition and length-frequency/age distribution of key species in the survey area.
- Measurement of hydrographic parameters (e.g. temperature and salinity) in the survey area.

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

### **3.1 Cruise narrative**

After loading and preparing the scientific equipment, FRV "Solea" left Cuxhaven port in the afternoon of June 29<sup>th</sup>. Calibration of the hydroacoustic equipment was conducted close to Helgoland Island the same evening, prior to the start of any survey operations. The hydroacoustic measurements started the next morning at 54°14,1' N, 007°53,7' E in the northeastern part of the survey area. Due to a technical problem the survey was interrupted for 24 hours the next day, when the vessel steamed back to Cuxhaven for some repairment. Further interruptions followed due to bad weather. On July 18<sup>th</sup> early afternoon, survey operations were accomplished at position 53°59,32' N, 008°15,45' E and FRV "Solea" steamed back to Cuxhaven port. The whole survey area was covered, but with larger transect spacing as initially anticipated. In total, 1873 nautical miles were monitored instead of the primarily planned 2289 NM.

### **3.2 Hydroacoustics**

#### **3.2.1 Calibration**

Both transducers (38 kHz and 120 kHz) were calibrated prior to the beginning of the survey in favorable weather conditions, while the vessel drifted near Helgoland Island. The overall calibration results were considered of good quality for both frequencies (38 kHz and 120 kHz). Resulting transducer parameters were applied for consecutive data-collection and post-processing of hydroacoustic survey data.

### 3.2.2 Echo recording

Hydroacoustic data were recorded with a Simrad EK80 scientific echosounder with hull-mounted 38 kHz and 120 kHz transducers. Post-processing and analysis of the data was accomplished with the latest EchoView software. Transducer settings applied were in accordance with the specifications provided in ICES (2015). Due to specific diurnal vertical migration of clupeids in the area, concentrations and dense schools of herring/sprat were present largely during daytime. At night, the schools dispersed and often were not discernible from scattering layers originating from plankton organisms or other vertically migrating scatterers. Thus, echo recording was generally only accomplished during daytime between 4 am and 6 pm (UTC), as in previous surveys. In some instances, the sampling of hydroacoustic data was extended to ca. 8 pm in areas with very low or no clupeid signals. This is considered uncritical, as during summer the light intensity at that time is still high with dispersion of schools usually occurring later in the evening. The overall cruisetrack as well as the assigned survey area are depicted in Fig. 1.

Clupeids were largely visible on echograms as pole shaped schools. An identification of echo signals was achieved by targeted fishery hauls on detected schools. Altogether, the fish schools and the corresponding echoes were not distributed evenly in the survey areas. Regions with particularly high fish densities values alternated with sometimes long transect sections of zero detections. As in previous years, the highest NASC values (i. e. echo signals) were recorded as usually in coastal areas of the inner German Bight and around Helgoland Island Herring abundance estimates, however, cannot be assessed before a final combination of acoustic and trawl catch data for the evaluation of survey results. This will be accomplished after biological samples have been worked up in the lab, and results will subsequently presented to ICES WGIPS.

### 3.3 Biological sampling (N. Rohlf)

Thirty 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 35 minutes, but usually was set to 30 minutes. Fishery 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 Fig. 1. Catches were sorted according to species, and length- and weight-distributions of individual species were measured. Of all clupeids (herring, sprat and anchovy were caught), 10 individuals per 0.5 cm length-class were sampled per rectangle. Their individual weight, sex and maturity stage was determined and the otoliths were sampled to enable age estimation.

Altogether, 25 different fish species were caught during the survey, plus one cephalopod and one crustacean species. A detailed overview on catch compositions (CPUE in  $\text{kg } 30\text{min}^{-1}$ ) of all 30 trawl hauls is given in Tab. 1. As in the previous years, sprat dominated the catches (present in 25 hauls or 83% of the total 30) and contributed the bulk of biomass of total catch weight (2.8 t, i. e. 81 %). Herring was somewhat more abundant in the survey area when compared to the previous year, but still on a low level. The total catch weight of herring summed up to 546 kg only (2014: 241 kg, obtained in 55 hauls). However, catches alone are not representative for abundance of small pelagics. Detailed conclusions on abundance cannot be given until echo integration is accomplished and trawl haul and hydroacoustic data are combined.

A detailed overview on numbers, weights and mean lengths of herring, sprat and anchovies sampled is given in Tab. 2a-c, together with their proportion on the total catch. Figures 3 - 5 show length distributions of these species as derived from total catches. Herring lengths ranged from 3 to 27 cm. At least three distinct peaks can be observed in their length frequency distribution. Sprat lengths ranged from 4.5 to 14.5 cm. In contrast to previous years larger quantities of small sprat (< 7 cm TL) were found in the survey area.

Only a very few anchovies were caught during the survey. Pilchards were entirely absent in the trawl hauls.

### 3.4 Hydrography

Vertical profiles of temperature and salinity were measured with a SeaBird SBE CTD-probe on a station grid covering the whole survey area (Fig. 1). Hydrography measurements were conducted in regular intervals along the cruise track. Altogether, 62 CTD casts were conducted during this survey. Surface temperatures ranged from ca. 14°C in the northernmost survey area to 18°C in the inner German Bight and along the Dutch coast (Fig. 6). Bottom temperatures ranged from 7.5 °C in the North to also 18°C in the southern part of the survey area. While the water column was well mixed south of ca. 54°N, summer thermal stratification with warm surface and cold bottom temperatures was evident northward.

Surface salinity ranged from about 30 psu near the river Elbe estuary to about 35.5 psu in the southern survey area. Levels near the seafloor were mostly similar (Fig. 6).

### 5. Survey participants

Dr. Eckhard Bethke (Cruise leader)	Hydroacoustics	SF
Michael Sasse	Hydroacoustics	SF
Dr. Norbert Rohlf	Biology	SF
Jörg Appel	Biology	SF
Erik Sulanke	Student assistant	SF

### 6. References

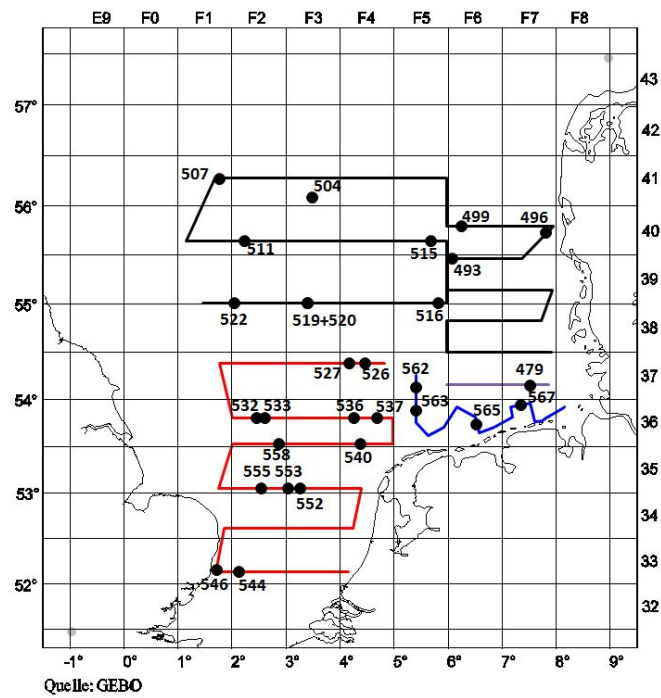
ICES (2015): Manual for International Pelagic Surveys (IPS). Series of ICES Survey Protocols SISP 9 – IPS. 92 pp. (Available via [www.ices.dk](http://www.ices.dk))

### 7. Acknowledgements

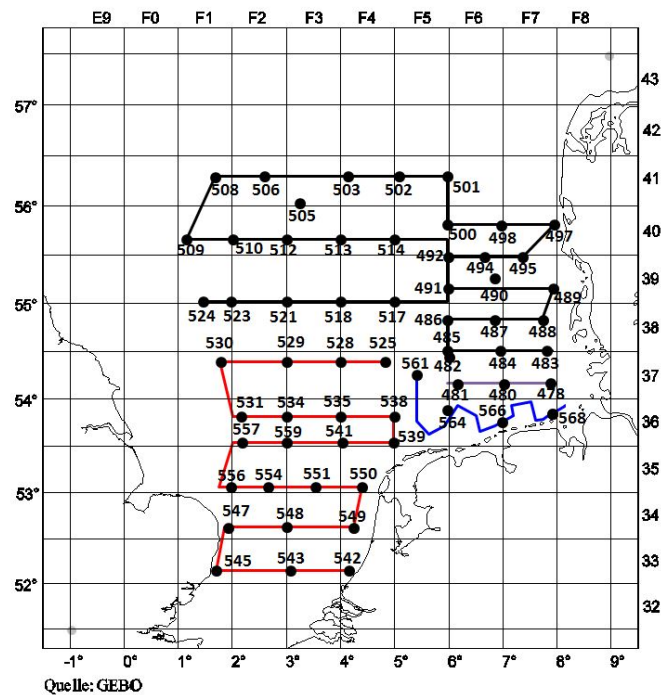
I hereby thank the crew of FRV "Solea" and Captain V. Koops as well as all participants for their outstanding cooperation and commitment that facilitated the successful accomplishment of this survey.



Hamburg, 04.11.2016  
(Dr. E. Bethke, Scientist in charge)



**Fig. 1:** HERAS Herring Acoustic Survey 2016. Cruise track and haul positions of FRV “Solea” cruise 722. ICES statistical rectangles are indicated in the top and right axis.



**Fig. 2:** HERAS Herring Acoustic Survey 2016. Cruise track and CTD stations of FRV “Solea” cruise 722. ICES statistical rectangles are indicated in the top and right axis.

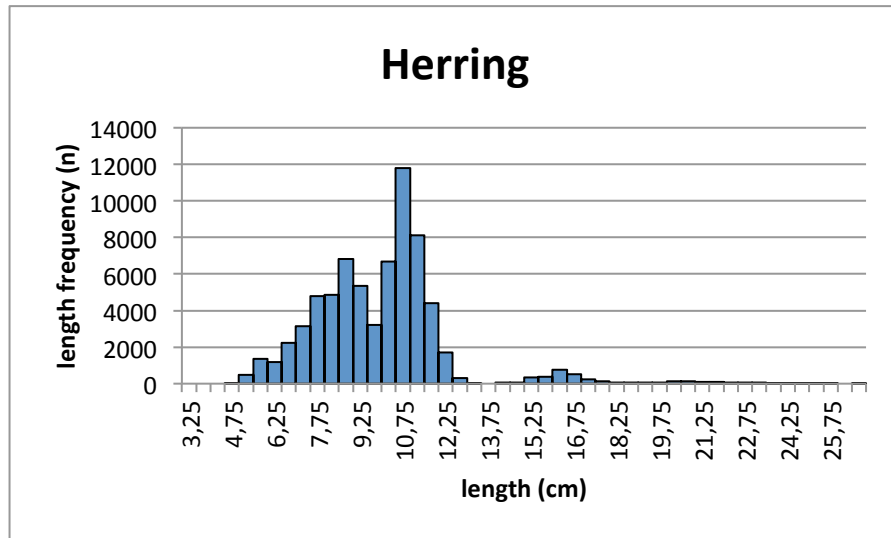


Fig. 3: Herring (*Clupea harengus*) length-frequency distribution FRV "Solea" cruise 722.

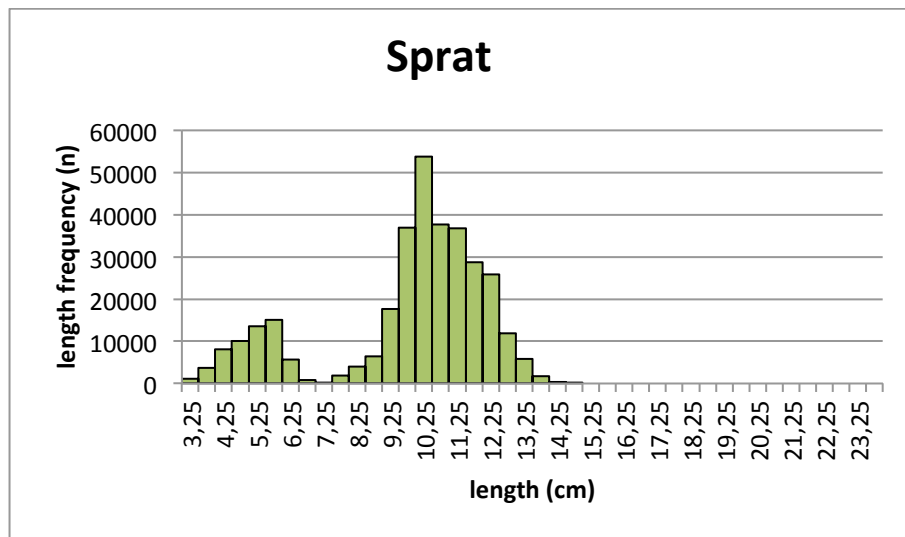


Fig. 4: Sprat (*Sprattus sprattus*) length-frequency distribution FRV "Solea" cruise 722.

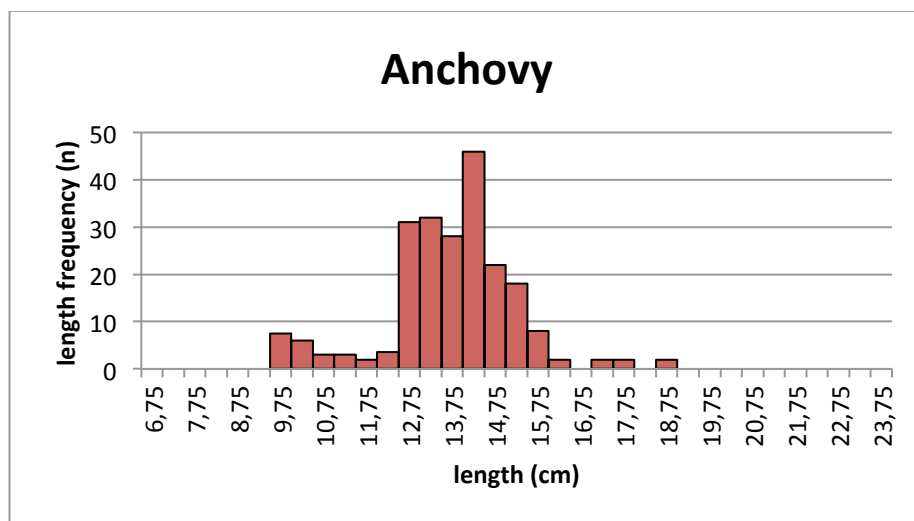
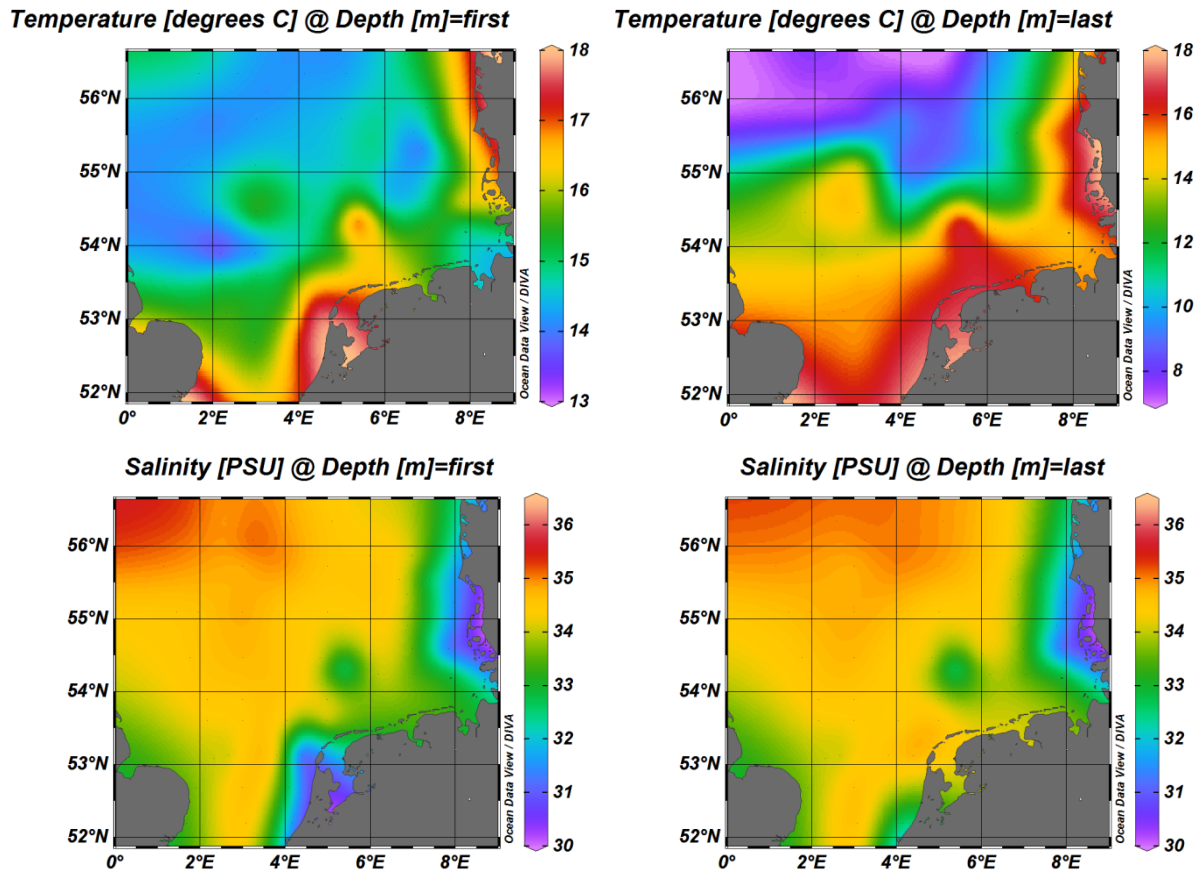


Fig. 5: Anchovy (*Engraulis encrasicolus*) length-frequency distribution FRV "Solea" cruise 722.



**Fig. 6:** Hydrography in the survey area of FRV "Solea" cruise 722. Temperature (°C) near surface (top panel, left) and at seafloor (top panel, right) and salinity (PSU) near surface (lower panel, left) and at seafloor (lower panel, right).

**Tab. 1:** Catch composition (CPUE in kg) FRV “Solea” cruise 722 (standardized to 30 minutes trawl duration).

HAUL	STATION	RECTANGLE	TOTAL (kg)	<i>AMMODYTES MARINUS</i>	<i>ARGENTINA SPHYRAENA</i>	<i>CLUPEA HARENGUS</i>	<i>CRYSTALLOGOBIUS LINEARIS</i>	<i>ECHIIHATHYS VIPERA</i>	<i>ENGRAULIS ENCRASICOLUS</i>	<i>EUTRIGLIA GURNARDUS</i>	<i>HIPPOGLOSSOIDES PLATESSOIDES</i>	<i>HYPEROPLUS LANCEOLATUS</i>	<i>LIMANDA LIMANDA</i>	<i>LITHODES MAJA</i>	<i>LOLIGO FORBESI</i>
1	479	37F7	294.35			22.63				1.63		0.18			
2	493	40F6	23.99			3.11				1.29					
3	496	40F7	1.86							0.29			0.25		
4	499	40F6	14.61			0.50				0.63					
5	504	41F3	7.47							0.19			0.07		
6	507	41F1	59.57			59.57									
7	511	40F2	43.16			35.92				0.67	0.02			0.35	0.33
8	515	40F5	66.07			55.90				0.86					
9	516	39F5	22.49			0.17				0.20					
10	519	39F3	15.37	0.30						10.97					
11	520	39F3	8.38	0.94						5.45		0.03			
12	522	39F2	0.94	0.02		0.00									
13	526	37F4	12.73			4.61				0.26					
14	527	37F4	79.57			0.03				5.13					
15	532	36F2	0.06					0.06							
16	533	36F2	0.27	0.01						0.19		0.05			
17	536	36F4	104.66			48.64				0.18					
18	537	36F4	28.85			16.17	0.00								
19	540	36F4	25.03		0.00	3.87		0.03					0.07		
20	544	33F2	28.78			4.41		2.71				0.01			
21	546	33F1	48.89			6.57		0.88	0.16						
22	552	35F3	6.07					0.05		0.06					
23	553	35F3	12.16					0.12							
24	555	35F2	68.94			3.88		1.06		0.39			0.06		
25	558	36F2	57.41							0.20		0.05	0.22		
26	560	36F3	254.27			0.01			0.01	0.10			0.20		
27	562	37F5	76.07			23.39							0.39		
28	563	36F5	694.37			163.31				0.07					
29	565	36F6	1090.55			88.75			3.77						
30	567	37F7	256.98			4.83				0.48					
<b>total (kg)</b>			<b>3403.9</b>	1.3	0.0	546.3	0.0	4.9	3.9	29.2	0.0	0.3	1.3	0.4	0.3
<b>proportion (%)</b>				0.0	0.0	16.0	0.0	0.1	0.1	0.9	0.0	0.0	0.0	0.0	0.0
<b>number of catches</b>				4	1	21	1	7	3	20	1	5	7	1	1
<b>presence (%)</b>				13	3	70	3	23	10	67	3	17	23	3	3



**Tab. 1 continued:** Catch composition (CPUE in kg) FRV "Solea" cruise 722 (standardized to 30 minutes trawl duration).

HAUL	STATION	RECTANGLE	TOTAL (kg)	MERLANGIUS MERLANGUS	PLEURONECTES PLATESSA	POMATOSCHISTUS SPEC.	POMATOSCHISTUS MINUTUS	RAJA CLAVATA	RAJA MONTAGUI	SCOMBER SCOMBRUS	SCYLIORHINUS CANICULA	SPRATTUS SPRATTUS	TRACHURUS TRACHURUS	TRISOPTERUS LUSCUS	Number of species
1	479	37F7	294.35	0.01						0.14		269.8			6
2	493	40F6	23.99	0.09								19.5			4
3	496	40F7	1.86	0.03						1.30					4
4	499	40F6	14.61	0.02						0.32		13.1			5
5	504	41F3	7.47	7.21											3
6	507	41F1	59.57												1
7	511	40F2	43.16	5.55						0.32					7
8	515	40F5	66.07	0.04								9.3			4
9	516	39F5	22.49	20.55								1.6			4
10	519	39F3	15.37									4.1			3
11	520	39F3	8.38									2.0			4
12	522	39F2	0.94									0.9			3
13	526	37F4	12.73	0.00								7.9			4
14	527	37F4	79.57	0.00			0.00					74.4			5
15	532	36F2	0.06												1
16	533	36F2	0.27									0.0			4
17	536	36F4	104.66	0.05						0.74		55.1			5
18	537	36F4	28.85	0.01			0.00					12.7			5
19	540	36F4	25.03									21.1			5
20	544	33F2	28.78									21.6			4
21	546	33F1	48.89	0.02	0.75	0.01		4.43				35.4	0.61	0.04	10
22	552	35F3	6.07									6.0			3
23	553	35F3	12.16	0.01								12.0			3
24	555	35F2	68.94	0.22		0.00						63.3			7
25	558	36F2	57.41		0.19				0.78			55.1	0.87		7
26	560	36F3	254.27						0.94		0.21	252.4	0.40		8
27	562	37F5	76.07	0.18								52.1			4
28	563	36F5	694.37									531.0			3
29	565	36F6	1090.55	0.01						0.57		997.4			5
30	567	37F7	256.98									251.7			3
<b>total (kg)</b>			<b>3403.9</b>	34.0	0.9	0.0	0.0	4.4	1.7	3.4	0.2	2769.4	1.9	0.0	
<b>proportion (%)</b>				1.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	81.4	0.1	0.0	
<b>number of catches</b>				17	2	2	2	1	2	6	1	25	3	1	
<b>presence (%)</b>				57	7	7	7	3	7	20	3	83	10	3	

**Tab.2a:** Numbers, weights and mean lengths of **herring** (*Clupea harengus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration)

Haul	Rect.	Stat.	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	herring					herring (% clups)
						catch (kg)	count (n)	range (cm)			
								min	max	mean	
1	37F7	479	294.3	292.4	99%	22.63	4366	7.75	16.25	9.3	8%
2	40F6	493	24.0	22.6	94%	3.11	317	7.75	16.75	10.9	14%
4	40F6	499	14.6	13.6	93%	0.50	73	8.25	12.75	10.1	4%
6	41F1	507	59.6	59.6	100%	59.57	689	17.75	27.25	21.7	100%
7	40F2	511	43.2	35.9	83%	35.92	789	14.75	24.25	17.9	100%
8	40F5	515	66.1	65.2	99%	55.90	1700	10.75	18.75	16.3	86%
9	39F5	516	22.5	1.7	8%	0.17	16	8.75	17.25	10.8	10%
12	39F2	522	0.9	0.9	98%	0.00	1	6.25	6.25	6.3	0%
13	37F4	526	12.7	12.5	98%	4.61	1710	6.25	9.25	7.5	37%
14	37F4	527	79.6	74.4	94%	0.03	3	7.75	14.25	11.0	0%
17	36F4	536	104.7	103.7	99%	48.64	9662	7.75	11.25	9.0	47%
18	36F4	537	28.8	28.8	100%	16.17	5205	6.25	8.75	7.7	56%
19	36F4	540	25.0	24.9	100%	3.87	1116	5.75	8.75	7.5	16%
20	33F2	544	28.8	26.1	91%	4.41	627	7.25	12.75	10.0	17%
21	33F1	546	48.9	42.2	86%	6.57	2373	6.25	9.25	7.7	16%
24	35F2	555	68.9	67.2	97%	3.88	2504	4.75	10.25	6.2	6%
26	36F3	560	254.3	252.4	99%	0.01	2	8.25	9.25	8.8	0%
27	37F5	562	76.1	75.5	99%	23.39	4322	5.75	15.25	8.6	31%
28	36F5	563	694.4	694.3	100%	163.31	21742	6.75	12.25	10.5	24%
29	36F6	565	1090.6	1090.0	100%	88.75	12228	9.75	12.75	11.2	8%
30	37F7	567	257.0	256.5	100%	4.83	495	10.75	12.75	11.3	2%

**Tab.2b:** Numbers, weights and mean lengths of **anchovies** (*Engraulis encrasicolus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration)

Haul	Rect.	Stat.	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	anchovies					anchovies (% clups)
						catch (kg)	count (n)	range (cm)			
								min	max	mean	
21	33F1	546	48.9	42.2	86%	0.16	14	9.8	12.3	10.4	0.37%
26	36F3	560	254.3	252.4	99%	0.01	1	12.8	12.8	12.8	0.00%
29	36F6	565	1090.6	1090.0	100%	3.77	196	11.8	18.8	14.1	0.35%

**Tab.2c:** Numbers, weights and mean lengths of **sprat** (*Sprattus sprattus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration)

Haul	Rect.	Stat.	total catch (kg)	clupeid catch (kg)	clupeid portion (%)	sprat					sprat (% clups)
						catch (kg)	count (n)	range (cm)			
								min	max	mean	
1	37F7	479	2.8	292.0	99%	269.8	35620	8.3	11.3	10.0	92%
2	40F6	493	40.6	23.0	94%	19.5	2082	8.3	13.8	10.5	86%
4	40F6	499	105.0	14.0	93%	13.1	1234	9.3	13.3	11.0	96%
8	40F5	515	38.9	65.0	99%	9.3	904	9.3	13.8	11.1	14%
9	39F5	516	59.7	2.0	8%	1.6	143	9.3	13.8	11.7	90%
10	39F3	519	611.4	4.0	27%	4.1	5322	4.8	6.3	5.2	100%
11	39F3	520	476.9	2.0	23%	2.0	2350	4.3	5.8	5.0	100%
12	39F2	522	10.3	1.0	98%	0.9	1033	4.8	5.8	5.2	100%
13	37F4	526	80.5	12.0	98%	7.9	1378	5.3	13.3	8.6	63%
14	37F4	527	549.6	74.0	94%	74.4	10002	7.8	11.8	10.0	100%
16	36F2	533	44.2	0.0	6%	0.0	1	12.3	12.3	12.3	100%
17	36F4	536	257.8	104.0	99%	55.1	5713	9.3	13.3	10.8	53%
18	36F4	537	290.2	29.0	100%	12.7	6724	5.3	11.3	6.2	44%
19	36F4	540	5.6	25.0	100%	21.1	3898	5.3	14.3	8.1	84%
20	33F2	544	42.2	26.0	91%	21.6	8595	4.3	11.8	6.1	83%
21	33F1	546	117.0	42.0	86%	35.4	13624	3.3	12.3	5.5	84%
22	35F3	552	275.6	6.0	98%	6.0	343	12.3	14.8	13.2	100%
23	35F3	553	42.4	12.0	99%	12.0	913	10.3	13.8	11.9	100%
24	35F2	555	49.7	67.0	97%	63.3	11980	4.8	12.3	8.7	94%
25	36F2	558	119.9	55.0	96%	55.1	4388	10.3	14.8	11.8	100%
26	36F3	560	59.0	252.0	99%	252.4	23389	9.8	14.3	11.3	100%
27	37F5	562	393.2	76.0	99%	52.1	22879	4.3	12.3	6.5	69%
28	36F5	563	34.4	694.0	100%	531.0	45417	5.8	14.3	11.4	76%
29	36F6	565	353.0	1090.0	100%	997.4	95130	9.3	13.8	10.8	92%
30	37F7	567	546.0	257.0	100%	251.7	18341	10.8	13.8	12.1	98%