Institute of Sea Fisheries

THÜNEN

Palmaille 9, 22767 Hamburg Telefon 040 38905-173 Telefax 040 38905-263 17.08.2015 E-Mail: matthias.schaber@ti.bund.de
Dr.Scha./vS/3953

Cruise report
FRV „Solea" Cruise 706
26.06. - 16.07.2015

Scientist in charge: Dr. M. Schaber

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*) distribution pattern was another objective of the survey.

Verteiler:
TI - Seefischerei
Saßnitzer Seefischerei e. G.

Per E-Mail:
BMEL, Ref. 614
BMEL, Ref. 613
Bundesanstalt für Landwirtschaft und Ernährung, Hamburg
Schiffsführung FFS "Solea"
Präsidialbüro (Michael Welling)
Personalreferat Braunschweig
TI - Fischereiökologie
TI - Ostseefischerei Rostock
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 rectangles as well as to prepare for a survey evaluation workshop (ICES WKEVAL), the hitherto used cruise track had been changed. This led to an increased coverage of the area as well as to overall longer hydroacoustic transect mileage (1963 nm). Due to very favorable weather conditions, the whole survey area, i.e. all transects could be covered as planned.

Recording of hydroacoustic data usually took place between 06:00 and 20:00 (6 am to 6 pm) with an occasional extension of the daily sampling to ca. 21:00 (9 pm) according to survey progress and echorecordings.

To allocate biological information to echorecordings and for the collection of biological samples, altogether 55 fishery hauls were conducted.

Generally, sprat showed the highest presence in fishery hauls and also contributed the bulk biomass to total catch weight. Overall catches of herring were extraordinarily low and well below catches of anchovies (despite lower presence of the latter). Altogether, 25 different fish and one cephalopod species were caught during the survey. Notable were low abundances of herring and high contributions of anchovies in the German Bight.

Hydrography profiles were measured with a vertically deployed CTD probe on 113 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 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 preparation of scientific equipment, FRV “Solea” left Cuxhaven port in the early afternoon of June 26th to start survey operations in the northeastern survey area due to favorable weather forecasts. Calibration of the hydroacoustic equipment was conducted early the next morning prior to the start of survey operations near the starting point of the hydroacoustic transect. Around noon June 27th, hydroacoustic recordings commenced. Throughout the survey, no interruptions or delays were encountered due to prevailing exceptionally good weather conditions. As local weather conditions were subjected to change, an overnight passage from the northeastern part of the area towards the central/southwestern area in order to take advantage of favorable weather in this area was conducted on July 4th. On July 15th early afternoon, survey operations were accomplished west of Amrum Bank and FRV “Solea” steamed back to Cuxhaven port. Altogether, all 1963 nm of planned hydroacoustic transects were covered.

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 from a drifting vessel near the starting point of the acoustic transects in the northeastern survey area. Calibration occasionally had to be interrupted due to technical and

computer issues, but overall calibration results were considered acceptable (38 kHz) and good (120 kHz) respectively. 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 EK60 scientific echosounder with hull-mounted 38 kHz and 120 kHz transducers. Post-processing and analysis of the data was accomplished with EchoView 6.1 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 6 am and 6 pm, as in previous surveys. In some instances, the sampling of hydroacoustic data was extended to ca. 9 pm in areas with very low or no clupeid signals. This is considered uncritical, as during this time of year the light intensity at that time is still high with dispersion of schools usually occurring later in the evening. The overall cruisetrack covered during this survey as well as the assigned survey area are depicted in Fig. 1. The survey effort per ICES rectangle as allocated to each participating research vessel had been assigned by ICES WGIPS prior to the survey (with a change of 2 rectangles) and was accomplished as planned.

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/NASC values alternated with sometimes long transect sections of zero detections. As in previous years, the highest NASC values (i. e. echo signals) were recorded in coastal areas of the inner German Bight and around Helgoland Island (Fig. 2). Further north however, unlike in previous years, NASC values were much lower along the coast. Other than in previous years, clupeids were also detected in more offshore areas e.g. on the northern border of the Dogger Bank. Similar to previous surveys, fish densities were comparatively high in the southwestern part of the survey area with more consistent rather than patchy recordings (as compared to e.g. 2013 and 2014) along the track. Overall, despite more consistent detections of clupeids mostly in the southern part of the total survey area, total NASC values recorded appeared significantly lower than those recorded in 2014. The actual effect of this low NASC values in combination with exceptionally low herring catches (see below) on 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)

Fifty-five trawl hauls were conducted during the summer acoustic survey. Trawling was carried out using a PSN 388 pelagic trawl (“Krake”). Trawl duration varied between six and 40 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. Altogether, fisheries operations took place in 30 ICES statistical rectangles (as compared to 26 in the previous survey). Catches were sorted according to species, and length- and weight-distributions of individual species were measured. Of all clupeids (herring, sprat, anchovy and pilchard), 12 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 and 1 cephalopod species were caught during the survey. A detailed overview on catch compositions (CPUE in kg $30min^{-1}$) of all 55 trawl hauls given in Tab. 1. As in the previous years, sprat dominated the catches (present in 39 hauls or 71% of the total 55) and

contributed the bulk of biomass of total catch weight (12.1 t, i. e. 91 %). Herring was much less abundant compared to previous years. The total weight of herring caught summed up to 241 kg only, which was less than 10 % of last year's herring catch. 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, anchovies and pilchard sampled is given in Tab. 2a-d, together with their proportion of the total catch. Figures 3 - 6 show length distributions of these species as derived from total catches. Herring lengths ranged from 5 to 26.5 cm. However, the dominance of young herring in the distribution, as commonly observed in former years, was not observed in 2015. Sprat lengths ranged from 4.5 to 15.5 cm. The overall abundance of anchovies has increased. Some hauls yielded almost exclusively anchovies. Pilchards were caught in seven hauls, sometimes in very small quantities, but sometimes also up to 50 kg during half an hour trawling.

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 either conducted directly after a trawl haul or, in case of no fishing activity, in regular intervals along the cruise track. Altogether, 113 CTD casts were conducted during this survey. Surface temperatures ranged from ca. 12°C in the northernmost survey area to almost 18°C in the inner German Bight and along the Dutch coast (Fig. 7). Bottom temperatures ranged from 9.5 °C in the North to also almost 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 29.7 psu near the Elbe river mouth to 35.1 psu in southern survey area with levels near the seafloor mostly similar (Fig. 7).

5. Survey participants

Dr. Matthias Schaber (Cruise leader)	Hydroacoustics	SF
Michael Sasse	Hydroacoustics	SF
Dr. Norbert Rohlf	Biology	SF
Jörg Appel	Biology	SF
Gitta Hemken	Biology	SF
Inken Rottgardt	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)

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 and amongst others included “overtime” trawl hauls, extended daily survey operations etc.

Hamburg, 13.08.2015
(Dr. M. Schaber, Scientist in charge)

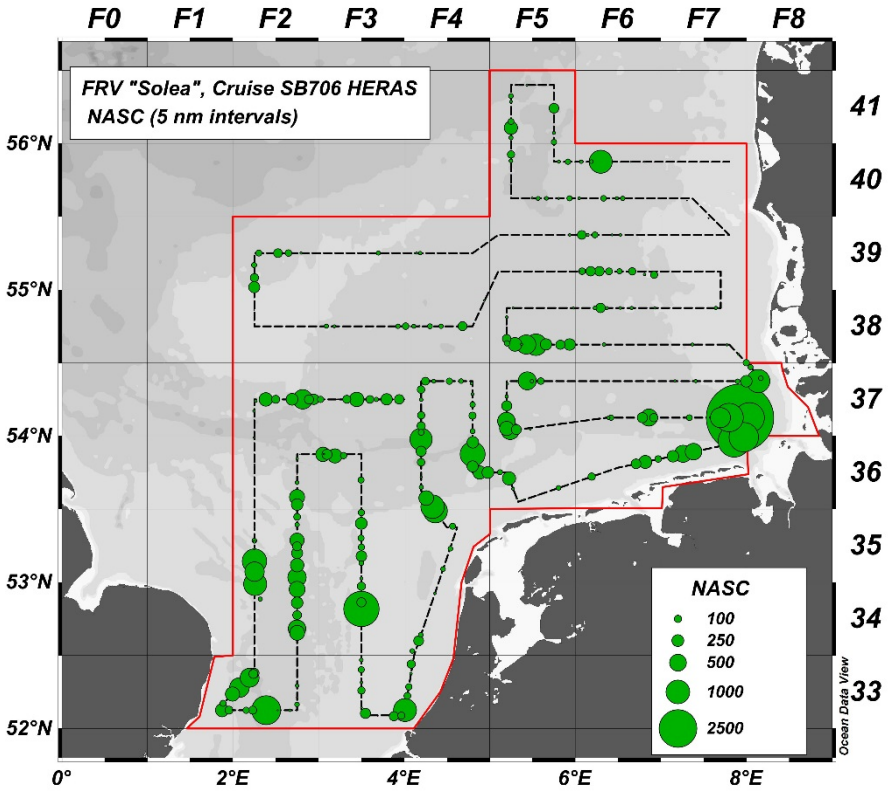

Fig. 1: HERAS Herring Acoustic Survey 2015. Cruisetrack (dashed line) and NASC (m^2 nm^{-2}, 5nm intervals) of FRV "Solea" cruise 706. ICES statistical rectangles are indicated in the top and right axis. Red line delineates assigned survey area.

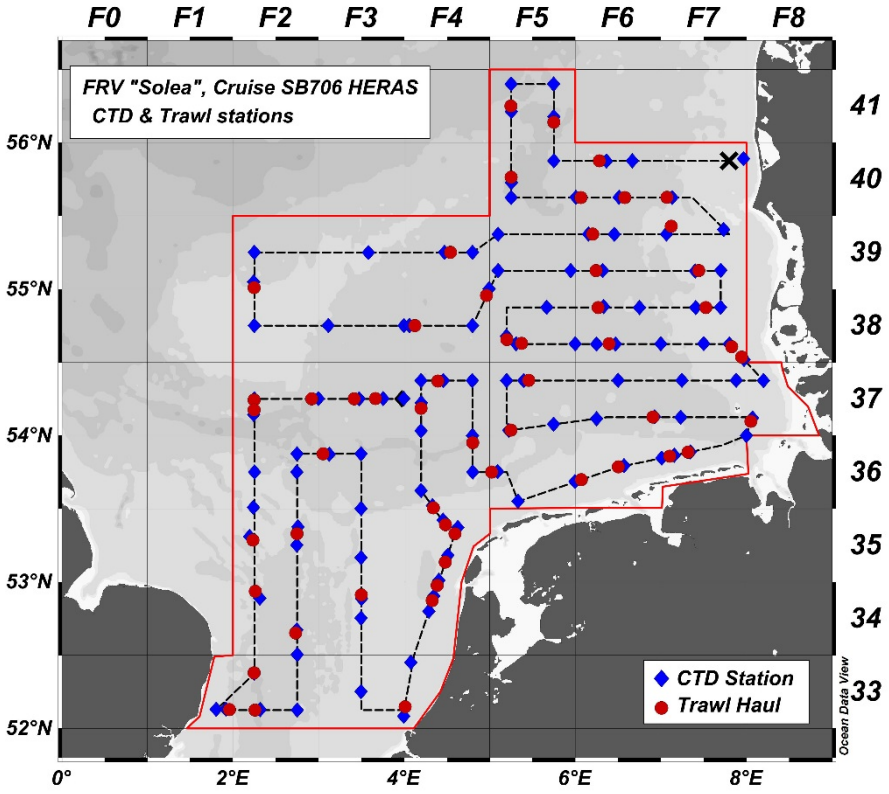

Fig. 2: HERAS Herring Acoustic Survey 2015. Cruisetrack (dashed line) as well as CTD and trawl haul stations of FRV "Solea" cruise 706. ICES statistical rectangles are indicated in the top and right axis. Red line delineates assigned survey area.

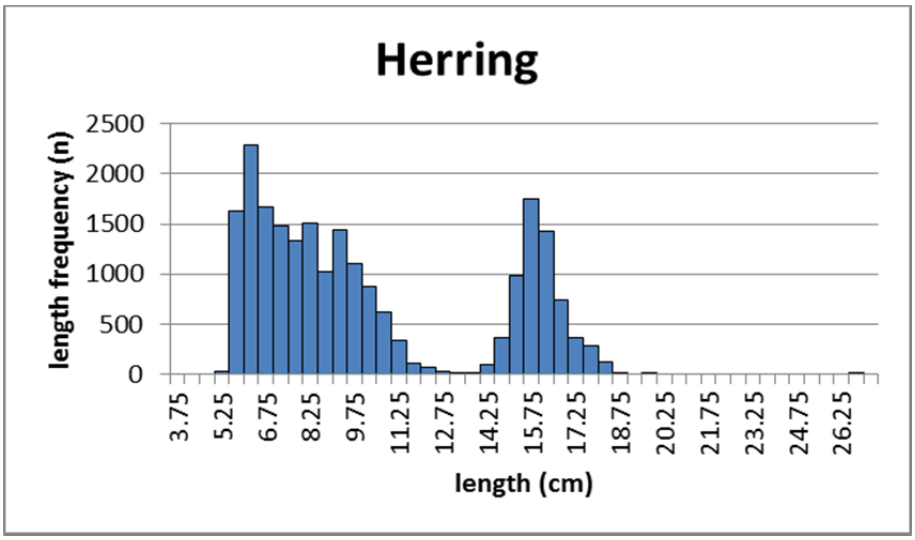

Fig. 3: Herring (*Clupea harengus*) length-frequency distribution FRV "Solea" cruise 706.

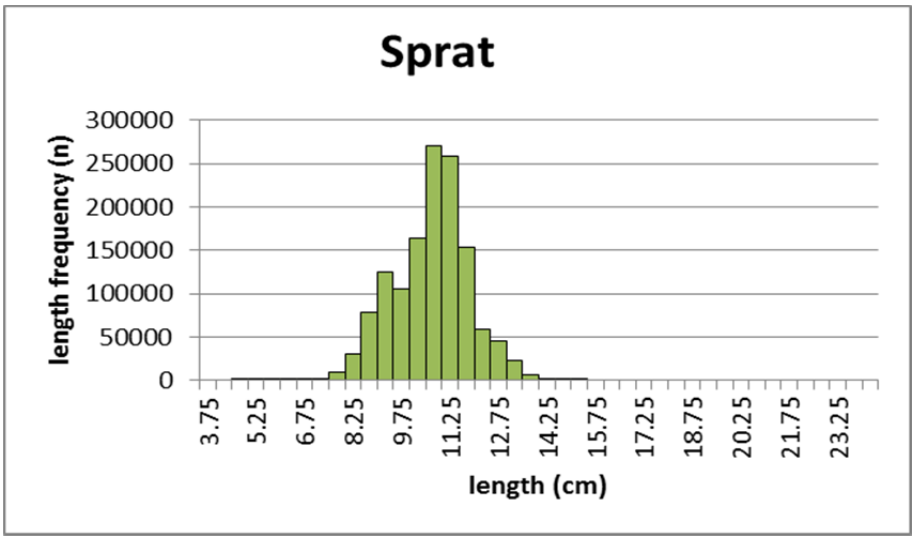

Fig. 4: Sprat (*Sprattus sprattus*) length-frequency distribution FRV "Solea" cruise 706.

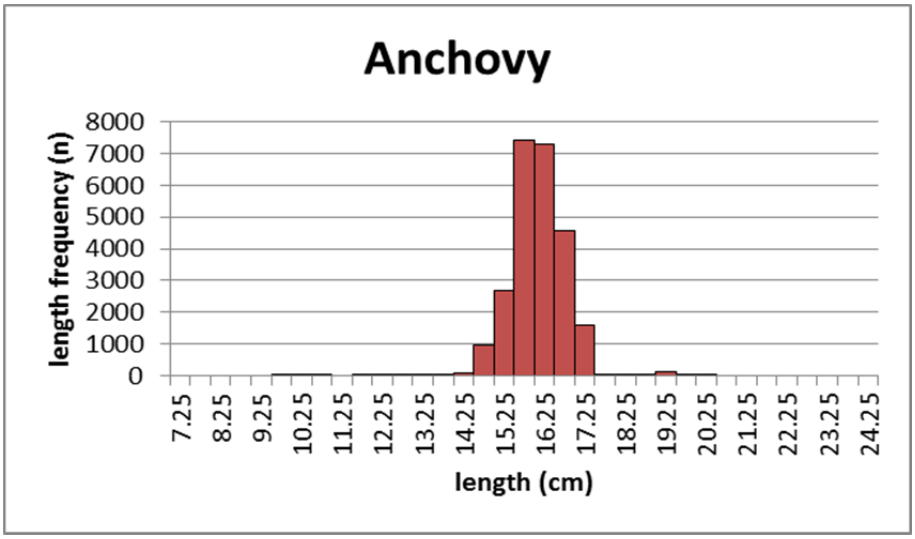

Fig. 5: Anchovy (*Engraulis encrasicolus*) length-frequency distribution FRV "Solea" cruise 706.

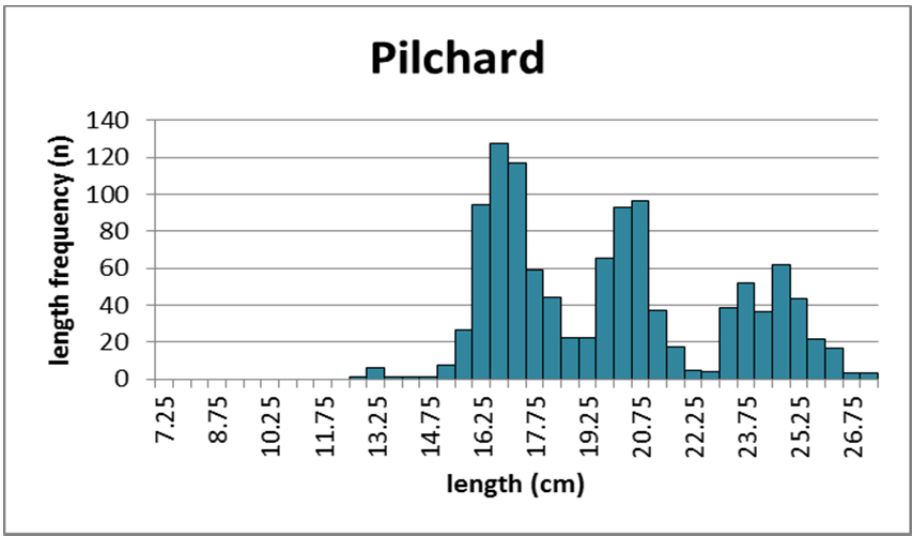

Fig. 6: Pilchard (*Sardina pilchardus*) length-frequency distribution FRV "Solea" cruise 706.

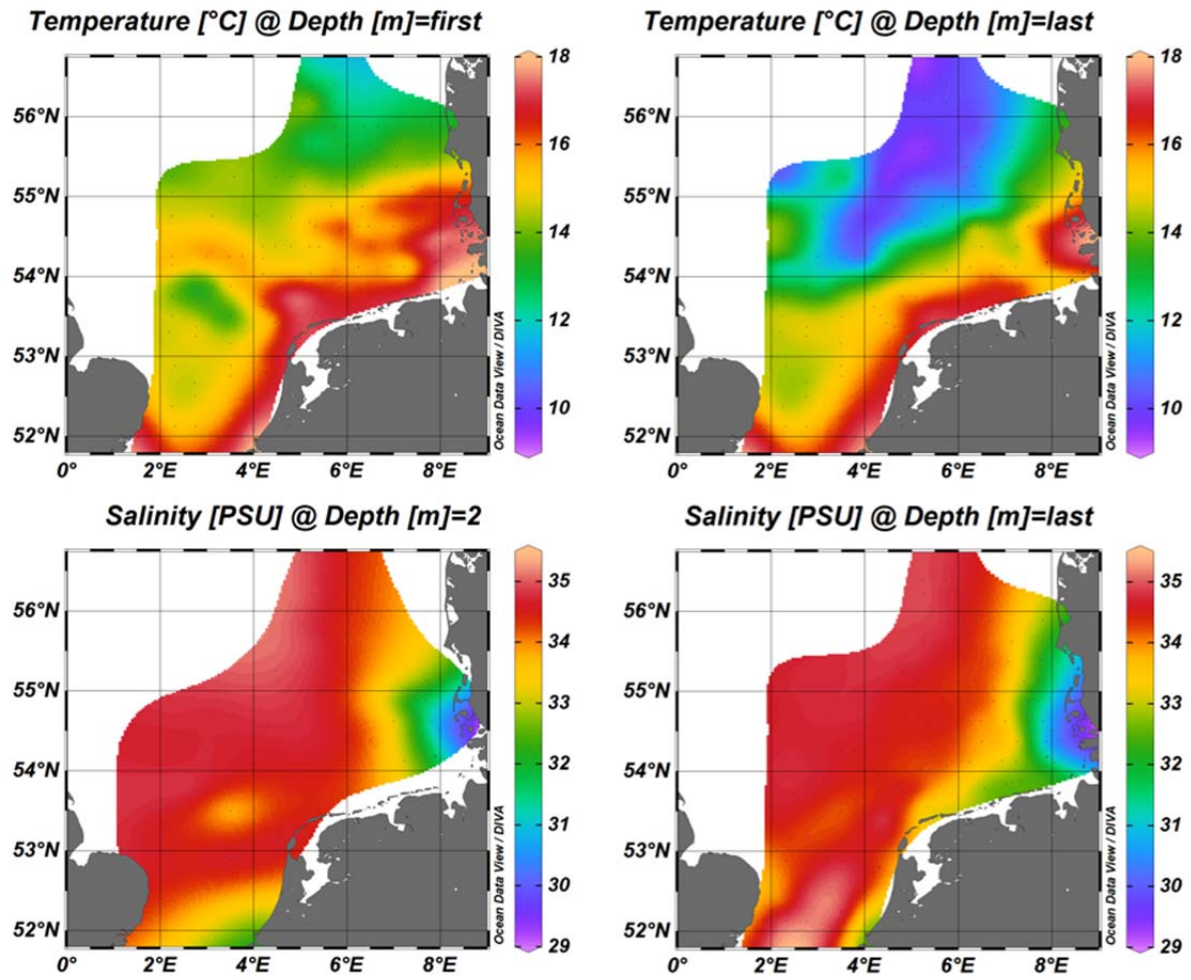

Fig. 7: Hydrography in the survey area of FRV "Solea" cruise 706. Temperature (°C) near surface (top panel, left) and at seafloor (top panel, right) and salinity (PSU) near surface (lower panel, left) and at seafloor (lower panel, right).

Tab. 1: Catch composition (CPUE in kg) FRV "Solea" cruise 706 (standardized to 30 minutes trawl duration).

Haul	RECTANGLE	STATION	Total (kg)	*ALLOTEUTHIS SUBULATA*	*AMMODYTES MARINUS*	*AMMODYTES TOBIANUS*	*BELONE BELONE*	*CLUPEA HARENGUS*	*CRYSTALLOGOBIUS LINEARIS*	*ECHIICHTHYS VIPERA*	*ENGRAULIS ENCRASICOLUS*	*EUTRIGLA GURNARDUS*	*GADUS MORHUA*	*HIPPOGLOSSOIDES PLATESSO*	*HYPEROPLUS LANCEOLATUS*	*LAMPETRA FLUVIATILIS*	*LIMANDA LIMANDA*
1	40F6	397	2.8					0.1				1.9					
2	41F5	399	40.6					38.0				1.2					
3	41F5	402	105.0	0.0				77.4				4.3		0.1			
4	40F5	403	38.9					27.1				7.8					
5	40F6	405	59.7					27.6			0.0	2.7					
6	40F6	406	611.4					3.2				1.9					0.8
7	40F7	407	9.3									0.9					
8	39F7	408	7.0									0.4					0.2
9	39F6	411	476.9					3.8			0.0	3.4					
10	39F4	414	0.9									0.9					
11	39F2	416	0.6									0.6					
12	39F2	417	10.3									0.0					0.0
13	38F4	421	80.5					0.7				1.5					0.3
14	38F4	423	2.7									2.7					
15	39F6	426	549.6					1.9				0.8					0.0
16	39F7	427	0.3									0.2					
17	38F7	430	11.9		0.1							0.3			11.3		0.2
18	38F6	432	44.2					1.1				0.8					
19	38F5	434	257.8					0.7				2.3					
20	38F5	435	290.2					0.7				1.1					
21	37F3	438	5.6									0.4					
22	37F3	439	42.2	0.0								1.0					
23	37F2	441	117.0	0.0				0.1				2.2					
24	37F2	443	0.5	0.0						0.0		0.4					
25	35F2	446	275.6					0.0		0.4							
26	34F2	447	42.4	0.0				4.2	0.0	3.9	0.0	0.3					
27	33F2	448	49.7	0.0				5.3	0.0	6.8		0.1					
28	33F1	450	119.9	0.1				1.2		0.4							0.1
29	33F2	451	59.0	0.0						1.8		0.1					
30	34F2	454	393.2					0.1		0.2		0.2			0.0		
31	35F2	456	34.4	0.0				1.0		0.3		1.4					
32	36F3	459	353.0					0.1				0.7			0.1		
33	34F3	463	546.0														
34	33F4	467	360.8					26.8			1.0						
35	34F4	470	67.3				0.6				5.3	0.2					0.0
36	34F4	471	28.2		10.1	6.3					4.9				4.3		0.2
37	35F4	472	0.6							0.0	0.1	0.3			0.2		
38	35F4	473	111.8								0.4				0.1		
39	35F4	474	0.3														
40	36F4	475	3049.7	0.1				0.5		0.2	0.1						
41	37F4	478	197.9					3.8				0.4					
42	37F4	480	160.0					0.8				0.4	3.0				
43	36F4	483	428.1	0.0				0.6									
44	36F5	485	560.8					0.2			0.1						
45	36F6	488	9.1								8.1						0.1
46	36F6	489	0.0														
47	36F7	491	53.5				0.1				51.4	0.1			0.2		
48	36F7	492	732.1					0.3			25.5						
49	37F8	494	920.9	0.0				11.3	0.0		0.4	0.2				0.0	
50	37F6	496	839.1					2.7			0.2						
51	37F5	499	607.7	0.0													0.1
52	37F5	501	31.0									0.8					
53	38F6	507	6.6	0.0								1.3					
54	38F7	511	14.7								2.1				0.0		
55	38F7	512	591.3	0.0	1.1	1.5					582.0				0.4		
	total (kg)		**13410.6**	0.4	11.3	7.7	0.7	241.1	0.0	14.0	681.6	46.1	3.0	0.1	16.7	0.0	2.1
	proportion (%)			0.0	0.1	0.1	0.0	1.8	0.0	0.1	5.1	0.3	0.0	0.0	0.1	0.0	0.0
	number of catches			15	3	2	2	29	3	10	17	38	1	1	9	1	11
	presence (%)			27	5	4	4	53	5	18	31	69	2	2	16	2	20

Tab. 1 continued: Catch composition (CPUE in kg) FRV "Solea" cruise 706 (standardized to 30 minutes trawl duration).

Haul	RECTANGLE	STATION	Total (kg)	*MERLANGIUS MERLANGUS*	*MICROSTOMUS KITT*	*POMATOSCHISTUS MINUTUS*	*SALMO TRUTTA*	*SARDA SARDA*	*SARDINA PILCHARDUS*	*SCOMBER SCOMBRUS*	*SPRATTUS SPRATTUS*	*SYNGNATHUS ROSTELLATUS*	*TRACHURUS TRACHURUS*	*TRIGLA LUCERNA*	*TRISOPTERUS LUSCUS*	Number of species
1	40F6	397	2.8	0.1							0.7					4
2	41F5	399	40.6	0.0		0.0					1.4					5
3	41F5	402	105.0	0.0							23.2					6
4	40F5	403	38.9	0.0							4.0					4
5	40F6	405	59.7	0.0							29.5					5
6	40F6	406	611.4	4.7							600.7					5
7	40F7	407	9.3	0.1						8.4						3
8	39F7	408	7.0	0.0						6.4						4
9	39F6	411	476.9								469.7					4
10	39F4	414	0.9	0.0												2
11	39F2	416	0.6	0.0												2
12	39F2	417	10.3	0.0							10.3					4
13	38F4	421	80.5	0.7	0.1						77.2					6
14	38F4	423	2.7	0.1												2
15	39F6	426	549.6	0.0							546.9					5
16	39F7	427	0.3	0.1												2
17	38F7	430	11.9	0.0												5
18	38F6	432	44.2	0.0							42.3					4
19	38F5	434	257.8	0.1						0.7	254.0					5
20	38F5	435	290.2	0.0							288.4					4
21	37F3	438	5.6	0.0							5.2					3
22	37F3	439	42.2	0.0							41.3					4
23	37F2	441	117.0								114.7					4
24	37F2	443	0.5	0.1												4
25	35F2	446	275.6	0.1						0.7	274.3					5
26	34F2	447	42.4	0.0							33.9					8
27	33F2	448	49.7	3.2							34.1		0.3		0.0	9
28	33F1	450	119.9							8.6	101.8		7.7	0.1		8
29	33F2	451	59.0							1.3	55.8					5
30	34F2	454	393.2							0.2	392.6					6
31	35F2	456	34.4	0.0							31.7					6
32	36F3	459	353.0	0.4							351.6					5
33	34F3	463	546.0							1.0	545.0					2
34	33F4	467	360.8						20.3	7.7	304.9					5
35	34F4	470	67.3	0.0					58.4	2.8						7
36	34F4	471	28.2	0.0					2.2	0.3			0.1			9
37	35F4	472	0.6													4
38	35F4	473	111.8	0.0							111.2					4
39	35F4	474	0.3							0.3						1
40	36F4	475	3049.7							17.2	3024.0		7.3	0.3		8
41	37F4	478	197.9	0.1							193.6					4
42	37F4	480	160.0	0.1							155.8					5
43	36F4	483	428.1	0.0						1.2	425.8		0.5			6
44	36F5	485	560.8							3.5	557.1					4
45	36F6	488	9.1					0.9								3
46	36F6	489	0.0	0.0								0.0	0.0			3
47	36F7	491	53.5	0.0					0.1	0.9	0.1			0.5		9
48	36F7	492	732.1	0.0							706.3					4
49	37F8	494	920.9				2.9			1.3	904.5			0.3		10
50	37F6	496	839.1	0.0					0.1	18.7	817.5					6
51	37F5	499	607.7	0.3					0.1	10.7	596.4					6
52	37F5	501	31.0	0.0						4.7	25.4					4
53	38F6	507	6.6	0.0						3.9	1.3					5
54	38F7	511	14.7	0.0						11.8			0.7			5
55	38F7	512	591.3	0.0					0.1	6.2						8
	total (kg)		**13410.6**	10.5	0.1	0.0	2.9	0.9	81.3	118.3	12154.1	0.0	16.6	1.2	0.0	
	proportion (%)			0.1	0.0	0.0	0.0	0.0	0.6	0.9	90.6	0.0	0.1	0.0	0.0	
	number of catches			42	1	1	1	1	7	23	39	1	7	4	1	
	presence (%)			76	2	2	2	2	13	42	71	2	13	7	2	

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

			total	clupeid	clupeid	herring					herring
			catch	catch	portion	catch	count	range (cm)			(%
Haul	Rect.	Stat.	(kg)	(kg)	(%)	(kg)	(n)	min	max	mean	clups)
1	40F6	397	2.8	0.8	28%	0.1	5	14.3	16.3	15.3	15.7%
2	41F5	399	40.6	39.4	97%	38.0	1366	14.3	17.8	15.8	96.4%
3	41F5	402	105.0	100.6	96%	77.4	2313	15.3	18.8	16.6	76.9%
4	40F5	403	38.9	31.1	80%	27.1	870	14.8	18.3	16.1	87.1%
5	40F6	405	59.7	57.1	96%	27.6	1011	14.3	18.3	15.5	48.3%
6	40F6	406	611.4	603.9	99%	3.2	128	13.8	16.3	15.0	0.5%
9	39F6	411	476.9	473.5	99%	3.8	144	12.8	17.8	15.3	0.8%
13	38F4	421	80.5	77.9	97%	0.7	21	15.3	17.3	16.2	0.8%
15	39F6	426	549.6	548.8	100%	1.9	74	12.8	17.3	15.1	0.3%
18	38F6	432	44.2	43.4	98%	1.1	76	6.3	16.3	11.5	2.6%
19	38F5	434	257.8	254.7	99%	0.7	30	7.3	16.3	14.0	0.3%
20	38F5	435	290.2	289.1	100%	0.7	25	7.3	19.8	15.0	0.2%
23	37F2	441	117.0	114.8	98%	0.1	2	14.8	16.3	15.5	0.1%
25	35F2	446	275.6	274.3	100%	0.0	7	5.8	6.8	6.3	0.0%
26	34F2	447	42.4	38.1	90%	4.2	2983	5.8	17.3	6.3	11.0%
27	33F2	448	49.7	39.3	79%	5.3	2992	5.8	17.8	6.7	13.4%
28	33F1	450	119.9	103.0	86%	1.2	247	7.3	16.3	8.8	1.2%
30	34F2	454	393.2	392.6	100%	0.1	3	13.8	17.3	15.5	0.0%
31	35F2	456	34.4	32.7	95%	1.0	616	5.3	26.8	6.8	3.1%
32	36F3	459	353.0	351.7	100%	0.1	16	5.8	17.8	8.8	0.0%
34	33F4	467	360.8	353.0	98%	26.8	4065	8.3	18.3	10.1	7.6%
40	36F4	475	3049.7	3024.6	99%	0.5	21	6.3	17.3	13.3	0.0%
41	37F4	478	197.9	197.4	100%	3.8	1155	6.8	9.8	8.1	1.9%
42	37F4	480	160.0	156.6	98%	0.8	230	6.3	16.3	8.2	0.5%
43	36F4	483	428.1	426.4	100%	0.6	20	8.3	16.3	15.2	0.1%
44	36F5	485	560.8	557.4	99%	0.2	77	6.3	7.8	7.1	0.0%
48	36F7	492	732.1	732.1	100%	0.3	30	9.8	11.8	11.1	0.0%
49	37F8	494	920.9	916.2	99%	11.3	3098	6.3	12.8	8.2	1.2%
50	37F6	496	839.1	820.4	98%	2.7	90	14.8	17.3	15.6	0.3%

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

			total	clupeid	clupeid	sprat					sprat
			catch	catch	portion	catch	count	range (cm)			(%
Haul	Rect.	Stat.	(kg)	(kg)	(%)	(kg)	(n)	min	max	mean	clups)
1	40F6	397	2.8	0.8	28%	0.7	53	10.3	11.8	11.2	84.3%
2	41F5	399	40.6	39.4	97%	1.4	153	8.8	12.3	10.5	3.6%
3	41F5	402	105.0	100.6	96%	23.2	1646	10.3	14.3	12.0	23.1%
4	40F5	403	38.9	31.1	80%	4.0	253	11.3	15.3	12.6	12.9%
5	40F6	405	59.7	57.1	96%	29.5	2749	10.3	12.3	11.3	51.6%
6	40F6	406	611.4	603.9	99%	600.7	64816	8.8	12.3	10.5	99.5%
9	39F6	411	476.9	473.5	99%	469.7	55640	8.3	12.3	10.5	99.2%
12	39F2	417	10.3	10.3	99%	10.3	682	11.8	13.8	12.4	100.0%
13	38F4	421	80.5	77.9	97%	77.2	7293	10.3	13.8	11.5	99.2%
15	39F6	426	549.6	548.8	100%	546.9	89110	7.8	13.8	9.5	99.7%
18	38F6	432	44.2	43.4	98%	42.3	4490	9.3	13.3	11.0	97.4%
19	38F5	434	257.8	254.7	99%	254.0	29746	8.8	12.3	10.6	99.7%
20	38F5	435	290.2	289.1	100%	288.4	30325	9.8	12.8	11.1	99.8%
21	37F3	438	5.6	5.2	93%	5.2	536	9.8	13.3	11.3	100.0%
22	37F3	439	42.2	41.3	98%	41.3	4060	10.3	13.8	11.4	100.0%
23	37F2	441	117.0	114.8	98%	114.7	12205	10.3	12.8	11.2	99.9%
25	35F2	446	275.6	274.3	100%	274.3	23015	4.8	14.3	11.9	100.0%
26	34F2	447	42.4	38.1	90%	33.9	8656	7.3	10.3	8.3	88.9%
27	33F2	448	49.7	39.3	79%	34.1	10123	5.3	13.8	7.7	86.6%
28	33F1	450	119.9	103.0	86%	101.8	15483	5.8	13.3	9.7	98.8%
29	33F2	451	59.0	55.8	95%	55.8	3317	9.3	14.8	13.1	100.0%
30	34F2	454	393.2	392.6	100%	392.6	40844	9.8	13.8	11.0	100.0%
31	35F2	456	34.4	32.7	95%	31.7	5023	8.3	12.8	9.8	96.9%
32	36F3	459	353.0	351.7	100%	351.6	39413	8.8	13.3	11.1	100.0%
33	34F3	463	546.0	545.0	100%	545.0	48932	9.3	13.8	11.6	100.0%
34	33F4	467	360.8	353.0	98%	304.9	19070	9.3	14.3	12.6	86.4%
38	35F4	473	111.8	111.6	100%	111.2	7221	11.3	14.8	12.7	99.6%
40	36F4	475	3049.7	3024.6	99%	3024.0	283875	8.3	13.8	11.2	100.0%
41	37F4	478	197.9	197.4	100%	193.6	31330	7.8	12.8	9.5	98.1%
42	37F4	480	160.0	156.6	98%	155.8	24420	7.8	12.3	9.7	99.5%
43	36F4	483	428.1	426.4	100%	425.8	47164	9.8	12.3	10.7	99.9%
44	36F5	485	560.8	557.4	99%	557.1	45577	9.3	14.3	11.8	100.0%
47	36F7	491	53.5	51.7	96%	0.1	8	12.3	13.8	13.1	0.3%
48	36F7	492	732.1	732.1	100%	706.3	74385	9.8	11.8	10.7	96.5%
49	37F8	494	920.9	916.2	99%	904.5	166856	7.8	10.8	9.2	98.7%
50	37F6	496	839.1	820.4	98%	817.5	68975	10.3	14.3	11.6	99.6%
51	37F5	499	607.7	596.5	98%	596.4	62928	8.3	13.3	10.9	100.0%
52	37F5	501	31.0	25.4	82%	25.4	2121	8.8	13.8	11.8	100.0%
53	38F6	507	6.6	1.3	20%	1.3	113	9.8	13.3	11.5	100.0%

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

			total	clupeid	clupeid	anchovies					anchovies
			catch	catch	portion	catch	count	range (cm)			(%
Haul	Rect.	Stat.	(kg)	(kg)	(%)	(kg)	(n)	min	max	mean	clups)
5	40F6	405	59.7	57.1	96%	0.03	1	15.8	15.8	15.8	0.05%
9	39F6	411	476.9	473.5	99%	0.04	2	16.3	16.3	16.3	0.01%
26	34F2	447	42.4	38.1	90%	0.03	4	9.8	11.8	10.6	0.08%
34	33F4	467	360.8	353.0	98%	1.01	41	13.3	17.3	15.8	0.29%
35	34F4	470	67.3	63.8	95%	5.34	168	14.8	20.3	16.7	8.37%
36	34F4	471	28.2	7.1	25%	4.86	169	12.8	19.3	16.3	68.65%
37	35F4	472	0.6	0.1	14%	0.08	2	16.8	20.3	18.5	100.00%
38	35F4	473	111.8	111.6	100%	0.44	14	15.8	19.8	16.8	0.40%
40	36F4	475	3049.7	3024.6	99%	0.08	3	16.3	16.3	16.3	0.00%
44	36F5	485	560.8	557.4	99%	0.06	2	15.3	16.3	15.8	0.01%
45	36F6	488	9.1	8.1	89%	8.08	259	14.8	19.8	16.5	100.00%
47	36F7	491	53.5	51.7	96%	51.44	2058	14.3	18.8	15.6	99.58%
48	36F7	492	732.1	732.1	100%	25.48	1047	13.3	17.3	15.6	3.48%
49	37F8	494	920.9	916.2	99%	0.38	24	11.8	16.3	14.3	0.04%
50	37F6	496	839.1	820.4	98%	0.16	5	17.3	17.3	17.3	0.02%
54	38F7	511	14.7	2.1	14%	2.09	69	15.3	18.3	16.5	100.00%
55	38F7	512	591.3	582.1	98%	582.00	20934	14.8	19.3	16.2	99.98%

Tab.2d: Numbers, weights and mean lengths of **pilchard** (*Sardina pilchardus*) and according proportion of total clupeid catch (normalized to 30 minutes tow duration)

			total	clupeid	clupeid	pilchard					pilchard
			catch	catch	portion	catch	count	range (cm)			(%
Haul	Rect.	Stat.	(kg)	(kg)	(%)	(kg)	(n)	min	max	mean	clups)
34	33F4	467	360.8	353.0	98%	20.3	152	19.8	26.8	24.6	5.74%
35	34F4	470	67.3	63.8	95%	58.4	905	15.8	27.3	19.4	91.63%
36	34F4	471	28.2	7.1	25%	2.2	53	14.8	24.8	17.2	31.35%
47	36F7	491	53.5	51.7	96%	0.1	4	12.8	15.8	13.9	0.17%
50	37F6	496	839.1	820.4	98%	0.1	5	13.3	13.3	13.3	0.01%
51	37F5	499	607.7	596.5	98%	0.1	3	15.8	15.8	15.8	0.02%
55	38F7	512	591.3	582.1	98%	0.1	5	14.3	16.3	15.3	0.02%