Institute of Sea Fisheries

THÜNEN

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Cruise report
FRV „Solea“ Cruise 675
27.06. - 17.07.2013

Scientist in charge: Dr. M. Schaber

Hydroacoustic survey for the assessment of small pelagics in the North Sea (HERAS Herring 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° N. The main focus was set on herring (*Clupea harengus*), whereas the evaluation of sprat (*Sprattus sprattus*) stocks was another objective of the survey.

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Due to mostly very favorable weather conditions, the whole survey area, i.e. all transects could be covered as originally planned. Altogether, 1875 nm of hydroacoustic transects were sampled.

Recording of hydroacoustic data usually took place between 06:00 and 20:00 (6 am to 8 pm) with an occasional extension of the daily sampling to ca. 21:00 (9 pm) according to survey progress.

To allocate biological information to echorecordings and for the collection of biological samples, altogether 35 fishery hauls were conducted. Generally, sprat showed the highest presence in fishery hauls and also contributed the bulk biomass to total catch weight, followed by herring. Altogether, the total number of fish species caught was lower than in the previous year (17 and 24 respectively).
Hydrography profiles were measured with a vertically deployed CTD probe on 80 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

Due to unfavorable weather conditions at the start of the survey, FRV „Solea“ left Cuxhaven port in the evening of June 27th and steamed towards Helgoland, where calibration of the hydroacoustic equipment was planned for the next day. However, prevailing weather conditions did not facilitate calibration, so on the next day “Solea” continued the passage to the northeasterly starting point of hydroacoustic transects near Esbjerg, where recording of hydroacoustic data commenced on June 28th. Due to still bad weather, the survey progress was hampered due to interruptions (excessive surface turbulence) and an unscheduled journey to Esbjerg harbor for an exchange of a member of the scientific crew. Afterwards, in increasingly better weather conditions, survey work commenced as planned and large progress was made. During the survey, a calibration of the hydroacoustic equipment took place twice (during regular survey work in the evening after daily measurements and again after accomplishment of survey). On July 15th, the survey was completed near the Elbe river mouth in the inner German Bight and “Solea” steamed to Helgoland Island for another calibration of the scientific echosounder (see above). On the morning of July 16th, FRV “Solea” entered Cuxhaven port after covering 1875 nm of hydroacoustic transects.

3.2 Hydroacoustics

3.2.1 Calibration

Both transducers (38 kHz and 120 kHz) could not be calibrated prior to the beginning of the survey due to unfavorable weather conditions. However, during the survey the weather improved significantly. On the evening of July 7th, the 38 kHz transducer could be calibrated with the vessel drifting, which yielded very good calibration results. However, as tidal currents strongly increased, calibration of the 120 kHz transducer was unsuccessful and had to be aborted. After the end of regular survey work, another calibration was conducted near Helgoland island, again with the vessel drifting. Then, both 38 and 120 kHz transducers were calibrated with very good (38 kHz) and good (120 kHz) results respectively. Resulting transducer parameters were applied for post-processing of hydroacoustic 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 Myriax´ EchoView 5.3 software. Transducer settings applied were in accordance with the specifications provided in ICES (2012). 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. Thus, echo recording was generally only accomplished during daytime between 6 am and 8 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 is depicted in Fig. 1. The survey effort per ICES rectangle as allocated to each participating research vessel had been provided by the planning group prior to the survey and was accomplished as planned.

An identification of echo signals was achieved by targeted fishery hauls. Altogether, the fish schools and the corresponding echoes were not distributed evenly in the survey areas. As in previous years, the highest NASC values (Nautical Area Backscattering Coefficients i. e. echo signals) were recorded in coastal areas of the German Bight and around Helgoland Island (Fig. 1). Unlike in the previous year, high NASC values were also measured in the northeastern part of the survey area. These echoes were mostly allocated to herring, whereas the signals recorded in more southwesterly regions near the UK coast mostly originated from sprat schools. In other regions, for example the offshore parts of the northern transects, almost no echoes originating from clupeids were recorded.

3.3 Biological sampling (N. Rohlf)

Altogether, 35 fishery hauls were conducted with a PSN 388 “Krake” pelagic trawl. Trawl duration varied between 10 and 60 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. 2. Altogether, fisheries operations were conducted in 23 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, sardine), 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, 17 different fish species were caught during the survey. A detailed overview on catch composition (CPUE in kg $30min^{-1}$) of all 35 trawl hauls conducted is given in Tab. 1. As in the previous years, sprat showed the highest presence (27 out of 35 hauls) and contributed the bulk of biomass of total catch weight (4.8 t, i. e. 57 %). Herring were caught in 25 out of 35 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 and sprat sampled is given in Tab. 2, together with their proportion of the total catch. Figures 3 and 4 show length distributions of both species as derived from total catches. Herring lengths ranged from 4 to 24 cm. As in previous years, the distribution was dominated by young herring around 8 to 9.5 cm. A second peak was found around 11 cm with also many herring in length class 15 cm or larger. Sprat lengths ranged from 4 to 14.5 cm. In rectangle 35F4, 67 kg of sardines were caught during one single haul. These fishes were relatively large, ranging from 21 to 27 cm (Fig. 5).

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. 2). CTD casts were either conducted after a trawl haul or in regular intervals along the cruisetrack. Surface temperatures ranged from 11 °C at the westernmost part of the survey area near the UK coast to 16.5 °C in the inner German Bight close to the Elbe river mouth. Surface Salinity ranged from 26.6 psu near the Elbe river mouth to 34.9 psu in the Dogger Bank area (Fig. 6). While all layers were generally well mixed in the southern part of the survey area, a distinct thermocline in ca. 25 m depth separating comparatively warm surface (13 °C) from cold (7 °C) bottom layers was evident in the northern part (Fig. 7)

5. Survey participants

Dr. Matthias Schaber (Cruise leader)	Hydroacoustics	SF
Michael Sasse	Hydroacoustics	SF
Dr. Norbert Rohlf	Biology	SF
Gitta Hemken	Biology	SF
Linda Olmos-Pino	Student assistant	SF
Karin Luzia Hipp	Student volunteer	-

6. References

ICES (2012) Report of the Working Group of International Pelagic Surveys (WGIPS). Annex VII: Manual for International Pelagic Surveys Version 1.01. ICES CM 2012 / SSGESST: 22

7. Acknowledgements

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

Hamburg, 24.07.2013
(Dr. M. Schaber, Scientist in charge)

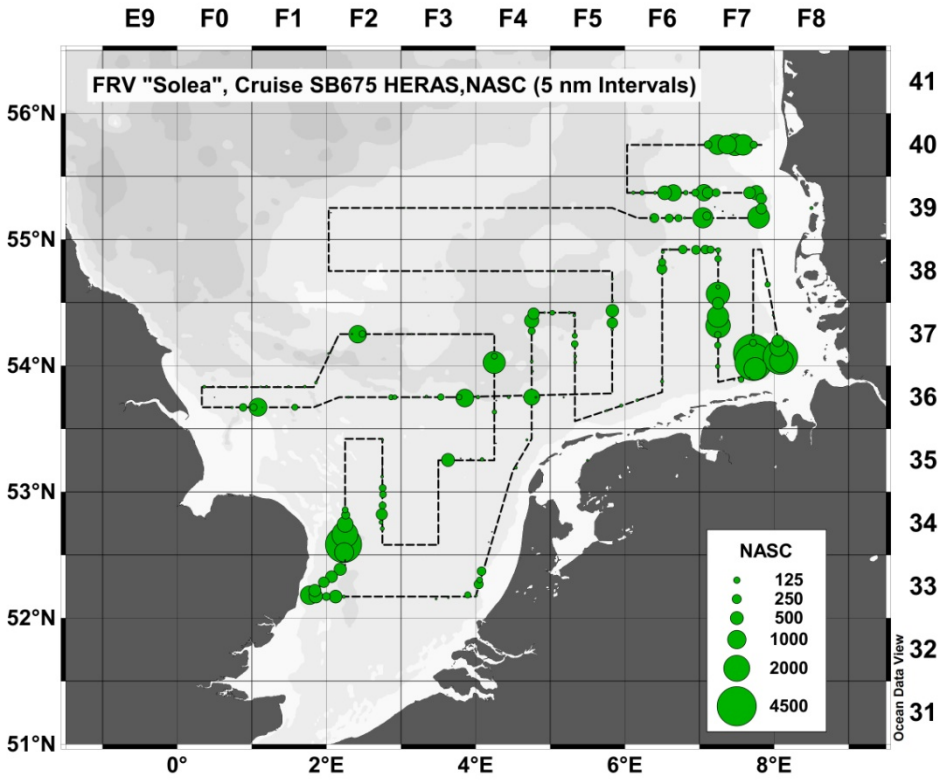

Fig. 1: HERAS Herring Acoustic Survey 2013. Cruisetrack (dashed line) and NASC (5nm intervals) of FRV "Solea" cruise 675. ICES statistical rectangles are indicated in the top and right axis.

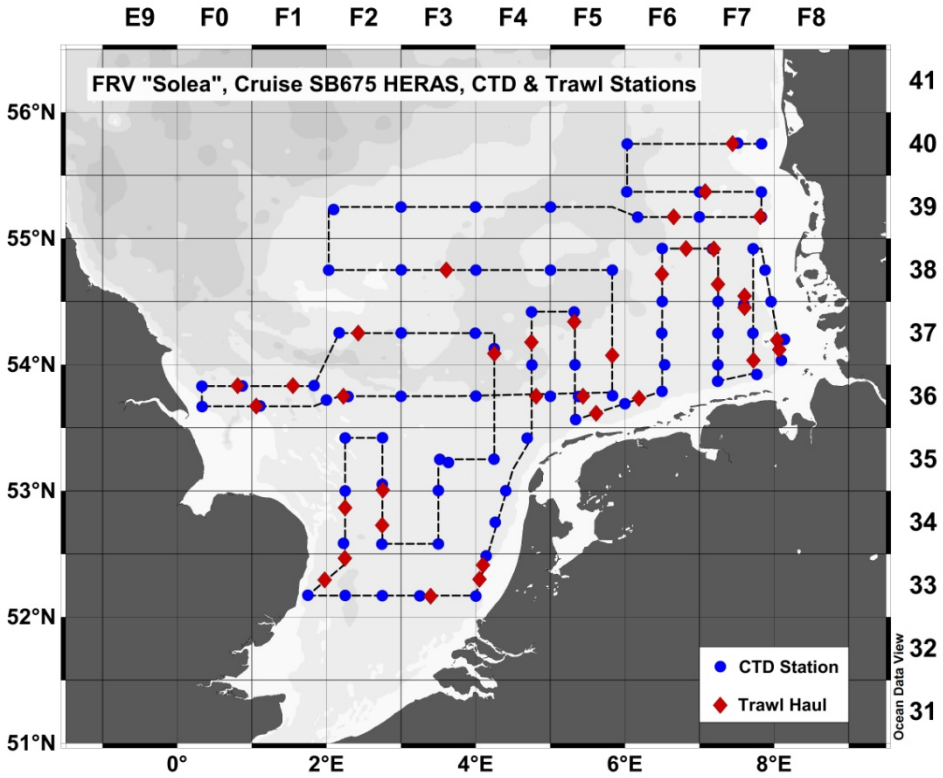

Fig. 2: HERAS Herring Acoustic Survey 2013. Cruisetrack (dashed line)as well as CTD and trawl haul stations of FRV "Solea" cruise 675. ICES statistical rectangles are indicated in the top and right axis.

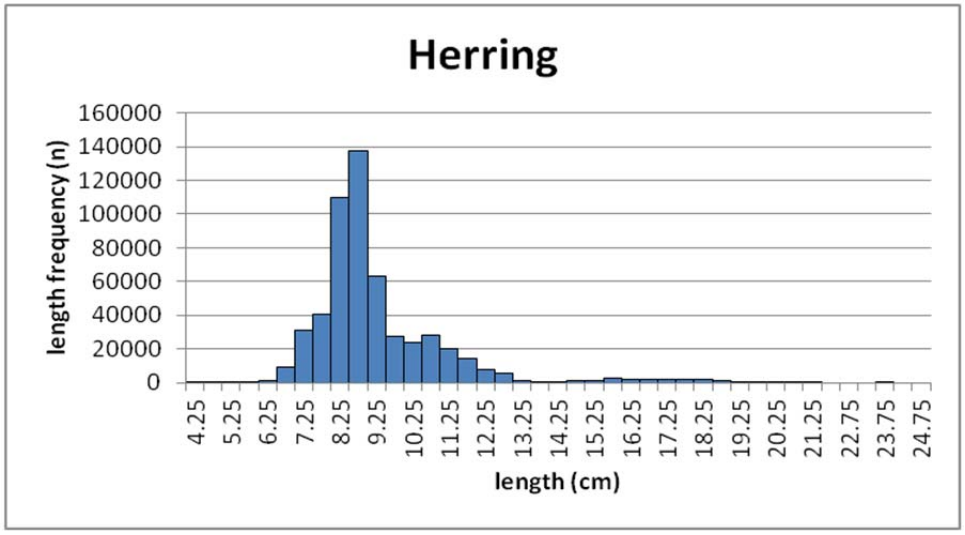

Fig. 3: Herring (*Clupea harengus*) length-frequency distribution FRV "Solea" cruise 675.

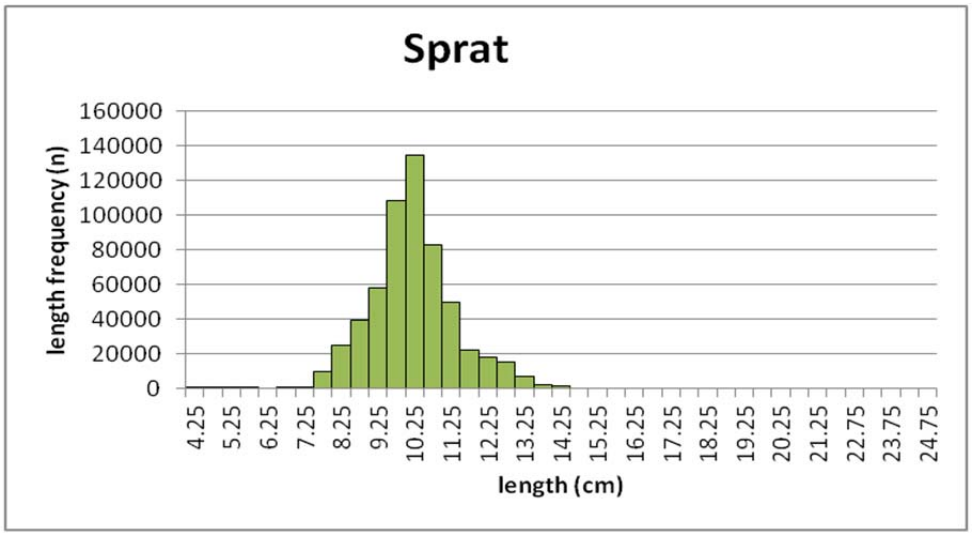

Fig. 4: Sprat (*Sprattus sprattus*) length-frequency distribution FRV "Solea" cruise 675.

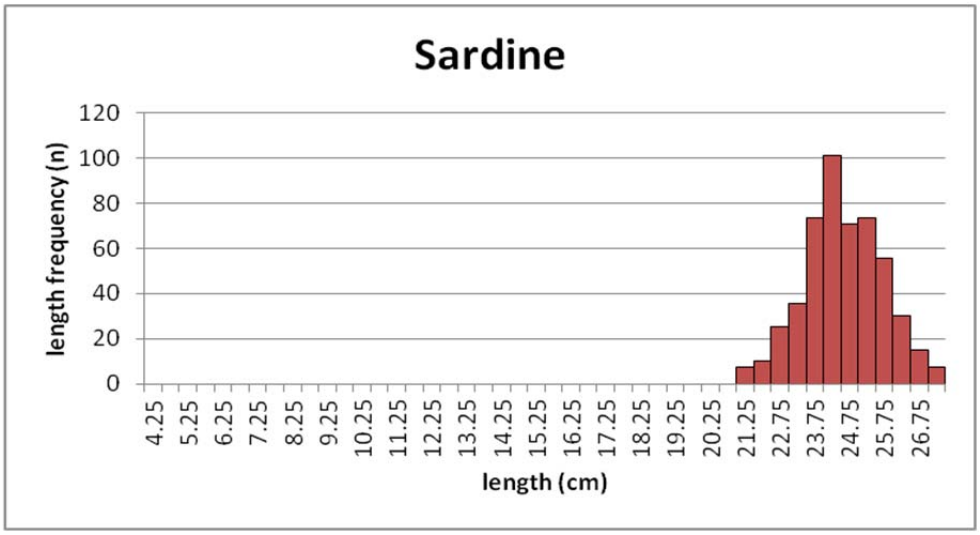

Fig. 5: Sardine (*Sardina pilchardus*) length-frequency distribution FRV "Solea" cruise 675.

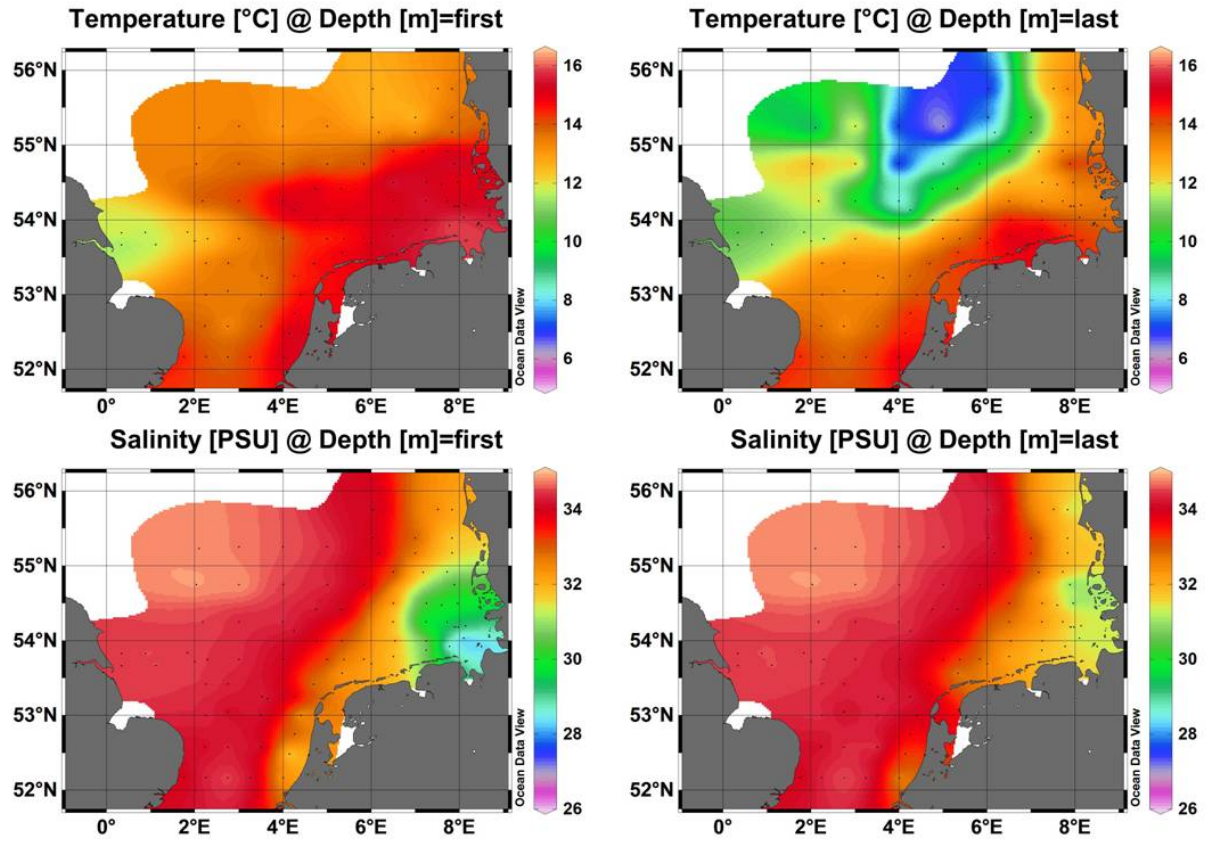

Fig. 6: Hydrography in the survey area of FRV "Solea" cruise 675. Temperature (°C) near surface (top panel, left) and at seafloor (top panel, right) and salinity (PSU) near surface (lower panel, left) and at seafloor (lower panel, right).

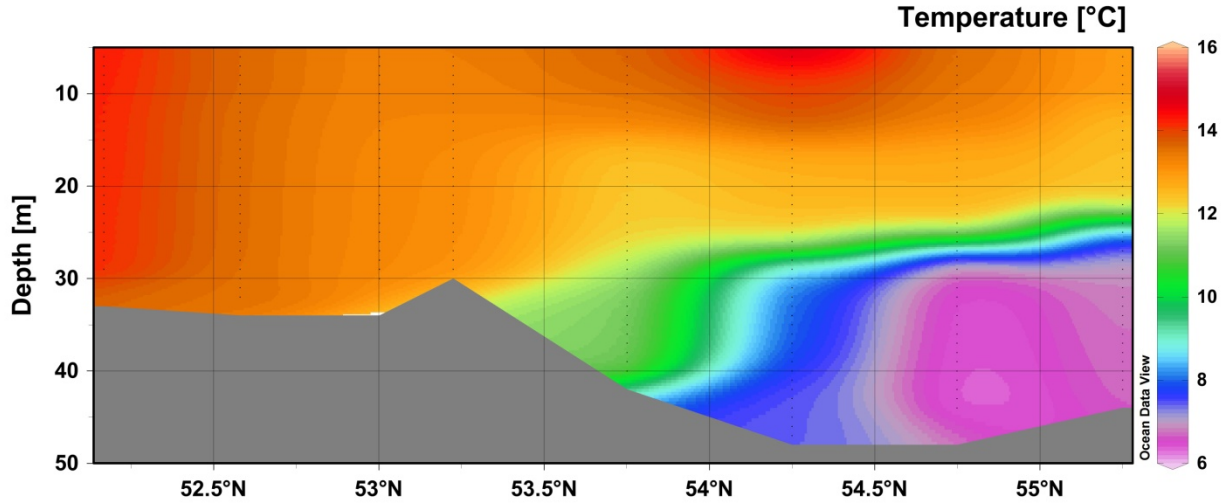

Fig. 7: Hydrography in the survey area of FRV "Solea" cruise 675. Latitudinal section along ~ 005° E showing distinct thermocline in the northern part of the survey area separating warm surface from cold deep layer.

Tab. 1: Catch composition (CPUE in kg) FRV "Solea" cruise 675 (normalized to 30 minutes trawl duration).

RECTANGLE	STATION	Total (kg)	*AMMODYTES MARINUS*	*AMMODYTES TOBIANUS*	*CALLIONYMUS LYRA*	*CLUPEA HARENGUS*	*ECHIICHTHYS VIPERA*	*EUTRIGLA GURNARDUS*	*HYPEROPLUS LANCEOLATUS*	*LIMANDA LIMANDA*	*MERLANGIUS MERLANGUS*	*PLATICHTHYS FLESUS*	*PLEURONECTES PLATESSA*	*POMATOSCHISTUS MINUTUS*	*SARDINA PILCHARDUS*	*SCOMBER SCOMBRUS*	*SPRATTUS SPRATTUS*	*TRACHURUS TRACHURUS*	*TRIGLA LUCERNA*	Number of species
40F7	691	416.8				415.4		0.0	0.1		0.0						1.2			5
39F7	696	0.7				0.2		0.5			0.0						0.0			4
39F7	699	371.0				249.4			0.0							16.9	104.6			4
39F6	701	7.5				4.9		2.6			0.0						0.0			4
38F3	709	12.9						12.9			0.0									2
37F5	713	4.2				0.0		1.4	0.0		0.0		0.4				2.3			6
36F5	715	29.3						2.2	0.0	0.4	0.0			0.0			0.0	26.7		7
36F4	718	590.8				17.6		0.0	0.0		0.3	0.3	0.7			13.2	557.8	0.6	0.1	10
36F2	721	364.7	0.7		0.0	0.7	0.1	4.1	38.0	0.0	0.7		1.3			1.9	317.0	0.2		12
36F1	724	564.3	0.1			17.8	0.1	0.2	1.0							0.2	544.9			7
36F0	728	0.3					0.1				0.0						0.2			3
36F1	730	0.0	0.0				0.0				0.0									3
37F2	733	250.2				0.1		0.7								0.3	249.0			4
37F4	736	467.2				404.8		0.8			0.5		1.2			21.2	38.6			6
34F2	745	358.8				0.4	0.0	0.0			0.0					0.6	357.8			6
35F2	746	115.6	0.0			0.0	0.0	0.0	2.5		0.0		0.2			1.4	111.3			9
34F2	751	144.8				11.5			0.0								133.3			3
33F2	753	253.9				0.4	0.9		4.3		50.7					0.4	196.9	0.2		7
33F1	754	222.8				3.2	1.9				0.2					0.2	217.4			5
33F3	759	0.0					0.0				0.0									2
33F4	761	108.3				0.1	0.0				0.1				62.9	23.8	20.5	1.0		7
33F4	762	7.2							0.0		0.0					0.2		6.6	0.3	5
37F4	768	156.4				53.8		0.5			0.0						102.1			4
37F5	771	158.5				119.7					0.3					0.1	38.4	0.1		5
36F5	774	8.5	1.6	0.0					0.4		0.1					6.1	0.1	0.2		7
36F6	776	67.4				1.2			2.1	0.1	0.0					23.0	39.0	1.9		7
38F6	781	404.9				156.9		0.4		0.4	0.1						247.1			5
38F6	783	9.7				7.3		2.2			0.0		0.3							4
38F7	784	2.1						1.0			0.0					1.0				3
38F7	786	484.3				123.1		0.3									360.9			3
37F7	792	1009.4				755.8										0.5	253.1			3
37F7	794	32.8		0.0				1.6	0.1	0.0	0.0					31.0				6
38F7	796	51.9						2.0	0.4	0.9	0.0		0.1			47.2		1.3		7
37F8	800	1011.4				633.7			0.3							3.1	374.3			4
37F8	802	709.9				211.0	0.0				0.2					1.7	497.0			5
total (kg)		**8398.4**	2.5	0.1	0.0	3189.0	3.2	33.5	49.4	1.9	53.3	0.3	4.2	0.0	62.9	194.0	4764.8	38.9	0.4	
proportion (%)			0.0	0.0	0.0	38.0	0.0	0.4	0.6	0.0	0.6	0.0	0.1	0.0	0.7	2.3	56.7	0.5	0.0	
number of catches			5	2	1	25	11	20	16	6	28	1	7	1	1	21	27	10	2	
presence (%)			14	6	3	71	31	57	46	17	80	3	20	3	3	60	77	29	6	

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	40F7	691	417	417	100%	415.4	100596	8.25	16.75	8.7	100%
2	39F7	696	1	0	26%	0.2	30	8.75	10.75	10.0	95%
3	39F7	699	371	354	95%	249.4	62921	7.25	10.75	8.6	70%
4	39F6	701	8	5	66%	4.9	150	14.25	19.75	16.5	100%
5	38F3	709	13	0	0%						0%
6	37F5	713	4	2	56%	0.0	1	14.75	14.75	14.8	1%
7	36F5	715	29	0	0%						0%
8	36F4	718	591	575	97%	17.6	5746	4.25	21.25	7.1	3%
9	36F2	721	365	318	87%	0.7	30	8.25	18.75	14.6	0%
10	36F1	724	564	563	100%	17.8	914	12.25	19.25	13.9	3%
11	36F0	728	0	0	64%						0%
12	36F1	730	0	0	0%						0%
13	37F2	733	250	249	100%	0.1	3	17.25	17.25	17.3	0%
14	37F4	736	467	443	95%	404.8	9746	14.75	20.25	17.8	91%
15	34F2	745	359	358	100%	0.4	11	14.75	18.25	16.4	0%
16	35F2	746	116	111	96%	0.0	1	14.25	14.25	14.3	0%
17	34F2	751	145	145	100%	11.5	2534	5.75	13.75	8.6	8%
18	33F2	753	254	197	78%	0.4	15	11.25	19.25	15.0	0%
19	33F1	754	223	221	99%	3.2	439	6.75	13.75	9.7	1%
20	33F3	759	0	0	0%						0%
21	33F4	761	108	84	77%	0.1	3	13.25	16.25	15.3	0%
22	33F4	762	7	0	0%						0%
23	37F4	768	156	156	100%	53.8	1637	8.25	19.25	16.4	34%
24	37F5	771	159	158	100%	119.7	7091	7.75	17.75	13.0	76%
25	36F5	774	8	0	1%						0%
26	36F6	776	67	40	60%	1.2	57	10.25	23.75	13.0	3%
27	38F6	781	405	404	100%	156.9	15926	9.75	17.75	11.1	39%
28	38F6	783	10	7	75%	7.3	231	10.75	19.25	16.4	100%
29	38F7	784	2	0	0%						0%
30	38F7	786	484	484	100%	123.1	12581	6.75	14.75	11.3	25%
31	37F7	792	1009	1009	100%	755.8	185877	7.25	10.25	8.7	75%
32	37F7	794	33	0	0%						0%
33	38F7	796	52	0	0%						0%
34	37F8	800	1011	1008	100%	633.7	66048	9.75	16.75	11.3	63%
35	37F8	802	710	708	100%	211.0	68400	6.25	12.25	7.8	30%

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	40F7	691	417	417	100%	1.2	147	4.25	6.75	5.2	0%
2	39F7	696	1	0	26%	0.0	1	11.25	11.25	11.3	5%
3	39F7	699	371	354	95%	104.6	12124	8.75	12.25	10.3	30%
4	39F6	701	8	5	66%	0.0	3	10.25	11.25	10.6	0%
5	38F3	709	13	0	0%						
6	37F5	713	4	2	56%	2.3	217	8.25	13.25	11.0	99%
7	36F5	715	29	0	0%	0.0	1	10.75	10.75	10.8	100%
8	36F4	718	591	575	97%	557.8	90020	6.75	11.75	9.3	97%
9	36F2	721	365	318	87%	317.0	40227	8.25	13.25	10.3	100%
10	36F1	724	564	563	100%	544.9	58541	9.25	14.25	10.8	97%
11	36F0	728	0	0	64%	0.2	17	9.75	12.25	11.2	100%
12	36F1	730	0	0	0%						
13	37F2	733	250	249	100%	249.0	28698	9.25	13.75	10.5	100%
14	37F4	736	467	443	95%	38.6	3959	7.75	14.25	10.8	9%
15	34F2	745	359	358	100%	357.8	26568	8.75	14.25	12.1	100%
16	35F2	746	116	111	96%	111.3	9094	10.25	14.25	12.1	100%
17	34F2	751	145	145	100%	133.3	18002	6.75	13.75	10.1	92%
18	33F2	753	254	197	78%	196.9	16606	7.75	14.25	11.7	100%
19	33F1	754	223	221	99%	217.4	43051	7.25	10.75	8.8	99%
20	33F3	759	0	0	0%						
21	33F4	761	108	84	77%	20.5	1397	10.75	14.25	12.2	25%
22	33F4	762	7	0	0%						
23	37F4	768	156	156	100%	102.1	12279	8.25	13.75	10.2	66%
24	37F5	771	159	158	100%	38.4	3554	8.75	13.25	11.2	24%
25	36F5	774	8	0	1%	0.1	8	9.25	12.25	10.5	100%
26	36F6	776	67	40	60%	39.0	3712	9.75	12.75	11.0	97%
27	38F6	781	405	404	100%	247.1	28574	8.25	14.25	10.2	61%
28	38F6	783	10	7	75%						
29	38F7	784	2	0	0%						
30	38F7	786	484	484	100%	360.9	35421	9.75	13.25	10.9	75%
31	37F7	792	1009	1009	100%	253.1	36981	8.25	10.75	9.8	25%
32	37F7	794	33	0	0%						
33	38F7	796	52	0	0%						
34	37F8	800	1011	1008	100%	374.3	39648	9.25	13.25	10.6	37%
35	37F8	802	710	708	100%	497.0	67692	8.25	11.25	9.9	70%

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

			Total	clupeid	clupeid	Sardine					Sardine
			Catch	catch	portion	Catch	count	range (cm)			(%
Haul	Rect.	Stat.	(kg)	(kg)	(%)	(kg)	(n)	min	Max	Mean	clups)
21	33F4	761	108	84	77%	62.9	505	21.25	27.25	24.57	75%