Preliminary

Acoustic Herring Survey report for RV "DANA"

25th June – 8th July 2014

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Cruise summary

Total days	14
Days of monitoring	12
Number of acoustic samples, ESDU monitored	1763
Number of trawl hauls	39
Number of CTD stations	40
Number of WP2 stations	20
Fish catch in kg	19610
Number of measured herring	16243
Number of measured mackerel	2162
Number of measured sprat	1431
Number of herring frozen for age and race-split	3296
Number of sprat frozen for age and race-split	463

1. INTRODUCTION

Since 1991 the DTU National Institute of Aquatic Resources (DTU AQUA) has participated in the ICES co-ordinated herring acoustic survey of the North Sea and adjacent waters with the responsibility for the surveying the Skagerrak and Kattegat area.

The actual 2014-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period June 27 June to July 8 2014, while calibration was done during June 25 to June 27 2014.

2. SURVEY

2.1 Personnel

During calibration 25/6– 27/6 2014
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Eik Ehlert Britsch
Christian Petersen
Thomas Thomsen
Anna K. Miesner
Alondra S. Rodriguez B.

During acoustic monitoring 27/6 - 8/7-2014
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Annegrete D. Hansen
Susanne Hansen
René Nyholm Erlandsen
Reinhard Jensen
Denns Ulrik Andersen
Anna K. Miesner
Alondra S. Rodriguez B

2.2 Narrative

The survey of R/V Dana started on June 24th at 19.00 UTC with departure from Copenhagen heading towards Bornö in Gullmar Fjord, Sweden for calibration of the acoustic equipment. The vessel was anchored at Bornö in the Gullmar Fjord, Sweden June 25th at 12.00 UTC. The calibration was initiated in the afternoon of June 25th and continued until the morning of June 27th.

At June 27th noon the scientific crew was exchanged outside the harbour of Skagen. After the short break, R/V Dana steamed northwest towards the border between Skagerrak and the North Sea. The acoustic integration was initiated on June 27th at 20.03 UTC at 57º49.5'N, 007º44.7'E with a CTD-station followed by integration for the north-western corner of the survey area.

The North Sea and western Skagerrak area was covered during the period June 27 – July 1, eastern Skagerrak during July 1-5 and Kattegat during July 5-8.

The acoustic integration was ended July 8 at 57º 23'N, 10º 44'E at 06.04 UTC as the termination of the towed body brook. The towed body was recovered.

R/V Dana arrived at Hirthals at 1130 UTC on July 8.

Totally the survey covered about 1763 nautical miles. Data from the 38 kHz echosounder were recorded mainly using a 38 kHz paravane transducer running at depths of 3 – 5 m, the depth depending on the sea state and sailing direction relative to the waves. Simultaneously, data from the 120 kHz and 18 kHz echosounders using hull-mounted transducers were also recorded. The quality of the latter data is strongly dependent on the weather conditions, but this year the weather was calm, so no data had to be excluded due to the weather. During trawling hull-mounted transducers were used for all three frequencies.

2.3 Survey design

The survey was carried out in the Kattegat and Skagerrak area, east of 6° E and north of 56° N (Fig. 1). The area is split into 8 sub-areas.

In principal the survey is designed with parallel survey tracks at right angles to the depth lines with a spacing of 10-15 nm in the area west of 10°E. Due to limitations regarding available time periods and places for fishing (late morning, early afternoon and immediately before and after midnight;

and a limited amount of fishable positions for bottom trawl hauls) this structure cannot not be kept strictly. Along the Swedish coast the transects are planned as east-west transects with a spacing of 10 nm approximately at right angles to the coastline. In Kattegat the survey track was made in a zigzag pattern adapted to the depth curves and the relatively heavy ship traffic.

2.4 Calibration

The echosounders were calibrated at Bornö in the Gullmar Fjord, Sweden during June 25 - June 27 2014. The calibration was performed according to the procedures established for EK60 with three frequencies (18, 38 and 120 kHz). This was the second calibration of the year, the previous one just before a cruise to the Norwegian Sea in May. The calibration of the paravane split-beam transducer at 38 kHz was done against a 60 mm copper sphere. The calibration of the three hull-mounted split-beam transducers at 18, 38 and 120 kHz were carried out against 63mm, 60 mm and 23 mm copper spheres, respectively. The results were close to those from the previous calibration earlier in May, and for 38 kHz on the towed body close to results from previous years. The calibration and setup data of the EK60 38 kHz used during the survey are shown in Table 1.

As we started to calibrate the 120 kHz echosounder it showed unable to give full power on the transducer and it was not possible to detect the calibration square on the quadrants of the transducer. As it was not possible to identify if the problems was on the GPT or the transducer, a 120 kHz GPT kHz was burred from SLU in Lysekil. The problem continued unchanged after changing to the Swedish GPT and the problem was identified to be in the transducer. After contact with Simrad we received a program for test of the transducer through the GPT. The test showed a failure on quadrant 1 and 4 on the transducer.

2.5 Acoustic data collection

Acoustic data were collected using mainly the Simrad EK60 38 kHz echosounder with the transducer (Type ES 38 7x7 degrees main lobe) in a towed body. The towed body runs at approx. 3 m depth in good weather and down to about 6 -7 m, as needed, depending on the weather conditions, this year mostly at 4 – 5 m. The speed of the vessel during acoustic sampling was 9 – 11 knots. Also EK60 18 kHz and 120 kHz data were collected. They have not been directly used for the survey estimate, but as an aid during judging when distinguishing between fish and plankton. The acoustic data were recorded as raw data on hard disk 24 hours a day also during fishing operations. During trawl hauls the towed body is taken aboard and the EK60 38 kHz echosounder run on the hull transducer, but data taken during fishing periods are not used for the biomass estimate. The sampling unit (ESDU) was one nautical mile (nm). For the purpose of the later judging process, raw data is pre-integrated into 1 m meter samples for each ping. These samples are stored in separate files one for each ESDU. Integration is conducted from 3 m below the transducer to 1 m above the bottom or to max 500 m depth.

2.6 Biological data - fishing trawls

The trawl hauls were carried out during the survey for species identification. Pelagic hauls were carried out using a FOTÖ trawl (16 mm in the codend), while demersal hauls were carried out using an EXPO trawl (16 mm in the codend). Trawling was carried out in the time intervals 1000 to 1600 and 2030 to 0300 UTC , usually two day hauls (pelagic on larger depth and demersal in shallow waters) and two night hauls (mostly surface or midwater). The strategy was to cover most depth

zones within each geographical stratum with trawl hauls. One-hour hauls were used as a standard during the survey.
The total weight of each catch was estimated and the catch sorted into species. Total weight per species and length measurements were made. The clupeid fish were measured to the nearest 0.5 cm total length below, other fish to 1 cm, and the weight to the nearest 0.1g wet weight. From each trawl haul 6 herring (if available) per 0.5 cm length class were collected and frozen for individual determination in land-laboratory of length, weight, age, race (North Sea autumn spawners or Baltic Sea spring spawners) and maturity. Fourier Shape Analyses calibrated to micro-structure formed in the otoliths during the larval period was used for the discrimination of herring race. Maturity was determined according to an 8-stage scale as also used by Scotland.

2.7 Hydrographic data

CTD profiles with a Seabird 911 were made immediately before or after each trawl haul. Salinity and temperature were measured continuously during the cruise at an intake at about 5 m depth. Data is stored together with position and weather data in the vessel's general information system The distribution of CTD stations is similar to trawl hauls and shown in Table 7 and Figure 3.

2.8 Plankton data

During the survey WP2 samples has been taken 2 times a day late evening and noon. Sampling has been conducted from 150 m or 5 m above bottom to surface with a 180 µm netting. The samples have been fractionised in size groups by filters of 2000 µm, 1000 µm and 180 µm. The samples have been dried for 24 hours and frozen for dry weight measurements at shore.
20 WP2 stations have been taken; see Table 8 and Figure 3.

2.9 Data analysis

The raw data is pre-integrated into 1 m samples for each ping and divided into 1 mile datasets and stored on harddisk as files. Scrutiny of the acoustic data is done for a fixed set of layers (3-6 m, 6-10, 10 – 20 and so on) for each mile, using special judging software. The software allows ignoring data from layers and/or intervals with interference from wave- or ship wake-bubbles or rarely with interference from bottom-integration. In areas with heavy abundance of jellyfish or zooplankton, usually krill, manually adjustable thresholds are applied separately to each layer to suppress background echoes.

For each subarea (56E06 – 58E08, C – E in Fig.1) the mean backscattering cross section was estimated for herring, sprat, gadoids and mackerel based on the standardized TS-relationships given in the Manual for Herring Acoustic Surveys in ICES Division III, IV, and IVa (ICES 2000):

$$\text{Herring TS} = 20 \log L - 71.2 \text{ dB}$$
$$\text{Sprat TS} = 20 \log L - 71.2 \text{ dB}$$
$$\text{Gadoids TS} = 20 \log L - 67.5 \text{ dB}$$
$$\text{Mackerel TS} = 20 \log L - 84.9 \text{ dB}$$

where L is the total length in cm. The number of fish per species is assumed to be in proportion to the contribution of the given species in the trawl hauls. Therefore, the relative density of a given

species is estimated by subarea using the species composition in the trawl hauls. The nearest trawl hauls are allocated to subareas with uniform depth strata. The length-race and length-age distributions for herring are assumed to be in accordance with combined length-race and length-age distributions in the allocated trawl hauls.

Length-age and length weight relationships by race for the herring were made based on the age and race analysis made on the frozen samples of single fish after the cruise.

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3. RESULTS & DISCUSSION

3.1 Acoustic data

The total number of acoustic sample units of 1 nm (ESDU's) collected for the stock size calculation is 1763. Cruise line for integration is given in Figure 2. During the survey acoustic data have been prepared for scrutinization at shore.

3.2 Biological data

During the survey in 2014 39 hauls were conducted, 20 surface hauls and 18 bottom hauls. The geographical distribution of hauls and details on the hauls are given in Figure 2 and Table 2. Catches in species is given in Table 3.

Length distributions of herring, mackerel and sprat by haul are given in table 5 to 7.

The total catch for the survey was 19.6 tons. Herring was present in 37 hauls with a total catch of 7.3 tons or 37.4 % of the total catch. Totally 16,243 herring have been measured. Length distributions of herring per haul are given in Table 5.

The total sprat catch was 841 kg or 4.3 % of the total catch. Totally 1,431 sprat have been measured. Length distributions of sprat per haul are given in table 6.

Mackerel were present in 28 hauls with a total catch of 1.6 ton or 8.2 % of the total catch. Totally 42,162 mackerel have been measured. Length distributions of Mackerel per haul are given in table 7.

For the total survey area herring, mackerel and sprat contributed to the total catch by 37%, 8 % and 4 % respectively.

3.3 Biomass estimates

Based on scrutinezed acoustic integration, catch data and race split of herring biomass estimates for herring (spring and autumn spawners) and sprat will be made at shore and reported for the Post Cruise Meeting for International Acoustic Survey in the North Sea, West of Scotland and Malin Shelf in Copenhagen January 2014 and WGIPS, Copenhagen January 2014.

3.4 Student project

During the survey a Special course (5 ECTS) with the title ”Cruise leader course” were conducted. To students were participating working on a special project “Jellyfish Monitoring”. A summary of the project and results are given in Annex 1.

4. General comments and recommendations

The 120 kHz haul mounted transducer is broken and has to be changed during the next docking in September. A change of the 38 kHz transducer is already planned.

The lower net drum broke during the survey and the crew had to change trawl net on the upper net drum 2 times a day. The crew did a nice work without comments, but it has to be secured that both net drums are functional for next survey.

Annex 1

Jellyfish Monitoring

by Alondra S.R. Buelna & Anna K. Miesner

Objectives

The aim of this study is to estimate the abundance, concentrations and species composition of large jellyfish in Kattegat, Skagerrak and North Sea, during the cruise on Dana from 25/6 to 8/7 2014.

Methods

CTD Mounted Camera

A GoPro camera (Hero3) was mounted to the frame of a CTD device facing downward in order to require data on the vertical jellyfish abundance. The water volume sampled was calculated as the product of the area of view and the vertical distance travelled by the CTD times two. Since the camera's case has a limit of 60 m depth, only stations above that depth were used by this method.

TowFish Mounted Camera

A GoPro camera's case was attached to a TowFish (Simrad EK60 38 kHz echosounder) that was towed at an average speed of 10 knots alongside Dana. The towed body was towed at around 5 m depth depending on the wave conditions. The distance travelled by the TowFish was calculated from the average tow speed and the period of time. The area of view multiplied with the distance travelled yielded the water volume sampled, which could then be used to calculate jellyfish concentrations. Whenever jellyfish were encountered, they were counted and the species identified.

Biological and Hydrographic data

The visual observation of jellyfish was complemented by biological and hydrographical information in order to yield a more comprehensive picture on the jellyfish abundance. Biological data was derived from trawl hauls. Jellyfish were separated from fish and consequently identified, counted and weighted. Some intact jellyfish's stomach content were analysed under a stereoscope and their content preserved in alcohol for subsequent species identification. Hydrographical data was acquired by a CTD (Seabird 911). Moreover salinity and temperature were measured continuously during the cruise at an intake at about 5 m depth. Data including position and weather information were stored in the vessel's general information system.

Results & Conclusion

Jellyfish concentration was increasing from the North Sea towards the Kattegat (Table 1). Moreover the concentration of jellyfish was increasing with decreasing distance from the coast. *Cyanea capillata* was the dominant species in the North Sea and in the Skagerrak while *Aurelia aureate* dominated in the Kattegat. Other jellyfish species, such as *Chrysaora hysoscella* and *Cyanea lamarckii* were encountered in very low numbers. Jellyfish were mainly encountered above the maximum level of chlorophyll and within 6 m from the surface (Figure 3, 4 & 5).We observed no correlation between the abundance of jellyfish and the hydrological conditions (salinity, water temperature) nor the bathymetry. The most effective monitoring device was the TowFish

mounted camera, since it allowed us to cover a large volume and clearly identify species and their abundance.

TABLE 1. AVERAGE CONCENTRATION OF JELLYFISH IN THE DIFFERENT SAMPLING REGIONS (SEE FIGURE 1)

Region	Jellyfish per 1000 m^3
North Sea	0.60
Skagerrak	1.01
Kattegat	16.67

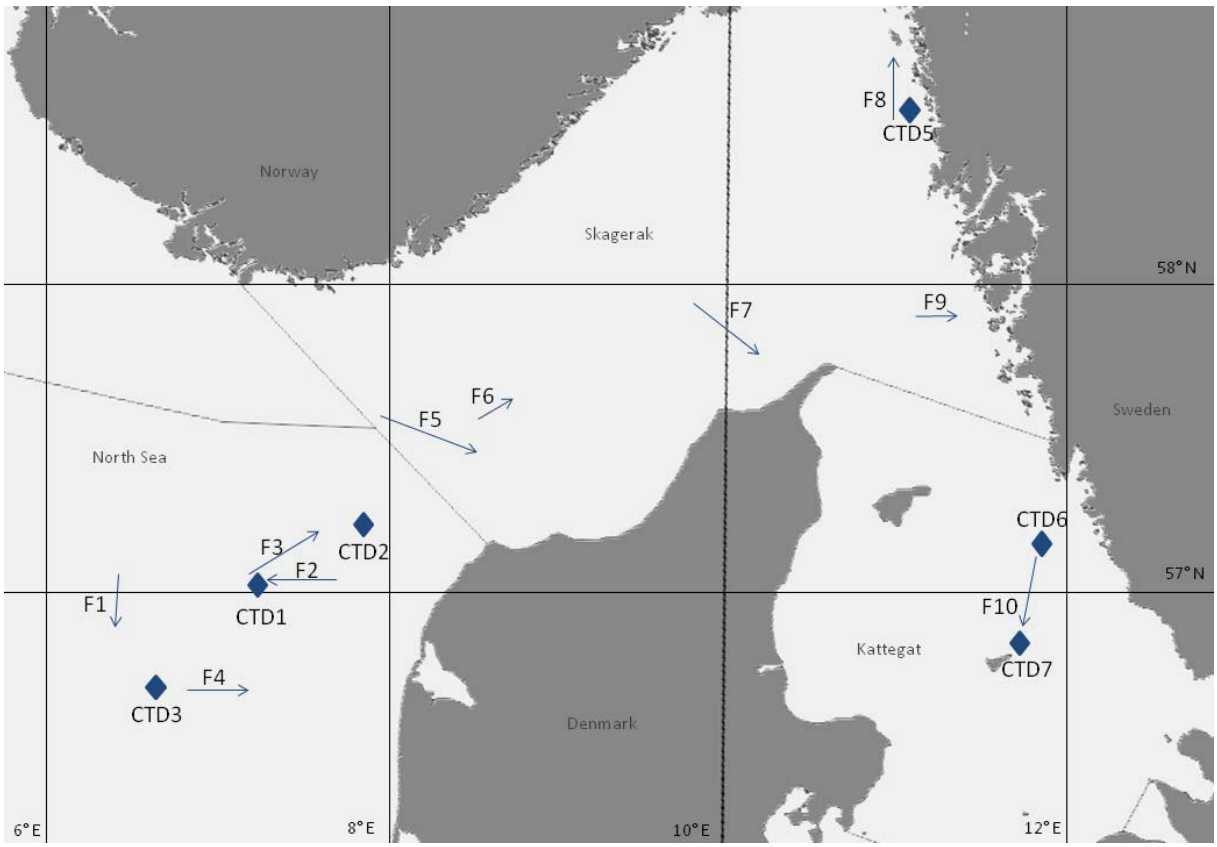

FIGURE 1. MAP OF THE CAMERA MOUNTED TOWFISH (F) AND CTD STATIONS.

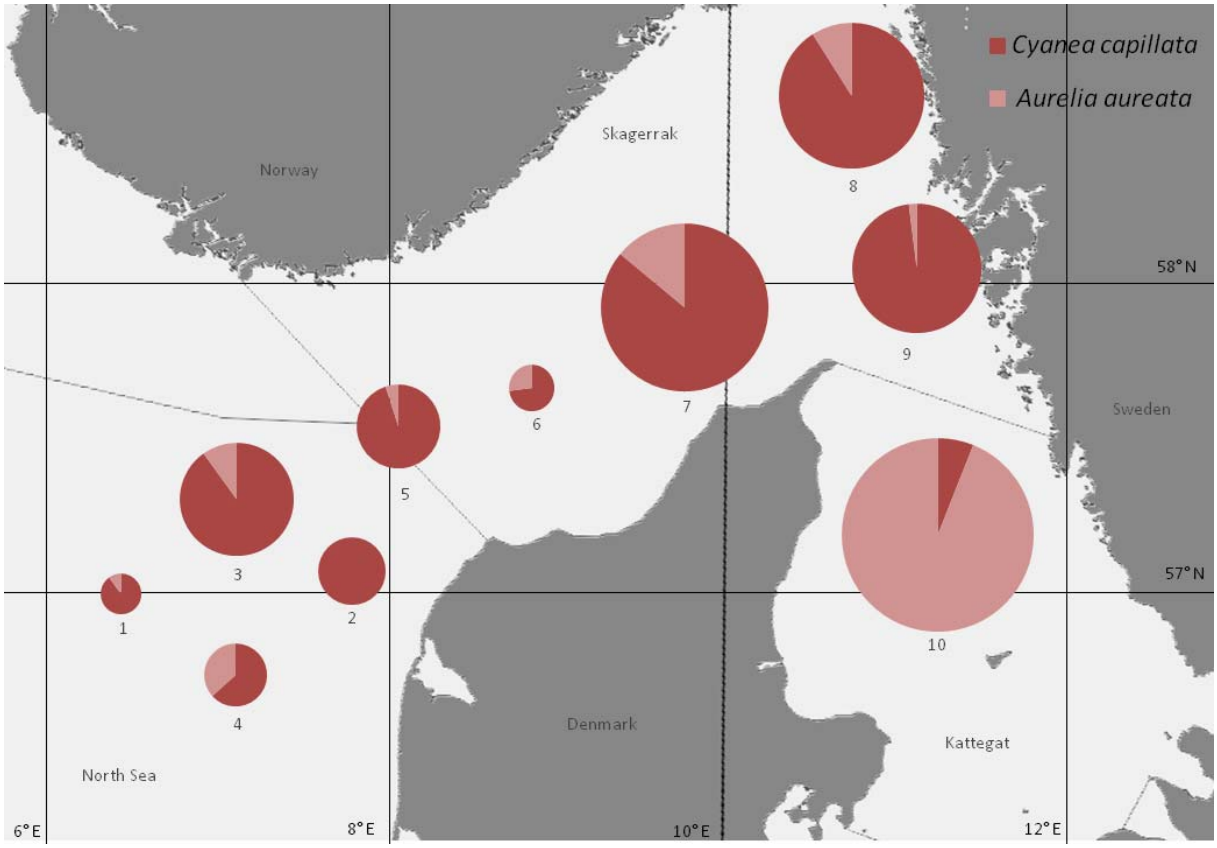

FIGURE 2. PERCENTAGE OF DIFFERENT JELLYFISH SPECIES IN THE DIFFERENT TOWFISH STATIONS

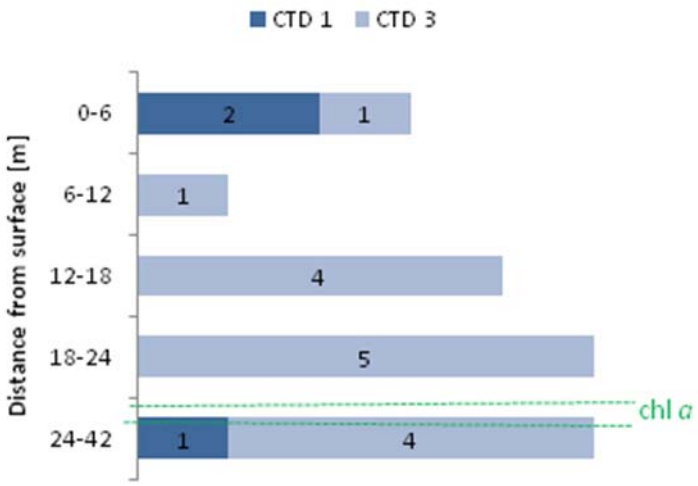

FIGURE 3. ABUNDANCE OF JELLYFISH IN DIFFERENT DEPTHS IN THE NORTH SEA WITH THE AVERAGE CHLOROPHYL MAXIMUM LEVEL.

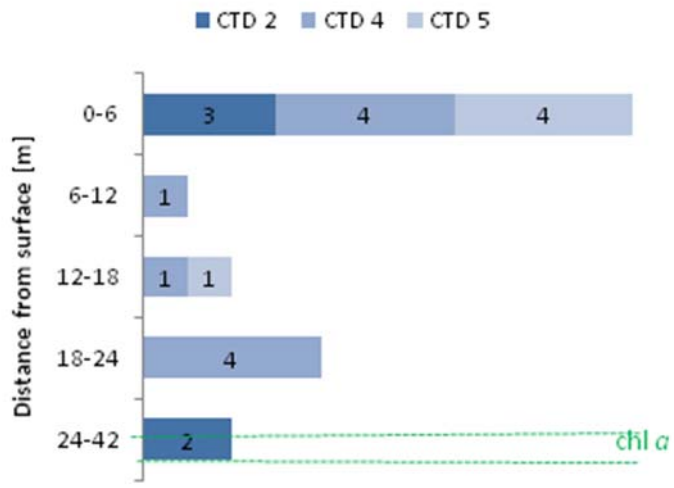

FIGURE 4. ABUNDANCE OF JELLYFISH IN DIFFERENT DEPTHS IN THE SKAGERRAK WITH THE AVERAGE CHLOROPHYL MAXIMUM LEVEL.

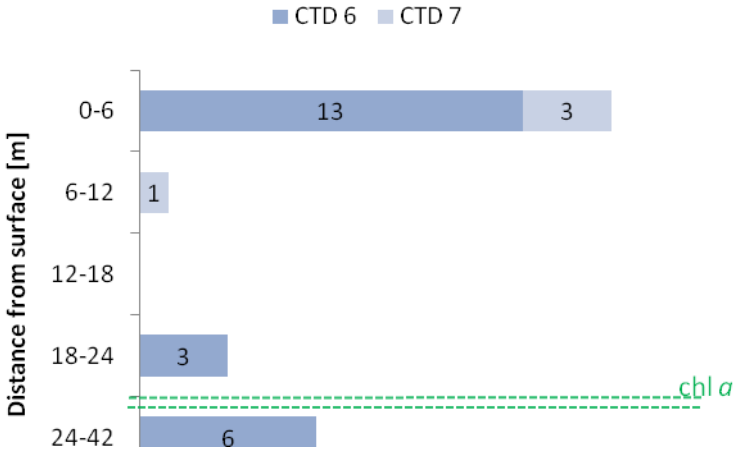

FIGURE 5. ABUNDANCE OF JELLYFISH IN DIFFERENT DEPTHS IN THE KATTEGAT WITH THE AVERAGE CHLOROPHYL MAXIMUM LEVEL.

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in July 2012. The map shows the subareas (strata) used in the abundance estimation.

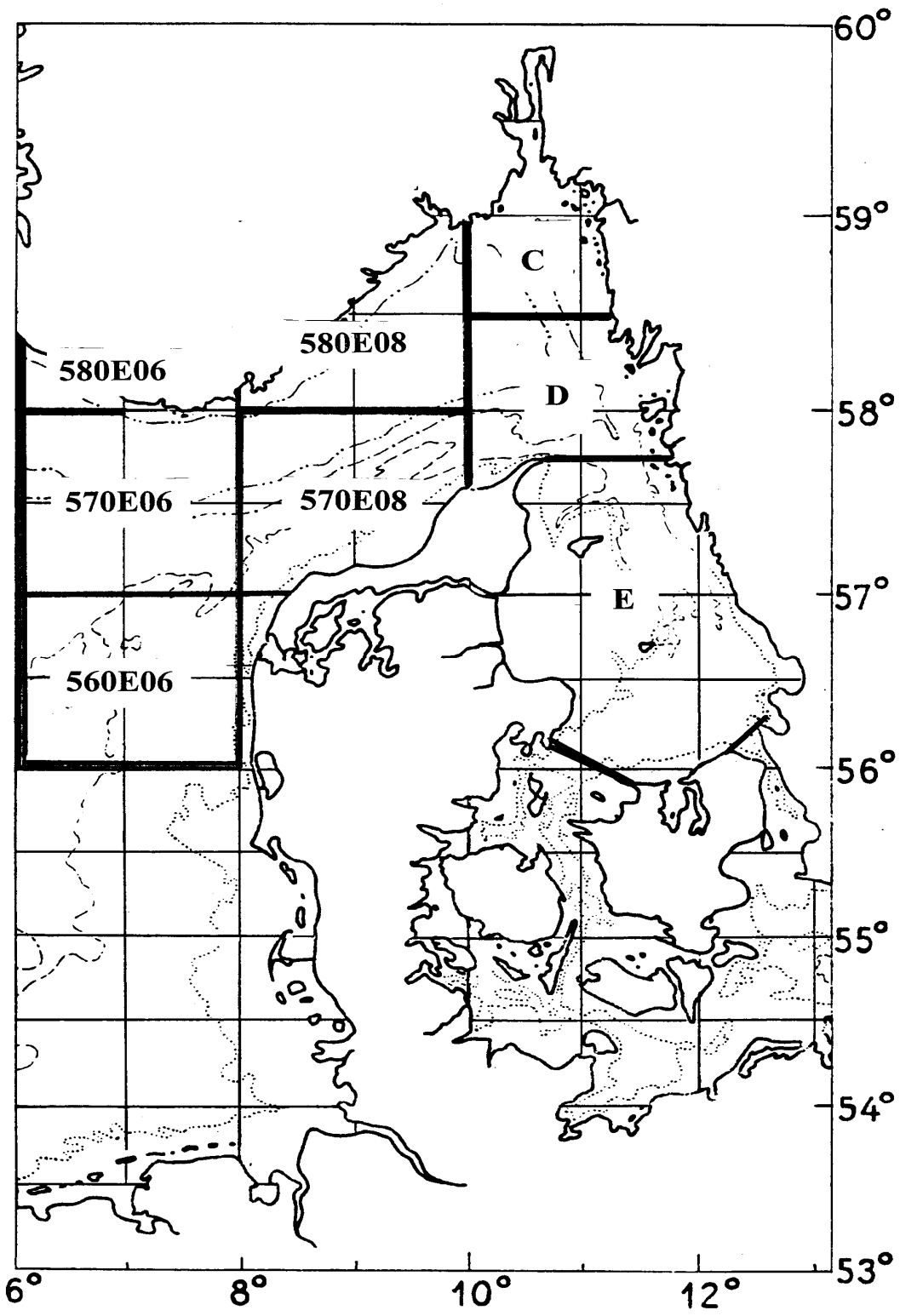

Figure 2. Map showing cruise track and trawl stations during the Danish acoustic survey with R/V Dana in June-July 2014.Black is pelagic hauls and blue is demersal hauls.

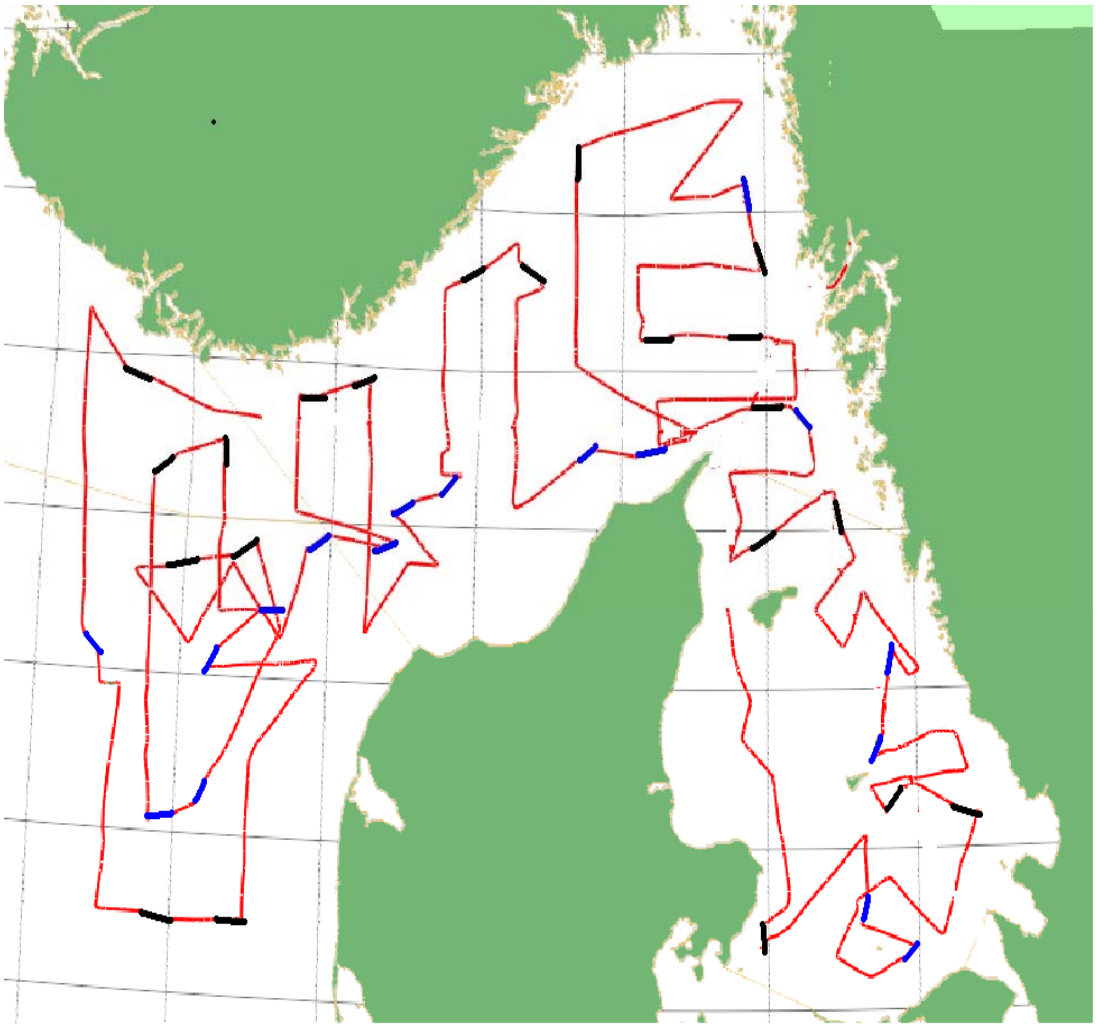

Figure 3. Map showing CTD and WP2 stations during the Danish acoustic survey with R/V Dana in June-July 2014. X are CTD stations and squares are combined CTD and WP2 stations.

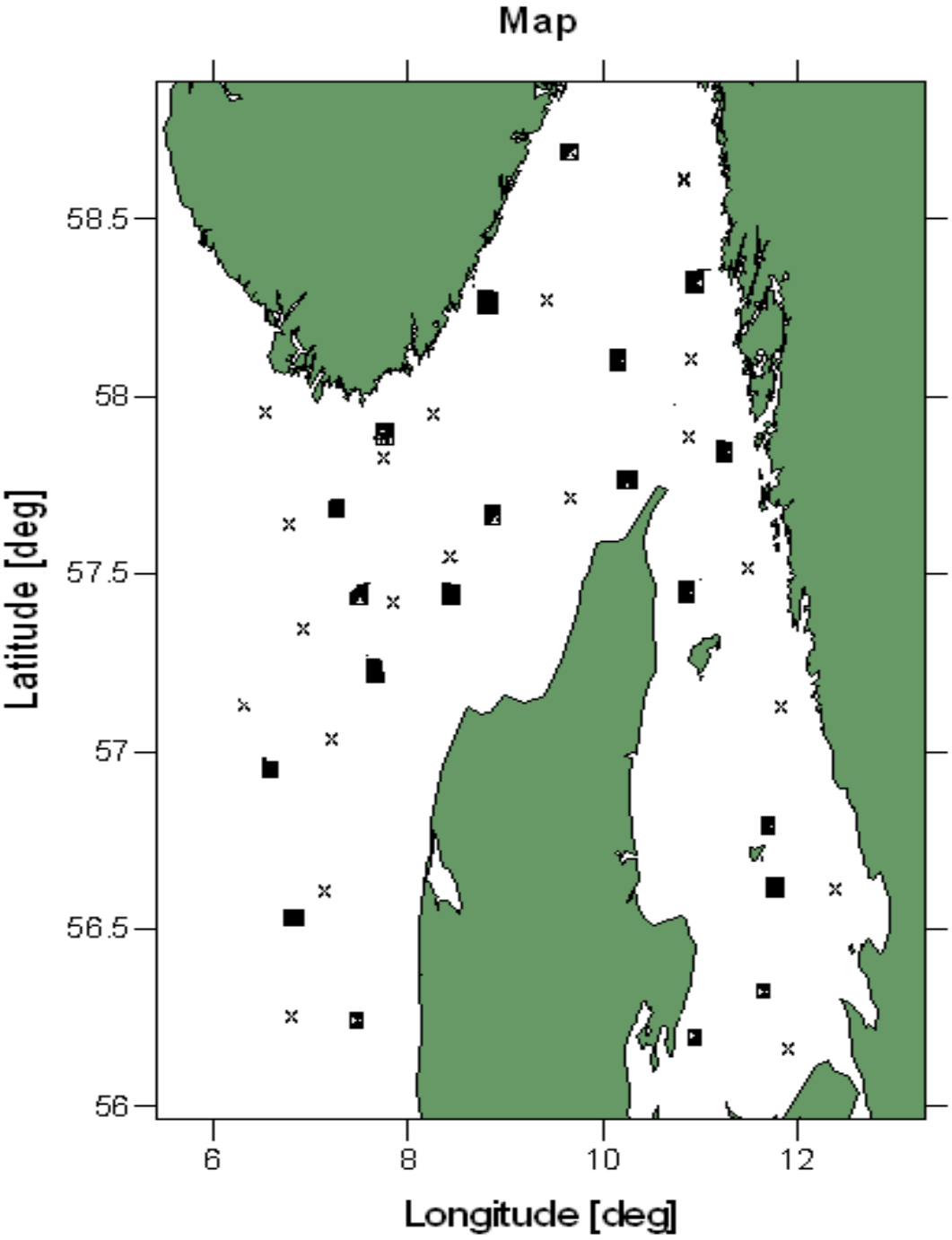

Table 1. . Simrad EK60 and analysis settings used during the Acoustic Herring Survey with R/V Dana Cruise June-July 2014

Transceiver Menu	
Frequency	38 kHz
Sound speed	1508 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Transducer Sv gain	25.40 dB
3 dB Beamwidth	6.9°
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	9.56 m
Measured NASC value for calibration	19300 m^2/nmi^2
Calibration factor for NASCs	1.00
Absorption coeff	6.063 dB/km
Log Menu	
Distance	1,0 n.mi. using GPS-speed
Operation Menu	
Ping interval	1 s external trig
Analysis settings	
Bottom margin (backstep)	1.0 m
Integration start (absolute) depth	7 - 9 m
Range of thresholds used	-70 dB

Table 2. Trawl hauls details for the Danish acoustic survey with R/V Dana in June-July 2014.

Date	Haul	Time	ICES	Position		Trawl	Wire	Trawl	Cath	Mean	Total		Trawling	Trawling	Wind	
						Direction	length	type	depth	depth	catch	Main Species	speed	duratin	speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	deg.	m		m	m	kg		Kn	min,	m/s	
28-06-14	34	00:22	44F6	57.56.050 N	006.40.581 E	293	350	Fotö	Surface	364	222	Herring, jellyfish, mackerel	3.9	60	8.2	2
28-06-14	117	10:53	43F6	57.06.146 N	006 21.028 E	132	350	Expo	Bottom	58	128	Dab, whiting,	3	60	6.5	2
28-06-14	128	13:09	42F6	56.57.648 N	006.29.290 E	69	340	Expo	Bottom	54	221	Cod, haddock	3	60	6.9	2
28-06-14	186	23:13	41F6	56.14.788 N	006.49.877 E	118	300	Fotö	Surface	39	420	Mackerel	3.6	62	7.2	2
29-06-14	202	00:18	41F7	56.14.541 N	007.22.046 E	84	300	Fotö	Surface	31	315	Herring	3.5	60	6.8	2
29-06-14	285	11:01	43F7	57.02.418 N	007.11.805 E	21	260	Expo	Bottom	35	205	Gunard, dab	2.9	60	1.1	2
29-06-14	302	13:54	43F7	57.13.738 N	007.34.278 E	95	320	Expo	Bottom	54	315	Herring	3	60	6.1	2
29-06-14	351	21:22	44F7	57.41.520 N	007.14.896 E	350	300	Fotö	Surface	359	176	Jellyfish, herring, mackerel	3.8	60	13.8	5
30-06-14	367	00:16	44F6	57.41.077 N	006.53.240 E	235	300	Fotö	Surface	300	255	Herring, mackerel, krill	4.1	60	13.1	5
30-06-14	440	10:23	42F6	56.32.905 N	006.50.129 E	80	240	Expo	Bottom	38	1333	Herring, jellyfish	3.4	60	10.1	5
30-06-14	452	13:17	42F7	56.36.834 N	007.09.691 E	21	250	Expo	Bottom	37	223	Jelyfish, gunard	2.9	60	9.9	5
30-06-14	508	21:21	43F7	57.25.701 N	007.29.177 E	249	300	Fotö	Surface	111	675	Herring	3.5	60	11	4
01-07-14	517	00:16	43F6	57.21.766N	007.01.875 E	256	300	Fotö	Surface	90	112	Herring, mackerel	3.1	61	7.8	4
01-07-14	605	11:06	43F7	57.25.772 N	007.52.645 E	52	500	Expo	Bottom	136	385	Herring Norway pout	3.1	60	3.5	4
01-07-14	622	14:02	43F8	57.26.357 N	008.20.330 E	86	350	Expo	Bottom	64	952	Herring	3.2	60	4.3	4
01-07-14	674	21:27	44F7	57.53.996 N	007.46.078 E	84	300	Fotö	Surface	431	249	Mackerel, jellyfish	3.5	60	3.7	2
02-07-14	687	00:16	44F8	57.56.962 N	008.09.652 E	81	300	Fotö	Surface	503	168	Herring , mackerel	2.9	60	4.3	2
02-07-14	777	11:16	44F8	57.33.111 N	008.27.080 E	64	500	Expo	Bottom	102	111	Haddock, Whiting	3.3	60	8.7	2
02-07-14	789	13:35	44F8	57.37.294 N	008.47.381 E	43	440	Expo	Bottom	85	297	Cod, haddock	3.5	60	11.2	2
02-07-14	839	21:05	45F8	58.16.614 N	008.51.377 E	60	300	Fotö	Surface	388	420	Mackerel	3.8	60	13.7	5
03-07-14	858	00:24	45F9	58.19.813 N	009.18.355 E	125	300	Fotö	Surface	572	169	Krill	3.7	60	13.8	5
03-07-14	928	10:40	44F9	57.43.619 N	009.42.181 E	60	250	Expo	Bottom	37	480	Whitting	3.6	60	12.7	5
03-07-14	942	13:21	44G0	57.44.369 N	010.07.230 E	75	430	Expo	Bottom	82	1284	Herring	3.4	60	12.4	5
03-07-14	1020	23:15	46F9	58.37.416 N	009.39.591 E	359	300	Fotö	Surface	425	360	Krill, herring	3.4	60	10	5
04-07-14	1107	11:19	46G0	58.34.946 N	010.50.595 E	183	430	Expo	Bottom	85	615	Jellyfish, herring	3	60	8.7	5
04-07-14	1121	14:00	45G0	58.22.280 N	010.55.930 E	169	350	Fotö	5-10	107	316	Mackerel, jellyfish	3	60	10	5
04-07-14	1170	21:14	45G0	58.05.996 N	010.12.182 E	80	300	Fotö	Surface	139	280	Herring	3.5	60	3.9	3
05-07-14	1187	00:15	45G0	58.06.442 N	010.45.936 E	87	300	Fotö	Surface	197	150	Herring	3.6	60	4.5	3
05-07-14	1273	10:58	44G1	57.53.347 N	010.55.449 E	84	295	Fotö	10	85	27	Jellyfish	4.7	60	7	3
05-07-14	1285	13:21	44G1	57.52.938 N	011.10.988 E	123	370	Expo	Bottom	61	3412	Jellyfish, herring	3	60	8.1	3
05-07-14	1342	20:57	43G1	57.27.487 N	010.54.315 E	58	300	Fotö	Surface	39	995	Herring, sprat	3.7	60	8.7	3
06-07-14	1363	00:22	44G1	57.35.590 N	011.27.368 E	160	300	Fotö	Surface	58	158	Herring, jellyfish, mackerel	4.1	60	6.3	3
06-07-14	1440	10:20	43G1	57.08.071 N	011.50.377 E	188	320	Expo	Bottom	57	445	Herring, jellyfish	3.2	60	4.9	3
06-07-14	1458	13:22	42G1	56.50.870 N	011.44.120 E	172	240	Expo	Bottom	39	1015	Herring, sprat	2.9	60	4.4	3
06-07-14	1518	21:16	42G1	56.38.328 N	011.48.278 E	39	300	Fotö	Surface	38	138	Jellyfish, herring	3.8	60	8.3	3
07-07-14	1535	03:21	42G2	56.37.387 N	012.16.528 E	102	300	Fotö	Surface	37	330	Herring, sprat	3.6	60	6.3	3
07-07-14	1619	10:41	41G1	56.09.578 N	011.53.419 E	44	205	Expo	Bottom	25	434	Jellyfish, invertebrates	3	60	10.5	3
07-07-14	1636	13:41	41G1	56.16.506 N	011.36.809 E	19	230	Expo	Bottom	30	195	Jellyfish, herring	2.9	60	4.9	3
07-07-14	1687	20:49	41G0	56.12.903 N	010.57.391 E	6	300	Expo	Surface	21	1670	Jellyfish, herring	3.2	60	8.6	3

Table 3. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June - July 2014.

Acoustic survey in Skagerrak and Kattegat June-July 2014																									
	Station		34	117	128	186	202	285	302	351	367	440	452	508											
	ICES sq.		44F6	43F6	42F6	41F6	41F7	43F7	43F7	44F7	44F6	42F6	42F7	43F7											
	Gear		Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö											
	Fishing depth		Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface											
	Total depth		364	62	52	37	31	35	55	359	300	38	37	111											
	Day/Night		N	D	D	N	N	D	D	N	N	D	D	N											
% of total	Total catch	Total	221.995	128	221	420	315	205	315	176	255	1333	223	675											
0.00	Anchovy	Engraulis encrasicolus	0.344				0.042																		
0.00	Blue whiting	Micromesistius poutassou	0.294								0.294														
4.29	Sprat	Sprattus sprattus	841.813				0.562			0.218		4.121	0.014												
0.05	Common weaver	Trachinus draco	9.364																						
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.066																						
0.00	Poor-cod	Trisopterus minutus	0.072																						
0.05		Anarhichas lupus	10.165		2.08							6.205													
0.01	Horse mackerel	Trachurus trachurus	1.694							0.336															
0.12	Garfish	Belone belone	23.168	0.646		0.434				9.7	0.474			0.212											
0.29	Long rough dab	Hippoglosides plattessoides	56.007	0.194	0.044			0.3					0.284												
4.28	Whiting	Merlangius merlangus	839.225	0.032	34.3	22.6	0.004	0.006	24.302	9.406	0.05	0.158	45.016	24.804											
0.78	Invertebrates	Invertebrata	152.481		0.678	0.24			1.596	0.92			2.344	1.096											
2.11	Dab	Limanda limanda	414.065		38.8	2.88	0.116	0.316	38	3.082			11.8	24.9											
0.37	Hake	Merluccius merluccius	72.99			13.8								3.8											
0.99	Gurnard	Trigala spp.	193.445		13.2	6.6	27.9	10.8	57.8	7.8			22.3	33.7	0.302										
1.21	Haddock	Melanogrammus aeglefinus	238.01	0.024	1.928	55.9			0.026	0.762		0.036		0.056											
0.00	Pollack	Pollachius pollachius	0																						
8.20	Mackerel	Scomber scombrus	1607.586	142.8		381.951	52.6	5.414		19.8	62.8		0.61	28											
0.42	Saithe	Pollachius virens	81.914		0.106				0.454		7.9														
1.13	Plaice	Pleuronectes platessa	222.174		14.6	2.256		37.3	10.5			4.71	17.1												
0.18	Lemon sole	Microstomus kitt	35.965		1.842	5.372		0.178	0.756			0.228	0.25												
37.43	Herring	Clupea harengus	7339.268	54.246	10.292	0.13	226.674		238.908	44.292	131.1	687.702	16.69	614.656											
0.00	Gray sole	Glyptocephalus cynoglossus	0.346																						
0.51	Norway pout	Trisopterus esmarki	100.173																						
0.42	Lumpsucker	Cyclopterus lumpus	82.218	3.496						9.9	9.4														
31.32	Large Medusa	Scyphozoa sp.	6141.04	3.566		0.816	9.383	21.452	7.714	2.922	91.9	3.872	473.257	91.3	31.83										
0.08	Greater sandeel	Hyperoplus lanceolatus	15.101		0.32	0.276			5.816	2.426			2.611	0.742											
2.76	Cod	Gadus Morhua	541.981		10.1	106.1			8.3	27.5			6.46	7.5											
0.00	Sole	Solea solea	0.328										0.328												
0.03	Pearlside	Mauorolicus muelleri	6.525	0.198						0.002	2.884														
2.27	Krill	Euphausidae spp.	444.637	7.085							33.754														
0.16	Picked Dogfish	Squalus acanthias	31.37	9.9							2.284														
0.02	Tarry ray	Raja radiata	3.762																						
0.02	Halibut	Hippoglossus hippoglossus	3.152		2.552				0.6																
0.06	Anglerfish	Lophiuspiscatorius	11.56		1.122			9.4																	
0.01	Norway lobster	Nephrops norvegicus	1.12																						
0.01	Flounder	Platichthys flesus	1.512																						
0.00	Hagfish	Myxine glutinosa	0.024																						
0.02	Squids, octopusses	Cephalopoda sp	4.882		0.744	0.194	0.212	1.675	0.594	0.856		0.044	0.186	0.008											
0.00	Solenette	Buglossidium luteum	0.044																						
0.37	Sandeel	Ammodytes marinus	73.343						8.86				64.257	0.2											
0.04	Sculpin	Myoxocephalus scorpius	7.062										0.254												
0.00			0.046										0.046												
100.00			19610.34	221.993	128.12	221.946	420	314.127	196.74	315.752	176.198	255	1331.825	223.054	675										

Table 3. continued.

Acoustic survey in Skagerrak and Kattegat June-July 2014																
		Station		517	605	622	674	687	777	789	839	858	928	942	1020	1107
		ICES sq.		43F6	43F7	43F8	44F7	44F8	44F8	44F8	45F8	45F9	44F9	44G0	46F9	46G0
		Gear		Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Expo
		Fishing depth		Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Bottom
		Total depth		90	136	64	430	503	102	85	388	572	37	82	425	85
		Day/Night		N	D	D	N	N	D	D	N	N	D	D	N	D
% of total		Total catch	Total	112	385	952	249	168	111	297	420	169	460	1284	350	615
0.00	Anchovy	Engraulis encrasicolus	0.344						0.008							
0.00	Blue whiting	Micromesistius poutassou	0.294													
4.29	Sprat	Sprattus sprattus	841.813											65.465		
0.05	Common weaver	Trachinus draco	9.364													
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.066													
0.00	Poor-cod	Trisopterus minutus	0.072											0.072		
0.05		Anarhichas lupus	10.165													
0.01	Horse mackerel	Trachurus trachurus	1.694				0.326	0.66							0.372	
0.12	Garfish	Belone belone	23.168	0.688			0.3	2.43			4.224	1			0.334	
0.29	Long rough dab	Hippoglosides plattessoides	56.007			0.068			0.906	0.328			0.202	43.295		
4.28	Whiting	Merlangius merlangus	839.225		16.1	109.3	0.332	0.418	38.124	12.8	0.18	0.066	325.106	66.439	0.024	2.266
0.78	Invertebrates	Invertebrata	152.481		0.614	0.16			2.612	0.366			7.955	25.868		0.249
2.11	Dab	Limanda limanda	414.065			0.574				1.634			51	208.576		
0.37	Hake	Merluccius merluccius	72.99		5.09				1.636	1.376			7.1	6.8		
0.99	Gurnard	Trigala spp.	193.445	0.372	0.094	3.662							6.825			
1.21	Haddock	Melanogrammus aeglefinus	238.01		1.586	10.854		0.01	40.576	109.21			0.238	14.938	0.006	
0.00	Pollack	Pollachius pollachius	0													
8.20	Mackerel	Scomber scombrus	1607.586	41.6		1.062	156.6	44.6	1.09	10.015	346.4	22.5		0.294	16.4	1.186
0.42	Saithe	Pollachius virens	81.914		40.3	0.872			4				0.768	9.144		
1.13	Plaice	Pleuronectes platessa	222.174		0.888	0.832			1.294				10	115.452		
0.18	Lemon sole	Microstomus kitt	35.965		1.176				0.572	0.106			1.71	23.145		
37.43	Herring	Clupea harengus	7339.268	66.2	216.217	790.148	0.27	73.212	4.47	4.046	11.99	19.9	0.12	586.377	47.312	105.012
0.00	Gray sole	Glyptocephalus cynoglossus	0.346										0.014	0.332		
0.51	Norway pout	Trisopterus esmarki	100.173		83.749					0.078				8.305		0.05
0.42	Lumpsucker	Cyclopterus lumpus	82.218					1.104				1.256			8.605	1.08
31.32	Large Medusa	Scyphozoa sp.	6141.04	2.74	0.586	1.358	90.7	32			57.5	1.968	10.8	1.65	3.604	504.273
0.08	Greater sandeel	Hyperoplus lanceolatus	15.101			0.482										
2.76	Cod	Gadus Morhua	541.981		18.6	32.6			12.6	156.6			37.102	107.845		
0.00	Sole	Solea solea	0.328													
0.03	Pearlside	Mauorolicus muelleri	6.525					0.199				0.024			2.936	
2.27	Krill	Euphausidae spp.	444.637					11.709				119.204			270.407	
0.16	Picked Dogfish	Squalus acanthias	31.37					1.658				1.438				0.79
0.02	Tarry ray	Raja radiata	3.762													
0.02	Halibut	Hippoglossus hippoglossus	3.152													
0.06	Anglerfish	Lophiuspiscatorius	11.56										1.038			
0.01	Norway lobster	Nephrops norvegicus	1.12													
0.01	Flounder	Platichthys flesus	1.512													
0.00	Hagfish	Myxine glutinosa	0.024													
0.02	Squids, octopusses	Cephalopoda sp	4.882	0.046												
0.00	Solenette	Buglossidium luteum	0.044													
0.37	Sandeel	Ammodytes marinus	73.343						0.002							
0.04	Sculpin	Myoxocephalus scorpius	7.062													
0.00			0.046													
100.00			19610.34	111.646	385	951.972	248.528	168	107.89	296.559	420.294	167.356	459.978	1283.997	350	614.906

Table 3. continued.

Acoustic survey in Skagerrak and Kattegat June-July 2014																	
		Station		1121	1170	1187	1273	1285	1342	1363	1440	1458	1518	1535	1619	1636	1687
		ICES sq.		45G0	45G0	45G0	44G1	44G1	43G1	44G1	43G1	42G1	42G1	42G2	41G1	41G1	41G0
		Gear		Fotö	Fotö	Fotö	Fotö	Expo	Fotö	Frotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Expo
		Fishing depth		5-10 m	Surface	Surface	10	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
		Total depth		107	139	197	85	61	39	58	57	39	38	37	25	30	21
		Day/Night		D	N	N	D	D	N	N	D	D	N	N	D	D	N
% of total		Total catch	Total	316	280	150	27	3412	995	158	445	1015	138	330	434	195	1670
0.00	Anchovy	Engraulis encrasicolus	0.344						0.026				0.024	0.244			
0.00	Blue whiting	Micromesistius poutassou	0.294														
4.29	Sprat	Sprattus sprattus	841.813					0.234	211.13	0.02		414.153	1.116	0.066	73.501	15.347	56.084
0.05	Common weaver	Trachinus draco	9.364				0.284		3.65	0.158		0.832	2.986	0.986			0.25
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.066					0.066									
0.00	Poor-cod	Trisopterus minutus	0.072														
0.05		Anarhichas lupus	10.165					1.88									
0.01	Horse mackerel	Trachurus trachurus	1.694														
0.12	Garfish	Belone belone	23.168	0.63	0.63	0.932			0.534								
0.29	Long rough dab	Hippoglosides plattessoides	56.007					8.9			0.474	0.626			0.274	0.112	
4.28	Whiting	Merlangius merlangus	839.225	0.142		0.132	0.068	43.628		0.016	30.462	25.053	0.904	0.034	1.222	5.677	0.054
0.78	Invertebrates	Invertebrata	152.481					1.15			12.847	40.227			26.586	26.501	0.472
2.11	Dab	Limanda limanda	414.065					0.738			0.296	7.4			11.6	12.265	0.088
0.37	Hake	Merluccius merluccius	72.99					32.808			0.58						
0.99	Gurnard	Trigala spp.	193.445					0.19			0.826	0.33	0.054	0.134	0.55		0.006
1.21	Haddock	Melanogrammus aeglefinus	238.01		0.006			1.322			0.162	0.324				0.046	
0.00	Pollack	Pollachius pollachius	0														
8.20	Mackerel	Scomber scombrus	1607.586	144.5	49.1	4.6		31.6	5.8	24.6		1.804	9.102				0.758
0.42	Saithe	Pollachius virens	81.914			17.5		0.87									
1.13	Plaice	Pleuronectes platessa	222.174					1.782			0.124	0.336			3.964	0.36	0.676
0.18	Lemon sole	Microstomus kitt	35.965					0.63									
37.43	Herring	Clupea harengus	7339.268	14.124	166.977	108.608	0.232	1094.961	749.288	82.4	231.464	419.839	48.588	188.389	5.986	48.772	229.676
0.00	Gray sole	Glyptocephalus cynoglossus	0.346														
0.51	Norway pout	Trisopterus esmarki	100.173	0.002				7.989									
0.42	Lumpsucker	Cyclopterus lumpus	82.218	3.04	2.648	6.585	0.924		2.138		2.556	4.1	10.9	3.12	1.68		9.686
31.32	Large Medusa	Scyphozoa sp.	6141.04	142.6	60.447	3.778	25.8	2177.198	22.2	50.8	160.267	96.948	63.9	137.055	300.652	82.383	1371.821
0.08	Greater sandeel	Hyperoplus lanceolatus	15.101									2.428					
2.76	Cod	Gadus Morhua	541.981	0.002				5.29			4.8	0.088			0.288	0.076	0.13
0.00	Sole	Solea solea	0.328														
0.03	Pearlside	Mauorolicus muelleri	6.525			0.282											
2.27	Krill	Euphausidae spp.	444.637			2.478											
0.16	Picked Dogfish	Squalus acanthias	31.37	10.5		4.8											
0.02	Tarry ray	Raja radiata	3.762												2.904	0.858	
0.02	Halibut	Hippoglossus hippoglossus	3.152														
0.06	Anglerfish	Lophiuspiscatorius	11.56														
0.01	Norway lobster	Nephrops norvegicus	1.12					0.63			0.172	0.096				0.222	
0.01	Flounder	Platichthys flesus	1.512						0.234				0.47		0.508		0.3
0.00	Hagfish	Myxine glutinosa	0.024									0.024					
0.02	Squids, octopusses	Cephalopoda sp	4.882					0.134					0.006	0.036	0.055	0.092	
0.00	Solenette	Buglossidium luteum	0.044										0.038	0.006			
0.37	Sandeel	Ammodytes marinus	73.343													0.024	
0.04	Sculpin	Myoxocephalus scorpius	7.062									0.352			4.19	2.266	
0.00			0.046														
100.00			19610.34	315.54	279.808	149.695	27.308	3412	995	157.994	445.03	1014.96	138.088	330.07	433.96	195.001	1670.001

Table 4. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2014.

Herring																																																			
Stratum																																																			
Station		34	117	128	202	351	367	440		452		508	517	605	622	674	687	777		789		839	858	928	942		1020	1107		1121	1170	1187		1273	1285		1342		1363		1440		1458		1518		1535		1619		1687
ICES sq.		44F6	43F6	42F6	41F7	44F7	44F6	42F6		42F7		43F7	43F6	43F7	43F8	44F7	44F8	44F8		44F8		45F8	45F9	44F9	44G0		46F9	46G0		45G0	45G0	45G0		44G1	44G1		43G1		44G1		43G1		42G1		42G1		42G2		41G1		41G0
Gear		Fotö	Expo	Expo	Fotö	Fotö	Fotö	Expo		Expo		Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo		Expo		Fotö	Fotö	Expo	Expo		Fotö	Expo		Fotö	Fotö	Fotö		Fotö	Expo		Fotö		Frotö		Expo		Expo		Fotö		Fotö		Expo		Expo
Fishing depth		Surface	Bottom	Bottom	Surface	Surface	Surface	Bottom		Bottom		Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom		Bottom		Surface	Surface	Bottom	Bottom		Surface	Bottom		5-10 m	Surface	Surface		10	Bottom		Surface		Surface		Bottom		Bottom		Surface		Surface		Bottom		Surface
Total depth		364	62	52	31	359	300	38		37		111	90	136	64	430	503	102		85		388	572	37	82		425	85		107	139	197		85	61		39		58		57		39		38		37		25		21
Day/Night		N	D	D	N	N	N	D		D		N	N	D	D	N	N	D		D		N	N	D	D		N	D		D	N	N		D	D		N		N		D		D		N		N		D		N
Total catch,kg		222	128	221	315	176	255	1333		223		675	112	385	952	249	168	111		297		420	169	460	1284		350	615		316	280	150		27	3412		995		158		445		1015		138		330		434		1670
Total catch Herring,kg		54.244	10.292	0.130	226.674	44.292	131.100	37.993	649.708	0.152	16.538	614.656	66.200	216.217	790.148	0.270	73.200	2.644	2.814	1.262	1.376	11.990	19.900	0.120	563.918	22.459	47.312	102.164	2.848	14.124	166.977	0.008	108.600	0.232	895.461	199.500	366.558	382.730	51.400	31.000	187.764	43.700	126.047	293.832	0.288	48.300	185.133	3.256	0.066	5.920	229.676
Sample Herring,kg		54.244	10.292	0.130	24.882	44.292	51.056	1.020	18.838	0.152	16.538	53.090	32.190	33.201	22.042	0.270	36.314	2.644	2.814	1.262	1.376	11.990	19.900	0.120	0.978	8.248	47.312	1.868	2.848	14.124	52.209	0.008	37.800	0.232	0.939	21.886	0.938	11.896	1.418	20.356	1.284	35.002	1.250	16.318	0.288	35.092	1.258	3.256	0.066	5.920	20.349
Length in cm	scm																																																		
5.5	11																																												1						
6	12																															1																			
6.5	13																																																		
7	14																															1							1						2						
7.5	15																								2			18											16						15						
8	16							1									1								3			58				1			27				38		3				35						
8.5	17							46		9							2								65			131							79		6		63		45				17		2				
9	18		1					79		10								1		2					59			111							57		2		80		91		7		3		3				
9.5	19							28		7								94		23					41			58							19		14		60		65		6		1		16		1		
10	20							9		2								107		92					16			29							9		30		36		26		47				37				
10.5	21																	99		46					9			5									50		13		8		56		1		30		3		
11	22																	52		8					1			1									7		4		1		38				42		2		
11.5	23																	2																			5						1				17				
12	24																																				1						1				4				
12.5	25																									1											1										1				1
13	26																									2														1			1						1		
13.5	27										1															4														3											
14	28		1		1				5		2				1											6												44		1								1			
14.5	29		8		29				46		9		8		6											19	1									1		53		4								2		1	2
15	30		21		208				139		38	6	9	19	11											24			1							44		83		24		14						1		6	8
15.5	31		97		342	7			186		86	32	49	60	70	2			2							30							3			81		95		34		7		7		2		5		15	33
16	32		81		179	2			140		115	109	114	151	128				1							24			1				1			132		69		46		20		12		3		12		27	116
16.5	33		41		30	1			59		92	162	148	177	184	2			2							11			1				3			125		32		28		39		23		5		7		41	237
17	34		14		6				24		47	92	143	132	112				1							11			6				10			100		16		51		43		80		27		13		24	203
17.5	35	1	4		1				6		24	47	71	60	37		1		4							7	5		10	1			20			44		12		55		69		134		75		3		13	37
18	36	3	3		1						5	26	41	32	9		4		2		3	2	4			6	18		15	2	5		30			33		6		45		57		64		98		4		10	4
18.5	37	4	6			3	2		2		5	14	31	18	5		37		3			8	2			5	25		18	6	15		30			17		1		45		21		31		115		5		2	1
19	38	3	1			7	3				3	18	15	20	7		35		6		3	8	7			12	36		5	11	17		46			8				27		21		14		80		6		1	
19.5	39	10	3			2	7				1	18	16	28	6		42		8		3	9	7	1		8	49		1	11	6		46			10		1		23		24		7		68		1		3	
20	40	35	8			23	36		1		5	28	19	14		1	34		7		3	17	13			4	53		3	16	8		53			1				26		26		4		53		4		4	1
20.5	41	55	7			17	29				7	48	11	15	4		48		8		4	16	15	1		3	56			19	11		43			4				15		24		3		43		2		2	1
21	42	77	2			42	48				6	40	14	12			52				7	17	17			3	56		1	20	23		39			2				11		22		4		30		2		1	
21.5	43	96				39	50				2	37	4	15	2		44		1		12	10	32			5	56		1	31	51		36			2				10		23		6		37		1		3	
22	44	115				27	60					23	4	6	1		40		1		3	16	29			2	60			23	64		45			1				7		23		2		7		1		1	
22.5	45	88	1			44	46					25	8	2	5	1	41		1		2	11	34			2	56			15	64		29			1				9		19		1		6		2		1	
23	46	56	1			29	49					24	5	3			35					8	18			2	41			6	77		27							3		17				8		2		2	
23.5	47	37				21	29				1	25	2	4	1		12					6	8			1	26			9	43		9			1				3		21				2		1			
24	48	22		1		11	21					16	4	2			14					1	11			2	12			5	48		17			3				3		17				3					
24.5	49	17				14	20					18		2			7					4	1				16			3	26		10									8				1					
25	50	6				13	22					13	2				8					5	2			2	5				22		12									6				1					
25.5	51	3				18	28					7	1				2					1	10				5			2	15		4									7								1	
26	52	5				19	14					11		1			3					1	7				2			1	24		3									12				1					
26.5	53	4				30	18					2	1				1						2			1	1			1	12		3									4									
27	54	3				14	6					6					2														2									1		8									
27.5	55	1				20	10					6					2										1				5																				
28	56	2				12	7					2					1														1											1									
28.5	57	1				1	3					1					2					2					2				2			1								2									
29	58						1															1																													
29.5	59					1																																													
30	60	1				2																																													
30.5	61																																									1									
31	62																																																		
31.5	63	3																																																	
32	64																																																		
32.5	65																																																		
Total no.		648	300	1	797	419	509	163	608	28	449	856	720	773	589	6	470	355	47	171	40	143	219	2	196	197	582	411	63	182	541	3	519	1	191	610	116	412	311	475	239	556	157	392	75	665	152	75	7	158	644
Mean Length		22.06481481	16.23833	24	15.49812	23.19809	22.86444	8.9939	15.60609	9.035714	16.36303	19.01402	17.32222	17.21281	16.59423	17.75	21.13085	10.15915	19.11702	10.10234	20.6875	21.4021	22.02968	20	9.068878	16.911168	21.2122	8.798054	18.16667	21.28571	22.81331	7	20.65511	28.5	8.748691	16.65082	10.22414	15.44175	8.993569	17.92105	9.196653	19.73112	10.39809	17.68878	8.046667	19.10526	10.51974	17.80667	10.85714	17.07595	16.56677

Table 5. Measured length distribution of mackerel by haul for the Danish acoustic survey with R/V Dana in June-July 2014.

Makrel																													
Stratum																													
Station	34	186	202	285	302	351	367	440	452	508	517	622	674	687	777	789	839	858	942	1020	1107	1121	1170	1187	1285	1342	1363	1458	1687
ICES sq.	44F6	41F6	41F7	43F7	43F7	44F7	44F6	42F6	42F7	43F7	43F6	43F8	44F7	44F8	44F8	44F8	45F8	45F9	44G0	46F9	46G0	45G0	45G0	45G0	44G1	43G1	44G1	42G1	41G0
Gear	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Expo	Fotö	Fotö	Fotö	Expo	Fotö	Frotö	Expo	Expo
Fishing depth	Surface	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Bottom	5-10 m	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface
Total depth	364	37	31	35	55	359	300	38	37	111	90	64	430	503	102	85	388	572	82	425	85	107	139	197	61	39	58	39	21
Day/Night	N	N	N	D	D	N	N	D	D	N	N	D	N	N	D	D	N	N	D	N	D	D	N	N	D	N	N	D	N
Total catch,kg	222	420	315	205	315	176	255	1333	223	675	112	952	249	168	111	297	420	169	1284	350	615	316	280	150	3412	995	158	1015	1670
Total catch Mackerel,l	142.800	381.951	52.600	5.414	238.908	19.800	62.800	0.680	0.610	28.000	41.600	1.062	156.600	44.600	1.090	10.015	346.400	22.500	0.294	16.400	1.186	144.500	49.100	4.600	31.600	5.800	24.6	1.804	0.758
Sample Mackerel,kg	31.400	30.200	32.500	5.414	10.512	19.800	30.000	0.680	0.610	28.000	41.600	1.062	25.300	44.600	1.090	10.015	31.400	22.500	0.294	16.400	1.186	29.000	19.900	4.600	16.100	5.800	24.6	1.804	0.758
Length in cm																													
15																													
16																													
17																													
18																													
19																													
20																													
21																													
22																													
23																										1			
24		1	1			2														4					1	4	5		
25		1	2			2								2				3		5		1	5	3	1	5	21		2
26		4	3			3				1				5				3		7		1	10	4	2	6	17		1
27	3	7	10			2				1	2		2	2			3	2		6		1	10	2	6	1	10		2
28	2	35	37	4		16	6			7	9	3	1	8		2	11	11		10		15	6	4	24	3	17		
29	34	55	64	4		19	32			13	22	2	13	39		9	34	26		17		52	20	2	25	3	12		
30	45	24	14	11	2	24	28			19	27		52	34		13	50	30		16		36	24	4	11	6	6	1	
31	25	7	6	1	30	8	17			11	23		20	16		6	18	12		8		10	7	2	1	2	9	1	
32	5	1	2	1	129	3	13			5	8		6	4		2	10	1	1			1	3						
33					108		4	1		6	13		3	3	1		1				1	1	2				2		
34	2		1		28	1	1	1		6	12			1	1		1	1				1	1				1	1	
35	1		1	1	5		2			8	13		1		1	1		1					1	1					
36	4	1			2		6		1	5	6					3					1						4	1	
37	1						2			2	4		1								1						5	1	
38			1			1	1			3	2																2		
39										3	1																1		
40			1																										
41																													
42																													
43										1																			
44																													
45																													
46																													
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60																													
61																													
Total no.	122	136	143	22	304	81	112	2	1	91	142	5	99	114	3	36	128	90	1	73	3	119	89	22	71	31	112	5	5
Mean length	30.2623	28.83824	28.88811	29.81818	32.50329	29.19753	30.74107	33.5	36	31.94505	31.64789	28.4	30.32323	29.52632	34	30.55556	29.84375	29.35556	32	28.30137	35.33333	29.36975	28.88764	28.18182	28.46479	27.09677	28.42857	33.6	26

Table 6. Measured length distribution of sprat by haul for the Danish acoustic survey with R/V Dana in June-July 2014.

Sprat													
Stratum													
Station		202	440	452	942	1285	1342	1363	1458	1518	1535	1619	1687
ICES sq.		41F7	42F6	42F7	44G0	44G1	43G1	44G1	42G1	42G1	42G2	41G1	41G0
Gear		Fotö	Expo	Expo	Expo	Expo	Fotö	Frotö	Expo	Fotö	Fotö	Expo	Expo
Fishing depth		Surface	Bottom	Bottom	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface
Total depth		31	38	37	82	61	39	58	39	38	37	25	21
Day/Night		N	D	D	D	D	N	N	D	N	N	D	N
Total catch.kg		315	1333	223	1284	3412	995	158	1015	138	330	434	1670
Total catch Sprat,kg		0.562	4.121	0.014	24.062	0.234	211.130	0.020	414.153	1.116	0.066	73.501	56.084
Sample Sprat,kg		0.562	0.808	0.014	1.144	0.234	1.518	0.020	4.512	1.116	0.066	3.438	3.790
Length in cm	scm												
5.5	11												
6	12												
6.5	13												
7	14									3			
7.5	15				8		1			40			
8	16				31		10			90			
8.5	17				94		27		2	55	2		
9	18				34		72		8	9	2		
9.5	19				16		67		19	3	1		
10	20		3		5		28	1	7	1			1
10.5	21		2		8		8		20	2		1	4
11	22		15		2		5		32	1		6	2
11.5	23		20	1	2	1	2		31			12	17
12	24		15			2		1	26	1		9	9
12.5	25		2		1				19	1		16	8
13	26	6	1			1			17	3		35	9
13.5	27	11			1	3			18			55	19
14	28	9				2			26	1	2	28	35
14.5	29	7	1			4			30	2		18	39
15	30	4							20	2		3	33
15.5	31								17	2		1	11
16	32								3			3	2
16.5	33												3
17	34												
17.5	35												
18	36												
18.5	37												
19	38												
19.5	39												
20	40												
20.5	41												
21	42												
21.5	43												
22	44												
22.5	45												
23	46												
23.5	47												
24	48												
24.5	49												
25	50												
25.5	51												
26	52												
26.5	53												
27	54												
27.5	55												
28	56												
28.5	57												
29	58												
29.5	59												
30	60												
30.5	61												
31	62												
31.5	63												
32	64												
32.5	65												
Total no.		37	59	1	202	13	220	2	295	216	7	187	192
Mean Length		13.89189	11.5	11.5	8.762376	13.46154	9.288636	11	12.48136	8.460648	10.35714	13.27005	13.82031

Table 7. CTD station details for the Danish acoustic survey with R/V Dana in June-July 2014.

Date	Haul	Time	ICES	Position		Bottom depth	Wind speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	m	m/s	
27-06-14	1	20:03	44F7	57.49.544 N	007.44.658 E	507	4	2
28-06-14	41	01:55	44F6	57.57.350 N	006.32.417 E	354	7.8	2
28-06-14	132	14:35	42F6	56.57.744 N	006.35.354 E	53	6.4	2
28-06-14	185	20:35	41F6	56.15.179 N	006.48.185 E	39	5.7	2
29-06-14	208	01:45	41F7	56.14.459 N	007.29.347 E	31	6.9	2
29-06-14	284	10:23	43F7	57.01.936 N	007.12.565 E	40	2.7	2
29-06-14	308	05:31	43F7	57.13.439 N	007.40.571 E	51	6.4	2
29-06-14	350	20:26	44F7	57.40.965 N	007.15.140 E	322	13	5
30-06-14	372	01:41	44F6	57.38.394 N	006.46.098 E	314	11.4	5
30-06-14	439	09:40	42F6	56.32.324 N	006.49.650 E	43	9.9	5
30-06-14	451	12:41	42F7	56.36.540 N	007.08.955 E	36	8.1	5
30-06-14	507	20:34	43F7	57.26.184 N	007.29.725 E	118	8.2	4
01-07-14	522	01:41	43F6	57.20.638 N	006.55.461 E	87	6.8	4
01-07-14	604	10:12	43F7	57.25.320 N	007.50.369 E	131	1.9	4
01-07-14	626	15:20	43F8	57.26.828 N	008.26.801 E	59	3.6	4
01-07-14	673	20:19	44F7	57.54.086 N	007.45.825 E	401	5.7	2
02-07-14	691	01:40	44F8	57.57.106 N	008.15.274 E	497	5.2	2
02-07-14	776	10:22	44F8	57.32.897 N	008.25.291 E	108	5.7	2
02-07-14	795	15:00	44F8	57.39.896 N	008.53.068 E	88	11.6	2
02-07-14	838	20:13	45F8	58.16.046 N	008.49.521 E	323	11.9	5
03-07-14	863	02:05	45F9	58.16.193 N	009.25.075 E	680	11.6	5
03-07-14	928	10:15	44F9	57.42.960 N	009.40.478 E	36	10.7	5
03-07-14	948	14:48	44G0	57.45.384 N	010.15.360 E	81	12.5	5
04-07-14	1025	00:41	46F9	58.41.207 N	009.39.851 E	405	8.4	5
04-07-14	1105	10:16	46G0	58.36.417 N	010.50.510 E	81	6.7	5
04-07-14	1125	15:24	45G0	58.19.030 N	010.56.476 E	107	9.1	5
04-07-14	1169	20:25	45G0	58.05.929 N	010.10.396 E	143	7.1	3
05-07-14	1192	01:40	45G0	58.06.456 N	010.53.995 E	165	4.4	3
05-07-14	1272	10:25	44G0	57.53.191 N	010.53.148 E	109	5.3	3
05-07-14	1290	14:52	44G1	57.50.445 N	011.16.426 E	84	8.2	3
05-07-14	1341	20:23	43G0	57.26.934 N	010.52.184 E	39	9.6	3
06-07-14	1369	01:48	44G1	57.31.127 N	011.29.778 E	60	6.8	3
06-07-14	1438	09:12	43G1	57.07.476 N	011.50.132 E	54	4.6	3
06-07-14	1462	14:47	42G1	56.47.405 N	011.41.981 E	30	5.9	3
06-07-14	1517	20:40	42G1	56.37.018 N	011.46.996 E	37	6.4	3
07-07-14	1540	01:48	42G2	56.36.785 N	012.23.763 E	31	7.5	3
07-07-14	1618	10:05	41G1	56.09.917 N	011.53.589 E	26	4	3
07-07-14	1640	15:07	41G1	56.19.462 N	011.39.235 E	30	4.9	3
07-07-14	1686	20:12	41G0	56.11.855 N	010.56.646 E	22	5.6	3

Table 8. WP2 station details for the Danish acoustic survey with R/V Dana in June-July 2014.

						Mean	WP2	Wind	
Date	Station	Time	ICES	Position		depth	depth	speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	m	m	m/s	
28-06-14	132	14:49	42F6	56.57.607 N	006.35.338 E	53	48.2	7.2	2
28-06-14	185	20:49	41F6	56.15.094 N	006.48.335 E	39	32.4	5.5	2
29-06-14	308	15:35	43F7	57.13.400 N	007.40.875 E	51	47.5	7.6	2
29-06-14	350	20:49	44F7	57.40.817 N	007.14.982 E	320	152.1	13.1	5
30-06-14	452	12:54	42F7	56.36.385 N	007.09.089 E	35	26.3	7.4	5
30-06-14	507	20:54	43F7	57.26.058 N	007.30.191 E	119	113.8	8.7	4
01-07-14	627	15:35	43F8	57.26.840 N	008.27.236 E	59	49.2	3.7	4
01-07-14	673	20:59	44F7	57.54.069 N	007.44.874 E	400	150.0	2.3	2
02-07-14	795	15:16	44F8	57.40.023 N	008.53.689 E	90	82.0	13	2
02-07-14	838	20:35	45F8	58.16.060 N	008.49.747 E	323	153.1	13.3	5
03-07-14	948	15:03	44G0	57.45.617 N	010.16.234 E	83	77.9	12	5
04-07-14	1025	01:04	46F9	58.41.203 N	009.39.963 E	411	151.1	9.4	5
04-07-14	1125	15:42	45G0	58.19.330 N	010.56.406 E	117	104.9	9.3	5
04-07-14	1169	20:46	45G0	58.08.976 N	010.10.201 E	145	140.3	7.1	3
05-07-14	1290	15:08	44G1	57.50.540 N	011.16.558 E	89	81.4	7.6	3
05-07-14	1341	20:35	43G0	57.27.021 N	010.52.507 E	39	31.9	10.1	3
06-07-14	1462	14:57	42G1	56.47.381 N	011.41.946 E	30	26.3	6.2	3
06-07-14	1517	20:51	42G1	56.37.155 N	011.46.866 E	37	29.9	7	3
07-07-14	1640	15:18	41G1	56.19.355 N	011.39.282 E	30	20.6	5.1	3
07-07-14	1686	20:21	41G0	56.11.946 N	010.56.727 E	21	15	7.1	3