Acoustic Herring Survey report for RV "DANA"

22nd June – 5th July 2016

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Cruise summary

Total days	14
Days of monitoring	12
Number of nautical miles monitored	1760
Number of trawl hauls	40
Number of CTD stations	40
Number of WP2 stations	20
Fish catch in kg	24292
Number of measured herring	15139
Number of measured mackerel	3031
Number of measured sprat	2372
Number of species measured	51
Total number of measured fish	33883
Number of herring frozen for age and race-split	3264
Number of sprat frozen for age and race-split	930

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 2016-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period June 22 June to July 5 2016, while calibration was done during June 22 to June 24 2016.

2. SURVEY

2.1 Personnel

During calibration 22/6– 24/6 2016
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Ronny Sørensen
Christian Petersen
Jerome Pierre Alexandre Pinti (student)
Maria Camila Serra Pompei (student)
Maria Sokolova (student)

Berthe Vastenhout (student)
Claus Halle

During acoustic monitoring 24/6 - 5/7-2016
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Annegrete D. Hansen
Helle Andersen
Flemming Thaarup
Brian Werner Thomsen
Asbjørn Andreasen
Ronny Sørensen
Jerome Pierre Alexandre Pinti (student)
Maria Camila Serra Pompei (student)
Maria Sokolova (student)
Berthe Vastenhout (student)

2.2 Narrative

The survey of R/V Dana started on June 22nd at 04.00 UTC with departure from Hirtshals 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 21th at 12.00 UTC. The calibration was initiated in the afternoon of June 22nd and continued until the morning of June 23th.

At June 23rd at 20.00 UTC Dana left Bornö to arrive in Skagen June 24th at 05.00 UTC for inspection of the cran for the towed which has been damaged during the calibration.

At June 24th noon the scientific crew was exchanged in Skagen. R/V Dana left Skagen at 12.07 UTC to steam northwest towards the border between Skagerrak and the North Sea.

Monitoring data collection was started the June 25 at 57º 50'N, 6º 55'E at 00.23 UTC With a trawl haul and a CTD.

The North Sea was covered during the period June 24 – 28, Skagerrak during June 28 - July 2 and Kattegat during July 2-5.

The acoustic integration was ended July 5 at 57º 22'N, 10º 44'E at 05.49 UTC.

R/V Dana arrived at Hirthals at 11.00 UTC on July 5.

Totally the survey covered about 1760 nautical miles of monitoring. 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 4 sub-areas.

In principal the survey is designed with parallel survey tracks at right angles to the depth lines with a spacing of 15 nm in strata 151, 17.5 nm in strata 41 and 10 nm in strata 31 and 21. 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.

2.4 Calibration

The echosounders were calibrated at Bornö in the Gullmar Fjord, Sweden during June 21 - June 23 2016. 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 April. 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 April, 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.

The 120 kHz echosounder showed large differences in the angel discrimination and service will be ordered for just after the survey for determination of the problem. As the 120 kHz is not the used frequency for the data collection the survey can be conducted with a possible failure on this echosounder. During the survey contact with Simrad has been made. After an investigation of the calibration data Simrad has approved that nothing is wrong with the 120 kHz sounder. The problems in the calibration is explained by Simrad due to objects in the water.

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

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. Furthermore fixated samples has been broad ashore for species identification as a part of a student project, see belove.

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 (21, 31, 41 and 151 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 ICES SIPS 9: Manual for International Pelagic Surveys (IPS):

$$\text{Herring TS} = 20 \log L - 71.2 \text{ dB}$$
$$\text{Sprat TS} = 20 \log L - 71.2 \text{ dB}$$

Gadoids TS = 20 log L – 67.5 dB
Mackerel TS = 20 log L – 84.9 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.

2.10 Cruise leader course

Four students from DTU-Aqua`s MSc Eng. In Aquatic Science and Technology have participated in the survey during a 5 ECTS Cruise leader course. 2 students have been working with monitoring of jellyfish with cameras. 2 students have been working with sampling of zooplankton and species identification. The students have worked together with the rest of the scientific crew under supervision of Karl-Johan Stæhr.

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 1760 Cruise line for integration is given in Figure 2. During the survey acoustic data have been prepared for scrutinization at shore and stock calculation in the Danish program. Data from transect shown in Figure 4 will be used in the stock estimation by StoX.

3.2 Biological data

During the survey in 2016 40 hauls were conducted, 21 surface hauls and 19 bottom hauls. The geographical distribution of hauls and details on the hauls are given in Figure 2 and Table 2. Catches by 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 24.3 tons. Herring was present in 35 hauls with a total catch of 9.9 tons or 40.9 % of the total catch. Totally 15,139 herring have been measured. Length distributions of herring per haul are given in Table 5.

The total sprat catch was 2.2 tons or 9.2 % of the total catch. Totally 2,372 sprat have been measured. Length distributions of sprat per haul are given in table 6.

Mackerel were present in 31 hauls with a total catch of 1.8 ton or 7.2 % of the total catch. Totally 3,031 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 40.9 %, 7.2 % and 9.2 % respectively.

Herring maturity

Based on the frozen single fish herring samples (3264 specimens) from each haul, where race analysis of the otoliths was used to differentiate between North Sea herring and Western Baltic herring, a maturity by age key was made for both races. It is given in the text table below. For North Sea autumn spawners specimens with maturity stage ≥3 and/or age ≥5 are regarded as mature and for Baltic spring spawners specimens with maturity stage ≥2 and/or age ≥5 are regarded as mature.

North Sea autumn spawners:

Kattegat, Strata 21									
WR	0	1i	1m	2i	2m	3i	3m	4i	4m
%	100.0	100.0	0.0	94.7	5.3	11.4	88.6	0.0	100.0

Skagerrak, Strata 31, 41 and 42												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
%	100.0	100.0	0.0	68.5	31.5	79.1	20.9	80.8	19.2	100.0	100.0	100.0

North Sea, Strata 151 and 152												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
%	100.0	100.0	0.0	89.9	10.1	36.8	63.2	18.0	82.0	100.0	100.0	100.0

Baltic Sea spring spawners:

Kattegat, Strata 21											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
%	100.0	96.3	3.7	73.9	26.1	12.0	88.0	0.0	100.0	100.0	100.0

Skagerrak, Strata 31, 41 and 42														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
%	100.0	97.3	2.7	69.7	30.3	17.3	82.7	4.5	95.5	100.0	100.0	100.0	100.0	100.0

North Sea, Strata 151 and 152														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
%	100.0	99.8	0.1	46.6	50.1	5.4	94.6	1.0	97.5	100.0	100.0	100.0	100.0	100.0

Sprat maturity

Based on 930 sprat collected over all length classes and hauls including sprat age, weight and maturity keys were established. The maturity key for sprat is shown in the text table below. Sprat with maturity stage ≥2 and/or age ≥3 are regarded as mature

Kattegat, strata 21							
WR	0	1i	1m	2i	2m	3	4
%	0	100	0	100	0	100	100

Skagerrak, strata 31, 41 and 42					
WR	0	1i	1m	2i	2m
%	0	0	0	100	0

North Sea, strata 151 and 152						
WR	0	1i	1m	2i	2m	3
%	0	100	0	100	0	100

3.3 Biomass estimates

Herring

The total herring biomass estimate for the Danish acoustic survey with R/V Dana in June-July 2016 is 98,311 tonnes of which 39.3 % or 38,650 tonnes is North Sea autumn spawners and 60.7 % or 59,660 tonnes is Baltic Sea spring spawners.
For the total number of herring the survey results give 2,247 mill, of which 48.7 % are North Sea autumn spawners and 62.3 % are Baltic Sea spring spawners.

The estimated total number of herring, mean weight, mean length and biomass per age and maturity stage in each of the surveyed strata are given in Table 10 and 11 for North Sea autumn spawners and Baltic spring spawners respectively.

A comparison for the results of the last 10 years surveys are given in the text table below.

	Autumn spawners		**Spring spawners**	
Year	Number in mill.	Biomass in tons	Number in mill.	Biomass in tons
2006	1530	98786	6407	471850
2007	4443	315176	8847	614048
2008	4473	80469	7367	450505
2009	9679	157707	1326	146590
2010	2723	148946	1461	88597
2011	5156	165589	3699	179898
2012	4805	259947	1955	122901
2013	1070	62126	1013	83601
2014	4576	58974	798	32875
2015	2950	103423	4874	179954
2016	1163	38650	1085	59660

Sprat

The total abundance estimate of sprat for the Danish acoustic survey with R/V Dana in June-July 2016 is 1773 million corresponding to a biomass at 24680 ton. Sprats were in 2016 found in Kattegat, Strata 21, with 53.9 %, Skagerrak (ICES 43F9) and in the North Sea, Strata 151 (ICES 41F6, 41F7, 42F6 and 42F7) with 46,9 %.

Abundance, biomass, mean length and mean weight per WR and strata are given in Table 12.

3.4 Hydrography

40 CTD stations have been taken. Information on the stations and distribution is given in Table 7 and Figure 3. Data from the CTD stations will be delivered to ICES hydrographical data base.

3.5 Plankton

20 WP2 stations have been taken. Information on the stations and distribution is given in Table 8 and Figure 3. Dry weight will be measured ashore for each of the three fractions 2000 µm, 1000 µm and 180 µm. The weight per fraction and station is given in Table 8. The geographical distribution per fraction is given in Figure 4. Species identification of zooplankton will be made ashore as a part of a student project connected to the Cruise leader course.

4 Cruise leader course

Four students from DTU-Aqua`s MSc Eng. In Aquatic Science and Technology have participated in the survey during a 5 ECTS Cruise leader course. 2 students have been working with monitoring of jellyfish with cameras. 2 students have been working with sampling of zooplankton and species identification. The students have worked together with the rest of the scientific crew under supervision of Karl-Johan Stæhr.

For more details see appendix 1.

Appendix 1

Jellyfish monitoring on Dana 22/06/2016-05/07/2016

Maria Sokolova and Berthe Vastenhoud

Three different types of jellyfish monitoring have been performed on this cruise: video monitoring by a camera on the CTD, samples of jellyfish have been taken from the catch and video monitoring on the towed body. CTD video sampling has been performed twice a day, once in the late afternoon after the last trawl during daytime, and once in the evening before the first night trawl. Therefore, in total 20 videos have been made at different locations and at different times during the day. The camera on the CTD has been mounted on a construction which also contained a light source, in order to visualize jellyfish even in deeper, darker waters. From the time that jellyfish are observed on the camera we can derive the depth at which the jellyfish are located, and see whether there is a correlation between salinity, temperature and preferred depth of the jellyfish observed. The salinity and temperature data are provided by the same CTD measurement. As the CTD samples have been performed at different locations, this also allows us to obtain a preliminary idea of the horizontal distribution of jellyfish.

Next to the video samples taken from the CTD, we have also mounted a camera looking sidewards from the towed body. These videos allow us in a later stage to obtain a better insight in the horizontal distribution of jellyfish. Samples have been taken if possible every morning after breakfast, and in the afternoon either in between the two afternoon trawls or after the last trawl in the afternoon. In total we have obtained 18 videos, all of approximately two hours. We will start with analyzing the CTD data before analyzing the videos of the towed body, as this will be probably done automatically by a program which is still in developing stage.

To obtain better insight in species distribution, we have analyzed the intact jellyfish caught in each trawl haul. Independently of the number of jellyfish caught in a haul, we have taken samples of 50 intact jellyfish per catch if there were more than 50 specimens caught. If there were less than 50 intact jellyfish specimens caught, the total jellyfish catch was analyzed. In this experiment we have analyzed the differences in jellyfish catch between the day and night trawls, concerning species, diameter and weight. The night hauls have been performed by using pelagic trawls, during the day fishing was done with bottom trawls. Therefore this might give us a better understanding on vertical distribution of jellyfish, next to the video samplings taken by the CTD. In total we have analyzed the jellyfish catch of 33 trawl hauls, from which 16 pelagic and 17 bottom trawls, with a total of 1512 jellyfish individuals.

Preliminary results from the trawl experiments show that the weight and diameter change according to a third power function, which can be seen in figure 1. Also, it appears that the dominant species in both pelagic and bottom trawls is *Cyanea lamarckii*.

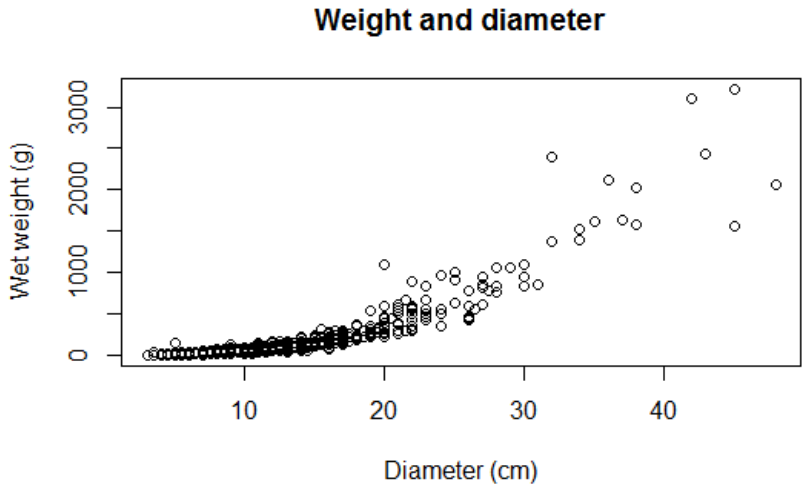

FIGURE 1. GENERAL PLOT OF WEIGHT AND DIAMETER ACCORDING TO ALL SPECIES.

When looking at the differences in diameter and weight between bottom and pelagic trawls, the diameter of the jellyfish is significantly larger in bottom trawls. The mean diameter in bottom trawls is 12.12 cm, in pelagic trawls the mean is 9.92

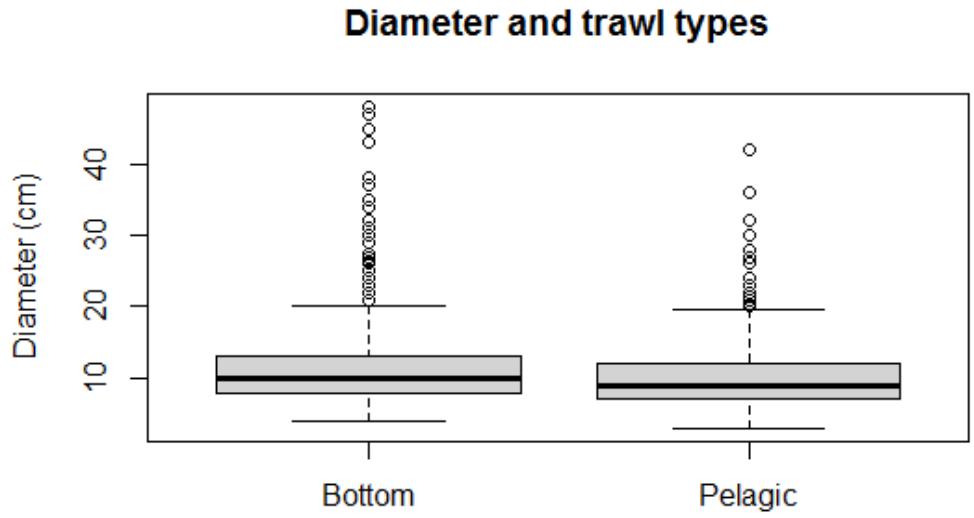

FIGURE 2. DIFFERENCES IN DIAMETER (CM) OF ALL JELLYFISH SPECIES BETWEEN BOTTOM AND PELAGIC TRAWLS.

Zooplankton sampling, herring acoustic survey, R/V Dana 2016

Jérôme Pinti and Camila Serra

Up until now the acoustic herring survey cruise, performed on R/V Dana (DTU) has centered on sampling mainly on the fishery, obtaining hydrographic data from the CTD, and for the last 5 years dry weight of plankton was also included. Our intention is to extend the acoustic survey cruise to an ecosystem-based survey, where environment factors would also be included to provide a better understanding of the data from the fishery herein obtained. In our case, we center in a more detailed analysis of the zooplankton, performing identification to the genus or species level and obtaining its size. Therefore, by starting this sampling, the intention is to initialize a record for size and taxonomic identification of zooplankton, with the finality to perform a statistical analysis to see if there is any correlation with the fishery, the plankton and other hydrographic factors.

The samples were taken on the R/V Dana (DTU), during the herring survey cruise, from the 21st of June to the 5th of July (including two days of calibration). WP-2 nets were used to take plankton samples; those were lowered twice a day: one just after the first fishing period (in the afternoon) and the other before the second period started (evening). In each round, a net was drawn first for dry weight, and then drawn a second time for samples meant for taxonomic and size identification. Regarding the dry weight, plankton was divided by size by means of three sieves (2000µm, 1000µm and 180µm), to be later introduced for 24h in an incubator at 70°C. Finally the samples were frozen as to be weighted onshore. For the second procedure, samples were sieved (180µm) and conserved in formaldehyde to be also analyzed onshore with a "Zooscan". From the CTD, hydrographic data was obtained (i.e. temperature, salinity, fluorescence and Oxygen), and data from previous years together with the fishery data were also provided. All in all, during this cruise, 20 samples for each technique were taken (refer to table 8 in the cruise report).

The expected output of this survey would be to see which (if any) environmental factors are correlated to the herring and sprat fisheries. For the time being, work on the data from previous years (since 2012) has been started onboard, where by means of a statistical model a significant correlation was observed between herring and the degree of stratification of the water column, the type of trawl used as well as to the ICES square the trawling was carried in. The total weight of the trawl was correlated to the degree of stratification of the water column, to the sea surface salinity and to the ICES Square. The same type of model will be also built for sprat abundance. Zooplankton data from this year will only be analyzed in September, but we expect that a more detailed analysis of the zooplankton community will provide a deeper insight between these trophic levels than the rough data provided solely by the dry weight.

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in June-July 2016. The map shows the subareas (strata) used in the abundance estimation.

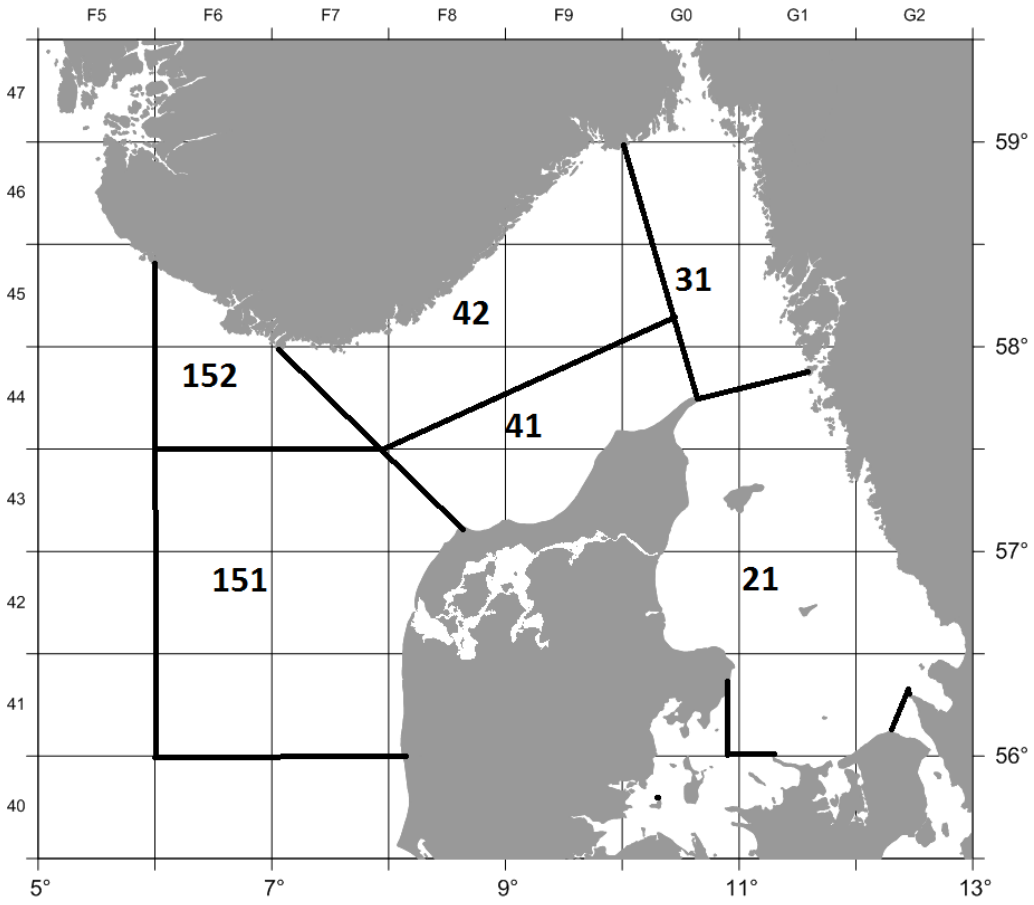

Figure 2. Map showing sailed route and trawl stations during the Danish acoustic survey with R/V Dana in June-July 2016.Read is pelagic hauls and blue is demersal hauls.

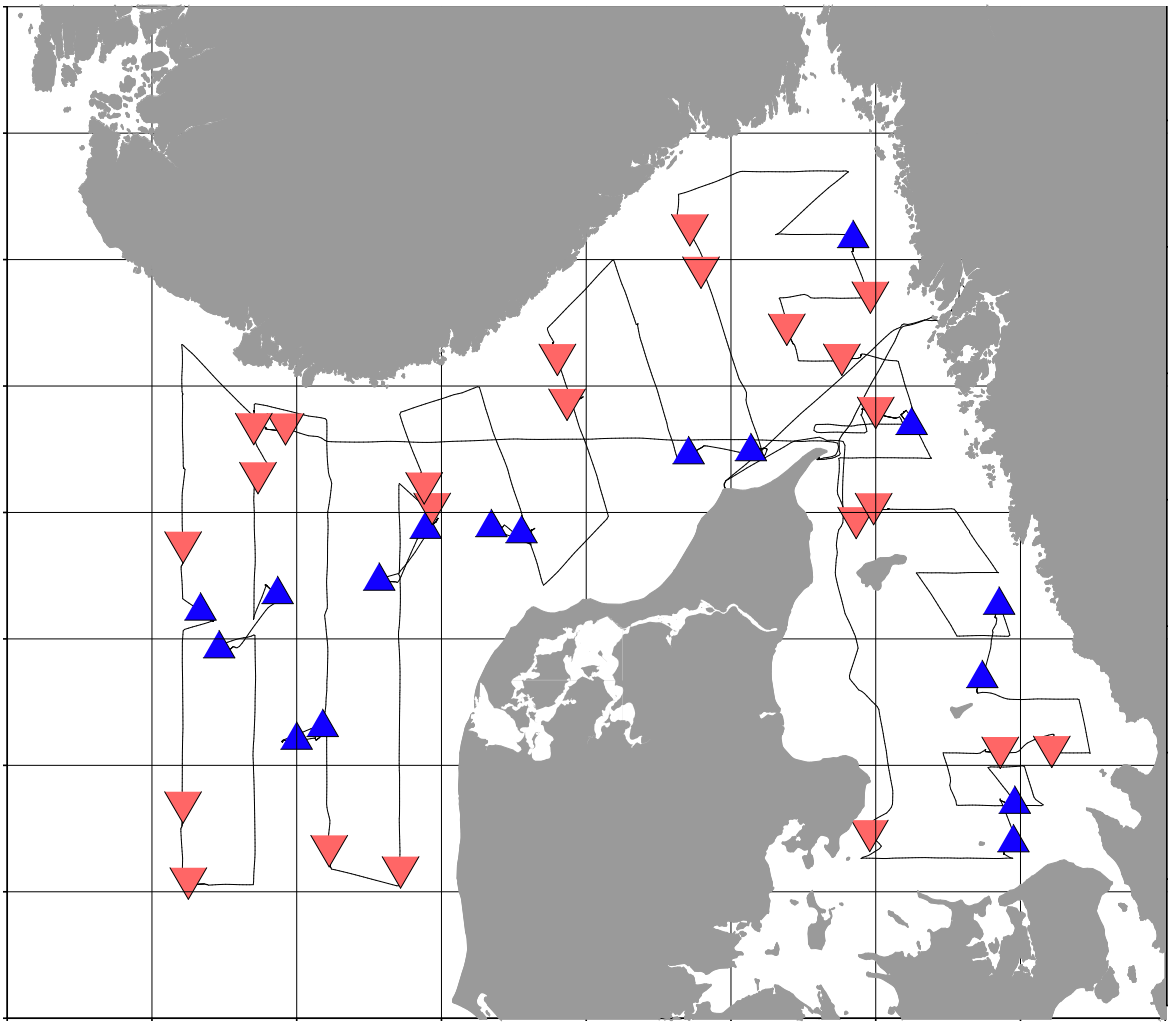

Figure 3. Map showing CTD and WP2 stations during the Danish acoustic survey with R/V Dana in June-July 2016. X are CTD stations and squares are combined CTD and WP2 stations.

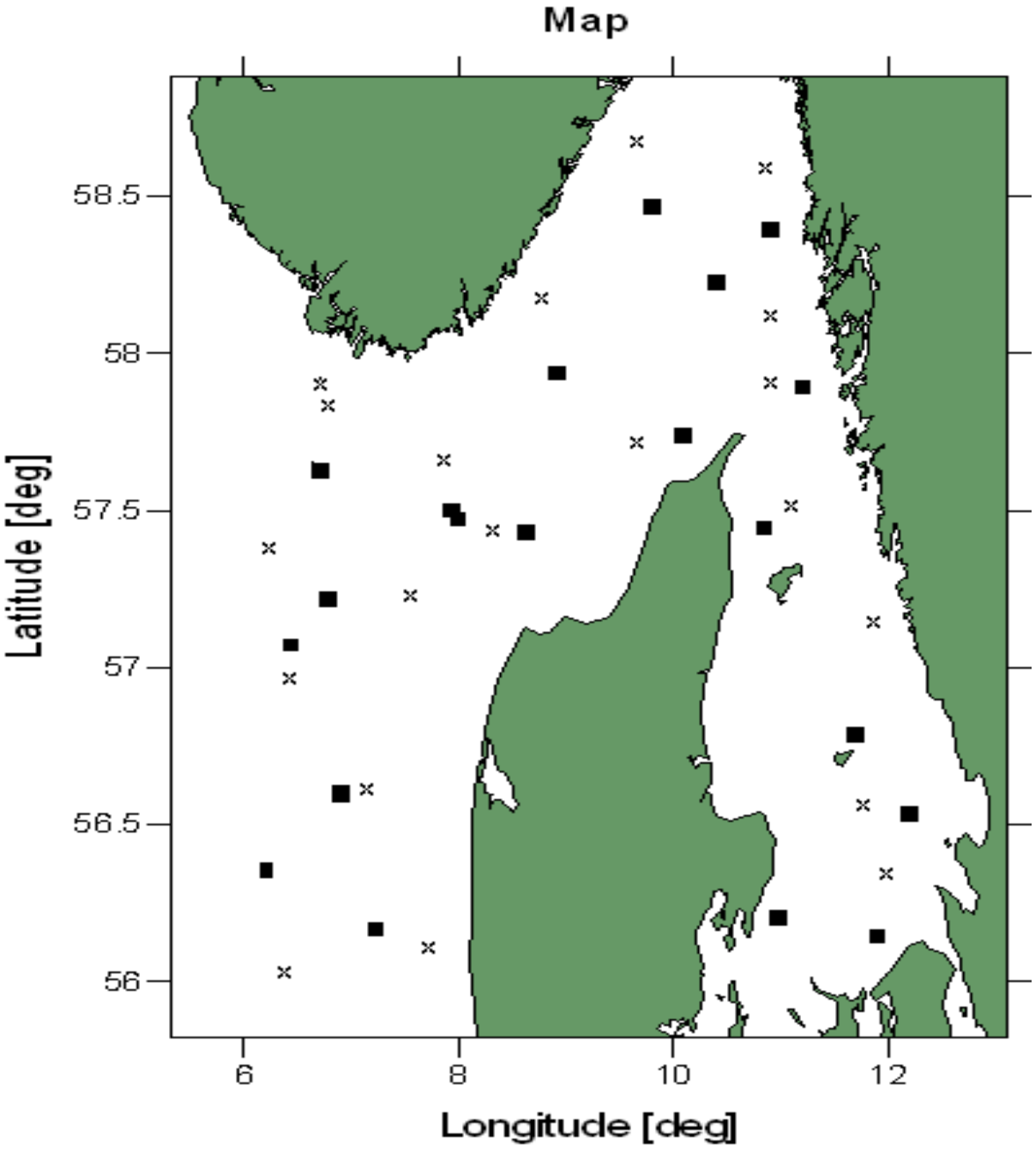

Figure 4. Distribution of dry weight in mg/m^2. A: Total weight, B: fractions 2000 µm, C: fraction 1000 µm and D: fraction 180 µm.

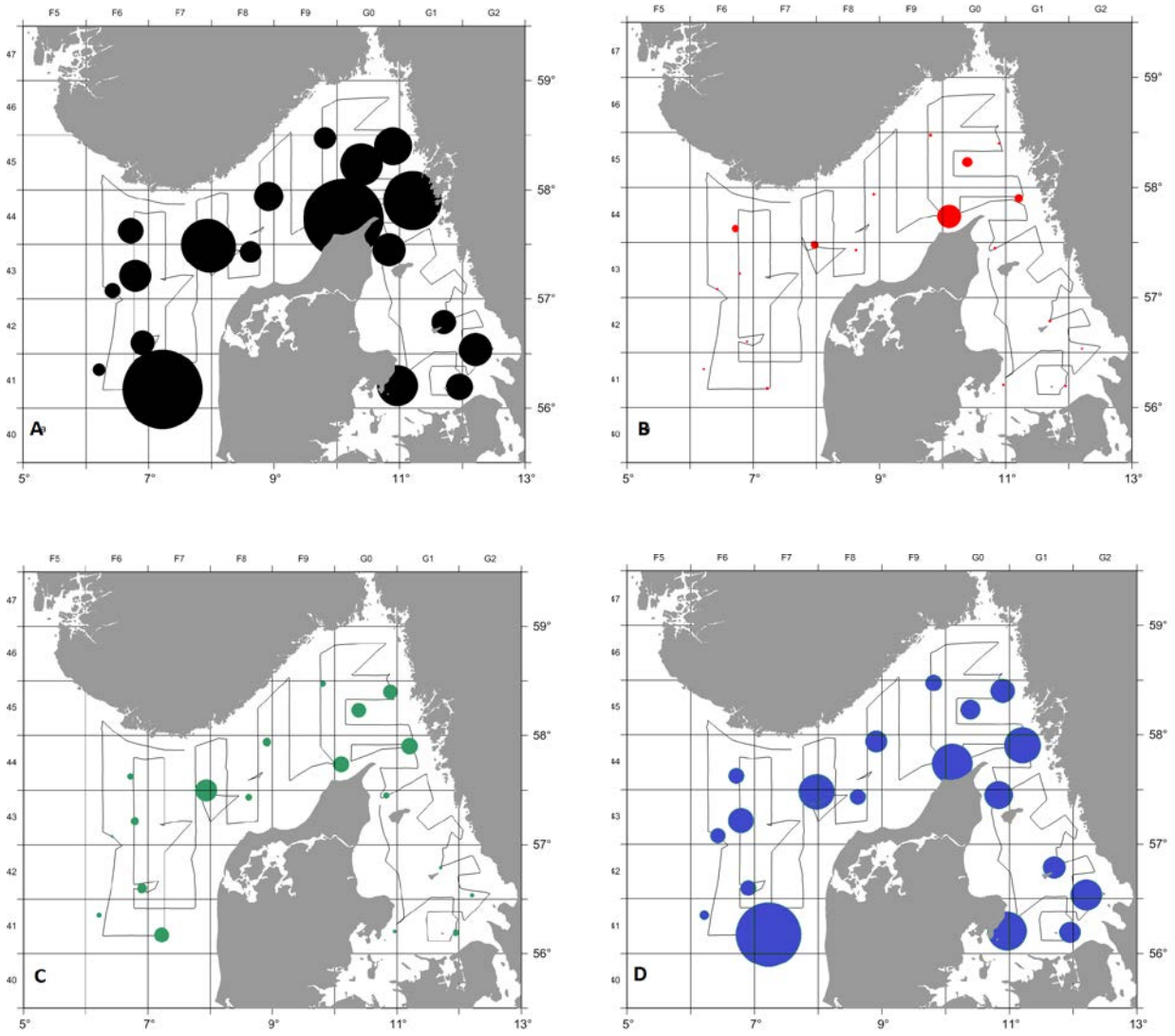

Table 1. . Simrad EK60 and analysis settings used during the Acoustic Herring Survey with R/V Dana Cruise June-July 2016

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 2016.

						Trawl	Wire	Trawl	Cath	Mean	Total		Trawling	Trawling	Wind	
Date	Haul	Time	ICES	Position		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	
25-06-16	2	00:23	44F6	57.49.754 N	006.55.343 E	275	300	Fotö	Surface	382	620	Herring,Blue whiting	3.7	60	4.4	1
25-06-16	83	10:46	43F6	57.21.703 N	006.12.919 E	181	490	Fotö	40-50	76	27	Jellyfish,Haddock, Mackerel	3.6	60	0.8	1
25-06-16	99	13:48	43F6	57.06.641 N	006.20.062 E	132	350	Expo	Bottom	60	300	Whiting	3.0	60	2.0	0
25-06-16	154	21:07	41F6	56.20.004 N	006.12.889 E	184	300	Fotö	Surface	46	250	Mackerel, Herring	4.0	60	6.3	0
26-06-16	172	00:17	41F6	56.01.967 N	006.15.087 E	86	310	Fotö	Surface	45	173	Gurnard, Mackerel, Jellyfish	3.6	60	5.7	2
26-06-16	259	10:50	42F6	56.57.686 N	006.27.808 E	46	350	Expo	Bottom	54	199	Whiting	3.5	60	11.1	3
26-06-16	280	14:25	43F6	57.10.549 N	006.52.031 E	313	410	Expo	Bottom	65	104	Haddock, Whiting	3.2	60	8.2	3
26-06-16	329	21:53	44F6	57.38.165 N	006.43.950 E	55	300	Fotö	Surface	304	460	Mackerel,Herring, Blue Whiting	3.8	60	3.9	4
27-06-16	341	00:28	44F6	57.49.804 N	006.42.204 E	4	300	Fotö	Surface	362	265	Herring, Mackerel, Blue Whiting	3.4	60	4.4	2
27-06-16	438	11:37	42F7	56.39.006 N	007.10.733 E	225	250	Expo	Bottom	36	838	Sprat, Whiting, Herring	3.4	60	9.8	2
27-06-16	448	14:18	42F6	56.36.005 N	006.59.897 E	270	270	Expo	Bottom	38	1250	Herring, Sprat	3.2	60	13.5	2
27-06-16	495	21:10	41F7	56.09.646 N	007.13.465 E	184	300	Fotö	Surface	29	1150	Herring, Mackerel, Sprat	3.8	60	6.6	4
28-06-16	515	01:11	41F7	56.04.601 N	007.43.047 E	336	300	Fotö	Surface	28	550	Jellyfish, Mackerel	3.4	29	6.2	3
28-06-16	596	10:36	43F7	57.13.732 N	007.34.143 E	60	380	Expo	Bottom	53	297	Haddock	3.5	60	7.6	3
28-06-16	615	13:42	43F7	57.26.045 N	007.53.411 E	54	550	Expo	Bottom	137	950	Norway pout	3.0	60	6.8	3
28-06-16	658	21:39	44F7	57.30.856 N	007.56.163 E	339	300	Fotö	Surface	194	284	Herring, Mackerel	3.8	60	4.1	3
29-06-16	673	00:15	44F7	57.35.740 N	007.52.835 E	42	300	Fotö	Surface	296	820	Herring	3.7	60	3.3	3
29-06-16	762	10:37	43F8	57.26.435 N	008.20.606 E	64	375	Expo	Bottom	64	193	Herring, Whiting	3.6	42	6.2	2
29-06-16	770	12:20	43F8	57.24.987 N	008.33.116 E	56	260	Expo	Bottom	37	183	Mackerel, Sandell, Cod	3.1	57	5.5	2
29-06-16	843	21:32	44F8	57.55.574 N	008.52.064 E	60	300	Fotö	Surface	520	434	Herring	3.6	60	5.4	3
30-06-16	859	00:21	45F8	58.06.212 N	008.48.060 E	347	300	Fotö	Surface	421	511	Herring, Whiting	3.4	60	9.1	3
30-06-16	944	10:36	44F9	57.43.723 N	009.42.373 E	48	250	Expo	Bottom	38	4303	Herring, Whiting	4.1	60	9.4	4
30-06-16	959	14:00	44G0	57.44.455 N	010.08.207 E	77	410	Expo	Bottom	82	1887	Haddock, Whiting	3.0	60	6.8	4
30-06-16	1017	21:39	45F9	58.26.914 N	009.47.580 E	43	300	Fotö	Surface	554	430	Herring	3.1	60	5.7	4
01-07-16	1033	00:30	46F9	58.36.989 N	009.42.953 E	330	300	Fotö	Surface	454	180	Herring	3.9	60	3.9	3
01-07-16	1120	11:38	46G0	58.35.015 N	010.50.591 E	182	420	Expo	Bottom	85	245	Norway pout, Whiting	2.9	60	14.3	3
01-07-16	1137	14:31	45G0	58.20.991 N	010.57.782 E	282	260	Fotö	10-40	94	46	Picked dogfish, Jellyfish	3.6	60	10.4	3
01-07-16	1180	21:23	45G0	58.13.369 N	010.23.130 E	156	300	Fotö	Surface	232	800	Herring	3.9	60	4.3	4
02-07-16	1196	00:21	45G0	58.06.237 N	010.45.962 E	83	300	Fotö	Surface	197	1900	Herring	3.4	60	6.4	4
02-07-16	1268	11:01	44G1	57.53.638 N	010.59.999 E	96	300	Fotö	Surface	67	35	Jellyfish, Herring	3.5	60	10.2	4
02-07-16	1281	13:10	44G1	57.50.671 N	011.14.823 E	320	300	Expo	Bottom	61	25	Whiting, Herring	3.5	60	9.8	4
02-07-16	1339	21:13	43G0	57.27.517 N	010.51.899 E	58	300	Fotö	Surface	41	190	Jellyfish, Herring	3.8	60	11.2	2
03-07-16	1356	00:20	44G1	57.30.816 N	010.59.134 E	84	300	Fotö	Surface	40	360	Jellyfish, Herring	4.1	60	12.3	2
03-07-16	1452	11:17	43G1	57.08.029 N	011.51.092 E	191	330	Expo	Bottom	56	660	Herring	3.0	60	10.0	2
03-07-16	1471	14:13	42G1	56.50.618 N	011.44.102 E	200	260	Expo	Bottom	39	1650	Sprat,Herring	3.0	60	9.3	2
03-07-16	1523	21:14	42G2	56.33.201 N	012.12.970 E	351	300	Fotö	Surface	46	85	Jellyfish,Mackerel,Herring	3.5	60	8.4	2
04-07-16	1540	00:20	42G1	56.32.984 N	011.51.620 E	289	300	Fotö	Surface	32	80	Jellyfish,Mackerel,Herring	3.7	60	9.9	2
04-07-16	1619	10:33	41G1	56.20.797 N	011.57.577 E	286	210	Expo	Bottom	32	470	Sprat	3.4	60	8.8	3
04-07-16	1635	12:59	41G1	56.11.661 N	011.57.011 E	225	210	Expo	Bottom	25	94	Sprat	3.1	60	9.5	3
04-07-16	1685	20:49	41G0	56.13.225 N	010.57.523 E	332	300	Expo	Surface	22	802	Jellyfish, Sprat	3.5	60	5.6	2

Table 3. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June - July 2016.

		Station		1	83	99	154	172	259	280	329	341	438	448	495	515	596
		ICES sq.		44F6	43F6	43F6	41F6	41F6	42F6	43F6	44F6	44F6	42F7	42F6	41F7	41F7	43F7
		Gear		Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo
		Fishing depth		Surface	40-50	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom
		Total depth		382	78	57	46	45	54	65	304	362	36	38	29	28	53
		Day/Night		N	D	D	N	N	D	D	N	N	D	D	N	N	D
%		Total catch	Total	620	27	300	250	173	199	104	460	265	838	1250	1150	550	297
0.033	Anchovy	*Engraulis encrasicolus*	8.051													0.050	
2.609	Blue whiting	*Micromesistius poutassou*	633.328	209.106							113.352	61.400					
9.246	Sprat	*Sprattus sprattus*	2244.28					1.342					257.429	206.415	210.253	1.309	
0.051	Squids, octopusses	*Cephalopoda sp*	12.382			0.774	0.062		0.063	0.410			0.295	0.032			1.780
0.000	Northern pink shrimp	*Pandalus borealis*	0.009														
0.013	Norway lobster	*Nephrops norvegicus*	3.039														
0.081	Common weaver	*Trachinus draco*	19.563	0.095													
0.000	Solenette	*Buglossidium luteum*	0.02										0.010	0.010			
0.092	Anglerfish	*Lophiuspiscatorius*	22.328			13.400			0.350	2.474							
0.009	Halibut	*Hippoglossus hippoglossus*	2.116														
0.034	Horse mackerel	*Trachurus trachurus*	8.355	0.447								1.417	0.567		0.477	0.286	
0.096	Garfish	*Belone belone*	23.364								0.850				1.202		
0.688	Long rough dab	*Hippoglosides plattessoides*	167.068			1.285			0.094	0.088			0.219	1.204			0.486
13.747	Whiting	*Merlangius merlangus*	3336.589	0.014	0.002	232.791	5.754	16.776	105.700	32.414		0.002	245.335	1.618	0.090	0.796	44.538
0.853	Invertebrates	*Invertebrata*	207.022			0.320			0.818	1.474			0.046	0.478	0.200	0.204	0.172
1.904	Dab	*Limanda limanda*	462.115						2.454				9.700	11.275		0.782	1.706
1.224	Hake	*Merluccius merluccius*	297.187			2.364				2.384			11.000	1.014	2.886		3.082
0.917	Gurnard	*Trigala spp.*	222.588		0.598	5.732	12.200	51.200	6.800	4.866			32.400	34.600	11.690	24.600	5.142
0.653	Krill	*Euphausidae spp.*	158.376								0.871	1.310					
4.544	Haddock	*Melanogrammus aeglefinus*	1102.917		7.120	3.044		0.008	16.700	41.400			0.332				158.652
0.022	Ling	*Molva molva*	5.318						1.242								
0.103	Pollack	*Pollachius pollachius*	25.1														
0.004	Pearlside	*Mauorolicus muelleri*	1.05	0.037							0.164	0.013					
7.216	Mackerel	*Scomber scombrus*	1751.353	102.536	5.100	2.162	112.624	41.626	0.732	0.855	194.004	75.200			230.000	91.500	2.192
0.571	Saithe	*Pollachius virens*	138.602									6.950			0.457		3.450
0.507	Picked Dogfish	*Squalus acanthias*	123.123	20.000							4.526	2.498		0.298			
0.387	Plaice	*Pleuronectes platessa*	93.837			5.714			1.456	1.704			13.400	14.000		1.130	1.902
0.153	Lemon sole	*Microstomus kitt*	37.178			7.639			2.434				0.806	0.726			0.917
0.000	Common dragonet	*Callionymus lyra*	0.063														
40.879	Herring	*Clupea harengus*	9922.203	279.966			71.028	12.412			135.495	102.500	215.964	974.738	675.814	1.224	0.151
0.016	Gray sole	*Glyptocephalus cynoglossus*	3.768														
0.002	Flounder	*Platichthys flesus*	0.453														
0.024	Bass	*Dicentrarchus labrax*	5.885														
0.105	Snake blenny	*Lumpenus lampretaeformis*	25.537														
0.003	Edible crab	*Cancer pagurus*	0.764														
0.003	Brill	*Scophthalmus rhombe*	0.62														
0.001	Hagfish	*Myxine glutinosa*	0.241														
2.888	Norway pout	*Trisopterus esmarki*	700.861		0.001					0.046							0.076
0.711	Lumpsucker	*Cyclopterus lumpus*	172.457	6.165							1.885	12.420					
7.832	Large Medusa	Scyphozoa sp.	1900.929	1.635	13.980	0.364	48.309	49.572	44.400	3.426	8.850	1.060	8.280	2.436	16.930	338.100	5.170
0.244	Twaite shad	*Alosa fallax*	59.272													59.000	
0.094	Greater sandeel	*Hyperoplus lanceolatus*	22.745			0.086			1.040				2.628	0.140			18.500
0.264	Sandeel	*Ammodytes marinus*	63.97						0.002		0.003		13.090	0.140			21.335
0.001	Sole	*Solea solea*	0.322											0.322			
1.155	Cod	*Gadus Morhua*	280.375			8.120	0.024	0.332	15.100	10.800			20.500				27.522
0.003	Tarry ray	*Raja radiata*	0.848														
0.000	Butter fish	*Phalis qunnellus*	0.024														
0.018	Sculpin	*Myoxocephalus scorpius*	4.408														
100.000			24272.003	620.001	26.801	283.795	250.001	173.268	199.385	102.341	460.000	264.770	832.001	1249.446	1149.999	518.981	296.773

Table 3. continued.

		Station		615	658	673	762	770	843	859	944	959	1017	1033	1120	1137
		ICES sq.		43F7	44F7	44F7	43F8	43F8	44F8	45F8	44F9	44G0	45F9	46F9	46G0	45G0
		Gear		Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Fotø
		Fishing depth		Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	10-40
		Total depth		137	194	296	64	37	520	420	38	82	554	454	85	94
		Day/Night		D	N	N	D	D	N	N	D	D	N	N	D	D
%		Total catch	Total	950	284	820	193	183	434	511	4303	1887	430	180	245	46
0.033	**Anchovy**	*Engraulis encrasicolus*	8.001	0.033											0.062	
2.609	**Blue whiting**	***Micromesistius poutassou***	249.47	73.200	42.100	42.100			41.700							
9.246	**Sprat**	***Sprattus sprattus***	1567.532				0.015									
0.051	**Squids, octopusses**	***Cephalopoda sp***	8.966	1.797	0.176		3.352	1.168			1.774				0.255	
0.000	**Northern pink shrimp**	***Pandalus borealis***	0.009												0.009	
0.013	**Norway lobster**	***Nephrops norvegicus***	3.039												0.936	
0.081	**Common weaver**	*Trachinus draco*	19.468													
0.000	**Solenette**	***Buglossidium luteum***	0													
0.092	**Anglerfish**	***Lophiuspiscatorius***	6.104									4.382				
0.009	**Halibut**	***Hippoglossus hippoglossus***	2.116									2.116				
0.034	**Horse mackerel**	***Trachurus trachurus***	5.161		0.990	1.050		0.483		0.740				0.552		
0.096	**Garfish**	***Belone belone***	21.312										0.344	0.737		0.219
0.688	**Long rough dab**	*Hippoglosides plattessoides*	163.692	16.000			0.290					82.521			17.751	
13.747	**Whiting**	***Merlangius merlangus***	2650.759	15.400			36.271	11.600			1733.969	577.424			53.844	0.053
0.853	**Invertebrates**	*Invertebrata*	203.31	0.498			0.008	0.096			8.390	2.175			33.114	
1.904	**Dab**	*Limanda limanda*	436.198	0.231			0.861	2.044			150.618	65.006				
1.224	**Hake**	***Merluccius merluccius***	274.457	76.000			4.646	7.935			139.800	15.800			5.058	
0.917	**Gurnard**	*Trigala spp.*	32.76				1.026	5.964			12.720	0.106			0.186	
0.653	**Krill**	***Euphausidae spp.***	156.195		22.900				18.902				57.330	12.500		
4.544	**Haddock**	***Melanogrammus aeglefinus***	875.661	15.644			1.049				7.985	849.543			0.095	
0.022	**Ling**	*Molva molva*	4.076				1.904					1.758			0.414	
0.103	**Pollack**	*Pollachius pollachius*	25.1				25.100									
0.004	**Pearlside**	***Mauorolicus muelleri***	0.836						0.770							
7.216	**Mackerel**	***Scomber scombrus***	892.822	0.252	79.600	173.700		57.200	39.741	197.188			12.028	26.869		0.417
0.571	**Saithe**	***Pollachius virens***	127.745	89.000		3.888	2.920	1.436			1.043	12.425		3.924	0.448	
0.507	**Picked Dogfish**	***Squalus acanthias***	95.801	1.692	1.636	3.824			2.072	4.496					13.600	27.200
0.387	**Plaice**	*Pleuronectes platessa*	54.531	0.983			1.374	4.640			1.725	39.000			0.307	
0.153	**Lemon sole**	*Microstomus kitt*	24.656	13.430			0.160				1.255	8.640			0.770	
0.000	**Common dragonet**	*Callionymus lyra*	0.063													
40.879	**Herring**	***Clupea harengus***	7452.911	25.410	120.600	577.153	68.700	13.368	317.617	288.495	2225.654	1.797	324.263	114.300	4.149	
0.016	**Gray sole**	*Glyptocephalus cynoglossus*	3.768	2.624								0.924				
0.002	**Flounder**	***Platichthys flesus***	0.453													
0.024	**Bass**	*Dicentrarchus labrax*	5.885													
0.105	**Snake blenny**	***Lumpenus lampretaeformis***	25.537												25.403	
0.003	**Edible crab**	*Cancer pagurus*	0.764													
0.003	**Brill**	***Scophthalmus rhombe***	0.62													
0.001	**Hagfish**	***Myxine glutinosa***	0.241	0.167											0.017	
2.888	**Norway pout**	***Trisopterus esmarki***	700.738	566.470			24.100					17.153			80.804	
0.711	**Lumpsucker**	***Cyclopterus lumpus***	151.987		8.755	10.185			11.600	16.000			34.800	18.594		
7.832	**Large Medusa**	Scyphozoa sp.	1358.417		7.065	8.100	7.935	23.400	1.290	4.082	11.962	118.730	1.234	2.460	1.009	17.900
0.244	**Twaite shad**	***Alosa fallax***	0.272													
0.094	**Greater sandeel**	*Hyperoplus lanceolatus*	0.351				0.081									0.027
0.264	**Sandeel**	***Ammodytes marinus***	29.4					29.400								
0.001	**Sole**	*Solea solea*	0													
1.155	**Cod**	***Gadus Morhua***	197.977	50.900			13.600	24.500			5.314	87.500			6.649	
0.003	**Tarry ray**	***Raja radiata***	0.848													
0.000	**Butter fish**	***Phalis qunnellus***	0.024													
0.018	**Sculpin**	***Myoxocephalus scorpius***	4.408													
100.000			17844.441	949.731	283.822	820.000	193.392	183.234	433.692	511.001	4302.209	1887.000	429.999	179.936	244.880	45.816

Table 3. continued.

		Station		1180	1196	1268	1281	1339	1356	1452	1471	1523	1540	1619	1635	1685
		ICES sq.		45G0	45G0	44G1	44G1	43G0	44G1	43G1	42G1	42G2	42G1	41G1	41G1	41G0
		Gear		Fotø	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Expo
		Fishing depth		Surface	Surface	Surface	Bottom	Surface	Surface	Bootom	Bottom	Surface	Surface	Bottom	Bottom	Surface
		Total depth		232	197	67	61	41	40	56	39	46	32	32	25	22
		Day/Night		N	N	D	D	N	N	D	D	N	N	D	D	N
%		Total catch	Total	800	1900	35	252	190	360	660	1650	85	80	470	94	802
0.033	**Anchovy**	*Engraulis encrasicolus*	7.906			0.071		0.278	0.102			6.525	0.930			
2.609	**Blue whiting**	***Micromesistius poutassou***	50.37	41.300	9.070											
9.246	**Sprat**	***Sprattus sprattus***	1567.517				0.046	6.148	4.543	3.513	1062.029	1.391	1.955	413.392	37.700	36.800
0.051	**Squids, octopusses**	***Cephalopoda sp***	0.444				0.224			0.211			0.003		0.006	
0.000	**Northern pink shrimp**	***Pandalus borealis***	0													
0.013	**Norway lobster**	***Nephrops norvegicus***	2.103				1.650			0.292				0.123	0.038	
0.081	**Common weaver**	*Trachinus draco*	19.468			1.044		7.500	4.424		1.988	1.926	2.546			0.040
0.000	**Solenette**	***Buglossidium luteum***	0													
0.092	**Anglerfish**	***Lophiuspiscatorius***	1.722				1.722									
0.009	**Halibut**	***Hippoglossus hippoglossus***	0													
0.034	**Horse mackerel**	***Trachurus trachurus***	1.346		0.986		0.174		0.091		0.095					
0.096	**Garfish**	***Belone belone***	20.012	0.882	0.588	1.030	0.538	3.624	13.230				0.001			0.119
0.688	**Long rough dab**	*Hippoglosides plattessoides*	47.13				40.031			4.378	1.828			0.725	0.168	
13.747	**Whiting**	***Merlangius merlangus***	222.198			0.049	67.027	4.491	7.892	27.653	96.242	0.791		14.748	3.288	0.017
0.853	**Invertebrates**	*Invertebrata*	159.029				5.635			1.500	126.323		0.112	5.159	20.300	
1.904	**Dab**	*Limanda limanda*	217.438	147.459			0.546			0.887	39.800			12.500	16.100	0.146
1.224	**Hake**	***Merluccius merluccius***	25.218				24.700			0.518						
0.917	**Gurnard**	*Trigala spp.*	12.758			0.157	0.904			1.034	2.758	0.457	1.438	5.665		0.345
0.653	**Krill**	***Euphausidae spp.***	44.563		44.563											
4.544	**Haddock**	***Melanogrammus aeglefinus***	1.345				1.312	0.015				0.008			0.010	
0.022	**Ling**	*Molva molva*	0													
0.103	**Pollack**	*Pollachius pollachius*	0													
0.004	**Pearlside**	***Mauorolicus muelleri***	0.066	0.066												
7.216	**Mackerel**	***Scomber scombrus***	305.827	51.500	217.511	0.287		6.300	13.005	0.988	1.940	6.240	6.990	1.066		
0.571	**Saithe**	***Pollachius virens***	12.661		12.515		0.146									
0.507	**Picked Dogfish**	***Squalus acanthias***	41.281	1.860			39.300			0.121						
0.387	**Plaice**	*Pleuronectes platessa*	6.502				1.148			0.478	0.938			0.236	3.600	0.102
0.153	**Lemon sole**	*Microstomus kitt*	0.401				0.298			0.103						
0.000	**Common dragonet**	*Callionymus lyra*	0.063				0.048			0.015						
40.879	**Herring**	***Clupea harengus***	3371.405	510.576	1601.249	4.534	35.544	66.256	196.957	609.414	314.828	3.752	2.535	12.838	0.456	12.466
0.016	**Gray sole**	*Glyptocephalus cynoglossus*	0.22				0.220									
0.002	**Flounder**	***Platichthys flesus***	0.453											0.265	0.188	
0.024	**Bass**	*Dicentrarchus labrax*	5.885					5.296	0.589							
0.105	**Snake blenny**	***Lumpenus lampretaeformis***	0.134				0.114			0.020						
0.003	**Edible crab**	*Cancer pagurus*	0.764												0.658	0.106
0.003	**Brill**	***Scophthalmus rhombe***	0.62												0.620	
0.001	**Hagfish**	***Myxine glutinosa***	0.057							0.032				0.025		
2.888	**Norway pout**	***Trisopterus esmarki***	12.211				11.812			0.065		0.332				0.002
0.711	**Lumpsucker**	***Cyclopterus lumpus***	52.053	40.100	3.698	0.787			0.035	0.607	1.232	0.636	2.110	0.834		2.014
7.832	**Large Medusa**	Scyphozoa sp.	1153.25	6.437	9.819	26.600	18.022	89.722	118.961	3.401		62.933	61.379	3.762	2.844	749.370
0.244	**Twaite shad**	***Alosa fallax***	0.272					0.272								
0.094	**Greater sandeel**	*Hyperoplus lanceolatus*	0.243											0.027	0.216	
0.264	**Sandeel**	***Ammodytes marinus***	0													
0.001	**Sole**	*Solea solea*	0													
1.155	**Cod**	***Gadus Morhua***	9.514				0.788	0.098	0.098	4.280		0.009		3.256	0.858	0.127
0.003	**Tarry ray**	***Raja radiata***	0.848												0.848	
0.000	**Butter fish**	***Phalis qunnellus***	0.024												0.024	
0.018	**Sculpin**	***Myoxocephalus scorpius***	4.408												4.408	
100.000			7379.729	800.180	1899.999	34.559	251.949	190.000	359.927	659.510	1650.001	85.000	79.999	474.621	92.330	801.654

Table 4. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2016.

Station	1	154	172	329	341	438	448	495	515	596	615	658
ICES sq.	44F6	41F6	41F6	44F6	44F6	42F7	42F6	41F7	41F7	43F7	43F7	44F7
Gear	Fotø	Fotø	Fotø	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø
Fishing depth	Surface	Surface	Surface	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	382	46	44.5	304	362	36	38	29	28	53	137	194
Day/Night	N	N	N	N	N	D	D	N	N	D	D	N
Total catch,kg	620	250	173	460	265	838	1250	1150	550	297	950	284
Total catch Herring,kg	279.966	71.028	12.142	135.495	102.500	215.964	974.738	675.814	1.224	0.151	25.410	120.600
Sample Herring,kg	62.166	17.378	12.142	77.759	51.988	19.170	18.203	15.242	1.224	0.151	25.410	65.767
Length in cm												
5.5												
6												
6.5												
7									1			
7.5									1			
8									6			
8.5									6			
9									6			
9.5									7			
10									7			
10.5									6			
11									3			
11.5												
12												
12.5								1	1			
13			2					13	2			
13.5			23			3	1	40	7			
14		4	72			4	6	99	4		6	
14.5		20	121			22	18	133	6		10	
15		63	101			76	84	133	12	1	45	3
15.5	1	121	71	3	2	153	158	110	5	3	40	3
16	3	123	45	6	2	150	191	42	3	1	40	3
16.5	4	94	12	14	6	124	85	13	1		28	3
17	8	75	2	5	5	51	35	3			15	1
17.5	9	22	2	6	10	3	6				10	5
18	4	11		1	1	2					8	3
18.5	7	1		1	3	2					2	2
19	17	2		3	3	1					2	4
19.5	20			6	5						3	5
20	45			18	18						13	6
20.5	97			42	35						30	17
21	121			69	56						52	43
21.5	128			55	73						48	57
22	71			51	59						21	33
22.5	46			46	45						15	35
23	44			41	35						9	34
23.5	23			47	35							33
24	16			46	24						5	40
24.5	12			43	23						4	28
25	8			39	21						1	23
25.5	9			43	18						1	31
26	4			23	18						5	25
26.5	3			7	9							19
27	2			13	3							27
27.5				13							1	16
28	2			15	7							9
28.5	1			9								17
29	1			8								8
29.5				7								5
30	2											3
30.5				2							1	2
31				1								1
31.5				2								2
32												
32.5												1
Total no.	708	536	451	685	516	591	584	587	84	5	415	547
Mean Length	21.45	16.04	14.86	23.10	22.32	15.88	14.60	14.78	11.88	15.50	18.78	23.68

Table 4. continued.

Station	673	762	770	843	859	944	959	1017	1033	1120		1180
ICES sq.	44F7	43F8	43F8	44F8	45F8	44F9	44G0	45F9	46F9	46G0		45G0
Gear	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo		Fotø
Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom		Surface
Total depth	296	64	37	249	420	38	82	554	454	85		232
Day/Night	N	D	D	N	N	D	D	N	N	D		N
Total catch,kg	820	193	183	434	511	4303	1887	430	180	245		800
Total catch Herring,kg	577.153	68.700	13.368	317.617	288.495	2225.654	1.797	324.263	114.300	0.569	3.580	510.576
Sample Herring,kg	63.504	25.328	13.368	86.200	45.599	25.638	1.797	37.232	38.434	0.194	3.580	46.626
Length in cm												
5.5												
6												
6.5										2		
7										5		
7.5										3		
8										3		
8.5										15		
9										9		
9.5										4		
10												
10.5												
11												
11.5												
12												
12.5												
13											1	
13.5												
14		2									1	
14.5		40									1	
15		74			2	9					3	
15.5		92	5		4	38	2				2	
16		62	14		19	50	1				2	
16.5		49	23	2	28	50	2	1			6	4
17		49	42	4	35	47	1	2	3		2	9
17.5		23	24	4	19	62	1	7	8		8	14
18		21	28	2	19	91		14	17		8	45
18.5		14	24	8	21	70	3	32	35		6	93
19	2	20	24	10	29	64	4	50	32		2	76
19.5	2	9	9	19	34	34	2	40	41		3	77
20	11	13	14	22	31	18	3	66	52		4	55
20.5	21	29	10	48	38	8	3	61	53		2	58
21	42	23	14	60	45	2	2	56	41		1	49
21.5	47	21	3	60	39		2	49	56		2	40
22	45	5	3	45	38		1	37	39		2	36
22.5	42	7	3	41	27		1	16	29		2	15
23	52	2	1	32	21			17	34		1	18
23.5	28		2	35	23		1	15	19		1	12
24	35			22	20			4	9			5
24.5	25			31	21			6	7			8
25	35			16	8			2	2			3
25.5	29			17	7				1			7
26	17			8	8			1				4
26.5	26			7	6			1	5			2
27	21			4	11			1	3			2
27.5	19			6	6							1
28	11			4	7			2	2			
28.5	7			5	2							2
29	9			3	1							2
29.5				3								
30	1			3								
30.5	1				1							
31				2								
31.5												
32				3								
32.5												
Total no.	528	555	243	526	570	543	29	480	488	41	60	637
Mean Length	23.72	17.07	18.28	22.48	20.87	17.70	19.29	20.61	20.93	8.32	18.24	20.20

Table 4. continued

Station	1196	1268	1281	1339		1356		1452		1471		1523
ICES sq.	45G0	44G1	44G1	43G0		44G1		43G1		42G1		42G2
Gear	Fotø	Fotø	Expo	Fotø		Fotø		Expo		Expo		Fotø
Fishing depth	Surface	Surface	Bottom	Surface		Surface		Bootom		Bottom		Surface
Total depth	197	67	61	41		40		56		39		46
Day/Night	N	D	D	N		N		D		D		N
Total catch,kg	1900	35	252	190		360		660		1650		85
Total catch Herring,kg	1601.249	4.534	35.544	30.256	36.000	56.357	140.600	549.414	60.000	1062.209	17.613	3.752
Sample Herring,kg	35.903	4.534	35.544	0.942	24.890	1.118	18.808	0.992	11.650	0.724	17.613	3.752
Length in cm												
5.5				14								
6				13		5		4				
6.5				15		15		26				
7				13		13		49				
7.5				15		24		29				
8				13		31		20		7		
8.5				19		32		20		15		
9				36		38		22		57		
9.5				35		25		37		46		
10				22		22		13		9		
10.5				11		8		5		2		
11				2		2		3		1		
11.5												
12												
12.5									1			
13									1			1
13.5									3			4
14									10		1	17
14.5					5				46		11	10
15			2		12		10		46		16	18
15.5	1		3		58		50		68		24	17
16	3		10		59		53		61		39	11
16.5	6		18		41		40		62		50	4
17	1		20		55		39		31		92	5
17.5	13		46		63		49		22		103	7
18	46		75		88		40		21		49	1
18.5	86	1	87		76		34		12		23	4
19	69		89		46		27		1		3	4
19.5	68	2	71		26		17		4		9	6
20	63	8	62		17		17		6		15	3
20.5	54	4	45		9		9		4		11	3
21	41	10	30		11		12		2		5	2
21.5	25	12	31		4		10		2		2	3
22	11	7	9		1		3				4	3
22.5	8	3	9				4		1		3	
23	6	3	4		3		4					
23.5	8	3	4		2		1		1			
24	1		1								2	
24.5		1										
25			2									
25.5	1											
26												
26.5	2	1										
27	1											
27.5			1									
28	1											
28.5												
29												
29.5												
30												
30.5												
31												
31.5												
32												
32.5												
Total no.	515	55	619	208	576	215	419	228	405	137	462	123
Mean Length	19.68	21.45	19.16	8.34	17.64	8.48	17.68	8.11	16.19	9.16	17.35	16.36

Table 4. continued

Station	1540	1619	1635	1685
ICES sq.	42G1	41G1	41G1	41G0
Gear	Fotø	Expo	Expo	Expo
Fishing depth	Surface	Bottom	Bottom	Surface
Total depth	32	32	25	22
Day/Night	N	D	D	N
Total catch,kg	80	470	94	802
Total catch Herring,kg	2.535	12.838	0.456	12.466
Sample Herring,kg	2.535	12.838	0.456	12.466
Length in cm				
5.5				
6				
6.5				
7				
7.5				
8	1			
8.5	2			
9	3			
9.5	6			
10	2			
10.5				
11				
11.5				
12				
12.5				
13				
13.5				
14		1		
14.5		1		
15	1	2	1	
15.5		13		6
16	3	19	1	48
16.5	4	45	1	126
17	6	54	1	105
17.5	9	66		38
18	11	31	1	6
18.5	3	19		10
19	5	17		12
19.5	3	16		3
20	4	16	1	4
20.5	2	12	1	
21	2	6	1	
21.5		1		
22	2	2		
22.5		2		
23	1	2		
23.5		2		
24	1	2		
24.5		1		
25			1	
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
Total no.	71	330	9	358
Mean Length	16.60	17.85	18.78	16.90

Table 5. Measured length distribution of mackerel by haul for the Danish acoustic survey with R/V Dana in June-July 2016.

Station	1	83	99	154	172	259	280	329	341	495	515	596
ICES sq.	44F6	43F6	43F6	41F6	41F6	42F6	43F6	44F6	44F6	41F7	41F7	43F7
Gear	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Fotø	Fotø	Expo
Fishing depth	Surface	40-50	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Surface	Surface	Bottom
Total depth	382	78	57	46	44.5	54	65	304	362	29	28	53
Day/Night	N	D	D	N	N	D	D	N	N	N	N	D
Total catch,kg	620	27	300	250	173	199	104	460	265	1150	550	297
Total catch Mackerel,kg	102.536	5.100	2.162	112.624	41.626	0.732	0.855	194.004	75.200	230.000	91.500	2.192
Sample Mackerel,kg	44.279	5.100	2.162	47.093	41.626	0.732	0.855	43.752	33.506	30.386	27.440	2.192
Length in cm												
15												
16												
17												
18												
19												
20								1	1			
21								1	1	1		
22	1											
23									1		2	
24						1			1	1	2	
25	1	2			2					1	1	
26	34	4		1	10			13	11	25	25	
27	75	13	1	10	19		1	76	54	62	71	1
28	56	9		25	21		1	65	72	40	26	2
29	14		1	22	13			34	17	4	3	
30	3		2	19	5			1	3	3	3	
31	3	1	1	11	9			7	2	1	3	
32	4			20	23			1	3	9	2	1
33	3			27	28	1		7	2	4	2	
34	8			10	13	1		1	4	4	3	1
35	6			16	7			3	2	1	2	2
36	5		1	4	7			2				
37	3		1	6	1				2			
38	2			2	1			2				
39	2		1					1				
40				2				2		1		
41	1						1					
42												
43								1				
44												
45								1				
46												
47												
48												1
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												
61												
Total no.	221	29	8	175	159	3	3	219	176	157	145	8
Mean length	28.54	27.17	32.38	31.42	30.76	30.33	32.00	28.50	28.04	27.91	27.49	33.38

Table 5. continued

Station	615	658	673	770	843	859	944	1017	1033	1180	1196	1268
ICES sq.	43F7	44F7	44F7	43F8	44F8	45F8	44F9	45F9	46F9	45G0	45G0	44G1
Gear	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Fotø	Fotø	Fotø
Fishing depth	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface	Surface	Surface	Surface	Surface
Total depth	137	194	296	37	249	420	38	554	454	232	197	67
Day/Night	D	N	N	D	N	N	D	N	N	N	N	D
Total catch,kg	950	284	820	183	434	511	4303	430	180	800	1900	35
Total catch Mackerel,kg	0.252	79.600	173.700	57.200	39.741	197.188	0.792	12.028	26.869	51.500	217.511	0.287
Sample Mackerel,kg	0.252	28.422	43.302	24.519	39.741	38.036	0.792	12.028	26.869	38.758	25.918	0.287
Length in cm												
15												
16												
17												
18												
19												
20												
21						2			5			
22			1		2	2			12	4	2	
23		3	2		2	5		1	15	7		
24					3	1			5	4		1
25		2			6	1		1	2	3	2	
26		7	8	17	13	12		8	10	13	19	
27		52	69	75	83	89	1	16	51	58	67	
28		69	86	40	69	88	1	17	58	79	37	1
29		14	37	6	10	16		6	8	46	12	
30		1	8									
31	1	2	1							3	1	
32			6		3			1				
33			3		1			3		2	1	
34		1	1		3	2		3		6	1	
35			1		3					1		
36		2	1		4			2		1		
37										1		
38		1	1				1					
39					2				1	1		
40			1		2							
41										1		
42												
43					1							
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												
61												
Total no.	1	154	226	138	207	218	3	58	167	230	142	2
Mean length	31.00	27.79	28.16	27.25	27.99	27.34	31.00	28.33	26.44	27.92	27.32	26.00

Table 5. continued

Station	1339	1356	1452	1471	1523	1540	1619
ICES sq.	43G0	44G1	43.G1	42G1	42G2	42G1	41G1
Gear	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo
Fishing depth	Surface	Surface	Bootom	Bottom	Surface	Surface	Bottom
Total depth	41	40	56	39	46	32	32
Day/Night	N	N	D	D	N	N	D
Total catch,kg	190	360	660	1650	85	80	470
Total catch Mackerel,kg	6.300	13.005	0.988	1.940	6.240	6.990	1.066
Sample Mackerel,kg	6.300	13.005	0.988	1.940	6.240	6.990	1.066
Length in cm							
15							
16							
17							
18							
19							
20		1					
21	3						
22	1	3					
23	2						
24	1	3					
25	1				1		
26	5	11			2	1	
27	13	40			3	2	
28	12	11			6	6	
29	2	4		1	8	10	
30				1	2	2	
31		1		1			
32				1		3	
33					2	2	
34		2			1	3	
35			1				
36						1	
37				2	1		
38							
39			1				
40					1		
41							
42							
43							
44							
45							
46							
47							
48							
49							1
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
Total no.	40	76	2	6	27	30	1
Mean length	26.38	26.93	37.00	32.67	29.44	29.93	49.00

Table 6. Measured length distribution of sprat by haul for the Danish acoustic survey with R/V Dana in June-July 2016.

Station	172	438	448	495	515	762	1281	1339	1356	1452	1471	1523	1540	1619	1635	1685
ICES sq.	41F6	42F7	42F6	41F7	41F7	43F8	44G1	43G0	44G1	43.G1	42G1	42G2	42G1	41G1	41G1	41G0
Gear	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Expo
Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bootom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	44.5	36	38	29	28	64	61	41	40	56	39	46	32	32	25	22
Day/Night	N	D	D	N	N	D	D	N	N	D	D	N	N	D	D	N
Total catch.kg	173	838	1250	1150	550	193	252	190	360	660	1650	85	80	470	94	802
Total catch Sprat,kg	1.342	257.429	206.415	210.253	1.309	0.015	0.046	6.148	4.543	3.513	1062.029	1.391	1.955	413.392	37.7	36.8
Sample Sprat,kg	1.342	5.261	4.412	2.477	1.309	0.015	0.046	1.254	0.464	0.438	2.808	1.391	1.955	2.252	2.706	3.819
Length in cm																
5.5																
6																
6.5							1									
7							1					1				
7.5												2				
8	2						2		1			7				
8.5	1							1	6			6				
9	4							2	16	1		2				
9.5	6			2	8			31	11	1	3	3		1		
10	17		1	9	18			52	14		7	12	2	1		
10.5	30		2	49	36		1	46	11		2	3	1	4		
11	36	8	12	73	22		2	10	2		4	12	6	8	5	1
11.5	17	34	19	45	22		1	1	1	2	16	14	13	30	24	15
12	9	73	65	19	9			1		8	31	17	26	40	62	50
12.5	7	110	95	12	3	1				6	29	15	32	34	52	71
13	3	70	67							3	31	13	22	21	33	40
13.5	2	38	19	2						3	23	9	13	12	17	30
14		10	7	2						1	19	1	8	6	5	17
14.5										3	6	2	5	3	3	11
15										2	4	1	4	1		6
15.5												1				
16											1					
16.5																
17																
17.5																
18																
18.5																
19																
19.5																
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21																
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22																
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23																
23.5																
24																
24.5																
25																
Total no.	134	343	287	213	118	1	8	144	62	30	176	121	132	161	201	241
Mean Length	10.86	12.52	12.45	11.16	10.80	12.50	9.19	10.12	9.62	12.65	12.64	11.37	12.61	12.28	12.42	12.79

Table 7. CTD station details for the Danish acoustic survey with R/V Dana in June-July 2016.

						Bottom	Wind	
Date	Stat.	Time	ICES	Position		depth	speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	m	m/s	
25-06-16	6	01:53	44F6	57.50.1530N	006.47.076 E	369	2.7	1
25-06-16	82	10:11	43F6	57.22.790 N	006.13.024 E	79	1.3	1
25-06-16	104	15:17	43F6	57.04.467 N	006.25.361 E	54	3.7	0
25-06-16	153	20:20	41F6	56.21.135 N	006.12.725 E	45	8.2	0
26-06-16	177	01:44	41F6	56.01.961 N	006.22.762 E	45	8.4	2
26-06-16	258	10:11	42F6	56.58.007 N	006.25.483 E	55	13.1	2
26-06-16	285	15:54	43F6	57.13.023 N	006.47.035 E	66	9.6	3
26-06-16	328	20:35	44F6	57.37.584 N	006.42.803 E	255	8.2	4
27-06-16	347	01:57	44F6	57.54.145 N	006.42.456 E	375	4.1	2
27-06-16	443	13:08	42F7	56.36.614 N	007.07.724 E	34	9.0	2
27-06-16	452	11:02	42F6	56.35.833 N	006.54.017 E	338	10.6	4
27-06-16	494	20:26	41F7	56.10.192 N	007.13.204 E	32	8.4	4
28-06-16	521	02:08	41F7	56.06.524 N	007.42.495 E	29	9.1	3
28-06-16	596	10:06	43F7	57.13.621 N	007.32.271 E	53	6.5	3
28-06-16	619	15:12	43F7	57.28.455 N	007.58.260 E	145	7.0	3
28-06-16	657	20:27	43F7	57.29.692 N	007.55.906 E	165	6.6	3
29-06-16	678	01:43	44F7	57.39.559 N	007.51.776 E	374	5.7	2
29-06-16	762	10:05	43F8	57.26.037 N	008.18.612 E	69	9.1	2
29-06-16	774	13:46	43F8	57.25.882 N	008.37.363 E	34	7.2	2
29-06-16	839	20:07	44F8	57.56.330 N	008.54.509 E	515	5.8	3
30-06-16	865	01:48	45F8	58.10.365 N	008.46.250 E	452	11.0	3
30-06-16	942	10:05	44F9	57.43.042 N	009.39.753 E	35	7.7	3
30-06-16	956	12:42	44G0	57.44.225 N	010.04.756 E	84	7.9	4
30-06-16	1013	20:13	45F9	58.28.059 E	009.48.734 E	615	7.4	4
01-07-16	1038	01:56	46F9	58.40.315 N	009.38.871 E	403	4.5	3
01-07-16	1120	10;58	46G0	58.35.497 N	010.50.615 E	82	10.3	3
01-07-16	1142	15:52	45G0	58.23.687 N	010.53.616 E	114	11.9	4
01-07-16	1178	20:18	45G0	58.13.565 N	010.23.746 E	273	10.3	4
02-07-16	1201	01:56	45G0	58.07.247 N	010.53.848 E	157	0.4	4
02-07-16	1267	10:01	44G0	57.54.543 N	010.54.373 E	124	7.1	4
02-07-16	1285	14:38	44G1	57.53.837 N	011.11.548 E	66	10.3	4
02-07-16	1337	20:20	43G0	57.26.865 N	010.49.942 E	41	7.0	4
03-07-16	1361	01:48	44G1	57.30.919 N	011.05.394 E	40	5.3	2
03-07-16	1451	10:22	43G1	57.08.544 N	011.51.183 E	54	9.4	2
03-07-16	1475	15:42	42G1	56.47.304 N	011.42.114 E	30	7.4	2
03-07-16	1522	20:25	42G2	56.32.085 N	012.12.221 E	51	5.2	2
04-07-16	1545	01:46	42G1	56.33.748 N	011.45.442 E	33	10.5	3
04-07-16	1619	10:12	41G1	56.20.731 N	011.58.806 E	32	8.2	3
04-07-16	1638	14:23	41G1	56.08.997 N	011.53.144 E	24	8.2	3
04-07-16	1683	20:10	41G0	56.12.346 N	010.57.767 E	26	5.7	3

Table 8. WP2 station details for the Danish acoustic survey with R/V Dana in June-July 2016.

						Mean	WP2	Wind		Dry Weight			
Date	Station	Time	ICES	Position		depth	depth	speed	Sea state	mg dry weight/m*2			
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	m	m	m/s		SumDryW	Frac2000	Frac1000	Frac180
25-06-16	104	15:31	43F6	57.04.578 N	006.25.567 E	55	51,8	0,3	0	4762	0	314	4447,6
25-06-16	153	20:33	41F6	56.21.096 N	006.12.838 E	45	41,8	7,7	0	3943	13,6	943,6	2986
26-06-16	285	15:54	43F6	57.13.023 N	006.47.035 E	66	53,5	9,6	3	9076	33,6	1910,8	7131,2
26-06-16	328	21:10	44F6	57.37.494 N	006.42.953 E	250	153,8	6,8	4	7441	1550	1282,4	4608,8
27-06-16	452	16:00	42F6	56.35.925 N	006.54.218 E	37	33,8	12,4	4	7021	37,2	2360,8	4623,2
27-06-16	494	20:37	41F7	56.10318 N	007.13.233 E	31	27,0	7,9	4	21402	240	3864,4	17298
28-06-16	619	15:39	43F7	57.28.687 N	007.58.499 E	147	136,9	8,6	3	14234	1556	2860	9817,6
28-06-16	657	20:59	43F7	57.29.840 N	007.56.231 E	168	152,8	5,3	3	14208	132	5891,6	8185
29-06-16	774	13:59	43F8	57.25.931 N	008.37.308 E	34	28,6	6,0	3	6239	133,6	1410	4695,2
29-06-16	839	20:36	44F8	57.56.536 N	008.54.654 E	521	154,4	7,4	3	8340	165,6	1987,2	6186,8
30-06-16	956	02:38	44G0	57.44.218 N	010.06.193 E	82	77,5	6,1	4	21363	6223,6	4178	10961,6
30-06-16	1013	20:45	45F9	58.28.496 N	009.48.654 E	621	151,2	7,7	4	6433	288,8	1317,2	4827,2
01-07-16	1142	16:17	45G0	58.24.098 N	010.53.630 E	110	101,7	10,9	4	10564	87,6	3624	6852
01-07-16	1178	20:45	45G0	58.13.864 N	010.23.270 E	292	150,1	8,0	4	11706	2368,8	3664,4	5673,2
02-07-16	1285	00:43	44G1	57.54.138 N	011.12.606 E	71	56,9	10,0	4	15922	1769,6	4198,4	9953,6
02-07-16	1337	20:37	43G0	57.26.956 N	010.49.835 E	40	38,5	6,0	4	9324	168,4	1273,6	7881,6
03-07-16	1475	15:53	42G1	56.47.278 N	011.42.207 E	30	27,4	7,6	2	7033	155,6	467,2	6410
03-07-16	1522	20:46	42G2	56.32.131 N	012.12.377 E	52	45,4	3,6	2	9362	0	690,4	8671,6
04-07-16	1638	14:23	41G1	56.08.997 N	011.53.144 E	24	19,0	8,2	3	7638	84,4	1444,4	6109,6
04-07-16	1683	20:20	41G0	56.12.325 N	010.57.785 E	22	18,4	5,8	3	11338	93,6	578,4	10666

Table 9 Survey statistics for the Danish acoustic survey with R/V Dana in June-July 2016

strata	Area, NM*2	ESDU	Haul	Mean Sa	Mean TS
ST21	3292.839	192	10	2.57E-06	1.22E-05
ST31	1911.706	92	7	3.66E-06	3.25E-05
ST41	1823.107	71	5	2.71E-06	4.07E-05
ST42	3710.053	144	8	3.11E-06	4.95E-05
ST151	6261.572	324	12	2.84E-06	3.59E-05
ST152	1716.322	87	5	1.47E-06	7.41E-05

Table 10. Abundance, mean weight, mean length and biomass by age group and sub area for North Sea autumn spawning herring in the Danish acoustic survey with R/V Dana in June-July 2016

Numbers Autumn spawning herring in mill.												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
21	628.5142	8.725094	0	2.526195	0.141665	0.01339	0.104492	0	0.011221	0	0	0
31	1.807243	94.61509	0	81.19763	0.598272	0.809842	1.873917	0.206375	1.066385	0.050713	0	0
41	0	26.55295	0	3.389092	0.003918	0.002636	0	0	0	0	0	0
42	0	79.14199	0	139.791	7.227971	2.793272	4.4269	1.455787	3.829027	1.110163	0	0.063909
151	0.283347	47.58193	0	0.570718	0.015297	0.008742	0	0	0	0	0	
152	0	1.558382	0	15.49028	1.797957	0.822994	1.429285	0.187486	0.853756	0.14821	0	0.019338
Biomass Autumn spawning herring in ton.												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
21	2318.458	290.9582	0	114.06	10.60445	1.084158	6.949178	0	1.315203	0	0	0
31	5.801749	5263.664	0	5965.957	52.64792	80.91491	191.2981	27.60006	127.9599	5.730531	0	0
41	0	1205.917	0	231.1913	0.407479	0.326894	0	0	0	0	0	0
42	0	4428.717	0	11784.82	881.6027	323.4535	591.6094	221.0886	737.5265	168.6339	0	14.63519
151	1.407694	1308.5	0	38.84627	1.590923	1.083948	0	0	0	0	0	0
152	0	84.73635	0	1401.138	231.3233	110.3556	196.6076	31.76697	156.7984	26.3065	0	5.039986
Mean length Autumn spawning herring in cm.												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
21	8.48	16.56	0.00	18.23	21.17	22.53	20.92	0.00	24.18	0.00	0.00	0.00
31	8.43	18.77	0.00	20.35	21.50	22.86	22.99	25.38	24.03	25.00	0.00	0.00
41	0.00	17.64	0.00	19.68	22.00	25.75	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	18.75	0.00	21.16	23.21	24.28	25.07	26.03	27.73	26.16	0.00	29.50
151	9.24	15.45	0.00	19.99	22.00	25.75	0.00	0.00	0.00	0.00	0.00	0.00
152	0.00	18.68	0.00	21.60	23.48	24.75	24.98	27.01	27.36	27.06	0.00	30.46
Mean weight Autumn spawning herring in g.												
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
21	3.69	33.35	0.00	45.15	74.86	80.97	66.50	0.00	117.21	0.00	0.00	0.00
31	3.21	55.63	0.00	73.47	88.00	99.91	102.08	133.74	119.99	113.00	0.00	0.00
41	0.00	45.42	0.00	68.22	104.00	124.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	55.96	0.00	84.30	121.97	115.80	133.64	151.87	192.61	151.90	0.00	229.00
151	4.97	27.50	0.00	68.07	104.00	124.00	0.00	0.00	0.00	0.00	0.00	0.00
152	0.00	54.37	0.00	90.45	128.66	134.09	137.56	169.44	183.66	177.49	0.00	260.63

Table 11. Abundance, mean weight, mean length and biomass by age group and sub area for Baltic Sea spring spawning herring in the Danish acoustic survey with R/V Dana in June-July 2016

Numbers Spring spawning herring in mill.														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
21	202.0383	13.63894	0.518916	4.237349	1.497143	0.133251	0.980781	0	0.273676	0.07103	0.021113	0	0	0
31	0.285822	62.33557	4.409636	53.98937	26.52026	7.002178	16.92262	0	6.230426	1.110074	0.050713	0.237849	0.142066	0.1094
41	0	32.48872	0	2.955147	0.450655	0.002349	0.031161	0.017491	0.003954	0.001318	0	0	0	0
42	0.238672	64.32125	0	106.4422	44.10811	13.55002	81.00337	2.139864	39.07346	9.364109	1.81189	0.165272	0.870549	0.688139
151	0.096459	245.9035	0	0.29559	0.182111	0.006556	0.048078	0	0.013112	0.004371	0	0	0	0
152	0	1.448997	0.244174	7.327453	7.46989	0.624992	11.04707	0.137972	5.269136	1.497991	0.282918	0.105566	0.134198	0.037151
Biomass Spring spawning herring in ton.														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
21	726.1063	461.8109	18.14337	178.0924	77.72751	9.009312	59.69872	0	17.96392	4.788561	1.300565	0	0	0
31	0.646184	3353.388	237.364	3619.92	2102.859	495.5345	1532.045	0	717.8968	156.3627	4.817703	22.59568	18.61062	10.06481
41	0	1379.604	0	199.7122	36.11387	0.232551	3.266997	1.294346	0.548332	0.213516	0	0	0	0
42	10.02421	3332.267	0	8427.478	4092.733	1323.082	8873.46	188.5996	5292.804	1415.656	316.8483	27.60048	134.6282	92.47568
151	0.527508	6712.751	0	23.63155	17.09806	0.649044	5.109346	0	1.818247	0.708102	0	0	0	0
152	0	64.25178	16.22777	612.6062	713.3199	72.94304	1295.038	8.416292	822.7746	222.6024	49.16666	16.51639	21.25659	7.583716
Mean length Spring spawning herring in cm.														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
21	8.28	16.79	17.32	17.95	19.75	21.27	20.94	0.00	21.41	22.04	22.27	0.00	0.00	0.00
31	7.76	18.74	19.15	19.80	20.93	20.87	22.51	0.00	24.31	25.70	25.00	23.50	26.50	24.00
41	0.00	17.29	0.00	19.66	20.59	23.00	23.32	21.00	26.83	28.00	0.00	0.00	0.00	0.00
42	17.50	18.39	0.00	20.82	22.09	22.75	23.85	22.45	25.55	26.45	28.27	28.00	27.29	26.30
151	9.34	15.40	0.00	20.80	21.75	23.00	23.77	0.00	26.83	28.00	0.00	0.00	0.00	0.00
152	0.00	17.65	20.02	21.02	22.16	23.53	24.27	20.50	26.62	26.07	27.50	27.55	27.29	30.23
Mean weight Spring spawning herring in g.														
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9
21	3.59	33.86	34.96	42.03	51.92	67.61	60.87	0.00	65.64	67.42	61.60	0.00	0.00	0.00
31	2.26	53.80	53.83	67.05	79.29	70.77	90.53	0.00	115.22	140.86	95.00	95.00	131.00	92.00
41	0.00	42.46	0.00	67.58	80.14	99.00	104.84	74.00	138.66	162.00	0.00	0.00	0.00	0.00
42	42.00	51.81	0.00	79.17	92.79	97.64	109.54	88.14	135.46	151.18	174.87	167.00	154.65	134.39
151	5.47	27.30	0.00	79.95	93.89	99.00	106.27	0.00	138.67	162.00	0.00	0.00	0.00	0.00
152	0.00	44.34	66.46	83.60	95.49	116.71	117.23	61.00	156.15	148.60	173.78	156.46	158.40	204.13

Table 12. Abundance, mean weight, mean length and biomass by age group and sub area for sprat in the Danish acoustic survey with R/V Dana in June-July 2016.

Numbers sprat in mill.							
WR	0	1i	1m	2i	2m	3	4
21	0	5.4026	0	671.1656	0	279.1083	0.8659
31	0	0	0	0	0	0	0
41	0	0	0	0.0014	0	0	0
42	0	0	0	0	0	0	0
151	0	7.7935	0	708.2964	0	100.8262	0
152	0	0	0	0	0	0	0
Biomass sprat in ton.							
WR	0	1i	1m	2i	2m	3	4
21	0	37.7036	0	8651.8740	0	4807.2319	18.8241
31	0	0	0	0	0	0	0
41	0	0	0	0.0171	0	0	0
42	0	0	0	0	0	0	0
151	0	75.7936	0	9335.8829	0	1752.6649	0
152	0	0	0	0	0	0	0
Mean length sprat in cm.							
WR	0	1i	1m	2i	2m	3	4
21	0	9.49	0	12.17	0	13.33	14.5
31	0	0	0	0	0	0	0
41	0	0	0	12.5	0	0	0
42	0	0	0	0	0	0	0
151	0	10.49	0	11.80	0	13.01	0
152	0	0	0	0	0	0	0
Mean weight sprat in g.							
WR	0	1i	1m	2i	2m	3	4
21	0	6.98	0	12.89	0	17.22	21.74
31	0	0	0	0	0	0	0
41	0	0	0	12.26	0	0	0
42	0	0	0	0	0	0	0
151	0	9.73	0	13.18	0	17.38	0
152	0	0	0	0	0	0	0