Acoustic Herring Survey report for RV "DANA"

25th June – 8th July 2015

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Cruise summary

Total days	14
Days of monitoring	12
Number of acoustic samples, ESDU monitored	1801
Number of trawl hauls	40
Number of CTD stations	46
Number of WP2 stations	22
Fish catch in kg	37502
Number of measured herring	19082
Number of measured mackerel	3543
Number of measured sprat	1987
Number of herring frozen for age and race-split	2936
Number of sprat frozen for age and race-split	814

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 2015-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period June 27 June to July 8 2015, while calibration was done during June 25 to June 27 2015.

2. SURVEY

2.1 Personnel

During calibration 25/6– 27/6 2015
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Eik Ehlert Britsch
Christian Petersen
Hans Erik Tjelum
Claus Halle

During acoustic monitoring 27/6 - 8/7-2015
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Annegrete D. Hansen
Susanne Hansen
Nina Fuglsang
Jan Pedersen
Lise Sindal
Ronny Sørensen
Jacopo Bridda, Monitoring technology group

2.2 Narrative

The survey of R/V Dana started on June 25th 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 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 in 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 20.01 UTC at 57º52.2’N, 007º36.9’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.

At July 8 at 17.11 UTC Dana was called for assistant in a rescue operation. The integration was stopped at 56º 31’N, 011º 32‘E. A capsized sailing boat was salvaged at 56º 19’N, 011º 39‘E. After the operation we steamed for a fishing station at 56º 13’N, 010º 57‘E. Due to the rescue operation approximately 30 NM of acoustic transect had to be cancelled.

The acoustic integration was ended July 8 at 57º 22’N, 10º 44‘E at 06.18 UTC.

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

Totally the survey covered about 1801 nautical miles of monetering. 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 2015. 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.

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.
22 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):

Herring TS = 20 log L – 71.2 dB
Sprat TS = 20 log L – 71.2 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.

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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 1801 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 2015 40 hauls were conducted, 22 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 37.5 tons. Herring was present in 37 hauls with a total catch of 15.9 tons or 42.5 % of the total catch. Totally 19,082 herring have been measured. Length distributions of herring per haul are given in Table 5.

The total sprat catch was 2.8 tons or 7.3 % of the total catch. Totally 1,987 sprat have been measured. Length distributions of sprat per haul are given in table 6.

Mackerel were present in 34 hauls with a total catch of 9.9 ton or 26.4 % of the total catch. Totally 3,543 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 42.5%, 26.4 % and 7.3 % respectively.

Herring maturity

Based on the frozen single fish herring samples (2936 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:

Skagerrak							
WR	0	1i	1m	2i	2m	3i	3m
%	100.00	100.00	0.00	92.49	7.51	100.00	0.00

Kattegat							
WR	0	1i	1m	2i	2m	3i	3m
%	100.00	100.00	0.00	100.00	0.00	100.00	0.00

North Sea							
WR	0	1i	1m	2i	2m	3i	3m
%	100.00	100.00	0.00	50.00	50.00	100.00	0.00

Baltic Sea spring spawners:

Skagerrak																	
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
%	100.00	98.76	1.24	59.56	40.44	7.10	92.90	3.66	96.34	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Kattegat													
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8
%	100.00	99.12	0.88	72.54	27.46	43.58	56.42	7.25	92.75	100.00	100.00	100.00	100.00

North Sea											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
%	100.00	100.00	0.00	99.39	0.61	0.00	100.00	0.00	100.00	100.00	100.00

Sprat maturity

Based on 814 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 ≥3 and/or age ≥3 are regarded as mature

Skagerrak								
WR	0	1i	1m	2i	2m	3	4	5
%	100.00	99.88	0.12	71.88	28.12	100.00	100.00	100.00

Kattegat										
WR	0	1i	1m	2i	2m	3	4	5	6	7
%	100.00	97.57	2.43	73.65	26.35	100.00	100.00	100.00	100.00	100.00

North Sea							
WR	0	1i	1m	2i	2m	3	4
%	100.00	96.32	3.68	84.04	15.96	100.00	100.00

3.3 Biomass estimates

Herring

The total herring biomass estimate for the Danish acoustic survey with R/V Dana in July 2015 is 283,376 tonnes of which 36.5 % or 103,423 tonnes is North Sea autumn spawners and 63.5 % or 179,954 tonnes is Baltic Sea spring spawners.

For the total number of herring the survey results give 7,823 mill, of which 37.7 % 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.

Relative Herring density (in numbers per nm²) of both stocks along the track of the Danish acoustic survey with R/V Dana in June-July 2015 is shown in Figure 4.

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

North Sea autumn spawners

From 2006 to 2007 there was an increase in the abundance of autumn spawners of 190 % and in the biomass of 219 %. The age structure in the abundance for 2006 and 2007 showed the same pattern with 86 % and 91 % of the total abundance as 1 WR for the two years respectively (see Table 12). This increase in both abundance and biomass from 2006 to 207 therefore corresponds to an overall increase of the abundance of autumn spawners in the survey area.

From 2007 to 2008 the abundance of autumn spawners showed an increase of 0.7% whereas the biomass showed a decrease of 74%. As it can be seen from Table 12 this contradictory development between abundance and biomass is the result of a dramatic change in age composition of the abundance from 2007 to 2008. In 2007 1 WR contributed to 91 % of the abundance of autumn spawners, whereas the 0 WR contributes to 88 % of the abundance in 2008.

From 2008 to 2009 the abundance of autumn spawners showed an increase of 116 % and the biomass showed an increase of 96%. As it can be seen from Table 12 the abundance in 2009 is dominated by 0 and 1 WR (81 and 19 % respectively), as in 2008. The abundance of 0 WR are the double of what was seen in 2008 and 1 WR are than 4 times the abundance in 2008. This can be explained by a general increase of the abundance of 0 and 1 WR in the survey area since 2008

From 2009 to 2010 the abundance of autumn spawners has decreased by 72 % whereas the biomass has decreased with 6%. From Table 12 it can be seen that the abundance is dominated by 1 WR in

2010 where it was dominated by 0 WR in 2008 and 2009. It looks as if the age structure in the abundance is on its way back to the structure seen in 2006 and 2007 (see Table 12)

From 2010 to 2011 the abundance of autumn spawners has increased by 89% whereas the biomass has increased with 7%. From table 12 it can be seen that the abundance of autumn spawners are dominated by 1 WR as in 2011 but the abundance of 0 WR and 2 WR has increased compared to 2010. The shift to a larger fraction of 0 WR compared with 2010 results in the larger in increase on abundance compared with biomass.

From 2011 to 2012 the abundance of autumn spawners has decreased by 7% whereas the biomass has increased with 11%. Table 12 shows that the fraction of 0 WR has decreased drastically from 2011 to 2012 whereas the fractions of 1WR and older have increased.

From 2012 to 2013 the abundance of autumn spawners has decreased by 78 % whereas the biomass has decreased with 76%. Table 12 shows that in 2013 no fish of 4 WR or older have been seen. For 0 and 1 WR the age structure in 2013 and 2012is comparable. The decrease in both abundance and biomass can therefore be seen as the result of both the lack of individuals of 4 WR or older and a general decrease of 0 and 1WR.

From 2013 to 2014 the abundance of autumn spawners has increased by 328 % whereas the biomass has decreased with 5% compared to 2013. From table 12 it can be seen that the abundance now is dominated by 0 WR were it for the last 4 years have been dominated by 1WR.

From 2014 to 2015 the abundance of autumn spawners has decreased by 36 % whereas the biomass has increased with 75% compared to 2014. From table 12 it can be seen that the abundance now is dominated by 1 WR (96%) as for the years 2010-2013. Therefore the Biomass has increased even the abundance has decreased.

Baltic Sea spring spawners

For the spring spawners no large changes in the age structure over the years from 2007 to 2015 have been seen (see Table 13).

From 2008 to 2009 there has been a decrease in the abundance of 82 % and in the biomass of 67 %. From Table 13 it can be seen that the major part of the difference in abundance between 2008 and 2009 lies in a decrease in the abundance of 0-3 WR (86%), whereas the abundance of 4 WR or older are at the same level.

From2009 to 2010 the abundance has increased with 9 %, whereas the biomass has decreased with 39.6%. From Table 13 it can be seen that there has been a change in the age structure of the spring spawners from 2009 to 2010. The abundance of 0-3 WR has increased with 39 % and the abundance of 4-13 WR has decreased with 83 %. This shift in the age structure of the abundance is reflected in the biomass.

From 2010 to 2011 the abundance has increased with 153 % and the biomass has increased with 96%. 2009 was the year with the lowest abundance in a period of the last 6 years and 2010 was the year with the lowest biomass. 2009 was exceptional with a very lower percentage of 0-3 WR compared to 4-13 WR. Whereas the age structure from 2010 and 2011 are back to the age structure seen before 2009 with abundance with approx.95 % 0-3WR and approx.5% 4-14 WR (see Table 13)

From 2011 to 2012 the abundance has decrease with 47% and the biomass has decreased with 32% compared with 2011. The abundance of 0-3 WR has decreased with 46% and the abundance of 4-13 WR has decreased with 67%, thereby the spring spawning herring are back to an age distribution like the one seen in 2010 (Table 13), but with a general lower abundance for both 0-3 WR and 4-13 WR.

From 2012 to 2013 the abundance of spring spawners has decreased with 47% and the biomass has decreased with 32 % compared with 2012. Table 13 shows that the abundance of 4-13 WR in 2013 is of the same size as in 2012. But for 0-3 WR there have been a decrease of 50% in the abundance, dominated by the 1WR.

From 2013 to 2014 the abundance of spring spawners has decreased with 21% and the biomass has decreased with 61 % compared with 2012. From table 13 it can be seen that both the abundance of 0-3 WR and 4-10 WR have decreased since 2013 by 18 % and 69 % respectively.

From 2014 to 2015 the abundance of spring spawners has increased with 511% and the biomass has increased with 447% compared with 2014. From table 13 it can be seen that both the abundance of 0-3 WR and 4-10 WR have increased since 2015 and the distribution between 0-3 WR and 4-10 WR are at the same level as the years before. Therefore it seems as a larger part of the spring spawning stock is within the survey area during the 2015 survey.

Sprat

The total abundance estimate of sprat for the Danish acoustic survey with R/V Dana in July 2015 is 2963 million corresponding to a biomass at 20894 ton. Sprats were in 2015 found in Kattegat, Strata E, with 92.9 %, Skagerrak (ICES 44F9 and 44G0) with 5.4 % and in the North Sea, Strata 560E06 and ICES 43F6 and 43F7, with 1.6 %.

Abundance, biomass, mean length and mean weight per WR and strata are given in Table 14.

Relative sprat density (in numbers per nm²) along the track of the Danish acoustic survey with R/V Dana in June-July 2015 is shown in Figure 5. Highest concentration is found in Kattegat on the border between ICES square 44G0 and 43G0.

4 Other work

During the 10 days between 27.6.15 and 08.7.15 on board of the research vessels Dana, different projects and pilot projects were carried out with the intent of collecting data and testing new monitoring possibilities for future experiments for the Monitoring technology group. The projects involved were: a) collection of photographic samples from the different hauls representing the major fish species found in the area of interest. This, connected to the GUDP VIND project currently on going at DTU AQUA in Charlottenlund, serves as a database for a fish recognition and measurement computer program (FishSizer) that has to be develop within the project itself; b) collection of video footage for the JellyCam project; c) filming of trawling operations.

The collection of the different type of data was connected with the Cruise Leader Course that was supposed to be held on board of the vessel but did not take place.

For more details see appendix 1.

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in June-July 2015. The map shows the subareas (strata) used in the abundance estimation.

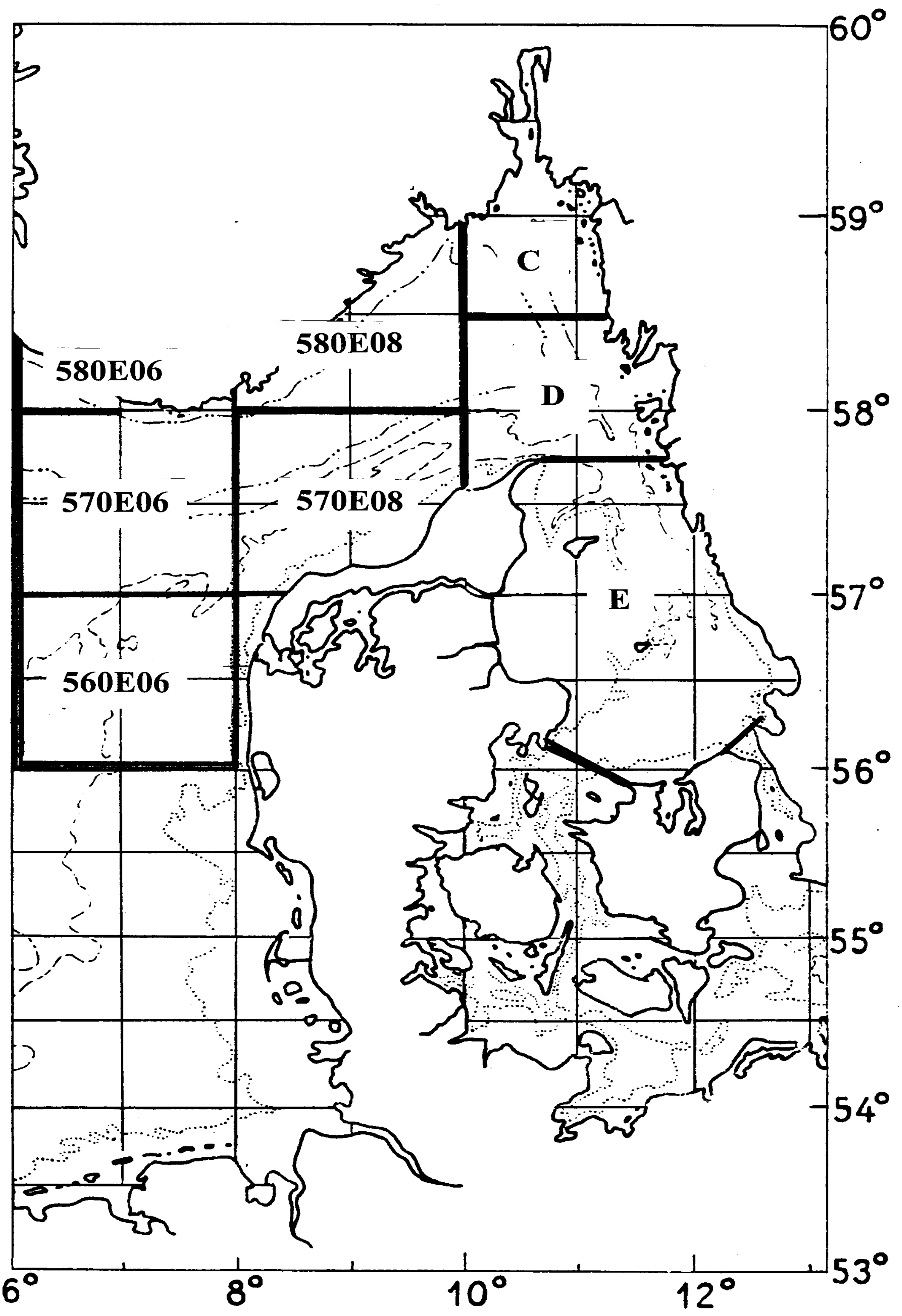

Figure 2. Map showing sailed route and trawl stations during the Danish acoustic survey with R/V Dana in June-July 2015.Read is pelagic hauls and blue is demersal hauls.

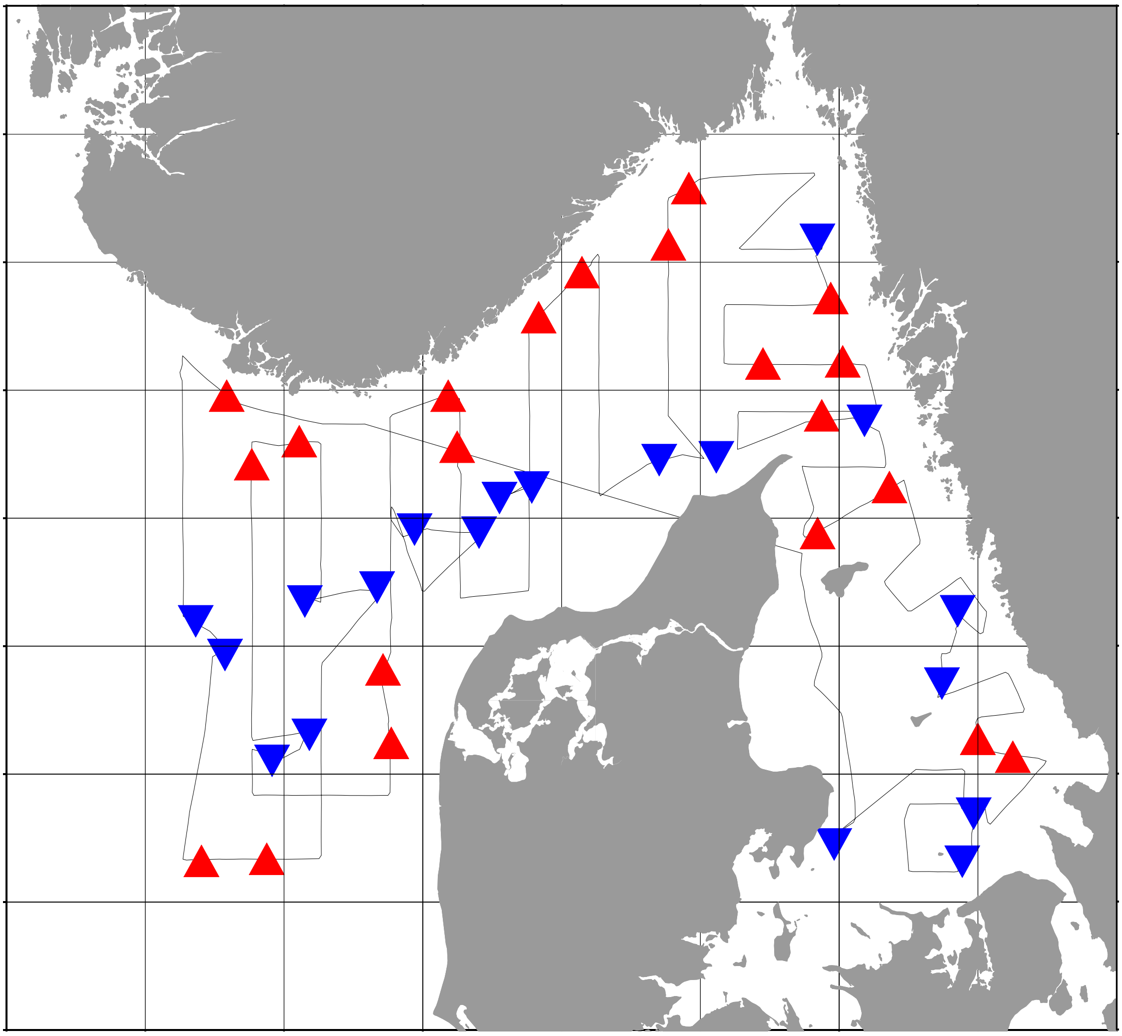

Figure 3. Map showing CTD and WP2 stations during the Danish acoustic survey with R/V Dana in June-July 2015. X are CTD stations and squares are combined CTD and WP2 stations.

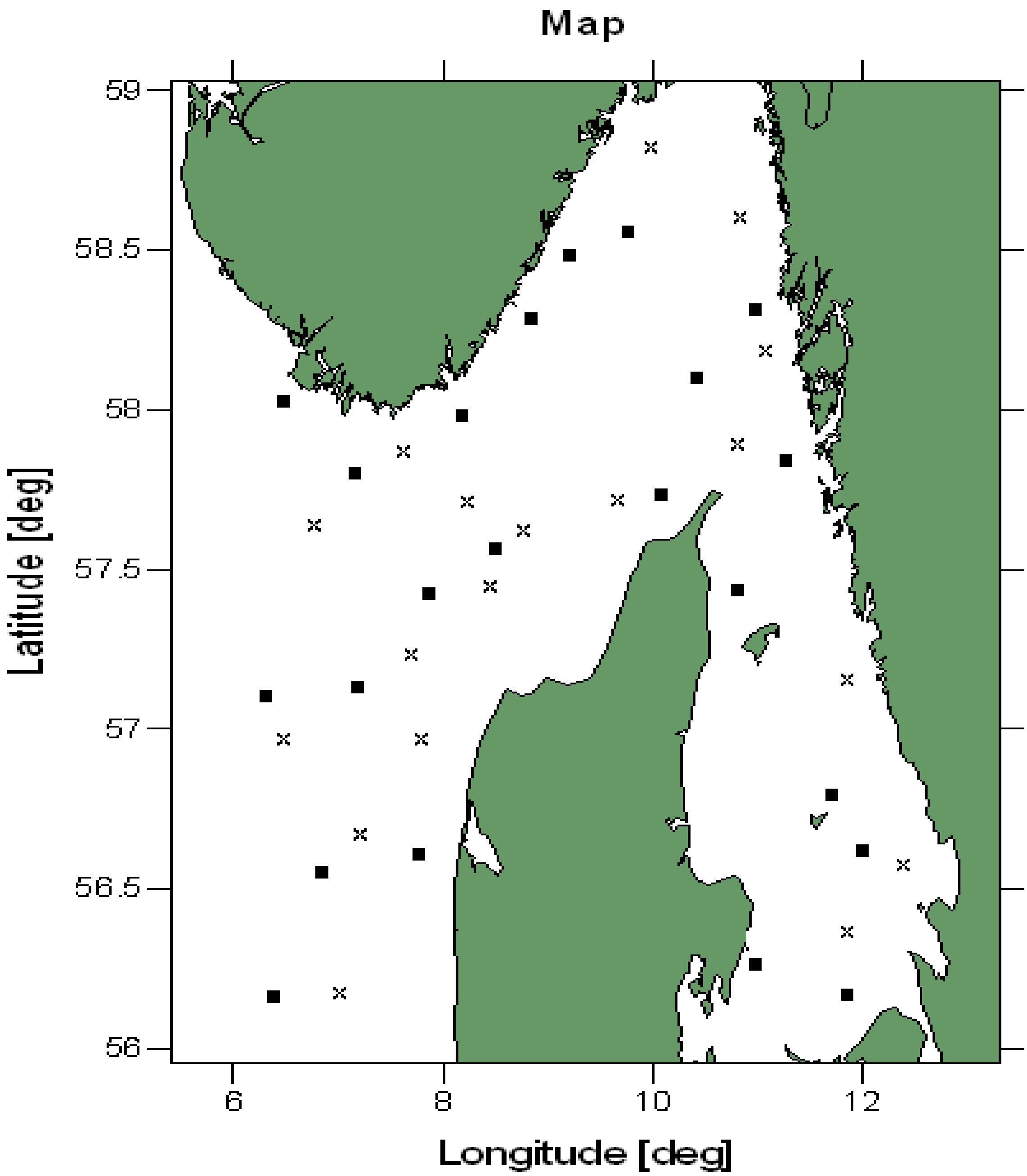

Figure 4. Relative herring density (in numbers per nm²) along the track of the Danish acoustic survey with R/V Dana in June-July 2015. Red circles indicate relative density of herring per ESDU.

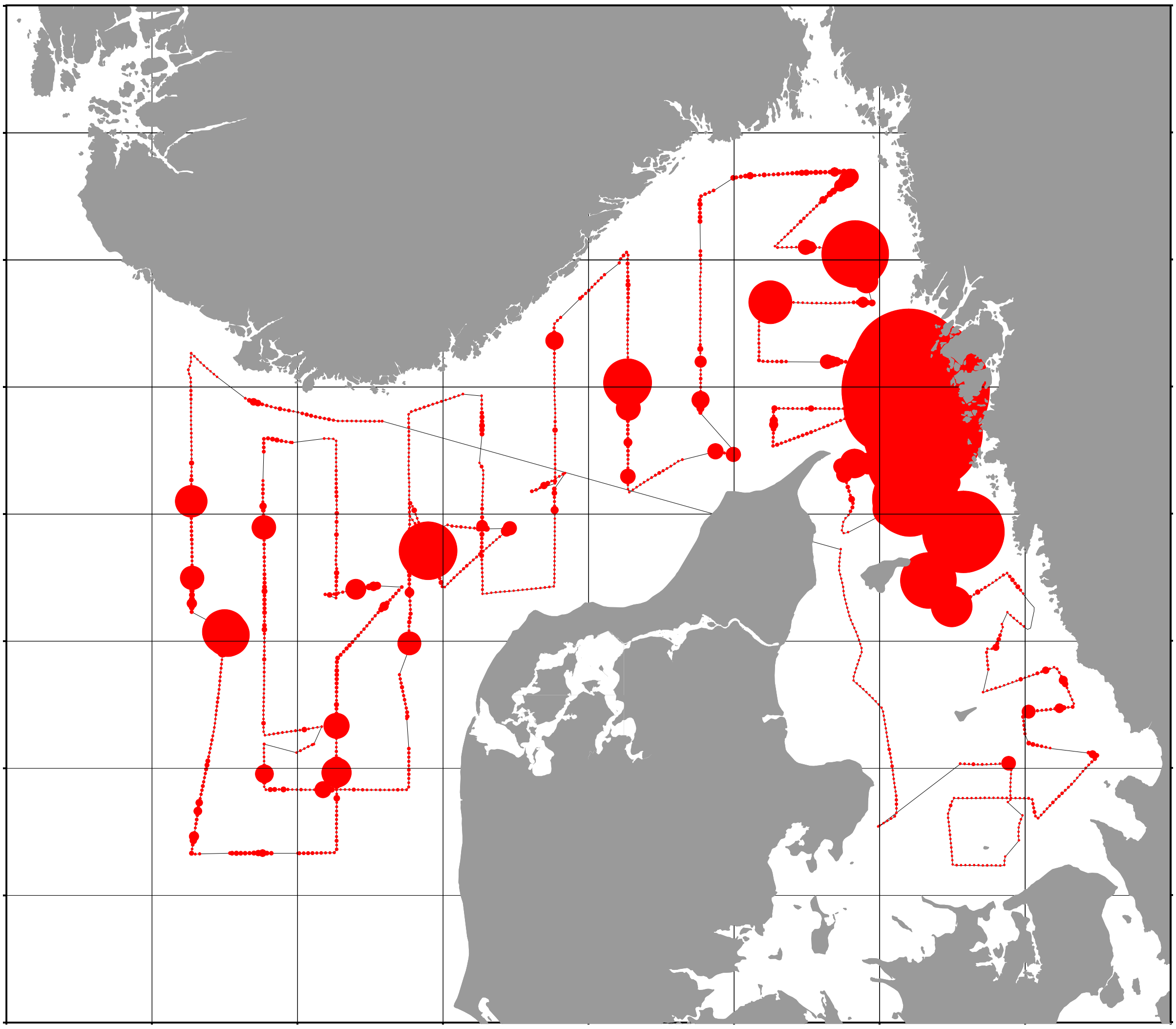

Figure 5. Relative sprat density (in numbers per nm²) along the track of the Danish acoustic survey with R/V Dana in June-July 2015. Red circles indicate relative density of sprat per ESDU.

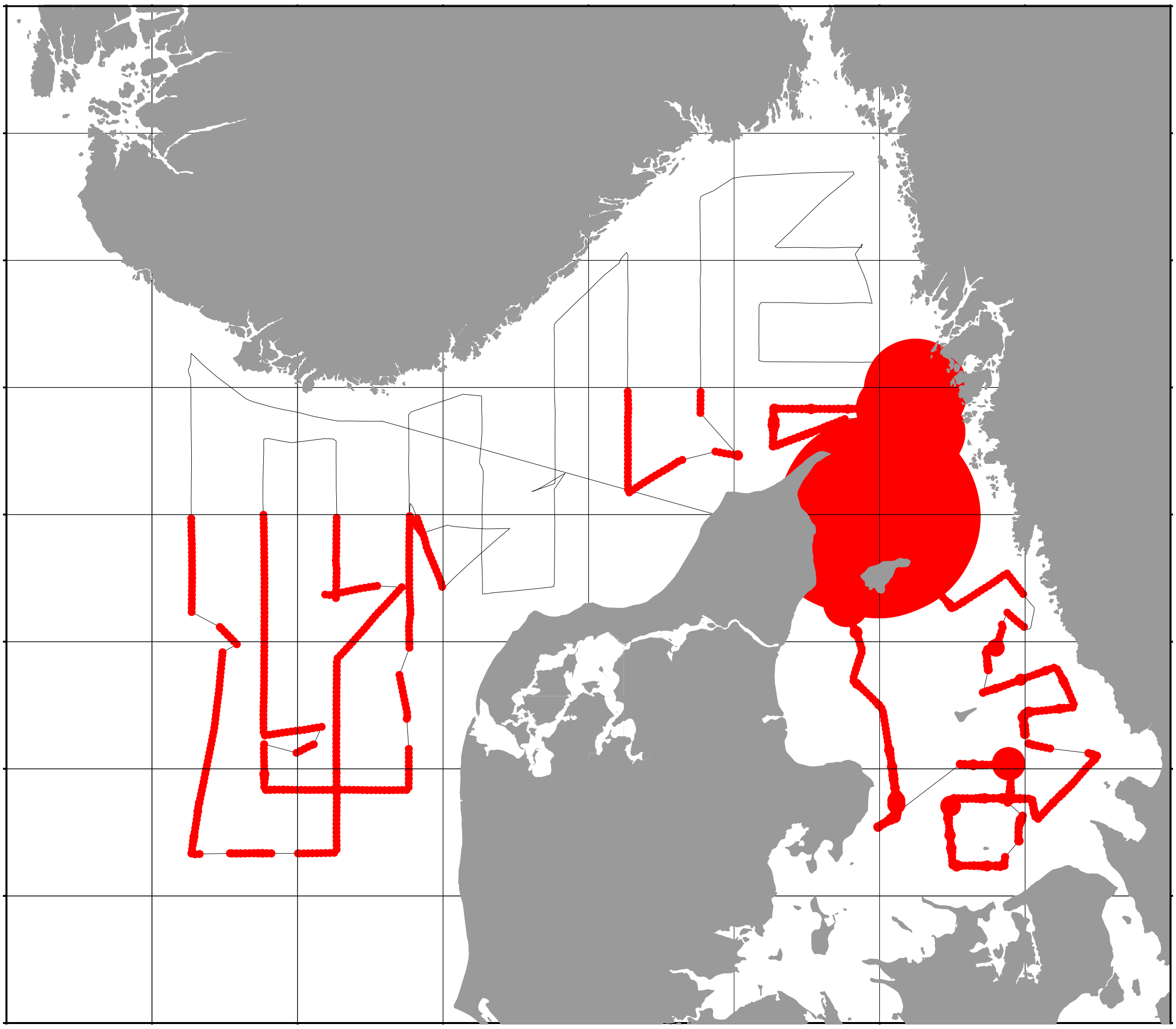

Table 1. . Simrad EK60 and analysis settings used during the Acoustic Herring Survey with R/V Dana Cruise June-July 2015

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 Survey statistics for the Danish acoustic survey with R/V Dana in July 2015

Stratum	Area, NM*2	ESDU	Hauls	Mean Sa	Mean TS
560E06	3980	235	8	1.98E-06	1.60E-05
570E06	3600	303	8	4.65E-06	3.79E-05
570E08	3406	201	7	5.21E-06	2.45E-05
580E06	209	17	1	2.32E-06	9.23E-05
580E08	1822	106	6	1.78E-06	1.05E-05
C	988	73	3	5.26E-06	1.25E-05
D	1837	144	7	1.15E-05	1.88E-05
E	5228	374	10	3.91E-06	1.27E-05

Table 3. Trawl hauls details for the Danish acoustic survey with R/V Dana in June-July 2015.

Date dd-mm-yy	Haul no.	Time UTC	ICES Square	Position Latitude	Longitude	Trawl Direction deg.	Wire length m	Trawl type	Cath depth m	Mean depth m	Total catch kg	Main Species	Trawling speed Kn	Trawling duratin min,	Wind speed m/s	Sea state
28-06-15	33	00:27	45F6	57.58.717 N	006.35.208 E	305	300	Fotö	Surface	373	440	Blue whiting,herring,mackerel	3.4	60	8.5	1
28-06-15	113	10:52	43F6	57.05.819 N	006.21.796 E	130	350	Expo	Bottom	57	425	Whiting, sandeel	3	60	5.85	1
28-06-15	126	13:31	42F6	56.57.922 N	006.34.457 E	272	350	Expo	Bottom	55	370	Herring	3.8	60	8.2	3
28-06-15	185	21:19	41F6	56.09.658 N	006.24.294 E	79	300	Fotö	Surface	42	360	Herring	3.6	60	5.7	3
29-06-15	199	00:11	41F6	56.10.152 N	006.52.519 E	93	300	Fotö	Surface	36	222	Mackerel, herring,gurnard	3.7	60	6	3
29-06-15	284	10:38	43F7	57.13.737 N	007.40.214 E	52	330	Expo	Bottom	53	305	Herring	3	60	7.9	2
29-06-15	303	14:19	43F7	57.10.463 N	007.08.989 E	98	330	Expo	Bottom	59	Invalid		2.8	45	10.1	2
29-06-15	356	21:20	44F6	57.48.041 N	007.06.579 E	260	300	Fotö	Surface	404	400	Mackerel, herring,gurnard	3.1	60	9.9	3
30-06-15	370	00:15	44F6	57.42.640 N	006.40.062 E	180	300	Fotö	Surface	303	1720	Herring	3.4	60	6.6	3
30-06-15	450	10:43	42F7	56.39.216 N	007.08.987 E	228	240	Expo	Bottom	37	560	Herring	3	60	4.6	1
30-06-15	463	13:14	42F6	56.33.115 N	006.54.815 E	264	240	Expo	Bottom	37	260	Greater sandeel, jellyfish	3	35	4.3	1
30-06-15	527	21:11	42F7	56.37.323 N	007.46.363 E	322	300	Fotö	Surface	30	523	Mackerel	3.6	60	1.8	1
01-07-15	543	00:15	42F7	56.54.543 N	007.46.869 E	35	300	Fotö	Surface	43	143	Mackerel, jellyfish	3.6	60	1.6	1
01-07-15	627	10:37	43F8	57.26.696 N	008.24.317 E	252	300	Expo	Bottom	65	870	Herring	2.9	60	1.7	1
01-07-15	644	13:44	43F7	57.27.322 N	007.56.415 E	237	570	Expo	Bottom	136	58	Saith, hake, Norway pout	2.8	60	3.2	1
01-07-15	694	21:24	44F8	57.58.705 N	008.10.981 E	85	300	Fotö	Surface	317	2544	Mackerel	3.7	60	5.3	1
02-07-15	707	00:33	44F8	57.46.739 N	008.14.854 E	153	300	Fotö	Surface	449	1262	Mackerel, herring	3.6	60	6.6	1
02-07-15	786	10:46	44F8	57.37.190 N	008.47.113 E	43	470	Expo	Bottom	84	2796	Norway pout	2.8	60	7.5	2
02-07-15	802	13:58	44F8	57.34.713 N	008.33.142 E	242	470	Expo	Bottom	102	1000	Norway pout,hadock	3	32	5.7	2
02-07-15	858	21:28	45F8	58.17.100 N	008.50.084 E	53	300	Fotö	Surface	302	160	Jellyfish, mackerel, herring	3.7	60	6.9	2
03-07-15	872	00:16	45F9	58.27.665 N	009.08.802 E	48	300	Fotö	Surface	346	950	Mackerel	3.7	60	3.1	2
03-07-15	953	10:34	44F9	57.43.601 N	009.42.199 E	62	250	Expo	Bottom	37	4624	Herring	3.2	60	3.9	1
03-07-15	967	13:40	44G0	57.77.271 N	010.06.892 E	77	410	Expo	Bottom	82	1190	Cod, herring, Norway pout	3.4	60	1.7	1
03-07-15	1030	21:22	46F9	58.34.161 N	009.46.160 E	357	310	Fotö	Surface	458	1432	Herring, mackerel	3.5	60	5.8	2
04-07-15	1044	00:19	46G0	58.47.371 N	009.55.026 E	55	300	Fotö	Surface	194	2035	Mackerel	3.9	60	3.9	2
04-07-15	1124	10:41	46G0	58.35.244 N	010.50.589 E	183	420	Expo	Bottom	85	880	Herring	3.1	60	3.5	2
04-07-15	1138	13:46	45G0	58.21.592 N	010.56.368 E	44	350	Fotö	20	103	13	Jellyfish	3.8	60	1.7	2
04-07-15	1193	21:18	45G0	58.06.247 N	010.27.072 E	94	300	Fotö	Surface	169	1427	Mackerel, herring	3.1	60	2.1	0
05-07-15	1209	05:31	45G1	58.06.750 N	011.01.543 E	19	300	Fotö	Surface	119	700	Herring, Mackerel	3.4	60	2.9	0
05-07-15	1296	10:56	44G0	57.54.101 N	010.52.494 E	75	300	Fotö	0-10	117	1567	Herring	3.1	60	4.2	1
05-07-15	1310	13:34	44G1	57.52.818 N	011.10.959 E	62	370	Expo	Bottom	62	2115	Herring	3.2	60	4.5	1
05-07-15	1367	21:05	43G0	57.26.502 N	010.50.700 E	49	300	Fotö	Surface	40	2260	Sprat	3.5	60	9.3	1
06-07-15	1384	00:22	44G1	57.37.292 N	011.21.737 E	56	300	Fotö	Surface	72	1620	Herring, mackerel	3.6	60	10.2	1
06-07-15	1467	10:38	43G1	57.08.181 N	011.49.548 E	183	330	Expo	Bottom	56	55	Invertebrates	3	60	15.3	5
06-07-15	1487	14:01	42G1	56.51.217 N	011.44.432 E	202	260	Expo	Bottom	41	355	Sprat, anchowy	3.4	60	13.7	5
06-07-15	1540	21:11	42G1	56.38.273 N	011.59.981 E	343	300	Fotö	Surface	32	300	Herring, sprat, mackerel	3.9	60	11.5	5
07-07-15	1555	00:22	42G2	56.34.082 N	012.15.095 E	80	300	Fotö	Surface	37	235	Herring, anchowy	3.9	60	13.5	5
07-07-15	1639	10:35	41G1	56.09.478 N	011.53.247 E	44	210	Expo	Bottom	25	127	Sprat, jellyfish	3	60	6.7	3
07-07-15	1654	13:06	41G1	56.20.740 N	011.58.143 E	291	230	Expo	Bottom	32	262	Sprat, herring	3.5	60	3.9	3
07-07-15	1725	21:33	41G0	56.13.305 N	010.57.847 E	15	300	Expo	Surface	21	79	Sprat, jellyfish	3.3	30	5.3	3

Table 4. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June - July 2015.

		Station		33	113	126	185	199	284	303	356	370	450	463	527	543	627
		ICES sq.		45F6	43F6	42F6	41F6	41F6	43F7	43F7	44F6	44F6	42F7	42F6	42F7	412F7	43F8
		Gear		Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo
		Fishing depth		Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom
		Total depth		367	57	55	42	36	53	59	404	303	37	37	30	43	65
		Day/Night		N	D	D	N	N	D	D	N	N	D	D	N	N	D
%		Total catch	Total	440	425	370	360	222	305	Failed	400	1720	560	260	523	143	870
0.42	Anchovy	Engraulis encrasicolus	157.015														
0.87	Blue whiting	Micromesistius poutassou	327.624	193.045							34.991	90.768					
7.33	Sprat	Sprattus sprattus	2750.143		0.295	0.448	18.358	0.133	0.468				2.770	0.065			
0.02	Common weaver	Trachinus draco	8.277											0.112			
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.052														
0.00	Poor-cod	Trisopterus minutus	0.074														
0.02		Anarhichas lupus	8.7														
0.15	Garfish	Belone belone	57.597					0.394							1.936	5.142	
0.27	Long rough dab	Hippoglosides plattessoides	100.274		1.338								0.520				
1.74	Whiting	Merlangius merlangus	652.163		159.797	7.430			1.968				2.890	0.605		0.080	0.291
2.49	Invertebrates	Invertebrata	933.811						0.120								
0.65	Dab	Limanda limanda	245.305		22.041	4.412			3.045				23.500	5.166			
0.24	Hake	Merluccius merluccius	88.789			4.762			1.756				3.600				4.000
0.46	Gurnard	Trigala spp.	172.729		11.981	5.322	51.800	33.400	6.160				12.400	15.500	16.800	3.374	2.378
0.92	Haddock	Melanogrammus aeglefinus	343.256		6.801	16.800			0.616								
0.05	Pollack	Pollachius pollachius	17.4														8.600
26.44	Mackerel	Scomber scombrus	9914.753	66.277	38.700	4.868	41.600	105.300	1.216		259.555	305.849	10.830	1.612	478.736	107.400	0.822
0.64	Saithe	Pollachius virens	240.254			1.380											7.000
0.00	Trout, rainbow trout	Oncorhynchus mykiss, Salmo gairdneri	0.108														
0.36	Plaice	Pleuronectes platessa	135.711		5.216				0.622				36.200	5.524			
0.10	Lemon sole	Microstomus kitt	38.924		2.640	4.914			0.418				0.646				
42.52	Herring	Clupea harengus	15945.11	133.700	37.534	286.405	180.960	50.100	241.336		70.200	1302.983	406.147			1.164	837.315
0.01	Gray sole	Glyptocephalus cynoglossus	3.459														
8.96	Norway pout	Trisopterus esmarki	3360.978		0.060												
0.28	Lumpsucker	Cyclopterus lumpus	106.662	7.469							4.376	2.252					
2.67	Large Medusa	Scyphozoa sp.	1001.39	34.191	4.618	4.855	67.064	32.800	22.723		29.676	18.048	51.730	58.098	25.528	25.700	
0.40	Greater sandeel	Hyperoplus lanceolatus	150.882		0.323	0.142			0.492					149.746			
1.47	Cod	Gadus Morhua	552.026	0.421	22.789	26.200	0.217	0.002	21.824		0.009	0.059	7.200				9.200
0.00	Sole	Solea solea	0														
0.00	Three-spined stickleback	Gasterosteus aculeatus	0														
0.00	Pearlside	Mauorolicus muelleri	0.291	0.105							0.071	0.007					
0.02	Ling	Molva molva	5.666														
0.02	Krill	Euphausidae spp.	6.99	3.992													
0.07	Picked Dogfish	Squalus acanthias	24.414	0.370							1.122		1.442				0.394
0.00	Tarry ray	Raja radiata	0.098														
0.01	Anglerfish	Lophiuspiscatorius	2.88											0.972			
0.00	Norway lobster	Nephrops norvegicus	1.47														
0.00	Snake blenny	Lumpenus lampretaeformis	0.268														
0.00	Brill	Scophthalmus rhombe	0.199														
0.00	Flounder	Platichthys flesus	1.593														
0.03	Squids, octopusses	Cephalopoda sp	12.096	0.430	1.181	2.062		0.026	1.958				0.124			0.005	
0.35	Sandeel	Ammodytes marinus	132.502		109.680				0.728					22.094			
0.00		Lampetra fluviatilis	0.074														
0.00	Sculpin	Myoxocephalus scorpius	0.495														
		Total	37502.51	440.000	424.994	370.000	359.999	222.155	305.450	0.000	400.000	1719.966	559.999	259.494	523.000	142.865	870.000

Table 4. continued.

		Station		644	694	707	786	802	858	872	953	967	1030	1044	1124	1138	1193
		ICES sq.		43F7	44F8	44F8	44F8	44F8	45F8	45F9	44F9	44G0	46F9	46G0	46G0	45G0	45G0
		Gear		Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Fotø	Fotø
		Fishing depth		Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bttom	20	Surface
		Total depth		136	317	449	84	102	302	346	37	82	458	194	85	104	169
		Day/Night		D	N	N	D	D	N	N	D	D	N	N	D	D	N
%		Total catch	Total	58	2544	1262	2796	1000	160	950	4624	1190	1432	2035	880	13	1427
0.42	Anchovy	Engraulis encrasicolus	157.015							0.074							
0.87	Blue whiting	Micromesistius poutassou	327.624			8.820											
7.33	Sprat	Sprattus sprattus	2750.143								7.574						
0.02	Common weaver	Trachinus draco	8.277											0.280			
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.052												0.052		
0.00	Poor-cod	Trisopterus minutus	0.074												0.074		
0.02		Anarhichas lupus	8.7				8.700										
0.15	Garfish	Belone belone	57.597		1.786	3.454				6.265			2.422	12.700			
0.27	Long rough dab	Hippoglosides plattessoides	100.274				4.600	0.288				47.781			11.713		
1.74	Whiting	Merlangius merlangus	652.163	1.284		0.074	42.400	58.000	0.127		58.500	56.279			6.741		
2.49	Invertebrates	Invertebrata	933.811								27.852	6.245			24.272		
0.65	Dab	Limanda limanda	245.305				19.600				14.000	147.267					
0.24	Hake	Merluccius merluccius	88.789	10.966			10.500	11.400			9.700	3.090			2.500		
0.46	Gurnard	Trigala spp.	172.729				0.372				10.665	0.279			0.364		
0.92	Haddock	Melanogrammus aeglefinus	343.256				64.000	140.900				111.756					
0.05	Pollack	Pollachius pollachius	17.4				8.800										
26.44	Mackerel	Scomber scombrus	9914.753	2.576	2490.156	751.425	0.434		48.000	802.383	0.304		519.806	1883.097			988.566
0.64	Saithe	Pollachius virens	240.254	25.200			131.000	66.100				2.112					7.300
0.00	Trout, rainbow trout	Oncorhynchus mykiss, Salmo gairdneri	0.108														
0.36	Plaice	Pleuronectes platessa	135.711				0.844				1.612	83.845				0.367	
0.10	Lemon sole	Microstomus kitt	38.924				0.284				3.310	26.712					
42.52	Herring	Clupea harengus	15945.11	4.473	28.709	456.676	29.730	1.466	23.459	108.700	4473.549	225.000	859.700	66.100	740.338	2.830	322.496
0.01	Gray sole	Glyptocephalus cynoglossus	3.459				0.708	0.870				1.881					
8.96	Norway pout	Trisopterus esmarki	3360.978	11.359			2374.578	696.309				148.879			56.815		
0.28	Lumpsucker	Cyclopterus lumpus	106.662			0.117			0.008	0.063			5.260			0.892	63.000
2.67	Large Medusa	Scyphozoa sp.	1001.39		23.346	37.571			88.300	32.411		3.343	44.812	72.628	29.902	8.548	41.805
0.40	Greater sandeel	Hyperoplus lanceolatus	150.882	0.123													
1.47	Cod	Gadus Morhua	552.026				97.400	20.600			14.400	319.257			2.922		
0.00	Sole	Solea solea	0														
0.00	Three-spined stickleback	Gasterosteus aculeatus	0														
0.00	Pearlside	Mauorolicus muelleri	0.291	0.036											0.072		
0.02	Ling	Molva molva	5.666				1.544					4.122					
0.02	Krill	Euphausidae spp.	6.99						0.932								2.066
0.07	Picked Dogfish	Squalus acanthias	24.414			3.772		2.700			1.534				3.600		1.768
0.00	Tarry ray	Raja radiata	0.098														
0.01	Anglerfish	Lophiuspiscatorius	2.88	1.908													
0.00	Norway lobster	Nephrops norvegicus	1.47												0.366		
0.00	Snake blenny	Lumpenus lampretaeformis	0.268												0.268		
0.00	Brill	Scophthalmus rhombe	0.199														
0.00	Flounder	Platichthys flesus	1.593														
0.03	Squids, octopusses	Cephalopoda sp	12.096				0.506	0.525		0.104	0.966	2.150		0.140		0.270	
0.35	Sandeel	Ammodytes marinus	132.502														
0.00		Lampetra fluviatilis	0.074														
0.00	Sculpin	Myoxocephalus scorpius	0.495														
		Total	37502.51	57.925	2543.997	1261.909	2796.000	999.158	160.826	950.000	4623.966	1189.998	1432.000	2034.945	879.999	12.907	1427.001

Table 4. continued.

		Station		1209	1296	1313	1367	1384	1467	1487	1540	1555	1639
		ICES sq.		45G1	44G0	44G1	43G0	44G1	43G1	42G1	42G1	42G2	41G1
		Gear		Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo
		Fishing depth		Surface	0-10	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom
		Total depth		119	117	62	40	71	56	41	32	37	25
		Day/Night		N	D	D	N	N	D	D	N	N	D
%		Total catch	Total	700	1567	2115	2260	1620	55	355	300	235	127
0.42	Anchovy	Engraulis encrasicolus	157.015				0.076	0.092		74.611	20.413	49.646	1.698
0.87	Blue whiting	Micromesistius poutassou	327.624										
7.33	Sprat	Sprattus sprattus	2750.143			0.338	2109.645		1.888	248.924	65.928	2.516	80.500
0.02	Common weaver	Trachinus draco	8.277	0.306	0.252		5.942	0.124		0.084	0.230	0.086	0.582
0.00	Four-bearded rockling	Enchelyopus cimbrius	0.052										
0.00	Poor-cod	Trisopterus minutus	0.074										
0.02		Anarhichas lupus	8.7										
0.15	Garfish	Belone belone	57.597				9.770	12.740			0.726	0.262	
0.27	Long rough dab	Hippoglosides plattessoides	100.274	0.059		33.339			0.574	0.062			
1.74	Whiting	Merlangius merlangus	652.163	0.059		209.177	30.947		2.018	10.530		0.076	0.196
2.49	Invertebrates	Invertebrata	933.811			5.721			858.000				10.300
0.65	Dab	Limanda limanda	245.305			3.211			0.144	0.410			1.330
0.24	Hake	Merluccius merluccius	88.789			26.500							
0.46	Gurnard	Trigala spp.	172.729			0.776		0.118	0.152	0.210			0.148
0.92	Haddock	Melanogrammus aeglefinus	343.256		0.036	2.245			0.102				
0.05	Pollack	Pollachius pollachius	17.4										
26.44	Mackerel	Scomber scombrus	9914.753	263.148	25.900	1.818	72.700	572.687		0.812	42.700	19.584	3.516
0.64	Saithe	Pollachius virens	240.254			0.162							
0.00	Trout, rainbow trout	Oncorhynchus mykiss, Salmo gairdneri	0.108								0.108		
0.36	Plaice	Pleuronectes platessa	135.711	0.106		0.869			0.128				0.168
0.10	Lemon sole	Microstomus kitt	38.924										
42.52	Herring	Clupea harengus	15945.11	381.564	1495.690	1745.338	10.048	1013.017	19.717	14.330	145.285	138.914	8.482
0.01	Gray sole	Glyptocephalus cynoglossus	3.459										
8.96	Norway pout	Trisopterus esmarki	3360.978			72.978							
0.28	Lumpsucker	Cyclopterus lumpus	106.662	2.328	5.452	1.012		0.076	2.424	4.808	0.770	0.678	1.644
2.67	Large Medusa	Scyphozoa sp.	1001.39	50.465	37.709	1.955	20.872	16.766	26.700		23.840	23.238	17.500
0.40	Greater sandeel	Hyperoplus lanceolatus	150.882										0.020
1.47	Cod	Gadus Morhua	552.026			9.343							
0.00	Sole	Solea solea	0										
0.00	Three-spined stickleback	Gasterosteus aculeatus	0										
0.00	Pearlside	Mauorolicus muelleri	0.291										
0.02	Ling	Molva molva	5.666										
0.02	Krill	Euphausidae spp.	6.99										
0.07	Picked Dogfish	Squalus acanthias	24.414	1.686	1.826			4.200					
0.00	Tarry ray	Raja radiata	0.098										0.098
0.01	Anglerfish	Lophiuspiscatorius	2.88										
0.00	Norway lobster	Nephrops norvegicus	1.47			0.862			0.076	0.166			
0.00	Snake blenny	Lumpenus lampretaeformis	0.268										
0.00	Brill	Scophthalmus rhombe	0.199										
0.00	Flounder	Platichthys flesus	1.593										0.500
0.03	Squids, octopusses	Cephalopoda sp	12.096	0.338		1.306							
0.35	Sandeel	Ammodytes marinus	132.502										
0.00		Lampetra fluviatilis	0.074										0.074
0.00	Sculpin	Myoxocephalus scorpius	0.495										0.318
		Total	37502.51	700.059	1566.865	2116.950	2260.000	1619.820	911.923	354.947	300.000	235.000	127.074

Table 5. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2015.

Station	33	113	126	185	199	284	356	370	450	543	627	644	694	707	786	802	858
ICES sq.	45F6	43F6	42F6	41F6	41F6	43F7	44F6	44F6	42F7	412F7	43F8	43F7	44F8	44F8	44F8	44F8	45F8
Gear	Fotø	Expo	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø
Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	367	57	55	42	36	53	404	303	37	43	65	136	317	449	84	102	302
Day/Night	N	D	D	N	N	D	N	N	D	N	D	D	N	N	D	D	N
Total catch,kg	440	425	370	360	222	305	400	1720	560	143	870	58	2544	1262	2796	1000	160
Total catch Herring,kg	133.7	37.534	286.405	180.69	50.1	241.336	70.2	1302.983	406.147	1.164	837.315	4.473	28.709	456.676	29.73	1.466	23.459
Sample Herring,kg	133.7	37.534	20.511	18.424	20.245	14.03	41.002	41.476	17.998	1.164	118.2	4.473	28.709	32.344	29.73	1.466	23.459
Length in cm																	
5.5																	
6																	
6.5																	
7																	
7.5																	
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11																	
11.5																	
12																	
12.5																	
13						1											
13.5				6	4												
14			3	42	43	2											
14.5		2	8	149	147	13					2						
15		15	6	186	235	68					42	1					
15.5		11	6	175	109	39				1	170	4	2				1
16		21	28	69	31	101					184	1	1				9
16.5		39	98	18	3	69		9		2	111		3				29
17		126	195	7	3	38		18		5	65	1	5	7	30	1	49
17.5		242	121	2		17	13	54		1	25		9	14	72	1	79
18	30	232	46	2		11	26	64			12	2	18	19	91	3	59
18.5	41	109	15			4	49	46	3		6		24	25	75		42
19	47	39	3			3	70	50	6		6		22	26	80		39
19.5	57	10	1			1	143	60	50		2	1	42	56	43		23
20	92	5	2				98	36	64		4	2	71	34	42	1	30
20.5	110	1					65	38	96		6	3	50	43	28		31
21	89						53	47	103		1	7	36	43	19		17
21.5	84	1					33	32	93	1	2	3	34	45	16		12
22	63		2				25	40	76	2		8	24	33	5	2	9
22.5	46						10	32	40	1		6	20	25	10		7
23	29						12	22	15			4	16	19	3		3
23.5	16						5	14	2			3	14	11	5		
24	10						2	8	1	2		1	5	8	2		3
24.5	19	1					2	11					3	10	3	1	
25	8						2	7					5	5	1		
25.5	6						2	5		1		3		6	1	1	
26	6							3				1		2	2	1	
26.5	4						1	2				1	3	2			
27	5						2	1		2			1	2			
27.5	1						1	1				1	1	2			
28	4						1	2				1	1	1	1	1	
28.5	1												1				
29	2						1										
29.5							1										
30	1						1										
30.5								1									

Table 6. Measured length distribution of mackerel by haul for the Danish acoustic survey with R/V Dana in June-July 2015.

Station	33	113	126	185	199	284	356	370	450	463	527	543	627	644	694	707
ICES sq.	45F6	43F6	42F6	41F6	41F6	43F7	44F6	44F6	42F7	42F6	42F7	412F7	43F8	43F7	44F8	44F8
Gear	Fotø	Expo	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø
Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface
Total depth	367	57	55	42	36	53	404	303	37	37	30	43	65	136	317	449
Day/Night	N	D	D	N	N	D	N	N	D	D	N	N	D	D	N	N
Total catch,kg	440	425	370	360	222	305	400	1720	560	260	523	143	870	58	2544	1262
Total catch Mackerel,kg	66.277	38.7	4.868	41.6	105.3	1.216	259.555	305.849	10.83	1.612	478.736	107.4	0.822	2.576	2490.159	751.425
Sample Mackerel,kg	25.2	13.01	4.868	12.756	20.9	1.216	14.196	18.456	10.83	1.612	13.376	16.22	0.822	2.576	16.065	20.265
Length in cm																
15																
16																
17																
18																
19																
20	3	1			1					1						
21	24	13	3	13	8		6	3	8	1	46	10		2	5	7
22	50	40	14	34	24	4	27	14	53	7	82	65	1	6	63	49
23	35	41	25	28	20	5	54	30	35	3	15	49	1	2	67	77
24	5	11	6	5	6	1	26	12	7		5	35			25	24
25	3	4	3	5	5	1	11	6	2	1	2	5			7	14
26	2			4	10	2	3	1				1			1	1
27				2	2											3
28					3			2								1
29	1	1			3		1									1
30	1	1		1	4			3								1
31		3		5	7			4					1	3		4
32	1	1		2	9		2	8						1	1	4
33		2		2	6		1	7			1			1		
34	2	1		3	5		2	7								
35	3	1			3			5		1			1			2
36	2	1			4			3						1		1
37				1	2			1								
38								2								
39																
40	1															
41																
42																
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56																
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58																
59																
60																
61																
Total no.	133	121	51	105	122	13	133	108	105	14	151	165	4	16	169	189
Mean length	23.25	23.43	22.84	24.02	26.61	23.38	23.56	27.00	22.45	23.14	21.97	22.78	27.75	25.88	22.87	23.67

Table 7. Measured length distribution of sprat by haul for the Danish acoustic survey with R/V Dana in June-July 2015.

Station	126	185	199	284	450	463	953	1313	1367	1467	1487	1540	1555	1639	1654	1725
ICES sq.	42F6	41F6	41F6	43F7	42F7	42F6	44F9	44G1	43G0	43G1	42G1	42G1	42G2	41G1	41G1	41G0
Gear	Expo	Fotø	Fotø	Expo	Expo	Expo	Expo	Expo	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Expo
Fishing depth	Bottom	Surface	Surface	Bottom	Bottom	Bottom	Bottom	Bottom	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	55	42	36	53	37	37	37	62	40	56	41	32	37	25	32	21
Day/Night	D	N	N	D	D	D	D	D	N	D	D	N	N	D	D	N
Total catch.kg	370	360	222	305	560	260	4624	2115	2260	55	355	300	235	127	262	79.315
Total catch Sprat,kg	0.448	18.358	0.133	0.468	2.77	0.065	7.574	0.338	2109.645	1.888	248.924	65.928	2.517	80.5	169.693	40.6
Sample Sprat,kg	0.448	4.9	0.133	0.179	0.648	0.016	0.397	0.028	3.158	1.888	2.068	2.742	0.527	2.601	2.156	2.641
Length in cm																
5.5																
6																
6.5																
7																
7.5									8							
8		1							14							
8.5									45							
9			1						142		5			1		
9.5		1							188		56			1		
10		14	1	1					94	1	81		4	2	26	19
10.5		67	6		1				11		48	2	7	15	34	61
11	2	55	3		9		2	1		1	23		4	17	21	41
11.5	4	27	2		6		6			1	10	3	2	28	19	24
12	3	6		2	13		3	1		2	3	10	4	35	18	20
12.5	10	2		3	9		3			5	7	25	2	34	23	13
13	5	1		4	6	1	5			5	4	42	6	32	26	15
13.5	2			2			5			10	6	39	4	15	9	12
14	4						1			10	1	25	5	11	4	11
14.5							1			14		8	2	6	1	8
15										27		10		3	5	2
15.5										8		2		4	2	2
16										9						
16.5										1		1		1		
17																
17.5																
18																
18.5																
19																
19.5																
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31.5																
32																
32.5																
Total no.	30	174	13	12	44	1	26	2	502	94	244	167	40	205	188	228
Mean Length	12.56667	10.84195	10.61538	12.54167	11.93182	13	12.51923	11.5	9.310757	14.37766	10.3668	13.31737	12.1125	12.3561	11.73404	11.61404

Table 8. CTD station details for the Danish acoustic survey with R/V Dana in June-July 2015.

Date dd-mm-yy	Haul no.	Time UTC	ICES Square	Position Latitude	Longitude	Bottom depth m	Wind speed m/s	Sea state
27-06-15	1	20:01	44F7	57.52.147 N	007.36.880 E	496	4	1
28-06-15	39	01:56	45F6	58.01.766 N	006.28.109 E	358	7.3	1
28-06-15	112	00:14	43F6	57.06.042 N	006.18.740 E	58	4.2	1
28-06-15	130	14:59	42F6	56.58.221 N	006.28.792 E	57	9.5	3
28-06-15	183	00:00	41F6	56.09.891 N	006.22.439 E	44	7.6	3
29-06-15	204	01:42	41F7	56.10.291 N	007.00.123 E	35	8.5	3
29-06-15	284	10:06	43F7	57.13.818 N	007.42.043 E	51	4.1	3
29-06-15	308	15:29	43F7	57.07.975 N	007.10.489 E	57	8.5	2
29-06-15	354	20:30	44F7	57.47.948 N	007.08.809 E	419	8.3	3
30-06-15	375	01:46	44F6	57.38.416 N	006.45.886 E	315	6.2	3
30-06-15	450	10:03	42F7	56.40.058 N	007.11.959 E	37	2.3	3
30-06-15	466	14:16	42F6	56.33.105 N	006.50.736 E	44	3.6	1
30-06-15	525	20:40	42F7	56.36.387 N	007.45.773 E	29	1.4	1
01-07-15	548	01:39	42F7	56.58.037 N	007.47.349 E	43	3	1
01-07-15	627	10:04	43F8	57.26.810 N	008.26.748 E	59	0.4	1
01-07-15	648	15:25	43F7	57.25.399 N	007.51.264 E	134	5.1	1
01-07-15	692	20:23	44F8	57.59.051 N	008.11.327 E	459	4.5	1
02-07-15	713	01:59	44F8	57.42.795 N	008.13.649 E	385	7.7	1
02-07-15	786	09:58	44F8	57.37.327 N	008.46.001 E	85	5.7	1
02-07-15	806	15:04	44F8	57.33.778 N	008.29.845 E	103	7	2
02-07-15	857	20:34	45F8	58.17.303 N	008.50.000 E	292	7.7	2
03-07-15	876	01:55	45F9	58.28.871 N	009.12.565 E	357	2	2
03-07-15	952	10:08	44F9	57.43.110 N	009.40.617 E	35	3.4	2
03-07-15	966	12:58	44G0	57.43.897 N	010.04.724 E	80	3.5	1
03-07-15	1028	20:34	46F9	58.33.269 N	009.45.942 E	487	7.2	1
04-07-15	1049	01:45	46F9	58.49.211 N	009.59.639 E	196	2.5	2
04-07-15	1124	09:58	46G0	58.36.052 N	010.50.596 E	82	0.2	2
04-07-15	1143	15:08	45G0	58.17.716 N	010.58.581 E	108	0.3	2
04-07-15	1191	20:32	45G0	58.06.057 N	010.24.851 E	146	1.3	2
05-07-15	1215	01:49	45G1	58.11.059 N	011.04.959 E	106	2.9	0
05-07-15	1296	10:07	44G0	57.53.368 N	010.48.825 E	129	3.6	0
05-07-15	1316	15:10	44G1	57.50.592 N	011.16.678 E	94	3.5	1
05-07-15	1365	20:30	43G0	57.26.138 N	010.49.118 E	45	3	1
06-07-15	1389	01:49	44G1	57.39.661 N	011.27.130 E	78	11.3	1
06-07-15	1467	10:05	43G1	57.09111 N	011.51.267 E	55	12.4	1
06-07-15	1492	15:27	42G1	57.47.743 N	011.42.871 E	35	13	5
06-07-15	1538	20:35	42G1	56.37.207 N	012.00.378 E	29	9	5
07-07-15	1562	01:46	42G2	56.34.266 N	012.24.178 E	33	15.5	5
07-07-15	1639	09:59	41G1	56.10.137 N	011.52.165 E	27	10	5
07-07-15	1659	14:33	41G1	56.21.820 N	011.51.239 E	31	6.6	3
07-07-15	1728	22:31	41G0	56.15.902 N	010.59.243 E	22	8.1	3

Table 9. WP2 station details for the Danish acoustic survey with R/V Dana in June-July 2015.

						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
28-06-15	40	02:20	45F6	58.01.882 N	006.27.910 E	357	150.0	7.6	1	6330.4	3.2	474.8	5852.4
28-06-15	112	10:15	43F6	57.06.032 N	006.18.914 E	59	53.0	3.3	1	3221.2	362.4	145.2	2713.6
28-06-15	184	20:50	41F6	56.10.006 N	006.22.333 E	45	40.0	7.6	3	1855.6	5.6	83.2	1766.8
29-06-15	308	15:41	43F7	57.08.043 N	007.10.655 E	57	52.0	7.9	2	3402.8	1307.2	48.4	2047.2
29-06-15	355	20:52	44F7	57.48.006 N	007.08.786 E	420	150.0	8.6	3	8337.2	3617.2	394.8	4325.2
30-06-15	466	14:27	42F6	56.33.130 N	006.50.609 E	44	39.0	3.7	1	10658.4	2416	1056.4	7186
30-06-15	526	20:50	42F7	56.36.310 N	007.45.852 E	29	24.0	1.4	1	9003.2	535.6	706.8	7760.8
01-07-15	648	15:43	43F7	57.25.455 N	007.51.388 E	134	129.0	5.2	1	10232	2013.2	2160	6058.8
01-07-15	693	21:00	44F8	57.58.839 N	008.10.259 E	459	150.0	3.8	1	11399.6	1571.6	2180.4	7647.6
02-07-15	806	15:20	44F8	57.33.710 N	008.30.000 E	101	96.0	8.2	2	8060.8	1270	1968.8	4822
02-07-15	857	20:34	45F8	58.17.055 N	008.48.963 E	292	Fail	7.7	2				
03-07-15	876	01:41	45F9	58.29.138 N	009.12.660 E	353	150.0	0.9	2	18423.6	7490.8	1804.8	9128
03-07-15	966	13:12	44G0	57.43.831 N	010.04.961 E	77	72.0	3.5	1	14955.2	6078.8	274.8	8601.6
03-07-15	1029	20:56	46F9	58.33.270 N	009.45.956 E	487	150.0	7.7	1	10260.8	2003.6	1511.2	6746
04-07-15	1143	15:28	45G0	58.18.986 N	010.58.710 E	108	Failed	0.9	2	11462.8	1175.2	1977.2	8310.4
04-07-15	1192	20:51	45G0	58.06.170 N	010.24.976 E	148	142.0	0.9	2	8728	2492	1393.2	4842.8
05-07-15	1316	15:27	44G1	57.50.637 N	011.17.061 E	97	92.0	3.6	1	7835.2	928.4	748	6158.8
05-07-15	1366	20:44	43G0	57.26.135 N	010.48.988 E	43	38.0	3.9	1	4758.4	360	359.2	4039.2
06-07-15	1492	15:39	42G1	56.47.802 N	011.42.933 E	35	30.0	11.6	5	4914.4	183.6	480.8	4250
06-07-15	1539	20:45	42G2	56.37.284 N	012.00.579 E	29	24	12.2	5	5508	710	402	4396
07-07-15	1659	14:44	41G1	56.21.817 N	011.51.035 E	31	26	6.6	3	4004	165.2	595.2	3243.6
07-07-15	1728	22:42	41G0	56.16.087 N	010.59.227 E	22	17	10.5	3	3248.8	206.8	293.2	2748.8

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 2015

Number of autumn spawning herring in mill.							
WR	0	1i	1m	2i	2m	3i	3m
580E06	0.00	0.71	0.00	0.33	0.00	0.00	0.00
570E06	0.00	268.45	0.00	18.98	1.88	0.00	0.00
580E08	0.00	84.68	0.00	11.08	0.30	0.15	0.00
570E08	0.00	418.54	0.00	1.71	0.26	0.04	0.00
C	5.75	314.83	0.00	9.57	0.54	0.00	0.00
D	56.62	1031.27	0.00	5.52	0.85	0.38	0.00
E	43.31	496.11	0.00	2.97	0.00	0.07	0.00
560E06	0.00	174.60	0.00	0.02	0.02	0.00	0.00

Biomass of autumn spawning herring in ton.							
WR	0	1i	1m	2i	2m	3i	3m
580E06	0.00	40.42	0.00	24.15	0.00	0.00	0.00
570E06	0.00	12393.58	0.00	1602.99	192.60	0.00	0.00
580E08	0.00	4537.07	0.00	942.88	34.94	16.33	0.00
570E08	0.00	13556.23	0.00	144.20	22.83	3.88	0.00
C	90.90	12041.02	0.00	846.61	62.13	0.00	0.00
D	945.49	36074.86	0.00	489.20	82.92	40.64	0.00
E	638.29	12400.30	0.00	142.10	0.00	6.92	0.00
560E06	0.00	6043.87	0.00	1.85	3.36	0.00	0.00

Mean length of autumn spawning herring in cm.							
WR	0	1i	1m	2i	2m	3i	3m
580E06	0.00	19.48	0.00	21.20	0.00	0.00	0.00
570E06	0.00	18.07	0.00	21.75	22.95	0.00	0.00
580E08	0.00	18.65	0.00	21.95	24.00	24.00	0.00
570E08	0.00	16.26	0.00	21.71	22.08	23.50	0.00
C	14.27	16.96	0.00	22.06	24.00	0.00	0.00
D	14.39	16.62	0.00	21.93	22.00	24.00	0.00
E	13.99	15.41	0.00	19.25	0.00	24.00	0.00
560E06	0.00	16.66	0.00	21.50	25.50	0.00	0.00

Mean weight of autumn spawning herring in g.							
WR	0	1i	1m	2i	2m	3i	3m
580E06	0.00	56.70	0.00	72.52	0.00	0.00	0.00
570E06	0.00	46.17	0.00	84.47	102.43	0.00	0.00
580E08	0.00	53.58	0.00	85.10	115.50	108.00	0.00
570E08	0.00	32.39	0.00	84.10	88.80	88.00	0.00
C	15.82	38.25	0.00	88.44	115.50	0.00	0.00
D	16.70	34.98	0.00	88.67	97.00	108.00	0.00
E	14.74	25.00	0.00	47.80	0.00	98.00	0.00
560E06	0.00	34.62	0.00	75.00	136.00	0.00	0.00

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 2015

Numbers of spring spawning herring in mill.

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	0.47	0.00	1.74	0.71	0.16	0.49	0.07	0.34	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
570E06	0.00	229.31	1.07	88.35	66.44	6.23	35.76	1.02	19.08	3.21	1.47	0.41	0.00	0.00	0.00	0.00	0.00
580E08	0.00	43.22	0.00	72.93	42.87	1.41	28.35	0.00	13.20	2.05	0.15	0.07	0.20	0.00	0.00	0.00	0.00
570E08	0.00	459.71	0.79	13.18	7.48	0.14	3.50	0.00	1.46	0.36	0.07	0.03	0.00	0.00	0.00	0.00	0.01
C	0.00	110.78	0.00	58.32	27.89	0.00	23.50	0.00	14.66	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00
D	0.00	1213.60	23.99	86.66	72.65	0.00	12.33	0.94	4.63	1.76	0.00	0.13	0.13	0.00	0.00	0.00	0.00
E	8.55	1379.34	12.18	83.97	31.78	5.16	6.68	0.63	8.03	1.20	1.02	0.12	0.29	0.00	0.00	0.00	0.00
560E06	0.00	530.24	0.00	4.01	0.02	0.00	0.47	0.00	0.02	0.21	0.18	0.00	0.00	0.00	0.00	0.00	0.00

Biomass of spring spawning herring in ton.

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	24.92	0.00	119.38	54.71	11.35	45.74	5.83	37.67	1.54	0.00	1.19	0.00	0.00	0.00	0.00	0.00
570E06	0.00	8537.60	58.68	6265.86	5587.01	447.06	3315.66	86.43	2076.00	293.42	115.11	55.23	0.00	0.00	0.00	0.00	0.00
580E08	0.00	2105.25	0.00	4842.59	3362.03	87.64	2377.31	0.00	1254.05	176.34	19.29	13.11	23.62	0.00	0.00	0.00	0.00
570E08	0.00	14052.20	53.55	822.97	611.10	8.84	311.03	0.00	156.98	34.36	6.17	3.99	0.00	0.00	0.00	0.00	2.24
C	0.00	3733.64	0.00	3957.86	2240.51	0.00	1946.92	0.00	1317.43	0.00	25.01	0.00	0.00	0.00	0.00	0.00	0.00
D	0.00	38731.89	1164.13	5064.92	4917.70	0.00	1131.16	63.89	468.03	159.98	0.00	26.16	15.75	0.00	0.00	0.00	0.00
E	152.54	34045.51	418.85	3587.10	1748.41	213.43	446.26	23.24	460.70	54.68	47.92	6.99	13.81	0.00	0.00	0.00	0.00
560E06	0.00	16091.54	0.00	148.64	1.43	0.00	32.58	0.00	3.06	13.85	13.12	0.00	0.00	0.00	0.00	0.00	0.00

Mean length of spring spawning herring in cm.

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	18.88	0.00	20.67	21.69	21.22	23.30	22.00	24.60	26.00	0.00	30.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	16.86	19.00	20.80	21.95	21.25	23.28	22.00	24.54	24.04	22.87	27.04	0.00	0.00	0.00	0.00	0.00
580E08	0.00	18.05	0.00	20.45	21.64	20.76	22.63	0.00	23.72	22.73	25.50	29.50	26.00	0.00	0.00	0.00	0.00
570E08	0.00	15.92	20.10	19.89	21.85	21.00	23.12	0.00	24.61	23.39	24.50	26.00	0.00	0.00	0.00	0.00	31.00
C	0.00	16.37	0.00	20.55	21.63	0.00	22.44	0.00	23.23	0.00	25.50	0.00	0.00	0.00	0.00	0.00	0.00
D	0.00	16.16	17.95	19.70	20.32	0.00	22.69	21.50	24.21	23.86	0.00	29.50	26.00	0.00	0.00	0.00	0.00
E	14.30	15.42	17.14	18.56	19.88	18.43	21.28	18.50	21.06	19.92	20.50	22.00	21.00	0.00	0.00	0.00	0.00
560E06	0.00	15.87	0.00	17.00	21.50	0.00	22.37	0.00	27.00	22.59	22.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean weight of spring spawning herring in g.

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	52.89	0.00	68.56	76.87	69.97	94.03	85.00	110.58	118.00	0.00	182.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	37.23	55.00	70.92	84.09	71.81	92.71	85.00	108.80	91.46	78.23	134.54	0.00	0.00	0.00	0.00	0.00
580E08	0.00	48.71	0.00	66.40	78.43	62.32	83.86	0.00	95.03	86.10	129.00	196.00	118.00	0.00	0.00	0.00	0.00
570E08	0.00	30.57	67.98	62.42	81.72	62.00	88.97	0.00	107.22	94.80	87.00	115.00	0.00	0.00	0.00	0.00	221.00
C	0.00	33.70	0.00	67.87	80.33	0.00	82.86	0.00	89.88	0.00	129.00	0.00	0.00	0.00	0.00	0.00	0.00
D	0.00	31.91	48.52	58.45	67.69	0.00	91.75	68.00	101.05	91.04	0.00	196.00	118.00	0.00	0.00	0.00	0.00
E	17.85	24.68	34.40	42.72	55.02	41.34	66.79	37.00	57.36	45.62	47.00	58.00	48.00	0.00	0.00	0.00	0.00
560E06	0.00	30.35	0.00	37.10	58.00	0.00	69.56	0.00	124.00	66.14	71.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 12. Age distribution in estimate of autumn spawners during the Danish acoustic survey with R/V Dana in June-July from 2006 to 2015 given as number per age and strata in mill.and % of total abundance given by age and strata.

Autumn spawners in 2006

Number in millions

Strata	WR 0	1	2	3	4	5	6	7	Totalt
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	313.22	77.82	1.31	0.00	0.00	0.00	0.00	392.36
580E08	0.00	72.47	5.61	0.00	0.00	0.28	0.00	0.00	78.36
570E08	30.99	425.10	40.41	2.00	0.00	0.00	0.00	0.00	498.50
C	0.00	125.25	21.23	0.00	0.00	0.32	0.00	0.00	146.79
D	0.00	265.61	13.04	1.53	0.00	0.00	0.00	0.00	280.17
E	6.57	107.84	17.39	1.23	0.00	0.00	1.09	0.00	134.12
560E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	37.56	1309.49	175.49	6.07	0.00	0.60	1.09	0.00	1530.29

Age distribution in % of total abundance

Strata	WR 0	1	2	3	4	5	6	7
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	79.83	19.83	0.33	0.00	0.00	0.00	0.00
580E08	0.00	92.48	7.16	0.00	0.00	0.36	0.00	0.00
570E08	6.22	85.28	8.11	0.40	0.00	0.00	0.00	0.00
C	0.00	85.32	14.46	0.00	0.00	0.22	0.00	0.00
D	0.00	94.80	4.65	0.55	0.00	0.00	0.00	0.00
E	4.90	80.41	12.97	0.92	0.00	0.00	0.81	0.00
560E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	2.45	85.57	11.47	0.40	0.00	0.04	0.07	0.00

Autumn spawners in 2007

Number in millions

Strata	WR 0	1	2	3	4	5	6	7	Totalt
580E06	0.00	4.28	0.78	0.00	0.00	0.00	0.00	0.00	5.05
570E06	0.00	121.40	56.69	5.73	0.08	0.00	0.00	0.00	183.90
580E08	0.00	59.15	26.53	0.00	0.00	0.00	0.00	0.00	85.68
570E08	0.00	753.58	118.42	0.00	0.00	0.00	0.00	0.00	872.00
C	0.00	75.63	7.93	0.00	0.00	0.00	0.00	0.00	83.56
D	0.00	1365.50	109.44	5.59	0.00	0.00	0.00	0.00	1480.53
E	0.00	1542.98	46.92	7.76	0.00	0.00	0.00	0.00	1597.67
560E06	0.00	134.85	0.00	0.00	0.00	0.00	0.00	0.00	134.85
All stratas	0.00	4057.35	366.72	19.08	0.08	0.00	0.00	0.00	4443.24

Age distribution in % of total abundance

Strata	WR 0	1	2	3	4	5	6	7
580E06	0.00	84.62	15.38	0.00	0.00	0.00	0.00	0.00
570E06	0.00	66.01	30.83	3.12	0.04	0.00	0.00	0.00
580E08	0.00	69.03	30.97	0.00	0.00	0.00	0.00	0.00
570E08	0.00	86.42	13.58	0.00	0.00	0.00	0.00	0.00
C	0.00	90.51	9.49	0.00	0.00	0.00	0.00	0.00
D	0.00	92.23	7.39	0.38	0.00	0.00	0.00	0.00
E	0.00	96.58	2.94	0.49	0.00	0.00	0.00	0.00
560E06	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	0.00	91.32	8.25	0.43	0.00	0.00	0.00	0.00

Autumn spawners in 2008

Numbers in millions

Strata	WR 0	1	2	3	4	5	6	7	Totalt
580E06	0.00	5.76	5.27	1.14	0.00	0.00	0.00	0.00	12.17
570E06	0.00	233.35	44.02	10.12	1.83	0.97	1.17	0.00	291.45
580E08	0.00	14.77	0.80	0.95	0.00	0.00	0.00	0.00	16.52
570E08	0.00	30.46	35.50	15.28	12.23	0.00	0.00	0.00	93.47
C	0.00	17.00	1.81	0.29	0.00	0.00	0.00	0.00	19.09
D	11.88	61.84	12.28	3.66	1.16	0.71	0.00	0.00	91.51
E	2347.35	13.79	1.01	3.67	0.00	0.00	0.00	0.00	2365.82
560E06	1556.12	26.99	0.00	0.00	0.00	0.00	0.00	0.00	1583.12
All stratas	3915.35	403.95	100.68	35.11	15.21	1.68	1.17	0.00	4473.15

Age distribution in % of total abundance

Strata	WR 0	1	2	3	4	5	6	7
580E06	0.00	47.34	43.32	9.35	0.00	0.00	0.00	0.00
570E06	0.00	80.06	15.10	3.47	0.63	0.33	0.40	0.00
580E08	0.00	89.39	4.83	5.77	0.00	0.00	0.00	0.00
570E08	0.00	32.59	37.98	16.35	13.08	0.00	0.00	0.00
C	0.00	89.02	9.46	1.52	0.00	0.00	0.00	0.00
D	12.98	67.58	13.41	3.99	1.27	0.77	0.00	0.00
E	99.22	0.58	0.04	0.16	0.00	0.00	0.00	0.00
560E06	98.29	1.71	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	87.53	9.03	2.25	0.78	0.34	0.04	0.03	0.00

Autumn sawners in 2009

Numbers in millions

	WR 0	1	2	3	4	5	6	7	Total
580E06	0.00	0.69	0.09	0.02	0.00	0.00	0.00	0.00	0.81
570E06	31.06	171.89	42.79	7.42	0.00	0.00	0.00	0.00	253.16
580E08	0.00	9.70	4.14	0.27	0.53	0.26	0.05	0.00	14.95
570E08	108.09	747.46	8.76	0.31	0.68	0.27	0.06	0.00	865.63
C	260.15	0.59	0.06	0.00	0.00	0.00	0.00	0.00	260.80
D	3864.97	482.56	3.47	0.16	0.85	0.37	0.00	0.00	4352.38
E	3409.91	277.26	0.30	0.00	0.00	0.00	0.00	0.00	3687.48
560E06	138.33	103.89	1.80	0.00	0.00	0.00	0.00	0.00	244.03
All Stratas	7812.52	1794.04	61.42	8.18	2.07	0.91	0.10	0.00	9679.24

Age distribution in % of total abundance

	WR 0	1	2	3	4	5	6	7
580E06	0.00	85.88	11.60	2.53	0.00	0.00	0.00	0.00
570E06	12.27	67.90	16.90	2.93	0.00	0.00	0.00	0.00
580E08	0.00	64.85	27.70	1.84	3.55	1.75	0.31	0.00
570E08	12.49	86.35	1.01	0.04	0.08	0.03	0.01	0.00
C	99.75	0.23	0.02	0.00	0.00	0.00	0.00	0.00
D	88.80	11.09	0.08	0.00	0.02	0.01	0.00	0.00
E	92.47	7.52	0.01	0.00	0.00	0.00	0.00	0.00
560E06	56.69	42.57	0.74	0.00	0.00	0.00	0.00	0.00
All Stratas	80.71	18.53	0.63	0.08	0.02	0.01	0.00	0.00

Autumn sawners in 2010

Numbers in millions

	WR 0	1	2	3	4	5	6	7	Total
580E06	0.00	5.16	0.21	0.10	0.04	0.00	0.00	0.00	5.50
570E06	0.00	19.01	6.15	0.66	0.70	0.14	0.00	0.11	26.76
580E08	0.00	6.73	2.03	0.71	0.66	0.17	0.00	0.00	10.30
570E08	0.00	1222.33	5.96	1.17	0.02	0.04	0.00	0.01	1229.52
C	0.26	3.03	0.51	0.11	0.21	0.00	0.00	0.00	4.12
D	0.06	202.86	7.37	1.70	0.02	0.01	0.00	0.00	212.02
E	49.68	966.47	8.69	2.14	0.00	0.00	0.00	0.00	1026.98
560E06	205.36	2.89	0.00	0.00	0.00	0.00	0.00	0.00	208.25
All Stratas	255.37	2428.48	30.91	6.58	1.64	0.36	0.00	0.12	2723.45

Age distribution in % of total abundance

	WR 0	1	2	3	4	5	6	7
580E06	0.00	93.80	3.77	1.75	0.67	0.00	0.00	0.00
570E06	0.00	71.02	22.96	2.45	2.60	0.54	0.00	0.43
580E08	0.00	65.40	19.74	6.85	6.39	1.62	0.00	0.00
570E08	0.00	99.42	0.48	0.09	0.00	0.00	0.00	0.00
C	6.34	73.59	12.37	2.70	5.01	0.00	0.00	0.00
D	0.03	95.68	3.48	0.80	0.01	0.00	0.00	0.00
E	4.84	94.11	0.85	0.21	0.00	0.00	0.00	0.00
560E06	98.61	1.39	0.00	0.00	0.00	0.00	0.00	0.00
All Stratas	9.38	89.17	1.14	0.24	0.06	0.01	0.00	0.00

Table 12 continued…

Autumn spawners in 2011

Numbers in millions	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	4.52	4.15	0.21	0.19	0.00	0.00	0.00	9.07
570E06	0.00	510.31	22.96	0.79	1.08	0.34	0.00	0.00	535.48
580E08	0.00	29.05	33.80	0.97	1.58	0.00	0.00	0.00	65.41
570E08	0.00	1095.58	86.44	3.23	1.29	0.20	0.00	0.00	1186.75
C	4.54	48.45	13.21	2.00	1.53	0.00	0.00	0.00	69.73
D	513.19	145.16	25.80	3.62	1.20	0.30	0.30	0.00	689.56
E	767.38	162.48	0.25	0.05	0.00	0.00	0.00	0.00	930.15
560E06	0.00	1669.55	0.00	0.00	0.00	0.00	0.00	0.00	1669.55
All Strata	1285.12	3665.10	186.62	10.87	6.87	0.85	0.30	0.00	5155.72

Age distribution in % of total abundance	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	49.85	45.80	2.27	2.07	0.00	0.00	0.00
570E06	0.00	95.30	4.29	0.15	0.20	0.06	0.00	0.00
580E08	0.00	44.42	51.68	1.48	2.42	0.00	0.00	0.00
570E08	0.00	92.32	7.28	0.27	0.11	0.02	0.00	0.00
C	6.52	69.48	18.95	2.87	2.19	0.00	0.00	0.00
D	74.42	21.05	3.74	0.53	0.17	0.04	0.04	0.00
E	82.50	17.47	0.03	0.01	0.00	0.00	0.00	0.00
560E06	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
All Strata	24.93	71.09	3.62	0.21	0.13	0.02	0.01	0.00

Autumn spawners in 2012

Numbers in millions	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	11.54	7.21	0.30	0.08	0.00	0.07	0.07	19.26
570E06	0.00	539.59	129.74	7.71	3.47	0.69	0.20	0.58	681.98
580E08	0.10	208.42	49.54	1.71	0.75	0.38	0.41	0.00	261.30
570E08	0.00	1247.08	114.79	3.07	3.47	0.26	0.00	0.19	1368.86
C	132.42	62.45	10.42	0.00	0.22	0.00	0.00	0.00	205.51
D	0.00	992.33	29.05	0.26	0.76	0.00	0.00	0.00	1022.40
E	54.99	722.62	7.38	1.33	1.20	0.44	0.00	0.00	787.96
560E06	0.00	457.36	0.21	0.00	0.00	0.00	0.00	0.00	457.57
All Strata	187.51	4241.38	348.34	14.38	9.96	1.77	0.68	0.83	4804.84

Age distribution in % of total abundance	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	59.91	37.45	1.57	0.40	0.00	0.34	0.34
570E06	0.00	79.12	19.02	1.13	0.51	0.10	0.03	0.08
580E08	0.04	79.76	18.96	0.65	0.29	0.15	0.16	0.00
570E08	0.00	91.10	8.39	0.22	0.25	0.02	0.00	0.01
C	64.44	30.39	5.07	0.00	0.11	0.00	0.00	0.00
D	0.00	97.06	2.84	0.03	0.07	0.00	0.00	0.00
E	6.98	91.71	0.94	0.17	0.15	0.06	0.00	0.00
560E06	0.00	99.95	0.05	0.00	0.00	0.00	0.00	0.00
All Strata	3.90	88.27	7.25	0.30	0.21	0.04	0.01	0.02

Autumn spawners in 2013

Numbers in millions	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	3.27	0.91	0.00	0.00	0.00	0.00	0.00	4.19
570E06	0.00	73.05	35.91	0.00	0.00	0.00	0.00	0.00	108.96
580E08	0.00	44.04	23.28	0.38	0.00	0.00	0.00	0.00	67.69
570E08	0.00	63.40	24.63	0.00	0.00	0.00	0.00	0.00	88.03
C	0.08	36.01	1.85	0.02	0.00	0.00	0.00	0.00	37.96
D	0.44	155.40	21.08	0.00	0.00	0.00	0.00	0.00	176.92
E	22.40	409.74	36.77	0.00	0.00	0.00	0.00	0.00	468.90
560E06	14.51	102.83	0.18	0.00	0.00	0.00	0.00	0.00	117.51
All Strata	37.42	887.73	144.61	0.40	0.00	0.00	0.00	0.00	1070.16

Age distribution in % of total abundance	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	78.16	21.84	0.00	0.00	0.00	0.00	0.00
570E06	0.00	67.04	32.96	0.00	0.00	0.00	0.00	0.00
580E08	0.00	65.06	34.38	0.56	0.00	0.00	0.00	0.00
570E08	0.00	72.02	27.98	0.00	0.00	0.00	0.00	0.00
C	0.20	94.87	4.87	0.06	0.00	0.00	0.00	0.00
D	0.25	87.83	11.92	0.00	0.00	0.00	0.00	0.00
E	4.78	87.38	7.84	0.00	0.00	0.00	0.00	0.00
560E06	12.34	87.50	0.15	0.00	0.00	0.00	0.00	0.00
All Strata	3.50	82.95	13.51	0.04	0.00	0.00	0.00	0.00

Autumn spawners in 2014

Numbers in millions	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	0.67	0.84	0.10	0.00	0.00	0.00	0.00	1.60
570E06	0.05	467.07	27.84	1.52	0.23	0.00	0.00	0.00	496.70
580E08	0.00	53.11	17.63	1.22	0.00	0.00	0.00	0.00	71.96
570E08	328.24	70.31	3.13	0.01	0.00	0.00	0.00	0.00	401.68
C	378.97	3.29	0.77	0.00	0.00	0.00	0.00	0.00	383.03
D	582.25	9.88	0.97	0.10	0.00	0.00	0.00	0.00	593.20
E	2109.46	126.41	1.28	0.02	0.00	0.00	0.01	0.00	2237.19
560E06	70.09	320.29	0.11	0.00	0.00	0.00	0.00	0.00	390.48
All Strata	3469.06	1051.02	52.56	2.97	0.23	0.00	0.01	0.00	4575.85

Age distribution in % of total abundance	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	41.99	52.08	5.93	0.00	0.00	0.00	0.00
570E06	0.01	94.03	5.60	0.31	0.05	0.00	0.00	0.00
580E08	0.00	73.81	24.50	1.69	0.00	0.00	0.00	0.00
570E08	81.72	17.50	0.78	0.00	0.00	0.00	0.00	0.00
C	98.94	0.86	0.20	0.00	0.00	0.00	0.00	0.00
D	98.15	1.66	0.16	0.02	0.00	0.00	0.00	0.00
E	94.29	5.65	0.06	0.00	0.00	0.00	0.00	0.00
560E06	17.95	82.02	0.03	0.00	0.00	0.00	0.00	0.00
All Strata	75.81	22.97	1.15	0.06	0.01	0.00	0.00	0.00

Autumn spawners in 2015

Numbers in millions	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	0.71	1.75	0.00	0.00	0.00	0.00	0.00	2.46
570E06	0.00	268.45	1.22	0.00	0.00	0.00	0.00	0.00	269.67
580E08	0.00	84.68	0.01	0.15	0.00	0.00	0.00	0.00	84.84
570E08	0.00	418.54	0.00	0.04	0.00	0.00	0.00	0.00	418.59
C	5.75	314.83	0.10	0.00	0.00	0.00	0.00	0.00	320.68
D	56.62	1031.27	0.02	0.38	0.00	0.00	0.00	0.00	1088.29
E	43.31	496.11	0.00	0.07	0.00	0.00	0.00	0.00	539.50
560E06	0.00	174.60	3.20	0.00	0.00	0.00	0.00	0.00	177.79
All Strata	105.68	2789.19	0.00	0.64	0.00	0.00	0.00	0.00	2895.51

Age distribution in % of total abundance	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	28.92	71.08	0.00	0.00	0.00	0.00	0.00
570E06	0.00	99.55	0.45	0.00	0.00	0.00	0.00	0.00
580E08	0.00	99.82	0.01	0.18	0.00	0.00	0.00	0.00
570E08	0.00	99.99	0.00	0.01	0.00	0.00	0.00	0.00
C	1.79	98.18	0.03	0.00	0.00	0.00	0.00	0.00
D	5.20	94.76	0.00	0.03	0.00	0.00	0.00	0.00
E	8.03	91.96	0.00	0.01	0.00	0.00	0.00	0.00
560E06	0.00	98.20	1.80	0.00	0.00	0.00	0.00	0.00
All Strata	3.65	96.33	0.00	0.02	0.00	0.00	0.00	0.00

Table 13. Age distribution in estimate of spring spawners during the Danish acoustic survey with R/V Dana in June-July from 2007 to 2015 given as number per age and strata.

Spring spawners in 2007															
Numbers in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
580E06	0	0.59	10.71	6.52	6.76	1.13	0.91	0.10	0.10	0	0	0	0	0	26.82
570E06	0	38.76	240.73	133.30	63.70	22.19	4.99	3.71	0.88	0	0	0	0	0	508.26
580E08	0	18.16	104.65	52.34	32.00	11.00	2.02	0.26	1.24	0.47	0	0	0	0	222.14
570E08	0	523.57	651.64	295.67	141.30	52.41	12.08	3.48	4.91	2.66	0	0	0	0	1687.73
C	0	500.81	329.72	87.72	27.43	6.10	1.21	0	1.40	0	0	0	0	0	954.39
D	0	531.74	612.87	161.57	51.80	10.31	0	0	1.76	0	0	0	0	0	1370.05
E	0	2138.61	1676.06	193.05	129.39	42.04	11.33	18.17	1.37	0	0	0	0	0	4210.02
560E06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All stratas	0	3752.24	3626.38	930.17	452.37	145.18	32.54	25.73	11.66	3.14	0	0	0	0	8979.40
													Total 4-13 WR		670.61
													Total 0-3 WR		8308.79
Spring spawners in 2008															
Numbers in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	4.75	22.36	11.44	4.64	1.63	0.23	0	0	0	0	0	0	0	45.06
570E06	0	2263.75	377.97	116.59	51.42	23.77	13.53	5.64	2.24	0.17	0.14	0	0	0	2855.22
580E08	0	49.79	59.90	36.90	7.15	5.02	1.89	1.00	0.48	0.13	0.00	0	0	0	162.26
570E08	0	701.72	228.78	147.20	71.33	46.00	41.03	15.91	6.89	5.64	0.00	0	0	0	1264.51
C	0	108.72	96.90	26.02	7.22	5.07	0.58	0.34	0	0	0.34	0	0	0	245.18
D	1.38	124.71	151.89	59.98	20.05	11.58	3.96	1.21	0	0	0.29	0	0	0	375.05
E	23.86	216.22	125.10	41.38	11.35	6.16	3.85	0.45	0.68	0.36	0	0	0	0	429.43
560E06	81.17	1903.13	5.62	0	0	0	0	0	0	0	0	0	0	0	1989.92
All stratas	106.42	5372.77	1068.54	439.52	173.17	99.23	65.08	24.55	10.28	6.31	0.77	0	0	0	7366.64
													Total 4-13 WR		379.39
													Total 0-3 WR		6987.25
Spring spawners in 2009															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.18	0.85	0.44	0.32	0.19	0.02	0	0	0.01	0	0	0	0	2.01
570E06	0	60.72	136.57	138.97	116.99	51.61	44.13	15.51	11.38	1.72	2.16	1.16	0	1.52	582.44
580E08	0	0.00	17.81	9.09	7.78	3.76	2.29	0.71	0.16	0.24	0.05	0	0	0	41.88
570E08	0	87.86	59.76	19.24	13.05	6.39	3.68	1.12	0.21	0.28	0.07	0	0	0	191.66
C	0	0.00	2.61	1.01	0.64	0.09	0.03	0.03	0.03	0	0	0	0	0	4.43
D	0	1.12	66.37	22.03	14.97	5.02	3.51	1.26	0.23	0.39	0.12	0	0	0	115.03
E	0.94	155.35	27.00	5.35	1.99	0.68	0.65	0	0	0	0	0	0	0	191.95
560E06	0	194.39	1.80	0.72	0	0	0	0	0	0	0	0	0	0	196.91
All stratas	0.94	499.62	312.76	196.86	155.73	67.73	54.30	18.63	12.01	2.64	2.40	1.16	0	1.52	1326.32
													Total 4-13 WR		316.13
													Total 0-3 WR		1010.19
Spring spawners in 2010															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.64	3.58	2.90	1.33	0.58	0.32	0.04	0	0	0	0	0	0	9.40
570E06	0	2.63	14.71	22.37	8.57	4.51	2.24	0.75	0.39	0.49	0.24	0.01	0.10	0	57.00
580E08	0	0.38	11.76	18.76	6.75	3.59	1.62	1.56	0.70	0.38	0	0	0	0	45.51
570E08	0	111.66	55.59	19.63	0.29	0.10	0.06	0.02	0	0.01	0	0	0	0	187.35
C	0	0.15	4.09	5.31	1.54	1.05	0.45	0.46	0.24	0.15	0	0	0	0	13.43
D	0	45.94	92.39	15.31	1.60	0.38	0.10	0.07	0.03	0.01	0	0	0	0	155.82
E	0.66	611.21	307.14	59.42	7.44	3.49	0.57	0.39	0.12	0.00	0	0	0	0	990.43
560E06	0	1.82	0.01	0	0	0	0	0	0	0	0	0	0	0	1.83
All stratas	0.66	774.43	489.28	143.70	27.52	13.70	5.36	3.28	1.47	1.04	0.25	0.01	0.10	0	1460.78
													Total 4-13 WR		52.72

Table 13 Continued..

Spring spawners in 2011															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.12	7.73	4.40	1.00	1.63	0.45	0.08	0	0	0	0	0	0	15.69
570E06	0	79.66	66.92	40.88	20.10	10.79	3.52	3.01	2.02	0.00	0.00	0	0	0	226.90
580E08	0	4.51	76.89	47.55	39.76	14.16	14.12	2.04	0.29	0.46	1	0	0	0	200.30
570E08	0	484.27	121.20	55.94	40.75	14.81	9.01	2.30	1	0.20	0	0	0	0	730.09
C	0	6.74	59.20	16.36	6.87	0.63	0.31	0.00	0.00	0.00	0	0	0	0	90.11
D	0	55.88	63.59	27.43	16.10	4.60	2.34	0.30	0.00	0.00	0	0	0	0	170.23
E	0.00	419.21	18.63	2.92	0.56	0.27	0.05	0.11	0.00	0.05	0	0	0	0	441.81
560E06	0	1824.43	0.00	0	0	0	0	0	0	0	0	0	0	0	1824.43
All stratas	0.00	2874.83	414.17	195.48	125.13	46.89	29.80	7.83	3.88	0.72	0.84	0	0	0	3699.57
													Total 4-13 WR		215.09
													Total 0-3 WR		3484.48

Spring spawners in 2012															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.09	12.74	4.11	1.82	0.83	0.45	0.41	0	0	0	0	0		20.79
570E06	0	0.80	53.18	18.53	7.18	5.64	2.64	1.49	1.14	0.25	0.00	0	0		91.00
580E08	0	6.38	127.18	31.48	11.14	2.07	2.28	0.00	0.00	0.00	0	0	0		180.53
570E08	0	37.49	185.06	18.31	4.00	8.21	4.20	1.39	1	1.05	0	0	0		260.68
C	0	2.80	70.51	11.69	3.71	0.56	0.43	0.00	0.00	0.00	0	0	0		89.70
D	0	122.36	149.95	10.99	1.72	1.38	0.20	0.00	0.00	0.00	0	0	0		286.60
E	0.97	687.18	244.61	18.12	2.48	2.87	0.68	0.12	0.00	0.00	0	0	0		957.03
560E06	0	67.84	0.70	0	0	0	0	0	0	0	0	0	0		68.54
All stratas	0.97	924.95	843.92	113.21	32.05	21.56	10.88	3.43	2.30	1.31	0.00	0.00	0.30	0	1954.88
													Total 4-13 WR		71.83
													Total 0-3 WR		1883.04

Spring spawners in 2013															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.00	13.30	21.51	1.73	2.27	0.15	1.08	0	0	0	0	0		40.03
570E06	0	0.00	79.65	102.40	14.42	7.68	3.52	3.75	0.76	0.20	0.23	0	0		212.61
580E08	0	0.00	76.53	67.67	7.85	2.80	2.77	0.38	0.20	0.00	0	0	0		158.27
570E08	0	1.02	41.58	27.43	2.83	1.00	1.03	0.15	0	0.10	0	0	0		75.32
C	0	0.95	10.20	2.93	0.25	0.14	0.11	0.01	0.01	0.00	0	0	0		14.61
D	0	2.82	59.97	19.34	1.84	0.48	0.47	0.08	0.00	0.15	0	0	0		85.51
E	0.00	23.99	275.63	102.36	9.65	5.01	0.00	0.00	0.00	0.00	0	0	0		416.64
560E06	0	8.44	1.42	0	0	0	0	0	0	0	0	0	0		10.01
All stratas	0.00	37.22	558.27	343.77	38.60	19.39	8.05	5.44	1.08	0.46	0.71	0.00	0.02	0	1013.00
													Total 4-13 WR		73.74
													Total 0-3 WR		939.26

Spring spawners in 2014															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0.02	0.51	3.80	2.94	1.01	0.02	0.02	0.03	0.06	0.02	0.00	0.00	0.00	0.00	8.41
570E06	0.00	30.56	38.57	30.67	12.70	0.85	1.27	0.22	0.09	0.14	0.00	0.00	0.00	0.00	115.08
580E08	0.00	37.89	64.59	55.29	6.55	2.44	0.72	0.00	0.25	0.00	0.25	0.00	0.00	0.00	168.00
570E08	26.99	6.21	3.59	1.14	0.19	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.16
C	67.41	3.31	5.38	2.85	0.76	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.77
D	42.64	4.33	2.74	1.62	0.40	0.03	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	51.81
E	171.83	122.86	4.49	2.93	0.31	0.10	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	302.61
560E06	4.40	29.63	0.22	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.28
All stratas	313.30	235.30	123.39	97.46	21.92	3.51	2.13	0.28	0.41	0.15	0.26	0.00	0.00	0.00	798.11
													Total 4-13 WR		28.66
													Total 0-3 WR		769.46

Spring spawners in 2015															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06		0.47	2.45	0.65	0.41	0.01		0.01							4.00
570E06		230.38	154.79	41.99	20.10	3.21	1.47	0.41							452.34
580E08		43.22	115.80	29.76	13.20	2.05	0.15	0.07	0.20						204.43
570E08		460.50	20.66	3.64	1.46	0.36	0.07	0.03					0.01		486.74
C		110.78	86.21	23.50	14.66		0.19								235.34
D		1237.59	159.31	12.33	5.57	1.76		0.13	0.13						1416.83
E	8.55	1391.52	115.75	11.84	8.66	1.20	1.02	0.12	0.29						1538.94
560E06		530.24	4.03	0.47	0.02	0.21	0.18								535.16
All stratas	8.55	4004.70	659.00	124.17	64.08	8.80	3.09	0.77	0.62	0.00	0.00	0.00	0.01	0.00	4873.79
													Total 4-13 WR		77.37
													Total 0-3 WR		4796.41

Table 14. 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 2015.

Numbers sprat in mill.									
WR	0.00	1i	1m	2i	2m	3.00	4.00	5.00	6.00	7.00
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	0.24	0.11	1.27	0.23	1.42	0.19	0.07	0.00	0.00
580E08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E08	0.00	0.22	0.07	0.11	0.22	0.33	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	0.63	156.74	0.00	0.87	0.43	0.00	0.00	0.00	0.00	0.00
E	9.25	2450.67	60.92	96.32	34.46	61.76	27.95	10.35	3.51	0.16
560E06	0.00	26.75	1.02	12.83	2.44	1.75	0.10	0.00	0.00	0.00

Biomass spratin ton.										
WR	0	1i	1m	2i	2m	3	4	5	6	7
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	2.60	1.33	16.79	3.25	24.67	3.60	1.45	0.00	0.00
580E08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E08	0.00	2.86	1.25	1.68	3.49	6.23	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	1.81	1008.41	0.00	8.22	3.61	0.00	0.00	0.00	0.00	0.00
E	26.51	15831.49	426.17	937.60	399.52	912.97	478.89	206.88	81.87	4.38
560E06	0.00	277.58	11.67	145.38	31.70	29.13	1.92	0.00	0.00	0.00

Mean length sprat in cm.										
WR	0	1i	1m	2i	2m	3	4	5	6	7
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	10.81	11.25	12.20	12.62	13.40	13.61	13.50	0.00	0.00
580E08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E08	0.00	11.42	12.00	12.67	12.17	13.56	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	7.50	9.31	0.00	10.50	10.50	0.00	0.00	0.00	0.00	0.00
E	7.50	9.38	9.74	10.95	11.65	12.91	13.65	14.55	15.39	16.42
560E06	0.00	10.78	11.14	11.12	11.83	13.23	13.73	0.00	0.00	0.00

Mean weight sprat in g.										
WR	0	1i	1m	2i	2m	3	4	5	6	7
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	10.71	11.77	13.22	14.43	17.36	19.31	19.64	0.00	0.00
580E08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E08	0.00	13.02	17.09	15.30	15.88	18.88	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	2.87	6.43	0.00	9.46	8.31	0.00	0.00	0.00	0.00	0.00
E	2.87	6.46	7.00	9.73	11.59	14.78	17.14	19.98	23.30	28.26
560E06	0.00	10.37	11.41	11.33	13.01	16.66	19.42	0.00	0.00	0.00

Appendix 1

REPORT OF THE DIFFERENT PROJECTS AND IDEAS FOR THE FUTURE

INTRODUCTION:

During the 10 days between 27.6.15 and 08.7.15 on board of the research vessels Dana, different projects and pilot projects were carried out with the intent of collecting data and testing new monitoring possibilities for future experiments. The projects involved were: a) collection of photographic samples from the different hauls representing the major fish species found in the area of interest. This, connected to the GUDP VIND project currently on going at DTU AQUA in Charlottenlund, serves as a database for a fish recognition and measurement computer program (FishSizer) that has to be develop within the project itself; b) collection of video footage for the JellyCam project; c) filming of trawling operations.
The collection of the different type of data was connected with the Cruise Leader Course that was supposed to be held on board of the vessel but did not take place. The reasons for this are beyond the purpose of this report and will not be discussed.

EXPLANATION OF THE DIFFERENT PROJECTS

FISH SIZER:

The FishSizer project involves the developing of an automatic/semi-automatic tool to measure and classify the different species found when trawling in the Skagerrak and Kattegat regions. It comprehends two distinct phases: the realization of a physical tool that will accommodate a specific number of organisms and take a picture for each sample; and the coding of dedicated software (MatLab used so far) to process the pictures, identify the fish species and measure each organism. The general idea behind the project is to develop a tool that can be easily placed inside a given fishing vessel and connected to the trawl catch. During this cruise, pictures were collected for almost every trawl hauls covering each different species encountered. Depending on the size, coloration and other factors, some species are easier to detect compared to others. To calibrate the software, a large amount of photographic data is needed. The computer software has been developed so far by the author of this document and Bjarne Stage (BS) at DTU AQUA. The testing of the code was then done live while on Dana, testing it with the pictures collected for each haul. The project is still in an initial prototyping phase and requires more experimental time and possibly different expertise. Been able to test this while on Dana has an enormous importance since the vessels'

FIGURE 1 EXAMPLES OF CATCH SAMPLE

routine of multiple catches per day provides a great amount of data that would be impossible to obtain from land. Also, there is the chance to work with fresh organisms, resembling the reality of a fishing vessel, while on land the testing so far has been carried out with frozen samples only from the sand-eels fishery.

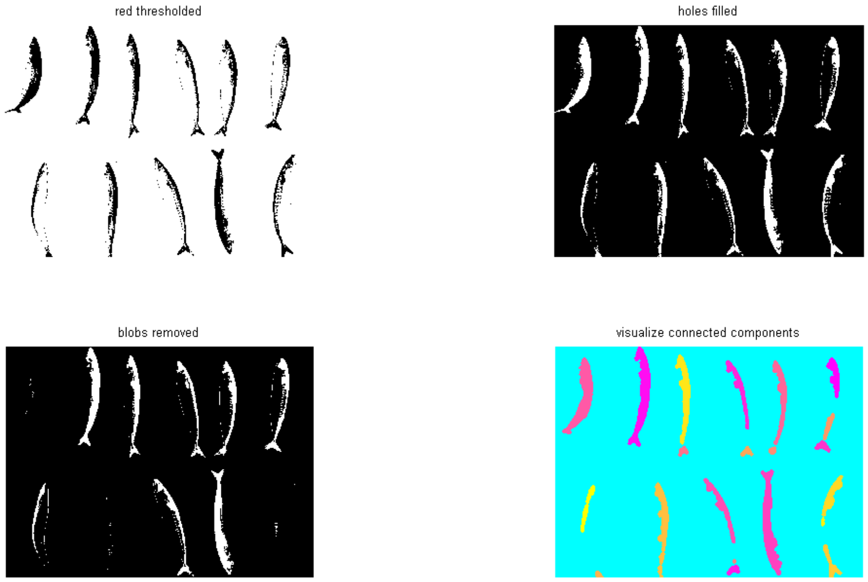

FIGURE 2 EXAMPLE OF DETECTION OF CATCH SAMPLE USING MATLAB

JELLYCAM PROJECT:

The JellyCam project has been started last year on board of the vessel as part of the Cruise Leader Course, where two students from the AS&T MSc were in charge of collecting the data and test the system. The project focuses on the collection of video footage from the tow-fish through a camera mounted on the upper side of the tow-fish. Since the tow-fish is always been used to collect acoustic data and stays in the water for long periods of time, it offers a perfect data collection station which is operational in a very short time. The camera is turned on before deploying the fish and the start and end coordinates and time are noted. It then stays in the water moving horizontally through the water as the vessel proceeds on its route. The outputs are hours-long videos used to quantify the jellyfish presence in different locations and time of the day. Given the stability of the fish in the water and the clarity of the video produced by the GoPro cameras, the quality of the data is high. Jellyfish counting has been done manually during last year by the two students involved in the project, while this year a MatLab code is being tested to automatically detect and count this type of organisms. This would greatly facilitate and speed up the processing increasing the system's performance even more.

What is interesting about this project is the collection of a completely new dataset done in an "opportunistic" way by using an already existing platform. Jellyfish can cause major problems to fisheries, beaches and sometime vessels if they reach extremely high concentration, but they also are a characterizing and important part of the ecosystem. Moreover, no data is currently available on the dispersion of these organisms in the Skaggerak/Kattegat areas. Using Dana as a platform for this project is a great advantage since different surveys are carried out throughout the year, offering the chance of collecting a vast and solid database in a short time. The possibilities for publications are very high within this project.

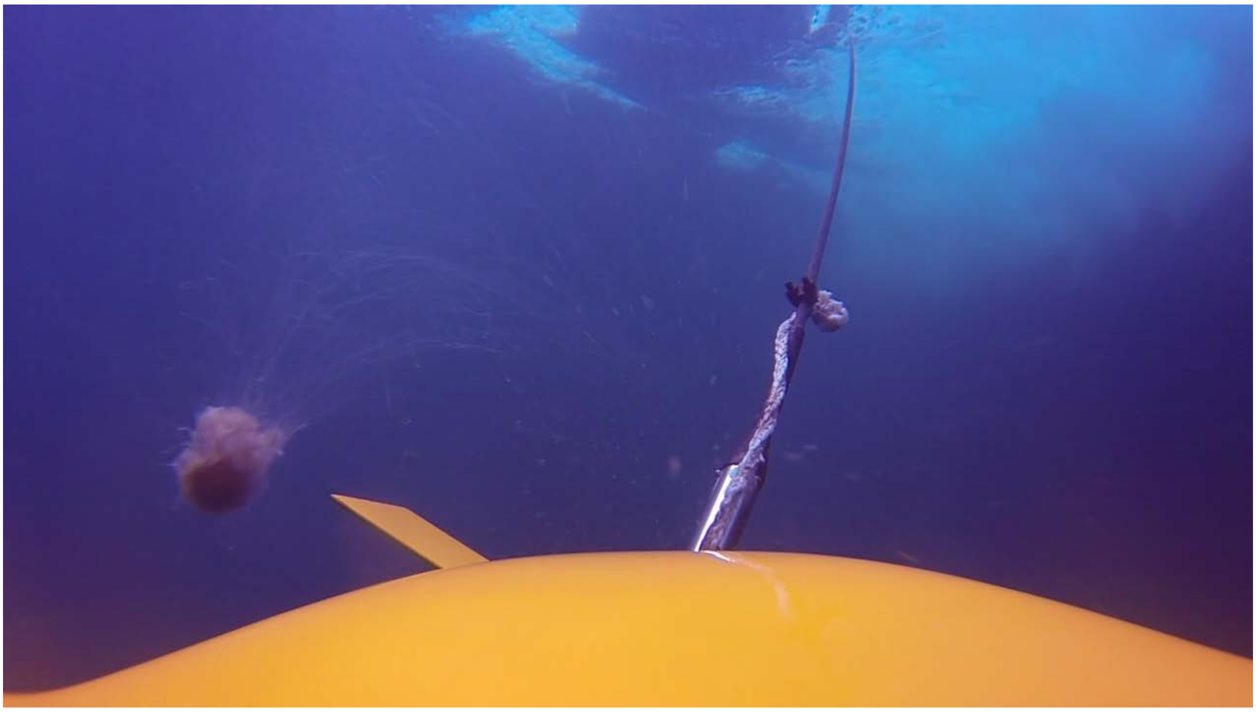

FIGURE 3 PICTURE TAKEN FROM THE TOW FISH

If there is an interest in continuing the collection of this data, some suggestions proposed by the author are:

1) Produce a standard camera system that is easy to mount on the tow-fish (as the GoPros are) and that can run for multiple hours without battery and data storage issues;
2) Refine the automatic counting software to speed up the processing of data;
3) Set this as a routine on board of the vessel. This is extremely easy to do given the very little amount of time and expertise that is needed to place the camera on the tow-fish;
4) Have a dedicated computer on board to deal with the process of heavy footage files;
5) Correlated the video/presence of jellyfish with other data easily available on board: CTD data and so forth, to have a deep and complete understanding of the causes for the presence/absence of these organisms

The JellyCam project presents a great opportunity for future students' project on board Dana, while collecting new data that will help in understanding the ecosystem of the areas in question.

FILMING OF TRAWLING OPERATIONS:

The filming of trawling operations is done on the side by the author to collect information which is useful for future or ongoing projects based on the use of the trawl nets. Moreover, members of the crew are interested in having the footage for themselves. The footages can also be used for publicity purposes by showing the public how the collection of fish data is done on a regular basis on board of Dana. Involving the public and authorities is always a good idea, especially when it comes to funding future projects. The footages could be used to produce informational video for the students coming on board Dana for the future Cruise Leader courses.