Acoustic Herring Survey report for RV "DANA"

30th June2009 – 13th July 2009

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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 2009-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period July 2 to July 13 2009, while calibration was done during June 30 to July 2 2009.

2. SURVEY

2.1 Personnel

During calibration 30/6 – 2/7-2009
Karl-Johan Stæhr (cruise leader)
Bo Lundgren (assisting cruise leader)
Torben Filt Jensen
Thyge Dyrnesli
Peter Faber
Frederik Mathisen
Mads Larsen
Dennis Lisbjerg

During acoustic monitoring 2/7 - 13/7-2009
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Bo Lundgren
Lise Sindahl
Jette Sandsted
Helle Andersen
Nina Fuglsang
Thyge Dyrnesli

2.2 Narrative

The survey of R/V Dana started on June 30 at 12.00 hours 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 early evening at the June 30. The calibration was initiated in the morning on July 1. and continued until July 2 in the morning.

At July 2 at noon the scientific crew was exchanged outside the harbour of Skagen. After the short break at Skagen, R/V Dana steamed towards the north-westerly corner of the survey area in Skagerrak. The acoustic integration was initiated on July 2 at 21,58 UTC at 57º52'N, 06º57'E.

The western Skagerrak area was covered during the period July 2 – 8, eastern Skagerrak during July 9 – 10 and Kattegat during July 11 – 13. The acoustic integration was ended at 57º26'N, 10º44'E at 06.00 UTC. R/V Dana arrived at Hirthals at 15.00 UTC on July 13.

On July 10 the survey was stopped from 06 to 11 UTC to go to Hirtshals for the repair of a trawlwinch.

Totally the survey covered about 2000 nautical miles. Data from the 38 kHz echosounder were recorded mainly using the 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 the 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 in the Skagerrak, 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. The transects along the Swedish coast 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 30-July 2 2009. 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 during 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. 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 similar to the previous calibration earlier in the year, 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 impedance data for the hull-mounted 38kHz transducer showed that two of the four segments had a significantly lower values than normal. The transducer is from 1985 and it is recommended to change it at the next docking of the vessel. Data from this transducer was not used for integration during this survey.

2.5 Acoustic data collection

Acoustic data were collected using mainly the Simrad EK60 38kHz 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, 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 also pre-integrated into 1 m meter samples for each ping. These samples 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 300 m depth. During trawl hauls the towed body is taken aboard and the EK60 38 kHz echosounder run on the hull transducer, but these data are not used for the integration.

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. 1 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. In each trawl haul 10 (if available) herring per 0.5 cm length class were sampled and frozen for individual determination of length, weight, age, race (North Sea autumn spawners or Baltic Sea spring spawners) and maturity in land. Fourier Shape Analyses calibrated to icro-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 Fig. 2.

2.8 Data analysis

The raw data is pre-integrated into 1m 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. It allows ignoring data from layers and/or intervals with interference from wave- or ship wake-bubbles or rarely with bottom-integration. In areas with heavy abundance of jellyfish or zooplankton, usually krill, manually adjustable thresholds is applied separately to each layer to suppress background echoes.

For each subarea (56E06 – 58E08, C – E in Fig.1) the mean back scattering cross section was estimated for herring, sprat, gadoids and mackerel based on the 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 the 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 single fish sampled in each haul and frozen for later for race analysis of the otolith 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) used in the stock size calculation is 1619. The number of ESDU per stratum is given in Table 2. Table 2 also shows the mean Sa and mean TS per stratum used in the abundance estimation. The outline of the strata is shown in Figure 1 and the cruise track for the survey is shown in Figure 2.

Historically, herring and sprat have not been observed in midwater trawl hauls at depths below 150 meters. Therefore, layers below 150 meter has been excluded from the estimation.

The relative herring density in numbers per nm^2 along the cruise track is shown in Figure 3. The distribution of herring is in 2009 primarily distributed in ICES squares 44F9, 44G0, 44G1 and partly in 45G1. This distribution is quite different from 2008 when the main concentration was further west (west of 8˚ E) (see fig 4). The main concentration is also geographically more concentrated than in 2007 when the large concentrations were found both in Kattegat and along the Danish coast in Skagerrak (see Fig. 5).

3.2 Biological data

During the survey in 2009 34 hauls were conducted, 20 surface hauls and 14 bottom hauls. The geographical distribution of hauls is shown in Fig. 2 and details on the hauls and catches are given in Table 3 and 4.

The total catch for the survey was 16.6 tons .Herring was present in 29 hauls with a total catch of 6.1 tons. In 2009, like in 2007 and 2008, herring was fished best during daytime in surface hauls in the deeper parts of Skagerrak. Length distributions of herring per haul are given in Table 5.
Sprat was present in the hauls in Kattegat (stratum F) where they contributed to the catch with 5.2%. . For the total survey area herring, mackerel and sprat contributed to the total catch by 36%, 10 % and 1 % respectively.

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

North Sea autumn spawners:

Skagerrak

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
%	100.00	99.49	0.51	54.67	45.33	50.00	50.00	60.00	40.00	100.00	100.00

Kattegat

WR	0	1i	1m	2i	2m
%	100.00	99.30	0.70	100.00	0.00

North Sea (Strata 560E06)

WR	0	1i	1m	2i	2m
%	100	96.77419	3.225806	100	0

Baltic Sea spring spawners:

Skagerrak

WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12	13
%	100.00	90.54	9.46	28.87	71.13	4.61	95.39	1.33	98.67	100.00	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
%	100.00	93.49	6.51	22.00	78.00	10.34	89.66	9.09	90.91	100.00	100.00

North Sea (Strata 560E06)

WR	0	1i	1m	2i	2m	3i	3m
%	100.00	21.74	78.26	0.00	100.00	0.00	100.00

3.3 Biomass estimates

The total herring biomass estimate for the Danish acoustic survey with R/V Dana in June-July 2009 is 304,298 tonnes of which 51.8% or 157,707 tonnes is North Sea autumn spawners and 48.2 % or 146,590 tonnes is Baltic Sea spring spawners.
For the total number of herring the survey results give 11,005 mill., of which 87,9 % are North Sea autumn spawners and 12.1 % 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 6 and 7 for North Sea autumn spawners and Baltic spring spawners respectively.

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

	2006	**2007**	**2008**	**2009**
Autumn spawners				
Number in mill.	1530	4443	4473	9679
Biomass in tons	98786	315176	80469	157707
Spring spawners				
Number in mill.	6407	8847	7367	1326
Biomass in tons	471850	614048	450505	146590

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 (seeTable 7). This increase 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 7 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. (Table 7).

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 7 the abundance in 2009 is dominated by 0 and 1 WR (81 and 19 % respectively. 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.

For the spring spawners no large changes in the age structure over the years from 2006 to 2008 has been seen. From 2008 to 2009 there has been a decrease in abundance of 82 % and for the biomass of 67 %. From Table 8 it can be seen that the major part of the difference in abundance between 2008 and 2009 lies in a decrease in abundance of 0-3 WR

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in June-July 2009. The map shows the subareas used in the abundance estimation.

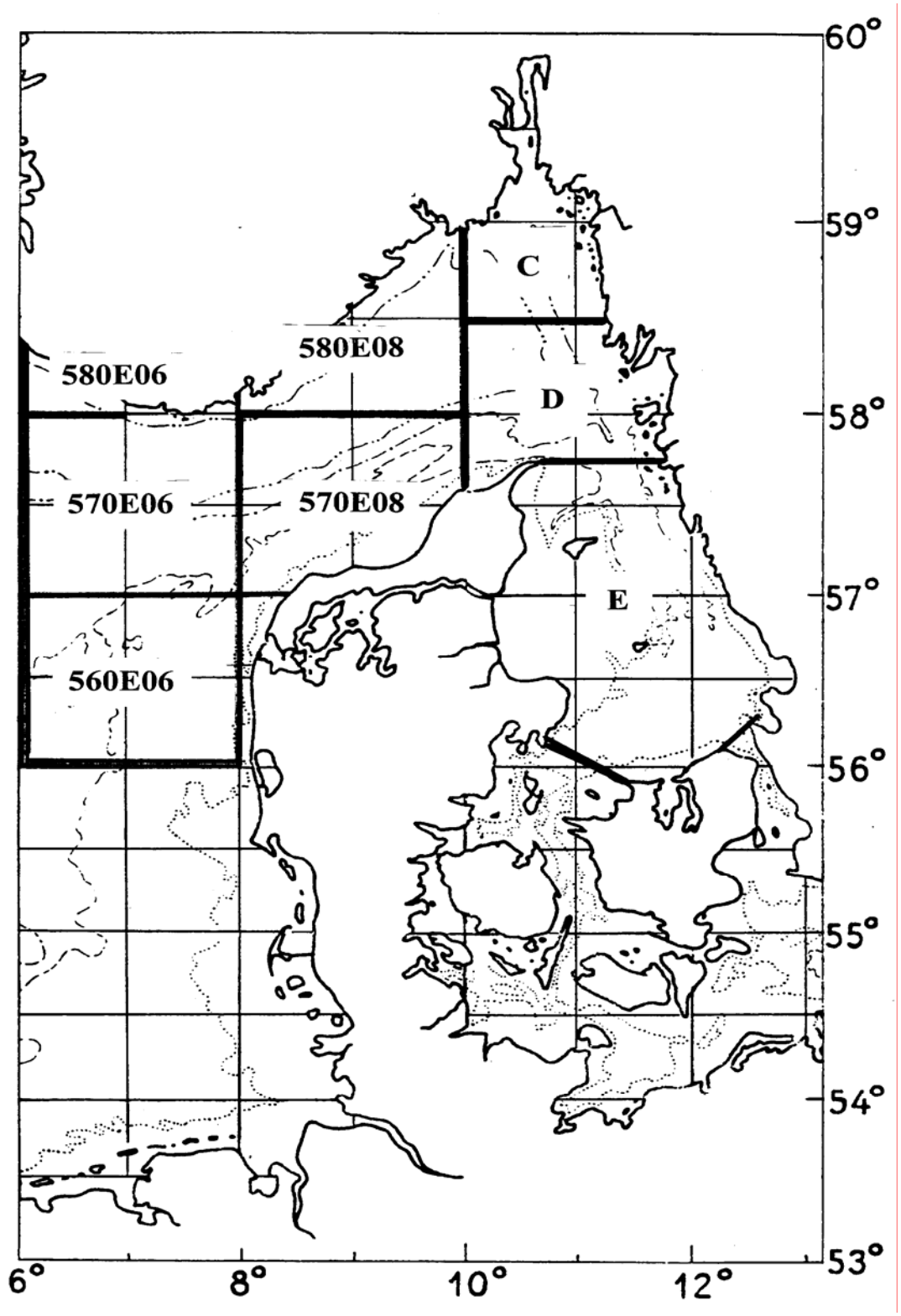

Figure 2. Map showing cruise track and trawl stations during the Danish acoustic survey with R/V Dana in June-July 2009.

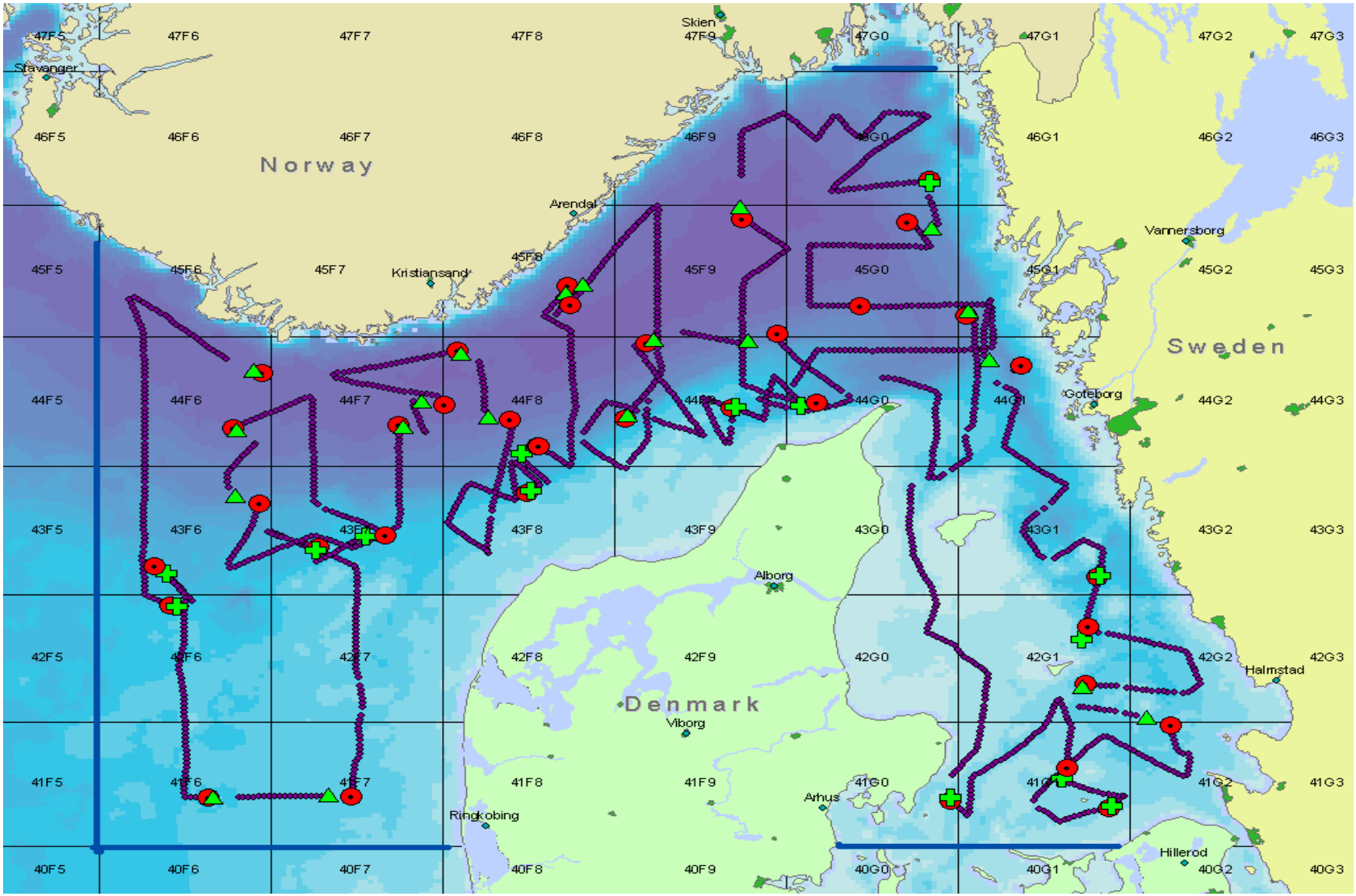

Figure 3. Relative herring density (in numbers per nm²) along the track of the June-July 2009 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

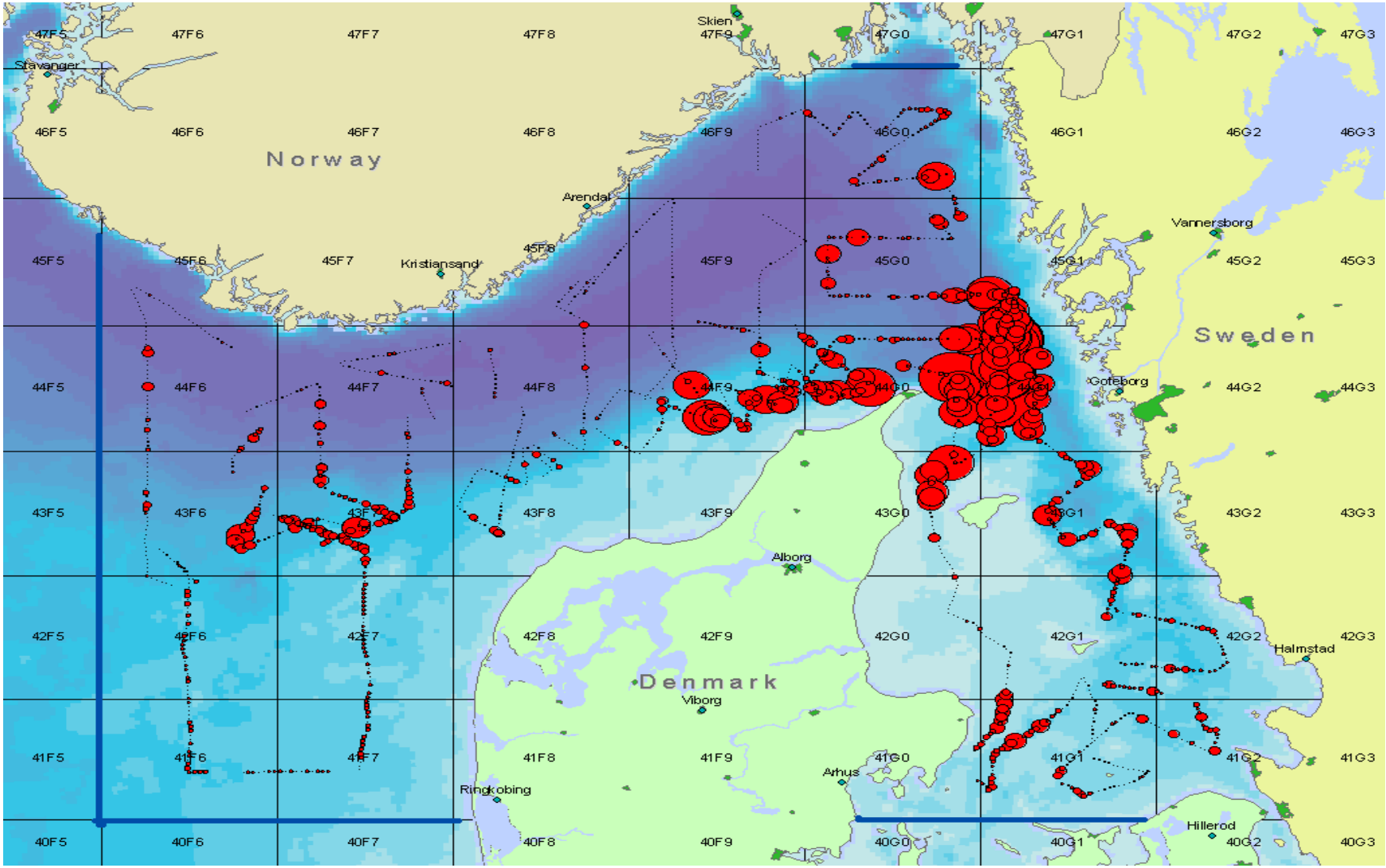

Figure 4. Relative herring density (in numbers per nm²) along the track of the June-July 2008 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

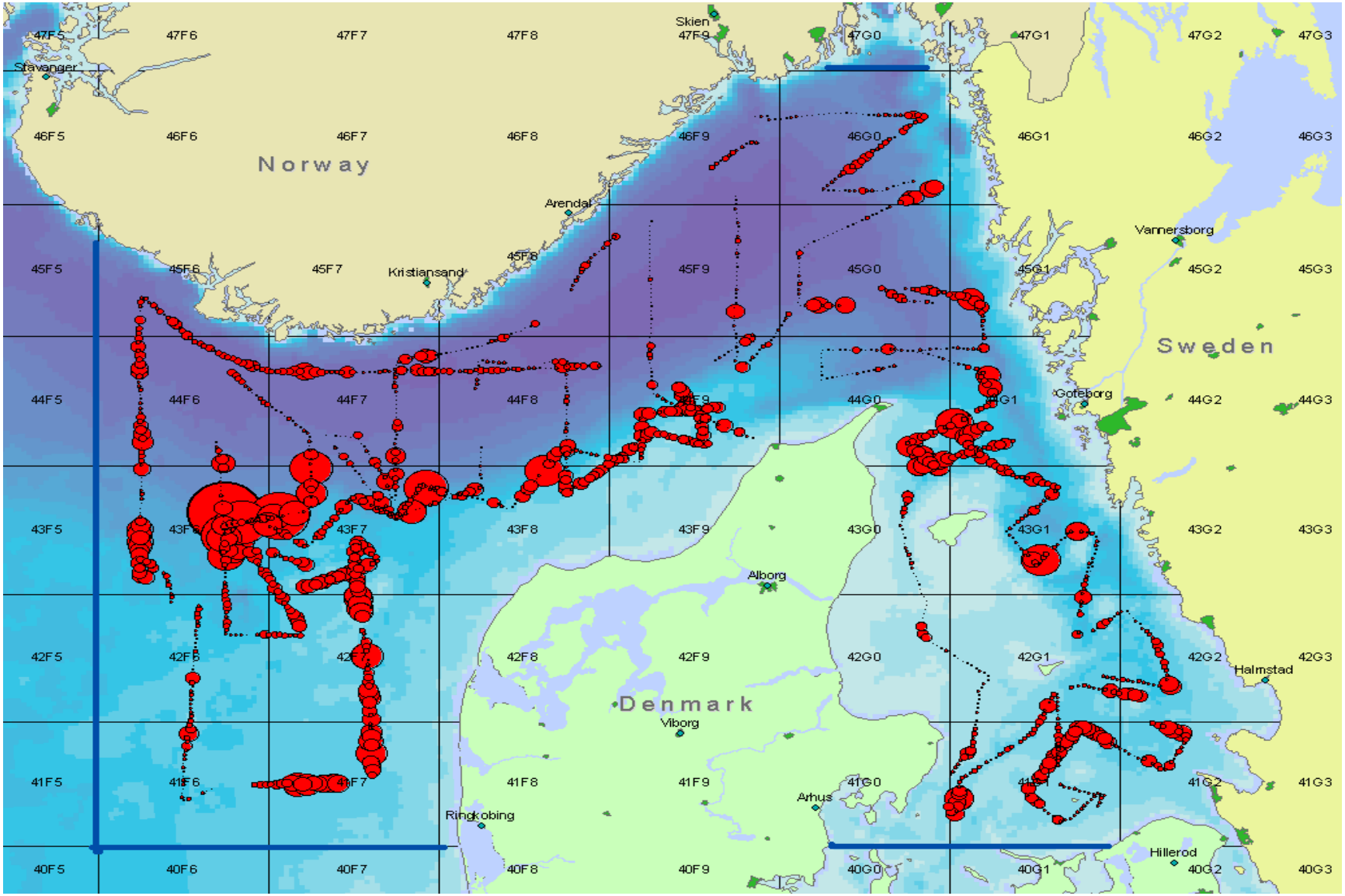

Figure 5. Relative herring density (in numbers per nm²) along the track of the June-July 2007 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

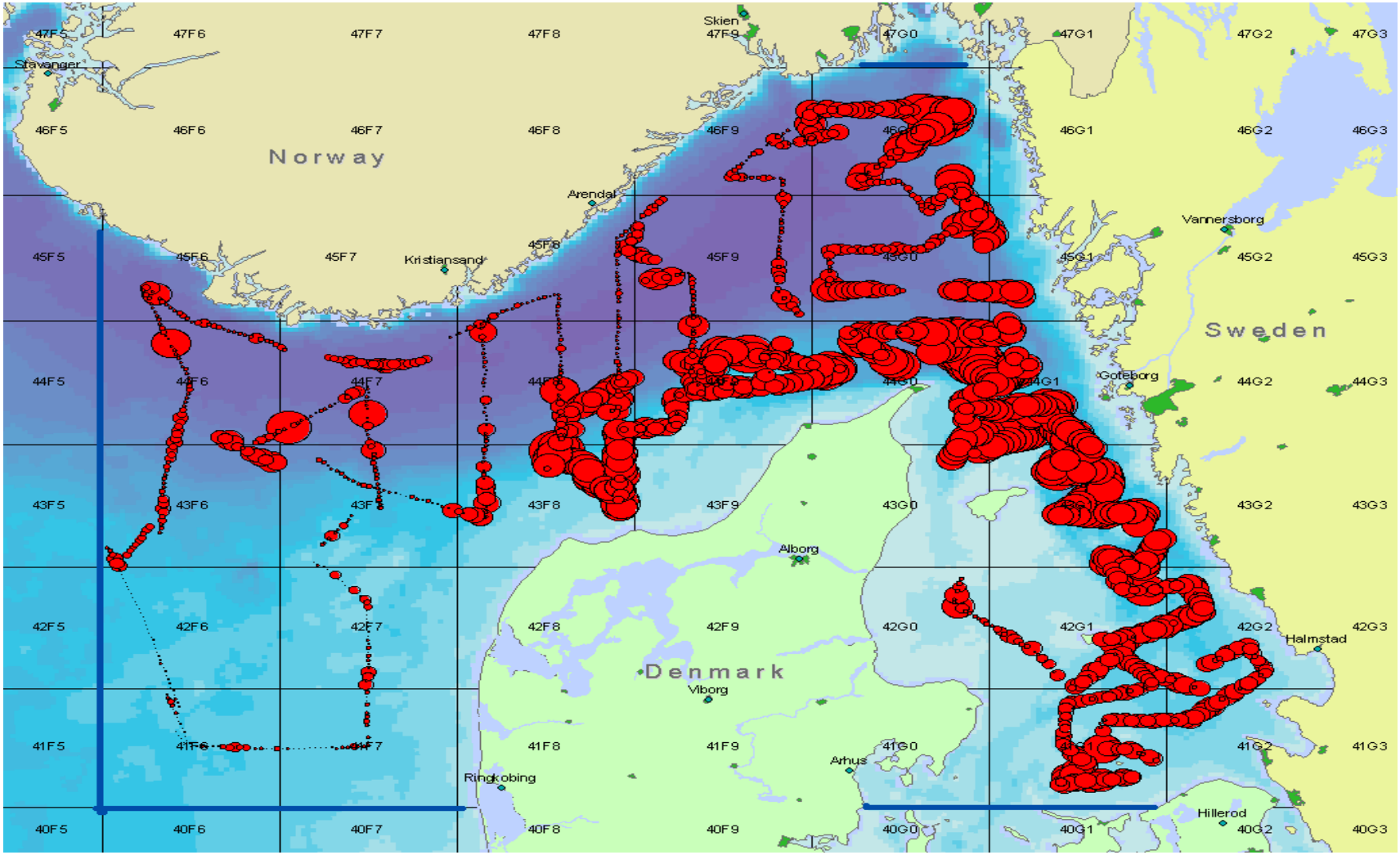

Table 1. . Simrad EK60 and analysis settings used during the the Acoustic Herring Survey with R/V Dana Cruise July 2009

Transceiver Menu	
Frequency	38 kHz
Sound speed	1508 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Default 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 June-July 2009.

Stratum	Artea, Nm*2	Logs	Hauls	meanSa	meanTs
560E06	3980	121	4	9.33E+08	5.78E+08
570E06	3600	317	7	4.92E+08	3.41E+08
570E08	3406	315	9	6.69E+08	3.25E+09
580E06	209	24	1	3.98E+07	5.51E+08
580E08	1822	139	5	6.22E+07	1.91E+09
C	988	79	3	2.27E+07	8.21E+08
D	1837	208	6	1.41E+08	1.26E+09
E	5228	406	7	4.24E+08	1.22E+09

Table 3. Trawl haul details for the Danish acoustic survey with R/V Dana in June-July 2009.

Date	Haul	Time	ICES	Position		Trawl Direction	Wire length	Trawl type	Cath depth	Mean depth	Total catch	Main Species	Trawling speed	Trawling duratin	Wind speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	deg.	m		m	m	kg		Kn	min,	m/s	
02-07-09	179	22:51	44F6	57.52.064 N	006.54.321 E	296	325	Fotö	Surface	392	440	Krill	3.2	59	0	1
03-07-09	283	10:31	42F6	56.57.399 N	006.27.345 E	90	300	Expo	Bottom	55	116	Haddock, Cod	2.9	60	3	1
03-07-09	296	12:56	43F6	57.04.968 N	006.23.707 E	314	300	Expo	Bottom	56	94	Haddock	2.1	60	3	0
03-07-09	361	20:53	41F6	56.11.794 N	006.40.490 E	88	400	Fotö	Surface	40	161	Mackerel	3.8	60	4	0
04-07-09	383	00:15	41F7	56.12.272 N	007.20.730 E	90	400	Fotö	Surface	29	680	Horse mackerel, Mackerel	3.7	60	2	0
04-07-09	470	10:41	43F7	57.10.454 N	007.16.244 E	189	300	Expo	Bottom	51	58	Whiting, Cod	2.8	60	5	2
04-07-09	485	13:19	43F7	57.13.893 N	007.33.680 E	83	300	Expo	Bottom	52	510	Haddock	3.2	60	8	3
04-07-09	546	21:11	44F6	57.38.547 N	006.48.576 E	127	320	Fotö	Surface	295	720	Herring	3.8	60	11	4
05-07-09	564	00:16	43F6	57.23.242 N	006.48.229 E	111	320	Fotö	Surface	94	200	Mackerel, Herring	4.3	60	12	4
05-07-09	645	10:56	44F7	57.39.279 N	007.46.620 E	106	340	Fotö	Surface	292	68	Herring	4.1	60	12	4
05-07-09	660	13:32	44F7	57.45.099 N	007.53.231 E	103	350	Fotö	Surface	454	80	Large medusa	4.1	60	13	4
05-07-09	712	21:22	44F8	57.56.127 N	008.06.710 E	113	320	Fotö	Surface	485	124	Large medusa, Krill	3.4	60	9	4
06-07-09	729	00:12	44F8	57.41.503 N	008.16.591 E	101	320	Fotö	Surface	241	190	Herring	3.6	60	9	4
06-07-09	816	10:39	43F8	57.24.324 N	008.31.326 E	58	240	Expo	Bottom	38	149	Greater sandeel, Gurnard	2.8	60	6	3
06-07-09	830	13:13	44F8	57.33.176 N	008.28.130 E	65	400	Expo	Bottom	101	3500	Norw ay pout	3.0	60	9	3
06-07-09	889	21:27	45F8	58.09.843 N	008.43.524 E	197	350	Fotö	Surface	428	200	Pearlside, Large medusa	4.2	60	6	3
07-07-09	905	00:15	45F8	58.11.855 N	008.49.301 E	200	375	Fotö	Surface	417	150	Pearlside, Large medusa	4.1	60	5	3
07-07-09	989	10:59	44F9	57.41.937 N	009.05.131 E	41	425	Fotö	Surface	91	9	Large medusa	4.0	60	3	3
07-07-09	1080	21:21	45F9	57.59.133 N	009.14.089 E	67	430	Fotö	Surface	448	565	Herring	4.0	60	5	2
08-07-09	1099	00:12	45F9	57.58.967 N	009.47.316 E	69	475	Fotö	Surface	119	555	Herring, Mackerel	4.2	60	6	2
08-07-09	1186	10:32	44F9	57.43.851 N	009.42.675 E	56	220	Expo	Bottom	38	2500	Herring	3.1	60	3	2
08-07-09	1199	12:59	44G0	57.44.109 N	010.05.476 E	73	400	Expo	Bottom	82	300	Whitting	3	60	3	2
08-07-09	1263	22:00	46F9	59.29.386 N	009.44.384 E	359	420	Fotö	Surface	480	340	Mackerel	4.2	60	2	2
09-07-09	1369	10:37	46G0	58.34.990 N	010.50.412 E	190	400	Expo	Bottom	89	400	Norw ay pout	2.5	60	10	3
09-07-09	1381	13:21	45G0	58.24.736 N	010.51.122 E	282	330	Fotö	Surface	154	47	Large Medusa, Herring	3.4	60	5	3
10-07-09	1627	21:01	45G1	58.05.847 N	011.04.128 E	54	420	Fotö	Surface	81	820	Mackerel, Herring, Horse Mackerel	4.0	60	3	3
11-07-09	1648	01:13	44G1	57.54.568 N	011.11.456 E	96	420	Fotö	Surface	59	1350	Herring	4.1	60	9	3
11-07-09	1735	10:36	43G1	57.04.661 N	011.49.639 E	26	320	Expo	Bottom	54	610	Large Medusa, Herring	2.4	60	9	4
11-07-09	1759	14:04	42G1	56.49.662 N	011.43.298 E	36	240	Expo	Bottom	54	400	Herring	2.7	60	9	4
11-07-09	1813	21:09	42G1	56.38.118 N	011.44.106 E	38	400	Fotö	Surface	32	400	Large Medusa, Herring	4.1	60	8	4
12-07-09	1832	00:12	42G2	56.30.855 N	012.06.289 E	60	210	Fotö	Surface	37	Invalid		2.4	60	2	3
12-07-09	1917	10.29	41G1	56.09.799 N	011.53.748 E	42	240	Expo	Bottom	27	200	Large medusa	2.9	60	1	3
12-07-09	1934	13:12	41G1	56.16.387 N	011.36.494 E	26	190	Expo	Bottom	30	160	Sprat	2.6	60	3	2
12-07-09	1994	20:49	41G0	56.11.890 N	010.57.656 E	2	275	Expo	Surface	19	599	Large Medusa, Herring, Sprat	3.2	60	9	3

Table 4. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June-July 2009.

	Station	179	283	296	361	383	470	485	546	564	645	660	712
	ICES sq.	44F6	42F6	43F6	41F6	41F7	43F7	43F7	44F6	43F6	44F7	44F7	44F8
	Gear	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Fotö	Fotö	Fotö
	Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Surface	Surface	Surface
	Total depth	392	55	56	40	29	51	52	295	94	292	454	485
	Day/Night	N	D	D	N	N	D	D	N	N	D	D	N
	Total catch	440	116	94	161	680	58	510	720	200	68	80	124
Herring	*Clupea harengus*	29.381	0.112	18.8	0.028	0.108	0.216	0.04	633.609	71.8	22.464	2.674	0.284
Norway pout	*Trisopterus esmarki*		0.266										
Large Medusa	*Medusa, spp*	57.645	0.338		2.418		0.682		16.317	29.6	35.2	67	83.21
Mackerel	*Scomber scombrus*	3.956			110.3	251.015			36.766	87.1	1.17	0.242	4
Krill	*Euphausidae spp.*	333.116							0.821				33.085
Horse mackerel	*Trachurus trachurus*				1.902	404.119							
Haddock	*Melanogrammus aeglefinus*		33.132	8.256			5.764	375.565		0.016		0.01	
Invertebrates	*Inv*		0.308	3.042			1.878	0.062					
Cod	*Gadus Morhua*		31.504	8.56			9.225	99.814					
Sprat	*Sprattus sprattus*												
Whiting	*Merlangius merlangus*	0.707	2.15	5.956	0.026		9.435	18		0.092	0.138	0.422	0.772
Gurnard	*Trigala spp.*		5.61	4.116	42.6	22	4.016			0.23			
Saithe	*Pollachius virens*	3.4											
Dab	*Limanda limanda*		2.364	18.8			3.552	0.81					
Garfish	*Belone belone*					0.182			30.5	11.5	1.776	4.26	2.5
Lumpsucker	*Cyclopterus lumpus*	1.552			1.37				1.812		6.96	4.95	
Plaice	*Pleuronectes platessa*		3.006	5.772			3.716	5.468					
Greater sandeel	*Hyperoplus lanceolatus*		9.34	0.036			1.334						
Long rough dab	*Hippoglosides plattessoides*			1.638			0.384	0.094					
Hake	*Merluccius merluccius*		5.9	2.462			7.1						
Common weaver	*Trachinus draco*												
Lemon sole	*Microstomus kitt*		10.495	1.224			5.712	0.658					
Sandrrl	*Ammodytes marinus*			0.144									
Anglerfish	*Lophiuspiscatorius*		3.106	6			1.994						
Halibut	*Hippoglossus hippoglossus*		7.9					2.884					
Pearlside	*Mauorolicus muelleri*	9.69							0.005				
Blue whiting	*Micromesistius poutassou*	0.452							0.17				0.21
	Cephalopoda sp		0.132	0.074	0.038		1.048	5.11		0.04			
Picked Dogfish	*Squalus acanthias*												
Wolffish	*Anarhichas lupus*			5.9				1.172					
Turbot	*Psetta maxima*				2.014		1.886						
Tarry ray	*Raja radiata*			2.87									
Flounder	*Platichthys flesus*												
Gray sole	*Glyptocephalus cynoglossus*						0.35						
Twaite shad	*Alosa fallax*					1.97							
Brill	*Scophthalmus rhombe*												
Sculpin	*Myoxocephalus scorpius*												
Poor cod	*Trisopterus minutus*			0.116									
	Myxine glutinosa												
Pilchard	*Sardina pilchardus*					0.606							
Norway lobster	*Nephrops norvegicus*												
	Lycodes vahli												
Anchovy	*Engraulis encrasicolus*												
Lamprey	*Petromyzon marinus*	0.1											
	Leptoclinus maculatus												
Snake blenny	*Lumpenus lampretaeformis*												
	Callionymus maculatus						0.012						

Table 4. continued.

	Station	729	816	830	889	905	989	1080	1099	1186	1199	1263	1369
	ICES sq.	44F8	43F8	44F8	45F8	45F8	44F9	45F9	45F9	44F9	44G0	46F9	46G0
	Gear	Fotö	Expo	Expo	Fotö	Fotö	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Expo
	Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Surface	Surface	Surface	Bottom	Bottom	Surface	Bottom
	Total depth	241	38	101	462	417	91	448	129	38	82	480	89
	Day/Night	N	D	D	N	N	D	N	N	D	D	N	D
	Total catch	190	149	3,500	200	150	9	565	555	2,500	300	340	400
Herring	*Clupea harengus*	100.7		11.67		3.678		346.867	292.417	2424.452	21.49	0.32	66.19
Norway pout	*Trisopterus esmarki*			3068.222							21.815		70.269
Large Medusa	*Medusa, spp*	20.329	5.534		40.244	50.36	7.36	16.714	9.514	2.94	0.815	51.05	
Mackerel	*Scomber scombrus*	1.358			16.8	1.422	1.092	136.472	196.373			160.2	
Krill	*Euphausidae spp.*	55.444			128.472	90.95		51.935	43.863			85.98	
Horse mackerel	*Trachurus trachurus*												
Haddock	*Melanogrammus aeglefinus*		0.202	94.937	0.014	0.078				2.168	25.962		7.723
Invertebrates	*Inv*		0.508	90.338						4.891	11.206		220.569
Cod	*Gadus Morhua*		4.234	83.274						6.635	22.848		1.318
Sprat	*Sprattus sprattus*												
Whiting	*Merlangius merlangus*	0.29	2.504	13.337	0.57	0.402	0.118	0.133	0.182	25.01	47.166		18.332
Gurnard	*Trigala spp.*		42.4	1.183						2.568			
Saithe	*Pollachius virens*		3.846	87.5							12.6	6	
Dab	*Limanda limanda*		1.52							16.434	26.079		
Garfish	*Belone belone*	5.52			1.5	0.304		3.648	12.49			1.75	
Lumpsucker	*Cyclopterus lumpus*	5.4			6	2.156	0.42	8.575	0.162			34.7	2.244
Plaice	*Pleuronectes platessa*		1.852	0.32						4.344	51.6		0.4
Greater sandeel	*Hyperoplus lanceolatus*		66.5										
Long rough dab	*Hippoglosides plattessoides*			16.885						0.488	42.349		2.511
Hake	*Merluccius merluccius*		6.15	29.1						7.355			2.642
Common weaver	*Trachinus draco*	0.096											
Lemon sole	*Microstomus kitt*		0.284	2.154						0.974	7.605		0.25
Sandrrl	*Ammodytes marinus*		11.482										
Anglerfish	*Lophiuspiscatorius*												
Halibut	*Hippoglossus hippoglossus*												
Pearlside	*Mauorolicus muelleri*	0.084			0.3	0.31		0.165					
Blue whiting	*Micromesistius poutassou*	0.778			6.1			0.39					
	Cephalopoda sp		0.218							0.336			
Picked Dogfish	*Squalus acanthias*					0.34							7.062
Wolffish	*Anarhichas lupus*												
Turbot	*Psetta maxima*		1.42										
Tarry ray	*Raja radiata*									1.406			0.126
Flounder	*Platichthys flesus*												
Gray sole	*Glyptocephalus cynoglossus*			1.08							0.648		
Twaite shad	*Alosa fallax*												
Brill	*Scophthalmus rhombe*												
Sculpin	*Myoxocephalus scorpius*												
Poor cod	*Trisopterus minutus*										0.917		
	Myxine glutinosa										0.902		
Pilchard	*Sardina pilchardus*												
Norway lobster	*Nephrops norvegicus*												0.234
	Lycodes vahli												
Anchovy	*Engraulis encrasicolus*												
Lamprey	*Petromyzon marinus*												
	Leptoclinus maculatus												0.07
Snake blenny	*Lumpenus lampretaeformis*												
	Callionymus maculatus												

Table 4. continued.

	Station	1381	1627	1648	1735	1759	1813	1832	1917	1934	1994	
	ICES sq.	45G0	45G1	44G1	43G1	42G1	42G1	41G2	41G1	41G1	41G0	
	Gear	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Expo	
	Fishing depth	Surface	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	
	Total depth	154	81	59	54	54	32	37	27	30	20	
	Day/Night	D	N	N	D	D	N	N	D	D	N	
	Total catch	47	820	1,350	610	400	400	Invalid	200	160	599	Total
Herring	*Clupea harengus*	14.194	196.441	1208.797	143.63	283.233	60.9		1	3.27	98.06	6056.825
Norway pout	*Trisopterus esmarki*		0.405		0.038	0.028						3161.043
Large Medusa	*Medusa, spp*	30.8	1.92	16.057	375.134	72.122	294.872		187.918	30.8	409.295	1916.188
Mackerel	*Scomber scombrus*		503.415	67.584	0.87	0.672	6.150				0.298	1587.255
Krill	*Euphausidae spp.*				74.677							898.343
Horse mackerel	*Trachurus trachurus*		117.459	50.522			6.15					580.152
Haddock	*Melanogrammus aeglefinus*	0.004			0.47	0.571				0.018	0.54	555.43
Invertebrates	*Inv*				1.867	5.275			2.226	14.1		356.27
Cod	*Gadus Morhua*				0.42				0.04	0.258		268.13
Sprat	*Sprattus sprattus*				0.344	0.67	10.28		4.856	92.7	83.849	192.699
Whiting	*Merlangius merlangus*	0.104	0.008		4.878	7.331	0.216		0.224	5.328	0.171	164.002
Gurnard	*Trigala spp.*				0.22	0.605	0.168			0.426	0.116	126.258
Saithe	*Pollachius virens*											113.346
Dab	*Limanda limanda*				0.46	19.1			0.556	8.37	0.21	98.255
Garfish	*Belone belone*		0.352	7.01			1.994					85.286
Lumpsucker	*Cyclopterus lumpus*	1.85			1.892	1.72			0.318		0.276	82.357
Plaice	*Pleuronectes platessa*				2.858	0.46			0.14	1.148	1.02	82.104
Greater sandeel	*Hyperoplus lanceolatus*				0.648	0.05					0.04	77.948
Long rough dab	*Hippoglosides plattessoides*				0.502	0.216				0.234		65.301
Hake	*Merluccius merluccius*				0.406							61.115
Common weaver	*Trachinus draco*					7.585	25.3		1.498		2.744	37.223
Lemon sole	*Microstomus kitt*				0.176	0.3						29.832
Sandrrl	*Ammodytes marinus*											11.626
Anglerfish	*Lophiuspiscatorius*											11.1
Halibut	*Hippoglossus hippoglossus*											10.784
Pearlside	*Mauorolicus muelleri*											10.554
Blue whiting	*Micromesistius poutassou*											8.1
	Cephalopoda sp								0.76			7.756
Picked Dogfish	*Squalus acanthias*											7.402
Wolffish	*Anarhichas lupus*											7.072
Turbot	*Psetta maxima*										0.764	6.084
Tarry ray	*Raja radiata*								0.094			4.496
Flounder	*Platichthys flesus*									2.498	0.586	3.084
Gray sole	*Glyptocephalus cynoglossus*											2.078
Twaite shad	*Alosa fallax*											1.97
Brill	*Scophthalmus rhombe*				0.19						1.016	1.206
Sculpin	*Myoxocephalus scorpius*								0.364	0.8		1.164
Poor cod	*Trisopterus minutus*					0.028						1.061
	Myxine glutinosa											0.902
Pilchard	*Sardina pilchardus*											0.606
Norway lobster	*Nephrops norvegicus*				0.32							0.554
	Lycodes vahli					0.3						0.3
Anchovy	*Engraulis encrasicolus*						0.16					0.16
Lamprey	*Petromyzon marinus*											0.1
	Leptoclinus maculatus											0.07
Snake blenny	*Lumpenus lampretaeformis*					0.034						0.034
	Callionymus maculatus											0.012

Table 4. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2009.

Station	179	283	296	361	383	470	485	546	564	645	660	712	729	830	905	1080	1099	1186
ICES sq.	44F6	42F6	43F6	41F6	41F7	43F7	43F7	44F6	43F6	44F7	44F7	44F8	44F8	44F8	45F8	45F9	45F9	44F9
Gear	Fotő	Expo	Expo	Fotő	Fotő	Expo	Expo	Fotő	Fotő	Fotő	Fotő	Fotő	Fotő	Expo	Fotő	Fotő	Fotő	Expo
Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Surface	Surface	Surface	Surface	Bottom	Surface	Surface	Surface	Bottom
Total depth	392	55	56	40	29	51	52	295	94	292	454	485	241	101	417	448	129	38
Day/Night	N	D	D	N	N	D	D	N	N	D	D	N	N	D	N	N	N	D
Total catch,kg	440	116	94	161	680	58	510	720	200	68	80	124	190	3500	150	565	555	2500
Total catch Herring,kg	29381	0.112	18.8	0.028	0.108	0.216	0.040	633609	71.8	22464	2674	0.284	100.7	11392	3678	364867	292417	2424.45
Sample Herring,kg	29381	0.112	18.8	0.028	0.108	0.216	0.040		69447	22464	2674	0.284	66452	11392	3678	99057	84728	34.527
Length in cm																		
5.5																		
6																		
6.5																		
7																		
7.5			5															
8		1	11															
8.5		1	40			5												
9		3	64			10												
9.5		2	47			6												
10		1	17			5												
10.5						1												
11																		
11.5																		
12																		
12.5																		
13																		
13.5																		
14			2															
14.5			2															1
15			1											2				3
15.5			2	1										1				5
16			38										1					21
16.5	2		99						19					1		1		9
17	3		116						28					1				24
17.5	6		94		1		1		61				7	3				60
18	7		35						73				1	7				90
18.5	15		11			1		4	90	1			8	20				113
19	10		7					2	87	2			5	18		1	1	108
19.5	11		1					4	78	4			10	13		4	8	78
20	10							7	82	2	1		16	13	1	4	6	60
20.5	15		1					4	77	1	1		20	13		10	12	27
21	15	1	1		1			7	42	6		2	15	12		13	23	14
21.5	15							12	48	11	1		32	9		24	31	13
22	32		1					11	55	10	2	1	32	11		35	35	4
22.5	17		1					28	35	17	1		30	4	1	39	63	1
23	22		1					25	20	10	1		27	7	1	38	51	2
23.5	20							22	23	15	3		30	3		35	46	2
24	15		1					24	15	13			19		1	33	44	1
24.5	12							27	14	6			29	1	1	45	39	
25	7							30	6	7	1		26	2	1	47	30	
25.5	7							35	10	12	3		28	1	1	42	33	
26	4							32	9	5	1		25		2	40	30	
26.5	8							45		4			22		3	36	21	
27	5							32	6	5			25		1	34	29	
27.5	2							43	2	8	2		26		2	42	22	
28	4							25		7	2		17	1	3	31	16	
28.5	3							34	1	3	1		17		3	22	16	
29	6							32	1	8			14			18	14	
29.5	2							24		4			5			15	14	
30	1							15		2			4			8	2	
30.5								11	1				2			3	2	
31								12					2			3	2	
31.5																	1	
32								3		1						1		
32.5	1							1										
Total no.	277	9	598	1	2	28	1	551	883	164	20	3	495	143	21	624	591	636
Mean Length	22.4	10.4	14.6	15.5	19.3	9.6	17.5	26.0	20.1	24.4	24.5	21.3	24.1	20.2	26.1	25.1	24.4	18.7

Table 4. Continued

Station	1199	1263	1369		1381	1627		1648		1735		1759		1813		1917	1934	1994
ICES sq.	44G0	46F9	46G0		45G0	45G1		44G1		43G1		42G1		42G1		41G1	41G1	41G0
Gear	Expo	Fotó	Expo		Fotó	Fotó		Fotó		Expo		Expo		Fotó		Expo	Expo	Expo
Fishing depth	Bottom	Surface	Bottom		Surface	Surface		Surface		Bottom		Bottom		Surface		Bottom	Bottom	Surface
Total depth	82	480	89		154	81		59		54		54		32		27	30	20
Day/Night	D	N	D		D	N		N		D		D		N		D	D	N
Total catch,kg	300	340	400		47	820		1350		610		400		400		200	160	599
Total catch Herring,kg	21.49	0.32	60366	5.824	14.194	79906	123.54	786.83	421.97	127942	15688	253833	29400	14.7	46.2	1006	3.27	98.6
Sample Herring,kg	3.778	0.32	0.992	5.824	14194	4.304	30.5	4.514	27.246	4895	15688	4466	16589	2766	21.27	1006	3.27	19.623
Length in cm																		
5.5																		
6																		
6.5																		
7																		
7.5	19		3															
8	153		8			6								5				
8.5	276		17			19								3			4	
9	192		26			77		5				27		17			13	
9.5	85		38			127		36				61		30			35	
10	12		38			153		87		5		60		74			51	
10.5	5		14			109		145		55		197		106			111	
11	1		3			59		87		191		209		90			81	
11.5			1			34		86		150		26		23			25	
12						17		46		73		7		3			1	
12.5						3		14		21	1		2					
13									1	3			2		1			
13.5									3		2		34					
14									12		6		81					
14.5							3		42		8		156		2			
15									62		14		112		1		1	
15.5									48		5		42		1	1		3
16									61		10		33		1		2	22
16.5									67		3		24		4	2		113
17							1		62		2		21		24	1	3	183
17.5							2		86		5		22		90	2	3	162
18							4		46		7		10		132	2	4	56
18.5				2			5		40		9		7		106	1	1	10
19				2			8		21		11		6		57	2	1	4
19.5		1		3	2		14		8		10		3		26	1		
20				2			21		11		27		4		31		1	
20.5				3	2		25		8		36		3		15			
21				5	2		35		4		45		2		9	4		
21.5				6	8		43		2		26		2		7	1	2	
22				6	12		29		6		17		2		1			2
22.5				8	8		27		4		9		2		1			
23		1		7	14		21		2		4							
23.5				7	7		18		6		2							
24				3	7		16		2		3				1			
24.5				3	7		8		2		1							
25				1	3		5		3									
25.5				1	8		8		2				1					
26					4		7		1									
26.5				1	11		6		1		1							
27		1			8		5											
27.5					3		1		1									
28					4		1						1					
28.5							1											
29							1		1									
29.5							1											
30																		
30.5																		
31																		
31.5																		
32																		
32.5																		
Total no.	743	3	148	60	110	604	316	506	615	498	264	587	572	351	510	17	339	555
Mean Length	8.7	23.2	9.4	22.2	24.1	10.0	22.0	10.8	17.1	11.3	19.6	10.5	15.3	10.4	18.4	18.7	10.8	17.2

Table 5. 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 2009

Numbers in millions											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
580E06	0	0.688877	0.003501	0.051104	0.042379	0.01018	0.01018	0	0	0	0
570E06	31.06361	171.0214	0.869232	23.39247	19.39864	3.709209	3.709209	0	0	0	0
580E08	0	9.646501	0.049029	2.263806	1.877303	0.137408	0.137408	0.318755	0.212504	0.261824	0.046534
570E08	108.0899	743.6838	3.779841	4.788262	3.970754	0.153006	0.153006	0.408108	0.272072	0.271035	0.055769
C	260.153	0.586728	0.002982	0.033011	0.027375	0	0	0	0	0	0
D	3864.972	480.1174	2.440241	1.897663	1.573672	0.078612	0.078612	0.512175	0.34145	0.37262	0
E	3409.909	275.324	1.938902	0.303746	0	0	0	0	0	0	0
560E06	138.3324	100.5406	3.351353	1.801204	0	0	0	0	0	0	0
Biomass in ton											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
580E06	0	50.75784	0.257981	7.019824	5.821318	2.071547	2.071547	0	0	0	0
570E06	132.5619	11987.5	60.92755	3865.998	3205.95	729.7679	729.7679	0	0	0	0
580E08	0	970.3719	4.932005	354.7811	294.2087	25.51769	25.51769	62.20684	41.47123	52.57189	12.51759
570E08	448.5365	44954.51	228.4854	605.2088	501.8804	28.43904	28.43904	80.15794	53.43863	54.34424	15.00198
C	1478.302	46.87994	0.238272	4.854056	4.025315	0	0	0	0	0	0
D	29197.17	16094.95	81.80406	288.3228	239.097	13.75718	13.75718	101.8426	67.89507	74.39242	0
E	27961.32	7627.155	53.71236	31.89329	0	0	0	0	0	0	0
560E06	615.4524	3868.201	128.94	90.42041	0	0	0	0	0	0	0
Mean length in cm											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
580E06	0.00	19.58	19.58	24.10	24.10	28.00	28.00	0.00	0.00	0.00	0.00
570E06	9.01	19.56	19.56	25.21	25.21	27.44	27.44	0.00	0.00	0.00	0.00
580E08	0.00	21.98	21.98	24.94	24.94	26.75	26.75	27.54	27.54	27.71	31.00
570E08	8.66	18.69	18.69	23.27	23.27	26.76	26.76	27.68	27.68	27.71	31.00
C	9.44	20.63	20.63	25.30	25.30	0.00	0.00	0.00	0.00	0.00	0.00
D	10.43	15.60	15.60	24.74	24.74	26.50	26.50	27.61	27.61	27.69	0.00
E	10.75	14.98	14.98	23.50	23.50	0.00	0.00	0.00	0.00	0.00	0.00
560E06	9.01	17.02	17.02	18.30	18.30	0.00	0.00	0.00	0.00	0.00	0.00
Mean weight in g											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6
580E06	0.00	73.68	73.68	137.36	137.36	203.50	203.50	0.00	0.00	0.00	0.00
570E06	4.27	70.09	70.09	165.27	165.27	196.74	196.74	0.00	0.00	0.00	0.00
580E08	0.00	100.59	100.59	156.72	156.72	185.71	185.71	195.16	195.16	200.79	269.00
570E08	4.15	60.45	60.45	126.39	126.39	185.87	185.87	196.41	196.41	200.51	269.00
C	5.68	79.90	79.90	147.04	147.04	0.00	0.00	0.00	0.00	0.00	0.00
D	7.55	33.52	33.52	151.94	151.94	175.00	175.00	198.84	198.84	199.65	0.00
E	8.20	27.70	27.70	105.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00
560E06	4.45	38.47	38.47	50.20	50.20	0.00	0.00	0.00	0.00	0.00	0.00

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Table 6. 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 2008

Number in millions																		
	WR																	
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12	13
580E06	0	0.164451	0.017181	0.244813	0.603232	0.020268	0.419386	0.004216	0.313401	0.192633	0.023753	0	0	0.01018	0	0	0	0
570E06	0	54.97762	5.74393	39.42384	97.14241	6.406288	132.5609	1.553009	115.4403	51.60876	44.12637	15.50616	11.37886	1.723057	2.162766	1.161041	0	1.520387
580E08	0	0	0	5.140794	12.66719	0.419149	8.673162	0.103269	7.676345	3.760147	2.286826	0.709197	0.16086	0.239065	0.046141	0	0	0
570E08	0	79.55254	8.311459	17.25201	42.50985	0.887137	18.3569	0.173225	12.87642	6.385305	3.680667	1.123925	0.205618	0.281966	0.065937	0	0	0
C	0	0	0	0.752594	1.85443	0.046638	0.965041	0.008472	0.629751	0.089266	0.02888	0.02888	0.02888	0	0	0	0	0
D	0	1.012524	0.105786	19.16085	47.21333	1.015757	21.01836	0.198697	14.7698	5.021978	3.509424	1.262183	0.232536	0.387166	0.122249	0	0	0
E	0.943303	145.2348	10.11128	5.938938	21.05623	0.553964	4.801023	0.180652	1.806519	0.675895	0.647134	0	0	0	0	0	0	0
560E06	0	42.25811	152.1292	0	1.801203	0	0.720481	0	0	0	0	0	0	0	0	0	0	0

Biomass in ton																		
	WR																	
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12	13
580E06	0	11.37461	1.188393	22.9798	56.62343	2.360789	48.85017	0.584172	43.42345	31.6572	6.151951	0	0	3.18634	0	0	0	0
570E06	0	2957.403	308.9824	4600.122	11334.94	968.1876	20034.04	281.3814	20916.02	10405.26	10057.51	3507.759	3236.487	427.8568	607.2392	323.9304	0	437.8715
580E08	0	0	0	641.0336	1579.54	62.19962	1287.054	18.98351	1411.107	777.3141	461.696	152.3672	39.928	58.64704	12.68878	0	0	0
570E08	0	4839.288	505.5973	1798.205	4430.871	123.7389	2560.443	31.58784	2348.029	1287	751.0273	249.6635	51.70862	69.16725	18.13268	0	0	0
C	0	0	0	76.66795	188.9138	6.038621	124.953	1.335083	99.24115	16.75842	4.216529	5.833827	4.563093	0	0	0	0	0
D	0	75.36048	7.873483	1951.807	4809.354	133.6241	2764.99	32.20565	2393.954	1046.924	665.9069	267.593	36.74064	92.17639	33.61848	0	0	0
E	18.13044	4812.735	335.0638	390.7809	1385.496	51.63575	447.5098	22.67194	226.7194	43.0316	89.47846	0	0	0	0	0	0	0
560E06	0	1631.354	5872.875	0	135.4505	0	86.45772	0	0	0	0	0	0	0	0	0	0	0

Mean length in cm																		
	WR																	
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12	13
580E06	0.00	19.35	19.35	22.08	22.08	24.02	24.02	25.07	25.07	26.23	29.71	0.00	0.00	32.50	0.00	0.00	0.00	0.00
570E06	0.00	18.35	18.35	23.31	23.31	25.59	25.59	27.07	27.07	27.93	29.01	29.31	30.76	30.82	30.77	30.00	0.00	29.50
580E08	0.00	0.00	0.00	23.45	23.45	25.25	25.25	26.93	26.93	27.96	27.87	28.29	30.37	29.53	31.50	0.00	0.00	0.00
570E08	0.00	18.68	18.68	22.41	22.41	24.85	24.85	26.98	26.98	27.80	28.06	28.55	30.45	29.54	31.50	0.00	0.00	0.00
C	0.00	0.00	0.00	22.59	22.59	24.63	24.63	25.92	25.92	26.82	26.00	27.50	27.50	0.00	0.00	0.00	0.00	0.00
D	0.00	20.28	20.28	22.60	22.60	24.58	24.58	26.06	26.06	28.04	27.52	28.17	27.50	29.22	31.50	0.00	0.00	0.00
E	13.69	16.53	16.53	20.64	20.64	22.76	22.76	24.47	24.47	27.55	25.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
560E06	0.00	17.10	17.10	21.50	21.50	24.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean weight in g																		
	WR																	
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12	13
580E06	0.00	69.17	69.17	93.87	93.87	116.48	116.48	138.56	138.56	164.34	259.00	0.00	0.00	313.00	0.00	0.00	0.00	0.00
570E06	0.00	53.79	53.79	116.68	116.68	151.13	151.13	181.18	181.18	201.62	227.93	226.22	284.43	248.31	280.77	279.00	0.00	288.00
580E08	0.00	0.00	0.00	124.70	124.70	148.39	148.39	183.83	183.83	206.72	201.89	214.84	248.22	245.32	275.00	0.00	0.00	0.00
570E08	0.00	60.83	60.83	104.23	104.23	139.48	139.48	182.35	182.35	201.56	204.05	222.14	251.48	245.30	275.00	0.00	0.00	0.00
C	0.00	0.00	0.00	101.87	101.87	129.48	129.48	157.59	157.59	187.74	146.00	202.00	158.00	0.00	0.00	0.00	0.00	0.00
D	0.00	74.43	74.43	101.86	101.86	131.55	131.55	162.08	162.08	208.47	189.75	212.01	158.00	238.08	275.00	0.00	0.00	0.00
E	19.22	33.14	33.14	65.80	65.80	93.21	93.21	125.50	125.50	63.67	138.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
560E06	0.00	38.60	38.60	75.20	75.20	120.00	120.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7. Age distribution in estimate of autumn spawners during the Danish acoustic survey with R/V Dana in June-July from 2006 to 2009 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

	WR							
Strata	0	1	2	3	4	5	6	Totalt
580E06	0	0	0	0	0	0	0	0
570E06	0	313.2245	77.82016	1.310689	0	0	0	392.3554
580E08	0	72.47082	5.607853	0	0	0.280924	0	78.3596
570E08	30.98883	425.0991	40.40881	2.000434	0	0	0	498.4972
C	0	125.2478	21.22575	0	0	0.317077	0	146.7906
D	0	265.6062	13.03738	1.528584	0	0	0	280.1722
E	6.566309	107.84	17.38965	1.233393	0	0	1.086413	134.1158
560E06	0	0	0	0	0	0	0	0
All stratas	37.55514	1309.488	175.4896	6.073101	0	0.598001	1.086413	1530.291

Age distribution in % of total abundance

	WR						
Strata	0	1	2	3	4	5	6
580E06	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
580E08	0.00	92.48	7.16	0.00	0.00	0.36	0.00
570E08	6.22	85.28	8.11	0.40	0.00	0.00	0.00
C	0.00	85.32	14.46	0.00	0.00	0.22	0.00
D	0.00	94.80	4.65	0.55	0.00	0.00	0.00
E	4.90	80.41	12.97	0.92	0.00	0.00	0.81
560E06	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

Autumn spawners in 2007

Number in millions

	WR							
Strata	0	1	2	3	4	5	6	Totalt
580E06	0	4.275523	0.777364	0	0	0	0	5.052887
570E06	0	121.3957	56.68901	5.730107	0.081208	0	0	183.896
580E08	0	59.14779	26.5337	0	0	0	0	85.68149
570E08	0	753.575	118.4236	0	0	0	0	871.9986
C	0	75.62764	7.928773	0	0	0	0	83.55641
D	0	1365.499	109.4435	5.590177	0	0	0	1480.533
E	0	1542.982	46.9248	7.764333	0	0	0	1597.671
560E06	0	134.8495	0	0	0	0	0	134.8495
All stratas	0	4057.353	366.7207	19.08462	0.081208	0	0	4443.239

Age distribution in % of total abundance

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

Autumn spawners in 2008

Numbers in millions

	WR							
Strata	0	1	2	3	4	5	6	Totalt
580E06	0	5.759368	5.270526	1.137006	0	0	0	12.1669
570E06	0	233.3463	44.01544	10.12295	1.827048	0.97172	1.166064	291.4496
580E08	0	14.77055	0.798776	0.95387	0	0	0	16.5232
570E08	0	30.46026	35.50228	15.28281	12.22556	0	0	93.47091
C	0	16.99621	1.806051	0.289902	0	0	0	19.09216
D	11.87653	61.8407	12.27512	3.655343	1.158641	0.706254	0	91.51258
E	2347.35	13.78818	1.011825	3.668854	0	0	0	2365.818
560E06	1556.124	26.99296	0	0	0	0	0	1583.117
All stratas	3915.35	403.9546	100.68	35.11073	15.21125	1.677974	1.166064	4473.151

Age distribution in % of total abundance

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

Autumn sawners in 2009

Numbers in millions

	WR							
	0	1	2	3	4	5	6	Total
580E06	0	0.692378	0.093482	0.020359	0	0	0	0.806219
570E06	31.06361	171.8907	42.79111	7.418417	0	0	0	253.1638
580E08	0	9.69553	4.141109	0.274816	0.531259	0.261824	0.046534	14.95107
570E08	108.0899	747.4636	8.759016	0.306012	0.680179	0.271035	0.055769	865.6255
C	260.153	0.58971	0.060386	0	0	0	0	260.8031
D	3864.972	482.5577	3.471334	0.157225	0.853625	0.37262	0	4352.385
E	3409.909	277.2629	0.303746	0	0	0	0	3687.476
560E06	138.3324	103.8919	1.801204	0	0	0	0	244.0256
All Stratas	7812.52	1794.044	61.42139	8.176829	2.065063	0.90548	0.102303	9679.236

Age distribution in % of total abundance

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

Table 8. Age distribution in estimate of spring spawners during the Danish acoustic survey with R/V Dana in June-July from 2006 to 2009 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	0.593178	10.7057	6.516733	6.757213	1.130936	0.912556	0.101399	0.101399	0	0	0	0	0	26.81911
570E06	0	38.75708	240.7347	133.2967	63.69759	22.19022	4.991084	3.714054	0.876192	0	0	0	0	0	508.2576
580E08	0	18.15803	104.6477	52.34023	31.99871	11.00413	2.016351	0.263722	1.235087	0.473737	0	0	0	0	222.1377
570E08	0	523.5698	651.6374	295.6745	141.2997	52.41417	12.07789	3.483336	4.914179	2.662495	0	0	0	0	1687.734
C	0	500.8124	329.7239	87.72303	27.4259	6.0958	1.20621	0	1.401935	0	0	0	0	0	954.3891
D	0	531.7442	612.8719	161.5708	51.79789	10.30695	0	0	1.758777	0	0	0	0	0	1370.05
E	0	2138.608	1676.057	193.0519	129.388	42.03677	11.33461	18.16506	1.374893	0	0	0	0	0	4210.016
560E06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All stratas	0	3752.242	3626.378	930.1738	452.365	145.179	32.5387	25.72757	11.66246	3.136233	0	0	0	0	8979.403
													Total 4-13 WR		670.609
Spring spawners in 2008													Total 0-3 WR		8308.794
Numbers in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	4.747417	22.36477	11.44426	4.644294	1.626579	0.23028	0	0	0	0	0	0	0	45.0576
570E06	0	2263.746	377.9704	116.5931	51.42066	23.76703	13.53144	5.641147	2.240824	0.168337	0.142474	0	0	0	2855.221
580E08	0	49.78858	59.89797	36.89878	7.153356	5.018811	1.894965	0.9969	0.476556	0.132367	0	0	0	0	162.2583
570E08	0	701.722	228.784	147.1977	71.33349	46.00456	41.0344	15.90546	6.888062	5.642334	0	0	0	0	1264.512
C	0	108.7159	96.90216	26.0226	7.21751	5.06947	0.579803	0.339799	0	0	0.337388	0	0	0	245.1846
D	1.378056	124.7084	151.8888	59.98314	20.05135	11.58314	3.955683	1.210712	0	0	0.28923	0	0	0	375.0485
E	23.86369	216.22	125.1047	41.38228	11.35295	6.158667	3.854107	0.451898	0.678876	0.362604	0	0	0	0	429.4297
560E06	81.1742	1903.126	5.624591	0	0	0	0	0	0	0	0	0	0	0	1989.925
All stratas	106.4159	5372.774	1068.537	439.5218	173.1736	99.22826	65.08069	24.54592	10.28432	6.305642	0.769092	0	0	0	7366.637
													Total 4-13 WR		379.3875
Spring spawners in 2009													Total 0-3 WR		6987.249
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.181632	0.848045	0.439654	0.317617	0.192633	0.023753	0	0	0.01018	0	0	0	0	2.013513
570E06	0	60.72155	136.5663	138.9672	116.9933	51.60876	44.12637	15.50616	11.37886	1.723057	2.162766	1.161041	0	1.520387	582.4357
580E08	0	0	17.80798	9.092311	7.779615	3.760147	2.286826	0.709197	0.16086	0.239065	0.046141	0	0	0	41.88214
570E08	0	87.86399	59.76186	19.24404	13.04964	6.385305	3.680667	1.123925	0.205618	0.281966	0.065937	0	0	0	191.663
C	0	0	2.607024	1.011678	0.638223	0.089266	0.02888	0.02888	0.02888	0	0	0	0	0	4.432833
D	0	1.118311	66.37418	22.03412	14.96849	5.021978	3.509424	1.262183	0.232536	0.387166	0.122249	0	0	0	115.0306
E	0.943303	155.346	26.99517	5.354987	1.98717	0.675895	0.647134	0	0	0	0	0	0	0	191.9497
560E06	0	194.3873	1.801203	0.720481	0	0	0	0	0	0	0	0	0	0	196.909
All stratas	0.943303	499.6188	312.7617	196.8644	155.7341	67.73399	54.30306	18.63034	12.00675	2.641433	2.397093	1.161041	0	1.520387	1326.317
													Total 4-13 WR		316.1282
													Total 0-3 WR		1010.188