

Annex 2C: Norway

ICES co-ordinated acoustic survey on Herring and Sprat in the North Sea

RV “Johan Hjort”, 13 – 21 July 2009

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1 INTRODUCTION

In 2009, the Norwegian Institute of Marine Research (IMR) carried out the Norwegian part of the ICES co-ordinated herring and sprat acoustic survey for the North Sea and adjacent areas. This acoustic survey is planned and co-ordinated by the Planning Group for International Pelagic Surveys (PGIPS 2009). Six countries cooperate in surveying the North Sea and Div. IIIa for an acoustic abundance estimation of herring and sprat. The Norwegian herring acoustic area was defined as the area between 56°30' and 62°N and between 2° and 6°E. During early spring the IMR decided to reduce the survey effort due to economical reasons and the survey was realised by covering only parts of this area. The ICES squares originally planned with the densest coverage were chosen as the Norwegian contribution. Data from the present survey will be combined with the other surveys to provide a combined age disaggregated abundance index for use in the assessment carried out by the ICES Herring Assessment Working Group (HAWG) to be held in March 2010.

Objectives for this survey with RV “Johan Hjort” were:

- a) To conduct an acoustic survey to estimate the abundance and distribution of herring and sprat in the north-eastern part of the North Sea, between 57°00' and 62° N, and between 2° and 5° E.
- b) To obtain biological samples. Herring were sampled for data on length, weight, age, sex, maturity and vertebrae count and infection by Ichthyophonus

In addition, 10 people, doing whale observations along the transects, were onboard. This, however, had no influence on the survey design.

2. SURVEY DESCRIPTION AND METHODS

2.1 Personnel

Else Torstensen	(Cruise leader, 13-21 July)
Cecilie Kvamme	(Scientist, 13-21 July)
Bjarte Kvinge	(Acoustic operator, 13 – 21 July)
Ingve Fjeldstad	(Acoustic operator, 13 – 21 July)

Annlaug Haugsdal	(Technician – pelagic fish, 13 – 21 July)
Anne-Liv Johnsen	(Technician – pelagic fish, 13 – 21 July)
Jan de Lange	(Technician – pelagic fish, 13 – 21 July)

2.2 Narrative

RV “Johan Hjort” left Stavanger at 1400 UTC 13 July 2009 and set the course south-east. Due to the reduction in available ship time, original plans had to be reduced. We started the acoustic survey at the Fladen Bank (43F2) at 0352 UTC 14 July in the position 57°11’N 03°04’E . The vessel then continued with east-west transects from south to north. The survey finished 21 July at 0431 UTC in position 61°02’N 03°50’E and the vessel proceeded to Bergen where “Johan Hjort” docked around 1000 UTC. Figure 1 gives the cruise track and distribution of trawl haul stations. In general the weather conditions were good.

The present report gives the results from the survey area covered by the Norwegian survey. Remember that the survey area, because of cut in survey time, does not cover the Norwegian survey area as agreed by the PGIPS meeting entirely (PGIPS 2009).

Samples of 25 herring from 2 stations between 57-58°N were frozen for later analysis at the Norwegian National Institute of Nutrition and Seafood Research (NIFES).

2.3 Survey design

The survey was carried out in systematically parallel east-west transects progressing northwards from N57° to N62°. The cut in survey time resulted in an inadequate coverage of the survey area, as only 16 of a total of 39 squares (41%) were covered adequately. The covered cells were the cells recommended by PGIPS to be covered with the highest effort, i.e. 7.5 nmi and 15 nmi spacing (marked with red and magenta in figure 4.3.1.2. in the PGIPS report – PGIPS 2009).

2.4 Calibration

Calibration of the echo sounders was not performed. The sounders on board “Johan Hjort” have turned out to be stable and the settings used were from the calibration made in February 2009. The main settings for the 38 kHz transceiver are given in Table 1.

2.5 Acoustic data collection

The acoustic survey onboard RV “Johan Hjort” was carried out using a SIMRAD ER60 38 kHz sounder and an ES38B SK transducer mounted on the drop keel. Acoustic data were collected 24 hours per day. Additional data were collected at 18, 120 and 200 kHz (ES120–7 transducer). These data were used to present the frequency responses as guidance in the scrutiny of the acoustic data for species allocations. The mean volume back scattering values (S_v) were integrated pr nm intervals from 9-13 m (depending on weather conditions and the use of keel) below the surface to 0.5 m above the seabed. The speed of the vessel during the acoustic sampling was about 9 knots. The acoustic data were archived on an external hard drive. The acoustic recordings were scrutinized twice per day using the new Post Processing System LSSS (ver. 1.2.2) (*Large Scale Survey System*, Korneliussen et al. 2006).

2.6 Biological data - fishing trawl hauls

Trawling was carried out for supporting the species identification of acoustic scatters and for biological sampling. For pelagic trawling an Aakra trawl or a Harstad trawl was used, and the hauls were monitored by a Scanmar TE40-2 (PL) (narrow beam) and depth sensor D1200. For bottom trawling a Campelen shrimp trawl with rockhopper gear was used.

The catches were sampled for species composition by number and weights. Individual biological samples (length, weight) of the most important species were taken according to the IMR fish sampling manual (Mjanger et al. 2008). Herring were examined for sex, maturity (8 point scale), fat, stomach content, vertebrae count and macroscopic evidence of *Ichthyophonus* infection. Otoliths were taken for age determination (number of winter rings).

2.7 Hydrographic data

A CTD station was taken at each trawl station. The general hydrographical situation was mapped during a specific survey early in July (survey RV G.M.Dannevig-2009307).

2.8 Acoustic data analysis

Data from the post-processing LSSS (sA) were averaged per 1 nm. The acoustic data were allocated to the following categories: herring, demersal fish, pelagic fish and plankton. To calculate integrator conversion factors the target strengths of the target species herring and sprat, were estimated using the following TS-length relationship:

$$TS = 20\log_{10}L - 71.2 \text{ dB}$$

Herring were separated from other recordings by using catch information and characteristics of the recordings (e.g. frequency response – Korneliussen et al. 2006). The abundance estimation (Toresen et al. 1998) was made by ICES rectangles and summed up for the whole area.

North Sea autumn spawners and Western Baltic spring spawners (WBSS) are mixed during summer in the area covered by RV “Johan Hjort” (east of 2°E). No system for workable stock discrimination on individual herring during the survey is available. The proportions of Baltic spring spawners and North Sea autumn spawners by age were calculated by applying the formula

$$WBSS = ((56.5 - VS(\text{sample})) / (56.5 - 55.8)) \quad (\text{ICES 1999})$$

WBSS is the proportion of WBSS and VS(sample) is the mean vertebrae count of the sample. All samples were worked up on board. The length-at-age and weight-at-age were assumed to be the same in the two stocks. The measured proportions of mature fish were applied equally to calculate the maturing part of each age group in both stocks.

3 RESULTS and DISCUSSION

The survey track, trawl hauls and CTD stations are presented in Figure 1.

3.1 Acoustic data

3.1.1 Herring

The distribution of sA-values assigned to herring, are presented as mean values (from 1 n.mi intervals) per ICES square in Figure 2. Herring were scattered distributed in the area in

general low densities. The highest mean sA recorded by ICES rectangle was 175 (46F2) followed by sAs of 54 in 43F2 and 30 in 50F2. Pelagic trawling was mainly based on random positions regularly chosen for trawling at the surface, i.e. not based on echo registration (65%). In the “Norwegian area” herring tend to keep close to the surface and may thus be underestimated. Most of the schools were small and occurred scattered throughout the area, either close to the surface or near bottom. Few “classical” herring schools were observed this year, neither near bottom nor higher up in the water column.

Norway pout occurred as dense aggregations and in great quantities over most of the area, contributing to a high level of confusion in allocation to species, i.e. herring or Norway pout, as they can be very similar also in frequency response (Fässler et al 2007).

3.1.2 Sprat

No sprat was observed by RV “Johan Hjort”. This is the same situation as has been seen the last years.

3.2 Biological data

A total of 34 valid trawl hauls were carried out, of which all (27 PT and 7 BT) were taken in the “herring” area (Figure 1, Table 2). In general 30 min hauls were made. Catch composition per haul is given in Table 3. Herring were present in 3 hauls of sample size >20 herring. The length distributions of herring are presented in Table 4. A total of 222 herring were length measured and 134 aged (winter rings in otoliths). No herring was observed to be infected by *Ichthyophonus*.

3.3 Abundance and Biomass estimates

3.4.1 Herring

The geographical distribution of the sA-values assigned to herring, are presented in Figure 2. It was generally low amounts of herring, but the highest values were encountered in the central area, between 57°N and 59°N. Total number of herring was 441 million (about 10% of 2008 estimate) of which 37% was North Sea Autumn Spawners (NSAS).

Total biomass of **NSAS** was estimated to 32 100 tonnes and the spawning stock biomass as 27 600 tonnes. These estimates are much lower than the respective biomasses from the Norwegian area last year: 239 000 t and 95 000 t, respectively, but this is probably partly a result of the reduced coverage in 2009. The proportions of mature 2- and 3-ringers by numbers were estimated at 100%, thus much higher than the proportions estimated in 2008: 54 and 99%, respectively. Of the estimated numbers of 1-ringers, 4% was classified as maturing (2008: 7%). The 1-ringers dominated the North Sea autumn spawners in numbers, making 34%, whereas only 14.8% of the biomass. In biomass, the 7+-group dominated with its 48%.

The total biomass of **WBSS** was 58 300 tonnes, a large reduction since last year (173 000 tonnes). This must however also be seen in the light of the reduced coverage of the Norwegian 2009 survey.

Few good acoustic marks of herring schools were observed and the majority of the trawling positions were regularly chosen for trawling at surface, i.e. not based on echo registration. Due to the tendency of staying near the surface during daytime, herring may have been underestimated.

Table 5 gives the mean length, mean weight, total numbers (millions) and biomass (thousands of tonnes) by age and maturity stage for the North Sea autumn spawners and the Western Baltic spring spawners in the Norwegian target area in July 2009.

3.5 Hydrography

A total of 34 CTD stations were sampled (Figure 1).

The hydrographical data are part of a general monitoring program of IMR/ICES, and will be analysed and published separately.

4. References

- Fässler, S.M.M., Santos, R., García-Núñez, N. and Fernandes, P.G. 2007. Multifrequency backscattering properties of Atlantic herring (*Clupea harengus*) and Norway pout (*Trisopterus esmarkii*). Canadian Journal of Fisheries and Aquatic Sciences 64: 362-374.
- ICES 2009. Report of the Planning Group of International Pelagic Surveys. ICES CM 2009/LRC:02
- Korneliussen, R.J., Ona, E., Eliassen, I.K., Heggelund, Y., Patel, R., Godø, O.R., Giertsen, C., Patel, D., Nornes, E.H., Bekkvik, T., Knudsen, H.P. and Lien, G. 2006. The Large Scale Survey System-LSSS, a new post-processing system for multi-frequency echo sounder data. ICES WGFAST Report 2006.
- Mjanger, H., Hestenes, K., Svendsen, B.V., de Lange Wenneck, T. 2008. Manual for sampling of fish and crustaceans. Ver. 3.16. Institute of Marine Research.
- PGIPS 1999. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES CM 1999/ACFM:12.
- Toresen, R., Gjørseter, H. and de Barros, P. 1998. The acoustic method as used in the abundance estimation of capelin (*Mallotus villosus* Müller) and herring (*Clupea harengus* Linné) in the Barents Sea. Fisheries Research 34: 27-37.

Table 1. RV “Johan Hjort”, survey 2009207. International acoustic survey on herring in the North Sea, 13–21 July 2009. Simrad ER60 and analysis settings used.

Transceiver Menu	38 kHz
Absorption coefficient (dB/km)	10.3 dB/km
Pulse duration (ms)	1.024 ms
Bandwidth (kHz)	2.43 kHz
Max power (W)	2000 W
Two-way beam angle (dB)	-20.6 dB
3 dB Beam width (deg) - along ship	6.91°
3 dB Beam width (deg) - athwart ship	6.83°
Calibration details	
TS of sphere	-34.3 dB
Range to sphere in calibration	20.1 m
TS transducer gain	26.92 dB
Sa correction	-0.59 dB
Log / Navigation Menu	
Speed	Serial from ship's GPS
Operation Menu	
Ping interval	1 s

Table 2. RV “Johan Hjort”, survey 2009207, 13-21 July 2009. Trawl stations in the North Sea. PT = Pelagic Trawl, BT = Bottom Trawl. H: herring sample (≥ 20 herring), h: herring present, but not a full biological sample. Gear code: 3270 = Campelen shrimp trawl with rockhopper gear, 3513 = Harstad trawl without large floats, 3532 = Aakra trawl, 3533 = Aakra trawl with large floats. Type: 1 = random position at surface, 2 = trawling on acoustic registration.

Date	Trawl haul no	Type	Gear code	Lat	Long	ICES sq	Time (UTC)	Water depth (m)	Trawl depth, max (m)	Duration (min)	Herring	Total catch (kg)
20090714	BT245	2	3270	57.050	2.592	43F2	0715	71	72	5		106
20090714	PT246	2	3513	57.182	2.905	43F2	1327	68	35	29		2
20090714	PT247	1	3533	57.403	2.648	43F2	2103	78	0	30		56
20090715	PT248	1	3533	57.648	3.940	44F3	0221	75	0	32	H	96
20090715	BT249	2	3270	57.667	4.725	45F4	0637	82	83	18		88
20090715	PT250	1	3533	58.160	2.320	45F2	2141	74	0	30	h	900
20090716	PT251	1	3533	58.165	2.833	45F2	0021	73	0	32		411
20090716	BT252	2	3270	58.162	4.043	45F4	0530	122	123	25	h	323
20090716	BT253	2	3270	58.432	2.993	45F2	1745	107	109	12		46
20090716	PT254	1	3533	58.432	2.280	45F2	2104	86	0	33	h	609
20090716	PT255	1	3533	58.572	2.067	46F2	2344	89	0	34		601
20090717	PT256	2	3532	58.687	2.280	46F2	0211	100	80	37		28
20090717	BT257	2	3270	58.680	2.678	46F2	0450	108	108	26	H	600
20090717	PT258	2	3532	58.683	2.800	46F2	0711	115	60	30		63
20090717	BT259	2	3270	58.938	2.913	46F2	1048	125	130	37	h	1200
20090717	PT260	2	3532	59.202	2.083	47F2	1641	119	70	31		37
20090717	PT261	1	3533	59.183	2.223	47F2	1859	120	0	30	h	127
20090717	PT262	2	3513	59.187	2.765	47F2	2210	116	30	30	h	439
20090718	PT263	1	3533	59.195	3.327	47F3	0140	155	0	30	h	224
20090718	PT264	1	3533	59.423	3.888	47F3	0649	277	0	31		117
20090718	PT265	1	3533	59.815	2.938	48F2	1809	108	0	32	h	45
20090718	PT266	1	3533	59.932	2.293	48F2	2156	113	0	31		124
20090719	PT267	1	3533	60.093	2.688	49F2	0142	97	0	31	h	246
20090719	PT268	1	3533	60.205	3.893	49F3	0708	292	0	31		198
20090719	PT269	1	3533	60.430	3.123	49F3	1214	137	0	32	h	703
20090719	BT270	2	3270	60.688	2.827	50F2	1522	124	125	30		209
20090719	PT271	1	3533	60.933	2.352	50F2	2138	125	0	27	H	1000
20090720	PT272	1	3533	61.080	2.833	50F2	0118	289	0	30	h	678
20090720	PT273	1	3533	61.400	2.128	51F2	0701	292	0	27	h	74
20090720	PT274	1	3533	61.907	2.327	52F2	1150	379	0	31	h	802
20090720	PT275	1	3533	61.908	3.337	52F3	1614	379	0	31	h	4997
20090720	PT276	1	3533	61.718	3.858	52F3	1952	286	0	34		2982
20090720	PT277	1	3533	61.408	3.858	51F3	2323	362	0	31		300
20090721	PT278	1	3533	61.153	3.825	51F3	0220	347	0	32	h	501

Table 3. RV “Johan Hjort” 13–21 July 2009. Catch composition in the trawl hauls (kg).

Species	Trawl haul no	BT245	PT246	PT247	PT248	BT249	PT250	PT251	BT252	BT253	PT254	PT255	PT256	BT257	PT258	BT259
	Serial no	24301	24302	24303	24304	24305	24306	24307	24308	24309	24310	24311	24312	24313	24314	24315
	ICES area	43F2	43F2	43F2	44F3	45F4	45F2	45F2	45F4	45F2	45F2	46F2	46F2	46F2	46F2	46F2
	Total catch (kg)	106.07	2.19	56.08	95.65	87.63	900.00	411.24	323.26	45.55	608.89	600.54	27.98	599.95	63.03	200.36
Herring	<i>Clupea harengus</i>				76.48		16.92		1.60		0.63			22.83		0.09
Mackerel	<i>Scomber scombrus</i>		2.19	55.40	10.20		883.08	350.00			600.00	600.00	20.00			0.41
Horse Mackerel	<i>Trachurus trachurus</i>															
Blue whiting	<i>Micromesistius poutassou</i>															
Saithe	<i>Pollachius virens</i>								5.73							8.43
Cod	<i>Gadus morhua</i>					13.32			5.10					14.70		5.53
Haddock	<i>Melanogrammus aeglefinus</i>	1.28			0.00	6.66			19.37	4.45				30.08		0.25
Whiting	<i>Merlangius merlangus</i>	4.89			0.01	0.84			5.63				2.58	22.75		3.06
Ling	<i>Molva molva</i>								1.27	0.35						
Pollack	<i>Pollachius pollachius</i>								3.63							
Hake	<i>Merluccius merluccius</i>								3.58	2.06				8.60		0.16
Norway pout	<i>Trisopterus esmarkii</i>	90.00				60.33			251.00	37.99			5.08	486.20		136.00
Poor cod	<i>Trisopterus minutus</i>								1.31							
Silvery pout	<i>Gadiculus argenteus</i>								0.85							
Dab	<i>Limanda limanda</i>	6.60				0.45										
Long rough dab	<i>Hippoglossoides platessoides</i>	3.30							11.60					5.00		9.76
Lemon sole	<i>Microstomus kitt</i>								1.87	0.04				1.55		
Megrim	<i>Lepidorhombus whiffiagonis</i>															
Grey gumards	<i>Eutripla gurnardus</i>				7.75	4.33		13.84			3.61	0.54	0.15	1.05		
E.Atlantic gumards	<i>Triglidae</i>															
Argentine	<i>Argentina sphyraena</i>					0.18			0.06	0.03				7.20		
Greater argentine	<i>Argentina silus</i>															27.61
Lumpsucker	<i>Cyclopterus lumpus</i>			0.47				42.84							28.66	
Medusae	<i>Hydroida</i>				1.17	1.50		4.56	10.00	0.10	4.65		0.17	34.37		8.72
Other				0.21	0.04	0.02			0.67	0.53						0.36

Table 3. RV “Johan Hjort” 13-21 July 2009. Ctd.

Species	Trawl haul no	PT260	PT261	PT262	PT263	PT264	PT265	PT266	PT267	PT268	PT269	BT270	PT271	PT272	PT273	PT274
	Serial no	24316	24317	24318	24319	24320	24321	24322	24323	24324	24325	24326	24327	24328	24329	24330
	ICES area	47F2	47F2	47F2	47F3	47F3	48F2	48F2	49F2	49F3	49F3	50F2	50F2	50F2	51F2	52F2
	Total catch (kg)	37.30	127.28	438.60	224.12	117.36	45.04	123.19	246.19	198.46	702.91	208.77	999.96	676.89	74.11	802.30
Herring	<i>Clupea harengus</i>		2.92	0.59	0.29		0.37		1.99		2.52		116.30	1.88	5.73	2.30
Mackerel	<i>Scomber scombrus</i>		94.50	28.22	180.00	41.97	22.00	119.42	240.00	126.00	700.00	2.56	856.05	590.78	65.87	713.15
Horse Mackerel	<i>Trachurus trachurus</i>				0.98			1.26	2.91	4.04			13.88	81.09	2.00	84.00
Blue whiting	<i>Micromesistius poutassou</i>				4.33											
Saithe	<i>Pollachius virens</i>				8.53							47.54				
Cod	<i>Gadus morhua</i>															
Haddock	<i>Melanogrammus aeglefinus</i>	12.39				0.02	0.01							0.14	0.01	
Whiting	<i>Merlangius merlangus</i>			0.46												
Ling	<i>Molva molva</i>											1.20				
Pollack	<i>Pollachius pollachius</i>											2.50				
Hake	<i>Merluccius merluccius</i>			8.86												
Norway pout	<i>Trisopterus esmarkii</i>			400.00								150.00				
Poor cod	<i>Trisopterus minutus</i>															
Silvery pout	<i>Gadiculus argenteus</i>											0.17				
Dab	<i>Limanda limanda</i>											0.17				
Long rough dab	<i>Hippoglossoides platessoides</i>											0.43				
Lemon sole	<i>Microstomus kitt</i>											0.44				
Megrim	<i>Lepidorhombus whiffiagonis</i>											0.08				
Grey gurnards	<i>Eutrigla gurnardus</i>	0.88	1.27	0.48			0.94		1.28	0.26	0.39	2.55				
E.Atlantic gurnards	<i>Triglidae</i>							0.72								
Argentine	<i>Argentina sphyraena</i>											0.75				
Greater argentine	<i>Argentina silus</i>															
Lumpsucker	<i>Cyclopterus lumpus</i>	4.030	0.192			15.020	0.032			8.165				3		2.848
Medusae	<i>Hydroida</i>	20.00	28.40			60.00	20.00	1.78		60.00			13.73		0.50	
Other					30.00	0.35	1.70					0.40				

Table 3. RV “Johan Hjort” 13-21 July 2009. Ctd.

Species	Trawl haul no	PT275	PT276	PT277	PT278
	Serial no	24331	24332	24333	24334
	ICES area	52F3	52F3	51F3	51F3
	Total catch (kg)	4997.27	2982.26	300.09	500.97
Herring	<i>Clupea harengus</i>	0.37			0.97
Mackerel	<i>Scomber scombrus</i>	4860.00	2900.00	207.02	445.28
Horse Mackerel	<i>Trachurus trachurus</i>	136.00	72.00	53.18	22.55
Blue whiting	<i>Micromesistius poutassou</i>			6.46	
Saithe	<i>Pollachius virens</i>			9.45	
Cod	<i>Gadus morhua</i>				
Haddock	<i>Melanogrammus aeglefinus</i>				
Whiting	<i>Merlangius merlangus</i>				
Ling	<i>Molva molva</i>				
Pollack	<i>Pollachius pollachius</i>				
Hake	<i>Merluccius merluccius</i>				
Norway pout	<i>Trisopterus esmarkii</i>				
Poor cod	<i>Trisopterus minutus</i>				
Silvery pout	<i>Gadiculus argenteus</i>				
Dab	<i>Limanda limanda</i>				
Long rough dab	<i>Hippoglossoides platessoides</i>				
Lemon sole	<i>Microstomus kitt</i>				
Megrim	<i>Lepidorhombus whiffiagonis</i>				
Grey gurnards	<i>Eutrigla gurnardus</i>				
E.Atlantic gurnards	<i>Triglidae</i>				
Argentine	<i>Argentina sphyraena</i>				
Greater argentine	<i>Argentina silus</i>				
Lumpsucker	<i>Cyclopterus lumpus</i>	0.91	9.26		1.25
Medusae	<i>Hydroida</i>		1.00	18.89	30.92
Other				5.10	

Table 4. RV “Johan Hjort” 13-21 July 2009. Herring length (cm) distribution in trawl hauls. The grey shades mark the samples that are merged and used for 57-58°N, 58-59.5°N and 59.5-62°N (from left side).

Trawl station	PT248	PT250	BT252	PT254	BT257	BT259	PT261	PT262	PT263	PT265	PT267	PT269	PT271	PT272	PT273	PT274	PT275	PT278
ICES sq	44F3	45F2	45F4	45F2	46F2	46F2	47F2	47F2	47F3	48F2	49F2	49F3	50F2	50F2	51F2	52F2	52F3	51F3
length (cm)																		
15.0	1																	
15.5																		
16.0	1																	
16.5	2																	
17.0	1																	
17.5	3																	
18.0	6																	
18.5	8																	
19.0	8																	
19.5	7																	
20.0	11																	
20.5	6																	
21.0	16																	
21.5	4					1												
22.0	7					1												
22.5	5						1											
23.0	1					1												
23.5	7	1				1												
24.0						1												
24.5		1				3												
25.0	3					1												
25.5	2				1													
26.0	1					3												
26.5					1	5												
27.0						1												
27.5																		
28.0						5												
28.5			1			8												
29.0						8												
29.5						18												
30.0			1			8												
30.5						12												
31.0			2			2				1								
31.5																		1
32.0			1		1													
32.5						3				1								
33.0						1												1
33.5																		
34.0																		
34.5																		
35.0																		
35.5																		
36.0																		
36.5																		
37.0																		
Grand total	100	2	5	3	84	1	17	2	1	1	6	9	100	6	17	6	1	3
Mean length	20.7	24.3	30.8	28.1	28.8	22.3	25.3	32.3	30.8	32.3	33.2	32.1	33.1	33.1	32.0	34.3	34.3	33.6
Mean weight	87.7	141.0	319.4	211.3	271.8	92.0	171.6	293.5	289.0	366.0	331.8	280.1	330.5	313.3	337.3	328.4	365.0	322.7

Table 5. RV “Johan Hjort” 13-21 July 2009. Herring mean length, mean weight, numbers (millions) and biomass (thousands of tonnes) by age and maturity stages in the herring stocks in the Norwegian survey area.

Age	L _{mean}	W _{mean}	North Sea Autumn Spawners				Western Baltic Spring Spawners			
			No (mill)	%	Biom (10 ³)	%	No (mill)	%	Biom (10 ³)	%
1I	20.4	82.8	53.9	32.7	4.5	14.0	62.6	22.7	5.1	8.8
1M	22.3	108.0	2.4	1.5	0.3	0.8	3.1	1.1	0.3	0.6
2I	24.0	111.0	0.0	0.0	0.0	0.0	3.6	1.3	0.4	0.7
2M	24.9	167.8	32.9	20.0	4.2	13.1	82.1	29.7	15.1	25.9
3I	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3M	27.4	232.8	10.2	6.2	2.4	7.4	7.6	2.8	1.8	3.1
4I	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4M	30.0	299.0	1.4	0.9	0.4	1.3	5.7	2.1	1.7	2.9
5I	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5M	30.2	275.1	6.5	3.9	1.8	5.7	14.3	5.2	3.9	6.7
6I	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6M	29.8	296.4	10.0	6.1	3.0	9.4	31.4	11.4	9.3	15.9
7I	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7M	31.1	319.8	12.2	7.4	4.0	12.4	20.0	7.2	6.3	10.8
8	30.2	314.5	17.6	10.7	5.7	17.6	31.4	11.4	9.7	16.7
9+	31.8	329.7	17.6	10.7	5.9	18.2	14.3	5.2	4.7	8.0
Total	26.1	205.1	164.8	100.0	32.1	100.0	276.1	100.0	58.3	100.0
Immature	20.5	83.7	53.9	32.7	4.5	14.0	66.2	24.0	5.5	9.5
Mature	28.2	250.6	110.9	67.3	27.6	86.0	209.9	76.0	52.8	90.5

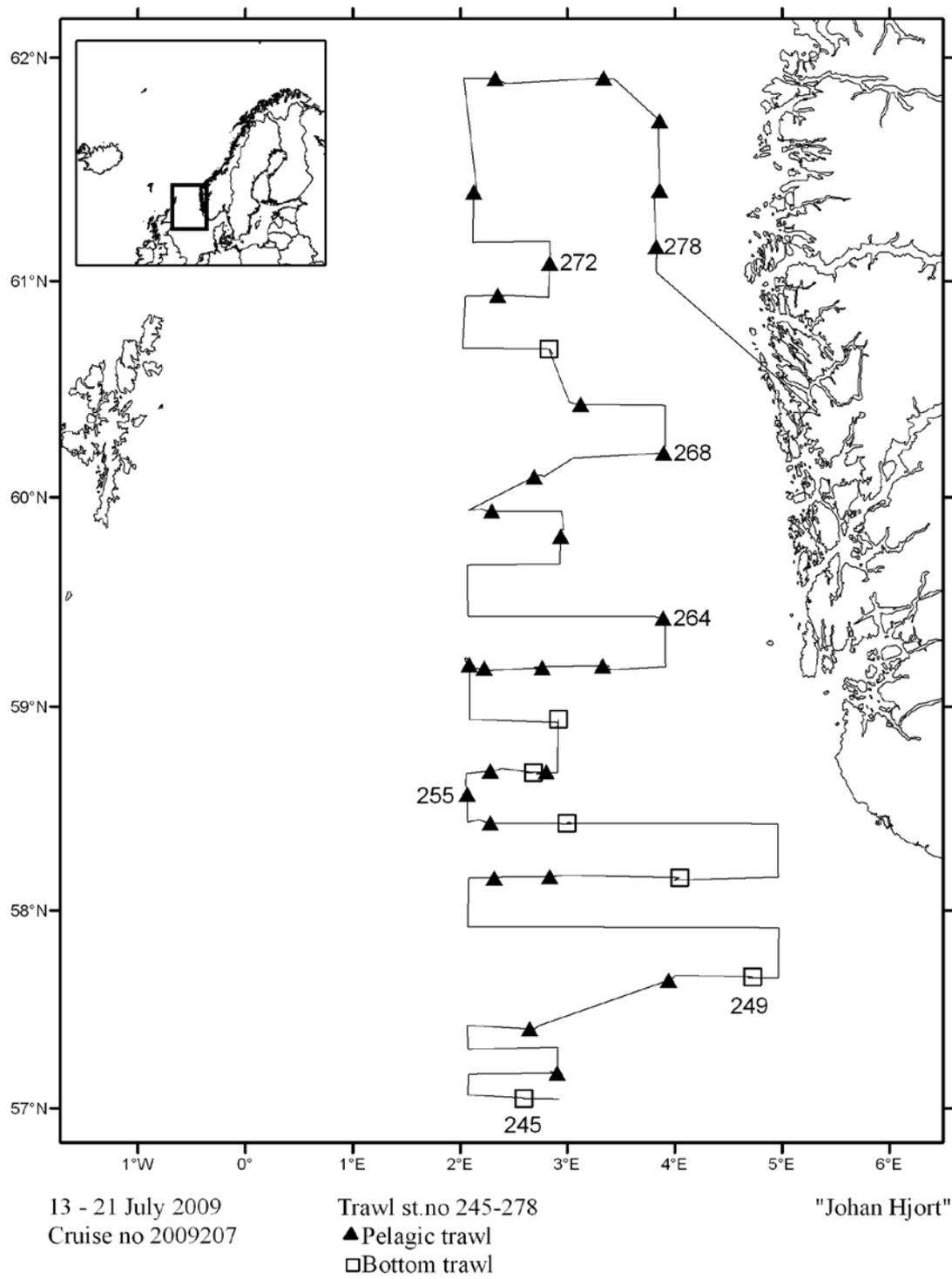


Figure 1. RV "Johan Hjort" 13-21 July 2009. Cruise track and fishing trawl hauls. CTD stations were taken at each trawl haul.

