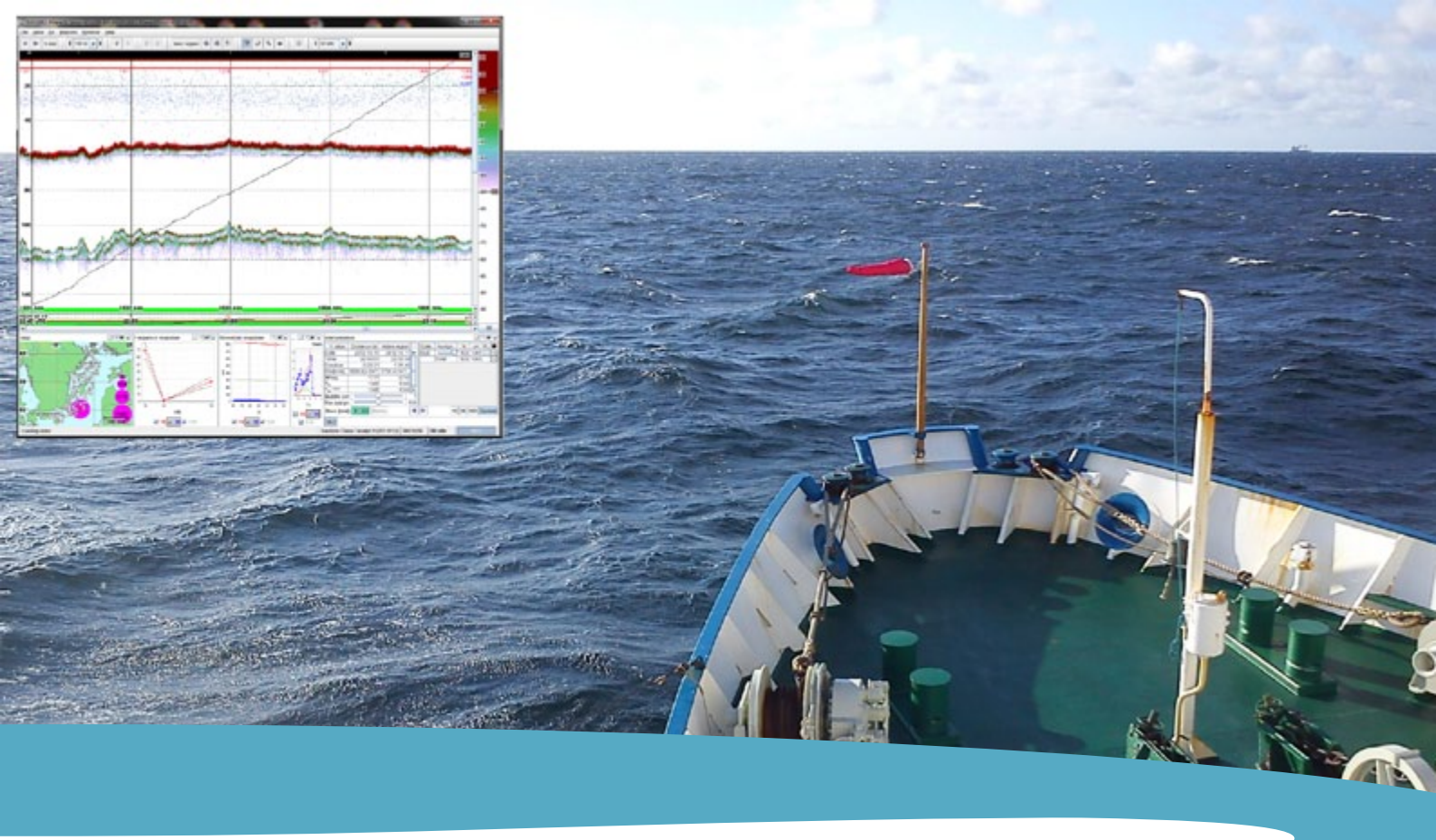

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Baltic International Acoustic Survey report, October 2014

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Baltic International Acoustic Survey report, October 2014

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Baltic International Acoustic Survey Report for R/V Dana

2014-09-30 - 2014-10-13

Niklas Larson
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1 Svensk Sammanfattning

Internationellt koordinerade hydroakustiska surveyer har regelbundet genomförts av Havsfiskelaboratoriet i Lysekil sedan 1978 i Östersjön. Baltic International Acoustic Survey (BIAS), som utförs varje år i oktober, regleras under Europeiska Commissionens Data collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för subdivision(SD) 27 och för delar av 25, 26, 28 samt 29. Dessutom har Sverige 2007-2012 tillsammans med Finland täckt SD 30. Syftet med undersökningen är att bedöma sillbeståndet och resultaten rapporteras till Baltic International Fish Survey Working Group (WGBIFS) och Baltic Fisheries Assessment Working Group (WGBFAS), båda är arbetsgrupper inom International Council for the Exploration of the Sea (ICES). Från 2011 används det danska forskningsfartyget R/V Dana efter det att svenska R/V Argos, som dessförinnan användts sedan 1978, tagits ur bruk utan befintlig svenskt fartyg som kunde ersätta.
Årets expedition startade 2013-10-01 i Gullmarsfjorden och slutade 2013-10-14 i Köpenhamn. Under surveyen samlas akustisk rådata in från ett kalibrerat vetenskapligt ekolod[1] och pelagisk trålning utförs för att få information om art och längfördelning. Den akustiska rådatan efterbehandlas i en mjukvara som 2011 byttes till en nyare programvara, LSSS[2]. Trålfångsten analyseras vad gäller arter samt längder, dessutom tar man fram en åldersstruktur på målarterna i fångsten som i detta fallet är sill, skarpsill och torsk. Därefter sammanställs de akustiska värdena med resultatet av analysen av trålfångsterna.
De deltagande länderna skickar årligen de som är vetenskapligt ansvariga för surveyen, samt eventuellt även expeditionsledarna, till arbetsgruppen WGBIFS. Där tas gemensamma riktlinjer och manualer fram och resultaten från varje land kombineras i en gemensam databas som rapporteras till WGBFAS, vilka använder BIAS resultaten tillsammans med annan information i en modell för att uppskatta det totala beståndet. Resultatet från 2013 års svenska BIAS survey bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön för SD 25 - 29. Tidigare års resultat samt mer information kring BIAS samt WGBIFS arbete finns i WGBIFS rapport[3]

2 Introduction

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978. The starting point was the cooperation between Institute of Marine Research (IMR) in Lysekil, Sweden and the Institute für Hochseefisherei und Fishverarbeitung in Rostock, German Democratic Republic in October 1978, which produced the first acoustic estimates of total biomass of herring and sprat in the Baltic Main basin (Håkansson et al., 1979). Since then there has been at least one annual hydroacoustic survey for herring and sprat stocks and results have been reported to ICES.
The Baltic International Acoustic Survey (BIAS), is mandatory for the countries that have exclusive economic zone (EEZ) in the Baltic Sea, and is a part of the Data Collection Framework as stipulated by the European Council and the Commission (Council Regulation (EC) No 199/2008 and the Commission DCF web page[4]).
IMR in Lysekil is part of the Department of Aquatic Resources within Swedish University of Agricultural Sciences and is responsible for the Swedish part of the EU Data Collection Framework and surveys in the marine environment. The Institute assesses the status of the marine ecosystems, develops and provides biological advices for managers for the sustainable use of aquatic resources.
The BIAS survey in September/October are co-ordinated and managed by the ICES working group WGBIFS. The main objective of BIAS is to assess clupeoid resources in the Baltic Sea. The survey will provide data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS).

[1] simrad.com
[2] Marec.no
[3] ICES CM 2014/SSGESST:13
[4] https://datacollection.jrc.ec.europa.eu/dcf-legislation

3 Methods

3.1 Narrative

Due to that R/V Argos was taken out of order, Sweden has rented R/V Dana since 2011 for the BIAS survey. The scientific staff was Swedish and the ship crew was Danish. This year's calibration of the SIMRAD EK60 sounder was made at Gullmarsfjorden on the Swedish west coast, the location change occurred 2011 because the normal calibration site at Högön is inaccessible for Dana due to deeper draft. The first part of the cruise started 2014-10-02 inbetween Sweden and Bornholm at the border between ICES subdivision (SD) 24 and SD 25, and ended 2014-10-12 a few nautical miles east from where it had started. The total cruise covered SD 27 and parts of 25, 26, 28 and 29.

3.2 Survey design

The stratification is based on ICES statistical rectangles with a range of 0.5 degrees in latitude and 1 degree in longitude (figure 1). The areas of all strata are limited by the 10 m depth line[5]. The aim is to use parallel transects spaced on regular rectangle basis normally at a maximum distance of 15 nautical miles and with a transect density of about 60 nautical miles per 1000 square nautical miles. The irregular shape of the survey area assigned to Sweden and the weather conditions makes it difficult to fulfill this aim. The total area covered was 21752 square nautical miles and the distance used for acoustic estimates was 1423 nautical miles. The cruise track and positions of trawl hauls is shown in figure 2.

3.3 Calibration

The SIMRAD EK60 echo sounder with the transducer ES38B was calibrated at Bornö in Gullmarssfjorden 2014-09-30 according to the BIAS manual[6] Values from the calibration were within required accuracy. The change of calibration site was decided after correspondance with Simrad. Due to the distance between the calibration site and the survey area the gain was recalculated using the equation: $G = G_0 + 10 * log10(c_0^2/c^2)$ (Bodholt 2002)

3.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60[7] echo sounder with the 38 kHz transducer (ES38b) mounted on a towed body is used for the acoustic transect data collection, additionally a hull mounted 38 kHz transducer (ES38B) was used during the fishing stations (the towed body is taken aboard when fishing). The settings of the hydroacoustic equipment were as described in the BIAS manual[8]. The post processing of the stored raw data was made using the software LSSS[9]. The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary sampling distance units (ESDUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and scattering layers were removed from the echogram using LSSS.

3.5 Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species so that it is impossible to allocate the integrator readings to a single species. Therefore

[5] ICES CM 2011/SSGESST:05 Addendum 2
[6] See footnote 4
[7] http://www.simrad.com/ek60
[8] See footnote 4
[9] www.marec.no/english/products.htm

the species composition was based on the trawl catch results. For each rectangle the species composition and length distribution were determined as the unweighted mean of all trawl results in this rectangle. In the case of lack of sample hauls within an individual ICES rectangle (due to gear problems, bad weather conditions or other limitations) a mean from hauls from neighboring rectangles was used. From these distributions the mean acoustic cross-section was calculated according to the target strength-length (TS) relationships found in table 1.

Clupeoids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)
Trachurus trachurus	TS = 20 log L (cm) - 73.0	(Misund, 1997 in Peña, 2007)
Fish without swim bladder	TS = 20 log L (cm) - 84.9	ICES CM2011/SSGESST:02,Addendum 2
Salmonids and 3-spined stickleback were assumed to have the same acoustic properties as herring.		

Table 1: Target strength-length (TS) relationships

The total number of fish (total N) in one rectangle was estimated as the product of the mean area scattering cross section s_A and the rectangle area, divided by the corresponding mean cross section σ. The total number was separated into different fish species according to the mean catch composition in the rectangle.

3.6 Hydrographic data

CTD casts were made with a "Seabird 9+" CTD when calibrating the acoustic instruments and whenever a haul was conducted, additional hydrographic data was collected on a selection of these stations.

3.7 Personnel

The participating scientific crew can be seen in table 2

Hilvarsson, Anneli	IMR, Lysekil, Sweden	Fish sampling
Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Larson, Niklas	IMR, Lysekil, Sweden	Scientific & Expedition leader, Acoustics
Lövgren, Olof	IMR, Lysekil, Sweden	Acoustics
Ovegård, Mikael	IMR, Lysekil, Sweden	Fish sampling
Palmen-Bratt, Anne-Marie	IMR, Lysekil, Sweden	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil, Sweden	Fish sampling
Svenson, Anders	IMR, Lysekil, Sweden	Expedition leader, Acoustics
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2: Participating scientific crew

4 Results

4.1 Biological data

In total 48 trawl hauls were carried out, 15 in SD 25, 2 in SD 26, 14 in SD 27, 9 in SD 28 and 8 hauls in SD 29. 2259 herrings and 1155 sprats were aged. Catch compositions by trawl haul is presented in Table 8. Length distributions for herring and sprat by ICES subdivision are shown in figures 3 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean backscatter [s_A], the mean scattering cross section [σ], the estimated total number of fish, the percentages of herring, sprat and cod per Subdivision/rectangle are shown in Table 3.

4.3 Abundance estimates

The total abundances of herring and sprat by age group per rectangle are presented in Table 4 and 6. The corresponding mean weights by age group per rectangle are shown in Tables 5 and 7.

5 Discussion

The data collected during the survey should be considered as representative for the abundance of the pelagic species during the BIAS in 2014 for SD25 to 29 and thus can be used in the assessment work done by WGBFAS.

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Commission DCF web page:
http://datacollection.jrc.ec.europa.eu/dcf-legislation

7 Tables, map and figures

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	379.5	5.416	201.35	92.47	4.51	1.441
25	39G5	979.0	485.0	1.917	2476.47	10.48	89.25	0.233
25	40G4	677.2	543.5	2.190	1680.58	33.76	47.66	1.846
25	40G5	1012.9	536.0	2.050	2648.08	23.46	73.97	0.301
25	40G6	1013.0	916.9	2.438	3809.25	38.74	59.72	1.408
25	40G7	1013.0	627.1	3.150	2017.05	70.60	28.47	0.387
25	41G6	764.4	879.9	1.868	3601.18	33.36	60.38	0.023
25	41G7	1000.0	525.1	1.648	3185.52	11.45	87.86	0.000
26	41G8	1000.0	519.8	1.115	4660.50	10.74	89.12	0.028
27	42G6	266.0	1199.8	2.484	1284.67	54.92	23.50	0.000
27	42G7	986.9	440.9	1.574	2764.24	39.67	20.92	0.033
27	43G7	913.8	292.1	0.963	2773.60	22.47	7.13	0.097
27	44G7	960.5	613.5	1.527	3859.39	46.95	12.46	0.002
27	44G8	456.6	820.9	0.657	5703.46	14.86	10.95	0.000
27	45G7	908.7	431.1	0.558	7016.60	22.95	49.66	0.000
27	45G8	947.2	1004.6	0.730	13041.78	22.31	50.56	0.002
27	46G8	884.8	706.5	0.654	9553.25	20.99	46.43	0.004
28	42G8	945.4	860.3	0.968	8404.17	14.01	54.38	0.021
28	43G8	296.2	200.3	1.595	371.92	39.93	30.79	0.106
28	43G9	973.7	485.1	0.637	7420.49	4.25	77.90	0.000
28	44G9	876.6	881.2	0.689	11212.65	8.36	37.46	0.026
28	45G9	924.5	680.0	0.485	12952.28	13.97	29.30	0.000
29	46G9	933.8	482.9	0.573	7865.63	12.09	42.24	0.000
29	46H0	933.8	643.3	0.902	6658.82	40.30	29.60	0.000
29	47G9	876.2	1779.7	0.630	24732.94	29.44	52.40	0.000
29	47H0	920.3	518.9	0.579	8243.07	37.14	47.56	0.000

Table 3: Survey statistics

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	9.09	1.85	4.75	0.81	0.34	0.84	0.17	0.34	0.00	0.00
25	39G5	2210.18	305.93	307.54	289.01	462.46	157.59	294.62	370.18	0.00	22.86
25	40G4	800.94	131.28	205.47	93.23	179.87	96.99	62.44	8.71	22.95	0.00
25	40G5	1958.91	562.82	303.17	158.54	385.48	277.17	88.89	144.18	6.02	32.64
25	40G6	2274.75	219.95	382.87	525.00	493.68	257.84	107.59	274.23	0.00	13.59
25	40G7	574.25	185.75	10.14	35.82	136.94	126.14	42.09	23.41	13.95	0.00
25	41G6	2174.48	1023.60	379.21	162.15	276.44	161.47	46.49	63.36	22.26	39.50
25	41G7	2798.73	588.12	106.88	284.14	778.52	221.72	210.40	404.75	187.50	16.68
26	41G8	4153.44	3400.76	5.49	71.73	324.06	80.05	68.52	125.76	24.43	52.65
27	42G6	301.94	11.47	26.75	94.02	39.37	88.67	5.73	35.93	0.00	0.00
27	42G7	578.24	543.97	11.80	14.75	4.76	0.00	0.00	2.95	0.00	0.00
28	42G8	4570.19	4200.85	30.27	57.58	103.22	85.48	31.53	40.23	21.04	0.00
27	43G7	197.67	195.55	0.06	0.00	0.67	0.67	0.06	0.66	0.00	0.00
28	43G8	114.50	106.99	0.00	1.74	0.95	2.29	1.74	0.79	0.00	0.00
28	43G9	5780.40	5626.55	15.43	17.69	61.87	21.79	26.48	10.59	0.00	0.00
27	44G7	480.70	470.60	1.99	0.00	0.00	1.38	1.68	1.38	0.00	3.67
27	44G8	624.46	594.53	0.00	17.46	2.49	4.99	2.49	2.49	0.00	0.00
28	44G9	4186.63	3597.83	51.51	187.46	88.84	68.17	105.70	87.13	0.00	0.00
27	45G7	3464.68	3462.60	1.04	0.00	0.00	0.00	1.04	0.00	0.00	0.00
27	45G8	6594.33	6577.34	0.00	6.79	10.19	0.00	0.00	0.00	0.00	0.00
28	45G9	3795.16	3793.34	0.00	0.68	0.46	0.00	0.23	0.46	0.00	0.00
27	46G8	4435.11	4435.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	46G9	3322.55	3308.83	0.00	2.09	0.00	2.09	5.36	2.09	0.00	2.09
29	46H0	1971.33	1971.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	47G9	12959.43	12946.43	0.00	0.00	12.99	0.00	0.00	0.00	0.00	0.00
29	47H0	3920.02	3912.06	0.00	0.00	3.98	0.00	1.67	2.31	0.00	0.00

Table 4: Estimated number (millions) of sprat

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4	3.83	12.00	15.00	18.00	18.40	19.00	20.00		
25	39G5	4.38	10.82	12.80	16.00	19.00	16.75	16.71		19.00
25	40G4	4.41	11.21	16.50	17.67	19.14	19.00	21.33	17.00	
25	40G5	3.80	12.60	13.67	15.29	17.50	19.33	18.80	22.00	17.00
25	40G6	4.48	12.40	13.00	16.00	18.25	17.50	15.67		19.50
25	40G7	4.70	10.67	11.80	15.75	15.29	17.50	17.50	17.50	
25	41G6	3.33	11.50	12.50	16.00	15.60	18.00	16.00	17.50	17.00
25	41G7	3.46	11.50	12.80	15.62	17.67	16.00	17.00	14.67	20.00
26	41G8	3.59	10.00	11.50	13.90	16.40	16.00	16.14	16.50	18.50
27	42G6	3.00	12.20	13.43	13.33	16.22	16.00	15.75		
27	42G7	3.30	12.00	13.00	14.33			11.00		
28	42G8	3.31	10.17	13.33	13.43	15.00	15.00	16.00	14.00	
27	43G7	2.55	8.00		11.50	12.50	16.00	12.00		
28	43G8	2.80		13.00	14.50	14.80	16.00	16.50		
28	43G9	2.80	10.40	11.00	12.60	14.25	15.57	14.00		
27	44G7	2.58	7.00			11.00	16.00	16.00		16.00
27	44G8	2.17		11.00	12.00	11.50	15.00	11.00		
28	44G9	2.92	10.75	13.00	13.00	12.67	14.25	15.43		
27	45G7	2.77	10.00				16.00			
27	45G8	2.46		11.50	11.67					
28	45G9	2.56		11.33	10.50		14.00	13.50		
27	46G8	2.33								
29	46G9	2.19		12.00		11.00	12.50	12.00		11.00
29	46H0	2.20								
29	47G9	2.40			11.00					
29	47H0	2.24			13.50		14.00	12.00		

Table 5: Estimated mean weights (g) of sprat

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	186.19	6.40	21.32	18.19	87.70	22.17	15.49	9.66	4.55	0.71
25	39G5	259.42	13.33	28.69	5.55	62.56	25.25	26.11	51.00	25.36	21.57
25	40G4	567.42	120.19	99.59	120.58	98.47	44.89	31.65	14.94	19.97	17.15
25	40G5	621.24	46.09	113.28	102.20	197.10	88.62	21.91	17.43	33.10	1.50
25	40G6	1475.89	24.63	228.33	133.70	374.45	73.47	323.62	171.63	144.60	1.45
25	40G7	1424.06	0.00	13.22	36.75	301.60	205.93	334.34	252.55	214.69	64.98
25	41G6	1201.39	31.40	133.51	176.56	335.67	155.22	152.04	135.21	74.26	7.52
25	41G7	364.76	3.60	4.83	35.70	181.80	51.75	32.57	44.07	8.72	1.72
26	41G8	500.67	14.82	0.00	55.99	39.79	43.39	98.24	132.75	46.92	68.77
27	42G6	705.56	0.00	0.00	19.67	264.59	89.55	124.15	135.01	44.10	28.49
27	42G7	1096.52	0.73	0.00	145.51	466.04	70.85	180.94	213.13	14.28	5.05
28	42G8	1177.47	19.26	3.96	158.36	184.88	109.74	338.08	222.02	137.72	3.46
27	43G7	623.21	26.10	2.62	94.30	256.64	71.23	95.85	27.24	41.37	7.86
28	43G8	148.49	0.79	0.96	9.21	32.03	31.84	26.09	23.98	22.63	0.96
28	43G9	315.32	112.75	0.00	1.50	41.41	29.11	76.83	41.71	8.40	3.60
27	44G7	1812.17	66.76	98.23	510.91	474.76	205.90	192.89	154.11	93.65	14.94
27	44G8	847.74	112.20	19.45	283.25	198.47	106.72	88.27	24.43	11.97	2.99
28	44G9	937.19	214.24	0.00	72.23	207.13	205.46	98.15	56.22	64.32	19.44
27	45G7	1610.59	1523.69	4.16	16.83	44.79	8.31	6.37	4.16	1.25	1.04
27	45G8	2910.19	1719.33	19.91	225.90	490.81	139.66	123.43	173.03	18.12	0.00
28	45G9	1809.67	1796.49	0.00	2.58	4.83	1.36	3.29	0.47	0.65	0.00
27	46G8	2005.71	1223.83	42.68	249.40	235.20	156.56	48.12	39.99	9.91	0.00
29	46G9	950.97	558.93	0.00	29.40	202.56	81.68	41.17	33.98	0.00	3.27
29	46H0	2683.38	1396.96	8.72	72.56	439.13	441.84	134.75	182.91	6.51	0.00
29	47G9	7281.43	6051.56	9.17	291.67	426.28	292.07	197.00	13.68	0.00	0.00
29	47H0	3061.52	2950.00	14.67	27.07	39.23	24.42	5.35	0.79	0.00	0.00

Table 6: Estimated number (millions) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	12.11	35.76	66.08	98.90	148.89	135.25	130.33	180.50	238.00
25	39G5	13.29	35.29	70.00	67.09	87.92	69.75	74.60	68.25	79.86
25	40G4	10.56	26.00	62.96	84.29	91.21	95.33	69.67	49.50	62.50
25	40G5	13.20	30.27	58.46	64.62	71.94	80.17	57.00	68.25	109.00
25	40G6	15.20	30.27	42.50	53.05	65.44	54.13	56.88	57.00	83.00
25	40G7		29.00	35.33	45.86	51.50	59.57	62.58	66.40	80.17
25	41G6	8.67	26.69	30.00	41.07	48.00	52.12	59.75	62.00	85.50
25	41G7	8.00	23.50	28.71	40.04	41.67	47.22	49.14	58.00	71.00
26	41G8	4.58		31.25	35.00	34.60	36.92	44.45	49.60	47.17
27	42G6			40.00	38.00	42.62	50.18	54.90	61.00	61.25
27	42G7	4.00		33.14	36.56	41.40	49.71	45.09	57.25	64.00
28	42G8	3.86	26.00	31.25	35.70	38.00	41.42	48.08	49.00	62.00
27	43G7	4.00	21.00	27.08	36.88	38.40	45.64	52.00	43.00	60.67
28	43G8	5.00	22.00	31.33	31.90	35.60	41.70	45.12	47.80	70.00
28	43G9	3.64		25.00	29.36	32.71	37.00	45.33	43.67	41.00
27	44G7	3.91	20.60	25.71	33.14	41.29	44.78	42.12	44.00	52.67
27	44G8	3.93	20.50	25.31	30.45	29.75	40.30	44.60	44.25	42.00
28	44G9	4.14		30.80	32.12	37.27	36.70	40.50	48.88	37.00
27	45G7	3.93	18.25	24.00	31.19	34.75	33.67	38.50	37.00	54.00
27	45G8	3.77	19.33	23.00	29.53	37.50	38.00	40.00	53.75	
28	45G9	3.38		27.62	33.24	39.00	38.42	45.33	63.00	
27	46G8	4.03	17.88	25.09	29.75	31.88	32.00	35.33	40.50	
29	46G9	3.51		23.25	26.57	33.10	27.80	31.00		37.00
29	46H0	3.50	13.00	19.25	24.17	29.64	29.86	34.86	40.00	
29	47G9	3.16	20.00	21.83	26.38	29.90	31.67	46.50		
29	47H0	3.31	19.50	23.42	26.38	28.22	28.67	35.50		

Table 7: Estimated mean weights (g) of herring

	Species	2	3	5	7	9	11	13	15
1	Ammodytes								
2	Aphia minuta								
3	Clupea harengus	941.58	223.30	35.00	629.70	318.90	80.43	356.26	179.18
4	Cyclopterus lumpus	0.15		0.43	0.32	0.49			
5	Gadus morhua	69.34	18.91	1.72	46.80	0.69		1.64	
6	Gasterosteus aculeatus			0.12			7.72	1.30	0.78
7	Hyperoplus lanceolatus								
8	Liparis liparis			0.00					
9	Lumpenus lampretaeformis								
10	Merlangius merlangus	4.73	7.80						
11	Myoxocephalus scorpius								
12	Nerophis ophidion								
13	Platichthys flesus	0.31	0.52						
14	Pleuronectes platessa		0.33						
15	Pollachius virens	12.00	0.32						
16	Pomatoschistus	0.06	0.16	0.01			0.07		
17	Pungitius pungitius							0.03	
18	Salmo salar	3.27							
19	Spinachia spinachia	0.01							
20	Sprattus sprattus	5.92	54.03	18.90	554.66	67.99	413.35	55.60	254.97

Table 8: Catch composition per haul.

	Species	17	19	21	23	25	27	29	31
1	Ammodytes								
2	Aphia minuta								
3	Clupea harengus	71.41	330.52	684.03	478.76	286.36	0.40	1495.27	96.12
4	Cyclopterus lumpus	0.23	0.22	0.93	0.13	0.32		0.24	0.53
5	Gadus morhua				0.01	0.02	0.64	0.52	
6	Gasterosteus aculeatus		41.72	12.24	14.47	15.46	84.11	27.69	10.16
7	Hyperoplus lanceolatus				0.19				
8	Liparis liparis								
9	Lumpenus lampretaeformis								
10	Merlangius merlangus								
11	Myoxocephalus scorpius						0.10		
12	Nerophis ophidion						0.02		0.01
13	Platichthys flesus								
14	Pleuronectes platessa								
15	Pollachius virens								
16	Pomatoschistus								
17	Pungitius pungitius		0.04	0.13	0.10	0.18	0.35		0.05
18	Salmo salar								
19	Spinachia spinachia								
20	Sprattus sprattus	829.94	81.49	90.95	0.81	3.78	10.29	55.29	0.60

Table 8 (continued): Catch composition per haul

	Species	33	35	37	39	41	43	45	47
1	Ammodytes								
2	Aphia minuta								
3	Clupea harengus	110.53	83.31	32.35	73.68	61.71	80.97	58.39	7.05
4	Cyclopterus lumpus	0.20	0.24		0.71	0.50			0.32
5	Gadus morhua				0.13			0.09	
6	Gasterosteus aculeatus	31.61	29.66	12.33	8.00	11.66	44.41	6.24	29.85
7	Hyperoplus lanceolatus		0.07			0.03			
8	Liparis liparis								
9	Lumpenus lampretaeformis	0.01							
10	Merlangius merlangus								
11	Myoxocephalus scorpius	0.08		0.12					
12	Nerophis ophidion				0.01	0.02		0.00	0.02
13	Platichthys flesus				0.09				
14	Pleuronectes platessa								
15	Pollachius virens								
16	Pomatoschistus								
17	Pungitius pungitius	0.10	0.09		0.01	0.03		0.06	0.04
18	Salmo salar					0.42			0.98
19	Spinachia spinachia								
20	Sprattus sprattus	9.45	113.88	29.09	28.54	25.07	117.62	11.81	40.11

Table 8 (continued): Catch composition per haul

	Species	49	51	53	55	57	59	61	63
1	Ammodytes								
2	Aphia minuta								
3	Clupea harengus	63.91	129.69	40.26	32.21	55.77	56.07	33.51	1.62
4	Cyclopterus lumpus	0.60	0.33	0.04	0.24		0.09	0.63	0.27
5	Gadus morhua								
6	Gasterosteus aculeatus	17.43	21.30	9.18	5.61	5.26	3.16	14.65	30.36
7	Hyperoplus lanceolatus								
8	Liparis liparis								
9	Lumpenus lampretaeformis								
10	Merlangius merlangus								
11	Myoxocephalus scorpius								
12	Nerophis ophidion	0.02		0.02	0.01		0.00	0.02	
13	Platichthys flesus								
14	Pleuronectes platessa								
15	Pollachius virens								
16	Pomatoschistus								
17	Pungitius pungitius	0.03	0.03	0.02			0.01	0.04	0.02
18	Salmo salar								
19	Spinachia spinachia								
20	Sprattus sprattus	19.08	70.69	36.26	18.41	39.65	0.62	52.66	30.95

Table 8 (continued): Catch composition per haul

	Species	65	67	69	71	73	75	77	79
1	Ammodytes			0.02				0.01	
2	Aphia minuta								
3	Clupea harengus	46.31	98.01	58.24	43.12	1.68	58.06	63.00	360.59
4	Cyclopterus lumpus	0.92	0.97	1.40	0.18		0.22	0.32	0.83
5	Gadus morhua		0.03				0.00	0.01	
6	Gasterosteus aculeatus	50.84	52.68	24.16	13.94	18.32	2.53	18.91	20.91
7	Hyperoplus lanceolatus		0.02	0.01			0.05		
8	Liparis liparis								
9	Lumpenus lampretaeformis								
10	Merlangius merlangus								
11	Myoxocephalus scorpius								
12	Nerophis ophidion								
13	Platichthys flesus	0.09							
14	Pleuronectes platessa								
15	Pollachius virens								
16	Pomatoschistus								
17	Pungitius pungitius			0.03	0.02			0.04	
18	Salmo salar				0.61				
19	Spinachia spinachia								
20	Sprattus sprattus	17.18	61.87	46.89	40.80	469.91	4.31	47.90	90.59

Table 8 (continued): Catch composition per haul

	Species	81	83	85	87	89	91	93	95
1	Ammodytes								
2	Aphia minuta								0.00
3	Clupea harengus	205.14	2.41	445.46	555.61	92.02	6.11	73.87	48.28
4	Cyclopterus lumpus		0.22			0.21			0.56
5	Gadus morhua	4.24		0.91	4.95	8.85	16.91	0.27	4.66
6	Gasterosteus aculeatus		0.26						
7	Hyperoplus lanceolatus								
8	Liparis liparis								
9	Lumpenus lampretaeformis								
10	Merlangius merlangus							1.19	4.46
11	Myoxocephalus scorpius								
12	Nerophis ophidion								
13	Platichthys flesus								0.24
14	Pleuronectes platessa								
15	Pollachius virens								
16	Pomatoschistus				0.04	0.01			0.74
17	Pungitius pungitius								
18	Salmo salar								
19	Spinachia spinachia								
20	Sprattus sprattus	69.83	304.50	121.90	0.83	112.39	193.49	65.19	38.62

Table 8 (continued): Catch composition per haul

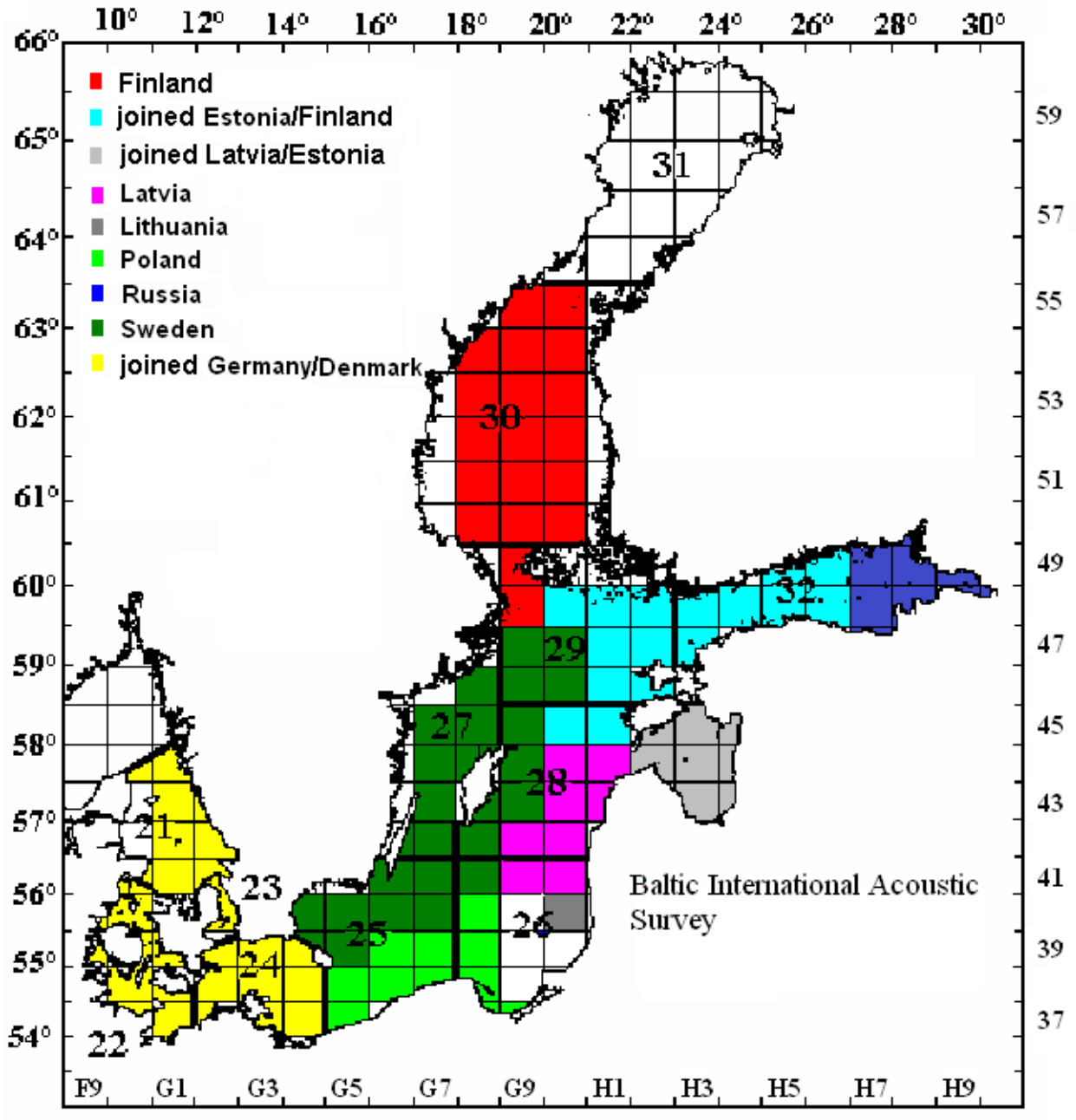

Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

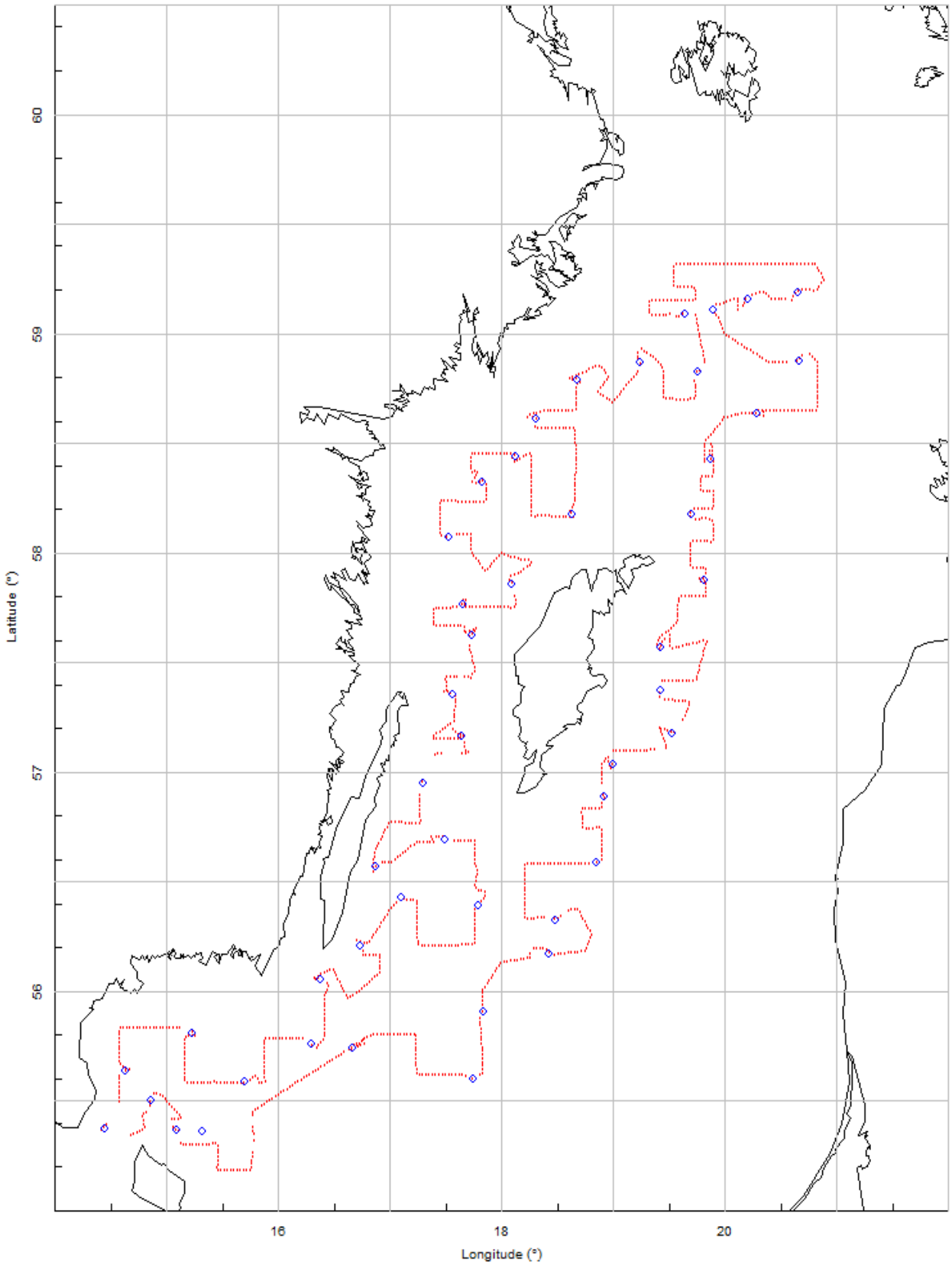

Figure 2: cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

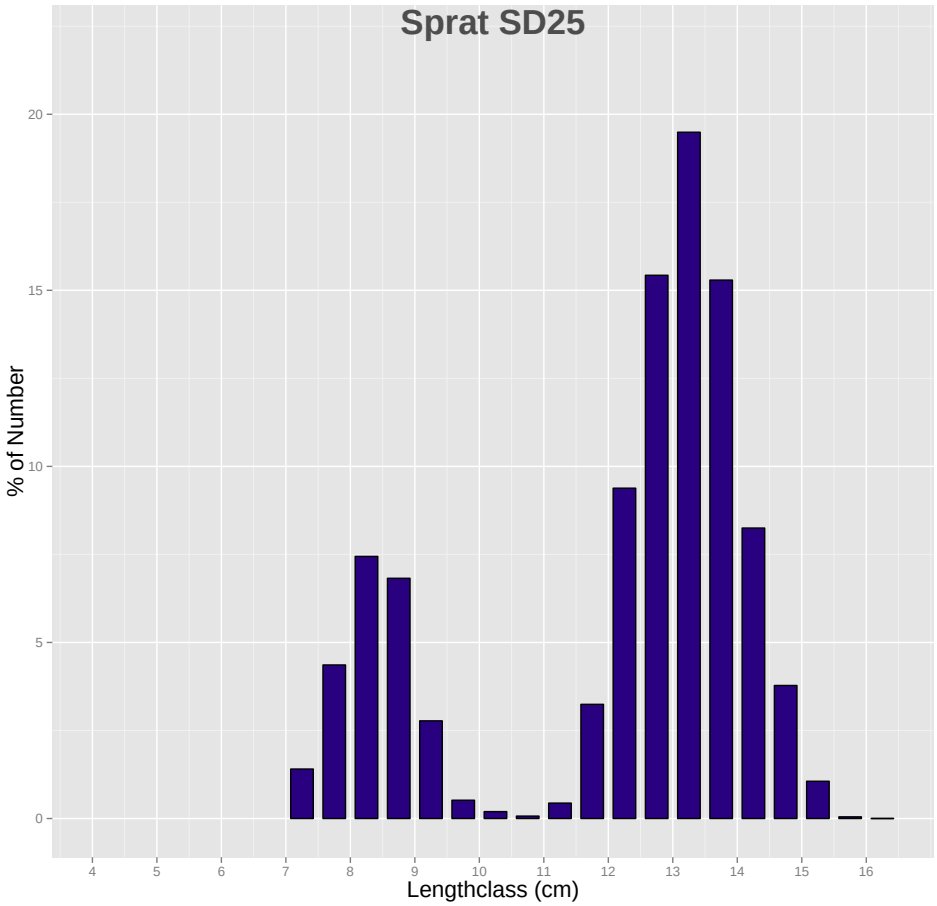

Figure 3: Length distribution of sprat

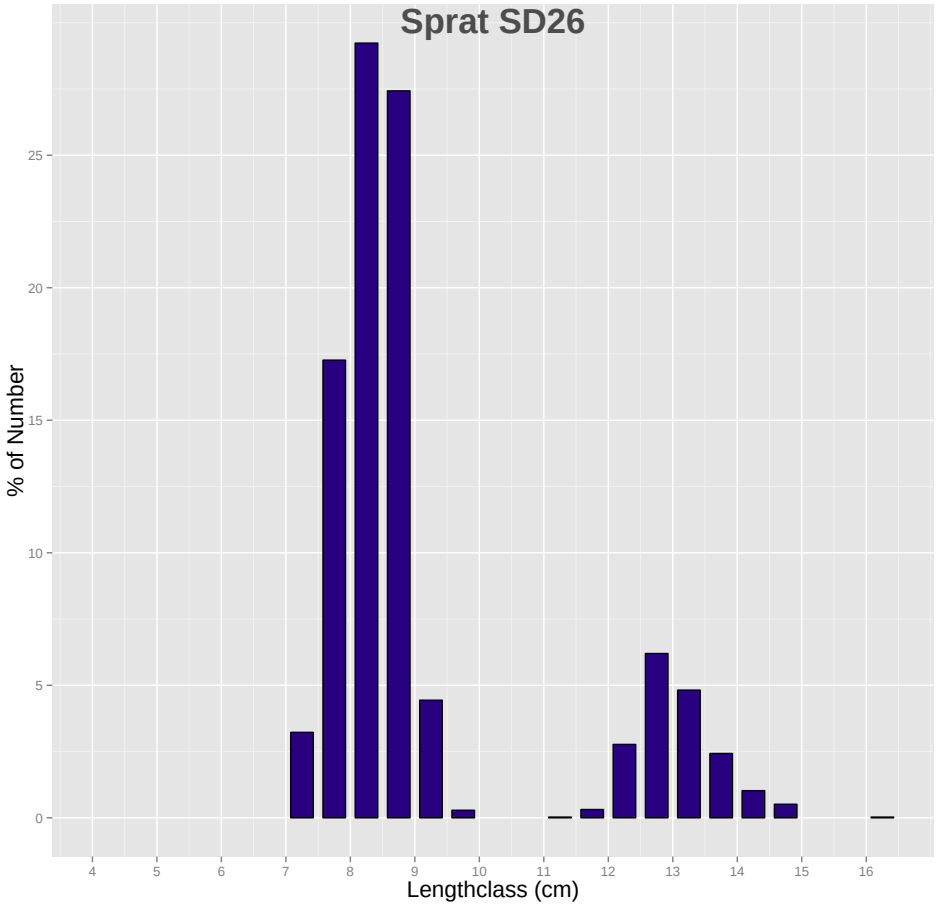

Figure 4: Length distribution of sprat

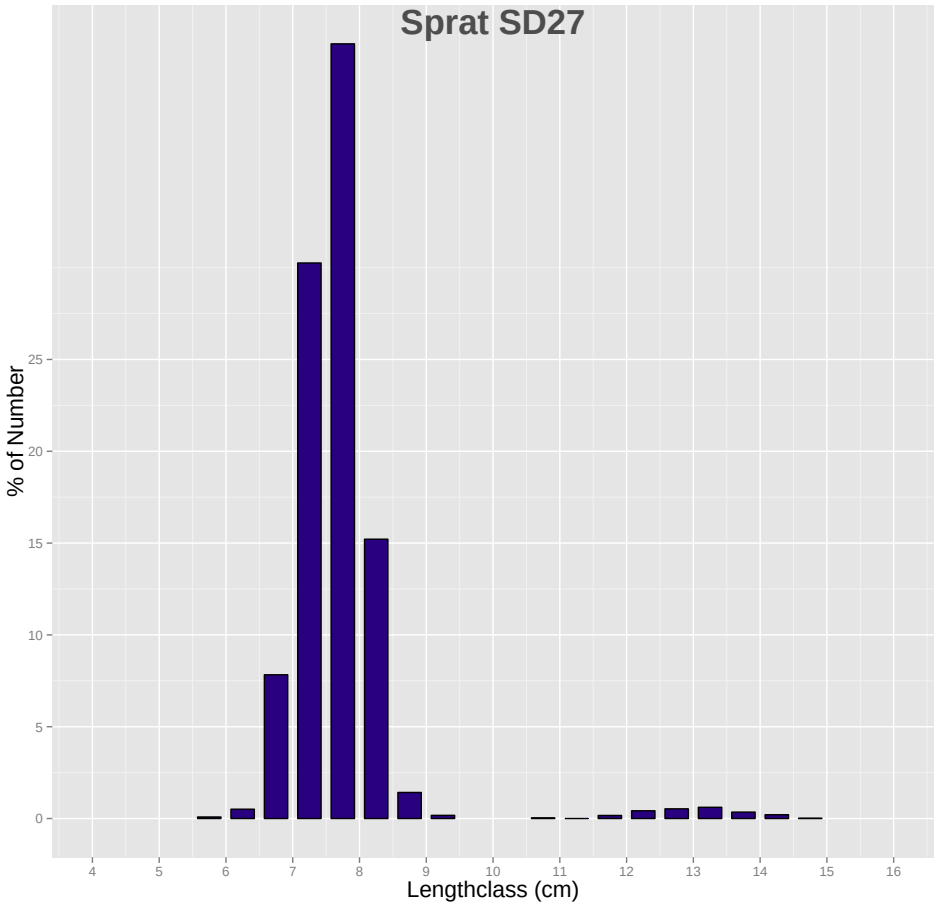

Figure 5: Length distribution of sprat

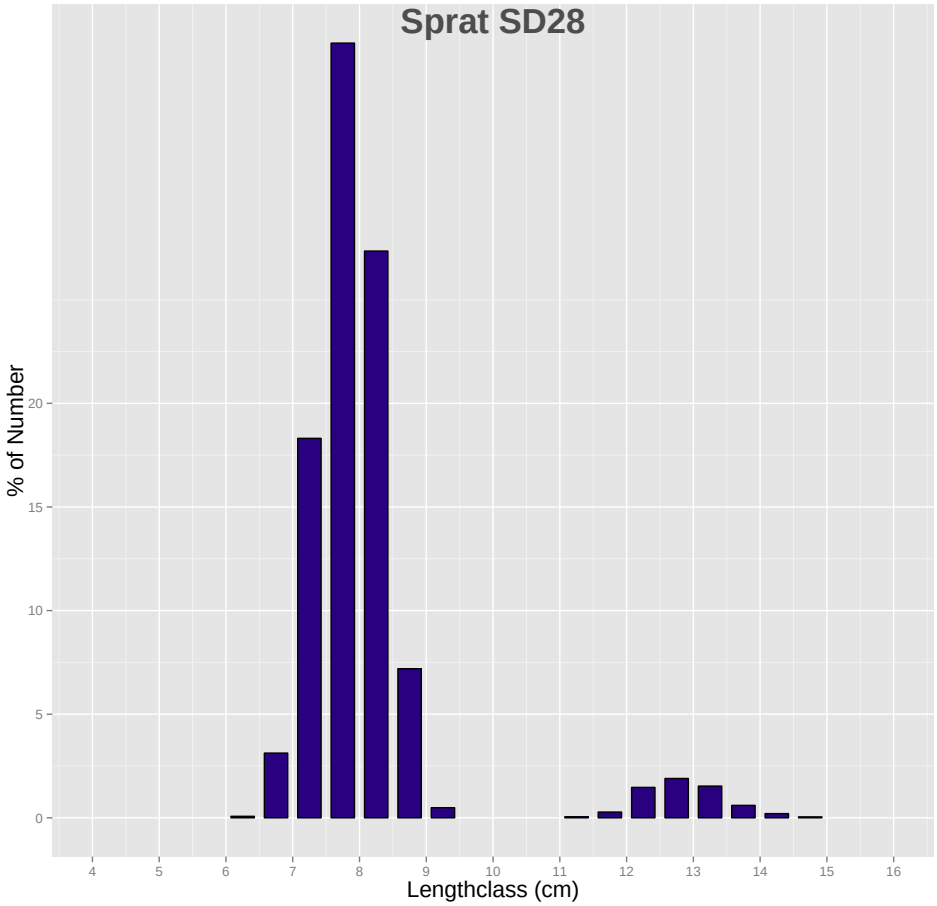

Figure 6: Length distribution of sprat

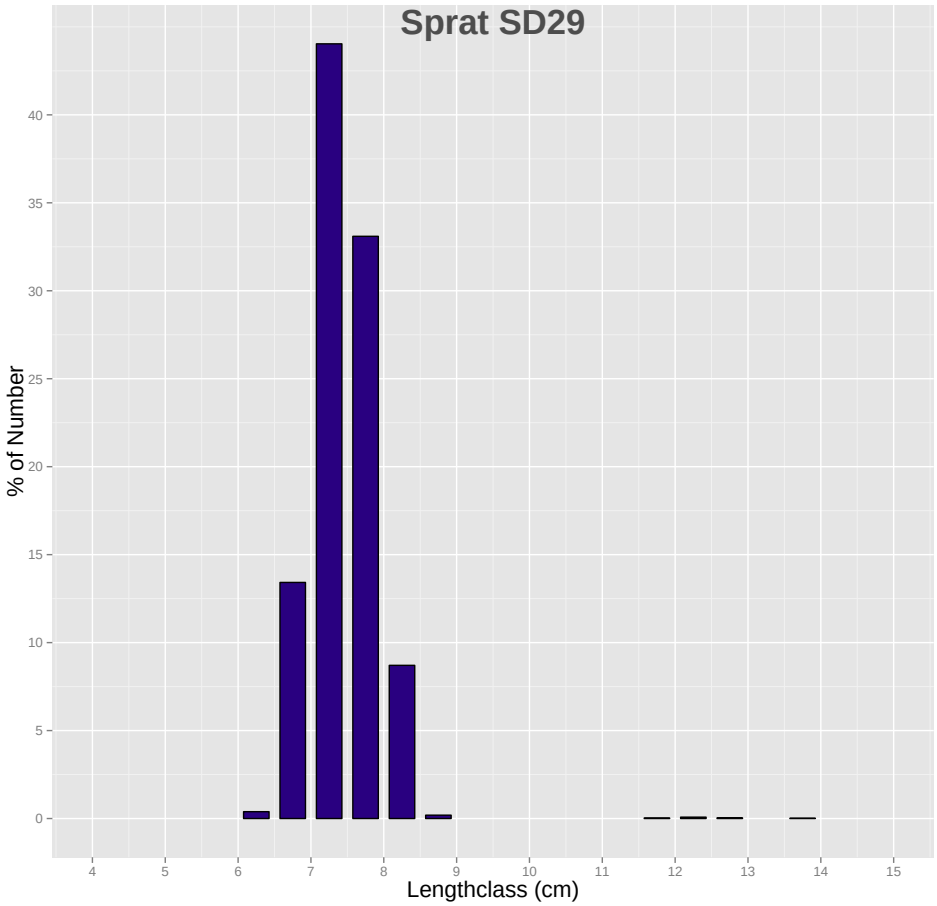

Figure 7: Length distribution of sprat

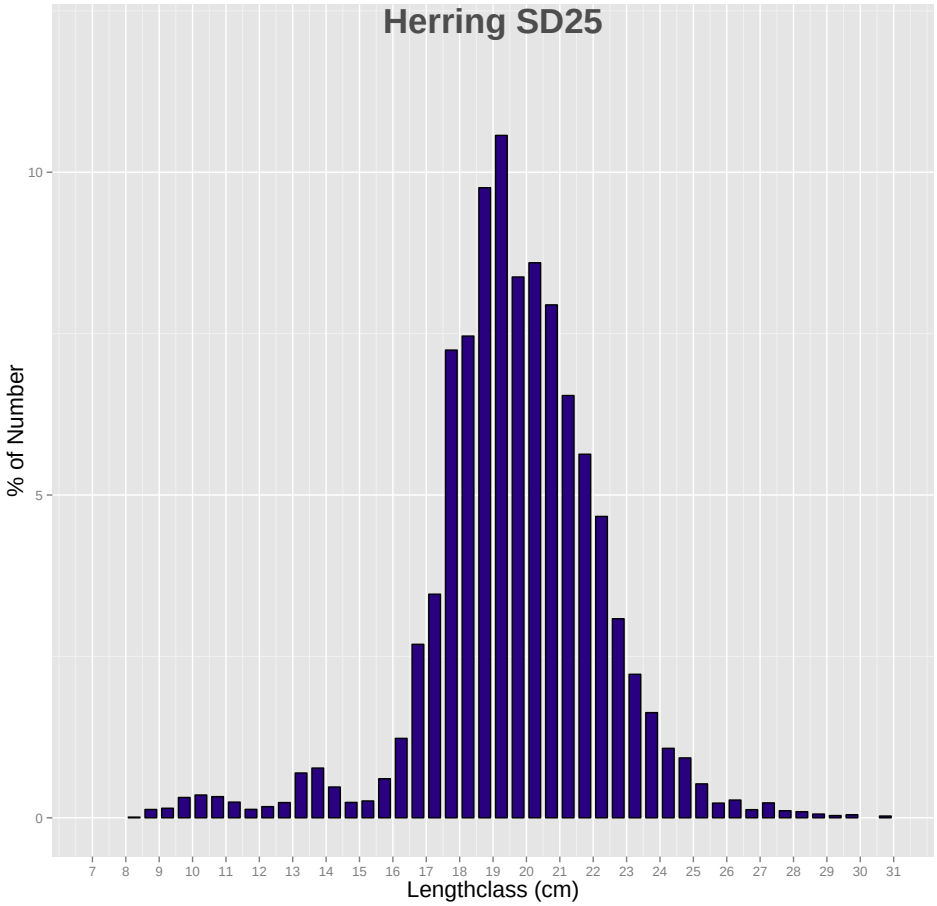

Figure 8: Length distribution of herring

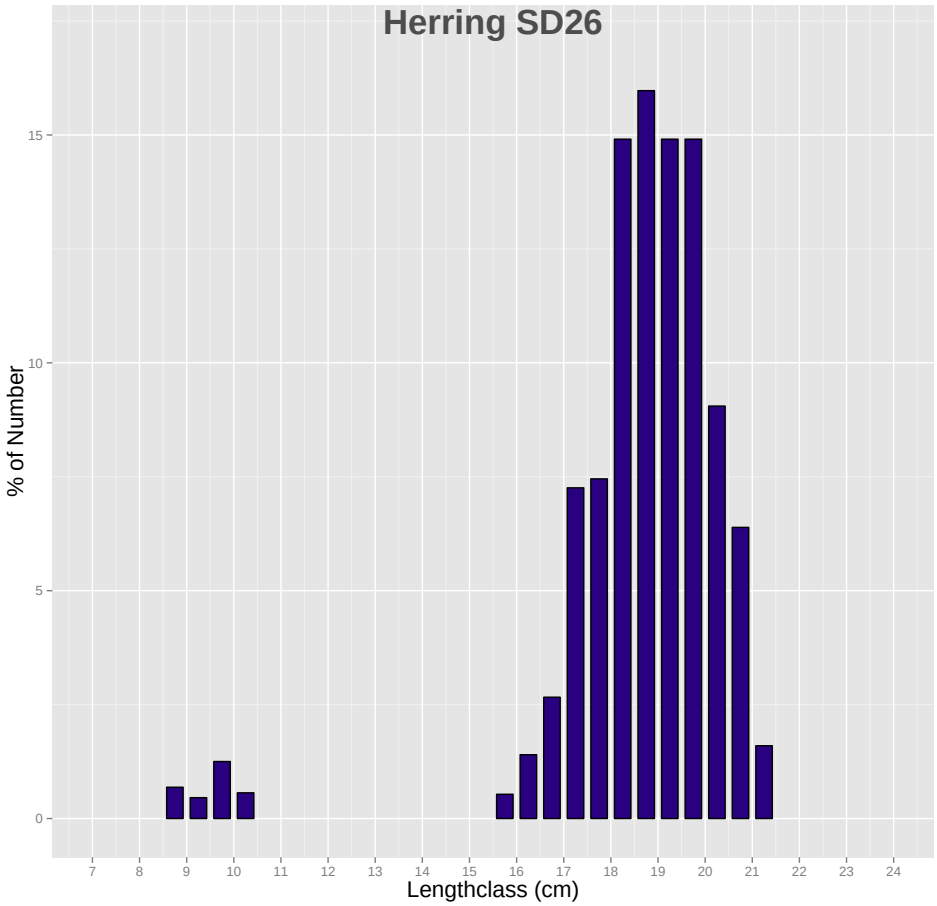

Figure 9: Length distribution of herring

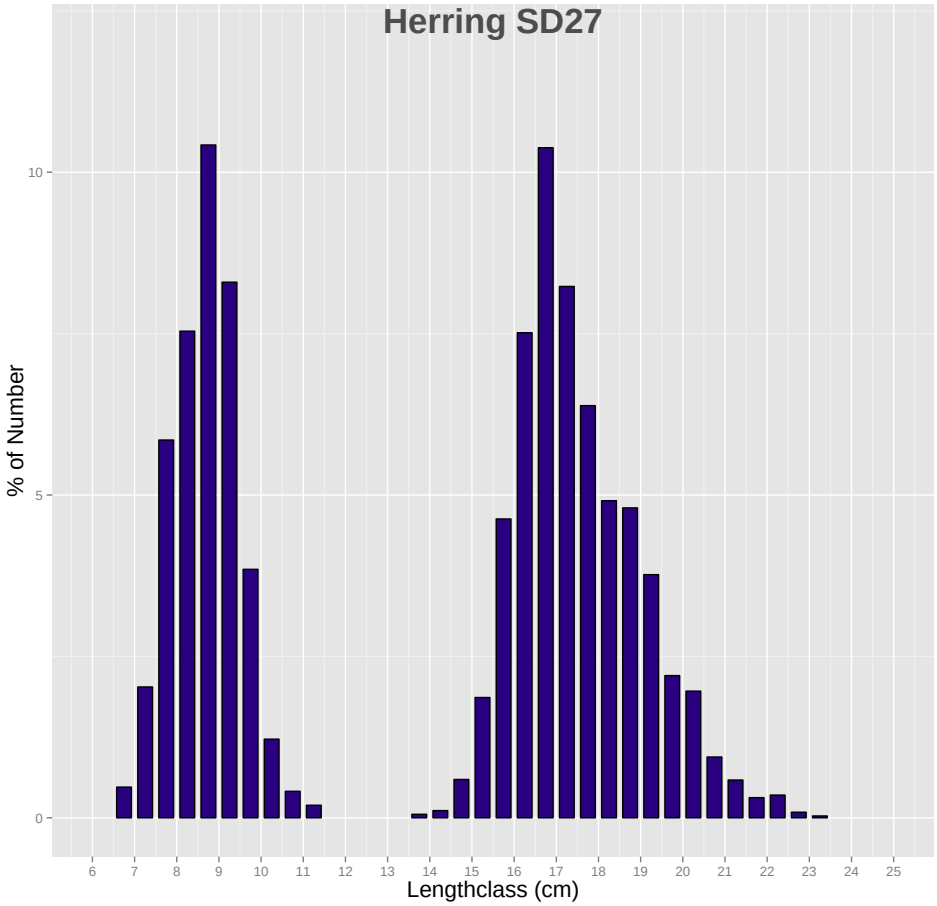

Figure 10: Length distribution of herring

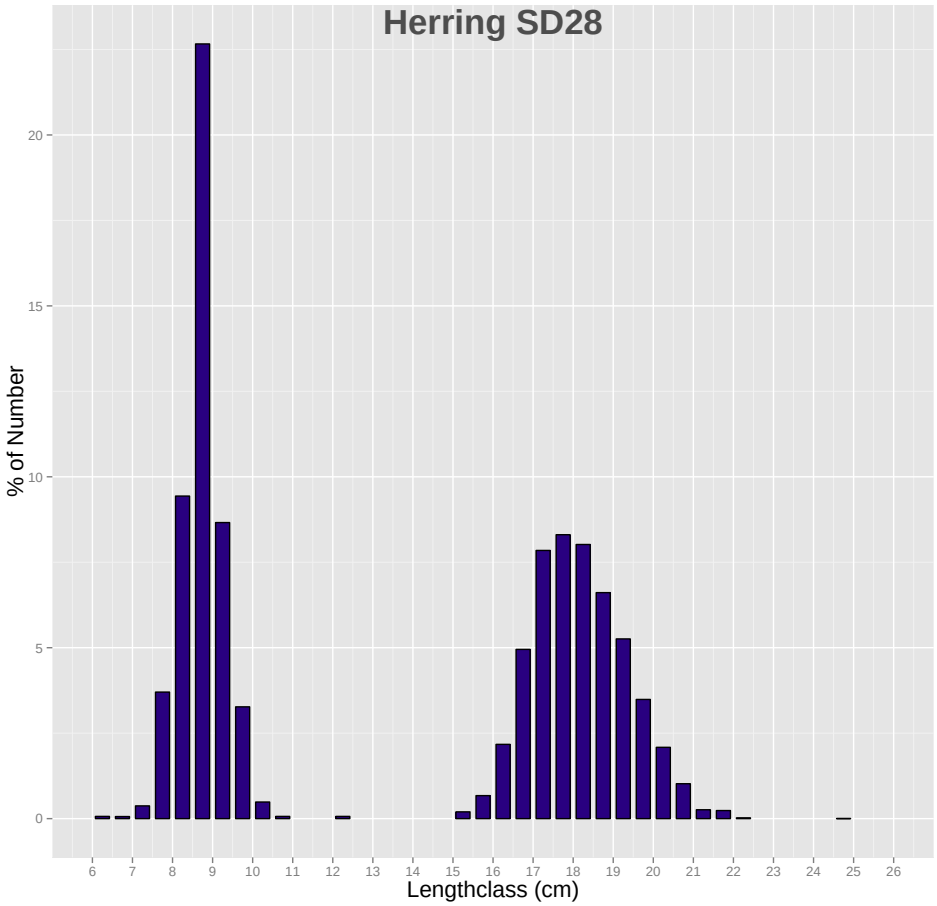

Figure 11: Length distribution of herring

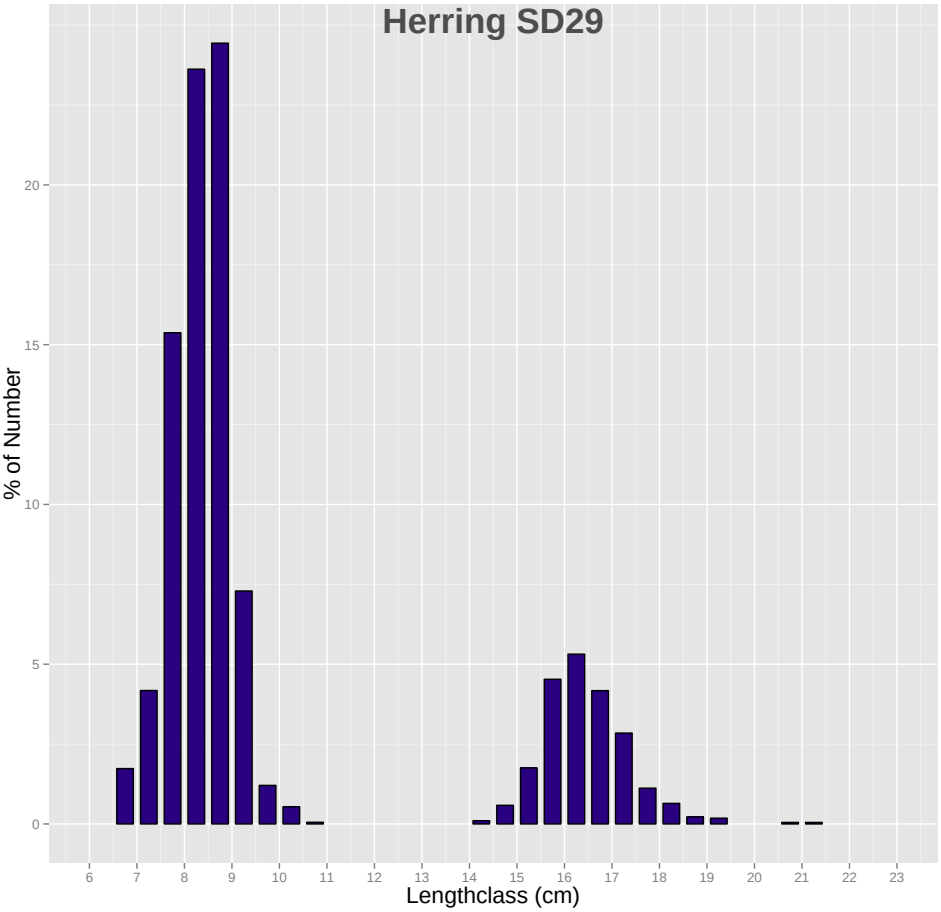

Figure 12: Length distribution of herring