Aqua notes 2024:29

Baltic International Acoustic Survey Report, R/V Svea, Sweden

Survey 2022-10-02 - 2022-10-17

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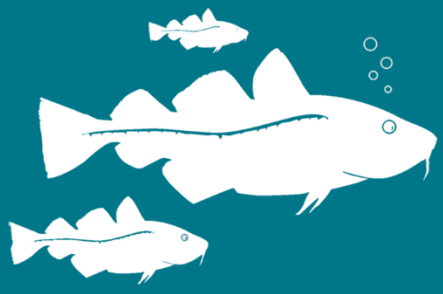

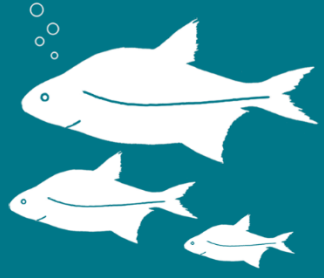

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Summary

Internationally coordinated hydroacoustic surveys in the Baltic Sea have been operated by the Institute of Marine Research in Lysekil since 1978. The Baltic International Acoustic Survey (BIAS), is performed annually in October. The survey is mandatory for each EU member state around the Baltic Sea, and is regulated under the European Commission's Data Collection Framework (DCF). Sweden is responsible for collecting data from subdivision (SD) 27 as well as parts of SD 25, 26, 28, and 29. The purpose of the expedition is to assess the stock status of herring and sprat, and this is done by producing an index of abundance each year. The results are reported annually to the International Council for the Exploration of the Sea (ICES) working groups Baltic International Fish Survey (WGBIFS) and the Baltic Fisheries Assessment (WGBFAS).

The 2022 survey was carried out with R/V Svea and commenced with echo sounder calibration on October 2, in Gåsfjärden (57°34.5 N, 16°35.0 E), after which the vessel headed eastward to SD 27 where the data collection started. The survey finished on October 17, in Kalmar (56°40.0 N, 16° 21.0 E). Through the survey, acoustic raw data was continuously collected using a scientific echo sounder (EK80 38 kHz). Biological data was collected through pelagic trawling to obtain information on species composition and length distribution. Acoustic raw data were post-processed using the Large Scale Survey System (LSSS) software. The trawl catches are analyzed for species composition and length distribution, and the target species herring, sprat, and cod were also analyzed to determine the age structure of each stock. The information on species and lengths from the trawl catches was integrated with the acoustic data to calculate an index of abundance of the fish species.

Guidelines and manuals are managed by WGBIFS and results from each country are compiled into a database. The results are used as an index of abundance by WGBFAS in the estimation of the total stock status of herring and sprat in the Baltic Sea. The results for BIAS were accepted by the WGBIFS and added to the index. Previous results and more information about BIAS and WGBIFS work can be found in the annual reports of the WGBIFS working group.

Sammanfattning

Internationellt koordinerade hydroakustiska expeditioner i Östersjön har regelbundet genomförts av Havsfiskelaboratoriet i Lysekil sedan 1978. Baltic International Acoustic Survey (BIAS), som utförs varje år i oktober, regleras under Europeiska Kommissionens Data Collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för datainsamlingen i subdivision (SD) 27 samt delar av SD 25, 26, 28 samt 29. Syftet med expeditionen är att ta fram underlag för bedömning av beståndsstatus för sill och skarpsill. Resultaten rapporteras årligen till Havsforskningsrådets (International Council for the Exploration of the Sea, ICES) arbetsgrupper Baltic International Fish Survey (WGBIFS) och Baltic Fisheries Assessment (WGBFAS).

Expeditionen 2022 genomfördes med R/V Svea och inleddes med kalibrering av ekolod 2022-10-02 i Gåsfjärden (57°34.5 N, 16°35.0 O) och därefter tog sig fartyget österut till SD 27 där datainsamlingen startade. Expeditionen avslutades 2022-10-17 i Kalmar (56°40.0N, 16°21.0 O). Under expeditionen samlades akustiska rådata in med ett vetenskapligt ekolod (Simrad EK80 38kHz) och biologiska data med hjälp av pelagisk trålning för information om art och längfördelning. Akustiska rådata efterbehandlas i programvaran Large Scale Survey System (LSSS). Trålfångsterna analyseras avseende artsammansättning och längdfördelning, målarterna sill, och skarpsill provtogs även för åldersbestämning för att ta fram åldersstruktur för respektive bestånd. Informationen om arter och längder från trålfångsterna integrerades med akustiska data för att räkna fram ett index för biomassan av fiskarterna.

WGBIFS har tagit fram gemensamma riktlinjer och manualer för deltagarna i BIAS och resultaten från varje land sammanställs i en gemensam databas. Resultaten utgör underlag för WGBFAS uppskattning de totala bestånden av sill respektive skarpsill i Östersjön. Resultatet från 2022 års BIAS har godkänts och förts in i WGBIFS gemensamma databas. Tidigare års resultat samt mer information kring BIAS och WGBIFS arbete finns i WGBIFS arbetsgruppens årliga rapporter.

Innehållsförteckning

1. Introduction

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978. The starting point was the cooperation between the Institute of Marine Research (IMR) in Lysekil, Sweden, and the Institut für Hochseefisherei und Fishverarbeitung in Rostock, German Democratic Republic, in October 1978, which produced the first acoustic estimates of the 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 in the Baltic Sea and results have been reported to the International Council for the Exploration of the Sea (ICES).

The Baltic International Acoustic Survey (BIAS), is mandatory for the countries that have Exclusive Economic Zone (EEZ) in the Baltic Sea, and is part of the Data Collection Framework (DCF) as stipulated by the European Council and the Commission (European Council, 2017) and the Commission Data Collection Framework (The Commission, 2021).

The IMR in Lysekil is part of the Department of Aquatic Resources at the Swedish University of Agricultural Sciences and responsible for the Swedish part of the DCF and surveys in the marine environment. The IMR assesses the status of the commercially used fish stocks and the marine ecosystems, develops and provides biological advice for the sustainable use of the aquatic resources.

The BIAS survey is coordinated and managed by the ICES working group for the Baltic International Fish Survey (WGBIFS). The main objective of BIAS is to assess herring and sprat abundance in the Baltic Sea. The survey provides data to the ICES working group Baltic Fisheries Assessment (WGBFAS).

2. Methods

2.1. Narrative

The survey was carried out using the Fisheries Research Vessel, Svea that that has been used for this survey since 2019. The total cruise covered subdivision (SD) 27 and parts of SDs 25, 26, 28 and 29 (Figure 1). The calibration of the SIMRAD EK80 echo sounder was performed in Gåsfjärden (57°34.5 N, 16°35.0 E) on the Swedish east coast. The survey started 2022-10-02 east of Gåsfjärden, and ended 2022-10-17, between mainland Sweden and Öland, close to Kalmar (Figure 2).

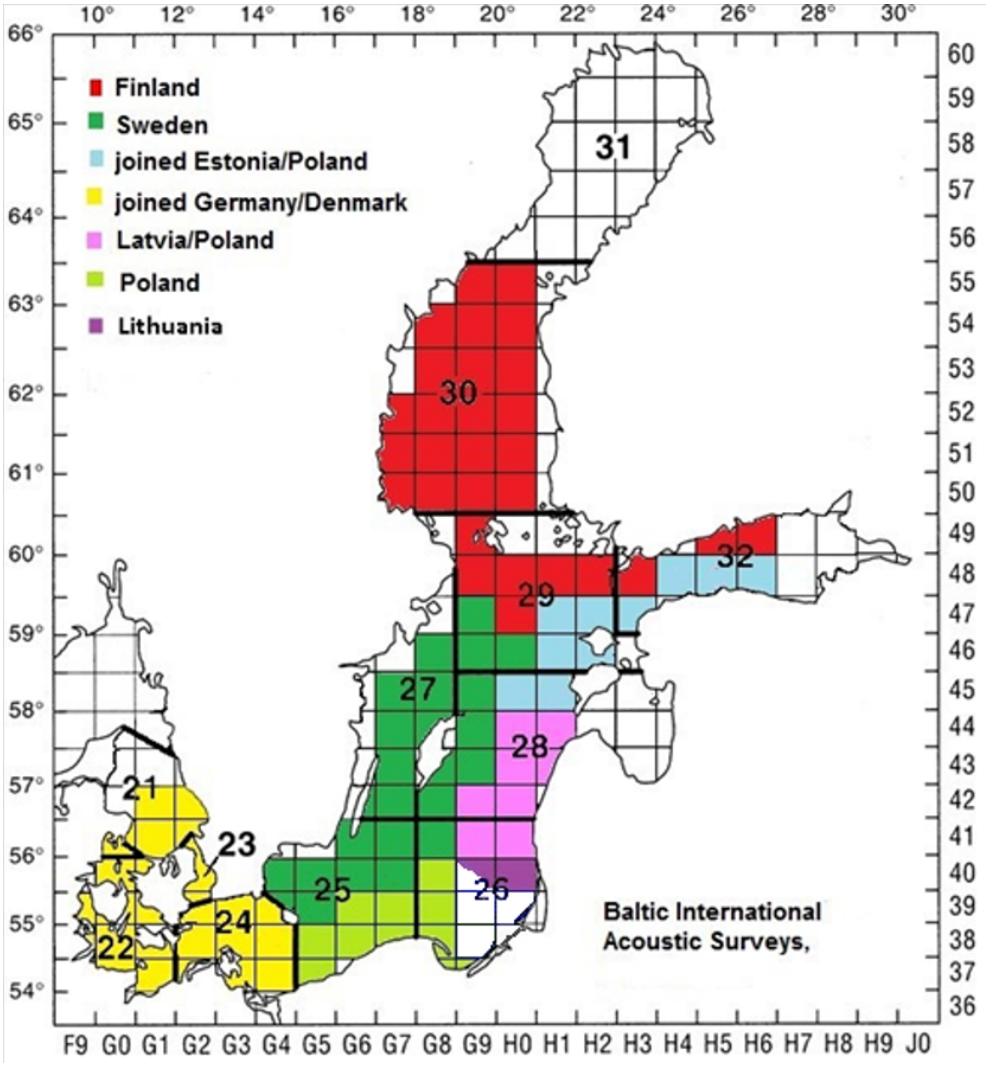


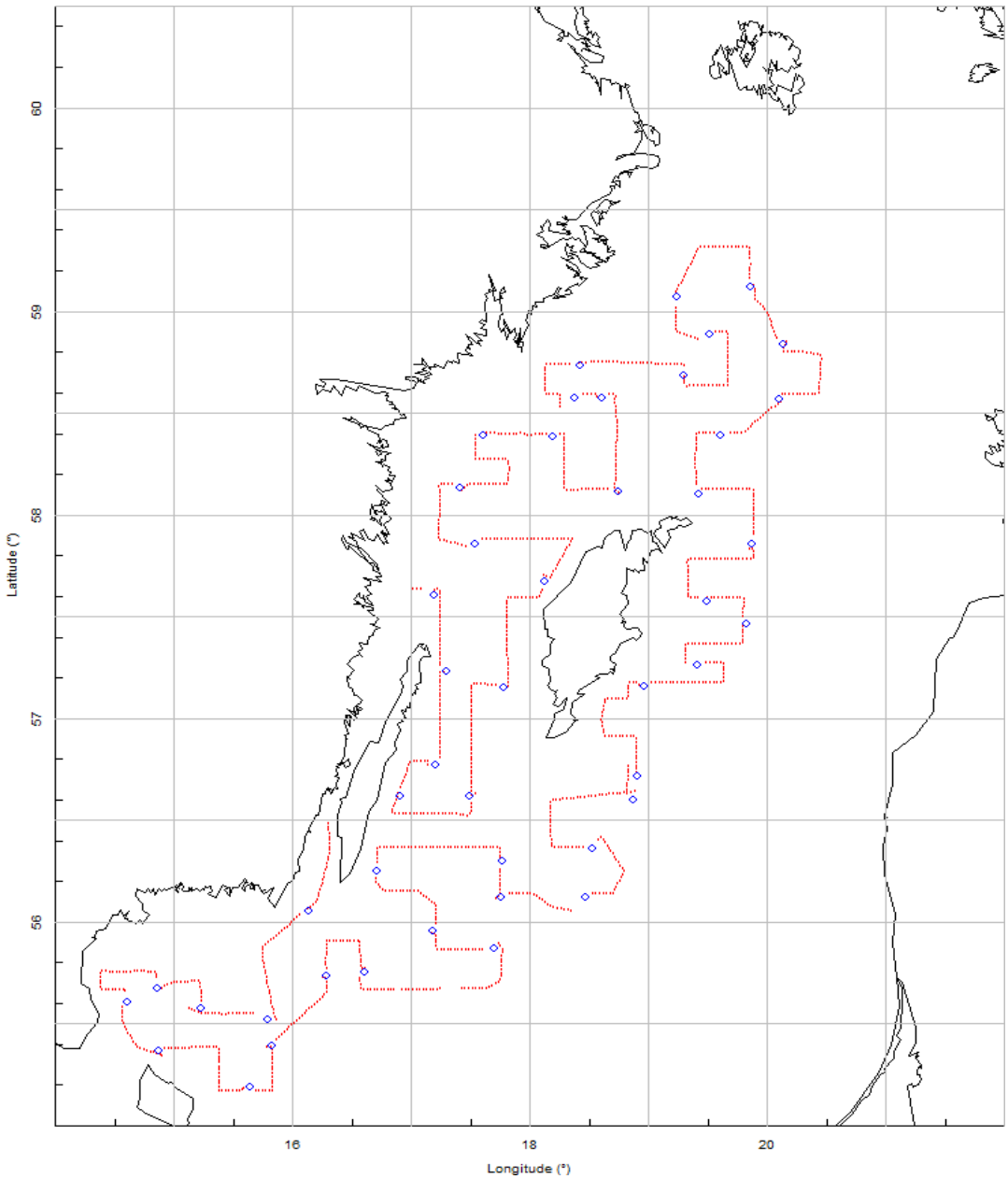
Figure 1. Allocation of ICES squares to each country in the BIAS survey 2022 (On axes: longitude, latitude and ICES name of square eg: 41G8).

2.2. Survey design

The survey design is based on ICES statistical rectangles (0.5 degrees in latitude and 1 degree in longitude; Figure 1). The 10 m depth line (ICES, 2017) limits the areas of all strata. The aim (ICES, 2017) is to use parallel transects spaced out 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. Due to the irregular shape of the survey area assigned to Sweden and occasional bad weather conditions during surveys the design may in parts be difficult to fulfill. The total area covered in 2022 was 20832 square nautical miles and the distance used for acoustic estimates was 1301 nautical miles. The cruise track and positions of trawl hauls are shown in Figure 2.

2.3. Calibration

The SIMRAD EK80 echo sounder with the 38 kHz transducer was calibrated in Gåsfjärden 2022-10-02, according to manuals (ICES, 2017; Demer *et al.*, 2015). Values from the calibration were within required accuracy.



Figur 2. Cruise track (red), positions of trawl hauls (blue) and survey grid of ICES squares (grey) for BIAS 2022.

2.4. Acoustic data collection and processing

The acoustic data sampling was performed around the clock. SIMRAD EK80 (simrad.com/ek80) echo sounder with the 38 kHz transducer mounted on a drop keel was used for the acoustic data collection. The hydroacoustic equipment was set in accordance with the IBAS manual (ICES, 2017). The post processing of the stored raw data was made using the software LSSS (Large Scale Survey System, marec.no/products.htm). The mean volume back scattering values (Sv) were integrated over 1 nautical mile (elementary distance sampling units, EDSUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and irrelevant scattering were removed.

2.5. Data analysis

The data analysis was carried out according to ICES 2017. The pelagic target species sprat and herring are usually distributed in mixed layers together with other species so that it was impossible to allocate the acoustic integrator readings to a single species. Therefore the species composition was based on the catch results from the executed hauls. For each rectangle the species composition and length distribution were determined as the unweighted mean of all trawl results in this rectangle. From these data, the mean acoustic cross-section was calculated according to the target strength (TS) relationships (Table 1).

The total number of fish (total N) in one rectangle was estimated as the product of the nautical area scattering coefficient sA and the rectangle area, divided by the corresponding backscattering cross section σ_{bs}. The total number was separated into different fish species according to the mean catch composition in the rectangle.

Tabell 1. Target strength (TS) relationships.

Clupeids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)
Fish without swim bladder	TS = 20 log L (cm) - 84.9	(ICES, 2017)
Stickleback and salmonids	TS = 20 log L (cm) - 71.2	(ICES, 2017)

2.6. Hydrographic data

CTD (Conductivity, Temperature, Depth) 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 the stations.

2.7. Personnel

The participating scientific crew are listed in Table 2.

Table 2. Participating scientific crew.

Björklund, Emilia	IMR, Lysekil	Fish sampling
Jernberg, Carina	IMR, Lysekil	Fish sampling
Larson, Niklas	IMR, Lysekil	Scientific & Exp. leader, Acoustics
Nilsson, Hans	IMR, Lysekil	Acoustics
Andersson, Linda	IMR, Lysekil	Fish sampling
Svenson, Anders	IMR, Lysekil	Acoustics
Risberg, Ronja	IMR, Lysekil	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

3. Results

3.1. Biological data

In total 54 trawl hauls were carried out, 16 hauls in SD 25, 2 in SD 26, 19 in SD 27, 9 in SD 28 and 8 in SD 29. In total 1659 herring and 1250 sprat were sampled for age analyses. Length distributions by ICES subdivision are shown for sprat in Figures 3-7 and for herring in Figures 8 to 12.

3.2. Acoustic data

The survey statistics concerning the survey area [NM^2], the mean nautical area scattering coefficient (SA[m^2/NM^2]), the mean backscattering cross section (SIGMA[cm^2]), the estimated total number of fish (NTOT[10^6]), the percentages of herring (Hher[%]), sprat (HSpr[%]) and cod (HCod[%]) per SD/rectangle are shown in Table 3.

3.3. Abundance estimates

The estimated 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.

4. Discussion

This year was the fourth year that R/V Svea was used for BIAS. The overall evaluation determined that the survey was accomplished as planned. Some bad weather occurred and thus the planned survey track had to be changed in some parts according to the situation. The data collected during the survey was reviewed and accepted at the WGBIFS meeting and was considered representative for the index of abundance of the pelagic species in 2022 for the covered area (Figure 2). For further information regarding the procedures of WGBIFS see the WGBIFS report (ICES, 2021).

5. Acknowledgements

Special thanks to the participating personnel from the Institute of Marine Research, Department of Aquatic Resources, at the Swedish University of Agricultural Sciences for their invaluable competence and dedication to quality data collection during the BIAS survey. We are also grateful to the crew of R/V Svea for their assistance. This survey is funded by the Swedish Agency for Marine and Water Management, ID: SLU.aqua.2023.5.4-408. Additionally, we extend our appreciation to Thomas Axenrot and Yvette Heimbrand from the Swedish University of Agricultural Sciences, Department of Aquatic Resources, for their insightful reviews, which contributed to enhancing the quality of this work.

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Tables and figures

Table 3. Survey statistics, see chapter 3.2 for more information.

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	206.2	3.096	191.34	61.99	27.26	9.517
25	39G5	979.0	116.1	2.419	469.81	45.38	53.38	0.946
25	40G4	677.2	427.9	2.660	1089.65	52.45	46.08	0.002
25	40G5	1012.9	136.9	2.095	661.70	32.89	65.81	0.238
25	40G6	1013.0	334.1	2.451	1381.22	68.17	25.60	1.305
25	40G7	1013.0	204.9	1.716	1209.40	30.19	48.60	0.109
25	41G6	764.4	508.1	1.428	2719.32	31.09	36.35	0.058
25	41G7	1000.0	360.4	0.840	4289.16	0.16	39.00	0.000
26	41G8	1000.0	275.6	0.577	4777.35	5.52	4.19	0.005
27	42G6	266.0	616.4	1.123	1459.87	12.49	41.59	0.000
27	42G7	986.9	318.7	0.917	3428.17	7.37	35.16	0.000
27	43G7	913.8	348.0	0.747	4255.13	0.84	37.73	0.000
27	44G7	960.5	367.3	0.513	6874.82	6.23	3.93	0.000
27	44G8	456.6	416.8	0.503	3784.52	4.52	6.79	0.000
27	45G7	908.7	171.9	1.128	1384.75	37.47	13.36	0.018
27	45G8	947.2	427.1	1.077	3756.97	17.44	42.99	0.014
27	46G8	884.8	256.1	0.928	2440.53	24.48	49.47	0.000
28	42G8	945.4	741.5	0.400	17513.06	0.51	0.61	0.000
28	43G8	296.2	366.4	1.915	566.64	67.83	5.34	0.096
28	43G9	973.7	458.4	0.992	4501.66	1.69	74.78	0.000
28	44G9	876.6	752.5	0.464	14222.91	2.94	2.88	0.002
28	45G9	924.5	582.3	0.566	9509.97	19.49	8.85	0.000
29	46G9	933.8	529.1	1.420	3479.73	42.33	33.62	0.004
29	46H0	933.8	372.1	0.790	4399.84	36.37	12.08	0.003
29	47G9	876.2	752.9	1.302	5065.12	68.48	15.30	0.000

Table 4. Estimated number (millions) of sprat per age group and area (Number sprat two year old (NS2)).

SD	RECT	NSTOT	NS0	NS1	NS2	NS3	NS4	NS5	NS6	NS7	NS8+
25	39G4	52	0	2	3	13	12	11	6	0	5
25	39G5	251	0	5	0	81	46	33	46	2	37
25	40G4	502	3	12	31	126	52	129	64	15	71
25	40G5	435	1	5	53	134	94	72	28	2	46
25	40G6	354	0	2	3	41	81	48	19	62	98
25	40G7	588	0	53	89	196	157	23	8	10	52
25	41G6	988	37	281	167	349	40	73	33	2	7
25	41G7	1673	30	157	185	712	184	150	146	7	101
26	41G8	200	0	22	52	82	24	10	10	1	1
27	42G6	607	14	69	148	289	14	45	5	20	4
27	42G7	1205	84	82	158	259	457	29	9	30	98
28	42G8	106	3	0	20	30	17	24	2	6	2
27	43G7	1605	167	198	590	462	69	94	0	11	14
28	43G8	30	16	0	5	6	2	0	0	0	0
28	43G9	3367	1138	169	1120	570	22	125	63	43	116
27	44G7	270	37	67	46	105	3	0	9	1	2
27	44G8	257	11	35	67	45	30	25	16	9	19
28	44G9	409	46	27	48	212	42	23	8	4	0
27	45G7	185	105	8	28	20	6	2	9	4	4
27	45G8	1615	381	16	608	290	132	150	0	2	35
28	45G9	841	402	3	135	166	90	0	30	2	13
27	46G8	1207	1065	33	28	64	10	5	0	0	3
29	46G9	1170	52	9	474	388	174	9	6	6	52
29	46H0	532	138	40	78	185	43	16	11	0	21
29	47G9	775	515	72	63	54	46	2	9	13	2

Table 5. Estimated mean weights (g) of sprat per age group and area (Weight sprat two year old (WS2)).

SD	RECT	WS0	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8+
25	39G4	6	13	16	15	16	17	16	23	18
25	39G5		11		14	14	16	16	18	17
25	40G4	3	12	14	16	19	16	17	12	15
25	40G5	4	9	12	12	15	14	17	18	17
25	40G6		11	11	13	14	14	16	17	15
25	40G7		11	10	12	14	15	16	18	13
25	41G6	4	6	11	13	15	14	14	16	14
25	41G7	6	12	11	13	14	15	15	17	15
26	41G8		12	10	12	12	14	13	19	15
27	42G6	5	11	11	12	13	15	15	14	16
27	42G7	4	11	11	13	13	12	16	15	15
28	42G8	5	6	9	12	13	13	14	14	15
27	43G7	5	8	10	13	14	14		13	15
28	43G8	4		9	11	12	12		16	
28	43G9	4	9	10	11	14	14	12	13	14
27	44G7	5	9	12	12	15		13	14	14
27	44G8	5	9	10	14	14	13	12	13	13
28	44G9	4	9	11	12	12	14	13	15	
27	45G7	4	8	10	11	12	12	12	12	13
27	45G8	5	8	11	12	13	14		15	14
28	45G9	4	8	9	12	11		14	14	12
27	46G8	4	8	9	10	12	13			13
29	46G9	4	8	10	13	14	14	14	15	14
29	46H0	4	9	10	11	13	12	13		13
29	47G9	4	8	10	12	10	14	13	12	15

Table 6. Estimated number (millions) of herring per age group and area (Number herring two year old (NH2)).

SD	RECT	NHTOT	NH0	NH1	NH2	NH3	NH4	NH5	NH6	NH7	NH8+
25	39G4	119	1	5	31	12	26	24	15	1	4
25	39G5	213	0	9	17	29	85	20	28	14	12
25	40G4	572	12	44	46	59	136	59	86	69	61
25	40G5	218	8	13	8	83	50	34	13	4	5
25	40G6	942	5	42	72	82	464	86	133	38	20
25	40G7	365	0	13	20	104	138	47	11	14	17
25	41G6	846	10	17	25	61	362	263	14	47	48
25	41G7	7	2	5	0	0	0	0	0	0	0
26	41G8	264	0	2	19	35	77	56	34	21	20
27	42G6	182	1	9	10	1	87	21	23	21	10
27	42G7	253	1	1	9	63	99	30	24	25	0
28	42G8	89	2	0	3	27	39	11	4	1	1
27	43G7	36	6	5	10	1	10	1	2	0	0
28	43G8	384	0	0	29	160	66	34	39	34	23
28	43G9	76	8	0	1	17	12	26	10	3	0
27	44G7	428	140	39	33	115	65	23	2	9	3
27	44G8	171	37	16	17	27	47	17	5	4	0
28	44G9	419	40	1	39	137	108	45	20	17	11
27	45G7	519	132	33	59	45	120	12	32	85	0
27	45G8	655	114	74	58	104	129	72	55	33	16
28	45G9	1854	1693	13	10	46	40	16	14	12	10
27	46G8	597	232	80	38	16	150	24	21	25	12
29	46G9	1473	419	97	103	438	89	51	75	192	9
29	46H0	1600	1229	14	34	56	108	62	35	57	6
29	47G9	3468	1786	288	340	427	207	153	103	108	55

Table 7. Estimated mean weights (g) of herring per age group and area. (Weight herring two year old (WH2))

SD	RECT	WH0	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8+
25	39G4	11	35	58	53	47	62	47	78	68
25	39G5		30	45	38	42	54	55	53	33
25	40G4	16	24	51	41	40	44	45	43	49
25	40G5	16	21	28	31	49	44	52	52	55
25	40G6	15	29	28	28	34	43	44	56	53
25	40G7		34	33	31	38	39	54	52	56
25	41G6	11	17	20	25	32	34	42	37	41
25	41G7	9	20				92			
26	41G8		20	25	27	28	36	33	41	41
27	42G6	7	24	23	22	30	35	35	33	43
27	42G7	7	17	26	24	29	42	36	36	43
28	42G8	6		25	26	32	34	33	41	45
27	43G7	6	18	25	22	26	39	29		
28	43G8			21	23	29	29	29	33	36
28	43G9	6		20	21	30	26	30	29	
27	44G7	6	17	22	23	29	29	38	33	31
27	44G8	6	19	25	23	27	32	34	37	
28	44G9	6	17	21	23	25	33	31	32	32
27	45G7	6	18	23	25	28	26	35	33	
27	45G8	6	18	23	23	28	32	31	33	29
28	45G9	5	17	22	23	26	26	30	28	35
27	46G8	6	16	20	18	27	25	32	30	37
29	46G9	5	18	20	23	30	33	31	29	60
29	46H0	5	17	20	22	25	27	31	27	37
29	47G9	5	17	21	22	25	30	31	32	31

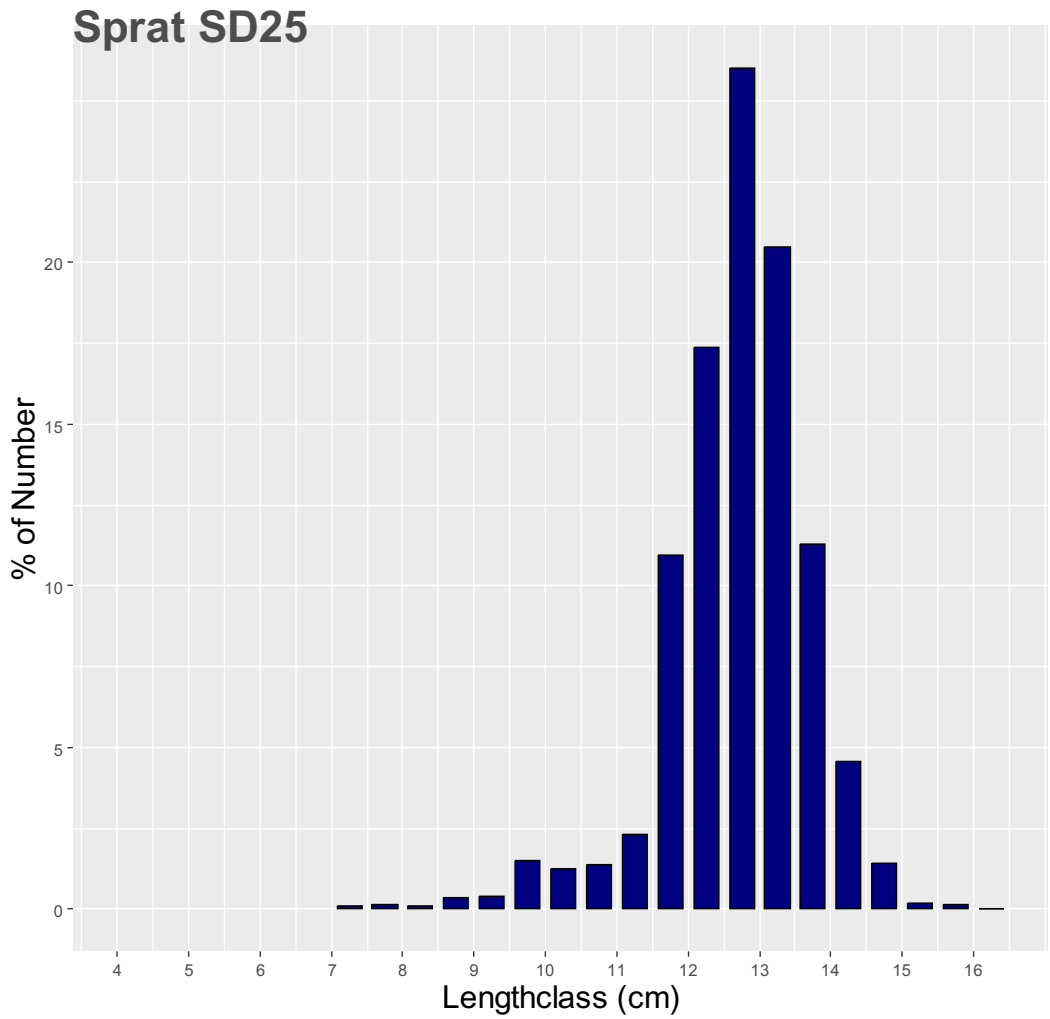

Figure 3. Length distribution of sprat from subdivision 25 for BIAS 2022.

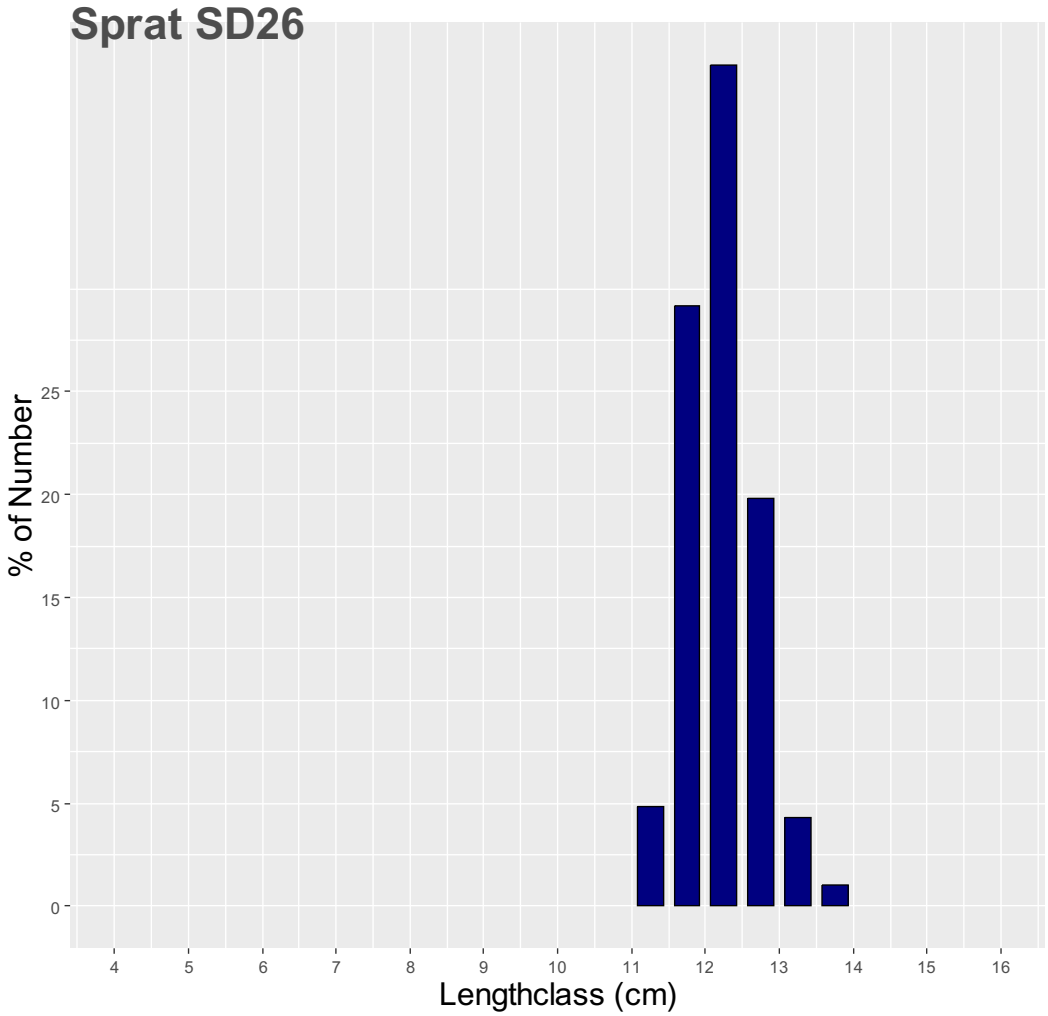

Figure 4. Length distribution of sprat from subdivision 26 for BIAS 2022.

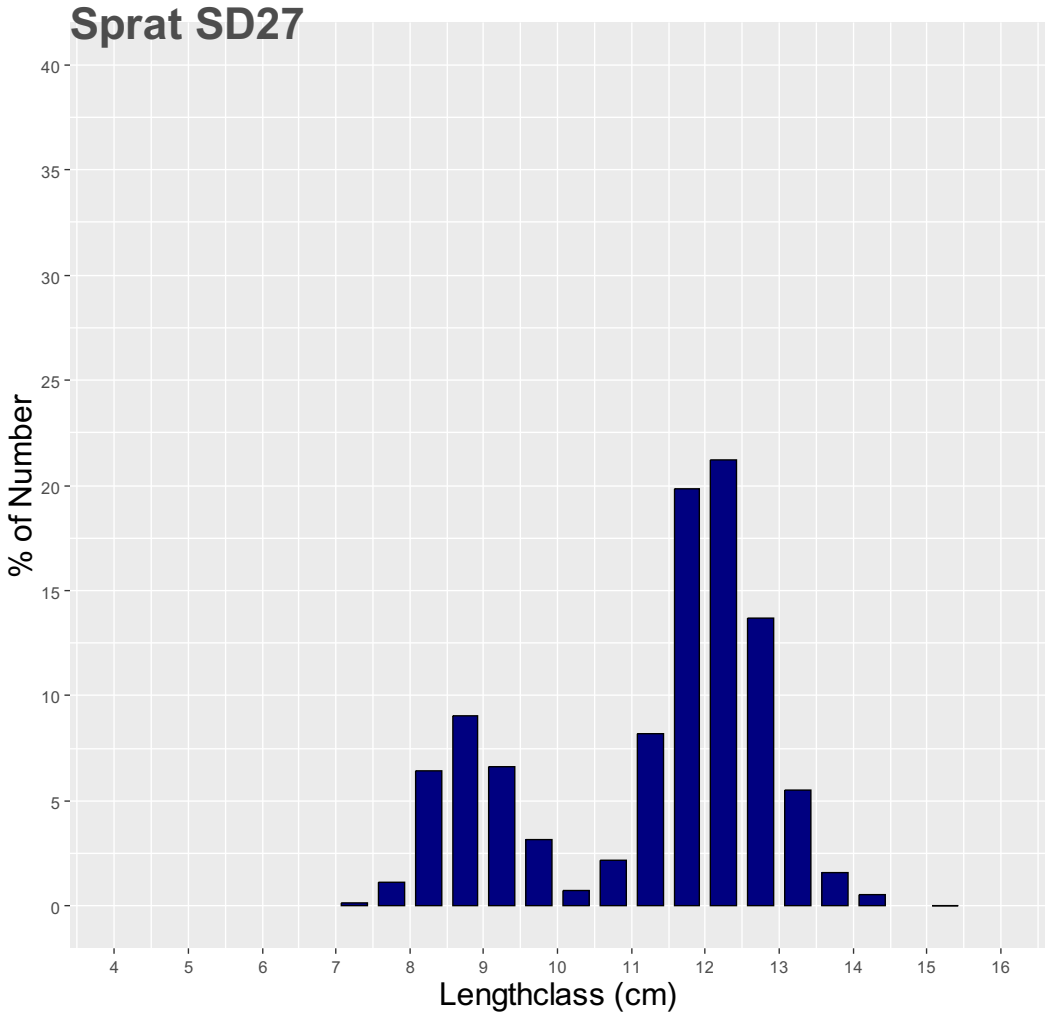

Figure 5. Length distribution of sprat from subdivision 27 for BIAS 2022.

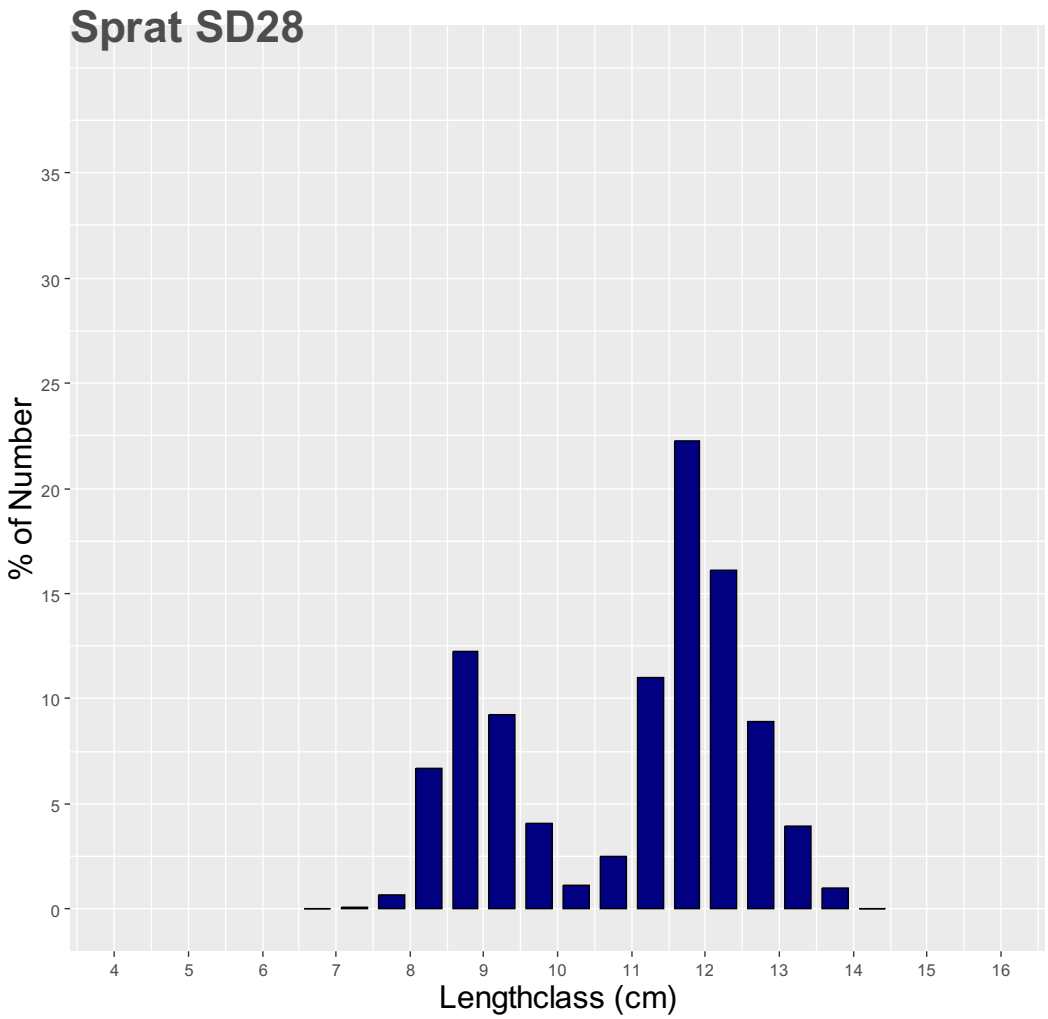

Figure 6. Length distribution of sprat from subdivision 28 for BIAS 2022.

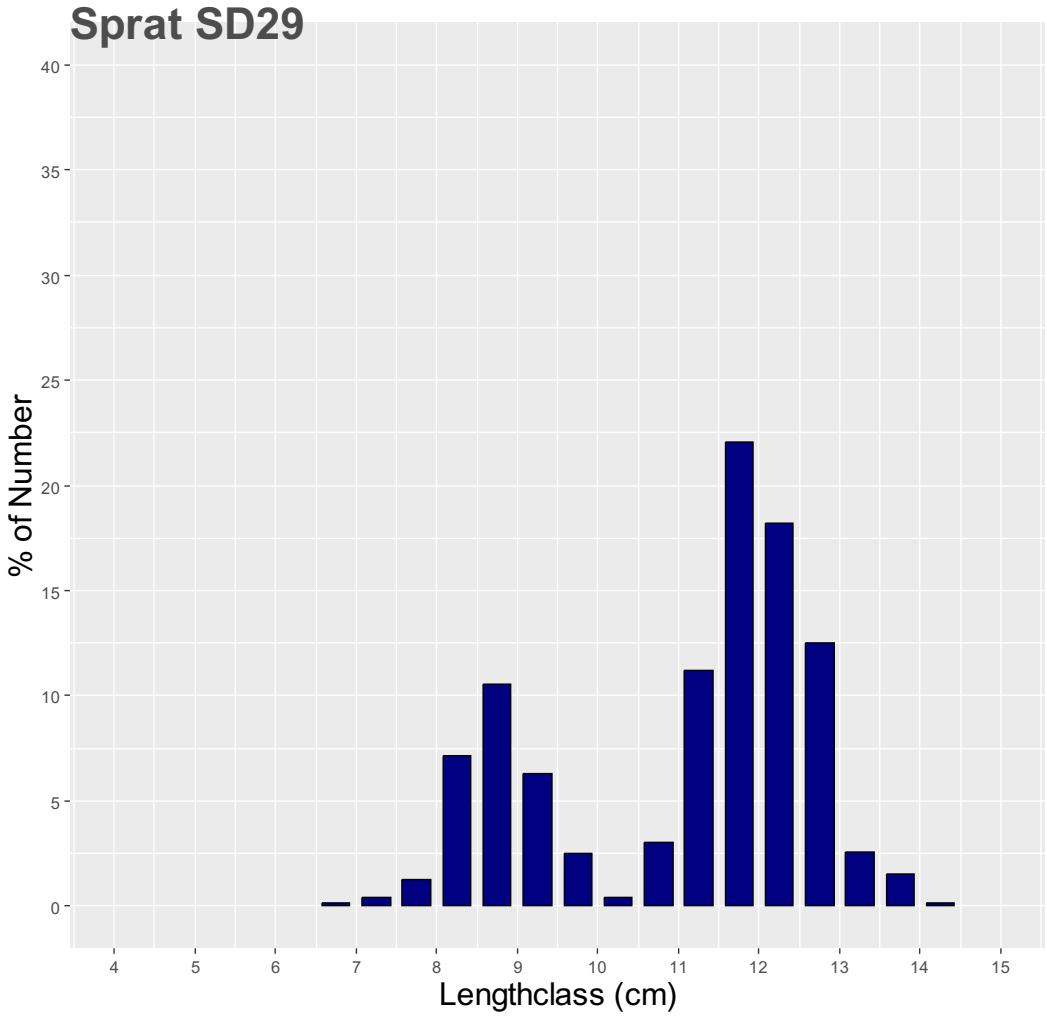

Figure 7. Length distribution of sprat from subdivision 29 for BIAS 2022.

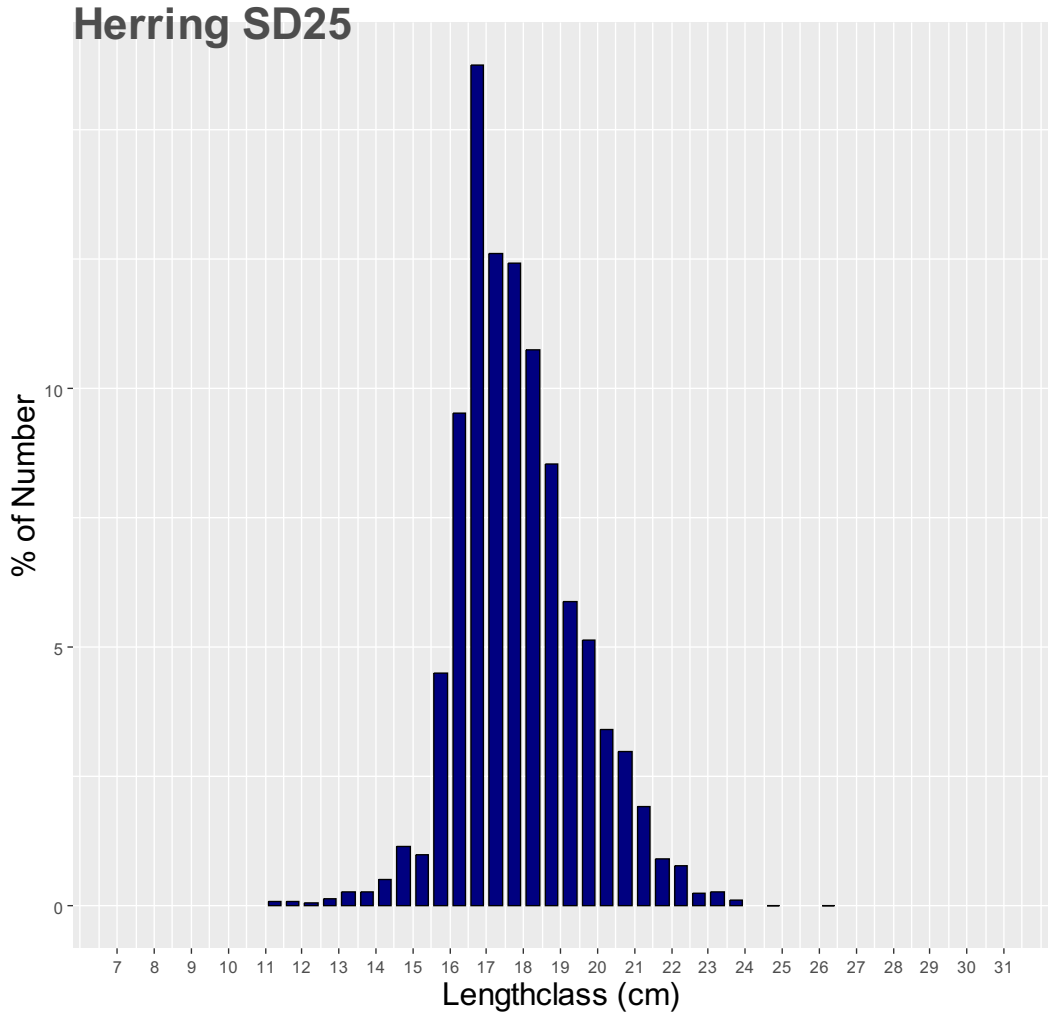

Figure 8. Length distribution of herring from subdivision 25 for BIAS 2022.

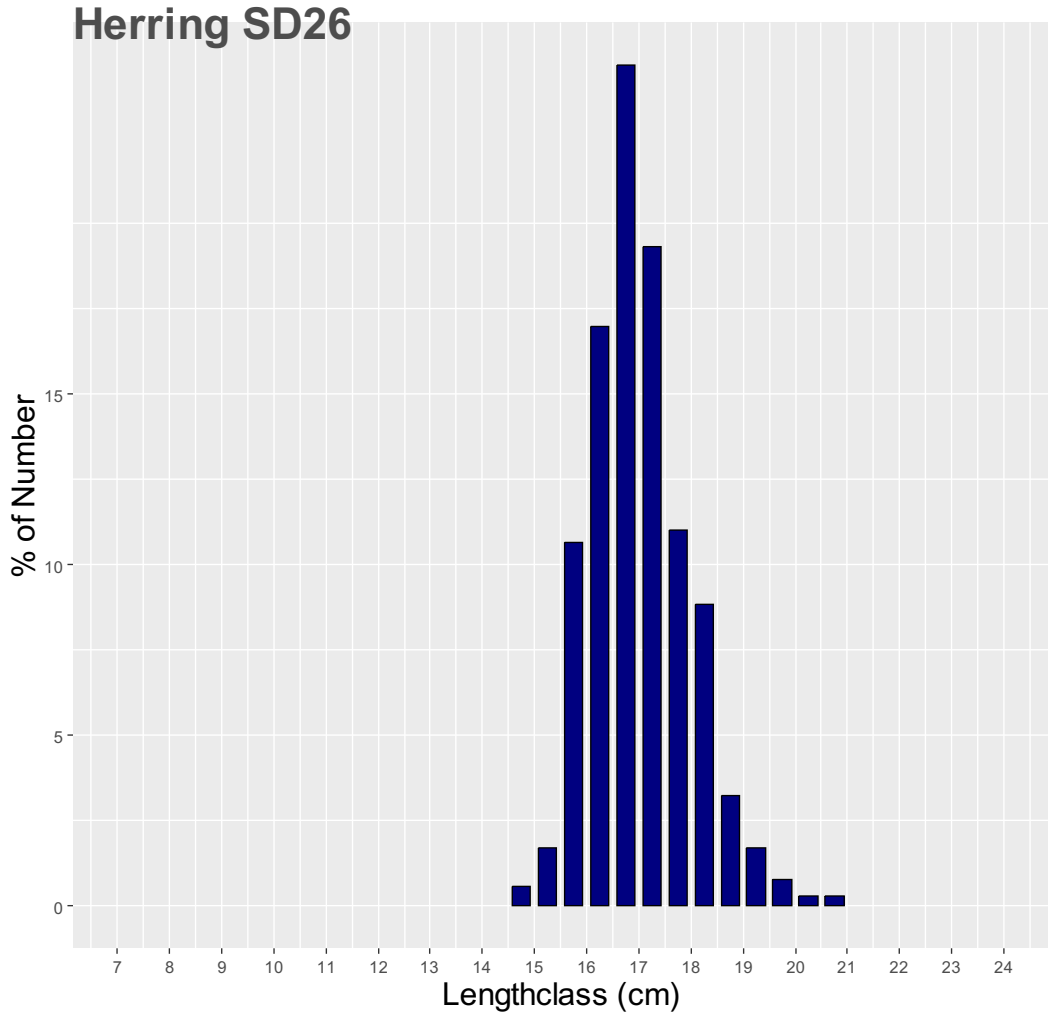

Figure 9. Length distribution of herring from subdivision 26 for BIAS 2022.

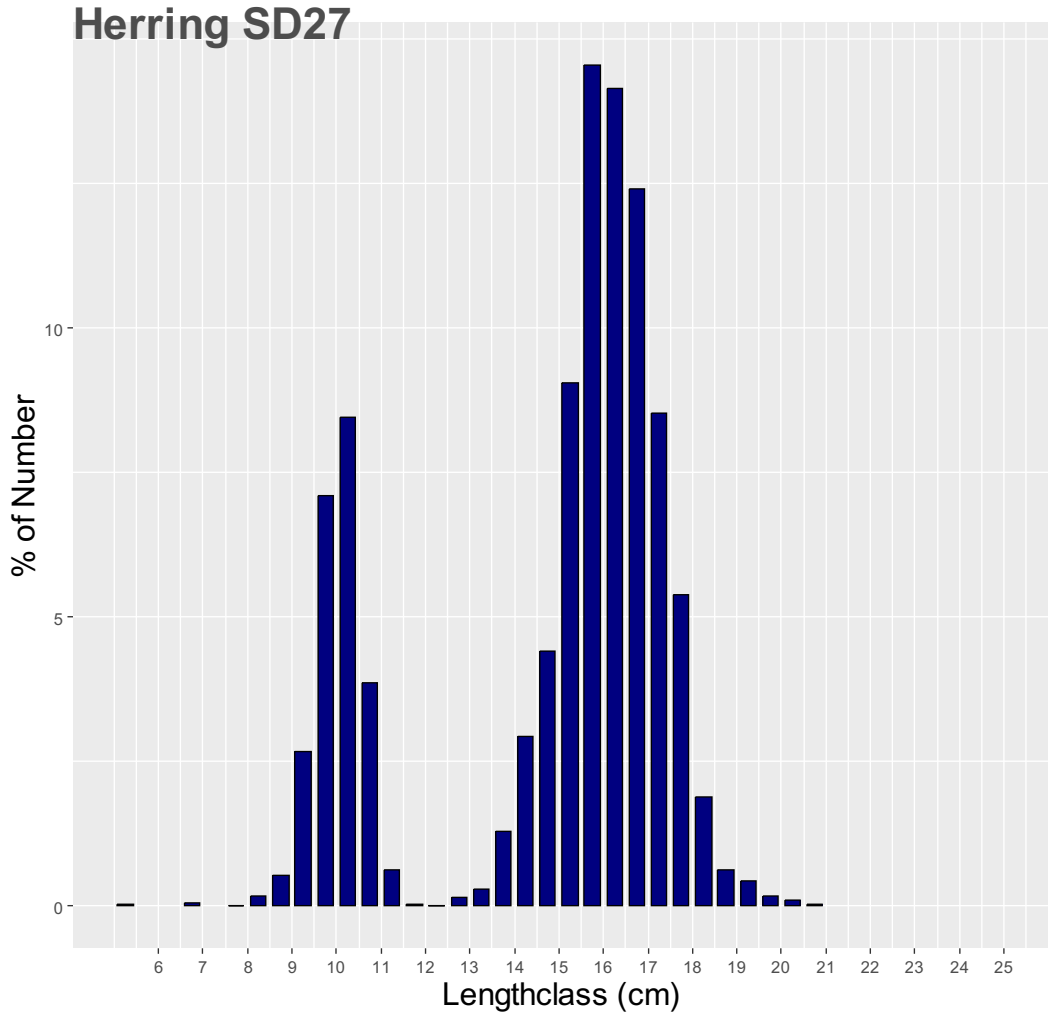

Figure 10. Length distribution of herring from subdivision 27 for BIAS 2022.

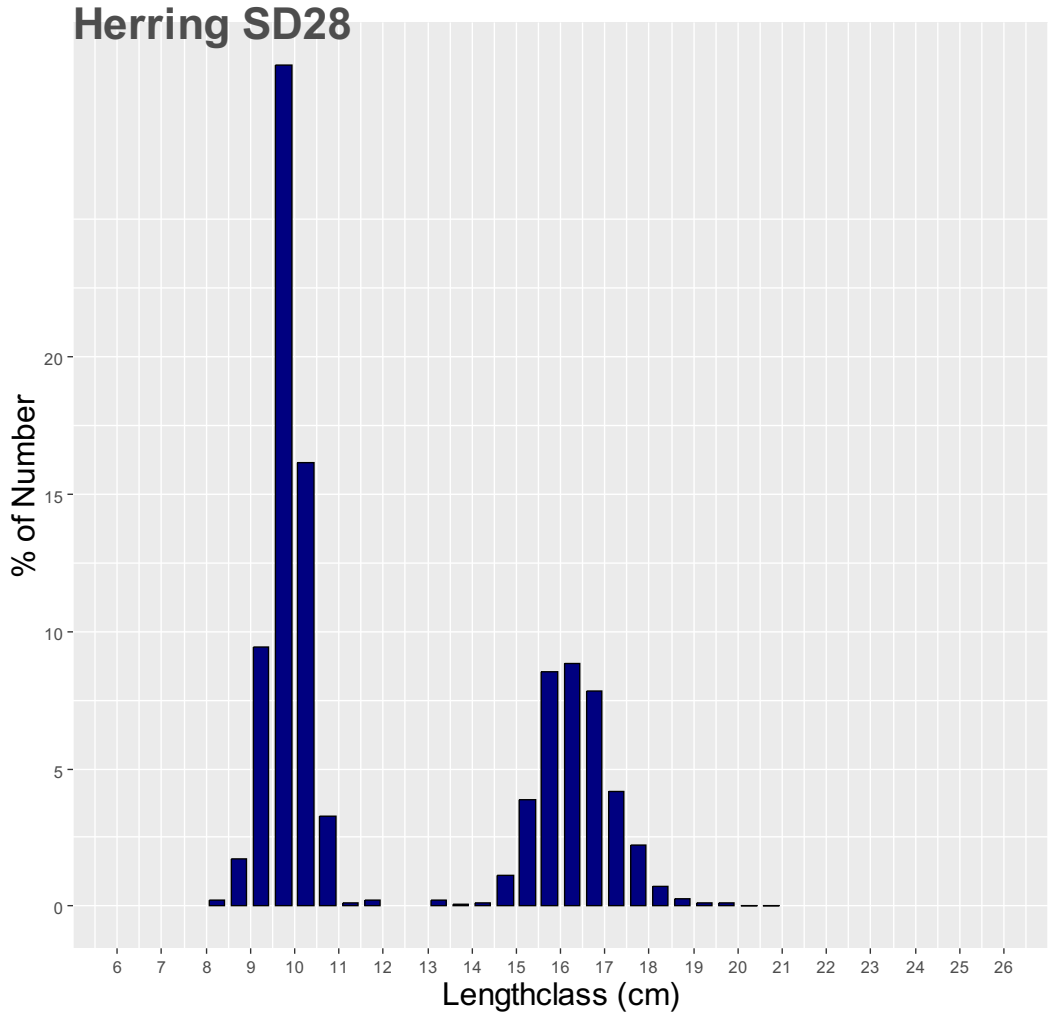

Figure 11. Length distribution of herring from subdivision 28 for BIAS 2022.

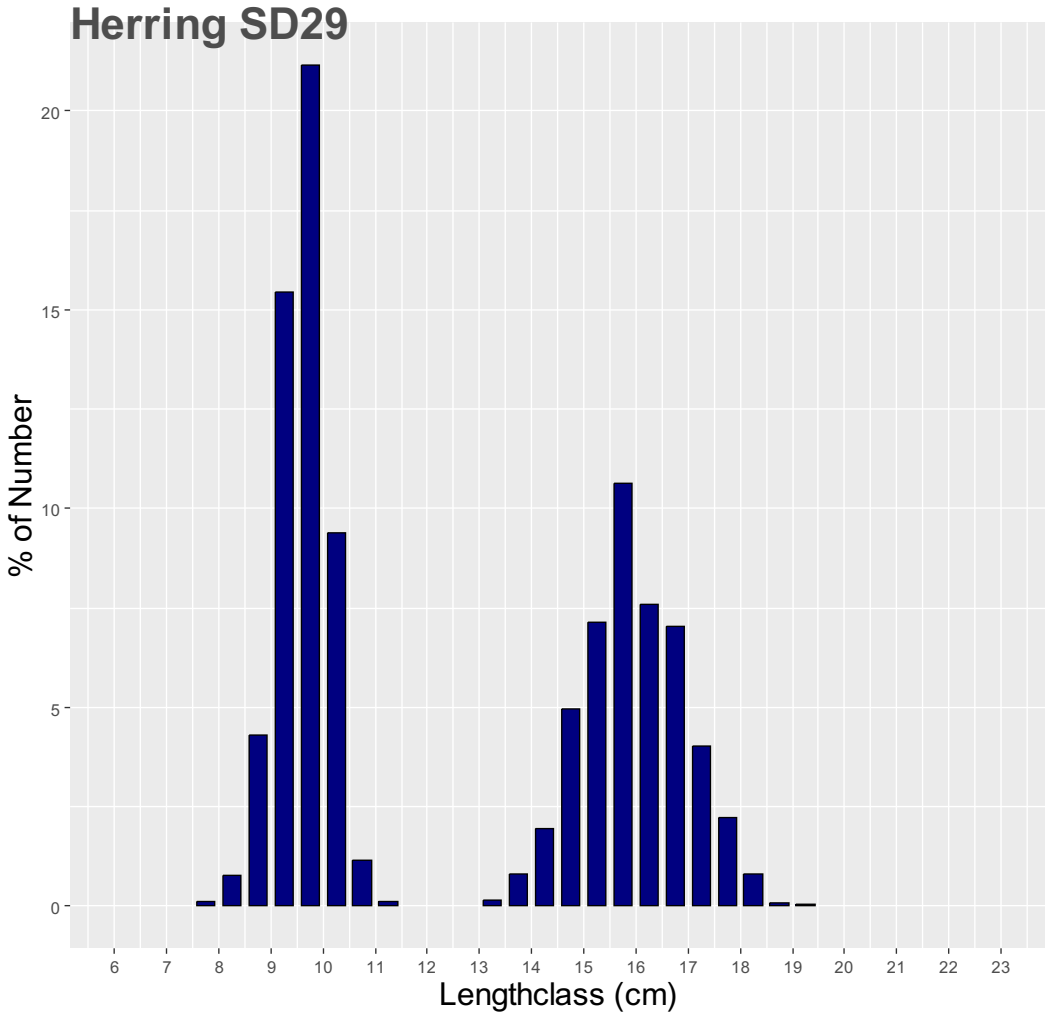

Figure 12. Length distribution of herring from subdivision 29 for BIAS 2022.