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Baltic International Acoustic Survey October 2020

Report, R/V Svea, Sweden

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Contents

1 Svensk sammanfattning

Internationellt koordinerade hydroakustiska expeditioner 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 Kommissionens Data Collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för subdivision(SD) 27 samt för delar av subdivisionerna 25, 26, 28 samt 29. Syftet med expeditionen är att bedöma beståndstatus för sill och skarpsill. Resultaten rapporteras årligen till Baltic International Fish Survey Working Group (WGBIFS) och Baltic Fisheries Assessment Working Group (WGBFAS), som båda är arbetsgrupper inom International Council for the Exploration of the Sea (ICES).
Expeditionen 2020 genomfördes med R/V Svea och inleddes med kalibrering av ekolod 2020-10-02 i Gåsöfjärden och därefter tog sig Svea österut till SD27 där datainsamlingen startade. Expeditionen avslutades 2020-10-14 i Karlskrona. Under expeditionen samlas akustiska rådata in med ett vetenskapligt ekolod (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 vad gäller arter samt längder, Målarterna - sill, skarpsill och torsk - provtas även för åldersbestämning för att ta fram åldersstruktur för respektive bestånd. Informationen om arter och längder från trålfångsterna används tillsammans med akustiska data för att räkna fram ett index för biomassan av fiskarterna.
WGBIFS tar fram gemensamma riktlinjer och manualer fram och resultaten från varje land kan sammanställas i en gemensam databas.

Resultaten utgör underlag för WGBFAS uppskattning de totala bestånden av sill respektive skarpsill i Östersjön. Resultatet från 2020 års svenska BIAS bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön. WGBIFS möte hölls, via videokonferans, i april 2021. Tidigare års resultat samt mer information kring BIAS och WGBIFS arbete finns i arbetsgruppens årliga rapporter.

2 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 marine ecosystems, develops and provides biological advices 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 resources in the Baltic Sea. The survey provides data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS).

3 Methods

3.1 Narrative

The survey was conducted onboard the Fisheries Research Vessel, Svea that was delivered in July 2019. The total cruise covered SD 27 and parts of 25, 26, 28 and 29 (Figure 1). The calibration of the SIMRAD EK80 echo sounder was made in the Gåsöfjärden on the Swedish east coast. The survey started 2020-10-02 east of Gåsöfjärden, and ended 2020-10-14 between Sweden and Bornholm at the border between ICES subdivision (SD) 24 and 25 (Figure 2).

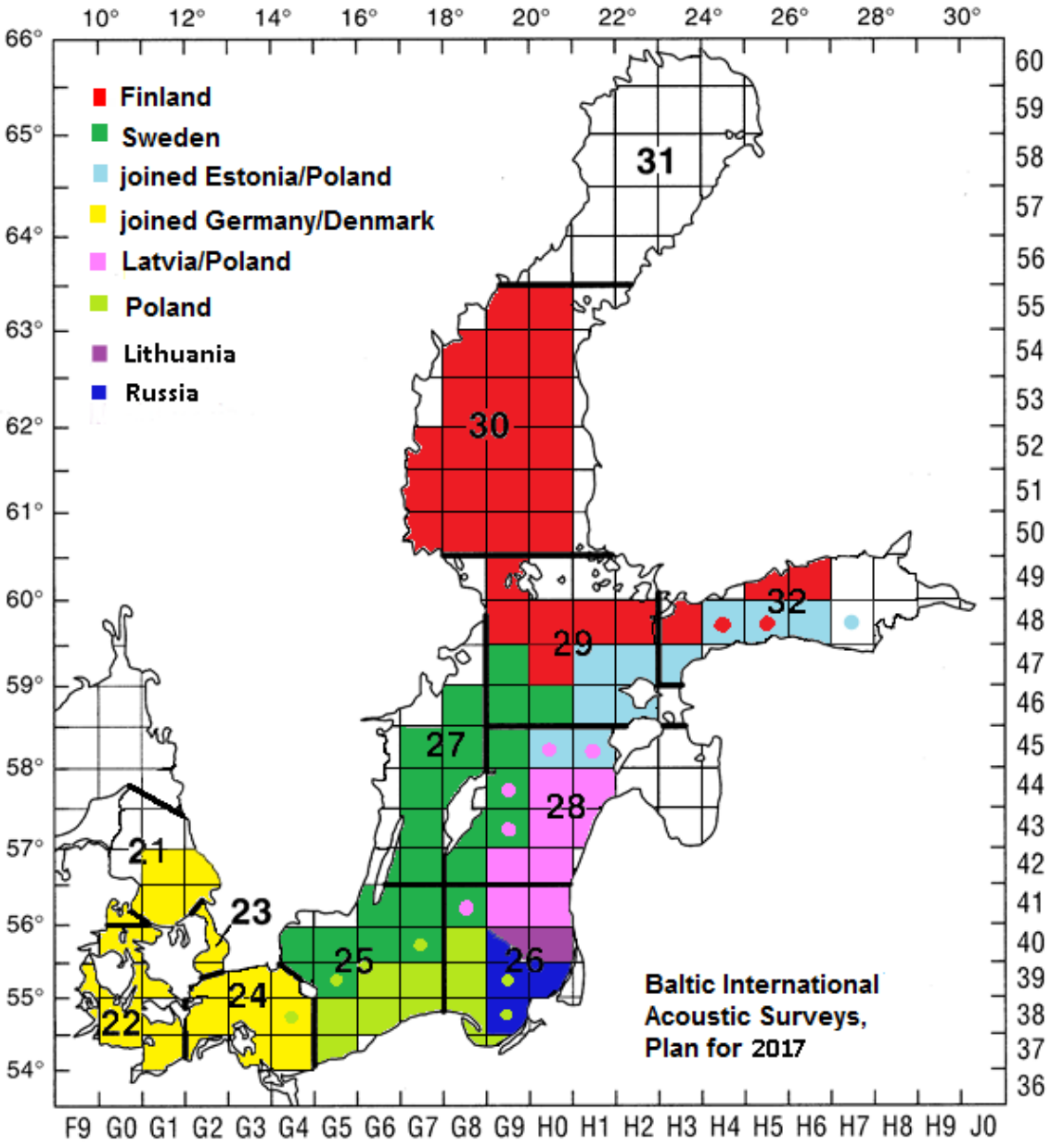

Figure 1. Allocation of ICES square to each country in the BIAS survey 2020 (On axes: longitude, latitude and ICES name of square eg:41G8).

3.2 Survey design

The survey design is based on ICES statistical rectangles with a range of 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 occational bad weather conditions during surveys the design is difficult to fulfill. The total area covered in 2020 was 20832 square nautical miles and the distance used for acoustic estimates was 1463 nautical miles. The cruise track and positions of trawl hauls are shown in Figure 2.

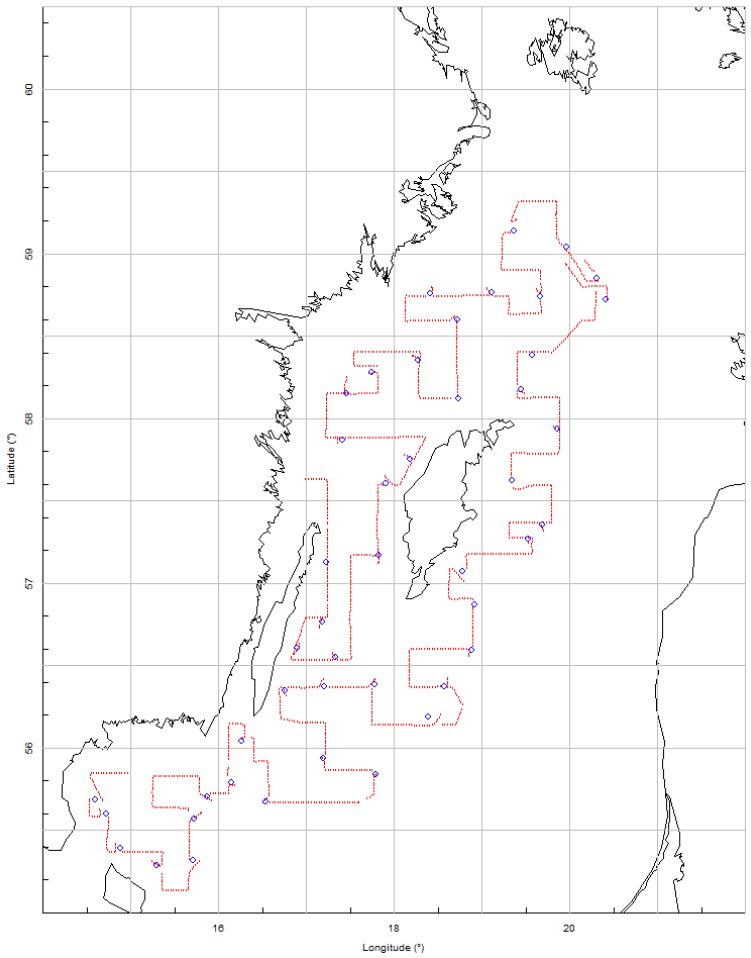

Figure 2. Cruise track(red), positions of trawl hauls (blue) and survey grid of ICES squares (grey) for BIAS 2020.

3.3 Calibration

The SIMRAD EK80 echo sounder with the 38kHz transducer was calibrated according to the IBAS manual (ICES, 2017). Values from the calibration were within required accuracy.

3.4 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 settings of the hydroacoustic equipment were as described in 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 sampling distance units, ESDUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and and irrelevant scattering 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 acoustic integrator readings to a single species. Therefore the species composition was based on the catch results from the allocated trawl 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 s_A and the rectangle area, divided by the corresponding backscattering cross section σ. The total number was separated into different fish species according to the mean catch composition in the rectangle.

Table 1. Target strength (TS) relationships.

Clupeoids	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)
Salmonids and 3-spined stickleback were given the same acoustic properties as Clupeoids.		

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 the stations.

3.7 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
Sjöberg, Rajlie	IMR, Lysekil	Fish sampling
Svenson, Anders	IMR, Lysekil	Acoustics
Svensson, Matilda	IMR, Lysekil	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

4 Results

4.1 Biological data

In total 46 trawl hauls were carried out, 15 in SD 25, 2 in SD 26, 14 in SD 27, 9 in SD 28 and 6 hauls in SD 29. In total 1287 herring and 1285 sprat were selected for age analyses. Length distributions by ICES subdivision are shown for sprat in Figures 3-7 and for herring in Figures 8 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean nautical area scattering coefficient (SA), the mean backscattering cross section (SIGMA), the estimated total number of fish (NTOT), the percentages of herring (HHer), sprat (HSpr) and cod (HCod) per SD/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

This year was the second year that R/V Svea was used for BIAS. For this reason some instruments were not totally up and running but as a whole the evaluation was that the survey was accomplished as planned. Some bad weather occurred and thus in some parts the planned survey track had to be changed according to the situation. The data collected during the survey was accepted at the WGBIFS meeting and thus representative for the index of abundance of the pelagic species during the BIAS in 2020 for the covered area (Figure 2). For further information regarding the procedures of WGBIFS see the WGBIFS report (ICES, 2021).

6 References

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7 Tables and figures

Table 3. Survey statistics, see chapter 4.2 for more information.

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	414.1	1.842	645.93	5.38	94.62	0.000
25	39G5	979.0	184.4	1.923	938.87	24.73	75.19	0.061
25	40G4	677.2	277.6	3.431	547.91	68.69	25.40	1.731
25	40G5	1012.9	355.3	1.847	1948.29	18.57	81.32	0.093
25	40G6	1013.0	396.5	1.635	2456.72	6.23	93.48	0.014
25	40G7	1013.0	266.2	1.490	1810.10	2.79	96.47	0.000
25	41G6	764.4	1180.6	1.622	5562.23	47.71	15.67	0.056
25	41G7	1000.0	535.8	1.849	2897.90	43.67	36.64	0.437
26	41G8	1000.0	420.0	1.750	2400.02	37.52	43.63	0.231
27	42G6	266.0	725.1	1.688	1142.77	48.76	14.63	0.000
27	42G7	986.9	297.6	1.668	1760.87	21.76	76.93	0.000
27	43G7	913.8	850.0	0.435	17851.69	0.00	15.82	0.000
27	44G7	960.5	244.3	0.751	3123.00	13.53	18.82	0.000
27	44G8	456.6	677.4	0.345	8960.33	0.64	14.39	0.000
27	45G7	908.7	632.6	0.650	8837.19	7.22	40.78	0.000
27	45G8	947.2	530.9	0.460	10940.92	2.97	4.42	0.000
27	46G8	884.8	487.4	0.544	7925.28	2.73	42.61	0.000
28	42G8	945.4	520.2	0.799	6156.08	15.07	7.06	0.136
28	43G8	296.2	1311.7	0.568	6846.34	0.34	76.49	0.000
28	43G9	973.7	529.8	1.162	4440.99	12.26	54.09	0.251
28	44G9	876.6	812.4	0.396	17992.53	0.03	6.92	0.000
28	45G9	924.5	1466.8	0.575	23593.31	5.27	33.31	0.106
29	46G9	933.8	697.9	0.522	12488.55	0.79	15.00	0.000
29	46H0	933.8	632.5	0.413	14288.68	0.18	20.58	0.000
29	47G9	876.2	1193.1	0.442	23670.46	1.81	24.16	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	611	0	3	75	133	210	75	112	4	0
25	39G5	706	1	13	22	304	104	183	65	12	3
25	40G4	139	0	5	22	44	40	9	11	3	4
25	40G5	1584	0	148	165	187	285	275	521	4	0
25	40G6	2297	0	279	251	727	581	198	199	0	62
25	40G7	1746	8	83	387	547	376	210	113	11	11
25	41G6	872	40	40	113	192	130	103	217	27	10
25	41G7	1062	78	103	240	128	96	178	239	0	0
26	41G8	1047	189	97	148	187	25	60	288	55	0
27	42G6	167	18	18	18	38	56	3	15	0	1
27	42G7	1355	72	241	289	267	74	207	200	5	0
28	42G8	435	249	12	36	14	24	29	48	20	3
27	43G7	2824	905	369	492	471	74	40	444	24	4
28	43G8	5237	4862	48	85	173	30	9	29	0	0
28	43G9	2402	479	282	398	0	297	539	348	26	34
27	44G7	588	218	79	93	31	70	45	44	5	4
27	44G8	1290	1275	2	0	2	2	0	9	0	0
28	44G9	1244	1218	15	3	5	0	4	0	0	0
27	45G7	3604	2923	196	147	99	82	70	85	0	2
27	45G8	484	346	24	20	48	17	7	15	3	3
28	45G9	7860	6648	150	295	402	106	80	69	32	78
27	46G8	3377	2489	329	116	94	206	41	55	4	42
29	46G9	1874	350	646	186	111	166	168	227	16	4
29	46H0	2940	2866	18	11	6	0	21	14	5	0
29	47G9	5720	5279	86	38	91	116	21	78	11	0

Table 5. Estimated mean weights (g) of sprat per age group and area (Weight sprat (WS)).

SD	RECT	WS0	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8+
25	39G4		11	13	15	16	15	16	19	
25	39G5	2	8	12	12	13	16	15	16	19
25	40G4		13	12	14	17	14	19	16	17
25	40G5		10	11	11	14	14	14	17	
25	40G6		9	13	12	16	15	12		15
25	40G7	3	8	10	13	13	14	13	14	14
25	41G6	3	9	10	10	11	12	14	13	14
25	41G7	3	10	10	11	12	14	14		
26	41G8	3	9	9	12	14	14	12	13	
27	42G6	3	10	13	11	13	15	14		16
27	42G7	3	8	11	11	13	14	13	14	
28	42G8	3	11	11	8	12	12	12	12	16
27	43G7	3	8	10	12	13	13	12	14	12
28	43G8	3	8	10	11	12	13	12		
28	43G9	3	10	11		11	14	12	11	13
27	44G7	3	9	10	11	13	11	13	14	12
27	44G8	2	9		11	8		11		
28	44G9	2	8	8	8		10			
27	45G7	3	8	10	11	12	13	13		14
27	45G8	2	9	11	11	12	12	13	14	12
28	45G9	3	9	9	11	11	12	13	14	12
27	46G8	3	8	9	9	11	12	13	13	12
29	46G9	3	8	11	12	11	12	12	14	15
29	46H0	3	8	9	10		10	10	11	
29	47G9	3	8	9	10	10	11	12	13	

Table 6. Estimated number (millions) of herring per age group and area (Number herring (NH)).

SD	RECT	NHTOT	NH0	NH1	NH2	NH3	NH4	NH5	NH6	NH7	NH8+
25	39G4	35	10	7	3	6	1	3	4	1	1
25	39G5	232	10	22	49	77	27	16	28	4	0
25	40G4	376	22	31	58	105	46	34	51	15	14
25	40G5	362	12	29	20	148	64	23	62	3	2
25	40G6	153	0	51	37	26	12	11	15	0	0
25	40G7	51	1	5	7	15	9	6	8	1	0
25	41G6	2654	13	309	487	873	299	460	210	0	4
25	41G7	1266	0	63	104	131	229	250	446	32	10
26	41G8	900	7	28	24	218	111	159	309	29	18
27	42G6	557	0	8	77	127	109	63	169	4	0
27	42G7	383	0	27	17	88	88	34	130	0	0
28	42G8	928	0	4	100	45	341	255	155	28	0
27	43G7	0	0	0	0	0	0	0	0	0	0
28	43G8	23	23	0	0	0	0	0	0	0	0
28	43G9	544	0	21	60	158	81	69	151	4	0
27	44G7	423	1	75	59	53	119	55	61	0	0
27	44G8	58	0	9	6	13	12	3	15	0	0
28	44G9	6	5	0	0	0	0	0	1	0	0
27	45G7	638	16	87	102	127	108	88	110	0	0
27	45G8	325	8	48	55	86	21	44	63	0	0
28	45G9	1244	0	156	168	417	9	167	312	0	16
27	46G8	216	0	37	75	55	19	16	13	2	0
29	46G9	99	3	17	14	10	21	19	16	0	0
29	46H0	25	25	0	0	0	0	0	0	0	0
29	47G9	430	246	158	10	0	5	0	5	5	0

Table 7. Estimated mean weights (g) of herring per age group and area. (Weight herring (NS))

SD	RECT	WH0	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8+
25	39G4	14	18	27	30	32	32	34	59	41
25	39G5	13	20	32	34	35	42	40	35	
25	40G4	16	28	50	67	77	81	81	58	87
25	40G5	17	23	39	35	40	31	37	54	49
25	40G6		28	26	35	38	38	29		
25	40G7	10	26	24	32	33	34	37	34	
25	41G6	14	19	26	33	33	34	38		46
25	41G7		19	24	28	32	31	38	38	46
26	41G8	5	22	22	27	34	37	38	46	48
27	42G6		18	21	25	29	31	32	34	
27	42G7		17	23	26	27	31	32		
28	42G8		17	23	26	29	32	33	38	
27	43G7	2								
28	43G8	4								
28	43G9		17	22	27	29	35	31	39	
27	44G7	4	16	21	25	28	28	28		
27	44G8		16	22	24	26	27	29		
28	44G9	4	19		26			29		37
27	45G7	4	16	22	24	27	29	29		
27	45G8	4	16	22	24	23	29	30		
28	45G9		16	22	23	33	29	30		32
27	46G8		16	21	25	28	30	26	31	
29	46G9	4	17	24	21	28	27	29		
29	46H0	3	16		18		25	19	24	
29	47G9	4	13	21		23		26	50	

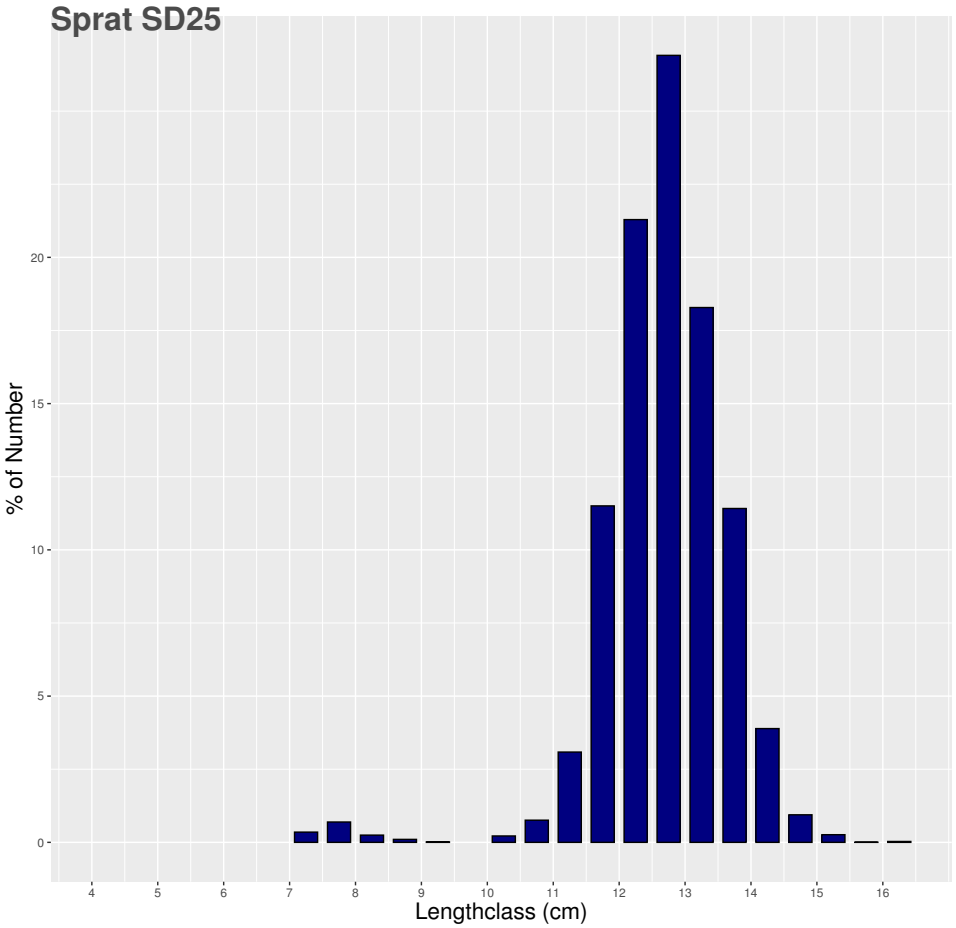

Figure 3. Length distribution of sprat from subdivision 25 for BIAS 2020.

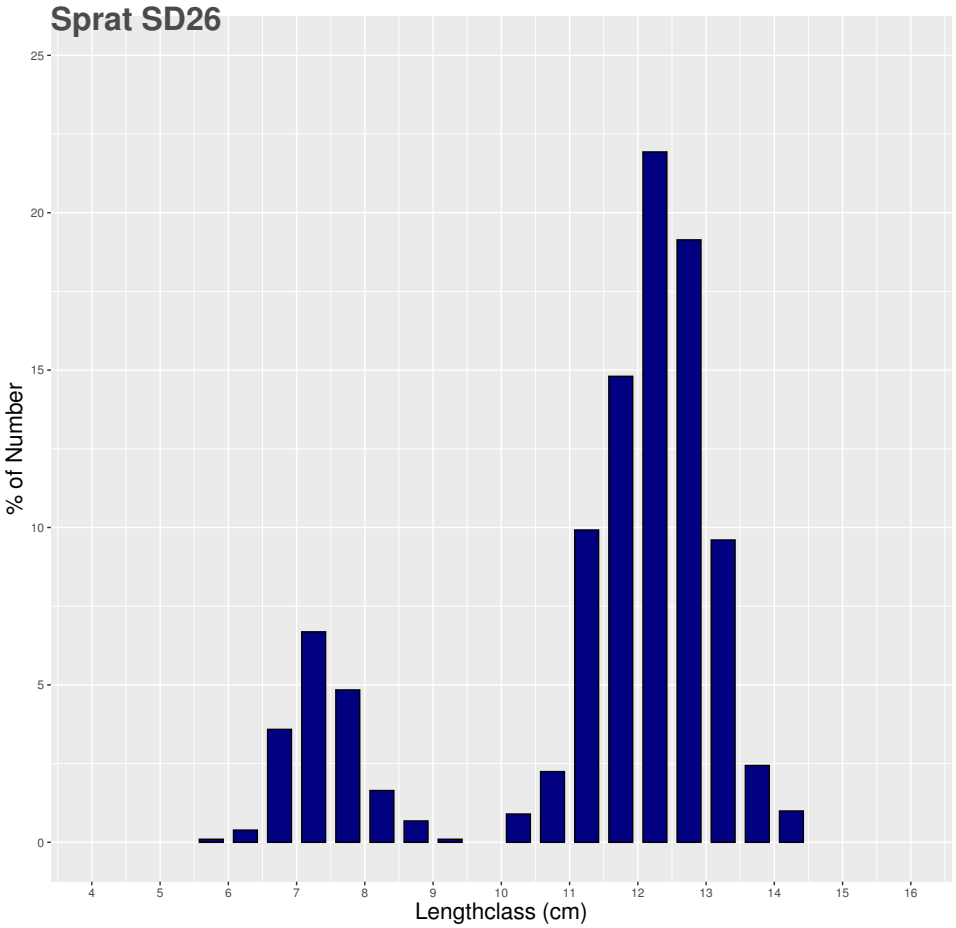

Figure 4. Length distribution of sprat from subdivision 26 for BIAS 2020.

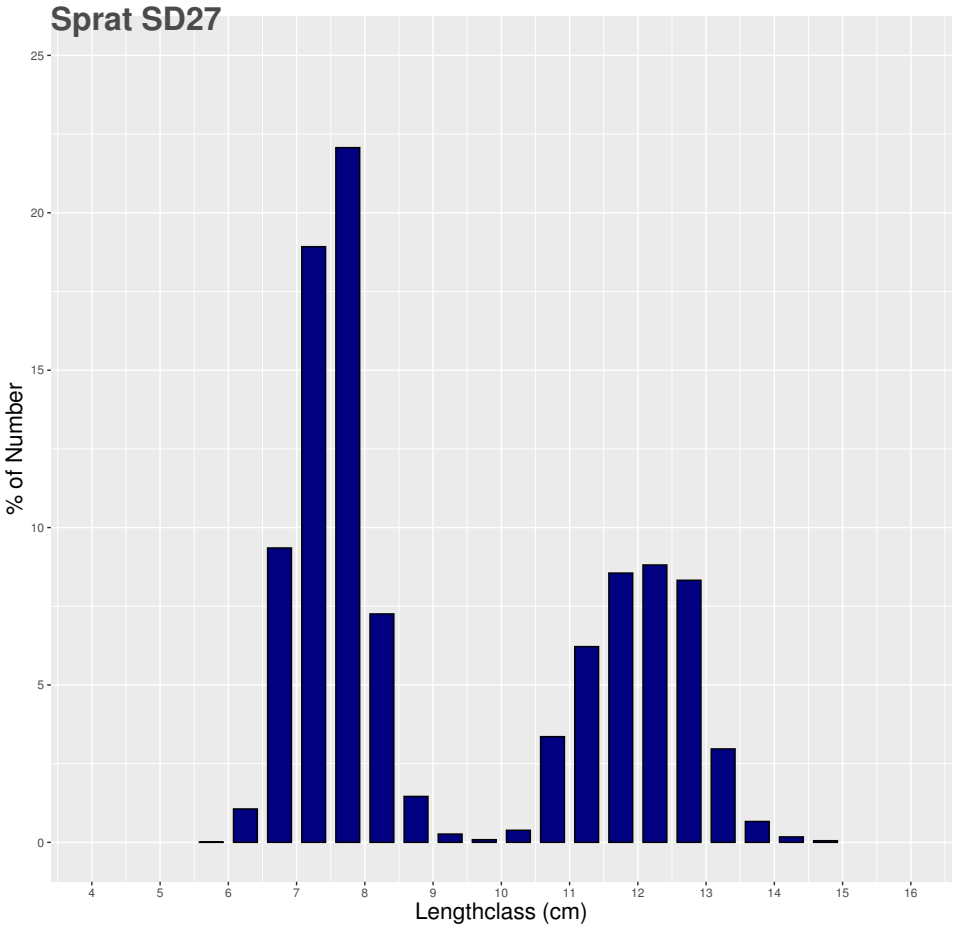

Figure 5. Length distribution of sprat from subdivision 27 for BIAS 2020.

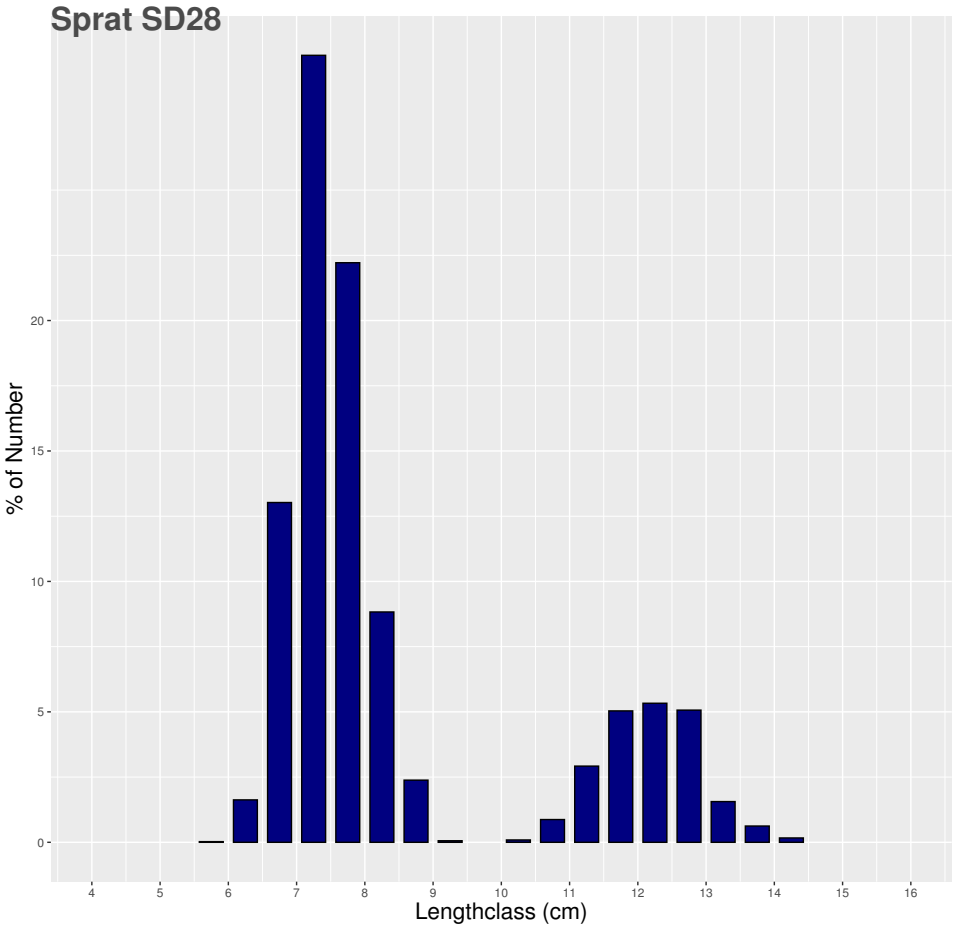

Figure 6. Length distribution of sprat from subdivision 28 for BIAS 2020.

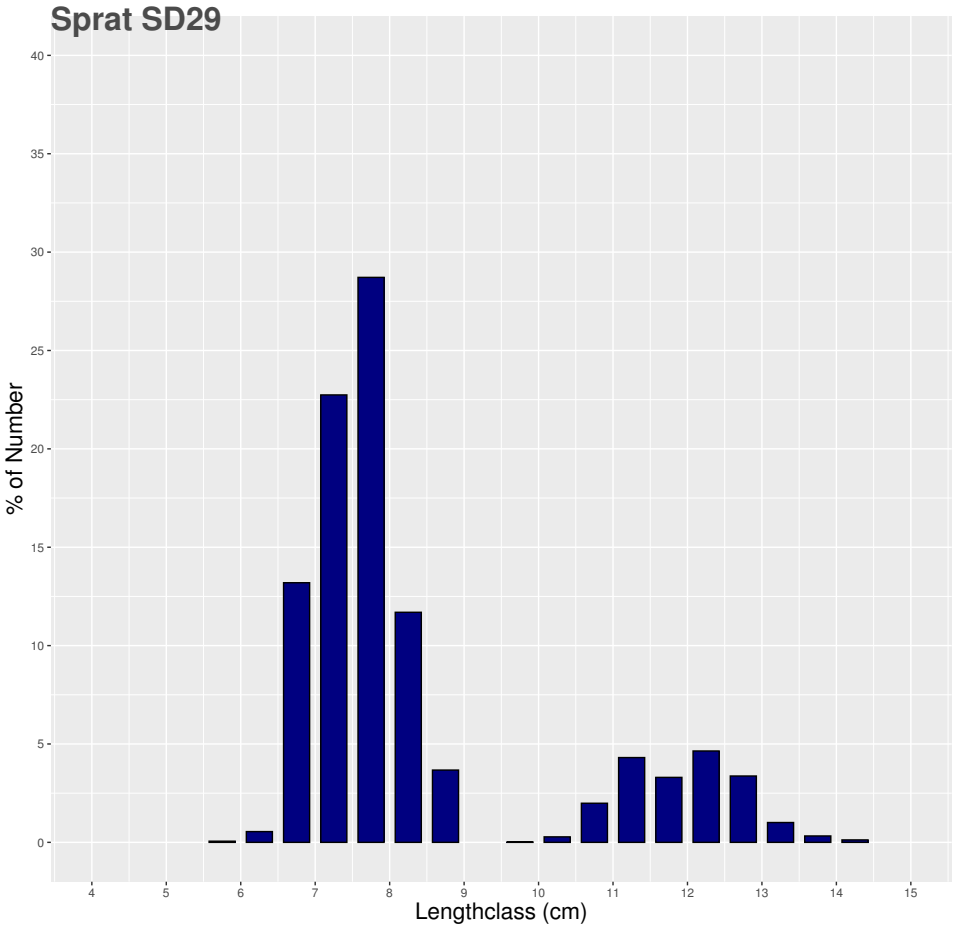

Figure 7. Length distribution of sprat from subdivision 29 for BIAS 2020.

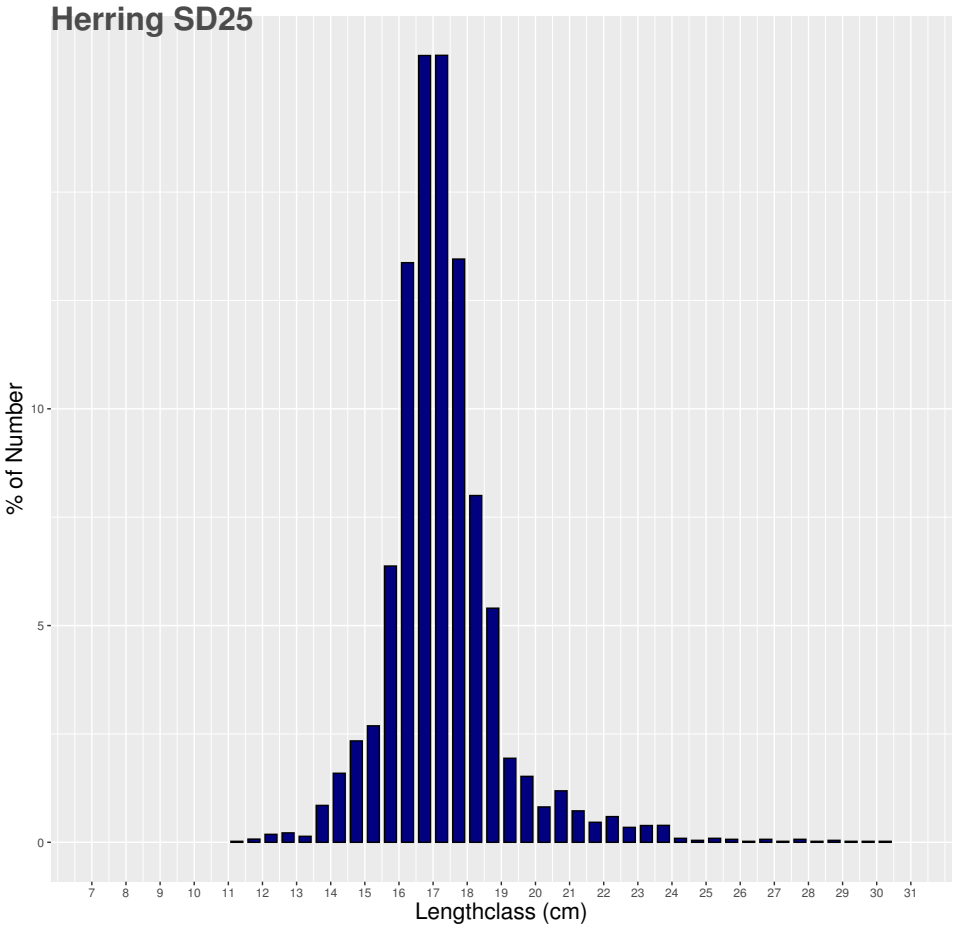

Figure 8. Length distribution of herring from subdivision 25 for BIAS 2020.

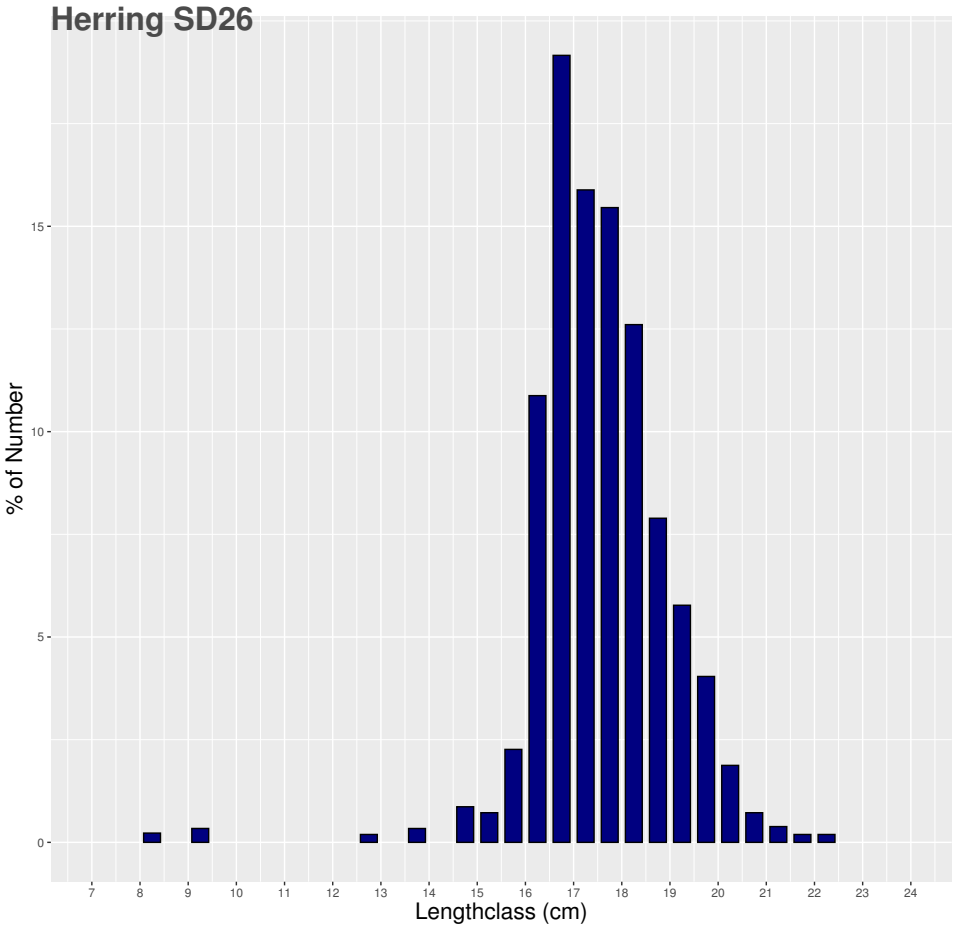

Figure 9. Length distribution of herring from subdivision 26 for BIAS 2020.

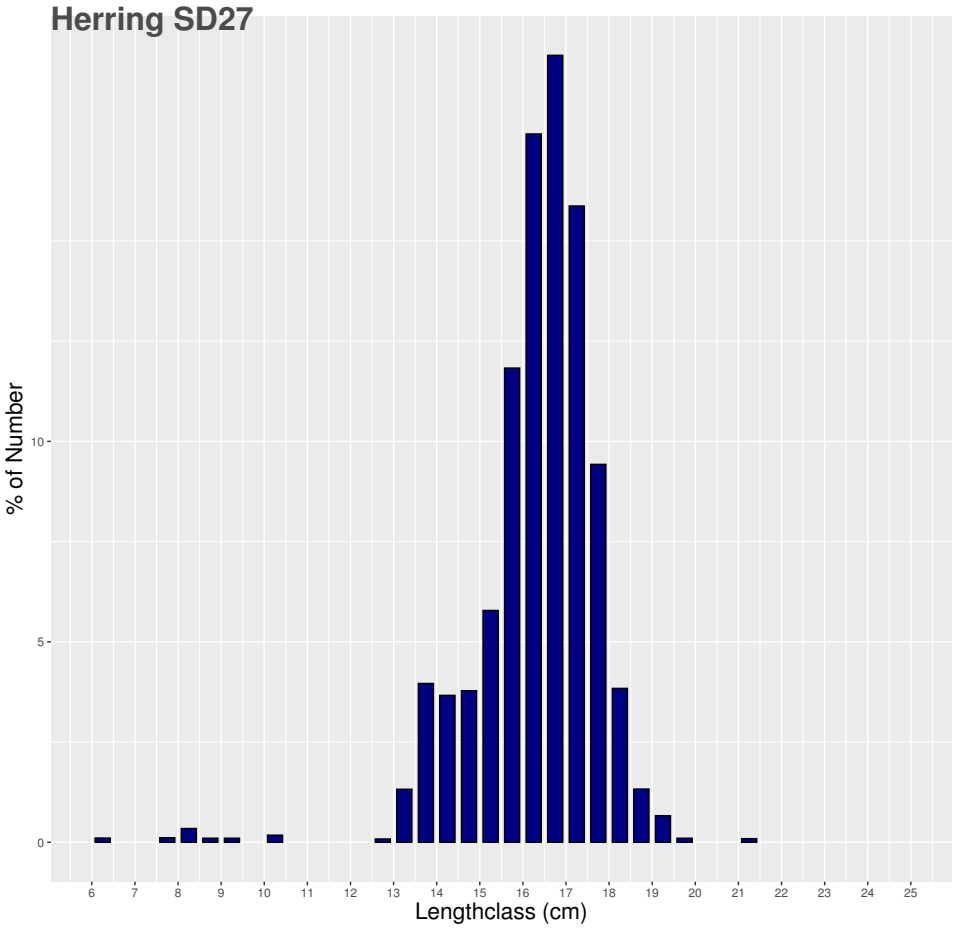

Figure 10. Length distribution of herring from subdivision 27 for BIAS 2020.

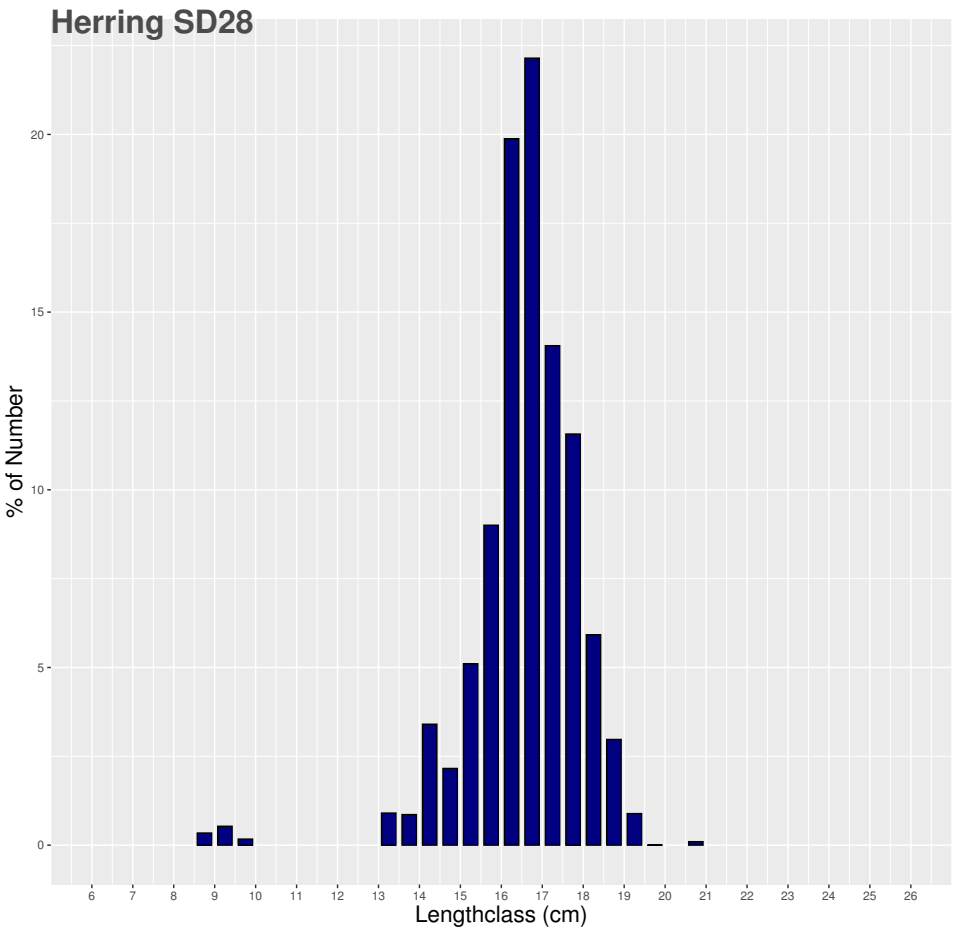

Figure 11. Length distribution of herring from subdivision 28 for BIAS 2020.

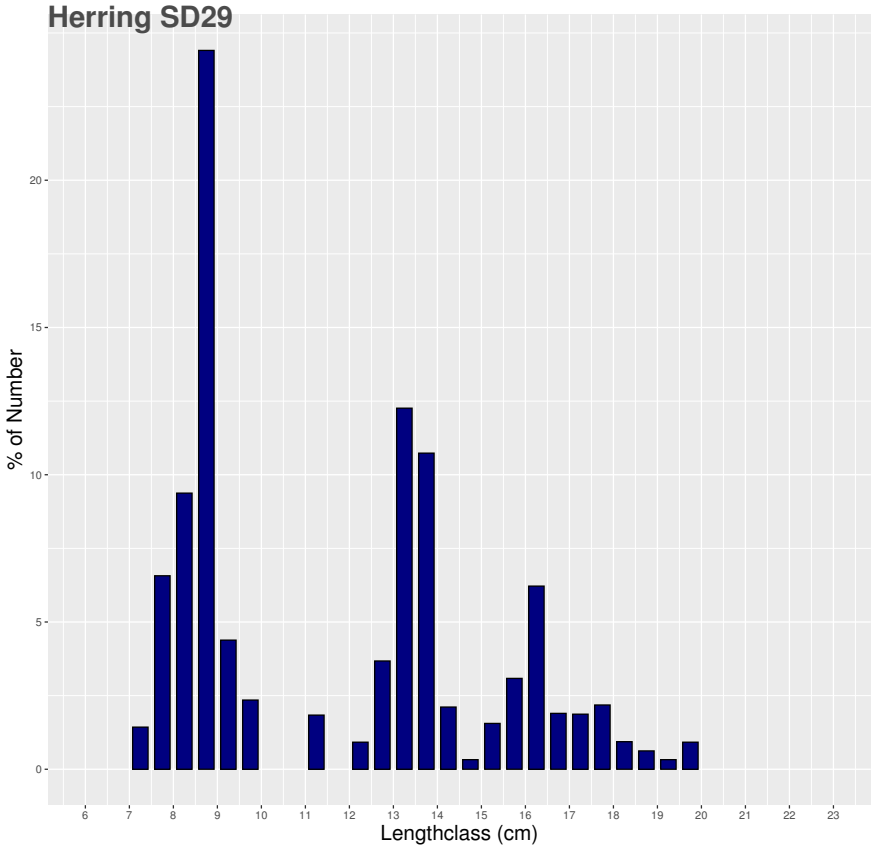

Figure 12. Length distribution of herring from subdivision 29 for BIAS 2020.