



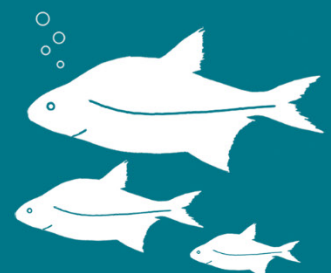
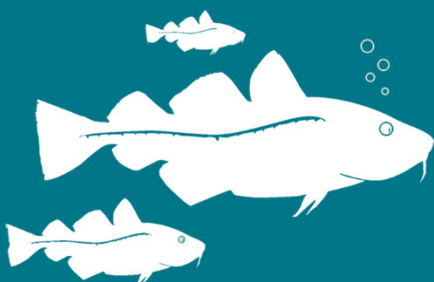
Aqua notes 2025:26

Baltic International Acoustic Survey Report, October 2023, R/V Svea, Sweden

Survey 2023-10-02–2023-10-16

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Baltic International Acoustic Survey Report, R/V Svea, Sweden – Survey 2023-10-02–2023-10-16

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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 2023 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 16, 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 beståndstatus 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 2023 genomfördes med R/V Svea och inleddes med kalibrering av ekolod 2023-10-02 i Gåsfjärden (57°34.5 N, 16°35.0 O) och därefter tog sig fartyget österut till SD 27 där datainsamlingen startade. Expeditionen avslutades 2023-10-16 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 längdfördelning. 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 2023 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.

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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 Hochseefischerei 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 2023-10-02 east of Gåsfjärden, and ended 2023-10-16, between mainland Sweden and Öland, close to Kalmar (Figure 2).

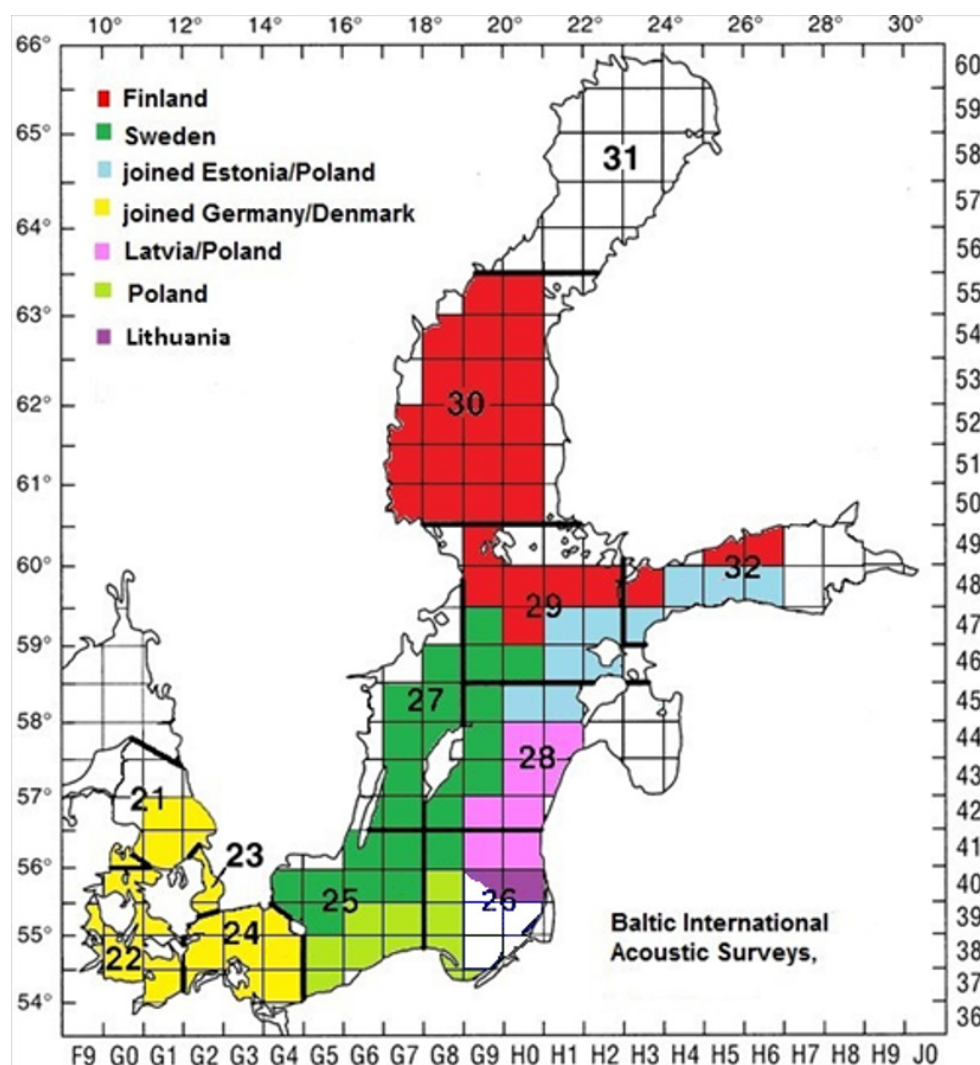


Figure 1. Allocation of ICES squares to each country in the BIAS survey 2023 (On axes: longitude, latitude and ICES name of square eg: 41G8).

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 2023 was 20832 square nautical miles and the distance used for acoustic estimates was 1439 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 Gås fjärden 2023-10-02, according to manuals (ICES, 2017; Demer *et al.*, 2015). Values from the calibration were within required accuracy.

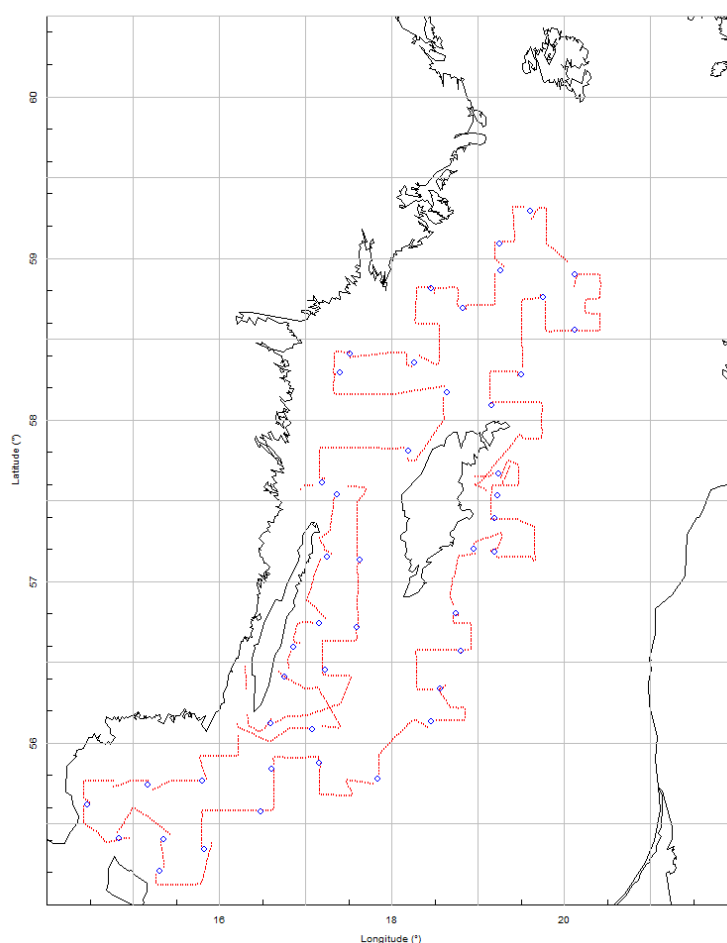


Figure 2. Cruise track (red), positions of trawl hauls (blue) and survey grid of ICES squares (grey) for BIAS 2023.

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.

Table 1. Target strength (TS) relationships.

Type of fish	Target strength	Reference
Clupeids	$TS = 20 \log L \text{ (cm)} - 71.2$	(ICES 1983/H:12)
Gadoids	$TS = 20 \log L \text{ (cm)} - 67.5$	(Foote et al. 1986)
Fish without swim bladder	$TS = 20 \log L \text{ (cm)} - 84.9$	(ICES, 2017)
Stickleback and salmonids	$TS = 20 \log L \text{ (cm)} - 71.2$	(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.

Jernberg, Carina	IMR, Lysekil	Fish sampling
Larson, Niklas	IMR, Lysekil	Scientific & Exp. leader, Acoustics
Lövgren, Olof	IMR, Lysekil	Acoustics
Risberg, Ronja	IMR, Lysekil	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil	Fish sampling
Svenson, Anders	IMR, Lysekil	Acoustics
Svensson, Mathilda	IMR, Lysekil	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

3. Results

3.1. Biological data

In total 46 trawl hauls were carried out, 15 hauls in SD 25, 2 in SD 26, 14 in SD 27, 9 in SD 28 and 6 in SD 29. In total 1324 herring and 931 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 ($\text{SA}[\text{m}^2/\text{nmi}^2]$), the mean backscattering cross section ($\text{SIGMA}[\text{cm}^2]$), the estimated total number of fish ($\text{NTOT}[10^6]$), the percentages of herring ($\text{Hher}[\%]$), sprat ($\text{HSpr}[\%]$) and cod ($\text{HCod}[\%]$) 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 fifth 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 2023 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	109.2	1.843	170.26	11.03	88.97	0.000
25	39G5	979.0	109.2	2.251	474.90	38.73	57.20	0.631
25	40G4	677.2	424.1	2.931	979.86	50.10	47.54	1.890
25	40G5	1012.9	552.4	2.144	2610.35	33.59	65.39	0.331
25	40G6	1013.0	405.4	2.229	1842.02	34.34	65.55	0.080
25	40G7	1013.0	435.5	2.181	2022.91	35.63	60.23	0.112
25	41G6	764.4	501.4	0.630	6085.56	10.41	0.15	0.050
25	41G7	1000.0	404.7	0.763	5303.44	3.66	23.65	0.000
26	41G8	1000.0	729.7	0.579	12600.06	6.27	0.12	0.000
27	42G6	266.0	489.7	0.383	3403.33	0.06	0.06	0.000
27	42G7	986.9	267.7	0.382	6911.89	0.14	0.23	0.018
27	43G7	913.8	369.8	0.378	8949.63	0.07	1.02	0.000
27	44G7	960.5	328.6	0.562	5620.61	4.17	9.78	0.000
27	44G8	456.6	558.0	0.492	5175.47	2.63	3.82	0.000
27	45G7	908.7	207.0	0.907	2072.51	23.09	0.25	0.000
27	45G8	947.2	392.1	0.566	6558.76	4.56	10.29	0.000
27	46G8	884.8	143.1	0.640	1980.10	11.71	3.82	0.000
28	42G8	945.4	375.2	0.672	5281.86	9.07	3.88	0.000
28	43G8	296.2	553.3	0.527	3110.83	0.70	9.87	0.000
28	43G9	973.7	317.5	0.859	3598.10	10.22	18.94	0.000
28	44G9	876.6	2212.5	1.278	15178.63	29.73	26.65	0.031
28	45G9	924.5	593.5	0.821	6686.39	2.97	35.18	0.000
29	46G9	933.8	378.6	0.651	5428.48	2.52	17.64	0.000
29	46H0	933.8	409.1	0.819	4666.11	13.88	13.93	0.003
29	47G9	876.2	347.4	0.844	3608.94	19.69	10.53	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	151	2	4	6	47	63	14	9	4	4
25	39G5	272	2	2	44	103	61	24	34	0	1
25	40G4	466	0	79	36	98	78	110	47	10	9
25	40G5	1707	0	47	108	632	492	101	211	24	93
25	40G6	1208	0	89	77	133	544	187	175	0	2
25	40G7	1218	0	49	167	256	320	74	86	8	258
25	41G6	9	0	1	0	6	0	0	1	0	0
25	41G7	1254	16	190	150	510	195	46	92	0	54
26	41G8	16	0	0	4	7	4	0	0	2	0
27	42G6	2	0	1	1	0	0	0	0	0	0
27	42G7	16	1	2	3	4	2	1	0	1	1
28	42G8	205	0	2	4	75	54	27	17	4	21
27	43G7	91	15	21	12	26	12	3	1	0	0
28	43G8	307	22	4	33	115	30	66	29	7	0
28	43G9	681	1	17	76	182	292	55	44	1	13
27	44G7	549	65	58	42	227	126	4	0	25	4
27	44G8	198	0	24	47	54	57	12	0	0	4
28	44G9	4045	142	12	551	924	472	705	496	305	437
27	45G7	5	0	0	0	2	3	1	0	0	1
27	45G8	675	84	126	76	221	73	21	30	0	44
28	45G9	2353	87	324	129	712	854	202	23	23	0
27	46G8	76	7	22	0	26	13	2	2	0	4
29	46G9	957	44	228	27	420	212	0	13	0	14
29	46H0	650	118	52	42	172	160	100	0	6	0
29	47G9	380	23	96	23	162	37	21	13	0	4

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	3	13	16	15	16	16	21	20	19
25	39G5	4	11	14	14	16	17	15	19	21
25	40G4		15	14	13	16	18	18	17	20
25	40G5		11	13	14	15	16	17	16	15
25	40G6		12	17	13	16	17	17		19
25	40G7		11	12	13	16	14	16	21	17
25	41G6		9		12			13		
25	41G7	4	11	12	13	15	15	15		18
26	41G8			8	11	8			12	
27	42G6		8	12						
27	42G7	4	9	13	13	15	15	10	16	16
28	42G8		11	11	13	15	15	12	16	14
27	43G7	4	9	12	13	13	15	18		17
28	43G8	3	11	12	12	14	14	13	15	
28	43G9	2	11	12	12	14	16	15	17	16
27	44G7	4	9	11	12	15	17		16	16
27	44G8		10	12	14	15	16			16
28	44G9	3	8	12	12	15	12	15	12	11
27	45G7				13	12	10			15
27	45G8	4	9	12	13	14	13	16		14
28	45G9	4	10	11	13	14	14	16	15	
27	46G8	4	10		12	14	15	13		13
29	46G9	3	10	9	13	14		15		16
29	46H0	4	11	12	13	14	16		14	
29	47G9	4	10	9	12	14	13	13	16	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	19	13	1	1	1	1	1	1	0	0
25	39G5	184	15	12	19	12	35	58	13	10	9
25	40G4	491	28	5	98	191	64	32	54	3	16
25	40G5	877	85	77	75	99	186	299	44	10	2
25	40G6	633	50	44	62	35	75	239	46	24	57
25	40G7	721	4	51	62	65	77	257	111	63	31
25	41G6	634	0	31	6	79	278	194	24	16	6
25	41G7	194	0	31	20	22	47	51	15	5	4
26	41G8	790	0	27	0	150	154	305	28	69	57
27	42G6	2	0	0	0	1	1	1	0	0	0
27	42G7	9	0	0	1	1	4	3	0	0	0
28	42G8	479	0	3	21	114	218	60	14	46	3
27	43G7	6	0	0	1	2	2	1	0	0	0
28	43G8	22	0	2	0	2	12	2	0	0	2
28	43G9	368	0	32	15	97	127	56	13	29	0
27	44G7	234	0	19	16	68	82	33	8	4	4
27	44G8	136	0	82	7	21	14	8	4	0	0
28	44G9	4512	0	2161	496	598	599	464	62	62	70
27	45G7	479	0	89	26	46	215	71	0	21	10
27	45G8	299	0	170	5	55	38	15	11	3	3
28	45G9	199	0	108	7	34	30	13	0	6	0
27	46G8	232	0	85	24	36	40	24	16	3	4
29	46G9	137	0	48	1	13	46	18	6	3	0
29	46H0	648	0	124	14	172	232	85	16	6	0
29	47G9	711	6	379	30	42	154	50	23	25	2

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	12	21	29	46	47	46	48	51	37
25	39G5	13	17	34	51	48	41	59	61	47
25	40G4	18	39	45	55	59	50	65	85	53
25	40G5	16	22	44	45	36	42	56	54	66
25	40G6	13	22	33	31	48	45	46	52	47
25	40G7	18	23	39	35	39	46	54	52	56
25	41G6		23	39	35	36	38	42	37	41
25	41G7		24	30	38	33	40	53	49	65
26	41G8		20		31	30	36	33	41	41
27	42G6				29	24	31			
27	42G7		21	29	30	33	34	40	58	56
28	42G8		23	32	35	35	43	53	44	49
27	43G7		23	29	30	40	41	35	41	
28	43G8		23		30	30	37			30
28	43G9		21	31	28	30	37	39	31	
27	44G7		21	25	28	33	34	39	36	41
27	44G8		21	39	26	30	31	25		
28	44G9		19	26	28	27	28	33	43	41
27	45G7		20	28	28	29	34		35	41
27	45G8		20	30	26	26	33	30	31	28
28	45G9		20	26	27	28	30		29	
27	46G8		19	20	25	31	32	33	31	34
29	46G9		20	43	24	29	31	31	29	
29	46H0		19	32	30	30	30	31	42	
29	47G9	6	19	21	23	27	30	30	30	31

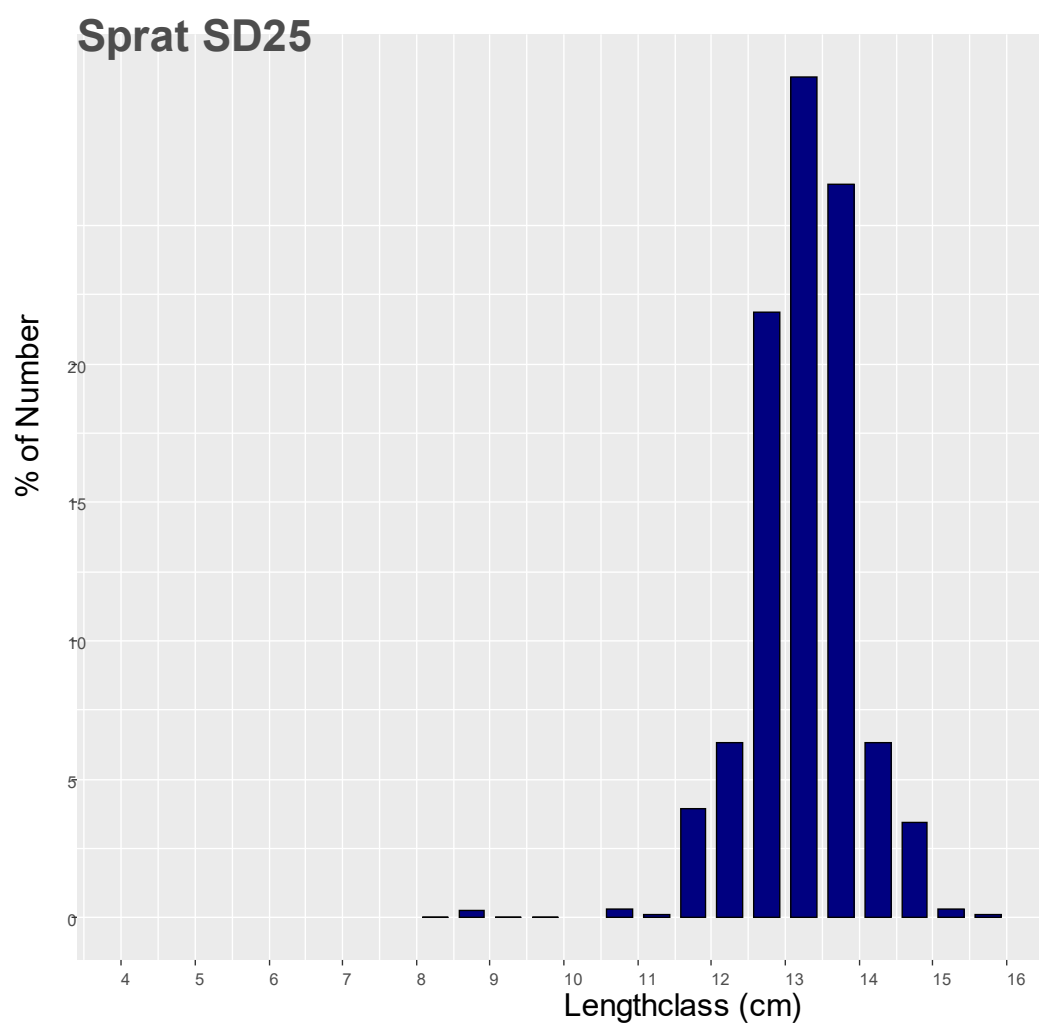


Figure 3. Length distribution of sprat from subdivision 25 for BIAS 2023.

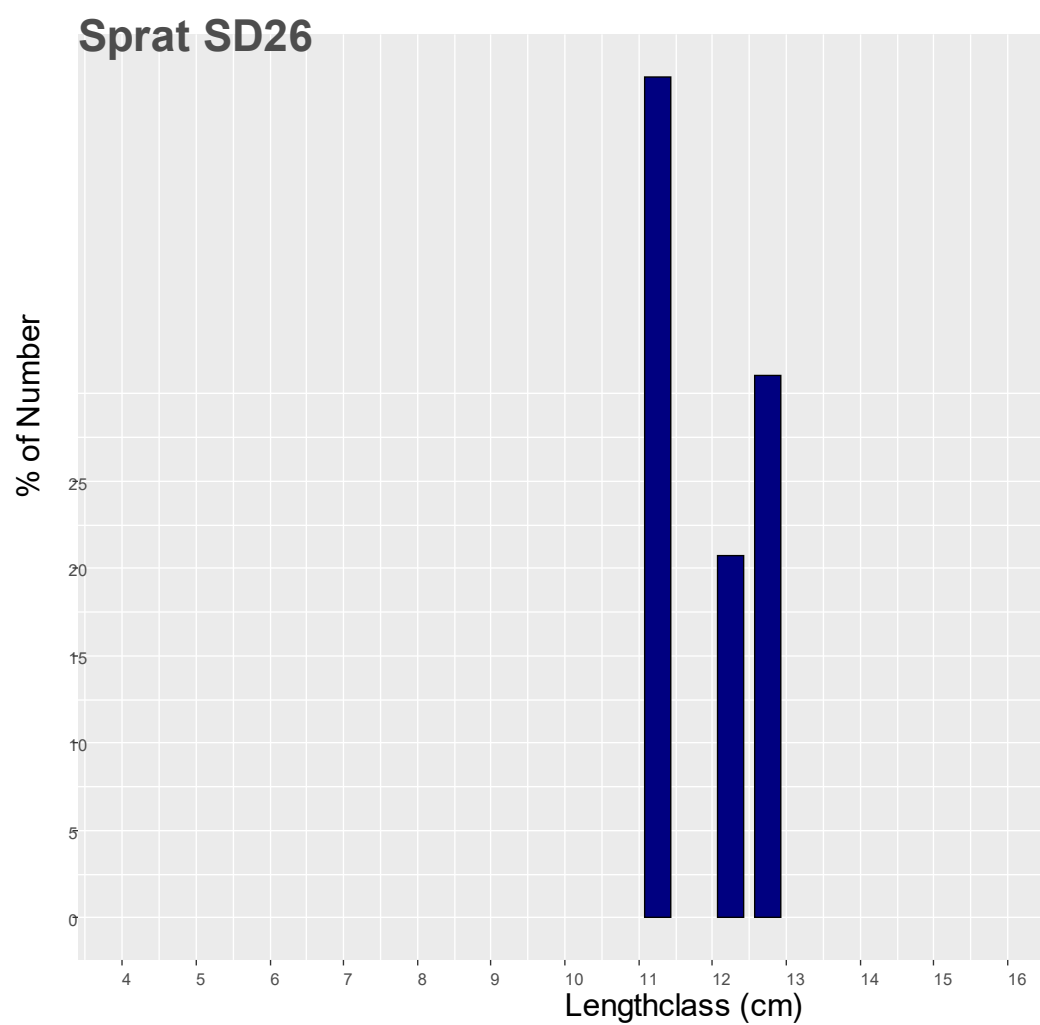


Figure 4. Length distribution of sprat from subdivision 26 for BIAS 2023.

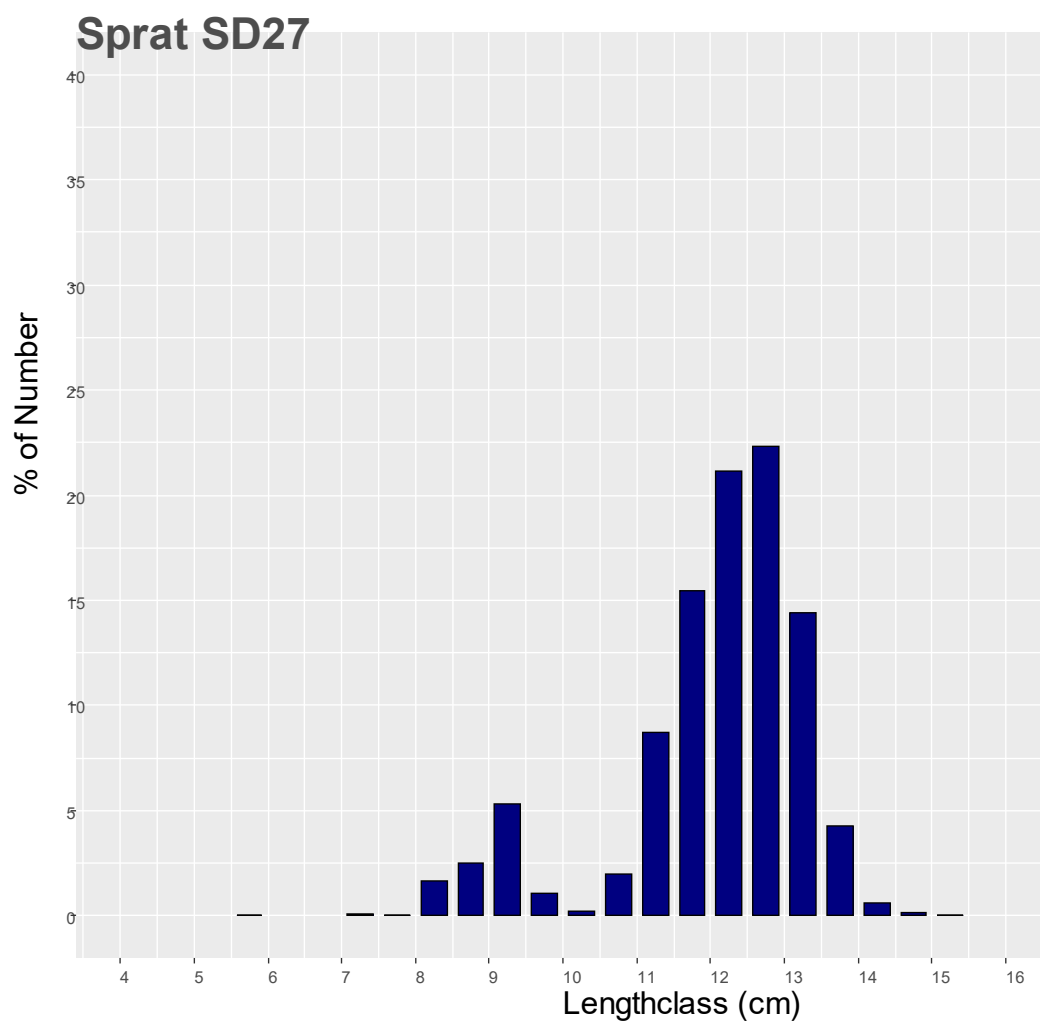


Figure 5. Length distribution of sprat from subdivision 27 for BIAS 2023.

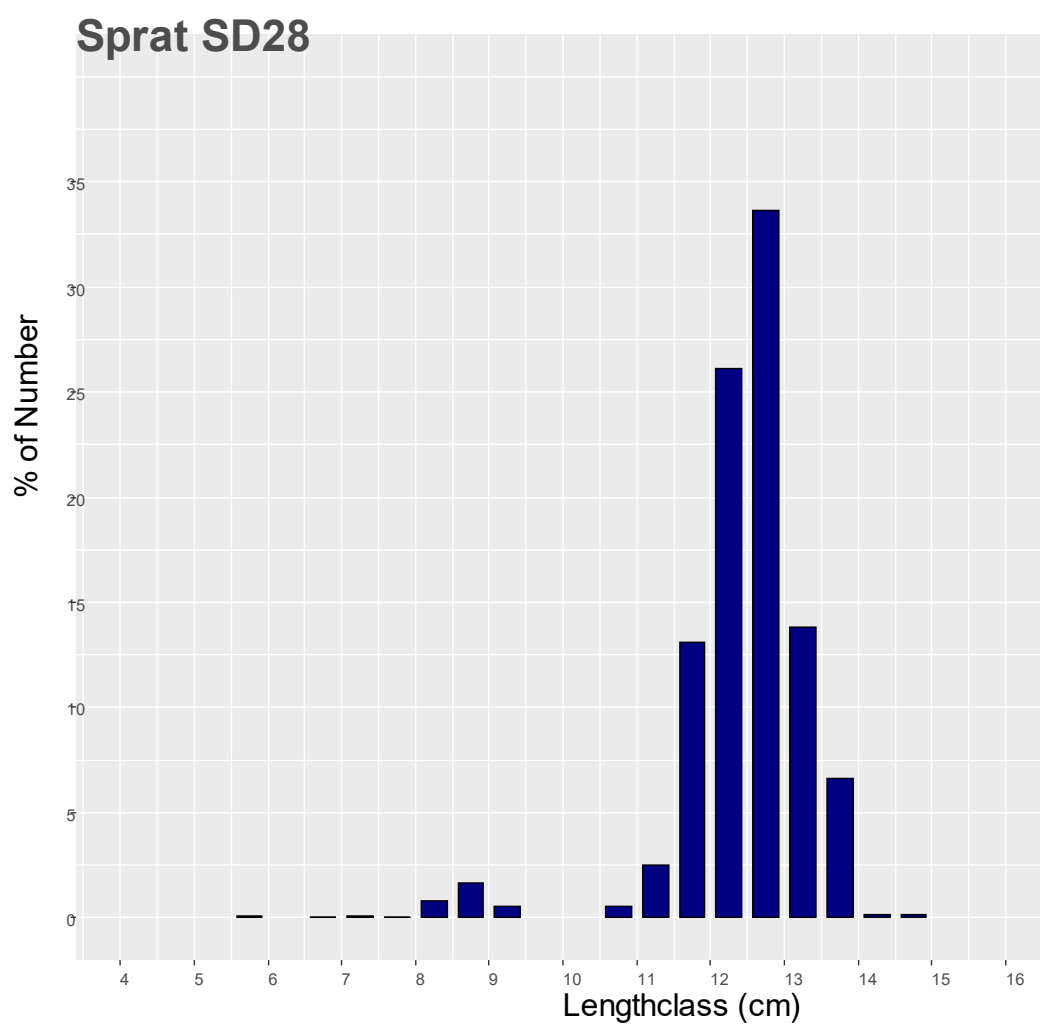


Figure 6. Length distribution of sprat from subdivision 28 for BIAS 2023.

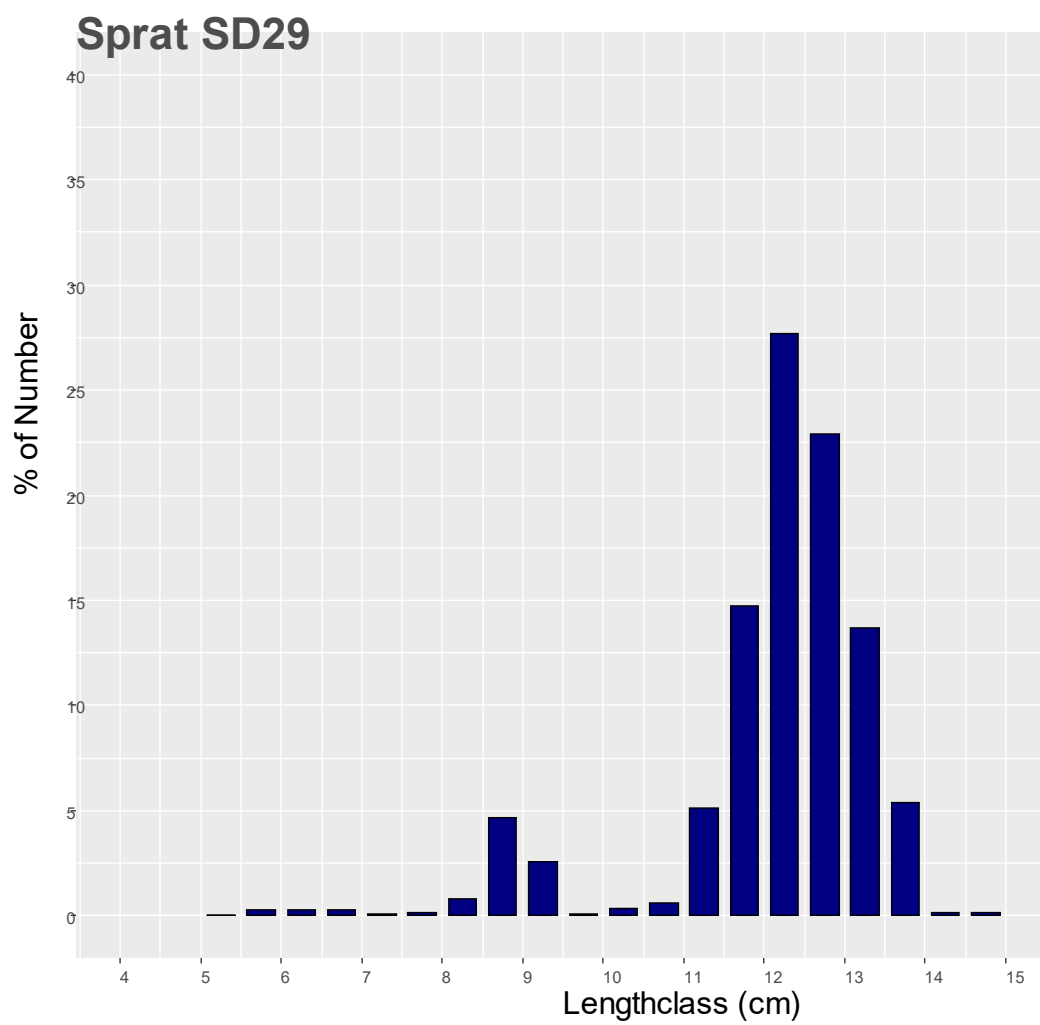


Figure 7. Length distribution of sprat from subdivision 29 for BIAS 2023.

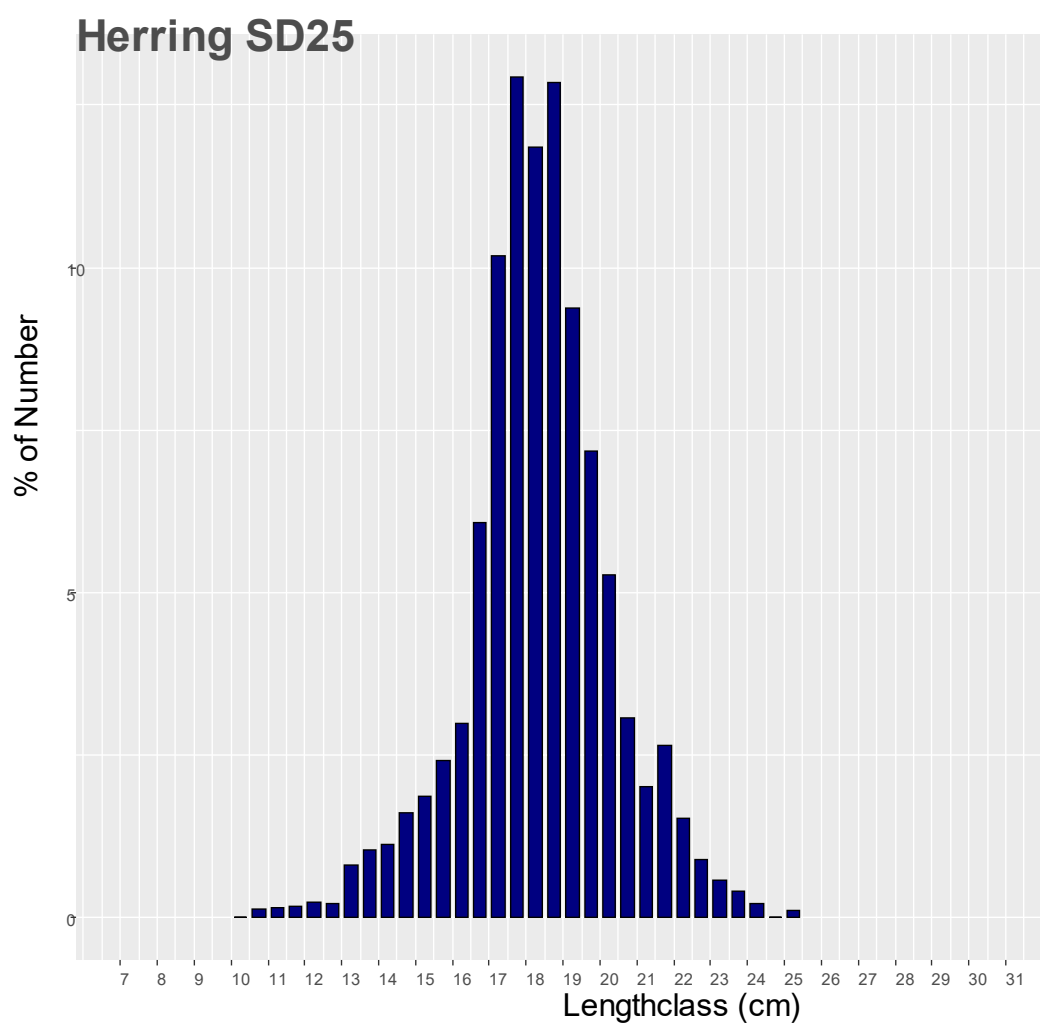


Figure 8. Length distribution of herring from subdivision 25 for BIAS 2023.

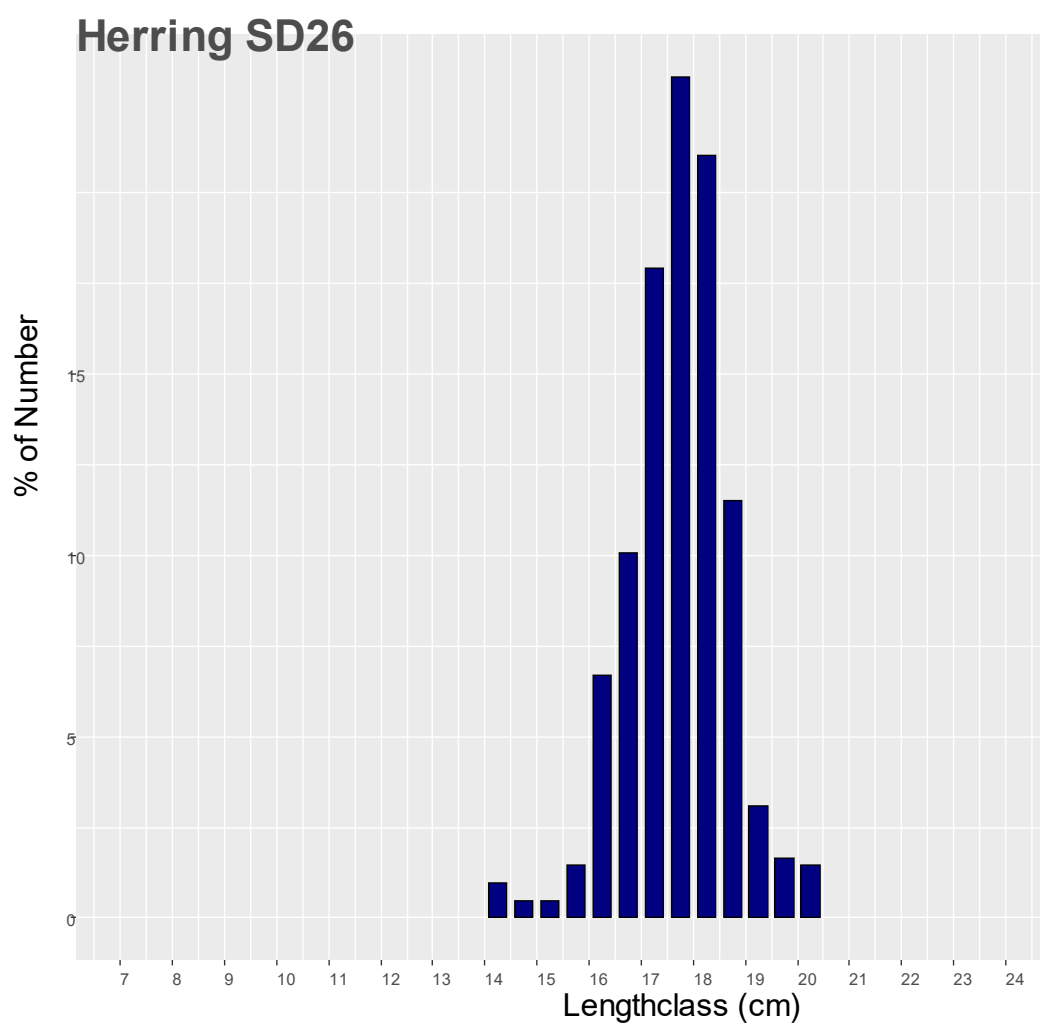


Figure 9. Length distribution of herring from subdivision 26 for BIAS 2023.

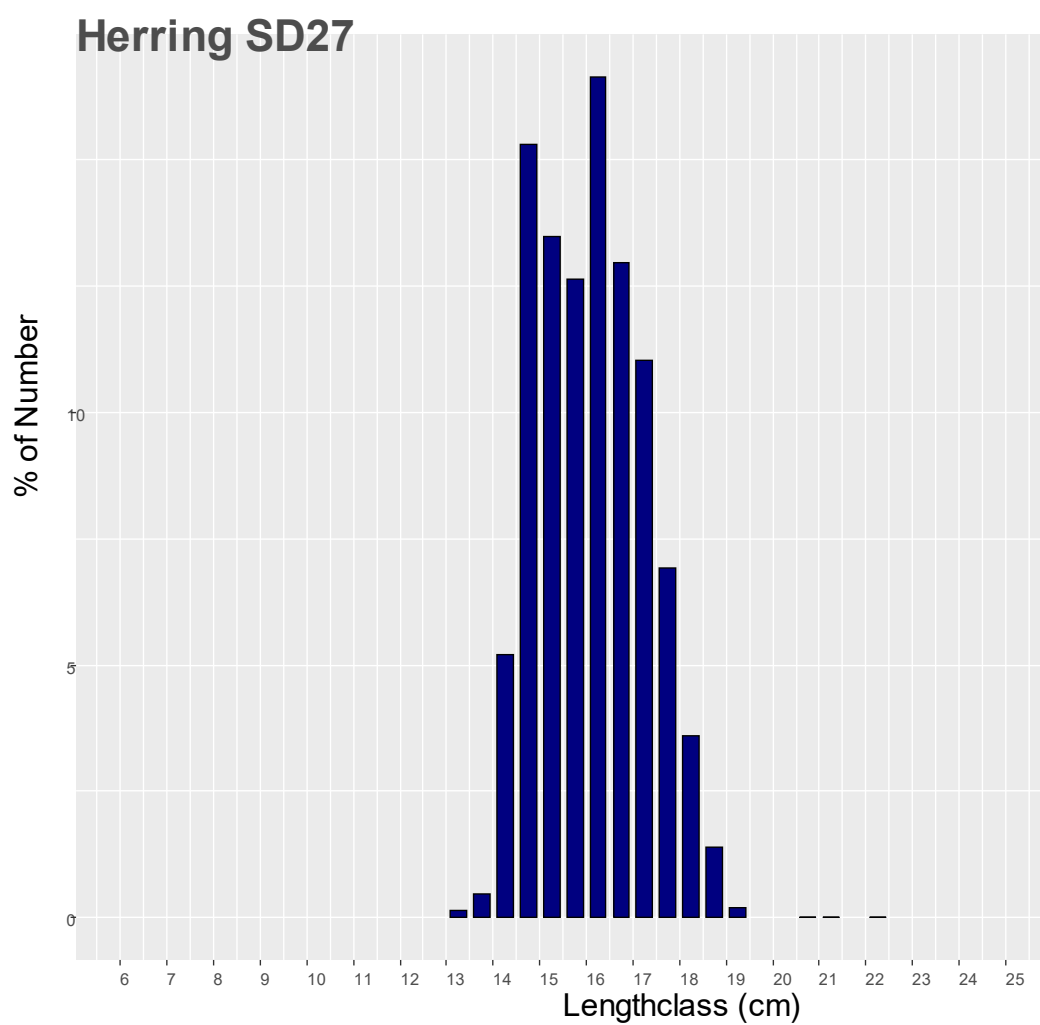


Figure 10. Length distribution of herring from subdivision 27 for BIAS 2023.

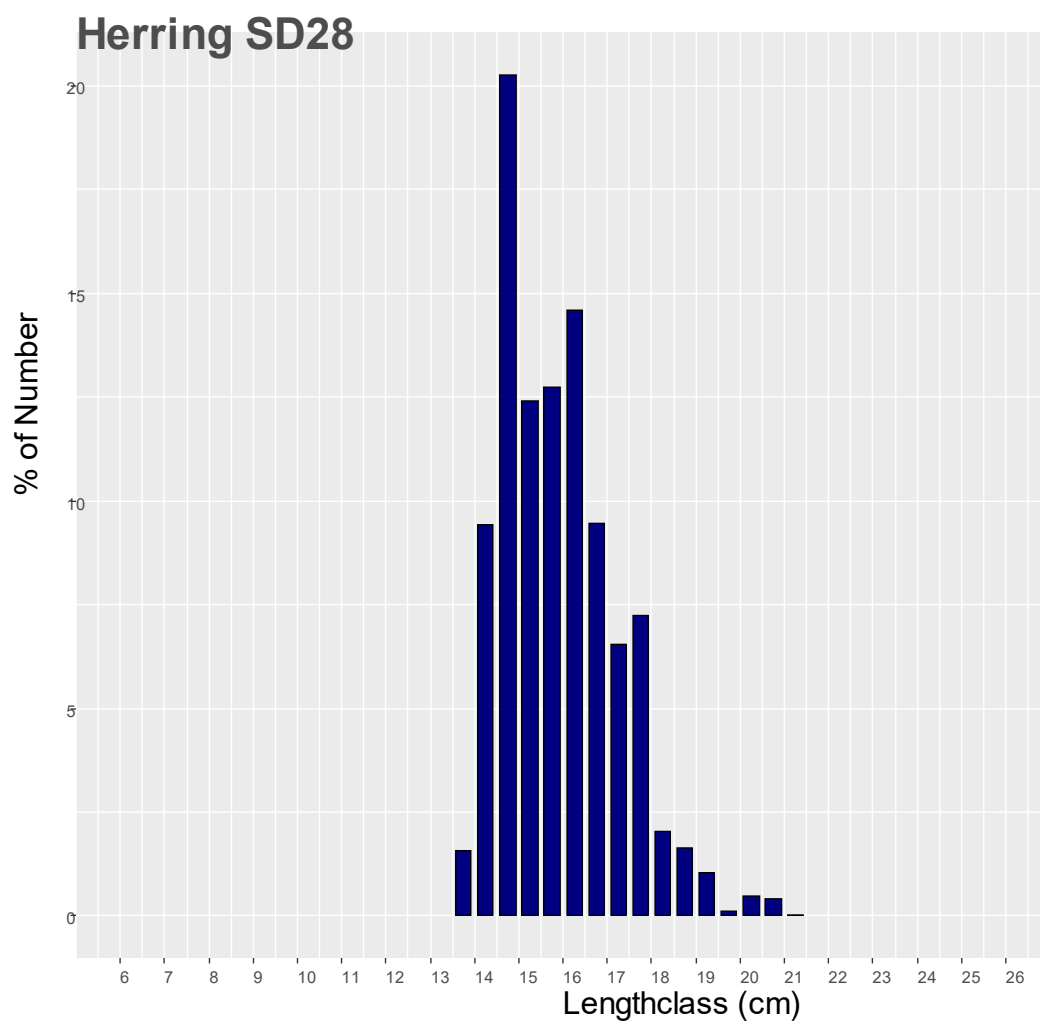


Figure 11. Length distribution of herring from subdivision 28 for BIAS 2023.

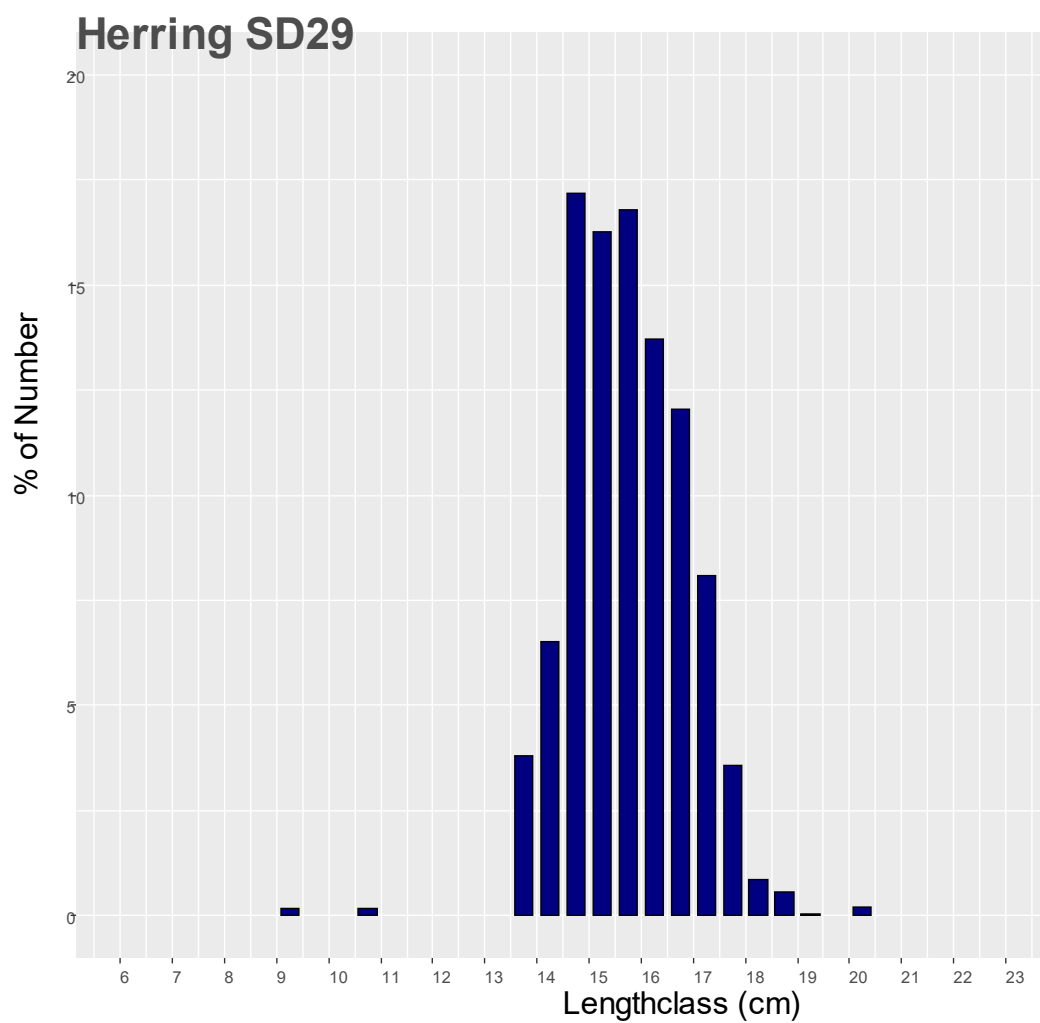


Figure 12. Length distribution of herring from subdivision 29 for BIAS 2023.