Baltic International Acoustic Survey Report for R/V Aranda

Cruise 11/2022

ICES_BIAS_2022
20st September – 3rd October 2022

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INTRODUCTION

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978 (Håkansson et al. 1979). The initial Finnish-Estonian (FIN-EST) research survey on the R/V Baltica was realised in October 2006 (Grygiel et al. 2007), in the framework of the long-term ICES Baltic International Acoustic Surveys (BIAS) programme. The FIN-EST BIAS surveys on the R/V Baltica were continued until 2012. Since 2007, Finland and Sweden joined together to additionally cover Bothnian Sea (ICES Subdivision 30). In 2012 Sweden could not support the funding of the survey in the Bothnian Sea due to economic difficulties within the DCF program and therefore the coverage of the SD30 had to be based on Finnish funding which resulted in half the normal effort (ICES 2013). In 2013, Finland installed fishing equipment and a Simrad EK60 echo sounder into the R/V Aranda and used the vessel in order to cover ICES SDs 29N, 30, and 32N. In 2017, the R/V Aranda was in dry dock for major renovation and therefore Danish R/V Dana was hired for Finnish BIAS2017 survey. Since 2018, R/V Aranda was used again.

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. 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). The aim of the cruise was to carry out Baltic International Acoustic Survey on herring and sprat covering SDs 29N, 30, and 32N during the autumn 2022, within the remit of the Natural Resources Institute Finland (Luke).

MATERIALS AND METHODS

NARRATIVE

The cruise was completed in two legs covering most of the Bothnian Sea (BS), the Northern Baltic Sea and the Gulf of Finland (GoF). Altogether 44 stations of 49 planned were completed during the survey. The research area, cruise track and trawl stations are shown in Figure 1. At every trawl station and calibration site a CTD (Conductivity Temperature Depth) cast was made.

The R/V Aranda departed from the harbour of Helsinki (Finland) on Tuesday 20.09.2022 at 16:55 (UTC 13:55) and the direct at sea research begun. Investigations were continued in the northern direction to SD 30. All at sea research were finalised in the morning 02.10.2022 and the vessel was navigated back to the port of Helsinki.

The Finnish BIAS 2022 survey had only a slight deviation from the original plan when the trawling could not be performed due to low fish abundance or stormy weather. In addition, Swedish authorities didn't allow R/V Aranda to use scientific echo-sounder in the territorial water of Sweden. Therefore, any research investigations were done in the Swedish territorial areas.

SURVEY DESIGN AND HYDROGRAPHICAL DATA

During the cruise, echo-integration was performed along the survey track from ICES Sub-Divisions 29N, 30, and 32N. A SeaBird CTD instrument (SBS 19 plus) was used with state-of-the-art sensors for salinity, temperature, oxygen, connectivity and depth.

CALIBRATION

The SIMRAD EK60 echo sounder with 38 kHz transducer was calibrated on 15.9.2022 on (N60°06.62', E025°00.12'), according to manuals (ICES 2017; Demer *et al*. 2015). The reference target strength of the 60 mm diameter copper sphere under the prevailing conditions was calculated using a web page application (https://swfscdata.nmfs.noaa.gov/AST/SphereTS/). Values from the calibration were within required accuracy (RMS = 0.13 dB)

ACOUSTIC DATA COLLECTION

The acoustic sampling was performed around the clock. SIMRAD EK60 echo sounder with the 38 kHz drop keel mounted transducer (ES38B) 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 done using the Echoview software (www.echoview.com). The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary distance sampling units (ESDUs) from 10 m below the surface to the bottom at 10 m intervals.

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, 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 neighbouring rectangles was used. From these distributions the mean acoustic cross-section was calculated according to the target strength (TS) - length (L) relationships TS = m log L (cm) – a, where species specified constants m and a were found in list below.

AcoCat	SpecCat	m	a
ABZ	Ammodytes tobianus	20	-71.2
ELE	Anguilla anguilla	20	-67.5
GAR	Belone belone	20	-67.5
HER	Clupea harengus	20	-71.2
LUM	Cyclopterus lumpus	20	-67.5
ENC	Enchelyopus cimbrius	20	-67.5
ANE	Engraulis encrasicolus	20	-67.5
COD	Gadus morhua	20	-67.5
GTA	Gasterosteus aculeatus	20	-71.2
GSE	Hyperoplus lanceolatus	20	-71.2
LAR	Lampetra fluviatilis	20	-67.5
LEM	Leptoclinus maculatus	20	-67.5
LIL	Liparis liparis	20	-67.5
LUL	Lumpenus lampretaeformis	20	-67.5
WHG	Merlangius merlangus	20	-67.5
TGQ	Myoxocephalus quadricornis	20	-67.5
MYS	Myoxocephalus scorpius	20	-67.5
NEM	Neogobius melanostomus	20	-67.5
NRO	Nerophis ophidion	20	-67.5
SME	Osmerus eperlanus	20	-71.2
FLE	Platichthys flesus	20	-71.2
PLE	Pleuronectes platessa	20	-67.5
GOB	Pomatoschistus	20	-71.2
POM	Pomatoschistus microps	20	-67.5
GPT	Pungitius pungitius	20	-71.2
SAL	Salmo salar	20	-71.2
TRS	Salmo trutta	20	-71.2
MAC	Scomber scombrus	20	-84.9
TUR	Scophthalmus maximus	20	-67.5
SPR	Sprattus sprattus	20	-71.2
SYM	Symphodus	20	-67.5
ELP	Zoarces viviparus	20	-67.5

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 δ (sigma). The total number was separated into different fish species according to the mean catch composition in the rectangle.

PERSONNEL

Cruise leader during the survey was Juha Lilja from Natural Resources Institute Finland (Luke). The acoustic measurements were performed by Natural Resources Institute Finland (Luke) as well as fish sampling. The participating scientific crew can be seen in the list below.

Chief scientist:	Juha Lilja	LUKE	
IT chief:	Perttu Rantanen	LUKE	20.09.2022 - 03.10.2022
	Anna Reunamo	SYKE	27.09.2022 - 03.10.2022
	Anu Lastumäki	SYKE	20.09.2022 - 03.10.2022
	Jukka Pönni	LUKE	20.09.2022 - 03.10.2022
	Jari Raitaniemi	LUKE	20.09.2022 - 27.09.2022
	Hannu Harjunpää	LUKE	20.09.2022 - 03.10.2022
	Topi Lehtonen	LUKE	27.09.2022 - 03.10.2022
	Velimatti Leinonen	LUKE	20.09.2022 - 27.09.2022
	Erkki Jaala	LUKE	20.09.2022 - 03.10.2022
	Riku Helisevä	LUKE	20.09.2022 - 03.10.2022
	Tommi Lindroth	FISH	20.09.2022 - 03.10.2022
	Toni Nikaniemi	FISH	20.09.2022 - 03.10.2022
	Jani Helminen	LUKE	27.09.2022 - 03.10.2022
	Roope Lehmonen	LUKE	20.09.2022 - 03.10.2022
	Jukka Pohtila	LUKE	20.09.2022 - 03.10.2022
	Markku Gavrilov	LUKE	20.09.2022 - 03.10.2022
	Pia Lindberg-Lumme	LUKE	20.09.2022 - 03.10.2022
	Rickard Yngwe	SLU	20.09.2022 - 03.10.2022
	Per Andersson	SLU	20.09.2022 - 03.10.2022

Luke: Luonnonvarakeskus / Natural Resources Institute Finland
SYKE: Suomen ympäristökeskus / Finnish Environment Institute
SLU: Sveriges lantbruksuniversitet / Swedish University of Agricultural Sciences

RESULTS

FISH CATCHES, BIOLOGICAL AND HYDRO-METEOROLOGICAL DATA

The number of planned trawling stations was 49. From these, 44 trawling stations were accomplished, and from those all were counted as "valid" (technically sound hauls and sufficient catch for a sample) (Table 1). The total number of trawling stations in Bothnian Sea (ICES SD 30) was 29 and 9 in northern Baltic proper (SD 29). In addition, 6 trawl hauls were done in the northern Gulf of Finland (SD 32).

The 9009 kg combined catches (Table 1) consisted of 22 fish species (8804 kg) and mostly unidentified organic matter categorized as "waste" (179 kg), but also small amounts of common jellyfish *Aurelia aurita* (26.5 kg) and the isopod *Saduria entomon*. The most common and abundant species were herring (*Clupea harengus*) (4359 kg), sprat (*Sprattus sprattus*) (3108 kg) and three-spined stickleback (*Gasterosteus aculeatus*) (1130 kg). All observed species are presented in Table 2. From the sub-samples of the 44 fish catches a total of 20628 measurements for species-specific length distributions (0,5 cm interval for herring and sprat, and 1 cm interval for other species) were performed according to Table 3.

Ten individual samples per statistical rectangle for age determination and maturity definitions by length-class were collected from herring and sprat, 3923 and 1935 samples respectively (Table 4). The mean weights for each length-class were also derived from these individual fish samples.
In addition, from BIAS survey on R/V Aranda 100 specimens of herring were collected from the Sea of Bothnia for contaminant analysis of Swedish Museum of Natural History (NRM).

Hydrographical data: temperature (°C), oxygen concentration (ml/l), salinity (psu), sound speed (m/s), oxygen concentration (% saturation), conductivity (mS/cm) and sound speed (m/s) were measured. Total of 44 CTD casts were done during the entire cruise.

ABUNDANCE ESTIMATES

The total area covered by the Finnish BIAS survey was 21537 square nautical miles (nmi^2), 29 rectangles, and after the scrutinizing, the distance used for acoustic estimates was 1406 nautical miles (nmi). The cruise track and positions of trawl hauls are shown in Figure 1. Abundance of Bothnian Sea herring in SD 30 from 2007 to 2022 with StoX calculations are shown in Figure 2. The survey statistics e.g., total abundance of herring and sprat are presented in Table 6. Estimated numbers of herring and sprat by age group in Subdivision 29 and 32 are given in Table 7 and Table 10, respectively. Corresponding mean weights by age group in Subdivision 29 and 32 are shown in Table 8 and Table 11, respectively. Estimates of herring and sprat biomass by age group in Subdivision 29 and 32 are summarized in Table 9 and Table 12, respectively.
Survey statistics for Bothnian Sea herring SD 30 based on StoX calculations in 2022 are given in Table 13. Estimated numbers, biomass, and mean weight of Bothnian Sea herring by age group in SD 30 were summarized in Table 14, Table 15, and Table 16, respectively.

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TABLES, MAP, AND FIGURES

Table 1. Trawl catches (kg) by species/category during the Finnish BIAS-survey in 2022.

Haul number	SD	Rectangle	Ammodytes tobianus	Aurelia aurita	Clupea harengus	Coregonus albula	Cyclopterus lumpus	Gadus morhua	Gasterosteus aculeatus	Gymnocephalus cernuus	Hyperoplus lanceolatus	Lampetra fluviatilis	Liparis liparis	Myoxocephalus scorpius	Nerophis ophidion	Osmerus eperlanus	Perca fluviatilis	Platichthys flesus	Pomatoschistus minutus	Pungitius pungitius	Saduria entomon	Salmo salar	Sprattus sprattus	Syngnathus typhle	Triglopsis quadricornis	Zoarces viviparus	"Waste"	Fish Catch
1	32	47H0		4.2	112.9				27.4											0.1		0.2	112.9				34.3	253.5
2	29	47H0		3.1	56.1		0.8		55.4						0.0					0.0			49.7				11.8	162.0
3	29	48G9		2.3	124.3				54.8											1.1		0.2	127.3	0.0				307.7
4	29	48H0		2.2	32.2				38.6						0.0					0.3			343.0				3.7	414.0
5	29	48H1			100.2				10.7					0.2	0.0	0.1				0.1			188.2				8.5	299.5
6	29	48H1		10.0	44.9		0.4		30.3						0.0					0.0			53.8				2.6	129.4
7	30	48H2			16.4				5.7						0.0	0.4				0.2	0.0		340.5				0.7	363.3
8	30	48H2		4.1	2.7		0.1		3.7						0.0					0.1			499.7				2.6	506.3
9	30	48H3			131.8		0.1		1.9						0.0	0.7		0.2		0.4	0.0	10.8	155.3				5.7	301.3
10	30	48H3			9.0		10.6		9.4											0.1			452.8	0.1			16.0	482.0
11	30	48H4			147.2				1.0							0.2				0.1			234.8				8.7	383.3
12	30	48H5			130.4				3.3							0.0				0.6			46.6				1.0	181.0
13	30	49G9		0.5	112.0			0.1	34.2		0.1		0.1		0.0					0.8	0.0	0.5	38.3				0.6	185.9
14	30	49H5			118.0				0.4							1.5				0.1			146.4				4.6	266.4
15	30	49H6			47.7	0.1			2.8			0.0				107.5	0.1			0.2	0.0		113.6				7.0	272.0
16	30	50G8	0.1		54.0				4.7						0.0					0.0	0.0		18.5				2.7	77.3
17	30	50G9			137.6				6.9						0.0	0.5				0.0			6.0					151.0
18	30	50G9			45.6				3.6											0.0		0.2	1.5				0.2	50.8
19	30	50H0			154.6				12.5							7.8			0.0	0.0		0.1	3.3				25.6	178.4
20	30	51G8	0.1		95.0				1.6						0.0								0.9				4.8	97.5
21	30	51G8			261.1				113.4														2.4					377.0
22	30	51G9			23.5				18.8						0.0	0.0				0.0	0.0		22.3				0.4	64.6
23	30	51G9			55.1				58.6											0.1			39.5				11.8	153.2
24	30	51H0			109.2				2.5							3.1				0.0			1.1				5.1	115.9
25	30	51H0	0.0		55.6				2.1			0.0				0.6					0.0		2.5			0.0	0.2	60.8
26	30	52G8			137.1				58.2						0.0								2.1	0.1			1.4	197.6
27	30	52G8			60.8				32.6						0.0					0.2		0.2	5.2					99.0
28	30	52G9			6.0				184.3														0.7					191.0
29	30	52G9			61.1				11.1						0.0					0.0			22.4				1.4	94.6
30	30	52H0			76.4				19.6													0.3	15.6				2.1	111.9
31	30	52H0			136.9				3.6				0.1		0.0				0.0	0.0		0.2	8.3				0.9	149.1
32	30	53G8			69.0				25.9														3.2				0.4	98.1
33	30	53G8			58.7				77.6														1.2				0.5	137.5
34	30	53G9			110.1				133.2												0.1		0.4				0.2	243.7
35	30	53G9	0.0		67.3				9.0											0.0			2.5				0.2	78.8
36	29	53H0			167.2				24.3							1.6					0.0		23.9				1.0	217.0
37	29	53H0			167.4				6.4						0.0							0.2	8.3				0.7	182.3
38	29	54G8			52.3				14.9						0.0						0.0						1.8	67.2
39	29	54G9			257.2				3.5																		4.3	260.7
40	32	54G9			44.0				2.3			0.0								0.0			1.4				2.3	47.7
41	32	54H0			162.0				3.2							39.4							0.8				3.1	205.4
42	32	54H0	0.1		205.5				0.8							11.5							1.1					219.0
43	32	55G9			242.6				7.1												0.0		5.3					255.0
44	32	55H0			100.4	0.0			8.4											0.0	0.1		5.1					113.9
	Total		0.2	26.5	4359.1	0.1	12.0	0.1	1130.2	0.0	0.1	0.1	0.1	0.2	0.2	174.9	0.1	0.2	0.0	4.6	0.3	12.8	3108.4	0.1	0.1	0.0	178.9	8803.6

Table 2. English, scientific, and Finnish names of observed species in Finnish 2022 BIAS-survey.

Fishnames		
English	**Scientific**	**Finnish**
Atlantic Salmon	Salmo salar	Lohi
Brown Trout	Salmo trutta	Meritaimen
Cod	Gadus morhua	Turska
Common Goby	Pomatoschistus microps	Liejutokko
Common Seasnail	Liparis liparis	Imukala
European Whitefish	Coregonus lavaretus	Siika
Flounder	Platichthys flesus	Kampela
Fourhorn Sculpin	Triglopsis quadricornis	Härkäsimppu
Great Sandeel	Hyperoplus lanceolatus	Isotuulenkala
Herring	Clupea harengus	Silakka
Lamprey	Lampetra fluviatilis	Nahkiainen
Lesser Sandeel	Ammodytes tobianus	Pikkutuulenkala
Lumpsucker	Cyclopterus lumpus	Rasvakala
Nine-spined Stickleback	Pungitius pungitius	Kymmenpiikki
Perch	Perca fluviatilis	Ahven
Pipefish	Syngnathus typhle	Särmäneula
Rock Gunnel	Pholis gunnellus	Teisti
Round Goby	Neogobius melanostomus	Mustatäplätokko
Ruffe	Gymnocephalus cernuus	Kiiski
Sand Goby	Pomatoschistus minutus	Hietatokko
Shorthorn Sculpin	Myoxocephalus scorpius	Isosimppu
Smelt	Osmerus eperlanus	Kuore
Snake bBlenny	Lumpenus lampretaeformis	Elaska
Snake blenny	Zoarces viviparus	Kivinilkka
Sprat	Sprattus sprattus	Kilohaili
Straightnose Pipefish	Nerophis ophidion	Siloneula
Three-spined Stickleback	Gasterosteus aculeatus	Kolmipiikki
Turbot	Scophthalmus maximus	Piikkikampela
Vendace	Coregonus albula	Muikku

Table 3. Number of length measurements /species and Sub-Division in Finnish 2022 BIAS-survey.

Species	ICES SD			Total
	29	30	32	
Ammodytes tobianus		9		9
Clupea harengus	2356	8592	1560	12508
Coregonus albula			1	1
Cyclopterus lumpus	13		6	19
Gadus morhua	1			1
Gasterosteus aculeatus	502	1740	288	2530
Gymnocephalus cernuus		1		1
Hyperoplus lanceolatus	4			4
Lampetra fluviatilis		3	1	4
Liparis liparis	1			1
Myoxocephalus scorpius	1			1
Nerophis ophidion	38	15	1	54
Osmerus eperlanus	4	163	45	212
Perca fluviatilis			1	1
Platichthys flesus			1	1
Pomatoschistus minutus		2		2
Pungitius pungitius	98	49	199	346
Salmo salar	6	5	1	12
Sprattus sprattus	1664	2011	989	4664
Syngnathus typhle	2		2	4
Triglopsis quadricornis		1		1
Zoarces viviparus		1		1
Total	4690	12592	3095	20377

Table 4. Individual samples of herring and sprat (for age determination) per SD in 2022.

Length class	Sprat			Sprat Total	Herring			Herring Total
	29	30	32		29	30	32	
45						2		2
50						5		5
55						20	1	21
60					1	21	2	24
65	7	1		8	3	50	5	58
70	29	3	1	33	20	47	16	83
75	61	17	7	85	62	75	27	164
80	76	21	14	111	68	69	40	177
85	81	40	22	143	86	93	45	224
90	16	13	2	31	20	32	16	68
95	4	12	1	17	21	29	12	62
100	14	4	9	27	18	20	13	51
105	61	35	49	145	7	21	6	34
110	63	91	49	203	3	10	3	16
115	63	115	51	229	4	10	3	17
120	61	135	51	247	2	8	6	16
125	52	141	51	244	15	20	20	55
130	33	133	39	205	28	66	42	136
135	3	109	11	123	40	129	50	219
140	1	58	2	61	39	159	50	248
145		21		21	44	171	50	265
150		2		2	41	181	49	271
155					38	181	50	269
160					32	176	50	258
165					25	165	46	236
170					19	165	28	212
175					7	158	9	174
180					3	134	1	138
185						120		120
190						98	1	99
195						79		79
200						50		50
205						28		28
210						18		18
215					1	7		8
220						12		12
230						2		2
235						1	1	2
265						1		1
295							1	1
Total	625	951	359	1935	647	2633	643	3923

Table 5. Numbers and locations of fishing stations (WGS-84) during Finnish BIAS-survey in 2022.

HaulNumber	HaulStationName	SD	HaulStartTime	HaulDuration (min)	HaulStartLatitude	HaulStartLongitude	HaulStopLatitude	HaulStopLongitude	HaulTrawlHeadrope	HaulBottomDepth	HaulDistance	HaulNetopening
1	48H3-1	32	2022-09-20T22:01	30	59.67350	23.15650	59.69433	23.18267	23	60	2778	12.3
2	48H2-1	29	2022-09-21T02:15	15	59.65333	22.57650	59.66333	22.55167	17	60	1389	20
3	48H1-1	29	2022-09-21T08:00	80	59.69967	21.06250	59.74550	20.97600	15	135	6914	17
4	48H0-1	29	2022-09-21T11:41	60	59.66667	20.89483	59.71633	20.82550	15.8	70	5556	18
5	48G9-1	29	2022-09-21T17:00	45	59.78883	19.94250	59.78983	19.87917	15.8	200	4167	17.6
6	49G9-1	29	2022-09-21T21:11	45	60.02650	19.43100	60.05734	19.38233	15.8	170	4306	20
7	50G8-1	30	2022-09-22T03:16	90	60.77934	18.83133	60.85567	18.82183	14.3	70	8334	16.8
8	51G8-1	30	2022-09-22T17:55	60	61.32784	18.89583	61.27883	18.88650	15.8	70	5371	17
9	51G8-2	30	2022-09-22T22:10	60	61.28750	18.12050	61.28817	18.08217	14.3	70	5556	17.1
10	52G8-1	30	2022-09-23T02:02	50	61.49133	18.07467	61.57084	18.07867	14.3	65	4630	16.9
11	52G9-1	30	2022-09-23T07:59	60	61.68600	19.15683	61.63583	19.14400	12.7	80	5556	15.9
12	52G8-2	30	2022-09-23T14:11	82	61.85267	18.22900	61.79133	18.18950	11.1	90	7593	15
13	53G8-1	30	2022-09-23T19:01	60	62.07167	18.15050	62.10717	18.22300	9.5	85	5556	15.4
14	53G8-2	30	2022-09-23T22:49	45	62.12734	18.60650	62.08967	18.59400	12.7	90	4167	17.5
15	53G9-1	30	2022-09-24T01:45	75	62.11517	19.15150	62.05267	19.08183	12.7	87	6945	17.3
16	54G8-1	30	2022-09-24T12:22	90	62.62900	18.80233	62.68817	18.80633	85.5	120	6667	19.6
17	54G9-1	30	2022-09-24T18:00	60	62.64517	19.33433	62.69333	19.34000	15.8	160	5371	16.2
18	55G9-1	30	2022-09-24T22:13	67	63.03617	19.41083	63.05734	19.52883	14.3	150	6204	16.5
19	55H0-1	30	2022-09-25T01:58	70	63.14367	20.06500	63.16033	20.18900	12.7	90	6482	16.4
20	54G9-2	30	2022-09-25T09:08	108	62.68067	19.53617	62.59667	19.53500	15.8	125	9001	16.8
21	54H0-1	30	2022-09-25T17:50	60	62.69000	20.22950	62.73417	20.18200	12.7	80	5556	16.3
22	54H0-2	30	2022-09-25T20:09	90	62.81583	20.43500	62.86633	20.33650	7.9	70	7223	21.1
23	53H0-1	30	2022-09-26T02:04	45	62.47867	20.35017	62.45417	20.41650	12.7	80	4167	16.7
24	53G9-2	30	2022-09-26T06:13	100	62.17617	19.84817	62.11033	19.93250	12.7	130	8334	14.7
25	52G9-2	30	2022-09-26T11:01	105	61.98450	19.89567	61.90917	19.97400	12.7	110	9723	18.5
26	52H0-1	30	2022-09-26T18:52	45	61.60600	20.15283	61.58967	20.21733	15.8	130	4028	16.3
27	52H0-2	30	2022-09-26T22:37	60	61.86550	20.23450	61.83767	20.31700	15.8	120	5556	18.8
28	53H0-2	30	2022-09-27T02:38	60	62.06600	20.35533	62.04083	20.44350	15.8	110	5556	17.1
29	51H0-1	30	2022-09-27T19:46	60	61.47750	20.78683	61.45750	20.88067	12.7	70	5556	15
30	51H0-2	30	2022-09-27T23:42	60	61.33300	20.52367	61.30983	20.61633	15.8	100	5186	18.4
31	51G9-1	30	2022-09-28T04:50	55	61.33484	19.78700	61.32267	19.90517	12.7	110	5093	16.3
32	51G9-2	30	2022-09-28T10:12	60	61.10900	19.72517	61.10883	19.82667	15.8	120	5371	16.5
33	50H0-1	30	2022-09-28T19:13	60	60.85483	20.45967	60.87117	20.55083	12.7	75	5556	16.2
34	50G9-1	30	2022-09-28T22:30	60	60.87667	19.83983	60.88217	19.93867	14.3	95	5556	17.8
35	50G9-2	30	2022-09-29T02:15	60	60.89400	19.50467	60.90800	19.59133	11.1	100	5371	11
36	47H0-1	29	2022-09-29T18:55	30	59.31033	20.27033	59.32650	20.30483	12.7	65	2778	16.4
37	47H0-2	29	2022-09-29T23:25	45	59.18300	20.90200	59.21533	20.87567	15.8	100	4167	17.1
38	48H1-2	29	2022-09-30T04:14	30	59.52117	21.12450	59.53083	21.16917	15.8	75	2778	16.8
39	48H2-2	29	2022-09-30T08:34	60	59.52984	22.15817	59.54433	22.24450	11.1	70	5556	17
40	48H3-2	32	2022-09-30T14:32	45	59.54217	23.38550	59.55383	23.45700	15.8	90	4167	17.2
41	48H4-1	32	2022-09-30T21:13	45	59.86533	24.75133	59.87200	24.82283	12.7	65	4167	15.7
42	48H5-1	32	2022-09-30T23:55	60	59.92750	25.09917	59.92733	25.19200	12.7	60	5556	15.5
43	49H6-1	32	2022-10-01T18:40	45	60.13183	26.33167	60.09483	26.33767	14.3	65	4167	16.7
44	49H5-1	32	2022-10-02T00:53	60	60.01317	25.04117	60.06067	25.05800	14.3	60	5556	16.7

Table 6. Survey statistics by area in SDs 29, 30 and 32 (r/v Aranda in 2022).

ICES SD	ICES Rect.	NM	N (million/nm²)	Area (nm²)	Sa (m²/nm²)	σ (cm²)	N total (million)	Herring (%)	Sprat (%)	Cod (%)	3-spinn. (%)
29	47H0	59	11.3286	920.3	780.674	0.68912	10425.68	34.03	14.44	0.00	51.41
29	48G9	51	10.5764	772.8	722.397	0.683027	8173.445	27.06	25.20	0.00	47.50
29	48H0	44	11.0033	730.3	828.577	0.753027	8035.701	10.71	60.51	0.00	28.51
29	48H1	56	15.2937	544	1207.142	0.789308	8319.761	21.81	42.10	0.00	35.83
29	48H2	61	10.7803	597	1172.075	1.087238	6435.84	3.61	93.87	0.00	2.37
32	48H3	64	7.4899	615.7	965.893	1.289597	4611.518	14.13	77.34	0.00	7.23
32	48H4	58	7.5161	835.1	1085.989	1.444885	6276.688	31.60	66.48	0.00	1.50
32	48H5	28	5.9261	767.2	917.216	1.547768	4546.468	48.99	33.39	0.00	12.68
29	49G9	35	7.2060	564.2	575.519	0.79867	4065.609	21.29	14.54	0.00	62.86
32	49H5	28	8.5202	306.9	1204.485	1.413682	2614.849	35.10	62.62	0.00	0.99
32	49H6	44	5.3231	586.5	846.433	1.590106	3122.011	16.95	49.90	0.00	7.53
30	50G8	27	2.5570	833.4	301.887	1.180624	2131.015	49.68	20.59	0.00	28.87
30	50G9	70	1.3166	879.5	224.474	1.704891	1157.99	66.01	4.79	0.00	28.95
30	50H0	37	3.1072	795.1	452.527	1.456373	2470.552	55.09	1.89	0.00	40.92
30	51G7	13	1.4247	614.5	350.231	2.458208	875.5029	83.40	1.30	0.00	15.15
30	51G8	76	2.4636	863.7	400.691	1.626418	2127.844	50.98	0.79	0.00	48.16
30	51G9	59	2.9932	865.8	194.550	0.649964	2591.555	21.31	12.07	0.00	66.47
30	51H0	65	0.7251	865.7	146.224	2.016611	627.7166	74.48	3.61	0.00	20.56
30	52G8	65	3.7635	852	281.864	0.74894	3206.512	16.81	1.29	0.00	81.83
30	52G9	69	2.3183	852	150.922	0.650992	1975.221	27.04	6.64	0.00	66.23
30	52H0	62	1.2736	852	184.432	1.448165	1085.068	48.54	8.16	0.00	43.19
30	53G8	55	4.2678	838.1	302.409	0.708578	3576.867	13.97	0.90	0.00	85.12
30	53G9	59	2.3464	838.1	193.356	0.824072	1966.479	27.42	1.26	0.00	71.29
30	53H0	71	2.1338	838.1	299.093	1.401726	1788.296	49.88	7.30	0.00	42.57
30	54G8	13	3.2360	642.2	322.810	0.99756	2078.159	25.08	0.00	0.00	74.82
30	54G9	43	1.2984	824.2	261.189	2.011556	1070.176	70.01	1.55	0.00	28.26
30	54H0	60	1.4286	727.9	319.880	2.239173	1039.851	76.29	0.80	0.00	8.65
30	55G9	16	1.4525	625.6	260.312	1.792129	908.7008	72.17	2.55	0.00	25.28
30	55H0	18	2.5678	688.6	191.520	0.745864	1768.157	25.14	2.31	0.00	72.49

Table 7. Numbers (millions) of herring by age in SDs 29 and 32 (r/v Aranda 2022).

SD	Rect	0	1	2	3	4	5	6	7	8+	Total
29	47H0	2853.87	51.49	190.40	229.86	76.34	50.30	22.01	49.72	23.58	3547.59
29	48G9	1879.27	68.24	116.38	98.76	25.25	10.83	2.41	4.10	6.51	2211.75
29	48H0	860.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	860.57
29	48H1	1340.84	117.41	151.93	108.93	33.76	21.08	8.25	20.51	11.84	1814.54
29	48H2	217.98	4.53	4.74	3.28	0.58	0.36	0.09	0.35	0.19	232.10
32	48H3	328.51	9.52	107.01	53.71	58.17	30.66	6.52	27.86	29.57	651.53
32	48H4	451.18	170.82	757.28	212.92	141.27	77.61	16.28	72.92	83.36	1983.64
32	48H5	102.92	102.33	927.34	343.48	290.28	152.59	33.89	133.23	141.38	2227.44
29	49G9	141.31	168.49	224.75	171.27	57.23	32.98	13.83	31.81	23.93	865.60
32	49H5	270.42	61.91	335.32	94.83	62.51	35.87	6.95	27.01	23.06	917.87
32	49H6	250.00	22.59	126.98	43.61	32.47	18.13	3.68	17.42	14.37	529.24

Table 8. Mean weight (g) of herring by age in SDs 29 and 32 (r/v Aranda 2022).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Average (g)
29	47H0	8.07	18.03	19.58	20.62	22.00	22.63	25.14	24.59	24.48	10.59
29	48G9	4.35	16.61	18.95	20.26	22.71	21.02	34.33	22.91	27.14	6.63
29	48H0	3.89									3.89
29	48H1	4.67	15.89	18.14	20.23	23.24	23.11	25.54	25.41	25.88	8.48
29	48H2	4.19	15.98	18.06	19.34	20.23	22.35	29.97	22.68	29.47	5.04
32	48H3	7.60	14.50	19.16	20.77	22.57	23.13	22.91	23.37	31.98	14.69
32	48H4	7.21	14.20	17.65	19.71	22.66	23.24	23.27	22.97	25.40	16.34
32	48H5	6.30	14.97	18.53	20.11	22.49	22.99	23.15	23.23	25.27	19.65
29	49G9	4.09	15.87	18.34	20.34	23.07	23.10	27.57	24.81	32.18	17.19
32	49H5	6.31	14.53	17.88	19.62	22.14	25.47	22.55	22.73	24.49	15.36
32	49H6	6.02	14.28	18.12	21.05	22.41	22.59	23.09	23.29	24.36	13.27

Table 9. Total biomass (ton) of herring by age in SDs 29 and 32 (r/v Aranda 2022).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	23019	928	3728	4739	1680	1138	553	1223	577	37585
29	48G9	8175	1133	2205	2001	574	228	83	94	177	14669
29	48H0	3352	0	0	0	0	0	0	0	0	3352
29	48H1	6256	1865	2757	2204	785	487	211	521	306	15391
29	48H2	912	72	86	63	12	8	3	8	6	1170
32	48H3	2497	138	2051	1115	1313	709	149	651	946	9569
32	48H4	3253	2425	13367	4196	3201	1803	379	1675	2117	32417
32	48H5	649	1532	17182	6909	6530	3508	784	3095	3572	43761
29	49G9	578	2674	4122	3483	1321	762	381	789	770	14880
32	49H5	1708	900	5997	1861	1384	914	157	614	565	14098
32	49H6	1504	322	2301	918	728	410	85	406	350	7023

Table 10. Numbers (millions) of sprat by age and area (r/v Aranda 2022).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	515.12	102.15	397.40	185.68	99.47	59.31	35.72	29.19	81.07	1505.11
29	48G9	989.00	137.27	455.00	191.20	92.92	58.22	34.73	29.64	71.90	2059.88
29	48H0	2443.15	267.03	1058.73	453.50	222.60	129.43	66.14	56.62	165.17	4862.35
29	48H1	1305.60	290.57	932.38	398.24	197.88	109.10	61.95	52.72	153.99	3502.42
29	48H2	1573.20	553.06	1903.85	822.09	409.69	238.53	124.64	107.82	308.44	6041.32
32	48H3	316.34	201.16	1334.83	569.91	221.89	264.63	96.67	179.04	381.87	3566.35
32	48H4	244.15	168.60	1278.48	648.91	315.31	441.39	182.23	279.76	613.99	4172.83
32	48H5	28.11	74.08	443.85	246.20	119.74	179.15	71.25	108.04	247.78	1518.20
29	49G9	165.28	37.72	148.23	77.74	46.08	31.10	21.66	16.96	46.25	591.04
32	49H5	47.76	84.16	615.25	282.43	115.30	139.09	50.15	88.75	214.46	1637.34
32	49H6	16.97	33.07	357.53	248.38	147.04	224.38	93.15	128.40	308.92	1557.85
30	50G8	202.96	44.88	89.30	25.32	23.08	13.58	8.90	4.45	26.36	438.83
30	50G9	13.28	6.91	13.69	4.33	5.09	3.03	2.18	1.06	5.90	55.47
30	50H0	0.00	4.64	12.61	4.13	5.69	3.64	3.33	1.78	10.91	46.72
30	51G7	0.00	0.32	1.90	0.93	1.59	1.00	1.00	0.63	4.06	11.43
30	51G8	0.00	1.20	3.07	1.43	2.38	1.45	1.36	0.84	5.02	16.74
30	51G9	56.07	43.18	76.09	24.75	30.38	17.97	14.06	7.49	42.86	312.85
30	51H0	0.67	5.29	7.16	2.05	2.06	1.14	0.86	0.51	2.93	22.66
30	52G8	0.39	1.62	6.17	2.64	4.93	3.58	4.05	2.37	15.51	41.26
30	52G9	0.00	29.36	38.22	11.13	12.83	8.15	6.70	3.19	21.61	131.18
30	52H0	0.00	14.69	25.92	8.61	10.64	6.50	5.00	2.55	14.59	88.50
30	53G8	0.00	0.10	2.62	1.79	4.14	2.87	3.46	2.16	15.22	32.35
30	53G9	0.17	2.04	4.33	1.75	2.74	1.79	2.11	1.47	8.34	24.75
30	53H0	0.00	25.85	42.85	12.69	13.64	8.07	5.92	2.97	18.56	130.56
30	54G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54G9	0.00	2.11	5.86	1.79	1.88	1.11	0.81	0.45	2.57	16.57
30	54H0	0.00	1.31	2.07	0.75	0.98	0.64	0.55	0.30	1.75	8.34
30	55G9	0.00	0.88	4.12	1.81	3.11	2.01	2.06	1.24	7.95	23.18
30	55H0	0.00	12.40	12.45	3.65	3.80	2.27	1.54	0.70	4.07	40.87

Table 11.Mean weight (g) of sprat by age and area (r/v Aranda 2022).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Average (g)
29	47H0	3.75	8.76	9.88	10.43	10.87	11.16	11.93	11.70	11.40	8.06
29	48G9	3.88	8.68	9.65	10.21	10.82	11.20	12.09	11.86	11.41	7.10
29	48H0	3.36	8.95	9.73	10.24	10.76	10.94	11.72	11.41	11.31	6.72
29	48H1	3.65	8.56	9.71	10.25	10.79	10.96	11.78	11.48	11.32	7.65
29	48H2	3.32	8.69	9.74	10.27	10.77	10.99	11.74	11.45	11.28	8.31
32	48H3	3.44	8.67	9.17	9.62	10.10	10.56	10.70	10.29	10.40	9.09
32	48H4	4.26	8.81	9.29	9.89	10.39	10.81	11.29	10.71	10.85	9.73
32	48H5	3.57	8.29	9.29	9.94	10.38	10.84	11.14	10.74	10.81	9.95
29	49G9	3.97	8.53	9.94	10.65	11.15	11.54	12.17	11.97	11.84	8.74
32	49H5	4.35	8.66	9.23	9.65	10.13	10.52	10.77	10.26	10.62	9.59
32	49H6	4.71	8.60	9.50	10.10	10.54	10.86	11.31	10.83	11.10	10.35
30	50G8	4.33	10.80	12.02	12.33	12.90	13.01	13.67	14.17	14.03	8.61
30	50G9	4.84	10.67	12.07	12.55	13.20	13.36	13.78	14.00	14.01	10.69
30	50H0		11.35	12.09	12.68	13.42	13.67	14.24	14.60	14.59	13.19
30	51G7		11.35	12.70	13.12	13.51	13.72	14.44	14.71	15.46	14.14
30	51G8		10.88	12.54	13.04	13.45	13.66	14.28	14.49	15.30	13.76
30	51G9	4.64	10.75	12.04	12.57	13.24	13.39	13.95	14.32	14.44	11.24
30	51H0	4.96	10.78	11.90	12.32	12.90	13.07	13.80	14.24	15.06	12.15
30	52G8	4.10	11.21	12.36	13.00	13.75	14.02	14.62	14.91	15.07	13.97
30	52G9	0.00	10.61	11.82	12.35	13.27	13.50	14.11	14.52	14.51	12.47
30	52H0		10.58	12.07	12.58	13.28	13.44	13.95	14.22	14.26	12.65
30	53G8		12.21	12.84	13.45	13.88	14.05	14.76	15.18	15.40	14.68
30	53G9	5.42	10.78	12.35	12.85	13.46	13.74	14.60	14.91	15.17	13.73
30	53H0		10.80	11.96	12.40	13.10	13.27	13.84	14.23	14.48	12.47
30	54G8										
30	54G9		10.85	12.13	12.51	13.07	13.19	13.88	14.37	14.36	12.68
30	54H0		9.94	12.23	12.64	13.38	13.56	14.21	14.45	14.49	12.83
30	55G9		11.43	12.41	13.04	13.62	13.79	14.49	14.91	15.05	13.93
30	55H0		10.32	11.73	12.24	13.12	13.24	13.70	13.93	13.89	11.89

Table 12.Total biomass (ton) of sprat by age and area (r/v Aranda 2022).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	1933	894	3926	1937	1082	662	426	342	924	12125
29	48G9	3837	1192	4390	1951	1006	652	420	351	821	14620
29	48H0	8215	2391	10303	4644	2394	1416	775	646	1868	32653
29	48H1	4771	2487	9054	4082	2135	1195	730	605	1743	26803
29	48H2	5222	4806	18546	8445	4411	2622	1463	1235	3480	50231
32	48H3	1087	1743	12240	5482	2241	2793	1035	1843	3972	32436
32	48H4	1039	1485	11881	6415	3277	4773	2057	2997	6660	40584
32	48H5	100	614	4123	2447	1243	1942	793	1160	2679	15102
29	49G9	657	322	1474	828	514	359	264	203	548	5168
32	49H5	208	729	5682	2726	1168	1464	540	911	2277	15704
32	49H6	80	284	3396	2509	1550	2438	1054	1390	3428	16129
30	50G8	878	485	1073	312	298	177	122	63	370	3777
30	50G9	64	74	165	54	67	40	30	15	83	593
30	50H0	0	53	153	52	76	50	47	26	159	616
30	51G7	0	4	24	12	22	14	14	9	63	162
30	51G8	0	13	38	19	32	20	19	12	77	230
30	51G9	260	464	916	311	402	241	196	107	619	3517
30	51H0	3	57	85	25	27	15	12	7	44	275
30	52G8	2	18	76	34	68	50	59	35	234	577
30	52G9	0	312	452	137	170	110	94	46	313	1635
30	52H0	0	155	313	108	141	87	70	36	208	1119
30	53G8	0	1	34	24	57	40	51	33	234	475
30	53G9	1	22	54	23	37	25	31	22	126	340
30	53H0	0	279	512	157	179	107	82	42	269	1628
30	54G8	0	0	0	0	0	0	0	0	0	0
30	54G9	0	23	71	22	25	15	11	6	37	210
30	54H0	0	13	25	9	13	9	8	4	25	107
30	55G9	0	10	51	24	42	28	30	19	120	323
30	55H0	0	128	146	45	50	30	21	10	56	486

Table 13. Survey statistics for Bothnian Sea herring SD 30 calculations (StoX) in 2022.

ICES SD	ICES Rect.	NM	Area (nm²)	Sa (m²/nm²)	Herring (%)	Sprat (%)	Cod (%)	3-spinn. (%)
30	50G8	27	860.46	301.89	49.68	20.59	0.00	28.87
30	50G9	70	885.63	224.47	66.01	4.79	0.00	28.95
30	50H0	37	839.67	452.53	55.09	1.89	0.00	40.92
30	51G7	13	670.77	350.23	83.40	1.30	0.00	15.15
30	51G8	76	871.65	400.69	50.98	0.79	0.00	48.16
30	51G9	59	871.99	194.55	21.31	12.07	0.00	66.47
30	51H0	65	871.07	146.22	74.48	3.61	0.00	20.56
30	52G8	65	858.17	281.86	16.81	1.29	0.00	81.83
30	52G9	69	858.17	150.92	27.04	6.64	0.00	66.23
30	52H0	62	858.17	184.43	48.54	8.16	0.00	43.19
30	53G8	55	844.28	302.41	13.97	0.90	0.00	85.12
30	53G9	59	844.28	193.36	27.42	1.26	0.00	71.29
30	53H0	71	844.28	299.09	49.88	7.30	0.00	42.57
30	54G8	13	660.25	322.81	25.08	0.00	0.00	74.82
30	54G9	43	830.32	261.19	70.01	1.55	0.00	28.26
30	54H0	60	733.93	319.88	76.29	0.80	0.00	8.65
30	55G9	16	659.44	260.31	72.17	2.55	0.00	25.28
30	55H0	18	744.60	191.52	25.14	2.31	0.00	72.49

Table 14.Numbers (millions) of herring by age in SD 30 (r/v Aranda 2022).

Rect.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
50G8	162.60	408.38	260.91	158.82	64.28	22.69	7.56	3.78	0.00	3.78	0.00	0.00	0.00	0.00	0.00	0.00	1092.80
50G9	16.70	92.56	255.99	158.77	87.80	91.41	24.46	22.06	2.46	6.10	3.68	0.00	4.92	1.28	0.00	1.28	769.46
50H0	103.32	145.59	389.80	544.78	140.89	42.27	28.18	9.39	14.09	14.09	4.70	0.00	0.00	0.00	0.00	0.00	1437.09
51G7	0.00	23.63	78.17	272.69	112.71	7.27	14.54	30.90	1.82	5.45	0.00	1.82	0.00	0.00	0.00	0.00	549.02
51G8	0.00	32.51	105.66	469.75	211.85	99.09	92.65	59.47	23.84	9.91	12.00	8.02	1.98	4.00	2.02	4.02	1136.78
51G9	446.08	28.24	39.52	14.99	10.09	3.43	2.61	0.00	10.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	555.45
51H0	0.84	4.78	105.01	188.25	78.51	48.32	11.01	7.84	16.40	1.56	0.77	0.75	0.75	3.14	0.00	1.53	469.46
52G8	16.08	35.81	90.56	198.16	104.84	44.75	17.00	16.11	6.26	4.48	0.00	4.47	1.79	0.00	0.00	0.89	541.20
52G9	180.62	74.29	75.64	35.57	13.10	8.22	3.14	1.27	0.00	0.64	0.00	0.00	0.00	0.63	0.00	0.00	393.12
52H0	43.08	24.63	37.04	153.88	126.29	33.25	27.62	26.64	8.57	14.27	11.46	24.67	0.00	0.94	0.00	0.95	533.30
53G8	0.83	1.65	48.82	178.78	179.65	17.39	51.32	5.80	3.31	0.83	1.66	0.00	0.83	1.66	1.66	1.66	495.84
53G9	93.00	23.12	41.47	83.76	91.81	100.60	18.39	5.58	4.77	0.79	1.57	1.60	3.95	1.59	0.00	0.00	471.99
53H0	76.77	12.81	128.04	385.38	135.33	41.35	64.16	14.28	15.69	2.85	0.00	1.42	1.42	2.86	0.00	4.31	886.67
54G8	0.00	2.01	34.12	154.56	154.56	80.29	52.19	18.07	20.07	8.03	4.01	0.00	2.01	0.00	0.00	6.02	535.95
54G9	28.82	6.16	24.98	256.53	152.88	117.67	40.20	32.49	12.98	56.08	13.19	6.41	6.47	3.91	2.62	1.18	762.60
54H0	2.62	4.10	169.20	367.94	114.21	40.98	54.68	12.58	4.37	12.96	2.86	2.88	2.95	1.47	0.00	1.47	795.27
55G9	10.13	70.90	177.25	250.68	91.16	25.32	35.45	5.06	5.06	7.60	7.60	0.00	2.53	2.53	0.00	0.00	691.27
55H0	23.36	13.35	133.49	166.87	90.11	6.67	21.69	8.34	10.01	3.34	0.00	1.67	0.00	1.67	0.00	0.00	480.58

Table 15.Total biomass (ton) of herring by age in SD 30 (r/v Aranda 2022).

Rect.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
50G8	788.4	5955.6	4977.4	3135.8	1409.7	480.6	190.2	91.9	0.0	101.3	0.0	0.0	0.0	0.0	0.0	0.0	17130.9
50G9	91.8	1483.7	5149.9	3580.7	2170.4	2368.9	646.6	654.0	73.1	176.5	105.3	0.0	173.5	53.0	0.0	53.0	16780.7
50H0	1029.9	2276.8	7754.6	11608.9	3300.6	1097.5	737.3	328.3	453.7	564.0	139.0	0.0	0.0	0.0	0.0	0.0	29290.7
51G7	0.0	378.9	1518.7	5870.7	2557.8	214.2	505.4	929.1	50.0	195.4	0.0	50.0	0.0	0.0	0.0	0.0	12270.2
51G8	0.0	534.6	2085.6	10564.0	5014.0	2764.1	2650.9	1811.1	806.1	353.3	500.2	357.1	99.8	170.7	101.1	167.9	27980.6
51G9	1885.9	489.5	816.8	339.8	238.9	87.9	70.9	0.0	220.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4149.8
51H0	0.8	77.7	2131.2	4211.3	1797.4	930.0	356.5	256.5	451.7	57.2	26.9	36.5	43.6	136.6	0.0	71.3	10585.3
52G8	57.6	586.4	1965.7	4564.0	2589.8	1351.2	557.1	495.1	216.0	211.5	0.0	175.2	111.6	0.0	0.0	54.5	12935.6
52G9	781.2	1298.4	1624.0	805.9	298.0	187.2	79.8	41.8	0.0	23.3	0.0	0.0	0.0	12.4	0.0	0.0	5151.9
52H0	173.8	432.3	765.8	3263.3	3081.6	853.0	751.5	790.2	291.8	386.8	348.3	616.8	0.0	36.3	0.0	31.8	11823.2
53G8	2.5	27.3	994.6	4217.5	4454.6	512.4	1386.1	201.5	90.1	28.8	56.4	0.0	28.8	64.9	95.2	92.7	12253.4
53G9	342.6	406.1	903.9	1850.3	2208.5	2784.6	567.5	191.0	165.0	35.6	75.8	52.5	166.1	59.7	0.0	0.0	9809.1
53H0	263.6	210.0	2922.2	8315.6	3423.2	1159.5	1744.7	442.4	550.1	99.9	0.0	69.7	74.0	121.4	0.0	324.0	19720.4
54G8	0.0	35.1	680.7	3468.0	3816.7	2144.2	1453.3	603.6	515.1	257.1	145.1	0.0	99.8	0.0	0.0	273.8	13492.4
54G9	93.4	108.4	483.4	7279.3	4109.7	3263.6	1193.2	1030.5	472.3	1563.0	464.2	202.4	224.3	173.0	113.1	47.4	20821.4
54H0	11.8	60.1	3576.8	7819.3	2704.3	1167.7	1414.0	319.3	175.7	452.4	96.5	103.7	125.9	61.6	0.0	100.1	18189.2
55G9	53.2	1163.3	3609.0	5560.3	2267.8	654.3	926.8	160.8	150.9	264.6	294.5	0.0	75.5	121.5	0.0	0.0	15302.4
55H0	98.6	216.8	2671.1	3720.3	2208.8	199.7	668.8	272.7	393.8	159.0	0.0	84.8	0.0	89.3	0.0	0.0	10783.7

Table 16. Mean weight (g) of herring by age in SD 30 (r/v Aranda 2022)

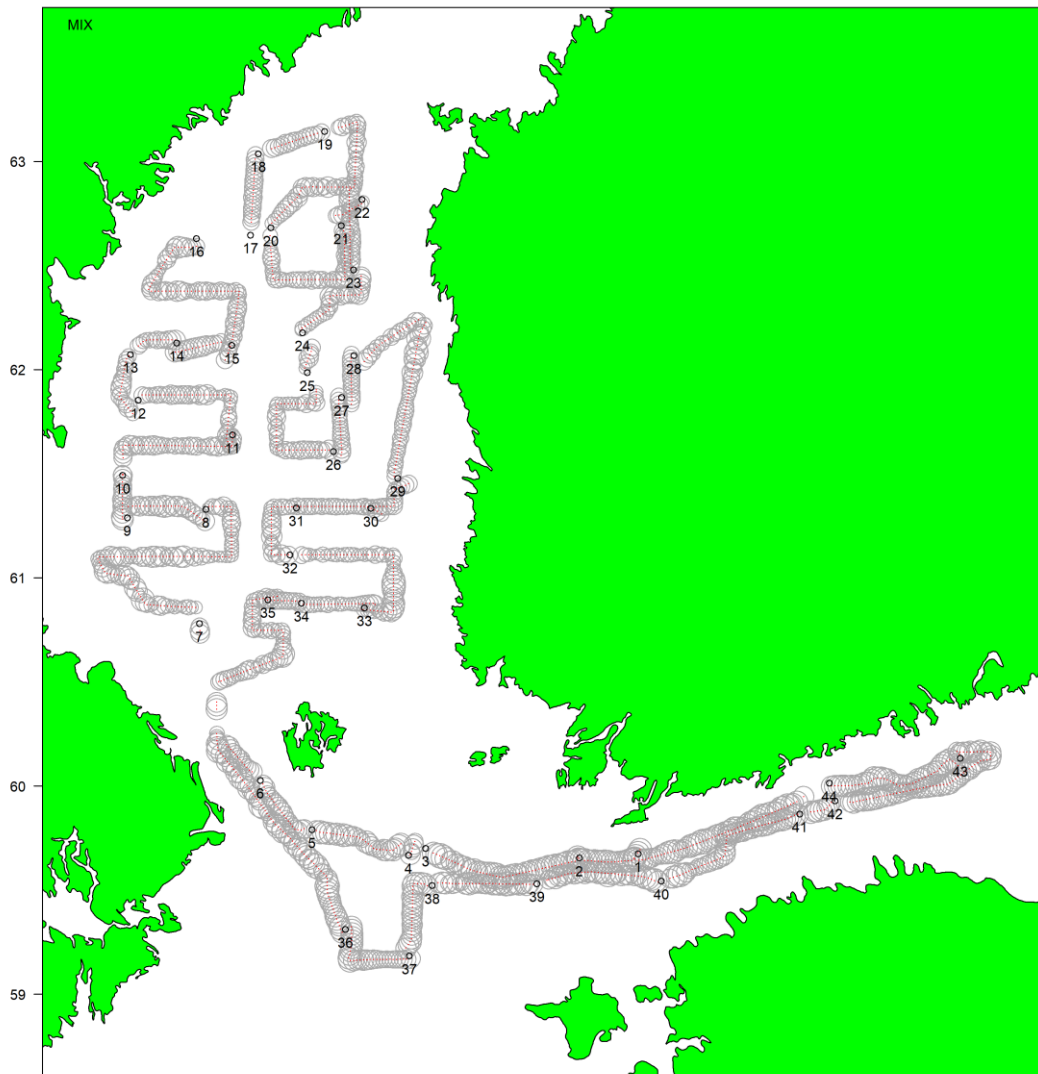| Rect.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
50G8	4.85	14.58	19.08	19.75	21.93	21.18	25.15	24.30		26.80							15.68
50G9	5.50	16.03	20.12	22.55	24.72	25.91	26.44	29.64	29.70	28.94	28.60		35.30	41.50		41.50	21.81
50H0	9.97	15.64	19.89	21.31	23.43	25.97	26.17	34.95	32.20	40.03	29.60						20.38
51G7		16.03	19.43	21.53	22.69	29.45	34.75	30.06	27.50	35.83		27.50					22.35
51G8		16.45	19.74	22.49	23.67	27.89	28.61	30.45	33.81	35.64	41.68	44.53	50.50	42.70	50.00	41.74	24.61
51G9	4.23	17.33	20.67	22.66	23.69	25.63	27.13		21.00								7.47
51H0	1.00	16.23	20.30	22.37	22.89	19.25	32.38	32.72	27.55	36.75	34.80	48.50	58.00	43.45		46.74	22.55
52G8	3.58	16.38	21.71	23.03	24.70	30.19	32.77	30.73	34.50	47.26		39.16	62.25			61.00	23.90
52G9	4.33	17.48	21.47	22.66	22.75	22.78	25.42	32.80		36.50				19.50			13.10
52H0	4.04	17.55	20.67	21.21	24.40	25.65	27.21	29.66	34.04	27.11	30.40	25.00		38.80		33.30	22.17
53G8	3.00	16.50	20.37	23.59	24.80	29.46	27.01	34.76	27.20	34.80	34.05		34.80	39.15	57.50	56.00	24.71
53G9	3.68	17.56	21.80	22.09	24.06	27.68	30.87	34.23	34.62	45.30	48.15	32.90	42.02	37.65			20.78
53H0	3.43	16.40	22.82	21.58	25.29	28.04	27.19	30.98	35.06	35.10		49.00	52.00	42.50		75.17	22.24
54G8		17.50	19.95	22.44	24.69	26.71	27.85	33.41	25.66	32.03	36.15		49.70			45.47	25.17
54G9	3.24	17.58	19.36	28.38	26.88	27.74	29.68	31.72	36.38	27.87	35.19	31.56	34.64	44.20	43.15	40.00	27.30
54H0	4.50	14.67	21.14	21.25	23.68	28.49	25.86	25.39	40.17	34.91	33.70	36.00	42.75	41.80		68.00	22.87
55G9	5.25	16.41	20.36	22.18	24.88	25.84	26.14	31.75	29.80	34.83	38.77		29.80	48.00			22.14
55H0	4.22	16.24	20.01	22.30	24.51	29.93	30.83	32.68	39.33	47.65		50.80		53.50			22.44

Figure 1. Cruise track and trawl stations of r/v Aranda during the Finnish BIAS-survey in 2022.
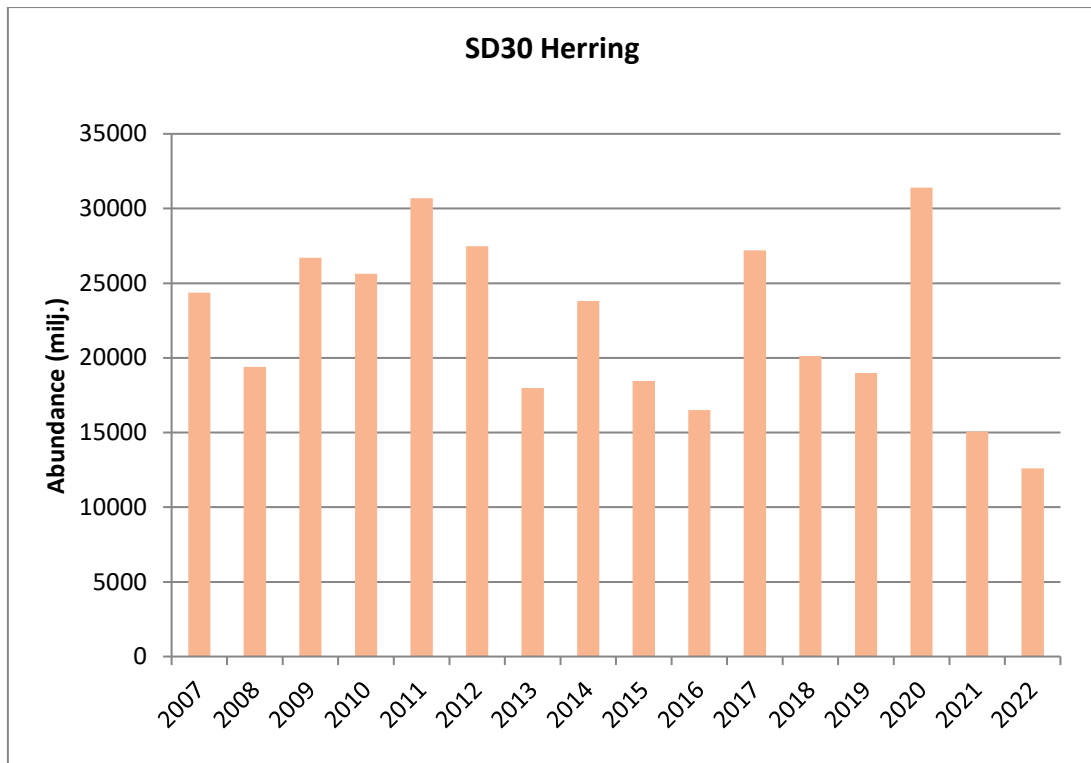
Figure 2. Abundance of herring in SD 30 from 2007 to 2022 with StoX calculations.