Baltic International Acoustic Survey

Report for R/V Aranda

Cruise 9/2021

ICES_BIAS_2021

21st September – 4th October 2021

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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 2021, 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 Sat 21.09.2021 at 20:00 (UTC 17:00) 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 04.10.2020 and the vessel was navigated back to the port of Helsinki.

The Finnish BIAS 2020 survey had only a slight deviation from the original plan when the trawling could not be performed due to low fish abundance and Swedish authorities didn't allow us to use scientific echo-sounder in the territorial water of Sweden. Therefore, we have not done any research investigations in territorial areas of Sweden.

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 16.9.2021 on (N60°26.39', E022°13.15'), 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 = 0.08 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	21.09.2021 - 04.10.2021
IT chief:	Perttu Rantanen	LUKE	21.09.2021 - 04.10.2021
	Marika Kirjakoff	SYKE	21.09.2021 - 04.10.2021
	Anu Lastumäki	SYKE	21.09.2021 - 04.10.2021
	Jukka Pönni	LUKE	21.09.2021 - 04.10.2021
	Jari Raitaniemi	LUKE	21.09.2021 - 04.10.2021
	Hannu Harjunpää	LUKE	21.09.2021 - 04.10.2021
	Arto Koskinen	LUKE	21.09.2021 - 04.10.2021
	Velimatti Leinonen	LUKE	21.09.2021 - 04.10.2021
	Erkki Jaala	LUKE	21.09.2021 - 04.10.2021
	Riku Helisevä	LUKE	21.09.2021 - 04.10.2021
	Tommi Lindroth	FISH	21.09.2021 - 04.10.2021
	Toni Nikaniemi	FISH	21.09.2021 - 04.10.2021
	Roope Lehmonen	LUKE	21.09.2021 - 04.10.2021
	Meri Helisevä	LUKE	21.09.2021 - 04.10.2021
	Markku Gavrilov	LUKE	21.09.2021 - 04.10.2021
	Pia Lindberg-Lumme	LUKE	21.09.2021 - 04.10.2021
	Rickard Yngwe	SLU	21.09.2021 - 04.10.2021
	Ulrika Tollerz-Bratteby	SLU	21.09.2021 - 04.10.2021

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 32 and 9 in northern Baltic proper (SD 29) . 6 trawl hauls were done in the northern Gulf of Finland (SD 32).

The 11998 kg combined catches (Table 1) consisted of 21 fish species (11563 kg) and mostly unidentified organic matter categorized as "waste" (427 kg), but also small amounts of common jellyfish *Aurelia aurita* (7.2 kg) and the isopod *Saduria entomon*. The most common and abundant species were herring (*Clupea harengus*) (7803 kg), sprat (*Sprattus sprattus*) (3028 kg) and three-spined stickleback (*Gasterosteus aculeatus*) (861 kg). All observed species are presented in Table 2. From the sub-samples of the 46 fish catches a total of 20624 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, 4477 and 1439 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 48 CTD casts were done during the entire cruise.

ABUNDANCE ESTIMATES

The total area covered by the Finnish BIAS survey was 22422 square nautical miles (nmi^2), 31 rectangles, and after the scrutinizing, the distance used for acoustic estimates was 1501 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 2020 with StoX calculations are shown in Figure 2. The total abundance of herring and sprat is 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 2020 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 2020.

Haul num.	ICES SD	Rectangle	Ammodytes tobianus	Aurelia aurita	Clupea harengus	Cyclopterus lumpus	Gadus morhua	Gasterosteus aculeatus	Gymnocephalus cernuus	Hyperoplus lanceolatus	Lampetra fluviatilis	Liparis liparis	Lumpenus lampretaeformis	Myoxocephalus scorpius	Nerophis ophidion	Osmerus eperlanus	Platichthys flesus	Pomatoschistus minutus	Pungitius pungitius	Saduria entomon	Salmo salar	Scophthalmus maximus	Sprattus sprattus	Syngnathus typhle	Triglopsis quadricornis	Zoarces viviparus	"Waste"
1	32	47H0			1320.6	0.4		18.1								5.92	0.22		0.25				963.37				49.2
2	32	47H0			138.08	0.8		7.09								0.23	0.26		0				462.23				26.3
3	29	48G9			16.824			1.73								0.26			0				116.19		0	0	27
4	29	48H0			15.669			1.74								0.22							115.24				7.13
5	29	48H1			106.88	0.4		32								0.26		0.01	0.06	0.06			32.349				3.03
6	30	48H1			104.4			3.2		0						0.27				0.01			16.34				6.74
7	30	48H2			87.025			2.04			0.1								0				1.036				20.8
8	30	48H2			165.87			5.6				0.02											3.076		0.1		3.3
9	30	48H3			400.98			4.68								0.01				0.01			3.882				5.43
10	30	48H3			41.58			40.1															2.082				3.28
11	30	48H4			431.47			31.1		0.3													2.203				14
12	30	48H5			213.17			1.71		0		0.05			0				0.01				0.074				2.97
13	30	49G9			82.12			39.7		0.1	0									0.02			0.149				5.89
14	30	49H5			234.67			37.4								0.14				0			1.167				1.64
15	30	49H6			249.7			28.1								0.02				0			1.29				2.85
16	30	50G8			98.592			12.3															0.138				0.94
17	30	50G8			288.18			14.1				0.24											1.228				16.3
18	30	50G9			304.51			9		0		0.56							0.03				2.25	0			5.62
19	30	50H0			129.09			0.54		0		0.02				0.52							10.422				2.4
20	30	51G7			250.62			1.68				0.24				0.52							7.899				4.03
21	30	51G8			142.37			1.6								8.11			0.02	0.02			3.735				10.1
22	30	51G8			154.51			0.7	0							10.3			0.03				1.399				2.01
23	30	51G9			165.8			3.44								0.56			0	0.01			0.766	0			2.42
24	30	51G9			187.06			7.91				0.78			0					0.02			0.59				4.64
25	30	51H0			210.02			2.21				0.42							0.02				0.236				3.1
26	30	52G7			323.08			24.1		0		0.02		0									0.908				8.8
27	30	52G8			108.97			29															0.236				0.8
28	30	52G8			111.49			19.5				0.01											0.152				1.85
29	30	52G9			109.64			20.9				0.03			0								0.114				0.34
30	30	52G9			8.879			70.8							0						0.58		0.195				0.58
31	30	52H0			63.417			112															0.377				0.68
32	30	52H0			77.172			6.49		0			0										1.106				0.22
33	30	53G8			112.63			2.2				0.02	0		0						0.19		0.93				1.02
34	30	53G8	0		82.345			0.76												0.01			0.113				1.74
36	30	53G8			34.95			0.79							0	6.99		0					0.749			0	0.49
37	30	53G9			72.232			2.3								0.94		0		0.01			0.077			0	1.43
38	29	53G9			44.902			42.1		0						0.2			0	0.01			7.366				8.39
39	29	53H0		0.6	94.268	0.2		54.9								0.1							15.356				3.63
40	29	53H0		3.1	5.01	1		118		0.1					0				0.02				62.309				11
41	29	54G8			347.38		7.6	3.88								0.64						1.25	29.817				19.4
42	29	54G9			35.069	0.3		6.34								0.33			0.28				832.83				52.8
43	29	54G9		2.7	10.865			11.9								4.86			0.3	0.02			63.428				18.9
44	32	54H0		0.8	1.14	0.1		4.46		0						0.9			0.14				57.126				12.3
45	32	54H0			233.5			9.94								6.32			0.9				115.85				30.5
46	32	55G9			154.61	0		12.4								1.39	0.11	0.03	1.08				56.066				9.25
47	32	55H0			31.78			1.23								1.24			0.01	0			33.611				12.1
Total			**0**	**7.2**	**7603.2**	**3.3**	**7.6**	**861**	**0**	**0.6**	**0.1**	**2.41**	**0**	**0**	**0**	**51.3**	**0.58**	**0.04**	**3.17**	**0.22**	**0.77**	**1.25**	**3028.1**	**0**	**0.1**	**0.1**	**427**

Table 2.English, scientific, and Finnish names of observed species in Finnish 2021 BIAS-survey.

Fishnames		
English	**Scientific**	**Finnish**
Small Sandeel	*Ammodytes tobianus*	Pikkutuulenkala
Baltic Herring	*Clupea harengus*	Silakka
Lumpsucker	*Cyclopterus lumpus*	Rasvakala
God	*Gadus morhua*	Turska
Three-spined Stickleback	*Gasterosteus aculeatus*	Kolmipiikki
Greater Sandeel	*Hyperoplus lanceolatus*	Isotuulenkala
Lamprey	*Lampetra fluviatilis*	Nahkiainen
Striped Seasnail	*Liparis liparis*	Imukala
Snake blenny	*Lumpenus lampretaeformis*	Elaska
Shorthorn sculpin	*Myoxocephalus scorpius*	Isosimppu
Straightnose Pipefish	*Nerophis ophidion*	Siloneula
Smelt	*Osmerus eperlanus*	Kuore
Flounder	*Platichthys flesus*	Kampela
Sand goby	*Pomatoschistus minutus*	Hietatokko
Nine-spined Stickleback	*Pungitius pungitius*	Kymmenpiikki
Atlantic Salmon	*Salmo salar*	Lohi
Turbot	*Scophthalmus maximus*	Piikkikampela
Sprat	*Sprattus sprattus*	Kilohaili
Pipefish	*Syngnathus typhle*	Särmäneula
Four-horn sculpin	*Triglopsis quadricornis*	Härkäsimppu
Eelpout	*Zoarces viviparus*	Kivinilkka

Table 3. Number of length measurements /species and Sub-Division in Finnish 2020 BIAS-survey.

Species	ICES SD			Total
	29	30	32	
Ammodytes tobianus		1		1
Clupea harengus	1957	9667	1417	13041
Cyclopterus lumpus	21		18	39
Gadus morhua	2			2
Gasterosteus aculeatus	715	2023	370	3108
Hyperoplus lanceolatus	2	15	1	18
Lampetra fluviatilis		2		2
Liparis liparis		111		111
Lumpenus lampretaeformis		2		2
Myoxocephalus scorpius		1		1
Nerophis ophidion	1	9		10
Osmerus eperlanus	49	361	158	568
Platichthys flesus			4	4
Pomatoschistus minutus	2	6	1	9
Pungitius pungitius	74	17	227	318
Salmo salar		2		2
Scophthalmus maximus	1			1
Sprattus sprattus	1528	808	1044	3380
Syngnathus typhle		2		2
Triglopsis quadricornis	1	1		2
Zoarces viviparus	1	2		3
Total	4354	13030	3240	20624

Table 4.Individual samples of herring and sprat (for age determination) per SD in 2020.

	Sprat			Sprat	Herring			Herring
L-class	**29**	**30**	**32**	**Tot.**	**29**	**30**	**32**	**Tot.**
45							1	1
50			2	2		2	1	3
55	7		11	18	1	19		20
60	27	2	19	48	7	32	18	57
65	34	3	23	60	12	54	20	86
70	42	4	30	76	8	71	24	103
75	43	9	31	83	20	75	14	109
80	35	13	9	57	20	46	16	82
85	10	3	2	15	20	44	31	95
90	1		1	2	15	16	11	42
95	4	1	1	6	14	20	8	42
100	16	1	15	32	12	13	11	36
105	51	16	47	114	6	12	7	25
110	54	28	39	121	2	8	3	13
115	62	42	36	140	5	16	3	24
120	59	58	53	170	41	73	25	139
125	57	101	39	197	62	142	46	250
130	37	92	10	139	59	183	51	293
135	9	74	5	88	59	193	49	301
140	1	42		43	56	188	48	292
145	1	25		26	43	191	44	278
150		2		2	57	193	46	296
155					57	187	41	285
160					57	190	41	288
165					52	188	21	261
170					36	181	5	222
175					22	181	2	205
180					16	164	2	182
185					8	139		147
190					3	109		112
195						63		63
200					2	39		41
205					1	28		29
210					2	21		23
215						13		13
220						9		9
225						4		4
230						3		3
235						2		2
240						1		1
All	**550**	**516**	**373**	**1439**	**775**	**3113**	**589**	**4477**

Table 5.Numbers and locations of fishing stations (WGS-84) during Finnish BIAS-survey in 2021.

Haul num.	Haul name	Date	ICES SD	StartLat.	StartLong.	StopLat.	StopLong.	HaulDuration (min)	HaulSpeed (knot)	HaulDistanca (nmi)	Catch (kg)	Headrope depth (m)	Bottom depth (m)	Doors spread (m)	Trawl opening (m)
1	48H3-1	22.9.2021	32	59.6543	23.2220	59.6847	23.2203	45	3,0	2,25	243	10	60	61,8	17,1
2	48H2-1	22.9.2021	29	59.6573	22.5478	59.6953	22.5247	45	2,8	2,1	238	28	62	81,3	14,8
3	48H1-1	22.9.2021	29	59.6687	21.1280	59.7083	21.0418	90	2,6	3,9	38	23	100	66	18
4	48G9-1	22.9.2021	29	59.9185	19.7478	59.8725	19.7370	60	2,5	2,5	219	25	125	80	11,9
5	49G9-1	23.9.2021	29	60.0803	19.4540	60.0205	19.4615	75	2,9	3,63	114	17	201	79	11,5
6	50G8-1	23.9.2021	30	60.9323	18.8757	60.8708	18.8895	75	3,0	3,75	135	50	80	103	10
7	51G8-1	23.9.2021	30	61.1000	18.1435	61.1125	18.0493	60	3,0	3	205	20	70	77	12,9
8	51G9-1	24.9.2021	30	61.1332	19.1847	61.1347	19.2927	60	3,0	3	446	15	75	68	15
9	51G8-2	24.9.2021	30	61.3118	18.1755	61.2880	18.1242	45	2,8	2,1	205	15	70	72	15,7
10	51G7-1	24.9.2021	30	61.2387	17.9821	61.1768	17.9143	90	2,8	4,2	188	17	75	69	17
11	52G8-1	25.9.2021	30	61.6352	18.1411	61.6400	18.0638	45	2,9	2,18	166	15	68	68	17,2
12	52G9-1	25.9.2021	30	61.6780	19.2335	61.6695	19.0993	81	3,0	4,05	91	50	65	90	10
13	52G8-2	25.9.2021	30	61.9007	18.4855	61.9532	18.3983	90	2,9	4,35	177	48	85	87	10
14	53G8-1	25.9.2021	30	62.1545	18.3850	62.1730	18.3530	30	2,9	1,45	173	14	90	69	16,8
15	53G8-2	26.9.2021	30	62.1573	18.8400	62.1815	18.8015	40	2,7	1,8	245	16	90	67	18,3
16	53G9-1	26.9.2021	30	62.2810	19.2325	62.3202	19.3315	75	3,0	3,75	220	70	95	100	9
17	54G8-1	26.9.2021	30	62.6147	18.7425	62.6743	18.8383	90	2,9	4,35	208	63	140	100	9,3
18	54G9-1	26.9.2021	30	62.6032	19.3287	62.6358	19.3385	45	3,0	2,25	191	17	130	70,2	16,7
19	55G9-1	27.9.2021	30	63.0440	19.5357	62.9782	19.5233	90	2,8	4,2	197	17	130	68,1	17,3
20	55H0-1	27.9.2021	30	63.1668	20.3777	63.0965	20.3757	90	2,8	4,2	69	42	80	90	10
21	54G9-2	27.9.2021	30	62.6467	19.6805	62.5775	19.6975	90	2,7	4,05	137	74	110	101	9,9
22	54H0-1	27.9.2021	30	62.6053	20.0755	62.5432	20.1098	60	2,9	2,9	161	97	97	67,8	17,4
23	54H0-2	27.9.2021	30	62.5950	20.2865	62.5502	20.3428	60	2,9	2,9	143	17	77	68,9	17
24	53H0-1	28.9.2021	30	62.4082	20.5620	62.3092	20.6377	75	2,9	3,63	25	15	80	67,4	15,8
25	53G9-2	28.9.2021	30	62.3267	19.5802	62.2488	19.6487	100	2,9	4,83	73	75	120	96	10,7
26	53H0-2	28.9.2021	30	62.0963	20.0407	62.0230	20.1173	95	2,9	4,59	76	80	140	98	11
27	52H0-1	28.9.2021	30	61.9688	20.6702	61.9317	20.7352	60	2,9	2,9	101	17	70	63	17,4
28	52H0-2	29.9.2021	30	61.8212	20.4780	61.7788	20.5112	60	2,9	2,9	69	100	100	64,5	15,7
29	52G9-2	29.9.2021	30	61.6610	19.6262	61.5912	19.7060	90	3,0	4,5	68	10	80	96	10,1
30	51G9-2	29.9.2021	30	61.3275	19.5702	61.3088	19.6037	30	2,8	1,4	122	17	80	68,4	16,9
31	51H0-1	29.9.2021	30	61.1007	20.0158	61.0613	20.0800	67	2,7	3,02	66	17	115	69,6	17,3
32	51H0-2	30.9.2021	30	61.0995	20.4680	61.0995	20.5562	75	2,5	3,13	88	17	90	65,7	18,5
33	50G9-1	30.9.2021	30	60.9472	19.2862	60.9092	19.3933	90	2,8	4,2	353	80	115	107	11,2
34	50H0-1	30.9.2021	30	60.8152	20.1465	60.7902	20.1757	47	2,8	2,19	194	17	70	68,5	17,8
35	50G9-2	30.9.2021	30	60.7988	19.7712	60.7812	19.8035	30	2,8	1,4	81	20	75	69,5	16,4
36	47H0-1	1.10.2021	29	59.1848	20.3413	59.1405	20.3598	30	2,8	1,4	350	20	75	68,9	17,8
37	47H0-2	1.10.2021	29	59.2222	20.8440	59.1720	20.8382	60	2,6	2,6	168	22	90	66	14
38	48H1-2	2.10.2021	29	59.5417	21.0483	59.5250	21.0467	24	2,8	1,12	275	14	80	73,2	14
39	48H2-2	2.10.2021	29	59.5710	22.7530	59.5483	22.7748	33	2,9	1,6	39	16	70	71,8	15,8
40	48H3-2	2.10.2021	32	59.5623	23.4782	59.5008	23.5158	90	2,8	4,2	225	17	85	71,2	16,9
41	48H4-1	2.10.2021	32	59.7563	24.0427	59.7338	24.0313	30	2,8	1,4	229	24	80	72,4	16,1
42	48H5-1	3.10.2021	32	59.9717	25.1032	59.9438	25.1490	45	2,8	2,1	154	15	70	69,7	16,4
43	49H6-1	3.10.2021	32	60.1220	26.3368	60.1007	26.3523	30	2,7	1,35	704	23	70	68	16,3
44	49H5-1	4.10.2021	32	60.0328	25.3430	60.0203	25.3492	15	2,9	0,73	345	18	70	67,1	18

Survey statistics by area r/v Aranda in 2021.

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	9.3561265	920.3	423.56	0.4527106	8610.443	2.01	10.29	0.00	87.65
29	48G9	28	6.3453261	772.8	611.68	0.9639786	4903.668	16.45	53.52	0.00	29.63
29	48H0	53	6.4129792	730.3	811.41	1.2652576	4683.399	38.72	40.66	0.00	20.38
29	48H1	76	9.1273371	544.0	1179.23	1.291977	4965.271	32.01	60.96	0.00	6.84
29	48H2	63	12.338582	597.0	1106.84	0.8970582	7366.134	3.60	82.28	0.00	13.42
32	48H3	63	9.6086429	615.7	777.70	0.8093758	5916.041	3.47	56.04	0.00	39.52
32	48H4	73	7.832607	835.1	837.07	1.0687045	6541.01	2.79	86.85	0.00	9.55
32	48H5	30	13.372846	767.2	1465.30	1.0957259	10259.65	3.21	88.79	0.00	7.40
29	49G9	39	3.9420023	564.2	428.66	1.0874058	2224.078	34.20	32.26	0.00	33.28
32	49H5	23	12.764531	306.9	1457.57	1.1418908	3917.434	2.06	96.57	0.00	1.13
32	49H6	45	11.970152	586.5	1650.08	1.3784971	7020.494	30.27	65.21	0.00	2.73
30	50G8	54	2.5525955	833.4	347.03	1.359525	2127.333	71.35	5.48	0.00	23.11
30	50G9	71	10.195432	879.5	453.88	0.4451821	8966.882	5.16	4.15	0.00	90.64
30	50H0	62	13.197395	795.1	602.92	0.4568462	10493.25	5.49	2.53	0.00	91.97
30	51G7	33	3.7349463	614.5	489.09	1.3094917	2295.124	45.40	6.55	0.00	48.01
30	51G8	60	4.9003786	863.7	561.33	1.1454902	4232.457	38.65	2.26	0.00	59.06
30	51G9	65	8.4833163	865.8	474.89	0.5597898	7344.855	11.56	0.66	0.00	87.76
30	51H0	57	1.8054937	865.7	231.93	1.2845873	1563.016	29.39	34.98	0.00	35.47
30	52G8	73	6.5523812	852.0	473.38	0.7224477	5582.629	18.96	0.89	0.00	80.09
30	52G9	57	5.4191768	852.0	300.64	0.5547701	4617.139	16.27	0.84	0.00	82.82
30	52H0	61	1.9550387	852.0	232.44	1.1889057	1665.693	43.92	2.55	0.00	53.43
30	53G8	87	4.2956439	838.1	368.60	0.8580869	3600.179	22.79	2.36	0.00	74.85
30	53G9	56	2.0888848	838.1	285.38	1.366189	1750.694	50.41	0.78	0.00	48.77
30	53H0	61	2.1900725	838.1	168.63	0.7699689	1835.5	19.58	4.89	0.00	74.11
30	54G8	17	1.8727141	642.2	294.97	1.5750824	1202.657	56.30	0.00	0.00	43.69
30	54G9	60	1.8699226	824.2	302.18	1.6160273	1541.19	55.59	1.73	0.00	42.59
30	54H0	44	1.794471	727.9	303.69	1.6923814	1306.195	59.26	4.08	0.00	34.22
30	55G9	24	1.6017519	625.6	242.51	1.514011	1002.056	55.34	2.45	0.00	42.19
30	55H0	18	1.0471734	688.6	210.86	2.0135809	721.0836	75.73	1.26	0.00	22.78

Table 6.Numbers (millions) of herring by age in SDs 29 and 32 (r/v Aranda 2021).

SD	Rect	0	1	2	3	4	5	6	7	8+	Total
29	47H0	1.44	12.13	75.35	25.62	19.25	10.77	5.24	13.24	10.13	173.16
29	48G9	93.64	226.95	272.66	54.72	47.78	26.85	14.87	29.91	39.33	806.71
29	48H0	128.72	524.61	686.74	142.74	115.53	56.92	29.88	66.57	61.72	1813.44
29	48H1	63.29	254.16	376.28	129.09	152.32	118.81	83.86	118.42	292.91	1589.14
29	48H2	226.24	13.64	8.60	2.65	2.24	1.15	0.93	1.58	7.97	264.99
32	48H3	52.96	36.28	61.62	4.22	21.61	8.22	1.75	12.31	6.21	205.17
32	48H4	40.41	20.52	43.04	5.92	23.85	12.04	3.65	18.99	14.31	182.71
32	48H5	14.69	121.87	115.79	6.58	32.95	9.75	5.71	13.99	7.66	328.99
29	49G9	95.70	210.08	243.31	50.65	49.77	27.70	17.51	32.41	33.49	760.61
32	49H5	0.00	35.81	31.69	1.30	5.26	1.61	1.23	2.17	1.52	80.58
32	49H6	6.73	544.55	687.31	66.00	321.16	134.03	43.02	201.74	120.80	2125.35

Table 7.Mean weight (g) of herring by age in SDs 29 and 32 (r/v Aranda 2021).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Average (g)
29	47H0	3.10	14.21	17.79	20.33	21.30	22.61	22.73	22.26	23.92	19.33
29	48G9	3.74	13.15	16.92	20.11	21.24	22.72	24.78	22.30	34.13	16.18
29	48H0	3.78	13.17	17.00	19.88	20.79	22.05	23.53	21.68	31.05	16.34
29	48H1	3.75	13.19	17.59	21.47	23.36	25.27	27.48	24.08	32.25	21.48
29	48H2	3.95	10.86	17.41	20.71	21.58	23.15	27.47	23.40	65.68	7.20
32	48H3	4.38	11.48	16.62	20.48	20.11	20.88	19.54	20.81	29.50	13.84
32	48H4	3.56	11.60	16.96	21.83	21.24	22.62	21.18	23.23	24.93	15.84
32	48H5	3.38	11.31	16.72	20.05	19.76	21.26	19.02	21.21	21.88	14.98
29	49G9	3.93	13.33	16.63	20.57	21.43	22.71	24.75	22.52	26.44	15.79
32	49H5	0.00	11.68	16.20	20.36	19.82	22.17	19.22	22.12	22.74	14.94
32	49H6	6.00	11.98	16.51	21.49	20.83	21.94	20.91	22.31	22.71	17.46

Table 8.Total biomass (ton) of herring by age in SDs 29 and 32 (r/v Aranda 2021).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	4.5	172.3	1340.4	520.9	410.1	243.5	119.1	294.6	242.3	3347.6
29	48G9	350.4	2983.4	4613.8	1100.6	1014.9	610.0	368.3	667.0	1342.5	13050.9
29	48H0	486.3	6909.8	11675.3	2837.9	2402.2	1255.3	703.2	1443.2	1916.7	29630.0
29	48H1	237.2	3352.9	6617.2	2771.9	3558.2	3001.8	2304.7	2851.1	9446.3	34141.5
29	48H2	894.5	148.2	149.8	55.0	48.3	26.6	25.6	36.9	523.2	1907.9
32	48H3	232.1	416.6	1024.1	86.3	434.7	171.5	34.2	256.2	183.1	2838.9
32	48H4	143.8	238.0	730.1	129.1	506.5	272.3	77.2	441.0	356.7	2894.8
32	48H5	49.6	1378.1	1936.1	132.0	651.0	207.2	108.6	296.8	167.7	4927.1
29	49G9	376.4	2799.4	4047.2	1042.1	1066.7	629.1	433.5	730.0	885.5	12009.9
32	49H5	0.0	418.1	513.4	26.4	104.2	35.7	23.7	48.0	34.6	1204.0
32	49H6	40.4	6524.3	11349.3	1418.1	6688.3	2941.1	899.6	4501.1	2743.5	37105.6

Table 9.Numbers (millions) of sprat by age and area (r/v Aranda 2021).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	39.11	179.20	289.27	102.72	125.76	19.82	22.99	96.66	10.66	886.19
29	48G9	375.30	1674.77	411.12	51.73	53.19	7.37	6.57	40.16	4.28	2624.49
29	48H0	167.68	869.99	427.68	113.73	137.72	21.30	28.90	116.91	20.21	1904.12
29	48H1	294.62	1418.31	615.37	182.71	219.18	33.92	45.19	186.19	31.34	3026.83
29	48H2	1369.19	3097.02	950.36	202.85	212.39	32.36	28.36	155.90	12.47	6060.89
32	48H3	57.58	1468.40	1009.72	199.41	202.25	60.29	52.09	254.13	11.64	3315.51
32	48H4	390.54	2054.94	1860.62	337.87	350.33	77.54	86.60	495.26	26.88	5680.59
32	48H5	682.01	3509.23	2684.45	518.16	531.80	164.86	180.88	762.77	75.51	9109.67
29	49G9	137.09	381.76	109.72	20.86	26.91	4.33	6.78	25.63	4.39	717.47
32	49H5	171.96	1605.93	1188.47	187.61	211.25	58.41	70.83	263.38	25.27	3783.10
32	49H6	57.23	1983.80	1644.12	225.01	254.23	52.04	52.48	296.15	13.08	4578.14
30	50G8	14.92	75.34	11.86	3.89	2.66	1.43	1.49	4.41	0.66	116.66
30	50G9	44.98	90.03	107.10	23.01	35.69	13.21	12.79	39.92	5.45	372.18
30	50H0	18.19	107.56	52.70	13.26	17.77	8.56	8.75	31.97	6.25	265.01
30	51G7	0.00	13.66	32.00	11.46	18.89	10.27	12.00	42.52	9.50	150.30
30	51G8	0.00	11.47	19.25	6.72	11.68	6.79	6.71	26.65	6.57	95.84
30	51G9	0.00	5.80	15.22	3.82	6.50	3.13	2.64	9.43	2.04	48.57
30	51H0	0.00	48.45	97.65	37.10	64.76	32.50	46.77	178.81	40.74	546.79
30	52G8	0.00	6.60	9.20	3.11	5.40	3.13	3.69	14.63	3.66	49.42
30	52G9	0.00	8.57	9.20	2.65	4.16	2.14	2.35	8.18	1.73	38.98
30	52H0	0.00	12.56	10.61	2.55	4.28	1.83	1.90	7.32	1.47	42.52
30	53G8	0.00	15.30	16.97	5.44	8.98	4.93	5.73	22.18	5.34	84.88
30	53G9	0.00	3.86	2.33	0.77	1.10	0.72	0.79	3.21	0.80	13.58
30	53H0	0.25	22.83	16.11	4.91	7.67	4.15	5.45	22.58	5.71	89.67
30	54G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54G9	1.25	3.97	4.84	1.69	2.72	1.54	1.76	7.12	1.77	26.67
30	54H0	0.00	2.12	7.67	3.62	6.66	4.00	4.63	19.48	5.06	53.24
30	55G9	0.00	9.67	3.94	1.33	1.96	1.15	1.24	4.34	0.95	24.58
30	55H0	0.00	1.19	2.20	0.70	1.16	0.64	0.58	2.09	0.49	9.05

Table 10.Mean weight (g) of sprat by age and area (r/v Aranda 2021).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Average (g)
29	47H0	3.68	7.56	9.53	10.22	10.38	10.42	11.05	10.61	11.31	9.27
29	48G9	3.69	7.17	8.50	9.90	10.23	10.17	10.78	10.26	11.25	7.07
29	48H0	3.71	7.25	9.08	10.23	10.50	10.55	11.26	10.83	12.15	8.13
29	48H1	3.45	6.79	9.27	10.20	10.48	10.54	11.26	10.80	12.18	7.86
29	48H2	3.51	6.83	9.05	9.89	10.20	10.24	10.81	10.24	11.30	6.78
32	48H3	3.22	6.16	8.11	9.22	9.11	8.09	9.58	8.12	10.27	7.32
32	48H4	3.47	6.21	8.19	9.15	8.95	8.83	9.72	8.56	10.71	7.33
32	48H5	3.52	6.26	8.12	9.31	9.15	8.84	9.97	8.74	10.52	7.31
29	49G9	3.58	7.22	8.67	10.31	10.74	10.92	11.39	10.97	11.36	7.19
32	49H5	3.44	6.35	7.98	9.24	9.10	8.74	10.02	8.30	10.27	7.30
32	49H6	3.10	6.45	8.00	9.07	8.90	8.38	9.58	8.08	10.27	7.40
30	50G8	4.00	8.49	10.61	10.07	12.16	12.00	12.45	12.60	13.37	8.54
30	50G9	3.77	9.35	11.32	11.64	11.93	12.23	12.72	12.51	13.17	10.25
30	50H0	3.91	9.00	11.14	11.53	12.29	12.58	13.06	13.29	14.01	10.31
30	51G7		9.60	11.79	12.48	12.74	12.99	13.29	13.61	14.05	12.62
30	51G8		9.08	11.93	12.54	12.78	13.02	13.44	13.77	14.27	12.59
30	51G9		9.49	11.73	12.18	12.22	12.57	13.03	13.28	14.18	12.09
30	51H0		10.14	11.41	12.55	12.95	13.37	13.48	13.76	14.10	12.82
30	52G8		9.40	11.76	12.46	12.79	13.17	13.73	14.05	14.50	12.72
30	52G9		9.40	11.53	12.12	12.48	12.79	13.30	13.51	14.04	11.91
30	52H0		9.09	11.34	11.96	12.29	12.73	13.20	13.37	14.00	11.39
30	53G8		9.32	11.60	12.35	12.69	13.06	13.48	13.86	14.40	12.33
30	53G9		9.39	11.41	12.08	12.87	13.05	13.62	14.01	14.49	12.01
30	53H0	5.08	9.38	11.25	12.08	12.74	13.22	13.66	14.06	14.62	12.09
30	54G8										
30	54G9	3.81	9.50	11.60	12.40	12.80	13.10	13.35	13.87	14.43	12.09
30	54H0		9.60	12.05	12.86	13.13	13.35	13.59	13.96	14.44	13.30
30	55G9		8.99	11.50	12.15	12.72	12.79	13.29	13.58	13.99	11.26
30	55H0		7.82	12.01	12.46	12.47	12.72	13.04	13.56	14.29	12.15

Table 11.Total biomass (ton) of sprat by age and area (r/v Aranda 2020).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	3376.1	1810.0	520.2	977.2	232.7	293.1	874.9	56.9	125.5	8266.6
29	48G9	135.6	2749.4	701.8	1227.5	291.0	310.8	1003.1	125.2	54.5	6599.1
29	48H0	177.9	33457.4	2684.4	3910.4	808.4	924.7	2808.9	221.6	262.6	45256.3
29	48H1	1491.7	12069.6	1122.5	1692.9	352.4	316.8	1163.2	61.2	41.0	18311.3
29	48H2	9136.7	30847.4	3654.0	5429.0	933.5	719.9	3287.9	160.4	34.1	54202.7
32	48H3	6120.5	30267.2	2107.0	2294.7	377.7	495.0	2467.8	0.0	194.2	44324.2
32	48H4	97.3	31691.7	8013.9	9399.0	1786.3	1726.5	8984.4	40.3	738.9	62478.4
32	48H5	102.7	10538.8	2865.7	3503.9	845.3	756.3	3979.6	103.1	564.5	23260.0
29	49G9	107.9	130.7	54.5	116.4	35.1	38.6	114.8	8.4	10.4	616.8
32	49H5	2870.3	3080.3	290.2	325.7	99.3	99.4	524.5	15.2	98.6	7403.4
32	49H6	897.3	12124.9	1436.8	1685.4	406.0	358.0	1963.4	38.7	267.3	19177.7
30	50G7	12.9	27.0	13.1	19.2	6.5	4.9	32.1	2.8	3.6	122.0
30	50G8	120.2	416.2	162.0	264.7	94.3	107.7	616.4	51.1	87.0	1919.6
30	50G9	0.0	0.0	1.8	3.8	1.4	3.2	13.8	1.6	2.8	28.5
30	50H0	0.0	16.8	24.3	62.0	22.5	35.5	211.4	15.8	43.8	432.0
30	51G7	0.0	59.7	17.1	21.3	8.8	7.6	48.7	2.6	6.9	172.8
30	51G8	4.0	37.9	27.6	72.4	31.7	59.6	341.7	21.1	86.7	682.7
30	51G9	0.9	13.9	12.5	20.3	6.1	9.4	63.4	4.0	28.2	158.7
30	51H0	0.0	0.6	6.6	19.7	7.5	14.9	76.1	6.3	13.5	145.3
30	52G7	0.0	0.0	0.0	1.3	0.5	0.7	5.7	0.2	0.7	9.0
30	52G8	0.0	10.5	1.2	2.9	1.6	1.4	10.3	0.5	2.0	30.4
30	52G9	2.2	38.8	11.7	25.1	9.2	11.4	76.9	4.2	9.9	189.3
30	52H0	0.0	0.0	4.4	17.0	8.2	16.4	106.6	5.7	37.2	195.4
30	53G8	0.0	6.6	2.7	9.5	3.8	5.1	37.9	2.0	8.3	75.9
30	53G9	0.0	0.4	4.0	7.9	2.6	5.6	23.6	2.8	4.6	51.5
30	53H0	0.0	0.3	6.3	18.5	9.2	18.8	94.1	7.5	22.2	176.9
30	54G8	0.0	0.0	0.0	0.9	0.0	4.0	19.6	1.2	10.9	36.5
30	54G9	7.3	74.7	28.8	62.8	25.6	34.3	204.1	14.4	35.7	487.8
30	54H0	1.4	78.3	63.1	181.0	77.7	150.6	803.0	57.0	198.8	1611.0
30	55G9	6.5	32.9	5.9	13.4	5.7	7.9	51.2	3.2	13.1	139.6
30	55H0	11.3	30.5	14.2	21.3	9.0	11.0	61.6	4.7	14.8	178.4

Table 12.Survey statistics for Bothnian Sea herring SD 30 calculations (StoX) in 2020.

ICES SD	ICES Rect.	NM	Area (nm^2)	Sa (m^2/nm^2)	Herring (%)	Sprat (%)	Cod (%)	3-spinn. (%)
30	50G7	19	435.88	363.91	84.04	1.46	0.00	14.44
30	50G8	49	827.34	406.99	75.36	8.26	0.00	16.27
30	50G9	70	884.56	393.97	77.17	0.10	0.00	22.05
30	50H0	22	740.59	335.28	62.60	2.36	0.00	23.12
30	51G7	26	673.52	665.31	62.12	0.57	0.00	37.24
30	51G8	52	868.90	680.50	83.62	1.68	0.00	14.68
30	51G9	61	871.99	400.97	50.51	0.46	0.00	49.00
30	51H0	62	872.00	245.07	83.38	1.01	0.00	15.54
30	52G7	37	544.28	608.09	94.56	0.06	0.00	5.20
30	52G8	56	858.17	790.92	27.76	0.04	0.00	72.16
30	52G9	71	858.17	595.87	24.10	0.27	0.00	75.63
30	52H0	50	858.17	341.28	48.07	0.59	0.00	51.32
30	53G8	58	844.28	505.79	31.91	0.13	0.00	67.95
30	53G9	52	844.28	623.27	40.66	0.06	0.00	59.28
30	53H0	54	843.93	337.98	67.96	0.77	0.00	31.08
30	54G8	13	651.40	615.49	92.27	0.14	0.00	7.16
30	54G9	79	830.32	432.60	94.02	2.37	0.00	3.12
30	54H0	45	657.18	477.09	83.71	6.30	0.00	6.21
30	55G9	30	624.63	604.23	89.90	0.38	0.00	9.47
30	55H0	28	677.80	403.12	90.30	0.71	0.00	2.95

Table 13.Numbers (millions) of herring by age in SD 30 (r/v Aranda 2020).

Rect	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
50G7	358.64	142.32	199.25	45.54	74.01	45.54	19.93	2.85	0.00	2.85	5.69	5.69	2.85	0.00	0.00	0.00	905.15
50G8	391.00	671.82	277.36	114.71	133.22	37.29	31.96	10.68	2.66	5.33	5.32	5.31	2.66	0.00	0.00	0.00	1689.32
50G9	10.30	963.21	453.28	103.02	36.06	30.91	30.91	0.00	0.00	5.15	0.00	0.00	0.00	0.00	0.00	0.00	1632.83
50H0	34.94	159.72	102.32	122.29	107.31	52.41	92.34	14.97	32.44	24.96	12.48	7.49	9.98	2.50	2.50	4.99	783.64
51G7	5.10	285.70	862.19	244.88	188.76	91.83	20.41	25.51	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1729.47
51G8	0.00	938.44	534.15	436.77	195.15	167.87	105.41	31.25	7.82	7.81	0.00	15.62	3.91	0.00	0.00	3.91	2448.12
51G9	34.32	487.21	245.11	245.40	101.36	196.69	24.36	12.18	8.10	4.06	0.00	2.03	0.00	0.00	0.00	4.05	1364.86
51H0	2.66	191.61	250.16	125.08	122.42	69.19	69.19	15.97	7.98	5.32	0.00	0.00	7.98	0.00	0.00	5.32	872.88
52G7	0.00	82.80	244.64	184.42	237.11	255.93	82.80	26.35	15.06	0.00	26.35	0.00	11.29	0.00	0.00	3.76	1170.50
52G8	9.19	337.35	499.44	288.28	287.48	84.79	194.32	30.40	21.33	100.11	3.04	3.04	0.00	3.02	0.00	6.13	1867.93
52G9	68.59	227.22	528.13	269.79	169.02	115.65	25.33	9.36	30.34	0.00	2.33	4.72	0.00	2.30	0.00	2.30	1455.07
52H0	4.70	319.72	306.06	84.87	153.77	51.75	95.72	20.04	4.91	4.93	0.00	0.00	0.00	1.64	0.00	20.21	1068.30
53G8	78.64	757.01	373.55	30.60	127.29	43.45	63.46	8.25	13.00	3.28	6.31	1.61	4.71	1.57	3.07	1.53	1517.31
53G9	1008.57	198.33	679.79	165.88	145.75	133.74	24.30	8.10	28.37	32.38	4.07	4.07	0.00	4.07	0.00	4.04	2441.45
53H0	3.63	273.24	356.77	172.08	132.26	58.00	27.18	27.19	16.30	7.26	0.00	3.63	1.82	12.69	1.82	3.62	1097.48
54G8	19.53	190.38	400.30	253.85	165.98	122.04	107.40	68.34	73.23	14.65	14.65	19.53	9.76	9.76	4.88	19.53	1493.79
54G9	111.47	353.05	402.77	135.79	181.69	150.03	108.90	72.76	21.79	2.41	2.43	7.39	9.74	2.43	2.53	0.00	1565.15
54H0	37.26	676.78	434.20	50.50	87.85	63.77	15.43	6.57	0.00	2.21	2.18	4.37	2.19	2.18	2.18	0.00	1387.68
55G9	1533.48	724.41	404.54	47.04	65.86	47.04	37.63	37.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2897.62
55H0	1319.60	352.29	173.16	41.80	47.77	23.88	23.88	17.91	5.97	0.00	0.00	0.00	5.97	0.00	0.00	0.00	2012.24
Total	5031.62	8332.59	7727.15	3162.57	2760.12	1841.79	1200.83	446.30	294.40	222.70	84.83	84.50	72.86	42.15	16.98	79.39	**31400.77**

Table 14.Total biomass (ton) of herring by age in SD 30 (r/v Aranda 2020).

Rect	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
50G7	880	2305	4217	963	2025	1303	682	158		113	311	403	113				13471
50G8	1032	9859	5811	2553	3511	1073	970	490	95	234	290	376	105				26397
50G9	41	15142	9151	2300	958	824	937			136							29489
50H0	194	2457	2101	2726	2675	1489	2927	450	1381	790	658	363	580	231	161	378	19562
51G7	60	4583	17771	5654	4681	2535	600	640	174								36699
51G8		14810	11275	10173	5482	5391	3272	1162	356	386		710	250			293	53562
51G9	104	7817	5373	6055	2513	4566	745	363	276	101		54				222	28188
51H0	4	3160	5261	2854	3145	1951	1993	507	238	295			321			165	19894
52G7		1425	5178	4492	6332	7354	2687	843	745		883		587			158	30683
52G8	29	5372	10694	8298	7965	2781	5112	965	836	3386	155	141		170		395	46299
52G9	196	3649	10994	6776	4599	3693	758	350	1190		87	215		117		83	32706
52H0	15	4998	6219	2043	3997	1470	2356	672	190	202				53		689	22903
53G8	265	11224	8036	697	3502	1245	1928	293	463	110	330	62	269	71	145	80	28720
53G9	2956	3062	13405	3867	3964	4070	693	230	874	913	193	240		193		188	34849
53H0	7	4262	7522	4074	3698	1852	958	923	489	344		152	96	570	96	149	25191
54G8	49	2820	8115	6258	4511	3608	3351	2193	2839	627	681	1005	554	332	272	857	38072
54G9	288	5128	7884	3135	4237	4418	3248	2580	623	82	121	292	322	114	117		32586
54H0	163	9666	8118	1241	2210	1867	507	206		86	93	162	67	93	151		24631
55G9	4533	10207	8207	1131	1720	1274	1025	1081									29176
55H0	6056	5210	3447	856	1186	620	634	510	169				355				19043
Total	16874	127155	158778	76144	72909	53384	35384	14616	10938	7804	3802	4174	3619	1945	941	3656	**592121**

Table 15.Mean weight (g) of herring by age in SD 30 (r/v Aranda 2020)

Rect	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
50G7	2.45	16.20	21.16	21.14	27.36	28.60	34.24	55.52		39.60	54.54	70.75	39.60			
50G8	2.64	14.68	20.95	22.25	26.35	28.78	30.34	45.88	35.51	43.81	54.54	70.75	39.61			
50G9	4.00	15.72	20.19	22.33	26.57	26.67	30.32			26.31						
50H0	5.56	15.38	20.54	22.29	24.93	28.42	31.70	30.05	42.57	31.67	52.74	48.50	58.12	92.47	64.30	75.66
51G7	11.80	16.04	20.61	23.09	24.80	27.61	29.40	25.10	34.01							
51G8		15.78	21.11	23.29	28.09	32.11	31.04	37.19	45.50	49.40		45.47	64.00			74.99
51G9	3.02	16.04	21.92	24.67	24.79	23.22	30.58	29.80	34.11	24.80		26.80				54.69
51H0	1.50	16.49	21.03	22.82	25.69	28.20	28.81	31.77	29.80	55.51			40.19			30.91
52G7		17.21	21.16	24.36	26.70	28.74	32.45	32.00	49.47		33.50		51.97			42.00
52G8	3.18	15.92	21.41	28.78	27.71	32.80	26.31	31.74	39.20	33.82	51.00	46.20		56.28		64.50
52G9	2.85	16.06	20.82	25.11	27.21	31.93	29.94	37.41	39.23		37.50	45.48		51.00		36.02
52H0	3.19	15.63	20.32	24.07	25.99	28.40	24.61	33.52	38.79	40.84				32.58		34.12
53G8	3.37	14.83	21.51	22.78	27.51	28.65	30.39	35.50	35.62	33.60	52.36	38.67	57.05	45.51	47.20	51.99
53G9	2.93	15.44	19.72	23.31	27.19	30.43	28.53	28.35	30.80	28.20	47.51	59.01		47.51		46.51
53H0	2.01	15.60	21.08	23.67	27.96	31.93	35.24	33.95	30.01	47.42		41.81	52.78	44.87	52.78	41.04
54G8	2.52	14.81	20.27	24.65	27.18	29.56	31.20	32.09	38.77	42.80	46.47	51.47	56.70	34.01	55.80	43.90
54G9	2.58	14.52	19.57	23.08	23.32	29.45	29.82	35.45	28.58	34.00	50.02	39.46	33.03	47.01	45.99	
54H0	4.36	14.28	18.70	24.58	25.15	29.28	32.87	31.40		39.00	42.71	37.05	30.78	42.71	68.97	
55G9	2.96	14.09	20.29	24.04	26.11	27.08	27.22	28.73								
55H0	4.59	14.79	19.90	20.47	24.84	25.95	26.55	28.47	28.30				59.50			

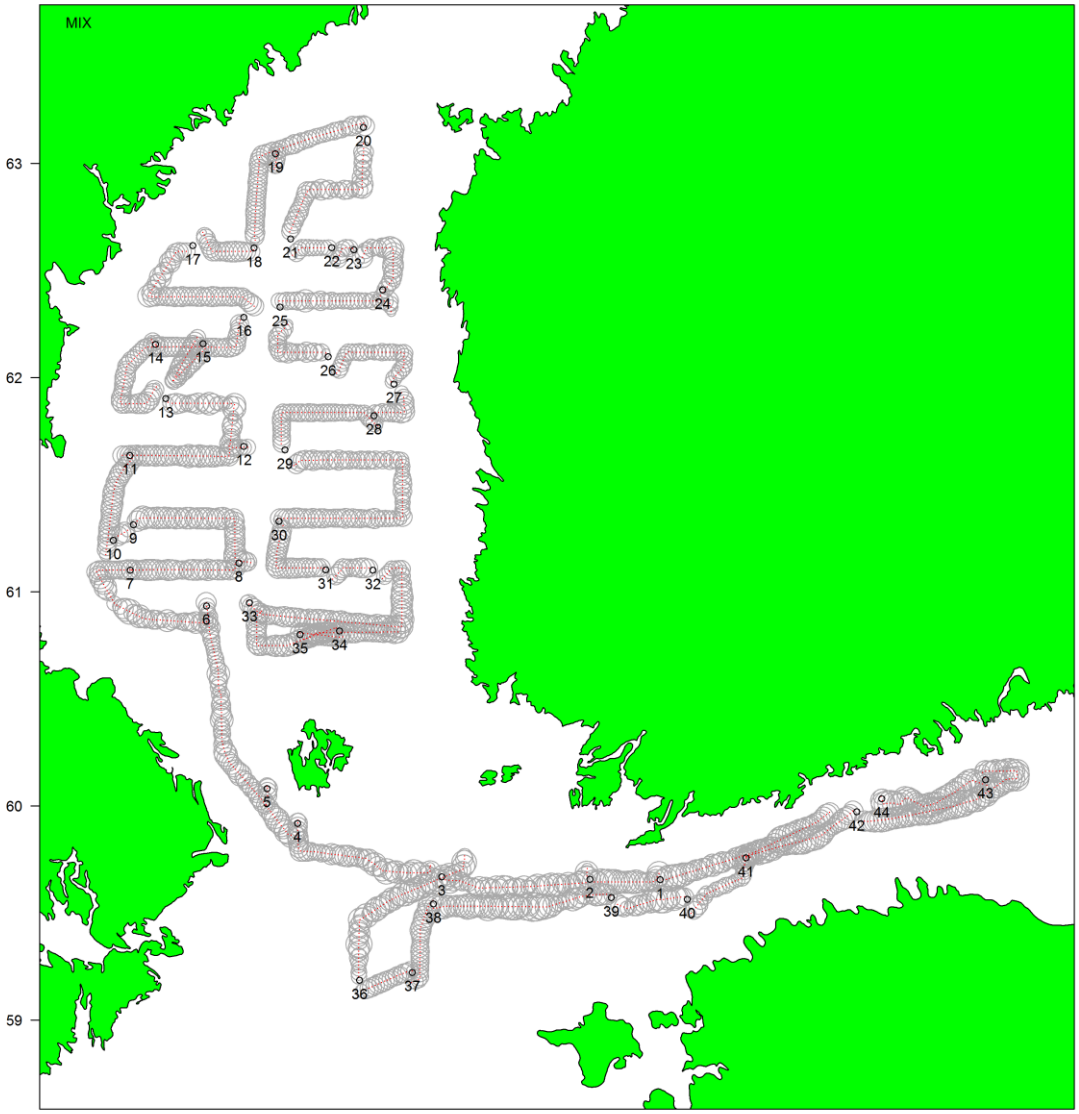

Figure 1. Cruise track and trawl stations of r/v Aranda during the Finnish BIAS-survey in 2021.

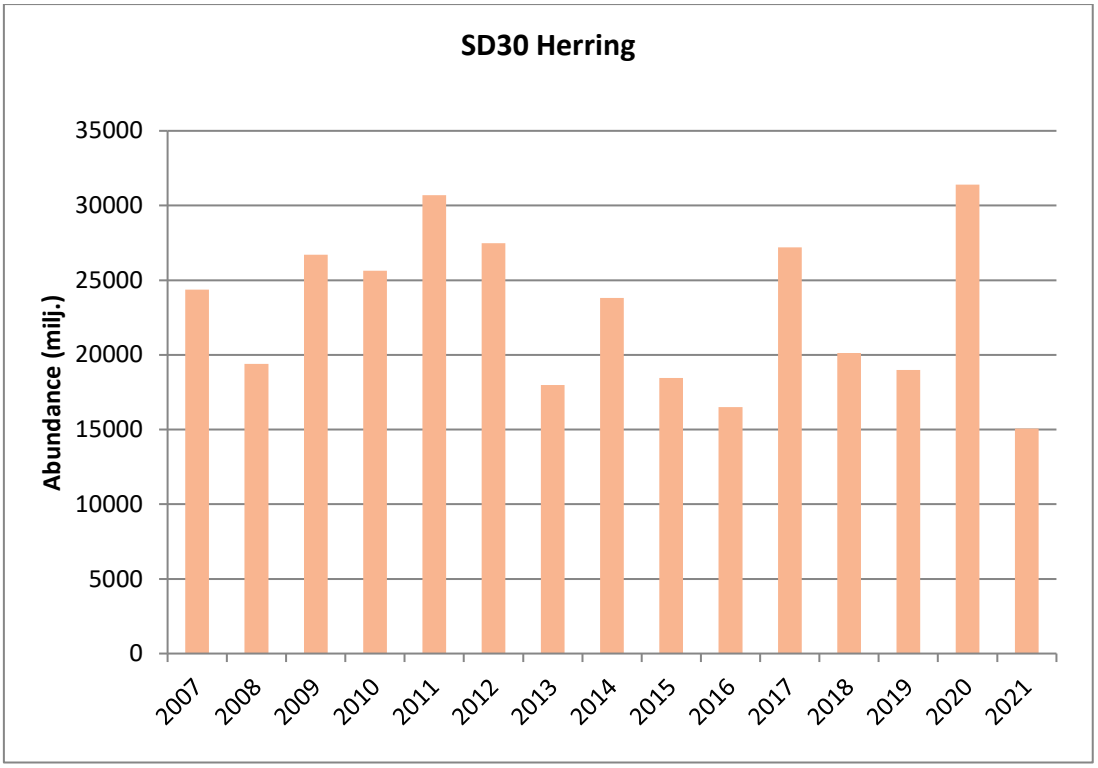

Figure 2. Abundance of herring in SD 30 from 2007 to 2021 with StoX calculations.