

Irish Sea acoustic survey (Northern Ireland)

Survey report for RV Corystes

27th August – 12th September 2022

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1. INTRODUCTION

Acoustic surveys of the northern Irish Sea (ICES Area VIIaN) have been carried by the Agri-Food and Biosciences Institute (AFBI), formerly the Department of Agriculture and Rural Development for Northern Ireland (DARD), since 1991. This report covers the routine Irish Sea survey in the autumn.

2. SURVEY DESCRIPTION & METHODS

2.1 Personnel

Gavin McNeill (SIC)
Peter McCorriston
Ian McCausland
Jessica Graham
Conall Hamill
Matthew Devine

2.2 Narrative

The vessel departed Belfast at 21:00 on the 25th August and proceeded to the east coast of the Isle of Man for acoustic calibration off Laxey on the 26th August. The survey started on the peripheral Irish Sea transects to the west of the Solway Firth at 05:15 on the 27th August and continued to the completion of transect 102 North of Anglesey on the 30th August. From here, the ship made way to the northeast of the Isle of Man and awaited recommencement of the survey at the start of transect 1 on the 30th August at 11:15 and end on transect 81 to the northwest of the Mull of Galloway 03rd September. After a brief overnight break, the survey continued along the western Irish Sea peripheral transects 03rd September at 05:00. Working south along the Northern Ireland coast, a discrete set of additional survey transects in the vicinity of Rig Bank was conducted on 03rd Sept. The final set of transects for the first phase of the survey ended on transect 101 on 07th Sept and a further set of transects around the Isle of Man were undertaken. Sea conditions were calm throughout the duration of the survey.

2.3 Survey design

The survey design of systematic, parallel transects covers approximately 620 nm (Figure 5B.1). The position of the set of widely-spaced (8-10 nm) transects around the periphery of the Irish Sea is randomized within +/- 4 nm of a baseline position each year. Transect spacing is reduced to 2 nm in strata around the Isle of Man to improve precision of estimates of adult herring biomass. Relatively lower effort is deployed around the periphery of the Irish Sea where the acoustic targets comprise mainly extended school groups of sprats and 0-group herring. Although this survey design yields high-precision estimates for these small clupeoids due to their extended distribution, the probability of encountering highly aggregated and patchy schools of larger herring remains low around the periphery of the Irish Sea compared with around the Isle of Man. Survey design and methodology adheres to the methods laid out in the WGIPS acoustic survey manual.

2.4 Calibration

The hull mounted Simrad EK60 acoustic system with 38 kHz split-beam was calibrated on the 26th August off Laxey on the east coast of the Isle of Man. Conditions were good and the calibration results satisfactory. All procedures were according to those defined in the survey manual. Summary of calibration results are presented in Table 5B.1.

2.5 Acoustic data collection

Acoustic data were only collected during 24hrs a day, except in coastal areas on the English and Irish coasts where data collection was restricted to daylight hours (0600-2100). Acoustic data at 38 kHz are collected in 15-minute elementary distance sampling units (EDSU's) with the vessel steaming at 10 knots. A Simrad EK-60 echosounder with hull-mounted split-beam transducer is employed, and data are logged and analysed using SonarData Echoview software. The system settings are given in Table 5B.1.

2.6 Biological data – fishing stations

Targets are identified where possible by aimed midwater trawling fitted with a sprat brailer. The net was fished with a vertical mouth opening of approximately 12m, which was observed using a Scanmar “Trawleye” netsounder. To facilitate determining the position of the net in the water column, a Scanmar depth sensor is also fitted to the headline.

Trawl catches are sorted to species level and then weighted. Depending on the number of fish, the sorted catch is normally sub-sampled for length measurements. Length frequencies are recorded in 0.5 cm length classes. Individual length-weight data are collected for all fish species contributing to the catches. Random samples of 50 herring (1+ gp) are taken from each catch for recording of biological parameters (length, weight, sex and maturity) and removal of otoliths for age determination.

2.7 Hydrographic data

Surface temperature and salinity were recorded using the through-flow thermosalinograph, and logged together with DGPS position at 1-minute intervals.

2.8 Data analysis

EDSUs were defined by 15 minute intervals which represented 2.5 nm per EDSU, assuming a survey speed of 10 knots. The surface-area backscattering (NASC) estimates are calculated for schools, school groups and scattering layers using a threshold of -60 dB. Targets in each 15-minute interval were allocated to species or species mixes by scrutinizing the echo charts together with acoustic records during trawling and maps of NASC values indicating location of trawls relative to school groups. In some cases, trawls with similar species and size composition are combined to give a more robust estimate of population length composition. Data were analysed using quarter rectangles of 15' by 30'.

The single-species or mixed-species mean target strength (TS) is calculated from trawl data for each interval as $10 \log \{ (\sum_{s,l} N_{s,l} \cdot 10^{0.1 \cdot TS_{s,l}}) / \sum_{s,l} N_{s,l} \}$ where $N_{s,l}$ is the number of fish of species s in length class l . The values recommended by ICES for the parameters a and b of the length- TS relationship $TS = a \log(l) + b$ are used: $a = 20$ (all species); $b = -71.2$ (herring, sprat, horse mackerel), -84.9 (mackerel) and -67.5 (gadoids). The weighted mean TS is applied to the NASC value to give numbers per square nautical mile. For herring, this is further decomposed into densities by age class according to the length frequencies in the relevant target-identification trawls and the survey age-length key. Mean weights-at-age, calculated from length-weight parameters for the survey, is used to calculate biomass of herring from the estimated numbers-at-age. The weighted mean fish density is estimated for each survey stratum (Figure 5B.1) using distance covered in each 15-minute EDSU as weighting factors, and raised by stratum surface area. Approximate standard errors are computed for the biomass estimates based on the variation between EDSUs within strata.

3. RESULTS

3.1 Biological data

Sampling intensity was relatively high during the 2022 survey with 32 successful trawls completed Figure 5B.2. Table 5B.2 gives the positions, catch composition and mean length by species for these trawl hauls. Twenty-nine hauls contained herring to be used in the analysis. The length frequency distributions of these hauls are illustrated in Figure 5B.3. Length frequency distributions reflect the general juvenile/adult herring distributions within the sampling area. The resulting weight-length relationship for herring was calculated from the sampling information as $W = 0.003017 * L^{3.383}$ (length measured in cm). The preliminary age length key (Table 5B.3) used in the analysis indicate that the population is composed of juveniles and adults fish (age 0-9). Age-length key for herring (Table 5B.3) from which otoliths were removed at sea during the Irish Sea 2021 survey have been included in this report as otoliths from the 2022 survey are still to be analysed. Age-length data will be updated for the 2022 survey upon completion of their analysis.

3.2 Acoustic data

The distribution of the NASC values assigned to herring and to clupeoid mixes (juvenile herring and sprat) are presented in Figure 5B.4. The highest abundance of herring was to the west of the Isle of Man and off the east coast of Northern Ireland.

3.3 Biomass estimates

The estimated biomass and number of herring and sprat by strata are given in Table 5B.4. The total number estimate comprises of ~6% age 0, 39% age 1, ~23% age 2, ~16% age 3, ~11% age 4 and 6% age 5+.

4. DISCUSSION

The herring stock estimate in the survey area (Irish Sea/North Channel) was estimated to be 118,023t. The major contribution of ages to the total estimates is from age 1 and age 2 fish by number and weight. The herring were fairly widely distributed within mixed schools at low abundance, with a few distinct high abundance areas. The bulk of 1+ herring targets in 2021 were observed west of the Isle of Man and off the east coast of Northern Ireland. (western side of stratum 7 and northern end stratum 3 respectively; Figure 5B.1), with a fairly scattered lower abundance observed throughout the Irish Sea (Figure 5B.4). The length frequencies generated from these trawls highlight the spatial heterogeneous nature of herring age groups in the Irish Sea (Figure 5B.3). The estimate of herring SSB of 61,805t is within the observed range for the time series and the biomass estimate of 111,012t for 1+ ringers for 2022 also remains within the observed range since 2011. Biomass estimates for herring SSB and herring +1 ringers are higher than observed over the previous three years of the time series.

The survey estimates are influenced by the timing of the spawning migration. The highest proportion of the 1+ biomass estimates were to the west of the Isle of Man (strata 7), off the east coast of Northern Ireland (strata 3) which is indicative of a later migration into the Irish Sea.

Sprat and 0-group herring were distributed around the periphery of the Irish Sea, with the most abundance of 0-group herring in the eastern side and in areas along the northern Irish coast to the west.

Results of a successive acoustic survey conducted later in early October confirmed similar biomass estimates to the main acoustic survey and to those observed in the last few years. The survey results are within the range of what has been observed historically.

TABLES AND FIGURES

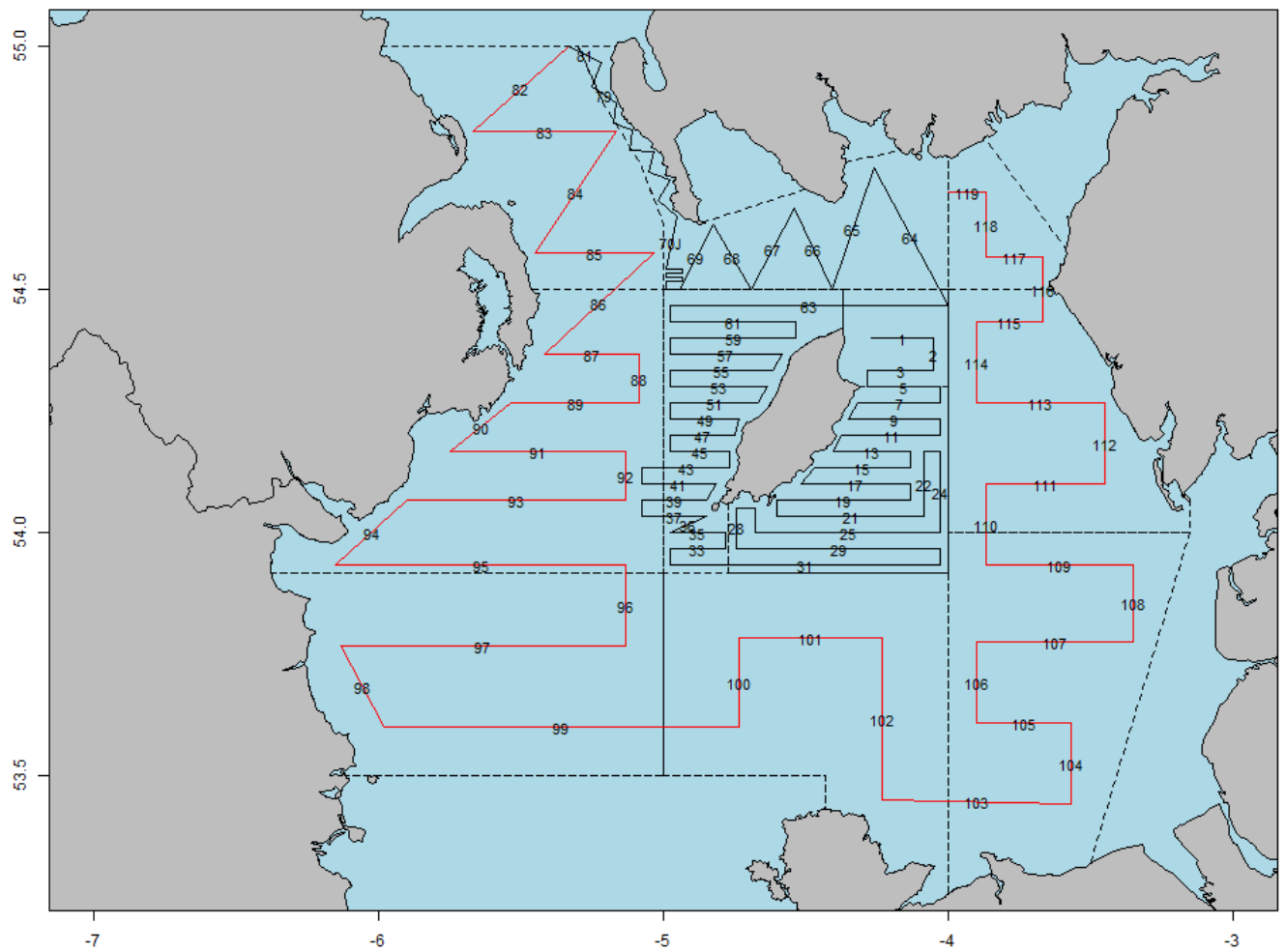


Figure 5B.1: Acoustic survey tracks for the 2022 Irish Sea acoustic survey. Survey design of systematic, parallel transects covers approximately 620 nm

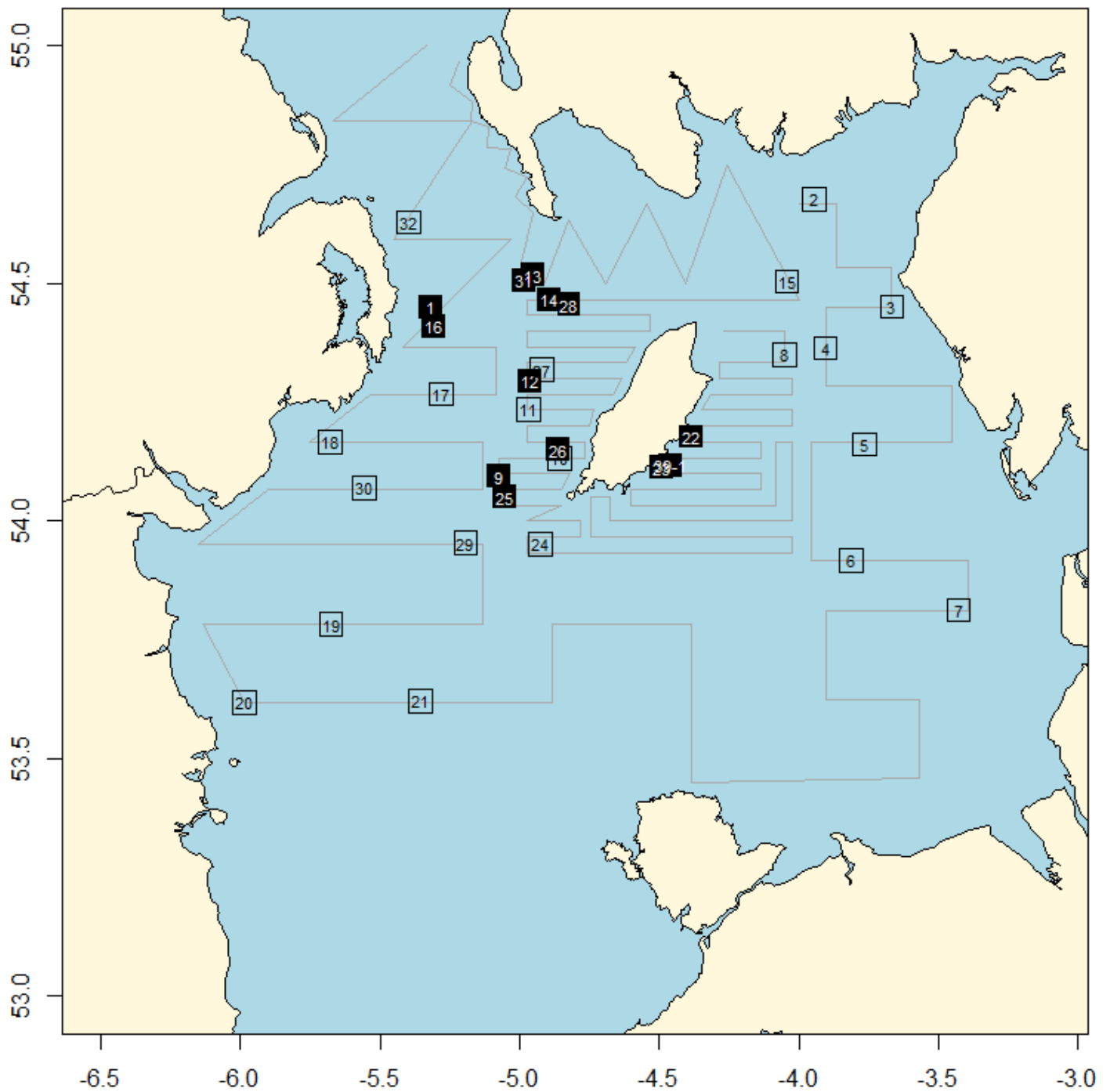
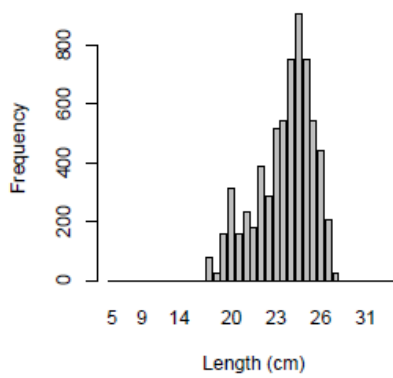
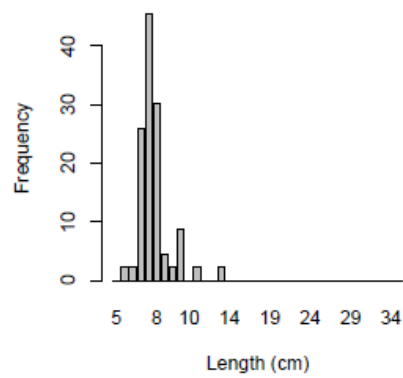


Figure 5B.2 Acoustic survey tracks with trawl positions of the 2022 Irish Sea and North Channel survey on RV "Corystes". Filled squares indicate trawls in which significant numbers of herring were caught or trawls with a high proportion of herring, while open squares indicate trawls with few or no herring.

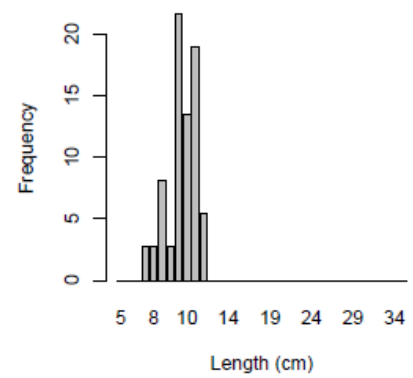
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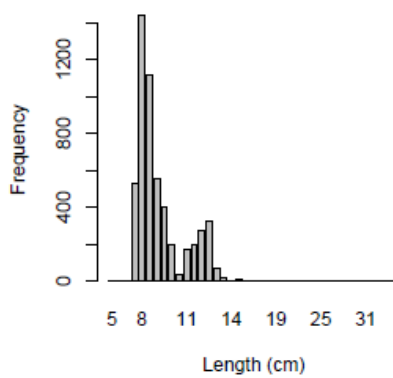
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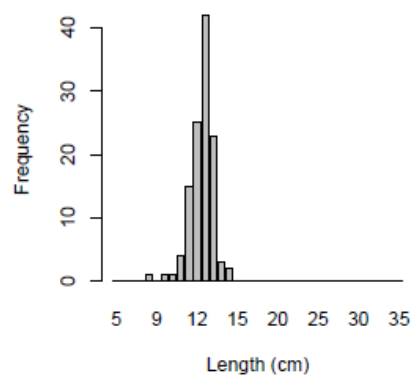
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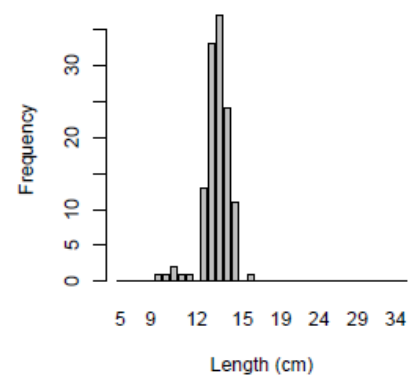
Tow-4



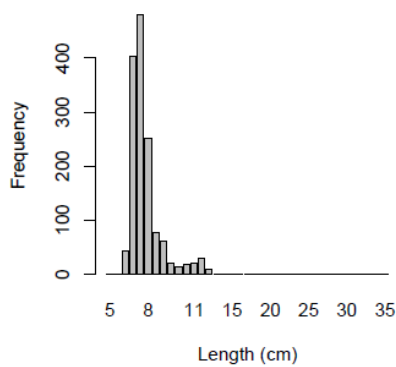
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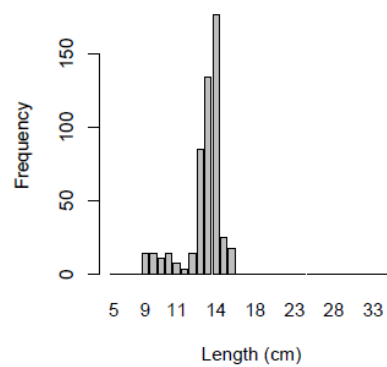
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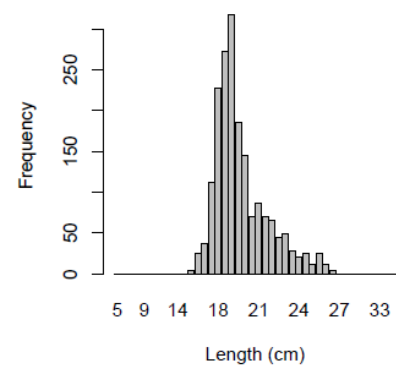
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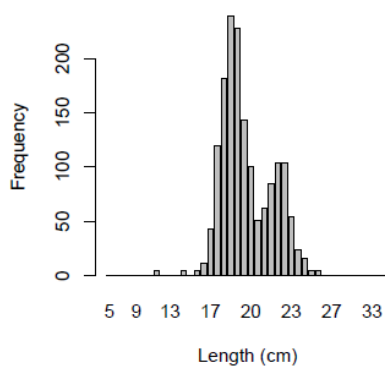
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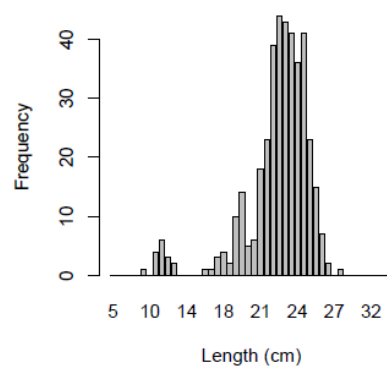
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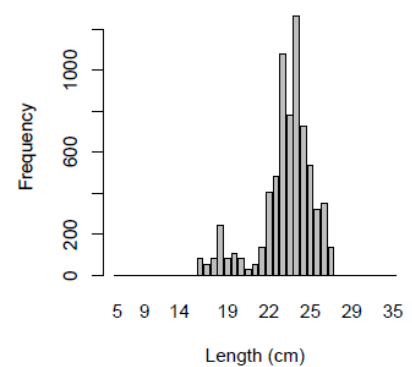
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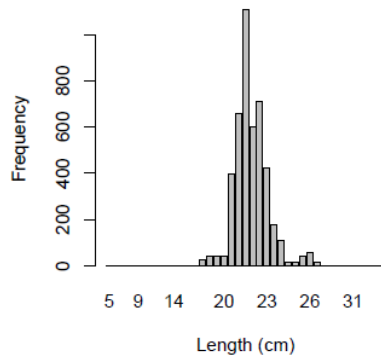
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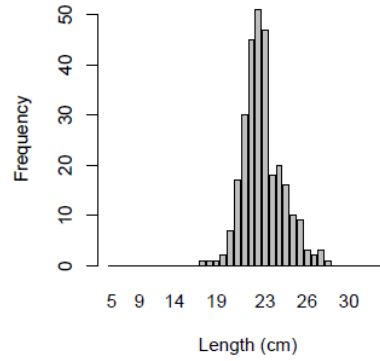
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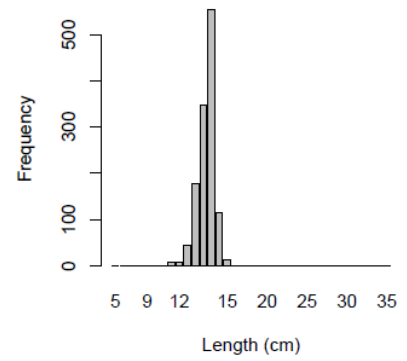
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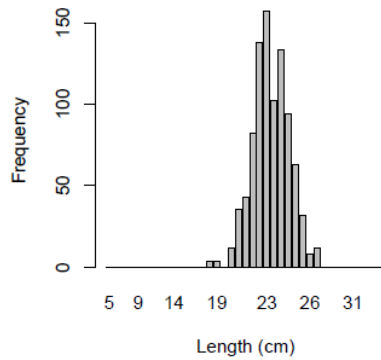
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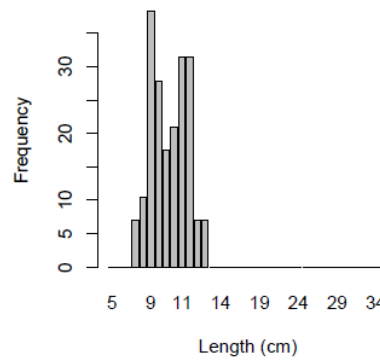
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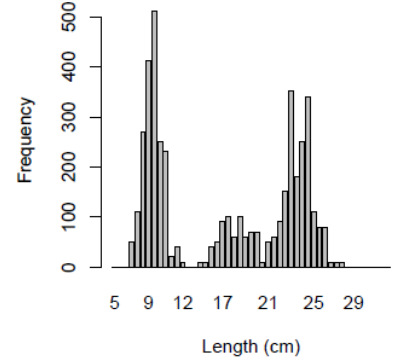
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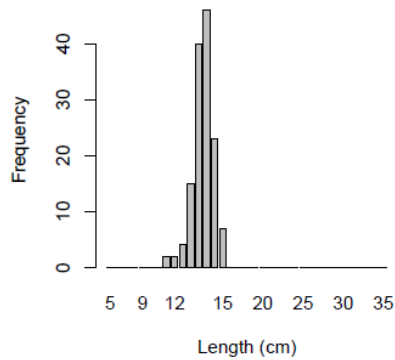
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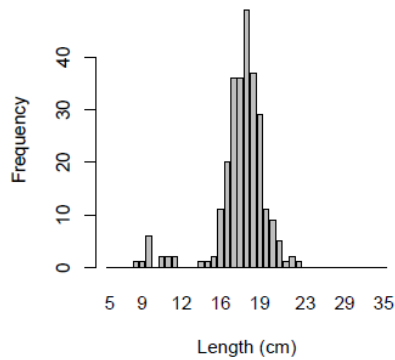
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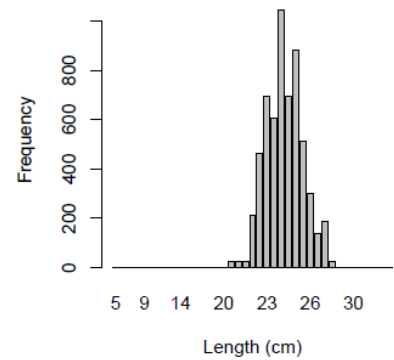
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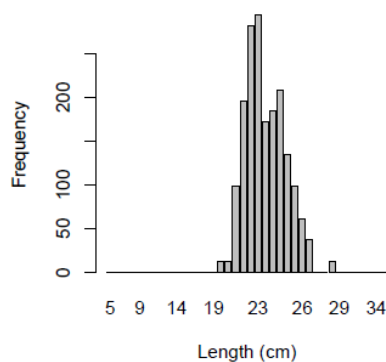
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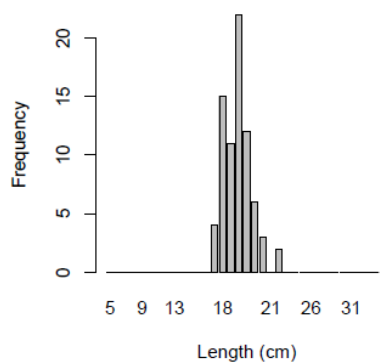
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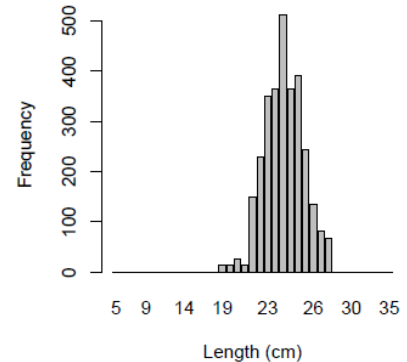
Tow-23



Tow-24



Tow-25



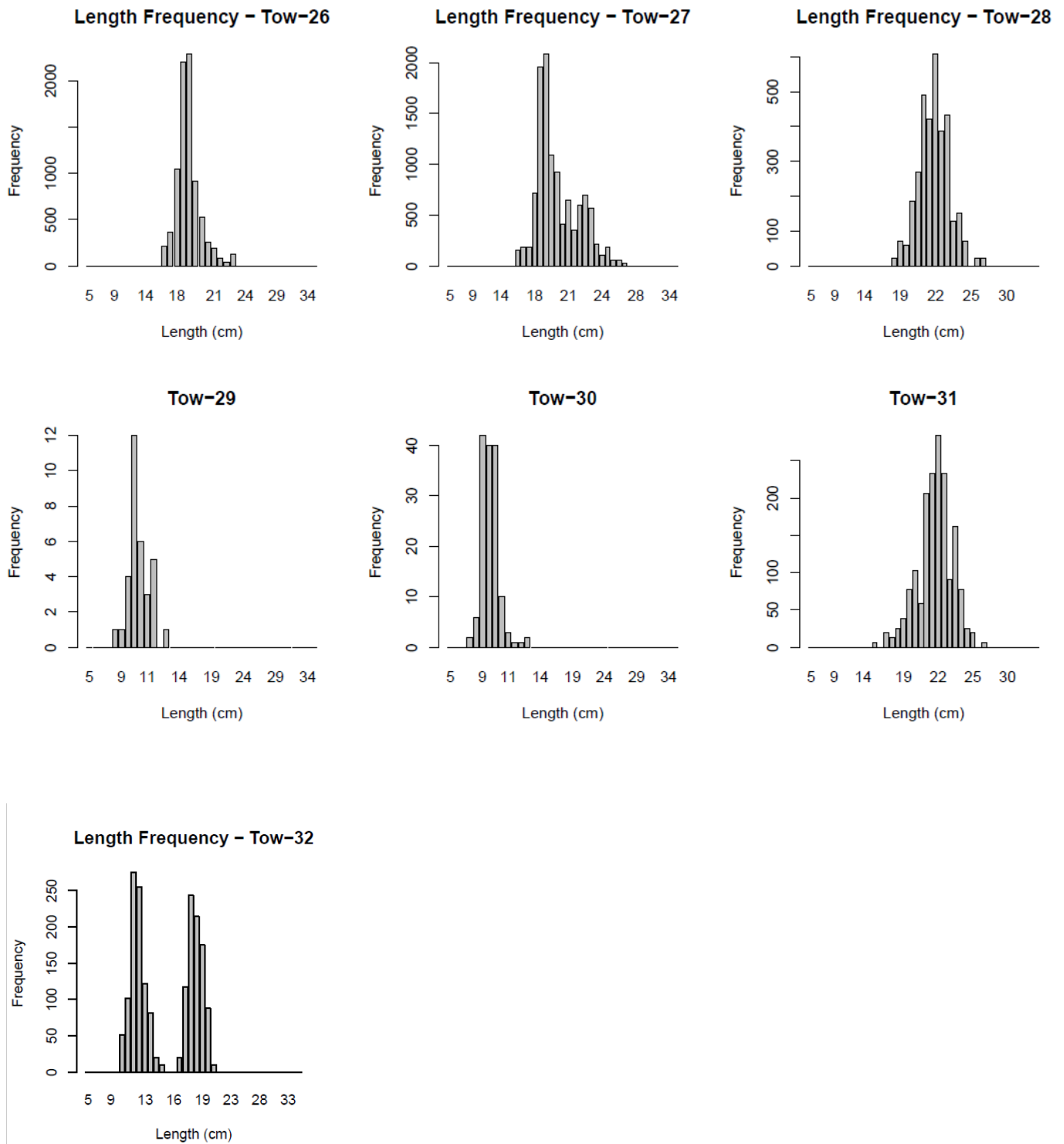


Figure 5B.3: Percentage length compositions of herring in each trawl sample in the 2022 Irish Sea and North Channel acoustic survey on RV "Corystes".

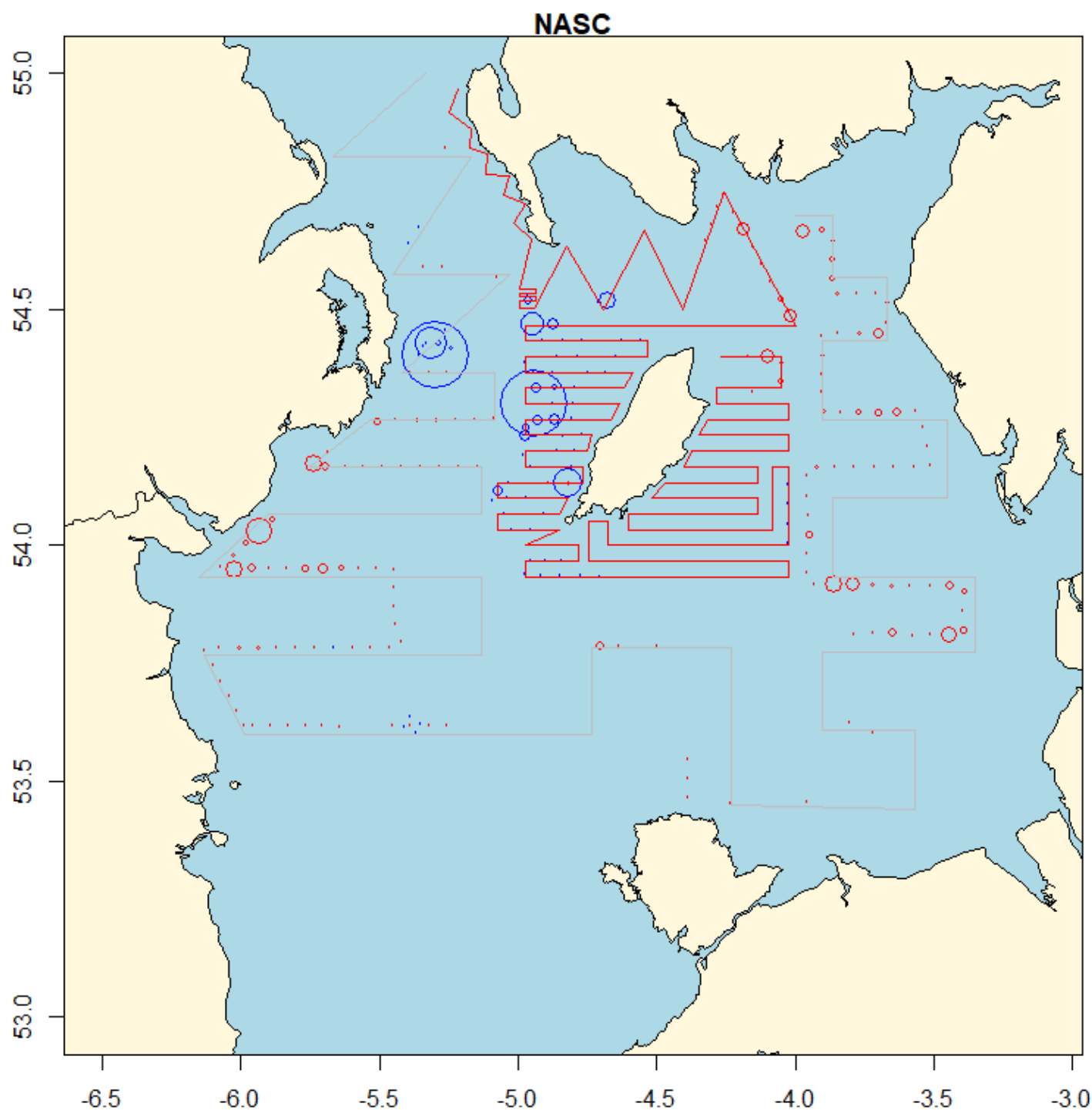


Figure 5B.4: Map of the Irish Sea and North Channel with a post plot showing the distribution of NASC values (size of ellipses is proportional to square root of the NASC value per 15-minute interval) obtained during the 2022 acoustic survey on RV "Corystes". (a) Open blue circles are for herring NASC values (maximum value was 12606 and (b) open red circles are for clupeoid mix NASC, which include juvenile herring and sprat (maximum value was 2341).

Table 5B.1: Simrad EK60 and analysis settings used on the 2021 and 2022 Irish Sea and North Channel herring acoustic survey on RV “Corystes”

TRANSCIVER MENU		
Year	2021	2022
Frequency	38 kHz	38 kHz
Sound speed	1508.1m.s ⁻¹	1509.6m.s ⁻¹
Max. Power	2000 W	2000 W
Default Transducer Sv gain	26.81dB	26.93dB
Athw. Beam Angle	6.98 deg	6.98 deg
Athw. Offset Angle	0.01 deg	0.02 deg
Along. Beam Angle	6.97 deg	6.96 deg
Along. Offset Angle	0.01 deg	0.01 deg
Calibration details		
TS of sphere	-33.6 dB	-33.6 dB
Range to sphere in calibration	11.5 m	11.5 m
Log Menu		
Integration performed in Echoview post-processing based on 15 minute EDSUs		
Operation Menu		
Ping interval	0.7 s	0.7 s
Analysis settings		
Bottom margin (backstep)	0.5 m	0.5 m
Integration start (absolute) depth	8 m	8 m
Sv gain threshold	-60 dB	-60 dB

Table 5B.2: Catch composition and position of hauls undertaken by the RV *Corystes* during the Irish Sea/North Channel survey, August/September 2022.

Tow	Date	Shooting Details				Total Catch (kg)	Percentage composition of fish by weight.								mean length (cm)	
		Time	Latitude	Longitude	Depth (m)		herring	sprat	mackrel	scad	anchovy	whiting	other fish	herring	sprat	
1	27/08/2022	13:56	54 27.043	5 19.155	104.5	750	100	0.00	0.00	0.00	0.00	0.00	0.00	24.5		
2	28/08/2022	08:18	54 40.709	3 56.796	29.55	67	0.86	98.92	0.00	0.03	0.00	0.00	0.19	7.5	8.5	
3	28/08/2022	10:40	54 27.0755	3 39.9917	22.8	78	0.61	93.71	0.19	0.00	0.00	0.06	5.43	10.0	10.5	
4	28/08/2022	13:20	54 21.856	3 54.278	41.8	272	10.80	85.79	0.07	0.01	0.00	0.05	3.28	8.0	10.0	
5	28/08/2022	18:24	54 9.706	3 45.839	19.83	19	8.37	91.35	0.26	0.01	0.00	0.00	0.01	12.5	9.5	
6	29/08/2022	08:59	53 55.051	3 48.714	32	54	4.11	45.46	3.52	14.44	0.00	29.44	3.03	13.5	10.5	
7	29/08/2022	11:30	53 48.76	3 25.674	23.5	84	9.70	89.26	0.29	0.02	0.00	0.58	0.15	7.5	6.0	
8	30/08/2022	12:57	54 21.046	4 3.078	38.8	52	16.78	83.10	0.11	0.00	0.00	0.01	0.00	14.0	8.5	
9	01/09/2022	22:58	54 5.6759	5 4.445	84	133	89.06	0.00	0.00	0.00	0.00	0.05	10.89	19.0		
10	01/09/2022	00:55	54 7.961	4 51.412	35	111	88.15	0.87	9.18	0.04	0.00	1.69	0.07	18.5	11.0	
11	01/09/2022	05:07	54 14.134	4 57.97	89.65	40	94.55	2.24	1.81	0.00	0.00	0.99	0.41	22.5	10.0	
12	01/09/2022	10:23	54 17.653	4 57.689	103	750	100.00	0.00	0.00	0.00	0.00	0.00	0.00	23.0		
13	01/09/2022	22:57	54 31.0488	4 56.9833	84	562	65.81	0.00	0.00	0.00	0.00	0.29	33.90	21.5		
14	02/09/2022	00:27	54 27.9991	4 53.564	47	118	23.29	0.00	0.00	0.00	0.00	0.00	76.71	22.5		
15	02/09/2022	08:38	54 30.2474	4 2.5417	41	71	34.42	42.83	3.65	18.67	0.00	0.00	0.43	14.0	10.5	
16	03/09/2022	03:33	54 24.633	5 18.453	100.1	104	100.00	0.00	0.00	0.00	0.00	0.00	0.00	23.0		
17	03/09/2022	09:41	54 16.046	5 16.724	70	62	2.35	97.65	0.00	0.00	0.00	0.00	0.00	9.0	10.0	
18	03/09/2022	11:41	54 9.997	5 40.608	23.2	65	0.00	88.30	11.70	0.00	0.00	0.00	0.00		11.0	
19	06/09/2022	12:32	53 46.9568	5 40.4852	84	262	93.13	6.87	0.00	0.00	0.00	0.00	0.00	16.5	8.0	
20	06/09/2022	15:27	53 37.109	5 59.074	29.16	53	5.39	87.95	6.65	0.01	0.00	0.00	0.00	14.0	7.0	
21	06/09/2022	21:51	53 37.348	5 21.206	76.7	26	49.72	5.86	0.00	0.00	0.00	18.24	26.18	18.0	8.5	
22	07/09/2022	22:08	54 10.625	4 23.162	31	775	90.15	0.20	8.32	0.00	0.00	0.61	0.72	25.0	8.5	
23	08/09/2022	01:29	54 6.802	4 29.312	29	200	100.00	0.00	0.00	0.00	0.00	0.00	0.00	23.0		
24	08/09/2022	19:55	53 57.146	4 55.539	64	3.5	100.00	0.00	0.00	0.00	0.00	0.00	0.00	19.0		
25	09/09/2022	01:29	54 3.0212	5 3.0158	59	351	100.00	0.00	0.00	0.00	0.00	0.00	0.00	24.0		
26	09/09/2022	05:02	54 8.982	4 51.759	36.17	442	100.00	0.00	0.00	0.00	0.00	0.00	0.00	19.0		
27	09/09/2022	13:15	54 19.1324	4 55.2829	78.5	710	100.00	0.00	0.00	0.00	0.00	0.00	0.00	19.0		
28	09/09/2022	20:36	54 27.341	4 49.307	61	273	100.00	0.00	0.00	0.00	0.00	0.00	0.00	22.0		
29	10/09/2022	12:21	53 57.2664	5 11.5717	67	0.258	100.00	0.00	0.00	0.00	0.00	0.00	0.00	10.0		
30	10/09/2022	16:02	54 4.257	5 33.462	60.63	0.838	100.00	0.00	0.00	0.00	0.00	0.00	0.00	10.0		
31	11/09/2022	17:42	54 30.381	4 58.901	114.16	147	100.00	0.00	0.00	0.00	0.00	0.00	0.00	22.0		
32	12/09/2022	11:30	54 37.728	5 23.689	60	52	100.00	0.00	0.00	0.00	0.00	0.00	0.00	18.0		

Table 5B.3: Preliminary age-length key for herring from which otoliths were removed at sea during the Irish Sea/North Channel survey 2021. Data are numbers of fish at age in each length class in samples collected from each trawl.

LENGTH (CM)	AGE CLASS (RINGS, OR AGES ASSUMING 1 JANUARY BIRTHDATE)									
	0	1	2	3	4	5	6	7	8+	TOTAL
7.5	3	0	0	0	0	0	0	0	0	3
8	3	0	0	0	0	0	0	0	0	3
8.5	5	0	0	0	0	0	0	0	0	5
9	4	0	0	0	0	0	0	0	0	4
9.5	5	0	0	0	0	0	0	0	0	5
10	8	0	0	0	0	0	0	0	0	8
10.5	7	0	0	0	0	0	0	0	0	7
11	9	0	0	0	0	0	0	0	0	9
11.5	11	0	0	0	0	0	0	0	0	11
12	7	0	0	0	0	0	0	0	0	7
12.5	8	0	0	0	0	0	0	0	0	8
13	10	0	0	0	0	0	0	0	0	10
13.5	5	0	0	0	0	0	0	0	0	5
14	5	0	0	0	0	0	0	0	0	5
14.5	5	1	0	0	0	0	0	0	0	5
15	4	0	0	0	0	0	0	0	0	5
15.5	0	1	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	1
16.5	0	0	0	0	0	0	0	0	0	0
17	0	6	0	0	0	0	0	0	0	0
17.5	0	9	0	0	0	0	0	0	0	6
18	0	13	0	0	0	0	0	0	0	9
18.5	0	15	0	0	0	0	0	0	0	13
19	0	13	0	0	0	0	0	0	0	15
19.5	0	13	1	0	0	0	0	0	0	13
20	0	7	8	0	0	0	0	0	0	14
20.5	0	8	10	0	0	0	0	0	0	15
21	0	0	24	0	0	0	0	0	0	18
21.5	0	1	25	0	0	0	0	0	0	24
22	0	0	25	0	0	0	0	0	0	26
22.5	0	0	27	3	0	0	0	0	0	28
23	0	0	19	4	0	0	0	0	0	31
23.5	0	0	15	10	0	0	0	0	0	29
24	0	0	4	10	0	0	0	0	0	25
24.5	0	0	2	17	1	0	0	0	0	22
25	0	0	0	20	1	0	0	0	0	23
25.5	0	0	0	17	9	0	0	0	0	26
26	0	0	0	10	14	2	2	0	0	28
26.5	0	0	0	1	11	1	3	0	0	16
27	0	0	0	0	8	2	1	0	1	12
27.5	0	0	0	0	4	2	2	2	0	10
28	0	0	0	0	1	1	1	0	0	3
28.5	0	0	0	0	1	0	0	0	0	1
29	0	0	0	0	0	0	0	0	0	1
TOTAL	99	87	160	92	51	8	9	2	1	509

Table 5B.4: Acoustic survey estimates of biomass (t) and numbers ('000) of herring and sprat by survey stratum from the AFBI acoustic surveys in 2022.

STRATUM	NO. SPRAT	BIOMASS SPRAT	NO. HER	BIOMASS HER
1	27118	102	17489	1500
2	0	0	42512	4858
3	1161843	4585	619590	39090
4	2019056	14857	341544	22923
5	0	0	127264	11392
6	2861770	8690	58314	844
7	1422	12	298813	14013
8	172621	828	11590	196
9	0	0	1701	202
10	4851846	17817	221251	1822
11	1370718	5153	60097	527
12	4383811	16972	465934	20657
13	0	0	0	0
14	0	0	0	0
Totals	16850206	69016	2266100	118023