

## **Irish Sea commercial acoustic survey (Northern Ireland)**

Survey report for FV Havilah

10<sup>rd</sup> October – 14<sup>th</sup> October 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 Irish Sea commercial survey conducted in the autumn.

## **2. SURVEY DESCRIPTION & METHODS**

### **2.1 Personnel**

Gavin McNeill (SIC)

Ian McCausland

Conor Sloan

### **2.2 Narrative**

The Irish Sea Acoustic Spawning Survey (ISSS) 2022 was conducted on the FV Havilah. The survey started on the Isle of Man grid at the start of transect 1 on 10th October and continued through to the end of transect 82 on the 12th October 2022. Sea conditions were variable during the survey, yet, no weather induced down time was recorded. Targets were identified by aimed midwater trawls, 1 successful tow was completed in 2022, which is consistent with fishing intensity for survey over time series, providing confidence in school recognition and supporting biological data for age stratified abundance estimation of target species (herring).

### **Survey design**

The survey design of systematic, parallel transects covers approximately 640 nm (Figure 5B.1). Transect spacing is set to 2 nm in strata around the Isle of Man where adult herring were expected to be most abundant but also to have a very patchy distribution with relatively low probability of encounter. The survey design is based on information on herring distribution in autumn obtained from previous surveys, and from patterns in the commercial fishery showing a concentration of herring in Manx waters at this time. 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 09<sup>th</sup> October in Laxey bay off 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 was collected 24hrs a day at 38 kHz 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 is 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 15m, 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 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 main Irish Sea Acoustic Survey 2022 with 32 successful trawls completed, an additional 1 trawl was successfully completed during the 2022 Irish Sea Acoustic Spawning Survey Figure 5B.2. Table 5B.2 gives the positions, catch composition and mean length by species for the 32 trawl hauls for the main Irish Sea Acoustic Survey and Table 5B.3 shows positions, catch composition and mean length by species for the further 1 haul completed during the commercial survey. The length frequency distributions of these hauls are illustrated in Figure 5B.3 for the main survey and Figure 5B.4 for the commercial survey. Length frequency distributions reflect the general juvenile/adult herring distributions within the sampling area. The preliminary age length key (Table 5B.4) used in the analysis indicate that the population is composed of juveniles and adults fish (age 0-9).

### 3.2 Acoustic data

The distribution of the NASC values assigned to herring and to clupeoid mixes (juvenile herring and sprat) and for herring only are presented in Figure 5B.5. The highest abundance of herring was to the east of the Isle of Man and also along the west coast of the Isle of Man

### 3.3 Biomass estimates

The estimated biomass and number of herring and sprat by strata are given in Table 5B.5. The total herring SSB estimate comprises is 47,282t

## 4. DISCUSSION

The herring stock estimate for the Irish Sea commercial survey area was estimated to be 58,267t. The major contribution of ages to the total estimates is from ages 2 fish by number and 3 by weight. The herring were distributed within a few distinct high abundance areas to the west and east of the Isle of Man. The bulk of 1+ herring targets in 2022 were observed to the south of stratum 8, southwest of stratum 9 and to the offshore ends of transects in stratum 7. Figure 5B.5, shows a further, fairly scattered, lower abundance observed throughout the remainder of the Irish Sea survey area. The length frequencies generated from these trawls highlight the spatial heterogeneous nature of herring age groups in the Irish Sea (Figure 5B.3 & 5B.4). The estimate of herring SSB of 58,267t and biomass estimate of 57,576 for 1+ ringers for 2022 commercial acoustic survey remain within range for the time series. The survey estimates are influenced by the timing of the spawning migration.

## 5 TABLES AND FIGURES

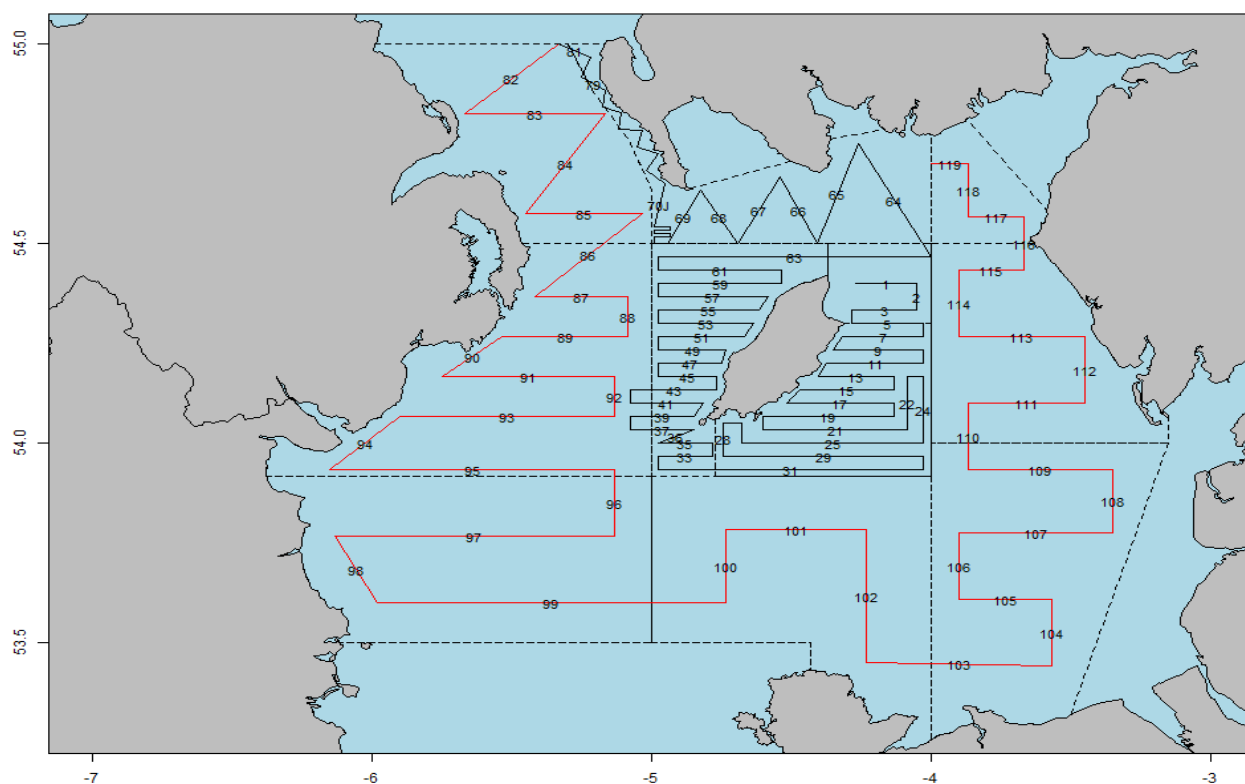


Figure 5B.1: Acoustic survey tracks (highlighted in black) for the 2022 Irish Sea acoustic survey. Survey design of systematic, parallel transects covers approximately 620nm.

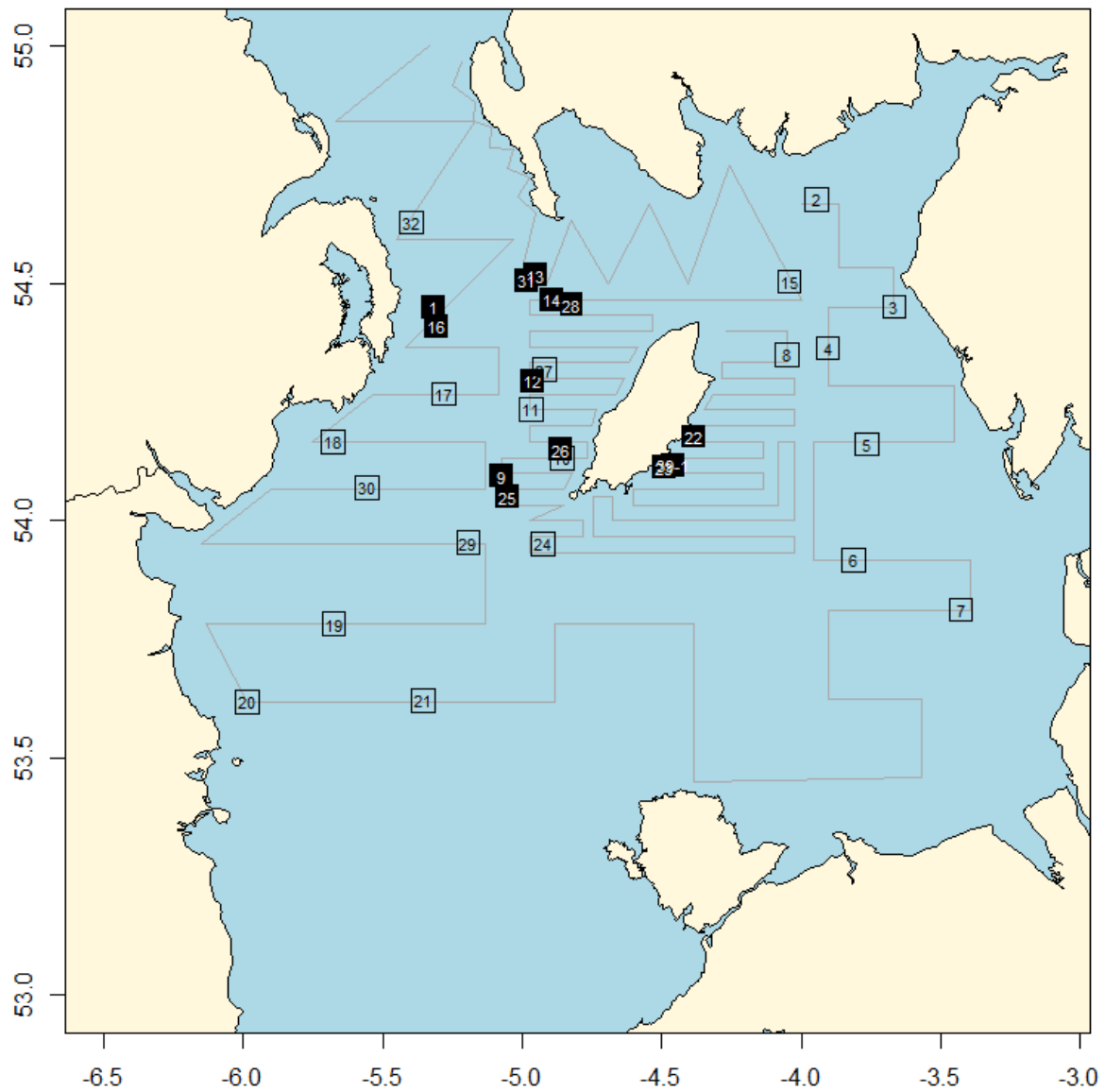
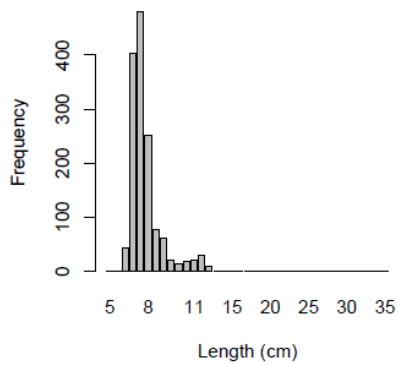
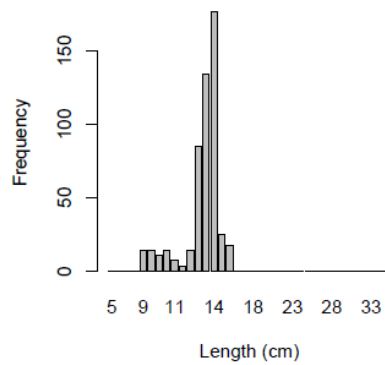


Figure 5B.2 Acoustic survey tracks with trawl positions of the 2022 Irish Sea and North Channel survey on FV “Havilah” and 2022 Irish Sea and North Channel commercial survey on RV “Corystes”. Filled squares indicate trawls in which significant numbers of herring were caught or trawls with a high proportion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

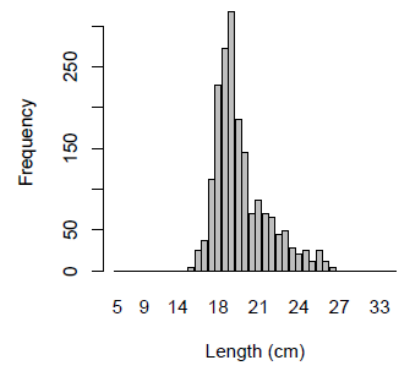
**Length Frequency – Tow-7**



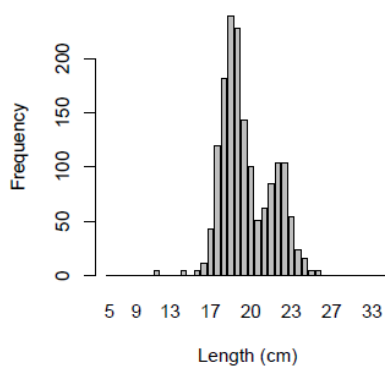
**Length Frequency – Tow-8**



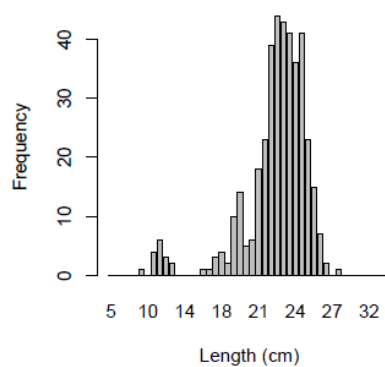
**Length Frequency – Tow-9**



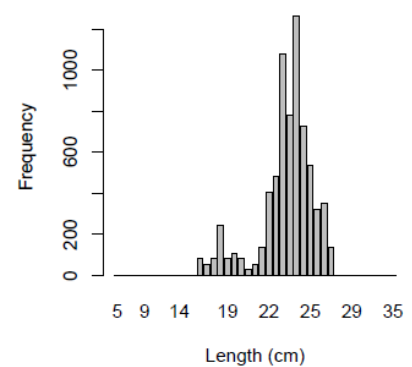
**Tow-10**



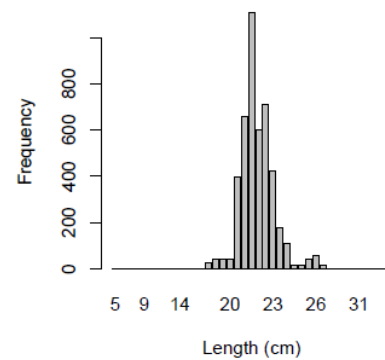
**Tow-11**



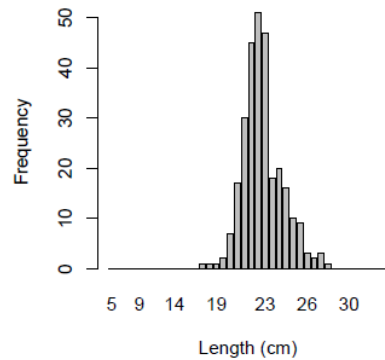
**Tow-12**



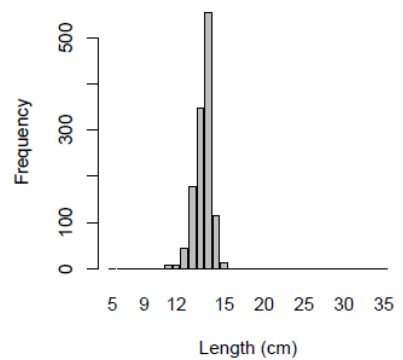
**Length Frequency – Tow-13**



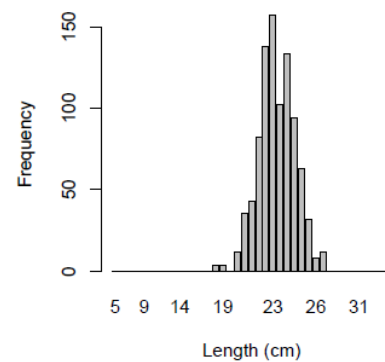
**Length Frequency – Tow-14**



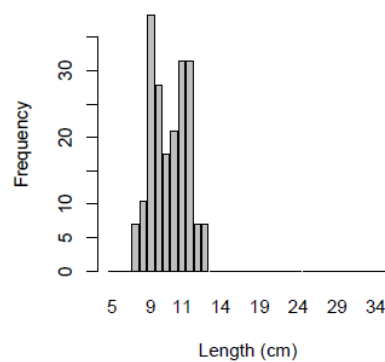
**Length Frequency – Tow-15**



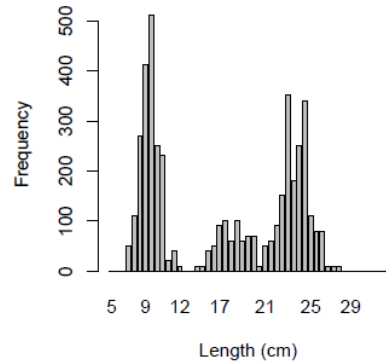
**Tow-16**



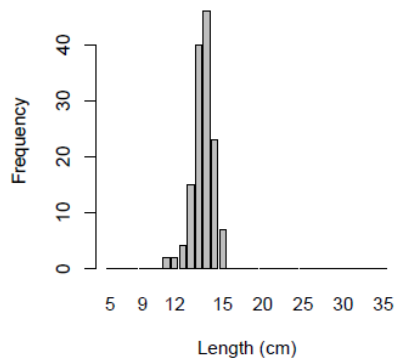
**Tow-17**



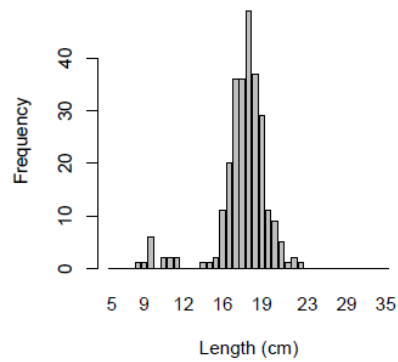
**Tow-19**



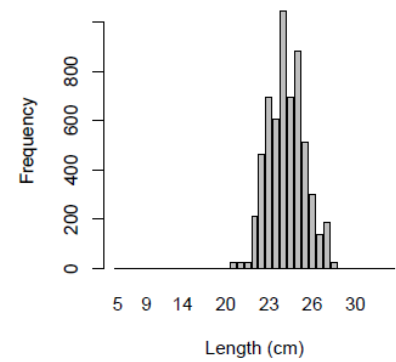
**Length Frequency – Tow-20**



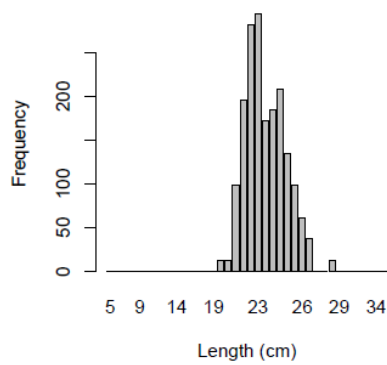
**Length Frequency – Tow-21**



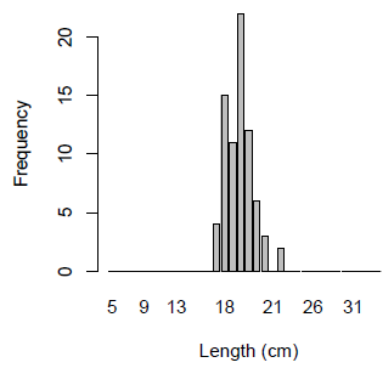
**Length Frequency – Tow-22**



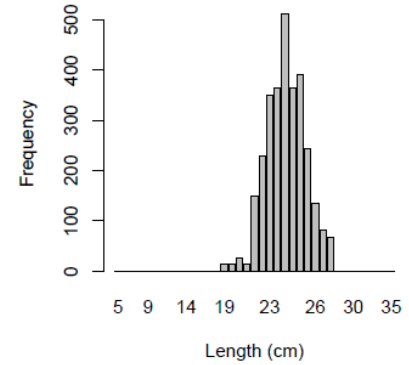
**Tow-23**



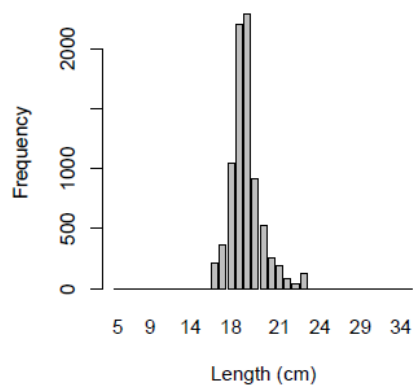
**Tow-24**



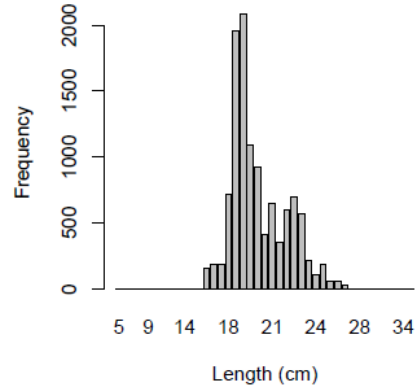
**Tow-25**



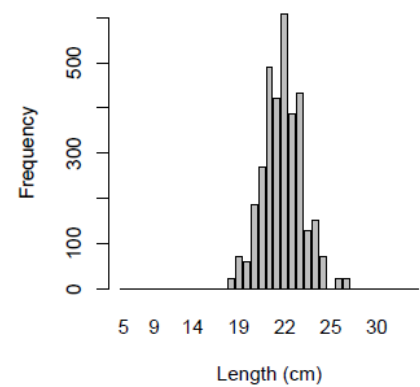
**Length Frequency – Tow-26**



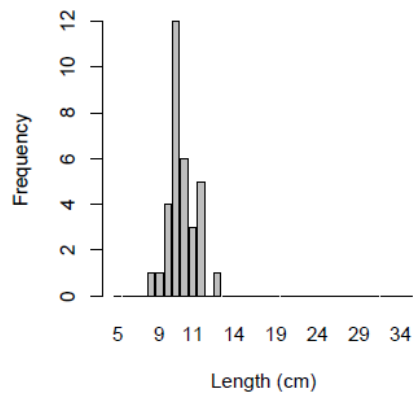
**Length Frequency – Tow-27**



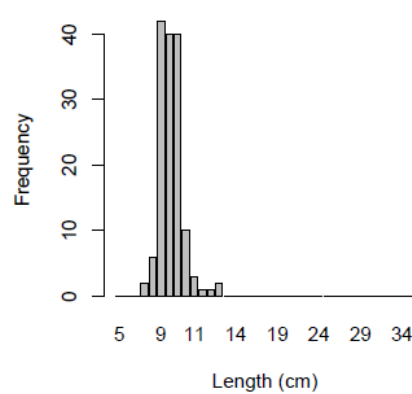
**Length Frequency – Tow-28**



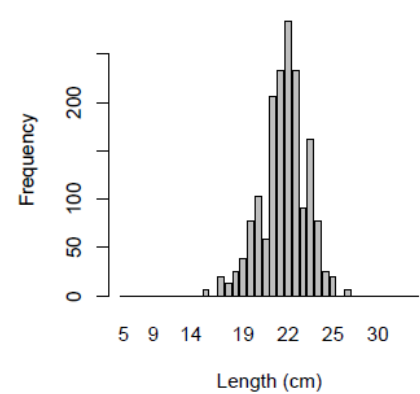
**Tow-29**



**Tow-30**



**Tow-31**



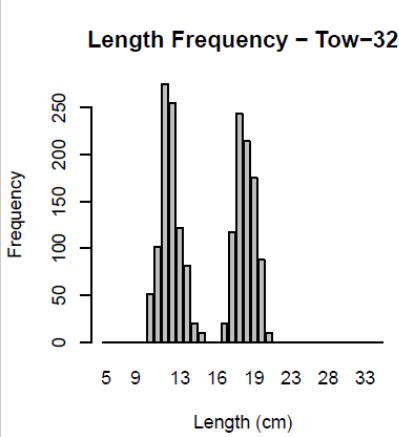


Figure 5B.3: Percentage length compositions of herring in each trawl sample in the August/September 2022 Irish Sea and North Channel acoustic survey on RV “Corystes”.

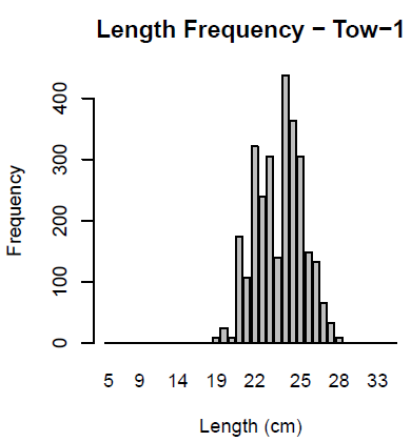


Figure 5B.4: Percentage length compositions of herring in each trawl sample in the 2022 Irish Sea and North Channel commercial acoustic survey on the FV “Havilah”.



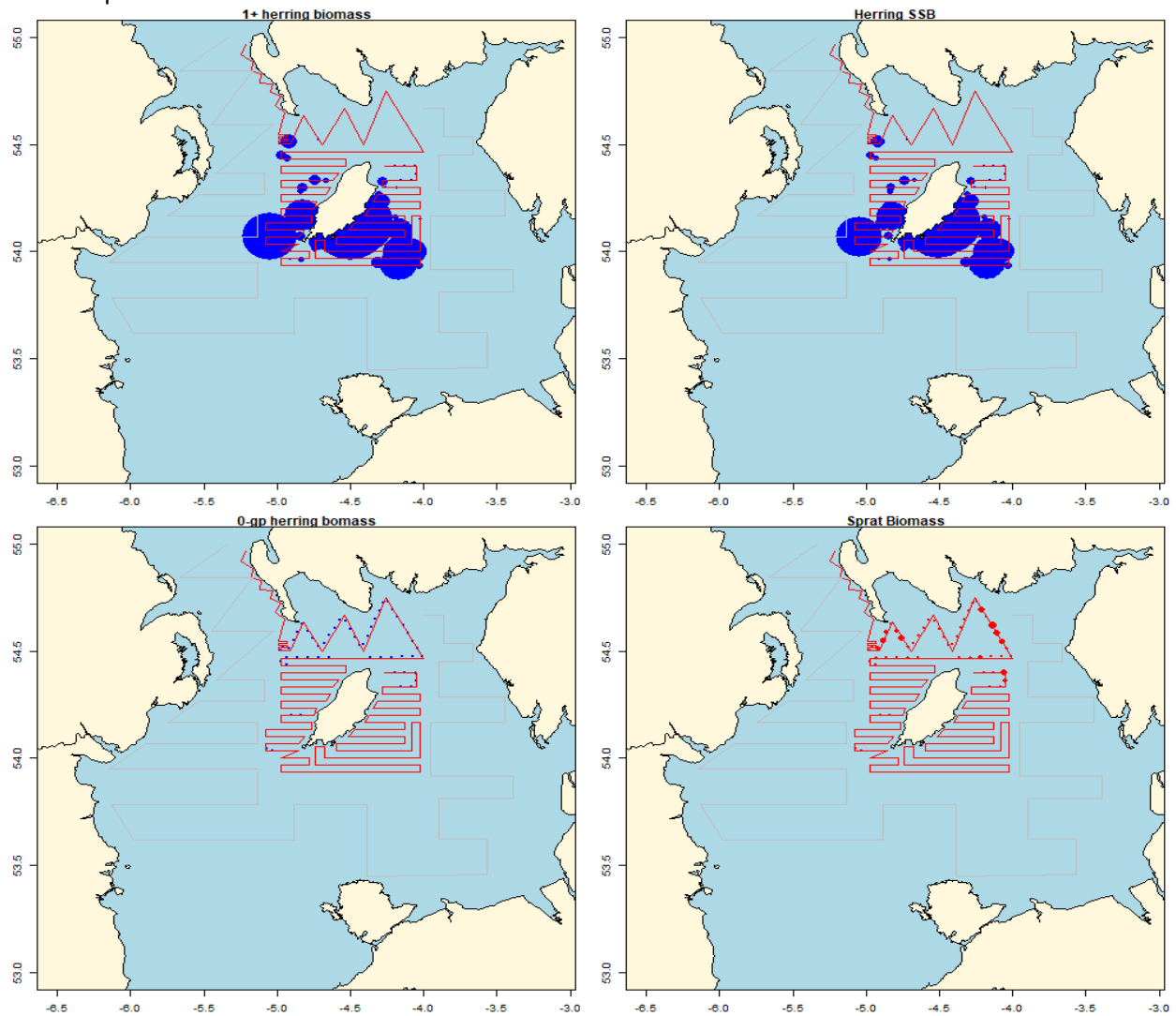


Figure 5B.5: Map of the Irish Sea and North Channel with a post plot showing the distribution of NASC values (size of ellipses is proportional to square root of the NASC value per 15-minute interval) obtained during the 2022 commercial acoustic survey on FV “Havilah”. (a) Solid blue circles are for herring NASC values and (b) solid red circles are for clupeoid mix NASC, which include juvenile herring and sprat.

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

<b>TRANSCEIVER MENU</b>		
Year	2021	2022
Frequency	38 kHz	38 kHz
Sound speed	1504.4m.s <sup>-1</sup>	1504.0 m.s <sup>-1</sup>
Max. Power	2000 W	2000 W
Default Transducer Sv gain	26.96dB	26.90 dB
Athw. Beam Angle	6.98 deg	6.98 deg
Athw. Offset Angle	-0.05 deg	-0.06 deg
Along. Beam Angle	6.97 deg	6.99 deg
Along. Offset Angle	-0.00 deg	-0.01 deg
<b>Calibration details</b>		
TS of sphere	-33.6 dB	-33.6 dB
Range to sphere in calibration	11.5m	11.5m
<b>Log Menu</b>		
Integration performed in Echoview post-processing based on 15 minute EDSUs		
<b>Operation Menu</b>		
Ping interval	0.7 s	0.7 s
<b>Analysis settings</b>		
Bottom margin (backstep)	0.5 m	0.5 m
Integration start (absolute) depth	8 m	8 m
Sv gain threshold	-60 dB	-60 dB

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					

Table 5B.3: Catch composition and position of 1 haul undertaken by the FV "Havilah" during the Irish Sea/North Channel commercial survey, October 2022.

[illegible]

Table 5B.4: 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)									TOTAL
	0	1	2	3	4	5	6	7	8+	
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.5: Acoustic survey estimates of biomass (t) and numbers ('000) of herring and sprat by survey stratum from the AFBI commercial acoustic survey October 2022.**

STRATUM	NO. SPRAT	BIOMASS SPRAT	NO. HER	BIOMASS HER
3	1276.031	10.15865	84135.04	6304.211
3a	0	0	33120.87	2500.903
5	2697436	9592.688	79240.51	3800.93
7	91542.94	340.8956	174811	13000.26
8	224156.5	966.0284	12878.97	664.0663
9	0	0	286665.7	27936.67
9a	0	0	41667.96	4060.702
Total	3014411	10909.77	712520.1	58267.74