

## Annex 5b: Northern Ireland

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Survey report for RV Corystes

25<sup>th</sup> August – 13<sup>th</sup> September 2014

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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

Pieter-Jan Schön (SIC)  
Mathieu Lundy  
Peter McCorriston  
Ian McCausland  
Jim McArdle  
Sarah Simpson  
Vanessa Brown

#### 2.2 Narrative

The vessel departed Belfast at 2200 on the 25<sup>th</sup> August and proceeded to the east coast of the Isle of Man for acoustic calibration off Laxey on the 26<sup>th</sup> August. The survey started on the peripheral Irish Sea transects, transect 119, to the west of the Solway Firth on the 27<sup>th</sup> August and continued to the completion of transect 94 to the east of Carlingford Lough on the 31<sup>st</sup> August, at which point the ship returned to Belfast for a staff change.

The survey recommenced on 5<sup>th</sup> September and concluded on the 13<sup>th</sup> September during which, the remaining peripheral Irish Sea transects and 2 further set of transects around the Isle of Man were completed. Sea conditions were reasonably good during both legs of the survey.

#### 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 26<sup>th</sup> 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 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 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  $10 \log \{ (\sum_{s,l} N_{s,l} 10^{0.1 TS_{s,l}}) / \sum_{s,l} N_{s,l} \}$  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 2014 survey with 35 successful trawls completed. Table 5B.2 gives the positions, catch composition and mean length by species for these trawl hauls. Thirty hauls contained herring to be used in the analysis, but only 10 hauls contained large numbers/proportions of herring. The length frequency distributions of these hauls are illustrated in Figure 5B.2. 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  $W = 0.00273 \cdot L^{3.343}$  (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).

#### 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.3 and for herring only in Figure 5B.4. The highest abundance of herring was west Isle of Man and south off the Mull of Galloway.

#### 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 ~73% age 0, ~10% age 1, ~6% age 2, ~6% age 3, ~3% age 4 and 3% age 5+.

### 4. DISCUSSION

The herring stock estimate in the survey area (Irish Sea/North Channel) was estimated to be 105,637t. The major contribution of ages to the total estimates is from ages 0 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 largest herring aggregations were found northeast of the Isle of Man and off the Northern Ireland coast.

Sprat and 0-group herring were distributed around the periphery of the Irish Sea, with the most abundance of 0-group herring in the north and north east. The bulk of 1+ herring targets in 2014 were observed northwest of the Isle of Man and south from the Mull of Galloway (southwestern corner of stratum 5 and northwestern corner of stratum 7; Figure 5B.1&4), 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.2).

The estimate of herring SSB of 61 705 t for 2014 is slightly higher than the 2013 estimate, and the biomass estimate of 79 866 t for 1+ ringers is, also higher than the 2013 estimate. Whilst the biomass estimate is slightly higher than that 2013, it remains significantly lower than the 2010 and 2011 estimates, which are the highest in the time series. More than a third of the 1+biomass estimate was to the north of the Isle of Man. This is an area of mixed size fish and the survey was mismatched with the migration of the main spawning biomass, as indicated by the high abundance of herring observed by the fishery on the Douglas Bank post survey. Results of a successive acoustic survey conducted later in September confirmed this. The evidence of higher abundance of spawning herring suggests poor reflection of the current age structure and abundance of the herring population in the Irish Sea.



## 5 TABLES AND FIGURES

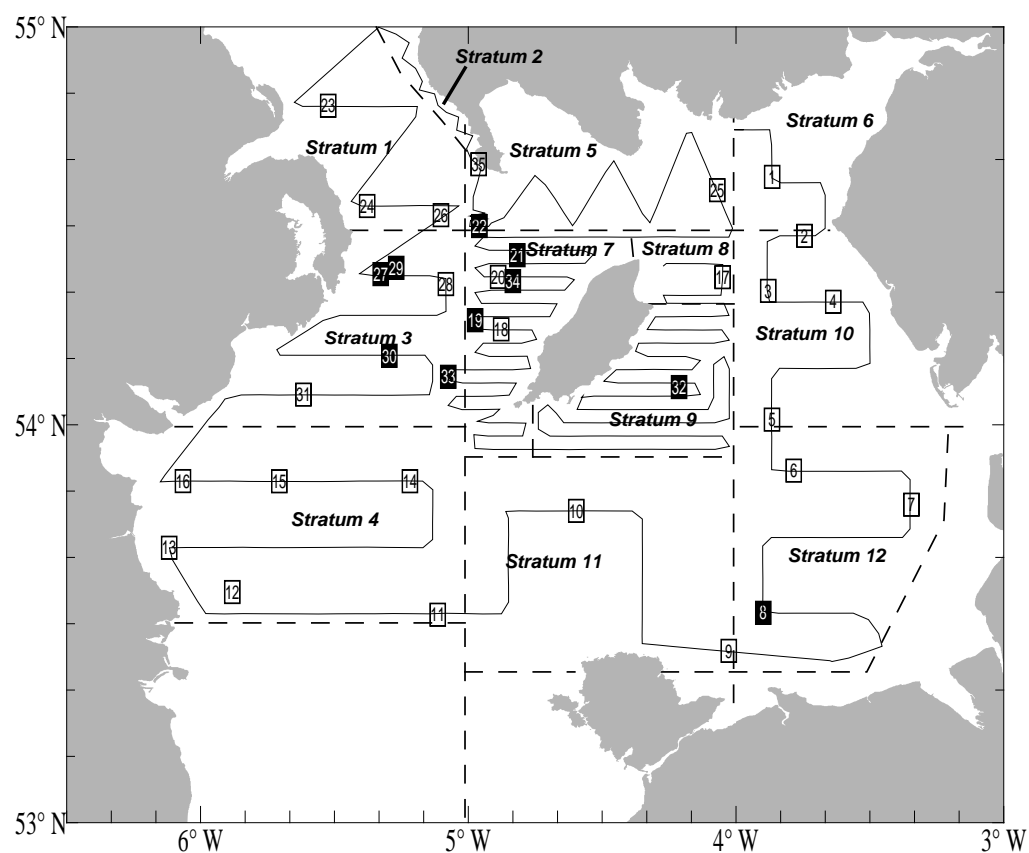


Figure 5B.1: Acoustic survey tracks with trawl positions of the 2014 Irish Sea and North Channel survey on RV “Corystes”. Filled squares indicate trawls in which significant numbers of herring were caught or trawls with a high proportion of herring, while open squares indicate trawls with few or no herring.

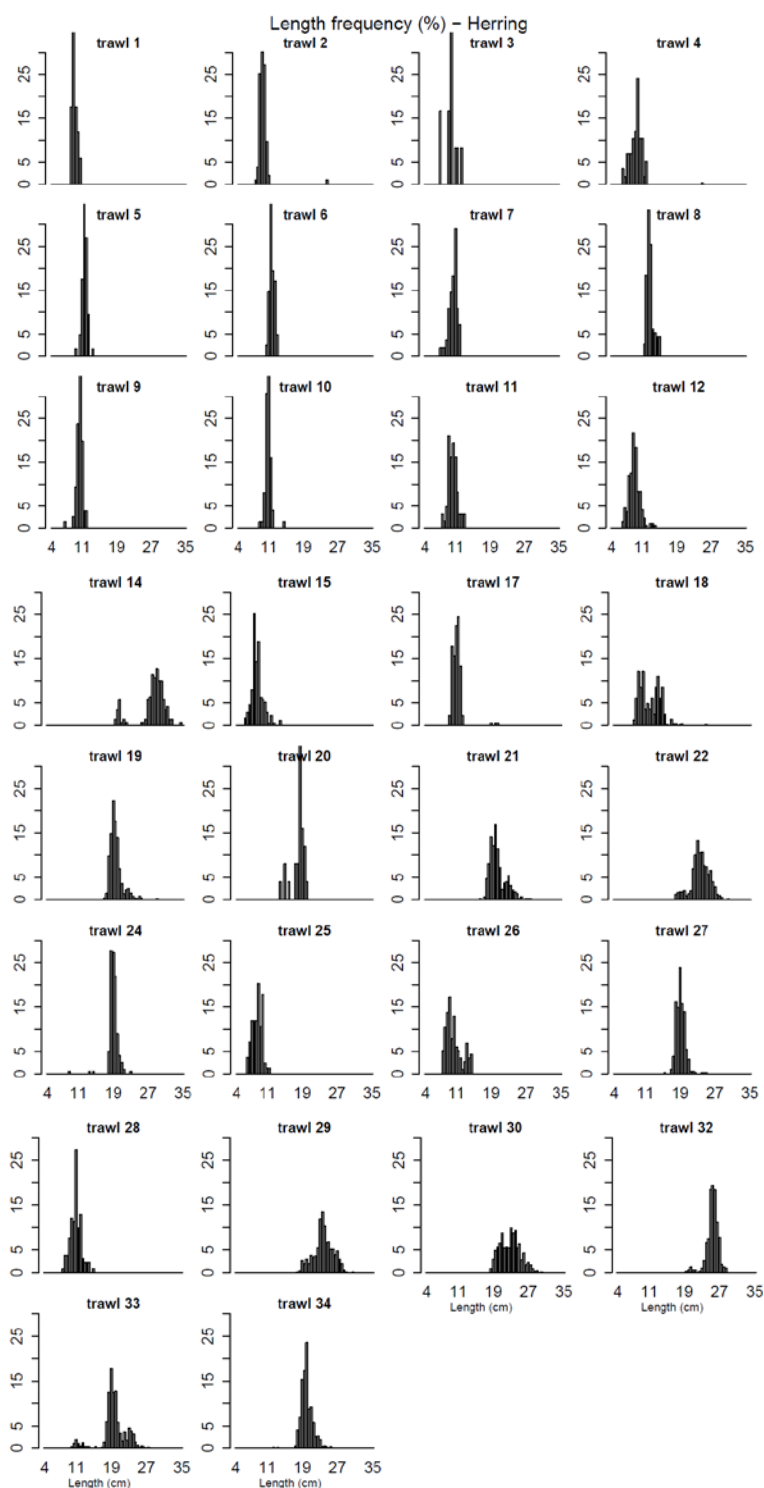
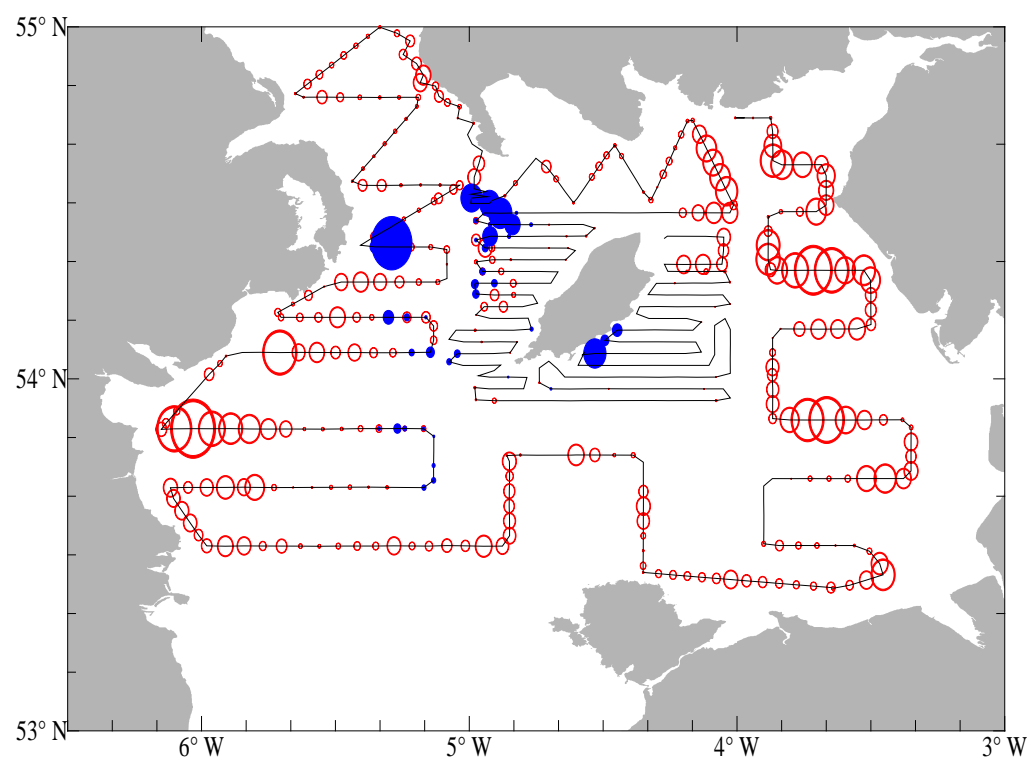


Figure 5B.2: Percentage length compositions of herring in each trawl sample in the September 2014 Irish Sea and North Channel acoustic survey on RV "Corystes".







**Figure 5B.3: 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 2014 acoustic survey on RV "Corystes". (a) Solid circles are for herring NASC values (maximum value was 17000) and (b) open circles are for clupeoid mix NASC, which include juvenile herring and sprat (maximum value was 20900).**

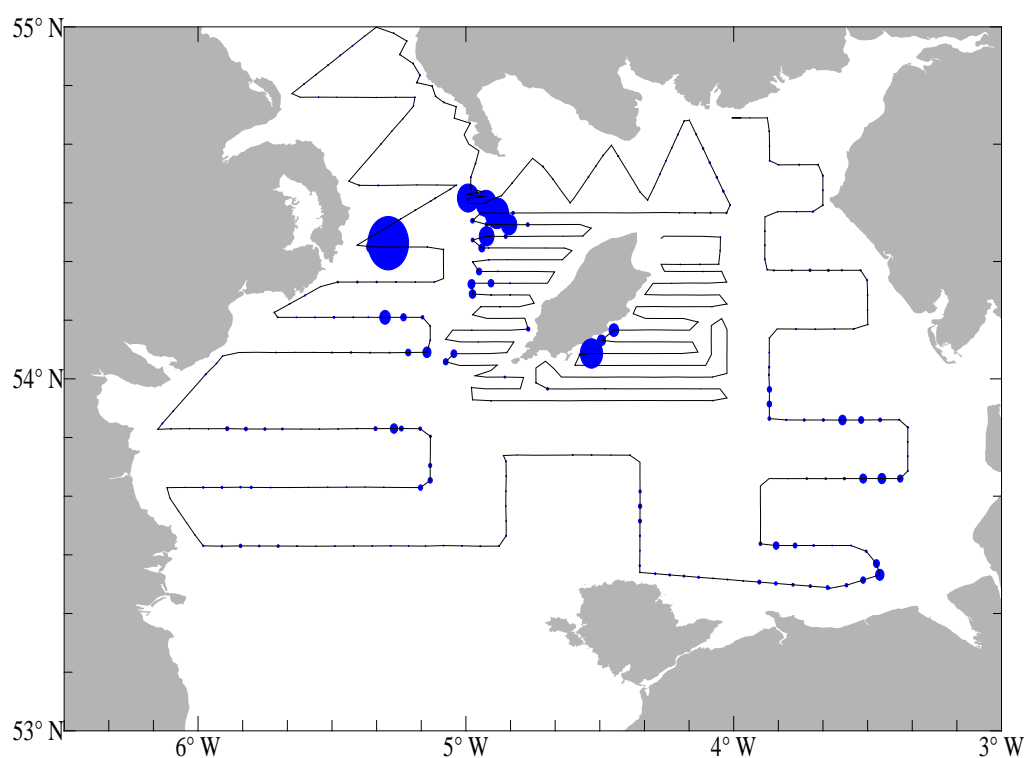


Figure 5B.4: Map of the Irish Sea and North Channel with a post plot showing the distribution of NASC values for assigned herring only (size of ellipses is proportional to square root of the NASC value per 15-minute interval) obtained during the 2014 acoustic survey on RV "Corystes" (maximum value was 17000).

**Table 5B.1: Simrad EK60 and analysis settings used on the 2013 and 2014 Irish Sea and North Channel herring acoustic survey on RV "Corystes"**

<b>TRANSCEIVER MENU</b>		
Year	2013	2014
Frequency	38 kHz	38 kHz
Sound speed	1511.5 m.s <sup>-1</sup>	1513.9m.s <sup>-1</sup>
Max. Power	2000 W	2000 W
Default Transducer Sv gain	24.74 dB	24.80 dB
Athw. Beam Angle	6.89 deg	6.93 deg
Athw. Offset Angle	0.05 deg	0.05 deg
Along. Beam Angle	6.88 deg	6.95 deg
Along. Offset Angle	0.16 deg	0.12 deg
<b>Calibration details</b>		
TS of sphere	-33.6 dB	-33.6 dB
Range to sphere in calibration	12.1 m	12.1m
<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



Table 5B.2: Catch composition and position of hauls undertaken by the RV *Corystes* during the Irish Sea/North Channel survey, September 2014.

Tow	Date	Shooting details					Total fish catch kg.	percentage composition of fish by weight							Mean length (cm)		Invertebrate catch (kg)		
		Time	Lat.	Long.	depth (m)			sprat	herring	mackerel	scad	anchovy	whiting g	other fish	sprat	herring	cephalopods	euphausiids	Pasiphaea
1	27/08/2014	08:04	54	37.4	3	51.9	28	33	97.78	0.29	1.90	0.00	0.02	0.00	5.9	9.5			
2	27/08/2014	11:05	54	28.5	3	44.7	29	57	90.77	1.42	2.98	0.00	0.06	3.32	5.7	10.0			
3	27/08/2014	13:40	54	20.2	3	52.8	46	355	98.72	0.48	0.78	0.00	0.00	0.01	5.7	10.2			
4	27/08/2014	16:07	54	18.6	3	38.2	38	405	97.41	0.86	1.40	0.00	0.33	0.00	6.4	9.8			
5	27/08/2014	20:37	54	0.8	3	51.9	38	233	97.19	2.38	0.17	0.00	0.10	0.00	8.4	11.8			
6	28/08/2014	08:07	53	53.1	3	47.1	38	566	96.61	0.73	0.62	0.00	1.99	0.04	8.7	12.0			
7	28/08/2014	11:18	53	48.0	3	20.7	23	182	97.18	1.57	0.05	0.01	0.00	0.92	5.6	10.7			
8	28/08/2014	17:09	53	31.7	3	53.9	50	184	50.60	47.08	2.17	0.14	0.01	0.00	12.1	13.1			
9	29/08/2014	10:12	53	25.9	4	1.6	44	756	93.05	1.01	5.78	0.00	0.13	0.00	7.1	10.7			
10	29/08/2014	20:32	53	47.0	4	35.8	69	128	98.00	1.25	0.58	0.00	0.00	0.05	6.4	11.1			
11	30/08/2014	08:53	53	31.4	5	6.9	76	67	92.31	0.67	5.87	0.00	0.00	0.05	6.6	10.6			
12	30/08/2014	14:05	53	34.8	5	52.9	57	196	87.18	12.38	0.10	0.00	0.00	0.07	5.9	9.4			
13	30/08/2014	17:02	53	41.5	6	7.0	20	338	62.46	0.04	35.22	0.00	0.00	1.78	5.7	12.5			
14	31/08/2014	06:42	53	51.5	5	13.1	66	156	0.00	25.91	0.00	0.00	0.00	72.49		17.3			
15	31/08/2014	10:44	53	51.5	5	42.4	82	301	92.66	3.85	3.49	0.00	0.00	0.00	6.6	9.0			
16	31/08/2014	13:29	53	51.5	6	3.9	35	645	99.53	0.20	0.26	0.00	0.00	0.01	6.9	14.2			
17	05/09/2014	19:19	54	22.3	4	3.0	44	400	96.42	0.44	2.94	0.00	0.18	0.02	7.0	11.4			
18	07/09/2014	08:48	54	14.4	5	52.6	67	337	92.53	4.13	3.12	0.00	0.00	0.01	7.2	12.3			
19	07/09/2014	10:29	54	15.8	4	58.5	109	999	0.00	50.85	2.16	0.00	0.00	45.32		19.8			
20	07/09/2014	17:15	54	22.3	4	53.3	71	202	97.08	0.61	0.60	0.00	0.00	1.42	10.4	18.3			
21	07/09/2014	22:50	54	25.6	4	49.0	58	636	0.00	98.89	0.83	0.00	0.00	0.17		20.7			
22	08/09/2014	03:25	54	30.0	4	57.5	106	1050	0.00	94.64	0.00	0.00	0.00	0.04		23.9			
23	08/09/2014	15:57	54	48.1	5	31.4	105	49	95.49	0.06	4.37	0.01	0.00	0.07	6.6	10.3			
24	08/09/2014	20:22	54	33.0	5	22.7	63	79	45.02	15.77	0.91	0.01	0.00	10.10	6.4	19.3			
25	09/09/2014	07:16	54	35.4	4	4.2	39	46	80.05	1.50	17.64	0.00	0.10	0.00	5.9	9.0			
26	09/09/2014	14:02	54	31.6	5	6.1	135	81	58.03	1.89	39.91	0.00	0.00	0.02	6.1	10.7			
27	09/09/2014	17:18	54	22.7	5	19.6	77	2000	0.00	100.00	0.00	0.00	0.00	0.00		19.4			
28	09/09/2014	19:23	54	21.2	5	5.0	124	17	0.31	7.68	0.99	0.00	0.00	87.89	6.1	11.2			
29	09/09/2014	23:53	54	23.7	5	16.2	111	3500	0.00	100.00	0.00	0.00	0.00	0.00		24.0			
30	10/09/2014	10:52	54	10.4	5	17.7	75	878	0.00	91.88	1.42	0.00	0.00	5.38		23.1			
31	10/09/2014	14:41	54	4.6	5	36.9	52	307	98.03	0.11	1.37	0.00	0.00	0.28	6.4	11.1			
32	11/09/2014	14:36	54	5.7	4	12.8	44	421	0.00	81.21	15.53	0.00	0.00	0.00		25.7			
33	12/09/2014	12:56	54	7.2	5	4.5	98	525	0.79	59.64	0.97	0.00	0.00	38.40	5.9	19.9			
34	13/09/2014	02:56	54	21.67	4	50.01	48	98	1.02	76.73	7.03	0.00	0.00	6.72	6.2	20.2			
35	13/09/2014	22:22	54	39.29	4	57.68	29	134	91.98	0.00	1.81	0.00	0.00	4.33	7.1				



Table 5B.3: Preliminary age-length key for herring from which otoliths were removed at sea during the Irish Sea/North Channel survey. 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	9	
6	1										1
6.5	4										4
7	5										5
7.5	6										6
8	9										9
8.5	11										11
9	17										17
9.5	18										18
10	18										18
10.5	18										18
11	19										19
11.5	17										17
12	17										17
12.5	14										14
13	10										10
13.5	11										11
14	11										11
14.5	7										7
15	6										6
15.5	5										5
16	2	1									3
16.5		3									3
17	1	7									8
17.5	1	14									15
18		26									26
18.5		27									27
19		29									29
19.5		38									38
20		34	6								40
20.5		32	5								37
21		19	4								23
21.5		8	13								21
22		3	12	1							16
22.5		1	19	6							26
23			14	10							24
23.5			11	8	2						21
24			7	18	4		1				30
24.5			4	11	4	2					21
25				14	6	2					22
25.5				6	9	2					17
26				3	10	2	3				18
26.5				1	13	5	1				20
27					5	3	2	1	1		12
27.5					5	5	4	1			15
28					2	7			1	1	11
28.5						3	1		2		6
29						1	1	1	1		4
29.5										1	1
30									1		1
30.5						1					1
<b>TOTAL</b>	228	242	95	78	60	33	13	3	6	2	760

**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 2014.**

<b>STRATUM</b>	<b>NO. SPRAT</b>	<b>BIOMASS SPRAT</b>	<b>NO. HER</b>	<b>BIOMASS HER</b>
1	2700374	4830	11533	488
2	1589591	2996	5620	228
3	13539283	24695	415808	39163
4	43983436	82248	352497	5274
5	8790664	13363	190177	17145
6	12801725	18836	21083	122
7	536101	3447	137479	11310
8	2039307	3625	6043	33
9	6808	19	57381	9126
10	50481323	83038	110156	767
11	25443355	50641	317109	4687
12	17204091	79375	1096179	17294
Total	179116058	367113	2721065	105637