

5 Herring (*Clupea harengus*) in divisions 6.a (South), 7.b–c, and 6.a (North), separate

5.1 Herring in divisions 6.a (South) and 7.b–c

Since 2015, this stock has been combined with herring in 6.a.N (Section 5.2) for assessment and advisory purposes. This management unit existed since 1982, when it was separated from 6.a.N. Until that time, 7.b–c was also a separate management unit. The stock comprises autumn, winter, and spring-spawning components.

The WG noted that the use of “age”, “winter rings”, “rings” and “ringers” still causes confusion outside the group (and sometimes even among WG members). The WG tries to avoid this by consequently using “rings”, “ringers”, “winter ringers” or “wr” instead of “age” throughout this section. However, if the word “age” is used it is qualified in brackets with one of the ring designations. It should be observed that, for autumn and winter spawning stocks, there is a difference of one year between “age” and “rings”, which is not the case for the spring spawners. Further elaboration on the rationale behind this, specific to Area 6.a.S, 7.b–c autumn, winter and spring spawners, can be found in the Stock Annex. It is the responsibility of any user of age-based data for any of these herring stocks to consult the stock annex and if in doubt consult a relevant member of the Working Group.

5.1.1 The Fishery

5.1.1.1 Advice and management applicable to 2018

In 2016 ICES advised TAC of 0 t and that a stock recovery plan be developed for herring stocks in 6.a and 7.b–c stocks (ICES, 2016a). However in February 2016, the European Commission asked ICES to advise on a TAC of sufficiently small size to allow ongoing collection of fisheries-dependent data. In June 2016, ICES advised on a scientific monitoring TAC of 1360 t for this stock (ICES, 2016b). The EC set a TAC slightly higher than this advice, at 1630 t was established by the EC (EU 2016/0203). This TAC was the same in 2017 and 2018.

Rebuilding plan

A revised proposed rebuilding plan for both 6.a.N and 6.a.S, 7.b–c stocks combined was reviewed by HAWG 2018 (ICES 2018, Annex 9). While the plan was considered to provide a framework for recovery of these combined stocks, it was considered unlikely that the revised proposed plan can aid the recovery of the combined stocks by 2020 as recent poor recruitments hamper a speedy recovery. Furthermore, ICES ACOM considered that further quantitative evaluation would be required to be used as the basis for advice.

5.1.1.2 Catches in 2018

The Working Group estimates of landings from 1991–2018 are given in Table 5.1.2. The catch has declined from 19 000 t in 2006 to 1495 t in 2018 as there is now a monitoring TAC in place for the combined stocks in 6.a and 7.b–c. In 2018 the majority of the quota taken close inshore. Catches over time are shown in Figure 5.1.1.

In 2018 the majority of the catch was taken in the fourth quarter. Subdivision 6.aS accounted for the vast majority of catch (Figure 5.1.9).

5.1.1.3 Regulations and their effects

Within the Irish fishery, the monitoring TAC in 2018 was allocated on a similar basis to 2016 and 2017. The quota was allocated, to a wide spectrum of small and large vessels. This resulted in more fishing opportunities across the fleet.

5.1.1.4 Changes in fishing technology and fishing pattern

The monitoring TAC, introduced in 2016 and continued in 2017 and 2018, has led to a change in the pattern of the fishery. In previous years, larger vessels dominated in the fishery and took their quotas often in one haul, in a somewhat opportunistic basis. The monitoring TAC is now allocated to vessels in six different categories from over 24 m down to under 12 m. The larger vessels were unable to utilize their quota in 2018 due to the timing of the fishery which opens in November.

5.1.2 Biological composition of the catch

5.1.2.1 Catch s-at-age

Catch-at-age data for this fishery are shown in Table 5.1.3 and Figure 5.1.2 and in percentage terms since 1992 in Table 5.1.4. In 2018, the fishery was dominated by 4- and 5-ringers (2012 and 2013 cohort), accounting for 53% of the catch, followed by 3-ringer at 17% (Table 5.1.4). These cohorts featured prominently in the previous year. Proportion-at-age in the catches from the fishery are similar to the catches from the MSHAS for most year, in 2018 catches from the MSHAS were dominated by 1-ringers (Figure 5.1.4).

5.1.2.2 Quality of the catch and biological data

The 6.a.S/7.b–c stock is well sampled, there have been sufficient samples to achieve the precision level sought by the ICES advice on the monitoring fishery since 2016. The numbers of samples and the associated biological data are shown in Table 5.1.7. The catch-at-age matrix tracks cohorts well in the past two years.

Mixing of autumn, winter and spring spawners takes place in this area which may lead to ageing difficulties regarding counting of winter rings.

5.1.3 Fishery-independent Information

5.1.3.1 Acoustic Surveys

The Irish Marine Institute conducted acoustic surveys in 6.a.S and 7.b–c on the west and north-west coasts of Ireland between 1994 and 2007 at various times of the year. An acoustic survey has been carried out in Division 6.a.N in June–July since 1991 by Marine Scotland Science. It originally covered an area bounded by the 200 m depth contour and 4°W in the north and west and extended south to 56°N, it had provided an age-disaggregated index of abundance as the sole tuning index for the analytical assessment of 6.a.N herring since 2002 (ICES, 2015b). In 2008, it was decided that these surveys should be expanded into a larger coordinated summer survey on recommendation from WESTHER, HAWG and SGHERWAY (Hatfield *et al.*, 2007; ICES, 2007; ICES, 2010a). The Scottish 6.a.N survey was augmented with the participation of the Irish Marine Institute and the area was expanded to cover all of ICES divisions 6.a and 7.b. The Malin Shelf Herring Acoustic Survey (MSHAS), as it is now known, has covered this increased geographical area in the period 2008 to 2018 as well as maintaining coverage of the original survey area in 6.a.N.

5.1.3.2 Industry acoustic survey in 2018

An acoustic survey of Atlantic herring *Clupea harengus* and horse mackerel *Trachurus trachurus* was conducted in ICES areas 6aS and 7b in November 2018 using the pair trawl vessels MFV Eilean Croine and MFV Sparkling Star. This survey is the third in a time-series that is hoped will be developed into a long-term index of spawning/prespawning herring in 6aS and 7b, for use in stock assessments in future. The survey track and associated biological hauls are presented in Figure 5.1.5 and the herring NASC values in Figure 5.1.6. In total 1400 nmi of cruise track was completed using 37 transects and related to a total area coverage of approximately 5600 nmi². Parallel transect spacing was set at 7.5 nmi for the wider area strata, and 3.5 nmi for Donegal Bay and Achill strata. Coverage extended from inshore coastal areas to the 200 m contour in the west and north where possible. A survey was carried out in Lough Swilly using a zig-zag design. Very strong herring marks were evident in Lough Swilly, an area where boats in the monitoring fishery were concentrating effort. There were a few herring marks in discrete areas around Glen Head, Bruckless Bay, Inishmurray and Inishbofin. Biological samples from the monitoring fishery of herring were used to augment the samples from the survey. Herring samples were taken from boats fishing in Lough Swilly and Bruckless Bay as close spatially and temporally as possible to the survey in these areas. Herring were dominated overall by 4-wr fish, 29% of the overall numbers. This age class is dominant in the catch data and the Malin shelf acoustic survey also. The total-stock biomass (TSB) estimate of herring for the combined 6aS/7b area was 50 145 tonnes (Lough Swilly = 32 372 tonnes, Donegal Bay = 9517 tonnes, NW area = 7710 tonnes and the remaining Achill strata = 545 tonnes). This is considered to be a minimum estimate of herring in the 6aS/7b survey area at the time of the survey. The CV estimates on biomass and abundance are high (~0.51 for herring) for the survey in 2018. For herring, this is mostly caused by the over-reliance on a few acoustic marks of herring in Lough Swilly and Bruckless Bay in particular (O'Malley *et al.*, 2019).

5.1.4 Mean weights-at-age and maturity-at-age

5.1.4.1 Mean Weights-at-Age

The mean weights-at-age (kg) in the catches in 2018 are presented in Figure 5.1.7. In recent years there was a decrease in mean weights relative to the late 1990s. Over the longer time-series there is little trend over time, but they have dropped in 2018 relative to 2017.

The mean weights in the stock at spawning time have been calculated from samples taken during the main spawning period that extends from October to February (Figure 5.1.8). The mean weights in the stock have dropped in 2018 relative to 2017 and have been showing a downward trend recently. Trends over the recent and longer time-series are similar to those in the catches.

5.1.4.2 Maturity Ogive

One ringers are considered to be immature. All older ages are assumed to be 100% mature.

5.1.5 Recruitment

There is little information on terminal year recruitment in the catch-at-age data and there are as yet no recruitment indices from the surveys. Numbers of 1-ringings in the catches vary widely but, with the exception of 2012 (2010 cohort), have been consistently low in recent years. Since the mid-1990s recruitment has been low, based on exploratory assessments.

5.1.5.1 Stock Assessment of 6.a (South) and 7.b–c

The ICES, WKWEST 2015 benchmark workshop (ICES, 2015) for the herring stocks in 6.aN, 6.aS and 7.b–c concluded that the assessment would be a combined stock assessment. Details of the

combined assessment for 6.a and 7.b–c are outlined in Section 4. No separate assessment is presented in 2018.

5.1.5.2 State of the stock

Not analytically determined.

5.1.6 Short-term projections

Not undertaken.

5.1.7 Medium-term simulations

Not undertaken.

5.1.8 Long-term simulations

Not undertaken.

5.1.9 Precautionary and yield based reference points

Not determined.

5.1.10 Quality of the assessment

Not ascertained.

5.1.11 Management considerations

There is no new information to alter the previous perception that this stock is in a state of collapse.

Fishing mortality should be kept low to allow rebuilding. The monitoring TAC should be maintained allowing sampling to continue.

The combined assessment (6a, 7b,c) shows SSB and recruitment at very low levels. F has reduced since the introduction of the monitoring TAC in 2016. The working group advocates maintaining separate management of each component.

5.1.12 Environment

5.1.12.1 Ecosystem considerations

Grainger (1978; 1980) found significant negative correlations between sea surface temperature (SST) and catches from the west of Ireland component of this stock at a time-lag of 3–4 years later. This indicates that recruitment responds favourably to cooler temperatures. Cannaby and Hosrevoglu (2009) present long time-series of sea surface temperature for this stock area, showing an increasing trend. Their data when compared with herring biology and fisheries data show that strong historic herring recruitments/fisheries correspond to cooler temperatures (Clarke *et al.*, WD 02 to HAWG 2012).

5.1.12.2 Changes in the environment

Since the mid-1990s the AMO has been in a positive phase, indicating warmer sea temperatures in this area. In recent year the AMO has mostly been in a positive phase, see: <http://www.esrl.noaa.gov/psd/data/timeseries/AMO/>. Warmer temperatures associated with positive AMO are considered detrimental to herring recruitment.

Table 5.1.2. Herring in divisions 6.a.S and 7.b–c. Estimated Herring catches in tonnes, 1991–2018. These data do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
France	-	-	-	-	-	-	-	-	-
Germany, Fed. Rep.	-	250	-	-	11	-	-	-	-
Ireland	22500	26000	27600	24400	25450	23800	24400	25200	16325
Netherlands	600	900	2500	2500	1207	1800	3400	2500	1868
UK (N. Ireland)	-	-	-	-	-	-	-	-	-
UK (England + Wales)	-	-	-	50	24	-	-	-	-
UK (Scotland)	+	-	200	-	-	-	-	-	-
Total landings	23100	27150	30300	26950	26692	25600	27800	27700	18193
Unallocated/ area misreported	11200	4600	6250	6250	1100	6900	-700	11200	7916
Discards	3400	100	250	700	-	-	50		-
WG catch	37700	31850	36800	33900	27792	32500	27150	38900	26109

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
France	-	-	515	-	-	-	-	-	-
Germany, Fed. Rep.	-	-	-	-	-	-	-	-	-
Ireland	10164	11278	13072	12921	10950	13351	14840	12662	10237
Netherlands	1234	2088	366	-	64	-	353	13	-
UK (N. Ireland)	-	-	-	-	-	-	-	-	-
UK (England + Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	6	-	-
Total landings	11398	13366	13953	12921	11014	13351	15199	12675	10237
Unallocated/ area misreported	8448	1390	3873	3581	2813	2880	4000	5116	3103
Discards	-	-	-	-	-	-	-	-	-
WG catch	19846	14756	17826	16502	13827	16231	19199	17791	13340

Country	2019	2010	2011	2012	2013	2014	2015	2016	2017
France	-	-	-	-	-	-	-	-	-
Germany, Fed. Rep.	-	-	-	-	-	-	-	-	-
Ireland	8533	7513	4247	3791	1460	2933	73	1171	1707
Netherlands	-	-	-	-	40	-	+	72	-
UK (N. Ireland)	-	-	-	-	-	-	-	-	-
UK (England + Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	5	-	-
Total landings	8533	7513	4247	3791	1500	2933	78	1243	1707
Unallocated/ area misreported	1935	2728	2672	2780	2468	2163	1000	971	520
Discards	-	-	-	-	-	-	-	-	-
WG catch	10 468	10 241	6919	6571	3968	5096	1078	2214	2227

Country	2018
France	
Germany Fed. Rep.	
Ireland	970
Netherlands	
UK (N. Ireland)	
UK (England + Wales)	
UK (Scotland)	
Total landings	
Unallocated/ area misreported	525
Discards	
WG catch	1495

Table 5.1.3. Herring in divisions 6.a.S and 7.b–c. Catch in numbers-at-age (winter rings) from 1970–2018.

	1	2	3	4	5	6	7	8	9
1970	135	35114	26007	13243	3895	40181	2982	1667	1911
1971	883	6177	7038	10856	8826	3938	40553	2286	2160
1972	1001	28786	20534	6191	11145	10057	4243	47182	4305
1973	6423	40390	47389	16863	7432	12383	9191	1969	50980
1974	3374	29406	41116	44579	17857	8882	10901	10272	30549
1975	7360	41308	25117	29192	23718	10703	5909	9378	32029
1976	16613	29011	37512	26544	25317	15000	5208	3596	15703
1977	4485	44512	13396	17176	12209	9924	5534	1360	4150
1978	10170	40320	27079	13308	10685	5356	4270	3638	3324
1979	5919	50071	19161	19969	9349	8422	5443	4423	4090
1980	2856	40058	64946	25140	22126	7748	6946	4344	5334
1981	1620	22265	41794	31460	12812	12746	3461	2735	5220
1982	748	18136	17004	28220	18280	8121	4089	3249	2875
1983	1517	43688	49534	25316	31782	18320	6695	3329	4251
1984	2794	81481	28660	17854	7190	12836	5974	2008	4020
1985	9606	15143	67355	12756	11241	7638	9185	7587	2168
1986	918	27110	27818	66383	14644	7988	5696	5422	2127
1987	12149	44160	80213	41504	99222	15226	12639	6082	10187
1988	0	29135	46300	41008	23381	45692	6946	2482	1964
1989	2241	6919	78842	26149	21481	15008	24917	4213	3036
1990	878	24977	19500	151978	24362	20164	16314	8184	1130
1991	675	34437	27810	12420	100444	17921	14865	11311	7660
1992	2592	15519	42532	26839	12565	73307	8535	8203	6286
1993	191	20562	22666	41967	23379	13547	67265	7671	6013
1994	11709	56156	31225	16877	21772	13644	8597	31729	10093
1995	284	34471	35414	18617	19133	16081	5749	8585	14215
1996	4776	24424	69307	31128	9842	15314	8158	12463	6472
1997	7458	56329	25946	38742	14583	5977	8351	3418	4264
1998	7437	72777	80612	38326	30165	9138	5282	3434	2942

	1	2	3	4	5	6	7	8	9
1999	2392	51254	61329	34901	10092	5887	1880	1086	949
2000	4101	34564	38925	30706	13345	2735	1464	690	1602
2001	2316	21717	21780	17533	18450	9953	1741	1027	508
2002	4058	32640	37749	18882	11623	10215	2747	1605	644
2003	1731	32819	28714	24189	9432	5176	2525	923	303
2004	1401	15122	32992	19720	9006	4924	1547	975	323
2005	209	28123	30896	26887	10774	5452	1348	858	243
2006	598	22036	36700	30581	21956	9080	2418	832	369
2007	76	24577	43958	23399	13738	5474	1825	231	131
2008	483	12265	19661	28483	11110	5989	2738	745	267
2009	202	12574	12077	12096	12574	5239	2040	853	17
2010	1271	13507	20127	6541	7588	6780	2563	661	189
2011	121	14207	9315	9114	3386	3780	2871	980	95
2012	5142	12844	16387	4042	1776	553	541	103	21
2013	61	3118	4532	12238	1665	1792	425	382	202
2014	34	465	8825	6735	12146	2406	1045	437	204
2015	27	1842	598	2553	1699	685	96	9	0
2016	69	1983	4252	1369	3025	2085	824	43	9
2017	30	1051	5241	4078	1025	2250	1061	480	76
2018	6	1567	1838	3280	2288	613	700	260	29

Table 5.1.4. Herring in divisions 6.a.S and 7.b–c. Percentage age composition (winter rings).

Year	1	2	3	4	5	6	7	8	9+
1992	1%	8%	22%	14%	6%	37%	4%	4%	3%
1993	0%	10%	11%	21%	12%	7%	33%	4%	3%
1994	6%	28%	15%	8%	11%	7%	4%	16%	5%
1995	0%	23%	23%	12%	13%	11%	4%	6%	9%
1996	3%	13%	38%	17%	5%	8%	4%	7%	4%
1997	5%	34%	16%	23%	9%	4%	5%	2%	3%
1998	3%	29%	32%	15%	12%	4%	2%	1%	1%
1999	1%	30%	36%	21%	6%	3%	1%	1%	1%
2000	3%	27%	30%	24%	10%	2%	1%	1%	1%
2001	2%	23%	23%	18%	19%	10%	2%	1%	1%
2002	3%	27%	31%	16%	10%	9%	2%	1%	1%
2003	2%	31%	27%	23%	9%	5%	2%	1%	0%
2004	2%	18%	38%	23%	10%	6%	2%	1%	0%
2005	0%	27%	29%	26%	10%	5%	1%	1%	0%
2006	0%	18%	29%	25%	18%	7%	2%	1%	0%
2007	0%	22%	39%	21%	12%	5%	2%	0%	0%
2008	1%	15%	24%	35%	14%	7%	3%	1%	0%
2009	0%	22%	21%	21%	22%	9%	4%	1%	0%
2010	2%	23%	34%	11%	13%	11%	4%	1%	0%
2011	0%	32%	21%	21%	8%	9%	7%	2%	0%
2012	12%	31%	40%	10%	4%	1%	1%	0%	0%
2013	0%	13%	19%	50%	7%	7%	2%	2%	1%
2014	0%	1%	27%	21%	38%	7%	3%	1%	1%
2015	0%	25%	8%	34%	23%	9%	1%	0%	0%
2016	0%	15%	31%	10%	22%	15%	6%	0%	0%
2017	0%	7%	34%	27%	7%	15%	7%	3%	0%
2018	0%	15%	17%	31%	22%	6%	7%	2%	0%

Table 5.1.5. Herring in divisions 6.a.S and 7.b–c. Mean weights-at-age in the catches 1970–2018.

	1	2	3	4	5	6	7	8	9+
1970	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1971	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1972	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1973	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1974	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1975	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1976	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1977	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1978	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1979	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1980	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1981	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1982	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1983	0.090	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1984	0.106	0.141	0.181	0.210	0.226	0.237	0.243	0.247	0.248
1985	0.077	0.122	0.161	0.184	0.196	0.206	0.212	0.225	0.230
1986	0.095	0.138	0.164	0.194	0.212	0.225	0.239	0.208	0.288
1987	0.085	0.102	0.150	0.169	0.177	0.193	0.205	0.215	0.220
1988		0.098	0.133	0.153	0.166	0.171	0.183	0.191	0.201
1989	0.080	0.130	0.141	0.164	0.174	0.183	0.192	0.193	0.203
1990	0.094	0.138	0.148	0.160	0.176	0.189	0.194	0.208	0.216
1991	0.089	0.134	0.145	0.157	0.167	0.185	0.199	0.207	0.230
1992	0.095	0.141	0.147	0.157	0.165	0.171	0.180	0.194	0.219
1993	0.112	0.138	0.153	0.170	0.181	0.184	0.196	0.229	0.236
1994	0.081	0.141	0.164	0.177	0.189	0.187	0.191	0.204	0.220
1995	0.080	0.140	0.161	0.173	0.182	0.198	0.194	0.206	0.217
1996	0.085	0.135	0.172	0.182	0.199	0.209	0.220	0.233	0.237
1997	0.093	0.135	0.155	0.181	0.201	0.217	0.217	0.231	0.239
1998	0.095	0.136	0.145	0.173	0.191	0.196	0.202	0.222	0.217

	1	2	3	4	5	6	7	8	9+
1999	0.106	0.144	0.145	0.163	0.186	0.195	0.200	0.216	0.222
2000	0.102	0.129	0.154	0.172	0.180	0.184	0.204	0.203	0.204
2001	0.086	0.122	0.139	0.167	0.183	0.188	0.222	0.222	0.213
2002	0.097	0.127	0.140	0.155	0.175	0.196	0.204	0.218	0.226
2003	0.102	0.134	0.150	0.167	0.183	0.196	0.216	0.210	0.228
2004	0.085	0.140	0.150	0.167	0.182	0.193	0.222	0.221	0.285
2005	0.105	0.135	0.150	0.162	0.174	0.188	0.200	0.237	0.296
2006	0.106	0.137	0.141	0.158	0.169	0.178	0.199	0.221	0.243
2007	0.118	0.144	0.145	0.168	0.179	0.189	0.197	0.233	0.237
2008	0.1108	0.1478	0.1503	0.1663	0.1745	0.1845	0.1938	0.1990	0.2407
2009	0.077	0.146	0.171	0.194	0.200	0.207	0.211	0.218	0.275
2010	0.104	0.131	0.168	0.189	0.201	0.212	0.218	0.226	0.229
2011	0.094	0.122	0.141	0.174	0.193	0.202	0.217	0.218	0.246
2012	0.09	0.134	0.179	0.196	0.214	0.237	0.228	0.243	0.236
2013	0.083	0.121	0.141	0.170	0.181	0.196	0.202	0.226	0.226
2014	0.105	0.139	0.136	0.155	0.168	0.175	0.184	0.183	0.187
2015	0.090	0.113	0.145	0.152	0.161	0.168	0.176	0.185	0.188
2016	0.09	0.125	0.149	0.163	0.182	0.188	0.19	0.21	0.201
2017	0.072	0.106	0.132	0.145	0.159	0.168	0.172	0.179	0.183
2018	0.085	0.101	0.127	0.144	0.155	0.166	0.172	0.170	0.174

Table 5.1.6. Herring in divisions 6.a.S and 7.b–c. Mean weights-at-age in the stock at spawning time 1970–2018.

	1	2	3	4	5	6	7	8	9+
1970	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1971	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1972	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1973	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1974	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1975	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1976	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1977	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1978	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1979	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1980	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1981	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1982	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1983	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1984	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1985	0.100	0.150	0.196	0.227	0.238	0.251	0.252	0.269	0.284
1986	0.098	0.169	0.209	0.238	0.256	0.276	0.280	0.287	0.312
1987	0.097	0.164	0.206	0.233	0.252	0.271	0.280	0.296	0.317
1988	0.097	0.164	0.206	0.233	0.252	0.271	0.280	0.296	0.317
1989	0.138	0.157	0.168	0.182	0.200	0.217	0.227	0.238	0.245
1990	0.113	0.152	0.170	0.180	0.200	0.217	0.225	0.233	0.255
1991	0.102	0.149	0.174	0.190	0.195	0.206	0.226	0.236	0.248
1992	0.102	0.144	0.167	0.182	0.194	0.197	0.214	0.218	0.242
1993	0.118	0.166	0.196	0.205	0.214	0.220	0.223	0.242	0.258
1994	0.098	0.156	0.192	0.209	0.216	0.223	0.226	0.230	0.247
1995	0.090	0.144	0.181	0.203	0.217	0.226	0.227	0.239	0.246
1996	0.086	0.137	0.186	0.206	0.219	0.234	0.233	0.249	0.253
1997	0.094	0.135	0.169	0.194	0.210	0.224	0.231	0.230	0.239
1998	0.095	0.136	0.145	0.173	0.191	0.196	0.202	0.222	0.217

	1	2	3	4	5	6	7	8	9+
1999	0.104	0.145	0.154	0.174	0.200	0.222	0.230	0.240	0.246
2000	0.100	0.134	0.157	0.177	0.197	0.207	0.217	0.230	0.245
2001	0.091	0.125	0.150	0.172	0.191	0.200	0.203	0.203	0.216
2002	0.092	0.127	0.146	0.170	0.190	0.201	0.210	0.227	0.229
2003	0.094	0.131	0.155	0.175	0.192	0.203	0.232	0.222	0.243
2004	0.081	0.133	0.151	0.175	0.194	0.207	0.238	0.233	0.276
2005	0.095	0.127	0.15	0.172	0.185	0.196	0.223	0.234	0.274
2006	0.092	0.130	0.133	0.162	0.177	0.186	0.209	0.238	0.247
2007	0.114	0.133	0.133	0.171	0.186	0.196	0.208	0.228	0.229
2008	0.098	0.136	0.140	0.174	0.185	0.196	0.192	0.205	0.234
2009	0.072	0.141	0.162	0.197	0.215	0.223	0.225	0.221	0.286
2010	0.092	0.128	0.157	0.189	0.208	0.227	0.234	0.239	0.247
2011	0.082	0.118	0.136	0.177	0.199	0.207	0.225	0.239	0.240
2012	0.084	0.135	0.182	0.203	0.214	0.226	0.225	0.21	0.226
2013	0.074	0.114	0.140	0.170	0.188	0.198	0.204	0.223	0.222
2014	0.093	0.128	0.135	0.154	0.169	0.170	0.188	0.169	0.206
2015	0.077	0.112	0.146	0.155	0.165	0.173	0.179	0.183	0.217
2016	0.078	0.119	0.147	0.164	0.185	0.191	0.197	0.21	0.175
2017	0.064	0.099	0.130	0.145	0.163	0.173	0.176	0.185	0.180
2018	0.072	0.097	0.126	0.146	0.156	0.168	0.172	0.169	0.170

Table 5.1.7. Herring in divisions 6.a.S and 7.b–c. Sampling intensity of catches in 2018.

Year	Quarter	Landings (t)	No. Samples	No. aged	No. Measured	Aged/1000 t
6.a.S	4	1495	29	1852	5952	1184
Total	4	1495	29	1852	5952	1184

Table 5.1.8. Herring in divisions 6.a.S and 7.b–c. Details of acoustic surveys dedicated to the 6a.S/7.b–c stock alone.

Year	Type	Biomass	SSB
1994	Feeding phase	-	353772
1995	Feeding phase	137670	125800
1996	Feeding phase	34290	12550
1997	-	-	-
1998	-	-	-
1999	Autumn	23762	22788
2000	Autumn	21000	20500
2001	Autumn	11100	9800
2002	Winter	8900	7200
2003	Winter	10300	9500
2004	Winter	41700	41399
2005	Winter	71253	66138
2006	Winter	27770	27200
2007	Winter	14222	13974
2016	Winter	35475	35475
2017	Winter	40646	40646
2018	Winter	50145	49523

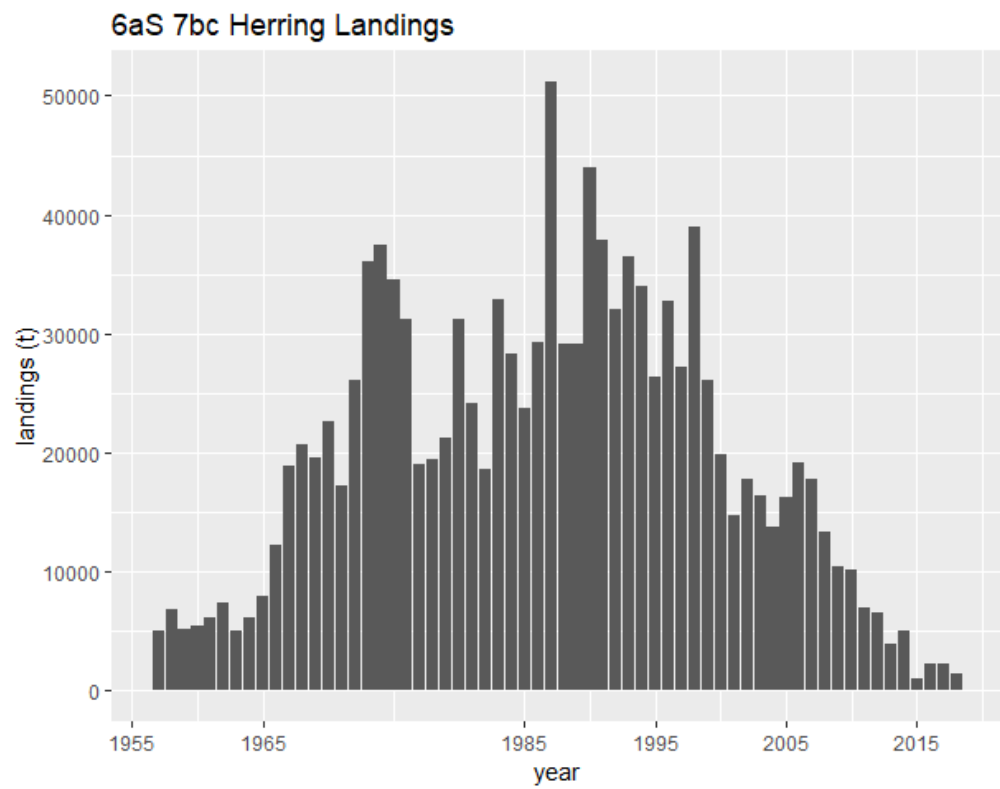


Figure 5.1.1. Herring in divisions 6.a.S and 7.b–c. Working group estimate of catches from 1957–2018.



Figure 5.1.2. Herring in divisions 6.a.S and 7.b–c. catch numbers-at-age standardized by year for the fishery 1957–2018.

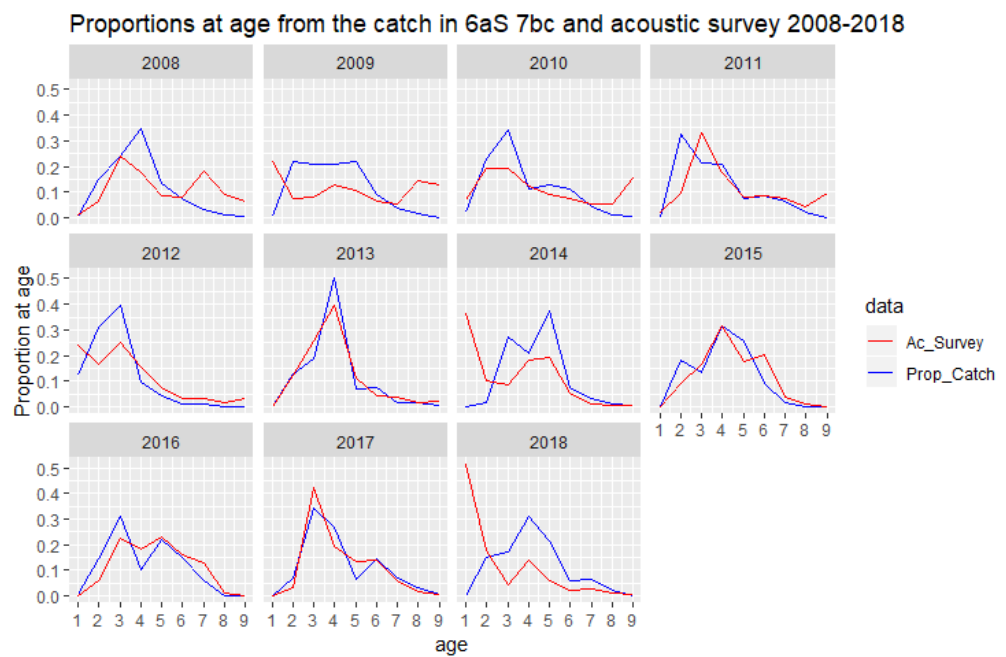


Figure 5.1.4. Herring in divisions 6.a.S and 7.b–c. Percentages-at-age in the 6aS/7.b–c catch and 6aS/7.b–c Malin Shelf acoustic survey (MSHAS) 2008-2018.

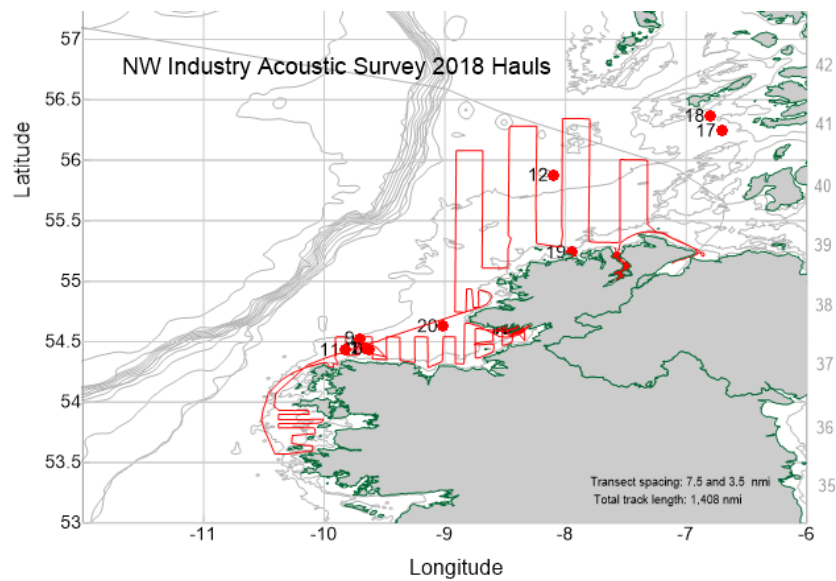


Figure 5.1.5. Herring in divisions 6.a.S and 7.b–c. Acoustic survey in 2018: distribution of biological samples obtained in 6a.S.

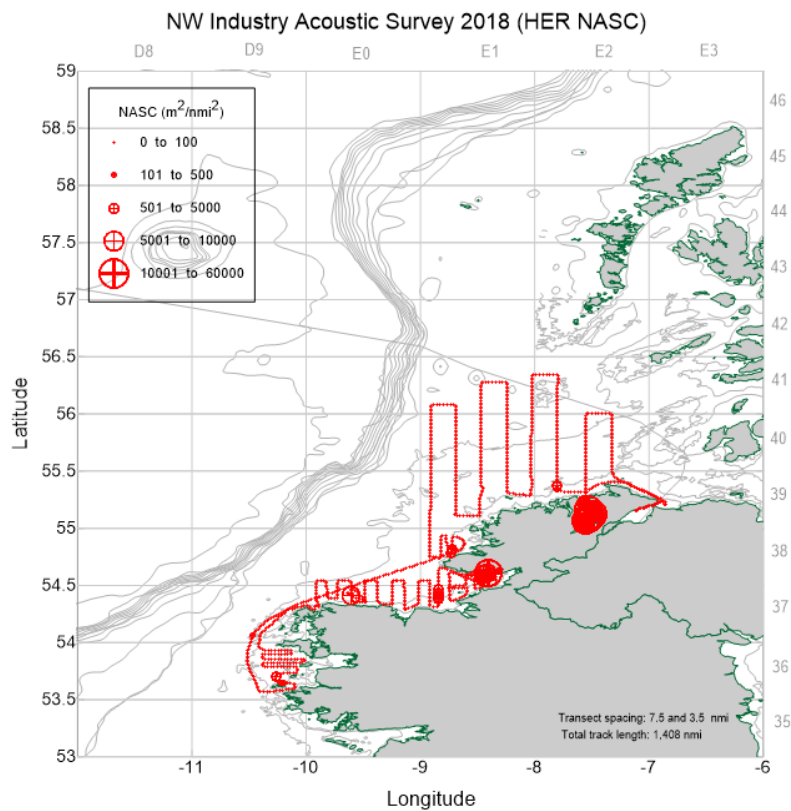


Figure 5.1.6. Herring in division 6.a.S and 7.b–c. Acoustic survey in 2018: NASC of herring.

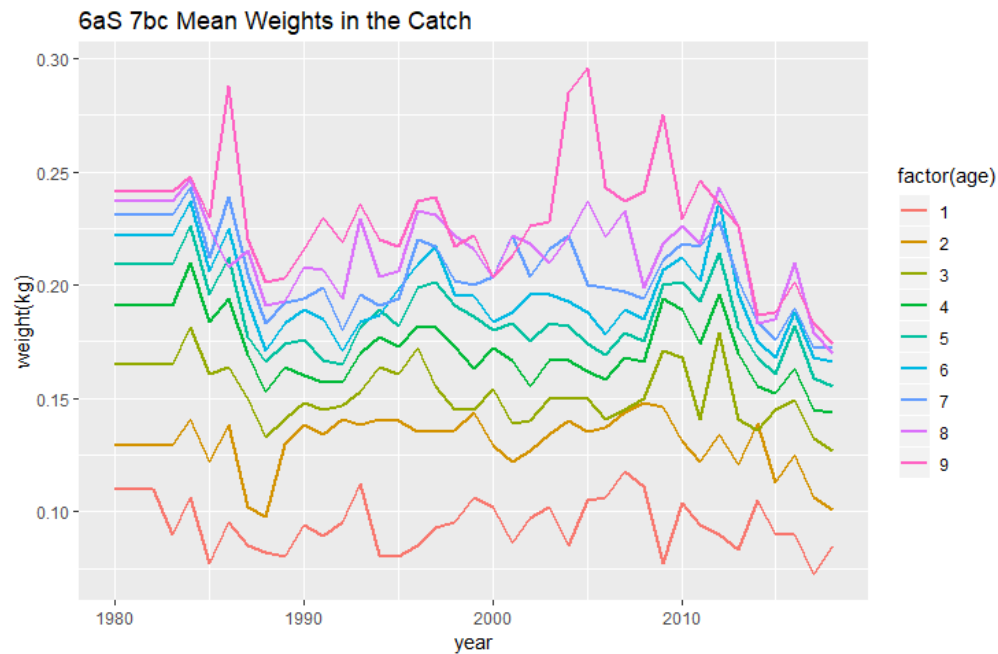


Figure 5.1.7. Herring in divisions 6.a.S and 7.b–c. Mean weights in the catch (kg) by age in winter rings (1980–2018). Prior to 1981 weights were fixed.

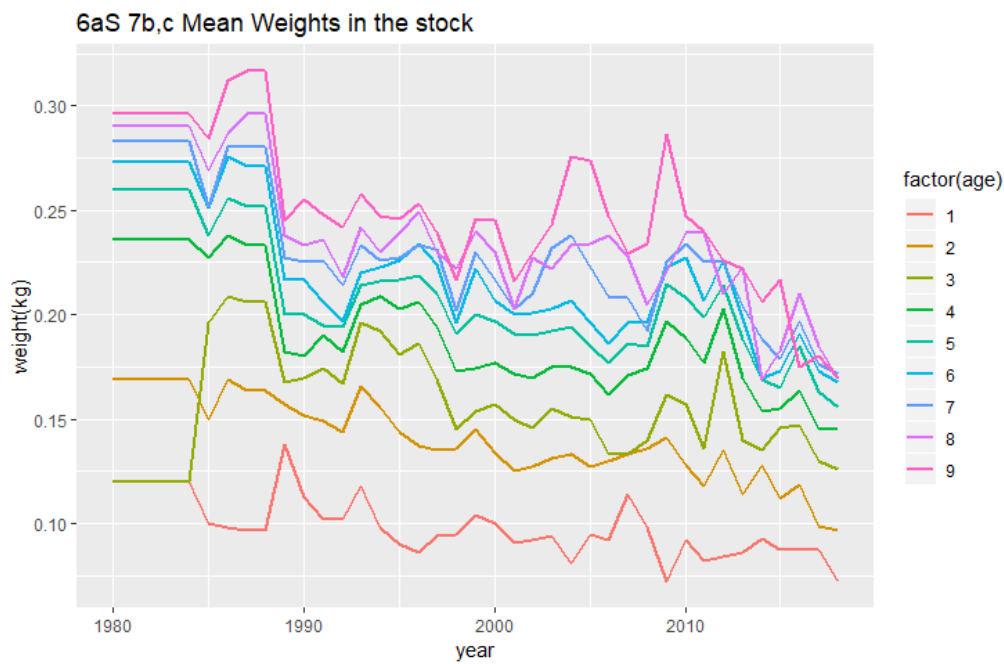


Figure 5.1.8. Herring in divisions 6.a.S and 7.b–c. Mean weights in the stock (kg) at spawning time by age in winter rings (1980–2018). Prior to 1981 weights were fixed.

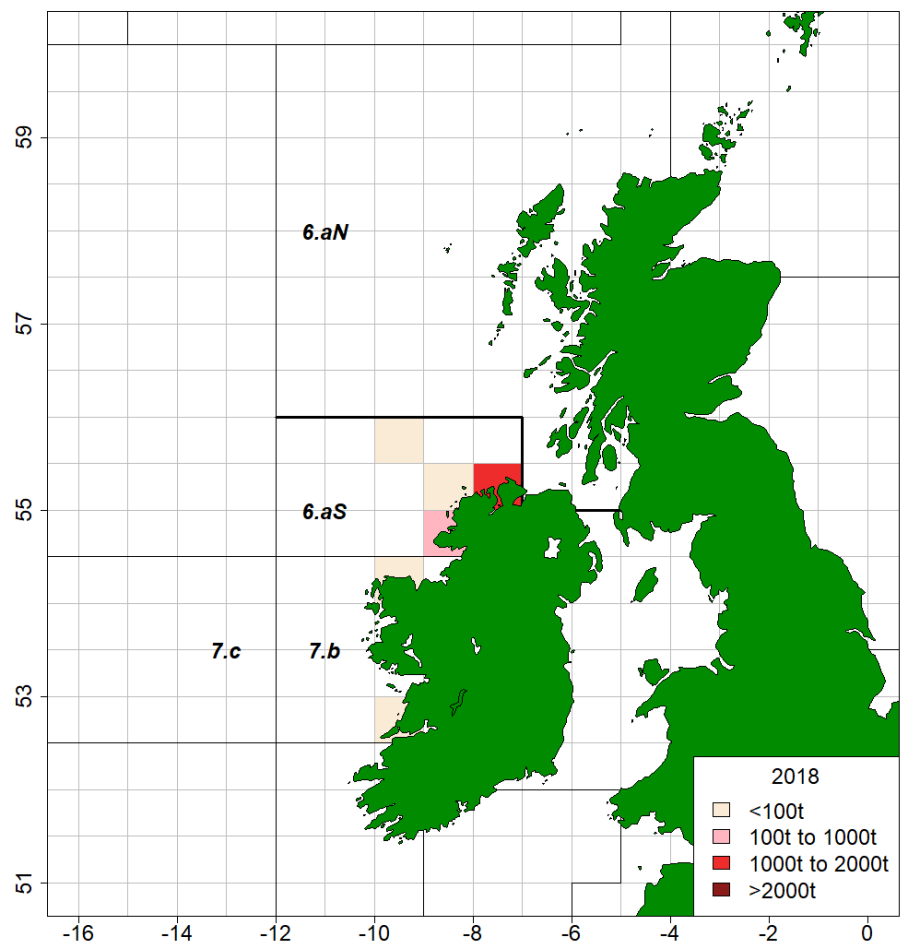


Figure 5.1.9. Herring in divisions 6.a.S and 7.b–c. Irish catches in 2018.

5.2 Herring in Division 6.a (North)

Since 2015 this stock has been combined with herring in 6.aS 7.b–c (Section 5.1) for assessment and advisory purposes. Prior to 2015 6.aN existed as a distinct management unit since 1982 when it was separated from 6.aS 7.b–c.

The location of the area occupied by the stock is shown in Figure 5.2.1. For assessment purposes the stock is considered as an autumn spawning stock only despite spring-spawning components occurring in the area.

The WG noted that the use of “age” “winter rings” “rings” and “ringers” still causes confusion outside the group (and sometimes even among WG members). The WG tries to avoid this by consequently using “rings” “ringers” “winter ringers” or “wr” instead of “age” throughout this section. However if the word “age” is used it is qualified in brackets with one of the ring designations. It should be observed that for autumn and winter spawning stocks there is a difference of one year between “age” and “rings” which is not the case for the spring spawners. Further elaboration on the rationale behind this specific to Division 6.aN autumn spawners can be found in the Stock Annex. It is the responsibility of any user of age-based data for any of these herring stocks to consult the stock annex and if in doubt consult a relevant member of the Working Group.

5.2.1 The Fishery

5.2.1.1 Advice and management applicable to 2018

Since 2016 ICES has advised a TAC of 0 t for the combined stock and that a stock recovery plan be developed for herring stocks in 6.a and 7.b–c (ICES 2018a). In 2016 the European Commission asked ICES to provide advice on a TAC of sufficiently small size to allow ongoing collection of fisheries-dependent data. ICES advised on a scientific monitoring TAC of 3480 t for the 6.aN stock component (ICES 2016) aiming to take 29 catch samples. Furthermore it was stipulated the data should be collected in a way that (i) satisfied standard length age and reproductive monitoring purposes by EU Member States for ICES and (ii) ensured that sufficient spawning-specific samples were available for morphometric and genetic analyses as agreed by the Pelagic Advisory Council monitoring scheme 2016 (Pelagic Advisory Council 2016).

The EC set a monitoring TAC for the 6.aN stock component slightly higher than this advice at 4170 t (EU 2016/0203) and the same for 2017 (EU 2017/127) and 2018 ((EU 2018/120).

5.2.1.2 The monitoring fishery

The industry–science survey aim is to improve the knowledge base for the spawning components of herring in 6.aN and 6.aS 7.b–c and submit relevant data to ICES to assist in assessing the herring stocks and contribute to establishing a rebuilding plan.

Utilizing ICES advice on the monitoring fishery (ICES 2016) together with the experience from 2016 a review of spawning areas and timing and discussions with fishing skippers four areas were selected for surveying in 6.aN (Figure 5.2.2). Areas 2 and 4 are considered to be active spawning areas and Area 1 a prespawning aggregation area that contains an unknown mixture of stocks of Western and potentially North Sea herring where a large proportion of catches has been taken in recent years (ICES 2016). Area 5 was a new addition for 2018 based on evidence from 2017 and local creel fishers of herring on the east side of the North Minch. Systematic acoustic surveys were conducted only in areas 2–5 in 6.aN but *ad hoc* acoustic data recorded by other vessels also.

A limited discard derogation was granted to the vessels during the period of the scientific survey to account for any bycatch of other species and any non-retained catches that could not be landed in marketable condition this particularly being the case for the three Scottish refrigerated-sea-water (RSW) vessels.

All vessels completed their scientific survey duties prior to catching their allocated quota. Samples for biological morphometric and genetic data were taken from all areas. Each of the five vessels involved in the survey were assigned specific objectives and provided with a vessel-specific survey manual describing the aims methods and sampling protocols and data recording templates.

Details of the survey are reported in WGIPS ICES (2019) and Mackinson *et al.* (2019).

5.2.1.3 Stock recovery plan

The Pelagic Advisory Council submitted a revised proposed rebuilding plan for both 6.aN and 6.a.S 7.b–c stocks combined which was reviewed by HAWG 2018 (ICES 2018 Annex 9)). While the plan was considered to provide a framework for recovery of these combined stocks it was considered unlikely that the revised proposed plan can aid the recovery of the combined stocks by 2020 as recent poor recruitments hamper a speedy recovery. Furthermore ICES ACOM considered that further quantitative evaluation would be required to be used as the basis for advice.

5.2.1.4 Catches in 2018

Historically catches have been taken from this area by Scottish and Northern Irish pelagic refrigerated seawater (RSW) trawlers and an international freezer-trawler fishery including vessels from the Netherlands Germany and England. The details of these fleets are described in the Stock Annex.

Implementation of the scientific monitoring fishery in 2018 resulted in the 6.aN TAC being split between the seven participating pelagic vessels.

The 2018 official catches of herring in 6.aN total 4063 t compared with the 4170 t monitoring TAC. This included 196 t caught out with the monitoring fishery by primarily as bycatch during the mackerel fishery. There were 4.31 t of non-retained herring catch during the monitoring fishery in 2018 under the discard derogation and 9.76 t of other species (Mackinson *et al.*, 2019).

5.2.1.5 Regulations and their affects

There are no new changes to the regulations relevant to the fishery in 6.aN.

5.2.1.6 Changes in fishing technology and fishing pattern

Implementation of the scientific monitoring fishery in 2016–2018 resulted in the 6.aN TAC being split between the seven participating pelagic vessels. In previous years the TAC would have been taken by a larger number of vessels.

5.2.2 Biological Composition of the Catch

Catch and sample data by country and by period (quarter) are detailed in tables 5.2.1 and 5.2.2. Biological data sampled from commercial hauls ($n = 34$) were used to allocate the age distribution for the 6.aN catches used in the assessment. One sample provided by Northern Ireland was not used as it contained only 46 fish in total. The samples were used to allocate catch-at-age (winter rings) (using the sample number weighting) to un-sampled catches in the same or adjacent quarters. The allocation of age distributions to un-sampled catches and the calculation of total international catch-at-age and mean weight-at-age in the catches were done following established

raising methods. A detailed description of the process in 2016 can be found in (WD02 HAWG 2017)). The same principles described in that document were followed in 2018.

The 2012 and 2013 year classes (4 and 5-ringers in 2018) continue to be prominent both in the catch in 6.aN and in the MSHAS_N acoustic survey index (54% of the catch 24% of MSHAS_N index figures 5.2.3 and 5.2.4 Table 5.2.5). These year classes are also coming through clearly in the neighbouring North Sea autumn spawning stock. One ringer herring were absent from the catch again this year which is not unusual. They are observed in survey data in 6.aN intermittently only and are rarely representative of year-class strength.

5.2.3 Fishery-independent Information

5.2.3.1 Acoustic survey-MSHAS_N

The survey values for number- weight- and proportion mature-at-age in the stock were revised in 2009 and reported in the 2010 HAWG (see Section 5.6.1 in HAWG ICES 2010). The 2018 survey values are shown in tables 5.2.4 and 5.2.5.

Full details of the 2018 survey are available in the Report of the Working Group for International Pelagic Surveys (WGIPS ICES 2019 Annex 4c).

Vessel	Period	Strata
Celtic Explorer (IRL) EIGB	03 July–21 July	2 3 4 5 6
Scotia (SCO) MXHR6	29 June–19 July	1 91 (North of 58°30'N) 101 111 121

The spawning-stock-biomass estimate for the acoustic survey in the area historically used for the 6.a (North) spawning-stock-biomass (Table 5.2.4) was 152 kt in 2018 an increase from the estimate of 139 kt in 2017 (Table 5.2.5).

The proportions of each year class in the catch and the survey are shown in Figure 5.2.5. The large proportion of 4-ringers observed in the catches was also evident in the acoustic survey results. The acoustic survey encountered only a very small proportion herring above age 7 (wr) similar to the pattern in the catches.

In contrast to recent years a large proportion of the stock was made up of 1 and 2 winter ring fish this year (64% of the total abundance and 44% of total biomass). As 1 winter ring fish are only sporadically picked up in the survey due to their distribution typically being in the more inshore areas it cannot be confirmed yet whether 2016 is a strong year class but it looks like the 2015-year class (2 winter ringers in 2018) is above average.

5.2.3.2 Acoustic survey- 6.a Herring industry–science survey 2018

An acoustic survey was undertaken to collect acoustic data and information on the size and age of herring required to generate an age-disaggregated acoustic estimate of the biomass of pre-spawning/ spawning herring in 6.aN. Total herring biomass was estimated to be 118 000 t (Table 5.2.6, figures 5.2.6 5.2.7 and 5.2.8) The survey methods and results were reviewed by ICES WGIPS (2019) who conclude that the survey provides a reliable estimate of the minimum biomass of mature herring at age observed in survey areas 5432 during the survey period. The survey provides a third datapoint in a new SSB survey series.

5.2.4 Mean Weights-at-age and Maturity-at-age

5.2.4.1 Mean weight-at-age

Weights-at-age in the stock are obtained from the West of Scotland part of the Malin Shelf herring acoustic survey (WGIPS ICES 2019) and are given in Table 5.2.4 (for the current year). The weights-at-age in the stock in 2018 were higher for 3 winter rings and similar for other age groups compared to last year (Table 5.2.7). Overall there is a trend of decreasing weights-at-age in the stock for all ages over the last ten years.

Weights in the catch (Table 5.2.8) in 2018 were lower for all age groups compared to 2016 and 2017 except age group 8 which were higher than in 2017 but lower than 2016.

5.2.4.2 Maturity ogive

The maturity ogive is obtained from the West of Scotland part of the Malin Shelf herring acoustic survey (Table 5.2.4 WGIPS ICES 2018). The survey provides estimated values for the period 1992–2018 (Table 5.2.9). In 2018 only 48% of age 2 winter ring fish were mature 91% of age 3 winter ring fish. Above age 5 maturity levels were 100%.

5.2.5 Recruitment

There are no specific recruitment indices for this stock. Both catch and acoustic survey recorded no catches of 1-ringer and typically the encounter of this age group occurs only incidentally. The first reliable appearance of a cohort appears at 3-ring in both the catch and the survey for this stock. In 2018 the proportion of 3-ringers was relatively high in the catches but moderate in the survey (Figure 5.2.4).

5.2.6 Assessment of 6.a (North) Herring

5.2.6.1 Stock Assessment

The ICES WKWEST 2015 Benchmark Workshop (ICES 2015/ACOM:34) for the herring stocks in 6.aN 6.aS and 7.b–c concluded that a combined stock assessment for these two stocks should be undertaken until it is possible to provide survey indices segregated by stock. Data for this stock were examined in detail by the benchmark group WKWEST (ICES 2015/ACOM:34). Details of the 2018 assessment for 6.a (combined) and 7.b–c are outlined in Section 5.6 of this report.

5.2.6.2 State of the stock

Not determined.

5.2.7 Short-term Projections

5.2.7.1 Deterministic short-term projections

Not undertaken.

5.2.7.2 Yield-per-recruit

Not undertaken.

5.2.8 Precautionary and Yield Based Reference Points

Not determined.

5.2.9 Quality of the Assessment

Not relevant.

5.2.10 Management Considerations

Recruitment has been at a low level since 1998 and even lower since 2013. The 2008 year class appears to be the only strong year class since 2000 from both the catch data and acoustic survey (Figure 5.2.3). The 2013 year class (4-wr in 2018) was strong in the 2016 catches and again in the 2017 and 2018 in both the catches and survey. This year class was also exceptionally large in the neighbouring North Sea herring stock. There is an almost complete absence in the stock of 8 and 9+ winter ring fish in both the catches and the acoustic survey the last couple of years. The acoustic survey index has been decreasing steadily since 2008. The 2016 value was the lowest on record for this stock. Although the 2017 and 2018 estimates was nearly double of 2016 the stock still remains at a very low level compared to the time-series overall.

The overall meta-population (the two stocks in 6.a and 7.b–c) is not in a healthy state and is estimated to be well below the B_{lim} value. The working group advocates maintaining separate management of each component.

A monitoring TAC of 4170 t was instated since 2016 to allow sampling for stock separation and maintaining the time-series of catch composition.

5.2.11 Ecosystem Considerations

Herring fisheries tend to be clean with little bycatch of other fish. Observers monitor some of the fleets. Scottish discard observer programs since 1999 and more recently Dutch observers indicate that discarding of herring in these directed fisheries is at a low level. The Scottish discard observer programme has recorded occasional catches of seals and zero catches of cetaceans in the past. The Scottish pelagic discard observer programme is no longer active it was terminated in 2011.

Herring are an important prey species in the ecosystem west of the British Isles and one of the dominant planktivorous fish in 6.aN. Bird mammal and stocks of larger predatory fish in the region rely on healthy productive herring populations.

5.2.12 Changes in the Environment

Temperatures in this area have been increasing over the last number of decades (Baxter *et al.*, 2008). There are indications that salinity is also increasing (ICES 2006/LRC:03). It is considered that this may have implications for herring. There is evidence that similar environmental changes have affected the North Sea herring and contributed to the recent changes in productivity of that stock (ICES 2007/ACFM:11).

Table 5.2.1. Herring in 6.a (North). Catch in tonnes by country 1991–2018. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
Faroës	482			274					
France	1168	119	818	5087	3672	2297	3093	1903	463
Germany	6450	5640	4693	7938	3733	7836	8873	8253	6752
Ireland	8000	7985	8236	6093	3548	9721	1875	11199	7915
Netherlands	7979	8000	6132	8183	7808	9396	9873	8483	7244
Norway	3318	2389	7447	30676	4840	6223	4962	5317	2695
UK	32628	32730	32602	-4287	42661	46639	44273	42302	36446
Unallocated	-10597	-5485	-3753	700	-4541	-17753	-8015	-11748	-8155
Discards*	1180	200					62	90	
Total	50608	51578	56175	54664	61271	64359	64995	65799	61514
Area-Misreported	-22079	-22593	-24397	-30234	-32146	-38254	-29766	-32446	-23623
WG Estimate	28529	28985	31778	24430	29575	26105	35233	33353	29736
Source (WG)	1993	1994	1995	1996	1997	1997	1998	1999	2000

* Unraised discards.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Faroës			800	400	228	1810	570	484	927
France	870	760	1340	1370	625	613	701	703	564
Germany	4615	3944	3810	2935	1046	2691	3152	1749	2526
Ireland	4841	4311	4239	3581	1894	2880	4352	5129	3103
Netherlands	4647	4534	4612	3609	8232	5132	7008	8052	4133
Norway									
UK	22816	21862	20604	16947	17706	17494	18284	17618	13963
Unallocated		277**	6244**	2820**	3490**				
Discards*					123	772	163		
Total	37789	35688**	41649**	31662**	33344**	31392	34230	33735	25216
Area-Misreported	-14627**	-10437**	-8735	-3581	-6885**	-17263	-6884	-4119	-9162
WG Estimate	23162**	25251**	32914	28081**	26459**	14129	27346	29616	16054
Source (WG)	2001	2002	2003	2004	2005	2006	2007	2008	2009

* Unraised discards.

** Revised at WKWEST 2015.

Country	2009	2010	2011	2012	2013	2014	2015	2016	2017
Denmark								23	
Faroes	1544	70				360			
France	1049	511	504	244	586	589			
Germany	27	3583	3518	1829	4025	3354	3292	1028	
Ireland	1935	2728	3956	3451	3124	2632	1799	569	10
Lithuania						770			
Norway							0.98		
Netherlands	5675	3600	1684	3523	1775	1641	956	300	829
UK	11076	12018	11696	12249	15906	16769	15260	3254	3356
Unallocated									
Discards*		95			30				
Total	21306	22510	21358	21296	25446	26115	21307	5174	4201
Area-Misreported	-2798	-2728	-3599	-2780	-2468	-4088	-2506	-450	
WG Estimate	18508	19877	17759	18516	22978	22027	18801	4724	4201
Source (WG)	2010	2011	2012	2013	2014	2015	2016	2017	2018

* Unraised discards.

Country	2018
Denmark	39
Faroes	
France	7
Germany	17
Ireland	84
Lithuania	
Norway	4
Netherlands	1000
UK	2911
Unallocated	
Discards*	
Total	4063
Area-Misreported	
WG Estimate	4063
Source (WG)	2019

* Unraised discards.

Table 5.2.2. Herring in 6.a (North). Catch and sampling effort by nation in the fishery in 2018.

Country	Quarter	Sampled Catch (t)	Official Catch (t)	No. Hauls	No. of samples	No. measured	No. aged	SOP
UK (Sco)	Q1	0	9	-	-	-	-	0%
	Q3	1196	1199	8	8	922	316	99%
UK (NI)	Q1	0	10	-	-	-	-	0%
	Q4	757	758	1	1*	46*	42	100%*
UK(E&W)	Q1	0	7	-	-	-	-	0%
	Q4	925	927	10	9	1553	185	100%
Ireland	Q1	0	67	-	-	-	-	0%
	Q4	0	17	-	-	-	-	0%
Netherlands	Q1	0	1	-	-	-	-	0%
	Q2	0	4	-	-	-	-	0%
	Q3	777	781	12	12	1543	92	99%
	Q4	212	215	4	4	372	82	98%
Others	All	0	68	-	-	-	-	0%
Total		3867	4063	35	34	4436	717	95%

* This sample was not used in the catch raising as it contained too few fish to be considered representative especially of such a large haul.

Table 5.2.3. Herring in 6.a (North). Catch in number.
Units: Thousands

Units : thousands

year

age 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967

1 6496 15616 53092 3561 13081 55048 11796 26546 299483 211675 207947

2 74622 30980 67972 102124 45195 92805 78247 82611 19767 500853 27416

3 58086 145394 35263 60290 61619 22278 53455 70076 62642 33456 218689

4 25762 39070 116390 22781 33125 67454 11859 26680 59375 60502 37069

5 33979 24908 24946 48881 22501 44357 40517 7283 22265 40908 39246

6 19890 27620 17222 11621 12412 19759 26170 24227 5120 19244 29792

7	8885	17495	16099	19347	5245	24129	8687	18697	92891	5562	11779
---	------	-------	-------	-------	------	-------	------	-------	-------	------	-------

9 1497 0057 7070 6046 4814 6147 10660 0707 10025 15911 5520

0 4422 7152 2525 4617 2522 7222 6222 15122 12521 27222 25722

Age	1966	1967	1970	1971	1972	1973	1974	1975	1976	1977	1978
-----	------	------	------	------	------	------	------	------	------	------	------

1 220200 57700 200220 207711 551705 51170 507010 172079 07055 54050 2202

2 74450 72501 77014 555005 021470 255027 124744 202007 517004 47757 4020-

3 20996 71907 255719 412816 175137 808267 151025 89066 101548 95854 20582

4 159122 23314 111897 302208 34203 131484 319178 63701 33302 22117 40692

5 13988 211243 27741 101957 66714 63071 82466 188202 23193 10083 6875

6	23582	21011	142399	25557	25716	54642	49683	30601	76289	12211	3833
7	15677	42762	21609	154424	10342	18242	34629	12297	10918	20992	2100
8	6377	26031	27073	16818	55763	6506	22470	13121	3914	2758	6278
9	10814	26207	24082	31999	16631	32223	21042	13698	12014	1486	1544

year

age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	247	2692	36740	13304	81923	2207	40794	33768	19463	1708	6216
2	142	279	77961	250010	77810	188778	68845	154963	65954	119376	36763
3	77	95	105600	72179	92743	49828	148399	86072	45463	41735	109501
4	19	51	61341	93544	29262	35001	17214	118860	32025	28421	18923
5	13	13	21473	58452	42535	14948	15211	18836	50119	19761	18109
6	8	9	12623	23580	27318	11366	6631	18000	8429	28555	7589
7	4	8	11583	11516	14709	9300	6907	2578	7307	3252	15012
8	1	1	1309	13814	8437	4427	3323	1427	3508	2222	1622
9	0	0	1326	4027	8484	1959	2189	1971	5983	2360	3505

year

age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	14294	26396	5253	17719	1728	266	1952	1193	9092	7635	4511.46
2	40867	23013	24469	95288	36554	82176	37854	55810	74167	35252	22960.61
3	40779	25229	24922	18710	40193	30398	30899	34966	34571	93910	21825.16
4	74279	28212	23733	10978	6007	21272	9219	31657	31905	25078	51420.22
5	26520	37517	21817	13269	7433	5376	7508	23118	22872	13364	15504.75
6	13305	13533	33869	14801	8101	4205	2501	17500	14372	7529	9002.21
7	9878	7581	6351	19186	10515	8805	4700	10331	8641	3251	3897.69
8	21456	6892	4317	4711	12158	7971	8458	5213	2825	1257	1835.56
9	5522	4456	5511	3740	10206	9787	31108	9883	3327	1089	576.39

year

age	2001	2002	2003	2004	2005	2006	2007	2008
1	147.07	992.20	56.11	0.00	182.50	132.46	130.75	0.00
2	83318.40	38481.61	33331.96	7235.79	9632.71	6691.49	34326.00	7898.43
3	15368.56	93975.05	46865.58	23483.32	23236.71	9186.07	17754.83	13039.08
4	9569.99	9014.40	53766.66	29421.79	20602.39	13644.88	6555.14	5427.59
5	25175.08	18113.71	7462.98	48394.28	10237.93	41067.79	14264.99	3219.52
6	9544.89	28016.08	4344.55	4151.94	9783.17	27781.86	30566.16	5688.56
7	6813.78	9040.10	12818.38	8100.36	1014.99	20972.98	21517.07	14832.27
8	4741.98	1547.87	9187.62	9023.67	1194.95	3041.71	13585.45	8142.31
9	1028.78	1422.68	1407.96	4265.93	1430.76	5088.99	4242.60	8968.60

year

age	2009	2010	2011	2012	2013	2014	2015	2016
1	1923.62	10074.12	1667.19	979.53	0.00	0.00	231.18	12
2	11508.54	20339.85	40587.92	14952.63	13681.14	8705.73	10854.96	8148
3	10475.63	16331.31	15782.93	46647.39	18181.74	15144.82	13937.56	3341
4	16586.96	9957.96	10333.90	9704.45	53116.88	21063.66	15716.60	3197
5	8332.17	14608.15	7190.29	8097.30	11681.99	42229.47	19386.70	2791
6	5688.68	6322.33	5071.43	6311.66	7093.01	7130.95	21621.33	2821
7	7514.70	4322.24	3164.16	3873.67	5098.64	2944.09	6397.35	3148
8	11793.98	5388.91	2611.38	1129.80	4324.63	2854.21	1932.73	739
9	9443.85	13199.28	7225.68	4013.80	5031.77	3511.43	1250.55	431

year

age	2017	2018
1	0.00	0.00
2	1122.16	1508.98
3	11929.71	3215.53

4 4082.50 6873.26
5 2075.35 5253.61
6 1443.79 3068.25
7 1416.35 844.50
8 767.37 852.31
9 273.34 680.89

Table 5.2.4. Herring in 6.a (North). Total numbers (millions) biomass (thousands of tonnes) mean weights mean lengths and fraction mature by winter ring of herring in the 6a (N) part not including Clyde and North Channel of the MSHAS survey in July 2018.

Age (ring)	Numbers	Biomass	Maturity	Weight (g)	Length (cm)
0	294	0.7	0.00	2.5	6.6
1	964	46.1	0.00	47.8	17.5
2	323	35.5	0.48	110.0	22.9
3	92	14.3	0.91	155.0	25.6
4	331	58.2	0.98	176.1	26.8
5	153	29.0	0.98	190.1	27.5
6	51	10.6	1.00	209.7	28.7
7	72	15.1	1.00	209.4	28.8
8	27	5.8	1.00	218.0	29.1
9+	13	2.8	1.00	222.2	29.3
Immature	1443	67		46.1	16.0
Mature	875	152		173.2	26.6
Total	2318	218	0.38	94.1	20.0

Table 5.2.5. Herring in 6.a (North). Estimates of abundance and SSB for the time-series of the West of Scotland acoustic survey in 6.a (N) not including Clyde and North Channel. Since 2008 this index comes from a spatial subset of the MSHAS survey. Thousands of fish at-age and spawning biomass (SSB tonnes). N.B. In this table “age” refers to number of rings (winter rings in the otolith).

Year/Age	1	2	3	4	5	6	7	8	9+	SSB
1991	338312	294484	327902	367830	488288	176348	98741	89830	58043	410 000
1992	74310	503430	210980	258090	414750	240110	105670	56710	63440	351 460
1993	2357	579320	689510	688740	564850	900410	295610	157870	161450	845 452
1994	494150	542080	607720	285610	306760	268130	406840	173740	131880	533 740
1995	441200	1103400	473300	450300	153000	187200	169200	236700	201700	452 300
1996	41220	576460	802530	329110	95360	60600	77380	78190	114810	370 300
1997	792320	641860	286170	167040	66100	49520	16280	28990	24440	175 000
1998	1221700	794630	666780	471070	179050	79270	28050	13850	36770	375 890
1999	534200	322400	1388000	432000	308000	138700	86500	27600	35400	460 200
2000	447600	316200	337100	899500	393400	247600	199500	95000	65000	444 900
2001	313100	1062000	217700	172800	437500	132600	102800	52400	34700	359 200
2002	424700	436000	1436900	199800	161700	424300	152300	67500	59500	548 800
2003	438800	1039400	932500	1471800	181300	129200	346700	114300	75200	739 200
2004	564000	274500	760200	442300	577200	55700	61800	82200	76300	395 900
2005	50200	243400	230300	423100	245100	152800	12600	39000	26800	222 960
2006	112300	835200	387900	284500	582200	414700	227000	21700	59300	471 700
2007	-	126000	294400	202500	145300	346900	242900	163500	32100	298 860
2008	47840	232570	911950	668870	339920	272230	720860	365890	263740	788 200
2009	345821	186741	264040	430293	373499	219033	186558	499695	456039	578 800
2010	119788	493908	483152	171452	163436	93289	64076	53116	223311	308 055
2011	22239	184919	733384	451487	204324	219863	198768	112646	263185	457 900
2012	792479	179425	728758	471381	240832	107492	106779	56071	104571	374 913
2013	-	136931	319711	599897	161597	69341	60566	24302	37398	256 089
2014	1031086	243227	217650	469032	519032	143402	30318	18677	11449	272 000
2015	0	121640	324964	649835	377636	442135	83103	22556	2086	387 000
2016	0	29593	108126	87773	111676	79130	62045	5530	957	87 907
2017	0	23287	325407	147112	101785	104599	44927	13004	4569	139 000
2018	964099	322798	92037	330580	152548	50636	72276	26636	12549	152 000

Table 5.2.6. Total Abundance and overall biological composition of herring in 6.a North from the industry acoustic survey in 2018.

Age	Abundance	Mature	Spawning	Biomass	Mean length	Mean weight
	('000s)			(t)	(cm)	(g)
1	3454	0%	0%	198	19.1	57.3
2	14252	98%	3%	1918	25.5	134.6
3	57465	99%	31%	9335	26.7	162.4
4	18576	97%	27%	3366	27.9	181.2
5	8360	100%	40%	1764	28.8	210.9
6	7806	98%	37%	1676	29.4	214.7
7	5307	99%	35%	1215	29.6	229.0
8	1895	100%	54%	447	30.1	235.6
9	593	100%	60%	126	29.0	211.8
10	225	100%	40%	60	31.2	266.7
Immature	4958	-	-	425	21.5	85.7
Mature	112980	-	-	19679	27.3	174.2
Spawning*	33063	-	-	6149	27.8	186.0
TOTAL	117937			20104	27.1	170.5

*Spawning herring is a subset of the mature herring.

Table 5.2.7. Herring in 6.a (North). Weights-at-age in the stock.

Units : kg

year

age 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968

1 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090

2 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164

3 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208

4 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233

5 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246

6 0.252 0.252 0.252 0.252 0.252 0.252 0.252 0.252 0.252 0.252 0.252 0.252

7 0.258 0.258 0.258 0.258 0.258 0.258 0.258 0.258 0.258 0.258 0.258 0.258

8 0.269 0.269 0.269 0.269 0.269 0.269 0.269 0.269 0.269 0.269 0.269 0.269

9 0.292 0.292 0.292 0.292 0.292 0.292 0.292 0.292 0.292 0.292 0.292 0.292

year

age 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980

1 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090 0.090

2 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164 0.164

3 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208 0.208

4 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233 0.233

5 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246 0.246

[illegible]

Table 5.2.8. Herring in 6.a (North). Weights-at-age in the catch.

Units : kg

year												
age	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.079
2	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
3	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
4	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158
5	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
6	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170
7	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180
8	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183
9	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185	0.185
year												
age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.079	0.079	0.079	0.079	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
2	0.104	0.104	0.104	0.104	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121
3	0.130	0.130	0.130	0.130	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158
4	0.158	0.158	0.158	0.158	0.175	0.175	0.175	0.175	0.175	0.175	0.175	0.175
5	0.164	0.164	0.164	0.164	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186
6	0.170	0.170	0.170	0.170	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206
7	0.180	0.180	0.180	0.180	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218
8	0.183	0.183	0.183	0.183	0.224	0.224	0.224	0.224	0.224	0.224	0.224	0.224
9	0.185	0.185	0.185	0.185	0.224	0.224	0.224	0.224	0.224	0.224	0.000	0.000
year												
age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	0.090	0.080	0.080	0.080	0.069	0.113	0.073	0.080	0.082	0.079	0.084	0.091
2	0.121	0.140	0.140	0.140	0.103	0.145	0.143	0.112	0.142	0.129	0.118	0.119
3	0.158	0.175	0.175	0.175	0.134	0.173	0.183	0.157	0.145	0.173	0.160	0.183
4	0.175	0.205	0.205	0.205	0.161	0.196	0.211	0.177	0.191	0.182	0.203	0.196
5	0.186	0.231	0.231	0.231	0.182	0.215	0.220	0.203	0.190	0.209	0.211	0.227
6	0.206	0.253	0.253	0.253	0.199	0.230	0.238	0.194	0.213	0.224	0.229	0.219
7	0.218	0.270	0.270	0.270	0.213	0.242	0.241	0.240	0.216	0.228	0.236	0.244
8	0.224	0.284	0.284	0.284	0.223	0.251	0.253	0.213	0.204	0.237	0.261	0.256
9	0.224	0.295	0.295	0.295	0.231	0.258	0.256	0.228	0.243	0.247	0.271	0.256
year												
age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
1	0.089	0.083	0.106	0.081	0.089	0.097	0.076	0.0834	0.0490	0.1066	0.0609	
2	0.128	0.142	0.142	0.134	0.136	0.138	0.130	0.1373	0.1398	0.1464	0.1448	
3	0.158	0.167	0.181	0.178	0.177	0.159	0.158	0.1637	0.1628	0.1625	0.1593	
4	0.197	0.190	0.191	0.210	0.205	0.182	0.175	0.1829	0.1828	0.1728	0.1690	
5	0.206	0.195	0.198	0.230	0.222	0.199	0.191	0.2014	0.1922	0.1595	0.1852	
6	0.228	0.201	0.214	0.233	0.223	0.218	0.210	0.2147	0.1959	0.1780	0.1997	
7	0.223	0.244	0.208	0.262	0.219	0.227	0.225	0.2394	0.2047	0.1863	0.1942	
8	0.262	0.234	0.227	0.247	0.238	0.212	0.223	0.2812	0.2245	0.2449	0.1854	
9	0.263	0.266	0.277	0.291	0.263	0.199	0.226	0.2526	0.2716	0.2802	0.2938	
year												
age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013		
1	0.0000	0.1084	0.0908	0.1152	0.0000	0.1121	0.0818	0.0613	0.0725	0.0000		
2	0.1541	0.1327	0.1580	0.1667	0.1705	0.1726	0.1549	0.1550	0.1469	0.1441		
3	0.1732	0.1632	0.1676	0.1881	0.2060	0.2141	0.1883	0.1894	0.1894	0.1746		
4	0.1948	0.1845	0.1929	0.1968	0.2310	0.2379	0.2129	0.2178	0.2076	0.1965		
5	0.2160	0.2108	0.2076	0.2105	0.2309	0.2457	0.2337	0.2340	0.2161	0.2020		

[illegible]

year

age	2018
1	0.00
2	0.48
3	0.91
4	0.98
5	0.98
6	1.00
7	1.00
8	1.00
9	1.00

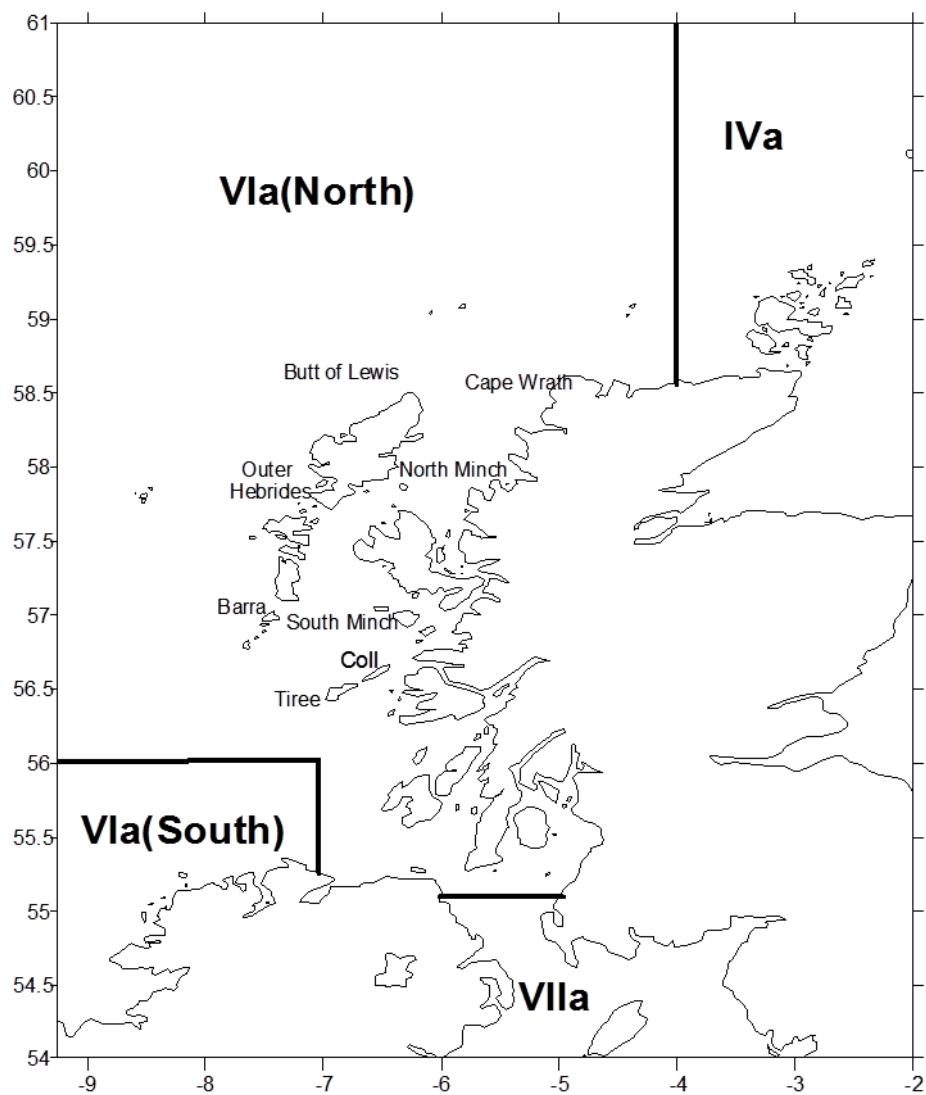


Figure 5.2.1. Location of ICES area 6.a (North) and adjacent areas with place names.

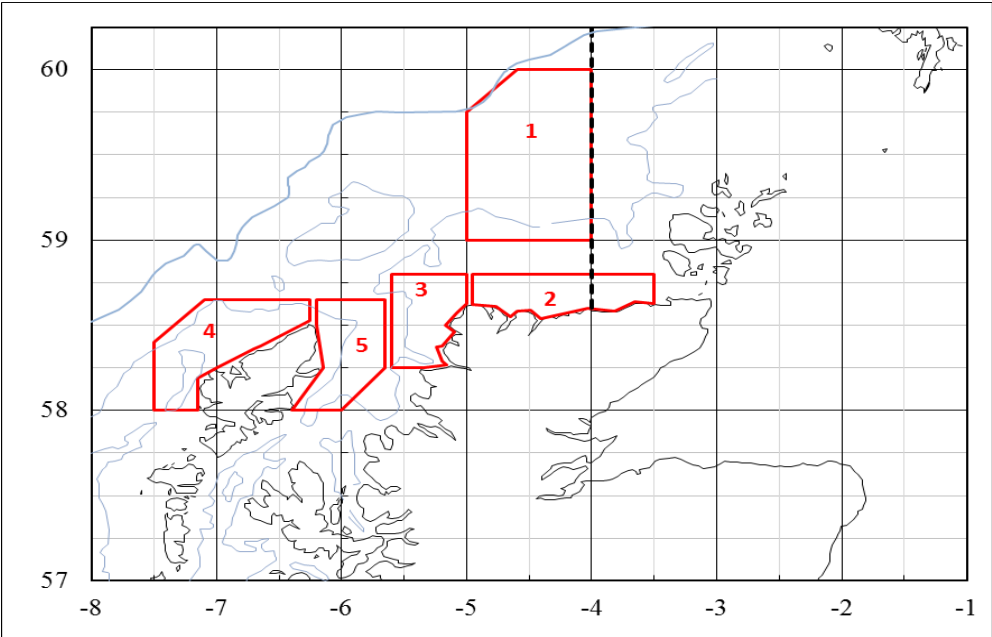


Figure 5.2.2. Planned survey areas used in the 6.a North surveys. Area 1- North pre-spawning mixing area Area 2 -East of cape Wrath Area 3 – The Minch Area 4 – Outer Hebrides Area 5 – east Minch.

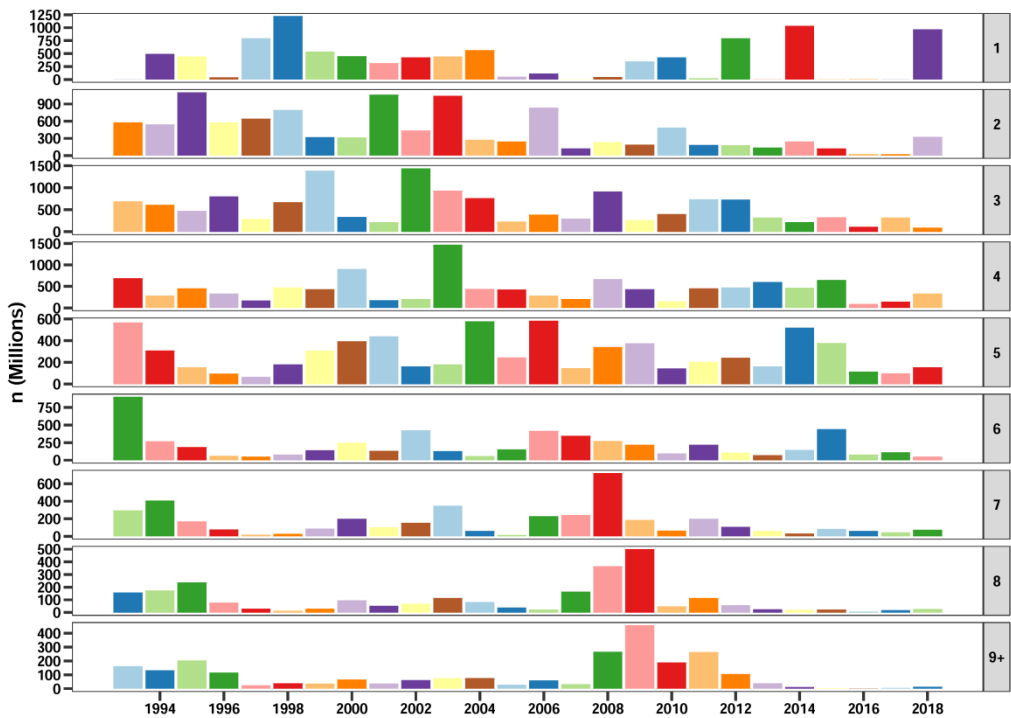


Figure 5.2.3. Herring in 6.a (North). West of Scotland (6.aN) autumn spawning herring subset from MSHAS indices (millions) by age (winter rings) and year from the acoustic surveys 1993–2018. Age 9+ includes ages 9 and older.



Figure 5.2.4. Herring in 6.a (North). Mean standardized catch numbers-at-age standardized by age 1957 to 2018.

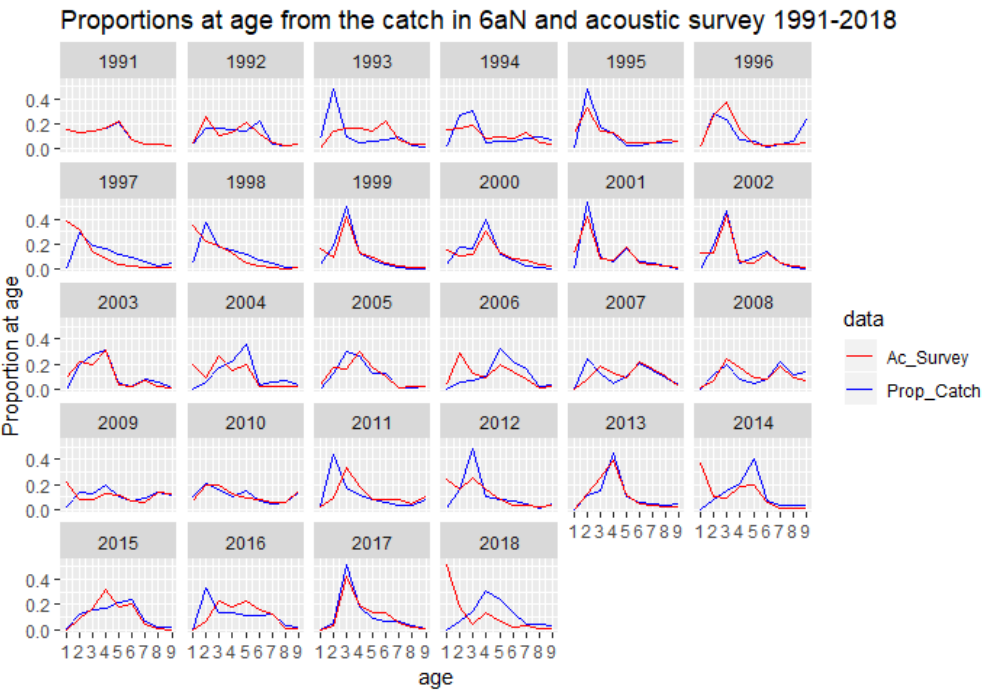


Figure 5.2.5. Herring in 6.a (North). Comparison of the proportions-at-age by year class in the acoustic survey and the catch 1991-2018.

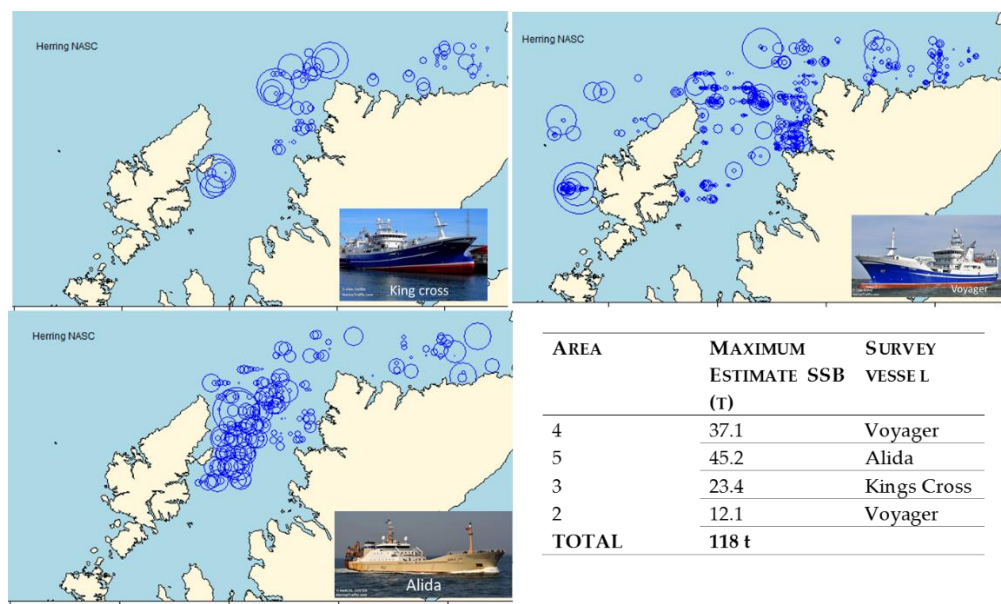


Figure 5.2.6. Maps of relative acoustic density (NASC m²/mn²) recorded during the 2018 6.aN herring industry–science survey. Bottom right panel – derived biomass estimates for each area (details in WGIPS 2019).

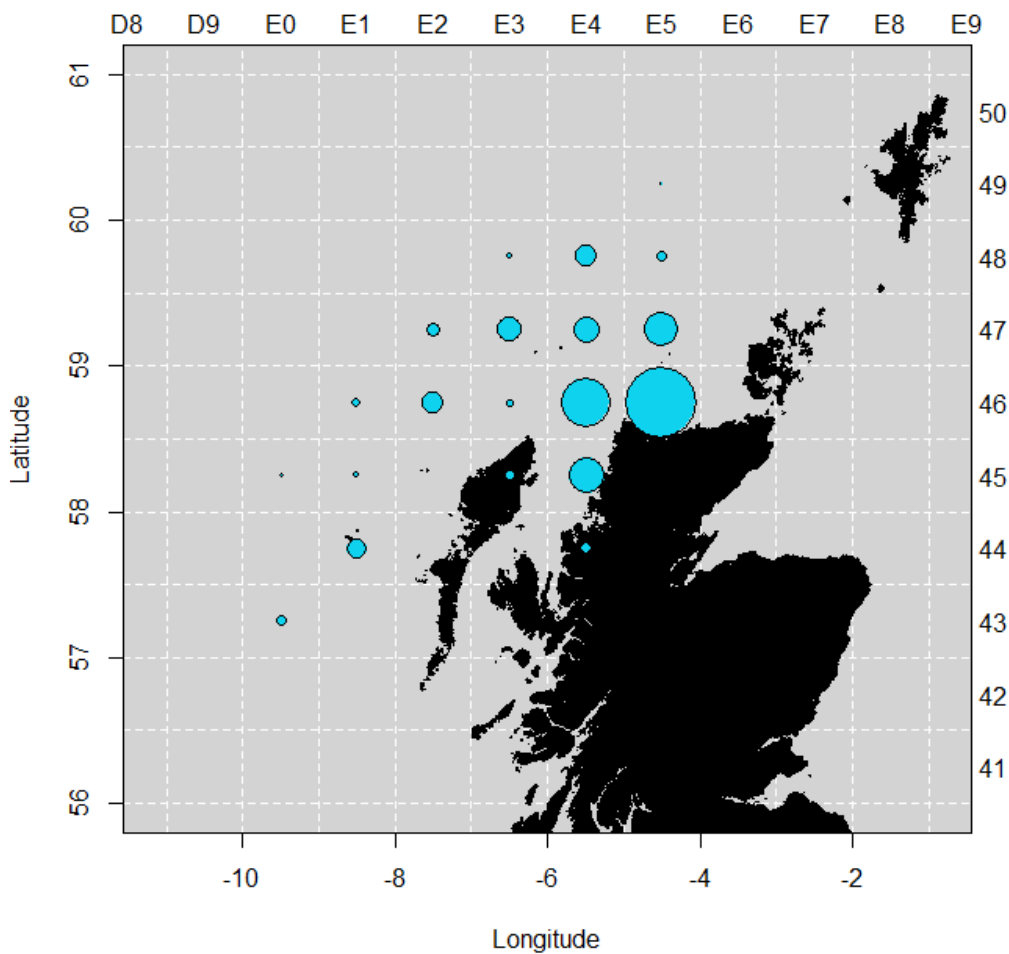


Figure 5.2.7. Herring in 6.a (North). Herring catches in tonnes in all quarters in 2018 by statistical rectangle. (Radius of bubbles of 0.25 degrees latitude = 3000 t). WG estimates.

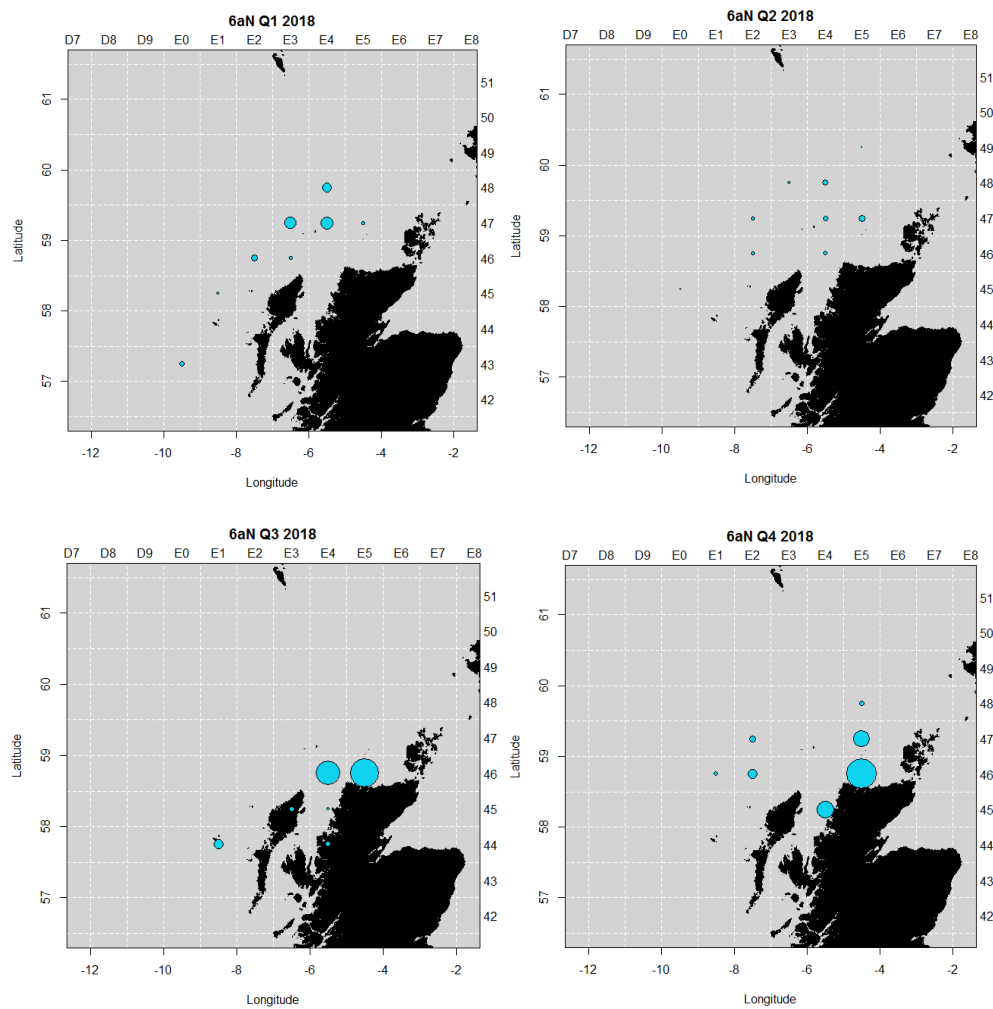


Figure 5.2.8. Herring in 6.a (North). Herring catches in tonnes by quarters in 2018 by statistical rectangle (Radius of bubbles of 0.25 degrees latitude = 3000 t). WG estimates.

References

O'Malley M. Blaszkowski M. White E. O'Brien S. & Mullins E. (2019). Atlantic Herring and Horse Mackerel in 6aS/7b; Industry Acoustic Survey Cruise Report. FEAS Survey Series: Industry Acoustic Survey/01/2018. Marine Institute